

Empirical Double Correction Method to Get Directly Site Amplification Factors of S-wave from Microtremors

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Seismologists and earthquake engineers have been discussing the validity of using the Horizontal-to-Vertical spectral Ratio (HVR) as a substitute for S-wave amplification factors (SAF) after Nakamura first proposed the idea in 1989. Discussion was complicated partly because of mixed use of HVRs for earthquake and microtremors.

To resolve the issue we first compared HVRs from observed microtremors (MHVR) and those from observed earthquakes (EHVR) at one hundred K-NET and KiK-net stations in Japan to calculate the spectral amplitude ratio between them, EMR. We categorize all the sites into five bins by their first peak frequencies in MHVR.

Then, we calculated average Vertical-to-Horizontal bedrock spectral ratios (VHbR) from the generalized spectral inversion at these sites and calculated the average VHbRs for the same five category. By multiplying VHbRs and EMRs to MHVR we can obtain SAFs ($=H/H_b$) of earthquake S-wave, which can be favorably compared with actual SAFs from the generalized spectral inversion.

This means that we need to double correct MHVR to obtain SAF, once for the difference between earthquake and microtremors and once for the non-zero site amplification in the vertical component. Since both EMRs and VHbRs are usually equal to or higher than 1.0 in a wide frequency range, the direct substitute of MHVR for SAF could lead to a large underestimation. The successful SAF estimation here should be due to the use of SAF with respect to the seismological bedrock where we can expect energy equipartition for three components and zero site amplification in both components.

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