

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, project leader  
Prof. Christian Tschudin, PERMASENSE principal investigator  
Dr. Daniel Vonder Mühl, PERMOS responsible  
Igor Talzi, PhD student (computer-science in PERMASENSE)  
Andreas Hasler, PhD student (geo-science in PERMASENSE)

Project description:

In PERMASENSE we develop a wireless sensor network for permafrost monitoring. It should be reliable and fully operational under harsh environments. After the initial phase of PERMASENSE with a first deployment on Jungfrauoch in autumn 2006, diverse technical challenges have been identified. Proper network functionality could only be established for limited time and eventually near real-time data of the installed temperature and moisture sensors could only be gathered for some weeks in April and May 2007. While the general setup seems to cope well to the environmental conditions met on Jungfrauoch, synchronization and communication schemes are still subject to extensive testing in a testbed in Zurich. Once this test gives evidence for reliable and year long operation in high alpine rock faces, we undertake a new setup at Jungfrauoch. This should latest be in spring 2008 to acquire data from the thawing period of the rock surface layer. The operation of conventional data loggers to monitor rock surface temperatures within PERMOS on the Jungfrau East Ridge, the west ridge of Mönch as well as the north and south faces of Eiger was again assured and data successfully gathered.



*Photo 1:* PermaSense "protective shoe" mounted on a little rock spur. In this steel housing, a wireless communication node will be mounted and protected from damage by falling rock or ice (photo: Stephan Gruber)



*Photo 2:* Installation of a sensor node between the roof of the research station and the Sphinx Terrace. This node is part of a PermaSense wireless sensor network prototype (photo: Andreas Hasler).

Key words:

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Permafrost, ground temperatures, monitoring, wireless sensor networks, rock fall

Internet data bases:

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<http://waypoint.cs.unibas.ch/cgi-bin/browselog>

Collaborating partners/networks:

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PERMOS, NCCR-MICS, TIC-ETHZ

Scientific publications and public outreach 2006:

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**Refereed journal articles**

Gruber, S. and W. Haeberli, Permafrost in Steep Bedrock Slopes and its Temperature-Related Destabilization Following Climate Change. *Journal of Geophysical Research* **112**, 2007.

Talzi, I., A. Hasler, S. Gruber and C. Tschudin, Investigating Permafrost with a WSN in the Swiss Alps. *Proceedings for EmNets-2007: 8-12*. Cork, Ireland, June 25-26, 2007.



*Photo 3:* Installation of temperature and conductivity sensors in the rock and ice face of the Sphinx (photo: Stephan Gruber).

### **Conference papers**

Hasler, A., I. Talzi, S. Gruber and C. Tschudin, First Experiences with Wireless Sensor Networks in Steep Bedrock Permafrost, European Geosciences Union, Vienna, Austria, April 15-20, 2007.

Hasler, A. and S. Gruber, Quantifying the Non-Conductive heat transport in the Surface Layer of High Alpine Rock Faces, European Geosciences Union, Vienna, Austria, April 15-20, 2007.

Tschudin, C. and I. Talzi, Turning Wireless Sensor Networks into a Science Grade Instrument, MICS newsletter, September 2007.

### **Magazine and Newspapers articles**

“Un thermomètre pour mesurer la fièvre des Alpes“, l’Hebdo, p. 15, August 9, 2007.

Noetzli, J., Vonder Mühl, D., Roer, I., Delaloye, R., Frei, C., Gruber, S., Haeberli, W., Hoelzle, M. & Phillips, M. (2007): Permafrost in den Schweizer Alpen 2004/05 und 2005/06. Die Alpen 9, 10-17.

### **Radio and Television**

“Felssturz; wenn die Berge brüchig werden” Documentary on rockfall and permafrost with PERMASENSE between others, ZDF / 3sat Film, May 2007.

“Messners Alpen” Part 3: “Vom Eiger zum Matterhorn” Documentary with a part on permafrost and natural hazards with Stephan Gruber, Uni Zürich, Schwenk Film GmbH, to be broadcast on different European TV channels in 2008.

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