



Monitoring Volcanoes: Reducing the Risks of Volcanic Hazards for Society

Hazards Caucus Alliance Briefing

June 25, 2018

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USGS Volcano Hazards Program

Mission: The Volcano Hazards Program (VHP) enhances public safety through forecasts and warnings of volcanic activity.

Core Responsibilities: Hazard assessments, monitoring of potentially active volcanoes, research and communication.

Impact: We give people time to prepare. Information to increase their resilience, and reduce their vulnerability. Volcano emergency response plans developed with stakeholders **well before a volcanic crisis**

Okmok Caldera

July 13, 2008



Photo courtesy of Kelly Reeves, Alaska Airlines

USGS Volcano Hazards Program

Hawaiian Volcano Observatory monitors
Hawaiian volcanoes, Centennial
anniversary in Jan. 2012

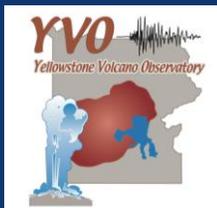


Alaska Volcano Observatory
monitors Alaskan and CNMI
volcanoes

Cascades Volcano Observatory
Monitors WA, OR, ID volcanoes



California Volcano Observatory
monitors CA and NV volcanoes, as
of February 2012.



Yellowstone Volcano Observatory, YNP, ID,
NM, AZ, CO, UT

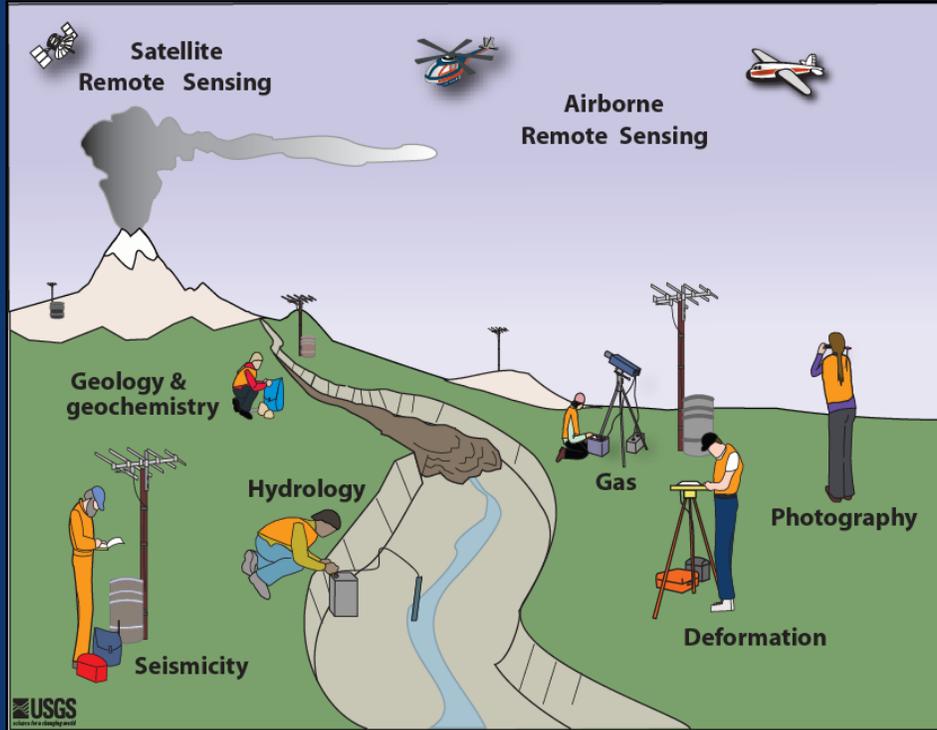
Working “behind the scenes” in the developing world since 1986



- 30 major crisis responses
- Infrastructure in 14 countries

- Contributed to saving 10' s of thousands of lives & 100' s of \$millions

Volcano Monitoring



Ground-based instrumentation is crucial for detection of unrest at the earliest stages. All data available are utilized

Fortunately, volcanoes exhibit precursors typically **weeks to months** before eruption, though some that erupt often can be reactivated quickly (**hrs. – days**)

Precursors include:

- Volcano deformation (inflation)
- Changes in snow or ice cover
- Increased seismicity
- Changes in gas emanation
- Anomalous high temperature pixels in TIR remote sensing imagery from satellites
- Changes in groundwater and stream geochemistry

Gas Emissions

Recent developments in UV/IR cameras and portable multi-gas spectrometers and DOAS scanner networks are making real-time gas flux measurements at active volcanoes a reality.



Dr. Maarten de Moor performing maintenance on one of the NOVAC DOAS scanners installed at Turrialba that OVSICORI uses to monitor SO₂ emissions in real time.



