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Update of the Italian National Landslide Inventory Map by exploiting Sentinel-1 P-SBAS data

Pierluigi Confuorto[1], Nicola Casagli[1,2], Francesco Casu[3], Claudio De Luca[3], Matteo Del Soldato[1], Davide Festa[1], Riccardo Lanari[3], Giovanni Onorato[3], and Federico Raspini[1]

[1]Earth Sciences Department of the University of Firenze – DST UNIFI, Via Giorgio La Pira 4, 50121 Firenze – Italy
[2]OGS - National Institute of Oceanography and Applied Geophysics, Borgo Grotta Gigante 42/c, 34010 Sgonico (Trieste) – Italy
[3]IREA-CNR, Istituto per il Rilevamento Elettromagnetico dell'Ambiente-Consiglio Nazionale delle Ricerche, Via Diocleziano 328, 80124 Napoli – Italy, via Bassini 15, 20133 Milano - Italy

Landslide inventory maps are fundamental tools for territorial planning, recording the location, the state of activity and the type of mass movement that affects an area (Guzzetti et al., 2012). In the last decades, the satellite Remote Sensing has represented one of the most useful techniques for studying landslides with its capability to detect large portions (km-scale) of the Earth surface: in this sense, DInSAR (Differential Interferometry Synthetic Aperture Radar) data are capable of retrieving surface displacements with centimeter to millimeter accuracy. The launch of Sentinel-1 (S1) satellites and the flourishing of fully automatic processing chains has encouraged the development of national scale monitoring service for the study of natural and anthropogenic hazards. Accordingly, the Parallel Small Baseline Subset (P-SBAS) processing chain, in the framework of an Operative Agreement with the Italian Ministry of Economic Development (MiSE) aimed at generating the displacement time-series and corresponding velocity maps of the entire Italian territory, has significantly boosted the systematic update of the landslide state of activity.

In this work, the Italian national database of landslides (IFFI landslide inventory) has been updated up to 2018 by exploiting national scale P-SBAS S1 analysis. In particular, the past landslide state of activity, which was obtained by exploiting the Envisat data (2003-2010 temporal range), has been compared with the one retrieved with P-SBAS S1 results (2014-2018 temporal range). With this comparative analysis, more than 56,000 landslides have been identified. The 74% of the studied landslides has been classified as dormant, having annual average velocity (projected along the slope direction) <7 mm/year (considering a value of two times the standard deviation) while the 26% has been considered as active (mean velocity >7 mm/year). In addition, a landslide reliability matrix was introduced to assess the quality of the new updated inventory, by using the point density and the standard deviation of the mean V_{slope} value of each considered landslide. Finally, the 2D horizontal (along the E-W direction) and vertical components of the MPs have been computed, aiming at the characterization of each landslide's movement direction and magnitude. The obtained results show the heterogeneity and the complexity of the Italian territory, with major differences among each region and between the Alpine and Apennine sectors. The work

demonstrates that nation-wide monitoring service Sentinel-1 DInSAR data, such as those generated by the P-SBAS method, can be very useful to systematically update landslide inventories, providing significant support to risk reduction practices.