Noise correlation analysis of S-net records

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We applied noise correlation analysis to continuous records of Seafloor Observation Network for Earthquakes and Tsunamis along the Japan Trench (S-net) to estimate crustal structure beneath the offshore region of northeast Japan. We used three-component records from 2017 to 2018 provided by National Research Institute for Earth Science and Disaster Resilience (NIED) and converted wavefoms from XYZ to UNE components. We analyzed accelerometer records because signal-to-noise ratio of accelerometer is higher than that of velocity sensor in the periods longer than a few seconds. The noise cross-correlation functions show periodic pulses every 60 seconds and a single pulse at zero lag. The periodic pulses and zero lag pulse can be attributed to coherent periodic noise and random noise, respectively, due to electric perturbation in instruments. The periodic noise depends on station, component, and time period. The random noise appears to be common only within stations along the same cable lines. We removed the periodic noise by computing cross-correlation functions of the difference waveforms between the records of one day and the records of one day before. The cable-dependent random noise was removed by fitting an empirical function to cross-correlation functions in the frequency domain. The noise reduction and staking within station separation bins enable us to extract Rayleigh and Love waves up to about 30 seconds. In the shorter period than 10 seconds, we found multiple modes of Rayleigh waves with group velocities of about 1.5 km/s and 0.3 km/s, which may have energy in ocean layer and sediment. In addition, we found Rayleigh waves propagating from coastal stations to deep offshore stations at the period around 4 seconds, whereas Rayleigh waves mainly propagate from deep offshore stations to coastal stations at the period around 8 seconds. The extracted surface waves may be useful to estimate crustal structure beneath the offshore region along the Japan trench.

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Keywords: S-net, Seismic interferometry, Ambient noise, Noise correlation, Surface wave, Japan trench

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