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Synthetic Study to Determine Adequate Infrasound Network Configurations for Resolving Source Directionality

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Sources including volcanic eruptions and buried explosions have been shown to produce directional infrasound radiation. However, infrasound sensor deployments generally consist of instruments placed on the Earth's surface. Therefore, directional sampling of the radiated acoustic wavefield (especially at angles close to vertical incidence) is generally limited. This insufficient wavefield sampling may bias source size estimates, including mass flow rate for volcanic eruptions or explosion yield.

Here we conduct a synthetic study with local infrasound sensors placed around a directional acoustic explosion source to investigate the configuration of infrasound sensors required to uniquely recover a directional source mechanism estimate. We use finite-difference time-domain methods incorporating rigid topography to obtain the numerical Green's functions for each synthetic station. We invert these synthetics to determine if the prescribed directional source mechanism and source-time function can be retrieved for a variety of station configurations. We consider the influences of environmental factors (wind, temperature, noise), as well as the directionality strength and orientation. The optimal sensor configurations to best estimate acoustic directionality found in this synthetic study will help guide future deployment configurations around active volcanoes and anthropogenic explosions.

Promotional text

This study will help improve our ability to determine yield estimates for underground explosion sources, where infrasound radiation has been shown to be directional. We help bridge the gap between infrasound research on volcanic eruptions and anthropogenic explosions.

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