



Relation between changes in debris-flow activity and degradation of alpine permafrost - a case study from the Schnalstal, Italian Alps

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In view of the general agreement on the contemporary rapid climate warming, much work is done on the various consequences of global change issues, particularly with respect to mountain environments. One of these issues is the effect of future climate change on alpine permafrost in high altitude areas as well as the associated implications on possible natural hazards. Due to permafrost degradation the loss of the ice armoury releases i.a. great amounts of loose material, which are easily eroded under certain meteorological conditions. Hence, an increased activity of debris flows as well as of other types of mass movements is to be expected in the relevant areas. Especially localities near the lower boundary of the discontinuous permafrost distribution are highly sensitive in terms of changes in climatic conditions. Therefore, lag time of reactions in these localities is comparatively short and consequences of changed conditions can be observed within decades.

The study presented analyses the existence of first indications of permafrost degradation in the head area of the Schnalstal, South Tyrol, by determining the development of debris-flow activity in selected slope areas for the last two decades. Special attention was paid to the altitude of the triggering areas, since the degradation of permafrost is hypothetically associated with a corresponding vertical retreat of especially active geomorphic areas. High-quality aerial photographs as well as fieldwork provided the basis for this multi-temporal analysis. In order to prove a connection between the de-

velopment of the debris-flow activity and the degradation of permafrost, the results were compared to the historical and current permafrost distribution of the area concerned. Latter were modelled by using the approach of the programs PERMAKART and PERM. Areas which are thought to have experienced degradation in the recent past are categorised as sensitive to erosive processes and therefore received special attention. The multi-temporal analysis showed that only one of the three selected slope areas experienced notable changes in the debris-flow activity during the last two decades. Almost half of the starting zones observed in 2006 developed after 1985. Although an altitudinal rise in the triggering areas of debris flows could be detected, the question whether a correlation between the degradation of alpine permafrost and the development of these new starting zones exists cannot be answered definitely, since almost all of these starting zones are located in an area, in which the occurrence of permafrost is, according to the modelling, probable and therefore distinct reactions to contemporary changes in climatic conditions appear unlikely. However, a relation between the development of new starting zones and a possible thickening of the active layer, as a reaction to the melting of a former hanging glacier, is thought to be likely.