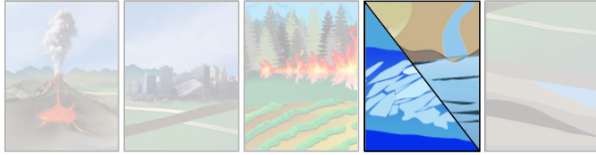
**NISAR: The NASA-ISRO SAR Mission**

Coastal Regions and Ocean Moods

Coastal regions contain rich environments that provide livelihoods for millions of people worldwide. However, because of their location at the margin between land and water, these areas are at risk from fluctuating conditions that exacerbate land loss, threatening the very ground beneath people's feet.

Delta Blues

The Mississippi Delta is the 7th largest delta in the world, with coastal wetlands covering ~4,000 mi². Its basin extends from the Gulf of Mexico to near the border with Canada, draining over 40% of the contiguous United States. Despite the fact that the Mississippi River carries 436,000 tons of sediments every day, it is estimated that 25% of the delta's land has been lost since 1932. Recent satellite records show the rate of land loss to the sea is 16.6 mi² per year. That is equivalent to losing 1 football field every hour. America is shrinking.

The loss of coastal wetlands increases vulnerability of infrastructure and populations along the coasts, and releases carbon that had previously been captured in wetland soil through erosion and oxidation. However, a few regions are growing and building land. What makes the difference between loss and gain?

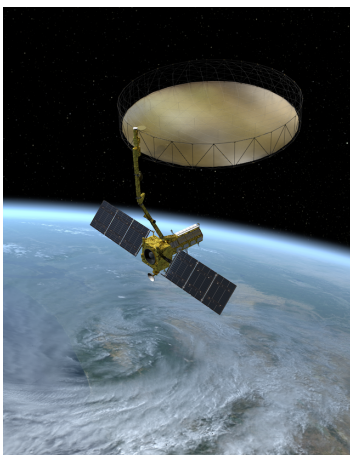


Photos (clockwise): U.S. Fish & Wildlife Service, NASA/JPL-Caltech, California DWR, USGS

Living on the Edge: The Ups and Downs of a Coastal Existence

About 40% of world's population and 39% of U.S. residents live in coastal areas, much of which is low elevation land. Coastal regions contain significant resources that support the livelihood of millions of people, providing food, protection and a wide variety of economic

opportunities. They host critical infrastructure related to transportation, fisheries, tourism and oil exploration. However, coastal resources and infrastructure are vulnerable to the ocean's moods, e.g., erosion by waves, sea level rise, storm surges and hurricanes.

**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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Land loss in low elevation coastal regions is driven by a complex array of factors. In the wetlands, wave-induced erosion is often tied to the health of the wetland vegetation, whose roots act to hold the soil together. In addition to erosion from physical wave action that is increased during storm surges, the presence of toxins or water of the wrong salinity or temperature can stress the plants, causing them to have less robust roots. The erosion is exacerbated by a lack of the influx of sediment that would help rebuild the land, and this loss significantly reduces the deposition of new soil to offset the loss to the ocean. The sediment carried by the river is either captured upstream in dams or prevented from entering the wetlands by levees intended to prevent storm surge from reaching population centers and economic assets along the river feeding the delta.

In the end, however, the wetland loss leads to deeper inland intrusion of the storm waters, a positive feedback loop whereby the wetlands recede, leaving coastal cities at greater risk from high winds and water during storms that blow in from the ocean.

It is encouraging to learn that in a few areas coastal deltas are actually expanding rather than losing ground. Understanding the difference between land loss and land gain may be critical to saving the deltas, because this information informs how to reverse the land loss in the shrinking deltas.

With coastal populations growing at rates nearing 10% every decade and the concomitant increasing demand for ocean resources, it becomes critical to understand the processes by which coastal wetlands are resilient or become vulnerable to the ocean's mood. Satellite imaging is the most efficient and reliable method to monitor the status of low elevation coastal regions given their large size and global geographic distribution. In particular, the oft-present layer of clouds covering these areas requires radar imaging, which pierces through clouds, providing an on-demand access to imagery of coastal areas. Because NISAR is a NASA instrument, its data will be available free of charge, so that it can be used to reduce risk to life and property throughout the United States.

Radar Imaging of Coastal Wetlands

In wetlands, the health of the vegetation is often an indicator of the area's resilience to storm surge, and hence to its ability to protect inland populations. Vegetation serves to decrease the energy of the incoming waves of a storm surge and to lower wind speed through increased resistance to near-surface flow. Radar remote sensing can be used to determine the type and status of vegetation, showing the spread or declines of species in response to changes in water depth, salinity, and temperature. Earth observations from space using the NISAR microwave radar will enable reliable and repeated measurements to be made of the coastal and inland large water bodies of the United States, informing land managers of where and how to implement coastal restoration projects.

Right: Radar-derived map of the Mississippi River indicating vegetation canopy height.

