



The Mountain Research Initiative (MRI): What Comes Next?

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The Mountain Research Initiative (MRI): What Comes Next?



MRD continually explores new avenues to promote global change research in mountains. Since the Swiss National Science Foundation (SNSF) renewed its funding for the initiative in 2010, MRI has pursued its program of global and regional networking activities, synthesis workshops, and new communication modes, but is now going beyond them to investigate more sustained efforts.

Research themes emerging from Perth

The conference on “Global Change and the World’s Mountains” in Perth in 2010 provided a snapshot of the current status of global change research in the world’s mountains, from which the mountain research community constructed assessments of important future research themes (Greenwood 2010; Björnson Gurung et al 2012). The following emerged as important themes over the next 5–10 years:

- Mountains in the global South;
- Nature and trajectory of ecological systems under global change;
- Institutions and social systems;
- Interactions between social and ecological systems;
- Global social drivers;
- Long-term monitoring (observing systems);
- Ecosystem services;
- Human agency in the mountains;
- Communication;
- Human presence in the mountains;
- Integrated analysis and modeling for land sustainability.

To translate these general themes into more concrete actions, MRI convened a 1-day workshop of its Global Commission at Imperial College, London, immediately following the International Geosphere-Biosphere Programme’s (IGBP’s) “Planet Under Pressure” Conference in March 2012. The MRI

Global Commission consists of the Swiss principal investigators who sponsor MRI at the SNSF, as well as MRI’s Scientific Advisory Board augmented by active mountain researchers.

The Global Commission brainstormed possible activities for the mountain research community with respect to each of these themes (Figure 1). Results were captured in detailed mind maps (available at <http://mri.scnatweb.ch/gallery/63>), which MRI later developed into initial descriptions of 9 “Concerted Efforts.” A few of these Concerted Efforts are discussed below.

Invitation to contribute

MRD intends to further develop these draft Concerted Efforts and invites members of the community to contribute their thoughts via e-mail. Efforts that gain traction within the community will certainly be included in MRI’s next proposal to the SNSF in 2013.

A union of mountain-observing sites

In 2005 the Global Change in Mountain Regions (GLOCHAMORE) project envisioned a worldwide global change research program using comparable methodologies and supporting comparative analysis, to be implemented through a network of mountain Biosphere Reserves. It was—and still is—a sound scientific idea, but numerous institutional and financial problems have limited its pursuit.

Instead of declaring a global program and then attempting to implement it in previously defined sites, an alternative route might be to work with specific sites and researchers to develop a comparative global program. This is how

evolution works: it does not create something entirely new by design, but rather uses the pieces it currently has available—the existing programs and researchers in this analogy—to fashion something that serves new purposes: in this case, a comprehensive global research program.

Which are these existing programs, researchers, and sites in our case? Networks such as the Global Observation Research Initiative in Alpine Environments (GLORIA) and the Mountain Invasion Research Network (MIREN) are among the best known and best working. Their highly specific foci—on alpine plant community composition change due to climate change (GLORIA) and on the invasion of mountain floras by exotic plants (MIREN)—have been key to their success, bringing together coherent communities of researchers who fund their activities independently. The fact that these networks are successful without centralized funding indicates that where there is an intellectual will, there is usually a financial way.

Other networks arising from institutional bases include the mountain sites within the South African Environmental Observing Network (SAEON), the 5 sites of the Western Mountain Initiative (WMI) in the United States, and the multiple mountain sites of the Chinese Academy of Sciences (CAS), among many others. In addition, a great variety of stand-alone sites and research teams from around the world could greatly expand representation of the world’s mountains in global change research. Many of these sites owe their existence to the extraordinary efforts of individual scientists, such as the site of Jebel-al-Akhdar in Oman, established by Reginald Victor of the Sultan Qaboos University.

FIGURE 1 Brainstorming MRI's future: Hilde Eggermont (UGhent) describes her vision, while Greg Greenwood listens and Astrid Bjørnsen Gurung captures the ideas in a mind map. (Photo by Claudia Drexler)



What glue could hold together a network of research sites? The recent launch of a mountain Long-Term Ecological Research (LTER) network (<http://gmba.unibas.ch/mountainLTER/mountainLTER.htm>) under the auspices of the Global Mountain Biodiversity Assessment (GMBA) highlighted the comparability of measurements. The research questions pursued at the 6 sites were quite diverse, even though the sites (1 in the Rockies and 5 in the European Alps) are representative of just 1 class of mountain regions: midlatitude temperate mountains with a pronounced cryosphere. The least common denominator among the sites was not a research question but rather the core environmental measurements that all sites conducted, with the emerging imperative to ensure data comparability.