New multi-gas sensor installed at summit of Augustine volcano, Cook Inlet, AK
June 14, 2015

VDAP Response to ongoing volcano crisis at Fuego Volcano, Guatemala

USGS-USAID Volcano Disaster Assistance Program has sent a geophysicist and lahar subject matter expert to Guatemala to assist with lahar awareness, planning and monitoring network design. VDAP staff are working with INSIVUMEH scientists and emergency responders (CONRED) to raise lahar awareness and delineate lahar and pyroclastic flow hazard zones.



Fuego in eruption **Feb. 1, 2018**

Image courtesy of NASA Earth Observatory



1. Volcán de Fuego, or "Volcano of Fire," blows out a thick cloud of ash, as seen from Alotenango, Guatemala, on June 3, 2018. #

Santiago Billy / AP

Fuego in eruption **June 3, 2018** generates deadly pyroclastic flow discharged to the southeast flank of the volcano

Image from Santiago Billy/Associated Press

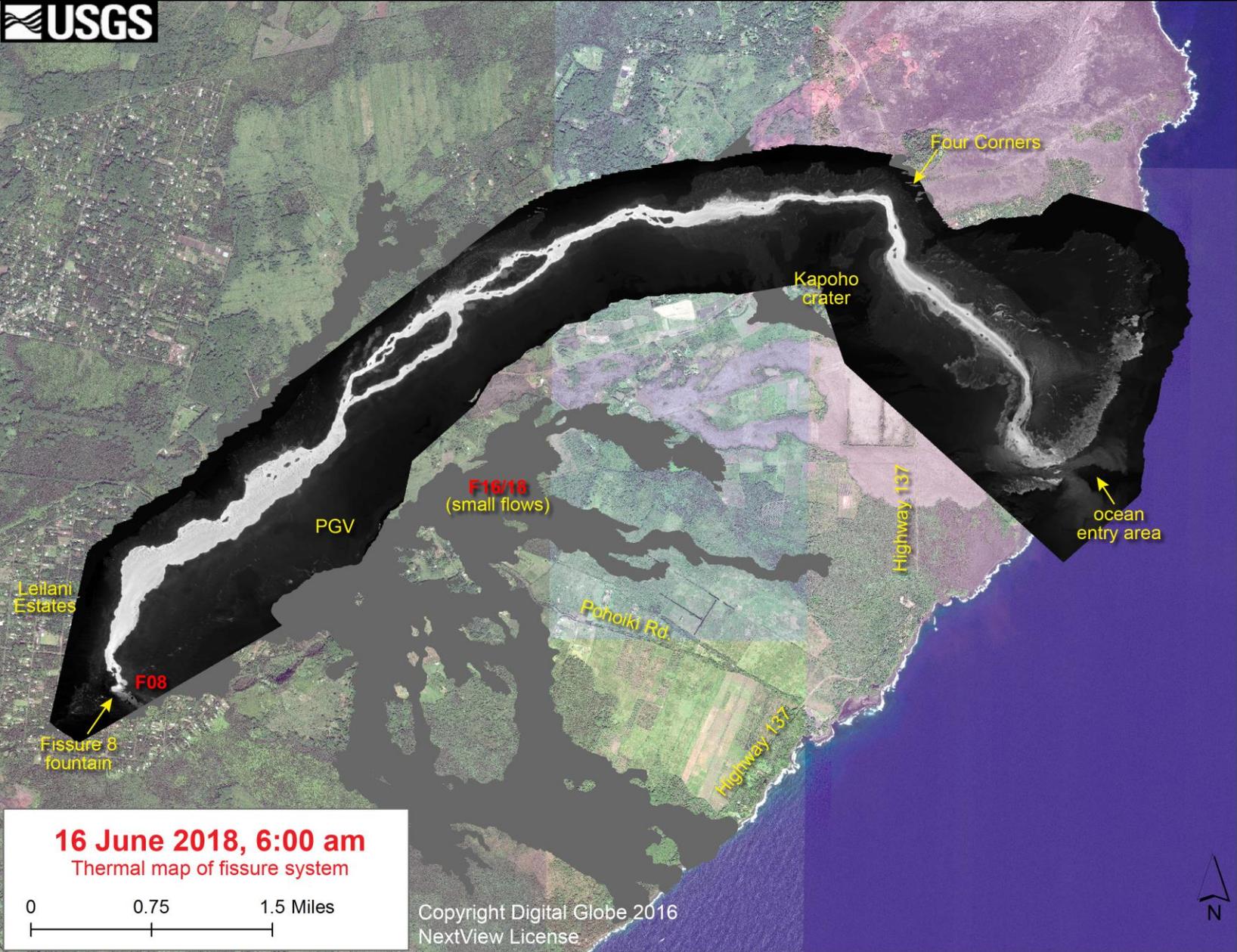
An international team of scientists from INSIVUMEH, University of Edinburgh, Michigan Technological Univ. have generated and distributed preliminary lahar (and pyroclastic flow) hazard maps for moderate and more intense rain activity on June 10, 2018.

