Kinematic constraining of the multi-fault rupture dynamics of the Norcia, Mw 6.5, 30 October 2016, Central Italy earthquake

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The 2016 Central Italy sequence showed a remarkable complexity involving multiple faults. Highly heterogeneous slip distributions were inferred from kinematic finite source inversions. The coverage and quality of the geodetic and seismic data allow resolving high-resolution details of rupture kinematics of the largest event of the sequence, the Mw 6.5 30 October 2016 Norcia earthquake. Composite fault rupture models suggest that two fault planes may have slipped simultaneously. Nevertheless, kinematic modeling cannot assess the mechanic viability of such multiple fault plane models.

Using SeisSol, a software package for simulating wave propagation and dynamic rupture based on the arbitrary high-order accurate derivative discontinuous Galerkin method, we therefore try to generate spontaneous dynamic ruptures models compatible with the two fault planes constrained by kinematic inversions. To this end, we adopt a simple slip-weakening friction law with spatially variable dynamic friction and initial strength parameters along multiple faults, compatible with the slip distributions found in the literature. Although we do not to aim to explore the full parameter space, our approach allows testing the feasibility of kinematic models in conjunction with successfully generating spontaneous dynamic rupture scenarios matching seismic and geodetic observations with geological constraints. Such linking enhances and validates the physical implications of kinematic earthquake source inversion.