Effects of the atmospheric structure and topography on infrasound propagation around Sakurajima

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Detailed observations and numerical studies on infrasonic propagation reveal that effects of the atmosphere layers and of the topography are more significant than it was thought. The topographic effect is more significant in near-source (less than 10 km) while the atmospheric structure has a strong effect at the regional scale (>100-1000 kilometers).

We use a dataset of infrasound generated by Vulcanian activity at Sakurajima and recorded by a dense network of well-calibrated infrasound sensors deployed around Sakurajima and at different distances <60 km from the crater. The effect on wave propagation of atmosphere and topography with the distance is numerically investigated by a 2.5D finite difference (FDTD) method while a pure 3D FDTD modelling is used to analyse the azimuth distribution around the crater.

We show how the amplitude ratio of individual stations with the reference station at 3 km from Sakurajima shows remarkable seasonal differences. Amplitude ratio can vary 2 times at the same distance but different azimuth due to topography and/or 5 times at the same station within one day by atmospheric changes.

Numerical results indicate that topography and atmospheric variations are the main factors affecting the acoustic wave propagation. Our work provide evidence that a detailed knowledge of the topography and of the meteorological conditions are needed for accurate analysis of the acoustic source.