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Revisiting the North Chile seismic gap segmentation using GPS-derived interseismic coupling

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The North Chile area did not rupture since the 1877 Mw 8.6 earthquake that produced a huge tsunami. Considering that upper plate deformation measured there by modern geodetic tools is due to some degree of locking on the subduction interface and the long elapsed time since 1877, many consider this area is a mature seismic gap where seismic hazard is high. We present a new GPS velocity field that describes in some detail the interseismic deformation between 18°S and 24°S. We invert for coupling distribution on the subduction interface using elastic modeling. Our measurements require that, at these latitudes, 10 to 12 mm/yr (i.e ∼15% of the whole convergence rate) are taken up by the clockwise rigid rotation of an Andean block bounded to the East by the subandean fold-and-thrust belt. This reduces the accumulation rate on the subduction interface to ∼56 mm/yr in this area. We describe coupling variations on the subduction interface both along-strike and along-dip. We find that this gap is segmented in at least two highly locked segments and two narrow low coupled intersegment zones (Iquique and Mejillones areas). This coupling segmentation is consistent with our knowledge of the historical ruptures and of the instrumental seismicity of the region. Intersegments correlate with high background seismic rate and local tectonic complexities on the upper or downgoing plates. The rupture of either the Paranal or the Loa segment alone could easily produce a Mw 8.0-8.3 rupture, and we propose that the Loa segment (from 22.5°S to 20.8°S) may be the one that ruptured in 1877.