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Modeling of slow slip events along the subduction zone off the Pacific coast of Mexico

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Recent high-resolution geodetic observations have revealed the occurrence of slow slip events (SSEs), along the Mexican subduction zone. In the Guerrero gap, large slow slip events of around Mw 7.5 have been observed (Lowry et al., 2001; Radiguet et al., 2012), and the 2006 Guerrero slow slip propagated at an average velocity of 0.8 km/day. Recurrence intervals of SSEs are around every 3-4 years. On the other hand, in the Oaxaca region, SSEs of Mw 7.0-7.3 repeat every 1-2 years and last for 3 months(Correa-Mora et al., 2009). The present study models SSEs along the subduction zone off Mexico, based on a model by Shibazaki and Shimamoto (2007).

We use a rate- and state-dependent friction law with a small cut-off velocity for the evolution effect. We also consider the 3D plate interface, which dips at a very shallow angle at 100-150 km from the trench. We set the unstable zone from a depth of 10 to 20 km, and the zone of SSEs from 20 to 30 km. By setting the effective normal stress at around 1 MPa and the cut-off velocity for the evolution effect at 10E-7.5 m/s at the SSE zones, we reproduce SSEs occurring at intervals of around 5 years with propagation velocities of 1.0 km/day. In the present model, velocity strengthening occurs at a velocity greater than 10E-7.5 m/s, and therefore only small slips occur at the SSE zone when earthquakes occur in the seismogenic zones. A Mw 7.4 subduction earthquake occurred beneath the Oaxaca-Guerrero border on March 20, 2012, and the 2012 SSE coincided with this thrust earthquake (Graham et al., 2012). We verify our model by comparing numerical results with the observations.

Keywords: slow slip event, Mexico, Subduction zone, a rate- and state-dependent friction law