Geophysical Research Abstracts
Vol. 14, EGU2012-11082, 2012
EGU General Assembly 2012

Instability of a highly vulnerable high alpine rock ridge: the lower Arête des Cosmiques (Mont Blanc massif, France)

L. Ravanel (1,2), P. Deline (2), C. Lambiel (1), and C. Vincent (3)

(1) IGUL, Université de Lausanne, Lausanne, Switzerland (ludovic.ravanel@univ-savoie.fr), (2) Université de Savoie - CNRS, EDYTEM, Le Bourget-du-Lac, France, (3) LGGE, Université J. Fourier - CNRS, Grenoble, France

Glacier retreat and permafrost degradation are actually more and more thought to explain the increasing instability of rock slopes and rock ridges in high mountain environments. Hot summers with numerous rockfalls we experienced over the last two decades in the Alps have indeed contributed to test/strengthen the hypothesis of a strong correlation between rockfalls and global warming through these two cryospheric factors.
Rockfalls from recently deglaciated and/or thawing areas may have very important economic and social implications for high mountain infrastructures and be a fatal hazard for mountaineers. At high mountain sites characterized by infrastructures that can be affected by rockfalls, the monitoring of rock slopes, permafrost and glaciers is thus an essential element for the sustainability of the infrastructure and for the knowledge/management of risks.
Our study focuses on a particularly active area of the Mont Blanc massif (France), the lower Arête des Cosmiques, on which is located the very popular Refuge des Cosmiques (3613 m a.s.l.). Since 1998, when a rockfall threatened a part of the refuge and forced to major stabilizing works, observations allowed to identify 10 detachments (20 m3 to > 1000 m3), especially on the SE face of the ridge. Since 2009, this face is yearly surveyed by terrestrial laser scanning to obtain high-resolution 3D models. Their diachronic comparison gives precise measurements of the evolution of the rock slope. Eight rock detachments have thus been documented (0.7 m3 to 256.2 m3).
Rock temperature measurements at the ridge and the close Aiguille du Midi (3842 m a.s.l.), and observations of the evolution of the underlying Glacier du Géant have enable to better understand the origin of the strong dynamics of this highly vulnerable area: (i) rock temperature data suggest the presence of warm permafrost (i.e. close to 0°C) from the first meters to depth in the SE face, and cold permafrost in the NW face; (ii) as suggested by the occurrence of rockfalls mainly during or at the end of hot periods in summer, degradation of the cleft ice – observed in several rockfall scars – has likely participated in the triggering of several if not all of these rockfalls; (iii) alternation of the ice content increase during segregation phases and its decrease during the summer periods has probably modified the geotechnical properties of the rock mass, especially since rockfalls have mostly been triggered in the active layer; (iv) evolution of the glacier have also directly interfered with the stability of the SE face of the ridge: rockfalls at the foot of the rockslopes were only possible because of the lowering of the glacier in the recent years.
Rockfalls that occurred at the lower Arête des Cosmiques thus probably result from the combination between permafrost activity/degradation and glacier shrinkage.