

Attenuation characteristics of peak motions during the 2011 Tohoku earthquake using EHD based on different fault models

SI, Hongjun^{1*}, KOKETSU, Kazuki¹, MIYAKE, Hiroe¹, IBRAHIM, Rami¹

¹Earthquake Research Institute, University of Tokyo

The M_w 9.1 Tohoku earthquake, occurred on 2011 March 11, caused over 15,000 people dead and over 3300 people missing. The earthquake, ruptured all the segments from off-Iwate to off-Ibaraki along the Japanese trench, for a total distance of about 480 km (e.g., Yokota et al., 2011), with a moment magnitude of 9.0 - 9.1, is one of the largest mega-thrust earthquakes in the world.

During the earthquake, abundant strong motion datasets have been derived. These datasets indicated that the observed PGAs and PGVs are generally less than the predictions by the existing attenuation models using fault distance (e.g., Boore, 2011; Si et al., 2011). On the other hand, it is also indicated that, by using equivalent hypocentral distance (EHD), the observations are generally consistent the predictions by Si and Midorikawa (1999)(e.g., Kanda et al., 2011; Nishimura et al., 2011; and Ohno, 2011). Since arguments on the appropriateness of EHD as a distance measurement still remain (e.g., Fukushima, 1994), it is needed to confirm the calculated EHDs and their variation.

In this study, considering that the EHD generally depends on the fault model used in the calculation, the variation of EHDs and its impact on attenuation characteristics of PGA and PGV are discussed based on 3 typical slip models proposed for the Tohoku earthquake. The first two models are the models proposed by Yokota et al. (2011) based on the joint inversion of teleseismic, strong motion, geodetic and Tsunami datasets, and Shao et al. (2011) based on the inversion of teleseismic datasets, relatively. The two models are characterized by the location of most ruptured area, around (Yokota et al., 2011) or easterly (Shao et al. (2011)) of the hypocenter. The third model is a uniformly distributed slip model, in which the slips are normalized to unit slips.

Using the EHDs calculated by the 3 fault model, The attenuation characteristics of PGAs and PGVs observed are compared with those predicted by Si and Midorikawa (1999). The results indicated that, (1) there are difference between the results based on different slip models, and the fitting is generally better by using the model by Yokota et al.(2011); (2) for part of the stations around Kanto area there are large differences between EHDs calculated from the uniformly distributed slip model and the inverted ones, leading to the differences in the attenuation characteristics for PGAs and PGVs.

Acknowledgement The strong motion data recorded by K-NET and KiK-net are used in this study.

Keywords: Equivalent hypocentral distance, Attenuation characteristics, 2011 Tohoku earthquake, Fault model