Strong ground motion prediction for the source fault model of Futagawa and Hinagu active fault zones (2) -Strong ground motion prediction -

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The research group for the Comprehensive Research Project for the Major Active Faults Related to the 2016 Kumamoto Earthquake supported by MEXT (PI: Prof. Hiroshi Shimizu, Kyushu Univ.) has conducted an integrated research on long-term evaluation of earthquake occurrence of active faults (Sub-theme 1), seismic activity and crustal structure (Sub-theme 2), strong ground motion prediction (Sub-theme 3) and outreach (Sub-theme 4). The research group of Sub-theme 3 developed a three-dimensional underground seismic velocity structure model in and around the source area and strong ground motion prediction for future earthquakes along the Futagawa fault zone and the Hinagu fault zone as there are still un-ruptured segments remained on these two fault zones after the 2016 Kumamoto earthquake. In this paper, we present the strong ground motion predictions.

Asano et al. (2019) explained how to develop the three-dimensional velocity structure model up to the engineering bedrock. We developed a subsurface velocity structure model down to the engineering bedrock, using boring database and miniature-size microtremor array measurement (e.g. Senna et al., 2018). We constructed source fault models for the Futagawa fault zone (Uto and Uto-hanto-hokugan segments) and for the Hinagu fault zone (Takano-Shirahata, Northern Hinagu, Southern Hinagu, Northern Yatsushiro Sea, and Southern Yatsushiro Sea segments). The location of the modeled source fault of the Uto segment is set to about 1km north from the present one (HERP, 2013). The active fault traces of the Hinagu fault segments are slightly modified from the research results by Sub-theme 1. We assumed two kinds of models for the dip angle setting of the source fault of the Southern Hinagu segment, 90deg. and 50deg. The latter is assumed referring to the microearthquake distribution by Sub-theme 2. The rake angle for each source fault was determined from the stress conditions of the source fault area by the stress inversion result (Sub-theme 2). The earthquake moment magnitude of the future Futagawa and Hinagu fault zones are 7.0 and 7.3-7.4, respectively.

We used “The Recipe” (Strong ground motion prediction for earthquakes with specified source model) (HERP, 2016) for strong ground motion prediction. The rupture starting points were assumed from the implication of the rupture starting point of the 2016 Kumamoto mainshock on the crustal resistivity distribution (Sub-theme 2). The hybrid (FDM and stochastic Green’s function method) method with the cross-over period of 1 sec was used for simulating ground motions on the engineering bedrock. Seismic equivalent linear analysis was applied to the area of the subsurface velocity model to get the time history of the ground motions at the surface and JMA seismic intensity was calculated using the simulated waveform data. Additionally, we estimated a JMA seismic intensity distribution in Kumamoto prefecture using PGV values of the engineering bedrock and JMA seismic intensity increments by the micro-topography classification and Vs30 values.

Keywords: 2018 Kumamoto earthquake, Strong ground motion prediction, Futagawa fault zone, Hinagu fault zone

