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Estimation of Time-Domain Site Effects in Osaka Basin, Japan

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Introduction

Site effect evaluation is one of the key issues for predicting strong ground motions to mitigate earthquake disaster. Conventionally, spectral domain methods (amplitude spectra) have been used for estimating site effects from observed ground motion records. However, for a construction of time history of ground motions the site effects in the spectral domain need phase information.

To get a proper site effect for estimation of time history of ground motions, Birgören and Irikura (2005) proposed a method that estimate site effects in time domain using wavelet transform. They estimated time-domain site effects (TDSEs) by averaging wavelet coefficients, after normalized by source and path effects, for many records. When they compared the Fourier amplitude spectra of the TDSEs with the amplitude spectra of the site effects estimated with a spectral inversion method, they found that the TDSEs amplitude spectra give underestimated amplifications. These underestimations are caused by the conventional averaging. Akazawa et al. (2008) proposed a different averaging technique to reduce the differences in the amplifications.

In this study we estimate TDSEs in Osaka basin, in order to check the ability of methods by Birgören and Irikura (2005) and Akazawa et al. (2008) and investigate dependency of TDSEs on azimuth of incident waves.

Method

In this study we use velocity records from stations of the strong motion observation network of the Committee for Earthquake Observation and Research for the Kansai Area (CEORKA). Two of the stations are placed on rock and the rest of them are placed on sedimentary soils. We use data of earthquakes, with a magnitude range of M_{JMA}= 3.7 - 5.5, and a hypocentral distance range of R < 250 km.

We apply a spectral inversion method (Iwata and Irikura, 1988) to determine the source and path effects that are necessary to apply the Birgören and Irikura (2005) method. The spectral inversion method allows separation of the source spectrum, the propagation path effect and the site effect. From the propagation path we estimate the Q-value of the study area.

We estimate TDSEs for all the events by removing the source and path effects estimated from the spectral inversion method. Then we made groups of events according to their positions with respect to the Osaka basin and we estimate TDSEs for the groups. To verify that the group members are similar we compare the standard deviation of the TDSEs estimated using all the events, with the standard deviation of the TDSEs of each group. Then we compare the time duration and amplitude of the TDSEs of each group to find the dependency of the TDSEs on the position of the events.

References

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