National Aeronautics and
Space Administration

Making Large Scale Stewardship of Forest Resources a Reality

NISAR is designed to monitor global forest extent and quality and to provide accurate and timely information on forest volume and products for sustainable development and management of ecosystem goods and services.

A 21st-Century Global Forest Watch

Forest ecosystems provide timber, fuel, and bioproducts and a variety of services by sequestering carbon from the atmosphere into the forest, purifying water and air, and maintaining wildlife habitats.   One of the greatest challenges facing forest managers in the US and elsewhere in the world is to maintain the health and resilience of the forest ecosystems. This requires a coordinated effort for systematic monitoring of forest cover, volume, and productivity, to develop techniques and policies for improving the stock and sustainable use of woody biomass.

Optical satellite observations as in Landsat have played a major role in monitoring the forest cover and changes globally. But, with the advent of modern radar techniques as in NISAR, frequent and uninterrupted observations of forest volume can become a reliable data and tool for forest managers to assess forest status.

Photos (clockwise): Flickr: Johan Weiland (CC BY-NC 2.0), USFS, Flickr: Neil Palmer/CIAT (CC BY-NC 2.0), NASA/GSFC

Forest Management and Monitoring

Forest managers and agroforestry industry are in need of accurate and timely data over large areas to assess forest development and prescribe actions necessary to achieve regeneration objectives. Increasing emphasis on ecosystem management, escalating silvicultural (e.g. reforestation) treatment costs, evolving computer-based decision support tools, and demands for greater accountability have produced significant demands for spatial data on forest structure and productivity at national and subnational scales globally.

The NISAR Mission – Global Observatory of Forest Ecosystems
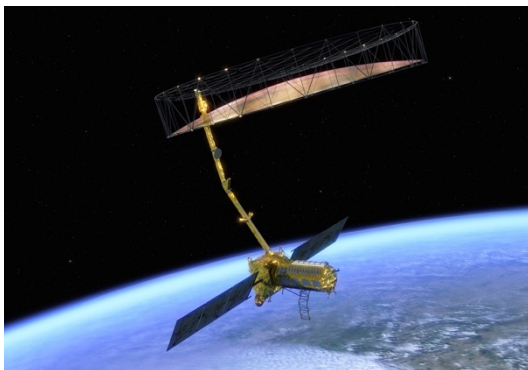
The NASA–ISRO Synthetic Aperture Radar (NISAR) mission, a collaboration between the National Aeronautics and Space Administration (NASA) and the Indian Space Research Organization (ISRO), will provide all-weather, day/night imaging of nearly the entire land and ice masses of the Earth repeated 4-6 times 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.

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In the US, the Forest and Rangeland Renewable Resources Planning Act of 1974 directed the Secretary of Agriculture to make and keep current a comprehensive inventory for a prospective Renewable Resources Assessment of the forest and rangelands of the US. These assessments were focused on analysis of present and anticipated uses, demand for, and supply of the renewable resources, with consideration of the international resource situation and with a strong emphasis of pertinent supply, demand and price trends. With increasing threats to forest resources from droughts, fire, and fragmentations, tracking the forest health, biomass stock, and tangible products such as timber has become a part of national security both at home and globally.

Moving toward an inclusive monitoring system, which can augment and enhance the national inventory data, requires a departure from the past remote sensing of only the forest cover. New active remote sensing techniques using both lidar and radar have the capability to measure both forest height and volume. This high spatial resolution data on forest structure and biomass density can be readily integrated into existing forest inventory systems.

The upcoming NISAR mission will observe forests weekly and collect the information needed to map global forests and shrub lands at 25 m resolution multiple times per year. Data products will be made available at intervals that are commensurate with the need of forestry organizations and industry in the U.S. and around the world. NISAR images will provide near global information sensitive to aboveground forest structure, and can be converted to forest volume and biomass once calibrated with the forest inventory data. The measurements collected every 6 days can help monitor forest disturbance and recovery from both natural and human sources allowing managers to improve forest health and products.

Radar Imaging of Forest Volume and Disturbance

With increased urbanization in proximity to forests, along with a growing variety of vegetation (fuel types) from changes in the landscape and management strategies, there is a pressing need for accurate, cost-efficient, large scale maps of forest biomass, fuel loads, disturbance and recovery. Emerging remote sensing technologies can provide exactly the kind of large scale maps needed to more accurately predict forest biomass, fuel loads, fire risk, and fire behavior.

 "The technology is now there to use radar to estimate forest fire fuel load (e.g. branch and stem biomass). And the team recognized that a much more efficient, accurate, and cost effective approach to sensing forest structure and fuels—and then mapping them—might lie at the heart of radar remote sensing technology," said biologist Don Despain, now retired from the US Geological Survey in Montana, who was instrumental in generating the fire management plans for the Yellowstone National Park.

Shown at right is the derived forest volume from airborne radar data (AIRSAR) data over the Yellow Stone National Park. NISAR will provide similar measurements from a spaceborne platform to enable monitoring changes of forest volume and fuel loads across the park weekly.

Yellowstone National Park

Volume m³ /ha

■	0-50
■	50-100
■	100-150
■	150-200
■	200-300
■	300-400
■	400-500
■	500-750
■	> 750
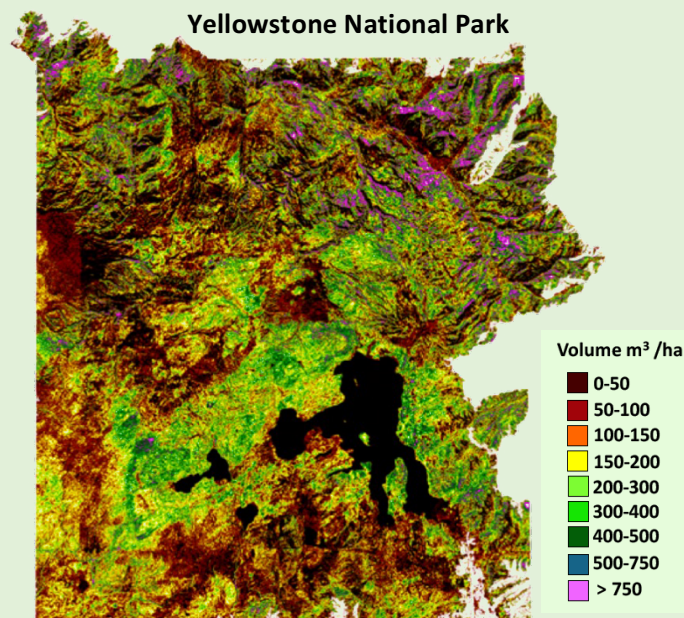
L-band airborne radar data collected over the Yellowstone National Park in 2003 was used to develop maps of forest volume and fire fuel load to help with park management and fire suppression for improving the recreational resources and revenues. (Saatchi et al. 2007).

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For more information, visit http://nisar.jpl.nasa.gov/applications

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