

Coastal Science Navigator Companion Guide

**Discover the U.S. Geological Survey
Coastal Science Products You Need**



Circular 1523

U.S. Department of the Interior
U.S. Geological Survey

Cover. Front—A solar-powered buoy floats in the water next to the research vessel *Sallenger*. Instruments on the buoy, along with others on the sea floor and on the beach, transmit high-fidelity, real-time wave, water level, and wind data to allow U.S. Geological Survey scientists to track how the water level transforms as waves travel toward the beach. This information is used to assess the accuracy and improve the models used in the Total Water Level and Coastal Change Forecast Viewer (see description on page 5). The resulting forecasts help inform coastal communities about potential coastal hazards.

Back—An aerial view of Fire Island, New York, showing back barrier, dunes, beach, and nearshore environments.

Title Page. U.S. Geological Survey technicians program remote field camera installations on Marconi Beach, Cape Cod National Seashore, Massachusetts. These cameras are part of CoastCams (see description on page 7), a nationwide network of coastal observing cameras. The photos they capture help researchers describe the processes at the interface of land and sea.

The background image shows two geologists working on a sandy beach. On the left, a person in a dark jacket and cap is kneeling and using a laptop. In the center, a bright yellow tripod stands on the sand. On the right, another person in a grey jacket and orange beanie is kneeling and holding a black surveying pole. The ocean and a clear blue sky are in the background.

Coastal Science Navigator Companion Guide

Discover the U.S. Geological Survey Coastal Science Products You Need

By Mira Anderberg and Sara Ernst

Circular 1523

**U.S. Department of the Interior
U.S. Geological Survey**

U.S. Geological Survey, Reston, Virginia: 2024

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment—visit <https://www.usgs.gov> or call 1–888–392–8545.

For an overview of USGS information products, including maps, imagery, and publications, visit <https://store.usgs.gov/> or contact the store at 1–888–275–8747.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this information product, for the most part, is in the public domain, it also may contain copyrighted materials as noted in the text. Permission to reproduce copyrighted items must be secured from the copyright owner.

All photographs and other images by the U.S. Geological Survey.

Parts of this guide reuse text, verbatim or with modification, previously published in the online Coastal Science Navigator and other U.S. Geological Survey websites.

Suggested citation:

Anderberg, M., and Ernst, S., 2024, Coastal Science Navigator companion guide—Discover the U.S. Geological Survey coastal science products you need: U.S. Geological Survey Circular 1523, 31 p., <https://doi.org/10.3133/cir1523>.

Library of Congress Cataloging-in-Publication Data

Names: Anderberg, Mira M., author. | Ernst, Sara, author. | Geological Survey (U.S.), issuing body.

Title: Coastal science navigator companion guide--discover the U.S. Geological Survey coastal science products you need / by Mira Anderberg and Sara Ernst.

Other titles: U.S. Geological Survey circular ; 1523. 1067-084X

Description: Reston, Virginia : U.S. Department of the Interior, U.S. Geological Survey, 2024. | Series: Circular / U.S. Geological Survey, 1067-084X ; 1523 | In scope of the U.S. Government Publishing Office Cataloging and Indexing Program (C&I); Federal Depository Library Program (FDLP) distribution status to be determined upon publication. | Summary: "Companion booklet to the online Coastal Science Navigator, a gateway to U.S. Geological Survey coastal science information"-- Provided by publisher.

Identifiers: LCCN 2024023148 | ISBN 9781411345621 (paperback)

Subjects: LCSH: Coast changes--United States--Electronic information resources. | Coastal ecology--United States--Electronic information resources. | Hazardous geographic environments--United States--Electronic information resources. | Climatic changes--United States--Electronic information resources. | Sea level--United States--Electronic information resources.

Classification: LCC GB460.A2 | DDC 333.9170973--dc23/eng/20240524 | SUDOC I 19.4/2:1523

LC record available at <https://lcn.loc.gov/2024023148>

ISSN 1067-084X (print)

ISSN 2330-5703 (online)

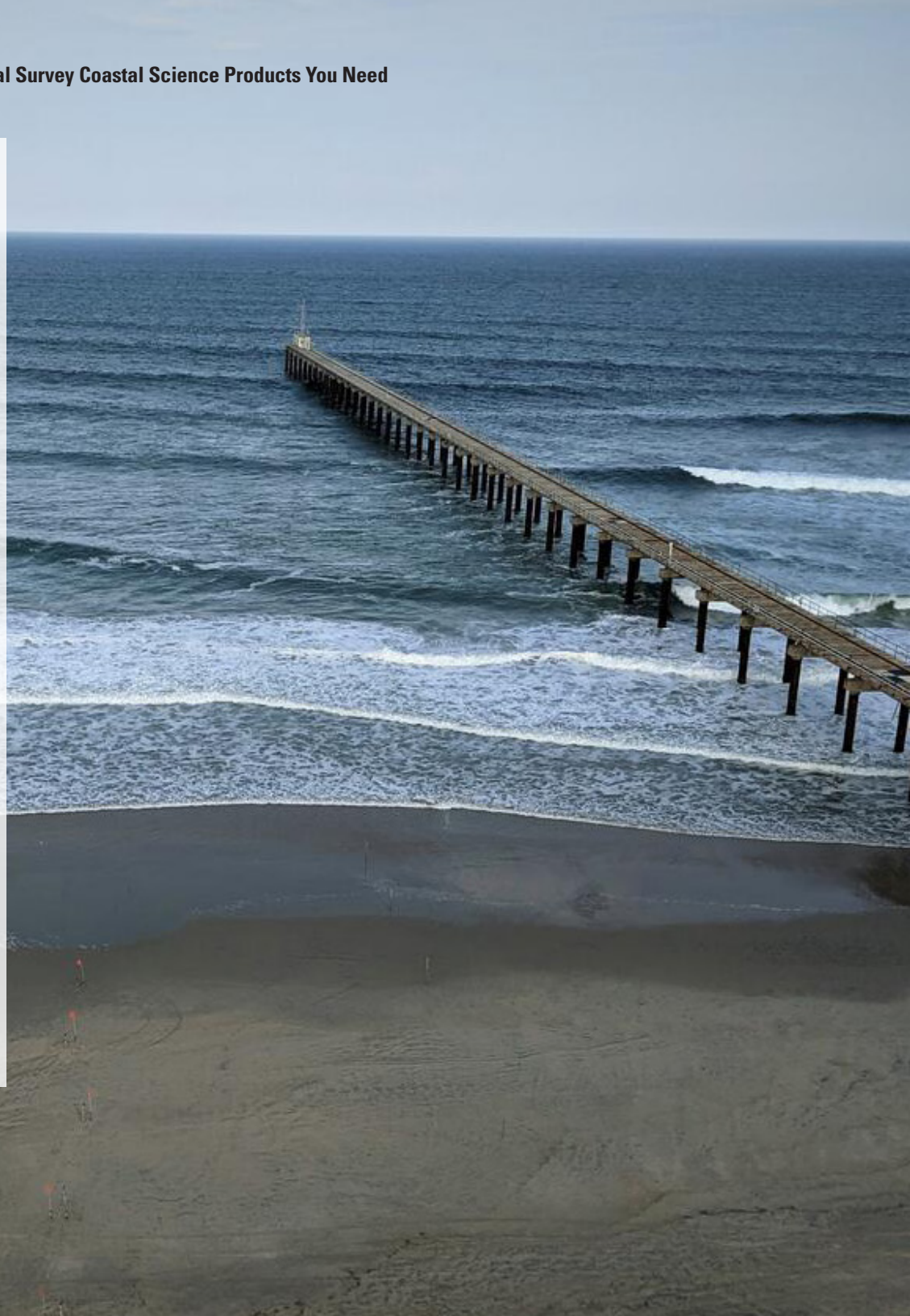
ISBN 978-1-4113-4562-1

Contents

Coastal Science Navigator Website.....	1
About This Guide.....	2
Icons.....	3
Products for the Present.....	4
Products for the Past.....	9
Products for the Future.....	16
Downloadable Software.....	21
Geographic Highlights.....	22
Atlantic Territories.....	24
Alaska.....	27
Pacific Territories.....	28
Table of Time Scale and Geographic Scope Product Filters.....	30

Abbreviations

CCH	Coastal Change Hazards
CCL	Coastal Change Likelihood
CFDT	Cliff Feature Delineation Tool
chirp	compressed high-intensity radar pulse
CMIP6	6th Coupled Model Intercomparison Project
COAWST	Coupled Ocean-Atmosphere-Waves-Sediment Transport
CoNED	Coastal National Elevation Database
CoSMoS	Coastal Storm Modeling System
CSMP	California Seafloor Mapping Program
DSAS	Digital Shoreline Analysis System
EXPRESS	Expanding Pacific Research and Exploration of Submerged Systems
GIS	geographic information system
HERA	Hazard Exposure and Reporting Analytics
IOOS	Integrated Ocean Observing System
lidar	light detection and ranging
SECAT	Seafloor Elevation Change Analysis Tool
SPCMSC	St. Petersburg Coastal and Marine Science Center
SQUID	Structure-from-Motion Quantitative Underwater Imaging Device
TWL&CC	Total Water Level and Coastal Change
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UVVR	Unvegetated to Vegetated Marsh Ratio



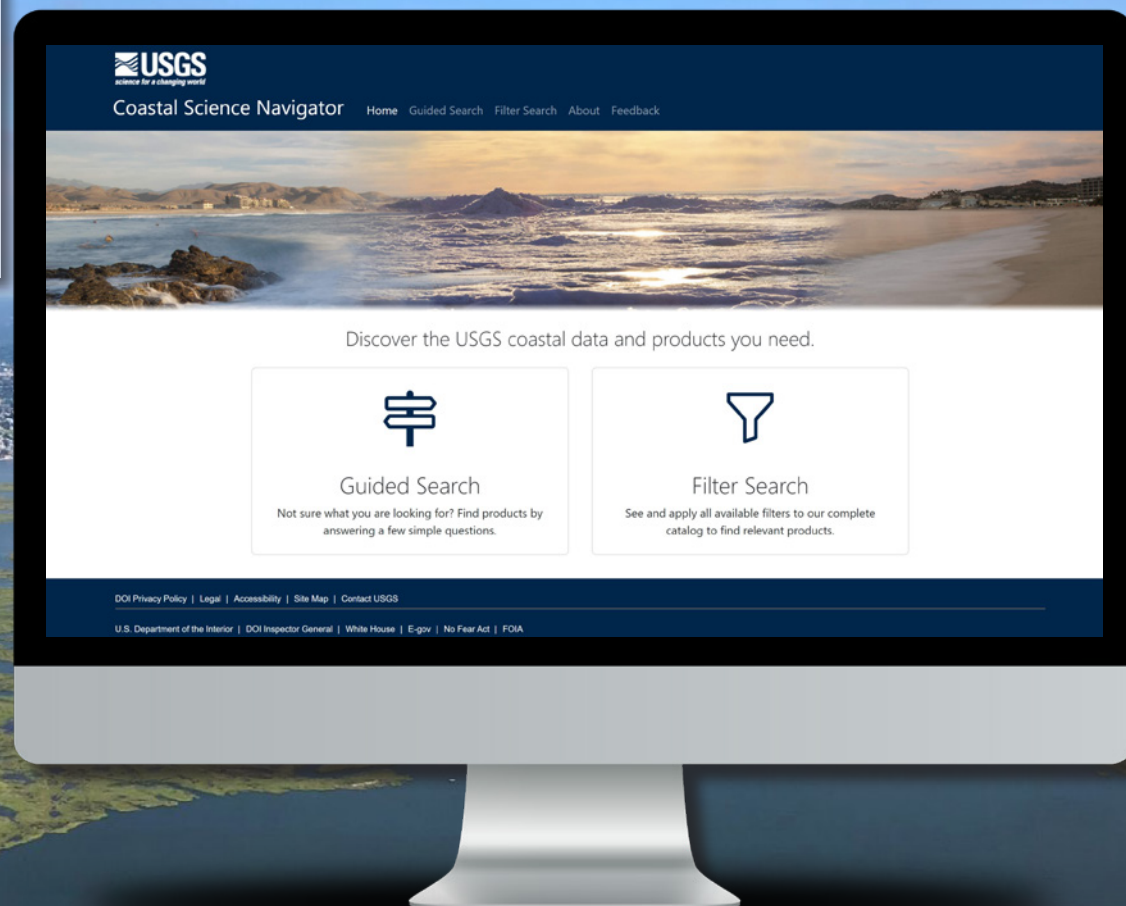
Coastal Science Navigator Website

The Coastal Science Navigator is an online gateway to a wide variety of U.S. Geological Survey (USGS) coastal change hazards-related information, data, and tools relevant to stakeholders' scientific and decision-making needs. The products within the Coastal Science Navigator provide data related to past, present, and future threats to our coastlines. The filter search allows users to see all available products and identify relevant options by time scale, geographic scope, coastal hazard theme, and other filters. The guided search suggests products based on users' answers to a short series of questions. A comprehensive summary is available for each product.

