Lessons learned from eruption scenarios and Kilauea 2020 response

(Kari Cooper, August 2022)

Data and samples collected during well-studied and well-monitored eruptions can lead to dramatic increases in our understanding of processes driving volcanic eruptions. However, the necessary shift to prioritize issues of public safety and hazard mitigation during a crisis means that scientific opportunities can be sacrificed. Thus, maximizing the scientific gains from eruptions requires coordinating science activities before and during volcanic eruptions so that we as a community can capitalize on opportunities to collect critical information and samples.

Scenario exercises

A critical component of CONVERSE is to facilitate cooperation between scientists at academic institutions and the U.S. Geological Survey, which is responsible for volcano monitoring and hazard assessment at domestic volcanoes. Since 2019, CONVERSE has conducted several workshops to allow groups representing the various disciplines in volcanology to formulate specific science questions that can be addressed with data collected during an eruption response and assess their capacities for such a response.

In November 2020, CONVERSE conducted a virtual response scenario exercise based on a hypothetical eruption of Mount Hood in the Oregon Cascades. Approximately 80 scientists participated for one or more days. The goal of the exercise was to test the effectiveness of forming a science advisory committee (SAC) as a model for facilitating communications between responding USGS volcano observatories and the U.S. academic community. More details on the scenario can be found in the EOS article (Fischer et al. 2021).

From February 4 to March 4, 2022, CONVERSE orchestrated a scenario exercise in response to a monogenetic volcanism event to develop a coordinated response plan for the US volcano science community. Over 60 scientists from both academic and governmental spheres participated. The scenario exercise featured volcanic activity in the San Francisco Volcanic Field (SFVF). As the scenario events unfolded, participating scientists collaborated in both disciplinary and transdisciplinary groups to identify fundamental science questions that an effective response would help address, and then proposed and ”executed” plans to collect critical data and develop timely models. Analogous to a real volcanic crisis situation, these proposals were reviewed by a Scientific Advisory Committee (SAC) set up for the region and tasked with orchestrating collaborative response activities. The scenario exercise was assessed for its effectiveness in co-generating knowledge, catalyzing transdisciplinary collaboration, supporting research confidence, and fostering a culture of inclusion within the volcanology community, which identified a clear need to support early career researchers through community. The 2022 CONVERSE exercise demonstrated how a fully remote, extended

scenario can be authentically implemented to coordinate science and co-generate knowledge. A full description of the scenario exercise, its outcomes and recommendation are published in Lin et al., (in preparation).

Common themes from scenarios

Conducting these scenario exercises demonstrated that such tabletop exercises can be a very effective way to practice eruption response, including testing models for interactions between observatory scientists and the broader community and identifying sticking points and challenges. In addition, the interactions that occur between individuals and groups within the context of these scenarios are good ways to build community and trust and as a result could help facilitate interactions during an actual event.

One common theme from the scenario exercises (and the Kilauea 2020-2021 eruption response) is that in all cases, being able to maximize the science done during an eruption requires a significant effort in pre-planning and preparation well in advance of the eruption, including:

- A plan for what samples/data are time sensitive and thus critical to collect during the response (e.g., time-series data, ephemeral samples). These plans need to be detailed enough so that any field team could conduct them, regardless of their specific expertise, because especially early on in a response it is unlikely that many teams will be allowed access to the volcano.
- Making connections between observatory and non-observatory scientists, building community, and building trust are critical to having any kind of outside participation in an eruption response. It is impossible to build these connections during the response because too much is going on, therefore it is necessary for this community-building to happen before eruption begins.

Remaining challenges identified from scenarios

The scenario exercises also identified some challenges that will require further community input and discussion. For example, what is the best way for the entire group of scientists to communicate during an eruption? A challenge with open communication is that much of the observatory data are behind a firewall, and in some cases can't be shared during the response because they could be sensitive information. An additional challenge is that even when things can be shared, the time to do so is limited. Therefore, a careful plan of how to communicate, and what to communicate between observatories and the broader scientific community is needed.

A second challenge is how to facilitate opportunities to have non-observatory scientists helping with eruption response efforts in a way that is useful to and that reduces the burden on observatory scientists? Some types of help from the broader community could be mutually beneficial because, for example, reducing the operational load on observatory scientists will

lead to those scientists having more ability to collect critical data and samples to advance the science. Many non-observatory scientists also are contributing expertise that builds on broader studies than just the particular eruption or volcano. This expertise may be valuable during eruption response. In addition, the opportunity to be involved in eruption response can be useful to the broader scientific community, especially early-career scientists who may be interested in pursuing a career in volcano science.

Kilauea 2020:

One tool to facilitate scientific coordination between observatory scientists and the broader scientific community is a Scientific Advisory Committee (SAC). CONVERSE has been developing and testing this concept during workshops and scenario-based activities like those described above. The December 2020 eruption of Kīlauea volcano, Hawai‘i, provided an opportunity to test and refine this model in a real-world setting. We present in a manuscript (Cooper et al., in review) details of the working model of a SAC developed during this eruption (Kīlauea SAC, or K-SAC), including discussion of the aspects of this model that worked well in this instance, and those that could be improved or modified. Briefly, successes of K-SAC included broadening participation of scientists involved in activities during the eruption, and developing and codifying procedures that form the basis of operation for SACs. Challenges encountered by the K-SAC showed that 1) the process of review of research proposals and making new connections between scientists was too slow to maximize the science done during an eruption, and 2) the purely advisory role of the SAC meant that final decisions still fell on the HVO SIC during the eruption, which did not lessen the workload in the way that had been envisioned. Possible ways to address these challenges include:

1) CONVERSE-supported activities between eruptions that build community and make connections between scientists such as workshops and scenario exercises such as funds for internships and visits
2) Pre-planning science activities that would facilitate more rapid implementation across a broader scientific group. Examples of this could be, developing a list of high-priority sample and data collection and the protocols for such collections so that field teams could collect the samples/data when conditions allow; developing potential research projects with observatory and non-observatory scientists before eruptions so that proposals could be submitted quickly during an event; and potentially writing generic proposals for rapid response that could quickly be modified and submitted to funding agencies during an eruption.
3) Continued discussion between observatory scientists, emergency responders, and academic scientists about the role of SACs and the best decision-making structure to support public safety and hazard mitigation as well as maximizing scientific returns.

The SAC model has promise as an integral part of these efforts moving forward, which will lead in the short and longer term to more effective hazard mitigation and greater scientific understanding.

References

Fischer, T.P., Moran, S., Cooper, K., Roman, D. and LaFemina, P., 2021. Making the most of volcanic eruption responses. EOS 102: https://eos.org/science-updates/making-the-most-of-volcanic-eruption-responses.

Lin, Y.C et al., (in prep.) Lessons Learned from the 2022 CONVERSE Monogenetic Volcanism Response Scenario Exercise