Geophysical Research Abstracts
Vol. 21, EGU2019-10217, 2019
EGU General Assembly 2019

Drone-deployed sensors capture multi-parameter perspective of explosions at Stromboli volcano

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Explosive volcanic eruptions are comparably short-lived events with potentially catastrophic consequences and long-term impact. Volcanic hazard assessment relies on detailed mechanistic understanding of the associated physical processes (magma ascent, priming, and eventually fragmentation), which are not directly observable.

A series of acoustic and pressure sensors were deployed in September 2018 near active vents at Stromboli volcano (Italy) to better constrain the physical processes of mildly to moderately energetic explosions. Five out of the eight active vents displayed explosive activity, which ranged in intensity, duration, and ash content. We used six time-synchronized microphone arrays with double sensors and a range of 1-200Hz and 10-10000Hz, respectively. Additionally, three infrasound arrays and twelve drone-deployed sensors, which measured temperature, humidity, electric potential, pressure, and sound. The arrays were deployed 200-500 m (horizontal distance) from the active vents, whereas the sensors were positioned directly adjacent to them. The location of each sensor was determined by the drone's GPS measurements (at 10Hz). Close observations of eruptive activity over 5 days allowed for a complete correlation of time, duration, and source vent of 100 explosions.

Selected Strombolian explosions were analysed for the distance-dependent acoustic and pressure signals to allow for 1) revealing the radial dissipation of signals from explosive eruptions, 2) better constraining conduit conditions (depth, open/closed), and 3) correlating these features to different types of explosive events. Enhanced understanding of the spatial shift of the acoustic signal produced by explosive eruptions will increase the reliability of volcano monitoring based on long(er) distance measurements.