Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS27-P11 Room:Convention Hall Time:May 23 17:15-18:30

Temporal seismic velocity changes associated with the 2011 Tohoku Earthquake from repeating earthquakes analyses

NISHIMURA, Takeshi[1*]

[1]Geophysics, Science, Tohoku Univ.

Recent studies using seismic wave interferometry for ambient noise report temporal changes of about a few percentages in seismic velocity of the structure associated with occurrences of large earthquakes and volcanic activities. These studies generally analyze surface waves with a period of about 1-10 s, hence the structures changing seismic velocity are considered to be quite shallow, about a few hundred meters to 1 km. In the present study, seismic velocity changes associated with the 2011 off Pacific ocean of Tohoku earthquake (M9) are reported based on analyses of similar earthquakes occurring before and after the earthquake.

From the hypocenter data base of JMA, we select earthquakes with magnitude of about 4 and find earthquake groups in which hypocenters of several earthquakes are located within a distance of about a few kilometers. Then, calculating the cross-correlation coefficients for the waveforms for about 30 s from the P-waves, we select similar earthquakes. By applying cross-spectrum method to direct P- and S-waves for a pair of the selected similar earthquakes, travel time differences of P- and S-waves for the two earthquakes are calculated The results obtained from the analyses of 8 pairs of similar earthquakes occurring at depth of 40 - 60 km show following characteristics. Travel time differences of P-waves are quite small, almost less than 0.01 s. On the other hand, significant changes are observed in the travel time differences of S-waves: Tohoku region where the M9 faults are closely located show travel time increases of about 0.01-0.06 s while Kanto, Chubu and Hokkaido regions do not show significant velocity changes. Travel time differences of S-waves detected in the east-west component are slightly larger than those in the north-south direction. Travel time differences are not observed both for P- and S-waves for the pairs of similar earthquakes occurring before M9 earthquakes. Therefore, the travel time increases of S-waves observed around Tohoku regions are caused by the occurrence of the M9 earthquake.

Seismic velocity decreases, that correspond to travel time increases, are often discussed with reduction of the rigidity of the shallow structure that are damaged by strong motions. The travel time increases observed in the present study may be explained by this mechanism. In such cases, the stations characterized by low S-wave velocity at shallow parts are expected to observe large travel time differences. But, the spatial distribution of shallow S-wave velocity measured in boreholes is not well correlated with the distributions of travel time differences. This inconsistency may suggest that some deeper regions decrease the S-wave velocity.

Keywords: Temporal seismic velocity change, The 2011 off the Pacific Coast of Tohoku Earthquake, crustal structure, repeating earthquake