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Development of an automated source inversion system

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Source rupture process has now become one of the fundamental information to be released as soon as possible if a large and/or damaging earthquake occurs. The National Research Institute for Earth Science and Disaster Prevention (NIED) has conducted the source inversion for damaging earthquakes in Japan using strong-motion data recorded by K-NET and KiK-net. It takes at least about one day to derive and publish a preliminary but plausible result on Website. Due to speed up of the K-NET and KiK-net data retrieval, an improvement of strong-motion seismographs, an advancement of real-time estimation systems for the hypocenter location and source mechanism information, and a sophistication of computer systems, it has become feasible to perform the source inversion automatically just after the earthquake. We have developed a prototype system for the automated source inversion analysis using the NIED real-time data. The automated system will accelerate the first release of the information on the source rupture process.

Triggered by the seismic intensity data, the system collects the K-NET and KiK-net acceleration, and F-net velocity strong-motion data. The system also obtains the hypocenter location and the moment tensor solution automatically determined by the AQUA system using the Hi-net and F-net data. The fault models are constructed using this source information for the two nodal planes with several cases of the relative location of the hypocenter in the fault plane. An algorithm to select strong-motion data used for the inversion considers the epicentral distances, azimuthal coverage and the site response data of each station evaluated by Morikawa et al. (2007). The inversion method follows the procedure proposed by Sekiguchi et al. (2000, 2002). We test the automatic analysis procedure for the previous damaging earthquake data. For the 2008 Iwate-Miyagi Nairiku earthquake (Mw6.9), the slip distribution and the rupture progression pattern are in fairly good agreement with those derived in the previous study (Suzuki et al., 2010), though the slip amount and the total seismic moment are relatively larger. For the 2007 Noto Hanto earthquake (Mw6.7), the result is roughly consistent with that derived by Asano and Iwata (2011). We will run the system and test the performance with the real-time data.

Keywords: Source inversion analysis, Real-time earthquake information, Strong-motion data, Automatic analysis