

Tsunami source of the earthquake doublet on Dec. 7 2012 derived from near-field records by ocean bottom pressure gauges

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On December 7, 2012, an earthquake doublet occurred in the Pacific Plate near the Japan Trench. Both earthquakes had magnitudes of Mw 7.2 and the early one was estimated to have a reverse faulting mechanism with a focal depth of about 55 km, followed by a normal faulting earthquake occurred at a depth of about 20 km. The accuracy of the hypocenter locations based on the seismic waveform analysis is not high; some studies estimated that the second earthquake occurred at the landward of the Japan Trench (Global CMT; JMA) whereas Lay et al. (2013) and Harada et al. (2013) showed that it occurred at the seaward of the Japan Trench. 17 ocean bottom pressure gauges (OBPs) were deployed by Tohoku University near the epicentral area and high-quality waveform data of the tsunami associated with the doublet were recorded. The analyses of near-field tsunami waveform will improve the accuracy of the hypocenter location and help to understand the generation process of this unique intraplate doublet. We carried out forward calculations of tsunami waveforms based on the previously obtained CMT solutions. The observed tsunami was modeled best assuming the Global CMT solution, in which the second shallow earthquake is located beneath the landward slope of the Japan Trench. We also calculated tsunami assuming the tsunami source model derived from far-field tsunami records (Inazu and Saito, 2014). The calculated waveforms matched well to the observation in arrival times but calculated amplitudes were systematically smaller than the observations. We inverted the near-field tsunami waveforms for the initial sea-surface height distribution. The estimated pattern resembled well to the tsunami model by Inazu and Saito (2014) and that calculated from the Global CMT solution. However, the far-field tsunami waveforms calculated by our tsunami model did not fit the observations completely in their amplitudes. These results of our preliminary modelings suggest us that the horizontal locations of the tsunami sources estimated by these previous studies are consistent with near-field observations but there is still a room for improvements in depth and slip amount of the faults, reflecting the observed tsunami amplitude. As a future study, we will investigate the reliability of the static coseismic shift recorded by the OBPs near the epicenters and improve tsunami source model by including far-field tsunami waveforms.

Keywords: tsunami, doublet earthquake, tsunami source model, ocean bottom pressure gauge