NOAA SENTINEL SITE PROGRAM

Chesapeake Bay Sentinel Site Cooperative

Website:
http://oceanservice.noaa.gov/sentinelsites/welcome.html

NOAA Sentinel Site Program: The NOAA Sentinel Site Program (SSP) utilizes existing assets, programs, and resources in a place-based, issue-driven approach to ask and answer questions of local, regional, and national significance that affect both NOAA Trust Resources and the surrounding communities.

Abstract

The Chesapeake Bay area, located in NOAA's Northeast Region, showcases the benefit of integrating existing sentinel stations and sentinel sites into NOAA's Sentinel Site Program. The Chesapeake Bay Sentinel Site Cooperative functions within a coherent geography providing integrated observations across a host of environmental monitoring programs. The Cooperative provides information to Chesapeake Bay communities and managers who need to address challenges such as storm flooding, long-term sea level rise, local sea level rise, barrier island movement, degraded water quality, and wetland loss. The information is also useful to federal and state restoration planners and living resource managers who are addressing these challenges.

Available Assets

- 20 NOAA tide stations, including 14 National Water Level Observing (NWLON) system gauges with long term sea level trends available
- Numerous historic tide gauge datasets and water level observations from other agencies (e.g. USGS, USACE, the Smithsonian Institution, US Fish & Wildlife Service, National Park Service)
- Over 30 active Continuously Operating GPS Reference Stations (CORS) within 20 miles of the coast or coastal estuaries, including one co-located at a NWLON tide station (Solomon's Island)
- Over 50 surface elevation table (SET) datasets connected to the National Spatial Reference System for monitoring wetland elevation change (over 200 SET datasets available through sister agencies, including over one hundred sites within Blackwater National Wildlife Refuge)
- Chesapeake Bay Operational Forecast System II (CBOFS II): a full 3D coastal hydrodynamic model for tides, currents, and storm surge developed by NOAA Office of Coast Survey (OCS)
- Nested hydrodynamic model for Poplar Island: based on a nested grid within the CBOFS II, Poplar Island is a model for how local sea level rise impacts can be included within a cutting edge physical hydrodynamic model
- NOAA VDatum: sea surface topography model defined for entire Chesapeake Bay and Atlantic coast, used to estimate locally defined tidal datums such as mean sea level
- Local high accuracy geodetic control networks with permanent survey markers within 7 sites across the Bay (4 in VA, 3 in MD)
- NOAA Chesapeake Bay Interpretive Buoy System (CBIBS): a network of Integrated Ocean Observing System (IOOS) based observing platforms that transmit information using wireless technology

- Chesapeake Bay Observing System (federal, state, university, bay-wide collaborative effort)
- Wetland elevation monitoring along fire management regimes at Blackwater NWR (U.S. Fish and Wildlife Service in collaboration with NOAA, using GPS technology)
- Southern Chesapeake Bay Shallow Water Quality Monitoring Program
- Virginia Estuarine and Coastal Observing System (VECOS): website designed to distribute water quality data sampled from the Chesapeake Bay and associated tributaries within Virginia• Marsh community assessments (e.g. species distribution, abundance, and diversity) in numerous wetland habitats, from coastal salt marshes to tidal fresh marshes.
- Marsh productivity (e.g. above and below ground biomass) and Submerged Aquatic Vegetation surveys within 7 National Estuarine Research Reserve (NERR) sites
- Extensive benthic habitat survey data
- Nekton productivity (e.g. recruitment)
- Ground water dynamics in seven wetland NERR sites
- NOAA Coast Watch (East Coast Node): disseminating satellite imagery data, including models of chlorophyll, turbidity, and water temperature
- Watershed-scale habitat mapping and change analysis at Virginia and Maryland Chesapeake Bay NERRs
- Enhancement of local U.S. Geological Survey (USGS)/Virginia Institute of Marine Sciences (VIMS) York River sea level rise and salt intrusion hydrodynamic model
- Vital signs monitoring of estuarine conditions at three Virginia National Park Service Parks
- Historical analysis of wetland change: GIS study quantifying wetland change/loss over time (Chesapeake Bay NERR)
- Comprehensive assessment of areas sensitive to coastal flooding
- Poplar Island case study for including sea level rise predictions in wetland creation/restoration – a multi- agency collaboration to address this critical need in the restoration community

