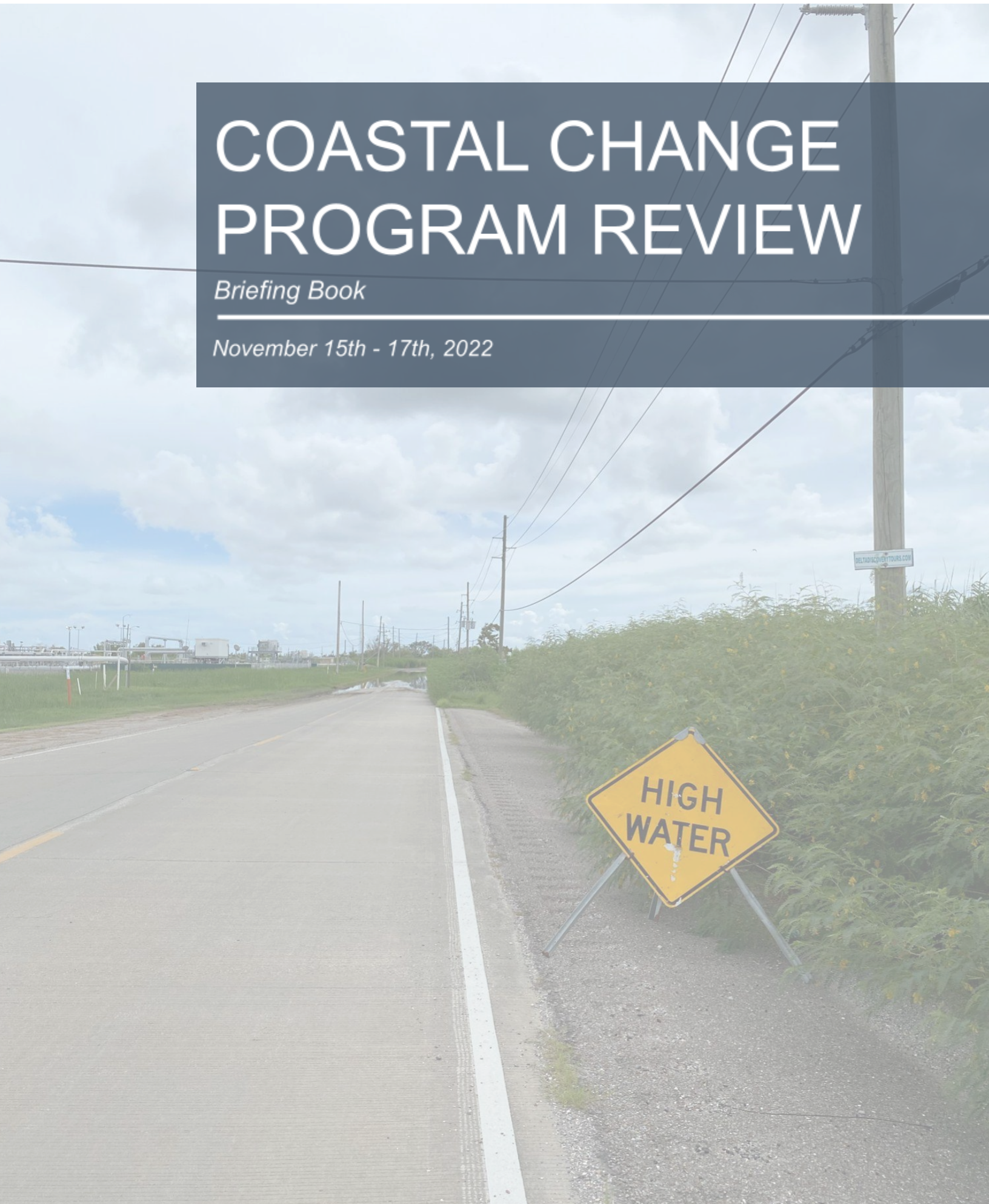
NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

SCIENCE SERVING COASTAL COMMUNITIES

COASTAL CHANGE PROGRAM REVIEW

Briefing Book

November 15th - 17th, 2022



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Guide to Reading this Document

The National Centers for Coastal Ocean Science (NCCOS) Coastal Change Program has assembled this document as an introduction to the program and as a reference for the Review Panel in addressing the scope and charge of the Program Review. We would like to highlight these sections in order of importance:

1. Panelist Charge - Each member of the Review Panel will use their scientific expertise and professional judgment to provide independent observations, evaluation, and recommendations on the Program portfolio.
2. Checklist of Panel Members' Duties
3. Review Evaluation Criteria -The review criteria are a set of questions encompassing the topics of quality, relevance, and performance that should guide the review.

During the three-day review, we will share presentations that unpack and provide context for the information captured in this document as well as provide a venue for discussion through questions and answer periods and several roundtables.

Points of Contact

Brittany King (brittany.king@noaa.gov) and
Elizabeth McNamee (elizabeth.mcnamee@noaa.gov) are your primary points of contact for this review.

Program Review Agenda

Silver Spring Civic Center, Fenton Room
1 Veterans Place, Silver Spring, MD 20910

Virtual Participation Link: meet.google.com/hsu-tmtn-khk
Call-in : +1 575-418-3921 (PIN: 710 963 480#)

Day 1: Tuesday, November 15, 2022		
Time	Description	Presenter(s)
9:00 am	**Opening Session - Welcome, Introductions, and Program Review Overview**	Brittany King Elizabeth McNamee
9:30 am	**Leadership Remarks, NCCOS and Coastal Change Program Overview**	Margo Schulze-Haugen David Kidwell
Break (10:20 pm)		
10:30 pm	**Internal Coastal Change Science Part 1**	Tomma Barnes Jenny Davis Shay Viehman Brandon Puckett
Lunch Break (11:45 pm)		
1:00 pm	**External Coastal Change Science: Effects of Sea Level Rise Program**	Trevor Meckley Peter Ruggiero Davina Passeri Renee Collini Brett Sanders
2:30 pm	**Complementary Products and Service Delivery**	Christine Buckel
Break (2:45 pm)		
2:55 pm	**Internal Coastal Change Science Part 2**	Theresa Goedeke Seann Regan Amy Freitag Sarah Gonyo
3:55 pm	**Recap and Questions**	Elizabeth McNamee
Adjourn (4:10 pm)		
4:15 pm	**Executive Session**	Review Panel Only

Day 2: Wednesday, November 16, 2022		
Time	Description	Presenter(s)
9:00 am	**Opening Session**	Brittany King Elizabeth McNamee
9:30 am	**Coastal Change By The Numbers**	Tomma Barnes
Break (10:00 am)		
10:15 am	**Open Discussion with Management**	Brittany King (Moderator) David Kidwell Tomma Barnes Theresa Goedeke
Break (11:15 am)		
11:30 pm	**Partner Conversations Part 1: Coastal Resilience Team (Virtual)**	Jenny Davis (Moderator) Shay Viehman (Moderator) Jeff King Sarah Spiegler Jennifer Moore Leslie Craig
Lunch (12:30pm)		
1:30 pm	**Partner Conversations Part 2: ESLR (Virtual)**	Trevor Meckley (Moderator) Renee Collini Davina Passeri Peter Ruggiero Brett Sanders Bret Webb
Break (2:30 pm)		
2:40 pm	**Partner Conversations Part 3: Social Science Team (Virtual)**	Theresa Goedeke (Moderator) Phyllis Grifman Ian Miller Sabrina Bornstein John Rozum
3:30 pm	**Closing Remarks**	David Kidwell
Adjourn (3:45 pm)		
4:00 pm	**Executive Session**	Review Panel Only
Group Dinner (6:00 pm) - Location TBD		

Day 3: Thursday, November 17, 2022		
Time	Description	Presenter(s)
9:00 am	**Deliberations & Initial Recommendation Development**	Review Panel Only
Break (11:00 am)		
11:15 am	**Panel Presentation(s) & Summary to Leadership**	Review Panelists
11:45 pm	**Thanks & Final Remarks**	Margo Schulze-Haugen

***Presenters are subject to change**

Review Panel

Members of the Review Panel include technical experts in different fields, program directors, and users of information. We have tried to balance the composition of the review panel, considering affiliation (Federal and non-Federal), scientific expertise, geography, and stakeholders. We do not expect each Panel Member to have command over the entire spectrum of the NCCOS Coastal Change Program.

Panel Chair

Neil Ganju, PhD
Research Oceanographer, Woods Hole Coastal and Marine Science Center
The U.S. Geological Survey
nganju@usgs.gov

Panel Members

Hilary Stockdon, PhD
Acting Program Coordinator, Coastal and Marine Hazards and Resources Program,
The U.S. Geological Survey
hstockdon@usgs.gov

Tina Hodges
Climate Change Policy Analyst, Office of the Secretary of Transportation,
The U.S. Department of Transportation
tina.hodges@dot.gov

John Callaway, PhD
Professor, Environmental Management (MSEM) Graduate Program Director,
University of San Francisco
callaway@usfca.edu

Lisa Auermuller
Assistant Manager, Jacques Cousteau National Estuarine Research Reserve
Administrative Director, Megalopolitan Coastal Transformation Hub, Rutgers
Tuckerton, NJ
auermuller@marine.rutgers.edu

Angelina Freeman, PhD
Research Scientist, Coastal Protection and Restoration Authority of Louisiana (CPRA)
angelina.freeman@la.gov

Neil Ganju, Ph.D. (Panel Chair)
Research Oceanographer, Woods Hole Coastal and Marine Science Center
The U.S. Geological Survey
Woods Hole, MA

Dr. Neil Ganju's research spans the multiple disciplines that converge in estuarine systems. Dr. Ganju's research projects include numerical model development, field observations of hydrodynamics and water quality, wetland and coastal vulnerability assessments, geomorphic change, and eutrophication. Dr. Ganju is the lead of the Estuarine Processes, Hazards, and Ecosystems project at the USGS Woods Hole Coastal and Marine Science Center. The project has been applying sediment transport and geospatial principles to address salt marsh vulnerability over the last decade. They use a combination of observational, remote sensing, and numerical tools to provide Federal and state agencies with actionable information for coastal management and restoration.

Hilary Stockdon, Ph.D. (Panel Member)
Acting Program Coordinator, Coastal and Marine Hazards and Resources Program
The U.S. Geological Survey
Reston, VA

Dr. Hilary Stockdon is the acting Program Coordinator of the U.S. Geological Survey Coastal-Marine Hazards and Resources Program. Prior to this role, she spent almost 20 years as a research oceanographer, studying coastal change processes and impacts with a goal of providing actionable scientific information for decision makers responsible for preparedness, response, and resilience along our nation's coastlines. Dr. Stockdon's research contributions include advances in: real-time forecasts and scenario-based predictions of coastal total water level and geomorphic change during storms; use of wave runup parameterization in coastal hazard assessments; barrier island response to extreme storms and hurricanes; modeling wave swash, setup, and runup; and lidar-derived measures of coastal change. Her work on the effects of storms on the coastal communities of our Nation has raised public awareness about the value of scientific information on coastal vulnerability, helping residents prepare for future events. She is also a co-executive director of the U.S. Coastal Research Program, which advances user-inspired coastal research by integrating Federal research priorities with community needs and transitioning research outcomes to the users.

Tina Hodges (Panel Member)
Climate Change Policy Analyst
Office of the Secretary of Transportation
The U.S. Department of Transportation
Washington, DC

Tina Hodges recently returned to the U.S. Department of Transportation to serve as a climate change policy analyst in the Office of the Secretary of Transportation. From 2020 to 2022 she worked in NOAA's Office of Oceanic and Atmospheric Research (OAR), where her responsibilities include leading evaluations of NOAA research programs and laboratories, strategic planning, risk management, and coordinating a partnership with the U.S. Department of Transportation on adapting transportation systems to climate change impacts. Prior to transferring to NOAA in September 2020, Ms. Hodges worked for 15 years at the U.S. Department of Transportation. Her work there included research, technical assistance and outreach to improve sustainability of transportation networks and enhance the resilience of transportation infrastructure to climate change impacts. She is a former Presidential Management Fellow. Ms. Hodges holds a Master's in Public Policy from the University of Maryland. Prior to her graduate studies, she conducted policy advocacy for a non-profit human rights organization.

Angelina Freeman, Ph.D. (Panel Member)
Research Scientist, Coastal Protection and Restoration Authority of Louisiana (CPRA)
Baton Rouge, LA

Dr. Angelina Freeman is a research scientist with the Coastal Protection and Restoration Authority (CPRA) of Louisiana. Her research interests have focused on coastal management, water quality, nutrient management, ecosystem functioning and restoration, and coastal geology. Dr. Freeman has authored articles exploring management strategies for coastal Louisiana restoration, improving ecological model algorithms to support CPRA management planning, and analyzing storm-induced hydrodynamics and sediment deposition on coastal Louisiana lakes and bays. Dr. Freeman understands science to application across a diverse range of coastal resilience topics. Dr. Freeman holds a Ph.D. in Oceanography and Coastal Sciences from Louisiana State University.

John Callaway, Ph.D. (Panel Member)
Professor, Environmental Management (MSEM) Graduate Program Director
University of San Francisco
San Francisco, CA

Dr. John Callaway is a Professor in the Department of Environmental Science at the University of San Francisco (USF). He recently served as the Delta Lead Scientist (2017-2020) for the Delta Science Program and Delta Stewardship Council. Prior to USF, he was the Associate Director of the Pacific Estuarine Research Laboratory at San Diego State University. Dr. Callaway teaches courses in wetland ecology and restoration ecology at USF and conducts research on wetland restoration, climate change effects on tidal wetlands, and wetland carbon dynamics. He has served on a number of advisory panels on wetland restoration and management, including in Louisiana, southern California, and the San Francisco Bay area. Currently he is an associate editor for Estuaries and Coasts, and is the co-chair for the 2023 meeting of the Coastal and Estuarine Research Federation in Portland, OR. Dr. Callaway received his M.S. in Biology from San Francisco State University and a Ph.D. in Oceanography and Coastal Sciences from Louisiana State University.

Lisa Auermuller (Panel Member)
Assistant Manager – Jacques Cousteau National Estuarine Research Reserve
Administrative Director – Megalopolitan Coastal Transformation Hub, Rutgers
Tuckerton, NJ

Lisa Auermuller is the Assistant Manager of the Jacques Cousteau National Estuarine Research Reserve (JC NERR) in Tuckerton, NJ where she has been employed there since 2002. Ms. Auermuller oversees the day-to-day management of JC NERR's Coastal Center as well as the Reserve's education, outreach, communications, and Coastal Training Program. Ms. Auermuller's primary areas of interest are coastal community vulnerability and resilience as they relate to current and future coastal hazards. Her work combines natural and social science aspects of the coastal decision-making process. Additionally, she also serves as the Administrative Director of Rutgers' NSF funded Megalopolitan Coastal Transformation Hub (MACH). In this role she serves as the central manager of overall operations of the multi-institution effort. Ms. Auermuller establishes mechanisms for collaborative sharing of findings among project partners, conducts regular outreach to promote coordination and collaboration with government agencies, community leaders, and facilitates meaningful and routine collaboration and sharing among project partners.

Guidance and Charge to Reviewer

Purpose of the Review

NOAA requires external, peer-reviews of its research and development programs on a periodic basis. Such reviews play a key role in program planning, management and oversight by providing feedback on both program design and execution. NCCOS is further interested in evaluation of its information products, their delivery to users, and engagement with stakeholders.

