Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

EU 2007.DE

Symposium Report

Time To Adapt

Climate Change and the European Water Dimension

Vulnerability – Impacts – Adaptation





Berlin - 12 to 14 February 2007

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Umwelt Bundes Amt
Für Mensch und Umwelt

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Conference Website:

www.climate-water-adaptation-berlin2007.org

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Table of Contents

INTRODUCTION

In the framework of the German EU Presidency, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, hosted the symposium "Climate Change and the European Water Dimension: Vulnerability – Impacts – Adaptation" from 12 to 14 February 2007 in Berlin. The event was organized together with the European Commission`s Directorate-General Environment and in close cooperation with the Directorate-General Research, the European Environment Agency and the Joint Research Centre of the European Commission.

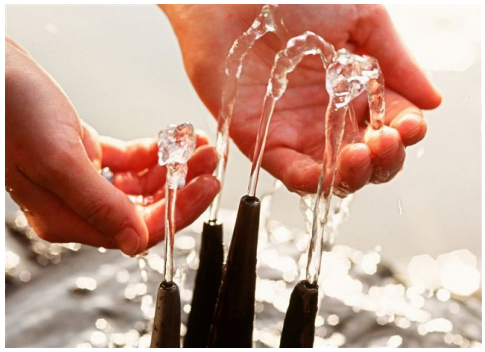
Water resources are a critical factor for a wide range of socio-economic sectors as well as for human health and the environment. Therefore, the vulnerability of water resources to the impacts of climate change should be a major concern and should score a high priority on the political agenda. Recently, efforts have been made by different actors at European level to improve the information basis on climate change impacts, to increase awareness, and to promote the development of adaptation strategies. A recent report by the European Environment Agency on "Climate change and water adaptation issues"[1] reviews the challenges facing Europe to adapt to the impacts of climate change on water resources, assesses the strengths and weaknesses of current policies and regulations, and describes progress and activities in European countries. In September 2006, three Directorates-General of the European Commission (Research, Environment and the Joint Research Centre) jointly organised a workshop[2] in Brussels that discussed climate impacts on the water cycle, reviewed research and policy, and thus paved the way for the development of an adequate policy-research interface. The workshop defined interactions between science and policy on climate change and the way in which scientific outputs could be translated into policies.

The Symposium "Time to Adapt" was an important element in this European process on climate change and adaptation, providing a broad platform for discussions and bringing together scientists and representatives from different policy and business areas, which created the basis for crosssectoral discussions and the development of integrative approaches. The preparation of the Symposium involved consultation with scientific experts and major stakeholders, as well as close cooperation with the European Commission.

This Symposium was successful in creating momentum for the development of adaptation strategies in Europe. It developed Key Messages (page 5) which contain recommendations for action and point to essential elements of adaptation and to promising opportunities. These are fleshed out in more detail in the Recommendations (page 43). This report also contains the full text of political speeches given during the event, and a summary of presentations and discussions.

Further information and background documents as well as all presentations are available at the conference website at:

http://www.climate-water-adaptation-berlin2007.org



KEY MESSAGES

A. It is time to adapt now! Scientific evidence urges action

The climate is changing! The scientific evidence conveys the clear message that this change will impact the water cycle in Europe, with potentially disastrous effects. The predicted impacts will aggravate an already serious situation where European water resources suffer due to existing and increasing pressures and insufficient integration of water management practices.

These impacts on water resources will significantly affect on key economic activities such as **agriculture**, **hydropower** and **energy production**, **tourism** and **navigation** in large parts of Europe. Equally important, attention needs to be given to the serious adverse impacts on **biodiversity** and **ecosystems**.

Therefore, while climate change mitigation should remain a priority, there is also an urgent need to develop strategies for adaptation to the already inevitable climate change-driven changes in water resources. However, interactions between mitigation and adaptation measures need to be considered in order to develop the most effective policies and incentives.

B. EU water and marine policy provides a solid basis for integrated water resource management – it should be used to factor in adaptation to climate change

Existing European water policy on freshwater, coastal and marine management is already fit to factor in climate change. Community actions on floods, water scarcity, droughts and the marine directive will complement the ongoing work. In particular, the Water Framework Directive (WFD) is a powerful tool to introduce climate change impacts into water resources management and river basin planning, at the latest in the second planning cycle in 2015 and preferably before. This process should integrate the needs, including the ecological needs, and impacts from all water-related sectors.

C. A successful adaptation strategy needs a common and integrated approach

Adaptation starts with using water more efficiently in all sectors

Measures to reduce demand should clearly be favoured over increasing supply. This applies to all sectors and users. Moreover, supply side management needs to become more efficient, e.g. by reducing leakages. Change in lifestyles as well as in consumption and production patterns are essential for both adaptation and mitigation.

Water-dependent sectors need to be involved

All relevant water-related sectors, such as agriculture, electricity production, inland navigation and tourism must be integrated under one common adaptation management process related to water. This relates to participation on all levels, whether administrative, institutional, private or from the civil society. Only a common and integrated approach will provide successful win-win solutions and avoid negative cross-sectoral feedbacks of measures or non-action in one sector. Water demand management should be introduced in all sectors.

All EU policy areas need to undergo an adaptation check

At present, not all EU policies contribute sufficiently to adaptation to climate change. In fact, some policies or their implementation may even be counterproductive. A systematic check of all policy areas on whether measures for adaptation to climate-related impacts on the water resources exist should be carried out by 2009, whether they are funding instruments, sector policies or environment policy. New policy proposals

should incorporate adaptation aspects in the impact assessment. This also applies to mitigation policies, e.g. the Biomass Action Plan. This will contribute to a better, more effective regulation.

Actions in all sectors need to be taken and integrated into broader water management

All sectors will have to take specific actions to factor in climate change. There are, however, some crosscutting conclusions which are applicable across all sectors.

First, integrated water management through implementation of the Water Framework Directive and other relevant water legislation is a precondition to effective adaptation strategies. Sector-specific actions and water-related needs of different users should be integrated into water management by close cooperation with these implementation processes.

Second, the future investments in infrastructure must be climate-proof. What appears to be a cost-effective investment under current conditions may become economically and ecologically not viable when considering the climatic predictions and their impacts on water resources. Flexibility of approaches is therefore key.

Third, compensation measures, subventions and incentives should increasingly consider climate change impacts and adaptation measures in order to be sustainable. On Community level, this will mainly affect the implementation of regional and cohesion policy.

In addition, the following specific conclusions were drawn:

- **Agriculture can make a stronger contribution to adaptation:** agricultural production needs to factor in climate change and effects on water availability and quality. There is certainly scope for improving the adaptive capacity of European agricultural systems including changes in land use and crop yield through incentives in the framework of changes to the funding schemes provided by the Common Agricultural Policy (CAP) of the EU, both the first pillar (direct payments) and the second pillar (rural development). The upcoming “health check” of the Common Agricultural Policy provides an opportunity to address these issues.

- **Energy and electricity production have an important role in mitigation and adaptation:** improving energy efficiency (including reductions in transmission losses) should play a key role in national and European mitigation and adaptation policies. Decentralised approaches and a diverse energy mix are likely to be beneficial both in terms of adaptation and mitigation on the supply side. The management of cooling water demands, in particular under low flow conditions, should be made a part of the river basin management plans.

- **Navigation management and planning needs to become climate-proof:** the focus should be on making the right choices regarding the infrastructure, compatibility with environmental legislation including climate change, and the development of an innovative navigation fleet that can cope with future climatic conditions. The NAIADES action plan can be used to support and guide the improvement of inland water transport development.

- **Truly sustainable tourism needs to be promoted:** Adaptation to climate change can only be achieved in the tourism industry if it becomes more sustainable. Thus, promoting the implementation of the efficient use of (water) resources within the tourism sector is a priority. A diversification of tourism activities could further help to make the sector more resilient to changes in climatic conditions and in water resources availability. Increasing awareness and fostering necessary behavioural changes among individuals and tourism enterprises is another important objective.

More intensive cooperation and common action at EU level

An intensive exchange among Member States and a common process for developing guidance should be organised in the context of existing mechanisms.

D. The "user pays principle" needs to be fully implemented

Economic instruments, as set out in the WFD, should be widely applied to recover the costs, including ecological costs, of coping with and adapting to climate change impacts, and to ensure that these costs are shared fairly between users, providers and polluters. These can become key instruments for the integrated approach. This should lead to a gradual move to full cost recovery in all sectors, taking into account social aspects. One way forward is the 'user pays principle', regardless of whether the water is taken from a tap, a river or an aquifer.

E. Further research activities are necessary to tackle adaptation issues more effectively – the science-policy dialogue needs to be continued and strengthened

F. Do not forget the world outside the EU! Adaptation and integrated water resource management should be a key element of development co-operation including co-operation with States in the European Neighbourhood

OPENING SPEECHES

Sigmar Gabriel, Federal Minister for the Environment, Nature Conversation and Nuclear Safety, Germany

Mr Correia, Mr Carl, Ladies and Gentlemen,

It gives me great pleasure to welcome you to Berlin to the symposium "Time to Adapt! Climate Change and the European Water Dimension".

"New Germany – Tropical nights in Bavaria…", "Up and down – The global weather is going crazy….", "Ski lifts relegated to museum pieces"

Such headlines have appeared in the papers in Germany in recent weeks - which have been far too warm for autumn and winter - and in connection with the publication of the new IPCC report ten days ago.

Autumn 2006 was the warmest autumn since the beginning of nationwide weather records in 1901. The temperatures over the last four months of 2006 alone were in some cases up to 5°C higher than the long-term average (1961 - 1990). The storm Kyrill in January - which was very unusual for this time of year - brought rail and air traffic in Germany and in many parts of Europe to a standstill. The damage totalled billions of euro.

Signs of climate change?

The IPCC report published on 2 February 2007 clearly shows that not only is climate change happening, it is also advancing more rapidly than even the most sceptical climate researchers expected. And there is no longer any doubt that humans are responsible for climate change! Over the

past 100 years the average global temperature has increased by 0.7°C, thus more rapidly than at any time over the past 20,000 years. In view of the concentration of greenhouse gases already in the atmosphere today, a further temperature rise can no longer be averted.

The global impacts of climate change and the dangers it poses are already being clearly felt. Glaciers are melting, the sea level is rising, the hazards of extreme weather events are increasing. The IPCC report shows that climate change caused by human activities is already leading to an increase in extreme weather events.

For example, in summer 2003 large regions of Europe were hit by a prolonged heat wave. Around 35,000 people died in Europe alone as a consequence of these scorching temperatures.

In the agricultural sector, damages of more than 10 billion euro were caused in central, southern and eastern Europe - damages that were not covered by insurances. Shipping on the Rhine had to be heavily restricted. A large number of power plants, including in Germany, were only able to work at a reduced capacity. Water from the rivers was already too warm, further heating would have had ecological consequences for the aquatic ecosystems and, from a purely technical perspective, the temperature of the cooling water was already much too high to be able to achieve a sufficient cooling effect.

The costs resulting from such events will continue to rise in future. The *German Institute for Economic Research* (DIW) predicts economic damages caused by global climate change of 137 billion euro by the year 2050 in Germany alone unless countermeasures are taken in good time. The expected damages at international level are even higher: Sir Nicholas Stern, former chief economist at the World Bank, presented the results of his study for the British Government at the beginning of November last year. I am delighted that we will be welcoming Mr Terry Baker, one of the co-authors of this study, on the third day of this symposium. He will tell us about the results of the study in greater detail. But one thing can be said already: the results are very alarming! If we do not act resolutely and swiftly to introduce measures, losses in growth of up to 20% of the global GDP by 2100 can be expected. However, if we take adequate measures today the damages can be restricted to around 1% of the global GDP.

In other words, we have to act now to minimise the negative impacts of anthropogenic climate change.

Germany took over the Presidency of the EU and the Chair of the G8 in January. We have placed the topic of climate change high on the agenda at both levels.

We are aiming for progress along two paths:

Firstly, we have to significantly reduce greenhouse gas emissions in Europe and worldwide. This is the only way to halt the global temperature increase and to limit it to below 2°C. To achieve this, the industrialised countries will have to reduce their greenhouse gas emissions by 30% by the year 2020 compared with 1990 levels. By 2050, reductions of 60 to 80% are necessary.

The Kyoto Protocol is a first, important step. But further steps must follow. The negotiations on the further development of the international climate protection regime beyond 2012 have already begun. In the framework of the UN climate negotiations in Nairobi in November 2006, the EU emphasised its willingness to continue playing a leading role and to set more ambitious absolute reduction targets. Germany even went a step beyond the EU position.

This year we can and we must set the decisive course for a multilateral climate protection regime for the post-2012 period. The crucial milestones for this are

- the European Council on 8 March, prepared by the Council of Energy Ministers on 15 February and the Council of Environment Ministers on 20 February,
- the G8 Summit in Heiligendamm at the beginning of June, prepared by a meeting of environment ministers of the G8+5 countries in mid March, and finally

I support the Commission's proposals:

- Without any ifs or buts the EU should endeavour to obtain a commitment from all industrialised countries to reduce their greenhouse gas emissions by at least 30% by 2020.

- In the – in my view unlikely – event that such an agreement cannot be reached, the EU should already make an unconditional pledge now to reduce its own greenhouse gas emissions by at least 20% by 2020. This will strengthen our international credibility.

A 30% objective should thus be quite clearly set. Some press reports, however, have recently been giving the wrong impression that the Community is only pursuing a 20% target. With this powerful message, the EU will help break the deadlock in international climate protection negotiations.

The EU targets are a key component of the negotiation package which we are preparing during our Presidency and which builds on the successful architecture of the Kyoto Protocol. It aims to ensure that we do not exceed the 2 degree limit which has been laid down as a guideline several times by the EU heads of state and government.

We can implement these ambitious targets in an economically expedient way if we closely interlink climate policy with energy policy. I therefore support the Commission proposals for a twin-track strategy on increasing energy efficiency and expanding renewable energies.

Secondly, we have to make progress with precautionary action against the impacts of climate change. Even if we succeed - and we must succeed! - in quickly implementing all climate protection measures under discussion and restricting a further increase in the global temperature to 2°C, we will nevertheless have to face the consequences of climate change that are already all but inevitable.

The issue of adaptation has increasingly become a focus throughout the EU in recent months, after studies carried out in a range of Member States on vulnerability regarding the impacts of climate change clearly showed the extent of impacts to be expected. In Germany we decided at the end of 2005, on the basis of relevant studies, to develop a national concept for adaptation to climate change by the end of 2008 in order to ward off risks for the population, economic damages and social impacts.

The prerequisite for intelligent, effective and efficient adaptation to climate change is a good understanding of regional and sectoral impacts. Regional modelling of climate development is an essential basis in this regard. Major scientific progress has been made in this field recently.

We have numerous indications that water resources, the water balance and thus the water sector will be particularly affected, although the impacts will vary greatly from one region of Europe to the next. Climate change intensifies the water cycle and alters the amount and distribution of precipitation. In northern Europe there is likely to be an increase in annual rainfall, in southern Europe a decrease. In winter there will be more rainfall than snow. And as precipitation patterns change, other components of the water cycle will change too.

