PERMOS – A Comprehensive Network for Monitoring Mountain Permafrost in the Swiss Alps

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Background

The network for Permafrost Monitoring in Switzerland (PERMOS) passed from first steps in the 1990ies, through a Pilot Phase (2000–2006) and has now reached its Implementation Phase (2007–2010). PERMOS complements the Swiss monitoring networks for snow and glaciers and is an early component of the Global Terrestrial Network for Permafrost (GTN-P) within ICG5/IGIT. Since 2007 PERMOS is managed by a Coordination Office and the Cryospheric Commission (CC) of the Swiss Academy of Sciences (SCNAT). The measurements are undertaken by several partner institutions from academia.

In 2007, the monitoring concept was updated based on experiences from the Pilot Phase and a sound evaluation of all measurement sites took place. In 2008, all approved sites will be updated to a uniform technological and methodological standard in order to consolidate the network until the end of the implementation phase in 2010.

Here, we intend to give an overview on the current state of the monitoring network, present some monitoring results, and describe recent and future developments.

Goal and Strategy

The main goal of PERMOS is the systematic, long-term monitoring of the state of mountain permafrost in the Swiss Alps. Since permafrost is purely defined on temperatures, the monitoring predominantly relies on the measurement of ground temperatures both at the surface and in boreholes in the subsurface. In addition, kinematics related to permafrost occurrence are quantified at each A-labelled site in the underground as well as at the surface at locations of different steepness and with various surface cover.

Evaluation in 2007

The time series of each potential PERMOS site were assessed according to length and temporal resolution, quality, site character, representativity, accessibility, contribution to the GHOST tier structure, and some additional parameters.

Criteria

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<th>Category</th>
<th>A – Approved</th>
<th>B – Retention</th>
<th>C – Reject</th>
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<td>a) Relevance to the overall aim of PERMOS</td>
<td>Measured for the next decades and standardized until 2010, fully financed</td>
<td>Part of PERMOS but subject to re-evaluation in 2009, partly financed</td>
<td>Not included in PERMOS</td>
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<td>b) Importance to society and politics</td>
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<td>c) Importance to research and academia</td>
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<td>d) Feasibility (e.g., accessibility)</td>
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Monitoring Results – Temperatures

Ideally, at each monitoring site temperature samples are measured in the underground as well as at the surface at locations of different steepness and with various surface cover.

Ground Surface Temp.

Ground temperatures at approx. 10 m depth in six different boreholes of the PERMOS Network (cf. Figure 2). Borehole temperatures build the base of the permafrost monitoring in the Swiss Alps, since with them they provide direct measurements of permafrost.

Rock Temperatures

Near-surface temperatures in the Kegel North face area or app. S14°E in a 50 cm cover. Means/cross make the temperature in spring (July) for all years measured and point to the extremely warm conditions in the year 2007.

Outlook

At each A-labelled site the following parameters shall be measured in the scope of PERMOS:

- Ground temperatures at a level 1 m deep borehole, near surface temperatures in steep and flat rock, as well as in debris or blocks, geophysical monitoring (mainly ERT), and climate variables (i.e., at least air temperature and snow thickness). Permafrost core is observed by photogrammetry based on air photos, geosurvey or differential GPS.

A comprehensive monitoring network must be set up among partners from academia and administration authorities, for providing the link to the state of the art knowledge from research as well as to interests from authorities and politics.

Acknowledgements

As a monitoring program, PERMOS involves many contributors and depends on a large number of supporting persons and institutions. The Swiss Academy of Sciences (SCNAT), the Federal Office for the Environment (FOEN), and the Federal Office for Climatology (MeteoSwiss) finance PERMOS. Equally important are the contributions of the academic partner institutions, which measure and provide the data PERMOS bases on.