

Path to the summit – inspire and drive sustainable mountain regions

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Managing Alpine Future 2007 – committing to a vision

It is four years since the first Managing Alpine Future Conference was held in Innsbruck.

Understanding global climate change as an indisputable fact with multiple challenges to human-environment systems, especially in mountain regions, the first conference, targeted at stakeholders from academia, governments, non-governmental and civil society organisations, international organisations and the private business sector, tried to stimulate and foster the interdisciplinary cooperation among them.

Recognising that mountains worldwide are facing a specific and new challenge and in order to maximise cross-fertilisation in the field of mountain research and development, the 2007 conference drew up the “Innsbruck Declaration” that documented the participants’ willingness to strengthen joint efforts to adapt mountain societies to this situation (Borsdorf et al. 2008):

The conference ‘Managing Alpine Future’ took place from October 15–17, 2007. The event brought together more than 400 scientists, practitioners and politicians from over 20 nations.

The international, inter- and transdisciplinary exchange of findings and experiences proved to be an important additional benefit. Based on sound scientific knowledge, the participants conclude that global warming is already a reality and will be reinforced in the future. Likewise, all areas of society and the economy are affected by the political, economic and cultural globalisation. In this context, mountain regions are especially vulnerable and are thus in need of regional adaptation strategies. In order to develop these, existing gaps in research should be closed, inter alia, in the fields of agriculture, society, health, mobility, energy and tourism, i. e. in core elements of Alpine economies. Joint efforts of science, politics and the industry are needed to face the challenges of global change in a sustainable way and effectively take advantage of the opportunities.

The participants of the conference welcome the willingness of the State of Tyrol to support this dialogue also in the future. They explicitly demand of the political and economic decision makers that they contribute to this process. That means that ‘Managing Alpine Future’ must be continued as a permanent dialogue, something that the present organisers – the University of Innsbruck, the Austrian Academy of Sciences and alpS – Centre for Natural Hazard Management – are prepared to do.

Managing Alpine Future II – our mission

As an initiative of the University of Innsbruck, the Austrian Academy of Science, and the alpS – Centre for Climate Change Adaptation Technologies, it is the intention of the conference “Managing Alpine Future II”, Innsbruck, 21–23 November 2011, to pursue the path set by the first conference.

In this sense, all activities to continue the discussion processes started four years ago are based on our belief that:

Mountains are inseparable human-environment systems

We understand mountains as inseparably connected human-environment systems. As the natural environment and the ecological systems comprise vital resources for basic functions in human life, natural and human systems are linked by a variety of interactions and feedback processes and are intrinsically interwoven as regional human-environment systems (e.g. Becker & Jahn 2000, 2006; Funtowicz & O'Connor 1999; GLP 2005; Kates et al. 2001; Price et al. 2004; Wardenga & Weichhart 2006; Weichhart 2005). In these systems the natural spheres, i.e. litho-, atmo- hydro-, bio-, and pedosphere, interact in many ways with the anthroposphere.

Regional/local mountain human-environment systems are open systems in the sense that they interact with the environment they are embedded in through the exchange of energy, material and information. The forces of globalisation accelerate this exchange. In fact, these mountain human-environment-systems are home to ca. 700 million people living there in highly specialised societies (Messerli & Ives 1997).

Mountains are especially vulnerable to global change

Their limited spatial niches make mountain human-environment systems especially vulnerable. They lack spatial alternatives and often quickly reach the limits to existence. As a consequence, they are facing intensified threats from global change impacts, both climate change and globalisation (Stötter & Monreal 2010).

The complex topography as well as the specific and spatially intensive variability of human–environmental systems further contribute to increasing the effect of global climate change on mountains regions far beyond average (Becker & Bugmann 1997). It is evident that in some mountain areas warming trends and anomalies are elevation dependent (Giorgi et al. 1997; Matulla et al. 2004a), and temperatures increase more rapidly at higher altitudes (e.g. in the Alps). The impact of intensified climate change on natural mountain environments has become especially apparent in the shrinking water storages of the cryosphere (Lemke et al. 2007; UNEP & WGMS 2008). This causes further drastic changes in regimes and amounts of runoff in mountain and adjacent lowland rivers (Viviroli et al. 2007; Bates et al. 2008). Glacier retreat and the thaw of permafrost in turn destabilise mountain slopes and endanger life and infrastructure in the valleys (Stoffel et al. 2005).

