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Adaptation of Water Management to Effects of Climate Change in the Danube River Basin

CONFERENCE PROCEEDINGS

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Johannes Kyrle, Secretary-General, Ministry for European and Internationals Affairs

Lucia Ana Varga, President 2007, International Commission for the Protection of the Danube River

Wilfried Schimon, Water Director, Ministry for Agriculture, Forestry, Environment and Water Management

Part 1 – The Challenge

9:20 Global Challenge of Climate Change

Prof. Keywan Riahi, International Institute for Applied Systems Analysis (IIASA)

25 minutes presentation, discussion

10:00 The Challenge of Climate Change for Europe

Prof. Manfred Grasserbauer, Technical University Vienna
30 minutes presentation, discussion

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Part 2 – European Response to Challenges

11:00 Research Findings of PRUDENCE (Prediction of regional scenarios and uncertainties for defining European Climate Change risks and effects)

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Otto Pirker, VGB Power Tech

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10 minutes presentation

16:10 Discussion of contribution of stakeholders

16:25 Final Discussion chaired by

Fritz Holzwarth, Head of the German Delegation to the ICPDR; Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Thomas Stratenwerth (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) opens the discussion with an impulse presentation, which should help defining concrete actions in the field of water management to adapt to the effects of climate change. All participants are kindly asked to bring in their ideas actively. Results will be fed into the ICPDR Ordinary Meeting (Dec 4-5, 2007).

17:30 End of Conference

2 Summary of outcomes

The Austrian Ministries of Agriculture, Forestry, Environment and Water Management and of European and International Affairs together with the International Commission for the Protection of the Danube River (ICPDR) organised the international conference *Adaptation of Water Management to Effects of Climate Change in the Danube River Basin*. The conference took place in Vienna on 4 December 2007.

The conference served as a platform to exchange information and experience on the topic of climate change, which has been attracting wide attention due to its global relevance. The development of best practice examples regarding the adaptation of the effects of climate change and the first design of management steps in the Danube River Basin (DRB) was declared aims of the conference organisers.

Several conclusions were achieved at the conference and will support the future management steps to be taken in the DRB regarding climate change. It has been concluded, that climate change is an issue of Danube basin wide significance, which has to be taken fully into account within the frame of Danube River basin management. Certain unclarities do exist related to climate change and the scientific investigations. However, state-of-play research outcomes on climate change signals in the DRB seem sufficient to build river basin management steps upon. Future steps and the implementation of respective measures should be based on findings of existing international and European scientific projects (such as EU 6 &7 Framework Programme projects, ENSEMBLES, Danube GLOWA), which include climate change prognosis for the entire basin.

The Danube River Basin Management Plan, which has to be developed by the end of 2009, will include a chapter on climate change. The chapter will reflect its relevance on the basin wide scale and future management options. In general, climate change will be addressed by a step-by-step approach respecting all significant water management issue, which have been identified for the basin. Further, the issues of flood protection and management, low water discharges and land use – all topics that are of high relevance in relation to climate change – will be fully taken into account. Holistic and coherent river basin management approaches should ensure the integration of all components as well as sectors of significance for the topic of climate change, the development of flexible management tools and the implementation of *no regret* measures. Future infrastructure projects in the DRB have to be climate proof – this means, which climate change has to be fully considered within their management and design.

These issues have been discussed in the frame of the 10 Ordinary Meeting of the ICPDR on December 4-5, 2007 in Vienna.

3 Keywan Riahi[1]: Global challenge of climate change

This presentation provides an overview of the global climate change challenge, its driving-forces, the main reasons for concern, as well possible response strategies to avoid dangerous anthropogenic interference with the climate system. The presentation builds to a large extent upon the recently published Fourth Assessment Report of the Intergovernmental Panel of Climate Change (IPCC, 2007), which assesses the latest scientific, technical and socio-economic literature relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation.

Global emissions of greenhouse-gases have increased markedly as a result of human activities since pre-industrial times. This increase in emissions has lead to unequivocal global warming, which is evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

Emissions projections from future scenarios indicate that without the tightening of current climate change mitigation policies, global GHG emissions will continue to grow at high pace over the next decades. This increase would cause further warming and induce many changes in the global climate system during the 21st century that would be larger than those observed today. Unmitigated climate change would thus increase the risk of climate-induced impacts for many climate sensitive and vulnerable systems, including food supply, infrastructure, health, water resources, coastal systems, ecosystems, global biogeochemical cycles, ice sheets, and modes of oceanic and atmospheric circulation.

Reducing the risk of irreversible climate impacts requires thus the mitigation of global GHG emissions aiming at the long-term stabilization of atmospheric GHG concentrations. Achieving this goal translates into the need of reducing emissions to virtually zero over long time-frames. The mitigation challenge is best illustrated by the stabilization scenarios for low stabilization levels, which would e.g. be consistent with the 2 ºC temperature target of the European Union. These scenarios indicate the need for rapid decarbonisation of the energy system, where global emissions would have to be reduced by more than 50% by 2050 (compared to 2000). Estimated costs of such transition pathways are estimated to be less than about 5.5% of global Gross Domestic Product (GDP) by 2030, which corresponds to slowing down annual economic growth by about 0.12 percentage points.

Although there are large uncertainties with respect to the deployment of individual future technologies, there is strong evidence that no single mitigation measure alone would be sufficient for achieving the stabilization of GHG concentrations at low levels. A wide portfolio of technologies across all GHG-intensive sectors is needed for cost-effective emissions reductions. The bulk of these emissions reductions would need to come from the energy sector, with the forest and agricultural sectors playing an important role for the cost-effectiveness. Energy-related measures range from energy conservation and efficiency improvements to shifts away from carbon-intensive coal to cleaner fuels (such as natural gas, renewables, and nuclear), as well as “add-on” technologies such as carbon capture and storage. Other important measures include changes in agricultural practices to reduce CH4 and N2O emissions, and enhancement of terrestrial sink activities in the forest sector.

Reducing the risks of climate change significantly, requires fundamental structural changes of the energy system in the long term, combined with accelerated technology diffusion and early investments over the next few decades. In addition, appropriate and effective investment incentives need to be in place for development, acquisition, transfer, and deployment of new technologies. Achieving a trend-

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reversal of presently declining trends of R&D expenditures in environmentally friendly energy technologies will thus be central for addressing the climate change challenge.

4 Manfred Grasserbauer[2]: The challenge of climate for Europe

The lecture will present major challenges posed by climate change for Europe and resulting research and development activities needed to assess possible impacts and develop adaptation measures. Focus will be on activities and products of the Joint Research Centre with a particular emphasis on water related issues and risk management.

It will discuss the following three challenging tasks:

1. To assess the exposure, vulnerability and adaptation potential to Climate Change of EU ecosystems:
Presentation of JRC reports on "Climate Change and the European Water Dimension" and "Marine and Coastal Dimension of Climate Change in Europe", Water Information System for Europe (WISE), Environmental Marine Information System (EMIS), European Soil Data Centre (ESDAC), European Forest Data Centre (EFDAC).

