



## **The recent eruptive activity of Mount Etna (Italy) monitored by a network of visible and thermal video cameras**

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The recent eruptive activity of Mount Etna in Sicily (Italy) has been well documented by multidisciplinary instrumental observations, and significantly improved the understanding of the eruptive dynamics of this volcano. The monitoring networks are currently developed and managed by the Catania Section of the Istituto Nazionale di Geofisica e Vulcanologia (INGV). Video footage from the network of the monitoring video cameras is analyzed to discriminate between different eruptive typologies and to derive physical and dynamic properties of the eruptions. The cameras are located in four different places around the volcano (Schiena dell'Asino, Milo, Nicolosi and Catania), at respective distances of 5, 11, 15 and 27 km from the summit craters. Four video cameras record in the visible band and one in the Long-wave infrared (LWIR) over 24 hours/day. The images acquired by the Schiena dell'Asino camera are sent to a receiver in Catania, through a 10 GHz microwave transmitter, whereas the signals from the other cameras are sent to Catania via 2 GHz video transmitters and/or cable. All images are digitized on computer, and archived on video tape and in AVI format with each clip representing 15 minutes compressed using 1 frame per two seconds, which are posted on the intranet server of the institute. A GPS Time-Code adds date and time to each frame before being digitized to 640 x 480 pixels. Meaningful frames are selected for analysis from footage of significant eruptive events, through dedicated software. The cumulative error regarding the measured parameters is estimated at up to 20%. In 2006, a new FLIR Thermavision A40M infrared camera was installed at Nicolosi. The camera detector is a 320 by 240 pixel uncooled microbolometer with a spectral range from 7.5 to 13 micrometer. Vertical and horizontal viewing is 18° and 24°, respectively, with a spatial resolution of 1.3 mrad. Thermal sensitivity is 0.08°C

at 30°C. Thermal images are converted on board the camera into a single value for the peak temperature found in a region of interest centred on the active craters. This value is transmitted with a frequency of 1 Hz to the acquisition centre in Nicolosi. If a peak temperature value is less than 2°C than the preceding value then the relative change is added to the cumulative temperature value. Consequently, when the curve is near vertical the images registered by the thermal camera suggest increases in explosive/effusive activity. On the contrary, if the curve is near horizontal the radiance of the eruptive theatre is constant or in diminution. Thermal images and thermal data are processed by dedicated software developed by LabVIEW 8.0 in detecting ash-rich eruptive columns, explosive and effusive activity. All these data are available at the INGV Control Centre and are used to alert on-duty staff in the early-warning procedures. This network of cameras furnished fundamental data to the Italian Civil Defence during the 2006 eruption, when ash-rich columns several km in height severely threatened the functioning of the nearby International Airport of Catania.