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Developing Effective Communication Practices for the International Community of Volcano Observatories

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Volcano observatories worldwide have comparatively different roles and responsibilities but share a similar objective: to provide situational awareness information to reduce risk from volcanic hazards. The skills and abilities of communication professionals at volcano observatories are as varied as the countries in which they reside. Resource challenges for effective and practiced communication include staffing, expertise, time, and budget. To better understand successful practices and challenges to be addressed, the fifth Volcano Observatory Best Practices meeting in November 2023 focused on improving communication for risk reduction. The meeting in Pucón, Chile, hosted about 70 participants from 28 countries who work in volcano observatories, research hazard communication, or are authorized to report volcano hazards and associated safety information.

Because many observatories lack dedicated communications professionals, the meeting was designed to introduce communication and behavioral theory, encourage sharing experiences, and facilitate discussion about practices and challenges as a global community. Common themes included building and maintaining trust; fostering relationships with communities, stakeholders, and research organizations; assessing and meeting end-user needs; addressing diverse populations; leveraging traditional and social media to amplify factual content; developing intra-observatory communication strategies and strengths; and evaluating communication efforts after a crisis. Attendants expressed that one of the most helpful topics to learn is the behavioral science associated with how people understand and respond to information about hazards and risks. An outcome of this meeting will be to develop a clearinghouse of shared resources that observatories can use to inform communication strategies and practices during and in between volcanic crises.

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Anticipatory Action and Early Action for Volcanic Crises: USAID/BHA and USGS Achievements and Remaining Challenges

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The U.S. Agency for International Development (USAID) Bureau for Humanitarian Assistance (BHA) is the lead U.S. government agency that coordinates international disaster assistance, harnessing the expertise of other U.S. government entities to effectively respond to natural disasters and complex crises worldwide.

For over 30 years, USAID/BHA has supported anticipatory action (AA) and early action (EA) through building local, national, and regional disaster-response capabilities to address natural hazards, including volcanoes. EA is a set of actions to reduce the impacts of a hazardous event before they fully unfold predicated on a forecast or risk analysis. AA is defined by the G7 as acting ahead of predicted hazards to reduce humanitarian impacts, requiring pre-agreed plans, reliable early-warning information, and pre-arranged financing that is released when an agreed trigger point is reached. EA/AA systematically links scientific communities with practitioners through establishing predetermined actions tied to monitoring/forecasting thresholds.

The jointly funded U.S. Geological Survey (USGS)-USAID/BHA Volcano Disaster Assistance Program (VDAP) helps counterparts address volcanic hazards and reduce risks worldwide. Since its inception in 1986, VDAP has supported AA/EA through assisting with developing early- warning systems and providing technical advice for eruption forecasting and impact evaluation. Counterparts' AA/EA have led to evacuations and closures of threatened infrastructure. While AA/EA is not new, there are aspects that should be further explored, including its effectiveness, the appropriate triggers for actions, and the sustainability and localization of AA/EA.

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Recent USGS Volcano Science Center tabletop exercises: preparation and planning for crises

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Over the past few years, the USGS Volcano Science Center (VSC) has conducted several tabletop exercises to prepare for potential volcanic crises in the U.S. We facilitated a 2021 eruption forecasting exercise focused on Mauna Loa volcano, Hawai‘i and a 2023 exercise using a volcanic event scenario at Newberry Volcano, Oregon. In the Mauna Loa exercise, participants learned about eruptive history and discussed potential vent locations, hazards, eruptive sequences, lava flow travel paths and lava advance rates. Participants discussed geophysical, geochemical, geodetic, and observational monitoring, conceptual models of the Mauna Loa subvolcanic system, and possible precursors to a future Mauna Loa eruption.

In the Newberry tabletop, participants learned about the eruptive history of Newberry Volcano and tested parts of the VSC’s “Response Plan for Significant Volcanic Events”. A key feature of the plan is an Incident Command System (ICS)-like organizational framework called the "Observatory Volcanic Event Response Team", or OVERT, that includes a hierarchical chain-of-command structure that follows the ICS’ span-of-control principle. The OVERT framework was designed to provide observatory Scientists-in-Charge with a checklist of crisis activities, to clarify roles and responsibilities for those working in the response, to streamline communications and decision-making, and to ensure that no individual is doing too much.

The exercises were run virtually so that staff from all USGS observatories could participate. Over 60 people participated in the first and 100 people participated in the second exercise, with self-reported high levels of engagement and marked increases in cross-disciplinary understanding and institutional learning throughout.