2. To develop risk assessment and risk reduction tools in the context of adaptation measures to Climate Change:
Presentation of European Drought Hazard Maps, new earth observation techniques for monitoring vegetation, European Forest Fire Information System (EFFIS), European Flood Risk Maps and European Flood Alert System (EFAS).

3. Linking the climate change policy agenda with the development agenda of European Union:
Presentation of the ACP (African-Caribbean-Pacific) Observatory with focus on deforestation and management of water resources.

These activities are carried out in support of the EU policy agenda in relation to climate change mitigation and adaptation, the environmental protection of inland and marine waters, flood risk management and development cooperation.

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5 Daniela Jacob[3]: Research findings of PRUDENCE: Prediction of regional scenarios and uncertainties for defining European climate change risks and effects

Meteorological and hydrological observations demonstrate that during the last decade the climate has changed. As reported by the *Intergovernmental Panel on Climate Change* (IPCC, 2001), a mean increase of temperature by 0.09 K per decade was observed globally from 1951 to 1989. Up to now, 2006, this trend has continued. Europe experienced an extraordinary heat wave in summer 2003, with daily mean temperatures being about 10° warmer than the long term mean. The increase of temperature varies depending on the region and season. If the temperature of the atmosphere increases, it should be assumed that the water cycle is intensified. However, it has not been possible until now to present clear statements on changes in the water cycle as a consequence of climate change.

Possible changes in regional climate can be studied using data from climate change scenarios, which depend on the development of greenhouse gases and aerosols, the quality of global and regional climate models involved and the methodology used to create the climate change signals. Uncertainties are associated within all parts and need to be analysed carefully.

Climate models and model quality control

Global climate models (GCM) have been developed to study the Earths climate system in the past and future, for which assumptions of green house gases are needed. Theses models are mathematical images of the Earth system, in which physical and biogeochemical processes are described numerically to simulate the climate system as realistically as possible. The model quality, however, can only be judge on in comparison with independent observations. Therefore, time periods of the past are simulated and the model results are compared against measurements before the models are used for climate change studies.

Even today global climate models provide information only at a relatively coarse spatial scale, which are often not suitable for regional climate change assessments. To overcome the deficiency two different principles to bring the information from the global model to the region of interest are used: statistical downscaling and dynamical downscaling. Statistical downscaling techniques connect the climate change signal provided by the GCM with observations from measurement stations out of the region to achieve higher resolved climate change signals. Dynamical downscaling describes the use of high resolution three dimensional regional climate models (RCM), which are nested into GCMs. RCMs are similar to numerical weather forecasting models, which are taken into account non-linear processes in the climate system. The results of both methods depend on both the quality of the global and regional models. As for GCMs, the model quality of RCMs needs to be analysed before addressing climatic changes. Therefore RCMs are nested into re-analyses data, which can be seen as close to reality as possible. The results of the RCM simulations of the last decades are compared against independent observations, means as well as extremes are considered.

PRUDENCE project

Within the PRUDENCE project, which has been funded by the EU under the 6th FP, several regional climate models carried out climate change simulations in a model inter-comparison project. Major results will be presented and special emphasis will be given on the applicability of climate change information in water resource management for Europe.

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In addition, results from new climate change simulations, which have been carried out within the European project ENSEMBLES will also be presented. Here possible change in the hydrological cycle within the Danube river basin will be investigated.

6 Peter Gammeltoft[4]: EU Policy - response to the challenge of climate change, water scarcity and droughts

The impacts of climate change on the Danube will be considerable, both with regard to too much and too little water, but also on water quality.

Particularly, the predictions for water stress are very serious for the Danube Region and this should be addressed in a sustainable way. The Communication on Water Scarcity and Drought from July 2007 shows policy options to this respect and they will be further elaborated in 2008. Full implementation of the Water Framework Directive is key to address the challenge of water scarcity. The Water Framework Directive can incorporate adaptation to climate change. The issue of climate change should already be included in the first RBMP and therefore it should also be coordinated at international level in the first cycle.

It is very important the ongoing developments in the Danube region, such as these concerning hydropower and navigation, will also start incorporating climate change impacts from now onwards. This will contribute to making the Danube river basin resilient to coping with climate change in the near future. Finally, combining water quantity and water quality issues as was done in the Tisza river basin analysis is a good example of how to address climate change and this should be the way forward for the whole Danube region.

7 Lučka Kajfež Bogataj[5]: Effects of climate change to the Alps – water towers to Europe

1. Introduction

The climate of the Alps highly of complex, due to the interactions between the mountains and the general circulation of the atmosphere. The ridges have an average elevation of 2500 m above sea level with a maximum up to 4800 m and as such are a barrier for atmospheric circulation. Another cause of complexity inherent to the Alps arises from the competing influences of a number of different climate regimes in the region, namely Mediterranean, Continental, Atlantic and Polar (Beniston, 2005a). The

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Alps often experience extreme weather events such as heavy precipitation, hail and drought, according to the nature and persistence of the associated circulation patterns.

Alpine climates have undergone significant change over the past century, mostly because enhanced radiative forcing due to anthropogenic greenhouse gases (Houghton et al., 2001). Temperatures (T) have risen by up to 2 °C in many parts of Alps between 1901 and 2000, which is well above the global-average 20th century warming. Precipitation (P) trends are more spatially variable, since the response of precipitation to warmer climatic conditions is more subtle than the change in T. The recent warming trend in the Alps already produced symptoms such as reduced snowfall, retreating glaciers, and increased rock falls that can be expected to worsen with climate change (IPCC, 2007).

2. Projected climate changes

In this century, the warming in Alps is projected to continue at a rate somewhat greater than its global mean. Under the A1B scenario, the simulated area and annual mean warming from 1980–1999 to 2080–2099 varies from 2.2 to 5.1°C with a median of 3.5°C. In most models, circulation changes enhanced the warming in winter (due to an increase in westerly flow) and late summer (due to a decrease in westerly flow). Several studies have indicated increased T variability in summer; both on inter-annual and daily time scales and reduced T variability in the winter. The number of frost days is very likely to decrease. For every °C increase in T, the snowline will on average rise by about 150 m, but at lower elevations the snowline is very likely to rise by more than this average estimate. For a 4°C shift in mean winter T in the Alps, as projected by recent RCM simulations for climatic change under a strong emissions scenario (the IPCC A2 emissions), snow duration is likely to be reduced by 50% at altitudes 2000 m to 95% at levels below 1000 m.

