

Revision of seismic hazard assessment after the 2011 Tohoku earthquake

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The Tohoku-oki earthquake (Mw 9.0) of March 11, 2011, was the largest event in the history of Japan. This magnitude 9.0 mega-thrust earthquake initiated approximately 100 km off-shore of Miyagi prefecture and the rupture extended 400 - 500 km along the Pacific plate. Due to the strong ground motions and tsunami associated by this event, approximately twenty thousand people were killed or missing and more than 220 thousands houses and buildings were totally or partially destroyed. This mega-thrust earthquake was not considered in the national seismic hazard maps for Japan that was published by the headquarters for earthquake research promotion of Japan (HERP). By comparing the results of the seismic hazard assessment and observed strong ground motions, we understand that the results of assessment were underestimated in Fukushima prefecture and northern part of Ibaraki prefecture. Its cause primarily lies in that it failed to evaluate the M9.0 mega-thrust earthquake in the long-term evaluation for seismic activities. On the other hand, another cause is that we could not make the functional framework which is prepared for treatment of uncertainty for probabilistic seismic hazard assessment work fully. Based on the lessons learned from this earthquake disaster and the experience that we have engaged in the seismic hazard mapping project of Japan, we consider problems and issues to be resolved for probabilistic seismic hazard assessment and make new proposals to improve probabilistic seismic hazard assessment for Japan.

After the Tohoku-oki earthquake, HERP had been reviewing the long-term evaluation for the area in which the Tohoku-oki earthquake occurred and released the revised version of the "Long-term evaluation of seismic activity for the region from the off Sanriku to the off Boso" in November 2011. In this revision, although the revision of the methodology of the long-term evaluation itself has not yet been made and the most part has remained a traditional evaluation, a new assessment has been made of the Tohoku-oki type earthquake. Based on this evaluation, we have been making a revision of the seismic hazard assessment. In this revision, not only results of the long-term evaluation have been revised, but also the upper limits of background earthquakes have been revised. In addition, here we propose three models in order to consider uncertainty of seismic activity.

We also have prepared the maps that show the strong-motion level for earthquake preparedness. For example, based on the averaged long-term seismic hazard assessment, evaluating strong-motion level for 5,000, 10,000, 50,000, 100,000 years return period, we have made the maps that show the distribution of strong-motion level, which represent effect of major earthquakes on active faults and subduction zone earthquakes with low-probability.

Keywords: National Seismic Hazard Maps, strong-motion, seismic hazard, probability