Comparative examination of the Probabilistic Seismic Hazard Maps in Japan with observed maximum seismic intensities for various periods

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The accuracy of the Probabilistic Seismic Hazard Maps in Japan (PSHMJ), which is being published by the Headquarters for Earthquake Research Promotion of the Japanese government, was examined by comparing the observed maximum seismic intensities with the PSHMJ. Miyazawa and Mori (2009) compared those only for about 500 years from 1498, and Kondo (2017) compared those for 30 years from 1890, 1920, 1950, or 1980. However, in this study, we compared those for 30, 60, 90, and 120 years from 1890, to show how the accuracy varies for various periods.

Following Kondo (2017), for synthetic seismic intensities, we combined the hazard curves in the engineering bedrocks for PSHMJ (Miyakoshi et al., 2016), the site amplification factors (Wakamatsu and Matsuoka, 2013), and the relationship of seismic intensities and peak ground velocities (Midorikawa et al., 1999; Fujimoto and Midorikawa, 2005). As in Miyazawa and Mori (2009), the Poisson distribution was assumed, and phenomena of return periods of 30, 60, 90, and 120 years were related to those with probabilities of exceedance in 30 years of 64, 45, 28, and 22%, respectively. Observed seismic intensities were derived from the JMA seismic intensity database (Ishigaki and Takagi, 2000; Ishigaki, 2007) and the reports of large earthquakes between 1944 and 1964 (Usami, 1985; Harada et al., 2016). The derived dataset consists of observed seismic intensities at 110 points. This observed dataset was compared with the synthetic seismic intensities at the corresponding points in PSHMJ.

As an index of the comparison, we first calculated the root mean square of differences between observed and synthetic seismic intensities. The results are 1.2, 0.8, 0.7, and 0.7 for return periods of 30, 60, 90, and 120 years, respectively. Since large earthquakes, which can lead to large seismic intensities, are phenomena happening once in several hundred years (plate boundary earthquakes) or once in several thousand years, it is expected that a smaller root mean square is obtained for a longer return period. The above results mostly meet this expectation, but they do not approach 0.4 to 0.5 for a return period of 500 years (Miyazawa and Mori, 2009) being saturated at 0.7 for 90 and 120 years. We secondly performed regression analyses, and similar saturation was also found. For example, the small number of observed seismic intensities can cause this problem, and therefore it will be considered further.

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Keywords: probabilistic seismic hazard map, observed maximun seismic intensity, return period

