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CLEAR editorial

Anthropogenically-induced climate change is per force a global phenomenon. However there will be stark regional differences in its impact. This differentiation derives in part from geographical variations in the changes to various sub-components of the climate system. Such changes, although difficult to attribute indubitably to anthropogenic influence, include modifications in the severity and frequency of occurrence of wind and rain storms, cyclones and droughts; in the patterns of oceanic circulation and sea and lake-level elevations; in desertification and glacier lengths; and in species diversity.

It is therefore of central importance to acquire an adequate understanding of the regional dimension of climate change and its impacts. Indeed the adoption of a regional approach is fundamental for the development of appropriate response strategies for mitigation and adaptation. In effect the extant processes for establishing global policy are of limited utility. They can only provide a framework and boundary conditions that need to be sustained by transformations taking place at the regional scale – changes in technologies, lifestyles, and institutions.

In this context the Alpine region is a particularly interesting area for the study of climate change. The region has always been, and remains, very sensitive to climate extremes and the vagaries of weather. Climate variations impact noticeably upon the duration of wintertime Alpine snow-cover and the extent of glaciers. Extreme weather events such as heavy precipitation and floods have pronounced impact, and phenomena such as landslides, mud flows, and avalanches are an on-going threat. Thus climate change induced modifications of the mean state of the Alpine atmosphere and variations in the severity of weather phenomena will be physically evident. Moreover, Alpine ecosystems, that have adapted to highly specific conditions which vary greatly over small altitudinal distances, could be subject to disruption and selective species extinction from loss of habita. In environmental terms, therefore, the Alpine region is highly vulnerable to climate change.

Concomitantly the present socio-economics landscape of the Alpine region is characterized by great wealth, a notable capacity to gain economic advantages from seemingly adverse circumstances, and a sensitive awareness of the natural environment's fragility. For climate policy, this has two major implications. First there may well be greater opportunities to pursue active climate policies in the Alpine region in comparison with other parts of the world. For example a readiness to perceive and seize upon advantages accruing from trail-blazing as a "first-mover" or, if not in the pioneering role, of operating effectively as a "fast-follower". Second an opportunity to build upon the ground-swell of public opinion prepared to countenance supplementing the economic rationale of climate policy based upon a primary concern for the avoidance of monetary damages with a societal rationale based upon the concern to for the avoidance of aesthetic and moral damages. The latter consideration is strengthened by the opportunities for economic advantages from moving either first or as a fast follower.

In the early 1990s a group of Swiss researchers engaged in a regional integrated assessment (IA) of Climate and Environment in Alpine Regions – the CLEAR project. The project drew together teams of researchers from numerous universities and several research institutions, and moreover the participants spanned a wide disciplinary spectrum that included atmospheric science, paleo-climatology, ecology, economics, and sociology.

The CLEAR project was part of the Swiss priority programme environment that aimed to foster transdisciplinary research. Within the CLEAR project a number of disciplinary projects investigated different aspects of regional climate change ranging from climate scenarios, impacts on ecosystems, and options for adaptation and mitigation. In addition a participatory process of Integrated Assessment (IA) formed an integral part of the project. This IA component aimed at covering the phenomenon of climate change in Alpine regions, its impacts and response options from a wide variety of perspectives.

CLEAR has proceeded in two waves. The first wave led to a wide-ranging collection of analyses about climate and environment in Alpine regions, together with a methodological proposal for regional integrated assessment (Cebon et al. [1]). The proposal took into account the heterogeneity of the scientific knowledge, and the irreducible uncertainty, of such an endeavor. Moreover, it recognized that a reduction in any specific uncertainty by additional research effort could, and almost invariably does, give rise to new uncertainties within the process. This tendency for a proliferation of uncertainties is particularly prevalent at the disciplinary interfaces (compare the macro-scopic uncertainty principle advocated by Pahl-Wostl [4]). Thus effective regional integrated assessments in the complex domain of climate change must deal with both heterogeneous ensembles of knowledge, and with mixtures of knowledge and ignorance. In the CLEAR project's methodological proposal

it is argued that feasibility depends upon the language games of science being embedded in a structured debate taking place in ordinary language.

