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Validation of probabilistic seismic hazard maps for Japan

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1. Introduction

The authors have tested and validated the probabilistic seismic hazard maps for Japan by comparing them with the observed seismic intensity at the strong ground motion observation sites [1], and by comparing with the estimated spatial distribution of seismic intensity based on the earthquake catalog [2,3].

In this paper, probabilistic seismic hazard maps (probabilistic maps) are estimated for time period of 30 years starting from 1890, 1920, 1950 and 1980, respectively, as well as that from 2010. In addition, spatial distribution maps of the maximum seismic intensity due to past earthquakes (experienced maps) are evaluated for the corresponding time period. These two types of seismic hazard maps are compared and examined for the validation of the national seismic hazard maps.

2. Method

Probabilistic seismic hazard maps for 30 years starting from 1890, 1920, 1950, 1980 and 2010 are evaluated. The earthquake occurrence model and ground motion attenuation model are identical to those adopted for the national seismic hazard maps [4], except for the probability of occurrence of earthquakes modeled with the non-stationary model, e.g., the large inter-plate earthquakes and the earthquakes on major active faults.

Experienced seismic hazard maps are evaluated based on the earthquake catalog. Earthquakes with magnitude 6.0 or greater are selected for Earthquake Category I and II, and 5.5 or greater for Category III. The data are divided into every 30 years starting from 1890, and the maximum seismic intensity in 30 years due to these earthquakes is estimated probabilistically.

3. Results

We compare the expected number of sites in Japan where the strong earthquake shaking (i.e., JMA Intensity 6W) is observed within 30 years for both probabilistic seismic hazard maps and experienced hazard maps. The expected number of sites is calculated by simply summing up the probability of exceedance at all the sites placed with approximately 250m spacing, and is considered as a simple measure of the total seismic hazard of Japan. The probabilistic and expected seismic hazards are consistent with each other except that the expected hazard is greater than the probabilistic one for the period starting from 1890.

Then, we check whether the strong shaking is really experienced or not at the site where the seismic hazard is estimated as high based on the probabilistic hazard map. It became clear that at the sites where the seismic hazard is dominated by the Category I earthquakes (large inter-plate earthquakes) or by the Category II earthquakes (large to medium size earthquakes in subduction zone), the ratio that the strong shaking is observed is high. On the other hand, at the sites where the Category III earthquakes (shallow inland earthquakes) dominate the seismic hazard, only weak correlation is observed between the probabilistic hazard and experienced hazard. These suggest that the strategy for the seismic risk management needs to be changed depending on the earthquake type dominating the seismic hazard for the site.

References

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