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Approach to broaden the period-range of long-period ground motion evaluation based on theoretical method

MAEDA, Takahiro[1*] ; IWAKI, Asako[1] ; MORIKAWA, Nobuyuki[1] ; IMAI, Ryuta[2] ; AOI, Shin[1] ; FUJIWARA, Hiroyuki[1]

[1]NIED, [2]Mizuho Information & Research Institute, Inc.

We have simulated long-period ground motions generated by megathrust earthquakes using various source models and 3D velocity structure model by the 3D finite difference method. To consider the influence of simulated ground motions on buildings, the analyzing period range of our simulation (3 - 20 seconds) was too long for most buildings. In this study, we examine the effects of more detailed velocity structure and seismic source models to broaden the analyzing period range.

As for the structure model, we used a newly constructing subsurface structure model (Senna et al., 2013, JDR) for the southern Kanto area. This model includes not only a deeper structure model but shallower layers than the engineering bed rock. By constructing deep and shallow structure model simultaneously, it is expected to improve ground motion simulation for period from 0.5 to 2 seconds. We assume two velocity structure models; one has shallow structure (Vs=250m/s) as a surficial layer (SD model) and other includes only the deep structure model (surficial layer has Vs of 500m/s) (D model). By comparing the simulated results assuming a point source, peak amplitude and duration for SD model are larger than those of D model. Simulated Fourier spectra indicated that the difference of two models is dominant at period shorter than about 2 second.

As for the source model, we used a characterized source model and uniform rupture velocity was assumed. In this study, we introduce a multi-scale heterogeneity (Sekiguchi and Yoshimi, 2006) to rupture propagation. We construct 274 source models for the Sagami Trough megathrust earthquake assuming different source area, hypocenter and asperity configuration and put the rupture heterogeneity on these source models. Influence of the rupture heterogeneity seems larger for shorter period range and is vary with hypocenter and asperity configuration.

To broaden a valid period range of long-period ground motion simulation, the shallow slower velocity layers and multi-scale heterogeneity of source model are worth taking it consideration. In addition, considering the appropriate simulation method is important, especially for long-period ground motion simulation, which needs a long-duration calculation.

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Keywords: long-perido ground motion, FDM, velocity structure model, multi-scale heterogeneity