Internal and External Partners Currently Involved

- NOAA: National Centers for Coastal Ocean Science (NCCOS), Office of Coast Survey (OCS), Coastal Services Center (CSC), Office of Ocean and Coastal Resource Management (OCRM), Emergency Response Division (ERD), National Estuarine Research Reserve (NERRS), NOAA Chesapeake Bay Office (NCBO), National Environmental Satellite, Data, and Information Services (NESDIS; CoastWatch), Center for Operational Oceanographic Products and Services (CO-OPS)
- Other Agencies: U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, U.S. Army Corps of Engineers, State of Maryland, Commonwealth of Virginia
- Academia: University of Maryland, Virginia Institute of Marine Science, Old Dominion University

Management Goals Addressed

Long term monitoring of sea level rise, inundation, storm impacts, water quality, and habitat suitability.

Point of Contact

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NOAA SENTINEL SITE PROGRAM

Hawaiian Islands Sentinel Site Cooperative

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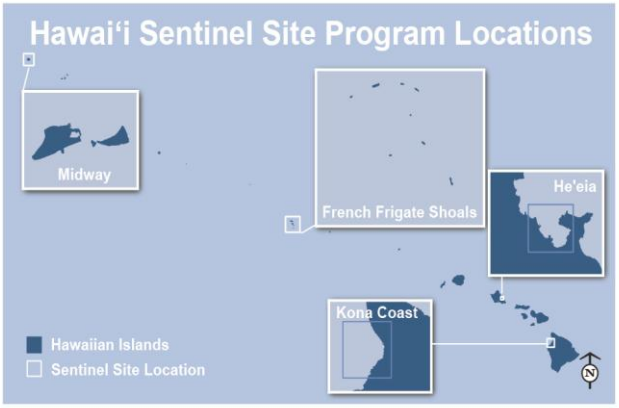

Abstract
The Hawaiian Islands Sentinel Site Cooperative is a compilation of sites that includes Midway and French Frigate Shoals in the Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands (NWHI), He'eia Wetland Restoration project (He'eia) on the island of O'ahu, and Kona Coast on the Big Island of Hawai'i. The Cooperative contains some of the most productive and unique ecological sites in U.S. waters and is widely recognized as one of the most valuable ecological locations in the world, which is why Midway and French Frigate Shoals were included in the World Heritage Site designation of the NWHIs.

While separated by great distance, the sites are connected through circulation patterns, species migration, geological origin, and geographic isolation. Midway and French Frigate Shoals have experienced little human impact and remain relatively pristine while He'eia and Kona Coast are more heavily populated and impacted. This human impact gradient provides a unique opportunity to assess how ecosystem health is impacted for both pristine and heavily stressed ecosystems, thus making it possible to extrapolate out the influence of climate change. Geographic separation makes it imperative to have strong, well established partnerships. Long-standing relationships are leading this Cooperative and include NOAA's National Ocean Service in Midway and French Frigate Shoals, the National Marine Fisheries Service in Kona Coast, and the local non-profit Kako'o 'Oiwi in He'eia. As issues of focus change and the Cooperative matures, partnerships are being expanded.

The strength of the Cooperative stems from each site having direct observation data record from several years to several decades. The reefs are some of the best studied in the world resulting in a strong baseline set of data and recent studies on connectivity and evolutionary time have increased our understanding of reef function and processes. The necessary infrastructure for accurate observations of climate change, including sea level and inundation, is in place and has been actively monitored and utilized for management decisions since installation. Because of the robust understanding of the reefs, sea level, and inundation frequencies and magnitudes, small changes are noticeable and more easily identified and understood.

Available Assets

- U.S. Geological Survey stream gauges
- NOAA tide gauges

- Biochemical baseline data (e.g. salinity, nutrient levels, etc.)
- Land cover and vegetation species data
- Invasive species monitoring and removal
- Coral and biological data
- Spatial carbon chemistry surveys
- High-resolution LIDAR imagery for the entire coastal zone

Internal and External Partners Currently Involved

- NOAA National Ocean Service program offices (Pacific Services Center, National Geodetic Survey, Office of Ocean and Coastal Resources Management, Office of National Marine Sanctuaries)
- Pacific Islands Fisheries Science Center, NOAA
- U.S. Geological Survey
- University of Hawaii
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- Bishop Museum
- Division of Aquatic Resources, State of Hawai‘i
- Coastal Zone Management Program, State of Hawai‘i
- Hawaii integrated Ocean Observing system
- Data integration program (PIMS)
- Koolaupoko Hawaiian Civic Club
- The Nature Conservancy

Management Goals Addressed

The information obtained in the Sentinel Site Cooperative directly assists in management decisions. Kona Coast is creating an integrated ecosystem assessment with the information obtained feeding back into broader management plans as well as decisions on specific topics, such as aquaculture. He’eia is working with local residents to utilize the data in improving management decisions – such as restoring damaged wetlands by monitoring rainfall, stream flow, and salt water intrusion. Data from French Frigate Shoals and Midway inform management decisions of the Papahānaumokuākea National Monument. Each location is undertaking the studies and management plans in an effort to balance human needs with ecosystem health so both can thrive.