It is the unique characteristic of mountain areas that natural, i.e. meteorological, hydrological, biological/ecological, geomorphological, conditions change sharply within relatively short distances. Due to general warming or changes in precipitation, boundaries between these systems undergo dramatic shifts and extraordinary

spatial variations of environmental resources, which imply tremendous challenges to societies in mountain areas.

Although there is a common pattern of global climate change challenges to mountain areas worldwide (e.g. melting cryosphere, increase in natural hazards), the position in the global circulation system and the specific state of development vulnerability and resilience/coping capacities make for great differences between mountain regions. While adaptation in the Alps may aim at maintaining a tourism-based economy and the resulting quality of life, in mountain regions like the Andes or the Himalayas the growing water scarcity raises the fundamental question of sheer survival.

Mountains are of global importance

But when we talk about mountains from a global perspective, we have to take into account the highland-lowland connections as well (UNCED 1992; Hassan et al. 2005, 2005). The mountains of the world have an exceptional relevance on a global scale as they provide resources and ecosystem services to half of the world population, water and minerals (Becker & Bugmann 2001; Löffler 2004; Viviroli & Weingartner 2004), not forgetting leisure and tourism aspects (Siegrist 1998; Smeral 2000). Climate change impacts in mountain regions will thus have significant repercussions for adjacent lowlands. If current levels of quality of life for both the people in mountain regions and those in dependent lowlands are to be sustained, adequate adaptation strategies to these challenges must be implemented now (Messerli 2010).

As human-environment systems, mountains are causally determined linkages of all natural spheres with the anthroposphere. Due to the complex topography as well as the specific and spatially intensive variability of highly specialised human-environmental systems, mountains are regions affected by climate and socio-economic change processes far beyond average. Furthermore, as global climate change is essentially a multi-faceted challenge and not a formally defined scientific discipline, this challenge can only be answered by an inter- and transdisciplinary approach, guided by the principle of embracing all available scientific knowledge for the development of practical solutions. As mitigation efforts have turned out to be insufficient, interdisciplinary dialogue and joint efforts of the international mountain community aim to inspire and drive sustainable adaptation.

Since 2007 progress has been made in many areas in mountain research worldwide. For the Alps, Price et al. (2001) have summarised the progress since the first Rio summit in a paper provided for the Swiss Presidency of the Alpine Convention. Within the DIAMONT project, a comprehensive and harmonised database was developed for the Alps, which provided the basis for an atlas of the Alps (Tappeiner et al. 2008). The Alpine Convention published a series of Reports (Permanent Secretariat 2008), and CIPRA a series of thematic publications on the Alps. The Alps are still the best researched mountain range in the world. In Austria a CD-ROM and booklet on climate change was produced that also took the European scale into account (BMWF 2008).

However, sustainable development is a major concern in all mountains of the world. The second Mountain Conference “Global Change and the World’s Mountains” in Perth, in 2010, followed this global perspective (<http://www.perth.ac.uk/specialistcentres/cms/conferences/perth2010/pages/default.aspx>). Prior to that, a COST Strategic Workshop with 400 participants on “Global Change and Sustainable Development in Mountain Regions” was held in Innsbruck in 2008 (Jandl et al. 2009). UNEP organised a conference on mountains as early indicators of climate change at Padova in 2008 (UNEVP 2009). Kohler & Marcelli (2009) published a book on mountains under climate change conditions, Nagy & Grabherr (2009) on alpine environments, while Veulliet et al. (2009) addressed natural hazard management in alpine environments. The GLORIA initiative carried out their second monitoring survey (Grabherr et al. 2010). IGF published a comprehensive book on challenges for mountain regions (Borsdorf et al. 2010).

