

Name of research institute or organization:

**Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie,
ETH Zentrum**

Title of project:

Permafrost temperature monitoring in alpine rock walls

Project leader and team

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Project description:

Progress of the thaw in the mountain permafrost has the correlation with the stability of steep slopes and rock faces. In the aspect of natural hazards, the monitoring of the response of the permafrost to the climate change therefore has the importance, especially in the Alps.

For the alpine permafrost, due to the large effect of topography, the ground surface temperature has the wide range of local variability. Consequently, the distribution of the mountain permafrost should be estimated by the empirical rules or modellings. Yet there are difficulties of the verification for these estimation, because the in situ measurement of ground surface temperature is rarely available, which is the essential parameter for the thermal state of permafrost. It is therefore important to perform the actual measurement not only for the verification of the permafrost model, but also for the grasp of the current state of permafrost by the real data.

Since 1995, VAW has the ongoing measurement of the temperature and deformation on the Jungfrau-Ostgrat. Two boreholes of twenty metres deep are drilled outwards from the inner tunnel, on both of north and south sides of the ridge. Eight thermistors and six point-extensometers are installed for each borehole.

Series of temperature and strain are shown in Figure 1 (north wall) and Figure 2 (south wall). Rock temperature of the north wall is always below the freezing point, seasonally changing between ca.-4C and ca.-9C. On the other hand, in the south wall the temperature sometimes exceeds freezing point, in which obviously the effect of latent heat is preventing the heating up during summer. This shows the importance of the water content to discuss the temperature variation. We also see the distinct temperature difference between north and south, which causes the heat flow in the rock wall from south to north.

Figure 3 shows the temporal variation with the 1-year running mean, which is averaged with 365-days window (i.e. each value represents the annual mean from the neighboring data points). Unexpectedly, the entire rock wall temperature doesn't show a remarkable trend of warming for the last 5years. In the south wall, the temperature at 8meters depth is close to freezing point, therefore the thickness of the permafrost is estimated less than 10 meters. Such shallow permafrost should be sensible to the climate variation.

Hereafter, we would examine the heat flow inside rock wall with further analyses of data. Modelling of the rock wall temperature would be also performed, for the prediction of the permafrost stability under the future climate scenario.

