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Ground-based interferometry for monitoring an active rockslide in the Italian Alps

N. Casagli (1), **C. Del Ventisette** (1), G. Mannucci (2), L. La Rocca (2), A. Ballini (2), G. Antonello (3), J. Fortuny-Guasch (3), D. Tarchi (3) and D. Leva (4)

(1) Earth Sciences Department, University of Florence, Italy (e-mail: nicola.casagli@unifi.it), (2) Regional Agency for Environmental Protection, ARPA – Lombardia, Milano, Italy (e-mail: g.mannucci@arpalombardia.it), (3) Joint Research Center of the European Commission, IPSC, Ispra, Italy (e-mail: dario.tarchi@jrc.it), (4) LisaLab Ltd. a JRC spin-off company, Legnano, Italy (e-mail: davide.leva@lisalab.com)

The ground based interferometry technique (GBInSAR) was applied to identify the deformation on the Ruinon landslide in order to carry out a real time monitoring system.

The Ruinon landslide is one of the most hazardous slope movements in the Italian Alps. It is located in Valfurva (High Valtellina), near the village of Bormio, in the Rhaetian Alps. The landslide is currently active, and its continuous movements affect an estimated volume of rock of about 30 million m^3. This landslide represent a serious threat to human lives and socioeconomic activities in the area.

The landslide is characterized by two main scarps oriented northwest-southeast, parallel to the main fracture system recorded on the slope. The “upper scarp” is located at an elevation of about 2100 m above sea level (a.s.l.), the “lower scarp” at about 1900 m a.s.l..

The ground based linear SAR system installed to monitor the Ruinon Landslide was settled up by the Joint Research Centre (JRC) of the European Commission and by LisaLab , a JRC spin-off company. The radar system was installed on the slope in front of the landslide, at an average distance of 1400 m. The system operates at a frequency of 17.35 GHz and produces a radar image of the observed area every 14.3

minutes. The pixel resolution in range is about 1.5m while the resolution in azimuth is between 2.6m and 5.2m in relation to the distance between the sensor and the observed area.

The application of the radar interferometry technique through ground-based instrumentation to the Ruinon landslide between 22/06/2006 and 22/06/2007, allow us to obtain multitemporal maps showing the complete displacement field of the landslide and to create, using binge of interference of the observed scene, velocity vs. time plots for a lot of selected pixel. This type of information is fundamental for the early detection of landslide accelerations.

The deformations are prevalently concentrated on two sectors; the first one corresponds to the east part of the upper scarp where the total displacement is of 636 mm/year along the line-of-sight towards the sensor. The second one corresponds to the upper sector of the lower scarp.

The monthly displacement maps point out that the deformation rate, both on the “upper scarp” and in the “lower scarp” decrease progressively from December 2006. The velocity of displacement increases from May 2007 especially in the faster sector of the landslide, localized in the upper scarp, where the velocity reached about 9 mm per day.

Furthermore a comparison between velocity changes and major rainfalls has been made. Indeed the rapid increasing in velocity recorded by GBInSAR is the result of a quick response to rainfall intensity.

Moreover, to validate a GBInSAR technique to monitor the Ruinon landslide, a comparison between the GBInSAR data and the in situ measurements has been carried out. At present the entire slope is monitored by the Geological Monitoring Centre of the Regional Agency for Environmental Protection (ARPA) of the Lombardia Region, through an extensive network composed of a series of extensometer and distometer sensors, part of which are equipped for real-time data acquisition and transmission. The trends of deformation recorded from GBInSAR monitoring in several point of the Ruinon landslide are comparable with those recorded from in situ measurements.