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Seismic hazard assessment using a new ground motion prediction equation

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In the "National Seismic Hazard Map for Japan" by Headquarters of Earthquake Research Promotion of Japan, seismic hazard is evaluated by the ground motion prediction equation (GMPE) of peak velocity by Si and Midorikawa (1999), and conversion from peak velocity to seismic intensity by using an experiential relation. It is indispensable that earthquakes of moment magnitude (Mw) 9 class take into consideration in the present seismic hazard evaluation. However Si and Midorikawa's (1999) equation is obtained from strong motion records of earthquake up to Mw 8.3. In this study we evaluate seismic hazard by using our new GMPE obtained by using strong-motion database including the records of the 2011 Tohoku earthquake and show the comparison it with the National Seismic Hazard Maps for Japan.

The target strong-motion parameters are peak velocity on an engineering bedrock (here, it is considered as the upper surface of Vs=400 m/s layer), and peak velocity and JMA seismic intensity on the ground. The value on the ground is calculated by using the amplification factor obtained from the average S-wave velocity up to 30 m depth based on the 250m-mesh national geomorphologic classification map.

First, we compare the ground motion distributions calculated from two GMPEs. Here we target following 6 assumed earthquake. (1) crustal earthquake on the Itoigawa-Shizuoka fault zone (Mw7.4), (2) crustal earthquake on the Muikamachi fault zone (Mw=6.6), (3) subduction-zone plate-boundary earthquake at Nankai Trough (Mw=9.1), (4) subduction-zone plate-boundary earthquake at Tokachi-oki reigion (Mw=8.1), (5) subduction-zone shallower intra-plate earthquake at Chishima trench region (Mw=8.2), and (6) subduction-zone deeper intra-plate earthquake at Chishima trench region (Mw=7.5). Amplification by the deep sediments layers can be obviously seen in our new result of peak velocity distribution. As the result, amplitude in our new result becomes larger in basin region and smaller in mountain region. On the other hand, the influence of the deep sediments is not so remarkable in result of JMA seismic intensity on the ground. The calculated value from our new GMPE is smaller in the distance area (in general 100 km or more) for subduction-zone earthquakes. Midorikawa and Ohtake (2002) pointed out that Si and Midorikawa's (1999) GMPE overestimates the peak values in distant region earthquake whose focal depth is deeper than 30 km. Our results are consistent with them.

Next, we compare the seismic hazard for the megathrust earthquake occurring at the Nankai Trough. Here we use the model in probabilistic seismic hazard maps by HERP (2013).

Moreover, we use the value of variance in the National Seismic Hazard Maps for Japan as it is. The hazard by our new GMPE decreases especially at the distant area as expected from comparison of above-mentioned strong-motion distribution. However, the decrease does not serve in Kanto and Osaka area where amplification by deep sediments is large. On the contrary, JMA seismic intensity is larger when exceedance of probability is lower at some points. This is considered that that the value of the set-up variation is not in agreement for JMA seismic intensity has influenced.

Keywords: seismic hazard assessment, grount motion prediction equation, variance of ground motion