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Slip distribution, coseismic deformation and Coulomb stress change for the 12 May 2008 Wenchuan (China, Mw7.9) earthquake

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The May 12, 2008 Wenchuan earthquake (Mw7.9) took place at the transition between the mountainous chain of Shan and the basin of Sichuan along the Longmen Shan Fault zone (31.1ºN, 103.3ºE; USGS). With a magnitude of 7.9 and a depth of ∼19 km the earthquake produced a 300-km-long fault rupture. It was the largest earthquake recorded in the region during the last centuries. It claimed more than 69,000 lives, induced widespread destruction over the region and raised concern about seismic hazard and source characterization for the Sichuan province. In the frame of our study, we selected 40 broadband waveforms (IRIS Consortium, USA) with good quality and satisfactory azimuthal coverage.
Body waveforms were prepared for inversion using Kikuchi and Kanamori's method [1] to obtain the spatiotemporal slip distribution of a finite rupture model (length=300 km, strike=229º, dip=33º, width=60 km). The slip distribution model obtained was used to determine the coseismic deformation and the stress change distribution using the Coulomb 3.0 software [2].
Our coseismic deformation results was compared with data from GPS stations located near the fault rupture. Results show that directions of coseismic deformations are consistent with GPS observations close to the fault.
Finally, we compare aftershock hypocenters that occurred during one month after the main shock with the Coulomb stress changes caused by this shock in the region. We observed that most aftershocks are located along the main fault plane without any noticeable clustering in the areas of increased stress.
Our results suggest the rupture of the 2008 Wenchuan earthquake was essentially unilateral, from SW to NE (N49E), covering a 260km length and with duration about 105 sec. The strongest moment release occurred about 85km from the hypocenter, ∼30sec after the start of the rupture. Motions are dominated by thrust mechanism, but the superficial section of the second half of the rupture also shows a significant strike-slip component.

[1]- Kikuchi, M., and Kanamori, H., 1982, Inversion of complex body waves: Bull. Seismol. Soc. Am., v. 72, p. 491-506.
[2] -King, G. C. P., Stein, R. S. y Lin, J, 1994, Static stress changes and the triggering of earthquakes. Bull. Seismol. Soc. Am. 84,935-953.