Unfortunately projections of changes in P patterns in mountains are tenuous in most GCMs because the controls of topography on P are not adequately represented. Climate models results indicate a south-north contrast in P changes across Europe, with increases in the north and decreases in the south. The annual mean change from 1980–1999 to 2080–2099 in the worst case scenario A1B is from –4% to –27% in Alpine area. In summer, most models simulate decreased P south of about 55°N. The most consistent and in largest decreases occur in summer, with increasing evaporation, but the area mean winter P also decreases in most models. Changes in P will vary substantially on relatively small horizontal scales in Alpine areas of complex topography. The details of this variation depend on changes in the future atmospheric circulation. Much larger changes are expected in the recurrence frequency of P extremes than in the magnitude of extremes (Beniston et al., 2007). Changing runoff from glaciers includes initial increases in total glacier runoff and peak flows, and considerable amplification of diurnal melts runoff amplitudes, followed by significantly diminished runoff totals and diurnal amplitudes as the glaciers continue to shrink.

3. Impacts on hydrological cycle in Alps

A warming climate as projected will enhance the hydrological cycle in Alps. This implies higher rates of evaporation, and a greater proportion of liquid to solid precipitation. These physical mechanisms, associated with potential changes in precipitation amount and seasonality, will affect soil moisture, groundwater reserves, and the frequency of flood or drought episodes. These imply serious consequences for water circulation and water management in the Alps: rainfall would decrease in summer and increase or become more intense in winter. In addition, the snow line would rise by 200 metres by 2050 and glaciers would continue to melt. Accordingly, floods in medium and low-lying regions would increase both in intensity and in frequency during winter. On the other hand, in summer, especially south of the Alps there would be more frequent droughts. Lakes in the alpine regions are particularly sensitive to climate change. At the same time, these are the areas where the highest and most rapid temperature increase is expected. Response of lakes to climate forcing is a high probability for earlier ice-out, increase of lake temperatures, and stronger thermal stratification in a warmer future.

The duration of snow cover is expected to decrease by several weeks for each °C of temperature increase in the Alps region at middle elevations (Martin and Etchevers, 2005). An upward shift of the glacier equilibrium line is expected from 60 to 140 m/°C. Glaciers will experience a substantial retreat during the 21st century (Haeberli and Burn, 2002). Small glaciers will disappear, while larger glaciers will suffer a volume reduction between 30% and 70% by 2050 (Paul et al., 2004). During the retreat of glaciers, spring and summer discharge will decrease. The lower elevation of permafrost is likely to rise by several hundred metres.

4. Conclusions

Climatic change in Alps is a complex mix of short- to long-term forcings, related to the intensity and persistence of weather patterns and enhanced radiative forcing due to anthropogenic greenhouse gases. It seems likely that alpine climate change will lead to changes in timing and amount of run-off in European river basins and that floods and droughts will become more frequent. Projected decline in precipitation in the Alps plus rise in temperature could produce a 40-70% reduction in runoff. Summer discharge of Alpine catchments will significantly decrease and winter floods will become more frequent. Because the Alps are the primary source for such major rivers as the Rhine, Rhone, Po, and Danube, the impact of reduced mountain precipitation would be felt far beyond the mountainous regions themselves. In facing up to climatic change, it is necessary to plan in terms of decades. The expected hydrological changes in Alps may be drastic and they need to be taken into account for the long-term integrated management of water resources. This includes the fields of spatial planning, environment and agriculture etc.

5. References

Beniston, M., 2005a. Mountain climates and climatic change: An overview of processes focusing on the European Alps. Pure and Applied Geophys., doi: 10.1007/s00024-005-2684-9

Beniston, M., 2005b: The risks associated with climatic change in mountain regions. In: Huber, U. M., Bugmann, H. K. M., Reasoner, M. A. (Eds.) Global Change and Mountain Regions; An Overview of Current Knowledge. Springer Publishers, Germany, 511-519

Beniston, M., D.B. Stephenson, O.B. Christensen, C.A.T. Ferro, C. Frei, S. Goyette, K. Halsnaes, T. Holt, K. Jylhä, B. Koffi, J. Palutikof, R. Schöll, T. Semmler and K. Woth, 2007. Future extreme events in European climate; an exploration of regional climate model projections, Climatic Change (**81):** 71–95.

EEA, 2004. Impacts of Europe's changing climate - An indicator based assessment. EEA Technical Report No. 2/2004, European Environment Agency.

Hantel M. and L.M. Hirtl-Wielke, 2006. Sensitivity of alpine snow cover to European temperature. Int. J. Climatol., in press

Houghton J. T., Ding Y., Griggs D. J., Noguer M., van der Linden P. J., Dai X., Maskell K., Johnson C. A., 2001. Climate change 2001: The scientific basis. Cambridge, Cambridge Univ. Press: 752 s. 2001. http://www.grida.no/climate/ipcc_tar/wg1/index.htm

IPCC, 2007. Summary for Policymakers. In: Climate Change 2007. Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.

Martin, E. and P. Etchevers, 2005: Impact of climatic change on snow cover and snow hydrology in the French Alps. In: Global Change and Mountain Regions (A State of Knowledge Overview) [U.M. Huber, H. Bugmann, and M. A. Reasoner (eds.)]. Springer, pp. 235-242.

Paul, F., A. Kääb, M. Maish, T. Kellengerger, and W. Haeberli, 2004: Rapid disintegration of Alpine glaciers observed with satellite data. Geophys. Res. Lett., 31, L21402, doi:10.1029/2004GL020816.

Räisänen, J., Hansson, U., Ullerstig, A., Döscher, R., Graham, L. P., Jones, C., Meier, H. E. M., Samuelsson, P. and Willén, U. 2004. European climate in the late twenty-first century: regional simulations with two driving global models and two forcing scenarios. Clim. Dyn. 22, 13-31.

8 Michael Becker[6]: Climate change and water management in the German Danube region

The German States of Baden-Württemberg and Bavaria and the German Meteorological Service agreed in December 1998 to work together in the long term in the Cooperation Project "Climate Change and Consequences for Water Resources Management" **(KLIWA).** The aim of **KLIWA** is to establish possible effects of climate change on the water balance of catchment areas in Southern Germany, to identify the consequences and to draft recommended action.

The Methodology: KLIWA Work Areas

Area A:

Determining Changes in Climate and Water Balance Analysing Meteorological and Hydrological Data of the 20th century.

Long-term meteorological and hydrological measurement data from Bavarian and Baden-Württemberg weather stations were analysed and trends were determined.

Area B:

Estimating Possible Impact of Climate Change on the Water Balance by Using Regional Climatic Scenarios for the first time in Southern Germany and therefore in the German Danube Region.

The data of the above-mentioned weather stations served as the basis for simulation with regional climatic models for the period 2021 - 2050. In turn, the future climatic data was used to feed finely meshed models for the water balance of the individual catchment areas.

Area C:

Recording Future Changes in Climate and Water Balance Data by defined long-term meteorological and hydrological measurements at stations in Bavaria, in Baden-Württemberg and from the German Meteorological Service.

Area D:

Developing Adaptation Measures and Adjusting Water Resources Management Action.

