An empirical estimation of long-period earthquake ground motion (2)- Reproducibility using the predictive model -

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1. INTRODUCTION

The first dataset from an earthquake of magnitude 8-class was provided by the dense strong motion networks K-NET and KiK-net (NIED) during the 2003 Tokachi-oki earthquake. Severe damage of oil-tank in Tomakomai, Hokkaido, Japan, nevertheless the distance from the hypocenter to the site was roughly 200 km. Also, during the 2004 Niigata-ken Chuetsu earthquake, some elevators of tall buildings in metropolitan area were significantly damaged. We know that the essential effects on long-period (1-15 sec.) ground motion (LPGM) are earthquake sources.

We examined a reproducibility of our LPGM predictive model applying to the observed strong motion datasets from three large earthquakes.

2. SHAKEABILITY IN LAND JAPAN

We determined a standard spectral attenuation model against distance for LPGM, using the records on hard rock sites, as a first step. Next, we estimated the shakeability of LPGM at a site by taking spectral ratio to the standard attenuation model. The standard attenuation model is expressed in terms of acceleration response spectra with 5 percents damping. It was obtained using 1,540 horizontal motions at hard rock sites of the KiK-net from 15 earthquakes (larger moment magnitudes than 5.7 and shallower depth than 60 km). We computed responses for 70 periods in the range between 1 to 15 sec..

3. PREDICTION OF LPGM WITH SHAKEABILITY

We examined a reproducibility of our LPGM predictive model applying to the strong ground motion from the 2003 Tokachi-oki, the 2004 Niigata-ken Chuetsu, and 2004 Kii hanto oki earthquakes, using the shakeability factor at a site determined by Yuzawa and Kudo (2009).

The 2003 Tokachi-oki earthquake: Aomori, Iwate, Akita and so on, were well reproduced with the similar level. However, the predictions underestimated at Tokachi, Obihiro and Yufutsu basins. Therefore, we added one standard deviation for the standard predictive model. A better result was obtained but the absolute LPGM levels are still slightly less than the observation. The case that we include both one standard deviations for standard model and shakeabilty at a site was the best in terms of preparedness of seismic safety for long period man-made structures, nevertheless the predictions give slightly overestimates.

The 2004 Niigata-ken Chuetsu earthquake: The predictions using the standard attenuation model and the average sheakability give a fairly good correlation to the observations. However, the case of adding one standard deviation for the standard predictive model gives much better predictions.

The 2004 Kii hanto oki earthquake: The LPGM at Osaka basin, Nobi basin and Omaezaki peninsula are well reproduced using the standard attenuation model and the average sheakability. However, the predictions at Kanto basin are considerably lower than the observations. If we apply one standard deviation for the standard predictive model, a fairly good matching was obtained.

Through these examinations, the prediction using the standard attenuation model and the average sheakability gives a similar ground motion level to the observation, however, the prediction by adding one standard deviation for the standard predictive model is suggested.

For seismic safety of long period man-made structures, it is suggested to include both one standard deviations for standard predictive model and shakeabilty at a site, nevertheless the predictions tend to slightly overestimate.

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