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Modeling the Interaction between Slow Slip Events and Earthquake Ruptures in the Nicoya Peninsula, Costa Rica.

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Subduction zones are where the largest earthquakes occur. In the past few decades, scientists have also discovered the presence of episodic aseismic slip, including slow slip events (SSEs), along most of the subduction zones. However, it is still unclear how these SSEs can influence megathrust earthquake ruptures. The Costa Rica subduction zone is a particularly interesting area because a SSE was recorded 6 months before the 2012 Mw7.6 earthquake in the Nicoya Peninsula, suggesting a potential stress transfer from the SSE to the earthquake slip zone. SSEs beneath the Nicoya Peninsula were also recorded both updip and downdip the seismogenic zone, making it a unique area to study the complex interaction between SSEs and earthquakes.

As most of the shallow SSEs were recorded around the Nicoya Peninsula, we chose to start using a 1D planar fault embedded in a homogeneous elastic half-space, with different dipping angles following several geometric profiles of the subduction fault beneath the Nicoya Peninsula section of the Costa Rica margin. This 1D modelling study allows us to better investigate the interaction between shallow and deep SSEs and megathrust earthquakes with high numerical resolution and relatively short computation time. The model provides information on the long-term seismic history by reproducing the different stages of the seismic cycle (interseismic slip, shallow and deep episodic slow slip, and coseismic slip).

We study the influence of the variation of numerical parameters and frictional properties on the recurrence interval, maximum slip velocity and cumulative slip of SSEs (both shallow and deep) and earthquakes and their interaction with each other. We then compare our results with GPS and seismic observations (i.e. cumulative slip, characteristic duration, moment rate, depth and size of the rupture, equivalent magnitude) to identify an optimal set of model parameters to understand the interaction between various modes of subduction fault deformation.