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## Improving monitoring techniques by exploiting TerraSAR-X data: an application to Campi Flegrei (Naples, Italy)

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Geodetic monitoring of the Neapolitan Volcanic District, including the Campi Flegrei caldera on the west of the city of Naples (Italy), is carried out via an integration between ground based networks and space-borne DInSAR techniques, exploiting the SAR sensors onboard ERS1-2 and ENVISAT satellites. This allowed, for instance, to follow the time evolution of the small uplift events which took place in 2000 and 2005-2006. Unfortunately, the use of the ENVISAT C-band could result sometimes in no information when dealing with very low deformation rates, as in the 2005-2006 case, when only continuous ground stations were able to detect the very beginning of the uplift event.

To overcome this problem, from December 2009 we decided to use an high resolution SAR sensor operating in the X band, i.e. TerraSAR-X from DLR.

TerraSAR-X High Resolution Spotlight scenes covering the main part of the Campi Flegrei caldera and centred on the Solfatara crater were used for a DInSAR analysis, using the GENESIS DLR's software. The first two scenes (Dec. 15 and 26) were acquired with a temporal baseline of only one repetition cycle (11 days) and formed an interferogram with a very small perpendicular baseline (16.5 m).

Apart from some minor atmospheric effects, the interferogram shows a small but clear deformation signal in the Pisciarelli area, close to the east side of the Solfatara crater. The ellipse shaped uplift area extends approximately 30 meters in E-W and 20 meters in N-S directions and the maximum deformation is up to 10 mm in the centre of the uplifted area.

The availability of a new scene (06/01/2010) allowed three possible combinations.

The deformation event highlighted by this analysis is consistent with geochemical observations carried out in Pisciarelli by INGV-OV.

Pisciarelli area is seat of a fumarolic field systematically monitored in the frame of the volcanic surveillance of the Campi Flegrei caldera. Two field surveys highlighted that, during the period of SAR images acquisition, a new and strong fumarolic vent appeared in the centre of the uplifted area. In fact the vent, firstly observed on Dec. 21, was absent on Dec. 16. The two independent observations, field surveys and SAR data, suggest that the opening of the fumarolic vent was preceded by the pressurization of a small part of the fumarolic field highlighted by the documented uplift. The correlation between the dynamics of the fumarolic field and the deformation signal is confirmed by the fact that in the 26/12/2009-06/01/2010 interferogram the deformation signal is no more detectable.

Finally, this case proves the high potentiality of TerraSAR-X High Resolution Spotlight data in monitoring volcanic activity with a resolution suitable for detecting also minor, but possibly dangerous, changes of the systems, as it could be in the early recognition of the signals generated by impending phreatic eruptions.

TerraSAR-X High Resolution Spotlight acquisitions will continue every cycle and PS-InSAR and SBAS algorithms will be applied to carefully monitor any further changes in the activity of the Campi Flegrei volcanic system.