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The Effect of the Basin Edge to the Directional Dependent Horizontal-to-Vertical Spectral Ratios of Microtremors

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Based on the diffuse field theory (Perton et al., 2009), Horizontal-to-Vertical (H/V) spectral ratios of microtremors (or ambient noise) correspond to the square root of the ratio of the imaginary part of horizontal displacement for a horizontally applied unit harmonic load, Im[G_{11}] and/or Im[G_{22}], and the imaginary part of vertical displacement for a vertically applied unit load, Im[G_{33}], where both the loads and receivers are at the same point on the free surface (Sanchez-Sesma et al., 2011). This theory can be applied to a site where the subsurface structure cannot be considered as sufficiently flat, horizontally layered (i.e., Im[G_{11}] /= Im[G_{22}]), and lateral heterogeneity exists, and the H/V spectral ratio of microtremors can be derived by the square root of the Im[G_{11}] and/or Im[G_{22}] and Im[G_{33}] (Matsushima et al., 2014).

The authors have shown that by using a numerical method such as the 3-D Spectral Element Method (SEM) (e.g., De Martin, 2011) to calculate the Green's functions from 3-D wave propagation analysis using a 2-D basin structure, it is possible to qualitatively simulate the significant directional dependency that can be seen in H/V spectral ratios of microtremors observed at sites on Uji campus, Kyoto University. The NS/UD has higher peak amplitude and EW/UD has higher peak frequency. The H/V spectral ratios derived from numerical analysis using Green's functions calculated for a simple 2-D basin model with one layer over bedrock show that the observed H/V spectral ratios are qualitatively simulated (Matsushima et al., 2014). Also, Matsushima et al. (2014) has shown that the shape of the H/V spectral ratio is distorted at sites close to the basin edge. This is an indication that if we observe microtremors at several sites close to the assumed basin edge, there may be possibility to identify the shape of the basin edge in detail.

In this study, we focus on the effect of the basin edge to the H/V spectral ratios and study the relation between the basin edge shape and the difference between NS/UD and EW/UD by simulating the H/V spectral ratios at sites close to the basin edge by numerical calculation. We consider a simple 2-D basin model with one layer over bedrock and change the shape of the basin edge. Also, we made micorotremor observation for two line arrays orthogonal to the 2-D basin in Uji and found that the observed H/V spectral ratios show the characteristics assumed from the numerical analysis.

From these results, we can see that the condition of the basin edge changes the H/V spectral ratios drastically at sites close to the basin edge. If we accumulate the relation between the shape and condition of the basin edge to the shape of the H/V spectral ratios in two orthogonal horizontal directions, we will be able to use the information from the observed H/V spectral ratios of microtremors to determine the basin edge shape.

References

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