Application of Adjoint Waveform Inversion to Hi-net Data in Central Japan Island

*Kota Mukumoto[1], Takeshi Tsuji[1]

1. Kyushu University

Since 2000, seismic velocity structures have been resolved by waveform-based tomography technique due to growth of computational resource. Waveform inversion problem can be solved by using adjoint technique. Adjoint technique takes advantage of full numerical simulation and finite frequency sensitivity kernels (banana-doughnut sensitivity kernels). These advantages can give more accurate estimation and fine structures in crustal and global seismic tomography model (Tape et al., 2009, Zhu et al., 2012).

In Japan, ray tomographic method mainly has been used for imaging crustal structures as P-wave velocity and S-wave velocity model (Matsubara et al., 2019). Seismic interferometry by using seismic ambient noise also has been implemented for S-wave velocity structures (Nimiya et al., 2020, Nishida et al., 2008). More recently, adjoint method was used to estimate velocity model in Kanto region and found more heterogeneous structures compared to models which was estimated by using ray-based technique (Miyoshi et al., 2016). In this research, adjoint tomography was employed to estimate S-wave velocity model in central Japan. In central Japan, existing velocity models were estimated by inverting either surface or first arrival of body wave. On the other hand, our velocity model was estimated by jointly inverting both surface and body waveforms.

We used 84 earthquakes and 35,065 waveforms data that recorded by 358 Hi-net stations. Because the signals with high signal to noise ratio were required, this study used earthquakes that have magnitude over than 4. Here, we tried to fit time-frequency phase misfit between observed and synthetic seismograms with period band of 30~5 second. Surface wave is dominant component in our data, therefore, synthetic data was obtained by spectral element method which can accurately estimate the effects of free surface topography. We found that the final model is similar to S-wave velocity model estimated by seismic interferometry (Nishida et al., 2008). Our results show velocity anomalies related with volcanos, Median Tectonic line and Niigata-Kobe Tectonic line.