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Group velocity distribution of Rayleigh wave in the central part of the Tohoku rejoin by ambient noise cross-correlation

Ryota Takagi[1*], Tomomi Okada[1], Hisashi Nakahara[2], Norihito Umino[1], Akira Hasegawa[1]

[1]RCPEV, Tohoku Univ., [2]Graduate School of Sci., Tohoku Univ.

Seismic interferometry has been a new seismological method to estimate subsurface structure. Seismic interferometry is based on the fact that cross-correlation function of random wave filed computed between a pair of stations contains Green' s function between the two stations. Recently, seismic interferometry has been applied for ambient noise to reconstruct surface wave propagating between two stations. Shapiro et al. (2005) performed tomographic method to obtain group velocity structure of Rayleigh wave. This method is called ambient noise tomography. In this study, we applied this method for dense seismic network at the central part of Tohoku including the focal area of the 2008 Iwate-Miyagi Nairiku earthquake.

Data are vertical component of continuous record not only of Hi-net short period stations but also of Tohoku Univ., JMA and F-net. First, we calculated daily cross-correlation function for each pairs after correcting instrument response, removing earthquake, whitening, and 1-bit normalizing. Then we averaged daily cross-correlation functions over about 3 month. Averaged cross-correlation functions had obvious peaks which seem Rayleigh wave. We applied multiple filter technique (Dziewonski et al., 1969) for reconstructed Rayleigh wave to determine group velocity dispersion. Using tomographic method, we estimated group velocity map at 1-16 s from dispersion.

Group velocity map at short period, especially at 2 s, shows clear correlation with surface topography. Low velocities were observed at Sendai Plain, Osaki Plain and Kitakami Basin, in contrast, high velocities were observed at Kitakami massif and Ou Backbone Range. It is considered that the propagation velocities estimated in this study depends on subsurface seismic velocity structure such as low-velocity sedimentary layer in plains and basins, and high velocity basement rocks in mountain ranges.

At the longer period from 10 s to 16 s, the low velocity area is distinct near the Mt. Kurikoma. Body wave tomography (e.g. Nakajima et al. (2001); Okada et al. (2010))showed low velocity zone at similar area at a depth of more than 10 km. We interpret that this low velocity area is caused by a part of magma supplying system to Mt. Kurikoma. Considering that Rayleigh wave at about 10 s has high sensitivity at about 10 km, we can observed a shallow part of the magma supplying system. We also found low velocity area at the Matsushima Bay. As well as the low velocity area near the Mt. Kurikoma, this low velocity area is also observed by the body wave tomography. The 2008 Iwate-Miyagi Nairiku earthquake (M7.2) occurred near the Mt. Kurikoma and the 2003 Northern Miyagi earthquake (M6.4) occurred near the Matsushima Bay This suggest these low velocity area may relate these inland earthquakes as hypothesized by Hasegawa et al. (2005).