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An example of integration of space and in-situ techniques as innovative strategy for landslide hazard assessment in urban context

Annamaria Vicari (1), Gianpaolo Cecere (1), Gerardo Colangelo (2), Nicola Angelo Famiglietti (1), Angela Perrone (3), and Sabatino Piscitelli (3)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Nazionale Terremoti, Roma, Italy, (2) Dipartimento Ambiente e Energia, Regione Basilicata, Potenza, Italy, (3) Istituto di Metodologie per l'Analisi Ambientale, Consiglio Nazionale delle Ricerche, Potenza, Italy

The integration of data from remote sensing with ground-based measurements represents a new challenge for landslide investigation, due to the necessity to develop innovative strategies and methods. Airborne and satellite methods can provide information on the surface characteristics of the investigated slope, such as geomorphological features, the areal extension of the landslide body, superficial displacement and velocity. In-situ geophysical techniques are able to measure physical parameters directly or indirectly linked with the lithological, hydrological and geotechnical characteristics of the terrains related to the movement.
A first example of this task, has been tested on Stigliano landslide, located in Basilicata Region (southern of Italy); a complex type of slide roto-translational, with very deep failure surface (about 40 m) in the high part of the slope, and earth-flows that involve the middle-low portion of the slopes for about 1.2 km length.
In particular, results coming from MTI techniques have been integrated with in–situ geophysical measurements for the monitoring of deformation phenomena in slow kinematics in the southern part of the town and the characterization of the slope. As MTI techniques, Advanced Synthetic Aperture Radar Differential Interferometry (A-DInSAR) have been used. A-DInSAR methodologies include both Coherence-based type, as well as Small Baseline Subset (SBAS) (Berardino et al., 2002, Lanari et al., 2004) and Persistent/Permanent Scatterers (PS), (Ferretti et al., 2001). Such techniques are capable to provide wide-area coverage (thousands of km2) and precise (mm–cm resolution), spatially dense information (from hundreds to thousands of measurement points/km2) on ground surface deformations. SBAS and PS have been applied to the town of Stigliano, where the social center has been destroyed after the reactivation of a known landslide. A direct comparison of the results has been shown that PS and SBAS techniques are comparable in terms of obtained coherent areas and displacement patterns, with slightly different velocity values for individual points. In particular, PS furnished a range of velocity between 5/25mm/year, while for SBAS we found values around 5/15mm/year. Furthermore, on the crown of the landslide body, a Robotics Total Station measuring distance values on 24 points has been installed. The displacement values obtained are in agreement with the results of the MTI analysis. To better characterize the landslide body, 2D Electrical Resistivity Tomography (ERT) have been carried out along two profiles located very close to the source area of the landslide. ERT is an active geophysical method usually applied in landslide areas with the aim to obtain information on the geometry of the investigated body, i.e. the slide material thickness, the location of areas characterized by a higher water content, the presence of potentially unstable areas (Perrone et al., 2014). The analysis and interpretation of the ERT in Stigliano town allowed the reconstruction of the subsoil geological setting, highlighting the presence of potentially unstable material. Thanks to data collected from space and ground, 6 eviction orders were issued for all the building at north of investigated area, showing as these techniques could be a useful tool in the case of early warning situations.