VOLCANO HAZARDS PROGRAM UPDATES

Kilauea volcano, USGS

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BY THE NUMBERS

57

Number of very high or high threat volcanoes that could directly impact nearby communities

7.7B

Pounds of air cargo at risk of disruption due to volcanic ash from Alaska eruptions each year

U.S. VOLCANOES
Number of active volcanoes in the United States and its territories
170

AVIATION NOTIFICATIONS
Number of Volcano Observatory Notices for Aviation (VONA) issued for aircraft during 2024
41

VOLCANO LOCATIONS
Number of U.S. states and territories that have active volcanoes
14

U.S. ERUPTIONS
Number of eruptions in the United States since 1980
147

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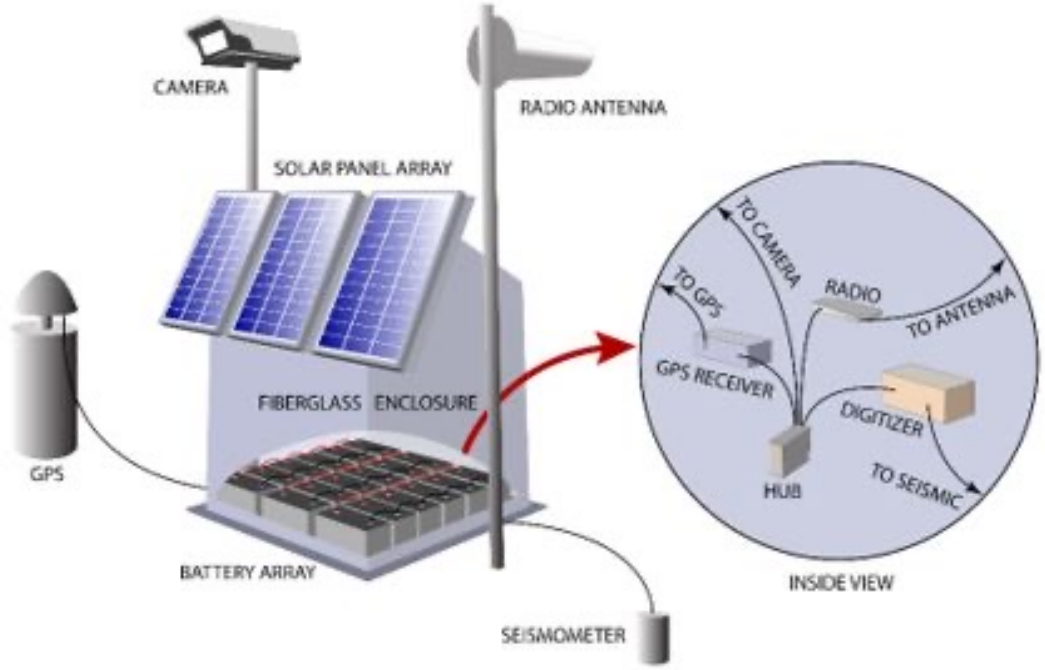
National Volcano Early Warning and Monitoring System (NVEWS)

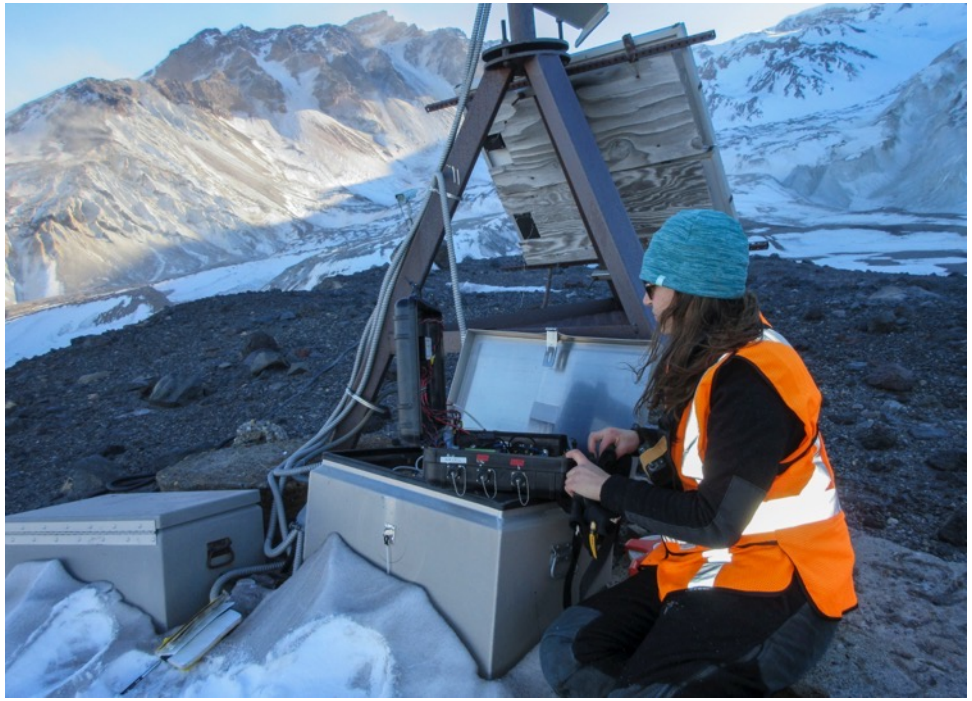
March 2019- Title V of the John Dingell Jr. Conservation, Management, and Recreation Act (P.L. 116-9)

- U.S. volcanoes monitored commensurate with the threats they pose
- U.S. volcano observatories will be an interoperable system
- National Volcano Information Service (NVIS) will aggregate and distribute real-time monitoring data from all observatories
- A Watch Office will provide 24/7 continuity of operations
- Authorizes an external grants program to support research in volcano monitoring science and technology
- Establishes an interagency advisory committee (DOE, DOD, FAA, NOAA, FEMA, NASA, NIST, NSF, volcano science community)

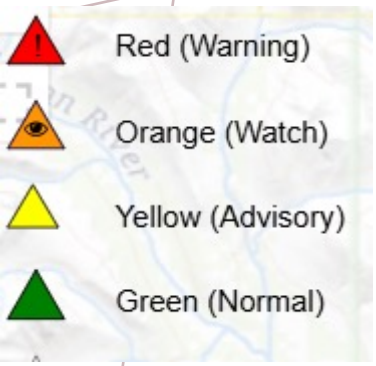
S.3533, Volcanic Ash and Fumes Act of 2022

- Incorporates capacity/expertise of NOAA into NVEWS





USGS



Elevated Activity at US Volcanoes July 28

Kilauea Volcano, HI Alert Level = **WATCH**. Aviation Color Code = **ORANGE**
The ongoing Halema'uma'u eruption is currently paused. Episode 29 is likely to begin within the next 3-5 days.

- **Spurr Volcano, AK** Alert Level = **ADVISORY**. Aviation Color Code = **YELLOW**
  Unrest persists at Mount Spurr. Seismicity remains slightly elevated.

- **Great Sitkin Volcano, AK** Alert Level = **WATCH**. Aviation Color Code = **ORANGE**
  Slow eruption of lava within the summit crater continues.

USGS

Current Volcano Hazard Program Responses

Kīlauea, HI has been intermittently erupting within the summit caldera in Hawai‘i Volcanoes National Park since December 2024.

- No lava-flow hazards or damage.
- Ash and volcanic gas hazards exist.

Mount Spurr, AK has been showing signs of elevated activity since Spring 2024.

- The forecast for eruption likelihood has gradually declined, but explosive eruption still possible that could produce ashfall in Anchorage.

Rainier, WA earthquake swarm that started 7/8/25 has decreased.

International- Volcano Disaster Assistance Program with State Dept., Indonesia remote support, Fiji monitoring, *NEW* Daily Report

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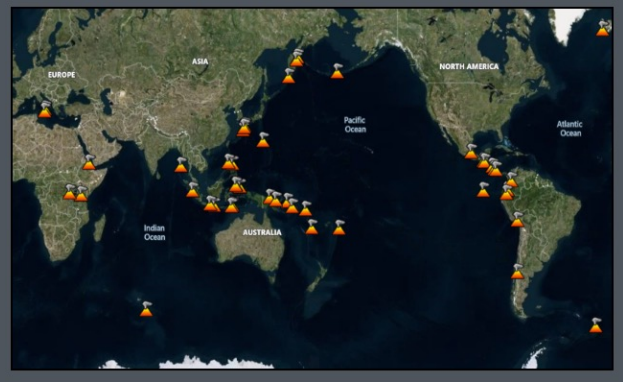
Daily Volcanic Activity Report

There are 28 volcanoes in the Daily Volcanic Activity Report (DVAR) for 28 July 2025, with 16 describing activity for continuing eruptions. The data shown is for the most recent date with available reports before today or the requested day. These data will change as additional information becomes available, such as from observatories that issue weekly reports. There are typically 40-50 continuing eruptions (map shows all current eruptions), and out of those generally around 20 will be actively erupting on any particular day.

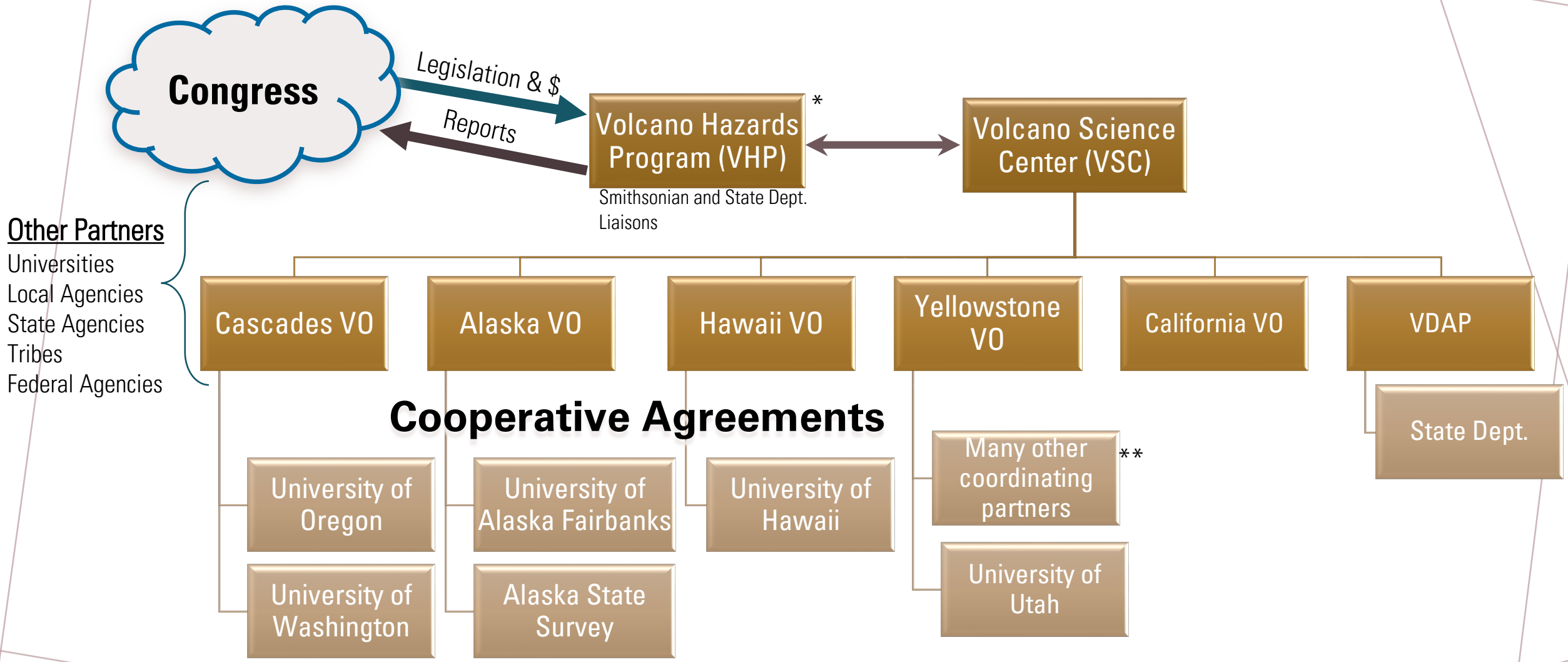
Select Date: [redacted]



List of Volcanoes with Eruptive Activity on 28 July 2025

Name	Country	Volcanic Region	Last Known Activity
Dukono	Indonesia	Halmahera Volcanic Arc	1933 Aug 13 - 2025 Jul 11 (continuing)
Great Sitkin	United States	Aleutian Ridge Volcanic Arc	2021 May 25 - 2025 Jul 11 (continuing)
Ibu	Indonesia	Halmahera Volcanic Arc	2008 Apr 5 - 2025 Jul 11 (continuing)
Kīlauea	United States	Hawaiian-Emperor Hotspot Volcano Group	2024 Dec 23 - 2025 Jul 11 (continuing)
Kanlaon	Philippines	Negros-Sulu Volcanic Arc	2024 Oct 19 - 2025 Jul 11 (continuing)
Lewotobi	Indonesia	Sunda Volcanic Arc	2023 Dec 23 - 2025 Jul 11 (continuing)
Lewotolok	Indonesia	Sunda Volcanic Arc	2025 Jan 16 - 2025 Jul 11 (continuing)
Marapi	Indonesia	Sunda Volcanic Arc	2023 Dec 3 - 2025 Jul 11 (continuing)
Merapi	Indonesia	Sunda Volcanic Arc	2020 Dec 31 - 2025 Jul 11 (continuing)
Popocatépetl	Mexico	Trans-Mexican Volcanic Arc	2005 Jan 9 - 2025 Jul 11 (continuing)
Poás	Costa Rica	Central America Volcanic Arc	2025 Jan 5 - 2025 Jul 11 (continuing)
Raung	Indonesia	Sunda Volcanic Arc	2025 Mar 13 - 2025 Jul 11 (continuing)
Reventador	Ecuador	Northern Andean Volcanic Arc	2008 Jul 27 - 2025 Jul 11 (continuing)
Reykjanes	Iceland	Iceland Neovolcanic Rift Volcanic Province	2025 Jul 16 - 2025 Jul 16 (continuing)
Sangay	Ecuador	Northern Andean Volcanic Arc	2019 Mar 26 - 2025 Jul 11 (continuing)
Semeru	Indonesia	Sunda Volcanic Arc	2017 Jun 6 - 2025 Jul 11 (continuing)

VHP PLANS, VSC OBSERVATORIES EXECUTE



*The VHP also provides small amounts of funds to other USGS science centers.

** Other non-coop YVO partners are National Park Service, EarthScope, Montana State University, University of Wyoming, and State Geologic Surveys of Wyoming, Montana, and Idaho

USGS

VHP STAFFING UPDATE

PROGRAM COORDINATOR
Filled: Gari Mayberry
GEOLOGIST, Duty Station: RESTON VIRGINIA

ASSOCIATE PROGRAM COORDINATOR
Filled: Wendy Stovall
GENERAL PHYSICAL SCIENTIST, Duty Station: VANCOUVER

PHYSICAL SCIENTIST – VACANT |
[FULL-TIME PERM] Series: GS-1301 | FPL: 14

PHYSICAL SCIENTIST – Bureau of Humanitarian Assistance
LIASION VACANT |
[FULL-TIME PERM] Series: GS-1301 | FPL: 14

PHYSICAL SCIENTIST – Smithsonian VACANT |
[FULL-TIME PERM] Series: GS-1301 | FPL: 13

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GENERAL PHYSICAL SCIENTIST, Duty Station: VANCOUVER

PHYSICAL SCIENTIST – VACANT |
[FULL-TIME PERM] Series: GS-1301 | FPL: 14

Filled, Start Date in Sept 25

PHYSICAL SCIENTIST – Bureau of Humanitarian Assistance
LIASION VACANT |
[FULL-TIME PERM] Series: GS-1301 | FPL: 14

Filled by Cassandra Smith in Jan 25

PHYSICAL SCIENTIST – Smithsonian VACANT |
[FULL-TIME PERM] Series: GS-1301 | FPL: 13

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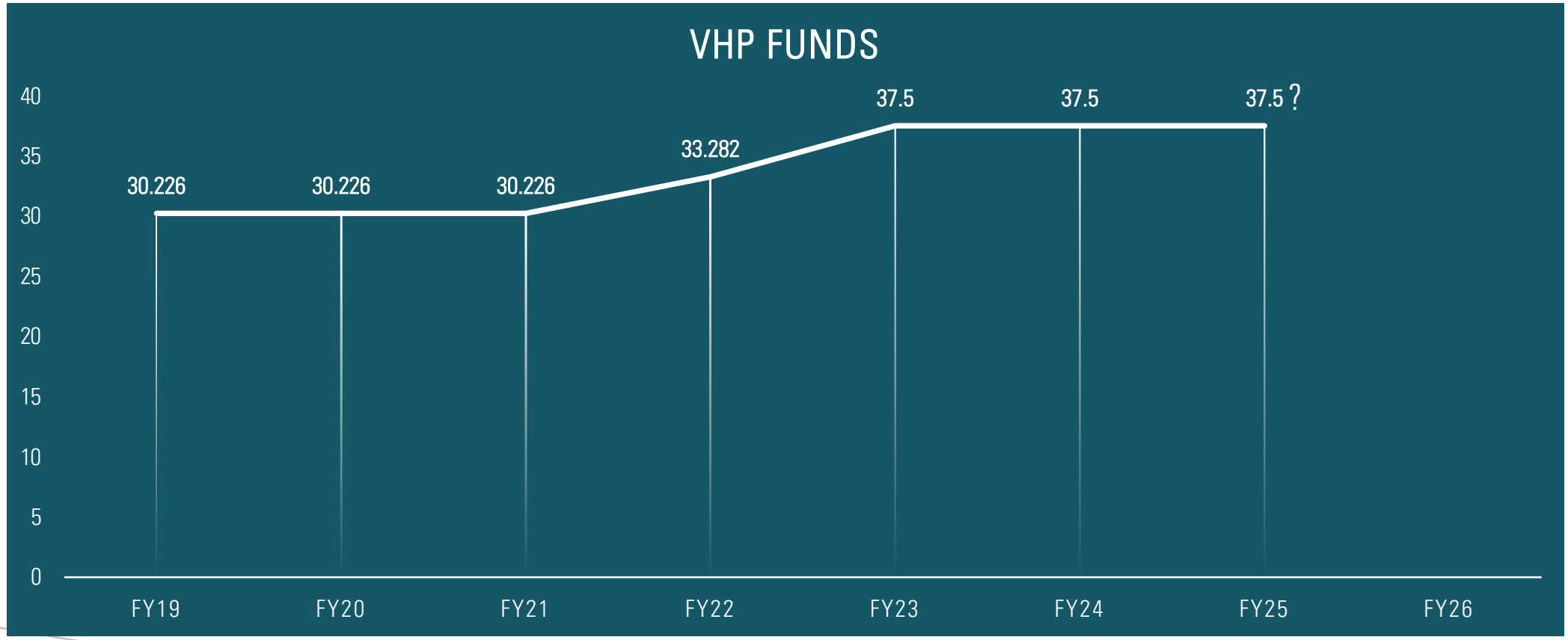
VHP FUNDING FY19-25?



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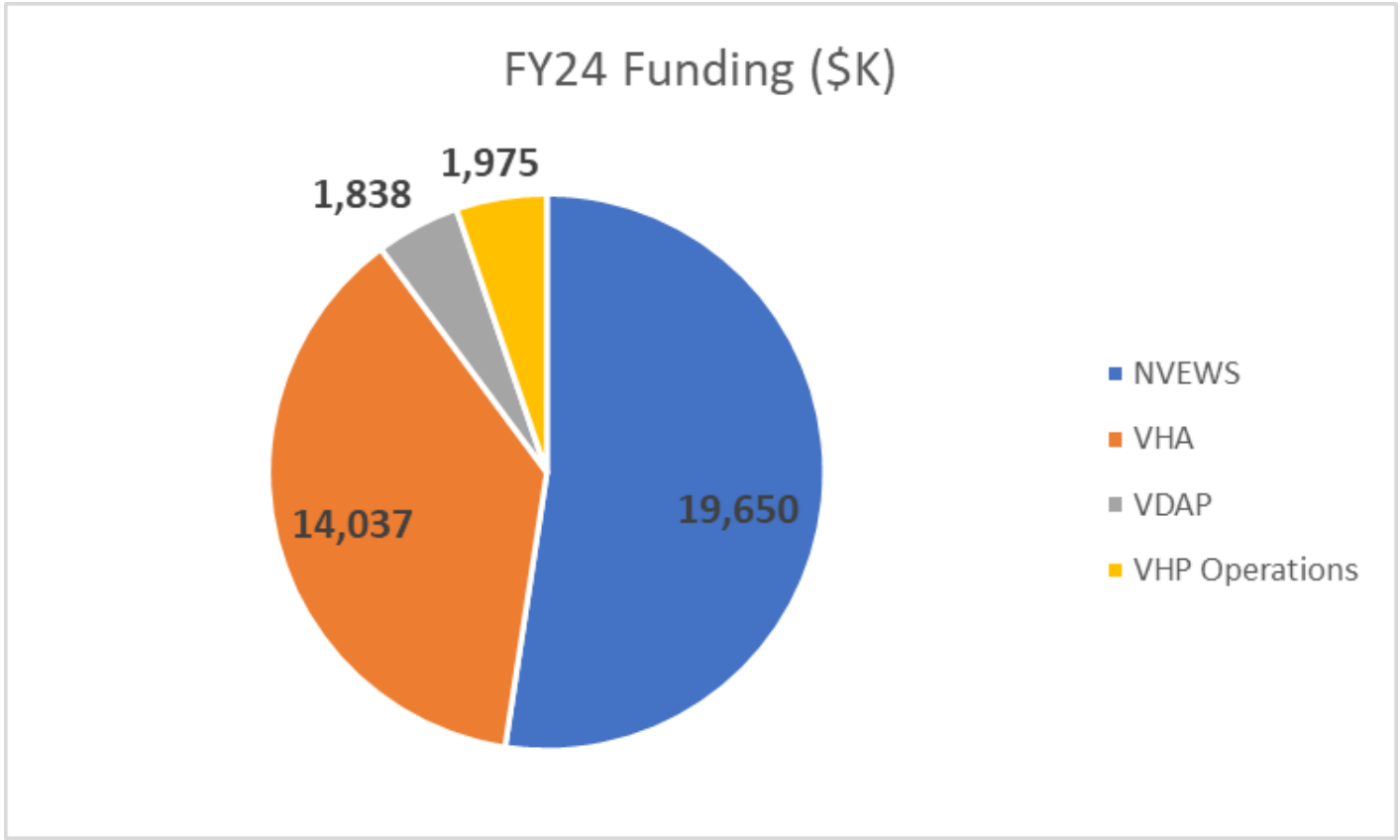
VHP FUNDING FY24/25



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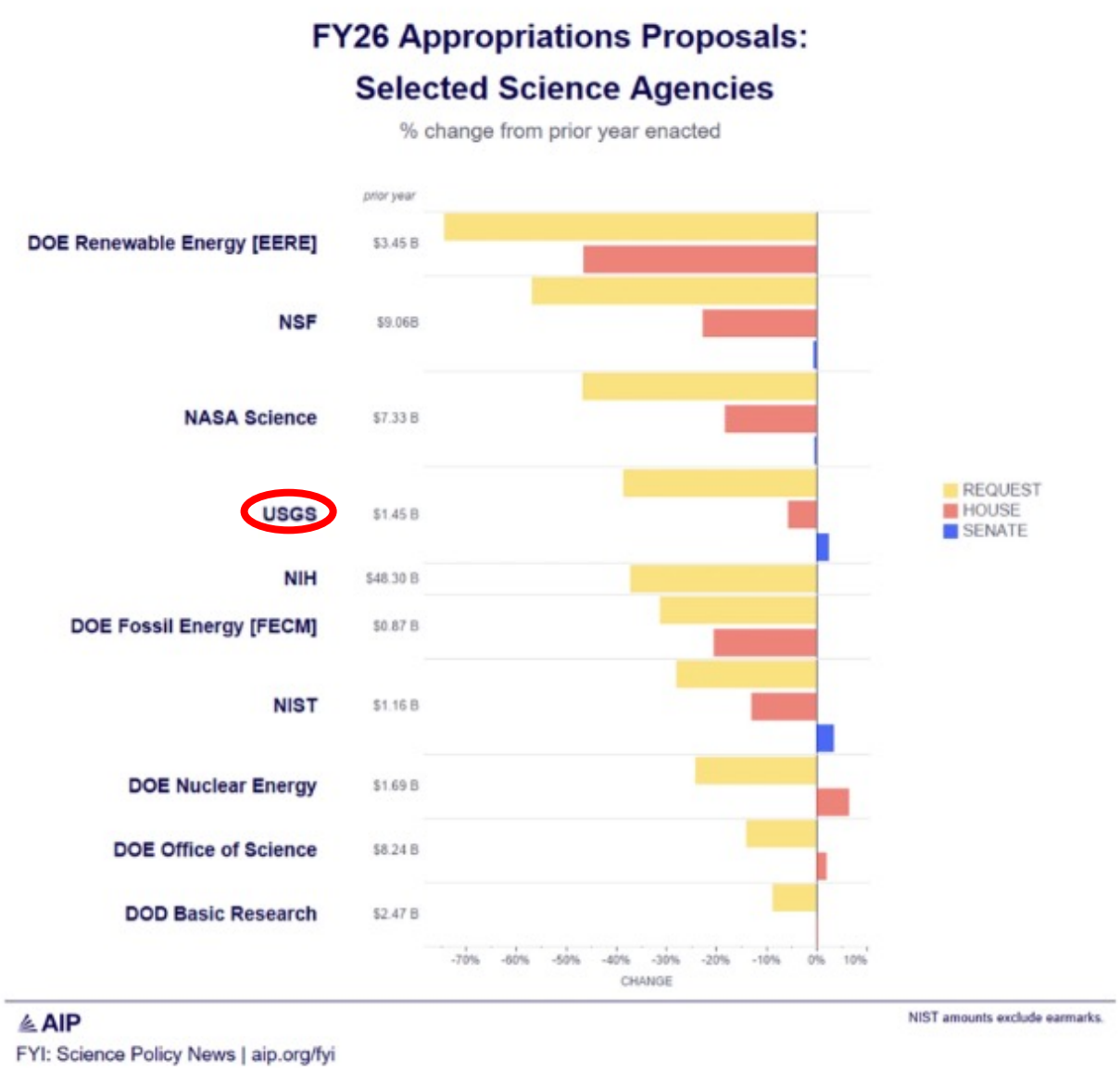
NVEWS FUNDING LANGUAGE

19	30,266	$1.54 M NVEWS, $4.14 M lahar
20	30,266	No NVEWS specific language
21	30,266	No NVEWS specific language
22	33,282	~$4 M
23	37.5	$2.591 M NVEWS
24	37.5	No NVEWS specific language
25	37.5	No NVEWS specific language
	Total	**$12,248,000**

USGS



This chart shows data from FYI's Federal Science Budget Tracker. FYI

From 7/25/25 AIP article: Where Congress is Splitting from Trump on Science Funding

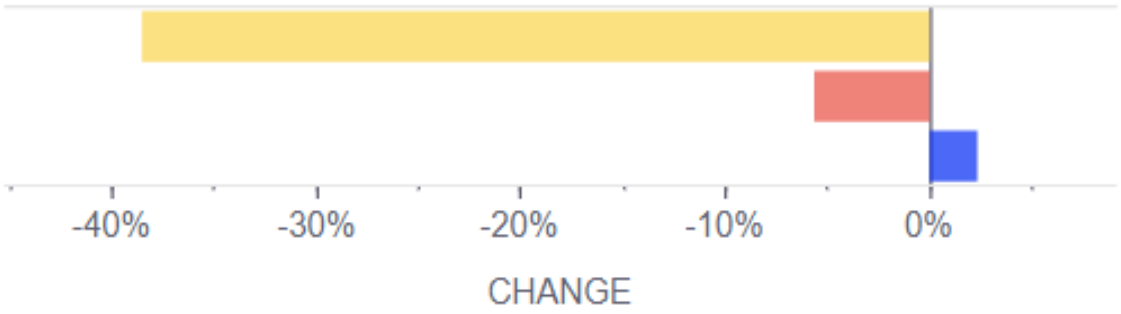
FY2026 Appropriations: U.S. Geological Survey

FISCAL YEAR

2026

REQUEST SENATE HOUSE

	PRIOR YEAR	FINAL
U.S. Geological Survey	$1,450 M	



USGS

Budget Details

Selected programs ($, millions)
% change over prior year enacted

Show summary view
Show all subprograms

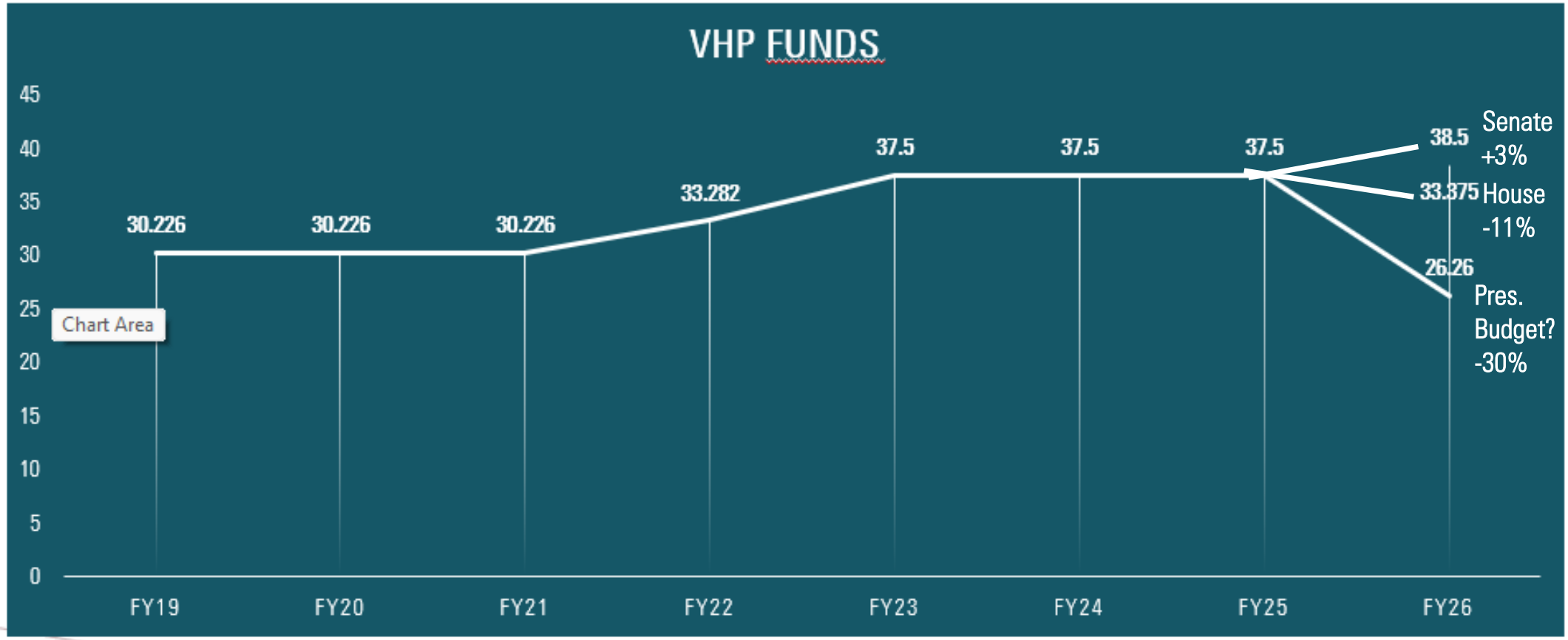
click rows for subprogram details

PROGRAM	ENACTED	REQUEST	HOUSE	SENATE	FINAL
U.S. Geological Survey	$1,450	$892	$1,368	$1,485	
Ecosystems		$0	$290		
Core Science Systems		$165	$283		
Water Resources		$224	$285		
Natural Hazards		$137	$191		
Coastal and Marine Hazards and Resources			$37	41,855	
Earthquake Hazards			$95	100,201	
Geomagnetism			$5	5,198	
Global Seismographic Network			$6	7	
Landslide Hazards			$14	16,685	
Volcano Hazards			$33	38.5	
Facilities		$149	$132		
Energy & Mineral Resources		$137	$105		
Science Support		$80	$82		

CHANGE

-100% 100%

VHP FUNDING FY19-26??



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NVEWS ACCOMPLISHMENTS

- ~55% buildout completion
- Rainier lahar detection system 95% complete
- Publication of recommendations for US volcano instrumentation
- NOAA collaboration on 7 priority areas
- National Volcano Information Service progress
- AGU Town Hall and International Volcano Conference Workshop

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NOAA-USGS PRIORITY TOPICS

- NOAA's Modernization of NVEWS Implementation Plan to Congress
- Shared Focus Priorities – Improve…
  1. Service on **monitoring and forecasting volcanic smog** (vog).
  2. Operational plans to warn of **volcanic debris flows/lahars** from eruptive and non-eruptive events
  3. Service on **quantifying airborne ash hazards** to aviation.
  4. Service on **quantifying ashfall hazard**s.
  5. Operational response and situational awareness through **near-real-time data sharing**.
  6. Service on **forecasting volcanogenic tsunami** and submarine eruptions.
  7. Efficacy of USGS and NOAA **hazard information products**.

USGS

NVEWS PENDING ACTIONS

- Continue NVEWS buildout- funding levels impact implementation
- Hiring a monitoring and evaluation specialist
- 24 x 7 watch capabilities
- External grant
- Building tribal relationships

USGS

LANDSLIDE HAZARD PROGRAM COLLABORATIONS

- Landslide staff at Alaska Volcano Observatory
- Development of modeling software
- Collaboration on Landslide Assessments, Situational Awareness, and Event Response (LASER) project
- Joint post-doc on volcano-generated tsunami
- Advisory Committee on Landslides

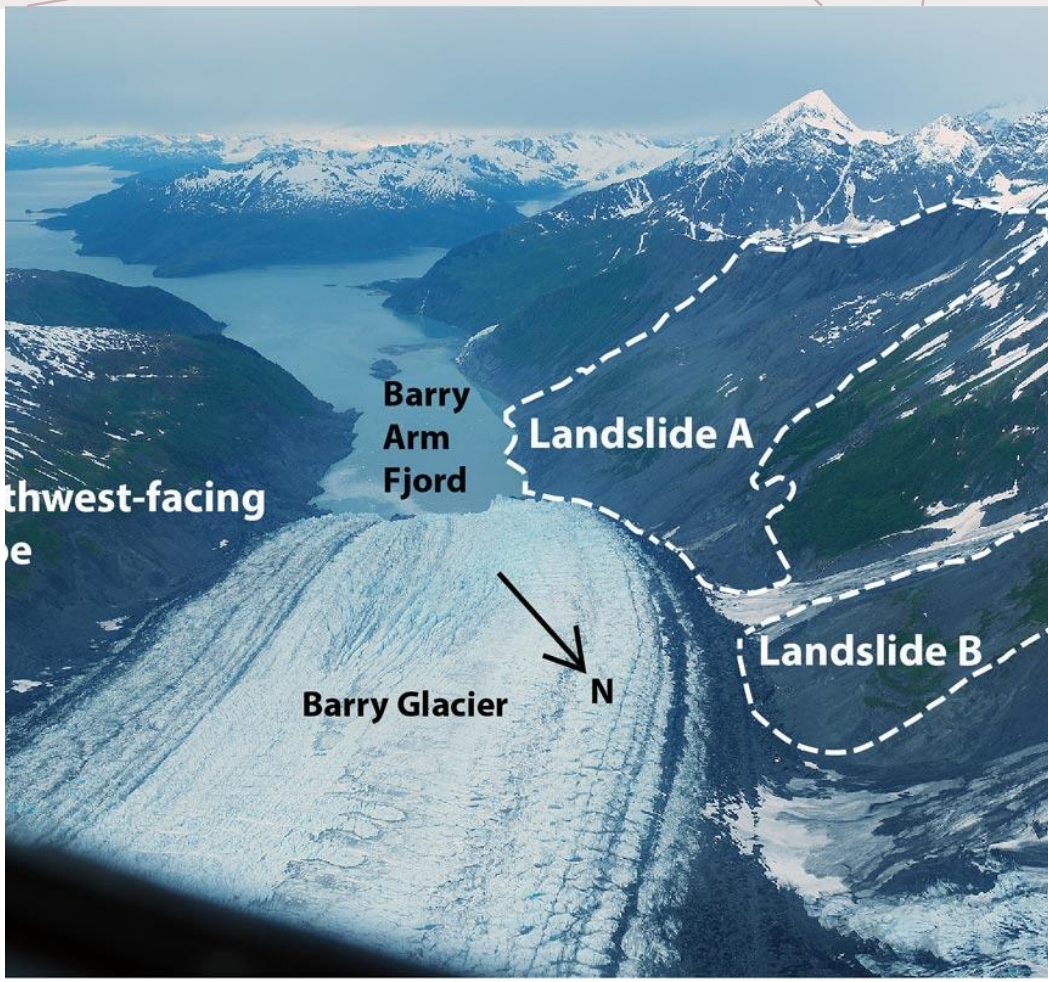

Photo by Gabe Wolken, Jun

USGS

EARTHQUAKE HAZARD PROGRAM COLLABORATIONS

- USGS National Earthquake Information Center (NEIC) volcano night watch and data archiving
- Hawaiian Volcano Observatory monitors earthquakes
- California Volcano Observatory works with the Northern California Seismic Network of the USGS Earthquake Science Center for CA volcano monitoring
- Joint postdoc on pre-and-post eruption characterization of seismic activity
- USGS Subduction Zone Science working group
- Scientific Earthquake Studies Advisory Committee

USGS

VHP IN THE FUTURE

- Several unknowns for the Volcano Hazards Program, including NVEWS in FY25-27 (budget, hiring, future staffing)
- Staffing shortages will likely continue- prioritization is necessary
- Focus on geothermal energy and critical minerals applications
- Increase Tribal engagement
- Some monitoring and evaluation expertise to tap into
- Expand partnerships (Earthquake and Landslide Hazard Programs, geothermal, federal and non-federal partners)

USGS

Thank you!

gmayberry@usgs.gov

@USGS Volcanoes
Instagram
Facebook
X

USGS

U.S. Geological Survey

NVEWS Reauthorization

Where NVEWS is at in the Reauthorization Process

July 29, 2025

Cassandra M. Smith, USGS Volcano Hazards Program

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NVEWS Reauthorization

Current bills in both House and Senate of the 119th Congress

H.R. 3176

To amend the John D. Dingell, Jr. Conservation, Management, and Recreation Act to reauthorize the National Volcano Early Warning and Monitoring System.

- Sponsor: Rep Begich [R-AK- At Large]

S. 1052

A bill to amend the John D. Dingell, Jr. Conservation, Management, and Recreation Act to reauthorize the National Volcano Early Warning and Monitoring System, and for other purposes.

- Sponsor: Sen Murkowski [R-AK]
- Cosponsors:
  - Sen Cantwell [D-WA]
  - Sen Hirono [D-HI]
  - Sen Sullivan [R-AK]

NVEWS Reauthorization

Current bills in both House and Senate of the 119th Congress

H.R. 3176

Key Changes

- Updates USGS authorization timeframe from 2019-2023 to 2026-2030
- Updates NOAA authorization timeframe from 2023-2024 to 2026-2030
- Instead of USGS and NOAA updates to Secretary of Interior and Secretary of Commerce

S. 1052

Key Changes

- Updates authorization amount from $55m to $75m
- Updates USGS authorization timeframe from 2019-2023 to 2019-2033
- Updates the NOAA authorization time frame from 2023-2024 to 2023-2034

NVEWS Reauthorization

Current bills in both House and Senate of the 119th Congress

H.R. 3176

Actions

- 5/5 – Introduced in House & Referred to the House Committee on Natural Resources
- 5/13 – Referred to the Subcommittee on Energy and Natural Resources
- 5/20 – Subcommittee Hearing Held
- 6/25 – Committee Consideration and Mark-Up
- 6/25 – Ordered to be reported by Unanimous Consent by Committee on Natural Resources

S. 1052

Actions

- 3/13 - Read twice and referred to the Committee on Energy and Natural Resources

NVEWS Reauthorization

Current bills in both House and Senate of the 119th Congress

H.R. 3176

Next Steps

- Come to vote and pass the house

S. 1052

Next Steps

- Senate hearings
- Senate committee mark up
- Vote out of committee
- Vote and pass the Senate

Reconciled Bill

Next Steps

- President Signs

Websites

43 USC 31k: National Volcano Early Warning and Monitoring System

Actions - H.R.3176 - 119th Congress (2025-2026): To amend the John D. Dingell, Jr. Conservation, Management, and Recreation Act to reauthorize the National Volcano Early Warning and Monitoring System. | Congress.gov | Library of Congress

Actions - S.1052 - 119th Congress (2025-2026): A bill to amend the John D. Dingell, Jr. Conservation, Management, and Recreation Act to reauthorize the National Volcano Early Warning and Monitoring System, and for other purposes. | Congress.gov | Library of Congress

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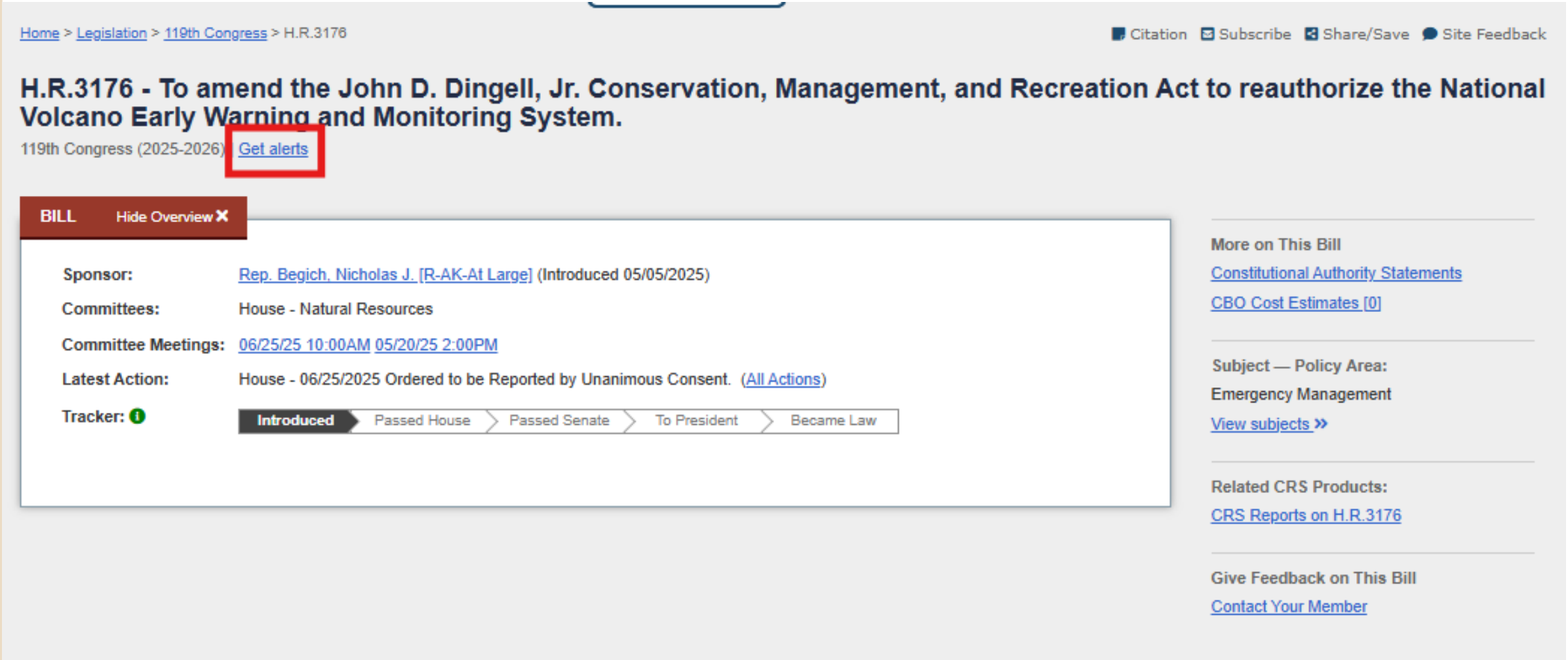
Legislative Alerts



U.S. Geological Survey

NVEWS AC Membership Update

Members Lost and Process to Replace

July 29, 2025

Cassandra M. Smith, USGS Volcano Hazards Program

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NVEWSAC Member Organizations

Wyoming State Survey (Erin Campbell)

New Mexico Bureau of Geology

Washington Department of Natural Resources

University of Oregon

California Governor's Office of Emergency Services (Yvette LaDuke)

University of California, Berkeley

Cornell University

Washington State Emergency Management

Arizona State University

Department of Energy

Department of Defense

National Oceanic and Atmospheric Administration* (Douglas Howard)

National Institute of Standards and Technology (Steven McCabe)

National Science Foundation

Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge

National Aeronautics and Space Administration (Benjamin Phillips)

Federal Emergency Management Agency (Wade Witmer)

Federal Aviation Administration

Nomination Announcement

After Nomination Notice Posted

- 30 days to submit nominations
- Email nominations to Gari Mayberry (gmayberry@usgs.gov)
- Nominees should have established records of distinguished service, be familiar with relevant areas of geology, volcanology, geography, hydrology, atmospheric science/meteorology, ecology, and related fields and have at least a general familiarity with U.S. Geological Survey programmatic activities relating to its participation in NVEWS.
- The candidate’s field of expertise should be specified in a brief nomination letter, along with a resume providing adequate description of the nominee's qualifications

Websites

Federal Register :: Document Search Results for 'national volcano early warning system'

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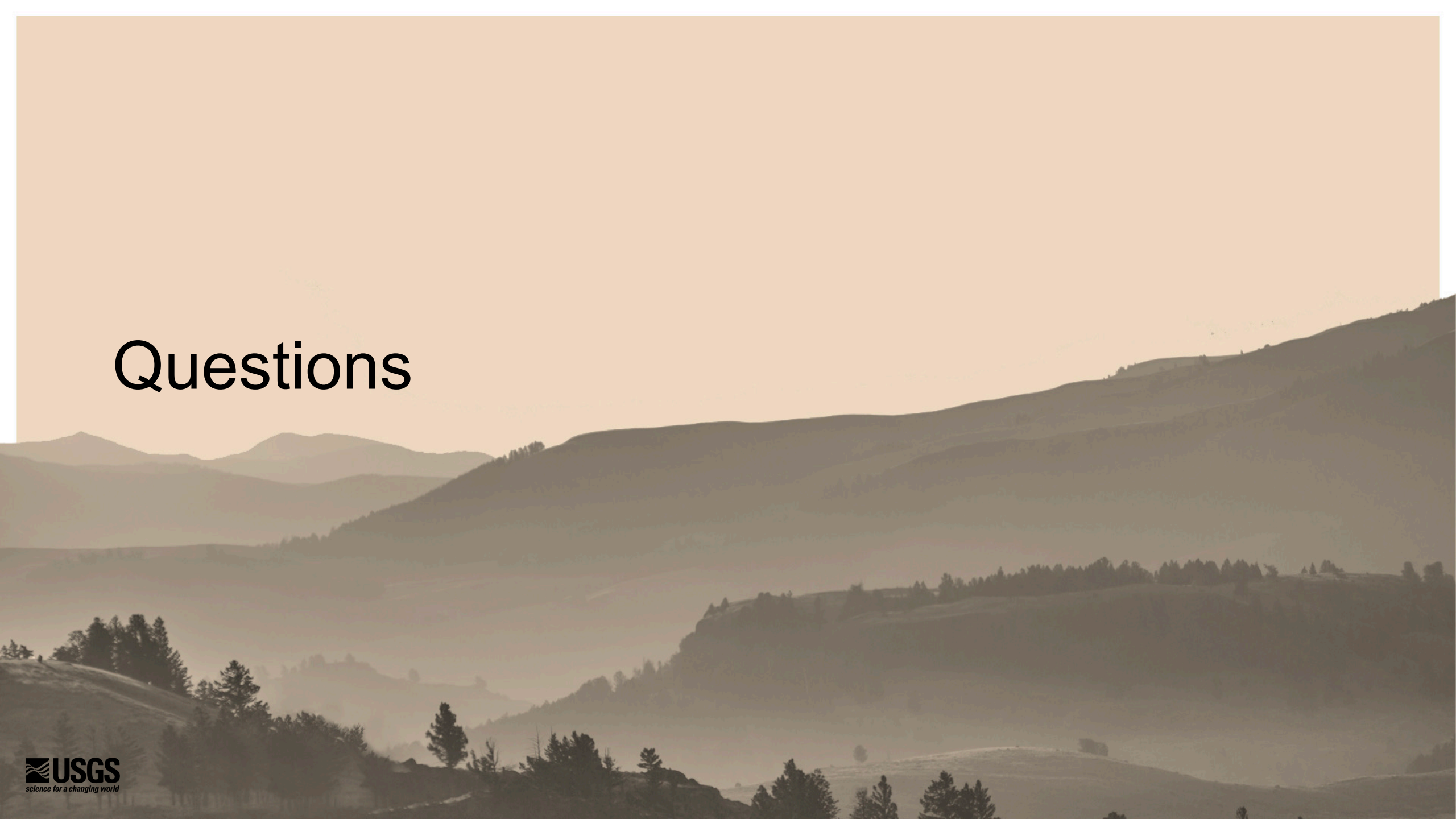
Questions



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NVEWSac member updates

July 29, 2025

Lauren Boyd (not present)

- Geothermal Technologies Office, DOE

Erin Campbell (not present)

- In transit to new position as Alaska State Geologist

Stephen Dornbos (not present)

- Arctic and Global Resilience Office, DOD

Nelia W. Dunbar
New Mexico Bureau of Geology and Mineral Resources
Director and state geologist Emerita (March 2024-present)
Director and State Geologist (2016-2024)
Staff scientist/geochemist (1992-2016)

