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Monitoring of mountain permafrost creep - variations of rockglacier kinematics in the eastern European Alps

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In high mountain geosystems, active rockglaciers give evidence of the present occurrence of permafrost. The kinematics of rockglaciers and their temporal variations may indicate the sensitivity to climate-induced changes. In general, parameters such as ice content and thickness, ice temperature, and changes in slope control the kinematics of rockglaciers. Variations of these parameters are influenced by the input of water, debris supply, snow cover characteristics, and temperature variations.

Monitoring in the European Alps realised by the application of ground-based and remote sensing techniques show a distinct increase in horizontal movement rates of numerous rockglaciers since the 1990s. The observed accelerations largely occurred in spite of numerous varieties in geology, topography, and regional climate of the study areas. In the eastern European Alps rockglacier monitoring was predominantly undertaken in South Tyrol (Italy) as well as in North Tyrol and Carinthia (Austria). In part, records from these areas document differentiated temporal kinematics since the 1950th.

For example, rockglacier monitoring in the South Tyrolean Alps was carried out in the Rieserferner-Ahrn natural preserve. The area, where rockglaciers are exclusively developed in igneous- and sedimentary gneiss, is located south of the Hohe Tauern range. Remote sensing and GIS techniques as well as on-site flow rate measurements were applied to detect the temporal varieties in creep and surface deformation of active rockglaciers. Dependent on the observed sites, the mean displacement rates were about 13-18 cm/year in the period 1956-1985 and 18-23 cm/yearbetween 1985 and 1999, corresponding to an increase of 28-36 percent. The rates oftentimes vary significantly

from one year to the next. For example, during 1992-93, 1997-99, and 2003-04 peaks of acceleration occurred. The outstanding warm summer of 2003 was followed by a strong displacement, which overtopped the rate between 1956 and 1992 by 150 percent.

In the observed areas of the Eastern Alps the parallelism between increasing permafrost creep rates and rising temperatures is largely evident. Furthermore, direct reactions to temperature changes were observed. It is therefore supposed, that the rise in temperature and the related influence on ground thermal conditions cause the temporal changes in permafrost creep, even though topographic parameters may trigger an increase in movement in particular cases. However, the variations of rockglacier kinematics in the European Alps are difficult to explain in detail as numerous parameters influence the rheology and corresponding data are so far limited.

References

Avian, M., Kaufmann, V. and G. K. Lieb, 2005, Recent and Holocene dynamics of a rock glacier system: The example of Langtalkar (Central Alps, Austria). Norsk Geografisk Tidsskrift, Vol. 59, 149-156.

Damm, B. and M. Langer, 2006, Rockglacier Surface Kinematics over a 50-years Period - Examples from the South Tyrolean Alps (Italy). Geophysical Research Abstracts, Vol. 8, 02585.

Damm, B. and M. Langer, 2006, Kartierung und Regionalisierung von Permafrostindikatoren im Rieserfernergebiet (Südtirol/Osttirol). Mitteilungen der Österreichischen Geographischen Gesellschaft 148, in press.

Kaufmann, V., Ladstädter, R., Kienast, G. and G. K. Lieb, 2005, Documentation of the creep process of Weissenkar rock glacier (Central Alps, Austria). Terra Nostra, 2005/2, 96-97.

Kellerer-Pirklbauer, A., 2005, Alpine permafrost occurrence at its spatial limits: First results from the eastern margin of the European Alps. Norsk Geografisk Tidsskrift, Vol. 59, 184-193.

Krainer, K. and W. Mostler, 2006, Flow Velocities of Active Rock Glaciers in the Austrian Alps. Geografiska Annaler (in press).

Schneider, B. and H. Schneider, 2001, Zur 60jährigen Messreihe der kurzfristigen Geschwindigkeitsschwankungen am Blockgletscher im äußeren Hochebenkar, Ötztaler Alpen, Tirol. Zeitschr. Gletscherkunde Glazialgeologie 37, 1-33.