It was against this backcloth that the second wave of CLEAR was conducted. Its design included several novel elements. A procedure for IA-focus groups was developed (in collaboration with the ULYSSES project, as documented in Kasemir et al. [3]). Groups of citizens were convened with a stratified random procedure (ensuring representation of various segments of the population) and given access to integrated computer models referring to climate change in the Alpine region. The creation and design of the latter models for this explicit purpose was a crucial part of CLEAR (see the contribution of Pahl et al.). Another key element was the bringing together of highly specialized researchers to interact both with each other and with ordinary citizens in debates about climate change. One outcome was that effective discussion between the constituents was possible without getting struck in the technicalities of specific disciplinary contributions.

The conduct of the IA-focus groups and the results of the deliberations were pivotal to the CLEAR process, and it is appropriate to provide an indication of their flavour here as a prelude to the subsequent sequence of contributions. Within the groups the discussion on climate change was broad ranging. Swiss citizens clearly see climate change as part of a much larger issue: the perception that there is something deeply amiss in the relationship between humankind and its global environment. This is viewed as a matter of moral and aesthetic judgment rather than one of scientific and economic rationality. What seems to be at stake is a lack of prudence and fairness, not simply of knowledge and efficiency. At the same time, however, these citizens take scientific and economic aspects into account when deliberating about possible ways out of the current impasse.

How then do citizens assess climate change in Alpine regions? The perception of environmental risks is overt. Anthropogenic climate change may disrupt features of Alpine landscapes which Swiss people in Switzerland value in aesthetic terms and for which they feel a moral responsibility both individually and collectively. Glaciers may melt away, floods and mudslides may increase in frequency and intensity, forests may drastically change their composition, some Alpine-confined species may disappear. In monetary terms it is acknowledged that the vagaries of global financial markets are of more immediate relevance to the Swiss economy than these broader aspects of climate change but money is not all that matters in life.

Moreover, citizens consider the impacts of climate change in other parts of the world are also important part of the overall problem. The problem is conceived not as one of monetary costs caused by specific alterations of the climate system, but as a situation in which humankind is perceived to be abusing the planet in pursuit of short-sighted and sometimes ruthless projects rather than inhabiting it as our shared home.

No simple solution emerges from the deliberations, and indeed this is testimony to their seriousness. What does emerge, however, is a vision inviting further research and further action. It is the vision of a low-energy society (see Imboden and Jaeger [2] and the contributions by Imboden and by Jaeger et al. in this issue). It is salutary to record that the citizens involved in IA-focus groups run within CLEAR in general see this as an attractive option! Irrespective of its correctness this viewpoint deserves to be noted.

Switzerland is a country that has turned a lack of resources into a comparative advantage. Less than a century ago the Alps carried connotations of a lack of agricultural land, difficulties for transport, and serious dangers in daily life. Accepting of the challenge posed by these conditions, the inhabitants developed skills and institutions that enabled them to establish a stable and secure society and to engage successfully in a variety of economic activities – including the marketing of the Alpine experiences to tourists world-wide. Is it mere naivety that prompts citizens, enjoying the fruits of wealth created by such enterprise, to perceive that a low-energy society could bring about more, rather than less, well-being?

A possible response of scientists in the climate community would be to dismiss the presumed naivety of the IA-focus groups as day-dreaming divorced from practical consequences. An alternative is to ponder whether the community should engage itself in an open dialogue with citizens on the moral and aesthetic concerns voiced by the focus groups. After all a physics-based insight of, say, translucent, lenticular Alpine clouds does not preclude an appreciation of its sheer physical beauty. Indeed scientific research on, and the social and political resolution of, a myriad of physical, ecological, social, and economic aspects of climate change will be confronted by the need to recognize and accommodate such differing, but not necessarily incompatible, sensibilities. It is in this spirit that we offer the basket of papers on climate and environment in Alpine regions that appear in this special issue.

