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Modeling slow slip events, non-volcanic tremor and large earthquakes in the Guerrero subduction zone (Mexico) with space-variable frictional weakening and creep

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We explore with numerical simulations the range of conditions leading to key observed features of NVT in relation to SSE and earthquakes along the Guerrero segment of the Mexican subduction zone. The Guerrero segment is known to produce some of the largest slow slip events (SSE) recorded so far with equivalent magnitude up to 7.5 Mw. These SSE, with apparent duration of about 6 month and recurrence time of about 4 years, are accompanied by strong activity of Non Volcanic Tremor (NVT) in central Guerrero. Recently, NVT triggered by the 8.8 Mw Maule earthquake were also been reported in that region. The geometry of the Guerrero subduction zone remains sub-horizontal between 150 km to 250 km from the coast, making it easy to model with a simple flat frictional interface.

We use a model with a planar interface governed by space-varying static/kinetic friction and dislocation creep in elastic solid. The model is tailored through the employed dimensions, distribution of rheological properties and boundary conditions to the Guerrero segment, with particular attention to conditions of the past 15 years for which observations are available. A section of the fault with zero weakening during frictional slip fails in a mode corresponding to a "critical depinning transition" that produces many observed features of NVT. When a high creep patch representing a section sustaining SSE is added, strong interactions between NVT and SSE are observed as in the natural fault system. We also examine triggering of NVT by larger remote earthquakes, implemented by adding periodic triggering oscillations to the regular tectonic loading. In addition to modeling observations of NVT and SSE made in Guerrero during the past 15 years, the simulations allow us to distinguish aspects of the observed behavior that are robust over long time intervals from aspects that change during intervals longer than the observational period.