[JJ] Evening Poster | S (Solid Earth Sciences) | S-SS Seismology

[S-SS14]Strong Ground Motion and Earthquake Disaster

convener:Masayuki Kuriyama(Central Research Institute of Electric Power Industry)
Tue. May 22, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)
Strong ground motion has social impacts as it induces earthquake disasters. We solicit contribution on any seismological topics related to strong ground motion that includes, but are not limited to, source processes, wave propagation, and site effects. We also welcome contribution on earthquake related disaster mitigation.

[SSS14-P33]A numerical experiment on the real-time prediction of long-period ground motions using response function: Case study in the Kanto plain using 3D simulation waveforms

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Keywords:Long-period ground motion, Real-time prediction, Response function, Kanto sedimentary basin, Love wave, Rayleigh wave

Introduction

In the Kanto plain, long-period ground motions (LPGMs) are frequently observed for shallow local and regional earthquakes. Large and complex 3D structure of the Kanto sedimentary basin develops complicated LPGMs, and consequently makes it difficult to accurately predict LPGMs as compared to other sedimentary basins in Japan. Despite this situation, the requirement of accurate prediction of LPGMs is increasing for the promotion of safety measure of large constructions such as high-rise buildings and oil tank storages in the metropolitan area. Thus, we conducted a numerical experiment on the real-time prediction of LPGMs based on response function (e.g., Nagashima et al., 2008) that characterizes excitation of LPGMs in the Kanto sedimentary basin. In our numerical experiments, synthetic LPGM waveforms (velocity waveforms in the period of 3-20 s) via 3D numerical simulations for the earthquake in the northern Kanto region were used.

Simulation of LPGMs

We conducted 3D numerical simulation of LPGMs during shallow moderate earthquakes based on finite-difference method (FDM) (e.g., Takemura et al., 2015). In our simulation, we used a sedimentary velocity structure model developed by our research group (Masuda et al. 2014). Structure beneath the basement was a stratified layered structure referred from the JIVSM (Koketsu et al., 2012). We selected the northern Tochigi earthquake (Mw 5.8) on 25 February 2013, located about 60 km north of the northern edge of the Kanto basin. Adopting the focal mechanism of F-net MT solution and changing focal depth from 0.5 to 16 km, we calculated LPGMs at K-NET/KiK-net and SK-net stations in and around the Kanto sedimentary basin.

Response function

In this study, we evaluated the response function of the basin by assuming a linear input-output relation of LPGMs between SK-net TCH2 (rock site) and other stations (in the Kanto basin). Station TCH2 is located to the south of the epicenter and outside of the Kanto sedimentary basin. For simplicity, assuming that the seismic waves in the study area propagate southward from the epicenter, we evaluated the response function from a common component waveform pair (e.g., UD–UD). Water-level method was applied for the calculation of time-domain response function.
We found that the characteristics of response functions is significantly different between components. The response function for EW component showed a simple packet-like shape and the properties of normal

dispersion. Whereas, the response function for UD and NS components showed complex time variations in amplitude. These findings can be interpreted by the properties of surface waves: In the case of this simulation, the response function for EW component reflects the propagation properties of fundamental Love wave and the response function for UD and NS components reflect the propagation properties of fundamental and higher-mode Rayleigh waves. We also found that the focal depth dependency on the response function is relatively small for EW component but large and complex for UD and NS components.

Prediction of LPGMs

We conducted a numerical experiment on the prediction of LPGMs by using response functions. We selected K-NET SIT003 as a target station, which is located about 20 km south of the northern edge of the Kanto basin and at the site with a bedrock depth about 3 km. In our numerical experiment, we used the response function from the simulation for the focal depth of 8 km, and investigated how accurately could we predict LPGMs for the events with the same epicenter but different focal depths (0.5 to 16 km). Our results showed that the accuracy of the prediction is sufficiently high for EW component despite of the large variation of focal depth. This result suggests that the response function method is rather robust for predicting LPGMs caused by Love waves. Future advanced study for different earthquake-station configurations should be conducted for achieving the practical real-time prediction of LPGMs in the Kanto plain.

Acknowledgement

The K-NET/KiK-net data and the F-net MT solutions were provided by the National Research Institute for Earth Science and Disaster Resilience (NIED). We also used the SK-net data that were provided by the Earthquake Research Institute, the University of Tokyo. Numerical simulations were conducted on the computer system of the Earthquake and Volcano Information Center at the Earthquake Research Institute, the University of Tokyo.