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Estimation of velocity discontinuities in sediment of Yokohama for the 2011 Off the Pacific Coast of Tohoku earthquake

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Acceleration seismograms were recorded at 62 stations in the Yokohama dense strong motion array (the Yokohama array) for the 2011 Off the Pacific Coast of Tohoku earthquake (Mw=9.0). We conducted the estimation of velocity discontinuities in a sedimentary layer of the Yokohama region by applying nonstationary ray decomposition method (NRDM) to the seismograms obtained in Yokohama. According to Japan Meteorological Agency, size of the fault was estimated about 450km long and 200km width. Therefore, it is difficult to apply the ordinary NRDM to the records obtained for this earthquake because of the hard identification of constitutive phases in S-wave. Thus, in this study, we conducted the NRDM in a statistical way. We analyzed the data following procedures.

We divided the S-wave data into a set of data window with a length of 20 s. After converting the acceleration data to velocity by numerical integration, we estimated transverse component wave which was treated this as SH-wave. Using this SH-wave, we calculated instantaneous power associated with rays in a homogeneous half space. The instantaneous power is represented as a function of lapse-time and the travel time towards depth-direction; depth-time in the (t, tau) space. We estimated local instantaneous power as a function of depth-time by integrating the instantaneous power along lapse-time. Then, we normalized the local instantaneous power using the global instantaneous power which was calculated by integration in the whole (t, tau) space. We applied the procedures to each data window, and then estimated the average local instantaneous power as a function of depth-time. We could obtain the velocity boundaries by using the local maxima of the power above.

Though we usually had to analyze numerous strong motion data to estimate the velocity discontinuities in a basement ? sedimentary layer system by using the ordinary NRDM, we think that we can estimate it using only a strong-motion data recorded at each site for this earthquake. It will make the ordinary NRDM much convenient.

Keywords: nonstationary ray decomposition, The 2011 off the Pacific Coast of Tohoku earthquake, Yokohama array, sedimentary layer, instantaneous power