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Subsidence monitoring update for Emilia-Romagna region (Italy) by integrated use of InSAR and GNSS data

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The alluvial plain sector (Po Plain) of Emilia Romagna region (Northern Italy) is a subsiding sedimentary basin, due to both natural and human-induced subsidence phenomena. Different Institutions without a plan consistent at regional scale initially monitored subsidence. In 1999 ARPA (Regional Agency for Environmental Prevention) Emilia-Romagna, on behalf of the Emilia-Romagna Region and in collaboration with DICAM Department of the Bologna University, established a network composed by 2300 leveling benchmarks, connected to 60 GNSS points, covering the whole Po Plain sector of the region. In 2005-2006 a first radar interferometry (PSInSAR™) analysis was conducted, exploiting both ESA (ERS – Envisat) and Radarsat satellite data.
ARPA, on behalf of the Emilia-Romagna Region, with advisory from DICAM and in collaboration with TRE Tele-Rilevamento Europa, has recently updated the regional subsidence map of the Po Plain sector, using a new integrated approach: in the last campaign, the measurement of the vertical displacement was in fact obtained by the combined use of permanent GNSS stations and advanced InSAR data. The integrated use of these complementary techniques allows to take advantage of the strengths offered by each approach, overcoming their weaknesses.
A SqueeSAR™ analysis of Radarsat radar images, acquired between 2006 and 2011, was carried out over the whole regional plain territory (more than 13.000 km2), allowing to obtain a map of vertical displacement for more than 2.000.000 measurement points (MP), with an average point density of 200MP/km2. In parallel, the data from 17 permanent GNSS stations with a long acquisition period were processed with appropriate time series analysis in order to calibrate and validate the InSAR results.
The final calibrated outcomes have permitted to obtain a complete and homogeneous map of the subsidence phenomena at regional scale, defining a both “absolute” and relative velocity datum with respect to the ITRF (International Terrestrial Reference Frame) and European Terrestrial Reference Frame (ETRF). The calibration methodology applied, the analysis performed on the InSAR dataset and the final products obtained, primarily the vertical movement velocity map, are reported.