The idea for the Coastal Science Navigator arose in 2020 in response to stakeholder feedback identifying the need for a central source for USGS coastal science information. It was published in July 2023 and initially included 55 products. Regular updates are planned to integrate other existing and new products.



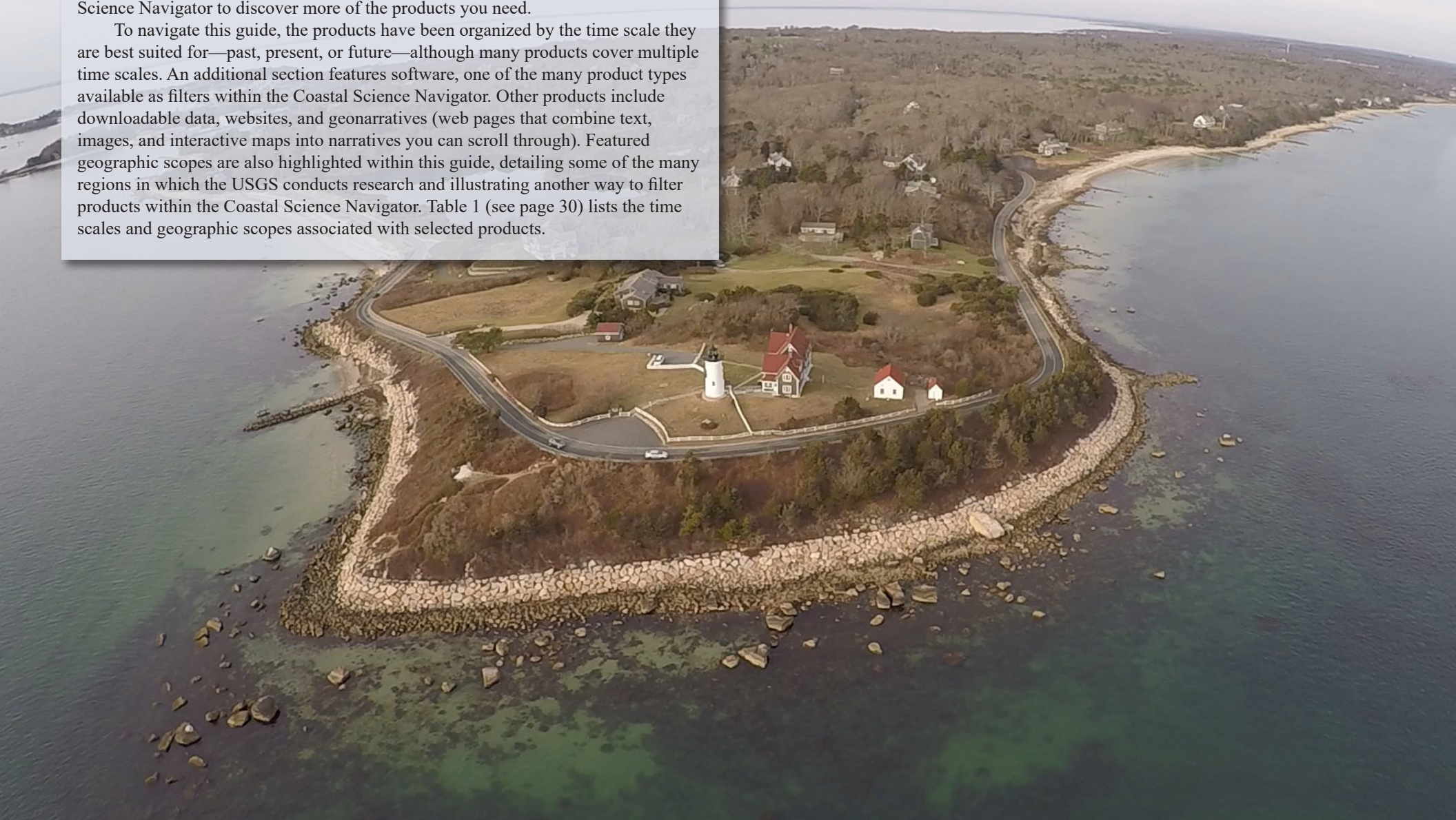
<https://www.usgs.gov/apps/coastalsciencenavigator/index.html>



About This Guide

This guide introduces some of the many coastal change hazards-related products available through the USGS. In it, we showcase the products included in the Coastal Science Navigator's initial publication in July 2023. While it is not representative of all the information, tools, and data available, we hope it serves as a compelling snapshot of what the USGS has to offer and encourages you to explore the Coastal Science Navigator to discover more of the products you need.

To navigate this guide, the products have been organized by the time scale they are best suited for—past, present, or future—although many products cover multiple time scales. An additional section features software, one of the many product types available as filters within the Coastal Science Navigator. Other products include downloadable data, websites, and geonarratives (web pages that combine text, images, and interactive maps into narratives you can scroll through). Featured geographic scopes are also highlighted within this guide, detailing some of the many regions in which the USGS conducts research and illustrating another way to filter products within the Coastal Science Navigator. Table 1 (see page 30) lists the time scales and geographic scopes associated with selected products.



Icons

Each product in the Coastal Science Navigator is tagged with filters from multiple categories. A few of the filters that can be used to search for products are reproduced here as icons below each description.

Time Scale Icons



Past



Present



Future

Coastal Hazard Theme Icons



Sea-level rise



Coastal change



Extreme storms

Geographic Scope Icons



Pacific territories



Hawaii



Alaska



West coast



Great Lakes



Gulf of Mexico



East coast




Atlantic territories



Products for the Present

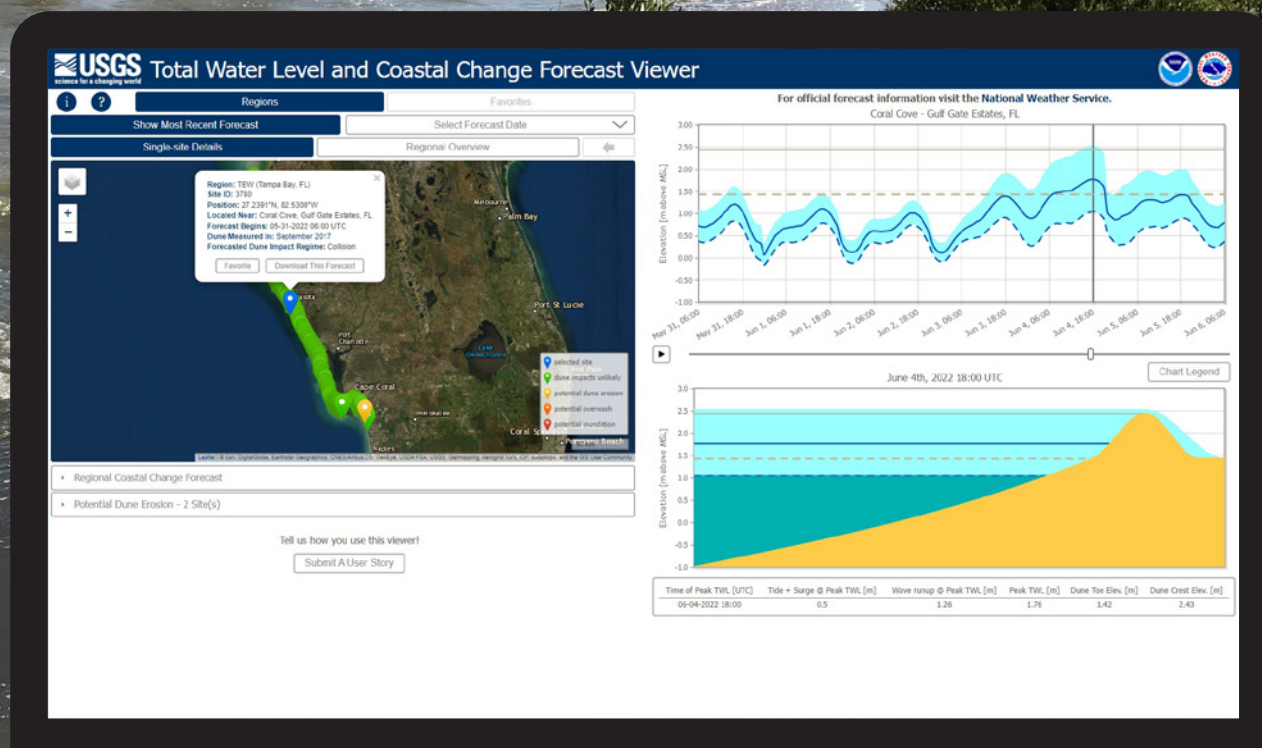
Our coasts are constantly changing on a variety of time scales as a result of multiple hazards. Products for the present (referred to as “now” within the Coastal Science Navigator) relate primarily to current coastal conditions. These include data that are released within minutes to hours after collection and forecasts of conditions for the immediate future, usually during the next several hours or up to 1 week. These products provide information on a short-term scale and address hazards to coastlines happening right now.

A large, white, spherical Helikite is suspended in the sky, tethered to a person on a beach. The beach is sandy with some dunes and vegetation in the background. The ocean is visible with waves breaking on the shore. A person is standing on the beach, looking out at the ocean.

A Woods Hole Oceanographic Institution scientist tows a Helikite on a beach in Pea Island National Wildlife Refuge on the Outer Banks of North Carolina. As an alternative to uncrewed aerial systems (commonly known as drones), U.S. Geological Survey and partner scientists use Helikites—helium-filled kite-balloons equipped with cameras—to collect imagery of the coastline. These photographs are then used to create a three-dimensional digital elevation map of the beach.

Total Water Level and Coastal Change (TWL&CC) Forecast Viewer

The TWL&CC Forecast Viewer provides real-time, 6-day forecasts of the total water level at the shoreline, as well as associated coastal changes, for mapped locations along the U.S., Gulf of Mexico, and Atlantic coastlines. Total water level is an estimate of the elevation at which the ocean meets the coast based on tides, surge, and wave runup data. The data can be used to determine the probability of dune erosion, overwash, and flooding that may threaten safety, infrastructure, or resources. Individual forecast and dune data can be downloaded directly from the viewer.