The independent and expert review and evaluation of a research program serves to ensure its scientific integrity, caliber, performance and relevance by providing written assessments and recommendations for ensuring the achievement of high research and performance standards. These principles are codified and outlined in NOAA Administrative Order 216-115B: Research and Development in NOAA which establishes the requirements and guidelines for conducting a review of NOAA programs.

The scope of this review is science that falls under the priority Coastal Change and was funded and/or conducted in the Fiscal Year (FY) 2017-2021 period.

Program Evaluation Criteria

Following enactment of the Government Performance and Results Act (GPRA) in 1993, the National Academies' Committee on Science, Engineering, and Public Policy produced a report on the unique purpose of Federal research programs and inherent challenges in their evaluation. The committee concluded that Federal research programs could be evaluated using three criteria: quality, relevance, and performance, and noted that such evaluations should consider factors beyond peer review of research publications by scholars in the field (National Academy of Sciences, 2001).

In its 2008 Guide to the Program Assessment Rating Tool (PART) and citing the National Academies report, the Office of Management and Budget (OMB) identified relevance, performance, and quality as criteria that can be used to assess the effectiveness of Federal research and development (R&D) programs. This approach was further endorsed in a 2008 NRC report, which stated that research program efficiency must be evaluated in the context of relevance, effectiveness, and quality.

NOAA, through an Administrative Order (NAO 216-115B, last issued June 6, 2022, and its previous editions), has adopted Quality, Relevance and Performance as core evaluation criteria. The NAO also calls for a periodic evaluation of research, development and transition activities as well as outreach efforts and stakeholder engagement.

In the context of this review, these criteria may be described in the following terms:

Quality is a measure of soundness, accuracy, and reproducibility of a specific body of research. This evaluation criterion establishes the relative merit of the research or program relative to that of contemporaries in the community of practice, and whether the scientific methodologies were appropriate, adhered to, and thoroughly documented. In general, it refers to the research publications, awards, innovations, and patents which imply adherence to values of objectivity, fairness, and accountability. It also requires evidence of established procedures for competitive, merit-based research funding and assuring scientific integrity.

Relevance refers to the value and significance of the Coastal Change portfolio to NOAA's mission, and the benefits of related products and services to stakeholders and broader society. The Office of Management and Budget refers to relevance as the "impact" of a program, i.e., measurable analysis of how NCCOS products and services accrued societal benefits, and who uses the products and how. In essence, relevance asks, "What would not have happened if the NCCOS Coastal Change Program did not exist, and how much would society have missed?" During a review, program personnel identify public benefits of the program, highlighting benefits uniquely provided by the Coastal Change Program. Benefits include increasingly more skillful and reliable program output, technology, or methodology that satisfies research priorities and user needs, and provides effective expert counsel and new options for the future.

Performance refers to an ability to manage in a manner that produces identifiable results effectively (achieving desired results) and efficiently (with maximum productivity and minimum wasted effort or money). Assessing performance involves evaluating the adequacy of the leadership, workforce, and infrastructure needed to achieve the designated goals. This is assessed by program management structures that produce the desired results, guidance, or framework for tracking progress toward agency's strategic goals and objectives, flexibility to address events or changing priorities, interaction with stakeholders, and extramural collaboration.

Reviewers' Responsibility

NCCOS will present information relevant to the Coastal Change Program during the course of the review in the form of presentations, the Briefing Book, and a web application. Each member of the Review Panel will use that information and any ensuing discussion to come up with independent observations, evaluation, and recommendations on different aspects of the portfolio. We have formulated the following questions to guide your review and to conform to the three core evaluation criteria:

Quality

1. How would you characterize the scientific quality of the findings and products generated by the Coastal Change Program?
2. Describe the value of the research provided to the scientific community, including resource managers, by the Coastal Change Program, and how can the Program enhance this value further?
3. Are scientific products delivered to the community in a manner that maximizes their utility (e.g.- timely, understandable, sufficiently detailed, and readily accessible format) and what actions would enhance their delivery?

Relevance

1. How and to what extent are products aligned with NOAA and NCCOS legislative mandates and priorities, and what actions would improve this alignment?
2. To what extent do those beyond the scientific community, including resource managers, use findings and products generated by Coastal Change Program projects to inform decision-making, improve preparedness, management and/or response to events and issues handled by other Federal, local, state, tribal, and regional governments?
3. Are there research gaps that should/should not be pursued and if so, why?

Performance

1. How effectively does the Coastal Change Program utilize funded collaboration and external partnerships to achieve desired program outcomes, increase overall return on investment, and strengthen the impact of our science?
2. How well does the Coastal Change Program execute its research and related studies in an efficient and effective manner given appropriated resources?
3. How effective are the strategies that the Coastal Change Program has for identifying, establishing and maintaining relationships with stakeholders and the non-scientific community, and what steps would expand and strengthen relationships and ensure they are effectively leveraged?

At the review, Panel Members will be free to ask these and any additional questions, as appropriate. We will provide adequate time each day for the Panel Members to discuss and deliberate on the information provided and come up with their own judgment and conclusions. Panel Members will present their preliminary findings to the Coastal Change Program and NCCOS leadership on Day 3 of the review.

Individual written reports will be due within 30 days after the review, by December 17, 2023. No consensus report will be submitted. Individual reviewer reports will also be compiled by NCCOS in a document for use by the Coastal Change Program.

Panel Chair's Responsibility

Per the Procedural Handbook for NOAA Administrative Order (NAO) 216-115A: Research and Development in NOAA, that governs External program Reviews: "The panel should be chaired by a Federal employee to comply with the Federal Advisory Committee Act (FACA), and the individual should also be from outside NOAA to avoid conflicts of interest. Per these guidelines, the panel's final report should summarize panelists' individual findings, rather than seek consensus of the panel. The Panel Chair will distribute the written reports to the NCCOS Director (margo.schulze-haugen@noaa.gov) and points of contact by January 17, 2023. More details on the Panel Chair's responsibilities are provided in the next section.

After the conclusion of the Program Review, information on the review (including the summary report) will be posted to the NCCOS website and will be available to the public.

Checklist of Panel Member Duties

Tasks/Duties of the Panel Chair

- ☐ Serve as the primary point of contact for the Review Panel and communicate with other members of the Panel to articulate the three core evaluation criteria (quality, relevance, and performance).
- ☐ Examine, in consultation with the Panel and prior to the review, a set of programmatic questions with sufficient breadth and depth that cover the purpose and objectives of the review.
- ☐ Introduce the Panel Members to the audience at the start of the review.
- ☐ Facilitate the question and answer session at the end of each presentation.
- ☐ Lead the panel discussion on the day's proceedings at the end of each day and suggest any changes or modifications to the remaining schedule.
- ☐ Determine a schedule for producing review products.
- ☐ Present their preliminary findings to the NCCOS leadership on the last day of the review.
- ☐ Compile all of the individual reviewer reports into a single document for use by the NCCOS leadership.
- ☐ Prepare a personal summary outlining the program review proceedings (e.g., what happened, salient issues, recommendations on the structure of the review) and the recurring themes or notable exceptions during presentations or in Panel Members' reports.

Tasks/Duties of Panel Members

- ☐ Each Panel Member (including the Panel Chair) will use the attached Evaluation Criteria and conduct an independent evaluation of the Coastal Change Program.
- ☐ These individual reports (prepared without consultations with other Panel Members or the Chair) will be based on an evaluation of content from:
    - ☐ Program Review Briefing Book
    - ☐ Sessions provided during the Program Review
- ☐ All non-Federal Panel Members and the Chair will be required to sign the attached Conflict of Interest Form

Deliverables & Due Dates (Chair and Panel)

- ☐ Panel Member Reports will be written and provided in electronic format (in Microsoft Word) to the Chair and NCCOS Point of Contact within 30 days after the conclusion of the program review (by **December 17, 2022**) .
- ☐ The Chair will provide a summary report to the NCCOS Director (margo.schulze-haugen@noaa.gov) and Points of Contact by **January 17, 2023**.

NCCOS Overview

NCCOS within the National Ocean Service

NOAA's National Ocean Service (NOS) provides data, tools, and services that support coastal economies and their contribution to the nation. The mission of NOS is to provide science-based solutions through collaborative partnerships to address evolving economic, environmental, and social pressures on our ocean and coasts. The National Centers for Coastal Ocean Science (NCCOS) is the research, monitoring and assessment organization within NOS. NCCOS delivers ecosystem science solutions: a) for the stewardship of ocean and coastal resources; and b) to support thriving coastal communities and economies.

Background

NCCOS was formed in 1999 as the focal point for NOAA's coastal ocean science efforts to meet its coastal stewardship and resource management responsibilities. The office conducts nationwide, multidisciplinary research that integrates a broad spectrum of physical, biological, chemical, and social sciences to inform and guide resource and community managers, while seeking a balance among resource use, economic development, restoration, conservation, and human health. NCCOS works closely with coastal managers and other stakeholders to determine research needs and ensure we are delivering valuable, relevant, timely, and actionable products and tools to inform decisions. Stakeholders are often engaged in project planning and execution and provide guidance throughout the research process. NCCOS science is guided by NOAA's legislative mandates, executive orders, and NOS priorities, as well as stakeholder engagement. By providing science products and tools, NCCOS helps communities plan for, adapt to, and reduce risks from the multiple challenges facing coastal communities.

Facilities

NCCOS leadership, scientists, program managers, and staff work in several facilities across the country. They are described below.

- **NCCOS Headquarters Silver Spring** - Silver Spring is the location of NCCOS headquarters, the Competitive Research Program, as well as scientific expertise in biogeography, habitat mapping, HAB forecasting and monitoring and bioeffects of chemical contaminants.
- **NOAA Beaufort Laboratory** - NCCOS staff in Beaufort conduct research on harmful algal blooms, habitat mapping, aquaculture siting and impacts, ecology of marshes and coral reefs, and coastal resilience and restoration. Facility

infrastructure includes seawater/culture facilities, analytical laboratories, scientific diving and small boats programs, and NCCOS business management functions.

- **Cooperative Oxford Laboratory (COL)** - COL is a partnership between NOAA, the Maryland Department of Natural Resources and the USCG Station Oxford. COL partners combine science, response, and management capabilities to meet respective missions and collaborate to address science and management challenges. The lab is a branch of NCCOS' Marine Spatial Ecology Division. COL scientific capabilities are diverse and include expertise in research to enhance preparedness and recovery in the face of coastal change, and research of novel methods to improve restoration and resilience practices.

- **Kasitsna Bay Laboratory** - The Kasitsna Bay Laboratory has been the Alaska field station for both NCCOS and the National Marine Fisheries Service since the late 1950s. NCCOS partners with the University of Alaska Fairbanks on lab operations and research. The Kasitsna Bay Laboratory is a part of NCCOS's Marine Spatial Ecology Division and conducts research on coastal impacts of climate change, ocean acidification, harmful algal blooms, and oil spills and hosts Federal, state, tribal, and university researchers.

- **Hollings Marine Laboratory (HML)** - HML is a NOAA-owned facility operated by NCCOS as a fully collaborative enterprise, governed by the five partner organizations through a Joint Project Agreement. HML partners consist of NOAA, the National Institute of Standards and Technology, the South Carolina Department of Natural Resources, the College of Charleston, and the Medical University of South Carolina. Scientists from all partner institutions work side-by-side in the laboratory, taking advantage of each other's special expertise.

NCCOS Science Priorities

FY 2017 - 2021 (the period under review)

NCCOS's Strategic Science Priorities for 2017-2021 are outlined in detail in Advancing Coastal Science and listed below.

1. Marine Spatial Ecology
2. Stressor Impacts & Mitigation
3. **Coastal Change: Vulnerability, Mitigation, and Restoration**
4. Social Sciences

Note that this program review focuses on science that falls within the Coastal Change priority.

FY 22 and Beyond

In 2021, NCCOS released its FY 2022-2026 Strategic Plan that outlines the following six science and organizational priorities:

1. Advancing Ecosystem Science for Conservation and Sustainable Use
2. Developing and Implementing Advanced Observation Technologies and Ecological Forecasts
3. **Facilitating Resilience and Adaptation to Inundation and Climate Impacts**
4. Detecting, Monitoring, and Mitigating Impacts of Chemical and Biological Stressors
5. Advancing Social, Economic, and Behavioral Approaches to Coastal Stewardship
6. Investing in our People and Achieving Organizational Excellence

We mention the most recent strategic plan (FY 22-26) to provide reviewers context for the direction NCCOS is heading. Moving forward, the Coastal Change Program is primarily captured under the third priority, highlighted above, with substantial contributing work from the fifth priority, also highlighted.

Coastal Change Program Overview and Priorities

Climate change alters coastal ecosystems and the services those ecosystems provide to coastal communities and economies. The increasing rate of sea level rise, coastal flooding, and frequency of extreme weather events increase risks to our coastal communities and natural resources. Globally, natural disasters (e.g., floods, storms, wildfires) caused $210 billion dollars in damages in 2020[1], showing the growing cost of climate change. Losses of this magnitude are projected to become commonplace. In the United States, 2020 was the 10th year in a row with eight or more weather events that each resulted in losses of $1 billion or more[2]. As a result of these events, people lost their lives, homes, businesses and/or property and the social fabric that knits the communities was disrupted.

NCCOS is committed to providing authoritative science, information, and tools to help communities and decision makers across the nation adapt to a changing climate, improve resilience, and manage and conserve ocean, coastal, and Great Lakes ecosystems, all through a strong lens of social equity for vulnerable communities. A resilient community is able to prepare and plan for, absorb, recover from, and adapt to adverse events. NCCOS helps communities become more resilient through timely and actionable scientific assessments, information sharing, and tool availability to help coastal communities plan for and mitigate climate-related risks.

NCCOS conducts and supports interdisciplinary research to advance understanding of the vulnerability and value of wetlands, coral reefs, and other natural coastal infrastructure under varying sea level rise, storm, and adaptation scenarios. Quantifying the ability of natural and nature-based features (NNBF)[3] to mitigate coastal inundation impacts and maximize protective value is an increasing focal area. For example, NCCOS scientists are monitoring and analyzing the evolution and effectiveness of existing natural infrastructure projects around the country to inform future efforts and fill knowledge gaps.

During the period covered under this review (2017- 2021) the Coastal Change portfolio comprised four distinct sub-priorities:

- **Vulnerability and Risk Assessment:** Coastal decision makers need to understand the risks and vulnerabilities facing their communities and ecosystems in order to help them become resilient. Coastal decision makers can include city,

[1]https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2021/2020-natural-disasters-balance.html
[2] https://www.climate.gov/disasters2020
[3] Note that “Natural and Nature Based Features” (NNBF) and “Nature-Based Solutions” (NBS) are used interchangeably in this book. NNBF was used under the previous priorities, and NBS is preferred under the 2022-2026 priorities. As a result, the term used indicates something about the timing of a project.

county, and state elected officials, coastal and emergency managers and planners, or leaders of industry or neighborhood associations. NCCOS develops models and tools that integrate biological, hydrologic, physical, socioeconomic, and other factors to evaluate coastal resilience. NCCOS provides assessments of a community or ecosystem's characteristics to provide a better understanding of how extreme events will impact its residents' or natural systems' ability to be resilient. These characteristics, which are subject to the impact and response of the community or ecosystem to events and disturbances, can help determine the vulnerability of the collective community, beyond its geographic, economic, or infrastructural vulnerabilities.

