[JJ] Evening Poster | S (Solid Earth Sciences) | S-SS Seismology

[S-SS14]Strong Ground Motion and Earthquake Disaster

convener:Masayuki Kuriyama(Central Research Institute of Electric Power Industry)
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Strong ground motion has social impacts as it induces earthquake disasters. We solicit contribution on any seismological topics related to strong ground motion that includes, but are not limited to, source processes, wave propagation, and site effects. We also welcome contribution on earthquake related disaster mitigation.

[SSS14-P12]**Accuracy of a vertical-component microtremor-array-survey method: with special reference to a simple method for estimating interval-averaged S-wave velocities as a starting point of further discussion**

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Abstract

In the previous paper (Cho et al., 2018), we introduced a simple method using vertical-component microtremor-array data so as to determine interval-averaged S-wave velocities at a 10-meter interval to the depth of 30m. We examined the estimating accuracy of that method by using microtremor data obtained in the Mashiki Town, Kumamoto, and finally concluded that the simple method can be positioned as a preliminary analysis tool. In this study, we regard this conclusion as a starting point for further discussion on a certain problem: what is the accuracy of a so-called inversion method in the first place? We focus the arbitrariness of the parametrization of a velocity structure model used for an inversion (e.g., the number of layers) and discuss the accuracy of microtremor array survey methods based on the analysis results of observed microtremor array data.

Contents in the previous paper

We determine interval-averaged S-wave velocities with a simple method in the following. Firstly, substitute an interval-averaged S-wave velocity from the surface to the depth of 10m, AVS_{0_10}, by a Rayleigh-wave phase velocity with the wavelength of 13m, C_{13} (Cho et al., 2008). Next, calculate interval-averaged S-wave velocities from the depth of 10m to 20m, AVS_{10_20}, and from the depth of 20m to 30m, AVS_{20_30}, by using the following equations:

$AVS_{10\_20} = (AVS_{0\_10}\ AVS_{0\_20}) / (2AVS_{0\_10} - AVS_{0\_20})$, (1)

and

$AVS_{20\_30} = (AVS_{0\_20}\ AVS_{0\_30}) / (3AVS_{0\_20} - 2AVS_{0\_30})$. (2)

AVS_{0_20} and AVS_{0_30} are the so-called Average S-wave velocities from the surface to depths 20m and 30m, respectively, which can be substituted by the values of the phase velocity of Rayleigh waves with wavelengths of 25m and 40m (C_{25} and C_{40}), respectively. We can obtain interval-averaged S-wave velocities of AVS_{0_10}, AVS_{10_20} and AVS_{20_30}, once we have a phase-velocity dispersion curve that convers above-mentioned wavelength ranges.

We applied the above simple method to microtremor array data obtained in the downtown Mashiki, Kumamoto. We compared between the analysis results with the simple method and those obtained with other surveys (i.e., a PS logging and a surface-wave survey). It turned out, from the comparison with the PS logging data, the interval-averaged S-wave velocity estimates by the simple method may be subject to errors of up to several ten percent in terms of their absolute values. On the other hand, it was shown from the comparison with a surface-wave survey data that the simple method can help evaluate relative, spatial variations in those S-wave velocities. In view of the simplicity of analysis, the analyzer-independent nature of the results and the limitations of analysis accuracy, we considered that a simple method presented here can be used as an effective tool for the preliminary analysis of microtremor data from small seismic arrays.

Problem suggested in this study

When drawing the above conclusion that the simple method is a preliminary analysis tool, we implicitly assumed that advanced inversion methods (e.g., linearized inversions, genetic algorithms) have estimating errors much smaller than those with that simple method. However, is this assumption really valid? Even when an inversion method using arbitrary model settings has produced ostensibly “high-precision” results (with small standard deviations), those results may contain biases that depend on model parameter settings. An often forgotten fact is that merely changing the number of layers in the settings for an inversion model strongly affects the inversion results. When those model-dependent biases are taken into account, the variations may turn out to be just as large as in the case of our simple method.

In this study, we draw illustrative examples from the preexisting research on microtremor array surveys in Mashiki with advanced inversion methods in order to evaluate the estimating errors contained in advanced-inversion models. Through the comparison with our simple method, we discuss the accuracy of microtremor survey method from the above-mentioned viewpoint. Furthermore, we discuss the positioning of our simple method and advanced inversion method.

Cho et al., 2008, BUTSURI-TANSA, **61**, 457-468.

Konno and Kataoka, 2000, Proceedings of Japan Society of Civil Engineers, **647/I-51**, 415–423.

Cho et al., 2018, Exploration Geophysics, in press.