United Nations Economic Commission for Europe

Ministry of Transport, Public Works and Water Management

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

WATER AND CLIMATE CHANGE: HOW TO DEVELOP AN ADAPTATION STRATEGY IN TRANSBOUNDARY BASINS

REPORT OF THE WORKSHOP HELD IN GENEVA, 10-11 MAY 2010

Introduction and attendance

The workshop "Water and Climate Change- how to develop an adaptation strategy in transboundary basins" was held on 10-11 May 2010 in Geneva back-to-back with the third meeting of the Task Force on Water and Climate under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) on 12 May 2010. The workshop was attended by more than 80 participants. Experts and official representatives from Afghanistan, Azerbaijan, Belarus, Belgium, Czech Republic, Finland, France, Georgia, Germany, Kazakhstan, Kyrgyzstan, The Netherlands, Portugal, the Republic of Moldova, Russian Federation, Serbia, Slovakia, Switzerland, Ukraine, United Kingdom, United States of America and Uzbekistan participated, together with representatives of the Intergovernmental Panel on Climate Change (IPCC), Organization for Security and Co-operation in Europe (OSCE), United Nations Development Programme (UNDP), United Nations Framework Convention on Climate Change (UNFCCC), World Meteorological Organization (WMO), International Fund for Saving the Aral Sea-Executive Committee (EC-IFAS), Interstate Coordination Water Commission of Central Asia (ICWC), the International Sava River Basin Commission, International Commission for the Protection of the Danube River, International Commission for Protection of the Rhine River, International Union for the Conservation of Nature (IUCN).

In addition, representatives of the following Non-Governmental Organizations attended: Cooperative Programme on Water and Climate (CPWC), Ecoproject, EUCC - The Coastal Union, Stockholm International Waters Institute (SIWI), Stockholm Environment Institute (SEI), World Wildlife Fund (WWF), Eco-TIRAS International Environmental Association of River Keepers, Wuppertal Institute, The Regional Environmental Centre for Central and Eastern Europe and the Regional Environmental Centre for Central Asia, Georgia Iv.javakhishvili Tbilisi State University, Southern Cross University, New South Wales and Wageningen University and Research Centre.

Background and objectives

Water resources are vulnerable and can be strongly affected by climate change, with wide-ranging consequences for human societies and ecosystems. With the full extent of the issue only recently being recognized, few countries have developed adaptation strategies so far. Such strategies only rarely include transboundary cooperation.

Recognizing the urgency of the issue, the Parties to the Water Convention developed the Guidance on Water and Adaptation to Climate Change. When adopting the Guidance at its fifth session in November 2009, the Meeting of the Parties also decided to focus future work in two areas:

- Promoting adaptation on the ground through the establishment of a programme of pilot projects in transboundary basins, particularly in South-Eastern Europe, and in Eastern Europe, Caucasus and Central Asia;

- Fostering exchange of experience on adapting water management to climate change in the pan-European region.

The workshop was organized to launch the programme of pilot projects and constituted the first step in establishing the platform for the exchange of experience. The aims of the workshop were to:

- Exchange practical experience and share lessons-learned on the technical and strategic aspects of adapting to climate change;

- Analyse the specific challenges of adapting water management to climate change in the transboundary context;

- Show how transboundary cooperation can be established in the different steps of developing an adaptation strategy: from the assessment of impacts and vulnerability to the selection of measures;

- Support countries engaged in the process of preparing national or regional adaptation strategies;

- Promote the implementation of the UNECE Guidance on Water and Adaptation to Climate Change.

Organization of work

The workshop consisted of the following sessions:

Session 1: An enabling environment: the international context

Session 2: Governance to adapt in a transboundary setting

Session 3: Jointly assessing climate change impacts

Session 4: Jointly developing adaptation measures

Session 5: Starting cooperation: Launch of the pilot projects and conclusion of the workshop

In addition, a special lunchtime session was held on 11 May in order to present a number of specific adaptation programmes and initiatives.

This report includes in the annex summaries or abstracts of the presentations given during the workshop, as provided by their authors. All material related to the workshop is available at http://www.unece.org/env/water/meetings/transboundary_adaptation_workshop.html.

Conclusions and recommendations

Currently, many countries are developing adaptation strategies some of which were presented during the workshop (such as Portugal, Czech Republic etc.).

In most cases, adaptation strategies are developed without taking transboundary aspects into account.

Some transboundary adaptation initiatives have started such as in the Rhine, Danube and Meuse rivers, mostly at the level of river basin commissions. Most of them currently focus on jointly assessing impacts. These projects (Rhine, Danube and Meuse) will be included in the programme of pilot projects under the Water Convention in order to enable mutual exchange of experience.

Many transboundary basins in the UNECE region need to adapt to both flooding and water scarcity.

The importance of water in climate change adaptation and mitigation as well as of transboundary cooperation is increasingly being recognized in the negotiations under and the activities of the United Nations Framework Convention on Climate Change (UNFCCC). The inclusion of the Water Convention activities into the Nairobi Work Programme represents a useful step.

Climate change adaptation requires a wide range of expertise involving many actors. Therefore cooperation with partners across organizations and disciplines is especially important. In most basins, some activities regarding climate change adaptation have already started which should be taken as a basis for further initiatives and projects.

Platform for sharing experience

Learning and exchanging knowledge on adaptation activities is extremely important to improve effectiveness. Sharing of positive and negative lessons learnt is crucial. Regular face-to-face meetings constitute a special added value to a platform. Therefore, the platform for sharing experience on water and adaptation to climate change in transboundary basins to be created under the Water Convention will include yearly meetings and workshops.

Coordination, mutual exchange and interlinkages are very important. Several platforms for sharing experience on adaptation in general already exist or are under preparation such as the *Adaptation Learning Mechanism* developed by UNDP in cooperation with the United Nations Environment Programme (UNEP), the Global Environment Facility (GEF), the World Bank and UNFCCC, the portal *we.adapt.org* developed by SEI or the Clearing House on adaptation, under development by the European Union. This needs to be taken into account in creating the UNECE platform. This platform should be linked to existing platforms. The specificity of the Water Convention platform is the focus on water and transboundary adaptation.

Creating an effective, user-friendly and populated platform is challenging and requires, among others, a community of convinced and committed users, existence of trust, development of a culture of sharing and demonstrating of benefits.

There is a tradeoff between creating an open platform and quality-checking of information posted on a platform. The latter can be ensured through user rating, allowing access only to registered and recognized users, engaging with organizations rather than individuals and making clear where information comes from, thus leaving decision to the users on which information they trust.

Jointly assessing climate change impacts

Models especially do not agree on precipitation impacts and certain issues such as the relation rain-snow is very little researched yet.

Scenarios, models and hydrological predictions still carry a lot of uncertainty and this will continue. Most of the uncertainty stems from the scenarios and uncertainty about human action. In the transboundary context, there is additional uncertainty due to lack of knowledge about the neighbours' actions; therefore transboundary cooperation is so important.

Deterministic models are no longer adequate as a basis for policy making, more realistic and inclusive approaches are needed. A range of hydrological models and scenarios should be taken into account.

Cooperation of neighboring countries in scenario and model elaboration and data exchange can help to use a wider range of models and scenarios and achieve higher credibility of predictions thanks to more data

Exchange of data should include agreement on how to use data at a transboundary level, on common baseline values, variables, methodologies, return periods and parameters to be used, etc.

Impacts on water quality, biodiversity and water-related sectors also need to be assessed.

Jointly developing adaptation measures

Despite the large uncertainty regarding climate change impacts no-regret and low-regret measures can and should be taken now.

Vulnerability assessment is very important in order to target adaptation measures most effectively. It should focus on both climatic and non-climatic elements and should be conducted iteratively. Several methodologies such as the Climate Vulnerability Index are available in this regard.

Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) are useful tools which can promote climate change adaptation and especially mainstreaming of adaptation into other policy fields. In the EIA and SEA process climate change impacts should be considered.

As predictions about climate change impacts are uncertain, investments in water infrastructure should be made flexible and adaptive and include a safety margin in order to be adaptable to a wide range of future climate scenarios.

Healthy freshwater ecosystems often have high natural resilience, can resist extreme events, and a transition into new ecological conditions can take place. "Hard" water infrastructure usually restricts or eliminates some of this natural resilience. Soft or "green" infrastructure to manage water can help combine control of water resources, restore flow regimes, and rebuild natural climate resilience

In developing adaptation measures, environmental, technical, financial, institutional, social, and cognitive / informational aspects of adaptation should be taken into account. In particular clear implementation responsibilities, flexible financial instruments, benefit and burden sharing, social learning and (transboundary) cooperation are crucial for effective adaptation action.

Launch of the pilot projects

Pilot projects are very important for advancing and gaining experience on adaptation and especially transboundary cooperation. Therefore, many experts are planning to follow closely the pilot projects in the programme under the Convention.

The workshop launched the following pilot projects:

a. Pilot project on the Chu Talas Basin, shared by Kazakhstan and Kyrgyzstan, implemented by the UNDP, UNECE and OSCE. This project will mostly focus on water scarcity.

b. Pilot project on the Dniester Basin, shared by Ukraine and the Republic of Moldova, implemented by OSCE, UNECE and UNEP. This pilot project will mostly focus on transboundary flood management.

c. Pilot project on the Sava river basin, shared by Bosnia and Herzegovina, Croatia, Slovenia and Serbia, implemented by the International Sava River Basin Commission and UNECE. This pilot project will mostly focus on transboundary flood management.

ANNEX
PROGRAMME AND SUMMARIES OF THE PRESENTATIONS GIVEN DURING THE WORKSHOP

WATER AND CLIMATE CHANGE:
HOW TO DEVELOP AN ADAPTATION STRATEGY
IN TRANSBOUNDARY BASINS

PROGRAMME

Session 1: An enabling environment: the international context
10 May 2010, 3.00 p.m. - 4.30 p.m.

Chair: *Mr. Joost Buntsma, Ministry of Transport, Public Works and Water Management, the Netherlands*

Introduction and welcome
Mr. Marco Keiner, Director, Environment, Housing and Land Management Division, UNECE

Introduction to the workshop and pilot projects programme
Mr. Joost Buntsma, Ministry of Transport, Public Works and Water Management, the Netherlands

The UNECE Guidance on Water and Adaptation to Climate Change
Mr. Jos Timmerman, Ministry of Transport, Public Works and Water Management, the Netherlands

The global context: Adaptation under the UNFCCC process and the Nairobi work programme
Ms. Xianfu Lu, United Nations Framework Convention on Climate Change

Activities of the European Union on water and climate change
Ms. Marieke van Nood, European Commission, Directorate General Environment

Weadapt: Information-sharing and collaboration for adaptation
Mr. Ben Smith, Stockholm Environment Institute

Session 2: Governance to adapt in a transboundary setting
10 May 2010, 4.30 p.m. - 6.00 p.m.

Chair: *Mr. Joost Buntsma, Ministry for Transport, Public Works and Water Management, the Netherlands*

Water allocations and hydrological changes: assessing institutional resilience in transboundary rivers worldwide
Ms. Kerstin Stahl, Institute of Hydrology, University of Freiburg, Germany

The Portuguese adaptation strategy and cooperation with Spain in the face of climate change
Mr. Rodrigo Oliveira, Technical University of Lisbon, and Mr. Luis Veiga da Cunha, New University of Lisbon, Portugal

Adapting the US-Canada 1909 Boundary Waters agreement to climate change
Mr. Eugene Stakhiv, International Joint Commission, International Upper Great Lakes Study

Environmental Impact Assessment as a means for integrating climate change into development - the example of the canal between Croatia and Serbia
Mr. Micun Stanic, Ministry of Environmental Protection and Spatial Planning, Serbia

6.30 p.m. Reception for all participants in the Restaurant des Délégués

Session 3: Jointly assessing climate change impacts
11 May 2010, 9.30 a.m. - 12.30 p.m.

Chair: Mr. Anton Keto, Finnish Environment Institute

Freshwater and climate change
Mr. Zbigniew Kundzewicz, Intergovernmental Panel on Climate Change (IPCC)

Activities of the World Meteorological Organization to support climate change adaptation in countries
Mr. Giacomo Teruggi and Ms. Sophia Sandstrom, World Meteorological Organization

Cooperation and difficulties in climate change scenario elaboration in the South Caucasus
Ms. Anna Sikharulidze, Iv. Javakhishvili Tbilisi State University, Georgia

Jointly developing a transboundary climate change impact assessment: the example of the Rhine
Mr. Ben van de Wetering, International Commission for the Protection of the Rhine

Drought management and objectives of regional cooperation in the Aral See basin
Ms. Natalya Agaltseva, Research Hydrometeorological Institute, the Centre of Hydrometeorological Service, Uzbekistan

Joint approach to climate change adaptation in the Meuse basin- the AMICE project
Ms. Maïté Fournier, Etablissement Public d'Aménagement de la Meuse, France

Moldova water resources in the face of climate change: role of interstate cooperation in assessing impacts and increasing preparedness
Mr. Roman Corobov, Eco-Tiras, Republic of Moldova

Adaptation to climate change in transboundary rivers with emphasis on shared estuaries and coastal areas in the Baltic, Black and Mediterranean Seas
Ms. Magdalena Muir, The Coastal and Marine Union

12.30- 2.30 p.m.: lunch

Special lunchtime session
11 May, 1.00 p.m. - 2.30 p.m.

Chair: Jos Timmerman, Ministry of Transport, Public Works and Water Management, the Netherlands

Targeting adaptation needs using the Climate Vulnerability Index
Ms. Caroline Sullivan, Southern Cross University, Australia

From floods to droughts - adaptation strategy in water management in the Czech Republic
Ms. Magdalena Mrkvickova, Masaryk Water Research Institute, Czech Republic

The CAREC/EC project on Multi-Sectoral Effects for the Central Asian Initiative on Sustainable Development water dialogue
Mr. Martin Lindenlaub, Regional Environmental Centre for Central Asia (CAREC)

Climate-related risk indicators and adaptive capacity of developing countries
Mr. Jose Luis Carrasco Terceros, Ecole Polytechnique Fédérale de Lausanne, Switzerland

Responses to climate change by the communities residing in the Usumacinta river basin (Mexico-Guatemala)
Mr. Jérôme Gandin, Laval University, Canada

Session 4: Developing jointly adaptation measures
11 May 2010, 2.30 p.m. - 4.00 p.m.

Chair: Ms. Meike Gierk, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany

Increasing ecosystem resilience as a measure to adapt to climate change
Mr. Sergiy Moroz, Worldwide Fund for Nature (WWF)

Adaptation to climate change in the Danube River Basin
Ms. Diana Heilmann, International Commission for the Protection of the Danube River

Adam project: adaptation and mitigation - mainstreaming climate adaptation into regional water and land use planning
Ms. Saskia Werners, Wageningen University, the Netherlands

Adaptation plans from England and Wales – lessons from the 2009 price review
Mr. Mike Keil, Ofwat, United Kingdom

Session 5: Starting cooperation: Launch of the pilot projects and conclusion of the workshop
11 May 2010, 4.00 p.m. - 5.30 p.m.

Chair: Ms. Meike Gierk, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany

The programme of pilot projects
Ms. Sonja Koeppel, Secretariat of the UNECE Water Convention

The pilot project on the Chu Talas river: presentations by riparian countries

The pilot project on the Dniester river: presentations by riparian countries

The pilot project on the Sava river: presentations by riparian countries and the secretariat of the International Sava River Basin Commission

Conclusions by the chairpersons

5.30 p.m. end of the workshop

SESSION 1 - AN ENABLING ENVIRONMENT: THE INTERNATIONAL CONTEXT

Adaptation under the UNFCCC and the Nairobi Work Programme on impacts, vulnerability and adaptation to climate change

Ms. Xianfu Lu, UNFCCC secretariat

Despite its relatively less prominent position on the international climate change agenda, adaptation has been gaining increasing attention in recent years. Indeed, adaptation to climate change is being discussed under three negotiating bodies of the United Nations Framework Convention on Climate Change (UNFCCC)[1]: (1) Subsidiary Body for Implementation (SBI) - the development and implementation of Nations Adaptation Programmes of Actions (NAPAs) for Least Developed Countries (LDCs), Adaptation Fund, and the adverse effects of climate change and the impacts of implementation of response measures; (2) Subsidiary Body for Scientific and Technological Advice (SBSTA) - the scientific and technological aspects of adaptation, notably the Nairobi work programme on impacts, vulnerability and adaptation (the Nairobi work programme); (3) Ad hoc Working Group on Long-term Cooperative Action (AWG-LCA) - enhanced action on adaptation and its associated means of implementation. Together with mitigation, technology, finance and capacity building, adaptation is now one of the main "building blocks" being considered by Parties to the UNFCCC within a future international climate regime.

Negotiations under the AWG-LCA were launched after the 13th Session of the Conference of the Parties (COP13) to the UNFCCC held in December 2007 in Bali, Indonesia, aiming at an agreement on long-term cooperative action to address the climate change challenge. The recent round of negotiations at COP15 in December 2009 in Copenhagen did not produce the agreement as expected. Instead the Copenhagen Accord was taken note by COP15 and was subsequently associated to by about 120 countries. On adaptation, the Accord highlighted, among other things:

- the need to establish a comprehensive adaptation programme including international cooperation;
- that adaptation is a challenge faced by all countries;
- LDCs, SIDS and Africa are among the most vulnerable;
- Developed countries are to provide adequate, predictable and sustainable financial resources, technology and capacity-building to support adaptation in developing countries;
- Near- and medium-term financial commitment by developed countries to address the needs of developing countries for mitigation and adaptation

Meanwhile, at its 9th meeting of the Adaptation Fund Board held in April 2010, a call for project proposals were issued, and three executing agencies (Centre de Suivi Ecologique from Senegal, World Bank and United Nations Development Programme) were accredited to manage grants from the Fund. This signifies the operationalization of the Adaptation Fund. Developing countries which are also Parties to the Kyoto Protocol can access the Fund to implement concrete adaptation projects and programmes. Although the monetization of Certified Emission Reductions (CERs) is the primary source for the Fund, the Spanish Government has recently donated EUR45 million to the Fund. It is hoped that these new developments will be translated into enhanced adaptation action on the ground, particularly in vulnerable developing countries for the years to come.

