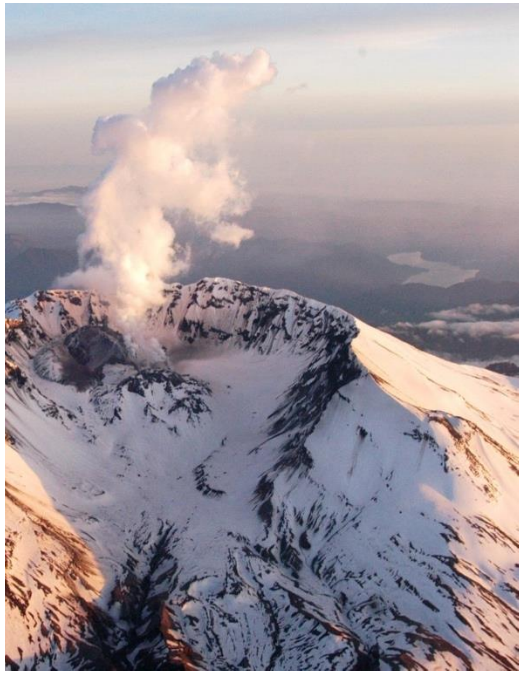
NVEWS Advisory Committee Meeting

SEPTEMBER 18-19, 2024

VANCOUVER, WA


Welcome


Logistics

- Restrooms
- Emergency exits
- Parking lot (virtual too)
- Plan for lunch
- Plan for the tour of the observatory

Engagement Considerations

- Raise your hand (in person and virtual)
- State your name and organization
- Virtual members please keep cameras on
- Notes will be taken and shared publicly
- Share the floor

Goals and Outcomes

Goals:

- Understand the USGS/VHP and NVEWS
- Become acquainted with the advisory committee participants

Desired Outcomes:

- Participants understand NVEWS and your roles as committee members
- The committee develops a path forward for the group

Introductions

- Name
- Organization
- Location
- Favorite volcano (if you have one)

Introduction to the USGS and VHP

GARI MAYBERRY AND MIKE GRIMM

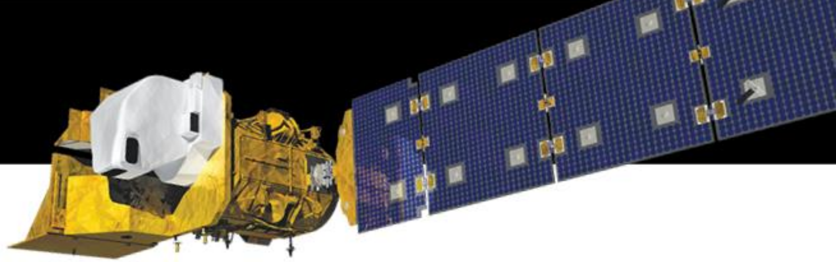
USGS Mission and Vision

USGS
science for a changing world

The **USGS mission** is to monitor, analyze and predict current and evolving dynamics of complex human and natural Earth system interactions and to deliver actionable information at scales and timeframes relevant to decision makers.

Vision Statement: Lead the Nation in 21st-century integrated research, assessments, and prediction of natural resources and processes to meet society's needs.

USGS by the Numbers



People

- **8,410** Employees
- **1,436** Contractors
- **591** Emeriti
- **198** Volunteers

Science and Monitoring

- **170,000+** Publications (since 1879)
- **54,000** 7.5-minute Quadrangles (Topographic Maps)
- **1000+** At-Risk Species Studied
- **25** Active Patents (85 since 1996)
- **1** Research Reactor
- **~20,000** USGS-operated Groundwater Wells monitored for water level and water quality
- **11,800+** USGS-operated Streamgages
- **~4,000** USGS-operated Earthquake Sensors in U.S.
- **~70** U.S. Volcanoes Directly Monitored of 161 Considered Active
- **14** Geomagnetic Observatories
- **3** Satellites
- **201M** Landsat data downloads
- **100%** Interferometric Synthetic Aperture Radar (IfSAR) Data Collected in Alaska
- **94.7%** National Coverage of 3DEP High-resolution Elevation Data
- **56%** U.S. Coverage of Geologic Maps (Detailed to Intermediate Scale)
- **171** Geologic Provinces USGS Assesses for Undiscovered Oil and Gas Resources
- **~100** Mineral Commodities for which USGS Collects National Data for 180 Countries

Locations

- **491** Laboratories
- **391** Facilities
  In all 50 states and 2 territories (Guam and Puerto Rico)
- **60** Science Centers *(7 Regions)*
- **22** Programs *(5 Mission Areas)*
- **10** Climate Adaptation Science Centers *(1 National - 9 Regional)*

Partnerships

- **4,300** Partners/Cooperators
- **5,157** Contracts, Cooperative Agreements, and Grants
- **43** Cooperative Research Units
- **54** Water Resources Research Institutes

Funding

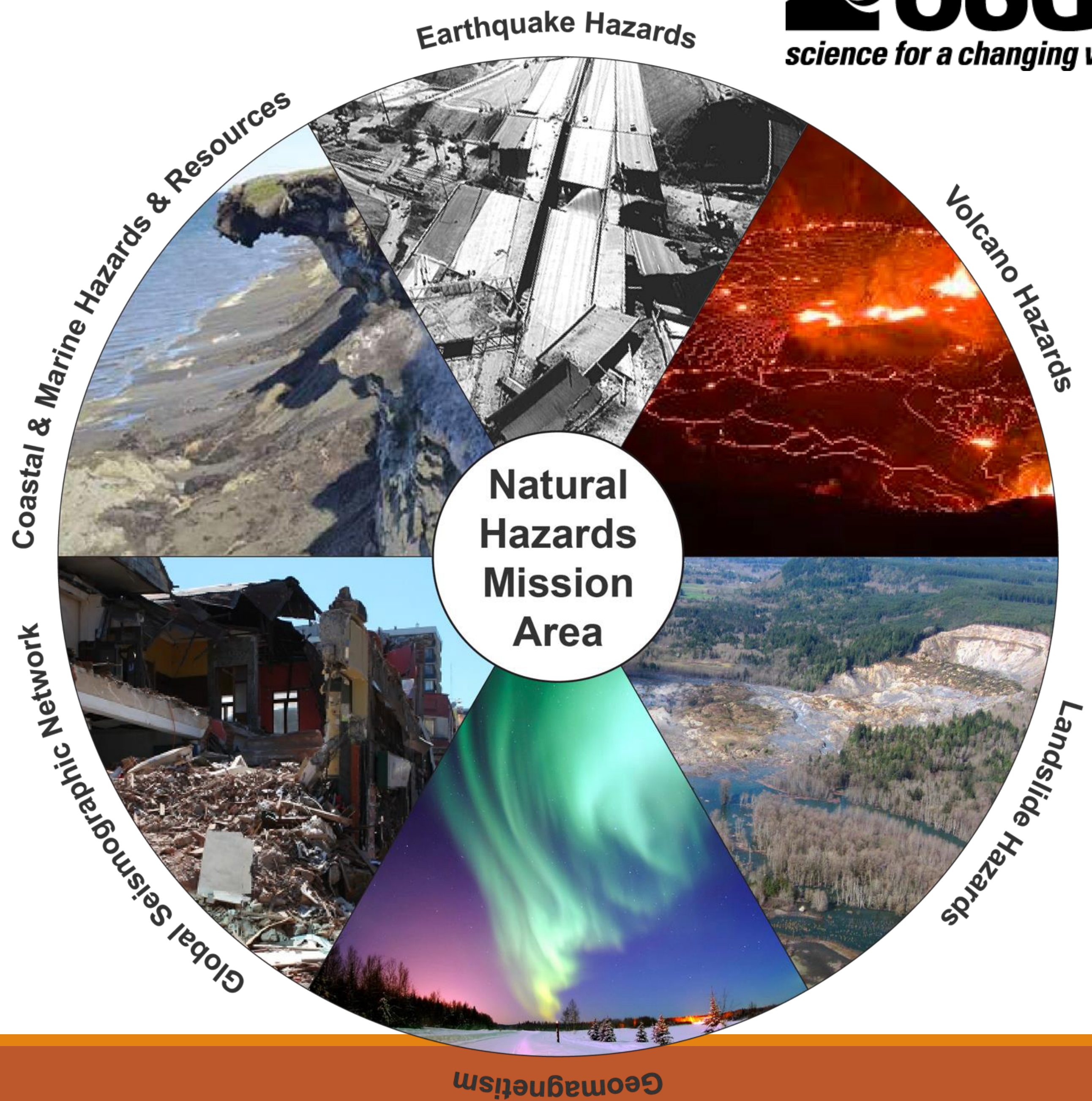
- **$1,455M** 2024 Enacted
- **$646M** 2024 Reimbursables
- **$69M** 2024 Bipartisan Infrastructure Law (BIL)

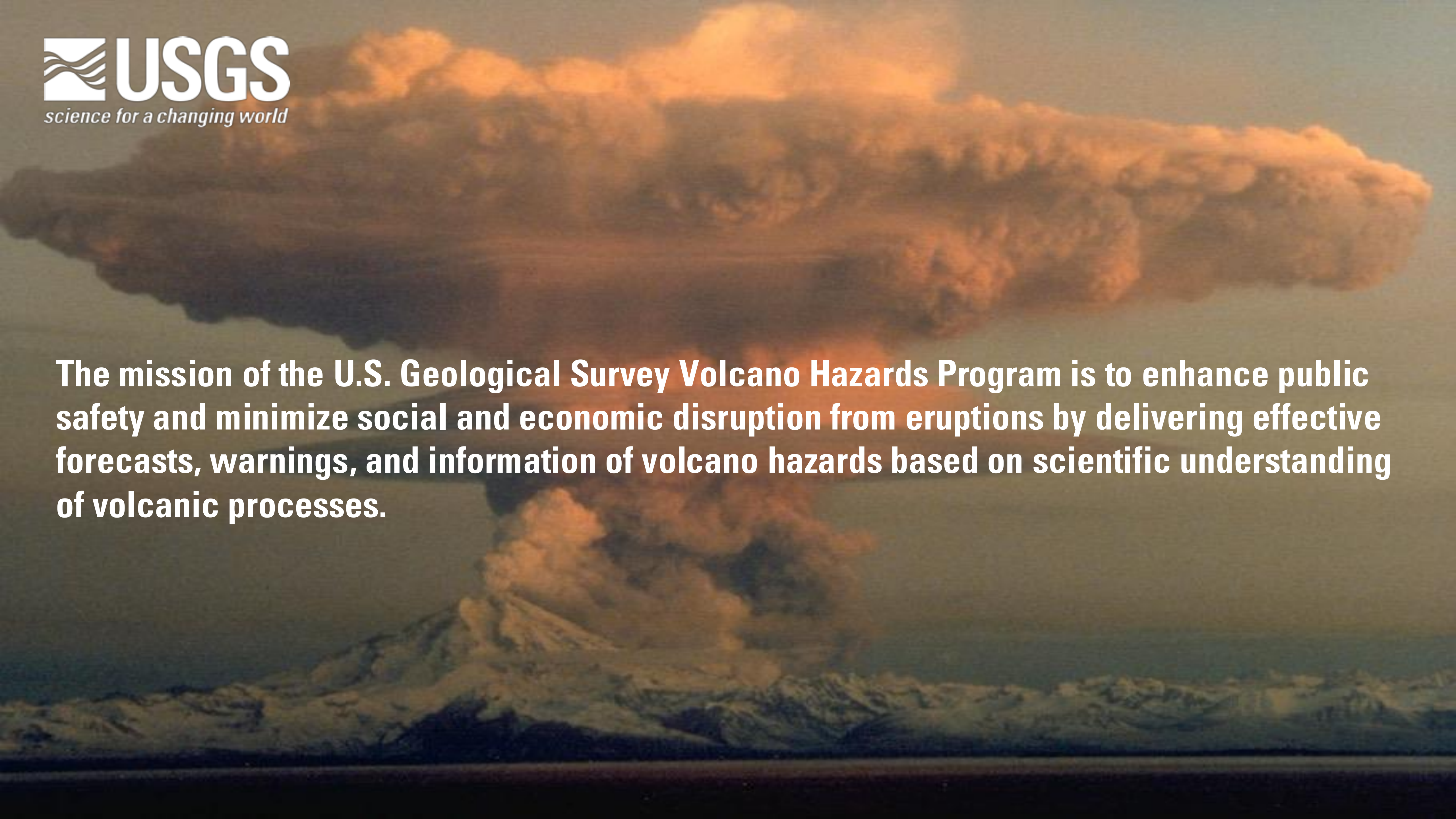
USGS

August 2024

The USGS Natural Hazards Mission Area

- Direct responsibility for six programs:
  - **Coastal/Marine Hazards & Resources**
  - **Earthquake Hazards**
  - **Geomagnetism**
  - **Global Seismographic Network**
  - **Landslide Hazards**
  - **Volcano Hazards**
- Coordinates and supports long-term planning and integration for the broader hazards mission of the USGS including floods, hurricanes, tsunamis, and wildfires
- Implements integrated science strategies for risk reduction through understanding multi-hazard vulnerability and exposure assessments
- Coordinates USGS emergency management and response activities following disasters

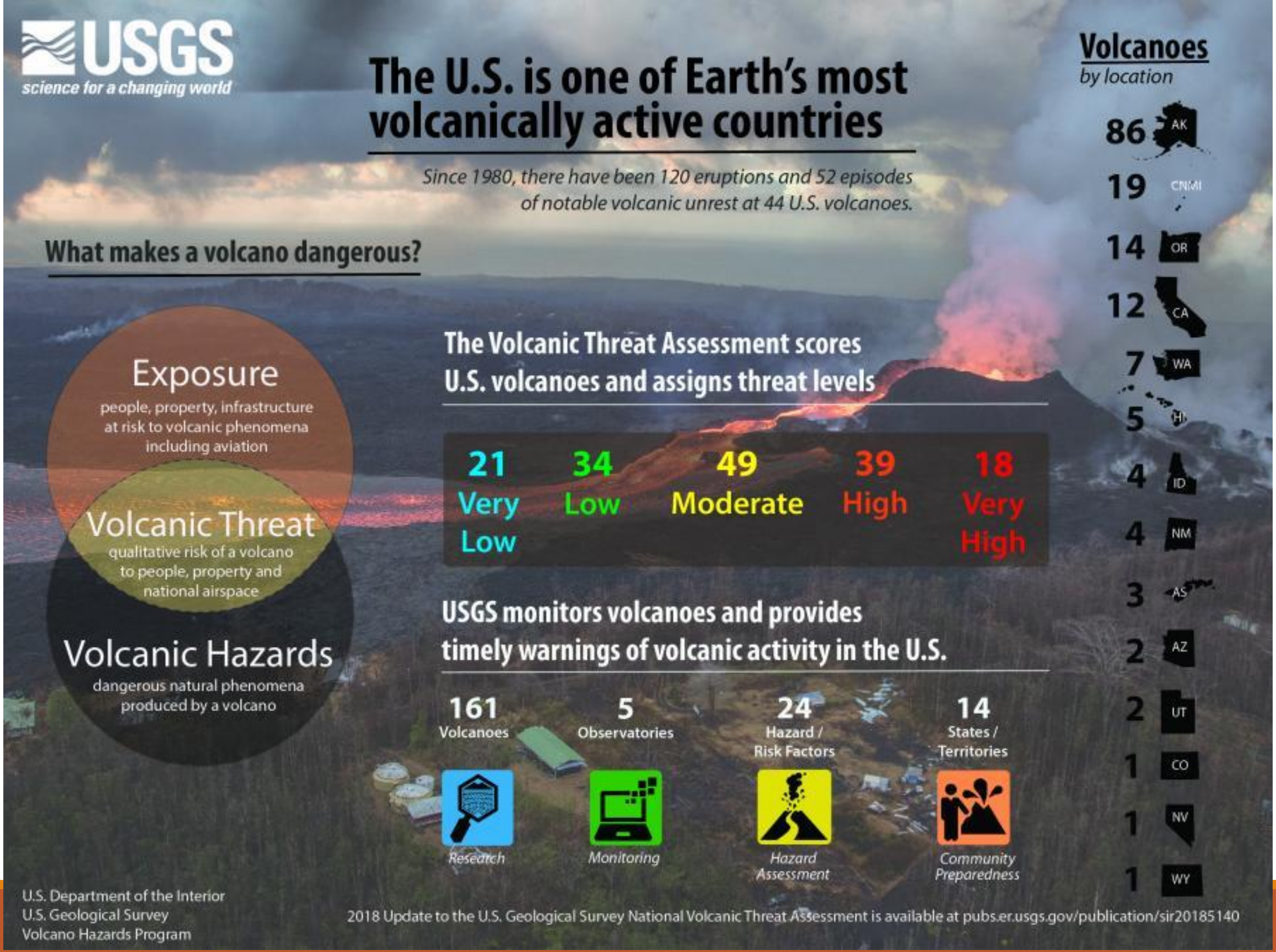




USGS

science for a changing world

The mission of the U.S. Geological Survey Volcano Hazards Program is to enhance public safety and minimize social and economic disruption from eruptions by delivering effective forecasts, warnings, and information of volcano hazards based on scientific understanding of volcanic processes.


USGS
science for a changing world
The U.S. is one of Earth's most volcanically active countries
Since 1980, there have been 120 eruptions and 52 episodes of notable volcanic unrest at 44 U.S. volcanoes.
What makes a volcano dangerous?
Exposure
people, property, infrastructure at risk to volcanic phenomena including aviation
Volcanic Threat
qualitative risk of a volcano to people, property and national airspace
Volcanic Hazards
dangerous natural phenomena produced by a volcano
The Volcanic Threat Assessment scores U.S. volcanoes and assigns threat levels
21 Very Low
34 Low
49 Moderate
39 High
18 Very High
USGS monitors volcanoes and provides timely warnings of volcanic activity in the U.S.
161 Volcanoes
5 Observatories
24 Hazard / Risk Factors
14 States / Territories
Research
Monitoring
Hazard Assessment
Community Preparedness
Volcanoes by location
86 AK
19 CNMI
14 OR
12 CA
7 WA
5 HI
4 ID
4 NM
3 AS
2 AZ
2 UT
1 CO
1 NV
1 WY
U.S. Department of the Interior
U.S. Geological Survey
Volcano Hazards Program
2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment is available at pubs.er.usgs.gov/publication/sir20185140

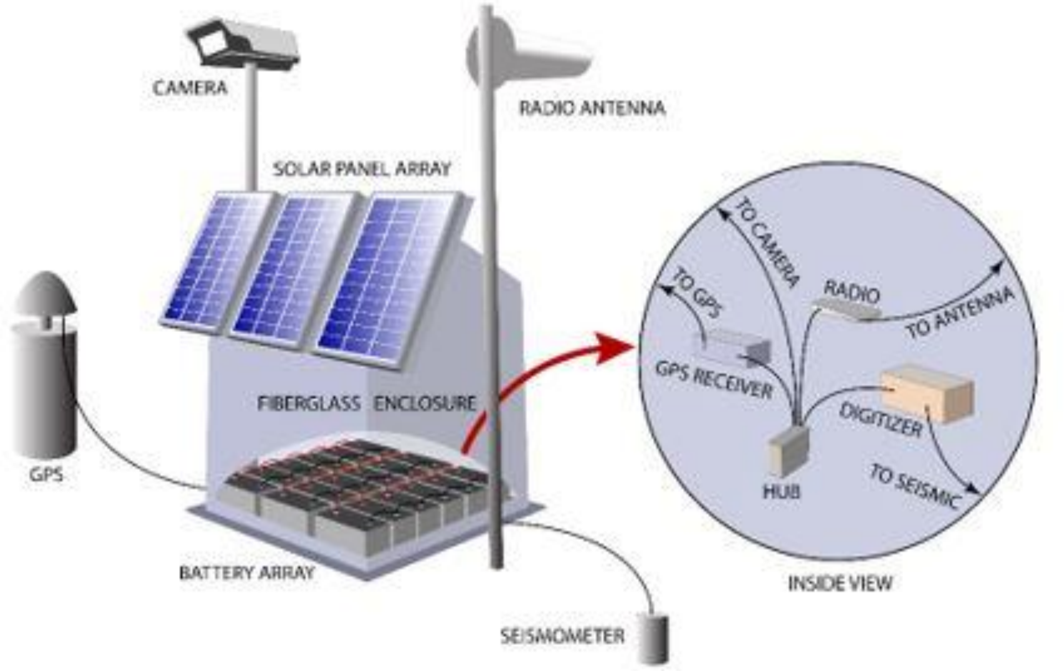
National Volcano Early Warning and Monitoring System (NVEWS)

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

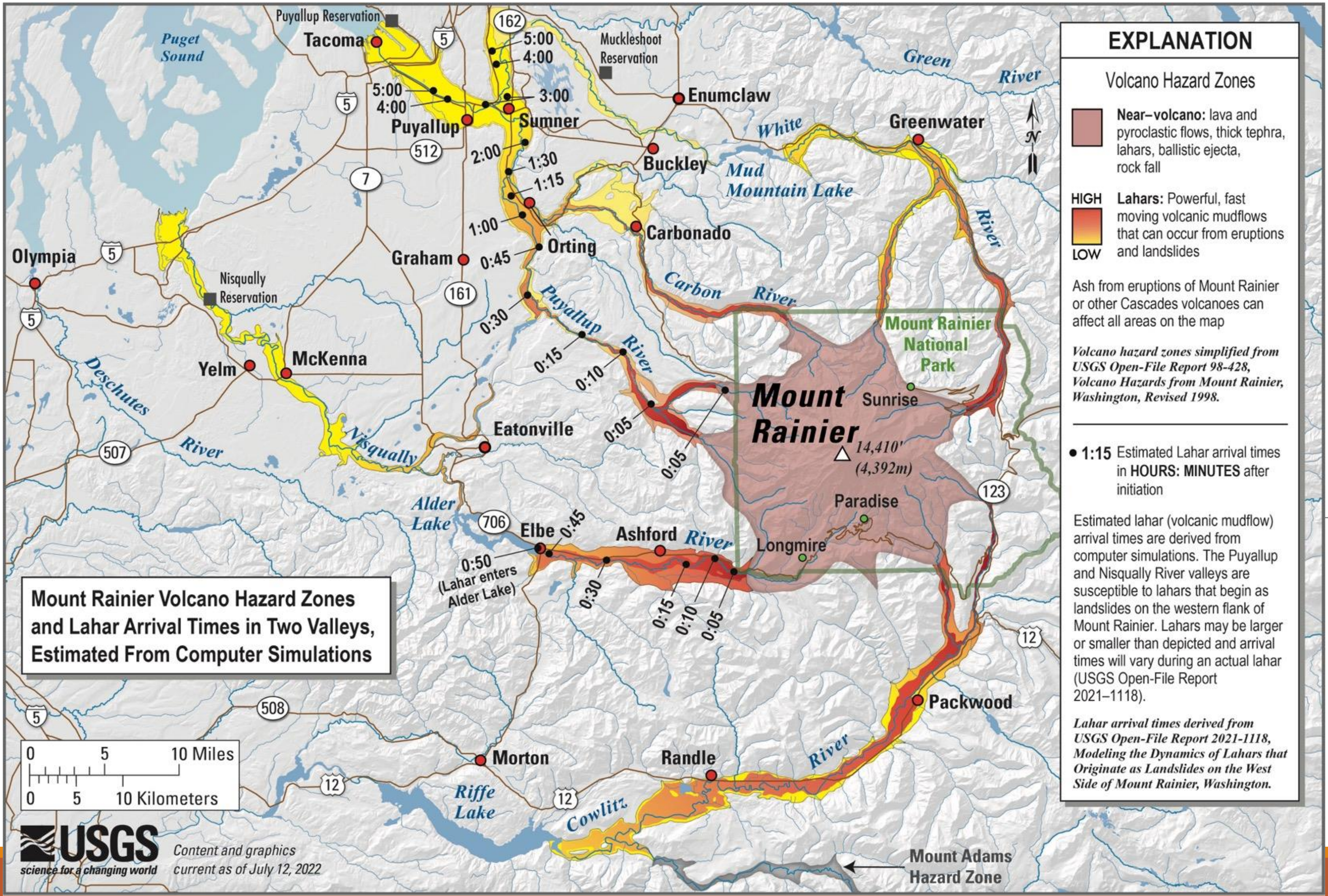
- U.S. volcanoes monitored commensurate with the threats they pose
- U.S. volcano observatories will be an interoperable system
- A Watch Office will provide 24/7 continuity of operations
- National Volcano Information Service (NVIS) will aggregate and distribute real-time monitoring data from all observatories
- 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



Volcano hazard assessments provide broad and scenario-based information to aid risk mitigation.



COOPERATOR REPORT TO: HAWAI`I VOLCANOES NATIONAL PARK

Preliminary Analysis of Current Explosion Hazards at the Summit of Kīlauea Volcano

Kyle Anderson, Don Swanson, Larry Mastin, Christina Neal

U.S. Geological Survey

Bruce Houghton

University of Hawaii Manoa

May 8, 2018

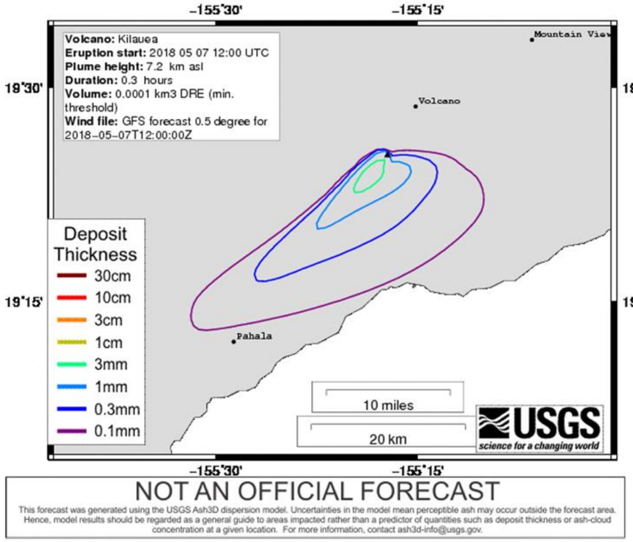
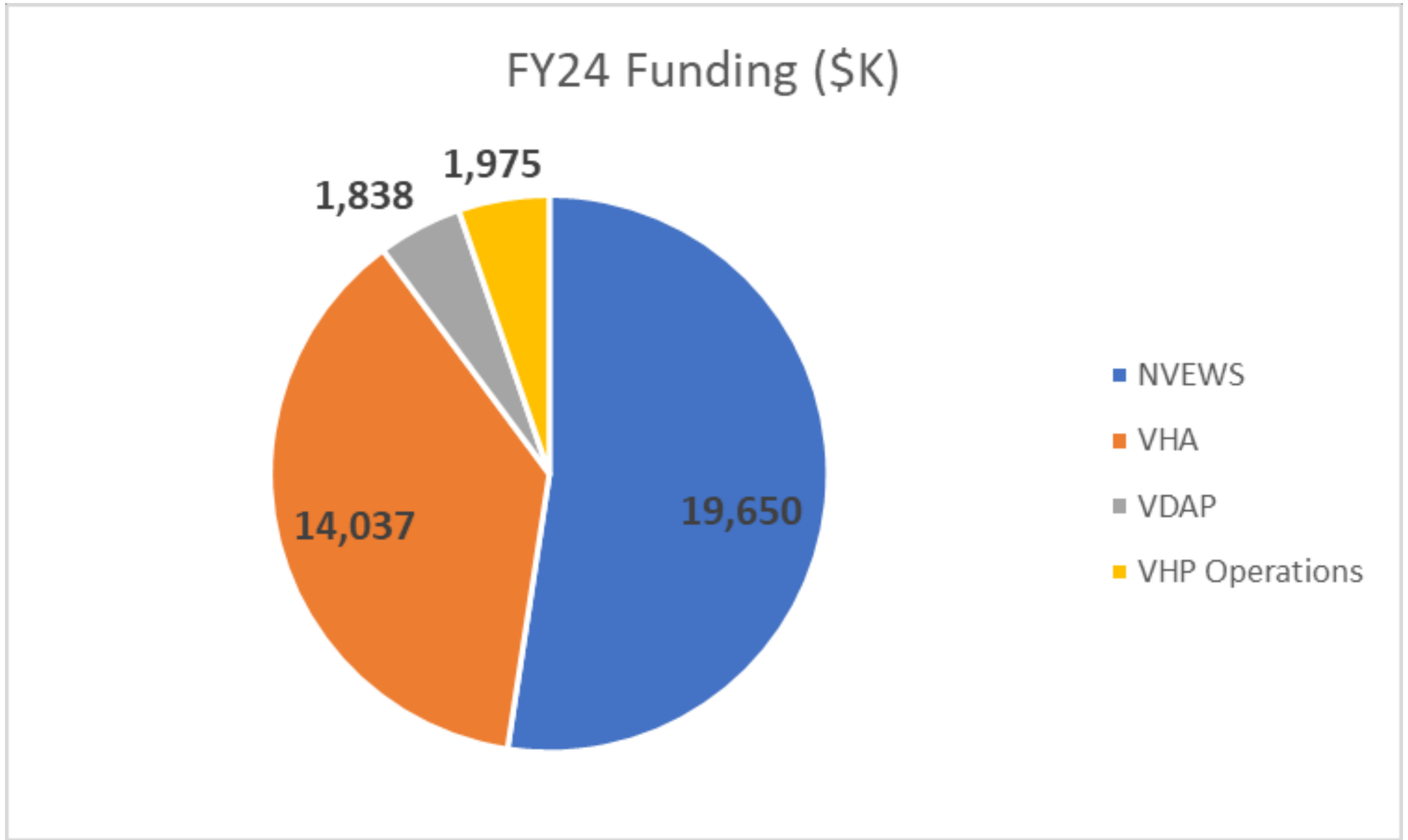


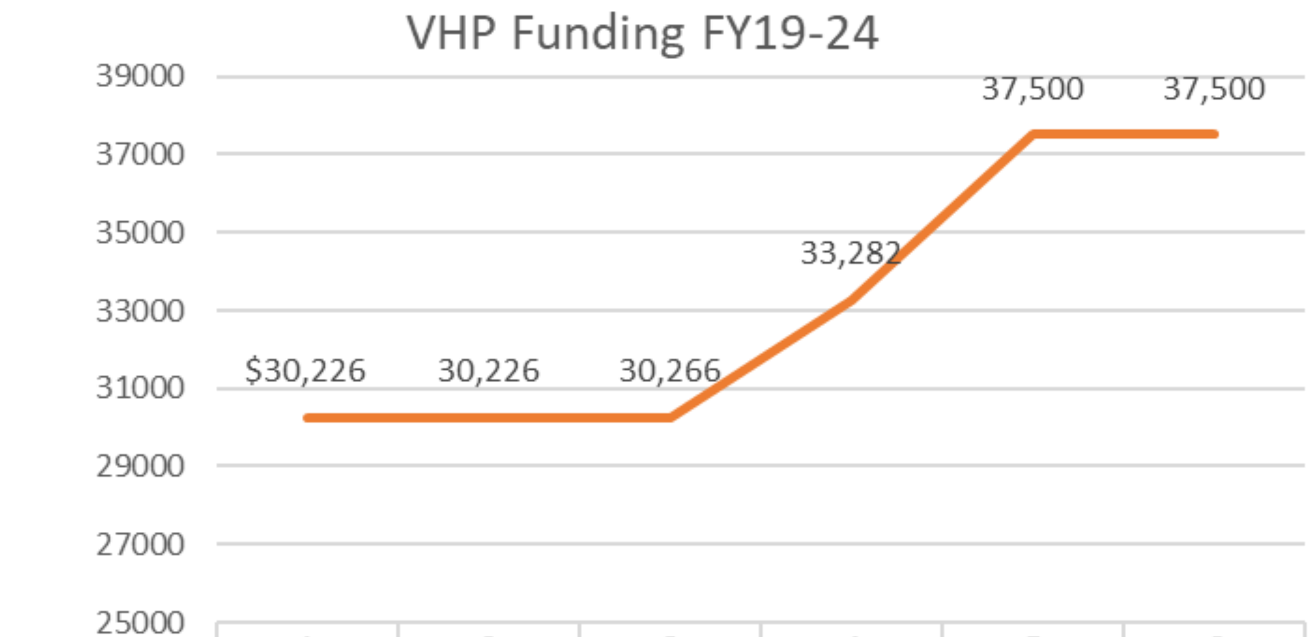
Figure 4: Model output showing possible extent and thickness for a plausible explosive event from the Kilauea summit should phreatic explosions commence. Contours show expected deposit thickness under wind conditions of May 7, 2018 (1200 UTC). The assumed plume height, duration, and erupted volume used in the simulation are listed in the legend. In this case the maximum thickness is predicted to be less than 1 cm (<0.5 inch) at a distance of less than 5 km (3 miles) from the vent.

VHP Funding



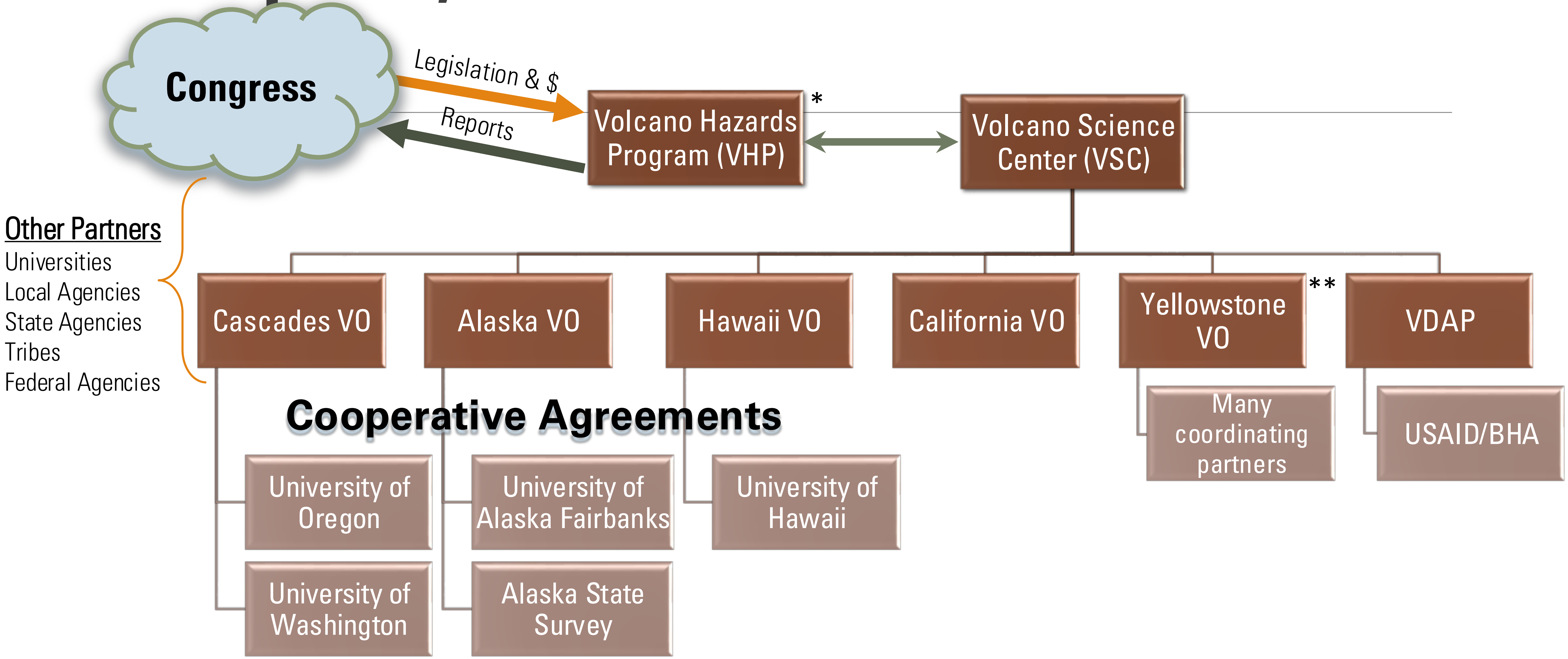
FY24 Funding ($K)
1,975
1,838
14,037
19,650
NVEWS
VHA
VDAP
VHP Operations

VHP Funding FY19-24



	1	2	3	4	5	6
Series1	19	20	21	22	23	24
Series2	$30,226	30,226	30,266	33,282	37,500	37,500

VHP plans, VSC Observatories execute



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

** YVO partners are Univ. Of Utah, National Park Service, EarthScope, Montana State University, University of Wyoming, and State Geologic Surveys of Wyoming, Montana, and Idaho

NVEWS Advisory Committee

GARI MAYBERRY

NVEWSAC Origin

TITLE V 5001.3.b

ADVISORY COMMITTEE.—The Secretary shall establish an advisory committee to assist the Secretary in implementing the System, to be comprised of representatives of relevant agencies and members of the scientific community, to be appointed by the Secretary.

John Dingell Jr. Conservation, Management, and Recreation Act (P.L. 116-9)

TITLE V—HAZARDS AND MAPPING

SEC. 5001. NATIONAL VOLCANO EARLY WARNING AND MONITORING SYSTEM.

(a) DEFINITIONS.—In this section:

(1) SECRETARY.—The term “Secretary” means the Secretary, acting through the Director of the United States Geological Survey.

(2) SYSTEM.—The term “System” means the National Volcano Early Warning and Monitoring System established under subsection (b)(1)(A).

(b) NATIONAL VOLCANO EARLY WARNING AND MONITORING SYSTEM.—

(1) ESTABLISHMENT.—

(A) IN GENERAL.—The Secretary shall establish within the United States Geological Survey a system, to be known as the “National Volcano Early Warning and Monitoring System”, to monitor, warn, and protect citizens of the United States from undue and avoidable harm from volcanic activity.

(B) PURPOSES.—The purposes of the System are—

(i) to organize, modernize, standardize, and stabilize the monitoring systems of the volcano observatories in the United States, which includes the Alaska Volcano Observatory, California Volcano Observatory, Cascades Volcano Observatory, Hawaiian Volcano Observatory, and Yellowstone Volcano Observatory; and

(ii) to unify the monitoring systems of volcano observatories in the United States into a single interoperative system.

(C) OBJECTIVE.—The objective of the System is to monitor all the volcanoes in the United States at a level commensurate with the threat posed by the volcanoes by—

(i) upgrading existing networks on monitored volcanoes;

(ii) installing new networks on unmonitored volcanoes; and

(iii) employing geodetic and other components when applicable.

(2) SYSTEM COMPONENTS.—

(A) IN GENERAL.—The System shall include—

(i) a national volcano watch office that is operational 24 hours a day and 7 days a week;

(ii) a national volcano data center; and

(iii) an external grants program to support research in volcano monitoring science and technology.

(B) MODERNIZATION ACTIVITIES.—Modernization activities under the System shall include the comprehensive application of emerging technologies, including digital broadband seismometers, real-time continuous Global Positioning System receivers, satellite and airborne radar interferometry, acoustic pressure sensors, and spectrometry to measure gas emissions.

(3) MANAGEMENT.—

(A) MANAGEMENT PLAN.—

(i) IN GENERAL.—Not later than 180 days after the date of enactment of this Act, the Secretary shall submit to Congress a 5-year management plan for establishing and operating the System.

(ii) INCLUSIONS.—The management plan submitted under clause (i) shall include—

(I) annual cost estimates for modernization activities and operation of the System;

(II) annual milestones, standards, and performance goals; and

(III) recommendations for, and progress towards, establishing new, or enhancing existing, partnerships to leverage resources.

(B) ADVISORY COMMITTEE.—The Secretary shall establish an advisory committee to assist the Secretary in implementing the System, to be comprised of representatives of relevant agencies and members of the scientific community, to be appointed by the Secretary.

(C) PARTNERSHIPS.—The Secretary may enter into cooperative agreements with institutions of higher education and State agencies designating the institutions of higher education and State agencies as volcano observatory partners for the System.

(D) COORDINATION.—The Secretary shall coordinate the activities under this section with the heads of relevant Federal agencies, including—

(i) the Secretary of Transportation;

(ii) the Administrator of the Federal Aviation Administration;

(iii) the Administrator of the National Oceanic and Atmospheric Administration; and

(iv) the Administrator of the Federal Emergency Management Agency.

(4) ANNUAL REPORT.—Annually, the Secretary shall submit to Congress a report that describes the activities carried out under this section.

(c) FUNDING.—

(1) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this section $55,000,000 for the period of fiscal years 2019 through 2023.

(2) EFFECT ON OTHER SOURCES OF FEDERAL FUNDING.—Amounts made available under this subsection shall supplement, and not supplant, Federal funds made available for other United States Geological Survey hazards activities and programs.

Citation: Pub. L. 116-9, title V, §5001: National Volcano Early Warning and Monitoring System

NVEWSAC History

March 2019 NVEWS authorized

2019-20 VHP Coordinator invites representatives of federal agencies listed in P.L. 116-9 (3)(D), plus select others, to join the NVEWSAC. This initial membership represents the governmental end users of NVEWS who can advise on what NVEWS functionality their agencies need.

FY2021 Federal agencies provided representatives for nomination.

Dec 2021 First NVEWSAC Charter signed

Jan 2023 Federal Registry Notice published (meeting goal in FY23 Q3)

FY2023 NVEWSAC meeting goal in FY24 Q4

July 2024 NVEWSAC charter reauthorized

Today- First NVEWSAC Meeting! On time!

NVEWSAC Charter

Regulated by the Federal Advisory Committee Act (FACA)

Duties

- The NVEWSAC will assist the Secretary in implementing the NVEWS and provide an annual report to the Secretary that describes its activities.
- Committee members will employ their familiarity with resources and subject matter experts within their respective agencies and institutions to enhance efficiencies in data gathering pertinent to NVEWSAC decisions and recommendations.
- Members are encouraged to outline opportunities for coordination and leveraging of resources between USGS, NOAA, and other organizations to increase the efficiency of NVEWS implementation when and where applicable.

Meetings

- The NVEWSAC will meet approximately one to two times annually and at other times designated by the DFO

Subcommittees

- Subject to the DFO's approval, subcommittees may be formed to compile information or conduct research

NVEWSAC Purpose

- Advising the Secretary on matters relating to implementing NVEWS
- Advising on meeting user end needs
- Providing guidance on achieving major operational objectives
- Advising on performance goals
- Possible leveraging of resources and infrastructure already in place or planned for future installation

FACA Requirements

- Determine need is in the public interest
- Fairly balanced membership
- Open meetings
- Advisory function only
- Terminate when no longer needed

FACA Requirements- Balance

Membership composition depends on:

- The advisory committee's mission
- The geographic, ethnic, social, economic, or scientific impact of the advisory committee's recommendations
- The types of specific perspectives required (e.g., consumers, technical experts, the public at large, academia, business, or other sectors)
- The need to obtain divergent POV on the issues before the advisory committee
- The relevance of State, local, or tribal governments to the development of the advisory committee's recommendations

NVEWSAC Member Organizations

Wyoming State Survey

New Mexico Bureau of Geology

Washington Department of Natural Resources

University of Oregon

California Governor's Office of Emergency Services

University of California, Berkeley

Cornell University

Washington State Emergency Management

Arizona State University

Department of Energy

Department of Defense

National Oceanic and Atmospheric Administration

National Institute of Standards and Technology

National Science Foundation

Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge

National Aeronautics and Space Administration

Federal Emergency Management Agency

Federal Aviation Administration

FACA Requirements- Closed Meetings

Common exemptions cited to legally close Federal advisory committee meetings include:

- Discussions of classified information
- Reviews of proprietary data submitted in support of Federal grant applications
- Deliberations involving considerations of personal privacy
- Preparatory and administrative work are also exempted

FACA Requirements- Subcommittees

Subcommittee meetings are not required to be open to the public if they report to an advisory committee and not directly to a Federal officer or agency. However, the need for public access changes if the subcommittee's recommendations are:

- Made directly to a Federal officer or agency.
- Adopted by the parent advisory committee without further deliberations by the parent advisory committee.

Chairperson

- Coordinate the writing of the annual report to the Secretary that describes committee activities
- Work with designated federal officer (DFO) to develop meeting agendas
- Help develop committee bylaws
- Serve a coordination role with the advisory committee members
- Certify accuracy of meeting minutes within 90 days of meetings

FACA Member Guidelines & Rules

- Provide your own independent judgement.
- Discuss/deliberate free from conflicts of interest.
- Uphold ethics considerations of…
  - Your agency (fed employees)
  - Your personal finances or party matters
- Notify Gari (DFO) if you find yourself in a position to advise on a matter that would affect your direct financial interest or the direct financial interest of the entity you represent.
- The committee is “advisory” only.
- All documentation is public – no need for FOIA.

Questions we should answer

- How should we select a chairperson?
- What should be the meeting cadence?
  - Should we form subcommittees?
  - Should we have additional topical virtual meetings during the year?
- Are there priority topics we should cover?
- How should we develop bylaws?
- What is your role?

Break

RETURN IN 15 MINUTES

USGS Volcano Science Center and observatory system

TINA NEAL AND SETH MORAN

USGS Volcano Science Center

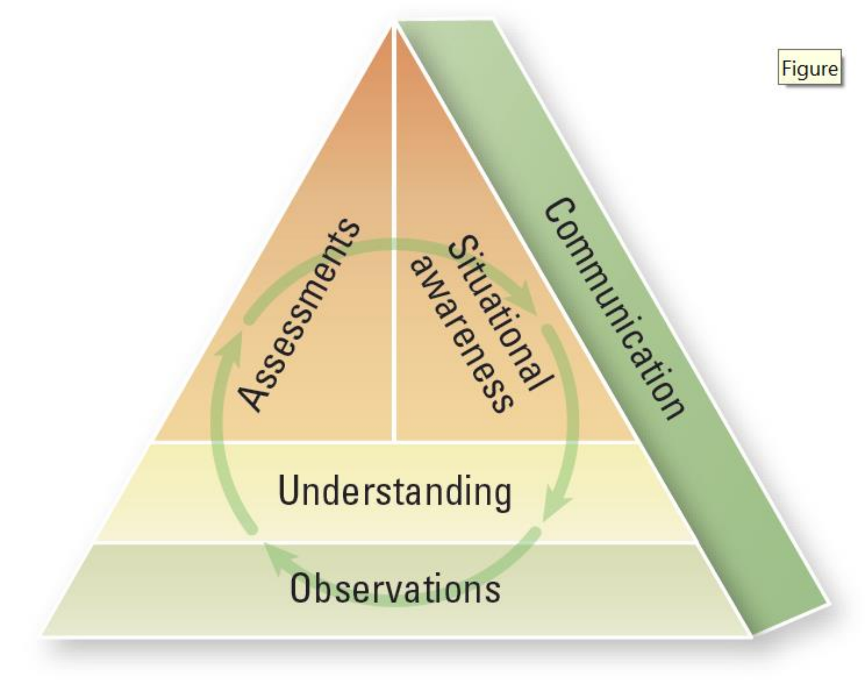
September 2024

Christina Neal, Center Director

Seth Moran, Deputy Center Director

USGS VOLCANO SCIENCE CENTER MISSION

To reduce impacts of volcano hazards on the nation through an integrated program of research into volcanic processes and monitoring, warning, eruption response, and hazard assessment and communication at 5 volcano observatories.

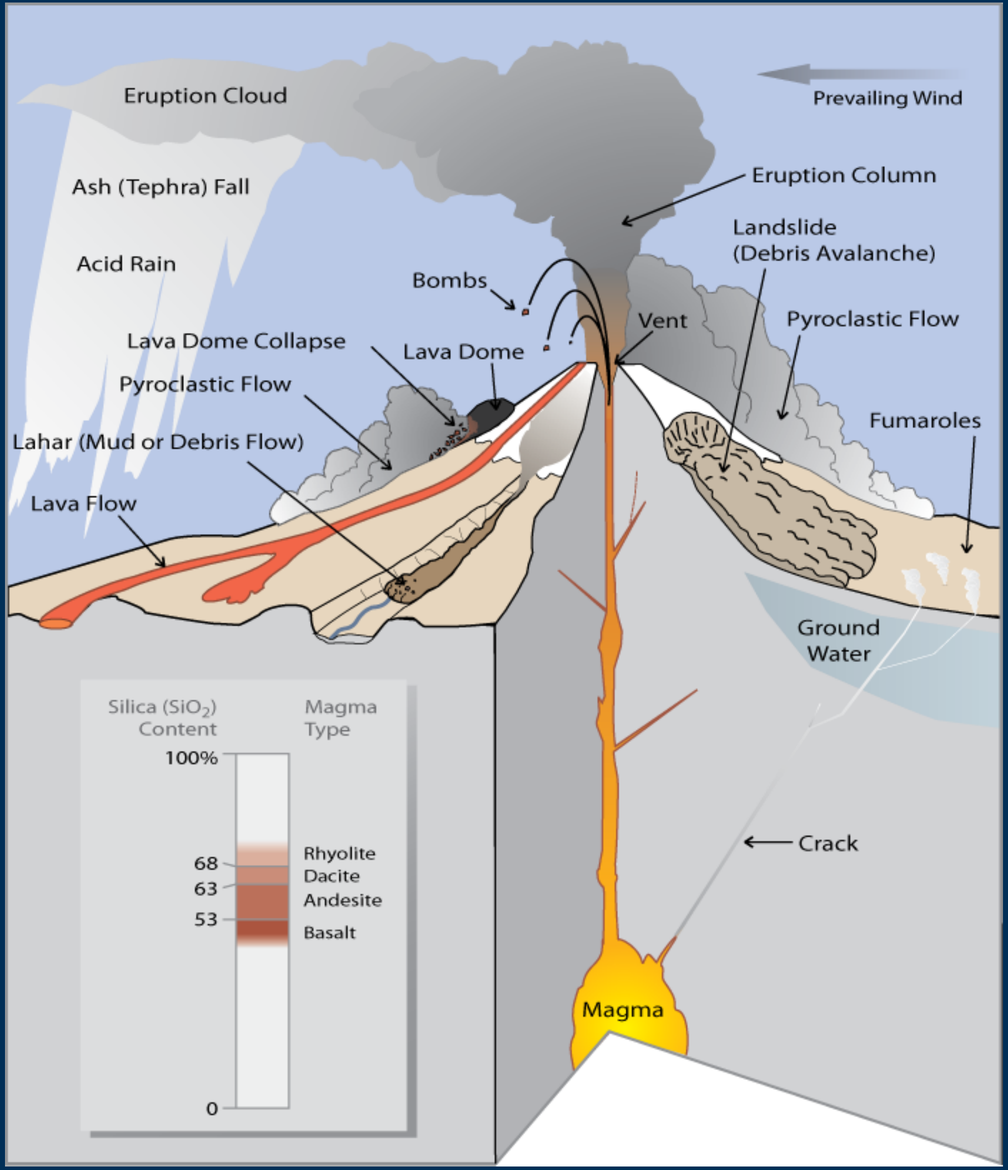


VSC also hosts the Volcano Disaster Assistance Program, co-funded by USAID, to provide volcano-crisis expertise and technical assistance to overseas partners.

VOLCANO HAZARDS


Ontake (Japan), 2014

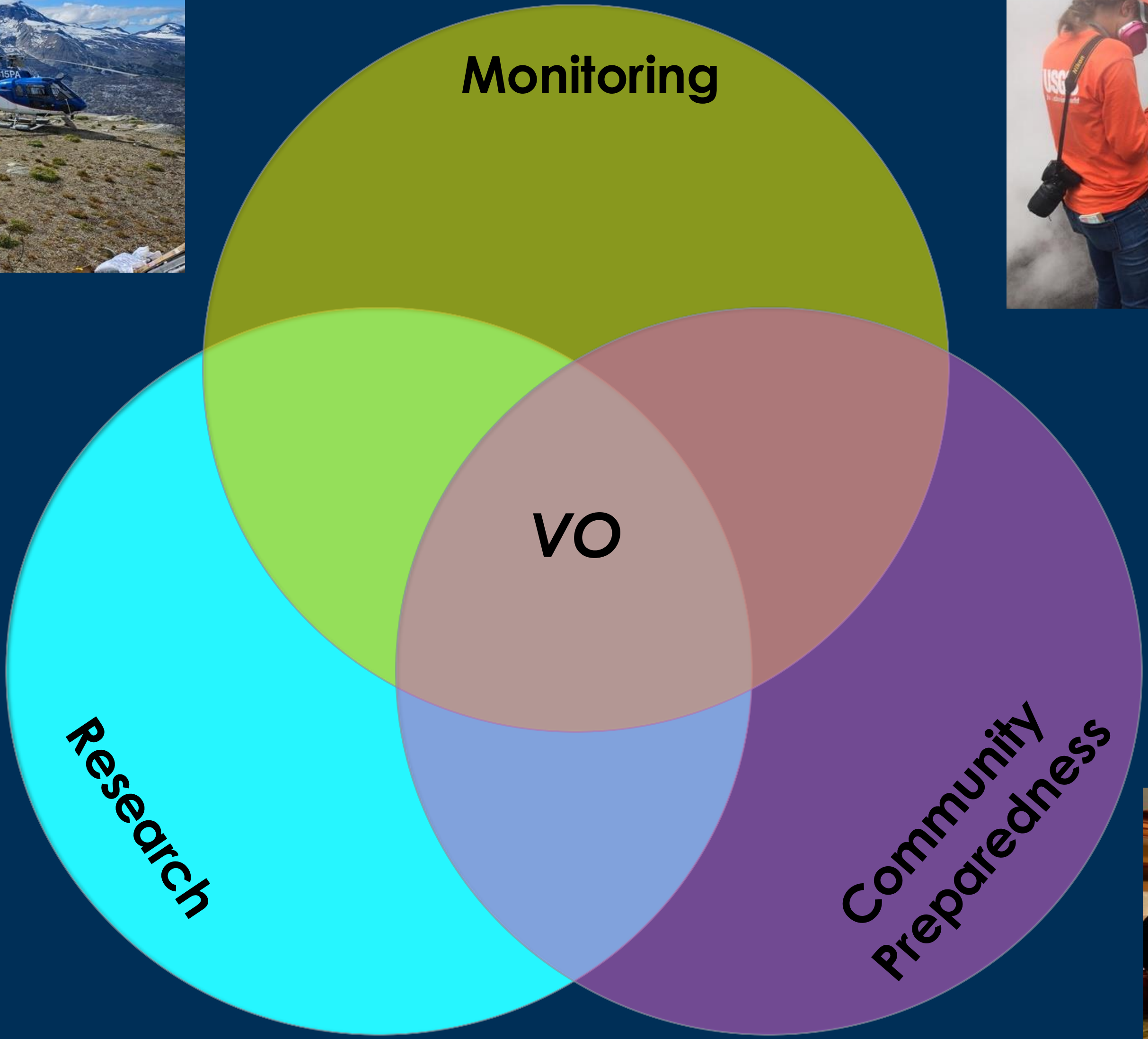

Mount St. Helens, 1982




Anchorage airport, 1992

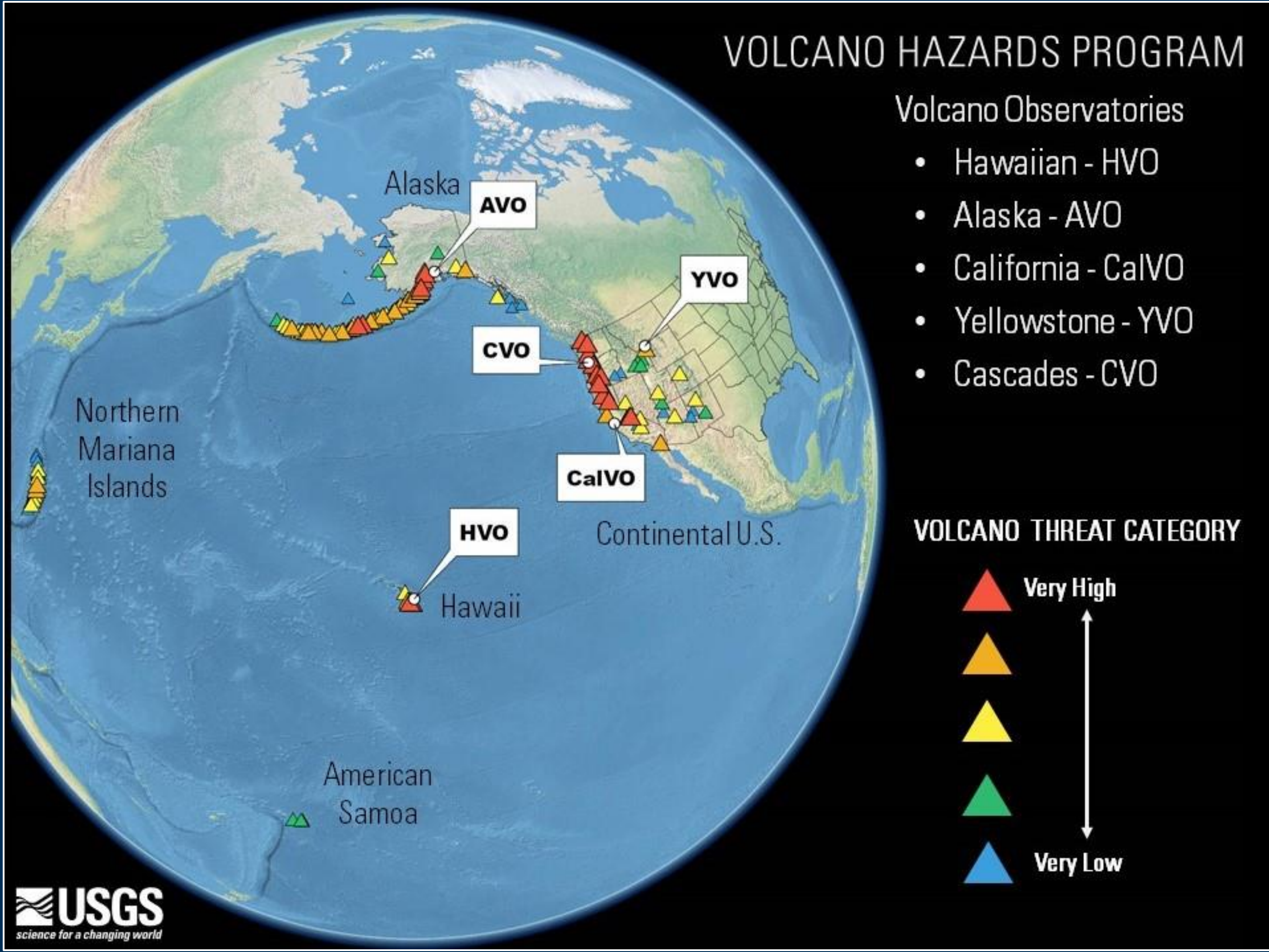

Kilauea, 2018

Volcano Observatory (VO): Three Core Functions



VSC VOLCANO OBSERVATORIES

- AVO: Anchorage and Fairbanks, AK
- CVO and YVO: Vancouver, WA
- CalVO: Moffett Field, CA
- HVO: Hilo / Hawai‘i Volc. Nat Park, HI
- Hundreds of monitoring installations
- Other USGS personnel:
  - Reston (Advanced Systems Center)
  - Washington DC (USAID, Smithsonian)
  - Flagstaff, Denver



VOLCANO SCIENCE CENTER HISTORY IN BRIEF (1)

- 1912: HVO established; USGS took permanent responsibility in 1947. A globally-recognized laboratory for the study of active volcanoes.

- 1967: USGS volcano hazards project established with focus on hazard assessment; grew out of Crandell & Mullineaux work on surficial deposits in Cascade Range. Project moved to CVO in 1987.

- 1982: CVO formalized after 1980 MSH eruption. Science and mitigation focus on lahar hazards ensues.

- 1986: USAID-USGS funded VDAP founded in 1986 after Nevado del Ruiz eruption and ~25,000 casualties in Colombia.

- 1988: AVO established as a partnership of federal and state science agencies in Alaska; 1989-90 Redoubt eruption launches focus on ash, hazards to aviation, and better warning systems in he US and internationally.

VOLCANO SCIENCE CENTER HISTORY IN BRIEF (2)

- 1999: LVO established as a virtual volcano observatory.
- 2001: YVO established to provide authoritative scientific voice about a 'super volcano'; now the largest volcano observatory consortium in VSC.
- 2006: Unified USGS volcano alert level and aviation color code system adopted.
- 2007: Volcano Notification System launched. [formal evaluation of efficacy planned for 2025]
- 2012: CalVO established to align regional expertise and monitoring with state emergency management, sunsetting LVO.
- 2019: NVEWS authorization codifies a unified, national-scale volcano monitoring program for the nation.

Alert Level: WATCH, Color Code: ORANGE2024-09-17 19:51:35 UTC

HAWAIIAN VOLCANO OBSERVATORY DAILY UPDATE
U.S. Geological Survey
Tuesday, September 17, 2024, 9:51 AM HST (Tuesday, September 17, 2024, 19:51 UTC)

KILAUEA (VNUM #332010)
19°25'16" N 155°17'13" W, Summit Elevation 4091 ft (1247 m)
Current Volcano Alert Level: WATCH
Current Aviation Color Code: ORANGE

VSC BLENDS RESEARCH AND APPLIED SCIENCE

- VSC pursues fundamental scientific questions in the lab and in the field about how volcanoes work (the USGS *research* mission).
- VSC determines volcanic histories to identify and characterize future hazards (the USGS *hazard assessment* mission).
- VSC applies technology to monitor volcanoes for unrest, issue timely warnings, and support decision makers and those at risk with actionable information (*application*).

Communication – *peer reviewed research, outreach, education, official warnings, and interagency coordination is foundational to all VSC work.*

THE VALUE OF REGIONAL VOLCANO OBSERVATORIES

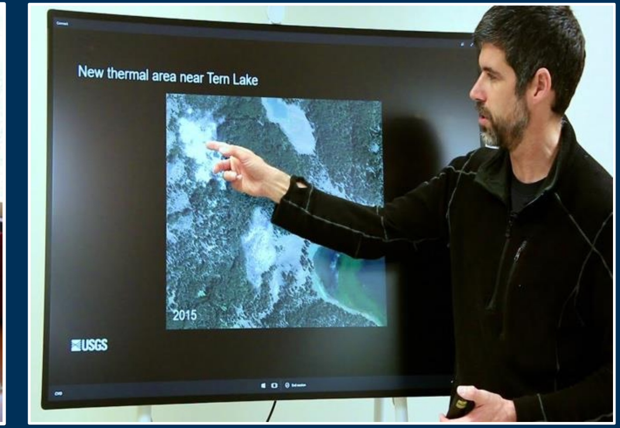
- Responsive to their stakeholders, the public, and cooperators
- Facilitate long-term monitoring, time-series data, and partner relationships
- Host multi-disciplinary science, technology, and outreach staff
- Serve as centers of excellence (e.g. laboratories, remote sensing, lahar warning systems)
- Serve as back-ups for each other, reinforcements during large events
- **Interoperability** of five observatories promotes efficiency, cohesion – a core concept of NVEWS

VSC WORKFORCE (2024)

- Permanent Employees ~ 155*
- Terms/Temps ~ 11
- Post-docs —12
- Volunteers – 64
- Emeriti – 28

- Cooperative Agreements with universities and state geological surveys provide additional expertise, equipment, students, logistics support.

