Monitoring Risk – Wildfires, Volcanoes, and Geohazards

Wildfires

Fire is a force of nature that humans have harnessed to heat our homes, cook our food, and clear land. But though we employ it regularly to our benefit, fire can very easily become a destructive force through carelessness and mistakes or via natural means.

Satellite observations can provide valuable information about wildfire risk conditions, which can help emergency managers and firefighters identify potential fire ignitions in even the most remote areas and reduce response times. For example, the level of drought stress in vegetation can be assessed and mapped, enabling the identification of drier areas of greater fire risk. And, from 2015, a new generation of lightning-mapping instruments on geostationary satellites will provide near-continuous hemispheric monitoring for lightning flashes – one of the leading natural causes of wildfires.

Once wildfires have taken hold, satellite observations help in providing information on fire extent, intensity, and hot spots over broad regions, including in remote areas that are not otherwise systematically observed. In addition, both meteorological and land-surface imaging satellites provide observations of smoke conditions, which is an important input to air quality monitoring.

Volcanoes

As discussed in the Part II case study on Volcanoes and Aviation, tracking the course of a volcanic eruption takes constant monitoring. In addition to helping track volcanic ash plumes, satellites provide a valuable tool for observing the ground around volcanoes for signs of deformation (see InSAR inset). Ground deformation can indicate that magma is flowing, which can be a valuable marker for a potential eruption.

The study of satellite data collected over volcanoes since the 1990s has shown that while deformation is not a certain indicator of impending eruption, a lack of deformation is an important indicator that no eruption will occur, with fewer than 10% of volcanoes that did not deform still erupting.

InSAR cannot replace existing field-monitoring methods, but does provide a useful addition to volcano-monitoring capability. In particular, InSAR is useful for keeping an eye on volcanoes that are difficult to access or that do not have ground-based instruments installed.

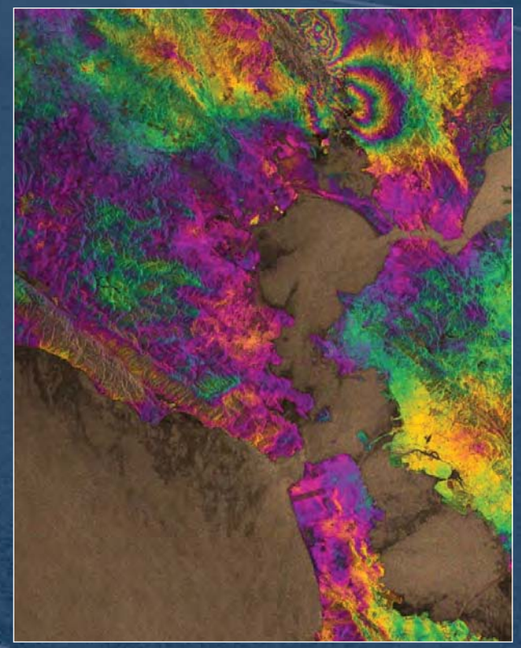
Geohazards and InSAR

Geohazards include a range of geological phenomena that present the risk of widespread damage over the short and long term, locally and more broadly – in particular earthquakes and landslides. InSAR is a powerful tool for monitoring the risks associated with geohazards.

InSAR uses two or more radar images in combination to detect surface changes over large areas. Small changes on the ground modify the reflected radar signal and lead to the rainbow-coloured fringes in the interferogram.

Unlike other techniques that rely on measurements at a few points on the ground, InSAR produces a spatially complete map of ground deformation with centimeter accuracy in a timely manner, and without subjecting field crews to hazardous conditions on the ground. The capability that satellites bring in this area represents a major leap forward in the way we will be able to monitor catastrophic geohazards in the future.

InSAR is used in some areas to track rates of subsidence, which can be a marker of potential landslide risk. It is also valuable for identifying the surface break of an earthquake and providing a guide to where rupture has not yet been detected or mapped.



Interferogram from Sentinel-1 / Napa Valley, CA, US

Image credit: ESA