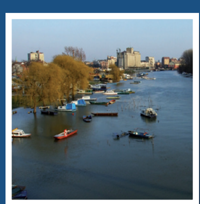
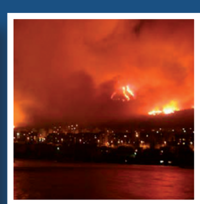
Strengthening Multi-Hazard Early Warning Systems and Risk Assessment in the Western Balkans and Turkey: Assessment of Capacities, Gaps and Needs

Regional Programme on Disaster Risk Reduction in South East Europe Activity 2 (WMO): Regional Cooperation in South Eastern Europe for Meteorological, Hydrological and Climate Data Management and Exchange to Support Disaster Risk Reduction (IPA/2009/199-922)





World Meteorological Organization
Weather • Climate • Water

DRR-SEE-1 (2012)
ROE-2 (2012)

Partners

UN Partners:

UNDP

ISDR
United Nations
International Strategy for Disaster Reduction

European Meteorological Partners:

ECMWF

EUMETNET
European Meteorological Services Network

EUMETSAT

Other Project Partners:

DMCSEE
Drought Management Centre for Southeastern Europe

Environment Agency of the Republic of Slovenia

ZAMG

Disaster Preparedness and Prevention Initiative for South-Eastern Europe

South East European Virtual Climate Change Center

NMHSs of IPA beneficiaries

Strengthening Multi-Hazard Early Warning Systems and Risk Assessment in the Western Balkans and Turkey: Assessment of Capacities, Gaps and Needs

Regional Programme on Disaster Risk Reduction in South East Europe Activity 2 (WMO): Regional Cooperation in South Eastern Europe for Meteorological, Hydrological and Climate Data Management and Exchange to Support Disaster Risk Reduction (IPA/2009/199-922)

DRR-SEE-1 (2012)
ROE-2 (2012)

Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box 2300
CH-1211 Geneva 2, Switzerland

Tel.: +41 (0) 22 730 84 03
Fax: +41 (0) 22 730 80 40
E-mail: Publications@wmo.int

This report has been produced with the financial assistance of the European Union. The views expressed herein can in no way be taken to reflect the official opinion of the European Union.

Table of contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ALADIN	ALADIN Numerical Weather Prediction Project; 16 members in Europe and North Africa
AMDAR	Aircraft Meteorological Data Relay
AROME	NWP model; Consortium of ALADIN and HIRLAM consortiums
ASCII	American Standard Code 2 for Information Interchange
AWAS	Agency for Watershed of Adriatic Sea
AWSR	Agency for Watershed of Sava River
AWS	Automatic Weather Station
BD	Brcko District
BiH	Bosnia and Herzegovina
CARDS	Community Assistance for Reconstruction, Development and Stability in the Balkans (EU)
CET	Central European Time
CMC	Crisis Management Center (FYR of Macedonia)
CMS	Crisis Management System (FYR of Macedonia)
COST	European Cooperation in Science and Technology
DB	Database
DBMS	Database Management System
DEM	Digital Elevation Model
DHMZ	The Hydrometeorological Service of Croatia
DLWM	Department of Land and Water Management
DMCSEE	Drought Management Centre for Southeastern Europe
DMI	Turkish State Meteorological Service
DPPI	Disaster Preparedness and Prevention Initiative
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSI	Turkish State Hydraulic Works
DW	Department of Water
DWD	National Meteorological Service of Germany
EC	European Commission
ECMWF	European Centre for Medium-range Weather Forecasts
EFAS	European Flood Alert System
EIE	Turkish General Directorate of the Electrical Power Resources
EMMA	European Multi-services Meteorological Awareness project of EUMETNET
EMS	European Meteorological Society
ETA	A numerical weather prediction model, descendent of the earlier HIBU (Hydrometeorological Institute and Belgrade University) model
EU	European Union
EUCLID	European Cooperation for Lightning Detection
EUMETNET	The Network of European Meteorological Services
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EU JRC	European Commission Joint Research Centre
EUR-OPA	The European and Mediterranean Major Hazards Agreement
EWS	Early Warning System
FBiH	Federation of Bosnia and Herzegovina
FHMI	Federal Hydrometeorological Institute (BiH)
FP7	Seventh Framework Programme of EU
FTP	File Transfer Protocol
GCOS	Global Climate Observing System
GDCE	General Directorate for Civil Emergencies (FYR of Macedonia)
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GOS	Global Observation System of WMO
GMT	Greenwich Mean Time
GPS	Global Positioning System
GPRS	General Packet Radio Service
GRIP	Global Risk Identification Programme
GSM	Global System for Mobile Communications
GTS	Global telecommunication System of WMO

HFA	Hyogo Framework for Action
HIRLAM	High Resolution Local Area Model; consortium 10 members NW EU
HMI	Hydrometeorological Institute of Montenegro
HMS	Hydrometeorological Service of the FYR of Macedonia
ICAO	International Civil Aviation Organization
ICPDR	International Commission for the Protection of the Danube River
ICT	Information and Communication Technologies
IEWE	Institute of Environment, Water and Energy (NHMS Albania)
IF	Indemnity Fund of the Serbian Ministry of Agriculture, Forestry and Water Management
IOC	Intergovernmental Oceanographic Commission
IPA	Instrument for Pre-accession Assistance (EU)
ISRBC	International Sava River Basin Commission
ISO	International Organization for Standardization
IT	Information Technology
IWMJC	Institute for Water Management Jaroslav Cerni, Belgrade, Serbia
KNMI	The Royal Netherlands Meteorological Institute
LAM	Local Area Model
LIDAR	Light Detection and Ranging
MARD	Ministry of Agriculture and Rural Development of Montenegro
MAFCP	Ministry of Agriculture, Food and Consumer Protection
MAFWM	Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia
MDGs	Millennium Development Goals
MHEWS	Multi-hazard Early Warning System
MMS	Military Meteorological Service (Albania)
MM5	The PSU/NCAR mesoscale model
MoEFWA	Ministry of Environment, Forests and Water Administration of Albania
MOIA	Ministry of Internal Affairs
MoU	Memorandum of Understanding
MSG	Meteosat Second Generation
NCAR	National Centre for Atmospheric Research (USA)
NCEP	National Centers for Environmental Prediction
NCIP	Turkish National Catastrophic Insurance Program
NFP	National Focal Point
NGO	Non-Governmental Organisation
NMHS	National Meteorological and Hydrological Service
NPD	National Policy Dialogue
NPDRR	National Platform for Disaster Risk Reduction
NPRD	National Protection and Rescue Directorate of Croatia (DUZS)
NWP	Numerical Weather Prediction
OC112	Operation Center 112
OP	Operational Procedure
PC	Personal Computer
PDSI	Palmer Drought Severity Index
PHARE	One of the three pre-accession instruments financed by the EU to assist the applicant countries of Central and Eastern Europe in their preparations for joining the EU
PRD	Protection and Rescue Directorate
PRS	Protection and Rescue Sector (BiH)
PSTN	Public Switched Telephone Network
QC	Quality Control
RASS	Radio Acoustic Sounding System
RA VI	WMO Regional Association VI
RHMSS	Republic Hydrometeorological Service of Serbia
RHMS RS	Republic Hydro-meteorological Institute of Republic of Srpska (BiH)
R&D	Research and Development
RS	Srpska Republic
RMTC	Regional Meteorological Training Centre
SEEDRMAP	South Eastern Europe Disaster Risk Mitigation and Adaptation Program
SEE	South Eastern Europe
SEEVCCC	South East European Virtual Climate Change Center

SEM	Sector for Emergency Management (Montenegro)
SMATSA	Serbian-Montenegro Air Transport Service Agency
SMS	Short Message Service for mobile phones
SODAR	Sonic Detection And Ranging
SOP	Standard Operating Procedures
SPI	Standardized precipitation index
TAGEM	Turkish General Directorate of Agricultural Research
TAKEP	Turkey Agricultural Drought Action Plan
TCIP	Turkish Compulsory Insurance Pool
TETRA	TErrestrial Trunked RAdio
TUGEM	Turkish General Directorate of Agricultural Production and Development
TUMAS	Turkey Meteorological Data Archiving and Management System
UHF	Ultra High Frequency
UKMO	The UK Meteorological Office
UNCCD	United Nations Convention on Desertification
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention for Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNSCR	United Nations Convention on the Rights of the Child
USAID	United States Agency for International Development
UTC	Coordinated Universal Time
WA	Water Agency
WASR	Water Agency for Sava river district
WATR	Water Agency for Trebisnjica river district
WB	World Bank
WD	Water Directorate of the Serbia Ministry of Agriculture, Forestry and Water Management
WIS	Water Information System
WMO	World Meteorological Organization
WRF	Weather Research and Forecast (a mesoscale model)

ACKNOWLEDGEMENTS

This work was conducted under the IPA/2009/199-922 project "Regional Cooperation in South Eastern Europe for meteorological, hydrological and climate data management and exchange to support Disaster Risk Reduction" funded by the European Commission (EC) Directorate General for Enlargement, through its Instrument for Pre-Accession Assistance (IPA).

The World Meteorological Organizations (WMO) would like to extend its deepest appreciation to the WMO Members who participated in this work. WMO is grateful for the significant contributions provided by senior management and experts from National Disaster Risk Management Agencies, National Meteorological and Hydrological Services, and other national, regional and international agencies. Specifically, we would like to highlight the support and engagement of the IPA beneficiaries NMHSs: the Institute of Environment, Water and Energy of Albania, the Federal Hydrometeorological Institute and the Republic Hydrometeorological Institute of the Republic Sprska from Bosnia and Herzegovina, the Meteorological and Hydrological Service of Croatia, the Hydrometeorological Service of the former Yugoslav Republic of Macedonia, the Hydrometeorological Institute of Montenegro, the Republic Hydrometeorological Service of Serbia, the Hydrometeorological Institute in Pristina, the Turkish State Meteorological Service and the Turkish State Hydraulics Works. This project involved a number of national and regional meetings and workshops for which the support of the host governments, and their National Meteorological and Hydrological Services and Disaster Risk Management Agencies, is highly appreciated.

WMO acknowledges the engagement and critical contributions received from regional agencies and centers, particularly the Regional Cooperation Council (RCC), the Disaster Prevention and Preparedness Initiative (DPPI), the European Centre for Medium-Range Weather Forecasts (ECMWF), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the Economic Interest Group EUMETNET, the Joint Research Centre (JRC) of the European Commission, the Drought Management Centre for SEE (DMCSEE), the SEE Virtual Climate Change Center (SEEVCCC) and the International Sava River Basin Commission (ISRBC).

WMO thanks the United Nations Development Programme (UNDP) for the fruitful partnership throughout the implementation of the project, as well as for its logistical support in organizing country missions, meetings and workshops. WMO also appreciated the benefits of the continuous dialogue with the World Bank and the United Nations Strategy for Disaster Risk Reduction (UNISDR) during this project, which is a follow-up of the South Eastern Europe Disaster Risk Mitigation and Adaptation Programme, initiated in 2007 by the World Bank, the WMO and the UN-ISDR.

WMO thanks also the United Nations Interim Administration Mission in Kosovo (UNMIK) for their valuable support in coordinated the project activities related to Kosovo (under UNSCR 1244/99).

This report was reviewed by a wide range of stakeholders, including the participating IPA beneficiaries, coordinated by the respective permanent representative to WMO and engaging the disaster risk management authorities, NMHS and other national agencies. Regional agencies and centers that have provided valuable inputs include ECMWF, EUMETNET, EUMETSAT, DMCSEE, SEEVCCC, and ISRBC.

This Report has been prepared within the framework of the WMO Disaster Risk Reduction Programme, engaging a number of WMO technical programmes and the WMO Regional Office for Europe, and with the support of two consultants, Mr Bengt Tammelin and Mr Vieri Tarchiani.

EXECTIVE SUMMARY

Introduction

The South East Europe (SEE) region is highly diverse in terms of geography and climate; however, the Western Balkans and Turkey are exposed to a range of similar natural hazards, including heavy precipitation causing floods and landslides, droughts and forest fires, earthquakes, prolonged cold and heat waves, severe thunderstorms and hailstorms. Disasters caused by hydrometeorological and climate-related hazards have a significant impact in the SEE region and might affect any country's economic standing and key sectors (agriculture, transport, water management, energy, tourism, finance). Furthermore, as revealed in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, it is expected that, due to climate change, the frequency and severity of such hazards will increase in the future. This would lead, together with changes in land-use patterns and increased human settlements in areas prone to disasters, to increased risks in the coming years. Disasters in SEE are often of cross-border nature due to the size of the countries and the geography of the region. Floods and fires are frequently crossing country borders, while droughts, heat waves and cold spells events are in general affecting areas much larger than the individual countries.

The Hyogo Framework for Action 2005-2015 (HFA) adopted by 168 countries at the Second United Nation World Conference on Disaster Risk Reduction (2005, Kobe, Japan), shifted the paradigm in disaster risk management from emergency response to a comprehensive and strategic approach that would include disaster risk reduction and transfer. As per HFA, a comprehensive disaster risk management framework requires: (i) scientifically sound risk assessment to quantify and understand the risks associated with natural hazards and their impacts; (ii) risk reduction through early warning systems and sectoral risk management; and (iii) financial risk transfer mechanisms. These must be underpinned by appropriate policies, legal and organizational frameworks as well as allocation of resources at national to local levels. Furthermore, effective information and knowledge sharing among all the relevant players, supported by education and training programmes is required.

In this respect, National Meteorological and Hydrological Services (NMHS) have vital contributions for HFA implementation. A fundamental mission of the National Meteorological and Hydrological Services and the World Meteorological Organization (WMO) is to contribute to the protection of the lives and livelihood of people by providing early warnings for hydrometeorological and climate-related hazards. They provide crucial support to Disaster Risk Management (DRM) agencies and other Early Warning Systems (EWS) stakeholders, as well as to various socio-economic sectors through provision of hydrometeorological and climate related data, information and services, within a multi-agency, multi-hazard and multi-level disaster risk reduction framework.
An assessment carried out in 2007-2008 by the World Bank, the WMO and the United Nations Strategy for Disaster Risk Reduction (UN-ISDR) through the South Eastern Europe Disaster Risk Mitigation and Adaptation Programme (SEEDRMAP), revealed serious deficiencies in the capability of the NMSHs of many of the SEE countries to provide the required support to DRR, as well as insufficient cooperation between the DRR stakeholders, including NMHSs, at national and regional level.

As a follow-up of the above assessment, WMO and the United Nation Development Programme (UNDP) implemented, in parallel, two complementary projects that were funded together as the “Regional Programme on Disaster Risk Reduction in South East Europe” by the European Commission Directorate General for Enlargement, through its Instrument for Pre-Accession Assistance (IPA). This programme is targeting the following eight IPA beneficiaries: Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo (under UNSCR 1244/99), and Turkey. The projects were initiated in April 2009 with the following two components:

- Component 1: “Building Capacity in Disaster Risk Reduction through Regional Cooperation and Collaboration in South East Europe”, implemented under the UNDP coordination;

- Component 2: “Regional Cooperation in South Eastern Europe for meteorological, hydrological and climate data management and exchange to support Disaster Risk Reduction”, implemented under the WMO coordination.

The aim of WMO project was to reduce the vulnerability of South Eastern European IPA beneficiaries to natural hazards such as drought, flood and forest fires. The project focused on building the national and regional capacity of the NMHSs in the provision of reliable weather, water and climate products and services, such as hazard analysis to support risk assessment and forecasts and warnings with adequate lead time to support the DRR activities of the individual IPA beneficiaries and the region as a whole. Building better cooperation between the NMHSs, which are the providers of hydrometeorological information and services, and the agencies responsible for civil protection and emergency response with the main economic sectors was one of the primary objectives.

The programme included detailed assessment of the DRR policies and practices, the NMHSs’ capacities, identification of respective gaps and needs in all beneficiaries. This assessment allowed policy recommendations to develop through National Policy Dialogues (NPD) organized in each beneficiary. In addition, areas in DRR and hydro-meteorological sector that would benefit from stronger regional cooperation have been identified based on consultations with the beneficiaries during the national assessments and the NPDs as well as other regional events. Opportunities for strengthening regional collaboration with relevant regional partners and centers have been identified. The outcomes of these assessments are presented in the present Report.

Methodology of assessment

A systematic approach was adopted by WMO to assess the capacities, identify gaps and needs in disaster risk reduction and EWS, particularly with respect to the provision of information and services for meteorological, hydrological and climate-related hazards in South East Europe. The assessment involved a systematic analysis of the DRR institutional framework in IPA beneficiaries, and the role of the NMHSs in this framework. The study also considered the core capacities of NMHSs, as well as the operational cooperation between NMHSs and other technical agencies and centres at the national, regional and international levels. This included the current status and future needs for monitoring and observation networks, hydrometeorological data management systems, hazard analysis and mapping capacities, forecasting capacities, warning products and services, information technology and telecommunication capacities.

This assessment was based on information obtained through the following process:

- A detailed WMO technical questionnaire sent to the NMHSs;
- Information collected during the joint UNDP-WMO mission in each IPA beneficiary including meetings with all DRR stakeholders, representatives of different sectors, NMHSs and/or discussions with project focal points and key experts;
- Exchanges and feedback received from the NMHSs;
- National Policy Dialogues (NPD) on DRR in each IPA beneficiary, where recommendations were discussed and endorsed at policy-making level.

This assessment was further complemented by analysing the national capacities for flood and drought risk assessment, through workshops and information collected during missions in all IPA beneficiaries.

Key findings

Based on the assessment of national capacities, specific technical recommendations were made to strengthen NMHSs capacities to support Disaster Risk Reduction regarding (i) the legal framework and institutional arrangements related to the role of NMHS in DRR, (ii) the operational relationships with other agencies, (iii) monitoring and observations networks and data exchange,

(iv) hydrometeorological forecasting, (v) hydrometeorological data management systems, (vi) hazard analysis to support risk assessment, (vii) information technology and telecommunication issues, (viii) warning products and services, (ix) climate change analysis, (x) human resources, and (xi) regional cooperation.

This assessment also led to the development of policy recommendations that were presented together with the UNDP during National Policy Dialogues on DRR organized in all IPA beneficiaries. These policy recommendations are following the five priorities of the Hyogo Framework for Action and were endorsed at policy level.

The overall analysis of this assessment revealed that in South East Europe:

- Strengthening DRM policies and strategies toward more preparedness and prevention is underway in the region: most of the IPA beneficiaries are currently restructuring their DRM processes, coordination, policies and strategies moving forward from post disaster response to preventive and preparedness strategies. This is an opportunity to foster institutional coordination and collaboration among NMHS and various partners in this area.
- The roles and responsibilities of NMHSs in DRR are increasingly recognised in the region. Most of the IPA beneficiaries highlighted the need for strengthening the institutional coordination and cooperation between the NMHSs, the DRM agencies, and other sectors, particularly, for the development of risk assessment and early warning systems.
- All countries in SEE realized that the technical and human capacities of their NMHSs need to be strengthened to support DRR and specifically risk assessment and EWS.
- Although capacities of NMHS in producing meteorological, hydrological and climate products and services vary across the region, IPA beneficiaries are confronted to common challenges related to their monitoring and observation networks, forecasting capacities, hydrometeorological data management systems, hazard analysis and mapping capacities, warning products and services development, IT infrastructure, climate change analysis capacities.
- IPA beneficiaries emphasised the need to promote regional cooperation in meteorology, hydrology and climate as a critical step toward improving DRR and EWS capacities.

A regional DRR strategy for South East Europe

During the consultations, the need for a clear regional DRR strategy highlighting the long-term priorities for capacity development and cooperation, with a corresponding regional action plan for implementation was highlighted. It was recommended that this strategy should:

- be founded on a comprehensive framework for disaster risk management within a multi-stakeholder and multi-hazard approach and identify and prioritize concrete areas of regional cooperation;
- ensure that gaps, needs and priorities are addressed in a coordinated fashion and with a long-term capacity development perspective;
- be underpinned with phased project proposals targeted at capacity development. Various projects in the region supported through bi- and multi-lateral cooperation should be integrated and aligned to avoid redundancies and address gaps;
- be aligned with the strategic priorities for the development of meteorological, hydrological and climate services in SEE;
- be complemented with corresponding regional agreements and trans-boundary agreements and regional operational plan (who, what, when, how and with whom). Specifically the Regional DRR Strategy and Regional Operational plans should consider the hazards posing risks across borders in the region, e.g., forest fires, floods, droughts, heat waves;
- be developed through a multi-stakeholder regional mechanisms which should identify areas of cooperation and develop, monitor and evaluate the regional implementation plan;

Priorities and next steps

A number of areas requiring regional cooperation have been identified including: (i) harmonisation of risk assessment methodologies, tools and capacities; (ii) coordination and harmonization of EWS for cross border hazards; (iii) sharing of good practices in DRR; (iv) more regional trainings and workshops; (v) development of regional project proposals in coordination with donors and funding agencies; and (v) establishment and/or utilization of Centres of excellence and cooperation mechanisms. In this overall context, the following areas have been identified as priorities for the development of future regional cooperation project or programmes aimed to strengthen the capacities of the hydrometeorological services to support Disaster Risk Reduction in South East Europe:

- Enhance the regional hazard assessment and mapping capacities;
- Enhance capacity to forecast hazardous meteorological and hydrological phenomena and deliver timely warnings to support DRR;
- Develop the capacity needed to support climate risk management and climate change adaptation into national and regional DRR agenda;
- Design a regional Multi-Hazard Early Warning System composed of harmonized national Early Warning Systems within a regional cooperation framework.

INTRODUCTION

Even though the South East Europe (SEE) region is highly diverse in terms of geography and climate, countries of Western Balkans and Turkey are exposed to a range of similar disasters caused by the impacts of natural hazards, including heavy precipitation causing floods and landslides, droughts and forest fires, earthquakes, prolonged cold and heat waves, and hailstorms. Disasters caused by hydrometeorological and climate-related hazards already have a significant impact in the SEE region and might affect any country's economic standing and key sectors (agriculture, transport, water management, energy, tourism, finance). Furthermore, as revealed in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change[1], it is expected that, due to climate change, the frequency and severity of such hazards will increase in the future, leading, together with changes in land-use patterns and increased human settlements in areas that are prone to disasters, to increased risks in the coming years. Besides their exposure to similar disasters, SEE countries are also often affected by cross-border disasters, as natural hazards do not know boundaries. Floods in transboundary rivers and fires in transboundary forests are frequently crossing borders in the region.

Adoption of the Hyogo Framework for Action (HFA) 2005 – 2015 by 168 countries during the Second United Nation World Conference on Disaster Risk Reduction (2005, Kobe, Japan) has led to a paradigm shift in disaster risk management from a post-disaster response to a comprehensive and strategic approach in disaster risk management encompassing preparedness and prevention strategies. The second high priority area of the HFA stresses the need for “identifying, assessing and monitoring disaster risks and enhancing early warning”.

Taking this into consideration, it becomes clear that any nation’s disaster risk management strategy should include development of (i) risk assessment to quantify and understand the risks associated with natural hazards and their impacts and (ii) Early Warning System (EWS), enabling national and local governments and communities to take appropriate measures toward building community resilience in anticipation of disasters. In this respect, National Meteorological and Hydrological Services (NMHS) have vital contributions to make to disaster prevention and preparedness, mitigation of the impacts of disasters, emergency response, recovery and reconstruction. A fundamental mission of the National Meteorological and Hydrological Services (NMHS) and the World Meteorological Organization (WMO) is to contribute to the protection of the lives and livelihoods of people by providing early warnings of hydrometeorological and climate-related hazards and related information to reduce risks. They are crucial support for Disaster Risk Management (DRM) agencies and other Early Warning Systems (EWS) stakeholders with regard to disaster prevention and preparedness, mitigation of the impacts of disasters and emergency response.

As part of the South Eastern Europe Disaster Risk Mitigation and Adaptation Programme (SEEDRMAP) initiated in 2007 by the World Bank, the World Meteorological Organization (WMO) and the United Nations Strategy for Disaster Risk Reduction (UN-ISDR), WMO and UNDP developed two complementary project proposals that were funded together as the “Regional Programme on Disaster Risk Reduction in South East Europe” by the European Commission (EC) Directorate General for Enlargement, through its Instrument for Pre-Accession Assistance (IPA). This programme is targeting the following eight IPA beneficiaries: Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo (as defined by UNSCR 1244/99) and Turkey and were initiated in March 2009. The aim of this WMO project is to reduce the vulnerability of South Eastern European countries to natural hazards such as drought, flood and forest fires. In recent years, these hazards have resulted in disasters with large economic and humanitarian impact. The project focuses on building the national and regional capacity of the National Meteorological and Hydrological Services (NMHS) in the provision of reliable weather, water and climate products and services such as hazard analysis to support risk assessment and forecasts and warnings with adequate lead time to support the Disaster Risk

[1] IPCC 4th Assessment Report, 2007

Reduction (DRR) activities of the IPA beneficiary countries and the region as a whole. Building better cooperation between the NMHS, which are the providers of hydrometeorological information and services and the agencies responsible for civil protection and emergency response, with the main economic sectors, is a primary objective. The outcomes of the WMO component of the project are presented in Annex 1.

Within this project, Activity 1.1 "National Policy Dialogues on DRR" was implemented in close cooperation between WMO and UNDP. Detailed assessment of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the IPA beneficiaries were completed and conducted to the development of policy recommendations, through National Policy Dialogues (NPD) organized in each beneficiary. This activity was implemented between March 2010 and December 2010.

Activity 2 "Flood and Drought Risk Assessment" focused on assessing the beneficiaries national capacities in flood and drought risk assessment. Two training workshops were conducted (i) on flood risk assessment (Oct. 2010, Istanbul, Turkey) and (ii) on drought risk assessment (Sept 2010, Ljubljana, Slovenia) to provide participating experts with self assessment capacities of their national system for flood and drought risk assessment. Detailed assessments of these capacities gaps and needs have been prepared. This activity was implemented between September 2010 and March 2011.

Activity 1.4 on "Regional Cooperation Roadmap" aimed to identify areas and opportunities for the strengthening of regional collaboration in meteorology, hydrology and climate to strengthen Disaster Risk Reduction (DRR) in SEE. Building on the outcomes of the National Policy Dialogues (Activity 1.1) and Flood and Drought Risk Assessment National Capacities assessments (Activity 2), the regional cooperation roadmap for strengthening Meteorology, Hydrology and Climate Services for Disaster Risk Management was developed through extensive consultations with national and regional stakeholders, including the workshop on "Regional cooperation in MHEWS and risk assessment in SEE" (Feb. 2011, Geneva), the Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management (March 2011, Sarajevo, Bosnia and Herzegovina), and the Regional Conference on Coordination and Cooperation in the field of DRR in SEE organised by UNDP (Sept 2011).

This report presents all the findings of these activities. Specifically, it focuses on the meteorological, hydrological and climate services capacities to support Disaster Risk Reduction and Early Warning Systems in the IPA beneficiaries of South East Europe. It includes (i) a description of the roles and responsibilities of the NMHS in DRR, the background of this project and the methodological approach of this analysis in the Background section (Chapter one), (ii) an assessment of the DRR institutional framework and the technical capacity of the NMHS to support DRR and MHEWS in the IPA beneficiaries with technical recommendations to strengthen these capacities (Chapters two to eight)[2], and (iii) a roadmap for the strengthening of regional cooperation in meteorology, hydrology and climate in South East Europe to support DRR and MHEWS (Chapter nine).

[2] As Activity 4.4 ("Assessment of current Institutional and Technical Capacity and Mechanisms in Kosovo (as defined by UNSCR 1244/99) for delivers of Hydromet products and services") was specifically addressing Kosovo (as defined by UNSCR 1244 / 99), the report of this assessment is provided independently in Annex 2.

1. CHAPTER ONE: BACKGROUND

1.1. Background on the roles and responsibilities of the NMHSs in the new DRR paradigm

A comprehensive national strategy for disaster risk management derived from the Hyogo Framework for Action 2005-2015 (HFA)[3] encompasses risk identification, risk reduction and risk transfer. These must be underpinned by strong political commitment that translates into clear policies and enforceable legislation to clarify roles and responsibilities of the stakeholders, organizational coordination, concept of operations, and information sharing to facilitate implementation of such a strategy from national to local levels. One such key stakeholder is the National Meteorological and Hydrological Service (NMHS) in each country (Figure 1).

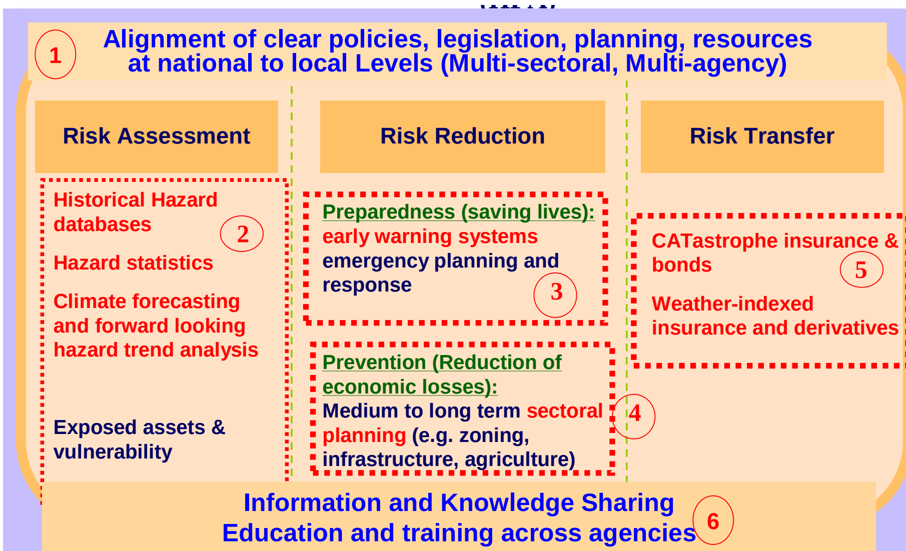


Figure 1. Role of the NMHS in Disaster Risk Reduction – WMO DRR Programme

A fundamental mission of NMHS and the World Meteorological Organization (WMO) is to contribute to the protection of the lives and livelihoods of people by providing early warnings of meteorological and hydrological hazards and related information to reduce risks. They are crucial support for Disaster Risk Management (DRM) agencies and other Early Warning Systems (EWS) stakeholders with regard to disaster prevention and preparedness, mitigation of the impacts of disasters, emergency response, recovery and reconstruction.

Effective disaster risk management must be founded on scientifically sound risk assessment, to quantify and understand the risks associated with natural hazards and their impacts. The goal of the NMHS is to provide and deliver useful, usable and credible products and services such as forecast and warning products or hazard information to meet country or territory needs, especially when an extreme weather-related event occurs.

NMHS role includes: systematic observation and monitoring of hydrometeorological parameters; provision of quality-assured historical and real-time hazard data; hazard analysis and mapping; as well as forecasts of hazards and their changing patterns. There is also need for hazard and risk analysis tools for quantification of exposure and vulnerabilities (e.g. casualties, construction damages, crop yield reduction, water shortages). However, analysis of hazard patterns from historical data is necessary but not sufficient for risk assessment. Changing patterns of climate hazards are posing challenges with longer-term strategic planning and investments (e.g.

[3] HFA was adopted by 168 countries during the World Conference on Disaster Reduction (January 2005, Kobe, Japan), provides the framework for a new paradigm in disaster risk management with a strong focus on prevention and preparedness strategies based on identification and quantification of potential risks.

infrastructure planning and retrofitting based on building codes and specifications, using only historical records (e.g. a 100 year flood may become a 30 year flood). Such climate analysis tools for assessing changes in severity, frequency, and occurrences of hydro-meteorological hazards at seasonal, inter-annual, decadal, and longer climate change time lines need to become available operationally and applied for risk assessment.

With the risk knowledge, countries can reduce risks, using (i) early warning systems and preparedness, (ii) medium and long-term sectoral planning (land zoning, infrastructure development, agricultural management, water resource management, etc.), and (iii) transfer the remaining risks through utilization of weather-indexed insurance and financing mechanisms to reduce and transfer the economic impacts of disasters at various levels and decision timelines.

All sectors require a wide range of meteorological, hydrological and climate information products and services, at different temporal and spatial scales, and with different information content. These information products include data products, forecasts, outlooks and analyses, and research products. Early warning systems have been demonstrated to be effective tools for reducing loss of life through improved emergency preparedness and response; however, emergence of climate prediction and forecasting tools provides unprecedented opportunities to provide outlooks and warnings with longer lead times that can be used for improved sectoral planning (supply/demand management and risk management practices in agriculture, urban planning, water resource management, etc.) and ultimately protection of livelihoods. In this context, the ability of NMHS to deliver these services is critical. The quality of forecasts and early warnings provided by NMHS depends on global and regional numerical weather prediction models and local-scale forecasting skills. This in turn depends on the availability and quality of observational data, technical and human resources of the NMHS and international cooperation and data sharing.

1.2. Background on the Regional Programme on Disaster Risk Reduction in South East Europe

In 2007, the World Bank, the World Meteorological Organization (WMO) and the United Nations Strategy for Disaster Risk Reduction (UN-ISDR) initiated the South Eastern Europe Disaster Risk Mitigation and Adaptation Programme (SEEDRMAP), aiming at developing or strengthening national capacities in this region along three components: (i) Disaster risk management institutional capacities and governance; (ii) Hydrometeorological Services and their cooperation with sectors; and (iii) Financial risk transfer mechanisms, to assist countries in reducing risks associated with natural hazards. During the first phase of the project, fact finding surveys and desk-top studies were performed as the basis for the development of relevant projects. Based on these results and further consultations with countries and the European Commission, WMO and UNDP developed in parallel two complementary proposals that were funded together as the "Regional Programme on Disaster Risk Reduction in South East Europe" by the European Commission (EC) Directorate General for Enlargement, through its Instrument for Pre-Accession Assistance (IPA). This programme is targeting the following eight IPA beneficiaries: Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo (as defined by UNSCR 1244/99) and Turkey and were initiated in March 2009. The components include:

1. Component 1: "Building Capacity in Disaster Risk Reduction through Regional Cooperation and Collaboration in South East Europe", implemented under the UNDP coordination;
2. Component 2: "Regional Cooperation in South Eastern Europe for meteorological, hydrological and climate data management and exchange to support Disaster Risk Reduction", implemented under the WMO coordination.

Within this project, Activity 1.1 "National Policy Dialogues on DRR" was implemented in close cooperation between WMO and UNDP. Detailed assessment of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries were completed and conducted to the development of policy recommendations, through National Policy Dialogues (NPD) organised in each beneficiary. This activity was implemented between March 2010 and December 2010.

Activity 2 “Flood and Drought Risk Assessment” focused on assessing the beneficiaries national capacities in flood and drought risk assessment. Two training workshops were conducted (i) on flood risk assessment (Oct. 2010, Istanbul, Turkey) and ii) on droughts risk assessment (Sept 2010, Ljubljana, Slovenia) to provide participating experts with self assessment capacities of their national system for flood and drought risk assessment. Detailed assessments of these capacities have been prepared with the support of an international consultant who visited all the beneficiaries. Based on these assessments, concrete project proposals for capacity development of the NMHS with other ministries and technical agencies have been developed. This activity was implemented between September 2010 and March 2011.

Activity 1.4 on “Regional Cooperation Roadmap” aimed to identify areas and opportunities for the strengthening of regional collaboration in meteorology, hydrology and climate to strengthen Disaster Risk Reduction (DRR) in SEE. Building on the outcomes of the National Policy Dialogues (Activity 1.1) and Flood and Drought Risk Assessment National Capacities assessments (Activity 2), the regional cooperation roadmap for strengthening Meteorology, Hydrology and Climate Services for Disaster Risk Management was developed through extensive consultations including the workshop on “Regional cooperation in MHEWS and risk assessment in SEE” held with (sub-) regional agencies and technical centres supporting DRR in Europe and South East Europe to identify opportunities for further strengthening regional cooperation projects and activities (16-17 February 2011, WMO Geneva), the Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management, with Directors of NMHSs and DRM agencies (28-29 March 2011, Sarajevo, Bosnia and Herzegovina) to finalise the draft regional cooperation roadmap; and the Regional Conference on Coordination and Cooperation in the field of disaster risk reduction in the region organised by UNDP on 11-13 September 2011 to endorse the regional road-map proposal prepared by UNDP and WMO in consultation with beneficiaries and regional partners.

1.3. Methodology for this assessment

The schematic presented in Figure 2 is an illustration of the core components of the support that NMHS provide to DRM agencies and other DRR stakeholders. This framework focuses on the key contribution of NMHS to the protection of the lives and livelihoods of people by providing early warnings of hydrometeorological hazards and related information to reduce risks, the core capacities required by the NMHS, as well as the technical operational relationships between the NMHS and other technical agencies or Centers at the national and regional levels. It can be summarised by its various components as follows (as numbered in the schematic):

1. National and regional governance and institutional frameworks: EWS must be underpinned by appropriate legislation and institutional frameworks that defines (i) roles and responsibilities of the various EWS stakeholders, (ii) organizational coordination and cooperation mechanisms, and (iii) appropriate allocation of resources.
2. National EWS users: there are many EWS users from governmental (e.g. Disaster Risk Management Agencies) to local communities, non governmental organization (NGOs), the media, various sectors of the economy and the general public. All have various requirements and needs of EWS products and services.
3. Service delivery and feedback mechanism: the NMS needs to understand and fulfil these user needs through an interface that enables effective service delivery as well as feedback for improvement of products and services over time.
4. Products and services: The suite of products and services provided by NMS comprises not only forecasts and warnings of hazards but also a wide variety of data products, hazards information and analyses in addition to provision of expertise for specific EWS-oriented studies and research, product design and to support decision-making.
5. Core operational components: the core capacities required to develop these products and services include capacities for observation, monitoring and operational forecasting. These basic NMHS capacities rely on supporting functions and activities such as data management, product development and the relevant Information Technology (IT) and

telecommunications, and a sufficient number of qualified and trained staff. Overarching capacities in Quality Management Systems (QMS) are essential for effective management of the preceding functions and activities.

6. Coordination mechanisms with other National technical and sectoral implementing partners involved in EWS: Other institutions also play an essential role in many areas through synergies and collaboration with NMHS in forecasting, warning and data exchange (e.g. hydrological, oceanographic, health services).
7. Coordination and cooperation with Regional Specialised Meteorological Centers: With consideration for the high resource requirements for development and sustainability of such services and need for trans-boundary cooperation, there are significant opportunities through strengthened regional coordination, cooperation and capacities of regional centers that benefit the SEE countries/territories. Such leveraging can be realized through enhanced coordination in monitoring, data exchange, sharing of good practices, leveraging technical resources and cascading of best tools and methodologies through regional products and services.

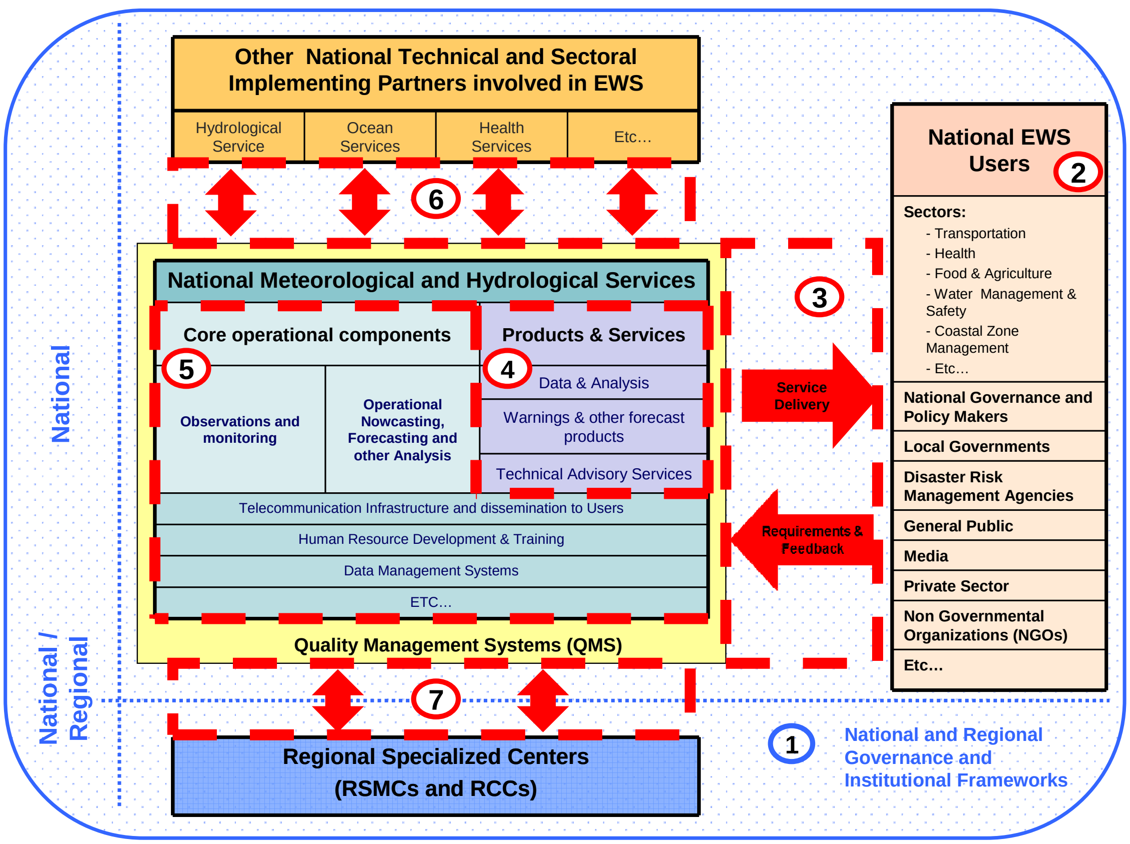


Figure 2. Schematic of linkages of NMHS with EWS stakeholders and core capacities of NMHS to support EWS and DRM stakeholders - WMO DRR Programme

The assessment on the NMHS capacities presented in this report is based on the schematic presented in Figure 2. Specifically, it has been developed through:

- A detailed WMO technical questionnaire sent to the NMHS;
- Information collected during the UNDP-WMO joint 2-day mission in each IPA beneficiary including meetings with all DRR stakeholders, representatives of different sectors and a visit to the NMHS and/or discussions with project focal points and key experts;
- Exchanges and feedback from the NMHS;
- The organization of a 2-day National Policy Dialogue (NPD) on DRR in each IPA beneficiary, where recommendations were discussed and endorsed at policy level.

This assessment was further complemented by analysing the national capacities for flood and drought risk assessment in all the IPA beneficiaries, through:

- The organization of two training workshops for the experts from the project countries on Flood risk assessment and Drought risk assessment (See reference section);
- The assessments of the national capacities, related gaps and needs for development of flood and drought risk assessments. Through the two training workshops, the participating national experts were enabled to conduct detailed assessments back in their country with the support of one consultant hired by WMO;
- The development of comprehensive national proposals for the strengthening and development of national capacities in flood and drought risk assessments. The consultant hired by WMO developed a national proposal based on the national assessment and through a mission in all IPA beneficiaries.

One of the key outputs of this “Regional Programme on Disaster Risk Reduction in South East Europe” is the development of a regional cooperation roadmap laying out the areas in disaster risk reduction and hydro-meteorological issues that require regional cooperation. Building on the outcomes of the National Policy Dialogues (Activity 1.1), MHEWS Training Workshop (Activity 1.3) and Flood and Drought Risk Assessment National Capacities assessments (Activity 2), the regional cooperation roadmap for strengthening Meteorology, Hydrology and Climate Services for Disaster Risk Management has been developed through the following process:

- Areas in DRR and Meteorological, Hydrological and Climate-related issues that require regional cooperation have been identified based on outcomes of consultations with IPA beneficiaries during the national assessments and the National Policy Dialogues;
- A workshop on “Regional cooperation in MHEWS and risk assessment in SEE” was held with (sub-)regional agencies and technical centres supporting DRR in Europe and South East Europe to identify opportunities for further strengthening regional cooperation projects and activities (16-17 February 2011, WMO Geneva);
- A Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management, with Directors of NMHSs and DRM agencies (28-29 March 2011, Sarajevo, Bosnia and Herzegovina) to finalise the draft regional cooperation roadmap; and
- A Regional Conference on Coordination and Cooperation in the field of disaster risk reduction in the region organised by UNDP on 11-13 September 2011 to endorse the regional road-map proposal prepared by UNDP and WMO in consultation with beneficiaries and regional partners.

The findings from these complementary assessments and activities have been integrated into the present comprehensive report, which provides a thorough analysis of the DRR framework and the technical capacity of the NMHS to support DRR and MHEWS in the IPA beneficiaries (Chapters two to eight) and a roadmap for the strengthening of regional cooperation in meteorology, hydrology and climate in South East Europe to support DRR and MHEWS.

2. CHAPTER TWO: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN ALBANIA

Albania is prone to several natural hazards like floods, drought, heavy rainfall or snowfall, wind storms, heat waves, landslides, avalanches, forest fires, airborne sand from deserts and some epidemics which are directly or indirectly related to hydrology, meteorology and weather conditions. Every year Albania faces some or several natural hazards causing human and economic losses.

This chapter presents all the findings related to the assessment of the DRR institutional framework in Albania and the technical capacities of the NMHS of Albania (Institute of Environment, Water and Energy, IEWE) to support Disaster Risk Reduction. It highlights that:

- The Albanian hydro-meteorological sector is more or less disordered and does not have the technical, human and financial resources to meet the needs for hydro-meteorological services in order to provide expected information and products to the Government, the socio-economic communities, to protection of human life, and to improve human and environmental safety. It neither has the capability to properly fill the international commitments of producing hydro-meteorological data to promote regional and global cooperation in production of better hydro-meteorological modelling and services to promote the human safety and well-being;
- In this regard, there is a need to establish and invest in fully operational 24/7 hydro-meteorological services (technical and human resources) to support risk assessment and early warning systems and promote operational monitoring, warning, forecasting and mapping of meteorological, hydrological and climate-related hazards. It is critical to perform comparative analysis of the existing institutional and legislative arrangements for hydrometeorological services, upgrade and modernize hydro-meteorological observation networks, data management and forecasting systems and provide sustainable organizational, human and technical resources to maintain and operate them. It is also necessary to strengthen the early warning capacity with a multi-hazard approach and enhanced cooperation with the Ministry of Interior, General Directorate of Civil Emergencies and other key stakeholders and the National Civil Emergencies Plan, to include contributions by the hydro-meteorological services;
- Development of Risk Assessment, MHEWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

2.1. Albania's vulnerability to hydrometeorological hazards

2.1.1. General overview of country's economic sectors

Albania, a formerly closed, centrally planned state, is making the difficult transition to a more modern open-market economy. Although the country is rich in natural resources, the economy is mainly bolstered by emigrant annual remittances, services, and the agricultural sector. Macroeconomic growth averaged around 6% between 2004 and 2008, but declined to about 3% in 2009-10. Inflation is low and stable. The agricultural sector, which accounts for over half of employment but only about 21% of GDP, is limited primarily to small family operations and subsistence farming because of lack of modern equipment, unclear property rights, and the prevalence of small, inefficient plots of land. The contribution of industry to the GDP is estimated at 20% and services accounts for about 60%.

2.1.2. Natural hazards in Albania

Geographical position of Albania as a Mediterranean country makes it a disaster prone country which is exposed to several natural hazards like flood, drought, heavy rainfall or snowfall, wind storms, heat waves, landslides, avalanches, forest fires, airborne sand from deserts and some epidemics, all being directly or indirectly related to hydrology, meteorology and weather conditions.

The river system poses the highest risk of flooding to the country. Floods are generally of pluvial origin and occur during the period November-March when the country receives about 80-85% of its annual precipitation. More recent flood records indicate that major flooding has occurred in all of the principal watersheds. Historically, the floods of November 1962 and January 1963 are considered to be the largest. In total about 70,000 hectares of agricultural land was flooded causing substantial economic damage, as well as major cities. The most recent flooding affected Albania in September 2002. It was caused by the River Erzeni and its tributaries and inundated the cities of Lezhe and Berat and their surrounding villages as well as other rural areas and agricultural land along the riverbanks of the above rivers. During the last weeks of 2009 and the first days of 2010 most parts of Albania experienced continuous heavy rainfall and periodic snow melt in mountain areas. This phenomenon occurred particularly in the north and northwest of the country. This resulted in the creation of a critical situation at the River Drini hydro-power plants and water-reservoirs as well as downstream. As a consequence of the above situation a large area of the Shkodra region was inundated from the 3 - 10 January 2010. 11,400 hectares, including 2,649 houses, was either under or surrounded by flood water. Eight communes/administrative units were heavily affected by this situation, including rural and national infrastructure, water pipelines, etc.

Table 1: Impacts of major floods in Albania

Event	Location	Impacts
Flood of November 1962 – January 1963	Part of cities of Shkodra, Berat, Lezhe and others	70000 ha agricultural land flooded Huge damages in flood infrastructure, road infrastructure, livestock loss, no victims
Flood of December 1970 – January 1971	Vjosa river area	14000 ha land flooded Damages and destruction of embankment, irrigation channels, bridges, pumping stations
Flood of September – October 2002	Part of cities of Lezha, Shkodra, Gjirokastra, Berat and others (11 districts in total)	33000 ha flooded Considerable loss in agriculture, damages in houses, businesses, roads, bridges, pumping stations, dams, electric stations, and other infrastructure, up to 9727 people evacuated, $17.5 million evaluated as total loss cost
Flood of December 2009 – January 2010	Buna River and Shkodra lake	10,500 ha agricultural land flooded Sustained damage in the nearby water supply, roads, bridges, and more than 2500 House Buildings and 5,300 residents evacuated

Snow precipitation is characteristic of the inland mountainous regions in the north and north-east and the centre and south. In mountainous regions snowfall usually begins in November and lasts until late March. High snowfall and frequent avalanches caused substantial damage in the winters of 1933/34, 1940/41, 1953/54, 1963/64 and 1972/73. The avalanches of Bater (Mati District) in March 1965 and of Feken (Mali me Gropa) of March 1981 were the most dramatic occurrences. The winter of 1985 was an exceptional one. In the period January-February, as a result of intense snowfall, large numbers of avalanches were triggered in the districts of Tropoje, Kukes, Diber, Puke, Shkoder and Mati. In total 68 people were killed, 135 injured and 1,604 houses were destroyed.

Land instability in Albania primarily occurs after massive torrential rain or snowfall. Various modes of landslide (rock falls, topples or torrent deposits) are often recorded along disturbed slopes along national and regional transportation routes, water irrigation and other surface channels and places of other engineering works. Last year in Albania eight serious landslides occurred in populated rural areas, affecting a large number of families, houses, infrastructure, etc.

During the last two decades the occurrence of forest fires in Albania has increased in number and also in the size of the area affected. The forests of Albania are especially prone to fire at the end of spring and during unusually warm and dry summers. The main causes of fires are primarily of an anthropogenic nature (human negligence, pasture burning and similar and to a lesser extent as a result of arson) and natural (lightning) character. Most damage occurs in the coniferous forests. In the summer of 2007 Albania experienced an extended forest fire, which affected 7 out of 12 qarks: 5 qarks declared an Emergency Situation for Natural Disasters and the ad-hoc Inter-ministerial Committee for Emergency Situations was established. The large area burned caused relatively high economic losses, but fortunately no one was killed.

Since the 1960s, the mean intensity, length and number of heat waves across the eastern Mediterranean have increased, particularly the accumulation of short (less than 6 days) but more intense heat wave events compared with previous decades. Albania is exposed to these increases and at least three events leading to mortality and economic loss have been recorded since 1980.

The severity of extreme events like drought, heat waves, forest fires and flooding has intensified over the last few decades and as revealed in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, this trend is expected to accelerate in the future as a result of climate change, leading, together with changes in land-use patterns and increased human settlements in areas that are prone to disasters, to increased hydrometeorological and climate-related risks in the coming years.

Albania suffers also frequently from earthquakes of different magnitudes.

2.1.3. Sectoral analysis of the vulnerability to hydrometeorological hazards

In Albania, key sectors of the economy are highly vulnerable to hydrometeorological hazards and climate change, and in particular the water sector and the agriculture. Since much of Albania's economic activity is dependent on the utilization of water resources, Albania's economy results to be particularly vulnerable to hydrometeorological conditions and climate variability and change. The hydrographic basin of Albania covers 43,305 km^2, of which 28,748 km^2 lie within its boundaries. The rest (i.e. 33 per cent) is in Greece, the Former Yugoslav Republic of Macedonia and Yugoslavia, so Albania shares upstream and downstream water resources with its neighbours. Thus, for Albania it is critical to build strong partnerships with those countries for water management including flood protection. Seven main rivers run from east to west in Albania. Most of the rivers discharge into the Adriatic (95%), while only 5% discharge into Ionian Sea.

Over 90% of energy production in Albania comes from hydropower plants, and agriculture is critically dependent on irrigation. However, the inadequate and poorly maintained infrastructure in each of the water-using sectors and the absence of institutional coordination has resulted in the lack of water supplies becoming a key constraint to many economic activities and to satisfying basic social needs.

With 58% of total labor and 19% of GDP, the agricultural sector continues to be one of the most important sectors of the Albanian economy. About 56% of the population lives in rural areas, where agriculture is the main activity. Agricultural production has increased at an average of 3% between 2002 and 2006, which is a lower rate than for the economy as a whole. The increase in yields has been substantial for grapes, potatoes, milk from cattle and goats, eggs, fruits and fodder. Fruit production (including grapes) has increased by 70% between 2000 and 2008, animal production by 21% and arable crops by 10%. Within arable crops wheat areas have decreased markedly. Vegetables production has increased notably, particularly in greenhouses.

Agriculture is a climate sensitive sector. With the majority of the rural population being poor and dependent on agriculture, rural communities are vulnerable and at risk from any changes that occur as a result of climate change. Present projections including increased temperatures, decreased precipitation and an increase in the number of extreme events pose a serious risk to agriculture production, water availability, food security and economic growth for rural livelihoods in Albania. Areas that are already under marginal rain-fed production will be at increasing risk, whilst communities in high rainfall areas will have more adaptation options to buffer their production systems against projected changes in climate. The irrigated agriculture sector will need more water to maintain production, although significant opportunity exists for improvements in system and on-farm water use.

2.2. Institutional Framework of Disaster Risk Reduction in Albania

2.2.1. Legal framework

In Albania DRR organization is defined by the National Plan for Civil Emergencies, which was adopted by the Council of Ministers and is derived directly from the Law on “Civil Emergencies” (Law No. 8756 dated 26.03.2001). The law “On Civil Emergencies” defines the main tasks and duties of the Directorate General for Civil Emergencies.

The Government of Albania is in the process of developing the National Strategy for Development and Integration. This strategy incorporates all sectoral strategies, including one for DRR. The Albanian strategy for DRR incorporates integrated environmental risk reduction policies into development plans at the national, qark and communal/municipal levels.

At the regional and communal level a designated office has been established to deal mainly with emergency management. All activities at these levels are based on the Law on Civil Emergencies, the Law on Fire Protection and the Law on Local Government. Structures at the communal level are coordinated and conducted by central government structures, but they maintain a level of dependency on communal authorities. Such a conduction and dependency is due to the definition of the Law on Local Government that civil emergency is a dual governmental function: central and local.

Besides the Law on Civil Emergencies and the decrees of the Council of Ministers that derive from this Law, there are a other laws and legal provisions that deal with environmental protection, environmental impact assessments, the protection and development of forests and pasture, agriculture and rural area development, the safety of dams and dykes, public health protection, urban planning and construction among others that create a more complete legal framework for DRR. In any event, a new law on civil emergencies is needed to provide a more organic, overall coordinative and preventive approach to DRR; in actual fact a new draft law is in place.

The Law on Water Resources (No. 8093 of 1996) (Water Law) is the primary legislation governing the country’s inland, maritime, surface, and groundwater and is intended to ensure the protection, development, and sustainable use of the country’s water and provide for its proper distribution. The

Water Law addresses water rights, water use, and governance of water resources. A new law on water management has been drafted but has not yet been approved.

The Law on Irrigation and Drainage (No. 8518 of 1999) established the responsibilities of the Ministry of Agriculture, Food and Consumer Protection concerning floods protection.

The relevant line ministries, such as the Ministry of Environment, Forests and Water Administration; the Ministry of Agriculture, Food and Consumer Protection; the Ministry of Health, the Ministry of Economy, Trade and Energy, and other ministries have designated offices for DRR and focal points officers. Such ministries are developing sectoral strategies with a DRR approach. These strategies and respective policies emphasize preventive targets against disasters.

The DRR National Policy Dialogue in Albania (2010) pointed out the commitment of Albania Government for the establishment of a National Platform for Disaster Risk Reduction. The Platform should strengthen the profile of DRR and to ensure that debate across all levels of government, technical agencies such as the hydro-meteorological services, civil society, NGOs and the private sector is ongoing and contributes actively to policy-making and planning. The National Platform will allow for the engagement of all major practitioners and technical specialists as well as representatives of communities and those affected. It will also promote awareness and coordination among the relevant sectors, and ultimately support the linking of such awareness and coordination to national planning, budgeting and implementation of DRR activities.

2.2.2. Institutional framework

At the national level the coordination mechanism for most aspects related to DRR is led by the Directorate General for Civil Emergencies of the Ministry of Interior. Even if this structure is still organized on a disaster-response mode, it is becoming increasingly active in aspects related to the coordination of recovery from disasters and in stimulating the incorporation of DRR principles and concepts into development planning. Meanwhile, the Directorate coordinates training activities for DRR, the legal provisions and DRR requirements for sectoral policies and plans. In parallel, each line ministry is responsible for the coordination of DRR aspects pertaining to their area of responsibility, thus reflecting DRR needs through development plans and improving capacities for DRR. The relevant national agencies involved in DRR for hydrometeorological hazards are:

- The Directorate General for Civil Emergencies, Ministry of Interior;
- The Institute of Environment, Water and Energy, Ministry of Environment, Forests and Water Administration;
- The Department of Land and Water Management, Ministry of Agriculture, Food and Consumer Protection;
- The Ministry of Environment, Forests and Water Administration.

2.2.2.1. Directorate General for Civil Emergencies

According to the law “On Civil Emergencies”, the main tasks and duties of the Directorate General for Civil Emergencies are policy making for emergency management and prevention and the implementation of overall civil emergency issues. This includes the implementation of relevant emergency response and recovery planning, coordination of all actors at the central (designated offices, or focal point officers, in the line ministries) and local level, management of the system, following education and training programmes, public awareness on natural/man-made disaster concerns, conducting relevant research, implementation of national/international agreements in the field between partners and the main actors, reporting periodically to the Government on the emergency management situation, hosting the technical secretariat of the ad-hoc Emergency Inter-ministerial Committee (when it is convened in the event of an emergency situation), dealing with emergency needs and damage assessments, management of respective resources/funds and monitoring of the emergency management database. A National Plan for Emergency Management has been produced in 2004 and it is expected to be updated.

2.2.2.2. Institute of Environment, Water and Energy

Currently official National Meteorological and Hydrological Service in Albania is represented by three different governmental Institutions: (i) the Institute of Environment, Water and Energy (IEWE), (ii) the Military Meteorological Service (MMS) under Albanian Ministry of Defense and, (iii) the Meteorological Service under National Air Traffic Agency (MSNATA). Besides them, there is also one private company performing weather forecast.

According to Government Decision Nr. 560 dt.22.08.2007 in the framework of the reform in Science in Albania, the Institute of Energy, Water and Environment (IEWE) was created based on the former Institute of Hydrometeorology and Hydraulic Research Center. This institute is under Polytechnic University of Tirana (Ministry of Education and Science). According to Civil Emergency Law nr° 8756, the IEWE provides information of curr ent meteorological and hydrological situation and weather forecasting, sending it to the Directorate General for Civil Emergencies. The IEWE is responsible to manage the national meteorological and hydrological networks, to provide studies about climate and hydrology, water and air quality in Albania, and to carry out studies about climate change and its impacts. In DRR, the IEWE does not have the mandate to issue warnings for the public but it has the responsibility to produce data from hydrological and meteorological stations, weather forecasts, hydrological forecasts, hydrometeorological warnings and air and water quality information to the authorities at different levels. It also has the responsibility to provide information to the DRR organization at different levels IEWE is also responsible for hazards data collection and post disaster analyses. This information is provided to the Directorate General of Civil Emergencies, which is responsible for flood risk assessment. IEWE is composed of three departments: (i) the Department of Climatology and Environment (ii) the Department of Water Economy, and (iii) the Department of Energy technologies.

The MMS operates its own meteorological observation network and has the mandate to produce public weather services, including weather forecast that are presented on TV. The MMS provides also commercial weather services to customers within different economic sectors of Albania. The Airport Meteorological service has its own observation station. Currently there is very little cooperation between the three meteorological services (IEWE, MMS and MSNATA).

2.2.2.3. Department of Land and Water Management (DLWM)

The Ministry of Agriculture, Food and Consumer Protection (MAFCP) is the principal government body responsible for the irrigation and drainage systems, and flood defense works. The General Directorate of Land & Water and Services within the Ministry of Agriculture, Food and Consumer, according to the Law on Irrigation and Drainage no. 8515, dated July 30, 1999, is responsible for defining institutional arrangements and competencies supporting a national policy in respect of irrigation, drainage and flood protection in Albania.

Within this Directorate, the Department of Land and Water Management (DLWM) has the mission of sustainable and effective management of agricultural land, irrigation system, drainage and protection from flooding. Within this department, the Department of Drainage and Flood Protection is responsible for floods protection and oversees the operation of Drainage Boards operating in the process of maintenance and rehabilitation of drainage infrastructure protection. The Drainage Boards are responsible at local level to operate and maintain the main drainage system and flood defense works within its drainage service area, so as to remove excess water and prevent water logging, the development of salinity and toxicity and to prevent flooding. In fulfilling its primary task, each Drainage Board shall, within its drainage service area routinely inspect, survey, maintain, and repair main drainage systems and flood defense works; prepare an periodically update an emergency flood plan; and maintain sea defenses.

2.2.2.4. Ministry of Environment, Forests and Water Administration (MoEFWA)

The mission of the Ministry of Environment, Forests and Water Administration (MoEFWA) is to draft and propose policies, strategies and action plans for the protection and administration of the environment, forests, waters and fisheries in order to achieve sustainable development, and to improve the quality of life and enable the country to join the European Union. The accomplishment of this mission is carried out through participation, initiation and coordination of the activities that lead to long-term developments and well being, by protecting the nature and raising the awareness of the public opinion. The MoEFWA may propose measures for the protection and preservation of the environment, forestry and water resources and is responsible for the implementation of water policy and forestry policy. In the last years, the Ministry of Environment, Forestry and Water has been more involved in floods management and protection. But the sharing of roles and duties with DLWM is not very clear.

2.2.3. Operational relationship with Disaster Risk Management and other Technical agencies

Each line ministry is responsible for the coordination of DRR pertaining to its area of responsibility. As there is little consultation with and guidance from the Directorate General for Civil Emergencies, institutionnal linkages and operational relationships with line ministries and technical agencies would need to be reinforced to match the existing legal provisions.

Among the relevant institutions, there is inadequate understanding of and capacity for DRR. Overall coordination is lacking. Albania does not yet have a National DRR Platform that would facilitate the interaction of key development players around the national DRR agenda and serve as an advocate for adopting DRR measures at all levels. DRR is frequently assumed without really being identified or defined. Moreover, many institutions are not adequately involved. For example, the hydro-meteorological sector does not yet participate fully in national and regional DRR through monitoring, analyzing, mapping, warning and forecasting hazards. It should be reorganized, with the objective of making it Public Service according to WMO standards. This can only be realized if adequate human, technical and financial resources are allocated to this sector, so that it can sustain its role towards the community and in different phases of DRR, including studies on impacts of climate change.

Standard Operating Procedures (SOP) and Quality Management Systems (QMS) between the NMHS and the DRM sector have not been developed. In addition, there is a lack of communication and exchange amongst different institutions involved in DRR. Different partners indicate the lack of concrete leadership and coordination from the DGCE. The institutions are not used to exchange, to share needs and capacities to respond to these needs. Quite nobody knows what the other does, if not for personal contacts. The National Platform for DRR could help in this direction.

2.2.4. Roles and responsibilities in flood and drought risk assessment

The Directorate General for Civil Emergencies is responsible of the national "Disaster Risk Assessment" and coordinates sectoral line ministries/institutions that have responsibility for the respective sectoral risk analysis, development strategies and integrated plans. At local level, Prefectures and Municipalities are responsible for their own risk assessment and planning. The DGCE coordinates the interministerial committee in case of disaster and collects from line ministries, from its own local teams and from local authorities all relevant information about the disasters (mainly impact data). Twice a year a synthesis of this information is prepared for the Prime Minister. Twice a year DGCE organizes meetings with the Prefects for planning the Emergency management on the next 6 months. Then the DGCE prepares the national plan for the areas exposed to higher risk. All the geographic analyses and maps supporting the plans are prepared by the Ministry of Defense.

IEWE participates in the National Committee for DRR. Up to now the role of IEWE has been to produce some basic statistics and analyses of extremes and climate variability from the national hydrometeorological data to be used for strategic planning of DRR, but it is not actively included into the planning procedure of the DRR system in the country.

Currently, the DLWM is charged by the Government for the flood protection in Albania, either related to agricultural areas or to urban or natural areas. This responsibility is mainly directed to flood management and prevention (planning, designing, building, maintaining flood protection infrastructures). DLWM prepared flood risk studies for the dams (agriculture related) in case of dam burst, but not for the rivers. After the floods of 2010, floods hazard maps have been prepared in the framework of the emergency management, by the CIMA Foundation using ground data collected by the Ministry of Agriculture and satellite images. For these inundation many information are available. For the other past floods some hazard and impact data have been collected by the MAFCP. MAFCP receives meteorological and hydrological data from IEWE and moreover collects hydrological data on his own stations and in case of floods can measure water levels in the flooded area.

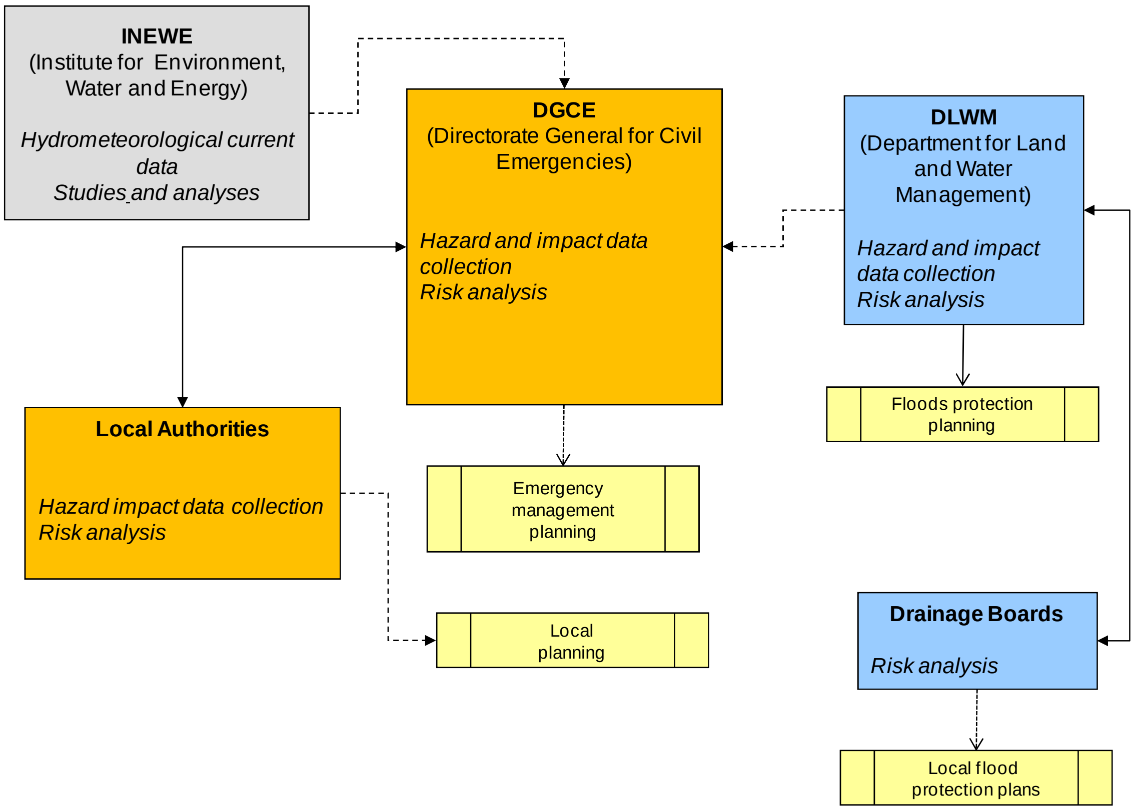


Figure 3. Work flow for floods and drought risk assessment in Albania

In conclusion, risk assessment is not operationally developed in Albania. The DGCE is a coordinating body, is collecting information about floods, but has not technical capacities for perform real risk assessment. However, line ministries have not the capacities to produce hazard maps and even exposure and vulnerability data are very sparse and spotty. The floods and drought risk assessment should be built from the foundation, starting from the legal and institutional framework, with clear mandates, duties and responsibilities with appropriate funding and human resources for the institutions, up to suitable data, tools and technical capacities. The process is actually going on project basis, with different and not always coherent external support, without a clear DRR strategy.

Concerning floods risk assessment, the legal framework is not clear and there are some overlaps and gaps, mostly concerning the share of responsibility between Ministry of Agriculture and Ministry of Environment. Actually the MAFCP is charged of the responsibility of any kind of floods, for management and also for flood protection planning, but in its mandate, only floods affecting agriculture or caused by agriculture related water infrastructures are mentioned. MAFCP has structural gaps hampering its capacity to perform systematically floods risk assessments or even floods hazard mapping. MAFCP does not have technical capacities for data management, spatial analysis and so on. In cases of project-based activities of floods risk analysis, technical activities are usually given for tenders. At local level the Drainage Boards up to now do not have flood risk assessment capacities, but are more focused on implementing and management of flood protection infrastructures. Even Municipalities do not perform any kind of floods risk assessment, and relevant national institutions whisper that in Albania there is no real spatial planning process at local level.

Concerning drought, it is not even considered as a real issue challenging problem by the Albanian Government, the only drought analysis are performed by the academics and in the framework of R&D projects.

2.2.5. Budget and funding for DRR

Regarding financial resources, the Law on Civil Emergency Services mentions that the State budget is the “primary financial resource for civil emergency planning and crisis management” and that ministries should have an annual budget for civil emergency planning and response within their respective field of activity. No mention is made, however, of the amount or percentage of budget that should be allocated to DRR. The Directorate General for Civil Emergency receives an annual funding of US$ 200,000.

For emergency issues, four types of budgetary provision are in place: (i) the emergency budget of the Ministry of Interior, (ii) the emergency budgets of local government, (iii) reallocated budgets of line ministries and (iv) the Council of Ministers Reserve Fund.

The Law on the State Budget allocates a yearly reserve fund at national and local levels. The Council of Ministers is entitled to use this fund in the event of a civil emergency situation, as well as for disaster reduction measures. In recent years, an inter-institutional action aimed at flood risk reduction has been implemented in the north-west part of Albania (the Lezha region). This increase in investment in the financing of disaster reduction has had positive results in areas such as Lezha, where flooding used to occur frequently but now the level of risk has significantly decreased.

Most of the funds are allocated for disaster preparedness and post-disaster recovery. These budgets are primarily intended for emergency situations, although there are training and development budgets within line ministries that include DRR elements. In overall terms though, the financial means for DRR in Albania are extremely limited at the present time, particularly at the local level.

On 16 May 2008, Albania has become the first country member of the Catastrophe Insurance Fund established as part of the SEE Catastrophic Risk Insurance Facility (CRIF) to receive USD 2.5 million from IBRD. These funds were allocated to cover its capital contribution to the Facility and the costs for conducting a public education campaign on the benefits of catastrophe insurance. The CRIF will offer innovative low-cost catastrophe insurance products for earthquake and flood risk to homeowners and small and medium enterprises (SME), including stand-alone catastrophe insurance coverage for damage to property and stand-alone catastrophe insurance coverage for financial losses sustained by SME due to such concerns as the interruption of business and damage to equipment. However, the national insurance sector is currently not involved and its mobilization is not guaranteed.

2.3. Technical Capacities of Hydrometeorological Services to support Disaster Risk Reduction

2.3.1. Monitoring and observations networks and data exchange

Quality of hazard analyses and global and regional weather forecasting depend strongly on quality and spatial density and representativeness of the observation network. Hydrometeorological observation networks are established not only for national needs but also to be a part of the WMO Global Observation System (GOS) comprising of standardized measurements taken at constant hours using surface observation and monitoring stations, upper air observation, hydrological measurements and satellite observations. International exchange of data is the core for monitoring and forecasting the weather globally, regionally and nationally. Historical data comprising long time series of accurate and representative measurements are essential for climatological studies, hazards analyses and for monitoring of climate change. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situations;
- reduction of vulnerability to the risks caused by meteorological, hydrological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale NWP modelling.

Table 2: Observation stations operated by IEWE

Type of observations stations	2007	2010	2011	GTS	Comments on 2010 network
Atmospheric domain					
Surface synoptic stations (> 8 obs./day)	17	22	30	no	In 2011 only 3 obs/day
Manned stations	1			no	
AWS or AWOS	1	7	10	no	only 1 operational
Cloud-height – automatic	0	0			
Agrometeorological stations	15	15		no	
Maritime/lake stations - manned	NA	2		no	none operational
Maritime/lake stations - automatic	0	0		no	
Ordinary climate station (3 obs./d)	24	110	77	no	
Rainfall station (2 obs./d)	25	15	24	no	
Rainfall station – automatic	0	0			
Meteorological towers	0	0			
Upper air radio sond stations	0	0			
Pilot balloon stations	0	0			
SODAR/RASS	0	0			
Wind profiler stations	0	0			
Lidar	0	0			
Access to AMDAR data					
Weather radars	0	0			
Hale radars	0	0			
Lightning detection stations	0	0			
Lightning detection hub station	0	0			
Satellite MSG ground station	0	0			
Hydrological domain					
Hydrometric stations	92	105		no	7 with automatic water level not operational
Stream gauge station – manual	0	0			
Stream gauge station – automatic	0	0			
Water level post – manual	0	0			
Water level station – automatic	0	0			
Maritime domain					
Buoys					
Buoys with meteorological observations					
Tidal stations	8	2		no	none operational
Tidal stations with met. observations	2	NA		no	
Environmental domain					
Air quality	11	NA		no	
Water quality	48	NA		no	
Nuclear deposition					
Ozone – near surface					
Ozone – upper air					
UV radiation					

The IEWE observation network is described in terms of number of different types of station in table 2. Among the 30 synoptic stations (actually collecting data only 3 times per day), there are ten Automatic Weather Stations (AWS), but the automatic observation system is not working principally due to energy supply problems, batteries damages or data logger problems. Thus data are manually collected and transmitted once per month to IEWE by the observers. At manned main meteorological stations manual observations are made and recordings are taken every three hours. The main station observations are communicated as soon as possible to the organization using different types of communication systems (phone, email, mobile phone, internet). From climate stations, monthly data is sent by post. The national hydrological observation network consists of 105 hydrometric stations of which 7 are equipped with automatic water level measurement systems, all purchased after 1998 and actually not fully operational. Additionally MMS operates 10 manned meteorological stations making 8 observations per day, and the Airport Meteorological Service has its own stations at the airports.

No meteorological or hydrological data is shared by IEWE through the WMO Globalé Telecommunication System (GTS) system, as the connection to the regional hub in Sofia, Bulgaria, does not work. MMS or the aviation data is also not linked to the WMO GTS system. In principle the data sharing protocol meet the WMO protocol.

In principle, all meteorological and hydrological observations and measurements in Albania are made according to WMO recommendations, but due to lack of calibration, maintenance and quality control, the measurements do not meet the WMO standards. Additionally, except the automatic stations, the equipment is obsolete. The number of automatic weather stations is very low compared to EUMETNET countries (and currently only one station is operational), and there are neither upper air observations nor weather radars. The maritime observations have declined further since 2007.

The World Bank Disaster Risk Mitigation and Adaptation Programme, foresees to strengthen the IEWE data collection and management capacities through the procurement of hydrological and meteorological stations, instruments and equipments. In addition, in the framework of a project on renewable energies, 20 AWS have been purchased and wait for being installed. This would be a significant contribution for the development of IEWE.

2.3.2. Hydrometeorological data management systems

Historical hydrometeorological data is critical for hazard analyses and planning and design within various economic sectors. In this regard, hydrometeorological data must be properly quality-ensured and stored in historical user-friendly digital databases.

In Albania, the hydrometeorological data produced by IEWE is stored in the National Hydrometeorological Archive. The time series start from 1951 and are stored in a non-converted ASCII format and for part of it in Excel tables on a Pentium IV computer using Windows with an is 250 Gb disk space. The quality control of the observations is done afterwards, so there is no real-time quality control system available. Back-up system does not correspond to standards used at most of the EU NMHS. The situation of available data is presented in Table 3, even if the real amount of data in the different formats is not precisely known.

Table 3: Available hydrometeorological data in Albania

Period	Hydrometeorological data available
1947-1990	80% of hydrometeorological data are quality controlled and digital in excel
1990-2000	100% of hydrometeorological data are quality controlled but only partially in digital format
2000-2011	Meteorological data are partially quality controlled and only a small amount in digital format Hydrological data are all on paper, water levels partially quality controlled, discharge values partially calculated.

Due to lack of quality control of data, lack of proper data management and lack of proper staff the hydrometeorological data collected is not adequate for scientific analyses and risk assessment.

IEWE disseminates historical data, near-real-time (IEWE has no real-time on-line stations) data and hazard monitoring data to the National Committee for Disaster Reduction and other DRR partners. Historical data is disseminated by hard copy mailing on demand. IEWE disseminates data from some hydrological and meteorological stations to agreed focal points (e,g. Tirana Commune Disaster Management) via SMS, internet, email and phone. Generally data are free of charge for government institutions and charged for private companies.

The World Bank Disaster Risk Mitigation and Adaptation programme, foresees to strengthen the IEWE data management capacities through data rescue, quality control and digitalization of the whole hydrological and meteorological data set, and the establishment of an information system for data storage and management (including receiving real-time data from AWS).

2.3.3. Hazard analysis and mapping to support risk assessment

Actually, there is no national institution that produces floods or drought hazard mapping. At national level, the only public institution producing maps is the Ministry of Defense.

IEWE collects soil moisture, soil temperature, phenological and evapotranspiration data. But this data are on paper and are not used for any analysis. Concerning floods analysis, IEWE calculates the maximum discharge with return periods, flood frequency, maximum water levels analysis in the cases of lakes and sea, 24 hours precipitations, maximum precipitation intensity. IEWE produces statistical analyses on averages, trends, variability and extremes and makes studies of potential impacts. Statistical analyses of meteorological data are used for drought monitoring. Some studies have been done on drought at IEWE, an exemple of which is the study on hydrological drought in the river Vjosa. Concerning meteorological drought, a preliminary study has been done for the characterization of drought prone areas, but it remains as a pilot as time series of data are not available for the whole country. The Standard Precipitation Index (SPI) is used in support of drought monitoring, with support from the South East Europe Drought Management Center (DMC-SEE) based in Slovenia and of which Albania is a Member. Overall, digitized historical data are not available for long time series, long-term analysis cannot be developed. Furthermore, IEWE doesn’t use any hydrological model or GIS technology.

IEWE is going to receive in 2011 hardware and the Metview-4 software from ECMWF to promote climate analyses. Metview is an interactive meteorological application, which enables operational and research meteorologists to access, manipulate and visualise meteorological data. The system is based on the ECMWF standards for graphics (Magics) and data access (MARS) but can also access locally stored data. IEWE is also partner of a project financed by the Italian Government after the 2010 inundation and implemented by the CIMA Foundation. This project aims to the implementation of a prediction and prevention system of forest fires and floods (DEWETRA, already operational in Italy for the Italian Civil Protection Department). In this framework, CIMA is developing a hydrological model for all the Albania river basins. This model is supposed to be transferred to IEWE, which will become the system manager. The same project foresees training and capacity building activities. The DEWETRA online system is actually used for viewing the products of Numerical Weather Models: ECWMF and COSMO LAMI 17. The products of the RISICO model for fire risk forecasts are also available within DEWETRA for Albania.

DLWM collects hazard data on floods, like flooded area, water depth, etc. But this data is not organized in a database and has not geographic reference. No geographical data exist about past floods, except for the 1963-64 and 2010 events. Indeed floods hazard maps exist for the West Plains done after the inundations of 1963-64 on a 100-year return period, and for the inundations of 2010. The latter have been made by CIMA Foundation using satellite data and field data collected by the MAFCP. DLWM has some information about floods damages, but such data is not organized in a database.

Some impact data could be retrieved from local governments regarding urban floods.

Concerning hazard information and impacts, reports on the situation are prepared by several institutions and structures. In order to be unified and reflect the relevant information requested. The Ministry of Interior has developed a series of standard assessment tools that are applied in Albania, including (i) First Notification Form (prepared at the Prefect level), (ii) The First Disaster Information Report (prepared by the Joint Assessment Team), (iii) Disaster Situation Report to OCHA, and (iv) Request for Line Ministries in Case of Emergencies.

The Rapid Needs Assessment Reports presented in the Civil Emergency Manual are practical tools to be completed by the respective authorities that help to get immediate information on the level of damage and the needs. The Rapid Needs Assessment of a large-scale civil emergency situation must be undertaken by a Joint Assessment Team. However, prior to this, any possible initial contributions must be made, using the same format, by the local authorities (Qark Civil Emergency officer, Prefect and communal and municipal authorities). In extreme situations it is possible that the initial interventions are made before or during the Rapid Needs Assessment: evacuation, search and rescue. Successive follow up assessments will be made using the same approach, but with greater detail as information becomes available and the situation stabilizes. DGCE receives daily reports from its local teams, local authorities and line ministries. These reports are stored as daily (.doc) files, there is no database of damages or impacts from disasters.

2.3.4. Forecasting

In Albania national weather forecasting are produced by three different organizations. Most visible weather forecasts are produced by the MMS.

IEWE produces general forecast for 24 hours, 3 and 5 days and 10 days outlooks. IEWE`s operational forecasting is based on use of printed analysis and forecast products from international forecasting centers and from the Montenegrin NMHS. The IEWE forecasters do not have access to any real-time data. Lack of national observation data is a severe obstacle especially for short term forecasting. Currently IEWE has only 2 duty forecasters and it does not have capacity to operate 24/7 weather forecasting services. IEWE does not produce special marine forecasts. Currently there is no capacity to download numerical weather prediction model products to be used for national weather forecasts, or to run any numerical weather prediction models. MMS has cooperation with the Italian meteorological service and gets their NWP products to be used for MMS weather forecasting.

No numerical hydrological models, wave models or dispersion models for airborne or waterborne pollutants are in operational use. IEWE produces by contract special forecasts for agriculture and aviation sectors.

2.3.5. Warning products and services

2.3.5.1. <u>Warnings and mandates</u>

The mandate to produce different warnings related to the hydrometeorological phenomena is not clearly defined (Table 4). Currently IEWE does not produce any public warnings. However, IEWE has a governmental role to produce up-dated maps and forecasts to the authorities. Hydrological studies for flood warnings have been done for different basins, but no mathematical model was used, only correlations with rainfall. Flood forecasting is given on the different river basins using the simple relationship between the meteorological forecasts and the water levels. MMS gives occasionally warnings in connection to its daily TV weather forecasts. Warnings to the aviation sector only are produced by the MSNATA.

2.3.5.2. Warning dissemination mechanism

Regarding products and warning dissemination, IEWE disseminates hazard monitoring data, forecasts and early warning to the Head of the National Committee for Disaster Reduction and other partners of DRR. The limited weather warnings produced up to now are disseminated to the public via media. MMS gives warnings in the TV presentations and by disseminating advisories to the media, who then edit their own weather forecasts and warnings. Currently there is no mandate to interrupt TV or radio programs, or to the have a continuous warning stripe on the TV screen in the case of the emergency. Method to send warnings directly as SMSs to mobile phones located at, or going to, site of danger is not in use in Albania.

Sectors like Ministry of Health or NGOs like Red Cross are not on the direct contact list of warnings of hydrological or meteorological hazards.

Albania is not member of the EUMETNET METEOALARM systems.

Table 4: Warnings issued in Albania for natural and technical hazards, based on Annex 2

Hazard	Exists in the country	Warning by	Type
Heavy precipitation	Yes	MMS	III
Flash floods	Yes		
River flooding	Yes		
Hailstorm	Yes		
Thunderstorm or lightning	Yes		
Heavy snow	Yes		
Freezing rain	Yes		
Dense fog	No		
Tornado or cyclone	Yes		
Hard wind	Yes	MMS	III
Storm surge	No		
Coastal flooding	Yes		
Heatwave	Yes		
Cold wave	Yes		
Drought	Yes		
Marine hazard	Yes		
Sandstorm	Yes		
Landslide or mudslide	Yes		
Avalanche	NA		
Airborne hazardous substance	Yes		
Waterborne hazards	Yes		
Hydrometeorological hazards for aviation	Yes	MSNA TA	III
Forest or wildland fire	Yes		
Smoke, dust or haze	Yes		
Earthquakes	Yes		
Tsunamis	Yes		
Volcanic events	No		
Dispersion of insect pests	Yes		
Desert locust storm	No		
Hazard for allergic reactions	Yes		

2.3.6. Climate change analysis

In general the role of IEWE is to monitor the climate, to cooperate with international centers in order to downscale projections produced by global models to local scale and to study the trends, variability and extremes, and furthermore to study the impacts of climate change to different socio-economic sectors in cooperation with the industry. For instance, IEWE produces monthly climatologic maps.

Analyses of impacts of climate change are not considered in different sectors yet. Only few studies on climate change in some regions have been done. Currently the Ministry of Health has tried to prepare a project for analyzing the impacts Meteorological and Climate Indexes on health.

It can be expected that also Albania could significantly benefit from the new South East European Virtual Climate Change Center (SEEVCCC), which was established in 2008 within the Serbian National Hydrometeorological Service.

2.3.7. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings. Currently IEWE does not have capacity and tools for automated production and dissemination of products and warnings (Table 5).

IEWE does not have access to TV or radio programmes or any web pages to disseminate their weather forecasts or any other products to the public and other users of weather services. Currently there are no communication experts employed by IEWE.

Table 5: Equipment in use for data communication and warnings and other products dissemination

Telecommunication Equipment	To receive data	To send data	To send warnings	To send products
Telephone	X		X	
Mobile Phone	X			
Telefax				
Dedicated Leased Lines				
UHF radio transceiver				
High frequency/Single side band radio				
HF Radio Email				
Aeronautical Fixed Telecommunication Network				
Very Small Aperture Terminal				
Data Collection Platforms used to transmit data from AWSs				
Global Telecommunication system (WMO-GTS)				
Meteosat Second Generation Satellite system				
Other satellite systems				
Internet				
Email	X			
Post/mail	X			
Print media				
TV –national				
TV-commercial				
Radio				
Bulletins	X			
Printed text				X

2.3.8. Human resources

In general, the number of IEWE staff is quite high, but the high number comes from high number of observers, while the share of operational staff (meteorologists, hydrologist, researchers) is very low compared to NMHS in the European Union. The IEWE operational staff (meteorology and hydrology) has good scientific background and knowledge, but there are very limited human resources to produce weather forecasts, to produce critical data for risk analyses of hydrometeorological extremes and to operate an adequate early warning system. Currently IEWE academic staff is R&D orientated. However, this investment in R&D produces a small impact on the quality and the quantity of hydrometeorological services and products to support DRR. The number of IEWE staff by branch and level of education is presented in Table 6. Since 2007 the number of IEWE forecasters has decreased.

Table 6: Number of IEWE staff by branch and level of education

Branch	**Field and education**														**TOTAL**
	Techn-icians	**Meteorologist**			**Hydrologist**			**Engineer**			**Physicist, Chemist, Economist**			**Other**	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Observation network	225														225
Telecommunication															
Data management	1			2	2			2				2			9
Weather forecasting				2											2
Hydrological forecasting															
NWP															
R & D				2	1	4	5			2			2		14
Weather modification															
IT personnel															
Commercial services															
Accounting															
General administration														7	7
Other															
TOTAL	**226**			**6**	**3**	**4**	**5**	**2**		**2**		**2**	**2**		**257**
Female in % of total	0			40	30	75	20	0		0		0	50		5
Men in % of total	100			60	70	25	80	100		100		100	50		95

2.3.9. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums, to which membership provides better and more services than to non-members.

EU based hydrometeorological organizations provide most state-of-the-art models, software and tools to be utilized by the member NHMSs. The European NHMSs have globally an unique opportunity to benefit from the state-of-the -art weather forecast modeling, medium-range weather forecast products at 16 km horizontal resolution (in near future at 8 km resolution) including the Extreme Forecast Index (EFI), re-analyzing data to be used e.g. for climatologic studies and the ECMWF super computer resources. The integration into the European hydrometeorological infrastructure is key to developing the capacities of the NHMSs to implement best European practices and to produce improved products and services in support of national economic development and DRR.

European Union research and networking programs create consortiums of excellence, and provides good opportunities to NMHS to network with NMHSs and commercial R&D companies and strengthen their capacities.

Currently the level of international cooperation is hydrometeorology in Albania is very low, especially when compared to EUMETNET NMHSs (Table 7) Active cooperation is related to weather forecasting, as IEWE receives daily NWP products from Montenegro and Serbia, and MMS from Italy. Bilateral cooperation with the Italy also concerns training activities and technical assistance by CIMA Foundation. Regionally, Albania is a participant in the DPPI and is involved in the ISDR system. IEWE is partner of the DMC-SEE programme and is participating in the DMCSEE project in the frame of EU's transnational cooperation programme.

Albanian hydrometeorological services would benefit significantly from membership in ECMWF, as they could receive NWP model products at 16 km horizontal resolution, which directly could be used with sufficient tools to produce automatically local quasi-site- specific 1-10 day weather forecasts. Furthermore ECMWF data could be used as input data if Albanian weather services were going to run smaller scale NWP model(s) in order to improve spatial accuracy of the forecasts. Presently, the most important elements of DRR in Albania are under development through the World Bank **"**Disaster Risk Mitigation and Adaptation Programme". The overall coordination of this project falls under the Ministry of Interior with a predicted total investment of USD 9.99 Million. The project is based on four components

- The first component of this project is Disaster Risk Management and Preparedness (USD 4.89 million). The objective is to support capacity building for emergency response mechanisms through the provision of necessary equipment and the strengthening of disaster risk mitigation;
- The second component concerns the strengthening of the hydro-meteorological services (USD 2.09 million). The objective is for disaster risk managers (including households, farmers and forest managers) to receive more accurate and timely hydro-meteorological forecasts and services in order to undertake more beneficial preparatory measures aimed at limiting the risks posed by weather;
- The third component deals with the development of building codes (USD 0.36 million). The objective is to reduce hazard risks through the development of improved building codes and mechanisms for the introduction of improved standards. The component activities include (a) development of a national building code, (b) training engineers in new design standards and (c) developing a mechanism for the licensing of engineers;
- The fourth component is aimed at catastrophe insurance (USD 2.65 million). Here the main objective is to increase the level of catastrophe insurance coverage among Albanian households and SMEs through the establishment of the SEE Catastrophic Risk Insurance Facility, of which Albania will be a shareholder and member.

Table 7: International and regional cooperation activities of IEWE and MMS

International and regional organization and cooperation mechanisms	IEWE	MMS
WMO	member, PR	no
WMO RAVI	member	no
RMDCN	no	
IOC	Member	
UNISDR	cooperation	no
UNDP	yes	no
EUMETSAT	no	no
ECMWF	no	no
EUMETNET	no	no
METEOALARM	Cooperation started	no
ECOMET	no	no
EUFP7 projects, networks	no	no
EU JRC		no
EU PHARE		no
EUCLID	no	no
EUR-OPA	member	no
EFAS		no
DMSEE	member	no
SEEVCCC		no
SAVA Commission	member	no
NWP consortium		no
NMHS bilateral	Montenegro, Serbia	Italy

It is critical to promote regional and other international cooperation in order to provide the public, the socio-economic sectors and the DRR with some adequate level of services, and to fulfill international commitments and agreements (e.g. WMO) for hydrological measurements and international data sharing, and to implement the law of hydrological services in Albania. Moreover is critical for Albania to strengthen collaboration with neighboring countries, particularly concerning water management and floods as Albania shares a great part of its upstream and downstream water resources with its neighbors.

2.4. Technical recommendations to strengthen NMHS capacities in support of DRR

The Albanian hydro-meteorological sector is more or less disordered with major weaknesses in its institutional and legal framework and if does not have the technical, human and financial resources to meet the needs for hydro-meteorological services to support DRR nationally nor to properly fill its international commitments of producing hydro-meteorological data. The identified gaps in the legal framework and institutional arrangements should be considered as a priority before further development of NMHS capacities to support DRR.

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. There is a need to prescribe a new law for hydrometeorological services in Albania, taking into account, national needs from public and different economic sectors, including Disaster Risk Reduction, regional cooperation and international commitments;
2. There is need to re-organize the national hydrological and meteorological services aiming to be a Public Service according to the WMO standards, and to better promote the national and regional DRR management;
3. The roles and responsibilities of the Hydrometeorological organizations in Albania pertaining to Disaster Risk Reduction should be clearly stated in the new framework for Disaster Risk Reduction under development.

Operational relationships with other agencies

4. There is an urgent need to develop Standard Operating Procedures (SOP) that would clarify the roles and responsibilities and the cooperation mechanisms for the development, the issuance and the dissemination of warning products and services;
5. There is the need to clearly define role and responsibilities of different institutions in floods and drought risk assessment and management, particularly amongst GDCE, MAFCP, MEFW and IEWE.

Monitoring and observations networks and data exchange

6. There is an urgent need to upgrade the Albanian meteorological and hydrological networks to meet the WMO standards and recommendations, and with consideration of the good practices of European NMHS;
7. There is a need to revitalize the network of synoptic, climatological and hydrological stations and gradually develop the network of automatic observations stations;
8. There is an urgent need to upgrade the calibration and maintenance system of the meteorological and hydrological equipment;
9. There is a need to further strengthen the observation network by developing remote sensing systems, including one upper-station, one or two weather radars and a lightning detection system;
10. There is an urgent need to develop real-time communication system for observations and data, including the connection to the WMO GTS.

Forecasting

11. There is an urgent need to develop an operational forecasting system that would issue regularly short-term and medium term forecasts products;

12. There is a need to further develop capacities to support DRR through nowcasting;
13. There is a need to Improve the capacities to use Numerical Weather Prediction (NWP) products;
14. There is a need to develop and integrate additional modelling for hydrology, air quality, and sea-wave and to link these models to NWP;
15. There is a need to improve capacities to use automatic analyzing, editing and dissemination tools;
16. There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks.

Hydrometeorological data management systems

17. There is an urgent need to initiate a data rescue programme to digitize and quality ensure the historical data;
18. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.

Hazard analysis

19. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment;
20. There is a need to acquire capacities and software for meteorological and hydrological analysis, GIS and hydrological modelling.

Information technology and telecommunication issues

21. There is an urgent need to reinstalled the connection to WMO Global Telecommunication System (GTS);
22. There is a need to ensure a data link to the observations sites;
23. There is an urgent need to put into operation a website for public weather service and warning dissemination.

Warning products and services

24. There is an urgent need to establish a 24/7 science based analyzing, forecasting and warning system;
25. There is an urgent need to design and develop meteorological, hydrological and environmental (e.g. air quality) warning products and services (i.e. format, thresholds) in close cooperation with the Disaster Risk Management stakeholders;
26. There is an urgent need to develop Standard Operating Procedures (SOP) that would specify the actions for the development, the issuance and the dissemination of warning products and services under a Quality Management System (QMS) framework.

Climate change analysis

27. There is a need to develop a climate data management system;
28. There is a need to develop the technical capacities for climate change projections downscaling to local scales;
29. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors.

Human Resources

30. There is a need to ensure adequate human resources to the hydrometeorological sector to sustain its role towards the community and in different phases of DRR;
31. There is a need to use optimally existing human resources through leveraging all three governmental Meteorological Services capacities;

32. There is a need to strengthen training programmes for the staff of the hydrometeorological sector on products and services related to disaster risk reduction, particularly in forecasting and operational hydrology;
33. There is a need to develop human capacities in telecommunication, data management and information technology to benefit from modern technologies.

Regional cooperation

34. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
35. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;
36. In order to improve their forecasting capacities, SEE countries should increase their cooperation with global, regional and specialized Centres (eg ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
37. A regional harmonization of watch and warning systems should be promoted;
38. Cross-border exchanges of real-time data, forecasts and warnings should be increased.

2.5. Recommendations from the Albania National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Tirana the 4-15 July 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: To improve and strengthen national and local government mechanisms to institutionalise lessons learned from previous disasters and incorporate them into DRR policy, planning and programming. Previous experiences of disasters and the response to them reveal and good knowledge of the disaster potential across the population and establish addressing disaster risk as a national priority. Capturing these experiences and using them to guide future DRR policy, planning and programming is an important step in ensuring that DRR is evidence-based and builds on the foundations of existing knowledge. Such mechanisms will help to promote and support dialogue, the exchange of information and coordination among relevant agencies and institutions at all levels with the aim of fostering a unified approach towards DRR.

Recommendation 2: To establish a National Platform for Disaster Risk Reduction. To further support the Government of Albania's existing and ongoing programme of disaster risk management, the establishment of a National Platform is proposed to strengthen the profile of DRR and to ensure that debate across all levels of government, technical agencies such as the hydro-meteorological, meteorological and the seismological services, civil society, non-governmental organizations and the private sector is ongoing and contributes actively to policy-making and planning. The National Platform will allow for the engagement of all major practitioners and technical specialists as well as representatives of communities and those affected. It will also promote awareness and coordination among the relevant sectors, and ultimately support the linking of such awareness and coordination to national planning, budgeting and implementation of DRR activities.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning

Recommendation 3: To establish and invest in fully operational 24/7 hydro-meteorological services (technical and human resources) as well as in the seismological sector to support risk assessment and early warning systems and promote operational monitoring, warning, forecasting and mapping of meteorological, hydrological and seismological hazards. This will build on the existing Disaster Risk Assessment and the Vulnerability and Capacity Assessment undertaken with support from the ARC. It is critical to perform comparative analysis of the existing institutional and legislative arrangements for meteorological, hydrological and seismological services, upgrade and modernize hydro-meteorological and seismological observation networks, data management and forecasting systems and provide sustainable organizational, human and technical resources to maintain and operate them. It is also necessary to strengthen the early warning capacity with a multi-hazard approach and enhanced cooperation with the Ministry of Interior, Directorate General for Civil Emergencies and other key stakeholders and the National Civil Emergencies Plan, to include contributions by the hydro-meteorological and seismological services.

Recommendation 4: To create appropriate mechanisms to increase coordination between the three meteorological organizations. With three organizations responsible for delivering meteorological services in Albania (Institute of Environment, Water and Energy (IEWE); Albanian Air Force Meteorological Service (MWFS); and, Tirana International Airport Meteorological Service) there is a need to develop an appropriate framework with the legal basis to ensure that roles and responsibilities in DRR are clearly defined.

Recommendation 5: To integrate policy, planning and programming in adaptation to climate change with DRR strategy. The frequency and magnitude of hydrological and meteorological hazards has the potential to increase due to climate change. It is critical to invest in local scale climate studies in order to promote adaptation to climate change and to ensure that climate change adaptation and DRR are integrated into one programme coordinated through the Directorate for Civil Emergencies and the hydro-meteorological service.

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 6: To integrate DRR into the education system in Albania at all levels – primary, secondary, university. Building on existing levels of awareness and expanding understanding to incorporate the future threats from climate change and other hazards, as well as new development, it is recommended that the Ministry of Education examines the potential for integrating DRR as a part of national curricula at all levels, particularly in those areas showing the highest levels of risk. In addition, universities and other tertiary education institutions should be encouraged to establish research programmes encompassing different disaster risks, the results of which should have a natural outlet through the National Platform.

Recommendation 7: To establish a National Training Centre for DRR and Civil Protection practitioners and community members, using the existing National Fire Fighting Training Centre as a foundation. The most challenging issue is the building (or, at least, the consolidation) of the culture of safety and resilience. This requires ongoing, continuous activities aimed at increasing community capacities, regular integration of DRR into (particularly local) development plans, training activities and simulation exercises for all levels, and, most importantly, greater potential for creating the potential for the development of the capacity of women as powerful agents of the transmission of the culture of safety and resilience to the younger generation. The establishment of a National Training Centre for DRR would support this ambitious agenda and assist the process of strengthening capacities within the many stakeholders.

Recommendation 8: Supported through bilateral, regional and international cooperation and partnerships, sustainable development, poverty reduction, good governance and disaster risk reduction are mutually compatible objectives and strategies, and in order to meet the challenges ahead, accelerated efforts must be made to mainstream and integrate disaster risk reduction into development and governmental and sectoral strategies. Furthermore, efforts must be made to build the necessary capacities at all levels of institutional organization in Albania to manage and reduce risk. Such harmonization of mutually compatible objectives can help to counter the negative effects of increased population, unsustainable development practices, degradation of natural resources, the increasing exposure of the poor to disaster risks, ineffective forecasting, defective environmental control measures, inadequate capacity development and lack of appropriate market mechanisms, all of which are amplified if disaster risk is not addressed effectively as an integral component of the implementation of development.

Recommendation 9: To support the development of studies and research around the reduction of specific risk factors that affect Albania. Although the major hazards that affect Albania are well known, far less is known about the detailed effects of these hazards, the vulnerabilities that are constructed in the face of these hazards and the capacities that are necessary to address them. Again, through the auspices of the National Platform for DRR, the results of studies and research can be examined and recommended for inclusion in development planning.

HFA priority 4: Reduce the underlying risk factors

Recommendation 10: In the context of reducing overall risks, and with consideration for increasing climate associated, seismic and geological associated risks, to develop national capacities for climate (hydrological and meteorological) and geological (including seismological) services to support medium and long-term sectoral planning, as a critical aspect of disaster risk reduction. Enhanced investments are needed in climate data rescue, climate and geological modelling, forecasting and analysis to support sectoral planning in at-risk sectors. Development of these capacities would require a strong collaboration and coordination across many ministries and with the meteorological, hydrological and geological services, as well as enhanced regional cooperation in this area with other South East European and EU countries.

Recommendation 11: To improve networking with international institutions/institutions present in the region and to promote the increased involvement of such organizations in the strengthening of DRR in Albania. To enhance regional and international cooperation for the purpose of exchanging observation data, knowledge, technology and expertise regarding DRR, to share research findings, lessons learnt and best practice, participation in joint trainings and workshops all of which would contribute to enhancing the ability of Government of Albania to strengthen its DRR programme, raise overall awareness and improve capacity development measures.

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 12: To strengthen disaster preparedness for effective emergency response at all levels and to promote disaster prevention. First, ensure that emergency response plans are targeted to the individual needs of the vulnerable communities, authorities and emergency responders. Second, establish guidelines for systematic development of contingency plans at all levels that are backed by the requisite human, material and funding resources. Lastly, harmonise standard operating procedures governing response to emergencies and standardize terminology and capacity development taking into account roles and responsibilities in emergency response.

Recommendation 13: To strengthen awareness about the importance of preparedness. Promote the engagement of the media in order to stimulate a culture of preparedness and strong community involvement through sustained public education campaigns and public consultations at all levels of society.

Recommendation 14: To increase the involvement of the private sector in activities aimed at DRR with special emphasis placed on insurance companies for the purpose of building on achievements already made in promoting public private partnerships (PPP) to better engage the private sector in DRR activities. This can be done by encouraging the private sector to place greater emphasis on and allocate more resources to pre-disaster activities, such as risk assessments and early warning systems and through the promotion of the development of financial risk-sharing mechanisms, particularly insurance and reinsurance against disasters.

Recommendation 15: To strengthen regional and international links to support more effective fire risk preparedness and prevention. During the last two decades the occurrence of forest fires in Albania and across the region as a whole has increased in number and also in the size of the area affected, the main causes being human negligence and pasture burning. Preparedness to reduce forest fire impacts includes the creation of coordination mechanisms between the forestry administration, local authorities, hydro-meteorological services and the population, as well as civil emergency authorities (particularly fire fighters). Regional cooperation in addressing the fire risk should be strongly promoted as there is an increasing fire risk throughout the region. Existing regional cooperation can serve as a good basis for such developments.

Recommendation 16: To increase the use of simulation exercises (including table-top exercises) as a regular feature of emergency response and preparedness training. Increasing and cumulative experience of disasters allows for the understanding and lessons learned to be used in practising response and preparedness procedures through all types of simulation exercises either in field situations or the classroom.

3. CHAPTER THREE: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN BOSNIA AND HERZEGOVINA

Floods are the most frequent major natural hazards in Bosnia and Herzegovina causing disasters by affecting large amounts of the population and causing significant economic losses. Other major natural hazards with significant impacts are drought, landslides, extreme temperatures, storm and wildfires. All these are caused directly or partially by extreme weather, water or climate conditions. In addition, a number of hazards pose risks across the borders in the SEE region, especially floods, forest fires and dispersion of airborne pollutants.

This chapter presents all the findings related to the assessment of the DRR institutional framework and the technical capacities of the NMHS of Bosnia and Herzegovina to support DRR. It highlights that:

- As there are no national level hydrometeorological services in Bosnia and Herzegovina, it is necessary to promote the cooperation between the hydrometeorological services of the two entities (FHMI, RHMS RS) and with the aviation weather services as well;
- There are needs to promote the DRR management and clarify the roles and mandates of different sectors and technical organizations, especially the hydrometeorological services.
- The technical, human and financial capacities of the NHMSs are not adequate to produce sufficient services and support to the DRM;
- There are urgent needs to establish a hydrometeorological database at the national level.
- It is necessary to enhance investments in climate modeling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors and investment plans of industry in order to promote economic development of the country;
- Development of Risk Assessment, MHEWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

3.1. Bosnia and Herzegovina vulnerability to hydrometeorological hazards

3.1.1. General overview of country's economic sectors

The economy of Bosnia and Herzegovina has been completely shocked by the collapse of Yugoslavia and the consequent war. Under former Yugoslavia, military industries were promoted in the republic, resulting in the development of a large share of Yugoslavia's defense plants. Now, Bosnia and Herzegovina faces the dual problem of rebuilding a war-torn country and introducing market reforms to its formerly centrally planned economy. High unemployment rate and declining reconstruction and humanitarian assistance from the international community are actually the two most serious economic problems.

The economy is based mainly on services and on the primary sector. Agriculture and forestry till 2004 contributed for 24% of the GDP. Services are the main contributor of GDP, for about 46% in 2004. The industry sector (10% of GDP) is characterized by a strong component coming from electricity production (5.7% of GDP in 2004).

Table 8: List of the economic sectors ranked by their contribution to GDP in BiH

Economic sectors	Contribution to GDP (%)		
	2002	**2003**	**2004**
Agriculture & forestry	25,5	24,7	24
Transport	9,6	10	9,9
Industry	10,5	10,2	10,4
- electricity production	4,1	4,8	5,7
Services	45,9	46,1	46,3
Construction	8,6	9,1	9,5

3.1.2. Hydrometeorological hazards in Bosnia-Herzegovina

Floods are the most frequent major natural hazards related to weather and climate in Bosnia and Herzegovina, causing disasters by affecting large amount of the population and causing significant economic losses. Approximately 75% of the territory of Bosnia and Herzego9vina is located in the transboundary Sava River Basin area and 25% of the country drain into the Adriatic Sea. In 1976, three floods affected 43 of 109 municipalities in the country. In April 2004, flooding affected over 300,000 people in 48 municipalities, destroyed 20,000ha of farmland, washed away several bridges, and contaminated drinking water. In December 2010, Bosnia and Herzegovina experienced the largest amount of precipitation recorded in the last 100 years, which resulted in massive floods on the entire territory. According to national authorities, the hardest hit areas were on Drina River, in Central and Eastern Herzegovina. In these areas alone, more than 4,000 people were evacuated.

