# CONCEPT FOR A SWISS PERMAFROST OBSERVATION NETWORK

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Efforts are presently being made to further develop a network for monitoring the long-term evolution of permafrost in the Swiss Alps. In such a temperate mountain region, glaciers and permafrost are close to melting conditions and, hence, become very sensitive to ongoing climate change. Moreover, because of increasing human activities, the reaction of the cryosphere to an atmospheric warming could generate stronger effects in the future than in the past. In order to document and to better understand the long-term behavior of the cryosphere in the Alps, the Glaciological Commission of the Swiss Academy of Sciences is reviewing its monitoring strategy. In addition to glacier parameters (fluctuation of the length and/or mass balance) recorded since 1880, permafrost parameters should also be monitored.

Alpine permafrost is characterized by a discontinuous distribution, mostly in bedrock or in block sediments, a deep active layer (1 to 5 m) and creeping processes (rock glaciers). The monitoring needs to be partially different relative to polar programs such as the International Tundra Experiment (ITEX) (Nelson *et al.*, 1996) and the Circumpolar Active Layer Monitoring (CALM) (e.g., IPA, 1997) developed for tundra regions. The foundations for a mountain permafrost monitoring network in the Swiss Alps were laid by Haeberli *et al.* (1993) at the Sixth International Conference on Permafrost in Beijing (China). A review of the concept is presented in this poster.

Researchers working on different topics of mountain permafrost have been interviewed to evaluate priorities of the network, potentially monitored variables and methods, financial requirements and data management. A workshop was held in March 1998 to discuss these issues and to jointly improve the concept.

Monitoring in Switzerland began more than ten years ago and in particular, has provided a better understanding of processes related to active rock glaciers. Further activities will consider sites with non-creeping permafrost and even with degrading permafrost. Monitoring will focus especially on the thermal state of the upper part of the ground and on the near-surface energy fluxes. Besides the temperature profile from the ground surface to the permafrost table, the most important parameters to be observed are the thickness, temperature and duration of the snow pack, as well as the air temperature.

Three alternatives for measurement are proposed, depending on cost:

(1) The "low cost" proposal consists of the annual observation of permafrost extent using both continuous and single measurements of the temperature at the base of the winter snow cover (BTS) (20 to 50 sites). The build-up of this "low-cost network" will start in summer 1998.

(2) In the "medium cost" proposal, the temperature profile from the ground surface to the permafrost table and the snow cover conditions are monitored (10 to 15 sites in non-creeping permafrost). Thus, shallow boreholes are to be drilled reaching depths of 5 to 10 m. The sites must be evaluated. The first drilling is planned for the summer of 1999.

(3) The "high cost" consists of deeper boreholes (more than 20 m) and energy balance stations (3 to 5 sites; e.g., existing boreholes at the Murtèl/Corvatsch and Schafberg/Pontresina rock glaciers).

At some sites, other types of permafrost modifications (deep long-term processes, mechanics, geometry, etc.) and associated phenomena (hydrology, snow patches, biology, slope instability, debris flow, etc.) are observed. Photogrammetric and geodesic surveys, as well as deformation measurements in boreholes, which offer important information on long-term permafrost creep processes, are performed at a few rock glaciers (5 to 8 sites).

The proposed network needs several years to be achieved. The concept represents a first step towards an official Swiss Permafrost Observation Network and will be adapted and refined regularly. It could serve as a prototype for other alpine regions. An international coordination between both scientists and mountaineering associations should also allow this concept to represent a first step towards a Mountain Permafrost Monitoring Network in the Alps.

## REFERENCES


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