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Ground deformation analysis in the Umbria region (central Italy) carried out via the SBAS DInSAR approach

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We present the first results of a region-wide attempt to detect and interpret ground deformations in the Umbria region of central Italy, by exploiting differential SAR interferometry (DInSAR). The experiment was aimed at testing the possibility of using the Small BAseline Subset (SBAS) technique to help identifying and monitoring landslides and other ground deformations in central and southern Umbria. The Small BAseline Subset (SBAS) technique allows investigating ground deformations at two distinct spatial scales [1-2]: (i) a low (coarse) resolution, regional scale, and (ii) a high (fine) resolution, local scale. At the regional scale, the technique generates mean deformation velocity maps and associated time series for areas extending for thousands of square kilometers (typically 100 x 100 km), at a ground resolution of the order of 100 x 100 m. The obtained products are particularly suited for regional scale displacement analysis, but can be conveniently used to outline individual and multiple distant sites affected by ground deformations. At the local scale, the technique allows for exploiting the SAR images at full spatial resolution (of the order of 50 x 20 m), detecting, monitoring and analyzing local deformations in space and time, with subcentimeter accuracy. The Umbria region is particularly suited for testing the technique in a "real case" study. Landscape in the region is typical of the Apennines mountain

chain and is characterized by rolling hills and mid-elevation mountains separated by large valleys and open intra-mountain basins. In the area crop out layered sedimentary rocks and subordinately volcanic rocks. The morphological and lithological setting is prone to slope instability. In the region more than 45,000 landslides have been identified and mapped, collectively covering an area exceeding 700 squared kilometers [3]. Towns and villages are mostly located on the hilltops and have only recently expanded on the slopes and the flat, low land areas. Several mass movements affect urban and sub-urban areas in Umbria, causing disruption and economic damage almost every year. We performed the DInSAR processing of a data set of 50 SAR images obtained from the SAR sensors onboard the ERS-1/2 satellites. SAR images (track 351, frame 2745) were acquired in the 9-year period from 1992 to 2000 along descending orbits. From the available SAR images, we have generated 141 interferograms characterized by a maximum spatial baseline of 300m, a time interval not exceeding 4 years, and a maximum Doppler frequency separation of 1000 Hz. Precise satellite orbital information obtained from the Technical University of Delft (The Netherlands) and the 3 arc second (about 90 x 90m) SRTM DEM of the investigated area were also used. The DInSAR processing led to the generation of mean deformation-velocity maps, and associated time series, at the regional and the local scales. Preliminary analysis indicate the capability of the technology to detect ground movements that can be attributed to landslides, on both the coarse resolution regional products, and the fine resolution local products. Furthermore, the regional and local products fit reasonably well surface displacement measurements obtained by GPS and sub-surface deformation measurements obtained by inclinometers in a known landslide area. Processing of an ascending-orbit data set obtained by the ERS-1/2 satellites in approximately the same area (track 172, frame 855) is in progress. The combined analysis of the results obtained from the ascending and the descending orbits will provide information on the E-W and vertical components of the observed deformations, thus allowing more advanced geological and geomorphological interpretations.

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