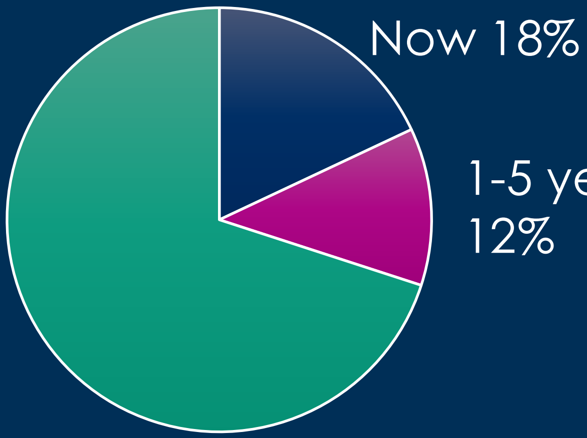
*plus ~2.5 FTE in other USGS science centers



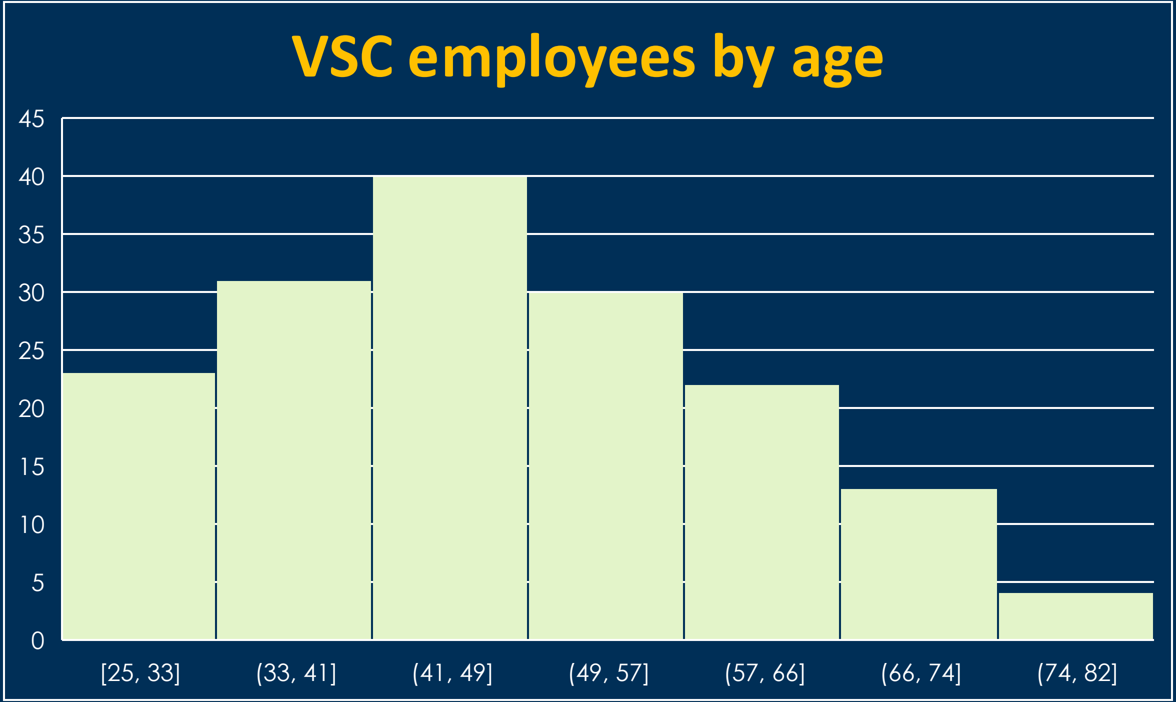
VSC WORKFORCE (2024)

Job Classification	2016	2024
Research	58	77
Operational	64	72
Admin/Manager	15	22

RETIREMENT ELIGIBILITY

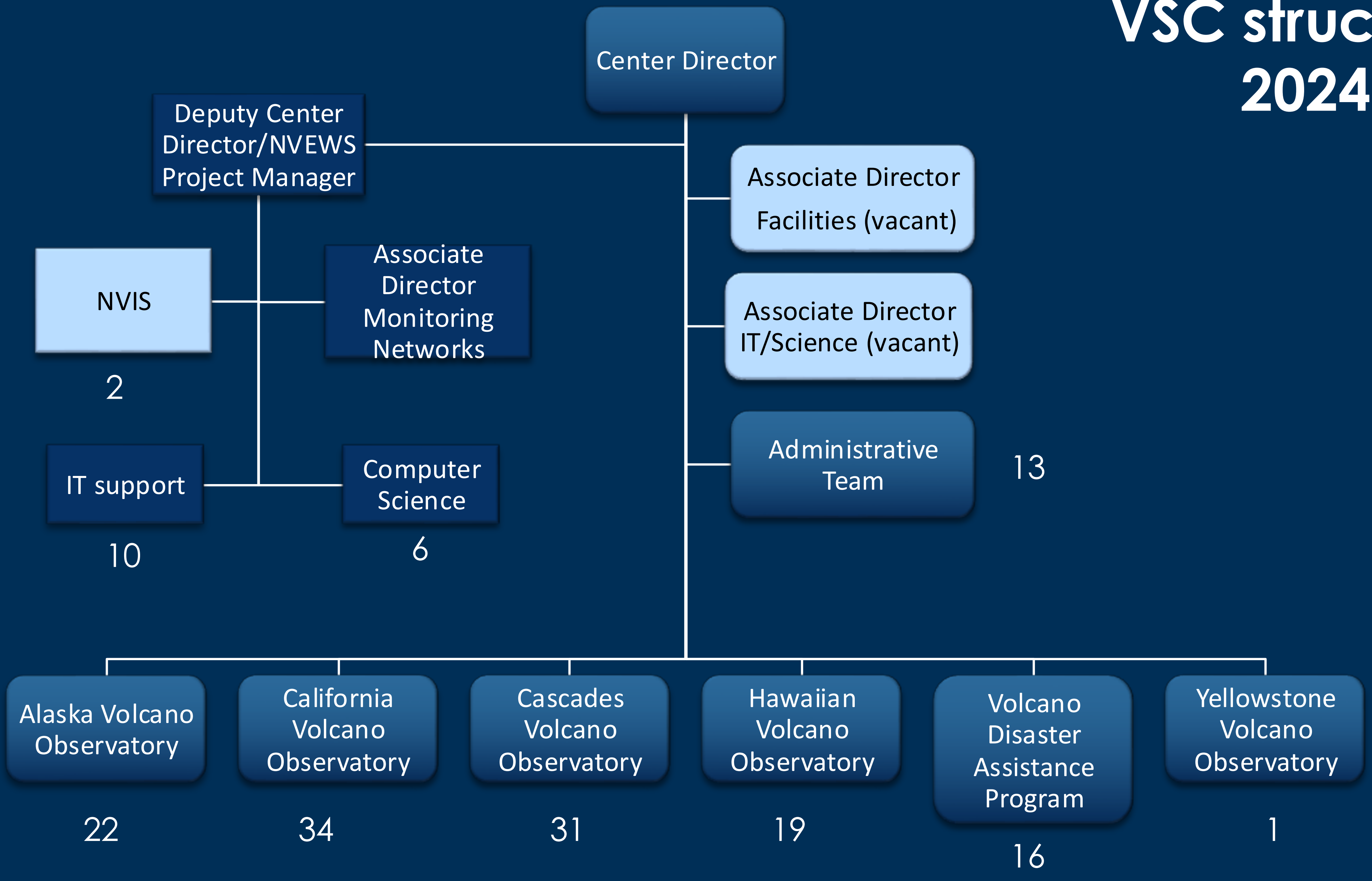


VSC Workforce 2024



GRADE	Number of employees
0-10	20
11	21
12	37
13	41
14	29
15	15
ST	3

VSC structure, 2024



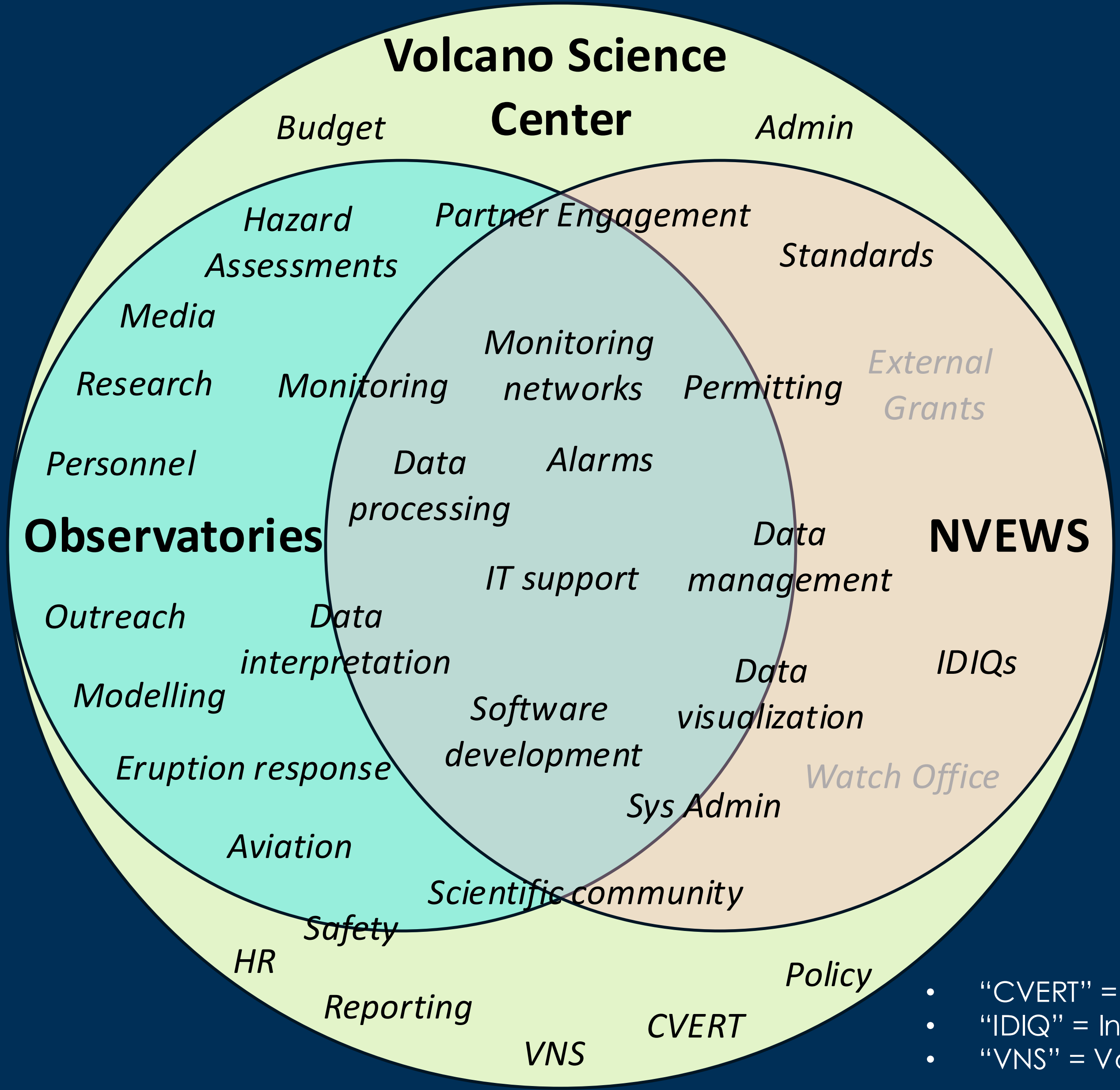
FY24 Volcano Science Center Allocations (approx.)

Gross Costs By Volcano Observatory FY2024						
Observatory	**Salary**	**OE**	**Other USGS centers**	**Co-ops**	**Total**	
AVO	$4,171,151	$437,549	$24,368	$4,259,755	$8,892,824	**AVO**
CalVO	$5,001,640	$357,712	$453,234		$5,812,586	**CalVO**
CVO	$5,486,429	$726,618	$39,894	$357,103	$6,610,039	**CVO**
HVO	$4,186,250	$591,059	$49,922	$500,000	$5,327,233	**HVO**
YVO	$284,835	$86,075	$277,224	$484,939	$1,133,073	**YVO**
VDAP-VSC Contribution	$1,467,763	$376,980	$18,277		$1,863,021	**VDAP-VSC**
	$20,598,063	**$2,575,996**	**$862,921**	**$5,601,797**	**$29,638,778**	

FY24 OE Allocations – non-Observatory projects

Project Title	OE
InSAR Applied to Volcano Studies	$25,000
Volcano Emissions	$50,000
Core Geochronology Operations	$8,000
Landslide Hazard Analyses Related to Volcanoes	$1,800
SEM/Microprobe Lab	$200,000
Information Technology	$100,000
Ash Hazard Impacts and Mitigation	$16,580
UAS	$14,000
Next Generation Hazard Assessments	$7,000
	$422,380

VSC, Observatories, and NVEWS – lots of overlap



- ***Much more will be said about NVEWS in the afternoon***

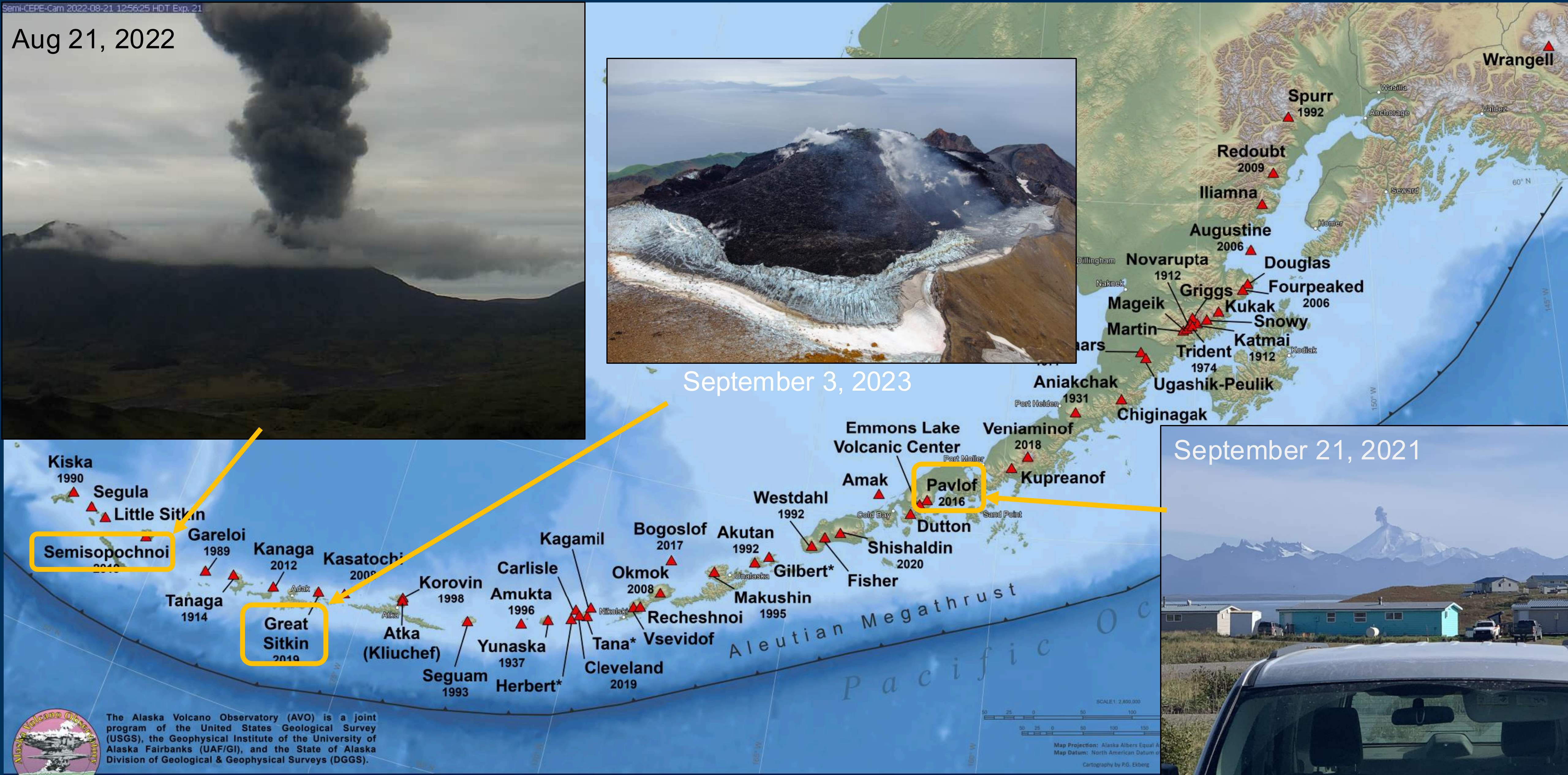
- "CVERT" = Center Volcanic Event Response Team
- "IDIQ" = Indefinite Delivery, Indefinite Quantity
- "VNS" = Volcano Notification System

Alaska Volcano Observatory

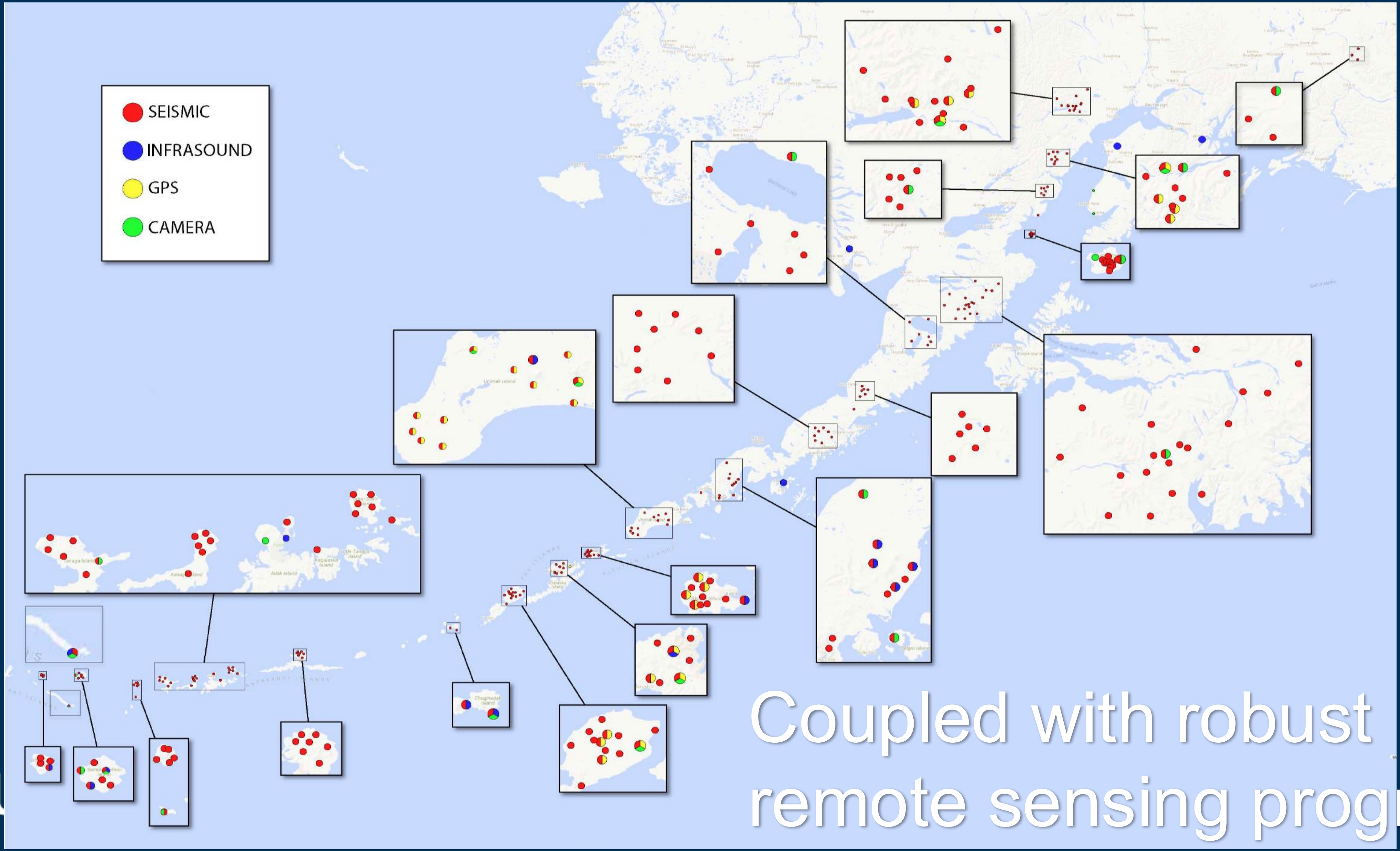
A cooperative program of:

- USGS
- University of Alaska Fairbanks Geophysical Institute (UAFGI)
- Alaska Department of Geological and Geophysical Surveys (ADGGS)

Alaska's volcanoes: "abundant, active, and ash-producing"



Monitoring networks span >2500 km (2021)



Coupled with robust remote sensing program

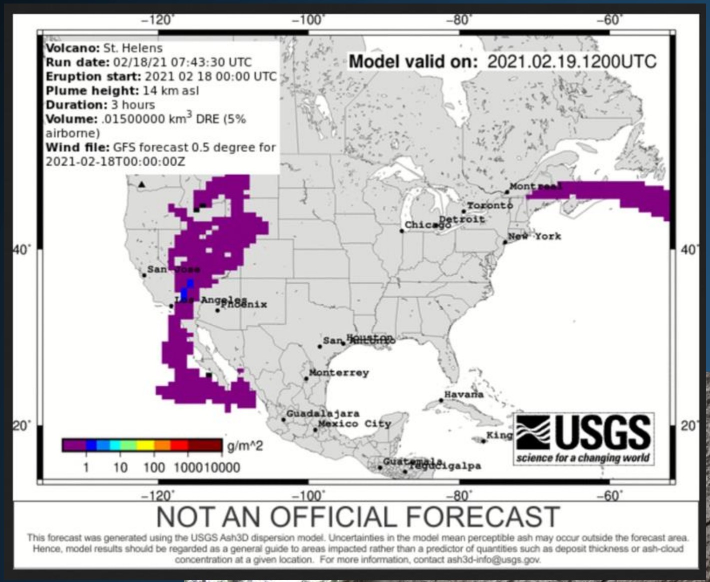
Some recent AVO highlights

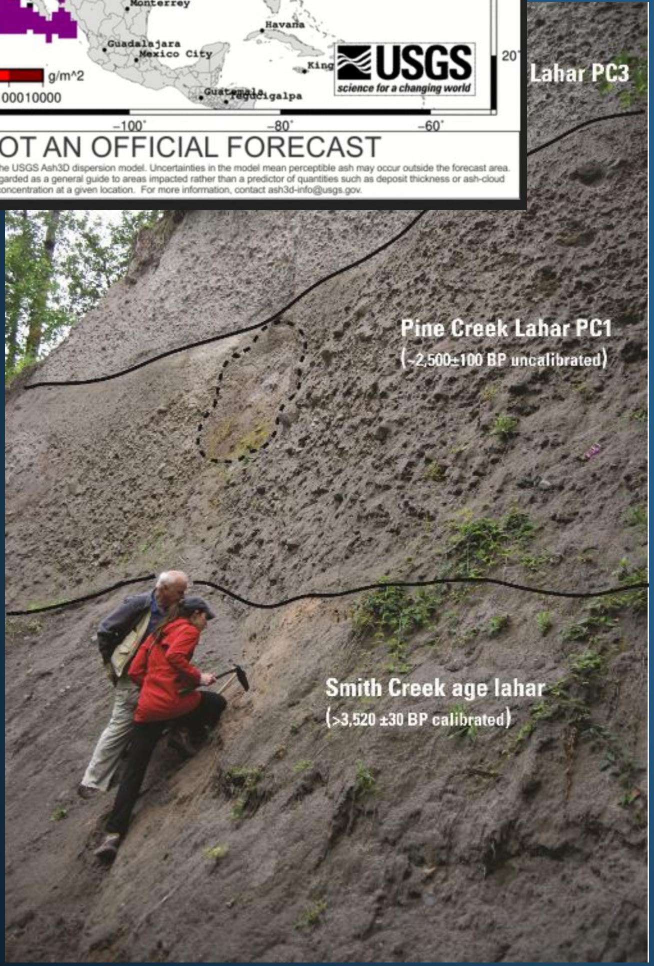
- A2D upgrades completed! Now, to maintain these new networks.
- Prioritizing hiring adequate field engineering staff, other support positions
- Integrating new data streams into improved assessments and forecasts, managing huge amounts of data (satellite, InSAR).
- Growing synergies with new USGS and ADGGS landslide hazard work in Alaska.
- Frequent eruptions provide opportunities for volcanic process research.
- Surprise Edgecumbe Volcano unrest and response; added to monitored list in 2023.

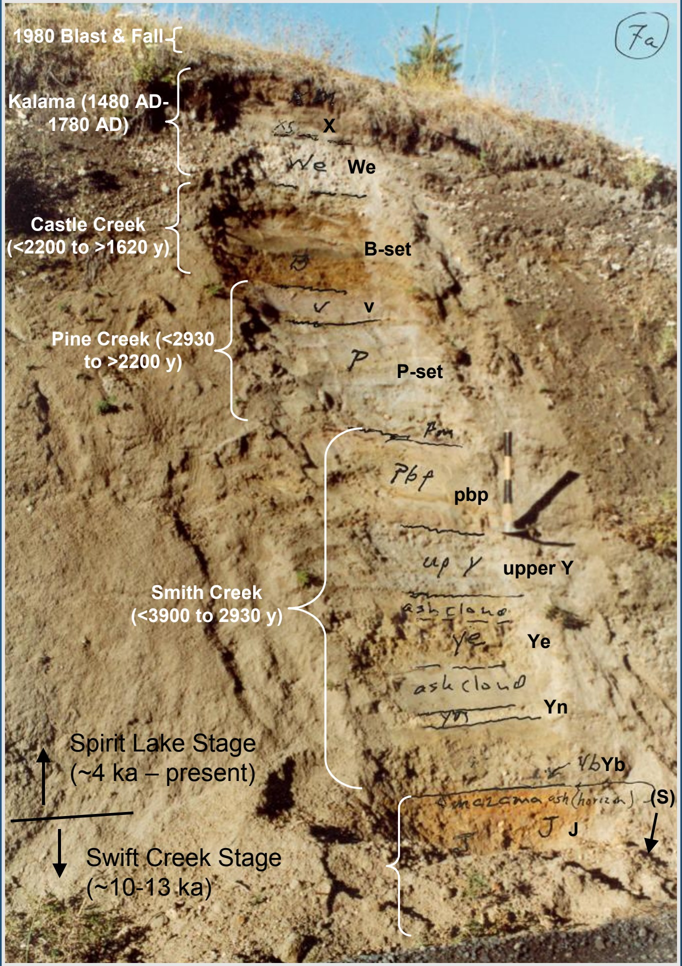
USGS

Cascade Volcano Observatory

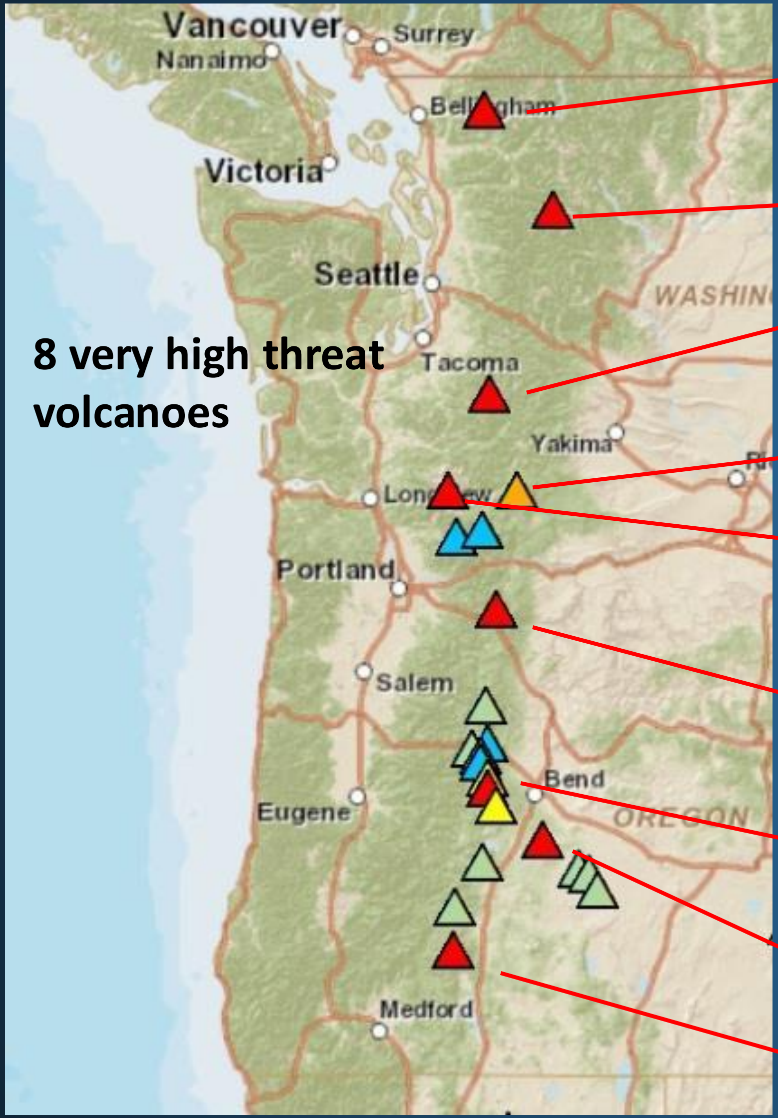
CVO expertise: volcanic histories, processes, modeling







Cascades Volcanoes Monitoring Status, 2024



Baker – 3 seismometers *(scoping new sites, planning permits)*

Glacier Peak – 1 seismometer *(plan 4 new stations; permits in hand)*

Rainier – 22 seismometers, 6 GPS, 1 tilt, 14 infrasound *(lahar detection system buildout nearing completion)*

Adams – 1 seismometer *(plan 4 new stations; permits in hand soon)*

St. Helens – 26 seismometers, 24 GPS, 3 tilt, 2 gas, 6 infrasound *(network is "complete", still plenty of O&M)*

Hood – 11 seismometers, 7 GPS *(plan 1 new station, permit in hand soon)*

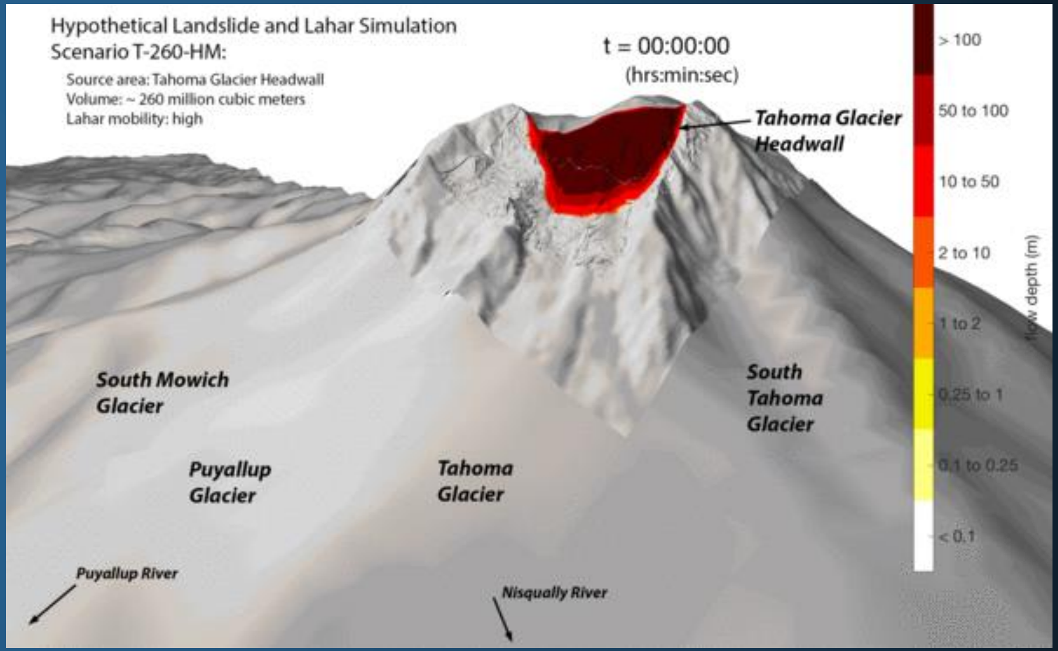
3 Sisters – 5 seismometers, 4 GPS

Newberry – 12 seismometers, 8 GPS *(plan 1-2 new stations)*

Crater Lake – 4 seismometers, 4 GPS *(will lose 1 for ~2 years)*

Some recent CVO highlights

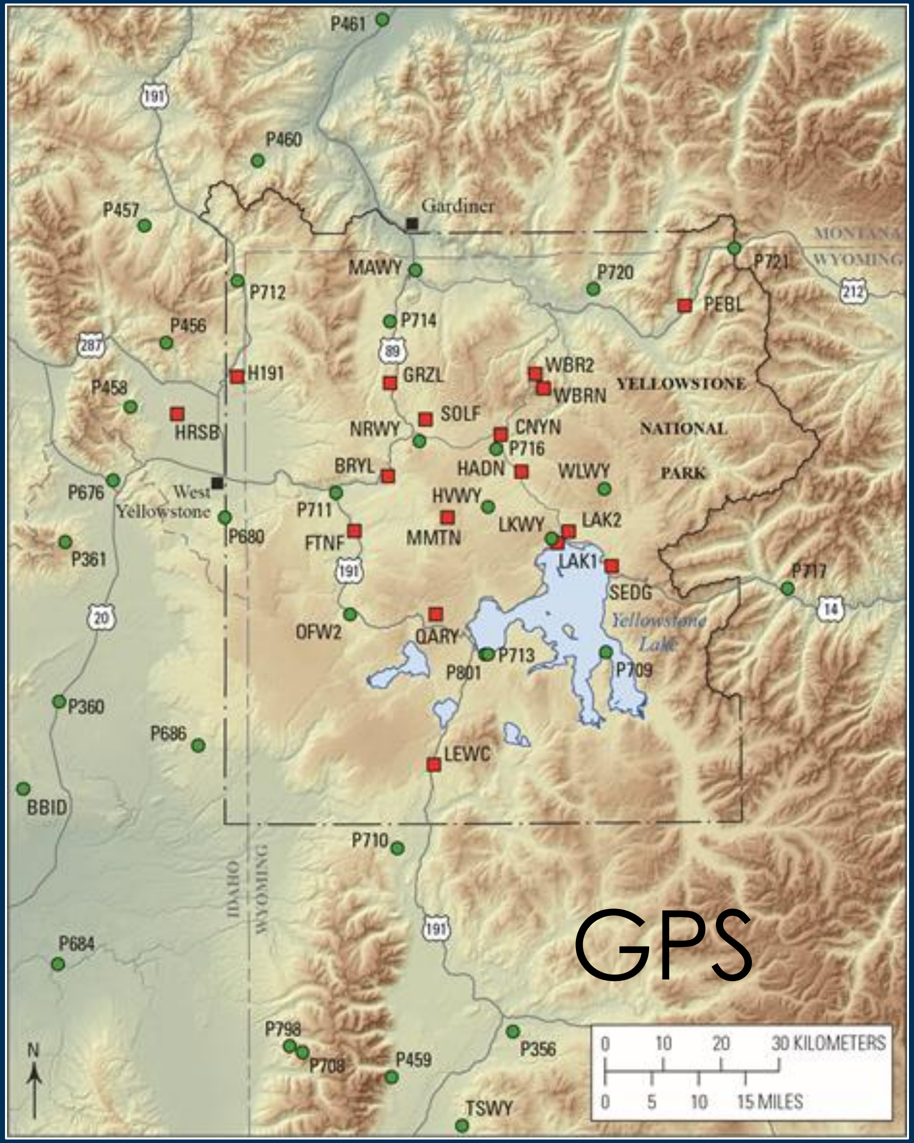
- Updated lahar inundation modeling for Rainier published early 2022.
- Rainier Lahar warning system installation essentially complete; focus now on software, algorithm and warning procedure development, practice.
- Permits in hand to place instrumentation on Glacier Peak: a critical monitoring gap.
- Nearing completion of an updated hazard assessment for Baker.
- Hiring focus on volcano hazard communication, coordination, field engineering, IT, CS.

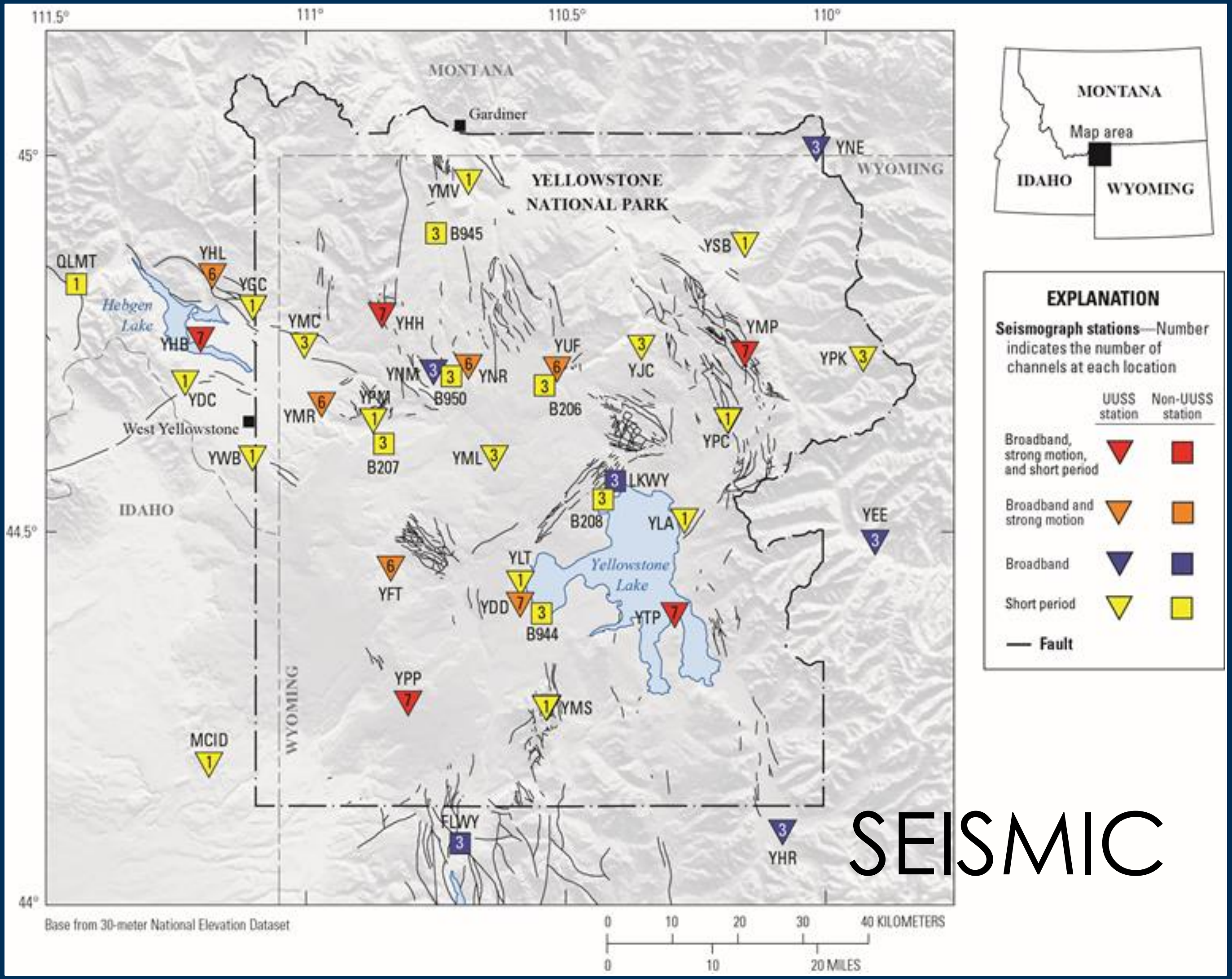


USGS

YELLOWSTONE VOLCANO OBSERVATORY

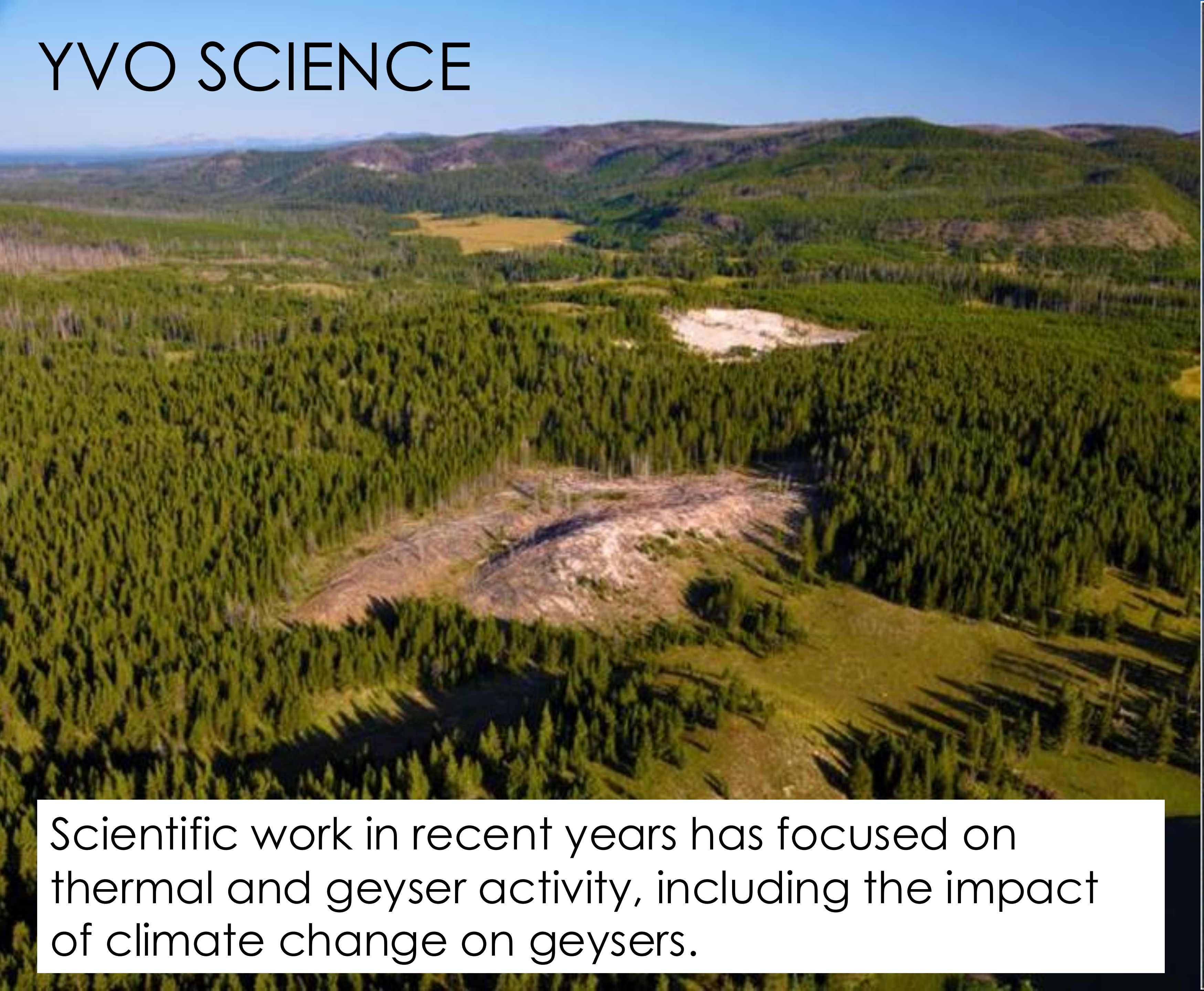
The Yellowstone Volcano Observatory (YVO) is a consortium of nine state and federal agencies who provide timely monitoring and hazard assessment of volcanic, hydrothermal, and earthquake activity in the Yellowstone Plateau region. The USGS arm of YVO is also responsible for monitoring and reporting on volcanic activity in the intermountain west U.S. states.





Yellowstone has a robust backbone monitoring network for earthquakes, ground deformation and YVO regularly samples water and gases.

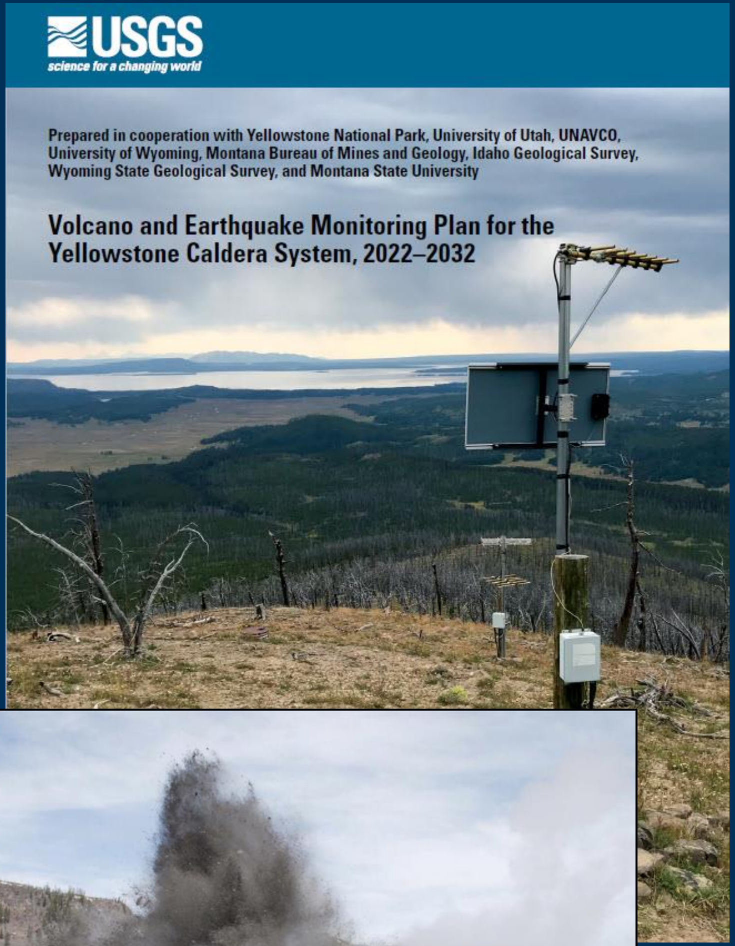
YVO SCIENCE



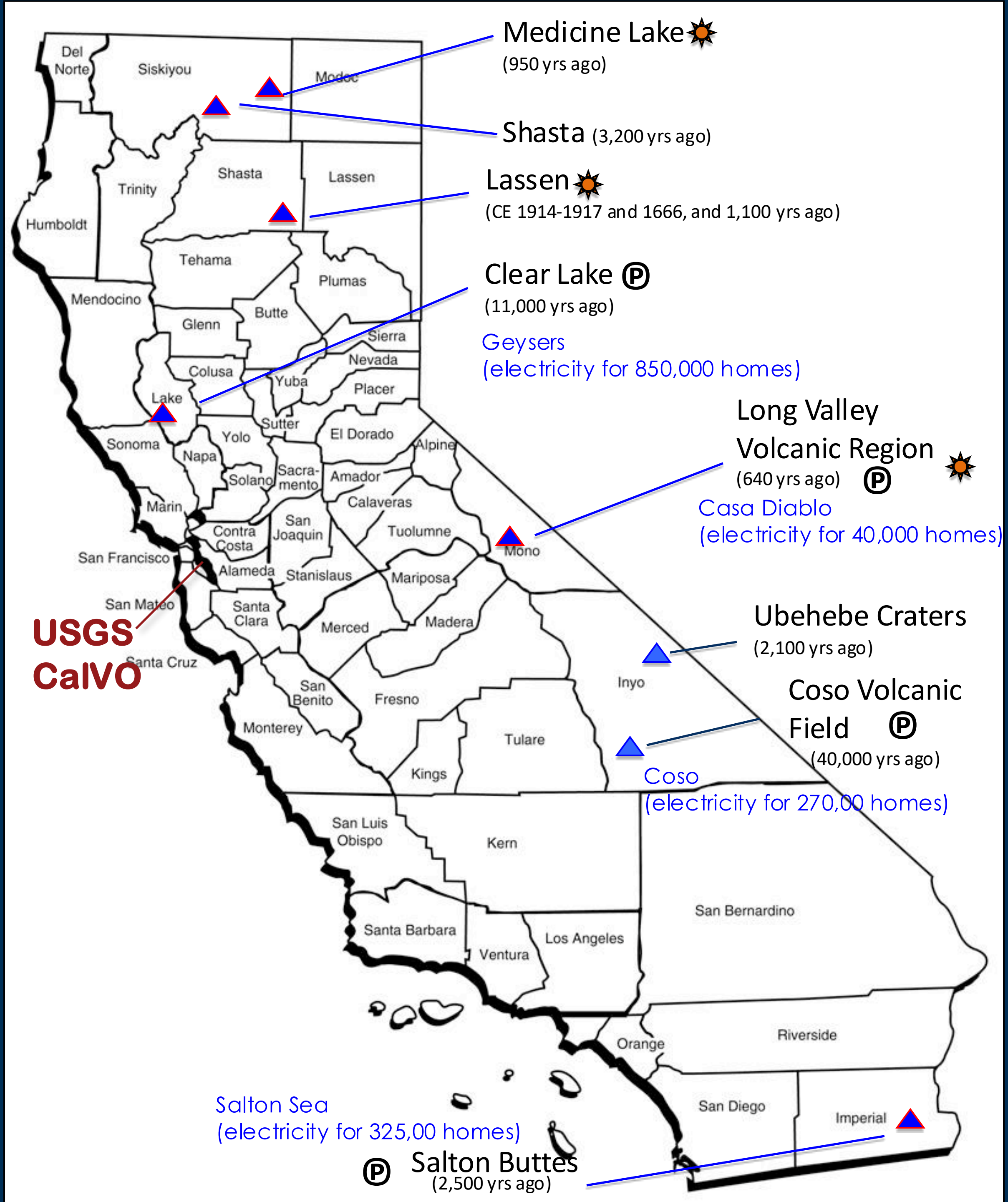
Scientific work in recent years has focused on thermal and geyser activity, including the impact of climate change on geysers.

SOME RECENT YVO HIGHLIGHTS

- Published monitoring plan for the next decade.
- Popular weekly “Caldera Chronicles” and monthly podcasts continue to attract a large audience.
- Focus on monitoring for hydrothermal explosions/hazards as part of NVEWS ‘roadmap’ effort
- Engagement with broader volcanology community on challenges of monitoring distributed volcanism in the American Southwest (tabletop exercise and AGU Chapman Conference).
- Exploring opportunities for further collaboration to address SW US volcanism.



CALIFORNIA VOLCANO OBSERVATORY



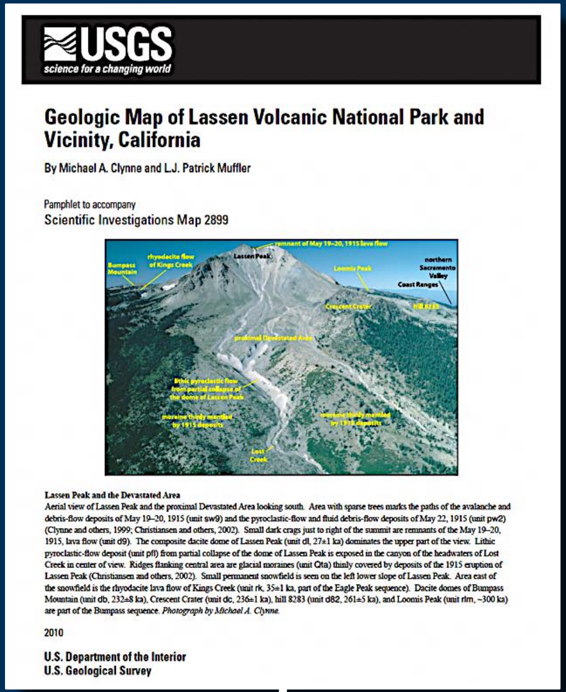
Very High to High Threat

Moderate Threat

Erupted last 1000 yrs

Ⓟ Geothermal Power

CalVO expertise: detailed geologic investigations, geologic mapping, geochronology, magma dynamics experiments, volcanic fluids, hazard assessments.


USGS
science for a changing world

Geologic Map of Lassen Volcanic National Park and Vicinity, California

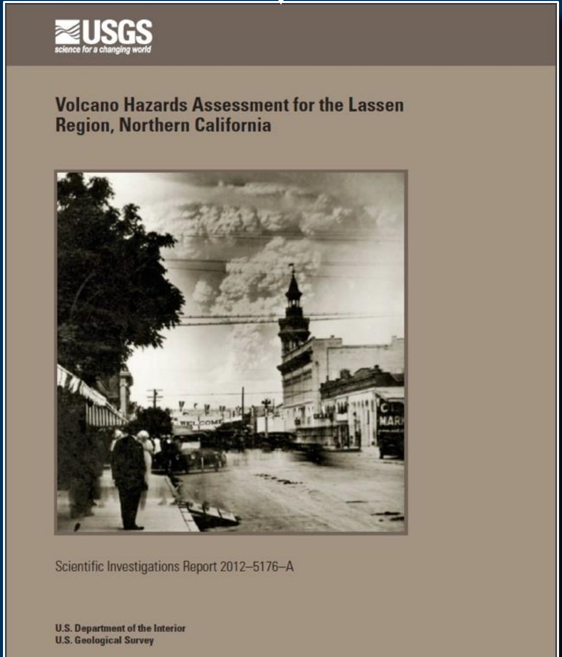
By Michael A. Clynne and L.J. Patrick Muffler

Pamphlet to accompany
Scientific Investigations Map 2899

Lassen Peak and the Devastated Area
Aerial view of Lassen Peak and the proximal Devastated Area looking south. Area with sparse trees marks the paths of the avalanche and debris-flow deposits of May 19–20, 1915 (unit sw9) and the pyroclastic-flow and fluid debris-flow deposits of May 22, 1915 (unit pw2) (Clynne and others, 1999; Christiansen and others, 2002). Small dark crags just to right of the summit are remnants of the May 19–20, 1915, lava flow (unit d9). The composite dacite dome of Lassen Peak (unit dl, 27±1 ka) dominates the upper part of the view. Lithic pyroclastic-flow deposit (unit pfl) from partial collapse of the dome of Lassen Peak is exposed in the canyon of the headwaters of Lost Creek in center of view. Ridges flanking central area are glacial moraines (unit Qta) thinly covered by deposits of the 1915 eruption of Lassen Peak (Christiansen and others, 2002). Small permanent snowfield is seen on the left lower slope of Lassen Peak. Area east of the snowfield is the rhyodacite lava flow of Kings Creek (unit rk, 35±1 ka, part of the Eagle Peak sequence). Dacite domes of Bumpass Mountain (unit db, 232±8 ka), Crescent Crater (unit dc, 236±1 ka), hill 8283 (unit d82, 261±5 ka), and Loomis Peak (unit rlm, ~300 ka) are part of the Bumpass sequence. *Photograph by Michael A. Clynne.*

2010

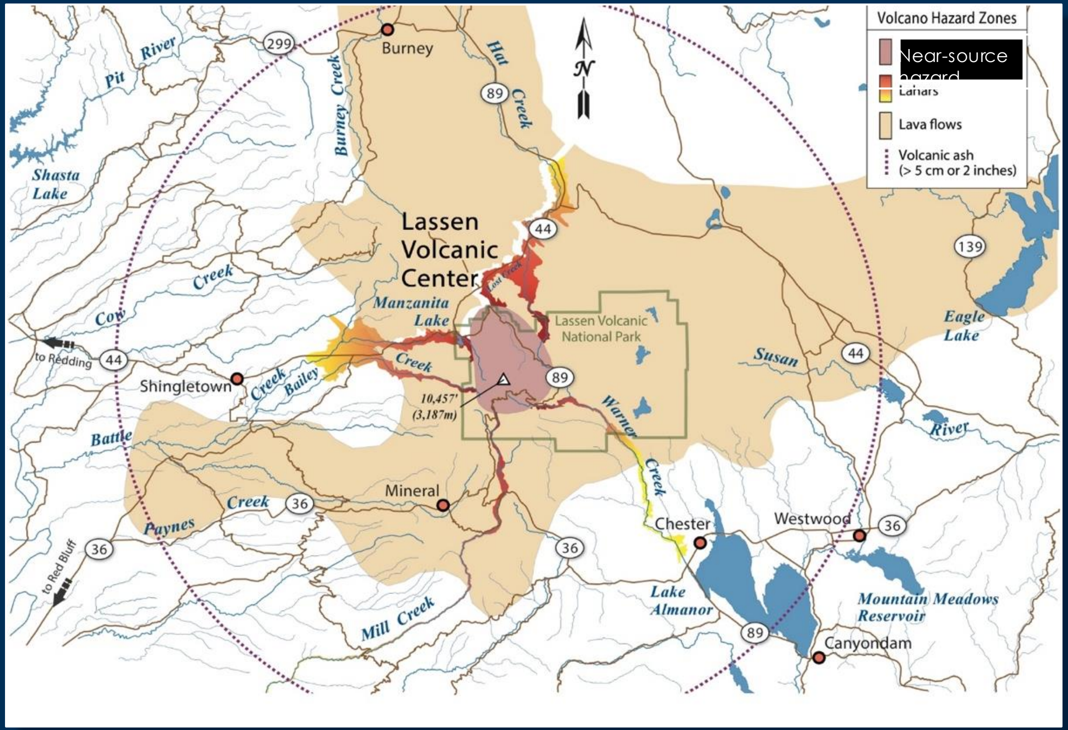
U.S. Department of the Interior
U.S. Geological Survey

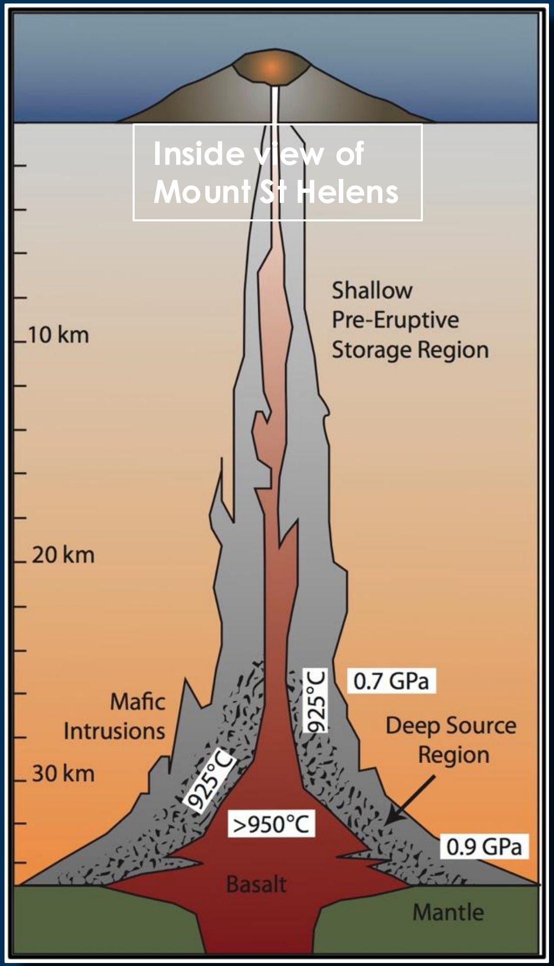

USGS
science for a changing world

Volcano Hazards Assessment for the Lassen Region, Northern California

Scientific Investigations Report 2012–5176–A

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





CalVO is a center of excellence for VSC laboratory-based research

SOME RECENT CALVO HIGHLIGHTS

- Long Valley tabletop exercise; expanding the pool of VSC staff with eruption response skills.
- Updated Clear Lake Hazard Assessment nearing completion.
- 2022-24 move to Moffett Field and decommissioning of Menlo Park is nearly complete.
- Hiring focus on critical lab and field skills.
- Planning for NVEWS expansions at priority volcanoes: Mono, Lassen, Shasta

Hawaiian Volcano Observatory

- Near constant unrest and eruption at Kilauea since 1983; a global laboratory for volcano studies.
- New paradigm of working from Hilo and forward stations in the Park; excellent working relationship with NPS and Hawaii County CD.
- Accessible eruptions are a proving ground for disaster supplemental-funded instrumentation including UAS, quantum gravimeter, lidar.
- Many staff hired after 2018 represent a new generation at HVO.

Sept 17, 2024

2018 Kīlauea Disaster-supplemental research projects

- Multiple, complex geophysical and geological investigations promise important new insights into Kīlauea

- 2018 eruption, 2022 Mauna Loa erution, and ongoing Kīlauea activity, significant new data sets to drive HVO, VSC, and partner science for years

Airborne electromagnetic mapping

New USGS facilities: occupancy ~ 2026

USGS
RESEARCH
CENTER
Hilo

HVO FIELD
STATION
Hawaii Volcanoes
National Park

SOME RECENT HVO HIGHLIGHTS

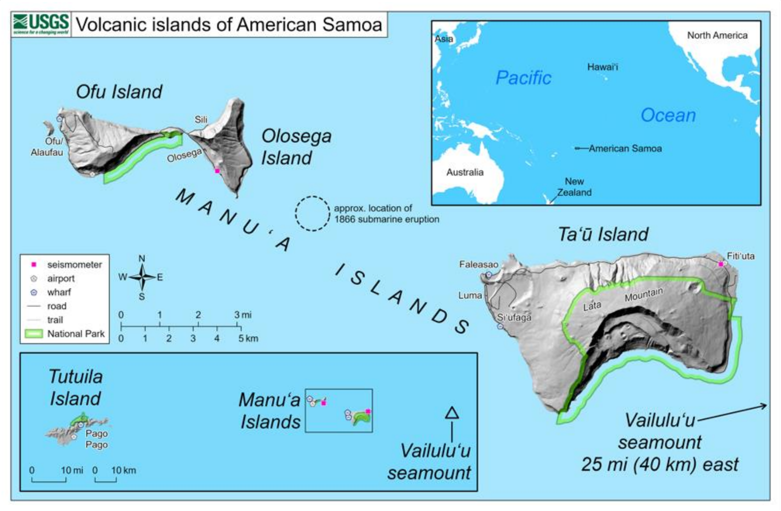
- Monitoring ongoing unrest and eruption at Kīlauea; ongoing deep seismic swarm at Pahala.

- Mauna Loa eruption 2022, successful pre-event outreach to those at risk, used new lava flow modelling informed hazard assessment during eruption, high altitude UAS flights.

- First HVO-NPS-Civil Defense interagency response plan completed 2024.

- Hiring focus on IT and Field Engineering.

- Addressing volcano hazards and unrest in American Samoa – 2022 seismic crisis, rudimentary monitoring in place, community engagement ongoing.



VOLCANO DISASTER ASSISTANCE PROGRAM

- 70 major crisis responses since 1986
- Assistance to ~19 countries

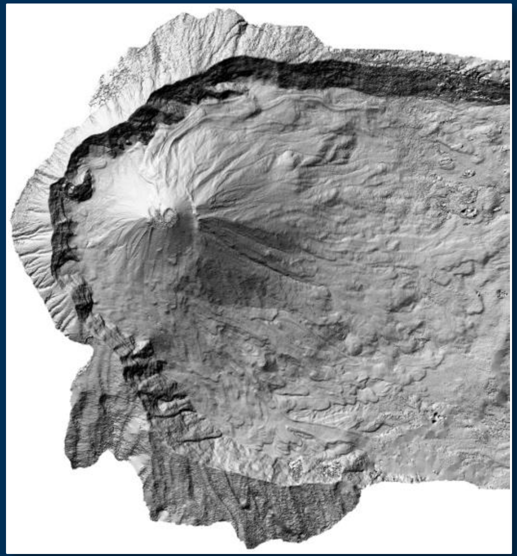
VDAP STATS

- ~25 full and part-time staff (most at CVO)
- VHP, USAID share salary equally (USAID covers all Operating Expenses)
- New 5-year agreement in FY23
- Divided into Engineering, Geophysics, Geochemistry and Geology, Remote Sensing and Photogrammetry teams, plus computer scientist, reporting and metrics.

VDAP ACTIVITIES

- Monitoring Network Donations and Assistance, Long-term capacity building and eruption response.
- Seismology, Geodesy, Geochemistry, Geology
- Hazard Assessments and Eruption Forecasts
- Mapping, Volcano Data, Probability Trees
- Training Workshops, Global Leadership,
  Int'l Field School with UHH
- Remote Sensing
- Reporting to USG (DOS, DOD, Embassies, etc.)

