Geophysical Research Abstracts
Vol. 17, EGU2015-6473, 2015
EGU General Assembly 2015

Geomorphological survey and remote sensing analysis: a multidisciplinary approach to reconstruct triggering factors of a DSGSD in Maso Corto (South Tyrol, Italy)

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In the Alpine regions, it is essential and urgent to define an improved and specific set of monitoring methods for the evolution of instability phenomena in order to avoid the closure of the installations because of the occurrence of natural calamities and to ensure the safety of citizens.
In this context the SloMove Project aims at consolidate know-how of the ordinary monitoring applications of surface movements, evaluate their pros and cons and optimize the expected technical procedures of investigation.
Within the SloMove project, an experimental composite monitoring has been carried out in the touristic site of Maso Corto (South Tyrol, Italy). Structural-Geomorphological Survey, GPS measurements and Time series analysis of SAR Interferometry data have been integrated.
The purposes of this experiment are: 1) to reconstruct the geomorphological dynamics and their state of activity; 2) to provide considerations on the role of permafrost as an influential factor for landslide activity.
Structural-Geomorphological survey highlighted control of structural asset of the outcropping lithologies on geomorphological markers, such as trenches, counterscarps, outcropping sliding surfaces. The area is characterized by metamorphic rocks, affected by foliation oriented between N350 and N30. Moreover, joints due to frost thaw activity are common in the shallow portions and the presence of two sets of tectonics fractures (N45, 45°-60° and N360, sub-vertical) has been recognized. In order to evaluate the state of permafrost, rock glaciers in the area have been investigated.
SAR interferometry data have been processed by TRE® through the SqueeSAR™ analysis using Radarsat and Envisat images acquired during a period between 2003 and 2009.
GPS surveys were carried out through the technique of Rapid-Static Relative Positioning during the summer months of 2012 and 2013.
Data shows that an area of 2km2, north of Maso Corto, is affected by a Deep Seated Gravitational Slide Deformation that affects the outcropping metamorphic rocks throughout most part of the slope. Deformation facing southeast is extremely slow, reaching a maximum average speed of 10-15 mm/y. A clearly visible sliding surface, rising further upstream, separates stable bedrock by the deformed layer. Structural-Geomorphological Survey allowed to understand the boundaries of the DSGSD that is located on the east flank of the mountain north of the town, where the adjacent re-incised N-S glacial valley rises the maximum deep.
Finally, GPS data measured 34 mm/y as the maximum horizontal velocity value of the rock glaciers in the study area. This low displacement rate let us assume that discontinuous, shallow, hot and thin permafrost may be present in the area.
The overall analysis of composite survey suggests that the DSGSD formation may result as consequence of deglaciation, subsequent river incision and presence of tectonic discontinuity surfaces, favorably oriented with respect to the maximum slope, whereas the recent degradation of permafrost, due to post-LGM global warming, might have triggered or increased the velocity of the movement.

Keywords: integrated monitoring, permafrost, DSGSD, InSAR, GPS, Rock Glacier, Geomorphological Survey, Alps