Geophysical Research Abstracts, Vol. 7, 07255, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07255

Surface deformation analysis of the tectonically active regions of Los Angeles and San Francisco (California) by applying DInSAR techniques

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Differential Synthetic Aperture Radar Interferometry (DInSAR) is a remote sensing technique that allows us to analyze deformation phenomena affecting both extended area and localized structures, by exploiting the phase difference of SAR image pairs relevant to the area under study.

A particularly effective way to detect and follow the temporal evolution of the displacements is via the generation of time series and in this context we have considered the technique referred to as Small BAseline Subset (SBAS) [1]. The SBAS approach utilizes an appropriate combination of the available multilook interferograms based on two key points: the data pairs used to produce the interferograms are characterized by small spatial and temporal baselines in order to limit decorrelation effects; a singular value decomposition methodology links independent SAR acquisition subsets separated by large baselines.

In this study we have applied the SBAS technique for investigating the ongoing land deformation relevant to the Los Angeles and San Francisco (California) metropolitan areas imaged from the ERS-1/2 satellites spanning the time period 1993-2002. These two areas are tectonically active regions with surface deformations that are a combination of fault related tectonics plus a variety of natural and anthropogenic signals, most notably aquifer changes and oil extraction.

The achieved results are space-time deformation products that can be exploited to

view not only the mean or smoothly varying long-term surface motion, but also its time varying patterns. Large seasonal oscillations of the Santa Ana aquifer observed in Southern California Integrated GPS Network (SCIGN) data are accurately matched in the DInSAR time series; moreover, correlations of the DInSAR time series with an annual sinusoid reveals amplitude and delay-time patterns that reflect the dynamics of the hydrologic system. Similar patterns, identified in the San Francisco area, are also analyzed in this work.

[1] P. Berardino, G. Fornaro, R. Lanari, and E. Sansosti, A New Algorithm for Surface Deformation Monitoring Based on Small Baseline Differential SAR Interferograms, *IEEE Trans. Geosci. Rem. Sens*., 40(11), 2375-2383, 2002.