Geophysical Research Abstracts
Vol. 17, EGU2015-12148, 2015
EGU General Assembly 2015

Natural and anthropogenic ground subsidence in the Sibari Plain basin (Southern Italy) detected by Envisat and Cosmo-SkyMed InSAR time series analysis

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We investigated surface ground deformations in the Sibari Plain (SP - Calabria, Southern Italy) which representing a Holocene coastal plain located along the boundary between Calabrian Arc and Southern Apennines. The plain is characterized by intense urbanization, groundwater exploitation, hydrogeological instability and the presence of capable faults.
Our study is founded on the application of the Small Baseline Subset multi-temporal InSAR technique to two SAR datasets acquired from 2003 up to 2013 by Envisat (ESA, European Space Agency) and COSMO-SkyMed (ASI, Italian Space Agency) satellites.
The Up component records a widespread subsidence, up to $\sim$ 20 mm/yr (Envisat and COSMO-SkyMed sensors), along the whole coastal sector from Villapiana Lido to Marina di Schiavonea, while low positive values ($\sim$1 mm/yr) are present moving inland.
Along the coastal area, the East component is characterized by common positive values (Eastward displacement), only in correspondence of the Laghi di Sibari and the Corigliano industrial area negative values are recorded.
We investigate the possible triggering subsidence mechanisms through the interpretation of the interferometric results based on geological, hydrogeological and land use information.
The thickness of the Plio-Quaternary succession is reconstructed by deep exploration wells and seismic data and a direct correlation between it and the subsidence, recorded by the InSAR data, is observed.
Recent study describes an active oblique-contractional belt (the Amendolara Ridge) in the Ionian Sea in front on the SP. We suggest that this active back thrusting can triggered a flexural subsidence mechanism.
We try to find correlations among ground deformation, recent fault activity and earthquakes occurrence. In detail, we analyze the Envisat and COSMO-SkyMed both ascending and descending time series depending on the earthquakes happened, during the period of InSAR data availability, close to the capable faults present in the study area. We suppose that fault activity and earthquakes do not play a role in the present SP subsidence.
We investigate also the correlation between subsidence and the thickness of the late Holocene deposits which are mainly related to the Crati Delta progradation. The thickness are estimated through the reconstruction of the Digital Surface Model of late Holocene succession bottom by the analysis of numerous well-logs. We observe that the compaction of late Holocene deposits contribute to the subsidence phenomena but does not represent the only triggering mechanism.
The contribution of the human-made factors on the ground deformation are also investigated. In detail, we reconstruct the phreatic water table variations between 2002 (bibliographic data) and 2013 (new data) and observe that the negative vertical movements are indifferently located in areas characterized by water table drop and rise. For this reason, we suggest that the water table drop represents an incremental factor of subsidence in the SP and not a triggering one as supposed by previous authors. Other incremental human-made factor of the SP subsidence consists of the fast urbanization of the coastal area during the last $\sim$50 yr.
The results of this study show a ground deformation pattern due to coexisting regional and local natural processes and human-made activities.