- **Natural and Nature-based Features:** How important is a natural coastline in protecting communities from the impact of storms and floods? A study conducted by The Nature Conservancy found that coastal wetlands prevented more than $625 million in property damages during Hurricane Sandy and reduced property damages throughout the Northeast U.S. by 10% on average[4]. Natural and nature-based features (NNBF) refers to the use of natural habitats, either alone, or in combination with human engineered structures for the purpose of coastal protection. Recently, NNBF have gained traction as a means to mitigate the potential impacts of shoreline erosion and storm-related inundation of coastal communities. The effective use of NNBF approaches requires data to provide guidance on how, where, and when to best employ NNBF solutions. NCCOS provides on-the-ground science components and partners with NOAA's Office for Coastal Management to help coastal communities use NNBF effectively for enhanced coastal resilience.

- **Climate Impacts on Ecosystems[5]:** The coastal zone is dominated by dynamic and complex interactions among biological and physical processes, so it is challenging to predict how emerging threats will affect the 124 million people who live in U.S. coastal counties. Approximately 39% of Americans living in coastal counties reside in an elevated coastal hazard risk category. These include children, the elderly, households where English is not the primary language, and those in poverty[6]. NCCOS is helping communities mitigate and adapt to climate

[4] The Nature Conservancy, Coastal Wetlands and Flood Reduction: Using Risk Industry-Based Models to Assess Natural Defenses in the Northwestern USA (October 2016), 9.

[5] This specific sub-priority is cross-cutting with other NCCOS priorities. As a result, much of the science within this sub-priority has been reviewed as part of other program reviews and therefore is not included in the Coastal Change program review.

[6] NOAA Office for Coastal Management: Fast Facts, Economics and Demographics https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html.

change by conducting research on detecting and assessing change in coastal ecosystems. By observing and predicting coastal ecosystems responses to climate change, NCCOS helps communities understand climate- ecosystem relationships and develop indicators to evaluate progress towards long-term community resilience.

- **Restoration:** Coastal ecosystems are vulnerable to habitat loss from impacts such as coastal storms, coastal development, declining water quality, and climate impacts. Habitat restoration offers a way to regain ecosystem services lost as a result of acute or chronic injuries. NCCOS is a leader in coastal restoration science, and will continue to develop scientific tools and evaluate methods to guide restoration of impacted habitats. This includes research to improve the scientific framework for natural resource damage assessment and restoration and developing sound mitigation and remediation strategies. NCCOS continues to establish national and international guidelines on conservation and restoration of marsh habitats, coral reefs, and other critical habitats.

The NCCOS Coastal Change portfolio complements NOS capabilities and maintains partnerships within NOAA and with external stakeholders. Projects regularly leverage water level observations and future water level scenarios delivered by NOS's Center for Operational Oceanographic Products and Services (CO-OPS), and involve collaboration with the Office for Coastal Management in stakeholder service delivery. Projects include coverage of National Estuarine Research Reserves and National Marine Sanctuaries through supporting management of NOAA's reserves and leveraging their regional networks. We continue to expand our collaborations that support land management and engineering projects, translating science to inform action, particularly with the U.S. Army Corps of Engineers (USACE), Federal Emergency Management Agency (FEMA), and Department of Transportation (DOT). Our research emphasizes the production of actionable science products, including models and tools, guidance documents, and visualizations.

Program Reorganization

The Coastal Change Program sub-priorities (along with other NCCOS priorities and sub-priorities) were updated in the 2022-2026 NCCOS Strategic Plan. Below are the sub-priorities of the updated Coastal Change priority, now referred to as the Facilitating Resilience and Adaptation to Inundation and Climate Impacts priority.

- **Science to support restoration and implementation of nature based solutions.** Provide guidance on design, siting, implementation, and evaluation of natural and restored habitats, and nature based solutions (NBS); assess and forecast how restoration/NBS implementation will meet goals, including reduction

of inundation and erosion impacts, and deliver other protection benefits in a changing climate.

- **User-driven science to inform holistic coastal planning**. This includes prediction of the effects of sea level rise (SLR) and inundation in order to inform policy and land management decisions, and infrastructure design; while incorporating NBS and other strategies that support resilient coastal communities and ecosystems.
- **Science to quantify the social and economic vulnerability of human communities under sea level rise to inform action.** Advancement and execution of approaches that predict the social and economic performance of mitigation and adaptation planning, including NBS and conventional flood mitigation approaches.
- **Science to understand, predict, and reduce climate change impacts on coastal processes and ecosystems.** NCCOS will follow the NOAA/NOS commitment "to provide climate data, tools, and services to Federal agencies, state and local governments, tribes, and the commercial sector" with an emphasis on projecting coastal inundation and other stressors related to rising seas, high lake levels, heavier precipitation, and more frequent extreme weather events and incorporate this knowledge into the next generation modeling systems and tool development.

We include these FY 2022-2026 sub-priorities to provide context for the future direction of NCCOS and the Coastal Change Program. Note that reviewer evaluation of the Coastal Change Program should still be under the previous (FY 2017-2021) priorities.

Organization and Funding Structure

Internal and External Science

NCCOS has two core approaches for delivering science to coastal managers. Internal science programs are complemented by competitive funding programs that disperse research funds externally. The former approach capitatizes on internal scientific expertise while the latter leverages scientific expertise from across the country, including from NCCOS scientists. Programwide, NCCOS has over 200 active projects meeting multiple strategic priorities. These projects involve hundreds of internal and external scientists who actively engage with stakeholders to provide actionable coastal science products. Having both internal science and external competitive funding programs allows NCCOS the flexibility needed to meet a diverse mission. Operated separately, these approaches allow NCCOS science to cover a diverse portfolio in communities across every coastal state and territory.

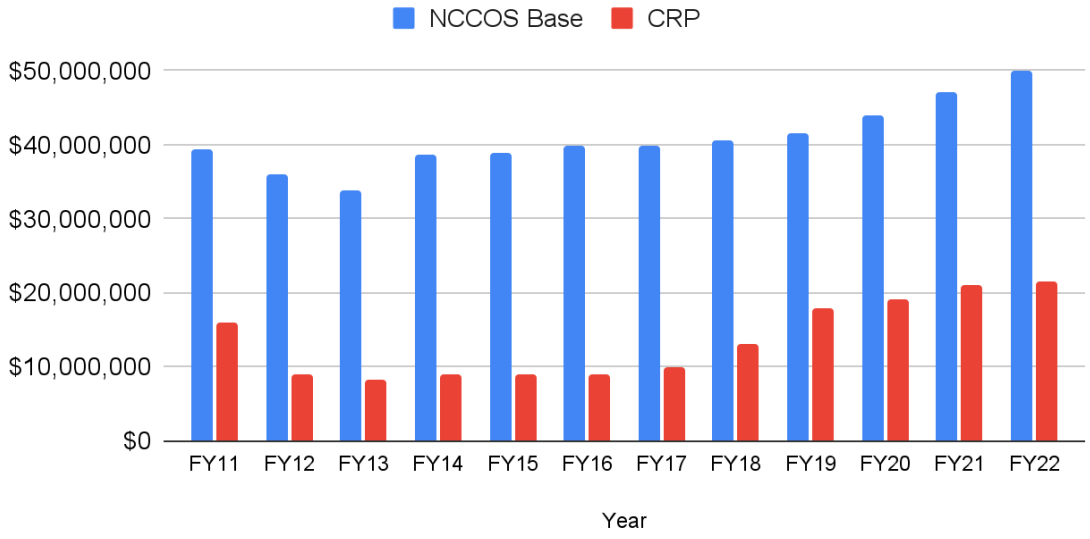
Internal science programs and scientists undertake applied research on a variety of topics that directly connect to local management needs and decision-making. Internal science programs develop collaborative science teams, often working in partnership with end-users who are grappling with issues in localities. NCCOS' internal science programs directly serve other NOAA programs, government agencies, and local decision-makers. Internal research programs often target research that will benefit multiple jurisdictions simultaneously in terms of meeting informational and management needs. On the other hand, the NCCOS Competitive Research Program is able to execute cooperative agreements to support academic institutions, private sector, non-profit organizations, and state and federal agencies that inform large-scale flood mitigation and restoration projects (e.g. Department of Transportation and U.S. Army Corps of Engineers). The strength of the external funding programs operate through funding opportunities and a competitive external review process to select the most effective projects targeting key science gaps nationally.

How our Coastal Change Science is Funded

In our annual Congressional appropriations, NCCOS has two "program, project or activity" (PPA) budget lines. The first is the "base" PPA which provides federal salary[7] and a variable amount of discretionary science funding for internal research. The second PPA explicitly funds the Competitive Research Program (CRP), which is external science. NCCOS total base funding and CRP total funding from 2017-2021 is shown in Figure 1 below.

Figure 1: Total NCCOS Base and CRP Appropriated Funding

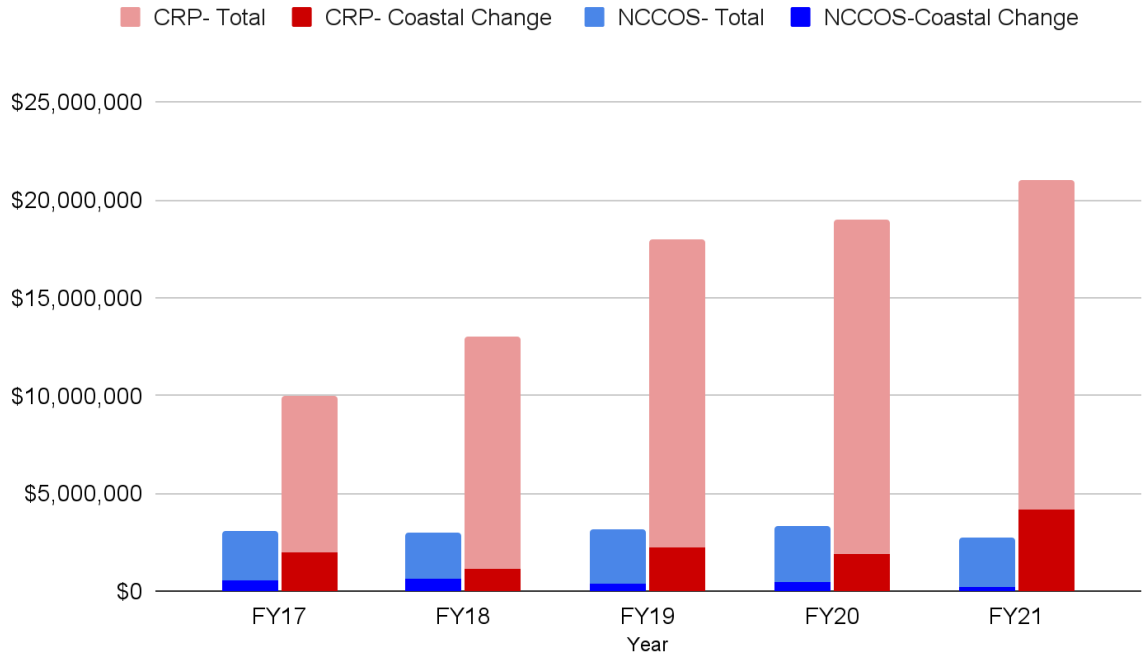
Note: Base funding is the sum of all Congressionally appropriated funds to the NCCOS PPA



[7] Note: Both internal scientist and staff and CRP program manager labor is funded by the NCCOS base PPA (i.e. the salary of CRP program managers comes from the NCCOS base PPA, not the CRP PPA).

Figure 2 shows the total science funding for both the NCCOS and CRP PPAs, and the amount that went towards the Coastal Change science for the period under review.

Figure 2: Proportion of science funding towards Coastal Change



NCCOS funding for internal science programs comes from three sources: discretionary funds, transfer funds, and reimbursable funds.

- **Discretionary funds** are provided to NCCOS as part of the Congressionally appropriated PPA mentioned above.
- **Transfer funds** are monies provided to NCCOS from outside of the program but from other parts of NOAA (e.g., Coral Reef Conservation Program, National Marine Fisheries Service).
- **Reimbursable funds** are provided to NCCOS from entities that are external to NOAA (e.g., another Federal agency; sometimes through another internal NOAA entity, etc). These funds are generally received through interagency agreements or Memorandums of Understanding (MOU).

Internal Coastal Change science is funded through all three of these sources. Figure 3 shows this breakdown, as well as the internal science labor costs.

Figure 3: Sources of funding for Internal Coastal Change Projects

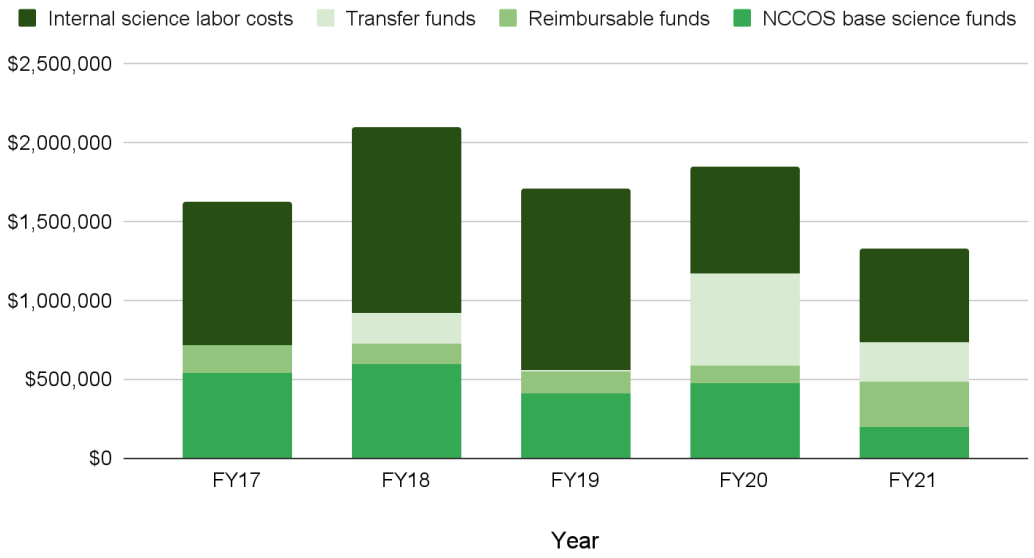
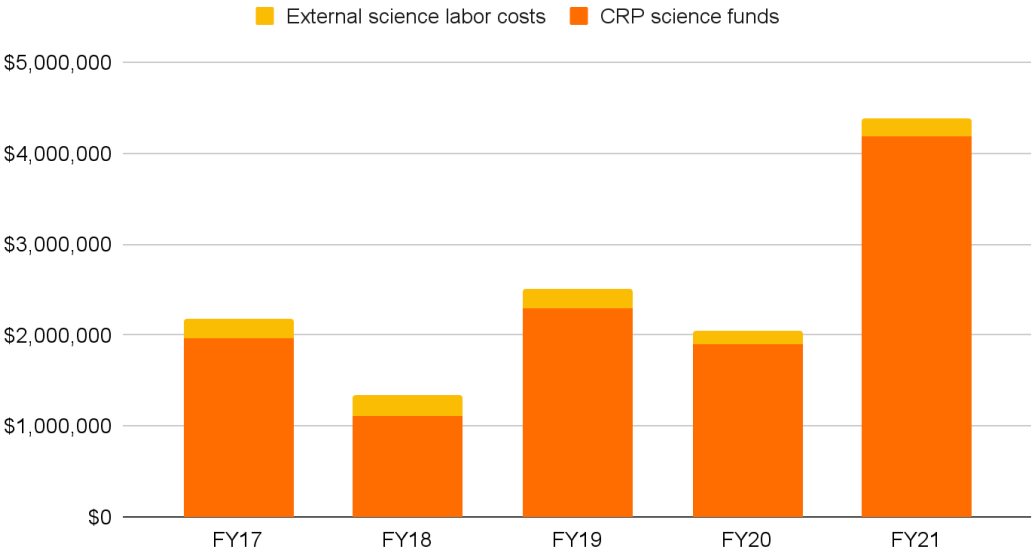


Figure 4 shows funding for External Coastal Change science (funded from the CRP PPA) as well as CRP labor (funded from the NCCOS base PPA).