Applying the results of Area B in the Danube Region consequently allows, in particular, statements to be made in relation to the trend in flooding phenomena during the next 50 years.

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Main Results analysing the historical data

Air Temperature: Things warming up

The average air temperature in Southern Germany rose by 0.5–1.2°C in the period 1931–2000. The greatest rise occurred as of the 1990s. The mean monthly temperature increase was most pronounced in the month of December at 1.8–2.7°C. In the Alpine Region the raise in temperature was about twofold higher as in the average (+ 2 °C during the last 70 years).

Snow cover: White Christmas - a childhood memory

In the years from 1951/1952 snow cover dropped by 30–40 percent, above all in low-lying areas up to 300m above sea level. The corresponding figure for moderate altitudes (300–800m above sea level), was 10–20percent. It was only in some high-altitude locations that there was more snow than previously.

Precipitation: Dry summers and rainy winters

The annual precipitation has remained approximately the same in most areas during the period under investigation. However, the distribution of precipitation has changed: The winter months have become damper and the summer months drier. Precipitation in the wintertime has increased by up to 30 percent in some regions. Parts of the Bavarian Forest in the German Danube region have been affected by this in particular as well as the Black Forest in Baden-Württemberg.

Increased precipitation in the wintertime is attributable to the increase in certain general weather situations over Europe. A time series analysis between 1881 and 1989 indicated that the so-called zonal circulations occur more frequently, particularly in the months of December and January. This weather condition brings generally a lot of rain in lowland areas and on plains owing to milder maritime air.

Consequently long-term measurements at selected river level river gauges indicated that flood events in the winter months have increased in some parts of the German Danube Region in the last 30years.

Use of Regional climate models and water balance models

The grid mesh width of a global climate model is inadequate for a regional climate analysis. Regional topographical peculiarities such as small mountain ranges or flood plains literally fall through the net. Since there was no optimum method of elaborating regional climate scenarios from the global climate model, three different methods of simulating the regional climate were selected for KLIWA: A statistical method, a statistical-dynamic method and a regional-dynamic climate model. This provides a certain bandwidth of feasible trends and comparison options. All three methods are based on the ECHAM-4 global climate model for the simulation period 2021 to 2050. The "human factor" was included with the B2 emission scenario of the IPPC - a continually increasing world population that finds sustained local solutions to economic, social and environment problems. The quality of the simulations was checked with the measured data of 1971 to 2000, i.e. the simulation of the actual situation was compared with the actual weather data.

In order to estimate the impact of the simulated regional climate change on the water balance, high-resolution water balance models (WBMs) were elaborated on the basis of a 1x1 km² grid for the KLIWA area.

Main Findings of the Regional Climate Simulations

Air temperature

The average air temperature will increase by 1.7 °C through to 2050. In summer, the mean daytime temperature will rise by 1.4 °C and will be 15°C. In the wintertime, the temperature increase is higher (from 2 °C to 4.5 °C). The temperature will rise mostly in the months of December to February. The number of summer days (days over 25°C) will increase greatly at all climate locations. The number of hot days (over 30°C) will double nearly everywhere.

Precipitation

During the simulation period, the recognised historical trend with damper winters and drier summers will continue. While it will rain up to 10percent less in the summertime by comparison with the present day, there will be far more precipitation in the wintertime - in some regions up to 35percent more, mostly in the western parts of the regions under investigation. In addition, days with heavy precipitation (over 25mm) will increase substantially in the wintertime, and the number of such days will double at many measurement stations. By contrast, there will be more days on which there is absolutely no precipitation: periods of drought in the summertime will be longer.

The cyclonal westerly weather situations that can bring higher precipitation will increase. From this, it can be seen that risk of flooding will increase in the winter months. Moderate floods above all will increase since the snow cover may build up and thaw several times in future milder winters.

Adaptation Strategies: "Flexible and no Regret"

Even if the model chain of global models - regional models - water balance models is still characterised by some uncertainties, the results indicate that flood events can be anticipated to a greater extent in future. Consequently, a flood adjustment strategy has been developed in order to be on the safe side. The German States of Baden-Württemberg and Bavaria have thus been the first States in Germany to introduce a climate-change factor when designing technical flood protection measures. This permits the assumed increase in flood runoff to be introduced as early as possible in the planning process.

In the Bavarian Danube Region a climate change factor has been introduced, as a global factor of 15 percent, for the statistical value of HQ100 on the basis of the investigation results at the time. The basis for the climate change factor will be further developed on the basis of further investigations. This may also lead to a regional adaptation.

Outlook

With KLIWA, climate protection policy in the German States of Baden-Württemberg and Bavaria is pursuing an important module of anticipatory, foresighted provision for existential requirements. To date, KLIWA has primarily dealt with the problems relating to flooding. In the future more emphasis will be given to analyse other effects of climate change on to the water balance. The indication of drier and warmer summers may bring periods of drought and consequently can cause problems for farmers, for inland waterway transport and power station cooling. The changed precipitation distribution will also impact on groundwater recharge. Another related topic is the trend in short-term precipitation (thunderstorms) bringing a great amount of water in a very short time and consequently causing local flooding to a greater extent, which is important for municipal drainage networks.

9 Andras Horanyi[7]: Climate change at Central and Eastern Europe: the CLAVIER project

The nations in Central- and Eastern-Europe (CEE) face triple challenges of the ongoing economic and political transition, continuing vulnerability to environmental hazards, and longer term impacts of global climate change. The overall aim of the EU FP6 project CLAVIER (CLimate ChAnge and Variability: Impact on Central and Eastern EuRope) is to make a contribution to successfully cope with these challenges. Three representative CEE Countries are studied in detail: Hungary, Romania, and Bulgaria.

In the framework of CLAVIER, ongoing and future climate changes are analysed based existing data and on climate projections with very high detail to fulfil the need of local and regional impact assessment. Researchers from 6 countries and different disciplines investigate linkages between climate change and its impact on weather patterns, air pollution, extreme events, and on water resources. Furthermore, an evaluation of the economic impact on agriculture, tourism, energy supply and the public sector is conducted.

The CLAVIER project is supported by the European Commission's 6th Framework Programme (contract number 037013) as a 3 year Specific Targeted Research Project from 2006 to 2009 under the Thematic Sub-Priority "Global Change and Ecosystems".

