Subsurface velocity change in Miyagi prefecture associated with the 2011 off the Pacific coast of Tohoku earthquake

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The 2011 off the Pacific coast of Tohoku earthquake (the 2011 Tohoku earthquake) caused a strong shaking in the eastern part of Honshu Island, Japan. We calculated the autocorrelation functions (ACFs) of ambient-noise waveforms in Miyagi prefecture and investigated the velocity change associated with the 2011 Tohoku earthquake.

Seismic Interferometry enables us to extract Green's functions of between two stations using correlation functions of ambient noise or coda waves (e.g., Campillo and Paul, 2003; Shapiro *et al*., 2005). In other words, an ACF of a waveform gives us the Green's function in the case that the source and receiver are collocated and let us detect reflected waves beneath the receiver. This method allows for the constant monitoring of the location of underground reflectors and the temporal change on subsurface velocity structure without artificial sources.

We investigated the temporal change in ACFs of the ambient noise observed at 10 Hi-net stations in Miyagi prefecture. Analysis period was 3 months, from February 1 to April 30, 2011. We used waveforms from 2:00 to 3:00 am (JST) to avoid effects of human activities. Detailed waveform processing was as follows.

First, the data were band-pass filtered from 1 to 3 Hz to improve of the signal-to-noise ratio. We then applied the one-bit normalization (Shapiro *et al*., 2005) to remove the effect of natural earthquakes as much as possible and calculated ACFs of ambient noises at stations in Miyagi prefecture. Finally, we obtained ACFs for individual day by averaging 60 one-minute ACFs to ensure the stability of the results which were used to monitor temporal changes.

Figure 1 shows calculated ACFs at Shiroishi station from February 1 to April 30, 2011. Black arrow indicates the date of the 2011 Tohoku earthquake (March 11, 2011). There are coherent wave groups with lag times around 4 and 5 seconds, which are reflected waves. We can see that the arrival times of the coherent waves after the 2011 Tohoku earthquake are later than the times before the earthquake, suggesting that the subsurface velocity became slower due to the 2011 Tohoku earthquake. This is consistent with the result of Nakahara (2014). In addition, we found that amplitudes of ACFs were reduced after the 2011 Tohoku earthquake. This would be due to the successive aftershocks. Isono *et al*., (2016, this meeting) discusses the effect of aftershocks on the one-bit normalization in the ACFs.

Acknowledgement:
We used Hi-net waveform data.

Keywords: Seismic interferometry, Velocity change, 2011 Tohoku earthquake

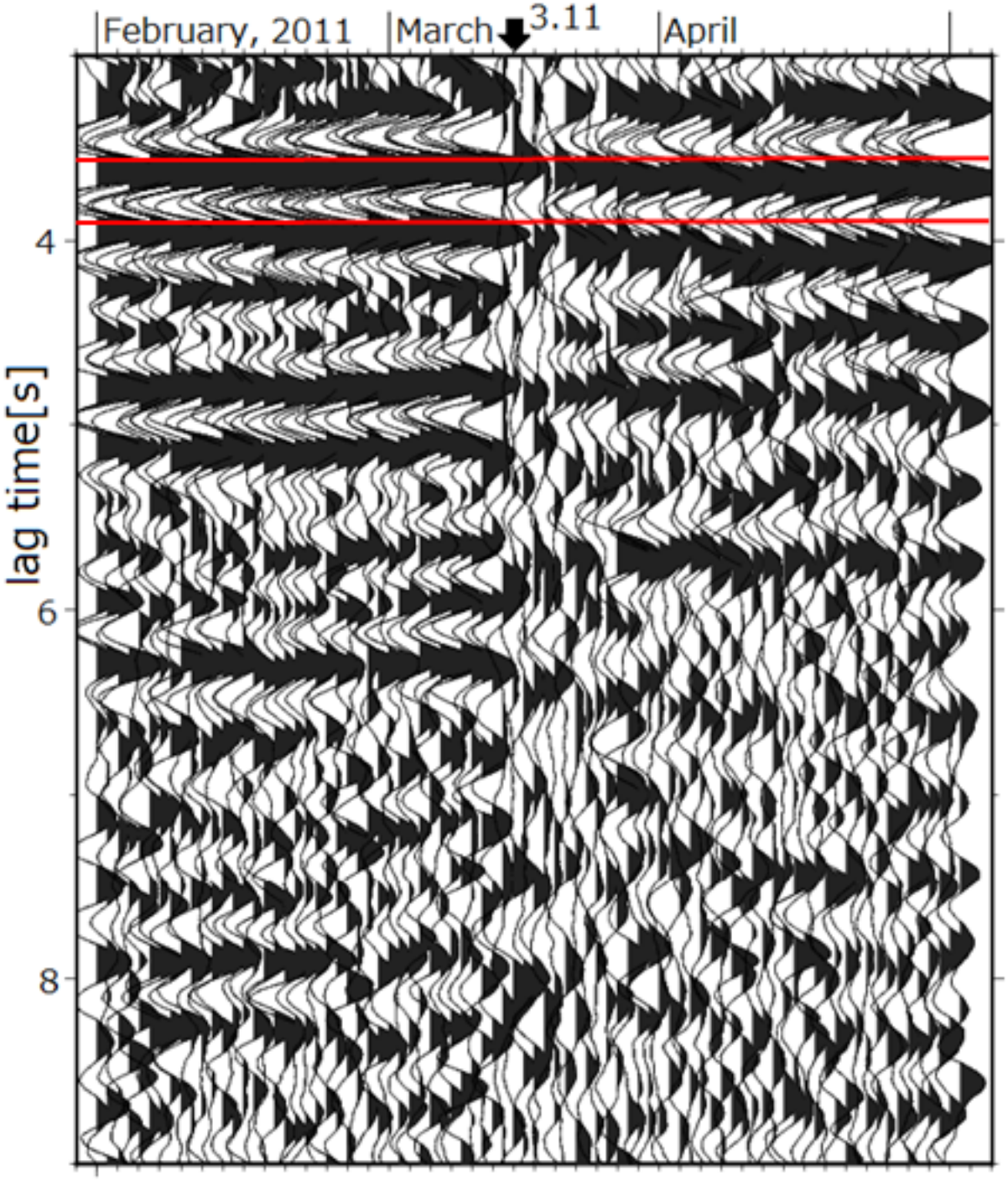

Figure 1. Calculated ACFs at Shiroishi station. Horizontal axis indicates dates from February 1 to April 30, 2011. Vertical one shows lag times of ACFs.

