# Predicting unpredictable systems: Can statistics help us forecast volcanic eruptions?

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In some respects, volcanoes are inherently unpredictable systems. However, preceding many volcanic eruptions measurable signs of unrest are often identifiable, which can often been seen to occur with a periodic nature. The identification of statistical patterns within precursory datasets may allow the use of probabilistic models to better understand deviations of physical phenomena at volcanoes. In particular, the identification of precursory seismicity at volcanoes has the added advantage of quick determination in real time of deviations from background levels which could indicate volcanic unrest.

The identification of precursory seismic activity ($\Omega$) prior to dome collapse at Soufriere Hills volcano, Montserrat allows some assessment of possible forecasting models. Low frequency seismic swarms which are related to the movement of fluid at depth can be seen to accelerate prior to dome collapses, which has been identified as a tool to use in real-time forecasting. Results from several known dome collapses between 1996 and 2007 suggest that a linearised power law relationship between the average rate of seismicity ($\frac{d\Omega}{dt}$) and the timing of the swarms ($t$) continuously overestimates the timing of the dome collapse. We therefore investigate the possibility of a different power law relationship to determine a more accurate timing of collapse.

Current models, including those adapted here, assume a direct link between seismicity at depth and a dome collapse on the surface, with little consideration of the transfer function or link between the two. A greater understanding of this transfer function and the physical relationship between what occurs at depth and what occurs on the surface shall be investigated through the development of conceptual models. Only once we have a better understanding of this function can we further develop the tools necessary for forecasting volcanic phenomena.