Frequently asked questions about air quality and health during the Mauna Loa eruption

This document complements an existing FAQ document on vog available on the Hawaii Interagency Vog Information Dashboard at https://vog.ivhhn.org/what-vog

Questions about health

What is Pele's hair?

Pele's hair is commonly produced from eruptions in Hawai'i, during fissure, vent, or lava lake activity, as well as at other similar eruptions around the world. Pele's hair is formed when liquid lava is propelled into the air, some of which stretches into long, thin strands of glass, which can look a lot like human hair. These strands can be carried by the wind and land on the ground far from the eruption site. The strands often break into much smaller, sharp pieces.

Is Pele's hair harmful if touched?

The broken pieces of Pele's hair can have sharp ends. They can poke or puncture the skin, like a wood splinter, if people handle these particles or walk on them with bare feet. This can be irritating or painful. Please warn children not to pick up or play with Pele's hair. The glass itself is not poisonous although it can be a problem if swallowed or inhaled (see next questions).

Is Pele's hair harmful if inhaled?

Most Pele's hair is too large to be inhaled. Particles in the air can only enter the lungs if they are less than 10 micrometers (PM_{10}) in diameter, which is about an eighth of the width of a human hair. It is possible for some Pele's hair to be this small, and analyses are ongoing to measure the very smallest hairs produced from the Mauna Loa eruption. People may be concerned that Pele's hair could cut, lacerate or abrade the lungs because it is made from glass and is sharp, but this does not happen because such tiny particles float in the air stream and gently deposit inside the lungs.

People with existing respiratory diseases, like asthma, might find that their symptoms are worse when they are exposed to airborne volcanic particles. They should always carry their medication and talk to their doctor about a treatment plan. People without existing respiratory disease may find that the particles cause them to cough or have a sore throat.

There is no evidence in the medical literature that other types of volcanic mineral particles (i.e. volcanic ash from explosive eruptions) can cause respiratory or other disease, but no medical studies have been conducted specifically on the effects of inhaling Pele's hair.

Is Pele's hair harmful if swallowed?

Young children may be attracted to the glass and be tempted to put the glass pieces in their mouth. The glass shards may cut or be a choking hazard. Please keep children away from Pele's hair.

How can I protect myself from Pele's hair?

The best approach is to limit exposure. The information compiled by IVHHN on precautions for volcanic ash also generally applies to Pele's hair (Public Information | IVHHN). When outdoors, consider wearing a well-fitting N95 or similar mask if you are in an area with falling or blowing Pele's hair. People involved in any clean-up of Pele's hair should make sure to wear an N95 mask, good gloves, eye protection, and protective clothes, as Pele's hair can irritate the skin.

What about effects from volcanic gases and other volcanic particles?

Sulfur - as sulfur dioxide (SO_2) gas and tiny sulfate aerosol particles - is the most abundant chemical species of concern and can cause respiratory irritation. Other gases, like hydrogen chloride (HCl) and hydrogen fluoride (HF), are emitted in much lower concentrations and are diluted rapidly in the atmosphere. Detailed information and FAQs on vog composition, protection, and impacts to human health, agriculture, infrastructure, and the environment is available on the Hawaii Interagency Vog Information Dashboard at https://vog.ivhhn.org/.

Is anyone checking whether there are any medical impacts from the eruption?

Yes. The Hawaii State Department of Health is using a health monitoring system known as syndromic surveillance to monitor for increased visits to hospital emergency departments, urgent care and health clinics that may be related to poor air quality and vog exposure from the Mauna Loa eruption.

Questions about air quality

Why do vog forecasts differ from real-time air quality monitoring data?

Vog forecasts are like weather reports. The forecasts can change many times throughout the day depending on rain and wind conditions. All forecasts have uncertainty and will not always match real-time measurements. Volcanic air pollution models are better at identifying where and when pollution may occur than the exact amount of the pollutant. Air quality forecasts and real-time measurements are best used in a combined way: when a model forecasts pollution in your area, you can use this information to stay alert and check air quality measurements (if available in your area).

Sometimes the air can look very hazy in the distance (e.g., looking across the ocean or against a mountain) while real-time air monitors in your area show little or no pollution. This may be because the vog is not at ground level or in the monitor's location. A detailed Briefing Note to explain differences in modeled and measured air quality can be downloaded at https://vog.ivhhn.org/content/mauna-loa-eruption.

Why is vog referred to as 'haze' in weather forecasts?

