Passive monitoring of groundwater using elastic waves

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It is important to monitor the state of groundwater for early prediction of the slope failures. Elastic waves can be a powerful tool to detect a small change in elastic wave speed or attenuation, because they reflect integral values along the propagating paths (Yoshimitsu et al., 2009). Some studies so far applied seismic interferometry in the landslide areas, detecting a decrease in elastic wave speed for coda parts prior to the catastrophic landslide (Mainsant et al., 2012). However, because they assume that change in elastic wave speed is uniform, where such changes took place remains unknown.

In order to estimate the detailed structures in the shallow (~ a few tens of metes) part and their temporal changes, we placed a seismometer at the toe side of a landslide area. We selected the landslide located in Shiga Prefecture, which is shown in the landslide distribution map by NIED. Springs are observed inside the landslide area, suggesting the ground water level is very shallow.

Seismic waveforms are recorded at the sampling frequency of 200 Hz. Travel times of the phases related to the shallow structure are considered to be short, which implies that we need larger sampling frequency. Therefore, we interpolated the raw data using cubic spline functions to obtain the waveform data every 1 ms. Then, we calculated the auto-correlation functions using 1 day records, followed by whitening process. As a result, we detected coherent phases with the travel time less than 1 s. In the next step, we discuss the cause and the temporal changes of these phases together with the changes of noise sources.

