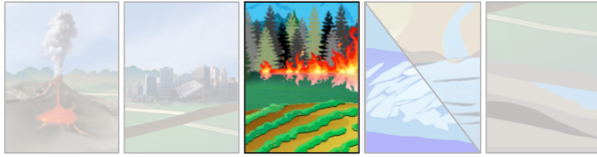


NISAR: The NASA-ISRO SAR Mission



Smart Firefighting: Arming land managers with new information

Fires are crucial to many ecosystems, yet often threaten developed urban areas, protected lands and regional air quality. Categorizing fire danger, detecting fires, identifying area burned and quantifying the severity of fires is critical for mitigating the impacts of fire.

Modern Technology and Fire

Fire management includes a combination of ground tactical strategies, inter-agency coordination, simulation modeling, proactive fuels management, and post-fire remediation. These activities are informed by field observations and make use of satellite and airborne observations in the visible to thermal infrared portion of the electromagnetic spectrum such as MODIS and VIIRS, which provide a continuous record of global fire detections since 2002, or Landsat sensors that provide area burned and land cover and land use information.

The use of remote sensing data in the fire management community is prolific, however optical imaging methods can be ineffective in cloudy areas and at high latitudes when daylight hours are short, e.g., Alaska. Radar imaging can help fill these information gaps.

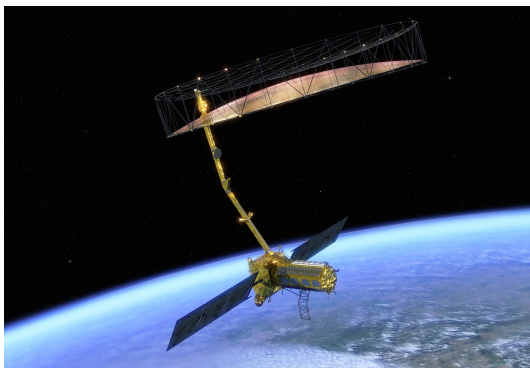


Photos (clockwise): USFS/Mike McMillan, NASA/JPL-Caltech, USDA, Flickr: Lisa, CC BY-NC 2.0

Fire management

Environmental protection policies and resources to manage public lands have remained relatively constant, yet high impact fires are becoming more common as urban sprawl into wildlands grows. In 1995 the cost to

fight wildland fires was approximately 16% of the US Forest Service budget but by 2015 it had grown to 52% of the annual budget (USFS 2015).



The NISAR Mission – Reliable, Consistent Observations

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. NISAR will also provide forest volume and biomass over time and with enough detail to reveal changes on human scales. 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.

NISAR: The NASA-ISRO SAR Mission

Land and fire managers are looking for as much information as possible to help manage fires. Because of the dangerous nature of fires and their sometimes-remote locations, remote sensing is a widely used and accepted tool used by national and international organizations to detect active fires, monitor impacts from fire and assess fire danger. For example, the National Interagency Coordination Center (NICC), the US Forest Service Wildland Fire Assessment System (WFAS), the US Forest Service Remote Sensing Application Center and the National Aeronautics and Space Agency (NASA) are among the key organizations in the U.S. providing information to land and fire managers of daily and seasonal projected fire danger, active fire detections, area burnt, and fire severity. Fire danger is determined by current moisture conditions, duration of those conditions, and vegetation water content, while fire severity refers to the total environmental change caused by fire. Managers customize this information based on local expert knowledge of the total fuels available to burn to provide

public service announcements and develop management strategies to mitigate potential impacts.

The upcoming NISAR mission will address fire management needs through a dependable observing strategy that will collect high resolution synthetic aperture radar (SAR) images over 90% of the Earth's land surfaces throughout the year. Radar images from satellites, such as NISAR, are known for their ability to penetrate through clouds, and their day/night imaging capability. NISAR imagery can provide observations that complement optical data and independent information that is sensitive to the changing structure and moisture conditions of terrestrial (land) ecosystems. Specifically, radar remote sensing with NISAR can provide observations detecting disturbance, vegetation and soil water content that are useful for monitoring fire danger, and biomass that is useful for quantifying total available fuel to burn and emissions lost to the atmosphere. All of these observations can help managers make informed decisions on how to allocate limited resources.

Active Fire Mapping using Radar

Observations of the Earth's land surfaces from space using radars makes it possible for reliable and repeated measurements to be made throughout the year despite varying duration of daylight hours or cloud cover. The structures of different land cover types provide a rich variety of responses to the radar illumination through time-varying polarization signatures. Because of the rapid changes in structure and composition after disturbance like wildfire, information like this can be used to determine area burnt, even when traditional methods do not work well.

Shown at right is the fire burn scar of the 2015 Lake Fire in San Bernardino National Forest, California. The image on top shows probability of change derived from interferometric radar (InSAR) using 14 pre-event images and one post-fire image from an overpass on June 29, 2015, using the airborne Jet Propulsion Laboratory (JPL) Uninhabited Aerial Vehicle (UAV) SAR radar instrument, which is a testbed for NISAR. For comparison, the plot shown at right below is the differenced Normalized Burn Ratio (dNBR) fire severity map obtained from Landsat. The radar is able to identify the more severely burned areas. Although it was possible in this particular fire to use both Landsat and InSAR data, there are many areas (e.g., Alaska) where it is frequently too dark or overcast to produce maps from optical data on a regular basis. Use of radar can improve mapping capabilities across many areas.