10 Gheorge Constantin[8]: Action Plan for water scarcity and droughts in Romania

Romania is the largest country in the Danube River Basin, both from the surface and population point of view. Its water resources are dependent by the Danube water regime, low discharges in the upstream part of the basin influencing the availability of water in the downstream part. Romania ranks amongst countries with relatively low water resources with only 1,840 cubic meters water/inhabitant/year, compared with the average 4,000 cubic meters water/inhabitant/year in Europe. In the last 100 years the yearly average temperature increases by 0.3 °C, simultaneously with a decrease of precipitation and river runoff. This situation affected in the last years water supply, agriculture, navigation, energy and water environment. Beside changes in climate, this situation is due to the country geomorphology, soils structure, river network, vegetation and human activity influence. The different scenarios concerning the effects of climate change on Romania shows that in the next 100 years we could have an increase in yearly average temperature between 2 °C and 5 °C (with higher increases in the southern part of the country) and a reduction of a river runoff by 20%. In order to tackle this issue Romanian authorities have developed a Strategy dealing with water scarcity and droughts. This strategy include a range structural and non-structural measures which include improvement of the legal and institutional framework, research and monitoring, reduction of water consumption, implementation of the economic mechanisms in the water sector, development of the water infrastructure, afforestation and public awareness and participation.

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11 Otto Pirker[9]: Consequences and challenges

In connection with the topic climatic change and hydropower two questions can be defined: On the one hand arises the question, what is the contribution of hydropower for the avoidance of CO_2 -emissions in Europe. A second complex of questions results due to the possible effects of climatic change and associated changes in the water regime on the generation of hydropower.

The first question can be answered relatively simply. In Europe hydropower is still the most important renewable source of energy. In 2005, approximately 10.5% of the entire generation in Europe came from hydropower plants. In comparison, the portion of all other renewable energies amounted to 4.6%. This means, that about 2/3 of renewable energy in Europe is generated by hydropower plants. This should be made clearer by looking at the installed capacity. The portion of hydropower constitutes approximately 19%. It must be emphasized particularly that hydropower, due to its positive characteristics regarding availability, rule ability and supply of reserve achievement, has an extremely important value for the operation of our grid and thus also for supply security of supply. Furthermore, hydropower is due to these characteristics the ideal partner for all other renewable energies, where the generation is not demand side -related.

Due to these characteristics it has to be said that the contribution of hydropower cannot be replaced by other sources of renewable energy, but that at best well adjustable thermal plants could be used as a replacement for hydropower.

In 2005 311,2 TWh of electricity were generated in hydropower plants in Europe (European Union 25). This means a saving of approximately 68.5 millions t oil or 103 millions t hard coal. This corresponds to a saving of approximately 230 millions t CO_2 (with oil) and/or 280 t CO_2 (with hard coal).

The discussion is getting more complex and more uncertain regarding possible effects of individual climate change scenarios concerning hydropower generation.

It can be seen, that the quantitative statements with regard to the change in the water regime specially in alpine areas, where a large part of hydropower generation is concentrated, are very unsafe.

Earlier examinations in the alpine areas have shown that through an increase of temperature by about 1-2° degrees Celsius it would primarily come to a displacement of the drain of the summer term in the winter half year. The complete drain freight would approximately remain the same. For the hydropower generation in alpine areas this could even mean a certain advantage. However uncertainties consist in the frequency of the occurrence of extreme events. This may be the future challenge for the operators of hydropower. On the one hand it deals with extreme floods and on the other hand with long time periods of drought, such as 2003 in Central Europe.

Generally these questions can be outlined:

- *What does an increase of extreme flood events mean for the hydropower?*
    - *Must the calculation criteria be adapted on spillways (partially executed in Europe)?*
    - *Do storage power plants offer an increased local flood protection?*
    - *Which roll will the hydropower utilization play in the prevention of nature dangers in the future?*
- *Which roll plays the hydropower in extreme drought situations?*

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- *Does the hydropower perform a contribution to the balance in extreme situations (roll of the storage HPP)?*
- *How strongly is the hydropower concerned in its production itself?*
- *How can the missing energy be allocated if simultaneously also the thermal production is alloyed?*
- *Which role do the storage power plants have at the same time?*

In the regional scale, one has already concerned himself with some of these questions in the last years. It appeared that the hydropower will not only be affected by possible climate changes, but rather can contribute above all - through the influence of the storage power plants - also to the reduction of the problem. European investigations are presently not yet well known, but would be however important because the problem differs regionally.

12 Otto Schwetz[10]: Navigation and climate change

Transportation is a necessary means for the people and the economies. The challenge of the prognosed climate change demands action of the transportation sector. The White Book of the European Commission „Time to decide“ stated, that inland navigation and short sea shipping should play a crucial role to make transportation more environmentally friendly. In all maps of inland waterways in Europe the Danube is an important link from North Sea to Black Sea. It is also the Corridor VII of the 10 Pan-European Transport Corridors and as such part of the South-Eastern Axis to the neighbouring countries.

The increasing economies of the „Danube Belt“ create also more cargo traffic, and besides this the heavily increasing number of containers coming from Asia are a additional problem.

As the railways are not in the position to match all these challenges, inland navigation on the Danube is the only way to avoid too many lorries on our roads. The necessary capacity is given.

Besides that it is obvious, that inland navigation hast he lowest impact to the environment, not only in the CO^2 discussion but also in the noise protection and others.

Inland navigation and inland vessels have also to be improved technically to the highest possible state oft he art: less pollution (Euro 5 engines), less draught, less waves, transponder based navigation systems, better locks managements. There are solutions on the market (RIS, Futura Carrier) but they have to be used.

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13 Christine Bratrich[11]: Adaptation to climate change – concerns WWF

Unique values at risk

The Danube impacts the lives of more than 80 million people. 20 million people rely directly on the Danube in their daily lives, i.e. for drinking water. Therefore, the ecosystems of the Danube River Basin are highly valuable in economic, historical and social terms. The Danube is also home to a unique mix of species, with about 2,000 plants and more than 5,000 animal species. Supporting 103 species in total, the Danube is one of Europe's richest rivers with regard to fish species; this includes seven fish species found nowhere else in the world.

WWF's expectation for the Danube basin

During the last century, temperatures have shown a relatively uniform increase of 0.95 °C across Europe. Future shifts in mean annual precipitation are expected to have distinct regional differences. Increasing values in northern Europe by 10-40%, but decreasing in some areas of central Europe region by up to 20% have been predicted. Most likely, the Danube Basin will have to prepare for direct climate change impacts such as more frequent flooding, longer periods of drought and an increase in water temperature. Indirectly, this will deteriorate water quality, support distribution of invasive species, worsen groundwater recharge, disconnect functional habitats and harm the natural biodiversity and overall river integrity.

Climate change comes after other drivers have already reduced natural river systems

Climate change, however, comes just on top of other drivers that have already reduced the natural ability of the Danube system to adjust and absorb disturbance. Healthy, free-flowing rivers respond to natural disturbance through dynamic movements and flow adjustments that buffer against impacts. Adjustments include lateral migration of channels and dynamic interactions between the main stream, floodplains, riparian zones, and groundwater. Over the last decades, however, the Danube has been sufficiently altered so that its natural ability to absorb disturbances is already severely limited. Ecologically sound climate change adaptation needs to consider all drivers and their cumulative impacts.