Although fire is listed as one of the top hazards in Bosnia and Herzegovina the collection of data has been minimal and as a result the risk is hard to quantify. Forest land covers approximately 50% of the territory of Bosnia and Herzegovina and is equally divided among the entities. In the Federation of Bosnia and Herzegovina and Republic Sprska, forest fires present a problem, burning anywhere from 1,000 to 3,000 hectares annually.

Other major natural hazards causing significant consequences since 1992 have been drought, landslides, extreme temperature, storm and wildfires. All these are caused directly or partially by extreme weather conditions. The occurrence of landslides in the mountainous areas of Bosnia and Herzegovina is very common due to the presence of underground water flows. After a large landslide that occurred in 2000 in the area of Zenica seven people lost their lives and many families remained homeless. The number of landslides has increased considerably over the last 15 years due to the uncontrolled exploitation of forests and minerals and because of an increase in illegal and or unplanned construction. Bosnia and Herzegovina have also a number of environmental issues. These include air pollution from the country's metallurgical plants and other sources. There also many other hazards related to weather, like harsh winter conditions. They may cause accidents which are in some countries on annual level even more costly than the traditional natural hazards. From Bosnia and Herzegovina no data of this type of weather related hazards was available.

The severity of extreme events like drought, heat waves, forest fires and flooding has intensified over the last few decades and as revealed in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, this trend is expected to accelerate in the future as a result of climate change, leading, together with changes in land-use patterns and increased human settlements in areas that are prone to disasters, to increased hydrometeorological and climate-related risks in the coming years.

3.1.3. Sectoral analysis of the vulnerability to hydrometeorological hazards

Agriculture is still one of the most important sectors of the economy (10.4% of the GDP in 2006) providing food security for large part of the population. Out of total area of 5,113 millions hectares of the country, 47% represents agriculture land. Bosnia and Herzegovina is relatively poor in agriculture resources with 66% of its territory considered mountainous or hilly and, only 20% of the country is suitable for intensive farming (around 1 million ha). The structural of agriculture is sector is characterized by small sized family farms which to large extent produce for home consumption – ; the state firms, generally much larger, are mostly not operating or in difficulties often due to not finalized state of privatization. Agriculture production in Bosnia and Herzegovina is dominated by crop production, with livestock production representing less than one third of the total output. The economically most important sub-sector of BiH agriculture is vegetables. Of considerable importance are also fresh cow milk, maize and potatoes. On the Entity level, the agriculture sector is more important for the economy of Republika Srpska (RS), when it is estimated to be around 13% of the GDP (2005), than for the Federation of Bosnia & Herzegovina where it stands stable at 6%. Agro-food processing industry is recovering after a long period of under-investment over the last decade and its share in the GDP is increasing (8% in 2005).

Agricultural sector in BiH is highly vulnerable to drought, because of lack of modern technologies, policies or strategies aiming to strengthen agriculture resilience to drought. The risk of drought is high in the north eastern and southwestern parts of BIH in relation to the central mountains. Main drought and floods affecting the country have been:

- in August 2002, BiH suffered the worst drought in 120 years, with an estimated decrease of agricultural production of 60% leading to a serious food crisis;
- a 4-month drought and a series of storms hit several communities in BiH in summer 2003. This caused an estimated EUR 200 million damage to agriculture and affected up to 200,000 people;
- in summer 2007, extreme heat and drought destroyed more than 40% of the country’s crop production resulting in extremely high food prices.

Projected climate changes in the SEE region will probably worsen the frequency and intensity of droughts and reduce the growing season for many crops.

Bosnia and Herzegovina possesses considerable water resources, and in the future water may become one of the foundations of the general economic development in many areas. However, the damages of the war, insufficient maintenance and inadequate regulatory framework, have brought water management, just like other sectors of the economy, into a difficult situation. The quality of potable water from the water supply system has been deteriorating steadily, the existing infrastructure is in poor condition, and water resources are increasingly polluted. Sustainable development in the field of water management is possible only with the implementation of the principles of integrated water resources management, by joint problem-solving in the main segments of water management, specifically in exploitation, protection of waters and protection from damaging effects of waters.

The condition of flood control facilities is very poor as a result of war damage, many years without maintenance, and minefields laid around some facilities. This is particularly true for towns along the Sava River. The consequences of floods resulting from exceptionally high waters in this area, if they were to occur, would be immeasurable. The situation is not much better in other parts of the country, as is evident from the floods in the Tuzla Canton in June 2001. The major damages, estimated at more than KM 60 million, were inflicted on crops, housing and infrastructure, and in the form of the erosion of arable land and the increased incidence of landslides. The problem of flood control in urban areas is also encountered in towns of Banja Luka, Čelinac, Prnjavor, Derventa, Modriča, Janja, Zvornik.

3.2. Institutional Framework of Disaster Risk Reduction in Bosnia and Herzegovina

3.2.1. Legal framework and policy supporting DRR in Bosnia and Herzegovina

The national policy of Bosnia Herzegovina (BiH) towards Disaster Risk Reduction (DRR) does not exist as a formal document but rather within the established system of decentralized responsibilities and capacities at all levels. The Ministry of Security (Sector for Prevention & Rescue) has coordinated the development of the National Platform for DRR.

At the national level, the framework is set by the Law on the Protection and Rescue of People and Material Assets from Natural and Other Disasters (hereinafter referred to as the Law on Protection and Rescue of Bosnia and Herzegovina) (Official Gazette BiH no.50/08) in Bosnia and Herzegovina, which was passed in 2008 and calls for the creation of a development programme that includes the development of mechanisms for Disaster Risk Reduction (DRR). Laws on the protection and rescue of people and property from natural and other disasters at lower levels of organization (i.e., the two entities, the Brcko District and the cantons) provide for the development of certain strategic documents which will, inter alia, include the issue of DRR. Entity level protection and rescue laws are:

- The Law on the protection and The Law on the protection and rescue (Official Gazette FBIH 39/03);
- The Law on the protection and rescue in RS (Official Gazette 01-346/02).

The national Law as well as legislation on protection and rescue in the entities prescribes the development of risk assessment. The basis for the national risk assessment is the Methodology for the Assessment of Risk from Natural and Other Hazards ("BiH Official Gazette" No. 86/09), which has been developed by the Sector for Protection & Rescue in cooperation with the UNDP. It includes a risk assessment whose goals are articulated as (i) identification of all hazards for the territory of BiH, (ii) an assessment of the vulnerability of people, property and critical infrastructure and (iii) the systematic dimensioning of risk, their likelihood, causes and consequences (expressed in human, material and or financial losses) as well as capacities.

Republic of Srpska has developed a Protection and Rescue Plan, which was delivered in 2003, whilst in 2008 the Federation of BIH adopted its Protection and Rescue Plan. Brcko District does not have its own plan.

There is no Ministry of Spatial Planning at state level, however they do exist at entity levels. Under the Law on Spatial Planning and Land Usage in the Federation of BiH spatial plans must contain data on areas prone to flooding. In RS there is the Spatial Plan of Republika Srpska for period 2005-2015.

Currently there is no law, which would clearly define the roles of hydro-meteorological services on the State level. In RS the duties and position of the Republic Hydrometeorological Service concerning floods and drought are regulated principally by the:

- Law of Administration of the Republic, Official Gazette of RS, No. 11/2008;
- Law on the meteorological and hydrological activity in Republika Srpska, Official Gazette of RS, no 20/2000.

In FBiH the duties and position of the Federal HydroMeteorological Institute concerning floods and drought are regulated by the:

- Law on Federal Ministries and other authorities of the Federal Administration (Official Gazette FBiH, 19/03);
- The Law on Hydro-Meteorological affairs of interest to Republic Bosnia and Herzegovina (Official gazette RBiH 10/76). The law is inherited from former Republic of Bosnia and Herzegovina and former Yugoslavia.

Furthermore the Law on Water (completely harmonized between Federation of BiH, Republika Srpska and EU Water Framework Directive), besides stating that preventive measures are to be taken to protect people and material goods from potential damage caused by waters, includes an assessment of the risk posed to areas as well as of the level of their vulnerability. The roles of FHMI and RHMS RS are also defined by the entity laws on water:

- Water Law (Official Gazette of the Federation BiH" 70/06);
- Regulation on the types and contents of the plans for protection from the harmful effects of water ("Official Gazette of the Federation BiH" 26/09);
- The Law on water RS (Official Gazette 01-557/06);
- Flood Risk Directive (Official Gazette of Republika Srpska, No. 50/06).

The Water Law of FBiH states that “Operational Plan for Flood contains planning of maintenance and updating of communications system for all levels of management the measures of flood control, and connects its system links with the Federal Hydrometeorological Institute”. Article 29 of the Regulation on the types and contents of the plans for protection from the harmful effects of water states that Federal Hydrometeorological Institute, in case of active flood:

- performs regular monitoring of hydrological and meteorological data;
- prepares reports on the quantity, type and intensity of precipitation in areas affected by rainfall;
- makes predictions on the intensity and rainfall, time, etc;
- regularly submits information system of water agencies in the data on water levels in rivers with hydrological stations under its jurisdiction and the state of snow cover;
- at the time of the active flood data from the fourth indent this paragraph, the competent Agency delivered every four hours, and if necessary more frequently.

According to the Water Law of RS (Section 90), flood protection includes the implementation of activities and measures aimed at reducing or preventing vulnerability of people and property from flooding, and removing the consequences of their actions. For protection from water, Republic of Srpska and local governments must provide planning of protection measures, construction and management of protection facilities, especially dams, dikes, facilities to stabilize the bottom and the banks and facilities for the drainage of internal water in accordance by this law. On the basis of Article 230 of Water Law (Official Gazette of the Republic of Srpska", No. 50/06) and Articles 82 and 69 of the Republic Administration Law ("Official Gazette of the Republic of Srpska", No. 118/08), Minister of Agriculture, Forestry and Water management shall issue an Order on Main Operating flood protection plan which define the flood protection in the area along the Sava river for each year.

The Sava River Commission prepared in 2009 the Sava River Action Plan, designed in full coherence with the European Flood Directive flood action plans for sub-basins. Thus the Action Plan requires Member States to first carry out a preliminary flood risk assessment to identify areas at risk of flooding. For such areas they would then need to draw up flood risk maps and establish flood risk management plans focused on prevention, protection and preparedness. According to the Action plan for sustainable flood risks management in the Danube Basin with applications on sub-basin of river Sava, the Republic of Srpska prepared the Action Plan for the period 2010-2021. Action plan should serve as an essential mean of support and harmonization between the given sub-basins in the area of flood risk, by:

- Preparation and maintenance of strategies and methodologies for flood protection;
- Improving the flood protection, focusing on the protection of human life and safety and providing the value of goods and property;
- Introduction of flood mapping;
- Increasing the willingness and responsibility in case of flooding;
- Improvement of bilateral and multilateral cooperation on the strengthening of planning, especially in planning.

Moreover, the Integrated Republic of Srpska Water Management Strategy and the Republic of Srpska Flood Risk Management Plan are in preparation.

3.2.2. Institutional framework

3.2.2.1. List of agencies involved in Disaster Risk Reduction for hydrometeorological hazards

At National level:

- Sector for Protection and Rescue (PRS) - Ministry of Security of BiH.

The country is governed at several levels: state level (Bosnia and Herzegovina), entity level (Federal of Bosnia and Herzegovina, Republic of Srpska, and District Brcko), canton level (only in FED BH) and on municipality level. The relations to international organizations (UN, WMO, etc.) are organized at state level, while e.g. hydro-meteorological and environmental monitoring and weather forecasts are organized at entity level.

In the Federation of Bosnia and Herzegovina:

- Civil Protection Administration (CPA);
- Federal Hydro Meteorological Institute (FHMI);
- Agency for Watershed of Adriatic Sea (AWAS);
- Agency for Watershed of Sava River (AWSR).

In the Republika Srpska:

- Civil Protection Administration (CPA);
- Republic Hydro-meteorological Institute of Republic of Srpska (RHMS RS);
- Water Agency for Sava river district (WASR);
- Water Agency for Trebisnjica river district (WATR).

On country level there are no national organizations responsible for hydrological or meteorological observations and services. The hydro-meteorological sector in BiH is divided into two entities the Federal Hydro Meteorological Institute (FHMI) in Sarajevo and the Republic Hydro-meteorological Service of Republic of Srpska (RHMS RS) in Banja Luka. District Brcko has no own hydro-meteorological institutions. The Ministry of Civil Affairs of BiH is an umbrella institution at the level of BiH, which coordinates the work of two institutes in the entities.

3.2.2.2. Sector for Protection and Rescue

The Ministry of Security of Bosnia and Herzegovina, in accordance with its statutory powers, has a leading role in DRR at the national level and most of the structures related to DRR activities are embedded in the system of emergency response. The Ministry of Security realizes its role in DRR through its organizational unit: the Sector for Protection and Rescue. In the event of a large-scale accident with trans-boundary effects or which cannot be resolved at the local (i.e., entity level leadership), the Ministry of Security of Bosnia and Herzegovina and the Coordinating Body of Bosnia and Herzegovina take the leading role. The Coordinating Body of Bosnia and Herzegovina is composed of the Council of Ministers (heads of relevant Ministries), five representatives from the Federation of Bosnia and Herzegovina, and five from RS and two from Brcko District with the Chairman of the Coordinating Body being the Deputy Minister of Security of Bosnia and Herzegovina.

At State level, the Sector for Civil Protection of the Ministry of Security is the central body with competences in, and responsibility for, international cooperation, internal coordination, strategic planning of protection and rescue measures and training programmes. The Sector for Protection and Rescue objectives in 2009 were the establishment of an effective disaster management and coordination body and an operational 112 Centre, the development of strategic documents specified in the State law (Methodology of Risk Assessment, Risk Assessment, and Emergency Response Plan), the protection and rescue coordination, including better networking with Ministry of Defense and other authorities, enhanced international cooperation, and the harmonization of protection and rescue law with by-laws in Bosnia and Herzegovina. The Ministry of Security coordinates and manages planning and exchange of data and information, and reports on the risk reduction activities of entities and Brčko District.

The Ministry of Security of Bosnia and Herzegovina - Protection and Rescue Sector was founded in 2004. Protection and Rescue Sector is managed by Assistant Minister, Head of Protection and Rescue Sector. Ministry of Security is authorized for:

- Execution of international obligations and cooperation in civil protection execution;
- Coordination of activities of Civil Protection Administrations of Entities in Bosnia and Herzegovina and adjusting their needs in case of natural or other disaster that affect Bosnia and Herzegovina;
- Passing programs and plans of protection and rescue.

The Protection and Rescue Sector is organized according to the constitution of BiH, the Framework Law on Protection and Rescue, and Entity Laws on Protection and Rescue/Civil Protection: At state level it is composed by 3 departments:

- Department for International Cooperation and Coordination;
- Department for Strategic Planning and Protection and Rescue Measures;
- Department for Structure and Training.

The Operational-Communication Centre of BiH -112 is also a part of Protection and Rescue Sector, and operational centres of other institutions and bodies of BiH, as well as the centres of Brcko District, will be connected to the Operational-Communication Centre. The Operational Center “OC 112” is authorized to collect and distribute data and warnings on the occurrence of natural hazards and other disasters and to make timely alerts to the population. The OC 112 should also create a central storage system that would allow for the establishment of easy mechanisms for collection, storage and dissemination of disasters data.

The Coordination Body of Bosnia and Herzegovina for Protection and Rescue is the Body of the Council of Ministers BiH.

At lower level, there are the Entity Civil Protection Administrations (Civil Protection Administration of Federation BH and Civil Protection Administration of Republic of Srpska) and Department for Public Security of Brcko District BH (Civil Protection Service). In the case of large-scale accident with trans-boundary effects or which cannot be resolved at the local entity level, the Ministry of Security and the Coordinating Body of BiH take the leading role. The Law on Protection and Rescue in BiH prescribes obligation of forming the Coordination Body BiH for protection and rescue as a professional and operational body of the Council of Ministers BiH. The Coordination Body would, in case of natural or other disaster, manage and coordinate protection and rescue actions.

At the request of the entities or BD the Coordinating Body proposes the declaration of a state of natural or other disaster within the territory of BiH to the Council of Ministries of BiH as well as the termination of the aforesaid state; it also coordinates the activities of protection and rescue with institutions, the entities and BD as well as the institutions and bodies at the level of BiH. It also coordinates the activities of protection and rescue of institutions and bodies at the level of BiH during the implementation of measures of prevention and preparedness for natural and other disasters and coordinates them with the entities and BD.

Department for Strategic Planning and Protection and Rescue Measures is involved in drought/flood risk assessment. They are members of the Interdepartmental Working Group for the Development of Risk Assessment regarding Natural and Other Disasters in Bosnia and Herzegovina.

3.2.2.3. Federal HydroMeteorological Institute of Federation of Bosnia and Herzegovina

FHMI is an independent institution overseen by the BiH Ministry of Civil Affairs for meteorology, BiH Ministry of Foreign Trade and Economic Relations for hydrology and BiH Ministry of Security for seismology. FHMI, according to the applicable laws, performs professional and other activities relating to permanent monitoring in the field of meteorology, hydrology, environment quality, seismology and astronomy; conducts researches of atmosphere, water resources, environment (water, soil, air), seismologic processes and astronomic events; collects, processes, analyses and publishes data from its scope for the Federation BiH; issues on daily basis weather bulletins and forecasts, and actively cooperates with the World Meteorological Organization applying its standards in data exchange and improvement of this service.

FHMI is responsible for measuring, observation, collecting, publishing, and providing information, products and services related to the weather, climate and water, as well as their application in the human activities that are under the influence of atmospheric and related phenomena. FHMI produces hazard information by request, gives expert advice to different sectors, and provides historical hydrometeorological data for risk assessment projects, etc.

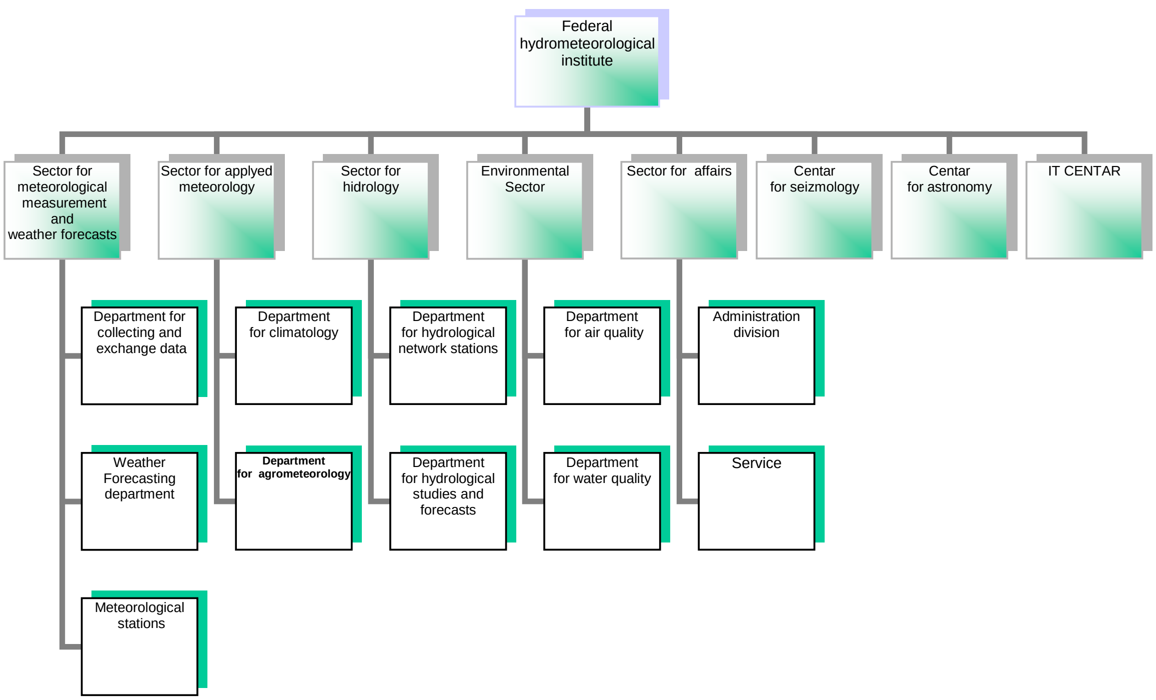


Figure 4. Organization chart of FHMI

3.2.2.4. Republic HydroMeteorological Service of the Srpska Republic

The Republic HydroMeteorological Service of the Srpska Republic is under the Ministry of Agriculture, Forestry and Water Management. According to the applicable laws, the obligations of RHMS RS under the law are:

- monitoring parameters: seismological, hydrological, meteorological, and air quality;

- creation and management of databases from the scope of activities;
- study of climate trends of climate, hydrology studies;
- weather forecasting;
- applied meteorology and hydrology;
- public information, media services;
- research activities;
- publishing and protection of data.

RHMS RS conducts the monitoring of hydrological and meteorological parameters, carries out an elementary statistical analysis of data and the analysis and forecast of meteorological parameters. The forecasts are issued as warnings in case of arrival of extreme weather (meteorological) and hydrological phenomena. RHMS RS has developed internal plans for strengthening the role of the institute relating to:

- Monitoring: the revitalization of the monitoring system, establishing new measurement stations, station automation and transmission of data, collecting center and database management; software for DB management, increasing the number of major meteorological stations with measurements of 24 x 7 days a week;
- Hydrology: establishing a system for hydrological forecasting, hydrological and hydrostatic model forecasts; integration with meteorological data and models, verification of the models output quality, a number of flow measuring stations in water streams;
- Meteorology: improving weather forecasting systems: working on the numerical prediction models for the development of new forecasting products; verification of model quality, analysis of specific synoptic situation through hind-cast runs of the model, now casting, using of forecasts in the weather alarm system;
- Climatology: creating climatological database; buying the software CLIDATA; climatological analysis and trends, participating in development programs, projects and cross-border cooperation.

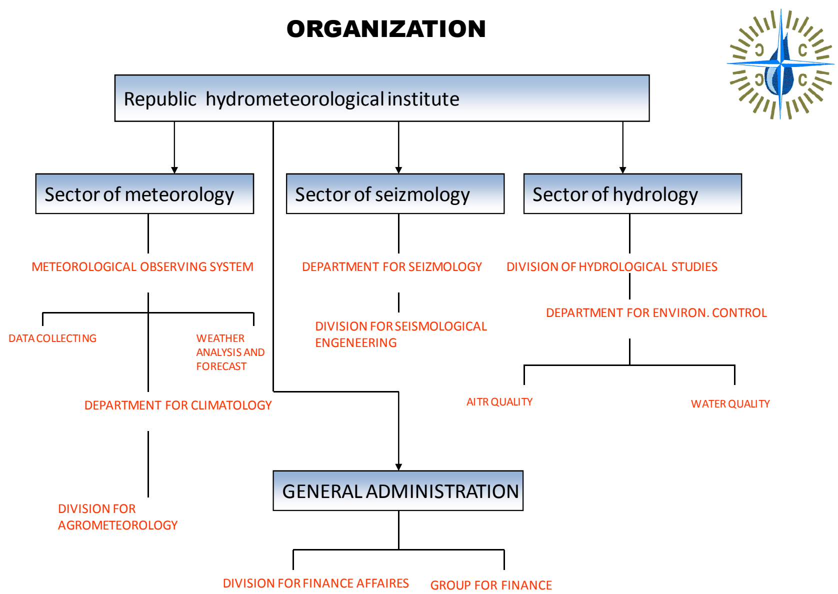


Figure 5. Organization chart of RHMS RS

RHMS RS has been involved in the working group of experts from different fields and sectors for the risk assessments of BiH threat from natural and other disasters. Government of Republic of Srpska at its session held on 4 and 5 March 2010 adopted a Decision appointing the members of Inter-working groups to work on risk assessments of BiH threat of natural or other disasters ("Official Gazette of the Republic of Srpska" No. 22/10).

3.2.2.5. Water Agencies

Currently there are 4 Water Agencies in Bosnia and Herzegovina, 2 in the Federation and 2 in the Republic:

- Agency for Water Catchment Area of the Adriatic sea Mostar, FBiH;
- Agency for Water Catchment Area of the Sava River, FBiH;
- Agency for Water catchment Areas of the Sava River Basin Bijeljina, RS;
- Agency for River Basin Water District of Trebišnice River from Trebinje, RS.

Water Agencies, established by Ministry of Agriculture, forestry, and water management, are responsible for implementation of long-term, middle term and annual water sector development plans:

- Flood protection;
- Maintenance, construction and operation of water sector facilities of general interest;
- Operation and Maintenance specially important independent regional water supply systems to the place of connection on municipal network;
- Preparation of drafts and technical studies for routine maintenance and rehabilitation;
- Participation in organization and implementation of studies and investigation tasks in water sector;
- Monitoring and control of water use, control of gravel exploitation;
- Exploitation of material from river course.

They are charged to implement the different steps foreseen by the European Flood Directive. The first step is planned to prepare a preliminary assessment of flood risk to be done by the end of 2011 and to be actualized in 2018, and thereafter in cycles of six years. The second step is the mapping of flood risk, to be done by the end of 2013. The third step is the preparation of flood risk management plans, to be completed and plans published by the end of 2015 and put into practice since the beginning of the 2016 and revised by the 2021 year and then actualized every six years.

The Agency for Water Catchment Area of the Adriatic Sea in Federation of Bosnia and Herzegovina (AWAS) is based in Mostar. AWAS is charged of watershed management, water use, water protection, protection from water, Hydrometeorological stations monitoring network, hydrologic and hydraulic modelling, flood mapping. AWAS has very closely collaboration with FHMI. The data collected by its own observation network are regularly transmitted to FHMI.

The Water Agency for Sava River District in Republika Srpska (AWSR RS) performs tasks related to:

- organizing the work and functioning of water management at the regional and river basin, as well as working offices of the water basin management;
- proposing long-term and medium term plans and programs for water resources development;
- taking care of providing the necessary funds and the manner of their use;
- monitoring the implementation of plans and programs for development of water management;
- controlling the dedicated use of funds;
- suggesting the rate of compensation;
- proposing the annual program and financial plan;
- proposing criteria and standards for routing and resource allocation;
- performing other duties in accordance with the law and other regulations of the Republic of Srpska and Bosnia and Herzegovina.

In the Agency, Water Management Sector and Department for Protection from Water are involved in floods risk assessment.

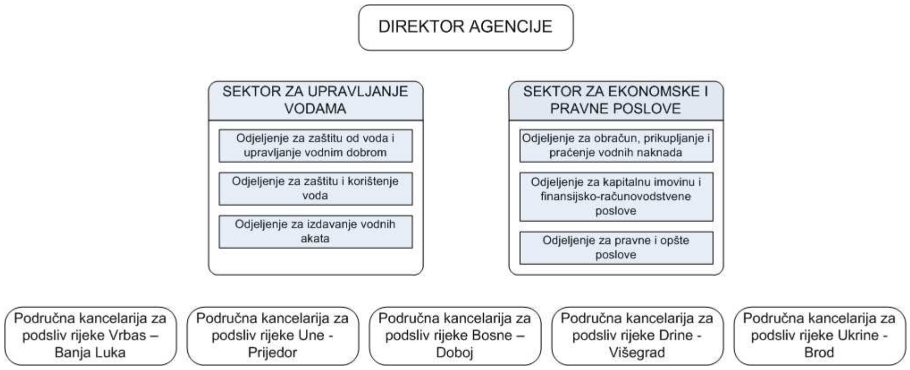


Figure 6. Organization chart of AWSR RS

AWSRRS is developing a real time flood prediction model for the Bosna river basin (Spanish financed flood risk mapping project-EPTISA). The objective is to implement a flood prediction and early warning system for the four remaining river basins (Sava, Una, Vrbas and Drina). An integrated flood forecasting and warning system is under the development.

3.2.3. Operational relationship with Disaster Risk Management and other Technical agencies

The national policy of BiH towards DRR does not exist as a formal document but rather within the established system of decentralised responsibilities and capacities at all levels. To date there is no national strategy aimed at DRR and nor is one mandated by law. The Ministry of Security, through the Sector for Protection and Rescue, has realised the importance of mainstreaming DRR into its national policy.

The Ministry of Security of BiH, in accordance with its statutory powers, has a leading role in DRR at the national level and most of the structures related to DRR activities are embedded in the system of emergency response. A National Platform for DRR, as a functional body, does not exist, but the Sector for Prevention & Rescue has prepared activities such as seminars and workshops for the development of a National Platform. Implementation of these activities is planned for 2011 and the Ministry of Security has established cooperation with the relevant UN institutions as well as with EU countries and other South Eastern European countries that have National Platforms, so that this important segment of DRR can be established. In particular, BiH has established cooperation with representatives of the former Yugoslav Republic of Macedonia, which currently Chairs the European National Platform, in order to gain expertise for the purpose of developing the BiH National Development Plan as well as a National Platform for DRR.

Currently the cooperation between FHMI, RHMS RS and the aviation weather services, as well with the agencies collecting hydrological data, is quite low. Standard Operating procedures (SOP) and Quality Management Systems (QMS) between the hydrometeorological services and the DRM sector have not been developed. Currently data exchange and cooperation with the Water Agencies also is not at optimum level.

3.2.4. Roles and responsibilities in flood and drought risk assessment

According to the Law on protection and rescue, risk assessment in BiH is performed at three different levels:

- National level, coordinated by the Ministry of Security BiH, Sector for Protection and Rescue;
- Entity level, coordinated by the Civil Protection Administrations;
- Local level, coordinated by the local Authorities.

The National Risk Assessment is under finalization, applying the Methodology for Risk Assessment regarding natural and other disasters in BiH adopted on September 30th 2009. This is coordinated by the Protection and Rescue Sector. Interdepartmental Working Groups composed by representatives of state and entity ministries, Public Safety Department of Brčko District BH, experts from various fields of governmental and non-governmental sector and civil society are established. Each working group developed the Risk Assessment concerning its thematic. Floods and drought are included among the 4 types of climatic hazards.

By the end of 2011 BiH will have a Disaster Risk Assessment that will consist of risk and vulnerability analysis. It is the first assessment for the whole territory and will be available for all institutions and public.

The two HMS participated in the working group, provided analyses of these main hazards, mainly statistical on frequency, number of events, affected areas. Water Agencies participated as well providing maps of areas affected by floods.

Concerning floods at entity level (Figure 7), Ministry of Agriculture, Forestry and Water Management is the main body authorized for both administrative and technical obligations, adopting general annual flood protection plans, organizing the preparation of water balances at entity level and for basic river basins. The Water Agencies, established by Ministry of Agriculture, Forestry, and Water Management, are responsible for implementation of long-term, middle term and annual water sector development plans. WAs collect floods information, make floods hazard maps and flood risk assessments. They are also charged to perform the preliminary floods risk assessment as per the EC Directive on floods. WAs provide information for physical planning to local and entity authorities, for environmental planning, hydroelectric companies, water user, etc.

Concerning impact data, Protection and Rescue Sector and OC 112 consolidate the drought/floods impact data delivered by lower levels, and utilize these data in specific reports regarding disasters impact in BiH. The reports with consolidated drought/flood impact data produced by the Sector are used by other state institutions, international and humanitarian organizations. WAs collect floods impact data as well as local authorities.

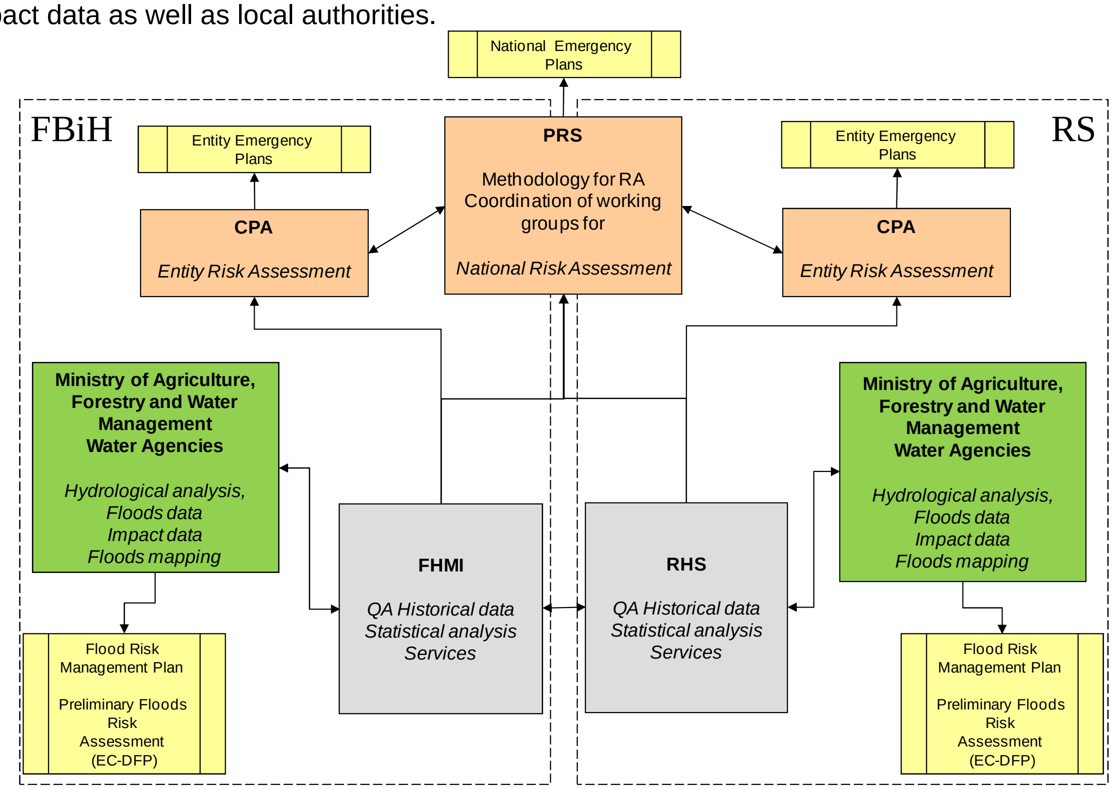


Figure 7. Workflow for Floods Risk Assessment in BiH

All existing planning documents are produced in line with a single methodology. At lower level of organization (entities, cantons and municipalities) there are inter-agency plans. Studies have shown that these plans are not very functional and useful only to a certain extent due to the actual system and structural changes in society, as well as an extremely complex system of bureaucracy. Protection and Rescue Sector is making efforts to consolidate the system conducting activities that should lead to a final goal: a unified methodology for preparation of planning documents at the state level, unified plans at state level and adequate guidance on the content, method of preparation and approval of these documents that would establish a system of mutual coordination plans for preparedness to disasters at the interdisciplinary multi-organizational level. The assumption is that this activity could be completed by the end of the 2012.

3.2.5. Budget and funding for DRR

Basic government funding mechanisms aimed at DRR are channelled through budgeting for projects aimed at the establishment, construction and functional development of a system of disaster management. Financing of these activities is conducted exclusively through planned budgeting for all institutions in the system working in this area. The Council of Ministers of BiH has provided significant financial resources, amounting to 4.2 million BAM (approximately USD 3 million) for the period 2009-2011, for the construction and establishment of a single European number for emergency situations: 112. The latter represents one segments of DRR as it is a contributing factor to preparedness: preparedness being one of the five priorities of the Hyogo Framework for Action. The specific issues of budgeting and funding at the state level are regulated by the Law on Protection and Rescue of BiH, which, among other things, requires the below stated:

- In the budget of the institutions of BiH and in accordance with the international obligations of BiH financial resources are to be ensured for the equipping, training and the setting up of an operational and functioning 112 centre, as well as equipping and training for an operational and functioning Coordinating Body. Professional development and training of civil servants and employees involved in protection and rescue within institutions and bodies at the level of BiH should be provided along with compensation costs for protection and rescue work of an international nature. In the case of natural or other disasters the execution of orders by the competent authority for protection and rescue and the provision of assistance to other states, entities and the Brcko District of BiH additional equipment and training of units may be provided;
- To finance part of the needs and activities referred to above funds can be secured through the financial and material technical benefits of the legal entities of BiH, donations given by other countries and international organisations and other forms of assistance. The lower levels of the organisational system in BiH (entities, cantons/regions) allocate significant budgetary resources for the development of the system of management for emergency situations.

In accordance with the organization of the public administration system in BiH all of the structures of public administration have their own budgetary resources. This fact explains the complicated system of relations in the activities aimed at introducing DRR. The entities have their own independent sources of financing and budgets and consequently the system of budgeting for DRR is not firmly established. So far the most significant assistance provided for the implementation of projects regarding DRR has come from the relevant UN structures: mainly from the UNDP, EU, NATO and through bilateral cooperation with DEMA.

3.3. Institutional and Technical Capacities of Hydrometeorological Services to support Disaster Risk Management

3.3.1. Monitoring and observations networks and data exchange

Hydrometeorological observation networks are established not only for national needs but also to be a part of the WMO Global Observation System (GOS) comprising of standardised measurements taken at constant hours using surface observation and monitoring stations, upper air observation, hydrological measurements and satellite observations. International exchange of data is the core for monitoring and forecasting the weather globally, regionally and nationally. Long-time historical time series of accurate quality controlled observations are required for hazard analyses, climatological studies and monitoring of climate change. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situations;
- reduction of vulnerability to the risks caused by meteorological, hydrological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale[4] NWP modelling.

Quality of hazard analyses and global & regional weather forecasting depend strongly on quality and spatial density and representativeness of the observation network. The most important data for numerical models is upper air observations (soundings). In Bosnia and Herzegovina there are no upper air observations or weather radar observations available. The availability of such data would significantly improve quality of aviation weather forecasts and in general for short-term forecasting and now casting.

The observation network in Bosnia and Herzegovina is described in terms of number of different types of station in Tables 9 (FHMI) and 10 (RHMS RS). Before 1992, the hydrometeorological network which was managed by the Republic Hydrometeorological Institute of Bosnia and Herzegovina consisted of about 600 stations, including 19 principle weather stations, 91 climatological and 276 rainfall stations. During the war the observation network was heavily destroyed. At present several regions in FED BiH and also in Republic of Srpska are totally uncovered with synoptic stations (especially eastern Bosnia). Currently FHMI and RHMS RS have their own separate meteorological and hydrological measurements, with the objective to monitor on entity level only.

At the moment no weather radars or remote sensing equipment is available. Satellite data is essential for forecasters. Currently FHMI has a satellite data receiving system. Data is received mainly as basic picture as currently FHMI does not have capacity to use digital data to produce own analyses. RHMS RS does not currently have equipment to receive satellite data except as internet pictures.

The data exchange between FHMI and RHMS RS is very limited. Data from only 13 main meteorological stations is sent internationally through the WMO GTS. In order to send data to the WMO GTS RHMS RS is connected to FHMI and both then to the GTS hub in Sofia, Bulgaria.

The meteorological sensors and equipment at the manned stations are mainly obsolete. Due to lack of calibration facilities, calibrations and maintenance the measurements from these stations do not meet the WMO requirements and standards.

FHMI collects the following data: (i) Climate data (hourly, daily, monthly): precipitation, temperatures (soil and air), pressures, wind speed and direction, relative humidity, cloudiness, snow cover, evaporation etc. and (ii) Hydrological data (hourly, daily, monthly): water level and water temperature. The data collection process for automatic weather stations of FHMI is based on the new IMS software, receiving and sending data through the ADSL connection, which completely abolished the previous method of communicating by phone and radio stations. For the first time, FHMI is sending hourly report from synoptic stations, which greatly improved the quality of work. Regarding hydrology, FHMI has access to 25 automatic hydrological stations with real-

[4] Mesoscale meteorology general definition: Horizontal dimensions generally range from around 5 kilometres to several hundred kilometres. Examples of mesoscale weather systems are sea breezes, squall lines and mesoscale convective complexes. Today horizontal resolution of mesoscale models is typically from 1 to 3 km.

time data transfer by using radio and/or GSM telecommunication systems (FHMI collects data from 10 hydrological stations with real time data transfer). Water Agencies periodically submit to FHMI data on water levels recorded on CD or via e-mail (circa 50 stations). FHMI operates also environmental measurements: air quality is measured in Sarajevo, Tuzla and Ivan Sedlo, nuclear radiation is measured at 6 stations of which one is out of order, ozone near surface is measured at 4 stations (Tuzla, Sarajevo and Ivan Sedlo) and UV radiation at 1 station. FHMI operates one regional GAW station, Ivan Sedlo. Components measured are NO2 (Saltzman method) and SO2 (Absorptio-Photemetry/Colorimetry).

Table 9: Observations stations operated by FHMI

Type of observations stations	2007	2010	GTS	Comments on 2010 network
Atmospheric domain				
Surface synoptic stations (> 8 obs./day)	16	14		
Manned stations	13	13	12	Availability of data 69%
AWS or AWOS	3	1	1	Availability of data 75%
Cloud-height – automatic	0	0		
Climatic stations (3 obs day)				
Agrometeorological stations	NA	17	12	Availability of data 88%
Lake stations – manned	0	0	0	
Lake stations – automatic	0	0		
Rainfall station – manual (2 obs./d)	26	26	0	Target 250
Rainfall station – automatic	0	0		
Meteorological towers	0	0		
Upper air radio sond stations	0	0		
Pilot balloon stations	0	0		
SODAR/RASS	0	0		
Wind profiler stations	0	0		
Lidar	0	0		
Access to AMDAR data	0	0		
Weather radars	0	0		
Hale radars	0	0		
Lightning detection stations	3	3	0	Old type
Lightning detection hub station	0	0		
Satellite MSG ground station	1	1	-	
Hydrological domain				
Hydrometric stations	80	80	0	Availability of data 70%
of which autom. water level/discharge	59	59	0	
of which real time data transfer				
Maritime domain				
Maritime weather stations – manned	1	1		
Maritime weather stations - automatic	0	0		
Buoys	0	0		
Buoys with meteorological observations	0	0		
Tidal stations	0	0		
Tidal stations with met. Observations	0	0		
Environmental domain				
Air quality	4	4	0	Sarajevo, Tuzla and Ivan Sedlo
Water quality	0	0		
Nuclear deposition	4	6	0	5 operational
Ozone – near surface	2	2	0	Only 1 operational
Ozone – upper air	0	0		
UV radiation	1	1	0	
GAW station	1	1	0	Availability of data 90%
Seismological domain				
Seismic stations	3	3		Availability 70%

In 2007 the RHMS RS network meteorological stations contained 29 stations (all types) whereof only two were manned Main Meteorological Stations (operational 24h) with 24 hours of work, i.e. Banja Luka and Gacko, and the main climatological station Čemerno was in preparation to become the main meteorological station (0-24 h). Even if the total number of stations has decreased, the number of AWSs increased in the last years (one situated in Banja Luka and 5 in the area of the river basin Trebisnjica). However, the loss of manned synoptic stations been replaced with AWSs further reduces the capacity to provide adequate observations for the DRR system.

Table 10: Observation stations operated by RHMS RS

Type of observations stations	2007	2010	GTS	Comments on 2010 network
Atmospheric domain				
Surface synoptic stations	16	3	1	Earlier 5 stations to GTS
Manned stations (8 obs/day)	14	1		
AWS or AWOS	2	6		
Cloud-height – automatic	0	0		
Agrometeorological stations	NA	1		
Lake stations – manned	0	0		
Lake stations – automatic	0	0		
Ordinary climate station (3 obs/day)	9	23		
Rainfall station – manual (2 obs./d)	NA	NA		
Rainfall station – automatic	0	0		
Meteorological towers	0	0		
Upper air radio sond stations	0	0		
Pilot balloon stations	0	0		
SODAR/RASS	0	0		
Wind profiler stations	0	0		
Lidar	0	0		
Access to AMDAR data	0	0		
Weather radars	0	0		
Hale radars	0	0		
Lightning detection stations	0	0		
Lightning detection hub station	0	0		
Satellite MSG ground station	0	0		
Hydrological domain				
Hydrometric stations		24		
of which autom. water level/discharge	0	0		
Maritime domain				
Maritime weather stations – manned	0	0		
Maritime weather stations - automatic	0	0		
Buoys	0	0		
Buoys with meteorological observations	0	0		
Tidal stations	0	0		
Tidal stations with met. Observations	0	0		
Environmental domain				
Air quality	0	1		
Water quality	0	0		
Nuclear deposition	0	0		
Ozone – near surface	0	1		At Banja Luka
Ozone – upper air	0	0		
UV radiation	0	0		
GAW station	0	0		
Seismological domain				
Seismic stations	5	5		3 operational , 1 partially

At manned stations RHMS RS takes measurements every hour during the working time of the station. According to standards of WMO, the data are registered in the weather diaries and are observations forwarded to a collection center. Data collection is automated to a lesser extent, the data is delivered to a greater extent in the form of synoptic reports for meteorology and txt. form for hydrological measurements. RHMS RS receives data from:

- Water agencies, this data are managed as the RHMS RS own data;
- FHMI, there is an agreement for data exchange, but is on demand and there are not automatic procedures for data exchange;
- Hydropower plants, but this data often are collected not applying WMO standards and only in some cases are used;
- Hydrometeorological services in the region, on project basis;
- the WMO GTS network.

RHMS RS operates an automatic air quality station in Banja Luka, 2 automatic monitoring stations in Bijeljina, manual stations for air quality (2 parameters) and temporal stations in Stanari, Ugljevik and Gacko. Additionally 4 automatic monitoring stations are operated in Banja Luka by Integral Engeenering. All measured data are sent to RHMS RS and forwarded to Sarajevo in FHMI and EIONET.

Currently there are 3 meteorological observatories in Bosnia and Herzegovina: Observatori Bjelasnica, Observatory Sarajevo –Bjelave (FHMI) and Observatory Banja Luka (RHMS RS). Radioactivity of air is measured (filter system) in following cities: Banja Luka, Novi Grad, Prijedor, Bijeljina, Gacko i Višegrad. Additionally radioactivity is measured from precipitation in Banja Luka at present. Near surface ozone is measured in Banja Luka.

Also other governmental entities, such as the different Water Agencies are also collecting, storing and analyzing relevant data from their respective area of responsibility. The Water Agency for the Adriatic Sea basin collects data on Water levels, Discharge, Rainfall, Air temperature, wind, solar radiation, evaporation, air pressure and Water quality. All data are received in real time from automatic hydrometeorological stations. The hydrometeorological network is under the ownership of three companies: (AVP Jadransko, Hydroelectric company EP HZH-B, and Hydroelectric company EP BiH), with 72 automatic hydrometeorological stations. Data for the last 10 years are stored in ASCII format (WordPad, excel). Older data are stored at FHMI. The Agency is receiving meteorological data from the FHMI, Hydroelectric companies and Croatia Waters. Data are shared with Federal Hydrometeorological Institute under a signed agreement, with Croatia Waters in case of floods events and with Faculties. The Water Agency for Sava River District in Republika Srpska (AWSR) collects data on temperature, water level, discharge, and water quality parameters. Data are collected automatically by the automatic measuring stations, and then transmitted to a central server. The server is configured in such manner, that in defined time periods it connects with each station and downloads the measured values, which are stored in the database in the form of time series data. One part of data has been collected manually or imported from the old database or taken from other institutions. Basic controls of data accuracy are done by the automatic measuring stations, and calibration and verification are made during the station maintenance 4 - 6 times a year. All data bases are implemented in Microsoft SQL Server, the server has a SAS hard disks in RAID1 configuration. Database backup are stored automatically. Access to the database or server is controlled by assigning permissions to individual users or groups. Data is exchanged with the Republic Hydro-Meteorological Institute, which is in charge of public dissemination of information. In accordance with the law, data is shared at entity level and at international level (ICPDR, ISRBC). Data are available on request to other institutions, and some of the information is available through the website: www.voders.org. AWSR-RS receives free data from other services: Republic Hydro-Meteorological Institute, Hydropower Trebisnjica, Visegrad, Zvornik and Bocac.

3.3.2. Hydrometeorological data management systems

Operational adequate data management system is part of the core capacities of modern hydrometeorological services. This includes data collection, quality control, data base, availability of data, and real time use of data. Historical hydrometeorological data is critical for hazard analyses and planning and design within various economic sectors. In this regard, hydrometeorological data must be properly quality-ensured and stored in historical user-friendly digital databases.

Currently in Bosnia and Herzegovina there is no common general hydrological or meteorological database at country level. FHMI and RHMS RS collect separately meteorological data and operate the databases which in both institutes include data collected by the state hydrological agencies. Additionally, the Water Agencies collect hydrological data. Up to now no actions are taken to merge these databases to form one national hydrometeorological database (with direct access from both hydrometeorological services) which would significantly improve production of state level and entity level analyses of different hydrometeorological parameters. The possibility of producing a joint state level hydro-meteorological database, which could be available at both services, was discussed in the WMO-UNDP mission meeting. The benefits from such a database would be significant.

The FHMI digital hydrometeorological database includes data since 1968. 65% of the pre-war historical data before are in digitised and archived in a database and the rest remains on paper format. 30 years of data are also compiled on Excel as result of different projects. These data are for the whole Bosnia and Herzegovina and are available at FHMI but not at RHMS RS. FHMI operates the digital database CLIDATA/Oracle, which was donated and installed by Czech Hydro-meteorological Institute through the WMO-VCP in 2005. Licence for Oracle was part of the donation. Typically data from synoptic stations are stored for each third hour, while data from climatological stations consist only of three observations per day, and from precipitation stations twice a day (12 h cumulative precipitation). Quality control and validation are provided by CLIDATA on 3 levels: (i) when data are entered or imported, using defined elements limits; (ii) through logic control, using formulas, which are created by administrator; and (iii) through spatial control, using GIS technology. Data security is ensured by backup copies, made regularly once per month. Control and validation of hydrological data are performed according to the guidelines to the hydrological service. There are needs to improve the software, and create the capability to include all data collected into the database. PENTIUM III and PENTIUM IV with Windows XP are in use.

RHMS RS hydrological and meteorological databases are in an Excel format, because RHMS RS still does not have CLIDATA. The meteorological database includes monthly data from 10 stations since 1960. Daily observations are available partially since 1980, but mainly from 1996. Latest database consists of data from 25 stations. An old DOS version of CLICOM is still used for storing some historical data. Many daily meteorological data are on paper. Historical hydrological data before the war are mainly on paper and in a little part in an Access database. Hydrological data after the war are in digital format (excel) but there are some missing periods. In order to backup the data they are copied on different media. There is a systematic review of data when digitized, on a daily and monthly basis in terms of climatological data.

It is necessary to urgently come up with a digital data base, including real time quality control. For both state and entity level planning and hazard mapping it would be vital to have one national level data base, or at least two synchronized databases operated by both services.

Concerning data dissemination and exchange, FHMI has signed Memorandum of understanding and cooperation with RHMS RS in Banja Luka. Data are exchanged through the internet, free of charge. Restrictions in data exist only for commercial purpose. FHMI receives also the data of water monitoring from the station under the jurisdiction of Water Agencies, regularly and without charge and restrictions.

Hydrological department of the Institute processes the data and prepare hydrologic reports, including Yearbooks. Yearbooks are printed in cooperation with Water Agencies. As a result of the restoration of hydrological stations and hydrological observation and measurements, after a break of ten years, hydrological yearbooks are printed again since 2001, initially only for the Sava River catchment area in the Federation of Bosnia and Herzegovina. Since 2005 yearbooks include collected and processed data from the surface hydrological stations for both Sava River and the

Adriatic Sea from the area of Federation of Bosnia and Herzegovina. As an example, Yearbook 2005 contains daily data on water levels for 50 stations, flows for 39 stations, water temperature – 23 stations, precipitation – 22 stations, and air temperature –23 stations.

Exchange and distribution of RHMS RS data is done according to the law of hydro-meteorological services and the Rules of Procedure of the hydrometeorological service, and according to the agreements of cooperation in the region, with other hydrometeorological services. RHMS RS shares data under the WMO information exchange obligations. Concerning hydrological data, daily information from 6 stations is exchanged through the WMO GTS system.

3.3.3. Hazard analysis and mapping to support risk assessment

Hazard analyses and risk assessment need to be based on long-time accurate and geographically representative measurements or observations. However, lack of state level hydrometeorological database and coordination of hazard mapping hampers production of hazard maps for Bosnia and Herzegovina.

FHMI Does not collect specific data on hazard but has historical data archives including the data registered in cases of floods and droughts. Concerning floods, its Hydrological Sector collects the hydrological data during the year, including periods of extreme phenomena, water levels and water discharges. Concerning drought, FHMI before the war, collected data on soil moisture and water stresses on agricultural crops (maize and wheat). But after the war these measurement have been abandoned. Actually, FHMI collects phenological data for 5 stations, which are stored on paper. Actually, FHMI produces drought indices.

RHMS RS also has historical data archives and monitors changes in water level, flow to a certain level of water, depending on whether the flow curve is defined in the zone of high water. RHMS RS collects some phenological data but not systematically.

Water Agencies collect information in case of floods about the flooded area, the water levels, the river discharge, etc. The AWAS FBiH has a database for water levels and flow discharge of past flood events. AWSR RS has some historical data, but not systematically organized in a flood database.

The Protection and Rescue Sector and its 112 Operationnal Center collect hazard data from entity civil protection administrations, water agencies and hydro-meteorological services. PRS does not have a database of past events, but with the establishment of the OC 112, there is an opening to create a central storage system, which would allow the establishment of easy mechanisms of data collection, storage and dissemination since the OC 112 is a unified system of communication throughout the whole territory of BiH. PRS does not perform analysis on such data, but hazard mapping has been performed by the Working group on Risk Assessment. PRS does not have yet GIS capacities and nor manage analysis and mapping tools, but it has planned to develop a Risk Observatory Project so that these analysis and mapping would be available in the future.

FHMI produces analyses on averages, trends, variability and extremes and makes studies of potential flood impacts. Studies of 100 year return periods have been done for some meteorological and hydrological extremes, for stations with long time measurements. Observed annual peak of discharge data are used to calculate statistical information such as mean values, standard deviations, skewness and recurrence intervals. This statistical data is then used to build frequency distributions, graphs and tables showing the likelihood of various discharges as a function of recurrence interval or surplus probability. Flood hazard maps have been produced for the Sava river as a part of an international project, and the hazard mapping for Una river is under preparation. Concerning drought mapping, only drought indices are available from FHMI, while RHMS RS has not been involved in the DMC-SEE programme and is not producing any drought index. FHMI operatively uses the following agroclimatic drought indices: Standardized precipitation index (SPI), De-Martonne aridity index, Seljaninov index; Precipitation quantity expressed in the percentage of long-term average for month, season and vegetation period. These indices are calculated on station data.

RHMS RS doesn't produce any systematic analysis on drought and floods. Only particular situations are analyzed, often at the request of specific ministries and scientific institutions.

Both HMSs have suffered lack of proper software for climatological and other analyses.

Due to the lack of GIS tools FHMI and RHMS RS currently are not able to produce hazard mapping. Currently the hydrological and meteorological maps produced by FHMI or RHMS RS are not in GIS format, which makes it difficult to use hydrological and meteorological climatological and hazard maps together with land use and other maps.

AWAS analyses past floods and make hydraulic simulations of past flood events. Flood mapping is performed for streams and rivers of I. category. AWAS produces flood mapping, thanks to its GIS expertise (Arc GIS). AWSRRS produces potential flood mapping using basic level of GIS expertise. At the moment, flood mapping is available only for river Bosna. AWSR uses basic geo-data (as digital model of terrain) and other geo-layers too (aerial photos, etc.).

Currently there is no designed body with responsibility to collect hazards statistics and impacts. Many institutions collect data in case of disaster, Municipalities, NGO, etc. but the data is not centralized nor harmonized, different figures emerge from different surveys and there is not a real assessment of damages. There are different standard protocols for collecting the drought/floods impact data at local level and the data analysis and information mapping is not standardized nor in line with EU directives.

PRS does not collect drought/flood impact data on the field. The Sector receives these data from Entity Civil Protection Administrations, consolidates them and utilizes this data in specific reports regarding disasters impact in BiH. The reports with consolidated drought/flood impact data produced by the Sector are used by other state institutions, international and humanitarian organizations.

AWAS collects damages data on buildings and damaged riverbanks and flood protection constructions. This information is collected mostly directly, but some information is received also from Municipalities and residents. AWSRRS started collecting data at the beginning of this year, but standard protocols don't exist yet.

3.3.4. Forecasting

Public weather forecasts are produced only at the entity level. There are no hydrological, flood forecasts or any environmental forecasts produced in Bosnia and Herzegovina. Currently 24/7 weather services are not available in Bosnia and Herzegovina.

Table 11: FHMI forecasting products

Forecast type	weather			Hydrological			environmental		
	provide	n/d	on web	provide	n/d	on web	provide	n/d	web
nowcasting	no			no			no		
12 hours	no			no			no		
24 hours	yes	3/d	yes	no			no		
48 hours	yes		yes	no			no		
3-,4-, 5-days	yes	1/d	yes	no			no		
one week	no			no			no		
10 days	no			no			no		
monthly outlooks	no			no			no		
seasonal outlooks	no			no			no		

n/d: number of observations per day

Table 12: RHMS RS forecasting products

Forecast type	weather			Hydrological			environmental		
	provide	n/d	on web	provide	n/d	on web	provide	n/d	web
nowcasting	yes	2/d	yes	no			no		
12 hours	yes	2/d	yes	no			no		
24 hours	yes	2/d	yes	no			no		
48 hours	yes	2/d	yes	no			no		
3-,4-, 5-days	yes	1/d	yes	no			no		
one week	no			no			no		
10 days	no			no			no		
monthly outlooks	no			no			no		
seasonal outlooks	no			no			no		

n/d: number of observations per day

The weather forecasting is based on observations, information received from international numerical weather prediction models run by international centers (1-10 day forecasts), or by FHMI or RHMS RS (1-2-3 day forecasts), and on use of international satellite image data. Satellite data is not used for e.g. drought and snow cover analyses and forecasts. The kind of forecasts produced by FHMI and RHMS RS are described in Tables 11 and 12. In addition, FHMI provides specialised agrometeorological forecasts to the agriculture sector on 7 day periods and RHMS RS produces 3-5 days specialized weather forecasts occasionally to agriculture, transport, water transport, construction, air transport, tourism and energy production sectors.

Both FHMI and RHMS RS use ECMWF forecasts for long term general forecasting. As Bosnia and Herzegovina is not a member of ECMWF, they do not have access to same state-of-the-art digital products. Both FHMI and RHMS RS operate numerical weather prediction models, as described in Tables 13 and 14. FHMI operates currently local scale models: the NMM (from Deutsche Wetter Dienst) at 14 km horizontal grid, and two local scale open source models, WRF-ARW and WRF-NMM from USA, which are run at 4 km and 5 km horizontal grid resolution. The boundaries are taken from global NWP model AFS operated by NCEP. FHMI does not have capacity to run coupled wave models, or any dispersion models. RHMS RS operates the ETA model at 32 km horizontal grid, and at local level the WRF-NMM model at 12 km and 5 km horizontal resolution. The models are run twice a day. RHMS RS also operates with the WRF ARW model. FHMI or RHMS RS have no data assimilation system in use in the NWP modelling. There are no flood forecasting models available. The outputs from numerical weather prediction models can be used for dispersion models of air borne pollutants. However, currently air quality models and NWP models are not coupled.

FHMI produces statistical monthly forecasts and uses seasonal forecasts produced by SEE VCCC Belgrade and ECMWF. Advanced NMHSs produce and disseminate forecasts for any requested place/location, and usually the dissemination is automatic and the products are produced individually for each customer. However, modern analysing, editing, visualisation and dissemination tools are not available in Bosnia and Herzegovina. In order to at least partially solve this problem, both HMS are going to have the METVIEW-4 system from ECMWF. METVIEW is an interactive meteorological application, which enables operational and research meteorologists to access, manipulate and visualise meteorological data. The system is based on the ECMWF standards for graphics (Magics) and data access (MARS) but can also access locally stored data. The HMS have participated the METVIEW training in March 2010 and the hardware and software will be installed in early 2011.

In hydrology, FHMI calculates discharge for gauged rivers using river cross section at main hydrological stations and discharge profiles. FHMI and RHMS RS do not use any hydrological model. AWAS uses 3 or 6 days weather prediction from “Aladin” of Croatian National Hydrometeorological Institute. Concerning hydrological models, AWAS uses HEC-HMS, HEC-RAS, MIKE 11. Models use hourly data from automatic hydrometeorological stations. AWSR uses HEC RAS hydraulic model for river Bosna (test phase), and in preparation for river Sana. At AWSR, the flood wave analysis for the river Sava is in preparation. Potential floods mapping is also done.

Table 13: Operational numerical models used by FHMI

Type of forecast	Name of the model	Δz km	Levels	boundaries from	Data assimilation	Times/day
Weather	HRM (DWD)	14	40	DWD (Germany)	No	2/d
Weather	WRF-NMM	4	30	AFS (USA)	No	2/d
Weather	WRF-ARW	5	30	AFS (USA)	No	2/d
Discharge	none					
Flood	none					
Flash flood	none					
See wave	none					
Air pollution	none					

Δz is the horizontal resolution

Table 14: Operational numerical models used by RHMS RS

Type of forecast	Name of the model	Δz km	Levels	boundaries from	Data assimilation	Times/day
Weather	ETA	32		AFS (USA)	No	2/d
Weather	WRF-ARW	12		AFS (USA)	No	2/d
Weather	WRF-ARW	5		AFS (USA)	No	2/d
Discharge	none					
Flood	none					
Flash flood	none					
See wave	none					
Air pollution	none					

3.3.5. Warning products and services

3.3.5.1. Warnings and mandates

In Bosnia and Herzegovina warnings of hydrometeorology-related hazards are produced by FHMI, RHMS RS and the new state level 112 system (Table 15). FHMI has the mandate to produce and present weather forecasts to the public and several economic sectors for the area of Federation of Bosnia and Herzegovina. The forecasts may include general information of extreme weather phenomena. RHMS RS issues warnings for the area of the Republika Srpska. The Aviation Weather Services in the both entities have the mandate to produce warnings to the civil aviation sector in respective entities. The night time services from Croatian Aviation Service for Sarajevo and from Serbian Aviation Service to Banja Luka are given to the pilots only.

The warnings produced by FHMI and RHMS RS are based on hydrological and meteorological observations and use of numerical weather prediction models. Currently the 112 center has on-line access to some of the hydrological and meteorological data, but the center does not have meteorological or hydrological experts in the team, so their capacity to produce warnings relies totally on services available from FHMI and RHMS RS. For instance flood, air quality or water quality warnings are not produced. Warnings for aviation sector are produced by state enterprises but not by FHMI or RHMS RS, which differs significantly from the system in use in most of the EU countries.

3.3.5.2. Warning dissemination mechanism

The warnings produced by FHMI or RHMS RS are available to the public through internet pages. Currently also SMS, phone, email, paper copy, fax are all available for dissemination of warnings.

FHMI disseminates warnings to public media and State Information Organizations by SMSs and Internet. RHMS RS produces regular bulletins 3 times a day and warnings up to 5 days in advance. In case of flood, bulletins are produced every 3 hours. The contents of the reports refer to the trend of water levels, length of dry period, the duration of rainfall and its amount. RHMS RS produces also special reports during extreme meteorological condition, such as floods, cold and warm wave, fires, thunderstorms and strong wind situations, sent to Civil protection Administration and on the OC 112.

Table 15: Warnings issued in BiH for natural and technical hazards, based on Annex 2

Hazard	Exists in the country	Warning issued at entity level			
		Given by	Type	Given by	Type
Heavy precipitation	Yes	FHMI	I	RHMI	I
Flash floods	Yes				
River flooding	Yes				
Hailstorm	Yes	FHMI	I	RHMI	I
Thunderstorm or lightning	Yes				
Heavy snow	Yes	FHMI	*		
Freezing rain	Yes				
Dense fog	Yes				
Tornado or cyclone	No				
Hard wind	Yes	FHMI	I	RHMI	I
Storm surge	Yes				
Coastal flooding	Yes				
Heatwave	Yes				
Cold wave	Yes				
Drought	Yes				
Marine hazard	Yes				
Sandstorm	No				
Landslide or mudslide	Yes				
Avalanche	Yes				
Airborne hazardous substance	Yes				
Waterborne hazards	Yes				
Hydrometeorological hazards for aviation	Yes	DAC	III	IABL	III
Forest or wildland fire	Yes				
Smoke, dust or haze	Yes				
Earthquakes	Yes				
Tsunamis	No				
Volcanic events	No				
Dispersion of insect pests	Yes				
Desert locust storm	No				
Hazard for allergic reactions	Yes				

* according to agreements with customers

Media produces their own warnings, and they may also use other information than that produced by FHMI or RHMS RS. FHMI has no direct visibility on TV or radio (no TV presenters or logo). RHMS RS has direct access to a TV station with its logo and presenters, as well as on the Radio of Republika Srpska. Currently they do not have the right to cut TV or radio programmes with urgent warnings. Alarm stripes during any programs are not used by the TV.

The European METEOALARM system is under preliminary preparation. The NHMSs have participated the training in Austria in June. However, internet must be considered as a passive warning dissemination system.

FHMI prepares analysis and calculates drought agroclimatic indices and provides weekly agrometeorological forecasts and warnings for the needs of farmers. This information is issued regularly and diffused through agrometeorological bulletins via Internet and radio stations to farmers, manufacturing companies and Ministries for Agriculture, Water Management, Forestry, scientific institutions and other users free of charge. Nevertheless, FHMI doesn't receive any feedback from the users. FHMI provides other information through bulletins, web pages, E-MAIL.
Concerning drought indices, the users are generally satisfied with time of delivery, format and comprehensibility, but drought is a slow-onset process and it is very difficult to predict the onset, duration frequencies and the end of drought periods. Drought indices are sometimes inadequate

for detecting the early onset and end of drought. FHMI often receives specific requirements, for example, determination of return periods or excedence probability of an extreme phenomenon.

RHMS RS analysis and warnings are available outside through internet and bulletins on media. The information is provided to some end users for free, but also at cost depending on the kind of institution. Universities, scientific institutions and individuals in the post graduated studies and PhD programs, government agencies and institutions, public services, get information and analysis for free. RHMS RS has some specific users for tailored information and products. Concerning feedback information, RHMS RS has cooperation agreements with some users ensuring a feedback concerning the quality of services and the verification of data and forecasts.

3.3.6. Climate change analysis

As climate change is expected to increase hydrometeorological extremes and hazards frequency and severity, it is critical to take into account the impacts of climate change also in hazards studies. It is necessary to produce representative projections of climate change for Bosnia and Herzegovina and downscale global model products to local scale and to study the potential impacts of climate change. Currently FHMI and RHMS RS do not have adequate capacity to produce these studies.

Bosnia and Herzegovina has joined the United Nations Framework on Climate Change in May 2010. It can be expected that also Bosnia and Herzegovina can significantly benefit from the new South East European Virtual Climate Change Center (SEEVCCC), which was established in 2008 within the Serbian National Hydrometeorological Service.

Table 16: Equipment in use for data communication and warnings and other products dissemination

Telecommunication Equipment	To receive data		To send data		To send warnings		To send products	
	FHMI	RHMS	FHMI	RHMS	FHMI	RHMS	FHMI	RHMS
Telephone	X	X	X	X				
Mobile Phone	X	X	X					
Telefax						X	X	X
Dedicated Leased Lines								
UHF radio transceiver		X		X				
High frequency/Single side band radio								
HF Radio Email								
Aeronautical Fixed Telecommunication Network								
Very Small Aperture Terminal								
Data Collection Platforms used to transmit data from AWSs								
Global Telecommunication system (WMO-GTS)	X	X						
Meteosat Second Generation Satellite system	X							
Other satellite systems	X							
Internet	X	X	X					
Email					X		X	
Post/mail	X	X						
Print media								
TV –national						X		X
TV-commercial						X		X
Radio						X		X
Bulletins					X	X	X	X
Printed text								

3.3.7. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. WMO GTS is the common tool to send and receive data, information and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings. Collection of data may be highly costly depending on the observation network. Use of the General packet radio service (GPRS) system has made data collection significantly cheaper. Both FHMI and RHMS RS use less modern communication systems as described in Table 16.

3.3.8. Customer relations and visibility

In order to promote development and sustainability of the NHMSs it is critical to have capacity to produce end-user oriented tailored products and have a good visibility among the public, industry and government. Currently the relations and cooperation between the both hydrometeorological services of Bosnia Herzegovina and industrial sectors are at very low level compared to advanced EUMETNET NHMS which also collect significant annual revenue from cooperation with industry. The visibility of both FHMI and RHMS RS is quite low at entity and state level.

The Services produce weather forecasts, but they have not regularly direct access to the public and industry through TV, Radio or newspapers, except RHMS RS, which has at one regular TV Station its regular prognosis and presenter and this prognosis is protected by their logo as well on the radio of Republic of Srpska. Media edits and produces their own forecasts, but the quality of their products is not verified scientifically. FHMI ends its forecasts to the Federal News Agency (FNA) which forwards the forecasts to the media while the RHMS RS gives its forecasts to the Serbian News Agency (SRNA) which then forwards the information to other media.

TV weather forecasts, which are very important for dissemination of information and warnings, are produced by the TV editors based on forecasts received through FNA, SRNA, and use of FHMI and RHMS RS and other internet pages. Currently the Services do not have technical capacity to produce e.g. SMS products which could be utilized (and paid) by public or different potential customer sectors.

FHMI main customers are the key economic sectors, including (i) the FBiH Ministry for Agriculture, Water management and Forestry for agriculture and forestry, (ii) the BiH Ministry of Security , FBiH Directorate for civil protection, FBiH Operations center 112, Cantonal Operations centers for Civil Protection, (iii) Transportation (iv) Energy (v) Recreation and tourism (vi) Environment /ecosystems and (vii) Health.

RHMS RS has some specific users of information and products:

- Republic of Srpska electric power industry: a project of delivery predicted values of temperature, precipitation and wind for 5 towns in the Republic of Srpska, which are used as inputs in the software that controls the use of capacity planning for production of electricity, depending on weather conditions and the assumed consumption;
- hydro power Trebišnjica: precipitation forecasts are issued to 144 hours in advance, which are used as inputs for planning the capacity at which power plants will operate, the discharge of the accumulations, and how it will manage the system in case of heavy rainfall and flood hazard;
- the Republic directorate for road maintenance for information about the prognosis of snowfall, ice, and snow cover height;
- Special bulletins to the Ministry of Internal Affairs, government and civil protection in the case that significant and extreme weather may cause disasters and adverse weather conditions which may endanger the normal functioning of the social community;
- information for many other users such as municipal service, plants that warm the urban environment, the organizers of various events when they need a good forecast of meteorological conditions during the course of events, or temperature, and whether there will be frost.

Concerning feedback information, RHMS RS has cooperation agreements with some users ensuring a feedback concerning the quality of services and the verification of data and forecasts. In relation to delivery of information, weather forecasts and the value of meteorological parameters, RHMS RS thinks to know exactly what the customer expects. The number of requests for information, warnings, forecasts of various types, RHMS RS receives now compared to few years ago, shows it has increased to dozens of times from the previous period and indicates the effectiveness and quality of work. This confirms that end-users use and are satisfied with the produced information. Nevertheless, it is important to note that there is a need of improved cooperation with decision makers, particularly in the case of extreme weather events. In this case, a better coordination of the preparatory phase of response is needed.

Currently the only possibility/method to get visibility is to produce the forecasts and other product on their own internet pages. However, at the moment the number of visitors of the internet pages is very low, especially when compared to countries where the visibility and appreciation of NHMSs is much higher.

3.3.9. Human resources

Currently the joint staffs of FHMI and RHMS RS is about 130, which is close to standard for a country of this size and population. However, most of the staff consists of observers at observation stations, while the number of experts with academic degrees (MSc) and qualified ICT experts is very low. This is just opposite to the situation in more developed hydro-meteorological services.

It must be noted that FHMI has currently no staff with academic training in meteorology or hydrology. The number of forecasters is extremely low (3) and only 2 of the weather forecasters have a BSc degree in physics and geography but, all of them are trained in forecasting on various international workshops and all of them are now studying for MSc in meteorology at Belgrade or Zagreb Universities.

Table 17: Distribution of the FHMI staff by branch and level of education

Branch	Field and education														TOTAL
	Techn-icians	Meteorologist			Hydrologist			Engineer			Physicist, Chemist, Economist			Other	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Observation network	45							1			1				47
Telecommunication								1			1				2
Data management								1			1				2
Weather forecasting											2			1	3
Hydrological forecasting															
NWP															
R & D															
Weather modification															
IT personnel	1								1						2
Commercial services															
Accounting	2														2
General administration															
Applied meteorology	2	3													5
Other															
TOTAL	**50**	**3**						**3**	**1**		**5**			**1**	**63**

RHMS RS currently has staff members with academic qualifications in the field of meteorology or hydrology. The number of forecasters is extremely low (4). However, 3 of the forecasters have MSc in meteorology and one is completing his doctorate studies. RHMS RS has three employees who have completed their degree at the Physics University of Belgrade, Department of Meteorology and one in Zagreb. In addition, there are only two communication experts at FHMI and one at RHMS RS. Furthermore, none of the forecasters or communication experts are working on a 24/7 basis.

The number of academic hydrometeorological and ICT/IT staff is both in FHMI and RHMS RS absolutely too low to have the capacity to work, and to produce services and products at same level than e.g. the Croatian and Serbian Hydrometeorological Services.

Table 18: Distribution of the RHMS RS staff by branch and level of education

Branch	Field and education														TOTAL
	Techn-icians	Meteorologist			Hydrologist			Engineer			Physicist, Chemist, Economist			Other	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Observation network	32							1			1			4	38
Telecommunication															
Data management	3					1					3				7
Weather forecasting	1					3									4
Hydrological forecasting															
NWP															
R & D															
Weather modification															
Seismology								2			2				4
IT personnel									1						1
Commercial services															
Accounting	1											1			2
General administration	1							1							2
Applied meteorology															
Other	3							6							9
TOTAL	**41**					**4**		**10**	**1**		**6**	**1**		**4**	**67**
Female in % of total															31
Men in % of total															69

Table 19: Share of FHMI and RHMS RS staff by sector and gender

FHMI	**Number of staff**	**% Women**	**% Men**
Meteorological	57	19.29%	80.71%
Hydrological	11	27.2%	72.7%
Environmental	6	83.3%	16.7%
Seismological			
Total	74	30%	70%
RHMS RS	**Number of staff**	**% Women**	**% Men**
Meteorological	41	24	76
Hydrological	3	0	100
Environmental	5	80	20
Seismological	5	60	40
Total	54		

3.3.10. Financial resources

In the Federation of Bosnia and Herzegovina entity the value of hydrological and meteorological services is not really recognised by the Federal Government, and there is very little political or ministerial support for the strengthening of the FHMI. RHMS RS, under the Repuiblika Sprska entity level Ministry of Agriculture, have better governmental understanding, and the staff is currently involved in many entity level projects. Still the financing is too low to implement any significant investments.

3.3.11. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums, to which membership provides better and more services than to non-members.

Table 20: International and regional cooperation activities of FHMI and RHMS RS

International and regional organization and cooperation mechanisms	FHMI status	RHMS RS status
WMO	member, PR	through FHMI
WMO RAVI	Member	Member
RMDCN	No	
IOC	No	
UNDP	cooperation	cooperation
UN_ISDR	cooperation	No
EUMETSAT	Access to data	Not yet
ECMWF	In process	In process
EUMETNET	In process	In process
METEOALARM	No	No
ECOMET	No	No
EUFP7 projects, networks	Use of a cluster data	No
EU JRC	No	No
EU PHARE	Not currently	No
EU CARDS	No	No
EUCLID	No	No
EUR-OPA	no	no
DMCSEE	Member	no
SEEVCCC	No	Some cooperation
SAVA Commission	Member	Member
SEE-GRID-SCI	Yes	yes
NWP consortium	No	No
NMHS bilateral	SEE NHMSs, Slovenia, Turkey, FYR Macedonia	Montenegro, Serbia FYR Macedonia
NHMS MoU	Turkey, Iran, Slovenia,	

EU based hydrometeorological organizations provide most state-of-the-art models, software and tools to be utilized by the member NHMSs. The integration into the European hydrometeorological infrastructure was given the highest priority in the 2007 project in developing the capacities of the NHMSs to adopt best European practices and to improve quality of products and services in support of national economic development and DRR. European Union research and networking programs create consortiums of excellence, and provides good opportunities to NMHS to network with NMHSs and commercial R&D companies and strengthen their capacities.

Currently the participation of Bosnia and Herzegovina in EU level cooperation has been very low. However regional and has improved during the latest years. The cooperation with EUMETSAT is improving and obviously in 2011 both institutes will have proper access to satellite data. Both NHMSs are negotiating with ECMWF and EUMETNET for closer cooperation and finally of memberships.

In BiH, most of water flows are transboundary. Given the international character of many rivers, it is well recognized that the water and risk management in these basins can take place only through international cooperation, with clearly defined objectives, criteria and restrictions. Bosnia and Herzegovina has ratified the Framework Agreement on the Sava River Basin, in 2002, with Croatia, Serbia and Montenegro and Slovenia. In 2004 Bosnia and Herzegovina signed the Danube Convention on the sustainable use of Danube River.

RHMS RS together with FHMI are the National Reference Centre for Water in the European Network Activities in EIONET structure, in the air quality sector and in the Danube Commission. Reports for European Environmental Agency (EEA) are prepared through cooperation with different institutions: Public Enterprises for ”Vodna područja slivova Jadranskog mora”, and «Vodno područje slivova rijeke Save», Directorate for Water RS, Institute for Water Bijeljina, UIBG Ltd. Bihac, etc.

FHMI has cooperation agreements or collaborations with national meteorological services of Slovenia, Croatia, Serbia, Montenegro, Macedonia and Turkey. FHMI is partner of the DMC-SEE project. FHMI has cooperation with the following international organizations: WMO, UNDP, GCOS, International Sava Commission, UNHCR, SEE GRID SCI consortium. It is also included in the DMCSEE programme and delegates member in DMCSEE steering committee, although it is not partner in the DMCSEE project in the frame of EU’s transnational cooperation programme.

RHMS RS has agreements on cooperation with the NHMSs of Macedonia, Montenegro and Serbia. RHMS RS has regional cooperation with the International Sava Commission, SEE-GRID-SCI consortium, DMC-SEE, SEE VCCC Belgrade. It has also cooperation with UNFCCC, UNDP and REC.

Up to now, the HMSs of Bosnia and Herzegovina have not fully utilized the regional opportunities of cooperation and the services produced by regional centers of excellence.

BiH participates in ”The Project for Support of Establishing the Joint Emergency Response Units in case of floods in region of SEE”, that has been launched through DPPI SEE. The aim of this project is to institute a disaster preparedness and prevention regional mechanism for regular information exchange with regards of water and floods situation. Participating countries, with support from the Donors and RCC, will establish and train Emergency Response Units in case of floods in the region of SEE. The Joint Emergency Response Units should be able to cross state borders quickly in order to help the efforts in the flood-affected areas in the neighboring countries.

Protection and Rescue Department initiated the partnership of Bosnia and Herzegovina and its Hydrometeorological Services with the Joint Research Centre of the EC through the Early Flood Alert System.

3.4. Technical recommendations to strengthen NMHSs capacities in support of DRR

The technical, human and financial capacities of the NHMSs are not adequate to produce sufficient services and support DRR and could be improved per the following recommendations:

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. There are needs by international organizations to accept and recognize that currently there are two NHMSs with equal status in Bosnia and Herzegovina;
2. There is urgent need to prescribe a new law for hydro-meteorological services in Bosnia and Herzegovina, taking into account international commitments, national and entity level needs from public and different economic sectors, regional cooperation and the role of hydrometeorological services in national and regional DRR;
3. There is an urgent need to clarify the mandates and communication routes for alerts, advisories, warnings and alarms from state level to different levels all the way down to the grass root level (individual people) using state-of-the-art communication systems;

Operational relationships with other agencies

4. It is critical to establish better cooperation between the entity Institutes, FHMI and RHMS RS, so that entity prognostic services within the methodology of their work incorporate making joint analysis, forecasts and warnings for the level of Bosnia and Herzegovina, and if possible to establish one 24/7 state level hydro-meteorological and seismological science based multi-hazard analysing and warning centre;
5. There are urgent needs to improve cooperation and data exchange;
6. There are needs to establish Standard Operating procedures (SOP) and Quality Management Systems (QMS) between the hydrometeorological services and the DRM sector.

Monitoring and observations networks and data exchange

7. There is an urgent need to upgrade and further modernize the meteorological and hydrological networks in Bosnia and Herzegovina and to gradually develop the network of automatic observations stations;
8. There is an urgent need to upgrade the calibration and maintenance system of the meteorological and hydrological equipment and to achieve the WMO standards for measurements;
9. There is a need to further strengthen the observation network by developing remote sensing systems, including one upper-station, one or two weather radars and a lightning detection system;
10. There are needs to improve the data transfer systems;
11. There is an urgent need to develop real-time communication system for observations and data.

Forecasting

12. There is a need to Improve the capacities to produce and use Numerical Weather Prediction (NWP) products;
13. There is a need to promote memberships in ECMWF and EUMETSAT;
14. There are needs to join some of the European NWP consortium would benefit the NWP modelling;
15. There is a need to develop and integrate additional modelling for hydrology, air quality, and sea-wave and to link these models to NWP;
16. There is a need to improve capacities to use automatic analysing, editing and dissemination tools;
17. There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks.

Hydrometeorological data management systems

18. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data;
19. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data;
20. There is an urgent need to establish a national database system;
21. There is an urgent need to establish a combined state level hydrometeorological database including the data collected by the Water Agencies.

Hazard analysis and mapping to support risk assessment

22. There is an urgent need to implement modern user friendly software for climatological and hazard analyses;
23. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment;

24. There is a need for GIS training, software and layers for hazard mapping. GIS compatible with the system that water agencies already have is needed (GIS components including layers, GIS software and hardware);
25. There is the need of developing numerical hydrological modelling and training;
26. There is the need to develop hazard databases including impacts and hazard extent.

Information technology and telecommunication issues

27. There is urgent need to promote the capacity of FHMI and RHMS RS to build their information and communication systems to an international level;
28. There are needs to take in use modern tools to automate production of services;
29. There are needs to improve the web pages.

Warning products and services

30. There are urgent needs to establish threshold values and criterion for different types of alerts and warnings;
31. There is an urgent need to establish a 24/7 science based analysing, forecasting and warning system;
32. There in urgent need to strengthen the capacity of the hydrometeorological services to produce flood warnings, to operate hydrological models and to connect hydrological models to numerical weather models;
33. There is an urgent need to engage meteorological and hydrological as well as seismological experts within the 112 center;
34. It is necessary to clarify the mandates and communication routes for alerts, advisories, warnings and alarms from state level to different levels all the way down to the grass root level (individual people) using state-of-the-art communication systems;
35. There are needs to promote provision of direct active warning mechanism from Hydrometeorological Services to the TV and radio, in order to promote dissemination of warnings to the public, and to establish state-of-the-art dissemination mechanisms for real-time hydrological and meteorological observations and warnings to the authorities and the 112 center;
36. There are needs to improve the exchange with end users in terms of information and support fostering the appropriate use of information, receiving feedbacks and suggestions for improving the delivered services;
37. There are needs to have international certification for operation of the institutes and production of services.

Climate change analysis

38. There is a need to develop a climate data management system;
39. There is a need to develop the technical capacities for climate change projections downscaling to local scales;
40. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors;
41. There is a need to strengthen the national capacity to produce local-scale projections of climate change in order to promote mainstreaming of adequate analysed impacts of climate change into DRR policy and strategy.

Human Resources

42. There is an urgent need to enhance technical and human resources and capacity of the hydrometeorological and seismological sector to real-time operational monitoring, warning and forecasting and mapping of meteorological, hydrological and seismological hazards;

43. There is an urgent need to increase the number of data management, computing and IT experts in both hydrometeorological institutes;
44. There are needs to increase the number of staff with academic MSc and PhD degrees;
45. There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects;
46. There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EUMETNET NHMSs.

Regional cooperation

47. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
48. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;
49. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres (e.g. ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
50. A regional harmonization of watch and warning systems should be promoted;
51. Cross-border exchanges of real-time data, forecasts and warnings should be increased.

3.5. Recommendations from the Bosnia and Herzegovina National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Sarajevo, on 21-22 June 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: To establish and adopt bylaws that support legislature pertaining to DRR. The mainstreaming of DRR into legislature, such as laws pertaining to spatial planning and forestry, in order to give greater legal authority to the process of building an effective DRR system and structure in Bosnia and Herzegovina, and ensure that the roles and responsibilities and mandates of the various technical agencies, such as the Hydro-met and seismological services, are properly reflected in the legal framework.

Recommendation 2: To formulate the National Platform for Disaster Risk Reduction. A goal for the Government is the establishment of a National Platform which should design responsibilities at the national through to the local level and facilitate and coordination across sectors by maintaining a broad based dialogue at the national and regional level aimed at promoting awareness among the relevant sectors, and ultimately linking such coordination to national planning, budgeting and implementation of DRR activities.

Recommendation 3: To clarify the roles and responsibilities increased cooperation and improved communication between all relevant segments. Promote and support dialogue, the exchange of information and coordination among relevant agencies and institutions at all levels with the aim of fostering a unified approach towards disaster risk reduction. Also promote community participation in disaster risk reduction through the adoption of specific policies, the promotion of networking, the strategic management of volunteer resources, the attribution of roles and responsibilities and the delegation and provision of the necessary authority and resources.

Recommendation 4: Efficient financial planning to ensure that DRR has its own budget allocation. Allocate resources for the development and implementation of disaster risk management policies, programmes, laws and regulations on Disaster Risk Reduction in all relevant sectors and authorities and at all administrative levels with budgets based on clearly prioritised actions.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning

Recommendation 5: To enhance the technical and human resources of the hydrometeorological sector to support risk assessment and early warning systems by promote operational monitoring, warning, forecasting and mapping of meteorological and hydrological hazards. It is critical to urgently renew the legislation for Meteorological and Hydrological Services, upgrade and modernise the national hydro-meteorological observation network, data management and forecasting system and to provide sustainable organisational, human and technical resources to maintain and operate it. It is also necessary to strengthen the early warning capacity with a multi-hazard approach and cooperation with civil protection authorities and other stakeholders in line ministries.

Recommendation 6: To enhance institutional capacity through multi-agency and multi-stakeholders (including both technical agencies such as Hydrometeorological services and civil protections and line Ministries) approach to carry out risk assessment too support policy and planning decision-making.

Recommendation 7: To mainstream adaptation to climate change into DRR strategy. The frequency and magnitude of hydrological and meteorological extremes and hazards are predicted due to climate change. It is critical to invest in local scale climate studies in order to promote adaptation to climate change.

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 8: To improve education of DRR. Promote engagement of the National Platform members, local communities and authorities such as police and fire brigade within the education programs in coordination with the Ministry of Education and local parent-teacher associations to develop sustainable public education programs at primary, secondary and tertiary levels so as to raise awareness and educate children about hazards.

HFA priority 4: Reduce the underlying risk factors

Recommendation 9: Reducing disaster risks by systematically integrating them into policies, plans and programmes for sustainable development and poverty reduction. Supported through bilateral, regional and international cooperation, including partnerships, sustainable development, poverty reduction, good governance and disaster risk reduction as mutually supportive objectives, and in order to meet the challenges ahead, accelerated efforts must be made to mainstream and integrate disaster risk reduction into development and governmental and sectoral strategies. Furthermore, efforts must be made to build the necessary capacities at all levels of institutional organization in Bosnia and Herzegovina to manage and reduce risk. In the context of the increasing risks associated with climate change, there needs to be enhanced investments in climate modelling and forecasting and analysis to support sectoral planning in at-risk sectors.

Recommendation 10: In the context of reducing overall risks, and with consideration for increasing climate associated risks, development of national capacities for climate services to support medium and long-term sectoral planing, is a critical aspect of risk reduction. Development of these capacities would require a strong collaboration and coordination across many ministeries and with the Meteorological and Hydrological Service, as well as enhanced regional cooperation in this area with other South Eastern European and EU countries.

Recommendation 11: Networking with international organisations/institutions present in the region. There is a need to enhance regional and international cooperation for the purpose of transferring observation data, knowledge, technology and expertise regarding DRR, to share research findings, lessons learnt and best practice, participation in joint trainings and workshops all of which would contribute to enhancing the ability of governments to strengthen DRR mechanisms, raise overall awareness and improve capacity development measures.

Recommendation 12: Examine the ways for establishment of regional funds for support to ongoing projects

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 13: Strengthen disaster preparedness for effective emergency response at all levels. First, ensure that emergency response plans are targeted to the individual needs of the vulnerable communities, authorities and emergency responders. Second, establish guidelines for systematic development of contingency plans at all levels that are backed by the requisite human, material and funding resources. Lastly, harmonise standard operating procedures governing response to emergencies and standardize terminology and capacity development taking into account roles and responsibilities in emergency response.

Recommendation 14: To strengthen awareness about the importance of DRR. Promote the engagement of the media in order to stimulate a culture of preparedness and strong community involvement through sustained public education campaigns and public consultations at all levels of society.

Recommendation 15: Increase the involvement of the private sector in activities aimed at capacity development with special emphasis placed on insurance companies for the purpose of developing sectoral involvement in DRR. There is a need to promote the establishment of public private partnerships to better engage the private sector in Disaster Risk Reduction activities. This can be done by encouraging the private sector to place greater emphasis on and allocate more resources to pre-disaster activities, such as risk assessments and early warning systems and through the promotion of the development of financial risk-sharing mechanisms, particularly insurance and reinsurance against disasters.

Recommendation 16: Increase the involvement of the NGO sector in activities related to DRR. Promote programmes for technical cooperation, capacity development, the development of methodologies and standards for hazard and vulnerability monitoring and assessment, the sharing of information and effective mobilisation of resources with a view to supporting national and regional efforts aimed at developing and strengthening DRR.

4. CHAPTER FOUR: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN CROATIA

The Government of the Republic of Croatia adopted the Natural and Man-made Catastrophes and Major Disasters Vulnerability Assessment on May 9, 2009. Key natural hazards affecting Croatia, as stated in the Assessment, are: flooding (river flooding and flash floods), earthquakes and forest fires. The other natural hazards affecting Croatia are: heavy rains, drought, heavy snow, icing on the roads, hailstorm, strong winds and heat waves. The biggest economic losses during the latest decades have been caused by drought, storm and hail and earthquakes. A number of hazards pose risks across the borders in the South East Europe (SEE) region, especially floods, forest fires and dispersion of airborne pollutants.

This chapter presents all the findings related to the assessment of the DRR institutional framework and the technical capacities of the NMHS of Croatia (Drzavni Hidrometeoroloski Zavod, hereafter referred to as DHMZ) to support Disaster Risk Reduction. It highlights that:

- The DHMZ is at high technical and scientific level compared to most of the NHMSs in SEE countries, but suffers from inadequate weather radar network, limited number of on-line automatic stations with present weather sensors, automatic cloud height sensors and rain gauges, insufficient number of forecasters and scientists and adequate premises compared to advanced NMHSs in EU countries;
- The technical and human resources of DHMZ need to be enhanced in operational monitoring, warning, forecasting and mapping of hydrometeorological hazards;
- It is necessary to enhance investments in climate modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors and investment plans of industry in order to promote economic development of the country;
- Development of Risk Assessment, EWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

4.1. Croatia's vulnerability to hydrometeorological hazards

4.1.1. General overview of country's economic sectors

Croatia is located across central and south-eastern Europe. It stands at the cross roads of the Adriatic Sea, the Balkans and Pannonian Plain. Croatia is bordered by Hungary, Slovenia, Bosnia and Herzegovina, Serbia and Montenegro. The International Monetary Fund (IMF) classifies Croatia as an emerging and developing economy. The World Bank classifies the country as a high income economy.

Croatia's total land area is 56,594 square kilometers and the country has a population of 4,489,409. Croatian economy, after struggling under the 1991 broke outs, stood on its legs once the tourism revived. According to per the IMF data, the nominal GDP in 2009 was $78.98 billion, which meant that the per capita GDP was $17,600. In comparison, Croatia ranked 70th in the world.

In 2009, economic output was dominated by the service sector which accounted for 73,6% percent of GDP, followed by the industrial sector with 20,5% and agriculture accounting for 5,9% of GDP. According to 2004 data, 2.7% of the workforce were employed in agriculture, 32.8% by industry and 64.5% in services. The industrial sector is dominated by shipbuilding, food processing, pharmaceuticals, information technology, biochemical and timber industry. Tourism is a notable source of income during the summers, with over 11 million foreign tourists in 2008 generating revenue of € 8 billion.

4.1.2. Hydrometeorological hazards in Croatia

As per the OFDA/CRED International Disaster Database, there is a high frequency of occurrence of flood and drought in the country for the period 1989 – 2006 (Figure 8), although drought has not been pointed out as one of the key hazards in the National Vulnerability Assessment.

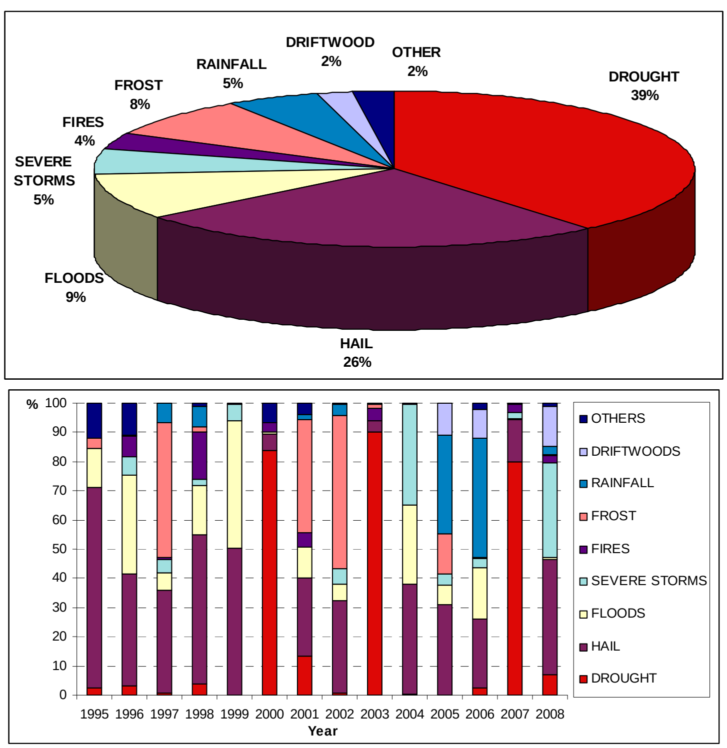


Figure 8. Economic losses due to natural hazards in Croatia - 1995–2008, total and per year.

The Government of the Republic of Croatia adopted the Natural and Man-made Catastrophes and Major Disasters Vulnerability Assessment on May 9, 2009. Key natural hazards affecting Croatia, as stated in the Assessment, are: flooding - river flooding and flash floods, earthquakes and forest fires. The other natural hazards affecting Croatia are: heavy rains, drought, heavy snow, icing on the roads, hailstorm, strong winds and heat waves. The biggest economic losses during the latest decades have been caused by drought, storm & hail and earthquakes as shown in Figure 9.

Long dry seasons without rain leads to severe drought, which accompanied by high temperatures devastates crops and increase the risk for wildfires. Croatia suffers highest damages due to drought mainly in the Mediterranean region and East Croatia.

River flooding occurs frequently. Croatia is located within the Danube basin and is under the influence of the Danube and Sava rivers and their tributaries; about 50% of the territory located below 200 m above sea level, or 15% of the country's total land area, and approximately 90,000 people are prone to floods. The total area prone to flash floods amounts to approx. 680 km^2, 62% of which is located in the Drava and Danube watershed, around 20% is located within the Dalmatian watersheds, 13% is located in the area of maritime-Istria watersheds, and 5% is located in the Sava watershed. According to the Assessment, there are in total 85 endangered cities, municipalities and settlements with approximately 160,000 inhabitants.

Forest fires occur mainly during dry periods throughout Croatia and especially during summer in the coastal areas when fire-fighting interventions require the engagement of substantial material, technical and personnel resources. At the same time, the evacuation of large numbers of tourists might be needed. The intensity of the potential fire risk depends on the wind speed, the forest density and the location of human settlements. The risk level is smaller in the north and increases toward the south. Also the neighbouring countries are prone to forest fires, which may broaden out over the boundaries and/or affect the neighbouring countries by impacts of smoke.

Heavy precipitation, heavy snow, slippery roads and high winds often cause hazards to transportation and human safety.

A number of studies suggest that weather-related disasters appear to be growing more frequent due to climate change. At the same time communities become more vulnerable to natural hazards.

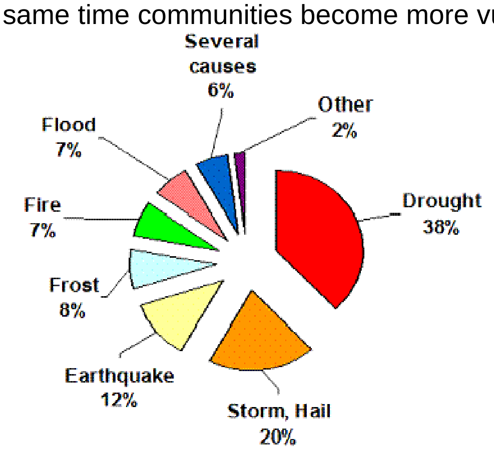


Figure 9. Economic losses caused by different natural hazards in Croatia, 1980-2002 (%)

4.1.3. Sectoral analysis of the vulnerability to hydrometeorological hazards

Water is a critical natural resource. It is used for drinking water, agriculture, wetlands services, and the production of hydroelectric energy, among others. Croatian fresh-water resources are abundant - indeed they are among the richest in Europe. Therefore, water resources are not considered a limiting factor for development in Croatia. However, while there is no shortage of water per se for use in Croatia, problems do exist. First, a large amount of pumped water is wasted, which leads to lost revenue of up to EUR 286 million (0.9% of GDP) per year and increased GHG emissions resulting from the additional use of electricity for pumping. Second, farmers often face water shortages at certain critical times of the year's growing season and, in general, the soil lacks moisture. Croatia uses a small fraction of the water resources available (about 1%). However, climate change may stress some of the systems that depend upon freshwater.

The Croatian energy sector is potentially vulnerable if climate change results in more frequently reduced river flows – which is likely given by the predictions of climate models simulating a drier Croatia. In the period 2000 – 2007, 50% of Croatian electricity production came from hydropower. During drought seasons in 2003 and 2007, significant losses in production resulted in increased costs for electricity production. A likely scenario for the future is a direct loss between EUR 16 - 82 million annually, with multiplier effects throughout the economy.

The impact from extreme weather on agriculture is expected to be significant because of the vulnerability of agriculture to climate conditions in general. Precipitation, temperature, weather extremes and flood and droughts do have separate and joined impact on the agricultural production. Agriculture is important to the economy of Croatia due to its overall value and its impact on food security, vulnerable populations, and the employment it generates. In 2001, 92% of Croatia was classified as rural and 48% of the Croatian population lived in rural areas. Generally, rural households are more vulnerable due to poorer access to basic infrastructure and poorer housing conditions than households in urban areas. Existing climate variability already has a significant impact on agriculture. Extreme weather events have resulted in average losses of EUR 176 million per year during 2000-2007. This represents 0.6% of national GDP, or 9.3% of the national Gross Value Added (GVA) generated by the agricultural, forestry and fisheries sector. Looking at the future effect on maize alone, the lost revenue due to climate change is estimated at about EUR 6-16 million in 2050 and EUR 31 - 43 million in 2100. This corresponds to 0.8-5.7% of all revenue from arable crop sales in Croatia in 2005. Most of this damage is due to water shortage during critical phases, as well as flooding and hailstorms, which also cause damage. Critical years, such as 2003 and 2007, showed huge economic damage that is difficult to recover. While some Government-supported insurance programmes and a new irrigation programme exist, current vulnerability to climate variability remains – particularly related to drought and also to flooding recently.

Tourism has long time been important in Croatia. In 2007 only, tourists stayed for a total of 56 million overnights and spent EUR 6.7 billion. Tourism generates about 20% of GDP and 28.7% of total employment (336,000 jobs). Thus, the tourism industry contributes significantly to human development in Croatia through the jobs and created salaries. By 2018, one-third of total employment is expected to occur in the tourism sector. In addition to those directly working in the tourist industry, there are many people employed in related industries that are directly impacted. Tens of thousands of families rely on tourism income in the gray economy and they supplement their incomes through tourism (unregistered apartment rentals, unregistered sales of agricultural, aquaculture or fishery products, etc.). The value of unregistered accommodation alone is equal to almost 1% of the entire country's GDP. Most projections of tourism in the EU show that by the end of the century, because of climate change, hotter daytime temperatures along the Adriatic coast will cause many beach tourists to avoid these destinations in the summer months in favor of cooler locations at the north. Conversely, the conditions for tourism along the coastline has indicated as improved in the spring and, to a lesser extent, in the autumn. Overlooking these facts could have serious adverse consequences on many local communities and, given important role of beach tourism, to the national economy. Hotter, drier summers with more extreme weather events such as floods and droughts and a rising sea level, may put human and economic development gains at risk.

4.2. Institutional Framework of Disaster Risk Reduction in Croatia

4.2.1. Legal framework and policy supporting DRR in Croatia

In Croatia the key legal document regulating disaster management is the Protection and Rescue Law, (adopted in 2004 and amended in 2007 and 2009). Other relevant laws regulating issues related to disaster risk reduction and the hydrometeorological sector include:

- Law on the Performance of the Hydro-meteorological Service in the Socialistic Republic of Croatia (Official Gazette No. 14, 1978) defines the responsibilities of DHMZ;
- Law on Physical Planning (Zoning) (OG No. 30/94, 68/98, 35/99, 32/02);
- Law on Water (OG No. 48/95);
- By–Law on Environmental Information System (OG No. 74/99, 79/99);
- Law on the Air Traffic 1998 (e.g., Article 166: Regulations issued by the Minister is based on the opinion of the DHMZ Director);
- Law on the Hail Suppression System (OG No. 53/01).

Other Environmental and Nature Protection Regulations are:

- Environmental Protection Act (OG No. 110/07);
- Regulation on Environmental Impact Assessment (OG No. 64/08);
- Environmental Protection Emergency Plan (OG No. 82/99, 86/99, 12/01, 14/01);
- Ordinance on Environmental Emission Inventory (OG No. 36/96).

Other Water Protection Regulations are:

- By-law on Hazardous Substances in Water (OG No. 78/98);
- The Ordinance on Issuance of Water Management Documents (OG No. 28/96);
- Regulation on Limit Values of Indices, Hazardous and Other Substances in Waste Water (OG No. 40/99, 6/01).

Besides these laws, there is however no specific disaster risk reduction related policy or strategy. DRR is not a defined priority in any framework and strategy and neither does it feature as a driver in achieving the MDGs.

The Strategy of Government Programmes for 2010-2012 has been adopted on September 10, 2009. This strategy directs the work of ministries or state administration bodies and partially addresses disaster management as part of the General Objective 10, “Police and armed forces in the citizens’ service. In addition, within the Specific Objective 12.1. “Environmental protection and effective environmental management” the DHMZ has been tasked to improve the quality and the amount of meteorological (climate related) and hydrological information, and raise awareness and involve the public. Previously, role and mandate of DHMZ was regulated by the Law on the Performance of the Hydro-meteorological Service in the Socialistic Republic of Croatia (OG No. 14/78). Spatial Planning, and Water Management have been addressed as a part of the regional development of the Republic of Croatia but DRR has not yet been tackled.

As per Protection and Rescue Law, the National Protection and Rescue Directorate (NPRD) is developing/updating the National Disaster Preparedness Plan for the Republic of Croatia, based on the National Vulnerability Assessment and Ordinance on the Methodology for the Development of the Risk Assessments and the Rescue and Protection Plans. According to the same Law, other ministries should develop risk assessment related to their area of responsibility, while county and local self-governments are responsible for the development of draft protection and rescue plans (i.e. disaster preparedness plans) for their respective administrative unit.

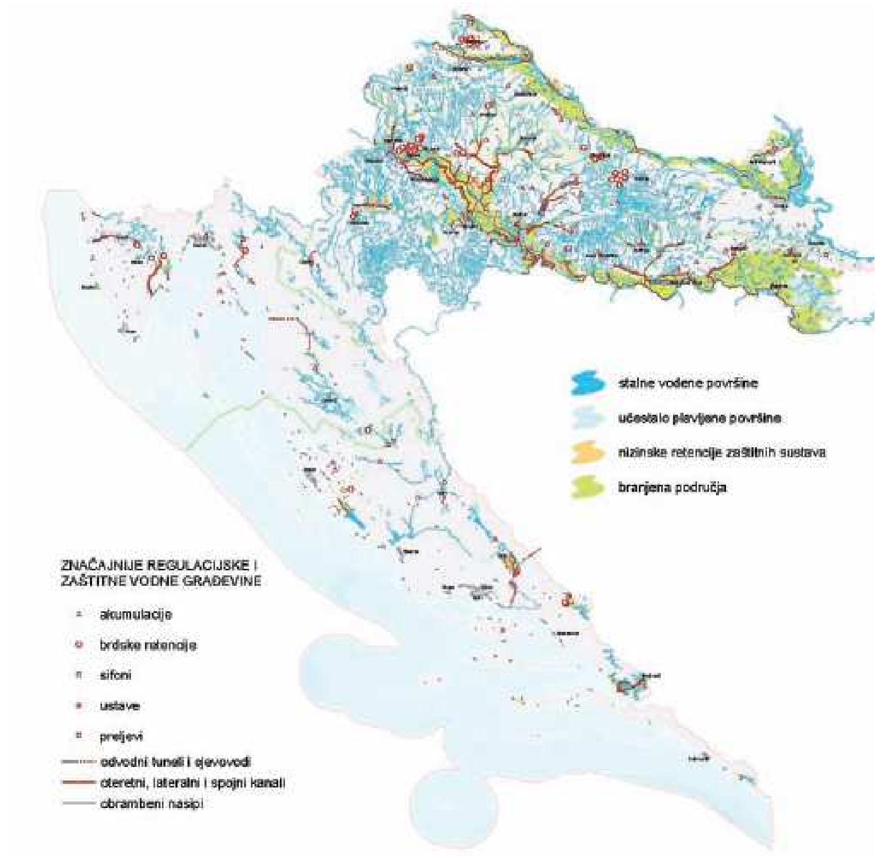


Figure 10. Flooding zones in Croatia - Water Management Strategy

National Flood Protection Plan ("Narodne novine" broj 84/10) defines the criteria needed to commence with regular and/or extraordinary flood and ice protection, the sections and constructions which are to be protected against flooding and ice, the measures needed to be undertaken before, during and after flood protection, the measures to be undertaken for ice protection, the legal and private entities responsible to undertake flooding protection measures, the communication system, the data collection and information sharing.

Water Management Strategy, adopted by the Croatian Parliament on July 15, 2008, is a long term planning document that defines the vision, mission, objectives and tasks of the national water management policy. The strategy implementation measures incorporate administrative measures including, inter alia, the development, adoption and regular updating of the National Flood Prevention Plan, the development of the National Flood Risk Assessment Maps and their presentation to the public (with an aim to introduce flood financial insurance), the introduction of relevant indicators and systematic monitoring of the flood and erosion protection measures and the introduction of flood insurance policy.

The Republic of Croatia signed the UN Convention to combat desertification in countries experiencing serious drought and/or desertification. The Croatian Government established the National Committee to Combat Desertification. The basic task of the Committee is the monitoring and participation in the preparation and implementation of a National Action Programme (NAP). In 2003 the Committee started to work on the preparation of a project under the title “National Action Programme to Mitigate the Effects of Drought and Combat Land Degradation” which was adopted in 2007. In 2004 National Project of Irrigation and Land and Water Management in the Republic of Croatia (NAPNAV) was launched. Its aim was to organize irrigation and concentration of agricultural land and introduce income crops, in order to ensure the conditions for the application of new technologies. This should result in better utilization of natural resources for more efficient agricultural production, and finally bring about the development of rural areas.

