Fostering Coastal Resilience In a Changing Environment

NESDIS's Capabilities Help Communities Plan and Recover

Waves as high as 18-feet crashed into California beach towns between December 2023 and January 2024—the "king tides" strewing debris, sweeping beach sand back into the ocean, and powering ocean flood waters up into the communities. The coastal flooding damaged or destroyed homes, shops, restaurants, beach access roads, playgrounds and more. At least one person died.

At NESDIS, scientists and engineers are working to better understand how climate change-induced sea level rise threatens coastal communities, ecosystems, and natural habitats with flooding and inundation. The ability of a coastal community or ecosystem to absorb events, such as higher-than-normal "king waves," and still bounce back, is called coastal resilience. The work NESDIS does helps improve coastal resilience through a variety of environmental data, information tools, products and services that can inform decisions made at local, state, and national levels.

Observing the Surface Through Clouds With Synthetic Aperture Radar

Much of the work to provide coastal resilience begins with remote-sensing: observations collected by satellites either operated by NOAA or by NOAA partners.

Advances in technology are constantly improving our ability to collect measurements from space. Satellites with Synthetic Aperture Radar (SAR) are useful in coastal storm conditions because SAR is able to penetrate clouds, capturing data regardless of weather conditions.

NESDIS scientists use satellite data to compare images taken before and after floods to create flood extent maps, which help emergency responders and managers understand the scope of the impact.

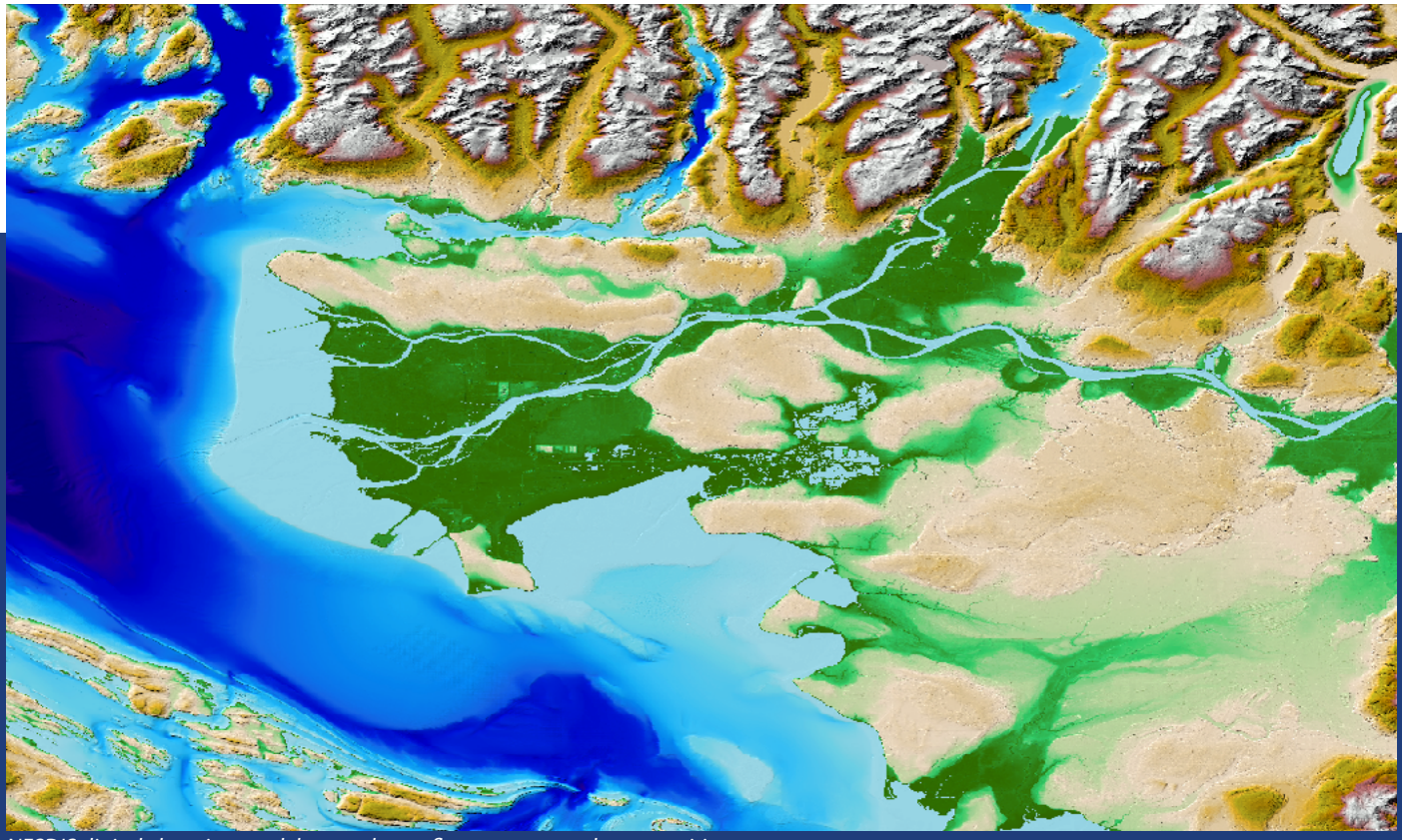
Unlocking the Potential of Satellite Data

In many cases, NESDIS partners with other federal agencies, local and state governments, universities and others to collect data. Some data come from in-situ sources, like ground sensors, which can be sparse, localized, or otherwise restricted. Satellite data helps fill in the observational gaps, and in the case of coastal communities where the depth and shape of underwater terrain is a significant consideration, can provide wide coverage in shallow waters to enable more complete mapping of coastal terrain.

