Geophysical Research Abstracts
Vol. 16, EGU2014-1292, 2014
EGU General Assembly 2014

Predictability skills of a multi-parameter monitoring on Piton de la Fournaise volcano (Reunion island).

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Volcanic eruptions impact on societal risk, and volcanic hazard assessment is a necessary ingredient for decision-makers. However, the prediction of volcanic eruptions remains challenging due to the complexity and the non-linearity of volcanic processes. Identified forerunners such as increasing seismicity or deformation or velocity changes within of the volcanic edifice prior to eruption are not deterministic. On Piton de la Fournaise volcano, we analyzed the short-term (i.e. the inter-eruptive period) time series of the seismicity rate, the deformation and the seismic velocity changes (deduced from seismic noise cross-correlations) over the period 2000-2007, with two main goals. First, we characterize the average pre-eruptive time patterns before 23 eruptions using superposed epoch analysis for the three observables. Second we use pattern recognition techniques and the formalization of error diagrams to quantify the predictive power of each forerunner either as used independently or as combined to each others. We show that when seismicity rate alone performs the best in the failure to predict and alarm duration space, the combination of the displacement and seismicity data allows reducing the false alarm rate. We further propose a tool that explores the prediction results in order to optimize prediction strategy for decision-makers, as a function of the risk value.