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Lessons Learned from Recent Rapid Onset Eruptions on the Island of Hawai'i.

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Kīlauea and Mauna Loa volcanoes on the Island of Hawai'i erupted six times in the past three years with extremely rapid onsets following periods of heightened unrest. All eruptions began in the summit calderas and were preceded by about one hour of seismicity as dikes propagated 1-3 km from the shallow magma chambers to the surface. The Kīlauea eruptions remained within the summit crater-caldera complex and posed no significant risk due to closures by the National Park Service. In contrast, the first eruption of Mauna Loa in 38 years had the potential to impact communities and infrastructure. We worked together over the past two years to develop several communication strategies to allay anxiety when talking to communities and media.

- 1) Decrease uncertainty. Data from the past eruptions was used to communicate the size, style, progression, and outcomes of an eruption despite not knowing the exact timing of onset or location of lava flows. In addition to official communications, we partnered with outside social media groups to extend our audience.
- 2) Present concrete preparedness actions for residents including identifying lava flow inundation zones and how to receive
- 3) Exchange actionable information with emergency managers. We communicated frequently before, during, and after eruption onsets to build stronger interagency partnerships. Identify actions that could potentially cause unintended disruption of economic activity.
- 4) Seeing is believing. We increased webcam coverage, published near real-time lava flow maps, and installed live video streams. These tools allowed residents to evaluate current conditions and reject misinformation.

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New developments, challenges and strategies in establishing a robust geophysical and environmental monitoring system of Pico de Orizaba volcano, Mexico

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Pico de Orizaba (Citlaltepetl) is the highest (5650 masl) andesitic stratovolcano in North-America and one of Mexico's topmost hazardous due to historical 1500-1600 CE eruptions, Holocene Plinian events, deep hydrothermally altered edifice prone to experiencing large landslides, yearly stational lahars further powered by accelerated glacier melting and more frequent extraordinary meteorological events, and recurrent volcano-tectonic earthquakes registered for 20 years that prove its vitality. Today's reactivation in addition to the inter-eruptive phenomena would threaten >300,000 people living at <25 km-distance from the crater. In this work, we present the newest developments aiming at establishing a robust volcano monitoring system of Pico de Orizaba. The new system was built upon the 20-years old seismic net and comprises eight stations installed at all the volcano flanks and equipped with seismic, meteorological and geodetic sensors plus two permanent video-cameras that transmit continuous real-time data on the different natural phenomena to the Seismological and Volcanological Observatory of Veracruz (OSV). Challenges have been and remain being mostly related to funding, institutional bureaucracy and complex administration, transportation and access to stations, data transmission, limitations in hardware and workmanship at high-mountain conditions (>4000 masl), and vandalism. We present the strategies followed by the OSV and collaborators in past and most recent times to succeed in these challenges, and demonstrate the superb benefits of multidisciplinary collaboration and of integrating and working with the local community and private industry in developing the newest Pico de Orizaba's monitoring system and future outcomes.

ID: 125

Built by professions that care—a long-term volcanic risk management system in the Cascade Range, Washington and Oregon, USA

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The 18 May 1980 catastrophic eruption of Mount St. Helens and subsequent eruptions through 1986 are well recognized as catalysts for advances in the understanding of volcano hazards and magmatic processes. Less well described is the impact that the dramatic eruption and prolonged response had on internal observatory operations and adjacent external professions in the Cascade Range. The unrest and eruptions prompted eruption forecasting and hazards communication and motivated emergency response planning. USGS scientists and their partners expanded staffing, deployed new instruments, developed new tools for eruption forecasting, and created new pathways for agency internal and external communication.

Multiple professions in science, news media, education, and emergency management found it beneficial to independently organize efforts that enhance volcano hazard communication and mitigation on behalf of their organizational interests. The news media developed a long-term interest in sharing stories about Cascade Range volcanoes. Educators created curricula about volcanoes. Park interpreters assembled signage and exhibits to inform the public. Together, these efforts provided motivation to form multi-agency volcano hazard working groups and to expand public communication efforts aimed at risk mitigation.

We call the sum of these pieces the Volcanic Risk Management System (VRMS). A VRMS at fullest scope is open-ended and includes partnerships with schools, parks around and on volcanoes, public safety agencies, news media members, tribal entities, and unaffiliated community champions who independently advance causes that are advantageous to their communities. Through continued collaborations, trusting relationships are built and contributions are made toward long-term risk management in the Cascades.

