Examination of Source Scaling Relations for Crustal Earthquakes in Japan

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**Abstract**

A three-stage scaling relationship of source parameters for crustal earthquakes in Japan has been developed (Irikura and Miyake, 2001, 2011; Murotani et al., 2015), in which source parameters obtained from the waveform inversion results of strong motion data are combined with those from geological and geomorphological surveys. The first bending point is caused to saturation of the fault width at the seismogenic zone. The second bending is related to saturation of surface rupture displacements becoming apparent from analysis of mega crustal earthquakes (> $M_w$ 7.4) over the world. The 2016 Kumamoto earthquake with $M_w$ 7.0 was one of the largest earthquakes since dense and accurate strong motion networks, such as K-NET and KiK-net, were deployed after the 1995 Hyogo-ken Nanbu earthquake. The scaling relationships of the source parameters of crustal earthquakes in Japan are examined whether they are applicable to the 2016 Kumamoto earthquake (Irikura et al., 2017). The rupture area ($A$ = 46.9 km x 19.8 km) were determined from an average of several slip inversion models from the strong motion data and the seismic moment ($M_w$ = 4.4E+19 Nm) was adopted from F-net solution. We found that $A$ *vs* $M_w$ for this earthquake follows the second-stage scaling within a standard deviation. The scaling relationship in this study coincides approximately with that of Hanks and Bakun (2002, 2008) in the first and second stages, where most earthquakes they examined occurred in California. This suggests that source parameters extracted from the waveform inversion results of crustal earthquakes in Japan have a good accordance with regressions in California. Then, we simulated the broadband ground motions of the 2016 Kumamoto earthquake using the empirical Green's function method based on a characterized source model from the recipe (Irikura and Miyake, 2011). The synthetic ground motions agree well with the observed motions within the frequency range of 0.2 to 10 Hz.