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Vents Pattern Analysis at Etna volcano (Sicily, Italy).

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Mount Etna is a composite stratovolcano located along the Ionian coast of eastern Sicily. It is characterized by basaltic eruptions, both effusive and explosive, occurred during a complex eruptive history over the last 500 ka. Flank eruptions occur at an interval of decades, mostly concentrated along the NE, S and W rift zones.

A vent clustering at various scales is a common feature in many volcanic settings. In order to identify the clusters within the studied area, a spatial point pattern analysis is undertaken using vent positions, both known and reconstructed. It reveals both clustering and spatial regularity in the Etna region at different distances.

The visual inspection of the vent spatial distribution suggests a clustering on the rift zones of Etna volcano. To confirm this evidence, a coarse analysis is performed by the application of χ^2- and *t-test* simple statistics. Then, a refined analysis is performed by using the Ripley K-function (Ripley, 1976), whose estimator $K(d)$, knowing the area of the study region and the number of vents, allow us to calculate the distance among two different location of events.

The above estimator can be easier transformed by using the Besag L-function (Besag, 1977); the peaks of positive $L(d)=[K(d)/\pi]^{1/2} - d$ values indicate clustering while troughs of negative values stand for regularity for their corresponding distances d ($L(d)$=0 indicates complete spatial randomness).

Spatial pattern of flank vents is investigated in order to model the spatial distribution of likely eruptive vents for the next event, basically in terms of relative probabilities. For this, a Gaussian kernel technique is used, and the $L(d)$ function is adopted to generate an optimal smoothing bandwidth based on the clustering behaviour of the Etna volcano.

A total of 154 vents (among which 36 are reconstructed), related to Etna flank activity of the last 4.0 ka, is used to model future vent opening. The investigated region covers an area of 850 km^2, divided into 3400 squared cells (50*68, each of 0.25 km^2 of area). Due to the uncertainty of the reconstructed vent position, a circular *error zone* (with radius equal to the uncertainty) is associated to these vents. For uniformity, an *error zone* is also associated to the known positions; then, after considering a regular grid spaced of 100 m, we are looking for points inside the relative *error zone*. This approach yields to the new concept of *point-vents*, and a total of 6886 of these are retrieved.

The obtained results evidence significant probability of future flank vent opening along S and NE rifts, as well as in the Valle del Bove, with minor probability to the W rift.

References

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