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Case study on the updating of landslide inventory map with remote sensing data

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The analysis of remote sensing data was carried out in order to assess the contribution of these information in support to the characterization and monitoring of instable slopes in Valfurva and Valdisotto area, East of Bormio in the Italian Alps, where significant rock slides and deep-seated gravitational slope deformations were recognised.

Available landslide inventory map was updated in GIS environment with the information from radar interferometric SAR processing of ERS and Envisat satellite data as points (persistent scatterers) indicating mean annual velocity and displacement.

Images from ESA satellites, with temporal range from 1995 to 2007, processed by Telespazio S.p.A. (a Finmeccanica company) by means of radar interferometric tecnhnique, have been used. The images were acquired in descending mode by the ERS-1/2 satellites (63 images) in the period Apr. 1995 – Jan. 2000 and by the Envisat satellite (19 images) in the period Aug. 2002 – Mar. 2007. From the interferometric processing on ERS-1 and ERS-2 images, 19524 coherent points were extracted (61.4 points/km^2). Instead, the coherent points extracted from Envisat images were 3896 (12.3 points/km^2).

The investigated area is 30 km x 30 km wide. The landslides characterized by the presence of persistent scatterers (both from ERS and Envisat images) are 108 of the total 869 (interested area 21.82 km^{2}of 62.75 km^2). Also 13 deep-seated landslides in the investigated area were previously mapped; 10 of them (area 49.49 km^{2}of 59.2 km^2) are characterized by the presence of coherent points.

The characteristics of landslides are highlighted in the GIS database: geometry, state

of activity, typology, monitoring systems, interventions, source of information; the updating actions and modifications coming from the interferometric data are recorded. Furthermore, for each landslides area, the occurrence of persistent scatterers and the statistical description of their velocities is reported.

Main changes recorded on the landslides regarded the state of activity while in some cases also geometry was modified. Moreover, the state of activity of deep-seated landslides was investigated.

The main criteria used to define the state of activity is related to the annual mean velocity retrieved from persistent scatterers: e.g. if point velocity from Envisat data are above 2 mm per year then landslides is classified as “active”.

Summing up, 108 landslides (12% of the total number) contain persistent scatterers (35% of the total area): 44 were updated, while the others remain unchanged. Focusing on the state of activity, in more than 30 landslides it was changed from the original: e.g. 4 relict to dormant, 7 from relict to active and 9 from dormant to active. Concerning the deep-seated landslides, the state of activity was changed from relict to active for 6 of them, while one was moved from relict to dormant.

In conclusion, data from interferometric SAR processing is proper to monitor slow moving landslides for risk assessment and hazard zonation, even if the integration with traditional methods and field surveys is still necessary. The updating of a landslide inventory using SAR interferometric processing could be likely delivered quarterly or half-yearly depending on satellite data availability.

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