The work undertaken through the Hawaiian Islands Sentinel Site Cooperative is translatable to other areas of Hawai‘i as well as the greater Pacific region. Every place on a coast is susceptible to increased coastal inundation and sea level change, but islands are especially susceptible because of a lack of places to move populations, a high percentage of the population dependent on coastal and oceanic ecosystems, and many islands – such as French Frigate Shoals – are low-lying meaning sea level rise can have devastating effects. The NOAA Sentinel Site Program creates a framework relatable to a wide range of locations that cover a wide range of populations, ecosystems, topographies, and because the areas already have a large set of data and management schemes in place.

Point of Contact

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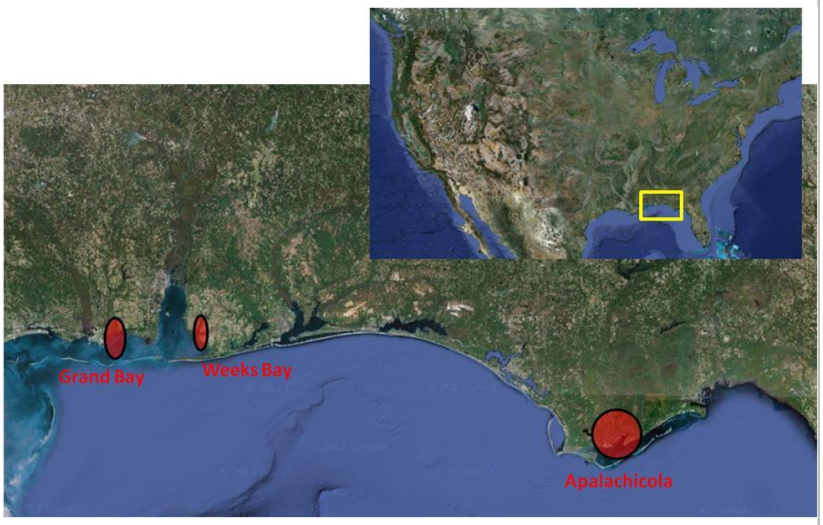
NOAA SENTINEL SITE PROGRAM

Northern Gulf of Mexico Sentinel Site Cooperative

Website:
http://oceanservice.noaa.gov/sentinelsites/welcome.html



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This cooperative incorporates the coastline and barrier islands from the Suwannee River in the Florida panhandle west to the Pearl River, at the state line between Mississippi and Louisiana. The area includes the Apalachicola, Weeks Bay, and Grand Bay National Estuarine Research Reserves as well as several National Wildlife Refuges and National Parks. This region, with low level topography and extensive marsh and other critical habitats, is highly susceptible to the effects of sea level change (SLC). The combined effects of sea level rise and tropical storms can have dramatic impacts on coastal communities and ecosystems, including more flooding, faster erosion, land loss, and saltwater intrusion into freshwater resources. Impacts can also reach offshore to valuable resources like oyster reefs and seagrass beds. Considerable ongoing monitoring and research activities, particularly within three NERRs sites, provide the baseline information and parameters required for an integrative ecosystem approach to addressing SLC. Building off of an NCCOS-funded project, this Cooperative would leverage the combined capabilities of three NERRs, NOS, the Gulf of Mexico Alliance and the NOAA Gulf Regional Collaboration Team to assess the impacts of SLC and develop capabilities and tools to facilitate conservation of coastal resources by local, state, and regional managers. Key products will include coupled models of hydrodynamics, sedimentation, salinity, and vegetation dynamics as well as classified maps that delineate high and low risk areas. These tools and products are envisioned to allow for assessments of risk and planning, coastal construction guidelines, resource protection and sustainability needs, and set back guidance.