Continuing the way paved by the Managing Alpine Future conference in 2007, international representatives from science, industry and public authorities are invited to discuss the status quo, potential future developments of technologies and strategies at a transnational and transdisciplinary level.

Innsbruck Mountain Competence – the whole is greater than the sum of its parts

In Innsbruck, the development of *Innsbruck Mountain Competence* is the local answer to the challenging situation of mountain human-environment systems identified and highlighted by the first Managing Alpine Future conference. For the main players in mountain research at Innsbruck, the logical next step following on from this conference was to join in a close cooperation called *Innsbruck Mountain Competence*.

Through the joint research focus on mountain human-environment systems, the alpS – Centre for Climate Change Adaptation Technologies (alpS), the Institute of Mountain Research: Man and Environment of the Austrian Academy of Sciences and the University of Innsbruck (the research focus Alpine Space: Man and Environment in general, and the Institute of Geography in particular) agreed on forming competence triangle for mountain research (see Figure 1). Within the University of Innsbruck, the University Research Focus Alpine Space – Man and Environment, the Alpine Research Station Obergurgl and the Research Centre Global Change – Regional Sustainability of the Institute of Geography contribute to the competence centre of mountain research and development in Innsbruck. While the University Research Focus Alpine Space – Man and Environment provides numerous research initiatives in a wide range of scientific disciplines, the Research Centre Global Change – Regional Sustainability of the Institute of Geography supplies the vital theoretical background for the consortium. In addition to contributing its internationally recognised research competence with a focus on Austrian mountains, the Institute of Mountain Research: Man and Environment (IGF) understands its role as that of an interface to the most important international networks, in close cooperation with the Mountain Research Initiative in Berne. With its large network of

private sector business partners, the alpS – Centre for Climate Change Adaptation Technologies guarantees a strong linkage to all relevant stakeholder communities within the consortium by carrying out target- and transformation-oriented research. Education, research and application are the pillars of the *Innsbruck Mountain Competence*. It also aims at disseminating research findings to practitioners and at encouraging dissemination of information and interaction using innovative and dedicated tools of communication technology, such as social networks, a wiki, GIS tools, clearinghouse and teaching tools, developed within 7FP project mountain.TRIP, coordinated by the IGF (Braun 2010).

Close cooperation within the partner network is guaranteed through joint staff and research projects at national and international level. All partners in Innsbruck contribute in a specific way; the synergies and capacity building potential add most of the value of the centre of competence in mountain research and development in Innsbruck. The combination of basic research and applied stakeholder-oriented research, of theory and practice, of indoor and field laboratories, of research and education demonstrates that in times of rapidly changing human environment systems, mountains with their resources and risks need new approaches and new research strategies. The main objective of the *Innsbruck Mountain Competence* is addressing the vital need for system, target and transformation knowledge, and – to a certain degree – also management knowledge.



Figure 1: Innsbruck Mountain Competence.

Climbing the mountains – some paths to the summit (with special reference to Austria and Switzerland)

The perception of environmental issues in politics started with the kick-off of the Man and Biosphere Programme (MAB) by the UN in Paris in 1971. A few months later, the first UN Conference on the Human Environment at Stockholm set a landmark for both politics and science. In the same year, the publication of the “Limits to Growth” (Meadows et al. 1972) gained an even wider audience. All these impulses paved the way for the first global mountain project “Impact of human activities on mountain ecosystems” of MAB in January 1973 at Salzburg. Numerous international conferences and projects followed. Based on these and due to the activities of some research activists like Bruno Messerli, Jack Ives, Lawrence Hamilton and others (who, with irony, called themselves the “Mountain Mafia”), chapter 13 dealing with sustainable development in mountain regions was included in the Agenda 21 at the Earth Summit of Rio de Janeiro in 1992. Ten years later, in 2002, the UN General Assembly declared the “International Year of the Mountains”. In 2010 the UN General Assembly finally passed the resolution “Sustainable Mountain Development”, thus giving a new impulse to politics and science (see Messerli 2010).