Expertise

Geochemistry, petrology, volcanology

Tephrochronology in New Mexico, Antarctica, Ethiopia, and other places

Dating young lavas using cosmogenic ^{36}Cl

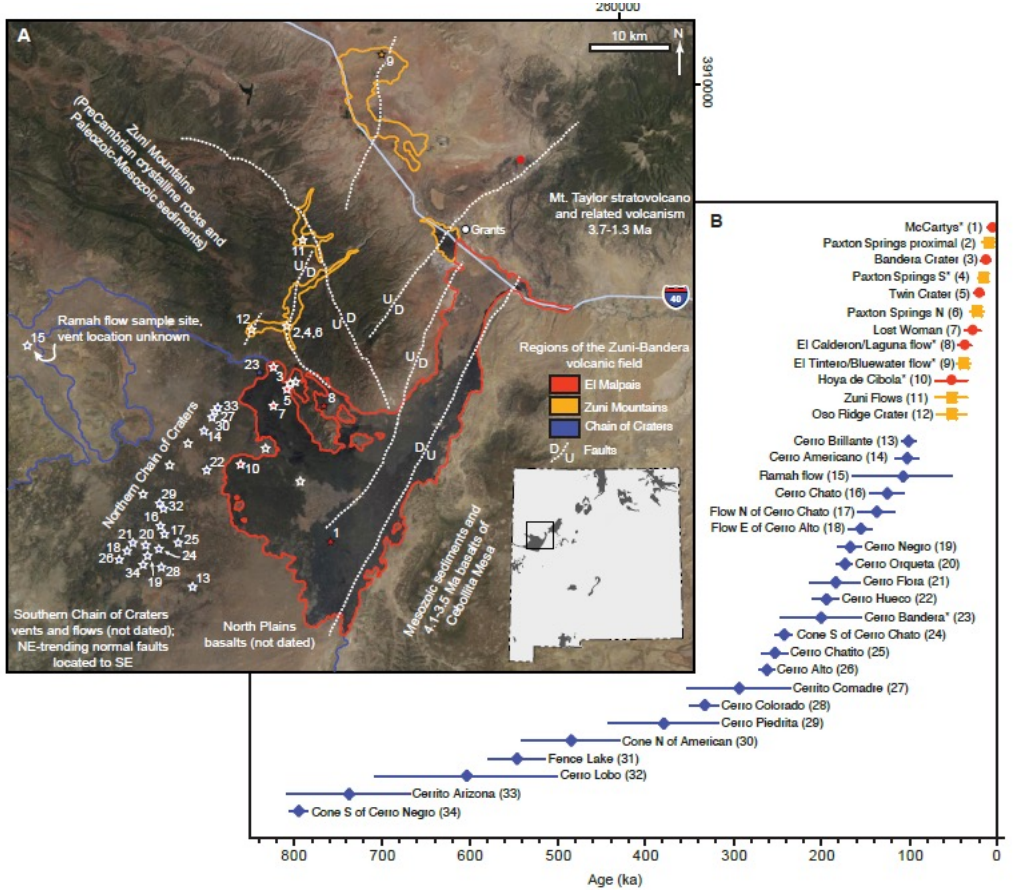
Active Volcano and Hazard Experience

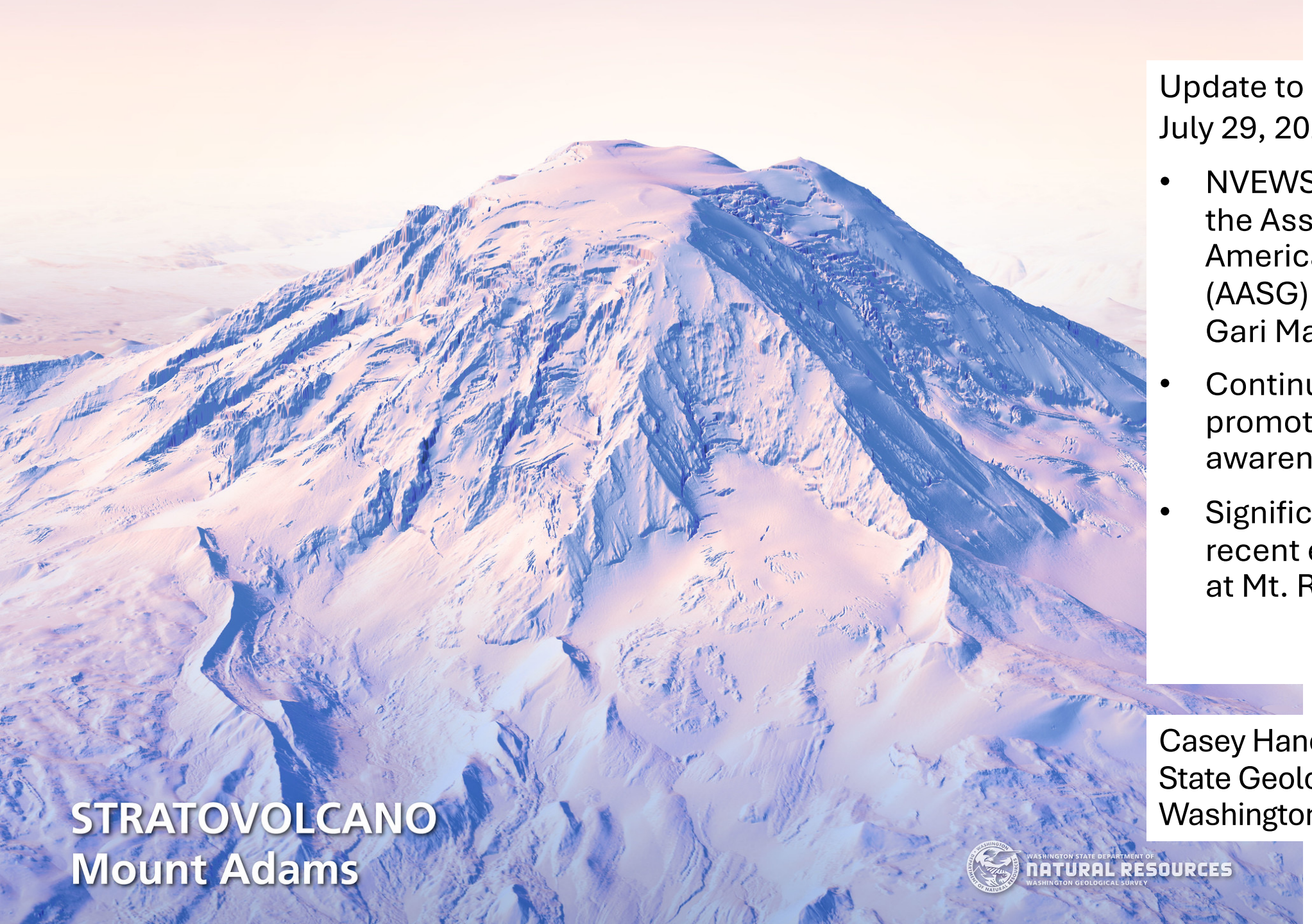
A temporal dissection of late Quaternary volcanism and related hazards within the Rio Grande rift and along the Jemez lineament of New Mexico, USA

Matthew J. Zimmerer

+ Author and Article Information

Geosphere (2024) 20 (2): 505–546. https://doi.org/10.1130/GES02576.1 Article history





Update to NVEWS FAC
July 29, 2025

- NVEWS presentation at the Association of American State Geologists (AASG) Annual Meeting by Gari Mayberry
- Continued outreach to promote volcano hazard awareness
- Significant interest in the recent earthquake swarm at Mt. Rainier

Casey Hanell
State Geologist and Director
Washington Geological Survey

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

Volcano Program Work

Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES

Yvette LaDuke, Manager

Earthquake, Tsunami and Volcano Programs

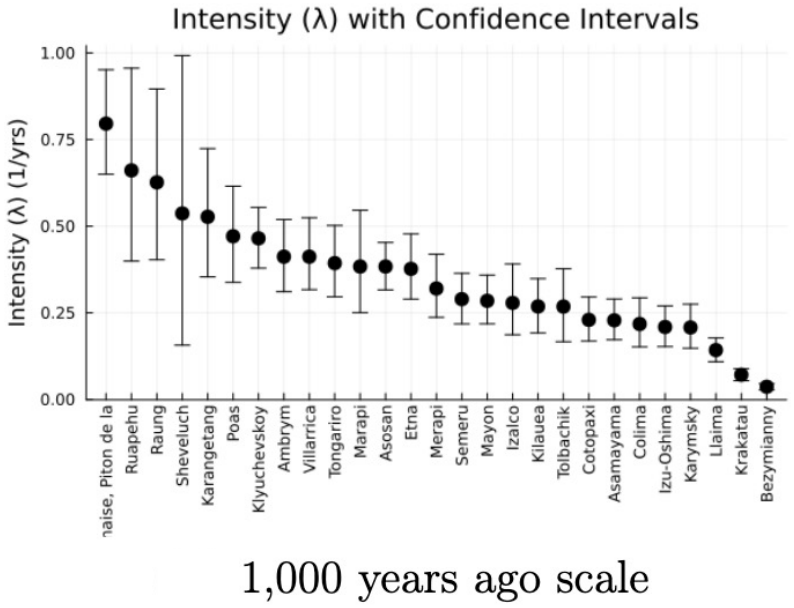
- Volcano Program
  - Collaborate with the USGS CA Volcano Observatory during volcanic activity with potential to impact California.
  - Volcano Con Ops Plan in final review.
  - Branch Duty Officers using Volcano Notification System.
  - Coordinating with Cal VO to conduct Duty Officer training for Cal OES SHB Duty Officers.
  - Developing volcano hazard educational outreach materials (adults & kids) for distribution at outreach events.

Leif Karlstrom

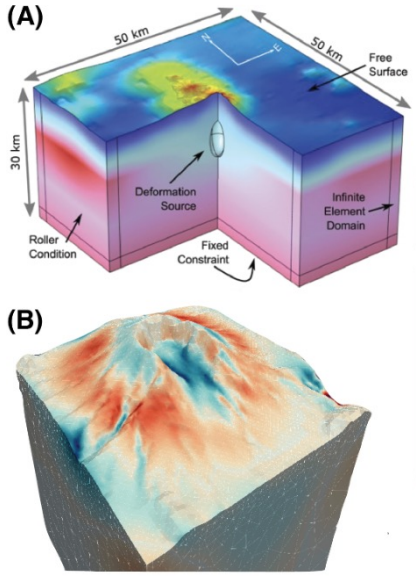
University of Oregon, Faculty since 2015

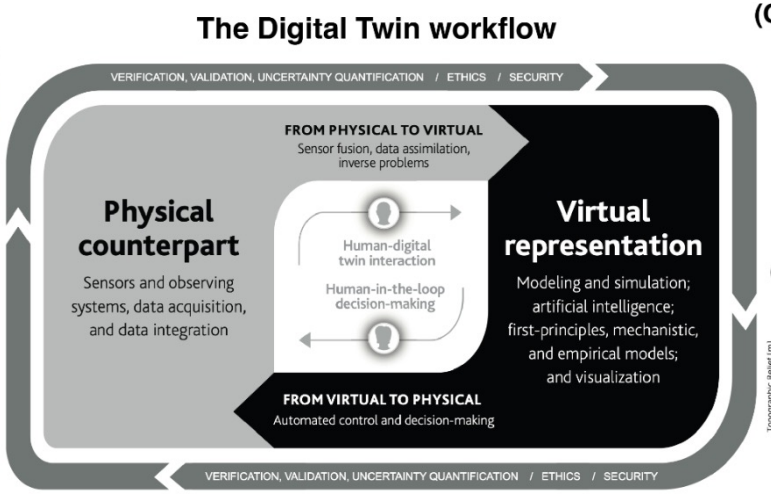
Current NVEWS-related research and activities: Some uncertainty, some success.

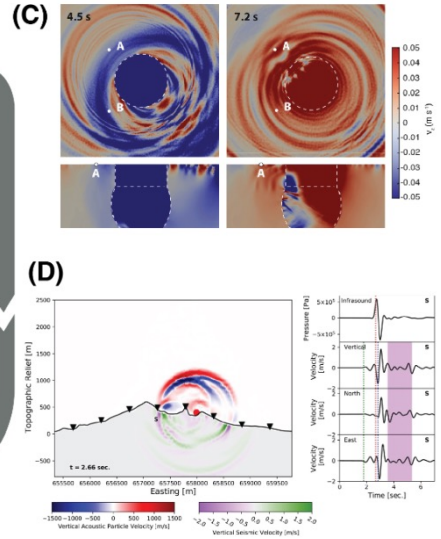
(a) Statistical approach for assessing completeness and recurrence of eruptions
- w/ new NSF postdoc Chris Harper



(b) USGS Powell Center on Digital Twin development, to enable joint interpretation of geodetic and seismic data (emphasis on NVEWS data applications)
- Co-I's: Mike Poland, Kyle Anderson, Brandon Schmandt
- Reviewed well enough to be selected, if funds are available







(c) USGS/NSF INTERN for current PhD student Keel Wilde to work at HVO through Dec 2025, synthesizing continuous gravity with GNSS/tilt to understand days-weeks ground deformation episodes ("DI events")

Michael Manga

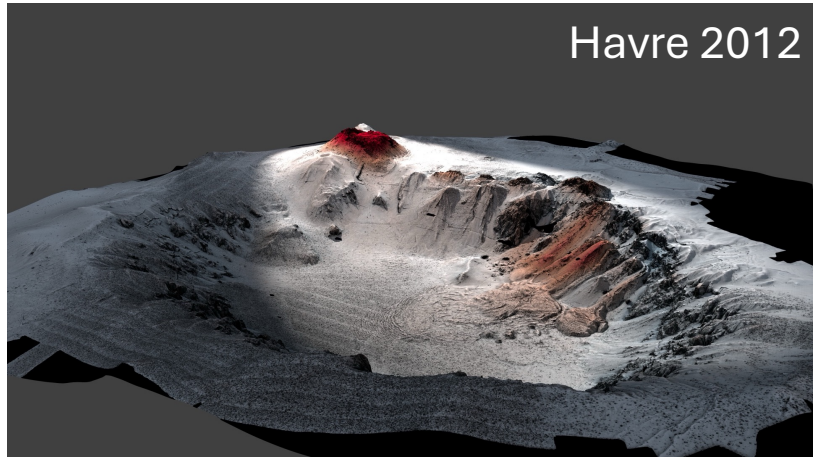
University of California, Berkeley

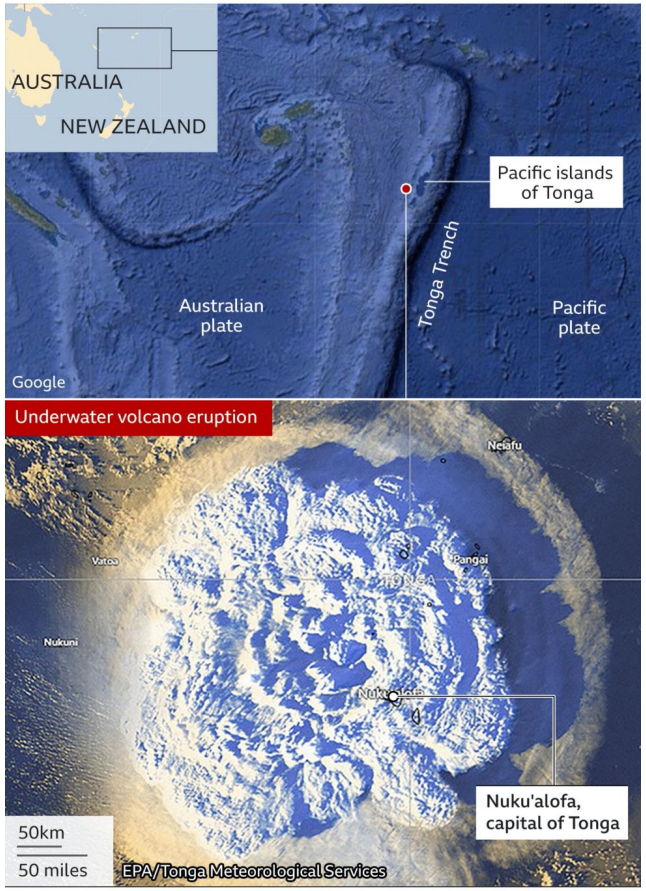
Faculty member since 2001

(Previously faculty at Univ Oregon 1996-2001)

- Why do volcanoes erupt in so many different ways?
- Why are there super eruptions?
- Why is magma focused at a volcano?
- How does a changing climate affect eruptions and vice versa?
- How does water erupt on icy satellites?

We learn a lot from studying offshore deposits of eruptions:
More faithful record of frequency and size, good chronology, connections between magmatic and tectonic processes





August 14, 2025 depart for cruise to study Hunga eruption (Australian RV Investigator)

- 15 Jan 2022 eruption, plume reached 58 km, heard in Alaska, 8,000 km away; tsunami damage around the Pacific; $90M US damage to Tonga
- 200,000 lightning strikes in first hour (Vaisala National Lightning Detection Network)
- 0.4 Tg SO_2 small (Pinatubo 20 Tg) but stratosphere H_2O increased 10-15% (leads to warming, not cooling)
- Given radius of umbrella cloud, VEI 5-6, biggest eruption of this century (so far); ashfall volume a couple km^3, similar to Havre 2012 and most of mass ~10 km^3 in density currents
- Density currents travelled far and fast (Clare et al., *Science* 2023)
- Conversion of thermal energy to kinetic and then potential energy by heat transfer to water

Matt Pritchard
Cornell University

Professor of Earth & Atmospheric Sciences

20 years in Role

Wins/Challenges:

- Successful international workshop with ~50 attendees
- Few observatory staff were able to attend
- Planning online version for 2026 focused on observatories

(updating successful online workshop from 2021)

Pre-IAVCEI workshop: June 28-29, 2025

Using Satellite Data for Volcano Monitoring

June 29 - July 4, Geneva, Switzerland
IAVCEI 2025
Scientific Assembly

Organisers:

- Juliet Biggs (COMET-Bristol)
- Carlos Andres Laverde (Servicio Geologico Colombiano)
- Marco Bagnardi (USGS-CVO)
- Grace Bato (JPL)
- Simon Carn (MTU)
- Loreto Cordova (OVDAS-Chile)
- Hannah Dietterich (USGS-AVO)
- Edna Dualeh (COMET-Bristol)
- Susanna Ebmeier (COMET-Leeds)
- Ben Esse (COMET-Manchester)
- Tarsilo Girona (USGS-AVO)
- Ian Hamling (GNS New Zealand)
- Gabor Kereszturi (Massey University)
- Paul Lundgren (JPL)
- Virginie Pinel (IRD-ISTerre)
- Michael Poland (USGS-CVO)
- Matthew Pritchard (Cornell)
- Isabelle Taylor (COMET- Oxford)

Convenors who actually attended:

- Juliet Biggs (COMET-Bristol)
- Marco Bagnardi (USGS-CVO)
- Edna Dualeh (COMET-Bristol)
- Ben Esse (COMET-Manchester)
- Gabor Kereszturi (Massey University)
- Virginie Pinel (IRD-ISTerre)
- Matthew Pritchard (Cornell)

Federal Aviation Administration

NVEWSAC

Karen Shelton-Mur, Federal Aviation Administration (FAA)

July 29-30, 2025

FAA interagency activities related to Volcanic Ash

- **Member of International Civil Aviation Organization (ICAO) workstream, International Airways Volcano Watch (IAVW)**
  - IAVW's focus is on activities geared to enhance and improve the safety of flight related to volcanic ash. Which includes improvement of global services related to volcanic ash, guidance and education, communication; etc.
  - FAA, USGS and NOAA personnel are all members on the workstream.
  - Recent accomplishments of the IAVW workstream led to the development of global requirements for a new Quantitative Volcanic Ash (QVA) Concentration Information Service.
  - QVA service will be developed/issued by the Volcanic Ash Advisory Centers (VAACs) for significant* volcanic ash clouds. There are 9 VAACs that provide global services for volcanic ash; the US operates two: VAACs Anchorage and Washington.
  - Requirements for QVA were proposed to the fifth meeting of the ICAO Meteorology Panel (METP) where they were endorsed and recommended to the Air Navigation Commission (ANC). QVA requirements later endorsed by the ANC.
  - Standards and Recommended Practices related to QVA are part of the eighty second amendment to ICAO Annex 3: Meteorological Service for International Air Navigation and found in the Procedures for Air Navigation Services - Meteorology with an applicability date of November 2025 for those VAACs that can do so. In 2026, the requirement will become applicable to all VAACs.

FAA interagency activities related to Volcanic Ash

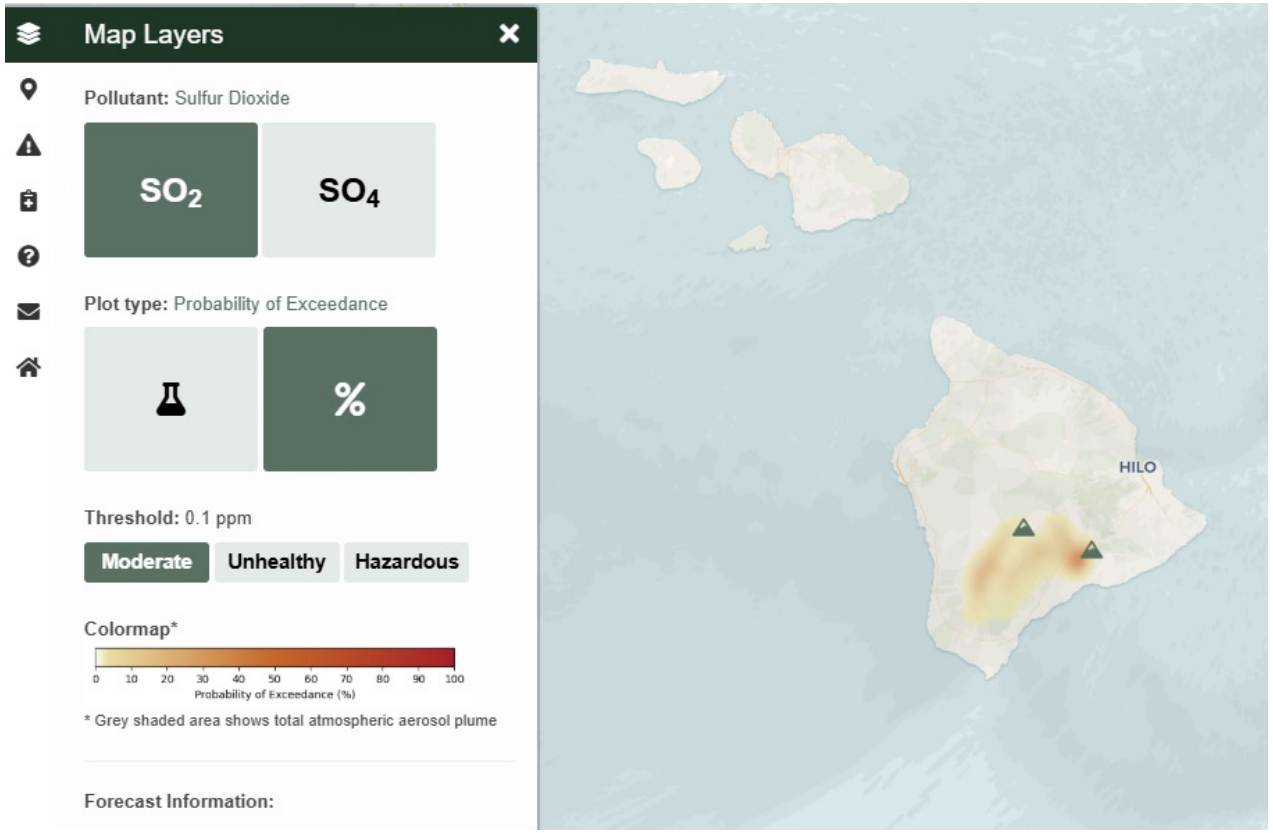
Established/co-lead Volcanic Ash Coordination Group consisting of members from the FAA, USGS, and NOAA

- Established to improve and increase communication and collaboration within the US Federal Agencies related to Volcanic Ash
- Means for IAVW members to continue to discuss requirements or policy related to Volcanic Ash services in a US focused meeting
- Educate non-IAVW members on the activities within the workstream
- Provide situational awareness on all things related to volcanic ash such as eruptions, exercises, stakeholder outreach and meetings/conferences

Collaboration with USGS/NOAA to develop means to disseminate the Volcano Observatory Notice for Aviation (VONA) via the Aeronautical Fixed Service (AFS)

- The AFS is a secure network that provides information to airlines "for the safety of air navigation and for the regular, efficient and economical operation of air services.“
- AMD82 to Annex 3 has elevated the dissemination of the VONA as a recommended practice applicable in Nov 2025 meaning all State Volcano Observatories should disseminate the VONA.
- USGS does not have a direct connection to the AFS, so it will distribute VONAs via email to an NWS gateway, that in turn will disseminate them for international air navigation.
- Interagency group has been meeting to work through technical issues, and drafting a letter of agreement for FAA, NWS and USGS management.

Dr. Ariel Stein : Director NOAA Air Resources Laboratory



VOG forecasts produced by University of HAWAII utilize ARL's HYSPLIT dispersion model and data from USGS.

- NOAA Implementation plan is now publicly available https://repository.library.noaa.gov/view/noaa/70905
- Work on science, coordination and transitions to operations continue to move forward
  - priority groups continue to meet
  - QVA priority group members planning trip to Anchorage in September and will meet with AVO.
- Expect uncertainty in resourcing to continue

Brian Terbush
Earthquake/Volcano Program Manager
Washington Emergency Management Division

Recent events/Successes in Washington Volcanoes:

- Meeting of Mt. St. Helens/Mt. Adams Coordination Workgroup
  - Planned updates this summer
- Successful response working together with USGS and PNSN sharing public information for Mt. Rainier earthquake swarm (Ongoing as of creating this slide, but slowing).
  - Excellent “test” opportunity to identify communication issues and test/update plans
- “May is Volcano Awareness Month” in Washington
  - Several Outreach Events and news stories bringing awareness to science and preparedness
- Updating other volcano coordination plans, as well as Standard operating procedures for response.

Christy Till

Arizona State University
Associate Director of Dept
Associate Professor
@ASU since 2014

NVEWS Advisory Committee Roles/Interest

- Volcano scientist interested in identifying data gaps that academic scientists can help fill, as well as training gaps that universities & colleges can help fill.
- Interested in how to continue to support critical volcano science in the US in current climate.
- Also currently serve on AGU Board of Directors
- Have relationships to two NSF funded consortia (CONVERSE & SZ4D) that have overlapping interests
- To represent SW region

U.S. National Science Foundation

Dr. Jennifer Wade. Program Director
Division of Earth Sciences (EAR)
Directorate for Geosciences (GEO)

EAR website

NSF FAQs and Updates on Priorities

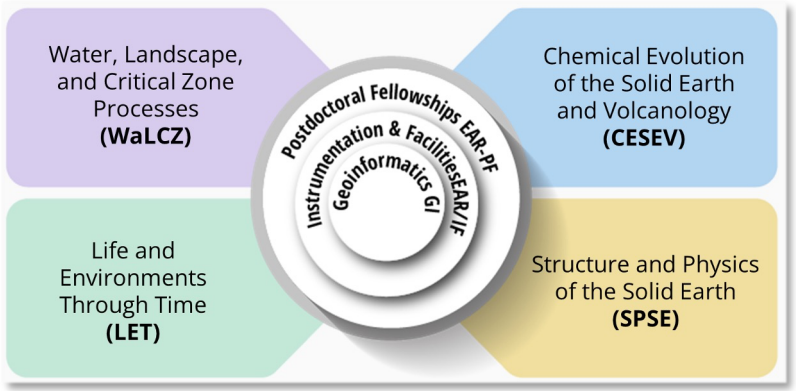
NSF FAQs re: Implementation of Executive Orders

Updates & Challenges

EAR reorganized the core programs into 4 ‘clusters’
NSF Director resigned; Brian Stone is acting in the role
NSF maintains two pages of FAQs and Updates which change regularly
10% of the staff (168) were fired; half rehired. Many have taken DRP, retired, or resigned
Some awards have been terminated
The FY26 outlook is uncertain

Wins

EAR remained nearly flat in FY25; awards are being made
Geohazards remain a priority topic area for the agency



JEFF WILLIAMS

Deputy Refuge Manager

Alaska Maritime National Wildlife Refuge

Homer, Alaska

USGS
science for a changing world

NVEWS – Where are we, and where are we going?

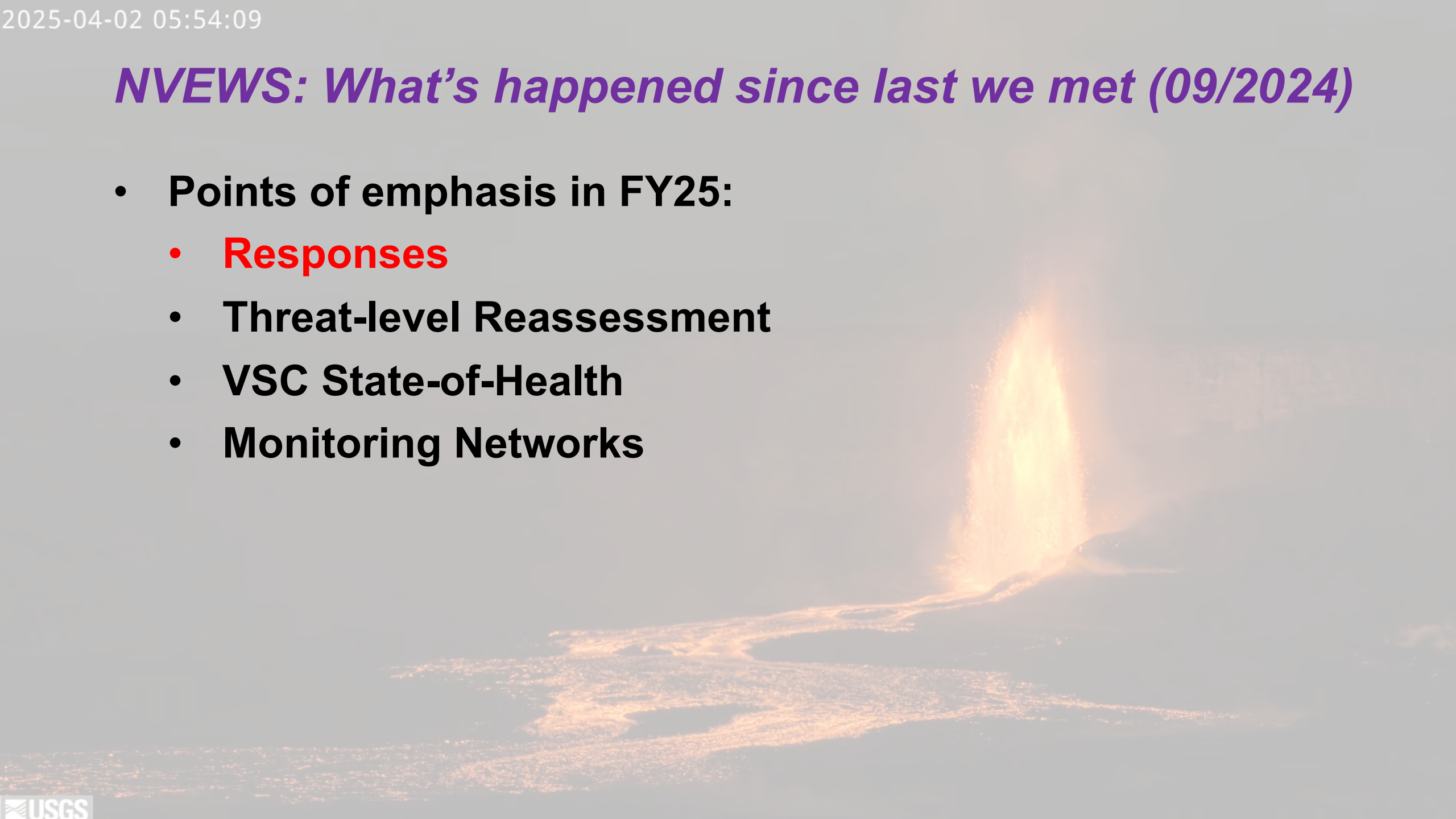
Seth Moran – NVEWS Program Coordinator

U.S. Department of Interior
U.S. Geological Survey

2025-04-02 05:54:09

NVEWS: What's happened since last we met (09/2024)

- **Points of emphasis in FY25:**
  - **Responses**
  - **Threat-level Reassessment**
  - **VSC State-of-Health**
  - **Monitoring Networks**



USGS

NVEWS: What's happened since last we met (09/2024)

- **Responses w/ relevance for NVEWS:**
  - **Mount Adams unrest, August – November 2024 (CVO Information Statement)**
  - **Mount Spur unrest, April 2024 – ongoing (AVO Alert Level change to Yellow)**
  - **Kilauea eruption: 29 episodes inside caldera between December 2024 – July 2025 (HVO Alert Level Orange)**
  - **Mount Rainier swarm, July 2025 (CVO Information Statement)**

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NVEWS: What's happened since last we met (09/2024)

- **Mount Adams swarm:**
  - **9 located earthquakes between Sept-November, dozens of other eqs too small to locate.**
  - **Normal rate; 1 located eq every 2-3 years**

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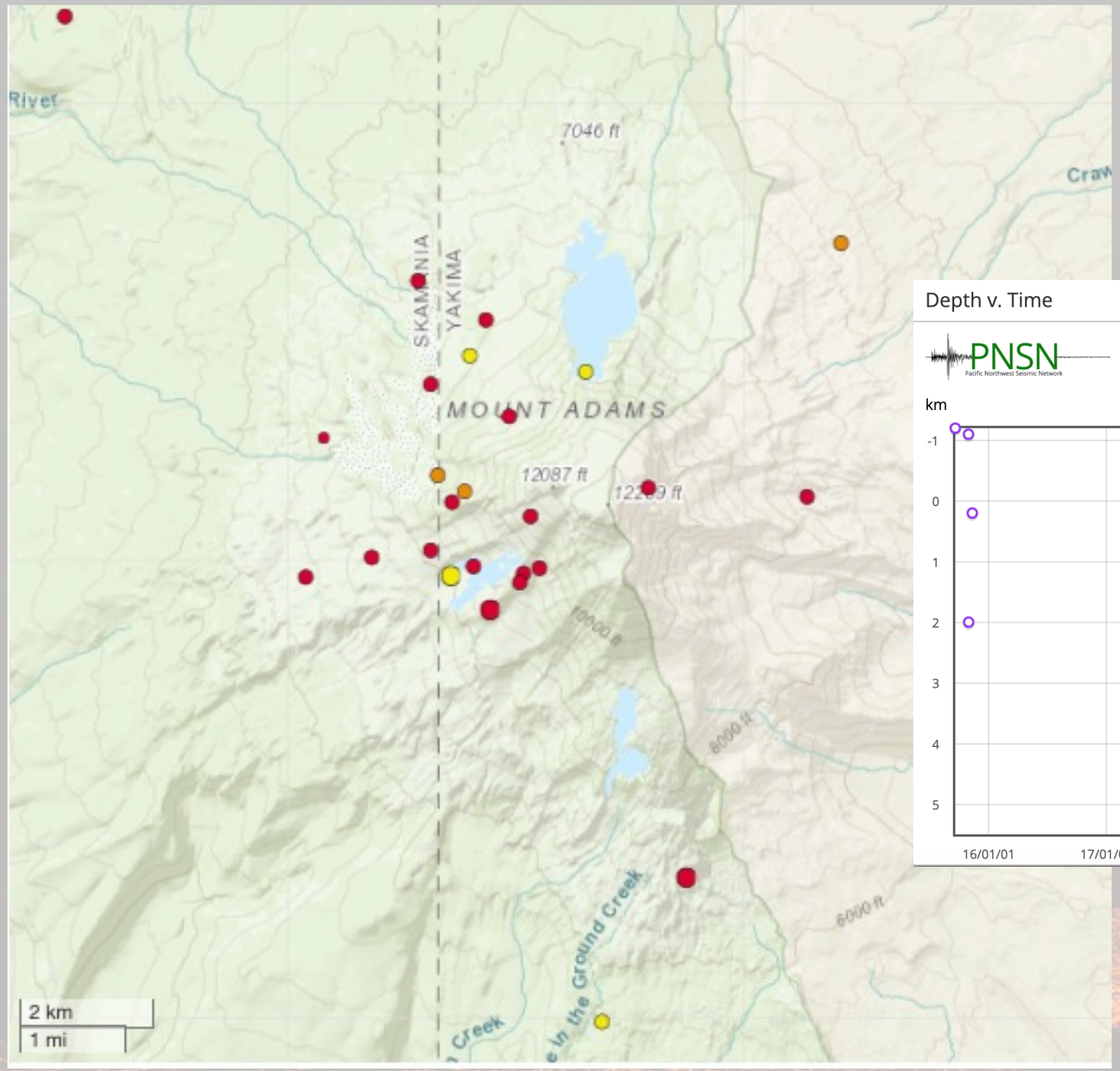

Depth v. Time

PNSN
Pacific Northwest Seismic Network

Magnitude
>5 4 3 2 1 < 1

km
-1
0
1
2
3
4
5

16/01/01 17/01/01 18/01/01 19/01/01 20/01/01 21/01/01 22/01/01 23/01/01 24/01/01

USGS

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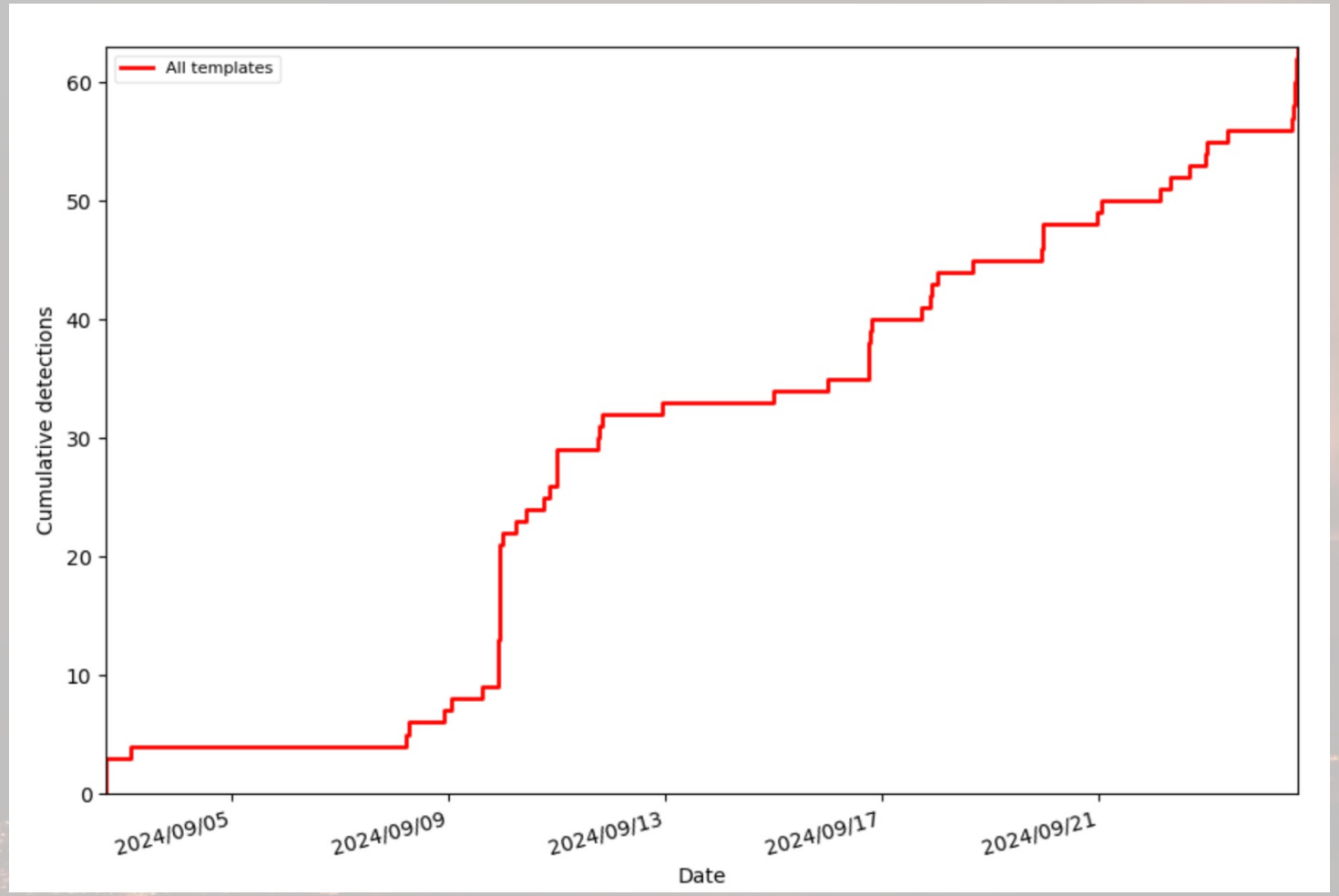
NVEWS: What's happened since last we met (09/2024)

- **Mount Adams swarm:**



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NVEWS: What's happened since last we met (09/2024)

- **Mount Adams swarm:**
  - **9 located earthquakes between Sept-November, dozens of other eqs too small to locate.**
  - **Normal rate; 1 located eq every 2-3 years**
  - **Adams has one station within 20 km (~10 km from summit)**
  - **Major uncertainty about location (under summit or off on a flank? how shallow?)**
  - **No deformation network (including 0 campaign GPS surveys)**

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NVEWS: What's happened since last we met (09/2024)

- **Mount Adams swarm:**
  - **Triggered meetings w/ local emergency managers**
  - **Significant congressional interest: Meetings w/ Cantwell (D-WA), Newhouse (R-WA), & Gluesenkamp-Perez (D-WA) staffers**
  - **CVO response: Installed 3 temporary stations (one < 10 km)**
  - **Illustrated the all the issues with having an under-monitored volcano wake up**

USGS

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NVEWS: What's happened since last we met (09/2024)

- **Mount Spurr unrest:**
  - **Over 3000 total earthquakes, 6 cm of outward radial motion, melting at summit**
  - **YELLOW/ADVISORY in October 2024**
  - **SO2 & CO2 detected by airborne flights March 2025 & for several months later**
  - **Multigas deployed at Crater Peak in June 2025; anomalous CO2 detected**
  - **Seismicity down, deformation paused ➔ Stalled intrusion**

USGS

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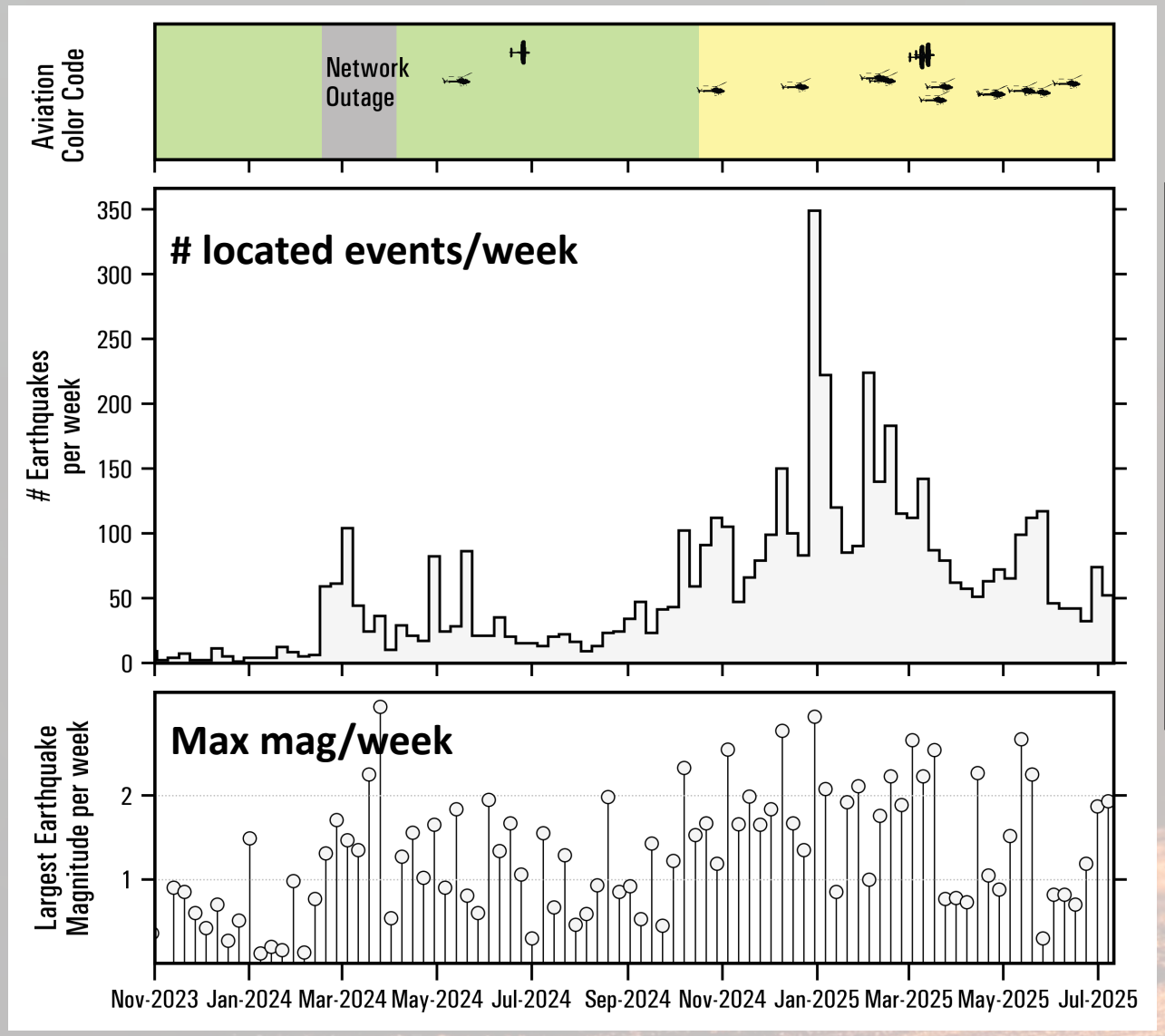

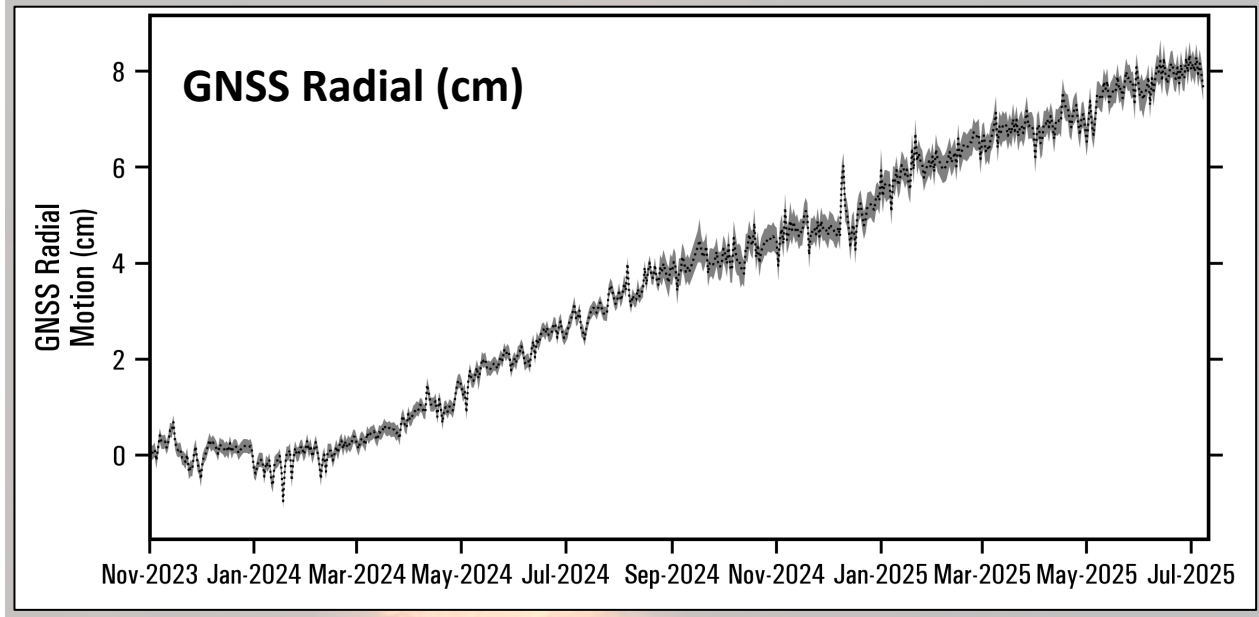

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NVEWS: What's happened since last we met (09/2024)

- **Mount Spurr unrest:**
  - **AVO was on high alert for months (stood up an OVERT)**
  - **LOTS of communication w/ partners and community members**
  - **New products developed to address ash hazards**
  - **Significant congressional interest: Meetings w/ Murkowski (R-AK) & Sullivan (R-AK) staffers**

