

Comparative study of the performance of source models for the 2011 Tohoku earthquake

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The 2011 Tohoku, Japan, earthquake is obviously the first M9 earthquake which was recorded by dense strong motion networks such as K-NET, etc. Several source models have been proposed to explain strong ground motions from this earthquake. It is significantly important to evaluate the relative performance of these models, especially in the frequency of engineering importance. From engineering point of view, the most striking feature of strong ground motions of the Tohoku earthquake is the generation of strong-motion pulses in the frequency range from 0.2 to 1 Hz observed at many sites along the coast of Miyagi through Ibaraki Prefecture. It is significantly important to consider the generation of such pulses in the strong-motion prediction for mega earthquakes, especially when the prediction is aimed at seismic design of structures. To model strong motion pulses from the Tohoku earthquake, a source model including nine subevents with relatively small size (on the order of several kilometers) was developed (Nozu et al., 2012). The model is called the 'SPGA model'. On the other hand, several 'SMGA models' have been proposed for the same earthquake, in which larger subevents (on the order of several tens of kilometers) are considered. In this study, the errors between the synthetic and the observed ground motions are evaluated for each of these source models. The result clearly indicates that the SMGA model cannot reproduce strong ground motions in the frequency range from 0.2 to 1 Hz, which is characterized by strong-motion pulses. In this frequency range, the performance of the SPGA model is significantly better than the SMGA models. The SPGA model also reproduces the seismic intensity proposed by Sakai et al. (2002), which is in good agreement with the building damage. Based on such results, the author concludes that the SPGA model should be used to calculate strong ground motions for a future mega earthquake as long as the strong motion prediction is aimed at structural safety.

Keywords: mega earthquake, the Tohoku earthquake, source model, strong ground motion, SPGA model, SMGA model

