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Continental scale SBAS-DInSAR processing for the generation of Sentinel-1 deformation time series within a cloud computing environment: achieved results and lessons learned

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The Sentinel-1 constellation of the Copernicus Program already represents a big revolution within the Earth Observation (EO) scenario. This result is mainly due to the capability of this constellation to acquire huge volumes of SAR data all over the globe, with a wide spatial coverage, a short revisit time (12 or 6 days in the case of one or two operating satellites, respectively), and a free and open access data policy. In particular, the availability of such a large amount of SAR data acquired through the TOPS mode, characterized by a short “orbital tube” (with a 200m nominal diameter) and a specific design for ensuring differential SAR interferometry (DInSAR) applications, has opened the possibility to investigate Earth surface deformation phenomena at unprecedented spatial scale and with a high temporal rate.

Among several advanced DInSAR algorithms, a widely used approach is the Small BASeline Subset (SBAS) technique, which has already proven its effectiveness to investigate surface displacements with centimeter- to millimeter-level accuracy in different scenarios. Moreover, a parallel algorithmic solution for the SBAS approach, referred to as Parallel Small BASeline Subset (P-SBAS), has been recently developed. This approach permits to generate, in an automatic and unsupervised way, advanced DInSAR products by taking full benefit from parallel computing architectures, such as cluster, grid and, above all, cloud computing infrastructures.

In this work we present the results of a DInSAR experiment, based on the P-SBAS approach, carried out at the European scale. In particular, we exploited the entire available Sentinel-1 dataset collected through the TOPS acquisition mode between March 2015 and September 2018 from descending orbits over large part of Europe. Moreover, the overall analysis was carried out by using the Copernicus Data and Information Access Services (DIAS) and, in particular, those provided by the ONDA DIAS platform, which was selected through a public tender. This activity, carried out as stress test of the EPOSAR service included in the Satellite Data Thematic Core

Service of the EPOS infrastructure, permitted to investigate the DIAS capacity to operationally serve systematic and automatic DInSAR processing services, such as the one based on the P-SBAS approach.

Our experiment was successfully completed, allowing the retrieval of the deformation time-series of the overall investigated area with the final products having the main characteristics summarized in the following:

- Exploited Sentinel-1 data: ~72.000
- Covered Area: ~4.500.000 km²
- Coherent (multilook) SAR pixels: ~120.000.000
- Final products pixel dimension: ~80 m
- Time elapsed: ~6 months

The presented discussion will highlight the main pros and cons of the exploited solution for such wide area DInSAR experiment. Moreover, the analysis of the achieved results will also show the high quality of the retrieved DInSAR results, that can be of interest for the Solid Earth scientific community, and the potentially positive impact of the presented solution for what concerns the future development of the European Ground Motion Service.

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