RADARSAT-1 Deformation Time Series Analysis Based on the SBAS-DInSAR Algorithm

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Abstract

Differential Synthetic Aperture Radar Interferometry (DInSAR) is a remote sensing technique that exploits the phase difference between SAR image pairs acquired at different times, in order to detect the relative displacement (projected along the sensor line of sight (LOS)) occurred among the acquisitions [1]. Over the last decade the investigations of ground motions associated with various geophysical phenomena have significantly evolved from analyzing single deformation events to detect the spatial and temporal deformation evolution through "interferometric" time series. In this context, several approaches have been proposed [2-3]; among these, the one referred to as Small BAseline Subset (SBAS) technique [3] implements an easy combination of a proper sequence of multi-look differential interferograms characterized by small spatial and temporal baselines.
The SBAS-DInSAR technique has been extensively applied to seismic, volcanic and subsiding areas, demonstrating its effectiveness [4-5] but, up to now, only ERS-1/2 and ENVISAT data have been exploited. On the other hand, the availability of large volumes of SAR data collected by the Canadian RADARSAT-1 sensor encouraged us to adapt the well-known SBAS-DInSAR processing chain to the RADARSAT-1 data too. To achieve this task several improvements were needed.
We present in this work the first results obtained by implementing the RADARSAT-1 SBAS-DInSAR processing algorithms; for the purpose, the following key modifications were carried out:

- the raw data focusing operation was modified to take into account the significant fluctuations of the Doppler centroid values within the SAR scenes;
- the differential interferograms generation algorithm was updated to compensate for the inaccuracies of the available orbital information.

Following the description of the processing chain, we present the results achieved on a set of 27 RADARSAT-1 SAR images collected from the descending orbits (Fine mode, Beam 5) from December 2004 to March 2007, and relevant to the test site area of New Orleans (USA) which extends for about 100 x 60 Km. From this data-set we generated 74 multilook differential interferograms characterized by a maximum perpendicular baseline value smaller than 1500 meters, with no constraint on the temporal baseline separation due to the shortness of the observation period. Satellite orbital information and the SRTM DEM were also used for the differential interferograms generation. Following the phase unwrapping operation [6], the differential

interferograms were inverted through the SBAS procedure and, for each coherent pixel of the radar images, we computed the time-dependent surface line-of-sight (LOS) displacements as well as the average LOS deformation rate.
The presented results are in general agreement with those previously achieved by Dixon et al. [7], and demonstrate the effectiveness of the implemented RADARSAT-1 SBAS-DInSAR processing chain.

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