The annual run-off of Europe's river basins has already changed in recent decades. While the run-off in rivers basins such as the Loire or Guadalquivir in southern Europe is decreasing, annual run-off in rivers basins stretching across Europe, such as the Danube, is increasing. Predictions for the year 2070 show a decrease in river flow for southern and south-eastern Europe of over 25% in some cases, with an increase of 25% in northern Europe. We will have to prepare for more frequent flooding, but also for longer periods with low water levels.

But the occurrence of extreme weather events is only one side of the coin. The other is the almost undetected gradual change, for example changes in the rates of groundwater recharge. Studies in Great Britain predict a 5 to 15% reduction in recharge. In the Elbe catchment area the average decrease is expected to reach 22% by the year 2055. In future many more people, in Europe too, will be living under water stress conditions.

The impacts of a higher variability of water availability and of extreme weather events will not only affect the water sector as such; a number of water-dependent sectors will have to adapt to direct or indirect impacts.

The fact that the resource water is particularly affected motivated us to organise this symposium during our EU Presidency together with the Commission's Directorate General Environment. The focus of this symposium has intentionally been placed on the need for and options for adaptation in the water sector and selected water-dependent sectors of the economy.

Do the existing European water policy instruments, in particular the Water Framework Directive and the future Directive on Flood Risk Management, already provide a suitable legislative framework for adaptation measures in the Member States?

Do other EU policies already take sufficient account of the need for adaptation to climate change, or are amendments necessary? If so, what can be amended to create the right incentives and to prevent conflict of goals?

What contribution can sectors on the demand and user side make?

Is there a chance that water demand, for example in the agricultural sector, can be reduced by means of innovative concepts?

What form will a joint integrative approach have to take in order to cover future water demand, to protect humans from the impacts of climate change on the water balance and to keep socio-economic impacts as low as possible?

How can we interlink measures to restrict the global temperature increase with adaptation measures?

This symposium aims to address precisely these issues and to collect answers and solutions.

I am confident that the results of this Symposium will make an important contribution to further discussion and decision-making processes at EU level. The European Commission has announced a green paper on adaptation for the first half of this year, and I am sure that the results of this symposium will find their way into this green paper, especially - and this is important to highlight - as three Directorates-General of the European Commission worked together in preparing this symposium. I am very pleased that you, Mr Correia, will be pursuing this issue further during Portugal's EU Presidency. I would be happy if interim stock-taking were possible in the Council of Environment Ministers in the second half of this year.

In the spirit of the headlines in a German newspaper - "He who adapts, wins" - I wish us all fruitful discussions and a successful symposium.

Thank you!

Francisco Nunes Correia, Minister for the Environment, Spatial Planning and Regional Development, Portugal

Mr. Sigmar Gabriel, Federal Minister for the Environment, Nature Conservation and Nuclear Safety;

Mr. Mogens Peter Carl, Director General for the Environment of the European Commission;

Ladies and Gentlemen:

Allow me first and foremost to thank and congratulate Sigmar Gabriel and the German EU Presidency for the timely idea of bringing together experts, stakeholders and policymakers to discuss water and climate change.

Climate change policymaking is the ultimate dot-connecting exercise. No other public policy nowadays conveys a greater sense of interdependence than climate change. And no other public policy is as urgent as combating the changing climate.

Just a couple of days ago former US Vice-President Al Gore visited Lisbon to meet with over 600 business, NGO and policy leaders. It was riveting to watch such a large gathering overwhelmed by the potency of the facts, and the scale of the challenge, but also excited by the opportunity that early and sound climate policies can bring about.

Climate change is already here, as the IPCC just reconfirmed at the recent Paris meeting! It poses huge threats on major human systems such as on water resources. And because a certain measure of a changed climate is certainly a given, we must start preparing to adapt. Climate change will have direct impacts on water availability and quality. As we all know, climate change has direct impacts on the timing and variability of water supply, and these impacts have profound implications on many sectors of our society. Water is used for just about all human activities and is essential for the sustenance of ecosystems. But

There are also indirect impacts derived from changes in economic and social activities which may lead to new pressures on the water systems, namely increased water demand and pollution.

Cut-crossing approaches to planning and policymaking are therefore essential.

This conference comes at a time where all Member States are engaged in starting the preparation of their River Basin Management Plans under the landmark Water Framework Directive. Climate change should be considered, as much as reasonable and possible, at all stages of this major planning effort.

In what concerns extreme events, we have all recently experienced floods and droughts at a pace that is possibly related to climate change, emphasising the need to evolve from our current water management practices onto more pro-active, based on risk analysis and more focused on prevention, protection and preparedness measures.

In this context, I should highlight the floods directive and the initiative on an EU action on drought events and water scarcity situations. I'll come to this one later.

Let me now just focus a bit on Southern Europe and the Mediterranean region:

The scenarios of climate change impacts, particularly in Europe, are well known to you all, including the fact that the region around the Mediterranean is one of the areas where climate change impacts will be more intense. The Stern Report only reinforced this concern clearly, stating that Southern Europe, and in particular

the Iberian Peninsula, will be the region most affected by climate change.

As a result, annual mean precipitation over southern Europe may decrease at a maximum rate of 1% per decade. However, relevant changes are expected at the seasonal scale. Winter is expected to get wetter at a rate of 1% to 4% per decade, while in the summer southern Europe may observe a drying up of up to 5% per decade or so. Therefore, Climate change will contribute to the worsening of some already existing water stress situations. And as you also know, in southern Europe, and around the Mediterranean sea, distribution of water resources is significantly irregular both in time and space. In Portugal alone, the annual precipitation may vary three fold from year to year and five fold from the dry interior south to the wet mountainous northwest. This irregularity is responsible for a significant number of water stress situations and obviously further complicates water resources management. The risk of drought will probably increase and its impacts will be conditioned by the available storage capacity of winter runoff. In the other hand The frequency and magnitude of intense precipitation events are likely to increase, especially in winter, leading to an increased flood risk.

Yes, we also have severe floods in southern Europe, more often in winter. And yes, we have witnessed recently, that central and northern Europe also has water scarcity problems. That's the eye-opening consequence of climate change – and, granted, poor planning practices over the years across many areas of the world.

It is also very likely that the frequency and intensity of summer heat waves will increase. Other conclusions point to adverse changes in river water quality, particularly in the regions where quality is already under threat.

Portugal has since year 2000 been working on integrated scenarios, Impacts and Adaptation Measures to climate change on Water Resources, Agriculture, Forest, Biodiversity, Energy, Health and Tourism.

However, our mitigation and adaptation research has in turn not been sufficiently considered in government decisions.

Portugal will succeed Germany in the EU Presidency. Climate change certainly is a common thread throughout the three presidencies of the Team Presidency.

We are fully aware that our credibility largely depends on what we do at home.

Just two weeks ago the Portuguese Prime-Minister announced a further package of climate-energy measures, setting more stringent goals and emphasising our ambition in terms of climate policy both to meet our Kyoto goal and to move ahead for the 2020 goals.

These measures include an increase from 39% to 45% of the electricity production from renewable sources by 2010; an increase from 5% to 10%, by 2010, of the total of biofuels used in transports, anticipating the proposed EU target in ten years; phasing-out of fuel plants by 2008 and 2010; partial fuel switching in coal combustion plants; a public procurement scheme with special focus on buildings and vehicles; and, last but not least, reinforcing the environmental component of the vehicle circulation tax from the current 10% to 30% by July 2007 and to 60% in 2008.

But as we all know, regardless of our success in reducing emissions in the short term, we will have to cope with some degree of climate change. Adaptation is therefore inevitable and if planned ahead it can significantly minimize the potential costs and suffering associated with climate change. As always, careful planning based on the current knowledge is the key to

any strategy aiming at minimizing threats and maximizing opportunities.

A sound water management policy has always required a capacity to decide under uncertainty and forecasting. In this perspective, climate change does not require any drastic change in water management thinking, as it only constitutes an additional source of

uncertainty that will influence future values of both the water demand and availability. The main conceptual change is the rejection of the traditional engineering assumption that considers the historical climate as a reliable indicator of future conditions.

Interestingly enough, climate change and water stress, in some cases, will emphatically recall traditional water management practices of arid and semi-arid regions that were "efficient" in conserving this most precious resource. We have to bring back those practices to modernity, in some sense, as part of our adaptation strategies. Adaptation thus means that the challenge of climate change must be integrated in the overall policy and planning strategy on water resources.

The adaptation strategy on water resources, as well as its associated action plans, must be defined at a basin scale and involve all stake-holders. It must include supply-side actions to increment and diversify water sources and demand-side actions to limit the growth and, if possible, reduce the pressures on water resources. In addition it must also address more general issues related to economic, social and institutional planning, development, land use and wealth enhancement.

Portugal's National Climate Change Plan will be updated in 2008-9 with the objective of including a full fledged adaptation chapter for Portugal.

It is in this sense also very important to work on the basis of the forthcoming Commission's green paper on adaptation, which will surely provide a cross-cutting basis for Europe's adaptation to climate change.

Given the importance of the transboundary river basins for the Portuguese water resources, (more than 50% of surface water flows from Spain) it is of paramount importance to develop joint projects in cooperation between Portugal and Spain on this topic. Just recently both countries decided to launch a joint study on the impacts of climate change on the Iberian Peninsula's biodiversity. We will surely carry on joint studies in Portugal and Spain on the impacts of climate change on Iberian water resources.

Dear Minister, Ladies and Gentlemen, I would like to stress, once again, that the views and experiences exchanged at this Conference will certainly help us all to define the necessary steps to establish an overall strategy to adapt water management to climate change.

The diversity of impacts of climate change that will occur across Europe should encourage us to work towards a common adaptation strategy, based on a real integration of water management and the various sectors which are strongly dependent on the availability of good quality and sufficient water (e.g. agriculture, electricity production, tourism).

Climate Change, on one hand, and Water Scarcity and Droughts, on the other hand, are two main priorities of the Portuguese Presidency later this year.

The Portuguese Presidency will work to take forward the issue of climate change and we will do our best to maintain the momentum vigorously generated by the German Presidency.

During our term, at the Informal Council of Ministers for Environment, that will take place in Lisbon on the 1st September, it is my intention to promote an open debate on Water Scarcity and Droughts on the basis of a Communication on this subject prepared by the European Commission. Discussion will obviously include the linkages with climate change, impacts to other sectors, relation with EU policy, regional relevance and scientific developments.

Portugal intends to work closely with all Member States and the Commission in order to ensure a comprehensive analysis of the main concerns in relation to water scarcity and droughts, considering that it will affect European regions in different ways, with climate change as a spreading cause of this problem.

Let me thank Sigmar and the German Presidency again for this timely and forward looking initiative.

Climate change is upon us. We must act now! Just imagine our children and grandchildren in a couple of decades looking back on today if we had not taken action. They would ask: “what were they thinking then?!” From our part, rest assured, we want no such question ever being posed.

Thank you very much.

Mogens Peter Carl, Director–General for the Environment, European Commission

1. There is ample evidence that we have to adapt to the water-related effects of climate change.

Ladies and Gentlemen,

There is overwhelming evidence that climate change is a problem we have to tackle urgently. The Stern report gave very clear warnings about the need for action. Reassuringly, however, it stated that effective action is still possible and that it is affordable - indeed, not only affordable, but a lot cheaper now than if we wait until later. As you know, Europe is taking action here at home and is calling for ambitious international action – and we will continue to do so until the rest of the world follows suit. But even if there is a rapid and worldwide commitment to take radical action to limit climate change, we can still expect some severe economic, environmental and social consequences in the short and medium term, until we have succeeded in de-carbonising the world economy. One major impact will be changes in the water cycle, and these in turn will seriously affect agriculture, industry and many other sectors. So we must not only identify the emerging problems as precisely as we can, but also define the most effective remedial action, and discuss and agree on who should carry it out.

On 10 January, the Commission called upon the Council and the European Parliament to take the lead for a reduction of developed country greenhouse gas emissions of 30% by 2020. The EU should, in any event, commit itself to a 20% reduction, even if others did not follow suit. Discussions in the Council are

moving in a positive direction, with very strong support from the German

Presidency. And only two weeks ago there was also the report by the IPCC Working Group. This again confirmed that the climate is indeed changing and that human activities have caused most of the change. I was struck by one very significant conclusion. In the last century global average temperature have already increased by 0.74 degrees, and they are likely to rise by a further 1.8-4.0°C by the end of this century.

A warmer atmosphere can contain more water vapour, so warming intensifies the global water cycle. This might effect precipitation considerably in some countries, such as Northern Europe that will receive much more rain while Southern Europe will increasingly suffer from droughts. In general we can expect rainfall and storms to become more frequent and more severe.

Warming will also cause the thawing of glaciers, ice sheets, sea ice, and snow cover, affecting for example Greenland's ice. This will lead to a rise in sea levels. The Alps and other mountain regions are particularly vulnerable due to the melting of snow and glaciers. As warming in the Alps is twice the world average, more precipitation will take the form of rain instead of snow and runoff patterns will change drastically. This will bring winter floods and summer droughts. Risks of erosion and landslides will increase. Impacts will also be felt further downstream. Major negative consequences will be felt not only in the tourism industry but also for the production of hydro-electricity.

Since 1998, Europe has suffered more than 100 major floods, causing extensive damage. We can all still remember the catastrophic floods along the Danube and the Elbe in the summer of 2002. We expect the intensity and frequency of such floods to increase considerably in the future. Meanwhile one third of Europe's population live within 50 km of a coast, and for many of them rising sea levels will start to cause real problems. Coastal zones will suffer from salt water intrusion. And other parts of the world will be even harder hit. Whole cities will be flooded. Islands will disappear.

Ironically, alongside the increased flooding and sea level rise, we in the European Union can expect severe water shortages, including in Southern and Eastern Europe. In Mediterranean river basins in particular, there is likely to be less water available, which will inevitably increase water stress. Each year since 1990 the average land area and population affected by droughts has doubled. Water scarcity is a problem that affects at least 14 Member States and around 100 million inhabitants in 26 river basin districts throughout Europe.

So it is clear that climate change will have a very significant impact on the water cycle. And this in turn will severely affect our soils and indeed all our ecosystems. It will have an enormous impact on biodiversity, particularly marine biodiversity. So it is important that any discussion of adaptation should focus on the European Water Dimension. The trends I have just described make it urgent to start taking action now on those problems that can be clearly identified. And on those issues where the picture is still uncertain, we need to prepare medium- and long-term plans which can be adjusted as the modelling exercises become more precise. These efforts need to be defined and agreed at European level since almost 80% of our river basin districts are international and the EU is bordered by marine waters on almost all sides.

As an example of adaptation, one of the central themes of the climate and energy package adopted by the Commission on 10 January is to tackle the energy problem by first making an effort to use our energy more efficiently. This will be put into effect by an impressive series of individual pieces of legislation, ranging from the reduction of CO2 emissions by cars, through the gradual de-carbonisation of the power sector including a strong push for 20% renewables by 2020, to the adoption of product and use specific legislation to increase the energy efficiency of the goods that we consume and the house in which we live. What we aim to do is to accomplish over the next

two years this Herculean task, similar to the completion of the internal market. In the same way, with water policy, one crucial way of adapting is to start by using the water still available more efficiently, before we turn our attention to other measures.