Sinabung, Indonesia



DEM with photogrammetry
Ecuador

SOME RECENT VDAP HIGHLIGHTS

- Remote responses in support of unrest Chiles-Cerro, Azores, and other volcanoes around the world
- Assisted with other VSC staff in Tonga response
- Post-covid resumption of onsite VDAP work across Latin America, South Pacific, Asia, Africa
- USAID-funded, daily global volcano report project initiated 2023
- Volcano Observatory Best Practices Workshop Nov 2023
- Support of domestic program: probability tree training, American Samoa crisis support

Looking ahead: Eruption-response planning has been a focus across the VSC

USGS

VSC eruption-response planning to improve stakeholder support and science outcomes

The VSC has managed significant responses to eruptions and significant volcanic unrest including:

- Mount St. Helens (1980, 2004-2008)
- Long Valley (1980)
- Mauna Loa (1984, 2022)
- Redoubt (1989, 2009)
- Spurr (1992, 2004)
- Augustine (1986, 2006)
- Bogoslof (2017)
- Kīlauea (1983-2018, 2020-2024)

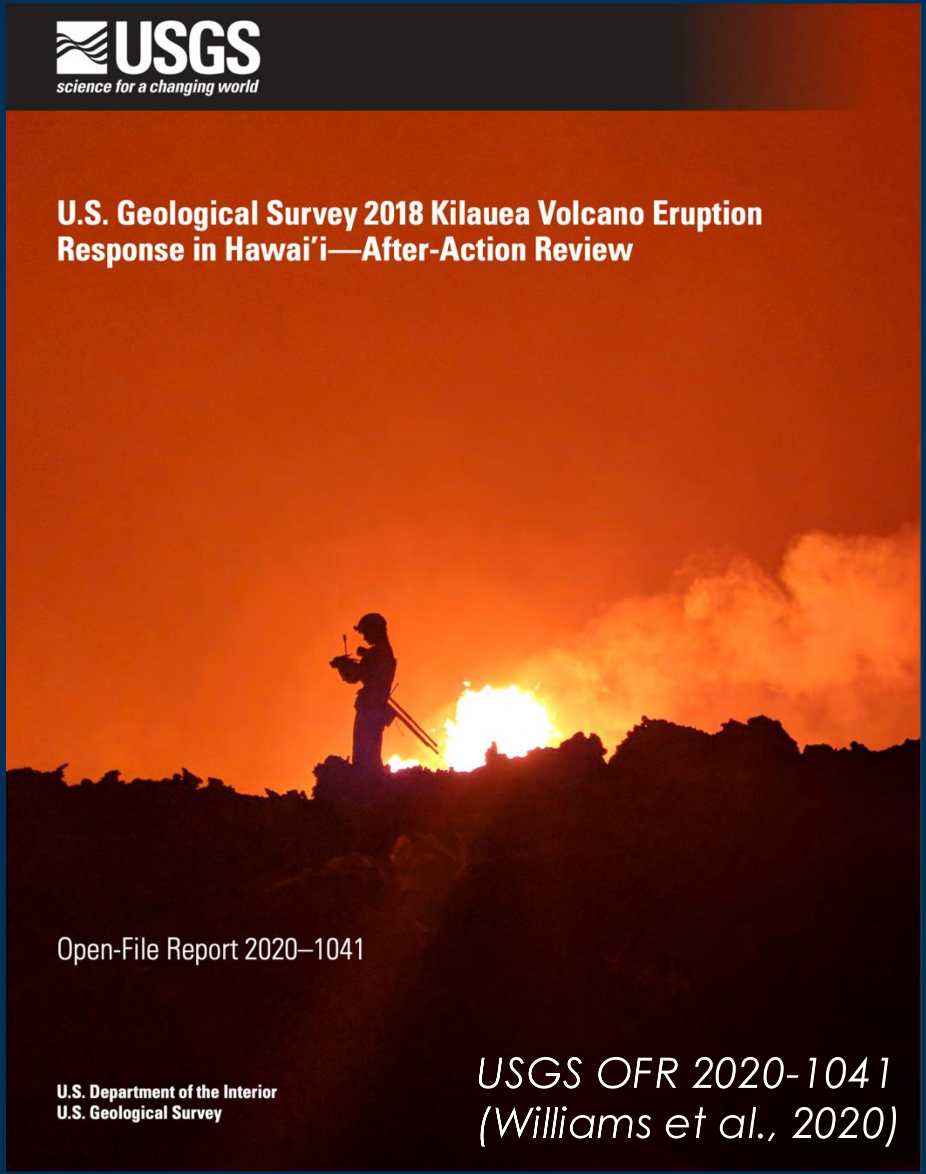
VSC eruption-response planning

- **All have been largely successful both scientifically and in terms of actionable information for stakeholders**
- **All have also had challenges, including:**
  - People having too much on their plates (bottlenecks, not everything getting done that needs to get done)
  - Occasional but significant difficulties with internal communications
  - Confusion over roles and responsibilities
  - Outside staff not fully knowing their roles or local cultural norms
  - Missed scientific opportunities

VSC eruption-response planning

- A principal cause of these challenges has been individuals and/or observatories getting overwhelmed
- Primary recommendation from 2018 Kīlauea after-action review:

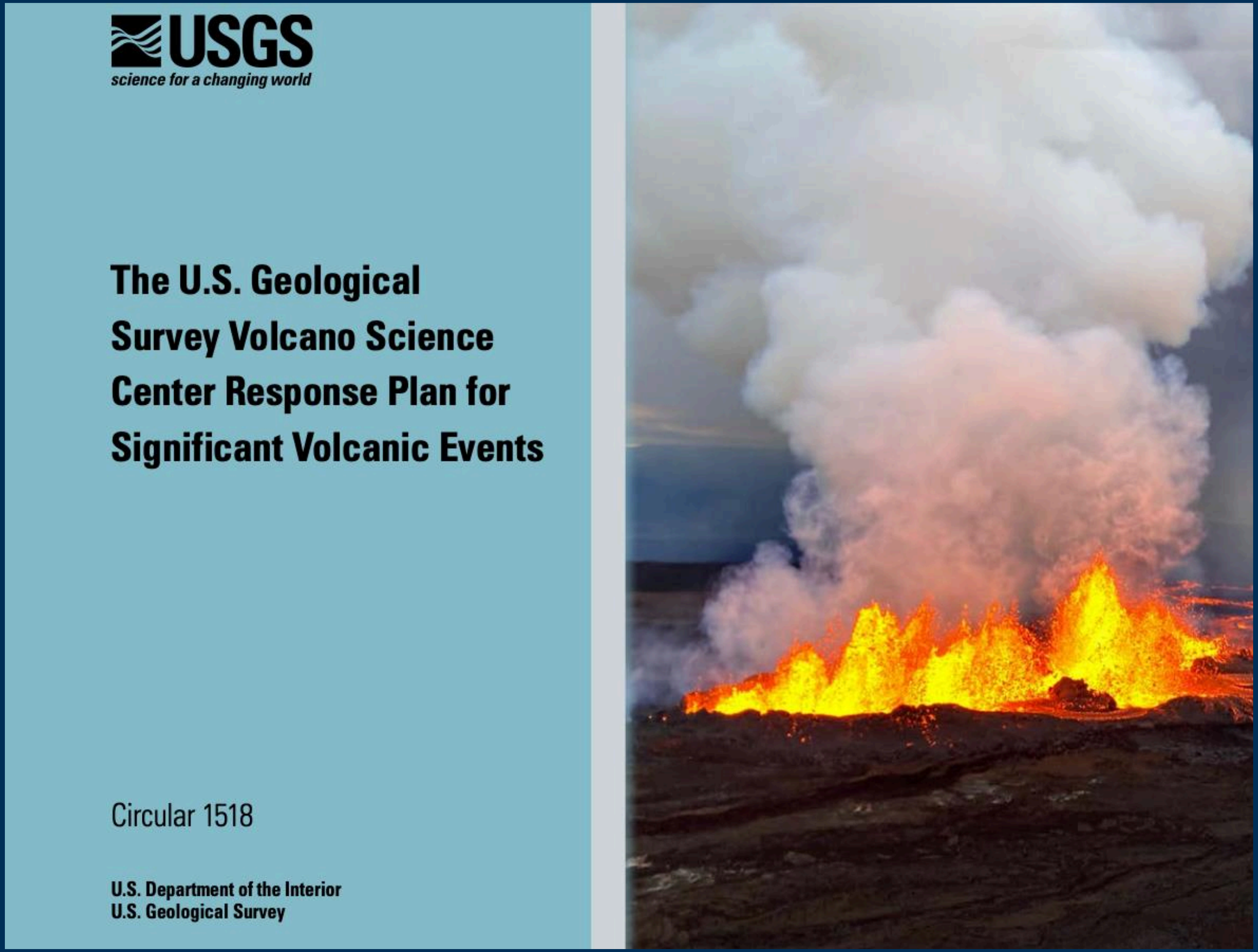
➔ ***The VSC and observatories need to have response plans***



USGS OFR 2020-1041 (Williams et al., 2020)

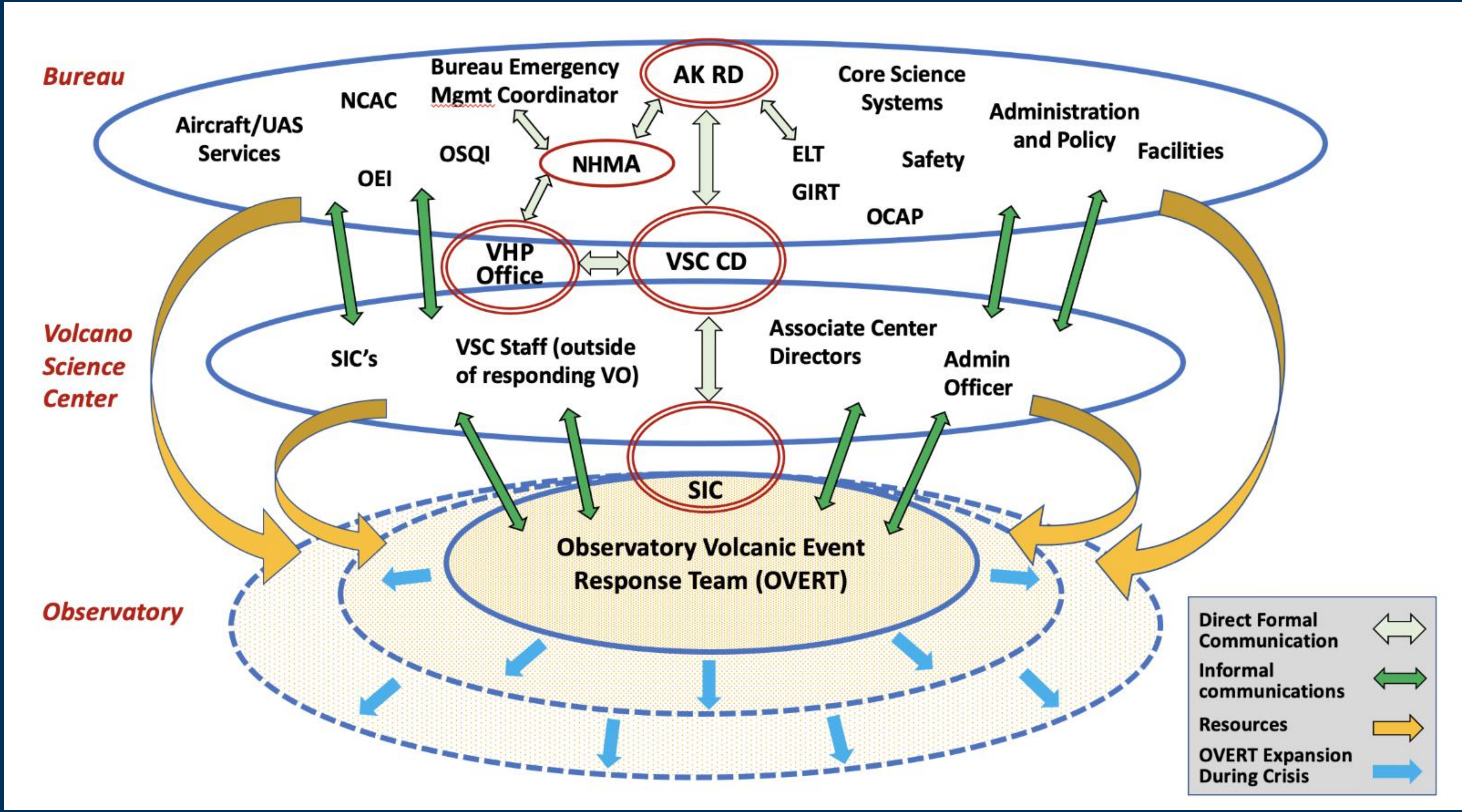
VSC eruption-response planning

- New VSC-wide umbrella response plan published in 2024
- Goals:
  - Pre-defined response roles with limited scope (to reduce overwhelm)
  - Create a transparent communication and decision-making system
  - Streamline decision-making through delegation
  - Ensure all bases are covered



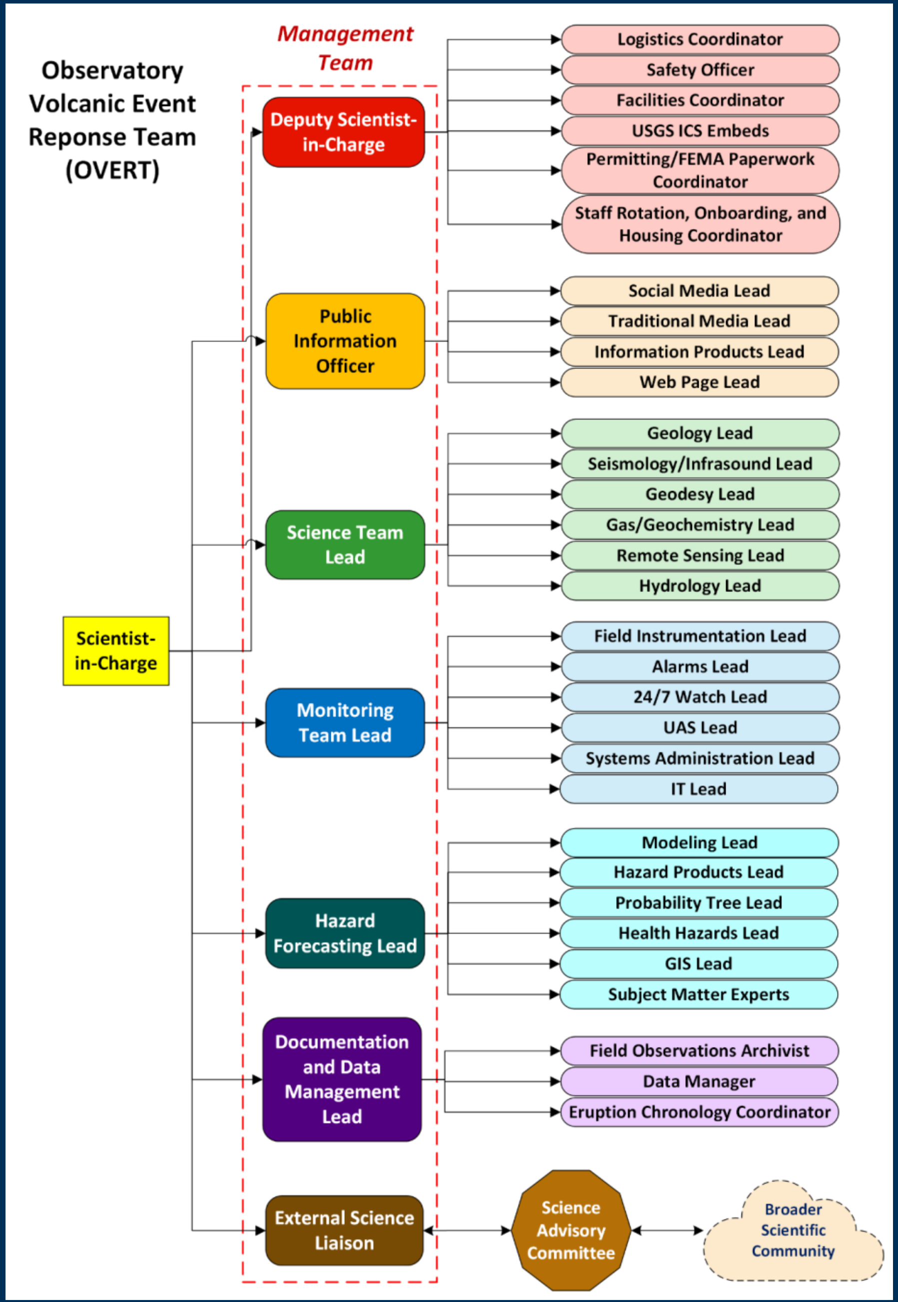
Moran et al., 2024

A new VSC eruption-response plan



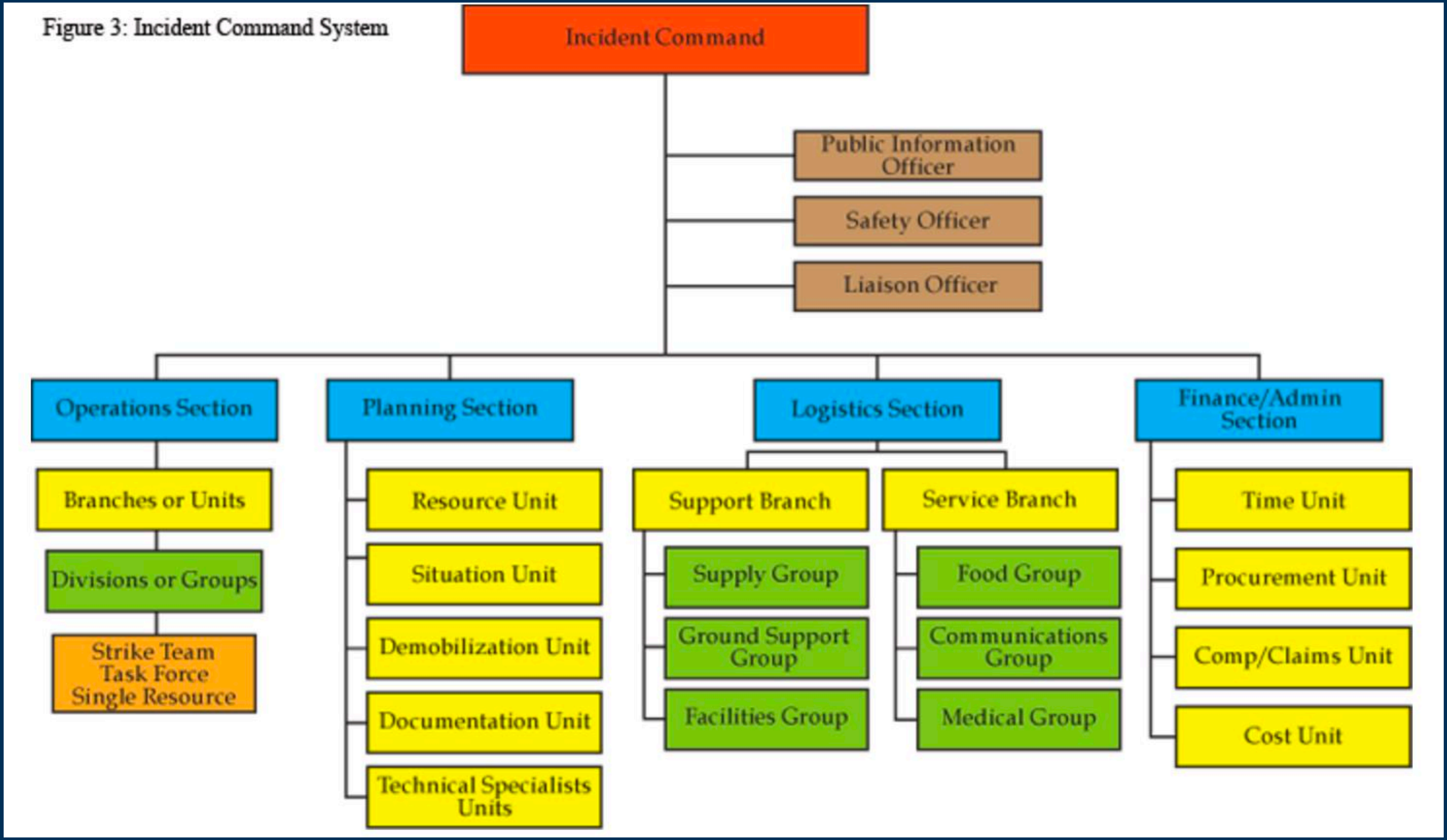
Moran et al., 2024

Observatory Volcanic Event Response Team (OVERT)

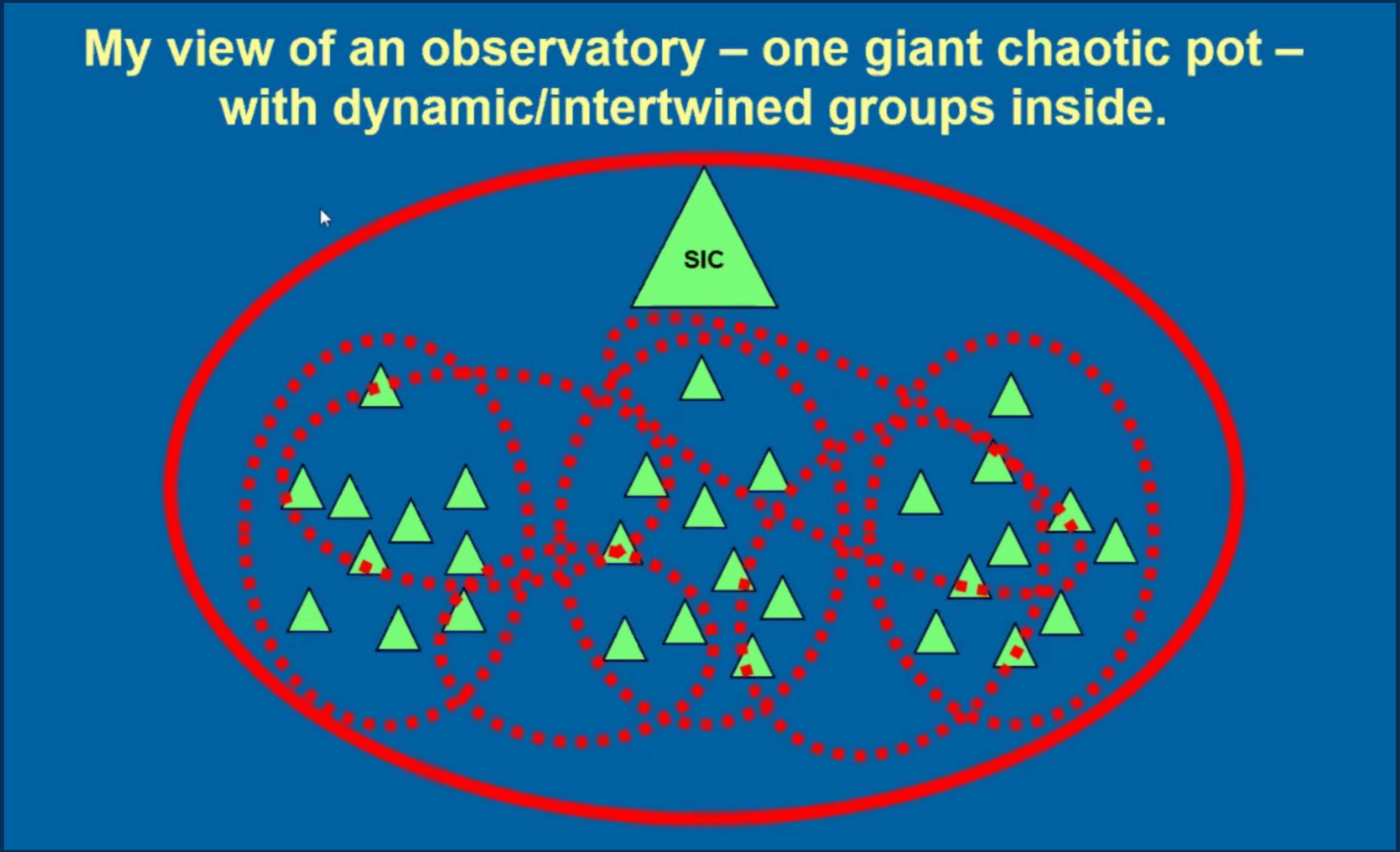


Moran et al., 2024

OVERT influenced by Incident Command System structure & philosophy

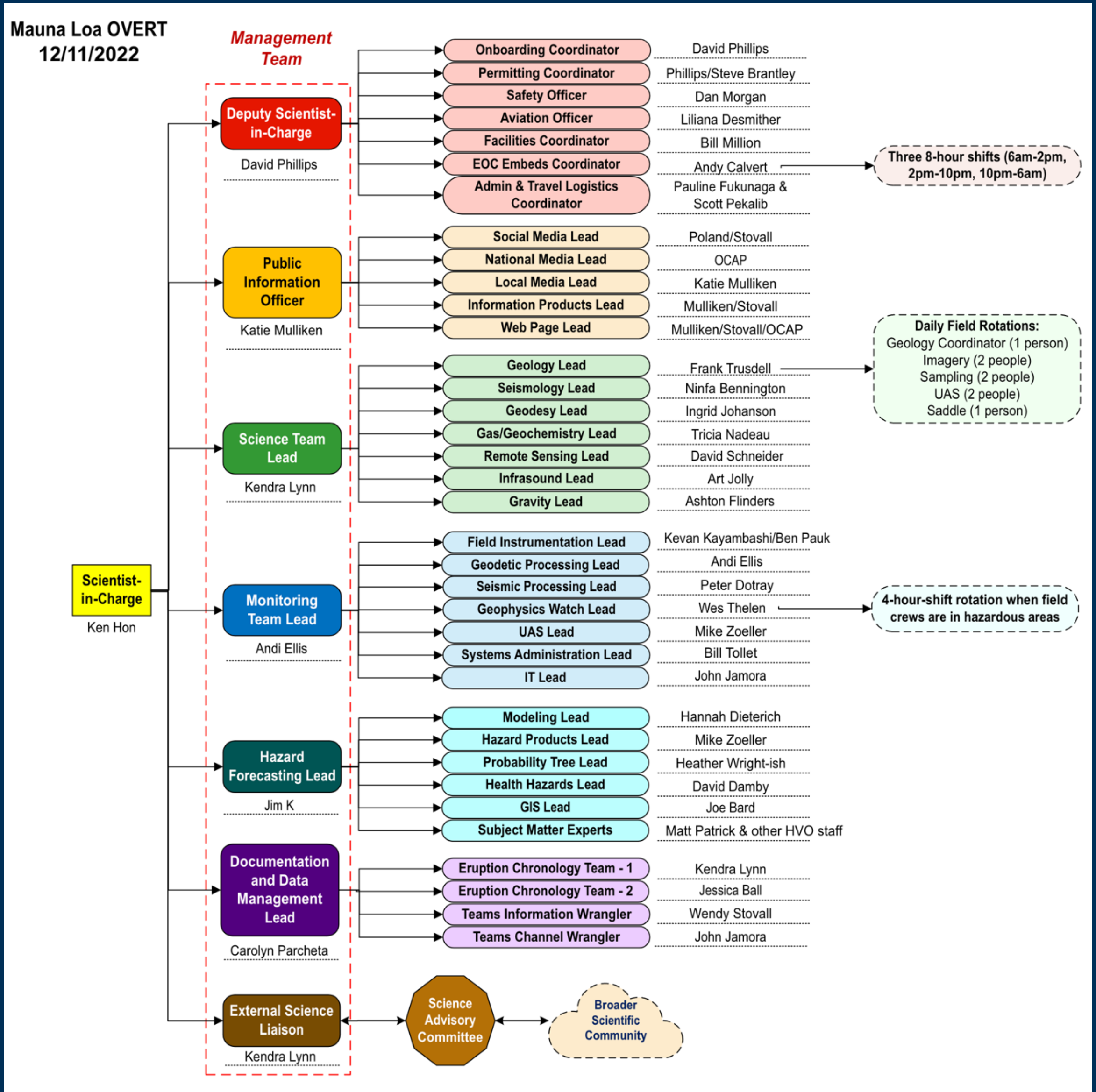


Primary challenge of crisis response is to transition from how VOs normally function…

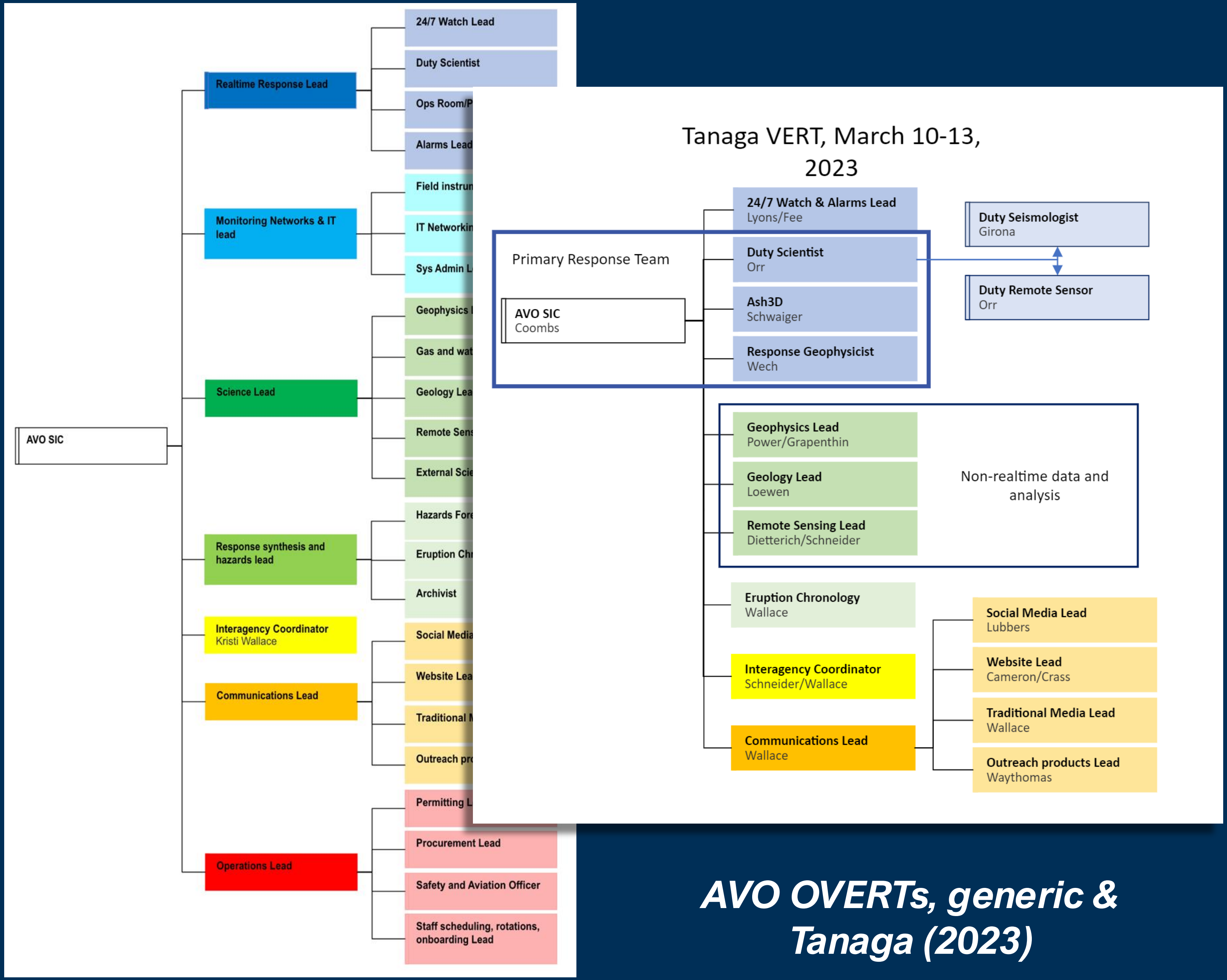


Tom Murray
Feb 3, 2022

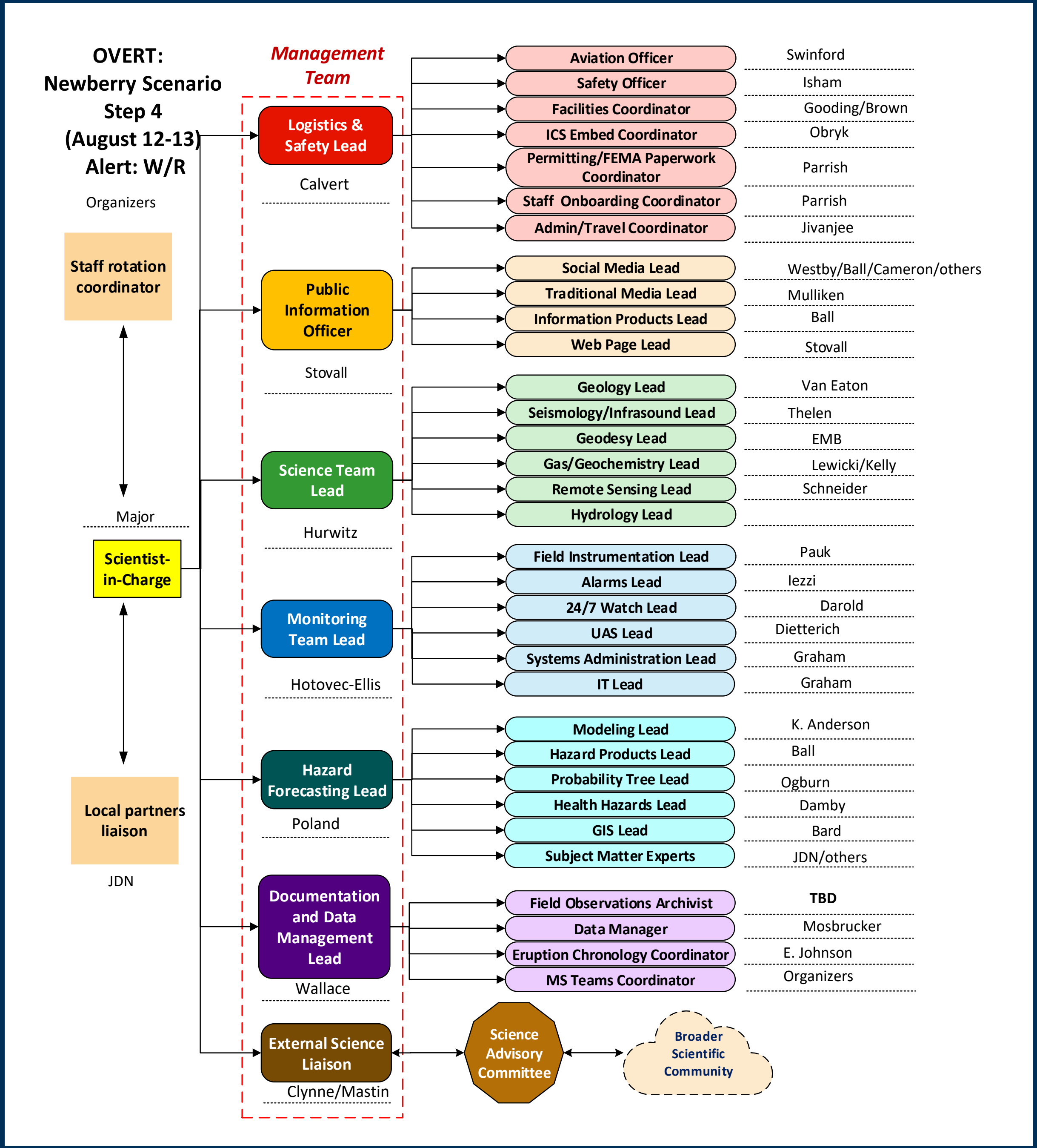
… to this



HVO OVERT
Mauna Loa 2022



AVO OVERTs, generic & Tanaga (2023)



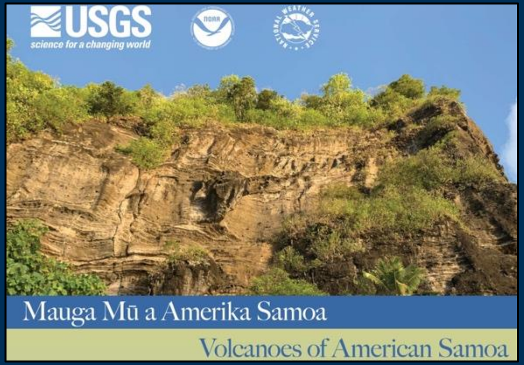
VSC Newberry tabletop exercise, April 2023

VSC looking ahead: some challenges

- Developing an effective hybrid workplace culture
- Hiring and retention: IT/CS positions, replacing lost research capacity
- Organizational structure: developing the right architecture for NVEWS and growth
- Facility flux: settling in at Moffett, new HVO buildings, facility cost increases
- Funding: end of disaster supplementals, increasing O/M each year
- Controlling network O/M costs: we need a long-term funding/HR model that maintains a vibrant research staff and sustainable NVEWS infrastructure and services

VSC looking ahead: opportunities

- NVEWS is a ready bucket for new funding and we have a plan; NOAA is now an NVEWS partner, and partnerships with many other groups are strong.
- FY22 funding bump jumpstarted the NVIS.
- We have an outstanding earlier-career cohort across VSC.



- Tonga and American Samoa activity - catalysts for new science and constituencies
- Broad interest in distributed volcanism in the SW – growth area.
- We are actively planning for the next big eruption, both internally and to improve coordination with academia


Thank you!
Questions/Discussion?

Lunch at HUB
Return at 1:30 p.m.

Write questions or comments on sticky notes to discuss when we return from lunch.

Food for thought:

- What is something new you learned about the USGS Volcano Hazards Program or the Volcano Science Center?
- What are you hoping to get out of this meeting?

Discussion

Introduction to the National Volcano Early Warning System

SETH MORAN

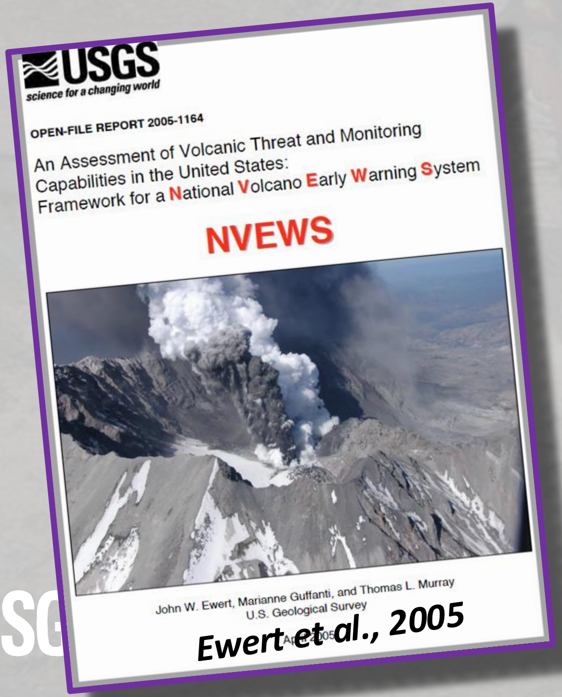
NVEWS – Where are we, and where are we going?

Seth Moran – NVEWS Program Coordinator

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

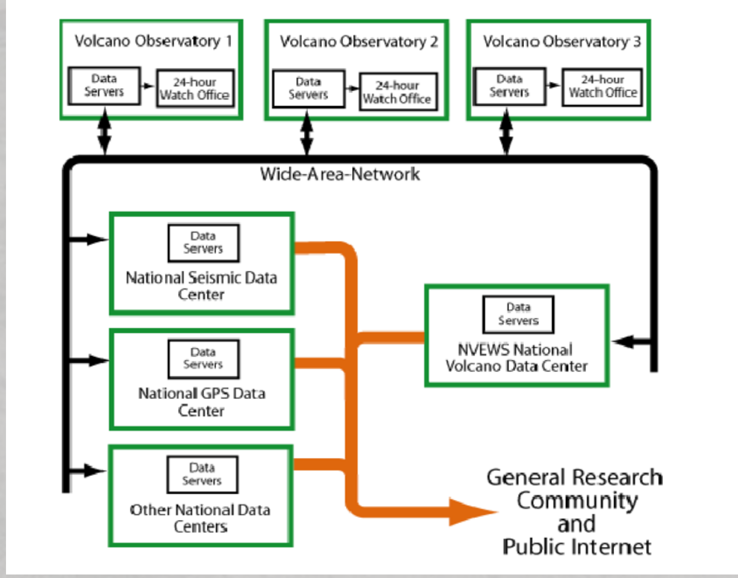
NVEWS: A Brief History

- **02/2004** – Meeting @ CVO to discuss “National Volcano Monitoring System” (later changed to “Early Warning System” for political reasons)
- **09/2004 –** MSH eruption brings WA Congressional interest in NVEWS
- **2005** – “An Assessment of Volcanic Threat and Monitoring Capabilities in the United States: Framework for a National Volcano Early Warning System”, by Ewert, Guffanti, & Murray



Ewert et al., 2005

- *First “Volcano Threat” ranking*
- *Monitoring gap analysis (based on instrumentation #s from 2004 meeting)*
- *Proposed creation of 24/7 Watch Office, External Grants Program, & National Volcano Data Center*



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.

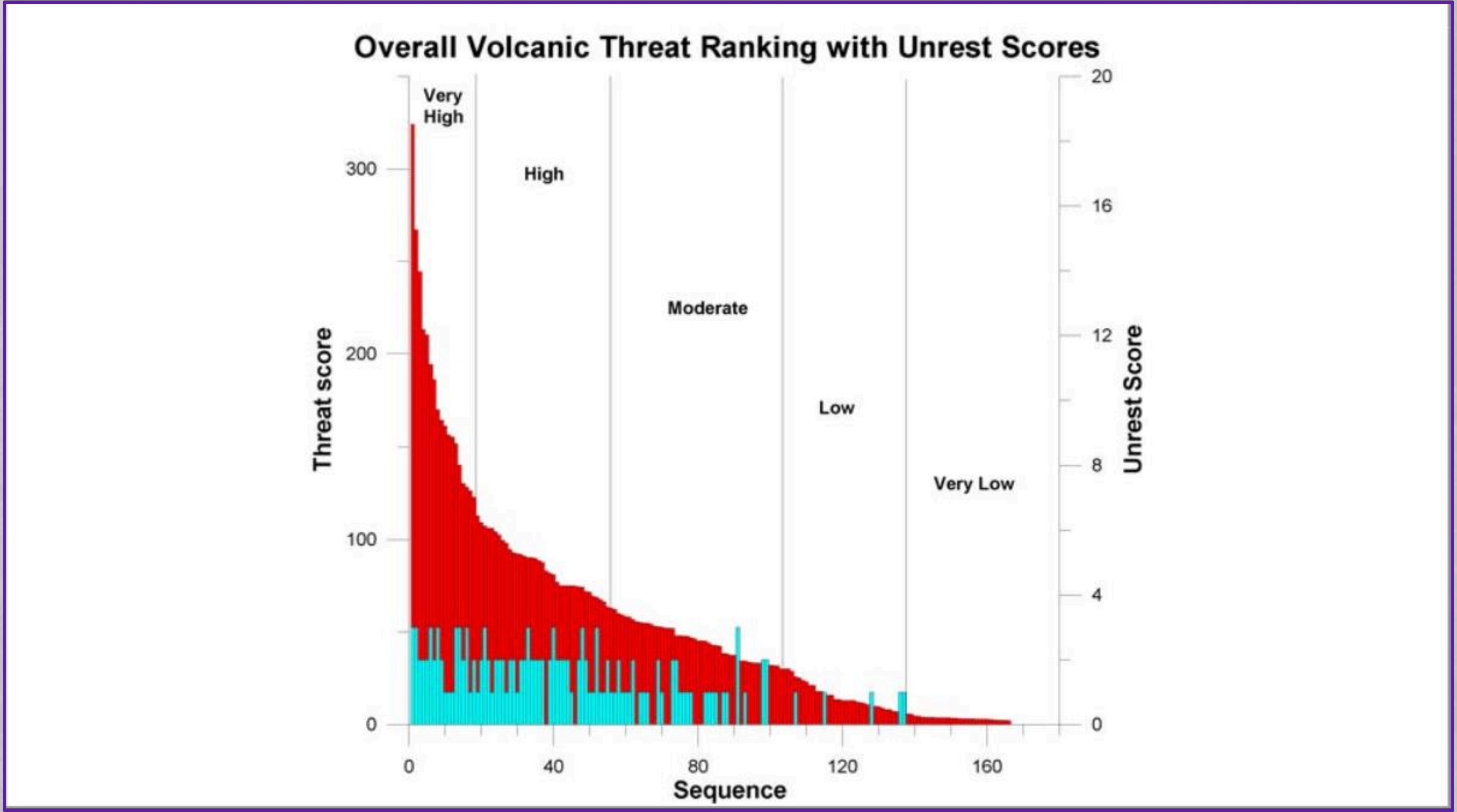
Hazard Factors	**Scoring Ranges**
Volcano type	0 or 1
Maximum Volcanic Explosivity Index	0 to 3
Explosive activity in past 500 years?	0 or 1
Major explosive activity in past 5000 years?	0 or 1
Eruption recurrence	0 to 4
Holocene pyroclastic flows?	0 or 1
Holocene lahars?	0 or 1
Holocene lava flow?	0 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

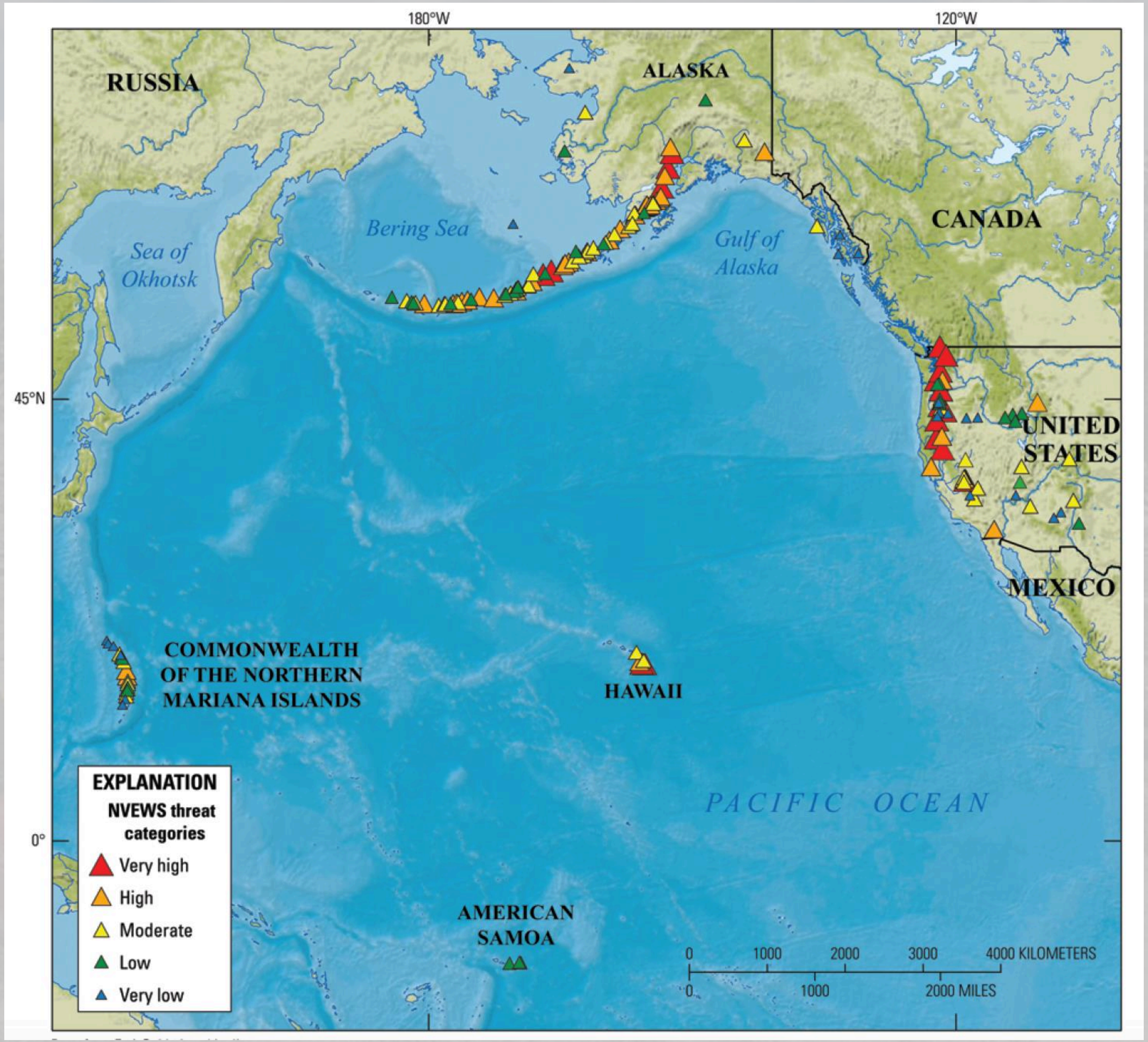


Ewert et al., 2005

USGS

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., American Samoa)



Ewert et al., 2018

Table 3. U.S. volcanoes listed by state/territory and threat groups.

[CNMI, Commonwealth of the Northern Mariana Islands; St., saint]

State/ territory	Threat group				
	Very high	High	Moderate	Low	Very low
Alaska	Akutan Island, Augustine Volcano, Makushin, Redoubt Volcano, Mount Spurr	Aniakchak Crater, Atka volcanic complex, Mount Churchill, Mount Cleveland, Mount Douglas, Fisher Caldera, Fourpeaked Mountain, Great Sitkin Volcano, Mount Griggs, Hayes Volcano, Iliamna Volcano, Kaguyak Crater, Kanaga Volcano, Kasatochi Island, Mount Katmai, Korovin Volcano, Mount Mageik, Mount Martin, Mount Moffett, No Seguam Isla cano, Snow volcanic co	Mount Adagdak, Amukta Island, Black Peak, Bogoslof Island, Mount Chiginagak, Mount Dana, Mount Denison, Mount Dutton, Mount Edgecumbe, Emmons Lake, Mount Gareloi, Frosty Peak, Kiska Volcano, Kagamil Volcano, Kialigvik, Kukak Volcano, Mount Kupreanof, Little Sitkin Island, Pavlof Sister,	Amak Island, Bobrof, Buldir Volcano, Buzzard Creek, Carlisle Island, Chagulak Island, Davidof Island, Herbert Island, Ingakslugwat Hills, Koniuji Island, land, Stepovak p, Tana, Uliaga nnamed, Wide	Behm Canal-Rudyerd Bay, Duncan Canal, Imuruk Lake, St. Paul Island, Tlevak Strait-Suemez Island
Washington	Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens	Mount Adams		en, West Crater	
Oregon	Crater Lake, Mount Hood, Newberry Volcano, Three Sisters			ater, Blue Lake ount Jefferson	Cinnamon Butte, Davis Lake, Devils Garden, Diamond Craters, Jordan Craters, Sand Mountain volcanic field
Idaho				e Moon, Hells e, Black Butte apí Flow	
California	Lassen volcanic center, Long Valley Caldera, Mount Shasta	Clear Lake vo Lake, Salto			Golden Trout Creek volcanic field
Nevada					
Wyoming		Yellowstone caldera			
Colorado			Dotsero		
New Mexico			Valles Caldera	Carrizozo Mountain	Red Hill-Quemado volcanic field, Zuni-Bandera volcanic field
Utah			Black Rock Desert	Markagunt Plateau	
Arizona			San Francisco Volcanic Field		Uinkaret volcanic field
Hawaii	Kīlauea, Mauna Loa	Hualālai	Haleakalā, Mauna Kea		
CNMI		Agrigan Island, Pagan Island	Alamagan Island, Anatahan Island, Asuncion Island, East Diamante, Farallon de Pajaros, Guguan Island, Sarigan Island	Maug Islands, South Sarigan seamount, Supply Reef, Zealandia Bank	Ahyi Seamount, Daikoku seamount, Esmeralda Bank, Fukujin seamount, Kasuga 2, Ruby
American Samoa				Tutuila Island, Ofu-Olosega, Taʻū Island	

- **18 Very-High-Threat Volcanoes**
  - **5 in Alaska**
  - **4 in Washington**
  - **4 in Oregon**
  - **3 in California**
  - **2 in Hawai'i**

USGS

Ewert et al., 2018

Table 3. U.S. volcanoes listed by state/territory and threat groups.

[CNMI, Commonwealth of the Northern Mariana Islands; St., saint]

State/ territory	Threat group				
	Very high	High	Moderate	Low	Very low
Alaska	Akutan Island, Augustine Volcano, Makushin, Redoubt Volcano, Mount Spurr	Aniakchak Crater, Atka volcanic complex, Mount Churchill, Mount Cleveland, Mount Douglas, Fisher Caldera, Fourpeaked Mountain, Great Sitkin Volcano, Mount Griggs, Hayes Volcano, Iliamna Volcano, Kaguyak Crater, Kanaga Volcano, Kasatochi Island, Mount Katmai, Korovin Volcano, Mount Mageik, Mount Martin, Mount Moffett, No… Seguam Isla… cano, Snow… volcanic co…	Mount Adagdak, Amukta Island, Black Peak, Bogoslof Island, Mount Chiginagak, Mount Dana, Mount Denison, Mount Dutton, Mount Edgecumbe, Emmons Lake, Mount Gareloi, Frosty Peak, Kiska Volcano, Kagamil Volcano, Kialigvik, Kukak Volcano, Mount Kupreanof, Little Sitkin Island, Pavlof Sister, …	Amak Island, Bobrof, Buldir Volcano, Buzzard Creek, Carlisle Island, Chagulak Island, Davidof Island, Herbert Island, Ingakslugwat Hills, Koniuji Island, …land, Stepovak …, Tana, Uliaga …nnamed, Wide	Behm Canal-Rudyerd Bay, Duncan Canal, Imuruk Lake, St. Paul Island, Tlevak Strait-Suemez Island
Washington	Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens	Mount Adams…	…	…en, West Crater	
Oregon	Crater Lake, Mount Hood, Newberry Volcano, Three Sisters	…	…	…ater, Blue Lake …ount Jefferson	Cinnamon Butte, Davis Lake, Devils Garden, Diamond Craters, Jordan Craters, Sand Mountain volcanic field
Idaho		…	…	…e Moon, Hells …e, Black Butte …api Flow	
California	Lassen volcanic center, Long Valley Caldera, Mount Shasta	Clear Lake volcanic field, Mono-Inyo Craters, Medicine Lake, Salton Buttes	Coso volcanic field, Mono Lake volcanic field, Mammoth Mountain, Ubehebe Crater		Golden Trout Creek volcanic field
Nevada			Soda Lakes		
Wyoming		Yellowstone caldera			
Colorado			Dotsero		
New Mexico			Valles Caldera	Carrizozo Mountain	Red Hill-Quemado volcanic field, Zuni-Bandera volcanic field
Utah			Black Rock Desert	Markagunt Plateau	
Arizona			San Francisco Volcanic Field		Uinkaret volcanic field
Hawaii	Kīlauea, Mauna Loa	Hualālai	Haleakalā, Mauna Kea		
CNMI		Agrigan Island, Pagan Island	Alamagan Island, Anatahan Island, Asuncion Island, East Diamante, Farallon de Pajaros, Guguan Island, Sarigan Island	Maug Islands, South Sarigan seamount, Supply Reef, Zealandia Bank	Ahyi Seamount, Daikoku seamount, Esmeralda Bank, Fukujin seamount, Kasuga 2, Ruby
American Samoa				Tutuila Island, Ofu-Olosega, Taʻū Island	

- **18 Very-High-Threat Volcanoes**
  - **Of these, 12 have experienced eruptions or significant unrest since 2000**

Ewert et al., 2018

Table 3. U.S. volcanoes listed by state/territory and threat groups.

[CNMI, Commonwealth of the Northern Mariana Islands; St., saint]

State/ territory	Threat group: Very high	High	Moderate	Low	Very low
Alaska	Akutan Island, Augustine Volcano, Makushin, Redoubt Volcano, Mount Spurr	Aniakchak Crater, Atka volcanic complex, Mount Churchill, Mount Cleveland, Mount Douglas, Fisher Caldera, Fourpeaked Mountain, Great Sitkin Volcano, Mount Griggs, Hayes Volcano, Iliamna Volcano, Kaguyak Crater, Kanaga Volcano, Kasatochi Island, Mount Katmai, Korovin Volcano, Mount Mageik, Mount Martin, Mount Moffett, Novarupta, Mount Okmok, Pavlof Volcano, Seguam Island, Semisopochnoi Island, Shishaldin Volcano, Snowy Mountain, Trident Volcano, Ugashik-Peulik volcanic complex, Mount Veniaminof, Westdahl Peak	Mount Adagdak, Amukta Island, Black Peak, Bogoslof Island, Mount Chiginagak, Mount Dana, Mount Denison, Mount Dutton, Mount Edgecumbe, Emmons Lake, Mount Gareloi, Frosty Peak, Kiska Volcano, Kagar Mount Kup Mount Rec Steller, St. M Tanaga Vol Mount Wra	Amak Island, Bobrof, Buldir Volcano, Buzzard Creek, Carlisle Island, Chagulak Island, Davidof Island,	Behm Canal-Rudyerd Bay, Duncan Canal, Imuruk Lake, St. Paul Island, Tlevak Strait-Suemez Island
Washington	Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens	Mount Adams			
Oregon	Crater Lake, Mount Hood, Newberry Volcano, Three Sisters		Mount Bache		
Idaho					
California	Lassen volcanic center, Long Valley Caldera, Mount Shasta	Clear Lake volcanic field, Mono-Inyo Craters, Medicine Lake, Salton Buttes	Coso volcanic Mammoth		
Nevada			Soda Lakes		
Wyoming		Yellowstone caldera			
Colorado			Dotsero		
New Mexico			Valles Caldera		
Utah			Black Rock D		
Arizona			San Francisco		
Hawaii	Kīlauea, Mauna Loa	Hualālai	Haleakalā, Mauna Kea		
CNMI		Agrigan Island, Pagan Island	Alamagan Island, Anatahan Island, Asuncion Island, East Diamante, Farallon de Pajaros, Guguan Island, Sarigan Island	Maug Islands, South Sarigan seamount, Supply Reef, Zealandia Bank	Ahyi Seamount, Daikoku seamount, Esmeralda Bank, Fukujin seamount, Kasuga 2, Ruby
American Samoa				Tutuila Island, Ofu-Olosega, Ta'ū Island	

- **39 High-Threat Volcanoes**
  - ➢ 30 in Alaska
  - ➢ 1 in Washington
  - ➢ 0 in Oregon
  - ➢ 4 in California
  - ➢ 1 in Hawai'i
  - ➢ 1 in Wyoming (Yellowstone)
  - ➢ 2 in the Marianas

USGS

Ewert et al., 2018

Table 3. U.S. volcanoes listed by state/territory and threat groups.

[CNMI, Commonwealth of the Northern Mariana Islands; St., saint]

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Washington	Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens	Mount Adams			
Oregon	Crater Lake, Mount Hood, Newberry Volcano, Three Sisters		Mount Bachel…		
Idaho				… Half Acre, Black Butte Crater, Wapi Flow	
California	Lassen volcanic center, Long Valley Caldera, Mount Shasta	Clear Lake volcanic field, Mono-Inyo Craters, Medicine Lake, Salton Buttes	Coso volcanic field, Mono Lake volcanic field, Mammoth Mountain, Ubehebe Crater		Golden Trout Creek volcanic field
Nevada			Soda Lakes		
Wyoming		Yellowstone caldera			
Colorado			Dotsero		
New Mexico			Valles Caldera	Carrizozo Mountain	Red Hill-Quemado volcanic field, Zuni-Bandera volcanic field
Utah			Black Rock Desert	Markagunt Plateau	
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American Samoa				Tutuila Island, Ofu-Olosega, Taʻū Island	

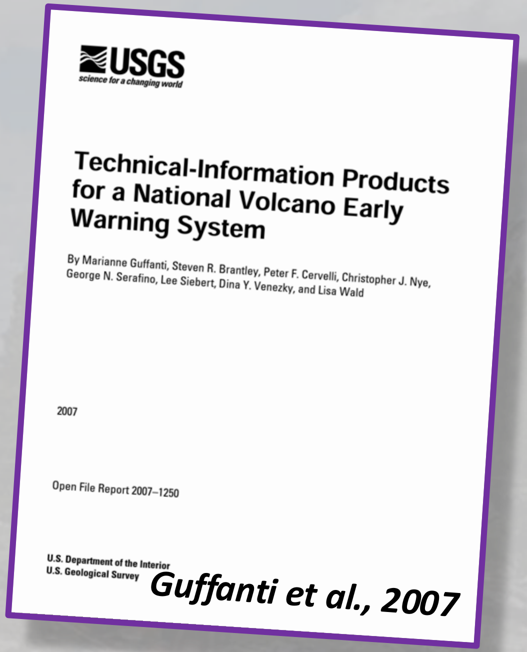
- **39 High-Threat Volcanoes**
  - **Of these, ~17 have experienced eruptions or significant unrest since 2000 (mostly in Alaska)**

USGS

Ewert et al., 2018

NVEWS: A Brief History

- **2006 –** Augustine eruption -- the first high-profile eruption since NVEWS concept first articulated
- **2007 –** "Technical-Information Products for a National Volcano Early Warning System" by Guffanti et al.
- **2008** – "Instrumentation Recommendations for Volcano Monitoring at U.S. Volcanoes under the National Volcano Early Warning System" by Moran et al.
    - ***Instrumentation types/numbers based on enabling capabilities demonstrably important for giving early warning at at least one volcano***
    - ***Instrumentation levels defined for different "Volcano Threat" levels***


USGS
science for a changing world

Technical-Information Products for a National Volcano Early Warning System

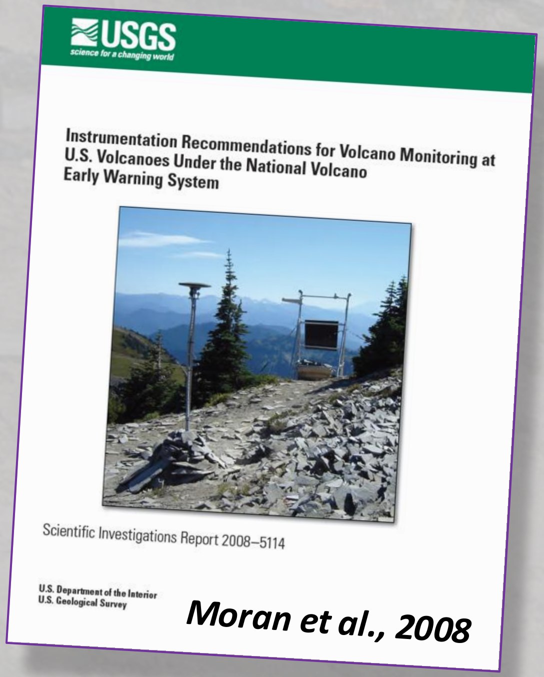
By Marianne Guffanti, Steven R. Brantley, Peter F. Cervelli, Christopher J. Nye, George N. Serafino, Lee Siebert, Dina Y. Venezky, and Lisa Wald

2007

Open File Report 2007–1250

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

Guffanti et al., 2007


USGS
science for a changing world

Instrumentation Recommendations for Volcano Monitoring at U.S. Volcanoes Under the National Volcano Early Warning System

Scientific Investigations Report 2008–5114

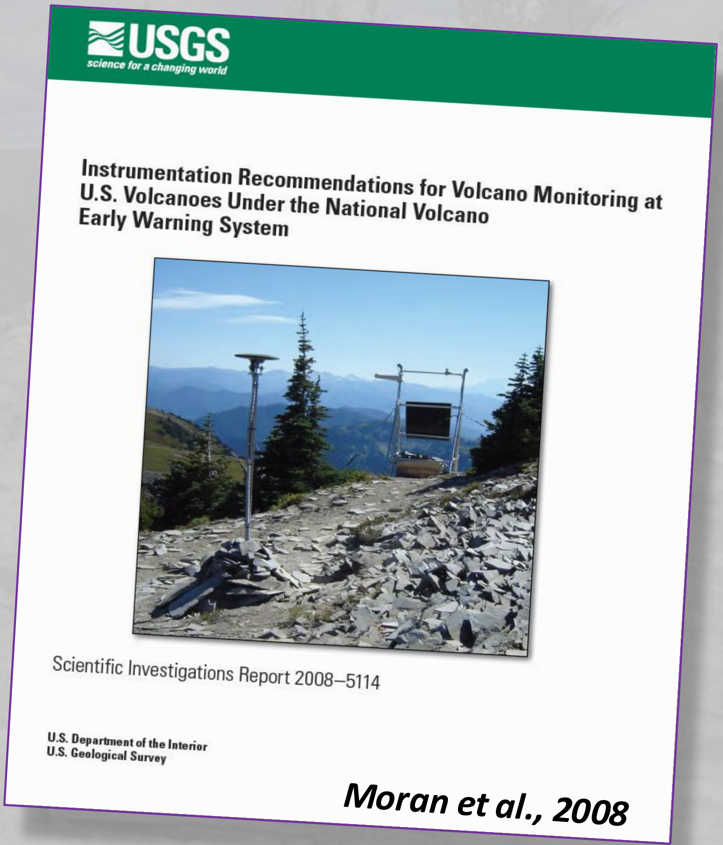
U.S. Department of the Interior
U.S. Geological Survey

Moran et al., 2008

USGS

NVEWS: A Brief History

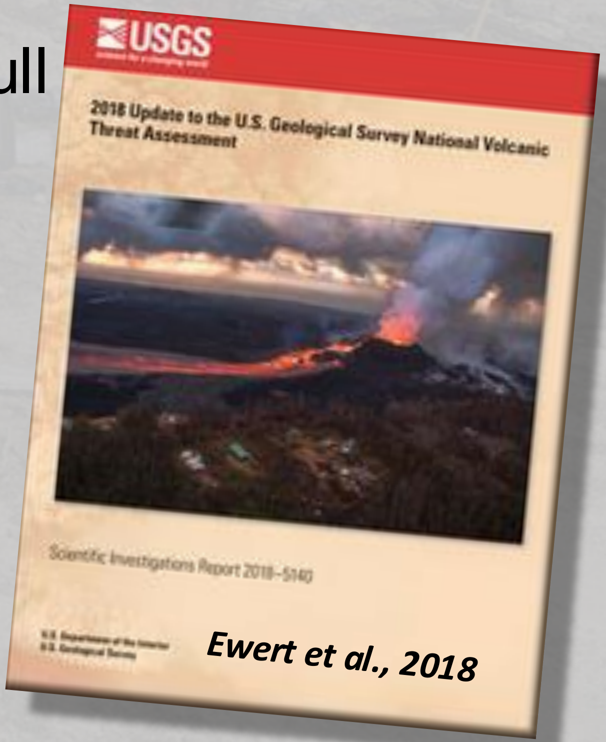
- **Instrumentation recommendations for volcano monitoring networks @ VHT/HT volcanoes**
  - ***Seismic:*** 12-25 stations within 20 km incl. 4 within 5 km
  - ***GNSS:*** 16-20 stations within 20 km incl. 8 within 5-10 km (along with regular InSAR & campaign measurements)
  - **Infrasound:** 4 single sensors w/ in 10 km & 2 four-element arrays within 15 km
  - **Gas:** Several real-time stations on actively degassing volcanoes
  - ***Shallow Marine:*** 4 seismometers (OBS, hydrophones) plus several infrasound on nearby islands.



USGS

NVEWS: A Brief History

- **2009** – ARRA stimulus funding provides boost for all VOs to do NVEWS work
- **2010 –** Senate Energy and Natural Resources Committee (SENRC) approves S.782 (”The NVEWS Act”) & sends to the full Senate. No vote taken.
- **2013** – S.1582 (“The NVEWS Act of 2013”) introduced to Senate Science & Technology Committee; no vote taken.
- **2017** – SENRC sends S.346 (“The NVEWS Act”) to the full passes bill on 05/17/2018. No vote taken in the House.
- **2018 –** “2018 update to the U.S. Geological Survey national volcanic threat assessment” published by Ewert et al.



NVEWS: A Brief History

- **2019** – NVEWS authorization introduced by Senators Murkowski (AK) and Cantwell (WA) as part of the “John D. Dingell Jr. Conservation Act”. Senate and House approve the bill February 2019, President Trump signs it into law March 2019.

What NVEWS is – the Congressional Authorization:

- **Signed into law in March 2019 as part of the John D. Dingell Jr. Conservation, Management, and Recreation Act (P.L. 116-9, Section 5001)**
- **Authorized at $55 million total ($11 million annually)**
- **Authorization expired at the end of FY2023**

133 STAT. 766 PUBLIC LAW 116–9—MAR. 12, 2019

Subtitle E—Miscellaneous

16 USC 7931. **SEC. 4401. RESPECT FOR TREATIES AND RIGHTS.**

Nothing in this title or the amendments made by this title—
(1) affects or modifies any treaty or other right of any federally recognized Indian Tribe; or
(2) modifies any provision of Federal law relating to migratory birds or to endangered or threatened species.

16 USC 7932. **SEC. 4402. NO PRIORITY.**

Nothing in this title or the amendments made by this title provides a preference to hunting, fishing, or recreational shooting over any other use of Federal land or water.

16 USC 7933. **SEC. 4403. STATE AUTHORITY FOR FISH AND WILDLIFE.**

Nothing in this title—
(1) authorizes the Secretary of Agriculture or the Secretary to require Federal licenses or permits to hunt and fish on Federal land; or
(2) enlarges or diminishes the responsibility or authority of States with respect to fish and wildlife management.

TITLE V—HAZARDS AND MAPPING

43 USC 31k. **SEC. 5001. NATIONAL VOLCANO EARLY WARNING AND MONITORING SYSTEM.**

(a) DEFINITIONS.—In this section:
(1) SECRETARY.—The term "Secretary" means the Secretary, acting through the Director of the United States Geological Survey.
(2) SYSTEM.—The term "System" means the National Volcano Early Warning and Monitoring System established under subsection (b)(1)(A).
(b) NATIONAL VOLCANO EARLY WARNING AND MONITORING SYSTEM.—
(1) ESTABLISHMENT.—
(A) IN GENERAL.—The Secretary shall establish within the United States Geological Survey a system, to be known as the "National Volcano Early Warning and Monitoring System", to monitor, warn, and protect citizens of the United States from undue and avoidable harm from volcanic activity.
(B) PURPOSES.—The purposes of the System are—
(i) to organize, modernize, standardize, and stabilize the monitoring systems of the volcano observatories in the United States, which includes the Alaska Volcano Observatory, California Volcano Observatory, Cascades Volcano Observatory, Hawaiian Volcano Observatory, and Yellowstone Volcano Observatory; and
(ii) to unify the monitoring systems of volcano observatories in the United States into a single interoperative system.
(C) OBJECTIVE.—The objective of the System is to monitor all the volcanoes in the United States at a level commensurate with the threat posed by the volcanoes by—

What NVEWS is – the Congressional Authorization:

“Establish within the USGS a system, to be known as the ‘National Volcano Early Warning and Monitoring System’, to monitor, warn, and protect citizens of the United States from undue and avoidable harm from volcanic activity.”

What NVEWS is – the Congressional Authorization:

<u>Purposes:</u>

1) Organize, modernize, standardize, & stabilize monitoring systems at AVO, CalVO, CVO, HVO, & YVO
2) Unify these monitoring systems into one ***interoperable*** system.

What NVEWS is – the Congressional Authorization:

System Components:

1) Observatories & monitoring networks
2) National 24/7 Watch Office
3) National Volcano Data Center (*now called the National Volcano Information Service*)
4) External grants program

What NVEWS is – the Congressional Authorization:

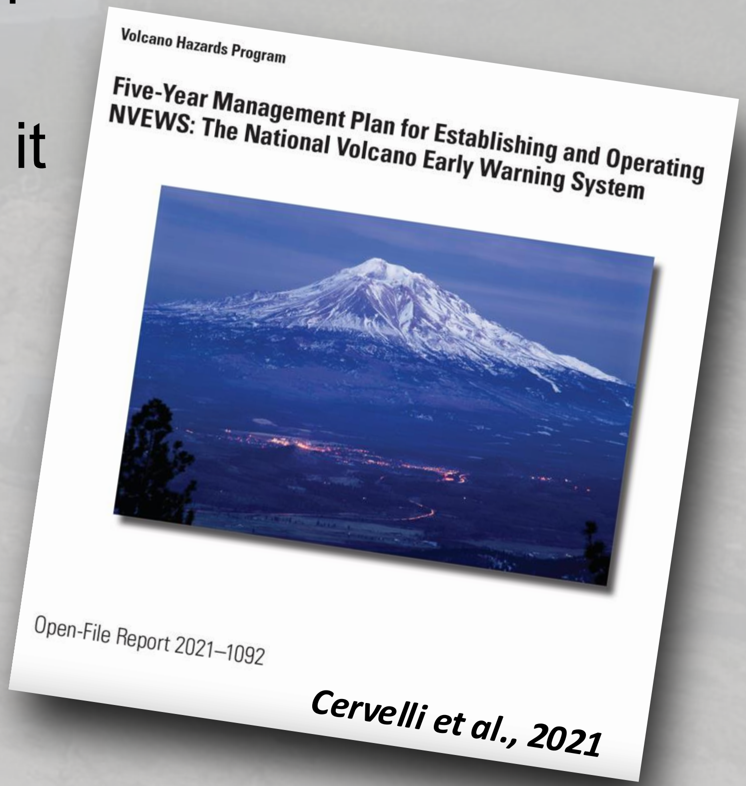
...and, a federal advisory committee:

(B) ADVISORY COMMITTEE.—The Secretary shall establish an advisory committee to assist the Secretary in implementing the System, to be comprised of representatives of relevant agencies and members of the scientific community, to be appointed by the Secretary.

USGS

NVEWS: A Brief History

- **2019** – NVEWS authorization introduced by Senators Murkowski (AK) and Cantwell (WA) as part of the “John D. Dingell Jr. Conservation Act”. Senate and House approve the bill February 2019, President Trump signs it into law March 2019.
- **2020** – USGS submits 5-year implementation plan to Congress (later published as Cervelli et al., 2021)
- **2022** – First new “NVEWS” money appropriated to USGS



USGS

NVEWS: A Brief History

18 years from conception (2004) to "NVEWS" funding (2022), during which time there were:

- *5 Volcano Hazards Program Coordinators*
- *6 Volcano Science Center Directors*
- *18 SICs across 5 observatories & 3 VDAP Directors*
- *12* significant unrest/eruption episodes at US volcanoes (*including 1983-2018 & 2020-2022 Kilauea)*
- *4 Presidents & 10 Congresses*
- *4 Boston Red Sox World Series victories*

NVEWS: A Brief History

- **2019** – NVEWS authorization introduced by Senators Murkowski (AK) and Cantwell (WA) as part of the "John D. Dingell Jr. Conservation Act". Senate and House approve the bill February 2019, President Trump signs it into law March 2019.
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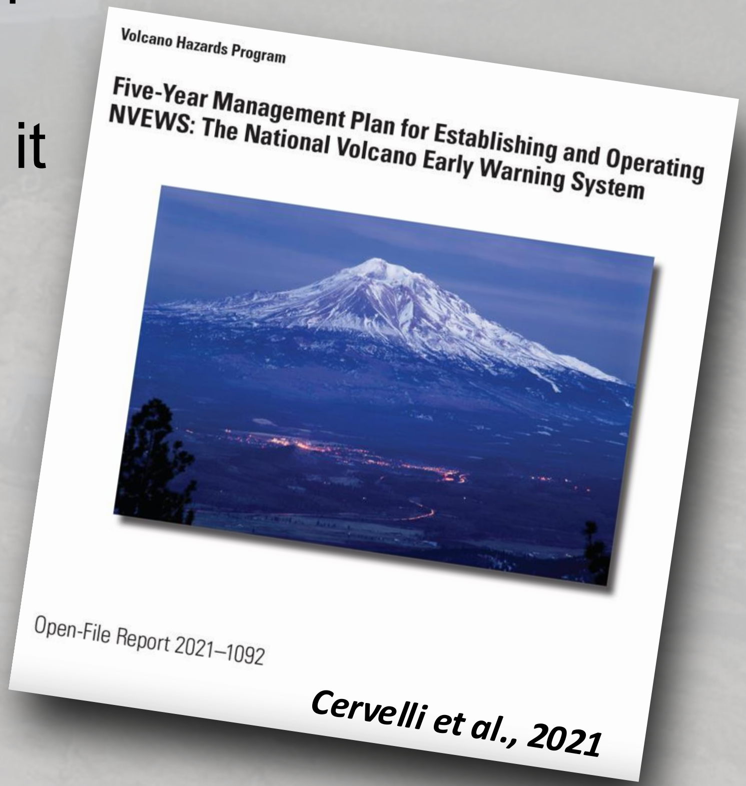
- **2022 –** "Volcanic Ash and Fumes Act" approved by Senate



USGS

What NVEWS is – the 2022 Volcanic Ash and Fumes Act (S.3533):

Main points:

- “integrates into the purposes of [NVEWS] relevant capacities of NOAA to strengthen the warning and monitoring systems of volcano observatories in the United States.”
- …also, this extended NVEWS authorization by a year! So, we’re good until October 1.
- The FUMES act is the next agenda item, so more to say later.

