

A study on the dynamic rupture simulations of the 2016 Kumamoto, Japan, earthquake sequence

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The 2016 Kumamoto, Japan, earthquake sequence mainly contains an M_w 6.2 earthquake happened at 21:26 Japan Standard Time (JST) on April 14, 2016 and an M_w 7.0 earthquake happened just 28 hours later. Both the earthquakes struck the Kumamoto prefecture with a maximum seismic intensity of 7 on the Japan Meteorological Agency (JMA) and caused heavy casualty and economic loss. The M_w 6.2 earthquake ruptured only Hinagu fault (HF), and M_w 7.0 earthquake ruptured both Hinagu and Futagawa fault. In this study, we try to simulate the rupture process of these two earthquakes and the ground motions from the M_w 7.0 earthquake.

We adopted a curved grid finite difference method (CG-FDM, Zhang et al., 2014) for the simulation since the method can model the complicated fault geometry for the M_w 7.0 earthquake. We first model the mainshock on a smoothed non-planar fault plane and discussed the influence of maximum principle stress orientation, static and dynamic friction coefficients, critical distance and so on. Then we perform the simulation based on a fault model modified from surface ruptures associated with the M_w 7.0 earthquake.

Our results for the mainshock show that the rupture started from the segment of Hinagu fault (HF) and propagate to Futagawa fault (FF). The slip distribution on the fault plane coincides with other results obtained from earthquake source inversions in the main features. We also confirmed that the synthetic waveforms are generally consistent with the observed ones in the main features.

We also simulated the earthquake on 14 April on the northern part of Hinagu fault (HF). The fault plane is a short subparallel fault with a higher dip angle of 85 degree. The results show that the rupture stopped on Hinagu fault (HF) and does not propagate to Futagawa fault (FF).

Keywords: 2016 Kumamoto earthquake, Dynamic rupture simulation, Strong ground motion