detectability of temporal variation in seismic velocity around an earthquake source fault, using a seismic interferometry

*Miyuu Uemura[1], Hironori Kawakata[1], Shiro Hirano[1]

1.Department of Physical Science College of Science and Engineering Ritsumeikan University

On the basis of experimental studies (e.g. Yoshimitsu et al., 2009 and Lockner et al., 1977), it has been expected that seismic velocity decreases prior to earthquakes. To detect temporal variation in the velocity, stable monitoring of the velocity for a long time is required. Seismic interferometry using micro-tremors is one of the potential techniques which enable us to detect such variation if seismic stations are densely located. With a seismic interferometry technique, some researchers have tried to detect the velocity variation before and after an earthquake using seismograms of a station pair whose interval was longer than ~20 km, but remarkable variation preceding target earthquakes have never been reported. If we can use seismograms of a station pair with a shorter interval, we might be able to detect the variation. In this study, we chose the 2014 Nagano Kamishiro Fault Earthquake (Mj 6.7) as a target, whose source fault (Kamishiro fault) is located between two NIED Hi-net seismic stations (N.HBAH and N.HKKH). The interval of these stations is about 7.3km.
At first, we investigated how frequency contents of micro-tremors depend on time, such as day or night, weekday or weekend. After checking, we confirmed that seismograms on Saturday night are the best for our analysis. After applying one-bit normalization, we divided continuous seismograms into one-minute seismograms. Then, we calculated the cross-correlation function of each one-minute seismograms pair of two stations, and stacked all cross-correlation functions for a period of six hours, on Saturday night. Finally, we obtained stacked cross-correlation from 2011 to 2015.
We found obvious and pulse-like phases around -2s, from which we estimate apparent seismic velocity ~3.5km/s. Further, we found the increase and decrease in velocity during two years before the earthquake. However, the variation of average velocity is as large as 10%, and we cannot find any corresponding phase in positive time. Moreover, we could not find any coseismic variation. It is suggested that distribution of the micro-tremor sources is anisotropic and asymmetric in space and unstable in time even though we focused only on November and December for every year. Consequently, if we try to detect the structure variation around a seismic source fault, we should confirm that the spatio-temporal distribution of the micro-tremors source does not change.
Acknowledgments: We used continuous waveform records of NIED high-sensitivity seismograph network in Japan (Hi-net).

Keywords: seismic interferometry, micro-tremor

