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Analysis of ground deformation detected using the Sbas-DInSAR technique in Umbria, central Italy

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Ground deformation affecting the Umbria region (central Italy) in the 9-year period from 1992 to 2000 was investigated through multi-temporal Differential Synthetic Aperture Radar Interferometry (DInSAR). For the purpose, the Small BAseline Subset (SBAS) technique was adopted, which allows studying the temporal evolution of the detected deformation at two spatial scales: a low-resolution (regional) scale, and a full-resolution (local) scale. For the analysis, SAR data acquired by the European Remote Sensing (ERS-1/2) satellites along ascending and descending orbits were used. The detected deformation were analysed to investigate their relevance to geophysical, geomorphologic, and human induced processes that may result in hazardous conditions to the population of Umbria. The low-resolution deformation data were used to: (i) determine the amount of displacement caused by the Umbria-Marche earthquake sequence from September 1997 to April 1998 in the Foligno area, (ii) determine the number and percentage of the known landslides that can be monitored by the DInSAR technology in the investigated area, and (iii) identify and measure subsidence induced by exploitation of a confined aquifer in the Valle Umbra. Results indicate that earthquakes moved the Foligno area westward from 0.3 to 3.9 cm and upward from 0.5 to 1.4 cm. Intersection in a GIS of the low-resolution deformation maps with a detailed landslide inventory map allowed determining that the portion of landslides that can be monitored by the SBAS-DInSAR technique in Umbria ranges from 2.7%

to 3.4%, and the percentage of the total landslide area ranges from 10.4% to 12.8%. In the Valle Umbra, a dependency was found between the time and the amount of detected ground deformation, and the record of water withdrawal. The full-resolution deformation data were used to investigate the movement of the Ivancich landslide, in the Assisi Municipality. Joint analysis of the spatial and the temporal characteristics of the ground displacement allowed formulating a hypothesis on the landslide geometry and deformation pattern.