- ***Significant land-use changes*** *caused already a loss of more than 80% of the historical floodplains along the Danube.*
- ***Impacts of hydropower use are severe both in upstream and downstream reaches:*** *A chain of reservoirs an 58 dams left only three free flowing sections in upper Danube. This created problems for fish migration, trapped bed load, loss of habitat and species as well as reduced water quality. In the lower Danube particularly the construction of the Iron Gate dams led to a significant reduction of the suspended load. Trapping efficiency of the Iron Gate reservoir is between 66% (year with flooding) and 85% (dry year), and on the average is 80%.*
- ***Waterway construction, fairway maintenance, and river regulation for navigation*** *in combination with trapped sediments resulted in a significant loss of habitats, incision of riverbed, and lowering of ground water tables.*

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WWF's principles for climate change adaptation in the Danube river basin

The Danube's ability to respond to altered climate condition is not unlimited. Climate shifts that will occur rapidly and lead to flows outside the natural range of variability will have important consequences for the river ecosystem and the people who depend on it. Therefore, WWF calls for four basic principles to be followed to ensure sustainable climate change adaptation:

- *Work with nature not against it*
- *Find the right balance between use and protection & support innovative technology*
- *Turn agriculture from problem driver to solution facilitator*
- *Integrate European policy and ensure wise use of EU funds*

'***Work with nature in the Danube basin and not against'*** should focus on sustainable landuse management (e.g. support afforestation, stop settlements in risk zones), protection of functional river and wetland systems, dislocation of dykes and removal of embankments wherever possible, and reconnection of side arms, floodplains and wetlands. After the Danube flood in 2006, WWF investigated the potential of remaining natural retention areas and potential floodplain areas for restoration. Forty-three different floodplains with high potential for flood risk mitigation were identified including a total of more than 10,500 km^2 remaining areas and more than 7,000 km^2 restoration sites (Fig. 1). WWF recommends these sites to be included in the Danube River Basin Management Plan for proactive restoration, rehabilitation, and management actions to enhance the resilience of riverine ecosystems and minimize all direct and indirect effects of climate change impacts.

'Find the right balance between use and protection & support innovative technology in the Danube' relates mainly to hydropower production and navigation. It includes avoiding new dams in the main Danube system but calls for empowering existing facilities. Furthermore, applying criteria for ecologically sound hydropower (e.g. the *greenhydro* concept) should become a standard in the Danube river basin. In addition, the use of existing dams to mitigate effects of flood and droughts needs to be considered for climate change adaptation. This again involves sound forecast systems and perhaps incentives mechanisms for hydropower companies to take financial risks. Climate change adaptation also requires that navigation fairway conditions are defined according to ecological needs. Flexible adaptation to changing weather conditions will be key for economically viable navigation. This includes renewing the old Danube fleet with new ship technology, supporting intelligent logistic chains and better river information systems.

'Turn agriculture from problem-driver to solution facilitator could set a landmark for climate change adaptation in the Danube region. There are many measures that farming can undertake that would help mitigating effects of climate change. The critical function is to reduce peak run-off and enable gradual release of rainwater. Also increased water efficiency and equal distribution will be key in future. Effective agriculture measures include e.g. improving rainwater infiltration by changing tillage practices; reducing run-off by introducing natural barriers, such as grass buffers and temporary ponds; providing more vegetative storage, by increasing mature forestry areas with build-up of leaf litter; slowing drainage by breaking up field drainage systems, providing flood storage through creating wetlands; increasing river channel flood flow capacities by re-instating natural water courses and reducing or setting-back flood protection dykes in agricultural land.

'Integrate European policy and ensure wise use of EU funds for the Danube' calls for applying the solidarity principle and integrating different EU legislation (i.e. WFD, Floods Directive, Marine Strategy Directive). The impacts of floods and water scarcity are not shared equally by all Danube regions. It is those least affected by floods and droughts in hilly up-stream areas, that will need to implement significant measures to mitigate damage further downstream. But also the middle and lower Danube region with their large number of disconnected floodplains will play a major role to alleviate the effects from accelerated flood flows. The EU's Cohesion Policy provides funding for helping regions to co-operate across frontiers. INTERREG programmes supported cross-border co-operation. Recognizing the principle of solidarity underpinning Cohesion Policy, the next programming period for Regional and Cohesion funds should allow financial resources to be allocated to the implementation of whole river basin district management plans, including measures to tackle floods and droughts, instead of allocating them on a project-per-project basis. Finally, the European Agricultural Fund for Rural Development (EAFRD), 2nd pillar of the EU Common Agricultural Policy (CAP), offers a vast range of measures and a budget of Euro 77.66 billion for the period 2007-13 which can cover for land-use measures to support sustainable measures for climate change adaptation in the Danube basin.

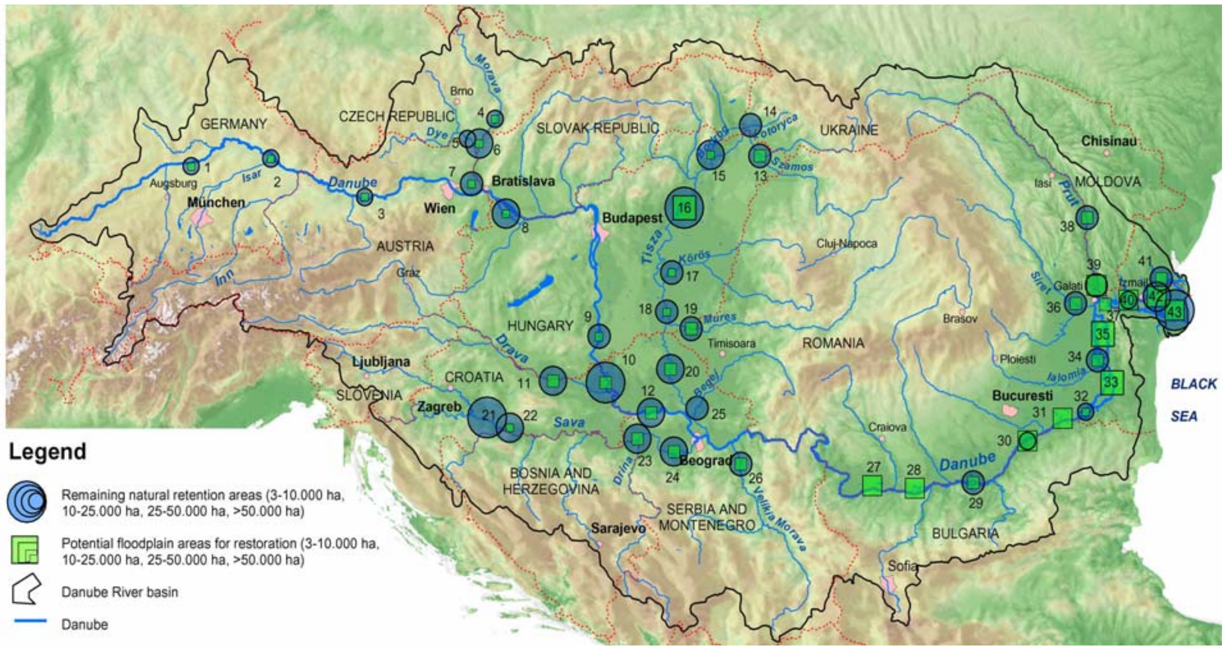

Fig. 1: Large floodplain areas with high potential to mitigate negative effects of climate change (blue dots: Remaining natural floodplain areas; Green rectangles: Floodplain areas with high potential for restoration; source: WWF 2006)

