ID: 38

The 2021 eruption in La Palma Island (Canary Islands, Spain): an example of the synergy that is needed between Science and Decision-makers

Stavros Meletlidis, IGN Volcano Monitoring Group

Centro Geofísico de Canarias del IGN, MITMA

The eruptive processes in Canary Ilsands were developed for more than 20 million years. The last 500 years we had 16 eruptions. Prior to 2021, the last 2 eruptions took place, in El Hierro Island (2011) and La Palma Island (1971).

On 11 September 2021, the monitoring network of IGN started to record an intense seismic swarm under the island and Civil Protection was alerted. A special Civil Protection plan concerning the volcano risk, namely PEVOLCA, was activated by the Canary Government. In the next 5 days, the seismic energy increased and deformation patterns were detected.

On 19 September 2021, an eruption began on the island of La Palma, which lasted 85 days, until 13 December 2021. It began as a fissural one, and in less than 3 months, emitted lavas that covered a surface of >12 km2, with a bulk thickness of 12m and generated new lava deltas. The ash layer at a distance of 2 km exceeded 1m. Lava flows destroyed thousands of edifices, infrastructures, communication networks and extensive areas of farmlands and greenhouses, greatly affecting the local economy. At least 8 evacuations were carried out and no casualties were reported due to the volcanic activity.

The Canarian Government successfully manage the crisis through the Scientific and Steering Committees. This plan is still active, nowadays run by the island government (as of 5th October, 2023), because two villages on the island have serious problems with CO2 diffuse emissions, associated to the magma emplacement.

ID: 241

The 2023 volcanic crisis at Nevado del Ruiz Volcano, Colombia.

Lina Marcela Castaño[1], John Makario Londoño

Servicio Geológico Colombiano, Bogotá, Colombia

On March 24, 2023, an increase in seismicity started at Nevado del Ruiz volcano (NRV). In the follow days, the seismicity located to the SW flank reached more than 6500 events and 12000 events by day on March 28 y 29, respectively. These thresholds in seismicity were never observed at NRV. On March 30, based on integration and interpretation of observations and monitoring data, the Geological Colombian Service (SGC) raised the volcanic alert level to Orange until June 27. The crisis had three phases, I) Increase in seismicity at SW of volcano with migration toward Arenas crater, II) Decrease in seismicity at SW of volcano and increase in seismicity at crater accompanied by increase in the energy level of thermal anomalies, and ash emissions, and III) Gradual and variable decrease in seismicity and other monitoring parameters.

During 89 days in Orange alert level, the SGC worked in an articulated manner with the National System for Disaster Risk management (SNGRD) in spite of the head of the institution which coordinates such System was changed two times during the crisis. A major finding of post-crisis analysis is that the SNGRD was strengthened with updating of its protocols, plans and response strategies and improving communication between scientists, civil authorities, and community. However, some things remained unfinished. There should be greater efforts to improve reduction and mitigation risk strategies not only during but outside the crisis.

ID: 256

Preparación Comunitaria para la Respuesta ante una posible Erupción del Volcán Nevado del Ruiz.

Lina Dorado[i], Marinson Buitrago[ii], Edwin Armenta[iii], Andrés Álvarez[iv]

[i] Líder del Equipo de Gestión del Riesgo de Desastres de la Dirección Nacional de la Cruz Roja Colombiana, [ii] Gestor de Manejo de Desastres y Crisis, Equipo de Gestión del Riesgo de Desastres de la Dirección Nacional de la Cruz Roja Colombiana, [iii] Coordinador de Programas y Operaciones, Delegación Colombia, Federación Internacional de la Cruz Roja y Media Luna Roja, [iv] Director de Gestión del Riesgo de Desastres, Cruz Roja Colombiana Seccional Caldas.

El Volcán Nevado del Ruiz, registró el 13 de noviembre de 1985 una erupción que ocasionó la muerte de 25.000 personas.

El 30 de marzo de 2023 el Servicio Geológico Colombiano cambio el Nivel de Actividad a Naranja “Erupción probable en término de días o semanas”, activó el Sistema Nacional de Gestión del Riesgo, la crisis volcánica duró tres meses, no se presentaron erupciones mayores.

