National Aeronautics and Space Administration

NISAR: The NASA-ISRO SAR Mission

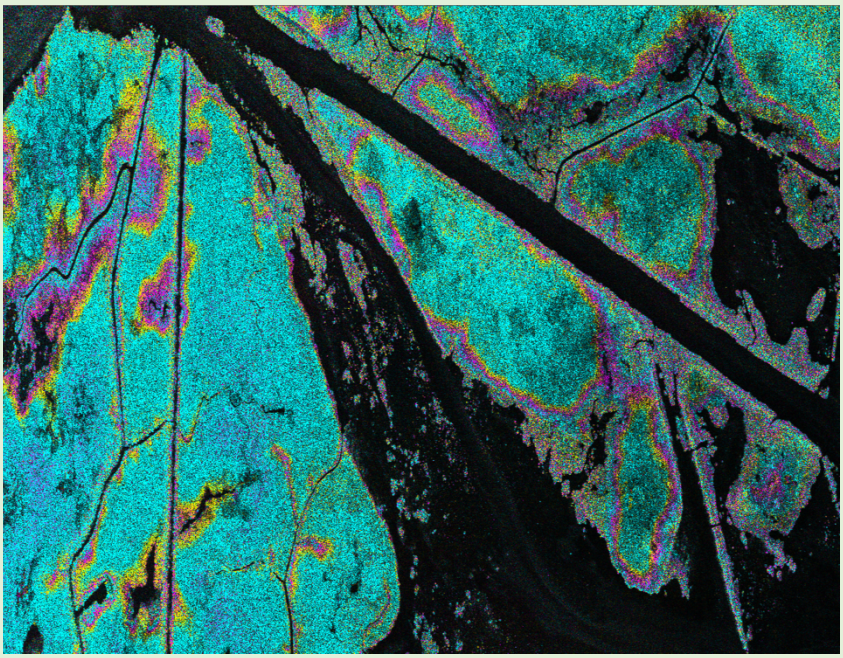
Flood Forecasting

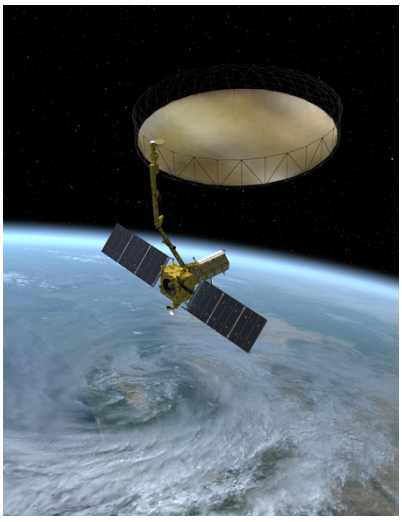
Flood forecasting informs downstream communities if a flood is coming and how much flooding to expect. Like a virtual stream gauge, synthetic aperture radar is able to measure changing water levels in standing vegetation as flood waters from heavy upriver rains head downstream.

Flood prediction can save lives and property

U.S. agencies, such as the NOAA Advanced Hydrologic Prediction Service and the US Army Corp of Engineers, monitor river levels using stream gauges permanently installed throughout the country. NISAR will augment this sparsely distributed network of stream gauges with continuous maps showing change in water levels in flooded areas.

The image to the right is an example of a false color "change in water level" map made from two radar images acquired two days and 7 hours apart by NASA's UAVSAR airborne radar in May 2015. The colors indicate how much the water level in the tidally flooded marsh near Wax Lake, Louisiana, has changed during the time period between the two observations. Blue/green areas are not flooded, and therefore unchanged, but yellow, orange and red areas have changed in water level by up to several inches. Black areas are open water and are surrounded by inundated vegetation. This type of information can provide invaluable information about changes in flood conditions for local, state, and federal agencies that provide assistance. [UAVSAR image NASA/JPL]





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. 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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Change in upstream water levels can be very useful for predicting downstream flooding. Permanent stream gauges are installed and monitored specifically for that purpose, but they are sparsely distributed. Not only will NISAR be capable of augmenting this network of stream gauges with continuous maps of change in water level in some areas, but NISAR will also be capable of monitoring the change in the level of floods far from the main river channel, where water can increase in level and subside at different rates. The same technology can provide information about soil moisture, another parameter needed for flood forecast models.

