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Broadband ground motion prediction of the Tokai earthquake by EGF method using the 2009 Suruga-bay earthquake

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Broadband ground motion predictions for the hypothetical Tokai earthquake were performed by the empirical Green's function (EGF) method (Irikura, 1986) at the K-NET and KiK-net stations located from Kanto to Chubu district. We used the observed seismograms of the Suruga-bay earthquake on August 11, 2009 as the element waveforms. And we also used the broadband seismograms recorded at the stations operated by TEPCO around the Tokyo bay area.

First, we performed a moment tensor inversion to estimate the seismic moment of the Suruga-bay earthquake with low-pass filtered waveforms at K-NET and KiK-net stations near the source area. And then, the stress drop value was determined, using the records of KiK-net stations, by comparison between the observed amplitude spectrums and the theoretical spectrums. The estimated seismic moment was $2.65E18$ Nm (M_w 6.2) and the stress drop was 20 MPa. The fault model for the Tokai earthquake in this study was set up basically in accordance with the model of the Central Disaster Management Council of Japan. However, size of the sub-fault was re-arranged larger than the original model.

We used the EGF method by Irikura (1986) and Irikura et al. (1999) for the summation of element waveforms. The compensations for differences of the stress drop and the focal depth between each sub-fault and the element earthquake were applied. Even though the focal mechanism of the Tokai earthquake disagrees with that of the Suruga-bay earthquake, we confirmed that the difference does not affect so much to the results.

The EGF method was applied to each observed waveform, and the maps of JMA seismic intensity and response spectrums were drawn up using the synthesized waveforms. The area of intensity 5+ was consistent with that of "National Seismic Hazard Maps of Japan"(Earthquake Research Committee, 2009). On the other hand, seismic intensity near the fault was considerably larger than the other result. It is because non-linear effect of sediment layers is not considered in the EGF summation.

In long-period range, we made distribution maps of response velocity spectra ($h=0.05$) at periods of 5 s, 7 s, and 10 s. The distribution at 5 s was consistent with the existing result (Long-period Ground Motion Hazard Maps in 2009, Earthquake Research Committee, 2009). However, amplitude of 7 s and 10 s in Kanto area is somewhat smaller than the existing results. To investigate the reason, we carried out finite-difference simulations for the Suruga-bay earthquake. The results showed that the degree of excitation of long-period surface wave, which is dominant at about 8-10 s in Kanto area, depends on the focal depth of the source. These results suggest that the consideration to the focal depth is important for the prediction in long-period range.

Keywords: Hypothetical Tokai earthquake, Strong motion prediction, Empirical Green's function method, Long-period ground motion