The National Weather Service (NWS) has set wording that can be used in their forecasts. Currently, there is not a specific weather element for 'vog', and the closest available word to describe the volcanic pollution is 'haze'. The NWS recognizes the importance of being able to accurately describe conditions in Hawai'i and is working to get the term 'vog' approved as an official weather element.

How do Hawaii Department of Health monitors and PurpleAir sensors differ?

The Hawaii State Department of Health (HDOH) operates a network of very sensitive and accurate air quality monitoring stations across the Hawaiian Islands (https://air.doh.hawaii.gov/home/map). These sites are 'regulatory grade' and are regularly calibrated and audited according to federal standards and protocols to confirm their accuracy. Many of these sites measure sulfur dioxide gas (SO_2) and tiny particulate matter less than 2.5 µm diameter, known as $PM_{2.5}$, which includes sulfate aerosol. These stations are expensive to install and operate, so are limited in number.

The HDOH monitoring stations report data as a number between 0-500 corresponding to the US Environmental Protection Agency (EPA) Air Quality Index (AQI) which represents the level of pollution. The reported value for a station represents the AQI for the individual pollutant with the highest AQI at the time of the measurement. There are also options for viewing levels of individual (rather than combined) pollutants, and for switching from AQI to a concentration measurement (in units of parts per million (ppm) for SO_2 and micrograms per cubic meter ($\mu g/m^3$) for PM).

There are many low-cost PM sensors on the market. Individuals or groups can purchase the sensors and install them themselves. PurpleAir is an example of a company that manufactures low-cost PM sensors and many people have installed these in Hawai'i. Data from the sensors are uploaded to the PurpleAir map directly via wifi and are reported using the US EPA AQI. It is important to remember that these sensors do not detect SO_2.

Low-cost sensors cannot be calibrated after they are made, and they may not retain their accuracy over time. Also, the sensors do not account for local conditions, such as relative humidity, which may affect measurements. They are best used as an indicator of relative changes in air quality, and may not be appropriate for comparing to AQI thresholds. PurpleAir does not install or maintain any of the sensors, and there is no way to know if an individual sensor may be impacted by a local pollution source such as smoking, barbeque, heavy traffic, etc. While these data are less accurate than the HDOH regulatory sites, their strength is in the number and distribution of sensors over a wide area. This provides general information about air quality in an area, even though the accuracy of individual sensors may vary.

Why is there a focus on sulfur dioxide gas hazards?

After water vapor and carbon dioxide (CO_2), SO_2 is usually the most abundant gas emitted from volcanoes. SO_2 is also the only volcanic gas that is likely to pose an immediate health threat away from the Mauna Loa eruption sites. People with asthma or other chronic lung diseases can be particularly sensitive to SO_2

but people without chronic lung diseases can also feel the effects of SO_2 and sulfate aerosol. Other volcanic gases are very quickly diluted in the air to non-hazardous levels. The other gases pose a hazard only to people in the immediate vicinity of the eruption, such as scientists, first responders or people viewing the eruption.

There are occasions when other volcanic gases may be found in hazardous concentrations at locations away from an eruption. CO_2 has, on very rare occasions, caused fatalities near volcanoes. Large water lakes nearby volcanoes, or in the crater, can accumulate CO_2 over time and suddenly release the gas if the lake overturns. As CO_2 is heavier than air, it can then flow downslope at ground level and cause suffocation of people and animals. This is not a concern at Mauna Loa or anywhere on Hawai‘i at present. Concentrations of HCl often become elevated close to places where lava enters the ocean. This is due to boiling of seawater which creates a plume known as ‘laze’. There is currently no lava ocean entry associated with the Mauna Loa eruption, so HCl exposures are not currently of concern.

Do I need to be concerned about heavy metals in the vog?

Unlike SO_2 gas, which can cause health problems immediately or over hours or days, the negative health impacts from heavy metals in the environment (including air, water, and soils) are caused by long-term exposure.

Heavy metals in vog were measured in populated areas during the 2018 Kīlauea lower East Rift Zone (LERZ) eruption (link to full results in a scientific publication). Mercury was not measured as part of this study (see information at the end of this section). Compared to human activities, Kīlauea’s Fissure 8 emitted substantial amounts of heavy metals but the airborne concentrations decreased rapidly between Fissure 8 and the populated areas. The airborne concentrations of heavy metals in nearby populated areas were only 0.01 to 1% of the original concentrations at Fissure 8, and similar to large mainland USA cities, including L.A., Chicago, and New York. However, we caution against over-comparing vog-affected areas and mainland air pollution because people are exposed for very different lengths of time (for example, months in the case of the intense 2018 LERZ eruption compared to potentially a whole lifetime for people in the cities).