14 Thomas Stratenwerth[12]: Impulse presentation: Results of Workshop in Bonn, Nov. 2007 on how to integrate climate change impacts and adaptation to climate change in the first River Basin Management Plan

The Greenpaper on Adaptation presented by the European Commission in June 2007 as well as its Communication on Water Scarcity and Droughts stresses that EU water legislation provides a good framework to address adaptation to the impacts of climate change in water management. In order to identify in more detail how climate change impacts and adaptation to them can be integrated in the implementation of in particular the Water Framework Directive (WFD) in June 2007 the European Water Directors established an activity on Climate Change and European Water Policy. The

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presentation will highlight the main outcomes of a workshop organised in the framework of this activity in November 2007. This workshop focussed on the question to what extent climate change aspects can already be taken into account in the first River Basin Management Plan to be delivered by the end of 2009, and on preliminary ideas for a checklist indicating those elements of the WFD where climate change effects need to be looked at in more detail in subsequent planning cycles.

15 Information about the speakers

Keywan Riahi:
International Institute for Applied Systems Analysis (IIASA), and Graz University of Technology

Keywan Riahi is a Senior Research Scholar in the Energy and the Transitions to New Technologies Programs at the International Institute for Applied Systems Analysis (IIASA). He is since 2005 also the Scientific Co-Coordinator of the Greenhouse Gas Initiative, the Institute's largest cross-cutting research effort. In addition, Prof. Riahi holds a part-time appointment as Visiting Professor in the Field of Energy Systems Analysis at the Graz University of Technology, Austria.

Prof. Riahi served regularly as a Lead Author to many Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC), including the IPCC's Third and Fourth Assessment Reports, as well as the IPCC's Special Report on Emissions Scenarios (SRES) and the Special Report on CO2 Capture and Storage (SRCCS). He is the author of many scientific journal articles, and has co-authored and guest-edited several books and Special Journal Issues in the fields of energy and climate change.

Prof. Riahi's main research interests are the long-term patterns of technological change and economic development and, in particular, the evolution of the energy system. His present research focuses on energy-related sources of global change, and on future development and response strategies for mitigating adverse environmental impacts, such as global warming and acidification.

Prof. Dr. Dr. h. c. Manfred Grasserbauer
Vienna University of Technology

M. Grasserbauer holds the Chair for Analytical Chemistry at Vienna University of Technology since 1990. From 1997 to 2007 he served as Director at the Joint Research Centre of the European Commission, where he managed the Institute for Environment and Sustainability (IES) during the last five years.

Present areas of scientific interest and expertise refer to analytical and environmental sciences, with focus on advanced approaches for environmental monitoring (in-situ measurements, modelling and earth observation techniques) and sustainability issues (climate change, management of natural resources - like water, soil, forests - clean energies, transport and air quality, global development issues).

M. Grasserbauer is Corresponding Member of the Austrian Academy of Sciences and Member of Commission on Clean Air and serves on the Board of Governors of the Helmholtz Research Centres for Environment and Health (GSF), München and for Environmental Research (UFZ), Leipzig.

Daniela Jacob
Max Planck Institute for Meteorology

Academic education and professional employment:

1967 - 1971	Primary School: Grundschule West, Bad Salzuflen
1971 - 1980	Secondary School: Neusprachliches Mädchengymnasium, Bad Salzuflen
May 1980	Abitur
1980 - 1986	Studies of Meteorology at the Technical University Darmstadt
Nov 1986	Diploma thesis: Simulation der Smog-Episode im Januar 1985
1986 – 1991	Ph.D. Student at the GKSS Research Center, Geesthacht. Group leader: Dr. Dieter Eppel. Ph.D. supervisor: Prof. Dr. Hartmut Graßl
May 1991	Dissertation at the University of Hamburg, Department Meteorology: “Numerische Simulation der Wolkenbildung in einer Land-Seewind-Zirkulation”
1991 - 1992	Post-Doc position at the GKSS Research Center, Geesthacht
1992	Visiting scientist with Dr. Terry Clark at NCAR (National Center for Atmospheric Research), Boulder, Colorado, USA, division of Mesoscale and Microscale Modelling. Working title: Simulation of snow storms with the Clark model using the two-way nesting technique
Since 1993	Scientist at the Max-Planck-Institute for Meteorology in Hamburg

Community services

Since 1994	Scientific leader of model development and application of the regional climate model REMO
1997 - 2000	Coordination Committee Member of CLIMPACT (Regional Climate Modelling and Integrated Global Change Impact Studies in the European Arctic) - an European Science Foundation Network
Since 1999	Recognition by the Deutsche Meteorologische Gesellschaft as Consultant Meteorologist for the area wind energy
2000 - 2005	Associate Editor of the Magazine Environmental Fluid Mechanics in the publisher Kluwer. Editor-in-Chief: Benoit Cushman-Roisin
2001 - 2005	Chair of the BALTEX Working Group of Water and Energy Cycles
2002 - 2005	DEKLIM-speaker for the area Baltic Sea
2002 - 2003	Member of the Scientific Steering Committee of ProMed, Project Mediterranean
2003 - 2006	Project management COSMOS
Since 2004	Deputy Director of the Department „Atmosphere in the Earth System“ at MPI-M
Since 2004	Member of the ENSEMBLES Management Board
Since 2005	Baltex Science Steering Group Member (BSSG)
Since 2006	Scientific Advisory Board Member Wegener Center for Climate and Global Change, University of Graz, Austria
Since 2006	Member of the IOW Scientific Advisory Board, Baltic Sea Research Institute, Warnemünde
Since 2006	Member of the Expert Group on Offshore Meteorology, POW WOW (Prediction of Wind, Waves and Offshore Wakes, Instituto NAcional de Engenharia, Tecnologica e Inovacao, Lisboa)
Since 2006	Scientific Director of COSMOS

Since Apr 2007 Member of the Int. Science Advisory Council of the Netherlands National Research Programme Climate changes Spatial Planning

Since July 2007 Expert Reviewer for the Natural Sciences and Engineering Research Council of Canada (NSERC)

Since Oct 2007 Member of the UN Expert Group on Climate Change and Water WWAP

Since Oct 2007 Review Panel Member of the European Research Council (ERC)

