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Temporal variation of the Rayleigh admittance: Implication for S-wave velocity changes in the toe of the Nankai accretionary prism

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A cabled seafloor network with 20 stations (DONET: Dense Oceanfloor Network System for Earthquake and Tsunamis) has been constructed on the accretionary prism at the Nankai subduction zone of Japan between March 2010 and August 2011, which means that the observation period became more than 4 years. Each station contains broadband seismometers and absolute and differential pressure gauges. In this study, we estimated the Rayleigh admittance at the seafloor for each station, i.e. an amplitude transfer function from pressure to displacement in the frequency band of microseisms, particularly for the fundamental Rayleigh mode of 0.1–0.2 Hz. The pattern of the transfer function depends on the S-wave velocity structure at shallow depths beneath stations (Ruan et al., 2014, JGR). Therefore, plotting the Rayleigh admittance as functions of time and frequency, we investigated temporal variations of S-wave velocity within the accretionary prism.
We calculated the displacement seismogram by removing the instrument response from the velocity seismogram for each station. The pressure record observed at the differential pressure gauge was used in this study because of a high resolution of the pressure observation. In the frequency domain, we smoothed the two kinds of spectra (displacement and pressure) with ± 2 neighboring samples, and estimated the amplitude transfer function of displacement/pressure. Here, we used the ambient noise of the two records. To display their temporal variations, we plot the averaged transfer function with intervals of 7 days.
As a result, we found a long-term temporal variation of the Rayleigh admittance at two stations. These stations are located at the southern part of the array and near the trench, where the activities of very-low frequency earthquakes (VLFEs) within the accretionary prism on 2004, 2009, and 2011 have been previously reported. The admittance at a frequency of 0.1 Hz has gradually decreased during the observation period, which implies that S-wave velocity within the accretionary prism tended to be high. This change may indicate fluid emissions from marine sediments due to the horizontal compaction.