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Seismicity models of forecasting future M7-class earthquake epicenters in the southern Kanto region, central Japan

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The Earthquake Research Committee, Government of Japan, reported that there is a 70% chance of an earthquake with a magnitude of around 7.0 (M7) in southern Kanto in the next 30 years, as estimated based on the past five earthquakes in the region. Probable hypocenters of M7 earthquakes are crucial factors for refining seismic hazard maps for the region.

We take an empirical approach to the problem by deriving probability models of M7 epicenters based on reliable evidence. In the present study, we attempt to employ focal mechanism solutions. First, we calculate the Kagan angle between an observed mechanism and an expected one, which can be estimated by assuming configurations of plate interfaces and relative motions between them. Inter-plate events with Kagan angles below a certain threshold are assigned. We estimate the ratio of the number of inter-plate events to the total number for every 0.1 by 0.1 grid space. After applying smoothing with Akaike's Bayesian information criterion, we obtain statistically significant ratios at every grid. We incorporate this ratio into a model to produce the following different catalogues. 1. Original catalogue of earthquakes exceeding M5.0. 2. Pacific plate earthquakes (Inter-plate and within Pacific plate). 3. Philippine and North American plates. 4. Inter-plate between Philippine and North American plates. 5. Intra-plate (Philippine or North American). We then apply smoothing kernels of different wavelengths to these catalogues and obtain dozens of models.

The likelihood of each model is tested with sixteen past M7 earthquakes. The best model performs 1.3 times better in average probability gain than does the model used in the current national seismic hazard maps for Japan.

Keywords: M7-class earthquakes, Southern Kanto, Earthquake forecasting model, Seismic hazard