FULL EXPLOITATION OF THE SBAS-DInSAR ALGORITHM IN ACTIVE SEISMOGENETIC SCENARIOS

M. Manzo[1], P. Berardino[1], M. Bonano[1,2], F. Casu[1], R. Lanari[1], A. Manconi[1], M. Manunta[1], A. Pepe[1], S. Pepe[1], E. Sansosti[1], G. Solaro[1,3], P. Tizzani[1,3], G. Zeni[1]

[1] IREA-CNR, via Diocleziano 328, 80123, Napoli, Italy
[2] Università di Roma "La Sapienza", 00185, Roma, Italy
[3] INGV-OV, via Diocleziano 328, 80123, Napoli, Italy

1. INTRODUCTION

We perform a full exploitation of the Differential SAR Interferometry (DInSAR) algorithm referred to as Small BAseline Subset (SBAS) technique [1] to investigate long term surface deformation occurring in extended, seismogenetic areas. To this aim we benefit of the SBAS technique capability to work in multi-frame and multi-sensor scenarios in order to improve the spatial and temporal coverage, as well as to employ new generation SAR sensors to increase the temporal sampling of the retrieved time series. In this work we apply the SBAS algorithm to analyze the temporal evolution of the detected displacements affecting three different seismogenetic scenarios by means of deformation time series retrieved through data acquired by European (ERS-1/2, ENVISAT) and Italian (COSMO-SkyMed) satellites. In particular, we focus on the analysis of the deformation patterns associated with the activity of the San Andreas (SAF, California, USA), the North Anatolian (NAF, Turkey) and the Paganica (PF, Abruzzo, Central Italy) Faults.

2. SBAS-DInSAR ANALYSIS

2.1. San Andreas Fault

The SAF study is focused on the use of the extended version of the SBAS technique, allowing to produce deformation maps and the corresponding time series of very extended areas [2]. This is done by exploiting relatively low resolution DInSAR interferograms computed from long SAR image strips, which are obtained by jointly focusing contiguous raw data frames. In particular, we make use of a sequence of 49 and 53 ERS epochs relevant to the 127 and 356 adjacent orbit tracks (frames: 2925-2943), respectively, thus covering an area of about 200x200 km along the SAF southern segment and surroundings. The achieved results show the deformation occurring in the area during the 1992-2006 time interval due to the fault activity as well as the effect of the Landers earthquake (28 June 1992), see Figure 1. Moreover, we present the results of the comparison between the SBAS measurements and the data of the continuous GPS deployed in the area and belonging to the USGS-SCIGN network [3]; the performed analysis shows the good agreement between the radar and geodetic measurements (Figure 1).

2.2. North Anatolian Fault

In the NAF study we exploit the extended version of the SBAS technique allowing to jointly process ERS and ENVISAT time series [4], thus guaranteeing the continuity of the surface deformation monitoring during the last two decades. More specifically, we utilize 89 images acquired between 1992 and 2009 from the ERS-1/2 and ENVISAT satellites (track: 336, frame: 2781). As a result, we obtain the mean deformation velocity map and the corresponding time series of the overall area, where several ongoing deformation phenomena are clearly visible. In particular, in addition to the well known co-seismic displacement caused by the Izmit earthquake (17 August 1999) and associated events, several areas that are subject to subsidence (often in excess of 10 cm per decade) have been identified within the city of Istanbul. A detailed discussion of the overall results is presented.

2.3. Paganica Fault

The last case study is focused on the PF area where we apply for the first time the SBAS technique to a 33 data set acquired by the COSMO-SkyMed constellation (high image mode, 35.9° look-angle) on right ascending orbits. The exploited data span the 4 April – 13 October 2009 time interval and include one image acquired before the 6 April 2009 earthquake, that stroke Central Italy, partially destroying L’Aquila town, several surrounding villages, and causing hundreds of casualties. A detailed analysis of the co- and, possibly, of the post-seismic signal will be presented by benefiting of the short revisit time of the COSMO-SkyMed constellation (6 days average) and of the high spatial resolution and density of the exploited measurements.

