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A New Statistical Model for Eruption Forecasting at Open Conduit Volcanoes: an Application to Mt Etna and Kilauea Volcanoes

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One of the main goals in volcanology is to forecast volcanic eruptions. A trenchant forecast should be made before the onset of a volcanic eruption, using the data available at that time, with the aim of mitigating the volcanic risk associated to the volcanic event. In other words, models implemented with forecast purposes have to take into account the possibility to provide "forward" forecasts and should avoid the idea of a merely "retrospective" fitting of the data available. In this perspective, the main idea of the present model is to forecast the next volcanic eruption after the end of the last one, using only the data available at that time. We focus our attention on volcanoes with open conduit regime and high eruption frequency. We assume a generalization of the classical time predictable model to describe the eruptive behavior of open conduit volcanoes and we use a Bayesian hierarchical model to make probabilistic forecast. We apply the model to Kilauea volcano eruptive data and Mt. Etna volcano flank eruption data.

The aims of this model are: 1) to test whether or not the Kilauea and Mt Etna volcanoes follow a time predictable behavior; 2) to discuss the volcanological implications of the time predictable model parameters inferred; 3) to compare the forecast capabilities of this model with other models present in literature. The results obtained using the MCMC sampling algorithm show that both volcanoes follow a time predictable behavior. The numerical values of the time predictable model parameters inferred suggest that the amount of the erupted volume could change the dynamics of the magma chamber refilling process during the repose period. The probability gain of this model compared with other models already present in literature is appreciably greater than zero. This means that our model performs better forecast than previous models and it could be used in a probabilistic volcanic hazard assessment scheme. In this perspective, the probability of eruptions given by our model for Mt Etna volcano flank eruption are published on a internet website and are updated after any change in the eruptive activity.