At the sub-regional level, the Sava River Commission prepared in 2009 the Sava River Action Plan, designed in full coherence with the European Flood Directive (EFD) and flood action plans for sub-basins. The Action Plan requires Member States to first carry out a preliminary flood risk assessment to identify areas at risk of flooding. For such areas Member States would need to draw up flood risk maps and establish flood risk management plans focused on prevention, protection and preparedness.

At the European level, the following regulations of the European Union have been signed by Croatia:

- European Flood Directive of 18 September 2007 on the assessment and management of flood risks;
- Council Directive 90/313/EEC of 7 June 1990 on the freedom of access to information on the environment;
- Commission Decision 2008/721/EC of 5 August 2008 setting up an advisory structure of Scientific Committees and experts in the field of consumer safety, public health and the environment and repealing Decision 2004/210/EC;
- Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

And at the International levels, the following treaties have been signed by the Republic of Croatia:

- Law on Ratification of the United Nations Framework Convention on Climate Change (Rio de Janeiro 1992);
- Kyoto Protocol to the Convention on Climate Change (Kyoto 1999);
- Convention on Long-range Transboundary Air Pollution (Geneva 1979);
- Protocol to the Convention on Long-range Transboundary Air Pollution on Long Term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (Geneva, 1984);
- Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Further Reduction of Sulfur Emissions (Oslo 1994);
- Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants (Aarhus 1998);
- Stockholm Convention on Persistent Organic Pollutants (Stockholm 2001);
- Law on Ratification of the United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa – Convention to Combat Desertification (Paris 1994);
- Cooperation Agreement with WMO, International Civil Aviation Organization (ICAO), and EUMETSAT;
- Cooperation Agreement with ECMWF, EUMETNET, and Economic Interest Grouping of the National Meteorological Services of the European Economic Area (ECOMET).

At the moment, the existing legal framework does not properly recognize DRR in Croatia. Disaster risk reduction and disaster prevention and mitigation are not addressed nor recognized as topics by the Protection and Response Law. The Law equals them with the activities aimed to eliminate the consequences of disasters. Within that framework, the national protection and rescue system, and its key actor NPRD, has been more oriented toward preparedness for rescue and emergency response rather then to disaster prevention.

4.2.2. Institutional framework

4.2.2.1. <u>List of agencies involved in DRR</u>

The Government of the Republic of Croatia is responsible for the management and efficient functioning of the protection and rescue system in disasters. At the same time, the responsibilities related to DRR, disaster prevention and mitigation are widely distributed among various institutions within the state administration. The organization and structures established at national level are, in general terms speaking, mirrored at the other administrative levels. There is no DRR leading agency, although National Protection and Rescue Directorate (NPRD) is contributing to the overall DRR coordination. DRR is highly diversified, both at the legislative and organizational/institutional level, with several Ministries and Governmental entities being responsible for different aspects of disaster prevention and mitigation, while NPRD has been focused primarily on preparedness for response and response. The agencies engaged in DRR for hydrometeorological hazards are:

- The National Protection and Rescue Directorate (NPRD);
- The Croatian Meteorological and Hydrological Service (DHMZ);
- The Croatian Waters (CW).

4.2.2.2. National Protection and Rescue Directorate

The National Protection and Rescue Directorate (NPRD) is an independent, professional and administrative organization in the Republic of Croatia, which prepares, plans and manages the operational forces and coordinates actions of all the protection and rescue system. The basic NPRD tasks are stipulated by the Law on Protection and Rescue. The most important tasks are risk and vulnerability assessment (not for floods nor drought), drafting measures aimed at preventing crises and accidents, ensuring that these measures are implemented, and effective emergency management in case of major disasters.

The 112 center of NPRD is the established mechanism for continuous collection and sharing of general risk information. The Service 112 reports on all risks and hazards, and if needed, alerts citizens, legal entities, administration bodies, rescue services, respective civil protection forces and relevant NPRD management. The Service also keeps records on hazards, accidents and disasters, and maintains the public alarm system in the Republic of Croatia and coordinates decisions and orders sharing.

Concerning DRR, the NPRD has the following essential functions:

- to estimate the risk of disasters and major accidents to the area, the cause or subject, and to hold vulnerability assessments and develop plans for protection and rescue of local (regional) governments;
- to prepare statutory guidance for risk management to all protection and rescue stakeholders;
- to monitor and analyse the situation in the field of protection and rescue, and to propose to Croatian Government measures to improve the situation and directing the development of protection and rescue system;
- to collect, analyze and direct the data on hazards and consequences of disasters and major accidents in a single information system;
- to lead a unified information database of operational forces, means and measures taken in the protection and rescue;
- to propose to the Croatian Government assessment of threats and plan for protection and rescue of Croatian;
- to perform the preparation, construction and maintenance of public warning systems,
- to perform regular duties of 112;
- to develop and update the bylaws and standard operating procedures;
- to propose types and amounts of state commodity reserves necessary for the protection and rescue;
- to collaborate with industry and scientific institutions in developing technology and equipment for protection and rescue;
- to cooperate with the competent authorities of other countries and international organizations to protect and rescue.

NPRD is divided into organizational entities (Figure 11). The central national administration consists of the Directors Cabinet, International Cooperation Department and the Internal Affairs

Department as well as five sectors: (i) Civil Protection Sector (ii) Fire Fighting Sector (iii) Sector for 112 System (iv) Fire Fighting and Protection and Rescue School and (v) Personnel, Legal and Finance Sector. The functionality of the Directorate is ensured through its territorial organization i.e. each County has a County Protection and Rescue Office consisting of Prevention, Planning and Supervision Department and the County 112 center. In County Offices of the four biggest cities Zagreb, Rijeka, Osijek and Split there are Protection and Rescue Departments, while in the County Offices on the coast (Zadar, Šibenik, Split and Dubrovnik) there are also State Intervention Units (Figure 12).

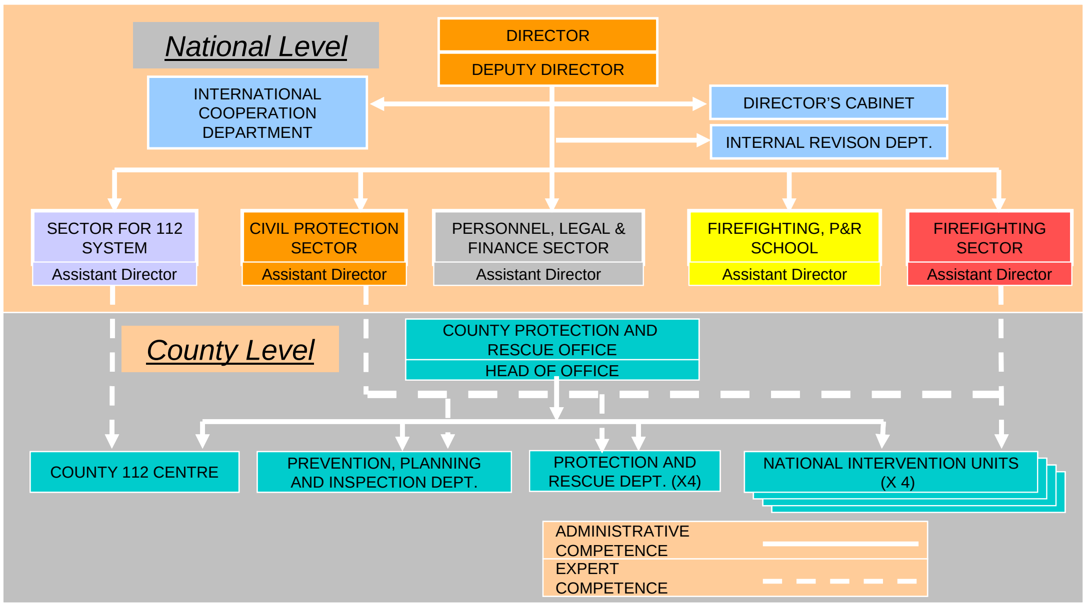


Figure 11. NPRD structure

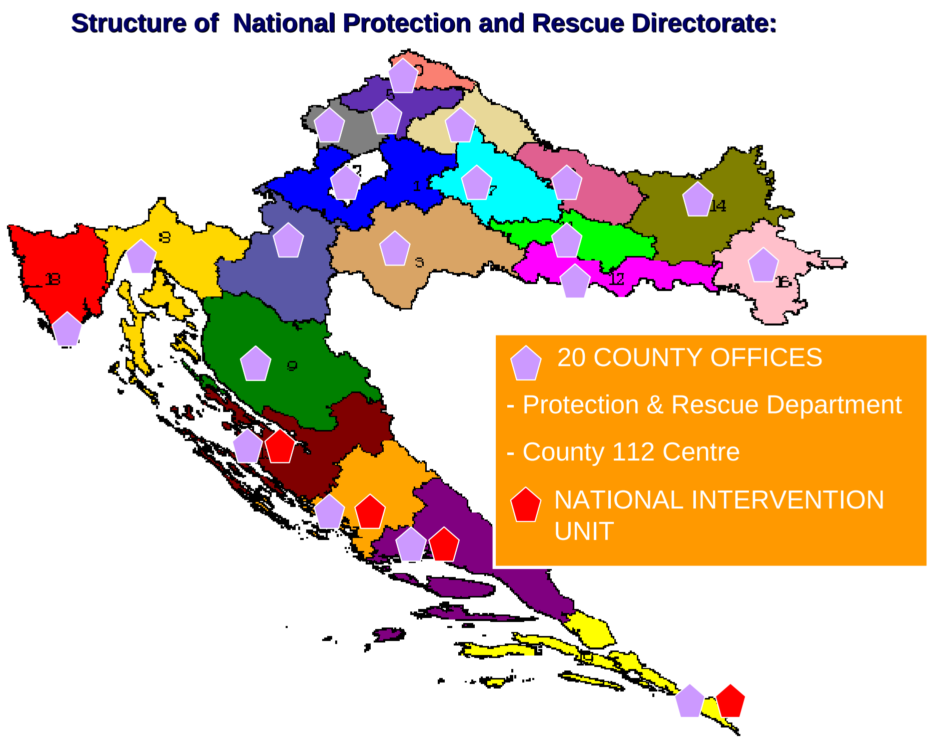


Figure 12. NPRD offices and units

4.2.2.3. Croatian Meteorological and Hydrological Service

DHMZ is part of Croatian governmental administration. As a central state institution it has responsibilities in meteorology, hydrology, climatology and air quality. DHMZ reports directly to the Ministry of Finance, so the arrangement is different from the European NHMSs, which typically are under other ministries. Currently the role of DHMZ is to provide basic statistics and analyses of extremes and climate variability to be used for strategy planning of DRR, but it is not actively included into the planning procedure of the DRR system in the country.

DHMZ is a national centre of exellence based on high standards of scientific, professional and technical resources for the production, collection and dissemination of high-quality meteorological and hydrological information. DHMZ basic tasks are stipulated by the Law on meteorological and hydrological activities in Croatia as follows: to provide support to economic development, environment protection, to act towards the preservation of life and material goods from natural hazards and disasters and to mitigate their consequences.

The role of DHMZ is defined in the "Law on the Performance of the Hydro-meteorological Service in the Socialistic Republic of Croatia (OG No. 14/78)" issued 11.4.1978:

- to be responsible for national observation networks (meteorology, hydrology, air quality, sea water quality, fresh water quality);
- to give warnings on coming hydrometeorological hazards and their development;
- to provide reports, forecasts and warnings to the relevant republic administrative entities on hydro-meteorological hazards valuable for floods and other risks protection, as well as for the navigation security, and to provide reports and forecasts on air pollution and warnings on sudden pollutions of rivers, lakes, see and air;
- to participate in national and international exchange of data and information.

DHMZ is also responsible for international work, cooperation and implementation of work and activities under the Framework Convention on Climate Change, and Vienna Convention on the protection of the ozone layer.

Meteorological and Hydrological Service of Croatia is composed by eight research and operational divisions as described in Figure 13.

Concerning DRR, the DHMZ produces services and actions for different levels of the DRR community in coordination with the National Protection and Rescue Directorate at national and community level. The role of DHMZ is to provide basic statistics and analyses of extremes and climate variability to be used for strategy planning of DRR, but it is not actively included into the planning procedure of the DRR system in the country. Concerning floods risk assessment, DHMZ is a provider of hydrological and meteorological data to CW, which has the mandate for floods risk assessment for defense planning. DHMZ provides also short/medium/long term weather forecasts for floods forecasting. Concerning drought, DHMZ performs hazard assessment and mapping, even if no other institution is in charge of drought risk assessment. It should be noticed that DHMZ produces forest fires risk mapping, which is very closely linked with drought. DMHZ has also established Disaster Risk Reduction Focal Point that coordinates activities at national, regional and international level.

An important milestone of DHMZ implication in DRR was the beginning of the performance of METEOALARM on 13th July 2009.

Finally, DHMZ is still very active in performing partnership with media and issuing meteorological and hydrological information on internet, newspapers, mobile, radio and television, including weather presentation at the national and private radio and television stations.

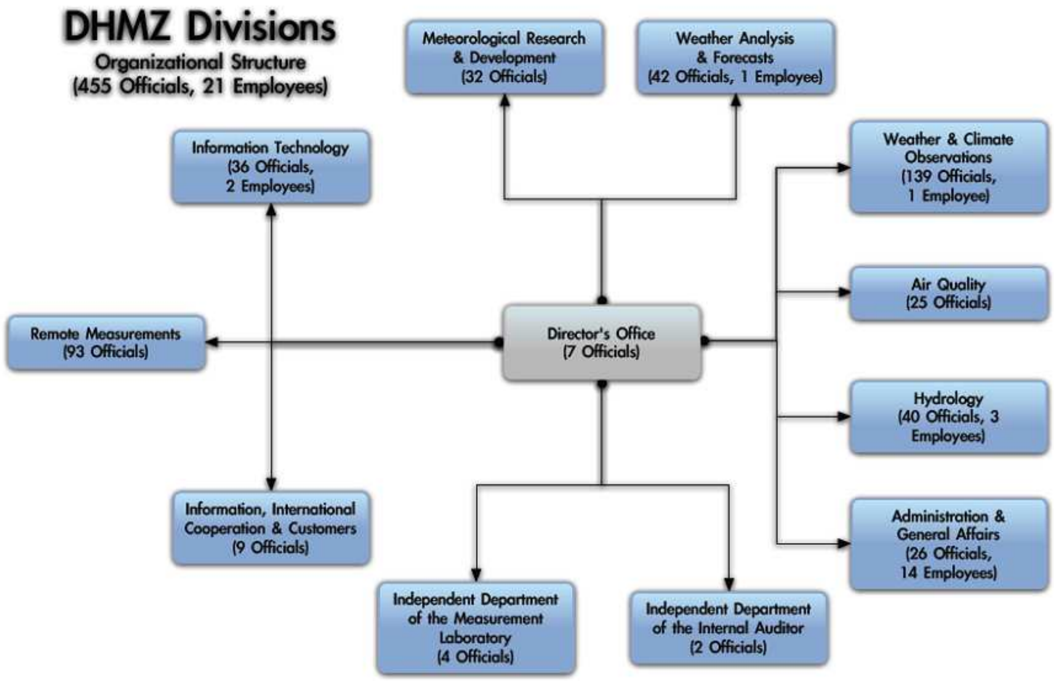


Figure 13. Structure of DHMZ

Budget of DHMZ is about 15 M€ in 2011, as well as in next 2 years i.e. for 2012 and 2013, respectively. Remarkably, hail suppression activity is still performing by ~ 5 M€ budget support. It is assured coverage of total DHMZ performance by the state budget up to 95%, still not canceling non-profit activity what is 16% of 2008 DHMZ budget. These non-profit funds are not adding to the DHMZ total budget because it is drowned in the state budget. The benefit of this non-profit contribution is in raising the DHMZ cost-benefit scale and has convincing potential in applying for budget rebalances for more funds.

In Croatia there also other entities, which provide hydrological or meteorological services and operate observations or observation networks. These include:

- Croatian Air Navigation Services (www.crocontrol.hr) is a state institution in charge of aeronautical weather service. Aviation meteorology division from Croatian Air Control operates synoptic meteorological stations at main airports;
- Croatian Army has its own meteorological unit;
- Hrvatske Autoceste operates about 100 automatic weather stations along the motorways;
- Institute of Oceanography and Fishery; Hydrographic Institute Split and Ruder Boskovic Institute are active in oceanography;
- Croatian Health Institute performs Air quality monitoring.

4.2.2.4. Croatian Waters

Croatian Waters (CW) is the responsible governmental organization for flood risk management, floods risk assessment and for floods defense planning. CW conducts integrated management of Croatian water resources on four river basin districts comprising one or more river basins of the major watercourses or parts thereof, which constitute a natural hydrographic unit, as follows:

- The river basin district of the Sava River basin ;
- The river basin district of the Drava and Danube river basins;
- The river basin district of the Istrian-Littoral basin;
- The river basin district of the Dalmatian basin.

The main activities of Croatian Waters, based on the principle of sustainable development and conducted with the purpose of achieving integrated water management, are the following:

- protection from adverse effects of water;
- water use;
- protection of water from pollution.

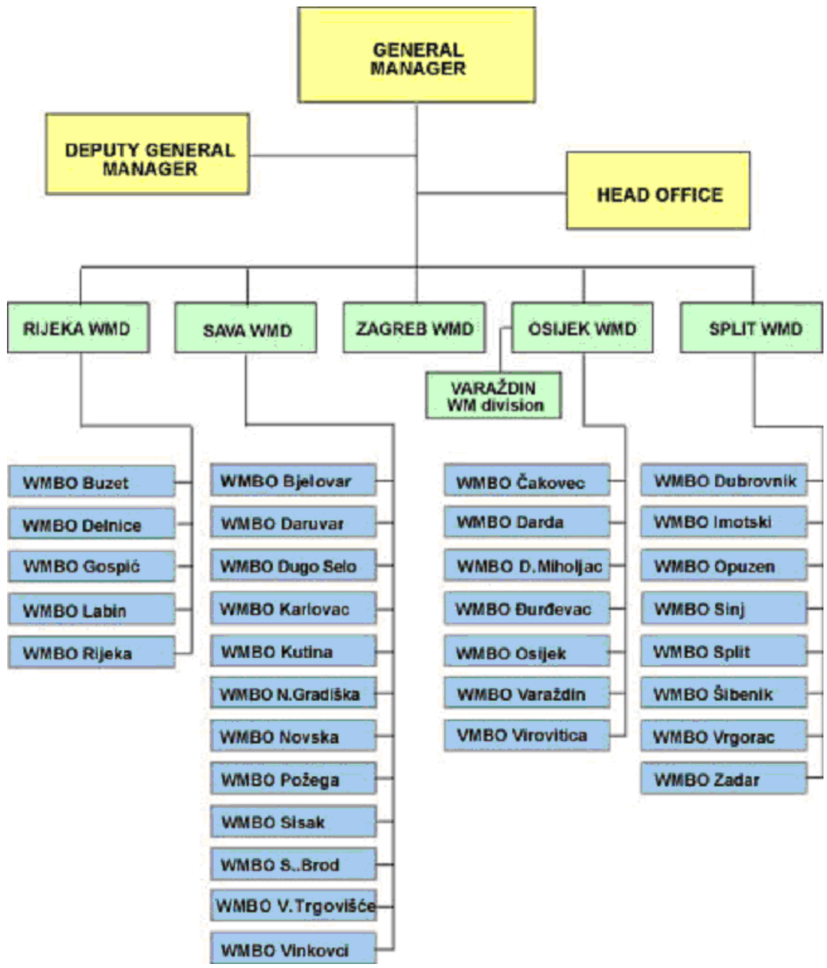


Figure 14. Croatia Waters structure

Croatian Waters activities related to floods risk reduction are:

- monitoring the quantities and levels of surface water, groundwater, and sediment;
- regulation of watercourses, construction of water regulation and water protection structures, as well as of water structures for amelioration drainage;
- technical and economic maintenance of watercourses, water estate, water regulation and water protection structures, including maintenance of navigable waterways and structures for the protection against erosion and torrents, as well as of water structures for amelioration drainage;
- protection from floods on state waters in accordance with the National Flood Protection Plan;
- protection from floods on local waters, protection from erosion and torrents, and amelioration drainage in accordance with flood protection plans for catchment areas enacted by county assemblies;
- coordinating implementation of the National Water Protection Plan, coordinating water protection planning of regional and local communities.

The Croatian Waters have signed an agreement with the 112 center of NPRD concerning flood risk and pollution risk (water quality) for fresh water and coastal waters.

Croatian Waters also has an agreement with DHMZ; they share the observation network, data and databases. DHMZ produces quality controlled national and international (transboundary rivers) hydrological data (both near real-time and historical) in agreed format. Concerning flash floods warnings, the responsibility is shared between DHMZ and Croatian Waters. For defense of river floods Croatian Waters is responsible for fighting against the flood (with assistance of army and others), while warning of the people is the responsibility of the 112 center of NPRD.

4.2.2.5. Institutional mapping of the key vulnerable sectors

Ministry of Economy, Labor and Entrepreneurship conducts active policy of employment and administrative and other work concerning:

- Industry, except food and tobacco industry; shipbuilding; energy; mining; crafts; cooperatives, except agricultural; small and medium entrepreneurship; trade; trade politics; national production protection politics; economic cooperation with foreign countries;
- Involvement in European economic integration; coordination of activities concerning Croatia's membership in the World Trade Organization and participation in multilateral trade negotiations within the framework of this organization;
- Export and foreign investment promotion; establishment and development of entrepreneurial and free zones, situation and market appearances; supply and prices; consumer protection; strategic commodity reserves; privatization of shares and stakes in companies owned by the Republic of Croatia; restructuring and recovery of legal entities is a part of the Ministry of Economy activities.

The Ministry of Economy conducts administrative and other work concerning: work relations; labor market and employment; relationships with unions and employers' associations; labor law status of Croatian citizens employed in foreign countries and work concerning their return and employment in the county; labor law status of aliens employed in the Republic of Croatia; occupational safety; international cooperation in labor and employment sector and pension and disability insurance system and policy. The Ministry of economy also conducts work concerning: promotion and systematic enhancement of crafts, cooperatives, except agricultural, small and medium entrepreneurship; effects of economic system instruments and economic policies and measures on the development of crafts, cooperatives, small and medium entrepreneurship and business activities of craftsmen and entrepreneurs; realization of international cooperation, implementation of special programs of the Government of the Republic of Croatia in the area of crafts, cooperatives, small and medium entrepreneurship.

Ministry of Agriculture, Fisheries and Rural Development does administrative and other tasks related to: state border inspection of plant's protection and state border veterinary inspection; setting up and carrying out of land management, except ownership rights; regulation of legal rights on agricultural land, forests and forest land owned by the state, except ownership rights; forestry and hunting; inspection tasks related to agriculture, fishing, forestry and hunting, quality of agricultural and food products and veterinary medicine; carrying out the stimulative measures in agriculture and fishing and their adjustment to the World Trade Organization criteria; regulation and coordination of co-financing with the state budget of agriculture, fishing and processing of agricultural products; agricultural co-operatives; protection and recognition of agricultural plant species; protection of agricultural land; definition of registration procedures for agricultural land; management and disposition of state owned agricultural land; conversion of agricultural land to building land; regulation of relations and terms of manufacture, transport and use of plant protection agents in agriculture and forestry; definition of terms of manufacture of wine and other grape and wine derived products; carrying out of measures for detection and prevention of contagious diseases of animals and definition of terms and means of carrying out of disinfections and pest control; definition of boundaries between inner and outer fishing sea belt, fishing boundaries and definition of purpose, type and quantity of fishing tools and equipment which may be used in fishing.

The Ministry of Tourism regulates tourism “industry” in Croatia, especially, coordinating marketing and promotion of Croatia as touristic destination. It was shown that tourism in Croatia could be under influence of global climate worming including effects of sea-level rise and water supply. During summer it can become uncomfortable in some areas while the touristic season could be longer in general. Services in the tourism sector within the tourism sector are: the provision of services of a tourist agency, tourist guide, tourist escort, entertainment organizer, agency representative, tourism services in nautical tourism, tourism services on rural farms or family agricultural farms, tourism services in other forms of the tourism offer and other services provided to tourists in connection with their travel and stay.

The Ministry of Environmental Protection, Physical Planning and Construction performs administrative and other tasks related to general policy of environmental protection in order to fulfill conditions for sustainable development; protection of air, soil, water, sea, plant and animal life in the totality of their interaction; ensuring the monitoring of the status of air, soil and marine environment pollution and ensuring the implementation of measures to prevent air, soil and marine environment pollution and protection measures; preparation of measures to improve the environmental protection status and to implement the environmental protection goals laid down in the environmental protection strategy and to prepare reports on the environmental status in the state; proposing, promoting and monitoring of measures for environmental protection improvement; ensuring implementation of environmental impact assessment; ensuring implementation of the pollution cadastre; systematic monitoring of the environmental status; keeping of the environmental information system; establishing environmental measures, requirements and approvals; care, co-ordination and supervision of financing environmental protection programmes; waste management; preparation of proposals for environmental protection standards; assessment of working conditions for legal and natural persons in the field of environmental protection; achievement of international environmental protection co-operation; administrative supervision and supervision over the expert work of the Environmental Protection and Energy Efficiency Fund; environmental protection inspection; encouragement of environmental protection-related education and research. The Ministry performs administrative and other tasks related to physical planning in the Republic of Croatia and coordination of regional physical development; planning, use and protection of space; international cooperation in physical planning; spatial planning inspection tasks; spatial information system; monitoring of the status of space and implementation of physical planning documents of the Republic of Croatia; location permits; cooperation in development of physical planning documents of counties, cities and municipalities in order to ensure requirements for management and protection of space and coordination of activities of state administration bodies participating in development, adoption and implementation of physical planning documents; ensuring requirements for development and improvement of operation of legal and physical persons in the field of physical planning; settlement planning and regulation of the building land use. The Ministry performs administrative and other tasks related to the establishment of requirements for the designing and construction of construction works; business operation of legal and physical persons in the field of construction, the Croatian Chamber of Architects and Civil Engineers and other engineers involved in construction; monitoring and analyzing the quality of construction and designing services in construction; construction and use permits; use, maintenance and removal of construction works; building inspection tasks, as well as conducting administrative procedures in the field of housing and municipal economy. The Ministry performs administrative and other tasks related to the functioning of instruments and measures of economic policy in construction; housing; housing policy; apartment and settlement construction; social and official apartments; implementation of special programmes of the Government of the Republic of Croatia in housing; municipal economy; policy, monitoring and improvement of the status in municipal economy; international cooperation in construction and housing.

Ministry of Science, Education and Sport is in charge of administrative and other activities relating to the following: preschool education, elementary school and secondary education in the country and abroad; curriculum; textbooks, educational standards; development of the educational system; professional education and permanent education of kindergarten and school teachers;

student standard; inspection and professional and pedagogic control; establishment of educational institutions and control of their compliance with the laws; securing financial and material conditions for work in education; qualifying the children, youth and adults for acquiring technical knowledge and skills, and activities of various associations in its domain. The Ministry also performs administrative and other activities relating to the following: system and design of curricula for higher education in the country and abroad, and securing financial and material conditions for work, professional education and permanent education of teachers, accommodation, food and other issues relating to student standard, and inspection in higher education. The Ministry performs administrative and other activities relating to the following: development of the scientific-research activities and scientific and technical information and communications; development of scientific-research and other legal persons; development of science and application of scientific achievements in certain areas, harmonization of the financing program of constant research activity and contractual projects for the purpose or realization of the national scientific-research program and scientific programs of special interest; planning, harmonization and implementation of IT development and its interconnection into an integral IT system of the Republic of Croatia; monitoring, recording and realization of scientific, technical and technological cooperation with foreign countries and international organizations pursuant to international agreements; sending Croatian experts abroad and participation of foreign experts in research in the Republic of Croatia, cooperation with Croatian experts abroad; activities regarding scholarships, specialist training and practical training of Croatian and foreign experts pursuant to international, national, business and other agreements. The Ministry performs administrative and other activities relating to the following: development of sports and physical education; protection and advancement of the health of children, youth and adults, and to the activities of sports associations. The Ministry performs administrative and other activities relating to the following: qualification of children, youth and adults for acquiring technical knowledge, and skills, and to the activities of associations in the field.

Ministry of Regional Development, Forestry and Water Management, performs among other administrative and other tasks related to:
planning, implementation and coordination of regional development policy, encouraging the development of areas lagging behind the national average development, encouraging the development of cross-border, transnational and interregional cooperation and project development for the use of pre-accession funds of the European Union and other international sources of funding intended for regional development; Coordination of all activities related to harmonization with the EU in regional policy and structural instruments; Forestry, forest protection, regulation of relations in the woods and forest land owned by the state, keeping records of forests and other registers; Planning and relations of production, transport and use of forest seeds and forest seedlings, forest ecology, forest protection against natural disasters and human impacts, fires, conservation of forest genetic resources and forest reproductive material; timber industry, a record capacity for primary processing of wood, manufacture of pulp, paper and other wood industry capacity, monitoring and analysis of wood products in the EU and the world, encouraging the use of renewable energy in the form of biomass, improving the processing and use of wood and wood products; Defining the national policy of water management and coordination of water management development with the needs of economic development and EU accession process, and the conclusion and implementation of intergovernmental agreements and other documents in the field of water management, organization and implementation of projects in water management; water management and water-economic system, regulation of watercourses and other water and protection from the harmful effects of water and ice; protection from erosion and torrents of water protection and protection of the sea from pollution from land; hydro drainage and irrigation; securing water supplies to supply the village with drinking water and industrial water to the economy, the use of water power: planning and coordinating the development and construction of public water supply systems and public sewerage systems of national interest; Inspection for protection from water, water use and water protection from pollution.

Ministry of the Sea, Transport and Infrastructure does administrative and other tasks related to: protection of the sea from the ship caused pollution; sea ports, maritime property and definition of borders of maritime property, marine insurance and maritime agencies; inland waterways ports;

shipping centres on land; airports; means of transport except the tasks which are responsibility of other ministries; telecommunications and post; definition of technical prerequisites and terms of use of facilities, technical equipment and installations of telecommunications and radio communications; legislation of subordinated laws and regulations about concessions for providing public telecommunication services; broadcasting and distribution of radio and television programmes; international coordination of utilization of radio frequency ranges, domestic utilization of radio frequency ranges; issuing of permits for radio stations to domestic and foreign persons; inspection duties; safety of maritime shipping, domestic and international road traffic and roads, except the tasks which are the responsibility of Ministry of Interior, rail traffic safety, air traffic safety, inland waterways traffic safety, telecommunications and post, domestic and international postal and telecommunications traffic and regulation of radio frequency ranges; tasks of Coast Guard (port authorities).

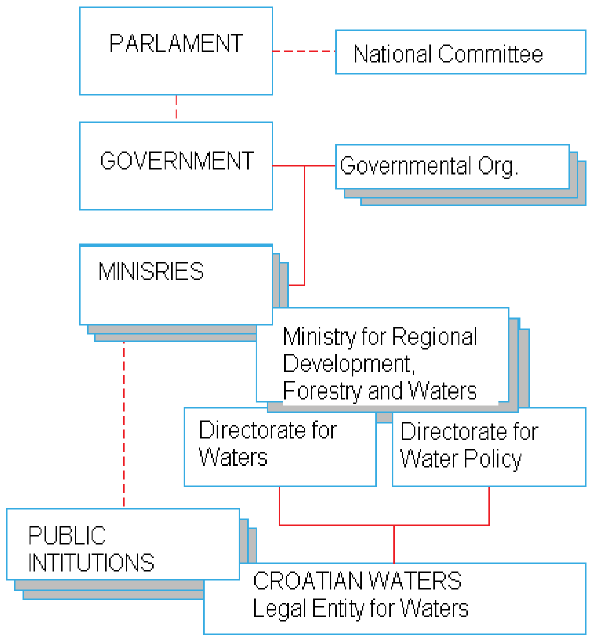


Figure 15. Water Management decision-making diagram in Croatia

4.2.3. Operational relationship with Disaster Risk Management and other Technical agencies

At national level, there is a disaster management system in place, which is predominantly disaster preparedness and response oriented.

The NPRD is the leading organization for the protection and rescue of people, assets and environment. The NPRD collects data, establishes data-bases and records on all events, accidents and disasters in country as well as on big accidents and disasters abroad, disaggregates their consequences and protection and rescue intervention modalities; it analyses data per categories, time and geographic area, and reports on them on monthly and yearly basis to the government; it monitors the protection and rescue situation, collects and analyses data on hazards and disaster consequences, and keeps the records on operational protection and rescue forces, their location, equipment and material needs, in a single GIS database.

Other governmental entities, such as DHMZ, Republic Seismological Survey, Croatian Forests, Croatian Waters and similar, are also collecting, storing and analyzing data and information from their respective area of responsibility, relevant for effective and efficient disaster management. All of them are linked to the integrated operational-communicational centre (Centre 112), and information is shared via System 112.

DHMZ maintains the database of all meteorological and hydrological events including extreme events according to WMO standards. DHMZ is disseminating hydro-meteorological hazard products, such as historical data archives, real-time hazard monitoring, forecasts and outlooks, and early warnings to relevant Ministries, emergency response services, general public and news media. DHMZ also provide the following value added services in support of hydro-meteorological risk assessment activities: quality controlled historical databases of hydrological and meteorological measures, statistical analyses to characterize the hazards, hazard mapping and high-risk zone analysis (heavy precipitation, drought, snow, ice, hail, storm, forest fire), and technical advice (in support of emergency plans, emergency response planning, provision of data and expertise to support hydro-meteorological risk assessment for development projects, etc.). In addition, DHMZ provides the following services based on real-time monitoring of hazards: hydro-meteorological maps based on observational sources, advisories - preparation to take action for impending hydro-metrological hazards, and warning for all kinds of meteorological extreme events (heavy precipitation, strong wind, cold and hot spells, heavy snow, hail, frost etc.). Operational data utilization and information exchange between DHMZ and System 112 has been regulated by the Standard Operating Procedures (SOP) for the utilization of the DHMZ weather forecasts. DHMZ operates according to the Quality Management Systems (QMS). DHMZ adopts an approach opened toward providing services to state and non-state actors, particularly in DRR. This is also supported by the technical capacity of DHMZ to provide tailored information and to answer to specific requests. The capacity of DHMZ to provide adequate services is monitored through a specific plan (Figure 17). This approach makes DHMZ as one of the most advanced NHMS in the region.

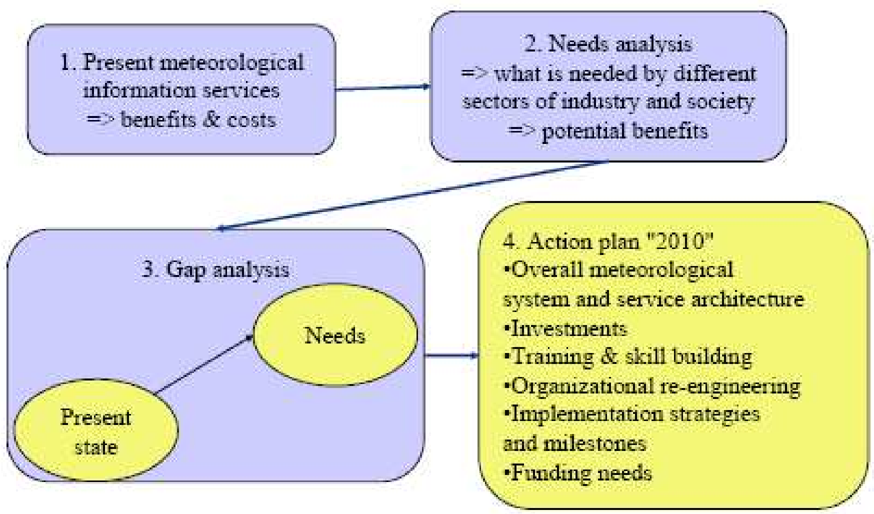


Figure 16. Plan for the analysis of Croatian meteorological and hydrological information services

Croatian Waters has, in accordance with the National Flood Protection Plan, made automatic certain number of water gauges within the flood monitoring system, thus allowing EWS receiving water level measurement data in real time. These data are shared with DHMZ and are also made available at the Croatian Waters web page and at the Croatian television teletex. Most of the rainfall measurement data are not, unfortunately, available in real time. Systematic water flow and water level prediction has been undertaken by the Croatian Waters at 5 distinctive locations/points. Croatian Waters has a geographical database of historical floods. CW performs floods risk assessments annually and elaborates Floods Defense Plans. Floods Risk Assessment is produced in-house with CW capacities. Only some hydrological analyses are assigned outside through tender procedures.

Croatia has established a National Platform for Disaster Risk Reduction (NPDRR) as a permanent forum for the exchange of opinions and presentation of views, proposals and achievements regarding DRR in all areas of human activity. The goal of the Platform is to provide guidance in integrating DRR in state policies and raising awareness of safety culture primarily through education. Platform produces annual reports and produces a platform to different organizations to meet and change opinions about the DRR. DHMZ is a member of the platform. Currently the platform has no legal or statutory basis being largely an ad hoc discussion forum.

There are no DRR focal points in the sectoral ministries although members of the Croatian National Platform Committee might be considered as such. The NPRD is the key entity for coordination, organization and management of disaster management issues, including emergency preparedness and response. The DHMZ, within its own structure, has established DRR Focal Point that coordinates activities at national, regional and international level.

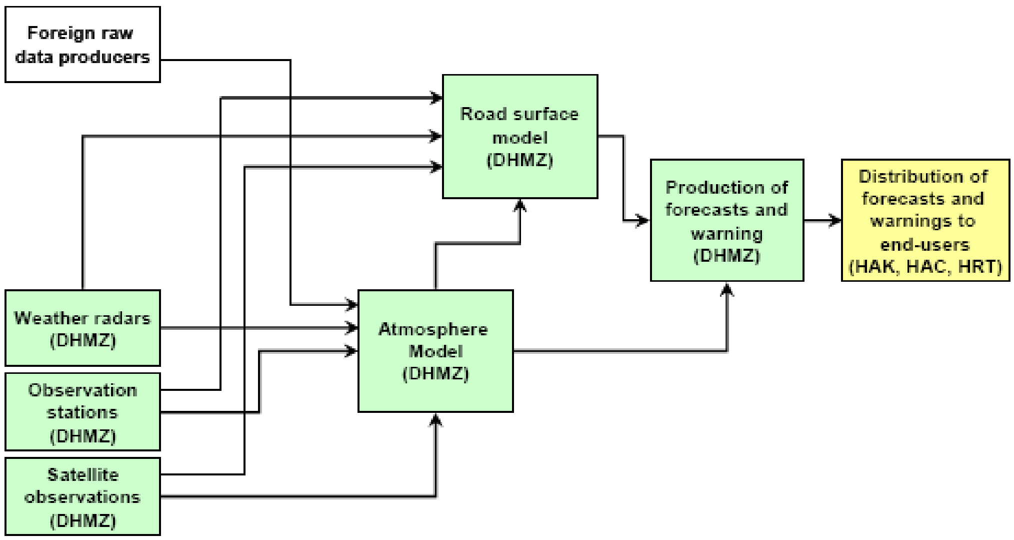


Figure 17. Production of meteorological information and warning services for road users in Croatia

4.2.4. Roles and responsibilities in flood and drought risk assessment

In the water sector, the integration of the European Flood Directive in Croatian law is an important step toward DRR mainstreaming. On the contrary drought aspects are not as well considered in the DRR framework. Drought is still considered as a climatic condition and the management of its effects is left to the farmer and it is not systematically addressed in legislation covering other sectors either.

Concerning floods risk assessment, the responsibility is shared between:

- Croatian Waters which has the mandate to prepare on annual basis floods risk assessment and floods defense plans;
- Local governments, which have the mandate of floods risk assessment for spatial planning purposes. Counties ensure the risk assessment framework and coordination.

Croatian Waters is fully involved in floods hazard mapping and risk assessment as requested by the EU “Directive on the assessment and management of floods risks”. The preliminary flood risk assessment is expected to be completed by 2011. NPRD, has the role of integrating floods risk assessment with other sectoral risk assessment prepared by relevant ministries into the National Risk Assessment. The same for the National emergency plan, which is based on sectoral plans, including the Flood defense plan produced annually by CW. DHMZ in floods risk assessment has only the role of providing to Croatia Waters historical data and some hydrologic or meteorological analysis.

Concerning drought, there is no institution in charge of risk assessment. DHMZ produces drought indices and drought mapping (meteorological and agricultural drought). DHMZ provides characterization and mapping of extreme events (including drought related parameters) to the Ministry of Agriculture for the assessment of exposure to climatic risks.

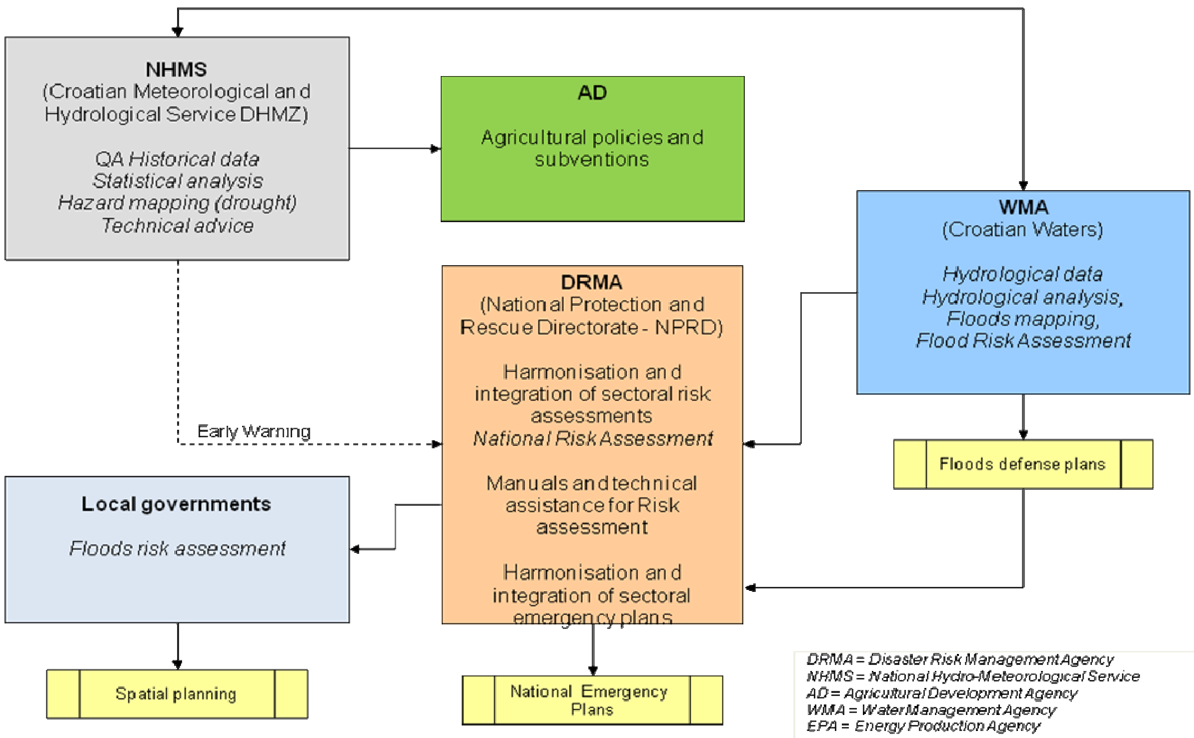


Figure 18. Workflow for drought and floods risk assessment in Croatia

National risk maps are available for the national level as part of the Natural and Man-made Catastrophes and Big Disasters Vulnerability Assessment. At the moment this assessment covers only the national level. Counties and local self-governments have commenced developing their respective vulnerability assessments: 90% have contracted the risk assessment development, 50% have started the development and 15% have finished the risk assessments. Risk maps should be part of the vulnerability assessments done at the regional and local self-government levels.

Up to now DHMZ has not participated in national projects to produce actual risk analyses for DRR or economic sectors. But, due to fact that most of the natural hazards are related to weather and climate it is natural that the DHMZ needs to have a very active and visible role in DRR. The DHMZ should be integrated into the DRR planning process in order to exploit its scientific capability and technical capacity in hazard characterization and mapping. In order to achieve this goal, the cooperation at the national level between DHMZ and NPRD and relevant institutions and end-users should be improved to further enhance national system for preventing and mitigating the impact of extreme weather and climate events.

4.2.5. Budget and funding for DRR

At the national level funding mechanism is a combination of a budget allocations for the National Protection and Rescue Directorate, other respective Governmental entities (DHMZ, Croatian Waters, Croatian Forests) and funds allocated for the implementation of specific disaster protection plans (like National Flood Protection Plan, Intervention Plan during Wild and Forest Fires on the territory of the Republic of Croatia and Activity Program for the Implementation of the Special Fire Protection Measures in Republic of Croatia in 2010). At the county and local self-government levels, fund should be allocated in their respective budgets.

4.3. Technical Capacities of Hydrometeorological Services to support Disaster Risk Reduction

4.3.1. Monitoring and observations networks and data exchange

Observations, and especially the upper air observations are essential for global, regional and local weather forecasting and numerical modelling of the atmosphere. Long-time historical time series of accurate quality controlled observations are required for hazard analyses, climatological studies and monitoring of climate change. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situations;
- reduction of vulnerability to the risks of meteorological, hydrological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale NWP modelling.

DHMZ has a relatively dense hydro-meteorological observation network (Table 21). The most important parameters collected by DHMZ are: air temperature, humidity and pressure, wind speed and direction, snow depth, sunshine duration, cloudiness, potential evapotranspiration, soil and sea temperature, river level and discharge. The DHMZ main weather stations are operated by professional observers, from 2 to 5 per stations. For the time been on all main weather stations, in exception of the wind, weather parameters are parallel measured by observers and electronic sensors. A few number of ordinary and rainfall stations is equipped with electronic sensors (about 32) mainly used for specific users like National Electricity Company, Hrvatske Ceste etc.

Real-time or near real-time data is available from 32 Automatic Weather Stations (AWS), weather radars and UV and Ozone measurements, which is a very small share compared to EUMETNET observation networks. Average distance between main meteorological stations is about 50 km, between climatological stations about 20 km and precipitation stations about 10 km. Currently DHMZ AWSs do not include some modern equipment like present weather sensors, visibility, cloud height sensors or sun shine trackers. Also the measurement frequency and data collection frequency vary from NHMS to NHMS, even if generally the data collection frequency in increasing. DHMZ is also operating 47 automatic hydrological stations plus 52 stations overseen by the Croatian Waters. DHMZ has two manned upper air sounding stations equipped with Vaisala PTU system using GPS tracking. Soundings are made twice a day; 00 GMT and 12 GMT. DHMZ operates lightning detection system, as part of the European EUCLID-network.

Weather radars are powerful tools in flood prone countries to forecast floods, and in general to provide basis for nowcasting and location of precipitation areas during hazard events and rescue operations. However, weather radars are very expensive investments. Currently DHMZ has 8 radars, of which 6 are analogical radars used mainly for hail monitoring. Only 2 of the radars are weather radars of older type: 1 analogical/Doppler purchased in 1981 and 1 digital/Doppler purchased in 1994. The Adriatic coast and Southern Croatia are not covered by meteorological radar monitoring.

Additionally DHMZ has air quality stations (21), surface level ozone sensors (1) and UV radiation sensors (2). Moreover DHMZ collects phenological data from about 60 agrometeorological stations.

DHMZ has adequate calibration system and the measurements done meet the WMO standards.

In addition, there are other institutions maintaining observing systems in the atmospheric, terrestrial, oceanic and environmental domains in Croatia. Hrvatske Autoceste d.o.o operates about 100 automatic weather stations along the motorways, Croatian Air Navigation Services has 5 meteorological stations, Institute of Oceanography and Fishery has 3 automatic weather stations, 1 moored-buoy and 2 research ships, and the Ruder Boskovic Institute has 1 moored-buoy equipped with automatic oceanographic and meteorological station, 1 AWS and 1 marigraph. Currently there is need for better coordination at national level among networks.

Table 21: Observation stations operated by DHMZ

Types of observation stations	Number			Connected to WMO GTS	Data transmitted using:
	2007	2010	2011		
Atmospheric domain					
Surface synoptic stations (> 8 obs/day)					
Manned stations	40	40	41	40	PSTN, web
AWS or AWOS	32	30	30	0	GPRS, satellitte
Cloud-height – automatic	0	0			
Ordinary climate station (3 obs./d)	110	110	117	2	PSNT, web
Rainfall station (2 obs./d)			336		
Rainfall station – automatic					
Agrometeorological stations			60		
Meteorological towers	0	0			
Upper air radio sond stations		2		2	PSNT, web
Pilot balloon stations	0	0			
SODAR/RASS	1	1		0	
Wind profiler stations	0	0			
Lidar	0	0			
Access to AMDAR data	0	0			
Weather radars	2	2		0	
Hale radars	6	6		0	
Lightning detection stations	0	?			
Lightning detection hub station	0	?			
Satellite MSG ground station		1			
Hydrological domain					
Discharge station - manual		80		0	
Discharge station – automatic			47 + 52*		
Water level post – manual					
Water level station – automatic					
Maritime domain					
Offshore – manned stations		10		0	PSNT, web
Offshore – AWS	0	0			
Buoys	0	0			
Buoys with meteorological observations	0	0			
Tidal/Marigraph stations	5	5			Hydrographic Institute Split
Tidal stations with met. observations	0	0			
Research vessels	1	1			Hydrographic Institute Split
Environmental domain					
Air quality		21		0	
Water quality		0			
Nuclear deposition					
Ozone – near surface		1		0	web
Ozone – upper air					
UV radiation		2		0	
GAW		0			

*DHMZ receives data from 52 hydrological stations owned by Croatia Waters

4.3.2. Hydrometeorological data management systems

Historical hydrometeorological data is critical for hazard analyses, and planning and design within various economic sectors. It is necessary also to have an adequate data base for atmospheric modelling and verification. In this regard, hydrometeorological data must be properly quality-ensured and stored in historical user-friendly digital databases.

DHMZ collects hydrological, meteorological, oceanographic, air quality and water quality data from its official national networks. The digital database(s) include Climate Data, Synoptic Data, Automatic Weather Stations Data, Aeronotical Data (Metar, TAF, Sigmet, Airmet, Gamet), Ravinsonde Data, Preciptation Water Analyse Data, UV-B Data and Ozon Data.

The time series of climate data (typically 3 observations per day) are very long on any level (from 1861), but other time series are quite short:

- Climate Data; From beginning for 50 stations (the longest since 1861) and additional 60 since 1981 to Present;
- Synoptic Data; From 1980 to Present;
- Automatic Weather Stations Data; From 1995 to Present;
- Ravinsonde Data; From 1971 to Present;
- Precipitation Data; From 1981 to Present.

DHMZ also maintains a database of official information on the meteorological and hydrological events including extreme events making damages in Croatia according to WMO standards. The database includes data about stormy wind, flash floods, river floods, coastal flooding, hail storm, thunderstorm and lightning, heavy snow, freezing rain, fog, heat waves, cold periods, drought, hydrological hazards to aviation, hydrometeorological hazards to road and railroad, avalanches, forest fire and wild land fire. DHMZ also maintains database on hazardous airborne and waterborne substances. DHMZ has a relational database developed in-house using PostreSQL, Flat file system and Borland Parad. The data management is on quite good level and is based on servers, workstations and PCs, using Intel, LINUX, IRIX and Minor. Following metadata is stored: official name, geographical coordinates and altitude. Quality control of data is done, for real-time data lower quality than for non-real data.

Phenological data are managed in a database, which will be soon renewed with a new one build in-house using PostgressSQL platform in order to harmonize this database with the meteorological and the hydrological ones. Phenological data for 10 stations have been integrated in the European phonological database built in the framework of the COST 725.

Also other governmental entities, such as Croatian Waters, Croatian Forests, are also collecting, storing and analyzing relevant data from their respective area of responsibility. The hydrological data collected through Croatian Waters network of automatic hydrological stations are managed and quality controlled by DHMZ in a joint database. Both institutions have full access to the database.

The process of linking separate databases into a single database and their transfer to the Geographic Information Systems (GIS) is time-consuming and requires financial means and appropriate information technology equipment and well-trained personnel. DHMZ has just started the development of a general geo-database and is acquiring official geographic layers.

4.3.3. Hazard analysis and mapping to support risk assessment

DHMZ has done several analyses of extreme weather conditions and produced hazard maps of e.g. heavy precipitation, drought, snow, ice, hail, storms and forest fire. NPRD is the designated national agency responsible for compiling, archiving, and providing official information on the impacts of disasters in the country. In this respect, NPRD is adopting very ambitious objectives, particularly concerning hazard data management and risk assessment through a single multi-hazard and multi-source Geographical Information System, which would merge all data on natural and technological hazards and make them available on the Internet.

Regarding droughts, DHMZ analyzes extreme weather conditions and produces drought maps, depending on user requirements or for specific projects. Different agrometeorological parameters are calculated and mapped for drought characterization: water balance, soil water content, dry days and spells. At DHMZ, Palmer index should become operational in the near future. Trends over time are calculated for each index. In the framework of the Drought Management Centre for South-Eastern Europe (DMCSEE) project, the DHMZ produces SPI maps. Tailored to the Ministry of Agriculture, DHMZ produces risk maps of specific agrometeorological conditions aiming to assess the exposure of the territory (Municipalities are the basic analysis unit) to climate risks. For each parameter (hail, wind, temperature,..) critical threshold maps are prepared. Moreover, a characterization of Croatian territory has been produced for agricultural planning and for agriculture subventions definition according to the European Directives including the (i) zones characterized by strong winds; (ii) zones characterized by frequent hail events, (iii) zones with extreme temperatures (high and low) and (iv) zones with low precipitation. DHMZ produced also Drought maps for the preparation of the National Action Plan in the framework of the UNCCD. DHMZ, as many of SEE NHMS, has not yet developed any application of remote sensing in agrometeorology.

Regarding floods, DHMZ doesn’t run numerical hydrological models, but statistical analyses are performed on hydrological data for normal reporting or on demand. It also has collaborations with the JRC EFAS initiative for floods forecast. In this framework, stages at JRC and trainings have been organized.

Croatian Waters is preparing hydrological analyses for the whole country in cooperation and through data sharing with the DHMZ. Croatian Waters also does not use numerical hydrological models, but only analytical correlations using rainfall, water levels and discharge. Meteorological forecasts are used probabilistically for floods forecasts. It is also producing flood risk analyses and inundation maps. Hazard maps are produced for each occurred flood. Local Croatian Water teams collect flood extension data with GPS and, measuring the water levels at water gauges, they evaluate the water depth in the flooded areas. Digital floods maps are then produced. In some cases, floods maps have been produced using remote sensed images e.g. Landsat for the inundations in 1993. But this technique is not operationally used, because CW estimates that cost/benefit ratio is still higher than using field surveys. Potential flood maps are produced both at central and local level according to the capacities of local offices of CW.

Floods and drought impact data are collected by local commissions coordinated by Municipalities in which participate Croatian Water local teams, Ministry of Finance and Ministry of Statistics. Damages are stored at the Ministry of Finance as economic value of damages per municipality or town. But there is a general lack of precise information about hazard impacts, particularly geographic data disaggregated at lower than municipality level and per type of damage. Also damages in agriculture are not available, neither the crop areas affected by floods nor the effect of drought to the yields.

DHMZ has GIS capacities, with one GIS expert within the climatological department and another in the hydrology department. Elwiss and ArcGIS packages are used. The Kriging extension of ArcGIS is used for interpolating agrometeorological parameters used in drought mapping. The SRTM DEM at 90 m resolution is used for the interpolation. Concerning official geo-information, GIS official layers for Croatia (like DEM, hydrographical network, etc.) are produced by a private company (Geodata), which has the monopole of geographic information. DHMZ has limited possibility to access these data because of their expensive prices.

CW has GIS capacities and is building a geodatabase containing basic physical layers such as: (i) Digital topographic maps at 1:25.000; (ii) Official DEM of Croatia (in acquisition), and (iii) Hydrographical network (in acquisition). The geodatabase should contain also the flood maps produced in the last 3 years. The lack of longer time-series hinders frequency or return period analysis using the floods maps. Flood risk assessment is then performed simulating past floods using historical data from the inundated sites and frequency analysis on the water levels. Moreover CW has the project to use digital urban master plans to be overlaid to past flood maps in order to enhance the flood risk assessment.

Up to now DHMZ has not participated in national projects to produce actual risk analyses for DRR or economic sectors. Probably one of the main gaps in the involvement of DHMZ for the development of tailored products for flood and drought risk assessment as well as for other hydrometeorological hazards is that DHMZ does not receive any feedback from the users.

4.3.4. Forecasting

DHMZ produces operational forecasts for different time scales, as described in Table 22: nowcasting (0-3 hours), short range forecasts (up to 72 hours), medium range forecasts (up to 10 days) and long-range seasonal forecasts (up to 6 months).

DHMZ, Marine Meteorological Centre Split (PMC), produces +12h, +24 h, +36h, +48h, +72h and +120h weather forecasts and warnings for the Adriatic Sea, and wave height (m) and mean wave direction forecast until +84 h. The Adriatic Sea forecasts are given in Croatian, English, German and Italian.

Currently hydrological numerical models are not in use and no hydrological forecasts are produced. Forecasting of air quality and dispersion of smoke from different origins can be done with numerical models linked to the NWPs. DHMZ has the HYSPLIT numerical model for airborne pollutants, but currently such models are not run operationally.

Special forecasts are produced for agriculture (2/week), land and water transport (2/day), energy production (1/day), construction, water management and tourism (by request).

Table 22: Different types of operational forecasts produced by DHMZ

Forecast type	Weather			hydrological			environmental		
	provide	n/d	on web	provide	n/d	web	provide	n/d	web
Nowcasting	If necessary		yes	no			no		
12 hours	yes		yes	no			no		
24 hours	yes		yes	no			no		
48 hours	yes		yes	no			no		
3-,4-, 5-days	yes	2	yes	no			no		
one week				no			no		
10 days	yes	2	no	no			no		
monthly outlooks				no			no		
seasonal outlooks	yes		no	no			no		

n/d: number of runs per day

DHMZ forecasts are based on the use of numerical models, real-time satellite information and observation data. Forecasts up to 10 days are based on NWP products from the ECMWF model, which run with 16 horizontal resolution. DHMZ own NWP modeling is done up to + 72 hours. Nowcasting suffers from lack of weather radar data. The operational NWP model is the ALADIN/HR (or AROME), which is the latest joint product of the European HIRLAM +Aladin consortiums. It is run twice a day at the domain shown in Figure 20. The horizontal grid size is 8x8 km^2 and number of vertical levels is 37. The length of time steps is 1 hour. AROME can also be used for mesoscale modeling at e.g. 2-3 km horizontal resolution, as done by some of the AROME consortium members. DHMZ also has capacity to operate other NWPs like MM5, COAMPS, HYSPLIT and EMEP4HR, which are mainly used for research and air quality purposes, but can also be coupled to ALADIN/HR at the high resolution mesoscale level when needed.

Weather conditions above Croatia are highly modified by orographic and surface features. This requires further development in mesoscale modelling and further increase in spatial resolution. At the same time nowcasting methods, based on combining satellite and radar data with the results of prognostic products of meso-models need to be developed.

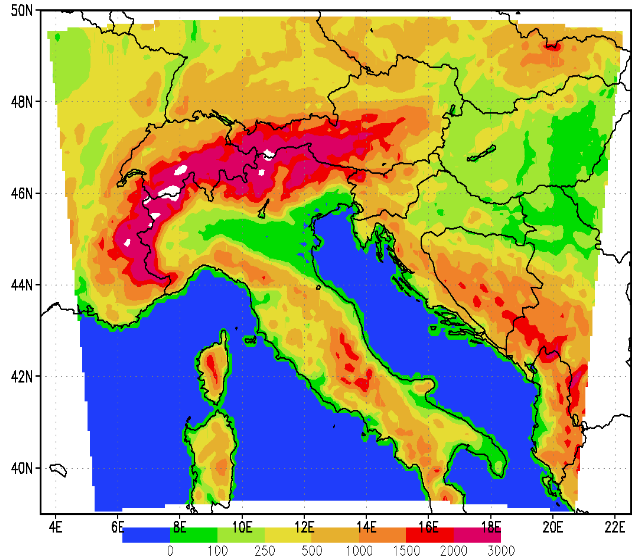


Figure 19. Area covered by DHMZ operational NWP model with and 8x8 km^2 horizontal resolution

DHMZ uses Metview, GRADS and TRIVIS software for producing NWP maps, meteograms and weather charts (Internet, FTP). Currently DHMZ does not have automatic system for production and dissemination of tailored user-specific weather forecasts.

Currently DHMZ has a SGI Altix LSB-3700 BX2 supercomputer available for NWP runs. As a member of ECMWF it also has possibility to use the ECMWF computers. The disk space available consists of 96 GB standard system memory and 2x146 GB/19Krpm SCSI disk drive. The computer resources are sufficient for current operations, but do not allow e.g. Climate Change modelling and research. The old headquarters with poor electrical system does not allow significant enhancement in the computing resources.

Currently DHMZ does not have an in-house back up system for its data management and numerical weather modelling, which poses a certain risk for DRR. On the other hand the electricity system of current premises does not allow use of any bigger computing systems, as the energy consumption of super computers is significant.

4.3.5. Warning products and services

4.3.5.1. Warnings and mandates

Weather services and forecasts are provided by several entities: DHMZ, Air Traffic Control, private companies and Croatian Army. However, only the DHMZ has the mandate to issue general science based warnings of hydrometeological hazards (strong winds, hail storm, thunderstorm, heavy snow, freezing rain, dense fog, storm surge, icing of roads, heat & cold waves, drought, river flooding and marine hazards) through media, its internet pages and the European METEOALARM system, and directly to authorities. In the warning messages disseminated, DHMZ does not analyze potential impacts of the hazards. DHMZ-Split produces warnings for the whole Adriatic Sea. DHMZ also shares some responsibilities, and some of the warnings are given by third parties (see Table 23). DHMZ provides specialized alerts and warnings to health, sanitation, housing, food security, fresh water, transportation, land-use planning and maritime sectors. The early warnings produced by DHMZ are based on analyses of national and international hydrometeorological observations, on international and DHMZ numerical weather predictions and following of international global and regional weather forecast products, on availability of satellite images, on scientific standard of the DHMZ staff, and national and international cooperation. Forecasting of air quality and dispersion of smoke from different origins can be done with numerical models linked to the NWPs. Concerning e.g. the recent Icelandic volcano ash the DHMZ did modelling of dispersion, and has the role of advisor to the aviation sector. In order to produce new warnings e.g. to the health or transportation sector cooperation between DHMZ and respective sector is needed, as well as properly financed R&D projects.

The Croatian Waters is the responsible governmental organization for flood risk management. The Croatian Waters have signed an agreement with the112 center of NPRD concerning flood risk and pollution risk (water quality) for fresh water and coastal waters. Croatian Waters also has an agreement with DHMZ; DHMZ produces quality controlled national and international (transboundary rivers) hydrological data (both near real-time and historical) in agreed format. Concerning flash floods the responsibility is shared among DHMZ and Croatian Waters. For defense of river floods, Croatian Waters is responsible for fighting against the flood (with assistance of army and others), while warning of the people is the responsibility of the 112 center of NPRD.

Table 23: Warnings for natural and technical hazards in Croatia based on Annex 2

Hazard	Exists in the country	Frequency per year	Warning by	Type
Heavy precipitation	Yes		DHMZ	I
Flash floods	Yes		DHMZ + CW	II
River flooding	Yes	1	DHMZ + CW + PRD	II
Coastal Flooding		1		
Hailstorm	Yes		DHMZ	I
Thunderstorm or lightning	Yes		DHMZ	I
Heavy snow	Yes		DHMZ	I
Freezing rain	Yes		DHMZ + CR	II
Dense fog	Yes		DHMZ + CR	II
Tornado or cyclone	No		DHMZ	I
Hard wind	Yes		DHMZ	IIII
Storm surge	Yes		DHMZ + HI	II
Heatwave	Yes		DHMZ	I
Cold wave	Yes	2	DHMZ	I
Drought	Yes	2	DHMZ + MA + CW	II
Marine hazard	Yes	5	DHMZ	I
Sandstorm	No			
Landslide or mudslide	Yes	1	DHMZ + GI	II
Avalanche	Yes	1		
Airborne hazardous substance	Yes		DHMZ +NS + PRD	II
Waterborne hazards	Yes		DHMZ +NS + PRD	II
Hydrometeorological hazards for aviation	Yes	2	CAC	III
Forest or wildland fire	Yes	10	DHMZ + PRD	II
Smoke, dust or haze	Yes		DHMZ	I
Earthquakes	Yes	1	GI	III
Tsunamis	No		DHMZ + GI + HI	II
Volcanic events	No		DHMZ + GI	II
Dispersion of insect pests	Yes			
Desert locust storm	No			
Hazard for allergic reactions	Yes			

HI = Hydrographic Institute, CR = Croatian Roads, CW = Croatian Waters, MA = Ministry of Agriculture, PRD = National Protection and Rescue Directive, GI = Geological Institute, NS= State Institute of Nuclear safety, CAC= Croatian Aeronautical Control.

The 112 center of NPRD is the established mechanism for continuous collection and sharing of general risk information. The Service 112 reports on all risks and hazards, and if needed, alerts citizens, legal entities, administration bodies, rescue services, respective civil protection forces and relevant NPRD management. The Service also keeps records on hazards, accidents and disasters, and maintains the public alarm system in the Republic of Croatia and coordinates decisions and orders sharing.

4.3.5.2. Warning dissemination mechanism

Currently, the dissemination of the warnings is based on an Integrated Communication Network centered on the 112 Operation Center and including advanced IT solutions, SOP, warnings and warning levels (Figure 20). The National Centre 112 is functioning as an integrated operational-communicational hub in the international communication system for all protection and rescue aspects. The National Centre 112 continuously collects and analyzes the following data and information:

- the water levels and their tendencies;
- meteorological conditions;
- seismological activities;
- fire risks;
- radiological emission levels;
- environmental pollution levels;
- emergency medical transportations by air or sea;
- epidemics and pandemics;
- road, air, railway, sea, river and communication traffic, and the situations at the border crossings.

Figure 20. Croatia integrated communication network

When data and information are received by 112 center, they are analyzed, transformed into reports and submitted to respective NPRD managers and the other relevant protection and rescue actors. If there is an emergency, provides emergency report to respective protection and rescue actors, shares information between protection and rescue actors, conveys decisions, directives, orders, measures and reports from respective managing to operational structures, and collects operational reports and submit them to the managing structures.

The circulation of warnings in the system is regulated by Standard Operative Protocols (Figure 21). The main emphasis is in warning dissemination between organizations, rather than in mechanism to disseminate rapid information all the way to the grass root level. Currently e.g. SMS messages to different target groups in danger for different types of hazards are not in use.

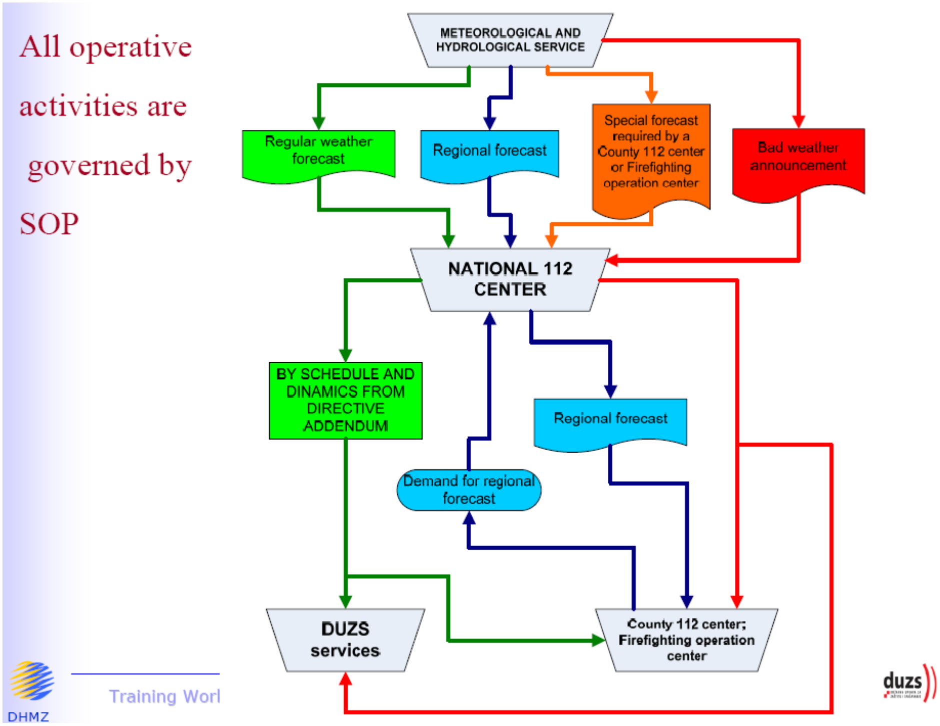


Figure 21. Standard Operative Procedures between NPRD and DHMZ for weather forecasts

In addition to the SOP of the 112 system, DHMZ has adopted also web and IT solutions. For communication and dissemination of information and alerts, DHMZ has tailored Internet pages available for Fire Brigades only (at all 3 levels: country, counties, local). DHMZ provides warnings to the public through TV, radio and other media and its internet pages. However, it does not have the mandate to cut TV or radio programs in case of emergency or exceptionally harsh weather conditions, or to have an information stripe to be added on every TV presentation (as in many of the EU countries). It gives warnings directly to 112, Fire Brigades, Government, ministries, aviation authorities and to different economic sectors like agriculture and transportation. DHMZ Split provides warnings to maritime sector. Forest fire index is produced by DHMZ for the Fire Brigades, but it is not announced for public, as it has been noticed that this activates pyromaniacs. In case of hazard, or potential hazard, the DHMZ also gives information and advisories through phone and mobile phones. Shipping companies, national rescue organization and the pollution mitigation authorities at sea usually monitor the standard meteorological reports in textual and graphical format, and if necessary communicate personally with the forecaster. DHMZ also transfers all its information to be disseminated through the NPRD internet pages. Finally, as member of EUMETNET the DHMZ also provides warnings to the EU METEOALARM system. However this cannot be considered as an active but a passive method to disseminate information.

Currently DHMZ does not have a state-of-the-art fully automated dissemination system of products and warnings. Such a system would significantly speed up the dissemination system and provide the warnings in individually tailored formats to each sector and part of the DRR system. Nevertheless, this approach demands to strengthen the mutual exchanges with the DRR partners in order to understand the needs and requirements of the users and obtain feedbacks from them.

4.3.6. Climate change analysis

DHMZ cooperates with major European Climate Change R&D and modelling centers such as the HADLEY center (UK), and the Max Planck Institute (Germany). DHMZ has produced downscaled projections of climate change for Croatia. Currently DHMZ does not have sufficient amount of scientific staff, numerical modelling staff and computer power to produce independently large scale and very detailed climate change studies. It can be expected that Croatia could significantly benefit from the new South East European Virtual Climate Change Center (SEEVCCC), which was established in 2008 within the NMHS of Serbia.

4.3.7. Research and Development

The research cooperation and networking with European NHMSs and other research units could be improved. Currently DHMZ does not fully utilize the possibilities to gain from the EU research cooperation and funding, and the FP7 research and networking (e.g. Marie Curie) programmes, and COST actions, are not well known. However, it may be noted that it is difficult to find e.g. meteorology directly as a research topic, but it can built into proposals under several research areas like renewable energy, nuclear energy, construction, transportation, environment, etc.

4.3.8. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings. Croatia has an integrated communication network within the DRR management and respective agencies and DHMZ is part of that network.

Table 24: Equipment in use for data communication and warnings and other products dissemination

Telecommunication Equipment	To receive data	To send data	To send warnings	To send products
Telephone	X	X	X	X
Mobile Phone				
Telefax	X	X	X	X
Dedicated Leased Lines	X		X	
UHF radio transceiver				
High frequency/Single side band radio				
HF Radio Email				
Aeronautical Fixed Telecommunication Network				
Very Small Aperture Terminal				
Data Collection Platforms used to transmit data from AWSs	X	X		
Global Telecommunication system (WMO-GTS)	X	X		
Meteosat Second Generation Satellite system	X			
Other satellite systems				
Internet	X	X		X
Email		X		X
Post/mail	X	X		X
Print media				
TV –national				X
TV-commercial				X
Radio				X
Bulletins		X		X
Printed text				

DHMZ is connected to Internet via 10 Mb broad-band, and to WMO GTS via a 512 kb cable. The data exchange protocols meet the WMO, EU, EUMET and the EUMETNET standards.

DHMZ has an adequate contingency plan that ensures continuity of warning products of warnings and services in case of organizational emergencies. In case of power failure reserve power is available.

4.3.9. Human resources

The number of staff is relatively high, compared to other SEE NHMSs. More than half of the staff is technicians; more than half of them work with observations or hail prevention. The scientific level and education of the operational staff is quite good with respect to the duties, but DHMZ suffers from lack of academic and ICT staff.

Table 25: Number of DHMZ staff by branch and level of education

Branch	Field and education														TOTAL
	Techn-icians	Meteorologist			Hydrologist			Engineer			Physicist, Chemist, Economist			Other	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Observation network	90	15		1	2		1								109
Telecommunication	10	2	1	1											14
Data management	15	5	2		3	1									26
Weather forecasting	5	15	3	1											24
Hydrological forecasting	10	1	1		3										15
NWP	1	2	2	1											6
R & D	3	5	8	3											19
Weather modification	70	10													80
IT personnel	5	5													10
Commercial services															
Accounting	15														15
General administration	10													5	15
Other	17	26	5	2				3			3	1		29	86
TOTAL	**251**	**86**	**22**	**9**	**8**	**1**	**1**	**3**			**3**	**1**		**34**	**419**
Female in % of total	30	60	60	50	60										
Men in % of total	70	40	40	50	10										

Unlike the hydrometeorological services of the European Union, the DHMZ does not have capacity and forecaster resources to operate a 24/7 monitoring, analysis and forecasting system. This causes a significant risk to operational DRR and early warning system, even if current staff could be made to work overtime and additional shifts in case of threat of a hazard or during an event of a hydrometeorological extreme. The office hours for the weather forecasting department are from 04 to 18, daily.

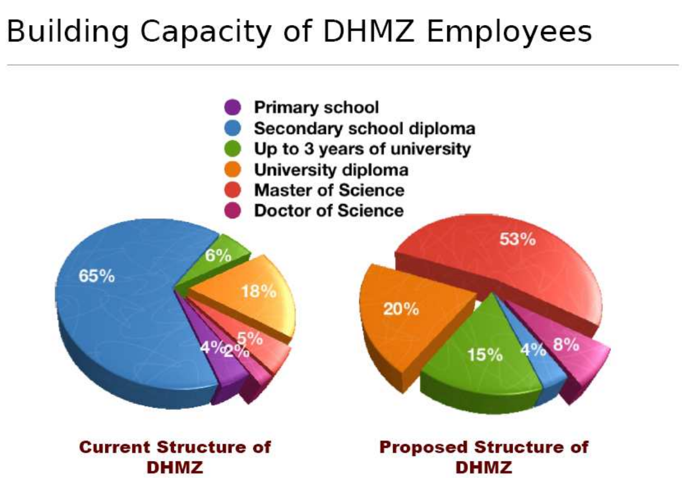


Figure 22. Current and proposed human resources capacities for DHMZ

The number of communication experts is 3, which is not enough to ensure 24/7 communication system. DHMZ has a number of experts working in data management and computing: 5 “helpdesk” experts, 3 data base experts, 2 quality control experts and 3 software experts. None of these experts are available 24/7. The number of main computers and other computing experts is low compared to more advanced NHMSs. Currently DHMZ employs two translators and additionally the services of one translator are used by outsourcing to translate mainly weather forecasts. At more advanced NHMSs the weather forecasts are produced automatically in required languages.

In future it is necessary to increase the number of academic staff in order to meet properly the increasing demand to produce R&D services to the community. Also the development of tools, software and services will be done through investment into R&D. However, this cannot be properly implemented without sufficient number of high quality and trained ICT and IT staff.

4.3.10. Internal capacity building

DHMZ has invested in internal capacity building and technical training of the staff by providing technical training on the forecasting of hazards including up-to-date training of new forecasting technologies, by conducting training of disaster risk reduction processes and by inviting experts and lecturers from other organizations. DHMZ also participates in drills concerning DRR activities.

DHMZ has a quite extensive interaction programme with industry and customers including press conferences, reports and training for media, educational modules and training programmes targeted at general public and collaboration with schools and universities.

4.3.11. Premises

Current premises do not meet the standards of a developed NHMS with needs of secure computing and communication systems, business type cooperation with the industry and other end-users of hydrometeorological services, adequate working space for experts and other staff and for the technical equipment and instruments, and they do not give an image of a modern and active governmental research and service institute.

Current premises do not make it possible to promote the communication, data management and numerical forecasting with adequate back-up systems (all critical for EWS and DRR) due to restrictions in the electricity capacity in the ancient and obsolete headquarters of the DHMZ.

4.3.12. Financing

DHMZ, as a critical part of the DRR, is severely under-financed for essential parts concerning DRR. DHMZ does not have resources to operate a 24/7 analysing and forecasting system (unlike the EUMETNET NHMSs). DHMZ is also under-financed with respect to purchase, operate and maintain adequate hydrometeorological observation network (adequate number automatic real-time meteorological and hydrological stations) or modern weather radar and lightning detection networks. However, DHMZ has important governmental financing for hail monitoring and suppression. The benefits from this financing for DRR, and the agriculture sector in general, are very doubtful and the whole system scientifically questionable. Due to the structure of the DHMZ financing and budget, DHMZ cannot use its current human and financial resources to promote its services to DRR.

Up to now, the DHMZ has not received financial resources to implement investments in order to strengthen its capacity to better promote national, regional and European DRR, as proposed by the recent UNISDR-WMO-WB initiatives and project reports. The value of better hydrometeorological observations and services to the national economic development, and especially to DRR, is not yet fully recognized and appreciated by the Croatian Government and politicians.

DHMZ benefits from cooperation with EUMETNET, ECMWF, EUMETSAT, EU METEOALARM and cooperation with regional and other European NHMSs. Participation in these organization is financed by the government (as proposed in the SEE 2007).

4.3.13. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums, to which membership provides better and more services than to non-members.

The European NHMSs have globally unique opportunities to benefit high level services and cooperation from memberships of European hydrometeorological organizations, including ECMWF´s the state-of-the-art weather forecast modelling, medium-range weather forecast products at 16 km horizontal resolution (in near future at 8 km resolution) including the Extreme Forecast Index (EFI), re-analysing data to be used e.g. for climatological studies and the ECMWF super computer resources. The integration into the European hydrometeorological infrastructure was given the highest priority in the 2007 project in developing the capacities of the NHMSs to adopt best European practices and to improve quality of products and services in support of national economic development and DRR. DHMZ has actively become member of main organizations and the leading consortium of numerical weather prediction models.

Table 26: International and regional cooperation activities of DHMZ

International and regional organization and cooperation mechanisms	DHMZ status
WMO	member, PR
WMO RAVI	Member, Presidency
RMDCN	Yes
IOC	Member
UN-ISDR	Cooperation
UNDP	cooperation
Red Cross	cooperation
EU	active cooperation
EUMETSAT	Member
ECMWF	Co-operating State
EUMETNET	Member
METEOALARM	Member
ECOMET	Member
EUFP7 projects, networks	Some projects
EU JRC	Participates in flood forecasting, forest fire index
EU PHARE	Projects within air quality
EUCLID	Member
EUR-OPA	member
DMCSEE	Member
SEEVCCC	Member
SAVA Commission	Member
NWP consortium	AROME
NMHS bilateral	Austria, France, Hungary, Slovenia, BiH, Slovakia, Hungary, Montenegro, Poland
NMHS MoU	Finland, Germany, Netherlands
DPPI	Member
RCC	Member

European Union research and networking programs create consortiums of excellence, and provides good opportunities to NMHS to network with NMHSs and commercial R&D companies and strengthen their scientific, human and technical capacities. Up to now DHMZ has not effectively used the possibilities provided the EU R&D programmes, and the capacity of the DHMZ staff has been low to produce project applications and/or to participate build-up of scientific consortiums.

Currently the level of international cooperation is more active than in the other SEE NHMSs. DHMZ has a visible role within WMO and leading role in regional cooperation.

The main frameworks for regional and sub-regional cooperation are the Regional Cooperation Council (RCC), Disaster Preparedness and Prevention Initiative (DPPI), Central European Initiative and Civil-Military Emergency Preparedness and the South Eastern Europe Council.

Three years ago the idea to link all countries in the Danube watershed into one information network has been launched in DPPI with the objective to harmonize hydrological data, because some countries were measuring the water levels while others the water flow (m3 per second).

Moreover, bilateral agreements with Slovenia, Bosnia and Herzegovina, Hungary, Austria and Slovak Republic, as well as membership to the International Sava River Basin Commission and the International Commission for the Protection of the Danube River should enhance the early warnings, prevention from and mitigation of flooding of Sava and Danube rivers and their tributaries.

In the sub-region, DHMZ is also contributing to steering activities of the Drought Management Centre for Southeastern Europe (DMCSEE) in Ljubljana (Slovenia)), participates in the DMCSEE project financed by EU and is building up resources and potentials for the establishment of the Sub-regional (WIS-DCPC) Marine Meteorological Centre (Croatia).

Concerning data exchange and common modelling of transboundary rivers Crotian Waters has a cautious approach. On the basis of the experience of past initiatives, CW stresses the concept of an “acceptable level of data exchange”, even if they recognize the importance of the interoperability of systems and the exchange of data for hydrological modelling and analysis in shared catchments. Building on the Sava River experience, where problems in databases interoperability and in the sensibility of flood forecast models have been experienced, CW stresses the need of introducing some correction mechanisms able to harmonize the modelling sensibility between different countries. Indeed, the Sava commission identifies common criteria and the thresholds for the analysis. These criteria are established considering the technical capacity and the level of detail achievable by the different countries of the commission. In the case of Croatia such criteria are below national standards. Thus CW has the option or to use different criteria for Sava and for the other rivers, or to adopt Sava standards also for the other rivers reducing the quality of the results. CW sustains that both options are not acceptable dealing with the security of people and assets. CW stresses that national protection standards and rules must be common over all the country and the best achievable. So, the solution for CW is to establish a level of compensation that allow for each country the use of their own quality standard in terms of precision on transboundary rivers modelling. Nevertheless, CW would improve the hydrological and meteorological data exchange with neighboring countries through the DHMZ, which should ensure data quality control and data management.

4.4. Technical recommendations to strengthen DHMZ capacities in support of DRR

Among the SEE countries the technical capacity of DHMZ is at a high level, but compared to advanced EUMETNET NHMSs its observation networks and premises are obsolete, human resources are understaffed and financial resources are very low. It is necessary to modernize the DHMZ and ensure adequate human, technical and financial resources in order to sustain their role in different phases of the DRR: operational monitoring, mapping of hydrological and meteorological hazards, forecasting and warning per the following technical recommendations:

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. There are needs to promote awareness of the great potential which the DHMZ has to contribute to the DRR and the social and economic development in the countries;
2. There are needs to better integrate the DHMZ into the DRR planning process;
3. There is a need to increase the number of type I warnings by enhancing the mandate of DHMZ.

Operational relationships with other agencies

4. There is need to improve the cooperation at the national level between DHMZ and NPRD and relevant institutions and end-users to further enhance national system for preventing and mitigating the impact of extreme weather and climate events.

Monitoring and observations networks and data exchange

5. There are needs to modernize the hydrological and meteorological early warning systems - in terms of real-time data collection and dissemination of information;
6. There are urgent needs to further automatize the hydrological, meteorological and marine observation systems and to increase the number of automatic stations in cooperation with DRR management and industry;
7. There is a need to further strengthen the observation network by developing remote sensing systems, including 4-5 dual-polarization weather radars.

Forecasting

8. There is a need to further develop capacities to support DRR through nowcasting;
9. There is a need to improve the capacities in Numerical Weather Prediction (NWP) modelling to produce operationally mesoscale products and to implement data assimilation;
10. There are needs to promote use of very high resolution NWP models, which are essential for hydrological modelling in complex terrain;
11. There are urgent needs to implement hydrological forecasts;
12. There is a need to improve capacities to use automatic analysing, editing and dissemination tools;
13. There is a need to invest in proper back up capacity for NWP modelling.

Hydrometeorological data management systems

14. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data;
15. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.

Hazard analysis and mapping to support risk assessment

16. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment;
17. There is a need to strengthen the systematic collection of drought/floods impact information on a state level with standardized procedure and long-lasting approach;
18. It is necessary to invest more in climate mapping, forecasting and analysis so as to plan adequate adaptation measures in risk-exposed sectors;
19. There is a need to train staff in drought/floods analyzing, forecasting and warning to better respond to the requests of users or in the case that DHMZ is charged of other activities in risk assessment;
20. There is a need to strengthen GIS and remote sensing capacities for the agrometeorology Division, to strengthen agrometeorological modelling for specific crops (grape, olives),.agrometeorological operational modelling and forecasts, application of seasonal weather forecasts for crop yield modelling and to involve young scientists in agrometeorology.

Information technology and telecommunication issues

21. There are urgent needs to promote automatic production of tailored end-user-orientated services and automatic dissemination of forecasts and warnings.

Warning products and services

22. There is an urgent need to establish a 24/7 science based analysing, forecasting and warning system at DHMZ;
23. There is urgent need to promote production of flood and flash flood warnings;
24. To increase the number of warning products;
25. There is need to give the DHMZ mandate to have alarms shown on every TV channel as an info-stripe when needed.

Climate change analysis

26. There is the need of strengthening DHMZ technical capacity to better monitor climate through enhanced investments in climate modelling, forecasting and analysis ^to develop climate change impact studies to support sectoral planning for DRR and other at-risk sectors.

Human Resources

27. It is necessary to ensure adequate human, technical and financial resources to the DHMZ to sustain their role in different phases of the DRR: operational monitoring, mapping of hydrological and meteorological hazards, warning and forecasting;
28. There is urgent needs to increase the number of skilled weather forecasters to enhance the forecasting capacity to achieve 24/7 operation;
29. There are urgent needs to increase the number of hydrological modellers and researchers, NWP model experts, ICT and IT experts, engineers and observation network and maintenance experts, data management experts, PR experts and marketing experts;
30. There are urgent needs to promote training of the mid-management in leadership, project management and participation in EU R&D projects;
31. There are needs to improve laws, statutes, administrative practices and accounting systems to promote NHMS´s possibilities improve their commercial services, participation in EU R&D projects and to better adjust the structure and amount of staff to respond to new challenges, to enhance the base of financing and to promote sustainable development.

Facilities

32. There are urgent needs to have new premises for DHMZ in order to ensure data communication and exchange and production of NWP based weather forecasts which are critical for DRR, operation of industry and wellbeing of people.

Regional cooperation

33. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
34. Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans;
35. Modernisation and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing

opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;

36. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres (eg ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
37. A regional harmonisation of watch and warning systems should be promoted;
38. Cross-border exchanges of real-time data, forecasts and warnings should be increased.

4.5. Recommendations of the Croatia National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Zagreb, on 7-8 June 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: To encourage all existing disaster risk reduction actors in Croatia, as defined by the existing legal framework, to work together and invest additional efforts in recognizing and fulfilling existing disaster risk reduction tasks and responsibilities.

Recommendation 2: To strengthen coordination, strategic planning and management of disaster risk reduction at the national level through modifications of the existing institutional set-up by empowering, i.e. providing authority, accountability and responsibility to the National Platform to evolve into a multi-stakeholder national mechanism that serves as an advocate of disaster prevention and disaster risk reduction; provides coordination, analysis and advice on areas of priority; and undertakes strategic DRR planning and management.

Recommendation 3: To facilitate and support establishment of mirrored/similar/same mechanisms at the county and local self-government levels through strengthening and reinforcing local capacities, institutions and governance capabilities.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning
Recommendation 4: To enhance the early warning system and interoperability of the System 112 through modernization of the continuous and real-time collection and information sharing by expanding the hydrological, meteorological and air-quality monitoring networks, establishing integrated fire-protection system and ensuring functional horizontal and vertical links among all disaster risk reduction actors.

Recommendation 5: To strengthen technical and human resources of the State Seismological Survey, and enhance the modernization and improvement of the seismological monitoring network and data transmission system.

Recommendation 6: To enhance technical and human resources of the Meteorological and Hydrological Service in operational monitoring, warning, forecasting and mapping of hydrological, meteorological and ecological risks.

Recommendation 7: To further strengthen operational cooperation of the National Protection and Rescue Directorate and the Hydrological and Meteorological Service through joint training and improvements to the standard operating procedures across agencies linked to the different threat levels and lessons learnt from each disaster event.

Recommendation 8: To enhance investments in climate modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors.

Recommendation 9: To increase the awareness of the citizens and media regarding the early warning system and the European Emergency Number 112.

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 10: The Ministry for Science, Education and Sport is mandated to mainstream disaster risk reduction into national educational curriculum by establishing Curriculum Revision Working Group composed of the representatives from the Ministry for Science, Education and Sport, from the National Protection and Rescue Directorate, Meteorological and Hydrological Service, the Republic Seismological Survey, other respective line Ministries, the Croatian Red Cross, expert organizations and individuals.

HFA priority 4: Reduce the underlying risk factors

Recommendation 11: To develop the disaster risk reduction Strategy and corresponding Implementation/Action Plan as a first mutual step undertaken by the key disaster risk reduction actors, e.g. the National Protection and Rescue Directorate, the Hydrological and Meteorological Service, the Republic Seismological Survey, line Ministries and respective public enterprises, the Croatian Red Cross, civil society and business community toward integration of disaster risk reduction into the development policies, strategies and sectoral plans, followed with the implementation of the said Strategy.

Recommendation 12: To develop national capacities for climate services to support medium and long-term sectoral planning through strong collaboration and cooperation across line ministries and with the Meteorological and Hydrological Service, and through enhanced regional cooperation with other South Eastern European and EU countries.

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 13: To proceed with the establishment, in Croatia, of the Centre of Excellence for a training of fire fighters and coordination of response to forest fires in the countries of South Eastern Europe, including the harmonization of the development of fire-fighting brigades in the countries of the region through standardization of equipment and procedures, thus promoting regional cooperation and collaboration in disaster risk reduction in South Eastern Europe.

5. CHAPTER FIVE: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

The Former Yugoslav Republic of Macedonia is highly exposed to natural hazards like flood, drought, heavy rainfall or snowfall, wind storms, heat waves, landslides, avalanches, forest fires, airborne sand from deserts and some epidemics which are directly or indirectly related to hydrology, meteorology and weather conditions.

This chapter presents all the findings related to the assessment of the Disaster Risk Reduction (DRR) institutional framework and the technical capacities of the NMHS of the Former Yugoslav Republic of Macedonia (Hydrometeorological Service, hereafter referred to as HMS) to support DRR. It highlights that:

- Currently HMS does not have the technical, human and financial resources to fully support risk assessment and early warning systems of hydro-meteorological hazards;
- It is critical to upgrade and modernize the national hydro-meteorological monitoring and information exchange network and the forecasting system and to provide sustainable organizational resources, human resources (education and training, IT expertise, international cooperation and networking) and technical resources (upgrade the automatic hydrological and weather radar network, integrate hydrological models in NWP modelling, integrate air pollution dispersion models with NWP modelling) and increase the budget available to HMS for efficient meteorological and hydrological disaster risk monitoring, forecasting and warning;
- It is necessary to enhance investments in climate modelling and analysis in cooperation with SEEVCC to support strategic and sectoral planning for at-risk sectors and investment plans of industry in order to promote economic development of the country;
- Development of Risk Assessment, MHEWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

5.1. Vulnerability to hydrometeorological hazards in the former Yugoslav Republic of Macedonia

5.1.1. General overview of the country's economic sectors

Macedonia is a small economy with a gross domestic product (GDP) of about $9.4 billion (2009). It is an open economy, highly integrated into international trade, with a total trade-to-GDP ratio of 81.6% at the end of 2009. Agriculture and industry have been the two most important sectors of the economy in the past, but the services sector has gained the lead in the last few years. In terms of GDP structure, as for estimations 2010, the service sector constituted by far the largest part of GDP at 58.3%, up from 54.2% in 2000. The industrial sector represents 29.6% of GDP, down from 33.7% in 2000 while agriculture represents only 12.1%. Textiles represent the most significant sector for trade, accounting for more than half of total exports. Other important exports include iron, steel, wine and vegetables, food items, tobacco. The imports include automobiles, machineries and equipments, food products, fuels, and chemicals. Serbia, Montenegro, Greece, Turkey, Russia, Germany, Italy, Belgium, Spain, Bulgaria, Slovenia and Croatia are the predominant trading partners of Macedonia.

5.1.2. Hydrometeorological hazards in the former Yugoslav Republic of Macedonia

Most of the natural hazards in the former Yugoslav Republic of Macedonia are related to hydrometeorology and weather and climate conditions; droughts, winds and storms, heavy rains, river and city floods, flash floods, landslides, wild fires, extreme temperatures… Besides the hydrological and meteorological hazards, there are many other weather depending hazards affecting FYR of Macedonia like allergic reactions to dispersion of pollen, smoke and other air borne pollutants, dispersion of insect pests, slippery roads, diseases and many other things. The analyses conducted within the SEEDRMAP and SEEDMAI programs in 2008 risk analysis, show that regionally, the Former Yugoslav Republic of Macedonia ranks 4th by number of disasters and 4th by degree of disaster consequences in South East Europe. The 2007 UNDP report on the 1993-2007 period counts 16 major disasters caused by natural hazards with 122,000 people affected and US$ 441 million worth of damage.

The frequency and intensity of floods in the past several years in the Former Yugoslav Republic of Macedonia are on the rise. Statistics show that floods are caused by overflow of the large rivers Vardar, Crna Reka, Strumica, Treska, Pcinja, Lepenec and Bregalnica. 44% of all disasters in the 1989-2006 period were floods or flood related disasters. There were two major floods in 1962 and 1979 with damage ranging between 7.2 and 7.4% of the GDP. The 1993-2007 UNDP report, registers seven floods affecting 111,400 people and causing an estimated damage of around US$ 353,600. Only in 2004, intense rainfalls, caused floods and torrents affecting 26 municipalities (mainly in the area of upper Vardar, but also in the central, southern and south eastern part of the country) with estimated damage of 15 million Euros. Most of the damage from floods was caused in rural areas by flooding households and arable land. Concerning the impact of climate change on the Former Yugoslav Republic of Macedonia's water resources and extreme hydrological phenomena, the risks from intensive torrents and prolonged droughts are expected to increase.

Forest fires (95% caused by man) are recognized as one of the risks the Former Yugoslav Republic of Macedonia most often faces. In the 2003-2007 period, 1,329 fires were reported with 94,000 hectares burned. The area affected and the economic consequences of forest fires in the past few years support the previous conclusion. One of the most frequent and often crucial causes is weather, i.e. climate characteristics and extreme temperatures, which cause rapid and easy burning of the dry and flammable material. The Macedonian Forests Public Enterprise manages 935,000 ha or 90% of Macedonian forests and almost all of the state owned forests. Only a small share is managed by the National Parks Directorate and other public utility enterprises.

According to the 2008 SEEDMAI analysis, 13% of all disasters caused by natural hazards are related to extreme temperatures. Extreme temperatures and heat waves or cold waves are caused by climate effects. They have direct influence (diseases and fatal conditions) and indirect influence (effects caused by extreme weather conditions like floods, droughts or storms) on people's health.

According to climate change studies, projected changing climate and increasing climate variability in the region indicate a growing risk for extreme hydrometeorological and climate-related events in the region. Additionally along modernization of the societies they become more vulnerable to natural hazards. Better use of hydrometeorological data in planning and improvements in early warning systems can help to prevent hazards from becoming disasters.

5.1.3. Sectoral analysis of the vulnerability to hydrometeorological hazards

In Macedonia, the most sensitive economic sectors to hydrometeorological hazards are: the water management, the agriculture and forestry and the tourism sectors.

Water is a critical natural resource. The total water resources of Macedonia are estimated at: 18.8 km^3 from rainfall (with a 733 mm average rainfall); 6.36 km^3 discharged from the river basin areas; 0.52 km^3 groundwater; and 0.42 km^3 from the largest springs. According to the World Resources Institute, the annual water resources per capita for the Republic of Macedonia are about 3 137 m^3/year, while the average value for Europe is 10 680 m^3/year. Irrigation is the major user of the total water demands in the country, about 40%. According to the 2002 census, the number of households connected to public systems for water supply in urban areas is 82% to 100%. In rural areas, this percentage varies from 10 and 100. For urban water supply, both surface and ground water are used, as well as a combination of the two sources. The variations in the hydrological cycles of the rivers in the country are determined by the seasonality of the precipitation and the temperature.

There is a general trend of reduction of the annual values of the average discharges for all river basins in the country. The same trend is defined for the minimum and maximum annual discharges for the whole territory of Macedonia. The reduction of the average annual discharges is the most pronounced for the river Bregalnica at the Stip hydrological station and for the river Strumica at the Novo Selo hydrological station, i.e. in the region with a moderate-continental-sub-Mediterranean climate. The results indicate that river basins with a low precipitation would be severely affected by climate change. The series of average annual discharges for river Bregalnica at the Oci Pale hydrological station is characterized by a descending linear trend. Reduction of the decade discharges for the period 2000-2003 compared with 1961-1970 is 36%. The situation with the average annual discharges recorded for the same river at the downstream hydrological station at Stip shows a more drastic reduction, which, for the period 2000-2003, compared with the decade 1961-1970 is 58%.

The occurrences of extreme hydrological events (floods and droughts) have increased in frequency and intensity over the past decades. For example, during the last three decades regional floods caused by the biggest rivers in Macedonia – Vardar, Crna Reka, Strumica, Treska, Pcinja, Lepenec, and Bregalnica – caused an estimated total damage worth USD 193.8 million. The damage caused by floods directly affects the already fragile agriculture and local rural economies. In June 2004 the occurrence of high, intensive rainfall, caused floods and flash floods in 26 municipalities in the country located in the upper Vardar and in the central south and south-eastern part of the country. Economic losses experienced during the flash floods in 2004 show that 91.3% of the total damage is attributed to the agricultural production mainly in the south-eastern part of the country (Report of the State Commission, 2004). The biggest losses have been experienced in the rural areas where households and cultivated areas have been flooded.

In general, the country has difficulties coping with extreme hydrological events (droughts and floods) due to a lack of finance, technical, and institutional capacities as well as legal instruments.

Agriculture is a key sector in the Macedonian economy. Based on year 2010 data, it currently contributes an estimated 12% to GDP and is the only sector to have increased output since independence. If the processing activities are also encountered, the agriculture-related contribution to the GDP is some 18%. Within the country, some 50% of the total area of 2.57 million ha is classified as agricultural land. Of this resource 51% is classed as cultivated land and the rest as permanent pastures. The cultivated land is largely centered on valleys or old lake basins and an extensive area of it is irrigated. Although there has been a recent trend toward intensification and specialization, particularly with livestock and vegetable production, private farms tend to be highly diversified and grow a comparatively large number of crops. This diversification is partly due to a tradition of self-sufficiency in basic food needs and partly a risk-aversion strategy in response to climatic variation and unreliable markets. Typically, the smallholder farmer plants cereals, vegetables, fruit trees and livestock for self- sufficiency and, for cash crops, a similar mix, plus tobacco and grapes.

Macedonia is among the most arid areas in Europe. Drought is very frequent and can occur with various duration and severity, causing frequent damages to agricultural sector, mostly expressed as reduced yield. Due to this Macedonia developed irrigation schemes that cover almost one fourth of the arable land in the country (120 000 ha under irrigation) but only 20-30.000 ha are actually irrigated and most of Macedonian agriculture depends on rains and is very vulnerable to drought. In Macedonia there is not an operational monitoring or early warning system to support the agricultural sector in order to cope with drought phenomena. The most vulnerable agricultural zone is Povardarie region, especially the area of the confluence of the Crna and Bregalnica rivers with the River Vardar (Kavadarci as a corresponding meteorological station). Other highly vulnerable zones are: (i) the Southeastern part of the country (Strumica); (ii) the Southern Vardar Valley (Gevgelija); (iii) the Skopje-Kumanovo Valley (Skopje); and (iv) Ovce Pole (Stip).

Frequent and intensive droughts exacerbate social and economic conditions in the rural parts of southern and eastern Macedonia. For example, a prolonged drought in 1993 damaged most of the crop yields and in many cases resulted in a total crop failure. At the countrywide level, the damage caused by this drought amounted to 7.6% of the total national income.

According to the Annual Report of the Ministry of Agriculture, Forestry, and Water Economy (MOAFWE) for the year 2005, the animal breeding sector has been rather stable over the last seven years. Animal production in a broad sense is affected directly and indirectly by climate variability and change. Direct effects are correlated to projected temperature increase and increased heat stress on domestic animals. Indirect effects are correlated to the projected decrease of forage production, as well as in emerging diseases. It is expected that a shortage of locally produced animal fodder will decrease the amount of animal products in the country. It can be foreseen that some tropical diseases, especially those transmitted by insects, will leave their natural basin of endemia to spread to other countries out of their natural habitat.

The total forest land in the country is 11,596 km^2, out of which forests comprise 947,653 ha. The total wood mass is 74,343,000 m^3, and the total annual increment is 1,830,000 m^3 with an average annual increment of 2.02 m^3 per hectare. Some of the main threats and problems in forest management and governance are: illegal logging, forest fires, which have affected nearly 100,000 ha in the last ten years, climate change impact through the increased forests dieback process, insect calamities, and diseases. Based on past experience, as well as on the results from climate change scenarios, climate change impacts on forestry might be manifested through: a more intensive process of morphological changes to oak and fir; increased number of forest fires and burned area, due to the increased percentage of dead trees; and migration of tree species towards higher altitudes. Among the most important factors influencing forest fires, often decisive, are the weather conditions, more precisely the climate characteristics of the region. In the period 1999-2005 a total of 1,191 forest fires were recorded, with a burned area of 59,500 ha. and over 28 million total economic loss. The largest damage occurred in 2000, when the burned area was 46,000 ha. In the summer of 2007 Macedonia experienced extended wildfires, which severely affected forests and other vegetation over an area exceeding 40,000 hectares. One of the contributing factors was climate condition, i.e. a dramatic heat wave and the highest temperatures ever recorded along with the prolonged dry period pushed the usual summer forest-fire season drastically beyond its usual pattern. It is evident that forest fires not only destroy the biodiversity, change the micro-climate, and create potentials for erosion, but also cause enormous economic losses, which will take decades to be recovered.

With its lakes and mountains, more than 1,000 churches and monasteries, and more than 4,200 archaeological sites, Macedonia has a strong tourism potential. Mountain and lakeside tourism are the most attractive and revenue-raising in the country. On the other hand, these destinations are considered particularly vulnerable to climate change, as they are nature-based tourism destinations and all outdoor tourism activities are dependent on favorable climate conditions. The summer season could be extended as a result of the temperature rise, as per climate change scenarios, which could be of benefit, bearing in mind that these sites generate the highest revenues from tourism. But drought conditions could affect lake water levels and water supply. The water consumption needs of tourists have to be considered, especially in the Crn Drim catchment area. Tourism is also a large consumer of water per capita. Bigger water consumption would require provision of a new potable water supply resources, and construction of new sewage systems for both households and industry, especially for the tourist destinations. Inevitably, energy consumption will increase, also as the need for cooling of indoor premises becomes essential with the temperature increase. Increased duration of heat waves can have adverse affects on water quality, and can also be related to the higher risk of forest fires in tourist areas. Scenarios of climate change developed at the national level show an increase in the winter temperature, also accompanied with less snow coverage and later start of the skiing season.

5.2. Institutional Framework of Disaster Risk Reduction in the former Yugoslav Republic of Macedonia

5.2.1. Legal framework

In general, the disaster risk reduction policy and strategic framework in FYR of Macedonia are not defined in a single document (Figure 23). The Law on Protection and Rescue[5] and the Law on Crisis Management[6] are the key laws elaborating disaster risk reduction (DRR) policies. Both laws were adopted within one year (2004-05).

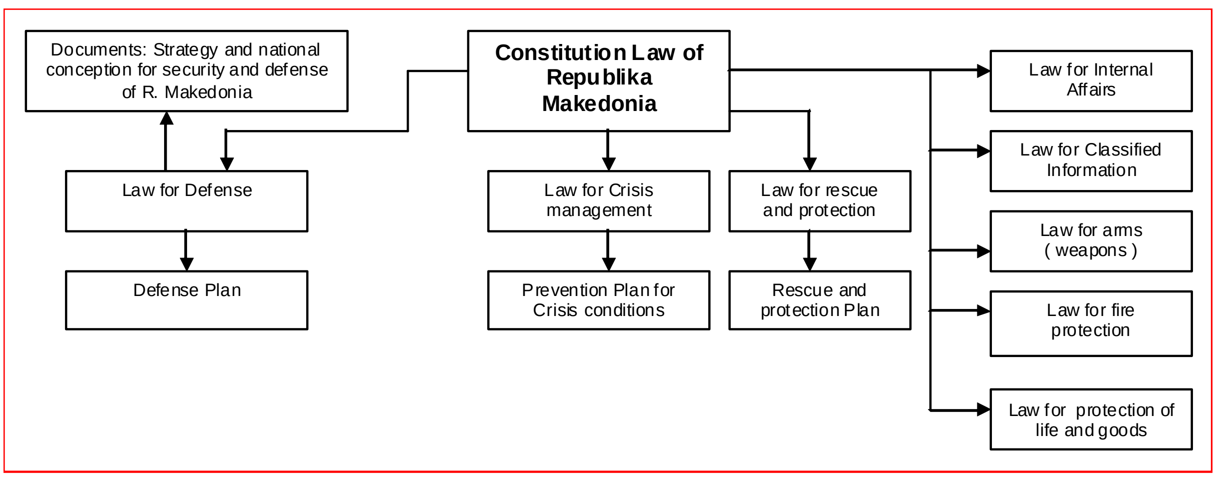


Figure 23. Legal framework for DRR in the FYR of Macedonia

The Law on Defense foresees transformation of the Civil Protection and fire fighting sectors and establishes a Protection and Rescue Directorate as an independent state administration body and a separate legal entity. Part 3 (Crisis Management) sets the foundation for the Crisis Management System (CMS), which is further regulated in the Law on Crisis Management. Then, this document

[5] Law on Protection and Rescue, Official Gazette of the Republic of Macedonia No. 36/04 of 10.06.2004.

[6] Law on Crisis Management, Official Gazette of the Republic of Macedonia No. 29/05 of 04.05.2005

envisages establishment of two new institutions – a Protection and Rescue Directorate (PRD) and a Crisis Management Centre (CMC). Within the relevant laws, they deal with policies, institutional setup, measures and activities for dealing with natural or technical and technologic disasters or states of crisis.

The Law on Protection and Rescue regulates the system for protection and rescues of people and goods against natural disasters, epidemics, epizootics, epiphytotics and other disasters in peace and war. Based on the Natural Disaster and Other Accident Risk Assessment, adopted by the Government, the protection and rescue system participants make Protection and Rescue Plans. Articles 50 to 56 of Chapter VIII (Protection and Rescue Measures) define prevention measures for the protection and rescue system. Article 51 defines the prevention measures that the system participants shall implement: make an endangerment assessment for possible hazards and a Protection and Rescue Plan; incorporate those measures in the regular plans and operations; spatial planning and construction of protection and rescue facilities; establishment and organization of a protection and rescue system; provide financial, human and other resources.

