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Stability and subsidence across Rome (Italy) in 2011-2013 based on COSMO-SkyMed Persistent Scatterer Interferometry

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Ground stability of the built environment of the city of Rome in central Italy has been extensively investigated in the last years by using Interferometric Synthetic Aperture Radar (InSAR), with focus on deformation of both the monuments of the historic centre (e.g., [1-2]) and the southern residential quarters (e.g., [3]). C-band ERS-1/2 and ENVISAT ASAR time series deformation analyses brought evidence of overall stability across the town centre, except for localized deformation concentrated in areas geologically susceptible to instability (e.g. western slope of the Palatine Hill), whereas clear subsidence patterns were detected over the compressible alluvial deposits lying in proximity of the Tiber River. To retrieve an updated picture of stability and subsidence across the city, we analysed a time series of 32 COSMO-SkyMed StripMap HIMAGE, right-looking, ascending mode scenes with an image swath of 40 km, 3-m resolution and HH polarization, acquired between 21 March 2011 and 10 June 2013, with repeat cycle mostly equal to 16 days. Persistent Scatterer Interferometry (PSI) processing was undertaken by using the Stanford Method for Persistent Scatterers (StaMPS) as detailed in [4], and more than 310,000 radar targets (i.e. PS) were identified, with an average target density of over 2,800 PS/km2. The performance of StaMPS to retrieve satisfactory PS coverage over the urban features of interest was assessed against their orientation and visibility to the satellite Line-Of-Sight, as well as their conservation history throughout the biennial investigated (2011-2013). In this work we discuss effects due to local land cover and land use by exploiting the Global Monitoring for Environment and Security (GMES) European Urban Atlas (IT001L) of Rome at 1:10,000 scale, thereby also evaluating the capability of the X-band to spatially resolve targets coinciding with man-made structures in vegetated areas. Based on this assessment, our PSI results highlight those environmental constraints that can prevent, even at such high spatial resolution, obtaining satisfactory PS densities in peri-urban areas with high vegetation coverage. With regard to recent deformation patterns, COSMO-SkyMed time series confirm the persistence of subsidence processes in southern Rome. In areas of recent urbanization, such as that surrounding the Basilica of St Paul Outside-the-Walls, the estimated vertical motion velocity reaches values higher than -7.0 mm/yr. Further proof of the potentiality of COSMO-SkyMed constellation to extend almost seamlessly ground motion time series from previous SAR missions is offered by the deformation detected at the single-monument scale over the archaeological ruins of the Oppian Hill, the monuments and historical building in the riverside quarter of Trastevere, and the Basilica di San Saba within the Aurelian Walls.

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