Effective decision making during volcanic crises using operations research and bayesian decision theory

Rosa Sobradelo[1], Rosa Sobadelo[2], Joan Marti[1], Christopher Kilburn[2], Stefania Bartolini[1]

[1]Group of Volcanology, SIMGEO-UB (CSIC), Institute of Earth Sciences Jaume Almera, Spain, [2]Aon Benfield UCL Hazard Centre, Department of Earth Sciences, University College London, UK

E-mail: rsobradelo@ictja.csic.es

Understanding the potential evolution of a volcanic crisis is crucial to improving the design of effective mitigation strategies. This is especially the case for volcanoes close to densely-populated regions, where inappropriate decisions may trigger widespread loss of life, economic disruption and public distress. An outstanding goal for improving the management of volcanic crises, therefore, is to develop objective, real-time methodologies for evaluating how an emergency will develop. Here we use operations research to show how evaluations can be improved during the different stages of an emergency by applying a Decision Model Architecture for volcanic crisis management.

Operations Research (OR) is a field of mathematics that uses advanced analytical methods to help make better decisions, and to arrive at optimal solutions to complex decision-making problems. We use a Bayesian Decision Theory approach from OR to design a model framework that incorporates decision making at all the stages of a volcanic crisis. The model combines the multiple hazard and risk factors that decision makers need for a holistic analysis of a volcanic crisis. These factors include all possible eruptive scenarios and their probabilities of occurrence, the evolution of the monitoring parameters, the evaluation of the population at risk, the evacuation time associated with each eruptive scenario, the cost of a false alarm, and the cost of a failed forecast. The combined results identify the most likely scenarios and provide the basis for establishing a range of recommended actions as an emergency evolves.