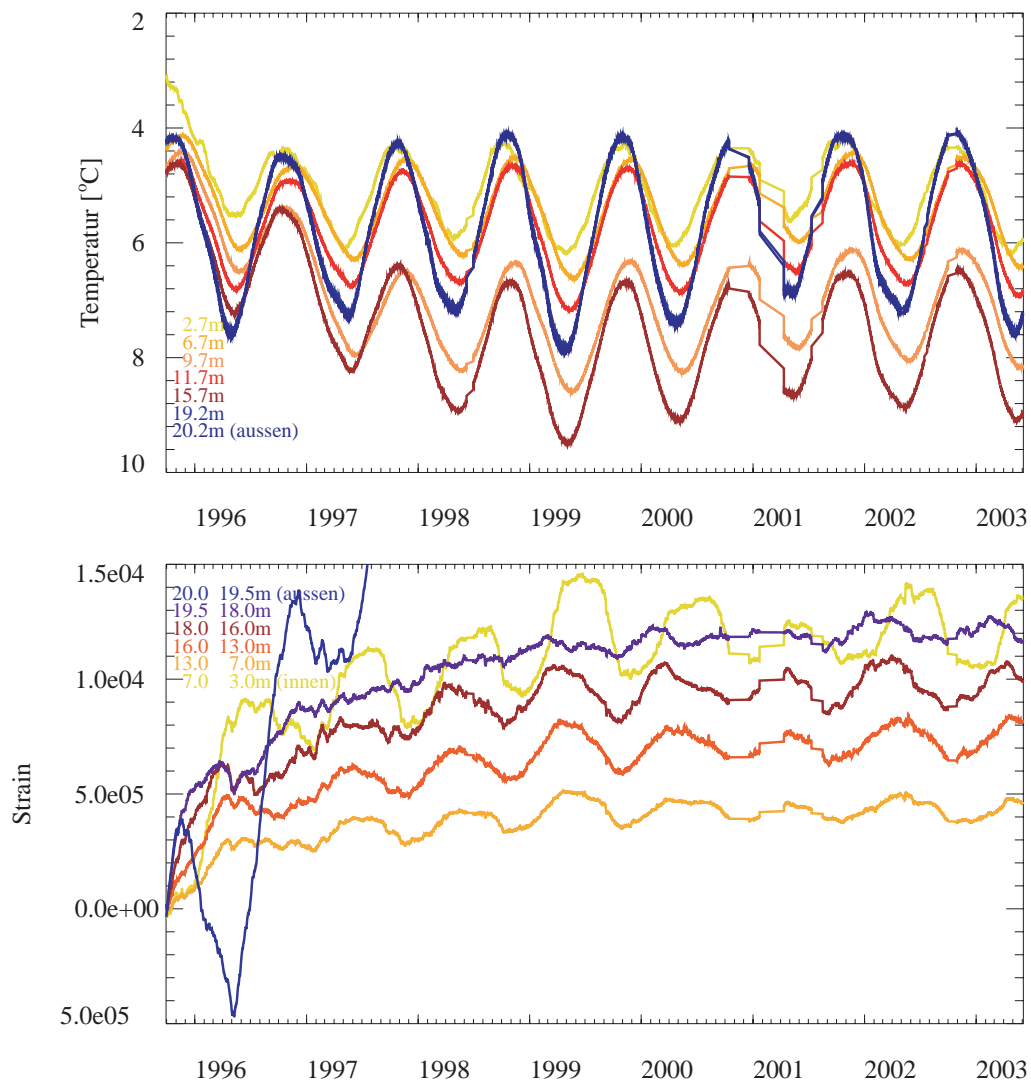


Figure 1
Measurement in the north wall. Temperature (upper) and strain (lower) are shown from 1996 to 2003.