During natural disasters, first responders often look to NASA to provide timely and valuable information to assist their work to mitigate damage and assess destruction by these common tragic events.

Many federal agencies and university researchers have difficulty evaluating the health of our waterways and wetlands due to lack of information regarding the ebb and flow of food waters during normal and extreme seasonal flooding. The data from NISAR over wetland areas will be invaluable to management authorities, scientists, and local planning agencies.

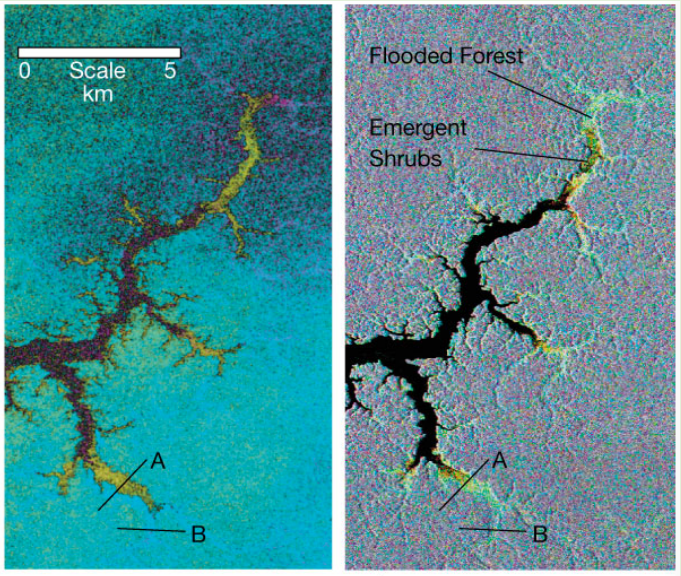
NISAR can meet these diverse needs through its dependable observing strategy that will collect high resolution data over 90% of the Earth's land surface. The use of actively generated microwave signals (L- and S-band, or equivalently 24 cm and 10 cm wavelength) by the satellite means that observations can be reliably planned, collected, and distributed. SAR images from satellites, such as NISAR, are known for their ability to penetrate through clouds and their day/night imaging capability. NISAR will provide crucial information regarding flooding events, even in remote areas without stream gauges or other sources of ground data measuring flood conditions.

Remote sensing of flood pulses

Using a technique called interferometry (InSAR), it is possible with radar to precisely measure very small changes in water level in areas with standing vegetation if repeated observations by radars like NISAR, are made from the same vantage point, i.e., from the same orbit.

This was first demonstrated with the NASA SIR-C mission that flew on the NASA Space Shuttle in 1994. SIR-C twice imaged the Purus River, a tributary of the Amazon–Solimões River, during flooded conditions. From these images, it was possible to measure centimeter-level changes in water level during the 24 hours that had elapsed between the observations. SIR-C demonstrated that radar could be used to make these types of measurements.

The unprecedented NISAR observing capability can provide this measurement twice every 12 days for the duration of the mission for the entire globe. NISAR will function like a virtual stream gauge for flooded conditions that occur along most of the world's major rivers, capable of precisely measuring change in water level with every observation.



"Change in water level" products in flooded, vegetated areas were first demonstrated by the NASA SIR-C Synthetic Aperture Radar (SAR). In this image, centimeter-level changes in water level were measured over the Purus river in Brazil from two observations acquired just 24 hours apart. (Alsdorf et al., Nature, 2000). Colors indicate how much the water level changed between the two observations. Between transects A & B there is 1-5 cm change in water level.