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Estimation of inter-station Green's functions using microtremor array data

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The seismic interferometry technique is used to evaluate seismic velocity structure beneath two observation sites [e.g., Ma et al. (2008); Yamanaka et al. (2010); Asano et al. (2012); Hayashida et al. (2014)]. The technique can be applied under the assumptions of non-stationary and uniform distribution of microtremor (ambient noise) sources and it is important to investigate whether the data satisfy the conditions. The array observations of microtremor [Yoshimi et al. (2012)] were conducted at 13 sites in Niigata prefecture, Japan. The surveys were carried out for more than 10 days per site and each array consists of three equilateral triangular arrays whose radii range from several hundred meters to several kilometers. Here we used the data to estimate inter-station Green's functions with the seismic interferometry technique. The stacked cross-correlation functions (CCFs) of microtremor showed coherent and dispersive wave trains in frequency ranges between 0.4 and 1.0 Hz for the small array, 0.2 and 0.7 Hz for the middle array and 0.1 and 0.6 Hz for the large array. The wave trains derived for each array correspond well to each other regardless of azimuth angles, showing the effect from the abnormal microtremor source can be negligible in this study. We also calculated theoretical Green's functions from the estimated S wave velocity structures with the spatial autocorrelation (SPAC) method for each site, assuming 1D velocity structure. The agreements between the calculated Green's functions and the derived CCFs from the seismic interferometry are generally good, especially at lower frequencies. Our results suggest that a combination of velocity structure estimation with surface-wave phase velocity (conventional array methods) and velocity structure validation with Green's function (seismic interferometry technique) provides better estimations for S wave velocity structures.

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Keywords: microtremor, seismic interferometry, Green's function, group velocity, SPAC method