Fortunately, we are not starting from scratch. The EU already has some powerful instruments available on water policy, chief of which is the Water Framework Directive. This Directive provides for the management of water over whole river basins. This ensures the availability of good quality surface and ground water in sufficient quantities. Other Directives currently being negotiated are the Floods Directive and the Marine Strategy Directive. Once adopted, they will enable us to deal with pressures from climate change related to the marine environment and floods throughout the whole EU. We are also preparing our analysis and proposals on adaptation to the impacts of climate change, and we will present our ideas on water scarcity and droughts later this year.

2. We must adapt in an integrated way

Of course these water problems are not just a matter for environmentalists, nor only for water managers. They will have a direct impact on a whole range of sectors that use and depend on water. The obvious ones are agriculture, tourism, energy and inland navigation. These sectors therefore have to be fully involved in developing any adaptation strategies if they are to be successful. To simplify, the water managers in the Member States influence the conditions of supply; the other sectors represent the demand side of the equation. So we need a common and integrated approach to provide solutions that combine supply and demand management. All economic sectors must participate.

It is essential to improve both water demand and water supply management. And here again all sectors must be involved. Given that water resources will inevitably become scarcer as a result of climate change –in many parts of Europe – water must be used more efficiently by all the sectors concerned. This scarcity should be reflected in water pricing policies for all users, as required under the Water Framework Directive. But we need to take further steps towards improving water efficiency as we have done for energy. We should consider introducing the 'user pays principle' for the use of water, regardless of whether the water is taken from.

3. We need to take action at EU level

To face all these challenges, there are some specific steps we need to take at EU level. One tool that could prove very useful is the water basin management plans that Member States are required to prepare under the Water Framework Directive. The incorporation of climate change measures should be made obligatory for the second cycle of reports in 2015. But already in their first plans for 2009 Member States should take climate change into account, so as to avoid adopting measures which later become less effective as climate change impacts increase. Moreover, the costs will be lower if we take action now, in stead of in 5 years.

Here again, as I said before, it is important to involve other policy areas too. We should not only look at the environment, and adapt our water policy accordingly. It is very much up to other sectors like agriculture, energy, transport and tourism to adapt their own operations to use water in the best possible way, taking into account regional characteristics.

I have already mentioned the idea of applying a 'user pays' principle to water. Introducing this principle at EU level would establish a level playing-field and make water users across Europe, including all parts of transboundary river basins, think twice about how they use this precious resource. It would also put a stop to needless losses or waste, ensuring that water remains available for essential uses. In other words, it would encourage the efficient use of water.

There is huge potential for water savings throughout the EU and we shall be making a careful assessment of this potential in the coming months. It is already clear that significant amounts of water could be saved for public water supplies.

Apart from the public water supply, it is clear that all economic sectors can save water. In agriculture, it

seems logical to adapt production to the amount of water available locally. Farmers should be encouraged to select crops that consume less water, especially in river basins where water is scarce. One way of helping to achieve this would be to remove incentives for irrigated crops.

The EU's structural and rural development funds also have a big role to play in supporting adaptation measures on the ground.

In order to adapt to this changing future, we need to act now. Early and ambitious action is the best option if we are to keep costs low. In a few months, the Commission will present its initial ideas on what action should be taken now. Just one final thought. Nearly all that I have said has been very “Euro-centric”, and I have little if any doubt that we will succeed, together, in the enormous task ahead of us, although we will certainly not be able to neutralise all effects of climate change, far from it. There is a much bigger problem out there, in the developing world, where climate change will uproot tens of millions of people who will have to move to another location, perhaps to another country, and/or make the production and supply of food even more precarious, especially in Africa. And this in circumstances infinitely more difficult that those that we will be facing here in Europe. This will require a huge effort of organisation and solidarity for which the “international community” is simply not geared up.

I would like to finish by reacting to the suggestion made by Minister Gabriel. Yes - we will indeed take account of the ideas put forward during this Conference and its conclusions when we prepare our Paper.

I am very pleased that the German Presidency has organised this Conference, the timing of which could hardly be better. My colleagues and I will listen carefully to the ideas and solutions that we hope you will present in your working sessions.

Thank you.

SCIENTIFIC BACKGROUND

In the following, the scientific evidence on climate change impacts on water resources in Europe and the resulting challenges for European societies are briefly presented. The text is based on the discussion papers that were drafted in preparation of the Symposium, and on the presentations given on the subject during the conference. Speeches were given by a number of high-level experts: Nigel Arnell, University of Southampton; Daniela Jacob, Max Planck Institute for Meteorology Hamburg; Pavel Kabat, Wageningen University; Axel Bronstert, University of Potsdam; Annette Menzel, Technical University Munich; Elisabeth Lipiatou, European Commission Directorate-General Research; and Jacqueline McGlade, European Environment Agency. The session was chaired by Wolfram Mauser, Ludwig-Maximilians-Universität Munich. The presentations are available for download at the conference website (http://www.climate-water-adaptation-berlin2007.org).

The global mean surface temperature has been continually increasing over the past decades, and most scientists agree that we are witnessing a change in the global climate largely caused by anthropogenic emissions of greenhouse gases. Though single events, like the summer 2003 heatwave or hurricane Katrina, cannot serve as evidences for such a global phenomenon like climate change, they belong to a range of extreme weather events, which are expected to occur more frequently in a warmer climate. Due to the complexity of the earth system and the manifold processes influenced by the climate, multiple impacts along different causal chains are to be expected.

The evolution of the global emissions will significantly influence the magnitude of future climate change. Therefore in order to mitigate climate change and to prevent disastrous impacts, the reduction of greenhouse gas emissions should be the primary political goal. In this context, the EU’s objective is to limit global temperature rise to 2°C above pre-industrial levels (European Commission 2005).

However, efforts are also necessary to cope with the changes in climate and associated impacts on water resources that are already happening or that are unavoidable even if emissions are stabilised now. Adaptation to climate change effects is gaining relevance on the European political agenda.

Elisabeth Lipiatou

What has been observed?

Temperature and precipitation are the most important climatic drivers for the water cycle and changes in these parameters are expected to have considerable impacts.

During the last century, temperature has shown a relatively uniform increasing trend of 0.8-0.95°C over Europe (EEA, 2004). In winter, this warming trend has been accompanied by an increase in the number of both warm and cold spell days.

Axel Bronstert

More heterogeneous than the trends in temperature that the observed higher temperatures stimulate the global hydrological cycle (more evapotranspiration leads to more water vapour in the atmosphere and to more precipitation), but regional trends are different as precipitation depends on regional circulation patterns and local orography. So, mean annual precipitation increased in Northern Europe by 10-40% while it decreased in some areas of Central Europe and the Mediterranean region by up to 20% (Klein Tank et al., 2002). Changes in seasonal precipitation patterns were also quite pronounced (see Figure 1). Some of the resulting impacts on the hydrological cycle are already being observed: more extreme precipitation events are recorded; Central Europe, the United Kingdom and Southern Scandinavia have reported prolonged drought periods in summer; Southern Europe experienced extended winter droughts and river discharge has consequently decreased in many catchments; ten out of twelve European glacier regions are currently melting; sea levels in the North Sea and Baltic Sea have been rising over the last century.

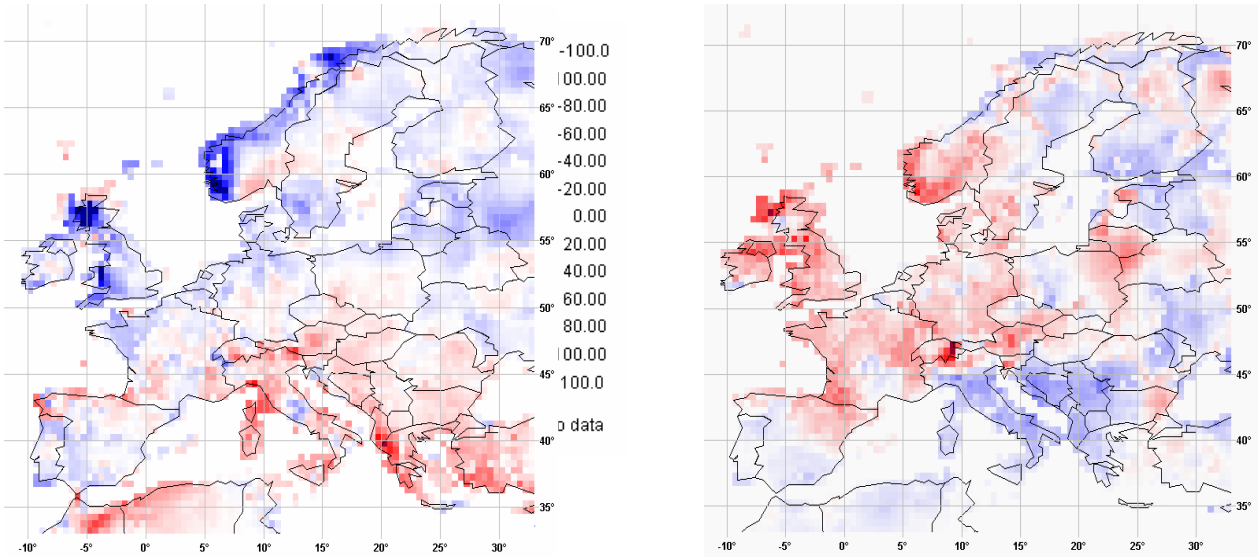


Figure 1: The observed trend in precipitation over the last century (difference mean annual values 1975/2004 and 1931/1960) for a) winter and b) summer season (seasonal sums in mm). Source: PIK Global Climate Dataset, 2007.

What are the projections for the future?

Despite uncertainties about the degree of the projected changes, there is general scientific agreement that the observed trends of a changing climate are going to continue and are likely to accelerate in some regions. Dependent on future greenhouse gas emissions, projections for the year 2100 anticipate the European mean temperature to rise by 1.0-5.5°C (IPCC, 2007). The range is due to differences in emission scenarios and uncertainties associated with the climate models. In winter, this warming trend is expected to be greater over Eastern Europe, in summer over the western and southern European countries (Georgi et al., 2004). In Northern Europe, winter warming is projected to be larger than in summer, with the reverse trend expected for Southern and Central Europe (Räisänen et al., 2004). Cold winters, which occurred on average once every 10 years in the period from 1961 to 1990, are likely to become rare in Europe and will almost entirely disappear by 2080. In contrast, by 2080 nearly every summer in many parts of Europe is projected to be hotter than the 10% hottest summers in the current climate (EEA, 2004).

Due to the complexity and various interacting factors in climatic processes, the impacts of climate change on precipitation and water resources will most probably show contrasting and site specific trends in different European regions.

Pavel Kabat

Wolfram Mauser

In **Northern Europe** mean annual and winter precipitation is anticipated to increase, with the latter reaching values of up to 15-30% by the end of the century (Georgi et al., 2004). As a general trend demonstrated by many modelling studies, runoff in higher-latitude areas will most likely increase in winter and decrease in spring due to the fact that less

precipitation will fall as snow in winter and less snow melting will occur in spring. Annual runoff is expected to rise corresponding to increased precipitation, up to 10% by the 2050s and 50% by the 2080s. This would have beneficial effects on water availability and hydropower, but may be accompanied by higher risks of floods. In North-Eastern Europe, for example, the magnitude of 100-year flood discharges might rise by more than 25% by the 2080s (EEA, 2005).

In **Southern Europe**, precipitation might experience pronounced reductions of up to 70% by the end of the century (Räisänen et al., 2004), but the occurrence of flash floods is still expected to rise. According to the projected drying trend for the Mediterranean, water availability is anticipated to decrease. In south-eastern Europe, summer flows could be reduced by up to 50% by the 2050s (EEA, 2005). Water stress is thus projected to rise, particularly in southern France and Italy, Spain, Portugal, and Greece. By 2080, 14-38% of the population in the Mediterranean could be living in areas experiencing increased water stress (Schröter et al., 2005; Arnell, presentation at the conference).

Nigel Arnell

In **Central Europe**, large reductions in summer precipitation could occur by the end of the century, between 30 and 70%, depending on scenario (Georgi et al., 2004; Räisänen et al., 2004). In winter, precipitation and the risk of snow-melt floods are anticipated to increase. Overall, a reduction in annual flows is expected.

In **Western Europe**, winter precipitation is projected to increase between 15 and 30% by the end of the century, while summer rainfall could decrease by 30 to 45% (Georgi et al., 2004). Western European countries might thus experience regularly occurring dry periods in the future, and the longest dry-spells could increase up to 50% by the 2080s (Good et al., 2006). However, the projected impacts comprise inherent uncertainties, which result from differences in climate models as well as unknown future development paths. Despite these uncertainties some trends are very clear: higher temperatures will alter snow melt dynamics and thus change the timing of maximum discharge. This will lead to **reduced water availability during spring and summer** in snow and glacier fed river systems across Europe. Large parts of Europe will experience significant summer drying and an **increased risk of droughts**. Rising temperatures will cause an intensification of the hydrological cycle, and in most European regions model simulations project an **increase in the frequency and intensity of extreme precipitation and flood risk**. The flood frequency and magnitude will most probably increase in the regions experiencing increase in precipitation, while drought frequency will be higher in regions with reduction in precipitation. According to the latest assessments, some river basins in Europe may experience an increase in frequency of both floods and droughts (Jacob, presentation at the conference),

though uncertainties remain high. In coastal regions, flood risk would be further intensified by the anticipated **rise in sea level**, which could reach 10 to 70 cm by 2050. These developments have the potential to negatively impact on water quality and to disrupt water supplies.

Daniela Jacob

What are the expected impacts on water-related sectors?

Since most human activities rely on water supply, many of the key sectors of the European economies are sensitive to changes in the availability of water resources and extreme events. This sensitivity varies widely between and within the sectors.

Water resources management and water supply and sanitation services. Although the impacts of climate change on water resources vary strongly between European regions, three main challenges to the management of water resources can be identified: (a) an increase of flood risk in river basins and along coastal zones, (b) a decrease in water availability during summer season, and (c) a deterioration of water quality. Ensuring efficient flood protection and preventing loss of lives and damage to assets in flood prone areas along rivers and coasts may become a serious challenge in many European regions. The increase in intensity and frequency of extreme precipitation events is likely to put sewerage networks under additional pressure, and the current hydraulic capacity of the networks will be exceeded more often. Water management under drought conditions in Southern and Central Europe will have to respond to additional challenges under a warmer and drier climate. Water supply services will be faced by the challenge to satisfy consumer demand during periods of intensified water shortages. Excess water can also have a negative impact on water quality by increasing pollution load from diffuse sources in high water periods. Reduced water levels, on the other hand, mean that pollutants from point sources will become less diluted. In combination with increased water temperatures and reduced dissolved oxygen levels, this could seriously affect the ecological balance of freshwater systems.

