Hawai‘i’s active volcanoes are monitored by several complementary techniques

The Hawaiian Volcano Observatory (HVO), one of five volcano observatories in the United States, uses the methods described below to monitor volcanoes and earthquakes in Hawai‘i.

Geodesy (Volcano Deformation)

Active volcanoes change shapes in subtle ways that can provide clues about what is happening below ground. Deformation monitoring detects the build-up of stress and pressure caused by magma rising toward the surface.

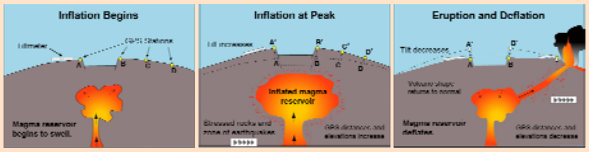
Global Positioning System (GPS)

Continuously recording GPS receivers are cemented in place and report their positions to within a few millimeters. As magma is injected into a volcano, or displacement occurs along a fault, changes in shape are recorded as movement of the GPS receiver.

GPS measurements are recorded annually during survey campaigns (above) or continuously by instruments installed on the volcanoes (right).

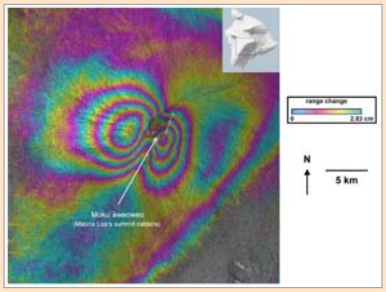
Electronic Tiltmeters

Tiltmeters are highly sensitive instruments designed to detect tiny changes in slope on the surface of the volcano. They excel at imaging fast, short-term events in real time, and provide early warning of changes that could lead to an eruption.



Interferometric Synthetic Aperture Radar (InSAR)

InSAR is a remote-sensing technique. Radar images of the Earth's surface acquired by orbiting satellites are compared to show subtle ground surface movements that occur between different satellite orbits. This results in a detailed map of ground motion directed toward (or away from) the satellite.

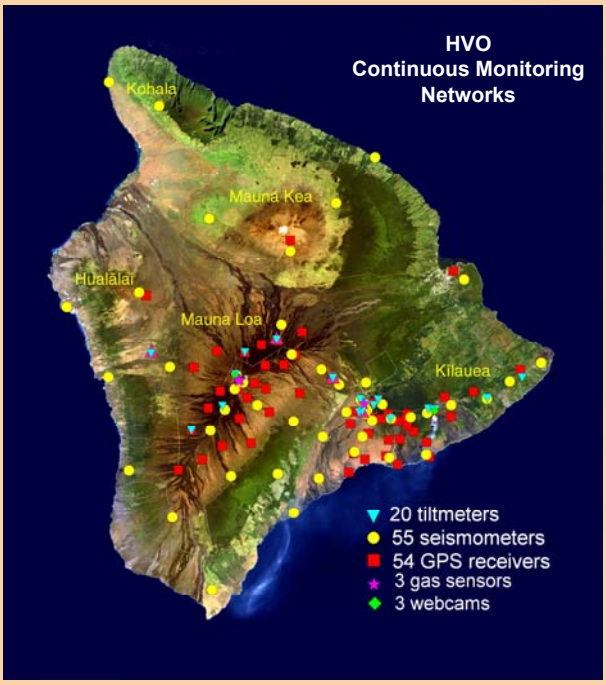


InSAR image of Mauna Loa during a period of rapid deformation in 2004-2005. *Each cycle of colored fringes represents about 3 cm (1.2 in) of motion toward the satellite. The butterfly-shaped pattern indicates inflation of a complex magma reservoir system beneath Mauna Loa.*

For more monitoring information, go to HVO and USGS Web sites at:

http://hvo.wr.usgs.gov

http://volcanoes.usgs.gov/activity/methods/index.php



Remotely located instruments transmit real-time data via radio signals to HVO 24 hours a day, seven days a week. Instruments are concentrated on Kīlauea and Mauna Loa, Hawai‘i’s two most active volcanoes.

Seismicity (Earthquakes and Tremor)

As magma moves within a volcano, it tends to break rocks and produce earthquakes that can be located and studied using arrays of seismometers. The movement of magma or gas can also produce continuous vibrations known as tremor.

Data from HVO’s seismic network is displayed on computer monitors in the observatory.

Recent earthquake information is posted on HVO’s Web site at http://tux.wr.usgs.gov/.

Seismometers are installed and maintained by HVO electronic technicians.

Webcam and Satellite Imagery

These techniques offer regular observations from fixed locations that are useful to detect environmental changes, increased steaming, or other visual changes that might indicate changes in a volcano’s status. Most satellites also have infrared capabilities that allow direct detection of heat increases produced by volcanic activity.

Satellite image of Kīlauea’s summit gas plume in March 2008.

Gas Measurements

Volcanic gases bubble out of magma as it rises beneath the volcano’s surface. Changes in the amount and composition of gas emissions can be related to magma movement.

Continuous data from gas sensors atop Mauna Loa are used to detect changes in the volcano.

Gas emissions from Kīlauea’s summit and east rift vents are sampled daily or weekly.