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Simulation of long-period ground motion using 3D structure model of the Kanto Basin

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Introduction

The development of a more realistic seismic structure model of the Kanto Basin is required for the precise evaluation of the long-period ground motions in the Tokyo metropolitan area. In this study, on the basis of the three-dimensional (3D) finite difference simulation, we validated the effectiveness of the currently developed seismic structure models of the Kanto Basin for long-period ground motions using observed seismic waveforms of shallow moderate earthquakes.

3D finite difference simulation of long-period ground motions

We conducted 3D finite difference simulation of long-period ground motions during two shallow moderate earthquakes: the northern Tochigi earthquake on February 25, 2013 (Mw 5.8) and the Mid. Niigata earthquake on October 27, 2004 (Mw 5.8). Both earthquakes were occurred on the north of the Kanto Basin. The 3D structure model of finite difference simulations covered a zone of 201.6 $\times$ 127.5 $\times$ 60 km^3, which was discretized by grid intervals of 0.15 km in horizontal directions and 0.075 in vertical direction. A staggered-grid finite difference method with fourth-order and second-order in space and time, respectively, was used in our simulations. We conducted simulations using three structure models: JIVSM (Koketsu et al., 2008), SBVSM (Masuda et al., 2014, SSJ; Takemura et al., 2015) and SBVSM2, which was constructed by incorporating local S-wave velocity structures around the northern edge of the Kanto Basin estimated by waveform modeling (Takemura et al., 2014, SSJ). To construct a subsurface structure beneath the sediment of the Kanto Basin, we adopted JIVSM structure for all structure models.

Simulation result

It was verified that the observed long-period ground motions in the northern area of the Kanto Basin were practically well simulated by SBVSM, compared to JIVSM. The reproducibility of observed long-period ground motions was further improved when SBVSM2 was used for 3D finite difference simulations. This result indicates that a method proposed by Takemura et al. (2014) is practically useful for the improvement of the sedimentary structure model of long-period ground motions. This improvement may help us to better understand the characteristics of the excitation and propagations of surface waves at the edge of sedimentary basin. In addition to these findings, it was realized that the reproducibility of observed long-period ground motions by three structure models was not high enough in the western area of the Kanto Basin, where the past geophysical investigations are insufficient to construct a precise basin structure model. In our poster presentation, we will summarize the characteristics of SBVSM and SBVSM2 in more detail and discuss the relation between the characteristics of surface waves and sedimentary structure around the basin edge.

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Keywords: long-period ground motion, Kanto Basin, simulation of seismic ground motion