Relationship between Irregularity of Boundary of Subsurface Geology and Spatial Variation in Peak Periods of Horizontal to Vertical Spectral Ratio of Microtremors -A Study Based on Numerical Simulations-

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Earthquake motions on an irregularly layered subsurface geology (hereafter irregular site) sometimes show a higher amplification than on a stratified media (hereafter flat site) due to, for example, a focusing effect of seismic waves. An exploration of depth distribution of geological boundary is necessary for a reliable estimation of amplification factor at an irregular site, but it is too costly to make such a survey at every site in practice. Before a detail survey, a simple method to sort out irregular site from flat site is desired for insufficient geological information sites. Focusing on spatial variation in peak periods of horizontal to vertical spectral ratios (hereafter HVSRs) of microtremors, we showed in Motoki et al.(2012) that the values of coefficients of variation (hereafter CVs) were obviously separated between irregular sites and flat sites. In this report, we performed 2 investigations using numerical simulations with respect to a relationship between CVs and irregularity of subsurface geology.
First, in order to reveal what kind of parameters of subsurface geological model affected amplitude of CVs, we analyzed a sensitivity for CVs by numerical simulation with various parameters. The basic geological model was constructed based on results of drilling method at Nabari site where mobile microtremor measurements were also conducted. CVs of simulated motions with the basic model are almost consistent with the CVs by the observations. We found out that slope angles and horizontal sizes of irregularity affected amplitudes and inflection distances of CVs.
Second, we directly compare CVs to irregularity of subsurface geology, using results of simulated microtremors and geological models. For a comparison, we converted CVs to a power spectral density (hereafter PSD) via a semivariogram, which were frequently used in geostatistics. The PSD estimated from the CVs showed a good agreement with the PSD calculated from geological model in the wave number range corresponding to interstation distances to estimate the CVs. Note that we can say CVs reflect irregularity of subsurface geology.
We evaluated the difference of CVs by fluctuating irregularity of subsurface geology through numerical simulations. Consequently, we found that CVs can be an index of the irregularity, and we will suggest a procedure and a threshold in future works.

Keywords: Microtremors, Peak period of H/V, Spatial variation, Coefficients of variation, Power spectral density

