Dynamic rupture simulation with complex fault geometries for the 2016 Kaikoura, New Zealand, earthquake

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The 2016, Mw 7.8, Kaikoura earthquake is a unique event with its rupture process that propagated through the significantly complicated fault system, suggested according to field surveys and an Interferometric synthetic aperture radar InSAR observation (Hamling et al., 2017, submitted). The InSAR observation infers up to 19 fault segments, where some of them are newly identified. Since the fault geometry is considered as one of primary parameters controlling the initiation, propagation and termination of earthquake ruptures, it is important to understand which conditions allow the rupture to propagate through multiple fault segments having such complicated geometries. In this study, we apply the dynamic rupture simulation to reproduce the observed rupture processes and slip distributions. For the numerical analysis, we employ the spatio-temporal boundary integral equation method with the fast domain portioning method (FDPM), which enables us the accurate and efficient analyses of the nonplanar fault geometry. The fault model is developed by referring Hamiling et al. (2017). The regional stress field is determined based on the seismological stress tensor inversion done previously in this region (Balfour et al., 2005, GJI). The observationally constrained stress axes were consistent with the overall dextral faulting of the NE-SW trended fault systems but locally some fault segments appear to be obliquely oriented. The preliminary computation shows that the distribution of the tractions resolving the regional stress on each fault segment was largely varied over the fault system, suggesting to cause the complex rupture process.

Keywords: Dynamic rupture simulation, Boundary integral equation method, Complex fault geometry