Figure 4: Sources of funding for External Coastal Change Projects



The number of Coastal Change projects (Figure 5) and the total funding towards Coastal Change projects (Figure 6) for both internal and external science are shown below.

Figure 5: Number of Coastal Change Projects

Note: Projects under a no-cost extension are not included in that year

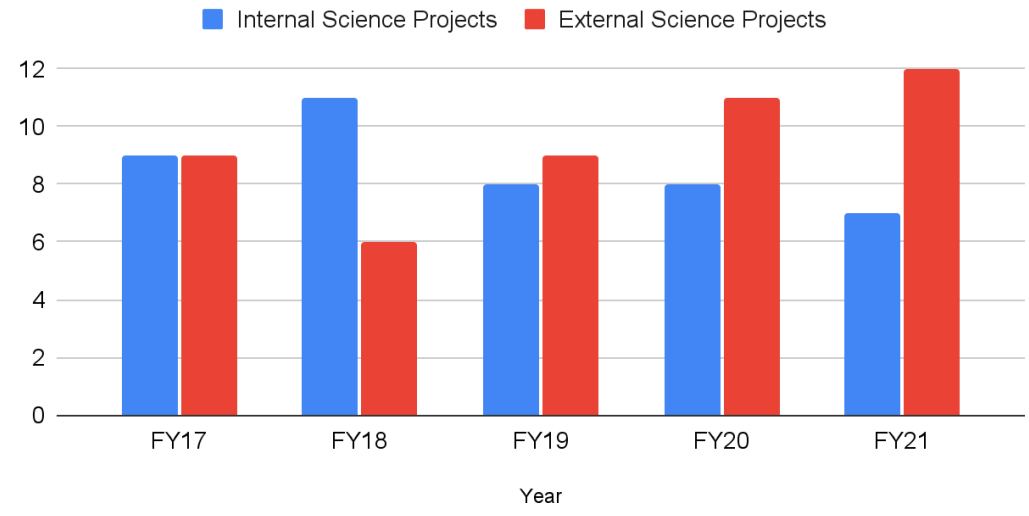
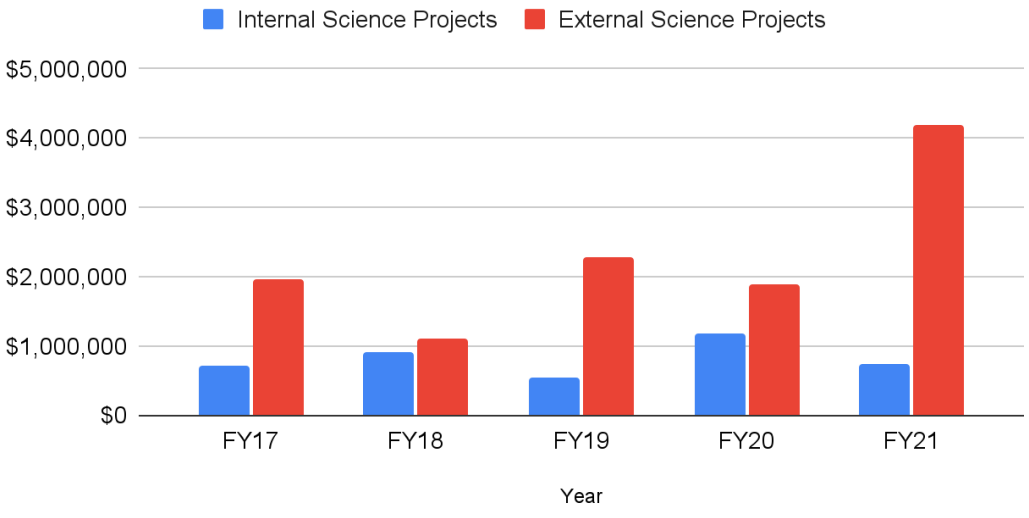


Figure 6: Coastal Change Project Funding

Note: Includes transfer, reimbursable, and discretionary funds. Does not include labor.



Coastal Change: External Science

The Competitive Research Program (CRP)

The Competitive Research Program (CRP) supports the development of actionable information and tools that improve how the nation protects, manages, and conserves ocean and coastal ecosystems. CRP funds regional-scale and targeted research through a competitive, peer-reviewed process to address our Nation's most pressing issues including harmful algal blooms and hypoxia research, coastal resiliency, sea-level rise, ocean acidification, mesophotic coral ecosystems, and effective ecosystem-based management.

External research supported by CRP seeks to produce actionable information and user-driven products that will enable resource managers to assess management and policy strategies, as well as increase scientific understanding on issues threatening ecosystems and communities. To accomplish this,CRP emphasizes a collaborative research process that includes advisory groups comprised of resource managers, planners, policymakers, and impacted communities. To ensure useful results, CRP requires articulation of outcomes that benefit management and a process for engagement in proposals and recipients must report progress toward achieving outcome-based goals annually. The Effects of Sea Level Rise Program (ESLR) is the only program within CRP falling within the Coastal Change Priority area.

Effects of Sea Level Rise Program (ESLR)

ESLR is a multidisciplinary research program that co-develops science products with coastal managers to identify local coastal vulnerability and solutions to mitigate flood risk. ESLR provides a suite of science products and tools useful to coastal managers that are capable of evaluating coastal vulnerability under multiple sea level rise, inundation, and coastal management scenarios. These outputs enable coastal managers to plan for or mitigate regional impacts of sea level rise in their specific region. ESLR projects principally explore the vulnerability of natural ecosystems, evaluate the potential for natural structures (e.g., barrier islands, wetlands, etc.) to reduce coastal inundation, and develop best practices for the inclusion of ecosystems in coastal protection strategies. In many cases, fostering natural coastal features provides a cost effective alternative to rigid hardened structures that may not be as effective in reducing flood risk or maximizing the value of the coast to the local community. Providing the scientific foundation for coastal decision making, particularly related to SLR and coastal flooding, is a high priority need identified by NOAA. To address this need, NCCOS's ESLR Program has sought to develop a suite of science approaches and products required to assess coastal vulnerability and solutions to SLR and

inundation. Application of outputs allows for improved coastal planning, management, mitigation, and ecosystem restoration in response to SLR and inundation.

The ESLR Program was initiated in 2005 in North Carolina to examine ecosystem impacts in a collaboration with state and local managers that resulted in the development of mapping and modeling tools. The ESLR Program shifted to the northern Gulf of Mexico in 2010, with an emphasis on a collaborative research approach to develop dynamic models of coastal change and improved abilities to examine SLR impacts to storm surge.

2009 FFO[8]

2010-2017	Predicting Impacts of Sea Level Rise in the Northern Gulf of Mexico (AL, FL, MS)

In 2015, the ESLR Program initiated its first competition that led to a suite of projects in support of the NOAA Sentinel Site Program that focused on advancing capacity and capabilities required to improve long-term regional and local ecosystem predictions of SLR and coastal inundation effects. These projects occurred in West Hawai'i, North Carolina, and San Francisco Bay (CA).

2015 FFO

2015-2017	Refining Ecosystem Model Inputs for Sea Level Rise Vulnerability in the San Francisco Bay Estuary (CA)
2016-2019	The Coastal Recovery from Storms Tool (CReST): A Model for Assessing the Impact of Sea Level Rise on Natural and Managed Beaches and Dunes (NC)
2016-2019	Understanding and Predicting Changes in Coastal Marsh Ecosystem Services: Realizing the Combined Effects of Sea Level Rise, Tides, and Storm Surge on Marshes and their Capacity to Protect Shorelines (NC)
2016-2019	Sea-level Rise Modeling as a Catalyst for Effective Ecological Management in West Hawai'i (HI)

In 2016, the second competition was run, resulting in support for three additional projects that reflect a new focus of the ESLR Program on the use of Natural and Nature-based Features (NNBF) for coastal protection and ecosystem services. These three projects occurred in Southern California and the Gulf of Mexico.

[8] FFO- Federal Funding Opportunity

2016 FFO

2016-2020	Dynamic Sea Level Rise Assessments of the Ability of Natural and Nature-based Features to Mitigate Surge and Nuisance Flooding in the Northern Gulf of Mexico (AL, FL, LA, MS)
2016-2020	Marshes on the Margins: Developing Tidal Wetlands Adaptation Strategies in Southern California (CA)
2016-2020	Codevelopment of Modeling Tools to Manage Sediment for Sustainable and Resilient Coastal Lowland Habitat in Southern California (CA)

In 2019, the third funding opportunity led to six additional awards of three years in length beginning in FY2020 and two additional awards beginning in FY2021. These awards support work around the country and have a similar focus on determining the potential for implementing NNBF for coastal protection and ecosystem services across many different coastal habitat types.

2019 FFO

2020-2023	Keeping it in the System: Beneficial Use of Dredged Sediment to Increase Resiliency of Coastal Marshes in the Southeast (FL, NC)
2020-2023	Integrated Modeling of the Effects of Sea Level Rise across Estuaries, Marshes and Barrier Islands in Mississippi Sound (AL, MS)
2019-2022	Quantifying the Benefits of Natural and Nature-Based Features in Maryland's Chesapeake Bay Under Different Sea Level Rise Scenarios to Inform Conservation and Management Decisions (MD)
2019-2022	Is an Old Dune a More Resilient Dune? Assessing How Dune Formation Affects Coastal Protection from Storms and Sea Level Rise in North Carolina (NC)
2019-2022	How Natural and Nature-based Features Could Enhance Coastal Resilience of Urban and Natural Ecosystems in Southwest Florida (FL)
2019-2022	Exploring Ecosystem and Community Vulnerability to Surface and Subsurface Flooding with Sea Level Rise and Adaptation Strategies in California (CA)

2019-2022	Ecological Impacts of Sea Level Rise on Flood Protection and Blue Carbon Capture in Pacific Northwest Wetlands (OR, WA)
2019-2022	How to Increase Ecosystem Services of Coastal Beaches and Dunes in the Pacific Northwest through Adaptation Planning (OR, WA)

In 2021, ESLR ran its fourth competition, with a focus on NNBF through supporting projects focused on evaluating and quantifying the ability of NNBF approaches to mitigate the effects of SLR and inundation (storm surge, nuisance flooding, and/or wave actions) in two focal areas: Coastal Resilience and Surface Transportation Resilience. Coastal Resilience focused broadly on mitigating impacts on coastal ecosystems, communities, and infrastructure. Surface Transportation Resilience focused specifically on mitigating impacts to surface transportation infrastructure (i.e., road, public transportation, and rail) and connecting advanced numerical flood modeling to pavement deterioration modeling, a priority area for both NOAA and the Federal Highway Administration. Five new projects were funded (three under the Coastal Resilience and two under Surface Transportation Resilience priority areas), focused on the Northeast, Mid-Atlantic, Southeast, and the Gulf of Mexico.

2021 FFO

2021-2025	Evaluating Risk of Tidal Marsh Inundation and Monetizing Services to Prioritize Management Actions (GA, SC, NJ, DE, PA)
2021-2025	Coastal Communities' Pavement Resilience to Sea Level Rise Using Natural and Nature-Based Features (NH, MA, ME, AL)
2021-2025	Modeling, Visualizing and Communicating Nor'easter and Hurricane Threats Under Sea-Level Rise to Support Coastal Management within New England (RI, MA, ME)
2021-2025	Living with Sea Level Rise in the Texas Coastal Bend (TX)
2021-2025	Surface Transportation, Sea Level Rise, and Coastal Storms: A Sustainable Path to Increased Resilience (AL)

ESLR Event Response Program

The ESLR Event Response Program also provides modest funding to augment current or prior research to help offset costs of immediate mobilization of response and/or assessment efforts associated with events that are difficult to plan as part of a scientific study.

Event Response

2019-2020	Post–Hurricane Dorian Data Collection to Improve Understanding of Beach, Dune Recovery Following Storms
2019-2020	Evaluating the Resilience of North Carolina Natural and Living Shorelines following Hurricane Dorian
2020-2022	Evaluating Wave Impact Reduction and Shoreline Protection Provided by "Oyster Reef Living Shoreline Projects" During Storm Events

Other

2015-2021	A Multidisciplinary, Integrative Approach to Valuing Ecosystem Services from Natural Infrastructure

In FY22, three "rescue" awards were funded from the previously described 2021 FFO-two in the Coastal Resilience focal area, and one in the Surface Transportation Resilience focal area.

2022 and beyond:

2022-2026	Turning the Tide: Advancing Natural Solutions to Sea Level Rise Impacts for Improved Management on the North-Central California Coast
2022-2026	Transportation Systems and Flood Resilience under Dynamic Sea Level Rise: Integrated Modeling to Assess Natural and Nature-Based Solutions for Roadway Flooding in Hampton Roads, Virginia
2022-2026	Salt marsh evolution along the South Atlantic Bight

ESLR Major Accomplishments (2017 - 2021):

- **ELSR is responsible for a paradigm shift in model approaches:** ESLR has facilitated a paradigm shift in how to model sea level rise impacts and conduct vulnerability assessments by demonstrating the need for more accurate products by incorporating dynamic coastal processes. This approach was highlighted in a 2014 Department of Transportation hydraulic engineering manual case study and continues to be elevated. This approach has resulted in a flourishing of coupled approaches with the formulation and advancement of multiple approaches around the country including Hydro-MEM, ACUNE+, WARMER-Delft, WindSurf, CoSMoS-ModFlow, and other combinations. These approaches are becoming the standard within the field.

- **ELSR is a leader in the formation of novel interdisciplinary teams:** ESLR has supported the formation of transdisciplinary science teams required to inform mitigation of coastal flooding under sea level rise and its social, economic, and ecological impacts. Teams often include physical scientists, ecologists, economists, social scientists, and extension experts to create the modeling infrastructure for evaluating coastal management and policy actions to inform decision making and regional planning. These teams are instrumental to more innovative coastal management that allows for simultaneously considering multiple management, climate, and weather scenarios.

- **ESLR brought the Co-Produced Science Concept to coastal modeling and management.** ESLR has led the codevelopment of science process with coastal decision makers from the proposal stage. This has now become the standard approach in the field, and other NOAA offices have looked to ESLR for guidance on how to foster interdisciplinary science teams that work with end users. ESLR was well ahead of the field, adopting the codevelopment approach since 2009 and then adapting it with each of our funding opportunities to refine the process.