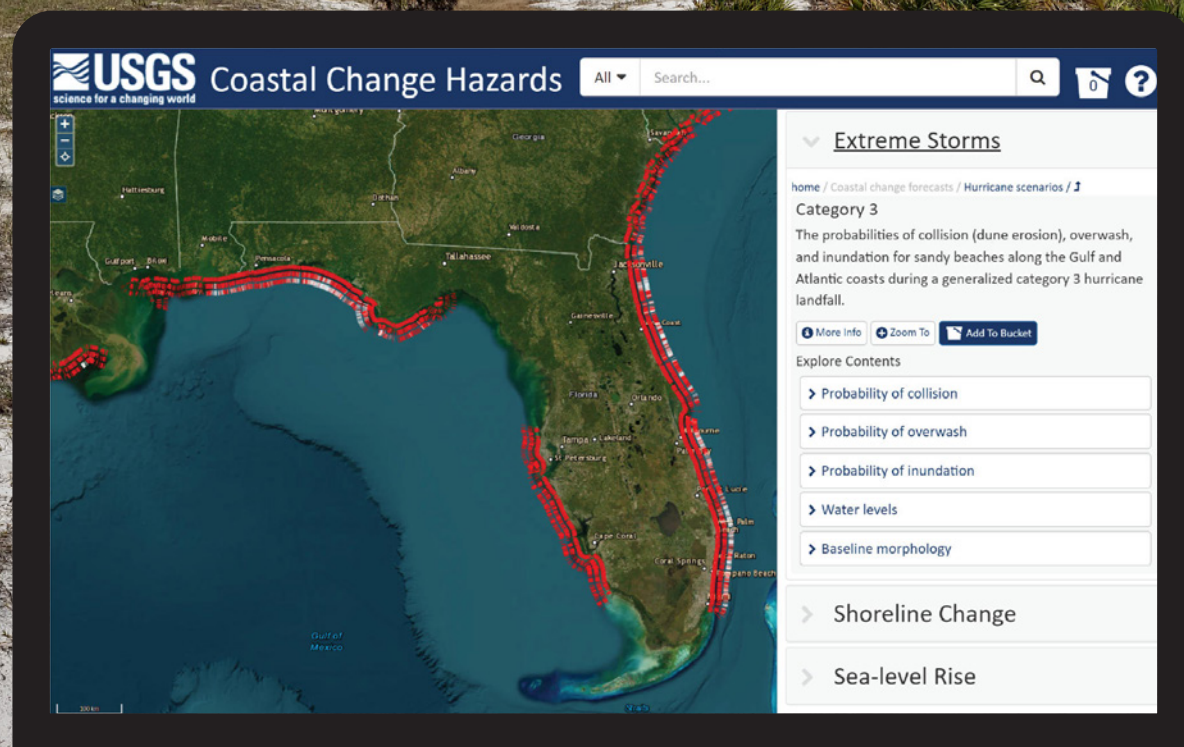


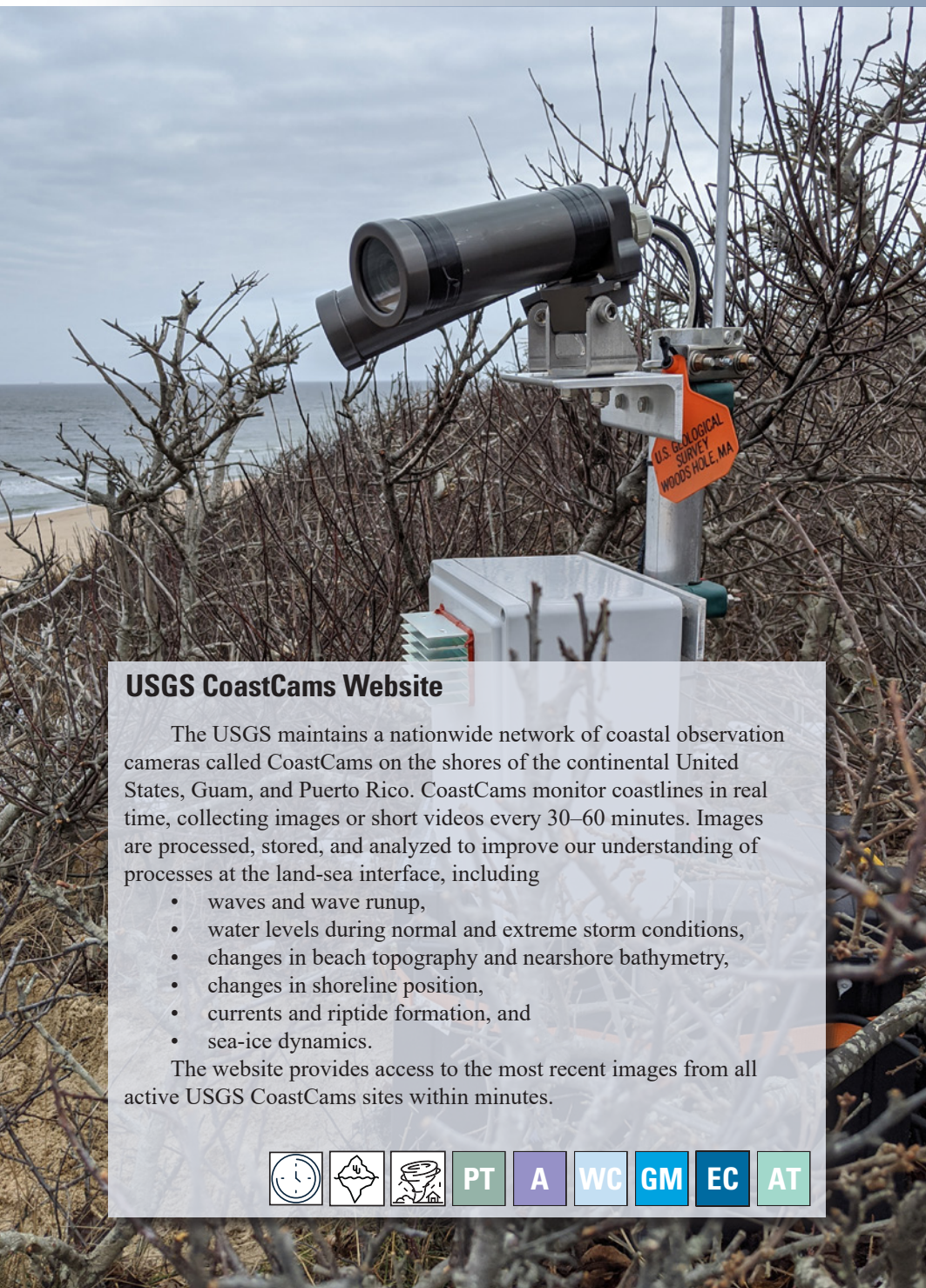
Coastal Change Hazards (CCH) Portal

Coastal landscape change poses risks to human lives, property, and habitats. Climate change exacerbates these changes by causing sea-level rise and extreme weather events. The CCH Portal is an interactive map that provides national assessments of coastal change at scales useful to local communities, regional managers, and decision makers. Users can explore the potential for hazards, including

- storm-induced coastal erosion,
- forecasts of extreme water levels for recent and active storms,
- historical shoreline change, and
- vulnerability to sea-level rise.

Datasets and geographic information system (GIS) map layers are available for download.



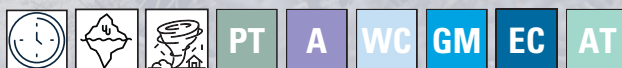


USGS CoastCams Website

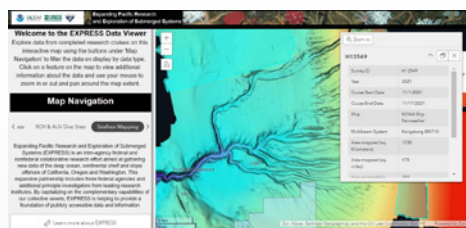
The USGS maintains a nationwide network of coastal observation cameras called CoastCams on the shores of the continental United States, Guam, and Puerto Rico. CoastCams monitor coastlines in real time, collecting images or short videos every 30–60 minutes. Images are processed, stored, and analyzed to improve our understanding of processes at the land-sea interface, including

- waves and wave runoff,
- water levels during normal and extreme storm conditions,
- changes in beach topography and nearshore bathymetry,
- changes in shoreline position,
- currents and riptide formation, and
- sea-ice dynamics.

The website provides access to the most recent images from all active USGS CoastCams sites within minutes.



Differences in wave runoff during *A*, a January 2023 storm event and *B*, a calm September 2023 day at Main Beach, Santa Cruz, California.



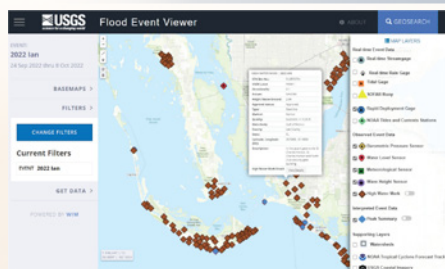
Expanding Pacific Research and Exploration of Submerged Systems (EXPRESS) Data Viewer

The EXPRESS data viewer is an interactive map that shows bathymetric, habitat, and geologic data collected during more than 20 dives made by remotely operated vehicles and autonomous underwater vehicles. Multiple Federal and non-Federal organizations have been collaborating to map, explore, and characterize the waters of the Pacific Outer Continental Shelf, focusing on marine geohazards, deep sea ecosystems, and energy resources.

WC

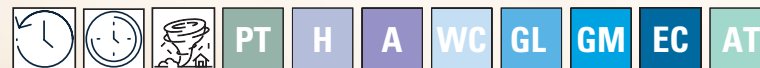
Real-Time Forecasts of Coastal Change

This interactive geonarrative provides an overview of hazards affecting our coastal communities and the tools USGS researchers have developed to forecast them. Products highlighted include the Coastal Change Hazard Portal and the Total Water Level and Coastal Change Forecast Viewer.



Flood Event Viewer

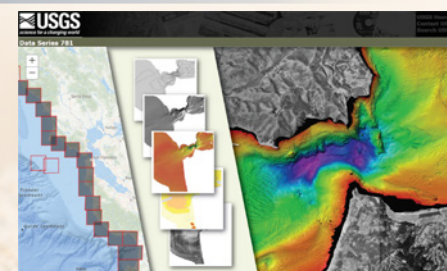
This interactive map allows users to explore and download sensor data and high-water marks for more than 40 years of flood events cataloged in the USGS Short Term Network. Users can view weather events, including hurricanes and nor'easters, and can also view real-time data from a range of USGS streamgage monitoring stations.



California State Waters Map Series Data Catalog

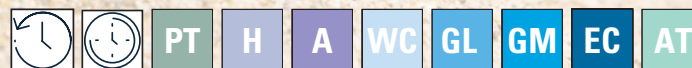
This data catalog was designed by the California Seafloor Mapping Program (CSMP) to be a comprehensive sea-floor map of the bathymetry, marine benthic habitats, and geology within 3 nautical miles of California's coast. The CSMP has created over 100 maps with associated GIS data layers, including bathymetry, bathymetric contours, acoustic backscatter, sea-floor character, potential benthic habitat, and offshore geology. This data catalog includes a brief description, a thumbnail of the data, and links to metadata and other downloadable files.

WC



SandSnap

SandSnap is a collaborative effort designed to build a database of beach sand grain sizes while engaging community scientists and educating young students about coastal processes. SandSnap uses a machine-learning model based on image contributions from the public. More community participation is always welcome.



Products for the Past

To understand how our coastlines have changed over time, scientists study the past and compare historical data to present observations. In this context, the past refers to any information related to conditions before the present, including direct observations, hindcasts, and archived forecasts. These products focus on the use of prior coastal change data to inform predictive models, help identify vulnerable locations, and monitor and emphasize historically known hazards.

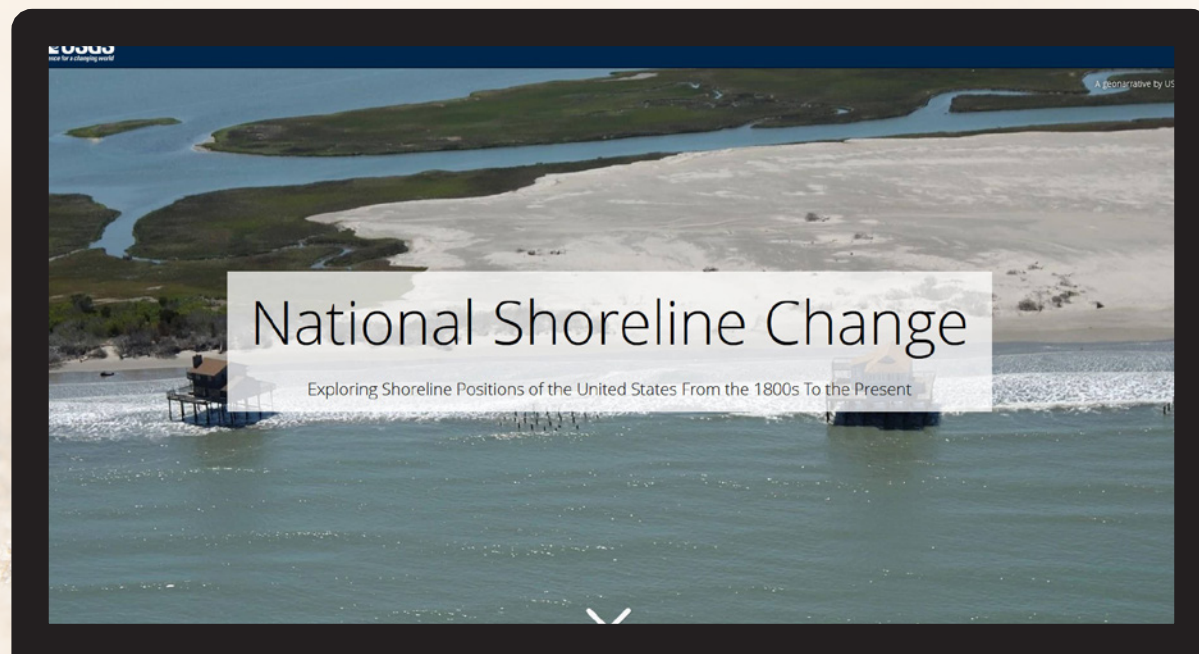
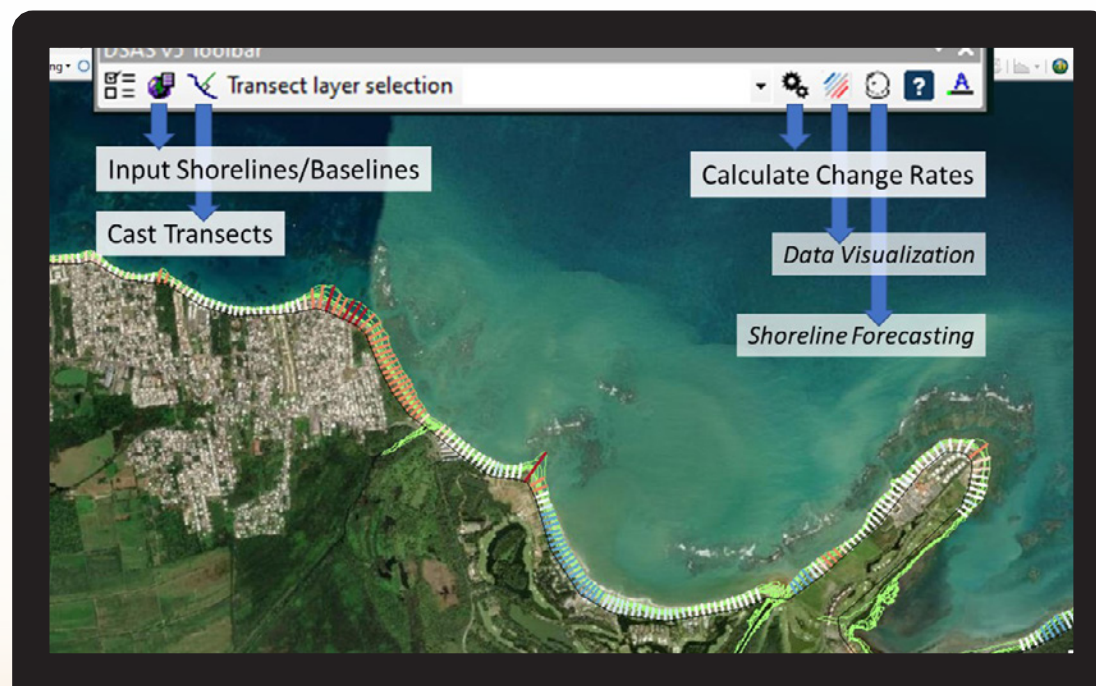


The research vessel *Sallenger* collects data about the reef in Looe Key, Florida, with a SQUID-5. The SQUID-5—a Structure-from-Motion Quantitative Underwater Imaging Device with five cameras—is towed along the surface while its downward-facing cameras provide overlapping views of the sea floor and an onboard global navigation satellite system tracks its position. This advanced underwater imaging system is specifically designed to allow the construction of high-resolution (subcentimeter) three-dimensional models of the sea floor.

