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Improvement on Method toward Automating Determination of Earthquake Fault Planes and Slip Distributions

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The earthquake source parameters (the geometry, size, and slip distribution of earthquake faults) are important for estimating the characteristics of strong ground motions caused by large earthquakes. To reduce the time taken for the determination of the source parameters, the use of automation without the need for human inspections is inevitable. However, such automation is now limited to determination of point-source moment tensors. Generally, when a point-source moment tensor gives two candidates for a fault plane, one chooses which is the fault plane, by seeing the aftershock distribution and other information (e.g. an active fault map). Determination of earthquake fault planes and moment-release distributions has not been automated yet.

Based on seismic waveform modeling, Kuge (BSSA, 2003) proposed the method that can be automated, which composes of three steps providing point-source moment tensor solutions, fault planes and their length, and distributions of moment release on the finite faults. The method was tested for five Japanese inland earthquakes in the period from 1995 to 2000. The results suggested that the method enabled us to automate the determination of fault planes and moment-release distributions. On the other hand, most of the earthquakes tested by Kuge (2003) were strike-slip earthquakes. It was still uncertain how well the method can work with dip-slip earthquakes.

We applied Kuge (2003)'s method to recent large shallow earthquakes in the period from 2003 to 2008. The JMA magnitude of the earthquakes is larger than 6.7, and the depth is shallower than 60 km. We used the waveform data from KiK-net and K-NET. In this study, we especially focused on the results of the 2008 Iwate-Miyagi Nairiku, the 2007 Noto-Hanto, the 2005 Fukuoka Seiho-Oki , the 2004 Niigata Chuetsu earthquakes because the earthquake source processes, which include the fault planes and moment-release distributions, have been well investigated by previous studies. By comparing our results to the previous studies, we found that the method fails to determine the correct fault planes for the dip-slip earthquakes when data close to the epicenters were used. Performing further tests for the earthquakes having the problem, we improved the method in order to reduce the time and obtain correct results.

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