Science, technology, engineering and mathematics

What is a volcano?

Explore the volcanos! What is a volcano? How is it constructed, how many types of volcanos has the earth and how can they affect our lives? This unit will help you answer these questions, explore the earth and contemplate on this very interesting scientific issue.

Discipline area	Geography
Topic	Volcano
Estimated time	2h 40'
Learning goals	If you go through the whole learning unit, you will • learn about the different types of volcanos • know where the volcanos are placed in the earth • know how the volcanos effect the climate • know why NASA works on the volcanos

Warm-up

Let's first warm you up!
With your buddy, answer the following 5 questions to understand «what is a volcano?»
The answers will give you an idea of how a volcano can affect the earth and specifically the climate with its lava and ashes.

1. Look at Image 1.

What do you see in the first volcano image?

Lava fountain at Kilauea Volcano, Hawai'i

2. Look at Image 2.

What do you see in the second volcano image?

Mount Saint Helens eruption, July 1980

This eruption sent ash till 18 km into the air and was visible even from places which were 160 km far!

3. Look at Image 3.

What do you see in the third volcano image?

Lava bubbles up from Kilauea Volcano in Hawai'i

4. How are the three images different?

5. How are the three images similar?

Learn

1

What is a Volcano?
A volcano is an opening on the surface of a planet or moon that allows material warmer than its surroundings to escape from its interior. When this material escapes, it causes an eruption.

Volcanoes can be:

- **active**: erupted recently/are expected to erupt soon!
- **dormant**: no eruption for a long time… but who knows!
- **extinct**: they will likely never erupt again.

Volcanoes on Earth form from rising magma. Magma rises in three different ways.

An eruption can be:

- **explosive,** sending material high into the sky or
- **calmer,** with gentle flows of material.

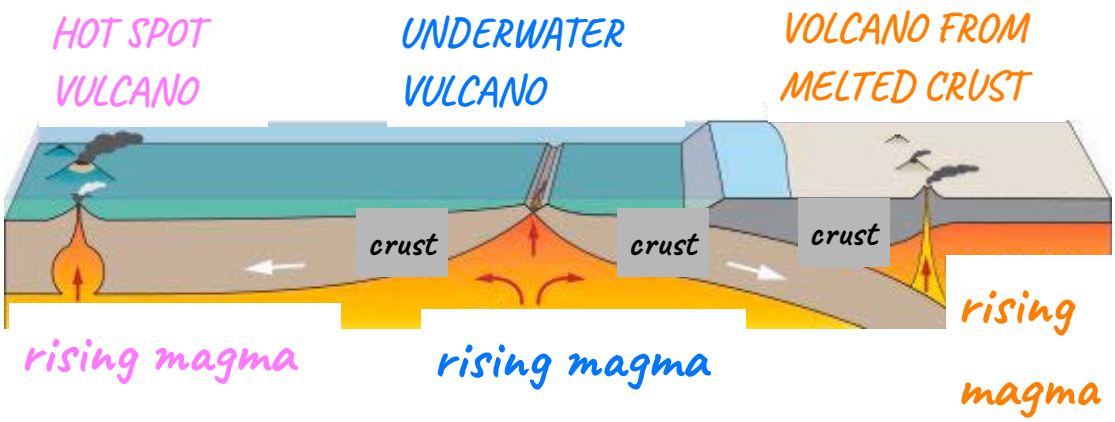
The erupted material can be liquid rock ("lava" when it's on the surface, "magma" when it's underground), ash, cinders, and/or gas.

Magma can rise when:

1. Tectonic plates slowly **move away from each other.** The magma rises up to fill in the space. Underwater volcanoes can form.

2. Tectonic plates **move toward each other**. And part of them can be forced deep into its interior. With the high heat and pressure the crust melts and rises as magma.

3. **Hot spots** - hot areas inside of Earth – form, heat up magma, which becomes less dense and rises!

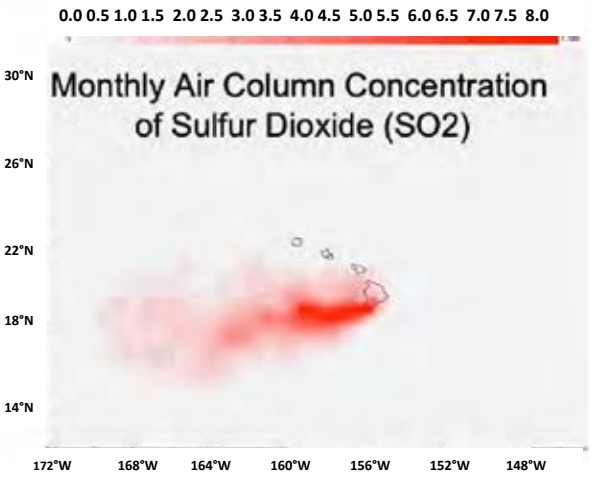


2

See how a local volcanic event can have a global impact on climate. You will use datasets about two different volcanos! Look at the graphs and answer the questions!