USGS

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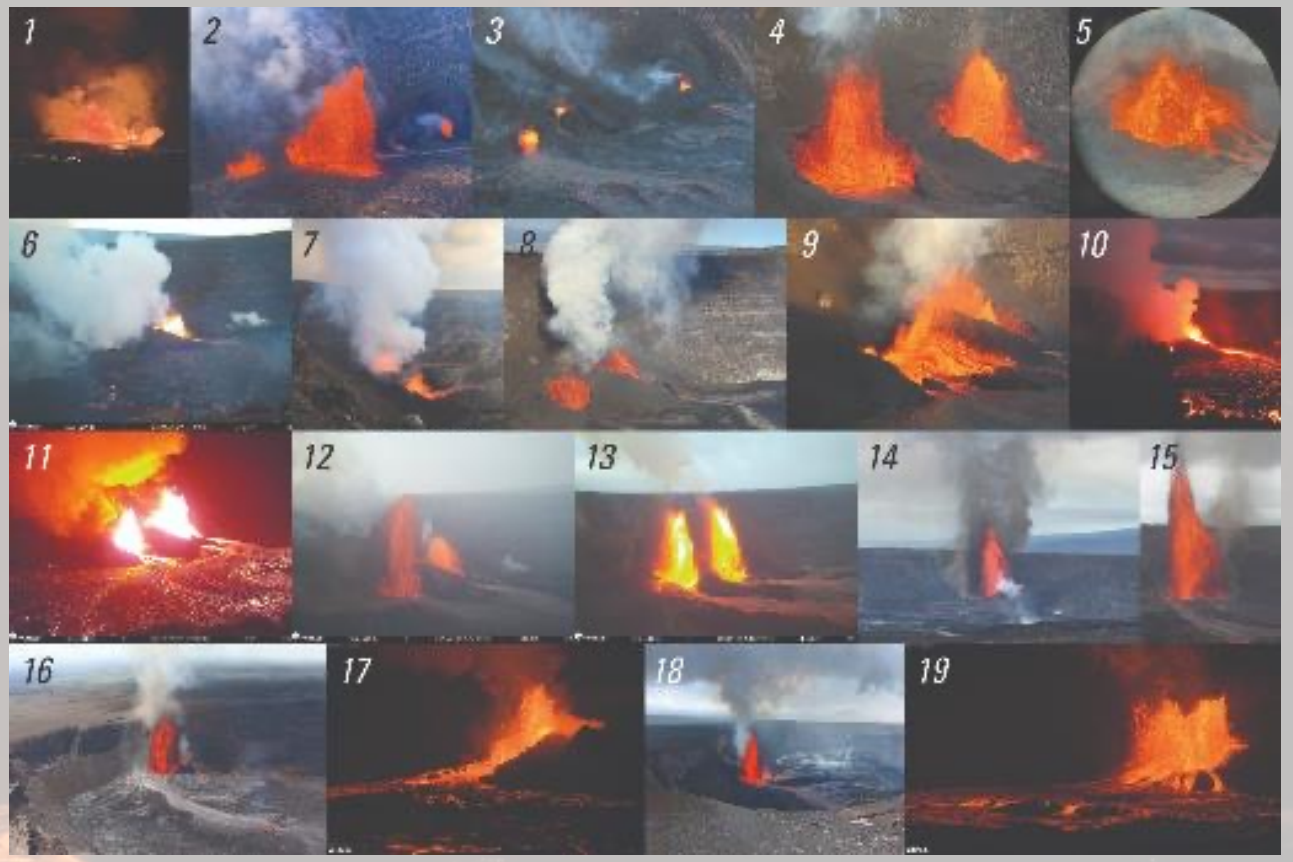
2024-2025 HALEMA‘UMA‘U ERUPTION
ONLY THE 4th DOCUMENTED EPISODIC HIGH FOUNTAIN ERUPTION

- 29 episodes, 2nd most out of 4 recorded episodic eruptions
- Eruptions 7-10 days apart, ~5 million m^3
- 3 live video streams
- Response: Mapping; measurements of lava and gas chemistry, erupted volumes, fountain heights; thermal maps; photos; quantitative video; tremor, tilt, infrasound, and LPs



FAMILY PORTRAIT OF FIRST 19 EPISODES

USGS

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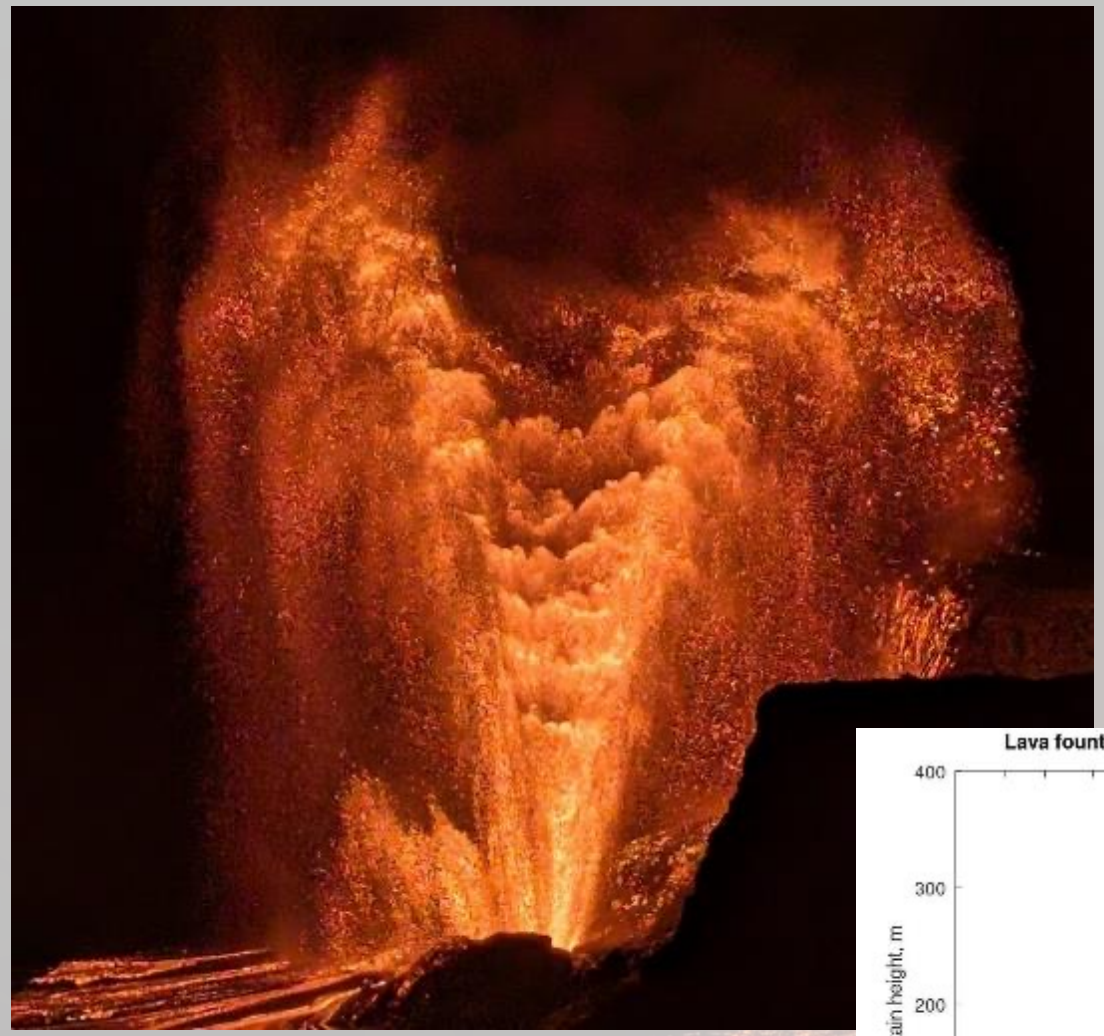
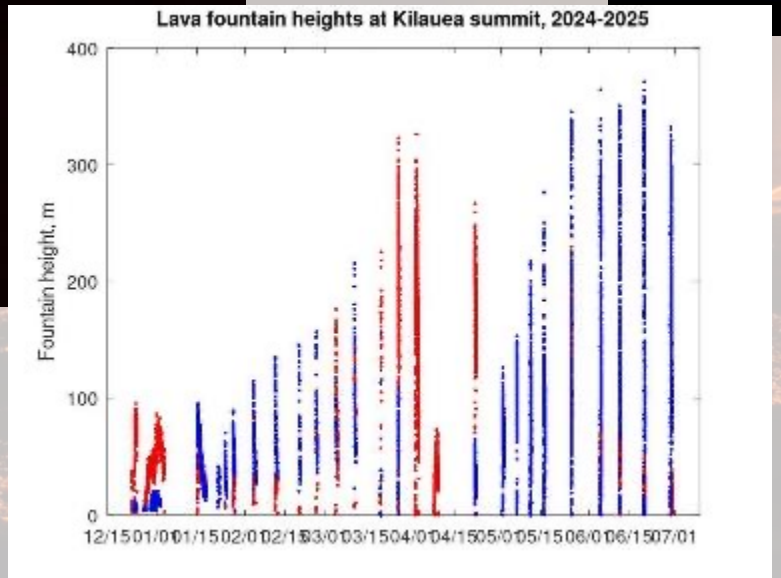
2024-2025 HALEMA‘UMA‘U ERUPTION



Maximum Fountain Height
365 meters
(1200 feet)



Eruption plume to 6000 meters
(20000 feet)

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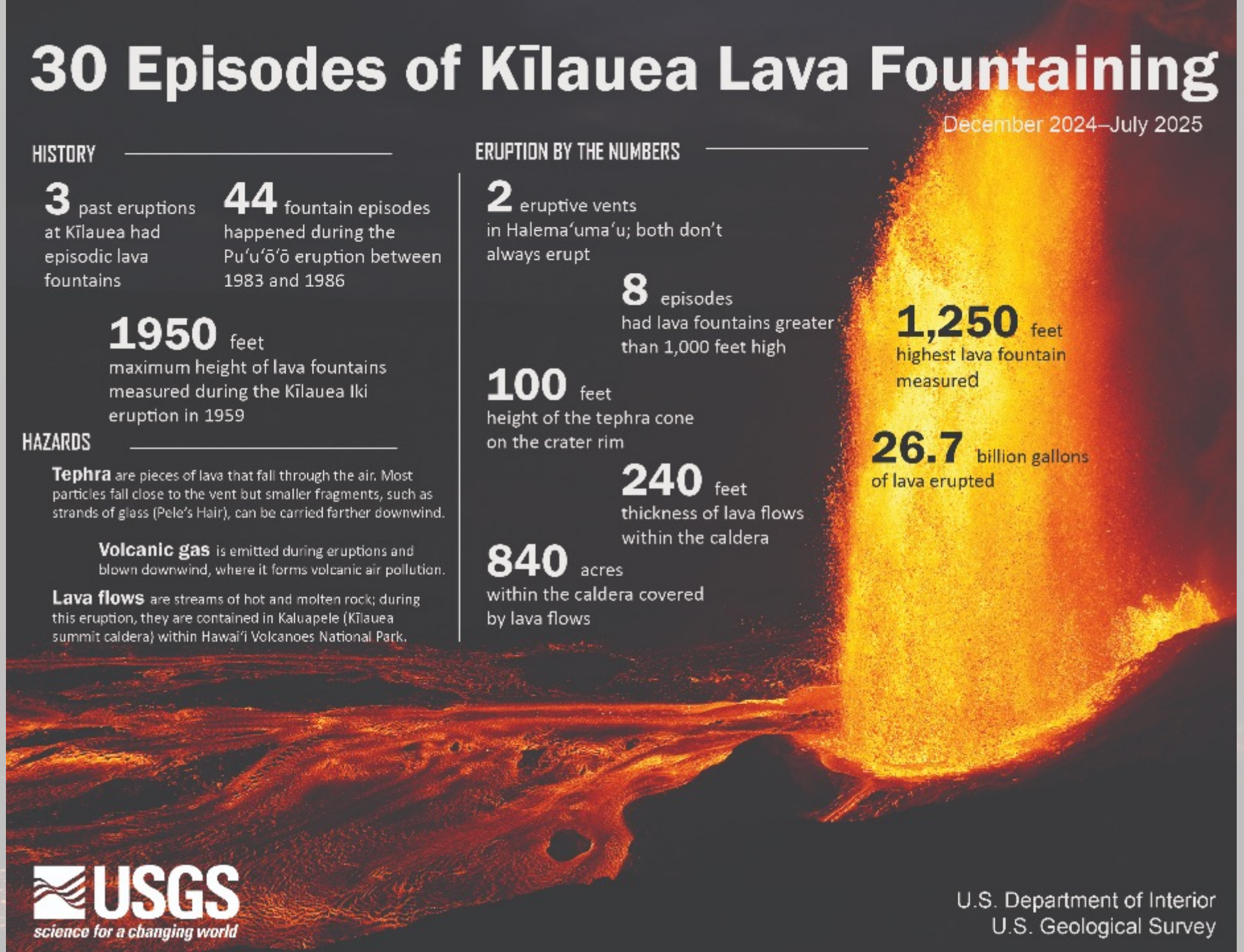
Summary slide for a Volcano Watch article, assuming we get to episode 30 this week



USGS

NVEWS: What's happened since last we met (09/2024)

- **Kilauea eruption:**
  - **HVO staff in fairly constant response mode (VSC rotations from other VOs started in June) ➔ Difficult to make progress on NVEWS completion goals**
  - **Tephra disrupting telemetry, burying instruments**
  - **Tephra accumulation making field site access difficult (snowshoes required in some cases)**
  - **Plumes have reached > 15,000' above ground level, triggering questions from aviation community.**
  - **VOG major issue for some episodes (e.g., #29)**

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NVEWS: What's happened since last we met (09/2024)

- **Mount Rainier swarm (July 8-ongoing):**
  - **Over 1000 located earthquakes (largest M 2.4), many more unlocatable; depths between several km above & below sea level**
  - **Peak event rate ~40/hour**
  - **Still going (M 1.3 this a.m.), event rate now down to 1 every few hours**
  - **No deformation or forms of unrest detected**
  - **Most significant swarm since monitoring began (1987)**

USGS

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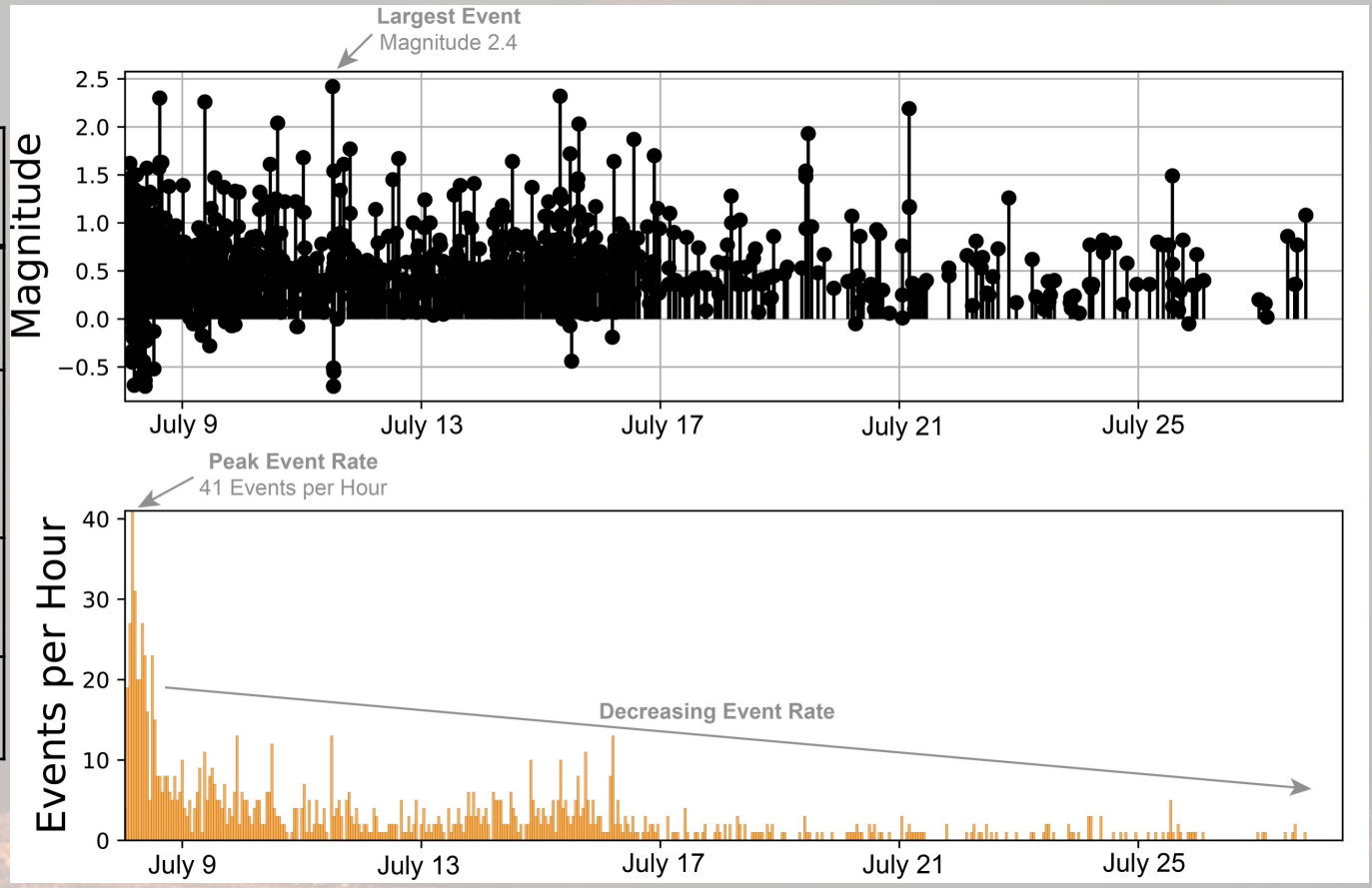
Mount Rainier Swarm (July 8 – present)

	2009	Current
Number of Located Events	121	>1030
Maximum Event Rate (per hour)	18	41
Maximum Magnitude	2.5	2.42
Number of >M1	15	>100



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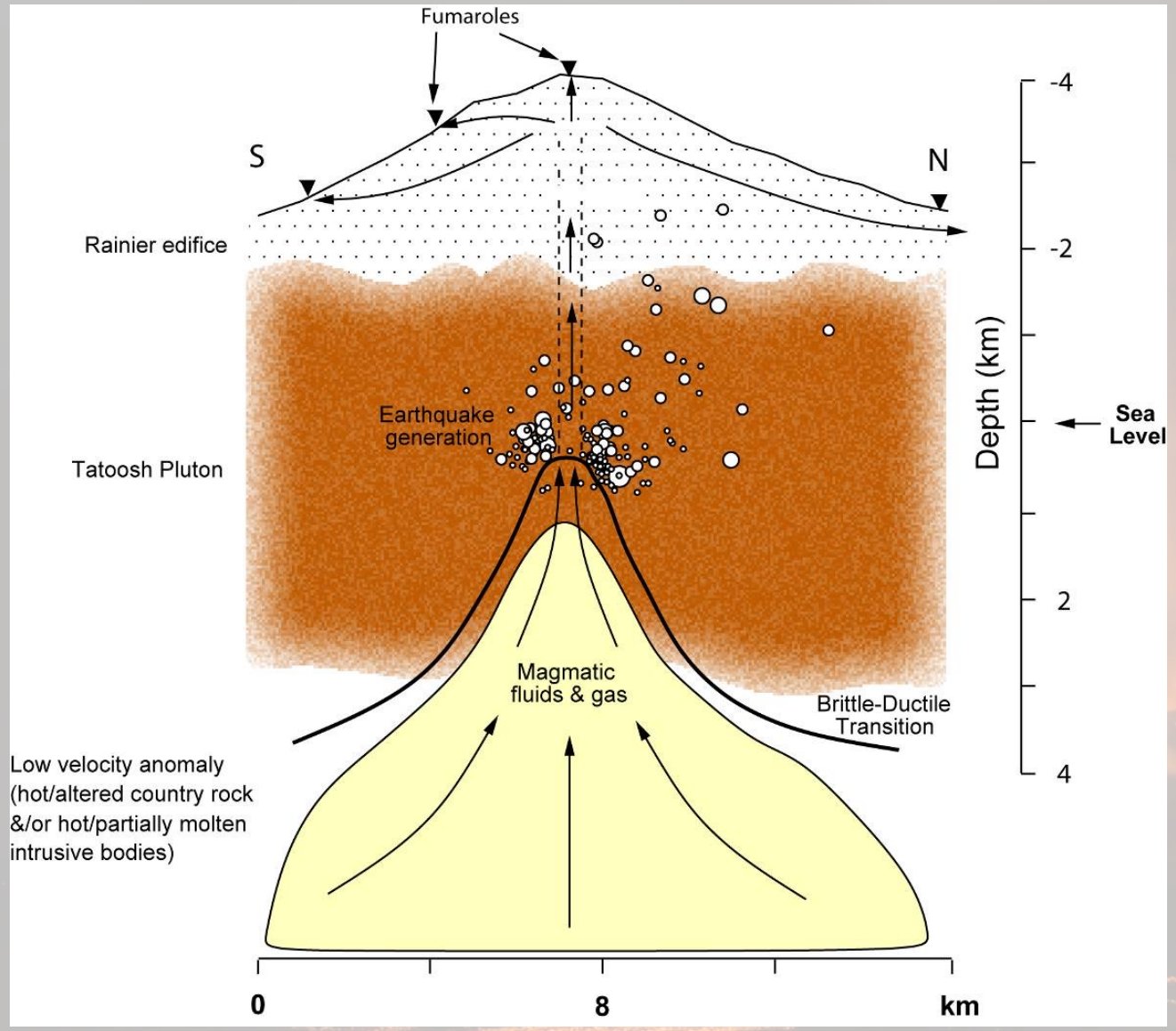

Moran et al., 2000

NVEWS: What's happened since last we met (09/2024)

- **Mount Rainier swarm, July 2025:**
  - **Largest swarm ever recorded at Rainier (eclipsed 2009 by an order of magnitude)**
  - **Cause – hydrothermal fluid circulation (?)**
  - **CVO engaged in lots of communications with emergency management community (which was already prepped by year of CVO comms, including a June '25 meeting at CVO)**
  - **Even at a well-monitored volcano, there were/are short-comings (e.g., ability to constrain shallow depths is poor (need summit station), deformation network marginal)**


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NVEWS: What's happened since last we met (09/2024)

- **Points of emphasis in FY25:**
  - **Responses**
  - **Threat-Level Reassessment**
  - **VSC State-of-Health**
  - **Monitoring Networks**

USGS

US Volcano Threat Rankings:

- **Threat = Hazard * Exposure**

Table 2. List of the 15 hazard and 10 exposure factors used in the NVEWS threat assessment and their scoring ranges. Detailed explanation of the factors is given in Appendix 2.

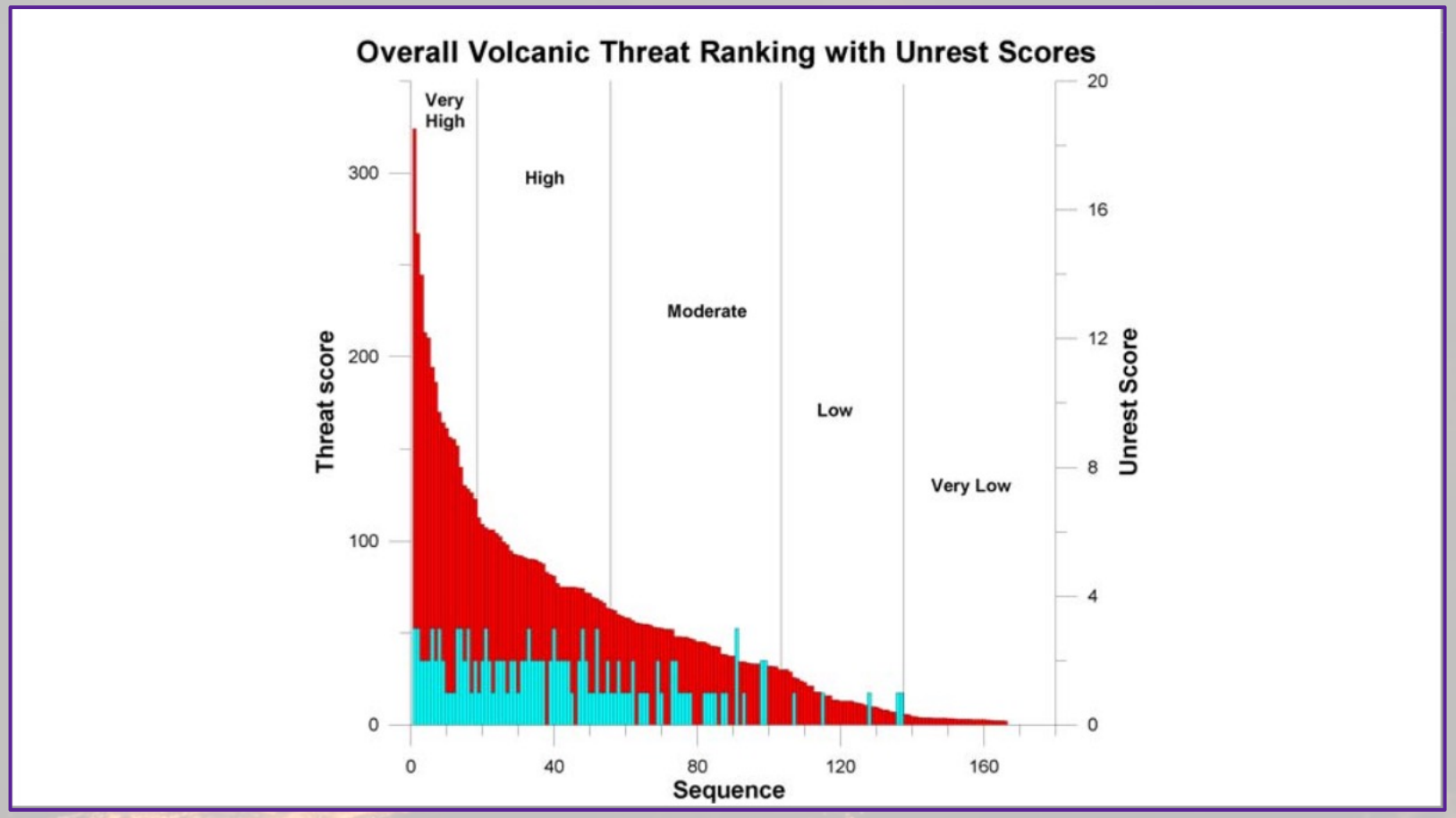
Hazard Factors	**Scoring Ranges**
Volcano type	0 or 1
Maximum Volcanic Explosivity Index	0 to 3
Explosive activity in past 500 years?	0 or 1
Major explosive activity in past 5000 years?	0 or 1
Eruption recurrence	0 to 4
Holocene pyroclastic flows?	0 or 1
Holocene lahars?	0 or 1
Holocene lava flow?	0 or 1
Hydrothermal explosion potential?	0 or 1
Holocene tsunami?	0 or 1
Sector collapse potential?	0 or 1
Primary lahar source?	0 or 1
Observed seismic activity	0 or 1
Observed ground deformation	0 or 1
Observed fumarolic or magmatic degassing	0 or 1
Total of Hazard Factors	
Exposure Factors	
Log_{10} of Volcano Population Index (VPI) at 30 km	0 to 5.4
Log_{10} of approximate population downstream or downslope	0 to 5.1
Historical fatalities?	0 or 1
Historical evacuations?	0 or 1
Local aviation exposure	0 to 2
Regional aviation exposure	0 to 5.15
Power infrastructure	0 or 1
Transportation infrastructure	0 or 1
Major development or sensitive areas	0 or 1
Volcano is a significant part of a populated island	0 or 1
Total of Exposure Factors	
Sum of all hazard factors X Sum of all exposure factors = Relative Threat Ranking	

Ewert et al., 2005

USGS

US Volcano Threat Rankings:

- **Threat = Hazard * Exposure**
- **169 potentially active US volcanoes ranked**



Ewert et al., 2005

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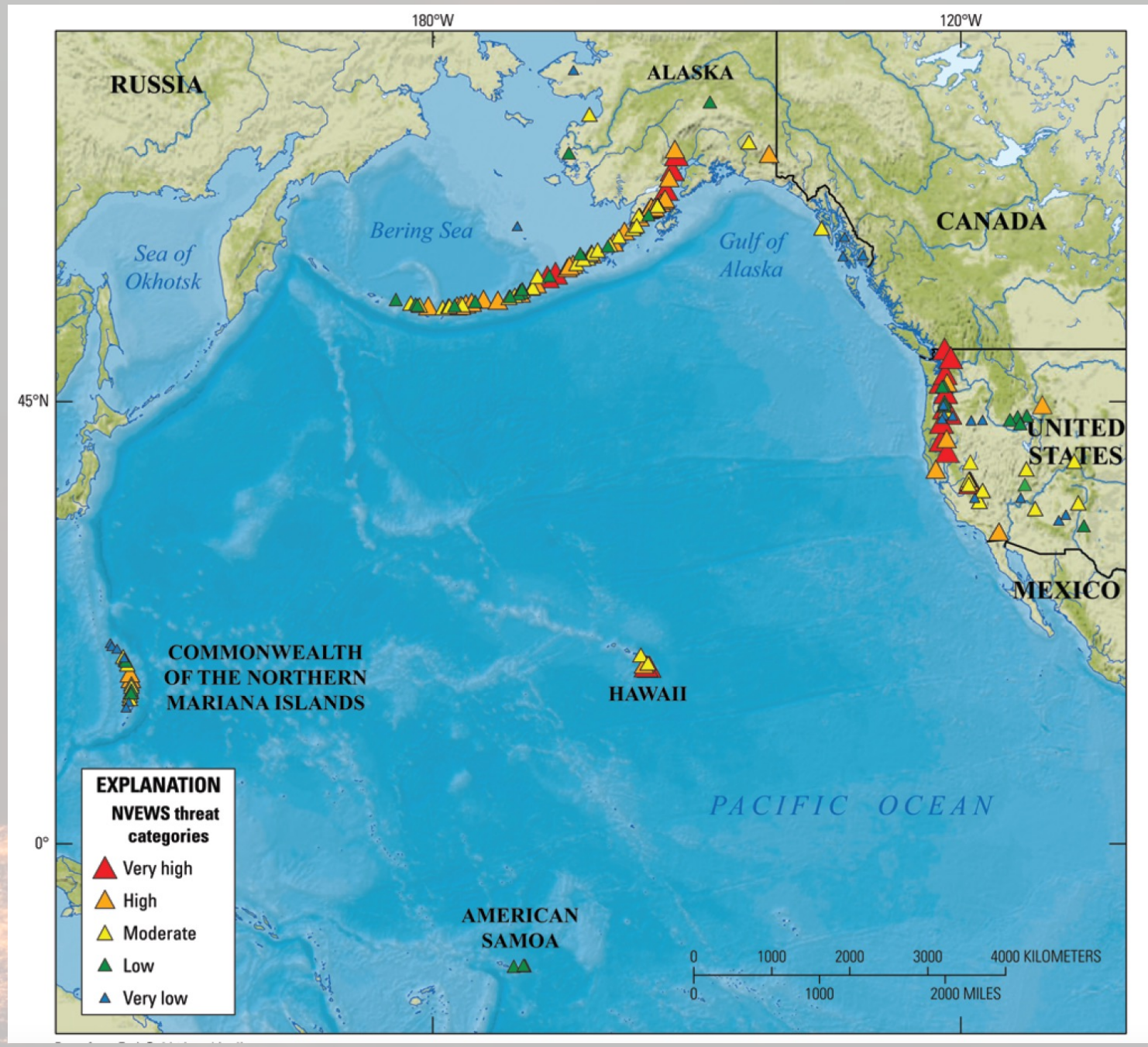
US Volcano Threat Rankings:

- Threat = Hazard * Exposure
- 169 potentially active US volcanoes ranked
- 2018 re-scoring ranked 161 volcanoes:
  - Several centers found to have not erupted in Holocene
  - Several underwater volcanoes added (e.g., in American Samoa)



Ewert et al., 2018

USGS

NVEWS: What's happened since last we met (09/2024)

- **2025 Volcanic Threat-Level Reassessment:**
  - **Rationale for reassessment: New geologic knowledge, unrest at several centers w/out previous unrest (Edgecumbe, Adams)**
  - **Team of 7 VSC staff (Deligne (HVO), Johnson (CVO), Orr (AVO), Stelten (CalVO/YVO), Diefenbach (VDAP), Ramsey (VDAP), Moran (Chair)) are updating rankings**
  - **VHP Program Council guidance: update scores but don't make major changes to rubric or volcano groupings (e.g., DVFs will be addressed later)**

NVEWS: What's happened since last we met (09/2024)

- **2025 Volcanic Threat-Level Reassessment:**
  - **Volcano List:**
    - **Some volcanoes formerly separated have been combined, some have been removed (only Pleistocene eruptions), some have been added (e.g., a few additional submarine volcanoes)**
    - **Questions still exist about lumping & splitting (e.g., should Three Sisters be considered a volcanic field (which has implications for recurrence rate)?)**

NVEWS: What's happened since last we met (09/2024)

- **2025 Volcanic Threat-Level Reassessment:**
  - **Hazard & Exposure Factor Adjustments:**
    - **Some factor definitions have been tweaked to improve clarity & consistency across factors (e.g., when do you count a death as being caused by a volcano (Mammoth, Spurr, Hood)?)**

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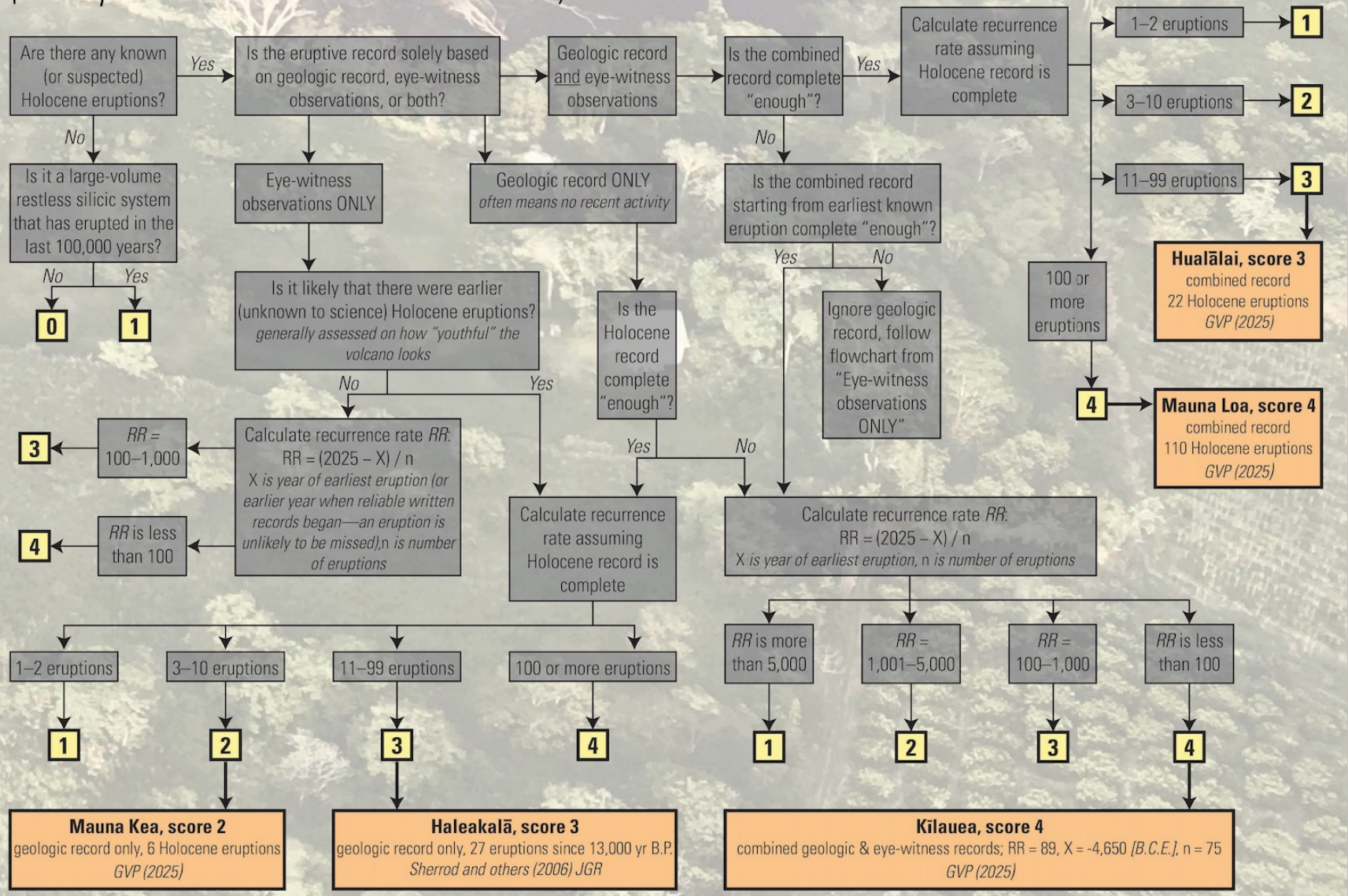
Example of how we ensure consistency: recurrance rate factor

One of 'highest value' factors: volcanoes can be assigned up to 4 points

Developed annotated **flow chart** to provide visual **transparency, rationale,** & **data**

(example shows Hawaiian volcanoes)



Deligne et al., 2025

NVEWS: What's happened since last we met (09/2024)

- **2025 Volcanic Threat-Level Reassessment:**
  - **Hazard & Exposure Factor Adjustments:**
    - **We've debated a number of factor definitions, some of which have been tweaked to improve clarity, including:**
      - **When to attribute a death to a volcano (Mammoth, Spurr, Hood)?**
      - **What counts as unrest (Adams)?**
    - **Population requirement removed from some hazard factors (e.g., volcanic islands w/ no permanent populations still have significant visitation)**

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NVEWS: What's happened since last we met (09/2024)

- **2025 Volcanic Threat-Level Reassessment:**
  - **Updates that factor into rescoring:**
    - **New geologic knowledge for individual volcanic centers**
    - **New exposure data (things have changed since 2018 (NPS))**
    - **New unrest, eruptions, & monitoring changes since 2018**

NVEWS: What's happened since last we met (09/2024)

- **2025 Volcanic Threat-Level Reassessment:**
  - **Goals:**
    - **Preliminary rescoring completed in time for October VHP Program Council meeting**
    - **Scoring rubric and refined definitions published as USGS data release**
    - **New rankings released as a short publication**
    - **Possible that the number of VHT and/or HT volcanoes will increase by a handful**
    - **Likely that rankings within categories will shift**


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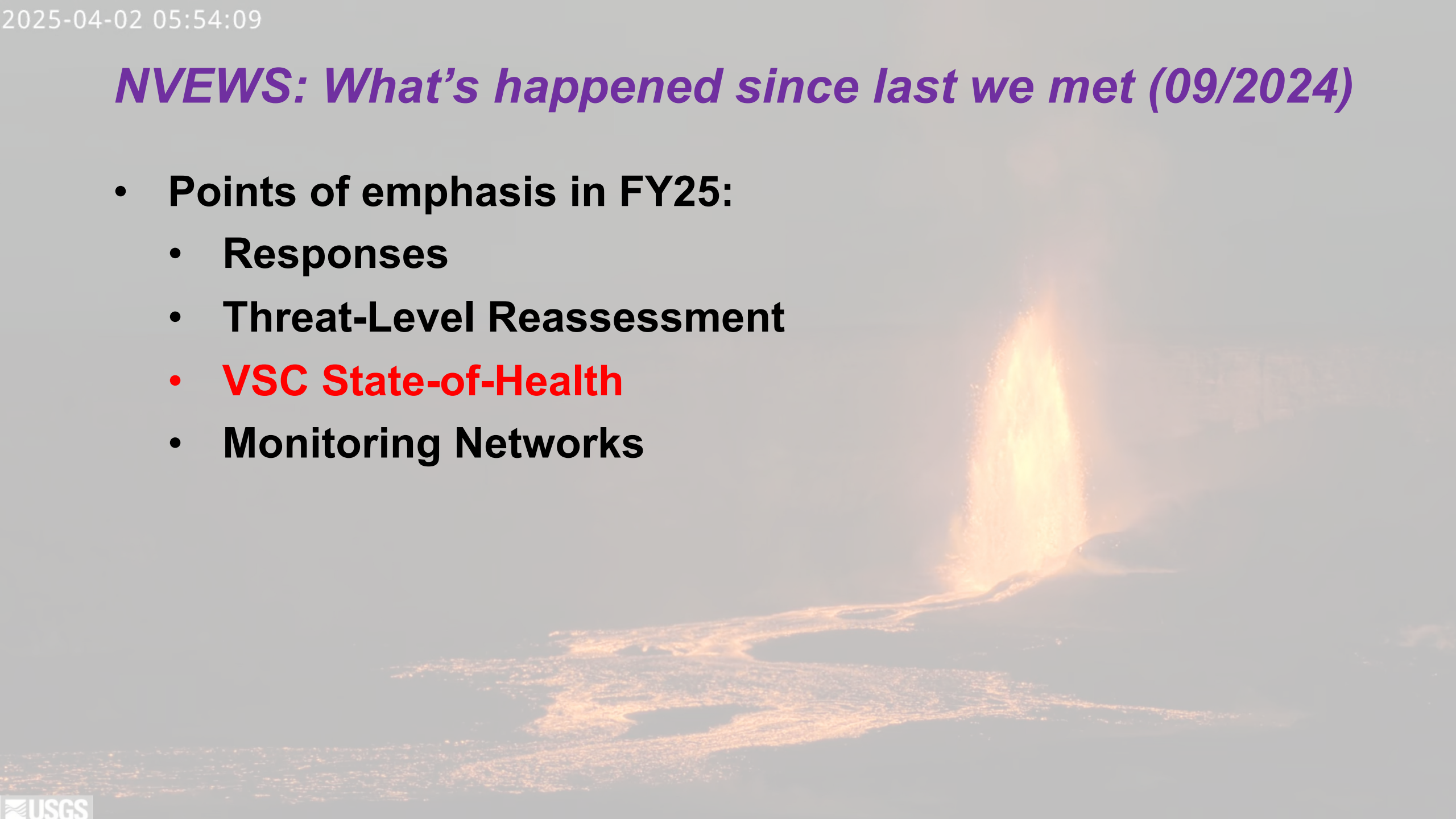
NVEWS: What's happened since last we met (09/2024)

- **Points of emphasis in FY25:**
  - **Responses**
  - **Threat-Level Reassessment**
  - **VSC State-of-Health**
  - **Monitoring Networks**



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NVEWS: What's happened since last we met (09/2024)

- **Volcano Science Center staffing status:**
  - **Gains:**
    - **New Hires: 7 (3 FEIT, 2 RGE, 1 safety/aviation, 1 sed lab)**
    - **Term-Perm conversions: 3 (RGE)**
    - **Merit promotions: 2 (FEIT)**

USGS

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NVEWS: What's happened since last we met (09/2024)

- **Volcano Science Center staffing status:**
  - **Losses (all since February 1):**
    - **Normal retirement: 1**
    - **VSIP/VERA: 1**
    - **DRP: 10**
    - **Death: 1**
    - **Resignation: 1**
  - **Staffing level on Jan 1: 176**
  - **Staffing level on July 29: 164 (~7% down)**

USGS

NVEWS: What's happened since last we met (09/2024)

- **Volcano Science Center staffing status:**
  - **Key losses:**
    - **Tina Neal (VSC Director)**
      - **Moran acting VSC Director (also serving as VSC Deputy Director & NVEWS Manager)**
    - **John Paskievitch (VSC Instrumentation & Network lead)**
      - **Load distributed across FEIT leads, Thelen, Moran**
    - **Scott Graham (VSC IT lead)**
      - **Load distributed across IT staff, Emily M-B, Moran**

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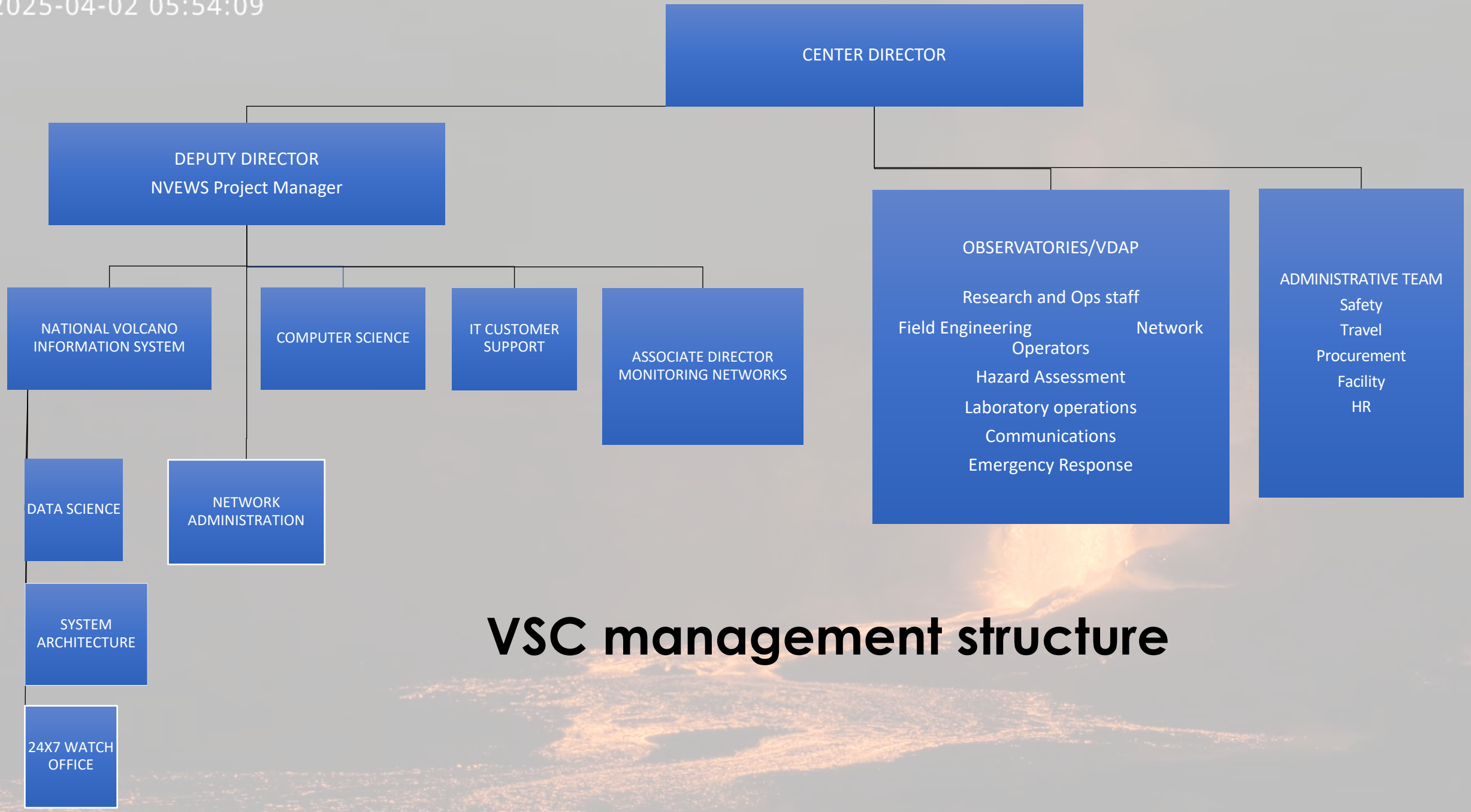

VSC management structure

USGS

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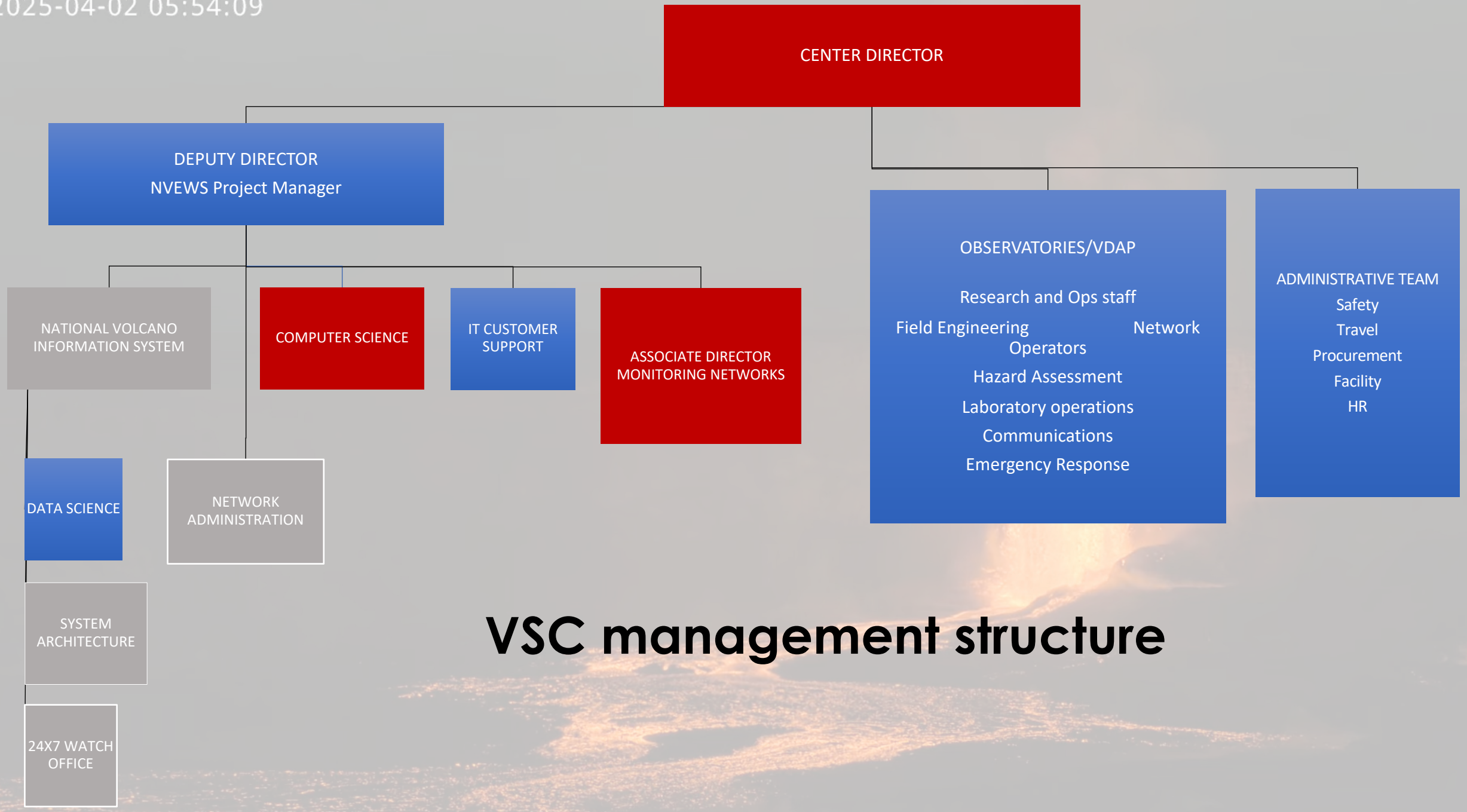

VSC management structure

USGS


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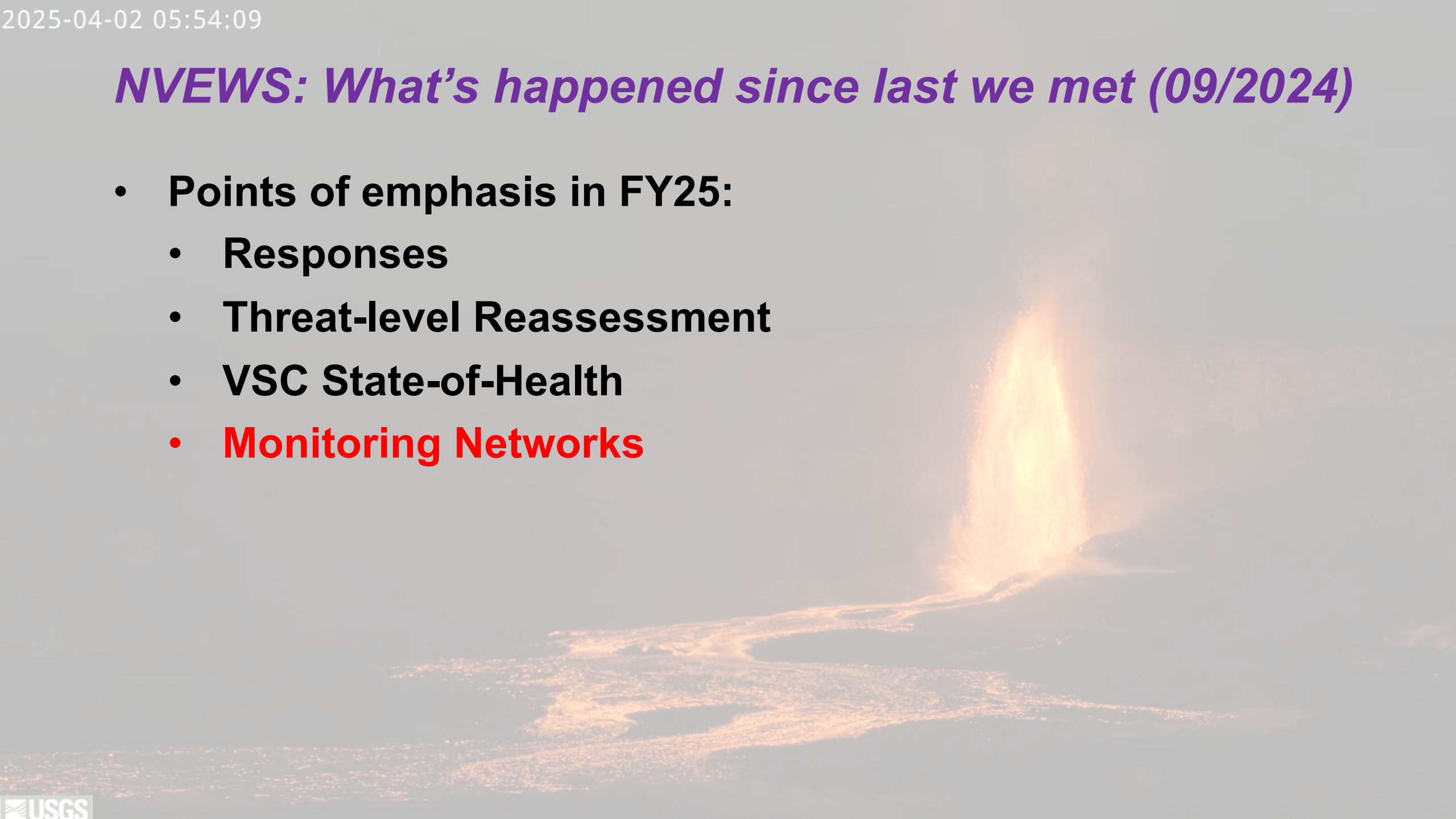
NVEWS: What's happened since last we met (09/2024)

- **Points of emphasis in FY25:**
  - **Responses**
  - **Threat-level Reassessment**
  - **VSC State-of-Health**
  - **Monitoring Networks**



USGS

- **Updated instrumentation report (Flinders et al.; published!)**

Table 1. Recommended instrumentation for volcano monitoring in the United States

Monitoring Level	1	2	3	4
Monitoring Need	**Minimal Monitoring**	**Limited Monitoring for Change Detection**	**Basic Real-Time Monitoring**	**Well Monitored in Real Time**
Volcano Threat Level	**Very Low**	**Low**	**Moderate**	**High/Very-High**
Seismic	Five seismic stations within 200 km, including two within 50 km of the volcanic center.	Five seismic stations within 50 km, including two within 10 km of the volcanic center.	Seven or more broadband seismic stations within 20 km of the volcanic center, including at least two stations within 5 km.	12 to 25 broadband seismic stations within 20 km of the volcanic vent center, including at least eight stations within 10 km and four or more within 5 km; at least one broadband/strong-motion station within 10 km. Small-aperture seismic array in places where logistics preclude placing stations high on the edifice.
Ground Deformation and Gravity	Baseline deformation measurements using InSAR; establish baseline GNSS and gravity survey networks, and repeat sparingly in case future unrest should warrant additional data collection.	InSAR images acquired annually or every few years incorporated into automated processing and analysis; GNSS and gravity surveys repeated every several years (depending on logistics); A single, continuous-mode GNSS station within 5 to 10 km of the deforming source.	5 to 10 telemetered continuous-mode GNSS stations, of which 4 are within 5 to 10 km of the deforming source and 1 is outside the area of expected deformation; and if conditions permit, 2 to 4 borehole tiltmeters within 5 to 10 km of the deforming source. InSAR processing on at least an annual basis, and GNSS and microgravity surveys (as appropriate) every several years to supplement data collected from continuously operating stations.	16+ continuous-mode GNSS stations, of which at least 8 are within 5 to 10 km of the deforming source and 2 are outside the area of expected deformation; if conditions are appropriate, 4 to 6 borehole tiltmeters within 5 to 10 km of the deforming source, and one continuous gravimeter. Regular InSAR acquisition and processing, including multi-temporal approaches as conditions warrant. GNSS and microgravity surveys to supplement data collected from continuously operating stations.