NVEWS: A Brief History

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- **2022** – First new "NVEWS" money appropriated to USGS
- **2022 – "**Volcanic Ash and Fumes Act" approved by Senate
- **2024? 2025? –** Reauthorization of NVEWS

USGS

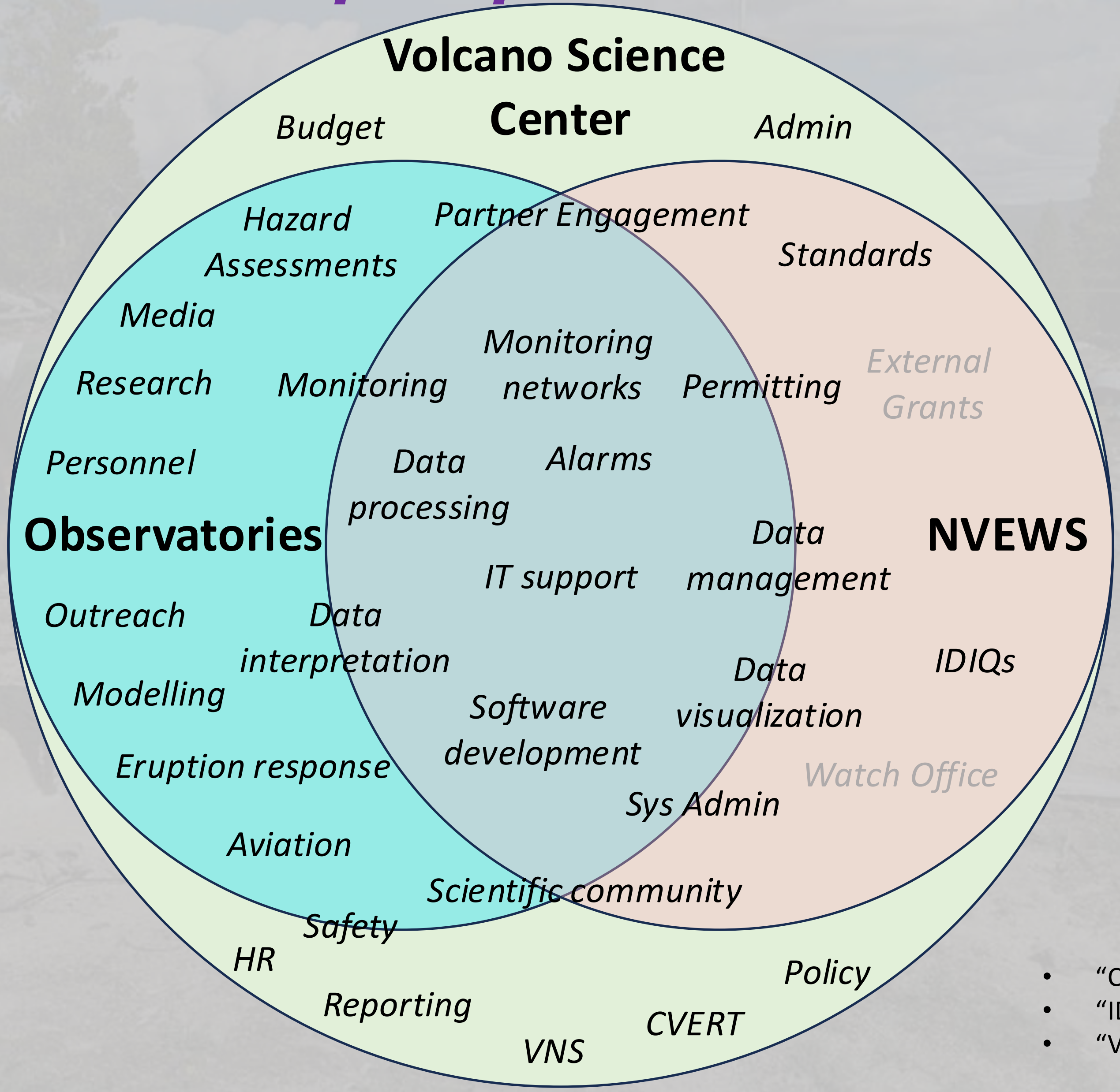
What it is – the VSC perspective:

NVEWS Mission Statement:

"The mission of NVEWS is to develop and maintain a fully integrated national-scale volcano monitoring system to ensure that volcanoes in the United States and its territories are monitored commensurate with the threat they pose, enabling scientists to improve timeliness and accuracy of hazard forecasts and for citizens to take effective action to reduce risk."

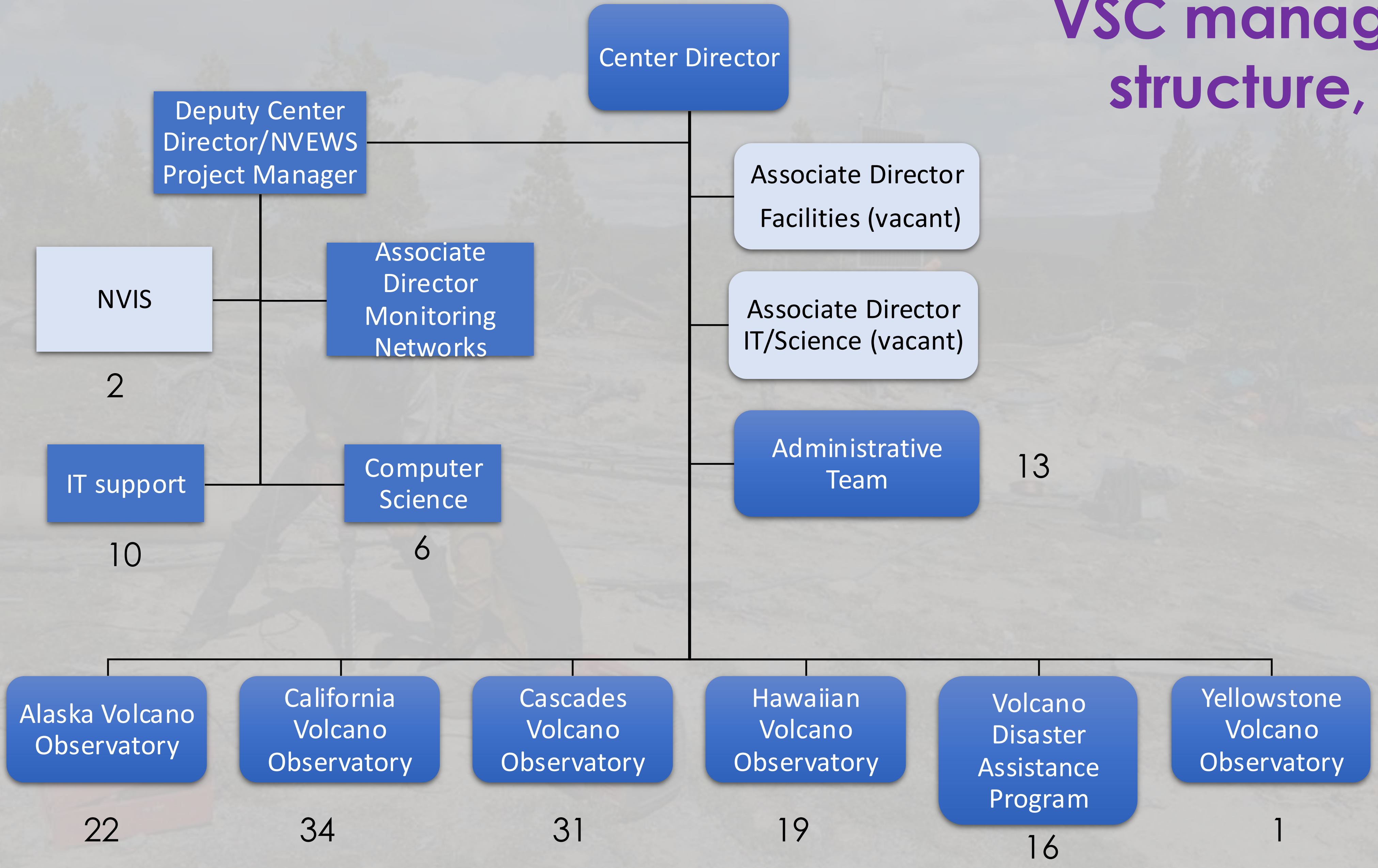
USGS

What it is – the VSC perspective:



- “CVERT” = Center Volcanic Event Response Team
- “IDIQ” = Indefinite Delivery, Indefinite Quantity
- “VNS” = Volcano Notification System

VSC management structure, 2024



What it is – the VSC perspective:

NVEWS encompasses:

- Volcano monitoring enhancements and M&O
- Monitoring-related IT & telecom infrastructure
- Monitoring network management (permitting, reporting)
- Monitoring equipment inventory (incl. response cache)
- NVIS
- 24x7 watch office (when there’s sufficient funding)
- External grants program (when there’s sufficient funding)
- NVEWS administration

NVEWS: The (near) future

- **2019-2023 NVEWS appropriations ($6.6 million) a lot less than what was authorized (~$55 million over 5 years, $11 million annually)**
- **Points of emphasis with explicit NVEWS 2022-2023 funding:**
    - **Monitoring networks**
    - **Interoperability across observatories**
    - **NVIS start up**

NVEWS: The (near) future

- 2019-2023 NVEWS appropriations ($6.6 million) a lot less than what was authorized (~$55 million over 5 years, $11 million annually)
- Points of emphasis with explicit NVEWS 2022-2023 funding:
  - Monitoring networks
  - Interoperability across observatories
  - NVIS start up

- **Updated instrumentation report (Flinders et al, in prep)**

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.

• 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)	% 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 %
Kilauea	Very High	1	HVO	1,443		38	48	79%	54	60	90%	18	21	86%	3	3	100%	10	10	100%	18	19	95%	88%
MSH	Very High	2	CVO		20	26	26	100%	24	24	100%	3	4	75%	4	6	67%	4	6	67%	2	2	100%	93%
Rainier	Very High	3	CVO		20	22	24	92%	6	12	50%	4	6	67%	12	14	86%	1	2	50%	0	0	100%	78%
Redoubt	Very High	4	AVO		20	8	10	80%	4	8	50%	3	5	60%	3	5	60%	0	0	100%	0	1	0%	62%
Shasta	Very High	5	CalVO		20	7	10	70%	7	8	88%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	67%
Hood	Very High	6	CVO		20	11	12	92%	7	10	70%	2	4	50%	3	6	50%	0	0	100%	0	1	0%	70%
Three Sisters	Very High	7	CVO		20	5	12	42%	4	8	50%	1	1	100%	0	3	0%	0	0	100%	0	0	100%	42%
Akutan	Very High	8	AVO		20	11	12	92%	12	12	100%	5	5	100%	1	6	17%	4	4	100%	0	5	0%	75%
Makushin	Very High	9	AVO		20	7	15	47%	3	8	38%	1	5	20%	3	8	38%	0	0	100%	0	5	0%	34%
Spurr	Very High	10	AVO		20	12	18	67%	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	58%	8	8	100%	0	1	0%	0	2	0%	0	0	100%	1	2	50%	64%
Augustine	Very High	12	AVO		20	11	15	73%	11	11	100%	2	5	40%	3	8	38%	0	0	100%	0	6	0%	60%
Newberry	Very High	13	CVO		20	11	16	69%	9	12	75%	0	1	0%	3	6	50%	0	0	100%	0	0	100%	66%
Baker	Very High	14	CVO		20	2	10	20%	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	13%	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	50%	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	50%	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	100%	23	26	88%	0	1	0%	0	0	100%	0	0	100%	0	0	100%	92%
Okmok	High	19	AVO		20	10	13	77%	8	8	100%	2	4	50%	1	7	14%	0	0	100%	0	0	100%	66%
Iliamna	High	20	AVO		20	7	8	88%	0	4	0%	2	4	50%	1	4	25%	0	0	100%	0	0	100%	50%
Yellowstone	High	21	YVO		50	47	50	94%	16	19	84%	1	1	100%	2	5	40%	5	5	100%	1	1	100%	89%
Aniakchak	High	22	AVO		20	6	10	60%	2	5	40%	1	4	25%	1	5	20%	0	0	100%	0	0	100%	42%
Hualalai	High	23	HVO	805		5	13	38%	1	3	33%	1	3	33%	0	1	0%	0	3	0%	0	1	0%	29%
Mono	High	24	CalVO		20	1	8	13%	5	8	63%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	32%
Martin	High	25	AVO		20	7	8	88%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	38%
Mageik	High	26	AVO		20	9	9	100%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	44%
Trident	High	27	AVO		20	8	8	100%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	42%
Katmai	High	28	AVO		20	8	9	89%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	40%
Veniaminof	High	29	AVO		20	8	8	100%	0	4	0%	1	4	25%	3	4	75%	0	0	100%	0	0	100%	60%
Atka	High	30	AVO		20	7	8	88%	1	4	25%	1	4	25%	4	4	100%	0	0	100%	0	5	0%	52%
Korovin	High	31	AVO		20	7	8	88%	1	4	25%	1	4	25%	4	4	100%	0	0	100%	0	5	0%	52%
Shishaldin	High	32	AVO		20	6	8	75%	6	6	100%	2	4	25%	3	4	75%	3	3	100%	0	1	0%	77%
Clear Lake	High	33	CalVO	2,799		12	12	100%	2	8	25%	0	1	0%	0	2	0%	0	0	100%	0	0	100%	61%
Adams	High	34	CVO		20	1	12	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%	0	4	0%	0	1	0%	0	3	0%	0	0	100%	0	0	100%	0%
Westdahl	High	36	AVO		20	6	8	75%	7	8	88%	0	4	0%	0	4	0%	5	5	100%	0	0	100%	62%
Novarupta	High	37	AVO		20	8	8	100%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	42%
Churchill	High	38	AVO		20	0	8	0%	0	4	0%	0	4	0%	0	4	0%	0	0	100%	0	0	100%	0%
Kanaga	High	39	AVO		20	6	8	75%	0	4	0%	1	4	25%	1	4	25%	0	0	100%	0	0	100%	40%
Ugashik-Peulik	High	40	AVO		20	4	8	50%	0	4	0%	1	4	25%	1	4	25%	0	0	100%	0	0	100%	30%
Pavlof	High	41	AVO		20	7	8	88%	0	4	0%	4	4	100%	6	6	100%	0	0	100%	0	5	0%	63%
Mount Griggs	High	42	AVO		20	7	8	88%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	38%
Kaguyak	High	43	AVO		20	1	8	13%	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%	0	4	0%	0	2	0%	0	4	0%	0	0	100%	0	0	100%	0%
Medicine Lake	High	45	CalVO		30	4	8	50%	3	8	38%	0	0	100%	0	0	100%	0	0	100%	0	0	100%	44%
Great Sitkin	High	46	AVO		20	6	8	75%	2	4	50%	2	4	50%	1	4	25%	0	0	100%	0	0	100%	55%
Kasatochi	High	47	AVO		20	0	5	0%	0	4	0%	0	4	0%	0	3	0%	0	0	100%	0	0	100%	0%
Cleveland	High	48	AVO		20	5	8	63%	2	4	50%	1	4	25%	2	4	50%	0	0	100%	2	2	100%	55%
Moffett	High	49	AVO		20	1	8	13%	0	4	0%	0	4	0%	0	4	0%	0	0	100%	0	0	100%	5%
Seguam	High	50	AVO		20	0	8	0%	0	4	0%	0	4	0%	0	4	0%	0	0	100%	0	0	100%	0%
Fisher Caldera	High	51	AVO		20	3	8	38%	3	8	38%	0	4	0%	1	4	25%	2	2	100%	0	0	100%	35%
Snowy	High	52	AVO		20	3	8	38%	0	8	0%	2	4	50%	0	4	0%	0	0	100%	0	0	100%	21%
Fourpeaked	High	53	AVO		20	1	8	13%	0	4	0%	0	4	0%	1	4	25%	0	0	100%	0	0	100%	10%
Douglas	High	54	AVO		20	1	8	13%	0	4	0%	0	4	0%	1	4	25%	0	0	100%	0	0	100%	10%
Semisopochnoi	High	55	AVO		20	6	8	75%	0	6	0%	2	4	50%	3	4	75%	0	0	100%	0	0	100%	50%
Salton Buttes	High	56	CalVO		20	6	8	75%	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%	0	4	0%	0	2	0%	0	4	0%	0	0	100%	0	0	100%	0%
Edgecumbe	Moderate(?)	58	AVO		20	4	8	50%	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	80%	2	2	100%	0	1	0%	0	1	0%	0	0	100%	0	0	100%	67%
Totals:						459	704	65%	288	530	54%	86	217	40%	76	240	32%	40	49	82%	26	66	39%	**54%**

USGS

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

# Seismic sites	Target (12-2 VHT, 6 HT)	twork letion %
460	704	4%

lete!

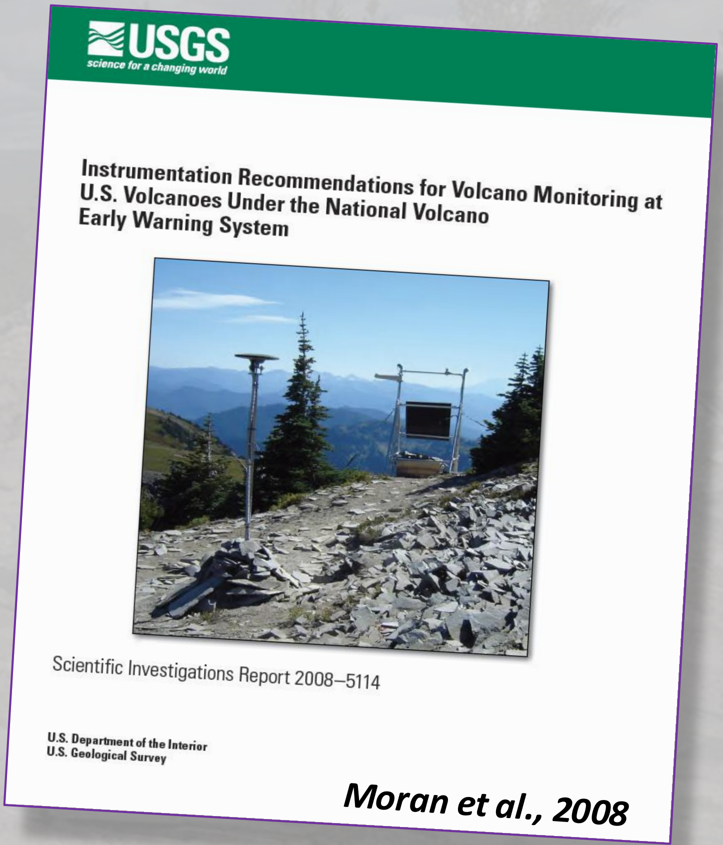
Challenges to completion:

- **Permitting restrictions (Wilderness, National Parks, Tribal Lands)**
- **Logistics**
  - **Difficult access (helicopter, long hikes, long boat rides)**
  - **Limited access windows (weather, permitting restrictions, fire season)**
- **Sufficient field staff**
- **Harsh environments**
- **More techniques coming online with time**
- **Annual O&M work requires more staff time and OE as networks get larger**
- **Funding**

USGS

Monitoring networks: How close to "complete"?

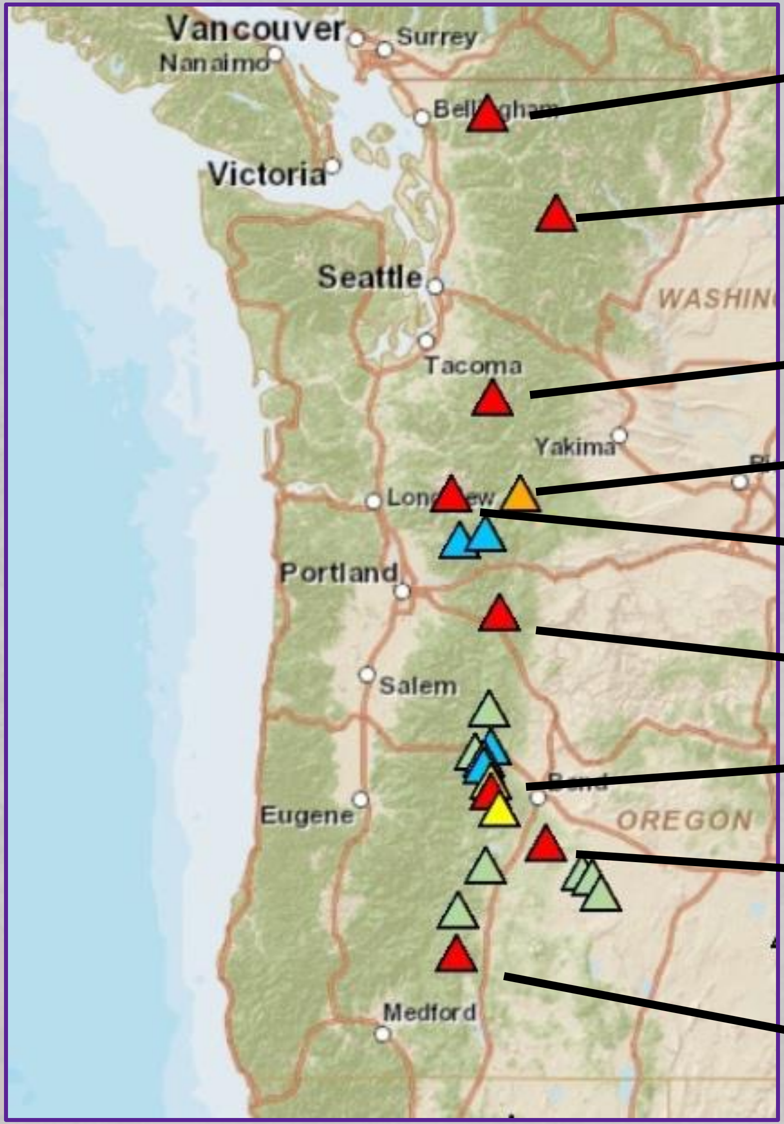
- **Instrumentation recommendations for volcano monitoring networks @ VHT/HT volcanoes**
  - ***Seismic:*** 12-25 stations within 20 km incl. 4 within 5 km
  - ***GNSS:*** 16-20 stations within 20 km incl. 8 within 5-10 km (along with regular InSAR & campaign measurements)
  - **Infrasound:** 4 single sensors w/ in 10 km & 2 four-element arrays within 15 km
  - **Gas:** Several real-time stations on actively degassing volcanoes
  - ***Shallow Marine:*** 4 seismometers (OBS, hydrophones) plus several infrasound on nearby islands.



Moran et al., 2008

USGS

Example - Cascade Volcano Monitoring Networks Status, 2024



Baker – 3 seismometers

Glacier Peak – 1 seismometer

Rainier – 22 seismometers, 6 GPS, 1 tilt, 14 infrasound

Adams – 1 seismometer

St. Helens – 26 seismometers, 24 GPS, 3 tilt, 2 gas, 6 infrasound

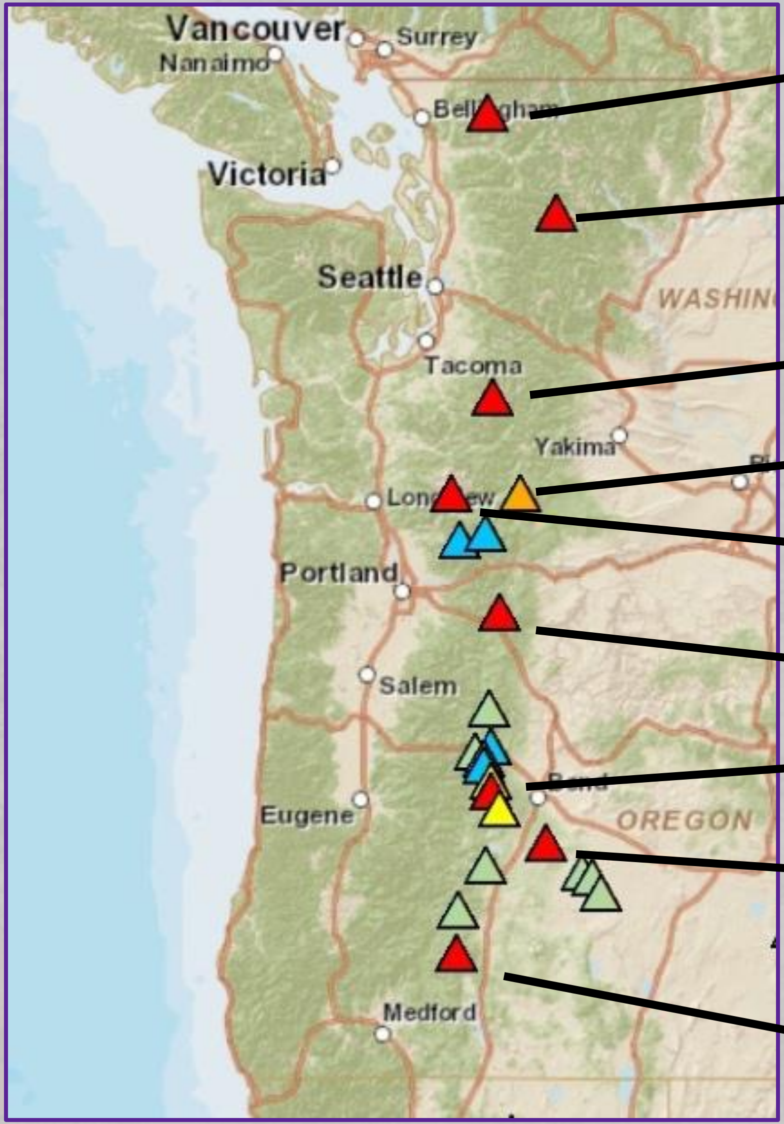
Hood – 11 seismometers, 7 GPS

3 Sisters – 5 seismometers, 4 GPS

Newberry – 12 seismometers, 9 GPS

Crater Lake – 4 seismometers, 4 GPS

Example - Cascade Volcano Monitoring Networks Status, 2024



Baker – 3 seismometers (13% complete)

Glacier Peak – 1 seismometer (5%)

Rainier – 22 seismos, 6 GPS, 1 tilt, 14 infrasound (82%)

Adams – 1 seismometer (4%)

St. Helens – 26 seismometers, 24 GPS, 2 tilt, 1 gas, 6 infrasound (93%)

Hood – 11 seismometers, 7 GPS (70%)

3 Sisters – 5 seismometers, 4 GPS (42%)

Newberry – 12 seismometers, 9 GPS (69%)

Crater Lake – 4 seismometers, 4 GPS (38%)

Great

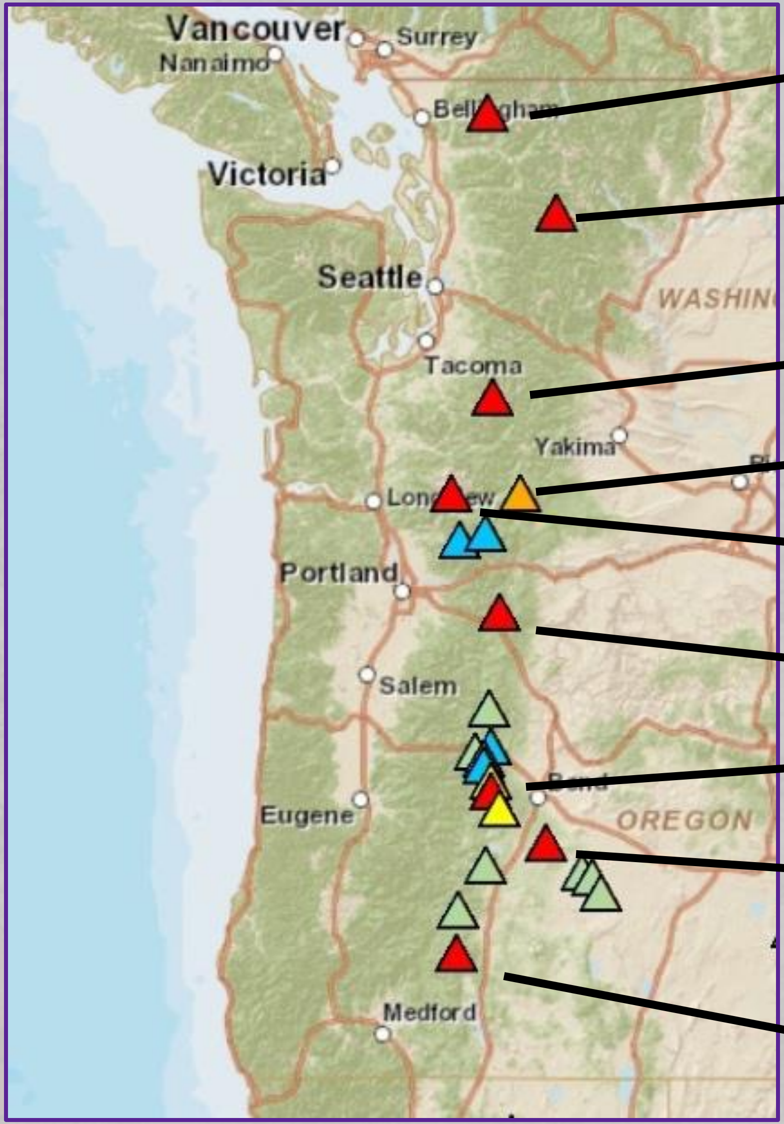
Good

Fair

Poor

USGS

Example - Cascade Volcano Monitoring Networks Status, 2003



Baker – 1 seismometer

Glacier Peak – 1 seismometer

Rainier – 7 seismometers, 1 GPS

Adams – 1 seismometer

St. Helens – 13 seismometers, 1 GPS

Hood – 5 seismometers

3 Sisters – 2 seismometers, 1 GPS

Newberry – 1 seismometer

Crater Lake – Zero

Great

Good

Fair

Poor

USGS

With only $6.6M in appropriated funding to date, where h... from?

- All of these appropriations have resulted in NVEWS-related progress
- Some have resulted in long-lived “bumps” to VHP base funding; some have not
- Current estimate: ~50% of VHP/VSC base funds go to NVEWS-related work (monitoring is something we’ve always done)
- Most VHP/VSC NVEWS-related base funding is now going to Maintenance and Operations

- ...een a part
- ...
  - ...to the AK
  - ...noes
  - ...es
  - ...18 eruption)
  - **2023-2027** – Merbok Disaster Supplemental (bolster AK networks)

USGS

NVEWS: The (near) future

- **2019-2023 NVEWS appropriations ($6.6 million) a lot less than what's needed for full implementation (~$55 million over 5 years, $11 million annually)**
- **Points of emphasis with 2019-2023 funding:**
  - **Monitoring networks**
  - **Interoperability amongst observatories**
  - **NVIS**

USGS

Interoperability: What's the right balance between centralization and observatory-centric operations?

- <u>Long</u> tradition of observatory-specific solutions created by observatory staff (e.g., Bob, RSAM, SSAM, McVCOs, Valve, Winston, Swarm, SitesDB, GeoDiva, Pensive, HANS)
    - Created by talented people identifying & solving problems
    - Interoperability should not quash local solutions

Interoperability: What's the right balance between centralization and observatory-centric operations?

- ***<u>However:</u>***
  - **NVEWS-related operations are now bigger & more diverse than they've ever been**
  - **Technology & IT security has become a lot more complicated with increased oversight/constraints**
  - **Responses often involve staff from multiple observatories (more data, higher expectations by partners/society/Congress, etc.)**

Interoperability: What’s the right balance between centralization and observatory-centric operations?

- **<u>Next 5-10 years:</u>**
  - **VSC needs to identify what parts of NVEWS require interoperable approaches**
  - **VSC needs to identify processes for achieving interoperability while minimizing disruption to observatories**
  - **NVEWS & NVIS-centric working groups need to be formed to help with decision-making and buy-in**

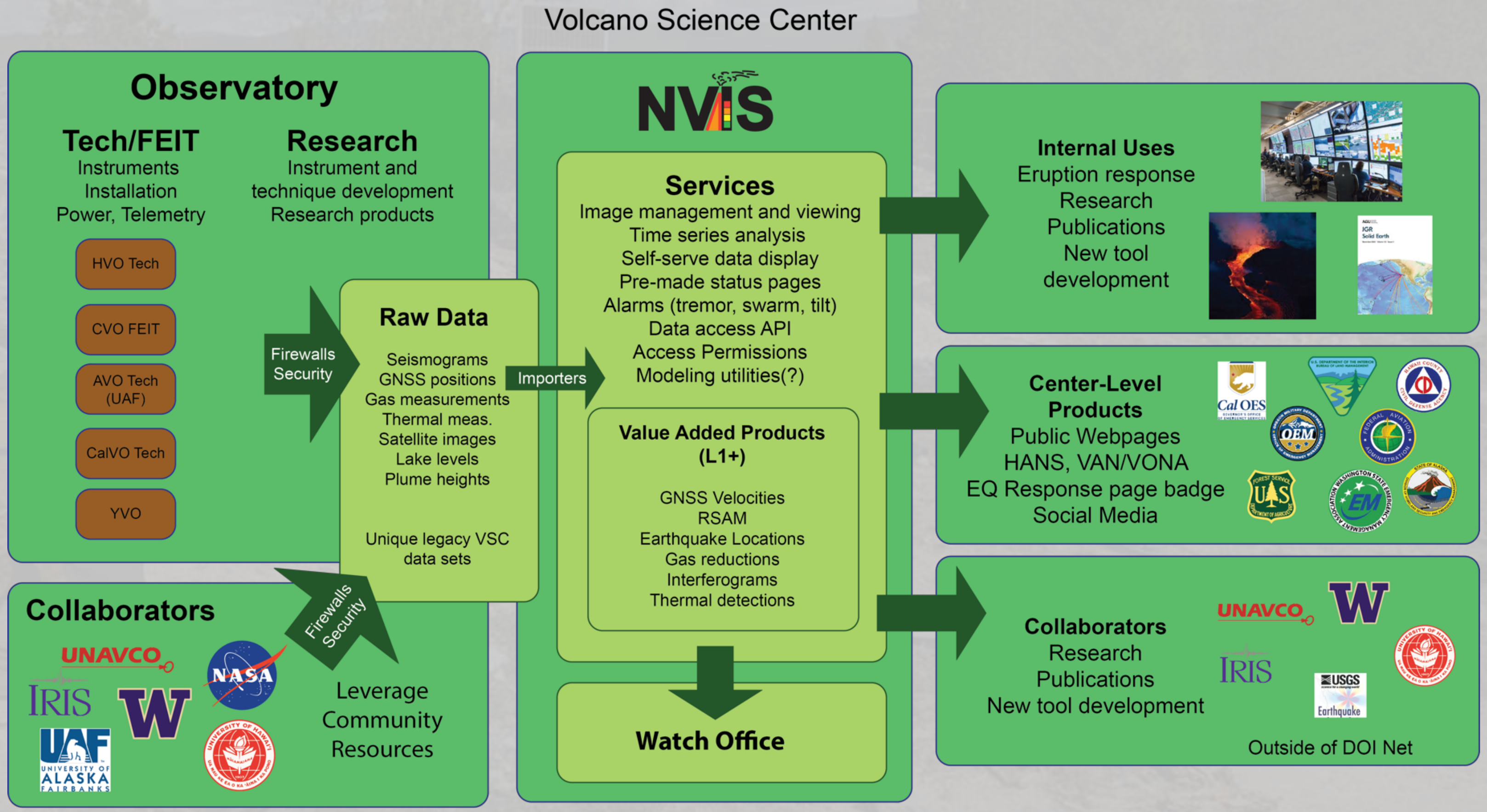
NVEWS: The (near) future

- **2019-2023 NVEWS appropriations ($6.6 million) a lot less than what’s needed for full implementation (~$55 million over 5 years, $11 million annually)**
- **Points of emphasis with 2019-2023 funding:**
  - **Monitoring networks**
  - **Interoperability amongst observatories**
  - **NVIS**

National Volcano Information Service (NVIS)

What is NVIS?

"A modern suite of data services to facilitate research, hazard analysis, and eruption response that will improve distribution internally, the scientific community, and stakeholders."



USGS

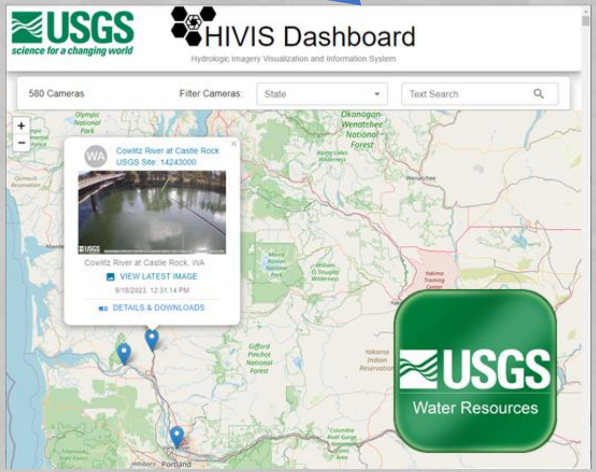
National Volcano Information Service (NVIS) – Update:

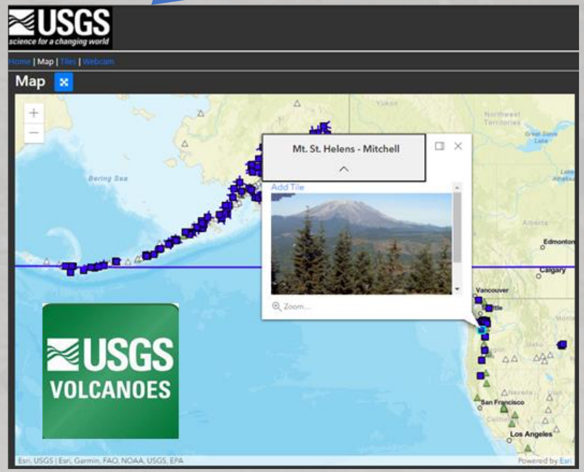
USGS NVIS

Current Focus Areas:

1) Inventory of all data pathways at each observatory
2) Pilot Projects
    - Cloud-based image management
    - Experimental cloud services
3) Future Goals
    - Modernize data services within Federal Government guidelines and regulations (will take time!!)

NIMS
National Image Management System
Image acquisition and archive in the USGS CHS cloud environment with internal and external access through web interfaces and API services.





NVIS → Timeline

Still a lot TBD

2022

Workforce planning meeting – Winter 2022

Internal NVIS advisory committee formed – Spring 2022

Data scientist hired

2023

Pilot Project Launched:

Webcam/image management

AWS Essentials Training

“Cloud 7” mapping of VSC network topology & data sources/ dependencies

2024

Cloud7

Second pilot project launched:

Move the VSC’s HANS interface to the cloud

Hires in progress: NVIS director, sys admin, network admin, developers

2025

USGS

NVEWS: The (near) future

- **As for the other parts of NVEWS:**
  - **24/7 Watch Office**
    - All Observatories have Duty rotations, most with 24/7 responsibilities (AVO, CVO, HVO)
    - Duty loads being performed as “other duties assigned”; ***there are no dedicated watch staff***
    - Would require hiring *at least* 7-8 FTE (~$1.5 million) to implement (model: add 1 volcano-specific staff position to each NEIC 8-hour watch slot, plus management, training, & IT/software support)
    - Would not supplant VOs responding to crises/eruptions (i.e., when volcanoes go to Orange/Red)

NVEWS: The (near) future

- **As for the other parts of NVEWS:**
  - **24/7 Watch Office**
  - **External Grants**
    - Would expand the range of research projects performed at U.S. volcanoes
    - Would bring external expertise to the VSC/VHP in a more formal way
    - Would require a new staff position to manage
    - ~$1 million/year minimum required to start this up

USGS


Questions?
HILTI
TE 76P

Volcanic Ash and Fumes Act

GARI MAYBERRY AND ARIEL STEIN

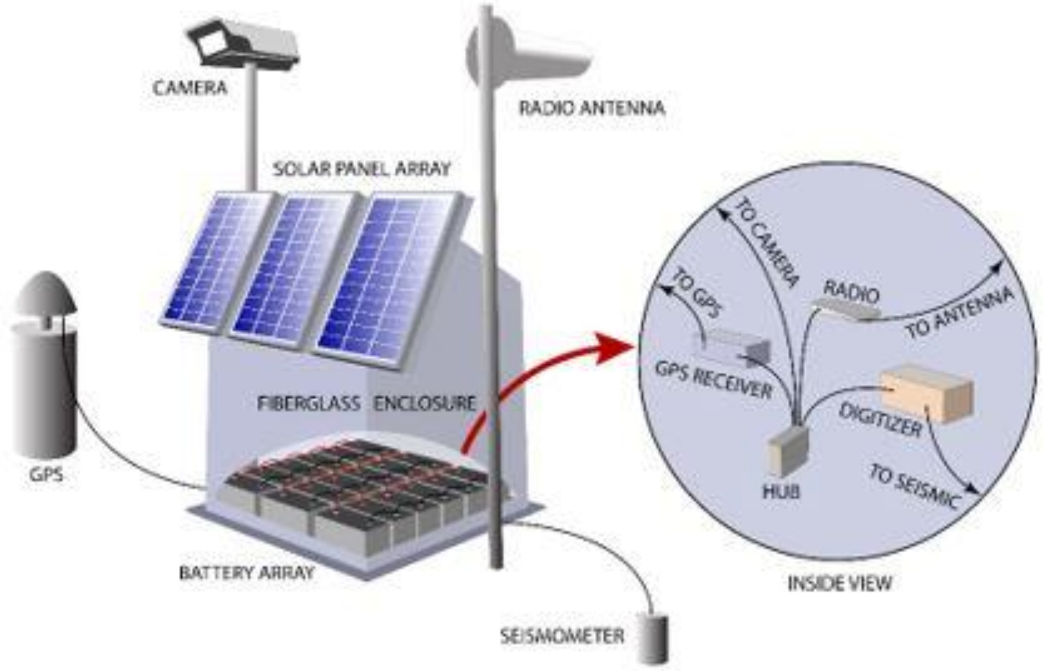
National Volcano Early Warning System (NVEWS)

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
- A Watch Office will provide 24/7 continuity of operations
- National Volcano Information Service (NVIS) will aggregate and distribute real-time monitoring data from all observatories
- 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 Dec 2022

- Incorporates capacity/expertise of NOAA into NVEWS



Volcanic Ash and Fumes Act

- December 2022- The Volcanic Ash and Fumes Act sponsored by Sens. Schatz and Murkowski was signed into law as part of the National Defense Authorization Act .
- This bill incorporates the capacities and expertise of the National Oceanic and Atmospheric Administration (NOAA) into the National Volcano Early Warning and Monitoring System.
- The bill integrates into the purposes of the system relevant capacities of NOAA to strengthen the warning and monitoring systems of volcano observatories in the United States.
- Includes observations and modeling of the results from volcanic eruptions (e.g., emissions of gases, aerosols, and ash; atmospheric dynamics and chemistry; and ocean chemistry) that are carried out by NOAA's Volcanic Ash Advisory Centers located in Anchorage, Alaska, and the District of Columbia.

Volcanic Ash and Fumes Act

From the Volcanic Ash and Fumes Act:

- “The bill provides for a memorandum of understanding to establish cooperative support of the activities of [NVEWS] from NOAA…”
- ”The Department of Commerce must (1) submit to the USGS annual cost estimates for modernization activities and support of [NVEWS] for NOAA; and (2) collaborate with the USGS to implement activities related to the expertise of NOAA, including observations and modeling of results from volcanic eruptions
- “Commerce must develop a plan to implement this bill during the five-year period beginning on the date on which the plan is developed. The plan shall include an estimate of the cost and schedule required for implementation.”

NOAA and USGS Collaboration

NOAA AND VHP HAVE COLLABORATED FOR MANY YEARS, ESPECIALLY ON ASH AND AVIATION, AND HEALTH ISSUES

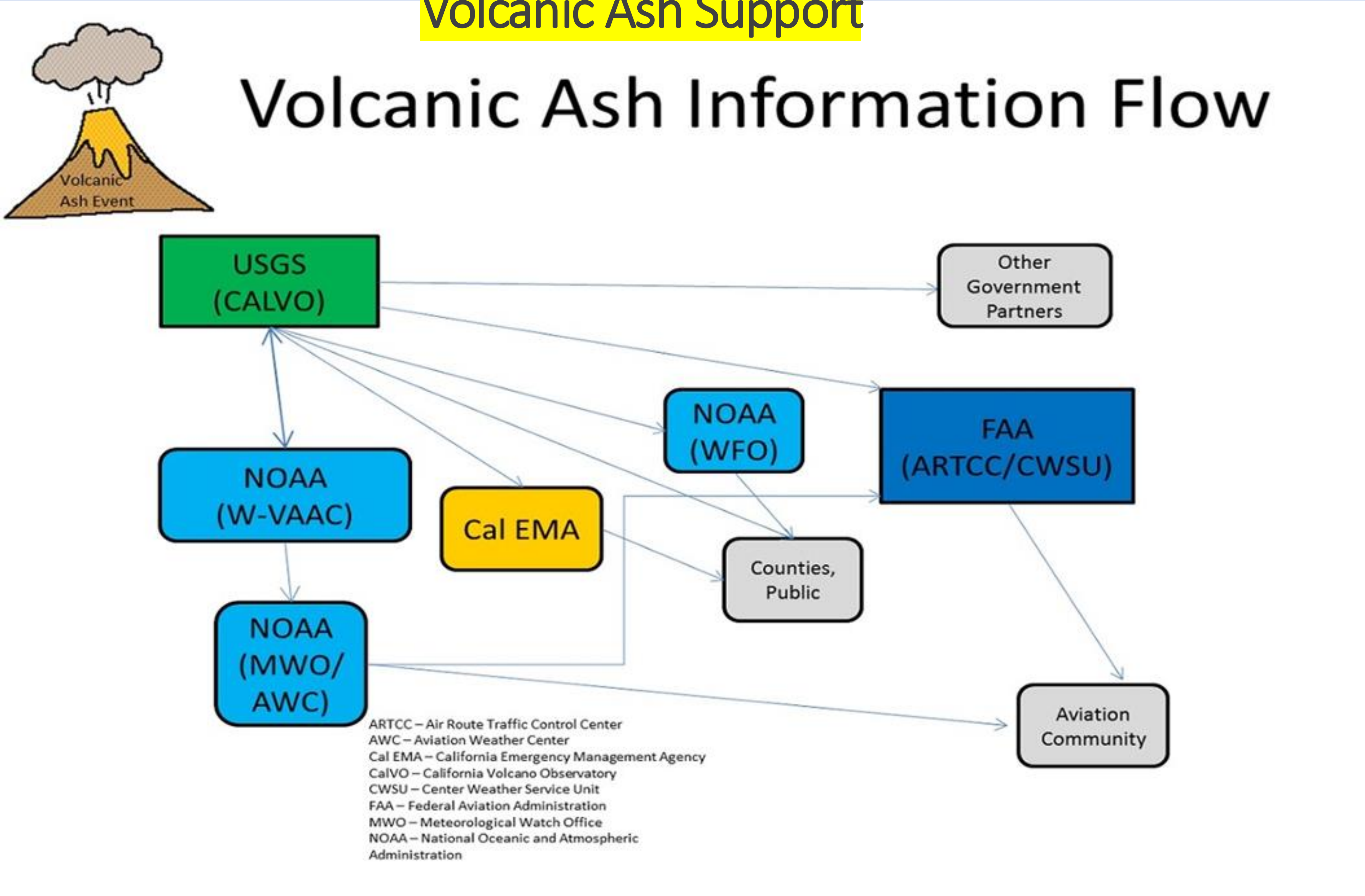
FY23 VHP AND NOAA BEGAN MEETING MONTHLY TO ADDRESS THE VOLCANIC ASH AND FUMES ACT

THE WORKING GROUP DEVELOPED 8 PRIORITY AREAS FOR COORDINATION

USGS-NOAA Fumes Act Priorities

1. Improve service on monitoring and forecasting volcanic smog (vog).
2. Develop/improve operational plan to warn of volcanic debris flows/lahars from eruptive and non-eruptive events
3. Improve service on quantifying airborne ash hazards to aviation. (Quantitative Volcanic Ash- QVA)
4. Improve service on quantifying ashfall hazards.
5. Improve near-real-time data sharing to improve situational awareness and operational response.
6. Improve service on forecasting volcanogenic tsunami and submarine eruptions.
7. Improve agency collaboration/cost savings through joint work agreements and missions in the US and its territories.
8. Improve efficacy of USGS and NOAA hazard information products.

Volcanic Ash Support

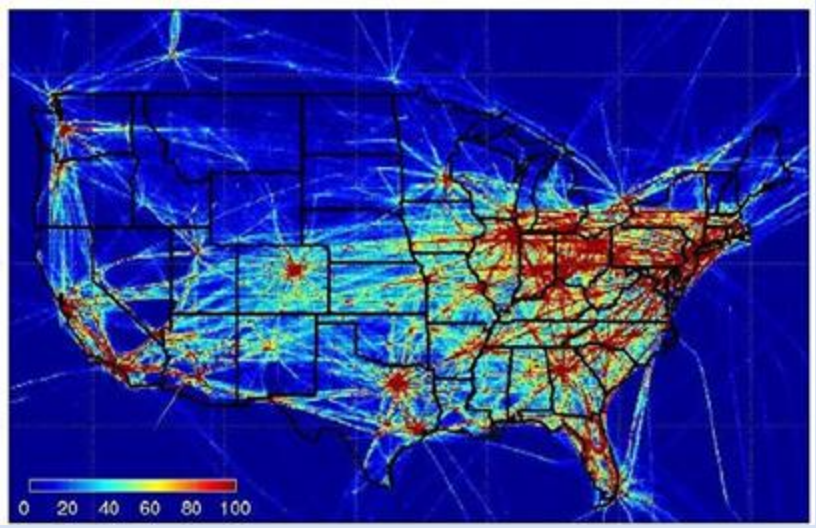


NOAA/NWS Aviation Services Facilities

Note: The FAA is the Meteorological Authority for Aviation Weather Services

NOAA/NWS provides aviation weather services around the clock

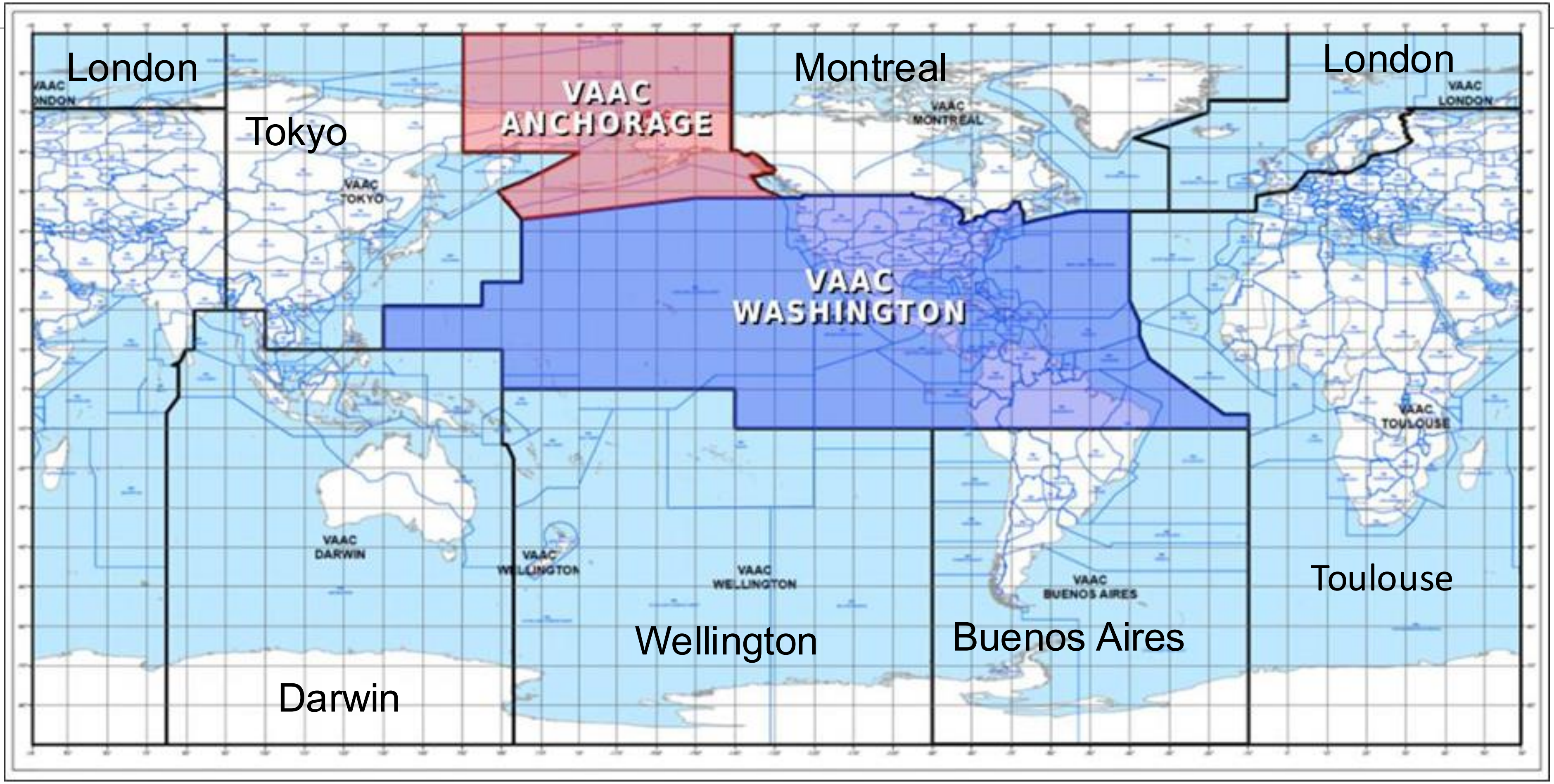
- **122 Weather Forecast Offices (WFO)**
- **21 Center Weather Service Units (CWSU)** + National Aviation Mets at FAA Command Center
- **3 Meteorological Watch Offices**
  - **Aviation Weather Center (AWC) in Kansas City, MO**
  - Alaska Aviation Weather Unit (AAWU) in Anchorage, AK
  - WFO Honolulu, HI
- **2 Volcanic Ash Advisory Centers**
  - AAWU
  - **NESDIS SPSD @ NCEP**
- World Area Forecast Center (AWC)
- Tropical Prediction Center in Miami, FL
- Storm Prediction Center in Norman, OK
- Space Weather Prediction Center in Boulder, CO



Aircraft Density

Volcanic Ash Advisory Centers (VAACs)

- Established in 1998 with ICAO Annex 3 Amendment 71.
  - International Civil Aviation Organization



VAAC Operations and Products

Volcanic Ash Advisory (VAA)

A text product issued to describe areas of airborne volcanic ash at up to four time period: Obs, T+6, T+12, and T+18 hrs

Various Types of VAAs

- **Near VAA**
  - VAA message that relays info about a neighboring VAAC's VAA where VA is within 150 NM of Anchorage VAAC AoR.
  - Some VAACs reissue the VAA with their header.
- **Handover From…**
  - First VAA in series after taking responsibility from neighboring VAAC for all or portion of an ash cloud. This is accompanied by specific remarks section of the VAA describing the handover.
- **Handover To…**
  - Last VAA in a series after handing off responsibility of an ash cloud to a neighboring VAAC. This is also accompanied by specific language in the remarks.
- **Partial Handover To/From**
  - Like the previous two, this incorporates both a forecast, remarks about neighboring VAAC's responsibility, and additional language similar to a Near VAA.
- **Last VAA**
  - The last VAA in a series for a cloud/volcano must state in the remarks: NO FURTHER ADVISORIES.

Meteorological Watch Office Warning Products

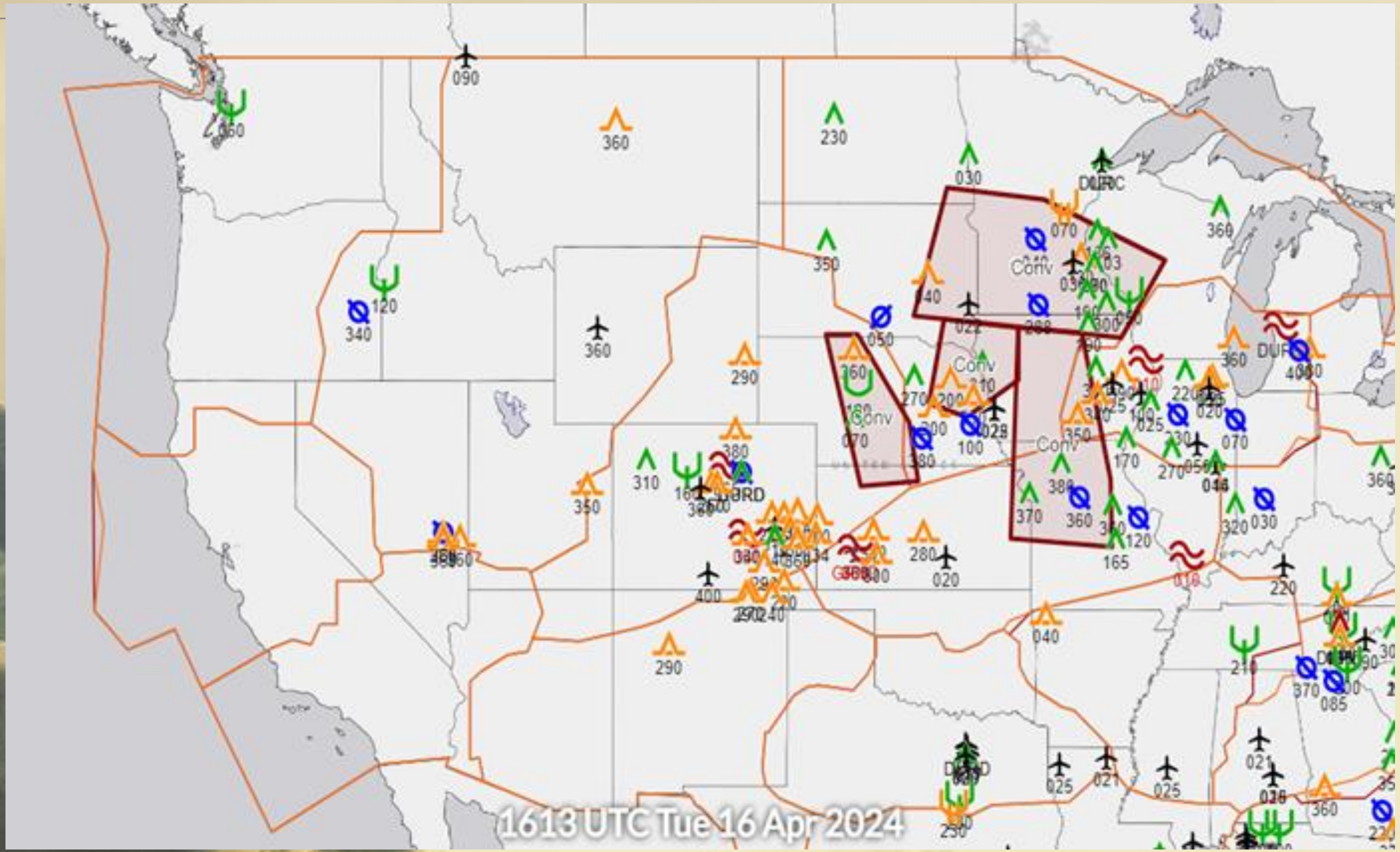
SIGMETs - Significant Meteorological Information

AAWU issues TWO types of SIGMETs

- **Weather SIGMET - (WS) for WMO Headers such as: WSAK01**
  - Icing, turbulence, dust storms, and thunderstorms (but not Convective)
  - Valid up **four** hours, uses one "smear" polygon
- **VA SIGMET - (WV) Headers such as: WVAK01**
  - Only for Volcanic Ash Warnings
  - Valid for **six** hours, uses two "snapshot" polygons

Aviation Weather Center (AWC)

- Responsible for Domestic and International En Route Forecasts & Warnings
  - Icing
  - Turbulence
  - Convection
  - **Volcanic Ash**
  - Low Ceilings/Visibilities
- AWC is also:
  - Meteorological Watch Office
  - World Area Forecast Center

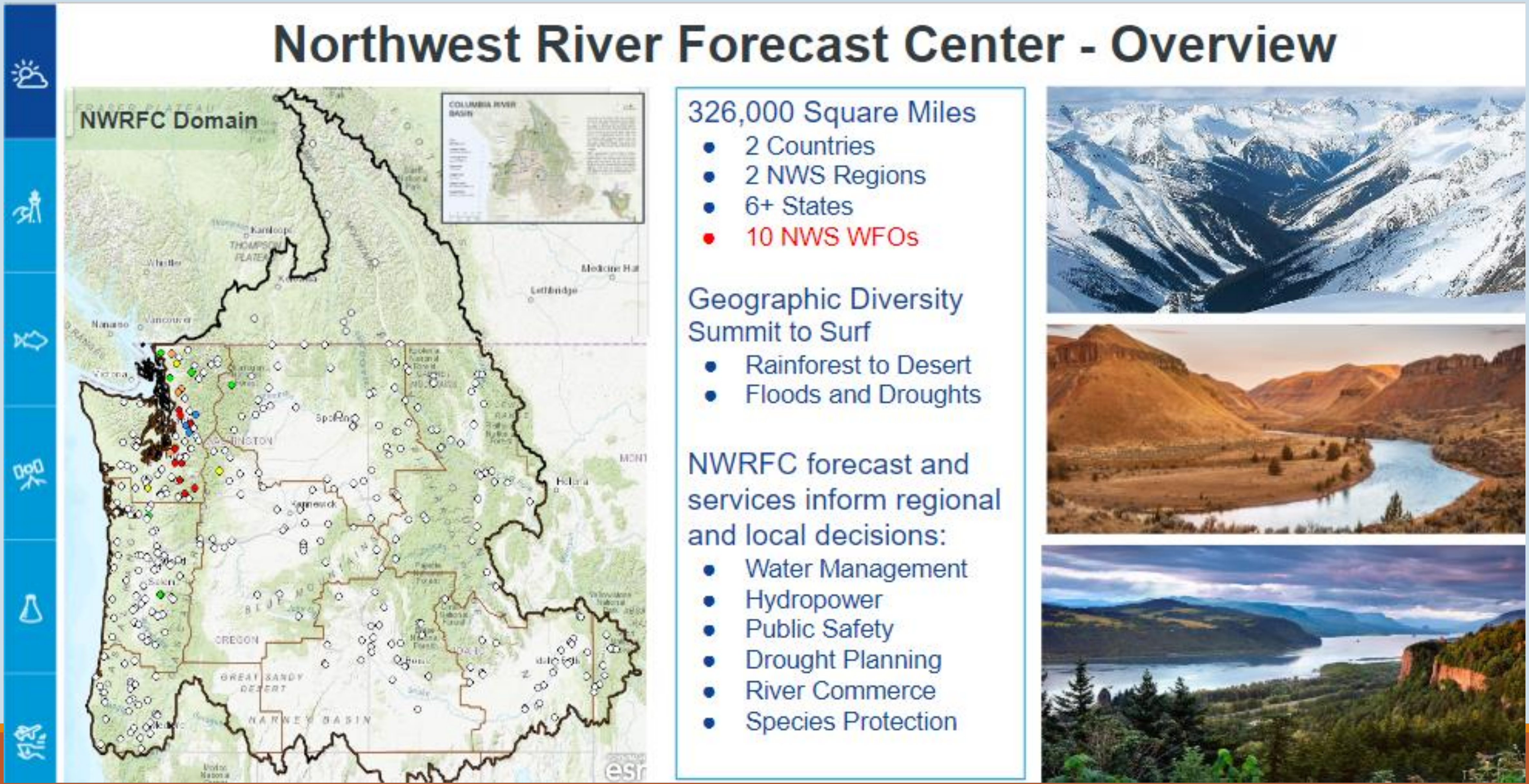


LAHARS & ASH on the ground

WFO Portland
County Warning Area

- 2 states
- 19 counties
- 5 recognized tribal nations

Large River Flooding from volcanic debris



Tsunami Warning Centers

Volcanoes can create tsunamis through many different mechanisms. Historically, volcanic eruptions are thought to be the cause of about 6% of all tsunamis.

It's worth discussing the recent Tonga event since both NTWC and PTWC put out actual tsunami alerts and measured tsunami waves.

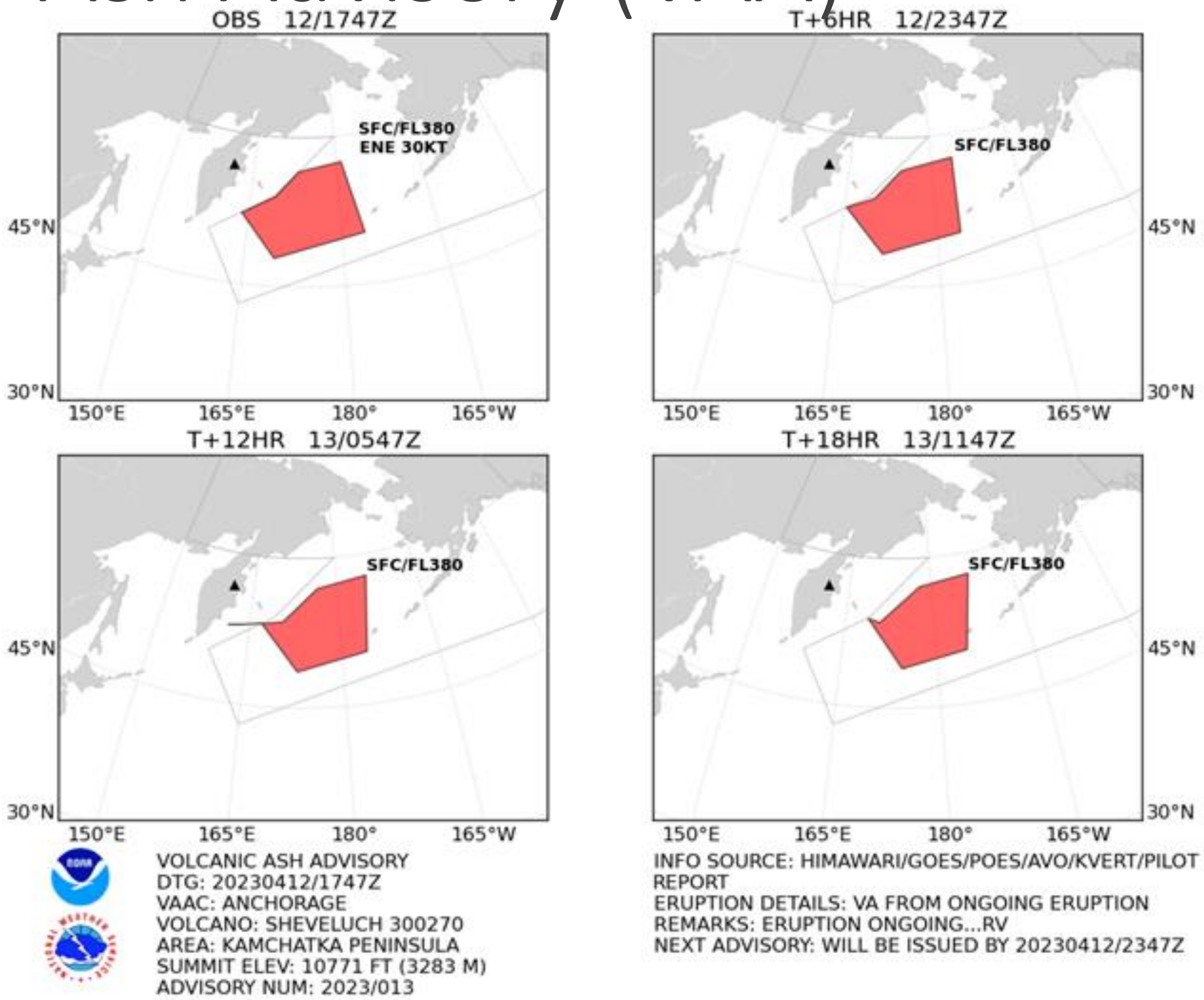
The Hunga Tonga-Hunga Ha'apai eruption (2022) created an atmospheric pressure wave resulting in a meteotsunami, and a classic tsunami resulting from significant disruption of the full ocean water column from under the surface.

NTWC depends on Volcano Observatories to notify them of increased volcanic activity or unrest to anticipate and respond to the potential for a tsunamigenic event (e.g., flank collapse of Augustine Volcano, Cook Inlet, Alaska).

The TWCs may create a long-standing special procedure for individual hazard areas to address unique concerns that fall outside of the core tsunami generation mechanisms of megathrust earthquakes. (roughly 85% of historical tsunami). Currently, NTWC only has a specialized procedure for one volcano (Augustine).

The TWCs are not concerned with ashfall.

