Near-fault observations of an offshore earthquake by DONET: Comparison of ocean bottom pressure gauges and strong-motion accelerometers

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New ocean-bottom networks for earthquakes and tsunami such as S-net and DONET have been recently deployed in the offshore Japan. One important feature of these networks is that seismometers and ocean bottom pressure (OBP) gauges are installed at the same sites. Tsunamis are designed to be recorded in terms of water pressure changes. During an earthquake, the water pressure near its fault area changes not only by tsunamis (i.e., sea surface heights) but also by water depth change of instruments themselves, vertical accelerations of a seafloor itself (i.e., reaction force from water column), and the seismic waves radiated (including ocean acoustic waves) (e.g. Saito and Tsushima, 2016).

In this study, we analyzed the OBP and strong-motion accelerogram records provided by DONET1 that associated with the 2016 Off-Mie earthquake (Mw 6). First, we compared the pressure records in the forms of acceleration, velocity and displacement recorded in strong-motion accelerograms. Velocity and displacement records were calculated by integrations of accelerometer seismograms. Because a simple integration leads to unreasonable results, we conducted the baseline correction by the method based on Iwan et al. (1985). Second, we estimated tsunami heights at stations near the fault in near real-time basis, using the records of OBPs and accelerograms combined.

We obtained the following results by these comparisons: (1) the pressure change proportional to ocean-bottom velocity especially for each first motion, (2) in contrast, at around 0.1Hz, the pressure proportional to ocean-bottom acceleration at some stations, and (3) during the coseismic period, the effect of displacement not contributing to the pressure change at the same site. (1) and (2) are consistent with the numerical simulations by Saito (2017).

Next, we removed the effect of accelerations using 0.05-0.1Hz band-pass filter from the OBP records that were processed by 0.1Hz low-pass filtering, enabling us to extract tsunami and displacement signals at 10s intervals. The resulted waveforms are matched well with 0.01Hz low-pass filtered OBP records, suggesting that this method would be useful for tsunami early warning with near-fault combined records of OBP and accelerograms.

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