Dynamic rupture simulation for the 2016 Kumamoto, Japan, Earthquake

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The earthquake generation is the fracture along subsurface fault planes driven by the concentrated stress fields, however, these geometrical and physical parameters are hidden in the depth, leading to difficulties to understand the underlying physics of the phenomena. The ongoing sequence of the Kumamoto, Japan, earthquake including the April 15, 2016, M_w 7.0, earthquake and precursory multiple M6-class earthquakes as well as the prolonged seismic activity, provides a unique opportunity to investigate into the mechanism of the earthquake generation with its unique tectonic conditions and well-observed patterns of the sequence. In this study, we conducted a set of fully dynamic simulations and show that the dynamic rupture sequence is mainly controlled by the irregularity of the fault geometry in the subjected regional stress field. We also show that the dynamic triggering of M-6 class earthquakes occurred along the Yufuin fault (located 50 km away) because of the strong stress transient up to a few hundreds of kPa due to the rupture directivity effect of the M-7 event, and the susceptible condition developed by the high geothermal condition. We further show that the rupture growth of M-7 event into SW (to the direction of the Uto segment of the Futagawa fault) is supressed by that the Takano-Shirahata segment of the Hinagu fault slipped again while it has been rupture associated with the precursory events. We compared the simulation results with the surface displacement obtained by InSAR analysis and the observed seismograph. In addition, this dynamic rupture simulation is made possible even on a PC cluster system by the newly developed numerical method called the Fast Domain Partitioning Method (FDPM) for the elastodynamic boundary integral equation method (BIEM).

Keywords: Dynamic rupture simulation, 2016 Kumamoto earthquake, 3D Nonplanar fault geometry