Current Volcanic Ash Graphic (VAG) and Volcanic Ash Advisory (VAA)



FVAK22 PAWU 121802
VAAAK2
VA ADVISORY

DTG: 20230412/1747Z
VAAC: ANCHORAGE
VOLCANO: SHEVELUCH 300270

PSN: N5639 E16122
AREA: KAMCHATKA PENINSULA
SUMMIT ELEV: 10771 FT (3283 M)
ADVISORY NR: 2023/013
INFO SOURCE: HIMAWARI/GOES/POES/AVO/KVERT/ PILOT REPORT
AVIATION COLOR CODE: RED
ERUPTION DETAILS: VA FROM ONGOING ERUPTION
OBS VA DTG: 12/1747Z

OBS VA CLD: SFC/FL380 N5205 E16350 - N4749 E16933 - N5009 W17626 - N5726 W17908 - N5634 E17304 - N5402 E16913 - N5205 E16350 MOV ENE 30KT

FCST VA CLD +6HR: 12/2347Z SFC/FL380 N5243 E16520 - N4818 E17133 - N5008 W17619 - N5742 W17608 - N5641 E17426 - N5350 E16955 - N5243 E16520

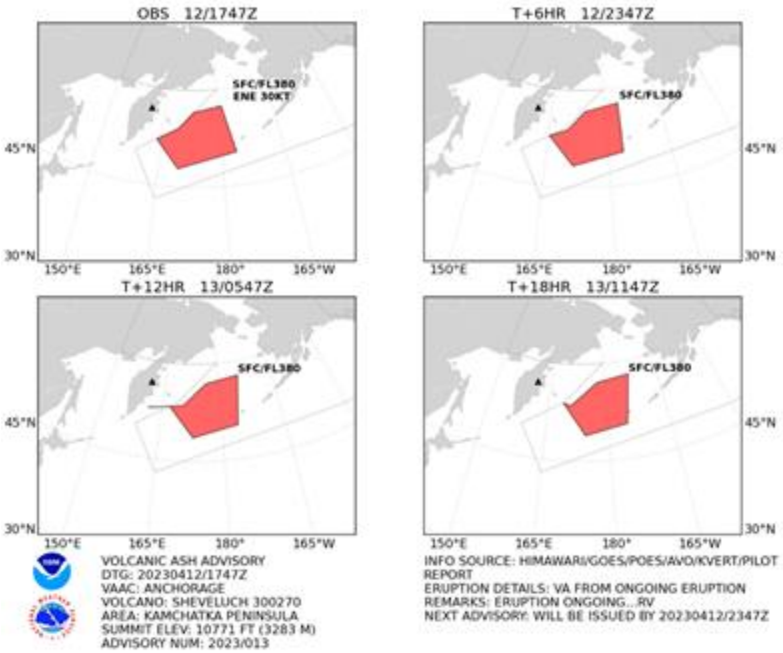
FCST VA CLD +12HR: 13/0547Z SFC/FL380 N5244 E16126 - N5317 E16654 - N4837 E17260 - N5016 W17604 - N5750 W17420 - N5657 E17627 - N5336 E17028 - N5317 E16708 - N5244 E16126

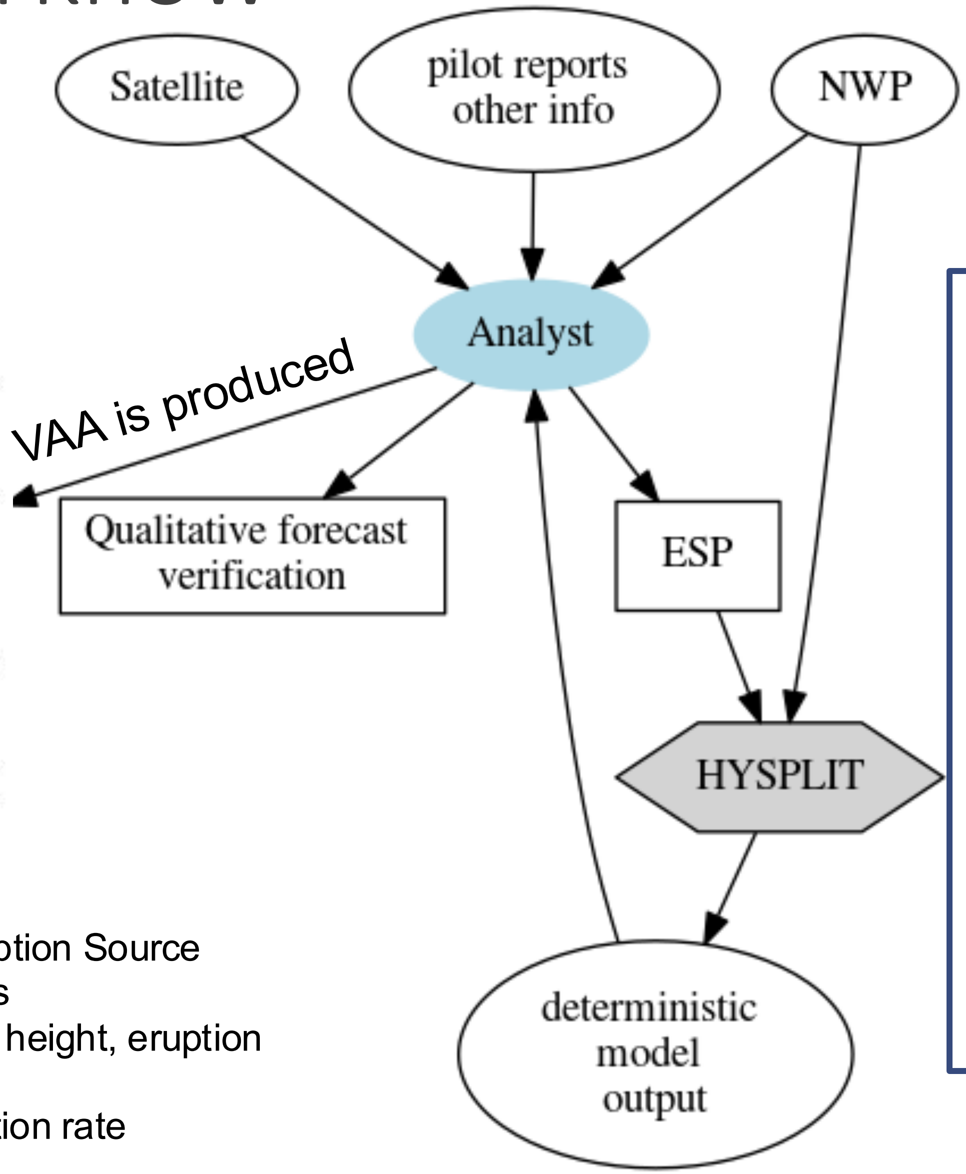
FCST VA CLD +18HR: 13/1147Z SFC/FL380 N5353 E16847 - N4857 E17430 - N5023 W17515 - N5754 W17256 - N5707 E17749 - N5333 E17048 - N5353 E16847 - N5353 E16847

RMK: ERUPTION ONGOING...RV

NXT ADVISORY: WILL BE ISSUED BY 20230412/2347Z

Approximate workflow





HYSPLIT AIR RESOURCES LAB

Transport and dispersion model is run on demand in an operational* environment in response to eruption.

Air Resources laboratory in NOAA office of atmospheric research supports the model development and R2O.

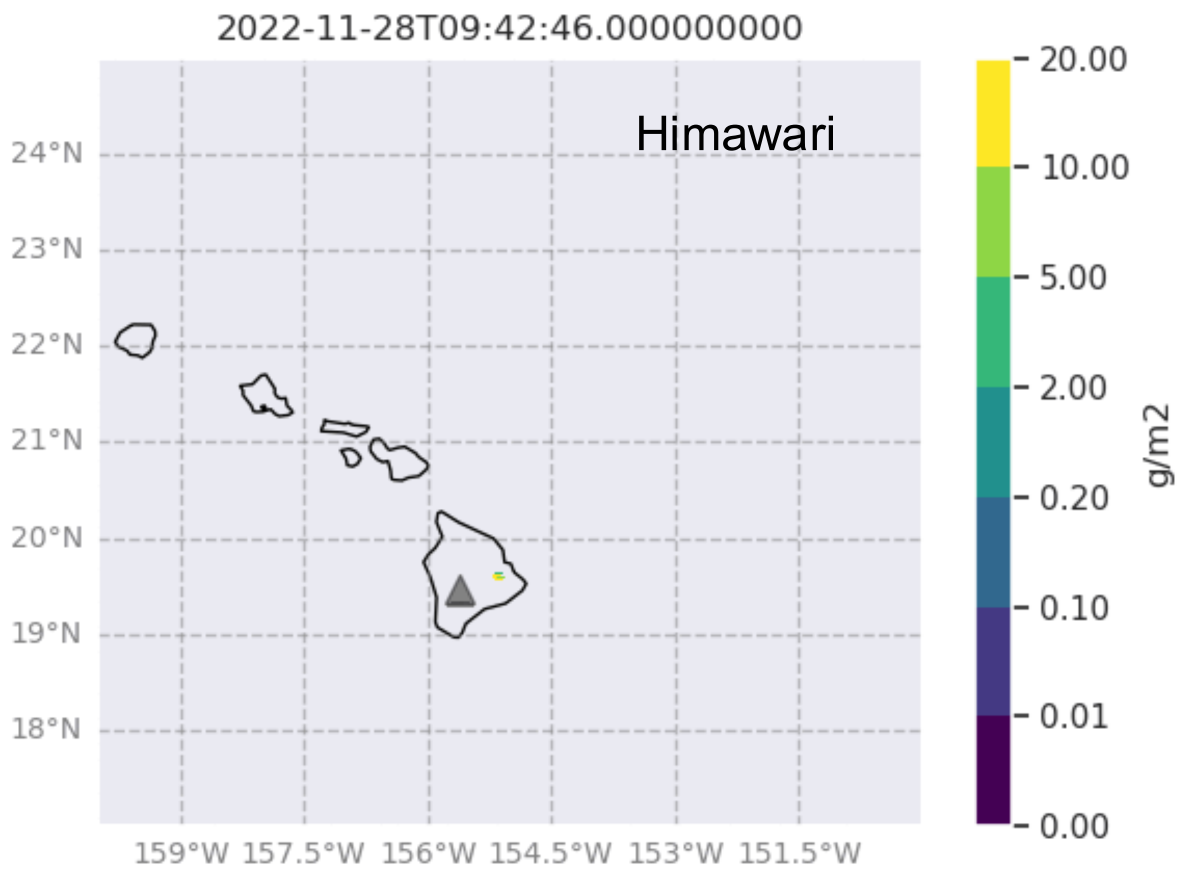
* Operational = reliably available 24/7

ESP = Eruption Source Parameters
e.g. Plume height, eruption duration,
mass eruption rate

NWP = output from numerical weather prediction model

Volcanic Cloud Analysis ToolKit (VolCAT)

https://volcano.ssec.wisc.edu/



Provides in near real-time

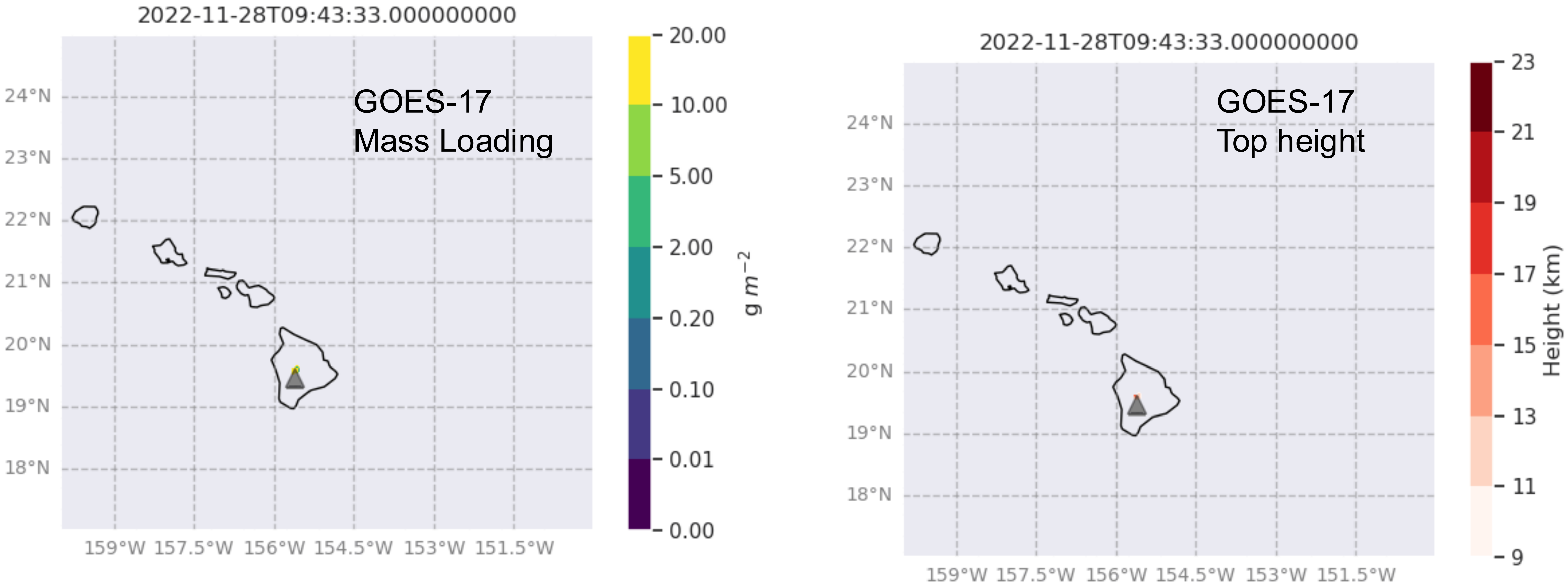
- Alerting
- Attribution and tracking of plume
- Column mass loading (shown)
- Estimate of cloud top height
- Effective radius
- RGB false imagery

Ash detection algorithm identifies ash using multi-spectral imagery from passive infrared (IR) sensors. Sensors aboard geo-stationary and polar orbiting satellites are used.

Short eruption of Mauna Loa in November 2022
Produced relatively little ash, but QVA would probably have been produced for it

Volcanic Cloud Analysis ToolKit (VolCAT)

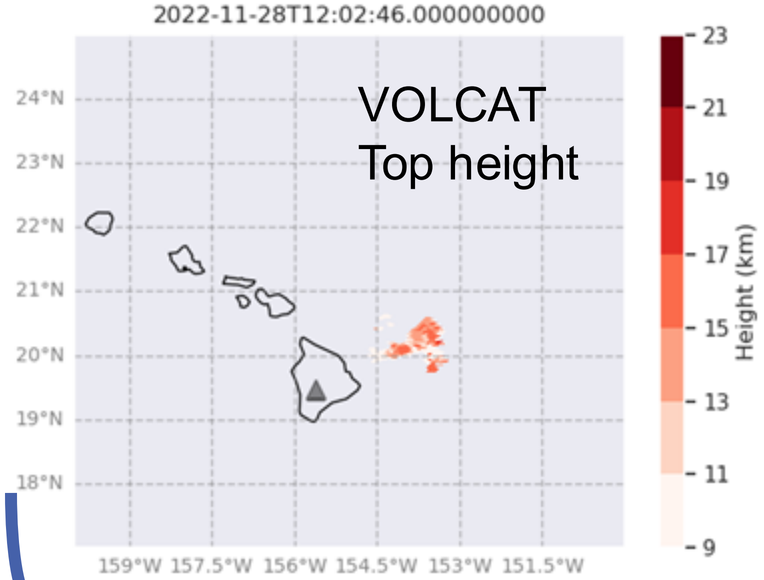
https://volcano.ssec.wisc.edu/

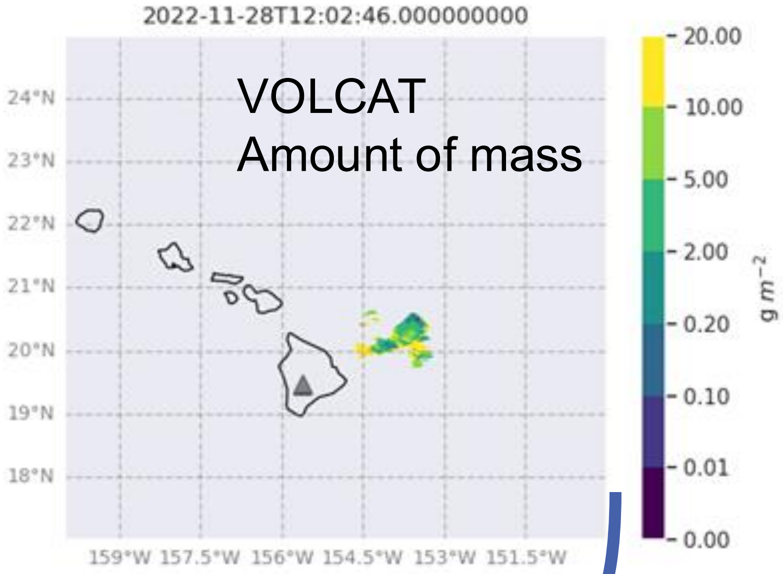


The eruption was visible to both Himawari and GOES-17
Some differences in the retrievals due to the different viewing angles

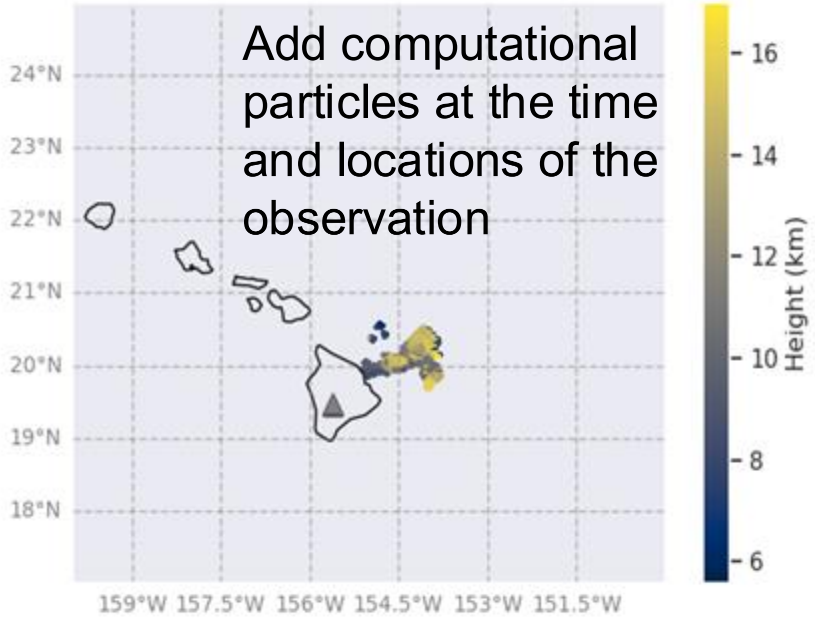
DATA FUSION

Example shows data insertion using retrieval at 12:00 UTC, Approximately 2.5 h after start of eruption

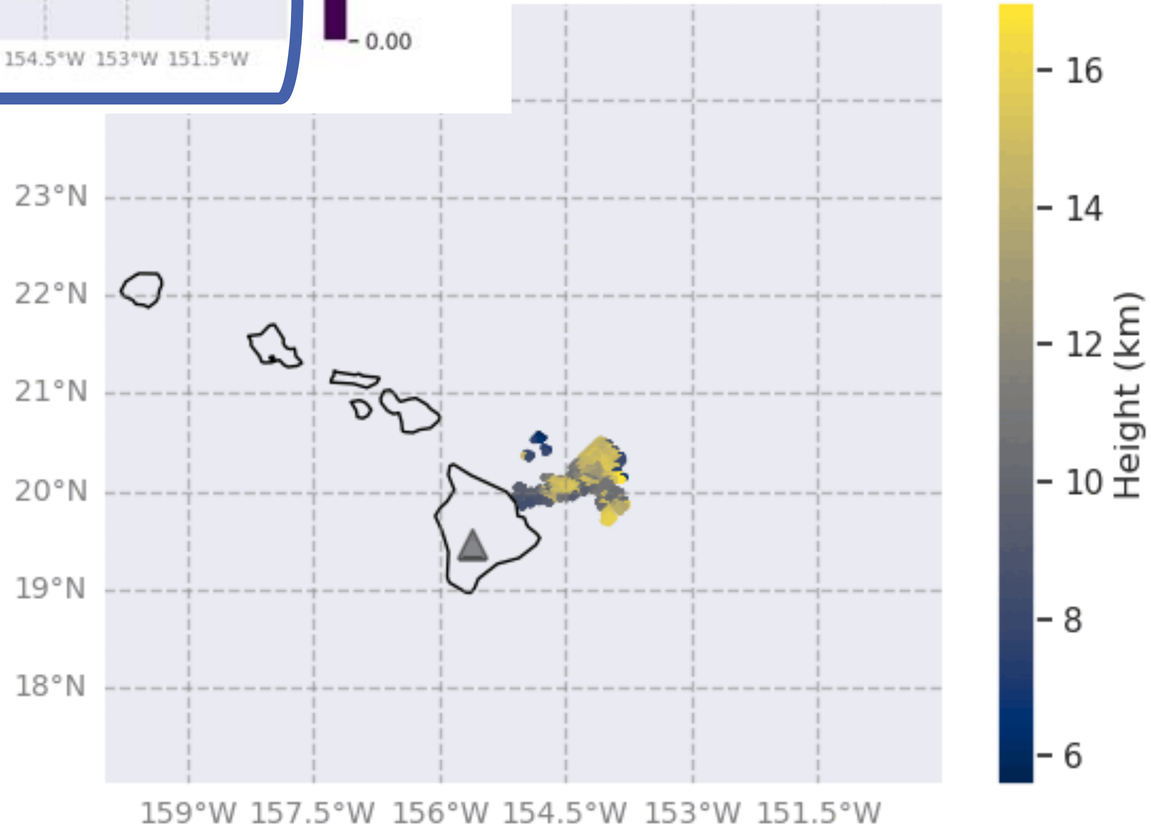




DATA INSERTION



Run forward



Emerging VAAC requirements

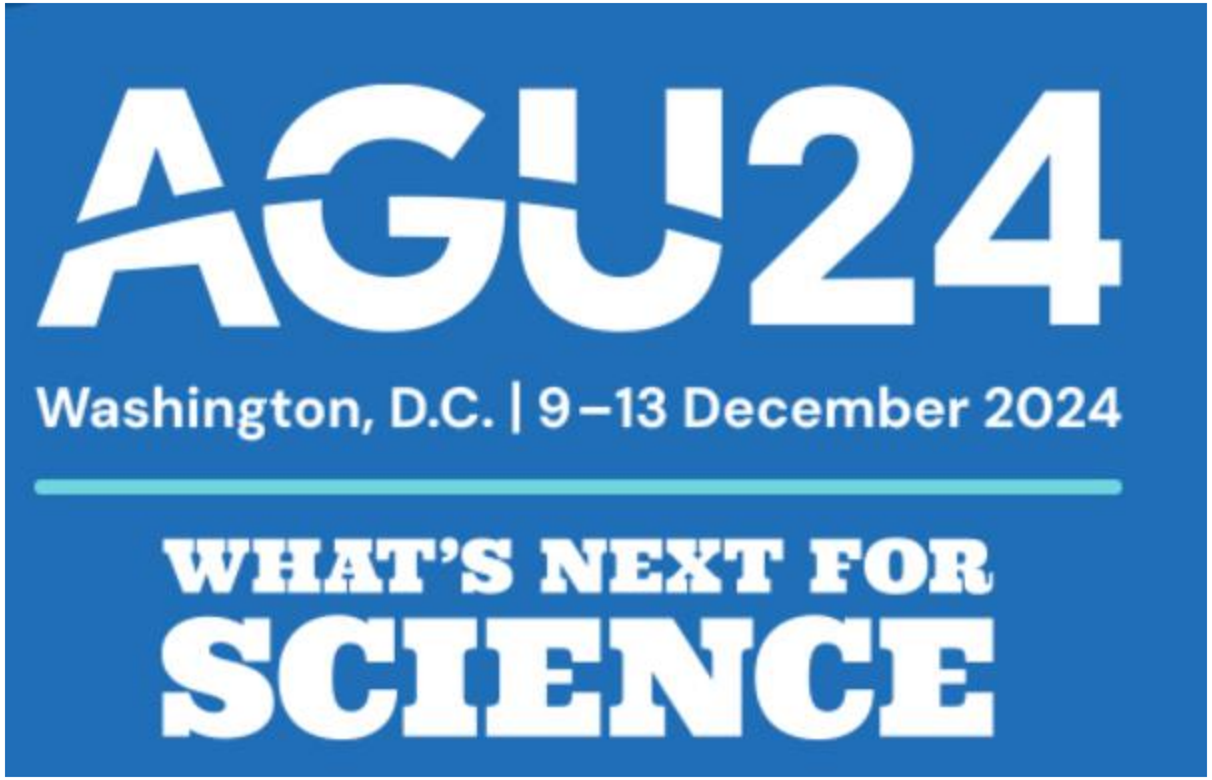
QVA - Quantitative Volcanic Ash

QVA is a data service, in a model-like format containing the VA forecast. HYSPLIT updates will support this service.

QVA is 'a product' to be issued by the VAACs potentially starting in November 2024 (recommended phase)

By November 2026, it will be required by the VAACs, and there is discussion that this will lead to the end of the legacy VAA TAC product.

American Geophysical Union NVEWS Townhall



Break

RETURN IN 15 MINUTES

VHP Strategic Plan & NVEWS Implementation Plan

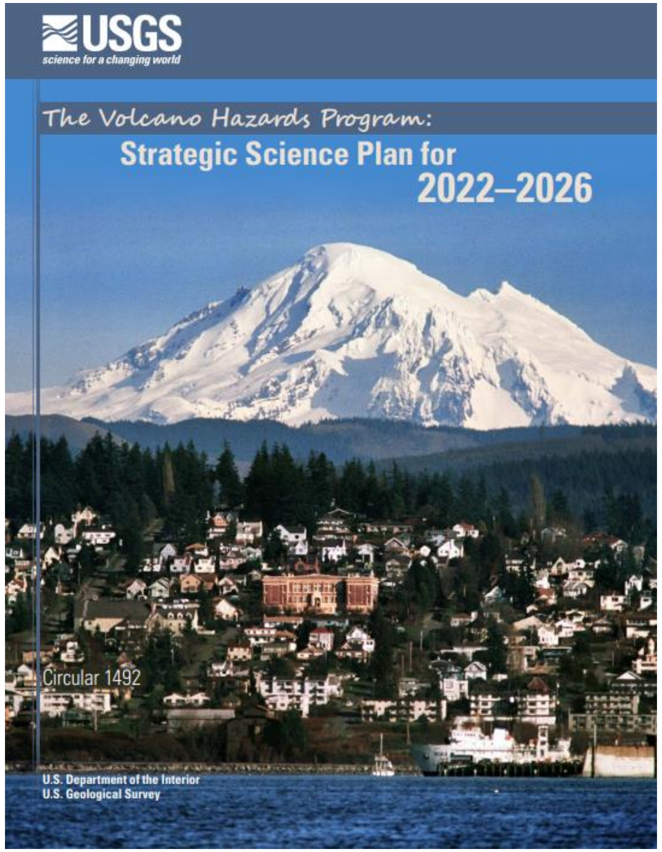
GARI MAYBERRY AND SETH MORAN

2022-2026 VHP Strategic Plan

GARI MAYBERRY

VHP Strategic Plan

- Developed through discussion with scientists-in-charge of the USGS volcano observatories and the director of the USGS Volcano Science Center
- Specifies six major strategic goals to be pursued over 5 years
- Purpose of these goals is to help fulfill the USGS VHP mission to enhance public safety and to minimize social and economic disruption caused by volcanic eruptions in the United States and its territories



Strategic Goals

(1) Continue—and when possible, accelerate—implementation of the National Volcano Early Warning System (NVEWS);

(2) Improve community preparedness for volcanic hazards;

(3) Develop the next generation of volcano hazard assessments using geographic information systems and other digital tools;

(4) Make observations with new instrumentation and take advantage of advances in real-time gas sensors;

(5) Rebuild the Hawaiian Volcano Observatory and its monitoring capabilities; and

(6) Form new partnerships and strengthen existing partnerships with other government agencies and with academia and industry, to advance volcano monitoring, increase understanding of volcanic processes, and disseminate USGS information.

Scientific Targets

(1) Increased understanding of volcano seismicity;

(2) Improved probabilistic forecasting;

(3) Deepened grasp of volcano eruption histories and geochronology;

(4) Newly developed and refined physical models of magmatic systems, leading to better situational awareness and accuracy of eruption forecasts;

(5) Improved warnings and forecasts of volcanic ash and gas clouds and characterization of volcanic smog sources; and

(6) Refined lava-flow modeling and forecasting of lava-flow paths.

NVEWS 2021 Implementation Plan

Volcano Hazards Program

Five-Year Management Plan for Establishing and Operating NVEWS: The National Volcano Early Warning System

Open-File Report 2021–1092

Cervelli et al., 2021

USGS

NVEWS 2021 Implementation plan

- **Required by Congress as part of 2019 authorization**
- **Constrained by $11 million/year authorization**
- **Two primary foci:**
  - **Improve monitoring at 34 of the 57 Very-High-Threat & High-Threat volcanoes**
  - **Build other NVEWS components (NVIS, 24x7 Watch Office, External Grants) identified in the authorization**

USGS

NVEWS 2021 Implementation plan

- **Improve monitoring at 34 volcanoes**
  - **Missing: 23 other VHT/HT volcanoes including Long Valley, Yellowstone, Medicine Lake, most in the Katmai area, Pavlof**
  - **Rationale: not enough $$ to make progress at all 57 VHT/HT volcanoes**

Very High Threat				
Kilauea	Hawaii	HI	HVO	263
Mount St. Helens	Washington	WA	CVO	235
Mount Rainier	Washington	WA	CVO	203
Redoubt Volcano	Cook Inlet	AK	AVO	201
Mount Shasta	Northern California	CA	CalVO	178
Mount Hood	Oregon	OR	CVO	178
Three Sisters	Oregon	OR	CVO	165
Akutan Island	Aleutian Islands	AK	AVO	161
Makushin Volcano	Aleutian Islands	AK	AVO	161
Mount Spurr	Cook Inlet	AK	AVO	160
Lassen Volcanic Center	Northern California	CA	CalVO	153
Augustine Volcano	Cook Inlet	AK	AVO	151
Newberry Volcano	Oregon	OR	CVO	146
Mount Baker	Washington	WA	CVO	139
Glacier Peak	Washington	WA	CVO	135
Mauna Loa	Hawaii	HI	HVO	131
Crater Lake	Oregon	OR	CVO	129
High Threat				
Mount Okmok	Aleutian Islands	AK	AVO	117
Iliamna Volcano	Cook Inlet	AK	AVO	115
Aniakchak Crater	Alaska Peninsula	AK	AVO	112
Hualalai	Hawaii	HI	HVO	109
Mount Katmai	Alaska Peninsula	AK	AVO	106
Mount Veniaminof	Alaska Peninsula	AK	AVO	102
Korovin Volcano	Aleutian Islands	AK	AVO	102
Clear Lake Volcanic Field	Northern California	CA	CalVO	92
Mount Adams	Washington	WA	CVO	92
Hayes Volcano	Cook Inlet	AK	AVO	90
Mount Churchill	Eastern Alaska	AK	AVO	82
Kanaga Volcano	Aleutian Islands	AK	AVO	81
Kaguyak Crater	Alaska Peninsula	AK	AVO	79
Pagan Island	Northern Mariana Islands	CNMI	AVO	79
Kasatochi Island	Aleutian Islands	AK	AVO	75
Mount Moffett	Aleutian Islands	AK	AVO	73
Seguam Island	Aleutian Islands	AK	AVO	73

Very High Threat (VHT)
17 of 18

High Threat (HT)
17 of 39

NVEWS 2021 Implementation plan

- **Improve monitoring at 34 volcanoes**

	Cost Category	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	Recurring
Capital Investment	Network Installation	$4,200	$6,300	$5,250	$3,150	$2,100	$21,000	—
	Station Permits	$390	$390	$330	$130	$70	$1,310	—
	Emergency Equipment Cache	$1,750	—	—	—	—	$1,750	—
Operations and Maintenance	Instruments and Telemetry	$1,326	$2,164	$2,806	$4,486	$5,286	$16,066	$7,086
	Data Center/Watch Office	$1,215	$1,857	$2,055	$3,025	$3,025	$11,175	$3,025
	External Data	$150	$150	$150	$150	$150	$750	$150
Coordination and Partners	Research Grants	$150	$300	$500	$750	$1,000	$2,700	$1,000
	Committee Activities	$20	$30	$50	$60	$80	$240	$170
Totals	Capital Investment:	$6,340	$6,690	$5,580	$3,280	$2,170	$24,060	—
	Operations and Maintenance:	$2,690	$4,170	$5,010	$7,660	$8,460	$27,990	$10,260
	Coordination and Partners:	$170	$330	$550	$810	$1,080	$2,940	$1,170
		Yearly Totals					Five Year Total	Annual Costs
		$9,200	$11,190	$11,140	$11,750	$11,710	$54,990	$11,430

USGS

NVEWS 2021 Implementation plan

- **Improve monitoring at 34 volcanoes**

	Cost Category	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	Recurring
Capital Investment	Network Installation	$4,200	$6,300	$5,250	$3,150	$2,100	$21,000	—
	Station Permits	$390	$390	$330	$130	$70	$1,310	—
	Emergency Equipment Cache	$1,750	—	—	—	—	$1,750	—
	Instruments and Telemetry	$1,326	$2,164	$2,806	$4,486	$5,286	$16,066	$7,086
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	Operations and Maintenance:	$2,690	$4,170	$5,010	$7,660	$8,460	$27,990	$10,260
	Coordination and Partners:	$170	$330	$550	$810	$1,080	$2,940	$1,170
		Yearly Totals					Five Year Total	Annual Costs
		$9,200	$11,190	$11,140	$11,750	$11,710	$54,990	$11,430

NVEWS 2021 Implementation plan

- **Build other NVEWS components: NVIS/24x7 Watch Office**

	Cost Category	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	Recurring
Capital Investment	Network Installation	$4,200	$6,300	$5,250	$3,150	$2,100	$21,000	—
	Station Permits	$390	$390	$330	$130	$70	$1,310	—
	Emergency Equipment Cache	$1,750	—	—	—	—	$1,750	—
Operations and Maintenance	Instruments and Telemetry	$1,326	$2,164	$2,806	$4,486	$5,286	$16,066	$7,086
	Data Center/Watch Office	$1,215	$1,857	$2,055	$3,025	$3,025	$11,175	$3,025
	External Data	$150	$150	$150	$150	$150	$750	$150
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	Committee Activities	$20	$30	$50	$60	$80	$240	$170
Totals	Capital Investment:	$6,340	$6,690	$5,580	$3,280	$2,170	$24,060	—
	Operations and Maintenance:	$2,690	$4,170	$5,010	$7,660	$8,460	$27,990	$10,260
	Coordination and Partners:	$170	$330	$550	$810	$1,080	$2,940	$1,170
		Yearly Totals					Five Year Total	Annual Costs
		$9,200	$11,190	$11,140	$11,750	$11,710	$54,990	$11,430

USGS

NVEWS 2021 Implementation plan

- **Build other NVEWS components: External Grants**

	Cost Category	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	Recurring
Capital Investment	Network Installation	$4,200	$6,300	$5,250	$3,150	$2,100	$21,000	—
	Station Permits	$390	$390	$330	$130	$70	$1,310	—
	Emergency Equipment Cache	$1,750	—	—	—	—	$1,750	—
Operations and Maintenance	Instruments and Telemetry	$1,326	$2,164	$2,806	$4,486	$5,286	$16,066	$7,086
	Data Center/Watch Office	$1,215	$1,857	$2,055	$3,025	$3,025	$11,175	$3,025
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		Yearly Totals					Five Year Total	Annual Costs
		$9,200	$11,190	$11,140	$11,750	$11,710	$54,990	$11,430

USGS

NVEWS 2021 Implementation plan

- **Build other NVEWS components: NVEWSAC**

	Cost Category	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	Recurring
Capital Investment	Network Installation	$4,200	$6,300	$5,250	$3,150	$2,100	$21,000	—
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Operations and Maintenance	Instruments and Telemetry	$1,326	$2,164	$2,806	$4,486	$5,286	$16,066	$7,086
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USGS

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- **Two primary foci:**
  - **Improve monitoring at 34 of the 57 Very-High-Threat & High-Threat volcanoes**
  - **Build other NVEWS components (NVIS, 24x7 Watch Office, External Grants) identified in the authorization**
- **Also calls for establishing an "Implementation Committee" composed of those involved in operational aspects of NVEWS**

NVEWS 2021 Implementation plan

- 2022-2023 appropriations: $6.6 M (half for NVIS)

	Cost Category	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	Recurring
Capital Investment	Network Installation	$4,200	$6,300	$5,250	$3,150	$2,100	$21,000	—
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	Emergency Equipment Cache	$1,750	—	—	—	—	$1,750	—
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  - **Build other NVEWS components (NVIS, ~~24x7 Watch Office~~, ~~External Grants~~) identified in the authorization**
- ~~**Also calls for establishing an "Implementation Committee" composed of those involved in operational aspects of NVEWS**~~

NVEWS 2021 Implementation plan

- **2022-2023 network installations**
  - **VSC installed or upgraded sites at 15 of the 34 volcanoes listed in the 2021 Implementation Plan**
  - **Sites were also installed/upgraded at 10 other VHT/HT volcanoes**
  - **New sites were also installed at two moderate-low-threat volcanoes (Edgecumbe (Alaska) & Ta’u Island (American Samoa)) that experienced significant unrest in 2022**

NVEWS 202X Implementation plan

- **Early stages of crafting a new plan (required by a reauthorization?), to be finalized by mid-end of FY25**
- **Plan will include:**
  - **Revised instrumentation targets, costs, & installation prioritization for all 57 VHT/HT volcanoes**
  - **Refined vision for NVIS**
  - **More detailed vision for 24x7 watch office capability**
  - **Reimagined vision for an implementation committee (or equivalent)**
  - **External grants**

Discussion

Public Comment

Adjournment

- Add any final thoughts or logistical items about beginning of Day 2, etc

NVEWS Advisory Committee Meeting

SEPTEMBER 18-19, 2024

VANCOUVER, WA

Day One Review, Questions, Reflections

VHP Office Staff

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

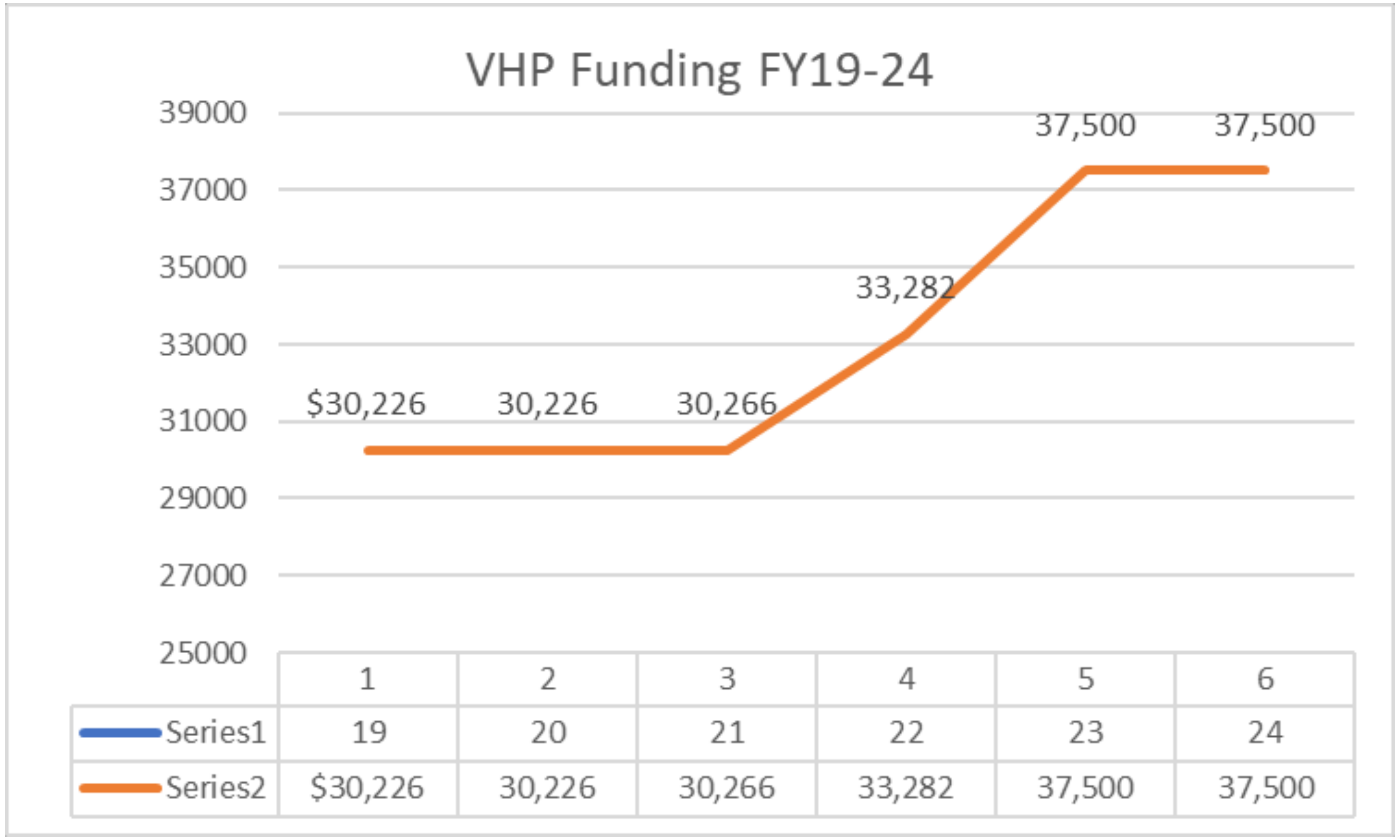
ASSOCIATE PROGRAM COORDINATOR
Filled: Wendy Stovall
GENERAL PHYSICAL SCIENTIST, Duty Station: VANCOUVER

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

VHP Funding FY19-24



NVEWS Funding Language

19	30,266	No NVEWS specific language
20	30,266	No NVEWS specific language
21	30,266	No NVEWS specific language
22	33,282	2 mill NVEWS (.5 O&M, 1.5 enhancements), 250 K hazard assessments, 766K fixed costs
23	37.5	2.591 K NVEWS, 750 K hazard assessment, 877 K fixed costs
24	37.5	No NVEWS specific language

Introductions

Brian Terbush, Washington State Emergency Management

Erin Campbell, Wyoming State Survey

Nelia Dunbar, New Mexico Bureau of Geology

Casey Hanell, Washington Department of Natural Resources

Leif Karlstrom, University of Oregon

Yvette LaDuke, California Governor’s Office of Emergency Services

Michael Manga, University of California, Berkeley

Matthew Pritchard, Cornell University

Christy Till, Arizona State University

Geohazards & Outreach Team
Washington Emergency Management

Brian Terbush
Washington Emergency Management Division

EARTHQUAKE/VOLCANO PROGRAM MANAGER

SINCE JUNE 2016 (~8 YEARS IN ROLE)

My work *(The volcano side)*

The State of Washington

Proclamation

WHEREAS, the May 18, 1980, eruption of Mt. St. Helens and its long-lasting impacts brought worldwide attention to the potential hazards of an eruption of Washington's volcanoes, the importance of which remains relevant today; and

WHEREAS, the State of Washington is home to five active volcanoes, four of which are considered very high threat and the fifth considered high threat; and

WHEREAS, geologic evidence indicates that the state remains vulnerable to the impacts of volcanic eruptions; and

WHEREAS, loss of life and property damage can be significantly reduced as preparedness measures are taken before, during and after a volcanic eruption; and

WHEREAS, Washington residents should become familiar with potential volcanic hazards in their communities, understand how they will be alerted to approaching volcanic hazards, become "2 Weeks Ready" for any disaster, and be aware of evacuation routes in order to prepare to respond effectively to an eruption; and

WHEREAS, state agencies and employees should be aware of and prepared for the impacts of volcanic eruptions so they may support the state's disaster response and recovery mission by continuing to provide essential public services during and after a volcanic eruption; and

WHEREAS, volcano hazard awareness in Washington will be highlighted during the month of May, as the Emergency Management Division; United States Geological Survey Cascades Volcano Observatory; other city, county, tribal, state, and federal agencies work together on activities that promote volcano hazard awareness and preparedness;

NOW, THEREFORE, I, Jay Inslee, governor of the state of Washington, do hereby proclaim May 2024 as

Volcano Awareness Month

in Washington, and I urge all people in our state to join me in this special observance.

Signed this 19th day of April, 2024

Governor Jay Inslee

Outreach

- "May is Volcano Awareness Month" in Washington – Governor Proclamation
- Create Publications/Materials/Videos
- @WaShakeOut Twitter/X account
- Coordinate events (Reddit AMA, Webinars)

Coordination

- State involvement in WA volcano workgroups
- International visits (Japan, New Zealand, etc.)
- Exercises/Drills
- Agreements/Contracts

Technical/Subject Matter Expertise

- Plans
- Exercises
- Mitigation Projects
- Conferences
- Volcano Alerting "Timelines"

Volcano and Hazard Experience

- M.S. in Geophysical Volcanology, Boise State University, 2015

Visited/worked on(*/experienced hazards at*) volcanoes in Guatemala, Ecuador, Japan, Mexico, Colombia, and the U.S.

<u>Work goal</u>: to help people around Washington understand that the volcanoes of Washington are part of our culture here in the State, and while they seem huge, they are something we can prepare for!

- **Empower everyone** to take action, and help them understand the mountains, their potential hazards, and how to safely enjoy them
- Encourage everyone to learn about their volcanoes by making it interesting and engaging

Work with the USGS

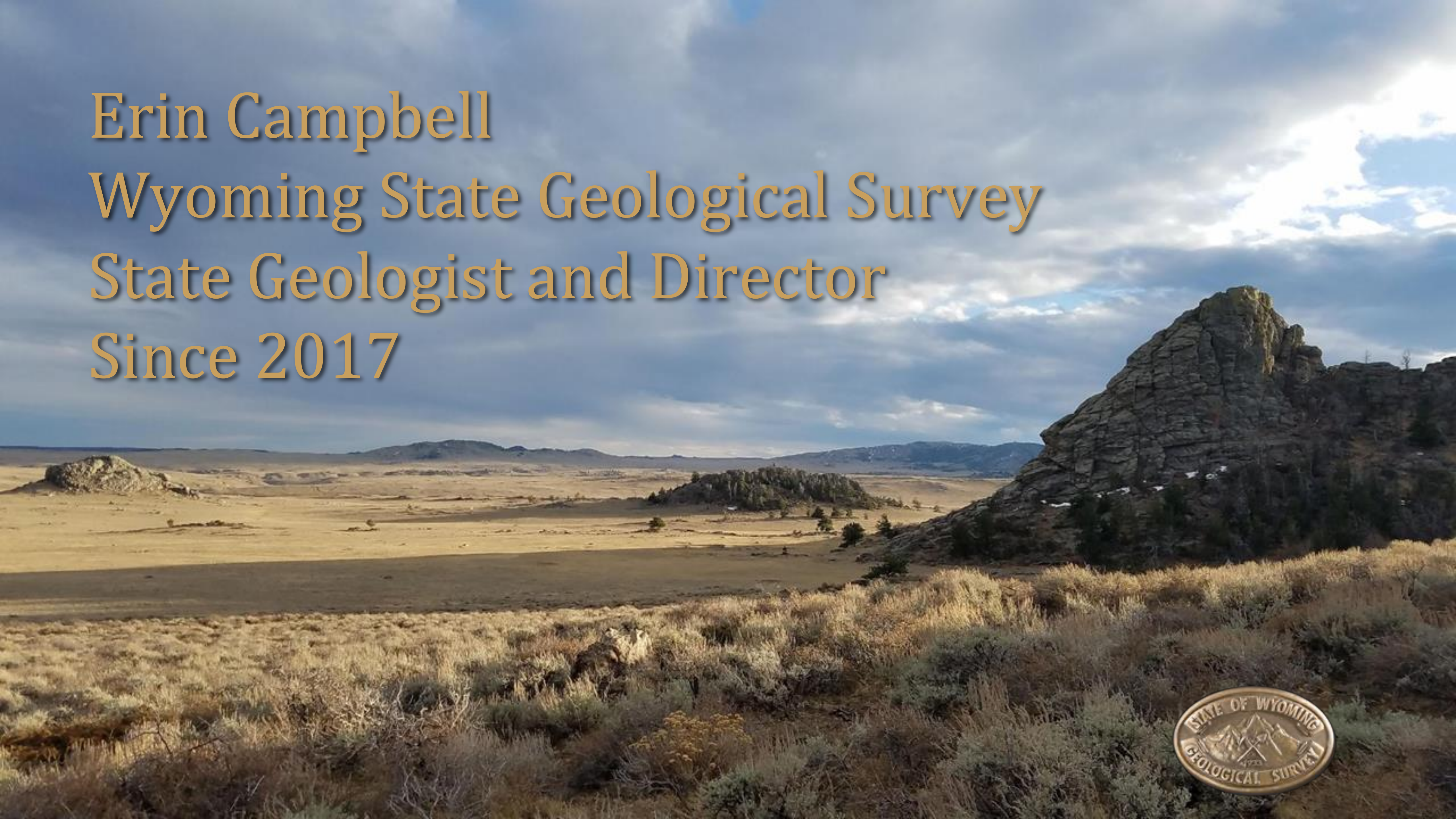
Many projects with both the earthquake side (ShakeAlert®) and volcanoes (USGS CVO)

- Work closely to plan annual Volcano Awareness month activities
- Binational Exchange 2018 – Colombia, Nevado Del Ruiz
- Support for Volcano Workgroups
- Join together on Reddit Ask-Me-Anything events, Volcano Movie "Live Tweets"
- Volcano Roadshows
- Help provide feedback on outreach materials intended for Washington
- Support Exercises together (recently, Mt. Rainier Lahar Call-down communications exercise)
- Support Social Science work around volcanoes, public risk perception, protective actions, etc.

NVEWS Advisory Committee Interest

Here to serve, and help represent the interests and needs of the people of Washington, and ensure that they have a strong understanding of volcanoes, how they will get alerted, and what to do when they receive information about the volcanoes.

Looking forward to the opportunity to learn from everyone here and their experience!



Erin Campbell
Wyoming State Geological Survey
State Geologist and Director
Since 2017

Responsibilities

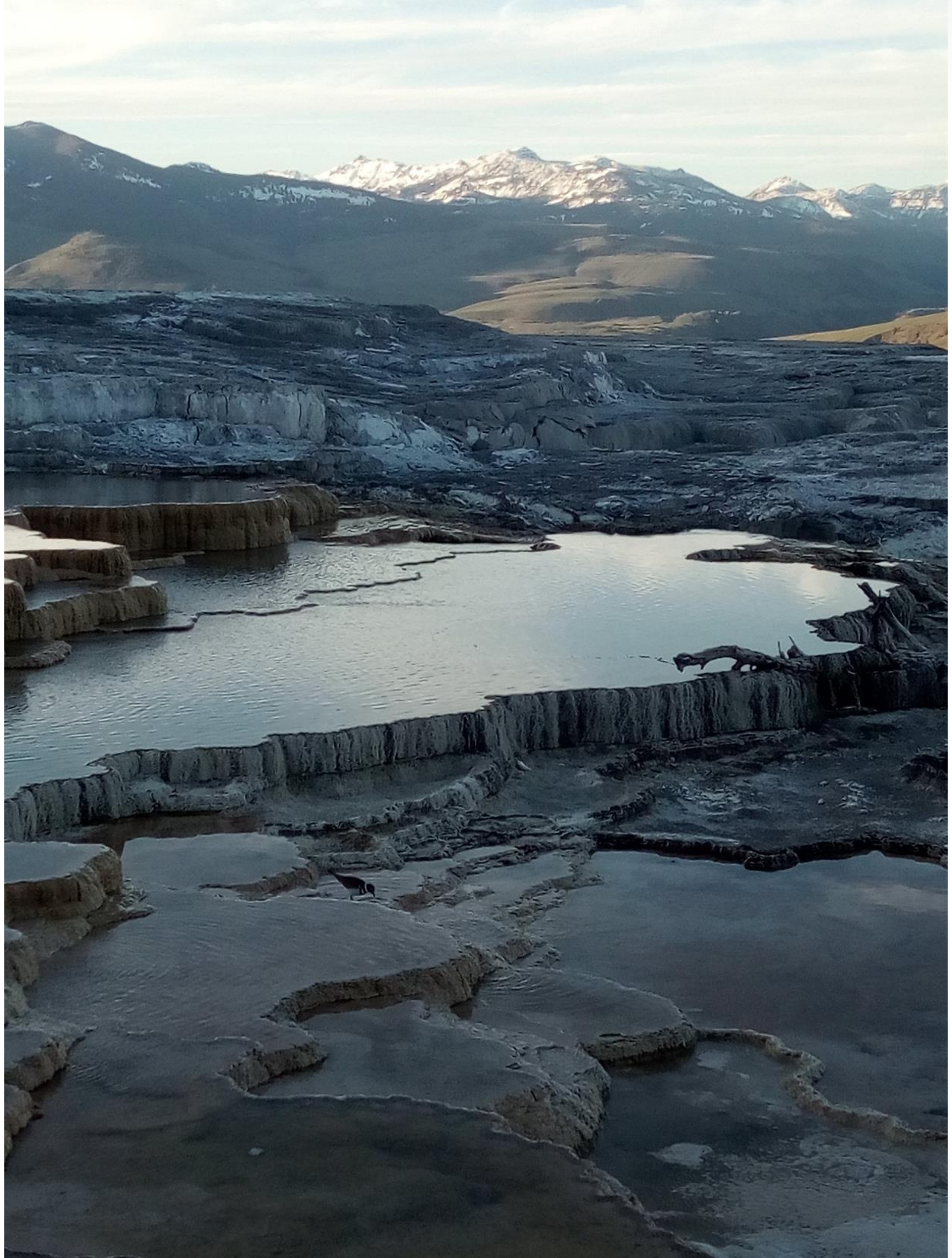
- Director of WSGS
  - 98,000 square miles, 580,000 residents, 3.5 billion years of geologic history
  - Areas of research
    - Natural resources: oil and gas, coal, trona, bentonite, uranium, critical minerals
    - Geologic hazards: landslides, quaternary faults, volcanic hazards, etc.
    - Groundwater
- State Geologist Roles
  - Governor’s Cabinet
  - Commissions: Wyoming Oil and Gas Conservation, Enhanced Oil Recovery
  - Boards: WY PG, State Groundwater, State GIS Advisory Board
  - Membership: WY CCUS, WY Renewable Energy, WY Nuclear Working Group, YVO
  - Other: AASG, NAS CER, NVEWSAC

Volcano and Hazard Experience

- Member of YVO
  - Data coordination
  - Hazard mapping
  - Public information
  - Wyoming State response
- HVO internship

Work with the USGS

- YVO
- AASG
    - Executive Committee 2019-2023
    - Collaboration with USGS Director
- WSGS mapping program
    - NCGMP
    - NGGDPP
    - NGMDB



NVEWS Advisory Committee Interest

- Hazard monitoring
- Public awareness
- National coordination

Yellowstone Biscuit Basin Hydrothermal Eruption, NPS photo

Nelia W. Dunbar
New Mexico Bureau of Geology and Mineral Resources

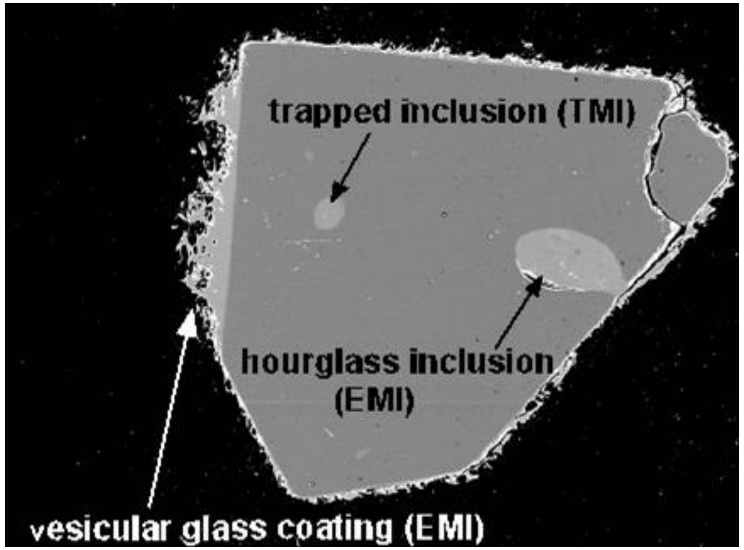
DIRECTOR AND STATE GEOLOGIST EMERITA (MARCH 2024-PRESENT)

DIRECTOR AND STATE GEOLOGIST (2016-2024

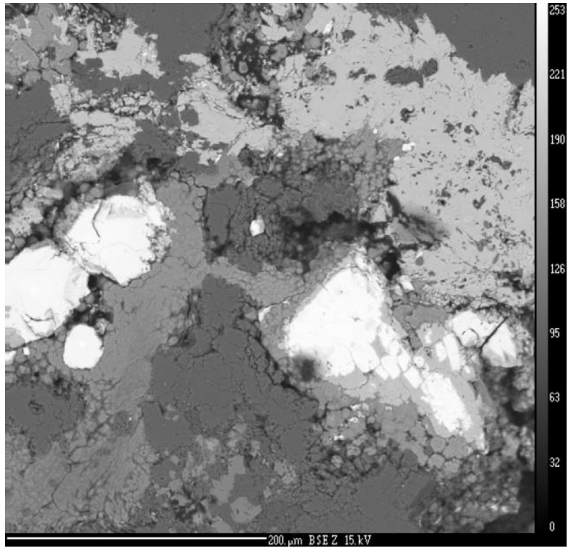
STAFF SCIENTIST/GEOCHEMIST (1992-2016)

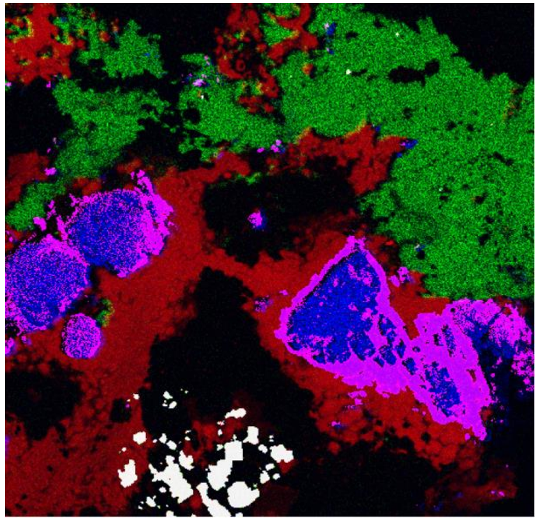
Geochemistry/petrology/volcanology

Pre-eruptive volatile content of melts



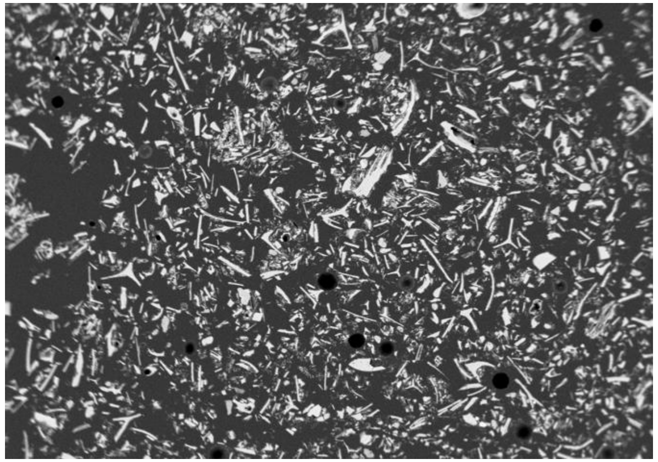
Transport and deposition in magmatic systems

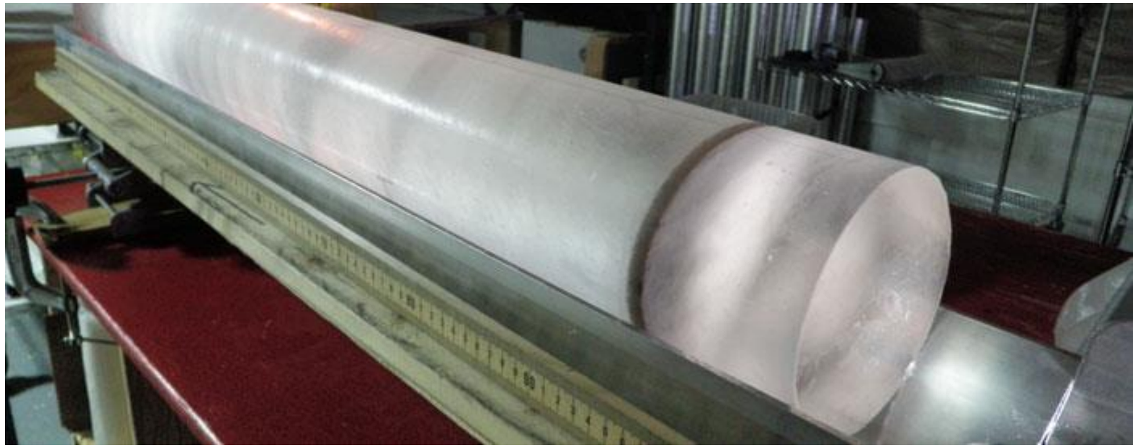




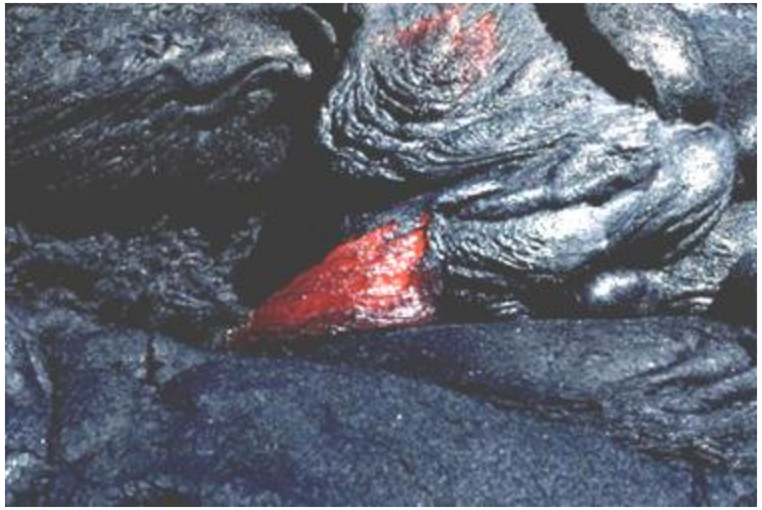
Synchysite	Thorite	Xenotime
$Ca(LREE)(CO_3)2F$	$(Th,U)SiO_4$	YPO_4

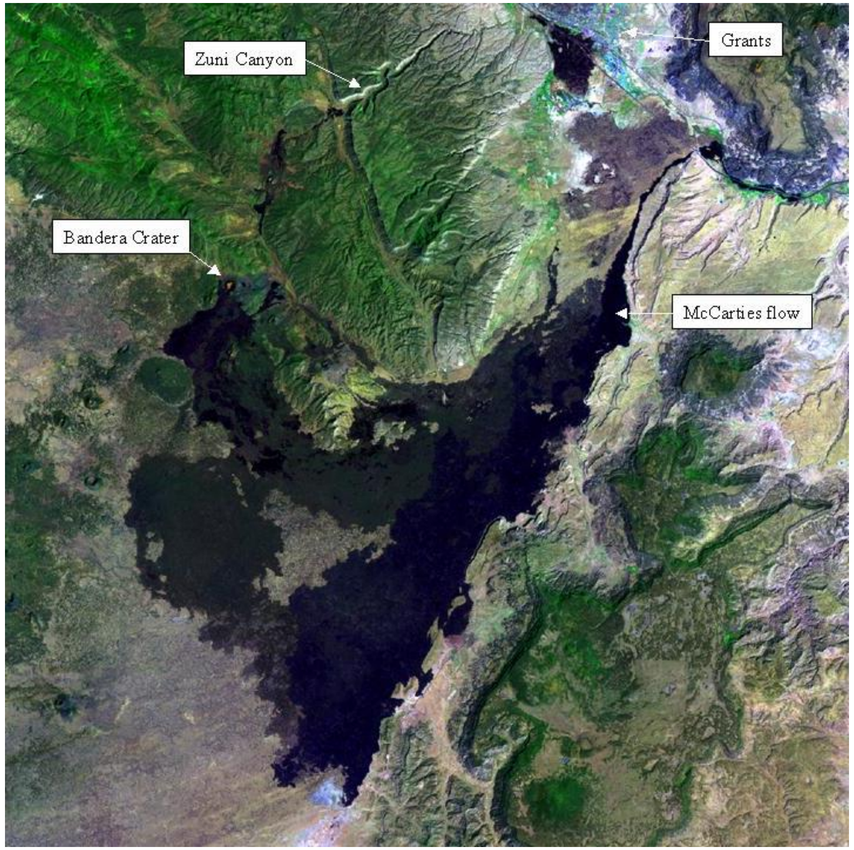
Tephrochronology in New Mexico, Antarctica, Ethiopia, and other places





Dating young lavas using cosmogenic ^{36}Cl





Volcano and Hazard Experience

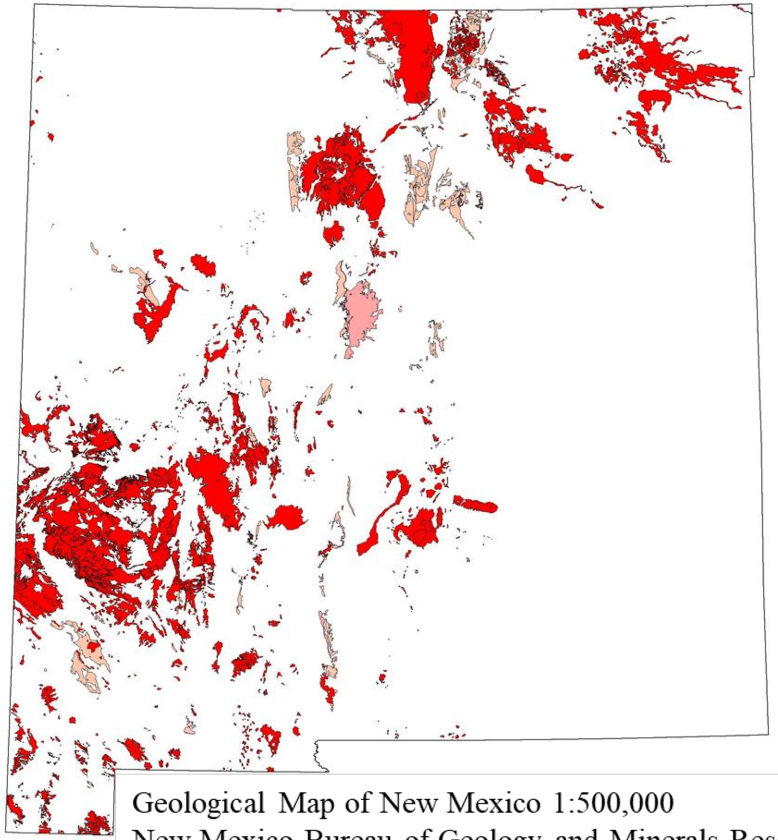
How do you interact with volcanoes, volcanic hazards, or other natural hazards in your professional capacity?