Kilauea eruption update

Fissure 8 feeding a channelized lava flow reaching the ocean at Kapoho

Minor oozing of lava at fissures 16/18

At Kilauea summit, seismicity and subsidence continues. Explosions with ash emission to 8000 to 10,000 ft.



USGS Response to Kilauea eruption

- The USGS Hawaiian Volcano Observatory is working closely with Hawai'i County Civil Defense, Hawai'i State Emergency Management, the National Park Service, FEMA and others to prepare for continued outbreak of lava threatening people and developed areas.
- USGS has 24/7 presence in the lava flow areas where USGS geologists and a USGS-OAS Unmanned Aircraft System Team track fissure activity and the advancement of lava flows.
- Sixteen USGS scientists from the other USGS volcano observatories and other USGS centers are on site in Hawaii assisting the Hawaiian Volcano Observatory (HVO).
- Using data from real-time networks of seismometers, tiltmeters, GPS and other instruments, data from satellite, UAS, and field observations, USGS scientists at HVO closely monitor activity for signs that hazardous conditions have increased, or may increase.
- Staff at other USGS volcano observatories are assisting in the response with public affairs, operations, and scientific interpretation. Other USGS staff and resources such as satellite data acquisition, Office of Communications, and supercomputing are assisting.
- USGS has a scientist 24/7 at the County Emergency Operations Center in Hilo. USGS has a mission-assigned subject matter expert to the FEMA Incident Management Assistance Team in Hilo. A second USGS scientist is splitting time between the County's emergency response team and the IMAT. A third scientist is embedded with the County Emergency Operations Center on Oahu.
- The USGS, Hawai'i Volcanoes National Park, and Hawaii County Civil Defense have scheduled daily media briefings. The local, national, and international media interest remains high.
- HVO is communicating with the public concerning the on-going situation through media, fielding direct inquiries, through its website and cooperation with Civil Defense.
 - <https://volcanoes.usgs.gov/observatories/hvo/>

Key Partners

Hawai'i County Civil Defense, Hawai'i State Emergency Management, the National Park Service, FEMA, NOAA/National Weather Service, NASA, U.S. Army Corps of Engineers

What Comes Next ?



- Monitoring data are consistent with continued accumulation of magma within the East Rift Zone. It is unknown whether the flows will continue to advance, or stop, and new lava flows are likely given the rate of activity seen at the rift zone. Additional outbreaks of lava are expected. It is not possible at this time to say when and where new vents may occur. Existing fissures may also be reactivated.
- Lava entrance to the ocean will continue to cause laze plumes (a corrosive mixture of steam, hydrochloric acid and volcanic glass particles) that can irritate the skin eyes, and lungs and make breathing difficult. These plumes need to be avoided at shore and at sea.
- At any time, activity at Kīlauea's summit may again become more explosive, increasing the intensity of ash production and producing ballistic projectiles very near the vent. Communities downwind should be prepared for ashfall as long as this activity continues. Ash could reach altitudes greater than 20,000 ft above sea level and pose a threat to aviation.
- Earthquakes in the summit area continue, as does deflation of the summit region. The earthquakes and ash explosions are occurring as the summit area subsides and adjusts to the withdrawal of magma from the summit.

Thank You! Questions? For more information see: www.volcanoes.usgs.gov

Updates on activity will be posted on the HVO website at <https://volcanoes.usgs.gov/volcanoes/kilauea/status.html>

You can receive these updates by email through a free subscription service: <https://volcanoes.usgs.gov/vns2/>

Resource on volcanic ash hazards: https://volcanoes.usgs.gov/volcanic_ash/ Fissures #2 and #7 in eruption on 5/5/18



Resource on vog: <https://vog.ivhhn.org/>

Hawai'i County Civil Defense will issue its own hazard notices should that become necessary: <http://www.hawaiicounty.gov/active-alerts/>

Hawai'i Volcanoes National Park status is posted on their web page:

<https://www.nps.gov/havo/index.htm>

At Kilauea's summit potential for explosive ash forming eruptions



On May 15, HVO issued a Volcano Observatory Notice for Aviation and raised color code from Orange to Red due to increased intensity of ash emission from Overlook Crater within Halema'uma'u.