- **ESLR has teamed up with FHWA to elicit the first teams of coastal scientists, transportation experts, and pavement engineers to foster a new age in resilient transportation planning.** ESLR has collaborated with the Federal Highway Administration to bring together the science teams necessary to run inundation and impact modeling with transportation professionals and pavement engineers to create the infrastructure to predict the impact of repeated inundation events on coastal roads for the first time. This accomplishment was commemorated by FHWA's 2022 Environmental Excellence Awards (EEAs) for the "Advancing Science to Better Consider the Ability of Nature-Based Solutions to Protect Transportation Infrastructure from Sea Level Rise and Flooding" project.

Coastal Change: Internal Science

NCCOS internal coastal change science included in this review falls within its Marine Spatial Ecology Division and spans multiple branches including the Coastal Resilience, Restoration and Assessment Branch, Biogeography Branch's social science team, and the Cooperative Oxford Laboratory. Our internal science informs community and ecosystem vulnerability and adaptation to climate change through evaluations of integrated community, ecosystem, and social and economic resilience. This science includes a focus on sea level rise and inundation and the impacts of changing temperatures and precipitation on coastal ecosystems and the communities that depend on them. We specifically emphasize:

- *Coastal community resilience* - Help communities plan for and respond to sea level rise and coastal inundation to reduce risk and enhance resilience. This includes working with communities to identify vulnerabilities and evaluate approaches for protection to inform climate resilient existing and future infrastructure development. We are particularly focused on green or nature-based solutions that creates or restores habitat and sequesters carbon while protecting shorelines and communities
- *Ecosystem resilience* - Provide actionable science to inform coastal ecosystem protection, restoration, and management, and predict how these ecosystems will be impacted by and provide resilience to climate change. We evaluate climate resilient ecosystems (e.g., coral reefs and wetlands) protection and restoration approaches, understand how additional factors (e.g., ocean acidification, rising temperatures) will exacerbate existing threats, predict how habitat and species interactions may change, and evaluate potential impacts on conservation measures, such as changes in the efficacy of marine protected areas
- *Social and economic resilience* - Provide science to inform marine spatial planning for ocean industries, such as renewable energy and aquaculture facility sitings that can minimize environmental and social impacts, while maximizing economic value to communities. We also conduct ecosystem service valuations and social vulnerability assessments to inform community adaptation planning, and to understand how the use and value of marine protected areas will evolve with a changing climate, and we provide tools to forecast and minimize the impacts of HABs and pathogens on fishing and aquaculture.

For the purpose of this review, we are presenting internal coastal change science with a focus on work being conducted by the resilience and social science teams within NCCOS.

Coastal Resilience Team

NCCOS has been working in the resilience realm for over 15 years with emphasis on complementing other NOS capabilities and establishing partnerships both within NOAA and with external stakeholders to provide the science needed for models and tools that allow coastal decision-makers and communities to make informed resource management decisions. Our coastal resilience research focuses on three main areas: nature based solutions, restoration, and vulnerability assessments. Our internal resilience science focuses on partnerships to conduct interdisciplinary research to quantify the value of natural coastal habitats in mitigating inundation and other climate change impacts on coastal communities. Regarding habitat, our focus has historically been on coral reefs and coastal wetlands.

Coral Restoration

Our coral restoration science portfolio includes applied quantitative evaluations of restoration design and success. We work with restoration managers to develop and apply new and current approaches to assessing restoration success towards meeting goals, spatial planning for restoration siting and design, and coral restorations as nature-based solutions. We have developed monitoring guidelines and created interactive spatial data tools, such as data viewers, databases, predictive models for endangered coral distributions, and habitat maps, to support restoration design and evaluation. We apply emerging technology, such as Large Area Imaging (i.e., LAI, underwater photogrammetry), to assess restoration changes to coral populations, benthic communities, and reef structure. We will continue to partner with Mission:Iconic Reefs, the large-scale coral restoration in the Florida Keys National Marine Sanctuary, to assess reef changes from restoration via LAI and in relation to the Keys-wide coral reefs (via NOAA coral reef ecosystem monitoring), as well as how coral restoration changes wave energy and coastal resilience. We have increased our focus on relating coral restoration to coastal resilience and climate stressors, including a post-hurricane assessment of coral reef injury to inform emergency coral stabilizations; a workshop of experts to plan practical approaches on how to integrate ecology, hydrodynamics, and engineering; relating reef status and restoration to climate change forecasts and impacts; and partnering with others to relate restoration to economic evaluation and community resilience. We plan to increase the focus on coastal resilience through evaluation of reef changes in relation to human use and benefits.

Projects:

2015-2019	Spatial Predictive Modeling of Threatened ESA Corals in the U.S. Atlantic and Caribbean
2016-ongoing	Coral conservation - spatial data curation for conservation management

2017-2018	Assessment of Hurricane Impacts to Coral Reefs in Florida and Puerto Rico
2018	Development of Coral Restoration Consortium's Guide to Monitoring Coral Restoration
2018	How should wave energy inform coral restoration actions: review and recommendations
2018-2023	Restoration Demonstration Project: Designing coral restoration for coastal protection
2020-2022	Developing and Scaling Up Emerging Image-based Technology for Evaluating Mission: Iconic Reefs Large-scale Coral Restoration in the Florida Keys National Marine Sanctuary
2021-2023	U.S. Virgin Islands Coral Reef Resilience Prioritization

2022 and beyond :

2022-2023	Nature-Based Infrastructure applications to coral reef restoration - Engineering With Nature
2022-2023	Develop Guide to Image-based Monitoring for Coral Reef Restoration
2022-2024	Modeling wave attenuation based on elkhorn coral restoration at Iconic Reefs

Coastal Wetlands

Our coastal wetlands science portfolio includes conducting fundamental research to understand how coastal wetland ecosystems respond and adapt to changes in water level, nutrient fertilization, hurricanes, and other environmental stressors. We conduct research to further develop methods for wetland monitoring and assessment including recent efforts to develop standardized uncrewed aerial systems (UAS)-based approaches that are accurate, repeatable, and easily adapted for use in wetland monitoring programs. In partnership with the U.S. Army Corps of Engineers (USACE), we have been heavily engaged in the development of strategies to guide the siting, design/implementation, and monitoring of NNBF. This work has primarily focused on the beneficial use of dredged sediments for marsh restoration through thin-layer sediment application, and the creation/restoration of coastal islands. We have also been active in analyzing the performance of living shoreline installations and providing guidance on optimal siting of living shorelines. We will continue to conduct performance evaluations, to quantify protective and habitat benefits provided by natural infrastructure, and continue to work with USACE and state agencies to determine how the capacity of natural and nature based infrastructure to mitigate coastal change varies over time as

these restoration sites mature and climate drivers change. We also plan to work more closely with our social science team (described in the next section) to better integrate work in natural sciences with social science vulnerability assessments to strengthen resilience capabilities and to enable us to focus on study sites with known equity or social justice issues.

Projects:

2004-present	Salt Marsh Ecology in an Era of Sea Level Rise
2004-ongoing	Estuarine Shoreline Stabilization – Assessment of the "Living Shoreline" Approach
2019-ongoing	Supporting Redesign of Battleship NORTH CAROLINA Park to Reduce Flooding
2015-2017	Guidance for the Successful Use of Living Shorelines
2016-ongoing	Thin Layer Application of Dredged Sediments for Coastal Resiliency
2017-2020	Assessment of the Beneficial Use of Dredged Sediment to Restore Mordecai Island, New Jersey
2018-2025	Evaluating the Efficacy of Island Restoration and Enhancement for Coastal Protection (two projects)
2020-2022	Development of UAS-based approaches for adding value to standard wetland monitoring programs
2021-2025	Blue Carbon in Nature-based Features

2022 and beyond:

2022	Wicomico Beneficial Use
2022-2024	Performance Analysis of Completed Nature-based Infrastructure
2022-2024	Systematic Evidence Map of Nature-based Solutions Performance
2022-2024	Advancing the Use of Remote Sensing for Monitoring Natural and Nature-based Features: Salt Marshes, Oyster Reefs, and Tidal Creeks

Complementary Products and Service Delivery

Coastal decision makers report that finding data, navigating models and tools, and applying these to locally relevant questions is difficult and too often becomes an unnavigable hurdle to decision making. The coastal resilience team has a portfolio of projects addressing these issues using a co-production approach to data and products. This data application and visualization group works across NCCOS to add a range of complementary products that explain the data and utility and provides direct access to it with examples of use including value added analyses that go beyond sharing raw data. They utilize scrolly-telling (or story maps), infographics, and data viewers to better meet the needs of end users/stakeholders/decision makers/clients.

This group contributes to internal and external science projects at all stages of a co-produced project. For a small cost (typically time only) their complementary products contribute significantly to the project's impact. During FY22 and beyond, this group is continuing work with ESLR projects and the Coastal Resilience Branch and extending their scope by collaborating with the social science team and the Stressors and Detection division of NCCOS.

Projects & Products:

2010-2017 Predicting Impacts of Sea Level Rise in the Northern Gulf of Mexico (AL, FL, MS) (2009 FFO)
- *See future storm surge and floodplains with sea-level rise*
- *See marsh vulnerability and migrations with sea-level rise*

2015-2017 Refining Ecosystem Model Inputs for Sea Level Rise Vulnerability in the San Francisco Bay Estuary (CA) (2015 FFO)
- *See the story map*

2016-2020 Dynamic Sea Level Rise Assessments of the Ability of Natural and Nature-based Features to Mitigate Surge and Nuisance Flooding in the Northern Gulf of Mexico (AL, FL, LA, MS) (2016 FFO)
- *See the economic impacts of sea-level rise in the northern Gulf (initial demo phase)*
- *Resilient Gulf of Mexico data hub (coming soon)*

2017-2018 Assessment of Hurricane Impacts to Coral Reefs in Florida and Puerto Rico
- *Explore the data and images*

2018-2022 Improving Application of Marsh Predictions under Sea Level Rise

2021-2022 Transportation Resilience Principles Storymap
- *See approaches and resources for more resilient coastal roads*

2022 and beyond:

2022-2024	Programmatic Execution of Vulnerability Assessments
2022-2024	Performance Analysis of Completed Nature-based Infrastructure
2023-2025	National Marsh Vulnerability Data Viewer

Coastal Resilience Team: FY22 and Beyond

- **NCCOS is currently conducting a spatial prioritization study on coral reef resilience in climate change conditions in the US Virgin Islands**. This study includes forecasts of increasing sea surface temperatures and other conditions from downscaled IPCC scenarios, current and historic coral and coral reef conditions, oceanographic variables, and human use. Results will be added to a currently existing Marine Data Atlas for the US Virgin Islands (a publicly-available GIS compilation created by NCCOS for the USVI Department of Natural Resources) and a technical report. Results will also be included in spatial modeling of coral populations under climate change conditions. Local USVI managers have been included in the design planning and will use results in spatial planning for marine conservation and for coastal resilience.

- **In 2022, NCCOS invested in the development of a multiyear research program to assess how coral restoration alters fine-scale reef hydrodynamics, thereby influencing the coastal protection services provided by the reef.** The goal of this work is to quantitatively relate coral restoration to coastal protection and aid in coral restoration design. This research is being conducted by the MSE Coastal Resilience branch in partnership with Duke University and the Florida Keys National Marine Sanctuary from FY22-FY26. Products will include journal publications as well as data visualization tools. The information will be used by the Florida Keys National Marine Sanctuary to inform restoration design for Mission:Iconic Reefs, the largest coral reef restoration on US coral reefs.

- **In 2022, NCCOS implemented a multi-year, multi-investigator effort to evaluate the performance of historical NBS projects**. This research program will fill knowledge gaps concerning how created features evolve over time with respect to the benefits they provide. The project involves an interative approach where different categories of NBS project type (ie. created islands, marshes, reefs) are evaluated in successive years.

- **In 2022, NCCOS launched a project to identify, collate, and map the evidence base surrounding the performance of NBS in coastal ecosystems**.

The project uses a synthesis approach called a "systematic evidence map," which is a gold standard among synthesis techniques to summarize the distribution and abundance of existing evidence. The project will highlight the current knowledge on NBS performance and help inform future approaches for performance assessment. This systematic evidence map will be the first NOAA-led initiative of its kind. This is innovative because it brings a highly-regarded synthesis method to our Federal agency and can demonstrate the value of applying this approach to assess the current state of knowledge (evidence base) and gaps to help inform resource management decisions

Coastal Resilience Team Major Accomplishments (2017 - 2021):

- **Since 2016, NCCOS has partnered with the USACE to investigate the beneficial use of sediments for NBS restoration/creation.** Specific activities have included design and installation of NBS features (NC), monitoring and performance evaluation of recently built projects (MD and NJ), and development of guidance for future project implementation including: Engineering With Nature, Principles in Action: Islands (2022), and the International Guidelines on Natural and Nature-Based Features for Flood Risk Management (2021).
- **In 2018, NCCOS's long history of investigating living shoreline performance and providing guidance on the optimal use of living shorelines led to development of a web-based tool that allows users to assess the appropriate living shoreline design for their property based on site-specific wave energy conditions**. This tool, created in partnership with The Nature Conservancy, continues to be referenced by local project planners and regulators and to serve as a model for the development of similar tools in other geographies.
- **In 2022, NCCOS researchers published results of a five-year effort investigating the use of thin layer sediment placement in a low lying marsh in NC**. The findings provide guidance for the use of thin layer application and have already been referenced to by project planners (within USACE) and regulators (NOAA-NMFS) as a model for which to evaluate future projects.
- **NCCOS has led the development of scientific guidance on evaluating coral restoration success.** In 2020, NCCOS partnered with the Coral Restoration Consortium to develop and publish the Coral Restoration Monitoring Guide: Methods to Evaluate Success from Local to Ecosystem Scales. This technical report has been used to develop and implement monitoring protocols for both US and international coral restorations. In 2021-2022, NCCOS, the Florida Keys

National Marine Sanctuary, and the National Marine Sanctuary Foundation have been co-leading the development of the Mission:Iconic Reefs - Coral Restoration Monitoring and Research Plan. This guide lays out the path to evaluate the success of this large-scale, long-term restoration led by NOAA.

- **In 2020, NCCOS published a technical report on how major Hurricanes Maria and Irma damaged coral reefs in Puerto Rico, summarized emergency stabilization efforts of reef-building corals, and identified priority restoration areas for coastal protection**. This work was funded by FEMA and conducted in partnership with the NOAA Restoration Center (2018-2019). Now, in FY22-FY23, NCCOS is modeling how natural coral reefs and potential reef restoration scenarios impact coastal flooding (XBeach) on the San Juan metro coral reef area, which was identified in the report as a priority restoration site for vulnerable coastal populations and infrastructure. Flood models have been calibrated-validated using a 2019 field deployment of Acoustic Wave and Current (AWAC) meters and pressure sensors across the reef tract by USGS and NCCOS. Model scenarios include potential restoration scenarios (both natural and NBS) being considered for potential implementation by NOAA Restoration Center and Puerto Rico Department of Natural and Environmental Resources, pending a FEMA funding request. Results will be disseminated directly to NOAA Restoration Center project partners, PR DPNR, and published in the scientific journal literature.

Cooperative Oxford Laboratory (COL)

COL provides timely and actionable science solutions and tools to better understand ecosystem impacts, vulnerability and risks associated with changing climate and weather conditions to support coastal and community resilience. The Cooperative Oxford Laboratory includes three distinct NCCOS sub-priorities: Restoration, Vulnerability and Risk Assessment, and Climate Impacts on Ecosystems. Projects conducted under these priorities help communities mitigate and adapt to climate change by detecting and assessing change in coastal ecosystems. By observing, modeling and tracking the physical and biological responses to climate change, we can help communities understand climate- ecosystem relationships and develop indicators to evaluate progress towards long-term community resilience.

