# The evolution of ground surface temperatures and rock glacier dynamics in the Furggentälti Valley (Gemmi, VS)

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In the western part of the Swiss Alps near the Gemmipass, a long-term permafrost monitoring site has been installed by the University of Berne in 1987 to observe the further development of three rock glaciers and different periglacial processes and landforms (Mihajlovic et al. 2003). Situated in a relatively warm and wet climate at elevation levels between 2450 and 2850 m asl., this test area became one of the longest permafrost-related temperature and kinematics time series in the Swiss Alps and owns the “reference site” status within the national permafrost monitoring network PERMOS. The main goal of the current research in this area is to improve the understanding of the rock glacier dynamics regarding the evolution of ground surface temperatures and terrain movements observed during the past two decades.

Over the monitoring period several climatic events occurred and the air and ground temperatures and the kinematics as well show significant changes in long-term and a high seasonal and interannual variability. Furthermore the activity pattern and the morphology of the largest and lowermost rock glacier in the valley were completely changing during the last decade. Some parts at the rock glacier sides seem to become inactive while creep velocities in the center were increasing up to 400% compared to the average velocity before 1990 and thus forming distinctive shear zones (Krummenacher et al. 2008).

A signal-response analysis using meteorological data, ground surface temperatures, terrestrial photographs and kinematic data show that the overall rock glacier movements react very sensitive to climatic events (e.g. Delaloye et al. 2008 and Kääb et al. 2007). As the snow cover is modulating the atmospheric forcing at the ground surface and thus represents a key parameter for the ground thermal regime, its dynamics might also have a big influence on the kinematics. Probably a mostly temperature-driven creep mechanism is superimposed by landslide-like movement components which are sensitive to melt water infiltration and therefore causing acceleration connected to the snow melt period (like discussed in Ikeda et al. 2008). Compared with findings from other permafrost research sites in the Swiss Alps, the interannual variability of rock glacier creep follows a similar pattern (Delaloye et al. 2008).

REFERENCES

Delaloye, R., Perruchoud, E., Avian, M., Kaufmann, V., Bodin, X., Hausmann, H., Ikeda, A., Kääb, A., Kellerer-Pirklbauer, A., Krainer, K., Lambiel, C., Mihajlovic, D., Staub, B., Roer, I., Thibert, E. 2008: Recent interannual variations of rock glacier creep in the European Alps. In: 9th International

Conference on Permafrost, Fairbanks, Alaska, 29 June 2008 - 03 July 2008, 343-348.
Ikeda, A., Matsuoka, N. & Kääb, A. 2008: Fast deformation of perennially frozen debris in a warm rock-glacier in the Swiss Alps: an effect of liquid water. Journal of Geophysical Research, 113(F1), F01021. (10.1029/2007JF000859.)
Kääb, A., Frauenfelder, R. & I. Roer 2007: On the response of rockglacier creep to surface temperature increase. In: Global and Planetary Change 56, 172-187.
Krummenacher, B., Mihajlovic, D., Nussbaum, A., Staub, B. (Hrsg.) 2008: 20 Jahre Furggentälti – Permafrostuntersuchungen auf der Gemmi. Geographica Bernensia, Bern.
Mihajlovic, D., Kölbing, D., Kunz, I., Schwab, S., Kienholz, H., Budmiger, K., Imhof, M. & Krummenacher B. 2003: Developing new methods for monitoring periglacial phenomena. In Permafrost: Proceedings of the 8th International Conference on Permafrost, edited by M. Phillips, S. M. Springman, and L. U. Arenson, pp. 765 – 770, A.A. Balkema, Lisse, Netherlands.