Simulation of near-fault ground motion for the 2016 Kumamoto earthquake (Mj7.3) considering the surface rupture geometry

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The 2016 Kumamoto earthquake occurred along the Futagawa and Hinagu fault zones, causing several tens of kilometers of surface rupture with fault displacement up to 2 m. Associated with this earthquake strong ground motion and severe building damage were observed n the vicinity of the fault. It has been revealed that the conventional strong motion prediction method in Japan (“recipe”, HERP 2017) substantially underpredicted the observed moment magnitude as well as the amplitudes of the near-fault ground motion. In addition, a single-planar buried fault can hardly reproduce the detailed spatial distribution of near-fault ground motion and fault displacement.

In order to contribute to local seismic-risk reduction in regions with active faults, it is necessary to update the ground-motion prediction method and to construct seismic hazard maps with higher resolution focused more on near-fault regions.

In this study, we attempted to construct a kinematic fault rupture model for ground-motion prediction of this earthquake that incorporates the observed surface rupture geometry in the shallow part connected with multi-segment planar faults in deeper region (> 2 km depth). The fault model is represented by 100-m-interval point sources in the deterministic ground-motion simulation by 3D finite-difference method, in which the target frequency range is set to 1 Hz and lower. We use the detailed 3D velocity model around Kumamoto plain by Senna et al. (2018) combined with J-SHIS V2 velocity model.

We particularly focus on the distinctive strong motion and densely distributed building damage in the vicinity of the surface rupture in Mashiki town. The effects of the geometry and parameterization of the kinematic source model by comparison of our simulation results with the observed features.

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