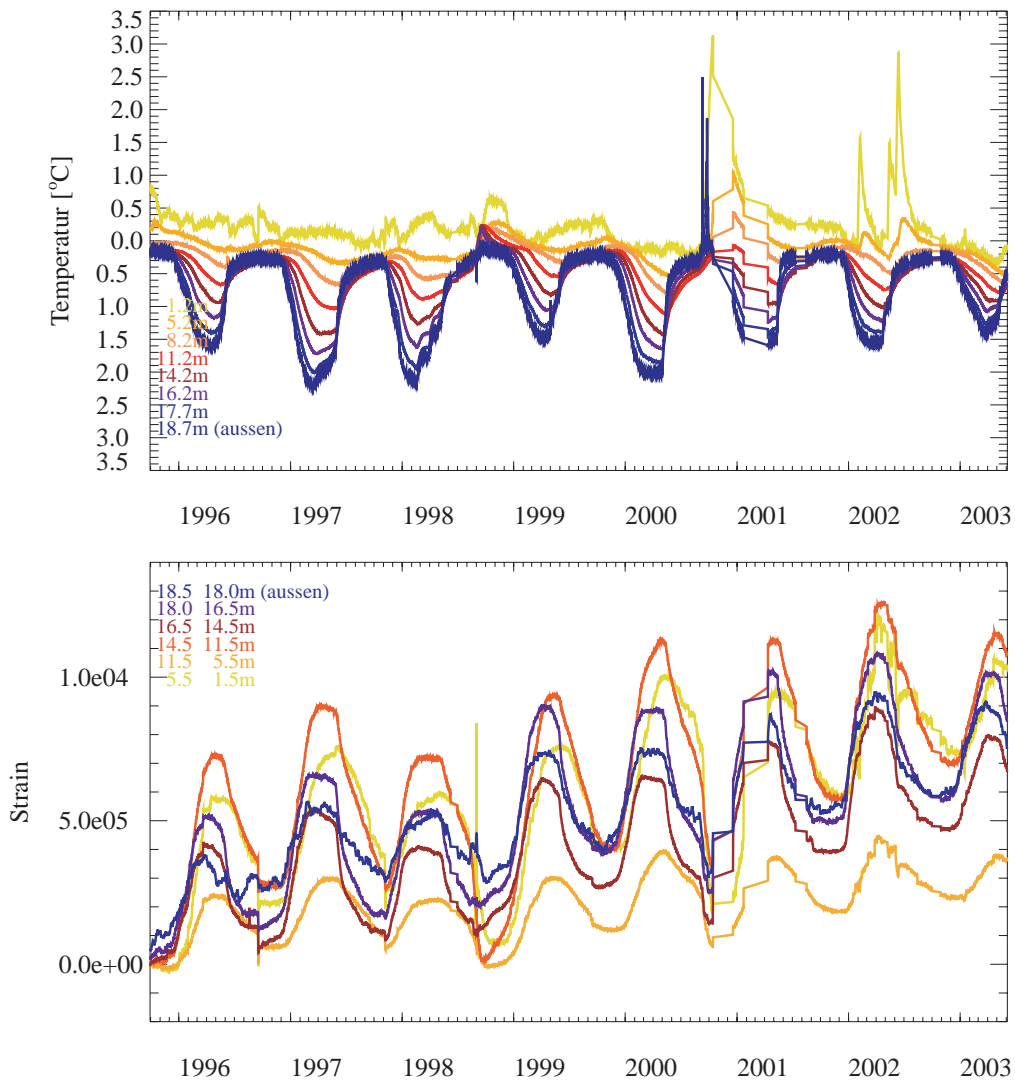


Figure 2
Measurement in the south wall. Temperature (upper) and strain (lower) are shown from 1996 to 2003.

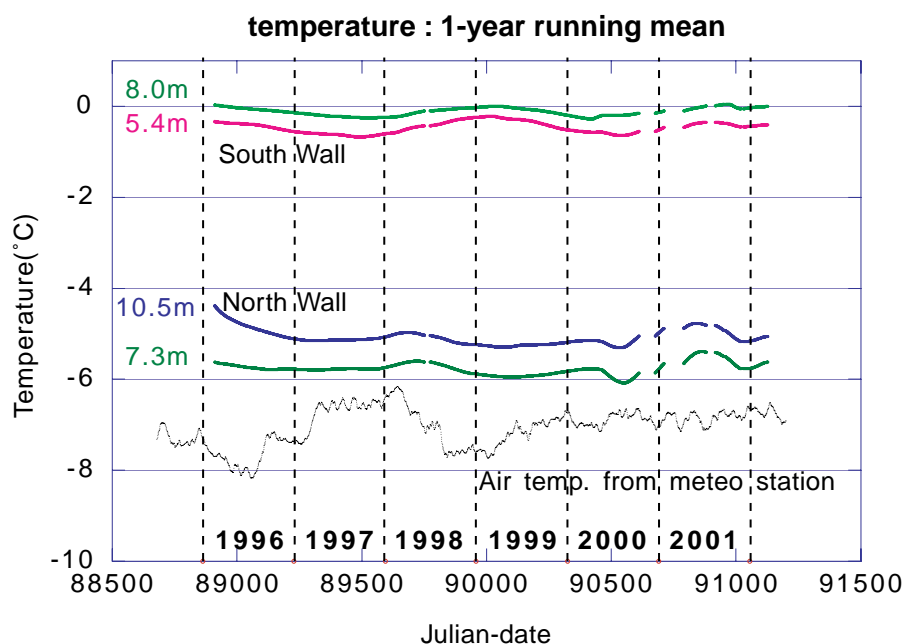


Figure 3
Smoothed temperature variation with one-year running mean. The value represents the annual mean temperature from the neighboring data points.

Key words:

Permafrost, temperature, rock wall, borehole, climate change

Collaborating partners/networks:

PERMOS (PERmafrost MONitoring in Switzerland)

<http://www.unibas.ch/vr-forschung/PERMOS>

Scientific publications and public outreach 2003:

Thesis

Wegmann, M., Frostdynamik in hochalpinen Felswänden am Beispiel der Region Jungfrauoch - Aletsch, PhD Thesis, ETH Zürich, 1998.

Data books and reports

Sueyoshi, T., Permafrost Temperature monitoring in Jungfrau-Ostgrat, Annual Report 2003, VAW, ETH Zürich, 2004. (in German)

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