Propagation of infrasound generated by an explosive eruption of Mt. Shinmoedake on 10 March 2018

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Mt. Shinmoedake is a part of the Mt. Kirishima cluster of volcanoes in Kyushu Island, Japan. It is located at 31.54 N, 130.53 E and its elevation is 1412 m. Explosive eruptions were observed more than 40 times in March 2018. In these events, air vibrations stronger than 100 Pa were observed several times at an air vibration sensor installed by Japan Meteorological Agency at the site within ~3 km from Mt. Shinmoedake. We focus on the explosive eruption at 1:54 (JST) on 10 March 2018. This event is the most significant air vibration (~272 Pa) observed on 10 March 2018. The infrasound sensors in Shikoku Island deployed by Kochi University of Technology detected the infrasound signals from Mt. Shinmoedake. We detected major signals three times at each of the sites 1 to 3, and four times at each of the sites 4 to 6.

We developed a new formulation for three-dimensional wave propagation in a stratified atmosphere and apply it to the analysis of the detected signals. The present formulation is based on the dispersion relation of the wave, which corresponds to Hamiltonian in particle mechanics, and Hamilton equations describing time variations of group velocity of the wave and wavevector. We adopt the dispersion relation $\omega = c_s k + \boldsymbol{u} \cdot \boldsymbol{k}$, where ω is angular frequency of the wave, c_s is sound speed, $\boldsymbol{k}$ is the wavevector, and $\boldsymbol{u}$ is wind velocity. Using the vertical temperature profiles provided by NRL-MSISE00(Picone et al., 2002) and the zonal and meridional wind profiles by HWM14 (Drob et al., 2015), we made ray tracing of the waves emitted at the explosive eruption observed on 10 March 2018. We show results of the ray tracing calculations and compare them with the signals detected by our infrasound sensors deployed in Shikoku Island(see the figure). Discussion is given on the origin and nature of the observed signals.

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