Suggestion of using a position estimation method for infrasound source findings in Antarctica

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We report relevance of a concept of position estimation method for infrasound sources to be applied for Antarctic observation. Infrasound is a kind of sound whose frequency is lower than 20 Hz. The sound can make long propagation in atmosphere because low frequency sound is hard to be affected by damping due to the viscosity of air. The infrasound signals can be generated by volcanic eruptions, entries of the meteorites, and collapses of ice sheets, etc. So it is highly expected for one of the remote sensing technologies for geophysical events. It is also useful for monitoring global climate change and crustal deformation. because we can acquire statistical geophysical event data. Occasionally, the infrasound is generated by an event accompanied by a disaster. So observation of infrasound might be helpful for presuming source positon and scale of the disaster. Our laboratory has been observing infrasound since 2008, accumulating a lot of datasets especially in Syowa station, Antarctica (Yamamoto et al., 2013). However, we need to make statistical data analysis to pick up many geophysical events from huge observation dataset. Further, identifying source position of the each event and classify the event into some categories is important. We developed automatic detection software for N-type impulsive signals. This software detects over-threshold events by using fluctuation in all spectrum data of the observed infrasound waveform (Sorimachi, 2016). There is a wave source position estimation algorithm called a 'grid search method' that have been used in the field of seismology (Japan Meteorological Agency, 2016). The grid search method is a method of dividing an interested area for searching source into numbers of fine grids and finding the most possible source location by analysis. A wave source is assumed for all grids, then the time required for reaching each observation point from the source by the sound speed is calculated. Therefore, a grid with the smallest error is found by comparing the actual time to the analyzed time. In case of estimating the sound source position from arrival direction determination, the volcanic eruption of Mt. Sakurajima was observed in previous research (Komatsu, 2012) by multi-site triangle-arrayed infrasound sensor system. At that time, they succeeded in estimating the infrasound source positon within a radius of 15 km from Mt. Sakurajima according to an intersection of arrival directions of sound wave detected by each sensor-array to estimate sound source point. We tried an optimization concept of position estimation method for sound sources with applying the Grid search method to our previous datasets. As for the verification of the proposed method, the data observed during Dec. 16-31, 2011 at Kinkowan High School, National Institute of Technology Kagoshima College, and University of Miyazaki around Mt. Sakurajima by Komatsu (2012) were used. This 15-days data include many infrasound events by the eruptions of Sakurajima volcano. As a result, we succeeded to find many events estimated at around Sakurajima volcano. Several events are estimated within 1 km radius of Sakurajima volcanic crater. Distribution of error for an event is shown in Figure 1. For the reason, we conclude that grid search method is useful for estimating infrasound source positon in Antarctica because the sensor distribution there is almost the same as the tested datasets.

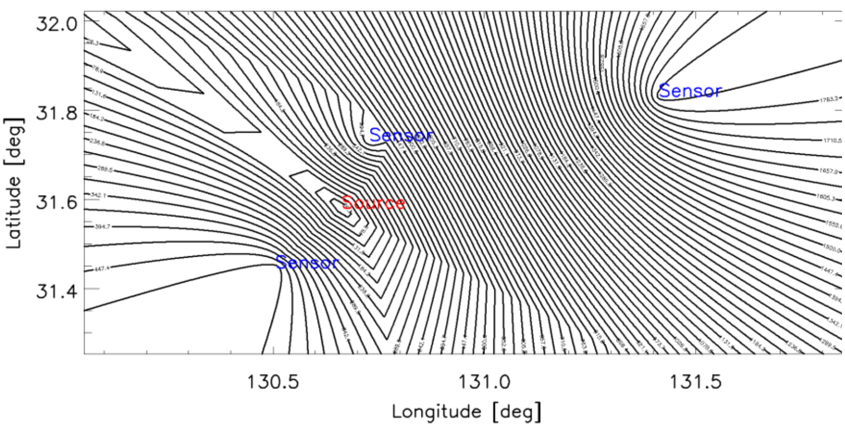

Figure 1. Distribution of error by grid search method at around Mt. Sakurajima.