Available Assets

- Suite of surface elevation tables in marsh habitats, in coordination with NGS, GOMA, and NCCOS at three NERRs. Additional ongoing monitoring and research activities on a suite of biological (e.g. oyster and marsh productivity) and physical parameters (e.g. sediment transport and circulation).
- Land cover data sets for the entire Cooperative region derived from 30-m resolution Landsat Thematic Mapper and Landsat Enhanced Thematic Mapper satellite.
- In association with the Northwest Florida Water Management District and FEMA, complete LiDAR coverage of the Cooperative region and recent flood plain mapping.

- Suite of modeling platforms, including ADCIRC-2DDI, POM 3D, SWAN, WASH123D, and MEMII that will be coupled allowing for delineation of new tidal boundaries, marsh erosion estimates, and habitat land cover changes, for example.
- Ongoing NCCOS-funded study, led by the University of Central Florida, on the Ecological Effects of Sea Level Rise in the region that will provide integrative capabilities and lead the development of tools and products to assess and predict impacts of sea level rise.
- Engaged local, state, and federal stakeholders, with an established management advisory committee, that includes resource managers and coastal planners.
- Capabilities for the dissemination of the information, products, and capabilities through partnerships that include the Coastal Training Program, CSC's Sea Level Rise Viewer, and GOMA.

Internal and External Partners Currently Involved

- NOAA National Centers for Coastal and Ocean Science (NCCOS)
- National Geodetic Survey (NGS)
- Coastal Services Center (CSC)
- Center for Operational Products and Services (CO-OPS)
- National Estuarine Research Reserves (NERRs; Apalachicola, Grand Bay, and Weeks Bay)
- NOAA Gulf Regional Collaboration Team
- Sea Grant (Mississippi-Alabama, Florida)
- Mobile Bay National Estuary Program (NEP)
- Gulf of Mexico Alliance
- Northwest Florida Water Management District
- County planners (Wakulla, Escambia, Bay)
- Academia (University of Central Florida, University of Florida, Florida State University, University of South Carolina)

Management Goals Addressed

The proposed Cooperative addresses several regional and national management goals. The Gulf Alliance Habitat Conservation and Restoration Priority Issue Team (PIT) has several long-term goals relevant to sea level change in this region, including improved conservation and restoration management tools, as does the Coastal Community Resiliency PIT. This Cooperative will also address needs outlined in the Surface Water Improvement and Management plan of the Northwest Florida Water Management District as well as management plans of the numerous protected areas in the region (e.g. NERRs, NWR, Aquatic Preserves). A Management Committee associated with the NCCOS project, will provide guidance and direction for tool and product development to best address these and other management plans and efforts.

Point of Contact

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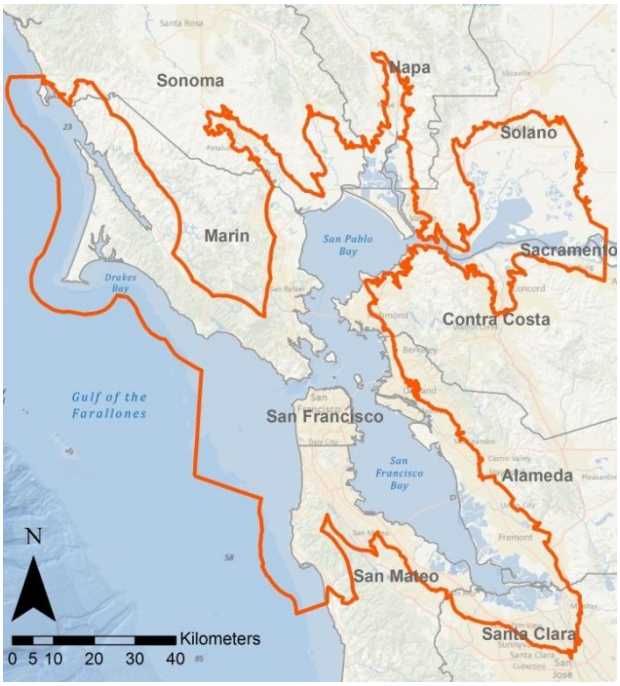
NOAA SENTINEL SITE PROGRAM

San Francisco Bay and Outer Coast Sentinel Site Cooperative

Website:

http://oceanservice.noaa.gov/sentinelsites/welcome.html



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Abstract

San Francisco (SF) Bay and its Outer Coast comprise the largest estuarine area on the west coast of the United States. Home to a bounty of natural areas such as Gulf of Farallones and Cordell Bank National Marine Sanctuaries and the San Francisco Bay National Estuarine Research Reserve as well as over 7 million people, the region serves as an ideal area for the variety of NOAA and partner programs to help achieve the vision of the NOAA Sentinel Site Program.

