EGU22-1464
https://doi.org/10.5194/egusphere-egu22-1464
EGU General Assembly 2022

InSAR-derived present-day rates and drivers of coastal land subsidence at Capo Colonna, Italy

Francesca Cigna[1] and Deodato Tapete[2]
[1]National Research Council (CNR), Institute of Atmospheric Sciences and Climate (ISAC), Rome, Italy
[2]Italian Space Agency (ASI), Rome, Italy

The Capo Colonna promontory in southern Italy has long been affected by ground instability involving not only coastal erosion and loss of land, but also a noticeable subsidence process, both posing risk to houses and roads built onto the promontory, alongside its archeological site including Hera Lacinia's sanctuary. Tectonic-induced submergence of some formerly exposed structures and sites and landward retreat up to 200 m were recorded over the centuries along the coastlines of this region. Anthropogenic activities associated with hydrocarbon exploitation add onto Capo Colonna's ground deformation drivers, with an influence zone that appears to be mostly limited to the shallow-marine terrace that defines the promontory. Subsidence at the site has been monitored since 2005 with geodetic and geophysical methods by the national hydrocarbons authority and the archaeological superintendence. More recent investigations included satellite Interferometric Synthetic Aperture Radar (InSAR) techniques, that revealed −1 to −2 cm/year subsidence rates in 1992−2014 [1-2]. Artificial corner reflectors were also installed to enhance the backscattering properties of the archaeological site and the coastline, trying to ease identification of persistent and coherent scatterers suitable to act as InSAR monitoring targets [2]. This work extends the temporal coverage of past InSAR surveys using two 6 year-long big data stacks of ~300 Sentinel-1 IW scenes each [3], allowing the estimation of subsidence rates and patterns to date, with an unprecedented weekly temporal sampling. The Parallel Small BAseline Subset (P-SBAS) method integrated in ESA's Geohazards Exploitation Platform (GEP) is used to run the advanced image processing workflow using a cloud environment. Present-day vertical rates are found in the order of −0.7 to −1.5 cm/year, with peaks of −2.3 cm/year. Two clear bands of east-west deformation are identified, with rates reaching ±1 cm/year and pointing towards the maximum subsidence center, i.e. west of a gas production well. While Sentinel-1 data corroborate the spatial association between land subsidence and gas extraction infrastructure (that was already observed in previous studies), the new results suggest an acceleration of the subsidence process with respect to its long-term trend. Some previously unknown short-term trend variations that overlapped onto the main subsidence process over the last few years are also highlighted, owing to the temporal granularity of the Sentinel-1 acquisitions. These outcomes contribute to advance the understanding of a local phenomenon studied for years, and prove the benefits that technical improvements in satellite observations can bring to refine coastal subsidence rates and distinguish driving factors.

[1] Tapete D., Cigna F. 2012. Site-specific analysis of deformation patterns on archaeological heritage by satellite radar interferometry. MRS Online Proceedings Library, 1374, 283-295. https://doi.org/10.1557/opl.2012.1397

[2] Cigna F. et al. 2016. 25 years of satellite InSAR monitoring of ground instability and coastal geohazards in the archaeological site of Capo Colonna, Italy. In: SAR Image Analysis, Modeling, and Techniques XVI, SPIE, Vol. 10003, id. 100030Q. https://doi.org/10.1117/12.2242095

[3] Cigna F., Tapete D. 2021. Sentinel-1 big data processing with P-SBAS InSAR in the Geohazards Exploitation Platform: an experiment on coastal land subsidence and landslides in Italy. Remote Sensing, 13, 885. https://doi.org/10.3390/rs13050885