The issue starts with a consideration of key physical processes. Frei et al. explore extreme precipitation and flood events. They demonstrate that some of the relevant physical processes could be sensitive to climate change, while a sound detection of changes in extremes by means of observational analysis is essentially impossible today, and will likely remain so during the next few decades. Both of these aspects could have implications for risk protection, infrastructure planning, water managment and insurance. Urban water management or flood-protection rely heavily in their risk assessment on the relative likelihood of such events. Climate change also offers chances for surprise at longer time scales, and Appenzeller et al. show that non-linear changes in the characteristics of natural climate modes can lead to an important uncertainty

in long-term projections of future climate changes. The mean state of the North Atlantic Oscillation and its long-term variability may have a pronounced effect on Alpine climate and the likelihood to be able to provide evidence for global warming. And as recent research has shown, abrupt changes in the thermohaline circulation of the North Atlantic may lead to a major disturbance in the climate over Europe and indeed world-wide. The likelihood for such changes depends on the emission history, in particular on the rate of increase in the carbon dioxide concentration of the atmosphere. In general the scientific community, including the IPPC, have eschewed detailed consideration of such high risk low probability events. However, such events are of potential importance, excite significant public interest and their study offers fascinating scientific challenges.

We then move to biological phenomena. Climate change could have a pronounced effect on Alpine ecosystems, and indeed they are believed to be particularly vulnerabe. Guisan et al. discuss the potential threat of climate change to biodiversity. An increase in temperature might induce a migration of the optimal species richness belt by several hundred meters upwards in elevation.

Finally consideration is given to the human factor in climate change. What are response strategies to cope with the risks of climate change at the regional level – both in terms of adaptation and mitigation? This question is different from an older one: what are response strategies to cope with actual climate change? The latter question is relevant for the study of important transitions in human history, including the so-called neolithical revolution, the fate of the Maya, and many more. However, we live in a different world. On the one hand, the technological and institutional dynamics of today's global society display an amazing and sometimes frightening ability to overwrite specific environmental circumstances. On the other hand, global society has developed an unprecedented ability to shape its own future – not via some central bureaucratic authority, but via a complex interplay between myriads of people acting in institutional settings like multinational corporations, financial markets, scientific organizations, government agencies, mass media, etc. In this interplay, expectations of future opportunities and risks play a key role – for investment in internet companies no less than for levels of oil production. In such a world, expectations of climatic risks require and trigger response strategies in their own right, well ahead of any actual unequivocally harmful climate change.

As a consequence, we have linked the investigation of response strategies with discussions involving various stakeholders, especially, but by no means only, citizens. A new methodology was developed for this purpose. This methodology encompasses the development of a specific kind of model and information platform that was used in IA-focus groups. The CLEAR platform, discussed by Pahl-Wostl et al., served as a means to integrate scientific information from the different projects within CLEAR on the causes of climate change and its global and regional impacts. Much emphasis was given to the analysis and communication of uncertainties. The option of a low-energy society is introduced to embed the climate change problem into a wider range of societal concerns. Such an embedding is a prerequisite for the discussion of any mitigation options at the regional scale.

Behringer et al. report on the assessment of adaptation options in tourism and in agriculture. Tourism and agriculture are of major importance for the economic prosperity of mountainous regions. It is evident that adaptation should be possible and that factors other than climate change may influence the development of these economic sectors. The assessment of climate change as well as its impacts were discussed with stakeholders of the tourism industry in focus groups. Farmers were questioned about their perception of climate change and the importance of the topic for farming. To use these results for an integrated research remains an ongoing challenge.

The contribution by Jaeger et al. reports how citizens perceive climate risks and the future development of energy use. They report on the method of IA-focus groups to explore citizens' views on climate change. An important result is that citizens perceive the future characterized by high levels of energy use as nightmarish, while they tend to see a future characterized by low levels of energy use as an attractive option. However, such a low-energy future should be achieved at low costs – a contradiction?

Imboden argues that a low-energy society is feasible in a country like Switzerland. The technological options and the lifestyle changes required are within the realm of what can be realized in the decades to come. The option of a low-energy society implies a reduction of current per capita energy consumption in European countries by a factor of three. Imboden argues that such a significant reduction in energy use is of utmost importance if one attempts to stabilize carbon dioxide concentrations.

In conclusion we record some central and overarching messages of the CLEAR project. The first is that the scientific community needs to devote increasing attention to the analysis of uncertainties and the effective communication of the associated issues. Second climate change research needs to devote more attention to options to reduce energy consumption in the short and medium term at low costs. Finally, the methodology of IA-focus groups seems a promising approach to include the opinion of citizens and other stakeholders into the research process.

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References

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