Non–magmatic branches in the Bayesian Event Tree for eruption forecasting (BET_EF), and their implications for unrest tracking

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In the previous set up of the Bayesian Event Tree for eruption forecasting (BET_EF), only magmatic eruptions are considered. However, non–magmatic events, such as increased hydrothermal, seismic or phreatic activity, are often obvious signals of volcanic unrest that may cause damages. Here we propose an implementation of the BET_EF that may account for these kind of non–magmatic risks related to volcanic areas. This implementation requires a modification at the second node of the Event Tree where the nature of the unrest is introduced. In order to assign the probability to the new branches of Node 2, suitable monitoring parameters, and thresholds should be established; ultimately, this requires a more profound understanding of the delicate transition from volcanic quiescence to unrest, and of the differences in the processes generating different kinds of volcanic unrest (e.g., what could be a precursor for a phreatic eruption?). We think that this further ramification of the BET_EF code will bring several advantages: it permits to (1) better describe the cause of unrest of any volcano, also including the numerous volcanoes in a state of non–magmatic unrest, not considered earlier, (2) forecast the evolution of non–magmatic unrest into non–magmatic eruptions (Node 3) that pose direct volcanic hazard without magma involvement (e.g., phreatic eruptions, mechanic failure of volcanic edifices, gas hazard), and (3) quantify the probability of non–magmatic unrest being precursory signals themselves when building up towards magmatic unrest or magmatic eruptions (e.g., tectonic earthquakes triggering an eruption, transition from phreatic to phreatomagmatic eruptions). The latter point implies strong modifications in the numerical calculations of the BET_EF probabilities. This research is part of the VUELCO project; the proposed modifications are useful to better describe volcanic unrest, especially for the closed–conduit target volcanic systems of Campi Flegrei (Italy), Morne Aux Diables (Dominica), Teide (Tenerife, Spain), Cotopaxi (Ecuador) and Soufrière Hills (Montserrat).