Estimation of Love wave phase velocity based on array analysis in the northern Tokyo bay area : Numerical experiments using synthetic seismograms

*Kaori Shimazu[1], Kazuo Yoshimoto[1], Shunsuke Takemura[2]

1. Graduate School of Nanobioscience, Yokohama City University, 2. National Research Institute for Earth Science and Disaster Resilience

In the Kanto sedimentary basin, long-period ground motions have been frequently observed during shallow moderate-to-large earthquakes [e.g. Yoshimoto and Takemura (2014)]. Strong long-period ground motions, which are caused by surface waves, complicatedly propagate within the Kanto basin due to 3D structures of low-velocity sediments and bedrock topography [e.g., Furumura and Hayakawa (2007)]. For the precise prediction of long-period ground motions, we should investigate propagation characteristics of surface waves and subsurface structure within the Kanto basin. Array analysis using dense seismic stations in the Kanto basin may be useful to capture propagation characteristics of surface waves and structural properties. In this study, as a basic study for investigating a seismic velocity structure of the Kanto sedimentary basin, we applied a beamforming technique to the seismograms synthesized based on FDM simulations.

We selected shallow moderate earthquakes for our beamforming analysis, e.g. the northern Ibaraki prefecture earthquake on March 19, 2011 (Mw 5.8), the northern Tochigi prefecture earthquake on February 25, 2013 (Mw 5.8), and the northern Nagano prefecture earthquake on November 22, 2014 (Mw 6.3). We synthesized velocity seismograms based on the FDM simulations using a velocity structural model SBVSM [Masuda *et al.*(2014); Takemura *et al.* (2015)]. Virtual seismic stations were distributed at an interval of 750 m in the range of 35.5˚N to 35.9˚N and 139.4˚E to 139.9˚E. Our FDM simulations can evaluate ground motions for periods longer than 4 s. In our array analysis using a three-component beamforming [Riahi *et al.*(2013)], the size of the small local array was adjusted according to the analyzed period of Love waves. The analysis was conducted on the six periods: 5.9, 6.4, 7.3, 8.5, 10.2 and 12.8 s. We analyzed the seismograms for time window of 51.2 s, including the maximum amplitude of energy envelope for horizontal components.

By comparing the estimated phase velocities by our array analysis with theoretical ones from local 1D structure of SBVSM, we confirmed that the phase velocities of Love waves propagating in the large sedimentary basin are successfully obtained. Observed dispersion curves show clear normal dispersions. At the period of 5.9 s, the phase velocity was estimated stably for seismograms of all earthquakes. This period corresponds to the dominant period of long-period ground motions within the Kanto sedimentary basin [e.g. Yoshimoto and Takemura (2014)]. We also found that the phase velocity tends to be estimated stably in large PGV areas of long-period ground motions. These results imply that the propagation of surface waves may characterize the magnitude of long-period ground motions. The other results in detail will be exhibited in our presentation.

Acknowledgement

FDM simulations of seismic wave propagation were conducted on the Earth Simulator of the Japan Agency for Marine-Earth Science and Technology. F-net MT solutions were provided by the National Research Institute for Earth Science and Disaster Resilience.

Keywords: Love wave, Kanto sedimentary basin, array analysis, phase velocity, FDM simulation