It remains to be seen if this focus is sufficient. The history of GLORIA and MIREN shows that a focus on questions,

rather than data, promotes continuity. Instead of declaring research questions in a top-down manner, it might be more sustainable to determine what questions can be answered based on the available sites. With just a little additional effort, we might be able to address at many of the sites some of the following research questions that emerged at the MRI Global Commission workshop, and in that way approach the more holistic vision of GLOCHAMORE.

A campaign to detect accelerated climate warming at high elevations

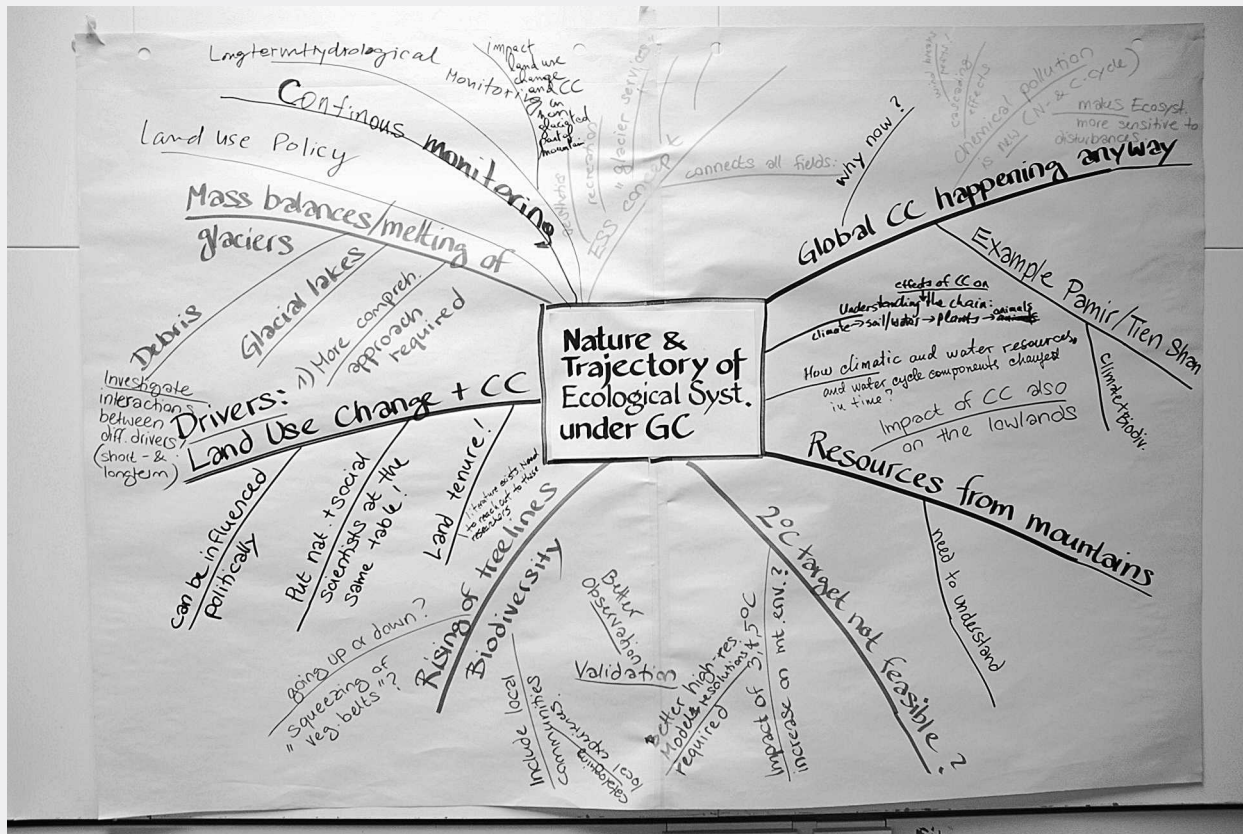
It is an article of faith that high elevations are very poorly represented in the global observing network. It then follows that we need more observing stations at high elevations. Although this might be correct, the community has had very mixed success in

establishing more observatories at high elevations. In contrast, the GLORIA and MIREN experiences teach us that focusing on key questions rather than a data deficit heightens the chance of success.

The rate of climate warming is certainly a leading candidate for becoming such a key question. Rangwala and Miller (2012) reviewed the available data and concluded that “a conclusive understanding of these responses will continue to elude us in the absence of a more comprehensive network of climate monitoring in mountains.” This uncertainty matters, because the mountain cryosphere is a critical reservoir in many parts of the world. Impact assessments based on a global rate of warming will be strongly biased if the rate of warming at high elevations is greater than the global mean.

