Effects of three-dimensional heterogeneous subsurface structure on observed seismograms inferred from numerical simulations of seismic wave propagation

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Recently, open source codes for simulations of seismic wave propagation (e.g., Aoi and Fujiwara, 1999; Maeda et al., 2017) have been significantly developed. By using opened three-dimensional (3D) subsurface structure models (e.g., Matsubara et al., 2008; Koketsu et al., 2012), we can easily conduct numerical simulation of seismic wave propagation across the Japan. To demonstrate effects of such 3D heterogeneities on seismic wave propagation, we conducted finite-difference method (FDM) simulation of seismic wave propagation around southwestern Japan.

We used parallel FDM simulation code (Furumura and Chen, 2004; Takemura et al., 2015) and Japan Integrated Velocity Structure Model (JIVSM; Koketsu et al., 2012). The model covered the region of 512×640×153.6 km^3, which was discretized by grid intervals of 0.125 km in horizontal directions and 0.1 km in vertical direction. FDM simulations could evaluate seismic wave propagation for period longer than 3 s via parallel computations conducted on the Earth Simulator. We assumed point sources of three moderate earthquakes in the F-net MT catalog. Event A is an interplate earthquake occurred in southeast offshore Mie on 1 April 2016, Event B is a crustal earthquake occurred in central Tottori on 21 October 2016 and Event C is an intraslab earthquake occurred in southern Kii Peninsula on 19 November 2016.

Simulation for Events B and C, which occurred in land-area seismic networks, practically reproduced observed seismograms. Assumed structural and source models were valid for simulation of land-area earthquakes. On the other hand, simulation of Event A was not well reproducing observed seismograms. It is indicating that structural, source or both models were not insufficient for simulation of offshore earthquake occurred outside of seismic network. In our presentation, we will show details of comparison between observation and simulation. Then, we will discuss modeling procedure of seismic wave propagation for such offshore earthquake.

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Keywords: Seismic wave propagation, finite-difference method, Three-dimensional heterogeneous subsurface structure, Crustal earthqauke, Intraslab earthquake, Interplate earthquake

