SINT-3: Fuentes sismogénicas corticales en Sudamérica

Estimating long-term slip rates on seismogenic crustal faults using mechanics, geomorphology and plate motion

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In this contribution I will examine the long-term kinematic behavior of crustal faults in response to tectonic loads affecting active plate boundaries by means of advanced techniques in geomorphology and numerical modeling. I will show that simple physical models can be used to estimating long-term slip rates on crustal faults as long as they are compliant to plate motion velocity. First, we are going to focus in the subduction margin of central Chile where the recent occurrence of large crustal earthquakes has shed some light on additional sources of seismic hazard for the country. We constructed a 3D boundary elements model (BEM) simulating subduction of the Nazca plate underneath South America to computing long-term surface deformation and slip-rates on crustal faults imbedded in the upper-plate wedge of the Andean forearc. We tested our model on the San Ramón Fault, a major thrust structure limiting the western front of the Andes with surface expression along the entire, 40 km long, extension of the Santiago de Chile basin. Long-lived thrusting has produced more than 2 km of differential uplift of the mountains. Interestingly, our models have been able to reproduce fault slip-rates that agree well with what has been reported on geologic and paleoseismic studies across the fault. Then, we will steer our attention to crustal faults adjacent to the San Andreas Fault System along the actively deforming Santa Cruz Mountains in Central California, controlled by local redistribution of stresses caused by changes in the geometry of the plate boundary. We are developing a method to invert long-term fault slip-rate distributions using topography by coupling a 3D BEM with a geomorphic incision rule. The nonlinear components of the geomorphic model required the use of a probabilistic invertion method, simulating the posterior density of plate velocity and rock erodability for the different mapped geologic units of this area. Calculated posteriors fall well within the broad range of reported values, suggesting that the joint use of elastic boundary element and geomorphic models may have utility in estimating long-term fault slip-rate distributions. These results might contribute to determining possible seismic scenarios for Santiago and Silicon Valley but perhaps more importantly, our approach could be used in estimations of long-term slip rates and surface deformation due to other crustal structures with unknown displacement history.