Numerical pressure and tsunami wave experiment on the 2022 Tonga submarine volcanic eruption using perturbation and FDTD method.

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With the explosion of Tonga volcano on January 15, 2022, a tsunami of over than 1m was observed along the coast of Japan. This tsunami phenomenon was explained as a sea wave generated by an explosive eruption that generated a global pressure wave and a resonance phenomenon (Proudman effect) with seawater. This barometric wave seems to be a Lamb wave considering the propagation velocity. However, since the propagation velocity of the tsunami is slower than that of the Lamb wave in this area, complete resonance does not occur. However, since a similar pulse-like tsunami is generated by the increase in atmospheric pressure when the Lamb wave passes, it is clearly observed by an offshore deep-ocean assessment device such as S-net. However, following the pulsed tsunami caused by the Lamb wave, a group of tsunamis with larger amplitudes were propagating, and the maximum tsunami height was the subsequent tsunami. Currently, the cause of this subsequent tsunami has not been explained. If there is a barometric wave that has a slower propagation velocity than the Lamb wave and is in a mode that strongly resonates with the tsunami, the maximum wave following the tsunami can be explained, but it is not found in the barometric pressure observation results at present. Then, we attempted to search for a pressure wave that caused strong resonance from numerical experiments. Using the equilibrium state of the physical atmosphere as the basic field, the barometric pressure wave was treated as the perturbation to form a linear wave equation, and the barometric pressure wave propagation from Tonga volcano to Japan was calculated numerically by the time region difference method (FDTD method). At the same time, the propagation of the tsunami excited by the same path was calculated. In this presentation, we will report the results.

Keywords: tsunami, Volcano, Atmospheric pressure wave, Numerical simulation, FDTD method

