Hawaii's Volcano

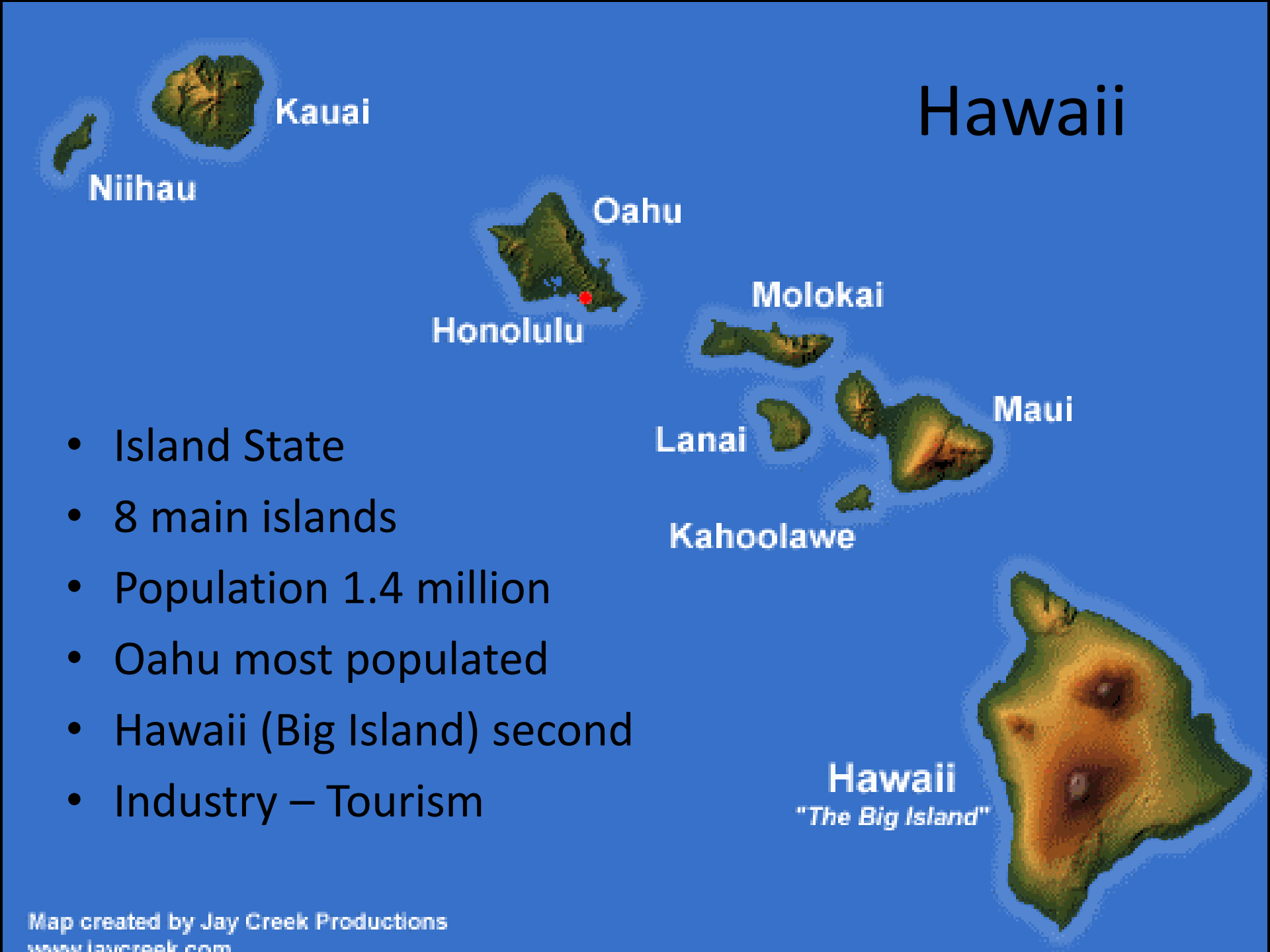
An Ongoing Exceptional Event

Hawaii Department of Health (HDOH)

Clean Air Branch

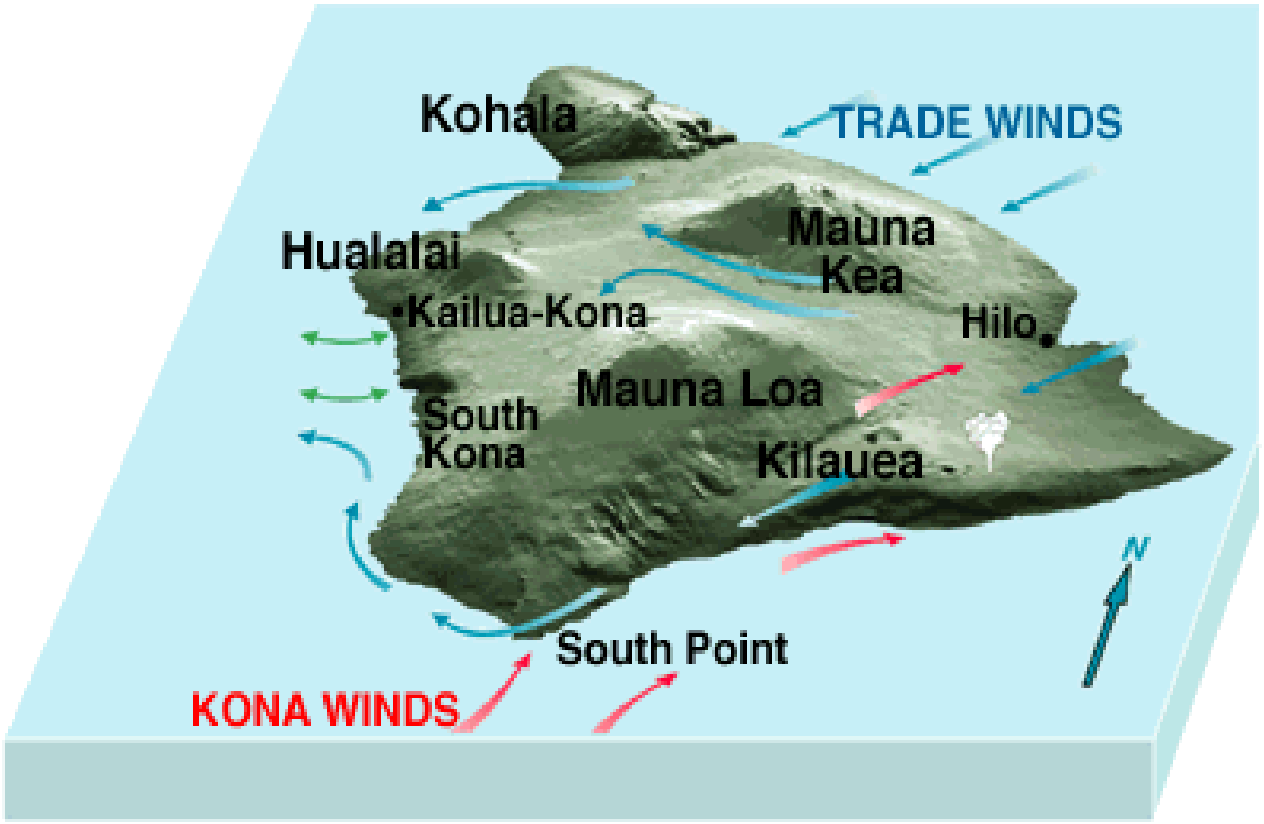
NACAA Cleveland 2018

Hawaii

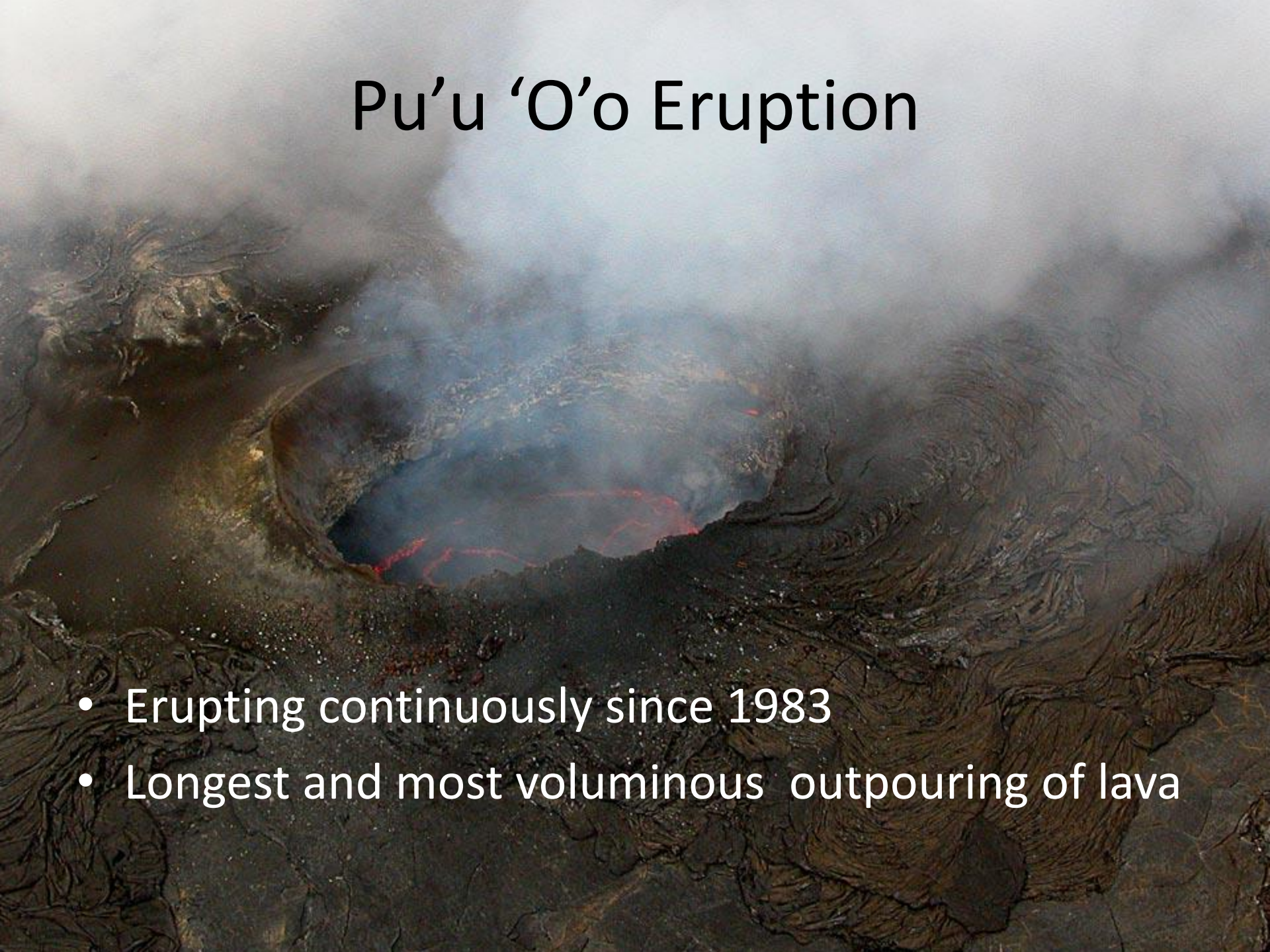


- Island State
- 8 main islands
- Population 1.4 million
- Oahu most populated
- Hawaii (Big Island) second
- Industry – Tourism

How Vog Travels



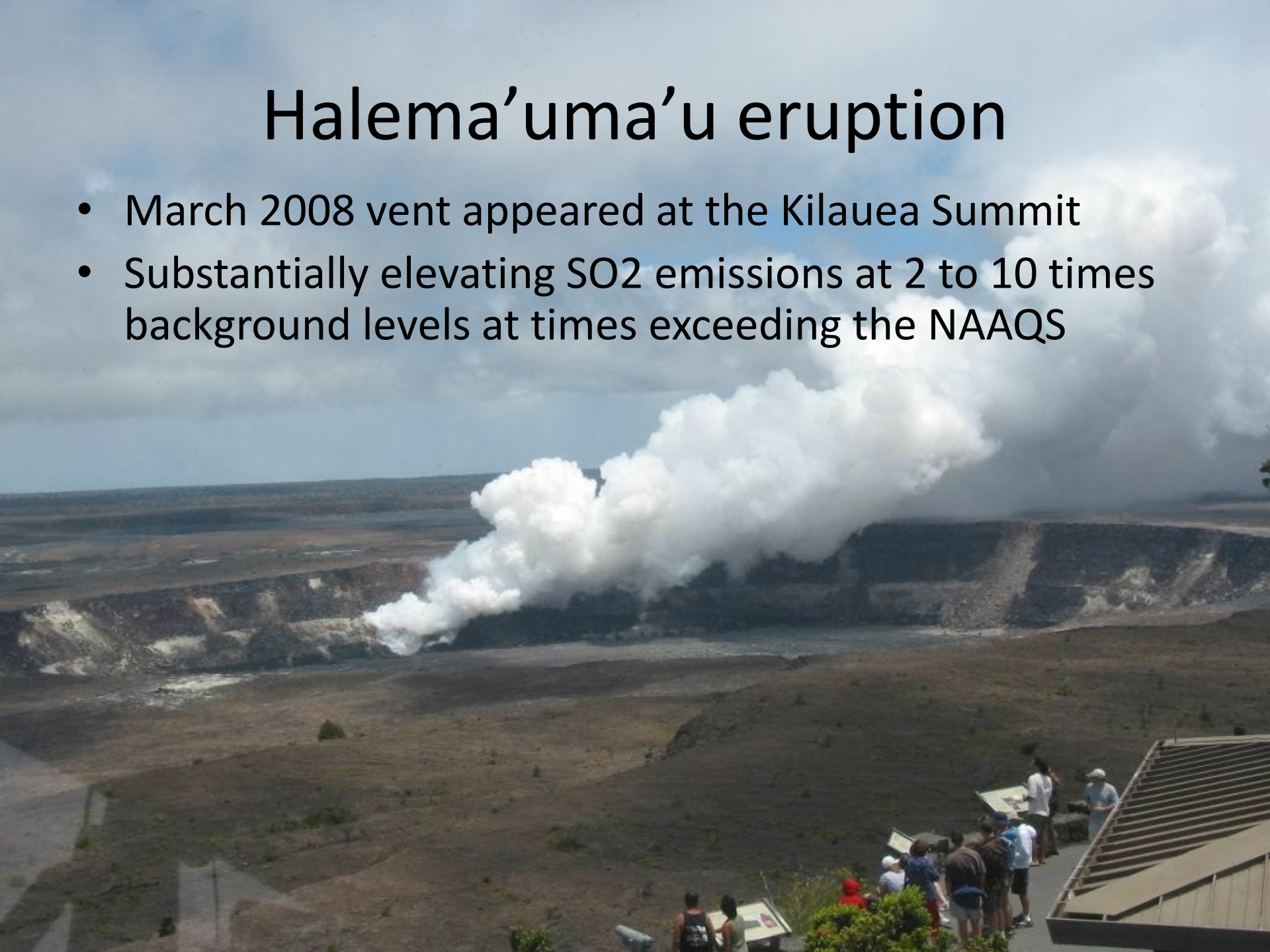
Pu’u ‘O’o Eruption



- Erupting continuously since 1983
- Longest and most voluminous outpouring of lava

