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Broadband Ground Motion Prediction for Miyagi-oki Earthquake Scenarios

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The omega-squared source model with a single corner frequency is widely used in the earthquake source analyses and ground motion simulations. Recent studies show that the Brune stress drop of subduction-zone earthquakes is almost half of that for crustal earthquakes for a given magnitude. On the other hand, the empirical attenuation relations and spectral analyses of seismic source and ground motions support the fact that subduction-zone earthquakes provide 1-2 times of the short-period source spectral level for crustal earthquakes. To link long- and short-period source characteristics is a crucial issue to perform broadband ground motion simulations. This discrepancy may lead the source modeling with double corner frequencies [e.g., Atkinson, 1993]. We modeled the lower corner frequency corresponding to the size of asperities generating for long-period ($>$ 2-5 s) ground motions by the deterministic approach and the higher corner frequency corresponding to the size of strong motion generation area for short-period ground motions by the semi-empirical approach. We propose that the double corner source spectral model is expressed as a period-dependent source model consists of either the asperities in a long-period range or the strong motion generation area in a short-period range and the surrounding background area inside the total rupture area. The characterized source model has been the potential to reproduce fairly well the rupture directivity pulses seen in the observed ground motions. We explore the applicability of the double corner source spectral model to broadband ground motion simulations for the Mw 7.6 and Mw 7.3 Miyagi-oki earthquake scenarios along the Japan Trench. The Mw 7.6 scenario is similar to the source model of the 1978 Miyagi-oki earthquake. The double corner source spectral model, where the size and stress drop for strong motion generation areas are respectively half and double of those for asperities, worked well to reproduce broadband ground motion time histories and seismic intensity distribution of the 1978 Miyagi-oki earthquake.

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Keywords: broadband ground motion simulation, Miyagi-oki earthquake, characterized source model, Japan integrated velocity structure model, hybrid method