Projects:

2016-ongoing Weather and Water: Using weather data to create models and tools to predict coastal impacts

Weather and Water Storymap (2021- 2022)

2016-2019 Development of a water clarity index and leading climate indicator for the Great Lakes

2019-ongoing Testing and developing novel oyster larval in-situ setting methods with Federal partners and local industry stakeholders

2022 and beyond:

2022-2024 NOAA - NASA RISE Project - Using Synoptic- based Models, satellite ocean observations to support sub-monthly to seasonal predictions of coastal inundation and anomalous sea levels

2022-ongoing Testing biodegradable oyster setting materials for potential greening gray infrastructure applications 2023-2026 Chesapeake Bay Climate Indicators and Fishery Impacts

Cooperative Oxford Laboratory Major Accomplishment (2017 - 2021):

- **Since 2013, NCCOS scientists have developed collaborative partnerships with State and Federal Sanctuaries offices, NOS CO-OPS, and academic institutions to develop integrated assessments, models and tools of coastal hazards and impacts related to climate variability and change.** Portable synoptic climatological frameworks have been used to evaluate cold-snap thermal stress and species mortality events in South Florida; develop water clarity historical reconstructions and model predictions in the Florida Keys and Great Lakes systems; and produce hindcasts/forecasts of anomalous sea levels associated with nuisance, or blue sky floods, for the U.S. Southeast and Mid- Atlantic coasts. Major work efforts and accomplishments can be found in NCCOS-supported publications (over fourteen refereed journal articles), story books and integrated marine protected area assessment tools.

Social Science Team

NCCOS initiated its internal research program in the social, economic, and behavioral sciences in 2009 with the addition of one Federal research sociologist to its scientific enterprise. Prior to this strategic redirection of personnel, there was limited investment into social science research. On the occasions when resources were invested, NCCOS secured services under contract from external vendors. The first fully resourced socioeconomic project executed by internal social science researchers was funded by NOAA in FY2010 as a part of its response to the Deepwater Horizon disaster. Completed in FY2013, this research developed a method for monitoring community well-being in the wake of the oil release, which caused dramatic change in coastal areas along the Gulf of Mexico. This research served as the foundation for our current community vulnerability assessment portfolio. Since that inaugural project, investment in

internal socioeconomic research slowly increased and the program has become more stable.

In NCCOS, our internal research in the social sciences generally follows one of three study designs. Descriptive studies provide descriptions of people, groups, issues, practices, processes, etc. Generally snapshots in time, these studies provide answers to the basic questions of who, what, when, and where. Explanatory or causal studies provide answers to more complex, relational questions that resource managers might have about people and natural resources. A more sophisticated type of research, it answers questions of why or how by explaining social relationships that have meaning in a management context. The third type, discrete choice experiments, allows researchers to assign monetary values to things that are not traded in a market setting, such as endangered species or tropical sunsets, and these monetary values can be used to understand preferences.

Different study designs require different types of data to answer research questions. In NCCOS we conduct primary data collections, typically social surveys, and we also make use of existing, secondary data. When conducting primary data collections we comply with all applicable Federal rules and requirements, such as OMB clearance under the Paperwork Reduction Act. We analyze tabular and spatial data, and visualize data in a variety of formats. We provide decision-makers with tools, maps, and other products to help communities sustainably manage their natural resources and protected areas, and to better understand and respond to coastal hazards.

Priorities

Within the social, economic and behavioral sciences, NCCOS has historically prioritized three focal areas of research. They are valuation of natural resources, assessing human usage of coastal and marine environments, and assessing vulnerability of coastal communities. Additionally, the NCCOS social science team supports broader efforts to conduct integrated ecosystem science and monitoring.

Our valuation research was initiated in response to priorities advanced by the National Ocean Service. There are many pressures on our coastal and marine ecosystems, even as we face more fiscally challenged management environments. To prioritize investments, managers need to know how important resources are to society. How do people value natural resources and “special places?” We also need to understand if the condition of those resources makes a difference when people are assessing that value. In NCCOS we define value broadly, including social and cultural value, as well as economic. NCCOS identifies, measures, and estimates the value of ecosystem services. More specifically, our valuation research is focused on three substantive tasks, including:

- collect baseline valuation data to help resource managers understand the values society places on natural resources or management units;
- characterize place-based and/or sociocultural values (non-economic values); and
- estimate how changes to resource conditions may influence associated changes in people's values.

As needed, we also engage in what is most aptly described as economic impact analysis. This is not, strictly speaking, valuation, but it does help managers to make informed decisions about how to protect valuable resources or prioritize management alternatives.

Our second focal research area considers human usage of coastal and marine resources. This line of research is useful from a marine spatial planning perspective (MSP). For MSP, it is imperative to know who is doing what, where, when, and why. Further, it is helpful to know answers to these questions relative to natural resources of interest. For instance, are the most intensely used recreational areas co-located with sensitive resources or habitat? Finally, understanding the social, spatial, and temporal patterns of human usage adds dimension to our comprehension of value, along with dependency, which can be even more significant to vulnerable, underserved groups or communities. For projects under this focus area, we regularly integrate social and economic data with physical, biological, and ecological data.

Our third research area, and a significant component for this panel review, is community vulnerability assessment. This research helps to answer the question: what can we do to ensure thriving coastal communities? Coastal managers would like to know if they can increase the likelihood that coastal communities will thrive, despite hazardous events or disasters, such as flooding. There are two dimensions to this thematic area. The first relates to vulnerability. Can we figure out how communities are vulnerable to different stressors, events, or changing environmental conditions? If yes, then perhaps these vulnerabilities can be mitigated. Mitigating vulnerabilities may make communities more resilient, the second dimension. Resilience relates to a community's ability to withstand and recover from hazardous events. Again, a key characteristic of this line of inquiry is the integration of social and economic data with biophysical data.

Impacts from coastal hazards threaten life and property, as well as compromise community well-being and coastal economies. By understanding the vulnerabilities of communities relative to exposure and risk to hazards such as sea level rise, flooding, water pollution, storms, and coastal erosion—communities can prepare and become more resilient. The Social Science Team provides coastal communities, planners, managers, and regulators with the information needed to better plan, recover, and adapt.

In addition to research we conduct internally on behalf of our Program's partners and customers, we also contribute to broader NOAA efforts that further ecosystem based assessment, monitoring and management. Presently, we have notable roles in two collaborative programs: CRCP's National Coral Reef Monitoring Program and NOAA's Gulf of Mexico Integrated Ecosystem Assessment Program. These research programs address coastal and ecological change, including climate change, in a variety of ways.

For the current NCCOS strategic planning cycle, FY22-FY26, internal research implementation priorities in the social, economic, and behavioral sciences are prioritized to meet three goals, which are:

- Inform decision-making, policy-making, and management related to human access, use, and values of coastal and marine environments;
- Improve the adaptive capacity of local communities to respond to hazards associated with climate change; and
- Inform management activities to mitigate human exposure to biological and chemical stressors in coastal and marine environments.

The second goal in this list is of primary importance for this program review. Its objective is to provide data and information that directly supports climate adaptation planning and activities at the county, municipal, or community level. More specifically, this goal targets climate-induced environmental changes that will have a substantial negative impact on human communities, particularly those that are underserved. Such change could include inundation, wildfire, storm events, ocean acidification, etc. This goal also includes examination of the value, perception, benefit, or effectiveness of adaptation activities, such as shoreline stabilization and habitat restoration.

Projects:

2014-2017	Science in Support of Adaptation Planning for Climate Variability and Coastal Hazard Vulnerability in the Chesapeake Bay
2017-2020	Assessing the Geographic Variability in Vulnerability to Climate Change and Coastal Risks in Los Angeles County
2018-2022	Economic Analysis of Shoreline Treatment Options for the Seacoast Region of New Hampshire
2021-2022	Integration of Social Science with Probabilistic Sea Level Rise Projections in Puget Sound

2022 and beyond:

2022-2023	Coastal Community Pressures, Resilience, and Shifts
2022-2024	Programmatic Execution of Vulnerability Assessments

2022-2026 Initiation of Programmatic Approach to Valuation of Ecosystem Services and Management Outcomes

Social Science Team: FY22 and Beyond

- **In 2022, NCCOS invested funds to shift execution of its internal community vulnerability assessment portfolio to a programmatic approach, as opposed to investing resources on a project by project basis.** This will enable the NCCOS MSE Social Science Team to more effectively and efficiently plan and execute community vulnerability assessments over the next five years. Additionally, seed funds were invested into efforts to develop a methodological framework for identifying, measuring, and tracking community resilience.
- **In 2022, the NCCOS MSE Social Science Team published a social vulnerability assessment in collaboration with Washington Sea Grant, the Puget Sound Partnership, and Coastal Geological Services, In**c. The assessment provided information on vulnerability to sea level rise; it informed management decisions in the Puget Sound and supported restoration activities. The NCCOS team delivered information in the form of a technical memorandum, geodatabase, and other data visualization products on exposure to sea level rise and social vulnerability within Puget Sound.
- **In 2022, NCCOS invested in development of a multiyear research program to assess the social, economic, and cultural value of habitat restoration or climate adaptation projects that employ nature-based infrastructure.** The goal of this body of work is to estimate the value and benefits of applicable Federal investments, and/or document the public's perceived value for these management approaches and activities. This research is being conducted by the MSE Social Science Team from FY22-FY26. Products will include technical reports as well as data visualization tools and materials.
- **In 2022, researchers with the NCCOS MSE Social Science Team completed a socioeconomic assessment for the Great Bay National Estuarine Research Reserve (GBNERR) producing informational products to help natural resource managers understand how communities adapt to coastal hazards, as well as the costs associated with public shoreline infrastructure projects.** Products from this research include journal publications and data visualization tools, including a story map and infographic. This information will be used by GBNERR staff to inform local coastal zone management and planning, including increasing community preparedness for the effects of climate change. Community outreach based on this research will be undertaken in partnership with the New Hampshire Coastal Adaptation Workgroup.

Social Science Team Major Accomplishments (2017 - 2021):

- **In 2015 and 2017, researchers with the NCCOS Social Science Team partnered with NOAA Fisheries, NOAA's Office of Coastal Management, NOAA Habitat Blueprint, the Maryland CoastSmart Program, Maryland SeaGrant, the Town of Oxford, MD, and Talbot County, MD to conduct two vulnerability assessments in the Chesapeake Bay region**. These projects identified a range of environmental threats, including sea level rise, storm surge, and stormwater flooding. It also identified and visualized related social, structural, and natural resource vulnerabilities across the region. Partners were provided with a technical memorandum describing assessment findings, as well as a geodatabase, map book, and other visualization products for each assessment. Information provided was used by local officials for adaptation planning.
- **In 2019, researchers with the NCCOS Social Science Team partnered with Scripps Institute of Oceanography to leverage research by a Master's student to supplement an ongoing community vulnerability assessment in Los Angeles County, CA.** The research provided our partners and stakeholders with valuable information published in a report entitled "Parcel Based Economic Impacts of Sea Level Rise and Coastal Flooding in Long Beach, California."
- **From 2017 to 2020, researchers with the NCCOS MSE Social Science Team partnered with the University of Southern California Sea Grant and NOAA's Office for Coastal Management (West Coast Region) to provide local decision-makers with indicators for social, structural, and natural resource vulnerability, as well as information on coastal hazards and impacts of most concern, base condition social vulnerabilities, and geographic areas of high hazard probability and high vulnerability.** Employing a locally-driven, holistic approach to project development and execution, the team delivered important information and data addressing a variety of natural hazards including sea level rise, flooding, erosion, wildlife, and drought. Information provided highlighted overlapping vulnerability and hazard to inform decision-making on adaptive action in the face of a changing climate, as well as opportunities to develop and implement innovative strategies to mitigate multiple concerns across multiple sectors at once. Results informed the County of Los Angeles' Climate Vulnerability Assessment, the City of West Hollywood's WeHo Climate Action (a comprehensive, innovative, and inclusive Climate Action and Adaptation Plan process), and the City of Malibu's Coastal Vulnerability Assessment project. Information was provided in the form of a technical memorandum, geodatabase, map book, consultation, and other data visualization products.

- **In 2021, researchers with the NCCOS MSE Social Science team were invited to participate in a coordinated congressional briefing to communicate the importance of assessing integrated community vulnerability in the face of climate driven impacts.** The briefing was co-hosted by the University of Southern California Sea Grant and the California Coastal Commission. Speakers included portfolio leads, Seann Regan and Chloe Fleming, as well as spokespeople from L.A. County's Chief Sustainability Office, Buro Happold on behalf of the City of West Hollywood, and the California Coastal Commission. The briefing attracted over 100 viewers, including staffers, Sea Grant extension officials, and representatives from NOAA, USGS, USACE, and local governments.

Appendix

Coastal Change Program Science Publications
Relevant for the Program Review
(from January 2017 to Present)

Effects of Sea Level Rise Program (70 publications):

Alizad, K., S. C. Hagen, S. C. Medeiros, M. V. Bilskie, J. T. Morris, L. Balthis and C. A. Buckel. 2018. Dynamic responses and implications to coastal wetlands and the surrounding regions under sea level rise. PLOS ONE 13(10); e0205176. DOI: 10.1371/journal.pone.0205176

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Bilskie, M. V., Angel, D. D., Yoskowitz, D., & Hagen, S. C. (2022). Future flood risk exacerbated by the dynamic impacts of sea level rise along the Northern Gulf of Mexico. *Earth's Future*, 10, e2021EF002414. https://doi.org/10.1029/2021EF002414

Bilskie, M.V., S.C. Hagen, and J.L. Irish. 2019. Development of Return Period Stillwater Floodplains for the Northern Gulf of Mexico under the Coastal Dynamics of Sea Level Rise. ASCE *Journal of Waterway, Port, Coastal, and Ocean Engineering* 145(2). https://doi.org/10.1061/(ASCE)WW.1943-5460.0000468

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Brand, M.W. L. Guo, E.D. Stein, and B.F. Sanders. 2021. Multi-decadal simulation of estuarine sedimentation under sea level rise with a response-surface surrogate model. Advances in Water Resources. Volume 150, April 2021, 103876. https://ui.adsabs.harvard.edu/abs/2021AdWR..15003876B/abstract

Brand, Matthew W., N. Gudiño-Elizondo, M. Allaire, S. Wright, W. Matson, P. Saksa and B. F. Sanders. 2020. Stochastic Hydro-Financial Watershed Modeling for Environmental Impact Bonds. *Water Resources Research* 56(8), e2020WR027328. https://doi.org/10.1029/2020WR027328

Buffington K. J., C. N. Janousek, B.D. Dugger, J.C. Callaway, L. M. Schile-Beers, E. Borgnis Sloane, K. M. Thorne. 2021. Incorporation of uncertainty to improve projections of tidal wetland elevation and carbon accumulation with sea-level rise. PLoS ONE 16(10): e0256707. https://doi.org/10.1371/journal.pone.0256707

Buffington, K. J., B. D. Dugger and K. M. Thorne. 2018. Climate-related variation in plant peak biomass and growth phenology across Pacific Northwest tidal marshes. *Estuarine, Coastal and Shelf Science* 202: 212-221. https://doi.org/10.1016/j.ecss.2018.01.006

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Coastal Resilience Team (30 Publications)

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Cooperative Oxford Laboratory (11 Publications)

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Pirhalla, D. E., Lee, C. C., Sheridan, S. C., & V. Ransibrahmanakul. 2022. Atlantic Coastal Sea Level Variability and Synoptic-Scale Meteorological Forcing. Journal of Applied Meteorology and Climatology, 61(3), 205-222. https://doi.org/10.1175/JAMC-D-21-0046.1.

