Subsidence mapping in Mallorca (Spain) via Sentinel-1 imagery and links with sedimentary basin characteristics

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Subsidence is a highly destructive natural hazard, which can be caused by both natural and anthropogenic causes. Its impacts include a decrease in storage capacity of aquifer systems, the creation of cracks and fissures, damages to buildings and infrastructures, and an increase of the susceptibility to flooding. In this study, Persistent Scattered Interferometry (PSI) has been used to process Synthetic Aperture Radar (SAR) images, for the detection and analysis of ground deformation and subsidence processes in the island of Mallorca. The study database is composed of 120 images captured by the Sentinel 1A and 1B satellites (between May 2016 and December 2019), from which we derived a map of accumulated displacement rates occurred during a 3 years and a half period. The results show important subsidence processes of up to 3 cm per year in large areas of the sedimentary basin of Palma, and of lesser magnitude (between 1 and 2 cm per year) in locations of the Inca basin and in small basins in the Tramuntana Range. A significant relationship has been observed between the thickness of the Quaternary sediment and the observed subsidence rates. The results highlight the high degree of geomorphological dynamism at very short time scales that characterizes Mallorca, and the vulnerability of certain urban areas, such as the city of Palma (400000 inhabitants), and agricultural areas, such as the Central Depression, facing the risk of subsidence and associated damages.