Long-term permafrost monitoring in the Jungfrau East ridge

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Part of this programme: PERMOS, GTN-P

Keywords: mountain permafrost; frozen rock walls; thermal regime; long-term permafrost monitoring

1. Project description

The sub-horizontal Jungfrau Ostgrat borehole is located at 3590 m asl in the North-facing wall of the Jungfrau East ridge (Fig. 1). It is 20 m long and is equipped with 9 thermistors and a data logger. Rock temperatures vary between -3.5 and -7.5°C (Fig. 2). Due to the time lag with depth, the highest rock temperatures are registered in winter and the lowest ones in summer. The high elevation of the borehole and its position in a steep rock wall make it valuable for long-term permafrost monitoring, as there are only eight boreholes in high elevation rock walls in the entire Alps.

The SLF permafrost rock fall data base has registered increasingly high fall activity from permafrost rock walls during summer heat waves, mainly affecting the near-surface rock layer which thaws in summer (active layer). The Jungfrau borehole temperature data clearly indicate a warming trend at all depths, as do other borehole data measured in high-elevation rock walls and indeed, in many boreholes worldwide (Biskaborn et al. 2019). This type of data is also essential in the analysis of deep-seated rock avalanches in permafrost, such as the 2017 Pizzo Cengalo event (Walter et al. 2019), which can occur year-round.

The borehole is part of the Swiss permafrost monitoring network PERMOS and the borehole temperature data can be viewed here: http://newshinypermos.geo.uzh.ch/app/DataBrowser/.

Figure 1. White arrow: Position of the Jungfrau East ridge (Northern flank) borehole (Photograph: Anna Haberkorn, SLF).

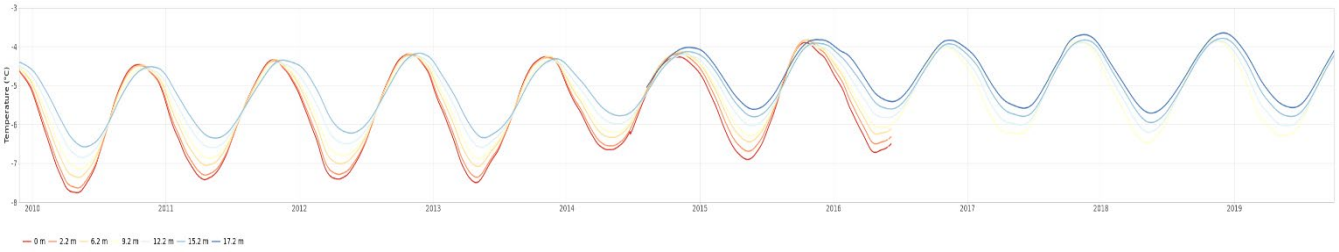

Figure 2. Borehole temperatures (2009-2019) in the Jungfrau East ridge borehole. (Legend: 0 is located 6 m from the outer surface of the rock wall). Data: SLF/PERMOS.

Internet data bases

www.permos.ch
http://newshinypermos.geo.uzh.ch/app/DataBrowser
https://gtnp.arcticportal.org/data/data-download

Collaborating partners / networks

PERMOS (Permafrost Monitoring Switzerland)
GTN-P (Global Terrestrial Network for Permafrost)

Scientific publications and public outreach 2019

Refereed journal articles and their internet access

Biskaborn, B.K., S.L. Smith, J. Noetzli, H. Matthes, G. Vieira, D.A. Streletskiy, P. Schoeneich, V.E. Romanovsky, A.G. Lewkowicz, A. Abramov, M. Allard, J. Boike, W.L. Cable, H.H. Christiansen, R. Delaloye, B. Diekmann, D. Drozdov, B. Etzelmüller, G. Grosse, M. Guglielmin, T. Ingeman-Nielsen, K. Isaksen, M. Ishikawa, M. Johansson, H. Johannsson, A. Joo, D. Kaverin, A. Kholodov, P. Konstantinov, T. Kröger, C. Lambiel, J.-P. Lanckman, D. Luo, G. Malkova, I. Meiklejohn, N. Moskalenko, M. Oliva, M. Phillips, M. Ramos, A.B.K. Sannel, D. Sergeev, C. Seybold, P. Skryabin, A. Vasiliev, Q. Wu, K. Yoshikawa, M. Zheleznyak, H. Lantuit, Permafrost is warming at a global scale, Nature Communications, **10**, 1, 264, doi: 10.1038/s41467-018-08240-4, 2019. https://www.nature.com/articles/s41467-018-08240-4

Walter, F., F. Amann, A. Kos, R. Kenner, M. Phillips, A. de Preux, M. Huss, C. Tognacca, J. Clinton, T. Diehl, and Y. Bonanomi, Direct observations of a three million cubic meter rock-slope collapse with almost immediate initiation of ensuing debris flows, Geomorphology, **351**, 106933, 2020. https://doi.org/10.1016/j.geomorph.2019.106933

Data books and reports

Huss, M., A. Bauder, C. Marty, and J. Noetzli, Schnee, Gletscher und Permafrost 2017/2018, Kryosphärenbericht für die Schweizer Alpen, Die Alpen / Les Alpes / Le Alpi, **95**, 7, 32–37, 2019.

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