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Interseismic coupling, segmentation and mechanical behavior of the Central Chile subduction zone.

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Global Positioning System (GPS) measurements carried out in Chile over the last two decades showed that an entire portion of the Nazca-South America subduction zone (38°S-24°S) was locked over this period of time. The induced accumulation of elastic deformation in the upper-plate was not released until the recent Maule earthquake of 27 February 2010 (Mw 8.8) that ruptured the southern part of this section. Locking or coupling between the two plates varies both with depth and along strike.
Here we use our own GPS data (an updated solution of our extended network in central Chile), combined with other published data sets, to quantify the spatial variations of the coupling that prevailed before the Maule earthquake. Using a simple elastic model based on the back-slip assumption, we show that coupling variations on the subduction plane are sufficient to explain the observed surface deformation, with no need of a sliver in central Chile. We identify four segments characterized by higher coupling and separated by narrow areas of lower coupling. This segmentation is in good agreement with historical and recent seismicity in Chile. In particular, the La Serena Bay (30°S-28°S) where the locked zone vanishes is a stable boundary where historical events stopped. The Maule region that ruptured in feb. 27th of 2010 (Mw 8.8) from 38 S to 34 S, was characterized by a well developped fully locked zone that extents far indepth and narrows where the earthquake stopped propagating (San Antonio at 34°S and south of Arauco peninsula at 38°S). These narrow zones of lower coupling are often associated with irregular bathymetric or coastal features (fracture zones or peninsulas).
Finally, coseismic and early post-seismic slip distribution of the Maule earthquake, occurring either in previously highly or weakly coupled zones, map a complex distribution of velocity-weakening and velocity-strengthening patches on the subduction interface.