

## Earthquake Occurrence Probability in Inland Japan by Applying the Gutenberg-Richter Model

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The Earthquake Research Committee (2006) evaluated the probabilities of earthquake occurrence along active faults and for background seismicity, and reported them in the 'National Seismic Hazard Maps for Japan'. They applied the Gutenberg-Richter (GR) model to background seismicity with a constant b-value (0.9).

We compared earthquake occurrence probabilities estimated by applying a constant b-value with those by applying variable b-values estimated for each region. The studied area is divided into small grids with interval of 0.05 degrees. The a-value and b-value are estimated by applying the GR model when the number of earthquakes (January 1, 1990 to December 31, 1999, more than M2.0, declustered with 10 days and 10 km) is larger than 50 within a radius of 40 kilometers from each grid. This procedure is performed with the help of the computer program ZMAP (Wiemer, 1996). As a result, b-values range widely from 0.44 to 1.60 among the grids. Earthquake occurrence probability for more than M6.0 during the period 2000.1-2009.12 is estimated by the GR model assuming that seismicity is stationary Poisson process.

Twelve earthquakes with more than M6.0 occurred in inland Japan from 2000 through 2008. Because five of them are associated with the 2004 Niigata Chuetsu earthquake (October 23, 2004, M6.8), we regard them as one event so that we treat eight earthquakes as independent events. Five of eight events occurred in relatively high probability (7.9%, 9.0%, 11.6%, 15.9%, 28.9%) region. The rest three events; the Rumoi event (Hokkaido Pref., December 14, 2004, M6.1), the Noto peninsula event (Ishikawa Pref., March 25, 2007, M6.9) and the west off Fukuoka Pref. event (March 20, 2005, M7.0), occurred in the region where the probability cannot be estimated because of the low seismicity.

Compared with the constant b-value (0.9) model, the earthquake occurrence probabilities obtained using the variable b-value model tend to increase for regions with low b-values and decrease for regions with high b-values. For example, in the area where the 2004 Niigata Chuetsu earthquake occurred, the probability based on the variable b-value model is 15.9% for more than M6.0 during the period 2000-2009 whereas it is 4.4% for the constant b-value model.

By the way, Nanjo et al. (2006) estimated the earthquake occurrence probability for more than M5.0 during the period 2000-2009 in central Japan using the pattern informatics (PI) model. The PI model assumes that seismic activation and quiescence would be an index of earthquake occurrence probability. Spatial distribution of high probability areas by the GR model almost correspond to those by the PI model. It is noteworthy that a similar result was obtained in both models whereas the GR model assumes seismicity is temporally constant and the PI model estimates the probability from temporal seismic change associated with seismic activation and quiescence.

Hirose et al. (2002) suggest that asperities of large earthquakes do not intrude into high b-value region on the plate boundary east off northeastern Japan. This means large earthquakes may not occur in high b-value area. Comparing b-value with the maximum magnitude of earthquakes (August 1, 1923 to December 31, 2008, more than M5.0, removing aftershocks) within a radius of 10 km (equivalent to the focal area of M6.5) from each grid, we find earthquakes with more than M6.3 do not occur in region with more than 1.07 in b-value and earthquakes with more than M5.5 do not occur in region with more than 1.09. Thus we suggest that large inland earthquakes also tend to be hard to occur in the high b-value area. Future study is necessary to investigate relation between absolute value of b-value and the largest magnitude of the future earthquake, and how we incorporate this information in earthquake occurrence probability.