The NOAA Sentinel Site Program provides a place-based, issue-driven approach to ask and answer questions of local, regional, and national significance that affect both NOAA Trust Resources and the surrounding communities, that will leverage existing assets, programs, and resources. The effort for the SF Bay Sentinel Site Cooperative is led by NOAA's Coastal Services Center, Gulf of the Farallones National Marine Sanctuary, and two NOAA-state partnerships – SF Bay Conservation and Development Commission and SF Bay National Estuarine Research Reserve.

The SF Bay Area Sentinel Site Cooperative combines and enhances current NOAA and partner efforts on climate change projects and programs addressing sea level rise and storms, ranging from Bodega Bay to Ano Nuevo along the coast, and San Francisco Bay, such as:

- Our Coast–Our Future: Planning for Sea Level Rise and Storm Hazards Within the Bay Area
- Bay Area Ecosystems Climate Change Consortium
- NOAA San Francisco Bay Coordination Group
- Adapting to Rising Tides
- San Francisco King Tides Initiative

NOAA and our partner programs are uniquely positioned and active in supporting and leveraging this effort, which will produce high visibility successes on climate change science, tools, adaptation, and outreach. The goal of the SF Bay Sentinel Site Cooperative is to improve resilience of coastal communities and natural areas to sea level rise and its impacts by providing:

- Tools to visualize potential sea level rise, inundation, flood frequency, marsh and socioeconomic impacts

- Socioeconomic vulnerability analysis that can be used as a model for other regions
- Adaptation plan for a Bay Area community that is transferable to other communities in and around the Bay region, and for protected area coastal habitats

Current Sources of NOAA and Partner Data and Information:

- NOAA water level gauges and Physical Oceanographic Real Time System (PORTS)
- National Estuarine Research Reserve and National Marine Sanctuary System-Wide Monitoring Programs
- Topographic, land elevation base layer data for sea level rise and inundation mapping
- Central and Northern California Ocean Observing System data sets and tools (e.g., wave frequency and energy)
- Stanford Unstructured Nonhydrostatic Terrain-following Adaptive Navier-Stokes Simulator (SUNTANS) model for understanding wetland changes, and restoration options
- NOAA National Ocean Service's Operational Forecast System
- U.S. Geological Survey Coastal Storm Modeling System (CoSMoS) – predicts inundation/flooding, wave heights, beach erosion, and cliff failures
- Delft 3D (limited area) – currently supports the Innovative Wetland Adaptation Techniques in Lower Corte Madera Creek Watershed project

NOAA Programs

- Office of Oceanic and Atmospheric Research:
  - Climate Program Office
- National Ocean Service:
  - Coastal Services Center
  - Cordell Bank National Marine Sanctuary
  - Gulf of the Farallones National Marine Sanctuary
  - National Geodetic Survey
  - Office of Coast Survey
  - San Francisco Bay National Estuarine Research Reserve
  - Bay Conservation and Development Commission
- National Marine Fisheries Service
  - Office of Habitat Conservation
  - Southwest Restoration Center
  - Southwest Science Center
- National Weather Service

Key Partners

- Bay Area Ecosystems Climate Change Consortium
- Point Reyes Bird Observatory (PRBO) Conservation Science
- National Park Service
- U.S. Geological Survey
- U.S. Fish and Wildlife Service