Como medida de preparación, La Cruz Roja Colombiana solicito un proyecto de emergencia financiado por el Fondo de Reserva para la Respuesta a Desastres - DREF de la Federación Internacional de la Cruz Roja y Media Luna Roja – IFRC. Este, fue aprobado en un término de cinco días por un valor CHF 496.034 (USD 545.103,67) que permitió realizar acciones de preparación comunitaria durante 5 meses.

El DREF Anticipatorio, implementó las líneas de acción: transferencias monetarias, filtros de agua, Sistema de Alerta Comunitaria, que permitieron apoyar la preparación de las comunidades que viven más próximas al cráter del volcán.

El DREF benefició a 3.336 personas de Villamaría en Caldas; Murillo, Vistahermosa, Casabianca, Herveo en Tolima y fue implementado en su totalidad en un tiempo óptimo, en lugares lejanos, con participación activa de las comunidades.

ID: 373

Coordinación efectiva en la respuesta a la crisis del volcán Nevado del Ruiz (Colombia) en 2023

Laura Sánchez[1], Luis Carlos Barreto[1], Sandra Mendoza[1], Oscar Andrés Arenas[2], Julieth Carolina Rodríguez[2], Marinson Buitrago Salinas[3]

[1]Subdirección para el Conocimiento del Riesgo, Unidad Nacional para la Gestión del Riesgo de Desastres, Bogotá, D.C. Colombia; [2]Sala de Análisis Estratégico, Subdirección para el Manejo de Desastres, Unidad Nacional para la Gestión del Riesgo de Desastres, Bogotá, D.C. Colombia; [3]Gestión de Manejo de Desastres y Crisis, Cruz Roja Colombiana, Bogotá, D.C. Colombia

En Colombia, el Volcán Nevado del Ruiz (VNR) es uno de los más activos, y su erupción en 1985 causó la peor tragedia volcánica de su historia; actualmente 57,090 personas habitan en zona de amenaza alta. En marzo de 2023, el VNR emitió actividad elevada respecto al nivel base, conduciendo a declarar alerta naranja y activar respuesta del Sistema Nacional de Gestión del Riesgo de Desastres (SNGRD). Aquí presentamos las acciones de respuesta y lecciones aprendidas de la crisis. Durante 13 semanas, se realizaron 18 Puestos de Mando Unificado para la respuesta coordinada de 22 instituciones. Las fases de la respuesta fueron: alistamiento, evacuación de población rural expuesta al VNR (161 personas), verificación y mejoramiento de rutas de evacuación, mejora de sistemas de comunicación, delimitación de zonas de alojamiento temporal, y activación de planes de respuesta nacional y territoriales. Aunque el último evento volcánico mayor fue hace 15 años, reportamos una alta preparación de los cuerpos de respuesta, y adecuada conciencia ante el riesgo de las comunidades expuestas al VNR. Las lecciones aprendidas fueron: i) la respuesta coordinada es fundamental para reducir el impacto de las crisis volcánicas, ii) construir y mejorar sistemas de alerta temprana para la evacuación oportuna, iii) mejorar comunicación con comunidades aumentando su conciencia ante el riesgo, iv) fortalecer capacidades locales de equipos de socorro existentes en territorio. Para continuar fortaleciendo el SNGRD recomendamos promover la colaboración entre entidades y comunidad e implementar planes comunitarios de evacuación, simulacros, y planes escolares de gestión del riesgo.

ID: 580

Respuesta ante crisis eruptivas del volcán de Fuego

William Chigna[1], Carla Chun[2]

[1]Departamento de Prevención en Volcanes, Coordinadora Nacional para la Reducción de Desastres -CONRED-, La Antigua Guatemala, Guatemala, [2]Observatorio Guatemalteco de Vigilancia Volcánica, Universidad Marino Gálvez, Ciudad de Guatemala, Guatemala.

