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Quasi-realtime analysis of seismic ACROSS signal transmitted from Morimachi

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We have analyzed temporal variation of transfer functions using seismic ACROSS signal transmitted from Morimachi station. Morimachi station locates just above the assumed rupture region of Tokai earthquake, and is suitable for monitoring the temporal variation of seismic velocity or reflection coefficient at the plate boundary. We found that the temporal variation of travel time of transfer function is, (1) larger amplitude in later phases compared to the previous ones, (2) well correlated with the precipitation near the transmitted or observed stations, and (3) abrupt change coincident with the strong ground shaking (seismic intensity is greater than 3) by the large earthquake (e.g. 2009/08/11 Suruga Bay earthquake). Seismic experiment using controlled source conducted in this region in revealed the strong reflection phase bouncing at the plate boundary between subducting Philippine Sea plate and overriding Eurasian plate (Iidaka et al., 2003). Frictional strength can be monitored by transmitting coefficient of acoustic waves (Nagata et al., 2008). This suggests the possibility for detecting the change of coupling coefficient before a large earthquake by monitoring reflection coefficient at the plate boundary. For the quick detection of such precursor change, auto-detecting procedure is necessary.

Using telemetered seismograms such as Hi-net, auto-processing program for analyzing temporal variation of travel time and energy ratio for distinct phases in transfer function has been developed. Low frequency type FM signal (carrier frequency: 5.51Hz; bandwidth: 2Hz) from Morimachi seismic ACROSS transmitter is used. The temporal variation is calculated from the reference time (in this case, first term). Nine Hi-net stations with the epicentral distance less than 40km and small noise level are used. Two or three prominent phases, whose travel time is later than direct S wave arrival, are selected and window duration for each phase is set to 1 second. The stacking length for each station is selected considering SN ratio. Since December, last year, we have run auto-processing program once a day and uploaded the figure of the temporal variation for the nine Hi-net seismic stations. The analyzing procedure is almost the same as the previous one. Continuous waveform is segmented into every 400 s. The travel time delay from a reference trace was calculated by means of the phase delay in frequency domain. The variance of noise channels for every four hours is stored to speed-up the weighted stacking process.

S-wave travel time for the reflection phase (SxS) at the upper boundary of the subducted oceanic crust of the Philippine Sea plate is calculated using high-resolution seismic tomography results obtained by the data from the dense linear array of the temporary seismic stations (Kato et al., 2010). We can detect the reflection phase for two stations in Hrt and Htt components: N.TT2H (distance: 21km) and N.TOEH (distance: 34km). These two phases are included in the auto-processing data. The reflection points locate just in the long-term slow slip (2000 ~ 2005) region and upper extension of the low-frequency earthquake zone along the subducting Philippine Sea plate. During the analyzed period, high activity of low-frequency earthquake occurred in November 2010. The relation between low-frequency earthquake activity and temporal variation of travel time and seismic energy ratio is not clear in this activity. Long-term slow slip event in this region will be expected to occur next 5 to 10 years. This even will give us the chance to verify the temporal variation corresponds to the slow slip at the plate boundary.

Acknowledgement
We used Hi-net seismograms in this analysis.

Keywords: ACROSS, temporal variation, reflection phase from plate boundary