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A stochastic view on the strain budget of the Ecuador-Columbia subduction zone

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The 2016 Pedernales earthquake ($M_w = 7.8$) ruptured a portion of the Colombia-Ecuador subduction margin where large historical earthquakes have been documented since 1906. This region offers a unique opportunity to investigate the strain budget over multiple earthquake cycles. It has been recently suggested that the moment released co-seismically in this part of the subduction margin exceeds by far the moment deficit accumulated inter-seismically since 1906, therefore challenging simple models with earthquakes resetting the elastic strain accumulated inter-seismically in locked asperities. However, such inferences are affected by large uncertainties due to observational or modeling errors, low resolution of inter-seismic slip-rate near the trench and the lack of information about past earthquakes. Inter- and co-seismic estimates are usually not accompanied by error estimates and are also affected by spatial smoothing constraints used to regularize slip inversions, which complicate a quantitative assessment of the strain budget. In this study, we propose a new co-seismic kinematic slip model of the 2016 Pedernales earthquake obtained from the joint inversion of multiple observations in an unsmoothed and fully Bayesian framework. We use a comprehensive dataset composed of multiple InSAR scenes, GPS offsets, tsunami waveforms along with near-field High-Rate GPS and accelerometers. In addition, we use inter-seismic GPS observations spanning the 1994 - 2012 interval to produce a Bayesian inter-seismic coupling model of the megathrust interface. Our stochastic co-seismic and inter-seismic solutions include the ensemble of all plausible models that are consistent with our simple prior information and that fit the observations within uncertainties. They allow us to perform probabilistic analyses on the complete strain budget during the 1906 – 2016 period in Central Ecuador.