Source mechanisms of the 2009 seismic sequence in the northwest of New Guinea Island, Indonesia

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On January 3rd, 2009 (UTC), large earthquakes successively occurred around Bird's Head peninsula, northwest of the New Guinea island, Indonesia. The first earthquake (Mw=7.7) occurred on 19:43 (UTC, 4th 04:43 at local time). The second one (Mw=7.5) occurred about three hours later (22:33 UTC, 4th 07:33 at local time) at about 100 km east of the first one. These earthquakes caused several casualties, and about 12,000 people in the New Guinea island lost their houses. In southwestern Japan, a tsunami advisory was issued and tsunamis with heights of several tens cm were observed.

We investigated the source mechanisms of the earthquakes that occurred in the seismic sequence. We used data from the broadband seismograph network in Indonesia, which is operated as a part of the Indonesian Tsunami Early Warning System (InaTEWS) by BMKG in Indonesia, GFZ in Germany, CEA in China, and NIED in Japan. For the source inversion, we used the method of Nakano et al. (2008).

We obtained the following results by preliminary analysis (source parameters may be updated after detailed analysis). The first earthquake (19:43 UTC) was located 10 km below the northern shore of the Bird's Head peninsula. Mw and the rupture duration (T) were estimated as 7.7 and 40 s, respectively. The focal mechanism showed a reverse-type fault with the compression axis oriented to NS. The second earthquake (22:33 UTC) was located about 70 km east of the first earthquake, with a depth of 10 km. Mw and T were estimated as 7.5 and 36 s, respectively. The focal mechanism was similar to that of the first one. Since these earthquakes occurred at nearly the same time and location with similar sizes, these earthquake may be regarded as an earthquake doublet. Since the rupture durations of these events are comparable to typical durations for events of these magnitudes, these events were not tsunami earthquakes.

We also applied the source inversion analysis to aftershocks. We obtained source parameters for about 20 earthquakes that occurred until the end of January. The aftershocks mostly aligned on a plane dipping to the south. This plane may represent a plate subducting along the Manokwari trough. On the other hand, it was much difficult to recognize such a dipping plane from the preliminary source locations obtained by USGS PDE, since the source depths of most earthquakes were not constrained. The source mechanisms were reverse-type faults, similar to those of the mainshocks. The focal mechanisms of some events including the largest aftershock (Mw=5.9), on the other hand, showed normal or strike-slip type faults. This may reflect a complex signature of the tectonic features around this region.