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Observations and modeling of non-volcanic tremor and slow slip events in the Guerrero subduction zone (Mexico)

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In this study we examine the relations between Slow Slip Event (SSE), Non Volcanic tremor (NVT) and regular earthquakes in the Guerrero subduction zone in order to clarify the phenomenology and physics of these manifestations of fault slip.

We investigate the triggering of seismic tremor and slow slip event in Guerrero by the February 27, 2010 Maule earthquake (Mw 8.8). Triggered tremors start with the arrival of the S wave generated by the Maule earthquake, and continue to occur during the passing of ScS, SS, Love and Rayleigh waves. The Rayleigh wave dispersion curve footprints the high frequency energy envelope of the triggered tremor, indicating a strong modulation of the source of NVT by the passing surface waves. This correlation and modulation by the passing waves is progressively lost with time over a few hours. The tremor activity continues during the weeks/months after the Maule earthquake. GPS time series suggest that the second sub-event of the 2009-2010 SSE in Guerrero is also triggered by the Maule earthquake. The southward displacement of the GPS stations starts coincidently with the earthquake and NVT. The long duration of NVT indicates a continuing deformation process at depth, which we propose to be the second sub-event of the 2009-2010 SSE. We show a quasi-systematic correlation between surface displacement rate measured by GPS and tremor activity, suggesting that the NVT are controlled by variations in the slip history of the SSE.

To explore the range of conditions associated with the observed long-term evolution of NVT in relation to SSE and earthquakes, we model the NVT both experimentaly and numericaly. We used a very slow friction experiment that indicates a systematic correlation between slip acceleration of a slider and emission of acoustic signals that are similar to NVT. A numerical modeling with a frictional fault in elastic solid that is tailored through model dimensions, distribution of creep, frictional properties, and boundary conditions to the Guerrero subduction zone is also presented. 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. "