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Site amplification factors derived from coda normalization method (4) amplification factors at borehole and surface

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Introduction

We have estimated broad band (f = 0.5-1, 1-2, 2-4 and 4-8 Hz) site amplification factor at each site of the KiK-net and F-net strong motion network in Japan based on the coda normalization method. Estimated amplifications are applied for shaking intensity to show the validity of our estimates on the site amplification factors at each site and in frequencies (Takemoto *et al.*, 2009). Comparison between free surface and borehole in Northeastern Japan revealed that site amplification factors dramatically differ over 2 Hz (Takemoto *et al.*, 2010).

In this study, we used simultaneous inversion of KiK-net borehole and surface stations and F-net stations in whole of Japan to discuss S-wave amplification characteristic at borehole and surface stations in quantitative form.

Data and Method

We used KiK-net surface and borehole stations and F-net nation-wide strong motion network developed across Japanese Islands. Using waveform data of acceleration record from 48 moderate earthquakes, we estimated the site amplification characteristic at each station in four frequency bands (f = 0.5-1 Hz, 1-2 Hz, 2-4 Hz, and 4-8 Hz).

The distribution of the site amplification characteristic in each frequency bands has been estimated by inversion. We assumed an F-net broadband seismic observation station installed in the basement rock site as unity (0 dB) site amplification.

Results

In the high-frequency band (f = 4-8 Hz), absolute value of the site amplification factor in the borehole is smaller than that of the on free surface. Site amplifications in borehole concentrate around 0 dB. The spatial distribution pattern of the site amplification factor is poor correlated between free surface and in the borehole (correlation coefficient r = 0.52). High-frequency wave has short wavelength and affected by small scale ($<$ 100-200 m) structure.

On the other hand, there is little difference between spatial distribution of site amplification factor at borehole and surface stations (r = 0.88) in low frequency band (f = 0.5-1 Hz). A few stations showed very high amplification ($>$ 20 dB) in both surface and borehole. Some stations showed small amplification around 0 Hz. Site amplifications in low frequency band have large deviation.

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Keywords: coda normalization, site amplification