Under the Law on Crisis Management, the Crisis Management System is organized and established for prevention, early warning and handling of crises that put at risk goods, health and life of people and animals, which have been caused by “natural disasters and epidemics or other risks and hazards which directly endanger the constitutional order and security” of the country or any part of it, when a state of emergency or war could not be declared. The CMS includes information collection, situation assessment and analysis, setting goals and tasks, development and implementation of prevention activities, early warning and crisis management. Under Article 2, the CMS is implemented by: the state administration and state authorities (Parliament, President and Government), the armed forces, the protection and rescue forces, the municipal and city of Skopje authorities, the public enterprises, institutions and services (including HMS), companies, civil associations, the Macedonian Red Cross, charity organizations and the media. Article 12 of the Law on Crisis Management establishes a national CMS institutional framework, consisting of a Steering Committee (SC), an Assessment Group (AG) and a Crisis Management Center (CMC). These bodies’ role is to facilitate and coordinate the proposal of decisions and to provide for consultations, coordination, timely response, efficiency and adequate use of available resources in times of crisis, as well as to provide for timely quality and realistic assessment of threats from risks and hazards to the country’s security.

The main strategic documents that may help assess how much DRR is integrated are: the National Security and Defense Concept (2003), the National Protection and Rescue Strategy (2009), the National Economic, Social and Environmental Sustainable Development Strategy 2009-2019; the Health Strategy 2020; the Strategic Commitment to Environment Protection contained in several documents.[7]; the EU Integration Strategy.[8] These documents define the framework of the national development policy, security and defense policy, and protection and rescue policy.

The National Protection and Rescue Strategy (NPRS) was adopted on 18 February 2009[9]. This document contains the principles, vision and objectives of the protection and rescue system, and guides its development and upgrade in line with international standards. The strategy, more precisely than the Law on Protection and Rescue, defines risk management (prevention, impact mitigation, preparedness and recovery) and sustainable development policy, as integral parts of the protection and rescue system. It requires the existence of a Methodology for the Content and

---

[7] Second National Environment Action Plan of the Republic of Macedonia (NEAP II, 2006), Environment Monitoring Strategy (2006), Environmental Public Awareness Raising Strategy (2005), Environmental Data Management Strategy (2005), Vision 2008 (2004), Spatial Plan of the Republic of Macedonia (2004), Energy Efficiency Strategy 2020 (2004), and National Health and Environment Action Plan (1999); National Strategy for Environmental Legislation Approximation, September 2007, project, *Ref. No.: 05MAC01/13/001-EuropeAid/121312/D/SV/MK*

[8] Law on Ambient Air Quality (Official Gazette of the Republic of Macedonia number.67/04 и 84/07); and Law on Water (Official Gazette of the Republic of Macedonia No. 87/08).

[9] The Parliament adopts the Strategy and decides on the protection and rescue budget. The Government determines and proposes the Strategy, adopts a decision on establishment of protection and rescue forces, adopts a decision on material reserve, distribution of humanitarian assistance, training and exercise activities, population evacuation and the value of damage.

Manner of Hazard Assessment; Protection and Rescue Planning and Natural Disaster and Accident Assessment, as well as a Protection and Rescue Plan.

The Protection and Rescue Plan, adopted in 2006, regulates management, protection and rescue in local government units, companies, public enterprises, institutions and services.

FYR of Macedonia initiated its National Platform for Disaster Risk Reduction (NPDRR) in December 2007. In July 2011 the third revised edition of NPDRR is adopted. The initial goal of the NPDRR is to provide a link among entities involved in disaster prevention and management.

The obligations and mandates of the HydroMeteorological Service (HMS) are properly described in the new Hydrometeorological Law issued in 2009. The law describes in details the role of the HMS. In preparation of the new law, the WMO recommendations and views have been taken into account. A new strategy for HMS has been adopted for 2008-2011, and it has been published also in official gazette. HMS has the mandate to produce commercial services and products. However, the revenue from commercial services is an income to the budget of the government. The new Hydrometeorological law includes a special topic of DRR, concerning communication and cooperation with CMC in case of hazard. According to the Law, HMS is a part of the National System for prevention and mitigation the consequences of disasters, and other urgent situations for protection of life and goods. In case of weather or flood disaster, HMS is acting according the regulations for crisis management, rescue and protection.

Environmental policies at strategic level are covered by the National Sustainable Development Strategy (NSDS) and by the National Environmental Action Plan (NEAP). In addition, the European Partnership signed in 2004 identifies that National Sustainable Development Strategy is required in priority areas. The country's Constitution and the Law on Environment contain sustainable development principles. In line with UN recommendations from the Rio Conventions and the Framework Convention on Climate Change, the First and Second National Communication on Climate Change have been prepared in 2003 and 2010[10]. Long-term impact of climate change is expected in the most vulnerable sectors: agriculture, forestry, water resources, biological diversity, health and tourism. The sectoral analysis of sensibility to climate change of 2006 was based on the climate change until 2006 and the expected scenarios of climate change for the particular regions in the state (until 2100). The Ministry of Environment and Physical Planning is responsible for coordination of climate change related activities. There is a Climate Change Project Unit in the Ministry of Environment and Physical Planning providing logistics support to the National Committee on Climate Change which is responsible for monitoring and coordination of the Convention implementation.

The Spatial Plan of the Former Yugoslav Republic of Macedonia (SPRM) is a management document and an integrated developmental project defining the spatial organization of the state and the objectives and concepts of spatial development. Item 7.2 of this document defines protection measures against natural disasters in more detail (protection against strong earthquakes, fires, floods and against other weather related disasters).

The National Development Plan 2008-2013 defines the development priorities of the Former Yugoslav Republic of Macedonia, therein recognizing the need to replace the traditional development concept with a new one, bringing economic growth policies closer to modern environment and nature protection standards, energy and resource savings and development of environment friendly technologies. The Development Plan include flood protection which links

[10] The drafting of the Convention on Climate Change began on 4 June 1992 at the Earth Summit in Rio de Janeiro, a conference organized by the United Nations on Environment and Development. It entered into force on 21 March 1994. The Republic of Macedonia ratified it with the Law on Ratification on 4 December 1997 (Official Gazette of the Republic of Macedonia No. 61/97), and entered into force on 28 April 1998. The Macedonian Parliament ratified the Convention on Biological Diversity in 1997 and became member on 2 March 1998. In 2000, the Ministry of Environment and Physical Planning set up a National Committee on Biological Diversity, an obligation arising from this Convention. In 2004 Macedonia ratified the Kyoto Protocol and in September 1998 the Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects.

development to water and calls for the following measures: sustainable water management and use of water resources; ensure sufficient quantities of quality water and mitigate consequences of water shortages; protection against and mitigation of consequences from harmful water effects; protect and preserve water; rationalize and reduce water spending for irrigation; develop water resources, provide new water reserves and quantities. The protection of air quality is discussed in the Plan on the Protection of Environment and Nature.

Macedonia ratified the UNCCD in 2002. The responsible organization is Ministry for environment, HMS in accordance with above Ministry and MAFW is responsible for preparation for National plan against desertification.

5.2.2. Institutional framework

5.2.2.1. List of agencies involved in DRR for hydrometeorological hazards

- Crisis Management Center
- Protection and Rescue Directorate
- Hydrometeorological Service of Republic of Macedonia (HMS) - Ministry for Agriculture, Forestry and Water Management

5.2.2.2. Crisis Management Center

The Crisis Management Centre (CMC) is an independent governmental body and a separate legal entity, a Directorate by position and function. The CMC started its operation in October 2005 and based on the Law on Crisis Management it has the responsibilities to ensure coordination, cooperation and communication of the National Crisis Management System (CMS). The competences of the CMC are the following:

- Providing crisis management support to the National Crisis Management System;
- Coordinating the national measures and activities for crisis prevention, early warning, alarming and response;
- Collecting, processing, analyzing and assessing information/data related to relevant risks and hazards;
- Preparation and updating of a unified assessment of all risks and hazards to the security of the country;
- Providing guidance and proposing measures and activities for the crisis management system entities etc..

On the operational level, CMC is working permanently 24/7 in 8 sectors (Regional offices in Skopje, Tetovo, Kumanovo, Stip, Strumica, Veles, Bitola, Ohrid) and 27 Regional Crisis Management Centers.[11] They are in charge of information, situation monitoring, data and information exchange, and proposal of crisis management and assessment measures. The Regional Centers set up regional staffs, which are composed of representatives from the ministries' local branches and from other state administration bodies, plus one municipality representative and a representative of the city of Skopje in their regional centers. The regional staffs get activated upon a decision of the CMC Director.

The CMC organizes information and alerting for early warning, situation monitoring, timely identification of phenomena and processes, which threaten state security and/or may lead to crisis, to inform the entities of the crisis management system and the population. Thus, the Center operates a single communication and information system with a single country-wide call number for risks, hazards and other accidents. The single communication and information system operates 24 hours a day, seven days a week.

[11] The centers are located in the following municipalities: Berovo, Bitola, Valandovo, Veles, Vinica, Gevgelija, Gostivar, Debar, Delcevo, Demir Hisar, Kavadarci Kicevo, Kocani, Kratovo, Kriva Palanka, Krusevo, Kumanovo, Makedonski Brod, Negotino, Ohrid, Prilep, Probistip, Radovis, Resen, Sveti Nikole, Struga, Strumica, Tetovo, Stip, Gazi Baba, Karpos, Kisela Voda, Centar, Cair and the city of Skopje.

CMC in accordance with prescribed legal obligations is basing its long-term planning process on the principle of the System for Planning, Programming, Budgeting and Execution (PPBE). CMC has adopted a Strategic Plan for the period 2011 – 2013 and one of the strategic priorities is preparation of the Integrated Assessment of all Risks and Hazards on the national and local levels.

Hazard exposure assessment of threats to state security is made and adopted to ensure planned, timely, comprehensive and coordinated adoption of decisions, guidelines and recommendations for protective measures and optimal crisis management. Upon a proposal of the Assessment Group, the Crisis Management Centre makes an assessment and submits it to the Steering Committee (Figure 24). The assessment is then adopted by the Government, which passes a decree on the assessment methodology, its content, structure, storage and updating and defines the entities in the crisis management system which receive the entire or parts of the assessment.

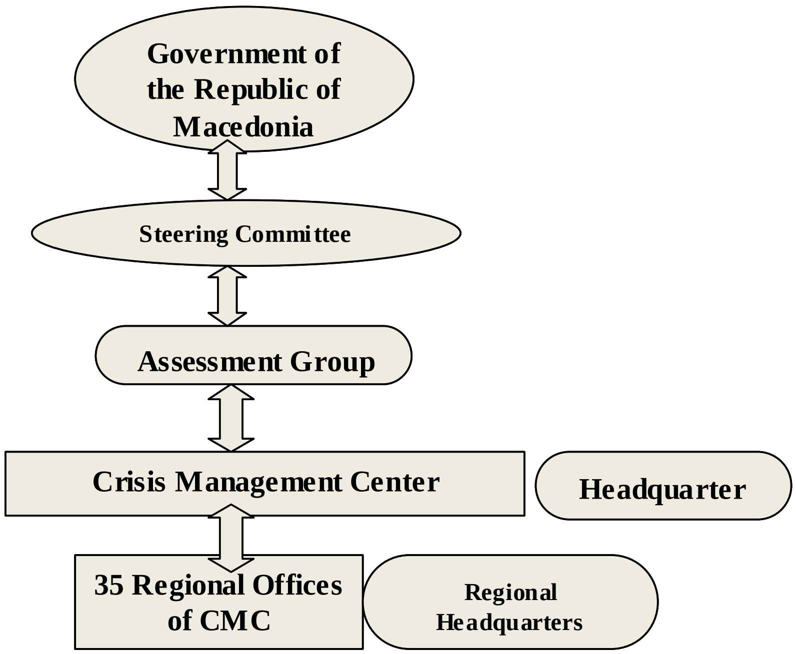


Figure 24. Decision flow within the Crisis Management Center

CMC in partnership with UNDP Macedonia implemented the project "Strengthening of the capacities of the Crisis Management Center". The key products of the project are: desk Review on existing legislation and relevant planning documents concerning the crisis management system, Web Based Gender Repository Database and Web Based System for Learning, Exam and Survey, Guidelines for Preparation of the National Crisis Management Plan, software applications for entry of attribute and spatial data in the GIS data-base and strategic planning, Guidelines for development of methodologies for assessment of risks and hazards and assessment of their implications over the lives and health of the citizens and goods of the country, Guidelines for Preparation of the Unified Risk and Hazard Assessment, historical database for events happened during 50 years, Guidelines for Preparation of the Unified Risk and Hazard Assessment, Preliminary Risk Profile of the Country, local level risk management projects, training drills in educational institutions, small scale disaster risk reduction infrastructure projects, Handbook for local authorities on crisis preparedness published, interactive educational computer game. Risks from floods/droughts were considered accordingly.

5.2.2.3. Protection and Rescue Directorate

The Protection and Rescue Directorate is an independent state administration body and a separate legal entity, which started operations on 16 May 2005. Pursuant to Article 17 of the Law on Protection and Rescue it is made up of a Directorate located in Skopje, 8 regional units and 35 branch organizational protection and rescue units. The Directorate is a professional and operational body in charge of performing specific protection and rescue activities (Article 18). The Main Staff is part of the Directorate composed of government appointed experts, seconded to the Directorate. Regional staffs are also established in charge of the regional protection and rescue forces (permanent forces: the PRD personnel, rapid response teams and territorial firefighting forces; reserve forces: main staff, 35 regional staffs, and forces units/platoons/companies). 5-15 member rapid response teams are also established, which are the pillars of the national protection and rescue forces (Figure 25).

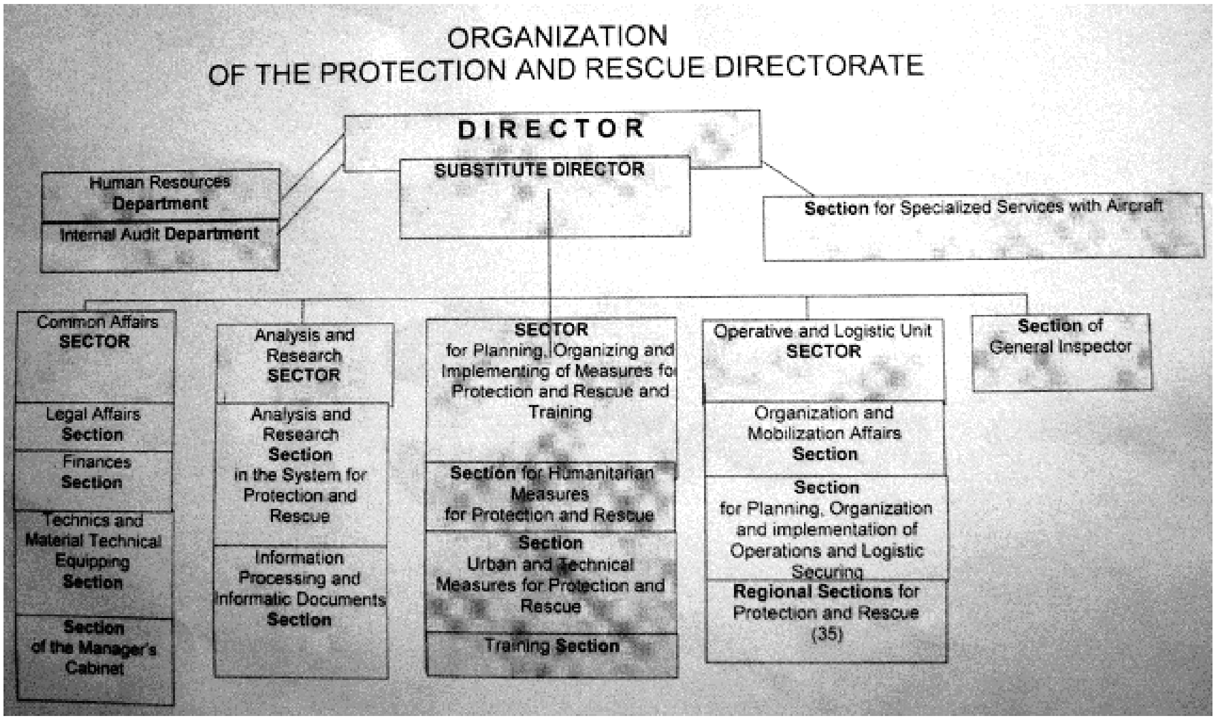


Figure 25. Organizational flow-chart of the NPRD

5.2.2.4. Hydrometeorological Service of Republic of Macedonia

The Hydrometeorological Service (HMS) was officially established in 1947 with the "Declaration of Foundation of Hydrometeorological Service of Peoples Republic of Macedonia". In 1978 it became Republic Hydrometeorological institute, a governmental organization. Since 1991 Hydrometeorological Service represents the national authority for hydrology and meteorology. From 2000, HMS is under the Ministry for Agriculture, Forestry and Water Economy. It is also overseen by the Ministry of Environment.

The roles of HMS in DRR are defined in the law of Hydrometeorological Activity, Part IV, Art 6 – Goals and mission of HMS: Meteorological and hydrological activities include activities concerning development and functioning of hydrometeorological monitoring, researching of the atmosphere, climate, waters and soil as well as application of meteorology and hydrology.

The Hydrometeorological Service (HMS) has the responsibility to operate the observation network and produce meteorological and climatological services in order to enhance people´s security and welfare, economic development and environmental protection. HMS has also many duties concerning environmental sector. Systematic control of surface water quality has been performed since 1964, while monitoring network on air quality dates from 1974. Lately HMS has significantly decreased its activities in the area of air quality, as the role of the Ministry of Environment has been increasing, and currently covers monitoring and dispersion modelling. Current main activities of HMS include air quality monitoring, monitoring of qualitative and quantitative characteristics of surface water at 20 measuring points and other tasks related to air quality and water quality (Figure 26).

HMS is governmental Service providing basic information in meteorology, hydrology, air quality and water quality. HMS is organized in 5 main departments and 2 main divisions (Figure 27).

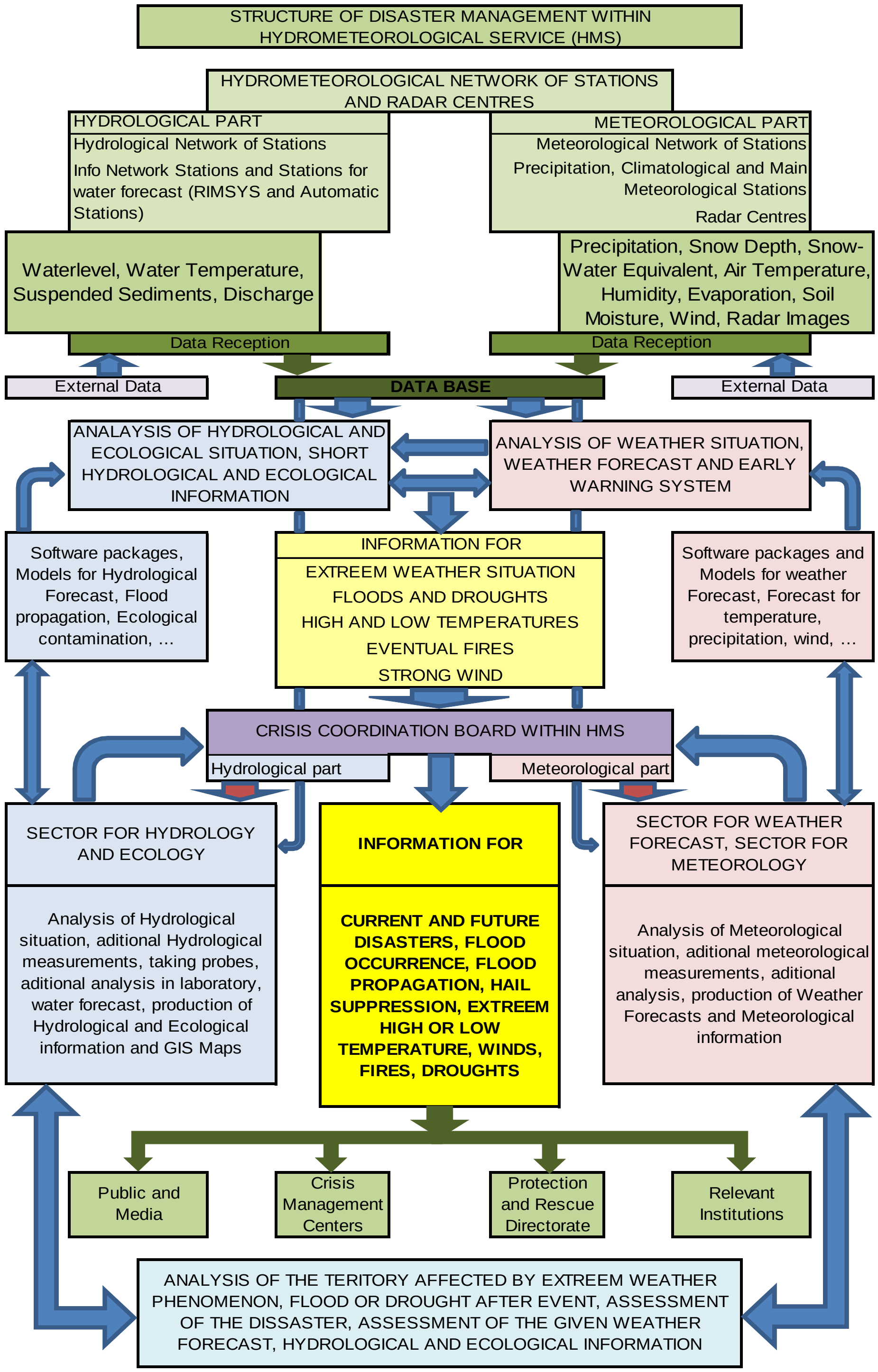


Figure 26. HMS workflow in DRR

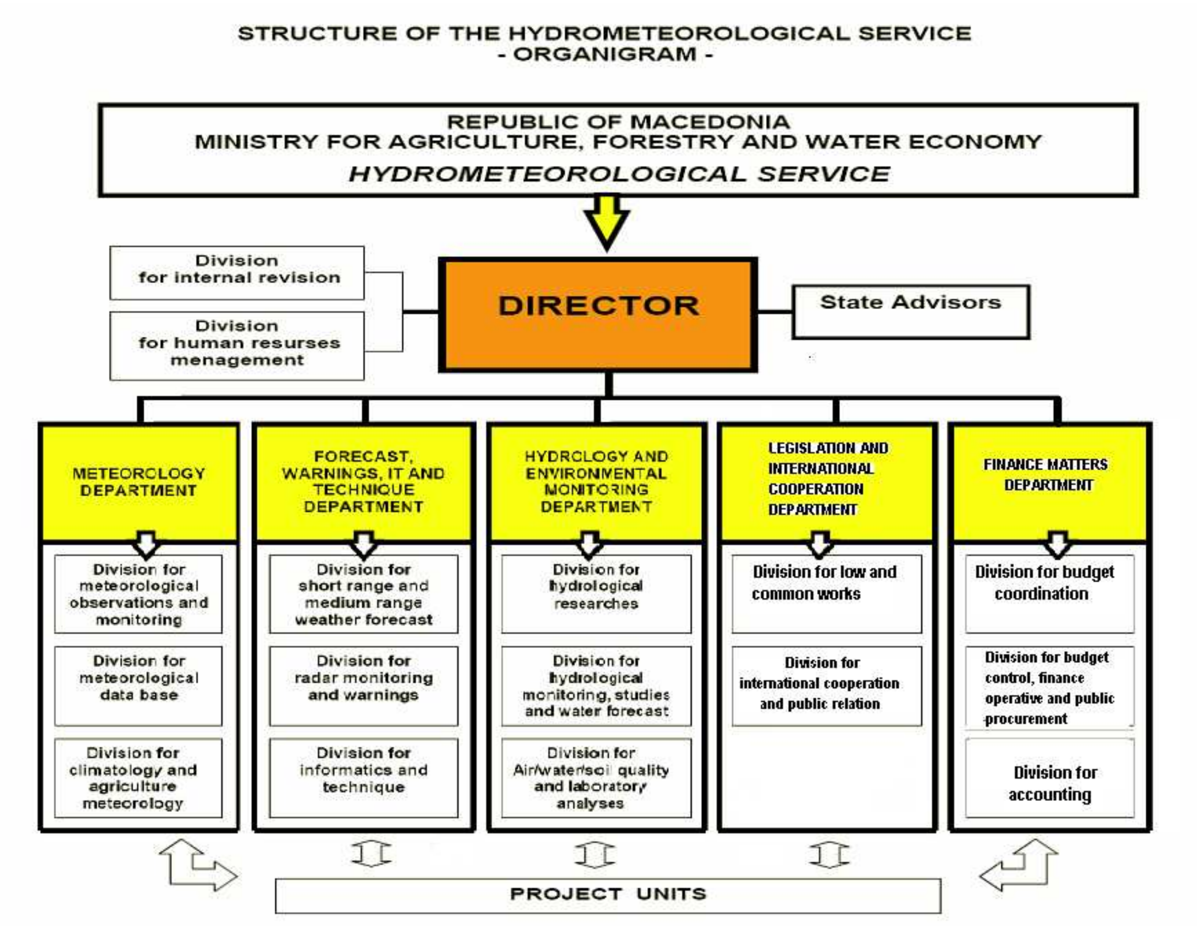


Figure 27. Organizational structure of HMS

FYR Macedonia is member of the WMO. The Permanent Representative (PR) with WMO is currently the HMS Director.

In FYR of Macedonia, there are also other entities, which provide hydrological or meteorological services and operate observations or observation networks. These include:

- Meteorological Office at the Airport, located at Skopje airport, is under Ministry of transport. The Office is financed by the income from aviation, not by the governmental budget. It provides weather services for two airports. The Office operates one AWS (AWOS 2000, includes present weather sensor) at both airports, and uses HMS data via internet for free. The Office is well equipped with satellite data receivers, visualising software and tools, etc. The salary level of meteorologists working for the Office is significantly above the salary level of HMS. There is no cooperation between the Office and HMS. The Office and the observations at the Skopje airport are available 24/7;
- Regarding hydrology and water for rivers lakes and groundwater, the following institutions are also involved: Ministry of Environment and Physical Planning, Water Economy Directorate – Ministry of agriculture, Forestry and water Economy, National Institute of Health protection (NIHP), Water Development Institute, and Hydrobiological Institute;
- According to the air quality Law, Ministry of Environment and Physical Planning is responsible for air quality issues on State level. Ministry operates its own air quality stations: 8 stations in Skopje and 10 outside. Out of these 13 are automatic monitoring stations: 5 in Skopje and 8 outside.

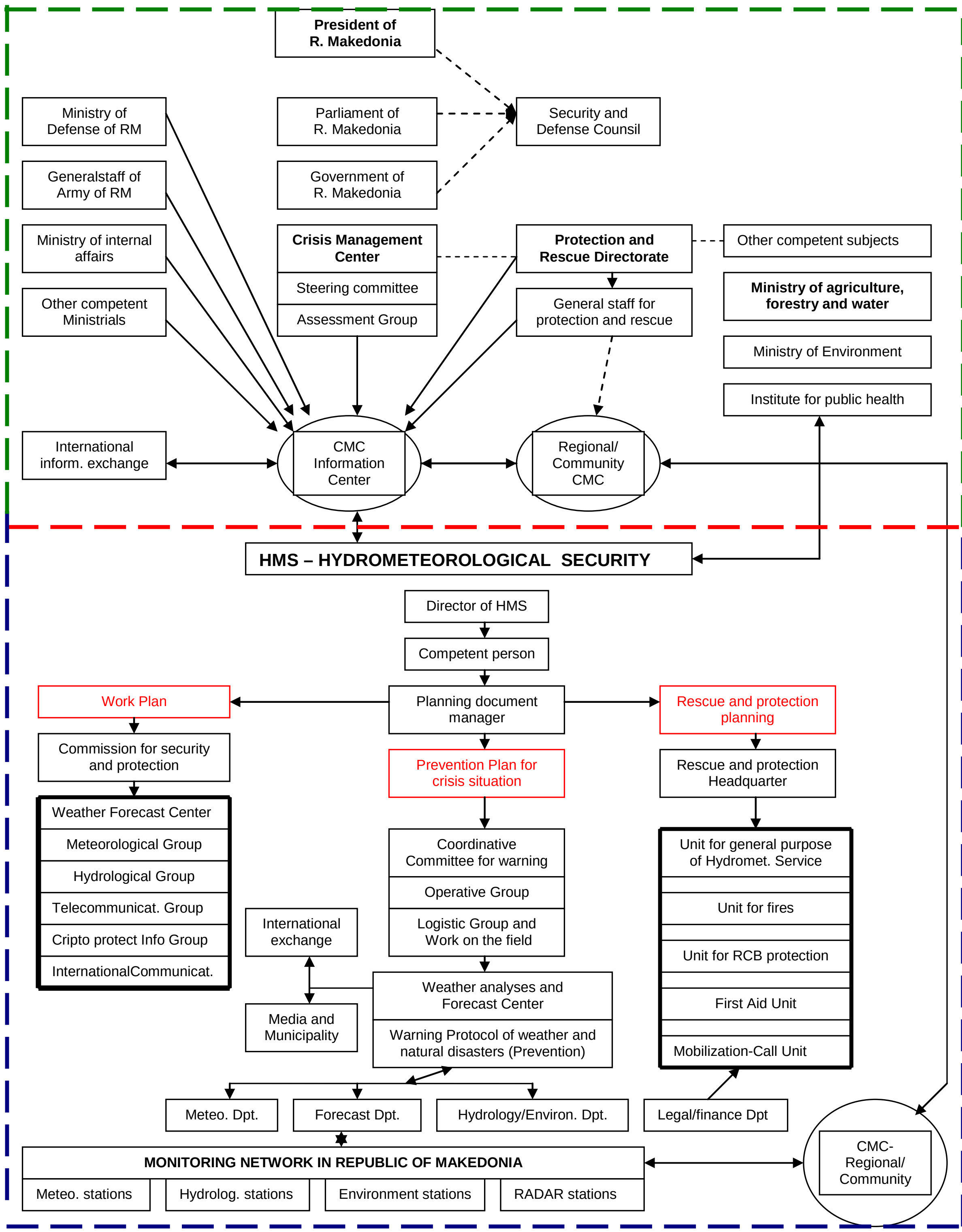


Figure 28. Information flows between HMS and the Crisis Management System

5.2.3. Coordination and cooperation

Standard Operative Procedures have been agreed for communication, coordination and cooperation amongst CMC/PRD (Protection and Rescue Directorate) and subjects of the Crisis Management System for flood protection. The following diagram shows the SOP inside the CMS (Figure 28).

The establishment of the National Platform of the Republic of Macedonia for Disaster Risk Reduction (NPDRR) is for the moment only formal, it is coordinated by CMC but other institutions that should be involved are not participating nor are informed on the platform activities. HMS is formally member of the National Platform of the Republic of Macedonia for Disaster Risk Reduction. HMS has nominated a Disaster Risk Reduction Focal Point, however, operationally the platform is not well established, and it was not quite clear what is the role of the HMS

The HMS has the responsibility to operate the observation network and produce meteorological and climatological services. HMS provides technical and scientific support for other agencies. HMS actually participates in DRR providing basic data, information and weather forecasts to other organizations, at state, provincial and local levels. Thus, the level of integration of HMS into the DRR policy making is not very high. On the contrary, from an operational point of view, HMS is strongly involved in Disasters Preparedness and Prevention activities. As described by the following flow chart, HMS is strongly involved in Early Warning, but also (bottom part of the flowchart) in prevention, providing basic information and services for hazard characterization.

5.2.4. Roles and responsibilities for flood and drought risk assessment

Based on Law on Crisis Management, Chapter III, article 21, para. 2, the Crisis Management Center is responsible for preparation and updating of the Integrated Assessment of all risks and hazards. In relation with the article 45 from the same law and for purposes of coordinated decision-making, issuance of guidance and recommendations for taking measures for prevention, as well as for crisis situation, the Integrated Assessment is being adopted. This document integrates the contribution from the specific assessments that are being prepared by the competent entities from CMS and is providing multi-sector approach in the assessment of the whole spectrum of risks and hazards. Under the Decree, the CMC should consolidate and systematize risk data and analyses into a single database through a multi-hazard assessment process. In this framework, CMC has also the role for coordination with competent institutions for analysis and assessment of vulnerability and exposure related to floods and droughts. The new Regulation on Methodology for Preparation of Integrated Assessment of all Risks and Hazards adopted in January 2011 prescribes detailed framework for analysis and assessment of the vulnerability and exposure including all the elements of the risk (geographic characteristics, population, infrastructure, individual and industrial facilities etc). It is also foreseen to design hazard and risk assessment guidelines and methodologies, with the support of UNDP.

Under the law on Protection and rescue, the PRD makes assessments on natural disasters including floods, and proposes measures for protection and rescue. PRD receives information from the HydroMeteorological service and the Ministry of Agriculture, Forestry and Water Management. The PRD also maintains an inventory of all natural disaster and accident risks and hazards. Using this data PRD produces assessments of vulnerability to natural disasters and other accidents as well (technical, technological and industrial accidents) of the Republic of Macedonia. PRD develops National Protection and Rescue Plans. Assessments and Plans are then adopted by the Government.

The HMS has the responsibility to operate the observation network and produce meteorological and climatological services. HMS provides technical and scientific support for other agencies. HMS actually participates in DRR providing basic data, information and weather forecasts to other organizations, at state, provincial and local levels. From an operational point of view, HMS is strongly involved in Disasters Preparedness and Prevention activities, providing basic information and services for hazard characterization.

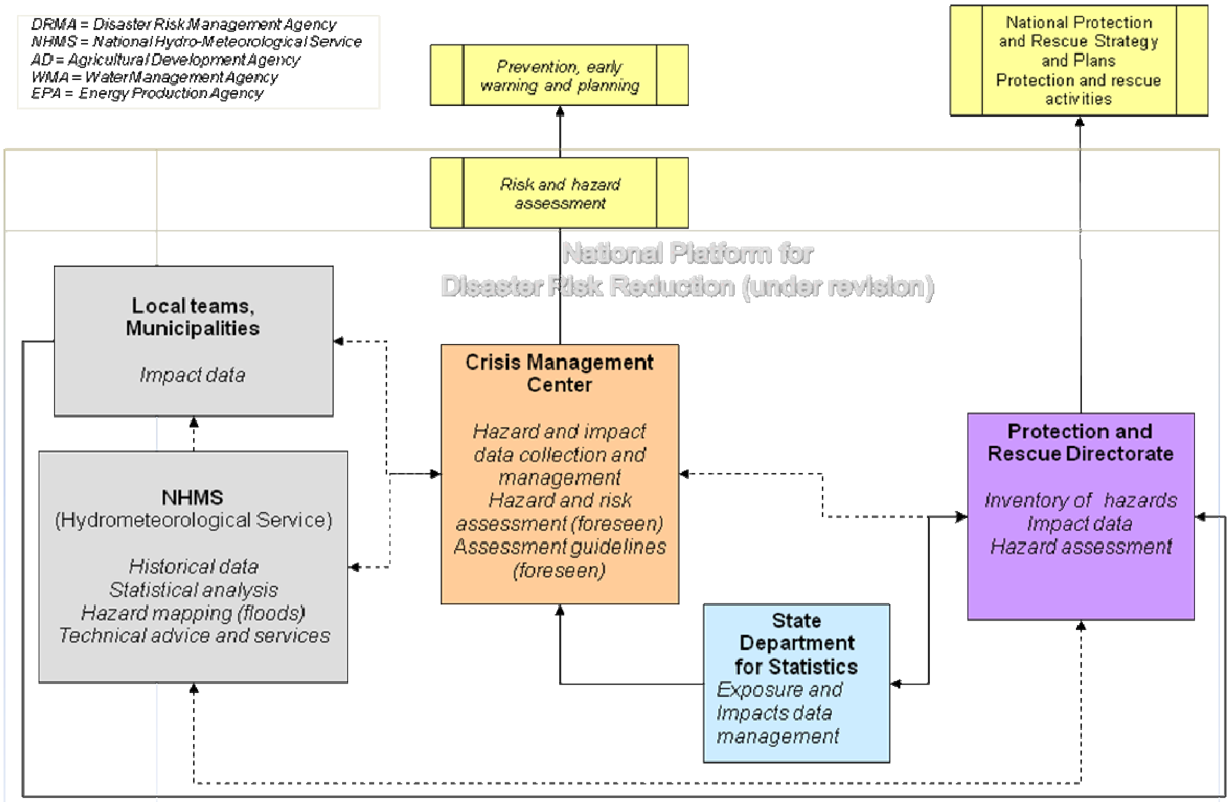


Figure 29. Work flow for drought and floods risk assessment in FYR of Macedonia

According to the law on protection and rescue, local governments set up commissions to assess disaster damages on the field and submit reports to Government Committee. The Governmental Commission submits information to the Government, which decides the refund rate of damages. Impact data on agriculture are collected by local commissions for drought assessment. The ministry of Agriculture has information about affected areas for floods and yields for droughts. These data are not systematized in a database. The impacts of floods are collected by local commissions at municipality level with the participation of PRD local teams, using damage assessment methodologies defined by the Ministry of Finance. The damage assessments are sent to central level for analysis and stored by Ministry of Finance, Department of Statistic, Local authorities and Municipals. Other line Ministries participate in the Crisis Management System and provide sectoral information to CMC.

Both, the CMC and the PRD are the key institutions for floods risk assessment. For floods risk assessment, there are several overlaps and lack of coordination between the two institutions. On the one hand, the protection and rescue system, which has been redefined in 2005 with the establishment of the PRD, addresses risks and hazards from natural and technological disasters in peace, emergency and war situations. With the development of the protection and rescue system measures and forces, the PRD has national and local operational capacities. On the other hand, the CMC is responsible for crises that threaten the basic values, interests and goals, and the constitutional order and security. CMC has developed multi-hazard and inter-sector approach in risks assessment. Both institutions have activities concerning floods risk assessment and their specific roles are not clearly defined, causing overlaps between these two institutions. Moreover there is the need to improve the operational linkages between the institutions involved in the CMS for inter-sector cooperation and collaboration.

The National Protection and Rescue Strategy (NPRS) is expected to bring better risk assessment, extended monitoring and forecasting and warning communication. It gives high priority to compatibility and regional and sub-regional information sharing on natural disasters and other accidents, by improving existing mechanisms and use of better communication technologies. The strategy implementation measures foresee local and national activities, such as: full cooperation among entities to reduce vulnerability, preparedness to involve all available resources in dealing with hazards, development of risk assessment programs and operational plans, upgrade of the National Protection and Rescue Plan, inclusion of natural disaster hazards assessment in development plans, etc. The Strategy envisages establishment of an IT center and application of modelling and simulation methodology and technology in protection and rescue. The Strategy sets general guidelines but fails to provide an action plan containing developed measures and indicators for monitoring. In this framework, PRD makes hazard assessments but not yet risk assessment or vulnerability analysis because of lack of methodologies. However, PRD foresees to develop an information system ensuring suitable information both for disaster managing and for planning. This system should include data from the State Statistical Bureau as (population, households, assets, and infrastructures), the Ministry of Agriculture, Forestry and Water Management (land use, crops areas, forests, orchards). This system will not only underpin the warning and forecast of hazard impact, but also the vulnerability analysis for risk assessment and as consequence the plans for protect and rescue.

CMC indicates that there is a lack of organized system for floods/droughts assessments, of methodologies for floods/droughts mapping and of technical knowledge and expertise and human resources. In this framework there is the need for:

- Improvement of the mutual cooperation, communication and data and information sharing between CMC and CMSs entities; this includes the development of SOPs for timely information and cooperation of the institutions and a clear attribution of tasks and duties;
- preparing guidelines and methodologies for hazard and risk assessment;
- establishment of the permanent process of data analysis and processing;
- establishment of integrated hazard mapping process;
- establishment of proper dissemination process for results of risk assessment;
- capacity building in drought and floods hazard and risk assessment.

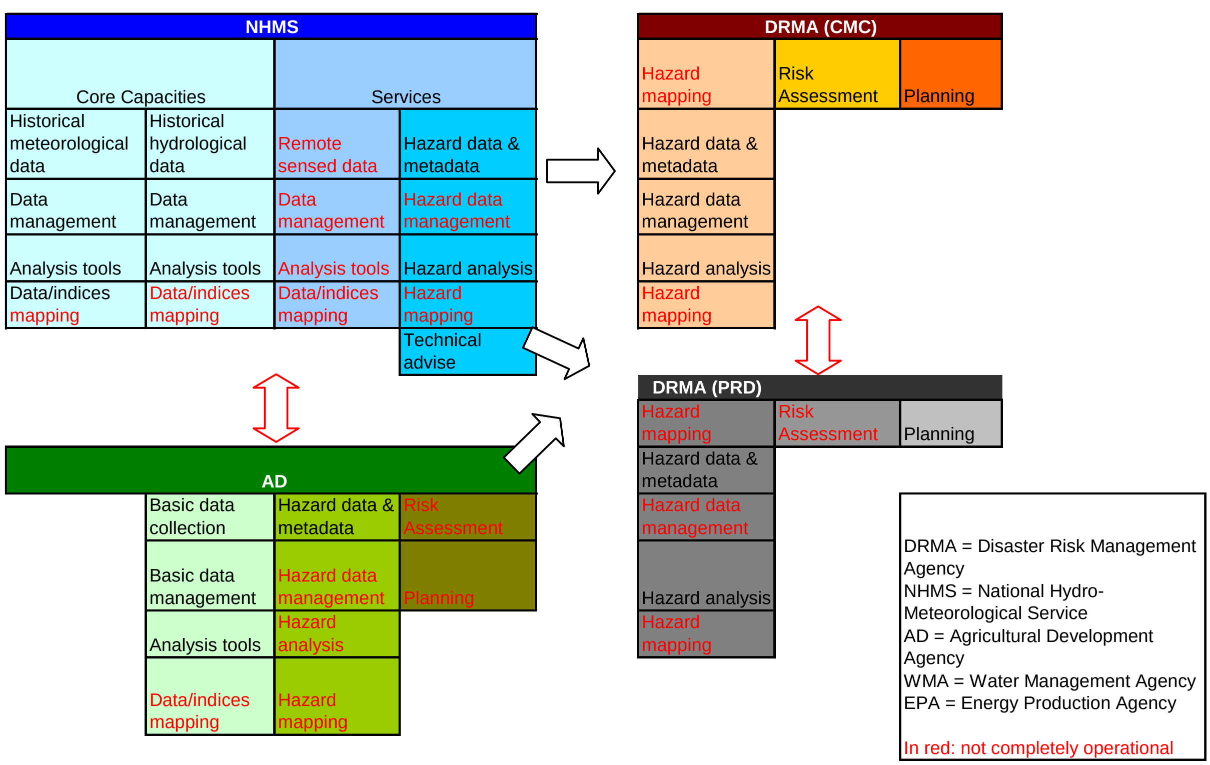


Figure 30. Operational linkages for flood and drought risk assessment

The integration of the hydrometeorological sector in planning of national DRR is at early stage. HMS has well defined role and duties in DRR principally as data and information provider. HMS needs to reaffirm its role in the flood/drought prediction and risk assessment in the state legal framework. The role of HMS could be emphasized becoming an independent Governmental organization, which could increase the status level of HMS. HMS provides also technical and scientific support for other agencies, but not systematically. HMS does not receive specific requests for providing services and never receives feedback from users. The chain should be better structured ensuring bi-directional flows and effective cooperation with institutions that deal with risk or hazards assessment. However, HMS does not have all the technical, human and financial resources to implement all the activities at desired level. Particularly, the hydrological division of HMS suffers of a chronic lack of human resources, hampering even the development of fundamental institutional activities. The Division estimates to be understaffed at 50% of its optimal level. The Ministry of Agriculture needs to be involved in drought risk assessment.

5.3. Technical Capacities of Hydrometeorological Services to support Disaster Risk Management

5.3.1. Monitoring and observations networks and data exchange

Hydrometeorological observation networks are established not only for national needs but also to be a part of the WMO Global Observation System (GOS) comprising of standardised measurements taken at constant hours using surface observation and monitoring stations, upper air observation, hydrological measurements and satellite observations. Historical data is essential for climatological studies, hazard analyses and monitoring of climate change. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situations;
- reduction of vulnerability to the risks of meteorological, hydrological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale NWP modelling.

The hydrometeorological network of HMS is described in Table 27. Currently HMS has 20 meteorological manned synoptic stations (measurements and observations every hour) and 2 automatic weather stations (AWS) (data received every full hour). The AWSs measure the ordinary parameters, but they do not have ceilometers (cloud height), present weather sensors or on-line video monitoring. Agrometeorological stations are manned and measure also the basic meteorological parameters. Manned stations can be activated to send data more frequently when needed e.g. for DRR purposes. Many of the equipment used at the manned stations are obsolete and needs to be replaced by new sensors. Currently ice free sensors are not used at any meteorological stations.

Upper air soundings are essential for global, regional and local numerical weather prediction models and for daily forecasting. Currently HMS operates one previous generation (Vaisala Loran C) sounding station located at the Skopje airport. The soundings are made once a day.

Weather radars are very powerful tools for aviation meteorology, tracking precipitation areas, to measure intensity of precipitation, flood forecasting and for short term weather forecasting (nowcasting). The weather radars, the WSR-74 S/X (1985) located in Gurishte and the MRL-5 (1990) located in Topolchani, are both digitalized but they represent very old radar technology.

The hydrological RIMSYS system, established in cooperation with Switzerland in 2008, provides real time information about water level and water temperature for rivers in the former Yugoslav Republic of Macedonia. Currently the hydrological network consists of 11 automatic stations with

GSM transmission of the data. It may be noted, that there are very few stations at the upper reaches of the rivers.

Satellite data in form of pictures is received through the MSG ground station. HMS does not have capacity to analyse the digital data and produce other products. Satellite data is used mainly for weather forecasting purposes but not e.g. for drought monitoring or snow surface/height analyses.

Main air quality monitoring networks are operated by HMS and Ministry of Environment. Modernization and automation of the Macedonian air quality monitoring network has been going on within an EU twinning project coordinated by the Finnish Meteorological Institute (FMI).

Table 27: Observation stations operated by HMS

Type of observation stations	Number			Comments of 2010 network
	2007	2010	2011	
Atmospheric domain				
Surface synoptic stations (> 8 obs/day)	23	22	20	
Manned stations	20	20	14	
AWS or AWOS	3	2	6	
Cloud-height – automatic	0	0		
Agrometeorological stations	0	9	24	
Ordinary climate station (3 obs./d)	18	16	16	Obsolete equipment
Rainfall station (2 obs./d)	165	145	150	
Rainfall station – automatic	0	0		
Meteorological towers	0	0		
Upper air radio sonde stations	1	1		1 sounding per day
Pilot balloon stations	0	0		
SODAR/RASS	0	0		
Wind profiler stations	0	0		
Lidar	0	0		
Access to AMDAR data	No	no		
Weather radars	3	2		Data availability 50%
Hale radars	NA	6		
Lightning detection stations	0	1		Old system
Lightning detection hub station	0	0		
Satellite MSG ground station	1	1		Only 1 operational
Hydrological domain				
Discharge station – manual	110	NA	35	
Discharge station – automatic	0	0		
Water level post – manual	150	NA	110	60% operational in 2011
Water level station – automatic	NA	17	17	Water level + temperature
Maritime domain				
Maritime/lake stations – manned	0	2		
Maritime/lake stations – automatic	0	0		
Buoys w/ meteorological observations	0	0		
Tidal stations	0	0		
Tidal stations with met. Observations	0	0		
Environmental domain				
Air quality monitoring stations	20	23		
Water quality –ground water	115	?		
Nuclear deposition				
Ozone – near surface	0	0		
Ozone – upper air	0	0		
UV radiation	0	0		
GAW station	1	1		

Data from only 3 stations are sent through the WMO Global Telecommunication System to international use. The National Meteorological Telecommunication Networks (NMTN) is based on Internet TCP/IP communication protocol and use of Virtual Private Network (VPN). HMS sends data to WMO GTS through the WMO RAVI Regional Meteorological Data Communication Network (RMDCN) using the TCP/IP protocol with a 128 Kbps connection. Outside the GTS system HMS does not exchange data with the neighbouring countries. Precipitation data hail information from the 2 radars and the RIMSYS hydrological data are available in near-real time on the HMS Internet pages. Hail radar images for single radars are available on HMS web pages for the day when the radar is in operation.

Agrometeorological stations are manned and measure also the basic meteorological parameters. Manned stations can be activated to send data more frequently when needed e.g. for DRR purposes HMS receives crop condition data from the local units of Ministry of agriculture, forestry and water supply, once per week by phone, free of charge for information of HMS agrometeorological Division. The Hydrology Sector receives data by the ELEM (Electric Power Company) which control Dams, by fax or post, free of charge.

HMS does not have adequate calibration systems and thus the measurements do not meet the WMO standards.

5.3.2. Hydrometeorological data management systems

Historical hydrometeorological data is critical for hazard analyses and planning and design within various economic sectors. In this regard, hydrometeorological data must be properly quality-ensured and stored in historical user-friendly digital databases. Collected Meteorological parameters are: Air temperature, precipitation, relative humidity, atmospheric pressure, sunshine duration, wind speed and direction, soil temperature and soil moisture, evaporation. Data are kept in two forms:

- Notes on paper (special record book and forms) and (data archive is not protected and not preserved at risk of loss or deterioration);
- Electronic form (from the EXCEL spreadsheet format and in a separate database CLIDATA). The HMS digital meteorological database includes data for the years 1949 – 2010 from Main Meteorological Stations (SYNOP stations) and from Regular Climatological Stations. HMS is currently digitalizing data from additional stations. Until this moment less of two thirds of the total amount of meteo data are digitized.

Validation is done both manually during the primary data processing and in CLIDATA using the control entries on the basis of formulas embedded in the database. Safety of data in CLIDATA are implemented in two levels: (i) First level is the standard structure: administrator - clients and different levels of freedoms secured with password; and (ii) Second level - a permanent backup of the operating system (Windows server 2003) and data server. Meta data are available for few meteorological stations and should be prepared for all stations of the meteorological network. Available metadata information includes: coordinates, altitude, address, name of the observer, measuring program, beginning period, and basin. There are some interruptions of metadata changes in location, instruments, station type, etc.

Collected hydrological parameters are: water level; discharge; water temperature; suspended sediments. All data are collected in HMS and controlled by technician and engineers, and are stored on the HydroPro Data Base since 2004. Older data are still in Excel files. A backup system has been recently installed.

Lack of budget and human resources hampers the capacity of HMS to ensure comprehensive, quality controlled meteorological and hydrological databases. As a consequence: the hydrological database is complete from 2004 to now, older data are on excel or in analogical. The meteorological database needs to be quality controlled and it is not complete (2/3 digitized). There is no phenological data base because of the lack of an appropriated software.

5.3.3. Hazard analyses and mapping to support risk assessment.

Long time series from representative hydrometeorological are essential for statistical analyses of hydrometeorological extremes and hazards and risk assessment. Analyses are important for planning within different industrial and economic sectors and for DRM.

HMS has historical hourly or 3-hourly data from hydrometeorological measurements, which can be used to build different types of statistical analyses of different hazards. However, HMS has suffered from insufficient user friendly software for climatological analyses. In order to remove that obstacle HMS is member of the METVIEW project and HMS will receive METVIEW hardware and software from ECMWF in early 2011. Metview is an interactive meteorological application, which enables operational and research meteorologists to access, manipulate and visualize meteorological data. The system is based on the ECMWF standards for graphics (Magics) and data access (MARS) but can also access locally stored data. HMS staff has already participated the METVIEW training in March 2010.

HMS performs meteorological and agrometeorological analysis, including dry period, heat waves, temporal distribution of precipitation, measurement and calculation of soil moisture, calculation of potential evapotranspiration (Penman-Monteith, Thornthwaite), calculation of De Martonne aridity index, Lang's rainfall index, drought index by Gracanin, Standardized Precipitation Index.

Hydrological analyses performed at HMS are: (i) Graph-analytical method for flood analysis in the River Vardar Catchment using real time estimation of the precipitation on the catchment with radars and meteorological stations network, (ii) Statistical and Stochastic Analysis for high water pick and flood frequency analysis, Unit Hydrograph and Synthetic Hydrograph analysis, MPF method, and (iii) Statistical and Stochastic Analysis for low water and low water frequency analysis.

In the past the Hydrology division collected data on floods events and has also produced floods maps. Moreover, some data exist on paper for great floods in 1962 and 1979. But actually, the division is not in condition of performing such measures because of lack of human and financial resources. Today, HMS has not any specific database for hazards data but can only perform on-demand analysis based on its historical database such as:

- For droughts: tables, graphs (drought index, high temperature, heat waves, dry period, sum of precipitation, etc);
- For floods: tables, graphs and basic maps for floods.

New threshold values have been produced in cooperation with CMC and adopted in order to classify the hazards. Production of some hazard maps is done by orders from government. Up to now HMS has produced hazard maps of flood hazards, hail hazards and chemical and biological waterborne hazards. However, statistical analyses to characterize the hazards have not been performed.

Concerning data analysis, HMS does not use modern software and technology for data analysis or presentation. The Hydrology division has some spatial analysis capacities, but the meteorological division does not have any capacity in GIS or spatial analysis. Capacity building activities are foreseen on the SAGA GIS software in the framework of the DMC-SEE Programme. HMS does not use any remote sensed data or information. Up to now drought indexes and SPI are calculated for the stations because of the lack of interpolation tools or capacities, but some activities of capacity building are foreseen in the framework of a bilateral cooperation with Hungary. Moreover the number of drought indices calculated could be improved, also using remote sensed data. HMS has some GIS capacities but lacks of software (official licenses) and human resources. HMS does not run any numerical hydrological model, water flow or discharge models are only graphic analytical tools.

CMC is developing the official hazard database for recording events, occurrences and conditions caused by natural and man-made accidents and disasters that have happened in the country in the past 50 years - droughts are not included. NPRD has an inventory of information about flood events (only "main" floods), mainly reports with some kind of characterization of the event. Moreover, PRD each year makes an assessment of problems and risks concerning rivers, hydraulic infrastructures, and irrigation schemes. The information is then passed to the government for planning the intervention of prevention against floods. CMC needs the involvement of HMS in the Crisis Management System for hydrological analysis and floods characterization. There is the need of a direct technical link for exchange of data in real time between CMC and HMS. CMC needs also education and training for analysis and assessments of risks from floods/droughts and for risk modelling. CMC indicates also that there is a lack of methodologies, SOPs and expertise and knowledge in the field of hazard impact data collection and management. It indicates the need of education, training and access to data and information for strengthening the drought/floods impact data collection and analysis.

Lack of state-of-the-art software for processing hydrometeorological data hinders utilization of the data available and production of products and services.

Impact data, collected by local commissions, are stored by the Ministry of Finance, the Department of Statistic, Local authorities and Municipalities. NPRD receives hazard information from its 35 regional offices, which fully cover the country, and work closely with local government. These data cover just some of the needs of making the hazard assessment and plans for protection and rescue. PRD does not store the data in an organized database, but only keeps the reports of past events. Ministry of Agriculture collects data on crop damages caused by floods and drought participating in the local commissions for damages assessment. In case of drought, crop yields are collected; in case of flood the area flooded fields. The CMC is using the data and information from the competent institutions as an input in its assessments and reports.

Up to now none of these agencies is producing floods or drought maps. HMS has prepared in the past some flood maps. CMC and PRD produce reports and annual analysis, but specific hazard mapping capacities are lacking. At the CMC, within the Department for Operations and Operations Logistic there is a GIS Unit, but with very limited technical knowledge and expertise. This unit is recording in GIS only the events that have happened. At the moment, CMC is preparing methodologies for hazard mapping and for risks assessment and it is expected that in the mid-term it could be able to prepare this information products. PRD has very limited analysis capacities that could be exploited for drought or floods risk mapping.

5.3.4. Forecasting

HMS has operational production of 12 h, 24 h, 2 days, 3 days and 5 days weather forecasts. Nowcast (very short term) products are produced when required. The weather forecasts disseminated through Internet are given for the present day and for the next day, only. Tailored weather forecasts are produced occasionally for agriculture, water management and health sectors, and to the Crisis Management Center Directorate, Directorate for Protection and Rescue, and Fire brigades.

Table 28: Types of forecasts produced by HMS

Forecast type	Weather			hydrological			Environmental		
	Provide	n/d	on web	provide	n/d	web	provide	n/d	Web
Nowcasting	If needed		yes	no			no		
12 hours	yes		yes	no			no		
24 hours	yes		yes	no			no		
48 hours	yes		yes	no			no		
3-,4-, 5-days	yes		yes	no			no		
one week				no			no		
10 days	no		no	no			no		
monthly outlooks	no			no			no		
seasonal outlooks	no		no	no			no		

HMS operational NWP model is non-hydrostatic WRF-NMM numerical weather prediction model, which is freely available through internet from USA. The model domain over Europe is run on 13 km horizontal resolution, and separately over the Former Yugoslav Republic of Macedonia on 3 km resolution. The time step used is 1 hour. The models are run twice a day: 00 and 12 local time. The boundary conditions are taken from the global NCEP model operated by NOAA, USA. As the ECMWF starts to produce global NWP model data at 8 km resolution it is vital to invest in IT capacity to utilize this data and the WRF data for better forecast products and to use this NWP digital data for mesoscale modelling. The forecasters have appropriate access to hourly data from synoptic and automatic meteorological and hydrological stations.

HMS does not run any numerical hydrological, water flow or discharge models. Flood forecasting activities are carried out with classical methods using real time estimation of the precipitation on the catchment with radars and meteorological stations network.

HMS has provided hail suppression services for 30 years. Hail forecasts are based on hail radar observations and weather forecasts. For prediction of dispersion of airborne pollutants HMS has the capability to operate the numerical WRF mesoscale model, but HMS does not have any dispersion models for air or water borne pollutants.

Today it is necessary to have capacity to link also environmental forecasting models to NWP models. For prediction of dispersion of airborne pollutants HMS has the capability to operate the numerical WRF mesoscale model, but HMS does not have any dispersion models for air or water borne pollutants.

The computing resources are divided to run the NWP models for two domains with two server systems: (i) the Macedonian region Core 2, 2 Gb RAM, disk space 320 Gb and (ii) the European region 2 x Quad Core, Intel Xeon, 4 Gb RAM, disk space 2 X 320 Gb. The computing capacity for numerical weather predictions is quite limited.

Up to now HMS does not have proper software for visualization of NWP products in form of maps, or to produce automatic tailored products/layouts for different end-users. Products cannot be sent automatically.

5.3.5. Warning products and services

5.3.5.1. Warnings and mandates

HMS has the responsibility of issuing warnings, which are defined in the law, through the media (Table 29). The warnings given by HMS are based on observations, radar data, satellite data and numerical weather predictions. In the case of potential danger the Director of HMS is informed, data is sent to the CMC, government, and others, and a special document is prepared to the public.

HMS is the only NHMS in SEE which produces warnings also for pollen. HMS produces specialised warnings to the health sector. But neither HMS nor CMC has a clear picture how to produce warnings of airborne pollutants using numerical models.

5.3.5.2. Warning dissemination mechanism

Warnings produced by HMS are sent directly by phone, fax or e-mail to authorities and institutions according to a fixed contact list. Manual sending system is still in use, no automatic sending system is available. Data, forecast products and warnings (METEO ALARM) produced by HMS are available and visible at the Crisis Management Center (CMC) in real time.

The TETRA (TErrestrial Trunked Radio) is available for communication between authorities. However, HMS does not have access to the authority communication system.

Table 29: Warnings for natural and technical hazards in the FYR of Macedonia, based on Annex 2

Hazard	Exists in the country	Warning by	Type	Info of risks
Heavy precipitation	Yes	HMS	I	Yes
Flash floods	Yes			
River flooding	Yes	HMS	I	Yes
Coastal Flooding	No			
Hailstorm	Yes	HMS	I	Yes
Thunderstorm or lightning	Yes			
Heavy snow	Yes	HMS	I	Yes
Freezing rain	No			
Dense fog	Yes	HMS		
Tornado or cyclone	yes			
Strong wind	Yes	HMS	I	
Storm surge	Yes			
Heatwave	Yes	HMS	I	Yes
Cold wave	Yes	HMS	I	
Drought	Yes			
Marine hazard	No			
Sandstorm	No			
Landslide or mudslide	Yes			
Avalanche	Yes			
Airborne hazardous substance	Yes			
Waterborne hazards	Yes			
Hydrometeorological hazards for aviation	Yes	AWS	III	I
Icing of roads				
Forest or wildland fire	Yes	HMS	I	
Smoke, dust or haze	Yes			
Earthquakes	Yes			
Tsunamis	No			
Volcanic events	No			
Smoke from volcano abroad	Yes			
Dispersion of insect pests	Yes			
Desert locust storm	No			
Hazard for allergic reactions	Yes	HMS		

Warnings to the public are given via radio and TV within the ordinary weather forecast presentations. HMS does not have the mandate to give warnings e.g. as info stripes on ongoing TV programmes. Currently the cooperation with media is not at an optimum level. HMS plans to establish a studio for weather and warning presentation for TV and other media. However, advanced EUMETNET NHMSs do not invest anymore in this type of dissemination of information.

HMS disseminates alarms/warnings of harsh weather and pollen also through its web pages using the EUMETNET METEOALARM colour code. However, the Former Yugoslav Republic of Macedonia is not a member in the European METEOALARM system.

HMS disseminates free of charge real time data through its web page. Policies for data dissemination and exchange, according to the Hydrometeorological Law, allow HMS to provide data to other entities (e.g. data to CMC, Protection and Rescue Directorate, Ministry of agriculture, forestry and water supply, Ministry of transport and communication, Ministry of environment and physical planning.). After processing and controlling, data are issued to various customers and clients. The degree of processing depends on specific customer requirements. Data analyses are available on demand by request of any user. For Governmental institutions and for scientific research they are free of charge, for other users they are charged according to a cost list. Special tailored forms are delivered to NPRD and CMC, following agreed SOP, by Fax, E-mail or by hand if necessary. There is no feedback mechanism ensuring that the information responds to real users' needs. For the hydrological data an interactive system has been developed in the framework of RIMSYS system, established in cooperation with Switzerland. The system allows data dissemination through the web, providing real time information about water level and water temperature for rivers. Currently, RIMSYS includes 17 automatic stations with GSM transmission of the data. Up to now HMS does not have proper software for producing automatic tailored products/layouts for different end-users. Products cannot be sent automatically. The basic reasons are the lack of modern technology and human resources.

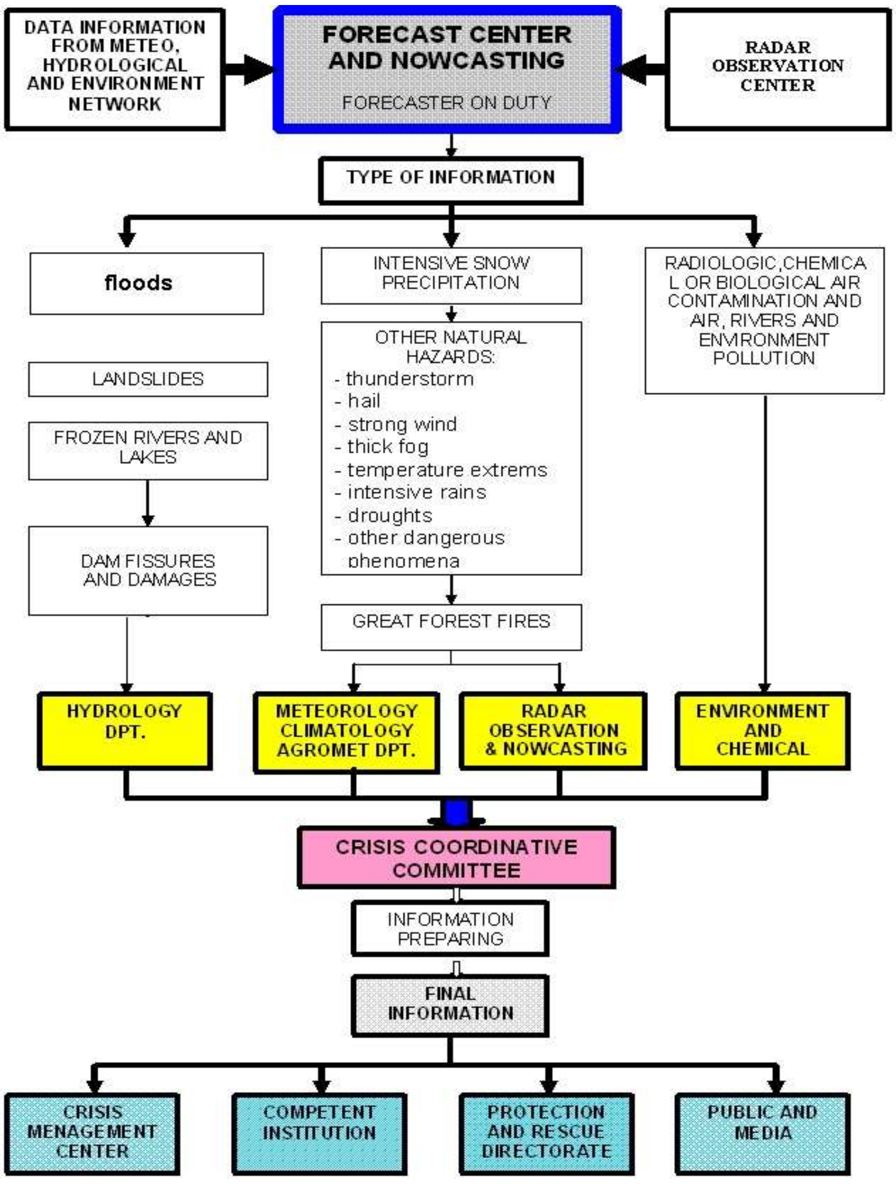


Figure 31. HMS decision flow for early warning

The National operations Center of CMC has a permanent direct link with the HMS through which relevant data is obtained regularly for the analysis of risks of flood and drought. Additionally, these data is being analyzed by CMC for the purposes of assessment, early warning and alarming. CMC and HMS have signed Agreement for cooperation. Standard Operations Procedures (SOPs) regulating the type of data and information, mode and procedures for their submission to CMC and for mutual cooperation are under preparation. Data dissemination and exchange is based on the Regulation for type of data and information, mode and procedures for their submission to CMC. In addition, within its regular work CMC is preparing Daily Reports (for internal use of CMS entities) and Weekly Reviews posted on the CMC web site (www.cuk.gov.mk), as well as monthly, quarterly, semi-annually and annually analytical reports (for internal use of CMS entities). Internal information within the CMS is disseminated through mail, fax, phone and e-mails. NPRD receives information from HMS and the Ministry of Agriculture, Forestry and Water Management, but such information does not meet the needs of PRD. Information received is processed and delivered to its 35 regional offices, to the Government and the public.

5.3.6. Climate change analysis

The main role of HMS in climate change issues is to produce background material and analyses based on observations. However, currently HMS does not have adequate human capacity to produce highly scientific support to Government and industry concerning magnitude of climate change, changes in climate variability or impacts of climate change on different socio-economic sectors. It can be expected that the Former Yugoslav Republic of Macedonia could significantly benefit from the new South East European Virtual Climate Change Center (SEEVCCC), which was established in 2008 within the Serbian National Hydrometeorological Service.

5.3.7. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings. The national data from hydrological and meteorological stations is mainly collected via telephone (fixed line) or UHF radio. Currently HMS does not have capacity to on-line data collection and tools for automated production and dissemination of products and warnings.

Table 30: Equipment in use for data communication and warnings and other products dissemination

Telecommunication Equipment	To receive data	To send data	To send warnings	To send products
Telephone	X		X	
Mobile Phone	X			
Telefax			X	
Dedicated Leased Lines				
UHF radio transceiver	X			
High frequency/Single side band radio				
HF Radio Email				
Aeronautical Fixed Telecommunication Network				
Very Small Aperture Terminal				
Data Collection Platforms used to transmit data from AWSs				
Global Telecommunication system (WMO-GTS)	X	X		
Meteosat Second Generation Satellite system				
Other satellite systems				
Internet			X	X
E-mail			X	
Post/mail				
Print media				
TV –national				
TV-commercial				
Radio				
Bulletins				
Printed text				

5.3.8. Contingency plans

In general the NHMSs need to have a clear contingency plan which ensures continuity of monitoring, data handling, data sharing and production of forecasts and warnings in case of power supply breaks, natural or technical hazards, strikes and troubles. Currently HMS lacks a proper comprehensive contingency plan and capacity to ensure proper operation during contingent breaks.

5.3.9. Customer service and visibility

In order to ensure their existence and to sustain development, it is necessary for the NHMSs to have customer orientated strategy and tailored products and to have a wide visibility and appreciation among the public, industry and government.

HMS forecasters present the weather forecasts on the TV (even if brief study among the public showed that public does not know who produces the forecasts) and produces weather forecasts for radio stations and the newspapers. HMS promotes its visibility through annual briefing meetings with the media.

Today Internet is very important method to disseminate information and to make the brand of the NHMS well known. HMS has renewed its home page, and provides weather services and other information in three languages. The layout could be better, forecasts and radar images could have more space and the pages could be more user-friendly. The number of daily visitors is not recorded.

Table 31: Number of HMS staff by branch and level of education

Branch	**Field and education**														**TOTAL**
	Techn-icians	**Meteorologist**			**Hydrologist**			**Engineer**			**Physicist, Chemist, Economist**			**Other**	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Met obs. network	51	5						2			1				59
Hydro. obs. network	9				4										13
Telecommunication	4	1						2							7
Data management	5		2												7
Weather forecasting	7	10													17
Hydrological forecasting	4				2										6
Climatology															
Agrometeorology															
NWP															
R & D		4						3							7
Environment	7							4			4				15
Weather modification	34	1						1			3				39
IT personnel	4	1						2							7
Commercial services															
Human resources	3										1				4
Accounting	5										2				7
General administration	17			1				1			3			3	25
Other											2				2
TOTAL	**150**	**22**	**2**	**1**	**6**			**15**			**16**			**3**	**215**
Female in % of total	20	60	50	0	35			35			60			35	30
Men in % of total	90	40	50	100	65			65			40			65	70

5.3.10. Human resources

HMS has a relatively large staff: 214 people (31% women, 69% men). Of these 129 are working with meteorology, 19 with hydrology and 14 with environmental matters. The average age of the staff is over 50 years. As the number of manned stations is relatively high an important part of the staff are observers, which have practically disappeared from more advanced NHMSs due to automated observation and measurement systems. The number of meteorologists, hydrologists and ICT experts is quite low. The educational level of the staff is quite low (mainly BSc level or less), with respect to requirements produced by advanced observation and ICT technology, numerical modelling, R&D and customer relationships.

The number of forecasters provides a possibility to run a 24/7 forecaster service. However, the data management and operation of the NWP systems is the core of NHMS operation. Currently HMS´s human capacity in data management and main computer experts do not allow 24/7 technical operation or production of sophisticated services, as HMS has only 2 main computer experts, 1 data base expert and 1 software expert and 1 communication expert, while there are no “helpdesk” or quality control experts.

Currently HMS does not have adequate human resources (scientists and experts) to fully respond the level of demands from a DRR system at typical level of an advanced EU country, or to develop and enhance its services to better support national development. Also the training of the HMS staff in DRR and hazard forecasting has been quite limited.

5.3.11. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums, to which membership provides better and more services than to non-members.

Table 32: International and regional cooperation activities of HMS

International and regional organization and cooperation mechanisms	HMS status
WMO	Member
WMO RAVI	Member
RMDCN	Member
IOC	No
UNDP	Yes
UN-ISDR	Yes
Red Cross/Red Crescent	No
EU	Some
EUMETSAT	Partner
ECMWF	Cooperative member from Jan. 2011
EUMETNET	Member
METEOALARM	Member since 2010
ECOMET	No
EUFP7 projects, networks	Not yet
EU JRC	
EU PHARE	Yes
EU CARDS	yes
EUCLID	No
EUR-OPA	No
DMCSEE	Yes
SEEVCCC	No
SAVA Commission	Cooperation
NWP consortium	None
NMHS bilateral	All SEE countries, USA,
NMHS MoU	Finland

EU based hydrometeorological organizations provide most state-of-the-art models, software and tools to be utilized by the member NHMSs. The integration into the European hydrometeorological infrastructure was given the highest priority in the 2007 project in developing the capacities of the NHMSs to implement best European practices and to produce improved products and services in support of national economic development and DRR.

The Former Yugoslav Republic of Macedonia has become a Co-operating State of ECMWF and EUMETNET in 2011. The negotiations of membership in EUMETSAT are going on at governmental level.

European Union research and networking programs create consortiums of excellence, and provides good opportunities to NMHS to network with NMHSs and commercial R&D companies and strengthen their capacities. Up to now HMS has very poorly exploited its possibility to participate in the EU R&D projects, COST actions and networking programmes. HMS is partner in the DMCSEE project financed by EU.

CMC has bilateral collaborations with homologues in Turkey, Bosnia and Herzegovina, Slovenia, Croatia, and Montenegro. At international level CMC collaborates with UNDP, UNISDR, and WMO.

HMS is open for international cooperation in order to promote the capacity and modernize its products.

At national level, there is the need of a better and clearer attribution of tasks and responsibilities of any organization involved in DRR in order to develop and promote the use of common methodologies and integrated policy approach. At regional level there is the need for the establishment of a regional network for cooperation.

5.4. Technical recommendations to strengthen HMS capacities in support of DRR

Currently HMS does not have adequate technical, human and financial resources to fully support risk assessment and early warning systems. It is critical to upgrade and modernize the national hydro-meteorological monitoring and information exchange network and the forecasting system and to provide sustainable organizational resources, human and technical resources and increase the budget available to HMS for efficient meteorological and hydrological disaster risk monitoring, forecasting and warning. The following technical recommendations:

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. There are needs to further improve the legal and institutional DRR framework;
2. There are urgent needs to re-organize the HMS to better support the substance areas of the organization, and to promote the capability to better implement the obligations and mandates given in the law;
3. There are urgent needs to upgrade the financing of HMS.

Operational relationships with other agencies

4. There are needs to improve cooperation with other technical agencies, including the Crisis Management Center and the National Protection and Rescue Directorate, through the understanding of their specific needs, the development of specific SOPs for warning and other products and services, as well as feedback mechanisms.

Monitoring and observations networks and data exchange

5. There are urgent needs to implement a proper calibration and maintenance of sensors in order to meet the WMO standards of measurements;
6. It is necessary to upgrade and modernize the weather radar network with 2-3 modern radars;

7. Investments in implementation of two daily upper air soundings would benefit the regional and local weather forecasts;
8. There are needs to strengthen and modernize the meteorological and hydrological surface networks and to increase the number of automatic stations; especially additional rain gauge and water level automatic stations on upstream catchments;
9. There are urgent needs to enhance international and regional data exchange.

Forecasting

10. There is an urgent need to take in use hydrological models;
11. There is an urgent need to establish a warning system for floods and flash floods;
12. There is a need to promote NWP modelling through membership in a European NWP consortium;
13. There is an urgent need to become a member of the SEEVCCC cooperation to promote national bases to adapt to climate change;
14. There is need to implement analysing, editing and visualization tools.

Hydrometeorological data management systems

15. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data;
16. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data. Specifically, the following tools and appropriate training would be required: New version of CLIDATA and training, update of HYDROPRO hydrological data base and training and additional component of the DEMAS Software for collecting Hydrological Data from automatic stations (DEMAS db);
17. There is a need to develop an agrometeorological database, including also phenological data.

Hazard analysis and mapping to support risk assessment

18. There is a need to define standard methodologies for hazard characterization and mapping, and for hazard risk assessment;
19. There is a need to develop hazard analysis and mapping based on historical data and climate change projections to support risk assessment;
20. There is a need to strengthen the systematic collection of drought/floods impact information on a state level with standardized procedure and long-lasting approach;
21. There is a need to strengthen GIS, spatial analysis and remote sensing capacities for hazard analysis and mapping, including GIS software and training, access to an officially agreed DEM;
22. There is a need to strengthen the agrometeorology capacities of HMS to support drought risk assessment (calculation of drought indices, water balance model, crop coefficients, use of remote sensing information in agrometeorology).

Information technology and telecommunication issues

23. There are needs to improve and modernize the communication facilities by introducing modern technology for information dissemination and its automatization.

Warning products and services

24. There are needs to further improve the warning products;
25. There are urgent needs to promote cooperation with the media;
26. There are urgent needs to establish a feedback mechanism from end users or stakeholders ensuring that information reached its target audience in a timely manner, suitable format and with requested contents.

Climate change analysis

27. There is a need to develop a climate data management system;
28. There is a need to develop the technical capacities for climate change projections downscaling to local scales;
29. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors.

Human Resources

30. There are urgent needs to increase the human capacity with meteorologists, hydrologists, NWP model experts, ICT experts, data management experts and marketing experts;
31. There are needs to increase the number of staff with academic MSc and PhD degrees;
32. There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects;
33. There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EUMETNET NHMSs.

Regional cooperation

34. There are urgent needs to promote cooperation with SEE NHMSs;
35. There are urgent needs to enhance data exchange, warning and watch coordination and cross border training activities;
36. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
37. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;
38. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting.

5.5. Recommendations from the Former Yugoslav Republic of Macedonia National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Skopje, on 15 November 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: Integrate the DRR concept in Republic of Macedonia’s key strategic documents and development and sectoral policies; Incorporate development and sectoral policies in a clear and comprehensive framework, i.e. produce a DRR Strategy which will link national, regional and local development priorities to natural disaster risk prevention and reduction; When incorporating DRR in national, regional and local sectoral policies institutions shall follow the DRR concepts and definitions accepted in the ISDR and use commonly accepted terminology.

Recommendation 2: When incorporating DRR in the various sectoral policies, use harmonized methodology and coordinated approach, emphasizing the proactive approach to promotion of development, adaptation to climate change and reduction of natural disaster risks.

Recommendation 3: Initiate adaptation/amendment of legislation to implement national and sectoral policies for accident and disaster risk reduction for later national and local implementation; In a coordinated approach, mutual coordination and respect of each others' advantages the actors of the Crises Management and Protection and Rescue systems (CMC and DRP) shall remove shortcomings causing overlaps of institutions' national or local responsibilities or activities.

Recommendation 4: The National DRR platform should blend into the current regulatory and institutional framework and continue its role as a public awareness promoter and a forum for harmonization and coordination of sectoral policies. The national platform shall improve its comparative advantages as an active and flexible forum for cooperation and initiation of projects and ideas that will facilitate efficient functioning of the DRR system.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning

Recommendation 5: CMC shall prepare a natural disaster risk analysis and monitoring methodology. In cooperation with other actors of the system, it shall organize appropriate training on that methodology; Improve cooperation between key institutions such as the CMC, PRD, HMS and IEEES for more efficient information exchange, implementation of standard operating procedures and their harmonization with the methodologies, procedures and recommendations of the UN/ISDR, DRR, WMO and of the European institutions engaged in this fields.

Recommendation 6: In cooperation with the other entities of the system, the CMC shall finalize the establishment of an early warning system, which will be based on natural and manmade disaster risk analysis, monitoring, and information sharing. The CMC shall continue with the introduction of the European Emergency Number 112; In preventing natural meteorological disasters, it is crucial to increase the technical capacities and expertise of the national hydro meteorological service, particularly in early warning on meteorological and hydrological disasters by improving weather and water measurement, analysis and forecasting.

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 7: The Protection and Rescue Directorate and the Training and Exercise Centre shall increase their capacity for efficient training of the central, regional and municipal headquarters, of the rapid response teams, the professional and volunteer firefighters, the command staff and the rescue and protection forces.

Recommendation 8: Establish partnership between educational, academic and research institutions and the Crisis Management System entities which promote and implement the DRR concept. The Ministry of Education and the Education Development Bureau, in cooperation with the educational and academic institutions, the CMS/PRS entities and CKRM, shall introduce continuous DRR education and training and shall support national and local projects in cooperation with UNDP and other relevant international institutions. Introduce compulsory and elective DRR courses in primary, secondary and higher education that will develop a culture of prevention and care for the relations between man, environment and development (as called upon by the UN in Approaching United Nations Decade of Education for Sustainable Development 2005-2014).

HFA priority 4: Reduce the underlying risk factors

Recommendation 9: Establish a comprehensive risk identification, analysis and monitoring process, including community risk exposure and community risk vulnerability assessment methodologies, for specific risks. The CMS entities shall develop appropriate risk exposure and vulnerability assessment methodologies, paying thereby attention to the socio-economic and gender aspects Separate funds shall be allocated within the existing budges to finance the DRR policy nationally and locally and to strengthen regional cooperation.

Recommendation 10: Enhance the cooperation between HMS and the other entities to fully use HMS's potential for monitoring and early warning on the impacts of hydrological, meteorological and environmental risks (data, analyses, human resources, reporting).

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 11: Strengthen technical and human resources of the hydro-meteorological sector to support risk assessment and early warning systems by promoting operational monitoring, warning, forecasting and mapping of meteorological and hydrological hazards. It is critical to upgrade and modernize the national hydro-meteorological monitoring and information exchange network and the forecasting system and to provide sustainable organizational resources, human resources (education and training, IT expertise, international cooperation and networking) and technical resources (upgrade the automatic hydrological and weather radar network, integrate hydrological models in NWP modelling, integrate air pollution dispersion models with NWP modelling) and increase the budget available to HMS for efficient meteorological and hydrological disaster risk monitoring, forecasting and warning.

Recommendation 12: Strengthen human resources for hydrological data management and analysis, modelling and water forecasting with at least 6 hydrologists (Construction Engineers – hydrology major); Strengthen human resources for automatic hydrological and meteorological observation station maintenance with 3 electronics technicians; Make organizational changes within HMS with emphasis on water forecasting and flood protection and meteorology (measurement instruments calibration); Modernize the Hydrological Information and Forecasting System.

Recommendation 13: Strengthen, modernize and regularly maintain hydrological and meteorological monitoring, and regularly upgrade measurement networks with modern monitoring, data collection and transfer systems using plans and standards; Include weather radars in hydrological monitoring as technically most efficient measurement tools for rain analysis and water and flood forecasting,, especially for early warning on flash floods.

Recommendation 14: Make hydrological models for water and long distance wave travel forecasting for rivers Vardar and Strumica, Crn Drim and their tributaries. Put in place a hydrological warning and alarming system, containing information on extremely dangerous water thresholds and hydrological maps for risky floodable areas in urban and rural areas.

6. CHAPTER SIX: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN MONTENEGRO

Montenegro is prone to several natural hazards like floods, drought, heavy rainfall or snowfall, wind storms, heat waves, landslides, avalanches, forest fires, airborne sand from deserts and some epidemics which are directly or indirectly related to hydrology, meteorology and weather conditions. A number of hazards pose risks across borders in the region, especially floods, forest fires and dispersion of airborne pollutants.

This chapter presents all the findings related to the assessment of the DRR institutional framework and the technical capacities of the NMHS of Montenegro (HydroMeteorological Institute of Montenegro, hereafter referred to as HMI) to support Disaster Risk Reduction. It highlights that:

- The legal and technical status of the HMI has been significantly improved in 2010. However, the legal status, the technical and human capacity of HMI and ability to support national and regional DRR are still at much lower level than at the NHMSs in EU countries;
- There are urgent needs to enhance the institutional capacity of HMI for hazard mapping and risk assessment, production and dissemination of early warning and local scale analyses of climate change;
- It is necessary to strengthen the hydrometeorological observation network, including further automatization and establishment of weather radar network;
- It is necessary to enhance investments in climate modelling in cooperation with SEEVCCC and forecasting and analysis to support strategic and sectoral planning for at-risk sectors and investment plans of industry in order to promote economic development of the country;
- Development of Risk Assessment, MHEWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

6.1. Montenegro's vulnerability to hydrometeorological disasters

6.1.1. General overview of country's economic sectors

Agriculture, tourism, industry and services are the top earners and priorities for economic development in Montenegro, with services and tourism carrying 49.6% and 20% of the GDP respectively. The energy sector is also essential for sustainable development but the challenges faced in Montenegro's energy sector are low efficiency, high losses in transmission/distribution systems, unfavorable consumption structures leading to high dependency on imports, minimal use of its own natural energy resources, etc. Natural and technological hazards including earthquakes, floods, landslides, forest fires and industrial incidents represent a considerable threat to the Republic of Montenegro. The recent urban sprawl and the industrial growth of the country have exposed an increasing number of people as well as infrastructure to the potential consequences of these hazards[12].

In 2008, the gross domestic product amounted to 3.09 billion Euros, i.e. 4.908 Euros per capita. For the same year, the service sector's share in GDP was 77.2%, the contribution of agriculture and industry (with mining) to the gross domestic product amounted to 9.3% and 13.5%, respectively. The electric power generation, mining, and metal processing make approximately 70% of industrial production[13].

Tourism is a significant branch of economy, which is regarded as one of the key development priorities. The number of tourists almost doubled during the period 2003 – 2007 (from approximately 0.6 to 1.1 million), while the number of overnight stays, during the same period, went up for more than 80%. In 2008, the country was visited by approximately 1.2 million tourists, with 7.8 million overnights. The visits/overnights realized in the coastal region prevail in the total tourism turnover.

The share of primary agricultural production in GDP for the period 2005 – 2008 remained on the level of approximately 9% to 10%. The agricultural land structure is predominated by pastures and meadows (approximately 87%), whereas arable land and gardens make up less than 10% of the total agricultural land. Animal husbandry is the most important branch of agriculture, with a share of 60% in the total new value.

6.1.2. Hydrometeorological hazards in Montenegro

Geographical position of Montenegro as a Mediterranean country makes it a disaster prone country which is exposed to several natural hazards like flood, drought, heavy rainfall or snowfall, wind storms, heat waves, landslides, avalanches, forest fires, airborne sand from deserts and some epidemics which are directly or indirectly related to hydrology, meteorology and weather conditions.

The most devastating impacts from hazards in Montenegro are caused by floods. According to the EM-DAT data since June 2006, four major floods have occurred affecting significantly almost 8,000 people. A summer heat wave in 2007 saw the highest European temperature of 43.3 degrees Celsius measured in the capital city Podgorica. The extreme heat and drought caused serious problems with water supply especially in coastal areas of Montenegro.

In Montenegro, fires of all scopes and levels are possible, from incident to disaster and very common in green and forest areas. Forests in coastal and central parts of Montenegro are most threatened due to high air temperatures and characteristics of vegetation in July and August, which also applies to February and March - periods of dry and warm winters.

[12] Igor Djuric, IPA Beneficiary National Needs Assessment: Montenegro. WMO – UNDP, 2010.
[13] First National Communication to the UNFCCC.

The northern and higher inland areas are prone to snowfalls and icing which may lead to long-term interruption of traffic on many roads and a complete breakdown of relations with many villages and some towns.

Weather conditions may occasionally lead to landslides and rock slides. Such disturbances most frequently occur following heavy long-lasting rains when intensively waterlogged grounds, with unfavourable physical and mechanical characteristics of the rocks they are composed of, break off and begin to slide, possibly threatening and damaging infrastructure facilities and neighbourhoods or some their parts. In Montenegro such disturbance are particularly prominent along highways and regional roads in northeast Montenegro, and to a lesser degree at the coast.

6.1.3. Sectoral analysis of the vulnerability to hydrometeorological hazards

Heavy rain is very common and often results in flash floods, landslides and rock falls which are potentially very damaging for settlements and public infrastructure, especially the 7,000 km road network, much of which is located in mountain areas. Forest fires are even more frequent and widespread, especially in the rural coastline areas and in the central region. Marked increases in losses from property damage and lost revenue due to business interruption caused by extreme weather events translate into the increased volatility of earnings in the sectors exposed to weather. These include utilities, tourism, agriculture, transportation, aviation and forestry. And this in turn, means a higher cost of capital for businesses operating in the region. Besides the direct costs associated with physical damage, natural disasters typically lead to a worsening of the fiscal position, as governments pay for reconstruction and sources of revenue are disrupted. Therefore, the total impact on the budget widely exceeds the direct costs of relief and reconstruction from natural disasters.

Vulnerability to floods and droughts has not yet been fully analyzed in Montenegro till now. The effects of climate changes and the vulnerability of several sensitive sectors (water resources, coastal areas, agriculture, forestry, biodiversity and public health) were analyzed within the First National Communication on Climate Change of Montenegro.

In Montenegro, there are significant differences in the distribution and abundance of water resources, starting with arid karst areas to those that are rich in both surface and groundwater. The rivers drain into two basins: the Black Sea, with a total area of 7,260 km^2 (or 52.5% of the territory) and the Adriatic Sea with about 6,560 km^2 (or 47.5%). Rivers and streams in the coastal area, with the exception of the Bojana River, are characterized by short watercourses and a relatively low average flow. Some of these rivers are drying up during the summer season, while during the rainy period almost all have a torrential character, which contributes to landslides and erosion. Not counting the water used for electricity generation, the largest water consumer is the population. In 2005, about 102 million m^3 of water was extracted for the purpose of water supply to the settlements (of which about 90% came from groundwater and spring water sources). There are two most vulnerable areas to floods areas in Montenegro. The first is area of Skadar-lake basin with tributaries and Bojana river. The second is the upper flow of Lim (and also Tara) and confluent streams with torrential character.

Agriculture is an important economic sector for Montenegro. The structure of agricultural households is unfavorable from the standpoint of intensive and competitive production given the fact that small farms (less than 5 ha) dominate. In the last ten years, there was a slight decline in total surface of agricultural land (a decrease of about 3,000 hectares), while the structure remained approximately the same, with certain decreases in the arable land and gardens, and pastures categories, and with increased perennial plantations and meadows areas. Vulnerability to droughts is manifested primarily in the southern part of the country, also because of the karstic terrain.

6.2. Institutional Framework of Disaster Risk Reduction in Montenegro

6.2.1. Legal framework and policy supporting DRR in Montenegro

The National Strategy for Emergency Situations was adopted by the Government of the Republic of Montenegro (MNE) in December 2006 and can be considered as a foundation for the modern structure of Civil Protection in Montenegro. It gives authority to the Ministry of Interior Affairs and Public Administration through its Sector for Emergency Management for further development of this document as well as the development of the National Platform for DRR which the Sector for with the participation of other relevant institutions is currently working on.

The National Strategy analyses all the risks affecting the territory of Montenegro, providing a survey on the actual capacity of the Montenegrin structures to cope with them. The survey highlights the operational capabilities of Montenegro with reference to the major risks on its territory, emphasizing the importance of constant monitoring of the hazards and the need for an integrated approach to disaster risk reduction.

The following laws constitute the specific legal frameworks:

- The Law on protection and rescue (Official Gazette of Republic of Montenegro no 13/2007);
- The Law on water (Off.gazz. RM, no. 27/07);
- The Law on hydrometeorological services (Off.gazz. RM, no. 26/10);
- The Law on Hydrographic services (Off.gazz. RM, no. 26/10).

The Law on protection and rescue prescribes a set of measures and activities to prevent danger of natural disasters, technological accidents and other disasters. In order to effectively protect the population and the material heritage against possible disasters and preventing the spreading of risk, the law prescribes to conduct activities related to collection and processing of data on potential risks, establish information and early warning systems. The law mandates that these preventive activities include assessment of vulnerabilities (defined as “a qualitative and quantitative analysis of data on the possible hazards of the occurrence of natural disasters” “with predictions of their possible future course and consequences, the proposal of the level of protection against risk and proposal of preventive and other measures for protection and rescue”) as well as development of plans for protection and rescue, spatial development and building buildings, establishment of a protection and rescue system and provision of material resources, personnel and other resources necessary to carry out the planned activities. The Law enables the overall adequate functioning and gives to municipalities competencies to act in cases of disasters.

Pursuant to Article 34 of the Law on Protection and Rescue, the Ministry adopted two documents; the Rulebook on the Methodology for the Development of Threat Assessment Studies of Natural, Technical-technological and Other Disasters and the Rulebook on Methodology for the Development of Protection and Rescue Plans. The Rulebook on the Methodology for the Development of Threat Assessment Studies delegates responsibility to the Sector for Emergency Management and other Ministries for risk assessment for the territory of Montenegro; to the local governments in coordination with the Sector for Emergency Management for the vulnerability assessment of municipalities and in the case of the private sector, to companies with more than ten employees, again in coordination with the Sector. The threat assessment will include an assessment of hazards or causes that may lead to the occurrence of disasters and the consequences that may arise for people, material and cultural goods and the environment; determining the appropriate organization of protection and rescue in order to prevent the occurrence of disasters or for purposes of rescue of people; and an assessment of needs and possibilities in the provision of human and material potentials necessary for achieving the estimated protection and rescue organization. The law stipulates that the Sector for Emergency Management coordinates the development of National Plans of Protection and Rescue. The National plan for protection of extreme meteorological occurrences and the National plan for flood protection are in course of drafting.

The Law on water defines the obligation of preparation of a General plan for protection from harmful effects of water. The current plan covers the period 2010-2016. It especially contains: works and measures which are undertaken preventively and in the period of high waters for protection from floods and erosion; method of institutional organization of defense; duties and responsibilities of the manager for protection; method for monitoring and recording data; method for early warning. The law foresees the preparation also of a yearly Operational Plan for the Protection of the harmful effects of water. At national level it should be prepared by the Water Department and the Ministry, while at local level it should be prepared by competent local authority, with the approval of the Ministry. The Operational Plans determine the names of managers of protection against the harmful effects of water, headquarters, bodies and names of companies and other entities that conduct legal protection against the harmful effects of water and means for operational implementation of protection.

The overall protection plan, provides that in case a major flood hazards (declaration of the fourth degree of danger of flooding), the management of protection and rescue of people, material and cultural goods is to be ensured by a Coordination Team for Emergency Management situations. In this case, further action regarding the protection and rescue operations are undertaken regulated by the National Plan for the Protection and Rescue of Flood, prepared by the Ministry of Internal Affairs and Public Administration, in accordance with the Law on Protection and Rescue. Ministry of Internal Affairs, through Department for Emergency situation and civil security coordinates the work of all segments of the system of protection and rescue, which are: Ministries, Police Directorate, other state bodies, Montenegrin Military, economic society, operative units for protection and rescue, Agency for environmental protection, Hydrometeorological Institute and Center for Eco-toxicological Researches.

The new laws on “Hydrometeorological services” and on “hydrographic services” established in April 2010, define the tasks of the Hydrometeorological Institute of Montenegro (HMI). It states that the HMI has duty to:

- Produce nonscheduled meteorological and hydrological information and warnings in situation before atmospheric and hydrospheric elementary disaster (emergency situation);
- Organize emergency observation and measurement of the hydrological stations profiles and emergency information shall be submitted;
- Monitor weather and waters;
- Collect and analyze data;
- Prepare forecast;
- Inform and alert responsible agencies.

The National Action Plan for the implementation of the National Strategy for Emergency Situations is in the process of development.

In April 2007, the Government adopted the National Strategy of Sustainable Development which recognizes climate changes and protection of ozone layer as a priority and the government is now in the process of developing the National Development Plan.

6.2.2. Institutional framework

6.2.2.1. List of agencies involved in DRR

The agencies that are responsible for management and implementation of different components of DRR are:

- Sector for Emergency Management (SEM), Department for Emergency Situations and civil security under the Ministry of Interior Affairs and Public Administration;
- HydroMeteorological Institute (HMI), under the Ministry of Sustainable Development and Tourism;
- Ministry of Rural Development and Agriculture;
- Directorate of Water, under the Ministry of Rural development and Agriculture;

- Local Authorities – Secretariats involved in water management.

The SEM with the participation of other relevant institutions is currently working on the establishment of a National Platform for DRR.

6.2.2.2. Sector for Emergency Management

The Sector for Emergency Management is situated within the Department for Emergency Situations and Civil Security under the Ministry of Interior Affairs and Public Administration. Based on the Law on protection and rescue, Department for Emergency Situations and Civil Security has obligation, in sense of preventive, operational activities of elimination of consequences. Also SEM obligation is to develop vulnerability assessment, plans for protection and rescue, establish and coordinating the system for protection and rescue (including the 112 center) and provide material means and other resources for conducting of planned activities. The duties of the Department include also risk and vulnerability assessment and planning for emergency responses. The process of risk assessment for drought and floods is performed by the Department for Risk Management. It is also responsible for the management of the national database of the risks as reported by the National Strategy for Emergency Situations. The duties of the Department encompass the drafting and development of strategic documents and plans at national or inter-municipal levels, cooperation with scientific bodies (universities), laboratories and other research institutions. As indicated by the National Strategy for Emergency Situations, line ministries and relevant agencies are involved in the preparation of specific plans, participating in the ad-hoc working groups and are responsible for providing specific data and analysis to the department of Risk Assessment. SEM relies also on operational units: Municipal services for protection and rescue, units for civil protection, units for protection and rescue of economic societies and other legal persons, aeronautic-helicopter unit, as well as voluntary units for protection and rescue.

6.2.2.3. HydroMeteorological Institute – HMI

The Hydrometeorological Institute of Montenegro (HMI) is the main actor related to hydrological, meteorological, environmental and marine observations, monitoring and services. TV stations and other media are also proposing meteorological services.

The HydroMeteorological Institute of Montenegro is under the Ministry of Tourism and Sustainable Development (previously was under the Ministry for Environment and Spatial Planning). According to the law on Hydrometeorological activity, HMI have mandate for the following activities:

- monitoring weather and waters;
- collecting and analyzing hydro-meteorological data and data on water and air quality ;
- preparing forecasts;
- informing and alerting responsible agencies.

The Hydrometeorological Institute (HMI) is responsible for tasks relating to: observation and measurement of meteorological, hydrological, hydrographical, environmental and agrometeorological parameters; analysing, processing and archiving of measured and observed parameters, making studies, surveys, analysis and information on climate, soil condition, air, surface and underground waters and coastal sea; forecasting and presentation of data in the field of meteorology, hydrology, hydrography, environment and agrometeorology, establishment of information systems with the bank of climate, hydrological, hydrographic, environmental and agrometeorological research, the establishment and maintenance of meteorological, hydrological and agrometeorological stations for monitoring weather, water, and air, construction and cadastre sources, springs and water facilities, testing sediment in rivers, control and evaluation of the quality of surface and ground water, rainfall, air and soil on the basis of analysis of physical, chemical, biochemical and radiological parameters; providing data, information and study for the maritime, air and road transport, electricity, water, agriculture, construction, tourism, military, security of property and persons and other interested parties; aero-radiosounding measurements and higher layers of the atmosphere, phenological observations; indirect provision of air navigation; implementation and maintenance of standards of meteorological and hydrological instruments and calibration of instruments in meteorological and hydrological stations, carrying out international obligations in the field of meteorology and hydrology and quality control of air, water, and other activities within its competency.

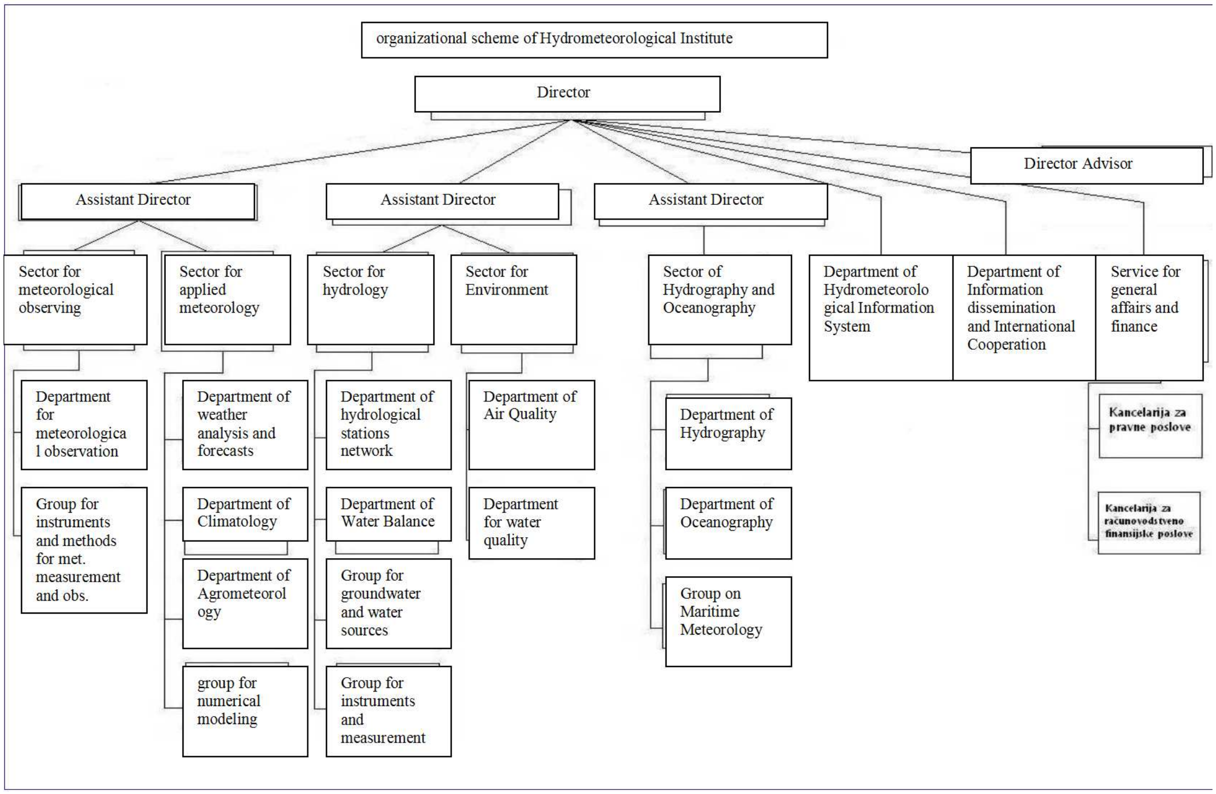


Figure 32. Structure of HMI

Regarding the Meteorological Services for the Aviation sector, the Serbian-Montenegro Air Transport Service Agency (SMATSA) provides air traffic services in the airspace of the Republic of Serbia, Montenegro, a part of international waters of the Adriatic Sea, as well as for 55% of the Upper Airspace of Bosnia and Herzegovina. SMATSA, which is a Serbian company partially owned by the Montenegrin government, produces warnings for the civil aviation sector using (free of charge) data, analyses and forecasts produced by HMI.

HMI has also the duty to produce nonscheduled meteorological and hydrological information and warnings in situation of hydrometeorological disaster (emergency situation). The structure of HMI and its various departments is described in the Figure 32.

6.2.2.4. Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development (MARD) is also in charge of water management. The Ministry is mandated to prepare the General Plan for protection from harmful effects of water each 6 years and the yearly Operational Plan. Within the Ministry, the Water Directorate is an organizational body dealing with Water Management. Water Directorate is responsible for planning and implementation of protection measures and infrastructures. WD is charged to prepare plans of water management for each river basin on the basis of floods risk assessment. According to the law on water, the WD is responsible for the implementation of the European Framework Directive on Water and the Directive for Floods Protection. In this context WD should prepare the Preliminary Flood Risk Assessment by 2011. Full employment in the administration of directorate is 8 people, including 3 engineers. The technical capacity of the Directorate is actually quite low. WD activities are carried out principally on project basis using external resources.

6.2.3. Operational relationship with Disaster Risk Management and other Technical agencies

In Montenegro, there is a disaster management system in place, which is predominantly disaster response oriented. The system of protection and rescue is realized through organized activities and reactions of preventive and operative character conducted by state bodies, local government units, business organizations, entrepreneurs and other legal and natural persons.

SEM is the unique body to coordinate Civil Protection in Montenegro. Currently most of the structures related to DRR activities are built into the system of management in emergency situations led by Coordinating Management Team for Emergency Situations. At the local level there are structured municipal teams responsible for the management of emergency situations, which are managed by the Governor.

The early warning system is currently in the process of being developed. Currently the system is located with the Coordinating Body for emergency situations, and each relevant ministry and institution has their place within it. The HMI has a role of providing information but it is not the focal point of the EWS. Currently the cooperation with the SEM and other Montenegrin technical agencies concerns mainly the disaster management, while very little cooperation exist for risk assessment and planning. HMI mainly releases data by request and the cooperation with DRR management is mainly on ad-hoc bases. Standard Operating Procedures (SOP) and Quality Management Systems (QMS) between the HMI and the DRM sector have not been developed.

6.2.4. Roles and responsibilities in flood and drought risk assessment

At national level, the institutional framework of drought/floods risk assessment is currently in the process to be defined. The process of drought/floods risk assessment at national level in Montenegro is organized upon different fields of activity and different administrative levels and could be strengthened by improving coordinations among these entities. Concerning floods, the legal framework attributes to:

- SEM the duty to perform flood risk assessment for planning emergency management;
- Ministry of Agriculture and Rural Development the duty to perform floods risk assessment for planning protection against the harmful effects of water;
- WD the duty to prepare Plans for water management of each river basin, including relative flood risk assessments (and the preliminary flood risk assessment according to the EC Directive for floods protection);
- Local authorities the duty to perform flood risk assessment for disaster prevention and for local spatial planning.

None of these four levels is actually fully operational according to international standards of Risk Assessment. Only WD performed ad-hoc floods risk analysis for some segment of rivers on project basis using external technical resources. Moreover some overlaps of competencies still exist, for example concerning floods between SEM and Ministry of Agriculture and Rural Development in planning for floods protection. In other cases, roles and responsibilities are becoming clearer.

Concerning drought, as per the law on protection and rescue, drought risk assessment is included in the meteorological extreme event risk assessment for planning emergency management. But as well as for floods, drought risk assessment is not implemented yet. HMI, even if in its mandate drought risk assessment is not clearly expressed, is approaching the issue on project basis.

SEM is responsible for the production of the National Plan for protection of extreme meteorological occurrences and the National Plan for flood protection. In order to produce this plan, SEM coordinates working groups composed by experts representing involved line ministries. Line ministries provide specific data and analysis for the analysis of threats and risks related to specific hazards as indicated by the Rulebook on the Methodology for the Development of Threat

Assessment Studies. These studies are not supported by spatial analysis on historical time series of data on hazards and impacts, rather they are qualitative evaluation of the threats.

