Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS28-P07 Room:Convention Hall Time:May 23 18:15-19:30

A hypothesis of a super subevent associated with the 2011 Mw9.0 Tohoku Earthquake

Ichiro Kawasaki[1*], Hiroshi Ishii[1], Yasuhiro Asai[1]

[1]Tono Research Institute of Earthquake Science

Kawasaki et al. (2012) proposed a rectangle fault model for the 2011 Mw9.0 Tohoku earthquake to match the synthetic waveforms by the exact solution in a half space of Okada (1980) to overall features of the GPS high sampling data of GEONET and continuos stress recording at TOS, Toki, Gifu prefecture, of TRIES. One of their conclusions was that rupture of maim fault started 40 s after the origin time of JMA. However, since their model did not elucidate transverse component of GPS displacements especially remarkable in the south Kanto district, we reanalyze the data.

Fig.1 shows records sections of the transverse component of GPS data (black) and synthetic waveforms (red) by the main fault of Kawasaki et al. (2012) in three directions of N90W, N125W and N145W. A horizontal axis is arrival time of S waves as reduced by the S wave velocity of 3.8 km/s. Fig.1 means that the remarkable pulse between broken lines at 70 s and 95 s of the pulse width of 25 s to 30 s and the amplitude of up to 70 cm was SH waves propagating at the S wave velocity. Fig.1 also suggests that corresponding source was within or close to the main rupture area.

Since a low angle thrusting dipping to the west does not radiate SH waves to the west and radiate only small amplitude SH waves to the south, the source of the SH waves is supposed to be a subevent having a separate fault plane in which strike slip component is dominant.

Since a node of the SH wave polarity lies in an N80W direction, a strike direction of the subevent should be around N60E or N150E. Starting from initial model of vertical left lateral strike slip fault above the plate boundary, we attempt trial and error approach to propose the following rectangle subfault model: strike direction N145E, dip angle 85, slip angle 85, origin time 20 s after the initiation of main fault, depth 40km, fault length 30 km, width 20 km, rupture propagation velocity of 3.0 km/s to the southwest and upward, rise time 15 s, dislocation 200 m and seismic moment 5.3x1021 Nm (Mw8.4). This subevent elucidates characteristic features of the SH waves at many GPS stations and the stress record at TOS. The SH phase is within wavetrains due to the main rupture and thus ambiguity of the fault parameters is large. However, for the pulse width of 25 s to 30 s and the large amplitude of up to 70 cm, we are sure that the dislocation was extraordinary large compared with a fault size. In this sense, we would like to call it a super subevent.

Fig.1 Record sections of the transverse component of the GPS high sampling data (black) obtained at the time of the 2011 Tohoku earthquake in three directions of N90W, N125W and N145W. Red traces are synthetic waveforms by a main fault model of Kawasaki et al. (2012) and the half space calculation of Okada (1980). A vertical axis is displacement in meter. Vertical spacing is arbitrary. A horizontal axis is a travel time reduced by S wave velocity of 3.8 km/s, assuming the JMA origin time and epicenter.

Keywords: 2011 Tohoku earthquake, subevent, GPS high sampling data, Continuous stress records, dislocation velocity