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The value chain approach for analysing warning systems and improvements – demonstrated for Hunga Tonga-Hunga Ha'apai

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Since late 2020, an international collaborative project, the High Impact Weather Project, under the World Meteorological Organization's World Weather Research Programme, has been developing guidance and tools for using value chain approaches to evaluate the end-to-end warning chain during severe weather and related events. Value chain approaches have a number of applications in this context including the design or improvement of a warning service or case study analysis. The project team contains a balanced mixture of physical and social scientists, leading to some fascinating interchanges and deepening understanding of how warning processes can be effective. Although the genesis of the work has been in hydrometeorology, a common analysis framework is potentially very useful across all natural hazards, for driving interdisciplinary improvements in multi-hazard warnings and ensuring an inclusive approach to science. Here we will show a simple value chain analysis for the extraordinary January 2022 Hunga Tonga-Hunga Ha'apai eruption, and discuss the potential application of the tool for future volcanic crises and for designing better warning systems.

ID: 255

The U.S. National Landslide Hazard Reduction Program: Opportunities to inform volcanic risk assessment and crisis management

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Volcanic mass wasting events, including landslides and lahars, pose a serious risk to life and property in drainages on and around volcanoes. Addressing this risk requires effective transdisciplinary collaboration between volcanologists, landslide scientists, and decision makers to enable the use of science and technology in an operational context. The newly established U.S. National Landslide Hazard Reduction Program, led by the U.S. Geological Survey, aims to reduce risk and losses from landslides of all types across the United States. It presents an opportunity to enhance collaborations between the USGS Landslide Hazards Program, Volcano Hazards Program, and their federal, state, and academic partners that improve characterization and communication of hazards and risks related to ground failure on volcanic slopes. We will share examples of current work at the science–operational interface and discuss what makes them successful. For example, the USGS-led Rainier Lahar Detection System is operated in partnership with state and local emergency managers, academics, and the National Park Service to detect and enable emergency alerting for lahars that threaten population centers on the slopes of Mount Rainier. In a non-volcanic setting, ground-based monitoring of the potentially tsunamigenic Barry Arm landslide in Prince William Sound, Alaska, has enabled relationship building and technology development that can be leveraged to benefit regional volcano monitoring and response efforts. We will also discuss how the National Landslide Hazard Reduction Program can build on these partnership models to improve multi-hazard risk assessment and preparedness in volcanic settings.

ID: 324

Ensemble Short-Term Eruption Forecasting at Vulcano Island (Aeolian Islands, Italy)

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One of the goals of volcanology is to produce a reliable forecast of volcanic eruptions. Short-term eruption forecasts consists of the quantification of the time varying probability based on the interpretation of monitoring signals through statistical models based on geological background, past history, as well as on expert judgement. When probabilistic models are adopted, only a single model is generally used, while ensemble of alternative models are widely used in many fields (including weather forecasting, seismology and, more recently, also volcanology) to obtain more reliable forecasts and more hints about the uncertainty on the forecasts. Here, we preliminary implemented two alternative models, the Bayesian Belief Network (BBN) and the Bayesian Event Tree (BET), for eruption forecasting at Vulcano (Aeolian Islands, Italy) and we merged them into an ensemble model. The obtained ensemble is applied to the exercise ”Vulcano 2022” organized by the Italian Civil Protection in April 2022 to simulate an escalation toward a potential eruption, organized following a recent unrest started in 2021. The forecast is focused on magmatic and phreatic eruptions, as well as on large flank collapses.

ID: 541

National and international contributions during La Palma (Canary Islands, Spain) eruption

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The eruption of La Palma, spanning from September 19 to December 13, 2021, holds historical significance as the most substantial volcanic eruption to affect Europe in the past 75 years. The eruption necessitated the evacuation of over 7,000 individuals, led to the destruction of 1,550 buildings, obliterated 69 kilometers of roads, and buried 348 hectares of crops beneath layers of lava. This crisis served as a remarkable opportunity to underscore the indispensable role of scientific-technical collaboration during volcanic emergencies.

Throughout the Tajogaite volcanic eruption, the Canary Islands Volcanological Institute (INVOLCAN) spearheaded efforts to engage a myriad of national and international scientific institutions, thereby optimizing the scientific management of the unfolding eruption. A total of 93 dedicated researchers, comprising 14 from Spain and 79 from abroad, represented 42 scientific institutions, including seven Spanish and 35 foreign entities. Their collaborative efforts spanned various domains, encompassing the analysis of volcanic gas geochemistry, seismology, geodesy, thermography, and petrology.