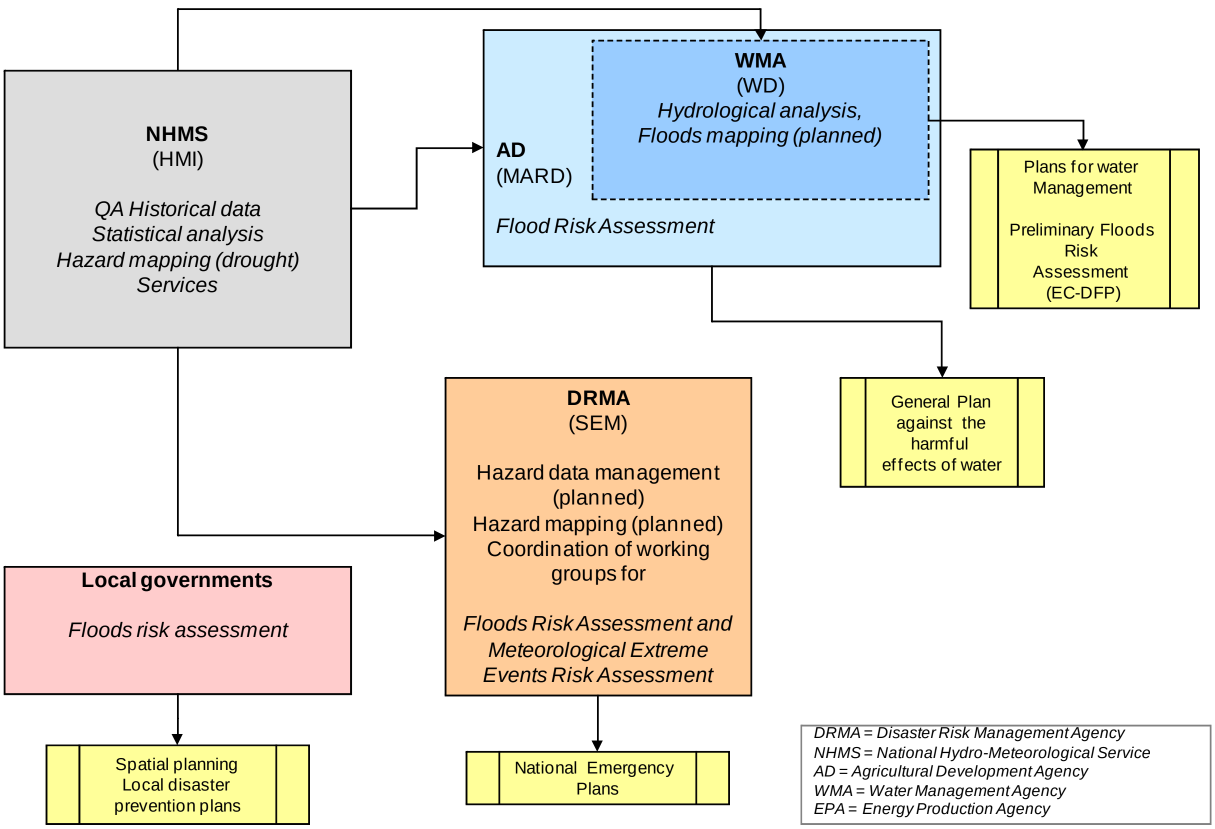


Figure 33. Workflow for drought and floods risk assessment in Montenegro

Currently the role of HMI is to provide basic statistics and analyses of extremes and climate variability to be used for strategical planning of DRR. HMI provides such information to SEM and also to Water Directorate. Flood risk assessment and analysis is still not implemented in HMI, while the drought risk assessment and analysis is actually supported within the project DMC-SEE. HMI is included in the National team for risk assessment formed on the state level and coordinated by SEM.

The WD is responsible for the planning of preventive works and measures to protect against the harmful effects of water. WD should ensure the identification of areas for which there is a risk of flooding, the production of maps of flood zones and their integration into the physical planning, the development of a Water Information Systems, the design, the construction and routine maintenance of facilities for protection against the harmful effects of water. Operationally, the WD operated some studies on project basis assigning the technical work to external service providers because WD didn't have yet strong technical capacity. But at least the IT component, including databases and GIS, would be managed in-house.

MARD is currently not involved in any activity aiming to analyze drought or to assess drought impacts on Montenegrin agriculture. The approach of MARD seems to be simply pushing toward irrigation for risk reduction in general.

6.2.5. Budget and funding for DRR

Protection and rescue is funded from the budget of the government, municipal budgets, voluntary contributions, international assistance, funds of business organizations, other legal persons and entrepreneurs and other sources. As the SEM does not have its own budget, it is financed from the budget of the Ministry of Interior; however, there are no budget allocation mechanisms to earmark funding for DRR. Furthermore, within other ministries, annual planning needs do not include specific programs oriented towards risk reduction so budgets can not be allocated for them. At the municipal level, spending on developing or implementing DRR measures is on ad hoc basis. HMI is severely under-financed for essential parts concerning DRR and it does not have resources to operate a 24/7 analyzing and forecasting system.

A window of opportunity exists to allocate resources if such programs and projects are created by the Ministries by September (date when plans are submitted to Ministry of Finance). Sources of international funding are mainly focused on ECO funds and it can be expected that if adequate DRR program/projects are prepared by Ministries there could be possibility of funding from EC funds. UNDP has also channelled activities through the Bureau of Crisis Prevention and Recovery, which could be directed at capacity development and improving risk assessment practices.

6.3. Technical Capacities of Hydrometeorological Services to support Disaster Risk Reduction

6.3.1. Monitoring and observations networks and data exchange

The meteorological and hydrological observations are the base for climatological studies and for global, regional and local weather forecasting. Main input for numerical weather prediction models are upper air soundings, which give the temperature, humidity and wind profiles from the ground to upper level of the atmosphere. Long-time historical time series of accurate quality controlled observations are required for hazard mapping and analyses of climatological trends. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situations;
- reduction of vulnerability to the risks of hydrometeorological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale NWP modelling.

The meteorological observation network in Montenegro (Table 33) consists mainly of 9 AWS (plus 2 aviation meteorological stations) communicating via GTS, 20 climatic stations and 60 rainfall stations. Data from automatic weather stations are available in the center of Podgorica every 10-min on HMI servers and on web-page. Data from hydrological automatic stations are collected in the centre once per day, and they are available on web-pages. Data from other hydrological and meteorological stations are measured with classical instruments. For hydrological parameters water stage from limnigraphs and discharges are available with some time delay. Data from meteorological stations: depending of type of stations measurements are taken every hour on main and air stations and climatological measurements are taken three times per day (07, 14, and 21) and every 10 minutes from automatic stations. These data are available with time delay.

HMI has no own calibration facilities for meteorological sensors. The Serbian hydrometeorological servcie assists with calibration of HMI meteorological sensors by request. Due to lack of national calibration system of hydrometeorological sensors and data acquisition systems, the quality of HMI measurements and data produced is questionable.

Weather radars are powerful tools in flood prone countries to forecast floods, and in general to provide basis for nowcasting and location of precipitation areas during hazard events and rescue operations. However, weather radars are very expensive investments. Currently there are no weather radars, lightning observations or upper air observations available. HMI does not have access to radar data from neighbouring countries.

Hydrology is a significant field of activity of HMI under two departments. HMI has a good coverage of Montenegro with 51 hydrological stations (31 in Black Sea basin and 20 in Adriatic sea basin) of which 31 are automatic and connected with the center in Podgorica. Lack of funds is HMI main problem in finishing automatization of remaining stations in the network.

Table 33: Observation stations operated by HMI

Types of observation station	Number		Connected to WMO GTS	Comments of 2010 network
	2007	2010		
Atmospheric domain				
Surface synoptic stations (> 8 obs./day)	18			
Manned stations	8	9	4	2 stations operate 03-21 UTC
AWS or AWOS	7	9	9	all AWS and GTS
Aviation weather stations		2		Automatic
Agrometeorological stations	0	0		
Ordinary climate station (3 obs./d)	20	20		2 automatic
Rainfall station (2 obs./d)	69	65		
Rainfall station – automatic	0	0		
Meteorological towers	0	0		
Upper air radio sond stations	0	0		
Pilot balloon stations	0	0		
SODAR/RASS	0	0		
Wind profiler stations	0	0		
Lidar	0	0		
Access to AMDAR data	No	No		
Weather radars	0	0		
Hale radars	0	0		
Lightning detection stations	0	0		1 station planned
Lightning detection hub station	0	0		
Satellite MSG ground station	0	1		
Hydrological domain				
Hydrometric stations	41	51		31 in Black Sea and 20 in Adriatic Sea
Stream gauge station – manual				
Stream gauge station – automatic				
Water level post – manual				
Water level station – automatic		31		
Maritime domain				
Offshore synoptic stations - manned	0	0		
Offshore synoptic stations - automatic	0	0		
Buoys	0	0		
Buoys with meteorological observations	0	0		
Tidal stations	0	0		
Tidal stations with met. observations	0	0		
Sea temperature	6	6		
Environmental domain				
Air quality	17	17		SO2, NOx, smoke, precipitation quality
Water quality-surface and sea waters	36			
Nuclear deposition				
Ozone – near surface				
Ozone – upper air				
UV radiation				
EMEP		1		on Zabljak mountain
UNEP/MEDPOL		1		

HMI operated some 15 air quality stations with 24 hour sampling, while the main responsibility of air quality monitoring in Montenegro was transformed to CETI in 2010.

In 2010, HMI installed a satellite weather station MSG 2nd generation DAWBEE drawn from the EU grant through the IPA Disaster Risk Reduction project conducted by WMO. The first meteorological images were received on 7 October 2010 from EUMETSAT meteorological satellites.

The number of stations from which the data is communicated to international data exchange trough the WMO GTS is very low (4 stations).

6.3.2. Hydrometeorological data management systems

Data management is the core of successful operation of an NHMS, data communication, use of NWP and other numerical models, commercial weather service and dissemination of data and products.

Synoptic and climate data are available since 1948 and agrometeorological data from 1951 to 2003. Some of the data is still in form of manual archives and needs urgently to be digitalized. In HMI, the data management used to be decentralized and based on PCs and servers. However, in 2009 a new CLIDATA database system was installed (replacing the CLICOM system), and a new hydrological database WISKI was taken in use. Meteorological sector has special staff working with meteorological data, while the hydrological data is managed directly by experts.

HMI collects hydrological, meteorological, hydrographical, oceanographic, air quality and water quality data from its official national networks. HMI has a sector of hydrography and oceanography which leads bathymetric measurements and surveys the sea and inland navigation paths. The oceanographic data consists only of sea temperature measurements near the coast, as well as of quality water at the beaches. The data is stored in a digital Oracle database. Part of data also available in excel data base. Archive of meteorological and limnigraph charts are in paper form.

For quality control and validation, the process is organized on three levels: (i) observers make an evaluation of measurements quality; (ii) meteorological technicians make logical consistency of data from paper documentation; (iii) Quality Control procedures and validation are performed within the database, i.e. CLIDATA for meteorological data and WISKI for hydrology.

Still in 2010 there were difficulties with operation of the database and sharing of data to different users within HMI. However, these problems were solved recently by purchasing a sufficient number of licenses. The technical data management systems, operation of data bases and sharing of data within HMI have been significantly improved in 2010.

The process of linking separate databases into a single database and their transfer to GIS is time-consuming and requires financial means and appropriate information technology equipment and well-trained personnel. In Montenegro there have been some attempts to produce a common database, but it has failed as the terms user access to the database was not properly defined.

Near real-time data are available on web-pages, and historical data are available only on demand.

According to international obligation for data exchange HMI shares in GTS data from 4 stations. HMI provides also data to meteorological services for aviation and maritime navigation. Furthermore HMI provides data to neighbouring countries (Serbia, FYROM, Croatia, and Republic of Srpska) with specific MoUs (in preparation phase for Slovenia, Bosnia and Turkey). Hydrological data are provided to the ICPDR and the Sava Commission.

Information about data (metadata) is scarce, nevertheless station documentation about geographical location (lat, lon, alt), observation practices and data about instruments are available in digital format. Metadata needs to include observation station specific information of sensors used, their transfer functions, siting of the sensors, description of masts, towers and booms, detailed description of the surroundings of the measurement site with special interest in nearby obstacles (type, size, height, distance, relevant angles) rather shown by photos (including a fisheye photo), etc.

6.3.3. Hazard analysis and mapping to support risk assessment

In Montenegro there is no inventory nor list or database of past floods or droughts. Some information on flood extent exists for the floods of 2009/10 at WD. Concerning droughts, some information is available from 2000, but it is not organized.

HMI collects hydrological data on flood events, which could be useful for hazard mapping, particularly water levels and discharges. Such data are collected using standard protocols for hydrological data, but no other specific protocols for hazard data collection or management is used. These data are managed within the WISKI database. HMI does not keep any separate hazards statistics, but statistics for high wind, heavy precipitation and extreme temperatures can be produced for each synoptic observation station. HMI collects phenological data, which are actually stored in excel for a time series of about 10 years.

Based on available hydrological and meteorological data HMI produces statistical analysis on flood frequency and probability. HMI has adequate tools for statistical analysis (Statistica, StartGraphics, Climdex), interpolation (Surfer), hydrological analysis (Hydras 3, Hyprom) and geographical and geomatics (Geomedia, Autocad, ArcView). WD has some technical capacity in terms of hydrological analysis and mapping, but they are not really exploited as the technical work is usually done by external service providers. They lack completely of tools for analysis and GIS.

Drought indices, analysis and early warning products are in preparation phase within the project DMCSEE. It is planned to make SPI available on a near real-time basis to relevant users in participating countries and broader SEE region.

In general there is no systematic process for flood and drought hazard analysis nor mapping. At the exception of the inundation of 2009/10 for which WD is preparing some maps of flooded areas and few inundations maps produced by HMI, most of the existing hazard analysis and mapping available in Montenegro have or are being produced on a project basis. These projects include:

- EWCM (Extreme Weather Conditions in Montenegro) project, which aims among other to determine criteria for the definition of weather related disasters in Montenegro and map the areas where certain types of disasters occur in order to determine the vulnerability level and assess possible damages of such disasters;
- the project Adricosm Star during which some tools for the understanding and simulation of the state of surface and underground waters have been developed, as hydrological forecasting model HYPROM (based on MIKE11), which has been implemented in Skadar lake basin. But this model still is not completely operative;
- The hydrological model HBV has been used in the framework of a collaboration with the Norwegian company Startcraft for modelling a tributary of the Lim river. HMI has provided the input data and the company has run the model. It is foreseen that HBV is installed at HMI and that hydrologist are trained in its use.

Main gaps consist in a lack of connection among various institutions, which are responsible for specific components of floods or drought risk assessment, but also the lack of specific capacities within the organizations.

Concerning disaster impact data, the practice in Montenegro is that relevant organizations collect data pertaining to their sector and hazards that impact them. Unfortunately no formal mechanisms have been developed for collecting, storing and accessing this data, which is currently scattered around different institutions acting at different levels. HMI, WD and SEM don't collect impact data.

SEM has an inventory of information about some past floods, but the data are not organized nor harmonized. MARD collects through the extension services some data on damages caused by floods at Municipal level. These surveys are performed when farmers claim for indemnities to the Municipalities. But this information is not organized and refers only to samples and not exhaustive inventories. Drought impact data are not collected by MARD. Concerning floods, local commissions make damages assessment after the floods. The information about damages exists in form of reports for the floods occurred in 2009/10, but for the previous years probably not. There is an extensive belief expressed by the stakeholders that a standardized methodology for impacts/damages assessment is needed. Thus, the establishment of a database or at list a meta-database of impact data per hazard is crucial in order to facilitate data access.

From an operational point of view, the process needs to be improved strengthening the analytical capacities of different actors, by introducing modern technologies of analysis, such as numerical modelling and GIS. Also the availability of data for the analysis should be improved through strengthening the observation network (density, automatization, and communication), improving the quality of databases (QC, software, data rescue) and the interoperability of different sources of data.

All the actors convene also that there is a need of standardized and specific methodologies for risk analysis and assessment according to the different types of event. Cooperation between Institutions should also be improved in the sense of data and information exchange and better organization of multidisciplinary meetings and working groups.

6.3.4. Forecasting

HMI publishes twice a day short-range +24h and +48h and daily weather forecasts +72 h, wave forecasts for the Adriatic Sea +72h and +72 h forecasts for dry and wet deposition for a domain covering South Europe and North Africa. HMI is preparing to produce weather forecasts also for longer period. The forecasts are available on the HMI home page. Currently nowcasting forecasts are not produced. HMI does not produce hydrological forecasts. HMI produces also special forecasts on contractual bases:

- every day 2-4 days forecasts to Agriculture sector;
- every day 2-days forecasts to road transport sector;
- twice a day 24 h forecast to water transport sector;
- every day 5-days forecast to energy production sector.

Global models cover entire planet, while regional models cover a limited area. In order to present processes in lower atmosphere, it is necessary to use ultra-fine resolution models i.e. a higher density grid of points where calculation is performed. Given that computer resources and time period are limited, fine resolution numerical models are used for smaller and limited areas, while initial and lateral conditions are provided from low resolution global models.

The weather forecasting is based on use of global NWP model products produced by international centers (ECMWF and GFS/USA), NWP modelling done by HMI and use of 3-hourly satellite data. Currently the forecasters do not have access to real-time data from the HMI observation network. HMI has in use several regional and local scale nested numerical models: ETA-MN (33 and 17 km horizontal resolution) and freely available models WRF (7 km) and NMM-MN (5 km). Data from global models of AVN GFS (USA) and ECMWF (Europe) are used as initial and lateral boundary conditions. As ECMWF is going to run global models on 8 km horizontal resolution it is vital to use this data for 1-10 days forecasts, and to increase capacity to run higher resolution (1-3 km) mesoscale model for Montenegrin territory.

The ETA model includes a dust transport module, which is used to forecast dispersion and deposition of dust from Sahara. WAM –Wave Atmospheric Model- is used to predict sea waves and it is run at 12.5 km horizontal resolution.

As HMI does not have adequate capacity to operate the models they are automatically run by a private Serbian meteorological consulting SEWA. It is envisaged that HMI would have at least two persons to work with NWP models. However, currently there is only one person at HMI that meets current needs and who is available for operational services for analysing and weather forecasting, and is available also after working hours.

Currently HMI has limited computing resources, and actually there is no backup system available to ensure sound computing in case of emergency. This makes the national DRR system at all levels quite vulnerable.

HMI does not operate any modern automatic processing and visualization software of Weather Prediction Products.

6.3.5. Warning products and services

6.3.5.1. Warnings and mandates

Currently there is no law which would define the responsibilities and mandates concerning production and dissemination of warnings and alarms for natural hazards. However, only HMI has the established mandate to issue general science based warnings of hydrometeological hazards (strong winds, hail storm, thunderstorm, heavy snow, freezing rain, dense fog, storm surge, icing of roads, heat & cold waves, drought, river flooding and marine hazards) through media, its internet pages and directly to authorities.

Table 34: Warnings for natural and technical hazards in Montenegro, based on Annex 2

Hazard	Exists in the country	Warning by	Type	Warnings / year
Heavy precipitation	Yes	HMI	I	10-20
Flash floods	Yes			
River flooding	Yes			
Coastal Flooding	Yes			
Hailstorm	Yes	HMI	I	5-10
Thunderstorm or lightning	Yes	HMI		60-70
Heavy snow	Yes			
Freezing rain	Yes			
Dense fog	Yes			
Tornado or cyclone	No			
Strong wind	Yes	HMI	I	
Storm surge	Yes	HMI	I	60-70
Heatwave	Yes			
Cold wave	Yes			
Drought	Yes			
Marine hazard	Yes	HMI	I	
Sandstorm	No			
Landslide or mudslide	Yes			
Avalanche				
Airborne hazardous substance	Yes			
Waterborne hazards	Yes			
Hydrometeorological hazards for aviation	Yes	SMATSA	III	
Icing of roads				
Forest or wildland fire	Yes			
Smoke, dust or haze	Yes			
Earthquakes	Yes			
Tsunamis	No			
Volcanic events	No			
Dispersion of insect pests	Yes			
Desert locust storm	No			
Hazard for allergic reactions	Yes			

HMI does not analyse potential impacts of the hazards. However, concerning flash floods HMI measures and forecasts precipitation, and gives an estimate whether this could cause flood or not. The warnings are based on 1-10 day weather forecasts, and on the data from the observation networks. Warnings on flooding are given in close communication and cooperation of Sector of Meteorology and Sector of Hydrology (precipitation + temperature + water level). HMI does not warn for floods or flash floods, but it warns for heavy precipitation and high water levels and indicates whether it might lead to flooding.

6.3.5.2. Warning dissemination mechanism

HMI provides information and warnings via bulletins to authorities, the 112 system and some industrial sectors with contract. In some cases, the produced information is tailored to specific users e.g.:

- Information to public disseminated via mass media;
- Information about weather condition to SEM via bulletins (also available on the web);
- Warning dissemination and alerting via Centre 112, and via Fax to SEM in case of expecting emergency situation;
- Bulletins, reports, studies for Ministry of agriculture, forestry and water management;
- Information about floods provided by official reports and direct communications to Ministry of water management.

In November 2010, HMI became the member of the EUMETNET METEOALARM system and HMI has received proper software and training. Some of hazard mapping analyses are available at the HMI official web page www.meteo.co.me.

Currently there are only few TV stations (e.g. RTCG 1 and VIJESTI), which prepare weather forecasts based on HMI data and information, or have specific contract with HMI, which engages meteorologists to make weather forecast and present it on the TV. Moreover, HMI forecast is used by two newspapers: Pobjeda and Vijesti.

Current dissemination mechanism of warnings and advisories is not very effective thinking about getting the information to the authorities and the public and especially to those who are at the dangerous areas with as long lead time as possible.

6.3.6. Climate change analysis

Information of impact of climate change at local level is essential for governmental and industrial strategy planning and for adaptation to climate change. Currently HMI does not have a specified or active role in climate change studies.

It can be expected that also Montenegro could significantly benefit from the new South East European Virtual Climate Change Center (SEEVCCC), which was established in 2008 within the Serbian National Hydrometeorological Service.

6.3.7. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings. Currently HMI does not have capacity for on-line data collection and tools for automated production and dissemination of products and warnings.

At present the data from the manual national network is collected via telephone lines and from AWSs by mobile phones. Climatic and some other data are delivered from the stations to headquarters by post. Data, information and products are distributed to media, other information channels and end-user by telephone, mobile phone, internet, email and post. Warnings are sent by phone and mobile phone only, which also guarantees some response from the receiver (Table 35).

HMI is linked to WMO GTS through connection to Sofia RTH.

Table 35: Equipment in use for data communication and warnings and other products dissemination

Telecommunication Equipment	To receive data	To send data	To send warnings	To send products
Telephone	X		X	X
Mobile Phone	X		X	
Telefax				
Dedicated Leased Lines				
UHF radio transceiver				
High frequency/Single side band radio				
HF Radio Email				
Aeronautical Fixed Telecommunication Network				
Very Small Aperture Terminal				
Data Collection Platforms used to transmit data from AWSs				
Global Telecommunication system (WMO-GTS)				
Meteosat Second Generation Satellite system				
Other satellite systems				
Internet				X
Email				X
Post/mail	X			X
Print media				
TV –national				
TV-commercial				
Radio				
Bulletins			X	
Printed text			X	X

6.3.8. Human resources

The HMI has scientific background and knowledge, but insufficient number of employees, to participate in DRR, and to produce critical data for analyses of hydrometeorological extremes and to operate an adequate early warning system.

The total number of HMI staff is 125, and the number of permanent employees is 113. Close to half of staff are women. The educational level of the staff is quite low; with only 7 persons with MSc degree.

In comparison to EUMETNET NHMSs the amount of human resources look quite adequate. However, more than half (65%) of the HMI staff are technicians/observers at manned weather and hydrological stations, while the number of observers at european NHMSs is very low due to high degree of automation of the observation network, but also of data management, analysis, production and information delivery systems. Actually the number of scientifically adequate staff of HMI in hydrological and meteorological sectors is alarming low, with respect to ordinary operational work and especially to DRR related duties: only 5 forecasters (while SMATSA has 7 forecasters). There is also significant lack of professional IT or ICT staff. Only one person is capable to run the numerical weather prediction models, and during the weekend, holidays/vacations, the model is running by itself using special script which initiates the model automatically.

Unlike the hydrometeorological services in EU the HMI has insufficient number of employees to operate a 24/7 monitoring, analysis and forecasting system. HMI suffers severely from lack of computing and IT systems , with proper back-up system, and human resources (which are critical for running of data collection, data management, data sharing and numerical weather models) makes the national DRR system at all levels quite vulnerable. The office hours for the weather forecasting department are from 04 to 18, daily.

Table 36: Number of HMI staff by branch and level of education

Branch	Field and education														TOTAL
	Techn-icians	Meteorologist			Hydrologist			Engineer			Physicist, Chemist, Economist			Other	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Observation network	56								2		7			2	67
Telecommunication															
Data management	13					3					7			1	24
Weather forecasting		1	1								2			1	5
Hydrological forecasting															
Climatology			2								1				
Agrometeorology											3				3
NWP			1												
R & D															
Weather modification															
IT personnel											2				2
Commercial services															
Accounting											3				3
General administration	8													3	11
Other															
TOTAL	**77**	**1**	**4**			**3**			**2**		**25**			**7**	**119**
Female in % of total	40	0	50			30			50		60			50	40
Men in % of total	60	100	50			70			50		40			50	60

HMI has lost qualified staff during the latest years to other sectors and providers of weather services. Currently it is difficult to get new people into the hydrometeorological sector. Low visibility, low salary level and less interesting brand of HMI does make it interesting for young people. However, these problems have been recognized by the decision makers, so it can be expected that the situation will be improved in near future. Currently there is either any university level education in meteorology available in Montenegro, which will be an obstacle for finding new academic staff.

6.3.9. Training related to DRR

Currently HMI has no training programme for experts. Due to low number of experts it is difficult to send staff to be trained by European or other advanced NHMS.

HMI participates in WMO and UNISDR workshops and training as much as possible. However, the low number of forecasters and meteorological and hydrological experts limits the possibilities for them to participate in this type of training, which would be very essential for HMI and the DRR in Montenegro.

6.3.10. Financing

HMI, which should have a critical part of the DRR budget, is severely under-financed for essential parts concerning DRR. HMI does not have resources to operate a 24/7 analysing and forecasting system. HMI is also under-financed with respect to purchase, operate and maintain adequate hydrometeorological observation network (adequate number automatic real-time meteorological and hydrological stations) or modern weather radar and lightning detection networks.

Up to now, the HMI has not received financial resources to implement investments in order to strengthen its capacity to better promote national, regional and european DRR, as proposed by the recent UNISDR-WMO-WB initiatives and project reports. The value of better hydrometeorological observations and services to the national economic development, and especially to DRR, is not yet fully recognized and appreciated at policy level.

6.3.11. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums. EU based hydrometeorological organizations provide most state-of-the-art models, software and tools to be utilized by the member NHMSs. The integration into the European hydrometeorological infrastructure was given the highest priority in the 2007 project in developing the capacities of the NHMSs to implement best European practices and to produce improved products and services in support of national economic development and DRR.

Table 37: International and regional cooperation partners of HMI

International and regional organisations and cooperation mechanisms	HMI status
WMO	Member
WMO RAVI	Member
RMDCN	No
IOC	No
UNISDR	Yes
UNDP	Yes
Red Cross/Red Crescent	MoU
EUMETSAT	no
ECMWF	Cooperating state
EUMETNET	Member
METEOALARM	Member
ECOMET	No
EUFP7 projects, networks	No
EU JRC	No
EU PHARE	No
EU CARDS	No
EUCLID	No
EUR-OPA	No
DMCSEE	Yes
SEEVCCC	Yes
SAVA Commission	Yes
NWP consortium membership	None
NMHS bilateral	Albania, Serbia, FYR of Macedonia, Croatia, Republic of Sprska
NMHS MoU	RedCross, Emergency situation organizations

Montenegro has become a cooperating state with ECMWF, which provides the HMI possibility to utilize all the ECMWF products. Currently there have not been any actions on governmental level to participate to EUMETSAT. HMI has become a member of EUMETNET METEOALARM in 2010, and a member of EUMETNET in 2011. HMI is partner in the DMCSEE project financed by EU.

HMI has many cooperation agreements with Hydrometeorological services of other countries in the SEE Region: including the Hydrometeorological Institute of FYR of Macedonia, the Republic

Hydrometeorological Service of Serbia, Albanian Institute of Energy, Water and Environment. MoU is under preparation with Slovenia, Turkey and FHMI/BiH.

There are also cooperation agreements with European countries (Norwegian Directorate for Water and Energy) and international organizations. Norwegian Directorate for Water and Energy was financing the automatization of part of the hydrological stations. It has also co-financed the purchase of hydrological database WISKI. HMI is collaborating with the Norwegian company Startcraft in the hydrological modelling of a river using HBV model.

HMI has experiences in research and development projects at the international level, such as:

- AdriCosmStar – integrated river basin and coastal zone management system, sponsored by the Italian Ministry of Environment, Land and Sea; project related to the bathymetric measurements of the Montenegro coastal area, Bojana river catchment and Scadar Lake;
- project SEE-ERA related to the regional transport of desert's sand;
- research project EWCM related to the extreme weather conditions in Montenegro.

Currently the level of international cooperation is at quite low level partially because of lack of experts and academic staff with good skills in European languages, especially English. This aspect is often under considered, but it hampers dramatically the participation of personnel to international workshops or trainings.

6.4. Technical recommendations to strengthen HMI capacities in support of DRR

Based on technical feasibility study of the HMI and assessment in the current DRR system in Montenegro, following recommendations can be made in order to promote the contribution of the hydrometeorological sector to the DRR in Montenegro.

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. There are urgent needs to improve the national legislation concerning the DRM and the role of different technical agencies including HMI;
2. There are needs to better integrate HMI into DRR planning;
3. There are needs to promote cooperation with other technical agencies.

Monitoring and observations networks and data exchange

4. There is an urgent need to establish a reliable calibration and maintenance system in order to produce measurements which meet the WMO standards;
5. There are urgent needs to establish automated weather stations at sea and coastal regions, where the tourism is growing rapidly;
6. There are urgent needs to establish a weather radar network;
7. There are needs to establish 1 upper air sounding station;
8. There are needs to establish automatic hydrological stations.

Forecasting

9. There is a need to further develop capacities to support DRR through nowcasting and long-term forecasting;
10. There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks;
11. There is a need to develop and integrate additional modelling for hydrology and air quality and to link these models to NWP;
12. There is a need to improve capacities to use automatic analysing, editing and dissemination tools.

Hydrometeorological data management systems

13. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data;
14. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.

Hazard analysis and mapping to support risk assessment

15. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment;
16. There is the need to develop capacities in the use of GIS, spatial analysis and management of geographic data;
17. There is the need to develop capacities in hydrological analysis;
18. There is the need to develop capacities in agrometeorological and drought analysis, including remote sensing applications;
19. There is the need for better management of hazard impact data.

Information technology and telecommunication issues

20. There are urgent needs to upgrade the communication system to promote on-line and real-time data collection;
21. There are urgent needs to modernize the communication systems to efficiently disseminate warnings and other products.

Warning products and services

22. There are needs to enhance the mandate and capacity of HMI to produce and issue more weather and climate related warnings efficiently and timely;
23. There is an urgent need to establish a 24/7 science based analysing, forecasting and warning system at HMI;
24. There are needs to further promote cooperation between HMI and different socio-economic sectors in order to increase the number of special services and warnings tailored to the needs of customers;
25. There are urgent needs to automate the warning production and dissemination systems.

Climate change analysis

26. There is a need to develop a climate data management system and climate analyses;
27. There is a need to develop the technical capacities for climate change projections downscaling to local scales;
28. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors.

Human Resources

29. There are urgent needs to promote the human resources through investment in forecasters, ICT experts, NWP experts and scientists;
30. There are needs to increase the number of staff with academic MSc and PhD degrees;
31. There are urgent needs to promote the skills especially in English in order to increase the capacity to participate in EU activities;
32. There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects;
33. There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EUMETNET NHMSs;

34. There are needs to increase the salary level of HMI staff to the level of meteorologist in the aviation sector in order to promote the attractiveness of HMI.

Regional cooperation

35. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
36. Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans;
37. Modernisation and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;
38. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
39. A regional harmonisation of watch and warning systems should be promoted;
40. Cross-border exchanges of real-time data, forecasts and warnings should be increased;
41. Improve the English knowledge of HMI technical staff.

6.5. Recommendations from the Montenegro National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Kolasin, on 24-25 November 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: To establish and adopt byelaws that support legislation pertaining to DRR in order to give greater legal authority to the process of building effective DRR systems and structures in Montenegro.

Recommendation 2: To promote and support dialogue and exchange of information and cooperation among all relevant agencies and institutions at all levels aiming at fostering a unified approach to DRR.

Recommendation 3: Creation of the National Platform for Disaster Risk Reduction which should establish responsibilities at the national through to the local levels, to facilitate coordination across sectors, relevant to DRR.

Recommendation 4: Clarification of roles and responsibilities by positioning the Sector for Emergency Management in accordance with best international practices, in such a manner that it will have direct responsibility to the Government.

Recommendation 5: Create a DRR action plan to enhance National Strategy for Emergencies with enumerated responsibilities and financial plan.

Recommendation 6: Ensure financing mechanisms for Disaster Risk Reduction are in place, utilizing both regular budget resources and financial resources from donor community.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning

Recommendation 7: To establish a national system for collection, analysis and dissemination of all relevant disaster data (to inform Early Warning System, but also related to post-disasters data collection).

Recommendation 8: To enhance institutional capacity by further developing capacity for Risk Assessment in the Sector for Emergency Management, Hydro-meteorology Institute and Seismology Institute.

Recommendation 9: To enhance technical and human resources of the technical agencies, such as hydro-meteorological institute to support the early warning system.

Recommendation 10: Increase capacity for Risk Assessments at Municipal Level (Sectors for Spatial Planning, local communities) with emphasis on Vulnerability Assessments.

Recommendation 11: Establish mechanisms to preserve existing and future capacity for Disaster Risk Reduction within relevant institutions.

Recommendation 12: Work on regional harmonization of Risk Assessment related methodologies.

Recommendation 13: Mainstream adaptation to climate change into all DRR strategic elements at all levels.

Recommendation 14: To develop national capacities for climate services to support medium and long-term sectoral planning in the context of reducing overall risks, and with consideration for increasing climate associated risks.¨

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 15: To integrate DRR into curriculum at all levels of education.

Recommendation 16: Develop capacity for DRR in media in order to raise level of public awareness on DRR.

Recommendation 17: Create and implement a DRR Strategy for awareness raising, in order to raise level of overall understanding of the importance of Disaster Risk Reduction among population at large.

Recommendation 18: Create national translation of UNISDR Terminology for Disaster Risk Reduction.

HFA priority 4: Reduce the underlying risk factors

Recommendation 19: Promote reduction of disaster risks by systematically integrating DRR outcomes and activities into policies, plans and programmes for sustainable development and poverty reduction as well as the National Development Plan.

Recommendation 20: In the context of reducing vulnerability, integrate DRR in implementation and ongoing development of Government Plans for Informal Settlements.

Recommendation 21: Develop national capacities for climate services to support medium and long-term sectoral planning in the context of reducing overall risks, and with consideration for increasing climate associated risks.

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 22: Strengthen the sustainability of disaster preparedness systems and structures through:

- Developing capacities for the implementation of policies, strategies and mechanisms for disaster preparedness and response to ensure sound linkages between international, national and local levels;
- Ensuring protocols and mechanisms of information management for effective response are permanently in place and regularly updated to anticipate future disasters.

Recommendation 23: Ensure standard operating procedures in response and response preparedness are well defined, regularly tested and continuously improved.

Recommendation 24: Define and improve role of media during disasters.

Recommendation 25: Introduce post-disaster recovery into disaster preparedness planning.

7. CHAPTER SEVEN: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN SERBIA

The major natural hazards to which the Republic of Serbia is exposed are: floods, torrential floods, storms, heavy rain, atmospheric discharge, hail, drought, landslide or landslip, snow deposits and avalanche, extreme air temperatures, ice accumulation on the water flow, earthquakes, epidemic livestock diseases and the emergence of pests and other large-scale natural phenomena that may endanger the health and lives of people or cause extensive damage. A number of hazards pose risks across the borders in the SEE region, especially floods, drought, forest fires and dispersion of airborne pollutants.

This chapter presents all the findings related to the assessment of the Disaster Risk Reduction institutional framework and the technical capacities of the NMHS of Serbia to support DRR. It highlights that:

- The new Law on Meteorological and Hydrological activity ("Official Gazette of the Republic of Serbia, No. 88/10) has identified as a priority the development of hydro-meteorological early warning systems, including hydro-meteorological hazard mapping, development of meteorological and hydrological databases, including the information on meteorological and hydrological disasters, creation of the national infrastructure of spatial meteorological and hydrological data in accordance with the EU INSPIRE directive, and the assessment of climate change impacts, vulnerability and options for adaptation to natural disasters related to climate change;
- The technical and human capacity and scientific skills of RHMSS are at a high level compared to most of the NHMSs in SEE countries. Memberships in European leading meteorological organizations have strengthened RHMSS capacity during the latest years. However, lack of modern weather radar technology, automated hydrological measurements, state-of-the-art communication facilities, experts and insufficient level of governmental appreciation and financing limits the capacity of RHMSS to produce state-of-the-art products and services for disaster risk reduction;
- Development of Risk Assessment, MHEWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

7.1. Serbia's vulnerability to hydrometeorological hazards

7.1.1. Hydrometeorological hazards in Serbia

The major natural hazards to which the Republic of Serbia is exposed are: floods, torrential floods, storms, heavy rain, atmospheric discharge, hail, drought, landslide or landslip, snow deposits and avalanche, extreme air temperatures, ice accumulation on the water flow, earthquakes, epidemic livestock diseases and the emergence of pests and other large-scale natural phenomena that may endanger the health and lives of people or cause extensive damage.

Table 38: Potential impacts of hydro-meteorological hazards on economic sectors - RHMSS

Hydro-meteorological hazards	Impacts
Hail	Damage of all field crops, damage of properties, injuries of people and animals, problems in transportation.
Strong wind and gust	Damage of properties, problems in transportation, damage of agricultural cultures, forest damage, damage of trees in parks and individual trees, problems in civil engineering construction works - especially works with cranes, indirect impact on the safety of people and animals, makes already existing dangerous security situations more complicated (forest and other fires, environmental disasters, disturbance of rescue actions).
Droughts	Enormous losses in agricultural production, problems in water supply, river transportation, hydro-electric power plants operation…
Spring and autumn frost	Damage to agriculture – vegetable, vineyards and fruit are especially vulnerable.
Flash flooding and flooding	Endangered lives of people and animals, damage in all weather dependent economy sectors, damage or major losses of properties.
Fires	Forestry damage, endangered lives of people and animals, a great danger for environment, industrial and other plants.
Extremely low air temperature	Endangered lives of people and animals, problems in thermal and electric power supply, road and river traffic problems, forestry damages, agriculture damages and damages of other weather dependent sectors of economy.
Extremely high air temperatures	Endangered lives of people and animals, problems in electric power supply, traffic problems, favourable conditions for forest and other fire occurrences.
Heavy and intensive precipitation	Causing of flooding and flash flooding, risk of mudslides and landslides, disabling the planned agricultural works. Endangered lives of people and animals, damage of properties.
Long-term precipitation	Causing of flooding, problems in all agricultural production activities, traffic problems, risk of landslides and mudslides.
Freezing rain and ice (glaze)	Traffic problems (to possible traffic blockade), problems in electric power supply - possible great damages in electric transmission systems, pedestrian injuries.
Snow	Problems in traffic and other forms of communication, problems in electric power supply.
Wet snow	Problems in traffic, problems in electric power supply - possible great damages in electric transmission systems.
Blizzard and snowstorm	Traffic problems (to possible traffic blockade), makes already existing dangerous security situations more complicated (partial or total blocking of rescue actions).
Thunderstorms (thundering and lightning)	The risk of thunder stroke, operation problems for all electrical devices, the risk of fire initiation, telecommunication problems, together with the risk of strong wind, gust wind and flash flooding.
Fog and low cloud	Traffic problems (to possible traffic blockade), makes already existing dangerous security situations more complicated (partial or total blocking of rescue actions).
Deviation from the usual climatological and weather cycle	Disruption of usual activities in water and food supply, supply of thermal and electric energy, possible negative impact to tourism and trade.

Floods are by far the most prevalent and constitute 34% of all occurring hazards in the 1989-2006 period, affecting 125,412 people. The valleys of larger water courses, in which the largest settlements and the best farmland, infrastructure, and industry are located, are highly prone to floods, that are occurring most frequently in the Vojvodina region and along the river courses of the Sava, Drina, Velika Morava, Juzna Morava and Zapadna Morava. For example in 2005, the Tamiš River breached a dam in Romania, causing major flooding in the Vojvodina province with economic damages reaching 12, 6 million €. In 2006, the flooding of the Drina river over three countries inundated 5% of total Serbian arable land, with damages of around 35, 7 million €, including in the city of Belgrade.

Droughts are most prevalent in the eastern portion of the country and the Pannonian Basin in the north; catastrophic droughts struck Serbia three times in the last 20 years. Mean damages, mainly to agricultural production, are estimated to reach 500 million € per year. A severe drought, coupled with the longest registered wave of extremely high air temperatures (10-17 days with temperatures from 35 to 45 degrees centigrade) occurred in July and August 2007.

Mainly triggered by droughts, wildfires are equally frequent and widespread during the dry summer season, threatening the 28% of Serbian territory covered by forests. Between 1998 and 2008, 853 forest fires burned an area of 16,357 ha. 258 forest fires were counted in 2007 alone, causing damages of approximately 40 million € burning more than 5200 ha.

7.1.2. Sectoral analysis of the vulnerability to hydrometeorologival hazards

Weather-dependent sectors are those sectors that are most dependent of the weather conditions and, at the same time, are critical to the national economy (high GDP share). GDP structure by sector in 2009 was: services 63.8%, industry 23.5%, agriculture 12.7%. Serbia's primary industries include processing of base metals, furniture, food processing, machinery, chemicals, sugar, tires, clothes and pharmaceuticals. The main Serbian agriculture products are wheat, maize, sugar beets, sunflower, raspberries, beef, pork and milk.

Table 39: Sectors exposed to hydrometeorological hazards in Serbia

Sectors	Hazards affecting these sectors	Sensitivity
Agriculture	Hail, Strong wind, Flood, Late/Early frost, Drought	High
Production transmission & distribution of electricity and heating energy	Extreme low & high air temperature, Heavy precipitation especially wet snow, Thundering and lighting struck, Drought	Relatively high
Transport (road, rail, river and air)	Fog, Heavy rain, Snow, Slippery conditions (glaze, freezing, ice), River froze	Medium, But air High
Civil engineering (road construction and bridges, water engineering, building construction…)	Strong wind and gust of wind, Heavy precipitation, Frost, Thundering and lighting struck	Relatively low
Water resources	Drought and Flood	Relatively high
Tourism and trade	Every deviation of normal climatologically and weather seasons	Medium

The agriculture sector is one of the most important sectors in the Serbian economy. Primary production from agriculture accounted for approx. 12.7% of GDP in 2009. Over two thirds of the total land area of Serbia is agricultural land and two thirds of the population in rural areas are involved in agriculture. Characterized by rich land resources and favorable climate, agriculture represents a vital sector of the Serbian economy.

A variety of different favorable natural conditions result in a high diversity of agricultural production. There are three broad agricultural regions that can be distinguished in Serbia on the basis of geography and climate, land quality, farm production systems, and socio-economic development, namely: Vojvodina, Central Serbia and Southern Serbia. Serbian terrain ranges from the flat and rich lowlands of Vojvodina in the north for crop farming and vegetable production, to hilly terrain in central Serbia and high mountains on the eastern, western and southern borders of the country, suitable for sheep and cattle breeding, and fruit and wine production.

Drought is a real threat for Serbian agriculture. For example, according to the evaluation of drought impacts on the crop yield in east Serbia in the period 1989–2000, the average drop in yield was 40.9% in comparison to the average annual yield in the years without drought. Bearing in mind the projected increase in air temperature and decrease in precipitation, it was concluded that agricultural production will be very vulnerable to climate change in the future. The assessment of potential climate change impacts on agriculture in Vojvodina generally indicate a high level of vulnerability of agricultural production to extreme weather conditions and systemically modified weather conditions, as well as of the damage that could cost millions. Also, the results of the crop production model SIRIUS showed that, in case of the climate change scenario A2, the yield of winter wheat in Vojvodina in 2040 and in 2080 will have dropped by 5–8% and 4–10%, respectively, relative to the average yield in the period 1981–2005.

Table 40: Estimated losses in Serbia caused by unfavourable hydrometeorological events

Sectors and Hazards	Evaluated losses	
	Mean annul economic losses (million €)	Human losses
Agriculture - Flood	From 38.75 to 106.25	Few, up to 10
Water Resource Management - Flood	About 24.5	---
Agriculture – Hail, Heavy rain and strong winds	About 91.45	Few, up to 10, thunderstruck
Agriculture – Drought	About 500	No losses
Energy Production (heating plants) – Extreme low air temperatures	About 8.95	Few, up to 10
Road maintenance – Snow, slippery conditions (glaze, freezing, ice)	About 43.75	-------
Human losses on highway, regional roads and local roads due to bad weather: from 105 to 131		
Commercial air transport	From 0.675 to 0.9	----
TOTAL	From 208.1 to 607.15	From few to 160

Regarding the water sector, the territory of Serbia covers two main river basins: From the territory of Serbia, the waters gravitate towards the Black Sea (the rivers of the Danube basin), the Adriatic Sea (the Drim and the Plavska Rivers) and towards the Aegean Sea (the Pcinja, the Dragovistica and the Lepenac Rivers). Southern, south–western and western parts of the country are richer in water than the northern, central and eastern regions. Flood protection is the most important aspect of defense against the harmful effects of water, due to the fact that in the flood–prone areas, about 1.6 million hectares, are situated over 500 larger settlements, more than 500 large commercial building, around the 1,200 km of railway and more than 4,000 km of roads. In order to protect from flooding, over 3,400 km of dams were built and river regulation of about 420 km was realised. However, long–term/multiannual investment reduction in the maintenance of facilities and of riverbeds has led to a reduction in the security and level of protection from the destructive effects of water. Due to lack of maintenance of riverbeds, embankments of waterways under a torrential hydrological regime are threatened. Climate change is expected to affect water resources in many different ways. A preliminary assessment of climate change effects on the water resources indicate that a decrease of water flow on the national level is to be expected in the forthcoming period caused by decrease in annual precipitation. It should also be taken into consideration that the above projections show that climate change might cause more intense flood and drought episodes, greater both in scope and duration.

7.2. Institutional Framework of Disaster Risk Reduction in Serbia

7.2.1. Legal framework and policy supporting DRR in Serbia

The Law on Emergency ("Official Gazette of the Republic of Serbia", No. 111/09) created a unified legal framework for the effective protection of citizens and property in emergency situations when the risks and threats or the consequences of disasters, emergencies and other threats to the population, environment and property are of such magnitude and intensity, that special measures must be used in their mitigation and elimination. The new Law on Emergency Situations has shifted the focus from preparedness and response to disaster prevention and risk reduction. The Law encompasses the guidelines and proposals of the United Nations International Strategy for Disaster Risk Reduction (UN / ISDR), as well as basic principles of Hyogo Framework for Action.

In accordance with the new Law on Emergency Situations, which entered into force in July 2010, preparations for drafting the National Strategy for Protection and Rescue started. Developing the Strategy involves participation of appointed representatives of all competent authorities, scientific and educational institutions, non-governmental associations (The Serbian Red Cross, humanitarian organizations and other relevant associations). The appointed representatives of the Republic Hydrometeorological Service as a National Hydrometeorological Service of the Republic of Serbia (RHMSS) also participate in the Strategy development. It has been planned that the Strategy and the Action plan include all disaster risk reduction components (prevention, risk reduction, emergency response and preparedness). The aspects of the organizational structure of DRR shall also be covered at all administrative levels (national level, autonomous level and local self-government level).

Other laws defining the legal framework are:

- Law on Ministries ("Official Gazette of RS", No. 65/08, 36/09 and 73/10);
- Law on Meteorological and Hydrological Activities ("Official Gazette of RS", No. 88/2010), regulates the authority of the Republic Hydro Meteorological Service of Serbia (RHMSS), as a National Hydro Meteorological Service in the establishment and functioning of the National Hydro-Meteorological system of early warning, the authority of RHMSS to issue warnings on the occurrence of disasters of meteorological and hydrological origin, as well as development of risk maps and vulnerability to weather hazards. The section of the Law on Meteorological and Hydrological activity related to the authority of RHMSS in DRR activities is in full compliance with the Law on Emergency Situations, and the Hydro Meteorological system of early warning is designed to represent an integral part of the national protection and rescue system;
- Law on Waters ("Official Gazette of RS", No. 30/2010), harmonized with the EU Water Framework Directive, identifies priorities in terms of protection against flooding and shipwreck water pollution;
- Framework Directive of the European Union on Water;
- EU Directive on Floods Protection.

The Sava River Commission prepared in 2009 the Sava River Action Plan, designed in full coherence with EFD (Directive of the European parliament and of the Council on the assessment and management of flood risks) flood action plans for sub-basins. Thus the Action Plan requires Member States to first carry out a preliminary flood risk assessment to identify areas at risk of flooding. For such areas they would then need to draw up flood risk maps and establish flood risk management plans focused on prevention, protection and preparedness.

7.2.2. Institutional framework

7.2.2.1. <u>List of agencies involved in hydrometeorological risks reduction</u>

- Sector for Emergency Management (SEM) - Ministry of Interior;
- Republic Hydrometeorological Services of Serbia;

- Water Directorate (WD) – Ministry of Agriculture, Forestry and Water Management (MAFWM);
- Indemnity Fund – Ministry of Agriculture, Forestry and Water Management.

7.2.2.2. Sector for Emergency Management

In June 2009, Protection and Rescue Sector of the Ministry of Interior (MoI) was reorganized into the Sector for Emergency Management, which is directly under the Minister of Interior. The Sector integrated the Protection and Rescue Sector of MoI and the Department for Emergency Situations of MoD. The structure of SEM is described in Figure 24. The most important step of the Sector toward the establishment of an integrated emergency management system was the setting up of a legal framework in this area. On 29 December 2009, the Serbian National Assembly adopted the new Law on Emergency Situations and the new Law on Fire Protection. In accordance with the Law on Emergency Situations, the Sector coordinates the activities of all state institutions involved in emergency and disaster management.

This Law defines activities, declaring and management in emergency situations; system of protection and rescue of citizens, material and cultural goods from natural and man-made disasters; rights and obligations of citizens, state agencies, autonomous provinces, local self-governments, companies and other legal persons and entrepreneurs; inspection and supervision, international cooperation and other issues relevant to organization and functioning of the protection and rescue system.

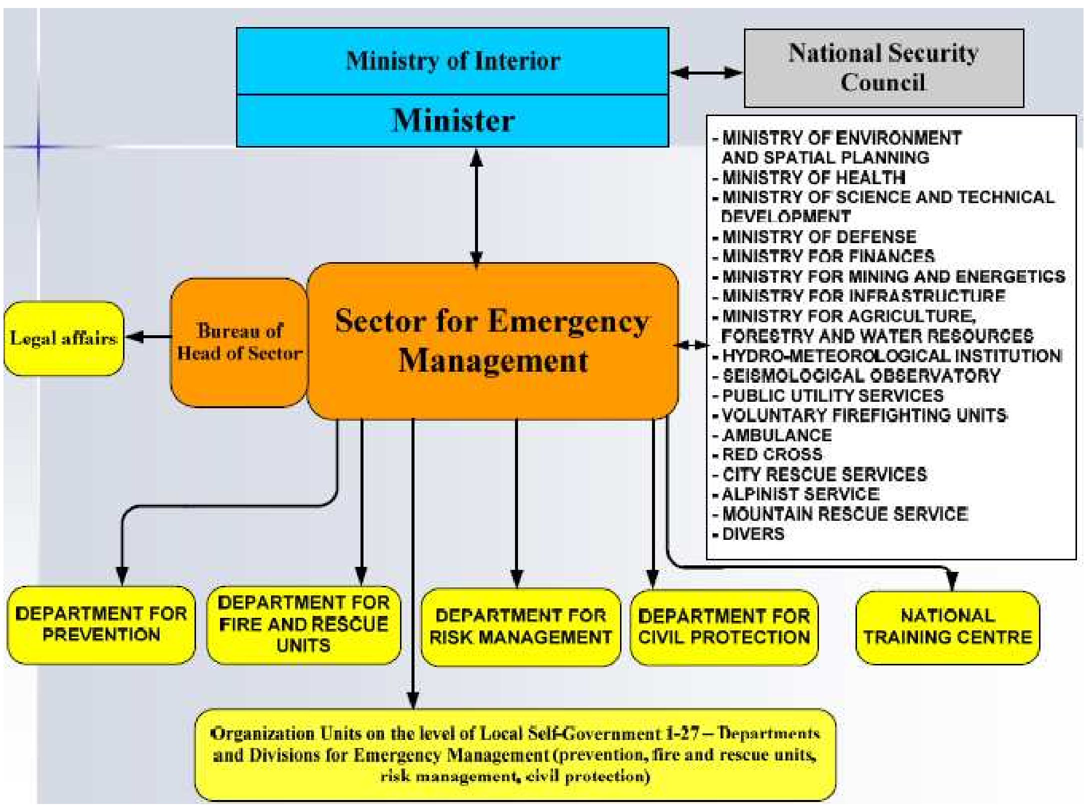


Figure 34. Structure of Sector for Emergency Management

The strategic axes of activity of the SEM are:

- Development of Emergency Plans;
- Adoption of National Strategy for Disaster Risk Reduction;
- Implementation of a single European emergency call number 112;
- Enhancement of international cooperation.

The first axe concerns the Development and Adoption of Emergency Plans, where SEM acts as coordinator of other actors setting up the mechanisms for emergency management. Within axe two, SEM is fostering the adoption of a National Strategy for DRR, aiming to risks and vulnerability reduction within the context of sustainable development to create the conditions for prompt first response and rescuing people and property. The implementation of 112 as a single European emergency call number includes also the establishment of an operational information center, which besides normal 112 activities should be able to store, manage and analyze data concerning hazards and risks. For the operational implementation of 112 center an ad-hoc working group defined the work plan and a draft of project proposal has been prepared for the IPA programme. The 112 information center will be also responsible for the floods risk assessment, while the sector doesn't have mandate for the drought risk assessment. The sector is still in the re-organization phase and also the legislative framework is not complete, thus it is not fully operational, particularly concerning risk assessment.

7.2.2.3. Republic Hydrometeorological Services of Serbia

Republic Hydrometeorological Service of Serbia (RHMSS), as a special organization within the state administration of the Republic of Serbia, performs the tasks of monitoring, research, analyzing and forecasting of weather, climate and water, air and water pollution, air and precipitation radioactivity including monitoring of transboundary air and water pollution, the activities of meteorological and hydrological support of air, land and river traffic, tasks of early warning and alarms against the occurrence of atmospheric and hydrological disasters and catastrophes, monitoring and action on hail-bearing clouds as well as other activities of National Hydrometeorological Service as public service important for preventive protection of human lives and mitigation of material damage. RHMSS also performs international obligations in the field of meteorology and hydrology as well as other activities defined by the law.

These duties of RHMSS are regulated by the Law on Ministries ("Official Gazette of RS", No. 65/08, 36/09 and 73/10), the Law on Meteorological and Hydrological Activities ("Official Gazette of RS", No. 88/2010), the Law on Waters ("Official Gazette of RS", No. 30/2010), the Law on emergencies ("Official Gazette of RS", No. 111/2009), the Law on Air Navigation ("Official Gazette of RS", No. 73/2010), the laws on ratification of the international conventions related to meteorology, hydrology, climate change and environment quality monitoring and other bilateral and multilateral regional agreements. In accordance with its jurisdiction stipulated by the laws and relevant international conventions and protocols, Republic Hydrometeorological Service of Serbia carries out the activities of international cooperation in the field of meteorology and hydrology as well as the functions of National meteorological, climate and hydrological center of Serbia in the World Meteorological Organization (WMO), Group on Earth Observations (GEO), European organization for the exploitation of meteorological satellites (EUMETSAT), European center for medium-range weather forecast (ECMWF), European regional telecommunication network of WMO (RMDCN), Danube Commission for the Danube navigation security, Protocol on long-term financing of the Cooperation program for the assessment of transboundary long-range pollutant transport in Europe (EMEP), then the function of National Focal Point in Intergovernmental Panel for Climate Change (IPCC), and participate in the implementation of the UN Framework Convention on Climate Change (UNFCCC), UN Convention on desertification (UNCCD) and other international treaties.

With regard to DRR activities, Republic Hydrometeorological Service of Serbia is responsible for the establishment and functioning of basic components of hydrometeorological early warning system as a part of National Protection and Rescue system coordinated by the Ministry of Interior-Sector for Emergency Management which, in disaster risk or disaster occurrence, activates, through the headquarters for emergencies, the proceeding pursuant to the adoption of the decision to declare emergency situation. The basic duty of RHMSS is to provide timely and reliable information necessary for the life and goods protection. For its operative work there are available products of global numerical models and own operational regional weather and climate models.

RHMSS computer resources make possible the carrying out of various functions and tasks of integrated meteorological and hydrological multi-hazard early warning system.

In accordance with the Law on emergencies and Law on meteorological and hydrological activities, RHMSS, as a competent organization for operative functioning of the hydrometeorological early warning system, is responsible to make the vulnerability assessments within the scope of its work and to make risk maps for particular meteorological hazard and send them to the Ministry of Interior which is coordinator for the preparation of protection and rescue plans.

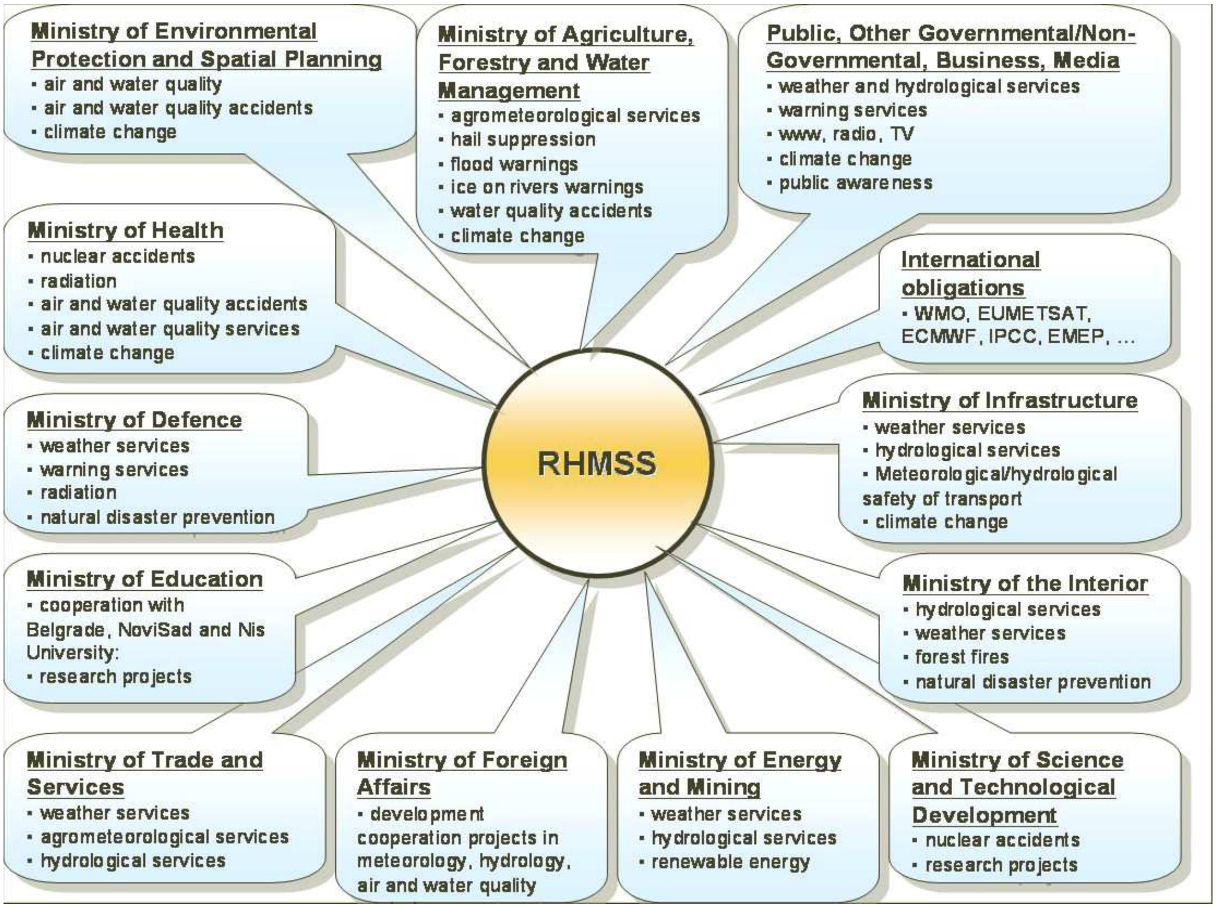


Figure 35. Operational linkages of RHMSS with other institutions in DRR

RHMS of Serbia is responsible for monitoring, detection, forecasting and issuing of warnings for the following hydro-meteorological hazards: Rotational high winds, Flash floods, Strong winds, Hailstorm, Thunderstorm or lightning, Heavy snow, Freezing rain, Dense fog, Heat waves, Cold waves, Drought, River flooding.

In the course of 2008, experimental development and operative implementation have been completed for the installation of early warning and alarm system against atmospheric and hydrological disasters and catastrophes for the territory of the Republic of Serbia, so-called “MeteoAlarm” and “HydroAlarm”. Serbian “MeteoAlarm” system has been included in the European Meteoalarm that represents one especially important EUMETNET program. Also, Serbia became a member of European Flood Alert System (EFAS).

RHMS is the host of sub regional South East European Virtual Climate Change Centre (SEEVCCC) which was included in 2009, in accordance with the Resolution of WMO RA VI, in the Pilot program of European network of WMO Regional Climate Centers. One of the key functions of the Center relates to climate monitoring, seasonal forecasting and warnings (Climate Watch) on the occurrence of climate extremes and disasters as well as development of scenarios of regional climate change and research of climate change effects, vulnerability and adaptation options. The Center and RHMSS have signed agreements on expert-technical cooperation with majority of NMHSs in the region. Strengthening of regional cooperation in the field of climate change will certainly contribute to more efficient functioning of national meteorological, hydrological and climate early warning system.

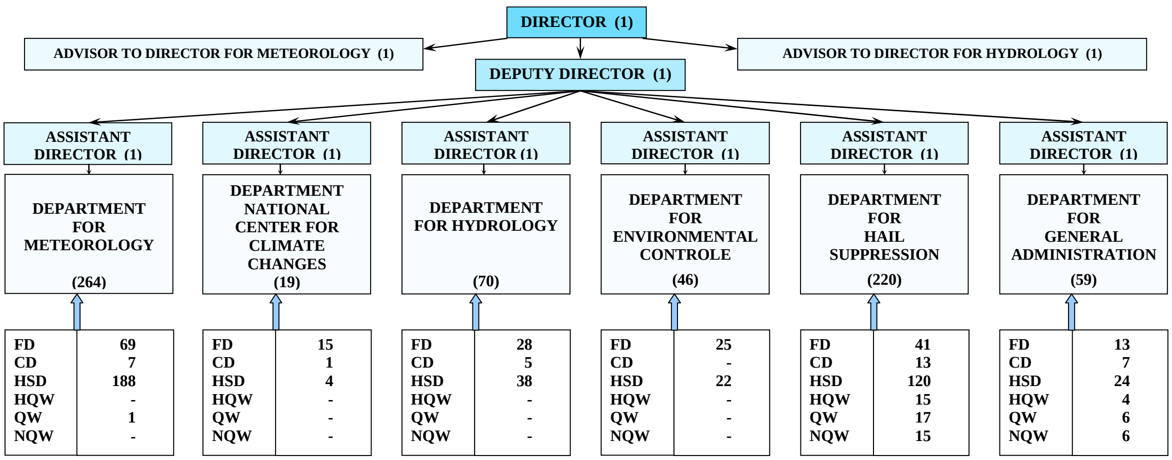


Figure 36. Organizational and Qualification Structure of the RHMSS

7.2.2.4. Water Directorate

Activities related to fresh water management (use, preservation, flood control, pollution control, water regime/quality and quantity, etc.) fall under the jurisdiction of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia/Republic Directorate for Water (WD).

WD is responsible for the flood protection infrastructures and for flood protection planning. In this framework WD performs flood risk assessment for the areas with flood defenses, but not for the other areas or those under the responsibility of other Water management institutions (Belgrade Vode, Serbia Vode etc.). WD is updating the Water Master Plan, which was adopted initially in 2002. WD is also involved in drought management, by proposing the appropriate accumulation and flows regimes in case of low water levels for hydrological drought management. WD, in collaboration with the Ministry of Environment and Spatial Planning, has been involved in the preparation of the second communication of Serbia to the UNFCCC, concerning the water resources issues.

In the framework of the International Commission for the Protection of the Danube River (ICPDR), the WD participates in the common assessment of floods and floods report on Drina and other 2 rivers have been prepared in 2010. In support to the framework agreement on the Sava river basin a protocol on flood protection has been signed, but not yet ratified. It should be a strong supplement to the FASRB, aiming to create the conditions for flood risk assessment and sustainable flood protection.

WD benefits of many international programs and projects, such as:

- Design and Implementation of a Water Management Information System in Serbia - European Commission;
- The overall objective of the project is to strengthen the protection of water resources, water quality and public health. More specifically it aims at strengthening the capacity of the Water Directorate of the Ministry of Agriculture, Forestry and Water Management to manage water resources, to provide improved access to information and data on water resources, and to promote the inter-institutional exchange of information and data on water resources;

- Study of flood prone areas in the Republic of Serbia – European Commission;
- The project has been designed to assist Serbia in the harmonization with the European Flood Directive in the fulfillment of its obligations in the integrated management of hydraulic resources field and the global protection against floods. In this project funded by the IPA Program (Instrument for Pre-Accession Assistance) of the European Union, the maps of the floodable zones following the master lines fixed by the European Flood Directive and Water Framework Directive (WFD) are prepared. Maps are based in GIS technologies to be incorporated lately to the National Water Management Information System;
- Regional Flood Risk Project on Danube river- European Commission, IPA programme;
- Flood vulnerability assessment in pilot basins - European Commission, under development;
- Sava hydrological modelling – US corps of engineering.

The WD coordinates all these initiatives and should ensure the methodological coherence in flood risk assessment and mapping, but doesn't take part of technical activities, being principally a managerial institution.

Other institutions are involved in water management. JVP "Srbijavode" (Public Water Management Company "Serbia Waters") was set in 1996 to implement the water management activities. The structure was altered in 2003 with the creation of the Provincial Secretariat of Agriculture, Water Management, and Forestry of Vojvodina Province and the setting up of the new JVP "Vode Vojvodine" (Vojvodina Waters), that covers water management responsibilities on the territory of Vojvodina Province. Field activities are carried out by 55 companies, under contractual arrangements with JVP "Srbijavode" and "Vode Vojvodine". Water supply public companies are guided by the Ministry of Public Administration and Local Self-government. The authority of the Ministry of Agriculture and Water Management in this regard is mainly in the sphere of issuance of water management criteria and permits for the use or release of water, as well as in the encouragement of and provision of subsidies for construction of capital projects.

7.2.2.5. Ministry of Agriculture, Forestry and Water Management - Indemnity Fund

The Indemnity Fund (IF) is an implementing agency of the Ministry of Agriculture. IF deals mainly with insurance and compensation in case of disasters. Drought, hail and strong precipitations are the priority hazard for insurance. The Ministry of Agriculture covers the 40% of insurance costs for the farmer. A pilot insurance project in Serbia is developed with Delta Generali and Swiss Re. RHMSS participate in this project, by providing meteorological data and analysis. Insurance companies collect data on damages in agriculture and as stated by the agreement they should provide them to RHMSS. The IF in collaboration with the Institute for statistics and the Institute for Science in Agriculture are developing the project for the "Establishment of the Serbian Farm Accountancy Data Network (FADN)" in the framework of IPA 2010 programme. The system of agricultural accountancy data to be developed aims to monitor the level of income and expenses of the registered farms and family farms, assess the efficiency of agricultural production and analyze the agricultural policy measures. The interesting aspect, concerning drought risk assessment is the establishment of a general database containing useful information for drought vulnerability assessment. The current phase doesn't foresee the development of a GIS, but only a statistical database organized geographically by Region and thematically per value of output and type of farm.

7.2.3. Operational relationship with Disaster Risk Management and other Technical agencies

RHMSS participates in the creation of the National Protection and Rescue Strategy, and the Director of the RHMSS holds the function of Member of the National Security Council and the Republic Emergency Headquarters.

RHMSS cooperates with other technical agencies related to hazard mapping, expert advice, provision of historical data for risk assessment, real time monitoring, issuance of hydrometeorological maps etc. However, the level of cooperation has been very low as the need of cooperation has not been fully acknowledged.

RHMSS has a quality control mechanism based on regular interaction with the stakeholders and by providing training for stakeholders to understand hazards and warnings. Currently there is not similar interaction with the general public, but RHMSS will open next year a possibility for feedback on their web pages.

7.2.4. Roles and responsibilities for flood and drought risk assessment

Flood risk assessment is under the responsibility of the Republic Water Directorate of the Ministry for Agriculture, Forestry and Water Management of the Republic of Serbia for the areas protected against floods and for flood defense planning purposes. The areas non protected are under the responsibility of Municipalities concerning flood risk assessment for spatial planning and of the Sector for Emergency Situations for flood risk assessment for disaster management planning.

For drought risk assessment, there is no specific legal or institutional framework. Drought is considered by SEM only as condition for wild fires. Operationally, drought risk assessment is performed under specific projects or activities by different collaborating institutions, among which RHMSS. RHMSS has clear mandate only for meteorological hazard risk mapping, including meteorological drought.

SEM is responsible for the national risk assessment, based on which, the Government determines the types of natural disasters and technical/technological accidents and hazards requiring preparation of plans, and determines the state authorities to be involved in their preparation. But being a new organization, SEM does not have yet all the capacities for playing operationally this role. The establishment of an operational information center is foreseen by the Project “Implementation of a single European emergency call number 112”, which besides normal 112 activities should be able to store, manage and analyze data concerning hazards and risks. The 112 information center will be also responsible for the management, analysis and mapping of information for the national vulnerability and risk assessments, including floods risk assessment, while the SEM does not have the mandate for drought risk assessment. Actually, hazard mapping is done within the Department for Fire and Rescue Units, which has some mapping capacities and a database of past events. A risk map for 4 types of hazard, including floods, has been prepared using the frequency of past events. Moreover, natural disaster risk maps, relating to forest fires, floods, landslides, earthquakes, droughts, storms and hail, have been made and they represent integral parts of the Spatial Plan of the Republic of Serbia. The National Vulnerability Assessment is in progress and the SEM ensures its coordination, as well as for the National Risk Assessment. Line Ministries and specialized services contribute in the framework of their specific mandate, providing data, elaborated information and analysis. Concerning risk assessment methodology, SEM is defining the methodology for the multihazard national risk assessment, which should be (as bylaw) approved by the government. This comprehensive methodology should take into consideration the existing thematic methodologies, e.g. the flood risk assessment methodology developed by the WD.

According to the Law on meteorological and hydrological activities and Law on emergencies, the RHMSS produces and periodically updates vulnerability maps and assessment of the Republic of Serbia for drought, floods and other meteorological natural hazards, applying a set of operational methodologies. RHMSS produces also risk maps, delivered to the ministry in charge for protection and emergencies activities. Moreover, drought and flood information are disseminated on regular basis. Additionally, some drought and flood information (relevant data sets, studies etc.) are delivered upon the request of various users. Concerning hazards, RHMSS produces analyses on averages, trends, variability and extremes and makes studies of potential impacts.

WD has mainly a coordination role, it is a managerial structure with few technical capacities. For technical issues WD relies on the Institute for Water Management Jaroslav Cerni (IWMJC) and in a lower measure on the RHMSS. WD, according to the new law on water, which adopts the EU Framework Directive on Water and the EU Flood Directive, is responsible for the three steps of flood analysis:

- Preliminary flood risk assessment for each river basin, to be completed by the end of 2011 using available data;
- Flood mapping including flood hazard maps and flood risk maps, to be complited by 2013;
- Floods risk management plans, to be completed by 2015.

Currently, WD is developing the first step and operationally this task is performed by the IWMJC. The Institute has been also involved since the beginning (2 years ago), and in partnership with the Ministry of Science to developed the methodology for flood risk assessment. This methodology should be applied by any flood risk assessment initiative in Serbia. Other countries in the ICPDR have adopted or are adopting their own methodologies and finally all methodologies will be tested as well as the comparability of their results. WD is also responsible for the flood risk assessment and the preparation of the national plan for floods protection (each 5 years) and also the annual plans, done in collaboration also with other concerned actors. These assessments and plans cover the area protected against floods, but the non protected areas are under the responsibility of SEM and Local Authorities. The Belgrade area is under the responsibility of Belgrade Vode, which is independent. The plans identify the roles and responsibility of different actors in floods protection and management. WD is developing the Water Management Information System, which in perspective should be interoperable with SEM Information system and RHMSS system. With RHMSS an agreement defining data exchange is already in development. WD has good operational relations with RHMSS, which provide to WD data, analysis and services. Relations with SEM are as well good, even if at the beginning the mutual roles and responsibilities were not clear.

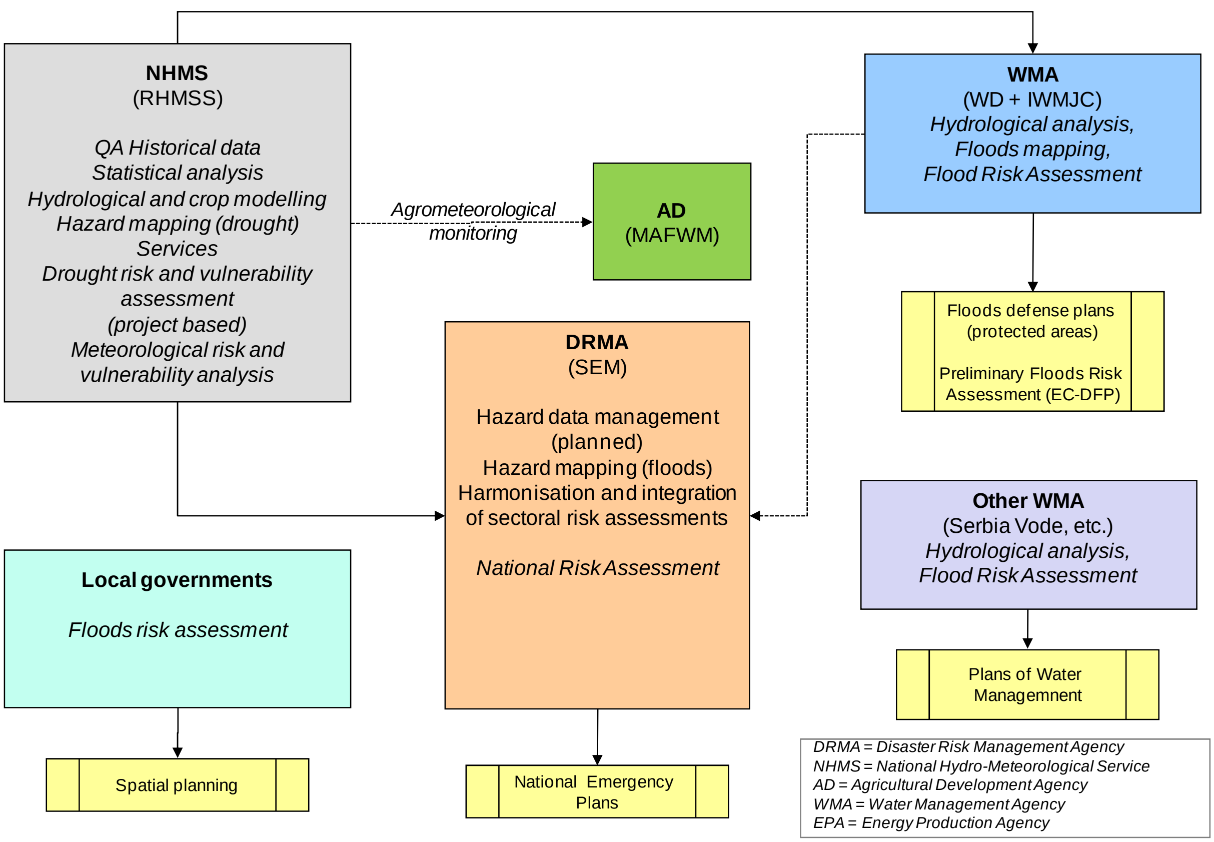


Figure 37. Floods risk assessment workflow in Serbia

Statistical data about agriculture production, surfaces and yields are stored and managed by the Institute for Statistics, while the Ministry of Agriculture stores only specific data for its own interest.

The methodology of data collection and also the processing are different so MAFWM and Statistical Institute data are not always comparable.

Concerning the impact of disasters, the data are collected at local level by the local commissions or the municipal headquarters for emergency situations, applying specific protocols for damage assessment. The data concern fires, floods, landslides and avalanches and are available generally on paper at the municipalities. Then they are transmitted to the special governmental commissions and finally stored at the Statistical Institute. WD collects data only for the damages of the hydraulic and flood protection infrastructures. Data about drought consequences in agriculture are not collected by the MAFWM, but they are however available at Municipality level in the various regions of the country. The RHMSS uses this data as feedback for validation/calibration of the drought monitoring system. Concerning floods, the data also exist, including damages to property and persons. But all the data are dispersed and available with different levels of precision from different actors: Municipalities, Ministry of Agriculture, Institute of Statistics, Ministry of Finance, etc. Damages to agriculture in case of floods are collected by the local commissions and are available generally on paper at municipality level. The data are quite precise but not digital.

7.3. Technical Capacities of Hydrometeorological Services to support Disaster Risk Reduction

7.3.1. Monitoring and observations networks and data exchange

Observations, and especially the upper air observations are essential for global, regional and local weather forecasting and numerical modelling of the atmosphere. Long-time historical time series of accurate quality controlled observations are required for hazard analyses, climatological studies and monitoring of climate change. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situations;
- reduction of vulnerability to the risks of meteorological, hydrological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale NWP modelling.

Table 41: Meteorological data collected by RHMSS

Term measurements	Periodical Daily measurements	Chronology of events	Agrometeorological data
- Air pressure at the station - Air pressure on the station - Dry thermometer temperature - Wet thermometer temperature - Relative humidity as per hygrometer - Wind direction - Wind speed - Sunshine duration - Precipitation quantity - Precipitation duration - Soil condition - Horizontal visibility - Quantity, description and amount of clouds - Phenomena in observation term	- Maximum air temperature - Minimum air temperature - Minimum air temperature at 5 cm - Precipitation quantity - Precipitation type - Snow soil cover degree - Characteristics of snow cover surface - Total snow height - New snow height - Evaporation as per Piche	- Identity, - intensity, - intermissions - duration of phenomena	- Soil temperature (three terms) - Evaporation from water surfaces (two terms) - Evapotranspiration at the lysimetric station - Belgrade (automatic hourly observations) - Soil moisture at 6 depth levels up to 1 meter - Phenological observations

Regular meteorological measuring of temperature, humidity, precipitation, wind and air pressure started on 1 January 1848 in Belgrade. In 1856 well-organized network of meteorological stations became operative in 20 towns of Serbia, and in 1857 there were 27 of them and that was the densest network in Europe at that time. Belgrade Observatory was founded on 26 March 1887, and became central institution for data collection from the whole Serbia. During the wars in late 1990s much of hydrometeorological instruments and facilities were damaged or destroyed. Renovation and upgrading of the observation network has been quite slow. However, since 2007 the number of automatic weather stations has significantly increased and RHMSS has been able to install one new technology weather radar. Actually, meteorological data collected by RHMSS are presented in Table 41. The current RHMSS observation network is described in terms of number of different types of station in table 42.

Table 42: Observation stations operated by RHMSS

Type of observation stations	**Number**		**Connected to WMO GTS**	**Comments of 2010 network**
	2007	**2010**		
Atmospheric domain				
Surface synoptic stations (> 8 obs./day)	31	60		
Manned stations	28	28	28	
AWS or AWOS	3	32	0	On-line stations
Cloud-height – automatic	0	0		
Agrometeorological stations	28	30		
Ordinary climate station (3 obs./d)	70	70		
Rainfall station (2 obs./d)	400	400		
Rainfall station – automatic	0	-		
Meteorological towers	0	0		
Upper air radio sond stations	1	1	1	LAN
Pilot balloon stations	1	0		
SODAR/RASS	0	0		
Wind profiler stations	0	0		
Lidar	0	0		
Access to AMDAR data	-	-		
Weather radars	3	3		
Hale radars	10	10		Occasionally available
Lightning detection stations	0	0		
Lightning detection hub station	0	0		
Satellite MSG ground station	1	1		
Hydrological domain				
Hydrometric station	185	200	21	60 sends data on-line
Stream gauge station – manual				
Stream gauge station – automatic				
Water level post – manual				
Water level station – automatic				
Environmental domain				
Air quality	24	24		
Water quality – surface water	149	149		12 real-time stations
Water quality likes and accumulation	33	33		
Ground water quality	68	68		
Nuclear radiation/deposition	NA	9		RHMSS only collects data
Ozone – near surface	1	1		In experimental phase
Ozone – upper air	0	0		
UV radiation	0	0		
GAW station	1	1		

Currently RHMSS has one about 20 years old AWS, one 5 years old and two 10 years old while all the others are MicroStep-MIS stations purchased in 2008-2009. The upper air sounding station is Vaisala DIGICORAIII with GPS system and soundings are done twice a day at 00 and 12 UTC.

RHMSS has 14 radars; the 10 Mitsubishi RC34A radars were installed 26-32 years ago and are mainly used for hail monitoring, 3 Gematronik weather radars were installed in 2000/2002 and the LCWR located in Beograd in 2007. The weather radar network in general is out-dated and does not meet the range and current technical capacity of modern radars. The old system requires big investments in maintenance. During the mission e.g. the Belgrade weather radar was not operational. In principle some of the radars could be upgraded, but not to the level of modern weather radars, which have e.g. possibility to detect different forms of rain, which is very essential in the climatic conditions in Serbia and SEE countries. Currently RHMS presents some of the radar images as single pictures showing the measured dBZ distribution from observed obstacles. However, the images do not represent very valuable information for other end-users than meteorologists without training. RHMSS does not have capacity to produce near-real-time composite pictures and animations of precipitation areas with intensity of rain, which are produced by EU NHMSs, and which are among the most popular and utilized products by companies and the public.

RHMSS uses the Meteosat Second Generation with multispectral imagery of the Earth's surface and cloud systems every 15 minutes from twelve spectral channels. The resolution is 1 km for the visible channel and 3 km for the others. For other information such as permanent data about the temperatures of clouds, land and sea surface data, the channels in the thermal infrared are used. Also, the Meteosat Second Generation (MSG) satellite has channels that absorb ozone, water vapour and carbon dioxide, which are used to analyze the characteristics of atmospheric air masses. The available data are used in the process of detection and monitoring of hydrometeorological hazards. Also, these data in combination with radar data are used in order to alert the warning.

The hydrological network consists of 5 regional station centers, which operate 119 surface water stations of the first order, 191 stations of the second order and 438 ground water stations. New technology is adopted during the latest years for discharge and water level measurements. In the network 66 stations located in main rivers monitor and send data in real-time and data from 41 of these are collected by automatic GSM system. Hydrological data observed by RHMSS are water level, water temperature, ice phenomena for surface water, and water level and water temperature for underground water: Hydrological data calculated by RHMSS are water discharge using rating curves.

RHMSS receives data also by other entities. The Law on meteorological and hydrological activity (“Official Gazette of RS”, No. 88/10) defines the National station network and Additional network of meteorological and hydrological stations. Additional networks of meteorological and hydrological stations can be established if the requirements are met regarding station location, program of meteorological and hydrological measuring and observing as well as the station reporting mode. RHMSS keeps the Register of national and additional networks of meteorological and hydrological stations. The owners of additional network are obliged to send to RHMSS available data and information obtained in the period before, during and immediately after the occurrence of meteorological and hydrological natural disasters, catastrophes and nuclear accidents. Hydrological data are provided by the Water management organizations and the power plants for national data, and by Data exchange as a part of Danube commission at the international level:.

The mechanism of acquisition is GTS, the data are free and are stored in the RHMSS database.

Air quality monitoring is based on collection of 24-hourly sample collection (1.6 – 2.5 m3/dan):

- 24 stations for measuring of SO2 smoke immission (soot);
- 18 stations for measuring NO2;
- 7 stations for precipitation sampling.

Water quality observations are strongly included into international data exchange: data from 18 surface water quality stations are sent to ICPDR and from 77 to EEA once a year, from 14 water quality accumulation measurements stations and from 16 ground water quality stations are sent to EEA once a year.

Nuclear radiation is monitored at 9 stations, but RHMSS only collects data from this network.

RHMSS is connected to WMO-GTS via RMDCN network has been established with ECMWF, DWD Germany, Austrocontrol Wienna and Hungarian Met Service. RHMSS sends bulletins and messages of different types according to the WMO and ICAO manuals. The data-sharing protocols meet WMO, EU, EUMETSAT and EUMETNET protocols.

Significant gaps in observing network of RHMS of Serbia are as follows:

- The density of main meteorological stations (synoptic stations) is about 2500 sq. km. This is the lowest level according to WMO recommendations and DRR requirements;
- Approximately 80% of meteorological and hydrological instruments and equipments are at the end of their life cycle including weather radars stations and computers;
- Insufficient number of Automatic Meteorological Stations, Automatic Rain gauge stations, Lighting location system, Radio sounds and other vertical profiling equipment, Automatic Hydrological Stations, Acoustic Doppler Current Profiler, Weather radars, adequate monitoring network for micro and mezzo atmospheric process and adequate telecommunication system for collecting such data;
- The existing Weather Radar Network is not fully automated.

RHMSS in cooperation with the government has developed the plan for modernization of Observing, Telecommunications and Forecasting. Modernization program is based on “Study on Economic Benefits of RHMS of Serbia”, The World Bank study group, 2005, Belgrade, Serbia and “Strengthening the Hydrometeorological Services in South Eastern Europe”, 2008., The World Bank, ISDR, WMO, Finnish Meteorological Institute.

7.3.2. Hydro-meteorological data management systems

Historical hydrometeorological data is critical for hazard analyses, and planning and design within various economic sectors. In this regard, hydrometeorological data must be properly quality-ensured and stored in historical user-friendly digital databases.

RHMSS has quite advanced data management system and facilities. There are several databases in use based on Oracle, OTHER, dBase IV and CLIDATA. However, the time series in digital format from climatological and synoptic stations cover only 45 years. Quality control is done in real-time and in non real-time. Data stored (with formats) into other storages currently are (average number):

- hourly data (paper sheets): 40 years series;
- hourly climatological data (dBase IV format): 39 years series for 5 stations;
- climatological data (paper sheets): 57 years series;
- rainfall data (paper sheets): 42 years series;
- rainfall data (dBase IV format): 15 years series;
- radar data (Convective clouds): 30 years series;

RHMSS collects data from the original paper reports, which are being digitized by manual typing. The digital data is stored in the CLIDATA database on Oracle. Part of data is also available in Access database. Older data (more than 45 years old) is still only on paper or in book, and needs to be digitalized. Non real-time data pass three levels of data quality control:

- Technical control consists of checking temporal consistency of the data files. Omitted data are either found and filled in, or left blank, depending on the paper from which the data have been digitized;
- Logical control is being performed using a developed logical test. The test has two levels. Level one, alarms for obvious erroneous data, exceeding physical limits of the measured

value. It also alarms on non-logical data combination (i.e. precipitation from a clear sky). Alarmed data must be corrected. Level two, alarms on critical values that most probably contain errors. These data are corrected only if they are proved to be an error; otherwise it is left for further data analysis;
- Comparison of data from two or more logically (climatologically) related stations is being performed using ad-hoc graphs for temperature time course and 'snapshot' graphs of station level pressure data, ordered by altitude. Data are corrected only if the outliers on the graphs are proved to be errors.

Real-time data are checked in 5 steps:
- The formats of all coded reports are checked;
- Surface and upper air reports are checked for internal consistency before storing and exchange;
- Checks on temporal consistency;
- Checks against the model background values;
- Surface and upper reports are included in QC.

Data stored currently into RHMSS database are (average number):
- climatological data (7, 14 and 21 h) - 45 years series;
- hourly data (SYNOP code).

Data stored (with formats) into other storages currently are (average number):
- climatological hourly data (paper sheets): 40 years series;
- climatological hourly data (MS Access format): 39 years series for 5 stations;
- climatological three terms data (paper sheets): 57 years series;
- rainfall data (paper sheets): 42 years series;
- rainfall data (MS Excel format): 15 years series;
- Data (without regard to formats) are stored permanently.

Metadata are not completely available. RHMSS is currently in the process of planning a strategy of running data rescue activities; reports on paper form are kept in the archive, but capacities of existing archive are insufficient to host the entire archived material.

Hydrological data Quality Control concerns logical and visual analysis of observed / measured data and data observed by regional offices staff during inspection; graphical control of data collected from all sources, comparing data from the same river – upstream and downstream stations. Hydrological data management is ensured by the Wiski database on Oracle with metadata, tools for data restore and recovery and authorized users access.

Table 43: Computer capacity in use for RHMSS data management

Server/Workstation/PC	Characteristics	Disk space	Security
HP ProLiant ML 110 Server	XEON Processor	2×160Gb	Symantec AntiVirus
PC (1)	Pentium 4	180 Gb	Symantec AntiVirus
PC (5)	Pentium 4	80 Gb	Symantec AntiVirus
PC (1)	Pentium 4	40 Gb	Symantec AntiVirus
PC (1)	Pentium 3	60 + 8 Gb	Symantec AntiVirus
PC (1)	Pentium 2	6 Gb	Symantec AntiVirus
PC (3)	Pentium 2	4 Gb	Symantec AntiVirus
PC (1)	Pentium 1	1,6 Gb	Symantec AntiVirus
PC (1)	Pentium 1	1 Gb	Symantec AntiVirus

The data management computing capacity is actually the same as it was already in 2007 consisting of server and several Pentium PCs (Table 43). The security system includes the Symantec AntiVirus software. Safety of database system consists of having two hard disk drives in mirroring mode (one disk is exact copy of another) and soon is planned to make one integral backup. In the near future it is planned to do regular backups (partially - every month and integrally - every six months).

Concerning the policies for data dissemination and exchange, RHMSS attitude is that the reliable weather and hydrological forecasts and warnings, also climatological data that are used for protection of life and property, are a public good. They have to be available to any person or group at essentially free of charge. Only analyses and special data processing are charged. Hydrological data are charged for non-governmental institutions and price list is adopted by Government.

7.3.3. Hazard analysis and mapping to support risk assessment

In accordance with the applicable regulations, natural disasters threat maps have been produced and they are related to forest fires, floods, landslides, earthquakes, droughts, storms and hail and they represent an integral part of the Spatial Plan of the Republic of Serbia. The most detailed are the information about the risk of flooding due to a long tradition in the development of flood protection system, including the preparation and update of the protection plans at the national, regional and local levels. With the aim of implementing the Law on Emergency Situations in part related to adopting the risk assessment and protection and rescue plans of Serbia, autonomous provinces and local governments from natural and other disasters, there is a need for further capacity building of competent authorities in order to apply the methodology of vulnerability assessment of the population and certain economy sectors to some natural disasters and multi hazard risk assessment, including the risk of climate change.

The Law on Emergency Situations and special laws regulating some sectoral aspects of DRR establish the obligation of all authorities to exchange relevant data and information. For example, the Republic Hydro-Meteorological Service of Serbia provides historical and operational meteorological and hydrological data, including the data on natural disasters of meteorological and hydrological origin, short-term, mid-term and seasonal weather forecasts, early warning and alarm on the occurrence of meteorological and hydrological disasters, hazard maps, vulnerability and risk of meteorological disasters, climate atlas, data of radar and satellite observations and climate and hydrological analysis and studies for the development of protection plans.

RHMSS operative drought monitoring procedures include the regular calculation of a number of well known moisture indices and other relevant parameters, as well as usage of some crop models. Within Meteorological sector of RHMSS, agrometeorological data are collected on soil moisture on 6 different levels up to 1m depth from 4 automated stations (Delta-T); phenological data are also collected from 52 phenological stations. Agrometeorological data for about 50 years are managed in an agrometeorological database. Moreover, data on heat waves are collected in critical phases of the development of dominant crops (winter wheat, corn) for 10 meteorological stations for the period 1949-2008. Moisture/drought conditions are monitored operationally by applying Standardized precipitation index (SPI) on the basis of collected daily precipitation data (P) from the network of main meteorological stations of RHMSS. SPI and several other drought indexes (PDSI, Z, Aridity Index (AI), Water Balance (WB)) for the period of 1949-2010 are stored and managed in the database. An assessment of drought consequences (foremost in agriculture) in the various regions of country is incorporated within the agrometeorological system. RHMSS drought analysis include the preparation of drought/moisture index on daily level. The indices are: Standardized precipitation index (SPI) for 1,2,3,6,9,12 and 24 months, Palmer`s indices (Z and PDSI), percents of normal and productive soil moisture storage. Used tools are Microsoft Office, MySQL, R.

Hydrological sector of RHMSS collects data on water level, discharge and temperature on the rivers, groundwater level and temperature. Yearbooks are prepared for each year. RHMSS doesn’t collect data on the flood extent, impacts or damages, which are collected by local commissions at Municipality level. Flooded areas are estimated and only in some cases measured with geographical coordinates.

So far RHMSS doesn't use standard protocols for hazard data collection/management. Multiannual data series on different drought indices make possible the preparation of analyses on drought frequency, intensity and return periods. The preparation of drought hazard maps is in progress for various time periods (seasonal, critical periods in crop development). The same is being done with heavy precipitation conditions. RHMSS is also preparing an agro-climatic classification of the regions of Serbia on the basis of average annual precipitation and deficit/surplus in soil water balance. Concerning floods, RHMSS doesn't produces floods hazard maps.

RHMSS is partially using GIS technology, but it doesn't have a common geodatabase at service level, including all basic information. Based on those methodologies and tools, RHMSS produces bulletins and information (maps and graphs of draught/moisture indices, as deviations from normal, SPI and Palmer`s index, maps of agricultural draught probability, risk vulnerability). RHMSS doesn't have capacities in remote sensing applications in agrometeorology.

Currently, there are few other organizations archiving drought or flood related information: Republic Committee for Disasters; Ministry of Interior, Sector for Emergency Management; "Srbija Šume", Republic Directorate for Forestry; Ministry for Agriculture, Forestry and Water Resources, Directorate for Water, Flood Protection Sector.

SEM actually has few capacities for hazard mapping, nevertheless a map for 4 different types of hazard has been prepared, using past events, including floods and fires. SEM has also geographic data on vegetation and land use which are used for fire risk assessment, integrating the fire risk maps produced by RHMSS using the Canadian model.

WD and operationally the IWMJC are performing the preliminary flood risk assessment, according to the EU Directive on Floods. The IWMJC has built a geodatabase containing all the available information about floods, collected by local authorities and the Ministry of Interior, Civil Protection Department. Some impact data are available, e.g. the number of flooded houses and infrastructures) but not for all floods and only aggregated at Municipality level. Moreover the database contains some other basic geographic information such as the population density, land use, morphology, etc.

In general, disasters impact data are officially collected at local level by the local commissions, applying specific protocols for damage assessment, then they are transmitted to the special governmental commissions and finally stored at the Statistical Institute. Civil protection, insurance companies, Red Cross are also collecting impact data. Some data about drought consequences (foremost in agriculture) in the various regions of country are also available at the Statistical Institute aggregated at municipality level. Other data about drought impacts on agriculture are collected by Delta Generali insurance company. Concerning floods, the data also exists, including damages to property and persons. But all this data are dispersed and available with different levels of precision from different actors: Municipalities, Ministry of Agriculture, Institute of Statistics, Ministry of Finance, etc.

Floods impact data on agriculture are collected by the MAFWM, when the Municipalities ask for compensation in case that at least 30% of the cropping area is flooded.

WD collects data only for the damages on the hydraulic and flood protection infrastructures. A central database for hazard impact data and damages doesn't exist. Many institutions manage their own impact data, e.g. Municipalities, Ministry of Finance, Ministry of Agriculture, Statistic Institute, etc.

RHMSS used drought impact data on agriculture as feedback for validation/calibration of the drought monitoring system. RHMSS has analyzed drought/flood impact data also within the Program of adaptation measures of the First national report for UN Framework Convention on Climate Change and the spatial plan of the Republic of Serbia.

In the framework of the Delta Generali insurance project, the data on damages collected by the insurance company will be shared with RHMSS.

RHMSS provides and disseminates drought and flood information on regular basis. After all, some drought and flood information (relevant data sets, studies etc.) are delivered upon the request of various users. Most of drought and flood information, which are prepared on regular basis, are free. Users cover expenses of arrangement of the response to special requirements.

Outputs of RHMSS drought monitoring and analyses (indices and other relevant parameters, assessment of drought consequences, studies, etc.) are utilized by various users. There is a whole spectrum of usages for this information: from planning of field operations and plant protection activities to medium-term and long-term planning of agricultural production and economic ambient and policy. Almost there is no formalized feedback mechanism. Nevertheless, RHMSS takes into account feedbacks received on occasion of contacts with users any time when content of information is discussed. Demands received by feedback are incorporated into the further hydrological information and forecasts (specific forecasting locations, extended forecasting period, etc…). Increased demand for more specific and challenging products is noticeable, e.g. detailed spatial analyses, high resolution maps, outputs from crop yield and plant disease/pest models, long-range drought forecasts, as well as assessment of the effects of expected climate changes on the various aspects of agricultural production. In case of flood information, estimation is that information fully meets the users' expectation in almost any case.

7.3.4. Forecasting

RHMSS has operational weather forecasting service available 24/7 producing nowcasting products several times a day, 12 hour forecasts 1-3 times per day, 24 hour and 2-5 day forecasts once or twice per day, 10 days outlooks once a day, 30 days outlooks twice a month and seasonal forecasts (probability of air temperature and precipitation) once a month. Weather forecast for ten major towns in Serbia, for current day and tomorrow, is updated twice a day. The forecast products are available for public on the RHMSS webpages. In addition, specialized forecasts are produced several sectors:

- Air transport - two days ahead – twice a day;
- Electricity production – two days ahead – twice a day;
- Water management – differ types of forecasts with different delivery frequency;
- Agriculture: (i) one to three days ahead - once or twice a week (ii) seven to ten days ahead – once a week (iii) thirty days ahead – twice a month;
- Heating energy production and transmission: (i) one to three days ahead – once or twice a week, (ii) seven to ten days ahead – once a week, (iii) thirty days ahead – twice a month, (iv) seasonal forecasts 6 months ahead – once a month;
- Fire brigades – Forest fire index and weather forecasts depending on the forecast type;
- Road maintaining companies -as for heating energy sector;
- Governmental organizations – as for agriculture sector;
- Transport, Water transportation, Construction, Tourism, Utilities, Health sector - on demand.

7.3.4.1. Weather forecasting

Weather forecasting is based on NWP models. ECMWF and DWD model products are used for 7 days forecasts, the Serbian ETA model for 120 hours and the WRF-NMM (USA) for 72 hours forecasts. The verification of NWP products are done according of "Recommendations on the verification of local weather forecast", ECMWF, TECHNICAL MEMORANDUM, No, 430, December 2003.

For medium term weather forecast RHMS of Serbia uses ECMWF global model products for 10 and 15 days at 16 km horizontal resolution.

Table 44: NWP models used operationally by RHMSS

Model	Type	Data assim.	Horizontal grid size	Vertical levels	Time step	Daily runs UTC	Boundaries from
ETA	hydrostatic	no	18 km	32	45s	00 and 12	DWD
WRF NMM	non-hydrostatic	no	10 km	38	24 s	00 and 12	ECMWF
WRF NMM	non-hydrostatic	no	4 km	45	10 s	00 and 12	ECMWF

Since June 2009 RHMSS is using ENSEMBLE (Article 41) of ECMWF seasonal forecasts and seasonal forecasts produced by own regional climate model-RCM-SEEVCCC in the 30 km resolution and the length of 7 months.

The computing capacity available for running the NWP models consists of two Linux based systems:

- A newer HP CX3000bl Cluster consisting of 16 nodes (8 BL2x220c servers) with 3.0 GHz and 6 GB of DD2 memory;
- An older stand-alone HP rx3600 with two Intel dual-core Itanium2 processors. The system should be replaced with a state-of-the art computing system.

As there is need to go to higher resolution (horizontal scale, vertical levels, time steps) in NMP modelling there will be needs to enhance the computer capacity.

For visualization of Numerical Weather Prediction Products RHMSS uses its own graphical package named MICA (Meteorological Information, Charts and Animations), MetView and MAGICS, graphical system from ECMWF and Grads from NCAR (USA National Center for Atmospheric Research) and also Messir Vision. Editing tools allow the forecaster to work on observations, change soundings and forecasts. Visualization actually covers a vide range of products from analyse and forecasting maps, and charts, to digital analysing and editing of NWP products and observations. E.g. tailored ready-to-print products can be produced and sent automatically to each newspaper, or disseminated on the NHMS web pages. Typically the modern NHMSs, and especially the private commercial forecasting offices, have a fully end-to-end automated production system. These NHMSs have also invested significantly in proper number of experts working with software development.

RHMS of Serbia prepares also forecasts of clear air turbulence and icing for the area of Serbia, Montenegro, part of Bosnia and Herzegovina, Bulgaria, Romania and Macedonia.

7.3.4.2. Hydrological forecasting

RHMSS uses several forecasting methods for hydrological forecasting. For large rivers, forecasts are made for few days ahead applying models for water waves propagation (flood routing). For the Danube river correspondent discharge, for the Sava river multiple linear correlation and for the Morava river MANS modelling are used. Non-linear conceptual TANK / SSAR models, based on modelling of water balance component of the hydrological cycle, have been applied for Kolubara river basin. Input data are daily values of water levels, discharge, rainfall, and air temperatures from the reporting hydrological and meteorological stations in the Kolubara river basin as well as forecasted rainfall values obtained from numerical meteorological forecasting models. According to operational experience, the TANK model did not give satisfactory results because after a prolonged dry period empties deep tanks give, as a final result, total lack of flow in the river. For small rivers the graphical coaxial correlation method is used. Method takes into account precipitation index, number of week in the year, time of rainfall duration and total rainfall.
Ice events forecast for Danube, Tisa, Sava and Great Morava rivers are issued in winter by applying a method of physical - statistical dependence of total heat loss indispensable for ice occurrence and hydrological elements.

The products of NWP models (ETA model, NMM model with 4km resolution) and ECMWF model are used as input for hydrological/hydraulic models. The South East European Virtual Climate

Change Centre (SEEVCCC) runs also HYPROM (an hydrological model based on Mike11) coupled with the regional Climate Model WRF-NMM.

Table 45: Available hydrological models for flood analysis

Methods	Basins	Lead time
Method of corresponding discharge/water level	Danube and Tisa	4 days
Models based on multi-linear correlation	Sava, Danube, Tisa	4 days
Adaptive model MANS	Velika Morava	
HBV model	Jadar, Kolubara, Jasenica, Kubrsnica and Mlava,	3 days

RHMSS also receives the flood warnings from the European Flood Alert System (EFAS), as RHMSS has been the member of EFAS since 2007. EFAS products are regularly reviewed by the EFAS partner network which currently consists of 24 National flood forecasting centres across Europe. EFAS is currently under development at the European Commission Joint Research Centre. Serbia became member of the EFAS in 2007. The European Terrestrial Network for River Discharge (ETN-R) is an information infrastructure for the automated collection, quality control and redistribution of near real-time river discharge and water level data from 30 European national and trans-boundary river basins, involving in total 35 countries. The ETN-R project will promote the EFAS system.

Table 46: Characteristics of the meteorological forecasts used for EFAS flood warnings

Forecast name	Forecast range	Number of ensembles
Deterministic DWD	7 days	1
Deterministic ECMWF	10 days	1
Ensemble ECMWF	10 days	51
COSMO-LEPS	5 days	16

7.3.4.3. Air quality

RHMSS has several models for dispersion of airborne pollutants:

- AIRMOD - Gaussian plume dispersion, uses stability classes;
- ISC3 MODEL – Gaussian plume dispersion, can be used for point, area, line and volume sources;
- AFTOX - (Air Force Toxics Model) is a Gaussian dispersion model that will handle continuous or instantaneous liquid or gas elevated or surface releases from point or area sources. Output consists of concentration contour plots, concentration at a specified location, and maximum concentration at a given elevation and time;
- DREAM8 – a modified DREAM is used to model dispersion of dust particles which is run operatively once per day.

Dispersion models are linked to the ETA NWP model.

7.3.5. Warning products and services

7.3.5.1. Warnings and mandates

According to the laws RHMSS is responsible for monitoring, detection of hazards, forecasting and warning formulation and information dissemination for the following hydro-meteorological hazards: rotational high winds, flash floods, strong winds, hailstorm, thunderstorm or lightning, heavy snow, freezing rain, dense fog, heat waves: period of abnormally high temperatures, cold waves: period of abnormally low temperatures, drought, river flooding. Since the legal regulations concerning EWS are new, sets of bylaws and relevant technical regulations need to be reached for the purpose of governing all the technical issues in the process of making, issuing and dissemination of warnings.

The RHMSS Early Warning System is divided into two parts consisting of Meteorological Early Warning System and the Hydrological Early Warning System. The law, bylaws and technical regulations define different warning levels and their relation to emergency preparedness and response decisions, as well as actions at national to local levels. The meteorological early warning is based on use of up to 10 days weather forecasts produced by ECMWF and other international centers, RHMSS NWP modelling, observations and satellite data.

Table 47: Warnings for natural and technical hazards in Serbia, based on Annex 2

Hazard	Exists in the country	Warning by	Type	Warnings / year
Heavy precipitation	Yes	RHMSS	I	
Flash floods	Yes	RHMSS	I	
River flooding	Yes	RHMSS	I	15
Coastal Flooding	No			
Hailstorm	Yes	RHMSS	I	
Thunderstorm or lightning	Yes	RHMSS	I	
Heavy snow	Yes			
Freezing rain	Yes			
Dense fog	Yes	RHMSS	I	
Tornado or cyclone	No			
Strong wind	Yes	RHMSS	I	
Storm surge	No			
Heatwave	Yes	RHMSS	I	
Cold wave	Yes	RHMSS	I	10,4
UV Radiation	Yes	RHMSS	I	
Drought	Yes	RHMSS	I	0,1 – 0,2
Marine hazard	No			
Sandstorm	No			
Landslide or mudslide	Yes			0,3 – 0,4
Avalanche	No			
Airborne hazardous substance	Yes	RHMSS	I	1
Waterborne hazards	Yes	RHMSS	I	30-50
Hydrometeorological hazards for aviation	Yes	SMATSA	III	21-66
Hydrometeorological hazards to road and rail	Yes			31
Forest or wildland fire	Yes	RHMSS	I	105
Smoke, dust or haze	Yes			
Earthquakes	Yes			
Tsunamis	No			
Volcanic events	Yes			
Dispersion of insect pests	Yes			
Hazard for allergic reactions	Yes			

The RHMSS Hydroalarm is developed as a part of Hydrometeorological Early Warning System and European Flood Alert System (EFAS).The early warning for hydrological sector is based on NWP modelling of precipitation, taking into account other parameters, predicting of heavy precipitation which may lead to flooding. The flood warnings are divided into two phases:

- First flood alert is announced when water stages in the river reach established threshold which is determined for every river section;
- Second flood alert is announced when water stages reach established threshold which is one meter below the embankment crown.

Ice events forecast for Danube, Tisa, Sava and Great Morava rivers are issued in winter.

A forecast of Fire Weather Index is issued today at 13 hours in the CET in winter time and at 14 hours at summer and it is valid from noon until the day after next day at noon. FWI forecast is for information only.

For other hazards, such as airborne hazardous substances (i.e. nuclear, biological, chemical, etc.), waterborne hazards (i.e. nuclear, biological, chemical, oil spills, etc.) or others are charged by other state organizations. However, RHMSS is actively involved in the process of monitoring and detection of these phenomena.

7.3.5.2. Warning dissemination mechanism

RHMSS is in constant operational cooperation with the competent services of the issuance of warnings and alarming. Information and forecasts about the state of water regime and the weather and climate, early warning and warning are sent through TV and radio stations, by phone, by fax and E-mail (special bulletins), Website, SMS to the public and the following institutions:
a) Meteorological warnings:

- Ministry of Interior (Sector for Emergency Management);
- Emergency services (Center for informing and alerting of the City of Belgrade);
- Serbian Government;
- Media (radio and TV stations);
- Local authority and public utilities;
- Other departments of RHMS of Serbia (hail suppression department, hydrological department, agro-meteorological department, air and water quality control department).

b) Hydrological warnings:

- Ministry of Interior (Sector for Emergency Management);
- Ministry of Agriculture, Forestry and Water resources Management;
- Ministry of Environment and Spatial Planning;
- Ministry of Defense and Civil Defence Administration;
- Water management centres at the rivers Danube, Sava and Morava;
- Ministry of Energy and Mining;
- Ministry of Health;
- Public Enterprise ”Electric power industry of Serbia”;
- Republic information centre;
- Belgrade information centre.