Halema’uma’u eruption

- March 2008 vent appeared at the Kilauea Summit
- Substantially elevating SO2 emissions at 2 to 10 times background levels at times exceeding the NAAQS



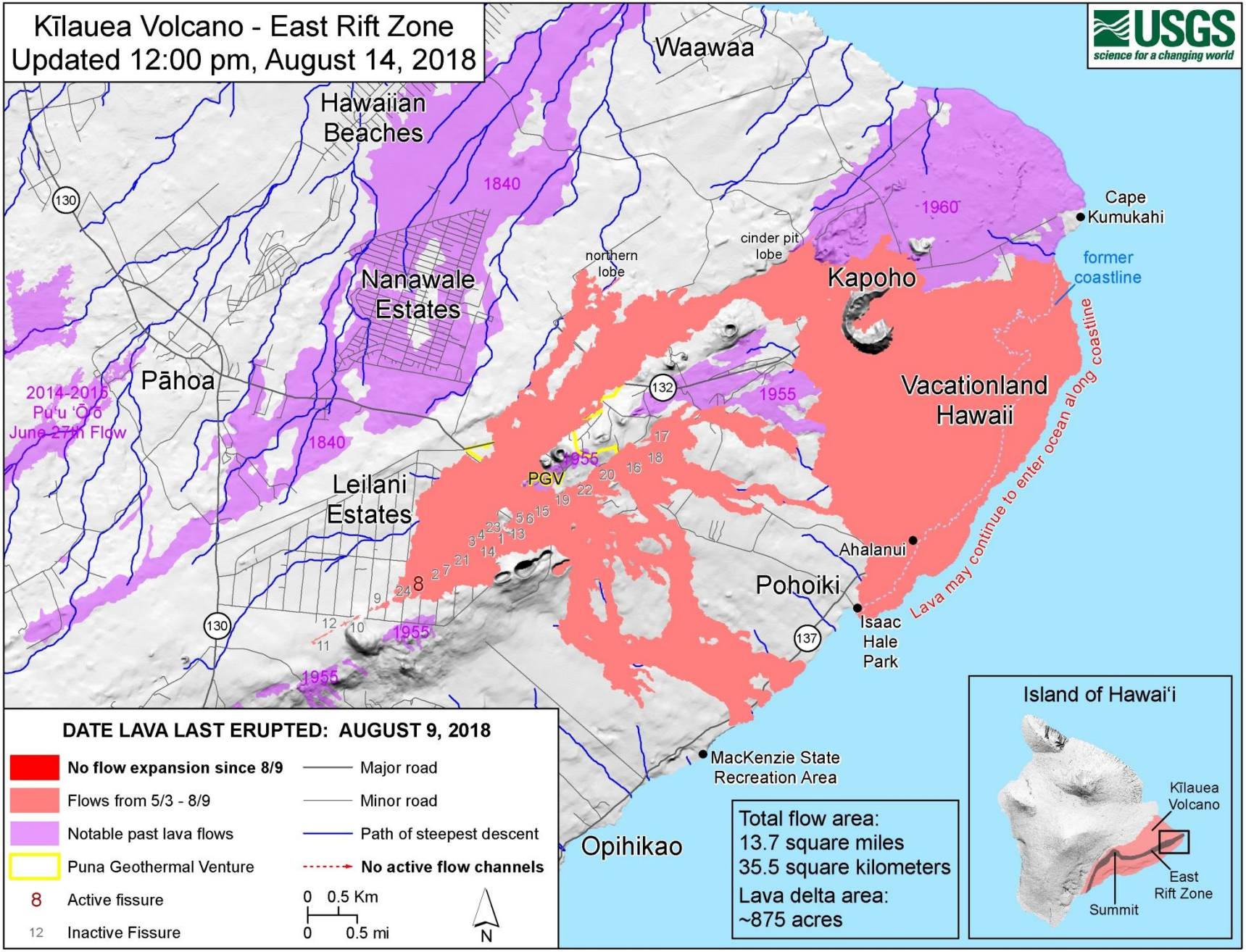
Lower East Rift Zone eruption

- May 2018 – August 2018
- Fissure 8 – Not named yet

Kilauea Volcano Emissions

- Sulfur Dioxide (SO2) emissions were approximately >10,000 tons per day (TPD), at times >50,000 TPD
- Highest SO2 emitter in the state is the HECO Power Plant on Oahu approximately 20 TPD


Kilauea summit is here
Pu'u 'O'o is here
Kīlauea Visitor Center
Kipuka Puaulu
1.2mi 1.9km
Wright Road
Nāmakani Paio
VOLCANO VILLAGE
KĪLAUEA CALDERA
Jaggar Museum
Thurston Lava Tube (Nāhuku)
Crater Rim Drive
Chain of Craters Road
KAHAUALE'A NATURAL AREA RESERVE
KĪLAUEA AREA
See detail map
Lua Manu Crater
Puhimau Crater
1982
Ko'oko'olau Crater
2.0mi 3.2km
Pauahi Crater
WILDERNESS AREA
1969
Pu'u Huluhulu
1.0mi 1.6km
Mauna Ulu Lava Shield
Mauna Ulu
Nāpau Trail
4.0mi 6.4km
Makaopuhi Crater
Kāne Nui o Hamo Lava Shield
1965-68
Nāpau Crater
2.0mi 3.2km
1.2mi 1.9km
Pu'u 'Ō'ō
EAST RIFT ZONE
1977
Kupaianaha Lava Shield
1983-1990s
1974
Cone Crater
4.0mi 6.4km
Hilina Pali Road
Mauna Iki Trail
6.3mi 10.1km
Kīpuka Kahāli'i
1969-74
Mau Loa o Mauna Ulu
2690ft 817m
19mi 29km
Nāulu Trail
2.0mi 3.2km
8.0mi 12.9km
Kalapana Trail
Kalapana Trail may be closed by active lava flows.
VOLCANOES
ONAL PARK
Muliwai a Pele
Kealakomo
1969
Hālōna Kahakai
HŌLEI PALI
Waha'ula Heiau
HILINA PALI
Keauhou Trail
5.0mi 8.0km
4.8mi 7.7km
2.2mi 3.5km
Alanui Kahiko
Hōlei Pali
HŌLEI PALI
0.7mi 1.5km
Pu'u Loa
Road closed by lava flow.
Chain of Craters Road
Hōlei Sea Arch
PU'U'EO PALI
Pu'u Kapukapu
1050ft 320m
1.4mi 2.3km
1.2mi 1.9km
Hilina Pali Trail
1.3mi 2.1km
1.6mi 2.6km
1.6mi 2.6km
2.0mi 3.2km
3.0mi 4.8km
1.4mi 2.3km
Halapē Shelter
Keauhou Shelter
3.1mi 5.0km
5.6mi 10.0km
Puna Coast Trail
Ka'ena Point
Ka'aha Shelter
Āpua Point


Kīlauea Volcano - East Rift Zone
Updated 12:00 pm, August 14, 2018
USGS
science for a changing world
Waawaa
Hawaiian Beaches
1840
Nanawale Estates
Pāhoa
2014-2015 Pu'u 'Ō'ō June 27th Flow
1840
Leilani Estates
130
130
132
137
northern lobe
cinder pit lobe
1960
Cape Kumukahi
former coastline
Kapoho
1955
Vacationland Hawaii
Lava may continue to enter ocean along coastline
PGV
1955
Ahalanui
Pohoiki
Isaac Hale Park
1955
1955
MacKenzie State Recreation Area
Opihikao
DATE LAVA LAST ERUPTED: AUGUST 9, 2018
No flow expansion since 8/9
Flows from 5/3 - 8/9
Notable past lava flows
Puna Geothermal Venture
8 Active fissure
12 Inactive Fissure
Major road
Minor road
Path of steepest descent
No active flow channels
0 0.5 Km
0 0.5 mi
N
Total flow area:
13.7 square miles
35.5 square kilometers
Lava delta area:
~875 acres
Island of Hawai'i
Kīlauea Volcano
East Rift Zone
Summit


Before
Copyright 2014 DigitalGlobe
NextView License


After
0
0.5 Miles
Image ©2018 Planet Labs, Inc., cc-by-sa 4.0

VOG

- Volcanic smog aerosols

  $SO_2 \Rightarrow H_2SO_4 \Rightarrow SO_4 \Rightarrow PM_{2.5}$
- Raymond Chuan study (1997)
  - Leeward side of island
    - Bimodal distribution
      - 1.7 μm, largely sodium sulfate and sodium chloride
      - 0.3 μm, almost entirely sulfuric acid
  - Windward side
    - Unimodal
      - 1.7 μm, dominant species sodium chloride

VOG

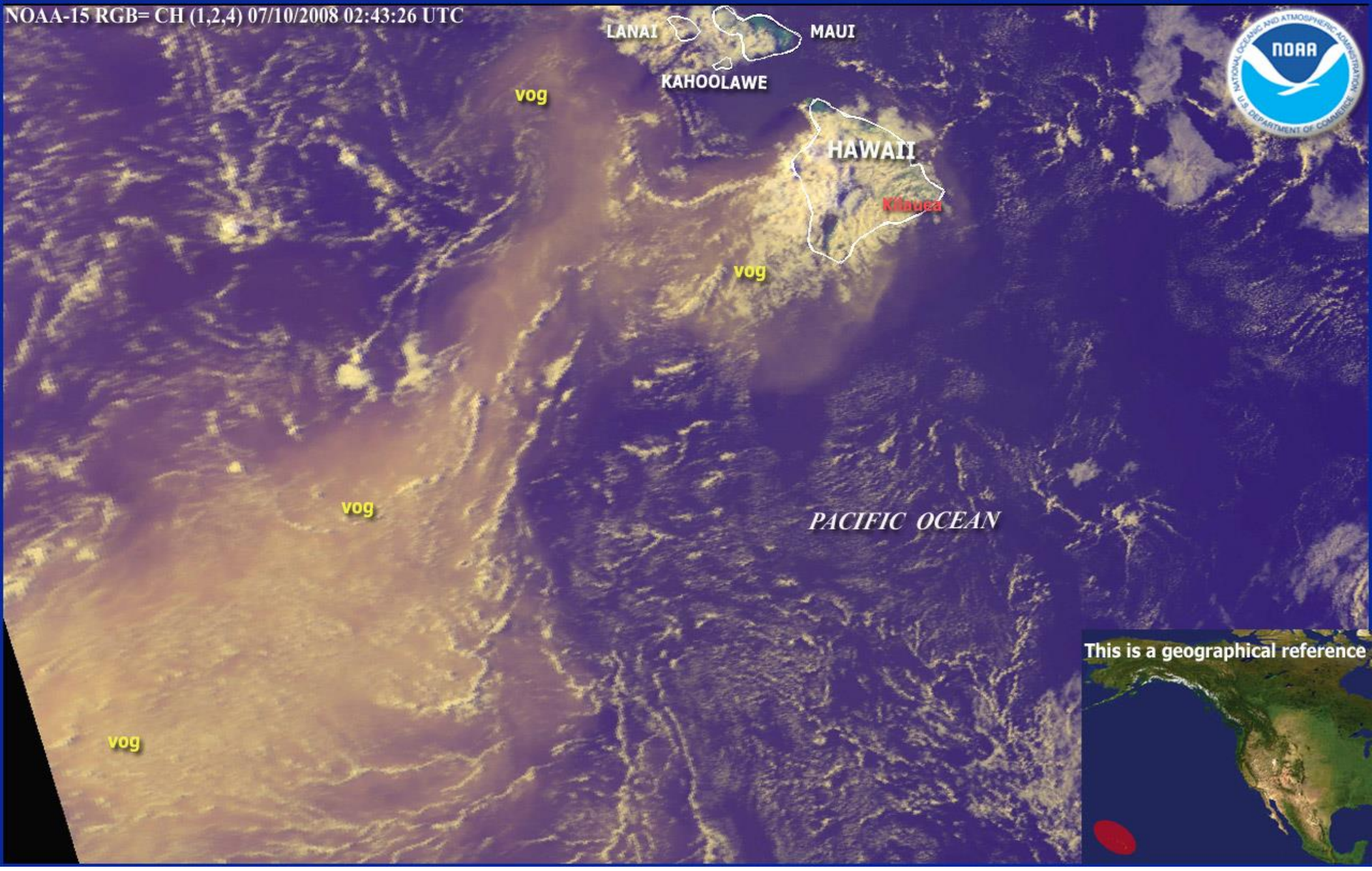
- Volcanic smog
- “Haze” in the air caused by a combination of weather, wind conditions, and volcanic emissions & activity.
- The direction & amount of wind, and other weather conditions affects the consistency of the vog.