Agriculture. Water shortages, which are amongst the main problems expected in a changing climate, would have a significant impact on the agricultural sector. In Central Europe, the projected shifts in precipitation patterns would notably reduce water availability during the vegetation period in summer and possibly increase the demand for irrigation water. Rising temperatures and evaporation rates would aggravate the situation in Southern Europe further, where the dependency on water for irrigation is high and water resources are already scarce.

The consequences for farmers could be critical, starting with higher costs for irrigation, and potentially leading to production losses or the complete loss of land due to desertification. Higher precipitation (in northern latitudes), on the other hand, is initially perceived as a lesser problem or even an advantage for agriculture. The largest risk for crops associated with higher precipitation will probably lie in the anticipated increase in the frequency and intensity of floods in flood-prone agricultural areas.

Electricity. In some areas (Scandinavia and Northern Russia), hydropower may benefit from increased hydropower potential, while in others (Southern and Central Europe) this potential will decrease due to reduced river runoff. In areas with increased precipitation and runoff, dam safety may become a problem due to more frequent and intensive flooding events. The generation of electric power in thermal power stations often relies on large volumes of water for cooling. Therefore electricity generation in thermal

power plants may be affected by increases in water temperature and water scarcity. The discharge of cooling water may be restricted if limit values for temperature are exceeded, which may force plant operators to work at reduced capacity or even temporarily close plants, with potentially serious consequences for energy supply. In regions with increasing water scarcity, the use of water for cooling may generally conflict with other water uses. Climate-induced changes in water resources may affect biofuel production (similar to agricultural crops) in different ways. In some regions (like Northern Europe) increased precipitation, higher temperatures and higher atmospheric CO2-concentrations might be beneficial for biomass production. In others, biomass cultivation may suffer both from water scarcity and drought or from flood damage to harvests. Intense precipitation events, increased flood risk, and sea level rise may increase the risk of infrastructure (generation and supply) damage. In some Member States (e.g. United Kingdom and Finland), nuclear power plants, nuclear fuel reprocessing or nuclear waste sites are located near the coast, which could lead to security problems as a consequence of sea level rise. Furthermore, energy supply infrastructure, in particular transmission grids, might be endangered and damaged by flooding events and avalanches. In addition, transmission networks may be affected by melting of permafrost soils.

Inland waterway transport (IWT) is sensitive to extremes in river flow. In particular, low water levels reduce loading capacity and affect transport prices. This problem may be exacerbated by climate change impacts in the future. To a lesser extent, IWT may suffer from the projected increase in frequency of floods and storm surges, which could temporarily disrupt transport. In some instances, IWT might also benefit from climate change, e.g. when higher temperatures and reduced ice cover on rivers in winter could improve navigation conditions in some regions. However in general the increased variability in climate conditions is likely to lead to more unstable navigability conditions on European waters and to increased costs of routine infrastructure maintenance (e.g. dredging) and renewal.

Tourism. An increase in the frequency and intensity of heat waves, droughts and water shortages might negatively affect the attractiveness of southern European holiday destinations in summer. By contrast, northern European and Alpine regions might become more attractive for tourism during summer. In winter, on the other hand, these regions could lose appeal due to reduced or less-reliable snow cover and the resulting threat to winter sports. The longer-term impacts could thus lead to an alteration of tourist flows and a shifting of tourism seasons. In summer, the massive movement from northern Europe to the Mediterranean, which today is the largest tourism flow globally (UNWTO 2003), could slow down. Southern Europeans may also travel north to escape uncomfortable summer conditions at home. In winter, the north-to-south flow of tourists could become stronger than today. In coastal areas, which play a major role for tourism, sea-level rise will pose a major challenge, threatening some of the most important recreational areas such as beaches and islands.

What are the expected impacts on ecosystems and human health?

Terrestrial ecosystems and biodiversity. Climate change projections indicate on a further northward movement of many plant species, and extinction of a large number of species with narrow climate requirements and restricted adaptation capabilities.

Current plant biodiversity in the Mediterranean region might be substantially reduced by the end of 21st century (EEA, 2004), while some endemic species in Northern Europe and in mountainous areas may be replaced by other species (Sykes and Prenticee, 1996; Pauli et al., 2003). Plant biomass production in Scandinavia and Northern Russia will most probably benefit from higher temperatures, longer growing season, and almost no drought stress. However in Southern Europe the increase in drought frequency will most likely affect plant growth negatively. Water ecosystems (lakes and wetlands) in Southern and Central Europe may suffer from further eutrophication under warmer and drier climate, and might be lost due to lowering of water level. Coastal ecosystems may be lost due to coastal flooding and erosion, and salinisation of groundwater and estuaries is possible due to sea level rise (Menzel, presentation at the conference).

Annette Menzel

Human health. Major threats for human health under climate warming are heatwaves, flood events, and tick-borne diseases (EEA, 2004). Heatwaves are projected to become more frequent and more intense during the 21st century, and therefore the number of excess deaths due to heat will most likely increase. Climate change is likely to increase the risk of extreme flood events in Europe, in particular the frequency of flash floods, which have the highest risk of fatality (EEA, 2004). Fatal consequences caused by floods may be however reduced by adaptation measures, like improved information, warning and rescue measures. Climate warming will most probably increase the geographical habitat of ticks, with possible negative consequences on human health. However, the uncertainties in the trends remain high.

TOWARDS AN EU POLICY FRAME-WORK FOR ADAPTATION

During the Symposium, key EU activities relevant in the context of adaptation to climate change impacts in the water sector were presented. Presentations were given by David Grand Lawrence from the European Commission's Directorate General for environment, Manfred Grasserbauer, director of the European Commission's Joint Research Centre, and by Jacqueline McGlade, Executive dirctor of the European Environment Agengy. The session was chaired by André Weidenhaupt, Director of Luxembourg's Administration de la Gestion de l`Eau.

It was highlighted that some important tools are already available in the framework of the EU Water policy, for instance the Water Framework Directive (WFD), and others are under development (the Floods Directive and the Marine Strategy Directive). However there is still a need of better linking the climate change policy agenda with the development agenda of EU.

In the context of WFD climate change should be considered as one of the pressures. In the second river basin management plan, which is due in 2015, the measures related to climate change should be included. Some of the measures foreseen by the Directive, such as the requirements to establish water pricing policies by 2010 and to use water resources efficiently, could be helpful for adaptation to climate change.

Climate issues were taken into account in the development of the Marine Strategy. The achievement of a "good environmental status" of the EU marine environment could be helpful for coping with impacts of climate change.

The risk of floods will most probably increase under climate change. The forthcoming Directive on the assessment and management of floods requires flood risk management plans to be developed at the river basin scale and on the basis of flood risk mapping. The rationale of the proposal recognises that climate

change, together with inappropriate river management and construction in flood risk areas, might increase the scale and frequency of floods in he future. The Directive text itself also makes reference to climate change, stipulating that projected climate change should be taken into account in the assessment of future flood risk.

In July 2007 the European Commission launched a Green Paper on Adaptation to Climate Change, and a Communication on Water Scarcity and Droughts, which is based on a current assessment on the water scarcity problem, and addresses measures needed additionally to the existing policies. The available information indicates that there is a considerable potential for water savings in different sectors, which contribute to structural imbalances.

The Commission also recognises that further research is needed to improve understanding of the key drivers and their interactions with human activities.

Jacqueline McGlade

Manfred Grasserbauer

From left to right: André Weidenhaupt, Peter Gammeltoft, Jacqueline McGlade and Manfred Grasserbauer

REPORTS FROM THE WORKING GROUPS

The aim of this symposium was to identify the impacts of climate change on the management and utilisation of European water resources and to develop suitable adaptation strategies. Modern water management approaches such as integrated water resources management at river basin level (IWRM) or integrated coastal zone management (ICZM) seek to find a balance of the water needs of different users and to involve all relevant actors and stakeholders in decision-making about water allocation and management. The protection of water resources and the long-term sustainability of water use is in the interest of all stakeholders alike.

It is clear that adaptation to climate change impacts also requires an integrated approach. Water management alone will not be able to deliver full adaptation, and the success of adaptation efforts will depend on the contribution of other sectors. In addition to water resources management and water supply and sanitation services, four other key sectors were selected for the analysis and discussion during the symposium: agriculture, electricity, inland waterway transport and tourism. These sectors not only rely heavily on the availability of water resources in sufficient quantity and/or quality and are thus vulnerable to changes, but they also may deliver substantial contributions to adaptation efforts through innovations and management adjustment.

Discussions on the focus sectors were organised in five parallel working sessions which took place on the second day of the event:

Working Session A:	**Water Resources Management / Water Supply and Sanitation Services**
Working Session B:	**Agriculture**
Working Session C:	**Energy / Electricity**
Working Session D:	**Inland Waterway Transport**
Working Session E:	**Tourism**

The working sessions were at the core of the symposium, and their results provided a key input to the conclusions and key messages which form the main output of the event. Working session results were reported back to the plenary on the following day, and sectoral results were thus brought back together again under the roof of an integrated and cross-cutting perspective.

The following sections provide brief reports on each individual working group. Names of speakers, chairpersons and rapporteurs can be found in the programme on page 50. Further background material is available for download on the conference website, including the presentations that were given during the working sessions, and input papers for each sector that present challenges resulting from climate-driven changes in water resources, outline possible adaptation measures, and analyse relevant policy areas.

Working Session A: Water Management / Water Supply and Sanitation Services

Working Session A: Water Resources Management / Water Supply and Sanitation Services. From left to right: Joost Buntsma, Rapporteur Merylyn McKenzie Hedger, Moderator Karl Schwaiger, Pamela Taylor, David King, José Ramón Picotoste and Luis Veiga da Cunha

The working session discussed challenges for water management resulting from climate change impacts as well as adaptation responses and needs. It attracted a large number of participants from national and EU authorities, universities and research, environmental NGOs and business. A wide range of issues were discussed, including water resources management at river basin level, water supply and sanitation services, and flood risk management, and a large number of problems and possible solutions were touched upon.

Presentations

Several speakers reported on research activities and adaptation initiatives in their countries, regions or business sectors, and provided input to the discussion. The presentations illustrated clearly that climate change causes a variety of problems for the water sector depending on regions and circumstances, and that European societies are

beginning to develop different and flexible adaptation solutions.

While adaptation to changing circumstances has always been an integral part of water policy and water management in **The Netherlands**, climate change creates new challenges which require the integration of other sectors in adaptation efforts. A close connection exists between water management and spatial planning, with building development in low-lying flood-prone areas being a major issue. Among other measures related to water and flood risk management, the Netherlands are currently implementing the innovative "Room for the River" concept. It is recognised that the former policy approach of rising dykes continuously higher will no longer be viable in the face of climate change. Instead, river cross sections are widened by situating the dikes further away from the river, or by lowering the river forelands, which leads to lower flood levels. The projects are funded through a regional general property tax. Compensation is paid to land and property owners affected by the measures.

In **Saxony (Germany)**, multifunctional dams with adaptive management are used as a tool to meet the climate impact challenges and to deal with increasing variability in hydrological processes. The presentation emphasised that the concept provides for increased flexibility, allows to react to different threats such as flood and drought, and may be integrated into larger schemes of integrated river basin management. It can also help to integrate upstream and downstream interests. While the focus is on flexible management of existing dam structures, Saxony is also implementing additional measures including changes in reservoir capacity and the planning and construction of new flood protection reservoirs. All information about the measures taken is made available to the public on the web site of Saxony's Environment Ministry, and plans are developed in discussion with all affected stakeholders and with up- and downstream residents.

In **Portugal**, extensive research has been carried out on regional climate change impacts (Climate Change in Portugal: Scenarios, Impacts and Adaptation Measures – SIAM an II[3]). The policy framework for adaptation supports a wide range of measures, from increased storage capacity and water transfers to the harvesting of dew and fog in Madeira and the Azores, to economic instruments to reduce water consumption, the reduction of leakage in supply systems, and water reuse and recycling technologies. In flood risk management, different instruments are envisaged as well: a reinforcement of defence structures as well as the displacement of people and facilities from high risk areas, and improved monitoring and insurance.

The **Spanish national climate change adaptation plan** provides a general framework for all activities related to the assessment of climate change impacts, vulnerability and adaptation. The ECCE project[4] (Preliminary Assessment of the Impacts in Spain due to the Effect of Climate Change), which was promoted by the Spanish Climate Change Bureau, delivered the information basis. Priority issues for the first phase of the adaptation plan will be the generation of regional climate scenarios, with a particular focus on the impact of climate change on water resources and coastal areas. Stakeholder participation is a key element of the programme.

Special action plans for drought reflect the high relevance of drought problems for Spain.

In **England and Wales**, by contrast to the usual perception, water resources are relatively scarce in certain regions, in particular during the summer months. Recent drought periods have highlighted this situation and increased awareness of other pressures on water resources, such as rising demand and per capita water consumption. Improving water use efficiency is one of the main challenges for water management in the United Kingdom, which will require the universal introduction of metering as a prerequisite for fair pricing and for better communication between water companies and their customers. Changes in building regulations may also be necessary, and innovative approaches such as water neutral development (post-development water demand of settlements does not exceed pre-development water demand) are being considered.

Both water supply and wastewater services will be affected by climate change, from infrastructure to operations to demand to finances. It is clear that the sector will no longer be able to rely on the patterns of the past, which constitutes a particular challenge for planning and investment of water and wastewater services. Adaptation will require changes in behaviour, lifestyle and priorities of individual consumers, discussions and decisions about how charges and taxation schemes should be designed, more efficient water use, and better communication between water companies and consumers. Potential trade-offs between climate change mitigation and adaptation approaches need to be considered – a higher level of treatment for instance increases energy use and greenhouse gas emissions.

Discussion results

Group discussions during the session emphasised the following key elements of adaptation:

- **Integrated solutions – they are easy to call for, hard to achieve, but essential for success!** Cross-cutting programmes and policies are beginning to be created in top-down and bottom-up approaches, but gaps remain, e.g. with regard to agriculture and food, the water-and-energy interface, and spatial planning. Involvement of stakeholders and affected citizens is key and requires the availability of full information to all, and an institutional setting that supports participation in the policy process. The environment must be a key element of integrated solutions: adaptation should not rely solely on technology, but take into account environmental concerns and ecological processes and dynamics. The information basis has to be improved, for instance through modelling of impacts on assets at regional scale, sharing of research and best practice, and the development of probabilistic climate models for more robust decision-making. Scientists and practitioners need to work together to figure out how best to adopt research results and apply them in adaptation activities.

- **Improving water efficiency is key - it will buy time as we progress in understanding impacts and planning adaptation.** There are multiple ways to improve efficiency, and measures can be taken across sectors and by all actors. Initiatives on water saving and recycling, possibly promoted at EU level, will help, as will reduced leakage in supply system and reduced water use, more efficient appliances and standards for housing development. Changes in behaviour will be required and can be supported through the introduction of metering and adequate pricing of water.

