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Detecting short period variations in lava flux

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Although the underpinning processes that govern the flow of lava have been recognized for some time, modeling the evolution of lava flow fields remains problematic due to the difficulties in fully constraining inputs to flow models. One of the main parameters controlling the evolution of individual flows is effusion rate, and long period effusion rate changes, such as flow-waning prior to the cessation of an eruption, can now be routinely incorporated in simulations. However, effusion rates commonly vary over a wide range of timescales (from years to minutes) and, for short period changes, neither the cause nor the effects are well understood. Nevertheless, short period changes can result in inaccuracies in the input data for simulations and can be responsible for altering flow directions by either building or breaching flow levees. Hence, understanding the processes involved in such changes is important for flow modeling and, furthermore, could eventually provide insight into flow instabilities within the conduit or variability within degassing processes.

Observations of short period (e.g. <1 hr) variations in lava flux have been made previously in the field but associated changes cannot be identified in effusion rate data because of the generally low sampling frequency of such data. During the last week of July 2008, trail cameras were used to obtain dense time series imagery of the active lava flow at Mount Etna, Sicily. The trail cameras were modified to capture timelapse imagery by adding an interval timer which triggered image capture every 10 minutes. During daylight, the cameras collected 5 M-pixel colour images and, during nighttime, they automatically switched to a 2 M-pixel camera which collected (uncalibrated) black and white infrared images.

For the color images, haze, cloud and sunglare combined with the low contrast between the active lava and its surroundings, prevented useful analysis. However, the infrared images captured at night clearly indicated the active flow areas and nighttime sequences covering the two main proximal lava channels detected significant variations in illumination. These variations represented short periods of enhanced incandescence which travelled down-channel at velocities of approximately 10-20 m/min. Over the 7 nights of measurement, the generation of these incandescent pulses was not consistent, with one night producing an average of one pulse per hour, decreasing to approximately one per night within a few nights. The pulses are interpreted to reflect short term changes in effusion rate, and their characteristics and possible causes will be discussed.