Summary for ERL visit

Wave propagation between F-net and NECESSArray retrieved from Ambient Noise

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The potential to extract wavefields in various scales from ambient noise is of interest for imaging the Earth. During the visit to ERI, I apply crosscorrelation techniques to ambient noise to retrieve propagating waves between F-net in Japan and NECESSArray in China. Both F-net and NECESSArray are continuous-recording broadband-seismometer networks and consist of about 80 and 120 receivers, respectively (Figure 1). NECESSArray was deployed in the northeast China during September 2009 and August 2011. The receiver spacing is about 80 km, and the size of the entire array is roughly 1500 km (east-west) by 650 km (north-south). Based on the shape of the arrays, with F-net and NECESSArray, I can create a large network that surrounds the Sea of Japan and extract wavefields traveling through the sea by applying seismic interferometry to ambient noise.

In the period of 20–67 s, the retrieved wavefields propagate about 4 km/s and 8 km/s, which corresponds to Rayleigh and P wave velocities, respectively (Figure 2). Because of the data quality or excitation, the crosscorrelation of vertical-vertical and vertical-radial components have better signal-to-noise ratio than other combinations. Here, I compute the power-normalized crosscorrelation to focus on the phase of traveling waves. Since I extract the wave propagation without spatially stacking of correlation functions, I can use these waves to image the velocity structure at the Sea of Japan.

Another potential of the large network is to extract global reflections from ambient noise because the sensors are all broadband (Figure 3). The ambient noise contains faint reflected waves as well as surface waves that propagate around the Earth. With averaging over all correlation functions according to the receiver offset, I can reconstruct these global waves. The waves may be related to coda waves of large earthquakes (because, for example, *ScS* waves are reconstructed in the vertical-vertical pair), but potentially, we can increase our knowledge of the deep Earth by using these waves.

Acknowledgments
I am grateful to NIED and the people involved in the NECESSArray project for providing the data and to Dr. Hitoshi Kawakatsu for organizing the project as well as managing the data available to me. I deeply thank people at ERI, especially Dr. Kiwamu Nishida as my host, for giving me the great opportunity to visit ERI. The stay was such an exciting time for me, and I enjoyed discussing many aspects of research, professions, and life. I believe that this visit is the start of future collaboration with researchers at ERI.

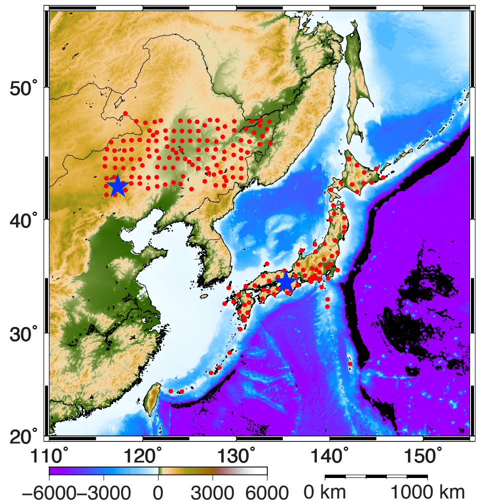

Figure 1. Geometry of seismometers in F-net and NECESSArray (red dots). The blue stars highlight two stations that are used in Figure 2.

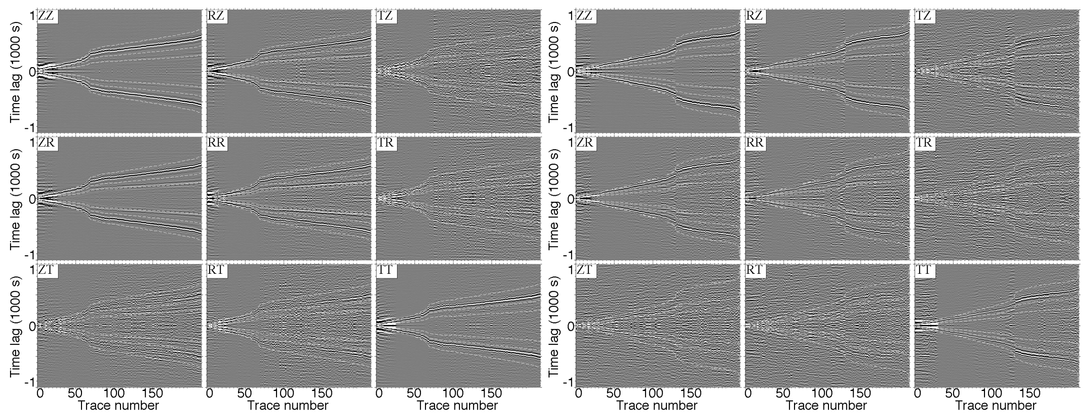

Figure 2. Single-station correlation functions in which the reference receivers are at the blue stars in Figure 1. (Left) Correlation functions with the station highlighted by the blue star in Japan. (Right) Correlation functions with the station at the blue star in China. Traces are aligned with the distance from the reference receivers. The periods of the waveforms are 20-67 s and the white lines indicate travel times with 3, 5, and 8 km/s apparent velocities.

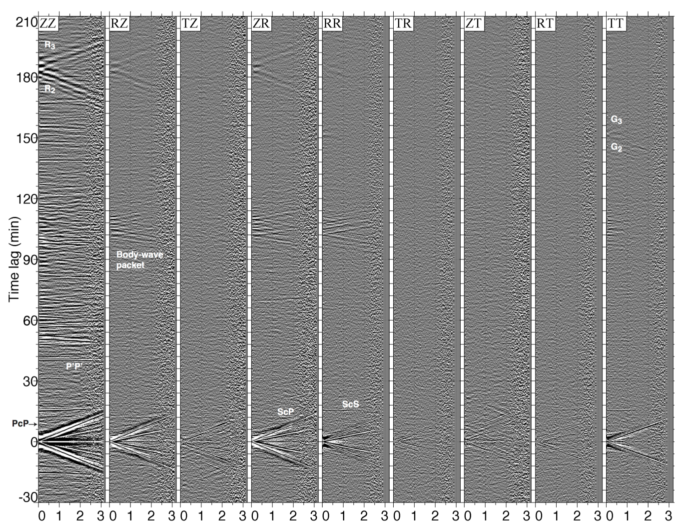

Figure 3. Global wave propagation retrieved by the binned stacking of all correlation functions. Global reflections (e.g., *PcP*, *ScS*) and surface waves travel along the Earth (e.g., R_2, G_2) are labeled.