The Tajogaite eruption marked a historic milestone as the first instance of such extensive scientific collaboration during a volcanic event of this scale. This exemplifies a paradigm shift in scientific management strategies for future volcanic crises, illustrating the potential for enhanced preparedness and response through international cooperation and knowledge sharing.

ID: 700

Co-producing the ECLIPSE programme with the Caldera Advisory Group, supporting the first Aotearoa NZ alert level rise for a supervolcano

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ECLIPSE (Eruption or Catastrophe: Learning to Implement Preparedness for future Supervolcano Eruptions) is a just-completed 6-year large multi-institutional research programme. It involves scientists across Aotearoa New Zealand in co-producing research, resources and plans with local and national emergency managers, mana whenua (Māori land owners) and the GeoNet Volcano Monitoring Group (VMG) through the interagency Caldera Advisory Group (CAG). CAG addresses planning and coordination activities for Te Ahi Tupua (known also as central Taupō Volcanic Zone calderas).

ECLIPSE was fortuitously timed: in 2022 unrest at Taupō resumed. Magma system understanding and earthquake location approaches from ECLIPSE aided the VMG in faster, more confident interpretations of the unrest. As a Volcanic Alert Level (VAL) rise became more likely, scientists from ECLIPSE, GeoNet and other key national programmes, in partnership with national emergency managers and CAG, developed messaging and resources. The VMG raised the VAL to 1 (minor unrest) on 20/9/2022. The team, together with scientists in the wider New Zealand Volcano Science Advisory Panel, also sketched out potential future scenarios, probabilities and possible impacts that were widely communicated to stakeholders, responding agencies and the public. Programme social scientists demonstrated that the scenarios and communications package were widely valuable, including across central government - notably the Ministry of Finance and the Director of Civil Defence Emergency Management. Media and public responses to the alert level rise were well informed and matched to the levels of increased risk, largely attributable to the broadly co-produced science and communication material.

ID: 85

Global Eruption Event Chronologies: A Call for Community Discussion

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Major advances have been made in recording and accessing global volcanic activity that is instrumentally monitored. However, observational data about volcanic events (e.g., flows, explosions) and their properties (e.g., length, volume) are largely available only as narratives in literature and observatory reports that cannot be easily analyzed quantitatively. To help remedy this, the USGS/USAID Volcanic Disaster Assistance Program (VDAP) has been populating E-chron, a global eruption chronology database, from published reports and is developing the Daily Volcanic Activity Report in partnership with the Global Volcanism Program (GVP).

The volcanology community currently has the opportunity to discuss how to standardize, record, store, share, visualize, and analyze eruption event chronology information. A global database of volcanic events and their properties that is updated as new activity occurs, is easily accessible through visualizations and queries, and can be analyzed alongside monitoring data has the potential to transform the science of eruption forecasting.

Additionally, such a database can feed public information websites, such as the GVP; can help observatories archive data at offsite locations; can be queried alongside other global databases, like WOVOdat; and can help observatories publish eruption chronologies.

This presentation seeks to start a community conversation. Are you collecting event data and/or event properties? What event types and properties are you tracking? What is your system for archiving event data? Do you need help setting up a system for collecting and archiving event chronologies? Would you be willing to share event chronologies and partner with a global database effort?

ID: 570

Towards a European Volcano Observatories (EVO) Network: why it is needed and steps for its implementation

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Thirteen institutions in Europe have formal mandates to monitor volcanoes and/or communicate on their status and potential hazards. These EVOs differ based on the levels of services provided, the formal mandates they have and the connections and relationships they maintain with civil authorities. Despite these differences, EVOs have in common the awareness that coordination is needed to improve the capabilities in responding to volcanic crises.

Several initiatives, dating back to the 80s, tried to identify and formalize such a collaboration between EVOs and more recently the project EUROVOLC boosted their connection. The ongoing Aristotle-ENSHP partnership, providing a service of scientific advice for natural hazards to the European Civil Protection, set a first milestone in formalizing a trans-national volcanological and operational cell which already includes several EVOs.

A recent workshop has been conducted with the main purpose of establishing a formal network to guide and support the collaboration between EVOs; to enhance scientific and technical coordination on operational, research, capacity and capability matters of mutual concerns; to generate consensus for common operating procedures; to facilitate interaction between EVOs and key international partners active in volcano risk reduction; to guarantee and encourage mutual support before, during and after emergencies; to draw a unanimous roadmap for the future of volcano monitoring, early-warning capacity and contributions to effective DRR at European level; and to strengthen the European volcanology community.

This talk will introduce the steps undertaken and the expected outcomes and timeline of this ongoing process of the creation of a European VOs Network.