This image, taken by the crew of Space Shuttle Atlantis, shows volcanic plumes from Kilauea rising up from Halema‘uma‘u Crater, Pu‘u ‘O‘o vent, and from along the coastline where lava flows from the East Rift zone into the ocean. The plumes have created a blanket of vog over the Big Island of Hawai‘i. May 2009.

NASA STS-125 crew,
NASA Earth Observatory

This NOAA-15 satellite image taken at 0243 UTC on July 10 shows a plume of gases and ash (volcanic smog) to the north and southwest of the Kilauea Volcano which is located at 19.25N 155.16W in the southeastern part of Hawaii's big island.

Credit: NOAA



VOG on Oahu

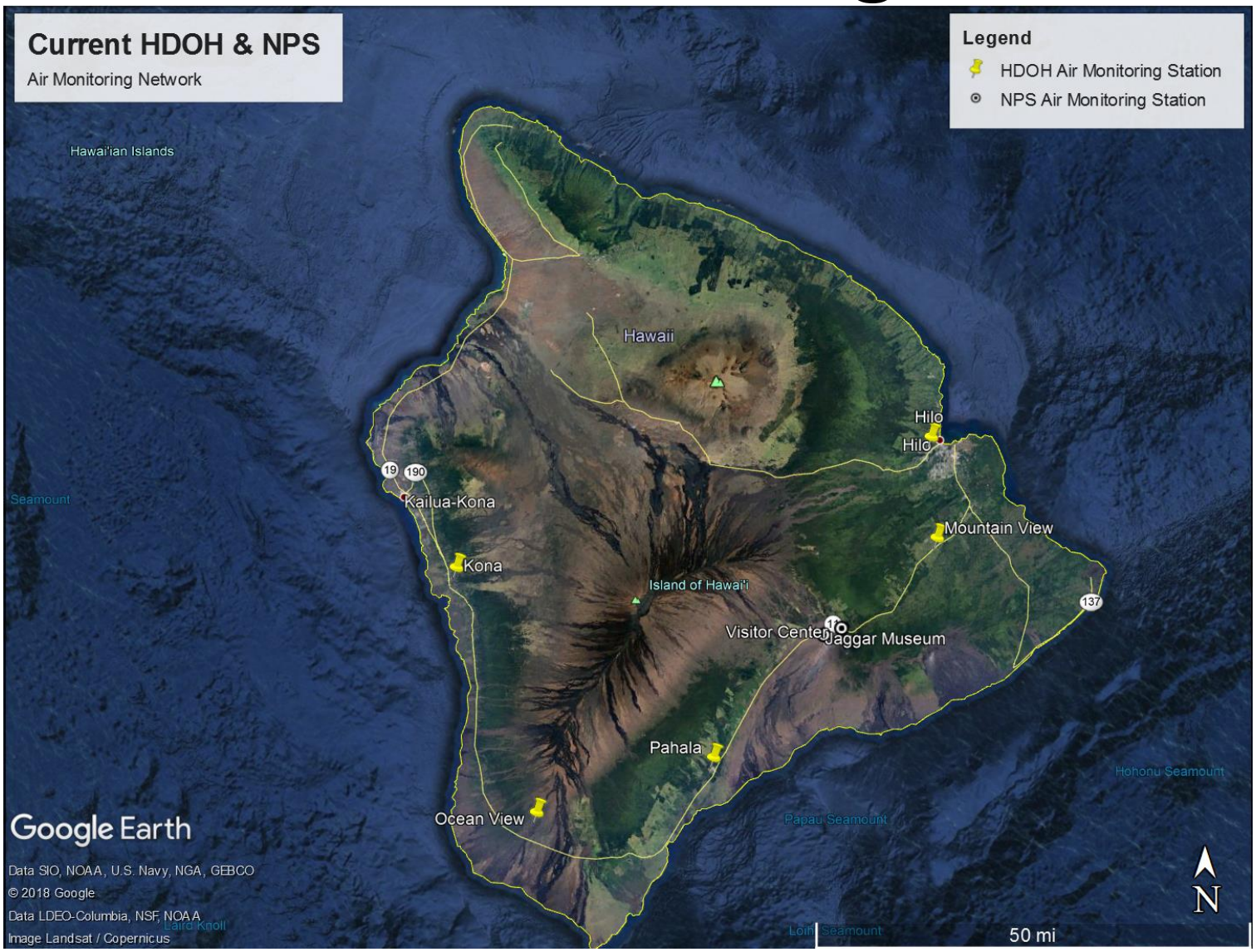





Vog Monitoring

- **Sulfur Dioxide, PM2.5, wind direction and wind speed**
- **HDOH stations located in Kona and Hilo prior to 2008**
- **HDOH added 3 stations located in Mountain View, Ocean View and Pahala after 2008**
- **The stations monitor impacts in areas where the majority of the population live and work**
- **HDOH developed an SO2 Short Term Advisory**
- **The National Park Service (NPS) maintains two stations in the Hawaii Volcanoes National Park (HVNP)**
- **NPS developed their own advisory and website to alert park employees and visitors**

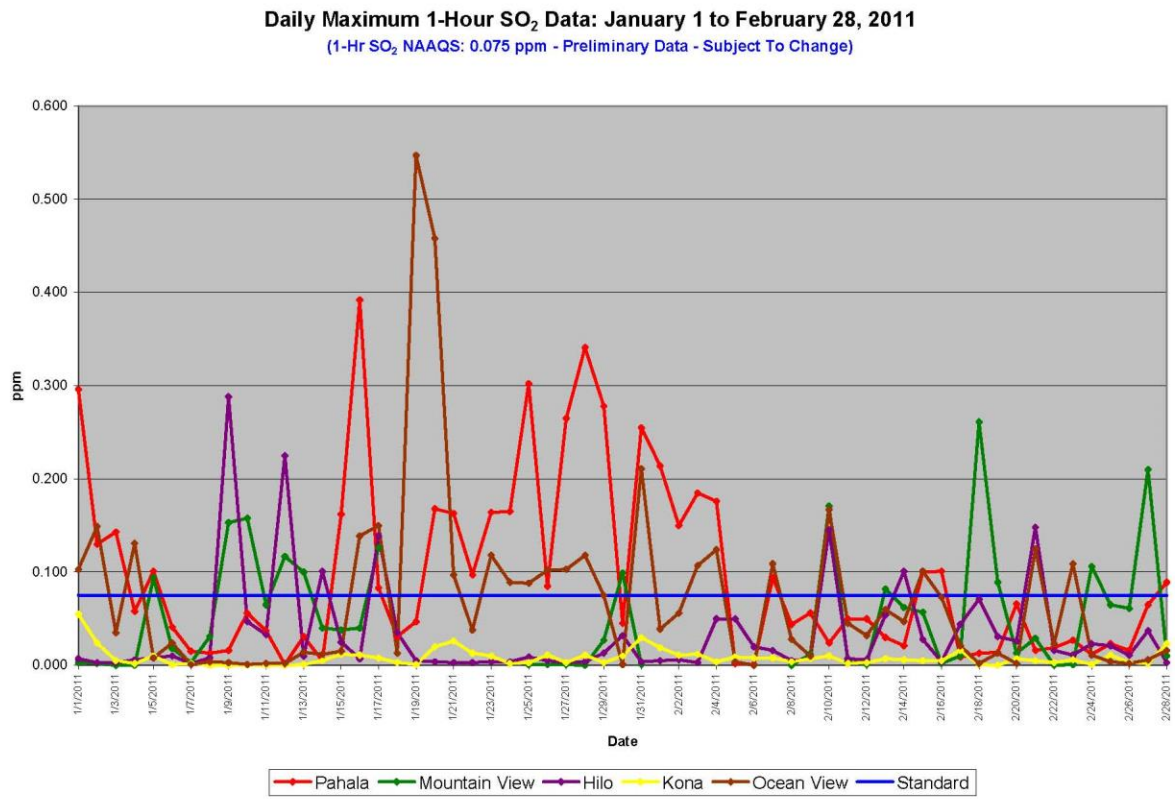
HDOH and NPS Existing Monitors



How people affected?

- Higher levels of sulfur dioxide and fine particulates emissions with possible exceedance of the NAAQS
- Volcanic ash
- Impacts to property, agriculture, and livestock
- Short term and long term health effects
- Increased doctors and hospital visits
- Acid Rain
- Effects on water catchment systems

NAAQS Exceedances



CAB 2/28/11 update

Volcanic Ash

- Ash fall in Hawai‘i was reported in early 2008 in:
  - Pahala
  - Na‘alehu in Ka‘u
- Described as “like dust”
- Larger particles of ash fall closer to the source of the volcanic emission
- Fine particles carry longer distances

Rising plume from a March 2008 Halema‘uma‘u explosion, drifting over the deserted parking lot, which is coated in brown ash.
U.S. Department of Interior, U.S. Geological Survey

Explosion debris on Crater Rim Drive near the Halema‘uma‘u Overlook, March 2008. The largest fragments at this distance from the source vent (~350 m.) are about 2 cm. in diameter. The yellow stripes on the road are barely visible.
U.S. Department of Interior, U.S. Geological Survey

Volcanic Ash Health Issues

A robust, brown, ash-rich plume from Halemaʻumaʻu Crater, drifting over Crater Rim Drive on the Big Island of Hawaiʻi, December 2008.

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

- Short-term exposure to ash can cause eye, nose & throat irritation.
- People with asthma, emphysema, & other respiratory conditions may experience:
  - Runny nose
  - Sore throat
  - Worsening of pre-existing respiratory conditions
  - Difficulty breathing
  - Eye & skin irritation

Lava enters the ocean (LAZE)

Agricultural & Livestock Impacts

Catchment Water Systems & Vog

- Catchment water systems can collect acidic water that can leach harmful contaminants from roofing & plumbing materials.
- Volcanic ash can get into the water, causing contamination, and interfering with common water treatment methods such as filtration and chlorination.
- Homeowners should NOT use catchment water for drinking or preparing food. County water spigots should be used instead.

Lower East Rift Zone Eruption

May 3, 2018

Hawaii County Response

- The County recognized the magnitude of the emission impact requested assistance from the State and Federal Agencies.
- An emergency proclamation was issued
- Emergency responders
- Hazard assessments and surveys
- Evacuations
- Air Monitoring Viewer

Emergency Response Agencies

- Civil Defense
- Hawaii Emergency Management Agency
- District Health Office
- Hazard Evaluation and Emergency Response
- EPA – Emergency Response Team (ERT)
- National Guard and Coast Guard
- Fire Department/Police

Agencies

Local
Hawaii County
Hawaii Fire Department (HFD)
Hawaii Police Department (HPD)
Hawaii County Civil Defense (HCCD)
University of Hawaii
Center for the Study of Active Volcanoes
Hawaii County Data Systems
Public Works

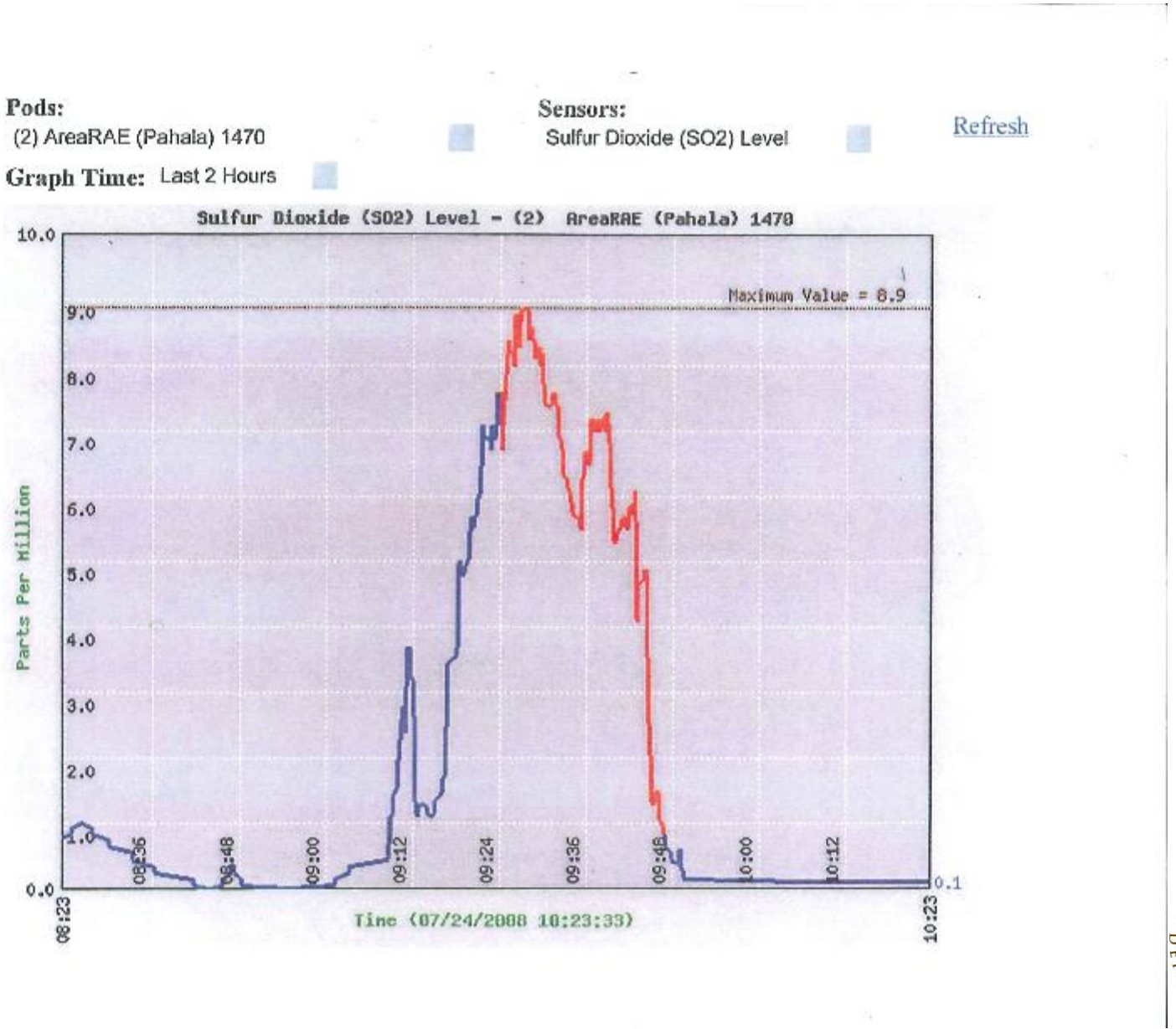
State
93d Civil Support Team (CST)
Hawaii National Guard
State Civil Defense
Hawaii State Laboratories (HSL)
Hilo Hospital
Ka'u Hospital
Pacific Disaster Center (PDC)
Department of Health (DOH)
Hazard Evaluation Emergency Response