- **Developing effective and fair market mechanisms to recover the costs of adaptation is a great challenge**. The question “who pays for which services and through which instruments” was debated intensely. Different taxation, insurance, charging, abstraction licensing, property rights and trading schemes in the different countries were referred to, and a need was expressed to clarify financial relationships. Water poverty needs to be avoided, and

affordability of water and socially acceptable pricing were recognised as important issues. Agricultural water use needs to be a key element of cost assessments, and incentives need to be created for agriculture to save water and improve efficiency.

- **Current EU policy provides tools for adaptation.** The EU Water Framework Directive (WFD) provides a powerful core policy for adaptation. However, the implementation timetable (finalisation of the first River Basin Management Plans - RBMPs in 2008) limits the scope for introducing adaptation into the first policy cycle. However, it should be ensured that there is enough flexibility in the plans to react to climate change impacts, and that no measures are taken now that will not be compatible with future climate change impacts and adaptation needs. Climate change impacts and adaptation concerns should be fully included in the second RBMPs. Discussants also called for an inclusion of climate change assessments in all actions under the proposed Flood Risk Management Directive. EU level leadership on adaptation is needed, for instance through the European Climate Change Programme (ECCP II), to ensure integration between departments and policy areas. Ideas for action included regulatory assessments of all Directives for climate change and water impacts, or extending the cross compliance principle to ensure compatibility of all measures with adaptation needs.

Working Session B: Agriculture

Working Session B: Agriculture. From left to right: Horst Gömann, Rapporteur Jørgen E. Olesen, Ana Iglesias, Moderator Marco Bindi and Bernard Seguin

Aim of the working session B was to discuss climate change impacts on the agricultural sector and possible adaptation strategies to overcome problematic developments. About 40 scientists and experts participated in the session, representing a broad cross-section of different EU member states (Scandinavia, Central Europe, the Mediterranean, the new East European member states and West Europe).

The draft conclusions of the session were that agriculture has a high potential for adaptation to climate change by e.g. diversification and adjusted management schemes as shifts to new crops and shifts in cropping seasons. Agricultural water use has to be optimised especially in Central and Southern European water-scarce regions. Northern regions will face an increase in nutrient losses and erosion due to increased precipitation with negative impacts as euthrophication of aquatic ecosystems. These impacts can be tackled by regional planning, landscape design and farming techniques. Agriculture can - through adapted land use management and changing to less water demanding crops - contribute to securing water resources (i.a. increase of ground water recharge), protecting water resources (less nutrient loss) and to improving flood management. Planning for adaptation in agriculture should also

consider effects on mitigation (appropriate production of bio-fuels, carbon sequestration) and vice versa.

There is certainly scope for improving the adaptive capacity of European agricultural systems through the funding schemes provided by the common agricultural policy (CAP) of the EU. Adaptive capacity might benefit from realising full de-coupling of payments. Rural development provided under the second pillar of the CAP can be used to directly support measures aimed at adaptation, as the development of new products, processes and technologies that are more adaptive, or measures on education and advice.

Presentations

Aim of the presentations was to give background information about research activities and adaptation initiatives in a variety of European regions, including examples from Spain, France, Scandinavia and Germany, and thereby to stimulate the discussion during the second part of the session. The presentations illustrated that the impacts caused by climate change differ especially from North Europe, where the climate scenarios show an increase of precipitation, to the South and Mediterranean, where the precipitation is expected to decrease. Following these differences also the adaptation strategies will differ, and it was discussed how this can be supported by the EU funding systems.

The first presentation (Bernard Seguin, France National Institute for Agricultural Science) discussed especially the problem of water scarcity and droughts,which can occur not only in Southern Europe, but also in many other parts of Central and Northern Europe, because of the general decrease of summer precipitation and increase of temperature stimulating evapotranspiration. It was further discussed whether irrigation can solve the problem of droughts, but it was stated that only limited areas are suitable for irrigation, and that under a decrease of water supply agricultural water demand will compete with water demand for other sectors. Other possibilities to stabilize crop yields would be to breed crop varieties which are more tolerant to water stress, to adapt the vegetation period and to switch to other crops, and here especially to C4 plants like maize, which have different assimilation strategies. This should be supported by adapted land use and water management (e.g. extensification) and policy making.

The second presentation (Ana Iglesias, University of Madrid) reported about climate change impacts on agriculture and possible adaptation strategies with a focus on agriculture in the Mediterranean. It was pointed out that climate change is only one stress among many affecting agriculture, and that the effects of climate change depend also on the social system established in a region or country. Results of the EU funded PESETA project were given, showing that the adaptive capacity of African countries of the Mediterranean is much lower than the ones of European countries. Crop yield simulations for Europe illustrated that the decrease of crop yields in South Europe will be, pending on the scenario, up to -30 %, while North Europe will under scenario conditions experience an increase of crop yields up to 30 %. Solutions to overcome negative effects are awareness rising, cultural change, cooperation, improved land and water management and improvements in water infrastructure and technology. However, the adaptation needs will demand for policy assistance.

The third presentation (Horst Gömann, German Federal Agricultural Research Centre) focused on agriculture in Central Europe. It was pointed out that climate change is not only for agriculture a challenge, but also for up- and downstream sectors. Results of the German project GLOWA illustrated that agriculture in Central Europe has the potential to cope with climate change and can even benefit, however, regional differences are important and may lead to situations where local farmers will suffer significantly. To support adaptation, support and contributions from political decision makers on all institutional levels are needed. A major challenge is still extreme events and their impacts on crop yields and also livestock. The added value of this presentation was clearly the insight into agro-economical developments and how they can influence farming and also land use pattern in Central Europe, taking the German "Renewable Energy Act" (e.g. bio-fuel production) and the liberalization of the European milk market as prominent examples.

The fourth presentation (Jørgen E. Olesen, Aarhus University) reported about responses of cropping systems to changes in water availability in Northern Europe, and made a strong link from climate change to water quality. Although there are possible increases in crop yields because of increasing precipitation under climate change, the increase of precipitation has also an impact on nitrate wash out, which would increase, and more intense rainfall can result in more erosion and phosphorous transport with surface runoff. This all would impact on the water quality of the Baltic Ocean, and adaptation of land use in the Baltic region has to counteract increased runoff. Therefore, designing landscapes to reduce nutrient losses becomes an important issue in Denmark.

Discussion results and conclusions

The discussion during the session was very lively and resulted in the following conclusions:

- **Impacts and vulnerability**: There are clearly different responses in South (lack of water) and North (lack in summer – excess in winter) Europe. Central Europe may be particularly affected through increased climatic variability (e.g. summer droughts). Benefits of climate change include longer vegetation period (North) and possible change in vegetation period (South). The timeframe of changes in vulnerability depends on whether change in mean conditions or change in variability is considered. An increasing pressure on irrigation systems and water supply in South (in particular in intensively irrigated regions) can be expected. Increased nutrient losses in the North can lead to negative effects on aquatic ecosystems (in particular near lakes or brackish waters), and an increased activity of pests and diseases (Central and North) might lead to an increase in the use of pesticides.

- **Adaptation options**: Adaptation can take place at different levels: Options at farm management level are e.g. to adjust cultivation intensity, crop hoice, sowing date, insurance and measures to reduce nutrient losses to aquatic environments. At water management level, possible adaptation measures are pricing of water, landscape (wetland, riparian land) management, land use planning and timing of water availability for irrigation to save water for later use (because of climatic variability). At national and EU level, possible options might be implementation and enforcement of regulations (Water Framework Directive) and changing subsidies related to irrigated crops. Technicological measures might be water conservation (e.g. mulching, conservation tillage), improved irrigation efficiencies (e.g. night time irrigation), improved varieties and cleaning of dirty/saline water. Education and advice is needed to ensure efficient adaptation at farm and regional scales.

- **Policy action**: Adjustment is needed of the CAP to include climate change aspects, in particular in relation to water use and protection of aquatic environment. Resource (e.g. water framework directive) policies and environmental (e.g.

biodiversity) policies need to be fully implemented including climate change aspects. Adjustment of policies has to account for regional differences in response to climate change. There is a need to better understand interactions among climate change and adaptation at various levels in society, which will determine policy efficiency and consistency, and a need to integrate also policies for developing countries.

- **Integrated approach**: Agriculture and land use planning have to be integrated to save and protect water resources and provide flood protection. Nature conservation issues should be integrated in agricultural land use management (amount and quality of water in aquatic ecosystems).

- **Conflict resolution**: There are landscape scale conflicts, e.g. related to management of excess water from urban/built areas, conflicts between objectives of individual farmers and objectives of the society, with other human use of water (e.g. navigation, tourism, cooling of power plants), conflicts considering relations with mitigation options (e.g. biofuel production) and enhancement of waste water reuse, e.g. for irrigation purposes.

- Possible ways to avoid problems are to improve awareness of possible conflicts and to introduce decision structures involving all stakeholders and market based instruments. This includes reform of water rights and water charges appropriate for different users of water, in order to promote efficiency of water use.

- **Economic instruments**: One important economic instrument would be to distribute costs according to amount of water consumed. Costs for protecting aquatic systems against pollution should be covered by the polluter. Another measure would be to redirect some of the CAP support (e.g. agro-environmental schemes) towards supporting implementation of increased water use efficiency in agriculture and for protecting aquatic ecosystems.

- **Funding**: Further reform of the CAP and redirection of funding towards supporting higher water use efficiency and protection of water resources and aquatic environments is crucial. The use of EU and national research and innovation capacities towards developing technologies that increase water use efficiency and protect aquatic ecosystems should be improved. In addition, EU structural and cohesion funds may be used to support adaptation. Funding also needs to go into communication and awareness rising.

- **Avoiding social impacts**: Effects of climate change and water use interact with current trends of increased urbanisation and pressures in rural development. Reductions in agricultural productivity from climate change may be substituted by increases in other rural activities (diversification), e.g. tourism. Abandonment of agricultural land may be needed in some regions, and planning is needed for this to limit social impacts.

Research needs: Knowledge gaps exist with regard to impacts, vulnerability and adaptation options in agriculture. Examples are how the increasing CO2 concentration will affect the overall water use and water use efficiency of various crops under European growing conditions, and how will a change in climatic mean and variability affect the water use, crop yields and applicability of various adaptation options. Other open questions are about the possibilities of optimising water use by shifting cropping seasons, changing crops and adopting water conserving practices, and how adaptation options will affect environment and biodiversity. Not clarified is also whether current options for reducing environmental impacts on quality of aquatic systems will be efficient and sufficient under climate change. There is a need for regional studies because impacts and adaptations vary strongly within Europe, for example on how to integrate agriculture in land use planning to save and protect water resources.

Working Session C: Energy / Electricity

Working Session C: Electricity. From left to right: Otto Pirker, Sten Bergström, Sylvie Parey, Rapporteur Nils R. Saelthun and Moderator Michel Colombier

The session discussed the relevance of water-related climate change impacts for the electricity sector and possible approaches to adaptation. Delegates from industry and industry associations, research and academia, NGOs, and European, national and regional authorities participated in the session.

Presentations

Four presentations provided input to the discussions, highlighting impacts and adaptation options from different perspectives.

Climate change and hydropower. Two presentations addressed the impacts of climate change with a focus on hydropower. While hydropower as a renewable electricity source plays an important role for the mitigation of climate change, climate change may also have serious consequences for hydropower production. In the Nordic countries, hydropower plays an essential or even dominant role in electricity production (e.g. up to 100% in Norway depending on circumstances). In this region, hydropower may be one of the winners under a changing climate – hydropower capacity in particular in winter is projected to increase. In other regions, particularly in the south of Europe, hydropower production may become more restricted due to more frequent drought conditions. Adaptation measures thus have to be adjusted to the specific circumstances of individual regions. An important concern is dam safety. Given the devastating effects of a dam failure, there is some urgency to explore whether rules and evaluation patterns should be adapted to adequately ensure safety in the face of changing climatic conditions. However, it was underlined that the uncertainty resulting from impacts of climate change should be integrated in guidelines for dam-designs and respective calculations. It was suggested to use ensembles of models and scenarios for any risk evaluation and develop adaptation strategies accordingly. Nevertheless, more research and careful analysis is needed in this respect, and sufficient communication of research results to stakeholders needs to be ensured.

The industry's view. Electricity companies are concerned about climate change impacts and active in undertaking own research to assess the impacts and to develop adaptation measures. The presentations highlighted that assessments at company or plant level are very complex and need to consider a variety of climatic variables such as humidity, wind and cloudiness, but also the influence of upstream installations on temperature and runoff of rivers. Existing management tools of industry, such as heat wave management plans, may be helpful in the adaptation context. Uncertainties in model projections, in particular with respect to climate

change-related extreme weather events, are seen as a key barrier to adaptation. The presentations and the following discussion suggested that changes in the whole electricity supply systems, including the energy mix and transmission and distribution grids, might support adaptation. Long-distance transmission of electricity might be used to alleviate shortage problems in areas hit by extreme events. However, the transmission grids themselves are vulnerable to climate change impacts such as increased storm or flooding frequency, and would need to be increasingly protected. Changes in the energy mix and decentralisation of electricity systems were discussed as potential adaptation approaches.

Discussion results

Group discussions yielded the following key results:

- **Decision-making and planning under uncertainty is a key challenge for adaptation.** Uncertainty in water resources data (precipitation, runoff averages and extremes) has increased strongly with climate change. For instance, it is uncertain how and to what extent dam safety will be affected by climate change impacts. Increased safety margins could be an adaptation response and should be included in planning where reasonable. Climate change impacts will differ strongly between regions, and adaptation responses need to be adjusted to the specific circumstances.

- **Adaptation should not compromise mitigation**. For instance, the supply of cooling water to thermal power plants may be endangered during prolonged drought periods. Substituting water with air cooling could be an adaptive response, but might reduce the efficiency of production and thus run counter to mitigation efforts.

- **Integrated river basin management is the basis for adaptation**. The obvious approach to tackling problems associated with water use conflicts, water scarcity and water quality, the consequences of extreme events (floods and droughts) and ecological concerns is integrated river basin management.

- **Electricity demand and demand management.** Climate change will lead to shifting seasonal demand patterns for electricity in Europe, in particular due to an increase in demand for cooling in summer and a decrease for heating in winter. Most likely the overall electricity demand will increase, as will peak loads. Demand management is a central element of climate change mitigation strategies, and may also play a key role for adaptation in the electricity sector. There thus might be a important potentials for win-win solutions.

Identification of research needs

A number of knowledge gaps and research needs as well as needs for action were identified during the discussion:

- **Climate change scenarios** need to be improved in order to deliver better predictions and better quantification and understanding of uncertainty. Downscaling methods need to be further developed to improve model projections on extreme events.

- More research on climate change **impacts specifically on the sector** as well as on **specific adaptation options** is needed. Mechanisms that facilitate adaptation, including new methods for decision making and investments under uncertainty, and structural or institutional barriers to adaptation should be a focus of research.

- More information on the **vulnerability of the electricity production and transmission / distribution systems** is needed. The present vulnerability of electricity supply under extreme events such as storms, floods and droughts should be assessed, and innovative approaches to the design of future system with higher robustness and efficiency should be developed.