1. This mapped plot shows the Monthly Air Column Concentration of **Sulfur Dioxide (SO2)** observed June 2018 on the Hawaiian Islands. Sulfur dioxide (SO2) is an atmospheric pollutant primarily sourced from fuel burning, industrial activity, and volcanic emissions. It also is the primary contributor to acid rain.

Where do you observe its highest concentration? (Those forms black and white are Hawaii; SO2 is coloured red)

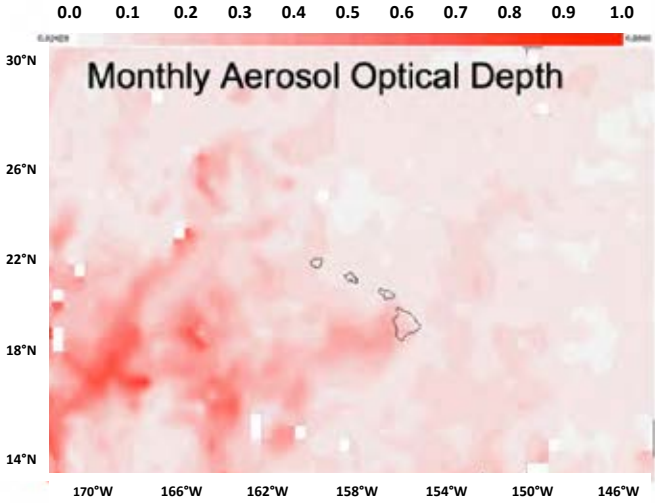


The units of these data are parts per billion by volume (ppbv), which is a ratio of the volume of this gas to a much larger volume of air.

A concentration of 1 ppbv il like:
half of a teaspoon of SO2 in a volume of air that would fit into an Olympic-sized swimming pool.

That is: 2.5 milliliters/0.084 fluid ounces of SO2 into 2.5 million liters/660,400 gallons.

https://mynasadata.larc.nasa.gov



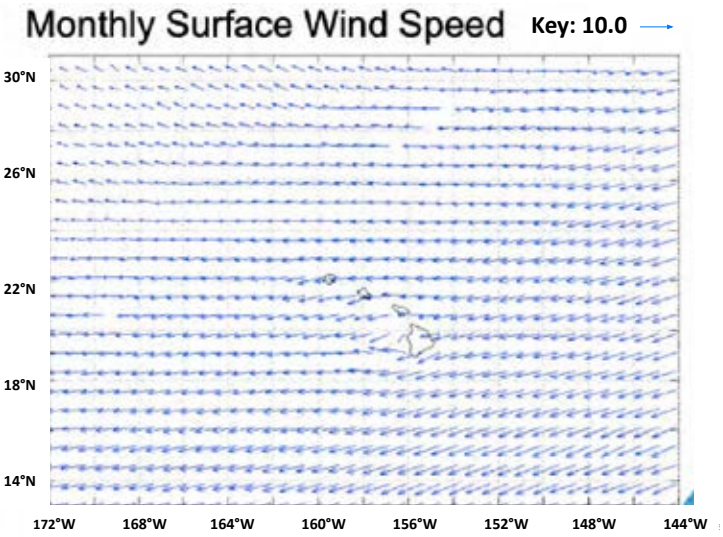
This mapped plot shows Monthly **Aerosol** Optical Depth observed June 2018 of the Hawaiian Islands.
Aerosols are tiny solid and liquid particles suspended in the atmosphere. Examples of aerosols include windblown dust, sea salts, volcanic ash, smoke from fires, and pollution from factories.

2. Where do you observe the highest concentrations?
(Aerosol is coloured red)

3. How do Monthly Aerosol Optical Depth compare to Monthly Air Column Concentration of Sulfur Dioxide (SO2)?

This mapped plot shows Monthly Surface Wind Speed observed June 2018 of the Hawaiian Islands. This quantity describes the monthly average wind speed at 10 meters above the ocean surface (the standard height where scientists take surface wind measurements, equivalent to the height of a 3-story building).

This map shows the strength and direction of wind by using small blue arrows (vectors). Longer vectors mean stronger winds. Also, the vectors point in the direction the wind is



blowing towards. The units of these data are meters per second. A speed of one meter per second is the same speed as a slow walk. A speed of 12 meters per second is the speed of the fastest human sprint ever recorded. A speed of 25 meters per second is the typical speed limit on an urban interstate highway or rural two-lane highway in the United States (55 miles per hour, around 90 km/h).