RHMSS has not the mandate to cut radio or TV channels, or order the TV channels to add a banner with the given warning on the program. It must be noted, that homepage or website is not an active warning system, but rather a passive information system. In order to provide warnings in a simple, but still effective way, the RHMSS has prepared the National METEOALARM system in accordance to the EUMETNET METEOALARM system. The Meteoalarm system in Serbia has been in use operationally since 2009. RHMSS also receives the flood warnings from the European Flood Alert System (EFAS), as RHMSS has been the member of EFAS since 2007. Four levels of risk are identified. Each colour represents one level of the risk. Green colour means - no warning. Yellow - significant water stage rise or fall. Ice is in movement and covers from 10% to 40% of water surface. Events that could require undertaking of measures for first flood or ice alert. Orange - Very significant water stage rise or fall. Ice is in movement and covers from 50% to 100% (immovable ice) of water surface. Events that could require undertaking of measures for second flood or ice alert. Red - extreme hydrological events and conditions. There is the intention to begin to use the Common Alerting Protocol (CAP) for exchanging public warnings and emergencies.

7.3.6. Climate change analysis

Within the Belgrade Climate Change Initiative adopted by the UNECE Sixth Ministerial Conference “Environment for Europe” held in Belgrade, Serbia, in 2007, the sub-regional South East European Virtual Climate Change Centre (SEEVCCC) was established in Belgrade hosted by the Republic Hydrometeorological Service of Serbia.

The basic mission of the Centre is the support to the SEE countries in meeting the needs for information on sub regional climate change projections, impact, vulnerability and adaptation options on a continuous basis, through its operational, research, coordination and educational functions. The SEEVCCC in cooperation with Regional Environmental Centre for Central and Eastern Europe has developed the South East European Climate Change Framework Action Plan for Adaptation (SEE/CCFAP-A) for 2009-2015. The SEEVCCC will provide coordination and facilitate implementation of the SEE/CCFAP-A. In addition, within the WMO Regional Association VI for Europe (WMO RA VI) Strategic Plan for the Enhancement of Meteorological and Hydrological Services in the Region, the functions of the SEE-VCCC Centre and its priorities are defined under the WMO RA VI Resolution on Regional Climate Centre Network established in September 2009. . The main objectives of SEEVCCC are to:

- Further strengthening of cooperation between national hydrometeorological services in the sub-region in the field of climate change;
- Support for accelerated transfer of knowledge and technology in the field of regional climate modelling and other techniques of regionalization (downscaling);
- Application of research results in impact studies, vulnerability assessment and adaptation options;
- Support to personnel and institutional improvement of national hydrometeorological services in performing relevant tasks related to climate change, education and public awareness, including their contribution to the implementation of various Conventions (United Nations Framework Convention on Climate Change, UN Convention on Biological Diversity, UN Convention on Combating Desertification).

SEEVCCC has close cooperation with advanced and well known centers like KNMI-ECAD, DWD and ECMWF. Climate change analyses are based on dynamical modelling using the RCM-SEEVCCC coupled atmosphere-ocean model regional dynamical downscaling with the following characteristics:

- ECMWF initial and boundary conditions: 112km resolution;
- SEEVCC model resolution: ~35km atmosphere ; ~20km ocean;
- Model start: 16th of each month;
- Forecast duration: 7 months (~215 days);
- Wall time: 23h for 7months forecast;
- Computer resources, HPXC cluster 3000 BL, 16 nodes – 128 cores and 3 GHz cpu, are currently quite satisfactory, but requires more power and speed when the ECMWF model resolution increases or when the SEEVCCC model resolution needs to be increased.

Up to now the Center has developed long-term research agenda and made effort to strengthen partnership and cooperation with the industry in order to study impacts of climate change on different socio-economic sectors in time scales from nearest decades to hundred years. These studies are essential for strategic planning of the government and different industrial sectors.

7.3.7. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings. Currently RHMSS uses several types of communication systems to collect data from the observation networks. Use of GPRS system, which allows communication of large amount of data at low costs, is increasing allowing also collecting more data more often than earlier. RHMSS has recently purchased/received significant enhancement to their computing and data management system. However, the system is not yet duplicated or equipped with a proper firewall. Further modernization of the major IT components are expecting from bilateral cooperation with MeteoFrance International.

RHMSS is connected to Internet via wireless broadband with 10 Mbps capacity. The Regional Meteorological Data Communication Network (RMDCN) connection to the WMO-GTS is with 512

Kbps capacity, which is quite low for increasing data and information exchange. Serbia has in use the Terrestrial Trunked Radio (TETRA) system, which was specifically designed for closed communication use by European government agencies and emergency services. Currently RHMSS does not have access to the TETRA system.

Table 48: Equipment in use for data communication and warnings and other products dissemination

Telecommunication Equipment	RD	RI	SD	SI	RW	SW	Remarks
Telephone	X						
Mobile Phone	X						
Telefax				X		X	
Dedicated Leased Lines	X	X	X	X	X	X	
UHF radio transceiver	X						
Data Collection Platforms used to transmit data from AWSs	X						
Global Telecommunication system (WMO-GTS)	X	X	X	X	X	X	WMO Regional Meteorological Data Communication Network
Meteosat Second Generation Satellite system	X	X			X		
Internet	X	X	X	X		X	
Email			X	X			
Print media			X	X		X	
TV –national			X	X		X	
Radio			X	X			
Local radio			X	X		X	
Bulletins			X	X		X	
RD = to receive data/observations, **RI** = to receive information/products, **SD** = to send data/observation, **SI** = to send information/products, **RW** = to receive warnings, **SW** = to send warnings							

Table 49: Number of RHMSS staff by branch and level of education

Branch	Field and education														TOTAL
	Techn-icians	Meteorologist			Hydrologist			Engineer			Physicist, Chemist, Economist			Other	
		BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD	BSc	MSc	PhD		
Observation network	132		11			12						9		3	167
Maintenance	11							1							12
Telecommunication	10							1							11
Data management	14		8			9								3	34
Weather forecasting	18		22												40
Hydrological forecasting	3					7								1	11
NWP	1		6											1	8
R & D	3		10												13
Weather modification	156		35					1						9	201
Environment	20							10				7			37
Agrometeorology	2		3					6							11
IT personnel			2					2					2		6
Commercial services															
Accounting	5											4		2	11
General administration	13													4	17
Other								2							2
TOTAL	**388**		**97**			**28**		**23**				**20**	**2**	**23**	**581**
Female in % of total	30		30			40		40				60			31
Men in % of total	70		70			60		60				40			69

7.3.8. Human resources

The number of RHMSS staff was 582 in November 2010. Since 2007 the total number of staff has decreased by about 100 people. The number of observers is relatively high, as the number of manual observation stations is still quite high in comparison to modern NHMSs. Experts have good theoretical background and awareness of modern observation, production and dissemination technologies. The middle age of the academic staff is relatively high. During the last two decades RHMSS has lost qualified academic staff to other countries. Due to low salary and lack of attractiveness of the sector it has been difficult to get new young talented experts and academics to the RHMSS.

Data management, numerical modelling, digitalizing and visualization are the core areas of modern NHMSs. RHMSS has invested in data management, computing and software experts even if the number of these experts is still quite low compared to more advanced medium size EUMETNET NHMSs.

Table 50: Data management and computing experts of RHMSS

Title	Number	Comments
Communication experts	4	
Main computer experts	5	2 are external collaborators. They are available 24 hours a day.
“Helpdesk” experts	2	
Data base experts	3	Also engaged in quality control.
Quality control experts	3	
Software experts	6	
Web masters	1	External collaborator engaged under contract.

7.3.9. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums, to which membership provides better and more services than to non-members.

EU based hydrometeorological organizations provide most state-of-the-art models, software and tools to be utilized by the member NHMSs. The European NHMSs have globally an unique opportunity to benefit from the stat-of-the -art weather forecast modelling, medium-range weather forecast products at 16 km horizontal resolution (in near future at 8 km resolution) including the Extreme Forecast Index (EFI), re-analysing data to be used e.g. for climatological studies and the ECMWF super computer resources. The integration into the European hydrometeorological infrastructure was given the highest priority in the 2007 project in developing the capacities of the NHMSs to implement best European practices and to produce improved products and services in support of national economic development and DRR.

Since 2007 Serbia has become a Co-operating state of ECMWF, a member of EUMETSAT, EUMETNET and EUMETNET METEOALARM and the host of the regional South East European Virtual Climate Change Center (SEEVCCC). Currently RHMSS has good cooperation with RHMI of Republic Sprska and FHMI of Federation of Bosnia and Herzegovina in Bosnia and Herzegovina, NMHS of the former Yugoslav Republic of Macedonia, NHMS of Montenegro, NMHS of Albania NMS of Germany, NMS of France, NHMS of Russia, NMS of Romania, NHMS of Bulgaria, NMS of Hungary and within the area of hail suppression with the Bac-Kiskun county in Hungary. In accordance with these agreements, the exchange of data, forecast products and information, early warning of meteorological and hydrological disasters are carried out.

The exchange of hydrological data and forecasts is carried out on the basis of the responsibility of the Danube countries to exchange hydrological and meteorological data and hydrological forecasts via GTS (global telecommunication system) - that has been stipulated a long time ago by the decisions of WMO and the Danube Commission. Within the Danube Commission, the hydrological data from the Danube basin are exchanged for the navigation purpose. Within the Sava Commission, preparation of operative data exchange from the Sava basin is now in progress for the navigation purpose, flood defense and accidental pollution. There is bilateral water management cooperation with Romania and Hungary; activities are carried out from meteorological and hydrological field that stem from water management cooperation with these countries. The establishment of bilateral cooperation with Croatia is now in progress.

Table 51: International and regional cooperation activities of RHMSS

International and regional organisations and cooperation mechanisms	RHMSS status
WMO	member
WMO RAVI	member
RMDCN	member
IOC	no
UNISDR	cooperation
UNDP	cooperation
Red Cross	cooperation
EUMETSAT	member
ECMWF	Co-operating State
EUMETNET	member
METEOALARM	member
ECOMET	no
EUFP7 projects, networks	
EU JRC	
EFAS	member
EU PHARE	
EU CARDS, IPA	yes
EUCLID	no
EUR-OPA	Through Ministry of Interior
DMCSEE	yes
SEEVCCC	RHMSS is the host institute
SAVA Commission	member
NWP consortium	none
NMHS bilateral MoU	Republic Sprska and Federation of Bosnia and Herzegovina of BiH, FYR Macedonia, Montenegro, Albania, Germany, Russia, Bulgaria, Romania, France, Hungary

Within the Drought Management Center for South East Europe (DMCSEE) activities, RHMSS participate in the DMCSEE project in the frame of a transnational cooperation in Southeastern Europe as partner (RHMSS has signed the Cooperation Agreement).

SEEVCCC hosted by RHMSS as a member of WMO Pilot implementation plan for RA VI RCC Network provide operational climate services, monitoring and forecasting functions as well as highly recommended research and capacity functions aiming to strengthen capacity of NMHSs. In cooperation with WMO, SEEVCCC/RHMSS hosted a Regional Climate Outlook Forum (RCOF) for South East Europe (SEECOF).

European Union research and networking programs create consortiums of excellence, and provides good opportunities to NHMSs to network with more advanced NHMSs and commercial R&D companies and to strengthen their human and technical capacities. Up to now RHMSS has not exploited these opportunities due to quite poor understanding of the possibilities, lack of networking with active EU research units and capacity of preparing applications and project proposals.

RHMSS participation in research and development programmes and projects concerns:

- Project DMC-SEE through the program of Transnational cooperation in SE Europe: RHMSS provide upgrading and verification of operative functioning of RHMSS system for monitoring and early warning against drought; analysis of drought vulnerability of certain areas and creation of risk maps;
- National Project: Hydrological Flood forecasting system for small and medium sized catchments in Serbia –RHMSS bilateral cooperation with Norwegian Water Resources and Energy Directorate (NVE);
- Program of transnational cooperation in SE Europe, Regional project: Assessment of flood risk for areas along the Danube that are prone to floods and creation of flood zone maps (DANUBE FLOODRISK Project);
- National project: Further improvement and development of Flood Forecasting Services in Serbia – RHMSS bilateral cooperation with NVE;
- Participation in the creation of hydrological and meteorological information required by the National Water management master plan;
- Participation in national multi-disciplinary research project related to climate change impact, vulnerability and adaptation, national spatial and protection planning against natural hazards and disasters.

7.4. Technical recommendations to strengthen NMHS capacities in support of DRR

The technical and human capacity and scientific skills of RHMSS are at a high level compared to most of the NHMSs in SEE countries. However, lack of modern weather radar technology, automated hydrological measurements, state-of-the-art communication facilities, experts and insufficient level of governmental appreciation and financing limits the capacity of RHMSS to produce state-of-the-art products and services for disaster risk reduction per the following technical recommendations:

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. The competence for issuing warnings has been defined by law and bylaws. Since these legal regulations are new, sets of bylaws and relevant technical regulations need to be reached for the purpose of governing all the technical issues in the process of making, issuing and dissemination of warnings;
2. There are needs to have ISO standardization for different activities within RHMSS.

Operational relationships with other agencies

3. There are needs to promote cooperation and strategic partnerships with other technical agencies in Serbia and with advanced EU NHMSs;
4. There are needs to foster the visibility of RHMSS in general and within the DRR management.

Monitoring and observations networks and data exchange

5. There are urgent needs to modernize the weather radar network in Serbia and to establish regional data exchange system in order to produce regional near real-time composite pictures;
6. There urgent needs to enhance the financial resources to maintain and upgrade the surface observation networks and increase the number of on-line meteorological and hydrological stations;
7. There are needs to establish the second upper air station and to implement the AMDAR system;

8. There are urgent needs to enhance regional real-time data exchange of hydrological and meteorological measurements.

Forecasting

9. There are needs to promote production of regional weather radar composite pictures to promote short term weather forecasts;
10. There are needs to promote use of weather radar data as input for numerical flood models;
11. Implementation of data assimilation in NMP modelling would promote quality of weather predictions and thus also other forecasts;
12. Membership in an international NWP model consortium would promote NWP modelling of RHMSS;
13. There is a need to improve the automatic analysing and editing tools to help the work of forecasters;
14. There are needs to promote provision of technical advice and specifications to enhance products and services to industry and disaster risk reduction applications;
15. There are needs to ensure adequate replacement of computers and components as the life cycle of them is quite short.

Hydrometeorological data management systems

16. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data;
17. There are need to enhance the capacity to use more data in real-time.

Hazard analysis and mapping to support risk assessment

18. There is the need of wide capacity building programs in vulnerability and risk assessment of all types of hazards;
19. There are needs to promote hazard mapping and risk analyses through digitalization of historical data;
20. There are needs to receive guidance and training in hazard analyses;
21. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment;
22. There is the need to develop a shared methodology for drought risk assessment and assessment of vulnerability to drought in agriculture;
23. There is the need to develop a shared methodological framework for the integration of climate change products in floods risk assessment;
24. There is the need of integrating climatic change analysis in disaster risk reduction and particularly in drought and floods risk assessment through guidance and training in the use of climate change information;
25. There is the need of agreed and shared methodologies for impact assessment and collection and management of structured and harmonised data on disasters impact necessary for vulnerability assessment;
26. There is the need of Training in GIS and remote sensing applications in agrometeorology.

Information technology and telecommunication issues

27. There is a need to improve the dissemination tools to enhance the quality of data available on internet, to produce automatically tailored ready-to-print products to media and to have automatic translation of forecasts to different languages;

Warning products and services

28. There are needs to provide further education and training for forecasting of natural and manmade hazards;

29. There are needs to enhance exchange of information (analysis, forecasts, bulletins) of airborne and waterborne pollutants;
30. There is a need to improve the warning dissemination mechanisms by utilizing the available infrastructure of the competent authorities;
31. There is a need to improve the degree of exchange with users, through the development of a drought information delivery system in the form of interactive service and through joint projects with the aim to demonstrate the benefits of drought information usage and to raise the overall awareness about importance of effective drought monitoring, risk assessment, preparedness and management;
32. There is a need to enhance the awareness of the public of warnings.

Climate change analysis

33. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors taking into account also shorter timeframes with regard to investments.

Human Resources

34. There are needs to enhance the educational (academic) level of the staff;
35. There is a need to enhance the R&D capacity and participation in EU R&D projects;
36. There is an urgent need to employ meteorologists, hydrologists, NWP experts, ICT experts and data management experts;
37. There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects.

Regional cooperation

38. A regional Multi-hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
39. Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans;
40. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;
41. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres (e.g. ECMWF) producing NWP, by developing their NWP capacities and established NWP model consortium or become members of existing NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
42. A regional harmonization of watch and warning systems should be promoted;
43. Cross-border exchanges of real-time data, forecasts and warnings should be increased;

7.5. Recommendations from the Serbia National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Belgrade, on 25-26 October 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: To encourage all existing disaster risk reduction actors in Serbia, as defined by the existing legal framework, to work together and invest additional efforts in recognizing and fulfilling existing disaster risk reduction tasks and responsibilities.

Recommendation 2: To strengthen coordination, strategic planning and management of disaster risk reduction at the national level through the establishment of the National Platform as a multi-stakeholder national mechanism that serves as an advocate of disaster prevention and disaster risk reduction; provides coordination, analysis and advice on areas of priority; and undertakes strategic DRR planning and management.

Recommendation 3: To further facilitate and enhance establishment of mirrored/similar/same mechanisms at the regional and local levels through strengthening and reinforcing local capacities, institutions and governance capabilities.

Recommendation 4: To develop the National Strategy for DRR and protection in emergencies and corresponding Implementation/Action Plan as a first mutual step undertaken by the key disaster risk reduction actors, e.g. the Sector for Emergency Management of the Ministry of Interior, the Republic Hydrometeorological Service of Serbia, the Republic Seismological Institute , line Ministries and respective public enterprises, the Serbian Red Cross, research and education institutions, NGOs, civil society and business community toward integration of disaster risk reduction into the development policies, strategies and sectoral plans, followed with the implementation of the National Strategy.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning

Recommendation 5: To enhance the early warning system and the establishment of the 112 system based in the Ministry of Interior through modernization of the continuous and real-time collection and information sharing by expanding the hydrological, meteorological, air, water, land, and biodiversity quality monitoring networks, establishing an integrated protection and rescue system and ensuring functional horizontal and vertical links among all disaster risk reduction actors.

Recommendation 6: To strengthen technical and human resources of the Republic Seismological Institute of Serbia, and enhance the modernization and improvement of the seismological monitoring network and data transmission system and of the Republic Hydrometeorological Service of Serbia in operational monitoring, warning, forecasting and mapping of hydrological, meteorological, climate-related and ecological risks.

Recommendation 7: To increase the awareness of the citizens and media regarding the early warning system and the Single European Emergency Call Number 112 as well as to raise public awareness and to inform and educate the population on disaster prevention measures.

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 8: To encourage mainstreaming of disaster risk reduction into national educational curriculum by establishing Curriculum Revision Working Group composed of the representatives from the Ministry of Education, from the Sector for Emergency Management of the Ministry of Interior, the Republic Hydrometeorological Service of Serbia, the Republic Seismological Institute of Serbia, other respective line Ministries, the Serbian Red Cross, NGOs, international organisations, expert organizations and individuals as well as research and education institutions.

Recommendation 9: Coordinated DRR research should be undertaken to improve methods for predictive multi-risk assessments and socioeconomic cost–benefit analysis of risk reduction actions at all levels. These methods should be incorporated into decision-making processes at regional, national and local levels. Strengthen the technical and scientific capacity to develop and apply those methodologies, studies and models, including the improvement of regional monitoring capacities and assessments.

HFA priority 4: Reduce the underlying risk factors

Recommendation 10: To incorporate disaster risk assessments into the urban and spatial planning and management of disaster-prone human settlements, in particular highly populated areas and quickly urbanizing settlements. The issues of informal or non-permanent housing and the location of housing in high-risk areas should be addressed as priorities. Also, to mainstream disaster risk considerations into planning procedures for major infrastructure projects, including the criteria for design, approval and implementation of such projects and considerations based on social, economic and environmental impact assessments.

Recommendation 11: To develop national capacities for climate services to support medium and long-term sectoral planning through strong collaboration and cooperation across line ministries and with the Republic Hydro-meteorological Service of Serbia, and through enhanced regional cooperation with other South Eastern European and EU countries and Centres.

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 12: To further strengthen operational cooperation of the Sector for Emergency Management of the Ministry of Interior and the Republic Hydro-meteorological Institute of Serbia through joint training and improvements to the standard operating procedures across agencies linked to the different threat levels and lessons learnt from each disaster event.

Recommendation 13: To strengthen technical and human resources of the Sector for Emergency Management, build capacities of the operational units within the Sector and strengthen regional cooperation and collaboration on the technical level through joint training.

Recommendation 14: To enhance the development of the National Training Centre of the Sector for Emergency Management, i.e. to augment the implementation pace of the National Training Centre Action Plan (as defined by the USAID funded PPES Program) and promote education and training of individuals to properly respond in case of disasters.

Recommendation 15: To proceed with the establishment of the Regional Centre for Emergency Management in Serbia, which will serve as a training centre and as preparedness and response coordination and management centre in the South Eastern Europe, where multi-hazard rescue teams and first responders of different expertise will be situated with all necessary personal and team equipment and emergency relief goods, and which will be part of the network of regional centres of excellences promoting regional cooperation in disaster risk reduction in South Eastern Europe.

8. CHAPTER EIGHT: METEOROLOGICAL, HYDROLOGICAL AND CLIMATE SERVICES TO SUPPORT DISASTER RISK REDUCTION AND EARLY WARNING SYSTEMS IN TURKEY

Potential disasters in Turkey are mostly associated with earthquakes, droughts, heavy rain and floods, landslides, rock falls, forest fires, industrial explosions and fires, extreme temperatures, wind and snowstorms, avalanches, heat wave and fog.

This chapter presents all the findings related to the assessment of the Disaster Risk Reduction (DRR) institutional framework and technical capacities of the Turkish State Meteorological Service (hereafter referred to as DMI) and the Turkish State Hydraulics Works (hereafter referred to as DSI) to support DRR. It highlights that:

- The technical and scientific capacities of DMI and DSI are quite advanced when compared to other south east European countries, but due to lack of comprehensive weather radar network, lightning detection network and relatively low number of on-line automatic stations with new state-of-the-art sensor systems not at the level of advanced EU NHMSs;
- The coordination and cooperation between DMI and DSI are not at adequate level according to general hydrological and meteorological forecasting and DRR;
- Currently there is no national hydrometeorological database;
- There are needs to promote cooperation between DMI, DSI and the industry in order to promote national economic development;
- A new national 112 center is under preparation and it is necessary to link the National Meteorological Service (DMI) and the National Hydrological Service (DSI) strongly to this center;
- Up to now the potential capacity of the Turkish hydrological and meteorological sector has not been utilized by the DRR sector, in order to produce local scale projections of impacts of climate change on different hydrometeorological parameters and their combinations, in order to study the impacts of the climate change to different socio-economic sectors, and to integrate climate change into national strategic planning;
- Development of Risk Assessment, MHEWS and other capacities to support national risk management could also benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among IPA beneficiaries and with various regional centers in Europe.

8.1. Turkey's vulnerability to hydrometeorological hazards

8.1.1. Natural hazards in Turkey

Potential disasters in Turkey are mostly associated with earthquakes, droughts, heavy rain and floods, landslides, rock falls, forest fires, industrial explosions and fires, extreme temperatures, wind and snowstorms, avalanches, heat wave, fog, transportation accidents and terrorist attacks. Given the size of Turkey and the fact that the main hazard type is earthquake, most disasters are localized in certain provinces and do not affect the entire country. However, there is no information for the vulnerability of social groups such as women, the elderly, minorities, etc.

Disasters are one of the biggest obstacles to the sustainable development and social security of Turkey. Measured in terms of direct economic losses, natural disasters have, on the average, accounted for 1% of GDP. The majority of the population lives in earthquake-prone areas, where major economic investments and significant vital infrastructure and related construction take place.

Floods are among the most frequent and costly natural disasters in Turkey in terms of human suffering and economic loss. The historical flood database for the period between 1955 and 2009 provides information for 4,067 flood occurrences in Turkey, causing 1,400 deaths and serious damage to 30,800 dwelling units.

Landslides, rock-falls, avalanches, and other disasters of hydro-meteorological origin have also caused the loss of many lives and considerable economic loss during the last 50 years. From 1955 to 2009 landslides affected 5,472 settlements and killed 200 people. In this period 68,300 dwelling units were relocated to safer places. Landslides frequently affect inner and eastern Anatolia, and particularly the Black Sea regions in Turkey.

There have also been thousands of people affected and some hundred people killed by extreme winter conditions, cold waves and heat waves during the years (EMDAT database), even though the direct economic losses of heat waves are not taken into account.

8.1.2. Sectoral analysis of the vulnerability to hydrometeorological hazards

In Turkey a systematic analysis of economic losses due to disasters and emergencies has never been done. However, according to some available estimation, during last 50 years the damages to private houses have been almost US$ 10 billons. Considering that about 8% of the people affected by disasters are victim of floods, the damages related to floods for houses only can be estimated at US$ 0.8 billion.

Geographically, there is a large variation in annual precipitation, evaporation and surface run-off parameters, in Turkey. Precipitation is not evenly distributed in time and space throughout the country and the rivers often have irregular regimes. There are 25 hydrological basins in Turkey for a total surface water run-off of 193 billion m^3/year. 31% of the potential is constituted by the Euphrates (Fırat) and the Tigris (Dicle) Rivers both of which have their sources in the eastern part of the country. Taking into consideration the population of 2007 which is 70,6 million, the quantity of water per capita per year is 1,586 m^3. Countries regarded as being rich in water resources have 8-10 thousand m^3 water per capita per year. The available water per capita per year in Turkey is about 1/5 of the water-rich countries. In Turkey, 74% of the water resources are being used in irrigation sector. Therefore, in the drought period shortage in water supply in some proportions is very important for economical aspects. Although the demands (except the strategic ones) in the drought periods can be fully met technically by constructing storage reservoirs, this solution is not accepted as a rational solution economically and evaluated as waste of resources. In these periods the demands must be met by making shortages in water supply. Due to its location in the Mediterranean Basin, Turkey will be one of the most affected countries by climate change, according to United Nation Water Report published in 1994. IPCC (Intergovernmental Panel on Climate Change) 4th Assessment Report states that annual amount of precipitation and the number of precipitation days are very likely to decrease and the risk of summer droughts is to increase in most of the Mediterranean Region. Flood is the second biggest hazard in Turkey, which causes higher economic loss after earthquakes. According to the records based on annual flood inventory studies, economic losses related to the flood disasters reaches 100 million US$/year and in the last 15 years, about 500,000 ha urban and agricultural areas were affected by floods. From this point, geographical, meteorological and physical characteristics as natural effects and human activities as socio-economic effects constitute the sensitivity level of Turkey to flood risk.

Almost one thirds of the total surface area of Turkey (77,95 million ha) can be classified as arable land. The country's large agricultural sector accounted for 29.5% of the employment in 2009. Historically, Turkey's farmers have been fairly fragmented. According to the 1990 Census, 85% of agricultural holdings were under 10 hectares and 57% of these were fragmented into four or more non-contiguous plots. Many old agricultural attitudes remain widespread, but these traditions are expected to change with the EU accession process. Under the available technology, 8,5 million ha area is estimated to be economically irrigable. Thus Turkey gives great importance to integrated regional development projects. The Southeastern Anatolia Project (GAP), Eastern Anatolia Project (DAP) and Konya Plain Project (KOP) can be mentioned among them. According to future projections, the share of irrigation use will decrease from 74% in 2008 to 64% by 2023. On the other hand, the domestic and industrial use would increase to 16% and 20% in this period, respectively. The water requirement increases steadily and the agricultural sector is the major consumer of water in Turkey with about 34 billion m^3/year while the water volume to be utilized by this sector would be expected at the level of 72 billion m^3/year by 2023. Agriculture sector nevertheless still remain particularly vulnerable to drought, both meteorological and hydrological, and the climate change projections indicate that the risk of summer droughts is likely to increase.

8.2. Institutional Framework of Disaster Risk Reduction in Turkey

8.2.1. Legal framework and policy supporting DRR in Turkey

Disaster Law (N.7269, 1959) is the main legislative document, which relates to all disaster related activities, and responsibilities at country level. Building on this act, the Regulation Concerning Fundamentals of Emergency Aid Organization and Planning Associated with Disaster Act No: 12777, defines the planning rules and the roles and duties of the central and provincial public institutions. In 2009 the Law on Establishment of Disaster and Emergency Management Presidency (5902/2009) established the “Disaster and Emergency Management Presidency” (AFAD) under the Prime Ministry. Moreover, some line ministries are involved in disaster risk reduction and post disaster response and rehabilitation issues. However, there are still some conflicts between laws governing sectoral responsibilities and the Disaster Law.

Other relevant laws are:

- Law on Establishment of Turkish State Meteorological Service, numbered 3127, dated 1937;
- Law on Establishment of DG for State Hydraulic Works (DSI), numbered 6200, dated 1953;
- Law on Protection against Floods, numbered 4373, dated 1943;
- Law on Precaution and Aid Against Disasters Effecting Common Life, numbered 7269, dated 1959;
- Law on Development Plan, numbered 3194, dated 1987;
- Prime Ministerial Circulars, namely River Beds and Floods, numbered 2006/27, dated 2006;
- Prime Ministerial Circulars, namely Rehabilitation of River Beds, numbered 2010/5, dated 2010;
- Law on Municipalities of Greater Cities, numbered 5216.

In addition to this law, some ministries like the Ministry of Environment and Forestry (MEF) and Ministry of Health, etc. are involved in disaster risk reduction and post disaster response and rehabilitation issues. However, there are still some conflicts between laws governing sectoral responsibilities and the Disaster Law as well as what type of planning processes are necessary for DRR which need clarification.

The Crisis Management Center in the Prime Minister's Office and provincial crises centers operate in case of an emergency at national and local level. According to the extent and severity of disaster, the operating administrative level becomes higher. The system may be termed both central and decentralized but is coordinated from central bodies.

Disaster risk reduction policies are included in Turkey's 8th and 9th National Development Plans. In the medium term program covering the years 2008-2010, there are also references to disaster risk reduction activities.

In the National Millennium Development Goals Report of Turkey, under Goal 7 (Ensure Environmental Sustainability) atmospheric pollution, deforestation, protection of biodiversity issues are addressed and uncontrolled increases in building stock is defined as a negative factor in promoting measures against disaster caused by the impact of natural hazards.

Disaster mitigation activities and studies on current or possible natural disasters in Turkey are carried out according to the Act No: 7269. Regulation Concerning Fundamentals of Emergency Aid Organization and Planning Associated with Disaster Act No: 12777, taking its basis from this Act, defines the planning rules and the roles and duties of the central and provincial public institutions.

The Agricultural Drought Coordination Board has been established with the Cabinet decision (2007/12477) of the 07 August 2007. The Board is coordinated under The Ministry of Agriculture & Rural Affairs (MARA). It constitute the Legislative framework for the Turkey Agricultural Drought Action Plan (TAKEP), which has been published by the Official gazette on 2nd March 2008. The Policy objective is to establish strategies and measures to minimize the impact of drought on farming and food security. Drought risk assessment issues are not included in the mandate of AFAD, because the Disaster Law does not consider drought among disasters. Floods risk assessment is included in the mandate of AFAD.

Several governmental institutions operate early warning systems in Turkey. The roles of Turkish State Meteorological Services (DMI) and Turkish State Hydrological Works (DSI) in the DRR management are defined in the Law No 5902. On policy level DMI and DSI have a role in the DRR planning through the Ministry of Environment and Forestry as sources of basic hydrometeorological information, but they do not have a role as integrated partners in policy making and strategy planning of the national DRR.

8.2.2. DRR institutional framework

8.2.2.1. List of agencies involved in DRR

The institutions responsible for hydrometeorological risk reduction at national level are:

- Disaster and Emergency Management Presidency (AFAD) under the Prime Ministry. AFAD has been established in December 2009, it is responsible for Disaster and Emergency Management of Turkey (but not for drought issues) and for an effective emergency management and civil protection issues nationwide;
- General Directorate of State Hydraulic Works (DSI) of the Ministry of Environment and Forestry, responsible for monitoring and hazard assessment of flood and hydraulic drought;
- General Directorate of State Meteorological Services (DMI or TSMS) of the Ministry of Environment and Forestry, responsible for monitoring and hazard assessment of meteorological hazards;
- General Directorate of Agricultural Production and Development (TUGEM) of the Ministry of Agriculture & Rural Affairs, is responsible for the Agricultural drought management and coordinator of the Turkey Agricultural Drought Action Plan;

- General Directorate of Agricultural Research (TAGEM) of the Ministry of Agriculture & Rural Affairs;
- General Directorate of Electrical Power Resources Survey and Development Administration (EIE) of the Ministry of Energy and Natural Resources. It has been founded on June 24, 1935 under law No. 2819, being governed by the provisions of private law and administrated in accordance with commercial methods, having the status of a juridical person and being bound to the Ministry of Energy and Natural Resources, carrying out engineering services for the production of electrical energy. EIE is an investor public organization.

In addition, at the local level, all the local institutions are also responsible for risk reduction. These include the Governorates, the District Authorities, the Special Provincial Administrations, the Metropolitan Municipalities and the other Municipalities.

8.2.2.2. Disaster and Emergency Management Presidency (AFAD)

Turkey's Disaster Management System was reorganized after the 1999 earthquakes and in 2009 a new department called "Disaster and Emergency Management Presidency" (AFAD) under the Prime Ministry was established merging under one umbrella organization the former three main disaster responsible organizations. AFAD is responsible for coordinating nearly all phases of disaster management including DRR at national level, and installs rules, regulations, and guidelines for preparation of DRR plans at sub-national levels. The Presidency moreover serves as official HFA Focal Point.

AFAD mandate is to formulate and implement policies and to provide coordination among the Government, NGO and private institutions. The presidency conducts: pre-incident works such as preparedness, mitigation and risk management, during incident works such as response, and post incident works such as recovery and reconstruction. AFAD is authorized for all disasters and emergencies in all country, not only hydrometeorological (at the exception of drought that is not considered as a disaster). It has a coordination role between institutions and organizations, the mandate to produce and implement policies on: (i) preparation and mitigation before the occurrence of events, (ii) response during the event, (iii) recovery after the event, and (iv) and for the effective implementation of these activities across the country. AFAD has the mandate to:

- define the needs of in kind, in cash and humanitarian assistance;
- determine management strategies;
- establish and operate all kinds of information, communication, forecasting and early warning systems;
- make proposals to the relevant authorities with the need of public investment and personnel;
- implement training activities and exercises;
- take the recovery measures to ensure return to normal life after the disaster;
- provide temporary settlement in disaster areas.

AFAD departments are (i) the Planning and Mitigation Department, (ii) the Response Department, (iii) the Recovery Department, (iv) the Civil Defense Department, (v) the Earthquake Department and the (vi) the Administrative Services Department. The Planning and Mitigation Department is heavily involved in DRR and his missions include:

- To prepare disaster and emergency response, risk management and hazard reduction plans which will be applied nationwide;
- To determine possible disaster and emergency areas and to pronounce preventive measures;
- To determine reconstruction, plan and project rudiments of disaster prone areas;
- To determine cash, goods and humanitarian aid rules;
- To work for informing and raising awareness of public about disasters and emergencies;

- To collect and evaluate information about disasters and emergencies occurred within the country and abroad related to Disasters and Emergencies;
- To determine administrative strategies;
- To coordinate forecasting and early warning systems.

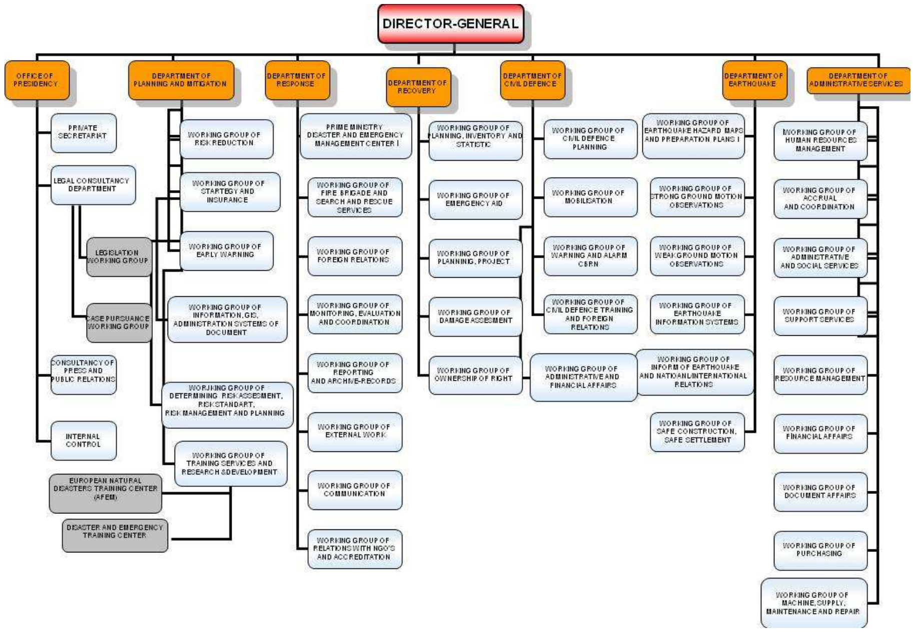


Figure 38. Organization chart of AFAD

8.2.2.3. Turkish State Meteorological Service (DMI)

The Turkish State Meteorological Service (DMI) was founded in 1937. It is the only legal organization, which provides all meteorological information in Turkey. The main objectives of the TSMS are to :

- make observations;
- provide forecasts;
- provide climatological data, archive data, and other information;
- communicate these to the public;
- provide meteorological needs of army and civil aviation.

Currently DMI operates the national meteorological observation network, it is in charge of national meteorological and climatological database. It produces climatological studies on extremes, variability and trends; prepare risk area maps. It also produces weather forecasts, it assesses. detects and predicts meteorological hazards using international and national weather forecasts, satellite data, observations; as well as formulates and disseminates hazards watches and warnings as well as other hazards related information and services to authorities and the public.

8.2.2.4. Turkish State Hydraulics Works (DSI)

The DSI, as the competent water authority, is the main organization responsible for water resources management. All water resources are managed in accordance with Law No. 6200. The DSI was established for the purpose of preventing damage caused by surface water and groundwater and ensuring the utilization of water resources for multiple purposes. In this framework DSI is responsible for the whole country except then for the large urban areas where the responsibility if held by the Municipalities. DSI operates the national hydrological observation network, it is in charge of the national hydrological database, produces annual and monthly reports,

and provides tailored hydrological services to agriculture, energy, environment sectors and to different branches of the services sector.
One of the basic duties and responsibilities of DSİ is building and operating protective structures against floods. It takes the necessary precautions and warns the relevant organizations in the event of flood emergencies. DSI conducts afforestation work and establishes recreation areas and facilities aiming at prevention of erosion, decreasing the sediment amount deposited in dams through rivers, restoring the environment of dam basins and their catchments.

DSI coordinates the preparation of the strategic and action plans for the water sector. DSI has 25 Regional Directorates. Major functions of these offices are firstly collect data in the field of mapping, hydrometric measurements, agricultural economy, land classification, drainage, groundwater and geology, and secondly to evaluate them for the planning, construction and operation of water structures.

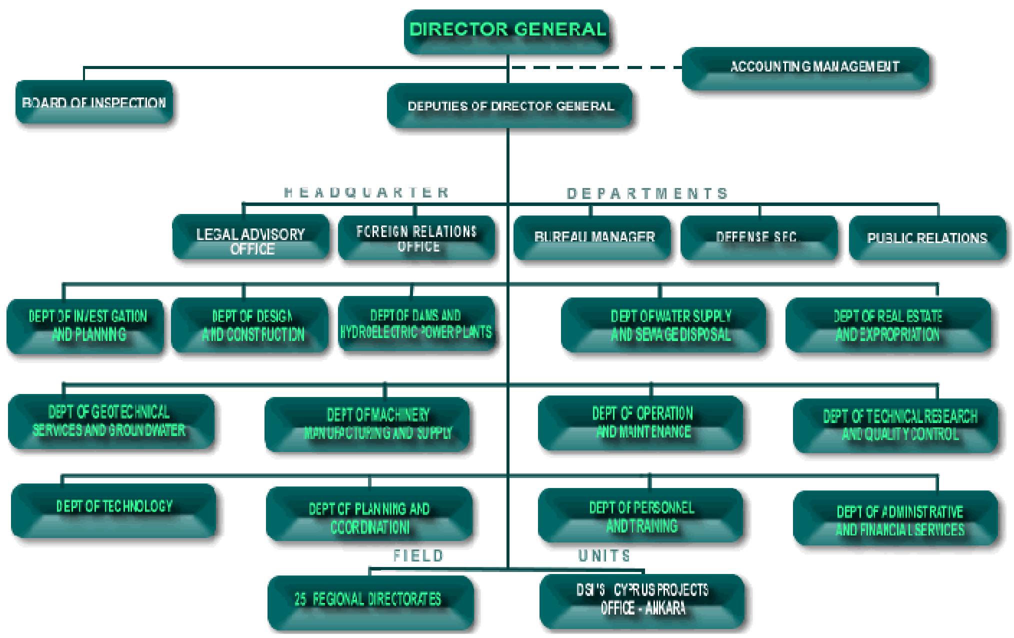


Figure 39. DSI organization chart

8.2.2.5. <u>General Directorate of Agricultural Production and Development (TUGEM)</u>

TUGEM is the coordinator of the Turkey Agricultural Drought Action Plan and particularly for the Monitoring & Early Warning Committee and the Risk Assessment Committee. TUGEM collects drought related data and information produced by different institutions involved in the Committees and the agronomic data coming up from the provincial directories of Ministry of Agriculture.

8.2.2.6. <u>General Directorate of Agricultural Research (TAGEM)</u>

TAGEM main object is to identify and disseminate tolerant plant species and varieties together with sustainable crop production systems to farmers in order to mitigate the effect of drought. TAGEM provides also services and information to TUGEM in the framework of the TAKEP. TAGEM collaborates with DMI for the development of R&D projects on agrometeorological early warning, crop simulation models and other initiatives. The research center based in Konya was nominated as a drought research center. The Bahri Dağdaş International Agricultural Research Institute studies drought risks in Turkey and is involved in drought monitoring. The institute has been recently reorganized so the roles and responsibilities of different departments haven't been yet defined.

8.2.2.7. General Directorate of the Electrical Power Resources Survey and Development Administration (EIE)

The General Directorate of the Electrical Power Resources Survey and Development Administration (EIE) is responsible for surveys related to electric power and for the rational use thereof. EIE has mandate for floods activities concerning Hydroelectric Power Plant (HEPP) projects. However, EIE does not perform drought related activities. The EIE activities related to floods are to collect, store and publish hydrological data, and to prepare engineering hydrology reports for HEPP projects. The department of Hydrological Surveys of EIE deals with collecting and storing hydrological data, analyzing it and producing hydrology reports. But those activities are just for HEPP project reports.

8.2.3. Operational relationship with Disaster Risk Management and other Technical agencies

The Crisis Management Center in the Prime Minister's Office and provincial crises centers operate in case of an emergency at national and local level. According to the extent and severity of disaster, the operating administrative level becomes higher. The system may be termed both central and decentralized but is coordinated from central bodies. Each ministry has a unit responsible for disaster management rather than they're being one national coordinating agency with a more complete proper legal mandate and power.

In terms of institutions, the DRR system involves all concerned governmental bodies and is replicated almost identically at the central (Prime minister), provincial (Governor) and local (Sub-governor/Qaimaqam/District Governor) levels.

The National Hydrological and Meteorological Services are responsible for providing data to the DRR system: DMI maintains the national meteorological observation network and produces meteorological analyses, weather forecasts and warnings; DSI operates the national hydrological observation network and provides hydrological services to agriculture, energy, environment and services sectors. Due to a lack of adequate cooperation and coordination between the Hydrological and Meteorological sectors, the hydro-meteorological sector does however not have the optimal capacities to respond to the demands of developing communities.

Several governmental institutions operate early warning systems in Turkey. DMI has short and long term weather predictions and for some cases announces warnings for flooding, severe weather conditions, and heat waves. DSI operates flood early warning and prediction systems mainly established after the 1998 heavy rains and flash floods occurred in NW Black Sea Region. Standard Operating Procedures (SOP) and Quality Management Systems (QMS) between the DMI, DSI and the DRM sector have not been developed.

The organizational structure of DRR at provincial level is under the authorization of the governor. The governor does not have an operational role but coordinates and mobilizes others. Each governorship has its own "Provincial Rescue and Aid Committee" and under this committee there are 9 service groups, which are responsible for only response and recovery activities. The Provincial Directorate for Disaster and Emergency Management are responsible for loss and damage assessment, preparation and application of civil defense plans and for the Management Center for Disaster and Emergency. The municipalities are responsible for mitigation, preparedness, and response measures.

Turkey started studies to establish a National Platform after 2007 Global Platform meeting. The draft scheme of this platform including membership, and short-term programs has been sketched out by NFP. However, Turkey has not established a multi-sectoral National Platform for DRR at the moment.

8.2.4. Roles and responsibilities for flood and drought risk assessment

In Turkey there is a strong institutional basis for the development of risk assessment, indeed AFAD has the competency of coordinating other relevant institution. AFAD is preparing the standards for the risk assessment of all hazards, including floods, even if this process is just starting and will take time. Moreover, recent legislation increased the responsibility of municipalities and AFAD should ensure the efficiency of the mechanism. Actually, the current capacity of DSI and DMI would ensure the provision of useful historical and current data.

AFAD ensures the coordination amongst the Government, NGO and private institutions in order to formulate and implement policies. As it has been established only in December 2009, so the risk assessment is still in progress and even the methodological framework is not completely defined. AFAD plans to develop a national disaster risk information system including a database on disasters.

Despite the legal and institutional framework is quite clear, flood risk assessment is just starting in Turkey and operationally the workflow has many gaps. Regarding floods, according to the current legislation, flood risk assessment should be performed at local level by the local governments for spatial planning purposes, and at national level by AFAD, which has clearly defined the risk assessment in its mandate, for the preparation of Emergency Plans. AFAD is charged also to develop a standard methodology for risk assessment and the guidelines for the local authorities. AFAD is also charged to support local authorities in the implementation of risk assessment if they don’t have the technical capacities.

DMI is charged of the meteorological measurements and analysis, so its contribution to floods risk assessment consists in providing meteorological and climatic data, analysis and indexes. DSI is charged to provide to AFAD and local governments flood hazard maps and analysis for implementing the flood risk assessment with suitable precision according to the scale of analysis. DSI is also charged of the flood protection planning, of evaluating the need for structural measures to protect flood prone areas. Moreover the floods risk analysis have many other users, including Municipalities, Banks of Provinces, insurance companies demanding flood investigation for the development of their own plans. AFAD is also charged of hazard impact data management and analysis even if at present a real comprehensive hazard database doesn’t exist yet. AFAD collects information about floods from all relevant institution and has agreed protocols for data collection with DSI and Municipalities. Flood hazard analysis and mapping have been provided by DSI till now for specific areas, but starting from 2011 these activities should become systematic.

DMI provides meteorological data to DSI, AFAD and local Governors. DSI is charged of the measurements on streams and uses both its own data and DMİ data to calculate discharges of the rivers and creeks for different return periods. DSI produced and provides to AFAD and local authorities maps of flood prone areas.

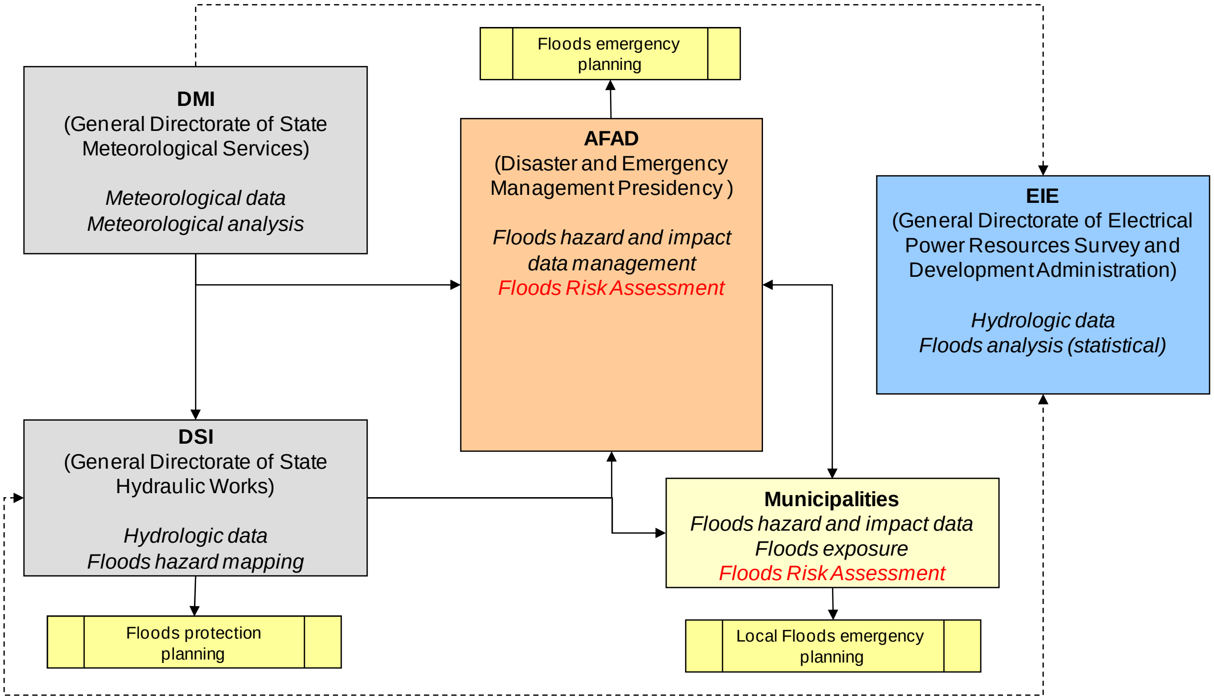


Figure 40. Floods risk assessment work flow in Turkey

Concerning drought, there is not a clear legal and institutional framework for risk assessment and there is not a responsible institution for drought risk assessment for planning purposes. Some institutions are analyzing the different aspects of drought from their point of view (DMI for meteorological drought, MoA for agricultural drought and mainly for current management, DSI for hydrological drought). AFAD does not have mandate for drought risk assessment, even if in the future drought would be considered among the disasters and then included in AFAD mandate. Actually, the existing Turkey Agricultural Drought Action Plan (TAKEP) aims principally to drought monitoring and management. It is however interesting to analyze TAKEP work flow, because it provides the framework for the collaboration of main actors on drought analysis. The main targets of TAKEP are to create public awareness on drought, to sustain agricultural water usage, to take proactive measures, and to implement effective actions to alleviate drought effect during drought period.

The General Directorate of Agriculture Production and Development (TUGEM) is the coordinator of these activities. Data is collected by the Provincial Directorate of Agriculture and sent to the Data Provider Unit. Then phenological observations and agricultural production information are analyzed by Monitoring & Early Warning Committee, which prepares a report presented to the Risk Assessment Committee. If there is the need, Evaluation reports from Risk Evaluation Committee are submitted to Agricultural Drought Coordination Board. The reports of the working groups are presented to the Ministry every month. DMI Agricultural Meteorology Division participates in both the committees providing each month drought indexes and precipitation analysis at national, regional, watershed and agroecological zones levels. For the Risk Evaluation committee, DMI produces also 3 SPI scenarios (± 20%) for the next 6 months. DSI also participate in the committee, but not AFAD.

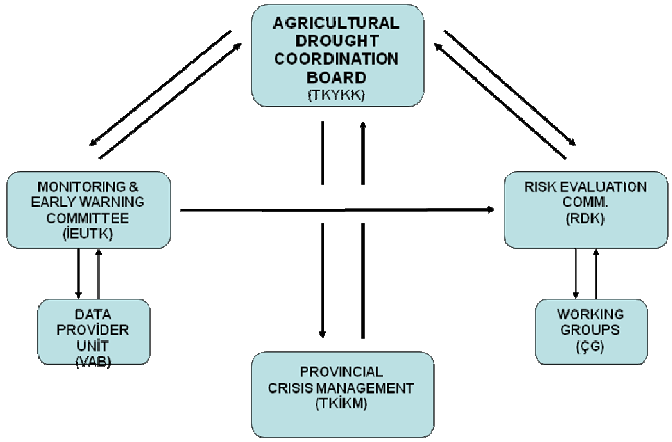


Figure 41. TAKEP workflow

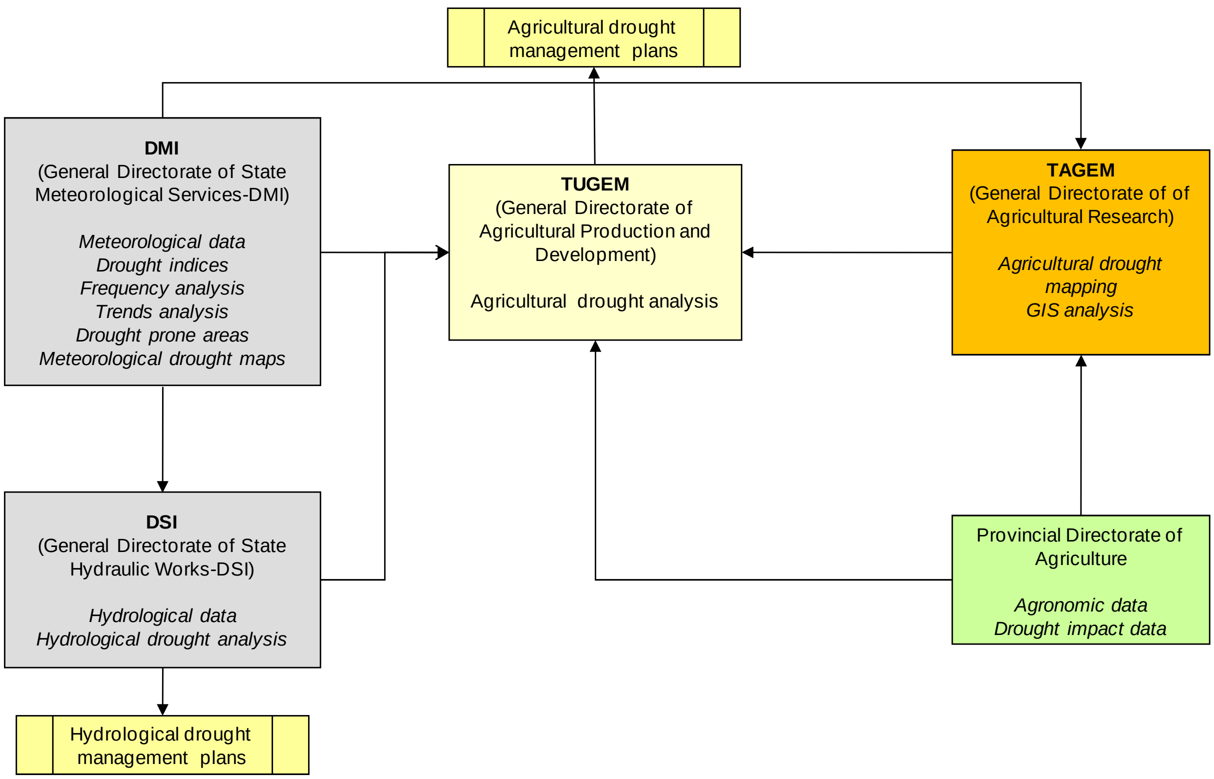


Figure 42. Drought analysis workflow in Turkey

8.2.5. Sources of funding

In Turkey, the State has a legal obligation (Disaster Law, No. 7269) to fund the costs of reconstructing buildings after an earthquake; but the State does not have a similar legal responsibility to provide funding for DRR. After the two major earthquakes in 1999, which caused widespread destruction of the building stock, the Government of Turkey decided to enforce earthquake insurance on a nationwide basis with the sole purpose of privatizing the potential risk by offering insurance.

One of the weaknesses of the insurance pool is that it is limited to earthquakes. It does not cover other disasters such as floods, landslides, or avalanches. Therefore a draft insurance law has been prepared and presented to the Parliament.

Hydro-meteorological risks such as drought, frost, hail, heavy rain, flood and storms cause significant agricultural damages in the country. In order to provide coverage to hydro-meteorological risks which are threatening the agricultural sector, and also with increasing likely effect of climate change dependent on global warming, the implementation of an insurance mechanism has been considered and for this purpose, "Agricultural Insurance Code No. 5363" was brought into effect in 2005. In order to improve and expand agricultural insurances and carry out other technical services “The Agricultural Insurance Pool” was established.

8.3. Institutional and Technical Capacities of Hydrometeorological Services to support Disaster Risk Management

8.3.1. Monitoring and observations networks and data exchange

Hydrometeorological observations and especially the upper air observations are essential for global, regional and local weather forecasting and numerical modelling of the atmosphere. Long-time historical time series of accurate quality controlled observations are required for hazard analyses, climatological studies and monitoring of climate change. Real-time observations are critical for:

- prompt reaction in meteorological, hydrological and air quality emergency situation;
- reduction of vulnerability to the risks of meteorological, hydrological and environmental hazards;
- short term forecasts;
- validation of forecasting models;
- improved data assimilation, which will benefit the global, regional, local and mesoscale NWP modelling.

8.3.1.1. DMI observation network

DMI has quite extensive and versatile observation network (table 52). The number of automatic weather stations (AWS) is 463, and almost 400 of them are in real time data collection through GPRS or satellite. All basic meteorological parameters have been measured by means of electronic sensors at this network. On the other hand, the AWSs used in the network have an open architecture to improve the capability of the system by adding new sensors or upgrading the software for advanced data collection and product generation. 246 new AWOS are being installed.
Automatic Weather Observing Data are collected instantly by using TCP/IP technology (GPRS,VSAT, ADSL). Synoptic and Aviation data are collected instantly by using web-based communication software (ADSL).The data collected at the stations are transmitted to operation center at the headquarters of TSMS in Ankara via GSM, satellite or ADSL. In unmanned stations data are directly transmitted from data collection unit (DCU) to the operation center while the data are transmitted to operation center after entering some data manually which can not be measured automatically. Data collected by DMI are:

- Air Temperature (daily max, min and average, hourly);
- Air Pressure (daily average, hourly);
- Air humidity (daily average);
- Cloudiness (daily average coverage);
- Rainfall amount (daily total amount);
- Evaporation (daily total amount);
- Evapotranspiration(daily total amount);
- Soil temperature (5,10,20,50 and 100 cm. depth) (daily average);
- Wind speed and direction (daily and hourly average, daily maximum wind speed, direction and time);
- Global solar radiation (cal/cm2 – hourly and daily total);
- Sunshine duration (hour – hourly and daily total);
- Snow depth (cm. daily);

- Precipitation type, intensity, and duration;
- Phenological data (collected on 250 stations).

Table 52: Observation stations operated by DMI in 2010

Type of observation stations	Number	Connected to WMO GTS	Comments on the network
Atmospheric domain			
Surface synoptic stations (> 8 obs./day)			
Manned stations	132	132	
AWS or AWOS	463	58	
-Cloud-height – automatic			
Agrometeorological stations	250		
Ordinary climate station (3 obs./d)	263	58	
Rainfall station (2 obs./d)			Not operational: 353 sts
Rainfall station – automatic			
Meteorological towers	0		
Upper air radio sond stations	8	8	
Pilot balloon stations	0		
SODAR/RASS	0		
Wind profiler stations	0		
Lidar	0		
Access to AMDAR data	no		
Weather radars	4		Only 3 operational
Hale radars	NA		
Lightning detection stations	0		
Lightning detection hub station	0		
Actinometrical stations	161		
Distrometer	5		
Satellite MSG ground station	1		
Maritime domain			
Marine weather stations	36		
Lake stations	2		
Buoys			
Buoys with meteorological observations			
Tidal stations			
Tidal stations with met. observations			
Environmental domain			
Air quality	7		
Water quality			
Nuclear deposition			
Ozone – near surface	7		
Ozone – upper air	1		
UV radiation	11		

Upper air soundings are essential input data for numerical weather prediction models. DMI has an upper air network composed of eight rawinsonde stations. This network was upgraded with GPS based ground receiving system in 2002. Two observations have been made at each station at 00:00 UTC and 12:00 UTC every day. Rawinsonde Stations are placed in: Ankara, Istanbul, Izmir, Diyarbakir, Erzurum, Samsun, Adana and Isparta. The network is capable of launching two different types of radiosonde from different manufacturers. The TEMP messages generated during the observations are transmitted to the center via ADSL or dial-up connection, and then transmitted to GTS network from the central communication server. Also, atmospheric profile data from ground to upper atmosphere with 1 hPa steps are generated, transmitted to centre and archived in a database. The upper air observations could be significantly improved by implementation of a wind profiler network, which would provide continuous data from the atmosphere, or/and by using the AMDAR data produced by airplane measurement system installed on commercial regular flights.

Weather radars are very powerful tools for aviation meteorology, tracking precipitation areas, to measure intensity of precipitation, flood forecasting and for short term weather forecasting (nowcasting). It will not be wrong to assert that weather radars, at least for today, are the only and essential instruments as active remote sensing systems which can provide real time (less than 15 minutes depending on the scanning strategy and processing features), accurate and high resolution (up to 150 m) weather information in large scale area (up to 500 km depending on the frequency used) particularly for nowcasting purposes. DMI has been operating a weather radar network of four (4) C-Band weather radars. The first radar of DMI was installed with dual polarization capability in Ankara in 2001. Then the network was formed by adding three weather radars in İstanbul, Balıkesir and Zonguldak in 2003. The project for installation of six (6) radars is still under implementation. It has been planned that the network will have 10 radars by 2011. In addition to the western part, north and south coasts of Turkey will be under coverage of radar network after the completion of that project. DMI has also planning to expand its network to cover whole country by adding new radars. Most probably DMI will be operating a weather radar network of almost twenty (20) radars within next decade. Currently, single and composite images are generated and archived from radar network. These products are available for the public in the web page of DMI. Weather radar network is controlled and operated by the radar operating center from Ankara, and the generations of the radar products and distributions of them to the users are performed from here. The prime communication media between radar sites and the operating center is satellite. The radio-link+terrestrial line is used as back-up of satellite system for the continuous operation of radar network.

DMI has a remote sensing division and has EUMETCAST and Metop/NOAA ground receiving stations. Satellite images are stored and disseminated through the DMI web pages, but used only for weather forecasting.

DMI sends data from quite many stations to WMO-GTS, as shown in Table 52.

8.3.1.2. <u>DSI observation network</u>

DSI has 710 precipitation stations, of which 357 are currently operational (452 in 2011) and 1176 discharge measurements stations (1117 in 2011). Additionally DSI operates 118 lake observation systems (120 in 2011), 150 snow stations (115 in 2011) and 1200 water quality (1000 in 2011) and sedimentation measurement stations (table 53). From those stations, hydrological and meteorological variables such as river flows, groundwater and lake water levels, sediment loads, water quality, amount of precipitation, and evaporations are collected and monitored. The data related to Turkey's ground and underground water sources (quantity and quality data) are centralized mostly via GSM, are quality controlled in terms of time, coherence and consistency and stored in the database. Currently DSI has access to the weather radar data, but DSI does not use the data to calculate precipitation or flood.

8.3.1.3. <u>Maintenance</u>

DMI has been able to recently modernize its calibration system, including a new wind tunnel for wind gauge calibrations. The Calibration Center of DMI works in accordance with TS EN ISO/IEC 17025:2005 standards and has been accredited since 30th of April, 2010 in the fields of temperature, relative humidity, pressure, wind speed. Other laboratories working in accordance with TS EN ISO/IEC 17025:2005 standards are the precipitation Laboratory and the solar Radiation Laboratory. However, as the whole calibration system is new it was not yet in full use in 2010. The strategy of calibration, including the frequency of calibration, of meteorological sensors is not yet defined. The strategy of selection and use of wind sensors is not yet decided. Anyway, as many of the stations are, and will be, located at sites with cold climate, it is necessary to take into account use of ice-free sensors, in order to ensure the quality of data (DMI has been mainly using cup anemometers in the network. There are a few ultra-sonic wind sensors which have been used for testing).

Table 53: Observation stations operated by DSI

Types of observation stations	Number		Connected to WMO GTS	Comments
	2010	2011		
Atmospheric domain				
Surface synoptic stations (> 8 obs./day)				
Manned stations				
AWS or AWOS				
-Cloud-height – automatic				
Agrometeorological stations				
Ordinary climate station (3 obs./d)				
Rainfall station (2 obs./d)	357		452	Not operational: 353 sts
Rainfall station – automatic				
Meteorological towers				
Upper air radio sond stations				
Pilot balloon stations				
SODAR/RASS				
Wind profiler stations				
Lidar				
Access to AMDAR data				
Weather radars				Only 3 operational
Hale radars				
Lightning detection stations				
Lightning detection hub station				
Actinometrical stations				
Distrometer				
Satellite MSG ground station				
Hydrological domain				
Hydrometric stations				
Discharge station – manual	1176	1117		
Discharge station – automatic				
Water level post – manual		120		lake gauge stations
Water level station – automatic				
Snow level gauges		115		
Water quality stations		1000		

8.3.1.4. Other observing networks

The General Directorate of the Electrical Power Resources Survey and Development Administration (EIE) has an observation network all over Turkey for hydrological data collection purposes. and collects: (i) water level on rivers and lakes, (ii) discharge measurements at Stream Gauging Station's(SGS), (iii) water equivalent of snow depth, (iv) sediment and (v) water quality. The data such as water level on rivers or lakes, discharges, snow depth, sediment and water quality sampling collected on the field are sent to the Administration Center in Ankara to be processed for quality control and validation. Only some Stream or Snow Gauging Stations are connected to EIE with GSM lines. Data is stored in a central database. Finally the data such as daily and monthly discharges, instantaneous peak discharges, lake level, snow-water equivalent, sediment and water quality of stations are published for general usage. EIE has a data catalogue, does not utilize remote sensed data or geographical data. EIE utilizes weather and climate data for just HEPP projects purposes. EIE does not utilize meteorological short-medium term forecasts. Mainly meteorological data, or sometimes hydrological data, during the engineering hydrology calculations of HEPP project are provided by other entities such as DSI and DMI. The data exchange follows official procedures ensuring free data exchange subordinated to copyright. Contrariwise, provision of data to third parties is prohibited. Actually, there is no regular data sharing with national organizations, neighboring countries or international organizations, but data sharing does not conflict with EIE's general policies.

8.3.2. Hydrometeorological data management systems

Historical hydrometeorological data is critical for hazard analyses, and planning and design within various economic sectors. In this regard, hydrometeorological data must be properly quality-ensured and stored in historical user-friendly digital databases. The DMI meteorological database includes following data:

- Climatological data (1926-Today);
- Ravinsonde data (1971-Today);
- Synoptic data(1980-Today);
- AWOS data (2003-Today);
- Aerodrome AWOS data (2003-Today);
- Metar data (03/2000-Today);
- Taf,Sigmet,Airmet data (2008-Today);
- Open Screen Observation Data (1999-Today);
- Sea Surface temperature data(Beginning– Today);
- Inversion analyze data (2006-Today);
- UV-B Data; From 1997 to Present;
- Ozon Data; From 1994 to Present;
- Precipitation Water Analyse Data; From 1999 to Present;
- Radar Data (2008 – Today);
- Satellite Data (2008 – Today);
- Model Data (2006 – Today).

Regarding validation and quality control, manual Climatological data are controlled by using Quality control software monthly. Automatic Weather Observing are controlled by using Quality control software and the human resources for quality control are 6. Synoptic and Aviation data are controlled by using Quality control software instantly.

For data management, data from 206 AWS are collected through a data Collection database that is MS SQL Server RDBMS and data from other 150 AWS are collected through ORACLE DB. All data are finally archived through a data archiving database, which is SYBASE RDBMS. These data include meteorological data (air temperature, air pressure, relative humidity, wind speed and direction, precipitation, solar duration and radiation, soil temperature) and meteorological information which are obtained from processed data. Archived data consist of ground level and various atmospheric level (standard atmospheric levels and significant levels in the atmosphere). Meteorological data are archived in relational database (Sybase ASE 15 and Informix 7.31 RDBMS). Data warehouse software (Sybase IQ15) is used to process meteorological data for production of meteorological information. Archived data are updated 20 - 22 days of every months after passing through data quality control system.

Turkey Meteorological Data Archiving and Management System (TUMAS) is the main repository of meteorological data at DMI. TUMAS uses Sybase RDBMS and MARS software which is used in ECMWF for achieve and retrieve data which are stored in different media (disk storage system, tape library). MARS software is installed in TUMAS and mainly works for archiving/retrieving data from/to disks or tapes. TUMAS has a web interface where all data are provided to internet users. Access to TUMAS is based on membership and provides access to achieved meteorological data http://tumas.dmi.gov.tr/wps/portal .

For example, DMI has an agreement with AFAD for providing data about extreme events. AFAD stores and uses this data internally for risk management and reduction. The feedback received from the users via Internet ensures the effectiveness of the dissemination mechanism. Moreover, in order to support the users of produced information, symposia are regularly organized in order to provide users with information about the products and about their use. Regional workshops are also organized for presenting the information products and collecting feedbacks. In the framework of the Ministry of Environment and Forestry it is planned to develop a WebGIS portal for the dissemination of geographical information, including DMI and DSI ones.

In TUMAS – mars section, all data is archived in bufr and grib format. Because MARS software does not support data except bufr or grib format.

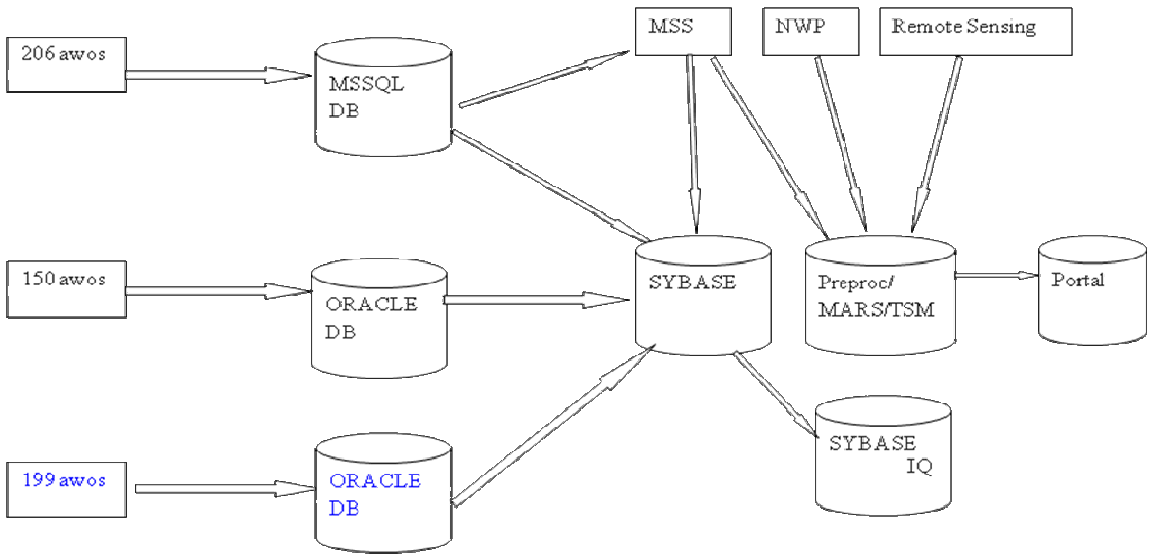


Figure 43. DMI data flow

The data dissemination through TUMAS implies some restrictions to users. Data are charged to private person and entities. Other users receive data free of charge by DMI data dissemination and exchange policy. Synoptic and Aviation data are shared via GTS with all WMO member countries in the framework of WMO Data Exchange Policy. DMI shares meteorological data with all related national organizations.

The data management facilities and computing power has significantly increased during the very last years. DMI has good computing resources for data management: HP DL380, HP ML370, HP LH6000R, IBM x3650, IBM x3755 and IBM p series P560. Disk space currently available: 11,6 TB SCSI and 11.8 TB SATA. The IBM TS3500 tape system capacity is 290 TB. for archiving all measurements and observations which are made by DMI.

The DSI hydrological database consists of precipitation and hydrological (discharge, water level from rivers and lakes, water quality) measurements. DSI has a big database in form of hard copy. Water database project has been started to produce a digital database. This database will also include water quality data.

Currently there is no common database of DMI and DSI data.

8.3.3. Hazard analysis and mapping to support risk assessment

Hydrometeorological hazard maps are required as basic information for flood risk assessment and consequent planning activities both at local and national level. According to current legislation and strategic planning, AFAD initiated the definition of risk assessment standards for the full spectrum of disasters. Moreover, AFAD is charged to develop risk assessment guidelines for local governments, which have launched risk assessment studies at local level.

AFAD collects data on flood events such as affected area for inventory studies. The data of past floods till 2009 were collected by General Directorate of Disaster Affairs (without spatial or geographic reference) and since 2009 are collected by joint investigations based on a proper protocol with DSI. Moreover some flood information is received from local governors. Flood extent is collected only since 2009. This data are centralized and archived in a database (up to 2009 the National Disaster Inventory System), which is mainly designed for impact data. The database contains physical information about the flood only since 2009. Even if AFAD receives meteorological data and data about meteorological extreme events from DMI and hydrological data from DSI, this data is not associated to the floods events in the databases. This data till now have not been used for floods mapping. As stated above, in the coming years all disaster related institutions would share their data with AFAD by a legal arrangement to analyze the risks. Then AFAD will keep and evaluate data that will come from all related institutions. A multihazard database should be developed for this purpose.

At AFAD, analysis on hazard data is generally limited to earthquakes. Concerning floods, hazard maps have been prepared for West Black Sea Region only (floods of 2010, maps produced by DSI). Flood analysis is made according to the event, the extent of the flooded area, the number of the affected buildings and the number of victims. Starting from 2011 AFAD and DSI should start the activities on flood data collection and hazard mapping on a systematic way. Actually AFAD didn’t produce any flood risk information, because it is a new organization and it is in the phase of the determination of the procedures, standards and methodologies. Concerning the risk information dissemination, AFAD’s primary stakeholders are city Governorates. So, AFAD will provide guidelines and technical support to local authorities and will receive back the local risk assessments. AFAD has technical capacities in GIS and databases development and management (Department of Data Processing).

AFAD collects floods impact data. AFAD has two different databases for hazards. The first is the National Disaster Inventory System (developed by the Turkey National Disaster Archive Project – TUAA - former General Directorate of Disaster Affairs). This database has been developed according to the EM-DAT criteria. Concerning floods, this database includes (i) date and place of the event, (ii) affected area, (iii) affected buildings, and (iv) affected people (number of dead, number of injured people). This database doesn’t have geographic references, except the name of the locality. The other database is the one archiving the data that is being collected since 2009 in collaboration with DSI, which has also geographic reference. This database contains many information related to the recent floods of the black sea region occurred in September 2010. AFAD uses this data to determine the country-level strategy for disaster and emergency situations.

DMI collects meteorological and climatological data, which are useful for drought characterization and mapping. DMI collects also phenological data on 250 stations. This data are stored in a database and could be used as drought indicators. On the basis of this data DMI analyses the meteorological extreme events in terms of frequency, intensity and distribution of the occurrences. Meteorological drought is analyzed using rainfall and drought indexes. DMI produces Standardized Precipitation Index, Percentage of Normal Index and climatic classifications using the Aydeniz Method. DMI analyses the extreme meteorological events in terms of frequency, distribution, intensity and return periods of the occurrences. Trends of precipitation, temperature and growing season length have also been analyzed. DMI also produces climate extreme indices by using RClimDex software. The Agrometeorological Division of DMI has the following analysis tools (also available on-line):

- Frost forecast and warnings for agriculture, including a warning dissemination system through SMS;
- Harvest time forecasting programme, producing i) forecasted harvest time, ii) current cumulative temperature, iii) long-term average cumulative temperature and iv) long-term average harvest time;
- Wheat forecasting yield (Agrometshell run by TAGEM).

DMI has GIS expertise (ArcGIS and Q-GIS) and organizes GIS training courses for WMO member countries of the VI region (connected to the FFGS project in the Research Division). DMI does not have a real geodatabase, but a centralized geographic layers archive. DMI produces maps of meteorological drought using drought indexes and frequency analysis. DMI has an agreement with the Ministry of Agriculture for producing Palmer drought index for the identification of the drought prone areas (meteorologically). DMI does not integrate any other non-meteorological information. Further analyses on drought are performed by the Ministry of Agriculture.

DSI performs hydrological analysis using its own hydrological data and meteorological data provided by DMI. DSI (through its Provincial directorates) collects floods severity and extent information, which is stored at DSI and also shared with AFAD. This information is mainly used for calibration of flood models. DSI keeps a database, which has records on river floods and flash floods. The DSI hazard database consists of data since 1954. DSI produced in the past maps of floods prone areas, which are still used by AFAD and City Governorates. For the inundations of September 2010 in the Black Sea region, DSI produced detailed floods maps. For some other small basins DSI has modeled the floods with HECRas Model in order to identify the potential water level for different returns periods. Currently, DSI is launching an initiative for the implementation of flood hazard mapping on 3 pilot regions. In perspective this maps should cover the whole country and be the basis for floods risk assessment. Concerning hydrological drought, DSI calculates the water balance region by region (average values and deviation) using precipitation, streams and surface water, in order to assess the water needs and eventually plan water retention or inter-basin water transfer infrastructures.

TUGEM collects and records all kinds of data that can affect plant growth on drought events like meteorological and precipitation data, phenological observations, agricultural production information. There are no protocols for hazard data management or for sharing data between the organizations. TUGEM collects some drought/floods impact data on agriculture from the Provincial Divisions, but they are mainly organized in forms and not as a database of events. Monthly syntheses per province are included also in the Monitoring and Early Warning Forecasts committee reports. Committees have been working for 2 years and the monthly reports are available. TUGEM, in the framework of the Risk Evaluation Committee, produces drought maps. TUGEM uses seasonal or monthly climate forecasts (downscaled ECMWF) from DMI for preparing the monitoring and risk evaluation reports. TUGEM analyses meteorological data and water capacity of dams for irrigation in risk assessment reports. TUGEM has not GIS specialists but relies on TAGEM specialists for analysis of water sufficiency index and remote sensed vegetation monitoring.

TAGEM generally collects vegetation data for cereals and legumes together with rainfall, temperature and humidity at monthly bases. TAGEM has GIS capacities and uses NDVI for vegetation monitoring. TAGEM has not yet established any methodology for agricultural drought risk assessment but its GIS & RS department should be responsible for this kind of analysis. The department produces for TUGEM and the TAKEP drought indices, vegetation indexes using GIS and remote sensed images for vegetation monitoring. TAGEM runs also the AgrometShell crop simulation model in the framework of a FAO project, which involves also DMI. Wheat yields are forecasted monthly starting from April.

At EIE annual instantaneous peak discharge values of SGS's are available, but EIE does not have any products such as hazard mapping, indices or risk mapping. EIE has produced floods analyses have been done only for HEPP projects. The performed analyses are: frequency analysis (2,5,10, 25, 50 100, 500, 1000, 10000 year-return period of discharge) and discharge of dams spillway. These analyses have been developed using mainly MS-excel and EIE does not have any numerical hydrological/hydraulic model.

8.3.4. Forecasting

8.3.4.1. Weather forecasts

DMI has quite good weather forecasting system based on use of numerical weather prediction (NWP) models. Weather forecasts are published for 1-5 days and disseminated to media and through the DMI web pages. Now casting are not produced operationally as there is not a sufficient weather radar network available.

DMI operates several NWP models: MM5, an open code model from NCAR and Penn State University (USA), and ALARO (ALADIN consortium). The horizontal resolution (mesh size) of MM5 is 13,5 km and 4,5 km consequently. The MM5 and ALARO are run 4 times daily, with boundaries from ECMWF and ARPEGE (MeteoFrance), which are used to forecast 0-72 h. The ARPEGE model has been developed jointly by Météo-France, and the European Centre for Medium-range Weather Forecasts (ECMWF) under the acronyms ARPEGE and IFS (integrated forecast system). This model includes, inter alia, an atmospheric general circulation model (GCM) which is intended by the French climate modelling community to be used for studying the anthropogenic climate impact. A preliminary version of this model has been available since 1992. DMI does not use data assimilation in its models.

Figure 44. Area modelled by the ALADIN NWP model - 4.5 km horizontal resolution

DMI has purchased a supercomputer system in 2009 and installation was completed by the end of 2009. The system consists of a SGI Altix 4700 (having 512 Intel-Itanium cpus and 1 TB memory.), 30 TB disk space for NWP model runs and more than 25 TB disk space and several smaller service and management servers.

Various software, including Metview-4 from ECMWF, are used for visualization of NWP data.

8.3.4.2. Hydrological forecasts

DSI does not run any hydrological models. Currently DSI does not produce numerical forecasts. However, DSI provides tailored hydrological services for different sectors. In hydropower sector the efficiency of the power plants could be improved if better hydrometeorological services could be provided.

However R&D projects are currently being implemented in tis area. In the context of flood monitoring and early warning system, DMI carries out the project, “Capacity Improvement For Flood Forecasting And Flood Control in the TR-BG CBC Region”, on EU funds. Hydrometric and meteorological stations in both Turkish and Bulgarian territories have been installed and a flood model has been set up and initiated. Thanks to this model, a flood can be forecasted 57 hours in advance. Another relevant project developed by DMI and DSI is the “Development and Implementation of International and Regional Flash Flood Guidance and Early Warning Systems in the Black Sea and Middle East Regions”. The project is implemented in collaboration with WMO, HRC, NOAA and USAID as main donor agency. In this framework discharge models will be applied in 2 pilot basins. The flash flood system functions at one level as a disaster mitigation tool by mitigating loss of life and injuries, and by rapidly targeting disaster response agencies to potential problem areas. On another level it can be used to provide maps of flash flood probabilities. These maps can be used to provide a risk assessment tool for spatial planning and guidance for planning flash floods prevention measures. Two pilot basins will be modeled using discharge 2 dimension models calibrated using information about past floods. Then the models will be used for the characterization of the basin in probability classes of flood occurrence under different return periods. This flood hazard maps would be used for the flood risk assessment by local authorities and AFAD by overlying the exposure maps (infrastructures, assets, etc.) that in the meanwhile Municipalities should have prepared.

8.3.4.3. Marine Environmental and Special weather forecasts

Daily 24 h marine forecasts (gale, weather, wind, wave and visibility) are produced for 6 h intervals for following areas: East Black Sea, West Black sea, Marmara, North Agean, South Aegean, West Mediterranean and East Mediterranean. DMI uses the METU-3 model, linked to the ECMWF model, for wave modelling.

For prediction of dispersion of airborne pollutants DMI has the capability to operate the DREAM model, linked to the NCEP weather prediction model. DSI is a partner in an EU twinning project for Buyuk Menderes River, to model dispersion of waterborne pollution and water quality.

DMI produces specialized weather forecasts to several sectors: agriculture, road transport (2/day), water transport (2/day), air transport, tourism, energy production (1/day), water management and fire brigades (1/day). However, e.g. the services for road transport and energy are quite limited compared e.g. to products provided by advanced EU NHMS, which partially depends on lack of good coverage of weather radars, lightning detection network and lower number of on-line weather stations. There is potential to enhance commercial scientific services to all sectors. In order to promote cooperation with different economic sectors it is necessary to enhance R&D activities and cooperation with high-tech EU companies and NMHSs and to implement state-of-the-art analyzing, production and dissemination tools.

8.3.5. Warning products and services

8.3.5.1. Warnings and mandates

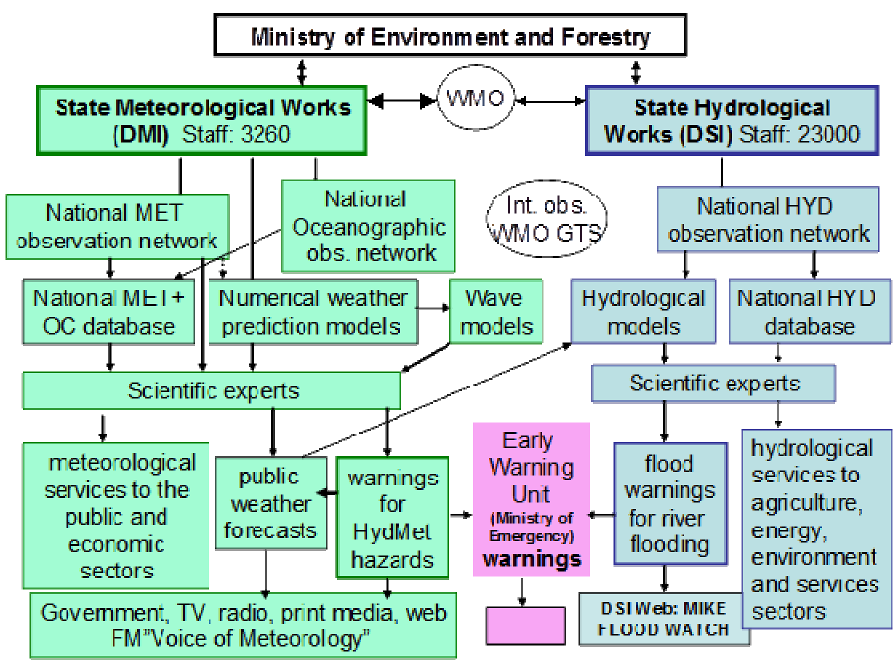


Figure 45. Production of hydrometeorological warnings in Turkey

In Turkey science based warnings for hydrometeorological events are given separately by DMI and DSI. The DMI warnings are based on numerical weather predictions from global models run by international centers, and local scale NWP models run by the DMI numerical center, real time satellite information and meteorological observations. DSI does not operate numerical models, and does not have access to the DMI NWP products. Additionally the new 112 system will obviously become one additional body for preparing and dissemination of warnings. However, currently the 112 system does not have any expertise in meteorology or hydrology.

Table 54: Warnings for natural and technical hazards in Turkey based on Annex 2

Hazard	Exists in the country	Warning by	Type
Heavy precipitation	Yes	DMI	I
Flash floods	Yes		
River flooding	Yes	DSI	I
Coastal Flooding	Yes		
Hailstorm	Yes	DMI	I
Thunderstorm or lightning	Yes	DMI	I
Heavy snow	Yes	DMI	
Freezing rain	Yes	DMI	
Dense fog	Yes	DMI	I
Tornado or cyclone	No		
Strong wind	Yes	DMI	I
Storm surge	Yes		
Heatwave	Yes	DMI	I
Cold wave	Yes	DMI	I
Drought	Yes		
Marine hazard	Yes		
Sandstorm	Yes	DMI	I
Landslide or mudslide	Yes		
Avalanche	No		
Airborne hazardous substance	Yes		
Waterborne hazards	Yes		
Hydrometeorological hazards for aviation	Yes	DMI	I
Forest or wildland fire	Yes	DMI	I
Smoke, dust or haze	Yes		
Earthquakes	Yes		
Tsunamis	No		
Volcanic events	No		
Dispersion of insect pests	Yes		
Hazard for allergic reactions	Yes		

There is certain cooperation and data exchange in production of hydrometeorological warnings by DMI and DSI, as shown in figure 45. However, currently the level of coordination between activities of DSI and DMI is not sufficient and due to lack of an active cooperation among hydrologists, meteorologists and disaster managers, early warning for hydro meteorological disasters especially for floods cannot be implemented properly.

As seen from table 54, there are many hazards related to meteorology and hydrology for which no warnings are currently given, flash flood being the most significant. However, warning for heavy precipitation issued by DMI may also include warning of potential flash flood. In order to promote flash flood forecasting and warning DMI is member of a recently started regional Flash Flood Warning System project financed by USAID and led by Hydrology Research Center, USA. The warning system will be based on analysis of satellite data, DMI NWP models and real-time precipitation data from the DMI observation network. There is a flood warning systems under preparation for 2 regions (Istanbul region).

8.3.5.2. Warning dissemination mechanism

Currently part of the warnings are disseminated directly to end-users, partly through authorities. The 112 center is still not fully operational. DMI disseminates warnings using media, SMSs to phones in hazardous region, internet and own radio station. DMI has an own 24/7 radio station which provides weather forecasts hourly, and warnings when needed (in Ankara FM 92.4 MHz, in Istanbul 103 MHz). DSI does not disseminate their results through media, but to the DSI regional directorates, who then warn the local city governors if needed. It also issues warnings on its own intranet pages: MIKE FLOOD WATCH.

8.3.6. Information Technology and Telecommunication capacities

Quick reliable communication system is critical for collection of data, data sharing and dissemination of products and warnings. Internet has become a very important tool among advanced NMHS to disseminate information and warnings.

Equipment in use at DMI and DSI for data communication and products and warning dissemination is described in Table 55. The public switched telephone network (PSTN) is the network of the world's public circuit-switched telephone networks. It consists of telephone lines, fiber optic cables, microwave transmission links, cellular networks, communications satellites, and undersea telephone cables all inter-connected by switching centers which allows any telephone in the world to communicate with any other.

Table 55: Equipment in use for data communication and warnings and other products dissemination

Telecommunication equipment	To receive data	To send data	To send warnings	To send products
Telephone				
Mobile Phone				
SMS			DMI	
GPRS	DMI			
PSTN	DMI			
Telefax				
Dedicated Leased Lines				
UHF radio transceiver				
High frequency/Single side band radio				
HF Radio Email				
Aeronautical Fixed Telecommunication Network				
Very Small Aperture Terminal				
Data Collection Platforms used to transmit data from AWSs				
Global Telecommunication system (WMO-GTS)				
Meteosat Second Generation Satellite system				
Other satellite systems				
Internet	DMI		DMI	
Email				
Post/mail				
Print media				
TV –national				
TV-commercial				
Radio			DMI	
Bulletins				
Printed text				
Manual collection	DMI			

8.3.7. Climate change analysis

Two different regional climate models have been run by DMI. These are RegCM3 of the International Centre for Theoretical Physics (ICTP) and PRECIS of Hadley Centre of the UK Met Office. IPCC-SRES A2 and B1 scenarios of ECHAM5 global model outputs were completed for 1961-1961(RF) and 2001-2099 period by using RegCM3 in 27 km resolution. The other global model, Hadam3P, output A2 and B2 were completed for 1961-1990 and 2071-2100 period by using PRECIS in 25 km resolution. Whole regional climate model studies and result will be shared on Eastern Mediterranean Climate Centre web page for benefits of neighboring countries. It can be expected that also SEE countries could significantly benefit from the Eastern Mediterranean Climate Centre (EMCC), which was established in 2009 by the Turkish State Meteorological Service in coordination with WMO.

8.3.8. Human resources

DMI has quite large staff compared to advance EU NHMSs: 3260 people (10% women, 90% men). 12 people are involved in operational numerical weather prediction (NWP) models. This together with the number of main computer experts allows a 24/7 NWP operation. DMI has relatively good IT staffing: 8 main computer experts, 8 helpdesk experts, 10 database experts, 6 QC experts and 20 software experts working mainly with internet, NWP and other similar products. The IT sector is operational 24/7.

DSI has about 23000 staff, of which 2500 with academic degree. About 20% of the staff are women. DSI uses about 10% of the national research budget.

DMİ has been serving as WMO RA VI Regional Training Center since 2001. During the past 10 years, tens of courses and workshops have been done such as telecommunications, satellite meteorology, climate indices, regional climate model, weather radar, AWOS, Agricultural Meteorology, NWP studies, and climatological applications and hundreds of participants have been benefited from these courses. These capacity building studies are contributing enhanced social and economic resilience and decision making in many climate-sensitive sectors such as water, agriculture, fisheries, health, forestry, transport, tourism, energy and disaster risk management in neighboring countries and their sustainable development.

Taking into account the increasing cooperation with the commercial sector and growing demands from the DRR and for international cooperation and participation in R&D projects it is vital to take these into account in the training program for scientific experts, mid management and top management.

DSI has a training center on Sedimentation, which gives training for technicians and scientists. This center will become UNESCO Category II Center.

There is a need to promote the DSI training program to include topics relevant to the DRR and cooperation with the different socio-economic sectors.

8.3.9. International and Regional Cooperation

Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale state-of-the-art numerical weather prediction models, use of satellite data and sharing of data from conventional and modern remote sensing systems. Regional, local and mesoscale numerical weather prediction models are developed by international consortiums, to which membership provides better and more services than to non-members.

EU based hydrometeorological organizations provide most state-of-the-art models, software and tools to be utilized by the member NHMSs. The European NHMSs have globally an unique opportunity to benefit from the stat-of-the -art weather forecast modelling, medium-range weather forecast products at 16 km horizontal resolution (in near future at 8 km resolution) including the Extreme Forecast Index (EFI), re-analyzing data to be used e.g. for climatological studies and the ECMWF super computer resources. EUMETNET provides cooperation with most advanced NHMSs; harmonization of observation and production of services; support to implementation of new technologies through joint projects, verification and exchange of experiences; and low membership fee.

European Union research and networking programs create consortiums of excellence, and provides good opportunities to NMHS to network with NMHSs and commercial R&D companies and strengthen their capacities.

DMI participates actively in international cooperation and a member of several organizations and initiatives as shown in Table 56. The international activity of DSI is at much lower level. DSI participates in cooperation with JICA in the Seyhan River project on Flood Control and Early Warning System.

Table 56: International and regional cooperation activities of DMI and DSI

International and regional organization and cooperation mechanisms	DMI status	DSI status
WMO	member	Hydrological advisor
WMO RAVI	member	no
IOC	member	
ICAO	member	no
UNDP	cooperation	some cooperation
UN ISDR	cooperation	some cooperation
EUMETSAT	member	no
ECMWF	member	no
EUMETNET	no	no
METEOALARM	no	no
ECOMET	member	
EUFP7 projects, networks		
EU JRC		
EFAS	no	
EU PHARE		
EU CARDS		yes
EUCLID	no	
EUR-OPA	member	
DMCSEE	member	no
SEEVCCC		no
DRRSEE	member	no
SAVA Commission	no	no
NWP consortium	ALADIN	no
NMHS bilateral		Bulgaria
NHMS MoU		

8.4. Technical recommendations to strengthen DMI and DSI capacities in support of DRR

Legal framework and institutional arrangements related to the role of NMHS in DRR

1. There is a need to better integrate the hydrological (DSI) and meteorological (DMI) sectors into the DRR planning process;
2. It would be vital to establish a 24/7 multihazard early warning center (center of excellence) at DMI through gathering experts from relevant institutions;

3. There are needs to clarify the mandates and communication routes for alerts, advisories, warnings and alarms to different levels all the way down to the grass root level (individual people) using state-of-the-art communication systems.

Operational relationships with other agencies

4. There is urgent need to promote cooperation between DMI, DSI and General directorate of Electric Power resources.

Monitoring and observations networks and data exchange;

5. There are urgent needs to enhance and modernize the weather radar network and produce real-time composite pictures of precipitation;
6. There is an urgent need to enhance the number of on-line stations in the meteorological, hydrological and maritime observation networks;
7. It would be vital to enhance the production and use upper air data by using wind profilers and/or AMDAR data.

Forecasting

8. There are needs to promote nowcasting and numerical mesoscale modelling;
9. There are needs to promote data assimilation in NWP modelling;
10. There are needs to promote seasonal forecasting;
11. There are urgent needs to implement hydrological models to be used over the country;
12. There are needs to promote assortment of numerical models (hydrological, dispersion of airborne pollutants, drift models, wave,..) and link them to the NWP models;
13. There are needs to promote the computer back-up system of NWM modelling;
14. There are to enhance investments in climate change modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors and investment plans of industry in order to promote economic development of the country.

Hydrometeorological data management systems

15. It is critical to establish a national hydrometeorological database;
16. There are needs to strengthen the data management capacity to promote data assimilation to be used in NWP modelling.

Hazard analysis and mapping to support risk assessment

17. There is an urgent need to establish a national combined hydrometeorological database;
18. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical hydrological and meteorological data and climate change projections to support risk assessment;
19. There is a need for strengthening the collaboration amongst AFAD, DMI and DSI in order to improve the risk assessment capacities end the quality of products provided by different institutions;
20. There is a need for a comprehensive methodology for flood risk assessment, including the specifications of information to be provided by relevant institutions, the characteristics of hazard database, containing not only impacts but also physical dimensions of the hazard, etc.;
21. There is a need to better define the institutional framework for drought risk assessment, with clear share of roles and responsibilities amongst different institutions and gathering the analysis of different aspects of drought under the coordination of AFAD;
22. There is a need of training DMI experts of Agrometeorological Division in remote sensing applications.

Information technology and telecommunication issues

23. There is a need to modernize the data communication systems to a level of advanced EUMETNET NHMSs.

Warning products and services

24. There is an urgent need to establish a warning system for floods and flash floods;
25. There are needs to enhance drought warnings;
26. Implementation of the METEOALARM system would promote dissemination of warning information.

Climate change analysis

27. There is a need to develop the technical capacities for climate change projections downscaling to local scales;
28. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors in order to promote adaptation to climate change.

Human Resources

29. There is a need to ensure the adequate human resources for DMI to have the capacity to manage the operational and DRR tasks;
30. There is a need to enhance the human resources in the IT sector.

Regional cooperation

31. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
32. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;
33. To improve their forecasting capacities, SEE countries should increase their cooperation with global, regional and specialized Centres (eg ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
34. A regional harmonization of watch and warning systems should be promoted;
35. Cross-border exchanges of real-time data, forecasts and warnings should be increased;
36. There is the opportunity to strengthen regional collaboration through the exploitation of DMI capacities, resources and facilities for training of experts from NMHS of SEE countries.

8.5. Recommendations from the Turkey National Policy Dialogue

Based on the detailed assessments of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries to support DRR, policy recommendations were developed. Initial results were presented to national stakeholders for review and discussions during National Policy Dialogues organised by WMO together with the UNDP in Ankara, 11-12 October 2010. During this meeting, high-level participants endorsed the assessment, as well as the set of recommendations emanating from it and presented hereunder.

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation

Recommendation 1: To improve and strengthen national and local government mechanisms to institutionalize lessons learned from previous disasters and incorporate them into DRR policy, planning and programming in Turkey.

Recommendation 2: To facilitate and support establishment of mirrored/similar/same mechanisms at the county and local self-government levels through strengthening and reinforcing local capacities, institutions, and governance capabilities.

Recommendation 3: To establish a “National Platform for Disaster Risk Reduction”.

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning

Recommendation 4: To establish and invest in fully operational 24/7 hydro-meteorological services (technical and human resources) as well as in the seismological sector to support risk assessment and early warning systems and promote operational monitoring, warning, forecasting and mapping of meteorological, hydrological and seismological hazards.

Recommendation 5: To prescribe a new law for hydro-meteorological services in Turkey.

Recommendation 6: To create appropriate mechanisms to increase coordination between the three hydro-meteorological organizations as a short term action.

Recommendation 7: To strengthen technical and human resources of the Meteorological, Hydrological, and Seismological Services in operational monitoring, warning, forecasting and mapping of seismological, hydrological, meteorological and ecological risks, and also enhance the modernization and improvement of the monitoring networks and data transmission systems.

Recommendation 8: To enhance the early warning system and interoperability of the System 112 through modernization of the continuous and real-time collection and information sharing by expanding the hydrological, meteorological and air-quality monitoring networks, establishing integrated fire-protection system and ensuring functional horizontal and vertical links among all disaster risk reduction actors.

Recommendation 9: To further strengthen operational cooperation of the Disaster and Emergency Management Presidency, Hydrological and Meteorological Services through joint training and improvements to the standard operating procedures across agencies linked to the different threat levels and lessons learnt from each disaster event.

Recommendation 10: To integrate policy, planning and programming in adaptation to climate change with DRR strategy.

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Recommendation 11: To integrate DRR into the education system in Turkey at all levels –primary, secondary, and university.

Recommendation 12: To increase the awareness of the citizens and media regarding the early warning system and the European Emergency Number 112.

Recommendation 13: The Ministry for National Education is mandated to mainstream disaster risk reduction into national educational curriculum by establishing Curriculum Revision Working Group composed of the representatives from the Ministry for National Education and Sport, from the Disaster and Emergency Management Presidency Meteorological and HydrologicalService, Universities, other respective line Ministries, the Turkish Red Crescent Society, expert organizations and individuals.

Recommendation 14: To establish a National Training Centre for DRR and disaster and emergency management practitioners and community members, using the existing European Natural Disaster Training Center (AFEM) and/or Disaster and Emergency Training Center at DEMP as a foundation.

Recommendation 15: To proceed with the establishment, in Turkey, of the Centre of Excellence for a Training of Fire Fighters and coordination of response to forest fires in the countries of South Eastern Europe, including the harmonization of the development of fire-fighting brigades in the countries of the region through standardization of equipment and procedures, thus promoting regional cooperation and collaboration in disaster risk reduction in South Eastern Europe.

HFA priority 4: Reduce the underlying risk factors

Recommendation 16: To systematically integrate measures aimed at reducing disaster risks into policies, plans and programs for sustainable development and poverty reduction.

Recommendation 17: To support the development of studies and research around the reduction of specific risk factors that affect Turkey.

Recommendation 18: To develop national capacities for climate (hydrological and meteorological) and geological (including seismological) services to support medium and long-term sectoral planning, as a critical aspect of disaster risk reduction.

Recommendation 19: Enhanced investments are needed in climate data rescue, climate and geological modelling, forecasting and analysis to support sectoral planning in at-risk sectors.

Recommendation 20: To improve networking with international institutions present in the region and to promote the increased involvement of such organizations in the strengthening of DRR in Turkey.

Recommendation 21: To develop national capacities for climate services to support medium and long-term sectoral planning through strong collaboration and cooperation across line ministries and with the Meteorological and Hydrological Service, and through enhanced regional cooperation with other South Eastern European and EU countries.

Recommendation 22: To enhance investments in climate modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors.

Recommendation 23: To develop the disaster risk reduction Strategy and corresponding Implementation/Action Plan as a first mutual step undertaken by the key disaster risk reduction actors, e.g. the Disaster and Emergency Management Presidency, the Hydrological and Meteorological Service, seismological observations and survey, line Ministries and respective public enterprises, the Turkish State Meteorological Service, civil society and business community toward integration of disaster risk reduction into the development policies, strategies and sectoral plans, followed with the implementation of the said Strategy.

HFA priority 5: Strengthen disaster preparedness for effective response at all levels

Recommendation 24: To strengthen disaster preparedness for effective emergency response at all levels and to promote disaster prevention in Turkey.

Recommendation 25: To promote the engagement of the media in order to stimulate a culture of preparedness and strong community involvement through sustained public education campaigns and public consultations at all levels of society.

Recommendation 26: To increase the involvement of the private sector in activities aimed at DRR with special emphasis placed on insurance companies for the purpose of building on achievements already made in promoting public private partnerships (PPP) to better engage the private sector in DRR activities.

Recommendation 27: To strengthen regional and international links to support more effective wild fire risk preparedness and prevention in Turkey.

Recommendation 28: To increase the use of simulation exercises (including drills, orientations, functional and table-top exercises) as a regular feature of emergency response and preparedness training in Turkey.

Recommendation 29: To proceed with the establishment, in Turkey, a “National Exercise Simulation Center” (NESC) at DEMP Headquarters.

9. CHAPTER NINE: REGIONAL COOPERATION IN METEOROLOGY, HYDROLOGY AND CLIMATE TO SUPPORT MULTI-HAZARD EARLY WARNING SYSTEMS AND RISK ASSESSMENT IN SOUTH EAST EUROPE

Even though the South East Europe (SEE) region is highly diverse in terms of geography and climate, countries of Western Balkans and Turkey are exposed to a range of similar disasters caused by the impacts of hydro-meteorological hazards. Development of Risk Assessment, Multi-Hazard Early Warning Systems (MHEWS) and other capacities to support disaster risk management and reduction could significantly benefit from regional coordination and cooperation, leveraging expertise, capacities, resources and information across the region among SEE countries and with various regional centers in Europe.

Within the European Commission (EC) Directorate General for Enlargement funded “Regional Programme on Disaster Risk Reduction in South East Europe” implemented jointly by WMO and UNDP, Activity 1.4 on “Regional Cooperation Roadmap” aimed to identify areas and opportunities for the strengthening of regional collaboration in hydrometeorology to strengthen Disaster Risk Reduction (DRR) in SEE. In this regard, this chapter which was developed through extensive consultations with the SEE countries and regional stakeholders, identifies the common challenges faced by SEE countries to strengthen their DRR capacities and specifically faced by the NMHSs to support DRR through risk assessment and early warning systems. It also provides a mapping of the existing cooperation mechanisms in South East Europe and the greater European Union, and identifies opportunities and challenges to strengthen SEE regional cooperation mechanisms to support risk assessment and Multi Hazard Early Warning Systems, as well as the specific areas requiring further regional cooperation in Disaster Risk Reduction.

9.1. Benefits of regional cooperation in meteorology, hydrology and climate to support DRR

As mentioned in Chapter One, availability of meteorological, hydrological and climate products and services is critical for an effective implementation of a comprehensive disaster risk management founded on HFA, encompassing risk assessment and the development of risk reduction and risk transfer mechanisms. NMHS have vital contributions to make to support informed decision-making within a comprehensive strategy for reducing the impacts of disasters caused by natural hazards. Development of Risk Assessment, Multi-Hazard Early Warning Systems (MHEWS) and other capacities to support disaster risk management and reduction could significantly benefit from improved regional coordination and cooperation in meteorology, hydrology and climate, leveraging expertise, capacities, resources and information across the region among SEE countries and with various regional centers in Europe, particularly in the following areas:

- **Operational regional and international cooperation in weather forecasting and hazard prediction:** Successful operation of NMHS is based on international cooperation. Weather forecasts and forecasting of natural hazards are based on products from global and regional scale numerical weather prediction models, use of satellite data and sharing of data. The European NHMSs have globally an unique opportunity to benefit from the state-of-the-art weather forecast modelling, medium-range weather forecast products and the super computer resources. Regional cooperation among all providers of hydrometeorological services and improved data production and data sharing will significantly benefit the quality of weather forecasting and production of early warning services at European and regional levels and in each SEE country.
- **Sharing of methodologies and good practices, leveraging expertise for the development/strengthening of risk assessment and MHEWS:** Development of risk assessment, MHEWS and other capacities could benefit from regional cooperation through the development and sharing of common methodologies and good practices that are adapted to the specificities and capacities of the SEE countries.

- **Addressing cross-border hazards:** Hazards that constitute the most significant risk to the SEE region, such as flood, forest fires or droughts, are often trans-boundary. Addressing these risks efficiently would require regional cooperation for the harmonization of methodologies, the adoption of common standards and the exchange of data and information related to hazard monitoring, forecasting and warning among the countries sharing the same river basin, forest or agriculture plain.
- **Developing regional climate products and services:** Climate change and its potential impacts have boosted social demands for tailored climate services. Climate research and operation requires huge amounts of resources in terms of computer power, model research and know-how, IT expertise as well as interpretation capabilities. Therefore, regional cooperation offers excellent opportunities for networking by pooling certain capacities of the NMHSs and other institutes in a region to develop products such as regional climate analyses as well as seasonal and climate forecasting. Over the years WMO has facilitated the establishment of the Regional Climate Outlook Forums (RCOF) as multi-stakeholder mechanisms engaging national, regional and international climate experts, sectoral practitioners and policy makers. Through an interactive process, RCOFs and associated Regional Climate User Forums (i) develop consensus regional climate outlooks, (ii) identify the requirements for regional climate information products and services, and (iii) foster multi-disciplinary sectoral cooperation to improve the quality of climate information products and services.
- **Cost-saving through regional cooperation:** Finally, regional cooperation to strengthen NMHSs capacities will also bring significant financial savings. As an outcome of the SEEDRMAP initial studies conducted in 2007, it was revealed that the strengthening of SEE NMHSs capacities through regional cooperation and coordination would cost 30% less compared to a stand-alone solution (the modernization plan was estimated at 63.2 million € with regional cooperation and 90.3 million € without).