Federal
Environmental Protection Agency (EPA)
United States Coast Guard (USCG)
Superfund Technical Assessment and Response Team (START)
Response Engineering and Analytical Contract (REAC)
Federal Fire Department
National Park Service (NPS)
National Oceanic and Atmospheric Administration (NOAA)
National Weather Service (NWS)
Defense Threat Reduction Agency (DTRA)
American Red Cross
United States Public Health Service (USPHS)
United States Geological Service – Hawaii Volcano Observatory (USGS -HVO)
Edgewood Chemical Biological Center

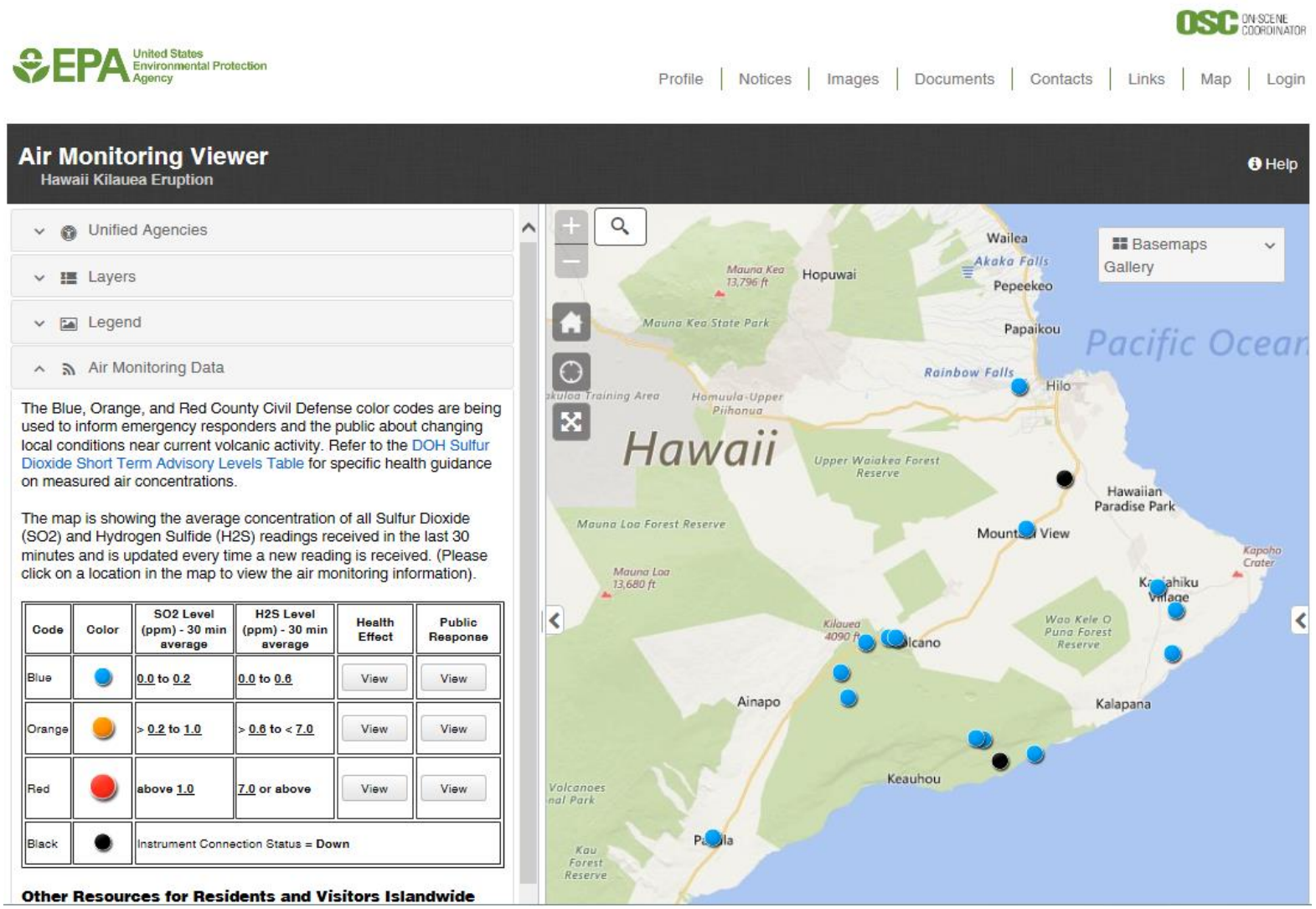
Hazard Survey

- Planned and executed more than 80 Survey missions
- Conducted 18 sorties of air-insertion Surveys to monitor isolated hazard areas
- Deployed strategic network of Area Rae monitors to provide early warning system for residential areas near the volcano
- Provided QRae and Area Rae training to over 50 HFD Hazmat (Train the Trainer)
- Assisted Hawaii County with developing a comprehensive SO2 response plan

Pahala SO_2 Levels (July 24, 2008)



Air Monitoring Viewer



AQI colors

EPA has assigned a specific color to each AQI category to make it easier for people to understand quickly whether air pollution is reaching unhealthy levels in their communities. For example, the color orange means that conditions are "unhealthy for sensitive groups," while red means that conditions may be "unhealthy for everyone," and so on.

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Note: Values above 500 are considered Beyond the AQI. Follow recommendations for the "Hazardous category." Additional information on reducing exposure to extremely high levels of particle pollution is available here.

HDOH and EPA

- Provide assistance to the County
- Deployed portable temporary air monitors (EPA)
- Developed emergency response action levels with input from EPA, Hawaii Poison Center and ATSDR/CDC
- Provide public advisories and information via website, brochures, and community meetings
- Additional ambient air monitoring

Emergency Response - AIR

- Temporary Air Monitoring
  - MIT Sensors for SO2

    9 sensors placed

    approximately 30 additional sensors arriving for various pollutants
  - EPA monitors for SO2, H2S, PM10 and PM2.5
  - Data available to Civil Defense and Hawaii County
  - Borrowed monitors from other states/agencies arriving

Temporary EPA Monitors

- Data used for emergency response efforts in the lower East Rift Zone
- Measures SO2 and hydrogen sulfide (H2S)
- 15 EPA stations
- Majority placed around the active fissure area
- Few placed in the southern and western areas of Hawaii island
- Replaced with DOH owned temporary monitors

Temporary EPA Monitors

HAWAII COUNTY S02 RISK ASSESSMENT AIR MONITORING PLAN

April 24, 2008
(Draft)

Auto Alert to Fire Chief at This Level

Air Quality Monitoring System

MONITOR LOCATION	Status	Agency	Type	S02 Detection
Hilo	active	State DOH	Fixed	≤ 1 PPM
Mt. View	active	State DOH	Fixed	≤ 1 PPM
Leilani (Puna E)	active	State DOH	Fixed	≤ 1 PPM
Pahala	active	State DOH	Fixed	≤ 1 PPM
Kona	active	State DOH	Fixed	≤ 1 PPM
Volcano (proposed)	proposed	State DOH	Fixed	≤ 5 PPM
S. Hilo/Naalehu/HOVE (proposed)	proposed	State DOH	Fixed	TBD
Various Locations (8)	planned	Hawaii County	Semi-mobile Area RAEs	0-20 PPM ± 1 PPM
County Fire Stations	oc active w: ordered	Hawaii	Field Q	0-20 PPM ± 1 PPM

Initial Alert

SO2 Level	Time Wt Ave
0.8 ppm	15 min

Dispatch FD Response Monitoring Crew to Impact Areas

SO2 Level	Time Wt Ave
3.0 ppm	1 hr

Or

SO2 Level	Time Wt Ave
5.0 ppm	15 min

Recommend Evacuation Advisory

DOH Guidance on Short-term Sulfur Dioxide (SO_2) Advisory Levels

SO_2 Conc. (ppm)[1]	Color Code & Air Quality Condition	Air Quality Description	Recommended Action/Activity[2]		
			Sensitive Groups[3]	People Experiencing Health Effects[3]	Everyone Else
>0 – 0.2	Green *(Good)*	Considered satisfactory & poses little or no risk	Highly sensitive individuals may be affected at these levels		Potential health effects not expected
>0.2-0.4	Yellow *(Moderate)*	Acceptable, however, may be moderate health concern for small number of people	Be aware that levels are slightly elevated	If you experience breathing difficulties, such as chest tightness or wheezing, stop activities, use a rescue inhaler and find a place to sit down and rest.	Potential health effects not expected, however actions to reduce exposure to vog may be useful
>0.4 - 1	Orange *(Unhealthy for Sensitive Groups)*	Members in sensitive groups, including healthy individuals with mild asthma, may experience health effects. They may be affected at lower levels than general public. Toward the upper end of this range, most asthmatics who are active outdoors are likely to experience some breathing difficulties. General public not expected to be affected in this range.	Avoid outdoor activities that cause heavy breathing or breathing through the mouth[4]	If you experience breathing difficulties, such as chest tightness or wheezing, stop activities, use a rescue inhaler and find a place to sit down and rest.	Potential health effects not expected, however actions to reduce exposure to vog may be useful
>1 - 3	Red *(Unhealthy)*	Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.	Avoid outdoor activities & remain indoors	Consider leaving the area	Avoid outdoor activities that cause heavy breathing or breathing through the mouth[4]
>3 - 5	Purple *(Very Unhealthy)*	Triggers health alert, meaning everyone may experience more serious health effects.	Avoid outdoor activities & remain indoors	Leave the area & seek medical help	Avoid outdoor activities & remain indoors
> 5	Maroon *(Hazardous)*	Triggers health warnings of emergency conditions. Entire population is more likely to be affected.	Avoid outdoor activities & remain indoors. Leave the area if directed by Civil Defense	Leave the area & seek medical help	Avoid outdoor activities & remain indoors. Leave the area if directed by Civil Defense

10/29/08

http://www.hiso2index.info/assets/FinalSO2Exposurelevels.pdf

Schools affected by the Vog

- Provide portable SO2 monitors
- Email alerts from HDOH stations
- Developed an action plan
- Shelter in Place

SULFUR DIOXIDE ACTION PLAN

CONDITION	SCHOOL ACTION
Green *Good* 0.0 – 0.2 ppm	1) Maintain normal school operations 2) Monitor air quality 3) Notify healthroom if staff/students are in need of medical attention 4) Affected staff/students will be evaluated by school health aide with reference to Respiratory Action Plan (RAP)
Yellow *Moderate* 0.2 – 0.4 ppm	1) Maintain normal school operations 2) Monitor air quality 3) Notify healthroom if staff/students are in need of medical attention 4) Affected staff/students will be evaluated by school health aide with reference to Respiratory Action Plan (RAP) 5) Updates will be made every hour or as needed
Orange *Unhealthy for Sensitive Groups* 0.4 – 1.0 ppm	1) Limit outdoor exposures by conducting indoor activities (Recess, PE) 2) Conduct Shelter in Place Procedures 3) Monitor air quality 4) Notify healthroom if staff/students are in need of medical attention 5) Affected staff/students will be evaluated by school health aide with reference to Respiratory Action Plan (RAP) 6) Updates will be made every hour or as needed
Red *Unhealthy* 1.0 – 3.0 ppm	1) Limit outdoor exposures by conducting indoor activities (Recess, PE) 2) Monitor air quality 3) Notify healthroom if staff/students are in need of medical attention 4) Affected staff/students will be evaluated by school health aide with reference to Respiratory Action Plan (RAP) 5) Updates will be made every hour or as needed
Purple *Very Unhealthy* 3.0 – 5.0 ppm	1) Conduct Shelter in Place (School-Wide Safer Room Procedure) 2) Monitor air quality 3) Notify healthroom if staff/students are in need of medical attention 4) Affected staff/students will be evaluated by school health aide with reference to Respiratory Action Plan (RAP) 5) Updates will be made every hour or as needed 6) Communicate with district office on current conditions and next steps
Maroon *Hazardous* 5.0+ ppm	1) Conduct Shelter in Place (School-Wide Safer Room Procedure) 2) Monitor air quality 3) Notify healthroom if staff/students are in need of medical attention 4) Affects staff/students will be evaluated by school health aide with reference to Respiratory Action Plan (RAP) 5) Updates will be made every hour or as needed 6) Communicate with district office on current conditions and next steps

