The Maule Mw 8.8 earthquake monitored by continuous and survey mode GPS

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The Maule earthquake of 27 February 2010 occurred in the seismic gap left by the Mw8.5 1835 earthquake. Since the late 90's, this gap was monitored by GPS. Over the last decade, and under the framework of the Chilean-French cooperation between U-Chile and CNRS, more than 20 cGPS stations were installed in the region between 37°S and 28°S. We combine our data with data available from other networks (CAP project, Bevis and co-authors in Chile and Argentina; RAMSAC Argentinian and RBMC Brasilian national networks, and IGS international network) to establish co-seismic displacements from continental scale to epicentral area. Benchmark networks were also installed and surveyed episodically in the region. In the rupture area, a network of 40 benchmarks distributed along 3 profiles was surveyed in 1996, 1999 and 2002, establishing the inter-seismic pattern of crustal deformation there, and re-surveyed immediately after the earthquake. We determine the co-seismic displacements at these sites by extrapolating the last known position at the date of the re-survey using the inter-seismic rate, and by comparing the obtained positions to the present positions. Our data base describes horizontal and vertical displacements at almost 100 sites, a third of them in the epicentral area showing metric displacements, with peak horizontal displacements of 4.7-4.9 m at Constitucion and at the tip of the Arauco peninsula, where uplifts reach almost 2 m. It also includes post-seismic time series at the cGPS sites.
We show that the rupture length is somehow smaller than the area covered by aftershocks and that no significant slip occurred north of 34.5°S (Pichilemu). We also show that the direction of slip is oblique to the trench, confirming the obliquity of the inter-seismic accumulation and the absence of slip partitioning in this area of Chile. Early post-seismic deformations are not proportional to co-seismic deformations: Constitucion and San Antonio exhibit similar patterns of immediate after-slip (~5cm in 10 days), when the rupture clearly did not reach the latitude of San Antonio. Those findings may have important consequences on the new seismic hazard in the metropolitan area, after the Maule 27-february event. Finally, we also show how high sampling rate GPS measurements (1s) allow to follow the rupture propagation and put constrains on its velocity.

(*) The LIA is the International laboratory created by U-Chile and CNRS in 2006, devoted to studying the seismo-tectonics of the Chilean trench