



Under which conditions, additional monitoring data are worth gathering for improving decision making? Application of the VOI theory in the Bayesian Event Tree eruption forecasting framework

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Standard and new generation of monitoring observations provide in almost real-time important information about the evolution of the volcanic system. These observations are used to update the model and contribute to a better hazard assessment and to support decision making concerning potential evacuation. The framework BET_EF (based on Bayesian Event Tree) developed by INGV enables dealing with the integration of information from monitoring with the prospect of decision making. Using this framework, the objectives of the present work are i. to propose a method to assess the added value of information (within the Value Of Information (VOI) theory) from monitoring; ii. to perform sensitivity analysis on the different parameters that influence the VOI from monitoring. VOI consists in assessing the possible increase in expected value provided by gathering information, for instance through monitoring. Basically, the VOI is the difference between the value with information and the value without additional information in a Cost-Benefit approach. This theory is well suited to deal with situations that can be represented in the form of a decision tree such as the BET_EF tool.

Reference values and ranges of variation (for sensitivity analysis) were defined for input parameters, based on data from the MESIMEX exercise (performed at Vesuvio volcano in 2006). Complementary methods for sensitivity analyses were implemented: local, global using Sobol' indices and regional using Contribution to Sample Mean and Variance plots. The results (specific to the case considered) obtained with the different techniques are in good agreement and enable answering the following questions: i. Which characteristics of monitoring are important for early warning (reliability)? ii. How do experts' opinions influence the hazard assessment and thus the decision? Concerning the characteristics of monitoring, the more influent parameters are the means rather than the variances for the case considered. For the parameters that concern expert setting, the weight attributed to monitoring measurement ω , the mean of thresholds, the economic context and the setting of the decision threshold are very influential.

The interest of applying the VOI theory (more precisely the value of imperfect information) in the BET framework was demonstrated as support for helping experts in the setting of the monitoring system or for helping managers to decide the installation of additional monitoring systems.

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