The seasons and latitude play an important role in determining where the strongest average surface winds are located. In general, surface winds are strongest in winter and in the middle and high latitudes. This is one factor that scientists use to determine the impacts of volcanic eruption on the atmosphere.

4. Where do you observe the stronger winds?

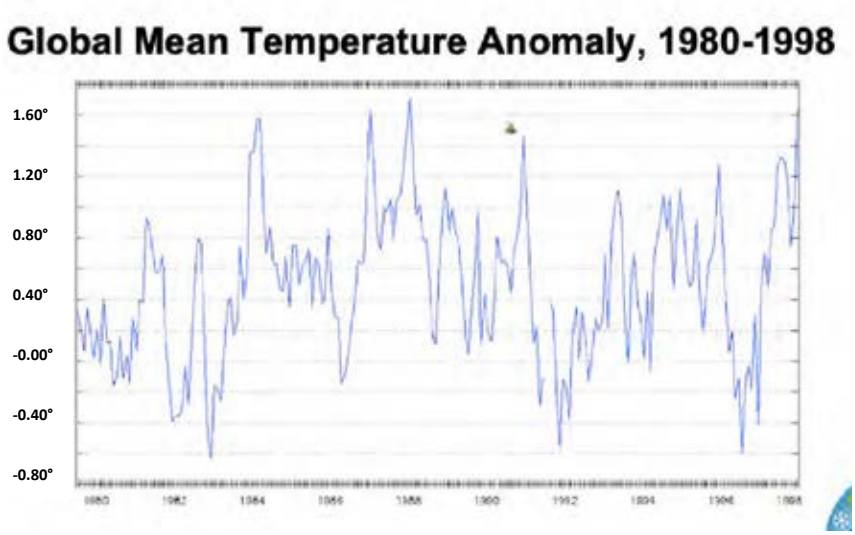
Let's move now to the Philippines!

The global impact of the **June 1991 Mount Pinatubo** eruption in the Philippines can be seen immediately following the Pinatubo eruption large amounts of sulfur dioxide and dust spread through the earth's atmosphere.

This mapped plot shows Global Mean Temperature Anomaly, 1980-1998.

The quantity describes the surface air temperature anomaly, which is the difference between the measured temperature and an average value taken across a long time period in the data (in this dataset, the 1951-1980 average temperature). Air temperature is in degrees Celsius.

The volcano image showcases the time when Mount Pinatubo erupted on June 15, 1991. Positive values on the Y axis mean global temperature is higher than pre-industrial temperature (~1850). The result was a measurable cooling of the Earth's surface for a period of almost two years.



5. Describe the pattern of global average temperature from 1980 until 1990.

6. Describe the pattern you observe after the volcanic eruption in 1991.

Answers:

1. There are much higher concentrations to the west of Hawaii than to the east. The high concentrations of sulfur dioxide seem to be coming from a small area on the southern end of the island of Hawaii. This is the eruption of the Kilauea volcano.

2. There are much higher concentrations to the west of Hawaii than to the east. The high concentrations of aerosols seem to be coming from the southwestern end of the island of Hawaii. This is the eruption of the Kilauea volcano.

3. There are higher concentrations of SO2 and aerosols over the same region west-southwest of Hawaii They both had the same orientation of plumes of aerosols and SO2.

4. Longer vectors mean stronger winds and arrow points in direction of wind; the stronger winds appear to be the East of the islands blowing to the West. Plumes of higher concentration SO2 and aerosols are in the same direction as the winds. If the wind was from a different direction, then the impact of the volcanic eruption would have been different. For example, the plume of aerosols may have occurred over a more populated area rather than over the middle of the ocean.

5. The values cycle between an anomaly of about 0 degrees Celsius to approximately 1.60 degrees Celsius until about 1991 when there is a significant drop in global temperature anomaly to about -0.30 degrees Celsius.

6. Describe the pattern you observe after the volcanic eruption in 1991. There is a small increase then a large decrease in air temperatures that lasts about 2 years.

Create

Are there volcanos in your country (the one you live in now or the one you have lived in before) or in the neighbouring countries? Get a map and locate them together.

Now it is time to create your own storyline and results from a volcano eruption.

1

Research online/in the library or by interviewing a local expert whether there was a volcanic eruption in recent years. When? Where?

2

Find out what the effects were on the local community? What was and could be in the future the effect for the environment and the climate?

3

Create a storyline with the dates, pictures and information you got.

4

Exchange your findings with other buddy teams.

Reflect

Discuss with your buddy what you have learned about volcanos and their effect on earth and on climate.