El volcán de Fuego es uno de los volcanes más activos en Guatemala, durante los últimos años ha presentado erupciones que originan el descenso de corrientes de densidad piroclástica. La erupción del 3 de junio del 2018 ha sido catalogada como una de las mas violentas recientemente debido al gran impacto que tuvo en donde afecto directamente a la comunidad de San Miguel Los Lotes. Debido a la ocurrencia de este evento se crea un nuevo Plan Nacional de Gestión de Riesgo de Desastres en Guatemala (2018-2022 CONRED) el cual tiene como objetivo orientar las acciones de todas las instituciones públicas, sociedad civil, academia, sector privado, agencias de cooperación y a la población en general en temas de gestión de riesgo de desastres en el país para contribuir con el desarrollo sostenible. Así mismo se da un nuevo énfasis en la aplicación de "Planes de respuesta local", en donde se capacita y empodera a los lideres comunitarios para que puedan actuar de manera pertinente ante un evento eruptivo. Se ha podido observar que fortalecer las capacidades de los comunitarios que se encuentran en los alrededores del volcán, a través de herramientas como mapas de amenaza volcánica y folletos de divulgación de amenazas, con el objetivo de empoderar a los líderes para la toma de decisiones en crisis volcánicas es importante para la toma de decisiones y para poder realizar las evacuaciones preventivas antes de un evento eruptivo.

ID: 642

Evacuation decision-making processes and challenges at Fuego volcano, Guatemala

Beth Bartel[1,2], Rüdiger Escobar Wolf[2], Ailsa Naismith[3], I. Matthew Watson[3]

[1]*Volcano Hazards Program, U.S. Geological Survey, Vancouver, WA, USA*

[2]*Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI, USA*

[3]*School of Earth Sciences, University of Bristol, Bristol, UK*

At Fuego volcano, Guatemala, despite ongoing risk reduction efforts, more than 400 people died during a paroxysmal eruption on 3 June 2018 when pyroclastic density currents (PDCs) reached populated areas. Since that event, PDC-producing paroxysmal eruptions continue to threaten the communities on Fuego's slopes. We used ethnographic and other source analyses methods to determine information availability and use in evacuation decision-making during and since the 2018 crisis. Results indicate that information availability and decision-making processes during the crisis were insufficient for most at-risk populations to make crucial evacuation decisions without external support, including the hardest-hit community of San Miguel Los Lotes and with the notable exception of the La Reunión golf resort, which evacuated independent of external support. Additionally, current crisis management practices, including decision-making processes, would be too slow and geographically limited to avert a disaster with similar characteristics. Our research demonstrates the importance of considering decision-making processes, resource availability, and competing risks in designing early warning systems. An effective system must be designed within the limitations of the scientific, technological, economic, and socio-political context in which it operates, and timely evacuations may be a significant challenge even within those limitations.

ID: 692

Crisis eruptiva de la erupción del volcán de Fuego del 03 de junio del 2018

Gustavo Adolfo Chigna Marroquín[1]; Dulce María González Domínguez[2]; Carla María Chun Quinillo[2]

[1]*Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología (INSIVUMEH), Ciudad de Guatemala, Guatemala.*

[2]*Instituto de Investigación de Ingeniería, Matemática y Ciencias Física, Universidad Mariano Gálvez de Guatemala, Ciudad de Guatemala, Guatemala.*

El volcán de Fuego es uno de los tres volcanes activos en erupción de Guatemala, es considerado de los más peligrosos, debido a la actividad eruptiva constante, la cercanía con las comunidades y los efectos que produce incluso después de los eventos eruptivos. La crisis eruptiva del volcán de Fuego dio inicio el día 3 de junio por la madrugada, con el inicio de una serie de flujos piroclásticos, los cuales fueron incrementando y desplazándose por las barrancas Santa Teresa, Seca, Ceniza y finalmente en Las Lajas. Dentro de las características de este evento sub-pliniano podemos mencionar: una columna de ceniza que en su punto máximo alcanzó una altura de entre 16 y 19 kilómetros; una serie de flujos piroclásticos cuyó impacto principal se generó en la barranca Las Lajas donde alcanzó una distancia de 12 kilómetros desde el cráter, devastó el campo de Golf La Reunión y la comunidad San Miguel Los Lotes causando la muerte de por lo menos 430 personas, afectó la infraestructura y la evacuación de varias comunidades alrededor del volcán. Este evento tuvo una duración aproximada de 16 horas, durante la atención a la crisis eruptiva se mantuvo el monitoreo visual, se generaron boletines informativos, se mantuvo la comunicación con CONRED y las instituciones que iniciaron la gestión para la atención y los procesos de reconstrucción. Posteriormente se elaboraron mapas de amenaza para lahares debido a la época de lluvia que iniciaba en el país y por flujos piroclásticos debido a que estos continuaban descendiendo.