Photo of Kilauea's Halema'uma'u crater in eruption May 18, 1924. Photo from northwest rim of Kilauea summit **present site of HVO**



Ash-rich plume on May 16

At 4:15 am HST on May 17 an explosion of a few minutes from Overlook Crater within Halema'uma'u produced an ash plume to **30,000 feet** confirmed by **NOAA/NWS NEXRAD** radar.

Pahala Town Hall Meeting on Ash Fall and Vog



Tina Neal, Scientist-in-Charge of HVO
and David Damby of USGS

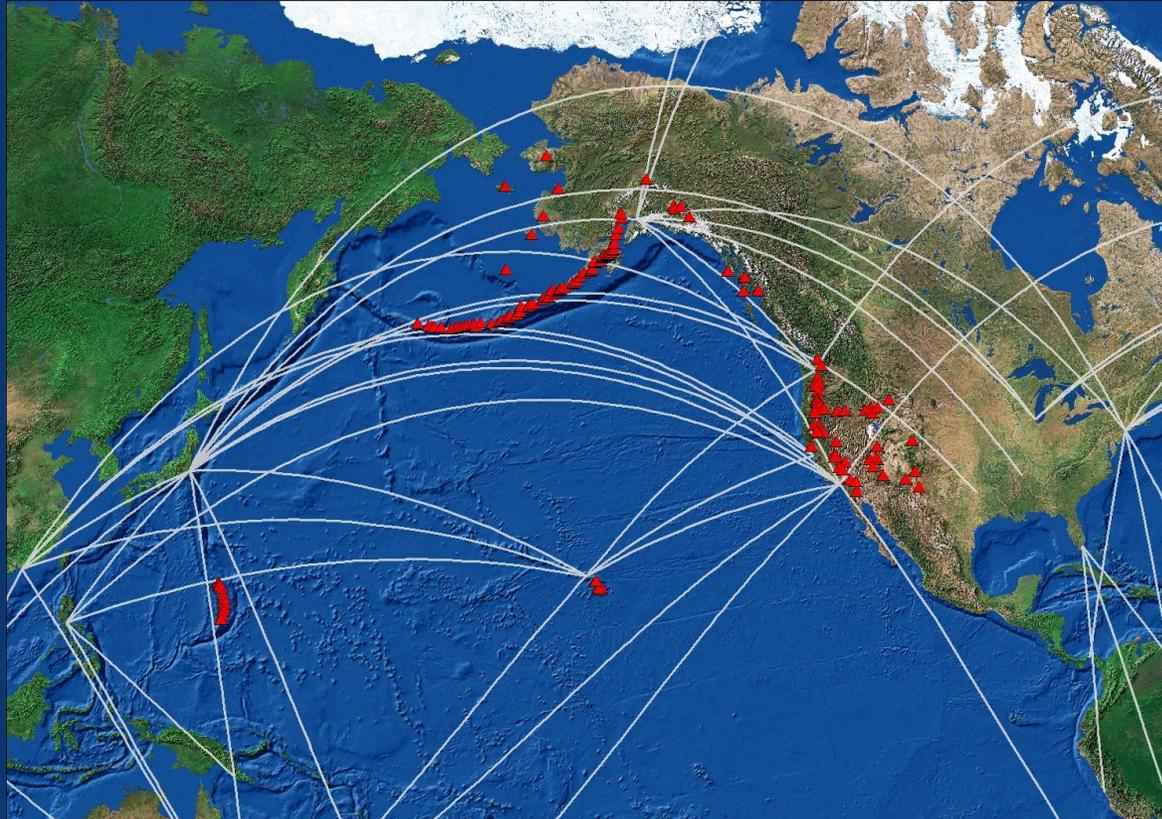


Talmadge Magno, Hawaii County Civil Defense Administrator,
Wendy Stovall of USGS Cascades Volcano Observatory

USGS scientists working with Hawaii County Civil Defense Emergency responders to give the public the information and resources they need to protect themselves from ash fall and vog hazards.

The Need for Volcano Monitoring around the Pacific

- There are ~1550 active volcanoes on Earth and more than 950 of these surround the Pacific Ocean
- Several hundred of these have erupted in historical time



- Pacific rim volcanoes tend to erupt explosively, injecting ash to commercial flight levels
- 61,300 persons travelling over North Pacific air routes daily

UAS flight provides spectacular view inside Halema'uma'u crater

Intense steaming from new collapse pit to north



New cracks and faults reflect ongoing subsidence

Footage shows rubble covered floor from recent wall collapse

Video image May 31, 2018 from USGS UAS OAS Dept. of Interior

Special Thanks to NASA Ames for engineering live video streaming on USGS-OAS UAS