Source rupture process and strong motion generation areas for the 2018 Hokkaido Eastern Iburi earthquake

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The 2018 Hokkaido Eastern Iburi, Japan, earthquake (M_w 6.6) occurred at a depth of 37 km, which is provided by Japan Metrological Agency (JMA), in western part of the Hidaka arc-arc collision zone. This earthquake caused strong ground motions with a maximum seismic intensity of 7 in the JMA scale and a maximum peak ground acceleration of over 1000 cm/s^2. In order to understand the mechanisms of generating the broadband strong ground motions during this earthquake, we estimate the spatio-temporal source rupture process based on the waveform inversion using strong motion data, and also construct the characterized source model consisting of Strong Motion Generation Areas (SMGAs) through the broadband ground motion simulations around the source area. To reveal the rupture process, we employ the multi-time window linear waveform inversion by using the strong motion waveforms (0.05-0.5 Hz) recorded around the source area. A curved source fault with a variation in strike angle is assumed by referring the relocated aftershock distribution. The theoretical Green’s function is computed assuming a 1D velocity structure model for each station. The SMGAs are estimated on the basis of forward ground motion simulation in broadband frequency range from 0.2 to 10 Hz using the empirical Green’s function method.

From the results of these source models and ground motion simulation, our principal findings are following. 1) The main large ground motions observed at near-source stations were generated by the up-dip rupture in the large slip area (i.e., the asperity area) identified at the depth shallower than the hypocenter, which coincides with the position of the SMGA1. 2) The SMGA2 and 3 played a key role to generate the observed later phases, which are not explained enough only by the SMGA1 or asperity area. 3) The estimated stress drop or short-period level, which control the high-frequency ground motion radiations, were larger than the average value of past large crustal earthquakes usually occurring in Japan. These findings are important to understand the source characteristics of the earthquakes occurring at deep depth in arc-arc collision tectonic zone.

Acknowledgements: The strong motion data from K-NET, KiK-net, and F-net were provided by the National Research Institute for Earth Science and Disaster Resilience (NIED). We also used the strong motion data from the seismic intensity observation networks of the JMA, Moment tensor solutions were routinely determined by F-net. The JMA unified earthquake catalog was produced by the JMA in cooperation with the Ministry of Education, Culture, Sports, Science and Technology (MEXT). This study was based on the 2019 research project “Examination for uncertainty of strong ground motion prediction for inland crustal earthquakes” by The Secretariat of the Nuclear Regulation Authority (NRA), Japan.

Keywords: The 2018 Hokkaido Eastern Iburi earthquake, Rupture process, Strong motion generation area

