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Distribution of Maximum Seismic Intensity due to Past Earthquakes Compared with Probabilistic Seismic Hazard Maps

Toshihiko Okumura[1*], Jun'ichi Miyakoshi[1], Yutaka Ishikawa[1], Satoshi Fujikawa[1], Hiroyuki Fujiwara[2], Nobuyuki Morikawa[2], Nobuoto Nojima[3]

[1]Shimizu Corporation, [2]NIED, [3]Gifu University

1. Introduction

The authors have verified the seismic activity models used in the national probabilistic seismic hazard maps by comparing them with recent earthquake occurrence data [1]. 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 [2],[3]. In this paper, spatial distribution of the maximum seismic intensity due to past earthquakes are evaluated for time period of 30 years starting from 1890, 1920, 1950 and 1980, respectively. Then the results are compared and examined with probabilistic seismic hazard maps for corresponding time period [4].

2. Method

Major past earthquakes are selected from the earthquake catalog by Utsu (1890-1925) and JMA (1926-2008), and classified into three earthquake categories adopted in the national seismic hazard map [5]. Earthquakes with magnitude 6.0 or greater are selected for 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 are estimated probabilistically by calculating the seismic hazard curve given the probability of earthquake occurrence 1 for each earthquake. When calculating the maximum seismic intensity, the earthquake type (inter-plate, intra-plate or upper crust) is given by considering the location of epicenter and the focal depth of each earthquake. The fault plane of each earthquake is adopted from the corresponding model if the earthquake is individually modeled in the national seismic hazard map, and if not, the circular or rectangular fault plane is assumed. The probability distribution of maximum seismic intensity is calculated at the sites with approximately 1 km spacing, and the spatial distribution of maximum intensity corresponding to the given probability of exceedance is estimated for each 30-year period.

3. Results

The distribution of maximum seismic intensity by the earthquakes in the 30 years from 1890, 192 0, 1950, and 1980 vary depending on the time period of interest.
For example, as for the Category I earthquakes (large inter-plate earthquakes) of the Philippine Sea Plate, three earthquakes, namely, Taisho Kanto, Tonankai, and Nankai earthquake have occurred within the time period between 1920 and 1949, and no Category I earthquake has occurred in other periods. By comparing this fact with the probabilistic seismic hazard maps of various time origins, the seismic hazard from southern Kanto to Shikoku region at 1920 was notably higher than that at 1890, and those three earthquakes have occurred as mentioned above. The seismic hazard of the area at 1950 decreased drastically except that the remaining influence of Tokai earthquake is observed, and then the hazard increase as time goes by. It is pointed out that the current seismic hazard of Izu peninsula to Shikoku area is as high as that at 1920.
The Category III earthquakes (earthquakes in upper crust) have occurred in various places in

these four time periods. Although the influence of the Category III earthquakes to the total seismic hazard is minor than that of Category I earthquakes, it is observed that most of the Category III earthquakes have occurred where the seismic hazard by Category III earthquakes is relatively high.

References

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[3] Miyakoshi, et al. (2007): Proc. 5th Annual Meeting of JAEE, 98-99.
[4] Miyakoshi, et al. (2010): Proc. JGU Meeting 2010 (submitted).
[5] http://www.jishin.go.jp/main/chousa/09_yosokuchizu/index.htm

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