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- **Monitoring networks; how close are we to "complete"?**

Volcano	Threat Level	Threat Ranking	Observatory	Network Area (km2)	Polygon dimensions (km x km or km if radius)	# Seismic sites	Target # (12-20 VHT, 6-8 HT)	Revised # of sites (overlap accounted for)	Revised target (overlap accounted for)	% Complete (overlap accounted for	# GNSS	Target # (16-20 VHT, 7-10 HT)	Revised # of sites (overlap accounted for)	Revised target (overlap accounted for)	% Complete (overlap accounted for)	# Cameras	Target #	% Complete	# Infrasound sites	Target #	% Complete	# Tilt	Target #	% Complete	# real-time gas sites	Target #	% Complete	Network completion %
Kīlauea	Very High	1	HVO	1,443		38	48	38	48	79%	54	60	54	60	90%	18	21	86%	3	3	100%	10	10	100%	18	19	95%	88%
MSH	Very High	2	CVO		20	26	26	26	26	100%	24	24	24	24	100%	3	4	75%	4	6	67%	4	6	67%	2	2	100%	93%
Rainier	Very High	3	CVO		25	22	24	22	24	92%	6	9	6	9	67%	4	6	67%	12	14	86%	1	2	50%	0	0	100%	82%
Redoubt	Very High	4	AVO		20	8	10	8	10	80%	4	8	4	8	50%	3	5	60%	3	5	60%	0	0	100%	0	1	0%	62%
Shasta	Very High	5	CalVO		20	7	10	7	10	70%	7	8	7	8	88%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	67%
Hood	Very High	6	CVO		20	11	12	11	12	92%	7	10	7	10	70%	2	4	50%	3	6	50%	0	0	100%	0	1	0%	70%
Three Sisters	Very High	7	CVO	1200		5	12	5	12	42%	4	8	4	8	50%	1	1	100%	0	3	0%	0	0	100%	0	0	100%	42%
Akutan	Very High	8	AVO		20	11	12	11	12	92%	12	12	12	12	100%	5	5	100%	1	6	17%	4	4	100%	0	2	0%	80%
Makushin	Very High	9	AVO		20	7	15	7	15	47%	3	8	3	8	38%	1	5	20%	3	8	38%	0	0	100%	0	4	0%	35%
Spurr	Very High	10	AVO		20	12	18	12	18	67%	4	8	4	8	50%	1	5	20%	4	9	44%	0	0	100%	0	1	0%	51%
Lassen Center	Very High	11	CalVO	3,475		7	12	7	12	58%	8	8	8	8	100%	0	1	0%	0	2	0%	0	0	100%	1	2	50%	64%
Augustine	Very High	12	AVO		20	11	15	11	15	73%	11	11	11	11	100%	2	5	40%	3	8	38%	0	0	100%	0	2	0%	66%
Newberry	Very High	13	CVO		25	12	16	12	16	75%	9	12	9	12	75%	0	1	0%	3	6	50%	0	0	100%	0	0	100%	69%
Baker	Very High	14	CVO		20	2	10	2	10	20%	0	8	0	8	0%	1	1	100%	0	4	0%	0	0	100%	0	1	0%	13%
Glacier Peak	Very High	15	CVO		20	1	8	1	8	13%	0	6	0	6	0%	0	1	0%	0	4	0%	0	0	100%	0	0	100%	5%
Mauna Loa	Very High	16	HVO	5,157		20	40	20	40	50%	34	38	34	38	89%	8	18	44%	1	3	33%	6	7	86%	2	3	67%	65%
Crater Lake	Very High	17	CVO		20	4	8	4	8	50%	4	6	4	6	67%	0	1	0%	0	4	0%	0	2	0%	0	0	100%	38%
Long Valley	Very High	18	CalVO		20	24	24	24	24	100%	23	26	23	26	88%	0	1	0%	0	0	100%	0	0	100%	0	0	100%	92%
Okmok	High	19	AVO		20	10	13	10	13	77%	8	8	8	8	100%	2	4	50%	1	7	14%	0	0	100%	0	0	100%	66%
Iliamna	High	20	AVO		20	7	8	7	8	88%	0	4	0	4	0%	2	4	50%	1	4	25%	0	0	100%	0	0	100%	50%
Yellowstone	High	21	YVO		50	47	50	47	50	94%	16	19	16	19	84%	1	1	100%	2	5	40%	5	5	100%	1	1	100%	89%
Aniakchak	High	22	AVO		20	6	10	6	10	60%	2	5	2	5	40%	1	4	25%	1	5	20%	0	0	100%	0	0	100%	42%
Hualalai	High	23	HVO	805		5	13	5	13	38%	1	3	1	3	33%	1	3	33%	0	1	0%	0	3	0%	0	1	0%	29%
Mono	High	24	CalVO		20	1	8	1	8	13%	5	8	5	8	63%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	32%
Martin	High	25	AVO		20	7	8	7	8	88%	0	8	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	38%
Mageik	High	26	AVO		20	9	9	0	0	100%	0	8	0	0	100%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	44%
Trident	High	27	AVO		20	8	8	8	8	100%	0	8	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	42%
Katmai	High	28	AVO		20	8	9	0	1	0%	0	8	0	2	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	40%
Veniaminof	High	29	AVO		20	8	8	8	8	100%	0	4	0	4	0%	1	4	25%	3	4	75%	0	0	100%	0	0	100%	60%
Atka	High	30	AVO		20	7	8	0	0	100%	1	4	0	0	100%	1	4	25%	4	4	100%	0	0	100%	0	1	0%	62%
Korovin	High	31	AVO		20	7	8	7	8	88%	1	4	1	4	25%	1	4	25%	4	4	100%	0	0	100%	0	1	0%	62%
Shishaldin	High	32	AVO		20	6	8	6	8	75%	6	6	6	6	100%	2	4	25%	3	4	75%	3	3	100%	0	3	0%	71%
Clear Lake	High	33	CalVO	2,799		12	12	12	12	100%	2	8	2	8	25%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	61%
Adams	High	34	CVO		20	1	12	1	12	8%	0	8	0	8	0%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	4%
Hayes	High	35	AVO		20	0	6	0	6	0%	0	4	0	4	0%	0	1	0%	0	3	0%	0	0	100%	0	0	100%	0%
Westdahl	High	36	AVO		20	6	8	6	8	75%	7	8	7	8	88%	0	4	0%	0	4	0%	5	5	100%	0	0	100%	62%
Novarupta	High	37	AVO		20	8	8	0	0	100%	0	8	0	0	100%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	42%
Churchill	High	38	AVO		20	0	8	0	8	0%	0	4	0	4	0%	0	4	0%	0	4	0%	0	0	100%	0	0	100%	0%
Kanaga	High	39	AVO		20	6	8	6	8	75%	0	4	0	4	0%	1	4	25%	1	4	25%	0	0	100%	0	0	100%	40%
Ugashik-Peulik	High	40	AVO		20	4	8	4	8	50%	0	4	0	4	0%	1	4	25%	1	4	25%	0	0	100%	0	0	100%	30%
Pavlof	High	41	AVO		20	7	8	7	8	88%	0	4	0	4	0%	4	4	100%	6	6	100%	0	0	100%	0	3	0%	68%
Mount Griggs	High	42	AVO		20	7	8	0	1	0%	0	8	0	2	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	38%
Kaguyak	High	43	AVO		20	1	8	1	8	13%	0	8	0	8	0%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	5%
Pagan	High	44	AVO/CNMI		20	0	8	0	8	0%	0	4	0	4	0%	0	2	0%	0	4	0%	0	0	100%	0	0	100%	0%
Medicine Lake	High	45	CalVO		30	4	8	4	8	50%	3	8	3	8	38%	0	0	100%	0	0	100%	0	0	100%	0	0	100%	44%
Great Sitkin	High	46	AVO		20	6	8	6	8	75%	2	4	2	4	50%	2	4	50%	1	4	25%	0	0	100%	0	0	100%	55%
Kasatochi	High	47	AVO		20	0	5	0	5	0%	0	4	0	4	0%	0	4	0%	0	3	0%	0	0	100%	0	0	100%	0%
Cleveland	High	48	AVO		20	5	8	5	8	63%	2	4	2	4	50%	1	4	25%	2	4	50%	0	0	100%	2	2	100%	55%
Moffett	High	49	AVO		20	1	8	1	8	13%	0	4	0	4	0%	0	4	0%	0	4	0%	0	0	100%	0	0	100%	5%
Seguam	High	50	AVO		20	0	8	0	8	0%	0	4	0	4	0%	0	4	0%	0	4	0%	0	0	100%	0	0	100%	0%
Fisher Caldera	High	51	AVO		20	3	8	0	1	0%	3	8	3	7	43%	0	4	0%	1	4	25%	2	2	100%	0	0	100%	35%
Snowy	High	52	AVO		20	3	8	3	8	38%	0	8	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	21%
Fourpeaked	High	53	AVO		20	1	8	1	8	13%	0	4	0	4	0%	0	4	0%	1	4	25%	0	0	100%	0	0	100%	10%
Douglas	High	54	AVO		20	1	8	0	2	0%	0	4	0	2	0%	0	4	0%	1	4	25%	0	0	100%	0	0	100%	10%
Semisopochnoi	High	55	AVO		20	6	8	6	8	75%	0	6	0	6	0%	2	4	50%	3	4	75%	0	0	100%	0	0	100%	50%
Salton Buttes	High	56	CalVO		20	6	8	6	8	75%	9	16	9	16	56%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	56%
Agrigan	High	57	AVO/CNMI		20	0	8	0	8	0%	0	4	0	4	0%	0	2	0%	0	4	0%	0	0	100%	0	0	100%	0%
Edgecumbe	Moderate(?)	58	AVO		20	4	8	4	8	50%	4	8	4	8	50%	0	4	0%	0	2	0%	0	0	100%	0	0	100%	36%
American Samoa	Low(?)	999	HVO	199	20	4	5	4	5	80%	2	2	2	2	100%	0	1	0%	0	1	0%	0	0	100%	0	0	100%	67%
Totals:						460	704	417	651	64%	288	527	287	492	58%	86	217	40%	76	240	32%	40	49	82%	26	50	52%	**55%**

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- **Monitoring networks; how close are we to “done”?**

09/2024

# Seismic sites	Target # (12-20 VHT, 6-8 HT)	% Complete	# GNSS	Target # (16-20 VHT, 7-10 HT)	% Complete	# Cameras	Target #	% Complete	# Infrasound sites	Target #	% Complete	# Tilt	Target #	% Complete	# real-time gas sites	Target #	% Complete	Network completion %
460	704	65%	288	527	55%	86	217	40%	76	240	32%	40	49	82%	26	66	39%	54%

07/2025

# Seismic sites	Target # (12-20 VHT, 6-8 HT)	Revised # of sites (overlap accounted for)	Revised target (overlap accounted for)	% Complete (overlap accounted for	# GNSS	Target # (16-20 VHT, 7-10 HT)	Revised # of sites (overlap accounted for)	Revised target (overlap accounted for)	% Complete (overlap accounted for)	# Cameras	Target #	% Complete	# Infrasound sites	Target #	% Complete	# Tilt	Target #	% Complete	# real-time gas sites	Target #	% Complete	Network completion %
460	704	417	651	64%	288	527	287	492	58%	86	217	40%	76	240	32%	40	49	82%	26	50	52%	55%

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- **Monitoring networks; 2025 field plans**
  - **AVO**
    - **Spurr response, Merbok Supplemental work**
    - **Maintenance at 12 other networks encompassing 20 HT/VHT volcanoes)**
    - **Spurr (#10, 51%) ➔ 1 new seismic/infrasound/gas (59%)**
  - **CalVO**
    - **Network maintenance ongoing (NCSN)**
    - **Analog-to-digital conversions @ 5 sites**
    - **Mono Craters (#24, 32% complete) ➔ 4 new seismic stations (53% complete)**

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- **Monitoring networks; 2025 field plans**
  - **CVO**
    - **Maintenance at 7 networks**
    - **MSH (#2, 93% complete) ➔ 1 new seismic (93% complete)**
    - **Rainier (#3, 82% completed) ➔ 5 new seismic (lahar detection sites, not within 20 km; still 82% complete)**
    - **Hood (#6, 70% complete)➔ 1 new seismic/infrasound (76% complete)**
    - **Newberry (#13, 69% complete) ➔ 1 new seismic (71%)**
    - **Adams (#34, 4% complete) ➔ 3 new seismic (2 > 20km; 9% complete)**

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- **Monitoring networks; 2025 field plans**
  - **HVO**
    - **Kilauea & Mauna Loa maintenance ongoing**
    - **Kilauea (#1; 88% complete) ➔ new stations being installed, others being destroyed; dynamic**
  - **YVO**
    - **Yellowstone (#21, 89% complete) – 1 new hydrothermal monitoring station (infrasound, seismic, GPS) (93% complete)**

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- **Monitoring networks; 2025 field plans**
  - **17 new installations across all 5 VOs by end of FY25 (10 of which "count" for NVEWS) ➔ 56% complete**
  - **One challenge to completion ➔ Target number (~1700) is large**
  - **Another challenge ➔ Large number of existing sites (~950) to maintain**
  - **Third challenge ➔ Staffing**
    - **HVO short-staffed & in constant response mode, can't do new installs w/out more people**
    - **AVO & CVO also need additional field staff**


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Questions?
USGS

USGS
science for a changing world

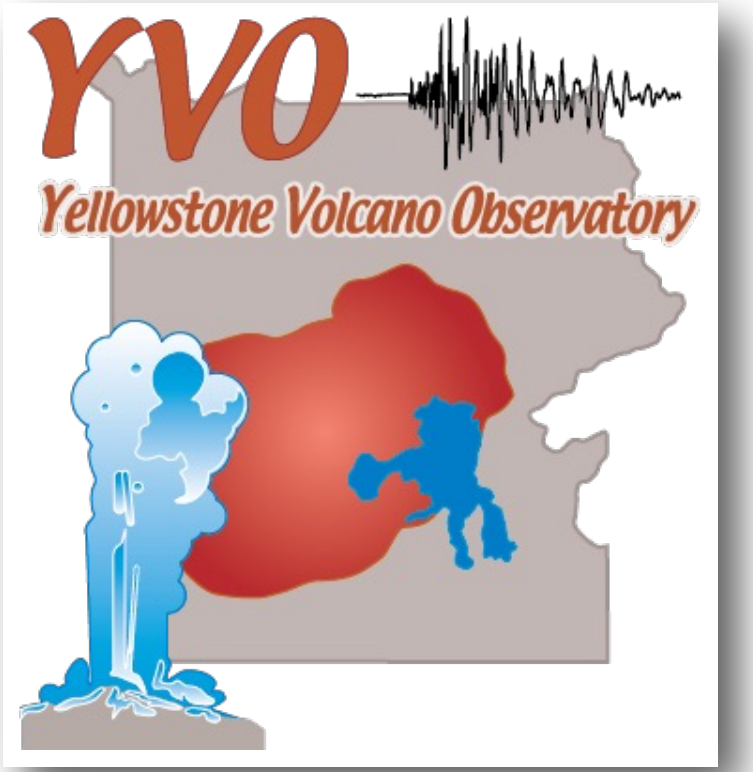
Yellowstone Volcano Observatory

Update for NVEWSAC

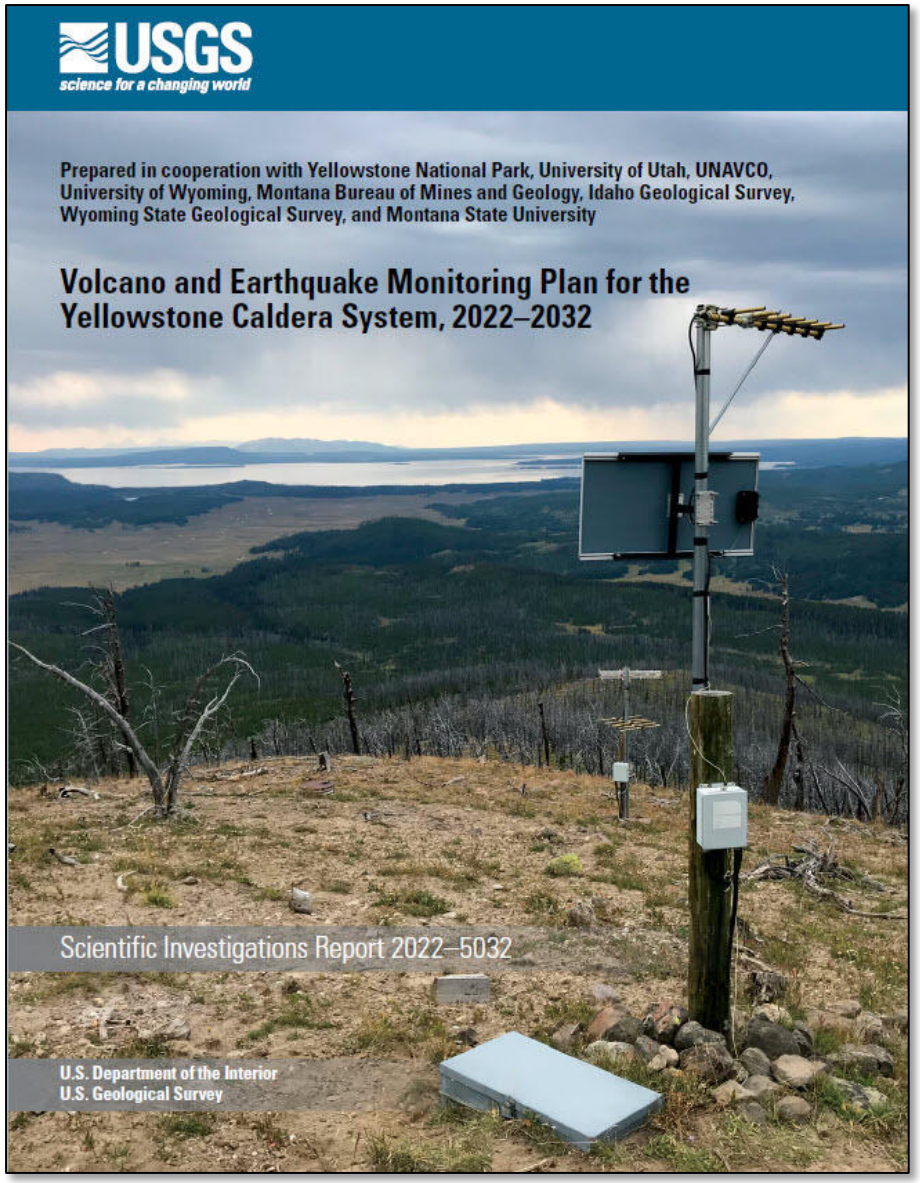
Michael Poland
Scientist-in-Charge, Yellowstone Volcano Observatory

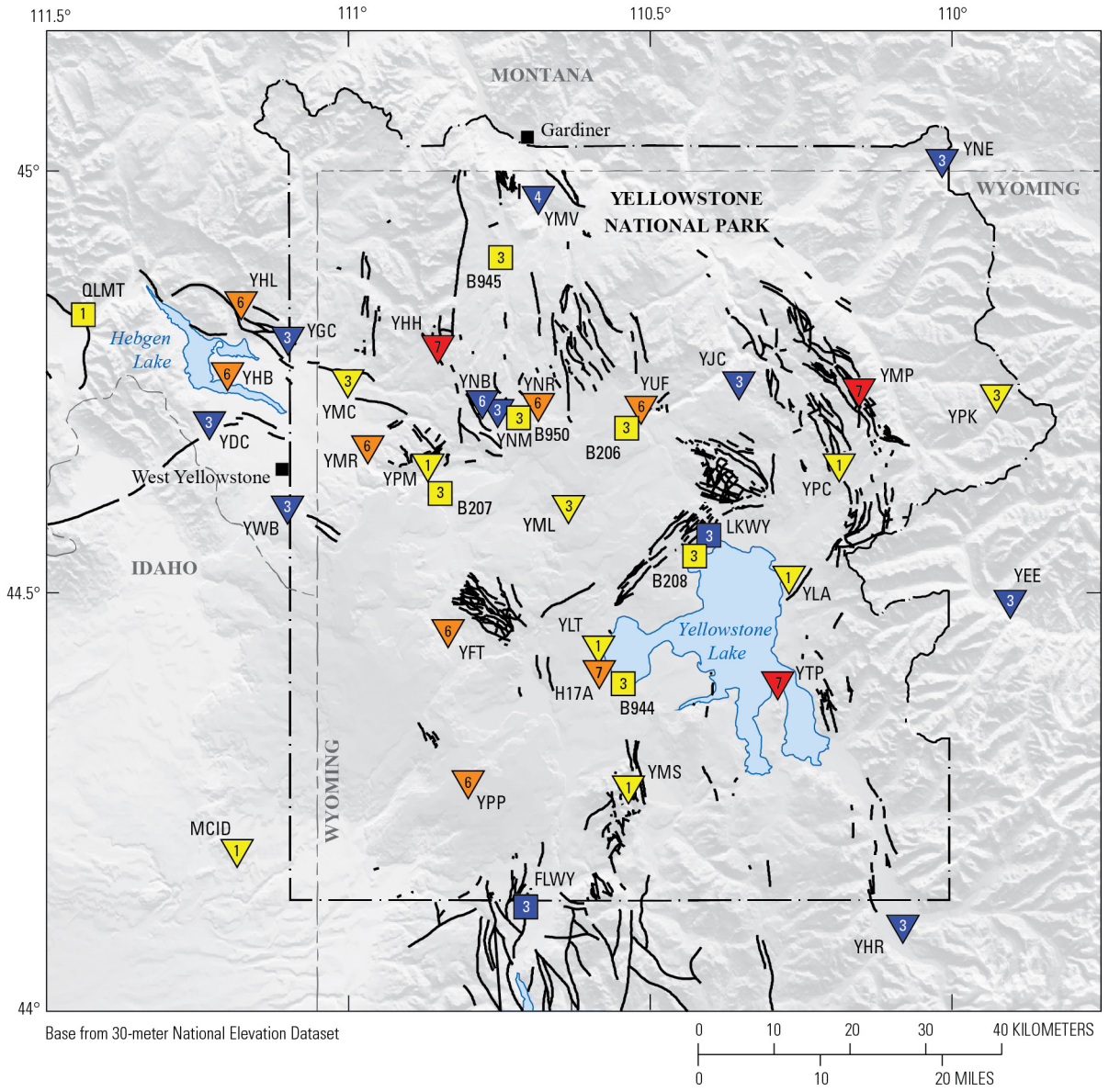
U.S. Department of the Interior
U.S. Geological Survey

YVO—who we are and what we do



Monitoring hydrothermal activity is a major YVO goal





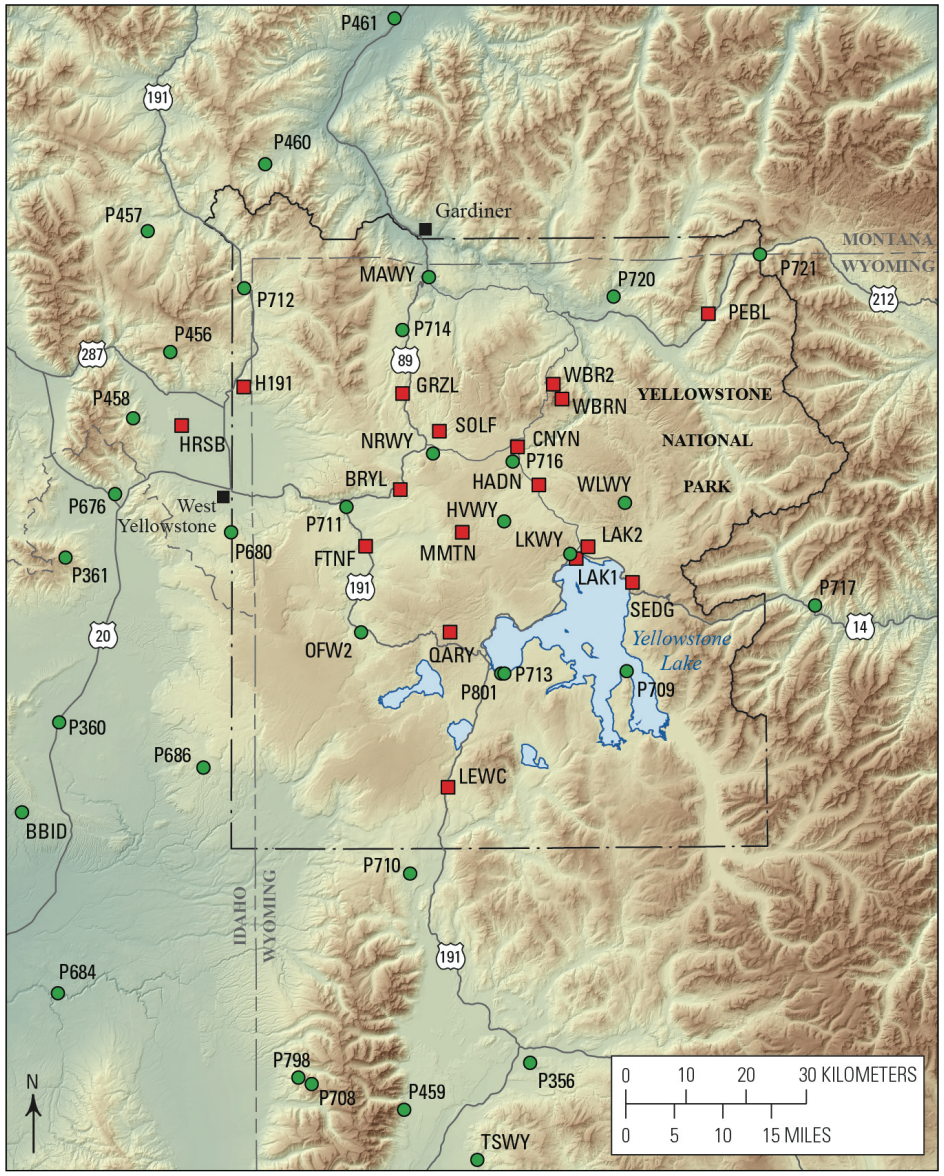
EXPLANATION

Seismograph station— Number of channels at each location given

	UUSS station	Non-UUSS station
Broadband, strong motion, and short period	▼	■
Broadband and strong motion	▼	■
Broadband	▼	■
Short period	▼	■

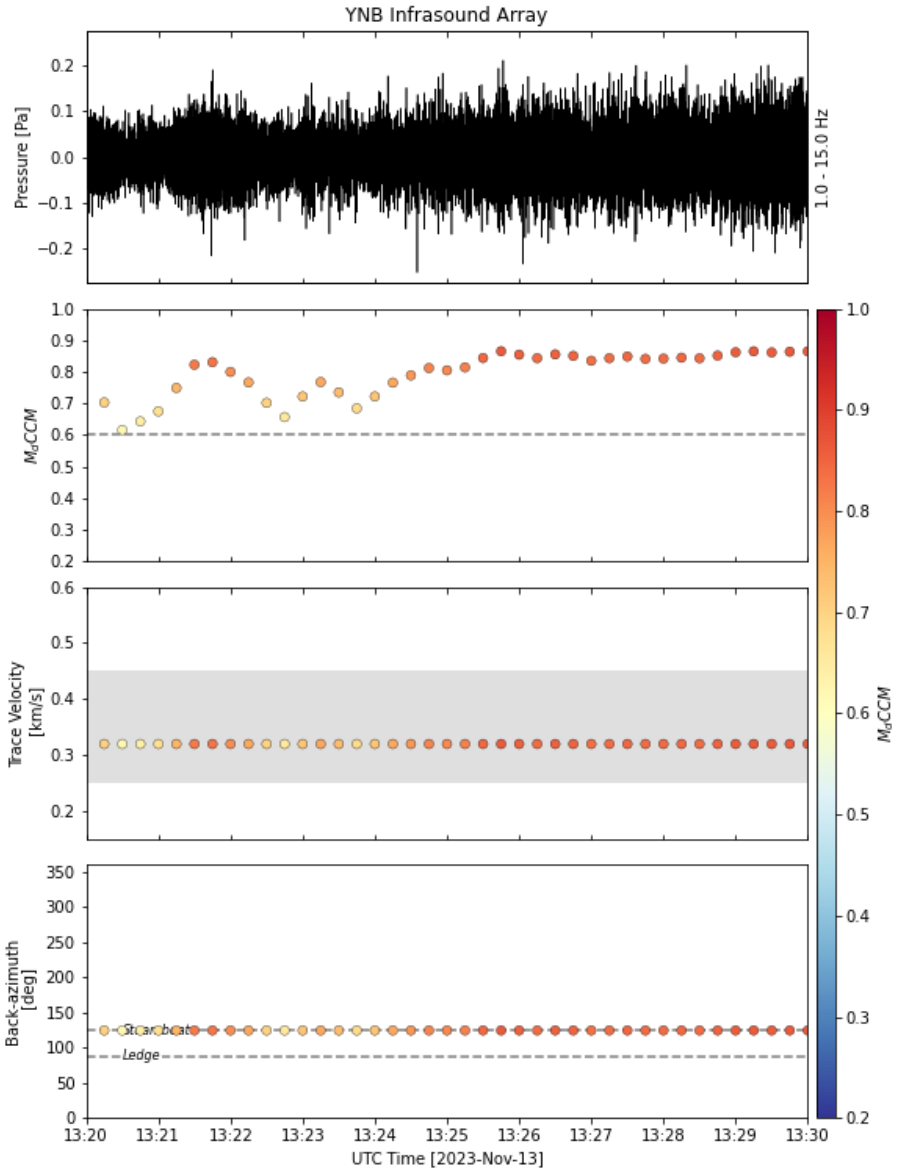
— **Fault**

Monitoring ground deformation

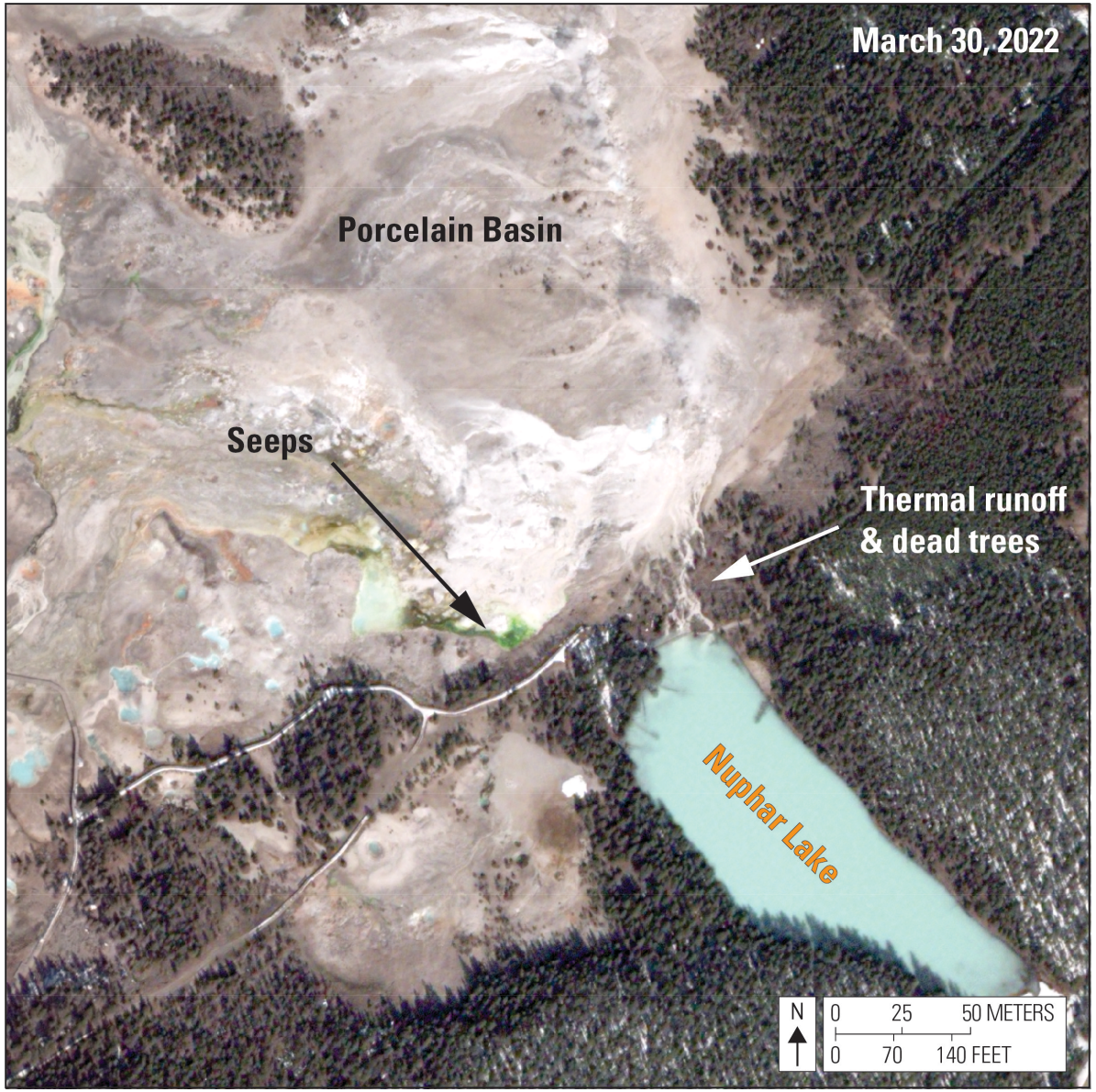


The July 23, 2024, hydrothermal explosion of Black Diamond Pool

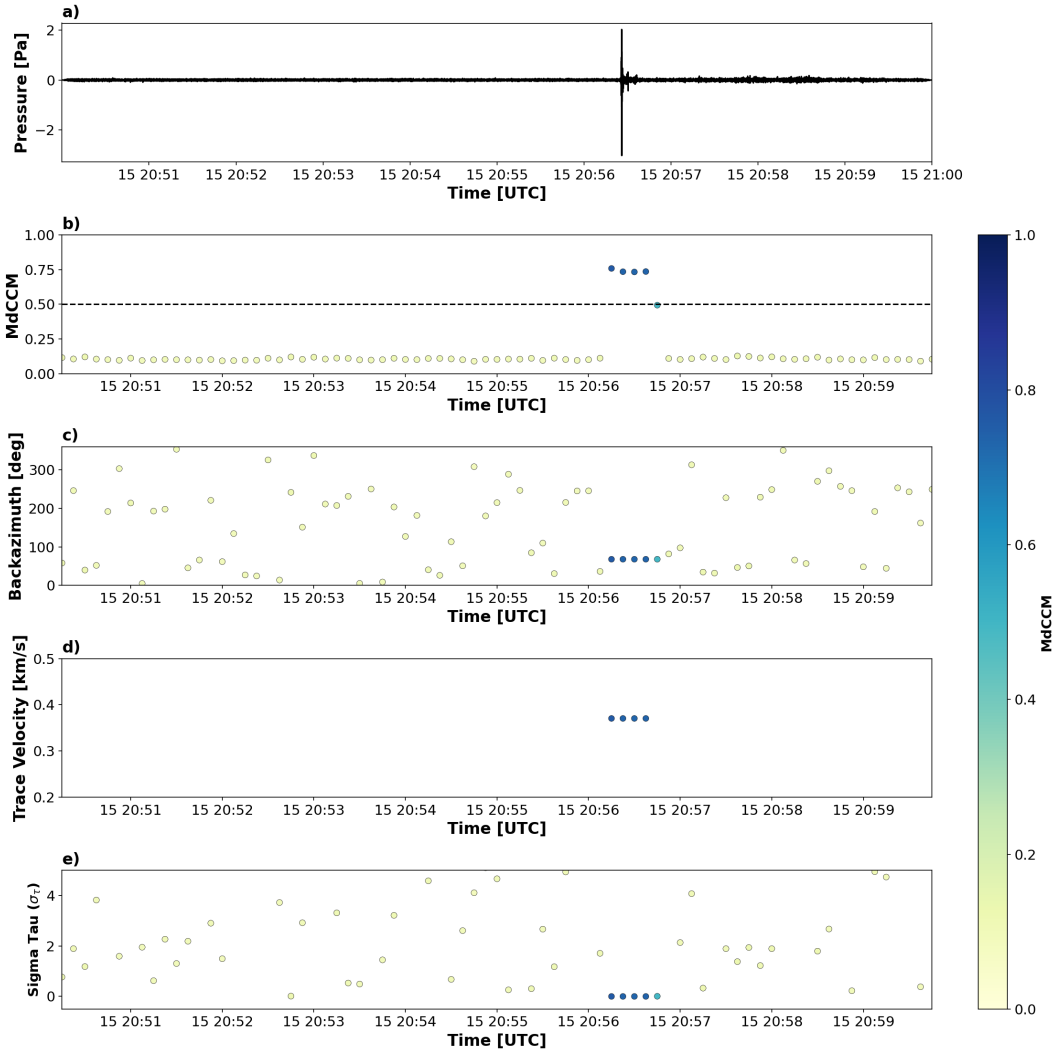
New Hydrothermal Monitoring site at Norris

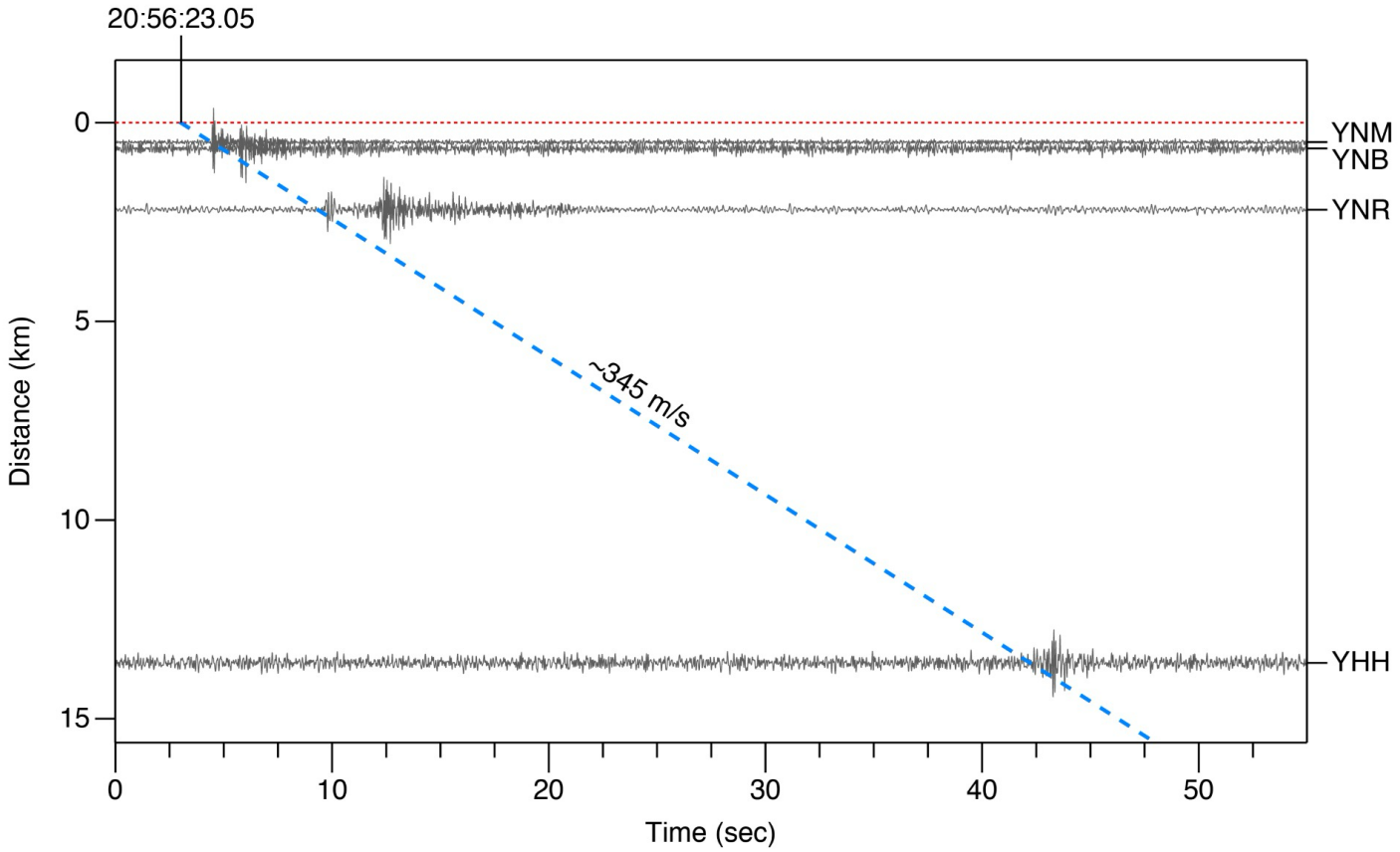


Norris Geyser Basin 2024 hydrothermal explosion

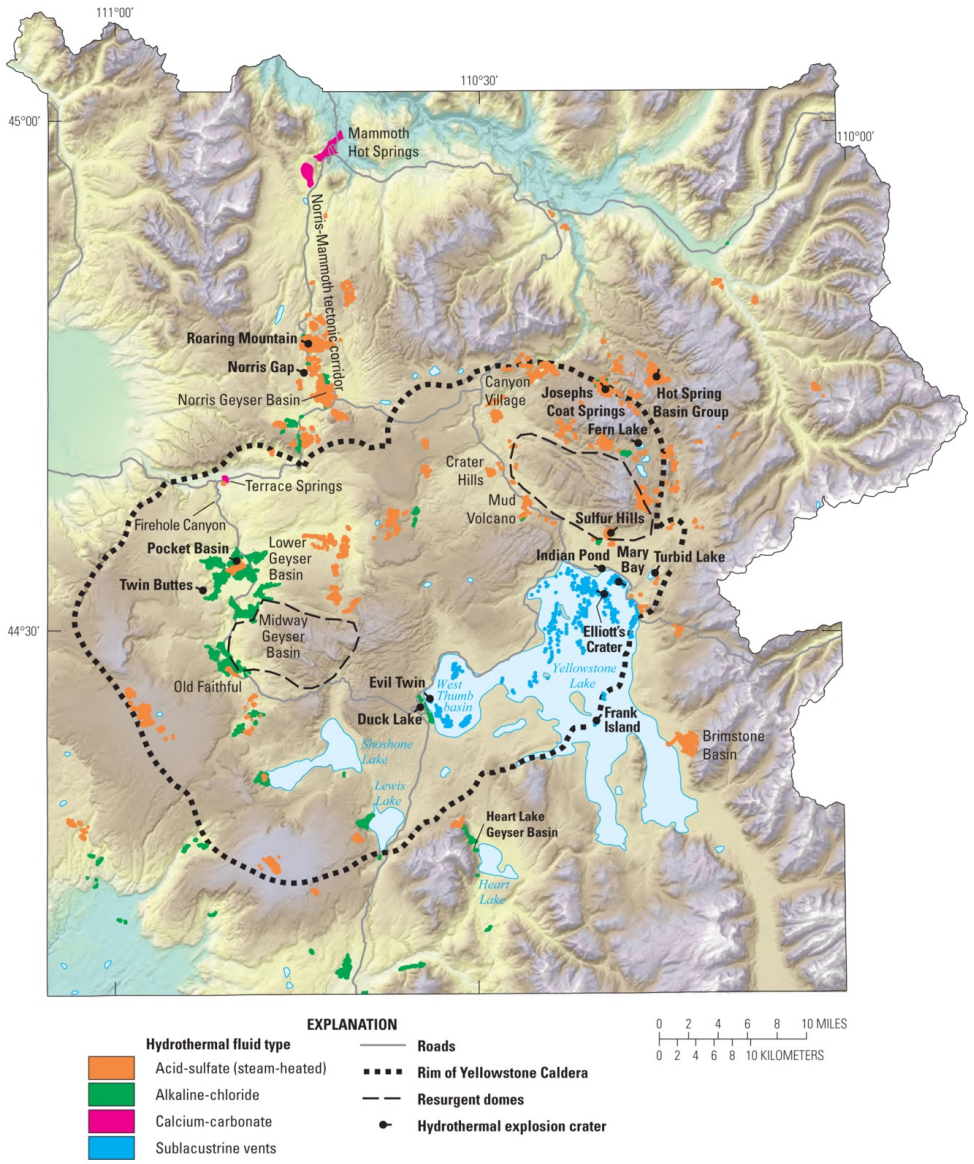


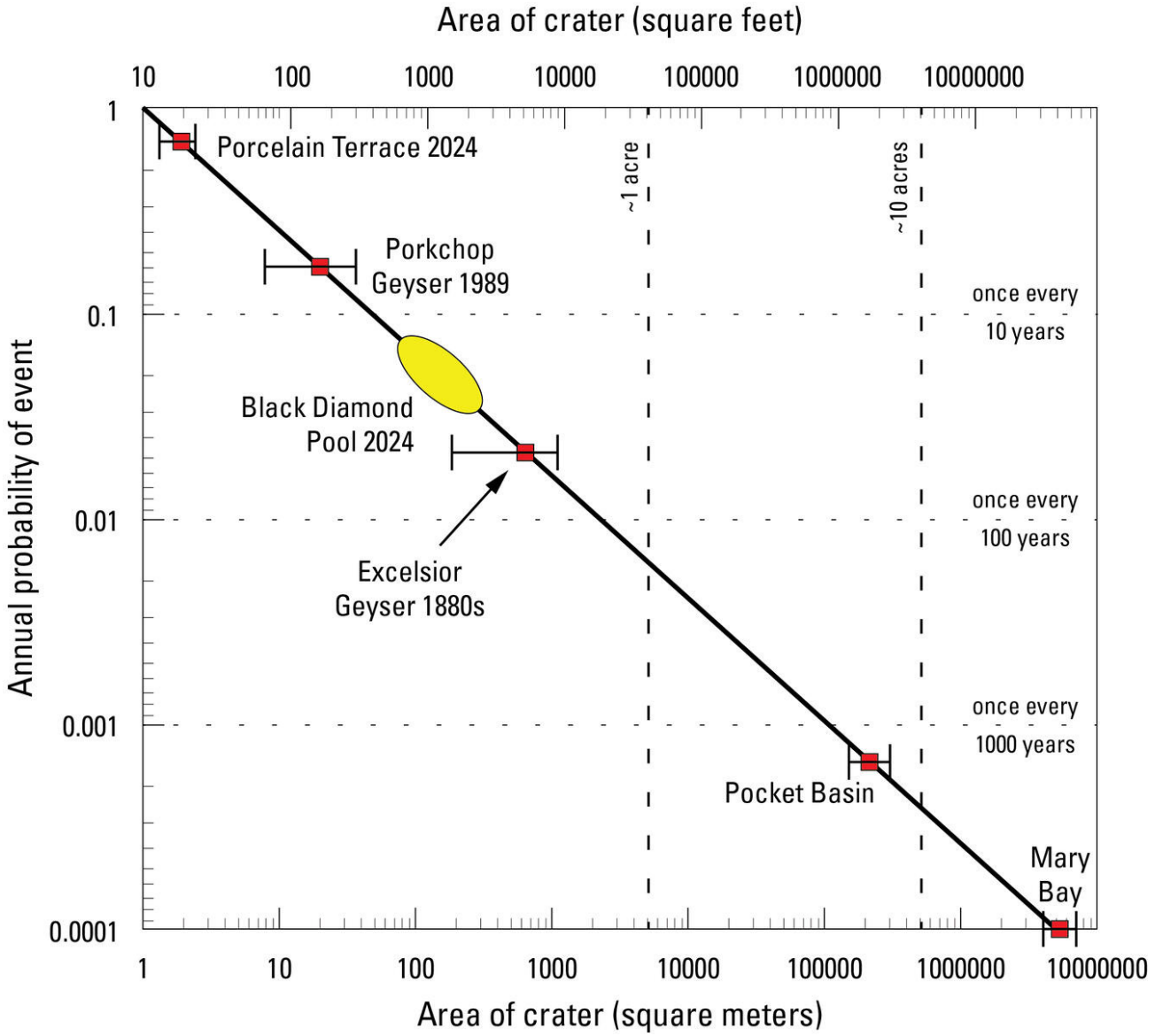
Norris Geyser Basin 2024 hydrothermal explosion



