Spectrum Characteristics of MeSO-net seismograms –Effect of Underground Installation -

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1. Introduction

In the Kanto district, high-density seismographs with about 300 accelerometers by MeSO-net have been deployed, and records from 2008 have been accumulated. By analyzing the MeSO-net records integrating with those obtained in K-NET and KiK-net, which is operated near the ground surface, it will able to largely improve structural images in seismic attenuation. However, MeSO-net is installed at a depth of 20 m and there is a problem to integrate records obtained at the surface. In this study, we investigated relative amplification factors among MeSO-net sites and compared the factors to those estimated at the surface sites, K-NET and KiK-net.

2. Method and Data

Observation records which are obtained at two closely located sites by the same earthquake have almost the same propagation paths, so the difference of the two site records can represent a difference of site amplifications because effects of source radiation and attenuation along paths are canceled out. Based on this idea, some studies have been investigated relative amplification factors between the sites. Recently, Ikeura and Kato (2011) proposed a new method that regards site pairs as a network and estimates relative ground amplification factors by using least squares method within the network.

In this study, the relative amplification factors in MeSO-net was examined by using the Ikeura and Kato's method. In order to compare with the amplification factors on the surface, the ground record of K-NET and KiK-net was also included in the analysis. The ARTB method (Herman, 1980) was used for least squares estimation. A distance between sites to pair is 10 km or short. The Fourier spectrum of every 1 Hz from 1 Hz to 10 Hz were used for the data. The strong motion records of MeSO-net from 2011 to 2015 and K-NET/KiK-net from 1996 to July 2016 were selected. Earthquakes with Mj 4 or more and depths less than 200 km were used. We only adopted records which the maximum acceleration amplitude is 100 Gal or less to exclude the nonlinearity effects resulted in strong ground motion. Finally, we used site pairs of 962,422 with 394 observation sites of 394, which include MeSO-net site of 297.

3. Results

In this study, first, we performed numerical experiments to vilify the validity of results given by the ARTB. The geometries of site and earthquake used in the experiments are the same to the actual investigation. After 50 times iteration, it is confirmed that synthesized dataset well reproduce the relative site amplifications assumed in artificially.

Then, we conducted 100 times iteration for the actual observation records to obtain the relative ground amplification. Fig.1 shows an example of the result at 5 Hz. Here we compare the relationship with the average S wave velocity to 30m depth (AVS 30) provided from the JSHIS. The amplification factors at the

ground surface (K-NET and KiK-net) is about 3 times larger than that at the underground (MeSO-net) on average. The amplification rate tends to decrease with increasing velocities of the AVS 30. This trend is consistent with the relationship for the PGV data expected based on Fujimoto and Midorikawa (2006) (black solid line in Fig. 1).

We confirmed that the residuals in the attenuation tomographic inversion can be greatly reduced by giving the relative amplification factors obtained in this study as a priori information.

4. Conclusions

Relative amplifications of ground motion were investigated for observation sites of the MeSO-net, K-NET and KiK-net by using the site-pair network and the least squares method. As a result, it was found that amplification factor in the MeSO-net of which seismographs are deployed at the underground, 20 m depth, is about 1/3 comparing with those of ground surface recorded in the K-NET and KiK -net on average.

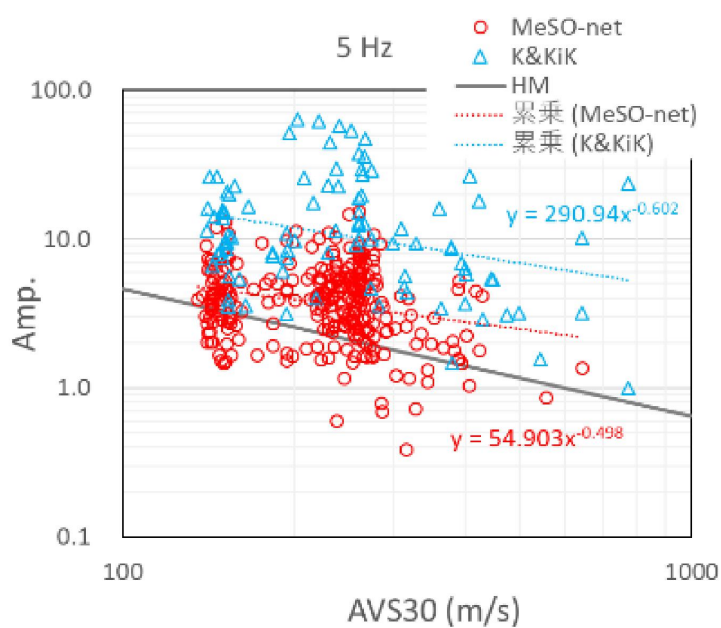Keywords: MeSO-net, Relative Amplification Factor

Fig.1 Relation between relative amplification factors at 5 Hz and AVS30 by JSHIS
△ : K-NET・KiK-net (free surface)   ○ : MeSO-net(underground G.L.-20 m)
HM : Relation between PGV and AVS30 by Fujimoto and Midorikawa(2006)