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Group velocity measurement of Rayleigh and Love waves in northeastern Japan on the basis of the cross-correlation analysis of microseisms

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If the generation of microseisms is randomly uniform in space and time, cross-correlation function of microseisms observed at a pair of stations for very long time windows well represents the propagation characteristics in the heterogeneous earth medium. Applying this method to microseisms registered by three-component seismometers, we can estimate the group velocity of Rayleigh and Love waves. Vertical (V), north-south (NS) and east-west (EW) component velocity records of microseisms registered at Hi-net stations (NIED) during 36 hours (0h Apr. 16 - 12h Apr. 17, 2005) are analyzed. NS and EW components are transformed into radial (R) and transverse (T) components for each pair of stations. Applying fourth-order band-pass filters (4-8s, 8-16s) to the records registered at two stations, calculating cross-correlation functions of one-bit signal pair for every time window of 360s in length, we take the average of nine cross-correlation functions for the whole length data. Clear wavelets are well recognized in the averaged cross-correlation function of the V×V component. The main phase of the V×V component is delayed by 90 degrees from that of the V×R component, which shows a retrograde particle orbit of Rayleigh wave. We also recognize clear wavelets in the cross-correlation function of the T×T component, which represents Love waves. The peak amplitude of the T×V and T×R components are smaller than that of the T×T component. We further estimate the group velocity from the envelope peak of the averaged cross-correlation function at each band period. We find some remarkable velocity structure in northeastern Japan: group velocity is high (> 3km/s) around the Kitakami Mountains and the Abukuma Mountains, and extremely low (~ 1km/s for Rayleigh waves in 4-8s band) in the Kanto Plain. These spatial changes in the group velocity reflect the shallow geological structure.