Point of Contact

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NOAA SENTINEL SITE PROGRAM

www.oceanservice.noaa.gov/sentinelsites

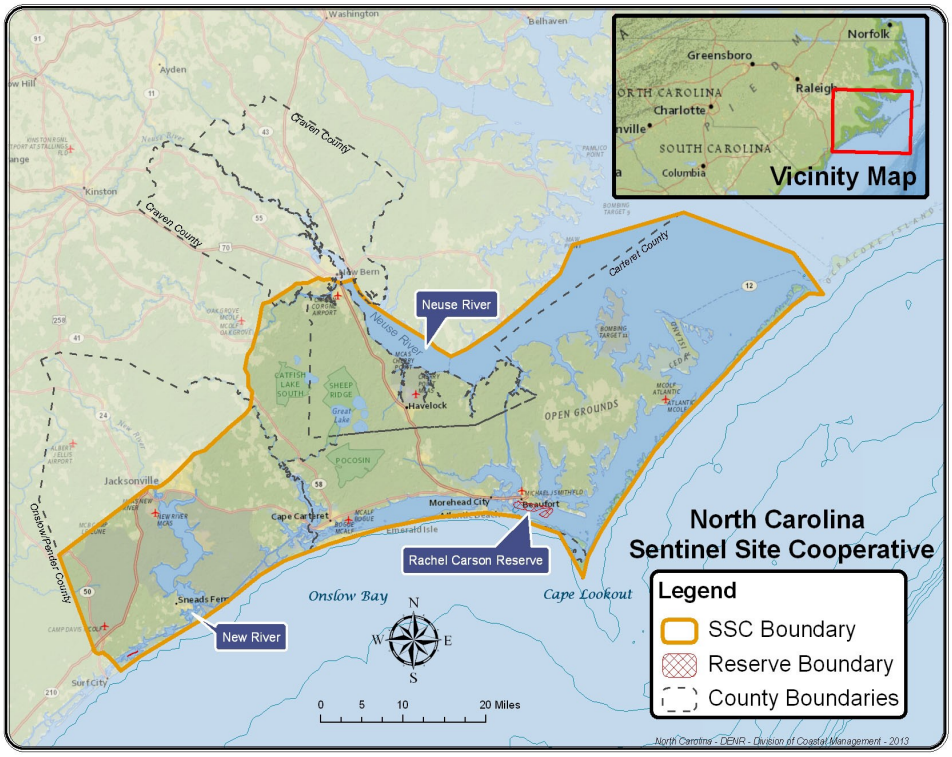
NOAA Sentinel Site Program

The NOAA Sentinel Site Program leverages existing research and monitoring resources to ensure resilient coastal communities and ecosystems in the face of changing conditions. The program's place-based approach focuses on issues of local, regional, and national significance that impact habitats and species managed by NOAA as well as surrounding coastal communities.

The North Carolina Sentinel Site Cooperative (NCSSC)

Why North Carolina?

- Location on the central coast of N.C. near the Beaufort NOAA laboratory and other marine science facilities
- Existing marine science facilities, coastal monitoring stations, updated bathytopology data, and protected areas ensure continuous information-gathering to inform coastal management
- N.C. coast is particularly vulnerable to sea-level changes due to high wave exposure, a gently sloping coastline, and an abundance of barrier islands
- Overlapping bio-geographic provinces, like those found on NC coast, are critical areas where climate change effects will be first detected



Future Opportunities

- Potential future expansion of the Cooperative to include the entire N.C. coast will provide information on sea-level change impacts across a variety of coastal ecosystems
- N.C.'s extensive coastal area supports economically important activities such as shipping, fishing, and tourism that would be heavily impacted by changing sea-level. Lessons learned at the NCSSC are transferable to regions with similar coastal economies.

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Goals for North Carolina Sentinel Site Cooperative

Goal 1: Increase understanding of sea-level rise impacts on coastal ecosystems through cooperative research and monitoring. Effectively translate findings to support informed decision-making.

Goal 2: Resource managers receive and apply the NCSSC scientific information to enhance sustainable and resilient conservation strategies for coastal ecosystems.

Goal 3: Coastal residents are better informed about how to address sea-level rise impacts.

Sea-Level Research & Monitoring Coordination Workshop

On March 12 & 13, 2013, the NCSSC hosted 35 scientists and coastal managers to coordinate research and monitoring activities in NCSSC region. Through facilitated discussions, the following were prioritized:

Gaps in Research & Monitoring

- More water level measures
- Central clearinghouse for NCSSC data
- Awareness of sea-level rise issues and impacts
- Understanding of sediment supply, dynamics, and land-use changes
- Improved coastal LIDAR data and bathymetry
- Economic assessment of sea-level rise on built environments and ecosystem services
- More water quality and data collection

Become Part of the North Carolina Sentinel Site Cooperative

- Join the Water Level Subcommittee – this committee formed as a direct result of the March 2013 Research and Monitoring Coordination Workshop, as a need for more water level monitoring was determined to be a high priority gap. This interagency group is now forming and will be defining their goals over the coming months.
- Join the Core Management Team – this interagency group is the main driving force of the Cooperative. Join the team and guide the future direction of the NCSSC.
- Conduct research that addresses the gaps identified in the Research and Monitoring Coordination Workshop.