9.2. Methodological approach to develop a regional cooperation roadmap in MHEWS and risk assessment for South East Europe

One of the key outputs of this “Regional Programme on Disaster Risk Reduction in South East Europe” is the development of a regional cooperation roadmap laying out the areas in disaster risk reduction and hydro-meteorological issues that require regional cooperation (Activity 1.4). Building on the outcomes of the National Policy Dialogues (Activity 1.1), MHEWS Training Workshop (Activity 1.3) and Flood and Drought Risk Assessment National Capacities assessments (Activity 2), the regional cooperation roadmap for strengthening Meteorology, Hydrology and Climate Services for Disaster Risk Management has been developed through the following process (Figure 47):

1. Areas in DRR and Meteorological, Hydrological and Climate-related issues that require regional cooperation have been identified based on outcomes of consultations with IPA beneficiaries during the national assessments and the National Policy Dialogues;
2. A workshop on “Regional cooperation in MHEWS and risk assessment in SEE” was held with (sub-)regional agencies and technical centres supporting DRR in Europe and South East Europe to identify opportunities for further strengthening regional cooperation projects and activities (16-17 February 2011, WMO Geneva);
3. A Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management, with Directors of NMHSs and DRM agencies (28-29 March 2011, Sarajevo, Bosnia and Herzegovina) to finalise the draft regional cooperation roadmap; and
4. A Regional Conference on Coordination and Cooperation in the field of disaster risk reduction in the region organised by UNDP on 11-13 September 2011 to endorse the regional road-map proposal prepared by UNDP and WMO in consultation with beneficiaries and regional partners.

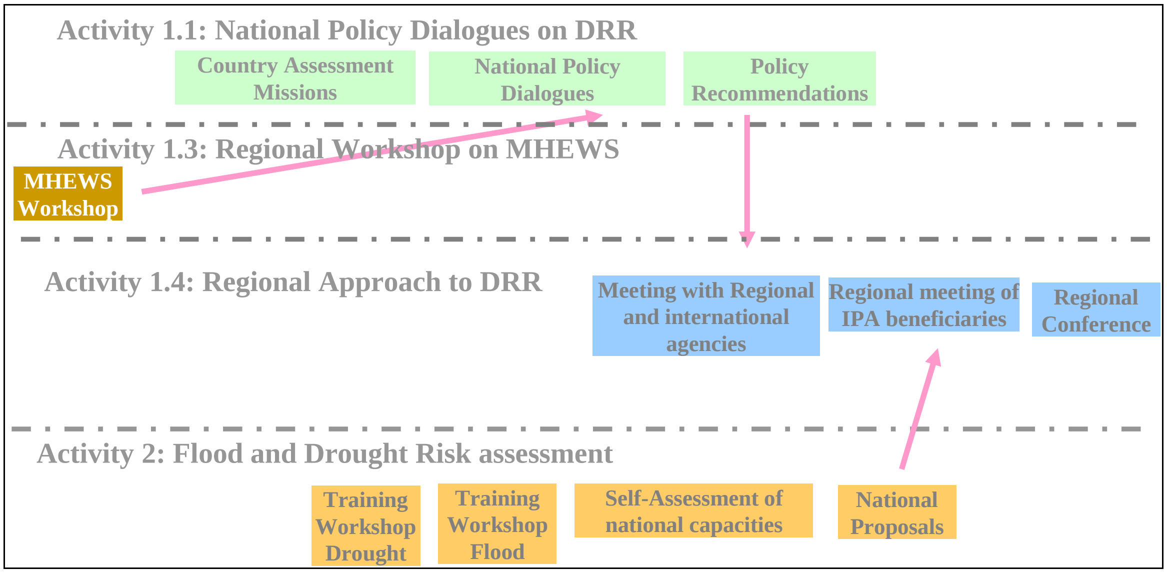


Figure 46. Methodological approach to develop a regional cooperation roadmap in MHEWS and risk assessment in SEE

9.3. Common needs and challenges of SEE countries to strengthen their DRR capacities

9.3.1. Outcomes of the National Policy Dialogues

As mentioned in Chapters 2-9, National Policy Dialogues on DRR have been organized in each IPA beneficiary, where policy recommendations were discussed and endorsed at national level. A detailed analysis of these recommendations is provided in Annex 4, which demonstrates that SEE countries are sharing common needs and challenges to strengthen their DRR capacities, particularly with respect to meteorological, hydrological and climate related issues. These common challenges and needs are highlighted in the following table 57.

9.3.2. Outcomes of the assessment of the capacities of the NMHSs to support DRR in SEE

The detailed assessments of the DRR framework and institutional and technical capacities of the NMHSs of the SEE countries to support DRR presented in Chapter 2-9 have led to the development of technical recommendations to strengthen the NMHSs capacities. A detailed analysis of these technical recommendations is provided in Annex 5, which demonstrates that SEE countries are sharing common needs and challenges to strengthen these capacities to support DRR. These common challenges and needs are highlighted in table 58.

Table 57: Common needs and challenges of the NMHSs of SEE to support DRR emerging from the NPDs

COMMON NEEDS AND CHALLENGES OF THE NMHSs OF SEE TO SUPPORT DRR EMERGING FROM THE NATIONAL POLICY DIALOGUES	No. of IPA beneficiaries concerned
HFA Priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation	
• All countries in SEE are aware of the new DRR paradigm that followed the adoption of HFA. The legislation related to disaster risk management has been recently or is currently being updated in many countries; however, an appropriate legal and institutional DRR framework has not been established in many countries yet.	All
• There is a common need to mainstream DRR and to move to real implementation of the HFA by: - integrating DRR within other development plans and sectoral policies; - developing DRR Action plans; establishing DRR institutional mechanisms at the local level; - establishing clear financial mechanisms to support DRR.	All
• Most countries of SEE have established or are in the process of establishing a National Platform for DRR.	Most
• There is a need to clarify the DRR institutional framework where there are overlapping and redundancies among the national agencies including technical agencies such as the NMHSs.	3
HFA Priority 2: HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning	
• There is a need for strengthened institutional coordination and cooperation among technical agencies and with the DRM agencies, including data exchanges, for the development of risk assessment and early warning systems.	All
• There is a need to strengthen the technical and human capacities of the NMHSs to support DRR and specifically risk assessment and early warning systems.	All
• There is a need to enhance coordination between several agencies in charge of hydrometeorology	3
• There is a need to invest in fully operational 24/7 hydrometeorological services.	2
• Trainings and methodologies for the development of risk assessments and early warning systems are required.	All
• Many countries have established a 112 system, and there is a need to clarify the differences and potential synergies between 112 system and EWS .	4
• There is a need to strengthen linkages between DRR and adaptation to climate change policies and strategies.	All
HFA Priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels	
• There is a need to develop appropriate programmes and curricula to integrate DRR at all levels of education.	All
• There is a need to promote citizen awareness of the risks as well as of the existing mechanisms and systems set up to reduce risks such as EWS.	All
HFA Priority 4 Reduce the underlying risk factors	
• There is a need to mainstream DRR into development and sectoral strategies and plans	All
• There is a need to develop long-term DRR strategies and to strengthen partnerships with international and development partners and promote their increase involvement in DRR.	All
• There is a need to develop capacities for climate services to support medium to long term sectoral planning with respect to climate change in all SEE countries.	All
HFA Priority 5 : Strengthen disaster preparedness for effective response at all levels	
• SOPs need to be well defined, regularly tested and continuously improved.	All
• There is a need to increase the use of simulation exercises.	All
• There is a need to strengthen preparedness for cross border hazards through regional and international cooperation.	All

Table 58: Common technical needs and challenges of the NMHSs of SEE to support DRR emerging from the capacity assessment

COMMON TECHNICAL NEEDS AND CHALLENGES OF THE NMHSs OF SEE SUPPORT DISASTER RISK REDUCTION	No. of beneficiaries concerned
Legal framework and institutional arrangements related to the role of NMHS in DRR	
• There is a need to prescribe a new law for hydrometeorological services.	4
• There is a need to reorganise the NMHS and better integrate it in the DRR institutional framework and planning.	5
• In this regard, the specific roles and responsibilities of the NMHSs in DRR should be clarified in most countries, particularly with respect to their mandate to issue early warnings, as well as the cooperation and coordination with other technical agencies.	Most
Operational relationships with other agencies	
• There is an urgent need to clearly define roles and responsibilities of the various agencies within the DRR framework, and to improve the cooperation among the NMHS, other technical agencies and the DRM agencies, particularly for data exchange, risk assessment and early warning systems.	Most
• In this respect appropriate SOPs should be defined within a Quality Management System.	Most
Monitoring and observations networks and data exchange	
• There is an urgent need to upgrade and modernize the meteorological and hydrological networks by:	
- upgrading the calibration and maintenance systems per WMO standards	5
- developing the network of Automated Weather and Hydrological Stations (all countries)	All
- increasing the number of remote sensing systems, including upper air sounding stations, weather radars, lightning detection systems	All
- developing or improving real time communication system for observation and data (i) at the national level and (ii) at the regional levels	2-4
• There is also a need to strengthen the marine observation networks in the coastal countries.	4
Forecasting	
• There is an urgent need to develop an operational forecasting system.	1
• There is a need to develop or strengthen nowcasting capacities to support DRR, including by developing the production of regional weather radar composite.	5
• There is a need to improve the capacities to use Numerical Weather Prediction (NWP) products and to join European or international NWP model consortium.	All
• There is an urgent need to develop hydrological modelling and to link these models to NWP and weather radar data for flood forecasting.	6
• There is a need to improve the automatic analysing and editing tools.	All
• There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks.	5
Hydrometeorological data management systems	
• There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data.	6
• There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.	5
• There is also a need to develop national hydrological or agrometeorological databases that would link all existing databases in one unified at the national level.	4
• There is a need to strengthen data management capacities for real time.	2
Hazard analysis and mapping to support risk assessment	
• There is a need to clearly define the institutional framework related to risk assessment and to specifically define the role of the NMHSs.	Most
• There is a need to define standard methodologies for hazard characterization and mapping, and for hazard risk assessment.	All
• There is the need to strengthen the collection of hazard data including impacts and hazard extent and to develop and maintain corresponding hazard databases.	5
• There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment.	All
• There is the need to develop capacities in the use of GIS, spatial analysis and management of geographic data; remote sensing.	All
	4

• There is a need to develop hydrological modelling for flood risk assessment. • There is the need to develop a shared methodological framework for the integration of climate change products in hazard risk assessment.	Most
Information technology and telecommunication issues	
• There is an urgent need to reinstall the connection to the WMO GTS.	2
• There is a need to modernize the telecommunication system for automatizaton and dissemination of forecasts and warnings.	All
• There is an urgent need to develop or improve websites for a better public weather service.	3
Warning products and services	
• There is an urgent need to establish a 24/7 science based analysing, forecasting and warning system.	4
• There is a need to further improve existing warning products and to develop new warning products and services in close cooperation with the Disaster Risk Management stakeholders as well as users from various sectors.	5
• There is a need to clarify the mandate roles and responsibilities of NMHS to produce / issue / disseminate official warnings for hydromet hazards through appropriate SOPs under a QMS framework.	4
• There is a need to improve the warning dissemination mechanisms by improving the communication systems, partnerships with the media, as well as enhancing the awareness of the population.	4
• There is a specific need to develop early warning systems for (i) flash flooding and (ii) drought.	4 - 3
Climate change analysis	
• There is a need to develop a climate data management system.	Most
• There is a need to develop the technical capacities for climate change projections downscaling to local scales.	Most
• There is a need to develop climate change impact studies in cooperation with DRR and other sectors.	Most
Human Resources	
• There is an urgent need to increase the number of data management, computing and IT experts.	All
• There is a need to increase the number of staff with academic MSc and PhD degrees in meteorology and hydrology.	All
• There is a need to promote training of the mid-management in leadership, project management, cooperation with industry, participation in EU R&D projects and English level.	All
• There is a need to establish a systematic training programme for NMHSs staff by adapting the trainings systems in use in some of the advanced EUMETNET NHMSs.	All
Regional cooperation	
• There is an urgent need to promote cooperation among SEE NHMSs.	All
• Methodologies and tools for production of flood and drought risk assessment and mapping at the national/regional level should be developed and harmonized in the region, based on good practices, particularly for flood risk assessment in transboundary river basins (Sava river).	All
• Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level including automatic on-line stations, a sub-regional radar network as well as a lightning detection network.	All
• To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres producing NWP.	All
• Cross-border exchanges of real-time data, forecasts and warnings should be increased.	All
• A regional Multi-hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process.	All
• A regional harmonisation of watch and warning systems should be promoted.	All

9.3.3. Opportunities and challenges to strengthen DRR through regional cooperation in meteorology, hydrology and climate

These thorough analyses provide a good basis for the strengthening of regional cooperation in meteorology, hydrology and climate in South East Europe to strengthen DRR. Indeed, it revealed that:

- **Strengthening DRM policies and strategies toward more preparedness and prevention is underway in the SEE region**: Most of the countries in the region are currently restructuring their DRM processes, coordination, policies and strategies moving forward from post disaster response to preventive and preparedness strategies. This is an opportunity to foster institutional coordination and collaboration among NMHS and various partners in this area.
- **The roles and responsibilities of NMHSs in DRR is increasingly recognised in South East Europe**. Most of the countries in the region highlighted the need for strengthened institutional coordination and cooperation between the NMHSs, the DRM agencies, and other sectors, particularly for the development of risk assessment and early warning systems.
- **All countries in SEE realised that the technical and human capacities of their NMHSs need to be strengthened** to support DRR and specifically risk assessment and early warning systems.
- **Although capacities of NMHS in producing meteorological, hydrological and climate products and services varies across the region, SEE countries are confronted to common challenges** related to their monitoring and observation networks, their forecasting capacities, their hydrometeorological data management systems, their hazard analysis and mapping capacities, their warning products and services development, their IT infrastructure or their climate change analysis capacities.
- **SEE countries urged the need to promote regional cooperation in meteorology, hydrology and climate** as a critical step toward improving DRR and EWS capacities. A number of areas requiring regional cooperation have been identified including:
    - Harmonisation of risk assessment methodologies, tools and capacities;
    - Coordination and harmonization of EWS for cross border hazards;
    - Sharing of good practices in DRR;
    - Regional Trainings and workshops;
    - Development of regional project proposals and coordination with donors and funding agencies;
    - Establishment and/or utilization of Centres of excellence and cooperation mechanisms.

9.4. Existing Cooperation Mechanisms in SEE and greater European Union

A comprehensive regional cooperation should be based on the existing cooperation mechanisms that are presented in this section.

9.4.1. Regional mechanisms and initiatives supporting DRR in South East Europe

9.4.1.1. The Regional Cooperation Council (RCC)

The RCC was officially launched on 27 February 2008, as the successor of the Stability Pact for SEE[14], with the goal to promote mutual cooperation and European and Euro-Atlantic integration of SEE in order to inspire development in the region for the benefit of its people. The RCC functions as a focal point for regional cooperation in SEE. The RCC provides the SEE Cooperation Process (SEECP) with operational capacities and acts as a forum for the continued involvement of those members of the international donor community engaged in the region. The work of the RCC

[14] The Stability Pact for SEE was launched in 1999 as the first comprehensive conflict prevention strategy of the international community, aimed at strengthening the efforts of the countries of SEE.

focuses on six priority areas: economic and social development, energy and infrastructure, justice and home affairs, security cooperation, building human capital, and parliamentary cooperation as an overarching theme (See Annex 6).

9.4.1.2. The Disaster Prevention and Preparedness Initiative (DPPI)

DPPI was launched in November 2000 under the framework of the Stability Pact for SEE in an effort to contribute to the development of a cohesive regional strategy for disaster preparedness and prevention for its 12 member States (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR Macedonia, Greece, Hungary, Moldova, Romania, Serbia and Montenegro, Slovenia and Turkey). The overarching goal of the DPPI is to foster regional cooperation and coordination in disaster preparedness and prevention for natural and man-made disasters in SEE and its objectives are to: (i) strengthen good neighbourly relations and stability through the exchange of information, lessons learnt and best practices in the field of disaster management; (ii) Enhance cooperation between DPPI partners in view of EU enlargement and the process of Euro–Atlantic; (iii) Support and encourage countries to develop, adopt and/or enforce state-of-the-art disaster emergency legislation, regulations and codes designed to prevent and mitigate disasters in line with guidelines and common practices accepted in the international community; and (iv) Assist and encourage countries in the region to implement HFA (See Annex 6).

9.4.1.3. The United Nations Strategy for Disaster Risk Reduction in Europe (UN-ISDR-Europe)

The UN-ISDR Europe core mandate includes awareness-raising activities in disaster risk reduction, including the promotion of the World Disaster Reduction Campaign, advocacy through policy formulation, the dissemination of guidelines to assist in the implementation of the Hyogo Framework for Action (HFA), promote the establishment of national platforms for disaster risk reduction, enhance networking and partnership-building to contribute to an effective culture of safety and protection of all communities in Europe. In SEE UN-ISDR is one of the key agencies involved in the SEE Disaster Risk Mitigation and Adaptation Programme (SEEDRMAP) which was initiated in 2007 with the World Bank and the WMO.

9.4.1.4. Other UN and international initiatives supporting regional cooperation in DRR

Through Component 1 of the EC DG Enlargement Project (See Chapter 1), **UNDP** is developing a regional cooperation roadmap for Disaster Risk Management that would focus on: (i) harmonization of policy and strategic planning and overall institution building for DRR; (ii) Support across the sub-region for the establishment of National Platforms for DRR; (iii) Capacity development for DRR involving joint training, the promotion of study tours, joint simulations and the establishment of common curricula for education purposes; (iv) Developing common practice in mainstreaming DRR in development; (v) Public awareness; (vi) The assessment of gender issues in DRR and the formation of common approaches to mainstreaming gender into DRR programmes within the sub-region; and (vii) Establishing a sub-regional approach to a coordinated approach to DRR and climate change adaptation (CCA).

Under the cooperation Programme SEEDERMAP, **the World Bank** supports mitigation of the adverse financial effects of natural hazards on the economies of SEE. The World Bank has contributed to the design of the South-Eastern Europe and Caucasus Catastrophe Risk Insurance Facility (SEEC-CRIF), which is contributing to the development of catastrophe insurance markets providing access to affordably priced insurance. In addition, the World Bank is providing loans to the governments of Croatia (14 million $USD), Albania (4 million $USD) and Moldova (4 million $USD) for the strengthening of Hydrometeorological Services, including support for the installation of automatic weather stations. A strong cooperation with WMO could be beneficial in ensuring that the infrastructure and systems developed with the World Bank financing are interoperable and are designed with consideration for regional cooperation issues.

9.4.2. Regional cooperation in meteorology in Europe

There are considerable capacities in Europe, through technical (sub-)regional and specialized centres and the European meteorological infrastructure that can be leveraged in support of capacity development for enhanced disaster risk management in SEE. Concerted efforts for collaboration at the European level were marked with the establishment of organizations such as European Centre for Medium-Range Weather Forecasts (ECMWF), European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the Conference of National Meteorological Services in Europe (EUMETNET). Through this cooperation European countries have joined forces to collectively develop capabilities in observations, monitoring, forecasting, modelling, research and the corresponding sharing of data, information products and services that underpin the current work of NMHSs not only in Europe, but the world over. The availability of these capacities offers opportunities for enhanced regional cooperation to support development and application of meteorological, hydrological and climate products and services for DRR in SEE. Membership of SEE countries to these organizations would, therefore, provide them with technical and operational support to improve meteorological, hydrological and climate services. These Centres could support interoperability, data harmonization and standardization, development of guidelines, training, development of products and services for different DRR applications.

9.4.2.1. European Centre for Medium-Range Weather Forecasts (ECMWF)

In 1967 the Council of Ministers of the European Communities meeting in Luxembourg decided to promote and encourage scientific and technical research in meteorology. As a result, the setting up of the “European Meteorological Computer Centre for Research and Operations” was agreed. This became the core of the activities of ECMWF, which was established on 1 November 1975. The main objective of ECMWF is to advance medium-range weather forecasting to fill the gap in the working programmes of National Weather Services of Member States in their efforts to contribute with products and services to their national economies. Today ECMWF has 19 Members States and 15 co-operation States (See Annex 6).

9.4.2.2. European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)

With the advent of satellite technology, European countries decided to establish EUMETSAT, in 1986, to deliver weather and climate-related satellite data, images and products – 24 hours a day, 365 days a year. It has a membership of 26 countries and co-operation agreements with 5 countries. Data from EUMESAT, which is accessible to SEE countries, is critical for monitoring of meteorological and environmental phenomena and for improving forecasting (See Annex 6).

Table 59: Status of SEE Membership in the European Meteorological network

Beneficiary	ECMWF	EUMETNET	EUMETSAT
Albania	Membership underway (through the project)	Membership underway (through the project)	
Bosnia and Herzegovina	Membership underway (through the project)	Membership underway (through the project)	
Croatia	Cooperating State	Member	Member
The former Yugoslav Republic of Macedonia	Cooperating State (through the project)	Member (through the project)	
Montenegro	Cooperating State	Member (through the project)	
Serbia	Cooperating State	Member	Cooperating State
Kosovo (as defined by UNSCR 1244/99)			
Turkey	Member		Member

9.4.2.3. EUMETNET – Conference of National Meteorological Services in Europe

Motivated by the success of EUMETSAT, 17 countries in Europe[15] created the EUMETNET to facilitate co-operation of its Members as a network to help them in providing: (i) leading expertise on weather, climate, environment and related activities; (ii) technical support to the corresponding scientific community; and (iii) high quality basic data and products. In 2010 EUMETNET acquired a legal personality under the form of an Economic Interest Grouping (under the Belgian law). Today, the network comprises 29 members. EUMETNET runs a number of different programmes between its members (See Annex 6) in various fields such as observing systems, data processing, basic forecasting products, research and development and training. Its METEOALARM Programme has created a European-wide public and multi-lingual portal for the provision of alerts to the public and authorities about severe weather 48 hours in advance. The EUMETCAL Programme, which is a computer-aided learning project, facilitates training of staff of NMHS through provision of various training modules.

9.4.2.4. Other institution or initiative supporting regional cooperation linked to meteorology

In the late 1990s and early 2000s, the Joint Research Centre (JRC) of the European Commission started the development of initiatives which, among others, provide valuable contributions to the work of NMHS in Europe. These include the European Forest Fire Information System – EFFIS (operational since 2003), the European Drought Observatory and the European Flood Alert System – EFAS (operational in 2003). While these initiatives provide valuable information on forest fires, drought and floods, they do not replace the role played at national level by the NMHS in these areas (See Annex 6).

The European Union legislation and guidelines can also be utilized as a driver to enhance regional cooperation supporting DRR. The EU Water Framework Directive requests EU Member countries to develop flood risk assessment (hazard maps and flood risk maps) and flood risk management plans, as well as to coordinate in transboundary river basins. Regarding droughts, although there is no directive, a guidance to EU members recommends to develop hydrological drought impact assessment, drought management plans, as well as an European Drought Observatory and early warning system by 2012.

9.4.3. Sub-regional hydrometeorological cooperation mechanisms in South-East Europe

9.4.3.1. The Drought Management Center for SEE (DMCSEE)

The DMCSEE was established in 2006 in Ljubljana, Slovenia, with the aim to promote the application of drought risk management tools and provide training on tools and methodologies for drought assessment, monitoring and early warning to the 13 Member countries of the SEE region.

9.4.3.2. The SEE Virtual Climate Change Center (SEEVCC)

The SEEVCC was established in 2008 in Belgrade, Serbia, with objectives to (i) fulfil the needs of SEE countries for information on sub-regional climate change; (ii) support the development of capacities of NMHS in the area of climate change in the SEE region; (iii) strengthen linkages between science and adaptation planning, policy planning, as well as management of climate risks, and (iv) promote a model of partnership between NMHS and other sectors dealing with climate change, as well as with relevant international organizations, regional climate centers, donors, etc.

9.4.3.3. The International Sava River Basin Commission (ISRBC)

The ISRBC is in charge of implementing the Framework Agreement on the Sava River Basin which was signed in 2002 by four riparian countries of the Sava river basin (Bosnia and Herzegovina,

[15] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom

Croatia, Serbia and Slovenia) to promote transboudary cooperation for the sustainable development of the region by focusing on navigation, water management and flood and drought risk reduction.

Two examples of cross-border disasters: a need for more regional cooperation

- December 2010 transboudary flooding in the Drina basin

At the end of November to the beginning of December 2010, heavy rains on the territory of Montenegro and Bosnia and Herzegovina simultaneously caused a high rise in the water level over the whole Drina River Basin. The high level wave in the Drina Basin caused floods on the territories of Montenegro, Bosnia and Herzegovina and Serbia with consequential significant material damage. Based on the available data, including ECMWF products, the Hydrometeorological Service of Serbia promptly provided forecasts and warnings for all participants in the flood defence system. Owing to this and measures taken by the Sector for Emergency Management the loss of human life was avoided and damage to property was mitigated, especially in the lower part of the Sava River. However, the lack of a common regional hydrometeorological information system for the Drina Basin among its riparian countries did not allow the hydrometeorological early warning system to perform at its best. From the aspect of the functioning of the flood risk management system on the Drina River as a water course cut by state borders or is the state border and whose regime is crucially influenced by the management of constructed accumulations, a need exists for inter-governmentally coordinated management of the waters within this Basin. In the case of the Drina River, this is possible to realize through regional projects that would also be supported by relevant international institutions.[16]

- August 2007 cross-border forest fires in Dubrovnik area

From 4 to 9 August 2007, an intense forest fire burned more than 3,400 hectares of vegetation between Croatia and Bosnia and Herzegovina in the Dubrovnik area. According to the Standard Operating Procedures for the transboundary actions in wild fire protection between Croatia and Bosnia and Herzegovina, fire brigades of both countries were authorised to operate in the cross-border area. During the fire, strong Bora wind complicated fire protection operations and precluded helicopter and airplane intervention. Therefore, it was very important to have reliable wind forecast. Croatia Hydrometeorological Service forecasted the Bora wind to last until the 6 August occupying the lowest 2 km level of the atmosphere with wind velocities exceeding 10 m/s. ALADIN/HR model and its application by HRID (High Resolution Isentropic Diagnosis) was utilised to predict the essential features of this local phenomena with high reliability. All information was available on a daily basis to the fire-fighters as a part of Standard Operator´s Procedure on weather forecast information[17].

[16] More information is available in ANNEX 7
[17] More information is available in ANNEX 8

9.5. Roadmap for the development of the hydrometeorological component of a regional DRR strategy

9.5.1. A DRR regional strategy for South East Europe

During the consultations, the need for a clear regional strategy in DRR highlighting the long-term priorities for capacity development and cooperation with corresponding regional action plan for implementation was highlighted. It was recommended that this strategy should include the following:

- The regional DRR strategy should be founded on a comprehensive framework for disaster risk management within a multi-stakeholder and multi-hazard approach and identify and prioritize concrete areas of regional cooperation;
- The regional DRR strategy should ensure that gaps, needs and priorities are addressed in a coordinated fashion and with a long-term capacity development perspective;
- The regional strategy would be underpinned with phased project proposals targeted at capacity development. Various projects in the region supported through bi-lateral and multi-lateral cooperation should be better integrated and aligned to avoid redundancies and address gaps;
- The strategic priorities for the development of meteorological, hydrological and climate services should be developed in context of the SEE regional strategy for DRR;
- The regional DRR strategy must be complemented with corresponding regional agreements and trans-boundary agreements and regional operational plan (who, what, when, how and with whom). Specifically the Regional DRR Strategy and Regional Operational plans should considered the hazards posing risks across borders in the region, e.g., forest fires, floods, droughts, heat waves;
- There is need for multi-stakeholder regional mechanisms to develop regional strategy, identify areas of cooperation and develop, monitor and evaluate the regional implementation plan.

9.5.2. Areas requiring regional cooperation in meteorology, hydrology and climate

9.5.2.1. Risk analysis, data management and exchange to support DRR and MHEWS

Floods, droughts, forest fires are among highest priority hazards in the region, with severe impacts on safety of lives and economic losses across the whole region. As risk assessment at regional, national and local levels is the foundation for the development and implementation of any DRR strategy, the following priorities have been identified in this area:

- Methodologies and tools for production of risk assessment and mapping at the national/regional level should be developed and harmonized in the region for the priority hazards, based on common standards. This would be particularly crucial for flood risk assessment in trans-boundary river basins, and forest fires;
- There is a need of integrated risk assessment and early warning decision tools (GIS platform based) that integrate hazard information (statistical and real-time) with exposure and vulnerability information from different sectors;
- Common meteorological, hydrological and climate databases, metadata, common GIS platforms need to be developed and adopted based on standards, as well as integrated, and quality controlled;
- There is a need for data exchange mechanisms and protocols at national, (sub-) regional and international levels (EUMETNET) to facilitate exchange of data, and formalized agreements across agencies;
- The existing sub-regional technical cooperation centers such as the SEE Drought Management Center and SEE Virtual Climate Change Center should be strengthened, as well as their cooperation with the global and European centers of excellence to develop their capacity to deliver regional products and services to support risk assessment;

- SEE Climate Outlook Forum (SEECOF) should be utilized in a multi-stakeholder mode as a mechanism to identify user needs and requirements for provision of regional climate products and services to be provided through the Regional Climate Centers;
- There is a need of methodologies and capacities to produce regional-scale projections of climate change, including hazard trends analysis and capacity development and training for the beneficiaries for downscaling for the national needs.

9.5.2.2. Operational cooperation of the NMHS and DRM Agency and service delivery

As operational cooperation between the DRM agencies and the hydrometeorological services is fundamental for the development of an effective early warning system, the following priorities have been identified in this area:

- National and regional development of early warning systems should be carried out on the basis of a number of principles that have emerged from the documentation and synthesis of good practices in developed and developing countries around the world;
- Ongoing MHEWS stakeholders workshops and trainings at national or/and regional level should be enhanced for a better understanding of roles and capacities among Meteorological Services, DRM agencies and key EWS stakeholders with regards to MHEWS;
- There is a need to develop Quality Management Systems in the hydrometeorological services and Standard Operating Procedures (SOPs) with their stakeholders as well as cooperation in the development of hydro-met products in support of 112;
- For flood warnings in transboundary basins (eg Drina, Sava) cooperation should be enhanced at the river basin level;
- Regional case-studies on multi-stakeholder, multi-country cooperation in EWS (2007 Dubrovnik fire, 2010 Serbia floods) supported by ECMWF products should be documented and published;
- A harmonized regional Multi-Hazard Early Warning System composed of coordinated national Early Warning Systems could be designed through the regional DRR strategy. The various operational aspects (trans-boundary, sub-regional, and regional) need to be identified and reflected in formalized agreements and SOPs. In this regard, the interoperability of observing network, regional coverage and data exchange and policies need to be considered, for consistency of hydrometeorological information.

9.5.2.3. Harmonization, exchange and real time coordination of hydrometeorological networks, forecasting expertise and watch and warning systems

With respects to monitoring, forecasting and watch and warning systems, regional coordination and cooperation is a must. In these areas, the following priorities have been identified:

- Regional cooperation and harmonization of the hydro-meteorological capacities need to be implemented in alignment with the regional DRR strategy to ensure alignment with regional priorities and operating plans in DRR;
- Modernization and interoperability of the meteorological and hydrological networks should be planned at the sub-regional level to benefit from economies of scale and financing opportunities. The planning should include automation and optimization of monitoring networks as well as integration of radars and remote sensing capacities into a sub-regional network;
- To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres (e.g. ECMWF) producing NWP, develop their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
- Strengthening of technical capacities of DMC SEE and the SEE Virtual Climate Change Center and their institutional capacities to support Members needs for products and training;
- A regional harmonisation of watch and warning systems should be promoted;

- Cross-border exchanges of real-time data, forecasts and warnings should be increased; in this regard the standards and data exchanges should be developed.

9.5.3. Priorities and next steps

In this overall context, the following areas have been identified as priorities for the development of future regional cooperation project or programmes aimed to strengthen the capacities of the hydrometeorological services to support Disaster Risk Reduction in South East Europe:

- Enhance the regional hazard assessment and mapping capacities;
- Enhance capacity to forecast hazardous meteorological and hydrological phenomena and deliver timely warnings to support DRR;
- Develop the capacity needed to support climate risk management and climate change adaptation into national and regional DRR agenda;
- Design a regional Multi-Hazard Early Warning System composed of harmonized national Early Warning Systems within a regional cooperation framework.

10. REFERENCES

- WMO Website of the project, http://www.wmo.int/pages/prog/dra/eur/DRR_SEEProject.php
- MHEWS Training Workshop, October 2009, Pula, Croatia, http://www.wmo.int/pages/prog/drr/events/Pula/index_en.html
- Technical workshop on Flood risk assessment, October 2010, Istanbul, Turkey, http://www.wmo.int/pages/prog/drr/SEE/Floods/index_en.html
- Technical workshop on drought risk assessment, September 2010, Ljubljana, Slovenia http://www.wmo.int/pages/prog/wcp/agm/meetings/slovenia10/index.php
- Workshop on "Regional cooperation in MHEWS and risk assessment in SEE, 16-17 February 2011, WMO Geneva
- Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management, Sarajevo, Bosnia and Herzegovina, 28 – 29 March 2011, http://www.wmo.int/pages/prog/drr/SEE/SarajevoMeeting/index_en.html
- Structure, Role and Mandate for Civil Protection for Disaster Risk Reduction in South East Europe, 2008, http://www.unisdr.org/files/9346_Europe.pdf
- Strengthening the Hydro-meteorological Services in South Eastern Europe, 2008, http://www.unisdr.org/files/7650_StrengtheningHydrometeorologicalSEE1.pdf
- South Eastern Europe Disaster Risk Mitigation and Adaptation Program, 2008, http://www.unisdr.org/europe/eu-gfdr-r/Concept-Note-SEEDRMAP.pdf
- Risk Assessment for South East Europe: Desk Study Review, 2008, http://www.unisdr.org/files/1741_SouthEasternEuropeDRMitigation.pdf

11. ANNEXES

ANNEX 1: OUTCOMES OF THE WMO IMPLEMENTED COMPONENT 2 OF THE EC DG ENLARGEMENT FUNDED REGIONAL PROGRAMME ON DRR IN SOUTH EAST EUROPE

ANNEX 2: DIFFERENT TYPES OF WARNING MANDATES FOR NMHS

ANNEX 3: ASSESSMENT MISSION TO KOSOVO (under UNSCR 1244/99) – FINAL REPORT

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

ANNEX 6: REGIONAL AND SUB-REGIONAL CENTRES AND INITIATIVES SUPPORTING COOPERATON IN DRR AND HYDROMETEOROLOGY IN EUROPE AND SOUTH EAST EUROPE

ANNEX 7: FLOOD WARNING AND RISK MANAGEMENT IN SERBIA

ANNEX 8: FOREST FIRES WARNING SYSTEM IN CROATIA

ANNEX 1: OUTCOMES OF THE WMO IMPLEMENTED COMPONENT 2 OF THE EC DG ENLARGEMENT FUNDED REGIONAL PROGRAMME ON DISASTER RISK REDUCTION IN SOUTH EAST EUROPE

ACTIVITY	OUTCOMES
1: Convene Regional and National Policy Dialogues	
1.1: National Policy Dialogues on DRR (with UNDP)	Detailed assessment of the DRR policies and practices as well as the NMHS capacities, gaps and needs in the beneficiaries were completed and conducted to the development of policy recommendations, through National Policy Dialogues (NPD) organised in each beneficiary. Assessment reports and recommendations will be published in 2011. Regional cooperation was also discussed during the NPDs. The outcomes of this activity are also input to activity 1.4.
1.2: SEE Climate Outlook Forum (SEECOF)	Through this activity the sub-region has developed strong and sustainable working mechanism to prepare seasonal outlooks through collaboration among climate experts from all beneficiaries. Steps have been undertaken to involve economic sectors; identification of the needs of sectors like water management, energy, disaster risk management has been initiated and the awareness of the users in the benefits of the seasonal forecasting in tactical planning has been raised. The overall capacity of IPA beneficiaries in utilizing and downscaling of products provided by leading long-range forecasting centres has been significantly improved. The outcomes of this activity are also input to activity 1.4.
1.3: MHEWS Training Workshop (with UNDP)	During the “MH-EWS Training Workshop” (Pula, Croatia, Oct. 2009) (see reference) participants discussed good practices in EWS and identified priority areas for strengthening institutional cooperation and coordination in EWS among NMHS, DRM Agencies and other EWS stakeholders. The outcomes of this activity are also input to activity 1.4.
1.4: Regional Cooperation Roadmap (with UNDP)	Areas in DRR and hydro-meteolrogical issues that require regional cooperation have been identified based on consultations with the beneficiaries during the national assessments and the NPDs (Activity 1.1), discussions during the SEECOF (Activity 1.2) and MHEWS Training Workshop (Activity 1.3), and Flood and Drought Risk Assessment (Activity 2). During the workshop on “Regional cooperation in MHEWS and risk assessment in SEE” (16-17 February 2011, WMO Geneva) opportunities for further strengthening regional collaboration and interested regional partners and centers were identified. The regional cooperation roadmap will be finalized during the Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management, in Sarajevo, Bosnia and Herzegovina, 28 – 29 March 2011.
2: Flood and Drought Risk Assessment (with UNDP)	Two training workshops were conducted (i) on flood risk assessment (Oct. 2010, Istanbul, Turkey) and ii) on droughts risk assessment (Sept 2010, Ljubljana, Slovenia) to provide participating experts with self assessment capacities of their national system for flood and drought risk assessment (see reference). Detailed assessments of these capacities have been prepared with the support of an international consultant who visited all the beneficiaries. Based on these assessments, concrete project proposals for capacity development of the NMHS with other ministries and technical agencies have been developed, as well as a regional proposal. Assessment reports and recommendations will be published in a comprehensive report with the outcomes of activity 1.1. The outcomes of this activity are also input to activity 1.4.
3: Engage with the European Meteorological Infrastructure	The goal of better integration of the IPA beneficiaries in the European Meteorological Infrastructure as a major driving force in developing their capacities to produce improved products and services in support of DRR has been achieved. All targeted countries made significant progress in understanding the roles and functions of the regional organizations and several countries succeeded in their applications for membership in ECMWF and EUMETNET. The preparation for integration to the MeteoAlarm system has progressed and individual countries has applied the requirements for such integration at national level. The integration to the MeteoAlarm web service is forthcoming.
4: Hydrometeorological data assimilation and management	All targeted beneficiaries acquired state-of-the-art software for processing hydrometeorological data (METVIEW-4 from ECMWF). This raises significantly their capacity to utilize data and products from leading forecasting centres and produce high quality local products leading to improvement of the accuracy and timelines of the warnings for hazardous events. This activity addresses the need for improvement of data quality through regular calibration and maintenance of the observing instruments and enhanced the cooperation with the WMO Regional Instrument Centre responsible for the sub-region. The secondment of experts from the IPA beneficiaries to the Regional Drought Management Centre contributed to strengthening its methodological and capacity building functions. The strong collaboration with EUMETSAT provided for filling a long-lasting gap in the capacity of some countries to receive and utilize satellite information in monitoring and forecasting hydrometeorological hazards.
5: Training and workshops	Building the capacity of the beneficiaries’ NMHSs to enhance their products and services for DRR was among the main objectives of DRR/SEE Projects. Through a strong programme of training, the project succeeded in providing ten high-quality training events on different subjects related to DRR. More than 220 experts and officials form the IPA beneficiaries actively participated in the training seminars and workshops organized by WMO in collaboration with UNDP, UN ISDR, ECMWF, EUMETNET, EUMETSAT, the Regional Drought Management Centre, the Regional Instrument Centre. Croatia, Turkey and Serbia were among the IPA beneficiaries that hosted training events and thus contributed to achieving the goals of the capacity building project components.

ANNEX 2: DIFFERENT TYPES OF WARNING MANDATES FOR NMHSS

It emerged from the two WMO expert's symposiums[18] that the operational roles of Meteorological Services in supporting the warning process, like those of other technical agencies with similar responsibilities such as hydrological or geophysical authorities, can be subdivided into three categories based on their mandates for specific hazards as illustrated in Figure 1:

Type I hazards:	NMHSs tend to have sole mandate to issue warnings for the hazard.
Type II hazards:	NMHSs have a joint mandate with a specialized technical agency for the development of warning for the hazard.
Type III hazards:	NMHSs provide data and products to other agencies that have the mandate for the development of the warnings for the hazard.

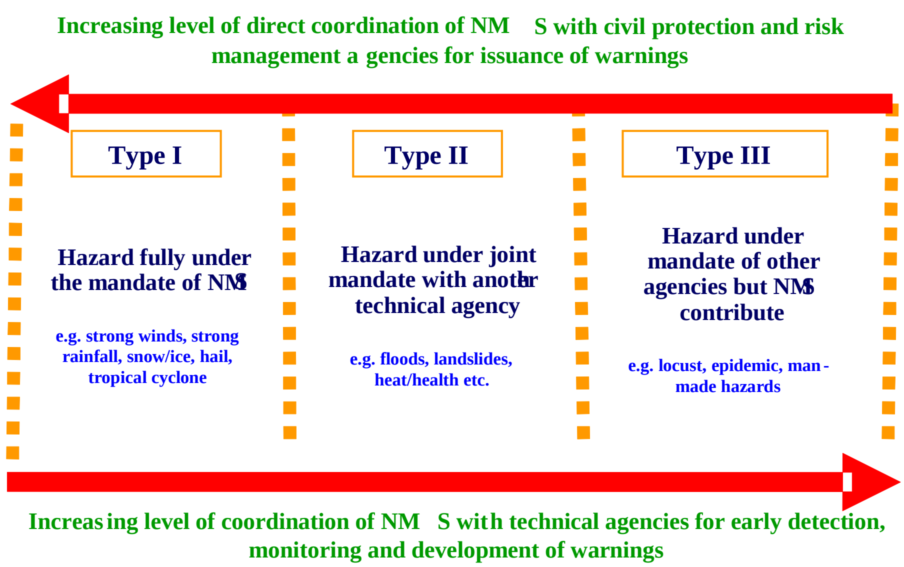


Figure 1: Levels of coordination between NMHSs with civil protection and risk management agencies and other technical agencies at national level.

[18] First Expert's Symposium on Multi-Hazard EWS, May 2006, Geneva, Switzerland http://www.wmo.int/pages/prog/drr/events/ews_symposium_2006/index_en.html and the Second Experts' Symposium on Multi-Hazard Early Warning, May 2009, Toulouse, France, http://www.wmo.int/pages/prog/drr/events/MHEWS-II/index_en.html

EC DG Enlargement / WMO project
Regional Cooperation in South-Eastern Europe for meteorological, hydrological and climate data management and exchange to support disaster risk reduction

ASSESSMENT MISSION TO KOSOVO (under UNSCR 1244/99)

30 November – 5 December 2009

Final Report

December 2009

ANNEX 3: ASSESSMENT MISSION TO KOSOVO (under UNSCR 1244/99) – FINAL REPORT

1 INTRODUCTION

Note: In the framework of the WMO DRR/SEE Project financed by the EC DG Enlargement, Kosovo is regarded as defined by the UNSCR 1244/99, therefore any mentioning of Kosovo in this report means "Kosovo under UNSCR 1244/99".

1.1 The World Meteorological Organization (WMO), in coordination with the United Nations Development Programmme (UNDP), is carrying out a project entitled “Regional Cooperation in South Eastern Europe (SEE) for Meteorological, Hydrological and Climate Data Management and Exchange to support Disaster Risk Reduction (DRR)”. The project is funded by the Directorate-General for Enlargement of the European Commission (EC) and implemented in partnership with the National Meteorological and Hydrological Services (NMHSs) of the project countries. The direct beneficiaries of the project are the NMHSs of the project countries, which are candidates or potential candidates for membership to the European Union: Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia, Turkey, and the Former Yugoslav Republic of Macedonia. In accordance with the EU policy for Enlargement, Kosovo, under the UN Security Council Resolution 1244/99, is also included as a beneficiary in the project. The project description can be found on the WMO website: http://www.wmo.int/pages/prog/rp/RAVIDRR-SEEProject.html.

1.2 As part of the project activities, an assessment mission to Kosovo was planned in close cooperation and consultation with UNMIK, in order to assess the human, institutional and technical capacity of relevant agencies in Kosovo to provide services aimed at the reduction of the vulnerability to natural hazards, including losses of life, property and economic productivity caused by weather and climate related natural hazards.

1.3 Mr Dušan HRČEK, a WMO consultant who is retired WMO staff with knowledge of the specific matter and the SEE region, carried out the assessment mission to Kosovo from 30 November – 5 December 2009. The mission was performed as outlined in the attached “Terms of Reference” (Annex 1). The programme of the WMO assessment mission to Kosovo is attached in Annex 2.

2 MEETINGS AND DISCUSSIONS

2.1 Meetings with the representatives of international organizations and the European Commission

2.1.1 Under the UN Security Council Resolution (UNSCR 1244/99), the UN Interim Administration Mission in Kosovo (UN MIK) has the mandate to provide an interim administration for Kosovo. Relations with International organizations are a necessary component of the mandate of UNMIK. Therefore, the WMO mission was conducted in coordination with UNMIK. Following the preliminary arrangements between WMO and UNMIK, the first meeting of WMO consultant in the course of the mission was held at the headquarters of UNMIK in Pristina, in order to review the arrangements for the planned meetings and visits. The introductory discussion was held with Mr Roque RAYMUNDO, Senior Human Rights Advisor, because the designated contact person in UNMIK Mr. Kris LITIERE was not available. The list of persons met in the course of the WMO assessment mission to Kosovo is attached in Annex 3. In the course of the mission, the WMO consultant was several times in contact with UNMIK for coordination purpose. The planned joint visit to Kosovska Mitrovica was not possible to organize, because the previous information on meteorological station in Kosovska Mitrovica, having close cooperation with the National Meteorological and Hydrological Service of Serbia, was not confirmed in the course of the mission visit.

2.1.2 The European Commission Liaison Office (ECLO) in Pristina plays a role in maintaining a closer contact with UNMIK and ensures that a permanent political and technical dialogue is maintained in relation to all Commission competences. The ECLO also implements assistance under the Instrument of Pre-Accession Assistance (IPA) covering the period 2007-2013. The IPA component I entails national and multibeneficiary projects. It comes under the responsibility of the Directorate-General for Enlargement, which is also jointly responsible for component II - cross-border cooperation with DG REGIO. A meeting was held with Mr. Gazmend SELIMI. The goals of the WMO mission to Kosovo were discussed as well as the inclusion of the capacity building needs of Kosovo Hydrometeorological Institute in the existing and future IPA projects.

2.1.3 The United Nations Development Programmme (UNDP) and WMO are the main partners in carrying out the Regional Programme on Disaster Risk Reduction (DRR) in South East Europe. In the Programme, the UNDP is focusing on Disaster Management Authorities, like WMO is focusing in its part to the National Meteorological and Hydrological Services. A meeting was held with Mr Edon S. MYFTARI, Programme Analyst – Justice & Security Sector, from the local UNDP Office. The cooperation between the Kosovo Hydrometeorological Institute (KHMI) and the Department of Emergency Management (DEM) in the Ministry of Internal Affairs was discussed. A possibility for the UNDP support to KHMI for a short-term project on international data exchange was also discussed. The UNDP Office was planning a visit to KHMI and for this purpose they would need a report of WMO mission.

2.2 Meetings with Kosovo authorities

2.2.1 The Agency for Coordination of Development and European Integration in the Office of the Prime Minister (ACDEI) is the National IPA Co-ordinator. A meeting was held with Mr. Albinot BIMBASHI, Director of the Human Development and Infrastructure Directorate. The programme of meetings and visits of the WMO mission was discussed as well as the IPA issues. Daily meetings were held with Ms. Vjosa BEQAJ, Senior Officer for Coordination of Development and European Affairs – Environment, in order to coordinate the activities of WMO mission in Kosovo.

2.2.2 In the Ministry of Environment and Spatial Planning, two Departments were visited: the Water Department and the Environment Department:

- In the Water Department a meeting was held with the Director Mr. Naser BAJRAKTARI. The Department's activities are carried out according to the EU Water Framework Directive. Close cooperation is taking place with the KHMI in hydrology. The Department is playing a role of information centre for floods.

- A meeting was held with the Director of the Environment Department, Mr. Muhamet MALSIU. Cooperation with the KHMI is very close in air pollution and water quality matters. Another important partner is the Kosovo Environment Protection Agency (KEPA), which has capacity to manage all environmental issues, including water, air quality, climate change impact assessment, mitigation and adaptation strategies, and nature protection.

2.2.3. In the Department of Emergency Management (DEM), Ministry of Internal Affairs, a meeting was held with the Director Mr. Fadil Kodra. The goals of the DRR/SEE Project were discussed as well as cooperation with the KHMI. The main natural hazards faced by Kosovo are flash floods, heat waves, drought, forest fires and earthquakes. One such recent example discussed during the visit was the forest fire around the border to Albania and Montenegro. Early warning is not included in their operational procedures, but they are aware of the importance of early warning systems for weather and climate related hazards and extreme events. There are no officially set down linkages or service level agreements between DEM and KHMI.

2.3. Meeting with the Ambassador of Slovenia

A meeting was held with HE Mr. Jožef Hlep, the Ambassador of Slovenia in Pristina. The goals of the DRR/SEE Project were presented and the role in the Project of the Drought Management Centre for SE Europe (DMCSEE) and WMO Regional Instrument Centre (RIC), both located in Ljubljana, was discussed. The Ambassador mentioned his recent contact with KHMI in the framework of the project on establishment of automatic air pollution measurements in Kosovo. The

Ambassador expressed the willingness for support the activities under the DRR/SEE Project linked to two Centres in Slovenia.

3 VISIT TO METEOROLOGICAL AND HYDROLOGICAL SERVICES

3.1 Visit to the Hydrometeorological Institute

3.1.1 The Kosovo Hydrometeorological Institute (KHMI) is accomplishing the hydro-meteorological works as stipulated in the Law on Hydro-meteorological Activities from 15 June 2006. The Ministry of Environment and Spatial Planning is a parent ministry of KHMI. The English translation of the Law on Hydro-meteorological Activities is attached in Annex 4. It is noted that the Law gives KHMI exclusive rights for the provision of weather forecast (Article 8, paragraph 8.1 refers). This could be a strong point for KHMI when establishing agreements with other service providers (e.g., the aeronautical meteorological service), as well as, in promoting its role as a provider of warning services. The Law does define the scope of the hydrometeorological activities, however, there is no reference to the need for compliance with the internationally agreed standards in the relevant WMO documents.

3.1.2. After the introductory discussion with Prof. Dr. Sylë TAHIRSYLAJ, Director of the KHMI, the synoptic station Pristina, located next to the HQ of the KHMI, was visited as well as the chemical labs in the separated renewed building at the same location. The meteorological station visited is well arranged having classical equipment and new automatic meteorological station. A new automatic air pollution measuring station MLU is also located there. The observer is well trained. The chemical labs of KHMI are equipped with up-to-date equipment and run with trained personnel.

3.1.3. The situation with personnel and infrastructure in meteorology and hydrology is less convenient as in the chemical labs. The rebuilding of the meteorological and hydrological network was taking place around 8 years ago. The project was funded by the European Agency for Reconstruction (EAR). Detailed Information on current situation in meteorology and hydrology was collected through a questionnaire sent to the Director of KHMI prior to the assessment mission and was completed with additional questions and answers in the course and shortly after the mission visit.

3.2 Visit to the Aeronautical Meteorological Service

The Aeronautical Meteorological Service (AMS) at Pristina International Airport was visited. The meeting was held with Mr Sherif GOSALCI, the Manager of METEO Department in the Air Traffic Services Division. The rebuilding of the aeronautical meteorological service at Pristina Airport was taking place around 8 years ago with support of the UK Royal Air Force. Pristina Airport is the only one international airport in Kosovo. MET Service has altogether 14 staff, 7 with high degree education and technicians. The functions of METEO Department are guided by ICAO Annex 3. At present there are few Standards and Recommended Practices identified in ICAO Annex 3 that are not fully followed within the METEO Department, including those in regard to provision of verification statistics and adoption of the ISO quality management system. The service has been partly modernized, but there are additional needs for using up-todate technology. There are plans for a new building for the METEO Department and further improvement of infrastructure. The forecasting staff and the observing staff within the METEO Department have received formal training through professional training courses delivered in the UK. There is a need for planned periodic trainings. Cooperation between the METEO Department and the KHMI exists, but it was agreed that closer co operation would be necessary, especially in order to avoid duplication of expensive equipment and make better use of the capacities of both sides.

4 RECOMMENDATIONS

4.1 Based on the overall objectives of the DRR/SEE Project, the provision of requisite hydrometeorological data, products and services in support to the disaster risk reduction is crucial. This implies availability of adequate infrastructure for monitoring the meteorological and hydrological parameters, forecasting capabilities, including early warnings for the main weather hazards, and adequate arrangements for the exchange and dissemination of the information to the respective civil protection services. Training of staff involved in all these areas and establishment of working arrangements between the agencies involved is very important.

4.2 Based on the analysis of the facts gathered during the mission, the general conclusion is that the situation in Kosovo is not favourable for efficient and effective DRR activities, which leads to high risk for the population and businesses.

4.3 The three key objectives for improving the provision of hydrometeorological services in support of DRR in Kosovo are:

- Establishing working arrangements between the provider of hydrometeorological data and services (KHMI) and the civil protection agency (DEM) in order to ensure provision of early warning and advice on meteorological and hydrological hazards
- Providing the minimum necessary physical infrastructure, implementing a first nucleus for a modern hydro-meteorological network, based on automatic stations with real-time transmission of data;
- Providing the necessary technical assistance and expert support, in order to operate this network (together with the existing network) for a reasonable number of years.

4.4 Together with these three “key” objectives, the following are also considered as important recommendations in the initial phase:

4.4.1 Data exchange and quality of data

4.4.1.1 The prerequisite for normal operation of each hydro-meteorological service is national and international data exchange. Therefore, the KHMI should start consultations regarding their link to the GTS using proper UNMIK channels to WMO. A cost effective approach using the Internet connection to appropriate GTS RTH should be considered. The funds needed for the project implementation could be found in the UNDP.

4.4.1.2. Regarding the RBSN, the Pristina and Prizren synoptic stations (station numbers 13477 and 13481 respectively) are required to disseminate regular SYNOP messages as part of the agreed European international exchange. The stations are not sending such information and this is a serious deficiency for the SE European subregion with negative impact on the monitoring of hazardous weather. Therefore, urgent action should be undertaken in coordination with the DRR/SEE partner countries (including Serbia, under which the two stations are listed in the RBSN list of stations) to find a solution to renew the production and dissemination of SYNOP.

4.4.1.3. From the point of view of DRR, the cross-border data exchange is important as a basis for exchange of early warnings. In this regard, the cross border cooperation should be strengthened.

4.4.1.4. It is recommended to improve the quality control (QC) of data, including systematic maintenance and calibration of instruments in accordance with the WMO Guide to Meteorological Instruments and Methods of Observation (WMO-No.8). The DRR/SEE Project includes capacity building activities with the help of the RA VI Regional Instrument Centre (RIC), including assessment missions to the targeted beneficiaries, followed by a training workshop in RIC Ljubljana. KHMI should be invited (through UN MIK) to nominate a participant in this training.

4.4.1.5. Currently, the Internet remains the principal means for accessing basic meteorological information from abroad. The installation of EUMETCast system is recommended, in order to assure reception of satellite imagery and other data and products from international centres.

4.4.2 Remote sensing

4.4.2.1 Weather radar information is a primary tool for early warning services in case of natural disasters related to weather and water. In view of the high cost of weather radar and the need for staff with adequate technical and scientific background and experience to operate it in a sustainable and effective manner, such a project should be a part of the future potential investment for improving of the early warning services. Optimization of the weather radar coverage over the Western Balkan countries is a future task for all countries participating in the DRR/SEE Project and should be included in the eventual continuation of the project through the IPA mechanism.

4.4.2.2 In the absence of near real-time weather radar information, availability of meteorological satellite information from the METEOSAT is essential for the analysis and forecasting of hazardous weather in support to DRR. The basic EUMETCast systems which can provide such information, along with a large amount of other necessary meteorological information, are relatively cheap and the installation of such a system in Kosovo is feasible. The effective use of such information is largely dependent upon the availability of well trained staff (weather forecasters). Taking note of the initiative undertaken by the EUMETSAT for providing access to the EUMETSAT data and services to a number of countries in Eastern Europe, Kosovo should also be considered as one of the recipients of assistance through the proper coordination channels, including the DRR/SEE Project.

4.4.3 Aeronautical Meteorology

4.4.3.1 It is recommended that an expert mission for aeronautical meteorology should be carried out to advise meteorological staff at the airport on expert issues (among them cost recovery to establish, certification of personnel, Single European Sky policies, Quality Management System, etc.).

4.4.3.2 The equipment currently existing and planned for both aviation and hydrometeorology, in particular telecommunication and data processing equipment and back-up systems should be integrated into a network. This is expected to optimise the utilisation as well as the human and financial resources. KHMI and AMS should cooperate to develop technical solutions for the networking.

4.4.3.3 The AMDAR data for Pristina are available for operational use. Currently Pristina is only served by British Airways when their B737 fleet is on this sector. The current schedule is one flight/three times a week. Expert assistance should be provided, in order to include the AMDAR data in operational use.

4.4.4 Climate

4.4.4.1. The enhancement of Hydrometeorological Institute's activities in climate issues is necessary, especially in climate expertise and future climate assessments for the purpose of adaptation to climate change. Cooperation with other countries in SE Europe is needed in using a regional climate model.

4.4.4.2. Regarding the implementation of CLIPS in Kosovo, it is important to assess the needs of climate services within Kosovo, targeted at socio-economic sectors.

4.4.4.3. The KHMI should consider using one of the six Climate Management Systems recommended by the WMO. One of them is CLIDATA, which is used in most of SE European countries.

4.4.4.4. The old data sets (from 1923) from meteorological and hydrological stations in Kosovo are included in the archives of Serbian NMHS in Belgrade. Discussions with Serbia through proper UNMIK channels should be initiated, in order that KHMI could use these data.

4.4.5 Agricultural meteorology

One of the main economic activities in the country is agriculture. Agrometeorological services should be improved to better serve the national needs. The ways for cooperation with DMCSEE should be explored.

4.4.6 Hydrology

4.4.6.1. The Framework Water Directive of EU (FWD) includes the EU approach that the river basin is the basic unit for addressing hydrological activities. Cooperation in trans-boundary river issues would enable Kosovo to participate jointly with neighbouring countries in projects with an aim to developing a basin-wide approach to management issues. It might eventually end in the preparation of a single international river management plan (like White Drini). Through improved data collection and management, and updated forecasting models, such project supported by EU could make available to the participating countries the necessary knowledge basis required for a) promoting sustainable water use based on a long-term protection of the available water resources, and b) mitigating the effects of floods and droughts.

4.4.6.2. The KHMI would benefit from the advice of an international specialist in hydrology. The expert hired by the World Bank for hydrology under the Sava River project in 2007 could be a convenient choice.

4.4.6.3. Monitoring of ground waters has to be reactivated by introducing the modern technique of measurements, in order to serve the needs of Kosovo.

4.4.6.4. Twinning projects, especially in connection with the environmental monitoring, where up-to-date equipment is already available in KHMI, are needed in order to make better use of the investment done.

4.4.7 Disaster risk reduction (DRR)

4.4.7.1. Improvement of the working arrangements and dialogue between the providers of hydrometeorological data and services and the civil protection agencies is one of the main objectives of the DRR/SEE project. The mission identified that, currently, there are no formal working arrangements between the KHMI and DEM. Therefore, the two agencies should initiate regular contacts and participate actively in the national dialogue meeting planned as part of Activity 1: Regional and National Policy Dialogues, of the DRR/SEE Project. KHMI and DEM should support the planned mission of a consultant under the same project activity in coordination with the UNDP.

4.4.7.2. UN MIK should be invited to arrange the participation of Kosovo in the planned meeting on the Development of Regional Approach to DRR.

4.4.8 Capacity building - Staff matters

4.4.8.1. The personnel of KHMI with 25 people are not adequate to serve properly the future needs of Kosovo in meteorology, climate, hydrology and environmental monitoring. Urgent capacity-building initiatives are needed for weather forecasting, climate and hydrology. On-site support by relevant experts in operational hydrometeorological service provision (including forecasting and warning services) to work with the KHMI staff at least for 6 months should be considered. KHMI should explore possibilities to hire an adequate number of young high degree graduates (meteorology, physics etc.).

4.4.8.2. Learning from the experience of other countries, including the SE European countries would without doubt contribute to the development of the Institute. Therefore, the establishment of a post of an adviser for international co-operation to the Director of KHMI would be appropriate.

4.4.8.3. It is recommended that succession planning is considered in regard of senior managers at the KHMI.

4.4.9 Capacity-building - Education and training

4.4.9.1. There is no doubt that the most significant single factor in determining the future efficiency and effectiveness of KHMI is the quality of the initial and continuing education and training provided for its staff. It is considered essential therefore, that KHMI does everything possible, using the possibilities available, to enhance the education and training opportunities for its staff. Therefore, a human resource plan should be developed and all meteorological and hydrological personnel should be given adequate periodic training and be regularly assessed regarding their theoretical and practical skills.

4.4.9.2 Possibilities for the on-job training should be sought as a high priority task.

4.4.9.3. A meteorological and hydrological library should be established, in order to use more efficiently the related expert literature. The missing WMO documents needed should be ordered from WMO Secretariat.

4.4.10 Stronger cooperation at the national level

4.4.10.1. A written agreement between KHMI and the authority responsible for aviation meteorology should be developed and implemented, first of all to enhance co-operation of the METEO Department at the Pristina Airport and the KHMI and introduce cost recovery mechanism in accordance with ICAO/WMO guidelines.

4.4.10.2 Cooperation with other national institutions, especially with the Department on Emergency Management in the Ministry of Interior Matters, with the emphasis on establishment of alert and early-warning systems, in order to face extreme meteorological and hydrological conditions. The KHMI should have a formally set down an agreement with the Department of Emergency Management for the provision of meteorological services to support the DRR activities within Kosovo.

4.4.10.3. Stronger cooperation at the national level should lead to better visibility of KHMI within the Governmental institutions, and consequently to more convenient budgetary support.

4.4.11 Cooperation in the framework of the DRR/SEE Project and other IPAactivities

4.4.11.1. Co-operation with countries in the Balkan sub-region of SE Europe having many common problems should be strengthened through the exchange of information and joint projects.

4.4.11.2. Cooperation with neighbouring countries in hydrology should be strengthened, especially on projects for international river basins.

4.4.11.3. Cooperation with financial institutions and donors should be further developed. There is a need to include capacity building of KHMI into 2011 IPA Project proposals for Kosovo. The UNDP support could be used for short-term small projects, needed to develop a rational proposal for capacity building. The World Bank is already present in Kosovo and cooperation could be extended to the field of meteorology and hydrology like it has been already done in some countries in SE Europe.

4.4.12 Cooperation with the European Meteorological Infrastructure

4.4.12.1. Weather warnings for the territory of Kosovo are provided by the Hydrometeorological Service of Serbia through the METEOALARM system developed by the EUMETNET optional programme EMMA (European Multi-services Meteorological Awareness). The contribution of KHMI to such weather-warning service should be discussed including ways to increase its usability by different users and the general public in Kosovo.

4.4.12.2. The KHMI should develop a plan for introducing advanced technologies which would allow the use of available forecasting models (such as ECMWF), thus improving weather forecasting/nowcasting capacity at the level of Kosovo (including the Metview software). This is a prerequisite for developing capacity for provision of adequate products and services in support of DRR.

4.4.13 The headquarters of KHMI

The activity of KHMI is split into two buildings at the same location, the headquarters and the building including hydrology and environmental labs. The HQ building is not in appropriate condition and should be rebuilt, in order to contribute to the efficiency of KHMI.

4.4.14 Communication with WMO

All communications between Kosovo and WMO, including the implementation of the above recommendations, should be done via UNMIK.

5 CONCLUSION AND ACKNOWLEDGEMENTS

The WMO consultant, who carried out the assessment mission to Kosovo, wishes to express his thanks to UNMIK for overall coordination of the activities of WMO mission. In addition, many thanks to Ms. Vjosa BEQAJ from ACDEI for her valuable assistance in the preparatory phase and then during the WMO mission activities in Kosovo. The WMO consultant would like to express his great appreciation and thanks to the Director of KHMI Prof. Dr. Sylë TAHIRSYLAJ and Mr Sherif GOSALCI, the Manager of METEO Department at Pristina Airport for the warm hospitality and the excellent support given to him. The mission was particularly pleased to see that all stakeholders are willing to move forward together in order to establish a credible hydrological and meteorological service to support socio-economic development in Kosovo. In this regard, the mission offered to continue to provide any additional guidance through WMO and UNMIK that would contribute to the establishment of an efficient and modern hydrological and meteorological service in Kosovo.

Annex 1 to mission report

WMO/EC DG Enlargement Project "Regional Cooperation in South Eastern Europe for Meteorological, Hydrological and Climate Data Management and Exchange to Support Disaster Risk Reduction"

Activity 4.4: Assessment of current institutional and technical capacity and mechanisms in Kosovo (as defined by UNSCR 1244/99) for delivery of hydrometeorological products and services

TERMS OF REFERENCE OF PROJECT CONSULTANT

Duration: 4 weeks, including: 1 week preparation of mission, 1 week mission to Kosovo (under UNSCR 1244/99) (November/December 2009), 2 weeks preparation of the assessment report.

Purpose: Assessment of the current status of the provision of meteorological and hydrological services in Kosovo (under UNSCR 1244/99), including the monitoring network, telecommunications, forecasting and warning capabilities, human resources and institutional arrangements. The focus is on the assessment of the capacity to contribute to disaster risk reduction activities. Assessment is to be done through a fact-finding mission.

Background: Under Security Council Resolution 1244/99, the UN Interim Administration Mission in Kosovo (UN MIK), has the mandate to provide an interim administration for Kosovo. Relations with International organizations are a necessary component of the mandate of UN MIK. The European Commission had included Kosovo (under UNSCR 1244/99) in the framework of IPA (Instrument for Pre-accession Assistance) and provided funds through the above project to extend the disaster risk reduction activities to the territory of Kosovo (under UNSCR 1244/99). The project activities coordinated by the WMO require a thorough analysis of the situation in Kosovo (under UNSCR 1244/99) regarding the availability of technical, human and institutional capacity to organize and provide meteorological and hydrological services and products in support to disaster risk reduction, including early warning system.

Duties: The consultant, specialist in meteorology and familiar with the situation in meteorology in SE Europe, will carry out, in close co-operation with UN MIK, the Agency for Coordination of Development and European Integration in the Office of the Prime Minister and the Hydrometeorological Institute of Kosovo (under UNSCR 1244/99), the following activities in coordination with WMO:

1. Preparation for the fact-finding mission:

   (a) Collection of relevant information available in WMO Secretariat and on the Internetas applicable for Kosovo (under UNSCR 1244/99);

   (b) Assistance in the preparation of the programme of the visit, which should be agreedin advance.

2. Visits and meetings:

(a) Visit to UN MIK and the Agency for Coordination of Development and EuropeanIntegration in the Office of the Prime Minister;

(b) Visit the local UNDP Office;

(c) Visit the European Commission Liaison Office in Pristina;

(d) Meeting with the Director of the Hydrometeorological Institute (KHMI) and visit to the Departments of KHMI, including weather forecast, climate, hydrology andenvironmental monitoring;

(e) Visits to at least one meteorological station and one hydrological post of KHMI;(f) Visit to other meteorological services, like aviation weather service, if not included in KHMI;

(f) Visit to meteorological station in Kosovska Mitrovica, which operates in close cooperation with the National Meteorological and Hydrological Service of Serbia;

(g) Visit to the Ministry of Environment and Spatial Planning, including the Water Department;

(h) Visit to the institution responsible for disaster risk management in Kosovo (under UNSCR 1244/99);

(i) Any other visit agreed with partners in “duties” above in the course of the mission.

3. Assessments:

(a) Assess the status of existing meteorological facilities, including meteorological, hydrological and environmental monitoring, data processing; telecommunication; forecasting; meteorological, climate and hydrological applications, instrumentation and workshop facilities in Kosovo (under UNSCR 1244/99);

(b) Assess the status of early warning systems for weather and climate related hazards and extreme events;

(c) Assess the capacity (technical, human and institutional) of the Meteorological and Hydrological Service of Kosovo (under UNSCR 1244/99);

(d) Assess the level of meteorological and hydrological service provision;

(e) Review the level of existing co-operation in the field of meteorology and hydrology in Kosovo (under UNSCR 1244/99) and at the international level;

(f) Identify possible areas to enhance the knowledge, to improve the technology, to reduce the costs of services and contribute to other aspects of capacity building of the meteorological and hydrological service in Kosovo (under UNSCR 1244/99);

4. Submit the fact-finding mission report to the Secretariat of the World Meteorological Organization.

Annex 2 to mission report

REGIONAL PROGRAMME ON DISASTER RISK REDUCTION IN SOUTH EAST EUROPE

Agenda
30 November – 04 December 2009

PURPOSE: Fact-finding mission to Kosovo as defined by UNSCR 1244/99 in order to assess the current state of the National Meteorological and Hydrological Service under the EC (DG Enlargement) Project

CONSULTANT: Mr. Dušan Hrček

Monday 30 November			
Participants	Institution / Subject	Time	Venue
Mr. Dušan Hrček Mr. Roque Raymundo	**UN Interim Administration Mission in Kosovo (UNMIK)**	10:30	UNMIK
Mr. Dušan Hrček Mr. Gazmend Selimi Ms. Vjosa Beqaj	**EC Liaison Office (ECLO)**	15:00	ECLO
Mr. Dušan Hrček Ms. Vjosa Beqaj	**Agency for Coordination of Development and European Integration**	16:30	Agency for Coordination of Development and European Integrat.

Tuesday 01 December			
Participants	Institution / Subject	Time	Venue
Mr. Dušan Hrček Dr. Sylë Tahirsylaj Ms. Vjosa Beqaj Ms. Hazbije Krasniqi	**Hydrometeorological Institute**	10:00	Hydrometeorological Institute
	Visit to a HM station	11:30	Hydroneteorological Institute
Mr. Dušan Hrček Mr. Albinot Bimbashi Ms. Vjosa Beqaj	**Agency for Coordination of Development and European Integration**	15:00	Agency for Coordination of Development and European Integrati.
Dr. Sylë Tahirsylaj Mr. Dušan Hrček	**Hydrometeorological Institute**	17:00	Hotel Prishtina

Wednesday 02 December 2009			
Participants	Institution / Subject	Time	Venue
Mr. Dušan Hrček Mr. Naser Bajraktari	**Ministry for Environment and Spatial Planning,**	10:00	Ministry for Environment and Spatial Planning,

Ms. Hazbije Krasniqi	Water Department		Water Department
HE Mr. Jožef Help Mr. Miha Erman Mr. Dušan Hrček	Embassy of Republic of Slovenia	15:30	Embassy in Prishtina

Thursday 03 December 2009			
Participants	Institution / Subject	Time	Venue
Mr. Dušan Hrček Mr. Sherif Gosalci Mr. Bahri Prebreza Mr. Bujar Surdulli	Aviation Weather Station	9:30	Aviation Weather Station, Airport Prishtina
Mr. Dušan Hrček Dr. Sylë Tahirsylaj Mr. Sherif Gosalci	Hydrometeorological Institute	11:30	
Mr. Dušan Hrček Mr. Muhamet Malsiu Ms. Hazbije Krasniqi Ms. miradije Asllanaj	Ministry for Environment and Spatial Planning, Environment Protection Department	14:00	Ministry for Environment and Spatial Planning, Environment Protection Department

Friday 04 December 2009			
Participants	Institution / Subject	Time	Venue
Mr. Dušan Hrček Mr. Edon Myftari Ms. Vjosa Beqaj	UNDP	09:00	UNDP
Mr. Dušan Hrček Mr. Fadil Kodra Mr. Alush Beqiri	Ministry of Internal Affairs, Department of Emergency Management	14:30	Ministry of Internal Affairs, Department of Emergency Management
Mr. Dušan Hrček Ms. Vjosa Beqaj	Wrap-up Meeting	16:00	Agency for Coordination of Development and European Integration

Saturday 05 December 2009			
Participants	Institution / Subject	Time	Venue
Mr. Dušan Hrček Dr. Sylë Tahirsylaj Mr. Sherif Gosalci	Wrap-up Meeting	09:00	Germia

Annex 3 to the mission report

List of officials met during the mission

Name	Position
Mr. Roque Raymundo	Senior Human Rights Advisor, UNMIK Mission H.Q., Prishtina
Mr. Gazmend Selimi	Senior Officer, European Commission Liaison Office (ECLO)
Mr. Edon S. Myftari	Programme Analyst – Justice & Security Sector, UNDP Office
Prof. Dr Sylë Tahirsylaj	Director, Hydrometeorological Institute (KHMI)
Mr. Sherif Gosalci	Manager, Meteo Department, Air Traffic Control Services (ATCS), Prishtina International Airport
Mr. Bahri Prebreza	Supervisor of the Forecasting Sub-Department, Meteo Department, ATCS
Mr. Bujar Surdulli	Supervisor of the Observing Sub – Department, Meteo Department, ATCS
Mr. Sabit Gashi	Observer, Meteo Department, ATCS
Mr. Albinot Bimbashi	Director, Human Development and Infrastructure Directorate, Agency for Coordination of Development and European Integration (ACDEI)
Ms. Vjosa Beqaj	Senior Officer for Coordination of Development and European Affairs – Environment, ACDEI
Ms. Hazbije Krasniqi	Head of Office for International Cooperation and European Integration, Ministry of Environment and Spatial Planning
Ms. Miradije Asllanaj	Officer for European Integration, Ministry of Environment and Spatial Planning
Mr. Sc. Naser Bajraktari	Director, Water Department, Ministry of Environment and Spatial Planning
Mr. Muhamet Malsiu	Director, Environment Department, Ministry of Environment and Spatial Planning
Mr. Fadil Kodra	Director, Department of Emergency Management, Ministry of Internal Affairs
Mr. Alush Beqiri	Senior Officer, Department of Emergency Management, Ministry of Internal Affairs
HE Jožef Hlep	Ambassador, Embassy of Republic of Slovenia, Prishtina
Mr. Miha Erman	Minister Counsellor, Embassy of Republic of Slovenia, Prishtina

Annex 4 to the mission report

Annex 4 to mission report

UNITED NATIONS
United Nations Interim Administration Mission in Kosovo

UNMIK

NATIONS UNIES
Mission d'Administration Intérimaire des Nations Unies au Kosovo

PROVISIONAL INSTITUTIONS OF SELF GOVERNMENT

KUVENDI I KOSOVËS
СКУПШТИНА КОСОВА
ASSEMBLY OF KOSOVO

Law No. 02/L-79

ON HYDRO-METEOROLOGICAL ACTIVITIES

Kosovo Assembly,

Based on Chapter 5.1 (i) and 9.1.26 (a). of the Constitutional Framework of Self-Government in Kosovo (UNMIK Regulation no. 2001/9, from 15 May 2001)

With the aim of good administration of Kosovo Hydro-Meteorological Institute, and the definition of this activity, policy and standards harmonization with World Meteorological Organization(WMO) and European Union:

Hereby adopts the following:

LAW ON HYDRO-METEOROLOGICAL ACTIVITIES

Article 1
Purpose

This law shall be regulate the hydro-meteorological works and the manner of their accomplishment.

Article 2
Definitions

Weather - represents the physical state of the atmosphere on a certain territory in a given time characterized by a determined combination of meteorological elements.

The climate - is characterized by a many yearlong regime of the weather in which are implied not only the dominant conditions but as well those possible of the weather for a given place or better to say in general the climate is determined as a result of all meteorological occurrences that characterized the average state of the atmosphere with a determined point of earth sphere. The clime represent a legal order of atmospherically processes that are created on a given place, as a result of complex interaction of solar radiation, solar circulation, atmosphere circulation and active covering surface, interaction which determine characteristical regime of the weather for a country.

First Resource - is the area of underground water on a fed up area and with direct contact with land surface.

KHMI - Kosovo Hydro-meteorological Institute

MESP - Ministry of Environment and Spatial Planning

Meteorological Occurrences are: Frost, Clouds, Rainfalls, Freezes etc.

Meteorological elements are: Temperature, wind, absolute and relative dampness, solar, atmospheric pressure etc.

Article 3

Regarding to this law the Hydro-meteorological works considered all the kind of element measurements and observation of the meteorological occurrences, hydrological, bio-meteorological, hydro-biological, elaboration and annunciation of the collected results of these measurements and observations, annunciation of regular and time by time information for weather, state of surface and underground waters, conduction and researching of the changes and occurrences of the atmosphere in hydrosphere with the importance for Kosovo economy, the study and assessment of their environmental impact.

Article 4

Kosovo Hydro-Meteorological Institute should accomplish the hydro-meteorological works.

Article 5

Hydro-meteorological works with interest for Kosovo are as following:

1. Construction and maintenance of the basic network of hydrological and meteorological stations,
2. Measurements and observations of the elements and occurrences: meteorological, hydrological, bio- meteorological, and hydro-biological,
3. Special measurements and observation on the field of radiation, radio-activity (in accordance with the law),
4. Measurements and observations of the electricity atmosphere and air, water pollution and rainfalls, according to the unique program and methodology that is valid for essential network stations,
5. Study, elaboration, conservation, exchange and data's annunciation of the hydro-meteorology and researching results on the monitoring network,
6. Organization, maintenance and calculating development, observation system of data base and accomplishing prognosis of the hydro-meteorological works,
7. Instrument maintenance and calibration for essential network of the stations,
8. The similar institutions that are engaged with the monitoring system are obligated to refer (for data base) to the KHMI,

9. Accomplishing the meteorological measurements and observations by the radar,

10. Accomplishing the systematic hydro-meteorological measurement and observation on the rivers waterfalls in usual cases and in cases of environmental disturbances, state of underground waters on the fed up ground, and on directly contact with the ground and underground, (on further text first resource),

11. The systematical pursuit and ascertainment of air pollution, rainfalls, underground and surface waters of first resource and ground, also the hydro-meteorological studies and conditions prognosis of the environment protection,

12. Publishing of the hydrological, meteorological analyses and short term specification of the: weather, water, ice on rivers, and weather impact on agricultural,

13. Premonition of any hydro-meteorological elementary fatality,

14. Given reports, foresight and premonition of central and local competent authorities on hydro-meteorological occurrences with importance for protection from flooding, ice, changes of water quality, as well as premonition regarding to the destruction and other water presented pollutions,

15. Weather studies, climate studies, underground and surface waters and their impact on the atmosphere,

16. Researching of weather changes, climates, waters discharged from artificial impact and study of the artificial activities methods about weather, climate and waters too,

17. Preparation of hydro-meteorological works and including of hydro-meteorological services for flood protection,

18. Other hydro-meteorological works which are determined by the law that is in interest for Kosovo.

Article 6

6.1. The financial means for financing of the Hydro-Meteorological works envisaged in Article 5 of this law shall be provided by the Kosovo's Consolidated Budget.

6.2. The financial means from paragraph 1 of this article shall be determined based on the yearly program of the work and pre-account for their realization which should be issued by KHMI until 30 September of the following calendar year.

6.3. The consent for yearly organization of the works and pre-account for their realization shall be given by the Government of Kosovo.

Article 7

7.1. The basic network of hydro-meteorological stations shall be determined with administrative order issued by the Government of Kosovo.

7.2. The proposal of basic network of hydro-meteorological station shall be prepared by KHMI, after it has received an Opinion by the competent Ministries for administration of nature resources.

Article 8

8.1. The hydro-meteorological works for their needs may be accomplished by physical and legal entities too, except of weather-forecast.

8.2. The authorities from paragraph 1 of this article are obliged that for the accomplishing of hydro-meteorological works from article 5 of this law for their need to take the consent by MESP, KHMI.

8.3. The legal and physical entities from paragraph 1 of this article are obliged that the acquired results by the monitoring to send to KHMI within 30 days.

Article 9

The researching, information results and data received with the accomplishing of the works from article 4 and 5 of this law are public data, except other cases envisaged by law.

Article 10

10.1. KHMI for the needs of physical and legal entities may accomplish any work envisaged by this article 5 of this law.

10.2. The financial means realized from the accomplishment of the works by legal and physical entities are incomes of Kosovo Consolidated Budget.

Article 11

11.1. Construction, reconstruction of hydro-meteorological buildings, or the accomplishment of other works on the buildings and the land on distance, from where shall be effected on nature regime or existing of the elements which monitored on the meteorological, hydrological stations, stations for monitoring of water, air and soil quality of the basic network may be done based on the competent body of Kosovo and competent Administration for the activities of water Economy.

11.2. Attached with the request for the issuing of the consent from paragraph 1 of this article, the investor is obliged to represent the opinion of KHMI too.

Article12

12.1. The owners, respectively the land users are obliged to allow the authorized persons to cross on their land, for accomplishing of hydro-meteorological works, in accordance with the law in force.

12.2. The owners, respectively the land users from paragraph 1 of this article have right for the compensation of any damage inflicted by the accomplishing of hydro-meteorological works according to the laws in force.

Article 13

13.1. All the persons that will act against the provisions of this law shall be considered as offences.

i. Legal entities will be fined from 3.000 until 30.000 Euro,
ii. Physical entities will be fined from 2.000 until 5.000 Euro,

13.2. If it starts the construction respectively reconstruction of the buildings or accomplishing of other works on the buildings and land on the distance that determine the change of natural regime or existing, Article 11. For the offences from paragraph 1 of this article will be fined the legal and physical person too, from 2.000 until 5.000 euro.

Article 14
Entry into Force

14.1. For the implementation of this law, all sub normative acts will be issued within a year.

14.2. All legal and sub legal acts, and those that are in contradiction with this law, shall not have effect from the day of entry into force of this law.

14.3. The present law shall enter into force after adoption by the Assembly of Kosova on the date of its promulgation by the Special Representative of the Secretary-General.

Law No. 02/L-79
15 June 2006

President of the Assembly

____
Kolë Berisha

5

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

COMMON NEEDS AND CHALLENGES OF THE NMHSs OF SEE TO SUPPORT DISASTER RISK REDUCTION EMERGING FROM THE NATIONAL POLICY DIALOGUES
HFA Priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation All countries in SEE are aware of the new DRR paradigm that followed the adoption of the HFA. The legislation related to disaster risk management has been recently or is currently being updated in many countries, however an appropriate legal and institutional DRR framework has not been established in many countries yet. There is a common need to mainstream DRR and to move to real implementation of the HFA by: - integrating DRR within other development plans and sectoral policies; - developing DRR Action plans; - establishing DRR institutional mechanisms at the local level; - establishing clear financial mechanisms to support DRR. Most countries of SEE have established or are in the process of establishing a National Platform for DRR. There is a need to clarify the DRR institutional framework in several countries where there are overlapping and redundancies among the national agencies including technical agencies such as the NMHSs.
HFA Priority 2: HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning There is a need for strengthened institutional coordination and cooperation among technical agencies and with the DRM agencies, including data exchanges, for the development of risk assessment and early warning systems in all SEE countries. All countries in SEE need to strengthen the technical and human capacities of their NMHSs to support DRR and specifically risk assessment and early warning systems. There is a need to enhance coordination between several agencies in charge of hydrometeorology (3 countries). Some countries need to invest in fully operational 24/7 hydrometeorological services (2 countries). Trainings and methodologies for the development of risk assessments and early warning systems are required for all SEE countries. Many countries have established a 112 system, and there is a need to clarify the differences and potential synergies between 112 system and EWS (4 countries) There is a need to strengthen linkages between DRR and adaptation to climate change policies and strategies
HFA Priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels All countries want to develop appropriate programmes and curricula to integrate DRR at all levels of education. There is a need to promote citizen awareness of the risks as well as of the existing mechanisms and systems set up to reduce risks such as EWS.
HFA Priority 4 Reduce the underlying risk factors All countries recommend mainstreaming DRR into development and governmental sectoral strategies and plans (urban and spatial planning, development plans…). There is a need to develop long-term DRR strategies in all countries and to strengthen partnerships with international and development partners and promote their increase involvement in DRR. There is a need to develop capacities for climate services to support medium to long term sectoral planning with respect to climate change in all SEE countries.
HFA Priority 5 : Strengthen disaster preparedness for effective response at all levels SOPs need to be well defined, regularly tested and continuously improved. There is a need to increase the use of simulation exercises. There is a need to strengthen preparedness for cross border hazards through regional and international cooperation.

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

HFA priority 1: Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
1: To improve and strengthen national and local government mechanisms to institutionalise lessons learned from previous disasters and incorporate them into DRR policy, planning and programming. Previous experiences of disasters and the response to them reveal and good knowledge of the disaster potential across the population and establish addressing disaster risk as a national priority. Capturing these experiences and using them to guide future DRR policy, planning and programming is an important step in ensuring that DRR is evidence-based and builds on the foundations of existing knowledge. Such mechanisms will help to promote and support dialogue, the exchange of information and coordination among relevant agencies and institutions at all levels with the aim of fostering a unified approach towards DRR. **2**: To establish a National Platform for Disaster Risk	**1**: To establish and adopt bylaws that support legislature pertaining to DRR. The mainstreaming of DRR into legislature, such as laws pertaining to spatial planning and forestry, in order to give greater legal authority to the process of building an effective DRR system and structure in Bosnia and Herzegovina, and ensure that the roles and responsibilities and mandates of the various technical agencies, such as the Hydro-met and seismological services, are properly reflected in the legal framework. **2**: To formulate the National Platform for Disaster Risk Reduction. A goal for the Government is the establishment of a National Platform which should design responsibilities at the national through to the local level and facilitate and coordination across sectors by maintaining a broad based dialogue at the national and regional level aimed at promoting awareness among the relevant sectors, and ultimately linking such coordination to national planning, budgeting and implementation of DRR	**1**: To encourage all existing disaster risk reduction actors in Croatia, as defined by the existing legal framework, to work together and invest additional efforts in recognizing and fulfilling existing disaster risk reduction tasks and responsibilities. **2**: To strengthen coordination, strategic planning and management of disaster risk reduction at the national level through modifications of the existing institutional set-up by empowering, i.e. providing authority, accountability and responsibility to the National Platform to evolve into a multi-	**1**: Integrate the DRR concept in Republic of Macedonia's key strategic documents and development and sectoral policies; Incorporate development and sectoral policies in a clear and comprehensive framework, i.e. produce a DRR Strategy which will link national, regional and local development priorities to natural disaster risk prevention and reduction; When incorporating DRR in national, regional and local sectoral policies institutions shall follow the DRR concepts and definitions accepted in the ISDR and use commonly accepted terminology. **2**: When incorporating DRR in the various sectoral policies, use harmonized methodology and coordinated approach, emphasizing the proactive approach to promotion of development, adaptation to climate change and reduction of natural disaster risks. **3**: Initiate adaptation/amendment of legislation to implement national and sectoral policies for accident and	**1**: To establish and adopt byelaws that support legislation pertaining to DRR in order to give greater legal authority to the process of building effective DRR systems and structures in Montenegro. **2**: To promote and support dialogue and exchange of information and cooperation among all relevant agencies and institutions at all levels aiming at fostering a unified approach to DRR. **3**: Creation of the National Platform for Disaster Risk Reduction which should establish responsibilities at the national through to the local levels, to facilitate coordination across sectors, relevant to DRR. **4**: Clarification of roles and responsibilities by	**1**: To encourage all existing disaster risk reduction actors in Serbia, as defined by the existing legal framework, to work together and invest additional efforts in recognizing and fulfilling existing disaster risk reduction tasks and responsibilities. **2**: To strengthen coordination, strategic planning and management of disaster risk reduction at the national level through the establishment of the National Platform as a multi-stakeholder national mechanism that serves as an advocate of disaster prevention and disaster risk reduction; provides coordination, analysis and advice on areas of priority; and undertakes strategic DRR planning and management. **3**: To further facilitate and enhance establishment of mirrored/similar/same mechanisms at the regional and local levels through strengthening and reinforcing local capacities, institutions and governance	**1**: To improve and strengthen national and local government mechanisms to institutionalize lessons learned from previous disasters and incorporate them into DRR policy, planning and programming in Turkey. **2**: To facilitate and support establishment of mirrored/similar/same mechanisms at the county and local self-government levels through strengthening and reinforcing local capacities, institutions, and governance capabilities. **3**: To establish a "National Platform for Disaster Risk Reduction".

Reduction. To further support the Government of Albania's existing and ongoing programme of disaster risk management, the establishment of a National Platform is proposed to strengthen the profile of DRR and to ensure that debate across all levels of government, technical agencies such as the hydro-meteorological, meteorological and the seismological services, civil society, non-governmental organizations and the private sector is ongoing and contributes actively to policy-making and planning. The National Platform will allow for the engagement of all major practitioners and technical specialists as well as representatives of communities and those affected. It will also promote awareness and coordination among the relevant sectors, and ultimately support the linking of such awareness and coordination to national planning, budgeting and implementation of DRR activities.	activities. **3**: To clarify the roles and responsibilities increased cooperation and improved communication between all relevant segments. Promote and support dialogue, the exchange of information and coordination among relevant agencies and institutions at all levels with the aim of fostering a unified approach towards disaster risk reduction. Also promote community participation in disaster risk reduction through the adoption of specific policies, the promotion of networking, the strategic management of volunteer resources, the attribution of roles and responsibilities and the delegation and provision of the necessary authority and resources. **4**: Efficient financial planning to ensure that DRR has its own budget allocation. Allocate resources for the development and implementation of disaster risk management policies, programmes, laws and regulations on Disaster Risk Reduction in all relevant sectors and authorities and at all administrative levels with budgets based on clearly prioritised actions.	stakeholder national mechanism that serves as an advocate of disaster prevention and disaster risk reduction; provides coordination, analysis and advice on areas of priority; and undertakes strategic DRR planning and management. **3**: To facilitate and support establishment of mirrored/similar/ same mechanisms at the county and local self-government levels through strengthening and reinforcing local capacities, institutions and governance capabilities.	disaster risk reduction for later national and local implementation; In a coordinated approach, mutual coordination and respect of each others' advantages the actors of the Crises Management and Protection and Rescue systems (CMC and DRP) shall remove shortcomings causing overlaps of institutions' national or local responsibilities or activities. **4**: The National DRR platform should blend into the current regulatory and institutional framework and continue its role as a public awareness promoter and a forum for harmonization and coordination of sectoral policies. The national platform shall improve its comparative advantages as an active and flexible forum for cooperation and initiation of projects and ideas that will facilitate efficient functioning of the DRR system.	positioning the Sector for Emergency Management in accordance with best international practices, in such a manner that it will have direct responsibility to the Government. **5**: Create a DRR action plan to enhance National Strategy for Emergencies with enumerated responsibilities and financial plan. **6**: Ensure financing mechanisms for Disaster Risk Reduction are in place, utilizing both regular budget resources and financial resources from donor community.	capabilities. **4**: To develop the National Strategy for DRR and protection in emergencies and corresponding Implementation/Action Plan as a first mutual step undertaken by the key disaster risk reduction actors, e.g. the Sector for Emergency Management of the Ministry of Interior, the Republic Hydrometeorological Service of Serbia, the Republic Seismological Institute , line Ministries and respective public enterprises, the Serbian Red Cross, research and education institutions, NGOs, civil society and business community toward integration of disaster risk reduction into the development policies, strategies and sectoral plans, followed with the implementation of the National Strategy.	

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

HFA priority 2: Identify, assess and monitor disaster risks and enhance early warning						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
3: To establish and invest in fully operational 24/7 hydro-meteorological services (technical and human resources) as well as in the seismological sector to support risk assessment and early warning systems and promote operational monitoring, warning, forecasting and mapping of meteorological, hydrological and seismological hazards. This will build on the existing Disaster Risk Assessment and the Vulnerability and Capacity Assessment undertaken with support from the ARC. It is critical to perform comparative analysis of the existing institutional and legislative arrangements for meteorological, hydrological and seismological services, upgrade and modernize hydro-meteorological and seismological observation networks, data management and forecasting systems and provide sustainable organizational, human and technical resources to maintain and operate them. It is also necessary to strengthen the early warning capacity with a multi-hazard approach and enhanced cooperation with the Ministry of Interior, General Directorate of Civil Emergencies and other key stakeholders and the National Civil Emergencies Plan, to	**5**: To enhance the technical and human resources of the hydrometeorological sector to support risk assessment and early warning systems by promote operational monitoring, warning, forecasting and mapping of meteorological and hydrological hazards. It is critical to urgently renew the legislation for Meteorological and Hydrological Services, upgrade and modernise the national hydro-meteorological observation network, data management and forecasting system and to provide sustainable organisational, human and technical resources to maintain and operate it. It is also necessary to strengthen the early warning capacity with a multi-hazard approach and cooperation with civil protection authorities and other stakeholders in line	**4**: To enhance the early warning system and interoperability of the System 112 through modernization of the continuous and real-time collection and information sharing by expanding the hydrological, meteorological and air-quality monitoring networks, establishing integrated fire-protection system and ensuring functional horizontal and vertical links among all disaster risk reduction actors. **5**: To strengthen technical and human resources of the State Seismological Survey, and enhance the modernization and improvement of the seismological monitoring network and data transmission system. **6**: To enhance technical and human resources of the Meteorological and Hydrological Service in operational monitoring, warning, forecasting and mapping of	**5**: CMC shall prepare a natural disaster risk analysis and monitoring methodology. In cooperation with other actors of the system, it shall organize appropriate training on that methodology; Improve cooperation between key institutions such as the CMC, PRD, HMS and IEEES for more efficient information exchange, implementation of standard operating procedures and their harmonization with the methodologies, procedures and s of the UN/ISDR, DRR, WMO and of the European institutions engaged in this fields. **6**: In cooperation with the other entities of the system, the CMC shall finalize the establishment of an	**7**: To establish a national system for collection, analysis and dissemination of all relevant disaster data (to inform Early Warning System, but also related to post-disasters data collection). **8**: To enhance institutional capacity by further developing capacity for Risk Assessment in the Sector for Emergency Management, Hydro-meteorology Institute and Seismology Institute. **9**: To enhance technical and human resources of the technical agencies, such as hydro-meteorological institute to support the early warning system. **10**: Increase capacity for Risk Assessments at Municipal Level (Sectors for Spatial Planning, local communities) with emphasis on Vulnerability Assessments. **11**: Establish	**5**: To enhance the early warning system and the establishment of the 112 system based in the Ministry of Interior through modernization of the continuous and real-time collection and information sharing by expanding the hydrological, meteorological, air, water, land, and biodiversity quality monitoring networks, establishing an integrated protection and rescue system and ensuring functional horizontal and vertical links among all disaster risk reduction actors. **6**: To strengthen technical and human resources of the Republic Seismological Institute of Serbia, and enhance the modernization and improvement of the seismological monitoring network and data	**4**: To establish and invest in fully operational 24/7 hydro-meteorological services (technical and human resources) as well as in the seismological sector to support risk assessment and early warning systems and promote operational monitoring, warning, forecasting and mapping of meteorological, hydrological and seismological hazards. **5**: To prescribe a new law for hydro-meteorological services in Turkey. **6**: To create appropriate mechanisms to increase coordination between the three hydro-meteorological organizations as a short term action. **7**: To strengthen technical and human resources of the Meteorological, Hydrological, and Seismological Services in operational monitoring, warning, forecasting and mapping of seismological, hydrological, meteorological and ecological risks, and also enhance the modernization and improvement of the monitoring networks and data transmission systems.

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

include contributions by the hydro-meteorological and seismological services. **4**: To create appropriate mechanisms to increase coordination between the three meteorological organizations. With three organizations responsible for delivering meteorological services in Albania (Institute of Environment, Water and Energy (IEWE); Albanian Air Force Meteorological Service (MWFS); and, Tirana International Airport Meteorological Service) there is a need to develop an appropriate framework with the legal basis to ensure that roles and responsibilities in DRR are clearly defined. **5**: To integrate policy, planning and programming in adaptation to climate change with DRR strategy. The frequency and magnitude of hydrological and meteorological hazards has the potential to increase due to climate change. It is critical to invest in local scale climate studies in order to promote adaptation to climate change and to ensure that climate change adaptation and DRR are integrated into one programme coordinated through the Directorate for Civil Emergencies and the hydro-meteorological service.	ministries. **6**: To enhance institutional capacity through multi-agency and multi-stakeholders (including both technical agencies such as Hydrometeorological services and civil protections and line Ministries) approach to carry out risk assessment too support policy and planning decision-making. **7**: To mainstream adaptation to climate change into DRR strategy. The frequency and magnitude of hydrological and meteorological extremes and hazards are predicted due to climate change. It is critical to invest in local scale climate studies in order to promote adaptation to climate change.	hydrological, meteorological and ecological risks. **7**: To further strengthen operational cooperation of the National Protection and Rescue Directorate and the Hydrological and Meteorological Service through joint training and improvements to the standard operating procedures across agencies linked to the different threat levels and lessons learnt from each disaster event. **8**: To enhance investments in climate modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors. **9**: To increase the awareness of the citizens and media regarding the early warning system and the European Emergency Number 112.	early warning system, which will be based on natural and manmade disaster risk analysis, monitoring, and information sharing. The CMC shall continue with the introduction of the European Emergency Number 112; In preventing natural meteorological disasters, it is crucial to increase the technical capacities and expertise of the national hydro meteorological service, particularly in early warning on meteorological and hydrological disasters by improving weather and water measurement, analysis and forecasting.	mechanisms to preserve existing and future capacity for Disaster Risk Reduction within relevant institutions. **12**: Work on regional harmonization of Risk Assessment related methodologies. **13**: Mainstream adaptation to climate change into all DRR strategic elements at all levels. **14**: To develop national capacities for climate services to support medium and long-term sectoral planning in the context of reducing overall risks, and with consideration for increasing climate associated risks.¨	transmission system and of the Republic Hydrometeorologic al Service of Serbia in operational monitoring, warning, forecasting and mapping of hydrological, meteorological, climate-related and ecological risks. **7**: To increase the awareness of the citizens and media regarding the early warning system and the Single European Emergency Call Number 112 as well as to raise public awareness and to inform and educate the population on disaster prevention measures.	**8**: To enhance the early warning system and interoperability of the System 112 through modernization of the continuous and real-time collection and information sharing by expanding the hydrological, meteorological and air-quality monitoring networks, establishing integrated fire-protection system and ensuring functional horizontal and vertical links among all disaster risk reduction actors. **9**: To further strengthen operational cooperation of the Disaster and Emergency Management Presidency, Hydrological and Meteorological Services through joint training and improvements to the standard operating procedures across agencies linked to the different threat levels and lessons learnt from each disaster event. **10**: To integrate policy, planning and programming in adaptation to climate change with DRR strategy.

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

HFA priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
6: To integrate DRR into the education system in Albania at all levels – primary, secondary, university. Building on existing levels of awareness and expanding understanding to incorporate the future threats from climate change and other hazards, as well as new development, it is recommended that the Ministry of Education examines the potential for integrating DRR as a part of national curricula at all levels, particularly in those areas showing the highest levels of risk. In addition, universities and other tertiary education institutions should be encouraged to establish research programmes encompassing different disaster risks, the results of which should have a natural outlet through the National Platform. **7**: To establish a National Training Centre for DRR and Civil Protection practitioners and community members, using the existing National Fire Fighting Training Centre as a foundation. The most challenging issue is the building (or, at least, the consolidation) of the culture of safety and resilience. This requires ongoing, continuous activities aimed at increasing community capacities, regular integration of DRR into (particularly local) development plans, training activities and simulation exercises for all levels, and, most importantly, greater potential for creating the potential for the development of the capacity of women as powerful agents of the transmission of the culture of safety and resilience to the younger generation. The establishment of a National Training Centre for DRR would support this ambitious agenda and assist the process of strengthening capacities within the many stakeholders.	**8**: To improve education of DRR. Promote engagement of the National Platform members, local communities and authorities such as police and fire brigade within the education programs in coordination with the Ministry of Education and local parent-teacher associations to develop sustainable public education programs at primary, secondary and tertiary levels so as to raise awareness and educate children about hazards.	**10**: The Ministry for Science, Education and Sport is mandated to mainstream disaster risk reduction into national educational curriculum by establishing Curriculum Revision Working Group composed of the representatives from the Ministry for Science, Education and Sport, from the National Protection and Rescue Directorate, Meteorological and Hydrological Service, the Republic Seismological Survey, other respective line Ministries, the Croatian Red Cross, expert organizations and	**7**: The Protection and Rescue Directorate and the Training and Exercise Centre shall increase their capacity for efficient training of the central, regional and municipal headquarters, of the rapid response teams, the professional and volunteer firefighters, the command staff and the rescue and protection forces. **8**: Establish partnership between educational, academic and research institutions and the Crisis Management System entities which promote and implement the DRR concept. The Ministry of Education and the Education Development Bureau, in cooperation with the educational and academic institutions, the CMS/PRS entities and CKRM, shall introduce continuous	**15**: To integrate DRR into curriculum at all levels of education. **16**: Develop capacity for DRR in media in order to raise level of public awareness on DRR. **17**: Create and implement a DRR Strategy for awareness raising, in order to raise level of overall understanding of the importance of Disaster Risk Reduction among population at large. **18**: Create national translation of UNISDR Terminology for Disaster Risk Reduction.	**8**: To encourage mainstreaming of disaster risk reduction into national educational curriculum by establishing Curriculum Revision Working Group composed of the representatives from the Ministry of Education, from the Sector for Emergency Management of the Ministry of Interior, the Republic Hydrometeorological Service of Serbia, the Republic Seismological Institute of Serbia, other respective line Ministries, the Serbian Red Cross, NGOs, international organisations, expert organizations and individuals as well as research and education institutions.	**11**: To integrate DRR into the education system in Turkey at all levels – primary, secondary, and university. **12**: To increase the awareness of the citizens and media regarding the early warning system and the European Emergency Number 112. **13**: The Ministry for National Education is mandated to mainstream disaster risk reduction into national educational curriculum by establishing Curriculum Revision Working Group composed of the representatives from the Ministry for National Education and Sport, from the Disaster and Emergency Management Presidency Meteorological and HydrologicalService, Universities, other respective line Ministries, the Turkish Red Crescent Society, expert organizations and individuals. **14**: To establish a National Training Centre for DRR and disaster and emergency management practitioners and community members, using

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

8: Supported through bilateral, regional and international cooperation and partnerships, sustainable development, poverty reduction, good governance and disaster risk reduction are mutually compatible objectives and strategies, and in order to meet the challenges ahead, accelerated efforts must be made to mainstream and integrate disaster risk reduction into development and governmental and sectoral strategies. Furthermore, efforts must be made to build the necessary capacities at all levels of institutional organization in Albania to manage and reduce risk. Such harmonization of mutually compatible objectives can help to counter the negative effects of increased population, unsustainable development practices, degradation of natural resources, the increasing exposure of the poor to disaster risks, ineffective forecasting, defective environmental control measures, inadequate capacity development and lack of appropriate market mechanisms, all of which are amplified if disaster risk is not addressed effectively as an integral component of the implementation of development. **9**: To support the development of studies and research around the reduction of specific risk factors that affect Albania. Although the major hazards that affect Albania are well known, far less is known about the detailed effects of these hazards, the vulnerabilities that are constructed in the face of these hazards and the capacities that are necessary to address them. Again, through the auspices of the National Platform for DRR, the results of studies and research can be examined and recommended for inclusion in development planning.		individuals.	DRR education and training and shall support national and local projects in cooperation with UNDP and other relevant international institutions. Introduce compulsory and elective DRR courses in primary, secondary and higher education that will develop a culture of prevention and care for the relations between man, environment and development (as called upon by the UN in Approaching United Nations Decade of Education for Sustainable Development 2005-2014).		**9**: Coordinated DRR research should be undertaken to improve methods for predictive multi-risk assessments and socioeconomic cost–benefit analysis of risk reduction actions at all levels. These methods should be incorporated into decision-making processes at regional, national and local levels. Strengthen the technical and scientific capacity to develop and apply those methodologies, studies and models, including the improvement of regional monitoring capacities and assessments.	the existing European Natural Disaster Training Center (AFEM) and/or Disaster and Emergency Training Center at DEMP as a foundation. **15**: To proceed with the establishment, in Turkey, of the Centre of Excellence for a Training of Fire Fighters and coordination of response to forest fires in the countries of South Eastern Europe, including the harmonization of the development of fire-fighting brigades in the countries of the region through standardization of equipment and procedures, thus promoting regional cooperation and collaboration in disaster risk reduction in South Eastern Europe.

