A preliminary analysis of long-period response spectra (1-10s) at S-net for the 2016 Mj7.4 off Fukushima earthquake

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The 2016 Mj 7.4 off Fukushima earthquake occurred on November 22, 05:59 JST. An Mw value of 7.0 was assigned for the earthquake by F-net NIED. The Mw values determined by USGS and GCMT were equal to 6.9. The Japan Meteorological Agency (JMA) focal depth was approximately 24 km. The event was a normal fault event based on moment tensor solutions by the organizations mentioned above. The above earthquake was the largest event that occurred off Fukushima after the deployment of S-net. One hundred twenty-five stations of five segments of S-net except for the outer rise segment, which was not in operation during the earthquake, successfully recorded the seismic motions during the earthquake. In our previous paper (Dhakal et al. 2018), we compared the observed absolute velocity response spectra (AVRS) for the earthquake at the K-NET and KiK-net stations with the ground motion prediction equation (GMPE) constructed by Dhakal et al. (2015) and found that the data were generally explained well by the GMPE. In this paper, we compared the AVRS computed from the ocean bottom strong-motion recordings at S-net stations with the GMPE by Dhakal et al. (2015).

We first examined orientations of the sensors from one-minute time windows before the earthquake and when the shakings subsided after the earthquake. We found that five stations namely, S2N12, S2N13, S2N14, S2N15, and S2N16 of S2 segment (off Ibaraki and Fukushima) located close to the epicenter, suffered rotations approximately between 0.1 and 10 degrees during the earthquake. The recordings from these five stations were not used in this study, and AVRS were computed following the method explained in Dhakal et al. (2015) from the ten-minute time window starting one minute before the earthquake origin time. The computed response spectra at the S-net sites were corrected for the site amplification effect of deep sediments using the J-SHIS subsurface velocity model following the method described in Dhakal et al. (2015). The spectra without correction (circles) and with correction for the site amplification are plotted in the attached figure as a function of hypocentral distance for the periods of 1, 2, 3, 5, 7, and 10 s, respectively. The plots show that the observed data at the periods of 1 to 5 s are generally within plus-minus one standard deviation of the median prediction curves after correction for the site amplification. With the increase of periods > 5 s, the plots indicate that the data deviate increasingly from the median prediction curves, especially at distances between about 100 and 500 km. The difference seems to be the largest at the period of 10 s among the analyzed periods. However, the difference is not systematic after correcting for site amplification and may be attributed to the velocity structure or the other factors such as the effect of oceanic water layer or the source effect such as the radiation pattern effect at the longer periods or their combinations. In conclusion, the observed response spectra at the S-net sites generally agree with the GMPEs by Dhakal et al. (2015) at periods of 1-5 s and differ increasingly at many sites with the increasing periods. Further analysis is ongoing, and we report the results in our future papers.

References

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