Digital Shoreline Analysis System (DSAS)

DSAS is a stand-alone open-source application that calculates rate-of-change statistics from multiple historical shoreline positions. The GIS of a user's choice is used to prepare the data for DSAS. The software provides an automated method for establishing measurement locations, performs rate calculations, and provides the statistical data necessary to assess rate robustness. A user-friendly interface allows the user to complete the workflow for shoreline change analysis.

The DSAS website provides an overview of the software, an in-depth user guide, and a link to download the software.



National Shoreline Change Data Catalog

The National Shoreline Change Data Catalog contains USGS-generated shoreline positions and rates of change for the east, gulf, and west coasts of the United States as well as the coasts of Hawaii, Alaska, and Puerto Rico. These data, which go back to the 1800s, can help identify which areas of the coast are most likely to change significantly over time and which are most susceptible to erosion or accretion. The shoreline data are analyzed with the Digital Shoreline Analysis System software (see description above) to compute rates of change.


A linked geonarrative, National Shoreline Change, describes how the USGS maintains shoreline positions by analyzing historical maps, aerial photographs, topographic surveys, light detection and ranging (lidar) elevation point clouds, and digital elevation models.



Remote Sensing Coastal Change Simple Data Distribution Service

This data service provides direct access to data generated by remote sensing technologies such as aerial and satellite-based imagery, structure-from-motion photogrammetry, and lidar. These data allow scientists to calculate trends in coastal erosion, understand how processes like landslides and river inputs shape coastal landscapes, and predict how the coast will respond to future storms and sea-level rise.

The data service allows timely public access to the hundreds of thousands of images and derivative products generated by USGS remote sensing activities. The images and data can be retrieved manually or automatically and have been used for rapid response assessment of the causes of, sizes of, and recovery options for both landslides and storm erosion affecting critical coastal transportation corridors.



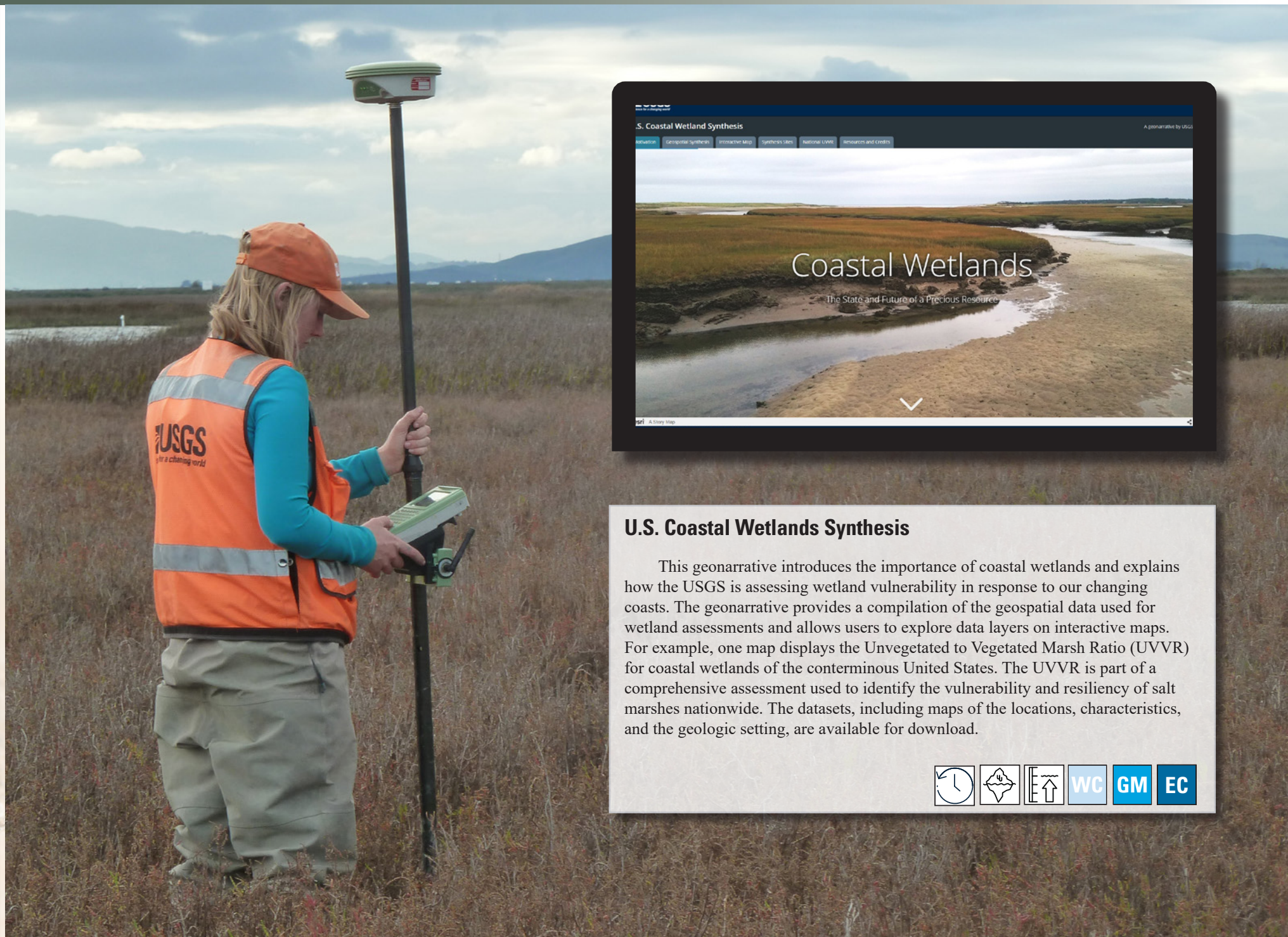
Coastal/Marine Hazards and Resources
/ Coastal and Marine Geoscience Data System

Remote Sensing Coastal Change Simple Data Distribution Service

Index of /data-services/rscg/pcmssc_planecam/CenCA_coastal_20230116/jpg_adobe/

Name	Last modified	Size
CAM707_20230116133926_78.jpg	2023-01-19 13:53	28M
CAM707_20230116133927_80.jpg	2023-01-19 13:53	28M
CAM707_20230116133928_80.jpg	2023-01-19 13:53	28M
CAM707_20230116133929_80.jpg	2023-01-19 13:53	28M
CAM707_20230116133930_80.jpg	2023-01-19 13:54	28M
CAM707_20230116133931_80.jpg	2023-01-19 13:54	26M
CAM707_20230116133932_80.jpg	2023-01-19 13:55	26M
CAM707_20230116133933_80.jpg	2023-01-19 13:55	26M
CAM707_20230116133934_80.jpg	2023-01-19 13:55	25M
CAM707_20230116133935_80.jpg	2023-01-19 13:56	25M
CAM707_20230116133936_82.jpg	2023-01-19 13:56	25M
CAM707_20230116133937_78.jpg	2023-01-19 13:57	24M
CAM707_20230116133938_82.jpg	2023-01-19 13:58	23M
CAM707_20230116133939_78.jpg	2023-01-19 13:59	23M
CAM707_20230116133940_80.jpg	2023-01-19 13:59	22M





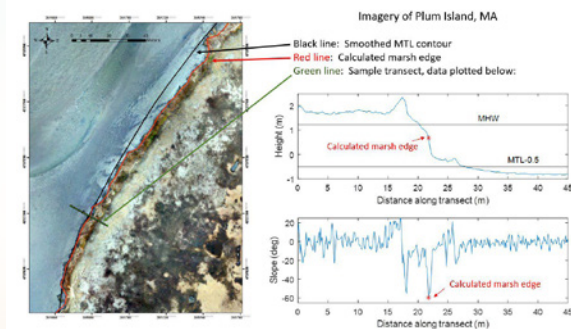
U.S. Coastal Wetlands Synthesis

This geonarrative introduces the importance of coastal wetlands and explains how the USGS is assessing wetland vulnerability in response to our changing coasts. The geonarrative provides a compilation of the geospatial data used for wetland assessments and allows users to explore data layers on interactive maps. For example, one map displays the Unvegetated to Vegetated Marsh Ratio (UVVR) for coastal wetlands of the conterminous United States. The UVVR is part of a comprehensive assessment used to identify the vulnerability and resiliency of salt marshes nationwide. The datasets, including maps of the locations, characteristics, and the geologic setting, are available for download.



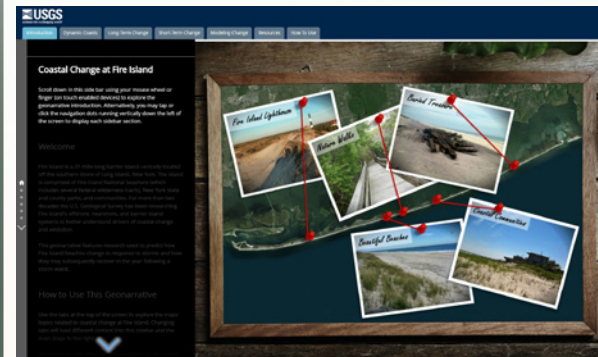
Marsh Shoreline of the Massachusetts Coast From 2013–14 Topographic Lidar Data

This downloadable dataset provides the updated marsh shoreline used by the State to identify areas of the Massachusetts coast prone to erosion. As a part of the Shoreline Change Project, the marsh shoreline was calculated from topographic lidar data by using a slope-based method that defines the shoreline as the steep slope found at the seaward edge of the marsh vegetation. The marsh edge is a preferred indicator for computing rates of change and for making position forecasts.



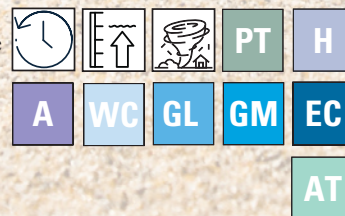
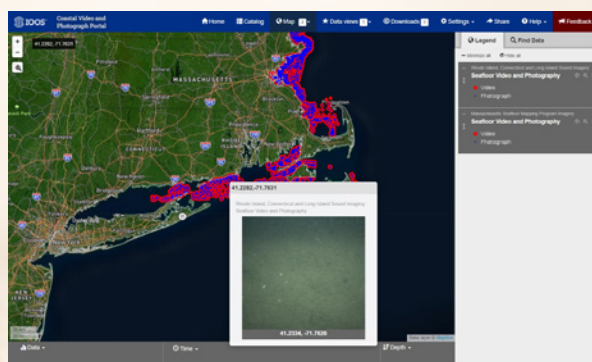
Coastal Change at Fire Island, New York

In this geonarrative, USGS scientists share research conducted at Fire Island from over two decades to deepen understanding of the dynamic nature of barrier islands and their susceptibility to dramatic changes due to natural and anthropogenic influences. The USGS seeks to understand how Fire Island beaches have changed in response to storms and predict how they may recover in the years following a storm event.



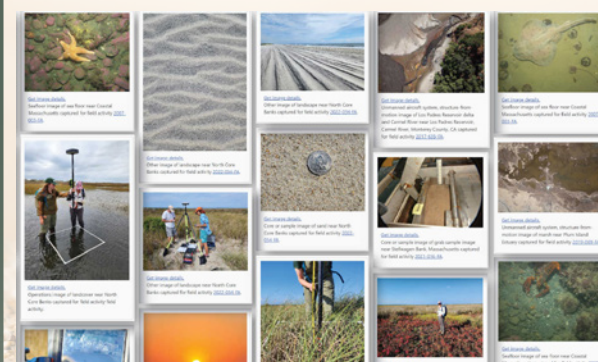
Integrated Ocean Observing System (IOOS)

The IOOS map viewer provides access to video and photography of the sea floor and aerial imagery of the U.S. coasts. The imagery is provided by the USGS Coastal and Marine Hazards and Resource Program's Seafloor Mapping projects and Hurricane and Extreme Storms research, as well as additional video and photographs from other USGS projects and IOOS partner agencies.



