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The relation of permafrost degradation and slope instabilities in high-Alpine steep rockwalls (Mont Blanc massif and Matterhorn): the research project PERMAdataROC

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Recently, large rock and rock/ice avalanches have occurred in high mountain areas worldwide (Mc Ginnis Peak, Alaska, 2002; Kolka-Karmadon, Caucasus, 2002). In the Alps, Brenva Glacier (1997), Punta Thurwieser (2004), the Drus west face (2005) and Dents du Midi (2006) are the most recent examples, while innumerable smaller rock falls have detatched from steep rockwalls during the hot Summer of 2003 (e.g. Mont Blanc massif or Matterhorn). Because (i) ice was observed in many starting zones; (ii) the mean annual air temperature (MAAT) in the Alps has increased in more than 1°C during the 20th Century; (iii) the warming trend has accelerated since 1980, the hypothesis of a relation between permafrost changes and an increase of high mountain rockwall instability gains force.

However, on the one hand, frequency and volume of instability events in high mountains are still poorly known because of the lack of systematic observations. On the other hand, ongoing permafrost changes in rockwalls remain poorly understood because of the difficulties in carrying on in situ measurements. So far, permafrost studies are mainly based on modelling, with a few existing instrumented sites.

The PERMAdataROC project aims at studying this relation between permafrost degradation and high mountain rockwall instability in two western Alpine areas, the Mont Blanc massif and the Matterhorn, based on the cross-cutting of the following three research axes:

1. Collection, maintenance and analysis of recent rockfall/avalanches in the Mont Blanc massif in a data base, based on (i) systematic survey of slope instability events

(localisation, exposition, time, meteorological conditions, snow conditions, estimated volume, path) carried out by local, trained people (mountain guides, rescue people, hut keepers) in collaboration with the researchers; (ii) digitalisation of the events in a GIS; and (iii) analysis of the topographical, geological and climatic parameters of the affected rockwalls. This data base is complemented by a second one consisting of past events that are documented from newspapers, hut and guide books as well as previous studies. Axis 1 started in Summer 2004.

2. Measuring and modelling the thermal regime in rockwalls. The instrumentation (thermistors at 5, 10, 30 and 60 cm depth) and measurement of relevant properties (albedo, irradiation, thermical conductivity) of rockwall superficial layer and surface at 7 selected study sites (3300-4500 m a.s.l.), combined with high altitude climatic data recorded by a movable automatic weather station, will allow for validation of the models for temperature distribution and variations in these rockwalls. This study started in Autumn 2004.

3. Monitoring of the morphological activity on representative rockwalls, by (i) frequently repeated surveys with long-range ground-based laserscan (LIDAR) and terrestrial photogrammetry; (ii) the installation of a geophone network in one of the study sites to determine the frequency and volume of rockfalls, considering variable parameters (altitude, aspect, slope angle, lithology, fracturing, shadow effect, height drop). This study started in Summer 2005.

As an illustration of this innovative research project, we present some first results of our investigations in the Mont Blanc massif and Matterhorn.