The movements of Venice revealed by multi-generation SAR-based EOS

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The subsidence of Venice and its lagoon has been systematically studied since the 1970s’ in connection with the frequency increase of flooding events during exceptional high tides. It is a well-known case study not so much for the subsidence magnitude but because each millimeter lost of elevation seriously threatens the conservation of the historical center and the surrounding lagoon considering their small ground elevation with respect to the mean sea level and the eustatic sea level rise.

During the last two decades, the use of satellites instrumented with SAR (Synthetic Aperture Radar) sensors and the interferometric processing have provided excellent information on the land displacements. The first SAR analysis on Venice was carried out by DInSAR (Differential Interferometric SAR) and provided several thousands of measurements, i.e. much more than those obtained by the few hundred benchmarks monitored by levelling since 2000 (Tosi et al., 2002). More recently the application of Persistent Scatterer Interferometry (PSI) has remarkably increased the number of measurable targets, achieving accuracies comparable to that of leveling and permanent GPS (e.g., Teatini et al., 2005; Teatini et al., 2007; Teatini et al., 2012). With the launch of the new generation X-band sensors, it becomes possible to obtain hundred thousands of data with high spatial resolution and a short revisiting time, and detect differential movements of single churches, palaces, bridges, etc. (Tosi et al., 2012; Tosi et al., 2013). Therefore, PSI opens new possibilities for a more accurate interpretation of the land subsidence and progressively takes over the in-situ traditional measurements (i.e. levelling and GPS), reducing their use just for the calibration of the SAR-based methodologies.

The aim of this work is to provide an overview of the ground movements of Venice obtained by SAR-based interferometry on more than 20 years of acquisition data from multi-generation satellites including ERS1/2, ENVISAT ASAR, Cosmo-SkyMed, TerraSAR-X, ALOS-PALSAR, RADARSAT-2, Sentinel-1. In particular, we discuss on the capability of the outcomes from the different satellites to quantify the ground movements of the historical center of Venice. An image of the subsidence evolution of the City since 1992, including details of single structures of particular interest is also given. Furthermore, the natural and anthropogenic causes of the ground displacements are highlighted.

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References