- Much might be gained by **making better use of existing research data** through improved dialogue between different sectors and actors. Joint research

ventures between research institutes and industry could effectively address critical issues and improve communication between researchers and decision makers.

- The **role of biomass in the future energy system and for adaptation** strategies has to be investigated. The potential for biomass production may increase under climate change. However, intensive biomass cultivation will among other things affect water resources. These complex interrelations urgently need to be assessed in more depth.

- It should be explored how **public participation** can be made a key element of adaptation strategies. Ways have to be found to integrate consumers in adaptation strategies and to ensure through information and communication that consumer behaviour contributes to sustainable adaptation solutions.

Working Session D: Inland Waterway Transport

Working Session D: Inland Water Transport. From left to right: Gunther Jaegers, Henk van Hoorn, Gabor Bálint, Rapporteur Bruno Schädler and Moderator Hans Moser

Generally, inland waterway transport (IWT) is characterised by a high degree of reliability and safety compared to other transport modes. However, the waterway infrastructure is to some extent shaped and influenced by nature, which makes it susceptible to changes in weather conditions and climate change impacts. In unregulated rivers or river sections, water level fluctuations already pose temporary challenges under current climatic conditions, since they complicate travel and draught planning and prevent a full utilisation of vessel capacity. In regulated waterways and canals, by contrast, management measures can be taken to ensure navigability, and constraints are only to be expected in extreme cases, for instance extended drought periods and low water flows. IWT is particularly sensitive to extremes in river flow.

This working session discussed potential impacts of climate change on IWT, technical opportunities to adapt to these impacts, and limits to adaptation. In the following, the presentations given during the session are briefly summarised, and the results of the discussion including suggestions for adaptation strategies are reported. The session was chaired by Hans Moser from the Federal Institute for Hydrology

in Germany, Bruno Schädler from the Swiss Federal Office for the Environment acted as rapporteur.

Presentations

Gábor Bálint from Vituki in Hungary gave the first presentation on "Low flows and navigation conditions - a Danube overview". He explained the current situation for the Danube river, and outlined the cumulative impacts of climate change. These impacts result in more frequent extreme events as well as in a decrease of the frequency and duration of ice cover periods. However, future trends regarding water flow are difficult to estimate, and additional research is needed to close these knowledge gaps. In the second part of his presentation Mr. Balint focused on the development and improvement of existing information services and their role in adaptation. He made it clear that a better co-operation and co-ordination between existing services (trans-national and trans-agency, inter-basin) and an increase in the lead-time of hydrological forecasts and hydro-meteorological warnings is essential to optimise inland waterway transport under changing conditions.

The second presentation by Henk van Hoorn from the Dutch Ministry for Transport, Public Works and Water management focused on inland navigation, climate change and possible adaptation measures for the Rhine basin. He outlined the consequences of low water flows, such as reduced load capacity, higher costs, a decrease in reliability of the transport mode, and an increase in waiting times at locks. He illustrated that these impacts became apparent during the dry summer periods in 2003 and 2005, and argued that a danger of modal shift might be the result if these problems were not tackled. He outlined several conceptual options for adaptation. A reduction of the greenhouse effect, i.e. climate change mitigation, should be the first priority. For adaptation, inland waterway transport might attempt to reduce its dependence on water depth, and/or to influence water depth. Improving the management of information could also help. For policy instruments, Mr van Hoorn suggested legislative and regulatory requirements as well as national policy guidelines.

Finally Gunther Jaegers from the European Barge Union presented opportunities for adaptation to climate change in inland waterway transport from an economical and technical point of view. He also demonstrated limitations in shipbuilding to adapt to low flow regimes. These limitations are a result of physical constraints (ship weight) and economic limitations under current circumstances (economic feasibility of shipping). Technical adaptation measures in shipbuilding, such as using new and lighter materials, are still in the development phase.

Discussion results

As a first result, the discussion yielded a common view on the impacts of climate change on IWT and on the general conditions for adaptation. Within several river basins, climate change is likely to cause longer periods with low water flow conditions and a higher variability of water levels. However, it is difficult to make detailed projections of these changes based on the currently available data, and further research is needed in order to better predict future flow conditions. The ice cover of rivers will be reduced in several cases, which might be beneficial for IWT in the winter season. Sustainable IWT can deliver valuable contributions to climate change *mitigation*. However, the discussion on *adaptation* in the IWT sector has just started and is still at a very early stage. The working group identified some elements and suggestions for further developing adaptation in IWT.

One of the first steps for the preparation of adaptation strategies is the identification of research needs (impacts, vulnerability and adaptation) and the promotion of research in order to reduce uncertainties. A comprehensive adaptation strategy might be developed based on current knowledge, but would need to be sufficiently flexible to react to new climate impacts projections and advanced scientific insights. "No-regret-policies" that will be viable under

the increasing variability of the hydrological regime should be given preference, and reversible measures should be considered in order to maintain flexibility.

Climate change and adaptation concerns might be introduced as one of the challenges for the future into IWT management and economic planning, for instance through the European NAIADES policy. Technical adaptation, such as the development and promotion of "adapted" ships, should be considered, but would need to be supported through research and development to ensure that they are economically feasible and environmentally friendly. Generally it needs to be ensured that adaptation in the IWT sector is in accordance with the requirements of the Water Framework Directive.

Improved communication within the sector and with other water-related sectors was seen as one important issue for the successful development, planning and implementation of adaptation strategies. River Commissions could play a key role for establishing and facilitating this dialogue.

Working Session E: Tourism

Working Session E: Tourism. From left to right: Moderator Gabor Vereczi, Tanja Cegnar, David Viner, Tamara Ratz and Rapporteur Wolfgang Seiler

Despite tourism's important economic role in providing more (especially rural) employment and a greater share of GDP than other sectors, interest in the particular impacts of climate change on this industry and the development of possible adaptation strategies has remained relatively low to date. Nevertheless, important consequences for various European regions can be expected and presentations in the working session explored the specific challenges for areas in coastal and alpine regions, Hungary and the United Kingdom. Below, these are presented first, together with results of ongoing research activities from the United Kingdom. The subsequent paragraphs summarise suggestions for adaptation strategies as given by the speakers, as raised during the ensuing discussions and as agreed in the final list of conclusions.

Impacts of climate change on tourism and current research results

For an overall overview, the impacts of climate change on tourism in coastal and Alpine regions were presented, underlining the dependence of the tourism sector on specific climatic and weather conditions, and how these could be threatened by climate change. Among the particular challenges mentioned

was the future availability of snow in mountain regions, the problem of heat waves for city tourists, and the impacts of sea level rise in coastal areas, as well as the threats resulting from droughts, flash floods and forest fires. The potential of climate change to propagate the spread of new diseases plus the strong dependence of tourism on natural resources, such as water, were further noted to add to the challenges faced by this sector.

Changes in temperature and precipitation could have a large impact on the tourism industry in Hungary. Holiday activities are mainly concentrated in the lake regions (such as Lake Balaton and Lake Tisza), thus creating a high dependence on climate and water dependent products ('sunshine and beach'). Although changes towards a more Mediterranean climate could potentially be beneficial, causing warmer summers and extending the length of the tourist season, negative impacts with respect to water quantity and quality could be particularly critical. At present, the level of awareness regarding climate change is relatively low. A further problem is the economic dependence on the seasonality of the tourism industry, coupled with a supply seasonality linked to holiday patterns. As a solution to the latter problem, the potential for re-scheduling school holidays to enable flexibility on the demand side, as happens to some extent in France, was discussed.

Case studies from the United Kingdom revealed a generally high level of awareness of climate change and the need to adapt. However, while research results showed that local business is aware of the future challenges, the low adaptive capacity of Small and Medium Enterprises (SMEs) was identified as a reason for inaction. Due to the lack of incentives from local authorities or the tourism board to implement adaptation responses, the government should instigate adaptation through regulation, information dissemination, infrastructure development etc. Further to these results, the Tourism Comfort Index (TCI) was discussed for its merits in indicating future tourist trends with available scenario information. Briefly, the TCI weighs various factors (temperature, wind, hours of sunshine etc) to determine a rough indicator which ranks tourism destinations in terms of 'comfort'. The TCI suggestions under current climate conditions reflect observed distributions of tourists across southern Europe away from low-scoring ("below-threshold") Northern Europe. When climate change scenarios are introduced into TCI maps, there is a resulting shift in tourist distribution northwards, as the extreme heat and other factors begin to produce "below-threshold" TCIs for Mediterranean regions (for example, from 2020 onwards). While the TCI has recognised short falls and produces crude results, its use in highlighting the consequences of climate impacts on tourism distribution was noted and generally accepted.

Discussion results and adaptation strategies

As a first step towards developing potential adaptation responses, the importance of perceptions by tourists should be noted. Tourists follow fashions and tend to concentrate in selected areas leading to significant stress on water and environmental resources in general. This can be influenced by providing proper information about water use and availability in destinations. Furthermore, only sustainable adaptation solutions should be considered. Current adaptation efforts in many ski resorts promote business as usual strategies, supporting unsustainable approaches such as artificial snow making, high mountain exploitation and glacier

preservation. Particularly problematic in this context are the allocations of government subsidies for such schemes.

A further important link that should be noted is the interaction between tourism and biodiversity. Whilst sensitive areas are attractive for development, they also constitute a tourism resource in their own right. Biodiversity regulation should thus be strengthened if ecosystems are to be preserved for tourism purposes.

The main outcomes of the discussion were the following:

- Improved water use efficiency should become one of the main priorities in the tourism sector. As tourism involves the exploitation of resources, the simultaneous preservation of those resources is essential. Efficient water use may be achieved by the introduction of water saving strategies and techniques, water recycling and tourist awareness. Eco-labels and the classification of different facilities as 'water-efficient' would further enable consumers to distinguish between operators and could thereby encourage water efficiency. Although water pricing was noted as a further incentive, tourism enterprises are unlikely to force caps on tourists' water use. To improve efficient water use within the tourism businesses and facilities, education schemes, staff training and Environmental Management Systems (EMS) may be introduced as further measures to increase awareness.

- A diversification of tourism activities could make the sector more resilient to changes in climatic conditions and in the use of water resources. The diversification of the tourism product should aim at developing alternative activities that are less dependent on water resources (in summer tourism), and on snow coverage (in winter tourism). In effect, this would mean more diversity on the seasonal scale, with operators starting to promote 'shoulder seasons', but also on the regional scale. Either, by supporting a change in the direction of tourist flows during the main seasons, or by diverting the attention from, for example, pure beach holidays to more hinterland activities. Such strategies should be supported by EU- as well as national policy actions.

- Improve the accessibility and use of climate information in the tourism sector, both for the consumer and the operator. The development of warning systems and information provision for tourists was suggested to help install confidence and therefore combat negative perceptions in drought-prone or high-risk areas. In addition, this would allow improving the preparedness for extreme events related to climate change and water (e.g. floods, storms, avalanches). Tourism operators, on the other hand, need seasonal forecast data to make decisions within their relatively short-term horizons. For this reason, access to the outcomes of water managers' climate impact research in understandable format (such as scarcity predictions, water quality data etc.) is essential. Especially, medium term climate projections, i.e. for the next 10-20 years, are needed for investment decisions in tourism infrastructure.

- Adaptation and integration efforts are needed at all levels. Governments need to implement sustainable planning strategies to avoid conflicts over water. Water adaptation issues should be incorporated into Environmental Impact Assessments of tourist infrastructures, taking account of the highly seasonal water demand generated by tourism. Climate change factors should be considered in national and local tourism policies, particularly in the context of transport infrastructure developments. While there is no need for establishing Tourism Ministries, integration is of paramount importance as climate impacts across sectors will both directly (reduced snow cover, water shortages etc) and indirectly (transport infrastructure, water quality, flooding etc) affect tourism. Policy responses should be particularly tailored to SMEs, because these make up the vast majority of tourism service providers. This is especially relevant for the promotion of EMS as vehicles for improving water standards (efficiency and management) in tourism enterprises.

- Outcomes of the discussion stressed that the tourism industry was a dynamic sector with short-term horizons, which has the potential to adapt and respond to climate and demographic changes. However, case studies from the different countries revealed stark differences in the level of awareness of tourism providers. While tourists will be able to adapt easily, using their knowledge to be more selective, low awareness levels of the tourism providers are seen as a barrier to adaptation.

DRAWING CONCLUSIONS

The working sessions were followed by several plenary sessions which aimed to place the results in a wider context and to extract the key messages and conclusions. Achim Steiner, Executive Director of the United Nations Environment Programme, gave a keynote speech, opening the perspective to developing countries. Terry Barker from Cambridge Econometrics reported on economic aspects of adapting to climate change, drawing on the results of the Stern report. The presentation of the working session results to the plenary was followed by a panel discussion, which was chaired by Alfred Thorwarth from the German Committee for Disaster Reduction. Members of the panel were Achim Steiner (UNEP), Mogens Peter Carl (European Commission), Astrid Klug (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany), Tony Long (WWF), Pedro Cunha Serra (Águas de Portugal), Daniela Jacob (Max Planck Institute for Meteorology), and Terry Barker (Cambridge Econometrics).

Statements by Fritz Holzwarth, German Water Director, and Peter Gammeltoft, Head of Water and Marine Unit of the European Commission's Directorate-General for Environment, concluded the plenary discussion. The Symposium ended with Concluding Remarks by Astrid Klug, Parliamentary State Secretary, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany.

Achim Steiner

Terry Barker

Tony Long

Pedro Cunha Serra

Panel discussion. From left to right: Pedro Cunha Serra, Tony Long, Peter Gammeltoft, Achim Steiner, Alfred Thorwarth and Astrid Klug

Astrid Klug, Parliamentary State Secretary, Federal Ministry for the Environment, Nature Conversation and Nuclear Safety, Germany

Ladies and Gentlemen,

The Symposium "Climate Change and the European Water Dimension" has come to an end. I know you've all worked hard since Monday and your efforts have been worthwhile.

The symposium is a real success. The conclusions and recommendations which have just been presented contain valuable input to the further development of adaptation strategies both at national and EU level. I congratulate you on this remarkable achievement.

At the end of such a symposium, it is always useful to ask two questions:

What have we learned that we can take home?

What impact will the symposium have?

Let me try to give some answers to both questions.

What have we learned? We have learned that the need for action is more urgent than ever before. The climate is changing and this will impact on the processes of the water cycle across the whole world with potentially disastrous effects, especially in developing countries, but also in European regions. It is time to adapt. Good professional water adaptation management is important and we need to work hard to improve it. But all our adaptation efforts will be wasted if we cannot keep global warming below the threshold of about 2 degrees Celsius and if we cannot limit the impacts to a manageable level. Therefore, we must keep the focus on reducing the emission of greenhouse gases.

Water is crucial for peace and sustainable development. There are too many disputes about water today, in almost all regions under water stress. I am not only thinking of disputes between countries and states, but also between communities, upstream and downstream, or even disputes within communities. And the impact of climate change on water has serious consequences for the environment and the human behaviour: When rivers and groundwater fall dry, when fields turn into desert, life for humans becomes difficult – if not impossible – and they have to move elsewhere.

