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Examination of the relative site amplification factor of OBS and their real-time correction: examples of Sagami Bay OBS

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Hoshiba (2013, JGR) proposed a method for real-time prediction of ground motion based on real-time monitoring as the next-generation EEW, in which detection of hypocenter and Magnitude are not required. In this method, site amplification is one of the important factors. Therefore, relative site amplification factor have been evaluated at KiK-net (Iwakiri and Hoshiba, 2011) and at JMA seismic intensity stations (Aoki and Hoshiba, 2013) in the frequency domain. Ocean Bottom Seismograph (OBS) will provide valuable information to grasp ground motion propagation from ocean area. However, it is necessary to correct the site amplification factor of OBS for applying real-time monitoring method. Hayashimoto and Hoshiba (2013, SSJ) reported relative site amplification factor of OBSs at Tonankai region (Tonankai OBS (JMA) and DONET (JAMSTEC)) as a preliminary result. In this study, we evaluate relative site amplification factor of Sagami Bay OBS (NIED, Eguchi *et al*., 1998, MGR) which is close to land stations, and examine the effects of real-time correction to predict ground motion of land station from OBS.

The averaged spectral ratio of a station-pair from many events can be regarded as the relative site factor when the hypocentral distances to station-pair are much larger than the distance of those stations. In this study, we use the waveform data from the Sagami Bay OBSs and adjacent land stations (K-NET and KiK-net, NIED), and select the dataset with the hypocentral distance which is greater than 100km. We compare Fourier spectra from the waveforms of S-wave portion (20s) on OBSs with those on adjacent land stations as the relative site factors. In examples of the relative site factors of OBSs to KNGH23 (KiK-net borehole station), the amplification factor of the horizontal component is greater than that of the vertical component for frequencies 1-10Hz. We conclude that the site effects of OBSs characterized by such a low velocity sediment layers causes those amplification factors.

In order to examine the effect of frequency-dependent relative site amplification factor, we compare the accuracies of predicted seismic intensity using the spectral ratio with those using the average of seismic intensity (frequency-independent factor). We design the causal digital filter (Hoshiba, 2013, BSSA) having similar amplitude property to relative site factor for the station pair. The filter parameters are estimated and applied for both horizontal and vertical components. And we use the real-time processing of seismic intensity (Kunugi *et al*., 2008, Zisin 2) to estimate seismic intensity from observed and predicted waveforms. Both of the techniques are applicable in real-time. We consider the RMS of residual between observed and predicted seismic intensities as the accuracy of site correction of each station pair. In the case of prediction of seismic intensities from OBSs data to land stations, the average RMS of frequency-dependent method are smaller than that of frequency-independent method. Similar results are also obtained at pairs of land station. These results indicate that the frequency-dependent site factor is crucial factor to predict seismic intensity from OBS data, and also show that OBS can be used as front stations in the method for prediction of ground motion based on the real-time monitoring.

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Keywords: Earthquake Early Warning, Ocean Bottom Seismograph, Real-time prediction of ground motion, Site amplification factor