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Seismic velocity changes due to the 2005 Miyagi-Oki Earthquake revealed from auto-correlation analysis of ambient noise

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We show temporal changes of auto-correlation functions (ACFs) calculated from ocean bottom records accompanied with the occurrence of a large interplate earthquake.

Seismic intererometry is one of techniques used to estimate the detailed properties of the Earth interior using a number of seismic records; a pair of seismic traces is correlated with one another to estimate a Green's functions as a response of subsurface elastic properties (e.g. Campillo and Paul, 2003). Some previous works for the seismic interferimetry of ambient noise showed that ACFs and cross-correlation functions have temporal changes associated with strong motions due to local large earthquakes (e.g. Wegler et al., 2009).

The 14 ocean bottom seismometers (OBSs) were deployed off Miyagi before the 2005 M7.2 Miyagi-Oki Earthquake. All of the OBSs used in this study were a free-fall/pop-up type with a vertical component geophone. We computed ACFs with time-window length of 120 s. Filtered one-hour traces at the frequency band of 0.5?2 Hz were used to compute correlation by the one-bit correlation technique. By taking ensemble average of ACFs among 24 hours, one-day ACFs were computed for several months including the Miyagi event at each station. The ACFs showed some common coherent phases throughout observing period. We assumed that computed the ACFs reflected subsurface structure just below the OBSs networks.

We investigated temporal variations of the ACFs during observed periods. Some distinguished coherent phases at lag times were delayed or changed after the 2005 Miyagi-Oki Earthquake. Furthermore, we investigated a dependence of a delay or change upon a lag time during the whole ACFs. We consequently found two factors for time-delay and change on ACFs due to the occurrence of the large earthquake. One is due to a decrease in seismic velocity around the stations owing to strong motions. The other is due to a local velocity change. If a local velocity change was observed by backscattered P waves, this change probably occurred at depths of ˜30 km near the plate interface.

Keywords: Seismic interferometry, auto-correlation function, ocean-bottom seismometer, ambient noise, velocity change