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Relation between S/N ratio of cross-correlation function and capability of group velocity estimation with seismic noise

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We have applied seismic interferometry to ambient noise data recorded at Hi-net stations around Chukyo area, central Japan, to estimate velocity structure of the sedimentary basin (Hayashida et al., 2012). The estimated group velocities of surface wave from the stacked cross-correlation functions (CCFs) show variations for each station pair, indicating subsurface velocity structure beneath the area and the estimated group velocities agree with the predicted ones from existing velocity structure models for many station-pairs. However, there is some difficulty in estimating group velocities for some station-pairs and it is important to evaluate its accuracies. In this study we examine the decays of signal and noise amplitudes of CCFs and the growth of signal-to-noise ratio (S/N) of the CCFs with increasing numbers of stacking. We also evaluated the relationships between the shifting patterns and interstation distances (15.2-87.7 km) and azimuths (almost all directions). The results show that the noise tends to decrease with the square root of the stacking number. On the other hand, the S/N ratios tend to increase in the first four months and remain mostly levels after that. For station pairs whose S/N ratios exceed 30, group velocities of surface waves are easily estimated. We also found that the S/N ratios sometimes exceed 100 for station pairs in an almost NNW-SSE direction. Our result indicates that group velocity of surface waves should be estimated considering the S/N patterns in seismic interferometry.

Keywords: seismic interferometry, ambient noise, surface wave, velocity structure model, Chukyo area