

Name of research institute or organization:

Department of Geography, University of Zurich

Title of project:

PERMASENSE & PERMOS: Measuring permafrost in Alpine rock walls

Project leader and team:

Dr. Stephan Gruber (lead geo-science in PERMASENSE)

Dr. Jan Beutel (lead computer-science in PERMASENSE)

Dr. Jeannette Noetzli (lead PERMOS)

Lorenz Boeckli (PhD student, PERMOS)

Stefanie Gubler (PhD students, geo-science in PERMASENSE)

Andreas Hasler (PhD students, geo-science in PERMASENSE)

Christin Hilbich (postdoc, geo-science in PERMASENSE)

Matthias Keller (PhD student, computer-science in PERMASENSE)

Roman Lim (technician staff, computer-science in PERMASENSE)

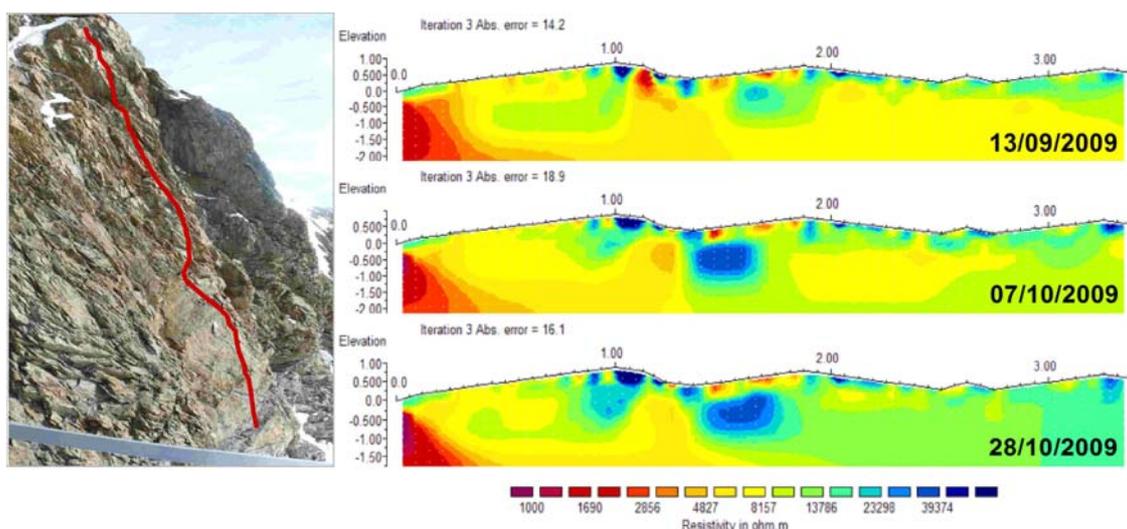
Nicole Wabersky (MSc student, geo-science in PERMASENSE)

Mustafa Yucel (technician, computer-science in PERMASENSE)

Project description:

The Swiss Permafrost Monitoring PERMOS operates a number of measurement sites around Jungfrauoch that are serviced once or twice per year. PERMASENSE is a multidisciplinary consortium aiming at the development of ultra low-power wireless sensor networks suitable for autonomous operation in high-mountain environments. This is done at the example of diverse permafrost-related measurements and the installations around Jungfrauoch provide insight into the temperature and moisture dynamics of rock masses undergoing freezing and thawing, the temperature dynamics of ice faces as well as the effect of rock fracture on subsurface temperature.

Since 6 February 2009 the PermaSense wireless sensor network on Jungfrauoch is operational. Ten sensor assemblies around Sphinx gather information about rock and ice temperatures and rock moisture at differing depths below the surface. Complementing the high-resolution time series of temperature and electrical resistivity measured in sensorrods, two permanent 2D geoelectrical profiles were installed at the southern rock face at Jungfrauoch in September 2009 to monitor the small-scale evolution of the permafrost. The profiles are 14 m long and cover an investigation depth of about 2 m. They are associated to 3 independent point measurements of the electrical conductivity at the same place by A. Hasler. The aim is a) to cross-check the results of the two independent methods, b) to aid the interpretation of different temperature and conductivity values due to small-scale heterogeneities within the rock face (influencing porosity, water flow, etc.), and c) a long-term observation of temporal changes in the ice and water content of the rock face due to climate change. Several electrical resistivity tomography (ERT) measurements were conducted between September and December, allowing first insights into the spatial pattern of seasonal freezing.



The Figure shows the vertical profile for 3 dates from mid September to end of October, with the colours representing different electrical resistivities. The resistivity is generally higher at the rock surface (due to dryer conditions) and decreases in deeper parts, representing slightly moister conditions. In addition, the upper part of the profile (right side), with higher resistivities than the lower part, exhibits a stronger resistivity increase with time than the lower part (left side). Such spatial and temporal differences will be investigated in more detail during future measurements and compared with the sensor rods installed as part of the wireless sensor network.

Key words:

Permafrost, monitoring, wireless sensor network

Internet data bases:

See www.permasense.ch and www.permos.ch.

Collaborating partners/networks:

Permafrost Monitoring Switzerland (www.permos.ch) and the National Center of Competence in Research on Mobile Information and Communication Systems NCCR-MICS (www.mics.org)

Scientific publications and public outreach 2009:

Conference papers

Beutel, J., Gruber, S., Hasler, A., Lim, R., Meier, A., Plessl, C., Talzi, I., Thiele, L., Tschudin, C., Woehrl, M. & Yucel, M. (2009): PermaDAQ: A scientific instrument for precision sensing and data recovery in environmental extremes. *Proceedings of the International Conference on Information Processing in Sensor Networks (IPSN) 2009*, San Francisco, California USA.

Data books and reports

PERMOS 2009. Permafrost in Switzerland 2004/2005 and 2005/2006. Noetzli, J., Naegeli, B., and Vonder Muehll, D. (eds.), Glaciological Report (Permafrost) No. 6/7 of the Cryospheric Commission (CC) of the Swiss Academy of Sciences (SCNAT), 100 pp.

Magazine and Newspapers articles

«Dem Berg den Puls gefühlt» UZH Unimagazin Nr. 3 2009

Beutel, J. & Gruber, S. 2009. «The quest for uptime in the mountains» MICS newsletter, März 2009.

Radio and television

«Abenteuer Wissen» ZDF 26.08.2009, produced by Taglicht Media

Address:

Department of Geography
University of Zurich
Winterthurerstr. 190
CH-8057 Zurich, Switzerland

Contacts:

Stephan Gruber
Tel.: +41-1-635 51 46
Fax: fax: +41-1-635 68 41
e-mail: stephan.gruber@geo.uzh.ch
URL: www.geo.uzh.ch

