alpS – Centre for Climate Change Adaptation Technologies

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Nordkette, Innsbruck, Austria. Photograph by Bernd Öggl.

Climate change in mountain regions

Following the findings of the Fourth Assessment Report of the IPCC (Solomon et al. 2007) and of the Copenhagen Diagnosis (Allison et al. 2009), global climate change is an indisputable fact. It will impact on every sphere of society, on every environmental niche, touch every region of the globe and will reshape human-environment systems as never experienced before. Mountain regions are particularly vulnerable to global climate change and they are highly sensitive indicators of climate change, e. g. approximately 7 000 km² of mountain glaciers have disappeared in the last four decades of the 20th century (Nogués-Bravo et al. 2007). Impacts on mountains will also have significant repercussions for adjacent lowlands. For example, mountains are the source for 50% of the world's rivers (Beniston 2003). In fact, half of the world population depends on mountain resources (Hassan et al. 2005). In the light of the gravity of challenges that global climate change will present in the near to mid-term future for humanity in general and for mountain regions in particular, the urgency to act now cannot be overstated.

This volume presents an impressive collection of research by the Institute of Mountain Research: Man and Environment (IGF), undertaken to shed light on causes, processes and outcomes of change in mountain regions. It is likely that these processes of change will be driven increasingly by climate forcing and consequently will accelerate in future. To confront these challenges goes beyond the realm of scientific concern – it is the global responsibility of the 21st century. Despite mitigation efforts to reduce greenhouse gas emissions, it is clear that global climate change will not be stopped from unfolding throughout the 21st century. Therefore, adaptation is the only way to avert the most threatening impacts of global climate change and indeed seize the opportunities it presents.

The concept of adaptation has expanded beyond its original biophysical realm to include human systems. Hence, adaptation is seen as the process by which social groups add improved methods of coping with the environment to their cultural repertoire (O'Brien & Holland 1992). Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, as well as autonomous and planned adaptation. Even if immediate benefits of adaptation measures can be achieved in a relatively short time, i.e. a few years, these measures have to be designed to meet social, ecological and economic (the "classic" pillars of sustainability; see Deutscher Bundestag 1998; UN Documents 2002) as well as cultural and political needs of the present and future generations. Sustainable and planned adaptation is thus called for.

To make adaptation work, there is a pressing need now for a concerted effort of all parts of society. Only an inter- and transdisciplinary approach that integrates all stakeholders can produce solutions for the requirements of science and business, of public administration and private households, of policy and decision makers.

For the successful implementation of newly developed adaptation technologies and strategies, communication, education, awareness building and knowledge transfer are vital.

alpS will focus on mountain regions and provide sound understanding of the regionally specific effects of global climate change, analyse the resulting constraints, opportunities and innovation potential in key resource areas and develop sustainable and commercially viable solutions in the technological and the socio-economic realm as a response to present and future challenges. Thus, it is the vision of alpS to develop adaptation technologies and sustainable solutions in order to

- meet the growing environmental and societal challenges of global climate change in mountain regions;
- reduce costs for society and secure profits for businesses by minimizing the bad risks and seizing the opportunities presented by global climate change;
- make Austria a market leader as business and research location for climate change adaptation technologies in mountain regions.

alpS is funded within the framework of the Austrian COMET – Competence Centres for Excellent Technologies Programme, which started in April 2010 and integrates scientific with business interests. The new centre is built upon the alpS – Kplus Centre for Natural Hazard and Risk Management founded in 2002 (Veulliet et al. 2009).

Tackling complexity

Global climate change entails a multitude of interlinked processes in the natural environment. Mountain systems are highly complex systems in themselves. Throw in the various needs, dependencies and drivers of human societies and the result is a system of almost insurmountable complexity. Untangling this web of interlinked processes and isolating the most important subsystems in order to develop scientifically sound, socially acceptable and economically feasible adaptation strategies and technologies is the objective of alpS. This requires clear priorities, tightly focussed objectives and a rigorously formulated research strategy (Fig. 1).

alpS is organized in three research areas according to spheres of the natural environment in which human-environment interactions take place: GEO, HYDRO and BIO. Within the GEO area, issues of the abiotic mountain environment are addressed. These include potentials related to and processes induced by topography and lithology (e. g. natural hazards, mountain tourism, solar and geothermal energy) and their impacts on mountain societies. The HYDRO area is focused on potentials and processes of the water cycle (e. g. shrinking cryosphere, variable water availability, hydropower) in mountain regions and their impacts on mountain societies. The BIO area addresses land-use management issues in mountain regions as well as ecological change aspects of global climate change (e. g. agriculture, forestry, fishery).

Apart from this clear thematic grouping of research projects based on the predominant sphere of human-environment interaction, alpS investigates the multiple impacts of global climate change on mountain societies following a three-tiered research logic that comprises i) an analysis of climate change impacts, ii) an evaluation of risks and opportunities and iii) the development of appropriate adaptation technologies and strategies in mountain regions.

The concept of risk lends itself particularly well to providing a theoretical framework within which processes of global climate change can be approached. It also lies at the heart of the alpS core competence stemming from its history and long-term experience in natural hazard and risk management.

