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Remote infrasound monitoring of Mount Etna: Observed and predicted network detection capability

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Volcanic eruptions are unique and valuable calibrating sources of infrasonic waves worldwide detected by the International Monitoring System (IMS) of the Comprehensive nuclear Test Ban Treaty Organization (CTBTO) and other experimental stations. Building a comprehensive database of volcanic signals is likely to help the scientific community to better characterize eruptive sequences and may help to prevent eruption disasters while on a longer term mitigate the impact of ash clouds on aviation.
In this study, we assess the detection capability of the existing infrasound network to remotely detect the eruptive activity of Mount Etna with a high level of confidence, and predict the performance of the future ARISE infrastructure network (Atmospheric dynamics InfraStructure in Europe). This well-instrumented volcano offers a unique opportunity to validate attenuation models using multiyear near-and-far field recordings. The seasonal trend in the number of detections of Etna at the IS48 IMS station (Tunisia) is correlated to fine temporal fluctuations of the stratospheric waveguide structure. The modeling results are consistent with the observed detection capability of the existing network. In summer, during the downwind season, a minimum detectable amplitude of $\sim$10 Pa at a reference distance of 1 km from the source is predicted. In winter, when upwind propagation occurs, detection thresholds increase up to $\sim$100 Pa. When adding four experimental arrays to the existing IMS network, thresholds decrease down to $\sim$20 Pa in winter. The simulation results provide here a realistic description of long-range infrasound propagation and allow predicting fine temporal fluctuations in the European infrasound network performance with potential application for civil aviation safety.