

**26th Session of the EFC Working Party on the Management of Mountain Watersheds****19th to 22nd August 2008, Oulu/Finland****AUSTRIAN NATIONAL REPORT****1. Impact of Climate Change on Natural Hazards in Austria**

The impacts of global warming are already apparent in the Alps, since mountain areas are exceptionally vulnerable to climate change. In the last years, frequent extreme events like storms and heavy rainfall have increasingly caused debris flows and floods, associated with considerable ecological, economical and social damage. Scientific studies predict further significant climatic changes for the future. These prognoses base on several different assumptions of emissions levels. On this basis a maximum global increase of temperatures by 6.4°C has been computed for the end of the century. The most likely figures, however, are between 1.8°C and 4.0°C (IPCC 2007). In addition, a decrease of 20% of the mean summer precipitation is expected in the Alps. By contrast regional changes between -10% and +20% have been computed for winter precipitation. As a result the seasonal distribution of precipitation will shift and the frequency and intensity of extreme events will increase.

Due to the location of large parts of Austria within the Alpine arc and related climatic conditions, the country is at considerable risk of being affected by natural disasters. Destructive floods, debris flows, land slides, rock fall and avalanches threaten especially areas in the mountainous regions. Without protection from natural disasters, Austria's river valleys would not be usable for permanent settlement. Alpine flood events are characterized by short acceleration time and strong sediment (bed load) transport. Drift wood causes extraordinary risks of inundation if bridges are blocked.

Recent research results indicate that Climate Change has a paramount impact on natural hazards in the Alpine environment. The following changes are expected:

- probable increase of **floods** in frequency and amplitude (above 100-year-flood) induced by
  - increase of precipitation in the winter, which falls as rain at lower altitudes and causes floods in combination with snowmelt ("rain on snow")
  - increase of intense rainfall up to high altitudes and extreme weather phenomena in the summer with high regional impact on floods and debris flows
  - shifting of snow line
  - soil desiccation → increase of surface runoff and floods
  - lower attenuation of floods due to the damage of protection forests and the change of the vegetation cover (by pests, erosion damage, over cutting)
  - increase of sediment transport due to melting permafrost (moraines) and the damage to natural vegetation caused by erosion and avalanches
- increase of **avalanches** in frequency and run out distances caused by:
  - heavier snowfall at middle and high altitudes in the late winter
  - sudden increase of temperatures up to high altitudes (Feb. 2008)
  - increase of snow drift
- extreme low water periods and **droughts** mainly in the summer due to an intensified evaporation and lower rainfall; thus increase of utilisation of water resources
- lowering of the water table; reduction of reservoirs of storage dams
- risk of **rock falls** and **slides** caused by:
  - melting permafrost
  - melting glaciers
  - Loss of cohesion of huge soil slopes

- intensive rainfall
- increase of precipitation in the winter
- threat to protection forests
- changes of natural vegetation
- drought cracks
- **soil erosion** intensified by:
  - dehydration of soils
  - melting permafrost
  - retreat of glaciers
  - damage to protection forests
  - changes of natural vegetation
  - more extreme rainfalls and debris flows in summer
  - full-depth avalanches in spring
- Risk of **forest fires** intensified by:
  - reduced rainfall and higher temperatures
  - increased dehydration of soils

Floods turn out to be the most important natural hazard during the last decades. Following the flood events in 1997 and 1999, wide areas in Austria were hit severely by exceptionally rare floods in August 2002, which in part have never been recorded before. These floods claimed nine lives, had very detrimental effects on settlements and caused damages of approximately 3 billion Euros. Three years later, in summer 2005, Austria's west experienced extreme rainfalls up to 250 mm a day, which led to disastrous floods again, causing damages of about 700 million Euros.

Floods are natural phenomena that cannot be prevented. However, modern flood protection can reduce the disastrous effects of floods to an acceptable intensity. Therefore, flood risk management is committed to the principles of sustainable flood protection, building on the interaction of prevention, protection and provision combined in an integrated flood risk management strategy, taking into account that extreme flood events can neither be prevented nor fully controlled (residual risk). All flood prevention strategies by structural or non-structural measures are based on a key planning instrument, the hazard map. This well established instrument preserves all necessary information concerning the intensity and frequency of flood events and displays the areas affected by floods (red or yellow zones). Hazard maps serve as basis for land use planning, building trade and security planning.

