Seismic Activity Model of Crustal Earthquakes in Probabilistic Seismic Hazard Maps of Japan

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The Earthquake Research Committee, Headquarter of Earthquake Research Promotion, released the National Seismic Hazard Maps for Japan[1], and the digital data and information are provided through Japan Seismic Hazard Information Station, J-SHIS of NIED [2].

The authors have verified the seismic activity models used in the national probabilistic seismic hazard maps by comparing them with recent earthquake occurrence data [3]. Moreover, the seismic hazard at various sites was compared with the number of times of the seismic intensity observed in the past to verify the seismic hazard map [4],[5].

In this paper, seismic activity models used for the shallow inland earthquakes are examined by comparing with the earthquake occurrence data, then, reference is made on a future direction.

In the national seismic hazard maps, inland earthquakes are categorized into the following three: (1) characteristic earthquakes on major active faults; (2) characteristic earthquakes on other active faults; and (3) background earthquakes. The model for type (1) earthquakes is made based on long-term evaluation for each fault. The range of magnitude is 7.0 or greater in MJ. As for the probability of earthquake occurrence, both 'average case' and 'maximum case' are considered according to how to treat the uncertainty within the base information to derive the probability value. Type (2) earthquakes are characteristic earthquakes occur on active faults of 10km or longer other than major active faults dealt as type (1). The range of MJ is 6.5 or greater. Type (3) is all the earthquakes except for type (1) and (2). Gutenberg-Richter relation is adopted in the seismic activity model for type (3), and the parameters are derived based on the earthquake catalog. In addition, since a suitable evaluation technique is not established for non-characteristic earthquakes on active faults, those earthquakes are treated as type (3).

The number of earthquakes expressed by these models is compared with the number of earthquakes occurred from 1926 to 2002. Four earthquakes including 1995 Kobe Earthquake are categorized as type (1) within this time period. Magnitude-frequency relation from the data lies between the 'maximum case' and 'average case' of the activity model. Three earthquakes, such as 1945 Mikawa, are classified into (2), and magnitude-frequency relation is several times the model. As for type (3) earthquakes, since the past earthquake data is referred to in constructing a seismic activity model, magnitude-frequency relation by model and data are consistent except for the magnitude greater than 7.0.

Based on the above, the further studies are necessary in the following field in order to improve the seismic activity model of shallow earthquakes:

(a) Additional investigation is necessary for major active faults whose probability of earthquake occurrence contains large uncertainty.

(b) It is necessary to establish an earthquake occurrence model for non-characteristic earthquakes which occur on active faults.

(c) In order to extend the type (2) model to a shorter active fault, rational method is required to evaluate the earthquake magnitude from fault length.

(d) Evaluation method of the maximum magnitude of background seismicity needs to be reexamined.

References

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