It can be presumed that activities of the “Mountain Mafia II”, which includes leading scientists and stakeholders like Martin Price, Bernard Debarbieux, Rolf Weingartner, Thomas Körner, and networkers like Thomas Schaaf, Thomas Scheurer and Gregory Greenwood, have supported these political processes and declarations.

In 2012 the leading statesmen of the world will meet again in Rio de Janeiro, 20 years after the first Earth Summit of Rio de Janeiro and ten years after the International Year of the Mountains. Some mountain scientists expect this event to make the year 2012 an “Anno Mirabilis”, a year of wonders, a turning point in the perception, policy of and research on mountain regions. The conference Managing Alpine Future II intends to inspire scientists from all over the world to prepare for the challenges of 2012.

As regards the development of mountain research in Austria and Switzerland, which Körner (2009) ranked among the three leading regions of mountain research worldwide, two minor paths to the summit should be mentioned, those of Austria and Switzerland. As mentioned above, the first global mountain project started in Salzburg, Austria. Another MAB project, dedicated to the Ötztal, Tyrol, brought researchers from many countries together for the case study of a highly complex Alpine environment. GLORIA, the Global Observation Research Initiative in Alpine Environments, installed about 100 monitoring sites (target regions) and some master sites in the most important mountain ranges around the world in order to observe the effects of climate change on mountain ecosystems. At the same time, the National Committee on Alpine Research was founded by the Austrian Academy of Sciences. In 2006 it established a research unit for mountain research and upgraded it into an institute in 2010 – the Institute of Mountain Research: Man and Environment (IGF).

In Switzerland, following initiatives from the IGBP and IHDP programmes, the Mountain Research Initiative (MRI) was conceived in 1999 and implemented some time later. This institution realised the project Global Change in Mountain Regions

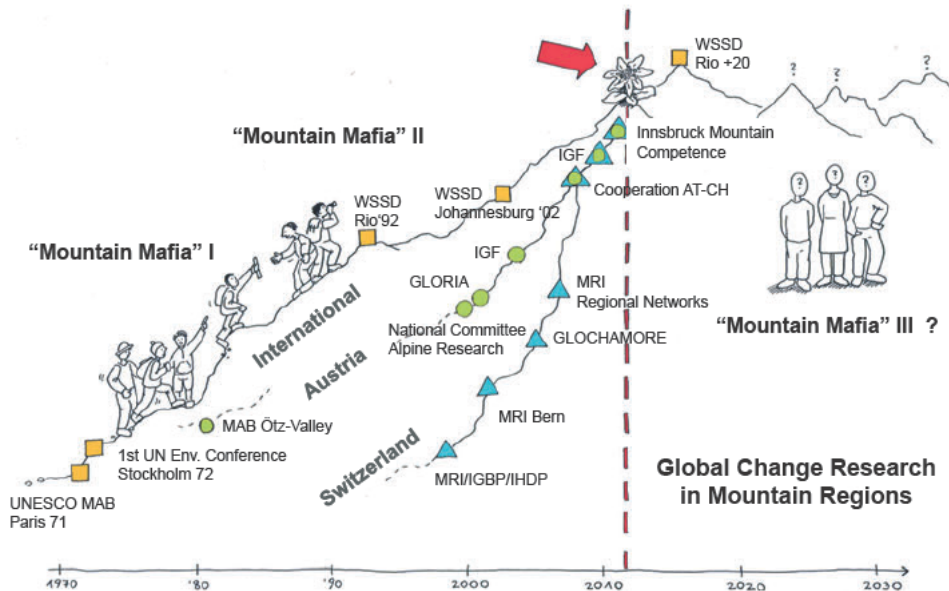


Figure 2: Ascending to the summit (sketch prepared by Astrid Björnsen-Gurung).

(GLOCHAMORE) within the 6th Framework Programme of the EU. The need for international cooperation led to the development of international and regional networks by MRI. In 2009 MRI and IGF decided to cooperate in operating mountain networks at European scale, i. e. MRI-Europe, Science for the Carpathians (S4C) and South Eastern European Mountain Research Network (SEEmore). Astrid Björnsen-Gurung, employed by IGF and MRI, is in charge of these networks and drew a simplified sketch (Figure 2) showing the different paths to the summits and the joining of the Austrian and Swiss paths, which could be a model for other cooperations of mountain science communities all over the world. It also becomes clear in this sketch that the main challenge for all of us will be the onward climb to a successful Rio + 20 conference in 2012.

