Broadband ground-motion simulation of the 2018 Hokkaido Eastern Iburi earthquake

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1. Introduction

The 2018 Hokkaido Eastern Iburi earthquake (M_{JMA}6.7) was an inland crustal earthquake at a focal depth of approximately 35 km. This earthquake brought strong ground motion to the southern Hokkaido, causing JMA seismic intensity of 6+ and 7 above the fault and nearby, and 6- in the city of Sapporo. The seismicity around the source region reaches to deeper region compared to other inland areas in Japan (HERP 2018). Inland crustal earthquakes at this depth have not been considered by the current ground-motion prediction procedure in Japan. Therefore it is necessary to examine whether the strong ground motion from this earthquake can be modeled by the conventional procedure.

2. Broadband ground-motion simulation

We conducted broadband ground-motion simulation using the characterized source model based on the “recipe” for strong motion prediction (HERP 2017), aiming to reproduce the observed ground motion. A planner fault is set referring to the fault slip model by Kubo et al. (2019, this meeting) with the length and width of 28km and 22km, respectively, in the lower crust. Rupture starting point is set to 35 km, and a single asperity is set several km shallower than the rupture starting point on the fault plane. Source parameters are derived by the recipe for inland crustal earthquakes. We call this source model the reference source model.

Broadband ground motion time-series on the engineering bedrock is computed using the J-SHIS v2 3D velocity model (Fujiwara et al. 2009, 2012). We employed a hybrid technique of the 3D finite-difference method (Aoi et al. 2004) and the stochastic Green’s function method (Dan and Sato 1998) superposed in time domain at the period of 1 s. JMA seismic intensity (I_{JMA}) on the ground surface is derived by using the empirical relationships between V_{S30}, PGV and I_{JMA} (Fujimoto and Midorikawa 2005, 2006).

Main features of the velocity waveforms in long-period range (> 1s), amplitude and travel time of the main phases, are found to be consistent with observed records at many observation stations. On the other hand, I_JMA on the ground surface systematically underestimated the observation. Although this underestimation can be attributed to many factors including the source and velocity models, since our simulation results underestimates the observation at all points in short-period component, we first examine the effect of the source parameters that mainly affects the ground-motion level of short-period components. The short-period level, or the source spectral amplitude level at short period, of this earthquake estimated by Tomozawa et al. (2018, SSJ) is 1 –2 times larger, depending on the dataset, than the empirical relation by Dan et al. (2001) which is employed in the recipe. Referring to their result, we set another source model that has smaller size of asperity and consequently higher short-period level, 1.5 times larger than the empirical relation of Dan et al. (2001). I_{JMA} computed with this source model was more consistent with the observation compared to the reference source model.

3. Summary

Broadband ground-motion simulations were conducted for this earthquake using the characterized source models. It was found that the ground motion computed with higher value of short-period level compared to the empirical relation for the ordinary inland crustal earthquake was more consistent with the observed ground motion. It maybe reflecting the feature of the earthquake source characterized by

the depth or the tectonic condition.
We will further study on the source characteristics and site response characteristics in order to better explain the strong ground motion records.

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