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Sentinel-1 data massive processing for large scale DInSAR analyses within Cloud Computing environments through the P-SBAS approach

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The SENTINEL-1 (S1) mission is designed to provide operational capability for continuous mapping of the Earth thanks to its two polar-orbiting satellites (SENTINEL-1A and B) performing C-band synthetic aperture radar (SAR) imaging. It is, indeed, characterized by enhanced revisit frequency, coverage and reliability for operational services and applications requiring long SAR data time series. Moreover, SENTINEL-1 is specifically oriented to interferometry applications with stringent requirements based on attitude and orbit accuracy and it is intrinsically characterized by small spatial and temporal baselines. Consequently, SENTINEL-1 data are particularly suitable to be exploited through advanced interferometric techniques such as the well-known DInSAR algorithm referred to as Small BAseline Subset (SBAS), which allows the generation of deformation time series and displacement velocity maps.
In this work we present an advanced interferometric processing chain, based on the Parallel SBAS (P-SBAS) approach, for the massive processing of S1 Interferometric Wide Swath (IWS) data aimed at generating deformation time series in efficient, automatic and systematic way. Such a DInSAR chain is designed to exploit distributed computing infrastructures, and more specifically Cloud Computing environments, to properly deal with the storage and the processing of huge S1 datasets. In particular, since S1 IWS data are acquired with the innovative Terrain Observation with Progressive Scans (TOPS) mode, we could benefit from the structure of S1 data, which are composed by bursts that can be considered as separate acquisitions. Indeed, the processing is intrinsically parallelizable with respect to such independent input data and therefore we basically exploited this coarse granularity parallelization strategy in the majority of the steps of the SBAS processing chain. Moreover, we also implemented more sophisticated parallelization approaches, exploiting both multi-node and multi-core programming techniques.
Currently, Cloud Computing environments make available large collections of computing resources and storage that can be effectively exploited through the presented S1 P-SBAS processing chain to carry out interferometric analyses at a very large scale, in reduced time. This allows us to deal also with the problems connected to the use of S1 P-SBAS chain in operational contexts, related to hazard monitoring and risk prevention and mitigation, where handling large amounts of data represents a challenging task. As a significant experimental result we performed a large spatial scale SBAS analysis relevant to the Central and Southern Italy by exploiting the Amazon Web Services Cloud Computing platform. In particular, we processed in parallel 300 S1 acquisitions covering the Italian peninsula from Lazio to Sicily through the presented S1 P-SBAS processing chain, generating 710 interferograms, thus finally obtaining the displacement time series of the whole processed area.
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