Tsunami Data Assimilation of the 2015 Torishima Earthquake

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The 2015 Torishima earthquake (M5.9) occurred at the Smith caldera, on May 2, 2015. It had a CLVD-type focal mechanism and generated larger tsunami waves compared to its seismic magnitude (Sandanbata et al., 2018). Therefore, it was regarded as a ‘volcanic tsunami earthquake’ –a tsunami earthquake with volcanic origin. The tsunami reached Hachijo Island, Boso Peninsula and Shikoku Island, and were recorded by tide gauges and ocean bottom pressure gauges (Kubota, 2018). Fukao et al. (2018) proposed an opening horizontal sill model to explain its origin. The abnormal mechanism makes it difficult to forecast tsunami from its seismic magnitude.

Tsunami data assimilation forecasts the tsunami by assimilating offshore observed data into a numerical simulation, without the need of calculating the initial sea surface height at the source (Maeda et al., 2015). In the Nankai region, the Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) records the water pressure and has real-time data transmission. Synthetic experiments showed that this observational system was able to forecast the waveforms at Shikoku Island by tsunami data assimilation approach (Wang et al., 2018). Here, we performed this method to retroactively forecast the tsunami of the 2015 Torishima earthquake. We assimilated the observations of 16 DONET stations and two ocean bottom gauges off Muroto. The tsunami waveforms at the tide gauges Tosashimizu and Kushimoto were forecasted, and compared with the actual records.

The comparison between forecasted and observed waveforms at two tide gauges suggested that our method could forecast the tsunami amplitudes and arrival time accurately. The tsunami warning could be issued to local residents of Shikoku Island more than one hour before its arrival. Our method is merely based on offshore observations, and could be implemented for future tsunami warning systems.

Keywords: Tsunami Data Assimilation, Tsunami Forecasting, Torishima Earthquake