Pirhalla, D. E., Sheridan, S.C., Lee, C.C., Barnes, B.B, Ransibrahmanakul V., and C. Hu. 2016. Water clarity patterns in South Florida coastal waters and their linkages to synoptic scale wind forcing. *Satellite Oceanogr. Meteorol.* 2, 26–40. https://doi.org/10.18063/SOM.2016.02.003.

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Sheridan, S. C., C.C. Lee, R. Adams, E.T. Smith, D. Pirhalla, and V. Ransibrahmanakul, 2019. Temporal modeling of anomalous coastal sea level values using synoptic climatological patterns. *Journal of Geophysical Research: Oceans*, 124. https://doi.org/10.1029/2019JC015421.

Smith, E., Lee, C. C., Pirhalla, D.E., Ransibrahmanakul, V. Chuanmin, H., Barnes, B. B., S.C. Sheridan, 2019. A synoptic climatological analysis of the atmospheric drivers of water clarity variability in the Great Lakes. Journal of Applied Meteorology and Climatology: doi.org/10.1175/JAMC-D-19-0156.1.

Social Science Team (7 publications)[9]

Allen, M.E., C.S. Fleming, S.B. Gonyo, E.K. Towle, M.K. Dillard, A. Levine, M. Gorstein, J. Loerzel, S.D. Regan, B.M. Zito, and P.E.T. Edwards. 2021. Resident perceptions of ecosystem services provided by U.S. coral reefs: Highlights from the first cycle of the National Coral Reef Monitoring Program's Socioeconomic Survey. Water 13(15), 2081. doi: 10.3390/w13152081. https://www.mdpi.com/2073-4441/13/15/2081

Fleming, C.S., M.K. Dillard, S.D. Regan, M. Gorstein, E. Messick, and A. Blair. 2017. A coastal community vulnerability assessment for the Choptank Habitat Focus Area. NOAA Technical Memorandum NOS NCCOS 225. Silver Spring, MD. 92 pp. https://doi.org/10.7289/V5/TM-NOS-NCCOS-225

Fleming, Chloe S., Regan, Seann D., Freitag, Amy, Burkart, Heidi. 2020. Assessing the Geographic Variability in Vulnerability to Climate Change and Coastal Hazards in Los Angeles County, California. NOAA technical memorandum NOS NCCOS ; 275. https://doi.org/10.25923/mgca-hc06

Fleming, C.S., Regan, S.D. 2022. Complementary social vulnerability assessment to support sea level rise planning in the Puget Sound region of Washington State. NOAA technical memorandum NOS NCCOS ; 302. https://doi.org/10.25923/rs2x-yk25

Fleming, C.S., Regan, S.D., Freitag, A., Burkart, H. 2022. Indicators and participatory processes: A framework for assessing integrated climate vulnerability and risk as applied in Los Angeles County, California. Natural Hazards [Forthcoming]. https://doi.org/10.1007/s11069-022-05628-w

Freitag, A., Burkart, H., Fleming, C. S., & Regan, S. D. 2022. Creating a quantitative, ecosystem-service-based index of nature in the highly urbanized and arid Los Angeles County. Environment and Planning B: Urban Analytics and City Science, 49(1), 304–320. https://doi.org/10.1177/23998083211003884

Gonyo, S. and B. Zito. 2022. The Cost of Shoreline Protection: A Comparison of Approaches in Coastal New England and the Mid-Atlantic. Ocean and Coastal Management. [In Review]

[9] The publications listed here are a result of projects that focus on climate-driven social dynamics. Other research areas within the social science team's portfolio have been reviewed as part of the 2019 Biogeography program review (or will be included in the next Biogeography program review), and therefore are not included in the Coastal Change program review.

Legislative Drivers

The following is a list of the major legislative, mission and policy drivers for the science and research conducted by NCCOS. This includes research highlighted in this review, as well as research presented in past NCCOS science reviews. These drivers help guide the efforts and activities for the accomplishment of various aspects of NCCOS's mission and goals.

NCCOS

- Coral Reef Conservation Act (CRCA), 2000
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 1980
- Endangered Species Act, 1973
- Estuary (Estuarine) Protection Act, 1968
- Harmful Algal Bloom and Hypoxia Research and Control Amendments Act (HABHRCA), 2014
- Invasive Species Executive Order, 1999, 2016
- Magnuson-Stevens Fishery Conservation and Management Act, 1976
- Marine Mammal Protection Act, 1972
- National Coastal Monitoring Act, 1992
- National Contaminated Sediment Assessment and Management Act, 1992
- National Environmental Policy Act (NEPA), 1970
- National Marine Sanctuaries Act (NMSA), 1972
- Oceans and Human Health Act, 2004
- Oil Pollution Act (OPA), 1990
- Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act), 2012

NCCOS Staff Biographies

NCCOS Leadership

Margo Schulze-Haugen
NCCOS Director (Acting)
NCCOS Deputy Director

Margo Schulze-Haugen has been the Deputy Director for NOS' National Centers for Coastal Science (NCCOS) since October 2018. Prior to coming to NCCOS, Schulze-Haugen had been the Chief of the Highly Migratory Species Management Division, in NMFS' Office of Sustainable Fisheries, since 2005. Schulze-Haugen received her Masters of Science in Fishery Biology from the University of Massachusetts at Amherst where she studied predator-prey interactions in the Connecticut River estuary. Schulze-Haugen graduated from Tufts University with a Bachelor of Science in Biology and English.

David Kidwell
NCCOS Deputy Director (Acting)
Competitive Research Program (CRP) Director

David Kidwell joined NCCOS in 2007 as a Knauss Marine Policy Fellow and formerly managed the Effects of Sea Level Rise (ESLR) research program before taking over the director role for the entire Competitive Research Program portfolio. With over a decade of experience in managing coastal science projects, Kidwell promotes a collaborative science approach to product actionable products and results. He currently co-chairs the Interagency Working Group for harmful algal blooms and hypoxia and remains active in NOAA-wide resilience activities. An ecologist by training, he received his M.S. in Marine, Estuarine, and Environmental Science from the University of Maryland. Prior to his time at NOAA, he worked with the U.S. Geological Survey conducting waterfowl and ecosystem quality research.

Competitive Research Program

David Scheurer, Ph.D.
Competitive Research Program (CRP) Director (Acting)
CRP Deputy Director

Dr. David Scheurer is an oceanographer at NCCOS and the Deputy Director of the Competitive Research Program (CRP). With close to 20 years' experience within CRP, he has broad experience across all scientific program areas to include expertise in program planning, execution and transitioning research results into management application. Dr. Scheurer received his B.S. degree in marine biology from Florida Institute of Technology, an M.A. degree in environmental science at Johns Hopkins University and a Ph.D. degree in ecology from the Marine, Estuarine, and Environmental Science program at the University of Maryland.

Trevor Meckley, Ph.D.
Program Manager, Effects of Sea Level Rise (ESLR) Program

An ecologist by training, Dr. Trevor Meckley received his Ph.D. from Michigan State University, while studying the invasive sea lamprey migration in the Great Lakes from a movement ecology perspective. These studies involved the use of mathematical and statistical techniques to develop mechanistic models of organism movement that answer applied questions on invasive species control. This background provided the foundation for managing applied research programs that often support the advancement of modeling methods to identify solutions to mitigate coastal flooding with natural approaches. He has more than 5 years of experience managing coastal science projects.

Brittany King, Ph.D.
Environmental Justice Specialist

Dr. Brittany King is environmental justice specialist in the Competitive Research Program. Her primary responsibilities include evaluating NCCOS portfolios to identify ways to enhance and develop programmatic strategies for incorporating underserved communities and environmental justice considerations, initiatives, and concepts into NCCOS science. She also supports NCCOS-wide efforts on diversity and inclusion. Dr. King holds a Ph.D. in Fisheries Science from Oregon State University. She also holds a MESM in Environmental Science and Management, specializing in Coastal Marine Resource Management, from the Bren School at UC Santa Barbara and a B.S. in Marine and Environmental Science from Hampton University.

Elizabeth McNamee
Knauss Fellow, Competitive Research Program (CRP)

McNamee joined CRP in February through the one-year John A. Knauss Marine Policy Fellowship Program. She primarily supports the management of ESLR projects, develops outreach and engagement materials around NCCOS science, and helped plan this Coastal Change Program Review. McNamee has a B.S. in Geography from McGill University and a joint M.S. in Soil Science and Agroecology from the University of Wisconsin-Madison. She is currently pursuing a Ph.D. in Agronomy from the University of Wisconsin-Madison with a focus on sustainable water use in irrigated agroecosystems.

Marine Spatial Ecology Division

Mark Monaco, Ph.D.
Marine Spatial Ecology Division Chief

Dr. Mark Monaco supervises the Marine Spatial Ecology (MSE) Division in NCCOS. He directs 45 Federal staff and approximately 50+ contract staff to implement MSE's research priorities. The Division conducts integrated assessments based on existing and field-generated natural and social science data and information to advance ecosystem based management. Dr. Monaco has been a practicing scientist and manager in the field of marine spatial planning and ecology for over 35 years.

During his career at NOAA, he led development and implementation of NOAA's Biogeographic Assessment Framework that has been used in conducting geospatial assessments to facilitate marine spatial planning processes and implementation plans. Applications include defining and evaluating the efficacy of marine protected areas, defining and modifying the spatial boundaries of marine managed areas, and supporting US States in developing and implementing marine spatial plans. He serves as the chair of the steering committee for NOAA's Integrated Ecosystem Assessment Program that provides a framework to inform ecosystem-based management. He represents NOAA on the Chesapeake Bay Scientific Technical Advisory Committee and co-Leads NOAA's Ecological Forecasting-Habitat Science and Ecological Forecasting Technical Team that addresses how habitats are changing in quantity and quality over space and time to forecast ecosystem responses to habitat modifications. Dr. Monaco received his Bachelor of Science degree in 1981 and his Master of Science degree in 1984 from The Ohio State University, and his Ph.D. in 1995 from The University of Maryland.

Coastal Resilience, Restoration and Assessment Branch

Tomma Barnes, Ph.D.
Coastal Resilience, Restoration and Assessment Branch Chief

Dr. Tomma Barnes' Branch is diverse and includes research scientists investigating the use of natural and nature based infrastructure (wetlands and coral reefs) as a means to enhance coastal resilience, and also to mitigate the potential impacts of storms and inundation to coastal communities; aquaculture siting and sustainability, and development of spatial products, models and other services that inform sustainable aquaculture siting and management.

Before coming to NCCOS in December 2018, Dr. Barnes worked for the United States Geological Survey (USGS) where she was doing similar work as a Branch Chief in Lafayette, Louisiana. Prior to that, she worked for the U.S. Army Corps of Engineers (USACE) as a Civil Works Planner in New Orleans, LA and Wilmington, NC, then as the Chief of the Planning and Environmental Branch at the Pittsburgh District. She holds a Ph.D. in Oceanography from Nova Southeastern University, an M.S. in Ecology and Evolutionary Biology with a Specialty in Coastal Zone Studies from the University of West Florida and a B.S. in Marine Science from Coastal Carolina University.

Jenny Davis, Ph.D.
Research Ecologist

Dr. Jenny Davis is a wetland ecologist in the Coastal Resilience, Response and Assessment Branch. Davis' current research focus is on the ecology and biogeochemistry of coastal wetlands with an emphasis on: 1) the resilience of natural coastal wetlands to shoreline wave energy, storms, and Sea Level Rise (SLR), 2) quantification of ecosystem services provided by natural and restored/created coastal habitats; and, 3) adaptive management strategies for enhancing wetland resilience to SLR. Prior to coming to NCCOS in 2013 she spent several years at the College of Charleston researching the role of marine viruses in the oceanic carbon cycle. Previous positions have afforded Davis the opportunity to study a wide range of topics, including bacterial water quality, nitrogen cycling in shoreline fringing marshes, genetic diversity in tropical seagrasses, and the production and fate of organic carbon in the Arctic Ocean. Davis received her Bachelors in Marine Biology from Texas A&M University at Galveston, Masters in Biology from Florida International University and Ph.D. in Marine Science from the University of South Carolina.

Shay Viehman, Ph.D.
Research Ecologist

Dr. Shay Viehman is a Research Ecologist in the Coastal Resilience, Restoration and Assessment Branch. Her current research focuses broadly on 1) the resilience of coral reefs to climate change, wave energy, and other disturbances, 2) quantification of changes to coral populations and reef communities, 3) coral reef restorations as nature-based solutions, 4) applications of emerging technology in large area imagery to detect change on coral reefs, and 5) data science and spatial modeling. She is the benthic lead for NOAA's National Coral Reef Monitoring Program in the Atlantic.

Dr. Viehman has a B.S. in Biology from Wake Forest University, a M.S. in Biological Sciences from Florida International University, and a Ph.D. in Marine Science and Conservation from Duke University. Prior to coming to NCCOS in 2004, she worked for the National Park Service for several years doing research coordination, coral reef monitoring, and coral restoration in south Florida. She has more than 20 years of research experience on tropical Caribbean coral reefs.

Christine Buckel
Ecologist, Geospatial Analyst and Data Visualization

Christine Buckel works on resilience centered projects that span a variety of topic areas including corals, marshes, storm surge and economic impacts under sea-level rise. She manages data of all types, analyzes their spatial and temporal patterns, and then develops data visualization products to help clients understand trends and patterns in an accessible way. Early in her career with NCCOS, Buckel traveled throughout the Caribbean and the U.S. East coast diving to record coral and reef fish community data and analyze their trends. Currently, she spends less time in the field and more time developing complementary products and data syntheses that move beyond sharing raw data and applying it to end user needs to support decision making. Buckel received her B.S. in Biology from the University of Nebraska and then later went on to the University of California, Santa Barbara for her M.S. in Marine Science.

Avery Paxton, Ph.D.
Research Marine Biologist

Dr. Avery Paxton is a Research Marine Biologist at NCCOS, where she focuses on coastal resilience and restoration. She quantifies ecological functions of created, restored, or impacted habitats to learn which interventions can best achieve intended ecological outcomes (e.g., coastal resilience, ecosystem services, community structure). Paxton's current research evaluates how natural and nature-based infrastructure (e.g., salt marshes, coral reefs, living shorelines) can boost coastal resilience. A major pillar of Dr. Paxton's research is conducting regional and global syntheses to gain new insight from previously collected data. Earlier in her career, Dr. Paxton determined ecological functions of human-made reef habitats, including artificial reefs and historic shipwrecks, and tested whether artificial structures provide similar fish habitat to natural reefs.

