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Scaling Relation of Mega-fault Systems considering Fault Segmentation

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This study is aiming at methodology of ground motion prediction for megafault systems based on dynamic rupture modeling. The motivation arises from that the 1995 Kobe earthquake is considered to rupture only some segments of the Nojima-Rokko-Arima-Takatsuki tectonic line, and never ruptures all the segments like the 1956 Keicho-Fushimi historical earthquake (over M7.5) which is one of characteristic earthquakes. How we can make a scenario for the next coming earthquake on the tectonic line? We think that it is important to capture the earthquakes based on the idea of the active fault segments and characteristics, rupture dynamics, and earthquake cycle simulation. We have a comparative study with Californian earthquakes in U.S. For example, earthquakes with different sizes occurred on the Northern San Andreas fault system (1906 Great San Francisco, 1989 Loma Prieta, etc.) and the Imperial Valley fault (1940 and 1979).

We are studying scaling relations between seismic moment (Mo) and fault Area (S) or fault length (L) considering fault segmentation. Irikura et al. (2006) compared two types of scaling models; Self-similar scaling, i.e. Somerville et al. (1999) and 3-stage scaling by Irikura and Miyake (2001). We develop the 3-stage scaling introducing an idea about saturation of fault displacement (D) and empirical relation between fault length and number of fault segments [Awata et al. (2006)]. We also consider difference of average stress drop between subsurface and surface earthquakes. Surface earthquake has smaller stress drop than subsurface earthquake [Kagawa et al. (2004)].

The result suggests the following phenomena.

1) Earthquakes smaller than Mo=7.5x10^18Nm, follow self-similar scaling relation is with constant stress drop. All the earthquakes are subsurface events.

2) Earthquakes whose fault widths (W) occupies the seismogenic zone, scaling follows the L-model with stress drop increasing with Mo. Here earthquakes are surface events. This phenomenon creates first bending point of 3-stage scaling.

3) Earthquakes whose D reach to observed maximum, scaling follows W-model with stress drop decreasing with Mo. This phenomenon creates second bending point of 3-stage scaling.

We found that definition of maximum W controls the first bending point and definitions of maximum D and number of fault segment control the second bending point. We are studying to adjust the parameters described above and obtained 3-stage scaling model that follows the observed data of previous earthquakes.

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