Ground Motion Simulation from a Large Subduction Earthquake using the Offshore-Onshore Ambient Seismic Field

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Strong long-period ground motions from large subduction earthquakes are difficult to simulate with current techniques due to the complex wave propagation through accretionary prisms and sedimentary basins. We show that the ambient seismic field recorded by offshore and onshore seismometers can be used to accurately simulate the ground motions of the 2004 Mw 7.2 off the Kii peninsula earthquake. We use one year of continuous data recorded by offshore seismometers of the DONET1 network, which has been deployed atop the Nankai subduction zone, and onshore Hi-net stations in the surrounding area. We retrieve offshore-onshore impulse response functions from the continuous records using seismic interferometry. After amplitude calibration, we show that the impulse response functions reproduce well the long-period ground motions of a moderate Mw 5.5 aftershock, which occurred in the vicinity of the large event. We extend the point source method, which is appropriate for moderate events, to finite source modeling to simulate the long-period ground motions of the Mw 7.2 event. The geometry of the source model is taken from the results from source inversions. Using scaling relations between moderate and large earthquakes, we discretize the fault plane into subfaults and spatially interpolate offshore-onshore impulse response functions to obtain one impulse response function for each subfault. The interpolated impulse response functions are finally summed up considering different rupture velocities. Results show that this technique can accurately simulate the long-period ground motions of the 2004 Mw 7.2 off the Kii peninsula earthquake.

Keywords: Simulations, Ambient seismic field, Strong ground motions, Green's functions, Long-period

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