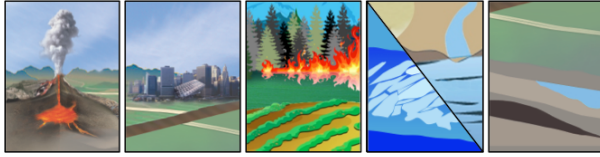




NISAR: The NASA-ISRO SAR Mission



Observing Hazards and the Environment of Florida

Florida's mild climate, beautiful beaches, exotic landscape, and abundant wildlife make it a popular destination for tourists from across the globe. Florida's resiliency to threats to these natural wonders can benefit from NISAR's observations of sinkholes, hurricanes, flooding, and the health of the Everglades.

Florida's Delicate Environment

Florida's beauty is the result of the balance between low-lying coastal areas, wetlands, and the shallow ocean combined with the subtropical climate. When humans settled along the coast, they were subjected to the hazards associated with rising seas, coastal erosion and risk from storm surges and flooding. Meanwhile under the surface, newly introduced saltwater can infiltrate into the porous limestone, threatening the water supply and coastal ecosystems. Monitoring these hazards and the changing environment is vital for the preservation of Florida.

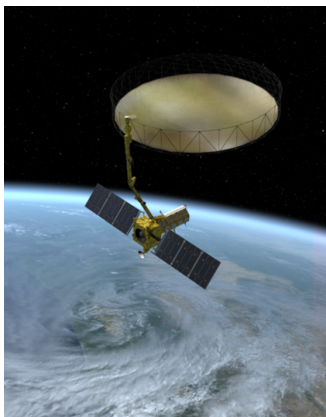


Photos (clockwise): USGS, FEMA, NOAA, NPS

Sinkholes

Sinkhole activity is a major natural hazard in Central Florida, causing \$200 million per year in property damage. In limestone areas sinkholes form after circulating groundwater has dissolved the rock under the surface. When a cavity has grown too big to support the overlying land, a sinkhole opens. Catastrophic collapses are likely preceded by subtle subsidence of the land surface by an

inch or less over periods of weeks to years. NISAR is an advanced radar system that can measure ground displacements of a fraction of an inch. With a repeat interval of 12 days and a spatial resolution of 100 square feet. NISAR can potentially identify surface movement indicative of underground activity before a sinkhole forms.



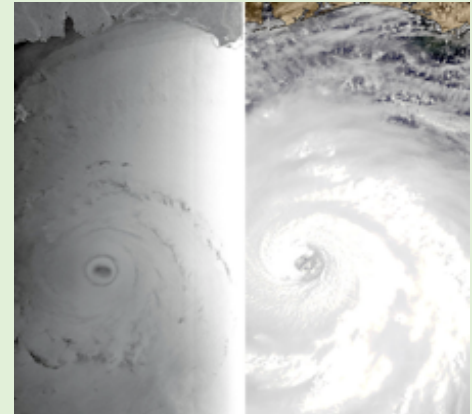
The NISAR Mission – Reliable, Consistent Observations

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.

Hurricanes

When a hurricane approaches, Floridians rely on forecasts by the National Hurricane Center for personal decisions about their safety. Whereas the forecasts of the hurricane tracks have improved significantly over the past decade, intensity forecasts remain difficult. Over the open oceans, in-situ observations are sparse. NISAR's all-weather day/night radar instrument can measure how the ocean surface has been agitated by the forceful winds, providing surface wind speed information to better model and forecast hurricanes.

Synthetic Aperture Radar image (left) and optical satellite images (right) of Hurricane Katrina on August 2005 were acquired by the European Space Agency's satellite Envisat. The radar senses the ocean surface, whereas the optical scanner senses the top of the clouds. The eye of the hurricane appears dark in the radar image, because the wind is less forceful in this area.



Credit: European Space Agency

Rising Sea Levels

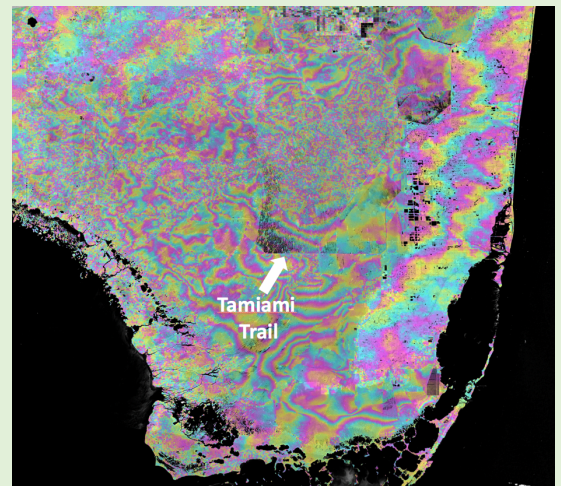
The hazards in Florida's coastal areas, particularly storm surges associated with hurricanes and nuisance flooding during high tides, are exacerbated by rising seas. More than 10% of the State's population of 21 million live at elevations 4" or less above the high tide level. The southeast Florida counties, collaborating through the regional Climate Change Compact, are preparing their cities for 12"-26" higher seas by 2060, requiring significant public investments. This does not include measures to secure the water supply, and it remains unknown when wells will turn salty. Long-term planning is difficult because the sea level projections are

uncertain. What is known is that Florida's fate is closely linked to the fate of the polar ice sheets and to Greenland in particular. A 1% reduction of the mass of the ice sheets would lead to global sea level rise of 2 feet. The ice sheets are losing mass by melting at the surface and by accelerated flow of the glaciers. The upcoming NISAR mission will provide frequent and regular measurements of the speed of the polar glaciers to determine whether the glaciers are accelerating. These observations will inform sea level projections and better planning for low-lying Florida counties.

Wetlands

The Everglades wetland, also known as the River of Grass, not only provides a refuge for the south Florida's residents and unique wildlife, but it is also a driver for the tourism industry and protects low-lying terrain from the advancing ocean. Everglades restoration and conservation is a top environmental priority at both the state and federal level. The upcoming NISAR mission will contribute in the monitoring of the hydrological system and how the water flows from Lake Okeechobee to Florida Bay. The satellite is well-suited to detect changes in the water level between two consecutive images, and will provide a time series of the water level across the entire wetland.

Right: Satellite radar interferogram of south Florida from two images acquired in fall 2015 by the European satellite Sentinel-1A. One color cycle represents a 3 cm change in water level. The white arrow shows where flow is halted by the Tamiami trail.



Credit: S.-H. Hong and S. Wdowinski