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The SBAS-DInSAR approach as a tool for monitoring millimetric displacements affecting infrastructures

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Differential SAR Interferometry (DInSAR) is a remote sensing technique that allows, in a non-invasive and non-destructive way, detecting and monitoring ground displacements with centimeter to millimeter accuracy by exploiting the phase difference (interferogram) between two SAR images relevant to the same area. The recent development of advanced DInSAR techniques, aimed at the generation of deformation time series, has led to the exploitation of the large archives of SAR data acquired, during the last 20 years, by the ERS, ENVISAT and RADARSAT satellites.
Among these advanced DInSAR approaches, we focus on the Small BAseline Subset (SBAS) algorithm (Berardino et al., 2002) that relies on the combination of DInSAR data pairs, characterized by a small separation between the acquisition orbits (baseline), in order to produce mean deformation velocity maps and the corresponding time series, maximizing the coherent pixel density of the investigated area. One of the main capabilities of the SBAS approach is the possibility to work at two spatial resolution scales, referred to as regional (with a spatial resolution of about 100m x 100m) and local (with a spatial resolution of about 5-10m) scale (Lanari et al., 2004). This allows us to investigate deformation phenomena affecting both extended areas and selected zones, in the latter case highlighting localized displacements that may affect single structures or buildings (at the full instrument resolution).
At the scale of single structures, the SBAS approach is particularly suited for monitoring the displacements occurring in urban areas (buildings, roads) or affecting single infrastructures (dams, bridges, highways).
In the last years, after the launch of the new generation SAR satellites (COSMO-SkyMed, TerraSAR-X, ALOS), the availability of SAR images at high spatial resolution scale (3 m) and with very short revisit time (4 days in the COSMO-SkyMed constellation) allowed to significantly improve the performances achievable in urban areas, both in terms of number of monitoring structures and of details that can be extracted from a single structure.
Accordingly, in this work we present the SBAS-DInSAR results achieved in the Napoli Bay area by exploiting SAR data acquired by different satellites (ERS, ENVISAT, RadarSAT-1, COSMO-SkyMed) with different characteristics (spatial resolution, temporal sampling, carrier frequency, etc.).
In particular, we have generated very long term time-series by processing almost 20 years (1992-2010) of SAR data acquired by the ERS-1/2 and ENVISAT ESA satellites; moreover we have exploited the RadarSAT-1 data acquired in the last 10 years over the Napoli Bay area, thus allowing us to make a comparison with the results already obtained by using the data acquired by the European satellites. Finally, the results obtained by processing the available COSMO-SkyMed dataset relevant to the investigated area have been compared to the previous ones, in order to show the impact of the improved temporal and spatial resolution of the new generation SAR sensors in the context of single infrastructure monitoring.

References

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