To facilitate the engagement of stakeholders, exchange of information and experiences, learning and collaboration, and catalyze targeted actions on adaptation, the SBSTA launched a 5-year programme, the Nairobi work programme, in December 2005.[2] It has nine action-oriented work

[1] Details on UNFCCC negotiations relating to, and work carried out on, adaptation to climate change can be found at the UNFCCC website <http://unfccc.int/adaptation>.

[2] Details of the Nairobi work programme and work carried out under the work programme can be found at the programme's website <http://unfccc.int/nwp>.

areas around two broad themes: impacts and vulnerability, and adaptation planning, measures and actions. Through a set of mandated activities from the SBSTA, the Nairobi work programme has become a common "meeting place" for sharing, learning and collaboration on adaptation. It has also been an effective mechanism to leverage and motivate actions. To date, it has engaged over 170 organizations from the public and private sector around the world, issued 9 calls for action highlighting the priority needs of countries, catalyzed over 90 action pledges by over 40 organizations, and developed and disseminated a wide variety of publications and other knowledge products.

From the perspective of the UNFCCC, significant opportunities exist for the water community to further enhance work on adaptation to climate change in water resources sector: (1) There is a clear mandate for developing and implementing adaptation plans, policies and programmes to manage water resources under a changing climate. This is included in the current AWG-LCA negotiating text on adaptation. (2) With pledges of financial, technology and capacity-building support associated with the Copenhagen Accord and financial resources mobilized under the Adaptation Fund, adaptation actions are to be enhanced through improved support. (3) With a significant number of adaptation projects (e.g. those under the NAPAs) currently being carried out, there is a considerable scope and need to document and disseminate good adaptation practices and lessons learned. The Nairobi work programme, through its possible extended mandate, can play a key role in facilitating this cross-sector, cross-region, and cross-scale learning process.

Activities of the European Union on water and climate change

Ms. Marieke van Nood, European Commission, Directorate General Environment

The impacts of climate change in the EU are very variable and most adaptation measures are being taken at national, regional or local level. However these measures can be supported and strengthened by an integrated and coordinated approach at EU level. Several EU policies and documents have been elaborated for this purpose.

White paper

The **Commission White Paper on Adaptation to climate change** highlights the need for increased resilience to adapt to climate change effects. It presents the framework for adaptation measures and policies to reduce the European Union's vulnerability to impacts of climate change.
The Adaptation White Paper focuses on four pillar actions: (1) Strengthen the Knowledge / Evidence Base, (2) Mainstream climate adaptation into key policy areas, (3) Employ a combination of policy instruments, (4) Advance work internationally on Adaptation.
Specific actions of the White Paper are as follows:

- Develop a European Clearing House Mechanism
- Develop methods, models, tools, data sets and prediction tools
- Develop guidance on river basin management and flood management
- Assess further needs for water efficiency in agriculture and households

One specific action in the frame of pillar 1 consists in developing a **European Clearinghouse Mechanism** to improve knowledge management. This database will be constituted of reliable and fundamental information and tools on climate change impacts, vulnerability and best practices, mainly generated by public agencies and research institutes. It will focus on exchanging harmonized and quality checked EU wide data at maximal resolution, providing a tool for neighbouring countries, interregional areas and areas in which there is scope for action at EU level (CAP, Water, Coastal, Marine, Natura 2000, TEN, Energy, Health...).

In the frame of the pillar 1, water vulnerability and adaptation measures have to be modelled. A consortium of four European research institutes (CESR, Alterra, Ecologic, CMCC), started in January 2010, is therefore working on establishing an assessment of vulnerability to impacts of climate change on water on medium and long term. Adaptation measures will also be identified and assessed.

In line with the EU Adaptation White Paper, the **European Parliament Action Climate of Carpathian Region** aims at analysing the vulnerability of the region to climate change impacts and the potential adaptation measures. It will investigate the detailed weather related and spatial structure of the Carpathian region and contribute to concrete policy proposals, as the Danube Climate Adaptation Strategy and national or regional adaptation strategies in general. It will also be contributing to the Knowledge Base on Climate Vulnerability and Adaptation (EU Clearinghouse).

EU Guidance Document

Several existing European Union (EU) policies address water management issues. The most important are the EU Water Framework Directive (WFD), the EU Floods Directive and the EU Water Scarcity and Droughts Strategy. The **Guidance Document n°24 under the Common Implementation Strategy of the Water Framework Directive** is a practical guidance on how to deal with climate change in those legislations.

This EU Guidance was identified as a priority action by the White Paper. It was produced by the Climate Change and Water Steering Group under the Water Framework Directive Common

Implementation Strategy, and based on agreed key policy messages of the EU Water Directors of 2008. The Guidance is addressed to river basin managers.

The purpose of this Guidance Document is to illustrate ways in which preparations can be made for climate change within the second (2015-2021) and third (2021-2027) River Basin Management Planning (RBMP) cycles. This will require Member States to demonstrate for example how climate change projections have helped pressures and impacts analysis, how monitoring programmes are aligned to detect climate change and how choices of measures are as far as possible robust. The Document focuses on both water quality and quantity, and on both extreme events (floods, droughts) and gradual climate change.

Blueprint

As a further step, the Commission will present in 2012 a **Blueprint to safeguard European waters**, which will include an assessment of river basin management and perform a review of the Strategy for Water Scarcity and Droughts and a review of the vulnerability of water and environmental resources to climate impacts and man-made pressures.
The Blueprint will examine the balance between water demand and the supply of clean water, taking into account the needs of both human activities and of natural ecosystems. It will also examine the effectiveness of the current policies and the need for further policies or measures necessary to strengthen the resilience of EU water policy.

weADAPT: Information-sharing and collaboration for adaptation

Mr. Ben Smith, Stockholm Environment Institute

The weADAPT platform (www.weadapt.org) is a collaboration to share information and experiences and build knowledge on adaptation. Led by the SEI Oxford Office it was created in 2007 to exchange experiences from adaptation projects, useful tools and methods for adaptation and to create a network of professionals creating and applying innovative knowledge and techniques to support adaptation. The principle behind the platform is that successful adaptation will require collaboration between experts and practitioners from many different areas and a process of learning from experience.

History

The initial platform was based around a wiki (wikiADAPT.org) and was launched in Bali at COP 13 as weADAPT. Users could download the climate change explorer tool (CCE) and use it to browse downscaled climate projections, and contribute their experiences, tools and case studies to the wiki.

During 2008 weADAPT was further developed by significantly increasing the content and user base of wikiADAPT, engaging users with the CCE and gaining international recognition for the work we were doing (e.g. from the OECD and many others in the adaptation community). A prototype adaptation-screening tool was developed and added to weADAPT to show different methods for screening adaptation decisions, and a multi-criteria analysis tool was added through a contribution from a partner.

Where we are now

All weADAPT content and tools are now integrated in the semantically driven website www.weADAPT.org in order to make it easier to access and use information. In practice this means that it is now far easier to find useful content, and that related content will automatically and dynamically be displayed alongside the page being viewed. The idea is to help users not only to find useful content and guidance but also to learn as they browse the site by directing them to information related to their interests but which they might not necessarily search for. For example a page on water management policies in Lesotho might also display links to information on expected climate changes and useful organizations working in the country.

All of the content from the wikiADAPT site has been transferred to the new weADAPT site, while maintaining the ability for registered users to add and edit pages. All of the content on the site is searchable and connected, so that wiki content, organizational pages and mapped Google Earth content is all displayed (see below). Users can create user profiles and have homepages where content related to their interests is displayed and constantly updated, as new content is added.

Google Earth

As a way of sharing information on who is doing what work on adaptation, and importantly where they are doing it, we have been working with Google.org to create a tool for users to share experiences via Google Earth. This tool allows users to explore projects, videos, climate projections, model data and adaptation experiences from a range of partner networks and organisations by browsing by location. A simple form allows partners to add their own information to the tool and all of the information is searchable so that users can create their own layers by choosing to display, for example, only projects relating to water management, or only projects in Eastern Europe. This provides a quick and easy way to find and share useful information for adaptation.

Screenshot from the Google Earth Adaptation Layer in weADAPT

Building a community of practice

One of the major lessons we have learnt is that is not easy to build a committed community of users who are engaged and regularly contribute to a platform. Creating the technology to allow users to easily share information is a help, however a platform will not be successful unless a strong community can be built around it. We have found that this requires an emphasis on building relationships, an appreciation of the benefits of sharing information and the creation of a shared purpose and goals. One of the barriers is that there can be reluctance on the part of organisations to share information which they see as 'theirs', and need to brand as such.

As a way to encourage ownership organisations can now create their own institutional entry pages to weADAPT. These are designed so that they appear to be 'owned' by the organisation (for example UNEP) thus retaining branding of the information but allowing it to be shared and accessible to other users of weADAPT. We are currently working closely with various existing networks on adaptation who will share projects and experiences through weADAPT (for example on community-based adaptation, or UNEP's network on adaptation in SE Asia).

Future Plans

The major focus for the next year will be on building the community of users and expanding the case study experience and guidance available through weADAPT. We are also exploring how to link with the University of Cape Town to provide access to climate projections and interpretation from global, regional and downscaled models. Guidance and support for prioritizing and choosing between adaptation options already exists on weADAPT and will be expanded and further developed.

We are working closely with various other adaptation platforms, for example the CBA-exchange and AfricaAdapt, on how to link between the platforms and share information. This could involve creating a common database which the different platforms involved would contribute to and draw information from.

Additional website features such as blogs and social networking to encourage collaboration between users are possible, but have not yet been implemented.

weADAPT users

There are over 1000 registered individual users of weADAPT who come to the site to look for guidance on a range of topics related to adaptation. The CCE tool has been used in a range of different contexts, including research projects, academic studies and many adaptation/development projects in Africa. Geographically the spread of users varies, with concentrations in East Africa, Asia and Europe and N. America.

At a partnership level have been working closely with the Regional Platform on Climate Change Adaptation in Asia to provide technical support through weADAPT (for example training material and the Adaptation Layer). Oxfam GB have been using weADAPT in their work on climate adaptation in different offices in Africa and Latin America. The community-based adaptation community is becoming increasingly involved in using weADAPT to share information and best practices on work being done at the community level - this is being coordinated through the Global Community Based Adaptation initiative led by IIED. We are seeing more and more use of weADAPT by emerging networks such as these.

SESSION 2 – GOVERNANCE TO ADAPT IN A TRANSBOUNDARY SETTING

Water allocations and hydrological change: assessing institutional resilience in global transboundary rivers

Ms. Kerstin Stahl*, Institute of Hydrology, University of Freiburg, Germany

Transboundary river treaties and river basin organizations are important institutions for defining how water is shared between countries. However, there are concerns about allocations' vulnerability to predicted climate changes. This contribution will present results from a project in which researchers from OSU and other Universities worked together with the World Bank to address questions about the future vulnerability of transboundary water allocations in transboundary rivers globally.

Hydrologic models that use climate change scenarios to simulate streamflow changes may be useful in predicting the ability of countries to meet treaty obligations in the future. We first assessed the suitability of such predictions by systematically comparing existing water allocation mechanisms from the global Transboundary Freshwater Dispute Database (TFDD) with the capabilities of different hydrologic modelling approaches that incorporate climate scenarios. Presently, many approaches do not necessarily capture the spatial detail to determine water availability at the location where water is to be delivered or monitored, thus hampering the assessment of the resilience of treaties that have explicit streamflow or water volume requirements. Reliable predictions can only be obtained where detailed observed data on river flow and its human alteration are available for model tuning.

However, an overview of global areas that are at potential risk can be obtained by mapping the relative exposure of transboundary river basins to hydrological change characteristics as well as their institutional vulnerability. One particular characteristic of climate change that may present serious challenges to riparian states is an increase in inter-annual water variability in the future. We therefore mapped a) the global exposure to such change based on past and future simulated inter-annual variability of runoff and b) the institutional vulnerability defined by treaties' allocation, variability management, and conflict resolution mechanisms and by the presence of a river basin organization and c) different levels of risk derived from the combinations of both. Understanding when and where to target capacity-building in transboundary river basins for greater resilience to change is critical. This study may assist this task with quantitative research into the relationship between climate change induced hydrological change and institutional capacity for accommodating change.

*based on joint work with (alphabetically): Shlomi Dinar[1], James Duncan[2], Amy McNally[3], Lucia de Stefano[2], Aaron T. Wolf[2], Matt Zentner[2]

[1] Florida International University
[2] Oregon State University
[3] University of California, Santa Barbara

The Portuguese Adaptation Strategy to the Impacts of Climate Change on Water Resources

Mr. Rodrigo Proença de Oliveira, Technical University of Lisbon and Mr. Luis Veiga da Cunha, New University of Lisbon

The Portuguese adaptation strategy to the impacts of climate change on water resources aims at reducing the country vulnerability to the impacts related to water in a way that is sustainable from the technical, economical, environmental and social perspectives.
The initiative was launched following a decade when the research on climate change impacts assessment was prevalent in Portugal, as well as in the world. The first SIAM project (Climate Change in Portugal: Strategies, Impacts and Adaptation Measures), launched in 2000 and concluded in 2002, was a pioneer study intended to deliver a set of integrated scenarios of climate change impacts on water resources, agriculture, forest, biodiversity, energy, human health and tourism. It was followed by the second SIAM project (2006) and by the CLIMAAT project (2006), the latter focused on the Atlantic Archipelago of Madeira, where climate change impacts may constitute a serious problem given the isolation and the limited resources of these island territories. Several other projects followed focused on specific regions, economic sectors or particular issues.

All these research projects considered water resources as one of the most important domains to be considered when addressing climate change in Portugal, as Southern Europe is expected be the european region mostly affected by climate change, with direct impacts on the availability, timing and variability of water supply. These impacts have profound implications on many sectors of our society.

The framework of the Portuguese adaptation strategy to the impacts of climate change on water resources is the future National Strategy for Climate Change Adaptation, whose guidelines were recently formally approved by the Government, following a period of public discussion. A sign of the importance that Portugal assigns to adaptation in the water sector is the fact that the water resources adaptation initiative was launched simultaneously with the overall National Strategy for Climate Change Adaptation and is expected to be concluded in the coming months.

To deal with the complexity of the impacts of climate change in water resources, the strategy assumes an interdisciplinary approach covering all water dependent sectors and aims at integrating climate change adaptation in the overall planning policy on water resources. At a time where all European Member States are engaged in concluding their River Basin Management Plans, in the context of the Water Framework Directive, climate change should be considered as much as possible at all stages of this major planning effort. The adaptive approach of the WFD enables a phased integration of relevant adaptations, as knowledge and practices become available, with the aim of reducing vulnerabilities and increasing resilience to environmental, social and economic problems arising from climate change.

The strategy assumes a broad and long-term perspective and proposes a flexible action programme that does not restrict future options and is able to cope with the current uncertainty associated with current climate scenarios. Generic actions are proposed for water resources planning and management, ecosystems and biodiversity management, water services, agriculture, energy production, coastal zones and tourism. Demand-side actions to limit the growth and to reduce the pressures on water resources are most important, together with supply-side actions to enhance water supply reliability.

To foster the integration of climate change adaptation in the current water resources planning and management, the strategy also adopts many ongoing initiatives such as the National Plan for an Efficient Use of Water, the Strategic Plan for Water Supply and Wastewater Treatment, the

National Strategy for the Effluents of the Agriculture and Cattle Breeding Industry and the National Programme on Dams with High Hydroelectric Potential

The development of a common strategy of adaptation to climate change in the River Basins shared by Portugal and Spain (Minho, Lima, Douro, Tejo and Guadiana) is also a major issue. This international effort would be a valuable exercise for testing the UNECE Guidance on Water and Adaptation to Climate Change.

Practical Approaches to Water Management Under Climate Change Uncertainty

Mr. Eugene Stakhiv, Institute for Water Resources, US Army Corps Engineers

Water resources management is in a lengthy and difficult transition phase in attempting to accommodate the large uncertainties associated with climate change, while simultaneously struggling with the implementation of a very difficult set of principles and institutional changes associated with integrated water resources management (IWRM). Water management is the principal medium through which many of the projected impacts of global warming will be felt and ameliorated – on such basic societal services as hydroelectric power, municipal and industrial water supply, agricultural irrigation, aquatic ecosystems and marshes, as well as commercial navigation and water based recreation. However, many of standard hydrological practices, based on assumptions of a stationary climate and variability, can be extended to accommodate a large subset of anticipated climate uncertainty. Adaptations of various strategies developed by the water management profession to cope with contemporary uncertainties and climate variability can also be effectively employed during this transition period, as a new family of hydrological tools and better climate change models are developed.

Adaptive management and the 'precautionary principle', as practiced by water managers, which historically relied on a 'standards-based' approach rather than on economic optimization, are key concepts that are central to the management of the vast network of existing water infrastructure, including ecosystem infrastructure. The same principles hold for the large proportion of water management demands subject to rainfed agriculture. The keystone of adaptive management is much improved meteorological and hydrologic data networks. These must be coupled with substantial improvements in climate models, especially regional circulation models that can provide more reliable 30-, 60- and 90-day forecasts. These initiatives would considerably improve water management capabilities in dealing with extreme climate impacts (especially floods and droughts).

Better adaptation to flood and drought and contingency preparedness and recovery operations is essential, for these are the leading edge of any adaptive management strategy that is inherently geared to dealing with uncertainty of climate variability and change, and inherently dependent on better forecasting and real-time data collection and analysis. Improvements in seasonal and intra-annual forecasts would offer the greatest positive changes to a broad array of water management functions – especially for agricultural irrigation, which uses approximately 80% of the freshwater resources of the globe, together with rainfed agriculture, and is essential to sustaining most economies of the developing world.

