Research report for the ERI visit from Mar 20 to April 18, 2018

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The visit to ERI is planned to investigate the possible topographic effect on short-period surface wave measurements from ambient noise correlations, which could be important for interpreting crustal seismic imaging and temporal monitoring measurements. After discussion with Maeda-san and Nishida-san when I arrived, we decided to focus on the effect of topography and dipping layer on the scattering properties of retrieved coda waves through high frequency waveform simulation experiments (up to 10 Hz), for which I have landslide monitoring results of Taiwan to compare. In the following, I summarized the progress of this simulation project during the stay:

- At first, I spent some time to set up and tuned environmental parameters for OpenSWPC codes (Maeda et al., 2017) on the server. I learnt in and out of the codes through simple model settings (e.g. layered 1-D model. Figure 1), and gradually added up the complexity of medium such as topography, dipping layers, and random heterogeneity (Figure 2). Maeda-san has been very helpful for simulation setup and all the details.
- During the stay, Nishida-san and I discussed several times on how to design the simulation experiments and what the important issues to look at. Coda wave interferometry has been a field getting more and more attention because of its wide applicability to different monitoring targets. However, to determine the spatial location of the seismic velocity change is still not an easy task to tackle. Many numerical studies have been performed for this issue (Orbemann et al., 2013, 2016; Colombi et al., 2014). We aim to understand the scattering properties (e.g. energy partition between surface and body waves) and verify the frequency-dependent sensitivity of coda waves by using high frequency simulation (Figure 2).
- I also had a chance to discuss with Nishida-san and his student for their volcano monitoring project, a good counterpart to our landslide project. The exchange of experiences and information from both sides is quite beneficial.
- In the experiments, we mainly focus on the autocorrelation functions as they usually contain coherent coda waves to higher frequency. We then conduct two simulations with and without the seismic velocity change at a designated depth range, and measure the shifting times of coda waves between two simulations. The

preliminary results with 1-D layered velocity model do show that the frequency-dependent measurements can be used to invert for the depth information of the velocity change (Figure 1). The results with more realistic models await for exploring (Figure 2).

In the next, we will continue finishing the measurements with more realistic models and compare with the actual data from the landslide monitoring project in Taiwan. The depth information derived from coda wave interferometry will be particularly critical for accessing the possible sliding interface of deep-seated landslides.

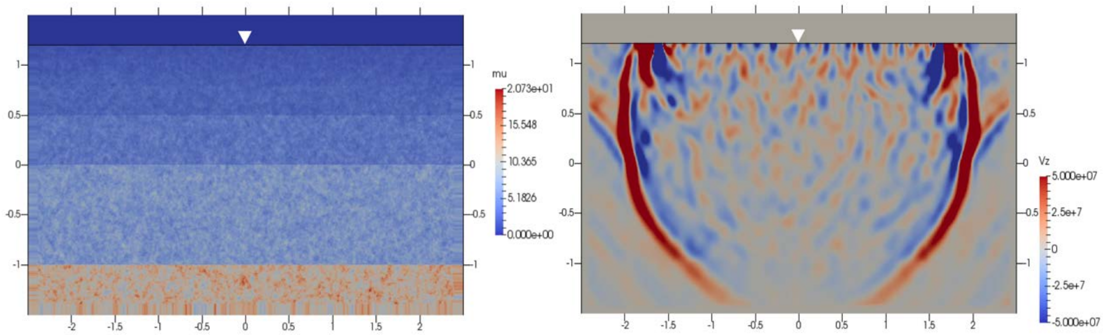

Figure 1 High frequency scattering wave simulation with simple 1-D layered velocity model. (left) 1-D layered velocity model; (right) a snapshot of scattering wave field simulated.

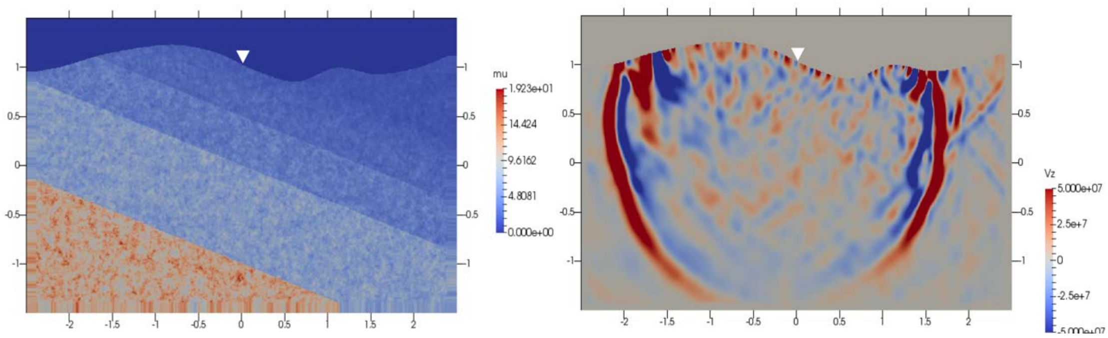

Figure 2 High frequency scattering wave simulation with realistic velocity model. (left) dipping layer model with topography; (right) a snapshot of scattering wave field simulated.

References

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