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Long-period ground motion evaluation for the Nankai Trough megathrust earthquakes

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We evaluate long-period ground motions associated with the Nankai Trough earthquakes (M8~9) in southwest Japan. Large interplate earthquakes occurring around the Nankai Trough have caused serious damages due to strong ground motions and tsunami. Such large interplate earthquake potentially causes damages to high-rise and large-scale structures due to long-period ground motions. The long-period ground motions are amplified particularly on sedimentary basins, where big cities have been established. Therefore it is important to evaluate long-period ground motions as well as strong motions and tsunami for the anticipated Nankai Trough earthquakes.

The long-period ground motions are evaluated by the finite difference method (FDM) using " characterized source models " and the 3-D underground structure model. The parameters of the characterized source model are determined based on a " recipe " for predicting strong ground motion [Earthquake Research Committee (ERC), 2009]. We construct various source models (more than 300 scenarios) assuming various possible source parameters, including rupture area, asperity configuration, and hypocenter location. Each source region is determined by " the long-term evaluation of earthquakes in the Nankai Trough " published by ERC. The asperity configuration and hypocenter location control the rupture directivity effects. These parameters are important because our preliminary simulations are strongly affected by the rupture directivity (Maeda et al., 2013). We apply the system called GMS (Ground Motion Simulator) for simulating the seismic wave propagation based on 3-D FDM scheme using discontinuous grids (Aoi and Fujiwara, 1999) to our study. The 3-D underground structure model used in the FD simulation is the Japan integrated velocity structure model (ERC, 2012).

We evaluate the long-period ground motions using the peak ground velocity (PGV) and velocity response spectra (Sv). The simulation shows a large variation of PGV and Sv at a site. The large variation is important to understand the seismic hazard. The variation at the Kanto region, an eastern extension of the source area, seems larger than those at the Nobi and Osaka regions. The scenarios with wider source area have larger PGV and Sv than those with smaller source area. The large number of simulations of this study allows us to select scenarios that correspond to representative (e.g. average and maximum) response spectra at each site.

Keywords: Nankai Trough, long-period ground motion, megathrust earthquake, hazard assessment, GMS