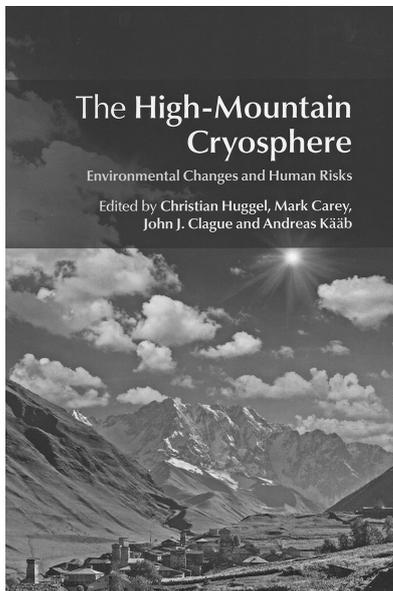


**The High-Mountain Cryosphere. Environmental Changes and Human Risks**, edited by C. Huggel, M. Carey, J.J. Clague and A. Kääh, 2015. Cambridge University Press (University Printing House), Cambridge, United Kingdom. 363 pages. Hardback: price USD 139.00, ISBN 978-1-107-06584-0.



When talking about high mountains within the context of past environments, present-day processes or future developments, we think implicitly of their reactions with the cryosphere. Low temperature impact is reflected in the nature of mountain areas at every latitude. At elevations above the common climatic influence related to sea level, changes are triggered by altitude, when entering the zone of below zero (Celsius) temperatures. The present book has a very meaningful subtitle, “Environmental Changes and Human Risk” – it introduces readers to the multiple interactions between an ever increasing population and a higher susceptibility to damage of the contemporary natural realm. Obvious to us is the fact that climate change (and its consequences, also in the cryosphere) have an impact on the rapidly growing populations, but we are less informed about the reverse situation. However, already in the late 1970s the Polish scientist Marian Pulina observed how inconsiderate water man-

agement could destroy glacier systems and lead to changes in their behaviour (Pulina 1982, 1984). It is easy to add such examples from industry, agriculture or tourism. Both sides of the problem are equally interesting and beg for more detailed studies. In the present book, the editorial team guaranteed a good selection of subject matters and high-quality results, consisting as it does of outstanding specialists of natural and social sciences. Christian Huggel is an expert of cryospheric hazards and mitigation who has authored numerous high-ranking papers and book chapters, edited several scientific works based on experiences from many glacier-covered areas of high mountains across the globe. He is an expert in IPCC and advisor at governmental levels, e.g., in Switzerland where he is employed at the University of Zürich. The social and cultural approach is represented competently by Marc Carey from the University of Oregon, who specialises in the environmental history of South America and other regions, having obtained numerous data on implications of climate changes and natural hazards, in particular glacier disasters on indigenous civilisations. He was also one of authors of the 2014 IPCC assessment report. Publications by John Clague from the Simon Fraser University, British Columbia, Canada, concentrate on Quaternary and environmental earth sciences across a wide range of topics, such as geological mapping, stratigraphy, natural hazards, climate changes and much more. He is both a reputed scientist and an expert of applied geology, both at home and across the globe. Andreas Kääh is Professor for Remote Sensing at the Department of Geosciences, University of Oslo. His works are devoted mainly to remote sensing of the cryosphere in various mountainous areas in the world (e.g., Global Land Ice Measurements from Space), with a particular interest in the Alps. Amongst other things, Andreas specialises in hazard and disaster assessment studies, i.e., analytical

and digital photogrammetry and DEM for terrain displacement measurements. He is very much engaged in the development of cryospheric sciences, having served for many years on executive boards of such organisations as the International Association of Cryospheric Sciences and the International Permafrost Association.

Amongst the 48 names of the authors of the 18 chapters of the book we find internationally renowned specialists from Austria, Canada, Chile, Germany, the Netherlands, Norway, Russia, Switzerland, USA and UK, working under auspices of Glacier and Permafrost Hazards in Mountains (GAPHAZ) Standing Group of the International Association of Cryospheric Sciences (IASC) and the International Permafrost Association (IPA). As the editors' note in the introduction, entitled "Human-environment dynamics in the high-mountain cryosphere", the rapid process of climate change that impacts the high-mountain cryosphere, we can generally observe, with the unaided eye, to be expressed by large-scale disappearance of glaciers, thereby exposing unstable, bareground landscapes, very highly prone to intensive processes of mass movements and hydrological interactions. The rapidly growing world population impacts remote mountainous environments and leads to hazards as a result of commoner human interaction and resource acquisition.