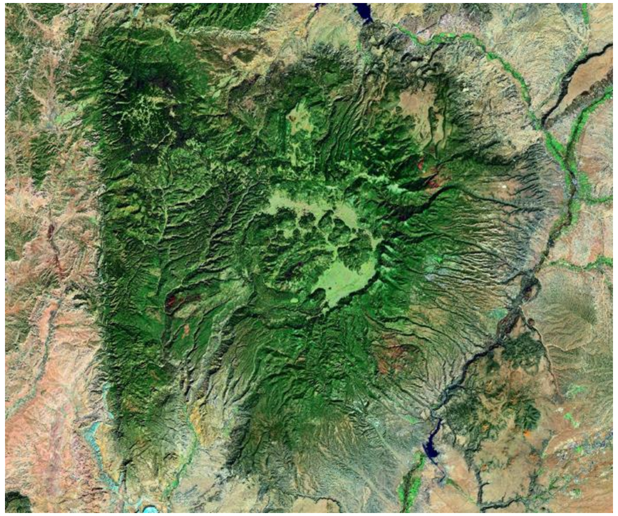
Work with the USGS

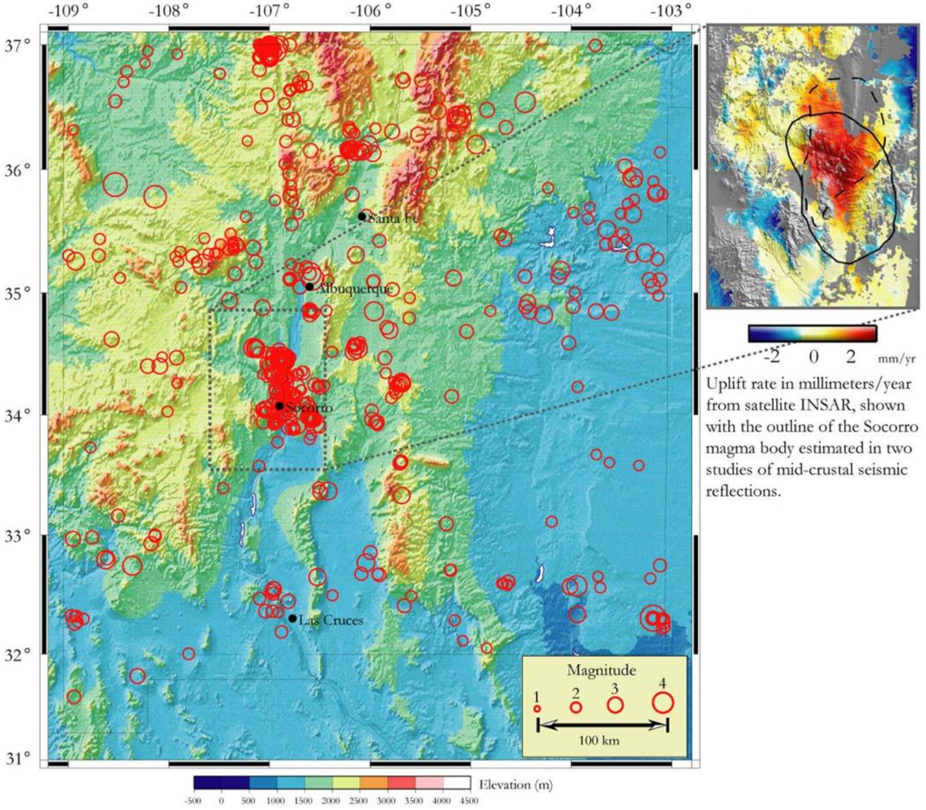
- Collaboration through the Association of American State Geologists
- State survey funding through USGS (Statemap, NGGDPP, Earth MRI)
- Serving on the National Academy of Science Committee tasked with evaluating the USGS Mineral Resources Program
- Scientific collaborations with USGS scientists
- Participated in the 2012 Volcanism in the American Southwest workshop, which was led by USGS

NVEWS Advisory Committee Interest



Geological Map of New Mexico 1:500,000
New Mexico Bureau of Geology and Minerals Resources, 2003

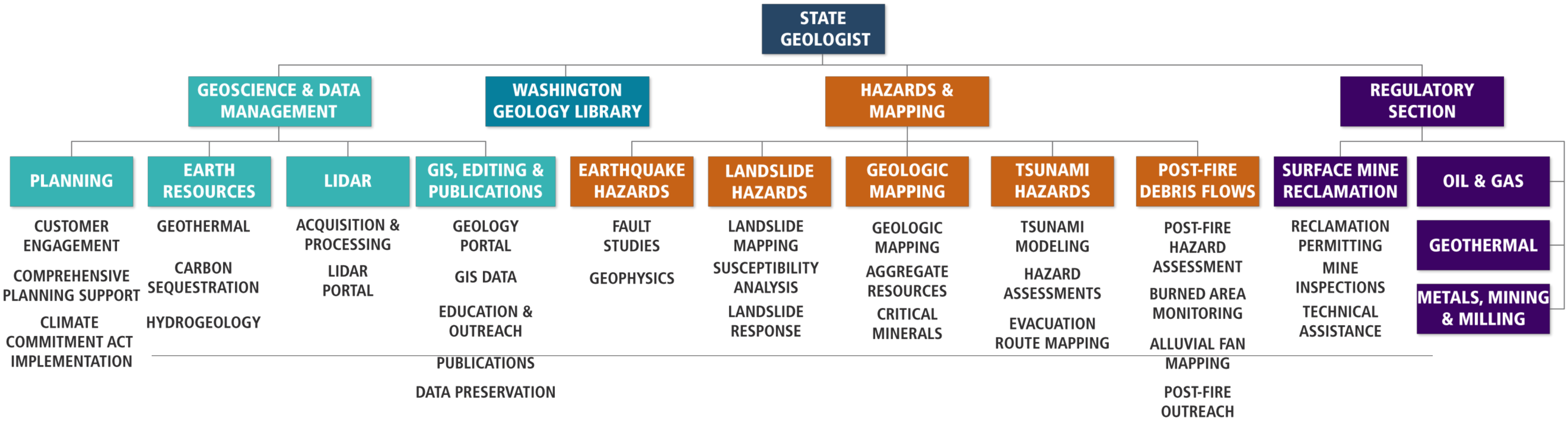


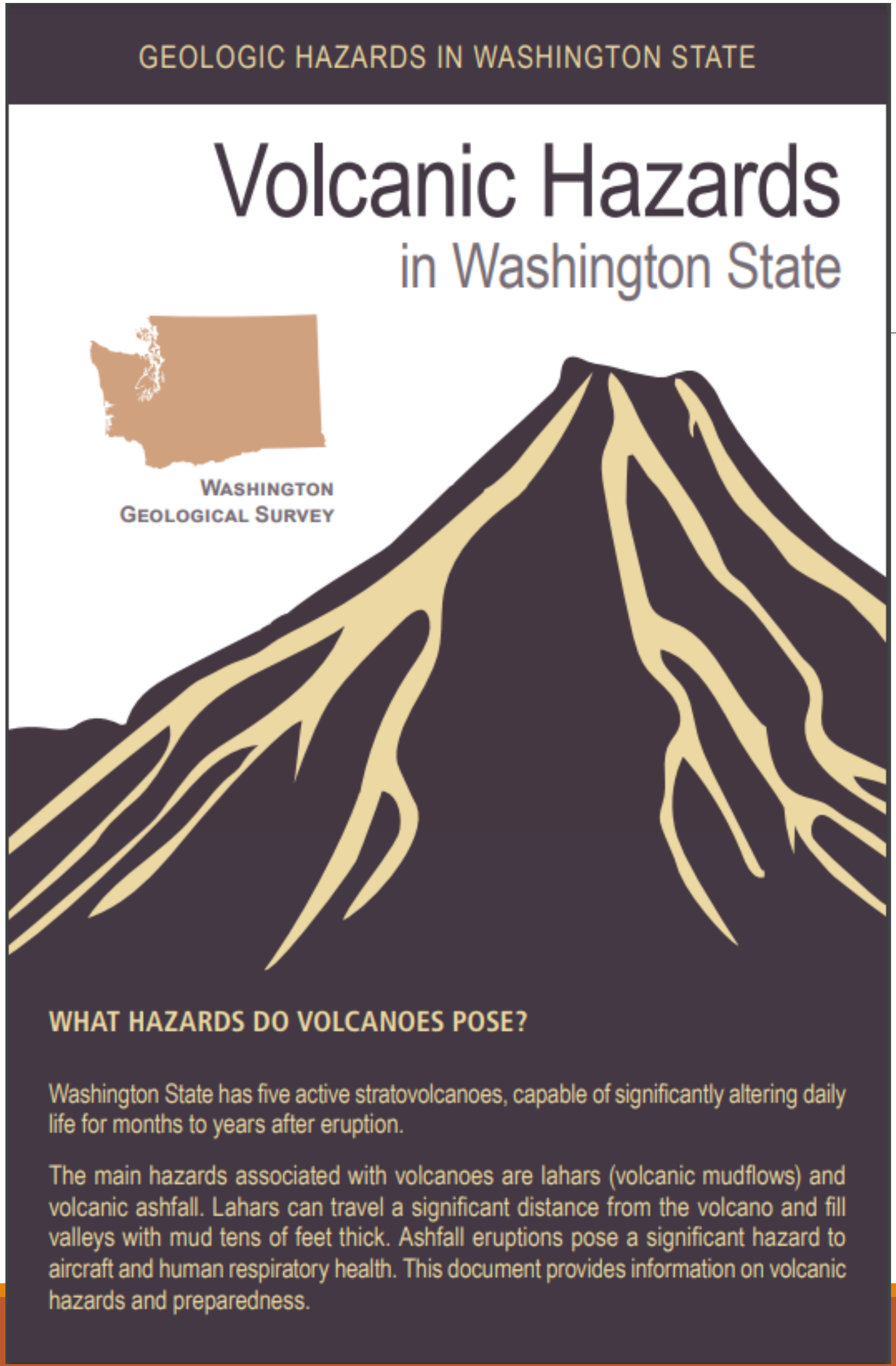


After NMBGMR web site and Fialko and Simmons, 2001

Washington Geological Survey

Casey Hanell, State Geologist and Director


STATE GEOLOGIST
GEOSCIENCE & DATA MANAGEMENT
WASHINGTON GEOLOGY LIBRARY
HAZARDS & MAPPING
REGULATORY SECTION
PLANNING
CUSTOMER ENGAGEMENT
COMPREHENSIVE PLANNING SUPPORT
CLIMATE COMMITMENT ACT IMPLEMENTATION
EARTH RESOURCES
GEOTHERMAL
CARBON SEQUESTRATION
HYDROGEOLOGY
LIDAR
ACQUISITION & PROCESSING
LIDAR PORTAL
GIS, EDITING & PUBLICATIONS
GEOLOGY PORTAL
GIS DATA
EDUCATION & OUTREACH
PUBLICATIONS
DATA PRESERVATION
EARTHQUAKE HAZARDS
FAULT STUDIES
GEOPHYSICS
LANDSLIDE HAZARDS
LANDSLIDE MAPPING
SUSCEPTIBILITY ANALYSIS
LANDSLIDE RESPONSE
GEOLOGIC MAPPING
GEOLOGIC MAPPING
AGGREGATE RESOURCES
CRITICAL MINERALS
TSUNAMI HAZARDS
TSUNAMI MODELING
HAZARD ASSESSMENTS
EVACUATION ROUTE MAPPING
POST-FIRE DEBRIS FLOWS
POST-FIRE HAZARD ASSESSMENT
BURNED AREA MONITORING
ALLUVIAL FAN MAPPING
POST-FIRE OUTREACH
SURFACE MINE RECLAMATION
RECLAMATION PERMITTING
MINE INSPECTIONS
TECHNICAL ASSISTANCE
OIL & GAS
GEOTHERMAL
METALS, MINING & MILLING



GEOLOGIC HAZARDS IN WASHINGTON STATE

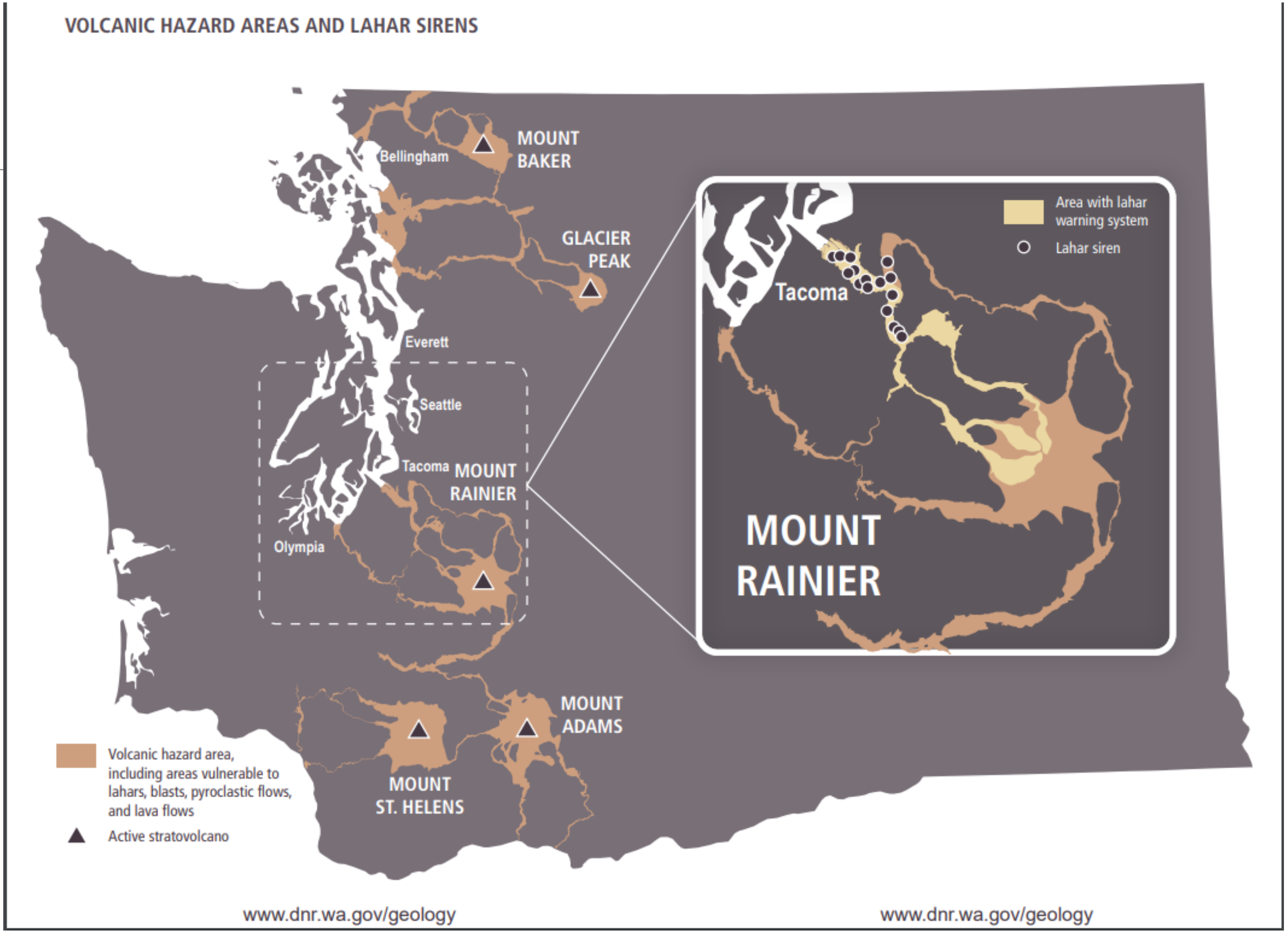
Volcanic Hazards
in Washington State

Washington Geological Survey

WHAT HAZARDS DO VOLCANOES POSE?

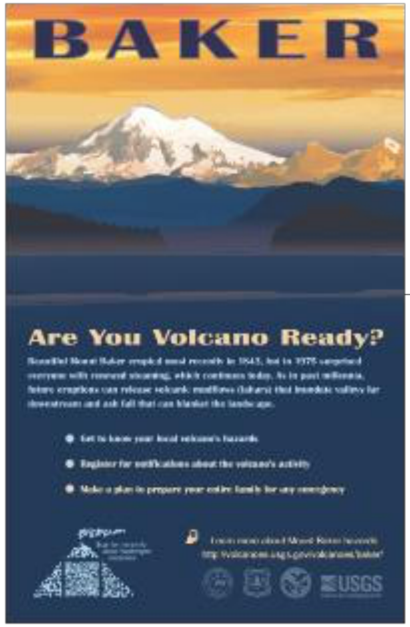
Washington State has five active stratovolcanoes, capable of significantly altering daily life for months to years after eruption.

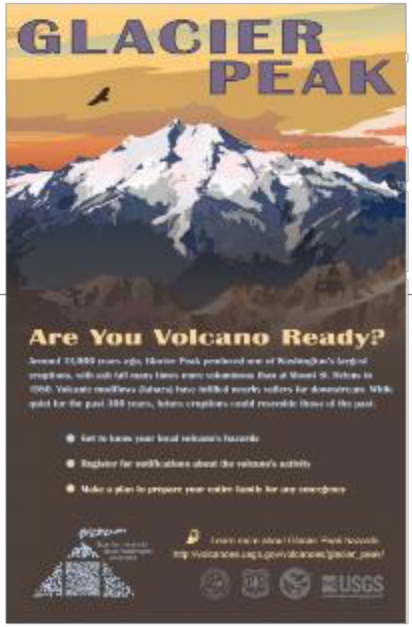
The main hazards associated with volcanoes are lahars (volcanic mudflows) and volcanic ashfall. Lahars can travel a significant distance from the volcano and fill valleys with mud tens of feet thick. Ashfall eruptions pose a significant hazard to aircraft and human respiratory health. This document provides information on volcanic hazards and preparedness.

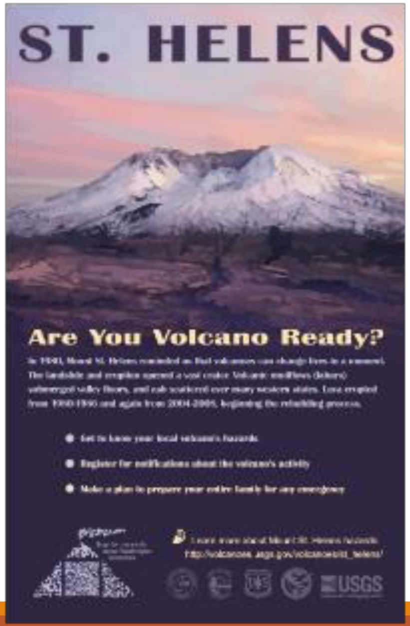


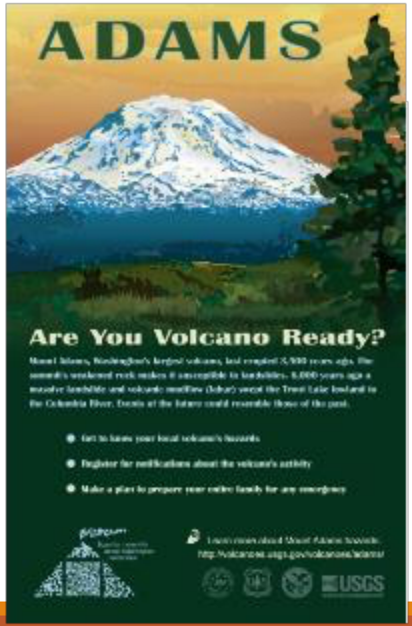
https://www.dnr.wa.gov/publications/ger_volcano_hazards_brochure.pdf

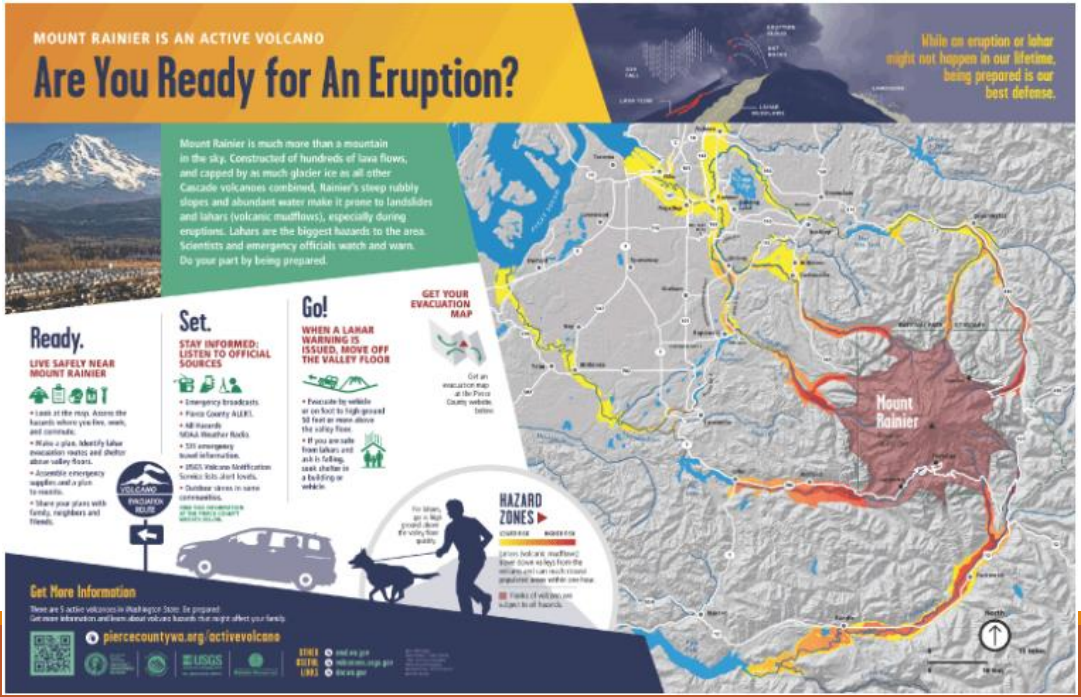
Volcano Preparedness Posters





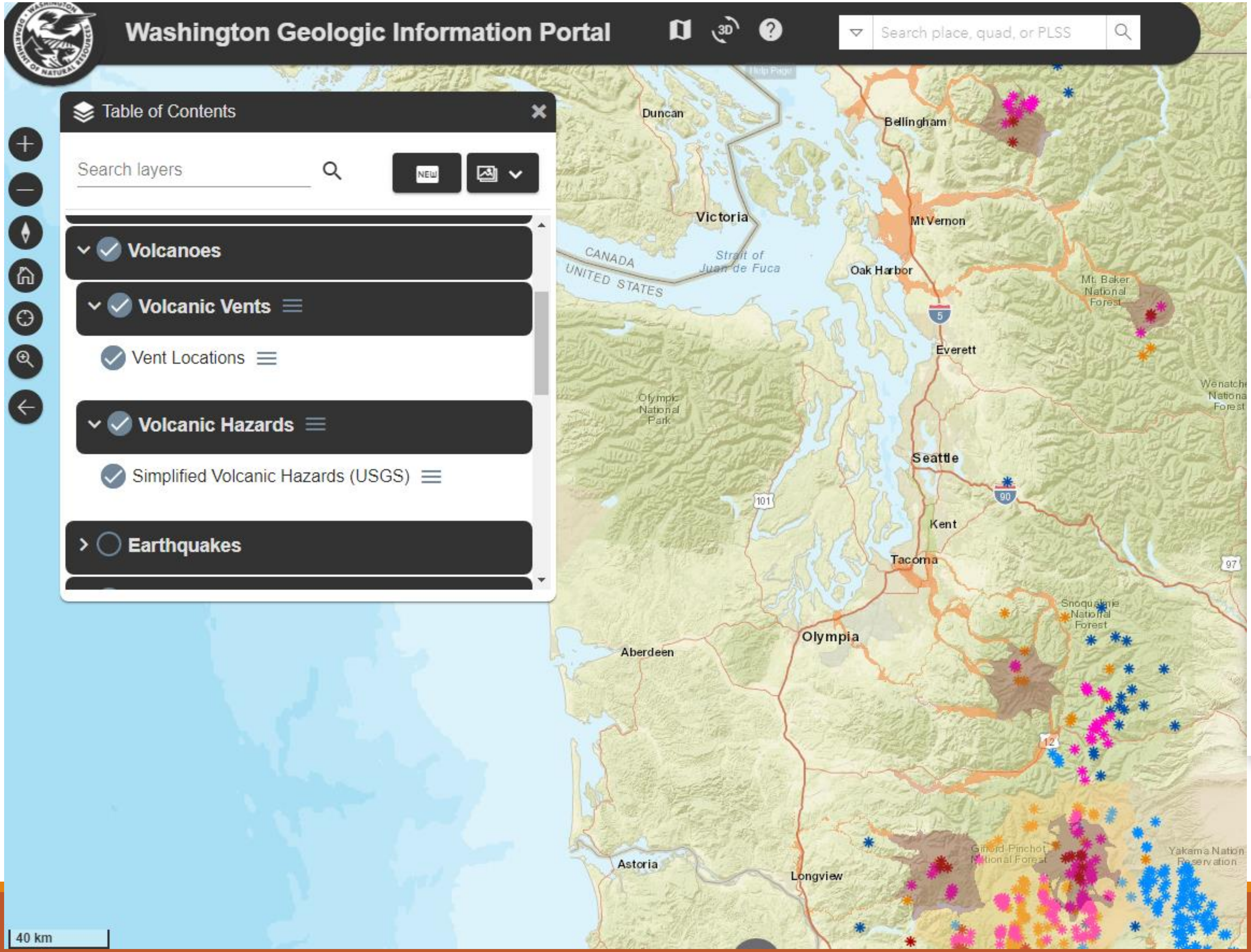


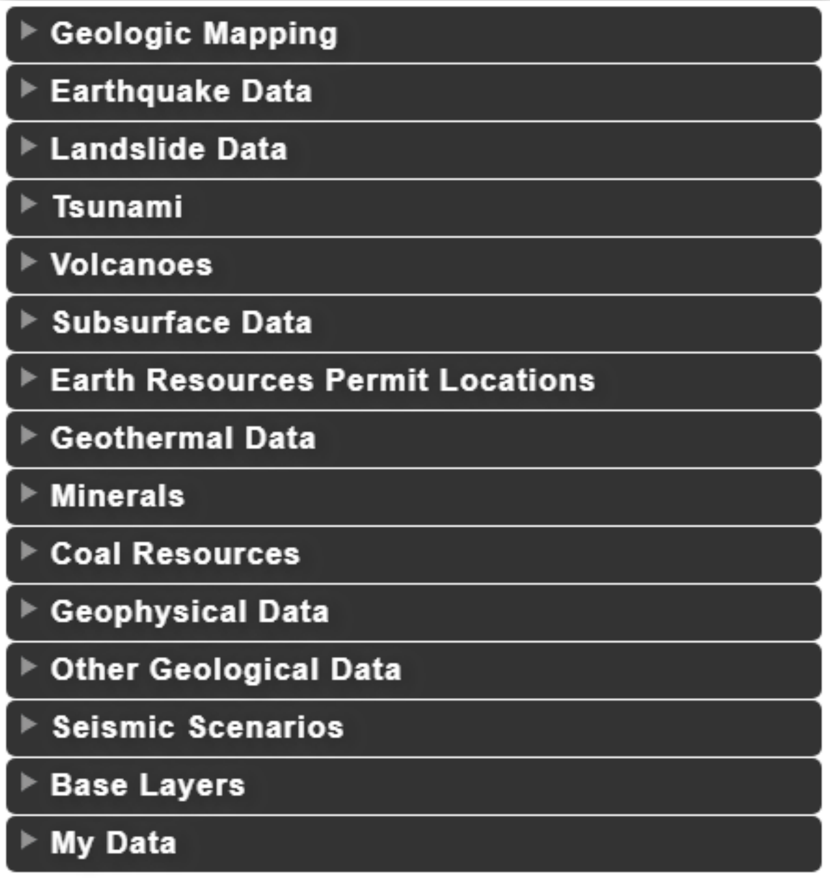




Check out our Geology Portal

https://geologyportal.dnr.wa.gov/

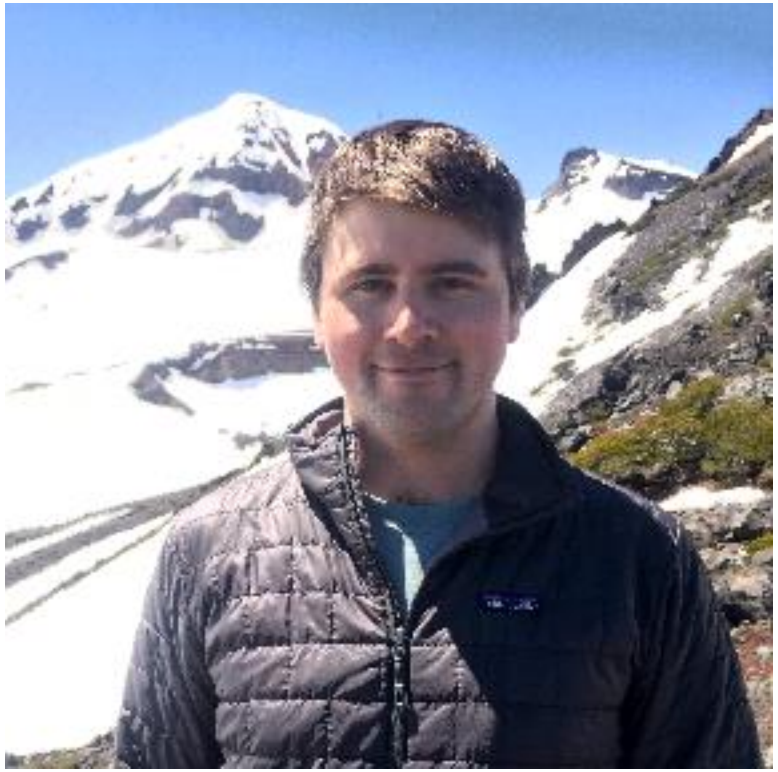




Mount St. Helens
A Mountain Reborn
WASHINGTON STATE DEPT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY
USGS
science for a changing world
The cataclysmic eruption of Mount St. Helens on the morning of May 18, 1980, instantly transformed the glacier-capped volcano and its surrounding forests and lakes into an unrecognizable landscape. Moments before the volcano erupted, an earthquake accompanied the collapse of 3.7 billion cubic yards of land on the north flank of the mountain—one of the largest landslides in recorded history! The lateral blast that instantaneously followed the landslide flattened everything in its path—as far as 17 miles away from the volcano. Pyroclastic flows covered the land to the north of the volcano with a mixture of hot gases and debris while the vertical eruption column sent ash and gas high into the atmosphere.
In addition to altering the volcano's physical landscape, the eruption catastrophically disrupted its productive mountain ecosystem. In the years and decades that followed, however, streams carved new paths through the volcanic deposits, the volcano grew bulky lava domes, and within the steep crater walls, a new glacier was born. Today, plants and animals have repopulated the lakes and lands around the volcano and life is once again flourishing.
Read more below for examples of how the landscape of Mount St. Helens has been continuously transformed since the eruption of 1980.
The main climbing routes to the summit of Mount St. Helens are not visible on this map.
The Worm Flows winter route starts at the Marble Mountain Sno-Park trailhead and the Monitor Ridge summer route starts at the Climbers Bivouac trailhead, both of which are behind the mountain in this view. The June Lake trailhead is also obscured.
WASHINGTON
inset map location
direction of map view
N
MOUNT ST. HELENS
MOUNT ST. HELENS NATIONAL VOLCANIC MONUMENT
Swift Reservoir
Marble Mountain
Ape Cave
Ape Canyon
Worm Flows
Swift Creek Flow
Butte Camp Dome
Crescent Ridge
Pumice Butte
Plains of Abraham
Windy Pass
Windy Ridge
Windy Ridge Viewpoint
Smith Creek Viewpoint
Donnybrook Viewpoint
Cedar Creek Viewpoint
Independence Pass
Harmony Viewpoint
Lahar Viewpoint
Lava Canyon Trailhead
Ape Canyon Trailhead
PUMICE PLAIN
Spirit Lake
floating logs
Bear Cove
Harrys Ridge
The Spillover
Johnston Ridge
Johnston Ridge Observatory
Loowit Viewpoint
North Fork Toutle River
South Fork Toutle River
Castle Lake
Mount Margaret
BOUNDARY TRAIL 1
The Dome
St. Helens Lake
Coldwater Peak
South Coldwater Trailhead
Coldwater Lake
Coldwater Lake Recreation Area
Mount St. Helens Science and Learning Center
Hummocks Trailhead
HUMMOCKS TRAIL 229
WINDS OF CHANGE TRAIL 232
ELK BENCH TRAIL 211D
LAKES TRAIL 211
SPIRIT LAKE HIGHWAY
STATE ROUTE 504
Elk Prairie
Hanaford Lake
Fawn Lake
Elk Lake
Forest Lake
1 Lava Domes
Between 1980 and 1986, a series of smaller eruptions formed a lava dome in the crater of Mount St. Helens. These eruptions added an estimated 100 to 120 million cubic yards of lava to the crater. An eruption from 2004 to 2008 formed a series of dacite spines that added an additional lava dome with 120 million cubic yards of material—enough to fill almost 37,000 Olympic swimming pools!
2 Crater Glacier
Movement in the crater snowfield in the mid-1990s signaled the arrival of Crater Glacier (also known as Tulutson Glacier). Since then, a combination of shade from a north-facing aspect and high crater walls, avalanches of snow, ice, and rock from the crater rim, and an insulating rock cover have fueled the glacier's continuous growth. In 2004, erupting lava began squeezing the glacier against the crater walls accelerating its downslope flow. Four years later the east and west arms of the glaciers merged, completely encircling the lava domes.
3 Spirit Lake
The debris avalanche from the 1980 eruption displaced Spirit Lake, pushing its waters 800 feet up the opposite slopes and completely filling the former lake basin with volcanic sediment. Amazingly, the elevation of the current lakebed is now higher than the lake's previous surface. Although the lake is not as deep as before, the shoreline is 200 ft higher than it once was and the surface area is nearly double its previous size. In the decades since the eruption, life has returned to the lake. Phytoplankton, the base of the aquatic food chain, reemerged, followed by frogs and salamanders. Rainbow trout, likely reintroduced by humans, now thrive in the lake's waters. A persistent mat of floating logs, remnant of the former surrounding forest, now covers 15–20 percent of the lake, providing additional habitat for insects and other life.
4 Pumice Plain
Pyroclastic flows from the initial and subsequent 1980 eruptions of Mount St. Helens blanketed the surface of the debris avalanche directly north of the mountain and left behind a barren zone known as the 'Pumice Plain'. Incredibly, within two years, native lupine plants bloomed on this sterile landscape. In turn, lupine added essential nutrients to the soil while also providing anchor points for other plants to take hold. In the decades since the eruption, many other native plants and animals, including pocket gophers and elk, have gradually returned to the Pumice Plain. It has become an invaluable living laboratory for scientists seeking to study how landscapes recover and develop after a seemingly catastrophic geologic event.
5 North Fork Toutle River
The debris avalanche completely buried the upper North Fork Toutle River near the mountain. Hours after the eruption, a volcanic mudflow known as a lahar entered the lower reach of the river, as ice and snow meltwater, groundwater, and sediment flowed from the deposit. The lahar traveled down the Toutle and Cowlitz River system to the Columbia River, choking downstream channels with sediment and debris. Today, the river winds a new course by eroding and transporting debris avalanche sediment down river. Including the lahar, over 400 million tons of sediment have been removed from the Toutle River basin since 1980, yet only about 15 percent of the debris-avalanche deposit has been eroded. Although many structures have been built to contain sediment and manage flooding, the North Fork Toutle River continues to erode and transport sediment downstream, promising that the effects of the 1980 eruption will continue to be felt into the foreseeable future.
Lava Domes 1
2 Crater Glacier
3 Spirit Lake
4 Pumice Plain
5 North Fork Toutle River
References:
Map: Daniel E. Coe, Washington Geological Survey (WGS)
Data Sources: Lidar (2002–2017)—U.S. Geological Survey (USGS), Washington State Department of Natural Resources (DNR), U.S. Army Corps of Engineers (USACE), National Aeronautics and Space Administration (NASA). Imagery—National Agricultural Imagery Program (NAIP). Roads—U.S. Forest Service (USFS), ©OpenStreetMap contributors (OSM). Trails—USFS, OSM. Place Names—USGS, USFS
Acknowledgements: Thank you to Maria Furtney of the WGS, Dr. Jon Major, Dr. Heather M. Wright, Adam R. Mosbrucker, and Joseph A. Bard of the USGS, Kristine Cochrane of the USFS, Abigail Groskopf of the Mount St. Helens Institute, and Alysa Adams of the Washington State Parks and Recreation Commission for their invaluable reviews of this map.
The BellTopo Sans font (designed by Sarah Bell) was used for the road, trail, land, and point of interest labels.
Most of the land shown on this map is managed by the U.S. Forest Service (USFS) and is part of Mount St. Helens National Volcanic Monument in Gifford Pinchot National Forest. Due to the sensitive nature of this area, access to many parts of the monument is restricted, and may require a USFS-issued permit. Please consult the USFS for all the rules and regulations before visiting Mount St. Helens.
https://www.fs.usda.gov/recarea/giffordpinchot/recarea/?recid=34143
to Mount St. Helens Forest Learning Center (10 miles) and Mount St. Helens Visitor Center (45 miles)
©2022 Washington Geological Survey
www.dnr.wa.gov/geology


STRATOVOLCANO
Glacier Peak
WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

Leif Karlstrom
University of Oregon



ASSOCIATE PROFESSOR, DEPARTMENT OF EARTH SCIENCES (SINCE 2015)

Website: https://pages.uoregon.edu/leif/
Email: leif@uoregon.edu

Brief overview of research

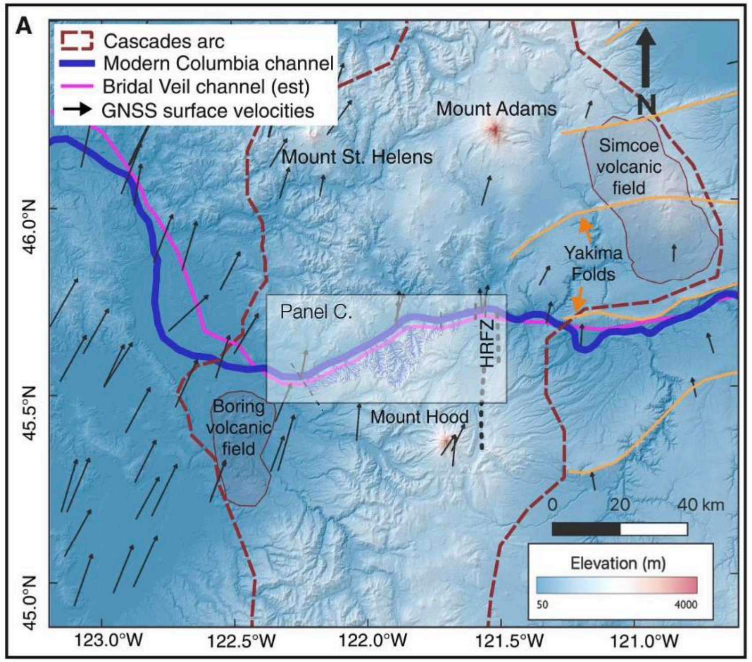
My group's volcanology research involves the development numerical modeling tools for understanding the processes driving magma transport and eruption, and approaches for integrating data constraints across a range of spatial and timescales. I'm particularly interested in gaps that have segment the field of volcanology, which tend to be at the intersection of subdisciplines.

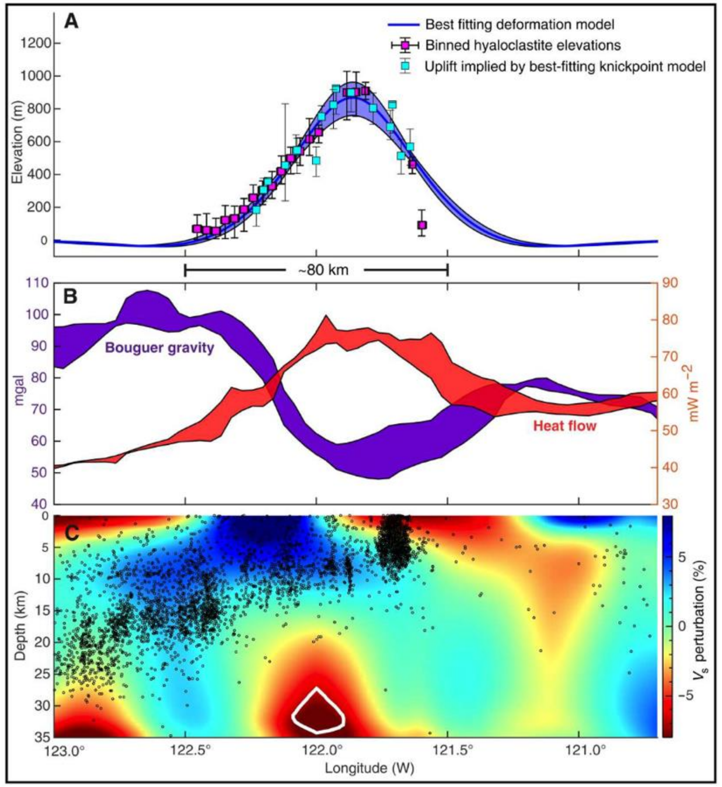
Three research themes to highlight here:

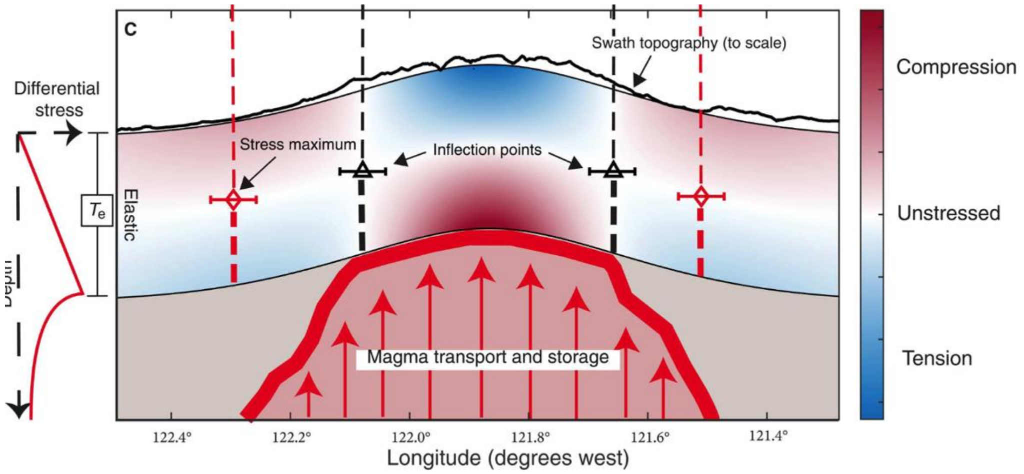
1. How are magmatic processes encoded in the eruptive record (e.g., sequences/cycles of eruptions, spatially distributed volcanism, and evolution of topography)?
2. Volcano deformation at the Earth's surface at timescales between ~1 second ("seismic timescales") and ~10 years ("geodetic timescales").
3. How does long-term (0.1-10 million years) thermal and mechanical preconditioning of the crust impact the style and magnitude of individual eruptive events?

How are magmatic processes encoded in the eruptive record (e.g., sequences/cycles of eruptions, spatially distributed volcanism, and evolution of topography)?

Klema et al., (2023) “The Magmatic Origin of the Columbia River Gorge, USA”, Science Advances.





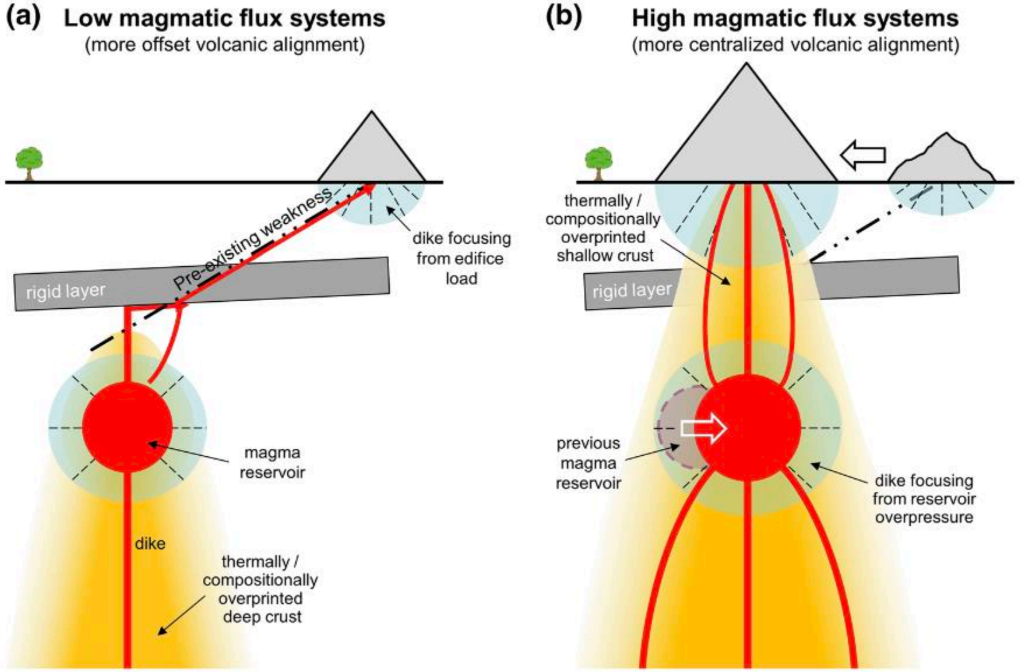


Mechanical model constrains long-term magmatic flux to central Cascades arc, and plausible origin for off-axis distributed monogenetic fields (Boring and Simcoe)

Topographic signatures of long-term unsteady magmatic flux correlate with geophysics.

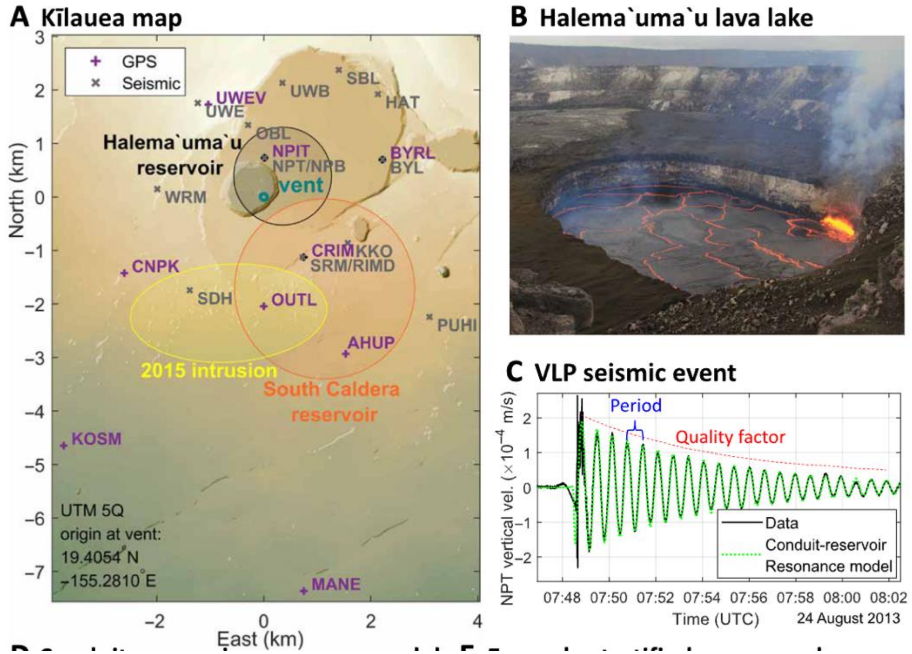
Volcano deformation at the Earth's surface at timescales between ~1 second ("seismic timescales") and ~10 years ("geodetic timescales").

Lerner et al., (2020) "The Prevalence and Significance of Offset Magma Reservoirs at Arc Volcanoes", Geophysical Research Letters.



Global review of published seismic tomography and geodetic imaging of magma reservoirs reveals ~20% are "significantly" laterally offset from overlying volcanoes – monitoring implications

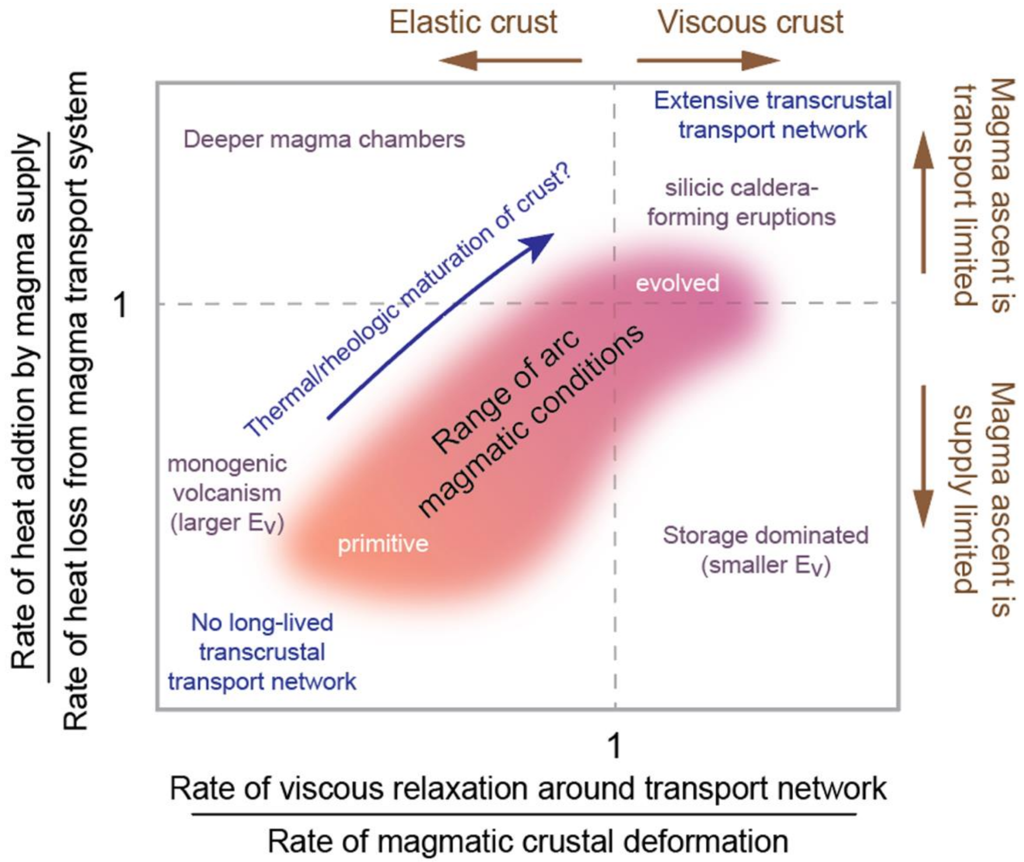
Crozier and Karlstrom (2022) "Evolving magma temperature and volatile contents over the 2008–2018 summit eruption of Kīlauea Volcano", Science Advances.



Catalogued and modeled "Very Long Period" seismicity at Kilauea to infer decadal-scale changes in magma dynamics

How does long-term (0.1-10 million years) thermal and mechanical preconditioning of the crust impact the style and magnitude of individual eruptive events?

Cooke et al., (2024) “Energy budget of subduction zone hazards” in review at Reviews of Geophysics.



Regime diagram for magmatic intrusion dynamics based on work in Karlstrom et al., (2017):

Long-term input of magmatic heat over 10s-100s kyr drives a shift in the mechanical response of the crust that fundamentally alters the style and size of future eruptions.

Volcano and Hazard Experience

How do you interact with volcanoes, volcanic hazards, or other natural hazards in your professional capacity?

I work on the fundamental science questions that underly volcanic and other other natural hazards.

Although I primarily develop modeling and data analysis tools, I also visit volcanoes and collect new data (both physical samples and geophysical data).

I am currently on the ”Subduction Zones in Four Dimensions” (SZ4D) steering committee and co-chair the “Modeling Collaboratory for Subduction”

University of Oregon is regional center for volcano expertise, with 10 active faculty members doing volcano-related research in the “Oregon Center for Volcanology”

Work with the USGS

I work in collaborative capacity with USGS research scientists at CVO, HVO, AVO, CalVO. I have co-authored peer-reviewed papers with 15 different USGS employees.

My students work with the USGS:

- one former students worked as intern at CVO under GRIP graduate funding

- two former students have been awarded Mendenhall post-doctoral fellowships at CalVO

NVEWS Advisory Committee Interest

I hope to assist in the implementation of NVEWS by advising the USGS on behalf of the academic science community.

I believe that there are opportunities for academic scientists to contribute to the USGS Volcano Hazards Program Strategic Science Plan (in which NVEWS is #1 stated goal) and I'm excited to explore similar opportunities with other state and federal agencies represented by the NVEWSac.

Cal OES
GOVERNOR'S OFFICE OF EMERGENCY SERVICES

Yvette LaDuke
CA Governor's Office of Emergency Services (Cal OES)

EARTHQUAKE, TSUNAMI AND VOLCANO PROGRAM MANAGER

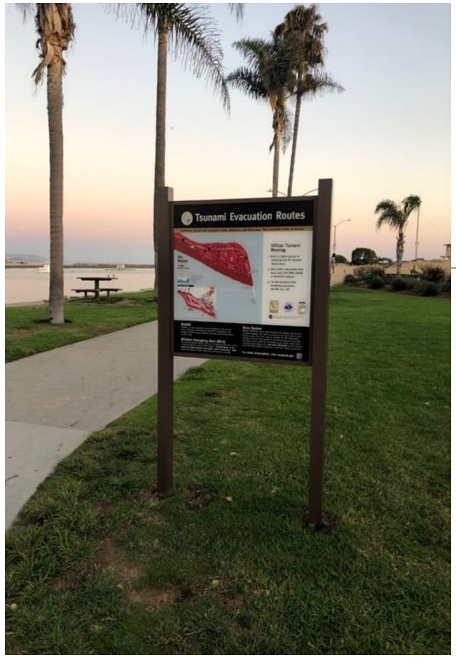
3.5 YEARS AS MANAGER, 5 YEARS AS TSUNAMI PROGRAM SPECIALIST

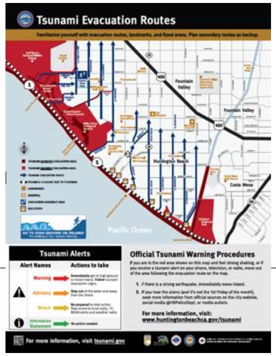
About Cal OES

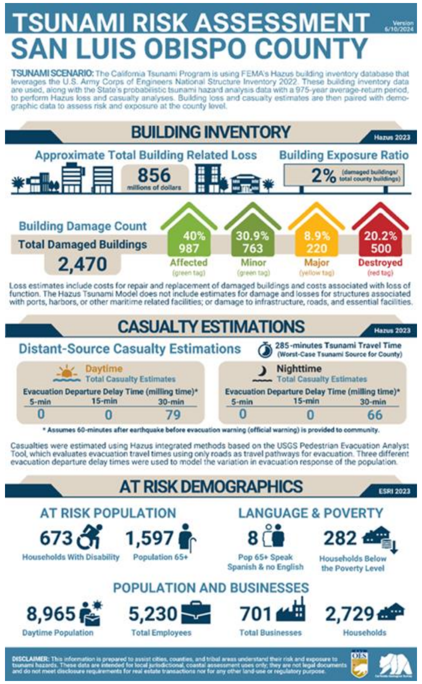
- Cal OES Mission:
  - We protect lives and property, build capabilities, and support our communities for a resilient California.
- California is home to over 38 million residents and millions of visitors throughout the year.
- Face numerous hazards and threats to people and property both natural and man-made.
- California's leadership hub during all major emergencies and disasters.
- Secure, respond, direct, and coordinate state and federal resources and mutual aid assets to support California's diverse communities throughout the state.
- Supports planning and preparedness, training, mitigation and recovery.

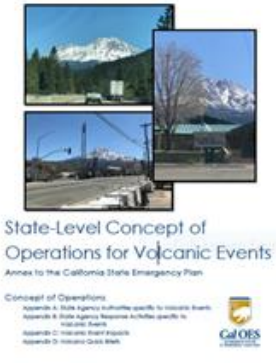
Seismic Hazards Programs Work

- Earthquake Program
  - NEHRP Grant Administration (Sub-Awards) – USC/SCEC, CGS, DRBTW, CPH
  - Statewide Education and Outreach in partnership with the Statewide California Earthquake Center (USC), Earthquake Country Alliance
  - Annual Great California ShakeOut events and Tour (Shake Trailer)
  - Annual Mitigation Program (Mini Awards)
  - Redwood Coast Tsunami Work Group (Cal Poly Humboldt) – Cascadia
  - Technical Support for State and Local Hazard Mitigation Plans, Emergency Operations Plans, etc.
  - Training and Exercise Support
  - CA Earthquake Clearinghouse Co-Chair, Logistical Support
  - Project w/ DRBTW to conduct structural and nonstructural assessments for Food Banks – HMGP Apps
  - DRB ToolKit – Small Businesses: Continuity Plans and Mitigation
  - Duty Officer Program – Earthquake Incident Response



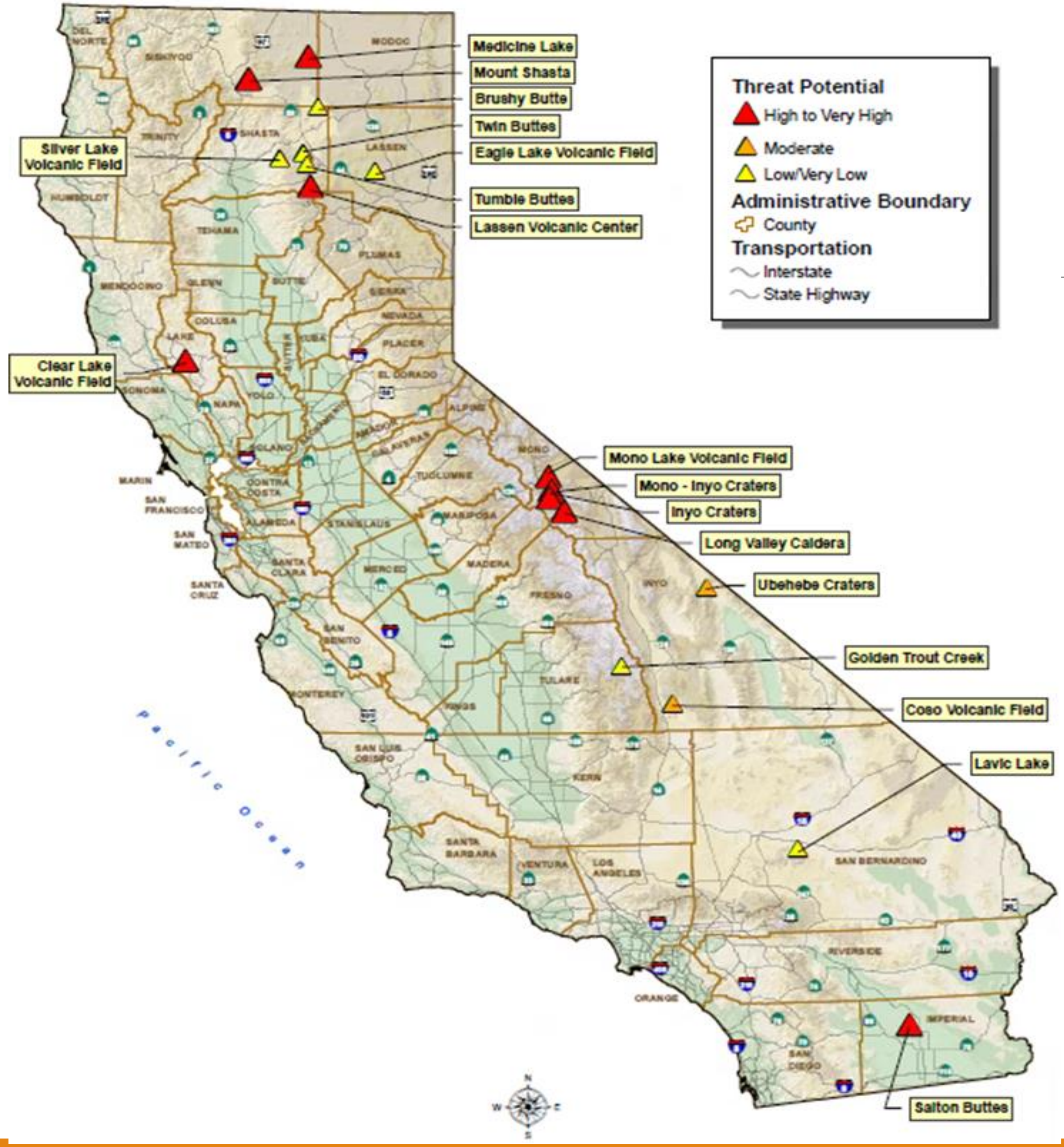






Seismic Hazards Programs Work

- Tsunami Program
  - NOAA/NTHMP Tsunami Grant Administration (Subawards) – USC/SCEC & Tsunami Research Center, CPH, CGS
  - Statewide Education and Outreach in partnership with the Statewide California Earthquake Center (USC), Earthquake Country Alliance
  - Annual Tsunami Preparedness Week
  - Support Evacuation and Maritime Exercises
  - Technical Support for State and Local Hazard Mitigation Plans, Tsunami Evacuation Plans, Emergency Operations Plans, etc.
  - Tsunami Sign Plans, Tsunami Signs, Evacuation Maps/Kiosks
  - Tsunami Debris Modeling - Tsunami Debris Plan (Annex to State Debris Plan)
  - Tsunami Risk Assessments (Hazus & ESRI Products)
  - Duty Officer Program/Tsunami Incident Response – Statewide Lead
  - Tsunami Hazard Mapping/Modeling



Volcano and Hazard Experience

- Preparedness and Mitigation Campaign for Earthquake and Tsunami
- Volcano Incident Monitoring/Collaboration w/ Cal VO – Situational Reporting
- 24/7 Duty Officer Program - Response
- Hazard training for first responders and local decision-makers
- Technical Support for State/Local Hazard Mitigation Plans, Emergency Operations Plans which include Volcano Hazard in some counties

Work with the USGS

Our Programs partner with the USGS:

- Earthquake Early Warning System – MyShake app powered by ShakeAlert, USGS computerized program
- Earthquake Program
  - Technical Support for Duty Officer Program
  - Attend Annual Northern California Earthquake Hazards Workshop
  - Earthquake Notification System Alerts
  - Aftershock Forecasts
  - Aftershock Forecast Products Pilot Test (Coming Soon!)
- Tsunami Program
  - Pedestrian Evacuation Modeling – time to evacuate Tsunami Hazard Areas (USGS Portland & Moffit)
  - Data and Risk Information to FEMA on the National Risk Index (USGS Portland)
  - Hazus (Tsunami and Earthquake – FEMA and USGS)

Work with USGS

- Volcano Program
  - Collaborate with the Volcano Observatory during swarm activity in volcanic regions of CA
  - Provides intel to our Program Duty Officers on volcanic incidents
  - USGS Shasta Lahar Workshop (2022)
  - Volcano Con Ops Plan (technical review by Cal VO) (2020)
  - Volcano Notification System alerts
  - Coordinating with Cal VO to conduct Duty Officer training for Cal OES SHB Duty Officers

NVEWS Advisory Committee Interest

- Voice for the Emergency Management field.
- Use of science as a foundation for Emergency Management actions and activities.
- Communication bridge between Science and Emergency Management.
- Learn more about NVEWS and how it can support California's Operations

Break

RETURN AT 10:40 AM

Introductions (continued)

Brian Terbush, Washington State Emergency Management

Erin Campbell, Wyoming State Survey

Nelia Dunbar, New Mexico Bureau of Geology

Casey Hanell, Washington Department of Natural Resources

Leif Karlstrom, University of Oregon

Yvette LaDuke, California Governor’s Office of Emergency Services

Michael Manga, University of California, Berkeley

Matthew Pritchard, Cornell University

Christy Till, Arizona State University

Michael Manga

University of California, Berkeley

FACULTY MEMBER SINCE 2001

(PREVIOUSLY FACULTY AT UNIV OREGON 1996-2001)

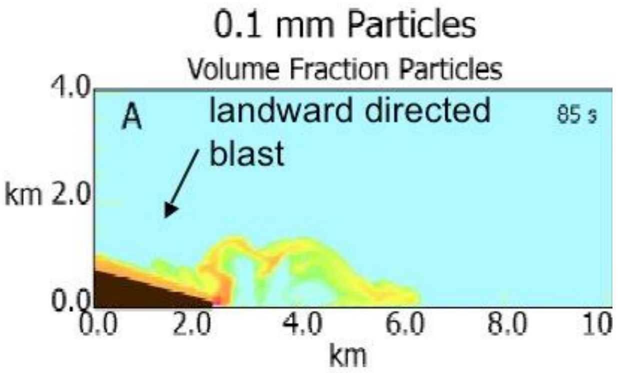
Why do volcanoes erupt in so many different ways?

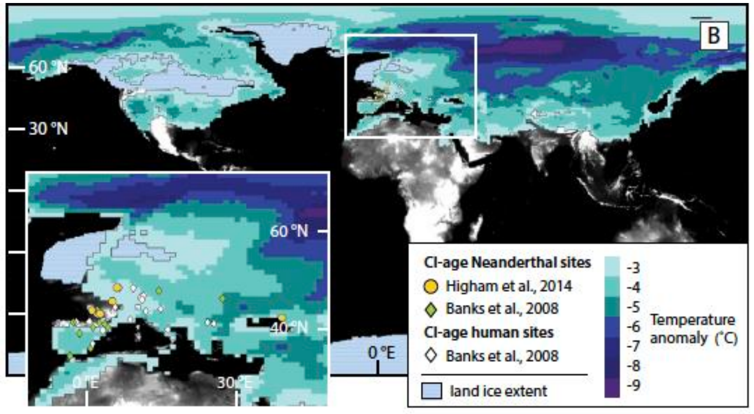
Why are there super eruptions?

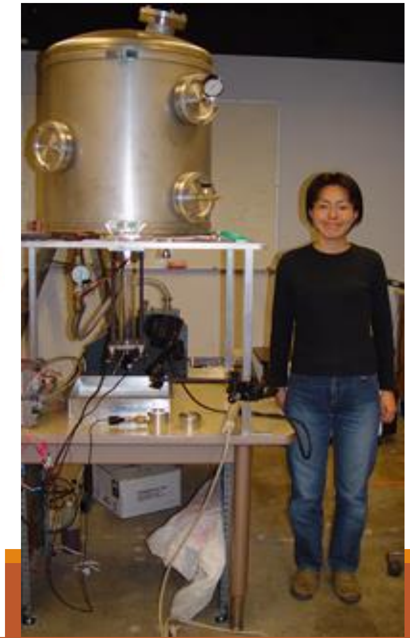
Why is magma focused at a volcano?

How does a changing climate affect eruptions and vice versa?

How does water erupt on icy satellites?







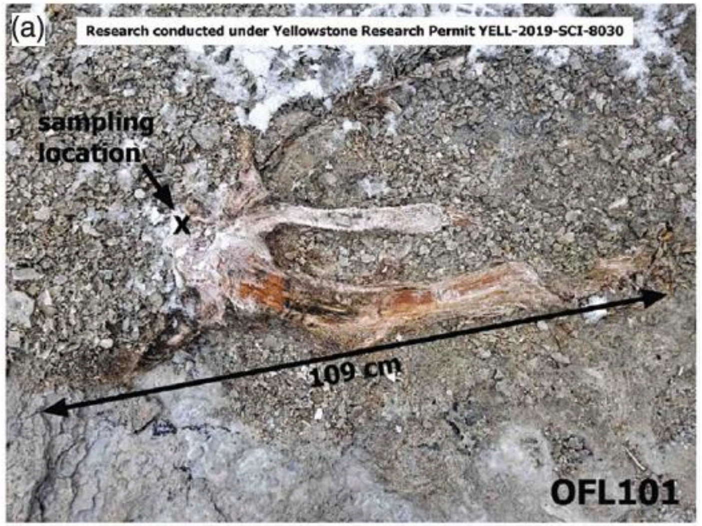
Work with the USGS: CalVO

Who: Shaul Hurwitz, Sara Peek, David Damby, and others

Where: Yellowstone, Chile, Long Valley CA, Mono Lake CA

Hurwitz, S., and M. Manga (2017) The fascinating and complex dynamics of geyser eruptions, *Annual Reviews of Earth and Planetary Science*, vol. 45, 31-59.

Munoz-Saez, C., M. Manga and S. Hurwitz (2018) Hydrothermal discharge from the El Tatio basin, Atacama, Chile, *Journal of Volcanology and Geothermal Research*, vol. 361, 25-35.



Hurwitz, S., J.C. King, G.T. Pederson, J.T. Martin, D.E. Damby, M. Manga, J.D.G. Hungerford and S. Peek (2020) Yellowstone's Old Faithful Geyser shut down by a severe thirteenth century drought, *Geophysical Research Letters,* vol. 47, e2020GL089871.