- Conditions are continuously monitored by the School Safety Manager and/or Vice Principal. Condition reports are made to the Principal.
- When SO2 elevated levels lasts for more than 30 minutes, appropriate actions are taken.
- Teachers and staff should continuously monitor reactions to Vog/SO2

Vog: Headache, breathing difficulties, increased respiratory ailments, watery eyes, sort throat

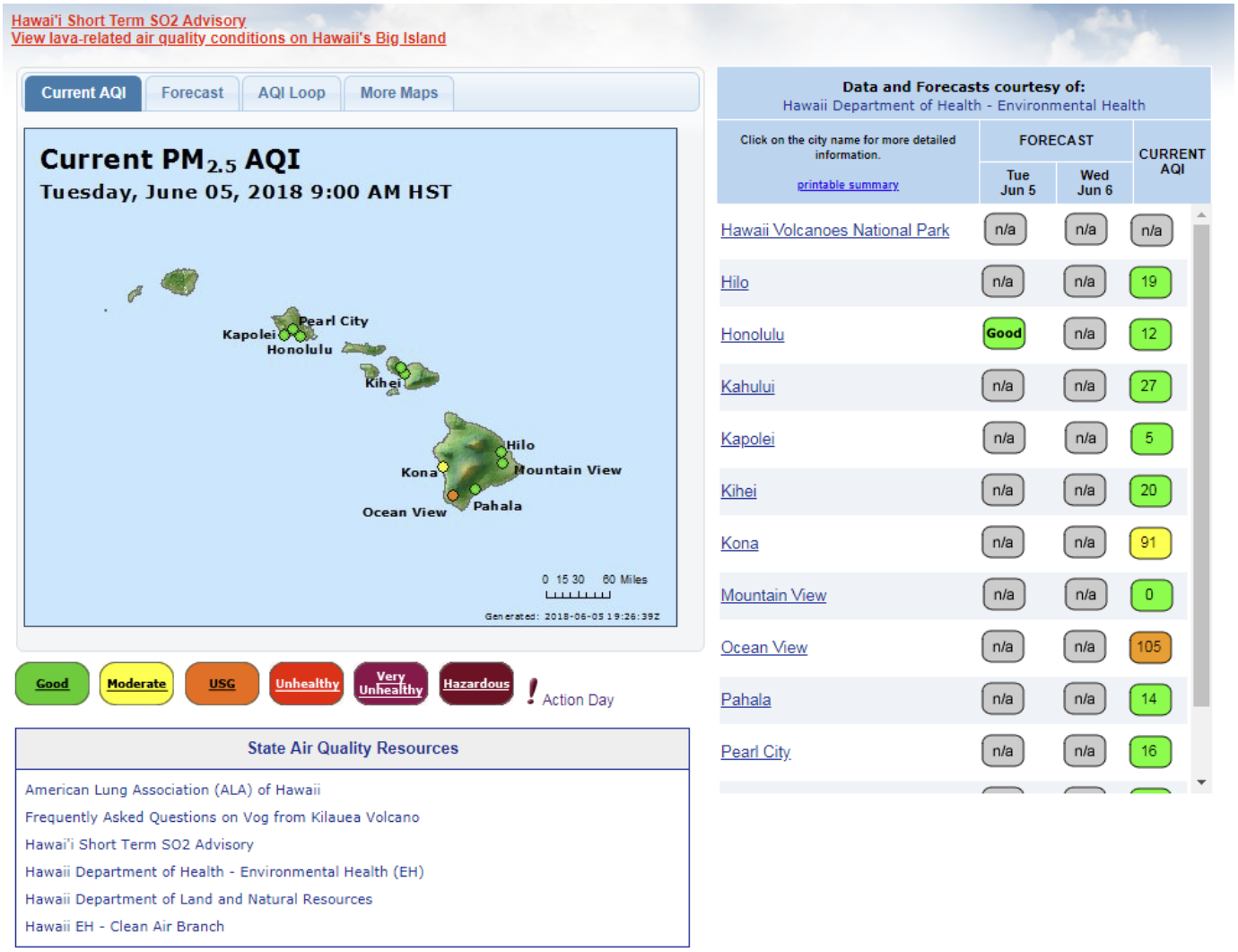
Sulfur Dioxide: Irritation to eyes, nose, throat and respiratory tract, burning eyes, coughing, difficulty in breathing, tightness in chest

v. KKPSO2.2 - DRAFT

Advisory System

- Established station alarm to alert Hawaii County Civil Defense and schools
- HDOH dissemination of the monitored results to the public through websites, text or email notifications
- PM2.5 Air Quality Index on EPA AirNow website
- Hawaii SO2 Advisory
- Hawaii Ambient Air Quality

AirNow


Hawai'i Short Term SO2 Advisory
View lava-related air quality conditions on Hawaii's Big Island
Current AQI
Forecast
AQI Loop
More Maps
Current PM2.5 AQI
Tuesday, June 05, 2018 9:00 AM HST
Pearl City
Kapolei
Honolulu
Kihei
Hilo
Kona
Mountain View
Ocean View
Pahala
0 15 30 60 Miles
Generated: 2018-06-05 19:26:39Z
Good
Moderate
USG
Unhealthy
Very Unhealthy
Hazardous
Action Day
State Air Quality Resources
American Lung Association (ALA) of Hawaii
Frequently Asked Questions on Vog from Kilauea Volcano
Hawai'i Short Term SO2 Advisory
Hawaii Department of Health - Environmental Health (EH)
Hawaii Department of Land and Natural Resources
Hawaii EH - Clean Air Branch
Data and Forecasts courtesy of:
Hawaii Department of Health - Environmental Health
Click on the city name for more detailed information.
printable summary
FORECAST
Tue Jun 5
Wed Jun 6
CURRENT AQI
Hawaii Volcanoes National Park n/a n/a n/a
Hilo n/a n/a 19
Honolulu Good n/a 12
Kahului n/a n/a 27
Kapolei n/a n/a 5
Kihei n/a n/a 20
Kona n/a n/a 91
Mountain View n/a n/a 0
Ocean View n/a n/a 105
Pahala n/a n/a 14
Pearl City n/a n/a 16

Message on AirNow page

Air Quality Information for Hawaii Residents and Visitors

The Hawaii Department of Health reports that vog conditions may increase and fluctuate in various areas of the state as the eruption of Kilauea volcano continues. Vog is a hazy mixture of sulfur dioxide gas (SO2) and fine particles (PM2.5) emitted from an erupting volcano.

If you are a Hawaii resident or visitor, stay tuned to and follow directions provided by Hawaii County public officials and emergency personnel.

Here are several resources for learning about Hawaii air quality conditions:

- **Hawaii Interagency Vog Information Dashboard** www.ivhhn.org/vog/ This site provides comprehensive information on vog and SO2.
- **Hawaii Short Term SO_2 Advisory**: http://www.hiso2index.info/
- **Hawaii outdoor quality data** https://emdweb.doh.hawaii.gov/air-quality/
- **VMAP Vog Measurement and Prediction Project** at http://mkwc.ifa.hawaii.edu/vmap/hysplit
- **AirNow information from real time PM2.5 monitors in Hawaii:** https://www.airnow.gov/index.cfm?action=airnow.local_state&stateid=12&mapcenter=0&tabs=0

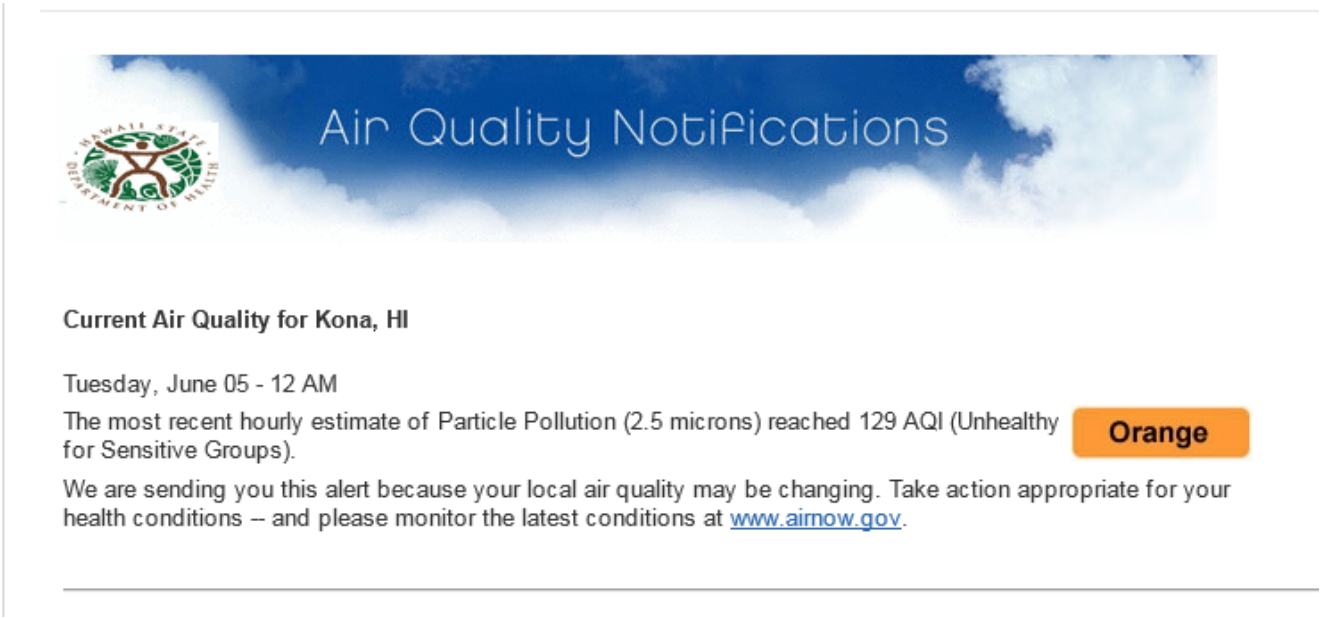
The Department of Health has advised residents and visitors to be prepared and aware of the surrounding conditions, and how they feel or may react to vog in the air

Here are some precautionary measures to take in the event of vog conditions:

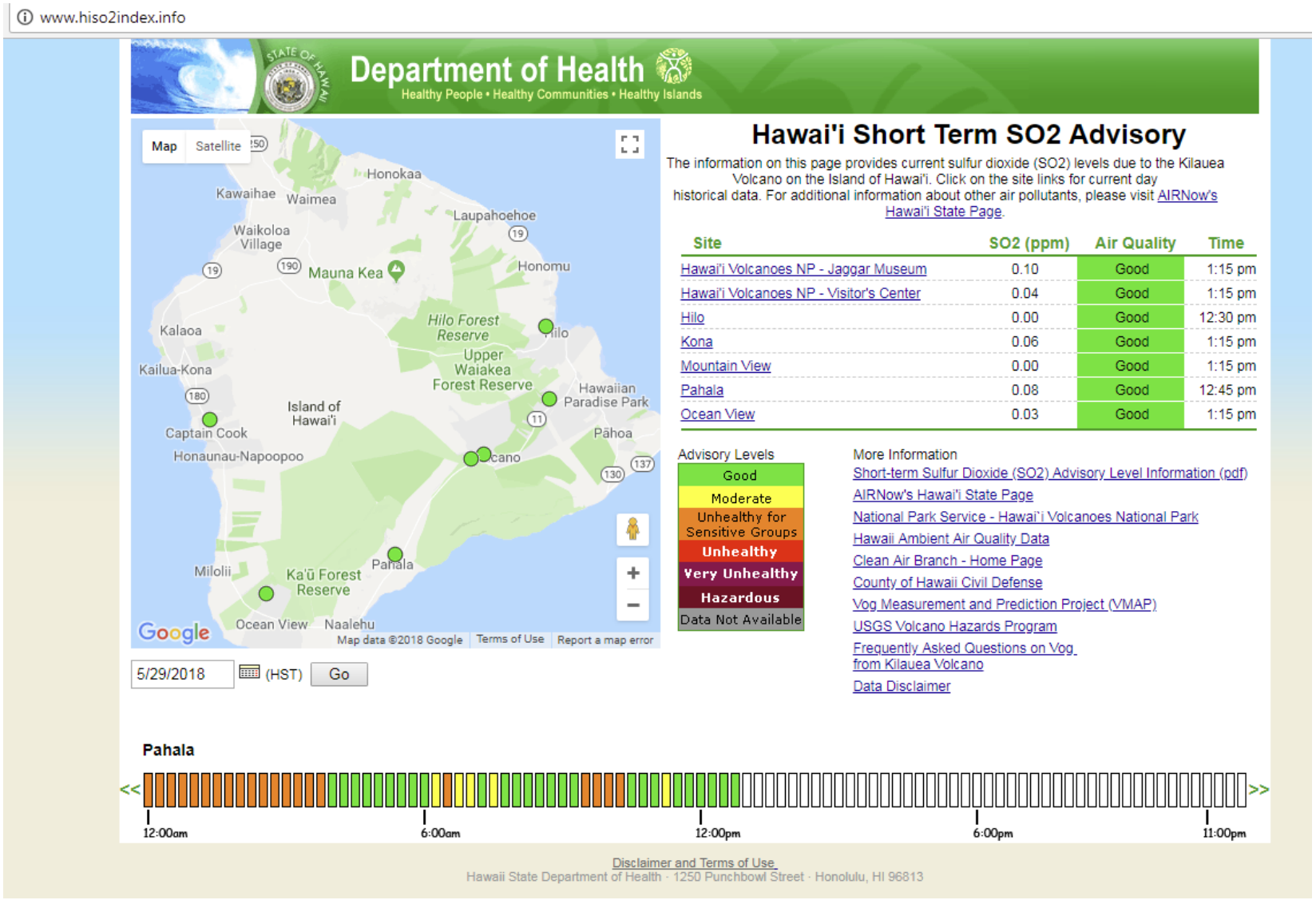
- Reduce outdoor activities that cause heavy breathing. Avoiding outdoor activity and exercise during vog conditions can reduce exposure and minimize health risks. This is especially important for sensitive groups such as children, the elderly, and individuals with pre-existing medical conditions such as asthma, bronchitis, emphysema or heart disease.
- Stay indoors and close windows and doors. If an air conditioner is used, set it to recirculate.
- Always keep medications on hand and readily available. Daily prescribed medications should be taken on schedule.
- Contact a doctor as soon as possible if any health problems develop.
- Do not smoke and avoid second-hand smoke.
- Drink plenty of fluids to avoid dehydration.
- Have family emergency plans prepared and ready.