Imagery Data System

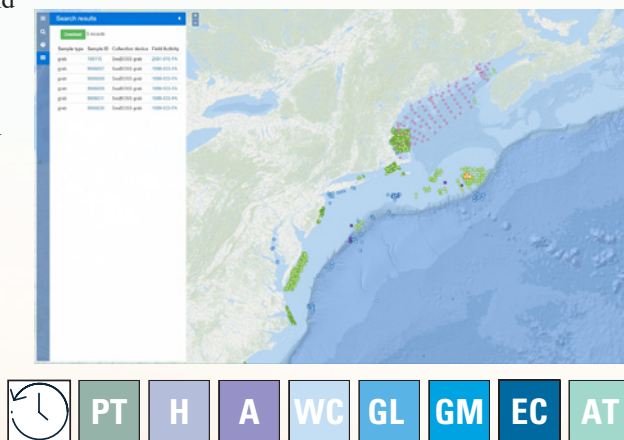
The Imagery Data System is a database of over 100,000 images collected by the USGS through the Coastal and Marine Hazards and Resource Program. Images include field work and ground reference data as well as



aerial and sea-floor imagery accessible through search tools and interactive maps.

Samples Repository Collections Inventory

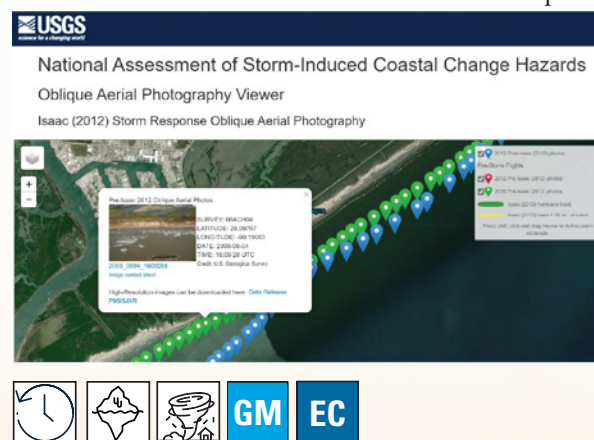
The Samples Repository Collections Inventory is an inventory database for the USGS Woods Hole Coastal and Marine Science Center's collection of geological and biological samples from coastal, marine, and near-shore environments. The repository can be searched via an interactive map or by search criteria such as field activity, sample type, collection device, or collection date.



Oblique Aerial Photography Viewer

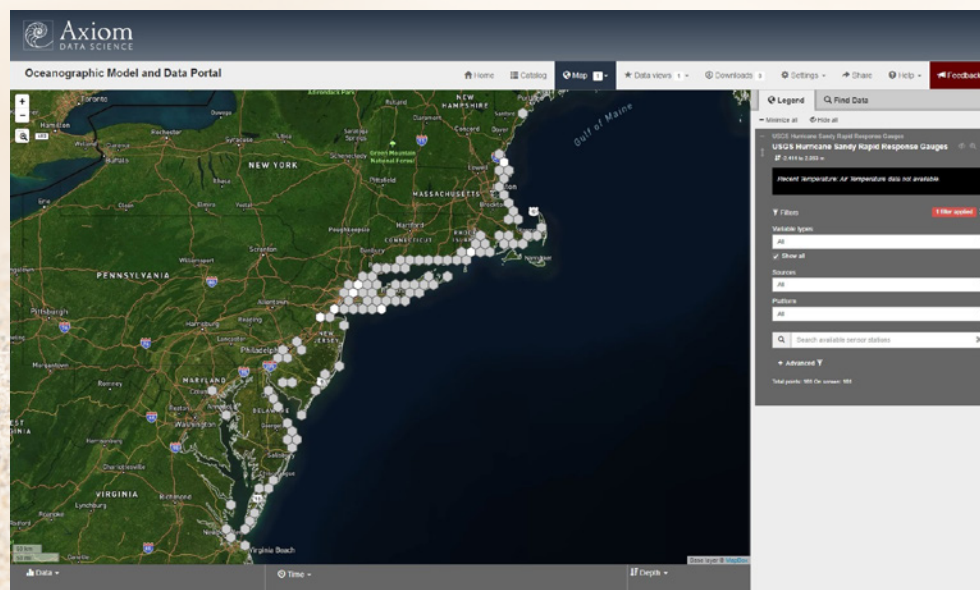
This interactive map provides access to 20 years of oblique aerial coastal imagery collected by the National Assessment of Storm-Induced Coastal Change Hazards project. The USGS has conducted baseline and storm response photography across

much of the gulf and east coasts to document and understand coastal changes in response to extreme storms. This imagery captures beach erosion and accretion, dune erosion, overwash, coastal infrastructure, and the damage to infrastructure due to impacting hurricanes.



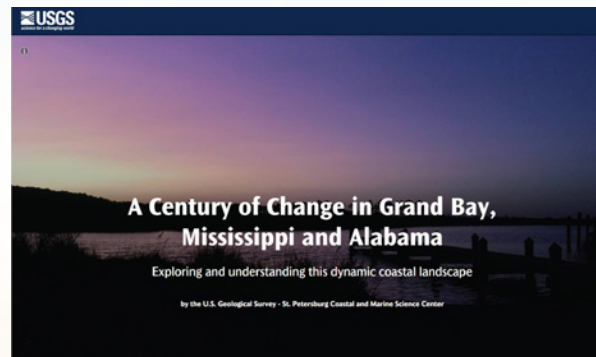
Oceanographic Model and Data Portal

The Oceanographic Model and Data Portal allows interactive exploration, visualization, and download of USGS oceanographic sensor and model data. Over 700 datasets are available for locations within the east, gulf, and west coasts of the United States as well as Alaska, Hawaii, Atlantic and Pacific territories, and the Great Lakes.



A Century of Change in Grand Bay, Mississippi and Alabama

This geonarrative describes USGS scientists' work in the Grand Bay National Estuarine Research Reserve to track and investigate erosion, accumulation, and exchange of sediment within the marsh.



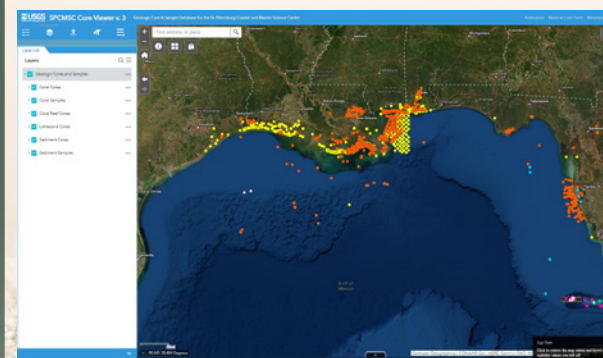
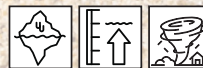
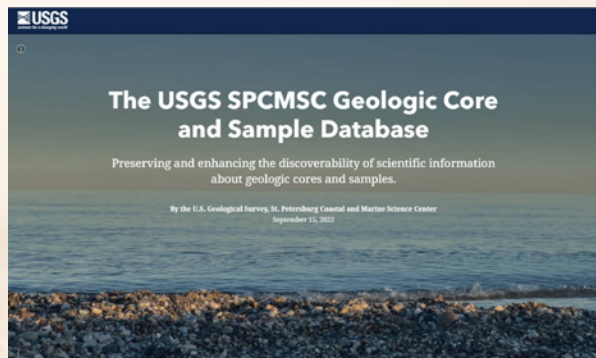
USGS Coastal and Marine Science in St. Petersburg, Florida

This geonarrative introduces USGS research aimed at deepening understanding of the processes that form and alter coastal and marine environments and the implications of these processes for natural hazards, resource sustainability, and environmental change.



The USGS St. Petersburg Coastal and Marine Science Center (SPCMSC) Geologic Core and Sample Database Geonarrative

This geonarrative describes a physical collection of over 1,000 cores and samples from sediments and corals amassed over 50 years by scientists at the SPCMSC. The samples are now cataloged in a public database accessed through the linked SPCMSC Geologic Core and Sample Viewer.




St. Petersburg Coastal and Marine Science Center (SPCMSC) Geologic Core and Sample Viewer

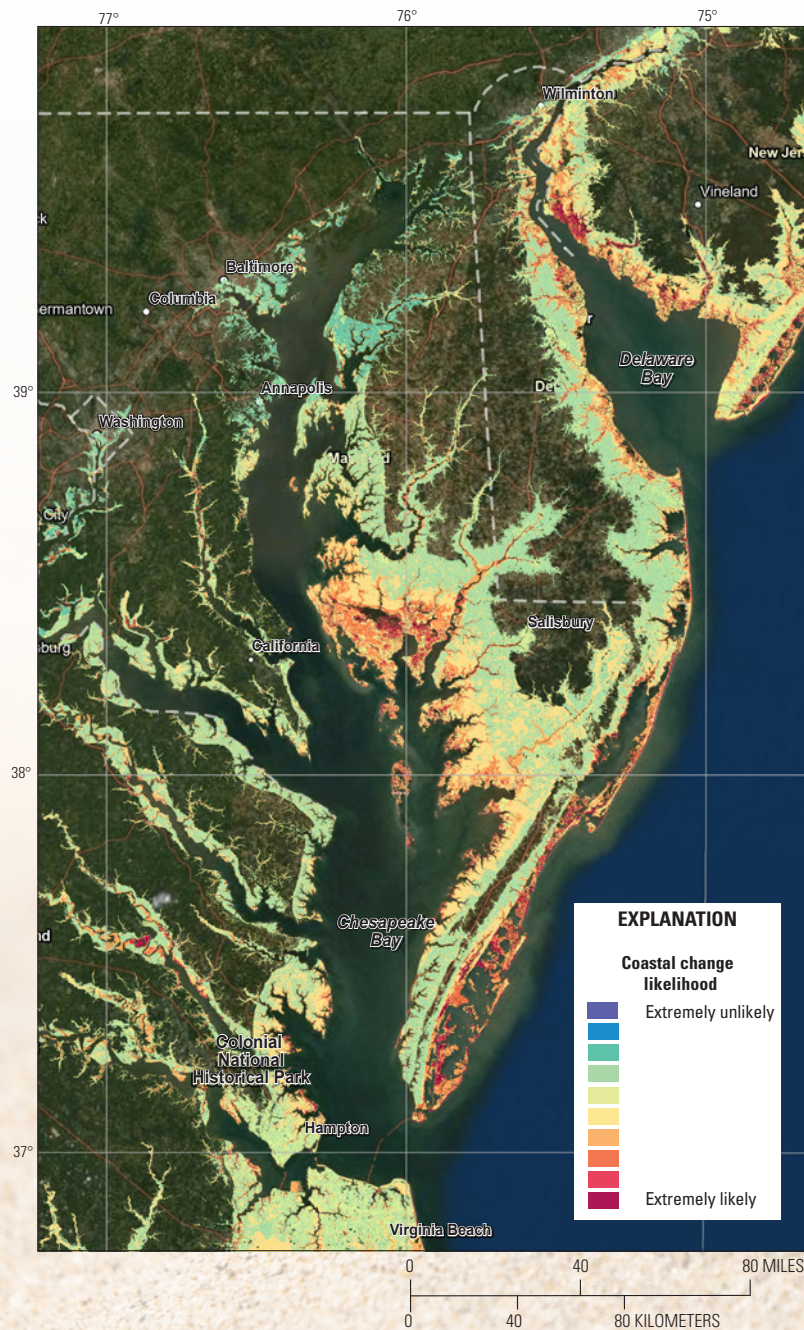
The map-based interface provides access to information on the coral, coral reef, limestone, and sediment cores and samples that have been collected, analyzed, published, or archived at the SPCMSC. Available data include the location of the collection site, current storage location, associated publications, photographs, and data analysis types.

Products for the Future

Scientists use current and historical data along with climate change projections to forecast how the coast might change in the future, particularly data on topics related to coastal hazards such as erosion and flooding. The future time scale in the Coastal Science Navigator includes products that predict coastal conditions more than 1 week into the future.



