



Potential and limitation of PSInSAR technique for landslide studies in the Piemonte Region (Northern Italy)

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The work concerns the application of PSInSAR technique for the landslide detection and monitoring in the Piemonte Region (Northern Italy). These activities are part of an ongoing research project supported by the Piemonte Regional Agency for Environmental Protection (ARPA Piemonte) and the National Civil Protection Authority with the aims to develop a methodological approach at regional scale for the PSInSAR data interpretation, to identify areas with ground deformations, where local authorities may concentrate future detailed geological studies and risk mitigation actions, as well as monitor large areas.

On the whole Piemonte territory a Standard Permanent Scatterer Analysis was performed by Telerilevamento Europa. In total 614 ERS scenes from different frame and tracks, acquired between 1992 and 2001 by the ESA sensors along descending and ascending orbits, were used for the interferometric analysis of the Piemonte Region. About 2 millions of PS were identified in the descending data-set, while only 300,000 PS were extracted from ascending scenes.

A full landslide inventory carried out in the IFFI project (national landslide inventory) has shown that more than 34,000 landslides affect the Piemonte region in different geological contexts (Alps, Apennines, hilly areas). The alpine environment with high slope gradients and the presence of foliated and unfoliated rocks is characterized by

the presence of rock-falls/topples, large complex landslides and deep seated gravitational deformations. In the Langhe area, characterized by asymmetrical valley and a monocline succession of marl and sandstone, translational rock-block slides and shallow landslides make up the majority of landslides. Many of the landslides in the Appennine area, characterized by sedimentary clayey rock, are slow earth and debris flows.

A method is proposed and applied to study PSInSAR results at regional scale taking into account the large amount of SAR data, the extension of the study area and the great variability of geological processes. The PSInSAR data interpretation is done into three steps. The first step corresponds to the deformation accuracy assessment and the identification of the areas with significant movements, the so-called “anomalous areas”. The “anomalous areas” are clusters of PS that due to their physical and spatial characteristics (deviation of deformation parameters respect to a field of velocity considered stable, minimum distance between two related points in movement and plurality) they can be an indication of geological processes. In the second step a preliminary interpretation of the “anomalous areas” is done through the integration in a GIS environment of the PS data with the topographic maps, the geology, the Digital Elevation Model, the landslide inventory and the geotechnical database. Detailed geomorphological, geological and geotechnical studies, field checks and the calculation of on-slope-direction displacement maps allow to obtain the detailed interpretation of the displacements identified in the PSInSAR analysis in the third step.

Potential and limitations of the PSInSAR technique for landslide detection at regional scale and monitoring are then estimated in relationship with the different slope instability typologies and the various geological environments. The preliminary results show that the technique is suitable to complement and integrate information derived from conventional methods for landslides mapping. Nevertheless, the success of the technique depends also on the typology of landslides and their related kinematics. The PSInSAR method is best suited for assessing the temporal evolution of slow and extremely slow landslides with constant velocity deformations, as large landslide in the Alps. Thanks to the high PS density it was possible to identify some areas with different displacement rates. Landslides with intermittent behaviour, such as that triggered by rainfall, are difficult to detect (rock block slides in the Langhe), nevertheless an application of the technique could be envisaged in the detection of collapse precursors or post-failure movements.