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

HFA priority 4: Reduce the underlying risk factors						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
10: In the context of reducing overall risks, and with consideration for increasing climate associated, seismic and geological associated risks, to develop national capacities for climate (hydrological and meteorological) and geological (including seismological) services to support medium and long-term sectoral planning, as a critical aspect of disaster risk reduction. Enhanced investments are needed in climate data rescue, climate and geological modelling, forecasting and analysis to support sectoral planning in at-risk sectors. Development of these capacities would require a strong collaboration and coordination across many ministries and with the meteorological, hydrological and geological services, as well as enhanced regional cooperation in this area with other South East European and EU countries. **11**: To improve networking with international institutions/institutions present in the region and to promote the increased involvement of such organizations in the strengthening of DRR in Albania. To enhance regional and international cooperation	**9**: Reducing disaster risks by systematically integrating them into policies, plans and programmes for sustainable development and poverty reduction. Supported through bilateral, regional and international cooperation, including partnerships, sustainable development, poverty reduction, good governance and disaster risk reduction as mutually supportive objectives, and in order to meet the challenges ahead, accelerated efforts must be made to mainstream and integrate disaster risk reduction into development and governmental and sectoral strategies. Furthermore, efforts must be made to build the necessary capacities at all levels of institutional organization in Bosnia and Herzegovina to manage and reduce risk. In the context of the increasing risks associated with climate change, there needs to be enhanced investments in climate modelling and forecasting and analysis to support sectoral planning in at-risk sectors. **10**: In the context of reducing overall risks, and with consideration for increasing climate associated risks, development of national	**11**: To develop the disaster risk reduction Strategy and corresponding Implementation/Action Plan as a first mutual step undertaken by the key disaster risk reduction actors, e.g. the National Protection and Rescue Directorate, the Hydrological and Meteorological Service, the Republic Seismological Survey, line Ministries and respective public enterprises, the Croatian Red Cross, civil society and business community toward integration of disaster risk reduction into the development policies, strategies and sectoral plans, followed with the implementation of the said Strategy. **12**: To develop	**9**: Establish a comprehensive risk identification, analysis and monitoring process, including community risk exposure and community risk vulnerability assessment methodologies, for specific risks. The CMS entities shall develop appropriate risk exposure and vulnerability assessment methodologies, paying thereby attention to the socio-economic and gender aspects Separate funds shall be allocated within the existing budges to finance the DRR policy nationally and locally and to strengthen regional cooperation. **10**: Enhance the cooperation between HMS and the other entities to fully use HMS's potential for monitoring and early warning on the impacts of hydrological, meteorological and environmental risks (data, analyses, human resources, reporting).	**19**: Promote reduction of disaster risks by systematically integrating DRR outcomes and activities into policies, plans and programmes for sustainable development and poverty reduction as well as the National Development Plan. **20**: In the context of reducing vulnerability, integrate DRR in implementation and ongoing development of Government Plans for Informal Settlements. **21**: Develop national capacities for climate services to support medium and	**10**: To incorporate disaster risk assessments into the urban and spatial planning and management of disaster-prone human settlements, in particular highly populated areas and quickly urbanizing settlements. The issues of informal or non-permanent housing and the location of housing in high-risk areas should be addressed as priorities. Also, to mainstream disaster risk considerations into planning procedures for major infrastructure projects, including the criteria for design, approval and implementation of such projects and	**16**: To systematically integrate measures aimed at reducing disaster risks into policies, plans and programs for sustainable development and poverty reduction. **17**: To support the development of studies and research around the reduction of specific risk factors that affect Turkey. **18**: To develop national capacities for climate (hydrological and meteorological) and geological (including seismological) services to support medium and long-term sectoral planning, as a critical aspect of disaster risk reduction. **19**: Enhanced investments are needed in climate data rescue, climate and geological modelling, forecasting and analysis to support sectoral planning in at-risk sectors. **20**: To improve networking with international institutions present in the region and to promote the increased involvement of such organizations in the strengthening of DRR in Turkey. **21**: To develop national capacities for climate services

for the purpose of exchanging observation data, knowledge, technology and expertise regarding DRR, to share research findings, lessons learnt and best practice, participation in joint trainings and workshops all of which would contribute to enhancing the ability of Government of Albania to strengthen its DRR programme, raise overall awareness and improve capacity development measures.	capacities for climate services to support medium and long-term sectoral planing, is a critical aspect of risk reduction. Development of these capacities would require a strong collaboration and coordination across many ministeries and with the Meteorological and Hydrological Service, as well as enhanced regional cooperation in this area with other South Eastern European and EU countries. **11**: Networking with international organisations/institutions present in the region. There is a need to enhance regional and international cooperation for the purpose of transferring observation data, knowledge, technology and expertise regarding DRR, to share research findings, lessons learnt and best practice, participation in joint trainings and workshops all of which would contribute to enhancing the ability of governments to strengthen DRR mechanisms, raise overall awareness and improve capacity development measures. **12**: Examine the ways for establishment of regional funds for support to ongoing projects	national capacities for climate services to support medium and long-term sectoral planning through strong collaboration and cooperation across line ministries and with the Meteorological and Hydrological Service, and through enhanced regional cooperation with other South Eastern European and EU countries.		long-term sectoral planning in the context of reducing overall risks, and with consideration for increasing climate associated risks.	considerations based on social, economic and environmental impact assessments. **11**: To develop national capacities for climate services to support medium and long-term sectoral planning through strong collaboration and cooperation across line ministries and with the Republic Hydro-meteorological Service of Serbia, and through enhanced regional cooperation with other South Eastern European and EU countries and Centres.	to support medium and long-term sectoral planning through strong collaboration and cooperation across line ministries and with the Meteorological and Hydrological Service, and through enhanced regional cooperation with other South Eastern European and EU countries. **22**: To enhance investments in climate modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors. **23**: To develop the disaster risk reduction Strategy and corresponding Implementation/Action Plan as a first mutual step undertaken by the key disaster risk reduction actors, e.g. the Disaster and Emergency Management Presidency, the Hydrological and Meteorological Service, seismological observations and survey, line Ministries and respective public enterprises, the Turkish State Meteorological Service, civil society and business community toward integration of disaster risk reduction into the development policies, strategies and sectoral plans, followed with the implementation of the said Strategy.

ANNEX 4: ANALYSIS OF THE RECOMMENDATIONS FROM THE NATIONAL POLICY DIALOGUES

HFA priority 5: Strengthen disaster preparedness for effective response at all levels						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
12: To strengthen disaster preparedness for effective emergency response at all levels and to promote disaster prevention. First, ensure that emergency response plans are targeted to the individual needs of the vulnerable communities, authorities and emergency responders. Second, establish guidelines for systematic development of contingency plans at all levels that are backed by the requisite human, material and funding resources. Lastly, harmonise standard operating procedures governing response to emergencies and standardize terminology and capacity development taking into account roles and responsibilities in emergency response. **13**: To strengthen awareness about the importance of preparedness. Promote the engagement of the media in order to stimulate a culture of preparedness and strong community involvement through sustained public education campaigns and public consultations at all levels of society. **14**: To increase the involvement of the private sector in activities aimed at DRR with special emphasis placed on insurance companies for the purpose of building on achievements already made in promoting public private partnerships (PPP) to better engage the private sector in DRR activities. This can be done by encouraging the private sector to place greater emphasis on and allocate more resources to pre-disaster activities, such as risk assessments and early	**13**: Strengthen disaster preparedness for effective emergency response at all levels. First, ensure that emergency response plans are targeted to the individual needs of the vulnerable communities, authorities and emergency responders. Second, establish guidelines for systematic development of contingency plans at all levels that are backed by the requisite human, material and funding resources. Lastly, harmonise standard operating procedures governing response to emergencies and standardize terminology and capacity development taking into account roles and responsibilities in emergency response. **14**: To strengthen awareness about the importance of DRR. Promote the engagement of the media in order to stimulate a culture of preparedness and strong community involvement through sustained public education campaigns and public consultations at all levels of society. **15**: Increase the involvement of the private sector in activities aimed at capacity development with	**13**: To proceed with the establishment, in Croatia, of the Centre of Excellence for a training of fire fighters and coordination of response to forest fires in the countries of South Eastern Europe, including the harmonization of the development of fire-fighting brigades in the countries of the region through standardization of equipment and procedures, thus	**11**: Strengthen technical and human resources of the hydro-meteorological sector to support risk assessment and early warning systems by promoting operational monitoring, warning, forecasting and mapping of meteorological and hydrological hazards. It is critical to upgrade and modernize the national hydro-meteorological monitoring and information exchange network and the forecasting system and to provide sustainable organizational resources, human resources (education and training, IT expertise, international cooperation) and technical resources (upgrade the automatic hydrological and weather radar network, integrate hydrological models in NWP modelling, integrate air pollution dispersion models with NWP modelling) and increase the budget available to HMS for efficient meteorological and hydrological disaster risk monitoring, forecasting and warning. **12**: Strengthen human resources for hydrological data management and analysis, modelling and water forecasting with at least 6 hydrologists (Construction Engineers – hydrology major); Strengthen human resources	**22**: Strengthen the sustainability of disaster preparedness systems and structures through: • Developing capacities for the implementation of policies, strategies and mechanisms for disaster preparedness and response to ensure sound linkages between international, national and local levels; • Ensuring protocols and mechanisms of information management for effective response are permanentl	**12**: To further strengthen operational cooperation of the Sector for Emergency Management of the Ministry of Interior and the Republic Hydro-meteorological Institute of Serbia through joint training and improvements to the standard operating procedures across agencies linked to the different threat levels and lessons learnt from each disaster event. **13**: To strengthen technical and human resources of the Sector for Emergency Management, build capacities of the operational units within the Sector and strengthen regional cooperation and collaboration on the technical level through joint training. **14**: To enhance the development of the National Training Centre of the Sector for Emergency Management, i.e. to augment the implementation pace of the National	**24**: To strengthen disaster preparedness for effective emergency response at all levels and to promote disaster prevention in Turkey. **25**: To promote the engagement of the media in order to stimulate a culture of preparedness and strong community involvement through sustained public education campaigns and public consultations at all levels of society. **26**: To increase the involvement of the private sector in activities aimed at DRR with special emphasis placed on insurance companies for the purpose of building on achievements already made in promoting public private partnerships

warning systems and through the promotion of the development of financial risk-sharing mechanisms, particularly insurance and reinsurance against disasters. **15**: To strengthen regional and international links to support more effective fire risk preparedness and prevention. During the last two decades the occurrence of forest fires in Albania and across the region as a whole has increased in number and also in the size of the area affected, the main causes being human negligence and pasture burning. Preparedness to reduce forest fire impacts includes the creation of coordination mechanisms between the forestry administration, local authorities, hydro-meteorological services and the population, as well as civil emergency authorities (particularly fire fighters). Regional cooperation in addressing the fire risk should be strongly promoted as there is an increasing fire risk throughout the region. Existing regional cooperation can serve as a good basis for such developments. **16**: To increase the use of simulation exercises (including table-top exercises) as a regular feature of emergency response and preparedness training. Increasing and cumulative experience of disasters allows for the understanding and lessons learned to be used in practising response and preparedness procedures through all types of simulation exercises either in field situations or the classroom	special emphasis placed on insurance companies for the purpose of developing sectoral involvement in DRR. There is a need to promote the establishment of public private partnerships to better engage the private sector in Disaster Risk Reduction activities. This can be done by encouraging the private sector to place greater emphasis on and allocate more resources to pre-disaster activities, such as risk assessments and early warning systems and through the promotion of the development of financial risk-sharing mechanisms, particularly insurance and reinsurance against disasters. **16**: Increase the involvement of the NGO sector in activities related to DRR. Promote programmes for technical cooperation, capacity development, the development of methodologies and standards for hazard and vulnerability monitoring and assessment, the sharing of information and effective mobilisation of resources with a view to supporting national and regional efforts aimed at developing and strengthening DRR.	promoting regional cooperation and collaboration in disaster risk reduction in South Eastern Europe.	for automatic hydrological and meteorological observation station maintenance with 3 electronics technicians; Make organizational changes within HMS with emphasis on water forecasting and flood protection and meteorology (measurement instruments calibration); Modernize the Hydrological Information and Forecasting System. **13**: Strengthen, modernize and regularly maintain hydrological and meteorological monitoring, and regularly upgrade measurement networks with modern monitoring, data collection and transfer systems using plans and standards; Include weather radars in hydrological monitoring as technically most efficient measurement tools for rain analysis and water and flood forecasting,, especially for early warning on flash floods. **14**: Make hydrological models for water and long distance wave travel forecasting for rivers Vardar and Strumica, Crn Drim and their tributaries. Put in place a hydrological warning and alarming system, containing information on extremely dangerous water thresholds and hydrological maps for risky floodable areas in urban and rural areas.	y in place and regularly updated to anticipate future disasters. **23**: Ensure standard operating procedures in response and response preparedness are well defined, regularly tested and continuously improved. **24**: Define and improve role of media during disasters. **25**: Introduce post-disaster recovery into disaster preparedness planning.	Training Centre Action Plan (as defined by the USAID funded PPES Program) and promote education and training of individuals to properly respond in case of disasters. **15**: To proceed with the establishment of the Regional Centre for Emergency Management in Serbia, which will serve as a training centre and as preparedness and response coordination and management centre in the South Eastern Europe, where multi-hazard rescue teams and first responders of different expertise will be situated with all necessary personal and team equipment and emergency relief goods, and which will be part of the network of regional centres of excellences promoting regional cooperation in disaster risk reduction in SEE	(PPP) to better engage the private sector in DRR activities. **27**: To strengthen regional and international links to support more effective wild fire risk preparedness and prevention in Turkey. **28**: To increase the use of simulation exercises (including drills, orientations, functional and table-top exercises) as a regular feature of emergency response and preparedness training in Turkey. **29**: To proceed with the establishment, in Turkey, a "National Exercise Simulation Center" (NESC) at DEMP Headquarters.

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Operational relationships with other agencies						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
4. There is an urgent need to develop Standard Operating Procedures (SOP) that would clarify the roles and responsibilities and the cooperation mechanisms for the development, the issuance and the dissemination of warning products and services; **5**. There is the need to clearly define role and responsibilities of different institutions in floods and drought risk assessment and management, particularly amongst GDCE, MAFCP, MEFW and IEWE.	**4**. It is critical to establish better cooperation between the entity Institutes, FHMI and RHMS RS, so that entity prognostic services within the methodology of their work incorporate making joint analysis, forecasts and warnings for the level of Bosnia and Herzegovina, and if possible to establish one 24/7 state level hydro-meteorological and seismological science based multi-hazard analysing and warning centre; **5**. There are urgent needs to improve cooperation and data exchange; **6**. There are needs to establish Standard Operating procedures (SOP) and Quality Management Systems (QMS) between the hydrometeorological services and the DRM sector.	**4**. There is need to improve the cooperation at the national level between DHMZ and NPRD and relevant institutions and end-users to further enhance national system for preventing and mitigating the impact of extreme weather and climate events.	**4**. There are needs to improve cooperation with other technical agencies, including the Crisis Management Center and the National Protection and Rescue Directorate, through the understanding of their specific needs, the development of specific SOPs for warning and other products and services, as well as feedback mechanisms.	**3**. There are needs to promote cooperation with other technical agencies.	**3**. There are needs to promote cooperation and strategic partnerships with other technical agencies in Serbia and with advanced EU NHMSs; **4**. There are needs to foster the visibility of RHMSS in general and within the DRR management.	**4**. There is urgent need to promote cooperation between DMI, DSI and General directorate of Electric Power resources.
Synthesis						
There are urgent needs in most countries to clearly define roles and responsibilities of the various agencies within the DRR framework, and to improve the cooperation among the NMHS, other technical agencies and the DRM agencies, particularly for data exchange, risk assessment and early warning systems. In this respect appropriate SOPs should be defined within a Quality Management System in most SEE countries						

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Monitoring and observations networks and data exchange						
ALBANIA	**BiH**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
5. There is an urgent need to upgrade the Albanian meteorological and hydrological networks to meet the WMO standards and recommendations, and with consideration of the good practices of European NMHS; **6**. There is a need to revitalize the network of synoptic, climatological and hydrological stations and gradually develop the network of automatic observations stations; **7**. There is an urgent need to upgrade the calibration and maintenance system of the meteorological and hydrological equipment; **8**. There is a need to further strengthen the observation network by developing remote sensing systems, including one upper-station, one or two weather radars and a lightning detection system; **9**. There is an urgent need to develop real-time communication system for observations and data, including the connection to the WMO GTS.	**7**. There is an urgent need to upgrade and further modernize the meteorological and hydrological networks in Bosnia and Herzegovina and to gradually develop the network of automatic observations stations; **8**. There is an urgent need to upgrade the calibration and maintenance system of the meteorological and hydrological equipment and to achieve the WMO standards for measurements; **9**. There is a need to further strengthen the observation network by developing remote sensing systems, including one upper-station, one or two weather radars and a lightning detection system; **10**. There are needs to improve the data transfer systems; **11**. There is an urgent need to develop real-time communication system for observations and data.	**5**. There are needs to modernize the hydrological and meteorological early warning systems - in terms of real-time data collection and dissemination of information; **6**. There are urgent needs to further automatize the hydrological, meteorological and marine observation systems and to increase the number of automatic stations in cooperation with DRR management and industry; **7**. There is a need to further strengthen the observation network by developing remote sensing systems, including 4-5 dual-polarization weather radars.	**5**. There are urgent needs to implement a proper calibration and maintenance of sensors in order to meet the WMO standards of measurements; **6**. It is necessary to upgrade and modernize the weather radar network with 2-3 modern radars; **7**. Investments in implementation of two daily upper air soundings would benefit the regional and local weather forecasts; **8**. There are needs to strengthen and modernize the meteorological and hydrological surface networks and to increase the number of automatic stations; especially additional rain gauge and water level automatic stations on upstream catchments; **9**. There are urgent needs to enhance international and regional data exchange.	**4**. There is an urgent need to establish a reliable calibration and maintenance system in order to produce measurements which meet the WMO standards; **5**. There are urgent needs to establish automated weather stations at sea and coastal regions, where the tourism is growing rapidly; **6**. There are urgent needs to establish a weather radar network; **7**. There are needs to establish 1 upper air sounding station; **8**. There are needs to establish automatic hydrological stations.	**5**. There are urgent needs to modernize the weather radar network in Serbia and to establish regional data exchange system in order to produce regional near real-time composite pictures; **6**. There urgent needs to enhance the financial resources to maintain and upgrade the surface observation networks and increase the number of on-line meteorological and hydrological stations; **7**. There are needs to establish the second upper air station and to implement the AMDAR system; **8**. There are urgent needs to enhance regional real-time data exchange of hydrological and meteorological measurements.	**5**. There are urgent needs to enhance and modernize the weather radar network and produce real-time composite pictures of precipitation; **6**. There is an urgent need to enhance the number of on-line stations in the meteorological, hydrological and maritime observation networks; **7**. It would be vital to enhance the production and use upper air data by using wind profilers and/or AMDAR data.

Synthesis

There are urgent needs to upgrade and further modernize the meteorological and hydrological network in all SEE countries by:

- upgrade the calibration and maintenance systems per WMO standards (5 countries)
- developing the network of Automated Weather and Hydrological Stations (all countries)
- developing the remote sensing systems, including upper air sounding stations (6 countries), weather radars (7 countries), lightning detection systems (2 countries)
- developing or improving real time communication system for observation and data at the national level (2) and at the regional levels (4)

There are also urgent needs to develop the marine observation networks in the four coastal countries

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Forecasting

ALBANIA	BiH	CROATIA	FYROM	MONTENEGRO	SERBIA	TURKEY
10. There is an urgent need to develop an operational forecasting system that would issue regularly short-term and medium term forecasts products; **11**. There is a need to further develop capacities to support DRR through nowcasting; **12**. There is a need to Improve the capacities to use Numerical Weather Prediction (NWP) products; **13**. There is a need to develop and integrate additional modelling for hydrology, air quality, and sea-wave and to link these models to NWP; **14**. There is a need to improve capacities to use automatic analyzing, editing and dissemination tools; **15**. There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks.	**12**. There is a need to Improve the capacities to produce and use Numerical Weather Prediction (NWP) products; **13**. There is a need to promote memberships in ECMWF and EUMETSAT; **14**. There are needs to join some of the European NWP consortium would benefit the NWP modelling; **15**. There is a need to develop and integrate additional modelling for hydrology, air quality, and sea-wave and to link these models to NWP; **16**. There is a need to improve capacities to use automatic analysing, editing and dissemination tools; **17**. There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks.	**8**. There is a need to further develop capacities to support DRR through nowcasting; **9**. There is a need to improve the capacities in Numerical Weather Prediction (NWP) modelling to produce operationally mesoscale products and to implement data assimilation; **10**. There are needs to promote use of very high resolution NWP models, which are essential for hydrological modelling in complex terrain; **11**. There are urgent needs to implement hydrological forecasts; **12**. There is a need to improve capacities to use automatic analysing, editing and dissemination tools; **13**. There is a need to invest in proper back up capacity for NWP modelling.	**10**. There is an urgent need to take in use hydrological models; **11**. There is an urgent need to establish a warning system for floods and flash floods; **12**. There is a need to promote NWP modelling through membership in a European NWP consortium; **13**. There is an urgent need to become a member of the SEEVCCC cooperation to promote national bases to adapt to climate change; **14**. There is need to implement analysing, editing and visualization tools.	**9**. There is a need to further develop capacities to support DRR through nowcasting and long-term forecasting; **10**. There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks; **11**. There is a need to develop and integrate additional modelling for hydrology and air quality and to link these models to NWP; **12**. There is a need to improve capacities to use automatic analysing, editing and dissemination tools.	**9**. There are needs to promote production of regional weather radar composite pictures to promote short term weather forecasts; **10**. There are needs to promote use of weather radar data as input for numerical flood models; **11**. Implementation of data assimilation in NMP modelling would promote quality of weather predictions and thus also other forecasts; **12**. Membership in an international NWP model consortium would promote NWP modelling of RHMSS; **13**. There is a need to improve the automatic analysing and editing tools to help the work of forecasters; **14**. There are needs to promote provision of technical advice and specifications to enhance products and services to industry and disaster risk reduction applications; **15**. There are needs to ensure adequate replacement of computers and components as the life cycle of them is quite short.	**8**. There are needs to promote nowcasting and numerical mesoscale modelling; **9**. There are needs to promote data assimilation in NWP modelling; **10**. There are needs to promote seasonal forecasting; **11**. There are urgent needs to implement hydrological models to be used over the country; **12**. There are needs to promote assortment of numerical models (hydrological, dispersion of airborne pollutants, drift models, wave,..) and link them to the NWP models; **13**. There are needs to promote the computer back-up system of NWM modelling; **14**. There are to enhance investments in climate change modelling and forecasting and analysis to support strategic and sectoral planning for at-risk sectors and investment plans of industry in order to promote economic development of the country.

Synthesis

There is an urgent need to develop an operational forecasting system (1 country)
There are needs to develop or strengthen nowcasting capacities to support DRR (5 countries) including by developing the production of regional weather radar composite
There is a need to improve the capacities to use Numerical Weather Prediction (NWP) products and to join European or international NWP model consortium (all countries)
There are urgent needs to develop hydrological modelling and to link these models to NWP and weather radar data for flood forecasting in many countries (6 countries)
There is a need to improve the automatic analysing and editing tools (all countries)
There is a need to improve the technical capacities to develop monthly and seasonal climate outlooks (5 countries).

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Hydrometeorological data management systems

ALBANIA	BOSNIA AND HERZEGOVINA	CROATIA	FYROM	MONTENEGRO	SERBIA	TURKEY
16. There is an urgent need to initiate a data rescue programme to digitize and quality ensure the historical data; **17**. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.	**18**. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data; **19**. There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data; **20**. There is an urgent need to establish a national database system; **21**. There is an urgent need to establish a combined state level hydrometeorological database including the data collected by the Water Agencies.	**14** There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data; **15** There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.	**15** There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data; **16** There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data. Specifically, the following tools and appropriate training would be required: New version of CLIDATA and training, update of HYDROPRO hydrological data base and training and additional component of the DEMAS Software for collecting Hydrological Data from automatic stations (DEMAS db); **17** There is a need to develop an agrometeorological database, including also phenological data.	**13**. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data; **14** There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data.	**16**. There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data; **17** There are need to enhance the capacity to use more data in real-time.	**15**. It is critical to establish a national hydrometeorological database; **16**There are needs to strengthen the data management capacity to promote data assimilation to be used in NWP modelling.

Synthesis

There is an urgent need to initiate a data rescue programme to digitise and quality ensure the historical data (6 countries);
There is a need to develop the technical capacities for data management and to adopt automatic quality control systems of hydrometeorological data (5 countries)
There are also needs to develop national hydrological or agrometeorological databases that would link all existing databases in one unified at the national level.
There are needs to strengthen data management capacities for real time (2 countries)

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Hazard analysis and mapping to support risk assessment						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
18. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment; **19**. There is a need to acquire capacities and software for meteorological and hydrological analysis, GIS and hydrological modelling.	**22**. There is an urgent need to implement modern user friendly software for climatological and hazard analyses; **23**. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment; **24**. There is a need for GIS training, software and layers for hazard mapping. GIS compatible with the system that water agencies already have is needed (GIS components including layers, GIS software and hardware); **25**. There is the need of developing numerical hydrological modelling and training; **26**. There is the need to develop hazard databases	**16**. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment; **17**. There is a need to strengthen the systematic collection of drought/floods impact information on a state level with standardized procedure and long-lasting approach; **18**. It is necessary to invest more in climate mapping, forecasting and analysis so as to plan adequate adaptation measures in risk-exposed sectors; **19**. There is a need to train staff in drought/floods analyzing, forecasting and warning to better respond to the requests of users or in the case that DHMZ is charged of other activities in risk assessment; **20**. There is a need to strengthen GIS and remote sensing capacities for the agrometeorology Division, to strengthen agrometeorological modelling for specific crops (grape, olives) .agrometeorological operational modelling and forecasts, application of	**18**. There is a need to define standard methodologies for hazard characterization and mapping, and for hazard risk assessment; **19**. There is a need to develop hazard analysis and mapping based on historical data and climate change projections to support risk assessment; **20**. There is a need to strengthen the systematic collection of drought/floods impact information on a state level with standardized procedure and long-lasting approach; **21**. There is a need to strengthen GIS, spatial analysis and remote sensing capacities for hazard analysis and mapping, including GIS software and training, access to an officially agreed DEM; **22**. There is a need to strengthen the agrometeorology capacities of HMS to	**15**. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment; **16**. There is the need to develop capacities in the use of GIS, spatial analysis and management of geographic data; **17**. There is the need to develop capacities in hydrological analysis; **18**. There is the need to develop capacities in agrometeorological and drought analysis, including remote sensing applications; **19**. There is the need for better management of hazard impact data.	**18**. There is the need of wide capacity building programs in vulnerability and risk assessment of all types of hazards; **19**. There are needs to promote hazard mapping and risk analyses through digitalization of historical data; **20**. There are needs to receive guidance and training in hazard analyses; **21**. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment; **22**. There is the need to develop a shared methodology for drought risk assessment and assessment of vulnerability to drought in agriculture; **23**. There is the need to develop a shared methodological framework for the integration of climate change products in floods risk assessment; **24**. There is the need of integrating climatic change analysis in disaster risk reduction and particularly in drought and floods risk assessment through guidance and training in the use of climate change information; **25**. There is the need of agreed and shared methodologies for impact assessment and collection and management of	**17**. There is an urgent need to establish a national combined hydrometeorological database; **18**. There is a need to develop hazard analysis and mapping (through GIS tools) based on historical hydrological and meteorological data and climate change projections to support risk assessment; **19**. There is a need for strengthening the collaboration amongst AFAD, DMI and DSI in order to improve the risk assessment capacities end the quality of products provided by different institutions; **20**. There is a need for a comprehensive methodology for flood risk assessment, including the specifications of information to be provided by relevant institutions, the characteristics of hazard database, containing not only impacts but also physical dimensions of the hazard, etc.; **21**. There is a need to better define the institutional framework for drought risk assessment, with clear share of roles and responsibilities amongst different institutions and gathering the analysis of

	including impacts and hazard extent.	seasonal weather forecasts for crop yield modelling and to involve young scientists in agrometeorology.	support drought risk assessment (calculation of drought indices, water balance model, crop coefficients, use of remote sensing information in agrometeorology).		structured and harmonised data on disasters impact necessary for vulnerability assessment; **26**. There is the need of Training in GIS and remote sensing applications in agrometeorology.	different aspects of drought under the coordination of AFAD; **22**. There is a need of training DMI experts of Agrometeorological Division in remote sensing applications.

Synthesis

There is a need to develop hazard analysis and mapping (through GIS tools) based on historical data and climate change projections to support risk assessment (all countries)
There is a need to define standard methodologies for hazard characterization and mapping, and for hazard risk assessment
There is the need to strengthen the collection of hazard data including impacts and hazard extent and to develop and maintain corresponding hazard databases (5 countries)
There is the need to develop capacities in the use of GIS, spatial analysis and management of geographic data; remote sensing (all countries)
There is a need to develop hydrological modelling for flood risk assessment (4 countries)
There is the need to develop a shared methodological framework for the integration of climate change products in hazard risk assessment (most countries)
There is a need to clearly define the institutionnal framework related to risk assessment and to specifically define the role of the NMHSs

Information technology and telecommunication issues

ALBANIA	BOSNIA AND HERZEGOVINA	CROATIA	FYROM	MONTENEGRO	SERBIA	TURKEY
20. There is an urgent need to reinstalled the connection to WMO Global Telecommunication System (GTS); **21**. There is a need to ensure a data link to the observations sites; **22**. There is an urgent need to put into operation a website for public weather service and warning dissemination.	**27**. There is urgent need to promote the capacity of FHMI and RHMS RS to build their information and communication systems to an international level; **28**. There are needs to take in use modern tools to automate production of services; **29**. There are needs to improve the web pages.	**21**. There are urgent needs to promote automatic production of tailored end-user-orientated services and automatic dissemination of forecasts and warnings.	**23**. There are needs to improve and modernize the communication facilities by introducing modern technology for information dissemination and its automatization. .	**20**. There are urgent needs to upgrade the communication system to promote on-line and real-time data collection; **21**. There are urgent needs to modernize the communication systems to efficiently disseminate warnings and other products.	**27**. There is a need to improve the dissemination tools to enhance the quality of data available on internet, to produce automatically tailored ready-to-print products to media and to have automatic translation of forecasts to different languages;	**23**. There is a need to modernize the data communication systems to a level of advanced EUMETNET NHMSs.

Synthesis

There is an urgent need to reinstall the connection to the WMO GTS (2 countries)
There are needs to modernize the telecommunication system for automatizaton and dissemination of forecasts and warnings (all countries)
There are needs to develop or improve websites for a better public weather service (3 countries)

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Warning products and services

ALBANIA	BOSNIA AND HERZEGOVINA	CROATIA	FYROM	MONTENEGRO	SERBIA	TURKEY
23. There is an urgent need to establish a 24/7 science based analyzing, forecasting and warning system; **24**. There is an urgent need to design and develop meteorological, hydrological and environmental warning products and services (i.e. format, thresholds) in close cooperation with the DRM stakeholders; **25**. There is an urgent need to develop SOPs that would specify the actions for the development, issuance and dissemination of warning products and services under a Quality Management System (QMS) framework.	**30**. There are urgent needs to establish threshold values and criterion for different types of warnings; **31**. There is an urgent need to establish a 24/7 analysing, forecasting and warning system; **32**. There in urgent need to strengthen the capacity of the hydrometeorological services to produce flood warnings, to operate hydrological models and to connect hydrological to numerical weather models; **33**. There is an urgent need to engage meteorological and hydrological as well as seismological experts within the 112 center; **34**. It is necessary to clarify the mandates and communication routes for alerts, advisories, warnings and alarms from state level to different levels all the way down to the grass root level (individual people) using state-of-the-art communication systems; **35**. There are needs to promote provision of direct active warning mechanism from NMHSs to the TV and radio, in order to promote dissemination of warnings to the public, and to establish state-of-the-art dissemination mechanisms for real-time hydrological and meteorological observations and warnings to the authorities and the 112 center; 36. There are needs to improve the exchange with end users in terms of information and support fostering the appropriate use of information, receiving feedbacks and suggestions for improving the delivered services; **37**. There are needs to have international certification for operation of the institutes and production of services.	**22**. There is an urgent need to establish a 24/7 science based analysing, forecasting and warning system at DHMZ; **23**. There is urgent need to promote production of flood and flash flood warnings; **24**. To increase the number of warning products; **25**. There is need to give the DHMZ mandate to have alarms shown on every TV channel as an info-stripe when needed.	**24**. There are needs to further improve the warning products; **25**. There are urgent needs to promote cooperation with the media; **26**. There are urgent needs to establish a feedback mechanism from end users or stakeholders ensuring that information reached its target audience in a timely manner, suitable format and with requested contents.	**22**. There are needs to enhance the mandate and capacity of HMI to produce and issue more weather and climate related warnings efficiently and timely; **23**. There is an urgent need to establish a 24/7 analysing, forecasting and warning system at HMI; **24**. There are needs to further promote cooperation between HMI and different socio-economic sectors in order to increase the number of special services and warnings tailored to the needs of customers; **25**. There are urgent needs to automate the warning production and dissemination systems.	**28**. There are needs to provide further education and training for forecasting of natural hazards; **29**. There are needs to enhance exchange of information of airborne and waterborne pollutants; **30**. There is a need to improve the warning dissemination mechanisms by utilizing the available infrastructure of the competent authorities; **31**. There is a need to improve the degree of exchange with users, through the development of a drought information delivery system in the form of interactive service and through joint projects with the aim to demonstrate the benefits of drought information usage and to raise the overall awareness about importance of effective drought monitoring, risk assessment, preparedness and management; **32**. There is a need to enhance the awareness of the public of warnings.	**24**. There is an urgent need to establish a warning system for floods and flash floods; **25**. There are needs to enhance drought warnings; **26**. Implementation of the METEOALARM system would promote dissemination of warning information.

Synthesis

There is an urgent need to establish a 24/7 science based analysing, forecasting and warning system (4 countries);
There is an urgent need to further improve existing warning products and to develop new warning products and services (i.e. format, thresholds) in close cooperation with the Disaster Risk Management stakeholders as well as users from various sectors (5 countries)
There are needs to clarify the mandate roles and responsibilities of NMHS to produce / issue and / or disseminate official warnings for hydrometeorological hazards through appropriate SOPs under a QMS framework (4 countries)
There is a need to improve the warning dissemination mechanisms by improving the communication systems, partnerships with the media, as well as enhancing the awareness of the population (4 countries)
There is a specific need to develop early warning systems for flash flooding (4 countries) and drought (3 countries)

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Climate change analysis						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
26. There is a need to develop a climate data management system; **27**. There is a need to develop the technical capacities for climate change projections downscaling to local scales; **28**. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors.	**38**. There is a need to develop a climate data management system; **39**. There is a need to develop the technical capacities for climate change projections downscaling to local scales; **40**. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors; **41**. There is a need to strengthen the national capacity to produce local-scale projections of climate change in order to promote mainstreaming of adequate analysed impacts of climate change into DRR policy and strategy.	**26**. There is the need of strengthening DHMZ technical capacity to better monitor climate through enhanced investments in climate modelling, forecasting and analysis ^to develop climate change impact studies to support sectoral planning for DRR and other at-risk sectors.	**27**. There is a need to develop a climate data management system; **28**. There is a need to develop the technical capacities for climate change projections downscaling to local scales; **29**. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors.	**26** There is a need to develop a climate data management system and climate analyses; **27** There is a need to develop the technical capacities for climate change projections downscaling to local scales; **28** There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors.	**33**. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors taking into account also shorter timeframes with regard to investments.	**27**. There is a need to develop the technical capacities for climate change projections downscaling to local scales; **28**. There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors in order to promote adaptation to climate change.

Synthesis

There are needs to develop a climate data management systems in most countries
There is a need to develop the technical capacities for climate change projections downscaling to local scales in most countries
There is a need to develop climate change impact studies in cooperation with DRR, industry and other sectors in most countries

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

<table>
<tr><th colspan="7">Human Resources</th></tr>
<tr><th>ALBANIA</th><th>BiH</th><th>CROATIA</th><th>FYROM</th><th>MONTENEGRO</th><th>SERBIA</th><th>TURKEY</th></tr>
<tr>
<td>29. There is a need to ensure adequate human resources to the hydrometeorological sector to sustain its role towards the community and in different phases of DRR;
30. There is a need to use optimally existing human resources through leveraging all three governmental Meteorological Services capacities;
31. There is a need to strengthen training programmes for the staff of the hydrometeorological sector on products and services related to disaster risk reduction, particularly in forecasting and operational hydrology;
32. There is a need to develop human capacities in telecommunication, data management and information technology to benefit from modern technologies.</td>
<td>42. There is an urgent need to enhance techni-cal and human resources and capacity of the hydromet sector to real-time monitoring, warning and forecasting and mapping of hydromet hazards;
43. There is an urgent need to increase the number of data management, computing and IT experts in both hydrometeorological institutes;
44. There are needs to increase the number of staff with academic MSc and PhD degrees;
45. There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects;
46. There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EUMETNET NHMSs.</td>
<td>27. It is necessary to ensure adequate human, technical and financial resources to the DHMZ to sustain their role in DRR: operational monitoring, mapping of hydrological and meteorological hazards, warning and forecasting;
28. There is urgent needs to increase the number of skilled weather forecasters to enhance the forecasting capacity to achieve 24/7 operation;
29. There are urgent needs to increase the number of hydrolo-gical modellers and researchers, NWP model, ICT and IT, and observation network and maintenance, data management, PR and marketing experts;
30. There are urgent needs to promote training of the mid-management in leadership, project management and participation in EU R&D projects;
31. There are needs to improve laws, statutes, administrative practices and accounting systems to promote NHMS´s possibilities improve their commercial services, participation in EU R&D projects and to better adjust the structure and amount of staff to respond to new challenges, to enhance the base of financing and to promote sustainable development.</td>
<td>30. There are urgent needs to increase the human capacity with meteorologists, hydrologists, NWP model experts, ICT experts, data management experts and marketing experts;
31. There are needs to increase the number of staff with academic MSc and PhD degrees;
32. There are urgent needs to train the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects;
33. There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EU NHMSs.</td>
<td>29. There are urgent needs to promote the human resources through investment in forecasters, ICT experts, NWP experts and scientists;
30. There are needs to increase the number of staff with academic MSc and PhD degrees;
31. There are urgent needs to promote the skills especially in English in order to increase the capacity to participate in EU activities;
32. There are urgent needs to train the mid-management in leader-ship, project manage-ment, cooperation with industry and participation in EU R&D projects;
33. There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EU NHMSs;
34. There are needs to increase the salary level of HMI staff to the level of meteorologist in aviation sector to promote the attractiveness of HMI.</td>
<td>34. There are needs to enhance the educational (academic) level of the staff;
35. There is a need to enhance the R&D capacity and participation in EU R&D projects;
36. There is an urgent need to employ meteorologists, hydrologists, NWP experts, ICT experts and data management experts;
37. There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry and participation in EU R&D projects.</td>
<td>29. There is a need to ensure the adequate human resources for DMI to have the capacity to manage the operational and DRR tasks;
30. There is a need to enhance the human resources in the IT sector.</td>
</tr>
<tr><th colspan="7">Synthesis</th></tr>
<tr><td colspan="7">There is an urgent need to increase the number of data management, computing and IT experts
There are needs to increase the number of staff with academic MSc and PhD degrees in meteorology and hydrology;
There are urgent needs to promote training of the mid-management in leadership, project management, cooperation with industry, participation in EU R&D projects and English level
There are needs to establish a systematic training programme for whole staff by adapting the trainings systems in use in some of the advanced EUMETNET NHMSs.</td></tr>
</table>

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

Regional cooperation						
ALBANIA	**BOSNIA AND HERZEGOVINA**	**CROATIA**	**FYROM**	**MONTENEGRO**	**SERBIA**	**TURKEY**
40. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **41**. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network; **42**. In order to improve their forecasting capacities, SEE countries should increase their	**47**. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **48**. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network; **49**. To improve their forecasting capacities SEE countries should increase their cooperation with	**32**. A regional MHEWS composed of inter-operable national EWS should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **33**. Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans; **34**. Modernisation and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network;	**34**. There are urgent needs to promote cooperation with SEE NHMSs; **35**. There are urgent needs to enhance data exchange, warning and watch coordination and cross border training activities; **36**. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **37**. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This	**35**. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **36**. Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans; **37**. Modernisation and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network; **38**. To improve their	**38**. A regional Multi-hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **39**. Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans; **40**. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network; **41**: To improve their	**31**. A regional Multi-Hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy; **32**. Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network; **33**. To improve their forecasting capacities, SEE countries should increase their cooperation with global, regional and specialized Centres (eg ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages

ANNEX 5: ANALYSIS OF THE TECHNICAL RECOMMENDATIONS FOR THE NMHS TO SUPPORT DRR

cooperation with global, regional and specialized Centres (eg ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting; **43**. A regional harmonization of watch and warning systems should be promoted; **44**. Cross-border exchanges of real-time data, forecasts and warnings should be increased.	global, regional and specialized Centres (e.g. ECMWF) producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting; **50**. A regional harmonization of watch and warning systems should be promoted; **51**. Cross-border exchanges of real-time data, forecasts and warnings should be increased.	**35**. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting; **36**. A regional harmonisation of watch and warning systems should be promoted; **37**. Cross-border exchanges of real-time data, forecasts and warnings should be increased.	plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network; **38**. To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting.	forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres producing NWP, by developing their NWP capacities and become members of NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting; **39**. A regional harmonisation of watch and warning systems should be promoted; **40**. Cross-border exchanges of real-time data, forecasts and warnings should be increased; **41**. Improve the English knowledge of HMI technical staff.	forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres (e.g. ECMWF) producing NWP, by developing their NWP capacities and established NWP model consortium or become members of existing NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting; **42**. A regional harmonization of watch and warning systems should be promoted; **43**. Cross-border exchanges of real-time data, forecasts and warnings should be increased;	between NWP models and hydrological models should also be developed for a better flood forecasting; **34**. A regional harmonization of watch and warning systems should be promoted; **35**. Cross-border exchanges of real-time data, forecasts and warnings should be increased; **36**. There is the opportunity to strengthen regional collaboration through the exploitation of DMI capacities, resources and facilities for training of experts from NMHS of SEE countries.

Synthesis

There are urgent needs to promote cooperation with SEE NHMSs;
Methodologies and tools for production of flood and drought risk assessment and mapping at the national/regional level (i.e. Digital Elevation Model, Hydrological models, Hazard analysis tools, Satellite-based observation) should be developed and harmonized in the region, based on good practices. This would be particularly crucial for flood risk assessment in transboundary river basins (Sava river);
A regional Multi-hazard Early Warning System composed of inter-operable national Early Warning Systems should be designed through a regional cooperation process. A comprehensive design and planning document should include institutional and technical aspects of MHEWS, as well as a cost-benefit analysis and a fund-raising strategy;
To improve their forecasting capacities SEE countries should increase their cooperation with global, regional and specialized Centres (e.g. ECMWF) producing NWP, by developing their NWP capacities and established NWP model consortium or become members of existing NWP model consortiums. Linkages between NWP models and hydrological models should also be developed for a better flood forecasting;
A regional harmonisation of watch and warning systems should be promoted;
Cross-border exchanges of real-time data, forecasts and warnings should be increased;
Risk assessment at regional, national and local level is the foundation for development of agreements and implementation plans;
Modernization and interoperability of the meteorological and hydrological networks should be implemented at the sub-regional level to benefit from economies of scale and financing opportunities. This plan should include automatic on-line stations, a sub-regional radar network as well as a lightning detection network

ANNEX 6: REGIONAL AND SUB-REGIONAL CENTRES AND INITIATIVES SUPPORTING COOPERATON IN DRR AND HYDROMETEOROLOGY IN EUROPE AND SOUTH EAST EUROPE

Centre	Membership	Capacities	Website
European Centre for Medium Range weather Forecasts (ECMWF)	*Full members*: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom *Co-operation agreements with*: Bulgaria, Croatia, Czech Republic, Estonia, the Former Yugoslav Republic of Macedonia, Hungary, Israel, Latvia, Lithuania, Montenegro, Morocco, Romania, Serbia, Slovakia and Slovenia	1. Provision of forecasts: • Medium term (2 to 10 days) • Monthly forecasts • Seasonal forecasts 2. Provision of training on the use of ECMWF products 3. Provision of computing services to Members 4. Development of research	www.ecmwf.int
Conference of the National Meteorological Services in Europe (EUMETNET)	*Member States*: Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, the Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Luxemburg, Montenegro, Netherlands, Norway, Poland, Portugal, Serbia, Slovenia, Spain, Sweden, Switzerland, United kingdom	Provision of a framework for cooperation among Members on observation systems, data processing, forecasting, research and development and training. Programmes include: • The EUMETNET Composite Observing System (EUCOS) • EUMETNET Automated Shipboard Aerological Programme (E-ASAP) • European Aircraft Meteorological Data Relay Programme (E-AMDAR) • Surface Marine Programme • Operational Programme for Exchange of Weather Radar Information (OPERA) • European Multi-Service Meteorological Awareness Project (EMMA) • Uniform Data Request Interface Programme (UNIDART) • METEOALARM • The European Virtual Organization for Meteorological Training	http://www.eumetnet.eu/
The European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)	*Member States*: Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxemburg, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom *Cooperating States*: Bulgaria, Estonia, Iceland, Lithuania, Serbia	1. Provision of operational satellite data and products that meet the meteorological and climate data requirements 2. Development of products based on EUMETSAT data 3. Training on the use of EUMESAT data 4. Real-time dissemination of data and products (EUMETCast)	http://www.eumetsat.int/Home/index.htm

ANNEX 6: REGIONAL AND SUB-REGIONAL CENTRES AND INITIATIVES SUPPORTING COOPERATON IN DRR AND HYDROMETEOROLOGY IN EUROPE AND SOUTH EAST EUROPE

Other Regional Centres Supporting Cooperation in Europe

Centre	Membership	Capacities	Website
European Commission Joint Research Centre (JRC)	*European Forest Fire Information System*: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Former Yugoslavian Republic of Macedonia (FYROM), Germany , Greece , Hungary, Italy, Latvia, Lithuania, Montenegro, Poland, Portugal, Romania , Slovakia , Spain, Sweden, Switzerland , Turkey, United Kingdom.	Provision of information on forest fires in Europe • Fire danger forecasts • Active fire detection • Fire monitoring • Damage assessment • Fire emissions • Post-fire soil erosion • EU fire database	http://effis.jrc.ec.europa.eu
	Drought observatory	Provision of information on droughts, land degradation and desertification • Rainfall anomalies • Soil moisture anomalies • Vegetation vigour	http://desert.jrc.ec.europa.eu http://edo.jrc.ec.europa.eu
	European Flood Alert System (EFAS): Albania, Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Macedonia, Moldova, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, The Netherlands, UK	Provision of flood forecasts, novel tools, techniques and data sets for flood forecasting	http://floods.jrc.ec.europa.eu/

ANNEX 6: REGIONAL AND SUB-REGIONAL CENTRES AND INITIATIVES SUPPORTING COOPERATON IN DRR AND HYDROMETEOROLOGY IN EUROPE AND SOUTH EAST EUROPE

Sub-regional Centres and Initiatives Supporting Cooperation in Meteorology

Centre	Membership	Capacities	Website
Drought Monitoring Centre for SEE (DMCSEE)	*Member countries*: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR of Macedonia, Greece, Hungary, Moldova, Romania, Slovenia, Turkey, Montenegro, Serbia	1. Application of drought monitoring and risk management tools 2. Training on tools and methodologies for drought assessment, monitoring and early warning 3. Facilitation of cooperation of regional NMHSs in international projects and organizations (e.g. in participation in JRC's Eropean Drought Observatory).	http://www.dmcsee.org/
SEE Virtual Climate Change Centre (SEEVCCC)	*SEE countries* Albania, Bosnia and Herzegovina, FYR of Macedonia, Serbia and Montenegro	1. Climate monitoring 2. Seasonal forecasts 3. Dust forecasts 4. Climate projections 5. Climate data	http://www.seevccc.rs/
INTERNATIONAL SAVA RIVER BASIN COMMISSION	Member Countries: Bosnia and Herzegovina, Croatia, Serbia, Slovenia	Coordination of activities to promote transboundary cooperation for sustainable development of the region	www.savacommission.org

ANNEX 6: REGIONAL AND SUB-REGIONAL CENTRES AND INITIATIVES SUPPORTING COOPERATON IN DRR AND HYDROMETEOROLOGY IN EUROPE AND SOUTH EAST EUROPE

Other Initiatives

Initiative	Membership	Capacities	Website
Disaster Preparedness and Prevention initiative for South-Eastern Europe (DPPI)	*SEE countries*: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Greece, Moldova, Romania, Serbia and Montenegro, Slovenia and Turkey	Coordination and provision of training	http://www.dppi.info/
Regional Cooperation Council (RCC)	*Albania, Austria, Bosnia and Herzegovina, Bulgaria, Canada, Council of Europe, Council of Europe Development Bank, Croatia, Czech Republic, Denmark, European Bank for Reconstruction and Development, European Investment Bank, European Union (EU), Federal Republic of Germany, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, The Former Yugoslav Republic of Macedonia, Republic of Moldova, Montenegro, North Atlantic Treaty Organisation, Norway, Organization for Economic Co-operation and Development, Organization for Security and Co-operation in Europe, Poland, Romania, Serbia, Slovakia, Slovenia, SEEan Co-operative Initiative, Spain, Sweden, Switzerland, Turkey, United Kingdom, United Nations, United Nations Economic Commission for Europe, United Nations Development Programme, United Nations Interim Administration Mission in Kosovo (UNMIK) on behalf of Kosovo in accordance with United Nations Security Council Resolution 1244, United States of America, World Bank*	Promotion of mutual cooperation and integration of SEE to steer development in the region	http://www.rcc.int/

MINISTRY OF SECURITY
BOSNIA AND HERZEGOVINA

WMO OMM

Regional Programme on Disaster Risk Reduction in South East Europe

Activity 2: Regional Cooperation in South Eastern Europe for Meteorological, Hydrological and Climate Data Management and Exchange to Support Disaster Risk Reduction (IPA/2009/199-922WMO)

Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management

Hotel Hollywood, Sarajevo, Bosnia and Herzegovina
28 – 29 March 2011

http://www.wmo.int/pages/prog/drr/SEE/SarajevoMeeting/index_en.html

CASE STUDY: FLOODS IN THE DRINA RIVER BASIN (NOVEMBER – DECEMBER 2010)

REPUBLIC OF SERBIA

Republic Hydrometeorological Service
and
Ministry of Interior-Sector for Emergency Management

ANNEX 7: FLOODS IN THE DRINA RIVER BASIN (NOVEMBER – DECEMBER 2010)

1. Study area

The study area is the Basin of the River Drina, which spreads over the borders between Montenegro, Bosnia and Herzegovina and Serbia with a minor part in Albania. The total surface of the Basin is around 19, 570 km^2.

The basic characteristic of the Drina Basin is its abundance of atmospheric water since, on average, it receives slightly more than 1000 mm of precipitation. In the upper part, up to the Lim from which it receives exactly one third of its water, the discharge of the Drina depends on the discharge of its tributaries, the Tara and the Piva. In the total course of the Drina (355 km without the river Tara), one third (115 km) consists of man-made accumulations. In the middle and lower part, the Drina has no major tributaries and its water regime depends primarily on natural conditions and accumulation management upstream, that is, power plant work regime. Due to the large precipitation, especially when accompanied by melting of snow, the Drina overflows its banks most frequently in its lower course, downstream from Zvornik, that is, in Macva and Semberija.

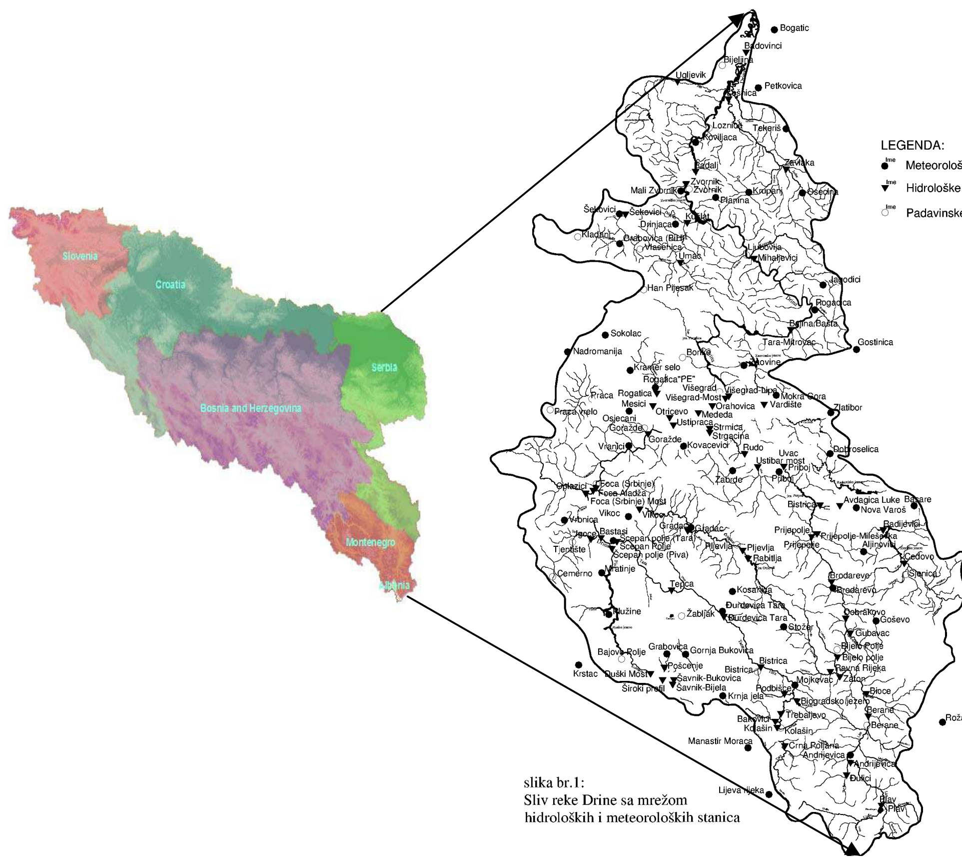


Figure 1: Sava river basin and meteorological and hydrological network on the Drina river basin

Hydrological knowledge about the Drina River Basin is on a high level owing to the high quality hydrological and meteorological observation system that was established for the construction of 5 accumulations and the optimum use of the energy potential. The mean value of the Drina River discharge at the confluence amounts to around 400 m^3/s. Most of its water (around 60 %) comes from the territory of Montenegro, that is, from the upper course that is characterized by high mountains (altitude higher than 1.000 m), on which the contribution of snow to the total annual precipitation is higher than 50 %.

ANNEX 7: FLOODS IN THE DRINA RIVER BASIN (NOVEMBER – DECEMBER 2010)

There are 81 precipitation and 60 hydrological stations located in the Drina Basin. However, data from majority of stations are not available for the purpose of monitoring the weather and water conditions and making real-time hydrological forecasts.

2. Flood in the Drina river basin in November-December 2010

At the end of November to the beginning of December 2010, heavy rains (in three days from 100 to 200 mm) on the territory of Montenegro and Bosnia and Herzegovina simultaneously caused a high rise in the water level over the whole Drina River Basin.

On the tributaries of the Drina (the Piva, the Cehotina, the Lim and the Jadar) as well as on the Drina itself, the flood wave lasted from the end of November until the end of the first decade of December 2010. The flood wave was of great scale, partly because the accumulations on the Drina Basin could not accept the immense quantity of water; hence, the water surged out during the time of wave peak, but not before it. Conditional warning levels were exceeded on all the rivers of the basin and at the hydrological station Radalj on the Drina (in Serbia), the water level of 659 cm, recorded on 3 December 2010, represented the absolute historical maximum.

The high level wave in the Drina Basin caused floods on the territories of Montenegro, Bosnia and Herzegovina and Serbia with consequential significant material damage.

3. Operation of Flood risk Management system on the Drina in December 2010

The Law on Emergencies and other special laws stipulate the competences and the roles of relevant bodies, legal persons and associations in DRR activities. The Protection and Rescue System established in accordance with this Law, represents a segment within the National Security System. It also represents an integrated form of managing and organization of subjects of the Protection and Rescue System engaged in the implementation of preventive and operative measures, as well as in realising protection and rescue of people and property from the impacts of natural disasters and other catastrophes, including impact remedial measures. The implementation of the Law on Emergencies and coordination of intersectoral activities lies within the competence of the Ministry of Interior-Sector for Emergency Management.

The Republic Water Directorate is a body within the Ministry of Agriculture, Forestry and Water Management. It is responsible for: water management policy, multipurpose water usage, protection from water, protection from floods, water protection measures, international cooperation and other activities according to the Law on Waters. Flood protection measures for certain areas are defined by the General and Operative Plan for Flood Defence and they are mutually harmonized. In accordance with them, the Hydrometeorological Service is obliged to prepare the elements for the adoption of an operative plan for next year, that is, update data from the meteorological and hydrological stations and observation points concerning the occurrence of ice as well as update data from water measuring instruments according to the criteria for the introduction of flood defences and also to continue work on the development of a forecast of flood wave occurrence.

The Republic Hydrometeorological Service of Serbia (RHMSS), as a special organization within the state administration of the Republic of Serbia, performs the tasks of monitoring, research, analysing and forecasting of weather, climate and water, early warning tasks and alerting of the occurrence of meteorological and hydrological disasters and catastrophes as well as other activities of a National Hydrometeorological Service as public service of significance in the protection of human lives and mitigation of material damage. The Republic Hydrometeorological Service of Serbia is responsible for the establishment and functioning of the basic components of the hydrometeorological early warning system as a part of the National protection and rescue system (Disaster Risk Management), which is coordinated by the Ministry of Interior-Sector for Emergencies. The RHMSS performs various functions and tasks of an integrated meteorological and hydrological system in the early warning against meteorological and hydrological natural disasters.

During the period of ice and flood defence, the Hydrometeorological Service is also obliged to provide complete hydrological and meteorological reports to the flood defence leaders, Ministries competent for emergency and water management, competent water management enterprises and the Republic Alarm Centre, as well as to provide and send water level forecasts for relevant water management stations in water areas where flood defence are foreseen, meteorological forecasts on daily air temperatures and precipitation for water areas where flood and ice defence is performed, and ice forecasts.

These duties of RHMSS are regulated by the Law on Ministries (“Official Gazette of RS”, No. 65/08, 36/09 and 73/10), the Law on Meteorological and Hydrological Activities (“Official Gazette of RS”, No. 88/2010), the Law on Waters (“Official Gazette of RS”, No. 30/2010), the Law on Emergencies (“Official Gazette of RS”), *etc*.

4. Performance of Meteorological and Hydrological Early Warning System of the RHMSS during the floods on the Drina River

The Meteorological and Hydrological Early Warning System of the Republic Hydrometeorological Service of Serbia (RHMSS) is a crucial facility enabling local and national governments to prevent and protect against the destructive action of meteorological and hydrological phenomena, such as floods, in order to avoid loss of human life and mitigate material damage.

4.1 The Meteorological and Hydrological Early Warning System-Analysis of the synoptic situation and weather conditions

In the period from 26 November to 1 December 2010, the Balkan Peninsula was on the frontal side of an upper-air trough and was influenced by southern and southwestern upper-air currents, and humid air from the Mediterranean. Three cyclones accompanied by frontal systems moved over the Balkan Peninsula and the last of them, with a pronounced orographic effect, caused abundant precipitation in the Tara, Cehotina, Piva and Lim Basins, that is, in the upper part of the Drina Basin, on 30 November and 1 December.

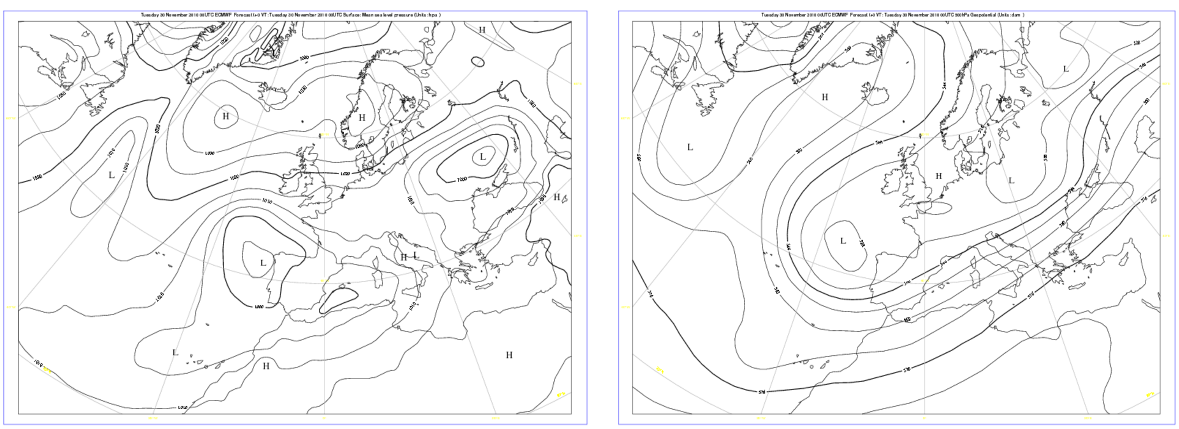


Figure 2: Synoptic situation over Europe on 30 November 2010. Geopotential of 500 hPa (left) and surface pressure (right)

In the period from 30 November 2010 (06 UTC) until 1 December (12 UTC), in the upper basin of the River Drina, *i.e.*, on the territory of Montenegro, the following precipitation quantity values were observed: Šavnik 168 mm, Žabljak 155 mm, Kolašin 152 mm, Plužine 145 mm, Mojkovac 133 mm, Bijelo Polje and Andrijevica 44 mm, Pljevlja 32 mm.

The precipitation recorded during the previous period, from 16 to 26 November 2010, had had an impact on soil saturation. The exceptionally heavy precipitation recorded on 30 November 2010 and 1 December 2010, the strong southern wind and high air temperature caused melting of the existing snow cover in the higher mountainous areas and a high water level and floods along the River Drina in the first half of December 2010.

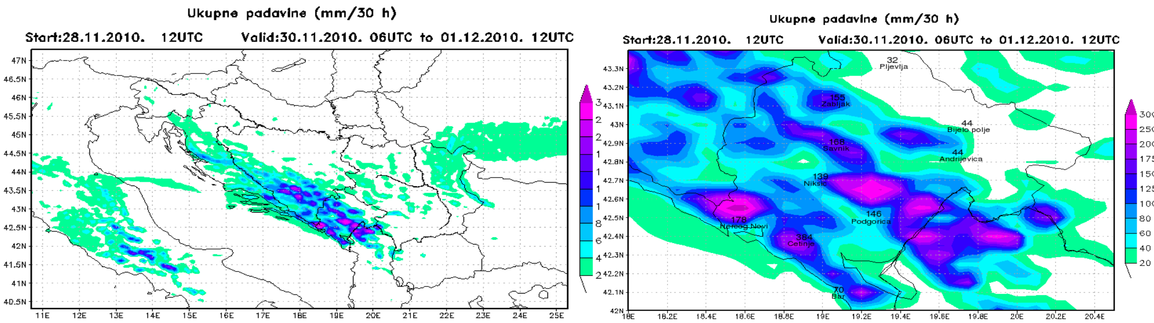


Figure 3: Forecast of accumulated precipitation (*t* + 72 h) for the area of the Balkan Peninsula from 06:00 UTC on 30 November until 12:00 UTC on 1 December 2010 (left); Forecast of accumulated precipitation (*t* + 72 h) and observed values for the area of Montenegro from 06:00 UTC on 30 November until 12:00 UTC on 1 December 2010 (right);

Based on ECMWF products and the results of numerical models operatively used in the RHMSS (WRF-NMM), the Meteorological Early Warning System issued warnings of an expected and great precipitation quantity in the area of the upper Drina River Basin. The meteorological information and warnings were sent to the Ministry of Interior-Sector for Emergency Management, the Ministry of Agriculture, Forestry and Water Management-Water Directorate and other competent water management and local bodies and they were also published on the internet pages www.meteoalarm.rs and www.meteoalarm.eu.

4.2 Hydrological Early Warning System: Real-time flood forecasting and issuing of warnings:

Based on data, forecasts and warnings of the Meteorological Early Warning System, the Hydrological Early Warning System of the RHMSS issued first warning of expected heavy precipitation in the area of Montenegro and Bosnia and Herzegovina on 28 November 2010. Subsequently, the development of the hydrological situation in the Drina River Basin was closely monitored.

Based on available hydrological data from the territories of neighbouring countries, data from the accumulations and the results of flood wave propagation, the first warning of a significant water level rise in the Drina Basin was issued on 30 November 2010. Warnings were sent to the Sector for Emergency Management of the Ministry of Interior of Serbia, Ministry of Agriculture, Forestry and Water Management-Water Directorate and the public water management enterprises “Srbijavode” and “Sava-Dunav”, as well as to local authorities and public media.

All the hydrological warnings, information and forecasts of the RHMSS were distributed to the authorities competent for the implementation of flood defence measures *via* electronic mail, phone and fax and were published on the internet pages of the RHMSS.

Of the real time hydrological data from the area of the Drina River Basin, the only available data were the morning water levels from the hydrological stations Foca and Gorazde (Bosnia and Herzegovina), Bijelo Polje (Montenegro) and Prijepolje and Radalj (Serbia). Data were also available from the work regime of the hydrological power plants “Bajina Basta” and “Zvornik”. Data on accumulation management in Montenegro were unavailable.

ANNEX 7: FLOODS IN THE DRINA RIVER BASIN (NOVEMBER – DECEMBER 2010)

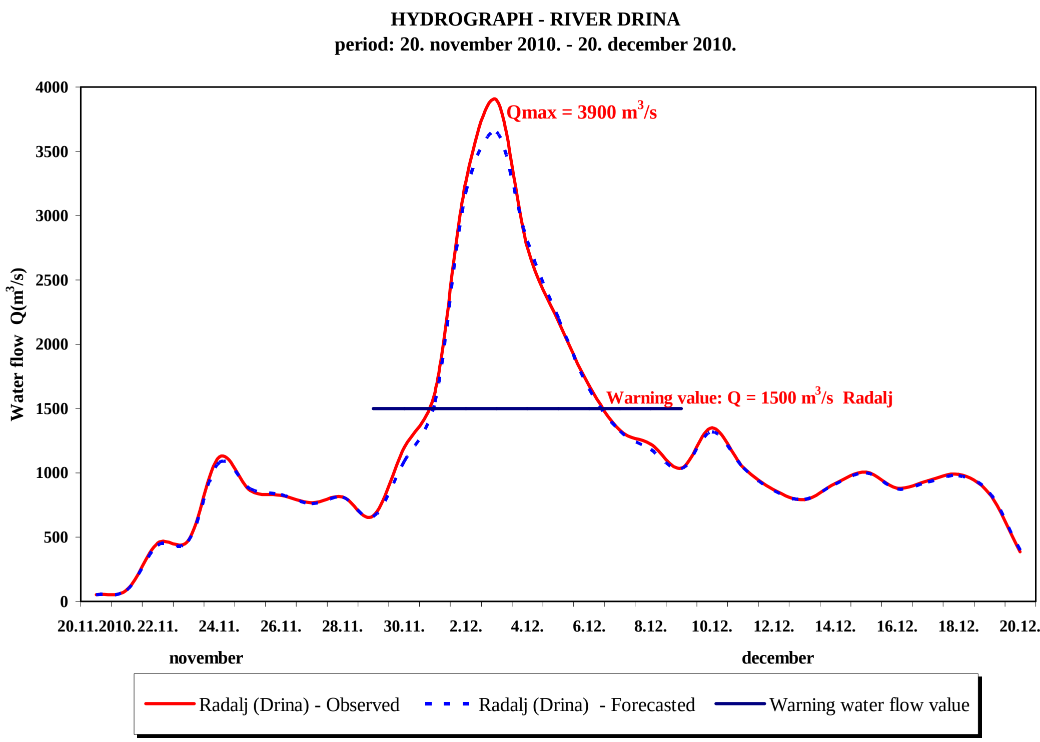


Figure 4: Hydrographs from the hydrological station Radalj on the River Drina for the period from 20 November to 20 December 2010.

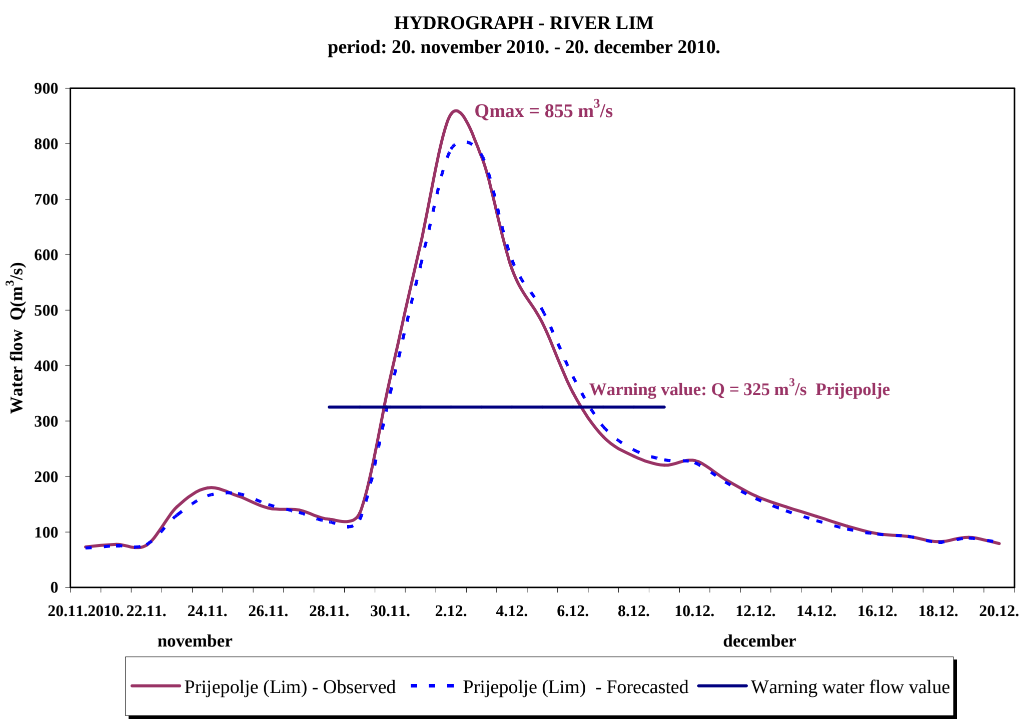


Figure 5: Hydrographs from the hydrological station Prijepolje for the River Lim for the period from 20 November to 20 December 2010.

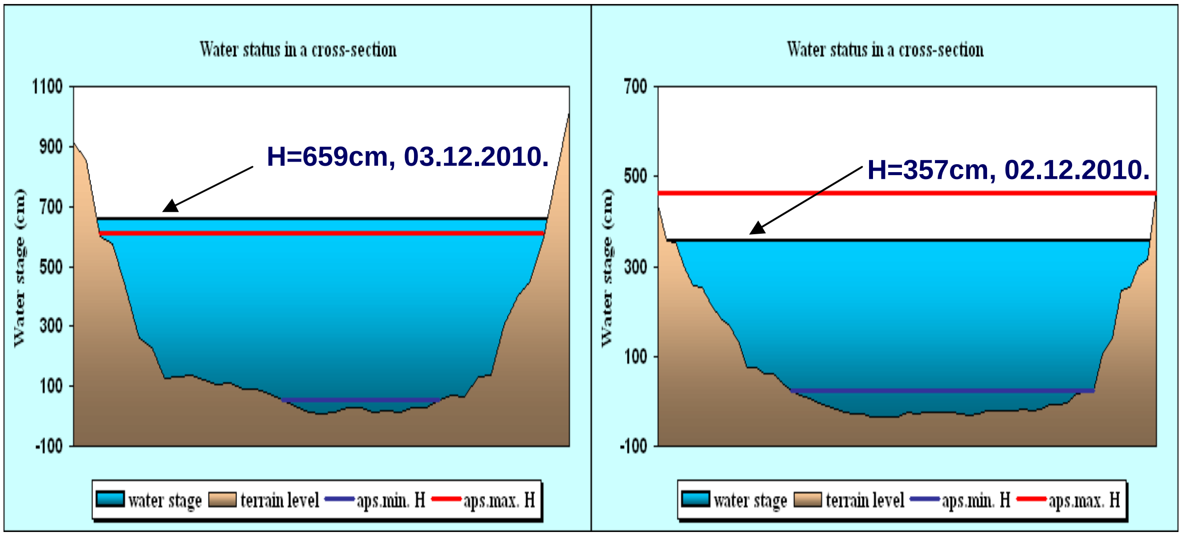


Figure 6: Cross sections with maximum water levels from the hydrological station Radalj for the River Drina (left) and from the hydrological station Prijepolje for the River Lim (right)).

Based on the issued meteorological and hydrological forecasts, warnings and alarms of the RHMSS, Sector for Emergency Management, the competent public water management enterprises, as well as other competent state and local authorities, took the necessary measures for flood defence.

4.3. Response of the Sector for Emergency Management of the Ministry of Interior

The officers of the Sector of Emergency Management of the Republic of Serbia were permanently engaged in supervising and coordinating field work. In addition, the Assistant Minister of Interior and the Head of the Sector of Emergency Management, units of the Fire and Rescue Department and Risk Management Department were also involved on the spot together with members of the Civilian Protection Department. They were engaged in aiding and evacuating the inhabitants of the affected area as well as in providing the necessary foodstuffs to citizens who refused to leave their homes and were encircled by water.

ANNEX 7: FLOODS IN THE DRINA RIVER BASIN (NOVEMBER – DECEMBER 2010)

Figure 7: Floods on the Drina River, western Serbia, November-December 2010

A great number of citizens and their households, as well as many vacation houses, were affected by the floods. During the flood in the lower part of the Drina basin, firemen and rescuers evacuated 1058 persons in several towns in Serbia (250 in Ljubovija, 60 in Mali Zvornik, 554 in Loznica and 194 in Sabac). In the field work, 5 regional specialized teams were engaged in the rescue, as well the water works from Belgrade, Novi Sad, Kraljevo, Nis and Kragujevac, local fire and rescue units and units from several cities in the Republic of Serbia (Uzice, Novi Pazar and Cacak).
Meetings of the emergency management staff were constantly been held in the municipalities of the Sava Basin. Members of the Sector for Emergency Management also participated in the meetings. The staff monitored the development in the field and made decisions on further actions of all those involved in flood defence activities. Damage assessment commissions were also established.

High-ranking government officials visited the municipalities affected by floods.

5. Meteorological and hydrological support during and after the disastrous floods

The Flood Warning System of the RHMSS collected all available meteorological and hydrological data, processed them, run them through meteorological and hydrological models and made preliminary risk assessment. Data from the Sector for Emergency Management of the Ministry of Interior of Serbia and from the public water management enterprise “Sava-Dunav” were also employed.

ANNEX 7: FLOODS IN THE DRINA RIVER BASIN (NOVEMBER – DECEMBER 2010)

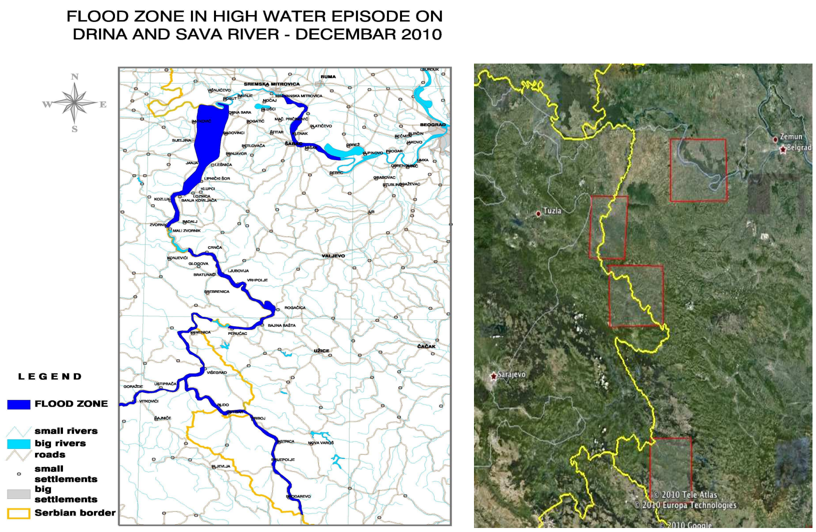


Figure 8: Flood zones determined based on the initial data collected from the field

During the December floods on the Drina, the RHMSS applied for and became an official user of the products of the EU/FP7 SAFER project (Services and Applications for Emergency Response), which was realized within the initiative GMES (Global Monitoring for Environment and Security) of the EU.

The basic advantage of the use of SAFER products is that they enable rapid availability of detailed maps of the flooded areas before, during and after flood cessation, which facilitates the monitoring of the extreme phenomenon and decision making in the process of flood defence. They also accelerate damage assessment after flood cessation.

A satellite image of flooded areas in the vicinity of the Drina and the Sava confluence, obtained within the mentioned SAFER project in cooperation with the company “Infoterra” from France, Is shown in Figure 9.

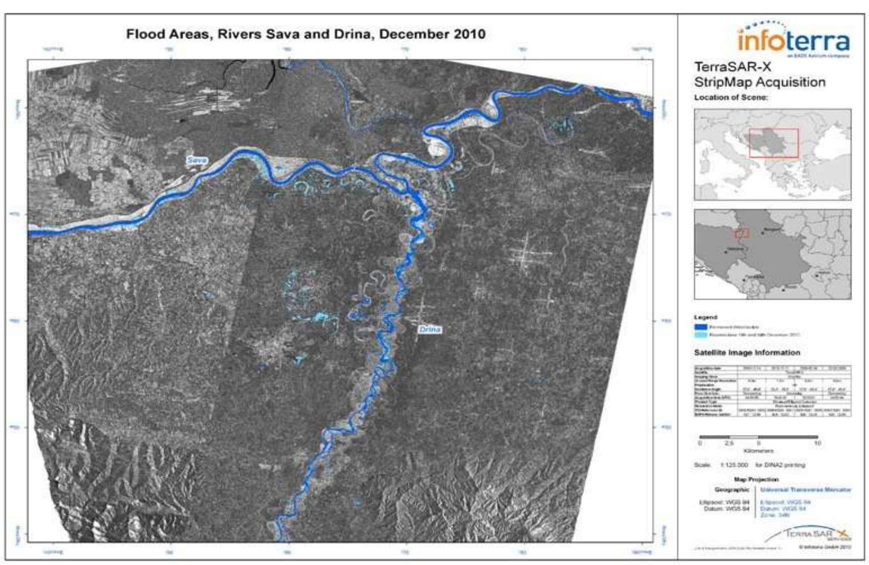


Figure 9: Satellite image of flooded areas on the River Drina and the River Sava (10 Dec 2010)

Owing to the created conditions for the utilisation of the products of the SAFER project, it was demonstrated that by using available contemporary means in the early warning system, it is possible to rapidly obtain significant site information and plan efficient actions in the process of flood prevention and protection.

This kind of improvement of the hydrometeorological early warning system would contribute to a faster identification of hazard areas and more efficient risk management of flood and other disasters.

CONCLUSIONS

The high water level on the Drina River at the end of November and beginning of December were caused by large-scale unfavourable meteorological and hydrological conditions on the territories of three countries.

Based on the available data, the RHMSS promptly provided forecasts and warnings for all participants in the flood defence system. Owing to this and measures taken by the Sector for Emergency Management, competent water management enterprises and the power generation sector, the loss of human life was avoided and damage to property was mitigated, especially in the lower part of the Sava River.

The observed problems in the functioning of the hydrometeorological early warning system were primarily related to the lack of a common regional hydrometeorological information system for the Drina Basin.

From the aspect of the functioning of the flood risk management system on the Drina River as a water course cut by state borders or is the state border and whose regime is crucially influenced by the management of constructed accumulations, a need exists for inter-governmentally coordinated management of the waters within this Basin. In the case of the Drina River, this is possible to realize through regional projects that would also be supported by relevant international institutions.

MINISTRY OF SECURITY
BOSNIA AND HERZEGOVINA

WMO OMM

Regional Programme on Disaster Risk Reduction in South East Europe

Activity 2: Regional Cooperation in South Eastern Europe for Meteorological, Hydrological and Climate Data Management and Exchange to Support Disaster Risk Reduction (IPA/2009/199-922WMO)

Regional Meeting for Strengthening Regional Cooperation in Meteorology, Hydrology and Climate Services for Disaster Risk Management

Hotel Hollywood, Sarajevo, Bosnia and Herzegovina
28 – 29 March 2011

http://www.wmo.int/pages/prog/drr/SEE/SarajevoMeeting/index_en.html

CASE STUDY: THE DUBROVNIK FIRE, 4-9 AUGUST 2007

REPUBLIC OF CROATIA

Meteorological and Hydrometeorological Service
and
National Protection and Rescue Directorate

ANNEX 8: THE DUBROVNIK FIRE, 4-9 AUGUST 2007

1. INTRODUCTION

The Government of the Republic of Croatia has adopted **the Natural and Manmade Catastrophes and Major Disasters Vulnerability Assessment** on 2009. The Assessment has been developed by the National Protection and Rescue Directorate (**NPRD)** in collaboration with the Meteorological and Hydrological Service **(DHMZ),** Seismological Service, Croatian Waters, State Geodetic Administration and different Ministries and has identified hazards and risks that endanger the Republic of Croatia. It has estimated the needs and opportunities for prevention, reduction and elimination of consequences of disasters and major accidents, and has established a foundation for developing protection and rescue plans, and the operational protection and rescue forces and resources of an integrated and comprehensive national management system in protection from disasters and major accidents. Key natural hazards affecting Croatia, as stated in the Assessment, are: flooding - river flooding and flash floods, earthquakes and ***forest fires***.

About 80% of the total forest fires in the Europe concentrate in the Mediterranean regions. South Eastern Europe (SEE) region is particularly vulnerable and consequences should be mitigated with better prevention and preparedness. In Croatia the average number of forest fires per year for the period from 1995 to 2000 was 300, but there has recently been a dramatic increase in the number of fires. In 2007 as much as 750 fires were reported and the burnt area was about 159.000 ha.

Here is presented one of the worst forest fires on record which was started on 4th August 2007 in the Dubrovnik area with a highlight on the operation of fire protection management in Croatia. This case shows the needs for regional cooperation in data sharing and technical assistance is crucial for risk reduction.

2. INSTITUTIONAL AND LEGAL FRAMEWORK IN SUPPORT OF FIRE PROTECTION

At national level, there is a disaster management system in place. As stated in the ***Protection and Rescue Law***, the protection and rescue are being realized through activities of the operational rescue and protection forces at the local self-government and county levels, and at the level of the Republic of Croatia. The National Protection and Rescue Directorate (NPRD) is the leading organization for the protection and rescue of people, assets and environment in the Republic of Croatia. Its mission is to constitute and maintain a modern system of protection and rescue in the Republic of Croatia, which will be able to respond with all available resources to all needs for the protection of people, assets and environment in events of disasters, accidents and other needs of a modern society, and if necessary, extend or obtain help from other countries in the emergency situations. Several plans and programmes related to disaster management have been already developed and adopted:

- ***Intervention Plan during Wild and Forest Fires on the territory of the Republic of Croatia (2001)*** as a strategic document that defines: who is accountable for the realization of the plan, their set-up, responsibilities and authorities, coordination and management system, capacity building of the Plan's implementers, public information procedures and financial means needed for its implementation;

- ***Activity Program for the Implementation of the Special Fire Protection Measures in Republic of Croatia*** (adopted every year) is the basic coordination and implementation document defining roles and responsibilities of national administration entities, public companies, regional and self-government units, citizens' associations and others involved in the implementation of the fire protection measures.

The Activity Program for the Implementation of the Special Fire Protection Measures in Republic of Croatia defining: the legal and general basis for the Programme implementation; activities related to the preparation for the summer fire protection season; preventive actions for fire risk reduction; development and introduction of new fire protection systems, techniques and technologies;

activities established by the State Plan of Engagement of Firefighting Forces and other Forces participating in Fire-fighting; operational activities; and financing and reporting on the Programme implementation.

The ***System 112*** is the established early warning system, i.e. the mechanism for continuous and real-time collection and sharing of risk information. The System 112 is located within the NPRD, and collects, analyses and further shares information, news and data. The System 112 reports on all risks and hazards, and if needed, alerts citizens, legal entities, administration bodies, rescue services, respective civil protection forces and relevant NPRD management. The System also keep records on hazards, accidents and disasters, and maintain the public warning system in the Republic of Croatia and coordinates decisions and orders sharing. DHMZ and other respective institutions also collect data and information relevant for effective and efficient disaster management.

Operational data utilization and information exchange between DHMZ and System 112 has been regulated by the ***Standard Operating Procedures*** for the utilization of the DHMZ weather forecasts. Institutional and legal framework that reflects the role of DHMZ is the Law on the Performance of the Hydro-meteorological Service (1978) defining that DHMZ should:

- provide warnings on approaching and developing hydro-meteorological hazards,
- provide reports, forecasts and warnings to the relevant republic administrative entities on hydro-meteorological hazards valuable for flood protection and from other risks, as well as for the navigation security, and providing reports and forecasts on air pollution and warnings on sudden pollutions of rivers, lakes, see and air,
- monitoring of meteorological, hydrological and biometeorological parameters and phenomena,
- data management, archiving and dissemination of data, products and information,
- analysis, research and development of meteorological products and services for the public, governmental bodies and specific users, and
- national and international exchange of data and information.

The Republic of Croatia has established the ***Croatian Platform*** for disaster risk reduction (2009) as a permanent forum for the exchange and provision of opinions, proposals and achievements contributing to disaster risk reduction in all areas of human activities with a view to making the disaster risk reduction. NRPD is the key coordination, organization and management entity regarding disaster management, including emergency preparedness and response. DHMZ has established DRR Focal Point that coordinates activities at national, regional and international level.

The Republic of Croatia has an active multilateral cooperation with regional initiatives and organizations ***Disaster Preparedness and Prevention Initiative for South East Europe*** (DPPI/SEE) and Civil-Military Planning Council for Southeast Europe, and within this cooperation assistance has been obtained primarily through capacity building. Croatia also participates in the EU Civil Protection Mechanism and the EU Civil Protection Financial Instrument. Bilateral agreements with Montenegro and with Bosnia and Herzegovina should enhance the early warnings, prevention from and mitigation of forest/wild fires in the south coastal area. Operation and information exchange between NRPD and Ministry of Security of Bosnia and Hercegovina has been regulated in 2006 by the ***Standard Operating Procedures for the transboundary actions in wild fire protection.***

3. THE DUBROVNIK FIRE, 4 – 9 AUGUST 2007

Hot and dry weather across southern Europe had led to the fire season of 2007 as a difficult one for the SEE. One of the worst forest fires on record was started on 4th August 2007 in the Dubrovnik area. The fire has been burning for several days, spreading from neighbouring Bosnia and Hercegovina. More than 3,400 hectares of vegetation burned (Figure 1). Dubrovnik is an Unesco world heritage site and major tourist attraction. The fires had become a source of serious concern and anxiety for the public because of the high tourist season and proximity of fires to the Dubrovnik and other settlements. Although no full-scale evacuation took place, people fled from the hillside villages, where the fire was reported to have destroyed several houses. Hundreds of tourists found themselves stranded for hours at Dubrovnik airport as flights were delayed and roads into the city were closed.

The fire started in the mountainous region. The fire crossed the border on 4 August 2007 at 7 p.m. near Župa Dubrovačka. After that the fire crossed the border on several other places along the fire line. The fire was burning quite quickly as it picked up speed with the help of the strong Bora wind and has been continuing since 9 August 2007.

Figure 1: *Map of the general area of the fire 4 – 5 August 2007. Red line is the border between the Croatia and Bosnia and Hercegovina. Orange line is the fire line.*

a) b)

Figure 2: *a) Picture of the part of the fire front in Dubrovnik and b) burned area*

ANNEX 8: THE DUBROVNIK FIRE, 4-9 AUGUST 2007

3.1 Operation of fire risk management

One of the worst forest fires on record was started on 4th August 2007 in the Dubrovnik area. The fire has been burning for several days, spreading from neighboring Bosnia and Herzegovina.

The first information about the fire on the territory of Bosnia and Herzegovina was received in ***Dubrovnik County 112 Center*** on 4 August at 10 a.m. One hour later Ministry of Security of the Bosnia and Hercegovina, in accordance with the Standard Operating Procedures for the trans-boundary actions in wild fire protection between Croatia and Bosnia and Herzegovina, issue the permission that Croatian fire fighting brigades can help and act at the cross-boundary area.

The fire crossed the Croatian border on 4 August 2007 at 7 p.m. near Župa Dubrovačka. After that the fire crossed the border on several other places along the fire line. The fire was burning quite quickly as it picked up speed with the help of the strong Bora wind and has been continuing since 9 August 2007.

The Croatian fighting service as a part of NPRD is quite well organized, having both professional and voluntary fire fighting organizations. Fire crews of 669 people and 102 cars were deployed during this fire episode. Nevertheless, the fire managed to spread, partly controlled by firefighters. Mountainous arduous area and strong Bora wind additionally complicated the fire protection and precluded helicopter and airplane intervention. Unexploded landmines left over from the war in the 1990s have been hampering the efforts of firefighters too. Upon the Bora wind decreasing three Croatian Canadair water-bombing planes were helping hundreds of firefighters to contain the blaze threatening. These fires have been continuing since 9 August 2007.

3.2 Performance of Meteorological and Hydrological Service (DHMZ)

DHMZ is very important part of the Warning *System 112*. The *Activity Program for the Implementation of the Special Fire Protection Measures in Republic of Croatia* defines the DHMZ activities related to the preparation of meteorological information relevant to fire protection.

Therefore, the Canadian Forest Fire Weather Index System is implemented in operational work. The actual and forecast forest fire weather index is calculated for the whole Adriatic area based on the observations at the meteorological network (Figure 3) and the operational numerical forecasting mesoscale model ALADIN/HR. DHMZ is also obliged to provide regional short and medium-term forecast. In the case of fire brigades intervention detailed monitoring of the meteorological conditions and special forecast is prepared. All operational activities are governed by Standard Operational Procedure (SOP) which came into the force in 2006 (Figure 4).

For the purpose of the fire protection it is constructed the special Internet page with all relevant meteorological data, forecast and information.

Figure 3: *Meteorological stations for wich actual and forecasted forest fire weather index are calculated.*

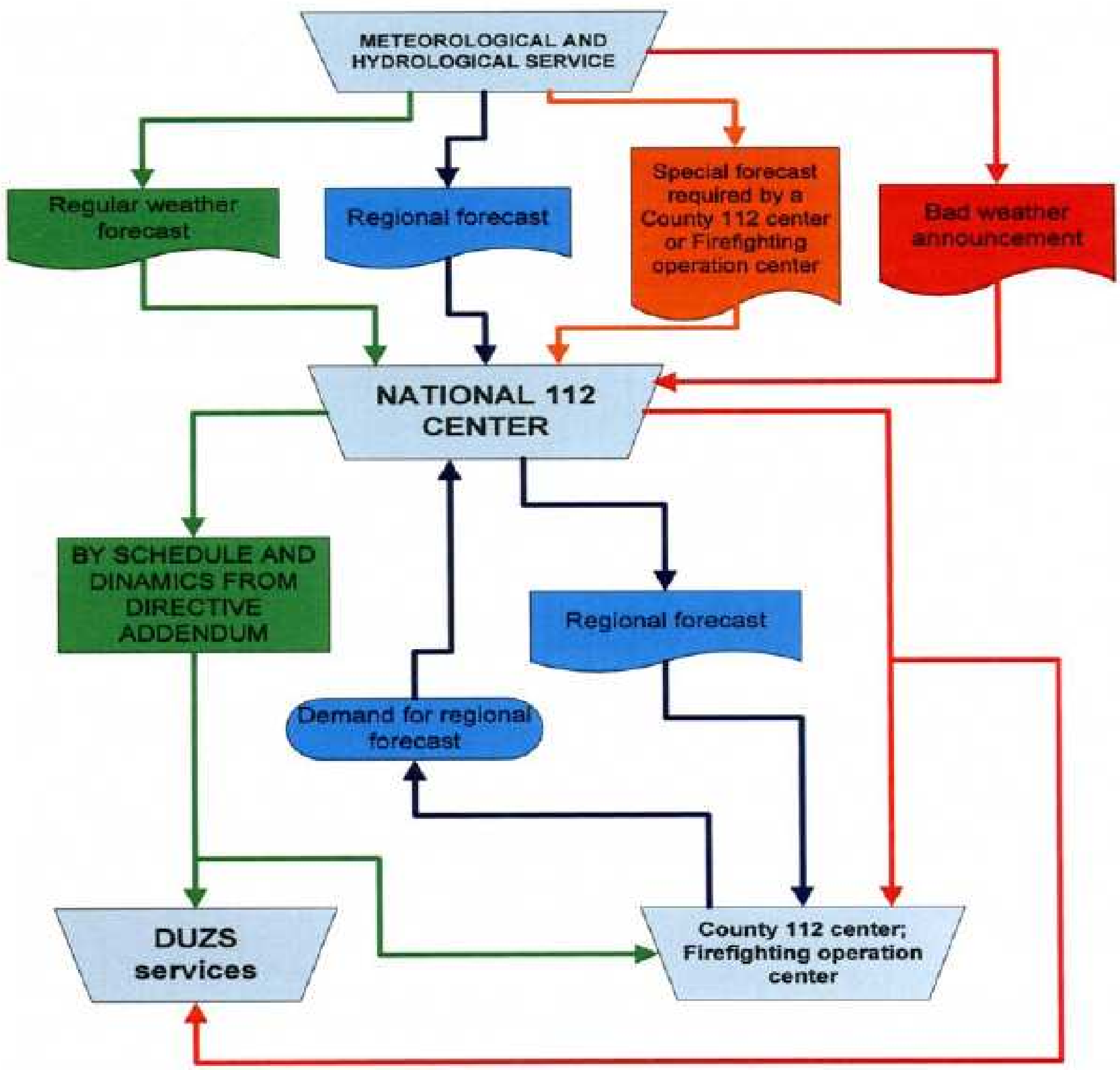


Figure 4: *Standard Operating Procedure between Meteorological and Hydrological Service (DHMZ) and National Protection and Rescue Directorate (NPRD, in Croatian DUZS)*

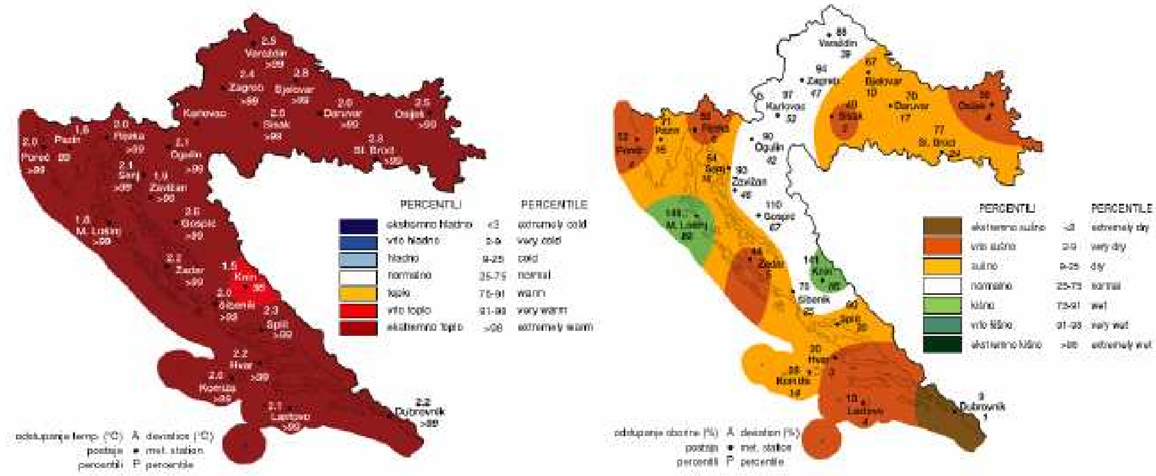


Figure 5: *Air temperature anomalies (left) and precipitation amounts (right) in summer 2007 in Croatia.*

The summer 2007 was extremely warm and dry in the whole Croatia (Figure 5). Such weather conditions were favourable for dramatic increase in the number of fires. In 2007 as much as 750 fires were reported.

The Canadian Forest Fire Weather Index for the Dubrovnik station has shown that FWI (Fire Weather Index) and ISI (Initial Spread Index) reached their maximum precisely on 4/5 August 2007 (Figure 6).

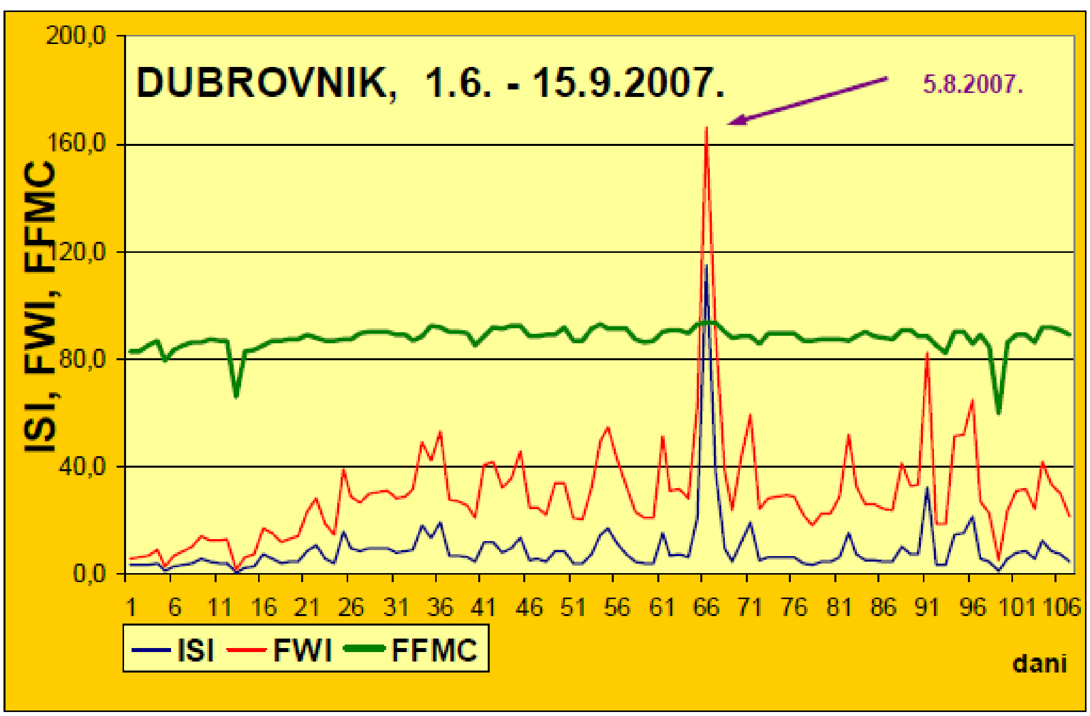


Figure 6: *Forest Fire Weather Index System for the Dubrovnik station in the period 1 June – 15 September 2007.*

Fire danger for this period was predicted by DHMZ and warnings were sent to the System 112 and Firefighting Operation Centre. There were also phone links between the shift leaders of Weather Forecast Analysis and Forecast Department and Firefighting Operation Centre. All information were available on the daily basis to the NPRD as a part of *Standard Operating Procedure on weather forecast information.*

Strong Bora wind additionally complicated the fire protection and precluded helicopter and airplane intervention. Therefore, it was very important to have reliable information regarding wind forecast. The weather forecast was based on the operational numerical model ALADIN/HR with 8 km horizontal resolution and dynamical adaptation of surface wind field on 2 km.

ALADIN/HR model and its application by HRID (High Resolution Isentropic Diagnosis) are able to predict the essential features of local phenomena with high reliability as well as their usefulness and applicability in making local forecasts and nowcasting. The Bora was forecasted to last until the 6 August. Wind velocities were forecasted to exceed 10 m/s and occupied the lowest 2 km level of the atmosphere (Figure 7). Huge space variability of the Bora (Figure 8) and its turbulent nature precluded the Canadair airplanes intervention until the 6 August.

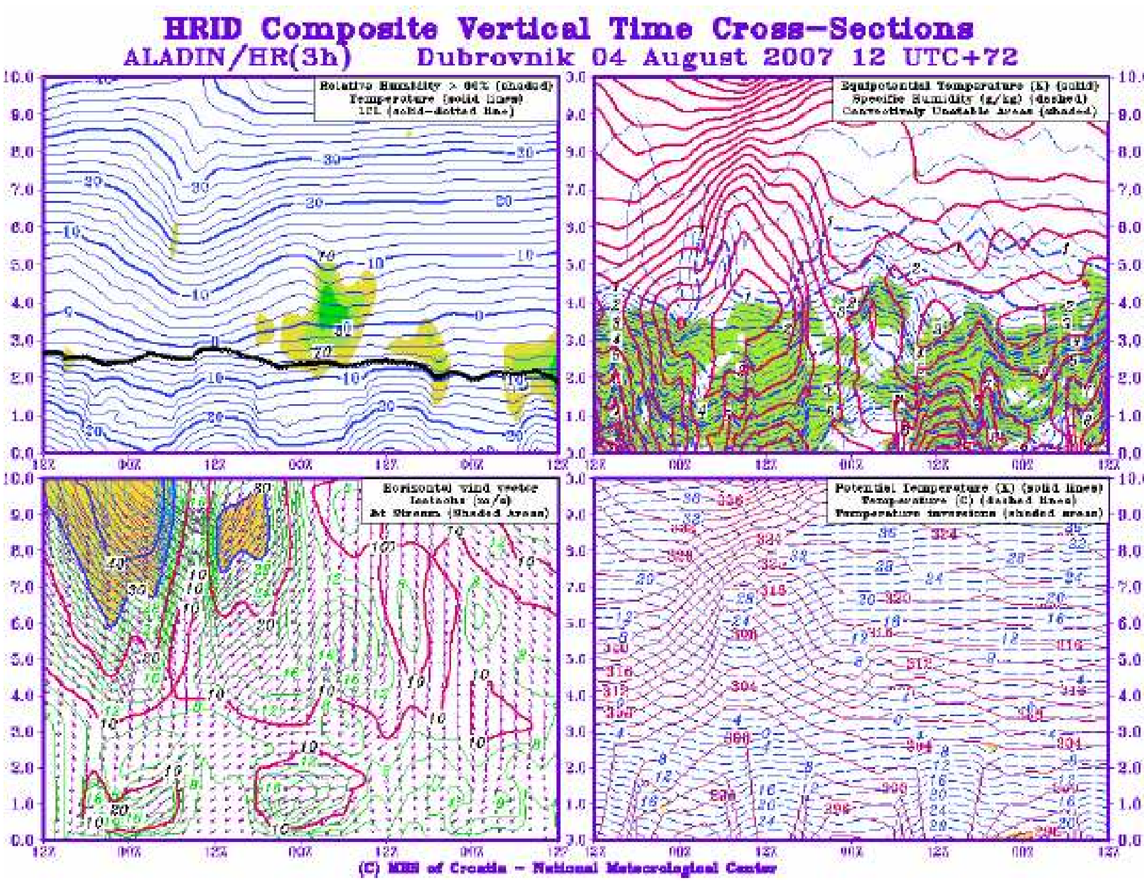


Figure 7: HRID (High Resolution Isentropic Diagnosis) vertical time-cross section for different meteorological parameters (relative humidity, temperature, equipotential temperature, specific humidity, convective unstable areas, horizontal wind vectors, isotachs, jet stream, potential temperature and temperature inversions) for Dubrovnik, 4 August 2007, 12 UTC + 72 h. Forecast based on ALADIN/HR.

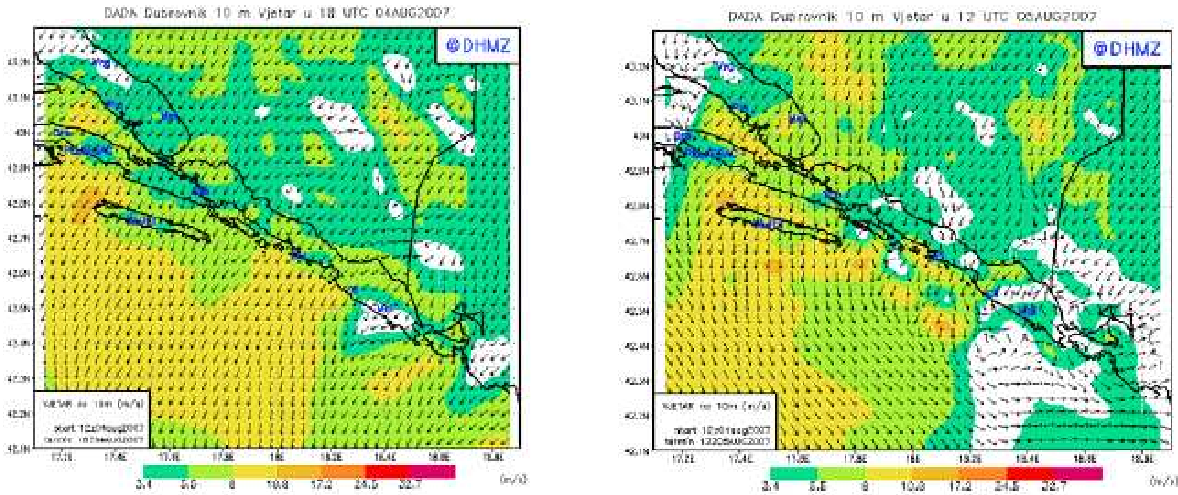


Figure 8: *ALADIN/HR 10 - m wind vectors forecast for 4 August, 18 UTC (left) and 5 August, 12 UTC (right).*

Based on the issued meteorological data, forecasts and warnings of the DHMZ, Firefighting Operation Centre took the necessary mesures for the fire protection.

After the event, additional analysis of the meteorological conditions prepared in DHMZ, show the possibility of detecting such largest fires from satellite (Figure 9).

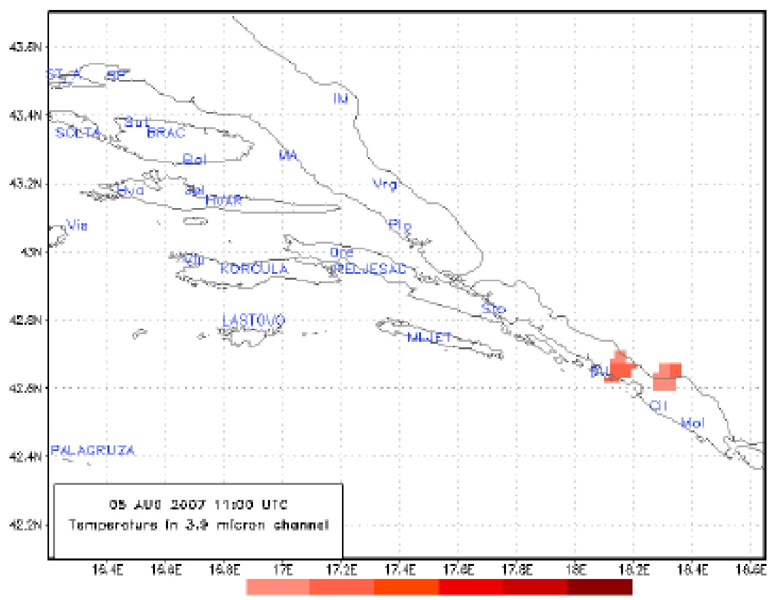


Figure 9: *MSG 3.9 µm temperature on 05 August 2007, 11:00 UTC. Hot spots in Dubrovnik area are seen.*

4. CONCLUSIONS

Forest fire protection activities in Croatia have a long tradition. The National Protection and Rescue Directorate (NPRD) is the leading organization for the protection and rescue of people, assets and environment in the Republic of Croatia. Several plans and programmes related to disaster management have been already developed and adopted. For example, *the Activity Program for the Implementation of the Special Fire Protection Measures in Republic of Croatia* defines all activities related to the preparation and acting for the summer fire protection season. Meteorological and Hydrological Service (DHMZ) supports the whole system with the relevant meteorological data and warnings. Operational data utilization and information exchange between DHMZ and System 112 has been regulated by the Standard Operating Procedures for the utilization of the DHMZ weather forecasts. The huge fire in Dubrovnik from 4 to 9 August 2007 is one of good example of cooperation at the institution level in Croatia.

International cooperation and data sharing, in such cases when the fire crossed the border, is essential. The Standard Operating Procedures for the trans-boundary actions in wild fire protection between the National Protection and Rescue Directorate of Croatia and Ministry of Security of Bosnia and Hercegovina come into the force in 2006. This SOP aims to pull together activities to identify and act in order to improve the efficiency of fire protection. Croatia thus could provide much easier and quickly assistance with fire-fighting equipment and fire-fighting aircrafts at the Bosnia and Hercegovina territory, which was the case in 2007. Although the Croatian fire fighting service is quite well organized and equipped, this case of the forest fire along the border shows the needs to enhance the technical and human capabilities in the other SEE countries.

International cooperation and data-sharing is essential to maximise the utility brought by access to use the modern technology (which is very expensive) and to minimize the national expenditure. Therefore, further enhancement of technical and human resources, both in Meteorological and Hydrological Services and Fire Protection Systems in the SEE is crucial. To enhance the national and regional fire fighting capacities there are needs to establish *SEE Regional Coordination Center for Forest Fire Fighting (SEE RCCFFF).*

ACKNOWLEDGEMENT

Our sincere thanks to all the people from the Meteorological and Hydrological Service (B. Ivančan - Picek, M. Tudor, M. Vučetić, V. Vučetić and N. Strelec - Mahović) and the National Protection and Rescue Directorate (T. Vuko) who have contributed to and worked on this case study.

For more information, please contact:

World Meteorological Organization

Communications and Public Affairs Office

Tel.: +41 (0) 22 730 83 14/15 – Fax: +41 (0) 22 730 80 27

E-mail: cpa@wmo.int

Disaster Risk Reduction Programme

Tel.: +41 (0) 22 730 80 06 – Fax: +41 (0) 22 730 81 28

E-mail: mgolnaraghi@wmo.int

7 bis, avenue de la Paix – P.O. Box 2300 – CH-1211 Geneva 2 – Switzerland

www.wmo.int