All this we know, and yet, there is not enough dynamic progress toward the adaptation of the water sector to climate change for all uses and all users in the future. This symposium aimed to strengthen the political profile of this issue by providing a platform for representatives from governments, science and research, stakeholder groups and non-governmental organisations to discuss the likely impacts of climate change on water management and water dependent sectors, as well as options for adaptation.

Let me highlight some of the key messages which you have given priority:

- Sustainable water resources management provides the basis for successful adaptation, which needs a common and integrated approach, in particular in sectors which are strongly dependent on the availability of clean and sufficient water, such as agriculture, electricity production, inland navigation and tourism. Only a common and integrated approach will provide successful win-win solutions, and avoid negative cross-sectoral feedbacks of measures or non-action in one sector.

- Regarding water management the Water Framework Directive (WFD) provides a valuable framework for introducing climate change impacts into water resources management and water basin planning. Planning tools which are under development for implementing the WFD will become

very helpful for the planning of measures for adaptation.

- High potential for mitigation and adaptation to climate change is given by agriculture, which has to be optimised especially in water-scarce regions. There is certainly scope for improving the adaptive capacity of this sector through e. g. funding schemes provided by the common agricultural policy of the European Union.

- Currently Europe has started a broad discussion on the future of its energy sector. Decentralised approaches and a diverse energy mix are likely to be beneficial both in terms of adaptation and mitigation.

- Regarding inland waterway transport a more detailed assessment of the vulnerability to climate change is needed. To maintain flexibility, reversible measures should be given priority.

- In order to promote the implementation of sustainable development measures in the tourism sector, improved water efficiency should become one of the main priorities. A diversification of tourism activities could further help to make the sector more resilient to changes in climatic conditions and water resources availability.

- Now we have a better understanding of what it takes to develop the right strategies. We have learned more about the nature of adaptation in the water sector and the magnitude of the challenges ahead of us.

- However, further research activities are necessary to tackle adaptation properly. In this regard priority should be given to issues like better understanding how the water cycle and the aquatic ecosystems reacts to climate change at local and regional water basin scale, quantification of economies and social impacts of climate change in different water related sectors as well methodologies to develop and evaluate adaptation strategies.

- Responses to the impacts of climate variability and climate change need to involve actions at many different levels. International treaties, conventions and global accords are the foundation for concerted action to mitigate global warming. Regional agreements provide a basis for better management of international waters to prepare for and alleviate extreme events. Information sharing, regional climate and weather forecasting and modelling, monitoring and early warning systems, all help water managers to prepare coping strategies. But it is on the ground, in the individual water basins and communities that the vital coping actions have to be taken. The strong message going out to governments and disaster relief agencies is that locally planned, locally managed adaptation to changing climatic circumstances is practical, beneficial and cost effective.

Now let me turn to the other question: What impact will this symposium have? What are our next steps?

The political outreach of this conference can be remarkable. We had participants from 24 European countries, from EU institutions, from several international stakeholder and non-governmental organisations as well as from UN organisations. This shows the growing awareness for the issue and I trust in all of you that you will carry the conclusions and recommendations of this symposium to your specific field of responsibility and spread the message that we urgently need to come to real action.

Second: With the recommendations which you have developed we will hopefully get the attention in the public which has been lacking quite often for these issues. Politics needs pressure from the public. This is how democracy works, and this is why the recommendations for adaptation are an important outcome of this symposium.

What will the German Government do with the outcome of this symposium?

We will do our best to disseminate the outcome of this symposium and to feed it into the political process. The Executive Director of UNEP Achim Steiner and many others have underlined that the issue of the impact of climate change on the water sector has an

important place on the international agenda. We also count on all of you to ensure that the key messages and conclusions of this symposium are heard. The outcome of this meeting will be presented at the Environment Council next week. We will also work together with our colleagues from Portugal who will follow up on the issue with a particular focus on water scarcity and droughts during their presidency in the second half of 2007. I am also confident that the outcome of this symposium will be reflected in upcoming communications announced by the European Commission for this year. But while developing our own adaptation strategies in the European Union we should not forget about the urgent need to support the developing countries - which are even more seriously affected by impacts of climate change - in adapting to these impacts. This support can for example be provided through mainstreaming adaptation into assistance schemes for developing countries and through international programmes and activities aimed at developing and improving adaptation measures. These include monitoring and the prediction of climate change impacts on water and water uses risk management, access to climate change risks insurance markets, preparedness and disaster response, methods to avoid and combat further land degradation and the development of more resistant food crops. Such efforts are particularly important in cases where current resource conflicts might be increase by climate change impacts. We are therefore willing to feed our results as well into the 16th Commission on Sustainable Development in 2008, where water will again be high on the political agenda at the United Nations.

The German Government is proud to have hosted this symposium and we are very happy about the close co-operation with our co-convenor, the DG Environment. You have been hard-working, dedicated participants and wonderful guests, and it has been a pleasure to have you here in Berlin. In particular I want to thank my guests on the panel, some of whom came a long way. This is especially true for you, Mr. Steiner. Thank you so much for coming.

Many people contributed to the successful outcome. I cannot thank them all by name, but I would like to pay a special tribute to a few.

I want to say special thanks to all participants who have chaired meetings and given reports. You have done an excellent job, your input, especially from the working groups, was essential.

Thanks also go to the members of the Steering Committee and the Scientific Committee, which met several times during the last twelve months to advise us and have been of tremendous help.

Substantial factual input and organisational services for the symposium have been provided by Ecologic and the Potsdam Institute for Climate Change Impact

Research, and I want to thank the team for its work during the preparation and execution of the Symposium.

Lastly I want to thank the officials in my ministry who have guided the preparations and have supported the minister and myself throughout the symposium. And I promise that we will bring this outcome actively into the various processes on international and European level.

Thank you again for coming here and for your valuable contributions. I wish you all a good and safe journey home.

RECOMMENDATIONS

A It is time to adapt now! Scientific evidence urges action

1. Climate is changing! The scientific evidence conveys the clear message that this change will impact the water cycle and water resources in Europe and worldwide. An increase in the frequency and intensity of extreme events such as floods and droughts is expected as well as long-term shifts in regional water balance and water availability. Both may have disastrous consequences for European societies.

2. Changes in water resources will not only have significant adverse impacts on the drinking water supply and wastewater services in Europe, but also on other key economic activities such as agriculture, hydropower and other electricity production, tourism and navigation. These damaging effects will by far surpass minor benefits that may be experienced by individual regions or sectors.

3. Ecosystems and biodiversity are likely to suffer from climate-driven changes in hydrology. Ecosystem services play a key role for human and economic activities, and their long-term protection and preservation should be given priority.

4. Changes in climate will occur, even if climate protection measures are effectively implemented today. Although the magnitude and shape of climate change impacts on the water cycle and water resources cannot be predicted exactly, scientific evidence is sufficient to urge immediate action.

5. Therefore, while climate change mitigation should remain a priority for policy-making, there is also an urgent need to develop strategies for adaptation to the already inevitable climate-change-driven changes in water resources at all levels of policy-making – from the European to national to local levels. There is now consensus on this among the science and policy communities.

B Sustainable water resources management provides the basis for adaptation

6. Adaptation should be embedded in integrated water management approaches, which allow for a consideration of all environmental, economic and social aspects. Action is required at all levels – policy, implementation and operational.

7. Decision-making under uncertainty is a particular challenge. Water management and the implementation of water policy needs to be capable to respond to unexpected developments caused by climate change. Strategies for adaptation need to be developed and implemented in a flexible way, in order to take into account further progress of scientific knowledge. Special emphasis should be placed on “no-regret” and “win-win” measures that are effective and sustainable under different scenarios.

8. For adaptation it may be necessary to define priority water uses and to find appropriate ways to implement prioritisation. Choices may have to be made concerning the allocation of water resources, and criteria and indicators need to be developed on the basis of which such choices can be made.

9. The water sector (water supply and sanitation services) will have to work on combined supply and demand side measures. This could include legal, regulatory and contractual requirements that foster implementation and an equitable repartition of costs among users, providers and polluters.

10. Reducing vulnerability to extreme weather events is key for adaptation, and both disaster prevention and response measures need to be part of strategies and approaches. Appropriate risk assessment for building development is essential to avoid the accumulation of assets in high risk areas, for instance in floodplains and along the coast. Flexible water management systems that can react to both water scarcity and flood situations may be helpful instruments.

C A successful adaptation strategy needs a common and integrated approach

Water dependent sectors need to be involved

11. Successful adaptation strategies have to follow a common and integrated approach that covers measures in all water-related sectors, in particular, in sectors that are strongly depending on the availability of clean and/or sufficient water, such as water supply, agriculture, electricity production, inland navigation and tourism. Such an approach will provide successful win-win solutions and avoid negative cross-sectoral feed backs of measures or non-action in one sector. It also allows to include the preservation of aquatic and other water-dependent ecosystems, which is a prerequisite for developing effective adaptation strategies.

12. Water needs to be used more efficiently across all sectors. Measures to be taken include water-efficient irrigation techniques and water-saving appliances, reduced leakage in supply systems, and water recycling and rain water harvesting. Changes in behaviour will be required and can be supported through adequate water pricing.

13. At all policy levels, potential conflicts between sector policies and adaptation needs should be identified, and efforts should be made to make different policies consistent with each other and compatible with adaptation. As a consequence, adaptation to water-related climate change impacts is not just an issue for environment departments at all levels, but is also a challenge to other Directorates of the European Commission, national ministries, regional and local government departments. In particular, local and regional authorities will need more practical guidance on how to cope with the local and regional impacts of climate change on water. On the other hand, local authorities can provide valuable information on measures that have been implemented already and help to identify best practice examples.

Relevant policies and projects need to be climate-proof

14. Future investments in infrastructure must be climate-proof. Investment that appears to be cost-effective under current conditions may become economically and ecologically not viable when considering the climatic predictions and their impacts on water resources. Flexibility in approaches is key to account for these uncertainties.

15. Climate change impacts and adaptation measures should increasingly be integrated in the design of compensation, subsidies and incentives schemes, in order to ensure their long-term sustainability. This has to be considered in the future development of the Community's regional and cohesion policy.

Current EU water policy provides ample tools to start adapting to climate change

16. Existing policy instruments and processes, such as those under European water policies and national integrated water and coastal zone management strategies, can be used as a starting point but have to be developed further through strengthening integrated approaches on all levels of governance.

17. The Water Framework Directive (WFD), with its objective to prevent further deterioration and to protect and enhance the status of aquatic and related ecosystems, provides a valuable framework for introducing climate change impacts into water resources management and river basin planning, as well as for assessing changes in the conditions of other sectors and for co-ordinating possible adaptation activities with the needs of these sectors. Climate change impacts should be taken into account when assessing pressures and impacts on water resources. Measures to cope with these impacts should become part of the Programmes of Measures in a stepwise manner. As much as possible, the consideration of such impacts should be incorporated into the first planning cycle in 2009. At a minimum, a screening of the likely effects of climate change on the pressures identified in the article 5 analysis and of

the climate impact sensitivity of the Programmes of Measures is recommended. This will help selecting measures today that will be effective, sustainable and cost-efficient under changing conditions. In the second planning cycle, climate change impacts should be taken fully into account.

18. The forthcoming EU Flood Risk Management Directive will be a useful framework to take into account climate change effects in the assessment and management of flood risk. The foreseen six year review cycle of Flood Risk Management Plans gives the opportunity to adapt to improved information on climate change impacts.

19. Present action at the EU level on water scarcity and droughts, which aims at a common strategy, should be closely linked to activities on climate change impacts and adaptation. Climate change will enhance water scarcity problems with negative impacts on water quality and aquatic ecosystems. Protection and integrated sustainable management of water resources will thus be particularly important under water scarce conditions.

Mitigation and adaptation need to be aligned

20. Synergies with climate change mitigation measures should be created. This means avoiding negative impacts of mitigation activities on the resilience of water resources as well as negative feedbacks of adaptation measures on mitigation. For example, new policies promoting agricultural production to mitigate climate change like the Biomass Action Plan should be assessed and monitored with regard to their possible side-effects on water resources. This also applies to future development of hydropower and navigation policies.

Participation and contribution by all actors and stakeholders are necessary.

21. Stakeholders at all levels have to be engaged in the process. Businesses and industries will have to develop their capacities to adapt. Also, adaptation efforts by private individuals will have to be bolstered in a variety of ways. Improved information and awareness of long-term perspectives, the necessity to adapt, and potential measures for adaptation are prerequisites for creating support for adaptation and for reaching agreement between different stakeholders on adaptation strategies. Participative approaches are necessary to enable the equitable use of water between different stakeholders and between upstream and downstream users. In order to encourage changes in the behaviour of individuals and in order to ensure support for adaptation policy, it is vital to create a shared understanding of climate change impacts and adaptation through information, education and discussion processes.

More intensive co-operation and common action at EU level

22. At EU-level, an intensive exchange between Member States on their approaches in addressing adaptation to climate change impacts through water resources management should be facilitated, and a common process for developing appropriate guidance, tools and methodologies should be organised in the context of the existing mechanisms. EU-level activities should further concentrate on improving monitoring and assessment of climate change impacts on water resources in Europe, enhancing the data base and the forecasting capabilities concerning extreme events (floods and prolonged droughts) and on developing appropriate indicators to support decision making and communication.

23. All EU policy areas need to undergo an adaptation check. So far, not all EU policies contribute sufficiently to adaptation to climate change. In fact, some policies or their implementation may even be counterproductive. A “climate-proofing” should be carried out by 2009 for all relevant policy areas, including funding instruments, sector policies and environment policies. For new policy proposals, adaptation aspects should be incorporated in the impact assessment. This will also contribute to a better, more effective regulation. The same should apply at national level.

D The user pays - Information on costs is needed to develop financing mechanisms

24. When making decisions about adaptation, the costs of adaptation measures as incurred today need to be weighed against their potential benefits for the future. Therefore, climate change impacts on water and water dependent activities need to be translated into economic terms. Assessments should include the current and future benefits and costs of both mitigation and adaptation measures, and they should take full account of environmental costs and benefits.

25. Appropriate financing mechanisms have to be developed to cope with the costs that will occur from adaptation. For this, information on the share of costs and benefits of proposed measures and on the scale, timeframe and the cost-effectiveness of investments needed for a given region is essential.

26. Economic instruments, as set out in the WFD, should be widely applied to recover the costs, including ecological costs, of coping with and adapting to climate change impacts, and to ensure that these costs are shared fairly between users, providers and polluters. A gradual move towards full cost recovery should be envisioned in all sectors, taking into account social aspects. One way forward is the 'user pays principle', regardless of whether the water is taken from a tap, a river or an aquifer or used for shipping and energy production. Water prices that fully reflect at least all investment and operational costs set strong incentives for consumers to reduce water consumption and increase water use efficiency. Experience shows that this approach can be highly successful, and suggests that appropriate water pricing forms a valuable adaptation option.

