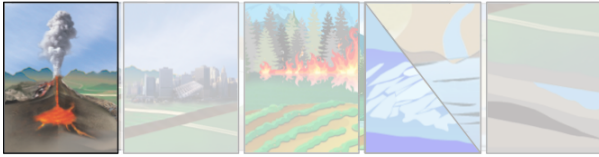


NISAR: The NASA-ISRO SAR Mission

Monitoring Volcanic Hazards

Earth is home to about 1,500 volcanoes that have erupted in the past 10,000 years, and today volcanic activity affects the lives and livelihoods of a rapidly growing number of people around the globe. Volcanic eruptions destroy cities and towns, eject ash clouds that disrupt air travel, and impact regional agriculture.

Volcanic hazards can be local, regional or global

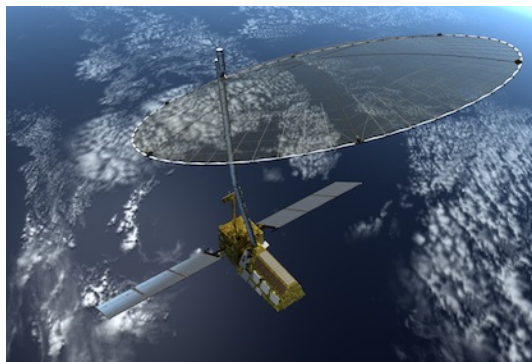
Volcanic eruptions produce a large range of associated hazards. Explosive eruptions eject ballistic rock fragments that can impact the surface up to several kilometers away from the vent. Smaller fragments are carried upward in eruption columns that sometimes reach the stratosphere, forming eruption clouds that pose a serious hazard to aircraft. Volcanic ash fall can collapse buildings, and even minor amounts can impact electrical systems and disrupt everyday life. Volcanic gases contribute to health problems, and also to acid rain that causes corrosion and harms vegetation and livestock. Lava flows inundate property and destroy infrastructure. Volcanic mudflows have the potential to devastate entire cities even far from the source volcano. Pyroclastic flows—high-speed avalanches of hot pumice, ash, rock fragments, and gas—can move at speeds in excess of 100 km/hr and destroy everything in their path.

Image Credit: USGS

**Monitoring Volcanic Activity with Radar**

Many volcanic eruptions are preceded by surface deformation induced by moving magma beneath the ground. Measuring this deformation is key to understanding the potential for future eruptions. Radar

observations from NISAR and other satellite missions can play a direct role in helping to monitor volcanoes and assess associated hazards, both during periods of unrest and during ensuing eruptions.

**The NISAR Mission: Diagnosing the state of Earth's land**

The NASA–ISRO Synthetic Aperture Radar (NISAR) mission, a collaboration between the National Aeronautics and Space Administration (NASA) and the Indian Space Research Organization (ISRO), will provide all-weather, day/night imaging of nearly the entire land and ice masses of the Earth repeated 4-6 times per month. NISAR's orbiting radars will image at resolutions of 5-10 meters to identify and track subtle movement of the Earth's land and its sea ice, and even provide information about what is happening below the surface. Its repeated set of high resolution images can inform resource management and be used to detect small-scale changes before they are visible to the eye. Products are expected to be available 1-2 days after observation, and within hours in response to disasters, providing actionable, timely data for many applications.



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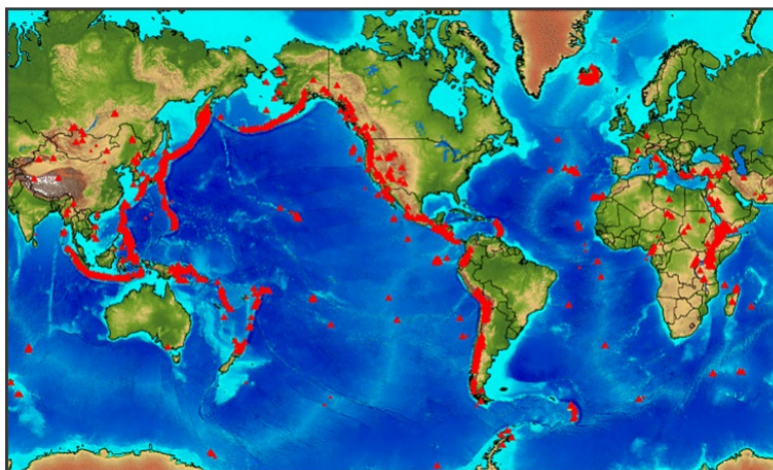
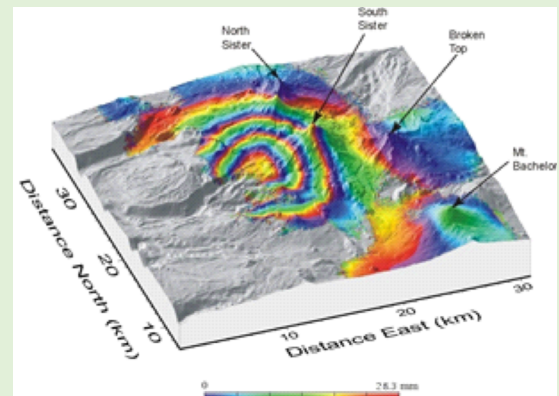
Data from NISAR and other radar missions allow us to identify and monitor surface deformation at quiescent and active volcanoes through the use of radar interferometry (InSAR). Only InSAR has the capability for monitoring deformation at virtually all of the world's potentially active volcanoes on land. InSAR observations allow us to build models of subsurface magma movement preceding, accompanying, and following eruptions – information that is critically important to understand the state of activity and anticipated hazards. Radar images that allow us to monitor and characterize volcanic processes are also used to map the extent of eruptive

products, like lava and ash, during an eruption. When combined with other measurements of volcanic activity, data from NISAR will facilitate the development of more realistic depictions of active volcanoes, which are critical for eruption forecasting.

All NISAR data products, including the InSAR results, will be freely available through a web portal. This way, the nation's investment in land surveys remotely acquired from space can be widely used by a variety of agencies and individuals to monitor volcanic processes and mitigate associated hazards.

Monitoring Volcanoes with InSAR

More than 50 volcanoes in the United States have erupted one or more times in the past 200 years. The most volcanically active regions of the nation are in Alaska, Hawaii, California, Oregon, Washington, and Wyoming. Unlike other techniques that rely on measurements at a few points, InSAR produces a map of ground deformation that covers a very large spatial area with centimeter- to millimeter-scale accuracy, even over remote areas with no ground-based monitoring resources. The figure to the right shows uplift (depicted as colored fringes) of the Three Sisters Wilderness in Oregon during 1995-2001, which was discovered by InSAR and would not otherwise have been known. The InSAR data indicated the intrusion of about 20 million cubic meters of magma about 5 km beneath the ground. The last eruption in this region was about 1500 years ago, and there will certainly be another eruption in the area in the future. Advanced knowledge of magma accumulation allowed for a better ground-based monitoring network to be installed, and for better communication of potential hazards to the local population. Image Credit: USGS



*Map showing areas of volcanoes in the world
[Global Volcano Program/Smithsonian
Institution; US Center for Disease Control]*