AirNow EnviroFlash

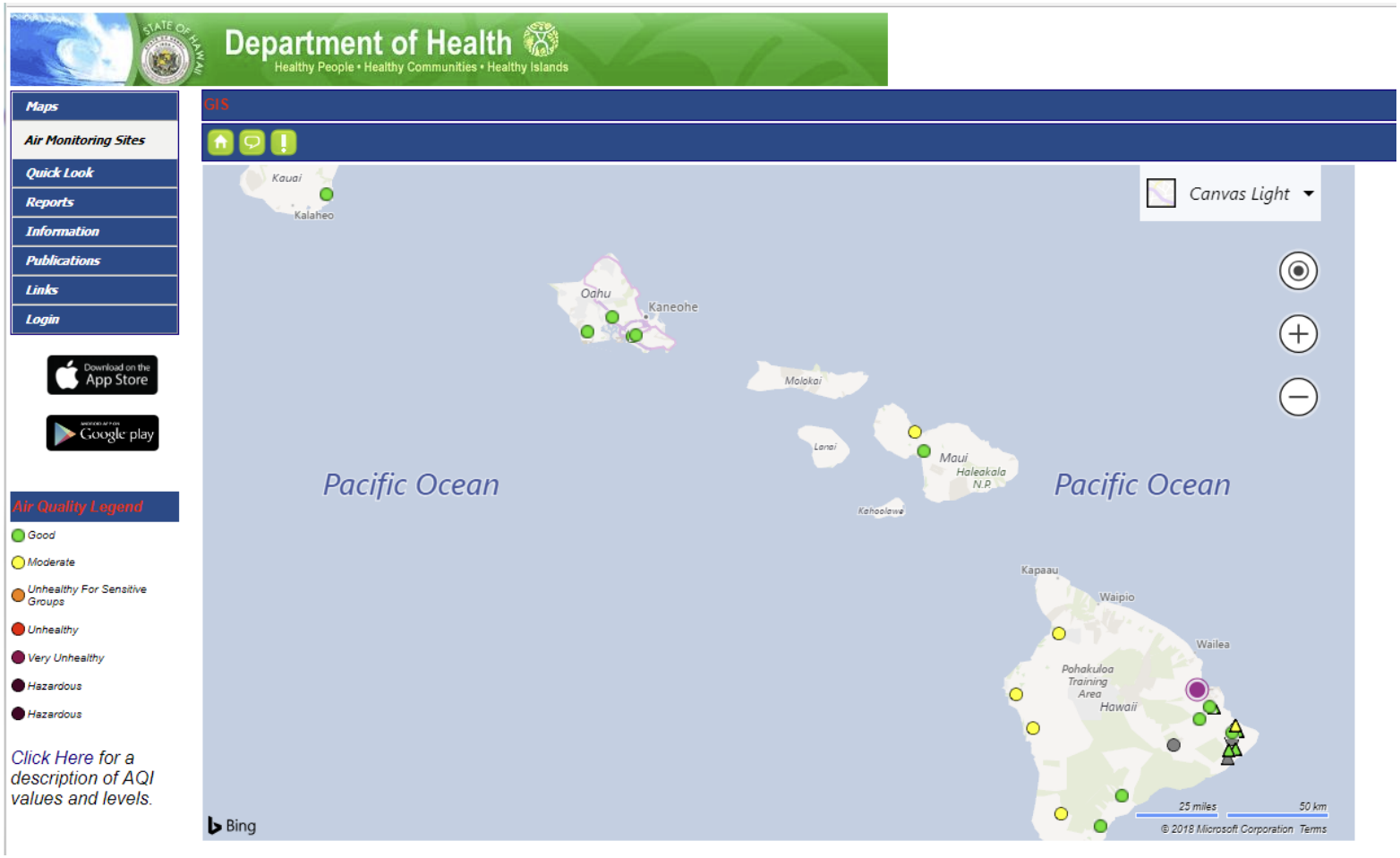
- Email notifications
- Subscribe at http://www.enviroflash.info/



Hawaii SO2 Advisory



Hawaii Ambient Air Quality



VMAP

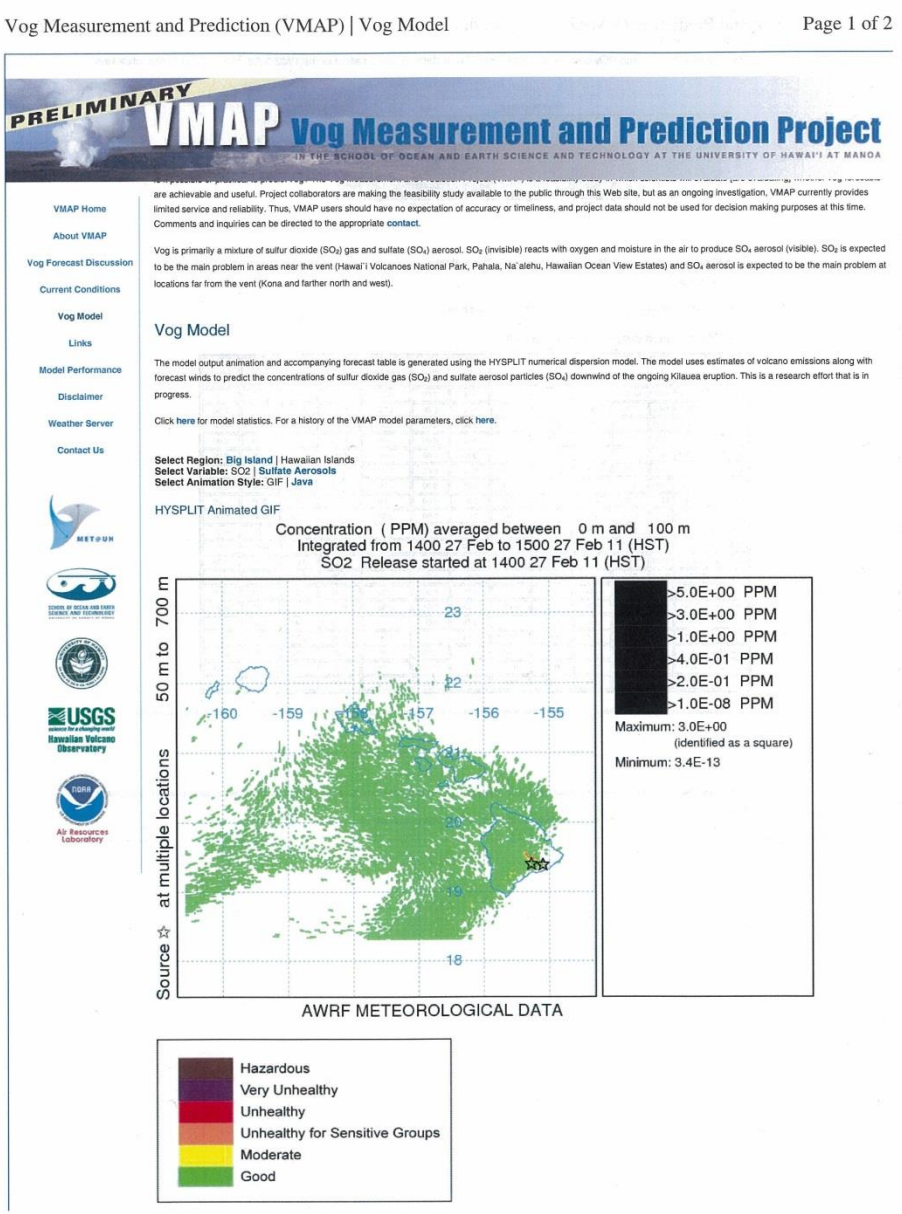
Vog Measurement and Prediction Project

- **University of Hawaii at Manoa**
  - Steven Businger, PI, Dept. of Meteorology
  - Keith Horton, CO PI, Hawaii Institue of Geophysics and Planetology
  - Roy Huff, Dept. of Meteorology
- **Collaborators**

  Jeff Sutton, USGS Hawaiian Volcano Observatory

  Tamar Elias, USGS Hawaiian Volcano Observatory

  Roland Draxler, NOAA Air Resources Laboratory



Air Quality Data on the Internet

- Hawaii Short Term SO2 Advisory:
- http://www.hiso2index.info/
- AIRNow's Hawaii State Page: http://airnow.gov/now.local_state&stateid=12&tab=0
- National Park Service – Hawaii Volcanoes National Park: http://www.nature.nps.gov/air/WebCams/parks/havoso2alert/havoalert.cfm
- Hawaii Ambient Air Quality Data: http://emdweb.doh.hawaii.gov/air-quality/
- Vog Measurement and Prediction Project VMAP: http://mkwc.ifa.hawaii.edu/vmap/hysplit/

Hawaii Interagency Vog Information Dashboard

General Information

- Hawaii Interagency Vog Information Dashboard: http://vog.ivhhn.org
- National Park Service for park closures and advisories www.nps.gov/havo/closed-areas.htm
- County of Hawaii Kilauea Eruption Update http://lavainfo.us
- Hawaii county civil Defense for current information, advisory or message http://co.hawaii.hi.us/cd/message.htm
- American Lung Association of Hawaii http://www.ala-hawaii.org/

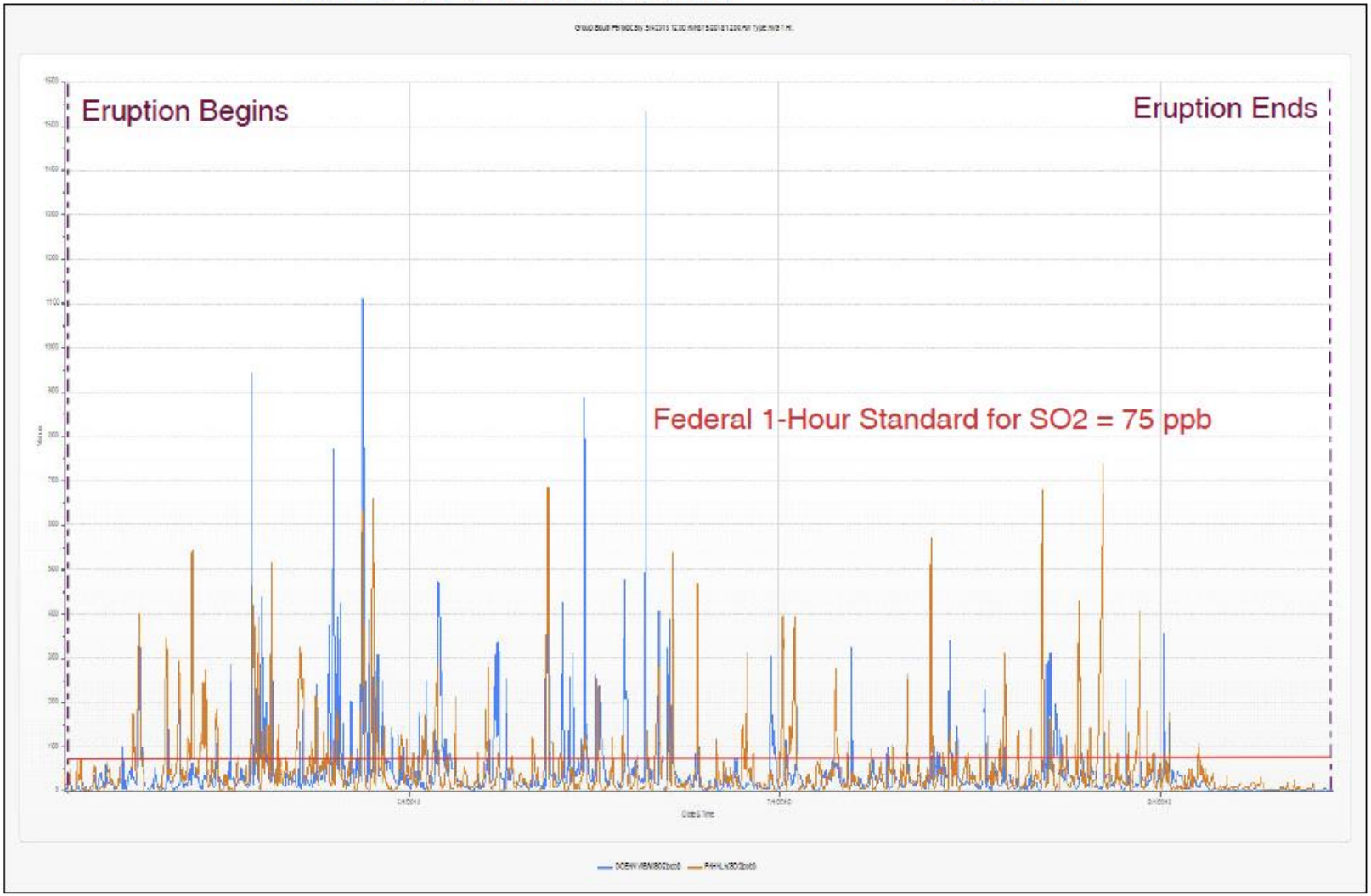
Ambient Air Monitoring

Existing HDOH and NPS Monitors

- 5 HDOH and 2 NPS monitoring stations
- Measures sulfur dioxide (SO2) and particulates (PM2.5)
- Located in Kona, Hilo, Ocean View, Pahala, Mountain View and the Volcano National Park
- Data available on websites
- Puna station was taken by the lava

