Estimation of the amplitude of infrasoundsignal based on sound diffraction

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Observation of infrasound signals generated from volcano eruptions provides us with important information directly reflecting explosion processes at the source. How to determine the locations of stations for acquiring clear signals has been one of the most fundamental problems for researchers. The best way to solve this problem should be a numerical simulation of infrasound wave propagation considering the propagation effect of topography (e.g., Kim & Lees, 2011; Lacanna & Ripepe, 2013). However, we have to take time and cost money to perform numerical simulations. In this study, we attempt to estimate the amplitude of infrasound signal by an easier method applying the sound diffraction theory. We replaced the cross-section of topography from the source to the station by an equivalent single screen and calculated the attenuation of the amplitude due to diffraction by the thin screen based on Macdonald's exact solution (1915). Then, our results were compared with the calculated amplitudes from 3D-FDTD simulation (Kim et al., 2015) and the observed amplitudes of 31 explosive events occurring at Showa crater, Sakurajima in September 2017. For comparison, the amplitude value was converted to the amplitude ratio with respect to the amplitude of the KUR station in the line-of-sight with the source. As a result, the amplitude ratios estimated by our method were determined at an accuracy of ±30% of the amplitude from the FDTD simulation at all stations. The amplitude ratio of our method was included in the range of the observed amplitude ratio at five stations. On the other hand, at one station, where the azimuth and distance from the source is almost similar to those of the KUR station, observation results cannot agree with the result of our method. This discrepancy suggests that the infrasound signal is affected by other effects than diffraction, such as reflection at the ground, and further study is required in the future.

Keywords: infrasound , diffraction, FDTD simulation

