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# Time-frequency localization of the acoustic components of the shock-tube flow

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Volcano monitoring relies on geophysical and geochemical observations to reconstruct eruption source parameters and understand the related eruption dynamics.
Volcano acoustic analysis is an emerging technique, which provides specific information about the underlying physical processes of single eruptions such as conduit conditions and length, fragmentation depth and pressure as well as details about the dynamics of the flow exiting the vent, including ejection velocity, the temperature of the eruptive products etc. Those data are important input parameters for eruption interpretation and forward-looking numerical approaches. However, this information cannot be deciphered with sufficient precision yet, because the link between the acoustic signals and most of the governing physical phenomena characterizing a volcanic eruption is poorly constrained.
In order to advance the interpretability of acoustic signals and allow for accurately quantifying the governing eruption parameters, we performed a parametric analysis under controlled laboratory conditions in an anechoic room. We systematically varied the boundary conditions (reservoir pressure (3, 4, 50 and 80 bar), length of the shock-tube (2 and 8 times the vent diameter) and vent geometry) and measured the acoustic signals of rapid-decompression induced pure-gas flow from a shock-tube with an array of 16 microphones aligned at well defined horizontal and vertical distance. A complex Morlet wavelet transform was applied to deconvolute the acoustic signals and locate the content of the signal both in time and frequency. This allowed to empirically identify the acoustic footprint of the experimental variables in the wavelet diagram.
The empirical results obtained help understanding the contribution of volcano-relevant physical and geometrical source parameters to the acoustic signals produced by the pure gas jet. These findings will serve to better interpret volcanic sound generated from impulsive explosive eruptions, ejecting gas-particle mixtures from complex volcanic craters in uneven terrain.