The Montserrat Volcano Observatory: its evolution, organization, rôle and activities.

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Abstract

The Montserrat Volcano Observatory (MVO) is a statutory body of the Government of Montserrat, and is the agency responsible for volcano monitoring operations on the island of Montserrat, in the West Indies. It was formed shortly after the first phreatic explosions from the Soufrière Hills Volcano occurred on 18 July 1995, and evolved from a hastily created, loose interim entity to a fully established volcano monitoring operation. Participating scientific teams have been drawn mainly from the Seismic Research Unit of the University of the West Indies, the U.S. Geological Survey, the British Geological Survey and various US and UK universities. Valuable support has come from the University of Puerto Rico and the Institut de Physique du Globe de Paris through its Observatories in Guadeloupe and Martinique. Despite its hurried inception, the MVO has been able to provide timely, high quality hazard advice to the civil authorities and has maintained an exceptional record of all scientific aspects of the eruption. Its public education and information efforts have been extensive, and there have been unusually high levels of interaction between scientists and the civil authorities, and between scientists and the public, both within Montserrat and outside in the wider world. The experience of setting up and running the MVO under difficult conditions has exemplified the advantages of teamwork and flexibility within monitoring operations, and the benefits of openness and clarity in public interactions.

As things stood then, it is perhaps not surprising that differing perceptions of the balance of risk and economic imperative overlapped into another area where substantial difficulties always arise in a volcanic crisis: the articulation of scientific uncertainty in the forecasting of future activity. Where the public is exposed to a given hazard, natural or otherwise, the lack of sufficient knowledge to quantify the attendant risk(s) with useful accuracy impinges upon a government’s ability to comprehend, and justify, the extent to which steps should be taken to eliminate or reduce that risk. In the first few weeks of the Montserrat crisis there was perhaps, at times, some unwarranted scientific dogmatism about what might or might not happen at the volcano,
especially in terms of it turning magmatic and explosive. The confounding effects of these diverging, categorical stances were then compounded for a short while by an overall diminution in communication between scientists and the various civil authorities. The result was a dip in the confidence of the authorities in the MVO team and, with it, some loss of public credibility; this was not fully restored until later, when a consensual approach was achieved.

5.3 Expert Elicitation
In an attempt to provide good advice to the decision-makers in the form of scientific consensus, a formalised procedure for eliciting expert judgements was adopted by the MVO in August 1995. This became necessary due to the need to provide urgent daily advice to the authorities at a stage when the nature and magnitude of future volcanic activity was most uncertain, and time for repeated and protracted scientific debates amongst a large group was just not available. Arriving at an agreed position each day by committee took an increasing amount of time and this became frustrating both for the scientists, who needed to press on with observations and measurements, and for the authorities who found it preferable to have a rapid and definitive answer provided as promptly as possible.

The formalized procedure which was introduced is based on the "Classical Model" for structured expert judgement (Cooke, 1991), following the suggestion first made at the International Symposium on Large Explosive Eruptions in Rome in 1993 to consider using this approach for producing a collective scientific opinion in a volcanic crisis (Aspinall and Woo, 1994). The method performs weighted combinations of expert judgments, where weights are determined by 'calibration' and 'information' performance on questions for which the true values are known, or become known a posteriori. However, in application, the procedure had to be adapted to the needs of real time crisis management. In open meetings, where some preferred to hold their counsel, others were more forceful in giving their opinions so, from the outset, it was felt better to focus the procedure on quantifying the informativeness of each individual's views, rather than rely too heavily on a hurried and questionable calibration score. (The problems of calibrating the expertise of a group of volcanologists are non-trivial at the best of times, let alone with an eruption going on outside the window!). This emphasis on informativeness (or degree of conservatism) meant there was an implicit assumption that roughly equal expertise attached to each member of the team, a reasonable supposition for the initial scientific group assembled in Montserrat. In fact, when the concepts of this approach were being introduced to the administrators and scientists it was novel to most, and several pressed for the scheme to be administered in such a way that no single participant was ever zero-weighted: all views would be used with some weight in the decision process. However, in order to bring an element of calibration into play, a preliminary set of five suitable seed questions was hastily prepared. While this set was aimed primarily at measuring the individual's informativeness factor, it was also used to provide a basic measure of how well each person might make quick judgements on issues related to safety and hazard mitigation in an emergency. The latter element of the exercise was undertaken, with general agreement, as an exploratory trial of the method in application in a live crisis. Therefore, the emphasis in the seed questions was placed on judgement of generic hazard-related variables and factors - such as percentage casualties from different sorts of volcanic action; durations of eruptions, and so on - rather than on the science of volcanology itself. Devising a broad range of fair technical questions to encompass geologists of all kinds, geodesists, geochemists and seismologists, for full execution of the procedure, was impracticable under the circumstances.
As the emergency progressed month by month, three shortcomings with the adopted approach emerged. First, having once used the initial set of seed questions for calibration, for uniformity these had to be repeated for scientists subsequently joining or replacing others in the team; over the course of three year’s activity, a total of more than sixty individual scientists and technical specialists participated in the different elicitations, although there were generally only between five and twenty present at any one time (to everyone’s credit, the calibration facts were not leaked to new arrivals at the observatory). Secondly, an experienced technical facilitator was not always available in Montserrat to supervise the elicitations, and thirdly, there was a fluctuating mandate to undertake formal elicitations as conditions and levels of anxiety varied. Notwithstanding these slight drawbacks, the approach was very successful in handling key ongoing issues, such as regular assessments of the scientific team's "comfort" with the current alert level.

There were divided opinions amongst the scientific group as regards the utility and soundness of the method, based as it is on concepts of subjective probability which are new to many, and, with an experienced technical facilitator not always available at the MVO, the technique was not used continuously. However, the majority of scientists supported the approach. After being discontinued in late 1995, the methodology was again re-introduced after the 17 September 1996 explosive eruption. It was then used more widely in the decision making process, being integrated into the alert scheme and used on a weekly basis to assist the Chief Scientist in Post to determine the appropriate level of alert. The method continued in operation in this context until the alert scheme was simplified in July 1997. Its use for assessing the appropriate alert level gave continuity to the decision making process, and provided a traceable record through time of the views of the scientific team (see, for example, Figure 13). Further details on the theory and potential application of this technique to volcanic crises are given in Aspinall and Woo (1994), and a brief account of its use at the MVO is contained in Aspinall and Cooke (1998).