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Bayesian Event Tree (BET) approach to Near Real Time monitoring on active volcanoes within ASI-SRV project: Mt. Etna test case

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ASI-Sistema Rischio Vulcanico (SRV) project is devoted to the development of a pre-operative integrated system managing different Earth Observation (EO) and Non EO data to respond to specific needs of the Italian Civil Protection Department (DPC) and improve the monitoring of Italian active volcanoes. The project provides the capability to maintain a repository where the acquired data are stored and generates products offering a support to risk managers during the different volcanic activity phases. All the products are obtained considering technical choices and developments of ASI-SRV based on flexible and scalable modules which take into account also the new coming space sensors and new processing algorithms. An important step of the project development regards the technical and scientific feasibility of the provided products that depends on the data availability, accuracy algorithms and models used in the processing and of course the possibility to validate the results by means of comparison with non-EO independent measurements.
The multivariate analysis allows to perform multiple comparisons in order to have a first idea of which variables are largely preferentially or rather rarely distributed, also considering their geographic localization.
The “Volcanic Parameter” cross correlation will allow to define the weight of each product that will be used as input in the BET-EF model (Bayesian Event Tree model for eruption forecasting) which is an already developed algorithm for the eruption model, and will be adapt, as it is, to the ASI-SRV needs. The BET model represents a flexible tool to provide probabilities of any specific event at which we are interested in, by merging any kind of available and relevant information, such as theoretical models, a priori beliefs, monitoring measures, and past data. It is mainly based on a Bayesian procedure and it relies on the fuzzy approach to manage monitoring data. The method deals with short- and long-term forecasting, therefore it can be useful in many practical aspects, as land use planning, and during volcanic emergencies.
For this work we have used a part of data that come from the monitoring of the Etna volcano, in particular the ground deformation measured by GPS stations (time series from 2002 to 2006), SO2 flux measured by COSPEC method (time series from 1996 to 2009) and the number of flank and summit eruptions from 1970 to 2009. Moreover deformation pattern analyzed with the InSar technique applied on EO Radar data and further products derived by EO optical data complete the used data set. All these data have been inserted in BET, where they have been transformed by a numerical method, with a mathematical algorithm, into likelihood of eruption.
The produced results will be disseminated through a WEB-GIS interface which will allow a multidisciplinary analysis improving the monitoring activity on Mt. Etna.