There is a considerable strategic difference between seeking new infrastructure and seeking answers to

FIGURE 2 Mind map of the MRI Global Commission's brainstorm regarding the nature and trajectory of ecological systems in mountains (see MRI website for more details). (Photo by Claudia Drexler)



a question. The first is an agency responsibility, has no final endpoint, and leads immediately to questions of recurrent cost. The second, although often requiring new infrastructure, is a scientific question, has a clear endpoint, and leads to a discussion of the activities needed to answer the question. This final point should outline what might be a large but nonetheless finite observation campaign fundable by research rather than by line agencies. The question of the rate of climate warming, along with the questions outlined below, could be a key element in the program of whatever union of mountain-observing sites can be created.

A global treeline network

As the mind map regarding the trajectory of ecological systems in mountains (Figure 2) shows, the MRI Global Commission singled out the

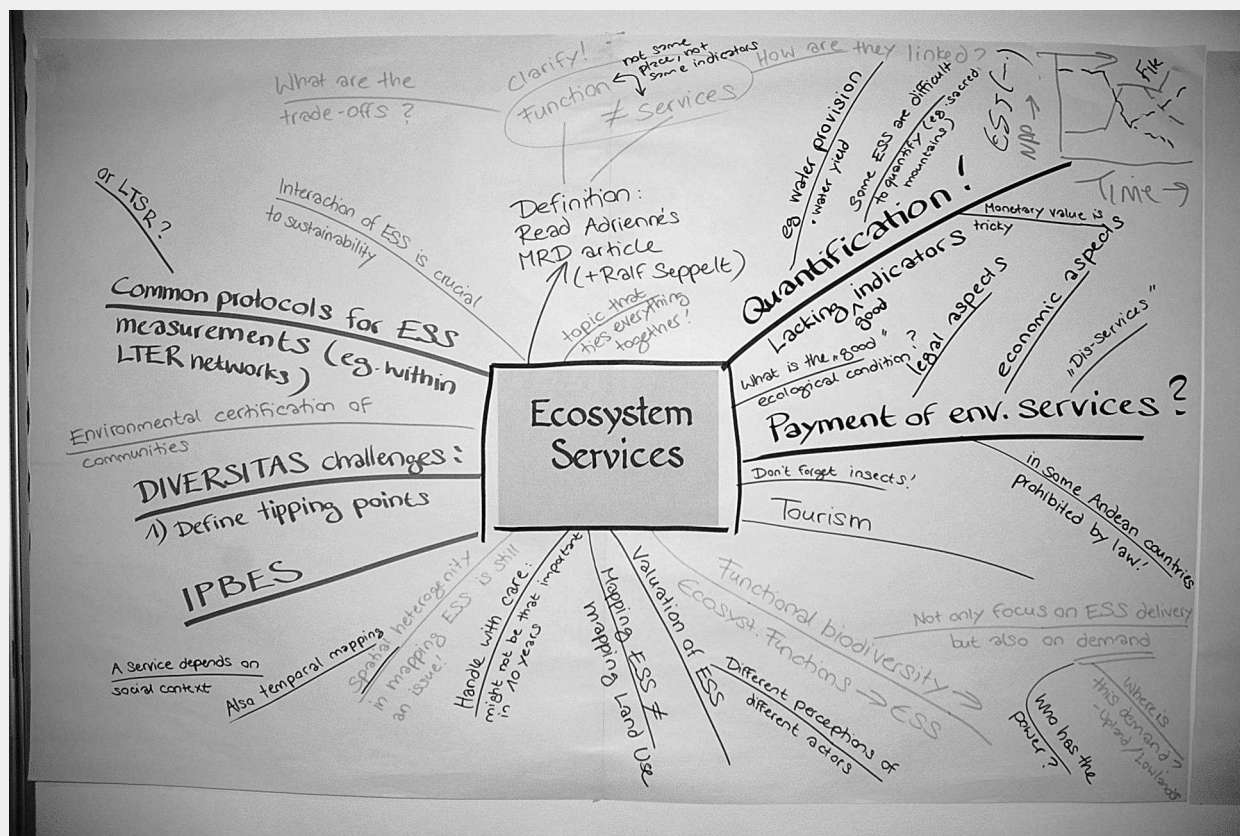
cryosphere and the treeline as sensitive indicators of climate change. The treeline was a major topic at the 2011 American Geophysical Union (AGU) meeting, and is the research focus for many members of the Mountain Geography Specialty Group of the American Association of Geographers (AAG). It is therefore surprising that a global network formally devoted to treeline research does not yet exist.

This story has its own lessons to impart. The European Council for Science and Technology (COST) is currently reviewing a proposed Action entitled "Enhancing the Resilience Capacity of SENSitive Mountain FOREst Ecosystems Under Environmental Change" (SENSFOR). This COST Action focuses on treeline forests and involves creating a network of treeline researchers from European nations. Harald Bugmann, MRI's previous president and an eminent

forest ecologist, organized an outline of Switzerland's interest in this topic. At the same time, David Cairns of Texas A&M University is organizing a workshop at the MtnClim 2012 meeting in October to scope the creation of a North American treeline network. As it turns out, Bugmann will also be at the MtnClim meeting; should the North American contingent get organized, they would have someone closely associated with the corresponding European effort already in their midst. This is how viable projects often begin: not by design but by fortuitous coincidence.