The design of new water infrastructure initiatives presents the biggest challenge in the current circumstances, i.e. the transition period, as the life of a typical project is usually 50 years or more, and encompasses the period when climate change impacts are expected to become more severe. Standard hydrologic methods (surface water and groundwater) are still useful, though carefully selected climate scenarios can be applied to test the robustness of the performance of various alternative designs to determine the 'best' (most risk-cost effective) design. However, economic decision criteria and evaluation practices would need to be revised in conjunction with the changes in hydrologic analyses. For example, the choice of the discount rate in any economic and financial analysis, whether it be internal rate of return or classical benefit-cost analysis is the single most important determinant of the economic/financial viability of a water project. Where ecosystem-based measures have been introduced to better manage water resources, the impacts of climate change on these measures must also be considered.

"What an EIA Expert Should Do to Start Adaptation to Climate Change"

Mr. Micun Stanic, Ministry of Environmental Protection and Spatial Planning, Serbia

The steps to be taken to take into account climate change during an environmental impact assessment:

→ *Raise Awareness*

1st step: get a new period of data from the year 1980 to as close as possible to 2010
2nd step: always get a trend of the temperat. data

→ *Adapt the Project Design*

3rd step: evaluate the influence of future climate change on the project:

- *for the design period of the project (usually 2025-2030)*
- *calculate the trend in question and check if there is possible influence*

→ *Include Extra Measures*

4th step: use parts of the project in question or other sources nearby to mitigate impacts of climate change

The Sava-Danube Navigation Canal

One of them is particularly very interesting in regard to climate change and transboundary issues. The republic of Croatia is planning to build a canal for navigation of vessels between the Danube and Sava river. It will be built completely on Croat territory but has possible impacts on the downstream sections of the Danube and Sava river on the territory of the Republic of Serbia as well as on a small river Bosut which lies between the two big rivers.

The Republic of Croatia notified the Republic of Serbia in regard to the Espoo Convention that it is planning a project The Danube-Sava Waterway Canal. The Serbian side replied that it is willing to take part in the EIA evaluation. The Assessment was forwarded to Serbia in the middle of 2009. A mutual meeting of experts was held in Beograd in February 2010 during which the Croat and Serbian side came to terms on the final outlook of the EIA.

One of the interesting points of discussion was about possible decreases in waterflows on the rivers that are connected by the canal. It was stated that changes in river flows in the future may be expected, hinting it will probably be in loss of water. However, It was also concluded that further investigation is not necessary, due to the fact that it was agreed that there will be no abstraction of water below 235 m3/sec on the Sava river.

With this measure of 235 the canal itself does not endanger the flows in the river. However, the river Sava in Serbia is sensitive on the decline in water in the low flow periods. Concentrations of polluting substances of all kinds are increased. During extreme low flows the whole ecosystem is endangered. Also, the Beograd water intake is on the Sava river as well as two largest thermal power plants in Serbia.

We mentioned that the data were devised during a drought analysis. In the summer of 2003 low flows were recorded on all the three largest rivers Danube, Tisa and Sava. On the Tisa we had an emergency situation. Due to high temperatures and very low flows the fish were endangered (oxygen). Serbia side asked the Hungary to release water from the Kishkere dam in order to save the situation, which they did when some rain fell in the basin. On the Danube and Sava rivers the situation was quite normal but we cannot say at what point such a situation may evolve if the flows decline permanently. In the end it was agreed to further investigate the trends and if they should be persistent in dropping, we would get together and make a plan to mitigate this.

If we go a step further, the future canal may be the best tool for the mitigation. The amount of water in the Danube is not endangered: there is more water and the water flows faster, so the Danube won't be polluted so easily. Therefore the Danube water could be used for lifting the minimum in the Sava river. This would however have to be agreed upon.

Afterword

So, we started off with an EIA about a canal. It led further to a discussion on possible depletion of river flows on the rivers that the canal connects, due mostly to climate change. Finally we came to the conclusion that probable trends in the future may require some measures to be taken. In this case the solution would be management of the canal. So we closed the circle.

SESSION 3 – JOINTLY ASSESSING CLIMATE CHANGE IMPACTS

Freshwater and climate change

Mr. Zbigniew W. Kundzewicz, Research Centre for Agricultural and Forest Environment, Polish Academy of Sciences, Poznań, Poland and Potsdam Institute for Climate Impact Research, Potsdam, Germany

A global perspective on climate change impacts on water resources is presented, that can be zoomed into regions. Global warming, very likely resulting from the increasing concentrations of greenhouse gases in the Earth atmosphere, is unabated, but a persuading Mauna Loa – like signature of climate change in existing hydrological records has not been detected ubiquitously. However, there is no doubt that freshwater resources are among the systems that are particularly vulnerable to climate change. In many regions, water resources have been (and are projected to be) subject to stress due to multiple factors, such as population growth (with consequences for food production), changes in affluence and living standards, while climate variability and change exacerbate the water stress. Due to the rising temperature in most regions, and decreasing precipitation in some regions, drought-affected areas have increased and are projected to further increase in extent. Increase in frequency and severity of summer droughts is likely in continental interiors. Augmenting of atmospheric humidity leads to increase in heavy precipitation with consequences to flood hazard. Ongoing glacier retreat and reduction in snow cover is projected to accelerate, reducing water availability, hydropower potential, and changing seasonality of river flows in meltwater-fed regions where more than one billion people live. Runoff and groundwater recharge are projected to increase over large areas, particularly in higher latitudes of Northern Hemisphere and to decrease over some dry regions at mid-latitudes and dry tropics. Climate change impacts on water resources are likely to be both positive and negative, but aggregated adverse effects are likely to outweigh the benefits, globally. The likelihood of deleterious impacts, as well as the cost and difficulty of adaptation, are expected to increase with magnitude and speed of the global climate change. Areas in which runoff is projected to decline are likely to face a reduction in the net value of the services provided by water resources, e.g. as habitat for freshwater fauna and flora or as energy source. Sea-level rise and overpumping leads to saltwater intrusion into coastal aquifers. Many sectors and systems (e. g. water supply and sanitation, agriculture, energy, human health, settlements, infrastructure, industry, transportation, tourism, insurance, and financial services) are dependent on water resources and their availability, so changes in hydrological regimes and water quality due to climate change will impact across the economy and society. These hydrological changes will combine with other pressures on water resources to challenge water management.

Water management decisions have always been made on the basis of uncertain information. However, uncertainty of regional and local climate projections is very high, posing a difficult challenge to the existing water management practices by adding uncertainties and novel risks, possibly outside the range of experience. Since the existing climate projections for the future are loaded with high uncertainty, the question may arise – adapting to what? Uncertainty in climate impact projections has implications for adaptation practices, which should not rely on precise (and unrealistic) projections of changes in river discharge, groundwater, etc.

Climate change mitigation acts on a global level (where local activities are integrated) over larger time scales due to the inertia of the climate system, slowing the rate of climate change and thus delaying the timing and magnitude of impacts. Mitigation can be interpreted as a kind of "source-control" solution, while adaptation is an „end-of-pipe" approach. The benefits of mitigation will not be realized until several decades later, thus adaptation is needed to address near-future impacts. However, without mitigation, the increasing magnitude of climate change may render the adaptation to impacts very difficult, if at all possible. If the mitigation is not effective and temperatures are allowed to rise strongly, the costs of adaptation measures are likely to soar and indeed their relative effectiveness would then diminish.

Activities of WMO to support climate change adaptation in the water sector

Mr. Giacomo Teruggi and Ms. Sophia Sandstorm, WMO

Climate-related activities

Decision-makers in many socio-economic sectors including water, agriculture, fisheries, health, forestry, transport, tourism and energy, are increasingly concerned by the adverse impacts of climate variability and change, but are not sufficiently equipped to make effective use of climate information to manage current and future climate risks as well as ecosystems. Consequently, there is not only an urgent need for enhanced global cooperation in the development of accurate and timely climate information but an equally urgent need for its exchange between the providers and users of climate services, thus ensuring that relevant climate information is integrated into planning, policy and practice at various levels. In order to address these needs and to provide an effective interface between scientists, service providers and decision-makers, the World Meteorological Organization and its partner organizations for the World Climate Conference – 3 (held in August-September 2009) established the Global Framework for Climate Services[3].

The objectives of the Framework are to provide a cooperative framework in which all nations, International Organizations, scientists and sectors will work together to meet the needs of users; to enable users to benefit from improved climate information and prediction; to mobilize climate science globally to advance the skills of seasonal-to-interannual and multi-decadal climate predictions to generate and provide future climate information on an operational basis; and finally to enhance cooperative global infrastructure to foster sharing new advances in science and information.

This will be done through its four major components, namely: 1. Observations and Monitoring; 2. Research & Modelling and Prediction; 3. Climate Services Information System that constitutes the key operational element that generates and disseminates climate information and 4. User Interface Programme, presenting a relatively new concept, which will develop ways to bridge the gap between the climate information being developed by climate scientists and services providers, and the practical information needs of users.

The Climate Services Information System builds on established global programmes such as the World Climate Programme and Global Producing Centers for Long-Range Forecast (GPCs)[4] that feed into other elements of the system such as the Regional Climate Centres (RCCs)[5] and Regional Climate Outlook Forums (RCOFs)[6]. A short description of three key elements of the Climate Services Information System is provided below:

- GPCs are WMO-certified centres that assist WMO Members by providing operational long range forecasts on the global scale as input for regional and national climate services. GPC products provided as minimum requirement include predictions for averages, accumulations, or frequencies over 1-month periods or longer; lead-time between 0 and 4 months; issue frequency which is monthly or at least quarterly; delivery of graphical images on their websites; long-term forecast skill assessment. The primary users of a GPC are RCCs, National Meteorological and Hydrological Services (NMHs) and other GPCs. Especially RCCs and Regional Outlook Forums (RCOFs) use global scale products to apply downscaling methods or Regional Climate Models to compute more precise predictions for certain regions.

[3] See http://www.wmo.int/pages/gfcs/index_en.html
[4] See http://www.wmo.int/pages/prog/wcp/wcasp/clips/producers_forecasts.html
[5] See http://www.wmo.int/pages/prog/wcp/wcasp/RCCs.html
[6] See http://www.wmo.int/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.html

- RCCs are centres of excellence designated by WMO's commissions for climatology and Basic systems that create regional products that support regional and national climate activities, and thereby strengthen the capacity of WMO Members in a given region to deliver better climate services to national users. RCCs support NMSs in implementing and maintaining climate services by regionalizing global climate products and introducing innovative regional products.
- RCOFs are forums/platforms that bring together the experts from a climatologically homogenous region and produce consensus-based user-relevant climate outlook products in real-time through regional cooperation and partnership, based on input from NMHSs, regional institutions, RCCs and GPCs.

A more thorough description of the different programmes is available here: http://www.wmo.int/pages/prog/wcp/wcasp/wcasp_home_en.html.

The way forward in addressing the need for improved climate information and services will be through consolidating and widening the networks, as well as through the establishment of a global extensive GPC-RCC-RCOF-NCC mechanism.

Water-related activities

Adapting climate information to the water sector is essential to understand the possible impacts of climate change on water resources.
The Commission of Hydrology (the governing body of WMO's Hydrology and Water Resources Programme, HWRP) at its thirteenth session (CHy-XIII) established a Theme Area on Water, Climate and Risk Management. Therefore, among the different activities mandated by CHy to the HWRP, it was also added[7]:

a) To contribute to the guidance material on seasonal flow forecasting (liaise with hydrological forecasting and prediction theme) – including quantifying uncertainties;
b) To prepare guidance material on the climate information requirements of water resources managers for operations, long-term planning and design;
c) To prepare guidance material on drought forecasting and indices – including quantifying uncertainties;
d) To prepare guidance material for factoring transient climates, non-stationary nature of data sets and uncertainty analysis in the estimation of design floods.

On the basis of this, taking into consideration the experiences made in the field of climate outlook forums, and keeping in mind the resolutions of WCC-3, WMO started to develop a process to transfer the experience of RCOFs to the water sector, for the establishment of « Regional Hydrological Outlook Fora »

A first approach towards this direction was done following a proposal from CIIFEN (Centro Internacional para la Invastigation del Fenomeno de El Niño) to adapt the seasonal climate forecasts to hydrological information, which led to a joint workshop in January 2010 in Guayaquil, Ecuador. The methodology proposed during this workshop was to elaborate seasonal climatic forecasts, taking into consideration their probability function, to obtain seasonal probabilistic forecast of discharge for a specific basin, through the use of Statistical Methods (such as the NHHM – Non Homogeneous Hidden Markov Model, calibrated with daily observed meteorological data) and disaggregating tri-monthly data in series of daily data for each station in the basin, as an input for hydrological modeling of the same basin.

In parallel to this, another Demonstration project is currently developed by WMO and the Global Climate Observing System (GCOS) in the framework of the Global Terrestrial Network Hydrology (GTN-H) of GTOS (Global Terrestrial Observation System), with the objective of demonstrating the

[7] See http://www.whycos.org/wordpress/?cat=13

value of GTN-H-related datasets to enhance hydrological outlooks provided to developing countries[8].

Moreover, in order to gather information, which is a necessary step for adaptation to climate change, and in response to scarcity or absence of data and information on freshwater resources (due in many cases to obsolescence of observing networks, insufficient data management capabilities and/or institutional weakness of National Hydrological Services), WMO is implementing since 1995 the World Hydrological Cycle Observing System (WHYCOS). WHYCOS is a programme that aims at improving the basic observation activities and data management through the establishment of a network of key national stations, and through the strengthening of technical and institutional capabilities of Hydrological Services, while at the same time promoting and facilitating dissemination and use of water-related information and strengthening international cooperation and data exchange, based on Resolution 25 of the WMO Congress General on the exchange of hydrological data and information[9].

WHYCOS consists of a number of regional components, each of which is independently implemented and responsive to local needs. Each HYCOS component brings together several hydrological services which have common interests, either because they share a common drainage basin or are in a well-defined geographical and hydrological region. HYCOS components are launched when the countries concerned have expressed their collective desire for such a development, and their commitment to making it a success.

To enhance resilience of communities to possible impacts of climate change, WMO is also carrying on the Flood Forecasting Initiative (FFI)[10], based on the analysis of weaknesses of current forecasting systems and with a focus to enhance the ability of National Hydrological and Meteorological Services (NMHSs) to provide improved flood forecasting services.

On a wider and more integrated scale, the WMO/GWP Associated Programme on Flood Management (APFM)[11] has the mission of supporting countries in the integrated management of floods (IFM), aiming at maximizing the net benefits from floodplains and minimizing losses of life. This strategy takes also into consideration the new challenges of uncertainty factors deriving from climatic changes.

APFM activities are mainly implemented through field demonstration projects (already implemented in Africa, South East Asia and Central and Eastern Europe) and through capacity building and advocacy on IFM, both through training courses and development of tools such as Adaptation to Climate Change in Flood Management (with Case Studies), or the Transboundary aspects of flood management, which are currently under development.
Moreover, APFM has implemented since one year the IFM HelpDesk[12], a facility that will provide guidance on flood-related issues to countries that are willing to adopt the IFM concept.
It is composed of a "Help yourself" part, where various materials can be downloaded or accessed on a free basis, and by a "Get help" part, where countries and institutions, such as local governments or universities, can request assistance in the development of IFM strategies.

On the basis of the experience gained and methodologies built in the framework of APFM, and considering the work carried out by the Agricultural Meteorology Programme[13], WMO is currently considering developing an Associated Programme on Drought Management, still at a preliminary phase.

---

[8] Additional information about this project can be found at the website http://www.wmo.int/pages/prog/gcos/index.php?name=RegionalWorkshopProgramme .
[9] See www.whycos.org, or http://www.wmo.int/pages/prog/hwrp/documents/Resolution_25.pdf for Res. 25
[10] See http://www.wmo.int/pages/prog/hwrp/FloodForecastingInitiative.html
[11] See www.apfm.info
[12] See www.floodmanagement.info
[13] See http://www.wmo.int/pages/prog/wcp/agm/agmp_en.html

In terms of cooperation with other International Organizations, WMO is currently coordinating the activities of the UN-Water Task Force on Water and Climate Change, while it has so far been cooperating successfully and with mutual interest and benefit to UNECE activities, especially in developing guidelines. WMO is now looking with interest at future UNECE activities linked to adaptation to climate change in the water sector, and willing to provide the required technical and scientific backstopping in UNECE pilot projects on adaptation to climate change in the water sector.

Jointly developing a transboundary climate change impact assessment: the example of the Rhine

Mr. Ben van de Wetering, International Commission for the Protection of the Rhine

The 1999 Rhine Convention, together with existing European Union (EU) and national legislation and policies and a strong political commitment in all countries in the Rhine catchment, provides a sound basis for developing and implementing an adaptation strategy on the impacts of climate change. Activities regarding adaptation to climate change have started with an assessment of the state of knowledge on climate change and its expected impact on the water regime in the Rhine, published in 2009. However, already in the 1990s, important measures were being taken regarding flood risk management, increasing the basin's adaptive capacity to respond to future expected climate changes.

Following the severe flooding in the Rhine in 1993 and 1995, the International Commission for the Protection of the Rhine (ICPR) developed and adopted a comprehensive "1998 Action Plan on Floods" covering the period up to 2020. In the context of the implementation of the 1998 Flood Action Plan, the flood damage risk (defined as the product of damage potential (€) and the probability of flooding (1 per year)) has been assessed. In addition, possibilities for reducing flood levels by implementing measures in the catchments' area have been identified. The resulting information was published in the "Rhine Atlas 2001" as one of the elements aiming at increasing peoples' "flood awareness". The flood forecasting system has also been improved, in particular by improved cooperation between water management administrations and weather services.
The Action Plan aims at improving the protection of people and property against floods and at the same time at improving the floodplains of the Rhine. Great efforts have been made towards implementing the Action Plan and almost all measures due to be implemented by 2005 have in fact been undertaken. Their positive effect is demonstrable. In 2007, Rhine ministers confirmed the need to develop adaptation strategies for water management in order to be able to address the effects of climate change, which are clearly discernible.

The implementation of the 1998 Flood Action Plan over the period 1995–2005 was evaluated in 2007. The assessments will be repeated once every five years, the next time covering the period 1995–2010.

Adaptation strategy for climate change impacts

To assess the impacts of the modification of the climate on the hydrological processes and the regime of the Rhine, the Conference of Rhine Ministers charged the ICPR in 2007 to draft a scenario study for the flow regime of the Rhine. This was the starting point for the discussion on adaptation to climate change.