ID: 237

Fire Departments role in volcanic evacuations and lessons learn from a 2013 Binational Exchange in Colombia

Zane Gibson

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In 2013 Orting Valley Fire and Rescue's (OVFR) Fire Chief was selected to be part of a bi-national exchange of first responders, Emergency Managers and Scientists in Colombia to discuss the effects of the 1985 Armero lahar and the strides the Colombia has made to effect change in volcanic hazard evacuation. In the decade since that exchange OVFR has made significant strides in assisting with the evacuation planning for a lahar from Mt Rainier. The City of Orting is considered the most at-risk community for volcanic hazards in the United States. In 2024 the Orting schools will participate with 8 other school districts when 34,000 students will practice a lahar evacuation drill. The plan developed in 2016 for the Orting School District is the plan that the 2024 drill is based upon. While working on evacuation planning it was very important to work with the USGS to determine where to evacuate to based on the best science available and additionally the timing of events down stream from Mt Rainier. Lahar evacuation planning has proved to be very beneficial to other emergencies as well, such as flooding, wildfire evacuation planning and dam failures. Chief Gibson stated the most impactful part of the binational exchange was listening to the survivors of the Nevada Del Ruiz lahar pleading with the participants to learn from their experience and apply what Colombia has built and successfully implemented for evacuations due to the event in 1985.

ID: 512

The ongoing multiparameter volcanic unrest at Mount Pelée (Martinique, France): challenges for scientific, monitoring and civil protection response

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After 86 years of eruptive quiescence, seismic unrest began on 1 Dec 2018 with deep distal VT seismicity before shallow-sourced VT seismicity increased in April 2019 culminating in 2021 with 2580 events. Dozens of long-period, hybrid and tremor events were recorded. Volcanic seismicity decreased (in number, magnitude, energy, swarms) with 659 events in 2022 and 257 events as of 09 October 2023. Nevertheless, unrest continues above baseline level with the largest VT recorded below Mount Pelée in 36 years (2023-01-31, Md 1,5-2,3, 1km below summit). Low frequency seismicity has continued to increase gradually with several deep LP events in 2023 including the second strongest signal since 1987. Since mid-2022 GNSS measurements show baselines with average extension rates ranging from 0 to +10 mm/year maximum. Despite low signal-to-noise ratios, modeling is compatible with a diffuse low-pressure source few kms below the summit. There is no major change in thermal springs geochemistry. Helium isotopes show a dominantly mantle source for gas from proximal thermal springs and underwater fumaroles. This ongoing unrest likely reflects transitory pressure increases at depth throughout the transcrustal magmatic system compatible with the source of historic magmatic eruptions (6-9 km and 12-16 km). This likely triggered ascent of a limited volume of magmatic fluids reactivating the shallow hydrothermal system. Unrest response remains challenging. A proactive dialogue is ongoing between scientists and all stakeholders. On IPGP's recommendation, authorities set the alert level to yellow (vigilance) on 2020-12-04, revised the volcano crisis response plan and coordinated two volcano crisis exercises.

ID: 567

Interdisciplinary approaches for long term science/policy/society engagement on data-poor active ocean island volcanoes.

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Of Earth's many populated active ocean island volcanoes, Tristan da Cunha is one of the most extreme, but perhaps only in terms of remoteness and accessibility. Its other characteristics and precipitating challenges are all too familiar to volcano scientists:

1) It has limited monitoring; 2) data on eruptive history, geomorphological evolution and hydrogeology is fairly scant; 3) what data we do have point to complexities in eruptive behaviour, diversity in composition, morphology and future vent location; 4) volcanic events have been infrequent (last eruption 1961-2); 5) there is a small population that have other more pressing daily concerns; 6) it is a multi-hazard environment also highly susceptible to climate change impacts; 7) Tristan is a UK Overseas Territory so institutional knowledge on-island and in the UK requires ongoing development; 8) official responsibilities for response to geohazards (and DRR) rests on key individuals, and 9) funding, capacity and capability to develop and employ hazard preparedness/mitigation measures are limited.

Addressing some of these challenges while maintaining long-term engagement with civil authorities has depended on building partnerships and collaborative relationships, demonstrating a deep contextual understanding and empathy, and a tenacity to explore opportunities for multiple research entry points (across disciplines). BGS regularly provide and update evidence for decision makers, not only during crises, but also to inform and implement context- specific DRR during periods of quiescence. In this presentation, we share lessons from almost 25 years of working on Tristan da Cunha, navigating the space between science, policy and society.

