

Space-based technology helps HVO monitor Hawaiian volcanoes

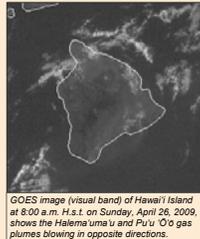
Space-based technology supplements ground-based techniques used by Hawaiian Volcano Observatory (HVO) scientists—and volcanologists worldwide—to monitor active volcanoes.

Satellites orbiting Earth provide data that can be used to detect and track the distribution of eruption plumes (ash and gases), identify and monitor thermal energy (heat) sources, and discern and measure surface deformation on volcanoes.

Some of the satellite-based techniques utilized by HVO scientists are described below.

Geostationary Operational Environmental Satellite Program (GOES)

GOES, a joint effort of NASA and NOAA, continuously records weather patterns around the world. HVO uses GOES visual and infrared imagery to detect thermal anomalies and monitor eruption plumes on Kilauea Volcano.



GOES image (visual band) of Hawai'i Island at 8:00 a.m. H.i.s.t. on Sunday, April 26, 2009, shows the Halema'uma'u and Pu'u 'O'o gas plumes blowing in opposite directions.

To learn more about GOES, see <http://www.goes.noaa.gov/>.

MODIS Thermal Alert System (MODVOLC)



This August 5, 2008, MODIS image shows three eruption plumes on Kilauea Volcano.

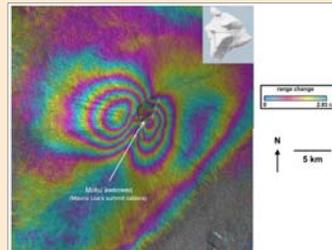
MODVOLC, developed by the University of Hawai'i at Mānoa, looks for high-temperature heat sources, such as unusual steaming or active lava flows, in images acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) sensors aboard two NASA satellites. HVO uses MODIS imagery to detect changes in a volcano's level of activity.

MODIS images can be viewed at <http://modis.gsfc.nasa.gov/>.

MODVOLC alerts are posted at <http://modis.higp.hawaii.edu/cgi-bin/modis/modisnew.cgi>.

Interferometric Synthetic Aperture Radar (InSAR)

Two radar images of the Earth's surface from orbiting satellites, differentiated only by time, are compared to show subtle ground surface movements that occur between orbits. The resulting interferogram is a detailed map of ground motion directed toward (or away from) the satellite. HVO uses InSAR to examine the topography and track surface changes on Hawai'i's volcanoes.



InSAR image of Mauna Loa during a period of rapid deformation in 2004–2005.

Each cycle of colored fringes in this interferogram represents about 3 cm (1.2 in) of motion toward the satellite. The butterfly-shaped pattern indicates inflation, or swelling, of a complex magma reservoir system beneath Mauna Loa.

To read more about InSAR, go to <http://volcanoes.usgs.gov/activity/methods/insar/index.php>.

Please visit HVO and USGS Web sites for more information on volcanoes and how they are monitored:

<http://hvo.wr.usgs.gov>

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

Global Positioning System (GPS)

GPS uses signals from a network of satellites to determine location—latitude, longitude, and altitude—of ground-based receivers.

On active volcanoes, intrusions of magma or displacements along faults can produce subtle changes in the shape of the ground. This surface deformation, which is recorded as movements of GPS receivers, can indicate where magma is located and whether or not it is likely to erupt.

GPS is an important tool used by HVO to measure surface deformation on Hawai'i's active volcanoes. Each year, HVO conducts routine campaign-style GPS surveys of about 100 sites to supplement data collected from over 60 permanent, continuously recording GPS receivers.



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



The sophisticated GPS receivers and data-analysis techniques used by HVO to measure surface deformation provide exceedingly precise measurements. Horizontal and vertical ground motions on a volcano can be determined to within fractions of an inch.



HVO geologists also use handheld GPS units to map active lava flows and other geologic features on Hawaiian volcanoes. They record location points as they walk or fly along the perimeter of a flow or feature, and then transfer the data to digital maps. These maps can be used to monitor volcanic activity and posted on the HVO Web site.

The use of GPS to monitor active volcanoes is further explained at <http://volcanoes.usgs.gov/activity/methods/deformation/gps/index.php>.