The main steps toward an Adaptation Strategy established by the ICPR are the following:

- Preparation of a synthesis of available literature (2009)
- Development of hydrological scenarios with the help of models (water discharges and temperature) (end of 2010)
- Assessment of the impacts on quality status and uses (2010-2011)
- Identification of possibilities to remediate impacts (2010-2011)
- Development of an adaptation strategy

The ICPR established the climate change expert group KLIMA in spring 2008. The group has mandate to develop hydrological scenarios and to discuss and evaluate climate change effects on the hydrological regime in the Rhine basin

A first step toward the Adaptation Strategy was an assessment of available information (2009) made by the expert group KLIMA entitled "Analysis of the state of knowledge on climate changes so far and of the impact of climate change on the water regime in the Rhine watershed". This assessment revealed changes in parameters like flood levels and duration, low water levels and duration and water temperature over the last 3–4 decades. A second step, the development of common scenarios for these parameters using a complex mix of different models, will be finalized by the end of 2010.

The recently started assessment of the impacts on quality status and uses will use the hydrological scenarios as a basis and will be carried out in parallel by three thematic Working Groups (Flooding, Ecology and Chemistry). As example of impacts we can mention the increase of rainfall in winter, which increases the risk of flooding, the reduced water levels in summer, which lowers the efficiency of fish ladders at hydropower plants or the increased temperatures in summer, which impair the migration of fish.

The discussion on the Adaptation Strategy has not yet started and will need a horizontal working group involving key members of all thematic Working Groups and a close link to policy level. We can however already say that the eventual adaptation strategy will take account of experience gained with implementing the 1998 Flood Action Plan as well as the wider experience of the ICPR in protecting the Rhine. Synergies between flood protection and ecosystem and water quality improvements will be sought wherever possible, and problems, for e.g. drinking water supply and navigation due to low water levels, will also be addressed.

In this process, the ICPR has a coordinating and guiding role. The actual implementation of measures (including financing them) is the responsibility of the countries in the catchment area.

Cooperation and difficulties in climate change scenario elaboration in South Caucasus

Ms. Anna Sikharulidze, Iv.Javakhishvili Tbilisi State University, Georgia

Climate change impact assessment for a trans-boundary river is a very difficult, expensive and time-consuming activity. Intensive cooperation between neighboring countries plays an essential role in the success of such efforts. Studies of the regional impacts of climate change must adress the problem of developing credible climate change scenarios as input for regional impact assessment. The spatial level of the Global climate models (GCM) is too high to represent surface features and atmospheric processes that are critical for understanding local impacts. Regional climate models (RCM) provide highly resolved information, but are very expensive. Therefore only a limited selection of global climate models and greenhouse gas emission scenarios (mainly 1 or 2) may be considered in the context of one country. However, it is well-known that it is preferable to consider a range of greenhouse gas emission scenarios in climate impacts studies. On the other hand, use of multiple climate models allows a better representation of the uncertainties and the range of possible outcomes. This is due to the fact that the uncertainty attributed to the global climate models and the uncertainty of future emissions are two major uncertainties currently identified. The use of different limited scenarios and GCM-s by neighboring countries may lead to differences in climate predictions and its impacts. Combined efforts of several countries for regional downscaling of different global climate models, validating obtained results against observed data and mutual agreement on selection of models and greenhouse gas emission scenarios will result in the development of more credible climate change scenario for the whole region and reduce the uncertainty introduced by modeling. The good example of such cooperation is the combined activity of the Caucasus countries (Azerbaijan, Armenia, Georgia) for preparation of their national communications to the UNFCCC. Under this activity the countries used RCM PRECIS (Providing Regional Climate for Impact Studies) to downscale climate data.

PRECIS (Providing Regional Climates for Impacts Studies) is a portable RCM developed and distributed by Hadley Centre, UK that can be run on a personal computer and can be applied to any area of the globe to generate detailed climate change scenarios. The PRECIS RCM is an atmospheric and land surface model of limited area with maximum resolution of 25 km. A typical experiment though, covering a 100-by-100 gridbox domain and including a representation of the atmospheric sulphur-cycle, run on a 2.8GHz machine, takes 4.5 months to complete a 30-year simulation.

This regional implementation process was organized and operatively directed by the UK Hadley Center, which has developed the PRECIS model and which handed it over to participating countries without any charge. It also organized capacity building workshops for national experts of implementing countries and is supporting them in online regime through established listserve. Hadley Center prepared the domain and boundary conditions as well for the mentioned region. Each country has performed several runs of model: Georgia – ERA Baseline and ECHAM4 B2 2020-2050 runs, Azerbaijan - ECHAM4 Baseline, ECHAM4 A2 2020-2050 and ECHAM4 A2 2070-2100 runs and Armenia together with Hadley Center -HadAM3P Baseline and HadAM3P A2 2070-2100 runs.

However, the countries have not agreed on how they will use the obtained data to develop their climate scenarios. Consequently the final climate scenarios of countries differ significantly.

1. Armenia predicts (Projections based on HadAM3P PRECIS runs):
   - An increase of annual temperatures – 1° C by 2030, 2° C by 2070, 4° C by 2100,
   - decrease in atmospheric precipitation – correspondingly 3%, 6% and 9%.

2. Azerbaijan climate scenario (Projections based on ECHAM4 PRECIS runs):

- temperatures by 2070-2100 may rise by 3°C - 6°C while in most parts of the country's area it rises by 5°C compared to temperatures in 1961-1990.,
- The level of rainfall in the country area may increase from west to east by 20% to 80%

3. Georgia averaged values obtained from HadAM3P and ECHAM4 PRECIS runs and forecasts of Selected GCMs within MAGICCC/SCENGEN statistical downscaling model.

- an increase in the mean annual temperature of 3-5°C at the end of century,
- decrease in precipitation by about 9-13%

So as seen that both Armenia and Georgia predict decrease in precipitation, while Azerbaijan has up to 80% increase. This is caused by different methodologies and different data that countries relied on, stressing the need more intensive cooperation for developing common scenario.
This is suggested to be performed under the planed regional project "Regional Climate Change Study for the South Caucasus Region" financed by the "Environment and Security' Initiative (ENVSEC)". The project has just started and will last 12 months. Under this project the participating countries (Georgia, Azerbaijan, Armenia) will develop common climate scenarios for whole Caucasus Region based on the research already performed under their Second National Communications Projects and also Undertake vulnerability assessment of a selected sector/geographic area of common interest based on regional climate change scenario.

Activities to be performed for developing common scenario includes:

- Agreement of common methodology which means the review of national climate scenarios prepared under SNC, identify methodological/technical issues and propose/agree on methodology and adjustments
- Development of the regional level future climate scenarios using agreed approach
- Review existing cooperation and data exchange modalities and identify ways to improve them.

Activities that may be performed in vulnerability studies include:

- Study on the vulnerability of transboundary rivers (Alazani and Iori basins): Azerbaijan – Georgia
- Study on the vulnerability of agriculture sector, particularly water deficit: Armenia – Azerbaijan –Georgia
- Forecast of extreme events: Armenia – Georgia
- Others….

Drought management and objectives of regional cooperation in transboundary rivers basins (Aral See basin)

Ms. Natalya Agaltseva
Research Hydrometeorological Institute, UZHYDROMET, Uzbekistan

Drought is an insidious natural disaster. The hydrological drought–phenomenon, among all natural disasters, has most serious consequences for all five countries using water from main transboundary rivers in the Aral See basin. The situation with the water resources becomes crucial during the dry years when hydrological drought is observed. The assessment of the driest period on the base of the extreme climate scenarios shows that vegetation runoff in Amudarya and Syrdarya transboundary river basins might be decreased for 25-40%. Especially unfavorable conditions are expected in the middle and lower streams of Amudarya and Syrdarya (in the irrigation zone).

There have been several intense droughts and heat waves in the recent years, such as those in Central Asia in 2000, 2001, 2007, 2008 which have increased the concern that droughts may be increasing in frequency. The recent increase of drought and heat waves in Aral see basin is consistent with the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, which stated that the world has been more drought-prone during the past 20 years and that climate projections indicate an increased frequency in the future.

There is an urgent need to develop drought monitoring and early warning systems as a component of adaptation strategy. A critical component of national and regional drought adaptation strategies is a developed drought monitoring system that would provide early warning of drought's beginning and end, determine its severity, and deliver that information to a broad group of users in a timely manner. With this information, the impacts of drought can be reduced or avoided in many cases.

The Drought Management Centre for Central Asia established during the last year is one of the relevant organizations of transboundary cooperation. This Center coordinates will consider the drought's management principle challenges and will plan the main cooperative activities for regional and national levels. This includes developing drought management plans and mitigation plans, moitoring of drought, participatiing in the design and development of drought early warning system; advising policy makers of drought policy; researching; organizing and conducting seminars, workshops and conferences for federal, state and foreign governments and international organizations and providing information for the media and the general public.

Some preliminary steps targeted at the assessment of impacts and vulnerability had already been done being funded through the national budget. Probably there will also be an additional international project.

The drought Management Centre for Central Asia is the regional unit that will bring together different countries with different economic and social backgrounds but with a common transboundary oriented water management, drought management, climate change and adaptation strategies development and implementation. Problems may be the best linkage in the really complicated chain of regional transboundary cooperation.

. The regional cooperation should be focused on: .

- ☐ Identification of the single transboundary water use concept under expected hydrological drought conditions;
- ☐ Drought forecast and assessment of its socioeconomic consequences;
- ☐ Development and implementation of the task-oriented programs focused on the drought prevention and risk reduction for agriculture;

- ☐ Ensuring preparedness of the management agencies and systems for prevention and mitigation of hydrological drought for extreme situations liquidation;
- ☐ Development of the drought monitoring, collection, processing, exchange and providing the information on the drought prevention and assessment the vulnerable territories;
- ☐ Preparation of population, officials of the management bodies to the actions under the drought;
- ☐ Liquidation of hydrological drought after-effects;
- ☐ Implementation the measures on the social protection of population affected by the drought;
- ☐ Support the operation of the Drought Management Centre for Central Asia;
- ☐ Design, development and establishing the facilities for timely and effective dissemination of the information acquired from drought early warning systems and its delivery to decision makers.

It is obvious that adaptation strategies are still to be developed and adaptation measures are still to be implemented. There will be a lot of disintegrating barriers on the way to developing strategies and implementing adaptation measures.

Compromises will be needed as well as best practices, lessons learned and scientifically sounded approaches. All these things are fused in the Guidance on Water and Adaptation to Climate Change as mainstream.

The Drought Management Centre for Central Asia would be a regional connecting link for climate change related issues, especially in the transboundary context. The centre could play a reliable and effective role in promoting the implementation of the UNECE Guidance on Water and adaptation to Climate Change because:

- ☐ its activities are going to be driven by main principles are stated in the Guidance that could be applied to drought management and drought planning;
- ☐ the use of best practices, lessons learned and scientifically sounded approaches are probably the only ways to succeed in developing adaptation strategies, in implementing adaptation measures and in promoting and popularizing the implementation of the principles of the Guidance.

Joint approach to climate change adaptation in the Meuse basin the AMICE project

Ms. Maïté Fournier, EPAMA, France

The Meuse basin: where is it, what are the challenges?

A river of north-western Europe, between the Scheldt and the Rhine, flowing south to north, exit in the North Sea.

- No glacier, few underground water = a rain-fed river = very reactive to modifications of rainfall patterns
- 905 km long, 9 million inhabitants, 5 countries
- Average 350 m3/s but range from 20 m3/s in extreme low-flows (summer 1976) and 3000 m3/s in extreme high-flows (winter 1993)
- Low population density to the south, very high stakes in the north = Rotterdam, Eindhoven, Maastricht, Liège
- Large part of the downstream area is under sea level
- Numerous channels to the Scheldt and Rhine
- Water exported to feed Brussels = 6 million inhabitants
- Flood management with large dams and flood areas
- New problems = flash floods and low-flows

Basis for cooperation do exist on the Meuse basin

The International Meuse Commission: People are getting used to working together for more than 10 years now and solidarity is strong.

The Meuse Commission has several transnational agreements and reports. The last published is the global management for the implementation of the Water Framework Directive (2009). A similar management plan will be produced related to the implementation of the Flood Directive.

One of the results of frequent meetings between State representatives are the works on the "Common Meuse": restoration of meanders, more space for water and conservation of natural areas along the Meuse, carried-out both by Flanders and the Netherlands.

Publication in 2009 of the book 'Van Regen tot Maas' translated into French 'Gouttes de Pluies, Flux de Meuse' is the first book about water management that is written at the international Meuse river basin scale.

Several and well-known funding Programs from the EU for the promotion of transnational cooperation (AMICE is funded under Interreg IV B – North West Europe).

This is how the AMICE Project was created.

Adapt by sharing knowledge

Climate evolution range is uncertain. Here is an example of maps taken from the literature and showing runoff evolution by 2020 and 2070: two different models Echam4 and HadCM3 that give different results.

For some regions, the trend is clear (even of the magnitude of change is different between the two models): Spain or Scandinavia.

In the Meuse, the different models indicate different trends! How do we solve that ? Do we take the mean value of the two models? No. We had to look for more models and for more detailed

results: especially the yearly mean value is useless in hydrology. We need trends for each season, especially the winter season (for floods) and the summer season (for low-flows) are relevant.

Partners went to look for advanced research form the Meuse countries climate institutes: Météo-France, KMI, KNMI and we had to run again the rainfall-runoff models.

AMICE Partners decided to create a "transnational Meuse climate scenario" to be able to work together. In parallel, they keep investigating impacts with the national/regional scenarios.

Summer and winter are quite clear trends but spring and autumn are much more uncertain.

I only present some of the results but all combinations of scenario (dry/wet), timeframe (2020-2050 / 2070-2100), season (winter, spring, summer, autumn) have been examined.

Partners used rainfall-runoff model to calculate the future high and low-flows under the transnational scenario. But they first had to agree on which variables to use for comparisons…
Impact variables were quite easy to choose since the most common are the same in all countries (others are used also for low-flows). Return periods was harder because the Netherlands are using much higher T than the upstream countries.

The statistical laws used to calculate a Q100 were also discussed. The statistical law is chosen based on visual "best fit" (expert judgement) and was different between France and Wallonia. Problematic because France has calibrated defensive works and Wallonia has drawn flood risk maps.

None of the two results is more true than the other . We decided on using the lowest value (explanations will be required on the French side!)

Results of rainfall-runoff modelling are bigger than values found in the literature (because they are not mean yearly values). Other combinations of scenarios, seasons and timeframes lie in between.

Now Partners are carrying-out the hydraulic modelling, but there are steady and unsteady models on the Meuse basin

AMICE is not just a study, this is also about making adaptation come true. The important message is "adaptation everywhere": upstream but also downstream, adapt to floods but also low-flows, use defensive protections but also flood preparation techniques. Illustrations with some of the AMICE Project investments

Adapt by using nature capacity

Nature to buffer extreme events: healthy ecosystem resist better to climate extremes, upstream ecosystems have a 'sponge' effect = they retain water when it falls and release it slowly.
Conservation of those habitats prevents the construction of water reservoirs: but requires huge surfaces.
AMICE acts for the conservation of some areas + prospection for potential new locations -> network of small soft protection measures

Adapt by improving existing infrastructure

HOWABO water management plan
Keep extra space around cities and create "green rivers" = farmland that can be used for emergency storage of extra water. Economical activities, tourism and flood defenses are combined. Flood defenses are FLEXIBLE.

Installation of pumps on the Lock of Ham.

Sluices are water consumers. River transport is bound to increase. How make water savings in channels?

Pumps can be installed on sluices: in summer, when pressures on water are high, water is pumped up. In winter, when water is plenty, the pump functions as a small water power plant.

Innovative systems are even fish-friendly!

Adapt by preparing to crisis

OSIRIS crisis management software.
Protections are never efficient 100%, a crisis may always occur. Protections have been designed to cope with present weather but not with the future. New defensive dikes are very expensive. Flood crisis management and preparedness are efficient ways to limit damages at reduced costs. People have to learn what to do in such cases.

Flood crisis management plans are now compulsory in every local community in France and Wallonia. Software exists to support the making and updating of such plans. They can be used in real time.

Adapt by communicating

Communication is difficult because :
- Climate change is questioned => be convincing (do not hesitate to start from beginning)
- Climate change is uncertain => no-regret measures, soft and flexible, manipulate figures with care (they are only trends and projections!)
- Climate change is a global phenomenon but with local impacts => everybody can/must do something (show-off volunteer actions and small-scale projects, best practices)
- Climate change impacts all sectors and communities => integrated solutions to avoid side-effects (need time and consultation…)
- Climate change adaptation costs money => cost-benefit analysis, define priorities

AMICE has been targeted at water managers and experts so far. We need to move to the public and to decision-makers now.

Moldova water resources in the face of climate change: Role of interstate cooperation in raising preparedness

Mr. Roman Corobov, "Eco-TIRAS" International Environmental Association of River Keeper, Republic of Moldova

General adoption and implementation of international water documents concerning climate change in EIT countries are affected by a number of negative factors that can be summarized as follows:

- Formal approach to addressing these issues, including the establishment of official institutions;
- Unstable economical and political situation;
- Low efficiency of authorities on all level and their potential inability to address binding demands of International Conventions and Agreements;
- Lack of openness and transparence in the work of governmental bodies that limits opportunities to provide independent monitoring of their actions;
- Financial constraints resulting in the priority of today's needs over long-term environmental goals;
- *Absence of the comprehensive vision of the future regional climate change and the identity in its transboundary projections.*

Climate change is global by its origin, but manifests itself on regional and local level. More than 120 years of instrumental observations in Chisinau demonstrate that only 16.4% of year-to-year variability in Moldova's air temperature is explained by the global processes and about 20% – by the processes in the Northern Hemisphere. That is why, future climate change impacts on water resources must be based, along with scenarios of expected climate for the country on the whole, on the more detailed scenarios for river basins; moreover, the latter must be transformed according to demands of particular water users.