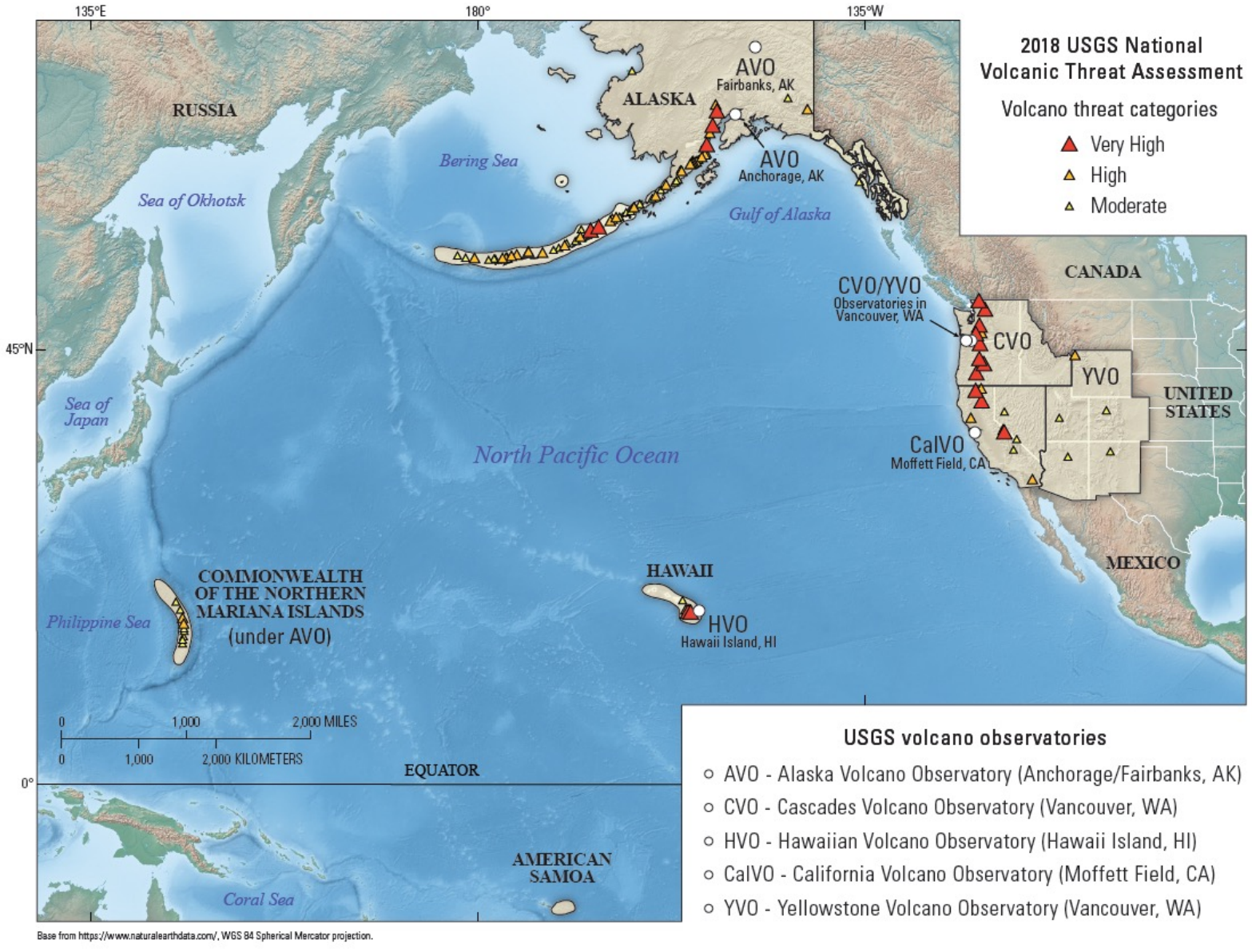


How often do hydrothermal explosions occur?



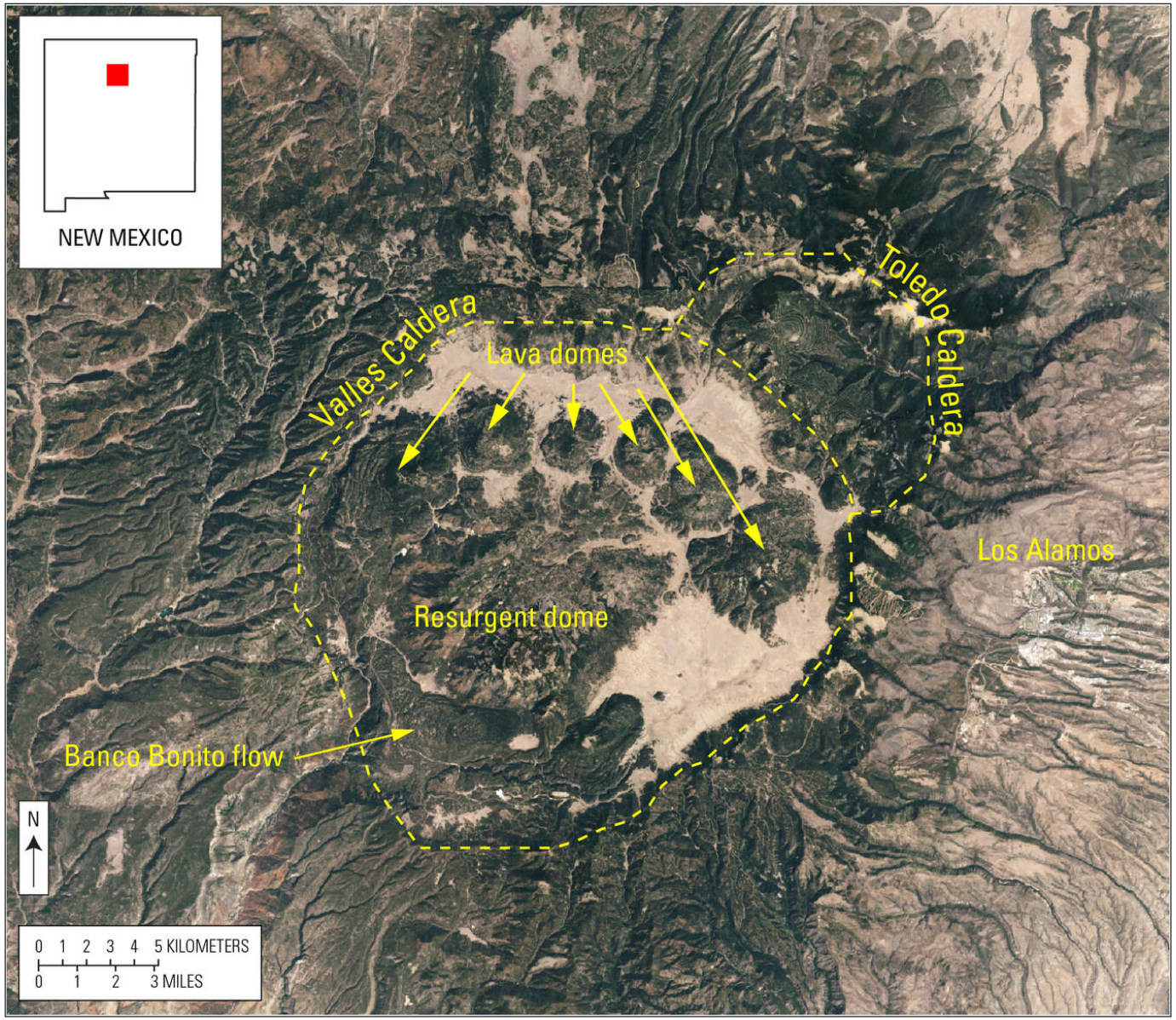


YVO is not just Yellowstone…

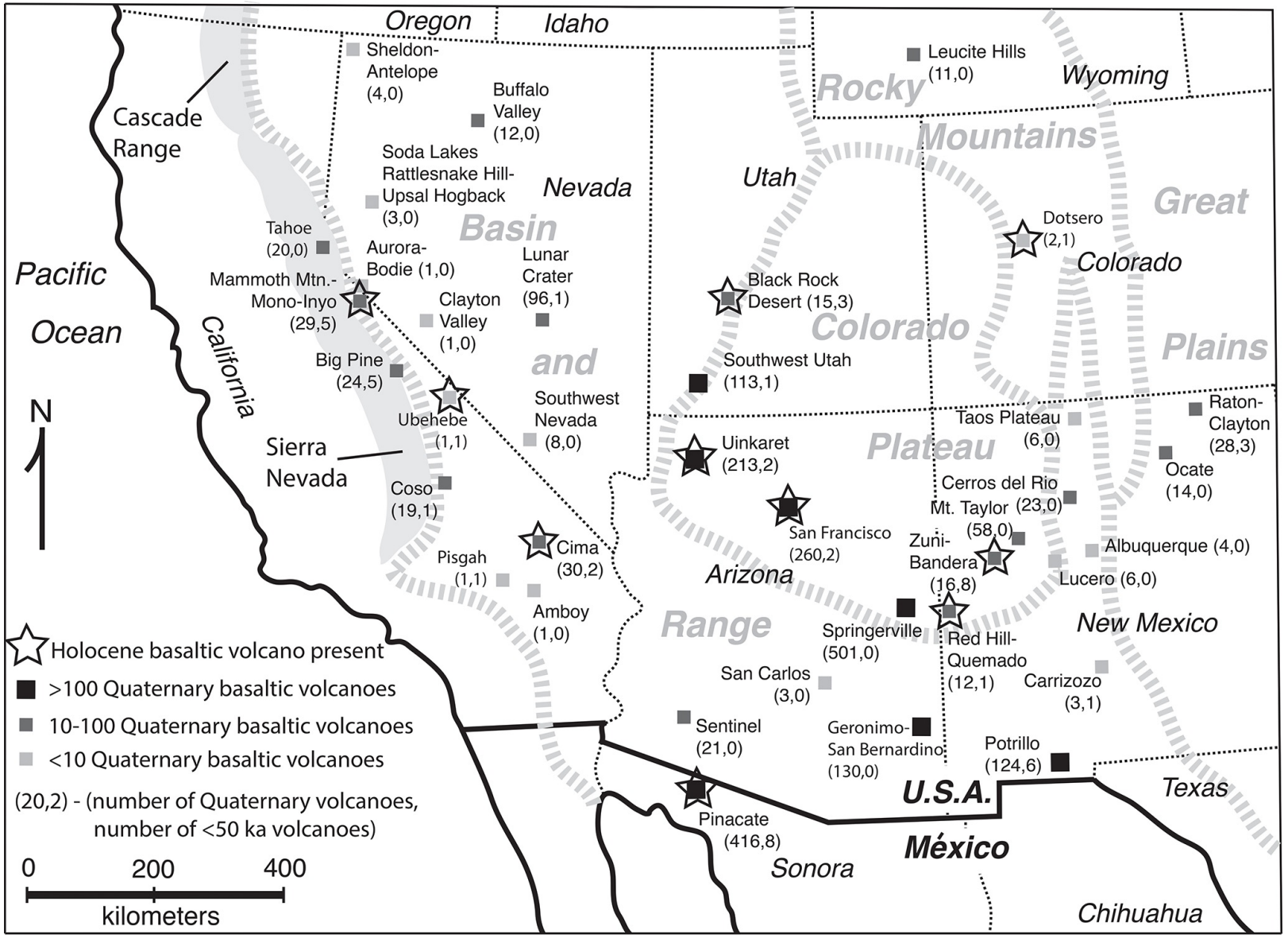


Distributed Volcanism

Valles Caldera, New Mexico



Valles Caldera, New Mexico



Valentine et al., 2021

Current status of NVEWS—YVO perspective

- Yellowstone
  - Lots of opportunities, and permitting is easy, but lots of equipment is needed to properly instrument that hydrothermal system
  - Strong dependence on EarthScope Consortium for GNSS network, University of Utah for seismic network (latter is funded by USGS)
  - Strong role as a natural laboratory for international research
- Southwest USA
  - How should we monitor the distributed volcanism of the southwest? Currently done by InSAR and regional seismic (not USGS data)
  - Need to develop and (more importantly) maintain partnerships
  - Are these moderate and low-threat volcanic systems worth an investment?

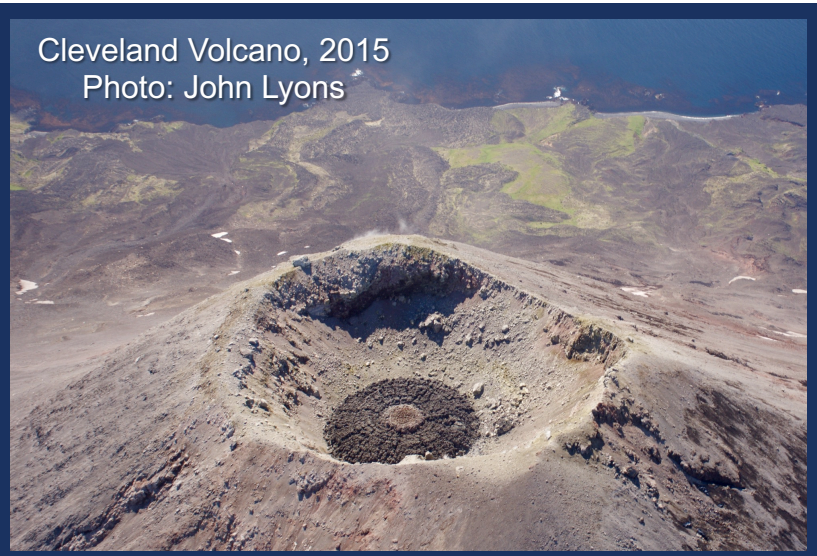
Additional NVEWS considerations for YVO

- In Yellowstone, can do a lot with a little at a very high-visibility volcanic system
- Tribal relationships in Yellowstone are via the park; there are possibly opportunities in the southwest (White Mountain Apache)
- Watch office is not all that relevant to Yellowstone
- External grants program could stimulate more work on all of the data being collected in Yellowstone (including hydrothermal), as well as new work in the southwestern USA
- What does YVO want from the NVEWSAC?
  - How important is distributed volcanism?
  - Where does Yellowstone hydrothermal work rank compared to other projects?
  - Should Idaho be part of YVO?

ALASKA VOLCANO OBSERVATORY

MATT HANEY, SIC

Great Sitkin Volcano, 2022
Photo: Ryan Hazen



Cleveland Volcano, 2015
Photo: John Lyons

NVEWS AC MTG, JULY 2025

USGS
science for a changing world

STAFF

- The USGS portion of AVO in Anchorage consists of 29 total staff members, including 16 scientific staff and 13 researchers, and 4 volunteers/interns
- The UAFGI portion of AVO consists of the Coordinating Scientist (David Fee), 4 other faculty (partial funding), 4 full-time staff, and 4 graduate students
- The ADGGS portion of AVO consists of the Volcanology Section Chief (Scott Crass) and 4 other staff members

2025 AVO Coordination Meeting

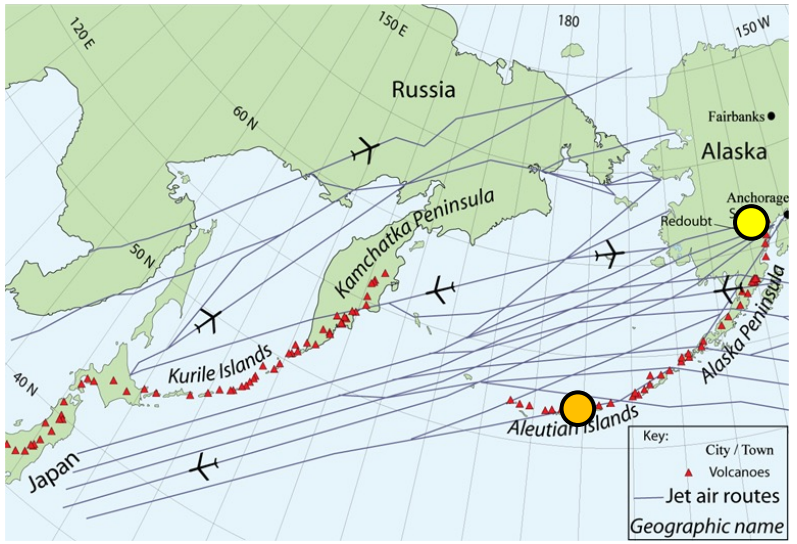

Grace Hall, Anchorage AK

- In total, about 50 staff members of AVO, spread out among the 3 partner organizations
- Many in VSC help perform essential tasks for AVO

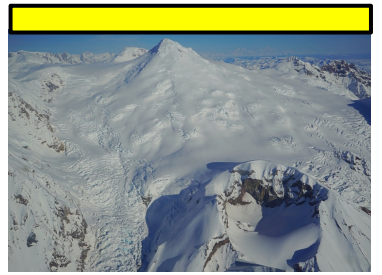
ALASKA-ALEUTIAN VOLCANIC ARC

- Ash effects on aviation most significant hazard
- >50k people/day fly over in aircraft
- 54 historically active volcanoes
- 2 volcanoes currently at elevated color code

Ashfall at Cold Bay Airport Sept. 25, 2023

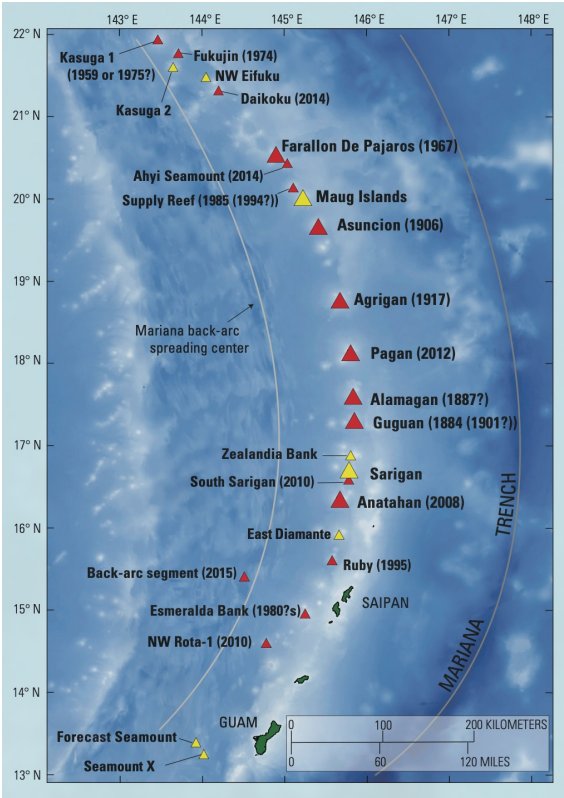


Great Sitkin



Spurr

Also monitor volcanoes in Northern Mariana Islands:



PARTNERS

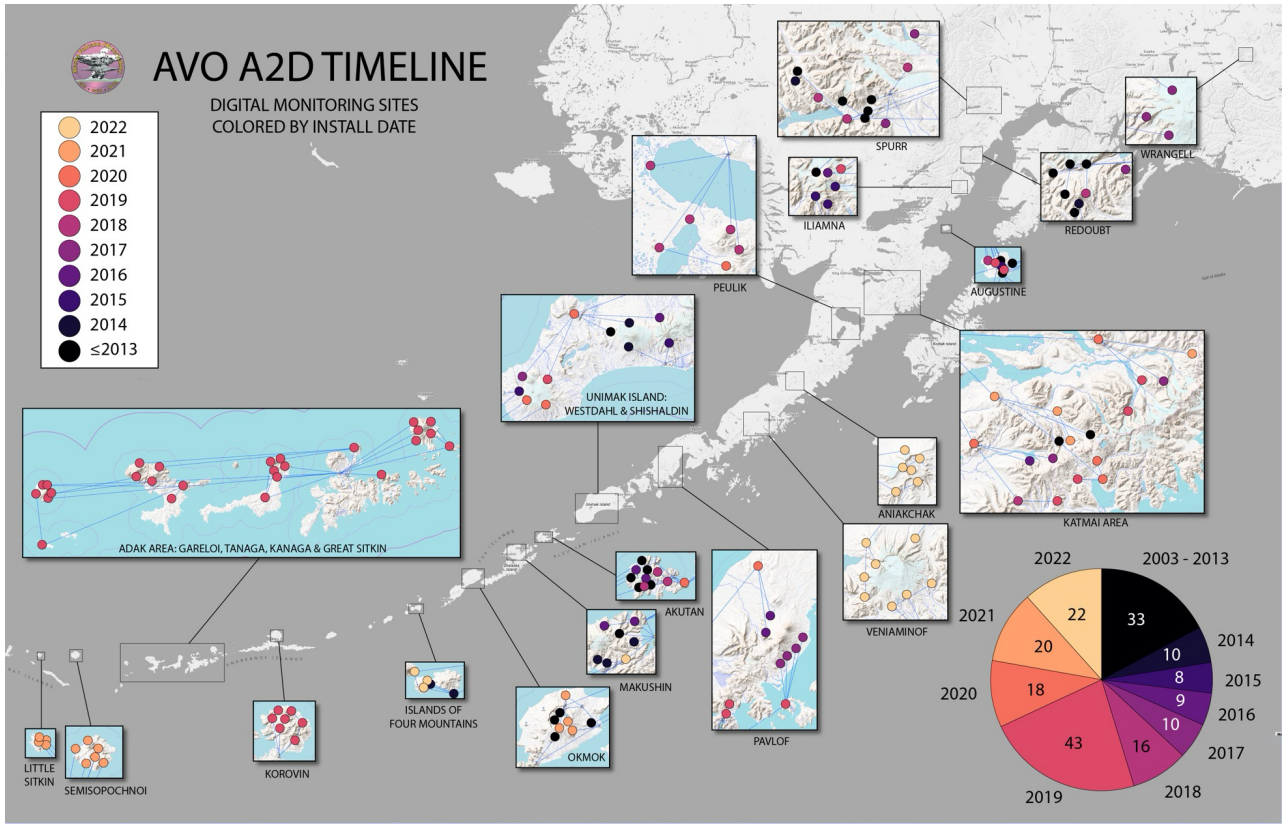
- AVO is a partnership based on cooperative agreements with the University of Alaska Fairbanks Geophysical Institute (UAFGI) and the State of Alaska Division of Geological and Geophysical Surveys (ADGGS)
- Interagency partners include the FAA, National Weather Service, NOAA, Air Force, Coast Guard, Alaska DHS&EM, Alaska Department of Environmental Conservation, and Alaska Division of Public Health
- AVO and Interagency partners maintain the "Alaska Interagency Operating Plan for Volcanic Ash Episodes"
- Regional partners include the Alaska Earthquake Center and the National Tsunami Warning Center
- AVO also partners with the National Earthquake Information Center (NEIC) on after-hours data checks and transmission of data to the IRIS Data Management Center

ONGOING PROJECTS AT AVO

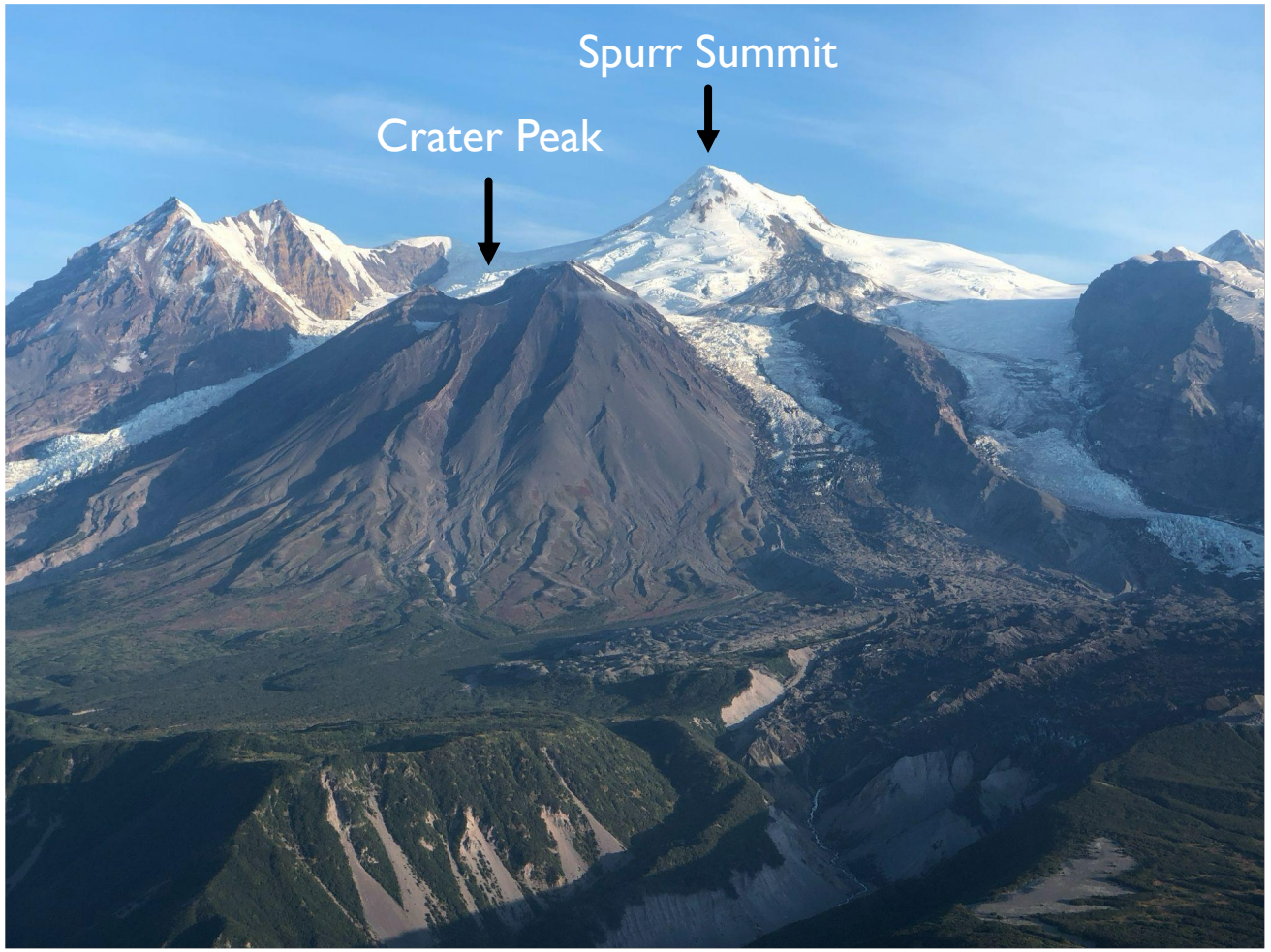
- Merbok Project
  - Goal to substantially improve overall level of operational resiliency during future major storms
- Next-Generation Hazard Assessment of Makushin Volcano
- Alaska Landslide Hazards Project
- PREEVENTS Project
- Ash and Aviation Project, Volcanic Ash Impacts Working Group, and Ash3D
- Eruption Response: Alaska averages 1-2 significant eruptions per year

RECENT ACCOMPLISHMENTS OF NOTE

- A2D Project Completion
  - A landmark achievement in the history of the observatory, this project transitioned the AVO network from antiquated analog technology to modern digital equipment
- AVERT Project Completion
  - Collaboration with Lamont-Doherty Earth Observatory at Columbia University, to improve monitoring at Cleveland and Okmok volcanoes in the Aleutian Islands
- Expanded use of infrasound for real-time volcano monitoring in the last decade
- AVO Booth at the Alaska Federation of Natives (AFN) convention past 2 years
- Response to significant unrest at Mount Spurr during 2024-2025



MOUNT SPURR

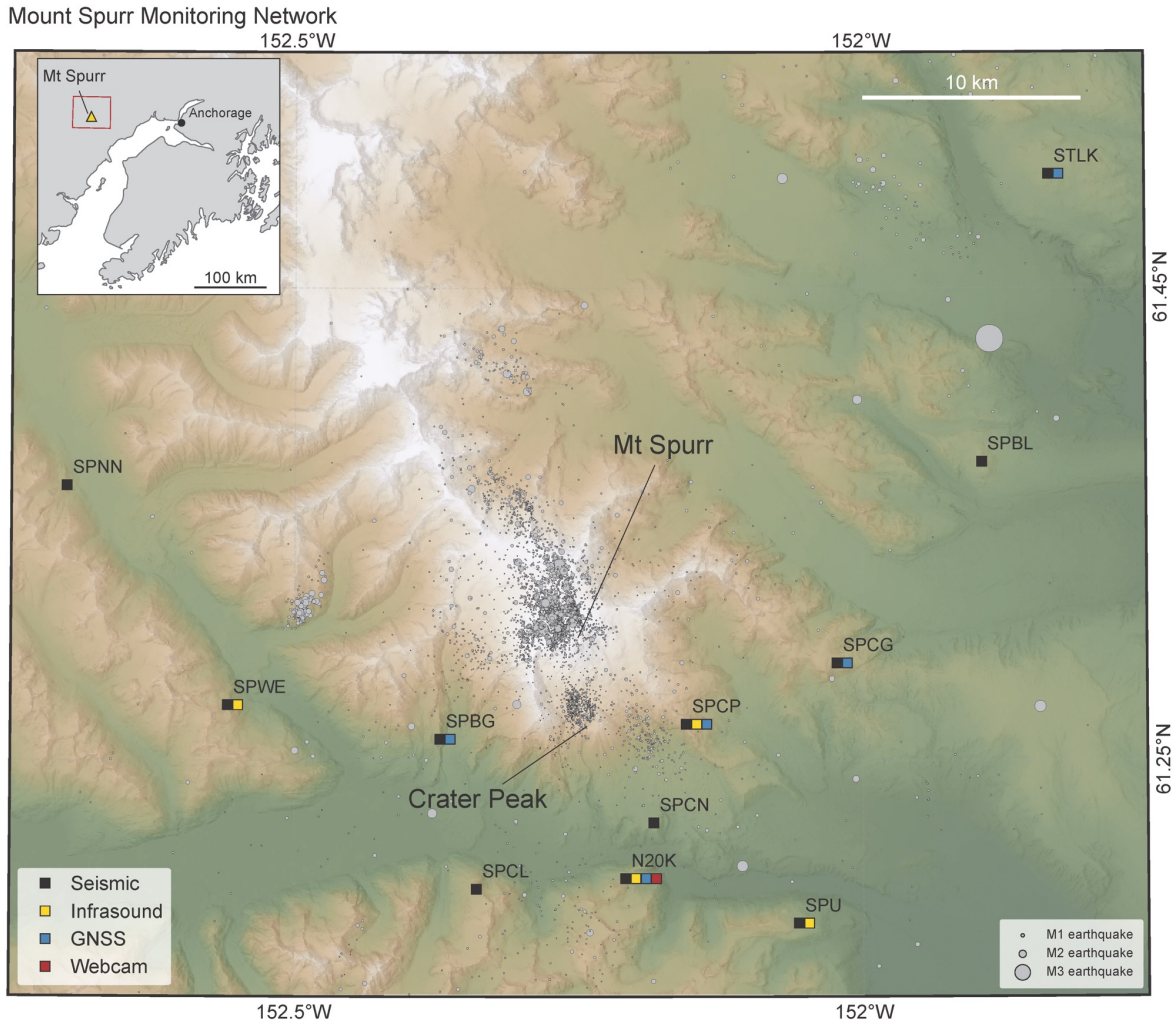


- Very-High-Threat due to frequent eruptions and location in Southcentral Alaska
- ~75 miles west of Anchorage
- Main hazard is ash – large volume of ice means hydrologic hazards also exist, but lack of nearby communities and infrastructure means threat of those is low
- Crater Peak erupted explosively in 1953 and 1992, causing ashfall of up to ¼ of an inch in Anchorage
- Non-eruptive unrest occurred between 2004-2006
- No historical eruptions from Spurr Summit, most recent estimated at over 5,000 years ago

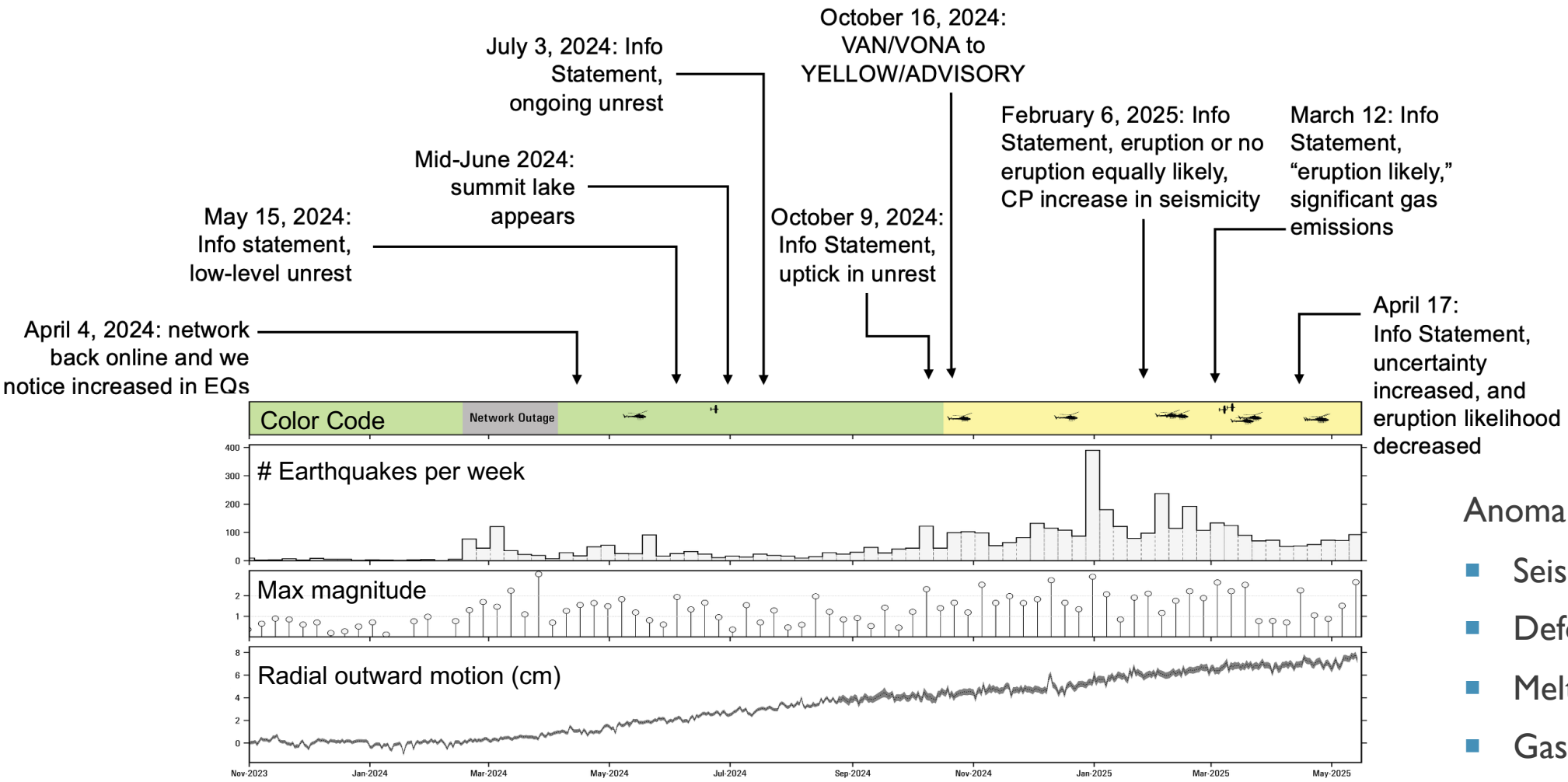
SPURR MONITORING

- AVO uses a combination of ground, air, and space-based instrumentation
- Ground: seismic, infrasound, GPS, webcam, gas (since June 17)
- Air: gas, thermal and visible camera
- Space: gas, thermal, and high-resolution imagery

Station N20K



SPURR UNREST 2024-2025



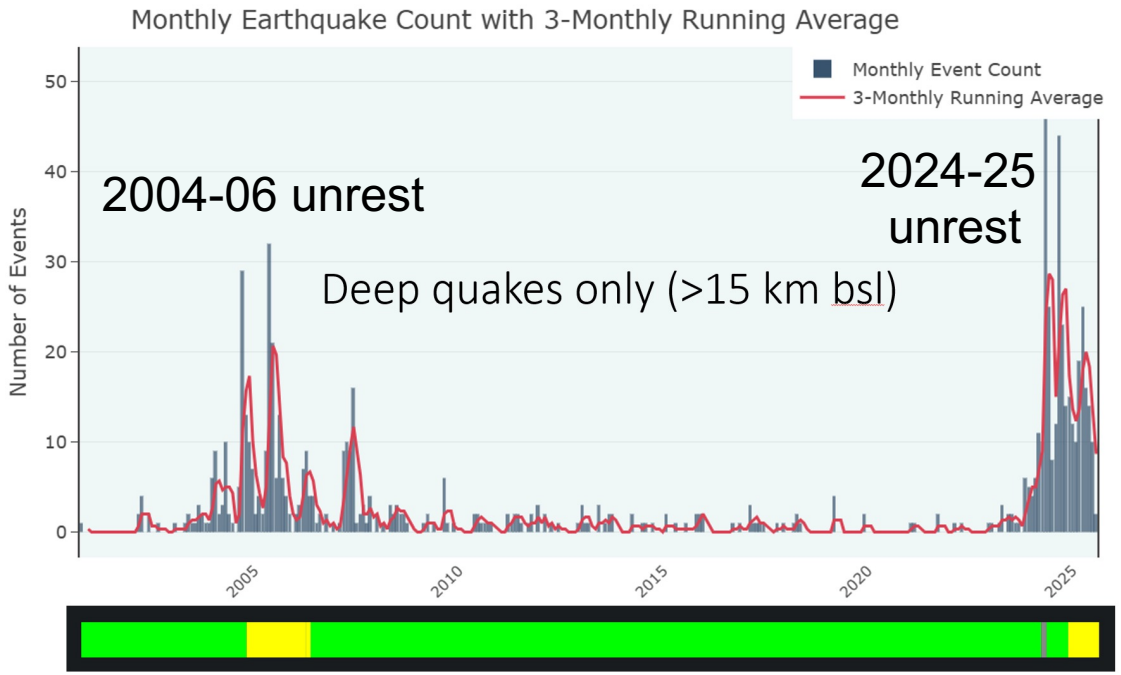
Anomalous levels of:

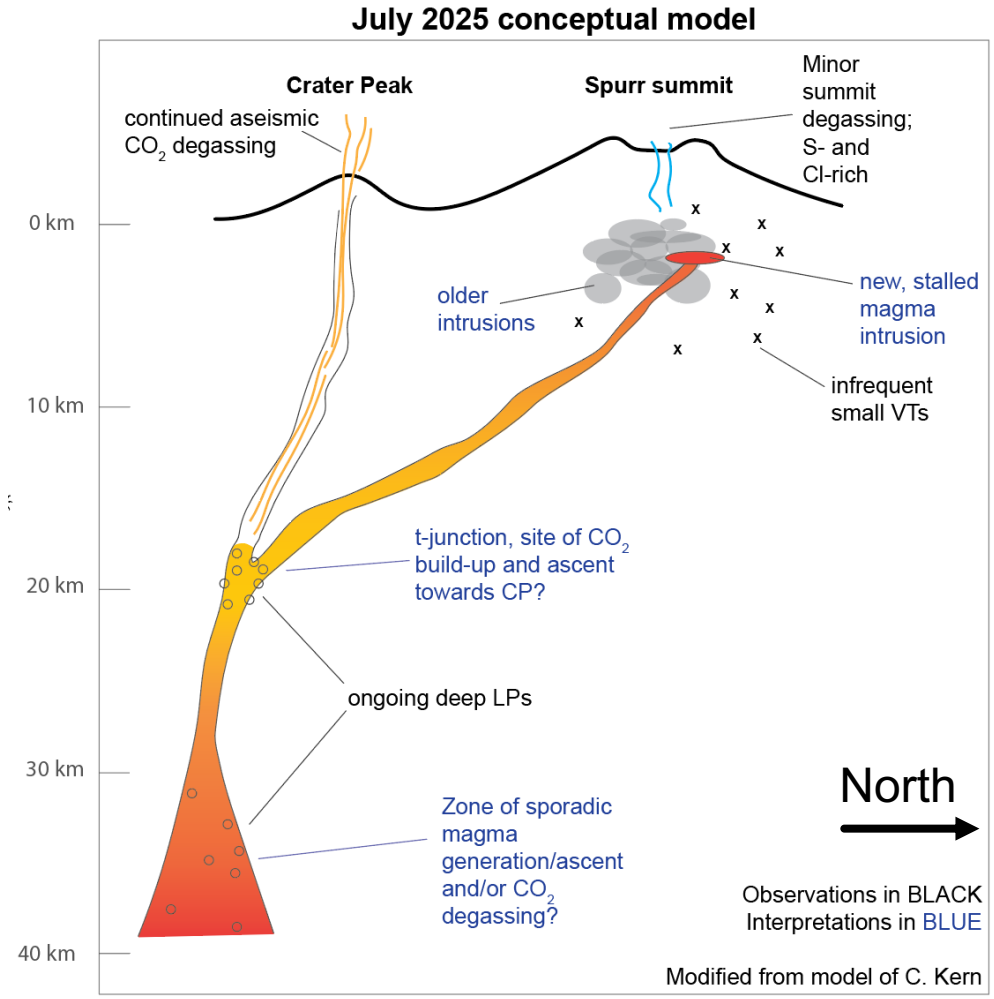
- Seismicity
- Deformation
- Melting at summit
- Gas emission (summit & CP)

SPURR CONCEPTUAL MODEL

Key observations:

- Activation of deep seismicity SE of Crater Peak during current unrest
- SO_2 and CO_2 degassing from summit, only CO_2 from Crater Peak





SPURR RESPONSE

- 13 gas flights since May 2024, 10 helicopter-based and 3 fixed-wing
- 8 Information Statements, 70+ interviews
- Observatory Volcanic Event Response Team (OVERT) started in February 2025
- AVO staff led a wide range of preparedness discussions, involving federal, state, and local emergency managers and stakeholders from various sectors, including health, aviation, water quality authorities, utility providers, and school districts
- Most recent Information Statement released yesterday (July 29) describes how the shallow magma intrusion beneath the summit has stalled

Mount Spurr steaming March 26, 2025

CHALLENGES AT AVO

- Right-sizing our field efforts in the post-A2D era and, eventually, post-Merbok era
- Current lease of AVO building (Grace Hall) runs through 2028
- How to best grow and support the nascent landslide hazards group within AVO?
- Completing long-term research projects while also assuming heavy response/operational load and limited science support staff
- Need for outreach and community engagement: Is it enough to warrant a dedicated staff member for outreach?

