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Regional interpretation of PSInSAR(TM) data for landslide investigations

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The work presents the results of a PSInSAR™ analysis carried out in a wide area of North-Western Italy (Lombardia and Piemonte regions) with an extension of about 40.000 km2. The regional study of PS data was part of a project concerning the geological interpretation of PSInSAR™ data, carried out in collaboration with local regional environment agencies (ARPA Piemonte and Lombardia Region). A set of SAR scenes acquired between May 1992 and December 2000 by the ERS sensor of the European Space Agency along ascending orbits and a set of scenes acquired between April 2003 and June 2007 by RADARSAT sensor along descending and ascending orbits were used by TeleRilevamento-Europa for a Standard PS Analysis. The RADARSAT images cover only a sector of Lombardia Region (Varese, Brescia, Bergamo, Sondrio provinces).
At regional scale the aims were: 1) to check the capability of the technique in the detection of the landslides in different geological and geomorphological environments using different sensors; 2) to verify how the PSInSAR™ technique can improve the results of the landslide database IFFI (the Italian Landslide Inventory) in terms of landslide areal extent evaluation and unmapped phenomena detection.
A database containing the areas where the SAR data showed anomalous movement (the so called anomalous areas) was built. This analysis takes into account the influence of the types of sensors (RADARSAT and ERS), of the different geometries of acquisition (ascending and descending) and of the geological and geomorphological characteristics of the main environments (Alps, Langhe Hills, Apennines) on landslide detection.
The results of the research have showed that the PSInSAR™ analysis for slope movements is limited to very slow landslides with constant movement (particularly DSGSD) that represent a small percentage of all landslides. Problems related with lack of scatterers and topographic effects also limit the number of landslides suitable for studies.
However regional landslide inventories traditionally based on aerial photo interpretation and field surveys can be improved by coupling with PSInSAR™ interferometry. The integration of the outcomes of the conventional geological, geomorphological studies with the results of the PSInSAR™ analysis improve the landslide inventory in terms of landslide areal extent evaluation and unmapped phenomena detection (about 60 landslides nor reported in the IFFI database were detected in the study area). Nevertheless, the integration with traditional methods and field surveys is still necessary for a correct interpretation of the PSInSAR™ results.
The analysis of PS data also showed that the landslide detection depends by some factors:
- scatterer distribution: the debris (rock fall, glacial, etc… deposits) in Alpine area is a good reflector and this increases the number of landslides detected in this area. Nevertheless, it is difficult to discriminate ground deformation due to different processes, as local settlement of man-made structure (e.g. Apennine and Langhe) or the shallow deformations caused by seasonal processes in debris (Alps);
- type of sensor: RADARSAT data allow to detect an higher number of landslides than ERS.
- geometry of acquisition: using two geometries of acquisition (ascending and descending) it is possible to detect more landslides.