Probability hazard map for future vent opening at Etna volcano (Sicily, Italy).

Alfonso Brancato (1), Giuseppina Tusa (2), Mauro Coltelli (2), and Cristina Proietti (2)

(1) University of Catania, Dept. of Biological, Geological and Environmental Science, Italy (abranca@unict.it), (2) Istituto Nazionale di Geofisica e Vulcanologia – Osservatorio Etneo, Catania

Mount Etna is a composite stratovolcano located along the Ionian coast of eastern Sicily. The frequent flank eruptions occurrence (at an interval of years, mostly concentrated along the NE, S and W rift zones) lead to a high volcanic hazard that, linked with intense urbanization, poses a high volcanic risk.

A long-term volcanic hazard assessment, mainly based on the past behaviour of the Etna volcano, is the basic tool for the evaluation of this risk. Then, a reliable forecast where the next eruption will occur is needed. A computer-assisted analysis and probabilistic evaluations will provide the relative map, thus allowing identification of the areas prone to the highest hazard. Based on these grounds, the use of a code such BET_EF (Bayesian Event Tree_Eruption Forecasting) showed that a suitable analysis can be explored (Selva et al., 2012).

Following an analysis we are performing, a total of 6886 point-vents referring to the last 4.0 ka of Etna flank activity, and spread over an area of 744 km2 (divided into N=2976 squared cell, with side of 500 m), allowed us to estimate a pdf by applying a Gaussian kernel. The probability values represent a complete set of outcomes mutually exclusive and the relative sum is normalized to one over the investigated area; then, the basic assumptions of a Dirichlet distribution (the prior distribution set in the BET_EF code (Marzocchi et al., 2004, 2008)) still hold. One fundamental parameter is the the equivalent number of data, that depicts our confidence on the best guess probability.

The BET_EF code also works with a likelihood function. This is modelled by a Multinomial distribution, with parameters representing the number of vents in each cell and the total number of past data (i.e. the 6886 point-vents).

Given the grid of N cells, the final posterior distribution will be evaluated by multiplying the a priori Dirichlet probability distribution with the past data in each cell through the likelihood.

The probability hazard map shows a tendency to concentrate along the NE and S rifts, as well as Valle del Bove, increasing the difference in probability between these areas and the rest of the volcano edifice. It is worthy notice that a higher significance is still evident along the W rift, even if not comparable with the ones of the above mentioned areas.

References

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