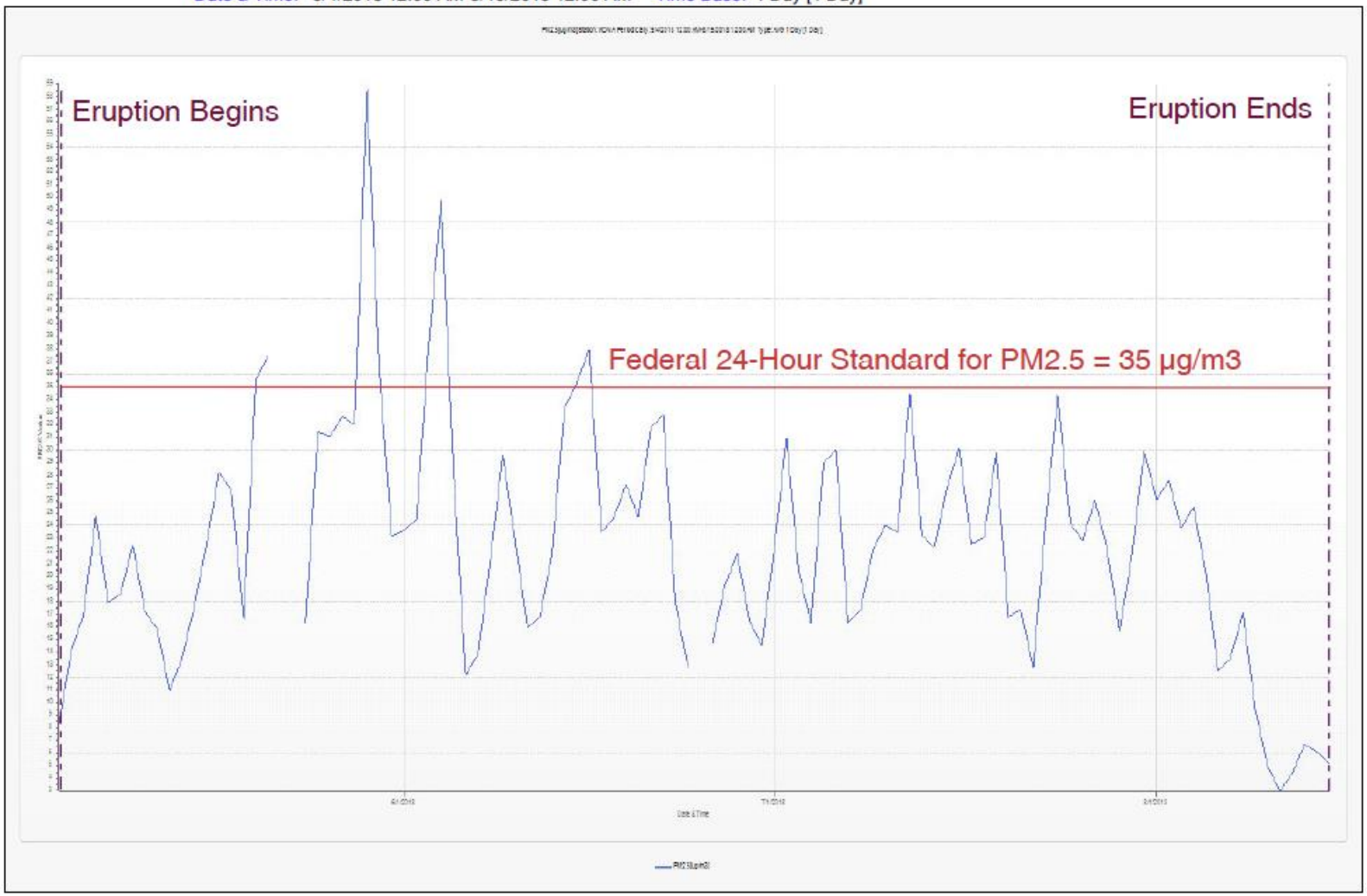
Pahala and Oceanview SO2

Group: South Periodically: 5/4/2018 12:00 AM-8/15/2018 12:00 AM Type: AVG 1 Hr.
Report Type: Group South
Date & Time: 5/4/2018 12:00 AM-8/15/2018 12:00 AM
Avg Type: AVG
Time Base: 1 Hr.



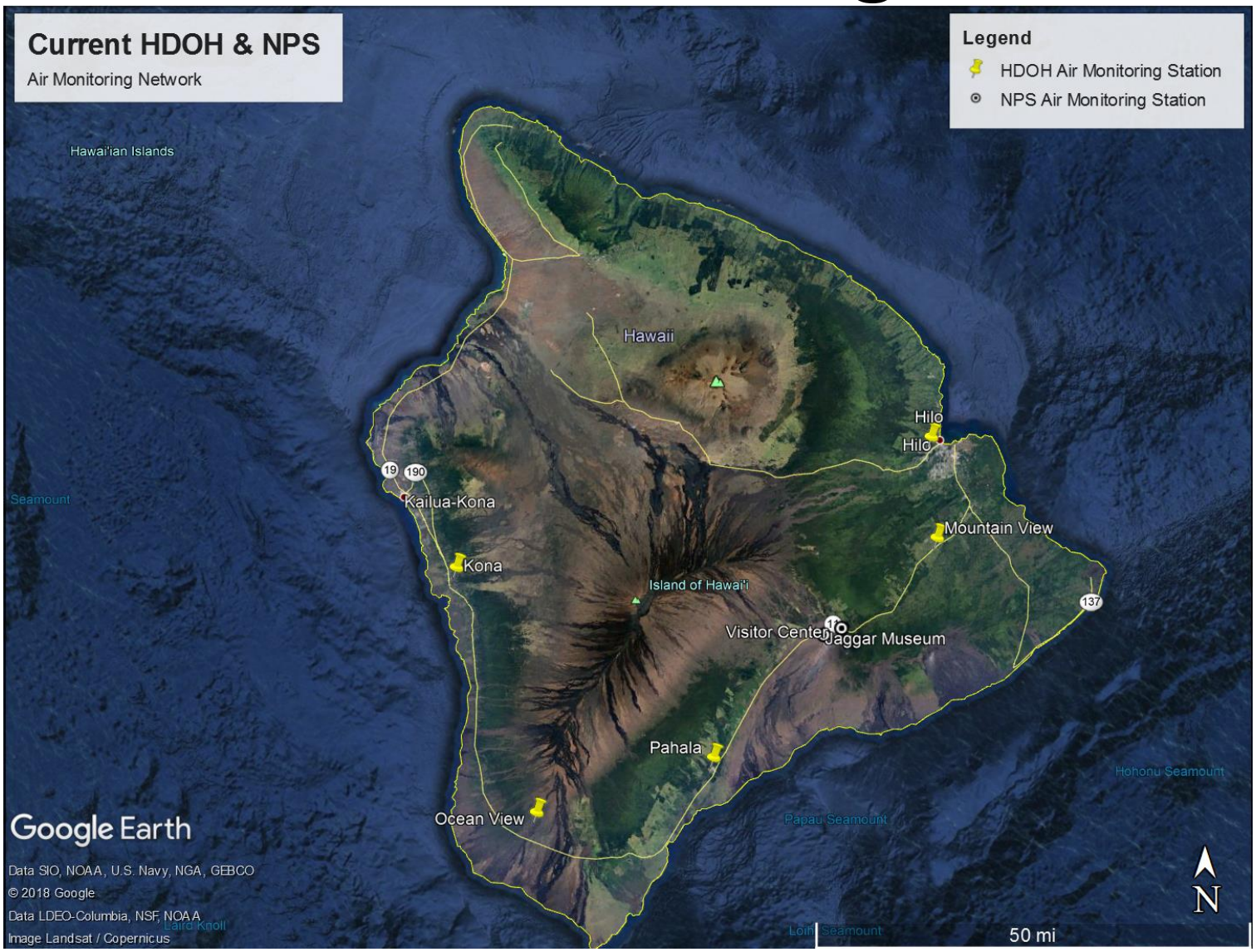
Kona PM2.5

PM2.5[ug/m3] Station: KONA Periodically: 5/4/2018 12:00 AM-8/15/2018 12:00 AM Type: AVG 1 Day [1 Day]
Report Type: StationReport Avg Type: AVG
Date & Time: 5/4/2018 12:00 AM-8/15/2018 12:00 AM Time Base: 1 Day [1 Day]



Vog in Kona

HDOH and NPS Existing Monitors



Additional Air Monitoring Stations

- Developing plan for long term stations
- Place additional stations in communities where currently no monitoring
- Replace the temporary EPA and MIT sensors
- Special purpose monitors (SPM)
- Regulatory monitors (SLAMS)
- Provide the data to the public

Additional Monitoring

- Proposed 10 additional monitoring stations
- Measures sulfur dioxide and fine particulates
- Around Hawaii Island
- Populated areas
- Targeted schools
- Community Feedback
- Few months to a year to establish and deploy

Siting Requirements

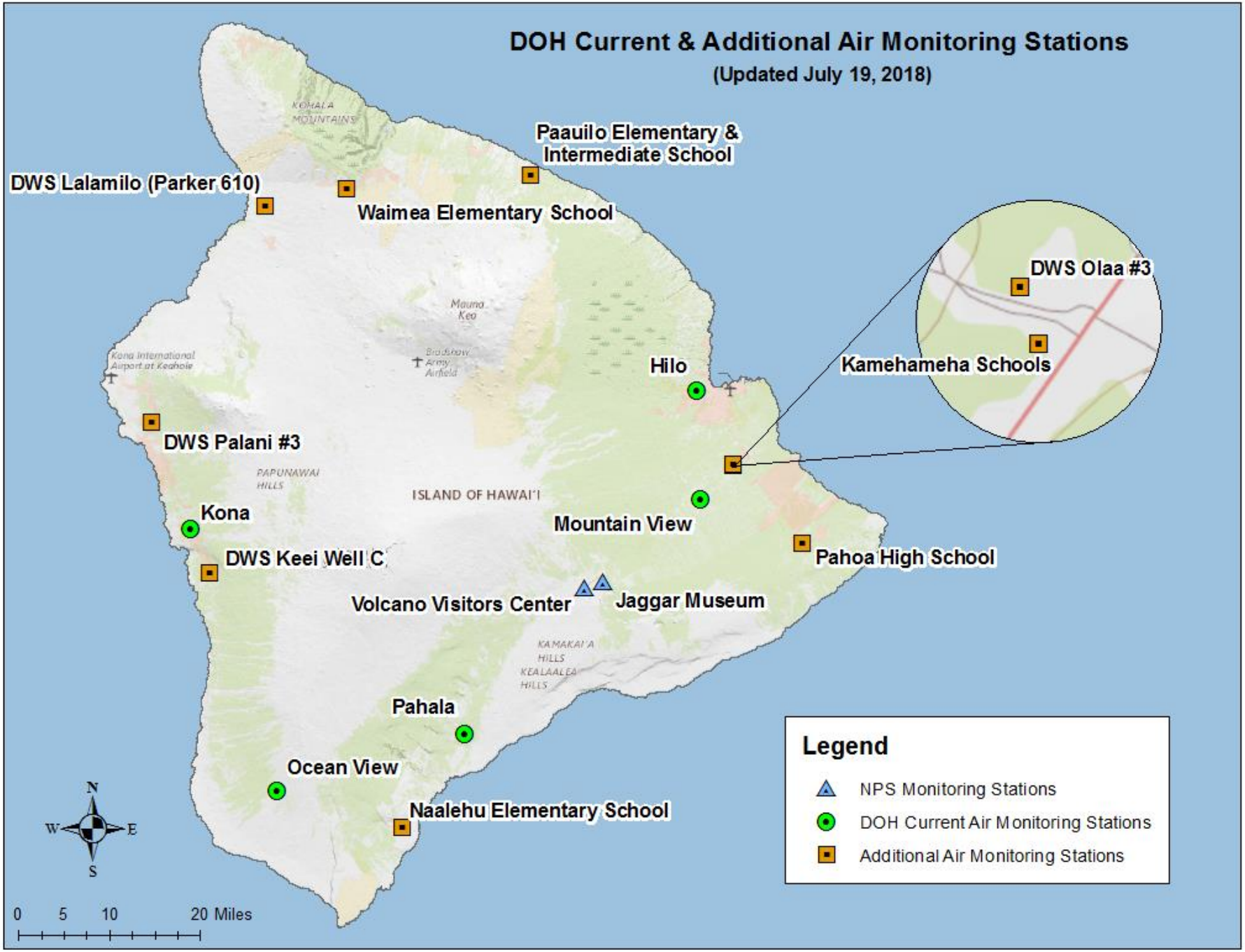
- Area 12 by 18 feet
- Security
- Access
- Utilities (electrical and communications)
- Meet EPA siting guidelines
- Approvals
- Lease or MOU agreements

