EARTHQUAKE DYNAMIC RUPTURE MODELING CONSTRAINED BY SEISMIC OBSERVATIONS

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Dynamic rupture models take into account physical processes governing the fault rupture, and thus their use seems to be the proper way to model realistic near-source synthetic seismograms. However, there is no guarantee that they provide realistic earthquake ground motions. Indeed, an improperly chosen distribution of dynamic parameters may lead to over- or under-estimated ground motions with respect to observations. To address this issue, we present dynamic rupture modeling using spontaneously propagating and stopping ruptures governed by linear slip weakening friction law with spatially variable dynamic parameters. The models are designed within a Bayesian framework (using Markov Chain Monte Carlo approach) subject to one of the following constraints: i) waveforms observed for a specific earthquake, and ii) Ground Motion Prediction Equations (GMPEs). In the first case, we apply the dynamic inversion to the 2016 Mw 6.2 Amatrice, Central Italy, earthquake. We obtain $\sim$5,000 accepted model samples from a million of visited models. In agreement with previous kinematic inversions, the dynamic rupture initiated by a localized transient nucleation followed by bilateral rupture propagation. The rupture accelerates towards the heavily damaged city of Amatrice where the peak acceleration of 0.8 g was measured. In the second application, we use the framework to simulate earthquake ruptures compatible with GMPEs. As a result, we obtain a variety of M6-7 realistic events with relatively complex rupture propagation. We explore the inferred dynamic and kinematic source parameters including fracture energy, radiated energy and efficiency, stress drop and its variability. Our study demonstrates how to construct dynamic rupture models with realistic ground motion radiation.