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Bayesian exploration of recent Chilean earthquakes

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The South-American subduction zone is an exceptional natural laboratory for investigating the behavior of large faults over the earthquake cycle. It is also a playground to develop novel modeling techniques combining different datasets. Coastal Chile was impacted by two major earthquakes in the last two years: the 2015 M 8.3 Illapel earthquake in central Chile and the 2014 M 8.1 Iquique earthquake that ruptured the central portion of the 1877 seismic gap in northern Chile. To gain better understanding of the distribution of co-seismic slip for those two earthquakes, we derive joint kinematic finite fault models using a combination of static GPS offsets, radar interferograms, tsunami measurements, high-rate GPS waveforms and strong motion data. Our modeling approach follows a Bayesian formulation devoid of a priori smoothing thereby allowing us to maximize spatial resolution of the inferred family of models. The adopted approach also attempts to account for major sources of uncertainty in the Green's functions. The results reveal different rupture behaviors for the 2014 Iquique and 2015 Illapel earthquakes. The 2014 Iquique earthquake involved a sharp slip zone and did not rupture to the trench. The 2015 Illapel earthquake nucleated close to the coast and propagated toward the trench with significant slip apparently reaching the trench or at least very close to the trench. At the inherent resolution of our models, we also present the relationship of co-seismic models to the spatial distribution of foreshocks, aftershocks and fault coupling models.