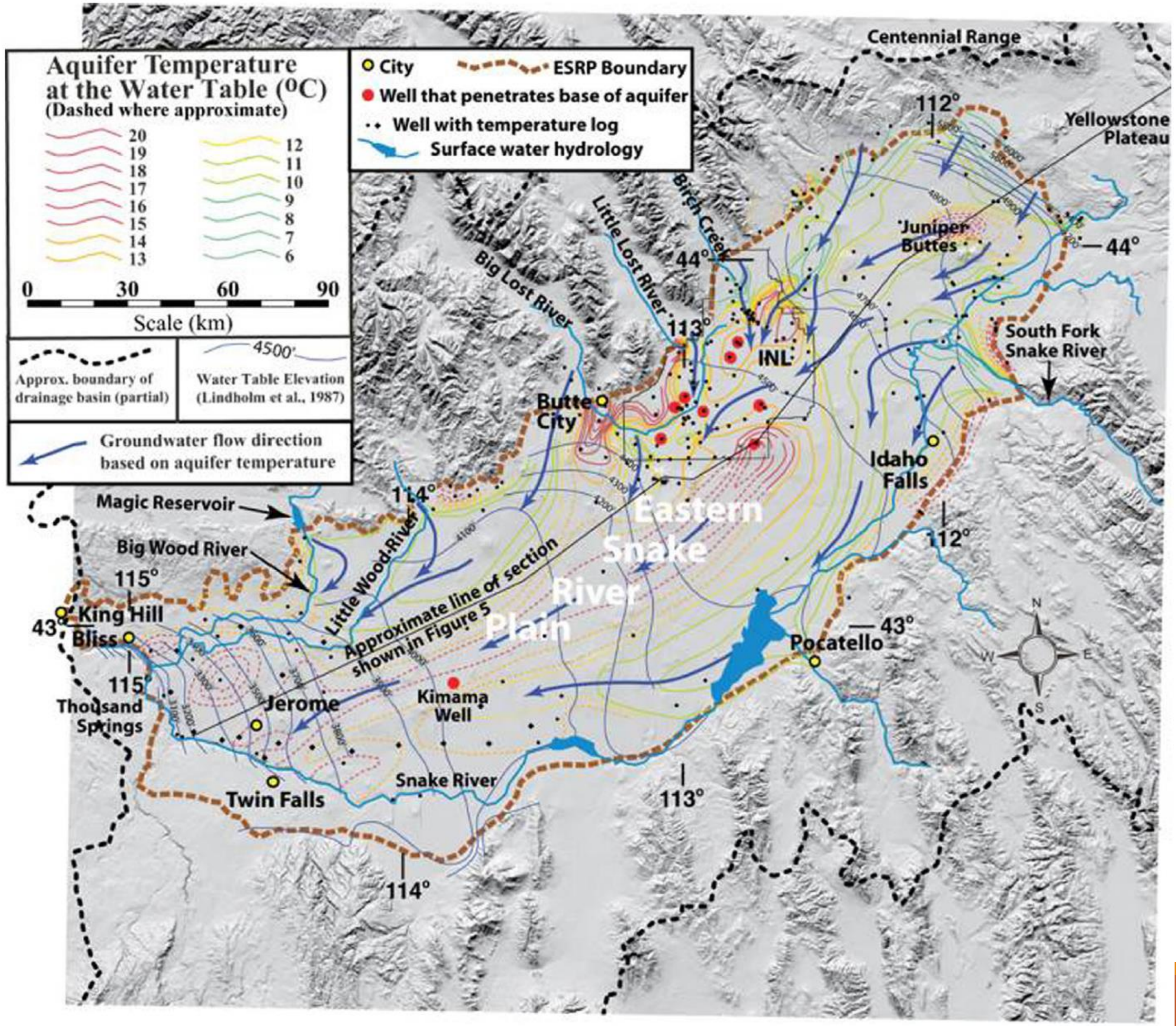
Churchill, D.M., M. Manga, S. Hurwitz, S. Peek, D.E. Damby, **B. Hosseini**, J. Hungerford, R. Conrey and J.R. Wood (2021) The structure and volume of large geysers in Yellowstone National Park, USA and the mineralogy and chemistry of their silica sinter deposits, *Journal of Volcanology and Geothermal Research*, doi.org/10.1016/j.jvolgeores.2021.107391.

Work with the USGS: CalVO and Geology, Minerals, Energy and Geophysics Science Center

Who: Steve Ingebritsen and Erick Burns

What: Hydrogeology and heat transport in the US Cascades, Snake River Plain

Burns, E.R., S.E. Ingebritsen, M. Manga, and C.F. Williams (2016) Evaluating geothermal and hydrogeologic controls on regional groundwater temperature distribution, *Water Resources Research*, vol. 52, 1328-1344.



Work with the USGS: HVO

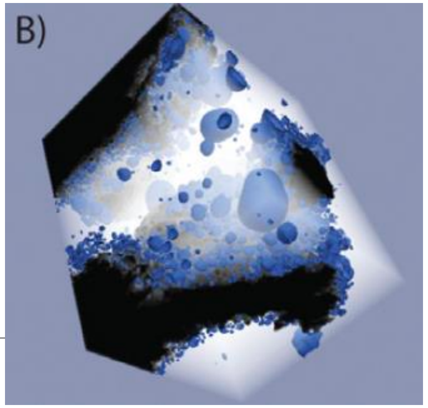
Who: Don Swanson, Tim Orr, Matt Patrick

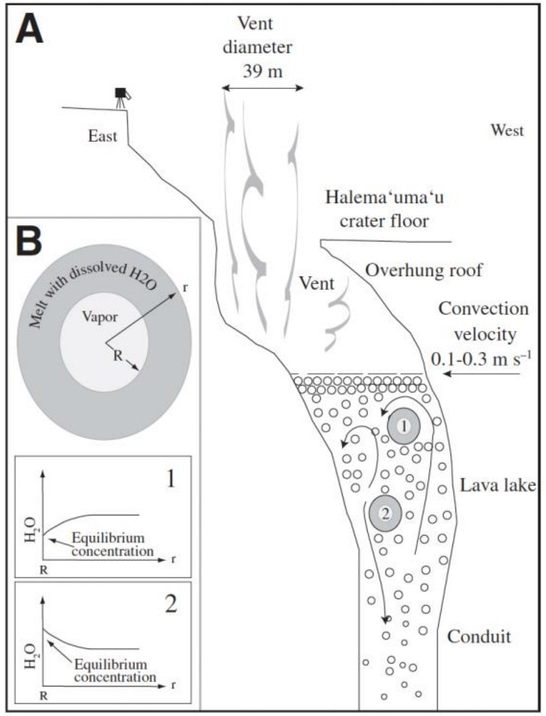
Where: Halelemaumau, Kilauea 2018

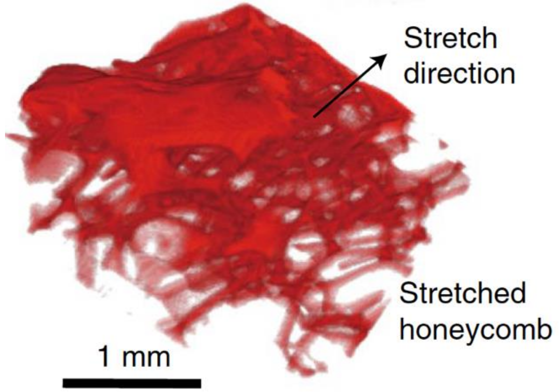
Carey, R.J., M. Manga, W. Degruyter, D. Swanson, B. Houghton, T. Orr, and M. Patrick (2012) External triggered renewed bubble nucleation in basaltic magma: The 12 October 2008 eruption at Halema`uma`u Overlook vent, Kilauea, Hawai`i, USA, *Journal of Geophysical Research*, vol. 117, B11202.

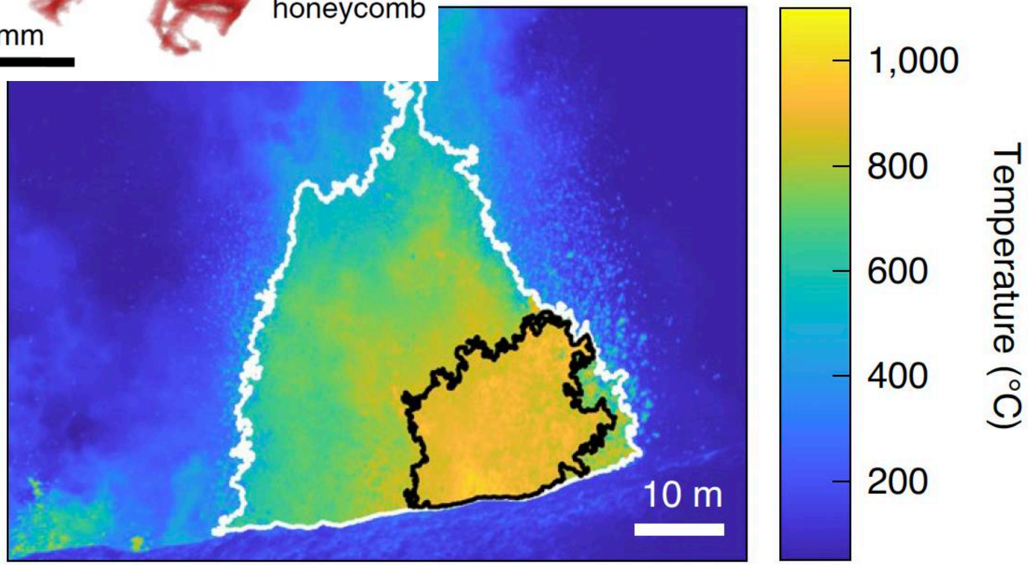
Carey, R.J., M. Manga, W. Degruyter, H. Gonnermann, D. Swanson, B. Houghton, T. Orr, and M. Patrick (2013) Convection in a volcanic conduit recorded by bubbles, *Geology*, vol. 41, 395-398.

Namiki, A., M. Patrick, M. Manga and B. Houghton (2021) Brittle fragmentation by rapid gas separation in a Hawaiian fountain, *Nature Geoscience*, vol. 14, 242-247.





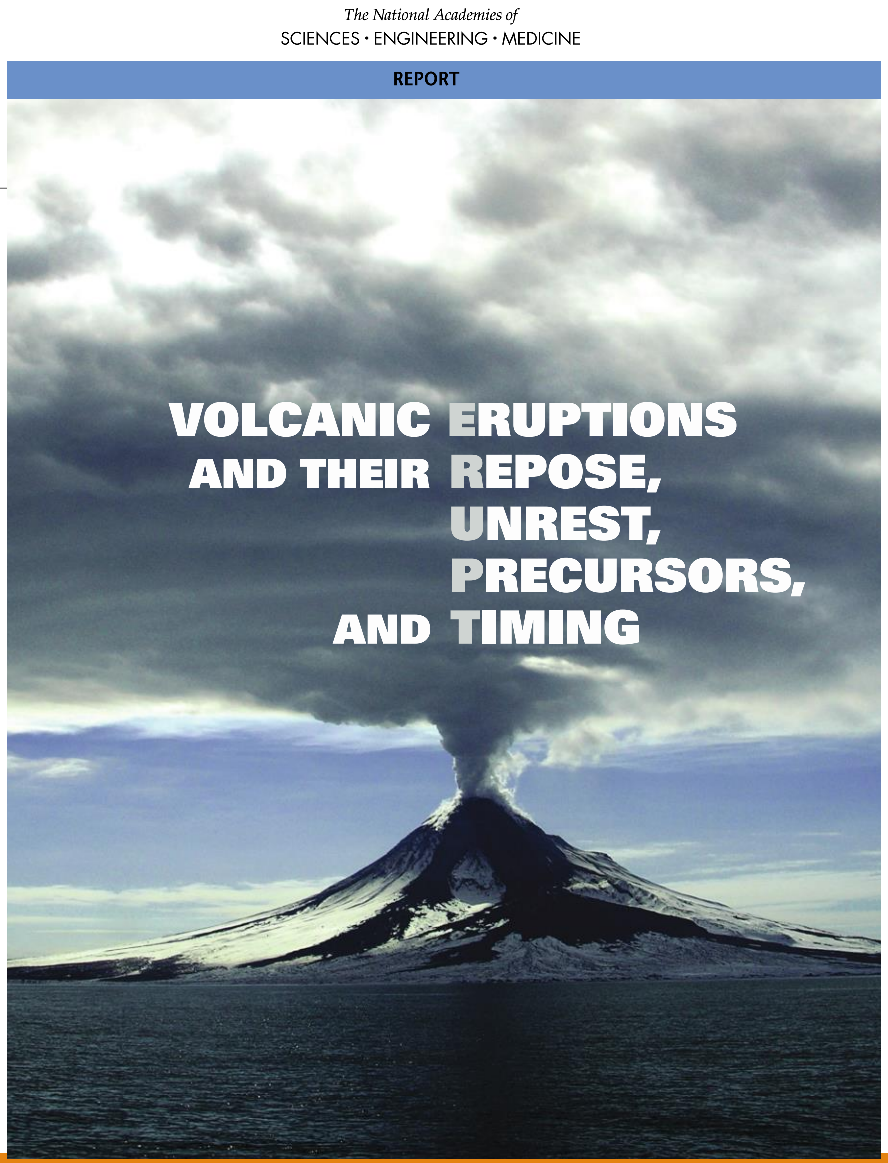




NVEWS Advisory Committee Interest

Chaired the National Academies Study about volcanoes (2017)

- Summarize current understanding of how magma is stored, ascends, and erupts
- Discuss new disciplinary and interdisciplinary research on volcanic processes and precursors that could lead to forecasts of the type, size, and timing of volcanic eruptions
- Describe new observations or instrument deployment strategies that could improve quantification of volcanic eruption processes and precursors
- Identify priority research and observations needed to improve understanding of volcanic eruptions and to inform monitoring and early warning efforts



Sponsors: NSF, NASA, USGS, National Academies

Summary of the ERUPT report: Grand Challenges

Forecast the onset, size, duration and hazard of eruptions by integrating observations with quantitative models of magma dynamics

Quantify the life cycles of volcanoes globally and overcome our current biased understanding

Develop a coordinated volcano science community to maximize scientific returns from any volcanic event

Chapter 5. Strengthening volcano science

Requirements for an effective volcano science community

Support for interdisciplinary collaboration and training, which is essential to making discoveries and integrating models and measurements

Shared community infrastructure, which is necessary for state-of-the-art modeling, analytical facilities, monitoring and field experiments

Databases that preserve and facilitate open exchange of information and hence enable exploration of the life cycle of volcanoes and improve forecasting

New technology and instruments that permit new detection, measurements and sampling, including previously inaccessible parts of ongoing eruptions

A coordinated response by the research community to eruptions globally to overcome observational bias

Observatory-academic partnerships, which will accelerate the translation of basic science to applications and monitoring

Chapter 6. Grand challenges in volcano science

Develop a coordinated volcano science community to maximize scientific returns from *any* volcanic event

The research community needs to be prepared to monitor and respond to eruptions globally

Requires multidisciplinary research, USGS-academic partnerships, training networks

Matt Pritchard
Cornell University

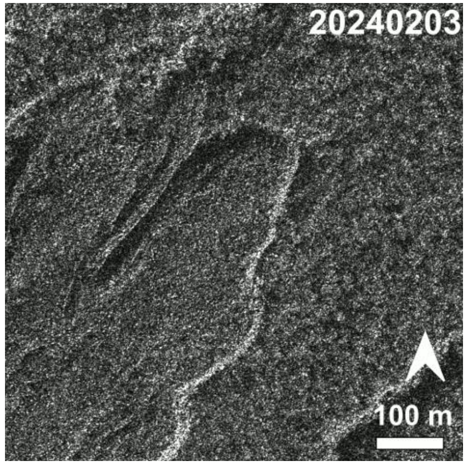
PROFESSOR OF EARTH & ATMOSPHERIC SCIENCES

20 YEARS IN ROLE

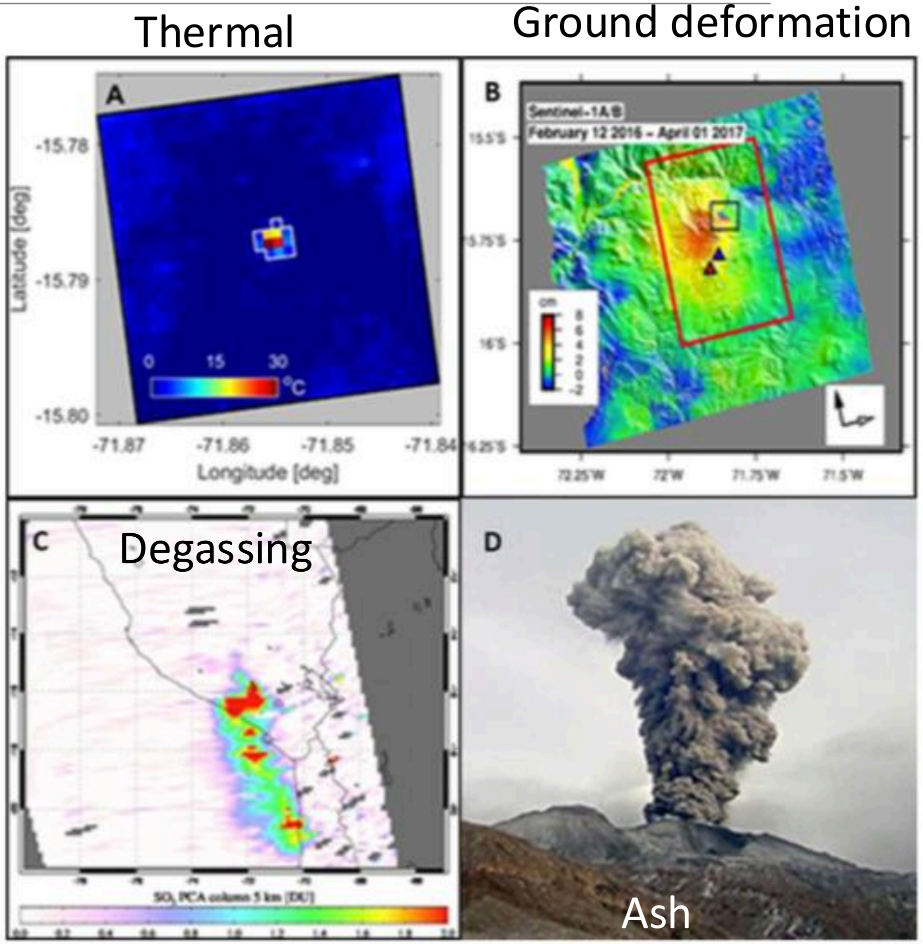
What I do:
Global Satellite Volcano Observations

Cornell Radar Interferometry and Remote Sensing

Ground deformation
Thermal
Surface & topography change
Degassing (through collaborators)
Ash (through collaborators)



Lewotobi, Indonesia lava flow



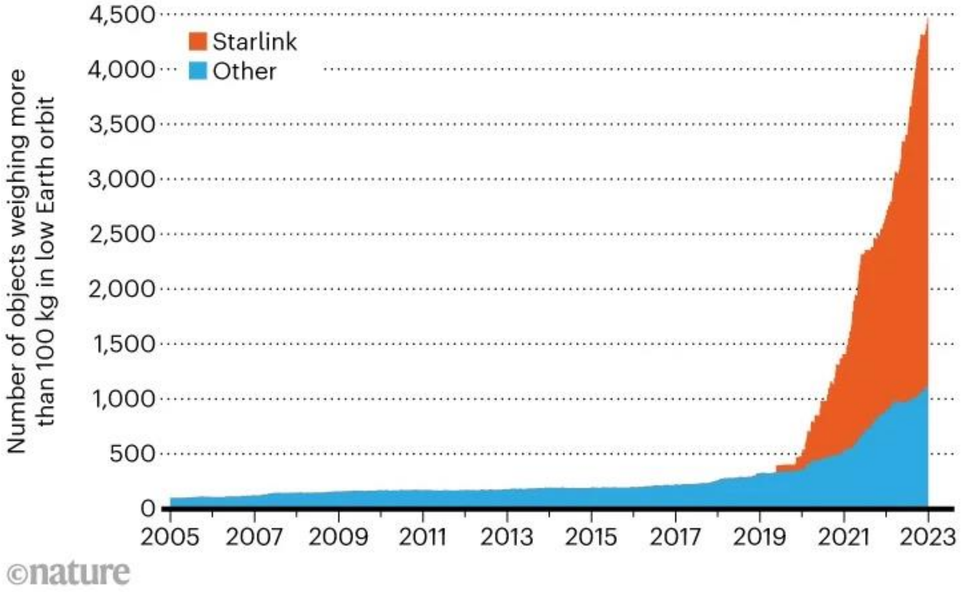
Sabancaya volcano, Perú

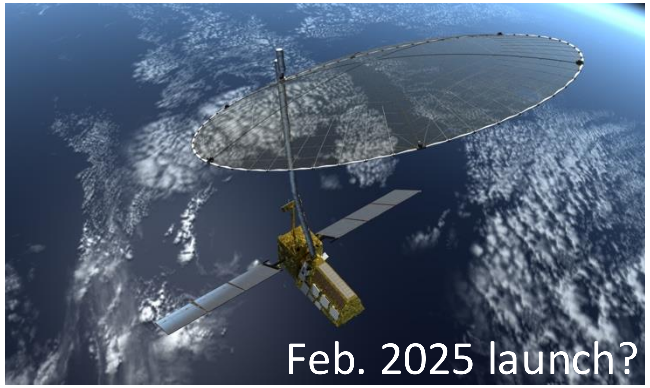
Paradox of feast and famine of satellite data

For some missions there is too much data for manual analysis:

Total number of satellites

Alexandra Witze, Nature, 2022

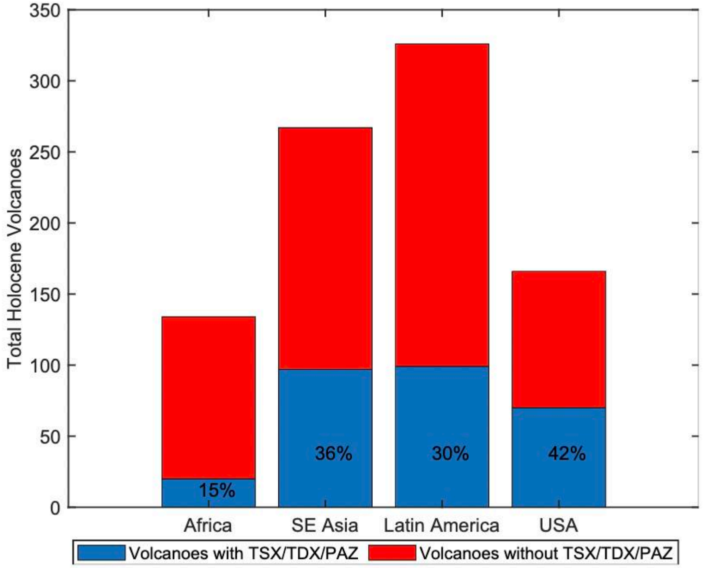




* NISAR will produce more data than all previous NASA missions combined from 60+ years

While some satellites with potential useful data miss most volcanoes

Other satellites with useful data are restricted and aren't used by observatories



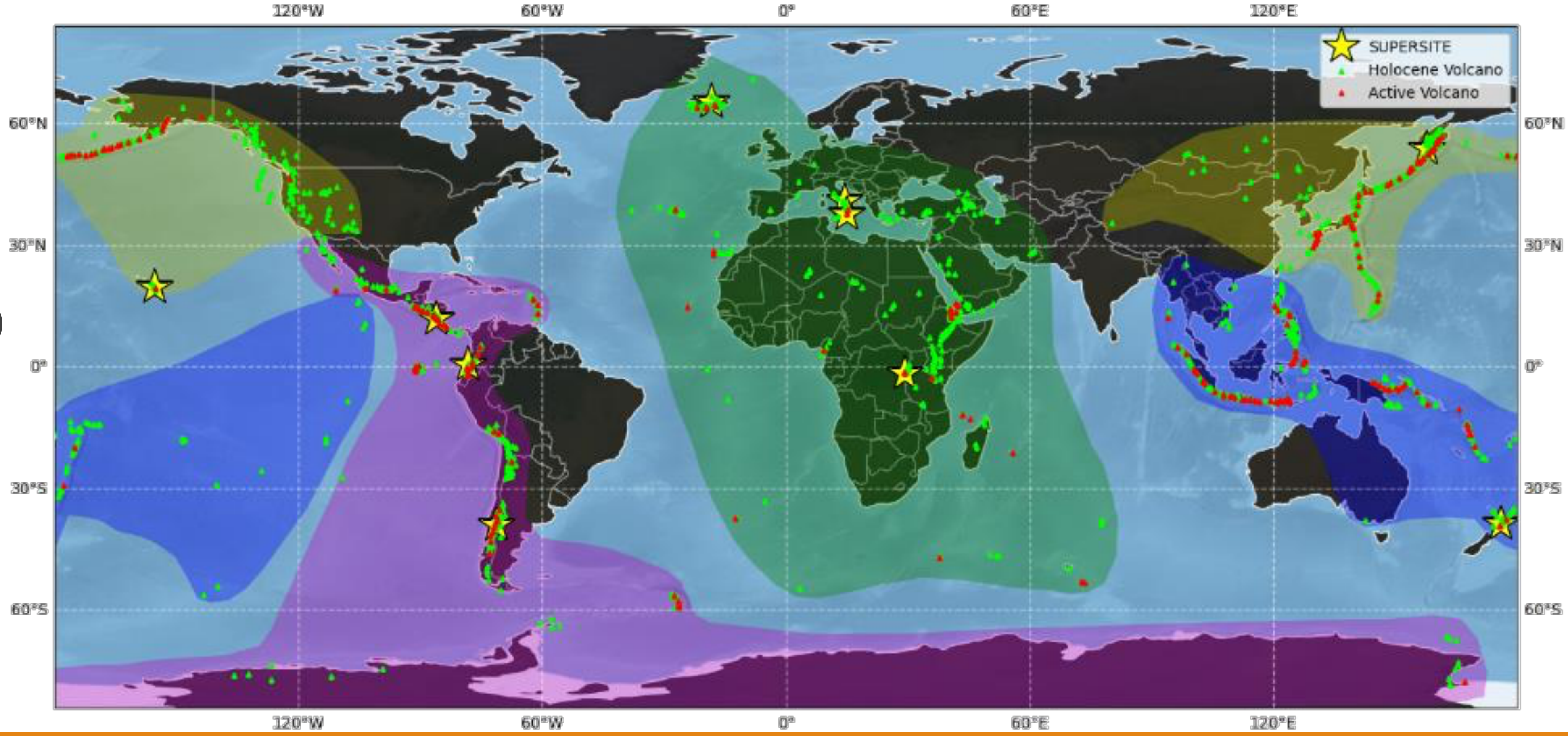
New project: Global Volcano Early Warning and Eruption Response from Space (G-VEWERS)

Committee on Earth Observation Satellites

Led by Mike Poland (USGS) & Susi Ebmeier (U. Leeds)

> 10,000 images per year from commercial missions

2024-2026, potentially renewable



Volcano and Hazard Experience: Challenge of getting satellite data to observatories

Collaborate with volcano observatories (Chile, Perú, Bolivia, Indonesia)

Share satellite data and interpretations at erupting & restless volcanoes

Work with the USGS

USGS Powell Center for Analysis & Synthesis

Volcano Remote Sensing Working Group 2017-2019

Co-Leader: Mike Poland YVO

Global satellite observing strategy (Pritchard et al., 2022):

- Weekly: 178
- Monthly (or weekly to maintain InSAR coherence): 342
- Quarterly: 839

Workshops to promote use of satellite data at volcano observatories

Co-organized with USGS and others

IAVCEI 2017 ~45 (In-Person)

NEWS No. 1 | April 2021 | INTERNATIONAL ASSOCIATION OF VOLCANOLOGY AND CHEMISTRY OF THE EARTH'S INTERIOR 4

WORKSHOP

Workshop on volcano monitoring infrastructure on the ground and in space
(Online February 18–23)

2021 >200 people

IAVCEI 2023
SCIENTIFIC ASSEMBLY
Ko Rūaumoko e Ngunguru Nei
30 Jan - 3 Feb | Rotorua, New Zealand

2023 ~50 (Hybrid)

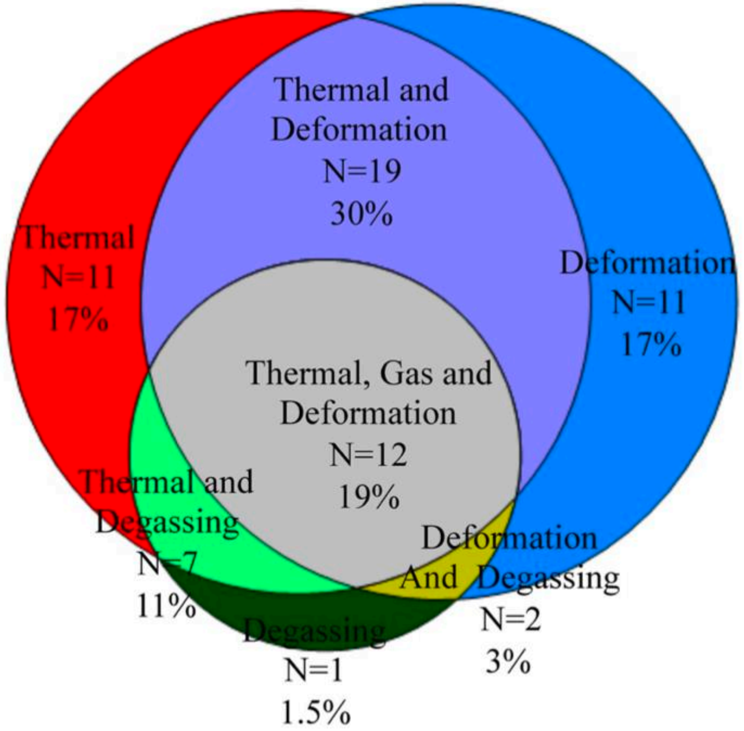
2025: Planned for IAVCEI

IAVCEI 2025
Scientific Assembly
June 29 - July 4, Geneva, Switzerland
sa.iavceivolcano.org

NVEWS Advisory Committee Interest

How do we grow use of satellite data at US volcanoes?

To do this, can we build partnerships between USGS, NASA, US academics & international community



39% with satellite detected activity

AGU ADVANCING EARTH AND SPACE SCIENCE

JGR Solid Earth

RESEARCH ARTICLE
10.1029/2021JB021684

Key Points:
- In the United States, 96 of 161 volcanoes have at least one type of detected activity (seismicity, deformation, and gas or thermal emissions)
- Forty-five percent of volcanoes with thermal emissions are only seen by medium-spatial resolution satellites (<100 m/pixel)
- Each volcano has an Activity Intensity Level; a higher score from multiple data types indicates a greater likelihood of magmatic activity

Quantifying Eruptive and Background Seismicity, Deformation, Degassing, and Thermal Emissions at Volcanoes in the United States During 1978–2020

K. Reath[1], M. E. Pritchard[1], D. C. Roman[2], T. Lopez[3], S. Carn[4], T. P. Fischer[5], Z. Lu[6], M. P. Poland[7], R. G. Vaughan[8], R. Wessels[9], L. L. Wike[1,10], and H. K. Tran[1]

[1]Earth and Atmospheric Sciences, Cornell University, Ithaca, NY, USA, [2]Earth and Planets Laboratory, Carnegie Institution for Science, Washington, DC, USA, [3]Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK, USA, [4]Geological and Mining Engineering and Sciences, Michigan Technological, Houghton, MI, USA, [5]Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM, USA, [6]Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA, [7]U.S. Geological Survey—Cascades Volcano Observatory, Vancouver, WA, USA, [8]U.S. Geological Survey—Astrogeology Science Center, Flagstaff, AZ, USA, [9]U.S. Geological Survey Headquarters, Reston, VA, USA, [10]Now at Department of Geology, University of Maryland, College Park, MD, USA

Reath et al., (2021)

Christy Till
Arizona State University

Associate Professor

@ASU since 2014

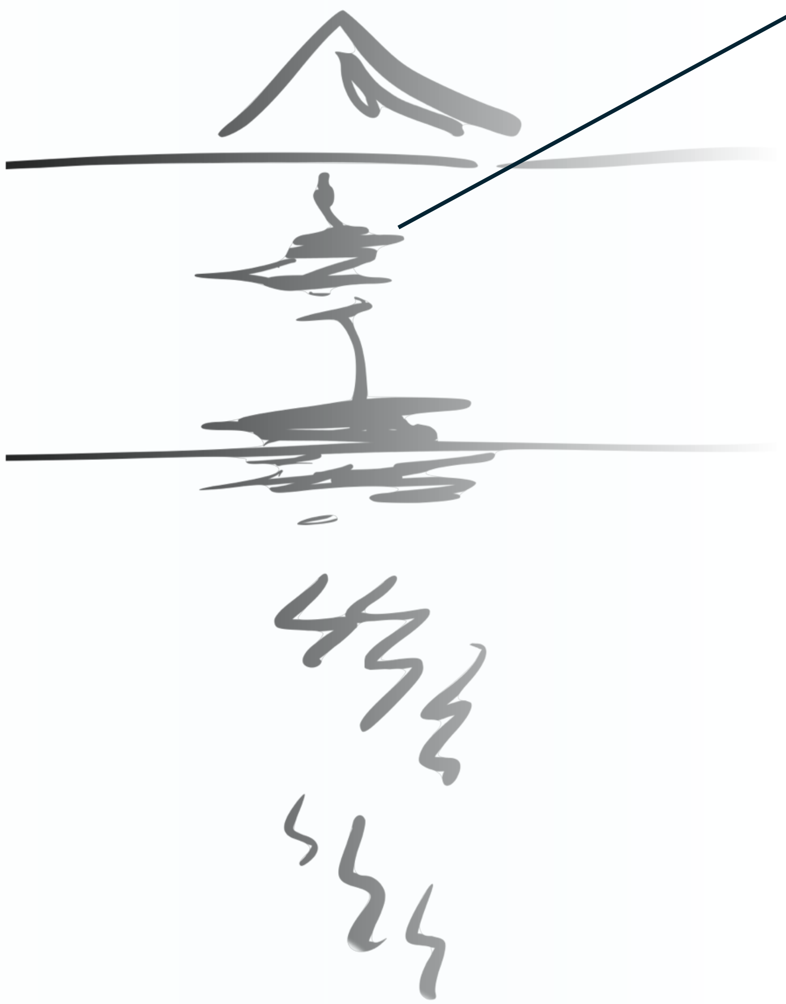
I run the Experimental Petrology & Igneous Processes Center (EPIC) at Arizona State University

We use,

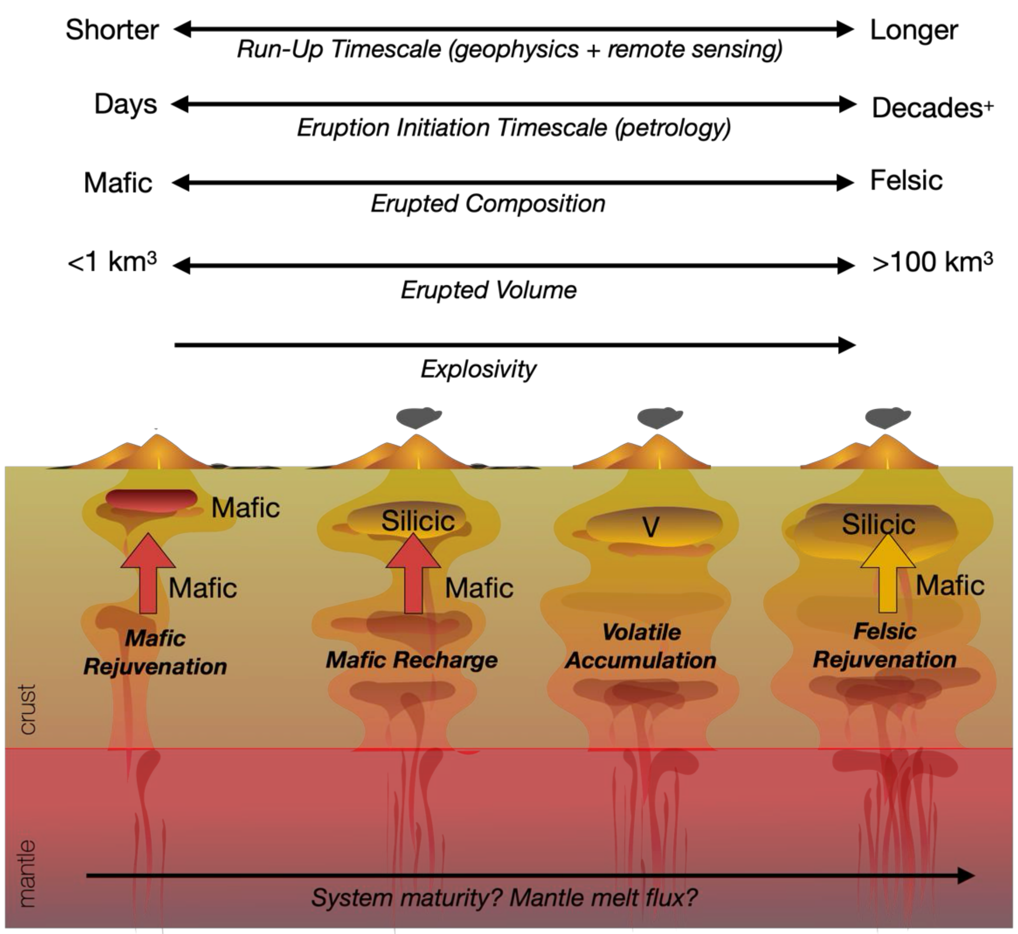
- high pressure & temperature experiments to simulate magma genesis in planetary interiors
- analytical geochemistry & geochronology of natural lava & tephra samples
- as well as a range of geochemical and petrologic models

to **address questions pertaining to the what, when, where & why of magma formation and eruption**.

Relevant Recent Research



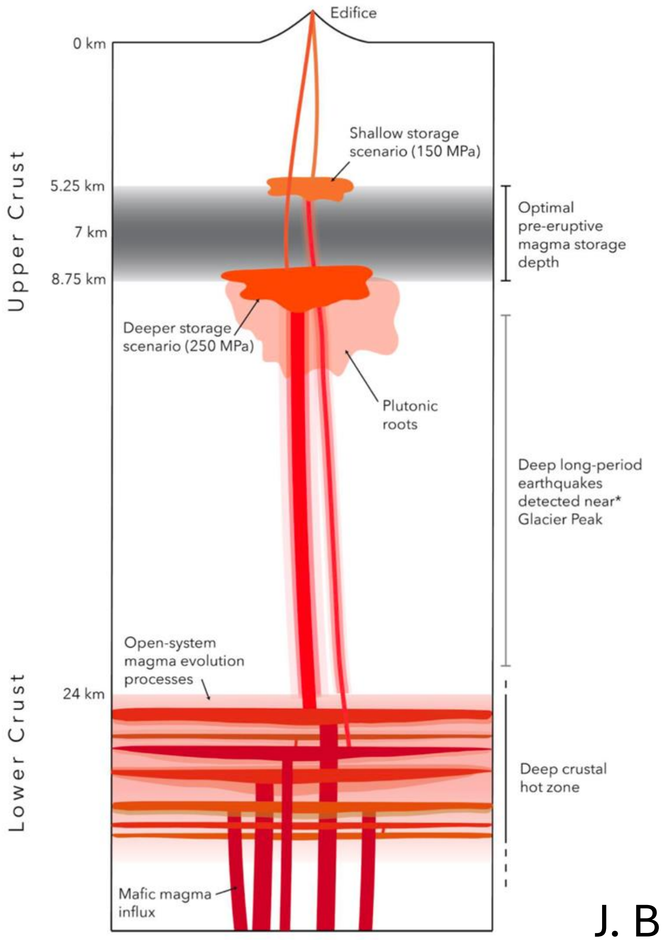
What upper crustal magmatic processes initiate eruptions & what are the associated eruption run-up timescales?



Kent, Till & Cooper, 2023

Relevant Recent Research

At what conditions was/is magma stored beneath high threat US volcanoes?



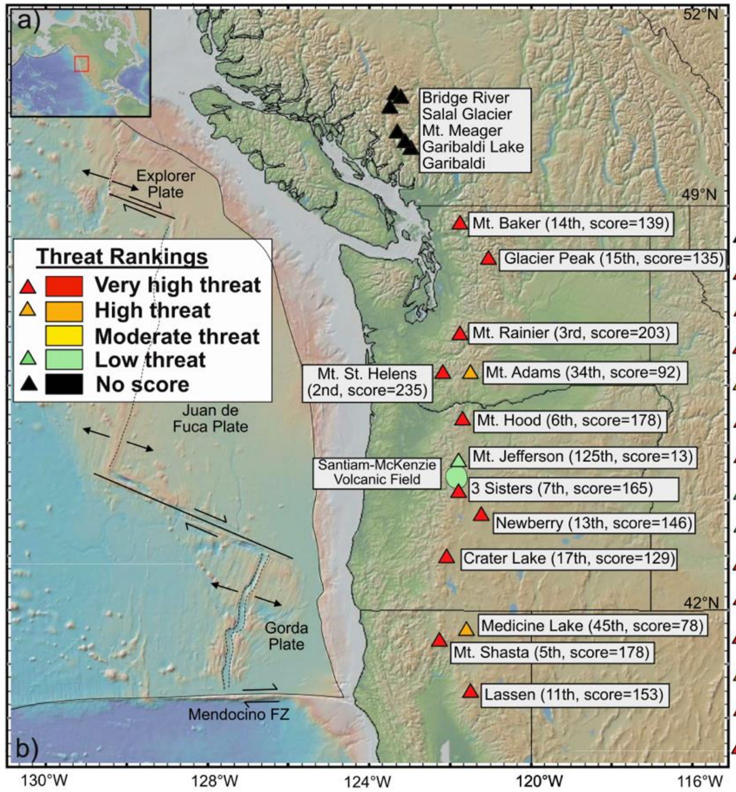
New model for the architecture of the Glacier Peak magmatic system based on experiments & petrology of eruptive lavas and tephras.

J. Bersson ASU Dissertation 2024

Relevant Recent Research

At what conditions was/is magma stored beneath high threat US volcanoes?

We are lacking a lot of data to answer this question for many of the US's highest threat volcanoes



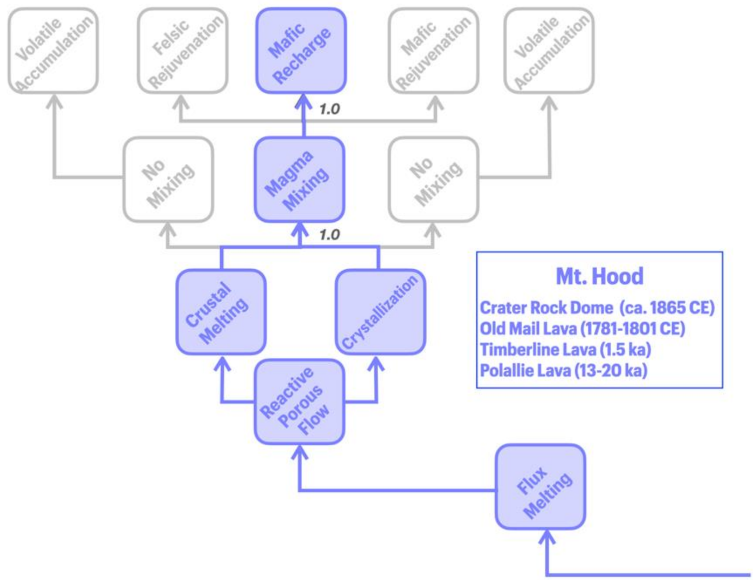
X No data ? Data exists but link to magmatic system unclear
93 # of measurements ✓ Data places constraint on depth

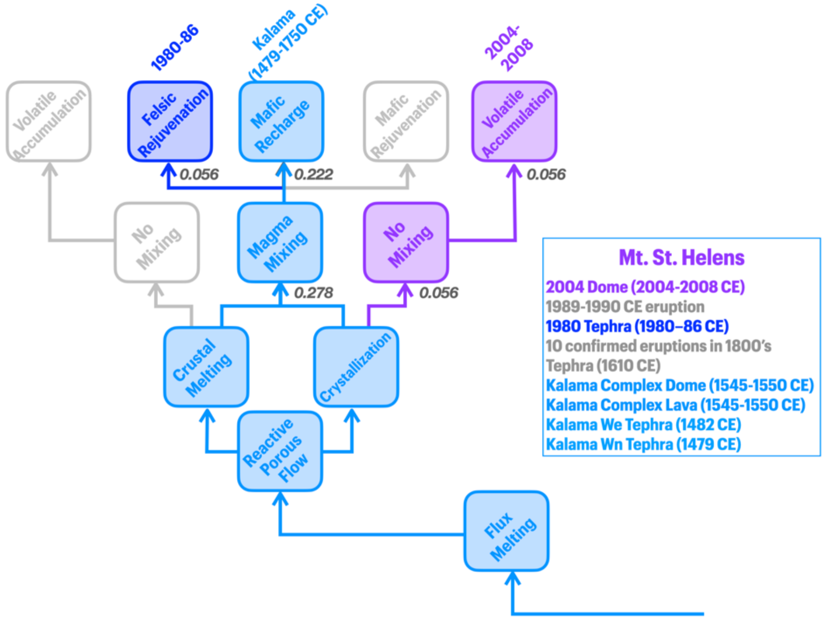
c)	Petrology						Geophysics				
	MI +Quant VB	MI no Quant VB	Cpx	Amp	Cpx-Opx	ExpPet	Geodetics	Magneto-tellurics	Seismics	LPs	3bb at <20 km
Canadian GVB	X	93	15	X	X	X	X	X	X	X	X
Baker	X	8	230	10	X	X	✓	X	X	31	1
Glacier Peak	X	16	18	X	X	X	X	X	X	8	X
Mt. Rainier	X	X	79	16	X	✓	X	✓ iMUSH Regional + local		18	13
Mt. Adams	X	X	1214	30	X	X	X			X	X
Mt. St. Helens	X	65	64	993	X	✓	✓			8	16
Mt. Hood	X	38	56	274	X	X	X	X	X	X	8
Mt. Jefferson	X	X	35	323	25	X	X	X	X	X	X
Santiam VF	X	77	X	X	X	X	X	X	X	X	X
3 Sisters	X	X	17	X	X	X	✓	X	X	1	4
Newberry	X	X	X	X	X	?	?	✓	✓	✓	8
Crater Lake	X	144	333	245	X	X	X	X	X	1	4
Medicine Lake	X	X	21	7	X	✓	?	X	✓	1	X
Mt. Shasta	X	45	328	X	116	✓	X	X	?	X	4
Lassen	13	192	535	542	X	✓	?	✓	?	20	1

Wieser, Kent, Till & Abers, 2023

Relevant Recent Research

What are common families or sequences of magmatic processes at a given volcano & can they be informative in an event tree context?





Till, accepted

Volcano and Hazard Experience

How do I interact with volcanoes?
I do field and laboratory research on volcanoes and their erupted products.

How do you interact with volcanic hazards?
I do fundamental research that can inform hazard assessments & eruption forecasting

Summer 2002: I volunteered & assisted with field work at the USGS in Anchorage, AK

2012-2013: I was a USGS Mendenhall Postdoctoral Fellow in what is now the California Volcano Observatory.

There I determined the first eruption initiation timescales for past explosive and effusive eruptions at Yellowstone volcano.

2020-2021: I planned to spend a sabbatical at CVO, which was cancelled due to COVID.

Ongoing: I collaborate with a number of USGS scientists at CVO & CalVO.

NVEWS Advisory Committee Interest

- Interested in identifying data gaps that academic scientists can help fill
- Interested in training gaps that universities & colleges can help fill
- Interested in funding science that currently lies in gap between NSF & USGS (external grants?)
- Have relationships to two NSF funded consortia (CONVERSE & SZ4D) that have overlapping interests
- To represent SW region

Federal Members Introductions

Lauren Boyd, Department of Energy

Stephen Dornbos, Department of Defense

Douglas Howard, National Oceanic and Atmospheric Administration

Steven McCabe, National Institute of Standards and Technology

Ariel Stein, National Oceanic and Atmospheric Administration (ask to tandem with Doug Howard?)

Jennifer Wade, National Science Foundation

Jeffery Williams, Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge

Lauren Boyd

U.S. Department of Energy’s (DOE) Geothermal Technologies Office (GTO)

DIRECTOR

15 YEARS AT DOE, 1 YEAR AS DIRECTOR, 2 YEARS AS ACTING DIRECTOR

Geothermal Technologies Office

Lauren Boyd leads the efforts of the U.S. Department of Energy's (DOE) Geothermal Technologies Office (GTO) to improve performance, reduce costs, and accelerate deployment of all geothermal technologies.

Develop strategy, and execute ~118M annually for geothermal research, development, and demonstration to advance all forms of geothermal energy.

Builds GTO's partnerships with industry, academia, the DOE national laboratories, and others to raise awareness, and advance geothermal as economically competitive and widely available part of the U.S. energy supply.

Manages DOE's international portfolio on geothermal and responsible for international collaboration surrounding geothermal research and policy.

Volcano and Hazard Experience

At DOE, I interact with volcanoes generally because the geologic processes that drive volcanic terrains also create ideal conditions for geothermal energy extraction. DOE research partners are investigating the opportunity for geothermal development at Newberry Volcano, for example. DOE has been peripherally involved in investigations surrounding Makushin and Augustine in my time at DOE, and historically, many other U.S. volcanic systems.

In addition, geothermal development is occasionally impacted during eruptions, for example during the eruption of Kilauea the Puna / Ormat / power plant was shut down and the recent eruptions of the Svartsengi volcanic system, in Iceland, involve mitigations for the Svartsengi / HS Orka power plant).

Induced seismicity another natural hazard that I am involved with mitigating in my professional capacity at DOE. Under my purview DOE funded the development of an induced seismicity mitigation plan for Enhanced Geothermal Systems operations, participates in subsurface energy systems assessments of seismicity (Induced Seismicity Potential in Energy Technologies | National Academies) and funds RD&D associated with expanding our understanding of seismicity in EGS systems.

Work with the USGS

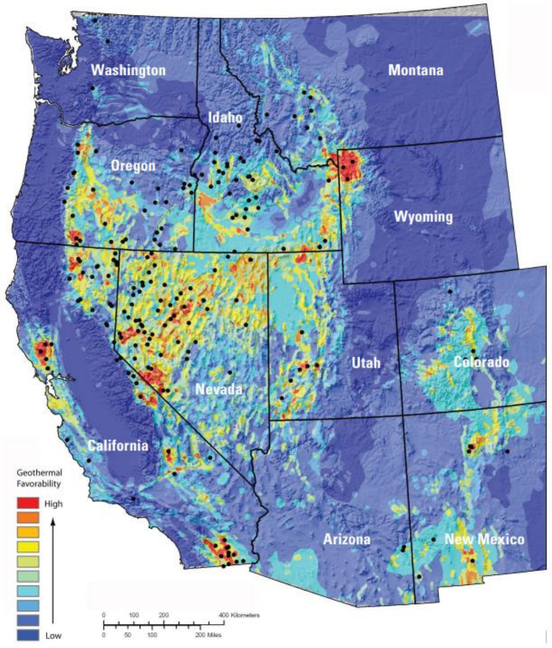
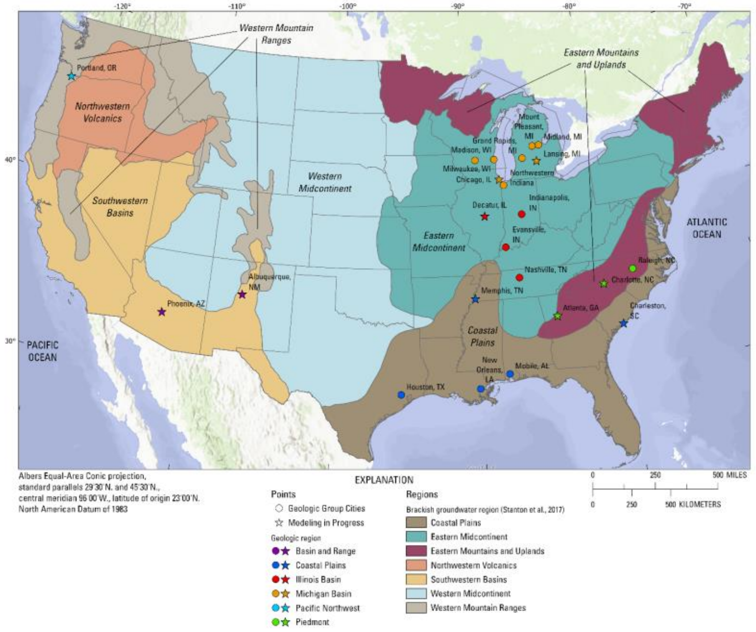


Figure 3. *Example map from one of a series of 28 spatial models showing the relative favorability of occurrence for geothermal resources in the western contiguous United States. The other models differ in details but show generally similar favorability patterns. Warmer colors equate with higher favorability. Identified geothermal systems are represented by black dots.*

[USGS Fact Sheet 2008-3082]



[fs20223082.pdf - Geologic Energy Storage (usgs.gov)]

- Collaboration on geothermal resource assessments for geothermal:
  - The U.S. Geological Survey's 2008 national resource assessment (Williams and others, 2008b) assessed the electric power potential in the western US.
- Collaborative review and appeals to draft legislation:
  - Recent joint review of "H.R. 8665, the Supercritical Geothermal Research and Development Act"
- Collaborative Research on Geologic Energy Storage.

Work with the USGS

Collaborative Geothermal Data Acquisition w/U.S. Geological Survey:
gdr.openei.org/submissions/1501

- **Geoscience Data Acquisition in Western Nevada (GeoDAWN):** Focused on new subsurface data in western Nevada and leveraging machine learning for better understanding of geologic conditions and stress regime.

- **GeoFlight:** Salton Trough: Data on hidden geothermal systems in Imperial Valley (CA), using specially equipped, low-flying aircraft to help identify unique surface and near-surface characteristics to create more accurate geologic maps for the area.

GeoFlight photos (Glamis Dunes) courtesy Kyle Kendall

NVEWS Advisory Committee Interest

The symbiotic relationship between geothermal energy and volcanic hazards offer potential benefits to both environmental sustainability and energy security.

Through collaborative monitoring and risk assessment, we can gain a deeper understanding of volcanic activity and its implications for geothermal development. This information can be used to inform thoughtful risk management strategies that protect both communities and the environment. By carefully considering the potential hazards and taking proactive measures to mitigate them, we can harness the power of volcanic heat to create a sustainable and resilient future.

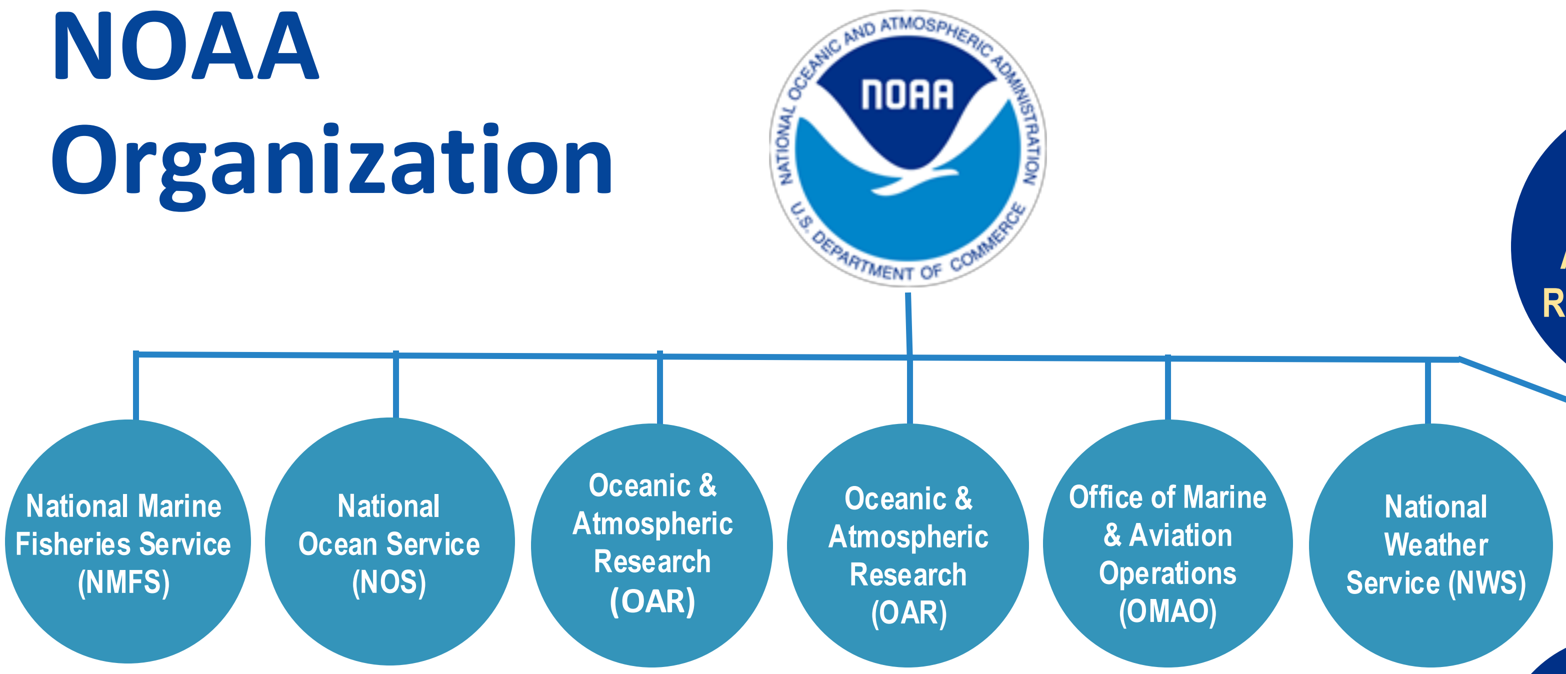
Douglas A. Howard, Ph.D., P.G.
Center for Satellite Applications and Research (STAR)

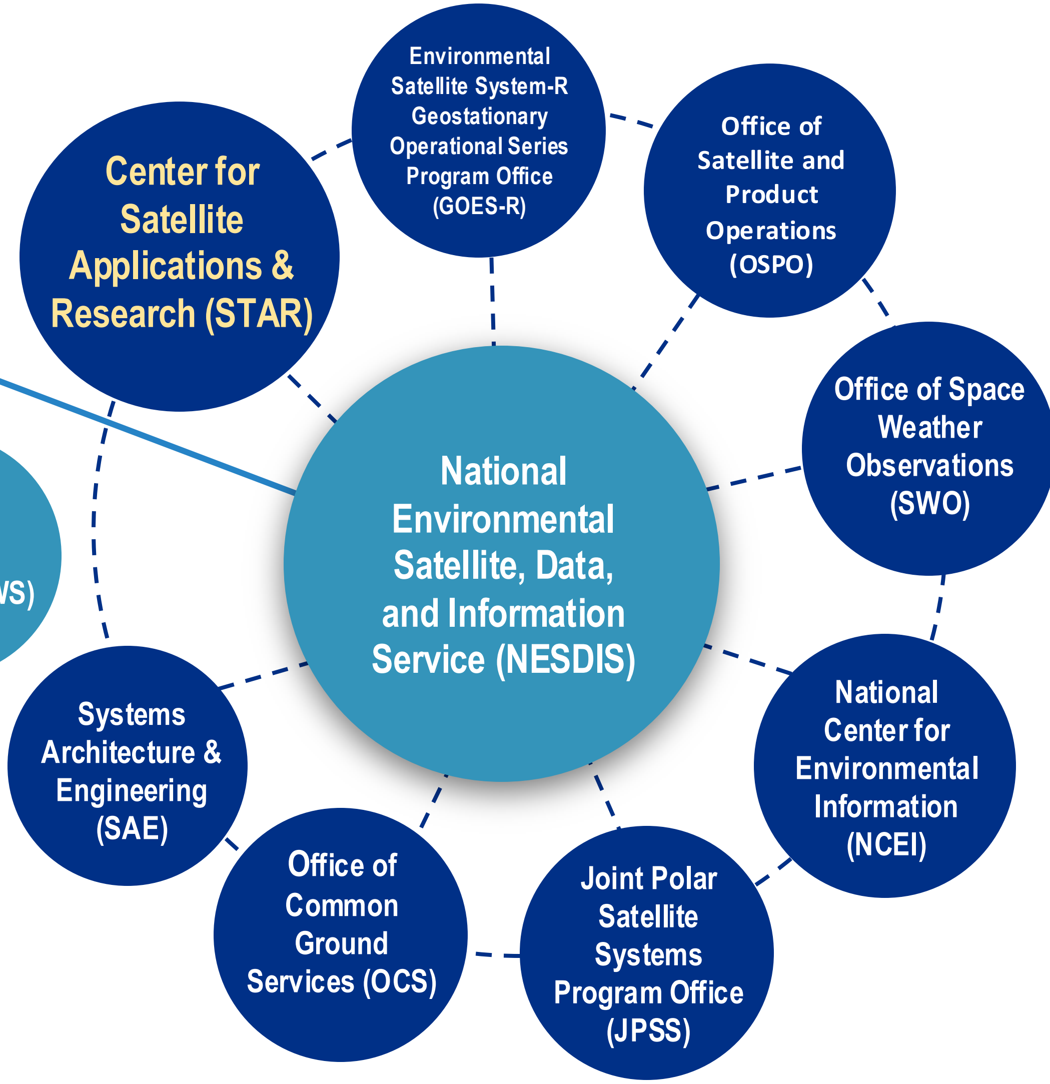
Director, STAR
Duration – 1 year 7 months

September, 2024

NOAA
National Environmental Satellite, Data, and Information Service

NOAA Organization





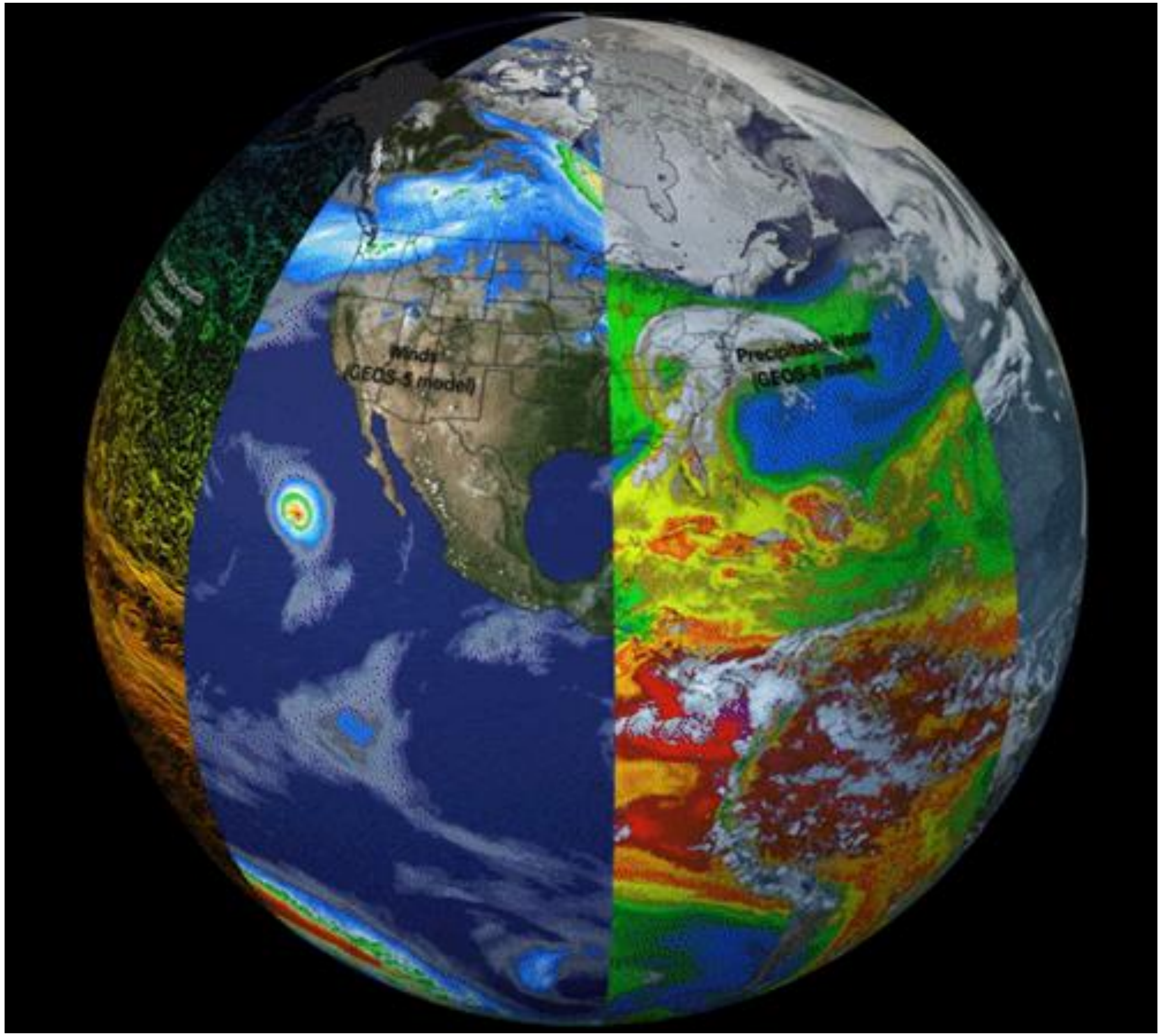
- The National Environmental Satellite, Data, and Information Service (NESDIS) is one of six Line Offices within NOAA.
- STAR is one of eight program offices within NESDIS.
- All program offices engage in significant cross-office partnerships to execute their missions.

NESDIS:

A trusted U.S. source of environmental information… with a global perspective.

NESDIS Mission:

Provide a truly integrated digital understanding of our earth environment that can evolve quickly to meet changing user expectations by leveraging our own capabilities and partnerships



STAR Mission

STAR’s mission is to use innovative science and applications to transform satellite observations of the Earth into meaningful information essential to society’s evolving environmental, security, and economic decision-making.

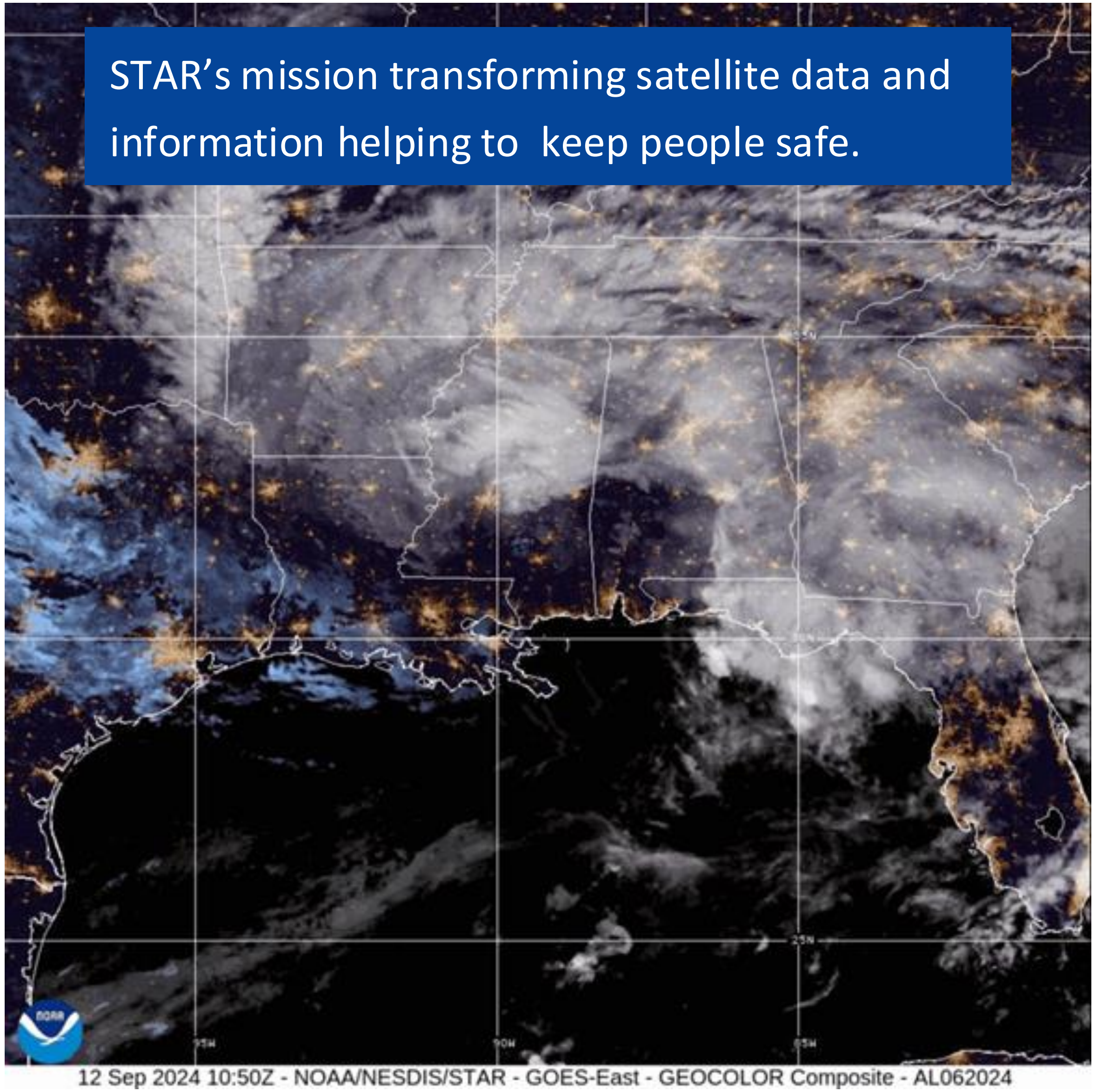
STAR Vision

A Climate and Weather Ready Nation powered by science-based solutions.

