Analysis of ground deformation using SBAS-DInSAR technique applied to Cosmo-Skymed images, the test case of Rome urban area.

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Remote sensing is a key tool for environmental monitoring due to its outstanding capabilities to provide unique and timely information about Earth surface. In particular, differential SAR interferometry (DInSAR) represents nowadays a well-established remote sensing technique for the investigation of surface deformation phenomena. Among the variety of DInSAR techniques that have been developed over the years, a very popular approach is represented by the Small BAseline Subset (SBAS) algorithm, which exploits a two-scale strategy, as detailed in and allows the detection and monitoring of very localized deformation signals that may affect, for instance, single buildings or man-made structures in urban areas.
This work is aimed at investigating the capability improvement of SBAS-DInSAR technique to map deformation phenomena affecting urban areas by exploiting SAR data acquired by the X-band sensors of the Cosmo-Skymed (CSM) constellation with respect to those of the ERS/ENVISAT radar systems, operating at the C-band. To this aim, we have applied the SBAS-DInSAR approach to three different archives of SAR images gathered by the CSM, the ERS and the ENVISAT platforms over the area of Roma (Italy) from 1992 to 2010. From the available SAR data-sets, we have accordingly obtained three mean deformation velocity maps of the area, as seen by the three different radar systems in the relevant observation time intervals; furthermore, for each coherent pixel, we have retrieved the corresponding displacement time series. The achieved DInSAR products have then used to perform the proposed comparative analysis, which has also benefited from the availability of external information, such as electrical resistivity tomography data, geological maps, leveling time series and building structural data.
We focused on the Torrino area, in the south-eastern sector of Roma, where independent studies had already revealed that significant deformation signals were present, testified by the serious damages which have affected many buildings in the area. However, this signal was not detectable into the ERS deformation time series being such buildings of recent construction. On the contrary,

the analysis of the ENVISAT DInSAR products, spanning the time interval between 2002 to 2008, has clearly evidenced the presence in the investigated areas of such a deformation signal in correspondence to one of the new buildings. Finally, the CSM deformation time series have definitely evidenced that buildings in this area are clearly affected by significant displacement signals with a rate reaching up to 5 cm per year. Two geoelectrical surveys have been executed to reconstruct the geological setting of the subsoil in order to investigate the causes of the observed ground settlements and to attempt a more detailed reconstruction of each single buildings behavior.
Additional investigations were also done on the urban area of Rome characterized by the presence of recent alluvial deposits (bed of the Tiber River and its tributaries), representing a critical element for the buildings stability; we remark that all the area located in alluvial deposits is affected by a major trend with significant velocity of subsidence that have in the past irreversibly damaged many buildings. The retrieved DInSAR products have revealed particularly helpful to perform simplified damage assessment analyses on each building, allowing us to study their stability conditions and to make some hypotheses on their possible critical evolutions in time.