The task is complicated for transboundary basins. Experience of the Dniester River shows that in climate change impact assessments two riparian countries (Ukraine and Moldova) use different Global Circulation Models (GCM), different emission scenarios and time-slices for baseline and future climates; such situation results in a discrepancy between projections of change in the river streamflow and natural water resources.

Todays science does not endorse the use of any single model or method for the national (basin)-scale assessment of likely climate change. It encourages using the range of models and methods. Therefore as a good alternative one can propose:

- The projections of changes in European climate, developed in the framework of the *PRUDENCE (**P**rediction of **R**egional scenarios and **U**ncertainties for **D**efining **E**uropean **C**limate change risks and **E**ffects)* project *(http://prudence.dmi.dk/)* by the end of this century (2071-2100), which are based on one global and nine regional models.
- Development of high-resolution climate change scenarios, using ***PRECIS*** *(**P**roviding **Re**gional **C**limate for **I**mpact A**s**sessment)* software *(http://www.precis.org.uk/).* This modeling system can be run over any area on a relatively inexpensive fast PC. Its serious advantage is also the well-organized system of workshops for potential users.

The transboundary nature of water resources at the Moldavian-Ukrainian border means that risks and challenges are shared and thus the adaptation to possible impacts must be coordinated between both states. Planning the responses across boundaries, the countries should focus on prevention of the transboundary impacts in an equitable and reasonable manner. Here, two moments are important:

1. In the impacts study, waters vulnerability should be considered both for the river basin on the whole, and for its individual parts, taking into account their physico-geographical, economical, environmental and other confounding factors. For this, any adaptive activity should be preceded by a detailed transboundary diagnostic study of the basin.

2. The basin-level climate change projections should include not only values of key climatic variables (air temperature and precipitation) but also their transformations into other indicators of new climate, such as likely evaporation and humidity conditions, bioclimatic potential, and so on.

The short survey of the on-going and planned international projects in Moldova shows that, in varying degree, many of them help to address challenges, which are put forward by global warming. For example, in the framework of the first phase of the OSCE/UNECE Project "*Transboundary cooperation and sustainable management of the Dniester River",* in 2005, the transboundary diagnostic of the Dniester basin was carried out. Main directions of this program's actions in 2007-2010 include improvement of legislative and institutional base for transboundary collaboration, development of cooperation on prevention and liquidation of the consequences of emergency situations and natural disaster on drinking water quality and human health, the creation of the Geographical Information System (GIS) of the transboundary basin.

To date, the concept of the Word Bank Project *"Disaster risk mitigation and adaptation in Moldova"* is approved. The objective of the project is to reduce the country's vulnerability to natural hazards and climate change impacts that may lead to serious human and economic losses. The realization of this program should improve the country's preparedness and response capabilities, and help to adapt to climatic hazards such as heat, drought and water shortage that are expected to increase in frequency and magnitude in a new climate.

Principal Moldova concerns in the climate-change-water discourse are summarized in the Moldova's Human Development Report 2009/2010: *"Climate change in Moldova: Socio-economic impacts and policy options for adaptation".* In particular, the principal statements of this report include:

- *To consider climate change among factors that influence water availability and quality, with specific adaptation measures to be applied for their control and improvement.*
- *To be successful, the policies should not focus on direct water use only, but also consider activities indirectly related to the water sector; special attention should be paid to the social flexibility of proposed measures.*
- *Water use planning should assume from "quasi natural" diminishing of available water resources due to climate change; the current practice disregarding this effect is not acceptable.*
- *To develop scenarios for water resources use under their shortage and to prioritize water consumption with focusing on public supply and irrigation.*
- *To establish strategic water reserves and regulation on efficient water use, incorporating new sustainable methods, like rain and snow water collection.*
- *To differentiate carefully adaptation approaches by type, region and social groups; no single solution fits everywhere.*
- *To establish special commissions for each of the main river basins, which should cooperate to exclude overlaps in their work; the commissions' activity should be based on a special regulation;*
- *To organize training sessions for authorities, general public and the private sector regarding water and sewage solutions, performed on a continuous basis.*
- *To reassess national traditions in water use, water saving culture and ethic.*
- ***Adaptation measures and priorities should be publicly debated**.*

Adaptation to Climate Change in Transboundary River Basins, with Emphasis on Shared Estuarine and Coastal Areas in Arctic, Baltic, Black and Mediterranean Seas

Ms. Magdalena Muir, The Coastal and Marine Union

The UNECE Guidance on Water and Adaptation to Climate Change has been finalized; and, most importantly, each region, country and sub-region in UN ECE has different water, estuarine and coastal vulnerability to climate change. There are some interesting lessons and approaches to be learned from the European Union (EU), as well as complimentary approaches from other regions and case studies.

For example, the EU Water Framework Directive is a legal framework to protect and restore clean water across Europe and ensure its long-term and sustainable use, with good status of freshwater and coastal waters as its core objective. The EU Marine Strategy Framework Directive extends water legislation to the marine environment, and is the environmental component of Europe's cross-sectoral Integrated Maritime Policy. The Marine Strategy Framework Directive establishes a common basis for the protection and management of Europe's seas, following the approach of the Water Framework Directive to ensure the good environmental status of all of Europe's marine regions and sub-regions.
These two Directives, along with the Integrated Maritime Policy and Recommendation for Integrated Coastal Zone Managements, form the EU regulatory framework for adaptation to climate change for coasts and watershed.

There are also complimentary approaches for UN ECE with the UNEP Regional Seas programme. This includes the Arctic, including the Arctic Council with European and North American cooperation; the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean; the Bucharest Convention on the Protection of the Black Sea against Pollution; the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea; and the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic.

Further complementary approaches for UN ECE exist under the Global Water Partnership (GWP), which includes a national and transboundary approach to integrated watershed and coastal management, and the recognition of the requirement for a coastal and marine component for climate and integrated watershed management. GWP Regional Actions overlap with EU, EUCC, UECE activities, particularly for GWP Southern Caucasus and Central Asia, GWP Central and Eastern Europe, and GWP Mediterranean.
.
Then the presentation discussed relevant observation and case studies for transboundary watershed management and climate change, with focus on coasts. I will turn first to climate observations for coasts and transboundary watersheds. For the Arctic, despite regional variation, there will be overall increased temperatures, less sea ice and coastal erosion. For the south Atlantic Ocean, the Mediterranean and the Black Sea, we will see increased temperatures and droughts. For the north Atlantic Ocean, the Baltic and theNorth Sea, there will be variable precipitation and flooding, and coastal erosion.

Several case studies for climate change and coasts have implications for transboundary watershed management for UNECE states. The completed EU Eurosion project addressed living with coastal erosion in Europe. Of particularl importance for transboundary watershed issues is the inter-relationship between exposure to erosion for coastal regions, the contribution of river basins to sediment budget, and vulnerability to sea level rise illustrated by this project.

The CONSCIENCE project is a very recently completed EU research project that tested six coastal sites in order to develop guidelines and tools for the sustainable management of erosion along the European coastline. Key concepts for policy making included coastal resilience, strategic sediment

reservoirs, favorable sediment status, and coastal sediment cell. CONSCIENCE defined and validated, through pilot applications, a methodology to support the implementation of the 4 key concepts for policy making for the European coasts, from EUROSION project. There could be some broad implications for guidelines and tools to UN ECE member states, depending on the watersheds and adjacent coastal regions. Six pilot sites were selected to represent the most common European coastal types: sand, gravel/shingle and cliffed coasts; high-energy open coasts (Atlantic coasts), medium-energy coasts (North Sea coasts, English Channel coasts) and low-energy coasts (Mediterranean coasts, Baltic Sea coast, Black Sea coasts).

The QualityCoast makes awards for sustainability in coastal towns and islands, including water quality, renewable energy, use of local products and businesses, so sustaining economic aspect. Twelve coastal towns and islands are collaborating to improve their performance in sustainability and tourism quality. Performance of all partners is reviewed by an independent jury for the QualityCoast Awards, and communities performance in these fields can be connected to international tourism marketing through the QualityCoast Award.

QualityCoast supports the Blue Flag and the Green Key Programme: the Blue Flag programme specifically applies to Beaches and Marinas, while the Green Key applies to Accommodation.
QualityCoast recognizes efforts toward sustainable urban development and tourism in the whole territory of the coastal destination: towns, small regions and islands. This is an example of holistic or territorial approach to adaptation. QualityCoast provides new ways of cooperation between coastal communities. The communities will join a network of like-minded communities and be able to share their experiences and exchange best practices in order to improve sustainability in the fields of nature, environment and socio-economics.

OURCOAST focuses on adaptation to risks and the impacts of climate change, information and communication systems, planning and land management instruments, and institutional coordination mechanisms, using case study approach for adaptive management practices. This project is just beginning and there is a case study collection distribution per regional sea and country. As of March 2010, this includes numerous case studies for the Baltic Sea, Black Sea, Central & Eastern Europe, and Europe.

Given the breadth of the UNECE membership and its under-represented Arctic watersheds and coastlines, the presentation concluded with a brief discussion of Arctic issues. There was first a discussion of science and policy for adaptation to climate change through the Arctic Council's Arctic Climate Impact Assessment Scientific Report, and the related Overview Report and Policy Document in 2004. These reports and subsequent initiatives resulted from the participation and cooperation of eight Arctic countries and six international indigenous organizations, and addressed adaptation and mitigation for countries, regions, and local communities.

Last, there was a brief discussion of Hudson Bay watershed (Canada/US) and Mackenzie River watershed (Canada), as examples of consideration and adaptation to climate change in transboundary watershed context. Many large rivers drain from the south and east into Hudson Bay or James Bay, and the Ungava Bay drainage in northern Quebec is also considered to be part of the Hudson Bay drainage area. There is no comprehensive transboundary watershed approach for the Hudson Bay basin yet between Canada and the US, and the watershed is treated *de facto* as a Canadian watershed.

The Mackenzie River Basin Board was created in 1997 by the Transboundary Waters Master Agreement between the governments of Canada, Saskatchewan, Alberta, British Columbia, Yukon and Northwest Territories. The Basin and Board also works with management structures for Beaufort Sea Large Ocean Management Area (LOMA). The Beaufort Sea LOMA, the Alaskan and Nunavut coasts and oceans. Efforts and projects in this watershed for climate change, and typify cooperative North American adaptive efforts by government, for oceans, coasts and watersheds on a sectoral, ecosystem and species basis.

LUNCHTIME SESSION

Targeting adaptation needs using the Climate Vulnerability Index

Dr Caroline Sullivan, Southern Cross University, Australia

Assessment of vulnerability to climate change is complex, touching on social, cultural and economic factors which need to be combined with the physical aspects of climate change. Many of the climate drivers of concern have a hydrological basis – water resources, floods, droughts, tidal waves, and humidity levels, all affecting different aspects of human livelihoods, including increases in the incidence of disease vectors. The presentation described here provided an account of how an evaluation of multiple drivers can be made, and used for comparison to support site-specific adaptation strategies and policy decisions. The *Climate Vulnerability Index* is a policy orientated approach which attempts to address this challenge in a holistic manner, by drawing together data from the bio-physical, economic and social sciences, and combining them in order to make a practical and cost-effective assessment of human vulnerability to climate and other drivers of global change.

Demonstrating global vulnerabilities using the climate vulnerability index (CVI)

The *Climate Vulnerability Index* (CVI) provides a measurement of values which represent an assessment of human vulnerability to the impacts of global change on water resources (including biophysical and socio-political drivers). High values of the CVI (which ranges from 1 – 100)[14] indicate a higher level of vulnerability to changing global conditions, providing an insight into where human communities may be most impacted by climate and global change.

The Climate Vulnerability Index is constructed from a range of indicator values representing six *Global Impact Factors* (GIFs). Each of these may be made up of several sub-indicators, depending on data availability and purpose of use. The *Global Impact Factors* (GIF) which make up the main components of the CVI are as follows:

- *Geospatial variability*
- *Resource quantification*
- *Accessibility and property rights*
- *Utilisation and economic efficiency*
- *Capacity of people and institutions*
- *Ecological integrity maintenance*

By combining these factors within a composite index, we obtain a measure which reflects the essence of what it means to be vulnerable, in the context of globalisation.

When this approach is applied using national level data, a value for each country can be calculated, with national values generated on the basis of a combined set of sub-indicators which measure specific characteristics of each *GIF* identified above. This can then be mapped as shown in Figure 1. The structure of the CVI is shown in Equation 1, where X_i refers to component i of the CVI structure (ie the GIFs), for the site-specific location being considered, while r acts as a weighting, and represents risks associated with that particular GIF, enabling the relative significance of different components to be taken into account. As a result, those who use the tool to assist with environmental management can easily input their own values to represent these weights. In this way, the CVI presents a flexible tool which can be widely used in differing conditions[15].

[14] Calculation of the Climate Vulnerability Index is made on a fully normalised set of indicators to reduce uncertainty associated with incommensurability.

[15] When comparisons are being made between different places, it is important to use the same variables with the same weights.

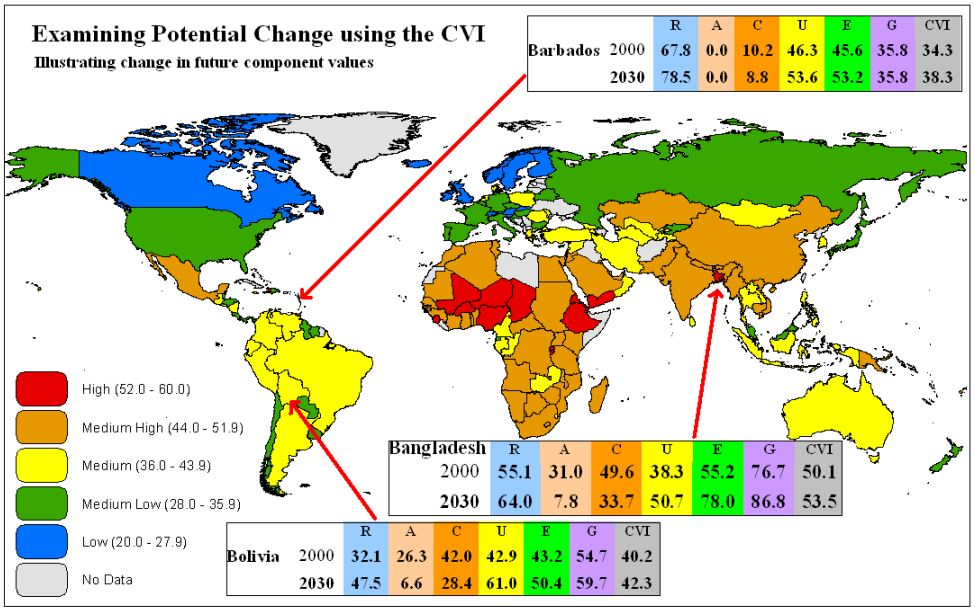
$$CVI = \frac{\sum_{i=1}^{N} r^i X_i}{\sum_{i=1}^{N} r_i}$$

[Eq. 1]

This structure was first introduced as a tool for water resource assessment in the development of the Water Poverty Index (WPI) (Sullivan, 2002). This has been further developed and applied in a number of contexts where quantifiable, spatially-distributed information can be helpful in determining policy responses. Although the approach to the determination of the value of the GIFs is standardised across locations, the way this *r* value is calculated will be determined by the level of sophistication of the national science base of each location, and its monitoring and statistical capacity. For the purposes of comparison, as in the example here, the GIF indicator values are based on internationally accepted measures sourced from available data sources[16], with neutral weights being used to represent this risk factor.

When the various component values of the Global Impact Factors have been calculated to reflect the current state, we can examine potential future states through the application of various scenarios. In the example presented in Figure 1, three cases are illustrated demonstrating how this method can be used to examine different possible futures to support economic development planning and policy. In the example here, scenarios are generated through the application of the HadCM3, a coupled atmosphere-ocean GCM developed at the Hadley Centre, and the 'Policy First Scenario' of UNEP.

Figure 1. Applying scenarios to Global Impact Factors



		R	A	C	U	E	G	CVI
Barbados	2000	67.8	0.0	10.2	46.3	45.6	35.8	34.3
	2030	78.5	0.0	8.8	53.6	53.2	35.8	38.3

		R	A	C	U	E	G	CVI
Bangladesh	2000	55.1	31.0	49.6	38.3	55.2	76.7	50.1
	2030	64.0	7.8	33.7	50.7	78.0	86.8	53.5

		R	A	C	U	E	G	CVI
Bolivia	2000	32.1	26.3	42.0	42.9	43.2	54.7	40.2
	2030	47.5	6.6	28.4	61.0	50.4	59.7	42.3

The inset panels in Figure 1 indicate how the CVI values are likely to change over time, but do so for different reasons. On this basis, different adaptation strategies can be identified. From the 148 countries examined for this study, it is possible to identify common vulnerability characteristics from the different Global Impact Factors. On this basis, it is possible to show that countries in the high risk category (red) are likely to have problems associated with property rights and access,

[16] These would include international organisations including UN Agencies, The World Bank and World Resources Institute, and internationally recognised NGOs.

relatively lower and less reliable resource assets, and a lower degree of human and institutional capacity, with a higher geospatial risk.
This analysis can be further applied to examine the distribution of vulnerable groups across different regions. This is illustrated in Figure 2, which provides an assessment and comparison of the number of people currently in different vulnerability categories in Asia and Africa. This information illustrates why Africa in particular needs a greater level of international support.