E Agriculture - key player in food production and landscape management

27. Agriculture has a high potential for mitigation (e.g. appropriate production of biofuels, carbon sequestration) and adaptation to climate change (e.g. diversification and adjusted management schemes as shifts to new crops and shifts in cropping seasons). Planning for adaptation in agriculture should also consider effects on mitigation and vice versa. Forests and forestry also play an important role both for mitigation and adaptation, and need to be considered in climate policies and strategies as well.

28. Agricultural water use has to be optimised, especially in central and southern European water-scarce regions. Northern regions will face an increase in nutrient losses and erosion due to increased precipitation, with negative impacts such as eutrophication of aquatic ecosystems. These impacts can be tackled by regional planning, landscape design and farming techniques.

29. Agriculture can - through adapted land use management and changing to less water demanding crops - contribute to securing water resources (i. a. increase of ground water recharge), protecting water resources (less nutrient loss) and to improving flood management.

30. There is certainly scope for improving the adaptive capacity of European agricultural systems through the funding schemes provided by the Common Agricultural Policy (CAP) of the EU. Adaptive capacity might benefit from realising full de-coupling of payments. Rural development funding, provided under the second pillar of the CAP, can be used to directly support measures aimed at adaptation, such as the development of new products, processes and technologies that are more adaptive or measures on education and advice.

F Electricity production and consumption

31. The adaptive capacity of alternatives for electricity generation should be used to assess the further development of the energy sector. Decentralised approaches and a diverse energy mix are likely to be beneficial both in terms of adaptation and mitigation on the supply side through energy efficiency, which should play a key role in national and trans-national European mitigation and adaptation policies.

32. The management of cooling water demand, in particular under low flow conditions, should be made a part of the river basin management plans,

and should include hydro peaking, minimum flow, reservoir management.

33. The electricity sector should take into account in its planning the vulnerability of the European electricity system to intensified climate variability and water related extreme events.

34. The existing grid should be assessed and if necessary further developed to reduce vulnerability against climate change. Options such as decentralised electricity production and / or an interconnected “European Grid” should be taken into account.

G Adaptation integrated part of inland waterway transport management and planning

35. Development of adaptation strategies is still in an early stage. A more detailed assessment of the vulnerability of inland waterway systems to climate change impacts on river discharge levels and the frequency of extreme floods and droughts is needed, as well as of the associated risks and of possible adaptation measures.

36. Nevertheless, no-regret policies based on current knowledge on increasing variability of the hydrological regime can be a starting point. To maintain flexibility, reversible measures should be given priority.

37. Adaptation should become an integral part of long-term Inland Water Transport (IWT) management and investment planning, involving all relevant actors (e.g. waterway managers, international inland water and river protection commissions, water authorities, ship owners, IWT customers). For instance, the European Development Plan, which is proposed by the NAIADES action plan, might be used to support and guide the sustainable adaptation of IWT infrastructure. The promotion and development of adapted ships that are economically feasible and environmentally friendly should be encouraged.

H The challenge of sustainable tourism

38. In order to promote the implementation of sustainable development measures in the tourism sector, improved water use efficiency should become one of the main priorities. This may be achieved by the introduction of water saving strategies and techniques, water recycling, tourist awareness and education schemes, staff training and Environmental Management Systems in tourism businesses and facilities.

39. A diversification of tourism activities, supported by EU as well as national policy action, could further help to make the sector more resilient to changes in climatic conditions and in water resources availability. The diversification of the tourism product should aim at developing activities that are less dependent on water resources (in summer tourism) and on snow coverage (in winter tourism).

40. As part of an integrative policy approach, water adaptation issues should be incorporated into Environmental Impact Assessments of tourist infrastructures, while climate change factors should be integrated into national and local tourism policies. Investments in water supply and waste water disposal infrastructure need to take into account the seasonally different demand and pressure generated by tourism.

41. Further research and in-depth analysis is needed on the behaviour of consumers (tourists) and tourism enterprises in reaction to changes in climatic conditions and water resources and on how changes in tourism flows will influence water demand and supply patterns. This analysis has to be regionally focused and should take other factors into account that influence tourism, such as ecosystem changes, demographic and economic trends, in order to be applicable as a tool for policy making.

I Further research activities are necessary to tackle adaptation issues properly

42. Scientific results and research will play a crucial role for enabling and facilitating adaptation processes. Through further research, more detailed information will become available on the impacts of climate change on the water cycle, in particular with respect to issues that are still subject to major uncertainties, such as future changes in the frequency and magnitude of extreme events. Research will also provide essential contributions to the identification of

the most adequate adaptation measures and strategies, for instance by investigating economic and cost aspects. To ensure that research generates information that is suitable and useful for adaptation, scientists and practitioners need to work together to figure out how best to adopt research results and apply them in adaptation activities.

43. Further research activities are necessary and should focus in particular on:

a. Better understanding and quantification of uncertainty throughout the chain of "emissions → climate change→ physical impact → ecological impact → socio-economic impact" and improving the communication and handling of uncertainty in political decision making processes.

b. Better understanding and quantification of economical and social impacts of climate change in the different sectors.

c. Further improving and linking climate, hydrological, bio-physical and socio-economic models to better understand the complexity of the water cycle and aquatic ecosystems and how these will react to climate change. Since projections of changes at regional or river basin level will be most relevant for adaptation, the downscaling of models to lower scales needs to be a focus of future research.

d. Identifying thresholds and points of no return beyond which recuperation of the water resources and the water dependent systems is no longer possible.

e. Options for adaptation strategies, which integrate sectoral and cross-sectoral measures, and the assessment of their ecological, social and economic potential, benefits and costs. Interdisciplinary approaches will be key, and attention should be given to the design of organisational structures that increase the capacity of water management to adapt to climate change.

f. Establishing of a solid baseline for evaluating Member State's adaptation plans, based on a historical archive of climatology

J Don´t forget the world outside the EU - Adaptation should be a key element of development co-operation

44. While developing their own adaptation strategies, the EU and its Member States should not forget about the urgent need to support adaptation in the developing world, since these countries will be most strongly affected by the impacts of climate change. Adaptation should be mainstreamed into the EU's development co-operation and assistance schemes, such as those for Africa and the EU neighbourhood countries. International programmes and activities aiming at the development and improvement of adaptation measures should be supported. Measures that may help developing countries to cope with climate change impacts include monitoring and prediction of climate change impacts on water and water uses, risk management, access to climate change risk insurance markets, preparedness and disaster response, methods to avoid and combat further land degradation, and development of more resistant food crops. Such efforts are particularly important in cases where current resource conflicts might be exacerbated by climate change impacts.

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IMPRESSIONS FROM THE SYMPOSIUM

PROGRAMM

	Monday, 12 February 2007
11:30-13:00	Registration
13:00	**Block 1 – Opening Session**
	Sigmar Gabriel, Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Germany
	Francisco Nunes Correia, Minister for the Environment, Spatial Planning and Regional Development, Portugal
	Mogens Peter Carl, Director-General for the Environment, European Commission
14:00-18:00	**Block 2 – Climate Change and Water Resources: Setting the scene**
14:00-15:30	Moderator: **Wolfram Mauser**, Ludwig-Maximilians-Universität Munich, Germany
	Nigel Arnell, University of Southampton, United Kingdom "Climate Change and Water Resources: Observed and Projected Global Trends"
	Daniela Jacob, Max Planck Institute for Meteorology, Germany "Climate Change and Water Resources: Observed and Projected Trends at regional scale in Europe"
	Pavel Kabat, Wageningen University and Research Centre, The Netherlands "Climate Change and its Impacts on Water Resources: Long term and gradual changes"
	Axel Bronstert, University of Potsdam, Germany "Climate Change and its Impacts on Water Resources: Extreme Events"
15:30-16:00	Discussion
16:00-16:30	Coffee Break
16:30-17:30	**Annette Menzel**, Technical University Munich, Germany "Climate Change and Water Resources: Impacts on Water Related and Water Dependent Ecosystems and Biodiversity"
	Elisabeth Lipiatou, DG Reserach, European Commission "Climate Change and its Impacts on Water Resources, Water Management and related Adaptation Strategies: Research Gaps and Priorities"
	Jacqueline McGlade, European Environment Agency "What does the scientific Diagnosis mean to Politics? Observations and Question Marks."
17:30-18:00	Discussion
20:00	Evening Event (Dinner)

	Tuesday, 13 February 2007
9:00-10:30	**Block 3 – Towards an EU Policy Framework for Adaptation**
9:00-10:00	Moderator: **André Weidenhaupt**, Administration de la Gestion de l'Eau, Luxembourg **Peter Gammeltoft**, DG Environment, European Commission "Framework of an EU Adaptation Strategy" **Jacqueline McGlade**, European Environment Agency "Climate Change and Water – Assessments and responses in EU Member States – an Overview" **Manfred Grasserbauer**, Joint Research Centre, European Commission "Climate Change and the European Water Dimension: Tools for Improved Risk Management"
10:00-10:30	Discussion
10:30-11:00	Coffee Break
11:00-13:00	**Block 4 – Impacts on Selected Sectors and Adaptation Challenges**
11:00-12:45	Moderator: **Peter Gammeltoft**, DG Environment, European Commission **Gernot Klepper**, Kiel Institute for World Economy, Germany "Climate Change and Water Resources – Socio-economic consequences" ***Introduction of background information on climate change impacts and adaptation challenges as well as of preliminary recommendations and conclusions on options for adaptation strategies and measures with regard to the following sectors:*** **Karl Schwaiger**, Federal Ministry for Agriculture, Forestry, Environment and Water Management, Austria "Water Management : Impacts, Adaptation Challenges and Options" **Marco Bindi**, University of Florence, Italy "Agriculture: Impacts, Adaptation Challenges and Options" **Michel Colombier**, Institute for Sustainable Development and International Relations, France "Energy Industry (Electricity): Impacts, Adaptation Challenges and Options" **Hans Moser**, Federal Institute of Hydrology, Germany "Inland Waterway Transport: Impacts, Adaptation Challenges and Options" **Gabor Vereczi**, World Tourism Organisation "Tourism: Impacts, Adaptation Challenges and Options"
12:45-13:00	Questions (comprehension)
13:00-14:15	Lunch Break

14:15-18:00	**Block 5 – Working Sessions** **Adaptation Strategies: Options for selected Sectors**
14:15-18:00	Working Session A: Water Resources Management / Water Supply and Sanitation Services Moderator: **Karl Schwaiger**, Federal Ministry for Agriculture, Forestry, Environment and Water Management, Austria - Rapporteur: **Merylyn McKenzie Hedger**, European Environment Agency **José Ramón Picatoste**, Ministry for the Environment, Spain: "The Spanish Adaptation Plan to Climate Change and the water resources sector" **Luis Veiga da Cunha**, New University of Lissabon, Portugal: "Adaptation strategies related to water management: An Example of the Situation in Southern Europe – a case study of Portugal" **Joost Buntsma**, Environmental Assessment Agency ,The Netherlands: "Water management responding to climate change impacts and projections - the Dutch experience" **David King**, Environment Agency ,United Kingdom: "Water Management in the UK: Integrating adaptive responses to climate change" **Pamela Taylor**, Water UK, United Kingdom: "How the water sector is already adapting to climate change impacts"
14:15-18:00	Working Session B: Agriculture Moderator: **Marco Bindi**, University of Florence, Italy - Rapporteur: **Jørgen E. Olesen**, Institute of Agriculture Sciences, Denmark **Bernard Seguin**, National Institute for Agricultural Research, France: "Adaptation of agriculture to increased drought risk induced by climate change in Southern Europe" **Ana Iglesias**, Polytechnic University of Madrid, Spain: "Climate change, water and adaptation in agriculture" **Horst Gömann**, Federal Agricultural Research Centre, Germany: "Perspectives for Agriculture in Central Europe under Changing Climate and Water Supply Conditions"
14:15-18:00	Working Session C: Energy / Electricity Moderator: **Michel Colombier**, Institute for Sustainable Development and International Relations, France - Rapporteur: **Nils R. Sælthun**, University of Oslo, Norway **Sten Bergström**, Meteorological and Hydrological Institute, Sweden: "A northern European perspective: climate change and the hydropower industry" **Sylvie Parey**, Electricité de France, France: "Water related impacts of climate change on the French electricity sector" **Otto Pirker**, Verbund-Austrian Hydro Power, Austria: "Climate change and hydropower"
14:15-18:00	Working Session D: Inland Waterway Transport Moderator: **Hans Moser**, Federal Institute of Hydrology, Gemany - Rapporteur: **Bruno Schädler**, Federal Office for the Environment, Switzerland **Gabor Bálint**, National Hydrological Forecasting Service, Hungary: "Low flows and navigation conditions" **Henk van Hoorn**, Ministry of Transport, Public Works and Water Management, The Netherlands: "Inland navigation, climate change and possible measures (policy focus)" **Gunther Jaegers**, European Barge Union: "Inland Navigation and adaptation to changing hydrological conditions"
14:15-18:00	Working Session E: Tourism Moderator: **Gabor Vereczi**, World Tourism Organisation - Rapporteur: **Wolfgang Seiler**, Institute of Meteorology and Climate Research, Germany **David Viner**, University of East Anglia, United Kingdom: "The Environment, Climate and Tourism: They are Changing!" **Tanja Cegnar**, Environmental Agency, Slovenia: "The impacts of climate change on tourism and potential adaptation responses in coastal and Alpine regions" **Tamara Ratz**, Kodolányi János University College, Hungary: "The Role of Climatic Factors in Hungarian Lake Tourism Development"

	Wednesday, 14 February 2007
9:00-9:20	**Block 6 – Climate Change Impacts on Water Resources and Adaptation Strategies in developing countries- a case for development co-operation**
	Keynote: **Achim Steiner**, Executive Director UNEP
9:20-9:40	**Block 7 – Climate Change and the Economic Relevance**
	Terry Barker, Cambridge Econometrics, United Kingdom "After Stern: the Economics of Avoiding dangerous Climate Change"
9:40-10:30	**Block 8 – Presentation of Results from Working Sessions in the Plenary**
	Moderator: **Peter Gammeltoft**, DG Environment, European Commission Summary from the sessions (Rapporteurs)
10:30-11:00	Questions / Discussion
11:00-11:30	Coffee Break
11:30-13:00	**Block 9 – Panel Discussion**
	Moderator: **Alfred Thorwarth**, Committee for Disaster Reduction, Germany Panellists: **Achim Steiner**, Executive Director UNEP **Astrid Klug**, Parliamentary State Secretary, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany **Mogens Peter Carl**, DG Environment, European Commission **Tony Long**, WWF European Policy Office **Pedro Cunha Serra**, Águas de Portugal **Daniela Jacob**, Max Planck Institute for Meteorology, Germany **Terry Barker**, Cambridge Econometrics, United Kingdom
13:00-13:20	**Block 10 – Presentations of Conclusions and Recommendations**
	Fritz Holzwarth, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany **Peter Gammeltoft**, DG Environment, European Commission
13:20-13:30	Concluding Remarks **Astrid Klug**, Parliamentary State Secretary, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany – End of Symposium –
13:30	Farewell Snack

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