Ground Motion and Rupture Process of the 2007 Noto Hanto Earthquake Inferred from Strong Motion Data of K-NET and KiK-net

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The 2007 Noto Hanto earthquake occurred on 25th March, 2007, 9:42 JST. Several strong motion stations of JMA and K-NET records instrumental seismic intensities of 6+. Its ground motion was recorded at 386 and 335 stations of the strong motion networks, K-NET and KiK-net, respectively. Peak ground accelerations of 945 and 903 cm/s/s (gal) were observed at stations ISK006 and ISK005. Peak ground velocity over 100 cm/s was observed at ISK005, where the logging data shows upper surface layer of 15 m is composed of silt. The dominant period of H/V spectral ratio around 1 Hz shifted before and after the earthquakes, suggesting that non-linearity effects occurred at ISK005 due to strong ground motion.

We performed a multi-time window linear waveform inversion method to estimate the rupture process from the strong motion data of 9 stations of K-NET and KiK-net. The observed acceleration records were integrated into velocity and bandpass filtered between 0.1 and 1 Hz. We assumed a fault plane model of 36 km x 24 km based on aftershock distribution, with strike and dip angles of N58E and 66^o, respectively, estimated by F-net. We inverted 11 s of the S-wave portion from 1 s before the S-wave arrivals. Theoretical Green's functions were calculated by the discrete wavenumber method (Bouchon, 1981) and the R/T matrix method (Kennett, 1983). Convolution of moving dislocation was introduced to represent the rupture propagation in a each subfault (Sekiguchi et al., 2002). Discretization in space is done by dividing the model fault planes was divided into 216 subfaults, each 2 km x 2 km. We assumed 6 smoothed ramp functions with 1 sec duration separated by 0.5 sec to represent the discretized time window on each subfault. Smoothing constraint that reduce differences among slips close in space and in time is introduced. Non-negative constraints (Lawson and Hanson, 1974) to limit the rake-angle variation are also adopted. The rake angles were allowed to vary within 45^o centered at 132^o which is the moment tensor solution of F-net. Appropriate values for the smoothing strength and the rupture velocity were selected based on ABIC (Akaike's Bayesian Information Criterion; Akaike, 1980) and the residual of the waveform fitting, respectively.

We obtained large slip region at the northeast and shallow part of the rupture starting point. This fact supports that the depth of CMT solutions by F-net was 7 km, which is shallower than the hypocenter depth of Hi-net estimation of 11 km, and well-developed surface waves were observed. Our estimation of the total seismic moment was 1.06 x 10∗∗19 Nm which corresponded to Mw = 6.6.