ID: 152

Challenge and Success in Volcanic Assistance by the USGS-USAID Volcano Disaster Assistance Program

VDAP, Team

Volcano Disaster Assistance Program, USGS, Vancouver, WA 98683 USA

The Volcano Disaster Assistance Program (VDAP), co-funded by USGS and USAID, supports international volcano observatories during unrest, eruption, and through long-term collaboration. Each situation brings its own challenges, teaching valuable lessons for us and our observatory counterparts. In this abstract we highlight recent experiences. At Agung in 2017, exhaustive but productive briefings by our Indonesian colleagues to local influencers (both religious and governmental) were critical to minimizing chaos during a time of major evacuations for >8 weeks prior to eventual eruption. At Sangay (Ecuador) donations of infrasound, seismic and gas monitoring stations in 2020 proved timely for detection of ongoing summit effusions and landslides. At St. Vincent in 2021, upon first sight of the cryptically emplaced dome, VDAP sent seismic stations that tracked precursory signals to the explosive eruption months later. The May 2021 eruption at Nyiragongo (DR Congo) lasted less than a day, but continuing earthquakes resulted in costly evacuations and frayed nerves. Ultimately, lack of trust among international groups of cooperators resulted in a difficult transition to a new monitoring network. Recently, new and old partners have started to interact through provision of satellite data during recent lava outpourings from neighboring Nyamulagira. Equipment was not installed in time for Tonga (Hunga) in 2022: useful monitoring could only be achieved through satellite and remote geophysical instrumentation. Extremely important *in situ* ground-based data was therefore never recorded for this consequential eruption. In all cases, rapid events can overwhelm observatories: pre-eruption planning and practicing remains critical.

ID: 168

Compound impacts from lava and tephra on buildings during the 2021 Tajogaite eruption of Cumbre Vieja, La Palma, Spain

Sebastien Biass[1], María-Paz Reyes-Hardy[1], Chris Gregg[2], Luigia Di Maio[1], Lucia Dominguez[1], Corine Frischknecht[1], Costanza Bonadonna[1], Nemesio Perez[3, 4]

[1]*Department of Earth Sciences, University of Geneva, 1205 Geneva, Switzerland*

[2]*Department of Geosciences, East Tennessee State University, Johnson City, Tennessee, US*

[3] *Instituto Volcanológico de Canarias (INVOLCAN), San Cristóbal de La Laguna, Tenerife, Canary Islands, Spain*

[4] *Instituto Tecnológico y de Energías Renovables (ITER), Granadilla de Abona, Tenerife, Canary Islands, Spain*

Eruptions being multi-hazard events, associated impacts are typically compound. Compound impacts result from the interaction of various hazardous phenomena (e.g., tephra fallout, lava flows) exhibiting multiple impact mechanisms (e.g., dynamic pressure and thermal radiation of lava flows) that evolve in space and time. Improving the accuracy of volcanic risk analyses requires investigating the evolution of hazards during an eruption to better characterize how interactions modulate impact sequences. We present a post-event building impact assessment for the 2021 Tajogaite eruption, which was characterized by a hybrid explosive/effusive activity. We focus on the locality of Corazoncillo, affected by tephra fallout since the beginning of the eruption and by an isolated lava flow after two months. We investigate the impact on 20 houses located <1 km SW from the primary eruptive vent. We reconstructed the chronology of hazards and mitigation actions, constrained the spatio-temporal evolution of hazards and linked these to observed impacts. Results reveal the dynamic nature of building impacts, with most buildings following a sequence composed by i) early tephra fallout, the impact of which was mitigated by roof cleanups, ii) initial lava inundation from immature 'A'ā flow, with dynamic pressure causing minimal impacts on reinforced concrete walls but thermal radiation burning some components, iii) flow inflation up to roof level and iv) roof inundation by late-stage pāhoehoe toes causing collapse from static load. Results also highlight the complex impact mechanisms associated with lava flows, which evolve as a function of the microtopography of urban areas.