Risks of change, change of risks

Since all future developments intrinsically exhibit some degree of uncertainty, they can be discussed in terms of a risk-conceptual framework. Within the research and development activities of alpS, the concept of risk

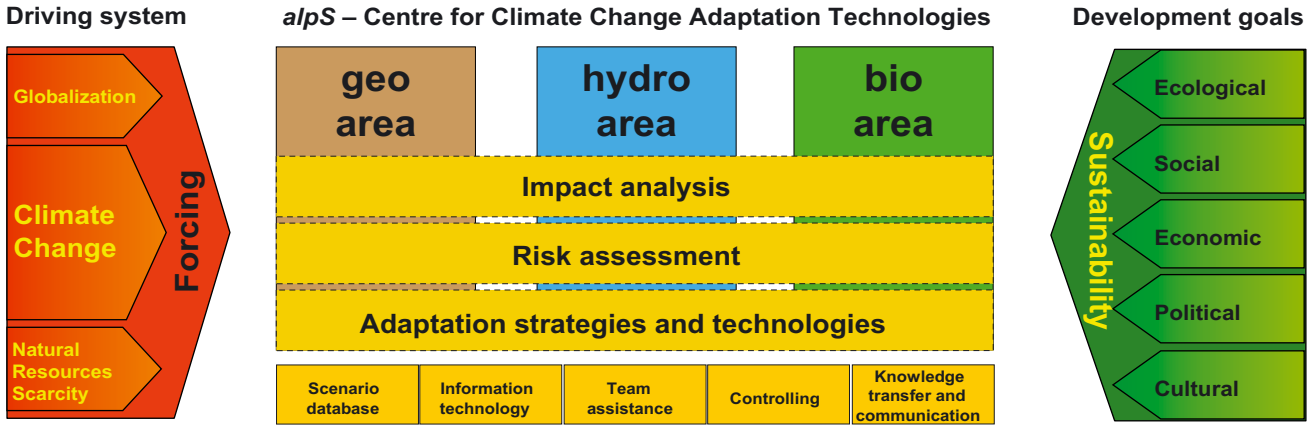

Fig. 1: Structure of the research areas of alpS.

is applied to the uncertain impacts of global climate change on environment and society on regional and local scales (UNEP 2007), whether the consequences be negative or positive. The linkage between impact and the exposed systems is determined by the sensitivity of the reacting system to the external impulse. As in most risk concepts, vulnerability and capacity or resilience are the interacting factors that govern the dimension of risk and as a consequence the adaptability of the human-environment system.

In global change research, risk has to be understood as an open and uncertain future, bearing options for both positive and negative outcomes. Thus, the often negatively connoted concept of risk is superseded by a neutral understanding allowing for both good risk, i. e. an opportunity to be grasped, and bad risk in the classical sense of a negative option to be avoided (Stötter & Coy 2008).

Risk concepts have a high integration potential (e. g. Bohle & Glade 2008; Veulliet et al. 2009) as they intrinsically tie together aspects of both the human and the natural environment system. They provide a vital prerequisite for the postulated inter- and transdisciplinarity of alpS. Since risk analysis helps to understand the likelihood of occurrence as well as the magnitude of an anticipated impact it constitutes the primary decision-making tool for development and deployment of adequate adaptation measures.

Communicating adaptation

As mentioned earlier, climate change adaptation goes far beyond a scientific interest. On the one hand, basic research to understand change processes in their enormous complexity is urgently needed; on the other hand, adaptation is a process that requires implementation carried by society in its entirety. Without adaptation of our behaviour, our way of producing and consuming, in short, our way of life, climate change adaptation research is worthless. To make climate change adaptation happen, excellent research is vital, but also dedicated and targeted communication of its results. Knowledge dissemination that reaches all involved stakeholders is paramount to the success of alpS and to successful climate change adaptation in general. Therefore a dedicated Knowledge Transfer and Communication Team will communicate scientific findings and present adaptation strategies developed by alpS to all parts of society. Again, the seven years of the alpS – Kplus Centre for Natural Hazard and Risk Management have given alpS a huge head start. A close network of business and scientific partners, of stakeholders in public administration and politics, of individuals and organizations has been developed and will now serve as an infrastructure already in place to be expanded, developed and utilized for the cause of climate change adaptation in mountain regions.

Research location Innsbruck

The close cooperation between the University of Innsbruck, and here the research focus Alpine Space – Man and Environment and in particular the research focus Global Change – Regional Sustainability of the Institute of Geography, as well as the Institute of Mountain Research: Man and Environment of the Austrian Academy of Sciences has been described as the "Innsbruck research triangle" (Borsdorf 2007: 16). Indeed, the collaboration in a multitude of research projects, the exchange of ideas, the mutual inspiration and the sharing of expertise between research personnel and not least a common approach and goals have produced synergies that have made Innsbruck the third most important research location for mountain research worldwide (see Körner et al. 2009). The new alpS – Centre for Climate Change Adaptation Technologies will continue to contribute to this successful pooling of research energy, certainly benefit from the world-class research infrastructure in place, form a bridge towards business and industry and honour the tradition of mountain research at one of its most obvious locations, in the heart of the European Alps.

Acknowledgements

The authors thank Johann Stötter and Annegret Thieken (alpS) who substantially contributed to the concept of the Centre for Climate Change Adaptation Technologies. Parts of the proposal and concept were used in this article.

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