NESDIS Scientists at Work

Using data from SAR and optical satellites, as well as in-situ data, a NESDIS team of specialists builds digital elevation models (DEMs) to help coastal decisionmakers. Specializing in the development of flood inundation maps that help assess the impact of coastal flooding, the effort is led by a group of scientists within the Satellite Oceanography and Climatology Division, marine Ecosystems and Coastal Branch at the NESDIS Center for Satellite Applications and Research (STAR) and the Marine Geology and Geophysics Section at the National Centers for Environmental Information (NCEI).

Coastal states and communities rely on NESDIS maps, grids, and data to model where flooding and inundation might occur – informing leaders making decisions about resilience. But those maps, grids, data and information from NESDIS—critical for U.S. coastal communities monitoring and preparing for disruption—depend on the expertise, research and services of our NOAA scientists.

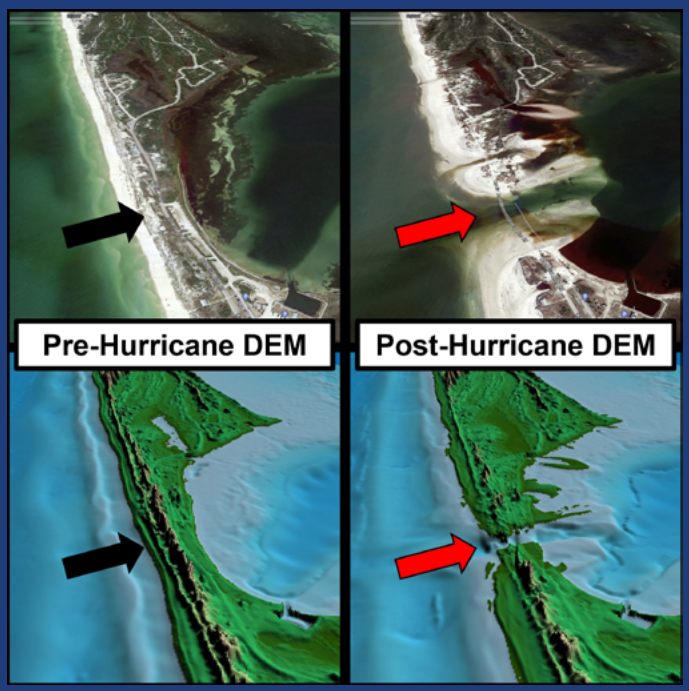


NESDIS digital elevation model maps the seafloor near coastal communities.

Resilience Toolkit Provides a Seamless Representation of The Ocean Floor

Accurate, high-resolution, three-dimensional coastal maps are essential to coastal flood modeling as the shape and depth of the ocean floor affect the speed and height of waves, and the coastal land topography primarily determines the inland extent of inundation. The NESDIS generated DEMs incorporate sonar data with high-resolution satellite lidar, satellite radar, and data from airborne campaigns map the seafloor near coastal communities.

Understanding coastal topography helps monitor for changes in coastline shape and stability, including low-lying areas susceptible to flooding and erosion. DEMs are used to create floodplain maps, which help identify and model areas prone to flooding during heavy rainfall, storm surges, or high tides such as the recent king tides that pummeled California's coastline.



Comparison of Pre-Hurricane digital elevation map and Post-Hurricane digital elevation map

Potential Exposure to Inundation?

A first look with NOAA's Sea Level Rise Viewer

This viewer gives communities a preview of their exposure to inundation from coastal flooding and sea level rise. The DEMs that form the base maps are customized for mapping inundation and have been used in selected coastal resilience efforts and for storm surge modeling and mapping by the National Hurricane Center.

Bridging The Knowledge Gap

Technical information like digital elevation models are only as good as the capability of the people expected to use them—and given the wide range of users who rely on NESDIS data products and services (local government officials, nonprofits, and private sector companies), NESDIS is working to build capacity among the user community.

Capacity-building fosters collaboration and coordination, as well as capability to use NESDIS information and products.

NESDIS-run workshops on digital elevation models give local scientists and emergency managers the knowledge required to develop and update DEMs used in modeling and planning for a resilient community.

> ***"These elevation models are crucial for assessing coastal and river water level risks from storm surges, tsunamis, and atmospheric river events and it will become even more valuable as climate change progresses with increasing sea level rise."***
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> *—Sean Mullen, Ocean Networks Canada*

> ***"The communities of Santa Cruz County are on the front lines of climate change impacts. The ability to forecast risk hazards such as tidal surges combined with extreme waves, winter rain storms, and wildfires are absolutely crucial for us. We use NOAA data to help us prepare for events, warn residents and businesses of possible dangers, and help build community resilience for future events. We've had NOAA staff embedded with us in our emergency operations center during storm events and other disasters. We rely on NOAA's expertise to help us safeguard lives, protect property, and care for our environment."***
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> *—David Reid, Director, Office of Response, Recovery, and Resilience (O3R), County of Santa Cruz, CA*