Site amplification factors for KiK-net stations in and around Ibaraki Prefecture estimated by the coda normalization method

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It is empirically known that the spatial distribution of the coda wave energy from a local earthquake is nearly uniform for long lapse times. The coda normalization method is a method of separating source, path, and site effects from coda wave records, based on this empirical characteristic (Sato et al., 2012). There are many studies on the evaluation of site amplification factors based on the coda normalization method (e.g., Takahashi et al. 2005; Takemoto et al., 2012). However, little attention has been paid on the magnitude of the variability of amplification factors estimated for different earthquakes in an identical region.

We applied the method to the strong-motion records for 21 KiK-net stations and F-net TSK (Tsukuba) station in and around Ibaraki Prefecture. We used the records of 31 earthquakes with $4.7 \leq Mw \leq 6.4$, which were classified into four groups depending on their locations. Stations with the epicentral distances less than 100 km were chosen for each earthquake, and the seismograms for lapse times greater than twice the direct S-wave travel time at the farthest station were used in the analysis. We selected TSK as the reference station for which the site amplification is expected to be low, and we obtained the amplification factor for each KiK-net station relative to TSK. We also calculated the geometric mean of the factors for each earthquake group.

We obtained the following results. (1) The low-frequency (0.5 to 1 Hz) amplification factors were apparently correlated with both basement depths and geological ages. It is consistent with previous studies such as Takemoto et al. (2012). (2) At the stations with shallow basement in the northern areas, the variability of the amplification factors among the earthquakes was small irrespectively of frequencies, and the geometric means of the factors for four earthquake groups were nearly the same. (3) At the stations with deep basement in the southern areas, the variability of the amplification factors among the geometric means of the factors for four earthquake groups were nearly the same. (3) At the stations with deep basement in the southern areas, the variability of the amplification factors among the geometric means of the factors for four earthquake groups were nearly the same. (4) The geometric standard deviations of the amplification factors were apparently correlated with both basement depths and geological ages. (5) There appears no clear relationship between the amplification factors and the hypocentral distances for most stations. It supports the empirical assumption that the spatial distribution of the coda wave energy is nearly uniform.

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We used the strong-motion records form KiK-net and F-net and the data of basement depths from J-SHIS (National Research Institute for Earth Science and Disaster Resilience).

Keywords: site amplification factor, coda normalization method, Ibaraki Prefecture