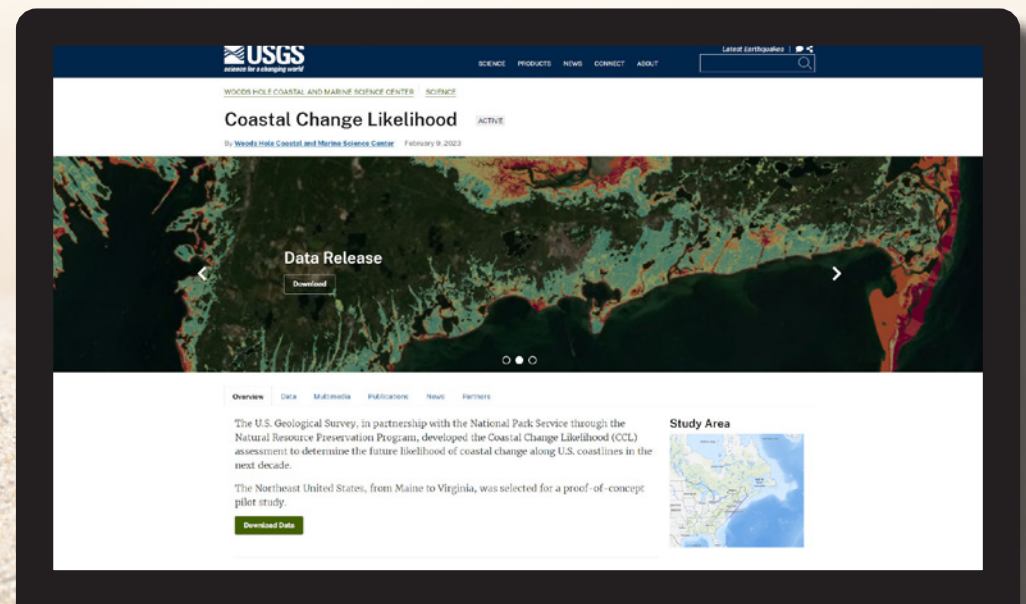
U.S. Geological Survey scientists use unmanned aerial systems to photograph our coasts. Photographs from different time periods can be compared, through a technique called structure-from-motion photogrammetry, to measure changes in the coastal bluffs (such as this actively eroding permafrost bluff on Barter Island, Alaska) and track how coastal hazards affect our coastlines.



Coastal Change Likelihood (CCL) Website

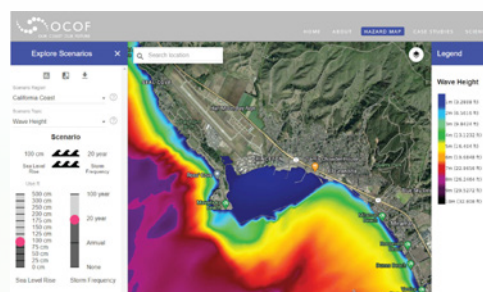
Understanding where the coast is most likely to change and which types of hazards are most likely to affect specific locations is essential to planning for future vulnerabilities of people and resources. The Coastal Change Likelihood assessment was created by the USGS in partnership with the National Park Service through the Natural Resource Prevention Program to determine the likelihood of change along U.S. coastlines in the coming decade. This pilot study—covering the coastal zone from Maine to Virginia—combines over 20 data sources describing the landscape and the hazards acting on it.

The website consists of a geonarrative, which provides an overview of the project, a data report, and datasets available for download. Three datasets were compiled from existing data describing event hazards, perpetual hazards, and the landscape fabric. Two datasets were generated by using supervised machine learning to describe how the unique combination of landscape fabric and hazards interact to influence future outcomes.



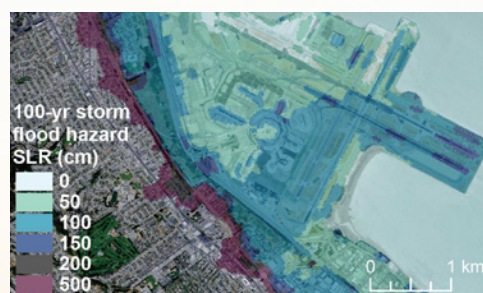
Planning for Future Coastal Hazards With the Coastal Storm Modeling System (CoSMoS)

Coastal communities need locally relevant tools to help them understand, plan for, and adapt to the impacts of climate change. CoSMoS is a dynamic modeling approach that makes detailed predictions about coastal flooding, erosion, and groundwater changes caused by sea-level rise and storms. The USGS provides a suite of products related to CoSMoS that coastal land managers and planners can use to inform their decision-making, including the four presented on the right.



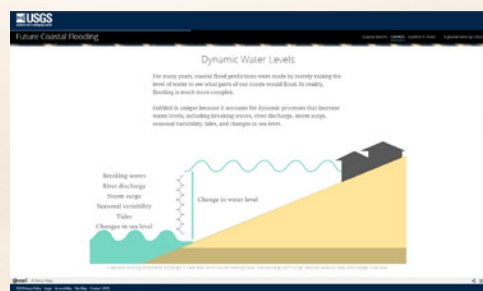
Our Coast, Our Future (OCOF)

OCOF is a California-focused web tool for viewing climate-driven coastal hazard projections from the USGS Coastal Storm Modeling System (CoSMoS). OCOF provides users with resources to understand, visualize, and adapt to sea-level rise and changing storm hazards. It includes downloadable datasets and layers displaying scenario-based predictions from CoSMoS, including coastal flooding, erosion, and rising groundwater hazards.



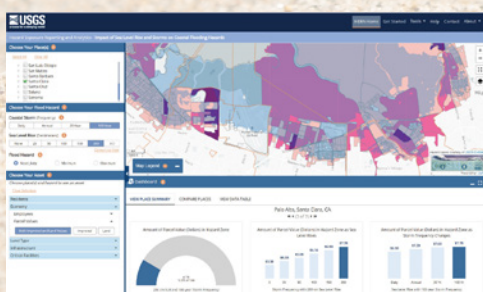
Coastal Storm Modeling System (CoSMoS) Results

This web page provides access to GIS downloads for all CoSMoS results, including coastal flooding, shoreline change, cliff retreat, and groundwater rise, applicable to a broad range of storm and sea-level-rise scenarios.



Future Coastal Flooding

This geonarrative provides a high-level introduction to CoSMoS, including why it was developed, what makes it unique, and examples of how it can be applied for local planning.



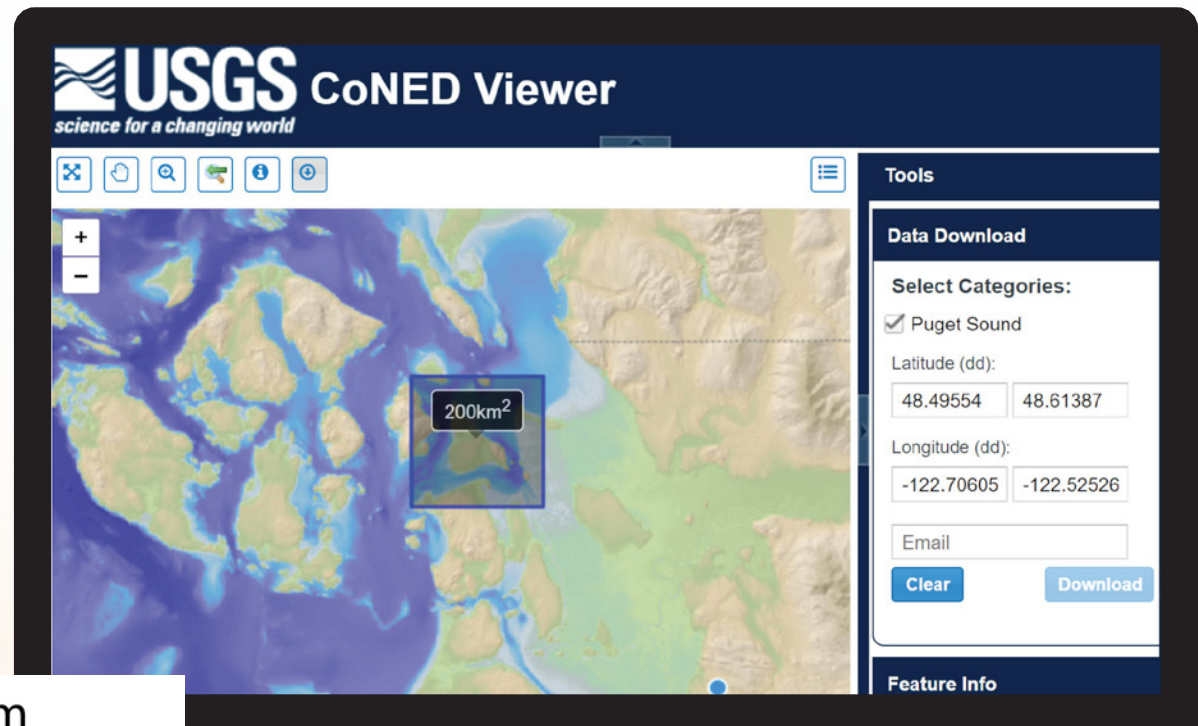
Hazard Exposure and Reporting Analytics (HERA)

The HERA web application includes an interactive map, data dashboard, and tools for users to map and estimate community and county exposure to CoSMoS-related climate-driven coastal hazards.

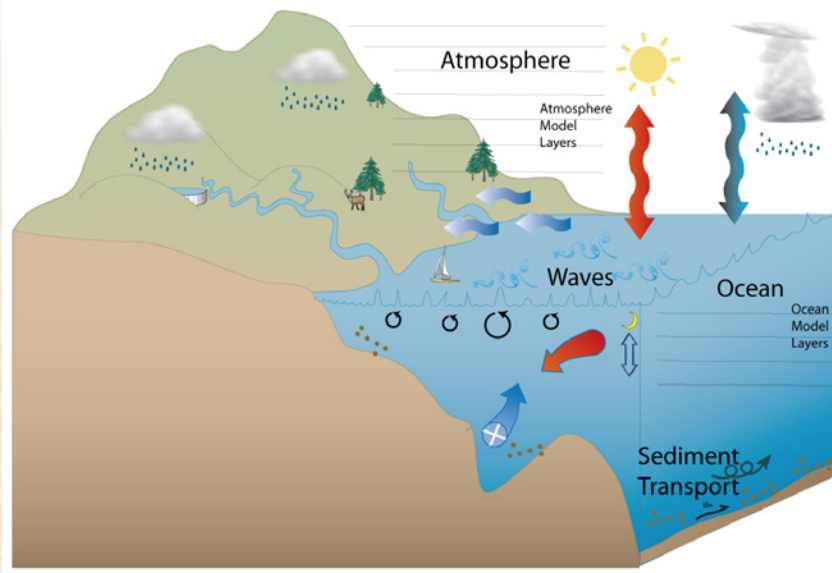


Coastal National Elevation Database (CoNED) Viewer

The CoNED viewer is an interactive map designed to allow users to explore and download integrated topographic (land elevation) and bathymetric (water depth) datasets for coastal regions. These high-resolution datasets are foundational for coastal hazard research and applications. They are used to map inundation hazard zones from riverine flood events, extreme storms, and sea-level rise. These datasets are also used to develop models of sediment transport, erosion, and storm surge.



COAWST Modeling System



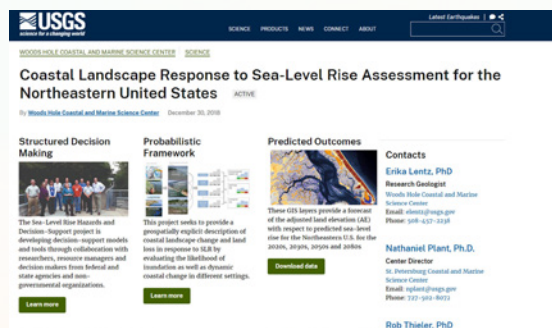
Coupled Ocean-Atmosphere-Waves-Sediment Transport (COAWST) Modeling System

The COAWST Modeling System combines multiple earth-system models to investigate the significant physical processes affecting our coastlines—such as waves, wind, tides, and storms—and to identify how these processes lead to coastal change. This open-source tool combines an ocean model, an atmosphere model, a wave model, and a sediment transport model. This software tool is the engine behind the COAWST Forecast Model, which covers the east coast and Gulf of Mexico and is available for download. It has output data every hour since 2010 and provides forecasts for short-term changes in coastal conditions.



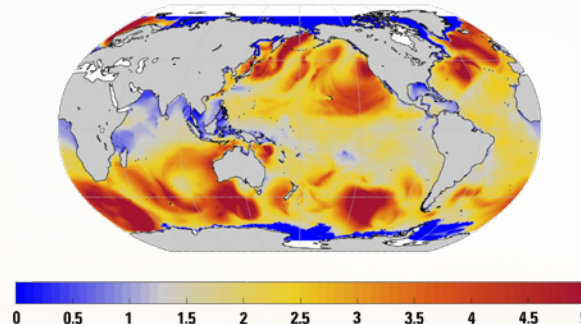
Coastal Landscape Response to Sea-Level Rise Assessment for the Northeastern United States Website

The Coastal Landscape Response to Sea-Level Rise Assessment project seeks to predict responses to sea-level rise for coastal landscapes under a range of future conditions by evaluating the likelihood of inundation and other dynamic changes. The website provides an explanation of the project's history, its decision-making process, and the framework used in the project. Predictions for the northeastern United States generated by this assessment are available for download as GIS map layers that include a range of potential changes to land elevation caused by sea-level rise and their probabilities of occurrence for the 2020s through the 2080s.



