Multidisciplinary Monitoring System of Eastern Sicily (Italy) devised by a specialist team (UFSO) at the INGV-Catania Section, Italy.

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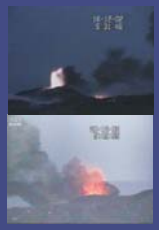
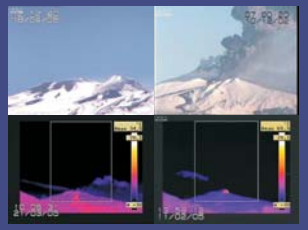
The Etna video network

Since 2001, the Catania section of the National Institute of Geophysics and Volcanology (I.N.G.V.) has been running the video stations that film the volcanic activity of the summit craters of Etna, Stromboli and the Fossa of Vulcano.
The video signals of 9 video cameras, six operating in the visible band and three in infrared, are sent in real time to the Institute operation room where they are visualized on monitors and archived on disc.
The video surveillance of the Sicilian volcanoes, situated near to densely populated areas, helps the volcanologists provide the Civil Protection authorities with updates in real time on the on-going volcanic activity.



At the moment, four video cameras are operating on Mt. Etna and they film the volcano from the south and east sides in continual mode 24 hours a day.
During emergencies, mobile video stations may also be used to better film the important phases of the activity. The single shots are published on the Catania section intranet and internet websites.

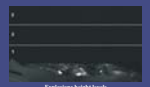


The video stations of Stromboli and Vulcano

After the destruction of the original Stromboli video station on 5 April 2003, four temporary video cameras were installed, two at a height of 400m a.s.l. (one visible and the other thermographic) and two in the Pizzo Sopra La Fossa area (one visible and the other infrared). With the installation of these cameras, for the first time in Italy, an active volcano has been monitored in continuous mode, twenty four hours a day, using infrared and thermographic video cameras.

To allow the monitoring of the Island of Vulcano crater area, a video station has also been installed at Lipari.

Vamos



Explosions height levels

Position of Stromboli craters

Parameters	Crater position	Explosion shape	Height levels
Possible values	South Central North	Narrow Wide	One Two Three

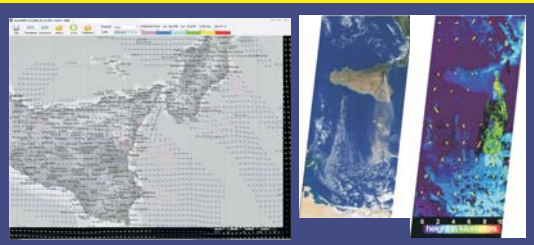
During the years of VAMOS monitoring activity, various and highly sophisticated models of video cameras have been tested and large quantities of data have been collected.
This allowed to refine a number of parameters used in the elaborations, eliminating complex image pre-processing functions that are no longer required, and freeing the computing resources needed for a new more sophisticated analisys approach.

Rate	Queue max	Max Threads	Max RAM	CPU Activity
5 fps	4	1	72	Minimal activity (<10%).
10 fps	9	1	78	Minimal activity with sporadic peaks above 10%.
15 fps	13	1	78	Minimal activity with sporadic peaks above 10%.
20 fps	19	1	82	Minimal activity with sporadic peaks above 10%.

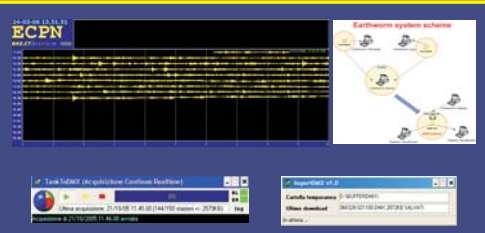
Test with a Pentium III 1 Ghz 512 MB Ram

Rate	Queue max	Max Threads	Max RAM	CPU Activity
5 fps	6	1	72	Triangle waveform with intervals of variable width and peaks up to 10%, mostly.
10 fps	11	1	86	Triangle waveform with short intervals and peaks between 40% and 45%.
15 fps	16	1	88	Constant activity around 20%, with peaks between 40% and 45%.
20 fps	23	1	82	Triangle waveform, always between 20% and 40% with sporadic peaks over 45%.

Test with a Pentium 4 3.2 Ghz 1 GB Ram



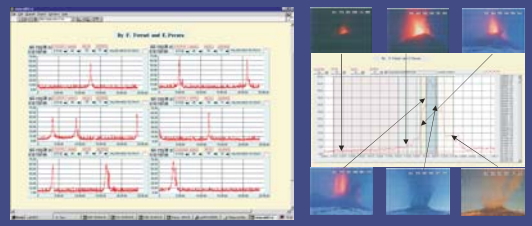
A paroxysistic episode at Etna may generate an ash column as high as 3-4 km on average, whose finer products, driven by the wind at height, can fall over the entire Etnean area. In such a way the CT- ME motorway and the Fontanarossa airport are also affected.



The INGV seismic network operates twenty four hours a day sending data in continuous mode.
Most of our seismic stations uses Earthworm system to perform acquisition and near-real time analysis of the Sicilian regional seismic network signals.
Each Earthworm node is made by one or more seismic stations.
It transmits data from remote sites to the data acquisition centre over the Net and/or dedicated links.
Earthworm is an open source system able to realize a complete monitoring system for seismic waveforms.

The resulting outputs, generated by custom software, are useful for real time analysis and alert communications; moreover using Earthworm based acquisition systems, all softwares are consistent with most of worldwide seismic networks and join the Earthworm community: local ring buffers are available to be shared by Earthworm users in order to realize a worldwide surveillance network.

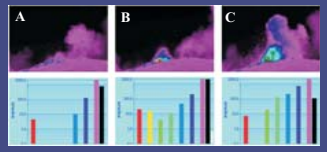
In order to improve system performance, UFSO has developed a dedicated software to generate virtual drum recorders, able to perform near-real time plots of acquired data from remote Earthworm nodes. Each node may concentrate data from many remote stations and/or other nodes, depending on their location. Wired GARR connection are used to connect the single nodes of the network.



Vota: Automatic system for the visualization and analysis in real time of volcanic tremor (Vote 1) and correlation of the volcanic tremor and images. The figure highlights well how an increase in the volcanic tremor corresponds to an intense phase of explosive activity.

Saraterm

Events classification is based on real-time processing of the image color histogram. Three main classes of events have been defined: (a) the absence of eruptive activity; (b) gas emission; (c) lava effusion.



The classification algorithm (d) uses threshold levels for a set of colors being recognized as tracers of the above phenomena. In particular, for the chosen color palette, an increase in the occurrence of color bands 1 and 2 indicates the occurrence of a lava effusion event, while an increase of color bands 3 and 4 is usually observed in the case of a gaseous emission.