Dr. Paxton began her career by earning a B.S. in Environmental Sciences from the University of Virginia, where her undergraduate thesis on shipwreck ecology stemmed from her time as a NOAA Hollings Scholar. After working as a research technician at the University of Washington Friday Harbor Labs studying rocky reefs and kelp forests, she earned her Ph.D. from the University of North Carolina at Chapel Hill, where she studied how reef fishes rely on rocky reefs, artificial reefs, and shipwrecks. Dr. Paxton conducted a joint postdoctoral fellowship with a nonprofit, a consortium of aquaria, and Duke University, studying reliance of a large coastal shark on artificial habitats before spending three years conducting research under contract to NCCOS through CSS-Inc.

Mike Greene
Biological Science Technician

Mike Greene is a member of the Coastal Resilience, Restoration, and Assessment Branch. His work focuses on determination of accurate coordinate and elevations for SET infrastructure and DEM analysis of marshes, shorelines and dredge sediments using high accuracy GNSS technologies and GIS programs. His work includes topographic, surveying, and leveling techniques. Greene began his time at NOAA in the National Marine Fisheries Service working in larval fish recruitment on the South Atlantic Bight Recruitment Experiment. In this role he spent many days at sea, first as a science party hand and advancing to an experienced sampling operator using MOCNESS, including responsibilities as Field Party Chief. In 1999 he transitioned to NOS within the Fisheries Ecology Team leading fisheries field parties in Florida Bay while tending to cruise duties. In 2005 he transitioned to the Coastal Estuarine Ecology Team. He was tasked with applying high accuracy GPS mapping techniques for the team. He works with vendors and NGS in training, project development and application on NCCOS projects. Greene's work includes the use of Sediment Elevation Tables in measuring sediment change in marsh environments. Greene uses NGS OPUS Projects to establish coordinate and vertical accuracy to SET marks and temporary water level stations and ArcGIS in development of Digital Elevation Models to analyze marsh and shoreline change in support of coastal resilience focusing on sediment reuse, natural and nature based infrastructure. Greene received his Associate's degree in Applied Science in Fisheries and Wildlife Management from Wayne Community College in 1993.

Brandon Puckett, Ph.D.
Research Marine Biologist

Dr. Brandon Puckett is a marine scientist in the Coastal Resilience, Restoration and Assessment Branch. Through applied research, he strives to provide science-based solutions that improve restoration outcomes, and the resilience of coastal ecosystems and communities. In these pursuits, he integrates general ecological principles with empirical observations (field- or lab-based) and numerical modeling. His research interests, broadly speaking, center around the ecology of coastal habitats—focusing primarily on oyster reefs, tidal wetlands, and, to a lesser degree, seagrasses. His recent research has focused on: 1) developing decision-support tools to inform oyster restoration, 2) evaluating the ability of nature-based solutions to enhance coastal ecosystem and community resilience, and 3) assessing vulnerability of coastal wetlands to natural and anthropogenic stressors, and 4) applying remote sensing technology (namely drones) to monitor and assess change in wetland and oyster reefs. Prior to joining NCCOS in 2022, Dr. Puckett served as the Research Coordinator for the North Carolina National Estuarine Research Reserve. Dr. Puckett received his B.S. in Environmental Science-Ecology from North Carolina State University, a M.S. in Fisheries Science from the University of Maryland, and a Ph.D. in Marine Science from North Carolina State University.

Biogeography Branch, Social Science Team

Theresa L Goedeke, Ph.D.
Team Leader/Social Scientist

Dr. Theresa Goedeke is the Team Leader for research in the social, economic, and behavioral sciences for the NCCOS Marine Spatial Ecology Division. She works with leadership to set strategic research goals, build partnerships, and oversee NCCOS' portfolio of internal social science research. She provides oversight and guidance to a team of six research staff, and serves as a Principal Investigator for interdisciplinary research projects.

Dr. Goedeke holds Bachelor's and Master's degrees in Sociology. In 2003, she earned a doctoral degree in Rural Sociology with speciality in natural resource and environmental sociology from the University of Missouri-Columbia. She is trained in quantitative and qualitative research methods. Funded by the National Science Foundation, her dissertation focused on endangered species science, law, and policy. In 2003, she completed a policy fellowship at the National Academies of Sciences with the Board on Agriculture and Natural Resources. She was a post-doctoral research associate from 2004-2007 at Florida A&M University, managing a project focused on coastal communities and climate change.

Dr. Goedeke joined NCCOS as a contractor in 2007, and entered Federal service as a Social Scientist in 2008. Her research at NCCOS has focused on community well-being and the use and management of coastal and marine resources. In 2016, she graduated from the US Department of Commerce's Executive Leadership Development Program. In 2021, she graduated from NOAA's Leadership Competencies Development Program (LCDP). She has completed rotational assignments with the National Park Service (2016), NMFS Pacific Islands Regional Office (2018), US DOC Undersecretary for Economic Affairs (2019), NMFS Restoration Center (2020), NMFS Southeast Fisheries Sciences Center (2020), and the US EPA Office of Environmental Justice (2021).

Seann Regan
Geographer/Social Scientist

Seann Regan is a human geographer with CSS, supporting NCCOS's social science portfolio. He is passionate about interdisciplinary science and analyzing the world through a spatial lens. His work at NCCOS is primarily focused on the vulnerability and resilience portfolio, Human Use Mapping and NOAA's Integrated Ecosystem Assessments, as well as providing geospatial expertise to the social science team. Regan received a Bachelor's of Science in Social Science from the University of Portland, and a Master's degree in Geography from Miami University.

Sarah Gonyo, Ph.D.
Economist

Dr. Sarah Gonyo has a Ph.D. in Environmental Economics from the University of Maryland, College Park. She joined the NCCOS social science team in 2014 and currently leads the team's offshore wind energy projects, co-leads the team's ecosystem service valuation and human use mapping portfolios, and is the technical lead for the Socioeconomic Component of the Coral Reef Conservation Program's National Coral Reef Monitoring Program.

Chloe Fleming
Coastal and Marine Social Scientist and Policy Specialist

Chloe Fleming is a coastal zone management and policy specialist with CSS, supporting NCCOS's social science portfolio. She co-leads the social science team's vulnerability assessment portfolio, is the NCCOS accountable lead for the Socioeconomic Component of the Coral Reef Conservation Program's National Coral Reef Monitoring Program, and supports the social science team's offshore wind energy social science projects.

Fleming began her career in marine and coastal science at University of Miami's Cooperative Institute for Marine and Atmospheric Studies (CIMAS) as a contractor to NOAA's Southeast Fisheries Science Center in 2014. During her time in Virginia Key, Fleming supported the Center's social science research group in conducting social science of commercial and recreational fishing populations in the U.S. Virgin Islands and Puerto Rico. In 2015, Fleming joined NCCOS's social science team to develop and provide social science information to inform coastal management decisions. She has supported projects in human use mapping, ecosystem service valuation, in addition to her current portfolio. Fleming received her Bachelor of Arts degree in Marine Affairs and Anthropology from the University of Miami in 2013, and her Master of Professional Science degree in Marine Affairs and Policy from the University of Miami's Rosenstiel School of Marine And Atmospheric Science in 2014.

Amy Freitag, Ph.D.
Sociologist

Dr. Amy Freitag has a Ph.D. in Marine Science and Conservation from Duke University. She joined the NCCOS social science team in 2016 and across all aspects of the team's research portfolio. Currently, her research focuses on human dimensions monitoring, spatial approaches to better understand and increase the resilience of coastal communities, and planning for new uses of ocean spaces such as aquaculture and offshore wind.

Heidi Burkart
Marine Scientist/Spatial Analyst

Heidi Burkart is a marine scientist and geospatial analyst, with 15 years of collective experience in scientific research support, evaluation and assessment, and data analytics and visualization. She holds technical expertise in the application of tools, such as geographic information systems (GIS), to compile, process, analyze, and visualize data that supports informed decisions linked to the sustainable use and management of natural resources and the communities that rely upon them. Currently, Burkart supports the NCCOS social science portfolios of research focused on vulnerability, human use, and ecosystem services valuation. Since 2016, Burkart has supported multiple projects within the Biogeography Branch of NCCOS. Initially, a primary task was her work with the RESTORE Council Monitoring and Assessment Program in which she built partnerships across multiple sectors to catalog monitoring and mapping efforts across the Gulf of Mexico region. Burkart received a Bachelor of Science degree in Biology and Marine Science from The University of Alabama in 2006, and a Master of Coastal Environmental Management degree from the Duke University Nicholas School of the Environment in 2012.

Amanda Alva
Marine Natural Resource Management and Policy Specialist

Amanda Alva is a marine natural resource management and policy specialist with CSS, supporting NCCOS's social science portfolio. She is currently a data analyst for the socioeconomic component of the Coral Reef Conservation Program's National Coral Reef Monitoring Program. She is a recent addition to the NCCOS social science team in 2022. Her background includes technical laboratory work, fieldwork, and social science studies in natural resources, conservation, and environmental policy. Alva received her Bachelor of Science degree in Marine and Freshwater Science from The University of Texas at Austin in 2019, and her Master of Science degree in Natural Resources from Auburn University in 2022.

Cooperative Oxford Laboratory

Doug Pirhalla
Research Physical Scientist

Doug Pirhalla is a lead scientist with background and expertise in remote sensing application, environmental impact assessment and modeling. Doug has fifteen years experience leading multiple projects to better understand, prepare and adapt to present and future impacts in coastal systems through scientific assessments and tool development. These tools will result in improvements in ecosystem service management, fishery/habitat resources management, and coastal community resilience. His main professional experience and focus is about collaborative science to understand and predict climate and weather-related impacts in coastal systems. He has led multiple projects to position NCCOS for success and achievement of strategic goals by: expanding the use of NOAA, NASA, and other satellite data technologies through research and modeling; targeting new modeling approaches for tool development; uncovering, researching and developing better opportunities within and outside the Federal sector to use NOAA products; and technological approaches to support a resilient, sustainable future. Pirhalla majored in Geography and Biology at Frostburg State University, and has a Master of Science degree in Environmental Science at Johns Hopkins University.

Evaluation Criteria Checklist

Criteria	Questions
Quality	How would you characterize the scientific quality of the findings and products generated by the Coastal Change Program?
	Describe the value of the research provided to the scientific community, including resource managers, by the Coastal Change Program, and how can the Program enhance this value further?
	Are scientific products delivered to the community in a manner that maximizes their utility (e.g.- timely, understandable, sufficiently detailed, and readily accessible format) and what actions would enhance their delivery?
Relevance	How and to what extent are products aligned with NOAA, NCCOS legislative mandates and priorities, and what actions would improve this alignment?
	To what extent do those beyond the scientific community, including resource managers, use findings and products generated by Coastal Change Program projects to inform decision-making, improve preparedness, management and/or response to events and issues handled by other Federal, local, state, tribal, and regional governments?
	Are there research gaps that should/should not be pursued and if so, why?
Performance	How effectively does the Coastal Change Program utilize funded collaboration and external partnerships to achieve desired program outcomes, increase overall return on investment, and strengthen the impact of our science?
	How well does the Coastal Change Program execute its research and related studies in an efficient and effective manner given appropriated resources?
	How effective are the strategies that the Coastal Change Program has for identifying, establishing & maintaining relationships with stakeholders, the non-scientific community and what steps would expand and strengthen relationships and ensure they are effectively leveraged?

Acronyms List

NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NCCOS	National Centers for Coastal Ocean Science
MSE	Marine Spatial Ecology
CRP	Competitive Research Program
ESLR	Effects of Sea Level Rise Program
COL	Cooperative Oxford Laboratory
HML	Hollings Marine Laboratory
CO-OPS	Center for Operational Oceanographic Products and Services
CRCP	Coral Reef Conservation Program
OCM	Office for Coastal Management
NMFS	National Marine Fisheries Service
NERRS	National Estuarine Research Reserves System
ONMS	Office of National Marine Sanctuaries
NAO	NOAA Administrative Order
FFO	Federal Funding Opportunity
FY	Fiscal Year
PPA	Program, Project or Activity
MOU	Memorandum of Understanding
GPRA	Government Performance and Results Act
PART	Program Assessment Rating Tool
OMB	Office of Management and Budget
R&D	Research and Development
FACA	Federal Advisory Committee Act
NNBF	Natural and Nature-Based Features
NBS	Nature-Based Solutions
USACE	Army Corps of Engineers
FEMA	Federal Emergency Management Act
DOT	Department of Transportation
SLR	Sea Level Rise
MSP	Marine Spatial Planning
HABs	Harmful Algal Blooms
LAI	Large Area Imaging
UAS	Uncrewed Aerial Systems
AWAC	Acoustic Wave and Current

Conflict of Interest Statement

(Rev 07/21)

United States Department of Commerce

REVIEWER CONFLICT OF INTEREST AND CONFIDENTIALITY CERTIFICATION FOR PEER REVIEWERS

1. Confidentiality of Documents and Restriction on Contact

I understand that _____ applications for proposed awards are made available to reviewers solely for the purpose of reviewing those applications against the published evaluation criteria for the financial assistance program.

I agree not to discuss the contents of the applications outside the Department during or after the review process, and to discuss the proposals within the Department only with the other reviewers and Department staff members and in the context of, and under the procedures for, application review. I agree to follow the written instructions provided by the Department for the completion of review forms. I agree to retain no copies of documents or parts of documents related to review.

I further agree not to contact the originators of applications being reviewed concerning any aspect of their contents. In addition, I agree not to use any information obtained as result of my participation as a panel member for personal or private gain.

As required by 5 U.S.C. § 2302(b)(13) and the annual Appropriations Act, these provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General or the Office of Special Counsel of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling. This agreement shall not be construed to prohibit or restrict an employee or applicant for employment from disclosing to Congress, the Special Counsel, the Inspector General of an agency, or any other agency component responsible for internal investigation or review any information that relates to any violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or any other whistleblower protection.

2. Conflict of Interest

I hereby certify that, to the best of my knowledge, I do not have a conflict of interest and that my particular circumstances are not likely to raise the appearance of a conflict of interest, impropriety, or the appearance of impairment of objectivity with respect to any application I am asked to review or comment on.

For purposes of this agreement, I understand that a financial interest may include employment, stock ownership, a creditor or debtor relationship, or prospective employment with an applicant. An appearance of impairment of objectivity could result from, an organizational conflict where, because of other activities relationships with other persons or entities, a person is unable or potentially unable to render impartial assistance or advice to the Government. It could also result from non financial gain to the individual, such as benefit to reputation or prestige in a professional field.

I also recognize that I will be considered to have a financial or other interest, and therefore a conflict of interest, if any of the following have a financial or other interest in the application I am asked to review or comment on:

(1) I, my spouse, minor child, or general partner.
(2) A profit or non-profit organization in which I serve as an officer, director, trustee, general partner, or employee; or
(3) Any person or organization with which I am negotiating or have an arrangement concerning employment, including consultantship or a past employer (within the last year).

I recognize that this certification is a continuing representation. I acknowledge that it is in effect at all times until I have completed all of the work preformed by me under this agreement.

If I discover that I might have a conflict of interest, might present a conflict of interest, or might have an appearance of impairment of objectivity with any application with the competition, I will immediately inform the appropriate Program official and refrain from further Work as a reviewer until authorized to continue.

I also understand that my views as a peer reviewer will be protected from disclosure to the extent permitted by law.

PRINTED NAME	SIGNATURE	DATE

COASTAL CHANGE PROGRAM REVIEW

Briefing Book

1305 East West Hwy, Rm 8110
Silver Spring, Maryland 20910
240.533.0300 | coastalscience.noaa.gov
facebook.com/noaacoastalsci | @noaacoastalsci