Pavlof 2016

OPPORTUNITIES AT AVO

- USGS-NOAA NVEWS Fumes Act: AVO has well-established relationships with NOAA and NVEWS priorities
- Tool Development: VOLCVIEW, AshCam, Rapid InSAR processing, Multiplot, Network State of Health Monitoring Dashboard
- Machine Learning: From tephra correlations (Lubbers) to seismic/infrasound event characterization (Tan) and thermal anomaly detection (Saunders-Shultz)
- New SEM purchased: quantitative geochemical abilities at AVO and VSC
- Geothermal exploration at Augustine Volcano in the Cook Inlet
- Expansion of landslide monitoring efforts into Southeast Alaska
- Advances in response equipment to deploy for volcanic unrest

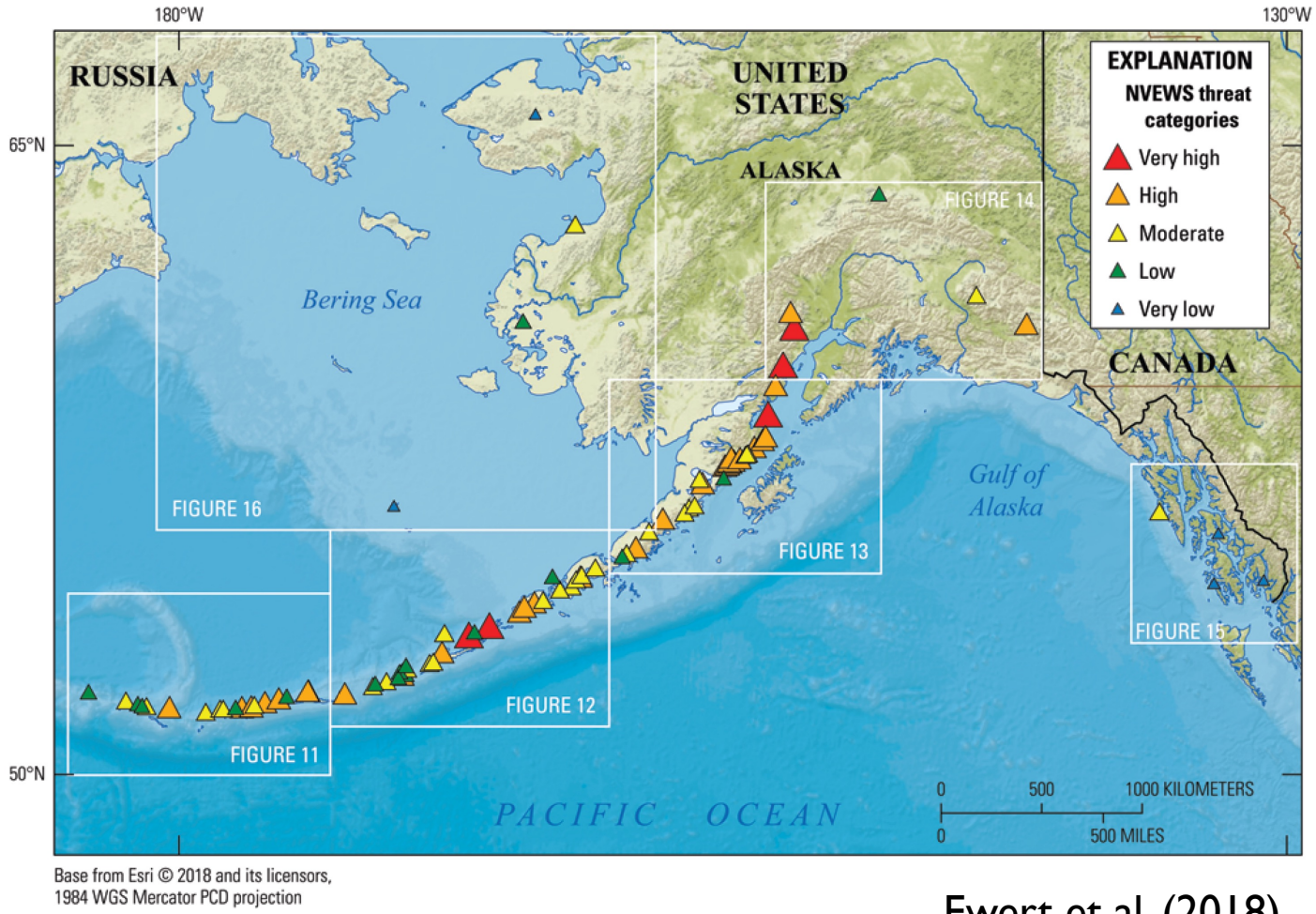
FUTURE DIRECTIONS OF THE OBSERVATORY

- Continuing to harden and improve resiliency of AVO receive facilities and data transmission
- Innovations and efficiencies in field work, such as boat-based servicing of Western Aleutian stations without a helicopter
- Bringing new technologies into the real-time monitoring network such as multigas sensors
- Upcoming special issue of Bulletin of Volcanology on the 2023 Shishaldin eruption
- Maintaining and improving the Cooperative Agreements with UAFGI and ADGGS
- Preparing for next significant eruption

Bogoslof volcano, 2017

Pavlof volcano, 2016

NVEWS IN ALASKA



Ewert et al. (2018)

- Alaska has:
  - 5 Very-High-Threat volcanoes
    - Spurr (Cook Inlet)
    - Redoubt (Cook Inlet)
    - Augustine (Cook Inlet)
    - Akutan (Dutch Harbor Area)
    - Makushin (Dutch Harbor Area)
  - 30 High-Threat volcanoes
  - 51 Moderate, Low, or Very-Low Threat
- Of the Very-High-Threat volcanoes, Makushin in most need of additional work to complete NVEWS plans

GETTING INVOLVED WITH AVO

- https://avo.alaska.edu/
- Follow along with AVO Social Media:

@alaska.avo @alaska_avo @alaska_volcano_observatory

BUDGET

	FY 23	FY 24
OE	461k	436k (incl. carryover)
Salary	3,550k	3,825k
Coops	4,385k	4,330k
Project Total	8,396k	8,591k

*Does not include Landslides work

USGS California Volcano Observatory Scientist in Charge updates for NVEWS

Current Status of NVEWS

- Two new hires! Margaret Glasgow and Josh Crozier
- Most EEW builds near volcanic centers now include broadband sensors
- Most NCSN/SCSN stations have been converted to digital
- Earthscope GNSS is transferring to USGS
- All California volcanic centers are moderately instrumented

- 15 analog stations need to be upgraded
- Five of these will be completed this year
- UNR coop just established – will build out four new stations in the Mono Basin

- No formal evaluation completed

Challenges and Opportunities

- All federal agencies are impacted by loss of staff (USGS, USFS, BLM, Parks), causing permitting new stations and rebuilds to take much longer
- We do not have adequate staff to take on GNSS operations
- All seismic and geodetic data are open source. We have no formal path for academic collaboration

- CalVO relies on ESC for station maintenance, processing and archival of seismic data, collection of GNSS data, strain-meter and long baseline tiltmeters
- This is both a challenge (funding, staff) and opportunity for collaboration

Plans

- Three-year plan to complete A/D transition will likely take > 3 years
- Looking ahead we are currently permitting more sites in the Lassen volcanic center
- We have identified where we could improve our networks and are beginning to plan permitting for those sites

- Uncertain status of the Sáttítla Highlands National Monument may impact monitoring in the Medicine Lake region

Comments

- Funding!

- If more funding becomes available, we have plans to use it
- Staffing levels are a primary concern

- Please advocate for Funding!

- At this point we have ½ of our staff trained to perform duty watch
- With little volcanic activity we are focusing on improving automatic processing of seismic and geodetic data

CalVO Monitoring

Monitoring Maps

Shasta	Medicine Lake	Lassen	Clear Lake	Mono-Inyo	Long Valley & Mammoth Mountain	Coso	Salton	Ubehebe
Most Recent	Most Recent	Most Recent	Most Recent	Most Recent	Most Recent	Most Recent	Most Recent	Most Recent
Last 2 Years	Last 2 Years	Last 2 Years	Last 2 Years	Last 2 Years	Last 2 Years	Last 2 Years	Last 2 Years	Last 2 Years
Since 1980	Since 1980	Since 1980	Since 1980	Since 1980	Since 1980	Since 1980	Since 1980	Since 1980

Pensive Spectrograms
CVO Backups: artemis | vulcan3

Daily Helicorders
Download this file locally and open the file to get images to load

Swarms

Network Covariance

REDPy

Useful External Links

CalVO Website

Latest Earthquakes
California (Last Day) | California (Last Week) | Significant Worldwide

Webcams
Alert California | Shasta | Lassen | Mammoth

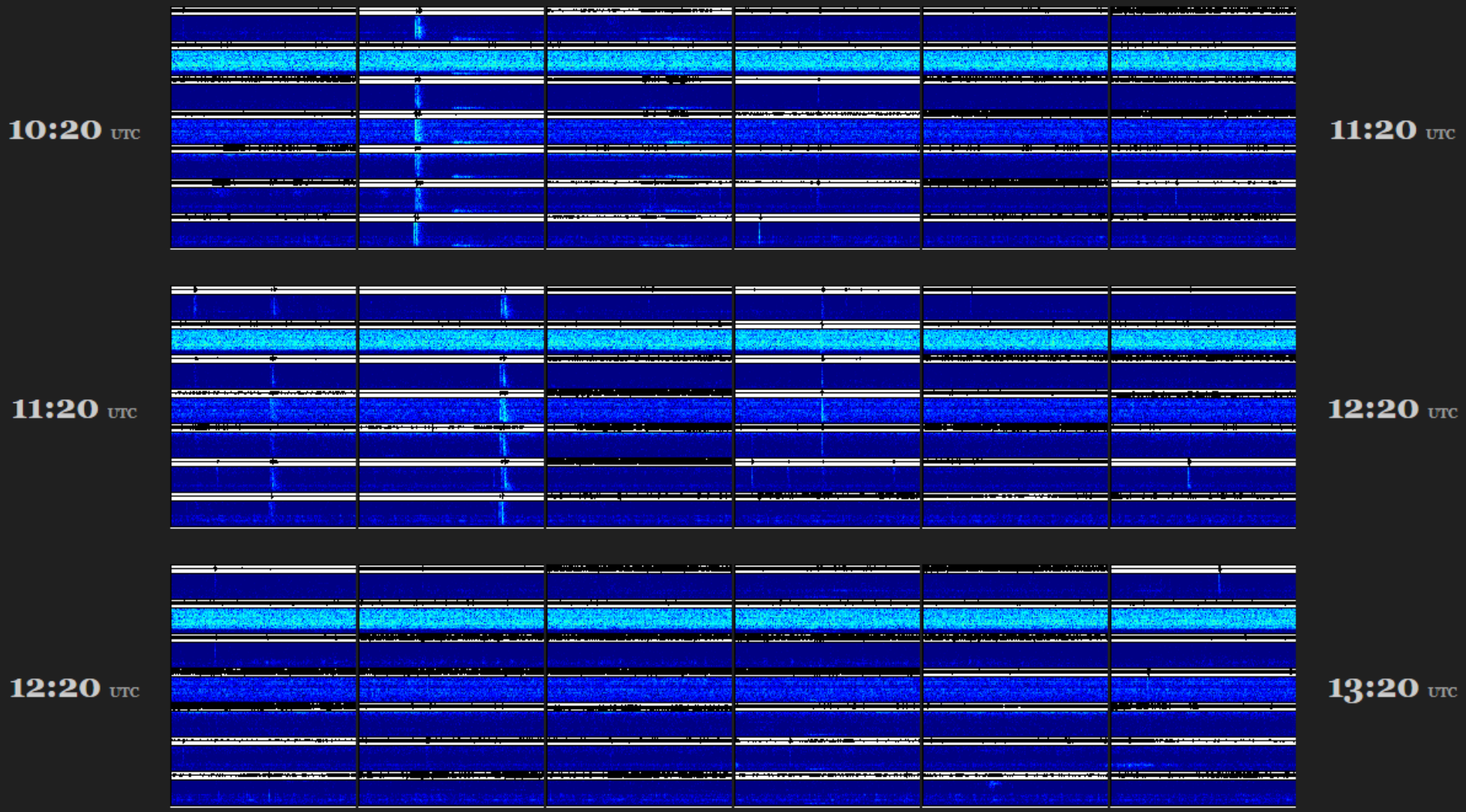
Satellite
Worldview (Thermal/SO2/Visible/etc.) | Tropomi (SO2) | Volcanic Cloud (Ash)

Last Week's Weather
Shasta | Lassen | Mammoth

Coso | Absolute time | Mosaic Options | Permalink | What Am I Looking At?

Coso

21 July, 2025 10:20 - 13:20 UTC



Updated 2025-07-22T01:10:03.914361Z (all times in UTC)

CalVO Swarms

20 entries per page

Search:

Swarm ID / Overview Image	Map	# Events	M_{max}	Latitude	Longitude	Depth	First Event	Last Event	Peak/Hour	Peak/Day	Duration
SaltonButtes2025-3	Map	69	4.34	33.16300	-115.63667	4.9 km	2025-07-11T07:38:53.230000Z	2025-07-13T23:18:34.830000Z	18	56	2.65
SierraBlock2025-3	Map	17	2.87	37.48017	-118.78833	3.3 km	2025-07-02T15:58:31.400000Z	2025-07-04T07:24:46.490000Z	5	13	1.64
CosoVolcanicField2025-2	Map	10	1.30	36.03400	-117.77550	2.1 km	2025-06-24T20:31:04.310000Z	2025-06-24T22:46:59.520000Z	9	10	0.09
SaltonButtes2025-2	Map	14	2.84	33.18358	-115.60567	3.1 km	2025-04-22T09:05:25.060000Z	2025-04-22T14:30:23.920000Z	7	14	0.23
CosoVolcanicField2025-1	Map	13	1.79	36.02917	-117.77900	1.6 km	2025-04-15T09:11:24.300000Z	2025-04-16T22:40:46.660000Z	2	8	1.56
SaltonButtes2025-1	Map	37	3.25	33.17933	-115.60650	2.7 km	2025-04-10T05:24:19.000000Z	2025-04-11T05:13:52.730000Z	10	37	0.99
SierraBlock2025-2	Map	10	1.32	37.52450	-118.87483	3.3 km	2025-02-21T16:43:41.890000Z	2025-02-22T17:09:48.730000Z	3	7	1.02
SierraBlock2025-1	Map	26	2.50	37.52683	-118.87442	3.3 km	2025-02-08T02:17:13.890000Z	2025-02-09T15:11:12.640000Z	11	24	1.54
SaltonButtes2024-2	Map	41	3.19	33.18133	-115.62200	4.4 km	2024-12-20T06:20:20.450000Z	2024-12-20T18:35:00.980000Z	14	41	0.51
MammothMountain2024-1	Map	87	3.37	37.63550	-119.04083	-0.9 km	2024-11-27T04:27:12.210000Z	2024-11-28T12:16:42.580000Z	29	76	1.33
SierraBlock2024-4	Map	10	1.19	37.53633	-118.82700	4.8 km	2024-11-01T09:18:57.290000Z	2024-11-01T23:27:04.500000Z	5	10	0.59
SierraBlock2024-3	Map	10	3.46	37.43242	-118.74525	11.4 km	2024-09-03T10:45:30.910000Z	2024-09-03T12:35:42.000000Z	7	10	0.08
LassenVolcanicCenter2024-1	Map	16	2.53	40.40408	-121.38017	5.8 km	2024-06-24T11:40:38.360000Z	2024-06-24T23:52:57.000000Z	5	16	0.51
SierraBlock2024-2	Map	12	3.02	37.51433	-118.83367	7.1 km	2024-06-02T04:56:36.210000Z	2024-06-03T19:49:16.320000Z	4	10	1.62
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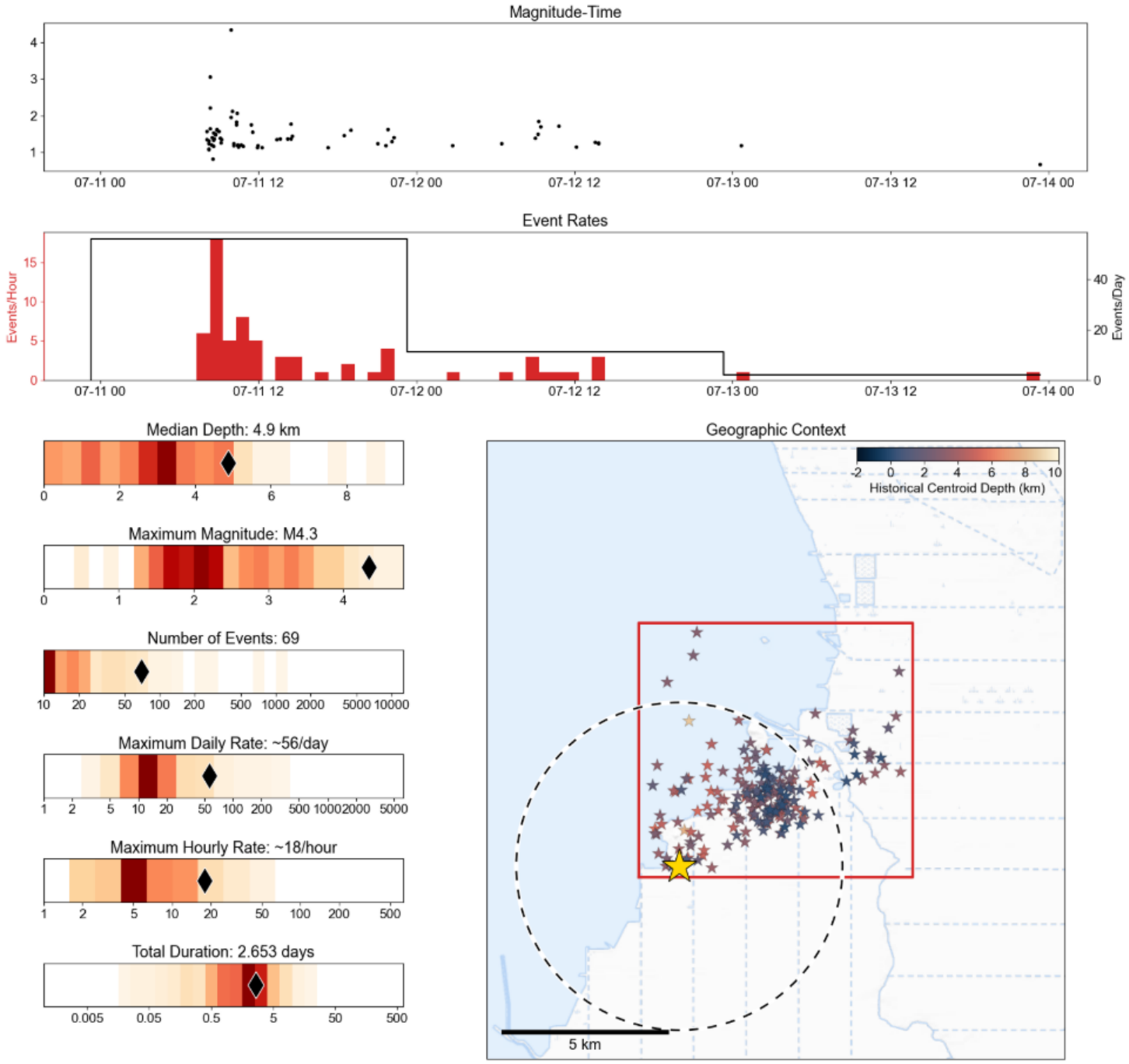
SierraBlock2023-9	Map	10	1.76	37.48058	-118.83450	0.9 km	2023-12-23T05:41:46.540000Z	2023-12-26T06:19:49.700000Z	2	6	3.03
LongValleyCaldera2023-1	Map	46	2.55	37.63025	-118.89133	5.8 km	2023-11-22T01:05:31.620000Z	2023-11-22T23:44:42.340000Z	16	46	0.94
CosoVolcanicField2023-1	Map	10	3.47	36.01958	-117.77183	2.1 km	2023-10-25T06:19:31.120000Z	2023-10-27T17:47:13.390000Z	3	7	2.48

Showing 1 to 20 of 3,251 entries

« ‹ 1 2 3 4 5 … 163 › »

Last alarm sent: 2025-07-12T09:12:09.240000Z (SaltonButtes2025-3)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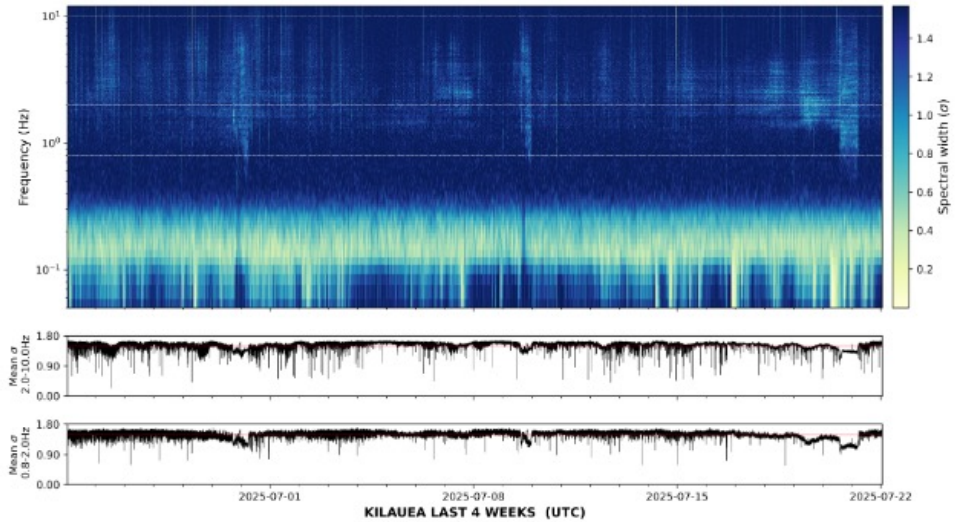
4
3
2
1
07-11 00
07-11 12
07-12 00
07-12 12
07-13 00
07-13 12
07-14 00
Event Rates
Events/Hour
15
10
5
0
40
20
0
Events/Day
Median Depth: 4.9 km
0 2 4 6 8
Maximum Magnitude: M4.3
0 1 2 3 4
Number of Events: 69
10 20 50 100 200 500 1000 2000 5000 10000
Maximum Daily Rate: ~56/day
1 2 5 10 20 50 100 200 500 1000 2000 5000
Maximum Hourly Rate: ~18/hour
1 2 5 10 20 50 100 200 500
Total Duration: 2.653 days
0.005 0.05 0.5 5 50 500
Geographic Context
-2 0 2 4 6 8 10
Historical Centroid Depth (km)
5 km

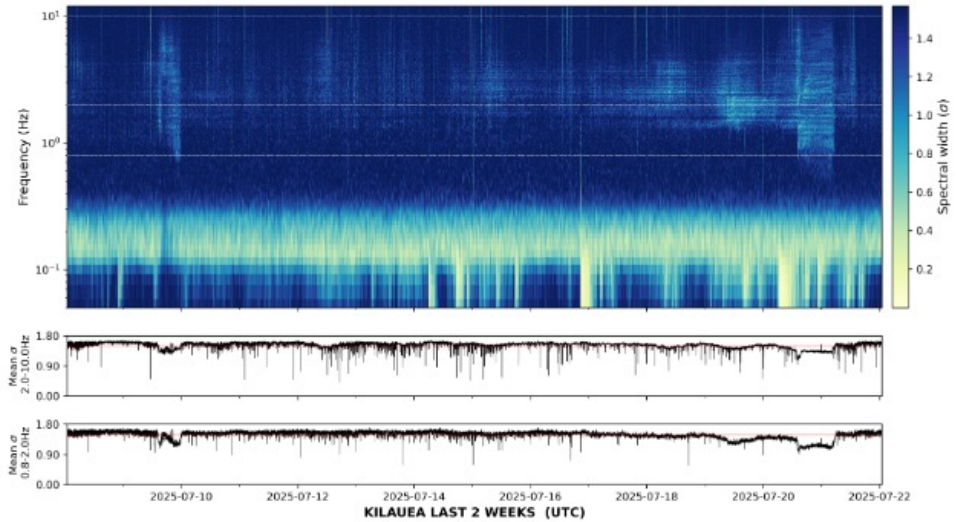
Kilauea

Station Map

FOUR WEEKS



TWO WEEKS



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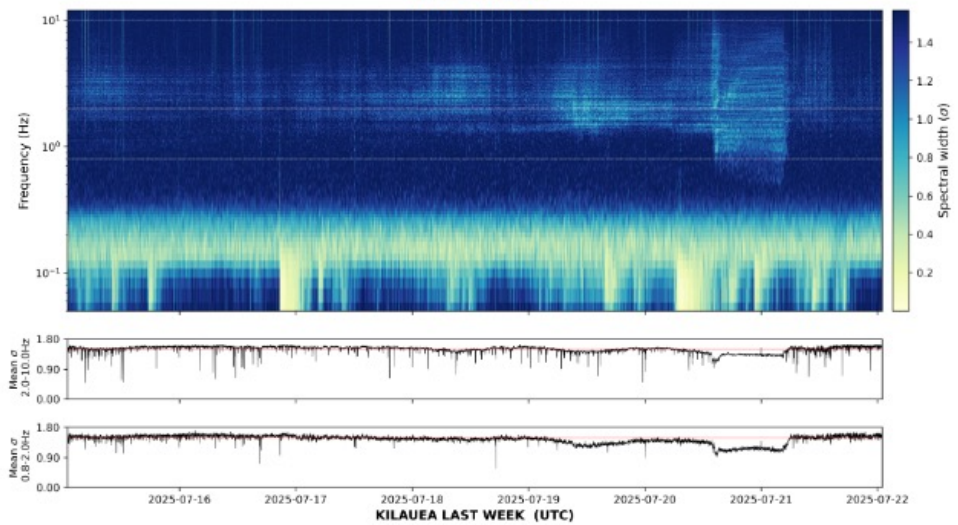
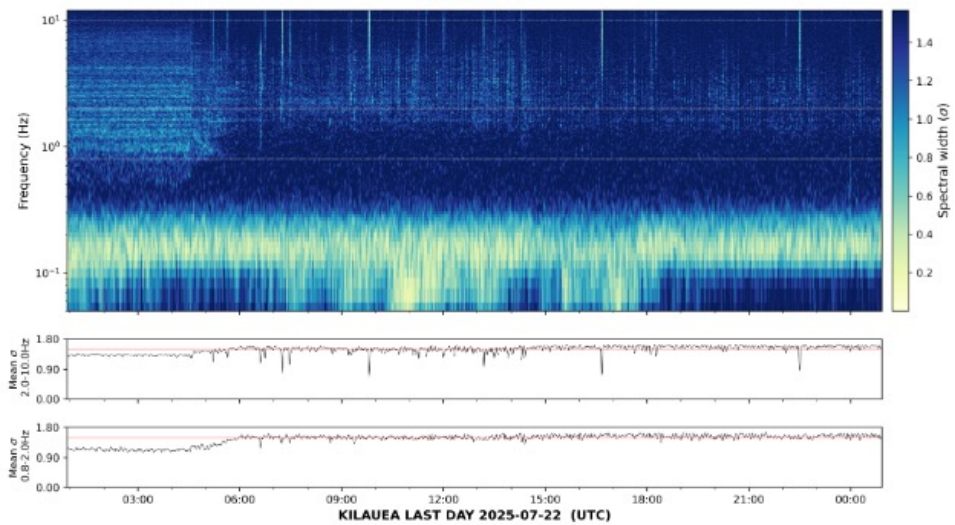
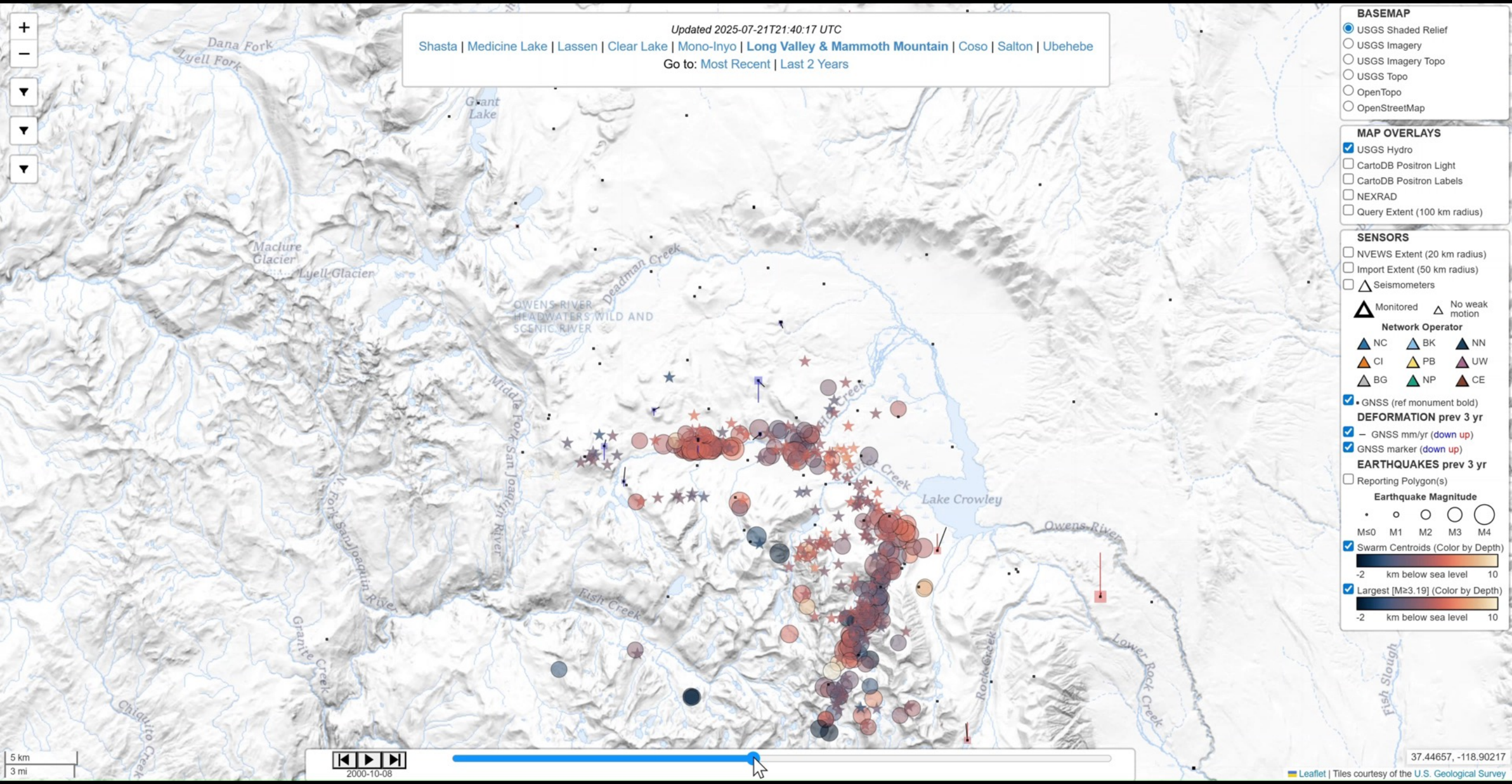


ONE DAY



Mauna Loa

Station Map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Shasta | Medicine Lake | Lassen | Clear Lake | Mono-Inyo | Long Valley & Mammoth Mountain | Coso | Salton | Ubehebe
Go to: Most Recent | Last 2 Years
BASEMAP
USGS Shaded Relief
USGS Imagery
USGS Imagery Topo
USGS Topo
OpenTopo
OpenStreetMap
MAP OVERLAYS
USGS Hydro
CartoDB Positron Light
CartoDB Positron Labels
NEXRAD
Query Extent (100 km radius)
SENSORS
NVEWS Extent (20 km radius)
Import Extent (50 km radius)
Seismometers
Monitored
No weak motion
Network Operator
NC
BK
NN
CI
PB
UW
BG
NP
CE
GNSS (ref monument bold)
DEFORMATION prev 3 yr
GNSS mm/yr (down up)
GNSS marker (down up)
EARTHQUAKES prev 3 yr
Reporting Polygon(s)
Earthquake Magnitude
M≤0
M1
M2
M3
M4
Swarm Centroids (Color by Depth)
-2
km below sea level
10
Largest [M≥3.19] (Color by Depth)
-2
km below sea level
10
Dana Fork
Lyell Fork
Grant Lake
Maclure Glacier
Lyell Glacier
Deadman Creek
OWENS RIVER HEADWATERS WILD AND SCENIC RIVER
Middle Fork San Joaquin River
N. Fork San Joaquin River
Granite Creek
Chiquito Creek
Fish Creek
Lake Crowley
Owens River
Rock Creek
Lower Rock Creek
Fish Slough
5 km
3 mi
2000-10-08
37.44657, -118.90217
Leaflet | Tiles courtesy of the U.S. Geological Survey

Questions?


CALIFORNIA VOLCANO OBSERVATORY
CalVO
U.S. GEOLOGICAL SURVEY

Outline (split into as many slides as needed)

- Current status of NVEWS at your observatory
  - What has been implemented, what is operational, what is planned
  - External technical evaluation of NVEWS (as a system or components)
- NVEWS-related challenges, vulnerabilities, and opportunities
  - Access and logistics issues
  - Dependance on instrumentation that is maintained by non-USGS funded organizations
  - Framework for interactions with academic researchers
  - Particular issues associated with observatory-specific volcanoes – what operations (relevant to NVEWS) are unique at your observatory compared to others.
- Plans for NVEWS post supplemental funds
- Current tribal relationships in context of NVEWS roll-out and future
- Comment on aspects of NVEWS that have yet to roll out
  - External grants program, 24x7 watch office
  - Anything else that is relevant
- What do you want from the NVEWSAC?

HAWAIIAN VOLCANO OBSERVATORY (HVO)

NVEWS SCIENCE ADVISORY COMMITTEE

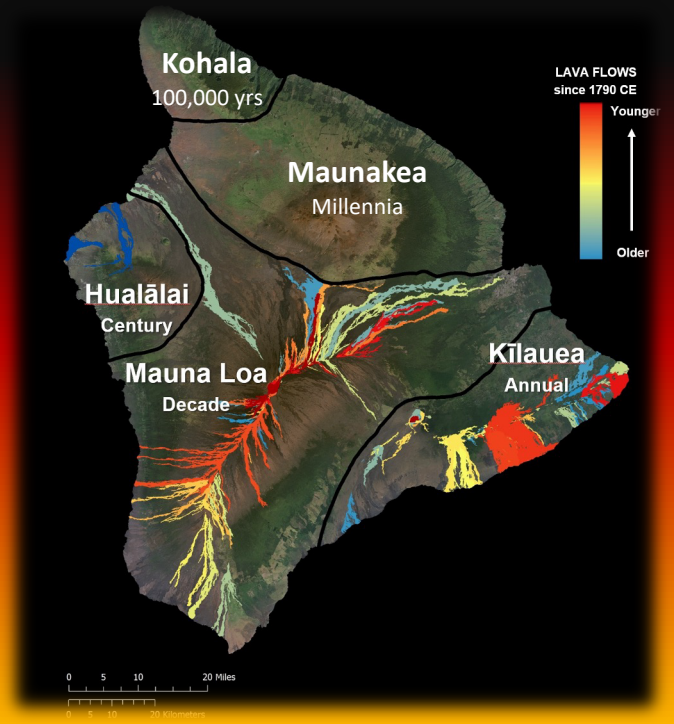
KEN HON-SIC

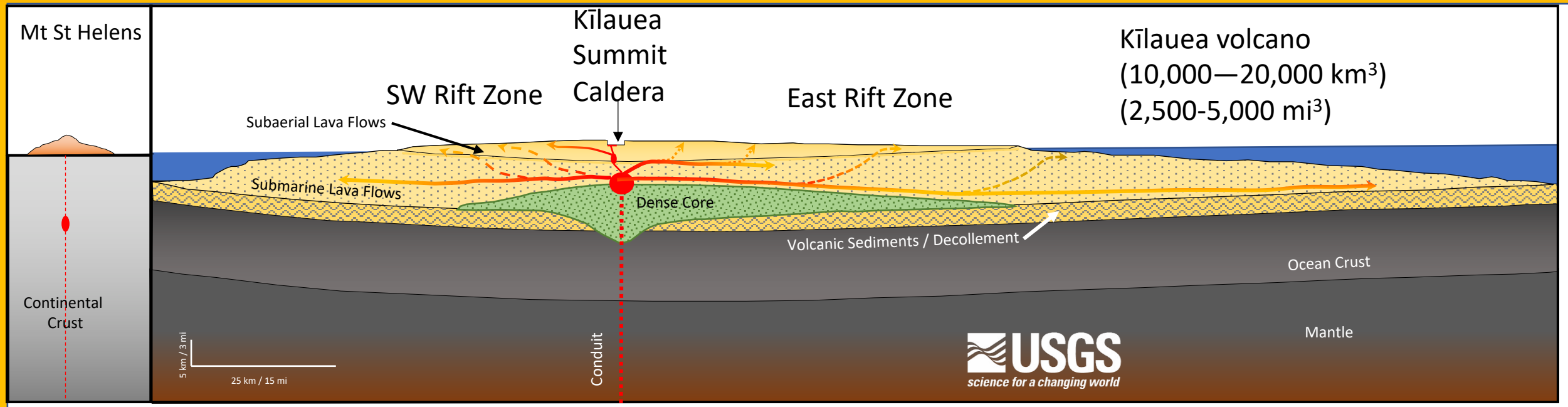
USGS science for a changing world

HVO

Hawaiian shield volcanoes are complex with a shallow main magma chamber that feeds magma via multiple pathways through connected rift zones up to 200 km long.

The Island of Hawai‘i is composed of 5 volcanoes, 3 of which are considered active including 2 of the most active volcanoes in the world.

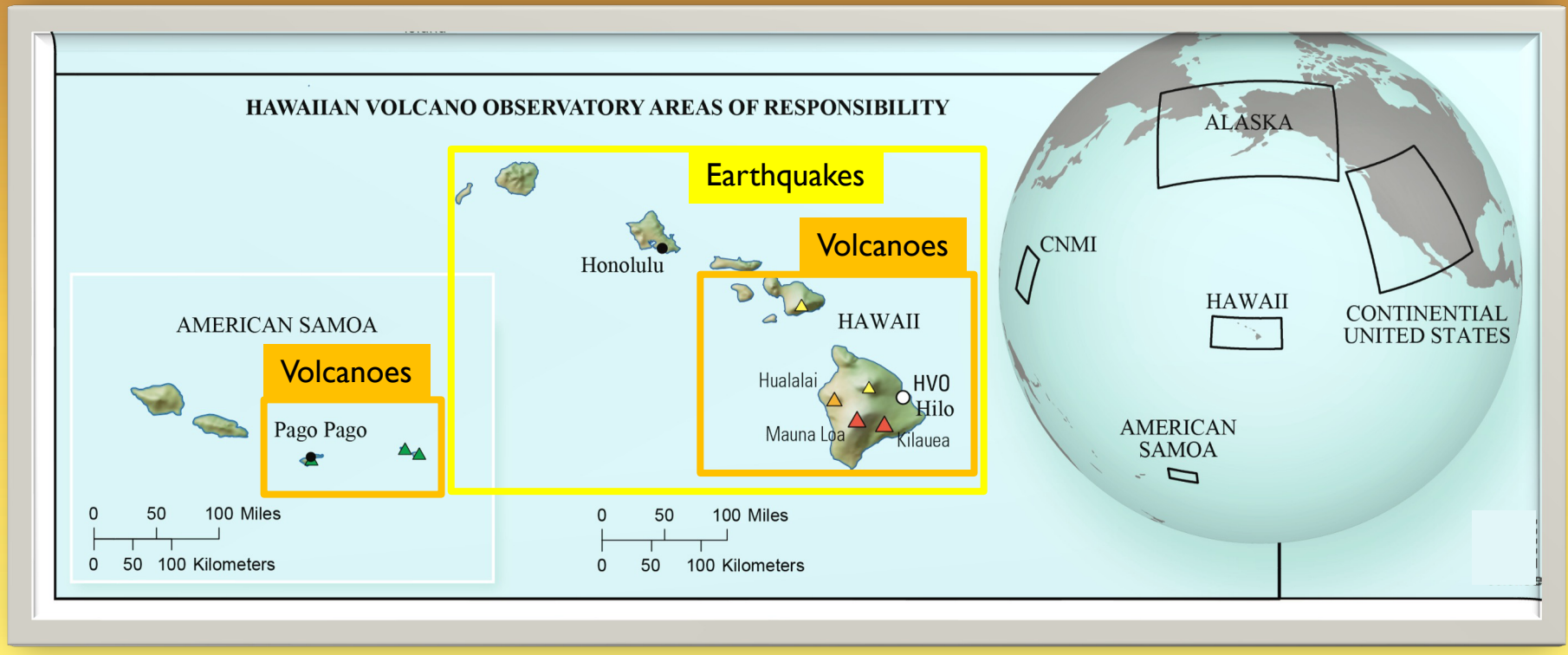




HAWAIIAN VOLCANO OBSERVATORY AREAS OF RESPONSIBILITY

USGS science for a changing world

- HVO is responsible for monitoring active volcanoes in the State of Hawaii and, recently, the Territory of American Samoa.
- HVO also has the responsibility of monitoring all earthquakes in Hawaii as part of USGS Advanced National Seismic System (ANSS). HVO also maintains the only USGS seismometers in American Samoa



3? Active Volcanoes in American Samoa

3 Low Threat: Ta'ū, Ofu-Olosega, and Tutuila

Last eruption 1866; Seismic Crisis August 2022 on Ta'ū

6 Active Volcanoes in Hawai'i

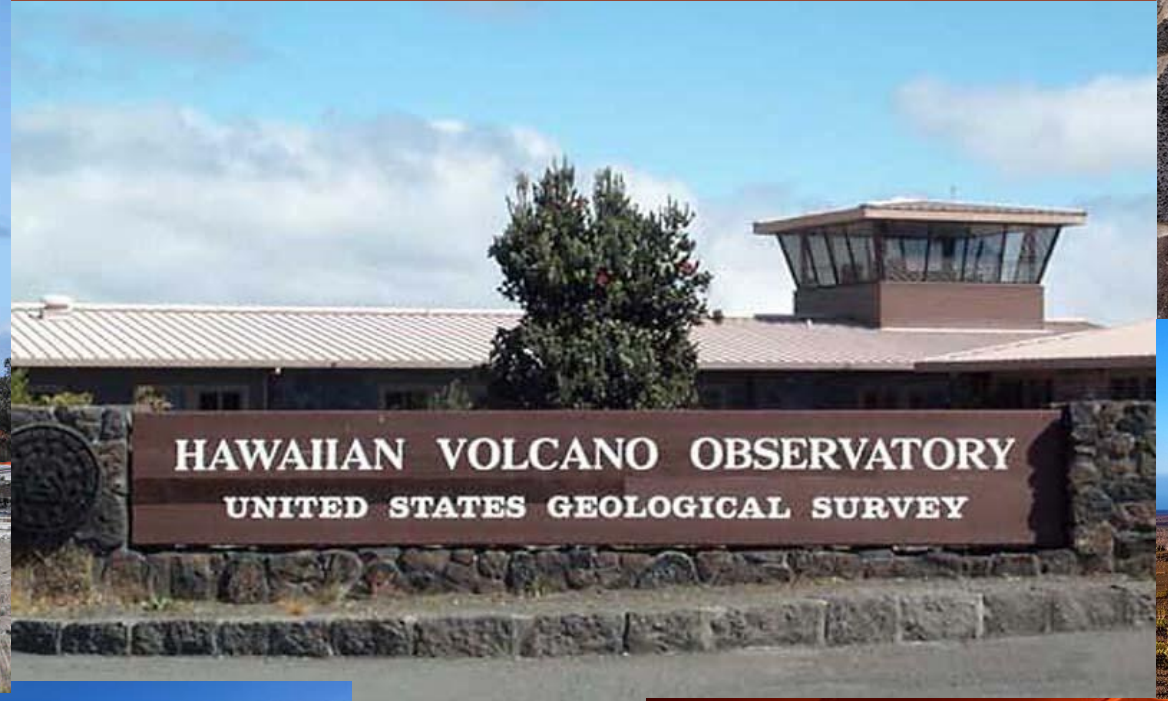
2 Very High Threat Potential: Kilauea, Mauna Loa

1 High Threat Potential: Hualalai

2 Moderate Threat Potential: Haleakala, Mauna Kea

1 Not Ranked: Kama'ehuakanaloa (Lo'ihi Seamount)


Hawaii Tribune Herald




Janice Wei, NPS


Kīlauea Military Camp
HVO moved to KVC in 1942.
Kīlauea Visitor Center (KVC)
Volcano House
Uēkahuna Bluff
Kaluapele

Field Station opens Jan 2026

Kīlauea Military Camp

HVO moved to KVC in 1942.

Kīlauea Visitor Center (KVC)

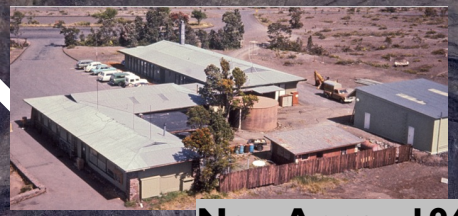
Volcano House

Uēkahuna Bluff

Jaggar's First HVO, 1912

HVO shared Ohi'a Wing with NPS, 1940

Modern HVO, 1986-2018



New Annex 1961

Kaluapele

HVO moved Uēkahuna Bluff, 1948 (built in 1927 for NPS visitors and

Perret's First Field Station 1911

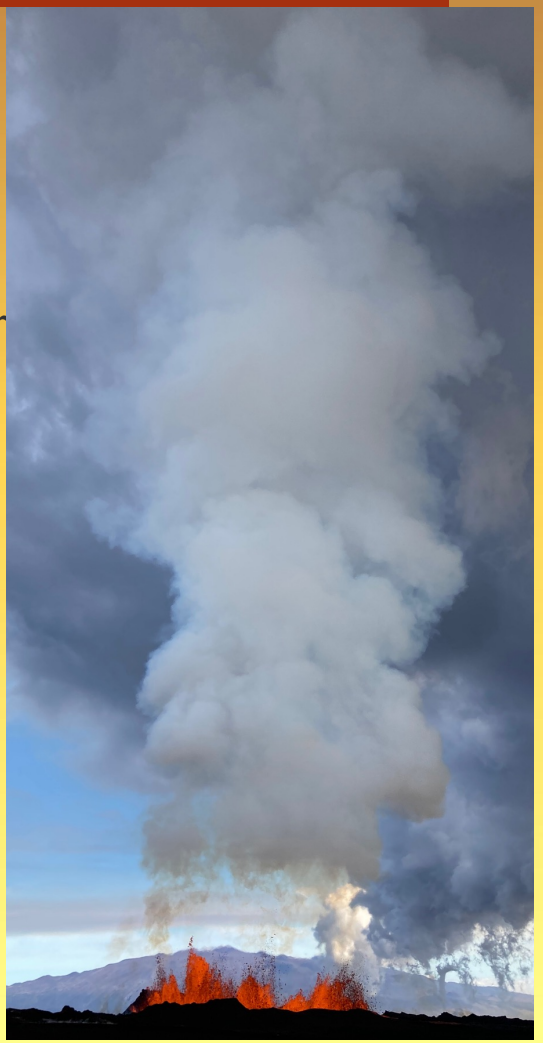
HVO IS THE STAFF

USGS
science for a changing world

- Approximately 30-35 staff at any given time
- More than 70% of the staff is new since 2018
- Field work 365 days a year, curse or blessing?

HAWAIIAN VOLCANO OBSERVATORY CULTURE

- Science done through the lens of Hawaiian culture
- Seek permission, Work with purpose, Serve the community
- Building and maintaining relationships are key to USGS HVO‘s success
- Eruptions always impact the community perception of the USGS even if ther is no damage
- Seismologists and Duty Scientists keep a constant watch
- 9 eruptions and 4 major intrusions in 4 years
- Strong collaborations with University of Hawai‘i and Hawai‘i Volcanoes National Park and Hawai‘i County
- Host many visitors and outside science collaborators
- Many former HVO staff now elsewhere in VSC still work on Hawai‘i topics
- Open data sharing, but we encourage co-authorships with a staff member



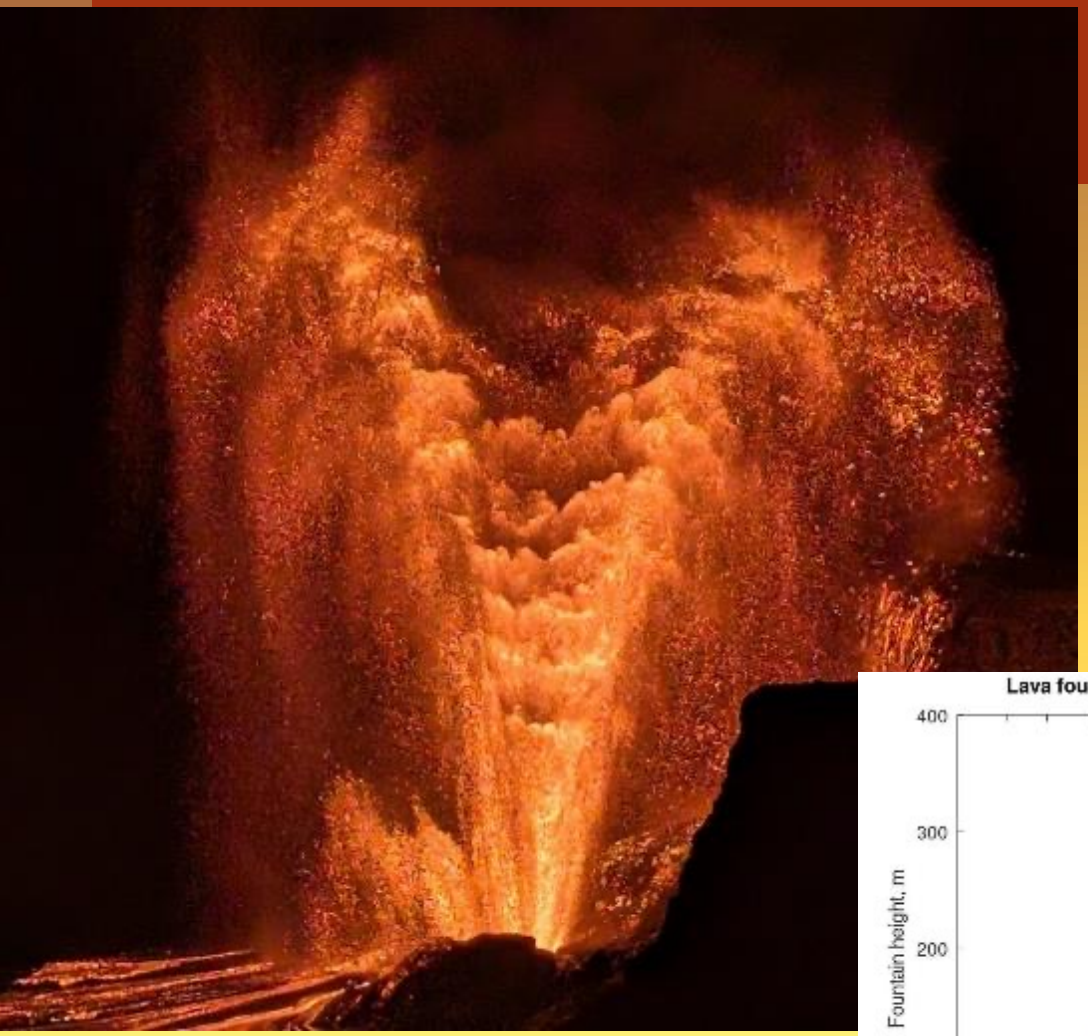
PURPOSE OF HVO

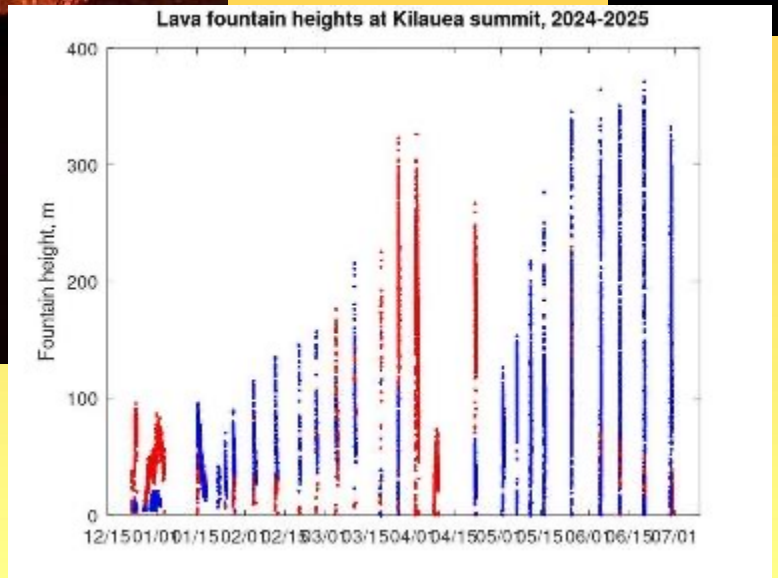
- Improve eruption forecasting for individual eruptions and for changes in eruptive style (effusive to explosive)
- To improve understanding of hazards and hazard mitigation in line with community wishes.
- Frequent eruptions make it necessary to have clear partnerships and communications..
- Frequent eruptions also make HVO a place to train other volcanologists, test new techniques, and provide exposure of the USGS to the public.