Challenges of Siting

- Costs (site improvements)
- Security issues, vandalism and theft
- Finding open areas
- Away from other sources of pollution (construction, imu)
- Does not meet EPA siting guidelines
- Schools
  - Policies, procedures, rules to abide by
  - Liability/safety concerns for students and staff
  - Lack of space
  - Lack of utilities

Additional Regulatory Monitoring Stations

HAWAII LONG TERM REGULATORY MONITORING STATIONS SITES AS OF JULY 19, 2018									
GEOGRAPHIC AREA	Puna	Puna	Puna	Kau	South Kona	North Kona	South Kohala	South Kohala	Hamakua
LOCATION	Pahoa	Keaau	Keaau	Naalehu	Honaunau	Kealakehe	Waikoloa	Waimea	Paauilo
SITE	DOE Pahoa High School (behind gymnasium)	Kamehameha Schools Switch Gear Building	DWS Olaa #3	DOE Naalehu Elementary School USGS Seismograph Bldg.	DWS Keei Well C Painted Church Rd., south end of facility	DWS Palani #3 - 2MIL Access from Tomi-Tomi Drive	DWS Lalamilo (Parker 610)	Waimea Elementary School	Paauilo Elementary & Intermediate School
Priority for PM 2.5	5	6	6	4	1	3	2	7	8
Priority for SO2	1	2	2	3	4	7	8	5	6
GPS COORDINATES	19° 29' 16.92"N 154° 56' 28.84"W	19° 36' 19.22"N 155° 03' 04.63"W	19° 36' 21.41"N 155° 03' 05.30"W	19° 03' 38.36"N 155° 34' 45.00"W	19° 26' 33.95"N 155° 53' 08.66"W	19° 40' 08.37"N 155° 58' 43.06"W	19° 59' 39.03"N 155° 47' 53.10"W	20° 01' 06.06"N 155° 40' 04.53"W	20° 02' 25.21"N 155° 22' 31.20"W
Elevation	690 feet	590 feet	600 feet	644 feet	900 feet	910 feet	590 feet	2675 feet	860 feet
APPROVAL OBTAINED	REQUEST LETTER SENT WRITTEN APPROVAL RECEIVED (VIA EMAIL)	REQUEST LETTER SENT WAITING FOR MOU FROM KSH	REQUEST LETTER SENT VERBAL APPROVAL WAITING FOR WRITTEN	REQUEST LETTER SENT PENDING PRINCIPAL Custodian ok'd site	REQUEST LETTER SENT VERBAL APPROVAL WAITING FOR WRITTEN	REQUEST LETTER SENT VERBAL APPROVAL WAITING FOR WRITTEN	REQUEST LETTER SENT VERBAL APPROVAL WAITING FOR WRITTEN	REQUEST LETTER PENDING VERBAL APPROVAL WAITING FOR WRITTEN	PENDING CONTACT WITH PRINCIPAL
Contact Information	DARLENE BEE PRINCIPAL 313-4300	PETER FUCHS DIRECTOR OF CAMPUS OPERATIONS 982-0038	CLYDE YOUNG MECHANICAL ENGINEER V 961-8790	DARLENE JAVAR PRINCIPAL 313-4000	ROBERT RAVENSCRAFT WATER DISTRICT SUPERVISOR 322-0600	ROBERT RAVENSCRAFT WATER DISTRICT SUPERVISOR 322-0600	WILLIAM O'NEIL 887-3030	SCOTT TAMURA PRINCIPAL 887-7636	MICHELLE BARBER PRINCIPAL 776-7710
Electrical									
HELCO installation required	YES (estimate $1,200)	YES (estimate $2,400)	YES (estimate $6,000)	NO	YES (estimate $7,500)	YES	NO	YES	YES
Electrical Contractor required	YES	YES	YES	NO	YES	YES	YES	YES	YES
SECURITY									
Area secured	NO	YES	YES	YES	YES	YES	YES	NO	NO
Need additional security	YES	YES	NO	NO	NO	NO	NO	YES	YES
SITING REQUIREMENTS									
Inlet probe unobstructed	YES	YES	YES	YES	YES	YES	YES	YES	YES
unrestricted airflow arc of 270 degrees including predominant wind path	YES	YES	YES	YES	YES	YES	YES	YES	YES
away from sources such as incineration or furnaces	YES	YES	YES	YES	YES	YES	YES	YES	YES
10 meters or further from tree drip lines	YES	YES	YES	YES	YES	YES	YES	may need to trim one tall tree/bush on property	YES
Minimum 1 meter vertically or horizontally away from any supporting	YES	YES	YES	YES	YES	YES	YES	YES	YES
2-7 meters above the ground	YES	YES	YES	YES	YES	YES	YES	YES	YES
immediate surrounding monitoring site not bare ground	YES (grass)	YES (grass)	YES (grass)	YES (grass)	NO (lava rock & gravel)	YES (gravel)	YES (gravel)	YES	YES
Neighborhood scale	YES	YES	YES	YES	YES	YES	YES	YES	YES
Away from Road	NO (30 ft.)	YES (approx. 100 ft.)	YES (approx. 300 ft.)	YES	YES	YES	YES	YES	YES
Notes		Select either Keaau site	Select either Keaau site May need to grade	Need to install window AC May need platform for PM	May need to grade Ensure that power pole does not interfere with access to tank	Provide coverage for Kailua-Kona/Holualoa Currently no electrical outlets may consider solar EBAM	Provide coverage for Waikoloa Village/resort area	Security issues	


DOH Current & Additional Air Monitoring Stations
(Updated July 19, 2018)
Paauilo Elementary & Intermediate School
DWS Lalamilo (Parker 610)
Waimea Elementary School
DWS Olaa #3
Kamehameha Schools
Hilo
DWS Palani #3
Kona
Mountain View
DWS Keei Well C
Pahoa High School
Volcano Visitors Center
Jaggar Museum
Pahala
Ocean View
Naalehu Elementary School
ISLAND OF HAWAI'I
Legend
NPS Monitoring Stations
DOH Current Air Monitoring Stations
Additional Air Monitoring Stations
N
W
E
S
0 5 10 20 Miles

Clean Air Branch

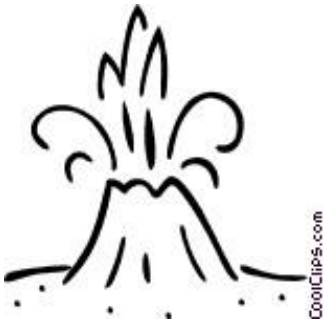
- Answer public and media calls or inquiries
- Provide information/data/technical guidance to Hawaii County, EPA, DOH DOC, and other Agencies
- Work with the DOH Communications to draft press releases and advisories
- Attended community meetings
- Reached out to EPA and other states for air monitoring equipment (sensors and analyzers)
- Reached out to EPA for assistance with funding
- Initiate plans for long term ambient air monitoring

Challenges - Monitoring

- Ambient air monitoring suddenly becomes emergency response monitoring
- Everyone wants a monitor in their backyard
- How many monitors and where to place them?
- Limitations and reliability of the data collection and data acquisition system
- Procurement and funding issues
- Providing email alerts from monitoring stations
- Maintaining possibly 15 stations on the Big Island with limited resources
- How to forecast due to the unpredictable nature of the volcanic emissions, topography and wind patterns
- Exceedance notification requirements

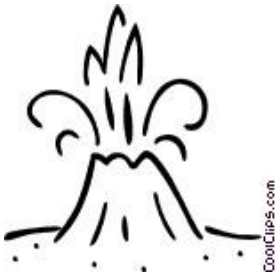
Other Challenges

- Coordination with other agencies
  - Roles and responsibilities
  - Communication
- Unpredictable high level spikes lasting from 5 minutes to several hours
- Agreement on advisory levels and time periods (5 minutes, 15 minutes, 1 hour)
- Public education, outreach and notification
  - Health effects, masks, air purifiers, shelter in place, etc.
  - Alerts, advisories, notifications, etc.
  - Tourism and businesses
- Providing information to people with no internet access



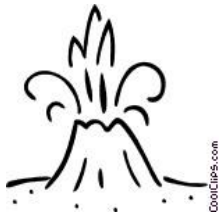
Lessons Learned

- Data must be of good quality, reliable, and useful to be meaningful
- To be useful the public needs to understand what the data means
- Shelter in place instead of evacuating
- The public wants timely alerts, notifications, and information
- To prevent public confusion information or alerts should be standardized
- Communicating health risk and educating the public is extremely important



Ongoing

- Continue to improve our monitoring capabilities and website to provide more timely information to the public
- Provide email notification to the public and media
- Forecasting air quality for particulates and SO2
- Exceptional events documentation due to the daily exceedances of the 1 hour SO2 standard
- Improve and update mitigation plans
- EPA Vog conference calls
- Vog studies
- Public outreach to educate the public

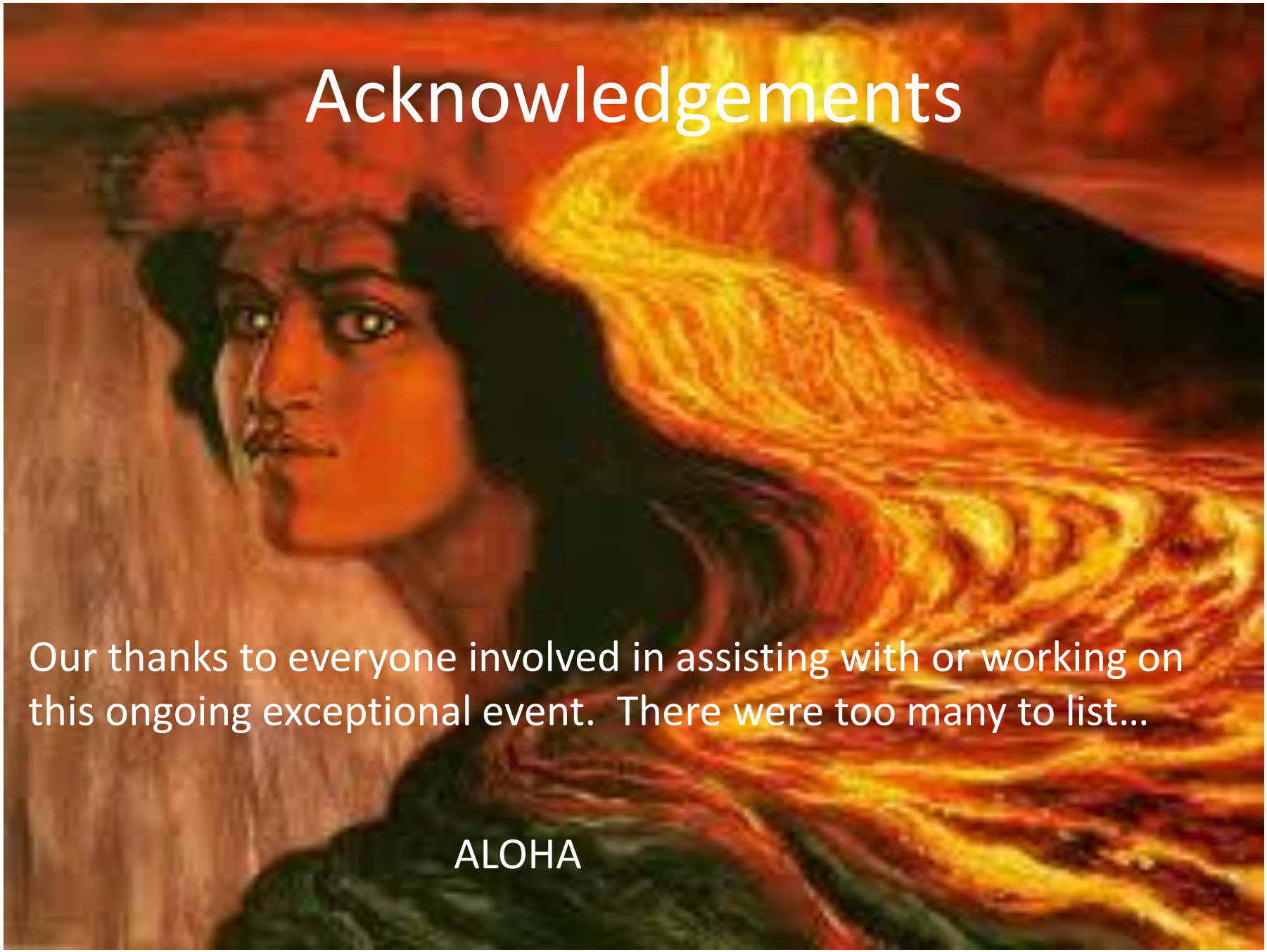


Preparedness and Planning

- Office of Public Health Preparedness
  - Determine roles and responsibilities
  - Provide training
  - Improve coordination between agencies
- Build capabilities for forecasting
- Prepare information for the public, press releases and advisories
- Ensure adequate inventory of equipment
- Reach out to other agencies for resources
- Comprehensive up-to-date Emergency Mitigation Plans
- Plan now for the possibility of the next event

We would like to acknowledge all of the state agencies and other organizations that offered assistance to Hawaii during this critical time. We would also like to give a special thanks to the organizations that loaned Hawaii air monitoring equipment during this event.

- EPA
- NACAA
- Western States Air Resources Council (WESTAR)
- California Air Resources Board (CARB)
- Sacramento Metropolitan Air Quality Management District
- Arizona DEQ
- State of New Jersey Department of Environmental Protection



Acknowledgements

Our thanks to everyone involved in assisting with or working on this ongoing exceptional event. There were too many to list…

ALOHA