



## **GAPHAZ: improving knowledge management of glacier and permafrost hazards and risks in mountains**

Christian Huggel (1), Chris Burn (2), John J. Clague (3), Ken Hewitt (4), Andreas Käab (5), Michael Krautblatter (6), Jeffrey S. Kargel (7), John Reynolds (8), and Sergey Sokratov (9)

(1) University of Zurich, Switzerland, (2) Carleton University, Canada, (3) Simon Fraser University, Burnaby, Canada, (4) Wilfried Laurier University, Waterloo, Canada, (5) University of Oslo, Norway, (6) Technical University München, Germany, (7) University of Arizona, USA, (8) Reynolds International Ltd., Mold, UK, (9) Moscow State University, Russia

High-mountain environments worldwide are undergoing changes at an historically unprecedented pace due to the sensitivity of the high-mountain cryosphere to climate change. Humans have settled in many mountain regions hundreds, even thousands of years ago, but recent intensive socio-economic developments have increased exposure and vulnerability of people and infrastructure to a large range of natural hazards related to high-mountain processes. Resulting risks are therefore increasing and highly dynamic.

GAPHAZ, the Standing Group on Glacier and Permafrost Hazards in Mountains of the International Association of Cryospheric Sciences (IACS) and International Permafrost Association (IPA), is positioned in this context. The objectives of GAPHAZ are to:

- improve the international scientific communication on glacier and permafrost hazards;
- stimulating and strengthen research collaborations in the field of glacier and permafrost hazards;
- compile a state of knowledge related to glacier and permafrost hazards in high mountains;
- work towards a greater transfer of information and improved communication between the scientific and governmental/policy communities;
- signpost sources of advice to international and national agencies, responsible authorities, and private companies; and
- act as a focal point for information for international media during relevant crises.

GAPHAZ has initiated a variety of activities over the past years to meet these objectives. One of the important issues is the development of standards of (1) how to make and portray technical assessments of glacier and permafrost related hazards and risks; and (2) how to communicate these to the public and a range of actors including those who implement measures. Thereby, difficulties of and need for better translation between techno-scientific understanding, and the situations and concerns of people most at risk in cold regions need to be recognized. Knowledge-transfer from the few well-researched and monitored regions to the more extensive and diverse regions needs to be addressed.. Standards are required to ensure an adequate level of quality and to avoid incorrect assessments with potentially adverse consequences, as experiences in the past have shown. Concepts and terminologies related to hazard and risk assessments must follow recently issued consensus statements, such as those of UN-ISDR and IPCC. Hazard assessments must be undertaken routinely and regularly, combined with appropriate ground-based and remote sensing monitoring. Assessments need to adequately consider the physical processes and their interactions. Integrative risk assessments should be achieved by interdisciplinary cooperation. There is still a lack of integration of physical/engineering and social aspects of glacier and permafrost hazards; therefore communication and exchange between natural and social science experts must be strengthened. In the design and implementation of risk reduction and adaptation measures, a close collaboration among scientists, policy makers, and local populations is necessary. Recognizing different perceptions of risks among actors are particularly important if risk reduction efforts are to be successful. Measures should generally be adapted to the local social, cultural, economic, political, and institutional context. Early warning systems are becoming increasingly important, and a growing number of experiences are available also for high-mountain environments. A systematic analysis and exchange of experiences using dedicated expert networks will be fostered by GAPHAZ in collaboration with other initiatives and actors.