ID: 699

Observatory mismanagement and its impact on health and safety: A personal perspective

Glenn Thompson

School of Geosciences, University of South Florida, Tampa, USA

Years ago, I was part of a young scientific team that led significant advances in monitoring of an actively erupting volcano. While we were enthusiastic about doing everything we could to enhance public safety and catalyze scientific research, the Director had no appetite for a difficult assignment. Bullying undermined operations, meetings were rare, and morale declined. The scientific team endeavored to hold operations together while their authority was eroded. This culminated in the removal of mission critical seismic monitoring hardware, software, and data. This jeopardized public safety at a time when the lava dome was growing towards the most populated area. Instead of tackling issues, the Director ignored them, leaving me no alternative but to go higher. I got no support, and was scapegoated, with long-term repercussions for my career and health, being ostracized from my peers and unable to publish innovative work. What lessons can we learn from this? Some are: (1) Appoint a Director who wants the job and has a good understanding of the monitoring programs. (2) Hold weekly meetings - they enable the latest observations to be shared and assimilated, allow other issues to be raised, and are crucial for team morale. (3) The Director must lead from the front, demonstrate that they understand the mission, and have the back of their team. (4) Encourage staff to voice concerns. Finally, I consider what I could have done differently, and my advice to others if they ever find themselves in a similar situation.

ID: 164

Assessing volcanic ashfall impacts on diverse agroecosystems: Lessons from recent eruptions in tropical regions

Heather Craig[1], Thomas Wilson[1], Carol Stewart[2], James H. Williams[1], Fiapaipai Auapaau[1]

[1] School of Earth and Environment | Te Kura Aronukurangi, University of Canterbury | Te Whare Wānanga o Waitaha, Private Bag 4800, Ōtautahi | Christchurch, Aotearoa New Zealand; [2] School of Health Sciences, College of Health | Te Kura Hauora Tangata, Massey University | Te Kunenga Ki Pūrehuroa, Te Whanganui-a-Tara | Wellington, Aotearoa New Zealand

There is a growing body of work assessing the impacts of volcanic ashfall on agricultural systems. This research has aimed to better understand the impact mechanisms to inform risk reduction strategies; and quantify relationships between ashfall properties, agricultural characteristics and consequence severity to improve impact forecasting. However, the diversity and complexity of agricultural systems presents a challenge when comparing across impact datasets. This is evident when relating impact data collected from temperate compared with semi-arid environments, or farmers growing locally sold produce compared with export-focussed agricultural economies. These eruptions caused vastly different impacts even when the hazard characteristics of the ashfall, such as soluble chemistry or deposit thickness, were similar.

Increasingly, we are developing an understanding of the unique nature of ashfall impacts to agriculture in tropical climates. Relevant case studies have included the eruptions of Ambae, Merapi, Kelud, Hunga Tonga-Hunga Ha'apai, Pinatubo and Tungurahua volcanoes. These studies have identified several key trends: 1) initial impacts to tropical farming systems are usually severe, with more vulnerable leafy crops and subsistence-style farming common; 2) if ashfall occurs during, or close to, the rainy season, often recovery can begin with little farmer intervention; 3) even in severe ashfalls, once replanting occurs recovery is typically extremely rapid; and 4) food security in the period between ashfall events and the reestablishment of crops is often a challenge.

