Geophysical Research Abstracts, Vol. 9, 09293, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09293

3-dimensional analysis of the thermal conditions in recent periglacial rock fall detachment zones

J. Noetzli (1), L. Fischer (1) and S. Gruber (1)

(1) Glaciology and Geomorphodynamics Group, University of Zurich, Switzerland (jnoetzli@geo.unizh.ch)

Permafrost is regarded as one of the crucial factors influencing the stability of steep rock in alpine areas and a temperature-dependent reduction in rock stability has been demonstrated in theory and laboratory experiments. Instabilities are expected to originate preferentially in locations with temperatures only little below the melting point. The locations of the detachment zones of many recent rock falls that occurred in Alpine permafrost confirm this. However, detailed process understanding and knowledge about the thermal conditions under which such instabilities develop is still lacking. New information may be gained e.g. from the analysis of the thermal conditions of recent periglacial detachment zones.

In alpine topography, the subsurface thermal field is mainly controlled by 3-dimensional geometry and aspect-related variable surface temperatures. Inside topographical features such as ridges, peaks or spurs complex 3-dimensional patterns of temperature distribution exist that induce strong lateral heat fluxes. Such 3-dimensional effects can lead to permafrost occurrence at only a few decametres depth that are not indicated by surface conditions. In terms of permafrost-related instabilities a thawing permafrost boundary may, for instance, lead to rock fall detaching from the warm or permafrost-free side of a ridge or peak. Additionally, due to extreme topography a temperature signal at the surface penetrates into the ground from more than one side. This significantly accelerates permafrost degradation and renders such locations specially sensitive to changes in surface temperatures. In fact, many detachment zones exist, where slope failure occurred in ridge or spur situations as, for example, the event at Punta Thurwieser in 2004 in the Italian Val Zebru or the rock fall at the NE-ridge of the Matterhorn, Switzerland, in 2003.

Based on an inventory of more than 50 recent rock fall events, we analyse high alpine rock fall detachment zones with focus on their thermal conditions and topographical and 3-dimensional situation. Surface temperatures are determined for all events collected and a detailed 3D-study is conducted for a smaller number of selected events. To calculate the subsurface thermal field we use a surface energy-balance model together with a 3-dimensional ground heat-conduction scheme that are both specially designed for use in complex topography. First results will be presented.