Oral | Symbol S (Solid Earth Sciences) | S-SS Seismology

[S-SS35_2PM1]Recent developments in microtremor surveys

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Microseisms and microtremors (hereafter called microtremors) are considered to be caused by ocean swells and human activities, respectively. Though they are recognized as noise to seismic observations, they can be turned into useful signal in other point of view. The nature of microtremors has been long studied. And the utilization of microtremors for engineering applications have been actively made in Japan such as the classification of site conditions based on the predominant periods, and the estimation of subsurface velocity structures by means of the spatial auto-correlation (SPAC) method and the horizontal-to-vertical (H/V) spectral ratio. These methods are now widely used all over the world in order to estimate shallow subsurface structures in terms of the prediction of strong ground motions. And in the last decade, studies on microtremors have been revitalized, mainly because seismic interferometry was developed and seismic observations became more efficient. For example, the H/V method was reinterpreted based on the theory of diffuse waves. And the centerless circular array (CCA) method was newly developed. Moreover, temporal changes in shallow subsurface structures caused by the nonlinear site effect can be detected by analyzing long-term continuous records of microtremors. In this session, we widely invite contributions on the nature of microtremors and their applications to exploration in order to understand the present status and discuss future directions of the subjects.

3:05 PM - 3:20 PM

[SSS35-P01_PG]Sophistication of microtremor methods to survey shallow structures, PartI: Development of automatic reading algorithms

3-min talk in an oral session

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We have been seeking an efficient way to maximize the potential of the microtremor methods for shallow surveys. It is considered that a practical approach has been gained in the observation by the development of portable seismometers (Senna, 2006, 2012) and by the finding of the full usability of the data obtained by a miniature array (radius Automatic readings of phase velocitiesLet us suppose that multiple dispersion curves have been obtained by either multiple arrays or multiple analysis methods (i.e., nc-CCA, CCA, and SPAC methods) at a single observation point. In the first step, apply the following procedure to each dispersion curve. (i) Divide the frequency range used for analyses into equally-spaced intervals (bins) in a logarithmic scale. Take an average of phase-velocity data in each bin. (ii) Exclude the results from the analyses either when the wavelengths relative to an array radius lie out of the range defined a-priori for each method or when they exceeds the analysis limits having been evaluated by the use of an array with a sensor at the center point. Also, exclude the results when they seem to align in a line passing through the origin. An automatic reading is obtained for each bin by averaging all values left after the procedure (ii). Readings are deleted, however, when they seem to align in a line passing through

the origin.*Automatic readings of peak and troughs of an H/V spectrum*First, an H/V spectrum obtained at a single observation point, or an average spectrum if there are multiple spectra as a representative value, is smoothed using a spectral windows having a frequency-dependent window width. Peaks and troughs of the spectrum are searched from the lower side of the frequency range by using the derivatives. We search pairs of a peak and a trough to stabilize the analysis result: A pair is excluded from the reading results when the difference in either frequency or H/V ratio between a peak and trough is smaller than a threshold. Also, a pair is excluded when a peak (trough) value is smaller than that of an anterior peak (trough). The peak and trough of each pair, thus obtained, are used for the depth conversion, and the resulting depths are averaged to be the representative depth obtained by an automatic reading.