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Monitoring volcanic activities using correlation patterns between infrasound and ground motion

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This paper presents a simple method to distinguish infrasonic signals from wind noise using a cross-correlation function of signals from a microphone and a co-located seismometer. The method makes use of a particular feature of the cross-correlation function of vertical ground motion generated by infrasound, and the infrasound itself. Contribution of wind noise to the correlation function is effectively suppressed by separating the microphone and the seismometer by several meters because the correlation length of wind noise is much shorter than wavelengths of infrasound. The method is tested with data from volcanoes, and demonstrates that the method effectively detects not only the main eruptions, but also minor activity generating weak infrasound hardly visible in the wave traces. In addition, the correlation function gives more information about volcanic activity than infrasound alone. The correlation pattern changes when the spectral feature of the infrasound and/or the seismic wave changes and the relative strength of infrasound and seismic wave changes, both of which are expected to be accompanied by change in eruptive activity. Therefore, a graphical presentation of temporal variation in the cross-correlation function enables to see qualitative changes of eruptive activities at a glance. This method is particularly useful when available sensors are limited, and will extend the utility of a single microphone and seismometer in monitoring and understanding volcanic activity. The method is used to analyze sequences of two recent eruptions of Asama and Shinmoe-dake volcanoes, Japan.