USGS Research Building UH Campus January 2027


USGS
Hawaiian Volcano Observatory
30 episodes of lava fountaining at Kīlauea

2024-2025 HALEMA‘UMA‘U, RARE EPISODIC ERUPION





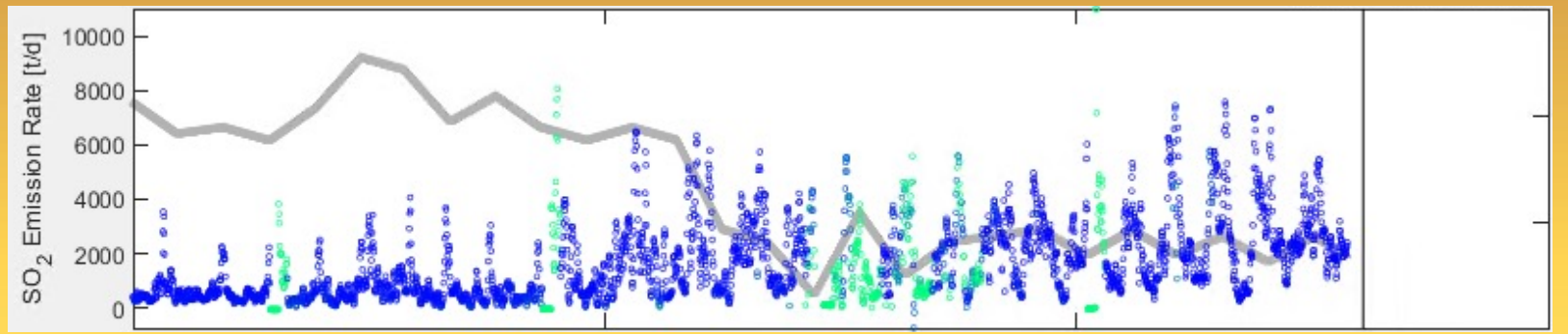
Maximum Fountain Height
365 meters
(1200 feet)

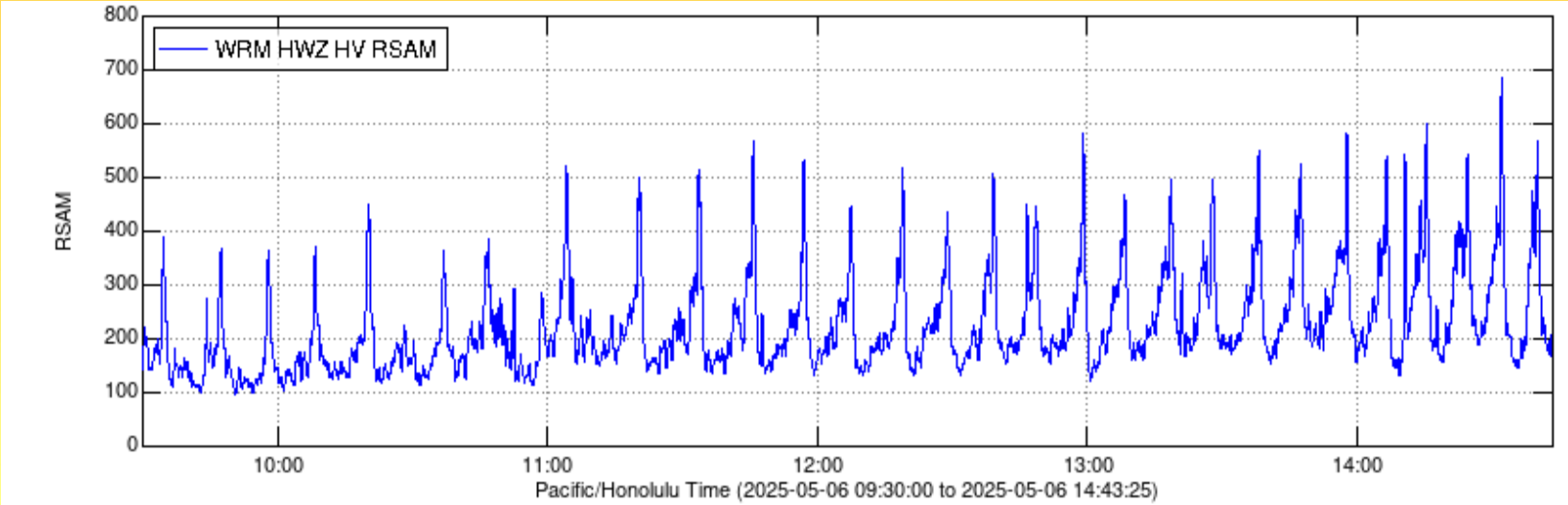
Eruption plume to
6000 meters
(20000 feet)

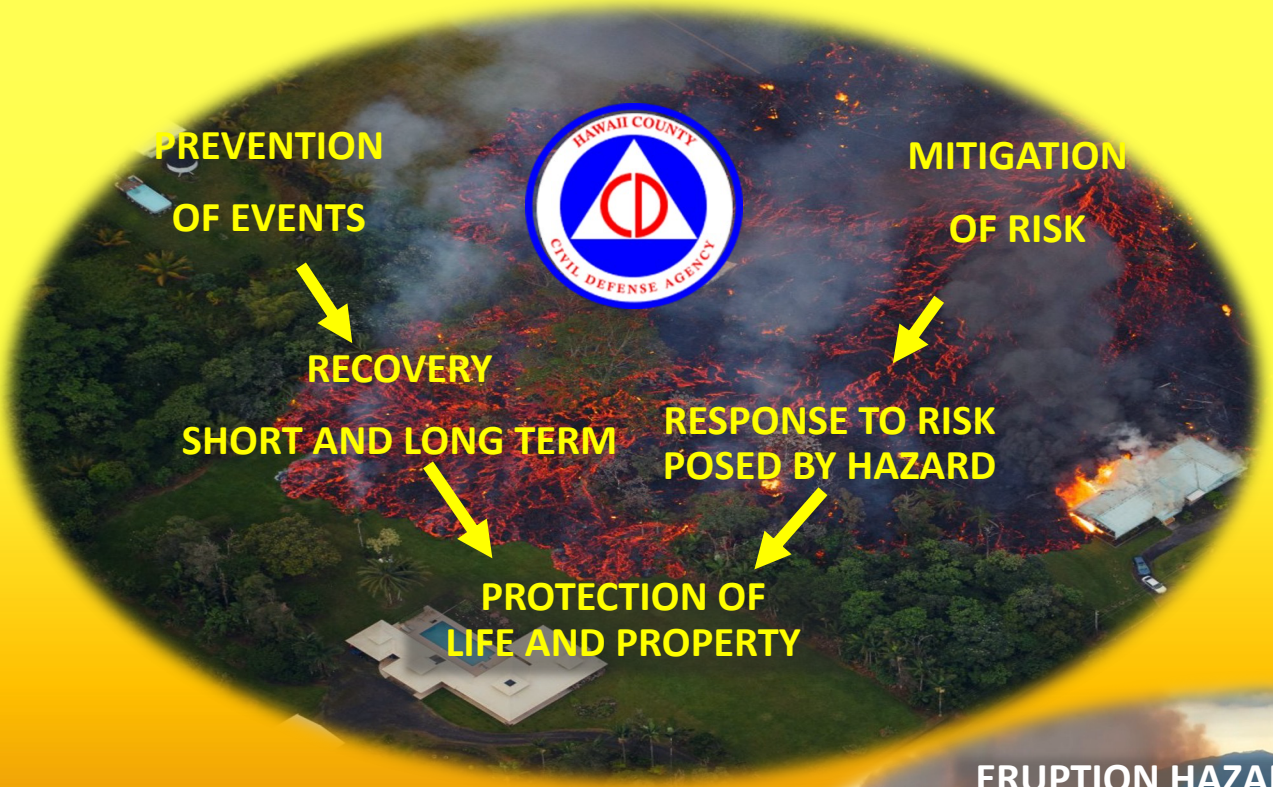
Eruption modeling and sustainability

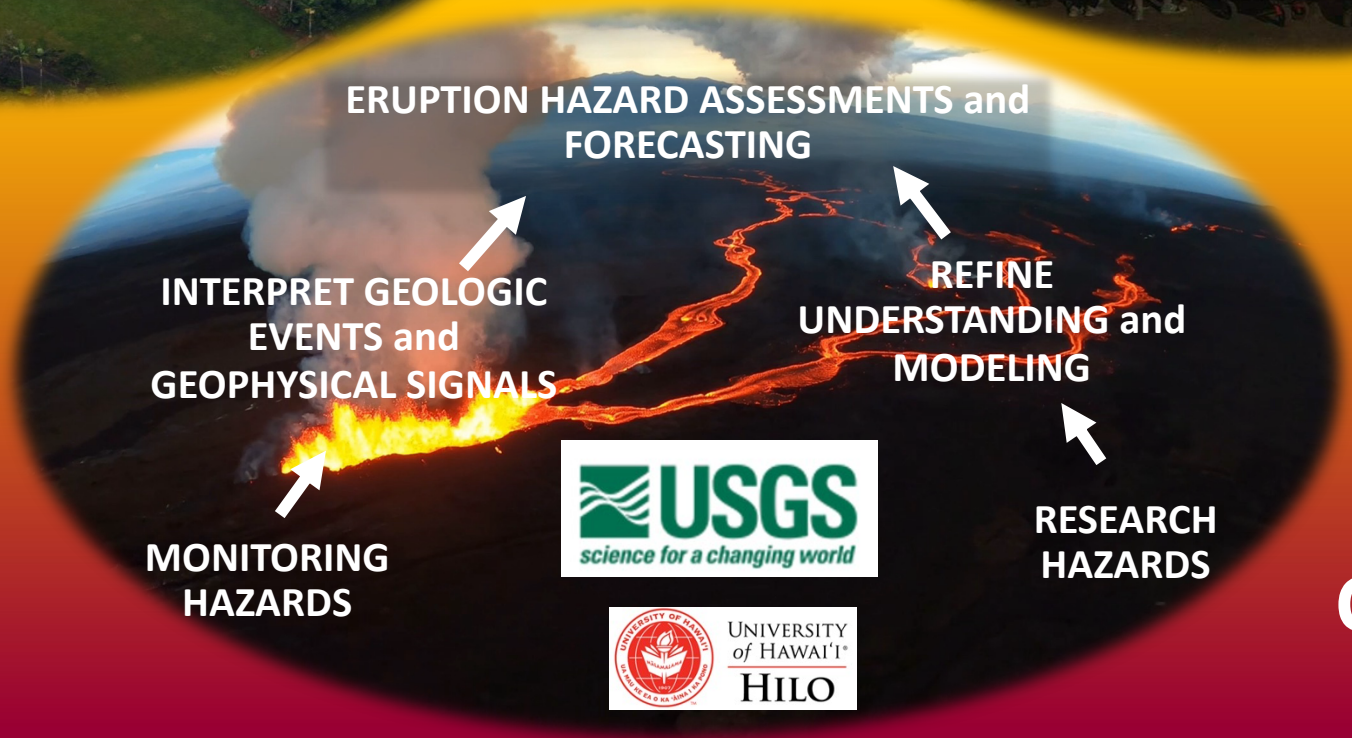
HIGH-RESOLUTION TRACKING OF SO_2 DEGASSING BEHAVIOR (AND ASSOCIATED ERUPTIVE PHENOMENA) VIA SPECTROMETER ARRAY AND UV CAMERA

- Earlier iterations of spectrometer array and UV camera became outdated in 2018; both have been revitalized in recent years via collaborations with CVO and the University of Sheffield (UK). Data from the ongoing eruption has yielded high-quality SO_2 emission rate data that demonstrates, along with seismicity, the persistence of gas pistoning behavior between eruptive episodes









3 Main Agencies

Civil Defense
National Park Service
USGS-HVO

Understanding Missions, Relationships and Communication

Island of Hawai'i Volcanic and Seismic Hazards

(population 200,000 + 20,000 visitors)

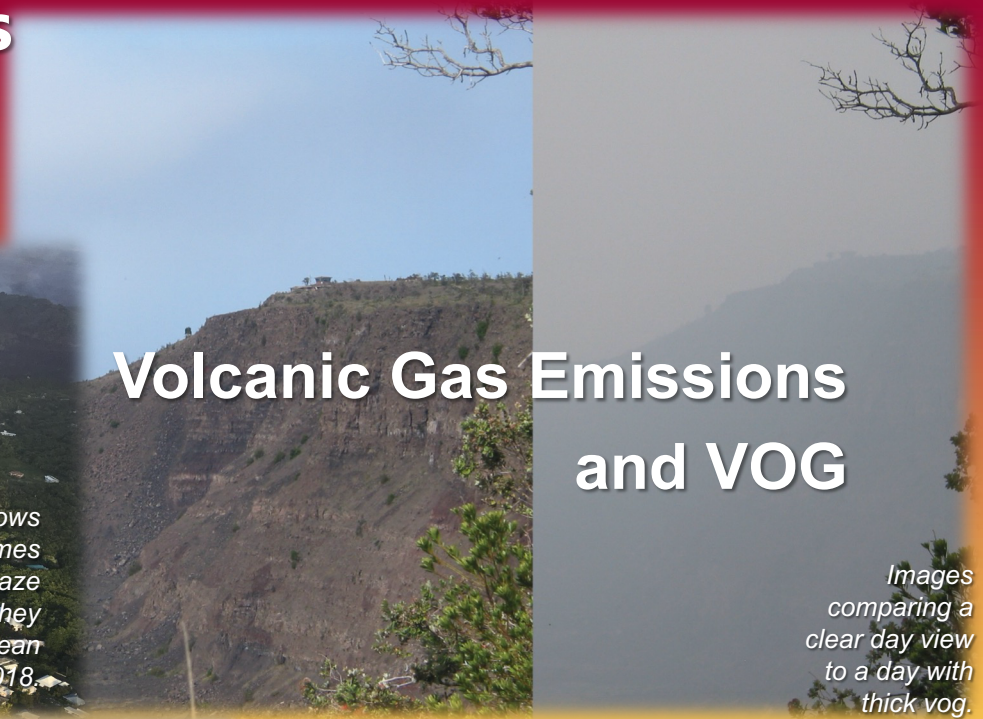
Large damaging events 1868, 1924, 1950, 1960, 1975, 1990, 2006, 2018

Damaging Earthquakes

Damage from the M6.7 Kīholo Bay earthquake in 2006.

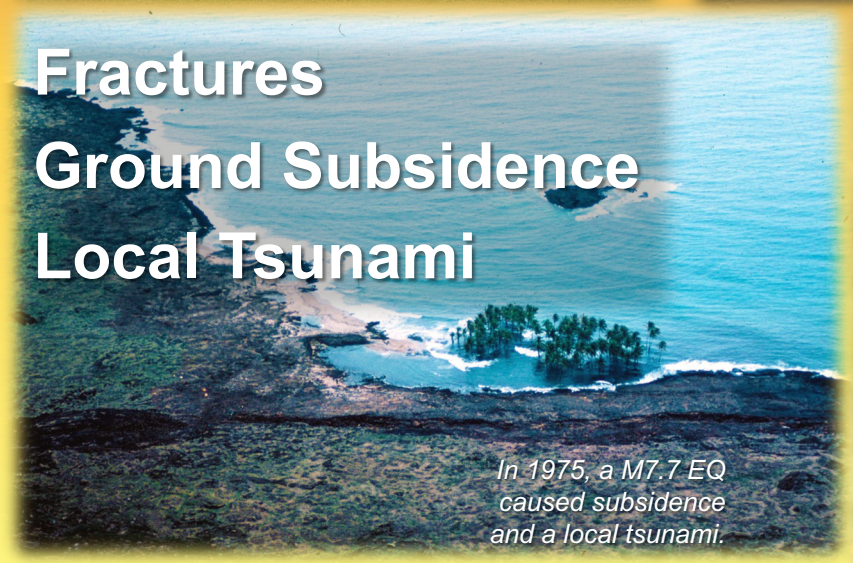
Ocean Entries

Kīlauea lava flows destroy homes and create a laze plume as they enter the ocean during 2018.



Volcanic Gas Emissions and VOG

Images comparing a clear day view to a day with thick vog.



Fractures
Ground Subsidence
Local Tsunami

In 1975, a M7.7 EQ caused subsidence and a local tsunami.

Lava Flows

Kīlauea's Explosive History

Kīlauea explosive eruptions in 1924 expelled large blocks in the summit region.

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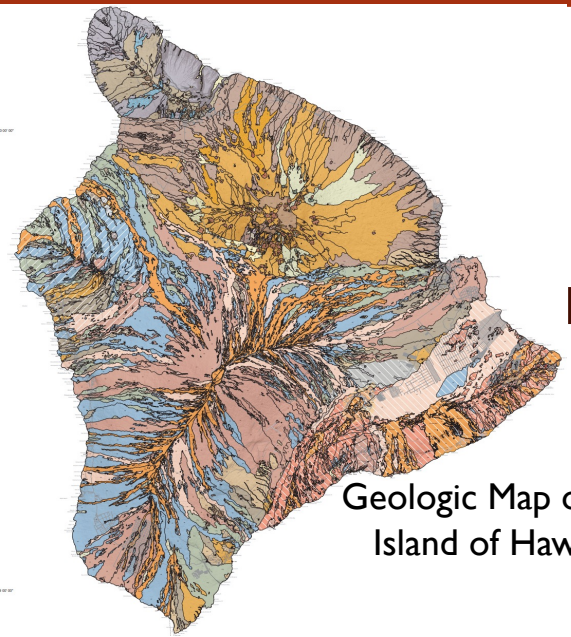
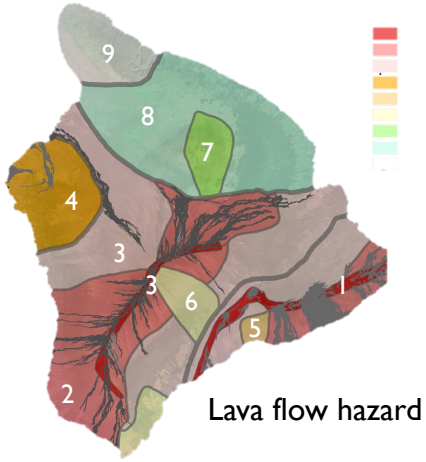
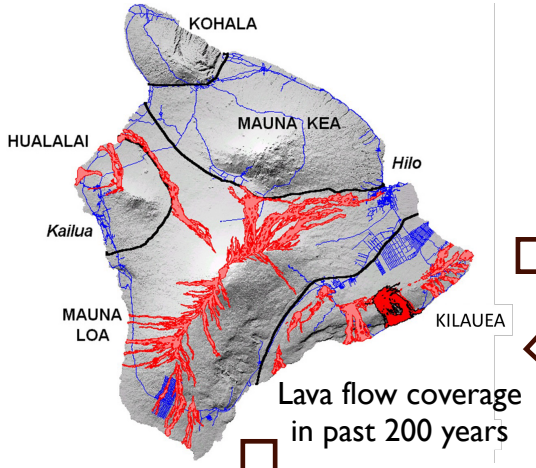
LAVA FLOW HAZARDS—GEOLOGIC MAPS AND DERIVATIVE PRODUCTS



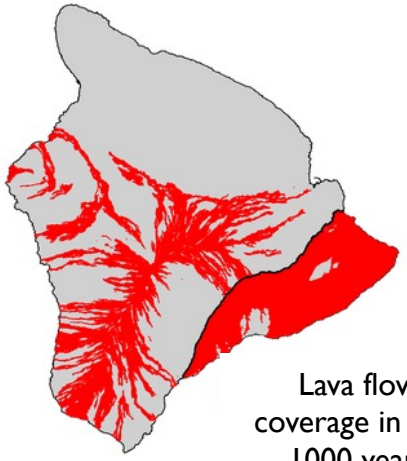
Geologic Map of the Island of Hawai'i



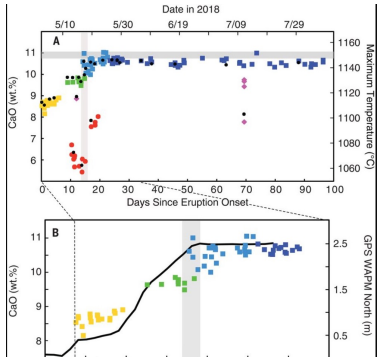
Lava flow hazard map



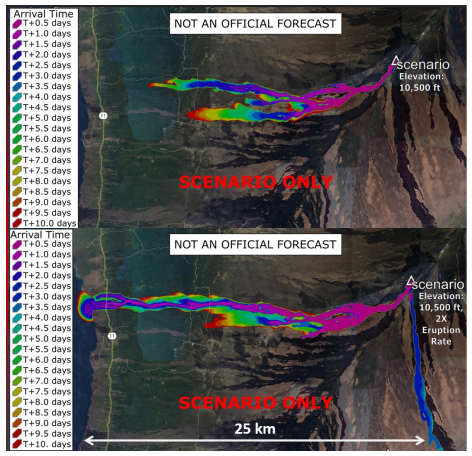
Lava flow coverage in past 200 years



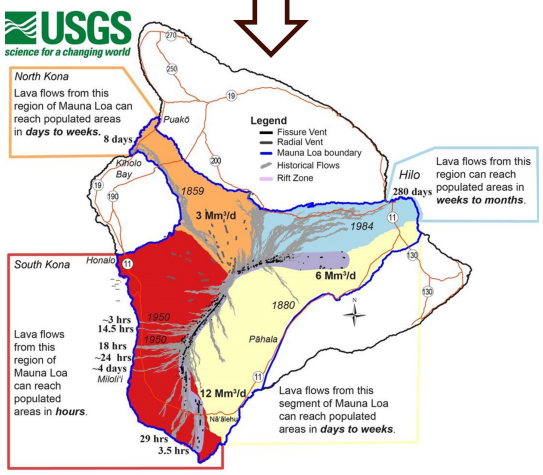
Lava flow coverage in past 1000 years



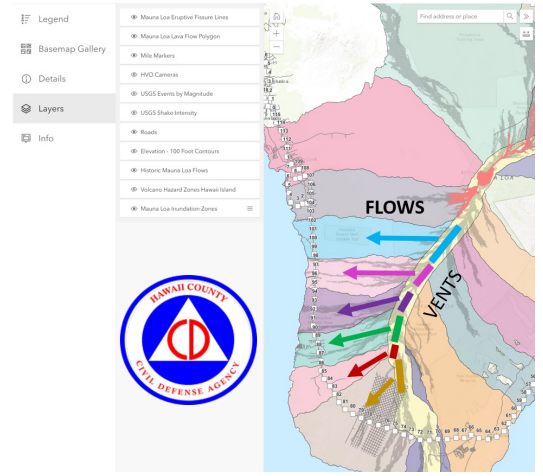
Near realtime chemistry and temperature



Lava flow modeling in near realtime



Lava flow arrival times



Interactive lava flow innundation map

USGS-HVO
science for a changing world

PARTNERS

- A) University of Hawai‘i supplies staff associates, students, and equipment under a USGS Cooperative Agreement.
- B) The primary interagency partners are Hawai‘i Volcanoes National Park and Hawaii County Civil Defense Agency.
- C) The Advanced National Seismic System (ANSS), National Earthquake Information Center (NEIC) and Pacific Tsunami Warning Center (PTWC) partner with HVO to provide accurate earthquake locations and assist with local tsunami warnings.
- D) Other partners include state agencies such as Hawai’i Emergency Management Agency (HIEMA), FAA, NWS, Dept of Land and Natural Resources (DLNR) and FEMA.

ANSS Advanced National Seismic System

USGS-NEIC
National Earthquake Information Center

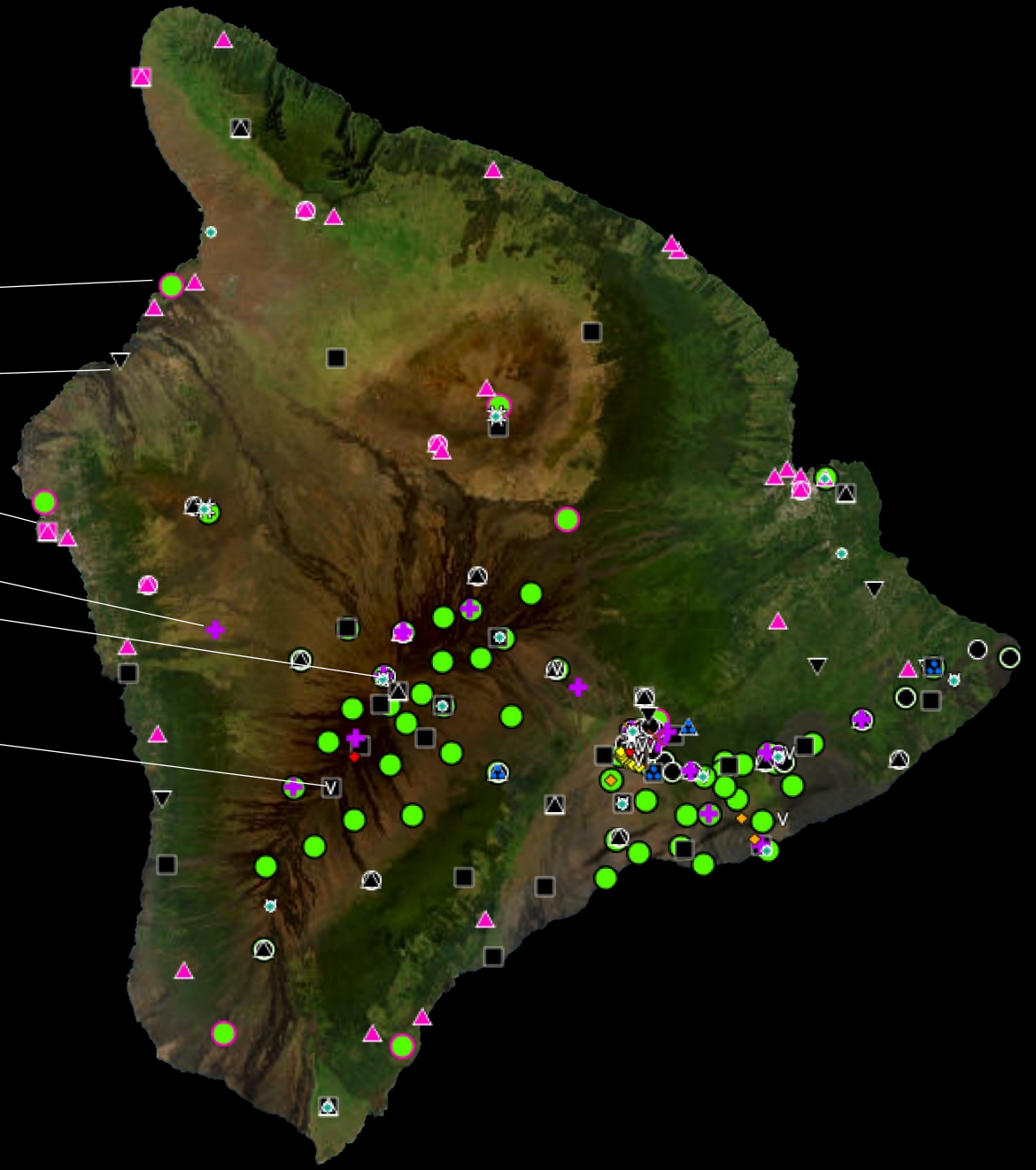
Pacific Tsunami Warning Center

Island of Hawai‘i Monitoring

Large, interconnected dense telemetry network

- GPS (green)
- Seismic (black and pink)
- Tilt (purple crosses)
- Gas (diamonds)
- Gravimeters
- Webcams (Vs)
- Laser Rangefinder
- Infrasound

Instruments are sometimes co-located.



USGS
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USGS
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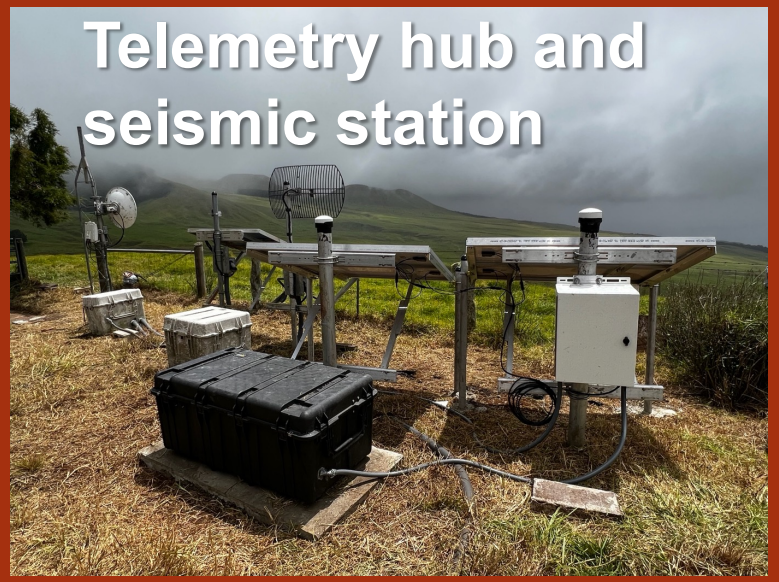
Monitoring Stations

Challenges in operating such a large telemetry network, developed unique designs required, new designs to accomodate failovers.

- GPS
- Seismic
- Tilt
- Gas
- Gravimeters
- Webcams
- Laser Rangefinder
- Infrasound

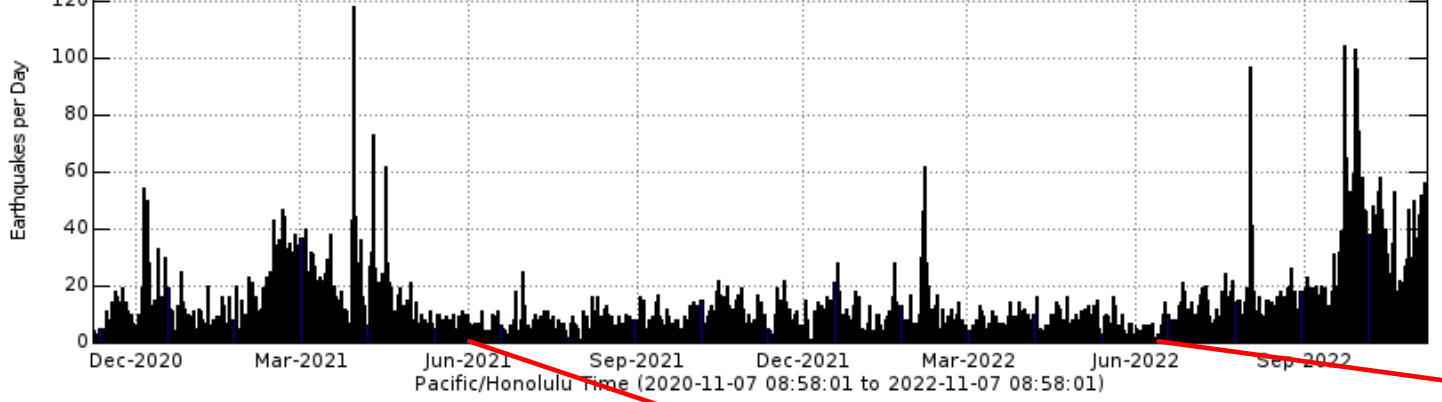


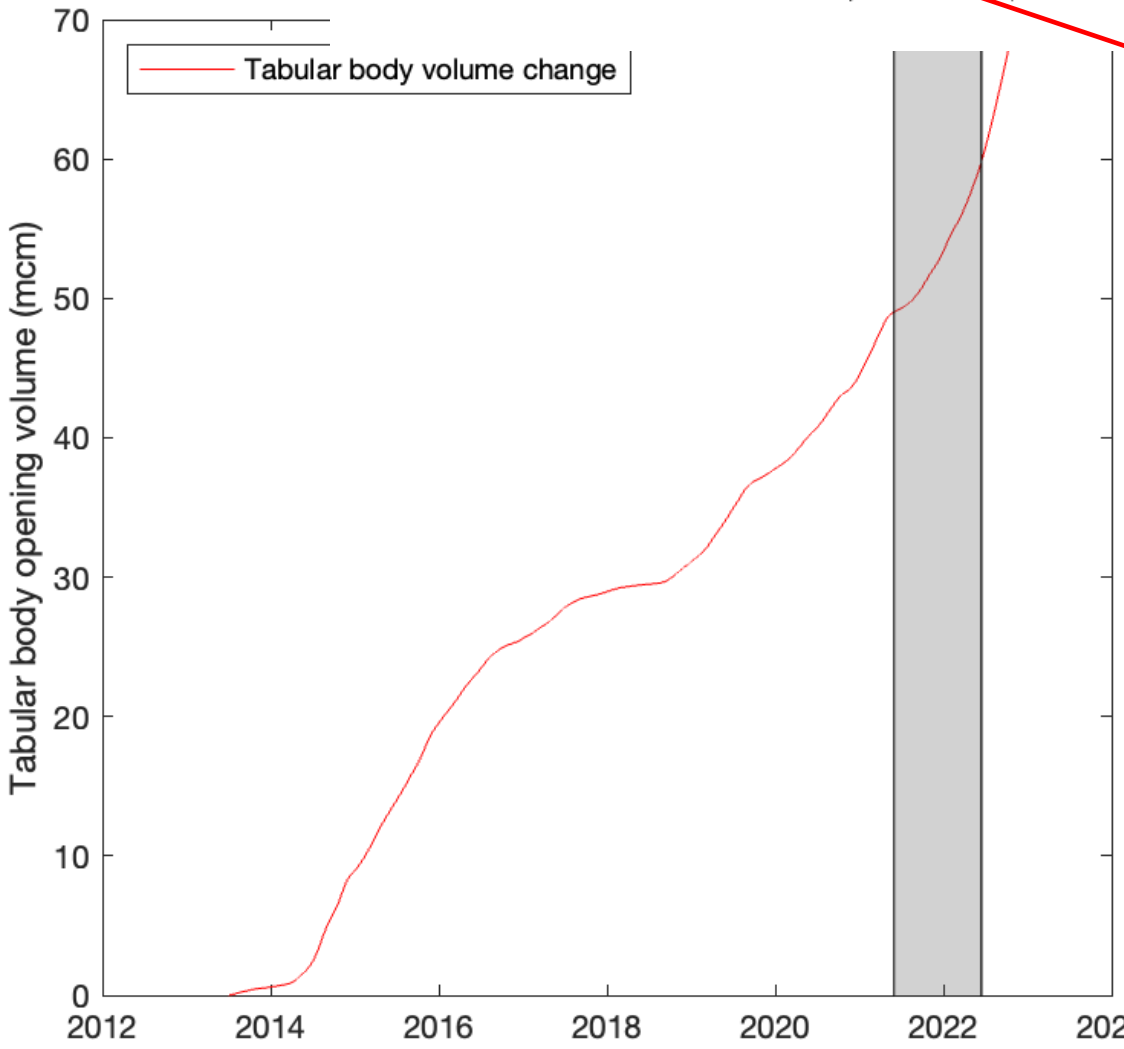
Instruments are sometimes co-located.

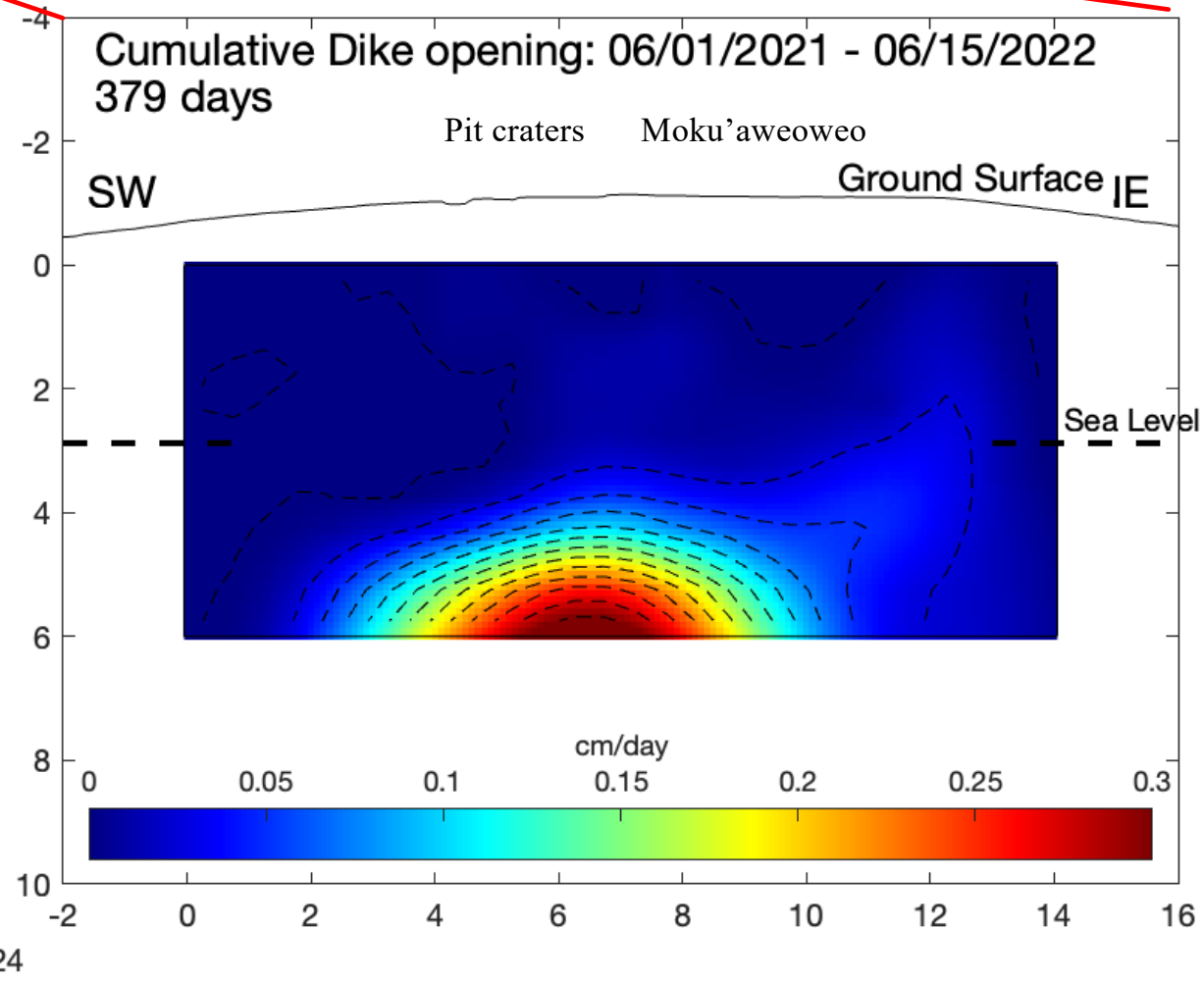
ONGOING PROJECTS AND ACCOMPLISHMENTS

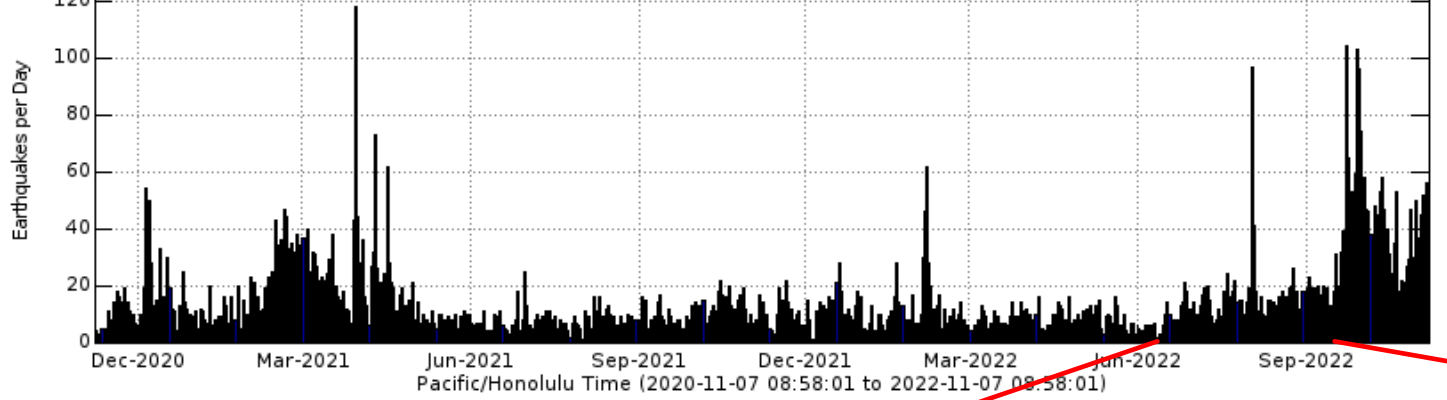
- Seismic Reflection and Refraction Imaging of Kīlauea summit along with nodal studies of Kīlauea's East Rift and Mauna Loa.
- New monitoring network in American Samoa
  - Installed 4 seismometers and 2 GNSS stations to monitor seismic crisis in August-September of 2022
- Upgraded many of our digital instruments and data radios
- Joined First Net, which allows cellular data transmission over a much larger area than comparable commercial service. Also allows for transmission of up to 1 Terabyte of data per month.
- Special Issue of Bulletin of Volcanology on the 2022 eruption of Mauna Loa is being published. Chapman Conference of summit collapses of shield volcanoes and their significance.
- Used Facebook live to stream interactive community meetings in both American Samoa and in Hawai'i during the Mauna Loa eruption

Streaming Webcam Mauna Loa 2022


Earthquakes per Day
0
20
40
60
80
100
120
Dec-2020
Mar-2021
Jun-2021
Sep-2021
Dec-2021
Mar-2022
Jun-2022
Sep-2022
Pacific/Honolulu Time (2020-11-07 08:58:01 to 2022-11-07 08:58:01)


Tabular body volume change
Tabular body opening volume (mcm)
0
10
20
30
40
50
60
70
2012
2014
2016
2018
2020
2022
2024


Cumulative Dike opening: 06/01/2021 - 06/15/2022
379 days
Pit craters
Moku'aweoweo
SW
Ground Surface
NE
Sea Level
cm/day
0
0.05
0.1
0.15
0.2
0.25
0.3
-4
-2
0
2
4
6
8
10
-2
0
2
4
6
8
10
12
14
16


Earthquakes per Day
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Mar-2021
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Sep-2021
Dec-2021
Mar-2022
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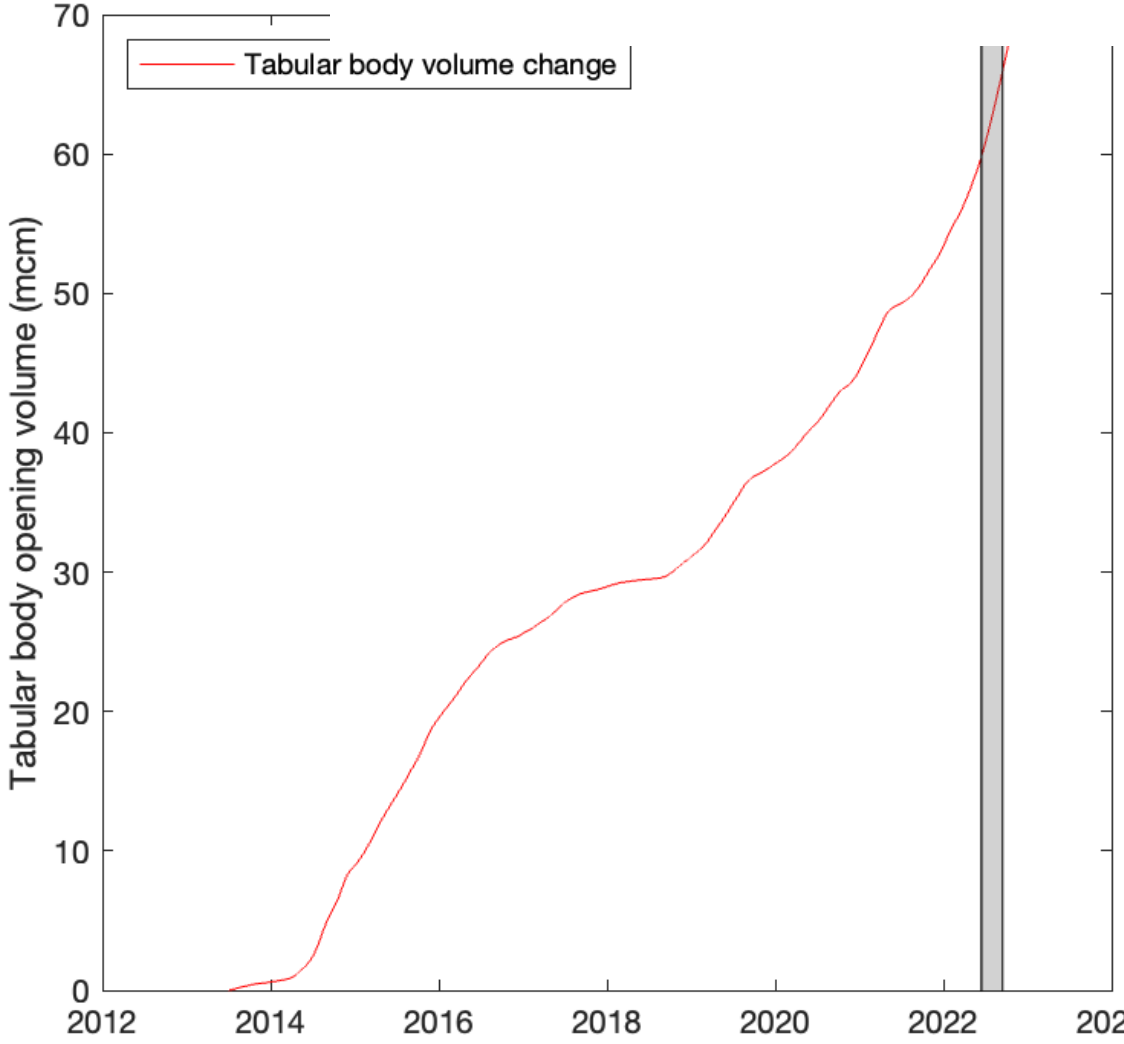
Pacific/Honolulu Time (2020-11-07 08:58:01 to 2022-11-07 08:58:01)


Tabular body volume change
Tabular body opening volume (mcm)
0
10
20
30
40
50
60
70
2012
2014
2016
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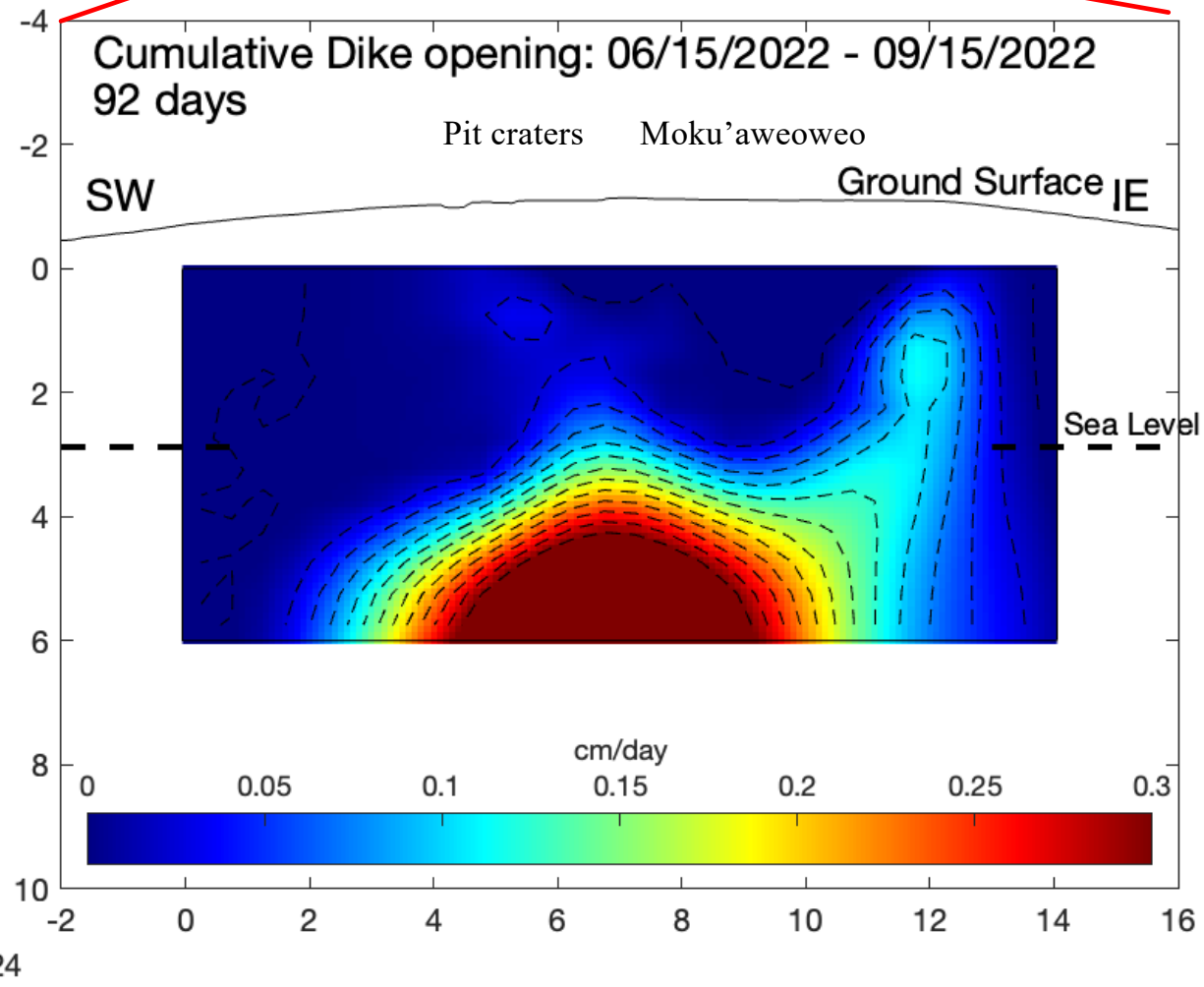
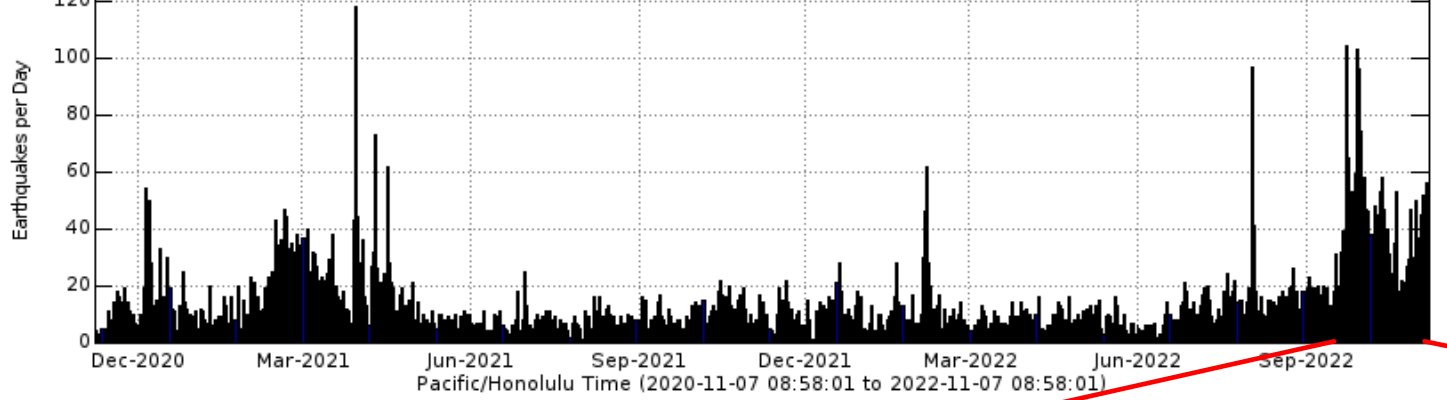
2020
2022
2024