## **2. Projects and Research Programmes related to Climate Change**

### **Flood Risk I + II (BMLFUW)**

Natural disasters such as floods or droughts have always had severe effects on humankind. In the 20th century, the number of severe flood disasters increased. In summer 2002, heavy floods also affected many regions of Austria, with severe consequences for settlements and industrial areas. This calls for pressing ahead with the implementation of integrated flood management, including measures for immediate protection and relief efforts as well as ecologically oriented flood prevention. The project Flood Risk was based on the 2002 flood event documentation (HABERSACK & MOSER, 2003). The analysis marks the next step in creating basic provisions for strategic decisions of integrated flood management.

A cause and effect analysis of the event is based on the results of a total of 46 subprojects in fields such as meteorology, hydrology, geomorphology, natural disasters, economic aspects, the law, spatial planning and disaster protection. This approach yielded suggestions for future improvements ("lessons learned") and suitable implementation strategies of integrated flood management.

After the flood disaster of 2005 the project Flood Risk II was started to implement the results of Flood Risk I in flood protection policy and strategies in Austria. This project runs from 2006 to the end of 2008.

### **ClimChAlp (Interreg III B)**

Administration authorities, researchers and experts from seven Alpine countries closely worked together to analyse and highlight the impacts of climate change in the Alpine Space and to elaborate the basis for adaptation strategies. The strategic ClimChAlp project "Climate Change: Impacts and Adaptation Strategies in the Alpine Space" was initiated by the Bavarian State Ministry of the Environment, Public Health and Consumer Protection. It was carried out in the framework of the Community Initiative INTERREG III B. The project with a total budget of approximately 3.5 million Euros (ERDF share 1.7 million) ran from March 2006 to March 2008.

### **StartClim**

The climate research programme StartClim was implemented in 2002 following extensive floods in Austria. It is based on an initiative of the Austrian Federal Minister of Environment. StartClim developed into a research programme for new topics concerning climate and climate change, analysed from different points of view and by different scientific disciplines. Results achieved so far demonstrate that substantial research work on climate, climate change and its impacts in Austria is essential. The large number of approximately 80 Austrian scientists and more than 30 Austrian institutions participating in StartClim show that the required know-how is available in Austria and is still growing.

### **CIRCLE (EraNet)**

Climate change is increasingly seen as one of the world's major challenges of the 21st century, and Europe is taking a leading role in responding to it. Whatever the success of mitigating climate change may be, certain impacts are unavoidable and European countries will need to adapt to these impacts, depending on the particular vulnerabilities and exposures in the different regions of Europe. Their adaptation response must be informed by a coherent body of research and it is CIRCLE's prime objective to contribute to such efforts by aligning national research programmes. This process will be a strong support for the overall goal: Implementing a European Research Area (ERA) for the field of climate change.

CIRCLE started in summer 2004 and will extend its activities within the ERA-Net frame for 2005-2009.

### **MEDEA (data information system for meteorological extreme events in Austria)**

The Austrian Environmental Agency is establishing a data information system for meteorological extreme events together with partners from AustroClim/StartClim and with the IIASA. MEDEA's scope: Meteorological extreme events are hitting Austria on a more and more frequent basis. Whether this is due to climate change is the subject of current research activities. Recent research results point to a correlation between global warming and the occurrence of extreme weather events - also in the Alpine region. MEDEA contributes to the research efforts for climate change by creating a common and integrative data basis which will provide new possibilities for data analysis. MEDEA aims to provide easy access to extreme weather data for the Austrian research community. MEDEA encompasses data on hail and thunderstorms, storms, droughts, heat waves, extreme precipitation as well as morphological and ecological impacts such as floods, forest fires, mudflows, landslides, avalanches, extreme erosion and of course the socio-economic damage caused by these events.