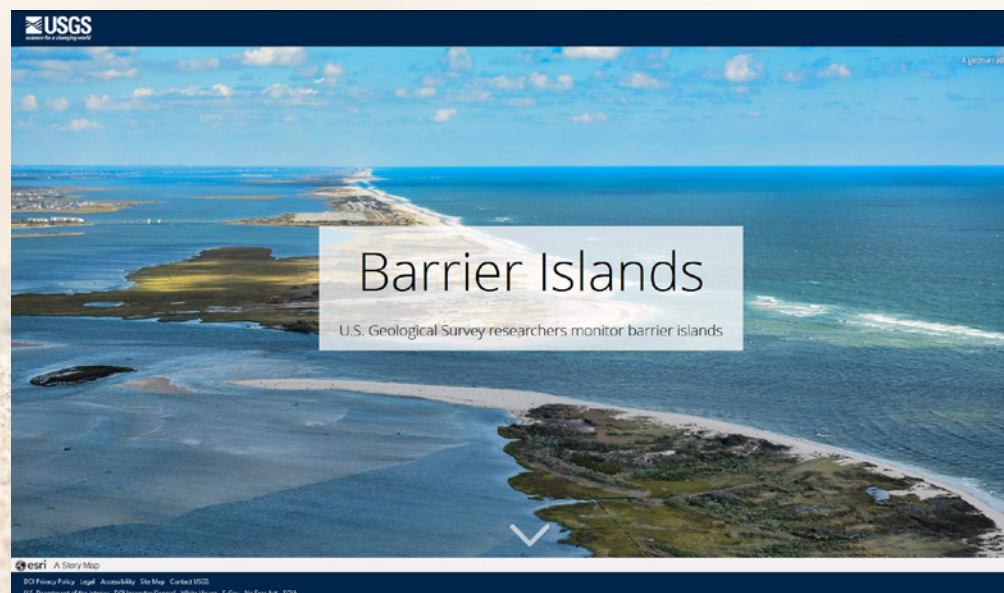
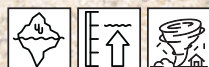
CMIP6 Ocean Wave Time Series Data

The Global Climate Models of the 6th Coupled Model Intercomparison Project (CMIP6) provides users with projected, hourly time series data for waves at specific locations along the open coasts in the United States from the present until 2050. These projections were created by applying wind and sea-ice fields from global climate models to the National Oceanic and Atmospheric Administration's WAVEWATCH III model.



Barrier Islands Geonarrative

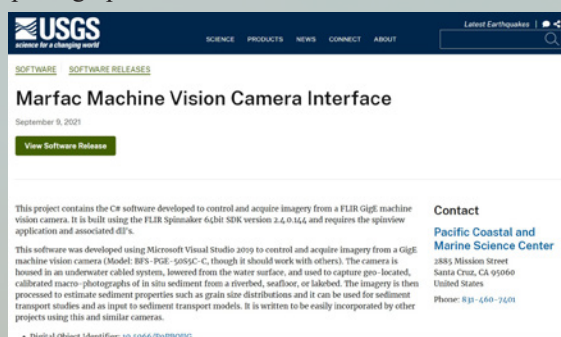
Barrier islands are important protectors of coastal ecosystems as they prevent coastline erosion and purify the water within estuaries and lagoons. This geonarrative features methods USGS scientists employ in studying barrier islands. Scientists use the models created from this research to predict how these islands may evolve in the future.



Downloadable Software

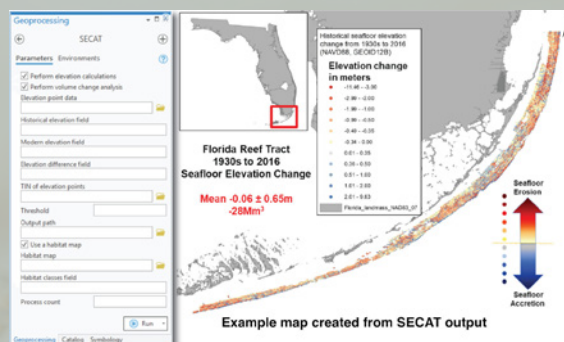
Marfac Machine Vision Camera Interface

The Marfac Machine Vision Camera Interface software was developed in C# to remotely control and acquire imagery from a GigE machine vision camera. These underwater cameras can capture geolocated and calibrated macrophotographs of in situ sediments in riverbeds, lakebeds, or the sea floor. The software can process the images to estimate sediment properties such as grain-size distributions, which can be used in sediment transport studies and models.



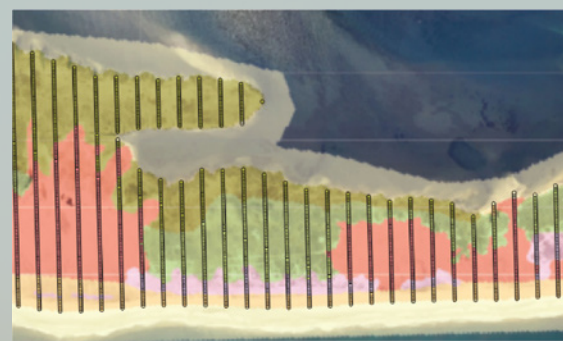
Seafloor Elevation Change Analysis Tool (SECAT)

SECAT is a Python script for ArcMap and ArcGIS Pro that computes sea-floor elevation changes and volume change differences between two digital elevation models. This program was developed to address complex GIS workflows and can reduce run times by 50 percent.



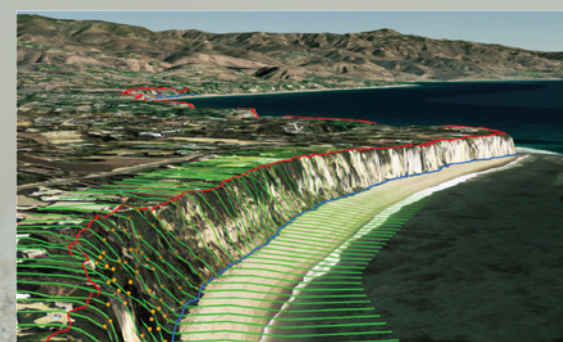
Bi-Transect Extractor

The Bi-Transect Extractor Python package is designed to calculate coastal geomorphology variables along shore-normal transects using a Bayesian network. Variables used in this calculation include beach height, beach width, elevation, shoreline change rate, substrate type, and vegetation. This Python package requires ArcGIS Pro to download and run.



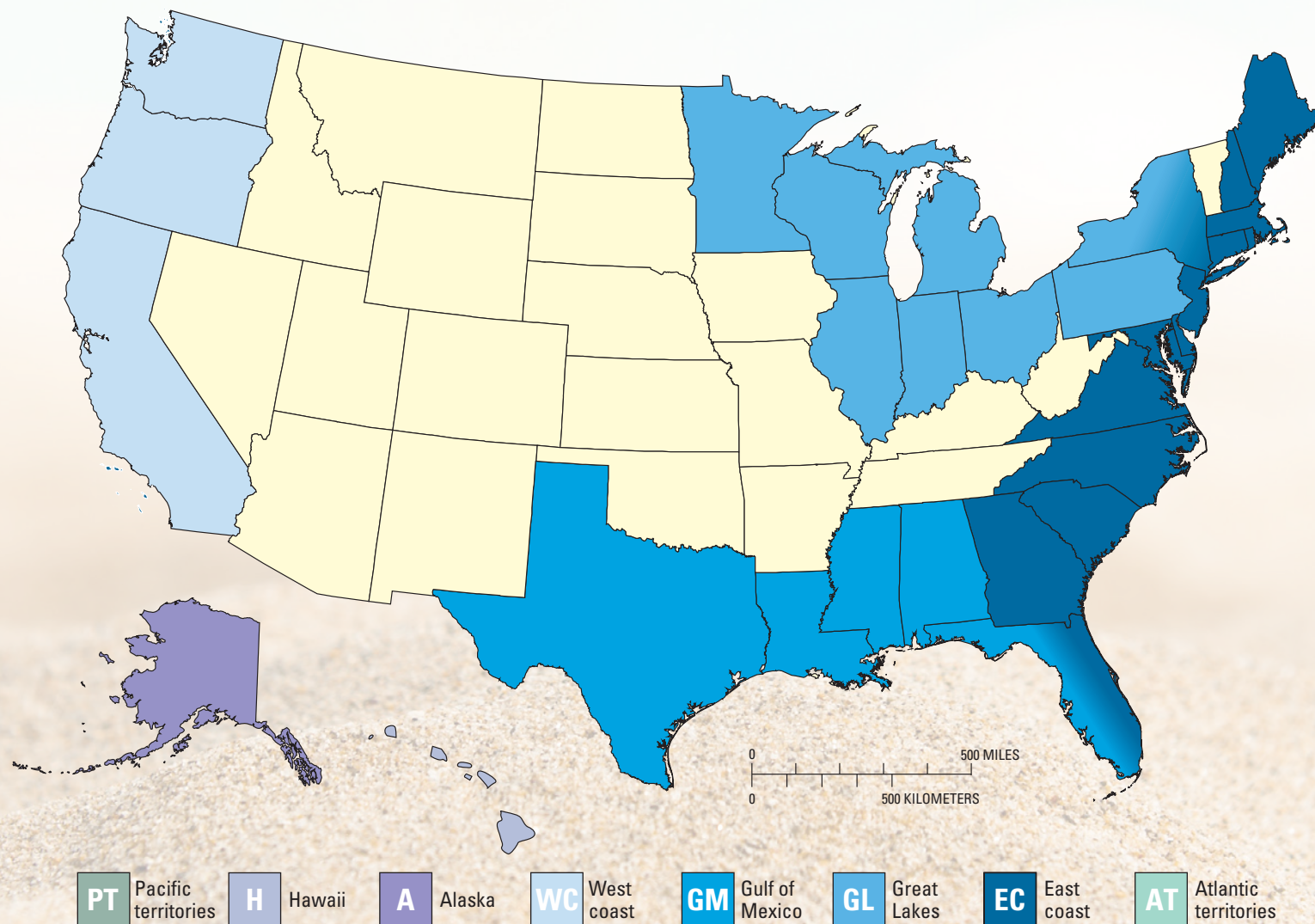
Cliff Feature Delineation Tool (CFDT) and Baseline Builder

The CFDT scans digital elevation models to delineate features on sea cliffs such as the cliff top, midline, toe, and convexities or concavities on the cliff face. The tool package can automatically generate alongshore baselines, determine landward/seaward direction, and cast cross-shore transects. The application is compatible with ArcGIS and generates three-dimensional shapefiles.



Geographic Highlights

In addition to searching the Coastal Science Navigator by timeframe, users can search for products by geographic region. The USGS conducts science related to coastal hazards across the continental United States, Hawaii, and the Atlantic and Pacific territories. The geographical categories highlighted in the following pages include products associated with the filters for coastal hazards (sea-level rise, coastal change, and extreme storms) and time frames (past, present, and future). Table 1, at the end of this guide, lists selected products and their filters.





A U.S. Geological Survey oceanographer stands on a coastal bluff of Barter Island, Alaska, at sunset. Researchers are studying how this rapidly eroding bluff changes under the variety of conditions affecting this stretch of coastline. Their findings can be used to improve computer-derived simulations of shoreline change, which, in turn, can be used by communities to plan for sea-level rise, changing storm patterns, and other threats to their coasts.

Atlantic Territories

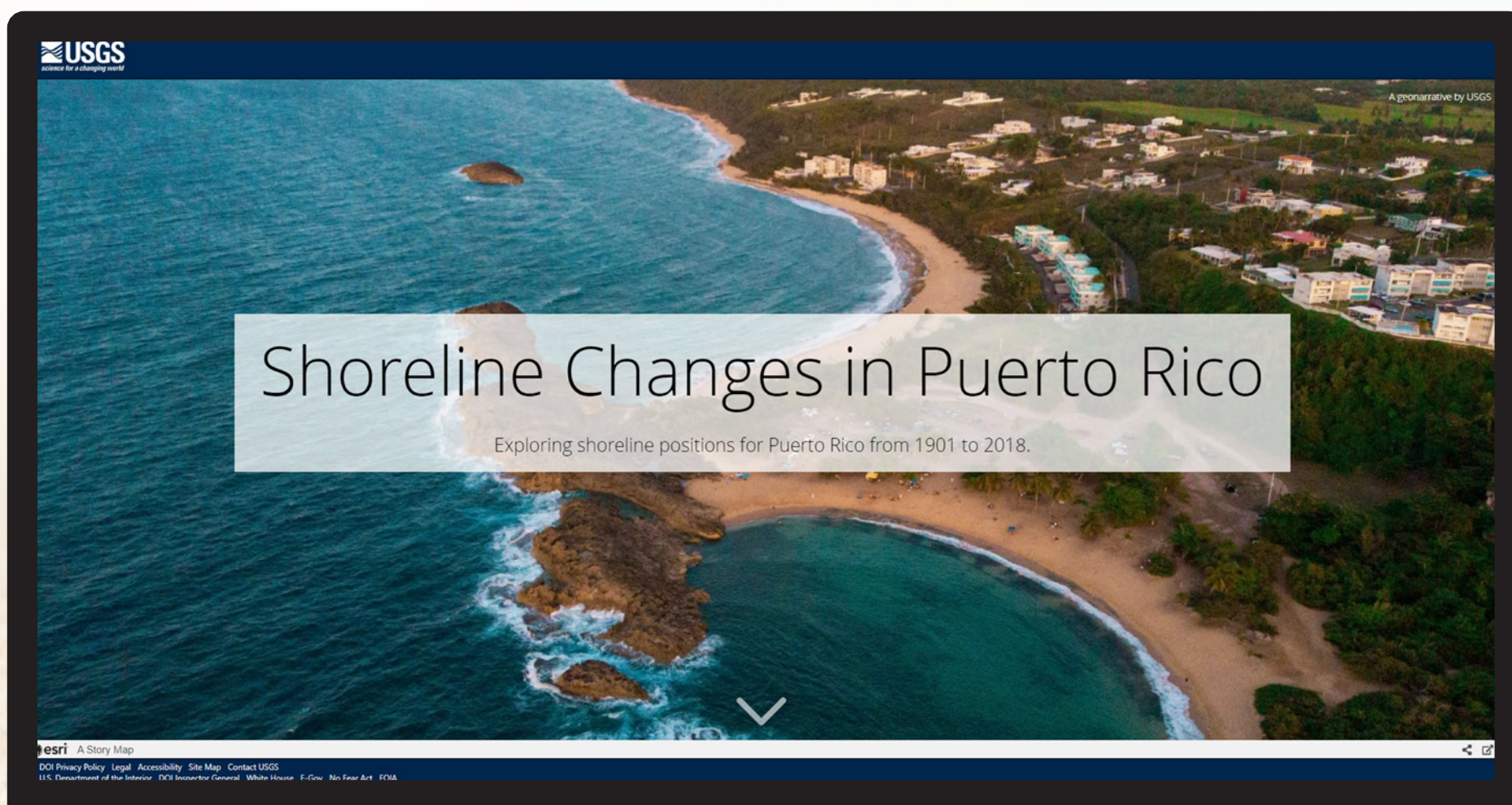
USGS Science in the American Territories