In all populated areas sampled on Hawai‘i Island, the metal concentrations were well below guidelines set by the US EPA and CDC’s Agency for Toxic Substances and Disease Registry (ATSDR)[1]. This means that, according to these guidelines, the levels of pollutants were not hazardous. However, these guidelines are designed for workplace exposures and may not be applicable to exposure of the general population, so the potential for impacts from long-term exposures to volcano-generated heavy metals in the air is unknown at this time.

[1] EPA/ATSDR guidelines for workplace settings (8 hour working day in a 40 hour working week) are available for airborne selenium, zinc, copper, arsenic and cadmium. For lead, there is a guideline for 3-months average in ambient air.

Mercury has not been measured in vog in populated areas, but we can infer some information from eruptions elsewhere. A fissure eruption in Iceland in 2021 had a similar emission rate of mercury to the 2008 Kīlauea summit eruption, at around 1 kg/day. The airborne concentration of mercury was measured in a populated area 8 miles from the Icelandic fissure and was found to be already below detection limits. Please note that mercury measurements which were made on different islands of Hawai'i in the 1980s are now thought to have significantly over-measured the concentrations due to technological challenges and should be viewed as a 'worst case scenario'.

It is not technologically possible to provide real-time monitoring of heavy metals, except for mercury gas, which is not routinely monitored. However, PM concentrations are monitored in real-time at HDOH air quality stations. Therefore, we have information on the amount of PM in the air, which includes most heavy metals. There are efforts to sample and measure airborne metals for longer-term laboratory analysis, including mercury, during the Mauna Loa eruption, but direct sampling of the volcanic plume is extremely challenging due to the high altitude location of the fissures and strong winds.

Questions about impacts to drinking water and agriculture

Will the vog make my catchment water dangerous to drink?

For information about impacts of volcanic emissions on catchment water supply systems, please see https://vog.ivhhn.org/catchment-systems. This page includes specific advice for precautionary measures for catchment users during heightened volcanic activity.

Volcanic emissions can acidify rainwater which, in turn, can dissolve metals such as lead, zinc and copper from roofing and plumbing materials. Volcanic elements (e.g., fluorine in the form of fluoride) may also get into rain catchment tanks close to the volcanic eruption. This is not currently an issue for the Mauna Loa eruption because of its high altitude and distance to populated areas.

It should be noted that, even if levels of metals are found to be above EPA recommended levels for drinking water, the EPA guidelines are based on exposure over many years. Targeted sampling of water tanks one year after the 2018 Kīlauea LERZ eruption revealed no evidence of heavy metal contamination associated with the volcanic eruption, including tanks in Leilani Estates, Lower Puna, and Hawai'i Paradise Park, as well as impacted locations farther down wind.

Please note the Hawaii State Department of Health advises people to not drink catchment water due to the risk of infectious diseases such as Rat Lung Worm and leptospirosis. However, showering, washing dishes and laundry uses are safe.

Does vog have an impact on heavy metals in soils?

We do not have enough evidence to answer this.

There are areas on Hawai'i Island where soil has high arsenic levels from non-volcanic sources. The contamination is from sugar cane cultivation in the first part of the 20th century which used arsenic-based

herbicides. The arsenic contamination can be very localized or widespread depending on historical uses. The implications for health are not clear-cut because arsenic in Hawai'i's iron-rich soils has fairly low bio-accessibility, meaning it doesn't get absorbed into the body even if people ingest it. Further information from HDOH about arsenic in Hawai'i soils can be found at https://health.hawaii.gov/heer/files/2019/10/Arsenic-in-Hawaiian-Soils-Questions-and-Answers-on-Health-Concerns-2018.pdf

Other heavy metals, such as lead, can be found in soils in Hawai'i as a result of historic activities. Lead is present in the soils in many areas due to the widespread historic use of lead-based paint and leaded gasoline. Exposure to lead in soil can be harmful for young children. Please visit https://lead.hawaii.gov for more information on lead exposure from the Hawaii Childhood Lead Poisoning Prevention Program.

Further resources:

The Hawaii Interagency Vog Information Dashboard
IVHHN Briefing note on interpreting volcanic gas measurements
IVHHN General information on volcanic gases and international air quality standards and guidelines
IVHHN The health hazards of volcanic and geothermal gases: a guide for the public
Dr Evgenia Ilyinskaya's work on heavy metals in vog has been covered in two podcasts with Hawaii Tracker: https://www.youtube.com/watch?v=HdQqx0RV9_4&t=6s and https://www.youtube.com/watch?v=iMtf_GYaKUA

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