

Assessing correspondence between volcanic activity and evacuation using time series and timeline data: forensic analysis from Soufrière Hills Volcano, Montserrat, 1996-2009

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Key words: Volcanic hazard, evacuation, timeseries analysis, forensic analysis

During a volcanic crisis, the usual response to an imminent and immediate threat to human life is to evacuate populations to safer areas. However, the scientific advice and civil authority decision-making processes are often complex, and improved understanding of their basis and interactions may help inform future crisis management. We explore the relationship between volcanic activity and evacuation of inhabited areas in order to investigate and characterise the drivers and timescales of volcanic crisis management during a prolonged period of escalating volcanic activity using examples from the eruption of Soufrière Hills Volcano, Montserrat, 1996 – 2009. An elemental time series approach is used to objectively quantify timeline relationships between the physical volcanic hazard and responses from risk-based decision making. Three representations of volcanic hazard are used: the total cumulative runout of pyroclastic density currents (a metric for the outcome of hazardous activity); the area evacuated (outcome of risk-based decision making), and seismic activity (an indicator of actual and ‘potential’ hazard). We compare time-series of these hazard expressions with an independent forensic analysis of available records of volcanic activity and response to risk by actions from decision-makers and the population. Nine evacuations took place in the periods April 1996 - December 1997 and January 2007-December 2009. Our analysis of both these periods identified weaker correlations between observed activity and evacuation when there was less surface activity or the volcano was entering a new style of eruptive behaviour, such as rapid dome growth, with the latter changes more prevalent in early stages of the eruption. Although these findings show that both observed and potential hazard are likely to influence evacuation decision-making over timescales of a few days, our qualitative analysis shows that other social processes, such as the necessity to maintain livelihood, can also exert a strong influence.