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An application of seismic interferometry for DONET data

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From 0.05 to 0.2 Hz, background surface waves, known as microseisms, are dominant, and they mask seismic signals of earthquakes. The microseisms are excited by oceanic-swell activities at random. Recently using their random excitation properties, researchers have developed ambient noise tomography (e.g. Shapiro et al., 2005). The group velocity anomaly of Rayleigh wave is shown by cross-correlation functions between pairs of stations. The measurements by modern dense networks of broadband seismometers reveal fine tomographic images. There is an application of seismic interferometry for data of ocean bottom seismometers [e.g. Harmon et al, 2007, Yao at al., 2011], but investigations of their propagations are still ongoing in particular in high frequency (>0.1 Hz). In this study, we will clarify properties of wave propagation using a dense network on the sea floor. We analyzed vertical components of broad band seismometers (Guralp CMG3T) and pressure (absolute pressure gauge of Paroscientific inc.) from 2011/7/19-7/29 at 18 stations of Dense Ocean floor Network System for Earthquakes and Tsunamis (DONET), which consists of 5 sub arrays. We divided the records into segments of 409.6 s, and we discarded transients such as earthquakes and local noises. We calculated their normalized cross-spectra between all pair of stations. Corresponding cross-correlation functions (CCFs) of vertical components show clear Rayleigh wave propagation below 0.1 Hz. Because observed Rayleigh waves have sensitivity to accretionary wedge from 0.1 to 0.5 Hz, their waveforms are distorted with long coda parts. Above 0.5 Hz, Scholte waves, which are boundary waves between a fluid layer and a solid layer [e.g. Yao et al., 2011], become dominant. Their phase and group velocity is around 1.5 km/s. CCFs of pressure gauge also show similar features except for those at stations above thick accretionary wedge. At the stations from 0.2 to 0.5 Hz, fundamental Rayleigh waves are dominant in vertical components, whereas first overtones are dominant in pressure records. We estimated dispersion curves from CCFs, based on Aki's SPAC method. In regions of thick accretionary wedge, fundamental Rayleigh waves are not clear from 0.2 to 0.5 Hz in vertical components. Their phase velocity is about 500 m/s, whereas phase velocity in other regions is about 1000 m/s. Observed frequency is consistent with results of CCFs. In future studies, we will invert the phase velocity into local 1-D structure beneath each sub-array.

Keywords: seismic interferometry, surface wave