A study on modeling method of active faults with surface rupture for strong ground motion evaluation

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In the strong-motion evaluation, the emphasis was mainly on modeling of short period strong-motion generation, the source faults was within the seismogenic layer, and its upper end was not 0km (surface). However, it is necessary to model the upper end of the source fault at 0km up even in strong-motion evaluation for earthquakes occurring in active faults where clear surface fault is identified.

As a first step to extend the source fault model to the ground surface in strong-motion evaluation, here we considered three models for the main shock of the 2016 Kumamoto earthquake (Mw=7.0) as below;
Model-1: The upper end and width of the source fault are 0km and 18km,
Model-2: The upper end and width of the source fault are 2km and 18km,
Model-3: The upper end and width of the source fault are 2km and 16km.
We assumed that the length of the source fault was 34km, which was same as the length of recognized surface fault, and seismic moment was 4.5e19 Nm in all models. And we applied the strike and dip as same as the model for the Futagawa segment of Futagawa fault zone by Headquarters for Earthquake Research Promotion (2014). Source parameters. For model-1, we set up two types of models. The one was using slip velocity time functions by Nakamura and Miyatake (2000) for whole source fault (Model-1NM). The other was using smoothed ramp type slip time functions for shallower than the top of the seismogenic zone (2km; Model-1SR). The locations of hypocenter and asperities were common to all models.

We performed strong-motion simulations for the above four source models using a 3-D underground velocity structure model J-SHIS V2 (Fujiwara et al., 2012). The main results are follows.
1. The difference of strong-motion distribution between Model-1 and others can be seen at region where distance from surface fault is within 2km.
2. There is almost no difference in strong-motion distribution at region where distance from surface fault is farther than 2km.
3. In Model-1NM, a abnormal waveform appears at some sites. It causes extremely large PGV and/or JMA seismic intensity.
We conclude that strong-motion evaluation for earthquakes in active faults whose the upper end of the source fault is 0km by using a smoothed ramp type slip time function for shallower than the seismogenic zone can provide appropriate results comparable to previous evaluations. However, it is necessary to establish a detailed modeling method of the position and shape of the source fault, the slip velocity time function at shallower part of the source fault.

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