The book aims to answer three basic questions, i.e., to find drivers of environmental, social and economic changes in the relationship between human activity and high-mountain cryosphere; the link between the influence of those drivers on natural and human systems; and the types of risk that result from these interactions. Thus, three essential parts of the book relate to these problems.

The first one, entitled "Global drivers", consists of five chapters, through which we can become acquainted first with the role of climate variability and large-scale circulation in changes of the mountain cryosphere, second with selected aspects of spatial and temporal characteristics of air temperature, precipitation and their extremes in mountainous environments; third, with snow and avalanches and long- and short-term tendencies that influence socio-economic development and, fourth, with problems on the edge of glacier recession and economic exploitation of newly created terranes in frozen areas and their future. Finally, in the last chapter cultural values of glaciers are studied, not only in a market-based background, but also as sociological phenomena in a changing environment.

The second part of the book, entitled "Processes", is the most extensive. In seven chapters

the most serious hazards that we can expect from high-mountain cryospheric environments under climate change and multi-directional human pressure are outlined. In the first chapter we learn how seismic and volcanic activities are connected with climate changes and which implications they have on the cryosphere, as glacier-induced earthquakes and intensification of eruptions followed by mass movements on volcanic slopes. Catastrophic mass wasting (the subject of the next chapter) is especially dangerous for large numbers of inhabitants of piedmont areas. They can be triggered in various ways, inclusive of effects of cryosphere degradation. Many examples of such effects are illustrated from various areas. Slope instability is often caused by glacier and permafrost decay, with detailed description from the Alps and quoting possibilities of forecasting their impacts. High erosional rates in the mountains, where sediments just released from glaciers or by deeper thawing of permafrost, increase the hazard of downwash. Assessment of these processes is carefully done. Glaciers are often seen as inexhaustible water resources. From the text it becomes clear that they vary regionally and moreover that discharge and total storage are decreasing, failing to meet the growing demand, especially in densely populated areas with limited access to water from other sources. In addition, there is also the threat of unexpected flooding, as a consequence of climate instability – such are increasingly more frequent nowadays. This interesting chapter shows the hazard of glacier floods not only to human life but also to the very sensitive cultural and economic infrastructure. In this part we cannot omit the relationships between inorganic and organic systems in the mountains. Processes may vary from place to place, both with the expansion of plants or their disappearance, linked to geomorphological and hydrological effects.

In nature, due to issues outlined, there are environmental consequences and responses, as described in the third part of the book. In the following chapters we meet people that inhabit the Himalayas and learn about the risk they are exposed to from more frequent extreme natural processes. In addition, what happens in the interaction of numerous volcanoes covered by ice (worldwide) and in areas where permafrost is in retreat, leading to a higher frequency of high-elevation debris-flows (e.g., in the Alps, but also elsewhere)? Finally, there is also a reference to increasing water conflicts, not only in glacier-covered environments but also elsewhere.

Finally, co-authored by the editors, there is a concluding chapter that underlines the highly complex nature of the problems touched by this

book. As shown, investigations are difficult both in terms of remoteness and harshness of territories, but also within the context of sensitivity being related to large part of the population that is dependent on the future development of high-mountain environments, not only in natural, but also man-made modes.

There are many scientists, engineers, volunteers, stakeholders and politicians who try to get to grips with problems of environmental change, impacting that part of civilization that is endangered by high-energy areas of high mountains and their forefields, not only from a territorial, but also from a mental point of view. What is needed most is an understanding of how these processes work and what can be expected in the future. On that basis we

can start to design tools and intelligent mitigation systems. The best start is from knowledge gathered and shared by specialists, like the one summarised here.

## References

- Pulina, M., 1982. Karst-related phenomena at the Bertil Glacier, West Spitsbergen. *Kras i Speleologia* 4, 67–82.  
Pulina, M., 1984. The effects of cryochemical processes in the glaciers and permafrost in Spitsbergen. *Polish Polar Research* 5, 137–163.

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