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An integrated geophysical approach: Field and modelling studies for a better understanding of infrasound signals at Yasur volcano, Vanuatu

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In August/September 2008 we accomplished a two-week multi-parameter measurement on Yasur volcano, Vanuatu to gain new insights into the mechanism of Strombolian explosions by simultaneously recording data from a wide range of different instruments. In order to investigate the general surface activity, part of the experiment setup consisted in the installation of two Doppler radars and one infrared camera at the crater rim. In addition to that, we deployed four infrasonic arrays and one broadband infrasound sensor to record acoustic pressure signals associated with the explosions. The surface observations reveal a change in activity regime during our measurement from almost ash free explosions dominated by ballistic clasts to explosions showing a very large ash load. The analysis of the corresponding infrasound recordings indicates a prominent change in frequency content and signal amplitude between these both regimes. The amplitude of the signal is muffled in the presence of ash, and the waveform is stretched out. Differences in the propagation medium may lead to this observed dispersion and attenuation. To quantify this idea, we modelled the propagation of acoustic waves in temporally changing media using a Fourier method. The used 2D and 3D algorithms incorporate a spreading cloud of either hot volcanic gas or of a hot gas ash mixture. The cloud's expansion speed, as well as its average temperature and its impedance were deduced from radar data and infrared videos. Our modelling results suggest that part of the variations in the infrasound observations can be attributed to the aforementioned propagation effects, and that changing acoustic signals do not necessarily reflect changing source processes.