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Volcano early warning system based on MSG-SEVIRI multispectral data

Gaetana Ganci (1,2), Annamaria Vicari (1), and Ciro Del Negro (1)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania, Italy (ganci@ct.ingv.it), (2) Dipartimento di Ingegneria Elettrica, Elettronica e dei Sistemi, Università di Catania

Spaceborne remote sensing of high-temperature volcanic features offers an excellent opportunity to monitor the onset and development of new eruptive activity. Particularly, images with lower spatial but higher temporal resolution from meteorological satellites have been proved to be a sound instrument for continuous monitoring of volcanic activity, even though the relevant volcanic characteristics are much smaller than the nominal pixel size. The launch of Spinning Enhanced Visible and Infrared Imager (SEVIRI), on August 2002, onboard the geosynchronous platforms MSG1 and MSG2, has opened a new perspective for near real-time volcano monitoring by providing images at 15 minutes interval. Indeed, in spite of the low spatial resolution (3 km2 at nadir), the high frequency of observations afforded by the MSG SEVIRI was recently applied both for forest fire detection and for the monitoring of effusive volcanoes in Europe and Africa.
Our Laboratory of Technologies (TecnoLab) at INGV-CT has been developing methods and know-how for the automated acquisition and management of MSG SEVIRI data. To provide a basis for real-time response during eruptive events, we designed and developed the automated system called HOTSAT. Our algorithm takes advantages from both spectral and spatial comparisons. Firstly, we use an adaptive thresholding procedure based on the computation of the spatial standard deviation derived from the immediately neighboring of each pixel to detect "potential" hot pixels. Secondly, it is required to further assess as true or false hotspot detections base on other thresholds test derived from the SEVIRI middle infrared (MIR, 3.9 μm) brightness temperatures taking into account its statistic behavior. Following these procedures, all the computations are based on dynamic thresholds reducing the number of false alarm due to atmospheric conditions.
Our algorithm allows also the derivation of radiative power at all “hot” pixels. This is carried out using the MIR radiance method introduced by Wooster et al. [2003] for forest fires. It’s based on an approximation of the Plank’s Law as a power law. No assumption is made on the thermal structure of the pixel. The radiant flux, i.e. the fire radiative power, is proportional to the calibrated radiance associated to the hot part of the pixel computed as the difference between the observed hotspot pixel radiance in the SEVIRI MIR channel and the background radiance that would have been observed at the same location in the absence of thermal anomalies.
The HOTSAT early warning system based on SEVIRI multispectral data is now suitable to be employed in an operational system of volcano monitoring. To validate and test the system some real cases on Mt Etna are presented.