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Temporal and Spatial Analysis of Landslides Through the SBAS-DInSAR Approach: the Ivancich, Assisi, test case

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Landslide risk is increasing as result of a variety of natural and human induced factors, and landslides are becoming an issue of societal and economical concern in many areas. Due to the large number of areas affected by landslides, and the complexity of the landslide phenomena, the landslide problem cannot be approached (and solved) only at the scale of an individual slope, applying a single engineering technique or method. The extent and complexity of the landslide phenomena require the integration of data and information obtained at different temporal and spatial scales. In the recent years, significant advancements in landslide investigations were obtained by processing remote sensing data, including radar data. In particular, satellite Differential SAR Interferometry (DInSAR) techniques have become standard tools for monitoring surface deformations caused by landslides. In the framework of the EU DORIS Project for the design of a pre-operational advanced downstream service for the detection, mapping, monitoring and forecasting of ground deformations, including landslides and ground subsidence, we have exploited the Small BAseline Subset (SBAS) DInSAR technique for the detection and long-term monitoring of landslides in Umbria, central Italy. We have used ERS-1/2 and ENVISAT SAR images taken in the period 1992-2010 to generate long-term deformation velocity maps at the regional and the local scale, and associated long time-series showing the temporal evolution of surface movements affecting unstable slopes in the study area. We have examined specifically the Ivancich landslide, a slow-moving, deep-seated, complex deformation in the Assisi municipality. In the landslide area, the DInSAR SBAS analysis has revealed a deformation trend of about 1 cm/year, in good agreement with the existing damage assessments. The obtained displacement time-series were compared to rainfall records for the same period in the study area. Results indicate the lack of a direct / immediate response of the surface deformation to the rainfall forcing. Results further indicate a complex temporal interaction between rainfall amount and ground movements.