Geophysical Research Abstracts
Vol. 12, EGU2010-9315, 2010
EGU General Assembly 2010

The Mw 7.9 Wenchuan (China) Earthquake: exploring the role of crustal heterogeneities from finite element analysis of DInSAR coseismic deformation

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A destructive (Mw 7.9) earthquake struck the Sichuan province (China) on May 12, 2008. The seismic event, the largest in China in more than three decades and referred as the Wenchuan earthquake, ruptured approximately 280 km of the Yingxiu-Beichuan fault and about 70 km of the Guanxian-Anxian fault. Surface effects were suffered over a wide epicentral area (about 300 km E-W and 250 km N-S). The huge earthquake took place within the context of long term uplift of the Longmen Shan range in eastern Tibet. The Longmen Shan fault zone is the main tectonic boundary between the Sichuan basin and eastern Tibet and is characterized by a large topographic relief (from 500m a.s.l. to more than 4000m) and large variations in rheological properties.
The coseismic deformation is imaged by a set of ALOS-PALSAR L-band SAR interferograms. We use an unprecedented high number of data (25 frames from 6 adjacent tracks) to encompass the entire coseismic area. The resulting mosaic of differential interferograms covers an overall area of about 340 km E-W and 240 km N-S.
The complex geophysical context of Longmen Shan and the variations of the fault geometry along its length can be better handled by means of numerical methods. The fault geometry is constrained by inversions of geodetic data and by taking into account the geological features of eastern Tibet and Sichuan basin. As a result, we build a Finite Element (FE) model consisting of two non planar faults embedded in a non-homogeneous medium with real topography of the area.
We develop a procedure to perform inversions of DInSAR data based on FE computed Green functions of the surface displacement field. We retrieve a complex slip distribution on the fault segments in a heterogeneous medium with realistic surface topography.