## **3. Adaptation Strategies and Recommendations**

- Transnational cooperation in the Alpine Space should be further intensified to exchange experiences, knowledge and methods between administration, technical authorities, and scientists. A continuous and long-term transnational and interdisciplinary cooperation for the development of common tools for risk prevention and management as well as implementation of harmonised adaptation strategies is indispensable. This cooperation should also interlink the experiences and results elaborated in different projects to be efficient and effective.
- Broadening and deepening the knowledge on climate change and its related impacts in the Alpine Space represents the basis for the elaboration of sustainable adaptation strategies. Climate scenarios on regional scale are an essential prerequisite for any future activity. Therefore climate data sets have to be harmonized in terms of temporal and spatial resolution to get more reliable model data for future climate scenarios. Methods for correcting uncertainties in model projections have to be developed and

- tested to derive regional impact scenarios with a high spatiotemporal resolution. Continuous monitoring of the data-sets is necessary.
- Monitoring of slope deformations and other natural hazards (e.g. avalanches, glaciers, debris flows) should be used for identifying critical areas as well as for protecting already existing settlements. It constitutes the basis for reduction of costs in protection works as well as potential damage restoration after a disaster remarkably. Monitoring represents an essential contribution for precaution and prevention. Therefore it can be used as an early warning system and finally contributes essentially to an integrated risk management.
  - Historic data as a retro-perspective analysis tool should be included for all kind of monitoring and scenario building. Therefore adequate databases should be continuously maintained on a transnational level. Transnational cooperation and information exchange should be promoted and data exchange facilitated.
  - A common transnational terminology concerning the assessment of risks and harmonization of different approaches of danger and hazard mapping should be elaborated to enable an efficient transnational cooperation. Such a harmonisation which follows homogenous minimum standards is also postulated by the Alpine Convention. Furthermore models for intersectoral (e.g. flood, erosion, slope deformations, etc.) hazard mapping should be developed and discussed on transnational level.
  - Hazard maps are still lacking in many municipalities. Comprehensive databases including all relevant spatial information on municipality and sub-local level should be established. Geographic Information Systems containing land-use and land cover, all available sectoral risk information and binding spatial regulations are most appropriate for this purpose. Such databases allow the detection of climate change-related spatial risks and are the precondition for adjusting and enhancing spatial planning on local and regional level.
  - A “risk dialogue” has to be initiated between experts, administration and the public. Risk communication substantially improved. This process should inform inhabitants and land owners about the on-site risks and the individual responsibility for risk precaution. Policy-makers should discuss and clarify in principle the balance between State and private responsibility for risk prevention, precaution and adaptation, also promoting a direct involvement of insurance companies.
  - Awareness raising, interdisciplinary communication and cooperation were identified as key factors of climate change adaptation. Therefore transnational campaigns on risk management and communication should be implemented to support adaptation actions on local, regional, national and transnational level. Policy-makers, administration, researchers, associations, enterprises as well as the public should be actively involved in those campaigns.
  - The cooperation between science and practice should be improved. Interfaces between spatial planners, technicians, industry, the leading economic branches and service providers, the police, fire brigades, civil protection, politics, the army and other stakeholders should be institutionalised.
  - The transnational Flexible Response Network established within ClimChAlp should be further developed and maintained. Transregional and transnational coordination of natural hazards management techniques should be enforced. Intensifying cross-border cooperation, sharing of experience and knowledge on integrated natural hazard risk management at operational and strategic level is best suited for facing all relevant effects of climate changes regarding natural hazards and risks.
  - An interdisciplinary, integrated approach of natural hazard and risk management and elaborated master plans (e.g. including local emergency trainings) should be continuously adjusted during and after extreme events. This approach represents the basis for a sophisticated early warning system. Although this kind of prevention requires adequate financial means and does not show immediate results, it is in the long run the cheapest and most sustainable way to save lives and goods.

- Development of an Alpine Protection Forest Strategy with attention of climate change and the resulting impact on mountain forests
- Adaptation of European Funding Principles and Strategies (LEADER, ELER etc.) in consideration of the economical future of alpine agriculture: Subsidies should focus on ecologic function of rural work rather than on specific agricultural products.
- Cross-linkage of basic functions of living in sensitive ecosystems (alpine valleys, highlands, mountain areas, sub arctic region) taking into account hazards and risks
- Fulfilment of goals due to the Kyoto-treaty: Counter-measures for the reasons of Climate Change in front of adaptation strategies.
- Discussion of a safety-charge in natural hazard management (design criterion) in adaptation to Climate Change
- Flood Risk Management focused on the whole river basin following the principles of “more room for the rivers” and “balancing the risk”