Estimation of phase velocities of Rayleigh and Love waves using the array observation records of 3-component microtremors

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1. Introduction

The author (2003) has proposed a method to estimate phase velocities of the Rayleigh and Love waves using array observation records of three-component microtremors. In this method, we apply the spactial auto-correlation (SPAC) method and it is supposed that the propagating directions are different between these two surface waves, but the each direction is fixed on only one. As a result, the derived representation of the phase velocities under this assumption were same as Okada and Matsushima (1989) whose assumption regarding to propagating directions of surface waves are not so clear.

To generalize the treatments of propagating directions of surface waves, we derive an analytical representation of the phase velocities on the basis of the array observations of 3-component microtremors under the following assumptions:

- propagating directions of surface waves are various
- propagating directions are mutually independent between Rayleigh and Love waves.

Although the basic formulations are slightly different from the previous analysis (Morikawa, 2003; also Okada and Matsushima, 1989), the results will be absolutely same as them.

2. Problem Setting and Results

We will suppose that the microtremors consist of the Rayleigh and Love waves and they are mutually independent stationary stochastic processes. The observations are carried out at the sits on a circular array and its center whose position vectors are r+r0 and r0, respectively. Then, the observed microtremors with the transverse and radial components are represented by the summation of the projections upon the transverse and radial from the Rayleigh and Love waves.

Using the spectral representation of the projected waves, we can calculate the spatial auto-correlation functions and its averaged values over the site directions. The difference from the previous analysis (Morikawa, 2003) is that the terms for the projection, which are sin(x) or cos(x), are included in the integrand for the spectral representation. However, we can obtain the same results as the previous analysis.

From this, we can verify the original formulation by Okada and Matsushima (1989) give the exact solution for the general case, though they do not mind seriously about the propagating directions of surface waves.

3. Conclusions

We derived the analytical representation of phase velocities using the array observation records of 3-component microtremors under the general case with respect to propagating directions of surface waves. The results were exactly same as the results by Okada and Matsushima (1989) also.