Air-Pressure Induced Tsunami After Tonga Volcanic Eruption

*Tung-Cheng Ho[1], Masumi Yamada[1], Nobuhito Mori[1]

1. Disaster Prevention Research Institute, Kyoto University

An unusual tsunami was observed after the eruption of the Hunga Tonga-Hunga Ha ‘apai volcano on 15 January 2022. The tsunami traveled to Japan, ~7700 km from the source, only seven hours after the eruption. The corresponding velocity was ~310 m/s, which is 1.5 times faster than the tsunami speed on the average ocean depth (4000 m). The leading tsunami was too fast to be induced by the vertical ground displacement of the eruption or the landslide mass movement. In addition to the tsunami waves, Japanese atmospheric barometers also observed long period air pressure change slightly earlier than the tsunami. The leading tsunami can be generated by the sudden air pressure change.
Air pressure changes cause sea surface uplift or depression, and long-period changes can induce tsunamis which are called meteotsunami. The observed air pressure change was a long period waveform of a half-period ~1500 seconds with a peak of 2hPa. We performed numerical analyses of the tsunami waves utilizing the recorded air pressure change signal. The tsunami induced by the air pressure was well explained in our model. The simulated tsunami waveforms fit the recorded waveforms in different types of stations in our analyses. We compared the ocean bottom pressure gauges (OBPGs), including S-net, DONET, and DART, and onshore pressure gauges and tide gauges maintained by JMA and JCG. Our preliminary results indicate that the pressure type gauges recorded the air pressure change and tsunami signal simultaneously. On the other hand, the tide gauges recorded the tsunami waves slightly after the air pressure change, suggesting that the air pressure change induced the tsunami waves.

Keywords: tsunami, Tonga, meteotsunami