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TI: The land subsidence of the Venice historical center: twenty years of monitoring by SAR-based interferometry
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AB: The subsidence of Venice, one of the most beautiful and famous cities in the world, is well known not by reason of the magnitude of the ground movement, which amounts to less than 15 cm over the last century, but because it has seriously compromised the ground safety level of the city in relation of its small elevation above the sea. The lowering of Venice is still today a subject of debates with large rumours on press releases every time a scientific paper is published on the topic. Over the last two decades, satellites instrumented with SAR sensors provided excellent data for detecting land displacements by inteferometric processing. In particular, the accuracy achieved by Persistent Scatterer Interferometry (PSI) and the impressive number of detected measurement points have progressively reduced the use of in situ traditional measurements, i.e. leveling survey, for monitoring land displacements of Venice. In fact, the intensive urban development makes the historical center an optimal site for PSI. On the other hand, the correct interpretation of the PSI outcomes, which provide the relative movement of single churches, palaces, bridges with millimetric precision and metric spatial resolution, require a deep knowledge of the city and its subsoil due to the peculiarity of this urban area developed over the centuries within the sea. We investigate the movements of Venice by Interferometric Point Target Analysis (IPTA) over the last 20 years using SAR acquisitions of the ERS-1/2, ENVISAT, TerraSAR-X, and Cosmo-SkyMed satellites. The density of detected scatterers is one order of magnitude larger with the newest very high resolution X-band sensors from TerraSAR-X and Cosmo-SkyMed, but by reason of the larger observation period the accuracy of the mean displacement rate of the C-band ERS and ENVISAT is higher. IPTA results have been calibrated using leveling and permanent GPS stations to correct the so-called flattening problem, i.e. the slight phase tilt resulting by the inaccuracy in estimation of the orbital baseline due to the not perfect knowledge of the satellite positions. The comparison between the measurements covering the period from 1992 to 2011 confirms the substantial stability of the city in its whole, with a subsidence rate averaging 1 mm/yr. However, the PSI measurements also provide evidence of local zones and single structures that are subsiding at faster rates due to the heterogeneous nature of the of the upper Holocene lagoon subsoil, different load and foundation of the historical palaces, and restoration works along the canals.
DE: [1240] GEODESY AND GRAVITY / Satellite geodesy: results
DE: [9335] GEOGRAPHIC LOCATION / Europe
DE: [4302] NATURAL HAZARDS / Geological
DE: [4323] NATURAL HAZARDS / Human impact
SC: Natural Hazards (NH)
MN: 2012 Fall Meeting