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Recurrent patterns in fluid geochemistry data prior to phreatic eruptions

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Not all volcanic eruptions are magma-driven: the sudden evaporation and expansion of heated groundwater may cause phreatic eruptions, where the magma involvement is absent or negligible. Active crater lakes top some of the volcanoes prone to phreatic activity. This kind of eruption may occur suddenly, and without clear warning: on September 27, 2014 a phreatic eruption of Ontake, Japan, occurred without timely precursors, killing 57 tourists near the volcano summit. Phreatic eruptions can thus be as fatal as higher VEI events, due to the lack of recognised precursory signals, and because of their explosive and violent nature.
In this study, we tackle the challenge of recognising precursors to phreatic eruptions, by analysing the records of two "phreatically" active volcanoes in Costa Rica, i.e. Poás and Turrialba, respectively with and without a crater lake. These volcanoes cover a wide range of time scales in eruptive behaviour, possibly culminating into magmatic activity, and have a long-term multi-parameter dataset mostly describing fluid geochemistry. Such dataset is suitable for being analysed by objective pattern recognition techniques, in search for recurrent schemes. The aim is to verify the existence and nature of potential precursory patterns, which will improve our understanding of phreatic events, and allow the assessment of the associated hazard at other volcanoes, such as Campi Flegrei or Vulcano, in Italy. Quantitative forecast of phreatic activity will be performed with BET_UNREST, a Bayesian Event Tree tool recently developed within the framework of FP7 EU VUELCO project. The study will combine the analysis of fluid geochemistry data with pattern recognition and phreatic eruption forecast on medium and short-term. The study will also provide interesting hints on the features that promote or hinder phreatic activity in volcanoes that host well-developed hydrothermal circulation.