THE 12 MAY 2008 SICHUAN (CHINA) EARTHQUAKE: NUMERICAL AND ANALYTICAL FAULT MODELS CONSTRAINED BY ALOS-PALSAR INTERFEROMETRY

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ABSTRACT

The magnitude Mw = 8.0 earthquake that struck China's Sichuan region on 12 May 2008 has been imaged by X, C, and L-band SAR satellites (ASI's Cosmo-Skymed, ESA's ENVISAT, and NASDA's ALOS, respectively), allowing to attempt the recovering of the ground deformation associated to the fault dislocation. In particular we analyzed a dataset of ALOS PALSAR FBS images covering the whole affected area that was quite large (~ 300 km EW, ~ 250 km NS) surface effects being detected very far from the epicenter. Aiming at measuring the deformation field more than sixty ALOS-PALSAR scenes have been used, relative to six tracks and about thirty frames. The application of L-band (wavelength 23.8 cm) interferometry has duly limited the signal decorrelation in particular whereas the high and steep relief heavily affected the coherence. The PALSAR sensor is a new high resolution Synthetic Aperture Radar (SAR). The advantages of PALSAR are the deeper penetration of vegetated areas resulting in less temporal decorrelation and the longer critical baseline thanks to the higher wavelength enabling more usable interferograms. FBS mode has 2 times better range resolution than most of the previous InSAR instruments which further increases the critical baseline (about 13.100 m at about 39° look angle) and improves the spatial resolution of the interferograms. All images have been acquired in ascending orbits, with a looking angle of about 39° and with a per pixel geometric resolution of 10 m. The temporal baseline of the interferograms ranges from one to four months while the spatial perpendiculr baseline is up to 1442 m. Due to the capabilities of PALSAR, the interferograms maintain a good coherence notwithstanding the very high and steep relief that strongly affects the InSAR processing while moving from the Sichuan basin westward.
We calculated ~ 45 differential PALSAR interferograms obtaining a good view of the co-seismic surface deformation along the fault. To measure the LOS displacements we applied a phase unwrapping algorithm to each interferogram. The resulting pattern ranges from a maximum of 1.24 m away from the satellite in the north portion to a maximum of 0.96 m toward the satellite in the south part of the investigated area. We already compared PALSAR results and coseismic GPS measurements. The result of the East, North and UP vectors projected onto the SAR LOS were clearly comparable with PALSAR measurements thus confirming the amount and distribution of surface displacements.
Finally, we used the displacement field to infer the geometry and the slip distribution of the seismogenic fault, by means of a linear and non-linear inversion of an analytic elastic source; an additional modelling has been then performed by means of a finite element approach.