Figure 2 Comparing human exposure to climate vulnerability

	AFRICAN VULNERABILTY		ASIAN VULNERABILITY	
	Total, millions	% of continent	total , millions	% of continent
High Vulnerability	239.35	34.3	-	-
Medium -High vulnerability	429.37	61.5	2,616.4	82.0
Medium vulnerability	29.32	4.2	426.8	13.4
Medium - low vulnerability	-	-	149.0	4.7
Countries included	Ethiopia, Niger, Eritrea, Chad, Nigeria, Djibouti, Rwanda, Mali, Burundi, Burkina Faso, Sierra Leone, Benin, Malawi, Guinea-Bissau, Senegal, Mauritania, Gambia, Mozambique, Morocco, Ghana, Lesotho, Angola, Sudan, Algeria, Uganda, Kenya, Egypt, Central African Rep., Togo, Botswana, Namibia, Tunisia, Congo DR(ex-Zaire), South Africa, Guinea, Zimbabwe, Zambia, Cameroon, Swaziland, Gabon, Congo (Rep)		Cambodia, India, China, Nepal, Vietnam, Myanmar, Pakistan, Bhutan, Papua New Guinea, Mauritius,Sri Lanka, Philippines, Mongolia, Singapore, Laos, Indonesia, Korea (Rep.), Thailand, Japan, Malaysia	

Futher information on this work can be found in the following publications:

Sullivan, C.A. and Huntingford C. (2009) *Water Resources, Climate Change and Human Vulnerability* In Anderssen, R.S., R.D. Braddock and L.T.H. Newham (eds) 18th World IMACS Congress and MODSIM09 International Congress on Modelling and SimulationJuly 2009, pp. 2377-2383. ISBN: 978-0-9758400-7-8.

Sullivan C.A. and Meigh, J.R. (2005) Targeting attention on local vulnerabilities using an integrated indicator approach: the example of the Climate Vulnerability Index. *Water Science and Technology,* Vol 51 No 5 pp 69–78*,* 30, 1195-1210.

Sullivan C.A. (2002). Calculating a Water Poverty Index. *World Development*

Sullivan C.A. and Meigh, J.R. (2007) Integration of the biophysical and social sciences using an indicator approach: Addressing water problems at different scales *Journal of Water Resources Management* 21:111-128

UNECE (2009) Guidance on Water and Climate P73-74

Acknowledgements
Funding for this work was provided by the Cooperative Programme on Water and Climate (Netherlands), the UK Natural Environment Research Council (QUEST and GHEM projects), and Southern Cross University, Australia.

From floods to droughts – adaptation strategy in water management in the Czech Republic

Ms. Magdalena Mrkvičková, Masaryk Water Research Institute, Czech Republic

Abstract

The aim of the presentation is to give an overview of adaptation activities that take part in the process of national adaptation strategy development. The described activities focus on protection of water resources, estimation of their availability, vulnerability assessment and water management during periods of drought.

Introduction – lessons learned from floods

As far as we know about climate change impacts, we expect a higher frequency in occurrence of hydrological extremes - flash floods and prolonged droughts. An adaptation strategy in water management should deal with both of these extremes.
In 1997 a devastating flash flood hit a large part of Moravia. This extreme event came after almost 60 years without any flood of similar scale. The consequences were severe – fifty people died, the total cost of damage reached 2.1 billion euros. After 1997 a complex flood protection strategy was developed with a flood forecasting and warning system. The strategy was embedded in the Water Act in 2001. The Flood protection strategy is aimed at preventing losses of human lives and preventing damage to material property of society and and to the environment. The strategy implies preventive measures: increasing the retention capacity of the river basins and affecting the evolution of floods. Protection against floods is ensured in compliance with flood protection plans. In 2002 the strategy was applied during next extensive flood event that affected a large area of Bohemia. The peak discharge of the Vltava (Moldau) River in Prague reached almost 5300 $m^3 \cdot s^{-1}$, the highest value ever recorded with a return period of over 500 years. The total damage was estimated at 2.4 billion euros. However the flood event was better controlled thanks to a better preparedness of responsible people and the number of casualties was reduced to 19.

Drought management policy missing

Even though several floods occurred in the last two decades, water resources are limited in the Czech Republic. Without any large river flowing into the country the renewable water resources depend only on the amount of rainfall. In general, after 1980, the regional annual amount of precipitation has increased slightly or remained the same, in comparison with long-term averages. Higher air temperature causes higher evapotranspiration and thus less water is left for groundwater recharge. With higher evapotranspiration the demand of water for irrigation consequently increases. In some regions, where the annual amount of precipitation does not increase, problems with a lack of surface water and also groundwater were observed. Public water supply in some regions is already under pressure. One reason is a decrease in the availability of water resources. Other reasons that contribute to the unsatisfactory situation originate from conflicts of interests between the environmental protection and public water supply and from restrictions in water abstractions due to detected pollution. However there is still no policy for dealing with the available water resources during a period of prolonged drought and water scarcity in the Czech Republic.

A Summer heat wave and drought in 2003 showed a lack of preparedness to droughts and crisis situations. When drinking water is not available, human lives are threatened. The summer heat wave and drought in 2003 was one of the ten worst natural disasters (in the amount of deaths) during the last hundred years in Europe, with almost thirty thousand casualities across Europe, (UNEP, 2004).

Even though the negative effects of the drought in 2003 in the Czech Republic were marginal in comparison for example with France, Spain, Italy and other southern and western EU countries, watermanagers should take this event as a warning that a complex strategy for dealing with drought and water scarcity should be developed to prevent or mitigate emergency situations caused by a lack of drinking water.

Activities in the process of national adaptation strategy development

Several activities, that are part of the process of developing a adaptation strategy in the Czech Republic, focus on tasks of drought management. The first activity – a review of General Plan for Surface Water Accumulation is almost finished at governmental level. The plan will be a legally binding document for spatial planning and creates part of national water management planning documentation. It contains a list of areas with suitable morphological, hydrological and geological conditions for possible future water storage. Within these areas, it is forbidden to place important infrastructure, industrial and agricultural structures and other structures that could have negative impact on possible future water storage.

The second activity – Regional Hydrogeological Study of Groundwater Resources is a research project that should start in this year and it is aimed at assessment of total storage and available amount of groundwater in hydrogeological zones with high importance. The results of the project should provide information about vulnerability of these groundwater zones. This kind of information is necessary for River Basin Management Plan preparation, for decision-making of water authorities and also for water balance estimation.

The third activity that should contribute to better preparedness to periods of drought is a research project 'Water Management Policy in Conditions of Water Scarcity and Prolonged Drought'. This project is in a stage of project proposal that is submitted for funding. The expected results of the project include a system of drought status indicators and guidelines for threshold setting with respect to actual groundwater level and surface water storage. Information on drought status will be published on a web page together with other hydrological information (currently information on actual hydrological data and statuses of flood activity is available). A hierarchy of measures that are applied during a period of drought should be set up together with rules for communication and sharing responsibilities among institutions that are involved in water management. Guidelines for Drought Management Plan should be prepared. Drought management policy will be embedded in the amended Water Act.

Conclusions

Flood protection strategy in the Czech Republic was developed as a reaction to a devastating flood in 1997. This strategy is institutionally and legally covered. However considering the opposite extreme, a complex drought management policy is still missing. Registered problems with water scarcity and also the known impacts of summer heat wave and drought in 2003 have motivated a shift in target in adaptation strategy development from floods to droughts. Drought management policy is understood to be a crucial win-win measure that should be a part of the national adaptation strategy. Proactive approach – to prepare the drought management policy before it is really needed – is preferred to reactive one.

Local Multi-sectoral Efforts for the CAI Water Dialogue

Mr. Martin Lindenlaub, The Regional Environmental Centre of Central Asia (CAREC), Republic of Kazakhstan

The Central Asian Initiative (CAI) on Sustainable Development is an initiative supported by five Central Asian Governments (Kazakhstan, Kirgizstan, Tajikistan, Turkmenistan, Uzbekistan) to establish with support of international donors multi-sectoral partnerships between governments, local authorities, local communities, NGO's and the private sector to address major environmental problems. Water related problems and water resources management are a key focus of the CAI.

The CAREC/EC project on Local Multi-sectoral Efforts for the CAI Water Dialogue has:

Step 1: Established multi-sectoral working groups on water related and transboundary problems in each of the CA countries,
Step 2: Elaborated proposals on selected transboundary water courses facing multi sectoral problems,
Step 3: Developed action plans and started respective resource mobilization efforts.

As an outcome of step 1 and 2 of the project a totality of 14 small transboundary river basins are selected (fig. 1) by national seminars held in Ashgabat, Bishkek, Almaty and Dushanbe. The following key problems of small cross-border rivers of Central Asia were identified:

- Degradation of the natural ecosystems and effects of climate change
- Inefficient use of water resources due to institutional and inter governmental barriers and due to short term interests of single stakeholders
- Lack of legal treaties on the joint utilization of transboundary rivers
- Pollution by municipal and industrial wastes and / or waste waters
- Pollution by agriculture
- Poor hygienic condition of the river water
- Overexploitation and desertification of farmland resources
- Lack of monitoring facilities

Selected transboundary basins (fig.1):

1. Aspara river (KZ-KG) downstream
2. Aspara river (KZ-KG) upstream
3. Karkara river (KZ-KG)
4. Tekes river (KZ-China)
5. Padysha Ata river (KG-KZ-UZ)
6. Isfara river (KG-TJ-UZ) upstream
7. Isfara river (KG-TJ-UZ) downstream
8. Kyzylsu river (TJ-KG)
9. Northern Fergana Canal (UZ-TJ)
10. Kutitang river (TU)
11. Alty-Yab river (TU-IRAN)
12. Murgap river (TU-AFG)
13. Etrek river (TU-IRAN)
14. Ugam river (KZ)

Project implementation at Aspara River as an example how to continue in step 3:

The Aspara river basin is located about 80km W of Bishkek with a total basin area of about 60km^2. The river is originated in Talasz Alatau mountains (Kirgizstan). It forms at a length of around 50 km the border between Kirgizstan and Kazakhstan and subsequently enters the Kazakhian step, where it infiltrates and evaporates. It does not reach a receiving watercourse.

The project implementation at Aspara river consists itself of 4 steps. These are:

1. doing an inventory
2. problem definition and scoping
3. development of an action plan
4. implementation of the action plan

An inventory was done for Kazakh and Kirgiz side separately by basin commissions. Lists of stakeholders were prepared and existing problems on both sides of the border identified. In case of Aspara River the problems are multifarious. There is a general degradation of the ecosystem, there are high and uncontrolled water withdrawals from the river, there are pressing water quality problems as well as a lack of enforced legal treaty between the two riparian countries Kazakhstan and Kirgizstan.

In a joint meeting, the problems were ranked. The outcome of the problem definition and scoping procedure was, that at Aspara river the high water demand for irrigation is recently the most pressing problem. This problem has to be addressed by the project.

An action plan focusing on this problem was elaborated. This action plan consists of a detailed inventory focused on the irrigation facilities on both sides of the border. Based on this inventory, improved irrigation techniques are identified and promoted. If necessary, reconstruction work on the irrigation facilities has to be carried out. Extensive training on improved irrigation techniques will be provided for the local farmers. Two workshops are to be held with participation of the basin commissions, farmers and local stakeholders. A new measurement and tariff policy is introduced.

After implementing this action plan, a new ranking of problems can be done and new action plans are to be developed. An important outcome of the project is that Transboundary Integrated Watershed Management (TIWM) should be an ongoing process to address a broad variety of problems in a watershed, including those caused or magnified by the effects of climate change.

A preliminary methodological framework for developing climate-related risk indicators and adaptive capacity of developing countries

Mr. José Luis Carrasco-Terceros, Mr. Juan Carlos Altamirano-Cabrera,
Ecole Polytechnique Fédérale de Lausanne, Switzerland

1. Introduction

The goal of the present document is to present a climate related-risk profile approach applicable to the example of Bolivia with the intention of offering a methodology framework for policymakers already involved in developing indicators of climate hazards. The application of the proposed methodology requires: (i) the identification of the vulnerable system to climate change impacts using the methodology framework proposed by Füssel (2007) (ii) the determination of the probability of a negative impact based on a climate-related risk equation and (iii) the identification of current adaptive capacity of the system to cope with climate hazards. We illustrate the proposed climate-related risk approach in the example of two regions in Bolivia. The information about negative impacts of climate extreme events in the Altiplano Western Highlands (AWH) and the Tropical Eastern Lowlands (TEL) of Bolivia were gathered from literature review and official documents of the Bolivian government. This paper aims at investigating the possible consequences on the water and land resources due to climate change impacts.

2. Climate change vulnerability

Although, at the moment, the conceptualization of vulnerability in climate change research has been enlarged and used in many different approaches, the scholars still have not built a clear terminology to characterize climate change vulnerability in a way that is objective, transparent and accessible. Several studies have been performed with various conceptualization and terminologies of vulnerability, which makes it difficult to compare the results on a rational basis (Brooks et al., 2005; Luers et al., 2003; Luers, 2005; Metzger et al., 2005; Turner et al., 2003).

We think that it is necessary to have a framework that allows us to compare the differences among the various studies of climate change vulnerability research based on five main dimensions proposed by Füssel (2007): (temporal reference, geographical system boundaries, vulnerable system description, attribute of concern and hazard) on
which the choices may vary from one study to the other.

3. Risk profile of climate change

A climate hazard can be understood as a damaging physical event, phenomenon or human activity that can affect human life, social and economic loss and environmental degradation (Adger et al., 2004). As a preliminary stage, it is important to set up the dimensions to analyze all extreme events that may affect the system.

A climate hazard occurs on the environment and may have negative consequences on the economy, society and state of infrastructure. Once all extreme events are listed, criteria should be used to select the critical events i.e. those extreme weather events that cause considerable economic damage and destruction of infrastructure (e.g. roads, bridges, irrigation channels). Thus, the selection of critical events that affects the system may be guided by a risk equation. The disaster risk equation is a product of two elements: exposure to climate hazard and the severity of a climate hazard impact in terms of economic loss and damage of vital infrastructure. The risk equation is mentioned in the next paragraph.

Risk equation of climate-related hazard

The concept of risk, applied to climate change research, varies from one scholar to another. Brooks et al. (2005) found 10 different definitions of risk which are products of four major elements: probability of a hazard, exposure to hazard, severity of the hazard
and vulnerability. Some authors, view risk as a function of two elements: vulnerability of the system and probability of some hazards (Brooks et al., 2005; Jones and Boer, 2003).

All these studies on climate vulnerability use statistical information relating the probability and frequency of a climate hazard. However, determining the occurrence of extreme weather events (e.g. droughts, heavy rainfalls, flooding) can be difficult. First, there is a lack of historical data in many developing countries and with climate change the frequency, location and intensity could change in the future. Second, it is not possible
to take all climate hazards into account for estimating climate vulnerability for a specific region, community or sector. Therefore we need a general expression for representing the climate hazard risk in order to select those critical extreme weather events.

The relation between climate hazard risk and destructive weather extreme events may be thought as the conditional probability on a climate hazard affecting the infrastructure and livelihoods in terms of physical and economic damage. Let A be the event that a destructive flooding occurs with significant loss of infrastructure (e.g. bridges, roads, private property) and livelihoods, and let B be the probability of occurrence of heavy rainfalls. Thus, the selection of climate-related risk of a system could be assessed by the following equation:

$$Pr\,(A \mid B) = \frac{PrA \cap B}{Pr(B)} = \frac{Pr(A)}{Pr(B)} \qquad (1)$$

where *Pr (A|B)* denotes the conditional probability of a climate hazard risk, that is, the probability that the infrastructure and livelihoods are impacted by a flooding (A), assuming that a heavy rainfall happens (B). The risk equation can be formulated as a conditional probability, using the above definition. Assuming that Pr(A); Pr(B) > 0.

4. Proposed methodology framework to identify more probable negative impacts due to climate hazards

The conceptual viewpoint of climate change vulnerability proposed by (Füssel, 2007) has been chosen to identify the vulnerable system to climate change impacts in Bolivia since it proposes an applicable framework and terminology of vulnerability concept based on five dimensions.

Hazards

In many regions of Bolivia, climate change impacts are causing loss of human lives, economic losses with significant destruction of vital infrastructure (e.g. roads, bridges, arable land) and loss of property and livelihoods. According to the National Adaptation Program of Climate Change in Bolivia, climate-related disasters such as heavy rainfalls and droughts caused the interruption of roads and loss of homes in 2008, valuated in 700 million dollars (Climático, 2009). Furthermore, agricultural production capacity of Bolivia could be reduced by droughts, destructive hail storms, heavy rain and can affect food security in urban areas which depend on agricultural products from rural areas (see Carvajal-Palma et al., 2000, pp 13).

In rural areas of Bolivia, households depend on products and services of ecosystems for their livelihoods. For instance, the forests supply fuel wood, livestock food, building materials, food, freshwater and plant medicines (Bluffstone et al., 2002). Further, local communities in rural areas

are economic dependent on farming systems, there are no other alternative activities in rural areas (Carvajal-Palma et al., 2000). However, human activities are rapidly degrading ecosystem services in the agricultural, forestry and biodiversity sectors. Intensive overgrazing practices reduce land's productivity in inter-Andean valleys (Aparicio et al., 2006). Increase of agricultural frontier, pastoral lands, and logging activities without sustainable planning expand areas of deforestation in tropical forest in the eastern lowland region (Mertens et al., 2004; Steininger et al., 2001).

Risk profile

Problems to estimate conditional probability of climate-related hazards

The selection of climate hazard hotspots that affects the AWH and the TEL would be guided by the Risk equation mention above. All climate hazards such as floods, droughts, destructive hail storms are considered by definition as extreme events that are rare and potentially destructive. The scientific community has hypothesized that climate change may be leading to accelerate the incidence and frequency of those events, still it is very difficult to predict occurrence of extreme events because of lack of past data records in many regions. Concerning the actual statistical methods for modelling extreme events, there exist best-developed mathematical models for extremes (Naveau et al., 2005). For example the extreme value theory, explains the behaviour of large and scarce data observations during a period of time (Butler et al., 2007).

For the case of a project, a detailed analysis of climate change impacts should be performed, based on historical data collection of extreme weather events, workshops with stakeholders involved in the project and discussions with local and international experts working on climate change research. The probability that the infrastructure and livelihoods are impacted by a climate hazard depends on the analysis of the economic weaknesses and the capacity of a system to adapt and cope better with the extreme weather events that are to come.

5. Conclusions

This document was written with the aim that scientists can provide scientific basis for stakeholders and policymakers in decision-making and risk management process. In order to better allocate financial resources before the occurrence of an extreme weather event, multiple maps of vulnerable regions to climate change impacts at local and regional level could be generated for different sectors i.e. agriculture, mining, industry or energy that are relevant to the country.

