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DInSAR-based monitoring services for ground deformation retrieval on active volcanoes and seismic regions through spaceborne and airborne radar sensors

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Surface displacement is one of the main parameters to assess the natural hazard in volcanic and seismic regions, as well as in areas affected by landslides and subsidence.

Differential Synthetic Aperture Radar Interferometry (DInSAR) is becoming one of the key techniques to measure ground deformation in any atmospheric conditions, with continuous day and night imaging capabilities and a high accuracy level, thanks to its capability to provide dense measurements at large spatial scale and at relatively low cost.

The increasing diffusion of the use of DInSAR is also due to the large availability of huge and easily accessible SAR data archives, as those acquired, since late 2014, by the Copernicus Sentinel-1 constellation, which is globally and routinely providing C-band SAR data with a defined repeat-pass frequency. Therefore, with such a constant and reliable availability of data, it is possible to use the DInSAR technique for monitoring purposes, such as those related to the measurements of ground motion in natural hazard prone areas.

In this work, we present the operative services and tools that have been developed at CNR-IREA, in the framework of its cooperation with the Italian Department of Civil Protection (DPC), for detecting and monitoring large scale surface deformation through the use of the DInSAR technique.

A first service is focused on seismic areas and relies on the publicly accessible earthquake catalogues. Once an earthquake that likely produces ground deformation occurs, it triggers an automatic DInSAR processing that generates the co-seismic induced displacement maps, by retrieving the relevant pre- and post-seismic Sentinel-1 acquisitions. While being focused on the Mediterranean region the system works at global scale.

A second service is devoted to volcano displacement monitoring. The designed system is fully automatic and the process is triggered by the availability, for every monitored volcano site, of a new SAR data in the Sentinel-1 catalogues acquired from both ascending and descending passes. The data, per each orbit, are automatically ingested and then processed through the well-known Parallel Small BAseline Subset (P-SBAS) DInSAR technique that allows generating the corresponding displacement time series and mean displacement velocity maps. The so-retrieved Line of Sight

(LOS) measurements are then combined to compute the Vertical and East-West components of the deformation, which are straightforward understandable by the end user. This service is currently operative for the main active Italian volcanoes (Campi Flegrei caldera, Mt. Vesuvius, Ischia, Mt. Etna, Stromboli and Vulcano), but it can be easily extended to include other volcanic areas on Earth.

Finally, a third tool is based on the use of an airborne platform which is equipped with a X-band and L-band SAR sensor, and that is used in conjunction with the already mentioned systems to provide further information on the areas under study.

Retrieved deformation results and their implication in the understanding of the analyzed phenomena will be discussed at the conference.

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