Geophysical Research Abstracts
Vol. 15, EGU2013-4262, 2013
EGU General Assembly 2013
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Study and monitoring landslide with Persistent Scatterer Interferometry (PSI): the case study of Rosone (Western Alps, Northern Italy)

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Large landslides are widespread both in the Alps and Apennines; the observed movements are generally from extremely slow to slow, fairly regular with some occasional acceleration, related to rainfall events of high intensity or long duration. Rapid and superficial phenomena are often associated and they result in significant socio-economic losses. They are also difficult to characterize in their boundaries and state of activity, to monitor with traditional tools due to their extension and low rates of movement, which are close to the detection limit of traditional monitoring equipment. Nevertheless, their management and prevention require a proper detection of ground movements for land use planning and/or civil protection purposes. Persistent Scatterer Interferometry (PSI) is a powerful tool for studying and monitoring such landslides.

This work illustrates the potential of Persistent Scatterer Interferometry (PSI) using SAR (Synthetic Aperture Radar) data for a detailed detection, characterization and monitoring of a large landslide (Rosone landslide) ground displacements at local scale.

The Rosone landslide is located in the Orco valley, Piedmont region (NW Italy) and it is one of the most studied of the western Alps due to its potential hazard. The landslide affects the penstock of the near hydroelectric plant and in case of collapse may creates a dam in the Orco river and an interruption of the road that connects the upper part of the valley with the plain.

The landslide has an areal extension of about 5.5 km2 and has been classified as a Deep Seated Gravitational Slope Deformation (DSGSD) affecting the southern side of the Orco - Piantonetto ridge modelled on lythotypes of the Gran Paradiso Massif (gneiss). The slope morpho-structural features allow to distinguish three adjacent sectors corresponding to three different evolution stages of the DSGSD. The sector of Bertondasco (0.5 km2) classified as complex landslide is the most interesting for its movements that affect the pen-stock. Bertondasco sector was also affected by a general instability and secondary reactivation, e.g. rock falls and rapid flows, that caused the evacuation of some villages in 1953. For this reason the landslide is monitored since the 60's with many instruments: optical, inclinometers, extensometers and in the recent years also with GPS. The range of movement observed (from few mm/yr to some cm/yr) is almost compatible with PSI.

The ERS (1992-2000) data processed with PSInSAR(TM) technique and the Radarsat data (2003-2009) processed with SqueeSAR(TM) technique by Telerilevamento Europa cover with good PS/DS density some sectors of the landslide.

The SAR data were compared with other monitoring data and the structural geomorphological, hydrological studies. On the other hand the PS data, the associated time series and some post-processing elaborations (e.g. projection of the velocity along the slope) were validated with other monitoring data and geomorphological evidences. This approach showed that PSI technique has the potential to improve the knowledge about the spatial distribution and temporal evolution of ground movements. Due to the benefits in density and for the easiness in data acquisition and storage over large areas, it was decided to integrate and largely replace the old monitoring system with a regular PSI analysis (every year) through Cosmo-SkyMed data in order to follow the evolution of the phenomenon for civil protection purposes. Some corner reflectors will be installed in 2013.