ID: 647

Long-term collabolation between Sakurajima Volcano Observatory and local authorities in Kagoshima for long-term Vulcanian eruption

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Sakurajima volcano started eruptive activity in October 1955 at the summit crater Minamidake and the eruption has continued for 68 years. Typical type of eruption Vulcanian are counted more than 15,000. The Sakurajima Volcano Observatory (SVO) as a facility of Kyoto University was established at the request of Kagoshima Prefecture to the national government when the eruptive activity increased after the onset. Major hazard of the eruption was ballistic bombs reaching villages (>2.7 km from the crater). SVO has provided appropriate advice to the local governments. Location of eruption shifted to Showa crater (east of Minamidake) in 2006. Vulcanian eruptions frequently repeated at the crater and pyroclastic flows sometimes occurred. On August 15, 2015, Seismicity suddenly increased accompanying rapid inflation ground deformation. The number of VT earthquakes was counted 1000 and tilt change amounted 47 micro radian. This is interpreted as a dyke intrusion of magma beneath the summit area. Japan Meteorological Agency upgrade alert level to 4 with the alert zone of 3km from the summit. This means evacuation of residents was necessary from 2 villages. SVO advised Kagoshima City, which is responsible to decision making of evacuation order, that evacuation from one additional village is recommended because of hazard of pyroclastic flow. Finally, Kagoshima City issued an evacuation advisory for the 3 villages. Volcanic disaster prevention council that was established in 2006 is useful for coordination and sharing information among authorities of disaster prevention management and volcanology.

ID: 54

Plinian eruption simulation during 2023 of the Volcán de Colima, Mexico.

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As a reminder of the potential danger presented by Volcán de Colima and its last significant eruption in 2015, a volcanic eruption simulation was conducted during the week of 10 – 15 July 2023. The Scientific Advisory Committee for Volcán de Colima (SACVC) met on three occasions to evaluate the fictional volcanic activity. The proposed scenario was a Plinian eruption similar to the one that occurred on 20th January 1913. Fictitious data for this potential eruption scenario were based on seismic, deformation, and geochemical data from recent eruptions of Volcán de Colima, as well as from Mount Merapi, Indonesia, which is a similar volcano in terms of magma composition, eruptive styles, and return periods. Throughout that week, the SACVC adjusted the volcanic alert level based on the fictional activity to communicate with the population.

The exercise involved the participation of state and municipal authorities, including Civil Protection, Public Safety, Health, etc. Personnel from the Army and the National Guard were also present. Ultimately, on Saturday, 15th July, two communities in the state of Colima, La Becerrera with the participation of 116 people and Montitlán with 46 people, were evacuated. This exercise greatly assisted decision-makers in establishing their response protocols for a volcanic emergency. The public's response was positive, primarily because due to recent volcanic activity people are aware of the potential risk. For the SACVC, it was a productive exercise, as it identified areas for improvement in risk communication, both to the population, as well as with government authorities.

ID: 771

Acciones del cuerpo de bomberos del municipio de Manizales en la gestión del riesgo del volcán Nevado del Ruiz, Colombia.

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La gestión del riesgo volcánico en el departamento de Caldas y específicamente en Manizales su capital, frente al Volcán Nevado del Ruiz, es para los bomberos de vital interés, en la reducción y manejo de emergencias. Se parte de las directrices del nivel central y baja al nivel municipal, marcando así la pauta al momento de materializarse el riesgo, para implementar las acciones en el Antes, Durante y Después para proteger la vida y bienes de la comunidad.

Participando en intercambios Binacionales y Regionales nos ha permitido compartir experiencias, aplicar mejoras prácticas y utilizar metodologías para la apropiación del conocimiento y la conciencia sobre el riesgo volcánico, para que las comunidades se preparen y actúen al momento de la crisis.

Se desarrollan acciones como: visitas de campo, planes comunitarios de gestión, simulacros, sensibilización sobre la existencia y uso de los Sistemas de Alerta Temprana (SAT), redes de comunicación permanente con información precisa y oportuna y apoyo en entrega de equipos y suministros utilizados en situación de crisis.

Los bomberos son el primer eslabón a nivel Municipal, inician cadena de llamados a quienes habitan la ribera de los ríos susceptibles de afectación por lahar, se activan los SAT remotamente, se apoya la evacuación de familias a zonas seguras y despliegan los recursos a las zonas afectadas para iniciar labores de búsqueda y rescate y salvamento, se activa todo el manejo de la emergencia.

Apoyamos labores de rehabilitación de la zona afectada, de la infraestructura en vivienda, vial y de servicios públicos.