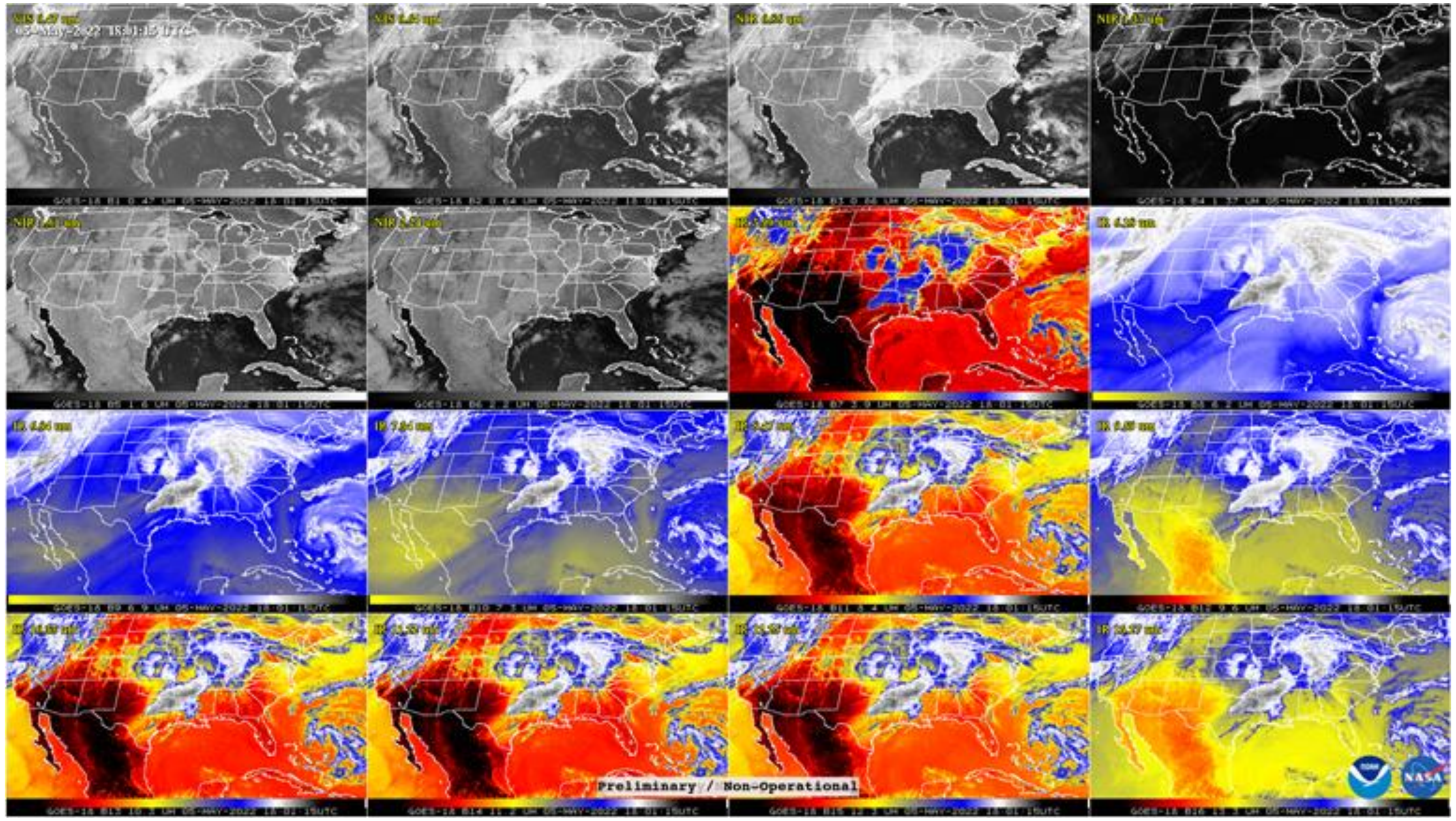
The raw data collected from NOAA Satellites is not usable without the functions STAR performs

Saving lives, providing warnings, to make informed decisions.

STAR provides imagery used for news feeds seen on media devices around the globe. We provide the data, information, and imagery that informs decision makers, first responders, local governments and the public about the extreme weather events, wildland fires, and coastal impacts that are occurring and potentially imminent to homes, livelihoods, and our families.



Instrument Calibration & Validation



STAR provides critical support to users during pre- and post-launch phases of NOAA satellite missions.

STAR By the Numbers

As a Research Center for NOAA Satellites…

25
science teams

25 science teams that have expertise in product/solutions development ranging from monitoring ocean properties to forecasting space weather phenomena

6.79
percent of research publications

Comprised 6.79% of the research publication output of all of NOAA for the period 2017 - 2021

5
terabytes of data

Disseminates up to 5 terabytes of data directly on a daily basis to partners like the NWS, armed services, federal, and academic partners for operational use

18
satellite observations data sources

Ingests data from over 18 satellite observations data sources for development of algorithms, testing, modeling, etc.

130
billion pieces of paper

Users download 15-20 terabytes of data from the STAR website on a daily basis–that's equivalent to a stack of 130 billion pieces of paper

Volcano and Hazard Experience

Professional capacity:

- Previous experience with geological mapping in volcanically active areas of Iceland
- Planetary research on glacial outburst floods (Jökulhlaups) as an Earth analogue to fluvial processes on Mars - Glacio-fluvial-volcanic interactions (Bárðarbunga volcano and Grímsvötn in Vatnajökull)

NOAA Capacity:

- STAR: Volcanic Cloud Monitoring (NOAA STAR/CIMSS)
- NOAA Air Resources Laboratory (ARL): HYSPLiT for Volcanic Ash

Work with the USGS

- Associate Program Coordinator for the National Cooperative Geologic Mapping Program
- Acting Program Coordinator for the National Cooperative Geologic Mapping Program
- Principal Research Advisor for the National Land Imaging Program (Landsat)
- Planetary geology research with the Astrogeology Science Center
- NOAA/NASA/USGS collaboration on the international QUAD Extreme Precipitation Workshops (Stacey A. Archfield)

NVEWS Advisory Committee Interest

- Helping the National Volcano Early Warning System meet its mission goals
- Utilized my professional expertise and experience and engage my NOAA network to assist

Thank you!

Questions?

Dr. Steven McCabe, P.E.
National Institute of Standards and Technology
Gaithersburg, MD

AS OF OCTOBER 1: DIRECTOR, DAMAGE IMPACT REDUCTION OFFICE

13 YEARS AT NIST, FORMER DIRECTOR OF NEHRP AT NIST

50 YEARS OF EXPERIENCE IN ENGINEERING FOR EARTHQUAKE:

- DESIGN ENGINEER, FACULTY RESEARCHER, NSF PROGRAM OFFICER AND NOW AT NIST

My Work at NIST

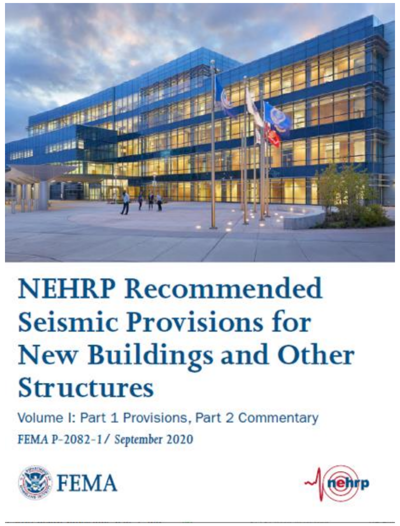
- Formerly, Leader of the Earthquake Engineering Group and Director of NEHRP
- Promoted to Manage Statutory Programs within the Engineering Laboratory
  - National Earthquake Hazards Reduction Program: NIST, FEMA, NSF & USGS
  - National Wind Impact Reduction Program: NIST, FEMA, NOAA & NSF
  - Disaster and Failure Studies – building collapses etc.
  - Possibly More to Come

Volcano and Hazard Experience

- No Volcano Work; Did tour Eruption Site on Hokkaido, Japan in 2003.
- Heavy Engagement with Hazards
  - NEHRP – NIST is the Lead Agency of the Program
    - USGS Produces Seismic Hazards Maps; Operates Instrument Networks, Operates Shake Alert on the West Coast
    - NSF funds Basic Research in Engineering, Social Sciences and Earth Science
    - FEMA leads the NEHRP Recommended Provisions for Seismic Design updates >>>> leads to inclusion in the Building Code
      - FEMA also has BRIC (Building Resilient Infrastructure and Communities) to fund hazard mitigation work in communities
    - NIST does Applied Research in Engineering for Earthquake Design, Building Code Improvements, Community Resilience & Social Science
  - NWIRP – NIST is the Lead Agency of the Program
    - NOAA does the Science on Hurricanes and Tornados
    - FEMA supports Recovery efforts and Building Code Improvements
    - NSF funds Basic Research in Wind Engineering and Social Sciences
    - NIST has an Active Wind Engineering Program looking at Damage from Storms and how Building Codes Perform

Work with the USGS

- USGS is a close partner of NIST in NEHRP.
  - We work with NIST Golden (primarily), nearly on a weekly basis.
  - We also work with USGS on updates to the NEHRP Recommended Provisions



- Other ties:
  - My mother-in-law was a long-time office manager in Crustal Studies at USGS at the Federal Center in Denver. Before that she was part of the USGS Group that began the earthquake work at Menlo Park in the 1960’s.
  - My mother worked at the Denver Ordinance Plant (Remington Arms) making machine gun bullets during World War II. Remington Arms formed the basis for the Federal Center

NVEWS Advisory Committee Interest

- Watched the USGS Development of Shake Alert with interest.
- Early warning is very important. It's an extremely important aspect of tornado and hurricane impacts on people. We deal with the question of storm warnings and their effectiveness in every severe storm we study for NWIRP.

  We surveyed a manufacturing plant that was destroyed by a tornado in late April. The plant had two minutes of warning that the tornado was on their property. Everyone somehow survived.

  In Hurricane Ian that hit the west coast of Florida, there were many fatalities from storm surge that caused flooding. People had determined early on that the track was not going to hit their community and apparently tuned out subsequent storm warnings. Problem is the storm track changed…

Ariel Stein
National Oceanic and Atmospheric Administration

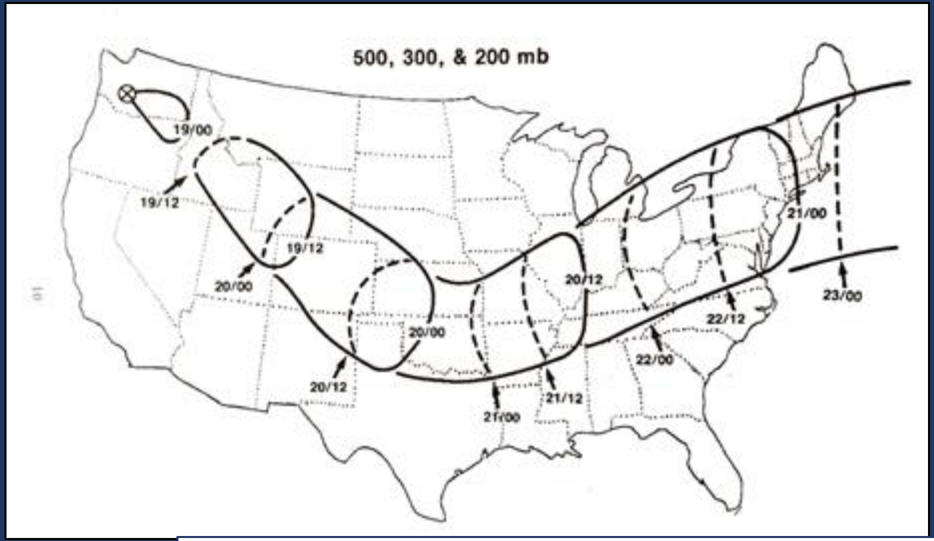
Director Air Resources Laboratory

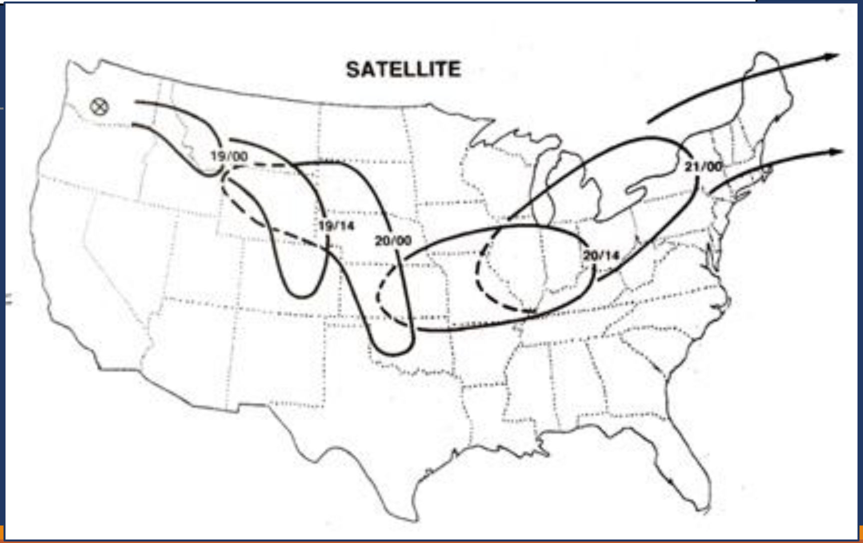
1980s

Mt. St. Helens volcano, Washington state – May 18, 1980

ARL forecast trajectories, text only, on NMC (now NCEP) computer and faxed

- **NOAA/FAA Memo. of Understanding (MOU)**





`

May 19-23, 1980. Top: Composite upper tropospheric trajectories (300, 300, 500 mb). Bottom: Ash cloud position from NOAA satellite imagery. (Draxler, 1981: Observing and forecasting motions of volcanic emissions shortly after the initial Mt. St. Helens eruptions. NOAA Tech Memo ERL ARL-95)

1980s - 1990

Galunggung volcano, Indonesia – June 24, 1982 -- BA 009

- **ICAO* International Airways Volcano Watch**

Redoubt volcano, Alaska – December, 1989 – June, 1990
December 15 -- KLM 867

Pilot: Climbing to level 390, we're in a black cloud, heading 130.
Pilot: KLM 867 we have flame out all engines …
Pilot: KLM 867 heavy, we are descending now: we are in a fall!
. . .

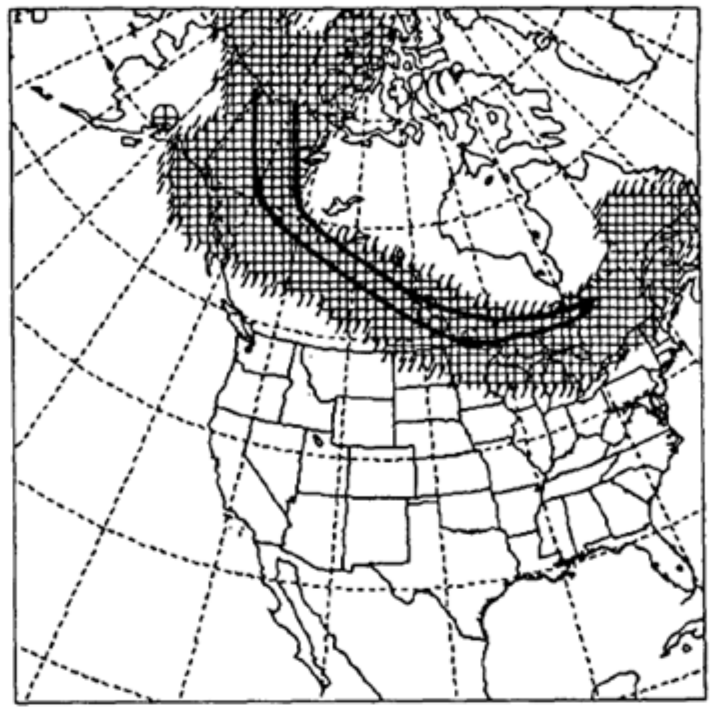
*International Civil Aviation Organization

Late 1980s / Early 1990s

ARL developed VAFTAD – Volcanic Ash Forecast Transport and Dispersion Model

Qualitative output – ash or no ash

Verification with hard copy satellite imagery (solid line on figure)



FORECAST CYCLE 92/06/28-12Z

VALID 92/06/30-03Z
TO 92/06/30-15Z

Heffter and Stunder, 1993: Volcanic ash forecast transport and dispersion (VAFTAD) model. Weather and Forecasting 8(4):533-541.

1990s

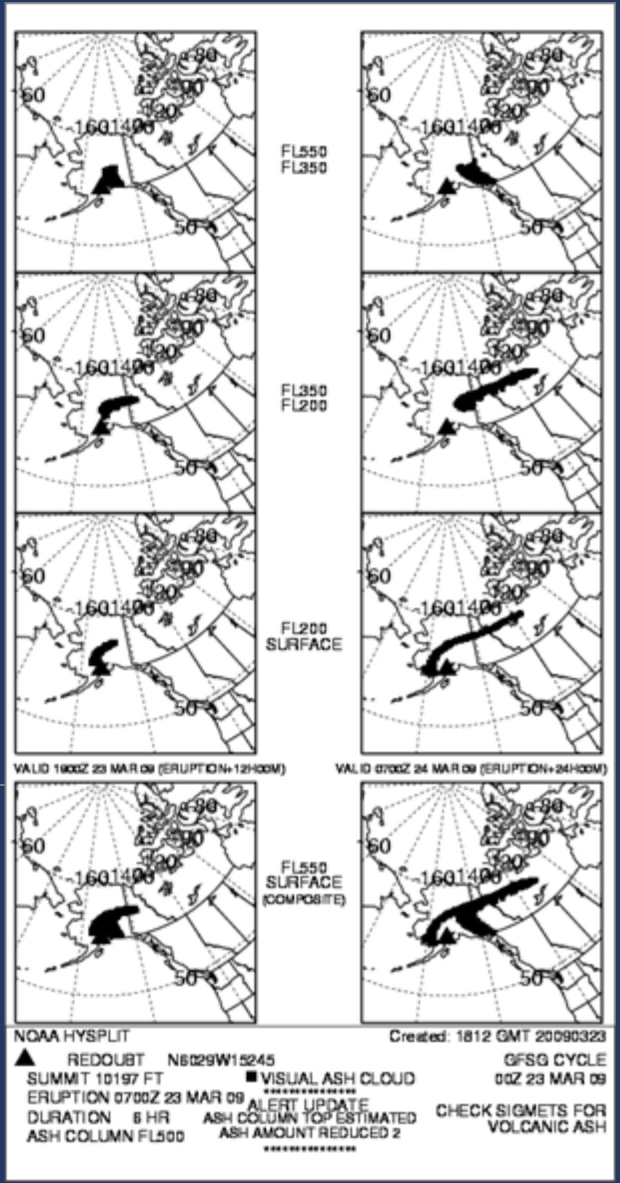
VAFTAD transferred to NWS Operations (R2O – Research-to-Operations)

ICAO – “VAFTAD-format graphic”

avoid ash

OFCM (now ICAMS*)

Volcanic Ash Working Group National Plan



*Interagency Council for Advancing Meteorological Services

2000s

NWS volcanic ash modeling - HYSPLIT instead of VAFTAD

VAFTAD look-alike graphic from HYSPLIT (NWS product)

avoid ash

US Geological Survey (USGS) – Eruption Source Parameters*

relation between eruption height and volume erupted ash

$H = 2.00\ v^{0.241}$

v="dense rock equivalent" (m^3/s) but need "fine ash"

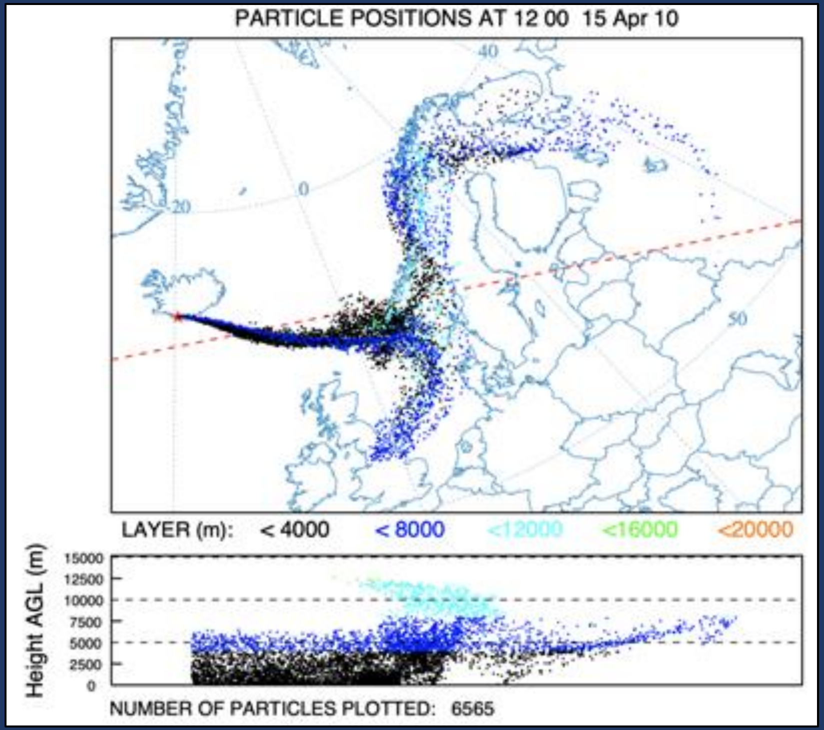
H=plume height (km)

*Mastin, L.G., et al., 2009: A multidisciplinary effort to assign realistic source parameters to models of volcanic ash-cloud transport and dispersion during eruptions, Journal of Volcanology and Geothermal Research, 186:10-21.

2010s

Eyjafjallajökull

- ICAO: risk assessment instead of ash avoidance
- Increased NWS capability
  - Time-varying source
  - Modify particle size distribution
  - Horizontally translate ash footprint

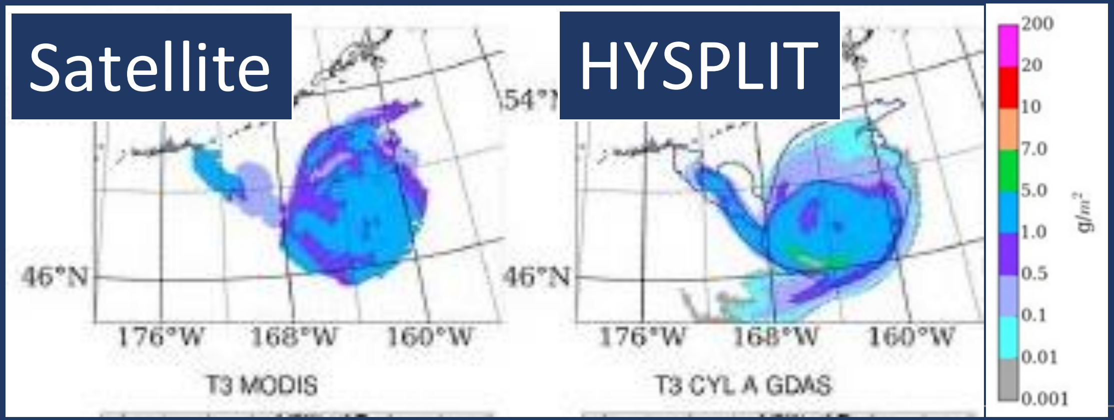


HYSPLIT Eyjafjallajökull snapshot.
HYSPLIT tutorial file xamp16.png
https://www.ready.noaa.gov/documents/Tutorial/html/index.html

2010s

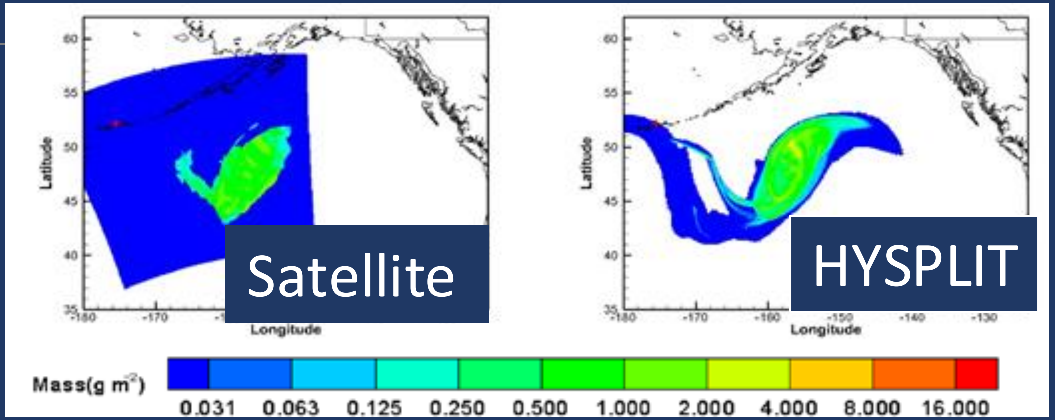
Research improving source terms for quantitative forecasts (mass loading) using satellite data

Kasatochi, Alaska, 2008



Crawford et al., 2016 (from Fig. 2)
Source – Cylindrical shape

Chai et al., 2017 (from Fig. 5)
Source from inverse modeling,
(different time period)



Crawford, A. M., et al., 2016: Initializing HYSPLIT with satellite observations of volcanic ash: A case study of the 2008 Kasatochi eruption, ,J. Geophys. Res.Atmos.,121, 10,786–10,803, doi:10.1002/2016JD024779.

Chai, T., et al., 2017: Improving volcanic ash predictions with the HYSPLIT dispersion model by assimilating MODIS satellite retrievals, Atmos. Chem. Phys., 17, 2865–2879, https://doi.org/10.5194/acp-17-2865-2017.

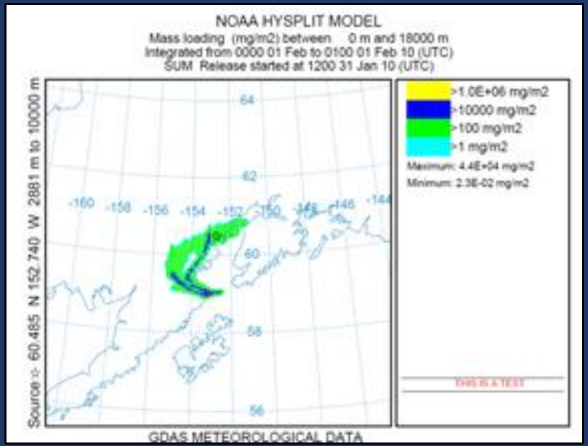
ARL web -

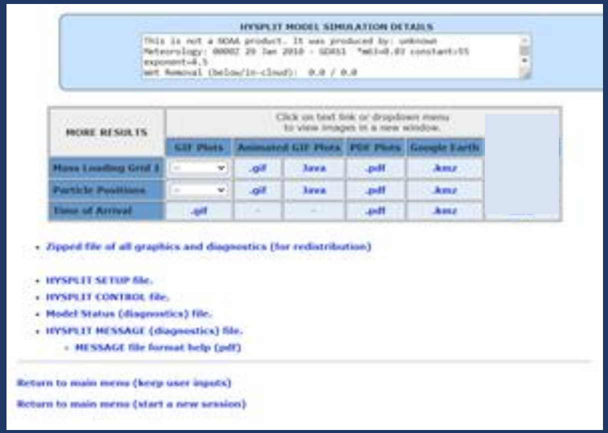
- ARL web page “READY”

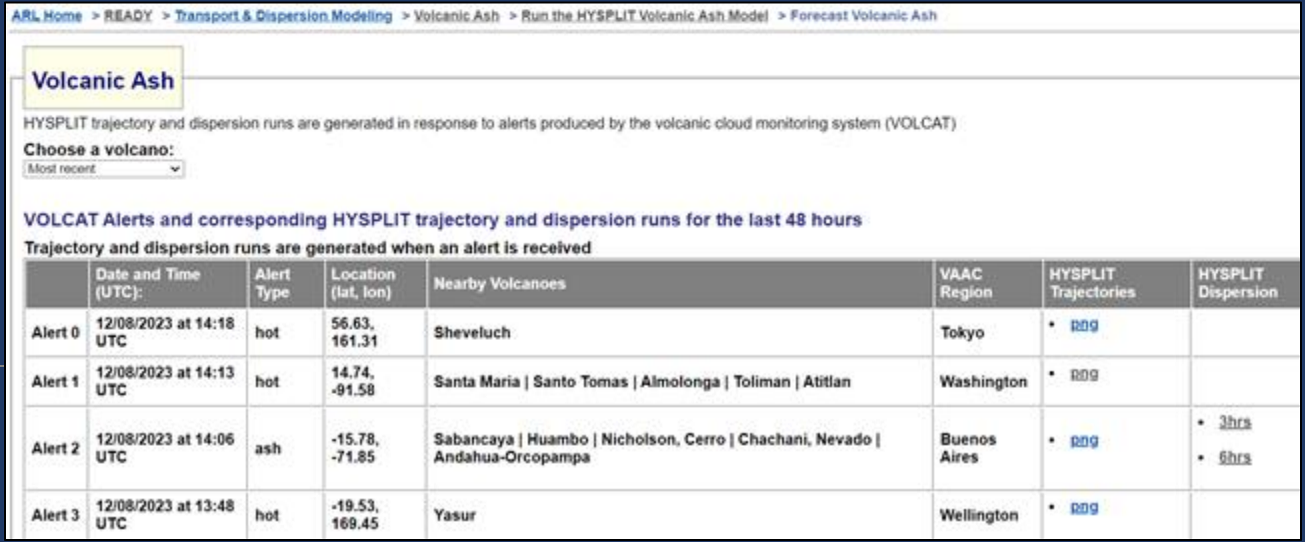
User-run quantitative products (2010s) https://www.ready.noaa.gov/HYSPLIT_disp.php

- Posted on ARL web page

Automatically-run HYSPLIT dispersion and trajectories upon receipt of satellite retrievals of ash or a hot spot (early 2020s)







ARL Home > READY > Transport & Dispersion Modeling > Volcanic Ash > Run the HYSPLIT Volcanic Ash Model > Forecast Volcanic Ash

Volcanic Ash

HYSPLIT trajectory and dispersion runs are generated in response to alerts produced by the volcanic cloud monitoring system (VOLCAT)

Choose a volcano:
Most recent

VOLCAT Alerts and corresponding HYSPLIT trajectory and dispersion runs for the last 48 hours

Trajectory and dispersion runs are generated when an alert is received

	Date and Time (UTC):	Alert Type	Location (lat, lon)	Nearby Volcanoes	VAAC Region	HYSPLIT Trajectories	HYSPLIT Dispersion
Alert 0	12/08/2023 at 14:18 UTC	hot	56.63, 161.31	Sheveluch	Tokyo	• png	
Alert 1	12/08/2023 at 14:13 UTC	hot	14.74, -91.58	Santa Maria | Santo Tomas | Almolonga | Toliman | Atitlan	Washington	• png	
Alert 2	12/08/2023 at 14:06 UTC	ash	-15.78, -71.85	Sabancaya | Huambo | Nicholson, Cerro | Chachani, Nevado | Andahua-Orcopampa	Buenos Aires	• png	• 3hrs • 6hrs
Alert 3	12/08/2023 at 13:48 UTC	hot	-19.53, 169.45	Yasur	Wellington	• png	

- Operational Implementation takes time
  - Need requirements, coordinate products, testing, approvals, etc.

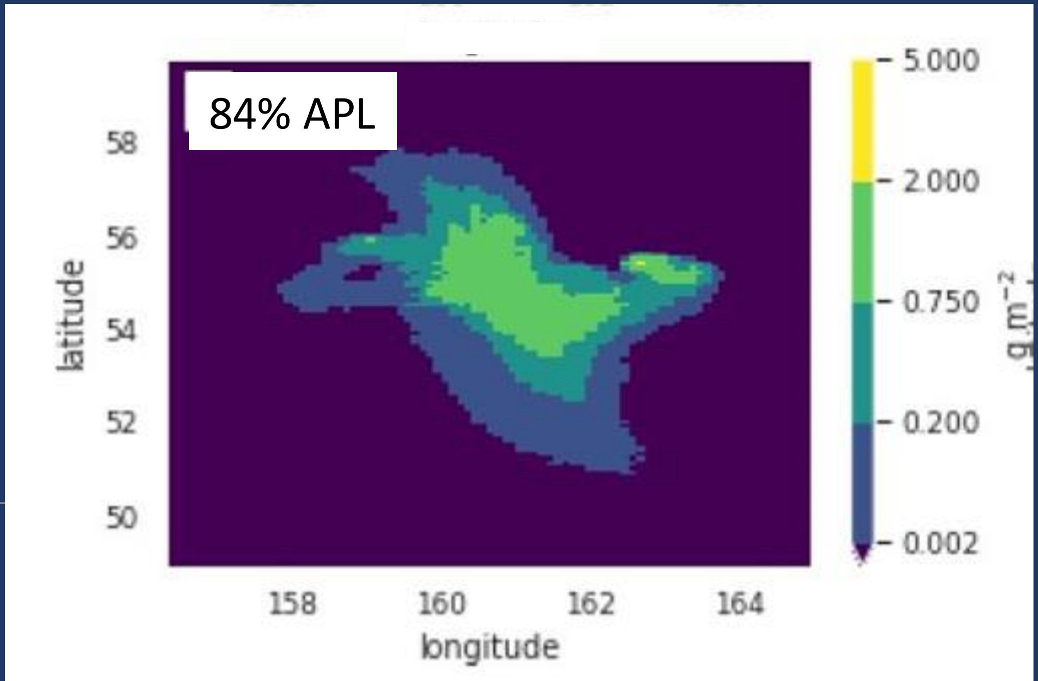
Through the present

NOAA Research funding – NWS Global Ensemble Forecasts

- Products, verification, bias correction (Crawford et al., 2022)

Leads to new workflow plan

- ingest satellite retrievals
- inverse modeling
- probabilistic products
- probabilistic verification



84% of ensemble members have mass loading < given value

APL = Applied Percentile Level

Crawford, A., et al., 2022: Evaluation and Bias Correction of Probabilistic Volcanic Ash Forecasts, Atmos. Chem. Phys., https://doi.org/10.5194/acp-22-13967-2022.

U.S. National Science Foundation

Dr. Jennifer Wade

Program Director
Division of Earth Sciences (EAR)
Directorate for Geosciences (GEO)

At NSF > 13 years

My role at NSF

- **NSF is an independent federal agency**
  - provides science and engineering grants which make up ~25% of federal support for basic research

- **NSF > GEO > Division of Earth Sciences**
  - Petrology & Geochemistry (+ more)

- **Program Directors**
  - manage the review + recommendation process for proposals
  - outreach, education, broadening participation in our community
  - internal policy, inter-directorate, inter-agency committees

Volcano and Hazard Experience

- **NSF invests in volcanologists and research infrastructure**
    - including me, in the Marianas + Central America

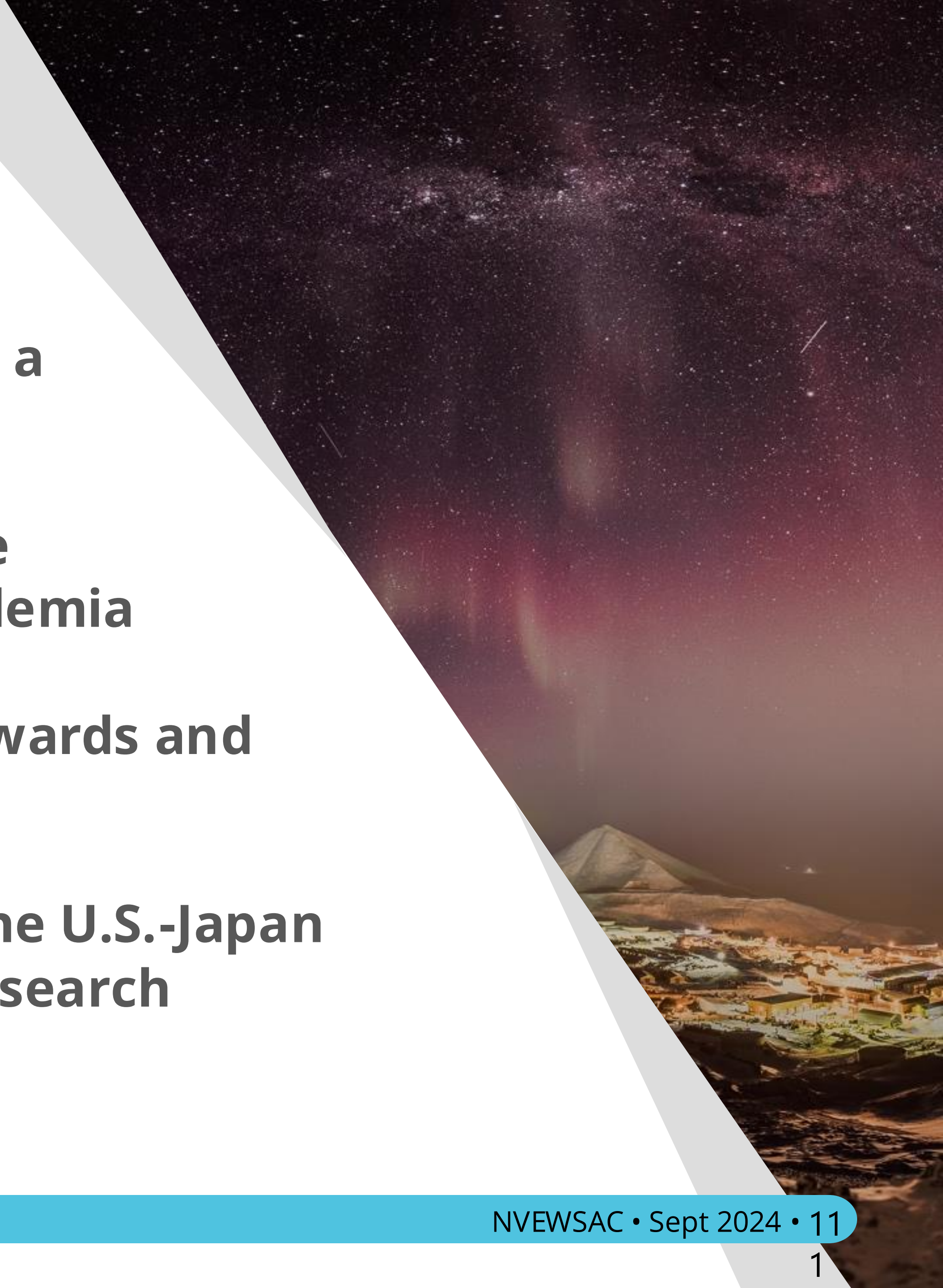
- **NSF Policy requires that any resulting data + samples be made widely available**

- **NSF coordinates with USGS, NASA, and others on volcano-volcano-related topics and other topics + hazards.**

- **NSF has a mechanism for rapid-response awards, which our researchers can use during/after eruptions** [U.S. + international]

Work with the USGS

- We meet regularly on a variety of topics at a number of different levels
- We collaborate on eruption rapid-response coordination between USGS staff and academia
- We invest in collaborations through NSF awards and shared infrastructure
- I serve as a member of the delegation to the U.S.-Japan Natural Resources Panel of Earthquake Research



NVEWS AC Interest

- We'd like to continue to coordinate and collaborate with the USGS on many levels
- We have and will continue to support fundamental research on the very high- and high-threat volcanoes in the U.S.
- We believe inter-agency coordination is critical to NVEWS success

Dr. Steve Dornbos
Department of Defense

ACTING DIRECTOR, GLOBAL RESILIENCE POLICY

OFFICE OF THE SECRETARY OF DEFENSE

1 YR, 8 MONTHS (>5 YRS IN DOD)

Jeff Williams

U.S. Fish and Wildlife Service

Alaska Maritime National Wildlife Refuge

My Work

The Office of the Under Secretary of Defense for Policy (OUSD Policy) is the policy lead for DoD, advising SecDef on all climate and energy resilience issues, integrating resilience into Department strategies, coordinating with the interagency (primarily White House, State, USAID and the IC) on whole-of-government climate and energy resilience, and working with allies on partners on advancing these issues globally.

Volcano and Hazard Experience

While my work at DoD has mostly focused on climate-related hazards, the Department does take an all-hazards approach to installation and operational resilience, which would include volcanic activity.

Work with the USGS

We work closely with DOI and other agencies as participants in the US Global Change Research Program (USGCRP) Working Group on National Security. USGS has also performed analyses in support of the Combatant Commands.

NVEWS Advisory Committee Interest

I am interested in learning more about the NVEWS Advisory Committee and supporting its work.

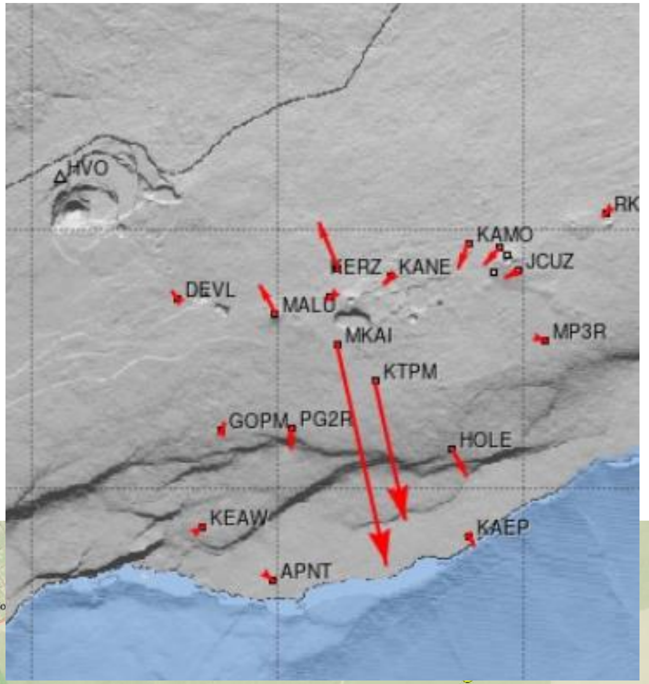
Lunch

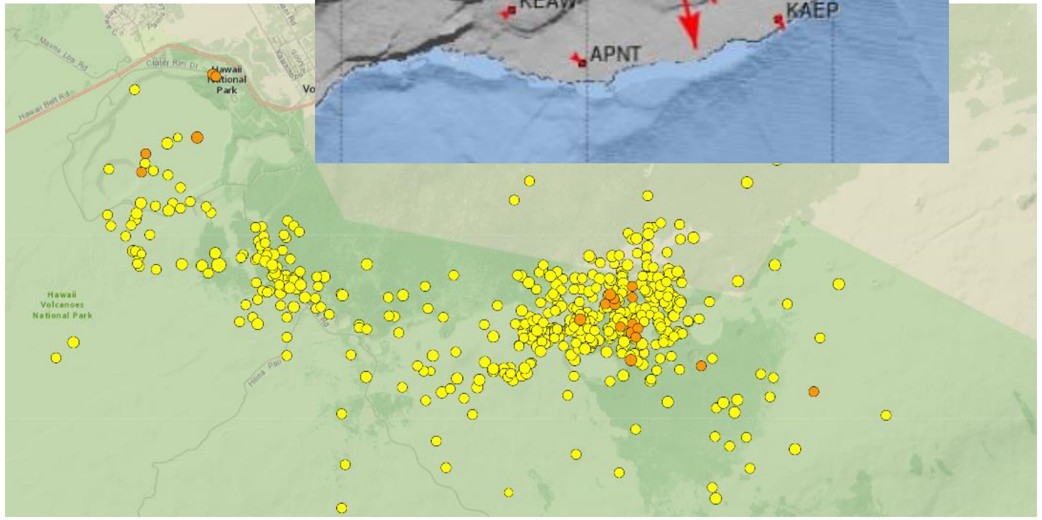
RETURN AT 1:30 PM

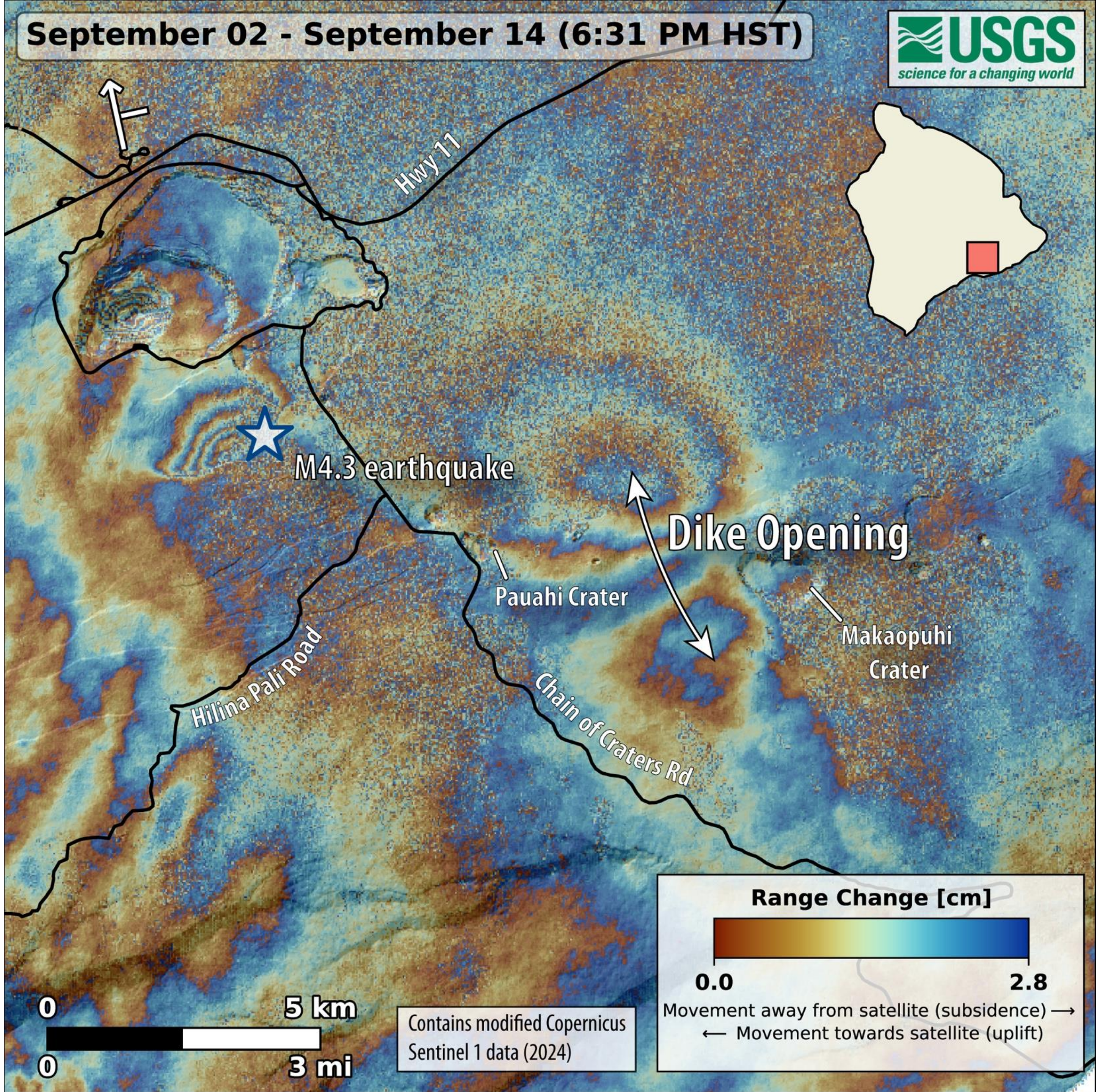
Discussion

Kīlauea – Eruption in Nāpau Crater

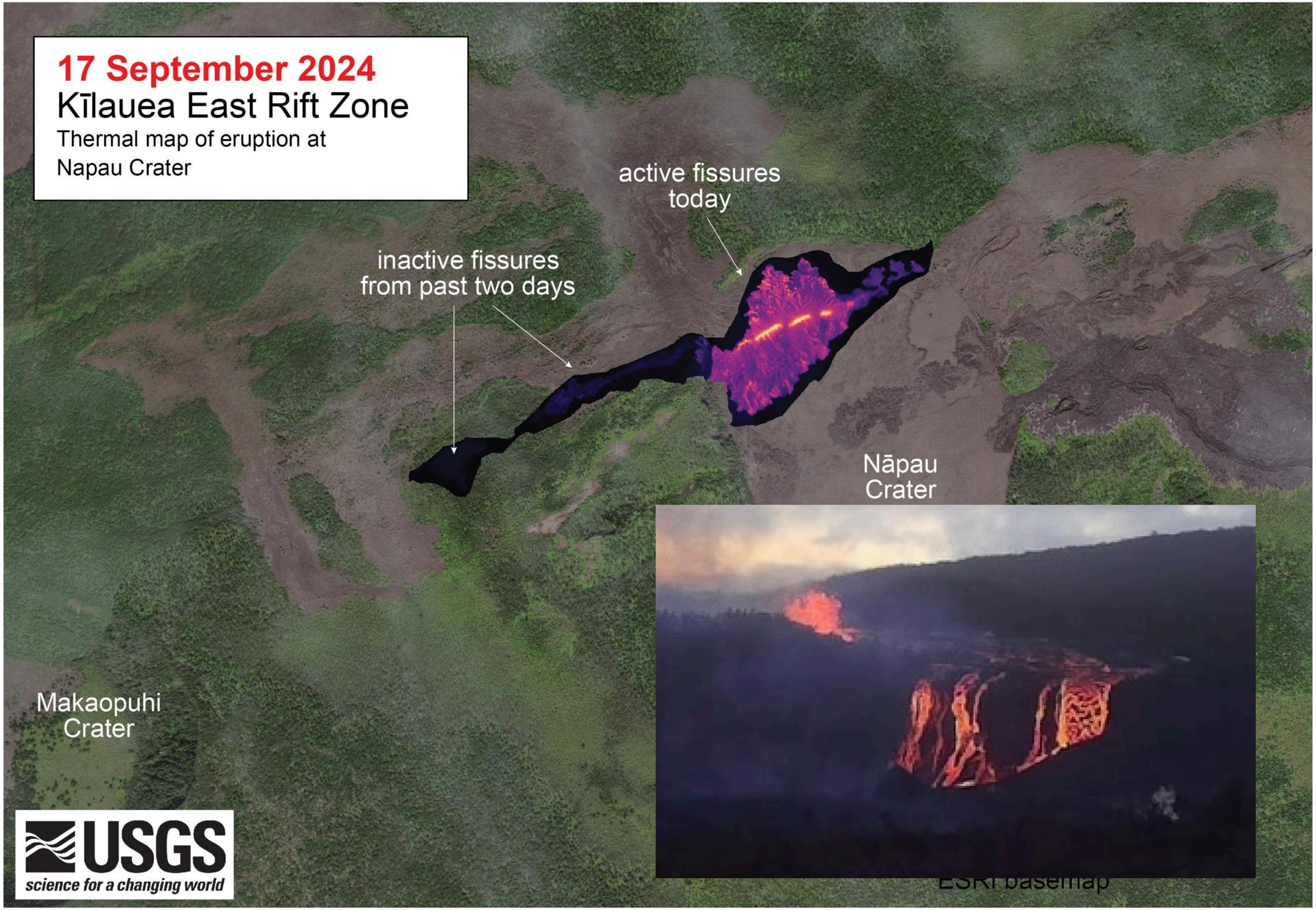
Couple of weeks of unrest

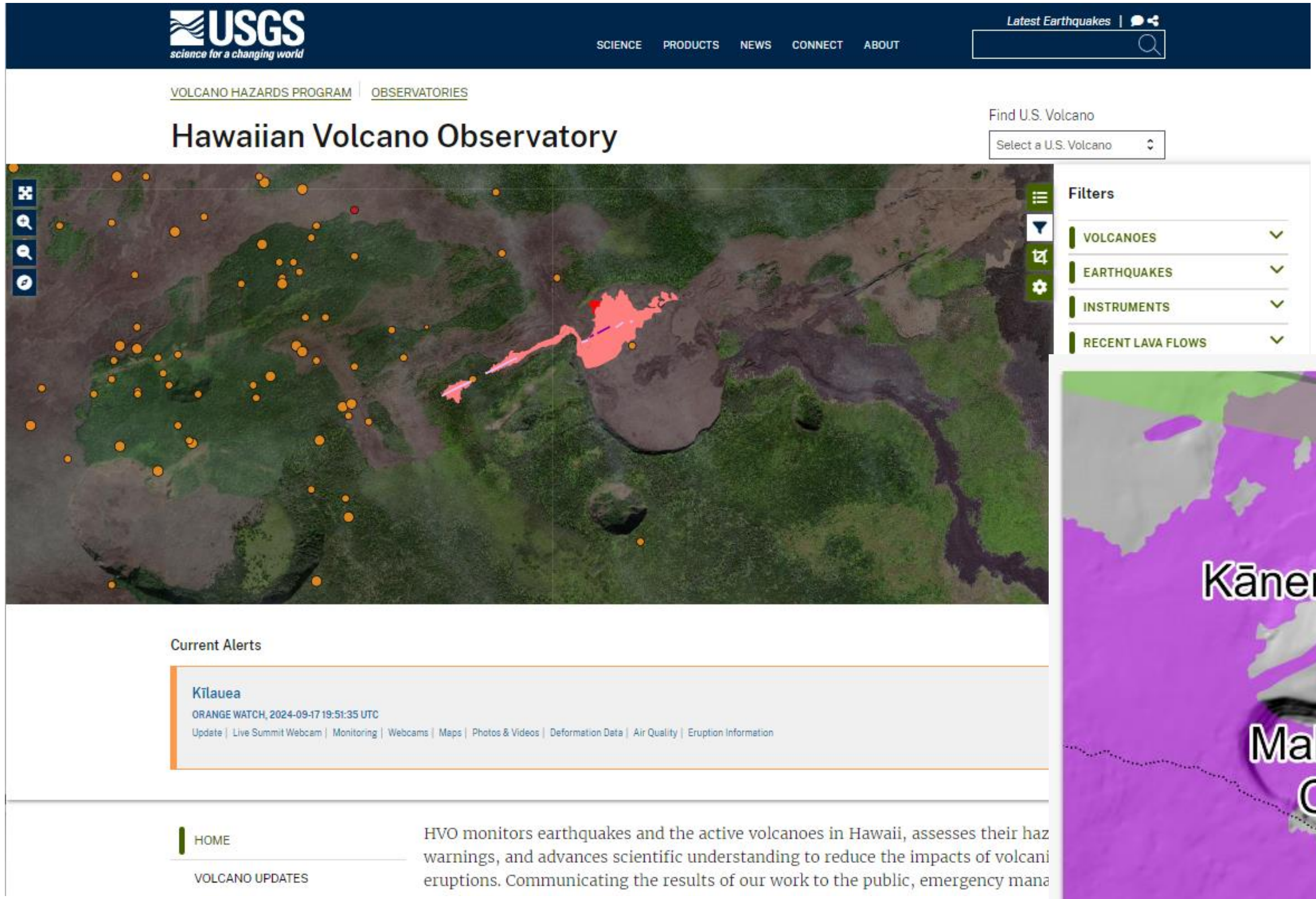


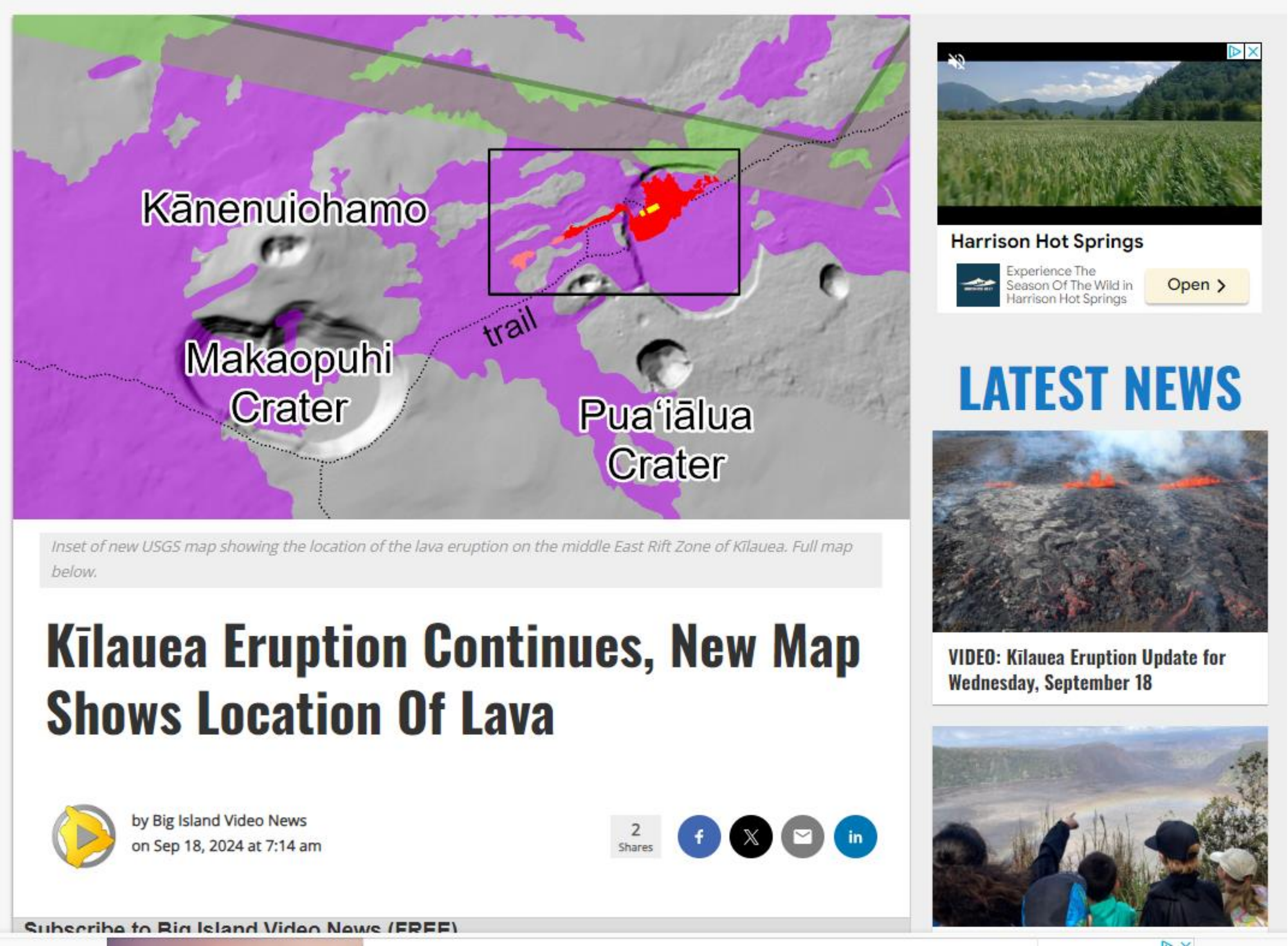





16 September 2
Kīlauea East Rift
Thermal map of two small
erupted on Sep 15.
Makaopuhi
Crater
USGS
science for a changing world


17 September 2024
Kīlauea East Rift Zone
Thermal map of eruption at
Napau Crater
active fissures
today
inactive fissures
from past two days
Nāpau
Crater
Makaopuhi
Crater
USGS
science for a changing world
ESRI basemap



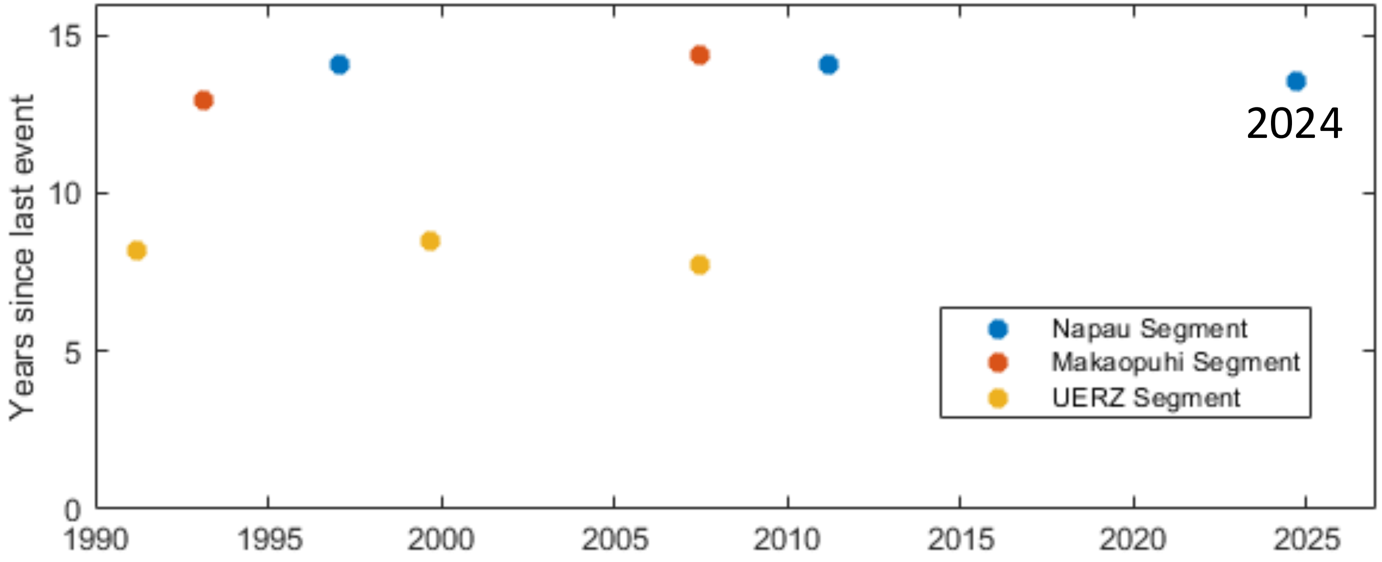


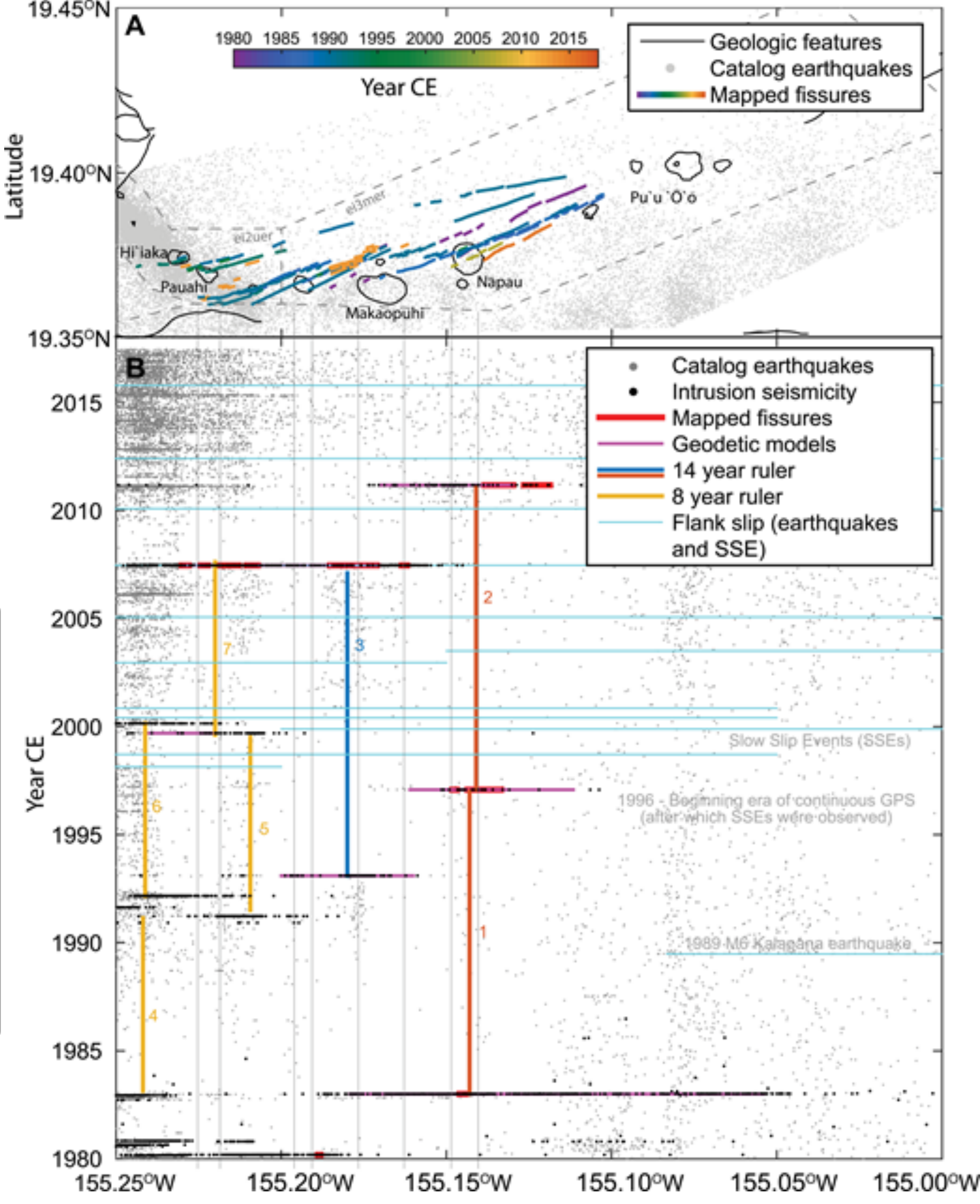
Hawaii-Science Advisory Committee
(The CONVERSE SAC)
Has engaged, but as of yesterday has not had any inquiries.

Periodic Dike Intrusions

Repeat interval of ~14 years on 2 segments, and ~8 years on uprift segments correlated to flank sliding rate.

(Montgomery-Brown and Miklius, *Geology* 2021).





Questions we should answer

- How should we select a chair?
- What should be the meeting cadence?
- Are there priority topics we should cover?
- Should we form subcommittees?
- Should we have additional meeting during the year?
- How should we develop bylaws?
- What is your role?

Questions we should answer cont….

- How to handle tribal issues
- How NVEWS should focus on serving underserved communities- What is NVEWS role related to risk?
- What does a well monitored volcano consist of?
  - How to incorporate remotely senses data into NVEWS?
  - Should there be levels of "done?"
- Advice about prioritization of the focus of NVEWS work given our budget.
  - Areas of possible growth with additional funds- SW/distributed volcanoes, external grants, 24x7 watch office.
  - If we take some of this on now, what do we cut?

Next Steps

Future Meeting Topics

- Meeting with volcano observatory Scientists in Charge
  - Discuss plans post supplemental funds
  - Discuss NVEWS-related challenges and opportunities
  - Current tribal relationships
- Provide details about the options that are being considered for a 24x7 watch office
- NVEWS vulnerabilities
  - Access and logistics issues
  - Depending on instrumentation that is maintained by non-USGS funded organizations
- Monitoring and evaluation of NVEWS
  - Economic impact study of various levels of funding
  - External technical evaluation of NVEWS (as a system or components)
- Learn from other NHMA Programs about coordinating work amongst agencies to arrive at the best science outcomes (e.g. LHP – lahars & debris flows, DOE monitoring seismicity of injection)

Other to dos

- Set up a repository with key documents for review- on FACA website
- Discuss with NOAA Fumes Act group 24x7 watch office lessons learned

Public Comment

Adjournment