At the moment many studies use pragmatic approaches to evaluate climate change vulnerability and adaptive capacity in different regions of the world. However, these studies do not use a set of indicators of climate-related risk to gather evidence of the system to cope with extreme weather events. As policymakers will decide to use these results it is important to ameliorate the climate risk equation proposed, in order to define which region or sector is more vulnerable to climate change impacts.

Acknowledgements: This research was carried out with the financial support of National Centre of Competence in Research (NCCR) Climate Program under the Technology Orientated Cooperation and Strategies in India and China project.

Responses to climate change by the communities residing in the Usumacinta transboundary river basin (Mexico and Guatemala)

Mr. Jérôme Gandin, Laval University, Canada

As a global phenomenon, the climate change affects every part of the planet. Its relation with the water cycle is highlighted by extreme meteorological events and even changes on a longer term (water scarcity for example). The variability of the climate and the intensity of the meteorological events make the management of water resources uncertain.

In the context of the transboundary river basins, climate change enforces the challenge in managing water resources. In 2008, 148 countries shared one or several transboundary river basins. The shared water areas cover almost half of the world area and are inhabitated by around 40% of the world population. De facto, the responses to climate change do not concern only the governments, but also the local population which has to find ways to adapt to these changes.

The Usumacinta river basin is one of the 276 transboundary river basins in the world. It is the largest river basin in Central America, the sixth in Latin America with a total of 106'000 km2. The Usumacinta river is 728 km long and flows from the highlands in Guatemala to the Gulf of Mexico. It is also the border between Mexico and Guatemala on 198 km. Its annual average discharge to the Gulf of Mexico is 105 200 million sq. meters. Thus, it has a great potential of hydropower even if no dams have been built on the Usumacinta river. In addition, the Usumacinta river basin is also known for its great biological diversity, the richness of its ecosystems and the quantity of freshwater resources. The Usumacinta river basin is indeed one of the most biologically diverse in the world and gathers one third of the total freshwater resources in Mexico.

Although the Usumacinta river basin contains significant water resources, there is no commission managing it at the level of the entire transboundary river basin. National entities do exist. On one hand, there is a council in Mexico that manages both the Grijalva and the Usumacinta river basins together. Yet, this council does not take into account the Guatemalan part of the latter river basin, neither for decision making nor data collection. On the other hand, in Guatemala, there isn't any commission at all nor any law concerning water.

Since unusual droughts and floods have occurred in the Usumacinta River Basin in recent years, some local communities decided to form an alliance in order to find solutions to the environmental changes which affect their daily life. This alliance, called "Alianza comunitaria por el desarrollo sostenible de la cuenca binacional del Usumacinta", has been created in 2001. In november 2005, some leaders representing more than 100 communities met in the city of Sayaxche in Guatemala to discuss and to commit in addressing responses to land degradation and adapt to the environmental changes, such as climate change.

The climate change is doubtless one the major threats of the Usumacinta river basin. In November 2007, the inhabitants of Tabasco Mexican State experienced catastrophic floods that damaged agriculture, equipment, facilities and caused more than 600 deaths and thousands of injured people. Although some view these exceptional rainfalls as fate, others consider them as an effect of climate change. Mario Molina, Nobel Prize in Chemistry in 1995, stated in November 2009 that the droughts and the floods occurring in Mexico, as well as the hurricanes in the Yucatan Peninsula, the rapid changes of the climate and the extraordinary meteorological events, could be connected to climate change. At the community-level, some major changes have been perceived. During two field trips in 2008 and 2009, 42 interviews and a survey including 502 participants have been realized to analyze the social perceptions of the communities towards the effects of climate change within the Usumacinta river basin. The results of the inquiry show the communities perceive some changes in terms of rainfall, water cycle, water availability, land cover and rate of flow of the rivers. Some of the respondents, who live in the same place since more than 40 years, notice an ever longer dry season and a decrease of the annual rainfall which cause

some changes on agriculture productivity and land cover. They also view a decrease of the water resources availability. In February 2009, some local inhabitants of the village Los Laureles in Guatemala acknowledge drawing water at the depth of 15 meters whereas at the same period of the year, 40 years ago, they drew water at 5 meters depth. Finally, the communities residing on the banks of the Usumacinta river basin noticed exceptional low levels and high levels in recent years. In 2008, exceptional heavy rainfall caused the flooding of entire villages during three weeks. Although the local communities face some major environmental changes, it is not easy to link them directly to climate change.

Anyhow, the alliance organized in the past years some workshops and meetings to bring capacity building to the local communities and make them aware of their responsibility in the environmental protection. 68% of the interviewed persons consider the alliance to be able to find ways to adapt to the environmental changes. The binational dimension of the alliance brings more opportunities to the communities in terms of cooperation, sharing of knowledge and experiences and financial and human resources. For instance, the alliance built up a system of warning and fighting forest fires between the local communities.

To conclude, this alliance points out the basin-scale commitment of local communities to adapt to the effects of climate change. In spite of their limited resources, both financial and technical, the alliance provides the local communities some ways to reduce their vulnerability to exceptional meteorological events and land changes. As a reminder, the alliance states that "each inhabitant has to consider climate change as a global concern. The Usumacinta river basin is as a casserole; if we decide to let it boil, then climate change will cause our death".

SESSION 4 – DEVELOPING JOINTLY ADAPTATION MEASURES

Increasing ecosystem resilience as a measure to adapt to climate change

Mr. Sergiy Moroz, Worldwide Fund for Nature (WWF)

For millennia, people and nature have been adapting to changing climate conditions. However the difference today lies in the rate and type of change, and the reduced capacity of ecosystems to respond to these changes because of limited habitat, connectivity and resources.

Climate change can be manifested in three different ways:

- Gradually, through a change in the "mean" climate;
- Through a change in climate variability, which is characterized by an increase in the intensity and frequency of extreme events such as floods and droughts;
- Through sudden step-level or stepwise changes, where a period of climate stability is followed by a period of rapid change.

The problem with adaptation is that our policies, institutions, conservation and water infrastructure design and management largely assume that climate is stationary, which is not the case, as shown before. We are not able to easily adjust to shifting or emerging climate conditions. But the solution lies almost entirely in our hands. We need to assess the vulnerability and resilience of the ecosystems, explore adaptation options and monitor the efficiency of the measures taken.

Two different approaches can be distinguished in the climate change adaptation activities: the current one referred to as "impacts thinking" and a new one referred to as "adaptation thinking" (Matthews & Wickett, "Embracing Uncertainty", *Climate and Development*, 2009). The first approach is a deterministic one and is based on physical and ecological modelling, which is trusted to be able to predict specific impacts. The second approach aims to embrace the uncertainty, which the freshwater variables are associated with, and treats ecosystems as "dynamic entities that will be inherently different from current and past ecosystem states". It is a more flexible approach.

Natural, wild freshwater ecosystems often have the ability to adapt to changing climate conditions by themselves. They have a high natural resilience and can resist to extreme events and transitions into new ecological conditions. However, humans have built a lot of "hard"infrastructure for water management such as dams, wells and irrigation systems, which restricts or eliminates some of this natural resilience. That is why "soft" or "green" infrastructure for water management can help combine control of water resources, restore flow regimes and rebuild natural climate resilience.

The example of the Lower Danube River

The conversion of floodplains for farming and other development has seen the loss of a great part of the Danube's floodplains, which were cut off by dykes. This has exacerbated flood peaks, as for example in 2005 and 2006, where big floods killed many people and caused many damages.
In 2000, WWF secured agreement from Bulgaria, Romania, Moldova and Ukraine to restore 2,236 km² of floodplain to form a 9000 km² "Lower Danube Green Corridor", which is intended to attenuate floods, restore biodiversity, improve water quality, and enhance local livelihoods. As of 2008, 469 km² of floodplain has been restored or is under restoration, which represents 14.4% of the considered area. Provided ecosystem services like restored floodplains for fisheries, forestry, animal feed, nutrient retention and recreation are estimated at €500/ha/yr, or approximately €85.6 million/yr.

The restoration of all the sites that make up the Lower Danube is estimated to cost €183 million, compared to damages of €396 million from the 2005 flood and likely earnings of €85.6 million per year. The floodplain restoration is clearly a cost effective adaptation.

Adaptation strategies should aim to retain ecological integrity. This can be achieved with the following elements:

- Secure ecosystems as the ultimate stakeholders in a basin
- Develop multiple "water futures" based on a range of possible qualitatively defined eco-hydrological conditions; use as the basis for flexible, low/no-regrets planning
- Vulnerability assessments should focus on both climatic and non-climate elements and flow regime and should be conducted iteratively
- Use tactical, active monitoring to trigger ecosystems & livelihoods resilience management (droughts, floods)
- Strategic, regular reevaluation of usage, flow, and climate data to determine which water future is evolving (facilitate state-level change)
- Maintain maximum natural connectivity

WWF proposes the following elements for an adaptative water strategy:

- Develop institutional capacity, which should be regarded as the single most important task in facilitating successful adaptation to climate change;
- Create flexible allocation systems and agreements, to protect social, environmental, and essential economic interests under conditions of varying water availability;
- Reduce external non-climate pressures, such as over-abstraction, poorly planned infrastructure or invasive species;
- Help species, human communities and economies move their range, as conditions in headwaters or lower reaches become unviable because of climate change;
- Paradigm shift in infrastructure planning and management
- Promote mainstreaming of climate change adaptation into sectoral policies
- Institute sustainable flood risk policies, to reduce flood risk by understanding how floods move through catchments and developing climate-appropriate risk reduction strategies such as accommodation, rather than defence
- Support climate aware planning
- Improve monitoring and responsiveness capacity – we must make sure that the results of monitoring processes are embedded within our management, planning and design processes.

For further reading:

- WWF, J. H. Matthews, T. Le Quesne, "Adapting Water Management, A primer on coping with climate change", *WWF Water Security Series 3*, March 2009
- WWF, "Water for life: Lessons for climate change adaptation from better management of rivers for people and nature", August 2008

Climate Change - adaptation process in the Danube River Basin and its sub basin

Ms. Diana Heilmann, International Commission for the Protection of the Danube River (ICPDR)

The Danube River Basin is the most international basin of the World – 19 countries share the basin of the Danube River. The International Commission for the protection of the Danube River (ICPDR) is a transnational body, established in 1998, to implement the Danube River Protection Convention (DRPC). Since 2000 the ICPDR became the platform for coordinating basin wide WFD-related activities

The countries cooperating under the DRPC, including those outside the EU, agreed to implement the EU WFD throughout the entire Danube River Basin District and prepared the Danube River Basin Management Plan and its Joint Program of Measures by the end of 2009.

Extremes of the Danube River Basin

Historically, and most recently in 2002, 2005 and 2006, disastrous flood events have occurred in the Danube River Basin. On the other hand water scarcity and droughts are also major challenges in some part of the Danube River basin (see draft ITRBM Plan) and climate change is expected to further influence the current situation.

Recognizing the impacts of extreme events – climate change – on natural resources, through negative side-effects on biodiversity and, water quality, the ICPDR began its climate change adaptation process in 2007. It organized in December 2007 a conference in Vienna on the Adaptation of Water Management to the Effects of Climate Change in the Danube region. (Climate Change Conference – 2007).

Process towards Climate Change adaptation

The goal of the Climate Change Conference – 2007 was to discuss the expected effects of climate change on the water cycle, such as increased droughts and floods, and how the related challenges can be met for the sake of nature and people.
The main conclusions from the Conference were:

- Climate change impacts
    - Are an issue of Danube River Basin wide significance
    - Will be addressed by a stepwise approach
    - Will be addressed respecting all significant water management issues for the Danube River Basin
    - Will address the issues of flood protection, low water discharges, drought and land use
- Climate change signals for the Danube River Basin are sufficient to act beyond existing scientific uncertainties
- Follow the ongoing Danube River Basin related scientific projects and their outcomes
- Existing Danube River Basin scientific activities (e.g. under EU FP 6 and 7 programmes) are the basis for the further development of measures
- Future infrastructure projects have to be "climate proof"
- Adaptation measures should be holistic and coherent in their approach (linking all relevant sectors)

This first cycle of the river basin management planning process has led to the conclusion that climate change is a significant threat to the Danube River Basin environment. The priority at this stage is to ensure that measures implemented to address key water management issues are "climate proof" or "no regret measures". Chapter 8 of the Danube River Basin Management Plan -

2009 on "Water Quantity Issues and Climate Change" includes the current state-of-play regarding knowledge on climate change in the Danube River Basin, the possible current and future impacts on water resources as well as on water management[17].

On 16th February 2010 Ministers and High level representatives of the Danube Countries have adopted a Ministerial Declarations - 2010, which includes the following statements in relation to `Impacts of Climate Change and Climate Adaptation`:

`*The Ministers and High level representatives of the Danube Countries*` emphasize that the impacts of climate change will increase and develop into a significant threat in the Danube River Basin if the reduction of greenhouse gases is not complemented by adaptation measures. We appreciate that the DRBM Plan draws some first conclusions and identifies future tasks in this regard.

The Ministers and High level representatives of the Danube Countries ask the ICPDR to develop until 2012 a Climate Adaptation Strategy in the Danube River Basin. This strategy should be based on a step-by-step approach and encompass an overview of relevant research and data collection, a vulnerability assessment, ensure that measures and projects are climate proof respectively "no regret measures" and ensure that climate adaptation issues are fully integrated in the second DRBM Plan in 2015.'

Water quantity related management issues (Flood and excess water events, drought and water scarcity as well as climate change) were defined as a relevant water management issue in the Tisza River Basin (TRB). These water quantity related management aspects will be taken into account in the Integrated Tisza River Basin Management Plan (ITRBM Plan) . [18]

Measures towards Climate Change adaptation[19]

Horizontal measures

Since there are common elements, which are relevant for measures related to extreme climate conditions (floods and water excess, droughts and water scarcity), and climate change, the following horizontal measures were identified relevant to the three water quantity issues:

- International Co-ordination
- Communication and consultation (including education and awareness raising)
- Incentives

Specific measures

In order to meet the goal of making the RBMPs "climate-proof/checked" by 2015 in the Danube as well as Tisza River Basin, the following steps proposed to be taken within this water management cycle:

- Ensure that monitoring systems used in the DRB and TRB have the ability to detect climate change impacts on ecological and chemical water status as well as the effects of climate change adaptation measures;
- Investigate on the effects of climate changes on ecoregions, typologies and reference sites as well as proposals for solutions;
- Implementation of pilot projects to define practical solutions at the local level for up-scaling to larger regions in the Danube and Tisza River Basin.
- Foster the improvement of models (climate and hydrological aspects) and of scenarios for the DRB and TRB as well as ensure the improvement regarding the presentation on climate fluctuations;

[17] Adopted in 16th February 2010.
[18] ICPDR - Draft ITRBM Plan will be available for public feedback between July –August 2010. More details see www.icpdr.org
[19] Information based on ICPDR - Draft ITRBM Plan (May 2010)

- Investigate on effects of climate change on the various sectors active in the DRB and TRB and the evaluation of indirect increases in impacts on water status;
- Conduct a climate vulnerability assessment of basin ecosystems;
- Promote and apply methodologies and standards for climate-proofing infrastructure projects and integrating climate considerations into EIA and SEA procedures,
- Enhance the sharing of research information on climate change in the DRB and TRB;
- Ensure that scientific information is 'translated' to water managers;
- Integrate all knowledge, results and lessons learnt related to climate change threats in the next RBM Plan;
- Agreement on a sustainable Danube Basin Development Strategy that outlines climate resilient economic development options also highlighting the role of the ongoing activities in the TRB integrated measures outlined in the current plan
- Future management cycles will have to be based on the evaluation of activities and new knowledge gained during the coming five years.

In line with the Ministerial Declaration adopted on 16th February 2010 by Ministers and High level representatives of the Danube Countries the next step in relation to the climate change process is to develop a `*Climate Adaptation Strategy in the Danube River Basin until 2012*`.

Mainstreaming Adaptation in Regional Land Use and Water Management

Ms. Saskia Werners, Wageningen University, The Netherlands

Headline Statement

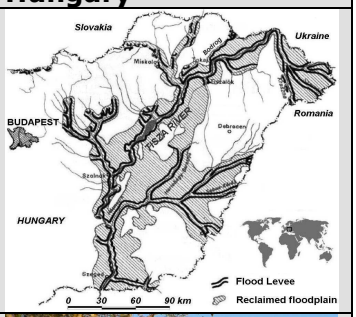
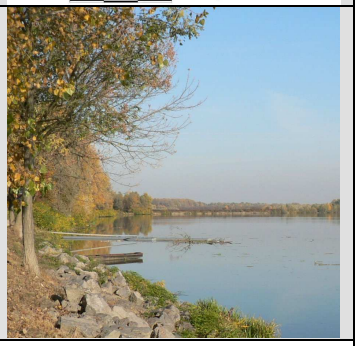
Based on our research in two study regions in Europe and one region in China, we find that adaptation is enhanced by pilot projects that test and debate diverse sets of new ideas through collaboration between recognised actors from civil society, policy and science. Promising for adaptation is the integration of (traditional) agro-environmental land use systems that regulate regional climate impacts with new technologies, organisational responsibilities and financial instruments. A key challenge is to create flexible financial instruments that facilitate benefit- and burden-sharing, social learning and that support a diverse set of potentially better-adapted new activities rather than compensate for climate impacts on existing activities.

Scope & Aim

Whereas the literature on adaptation is rich in detail on impacts, vulnerability and limits to adaptation, less is known on the conditions that facilitate adaptation in practice. Step-wise advances in action, coordination and engagement of actors at the local and regional level will be needed to handle the projected incremental changes in climate, and to address the increased possibility of extreme weather events. We use the term mainstreaming for this step-wise integration of adaptation actions into ongoing sectoral planning to reduce climate vulnerability. Land and water resources are directly impacted by climate change, and decisions regarding these resources affect ecosystems and human vulnerability. Although changing land use planning is a promising adaptation strategy to cope with climate change impacts, it is not yet extensively practised.

