

Name of research institute or organization:

WSL Institute for Snow and Avalanche Research SLF

Title of project:

-
1. Influences of the snowcover on thermal processes in steep permafrost rockwalls
 2. Long-term permafrost monitoring

Part of this programme:

PERMOS, Permasense

Project leader and team:

Marcia Phillips
Anna Haberkorn
Hansueli Rhyner
Robert Kenner
Martin Hiller
Marco Collet

Project description:

1. In the SNF-funded project entitled 'Influences of snow on permafrost rock walls' (project no. 200021E-135531, project duration 2012-2015) we investigated the role of snow on the thermal regime and mechanical stability of steep rock walls in collaboration with the Universities of Bonn, Fribourg, Zurich and the ETH Zurich. The research sites include the Sphinx north and south rock walls, which were equipped with various temperature and deformation logging devices by ETH and the University of Zurich in the context of the PermaSense project (www.permasense.ch). The data obtained is available online and ideally complements our data on snowpack characteristics, which was obtained manually in snow pits. The properties and distribution of the snow cover in rock walls with contrasting orientations were investigated at Sphinx and compared with those in other permafrost rock walls in the Swiss Alps (e.g. Gemsstock, Andermatt). Snow cover characteristics were modeled in parallel using the 1D model SNOWPACK, which was adapted to allow simulation of very steep terrain conditions.

2. The sub-horizontal Jungfrau Ostgrat borehole is located at 3590 m in the north facing wall of the Jungfrau Ostgrat (E ridge). It is 20 m long and equipped with 9 thermistors and a data logger. Rock temperatures vary on a seasonal basis between -4 and -8°C. The dominant form of heat transfer is conduction. Due to the time lag with depth, the warmest temperatures are registered in December and the coldest ones in May. The high elevation of the borehole and the fact that it is located in a steep, exposed rocky ridge make the data particularly valuable for long-term monitoring. Borehole temperature data now clearly indicate a warming trend (Figure 1). The borehole is part of the Swiss PERMOS network (www.permos.ch) and current borehole temperature data can be obtained and visualized online using the PERMOS data browser <http://shinypermos.geo.uzh.ch/app/BoreholeDataBrowser/>.

Both projects are valuable sources of data for the investigation of the role of permafrost regarding rock slope stability in high mountain regions. A large number of rock slope failures were registered within the active layer in the Swiss Alps during the summer 2015 heat wave (www.slf.ch/ueber/organisation/schnee_permafrost/projekte/felsstuerze_2015/index_EN). Our measurements at Sphinx and Jungfrau Ostgrat allow to discern the evolution of rock temperatures and active layer thickness, as well as the role of the snow cover and of snowmelt on rock temperature and rock slope stability.

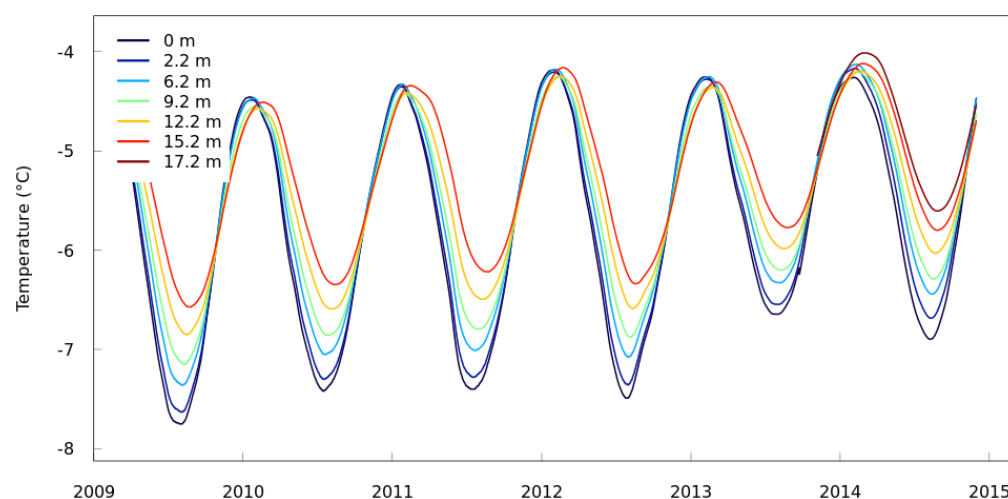


Figure 1. Borehole temperatures in the Jungfrau Ostgrat N borehole (Legend: 0m is located 6m from the outer surface of the rockwall).

Key words:

Mountain permafrost, frozen rockwalls, thermal regime, long-term monitoring, snow characteristics

Internet data bases:

www.permos.ch

www.permasense.ch

<http://shinypermos.geo.uzh.ch/app/BoreholeDataBrowser/>

Collaborating partners/networks:

Universities of Bonn, Munich, Fribourg and Zurich, ETH Zurich, PermaSense, PERMOS

Scientific publications and public outreach 2015:

Refereed journal articles and their DOI

Haberkorn A., M. Phillips, R. Kenner, H. Rhyner, M. Bavay, S.P. Galos, M. Hoelzle, Thermal regime of rock and its relation to snow cover in steep Alpine rock walls: Gemsstock, central Swiss Alps, *Geografiska Annaler: Series A, Physical Geography*, **97**, 579-597, doi: 10.1111/geoa.12101, 2015.
<http://onlinelibrary.wiley.com/doi/10.1111/geoa.12101/abstract>

Haberkorn A., M. Hoelzle, M. Phillips, R. Kenner, Snow as a driving factor of rock surface temperatures in steep rough rock walls, *Cold Regions Science and Technology*, **118**, 64-75, doi: 10.1016/j.coldregions.2015.06.013, 2015.

https://www.researchgate.net/publication/281667651_Snow_as_a_driving_factor_of_rock_surface_temperatures_in_steep_rough_rock_walls

Address:

SLF

Flüelastrasse 11

CH-7260 Davos Dorf

Contacts:

Marcia Phillips

Tel.: +41 81 417 02 18

Fax: +41 81 417 01 10

e-mail: phillips@slf.ch

URL: www.slf.ch