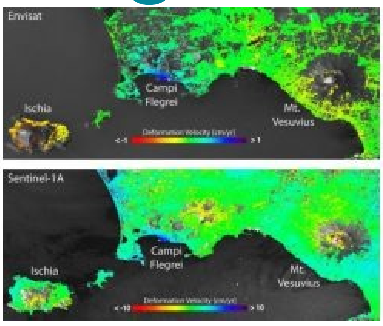
Sentinel-1 Pushes Radar Remote Sensing to New Level



Thanks to frequent observations from the year-old Sentinel-1A radar satellite, scientists are improving the remote sensing technique to map ground deformation and hence opening new doors for earthquake and volcano monitoring. By comparing data from past satellite radar missions – ERS and Envisat – with those obtained from the current Sentinel-1A, researchers of Italy's Institute for Electromagnetic Sensing of the Environment (IREA-CNR) have shown the dramatic improvement in surface deformation mapping.

To achieve this, the scientists used the Interferometric Synthetic Aperture Radar, or InSAR, technique. This involves combining two or more radar images acquired at different times. If something on the ground has changed between the acquisitions, the terrain deformation is displayed as a continuous sequence of coloured stripes called interference fringes, or an 'interferogram'.

SBAS

Taking the technique a step further, the scientists have applied an algorithm known as Small BAseline Subset (SBAS) approach to the interferometry technique. This permits the generation of spatially dense and highly accurate mean deformation velocity maps by 'focusing' the InSAR analysis only on interferograms characterised by a small spatial and temporal orbital separation between the radar images. This is particularly suitable when dealing with data collected by Sentinel-1A, which has a 12-day revisit time – a major improvement on previous radar missions.

Spatial coverage

In spite of the relatively short operational period of Sentinel-1A sensor, the system has already shown its capability to measure surface deformation with a few millimetre accuracy, said Riccardo Lanari, director of IREA-CNR. Moreover, and even more important, the results clearly show that, thanks to the small baselines characterising the Sentinel-1A data, it is possible to drastically increase the spatial coverage of the surface deformation maps, in terms of density of investigated pixels, compared to previous generation ERS and Envisat SAR systems, he continued.

This is evident when comparing the mean deformation velocity maps generated from Sentinel-1A and Envisat data over Italy's Bay of Naples, where three main volcanic complexes – Mount Vesuvius, the Phlegraean Fields and Ischia island – are located. In particular, thanks to its increased spatial coverage, the Sentinel-1A maps clearly show the volcano's 'spreading effect' at the summit of Mount Vesuvius, which was only partially visible with previous products from ERS and Envisat. Also evident is the improvement of the measurement density achieved over the Phlegraean Fields, characterised by an ongoing uplift.

Revisit time

The Sentinel-1 mission ensures a continuity of ground deformation measurements started by ERS and Envisat, but with better quality in terms of spatial mapping and acquisition frequency. In particular, Sentinel-1's 250 km-swath in the Interferometric Wide Swath mode allows it to routinely generate large-scale interferograms.

With the upcoming launch of Sentinel-1A's sister satellite – Sentinel-1B – surface deformation mapping will be further improved. The two-satellite system will shorten the revisit time to six days, enhancing the quality of the interferometric products.

Long-term monitoring of land deformation around Naples, as well as in other volcanic areas across the globe, is key to monitoring their evolution and potential risk.

Open Access

The possibility to access Sentinel-1 SAR data, with the large coverage and a free and open access data policy, opens new perspectives in civil protection scenarios, noted Michele Manunta, a researcher of IREA-CNR. For instance, they may already generate, in an operational context, interferograms of nearly the entire Italian territory.