Geophysical Research Abstracts
Vol. 18, EGU2016-15764, 2016
EGU General Assembly 2016

L band InSAR sudy on the Ganos section of the North Anatolian Fault Zone (NAFZ)

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The North Anatolian Fault (NAF), with a total length of about 1500 km, is one of the most active right-lateral strike–slip faults in the world. It defines the tectonic boundary between the Anatolian Plate and the Eurasian Plate in northern Turkey, accommodating ∼14–30 mm/yr of relative plate motion between the two plates (fig. 1). The Gazikoy–Saros segment (the Ganos fault, GF) is the onshore segment of the northern strand of the NAF between the Marmara Sea and the Gulf of Saros. It was last ruptured in 1912 with a Ms=7.4 earthquake that broke the entire inland segment of the fault, a length of about 50 km, and produced a right-lateral strike–slip component of at least 3 m. Other large historical earthquakes that have been attributed to the Ganos fault occurred in A.D. 824, 1343, 1509 and 1766 (e. g. Reilinger et al., 2000; Meade et al., 2002; Motagh et al., 2007; Janssen et al., 2009; Megraoui et al., 2012 ; Ersen Aksoy et al., 2010). The GF forms a 45 km long linear fault system and represents the link between the northern strand of the NAFZ in the Sea of Marmara and the North Aegean Trough where slip partitioning results in branching of the fault zone.
The present study aims at showing the results retrieved from L band Interferometric Syntethic Aperture Radar (InSAR) measurements for the monitoring of Crustal Deformation in the Anatolian Fault Zone in the frame of the MARMARA SUPERSITE PROJECT "MARSITE" on the Ganos section of the North Anatolian fault zone. We processed SAR data made available through the CAT-1 ESA (European Space Agency) archives, acquired by the L-band radar sensor ALOS PALSAR between 2007 and 2011. The aim of this exercise is to test L-band capabilities to map the spatial and temporal evolution of the present-day crustal deformation phenomena affecting the Ganos section of the NAFZ with high level of spatial details. The goal of this task is to assess whether InSAR L-Band data can be useful to evaluate the long-term behavior of active faults and eventual interactions between geologic structures, complementarily to GPS measurements and other in-situ observations on the study area. Mid-term monitoring (4 - 10 years) of the crustal deformation in the MARsite area is targeted. The ALOS Palsar archive over the Ganos Section of the NAFZ is not extraordinarily rich concerning the number of SAR scenes acquired with the same viewing and polarisation mode, which is a necessity when willing to perform a standard InSAR study. Thus, we decided to improve the number of potential SAR scenes by performing a processing on multiple polarisation data. We combine Fine Beam Mode Single Polarisation (FBS) and Fine Beam Mode Dual Polarisation (FBD) data, with a look angle of about 38.7°. We actually can process both these data together at the price of a decrease in spatial resolution but improving the data temporal sampling and dataset population. We then have 13 Single Look Complex (SLC) L-band data spanning 4 years, from 2007/07/07 to 2011/01/15. Besides, the satellite path orientation with respect to the fault orientation is optimal to obtain a suitable InSAR LOS sensitivity to strike-slip surface movement parallel to the NAFZ at the Ganos section. The shallow creep signal is expected to range from ∼0 to 1.5 cm/yr. From the 66 initial differential interferograms, we select a subset of 41 high-signal-coherence interferograms as input for the stacking procedure. Our results suggest that the tectonic signal within the velocity map retrieved from ALOS Palsar InSAR presented in this study is hidden beneath a number of interferometric phase contributions. The phase contributions are mainly due Radio Frequency Interferences (RFI) that are emitted from the ground and affect L-band data. RFI bias the amplitude and phase of the L-band signal resulting in serious co-registration problems and stripes on the interferometric phase. To compensate this bias, we apply RFI filtering during the SAR focusing. Unfortunately, the RFI filter application results in image distortions and difficulties in image co-registration. We could anyway measure a number of across fault 20km-length profiles that reveal a displacement gradient of 0.6 cm/yr. Is this due to tectonic movements ? At the present stage, our conclusion is that L-Band SAR data on the Ganos section of the NAFZ are too few and too affected by RFI to allow a robust seismotectonic interpretation. Longer-term data acquisitions are needed and could be provided by the new generation L-Band sensor Alos-2.