Automated processing of thermal infrared images of Osservatorio Vesuviano permanent surveillance network by using Matlab code

Fabio Sansivero, Giuseppe Vilardo, and Teresa Caputo

INGV - Osservatorio Vesuviano, Napoli, Italy (fabio.sansivero@ingv.it)

The permanent thermal infrared surveillance network of Osservatorio Vesuviano (INGV) is composed of 6 stations which acquire IR frames of fumarole fields in the Campi Flegrei caldera and inside the Vesuvius crater (Italy). The IR frames are uploaded to a dedicated server in the Surveillance Center of Osservatorio Vesuviano in order to process the infrared data and to excerpt all the information contained.

In a first phase the infrared data are processed by an automated system (A.S.I.R.A. Acq– Automated System of IR Analysis and Acquisition) developed in Matlab environment and with a user-friendly graphic user interface (GUI). ASIRA daily generates time-series of residual temperature values of the maximum temperatures observed in the IR scenes after the removal of seasonal effects. These time-series are displayed in the Surveillance Room of Osservatorio Vesuviano and provide information about the evolution of shallow temperatures field of the observed areas.

In particular the features of ASIRA Acq include: a) efficient quality selection of IR scenes, b) IR images co-registration in respect of a reference frame, c) seasonal correction by using a background-removal methodology, a) filing of IR matrices and of the processed data in shared archives accessible to interrogation.

The daily archived records can be also processed by ASIRA Plot (Matlab code with GUI) to visualize IR data time-series and to help in evaluating inputs parameters for further data processing and analysis.

Additional processing features are accomplished in a second phase by ASIRA Tools which is Matlab code with GUI developed to extract further information from the dataset in automated way. The main functions of ASIRA Tools are: a) the analysis of temperature variations of each pixel of the IR frame in a given time interval, b) the removal of seasonal effects from temperature of every pixel in the IR frames by using an analytic approach (removal of sinusoidal long term seasonal component by using a polynomial fit Matlab function - LTFC_SCOREF), c) the export of data in different raster formats (i.e. Surfer grd).

An interesting example of elaborations of the data produced by ASIRA Tools is the map of the temperature changing rate, which provide remarkable information about the potential migration of fumarole activity.

The high efficiency of Matlab in processing matrix data from IR scenes and the flexibility of this code-developing tool proved to be very useful to produce applications to use in volcanic surveillance aimed to monitor the evolution of surface temperatures field in diffuse degassing volcanic areas.