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1 Contribution of Permanent Scatterers technique to the analysis of subsidence in urban area

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Satellite InSAR (*Interferometric Synthetic Aperture Radar)* technique has shown in recent years its capabilities in providing precise measurements of ground displacements induced by subsidence, landslides, sinkholes and erosive processes. In the case of slow movements (up to few cm/year) affecting urban areas, the multi-interferogram technique, such as the Permanent Scatters (PS) (developed by Tele-Rilevamento Europa, a spin-off company of the Politecnico di Milano University), is able to retrieve the spatial distribution of displacements and their evolution along the monitored period.

Thanks to the availability of archive dataset of SAR images acquired by the ERS1 and ERS2 satellites (of ESA- *European Spatial Agency*) spanning from 1992 to 2002, and images by Envisat (ESA) and Radarsat (CSA- *Canadian Spatial Agency*) satellites spanning from 2003-to present, the PS analysis can be applied to provide the multi-temporal analyses of past movements (more than 15 years) and to monitor current ground movements. For these reasons the Italian Civil Protection Department (DPC) promoted a project (SAR.net) devoted to the development of an Italian satellite monitoring system, part of forecasting and warning systems used by the Functional Centre of DPC, based on the interpretation of satellite data processed with PS technique, for the monitoring and rapid mapping of ground movements over large areas.

The results obtained in the city of Rome, one of the areas selected as test site for the Italian satellite monitoring system, are here presented.

The PS analysis allows to identify, at basin scale, the areas affected by subsidence. For those areas where subsidence was detected, the interpretation of PS data was integrated with geological maps, stratigraphic and geotechnical data and historical urban planning maps.

This integrated analysis allows us ot interpret, at a detailed scale, the geological triggering factors of the ground subsidence. PS velocities are directly related to the thickness of the fluvio-deltaic deposits. Every non-direct relationship observed is due to the interaction of three factors: the typology of the deposits, their geotechnical characteristics and the urban land cover that influence the consolidation factors.

The results obtained confirm that this methodology is a valuable tool for the subsidence analysis and, in charge of subsidence risk management, fits the requirements of Civil Protection authorities, that are frequently faced to emergencies induced by the occurrence of ground movements in built-up areas.