3. REFERENCES

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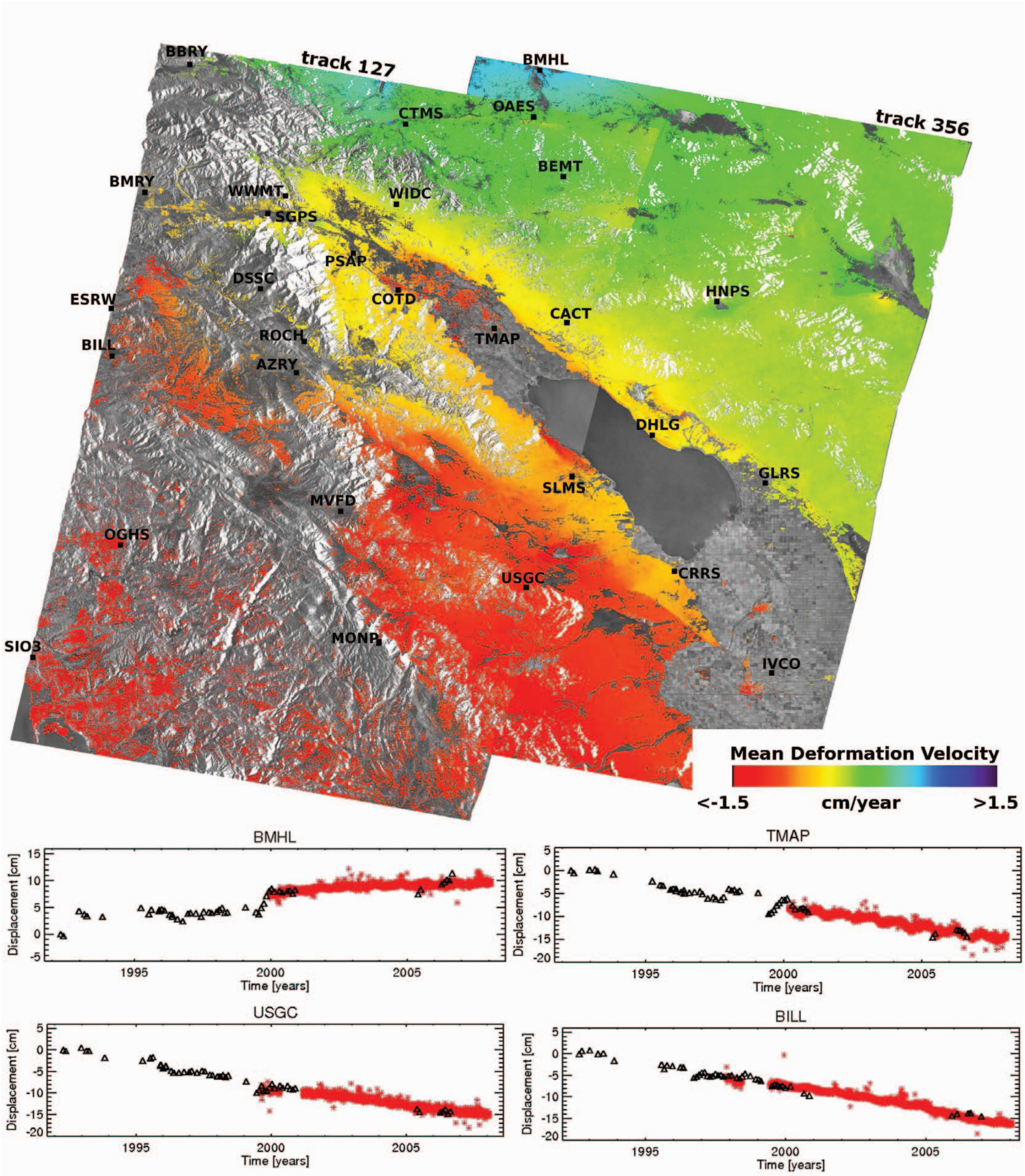

Figure 1 - Mosaicking of the mean deformation velocity maps (saturated between +/- 1.5 cm/year) of the San Andreas Fault area and surroundings, superimposed on a SAR amplitude image of the zone, and computed from a sequence of ERS epochs relevant to the 127 and 356 adjacent orbit tracks. The black squares identify the locations of the GPS stations belonging to the USGS-SCIGN network. The plots represent the comparisons between the SBAS-DInSAR deformation time series (black triangles) and the corresponding GPS measurements, projected on the SAR sensor Line-Of-Sight (red stars), for the pixels labeled as BMHL, TMAP, USGC and BILL, respectively.