Seismic imaging with teleseismic waves and ambient noises observed by a submarine cable in the Nankai subduction zone with distributed acoustic sensing

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Abstract

Using ambient noise records obtained by distributed acoustic sensing (DAS) techniques, fine-scaled seismic structures along a cable, particularly for S-wave velocity (Vs), have been estimated by dividing the cable to multiple segments. However, because wavelengths of surface waves at low frequencies often exceed lengths of the cable segments, it is difficult to measure the phase velocity of surface waves within the segments. In this study, we measured the phase velocity of surface waves at frequencies of 0.02–0.5 Hz, and examined the travel time tomography along the submarine cable. To measure the phase velocity at frequencies of 0.1–0.5 Hz, we used the method, introduced by Liu (2020), using ambient noise correlation. For low frequencies (0.02–0.1 Hz), we measured the differential travel times of surface waves from teleseismic events between two channels along the cable. This technique is equivalent to the one often used in global seismology. Moreover, we tried to detect P-to-s (Ps) converted waves by cross-correlating P waves in the vertical component at a land station with Ps waves emerging in the horizontal component at every channel along the cable. We applied a bandpass filter of 1–3 Hz to the cross-correlation functions. Using the velocity model from the surface wave analysis, we converted the time-domain cross-correlation functions to the depth-domain ones. As a result, we obtained the positive amplitude corresponding to the top of the oceanic crust within the subducting Philippine Sea Plate.