Dynamic rupture model of the 2014 northern Nagano, central Japan, earthquake (Part 3)

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We construct a dynamic rupture model of the 2014 northern Nagano, central Japan, earthquake to understand a mechanism of the earthquake and the present condition of the fault. Surface ruptures intermittently observed along the northern part of Kamishiro fault in the southwest of the hypocenter (Katsube et al., 2015). Waveform inversion results, on the other hand, showed that large slip mainly distributed in the northeast of the hypocenter (Asano et al., 2015; Kobayashi et al., 2015; Shiba, 2015; Horikawa, 2015). Kase (2015) constructed dynamic rupture models composed of a single fault or two parallel faults, but could not simulate both the surface rupture distribution and the slip distribution on the fault. In this study, we investigate a fault model with a vertical fault as an initial crack between the two parallel faults, considering the difference between the focal mechanism (JMA, 2014) and the CMT solution (NIED, 2014).
Fault model of the main rupture and tectonic stress field are the same as Kase (2015). Based on the aftershock locations determined by Imanishi and Uchide (2015) and the analysis of the InSAR data (Yarai, 2015), fault strike is N20E, and dip angles of the deeper and shallower regions than 2 km are 60 and 45 degrees. The fault model is composed of two segments: the 10.1 km long northeastern segment corresponding to the large slip region, and the 13 km long southwestern one corresponding to the surface rupture. The fault model has a 2 km left-step with 2 km overlap. In this study, we add a vertical segment with an initial crack between the two main segments. The southern part of the fault reaches the earth's surface, while upper depth of the northern part is 2 km.
Principal stresses are proportional to depth. Azimuth of the maximum principal stress is N60W, and stress ratio is 0.42 (MEXT et al., 2004). The minimum principal stress is vertical, and equal to overburden load. We assume hydrostatic condition. The medium has two-layered structure with 2 km deep boundary, based on the subsurface structure model around the fault (NEID, 2003).
We calculate dynamic rupture processes by the finite-difference method (Kase, 2010), assuming the slip-weakening friction law. The preliminary results show that a rupture initiated on the vertical segment promotes rupture propagation toward the deep portion on the northeastern segment and the shallow portion on the southwestern segment, which agrees with the rupture process of the 2014 northern Nagano earthquake.

Keywords: dynamic rupture, 2014 northern Nagano earthquake, numerical simulation