This geonarrative highlights USGS science related to threats affecting the five permanently inhabited American territories in the Atlantic and Pacific Oceans. These territories, home to 4 million people, are particularly vulnerable to impacts from climate change and other hazards.



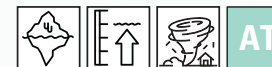
Shoreline Changes in Puerto Rico

This geonarrative (available in Spanish and in English) highlights a century of shoreline changes in Puerto Rico, including notable hurricane impacts. It outlines possible methods for protecting communities and mitigating coastal hazards, such as enhancing coral reefs, mangroves, and dunes.

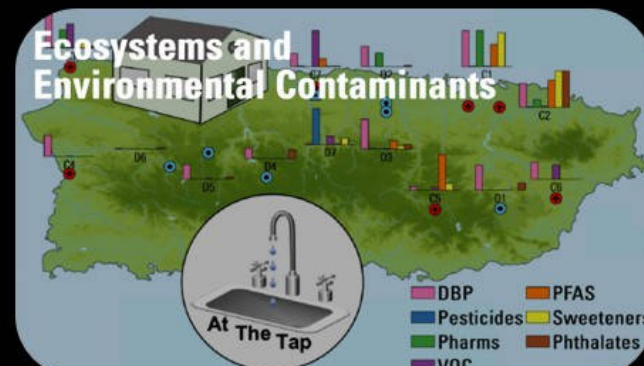
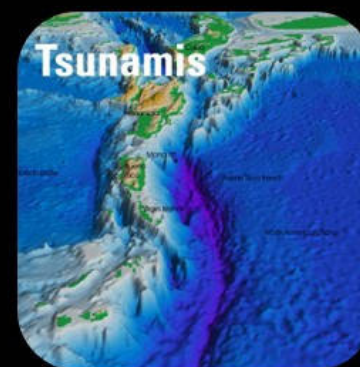
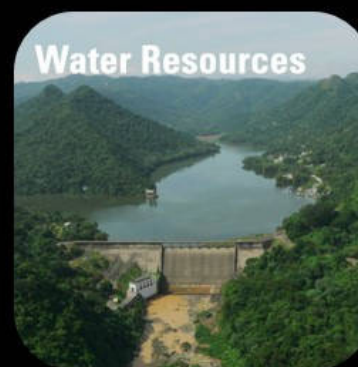


Puerto Rico Natural Hazards

This bilingual (English and Spanish) website compiles natural hazard resources available to Puerto Rico. Puerto Rico is subject to numerous threats and hazards, including hurricanes, landslides, earthquakes, tsunamis, flooding, environmental contaminants, and freshwater scarcity. Learn more about these hazards and explore USGS research in Puerto Rico through publications, data releases, data portals, and news highlights.



Explore USGS resources for Puerto Rico | [Explora los recursos del USGS en Puerto Rico](#)



USGS.gov/PuertoRicoHazards |
www.usgs.gov/LospeligrosdePuertoRico



Alaska

Coastal Change in Alaska

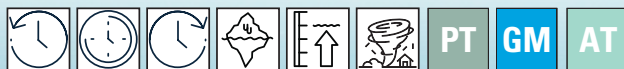
This geonarrative explores questions such as how permafrost and seasonal ice make coastal erosion on Alaska's north coast unique, how the USGS measures Alaska's historical and ongoing coastal change in order to make predictions about the future in a changing climate, and how future coastal changes are likely to affect Alaskan coastal communities and ecosystems.



Pacific Territories

Coral Reef Project Website

The website acts as a gateway to USGS research on coral reefs, with a focus on the geophysical processes that influence their health and sustainability. The website links to information on how the USGS maps, monitors, and models coral reefs to better understand, protect, and preserve our Nation's reefs. Current research can be explored by topic or by region. Data and GIS map layers are available for download.



The Role of Coral Reefs in U.S. Coastal Protection

This geonarrative uses interactive maps, photographs, and infographics to explore the protective role coral reefs play. Coral reefs are known for their biodiversity, tourism, and food supply, generating almost \$2 billion each year. They also reduce flooding and protect lives and infrastructure, creating even more economic advantage for maintaining and restoring our coral reefs.



The Role of U.S. Coral Reefs in Coastal Protection

[Meet the Reefs](#)
[Reefs protect us](#)
[What next?](#)
[Our Coasts](#)
[A geonarrative by USGS](#)

Meet the Reefs

Did you know that the United States are home to 22,000 square kilometers of coral reefs? That is approximately the size of the State of New Jersey, or about 4.5 Grand Canyons.

70 percent of these reefs are in the Pacific Ocean – mostly in the Hawaiian Islands, and also in territories such as Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

The rest of our reefs can be found in the Florida Keys, Puerto Rico, and the U.S. Virgin Islands.

A map showing locations of coral reefs in the United States

These reefs are important for many reasons – one study shows that they generate more than \$2 billion per year through their contributions to biodiversity, food production, and tourism (Brander and Van Beukering, 2013).

A Story Map

[DOI Privacy Policy](#)
[Legal](#)
[Accessibility](#)
[Site Map](#)
[Contact USGS](#)

[U.S. Department of the Interior](#)
[DOI Inspector General](#)
[White House](#)
[E Gov](#)
[No Fear Act](#)
[FOIA](#)

Table of Time Scale and Geographic Scope Product Filters

Table 1. Time scale and geographic scope filters for selected Coastal Science Navigator products.

[● indicates that product matches the filtering criteria; — indicates that product does not match the filtering criteria. Acronyms not defined in table: CMIP6, 6th Coupled Model Intercomparison Project; SPCMSC, St. Petersburg Coastal and Marine Science Center; USGS, U.S. Geological Survey]

Coastal Science Navigator product name	Time scale filters			Geographic scope filters							
	Past	Present	Future	Pacific territories	Hawaii	Alaska	West coast	Great Lakes	Gulf of Mexico	East coast	Atlantic territories
A Century of Change in Grand Bay, Mississippi and Alabama	—	—	—	—	—	—	—	—	●	—	—
California State Waters Map Series Data Catalog	—	—	—	—	—	—	●	—	—	—	—
CMIP6 Ocean Wave Time-Series Data	—	—	●	●	●	●	●	—	●	●	●
Coastal Change at Fire Island, New York	●	—	—	—	—	—	—	—	—	●	—
Coastal Change Hazards (CCH) Portal	●	●	●	—	●	●	●	●	●	●	●
Coastal Change in Alaska	●	—	—	—	—	●	—	—	—	—	—
Coastal Change Likelihood (CCL) Geonarrative	—	—	●	—	—	—	—	—	—	●	—
Coastal Change Likelihood (CCL) in the U.S. Northeast Region—Maine to Virginia	—	—	●	—	—	—	—	—	—	●	—
Coastal Change Likelihood (CCL) Website	—	—	●	—	—	—	—	—	—	—	—
Coastal Landscape Response to Sea-Level Rise Assessment for the Northeastern United States	—	—	●	—	—	—	—	—	—	●	—
Coastal Landscape Response to Sea-Level Rise Assessment for the Northeastern United States Website	—	—	●	—	—	—	—	—	—	●	—
Coastal National Elevation Database (CoNED) Viewer	—	—	—	●	—	—	●	—	●	●	—
Coastal Storm Modeling System (CoSMoS) Results	—	—	●	●	—	—	●	—	—	●	—
Coastal Wetlands Synthesis Products	●	—	●	—	—	—	●	—	●	●	—
Coral Reef Project Website	●	●	●	●	—	—	—	—	●	—	●
Digital Shoreline Analysis System (DSAS) website	●	—	●	—	—	—	—	—	—	—	—
Expanding Pacific Research and Exploration of Submerged Systems (ExPRESS) Data Viewer	—	—	—	—	—	—	●	—	—	—	—
Expanding Pacific Research and Exploration of Submerged Systems (ExPRESS) Geonarrative	—	—	—	—	—	—	●	—	—	—	—
Flood Event Viewer	●	●	—	●	●	●	●	●	●	●	●
Future Coastal Flooding	—	—	●	—	—	—	●	—	—	—	—

Table 1. Time scale and geographic scope filters for selected Coastal Science Navigator products.—Continued.

[● indicates that product matches the filtering criteria; — indicates that product does not match the filtering criteria. Acronyms not defined in table: CMIP6, 6th Coupled Model Intercomparison Project; SPCMSC, St. Petersburg Coastal and Marine Science Center; USGS, U.S. Geological Survey]

Coastal Science Navigator product name	Time scale filters			Geographic scope filters							
	Past	Present	Future	Pacific territories	Hawaii	Alaska	West coast	Great Lakes	Gulf of Mexico	East coast	Atlantic territories
Hazard Exposure Reporting and Analytics (HERA)	—	—	●	●	—	—	●	—	—	●	—
Imagery Data System	●	—	—	●	●	●	●	●	●	●	●
Integrated Ocean Observing System (IOOS)	●	—	—	●	●	●	●	●	●	●	●
Marsh Shorelines of the Massachusetts Coast from 2013–14 Topographic Lidar Data	●	—	—	—	—	—	—	—	—	●	—
National Shoreline Change Data Catalog	●	—	—	—	●	●	●	—	●	●	●
Oblique Aerial Photography Viewer	●	—	—	—	—	—	—	—	●	●	—
Oceanographic Model and Data Portal	●	—	—	●	●	●	●	●	●	●	●
Our Coast, Our Future	—	—	●	—	—	—	●	—	—	—	—
Puerto Rico Natural Hazards	—	—	—	—	—	—	—	—	—	—	●
Real-time Forecasts of Coastal Change	—	—	—	—	●	●	●	●	●	●	●
Remote Sensing Coastal Change Simple Data Distribution Service	●	—	—	—	—	—	●	—	—	—	—
The Role of Coral Reefs in U.S. Coastal Protection	—	—	—	●	●	—	●	—	●	●	●
Samples Repository Collections Inventory	●	—	—	●	●	●	●	●	●	●	●
SandSnap	●	●	—	●	●	●	●	●	●	●	●
Shoreline Changes in Puerto Rico	●	—	—	—	—	—	—	—	—	—	●
SPCMSC Geologic Core and Sample Viewer	●	—	—	●	—	—	●	—	●	●	●
SPCMSC Geoscience Data Viewer	●	—	—	●	—	—	●	—	●	●	●
Total Water Level and Coastal Change (TWL&CC) Forecast Viewer	●	●	—	—	—	—	—	—	●	●	—
U.S. Coastal Wetlands Synthesis	●	—	—	—	—	—	●	—	●	●	—
USGS CoastCams Website	—	●	—	●	—	●	●	—	●	●	●
USGS Science in the American Territories	—	—	—	●	—	—	—	—	—	—	●



For more information about this report, contact:

Director, Woods Hole Coastal and Marine Science Center
U.S. Geological Survey
384 Woods Hole Road
Quissett Campus
Woods Hole, MA 02543-1598

WHSC_science_director@usgs.gov
(508) 548-8700 or (508) 457-2200
or visit our website at
<https://www.usgs.gov/centers/whcmssc>

Publishing support provided by the Pembroke Publishing Service Center
Editing by Jonas Casey-Williams and Alana Parkes
Design and layout by Susan L Meacham



ISSN 1067-084X (print)
 ISSN 2330-5703 (online)
<https://doi.org/10.3133/cir1523>

