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Ensemble methods for Etna volcano warning system

Danila Scandura, Flavio Cannavò, Marco Aliotta, Carmelo Cassisi, and Placido Montalto
Istituto Nazionale di Geosifica e Vulcanologia, Osservatorio Etneo, Catania, Italy

The large amount of signals used for volcanic monitoring allow detecting volcano criticalities with unprecedented reliability. At the same time, the use of different monitoring networks makes essential the development of a system that synthesizes into a single information the overall state of the volcano. In this context, the ensemble learning techniques can play a useful role accepting different nature inputs and synthesizing the information in a single output. In broad terms, these techniques use many weak learning algorithms to achieve the best predictive performance compared to any obtained from classical learning algorithms. By averaging the results of each weak learner, the ensemble algorithms reduce the risk of using a single non-discriminative weak learning algorithm and allows for a more accurate classification.
Here we used the ensemble techniques to classify three different states of Etna volcano: 1) Quiet; 2) Strombolian activity; 3) Lava fountain. We carried out several simulations using a large data set spanning the 2011-2015 time interval, including the records of most part of monitored geophysical parameters and the corresponding volcanic state. Simulations were performed subdividing the available data into training and test sets. We checked the ability of the proposed method to recognize automatically the lava fountain episodes. To this purpose, we tested different ensemble techniques changing associated parameters and weak learners. The found system was able to identify the lava fountain episode with a reliability over 70% and to detect the beginning of lava fountain episode in the totality of the test cases. Results suggest that the proposed system can be seen as a promising tool for civil protection purposes.