Strong-motion simulation of the 2015 Southern Oita, Japan, earthquake (Mj5.7) using a 3D structure model including the land and sea-floor topography

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Oita prefecture is located in northeastern part of Kyushu Island which is characterized by active subduction of the Philippine Sea plate (PHS) beneath the Eurasian plate and several active volcanoes along with the volcanic front. Oita area has frequently been damaged by large earthquakes and tsunamis since ancient times. From the point of view of disaster prevention, it is important to improve the precision of strong ground motion prediction. In this study we construct a three-dimensional (3D) numerical structure model for simulation of the strong ground motion around Oita prefecture, which includes land and sea-floor topography and a seawater layer as well as subsurface structures of the arc side and the PHS slab, partially based on the J-SHIS model for near-surface structure (National Research Institute for Earth Science and Disaster Prevention) and the Integrated Velocity Structure Model for the arc crust and the slab-top depth model of the PHS (Headquarters for Earthquake Research Promotion, Japan). We then conduct the finite-difference-method (FDM) numerical simulations of strong motion for the 2015 Southern Oita, Japan, earthquake (Mj5.7) whose JMA hypocenter is located in the PHS slab mantle as well as the NIED F-net centroid and which has a strike-slip focal mechanism. We employ the Heterogeneity, Oceanic Layer, and Topography (HOT)-FDM scheme developed by Nakamura et al. (2012, BSSA) to simulate seismic wave propagation in land and ocean areas. From these simulations the best point source is found to be located in the PHS crust, not in the mantle, at depth of about 48 km which is shallower than the JMA hypocentral depth by 10 km. The simulated long-period (2-20 s) motions reproducing observed records demonstrate substantial contributions of thick low-velocity sediment layers in and around Beppu Bay and Oita basin to development of these motions. We also examine the topographic effects on the strong motion by analyzing these simulation results.

Keywords: strong motion, Oita, the 2015 Southern Oita, Japan, earthquake , long-period ground motion, simulation, finite-difference method

