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Detecting Temporal Evolution of the Subsurface Structure Associated with the 2011 Tohoku Earthquake Using Ambient Noise

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Temporal variation of the seismic wave velocity in central - eastern Japan associated with the 2011 off the Pacific coast of Tohoku Earthquake was preliminarily investigated using ambient seismic noise. Vertical components of the continuous seismic waveforms recorded by the seismic networks operated by NIED (Hi-net), JMA (Japan Meteorological Agency), and DPRI (Kyoto Univ.) were used for analysis. Cross-correlation functions (CCF) of 0.1Hz - 1.0Hz and 1.0 Hz - 2.0Hz frequency bands among station pairs whose separations are less than 120 km are calculated. CCFs from January 2011 to June 2011 are calculated and the temporal change of the lag times of the Rayleigh wave arrivals are compared. Auto-correlation functions (ACF) of 2.0Hz - 10.0Hz frequency band are also calculated for each single day for each station. Preliminary result of the CCFs show that the regions of velocity decrease are observed along the Pacific coast in the NE Japan, where experienced the strong ground motion at the mainshock, especially in the 0.1Hz-1.0Hz frequency band. However, CCFs in the Chubu district, where experienced no strong ground motion, exhibit no clear velocity changes in the CCFs of both frequency bands. Theoretical static strain change associated with the mainshock in the studied area is more than 10^{-5} large and velocity change associated with strain change was expected. The observed facts probably indicate that lagtime change in CCFs are caused by strong ground motion rather than strain changes. On the other hand, ACFs at several stations in both NE Japan and Chubu district clearly exhibit lagtime change that indicate subsurface velocity decrease. Observed feature in the ACFs in rather remote area are likely caused by not direct effect of strain change but indirect effect such as ground water level change caused by strain change, which is previously reported by Savage and Ohmi (2010, AGU FM).

Keywords: 2011 off the Pacific Coast of Tohoku Earthquake, Cross-correlation of ambient noise, Temporal change of subsurface structure