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東北地方日本海東縁地域における常時微動トモグラフィ
Ambient noise tomography in the eastern margin of the Japan Sea, NE Japan

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Seismic inteferometry has been used to estimate subsurface structure. Seismic inteferometry is based on the fact that cross-correlation function of random wavefields observed at a pair of stations contains Green's function between the two stations. Recently, seismic interferometry has been applied for ambient noise to estimate velocity structure, called ambient noise tomography. In this study, we applied this method for data of a dense seismic network in the region of the eastern margin of the Japan Sea. We estimated group velocity under the Sea of Japan and the western part of Tohoku region.

Date are vertical component of continuous record observed at 90 seismic station of Hi-net, JMA, Tohoku University, and temporary seismic stations installed for 'Multidisciplinary research project for high strain rate zone' promoted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan. Time period of data is 10 months from January 2009 to October 2009.

First, we calculated daily cross-correlation function for each pair. We divided day-long data into 287 segments with a length of 10 minutes and with an overlap of 5 minutes and downsampled the data with a sampling with a sampling frequency of 20 Hz. Then we corrected instrument response. In order to avoid contamination of outliers such as natural earthquakes and packet deficits due to error of data transfer, we did not use the segments that include outliers. Determination of the earthquake was carried out automatically by using a root-mean-square value of the amplitude. After these procedures, we applied a fast Fourier transform for data segments and multiply the spectrum of the first segment with the complex conjugate of the second spectrum. The cross-spectra is normalized by spectral amplitude of both segments. We computed averaged cross-spectra over all segments. The daily cross-correlation function is obtained by applying invert Fast Fourier transform for the averaged cross-spectra. Finally, we stacked all available cross-correlations functions for each station-pair during 10 months.

We applied band-pass filter for the cross-correlation functions with three periodic bands 2-5 sec, 5-10 sec, and 10-20 sec. Line up of the cross-correlations in order of separation distance between the two stations shows clear seismic wave propagation with an apparent velocity of 3 km/s, which corresponds to the fundamental mode of Rayleigh wave. We estimated group velocity in the period of 5-10 sec, which the peaks emerge. Group velocity between two stations is calculated by dividing the separation distance by the peak time of envelope function. As a first step, we averaged group velocities between certain station and all the other stations and estimated average velocity for each station. The average velocity of each station is about 2.5-3.5 km/s.

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