Cumulative Dike opening: 06/15/2022 - 09/15/2022
92 days
Pit craters
Moku'aweoweo
SW
Ground Surface
NE
Sea Level
cm/day
0
0.05
0.1
0.15
0.2
0.25
0.3
-4
-2
0
2
4
6
8
10
-2
0
2
4
6
8
10
12
14
16


Earthquakes per Day
0
20
40
60
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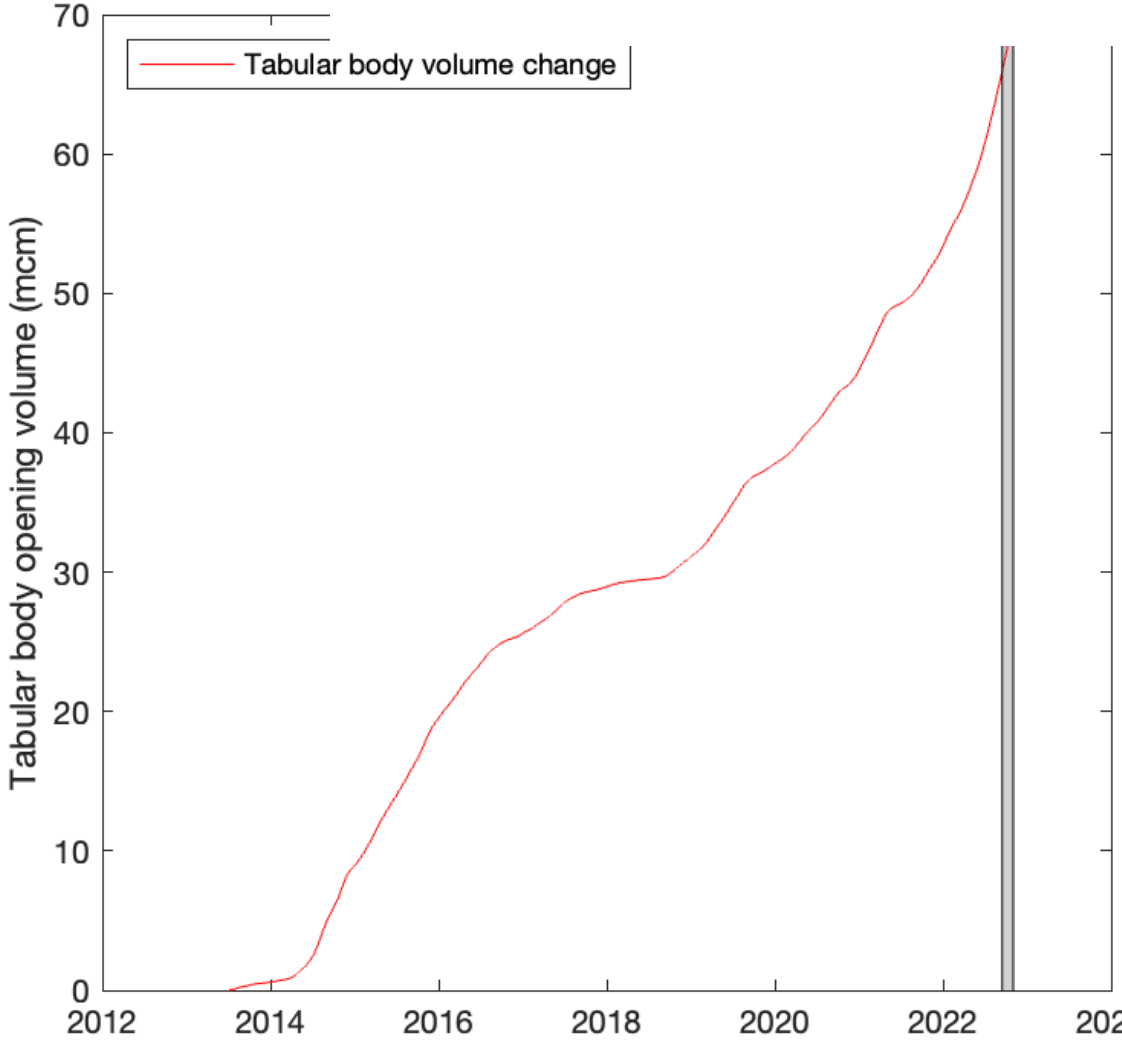
Dec-2020
Mar-2021
Jun-2021
Sep-2021
Dec-2021
Mar-2022
Jun-2022
Sep-2022
Pacific/Honolulu Time (2020-11-07 08:58:01 to 2022-11-07 08:58:01)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Tabular body opening volume (mcm)
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10
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40
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2012
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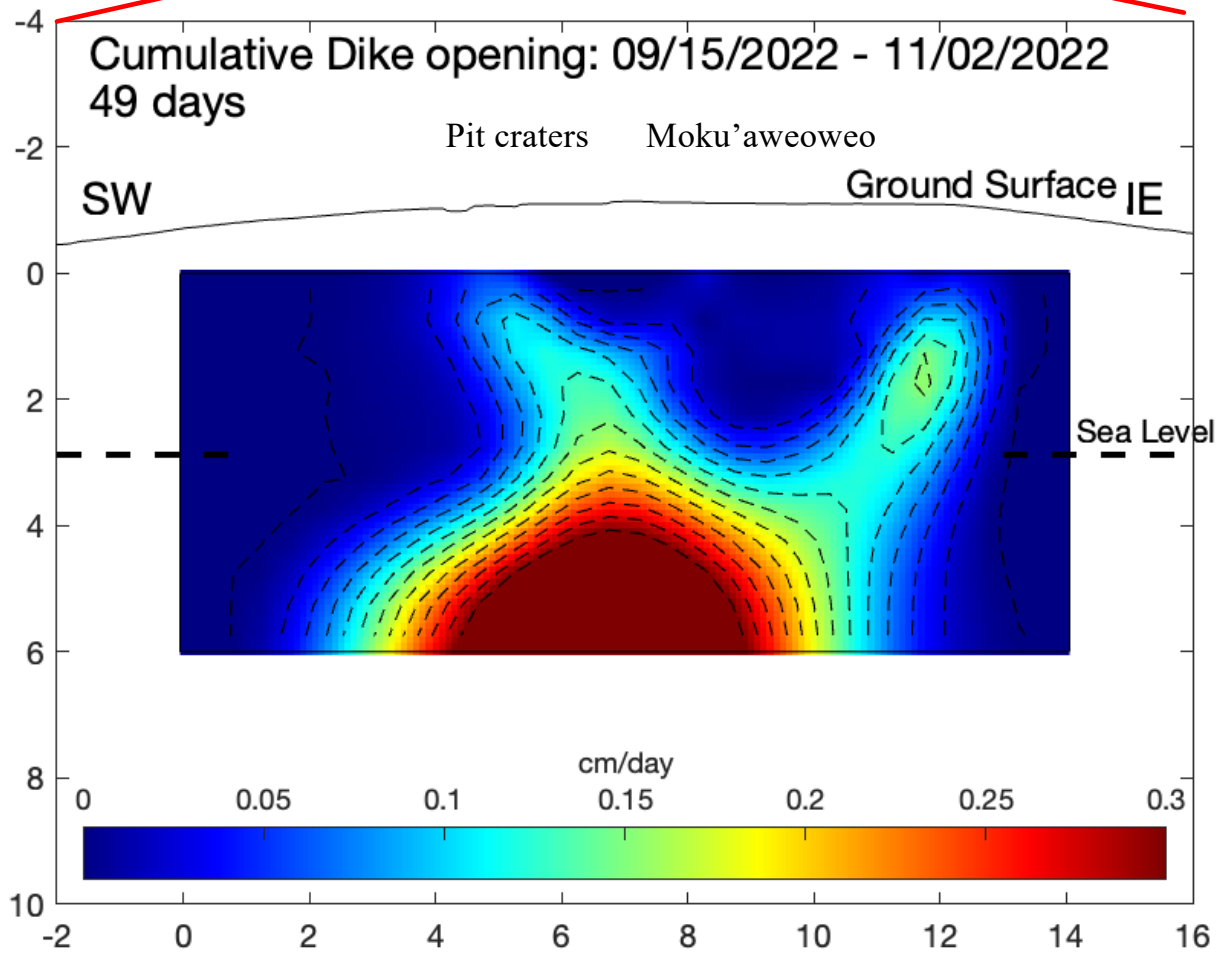
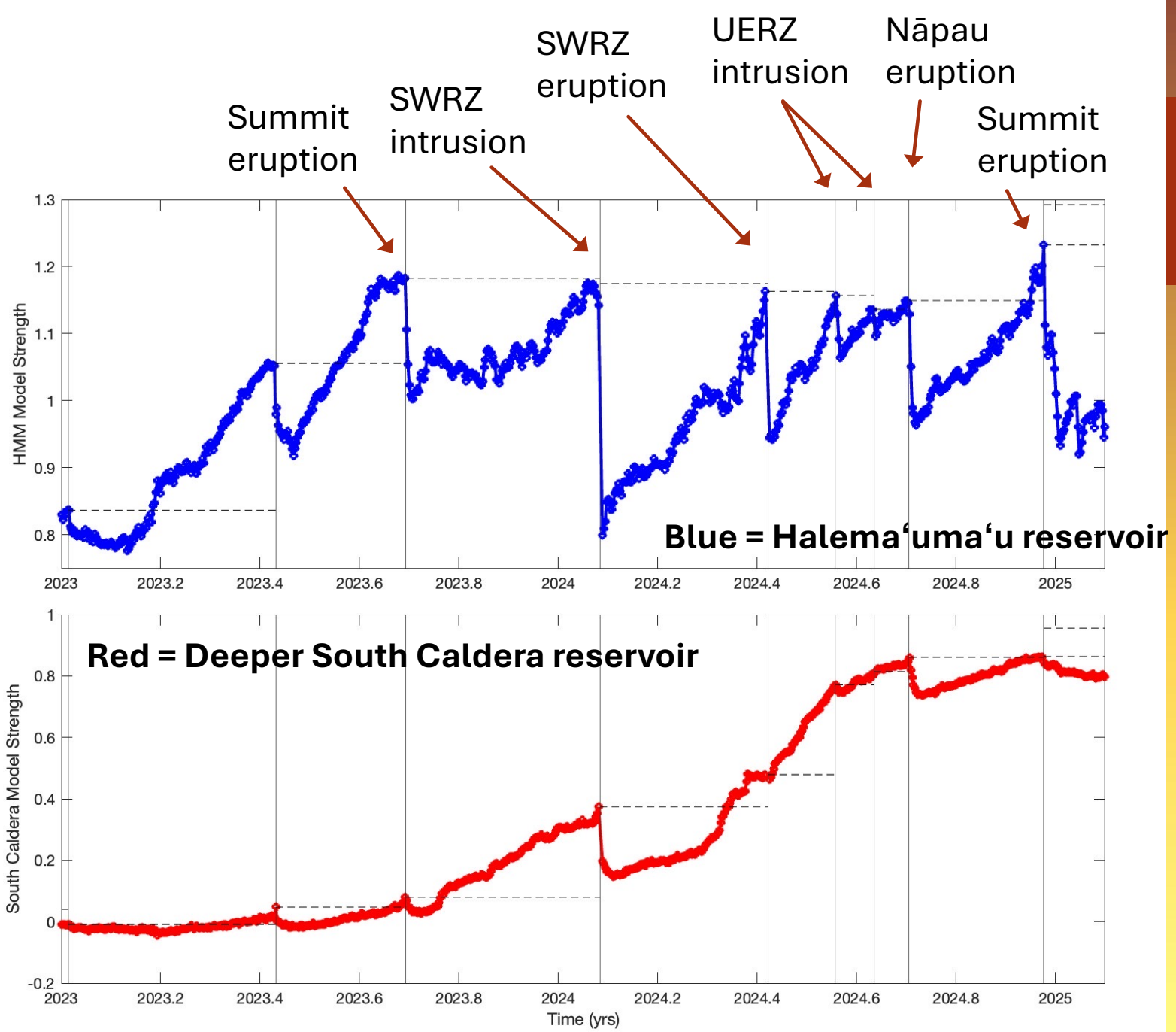
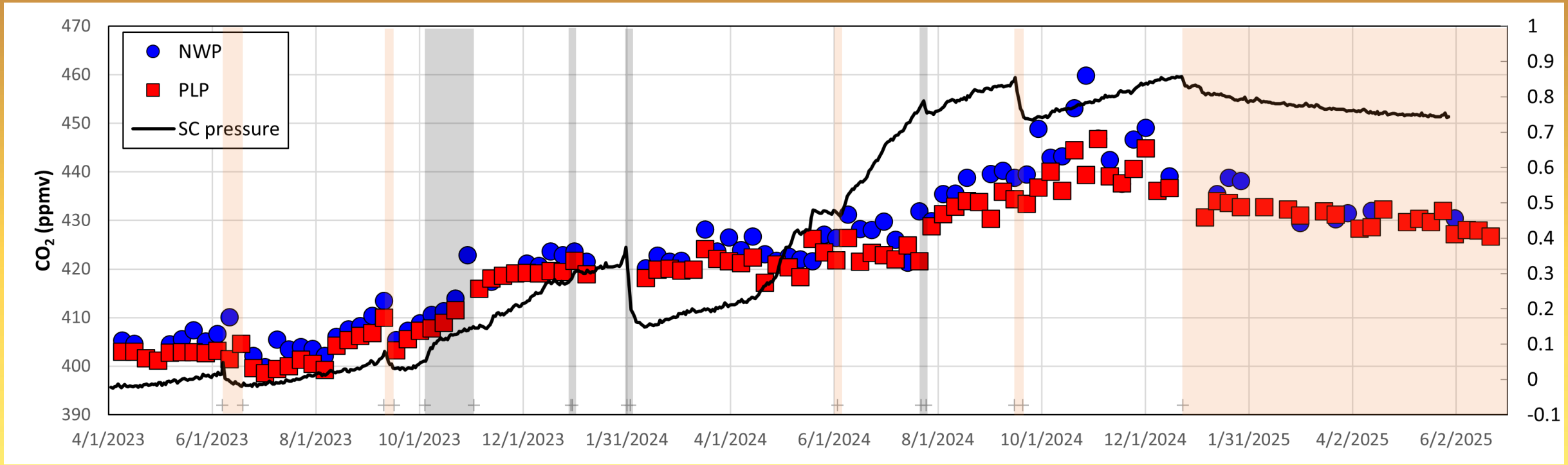
2024


Cumulative Dike opening: 09/15/2022 - 11/02/2022
49 days
Pit craters
Moku'aweoweo
SW
Ground Surface
NE
Sea Level
cm/day
0
0.05
0.1
0.15
0.2
0.25
0.3
-4
-2
0
2
4
6
8
10
-2
0
2
4
6
8
10
12
14
16



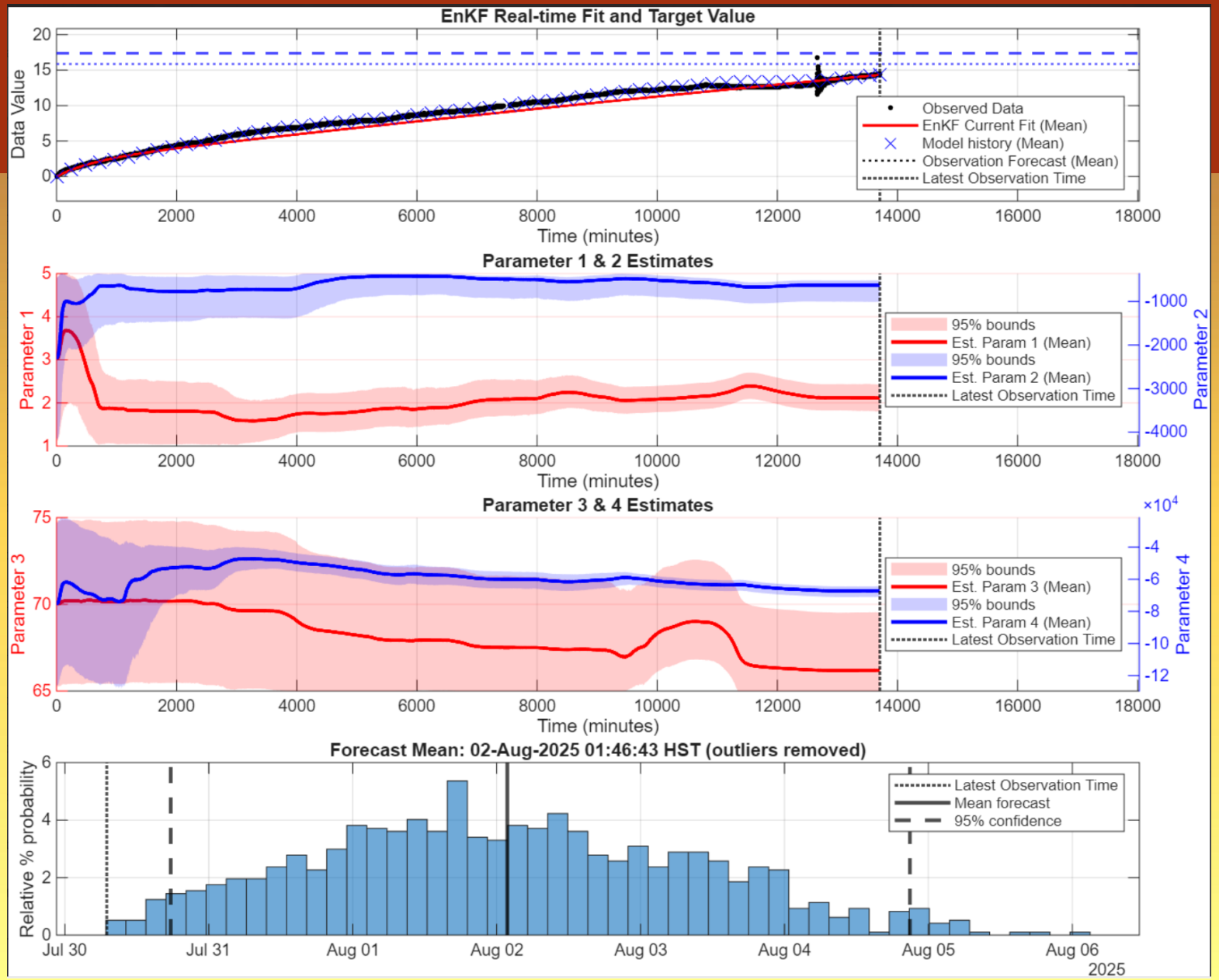
- **Consistent pressure level is associated with events through out the near-summit region (blue)**
- **Resupply of deep system in 2024, this is driving the current eruption (Red).**

TRACKING DEEP MAGMA INFLUX AT KĪLAUEA VIA NEW METHOD OF LONG-TERM, DIRECTIONAL MONITORING OF AMBIENT CO_2 CONCENTRATIONS



- After 2018 caldera collapse precluded traditional means of measuring CO_2 emission rate, this new concentration monitoring developed in collaboration with CVO has revealed linkages between CO_2 and eruptive/intrusive behavior, as well as modeled magma chamber pressure

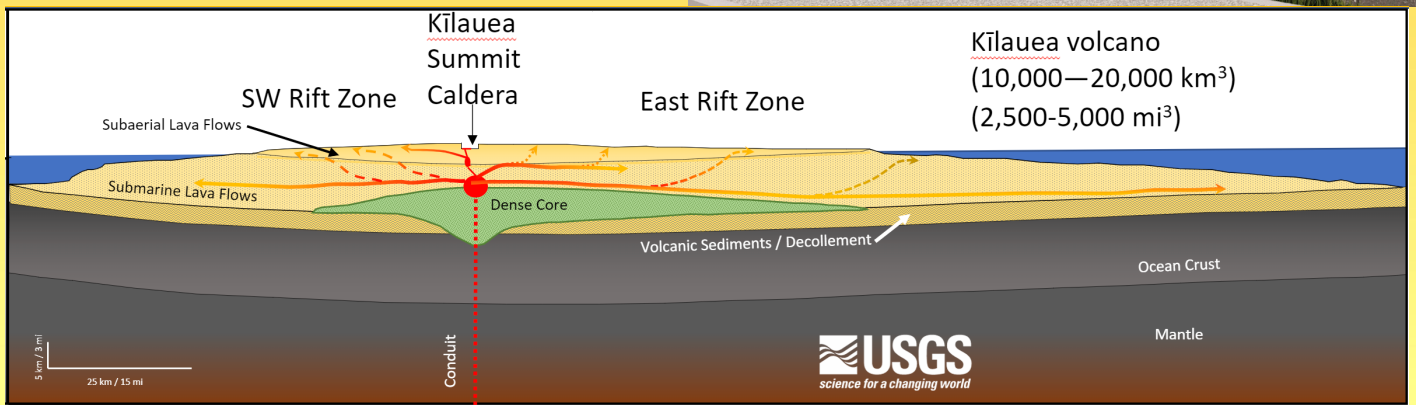
SHORT TERM FORECASTING OF CURRENT EPISODIC ERUPTION



CHALLENGES / QUESTIONS

- Challenge: Fill positions at HVO, develop a modern budget. Decide what size network we can afford to operate? Build smarter rather than more?
- Challenge: Instrumentation of populated regions of Kīlauea and Mauna Loa, vandalism and instrument noise are huge problems.
- Duty Scientists 24/7—Current "pseudo 24/7" monitoring burns out staff during seismic crises. Any implementation of a 24/7 should place personnel across volcano observatories

- Big Science and Hazard Question: What are the triggers to change Kīlauea from effusive to explosive behavior? Can we anticipate a major offshore event that drains the summit reservoir? Or an on shore event on Mauna Loa that covers much of Hilo in lava?



CASCADES VOLCANO OBSERVATORY

JON MAJOR, SIC

NVEWS AC MTG, JULY 2025

USGS
science for a changing world

WHO WE ARE

- Over 80 people!*
  - Geologists
  - Geophysicists
  - Hydrologists
  - Geochemists
  - Social Scientist
  - Field Engineering / Instrumentation Specialists
  - IT / Electronics
  - Modelers / Mathematician
  - Communications / Outreach
  - Safety Officer / Admin

*Includes VDAP, YVO, postdoctoral associates, other programs, interns

Mission: provide volcano hazards assessments, detect unrest, give timely warnings about volcanic activity, and work with stakeholders to ensure that communities are "volcano ready."

STAFF

- **Staff composition**
  - 1 Scientist-in-Charge
  - 1 VHP APC
  - 14 CVO RGE (excludes VDAP, VEP, YVO)
  - 22 CVO non-RGE (includes monitoring, outreach, IT, lab, hydro)
  - 14 VDAP team
  - 3 YVO team
  - 4 Volcano Emission Project (VEP) team
  - 6 VSC admin team
  - 2 VSC Associate Directors (IT and NVEWS)
  - 1 VSC web guru
  - 1 VSC safety officer
  - 3 Mendenhall postdocs; 1 NSF postdoc
  - 7 interns (VDAP IT, Geodesy IT; CVO Geology)
  - 6 non-VSC scientists (ESC, WMA, GMEG, PNSN)
  - 14 Emeriti/Volunteers (8 regular, 6 intermittent or mostly remote)
  - **Coming soon**: 1 APC, 1 volunteer intern; 1-2 relocation; 1 NSF intern

CVO—the physical facility

CVO has onsite and offsite warehouse facilities (at Fort Vancouver National Park); VEP lab, Petrology lab, 2 Electronics labs, National sediment lab (with SEM, laser diffraction, particle-size analyzer, robotic arm); rock saw room; rotap/drying oven room

Facility staff numbers may grow over next 5+ years even with retirements—facing increasing space crunch. ***CVO has been removed from GSA lease-termination list.***

Staffing concerns:

Looming retirements (0.5-5 years) 5 staff (3 RGE; 2 non RGE)

Loss of disciplinary capabilities

Staffing challenges to keep up with network O&M, IT services, data curation and analysis (keeping it all running in the field and in the observatory)

PROJECT UPDATES

- **CVO Project Highlights**

Rainier LDS

- Will complete physical buildout summer 2025
- Have signed MOU with Pierce County re: operational protocols of RLDS (working on MOU with WA EMD)
- Ongoing algorithm development
- TTX for Rainier unrest planned for spring 2026

Mount Adams

- 1 perm station installed; 1–2 install planned 2025; 1–2 in 2026

Mount Hood

- Seismic and infrasound install planned 2025

Mount St. Helens

- Infrasound site, 1 site relocation, site upgrade planned 2025
- Spirit Lake breach modeling report awaiting BAO approval

Crater Lake

- 2 new site install planned 2025 (permission pending)
- Site relocation due to NPS construction

Newberry Volcano

- Installed new seismic monitoring site in 2025

Mount Baker

- Lahar hazard modeling report published
- Additional lahar and ashfall modeling completed
- Network site scoping in progress; permit app planned for 2026

Glacier Peak

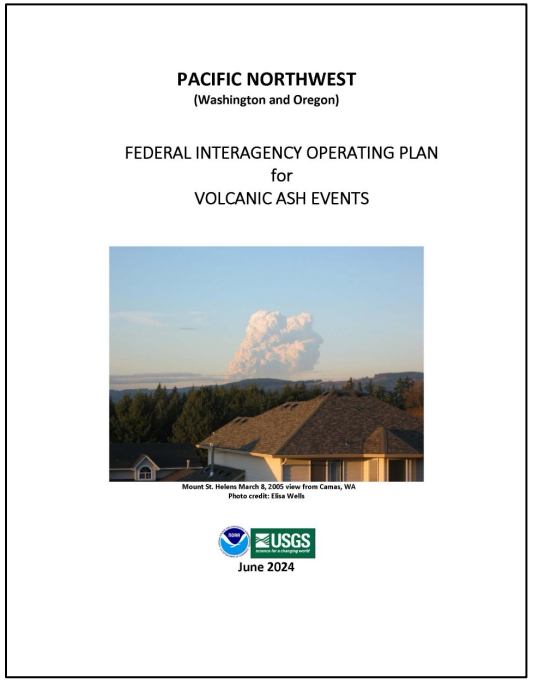
- PNSN upgraded site in 2024; USGS to install sites in 2026 or 2027; permit amendment under discussion

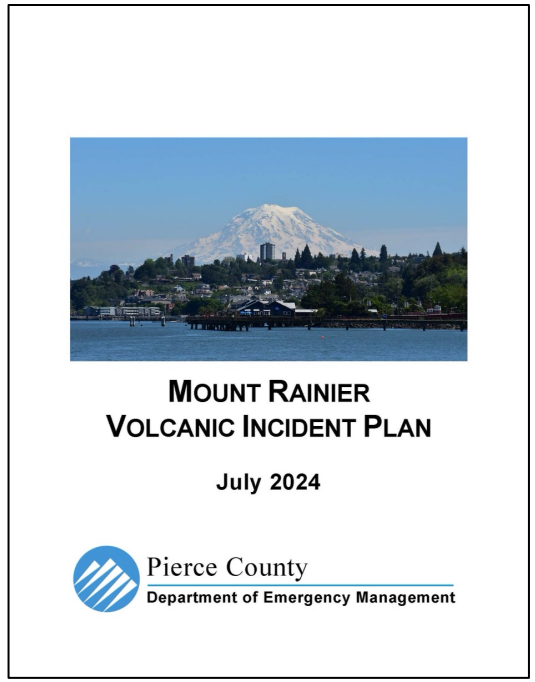
Overall monitoring network

More than 100 (and growing) monitoring stations on the landscape

PROJECT UPDATES CONTINUED

- **CVO Project Highlights**
- **Outreach**
  - Conducted in-house ICS training
  - Workshops on communications
  - Re-engaged Mount Hood volcano working group; goal to update Mount Hood Coordination/Response plan
  - Updated PNW ash event plan with NWS
  - Worked with Pierce County partner agencies to update Mount Rainier volcanic incident plan
  - Lots of public community engagement
  - Participated in Puyallup schools' lahar evacuation drill

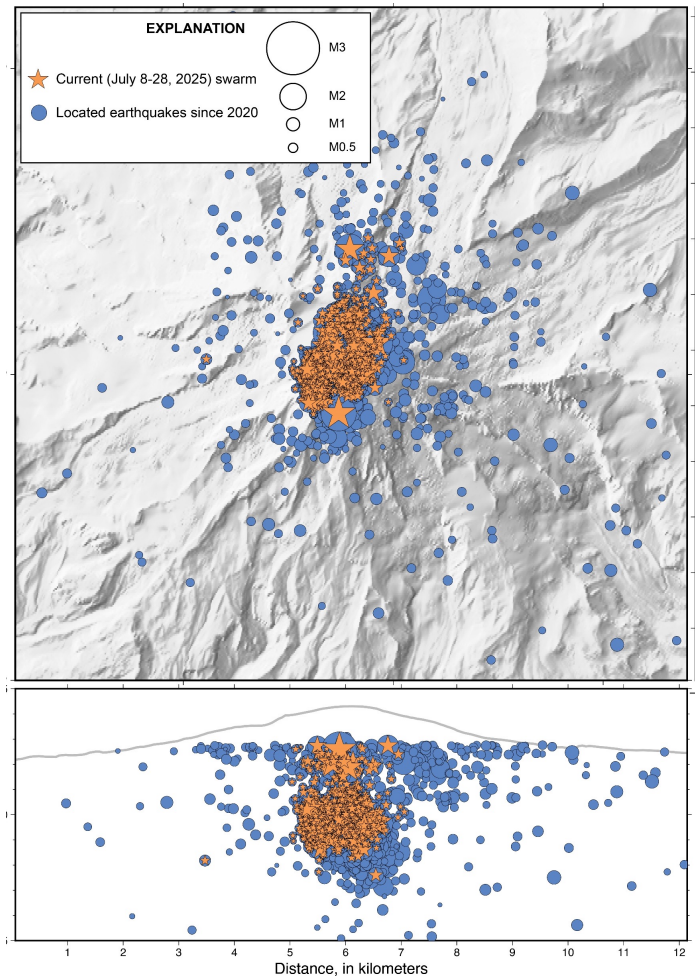




PROJECT UPDATES CONTINUED

- **Cooperative agreements**
  - **UW** – Continued O&M of PNSN sites at Cascades volcanoes (includes detecting and locating), upgrading instrumentation, maintaining continuous data flow, data analysis, and ensuring data archiving. Installed new strong-motion broadband seismic station at Mount Baker. Upgraded site at Glacier Peak in summer 2024.
  - **UO** – Funds facilitate temporary seismic node deployments at Mount Rainier, Mount St. Helens, and USGS flume and fund faculty and graduate students to do data analysis, develop methodologies for creating synthetic lahar seismograms, and conduct multi-phase flow modeling

JULY 2025 – MOUNT RAINIER EARTHQUAKE SWARM

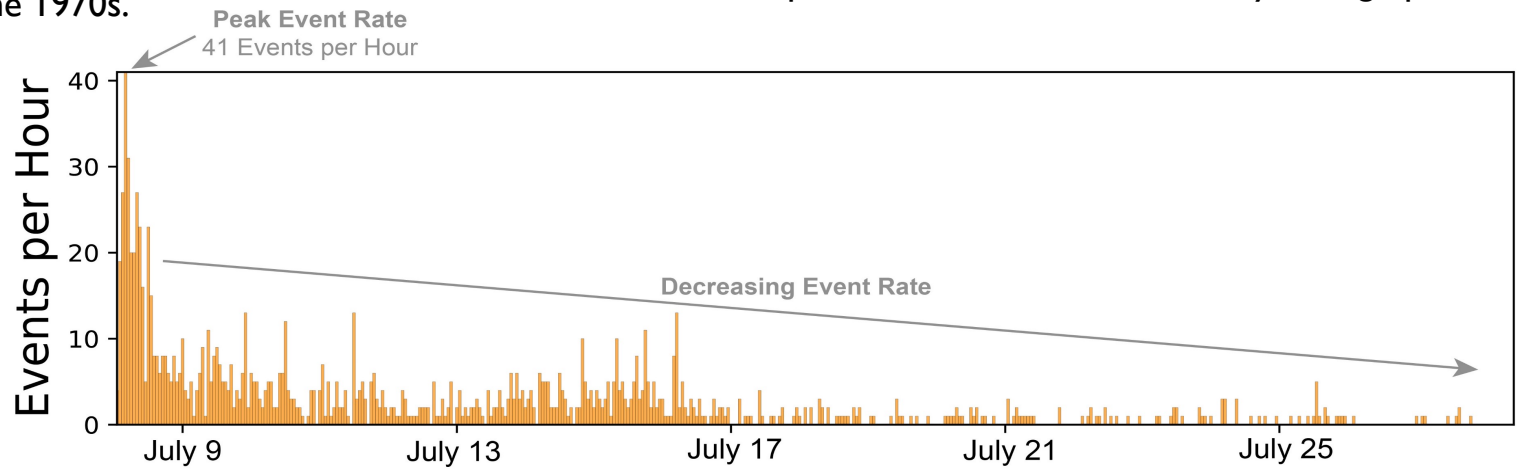


An earthquake swarm began at Mount Rainier around 1:30am PST on July 8th. The swarm successfully triggered alarms designed by seismologists and computer scientists at CVO, which alerted the duty seismologists to begin monitoring the swarm.

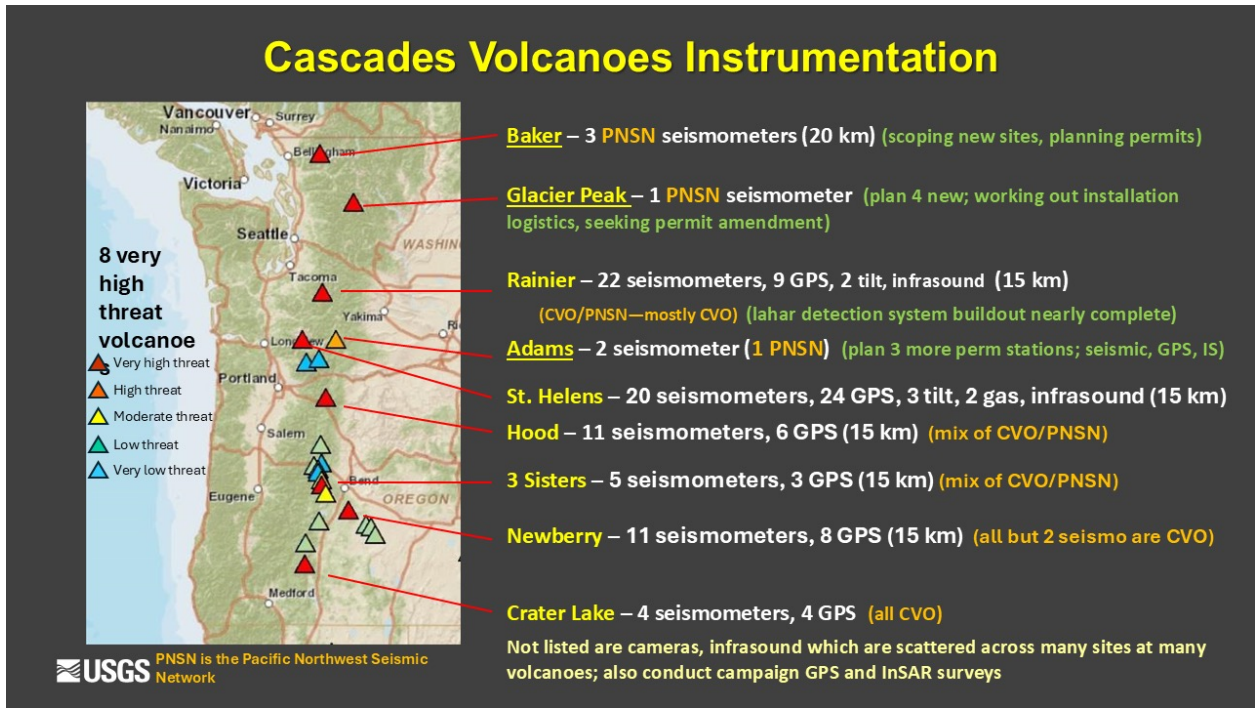
To date – the swarm has produced over 1000 locatable earthquakes and continues at low levels. This is the largest recorded swarm at Mount Rainier since seismic monitoring began in the 1970s.

CVO Response

- Duty seismologists activated the call-down tree.
- CVO team held a call with key partners and issued an information statement.
- Held five daily update partner meetings with 50–80 attendees each.
- Worked daily with PNSN, WA EMD, and NPS partners.
- Issued 1 info statement, 6 status updates, and 2 weekly updates.
- Updated CVO news website daily with graphics.



CHALLENGES



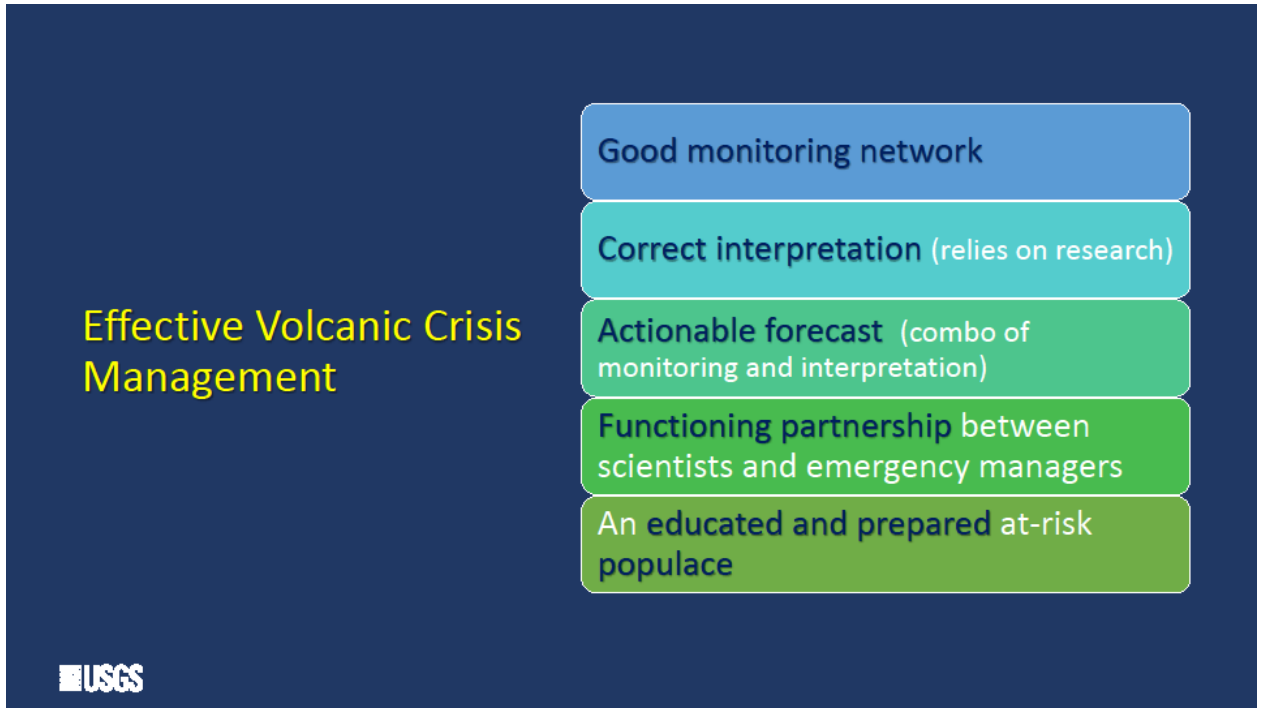
- Biggest challenge is….political and fiscal uncertainty
- Landuse agreements with landowners
- Monitoring O&M becoming more challenging the more instruments we put out – especially in remote areas (installs in very remote areas also challenging)
- Maintaining our cutting-edge research capabilities (in light of looming retirements)
- Poorly suited to monitor distributed volcanic fields
- With infrequent eruptions, keeping communities volcano ready
- Wildifres…helicopter availability, site vulnerability, air quality (staff health concerns)
- Data ingestion, data serving, data analysis

OPPORTUNITIES

- Opportunity for greater tribal engagement (limited engagement with Cowlitz, Yakama, Lumi, Nooksack, other tribal Nations)

- Opportunity through strategic hiring to set up the observatory for the next generation to continue cutting-edge research, monitoring and outreach
- Opportunity to tackle new disciplinary challenges (e.g., distributed volcanism; AI/Maching Learning)
- Opportunity to explore and foster closer collaborations with other programs (e.g, LHP through volcanic landslide and lahar research; GMEG through tephra catalogues and tephra IDs)
- Opportunity to foster closer ties with growing 'volcano center' programs in academia
- Opportunity to have greater community influence through strategic outreach projects

FUTURE DIRECTIONS OF THE OBSERVATORY



- Big operational projects on the horizon include expansion of volcano monitoring networks at Glacier Peak, Mount Baker, Mount Adams. GP is deep wilderness, Baker is largely wilderness, Adam's installs outside wilderness but presents limited capability of lahar alert—also west side only
- Begin moving into distributed volcanism. This is a hazard in Cascades but a weakness of our mission.
- Re-engage the multiple volcano working groups
- Re-imaging cooperative agreements—perhaps fold in other partner/collaborators to tackle research +/- monitoring O&M
- Explore more cross-center collaborations
- Improving cross-observatory interoperability

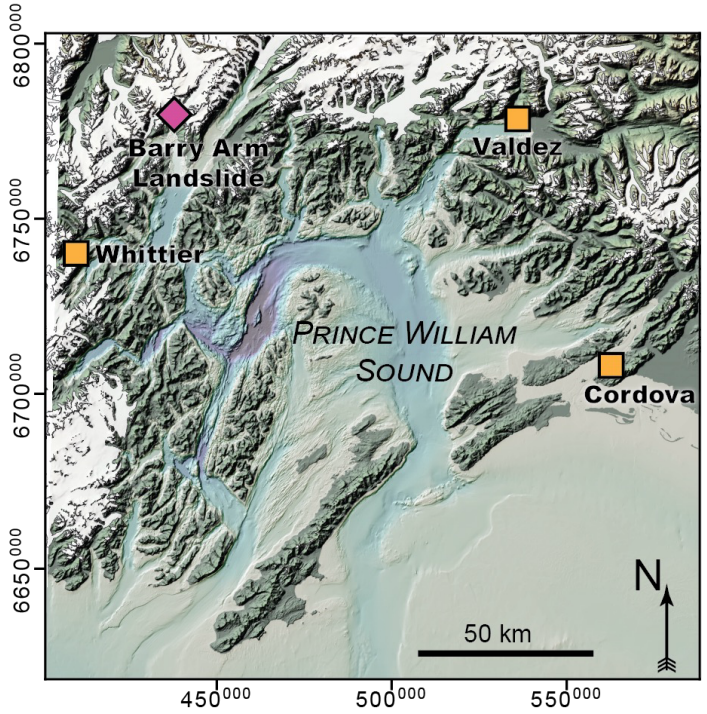
OTHER THINGS YOU WISH TO KNOW?

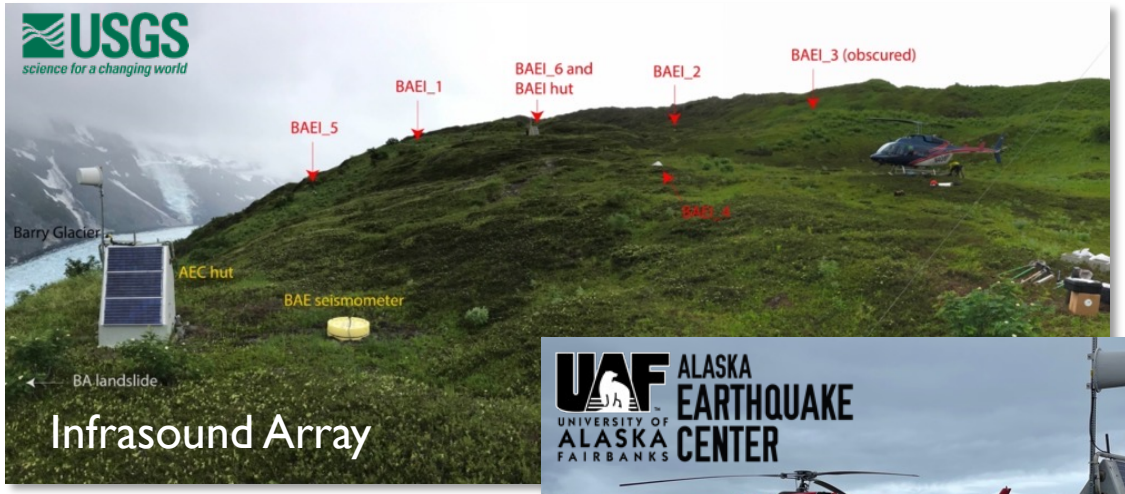
BUDGET

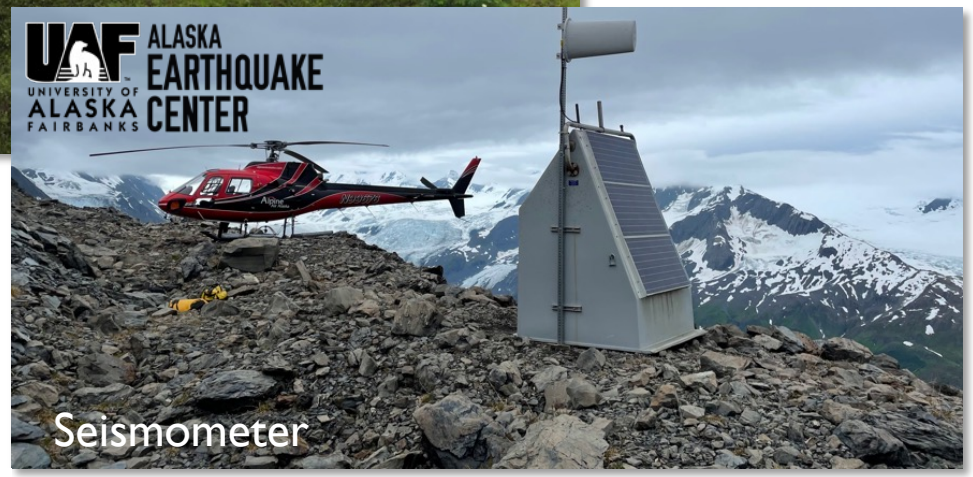
	FY 23	FY 24
OE	$1,065,145	$606,900 (much carryover)
Salary	$4,079,310	~$4,500,000
Coops	$350,000 (UW-PNSN) $150,000 (UO - research)	$350,000 (UW-PNSN) $150,000 (UO - research)
Project Total	$5,644,455	~$5,600,000

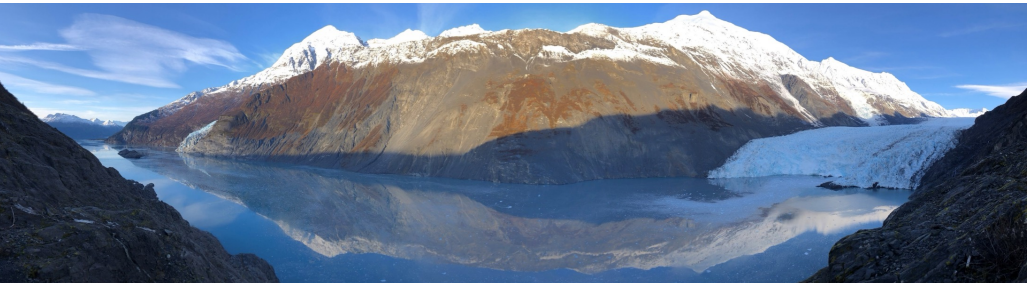
Bottom line: CVO ~$6M/yr program

LANDSLIDE HAZARDS IN BARRY ARM









USGS science for a changing world

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

State of Alaska Division of Geological & Geophysical Surveys

UAF University of Alaska Fairbanks Alaska Earthquake Center

NRCS Natural Resources Conservation Service