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The December 2008 Crammont rock avalanche, Mont Blanc massif area, Italy

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Rock avalanching is a very hazardous process in high mountain area, that generates a high risk in inhabited valleys (e.g. Kolka-Karmadon, 2002). Present glacier shrinkage and permafrost degradation in steep rockwalls could increase the frequency and magnitude of rock avalanching in the context of the current climate change.
We describe a small (c. 0.4 M m3) rock avalanche that occurred in December 2008 on Mont Crammont, 10 km from Mont Blanc summit (western Italian Alps), to discuss its control factors, and to consider the potential risk of this type of landslide.
The 400-m-high North face of Mont Crammont, composed by the 'Flysch de Tarentaise' sequence of the Valais Zone, is culminating at 2653 m a.s.l. in the rock avalanche area, with a mean slope angle of 50°. Located between 2400 m and the crest, the tens meters deep scar is controlled by the dense fracturing in the rock assemblage (conglomerate, limestones, schists, and sandstones).
The main part of the collapsed rock mass settled on the plateau at the foot of the rockwall, between 2150 and 1950 m a.s.l.. But c. 10 % of the rock mass travelled farther in two torrent beds, and reached the Doire river bed (1090 m a.s.l.), with horizontal and vertical travel distances of 3400 m and 1560 m, respectively. The rock avalanche mobility was enhanced by (i) the channelization in the torrent gullies, and (ii) the dense snow cover, that reduces the friction and fluidises the moving mass: a large amount of snow was incorporated, with e.g. a several m-thick mixed snow/rock deposit into the two gullies.
Three elements suggest that the rock avalanche could have been triggered by the current degradation of the permafrost: (i) seepage water was observed in the detachement zone in the days after the collapse, in spite of the negative air temperature; (ii) modelling of the rock temperature for north-aspect rockwalls within the range of elevation of the scar indicates that 'warm' permafrost (T > -2°C) could be present; (ii) no other rock avalanche deposit detached from the Mont Crammont ridge is present on the Lateglacial morainic complex deposited on the plateau.
Rock avalanche volume was computed by comparison of pre- and post-event LiDAR DTMs. We also present geomechanical characterization of the detachement zone from LiDAR point cloud processing, and back analysis calculation of the rock avalanche runout.