Decade-long temporal variation of near-surface seismic velocity and S wave azimuthal anisotropy in Southern Hokkaido

*Li-Wei Chen[1], Taka'aki Taira[1], Hiroe Miyake[2]

1. University of California, Berkeley, 2. The University of Tokyo

Temporal variations on elastic properties of the crustal structure provide a unique constraint on scoping its behaviors such as change of dynamic stress after earthquakes, seasonality from the hydrological responses, healing process of fractures, etc, which would lead us to better understand the underlying mechanisms and could provide information for site classification. In the past decade, noise-based monitoring has become a very well-developed and efficient procedure for probing the S-wave changes. Here we propose an earthquake-based method (Chen et al., 2017, EPSL) through interferometry of earthquake coda waves, which will allow us to extract the near-surface temporal variations on not only S-wave but additionally P-wave and S-wave azimuthal anisotropy (strength of anisotropy and the polarization direction of the fast S wave). We mainly focus on the southern Hokkaido area where experienced strong ground motion from the 2003 Mw 8.3 Tokachi-Oki and the 2018 Mw 6.7 Hokkaido Eastern Iburi earthquakes. We analyzed the data from all available KiK-net seismic waveforms (> 700 events) in a frequency band of 1-15 Hz around the southern Hokkaido area, following the recipe from Chen et al. (2017). We then evaluate the temporal robustness of the reconstructed Cross-correlation functions (CCFs) in each time segment to ensure the reliability of observation. Our preliminary result shows that most of the stations have sudden reductions of S- and P-wave (5.0-8.5% and 1-3% at IBUH03) after the two events and then recover by different rates at each site; changes in the fast S-wave polarization direction and strength of anisotropy (~60 degrees and -1% at IBUH03) are also observable during the coseismic periods. We suggest that the stress changes after the events created water-saturated cracks which are responsible for the reductions of seismic velocities and the changes of seismic azimuthal anisotropy. Furthermore, seasonality is notable from some of the observations which imply the changes of elastic properties might also be affected by the hydrological responses. We will compare the result with the groundwater level, precipitation, snow thickness, and atmospheric pressure to understand the possible mechanism of the temporal variation.

