Three-dimensional acoustic source localization of explosion and degassing events at Karymsky Volcano, Kamchatka, Russia.

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Recent research has drawn links between the acoustic signals of volcanic jets and those of man-made jet engines (jet noise), but this relationship has yet to be firmly established. Turbulent jet flows have been observed to produce acoustic signals extending from the nozzle to a finite distance downstream. One of the challenges of observing potential analogous acoustic sources from volcanoes is due to most microphone deployments being below the volcanic vent and restricted to topography that is predominantly two-dimensional. At Karymsky Volcano, Kamchatka, Russia, the topography of an eroded edifice adjacent to the volcano provides a platform for the deployment of an array of infrasound sensors in three dimensions. 5 infrasound microphones were deployed on this eroded edifice for 11 days in July 2012. The microphone deployment spanned a volume of approximately 2 kilometers horizontally, and covering 600 meters of elevation. When permitted by weather and daylight, continuous acoustic recording at 250 Hz was accompanied by FLIR, video, and gas emission data. During this time period, observed activity at Karymsky Volcano consisted of periods of semi-continuous high frequency (up to about 90 Hz) jetting and degassing, punctuated by a small number of discrete ash explosions. Here we present acoustic source localization results using a novel time-difference-of-arrival technique developed by Wilson Infrasound Observatories. Preliminary results in horizontal space show that events are clustered about the vent in a region 140 by 310 meters across. However, vertical distributions show only one explosion event located immediately at the vent, while other located explosions and degassing signals cluster persistently in a region between 175 and 650 meters above the vent. These results can be interpreted in three ways: (1) Bias in the locator algorithm or array geometry; (2) atmospheric or plume effects influencing sound propagation; or (3) sources decoupled from and above the vent region. Current work will attempt to determine which of these three cases is most plausible. This will be accomplished through forward model simulations for this array geometry, comparison with alternative location methods such as grid-based semblance, and evaluation of FLIR and video data. Development of this 3D localization technique may allow the identification of distinct sounds sources from volcanic eruptions. This helps to refine current understanding of the relationship between acoustic signals and the eruptive processes that generate them, and improves the effectiveness of acoustic monitoring of volcanoes.