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The FAMoUS toolbox goes to Yasur: field test of a FAst, MUltiparametric Set-up for real-time observation of explosive eruptions

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Explosive volcanic eruptions are intrinsically highly dynamical in space and time. For this reason, their observation in real time requires a broad range of sensors operating at high-sampling rates. Permanent networks meeting these requirements are limited to a few, intensively monitored volcanoes. Multiparametric experiments are run for limited periods at active volcanoes, but currently still require considerable logistic effort and a reliable forecast of "where" and "what" the activity will be. In contrast, the FAMoUS toolbox is a fast-deployed and flexible tool that can provide real-time observation of a broad variety of volcanic phenomena.
The core of the FAMoUS toolbox includes: 1) an Optronis CamRecord 600x2 high speed camera and data logger; 2) a FLIR SC655 thermal camera; 3) two InfraCyrus microphones. All instruments are time-synchronized via a hand- or microphone-operated trigger. GPS time stamp is also available. The toolbox also includes a custom-designed power supply system, two laptops, lenses, and tripods. Total weight amounts to less than 20 kg divided into 7 items easily fitting into four, hand-luggage-sized backpacks. Deploying FAMoUS requires less than 20' whereas removing can take less than 2', if needed.
The FAMoUS toolbox was first tested on Yasur volcano, Vanuatu Islands, in 10-12 July 2011, explosive activity ranging from strombolian explosions to ash venting and puffing. Visible and infrared high-speed videos were acquired at 500 and 50-200 frames per second, and 1280x1024 and 480-120x640 pixel resolution, respectively. Microphone signals were recorded at 1-20 kHz. Several volcanic processes have been thus investigated. 1) Initial jet-plume dynamics were characterized by zooming into the vents to estimate ejection velocities, gas-particle-atmosphere interactions, and mass eruption rates. 2) Ballistic pyroclast trajectories were recorded with a broader field of view, focusing on larger particles and using thermal data to discriminate juvenile vs. lithic bombs. 3) The generation and propagation of acoustic and shock waves was visualized in large-field videos and compared with microphone recordings. 4) The settling velocity of ash- to lapilli-sized pyroclasts was measured using high-speed videos, to be coupled with the thermal information on respective plumes and component/size distribution of collected samples.
Results from this first test illustrate the potential of FAMoUS for, e.g.,: i) tracking pyroclast ejection velocity and jet-plume development at a broad range of volcanic eruptions; ii) interpreting signals from infrasonic monitoring networks; iii) illuminating the development and thermal history of pyroclastic density currents; and iv) measuring the settling velocity and sedimentation rate of fallout pyroclasts [1]. Fast deploying and portability of FAMoUS could enhance the quasi-real time incorporation of such information into hazard mitigation eruption models.

[1] Taddeucci et al. (2011) Geology, 39; 891–894.