Estimation of shallow 3D S-wave velocity structure by applying surface-wave tomography using MeSO-net

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The estimation of S-wave velocity structure is essential to predict damage caused by earthquakes. Especially in the Tokyo metropolitan area, the earthquake hazard assessment has a significant meaning. Since the Tokyo metropolitan area located in the large-scale thick sedimentary Kanto basin and the population is centralized, the large damage due to earthquake is expected. However, it is difficult to conduct large-scale seismic exploration for the 3D velocity model construction due to heavy traffic and limited space in this area. Thus, constructing high-resolution 3D S-wave velocity structures of the Kanto basin is a challenging task. For this purpose, we performed surface-wave tomography on the Metropolitan Seismic Observation network (MeSO-net), which is deployed centered on Tokyo. It is suit for constructing 3D S-wave velocity structures in urban area since the surface wave can be extracted without active sources by applying seismic interferometry. In this study, we first computed cross-correlation of ambient noise to extract surface waves propagating between pair of stations. Then, we estimated surface-wave dispersion curves by applying a frequency domain method. Calculation in frequency domain simplifies estimation of dispersion curves. In this study, we developed iterative phase-velocity picking algorithm to estimate stable dispersion curves. We then estimated the 3D S-wave velocity structure by applying a direct surface-wave tomography method. This surface-wave tomography method can estimate S-wave velocity directly with 3D sensitivity kernels updated iteratively. Our result shows the S-wave velocity structure from surface to 2.5 km depth. The results show very low velocity which can reflect the thick sedimentary basin throughout the entire area. In the shallow part, we observed the low velocity anomaly corresponding to the soft sediments in low elevation area. In the deeper part, we observed the low velocity anomaly which is consistent with a trend of the pre-Neogene basement rock distribution. Our velocity model can also contribute to disaster management and assessment.