What is also evident: we need a next generation of mountain scientists to carry on, not only with research but also with political influence and actions. This is why the conference Managing Alpine Future II specifically addresses young scientists.

Proceedings of the conference

The current volume includes the contributions to the conference that passed the review process successfully. A complete overview including all abstracts is accessible on the conference homepage (www.alp-s.at/cms/conference). A second volume with the keynotes of the conference will follow in 2012.

The papers were proofread by Matthias Monreal (IGF and alpS) and layouted by Kati Heinrich and Valerie Braun (IGF). Harmonising the literature references was

a major challenge as most authors did not keep to the format provided by the editors. In some cases it was not possible to check all references against the original publication and so some are still incomplete or do not correspond to the quote in the text. As we intended to present the volume at the conference, we had to accept some deficits.

In contrast to the first Managing Alpine Future conference at Innsbruck (Borsdorf et al. 2008), the thematic areas were not defined in advance. So the organisers grouped the accepted papers in thematic areas. Seven foci have been defined, which build the chapters of this book and form the themes of the main conference sessions:

- Climate Change: from palaeo-climate to climate modelling
- Natural Resources and Ecology: from alpine meadows to ecosystem services
- Tourism and Energy: from mobility to snow-making
- Society and Culture: from education to migration
- Ethics and Politics: from consumer behaviour to multi-level governance
- Spatial Planning: from hazard zoning to land-use changes
- Hydrology: from flood retention to integrated water resource management

It is not surprising that the bottom-up process to arrive at the main chapters proved to be the key challenge of Managing Alpine Future. Climate change is one driver of transformation, globalisation being the other. Adaptation strategies and technologies are urgently needed to address these issues and to protect ecosystem services; to manage risks and hazards, especially in the hydrosphere; to develop tourism and energy further and to adapt spatial planning, political strategies and governance. Society and mountain culture are severely affected and the ethical aspect needs even more attention than before.

While the keynotes will focus on the general aspects, the contributions to this volume mostly concentrate on case studies in mountains all over the world. Articles cover the European mountain regions in total and examples from the Alps, the Scandes, the Hebrides and Iceland. The Andes are examined with reference to Bolivia and Chile. Papers on Asia analyse the Himalayas, the Central Mountain Ranges and the Turkish Black Sea Mountains, other case studies refer to the New Zealand and the Japanese Alps. Some papers include a comparative perspective.

In terms of themes, most articles cover not only system knowledge but also target and management knowledge in the search for ways to control and manage future developments in mountain regions. Topics of conference and proceedings volume include forest and forest fire management, land-use change, sustainable development, management of floods and runoffs, coping with water stress and scarcity, securing ecosystem services, climate change adaptation and vulnerability, groundwater availability, biodiversity, conservation and protected areas, permafrost, tourism, transport, renewable energies, consumption, demographic change and gender perspectives, perception, languages, social capital and quality of life.

The sub-systems all interlink: specific analyses of individual sub-systems are useful but only a general and integrated view of the super-system of mountain regions as provided for instance by the Global Land Project (GLP 2005) can give a comprehensive insight into the interrelation of the systems, the ongoing processes and the



Figure 3: Scheme of the mountain system (adapted from GLP 2005).

options for steering development in a sustainable direction (Figure 3). In the debates following the presentations, the multi-disciplinary setup of the conference can be turned into an interdisciplinary dialogue and, by including the contributions of practitioners, into a transdisciplinary dialogue. The editors will give a summary of the knowledge created in this way in the follow-up volume of the conference.

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The conference motto reads “Inspire and drive sustainable mountain regions”. We hope all conference participants and all readers of this book will be inspired and able to drive mountain development into a sustainable future, not only with respect to the unique nature, the mountain population and economy, but also to the benefit of the many people depending on the resources and ecosystem services provided by the mountains for their daily life.

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