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Large scale deformation mapping through the Cloud-Computing based Sentinel-1 P-SBAS pipeline

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The advent of the Sentinel-1 (S1) constellation has brought a big revolution within the EO scientific field thanks to its capacity to acquire huge volumes of SAR data all over the globe. Thanks to its characteristics, the S1 constellation makes it possible to map the ground displacements at unprecedented large scale, allowing the investigation of the Earth surface deformation dynamics in an innovative way. In this work we present a Cloud Computing-based interferometric pipeline, implementing the DInSAR P-SBAS approach, for the massive processing of S1 Interferometric Wide Swath (IWS) data, aimed at generating deformation time series at national/continental scale in efficient, automatic and systematic way. The presented pipeline manages: i) the transfer of the input data from the S1 archives to the computing resources within the CC environment; ii) the parallel processing of these data; iii) the exploitation of external data, like GPS measurements, to make the processing totally automatic and robust; iv) the long term storage of the generated results within the CC environment; v) the possibility to access and visualize the generated deformation maps and time series on a GIS system located in the cloud environment. The presented S1 P-SBAS pipeline can work with different S1 data-hubs, and can be ingested within different CC platforms.

Regarding the interferometric processing, the developed P-SBAS chain ingests S1 IWS SLC images and carries out several steps and algorithms, often very demanding from the computational point of view, in order to generate the final deformation time series and mean displacement velocity maps with a centimeter/millimeter accuracy.

Moreover, the presented pipeline also benefits from the use of external data both to automatize the DInSAR processing and to provide value-added information on the surface deformation. In particular, together with the S1 input data, we download the GPS measurements retrieved from the Magnet + Global GPS Network Map of the Nevada Geodetic Laboratory (University of Nevada), which provides GPS measurements continuously available and daily updated. This information is exploited in several steps of the processing chain where the automatic selection of a stable reference point is required. Moreover, since the S1 large spatial footprints make it possible to detect the surface deformation related to the tectonic trends, the GPS measurements are also exploited to identify and separate these long-wavelengths deformation patterns from the short-wavelengths ones associated to local ground displacement phenomena.

As preliminary experimental analysis we show the national-scale DInSAR processing performed over the whole Italian territory by exploiting the S1 data acquired from both ascending and descending orbits during the period March 2015 – August 2018. This analysis involved the processing of 6952 S1 IWS slices acquired from ascending orbits and 6031 S1 slices acquired from descending orbits. The generated mean velocity deformation maps of the entire Italian peninsula will be shown during the presentation.