Continuing the metaphor developed further above, the treeline activity suggests not so much evolution—as was the case for the union of mountain-observing sites—but rather supersaturation, where just a slight vibration leads to a complete change in state. The

FIGURE 3 MRI Global Commission mind map regarding ecosystem services (see MRI website for more details). (Photo by Claudia Drexler)



mountain research community seems ready for a treeline network, and a small effort may suffice to bring forth a functional structure.

Modeling coupled human–Earth systems in mountains

At the Perth Conference, Richard Aspinall, a principal researcher within the Global Land Project (GLP), lauded MRI's use of the GLP conceptual framework but noted that conference participants had barely touched a major theme of the GLP: integrated analysis and modeling in support of land sustainability. He challenged the community to make progress in this area.

At the heart of MRI (and GLP) is the concept of a coupled human–Earth system. The land system consists of 2 large subsystems, the ecological system and the social

system. These subsystems are coupled through reciprocal relationships. The social system impinges on the ecological system via management actions and pollution, whereas the ecological system impinges on the social system via ecosystem services and environmental hazards.

Modeling has been applied to each subsystem, for example in the form of watershed models for the ecological system and economic models for the social system. Coupled human–Earth system models combine these approaches to better understand the cycles of causality within the land system.

MRI has already begun to address this issue, for example at a synthesis workshop on “Building Resilience of Mountain Socio-Ecological Systems to Global Change” led by Julia Klein and Anne Nolin, which centered around coupled systems modeling.

Participants outlined not only a synthesis paper, but also a proposal to the United States National Science Foundation for a research collaborative network. If this proposal succeeds, we will have a situation inverse to that of the global treeline network: an American project could induce a European effort, and together they could attract other sites from around the world.

Quantification of mountain ecosystem services

Ecosystem services is a rapidly expanding area of research concerned with projecting ecosystem structures and functions into economic space. In doing so, it supports the conservation of ecosystem structures and functions via economic rationales and constitutes a principal link in the

coupled human–Earth system construct.

As the respective mind map shows (Figure 3), quantification is both a major concern and a prerequisite for a second major concern—the development of payment for ecosystem services. If you cannot quantify it, how can you get paid for it?

A method for quantifying mountain ecosystem services would operationalize the distinction between ecosystem functions (which occur without human appreciation) and ecosystem services (which require humans to receive the service). It would then provide standard protocols for measuring both functions and services. A deeper historical analysis of ecosystem services could show that the current package of ecosystem services from a given mountain region is not an ecological given but rather a function of which social groups have authority over the ecosystem.

The first step in this longer-term effort will be a synthesis workshop on “Qualities, Vulnerabilities and Management of Ecosystem Services in Mountain Regions Worldwide,” to be held in Switzerland in September 2012. The workshop was initiated several years ago by Ariane Walz of Potsdam, who is now preparing it together with Sandra Lavorel and Adrienne Grêt-Regamey. Although the main aim is to organize the publication of a special issue in a journal, the workshop might nonetheless bring participants together in a way that leads to the longer-term effort described above.

Understanding human societies in mountain regions

Two lines of inquiry emerged for the MRI Global Commission that appear at first glance to be best suited as book projects. The first involves describing the nature and drivers of human use of mountains. This project would update and expand the only available global, data-based summary of mountains—by Huddleston et al (2003)—by examining both the nature of human presence in the mountains and global social drivers in mountain regions (ie 2 of the research themes identified by the Global Commission).

A description of the nature of human presence in mountains would include characterization of mountain inhabitants (demography, education, livelihoods, social capital, identity, vulnerability, etc); the uses made of mountain environments by inhabitants (eg agriculture, pastoralism, tertiary sector), temporary residents (eg tourism), and external populations (eg energy production, water supply); and the governance systems that mediate these interests. The study of global social drivers in mountain regions would address, among others, differential economic development (diversification and specialization), migration, urbanization, cultural globalization, the loss of traditional knowledge and customs, and income inequality.

The second potential book project focuses on defining human agency in the mountains: why and how decisions are made that strongly influence the trajectory of the

coupled human–Earth system in mountains. This project would involve a comparative study of actors’ identities, epistemologies, and interests, as well as historical and contextual complexities, current governance arrangements, and the mechanisms by which change occurs in a range of mountain regions around the world. Each of these book projects could be further developed through sessions at scientific conferences, and each could also serve as a central theme of research within a union of mountain-observing sites.

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