Michael Becker
Bavarian State Ministry of the Environment, Health and Consumer Protection

1955 – 1959 Primary School in Mainz

1959 – 1967 High School (Humanistic Gymnasium) in Mainz, qualifying for admission to university

1967 – 1969 Military Service

1969 – 1975 Technical University of Darmstadt

Degree: Diplom-Ingenieur (MA in Civil Engineering and Water Management)

June 2006 up to now Head of the Section „Water Management Planning and Strategies“ in the Bavarian State Ministry for Environment, Health and Consumer Protection, responsible for the Implementation of the Water Framework Directive in Bavaria

2005 - 2006 Head of the Department „Climate Change, Water Framework Directive and Hydrological Services“ in the new Bavarian State Office for the Environment

2002 - 2005 Vice-president of the Bavarian State Office for Water Management and Head of its Department „ Hydrological Services“ (including Climate Change)

1999 – 2001 Head of the Department „ Central Services“ (including Finance, Human Resources, Electronic Data Processing) of the Bavarian State Office for Water Management

1992 - 1999 Head of the Section „ Hydraulics, Hydrology and Flood Warning” (including Climate Change and Project Evaluation) of the Bavarian State Office for Water Management

1989 - 1991 Water Department of the Bavarian State Ministry of the Interior, Section for Groundwater Protection at Industrial Sites, Waste Disposal Sites and Sites for the Use of water endangering substances

1984 - 1988 Regional Office for Water Management Weilheim (Upper Bavaria): Flood Protection, Torrent and Avalanche Control, Management of Sylvenstein Dam (Flood Control and Low Flow Augmentation); Groundwater Protection at new and old Industrial Sites

1979 - 1984 Bavarian State Office for Water Management: Project Evaluation; Cost-Benefit-Analyses; Management of the Bavarian Water Transfer System from the Danube to the Rhine Catchment; Minimal Water Requirements in Rivers

1976 - 1978 Post Graduate and Qualifying Studies for the Bavarian Water Administration

Andras Horanyi
Hungarian Meteorological Service (OMSZ), Department for Weather Forecasting and Climate, Division for Numerical Weather Prediction and Climate Dynamics

Education:

1989: Master degree in meteorology (Lorand Eötvös University, Budapest)

1996: Ph. D., Lorand Eötvös University, Budapest

Experiences:

Participation on the adaptation and development of the first numerical weather prediction model in Hungary.

Leadership of the national climate dynamics programme of Hungary

Gheorghe Constantin

Romanian Ministry of Environment and Sustainable Development

Gheorghe Constantin is Director for Water Resources Management in the Romanian Ministry of Environment and Sustainable Development. He is in charge with the implementation of the EU Directives in the water field, international cooperation for water management and development of the water regulations and strategies. Before working in the ministry he has worked as a Civil Engineer for developing water infrastructure, mainly water supply, irrigation and drainage.

Otto Pirker
Eurelectric WG Hydro, Verbund Austrian Hydropower AG

Born in 1954 in Austria. Dipl.-Ing. Dr. Otto Pirker obtained his diploma in Environmental Engineering at the University of Natural Resources and Applied Life Sciences in Vienna, Austria, and his Doctor's degree (Dr.rer.nat.tech.) in 1993 at the same Institute. Since 1982 he is employed at Verbund, the largest hydropower company in Austria.
Specialisation: water management, hydrology, hydropower development and ecological matter related to hydropower. His main experiences are in hydropower in general, hydrology of hydropower stations and water management. Mr. Pirker is the Austrian representative and chairman of the working group „hydro" at EURELECTRIC. He is also the chairman of a working group at VGB dealing with hydropower and the implementation of the EU – WFD. In several national organisations Mr. Pirker has a leading function as a hydropower expert.

Since 2003 Mr. Pirker has a lecture at the University of Natural Resources and Applied Life Sciences in Vienna, Institute of Water Management, Hydrology and Hydraulic Engineering on hydropower and water management.

Otto Schwetz

Tina Office Vienna

Otto Schwetz is a Counsellor of the Senate of the City of Vienna. He studied law at the University of Vienna, earning a law degree in 1973, and spatial planning at the Technical University of Vienna. He has worked for the Vienna Institute for Location Policies, as Deputy Head of the Danube Area co-ordination office, and is the Chairman of the working group for Transport of the Working Community of the Danube Regions (ARGE Donauländer). In 1996 he was the Deputy Head of the Co-ordination Office of the Chief Executive Office; in 1997 Deputy Head of International Relations Department of Chief Executive Office and Head of TINA (Transport Infrastructure Needs Assessment for Central and Eastern Europe) - Secretariat of the European Commission, DG TREN. Since 1998 he works as Manager of the Pan-European Transport Corridor VII, the Danube by appointment of EC-DG TREN and UN ECE. From 1998 to 2001 he was President of the Danube-Oder-Elbe Association, President of the International Canals and Waterways Organisation (ICWO), Washington D.C. (USA) and Head of Chief Executive Office-European Integration – Coordination Office European Transport - TINA Vienna and new TINA Vienna Transport Strategies Ltd. In 2002 he became a member of the executive board of PIANC, section Austria. Since 2003 he is CEO of TINA VIENNA Transport Strategies Ltd., a member of the Vienna Holding Ltd. In September 2005 he was elected for the 1st Vice-President of the Austrian Waterways and Inland Navigation Association and in November 2007 he became President of PIANC, Austrian section.

Christine Bratrich
WWF International, Danube Carpathian Programme

Dr. Christine Bratrich holds a PhD in Environmental Science at the ETH Zurich (Switzerland). Before coming to WWF, she worked for seven years at the Swiss Federal Institute of Aquatic Science and Technology (eawag) and for three years at the Institute for Hydraulic Engineering at the University of Stuttgart (Germany). She has significant experience in training, lecturing and coaching of freshwater ecology, restoration management, and environmental assessment. Currently, she is heading the freshwater programme of WWF's Danube-Carpathian Programme Office with staff based in Austria, Bulgaria, Romania, and Ukraine. She coordinates about 20 conservation projects and is responsible for WWF's high level policy-work with key partners (e.g. the European Commission, European Parliament, national governments, and ICPDR).

Thomas Stratenwerth
Federal Ministry for Environment, Nature Conservation and Nuclear Safety

Head of Unit "General, fundamental, International and European Aspects of Water Management"; Co-Chair of the Strategic Steering Group of the CIS-Activity on Climate Change and the EU Water Policy; Co-Chair of the Task Force on Water and Climate under the UN ECE Water Convention.

16 List of participants

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MÜLLER Gabriela	Austria	Ministry for Agriculture, Forestry, Environment and Water Management
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SPASIC Dragana		ICPDR
VOGEL Birgit		ICPDR
WELLER Philip		ICPDR
VARGA Lucia Ana		ICPDR President
RIAHI Keywan		IIASA
IGNJATOVIC Jovanka		The Regional Environmental Center