ID: 176

Cascading impacts due to road network disruption in an insular setting: the 2021-Tajogaite eruption (La Palma, Spain)

Lucia Dominguez[1], Sébastien Biass[1], Corine Frischknecht[1], Maria-Paz Reyes Hardy[1], Luigia Di Maio[1], Costanza Bonadonna[1] and Nemesio Pérez[2,3]

[1]Department of Earth Sciences, University of Geneva, 1205 Geneva, Switzerland [2]Instituto Volcanológico de Canarias (INVOLCAN), San Cristóbal de La Laguna, Tenerife, Canary Islands [3]Instituto Tecnológico y de Energías Renovables (ITER), Granadilla de Abona, Tenerife, Canary Islands

The 2021-Tajogaite eruption (Spain) represents a clear example where impacts of a long-lasting monogenetic volcanism and several volcanic products (i.e., lava, tephra, gas) generated important cascading effects on critical infrastructures. Due to a rigid infrastructure network, typical of insular environments, with low redundancy of roads, major disruption of the ground transportation and water systems strongly affected the daily life of the local population, particularly the agriculture sector. Quantifying the interconnections that provoked several orders of impacts demand sophisticated strategies of assessment. A major challenge consists of decoding disaster information provided by stakeholders (usually a narrative facts reconstruction) in relation with the physical impact evidences (usually a correlation between volcanic hazard level and the intrinsic system characteristics). Following a forensic approach to converge various type of data, we present here an integrative post-event impact assessment to classify three orders of impact on the road network. First, the physical damage due to lava burying; second, the subsequent disruption by tephra accumulation; and third, the cascading consequences on water and agriculture systems due to the loss of functionality of the road network. Using network analysis, we quantify the temporal evolution of various graph-analytics indicators to provide an objective measure of the loss of connectivity and the increasing travel time. This analysis helps identifying breaking points on the connectivity of the island that could be correlated with crucial aspects not only related to the response phase but also to the fast recovery of the road network.

ID: 372

Comunicación del riesgo volcánico: lecciones aprendidas de las últimas alertas volcánicas en Argentina.

Gabriela Jara Aburto[1], Sebastian Garcia[2], Pablo Forte[2], Gabriela Badi [2,3], Soledad Osores 4

[1]Observatorio Argentino de Vigilancia Volcánica (OAVV), Servicio Geológico Minero Argentino (SEGEMAR). CONICET, Argentina; [2]Observatorio Argentino de Vigilancia Volcánica (OAVV), Servicio Geológico Minero Argentino (SEGEMAR), Argentina; [3]Departamento de Sismología, Facultad de Cs. Astronómicas y Geofísicas, Universidad Nacional de La Plata, Argentina; [4]Servicio Meteorológico Nacional (SMN), Argentina.

Durante las últimas décadas, los Andes del Sur han sido escenario de diversas manifestaciones volcánicas que afectaron, directa o indirectamente, a las poblaciones aledañas. Si bien las erupciones de mayor magnitud ocurrieron dentro de territorio chileno –como Hudson (1991), Chaitén (2008) y Cordón Caulle (2011)–, la afectación no se restringió únicamente a ese país, sino que traspasó las fronteras, generando impactos en numerosas localidades del territorio argentino; principalmente vinculados a la caída y subsecuente removilización de ceniza volcánica. Las respuestas ante cualquier amenaza volcánica se ven condicionadas por las experiencias anteriores, principalmente en las localidades fueron afectadas en el pasado reciente. Es por esta razón que, a ante un cambio de alerta, independiente del escenario esperado o el estilo eruptivo del volcán, es común que se sobredimensionen las potenciales consecuencias, generándose ansiedad y preocupación excesiva de parte de localidades distantes. En muchos casos, este sobredimensionamiento se traduce en medidas preventivas excesivas y anticipadas que en el caso que el proceso no culmine en erupción pueden contribuir a la pérdida de credibilidad. De este modo, el rol del OAVV del SEGEMAR, en conjunto y de forma coordinada con otros organismos científico-técnicos como el SMN, en el marco del SINAGIR, no solo cumplen el papel de entregar información pertinente de todos los volcanes que puedan afectar el territorio nacional, sino que además deben comunicar de manera sensible y oportuna a la población, para disminuir la ansiedad en ella y tomar los resguardos necesarios cuando sea el caso.