In this study we examined the constraints and opportunities for mainstreaming adaptation to climate change in land use and water management in three study regions: the Guadiana River Basin in Spain and Portugal, the Tisza River Basin in Hungary and the Alxa region in western Inner Mongolia, China (see Table 1). The three regions have in common that they increasingly struggle with climate impacts on land use and water resources, including desertification and the occurrence of extreme events such as floods and droughts. However, the institutional contexts and governance traditions upon which adaptation practices have developed differ greatly. We analysed the conditions that either facilitate or limit adaptation according to six analytical dimensions: biophysical, technical, financial, institutional, social, and cognitive (the latter including informational aspects).

Table 1: Characteristics of the three study regions

	Guadiana Basin **Spain & Portugal**	**Inner Mongolia** **Alxa Region, China**	**Tisza River Basin** **Hungary**
			
			
Biophysical, land-use	Semi-arid climate, forest, agriculture, tourism	Arid climate, desert, livestock, agriculture	Continental climate, grassland, agriculture
Climate projection	Significant temperature increase,rainfall decrease	Temperature increase, rainfall trend uncertain	Temperature increase, rainfall more irregular
Area / Arable land	66,800 km2 / 20 million ha	270,000 km2 (main study area 72,000 km²) / 30,000 ha + 9 million ha steppe	46,000 km² (Hungarian part basin) / 2.6 million ha
Technical	2000 dams. Reservoir and irrigation system	Irrigation, groundwater and water transfers	2800 km river dikes, drainage system
Economic	Participation in EU and global market. Tourism. GDP 20,000 per capita Below EU average	Increasing market forces and industrialisation. GDP 2,000 euro per capita	Transition economy. GDP: 4,500 euro per capita. Below country average
Institutional	EU member in 1986. EU regulation. Regional competences defined in Spain and Portugal	Communist party-led state; well defined limited regional autonomy	EU member in 2004. Implementation national and EU regulations
Social	4 million people. Aging	200,000 people. Mongol minority	4.1 million people. Roma minority

Key Findings

Opportunities for using land use and water management planning to support adaptation and climate-proof regional development have started to emerge. These were analysed along to the following aspects:

Biophysical aspects: In all three regions, ecosystems have degraded and water resources are heavily exploited. Traditional landscape and resource use practices, such as the traditional floodplain production systems in the Tisza, had an active role in regulating climate extremes. This regulating service has motivated local populations, scientists and policy makers to explore the traditional agro-ecological production systems. Our research in the Tisza and Guadiana river basins show that preserving and managing diversification of land use has a great potential for reducing climate related risks.

Technical aspects: Existing technical solutions, like building dikes, run into limits or add to undesirable and/or longer-term effects. Pilot projects and demonstration activities have started to test the feasibility of new technologies. There is scope for the development and exchange of more sustainable technologies and information systems, including early warning systems (e.g. the cell phone based warning service in Inner Mongolia). Currently available integrated assessment models are not parameterised for assessing new technologies and more complex and innovative adaptation strategies, creating a barrier for the appraisal of mainstreaming.

Financial aspects: Financial resources are limited in each of the study regions and adaptation is often considered too costly and uncertain compared to expected benefits. Whereas there is a pressure on existing financial services (like insurance) to become more expensive, new financial instruments are also emerging (e.g. micro-grants). The implementation of adaptation strategies is constrained by unequal distribution of costs and benefits. For instance, measures taken to reduce land degradation and sand storms may be financially unsustainable, and water retention increases risks for those who store the water for the benefits of others. Mainstreaming adaptation complicates existing relations with donors or financial instruments. The European agro-environmental schemes for example, are not designed for inter-annual land use changes, driven by water availability. Creating markets for adaptation is a key challenge. All three regions identified opportunities for public-private partnerships in which marketable products obtain additional support in exchange for providing social and environmental services that support adaptation.

Institutional aspects: Divided, changing or unclear responsibilities are key constraints for adaptation actions in the Guadiana and the Tisza river basins. By contrast, in Inner Mongolia, the rigidity of the strictly defined roles of different organisations is considered a constraint, as is the limited communication of intended policy goals to beneficiaries. Stable adaptive governance is a complicated paradox. Adaptive governance is a relatively new concept that needs to be demonstrated to gain in appreciation. Inspiring examples are the emerging coalitions of government and non-government actors that are helping to put the adaptation agenda in a regional context and encouraging action in the region. Successful coalitions often have close connections to academics who act as brokers in the communication of climate risk and adaptation information. Our analysis in the Tisza region shows the importance of recognition of adaptation at an abstract level by responsible civil servants and advocation of an adaptation strategy by a credible regional coalition. The recognition of adaptation and political attention following a number of major (near) floods, provided a window of opportunity for changing land use and water management. Opposition is inherent to implementing more fundamental policy change and engaging with (potential) opponents is an important activity in adaptation planning.

Social aspects: Adaptation can fail or be counterproductive because social processes and structures are imperfectly understood. In the Tisza basin, for example, sites for water retention were rejected. In the Alxa region, the enclosure of livestock conflicts with traditional lifestyles. The Tisza study region shows that informal social networks around local production systems have degraded, but are remediable. Local populations hold a wealth of knowledge on how to cope with climate variability, which deserves to be taken into account while developing new policies and measures.

Cognitive and informational aspects: In the Alxa and Guadiana regions in particular people struggle to connect regional trends to global climate change. The causes of trends in desertification and reduced water availability are heavily contested. Adaptation policy so far does not address the diverse perceptions of risks and their causes. The Tisza region shows benefits of debating climate related risks and how best to respond; after various discussions on adaptation options, actors were quick to take advantage of a micro-grant scheme for implementing local solutions. This supports the notion of adaptation as a social learning process. All three regions suffer from a lack of (access to) information about climate impacts and adaptation options and policies. Newly emerging forums for debating adaptation strategies may prove to be valuable in this regard. At the regional level these are often associated with internationally funded projects. Yet, a gap remains between scientific adaptation theory and adaptation practice on the ground. There is a mismatch between model assessments of impacts and adaptation on one hand and 'real' adaptation options as discussed by people in the region or in the policy plans on the other.

Significance of this Work

Our research suggests that all six aspects of adaptation discussed above are needed to capitalise on opportunities for successfully planning and implementing adaptation. Institutional and cognitive aspects have been identified as particularly important, but the relative weight of each aspect depends on location and will vary over time. In all three regions, lessons can be learned from integrating traditional agro-environmental land use systems with new technologies and institutional designs, for example to preserve diversity in landscape and the regulation of climate impacts as an ecosystem services. The study regions suggest that it is important to balance formal regulatory rules and informal social factors in planning and implementation. Informal networks are crucial for social learning and adaptive capacity and may be particularly useful in times of crisis. At the same time, formal rules are required to include adaptation in longer term planning, investment and financial support of experimentation and adaptation.

We thank all interviewees, research partners and participants of the regional workshops for sharing their experience on adaptation practice!

More information: Saskia E. Werners [saskia.werners@wur.nl], J. David Tàbara, Henry Neufeldt, Darryn McEvoy, Xingang Dai, Zsuzsanna Flachner, Jennifer West, Francesc Cots, Giacomo Trombi, Nicola Lugeri, Piotr Matczak and Gert-Jan Nabuurs (2009) **Mainstreaming Adaptation in Regional Land Use and Water Management**. In: Making climate change work for us: European perspectives on adaptation and mitigation strategies (eds. Hulme, M. and H. Neufeldt). pp. 230-260. Cambridge University Press, 2009

Adaptation plans from England and Wales – lessons from the 2009 price review

Mr. Mike Keil, Ofwat, United Kingdom

In performing our duty as the economic regulator we are aware of the international context in which we operate. The scientific evidence strongly indicates that freshwater resources will be impacted by climate change. That is why we are keen to work within the framework of the European Commission's white paper on adaptation to climate change.

Within this context our policy is one of delivering behavioural change by water companies in England and Wales through use of the regulatory regime. Through this regime and by working with other government agencies on ensuring adaptation is taken into account, for example in River Basin Management Plans, we believe the tools exist to deal with the issues. We are keen to demonstrate the importance of implementation on the ground over increasing legislation.

As a monopoly industry the companies are regulated by Ofwat who determine the maximum level of water charges. This process, called the price review, occurs in five year cycles. Business plans for the period 2010 – 2015 have been assessed and the price levels determined. The 2009 price review has revealed valuable information regarding how water companies are planning to adapt to climate change.

This talk focuses on the main areas where progress has been made by companies and also highlights where further development is required. We specifically allowed adaptation related investment in the following areas:

- resilience of services from extreme events;
- catchment-wide land management schemes; and
- water efficiency and metering

In general, the evidence from the companies' business plans shows that they have made a good start in considering climate change adaptation. However, there is clearly much more to do. Many of the proposals we looked at during the 2009 price review demonstrated only a basic understanding of climate change risks. Companies have only just begun to investigate and understand the implications of the latest climate change scenarios.

A key priority for companies during the next five years is to deliver their plans. This will allow them to demonstrate that they can turn plans into action and tangible benefits for their customers. The lessons learned from these activities will strengthen the evidence base in this emerging area. This information will help future business planning. It may also have value in other sectors to encourage effective responses to a changing climate.

SESSION 5 – STARTING COOPERATION: LAUNCH OF THE PILOT PROJECTS AND CONCLUSIONS OF THE WORKSHOP

Promoting cooperation to adapt to climate change in the Chu and Talas transboundary basin (Kazakhstan and Kyrgyzstan)

Mr. Kenshimov, UNDP Kazakhstan and Ms. Nedvedova, Kyrgyzstan

The project aims to improve the adaptive capacity of Kazakhstan and Kyrgyzstan, to support dialogue and cooperation on the needed steps to design an adaptation strategy in the transboundary context and thereby prevent controversy on the use of water resources.

In 2006, Kazakhstan and Kyrgyzstan have established a bilateral transboundary water commission in and agreed upon water-sharing agreement and relevant tools for costs compensation. These cooperative arrangements might, however, be put at risk in the future by the possible negative impacts of climate change on water resources in the basin leading towards the need to re-consider current cooperation.

The specific objectives of the project will be:

- Modelling of the possible changes in water resources of the Chu-Talas basin associated with climate conditions and elaboration of joint scenarios,
- Preparation of joint vulnerability assessment, focusing on selected areas/sectors of importance for the work of the Commission,
- Development of a package of possible adaptation measures and relevant procedures for the Commission, which may contribute to decreasing potential tensions over changing hydrological regimes. Such procedures and measures will be built into the regular Commission's operations and policies, where appropriate.

As a first step, a baseline study will be conducted to identify and assess already ongoing or completed projects and national and international initiatives as well as existing data and impact assessments. This will be done through interviews with officials, initial data collection, contact with other previous and ongoing projects, etc. Depending on the results of the baseline study, subsequently, the collected data and information will be processed and used as a basis for developing an agreed upon impact assessment, based on joint scenarios and modelling. Based on the results as well as further information, a vulnerability assessment will be carried out in order to identify the most vulnerable areas, economic activities, ecosystems and population groups. The focus of the vulnerability assessment will be designed taking into account the work of the Chu-Talas Commission.

Based on the results of the vulnerability assessment, adaptation measures, their financing and implementation will be planned jointly with the riparian states. If possible, contacts to relevant donor institutions will be established. At the same time, the opportunity and options for adapting the Commission's procedures to allow coping with climate change impacts will be discussed and agreed upon so to integrate project findings into the regular commission activities.

Partners
Facilitating organizations: UNDP (Ms. Natalia Alexeeva and Mr. Amirkhan Kenshimov), UNECE (Ms. Sonja Koeppel, Mr. Bo Libert and Ms. Francesca Bernardini) and OSCE (Ms. Saba Nordstrom)
Countries: Kazakhstan: Committee of Water Resources, Ministry of Agriculture
Kyrgyzstan: Water Agency, Ministry of Natural Resources
Secretariat of the Chu-Talas Commission
Project duration: 3 years, Start: Jan 2010, End: Dec 2012

Reducing vulnerability to extreme floods and climate change in the Dniester river basin (Dniester III floods & climate)

Mr. Pencov, Apele Moldovei, Ms. Lysiuk, State Water Committee, Ukraine and Ms. Kutonova, OSCE

The project aims to reduce risks from climate change - and specifically flooding - for security by improving the adaptive capacity of Ukraine and the Republic of Moldova. More specifically, the project aims to expand and further strengthen cooperative management in the Dniester River basin to address cross-border management of floods, taking into account both current climate variability and long-term impacts of climate change on flood risks.

The Dniester river is shared by Ukraine and the Republic of Moldova. The Dniester in the Republic of Moldova also delimits the region of Transnistria. The initial phase of the UNECE- and OSCE-led Dniester basin cooperation project in 2005-6 produced a comprehensive assessment of the situation in the basin. Phase II, incorporated into ENVSEC, started in Summer 2006 and focussed on developing institutional and legal arrangements for joint basin management between Ukraine and the Republic of Moldova, with the aim to promote a legal agreement and develop an Action Programme of spin-off activities developed and agreed with the countries in 2007-8. The Programme promoted further development and implementation of legal mechanisms for basin cooperation; strengthening monitoring of water-related risks to public health; facilitation of cooperation on protecting the basin's biodiversity; increasing public awareness of basin-wide water and environmental issues; improving basin-wide exchange of water and environmental information. A joint Geographic Information System shared by the riparian states (including the Transnistrian region) was established and regular exchange of environmental information initiated. The pilot project will be carried out as part of the overall Dniester III project.

As a first step, ongoing or completed projects and national and international initiatives as well as existing data and impact assessments regarding climate change and flooding will be identified and assessed. Subsequently, the collected data and information will be processed and used as a basis for developing an agreed upon assessment of climate change impacts, with a special focus on flood problems. This will be done based on joint scenarios and modelling. Modelling and scenario building will help to assess climate change impacts, in particular on the occurrence, frequency and magnitude of extreme floods. Based on the results as well as further information, a vulnerability assessment will be carried out with a special focus on floods in order to identify the most vulnerable areas, economic activities, ecosystems and population groups. Different types of flood risk maps will be produced depending on the needs of the users and the data available, i.e. flood hazard maps and vulnerability or risk maps which will help in the prioritization of measures and areas for further action. Based on the results of the vulnerability assessment, further adaptation and especially flood risk reduction measures will be identified, prioritized and planned jointly by the riparian States, including financing aspects.

Moreover the project will support ongoing efforts in the Republic of Moldova and Ukraine to improve monitoring and forecasts of transboundary floods through the strengthening of the joint system for automated flow monitoring and data exchange (4- 6 new automated flow monitoring stations and data exchange infrastructure). Furthermore, capacity-building on flood alerts and flood communication will be provided through a workshop for national and local experts, the production of local early warning plans, and information material for the general population.

Partners:
Facilitating organizations: OSCE (Ms. Tamara Kutonova), UNECE (Ms. Sonja Koeppel, Mr. Bo Libert, and Ms. Francesca Bernardini) and UNEP (Mr. Nickolai Denisov)
Countries: Ukraine and Republic of Moldova, Plenipotentiaries, Dniester III project stakeholders, Ministries of Environment in both countries, State Water Committee in Ukraine
Project duration: 3 years, Start: Jan 2010, End: Dec 2012

Building the link between flood risk management planning and climate change assessment in the Sava River Basin

Ms. Marina Babic-Mladenovic, Institute Jaroslav Cerni and Mr. Dragan Zeljko, International Sava River Basin Commission

The project aims to support further expansion and strengthening of collaboration in the Sava River basin, to address transboundary management of floods, specifically taking into account impacts of climate change on flood risk management.

Since the establishment of the Sava Commission, flood management has been one of the main fields of cooperation of the Sava countries. In order to further strengthen the cooperation, Bosnia and Herzegovina, the Republic of Croatia, the Republic of Serbia and Republic of Slovenia (the Parties to the Framework Agreement on the Sava River Basin (FASRB)), recently developed and initiated **Protocol on flood protection to the Framework Agreement on the Sava River Basin**. The Protocol provides a starting point for step-by-step development of a common **Flood risk management plan** (FRMP), in accordance with the EU Flood Directive (2007/60/EU) and in line with the UNECE Water Convention. The climate change issue has been recognized and emphasized in the preamble of the Protocol. Recognizing the likely consequences of climate change on the water regime on the Sava River Basin and the need for effective adaptation measures, it is expected that the common FRMP shall take into account climate change impacts as well as various vulnerabilities of society, economy and environment.
This project should complement and support the joint activities of the Parties already started in the framework of the Sava Commission. Links will be established with the ongoing projects in the Sava river basin (Water and Climate Adaptation Plan for the Sava River Basin (WATCAP project), Sava RBM Plan preparation project, etc.) and the Danube river basin related activities, in order to secure a synergy towards common goals.

The main activities that will be performed during the course of the project are:

- Preparation of the overview of already completed or ongoing activities regarding the flood risk management planning in the Sava river basin (Sava river basin FAP, etc..), and in the Danube river basin (being relevant for the Sava river basin);
- Identification and assessment of existing legislation, strategies and plans related to FRM planning and climate change adaptation (transboundary and national) in the Sava basin;
- Assessment of data and information needs for preparation of joint FRMP for the Sava river basin and identification of data sources on national and international level,
- Initial flood vulnerability assessment of the Sava river basin and identification of the most vulnerable areas;
- Assessment if additional modelling of climate change impact on flood vulnerability is needed (starting point are WATCAP results),
- Preliminary identification of possible adaptation measures (costs, effectiveness, side effects, vulnerability reduction, feasibility of implementation, alternatives etc.);
- Preparation of a detailed Program for preparation of the first Flood risk management plan
- Sharing relevant experiences with other pilot projects under the framework of the UNECE Water Convention's platform for exchanging experience on transboundary cooperation

Partners
Facilitating organizations: International Sava River Basin Commission (Mr. Dragan Zeljko and Mr. Dejan Komatina), UNECE (Ms. Sonja Koeppel, Ms. Francesca Bernardini and Mr. Bo Libert)
Local partners: National institutions of the Parties (Bosnia and Herzegovina, Croatia, Serbia, Slovenia), responsible for the FASRB implementation
Project duration: 2.5 years, Start: June 2010, End: December 2012