

Aftershock observation in the source region of the 2004 Chuetsu earthquake: Part 2

Strong motion simulation

Shinichi Matsushima[1]; Kazuyoshi Kudo[2]; Ken Hatayama[3]; Hiroshi Kambara[1]; Takashi Hayakawa[1]; Akira Fukukita[1]; Minoru Sakaue[4]

[1] SIT, Shimizu Corp.; [2] Earthq. Res. Inst., Univ. Tokyo; [3] Natl. Res. Inst. Fire & Disaster; [4] Earthq. Res. Inst., Univ. Tokyo

First time in history, Seismic Intensity (SI) scale 7 of Japan Meteorological Agency (JMA) was observed by the SI Meter during the Mid Niigata prefecture Earthquake in 2004 (Mj6.8). One of the main features of this earthquake is that several aftershocks with magnitudes close to the mainshock occurred. During the series of earthquakes, the accelerographs at stations Kamaguchi Town Hall (SI meter), Ojiya (K-NET), and Tokamachi (K-NET) recorded maximum amplitudes over 1G and severely damaged areas arose in several distant places. Observation data were acquired at many K-NET and KiK-net stations, as well as those of the SI meters of JMA and local authorities, in and around the source region during the mainshock and aftershocks. With data from these dense networks, it is possible to do detailed analysis of these earthquakes, but data in the center of the severely damaged area were not recorded so much. In this study, we use aftershock recordings observed by Kudo et al. (2005) as Green's functions for semi-empirical Green's method and try to evaluate the strong motions in the severely damaged areas.

We use downhole data of KiK-net as Green's functions for the analysis, and estimate the rupture models. Then we evaluate the strong motions at the aftershock observation sites with the estimated rupture model. The aftershocks, which the data is used as Green's functions, should occur near the asperity with the same mechanism of the target earthquake. Since we are focusing on areas with severe damage, e.g. Kagaguchi and Tamugiyama districts, we select events that were recorded at many sites including these two areas and also KiK-net stations. From these criteria, we selected three aftershocks as candidates to use as Green's functions (Nov. 6 22:05 (Mj4.4, Mw 4.0, depth 5km), Nov. 8 1:55 (Mj3.3, Mw3.5, depth 5km), Nov. 12 2:24 (Mj4.3, Mw3.9, depth 8km)). We use source mechanisms determined by F-NET. Among these events, the Nov. 8 earthquake recorded maximum accelerations of 100cm/s/s and larger at stations Kawaguchi Town Hall, Tamugiyama Elementary School, and Kawaguchi Elementary School. The dominant periods varied from 0.1 second to 0.3 seconds. The dominant period at Budokubo and Kizawa districts were 0.3 seconds and others 0.1 second. We estimate the source parameters such as stress drop from the data. As for the rupture model, we locate the asperities considering the results of previous source inversions. The optimal location, total slip, and stress drop of the asperity as well as the off-asperity area is estimated by trail-and-error. We use the estimated rupture model to evaluate the strong motions of the mainshock at aftershock observation sites, and investigate how the characteristics of strong motions correspond to the damage.

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Reference: Kudo et al., Aftershock observation in the source region of the 2004 Chuetsu earthquake: Part 1 Outline, 2005 (JEPS2005)