



Interseismic Coupling maps in South America subduction zone as indicator of future large Megathrust Earthquakes

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We take benefit of about two decades of geodetic measurements and SAR data to characterize interseismic strain build up along the South America subduction zone in the Central Andes area from Lima, Peru, to Antofagasta, Chile. These observations require a heterogeneous pattern of interseismic coupling (ISC) of the plate interface that is determined through formal inversion of the data. Comparison with consistent slip models for the $M_w=7.7$ Nazca in 1996, the $M_w=8.4$ Arequipa in 2001, and the $M_w=8.0$ Pisco and $M_w=7.7$ Tocopilla earthquakes in 2007 indicate striking correlations between the locked areas in the interseismic period (corresponding to high ISC) and the location of great past earthquakes. Off shore the megapole of Lima, the ISC pattern appears to be relatively high and a repetition of the great $M_w\sim 8.6-8.8$ earthquake of 1746 is over-due even though this segment ruptured in a sequence of four $M_w\sim 8.0$ earthquakes of 1940, 1966, 1974 and 2007. By contrast, the region where the Nazca ridge subducts appears to be mostly creeping aseismically in the interseismic period (low ISC) and seems to play the role of a permanent barrier as no great earthquakes propagated through it in the last 500 years. In southern Peru, two asperities separated by an aseismic creeping patch are revealed. This aseismic patch may stop rupture as in 2001, or allowed it to propagate through as in the cases of the great earthquake of 1604 and 1868. The southern Peru asperity has accumulated the equivalent of a magnitude $M_w\sim 8.3$ earthquake but a re-rupture of the whole 1868 rupture is no to be excluded with a potency for a magnitude $M_w\sim 8.5$ earthquake. In northern Chile, ISC is very high and the rupture of the 2007 Tocopilla earthquake appears to have released only 4-10% of the elastic strain that have accumulated since 1877. The potency of that gap is equivalent to a magnitude $M_w\sim 8.7$ earthquake. This study thus provides elements to assess the location, size and magnitude of future large megathrust earthquakes in the Central Andes subduction zone.