Coastal and Ocean Community Modeling Workshop

October 19-21, 2021

MEETING LOGISTICS

- **Support** // If you need technical support at any time throughout the workshop:
    - Text/call 865-770-1157 or email jennifer.kidd@noaa.gov
    - Consider using a phone connection (on mute) in case of internet interruptions
- **Mute** // **Please MUTE your line** when you are not speaking to prevent feedback.
- **Slow connection** // If you experience a slow connection, turn off your video and close all other tabs. If that doesn't work, dial in via phone.

HOW TO REVISE YOUR GOOGLE MEET LAYOUT TO SEE MORE/ FEWER PARTICIPANTS

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- Launch Google Meet.
- In the bottom right of your screen, click the More Options button (it looks like three vertical dots ⋮)
- With the options menu open, choose Change layout
- Click the circle next to Tiled and use the slider at the bottom to choose how many video feeds you see (up to 49)

- When you are finished, click the X in the upper right-hand corner of the layout menu

HOW TO CONTRIBUTE

In the effort to make this workshop as "in-person" as possible, we are encouraging open "face-to-face" discussion during Q&A sessions and during the designated discussion sections. Please consider the following:

- Chat box
    - Add your thoughts to the discussion
    - Avoid holding side conversations
- "Raise Your Hand" in Google Meet to alert the moderator

PARTICIPATION GUIDELINES

- Help us enjoy our virtual togetherness by turning your video ON as often as possible for the duration of the workshop. We cannot wait to see your smiling faces!
- Breaks have been built into the agenda. Please avoid conducting other work (emails, calls, etc.) or having side conversations during the workshop.
- The workshop will run on time. Please rejoin the workshop on time after all breaks.

WORKSHOP CONCEPT

- **Focus:** NOAA's coastal and ocean models
- **Who:** NOAA employees and contractors, academics, Federal partners, and private industry

- **Workshop Themes:**
    - Enhancing communication and coordination between NOAA and external partners
    - Understanding NOAA's priorities for collaborative coastal and ocean model development
    - Enhancing processes and paths for transitioning Research-to-Operations-to-Research (R2O2R)
- **Workshop Outcomes:**
    - Enhance communication and collaboration between Federal and non-federal modeling communities.
    - Identify recommendations that will increase the efficiency of transitioning modeling systems from research to operations.
    - Ensure the concerns, needs, and aspirations in building a community of practice across government and non-government entities are understood.
    - Understand the community models NOS will develop for the UFS next generation ocean and coastal components.

SUGGESTED BACKGROUND READING

- Wilkin et al. 2017. Advancing coastal ocean modelling, analysis, and prediction for the U.S. Integrated Ocean Observing System
- Earth System Modeling Framework recommendations for High Performance Modeling Infrastructure
- Organizing Research to Operations Transition
- Unified Forecast System (UFS) Strategic Plan 2021 - 2025
- Draft UFS Organization and Governance
- EPIC Strategic Plan 2020 - 2025
- Strategic Implementation Plan For Evolution Of NGGPS To A National Unified Modeling System

NOTE: If you did not register, or are using a different email than the one you registered with, you may not have access to materials. You can request access, noting that delivery may be delayed until a break in the Workshop.

WORKSHOP AGENDA

TUESDAY, OCTOBER 19TH | The Big Picture (all times ET)

- Workshop convenes via Google Meet, or call-in via 240-490-4487 PIN: 944 899 553#
- If you are a NOAA participant and you are planning to listen in only, please join the Livestream (comment via via Gchat or text: murielle.gamache-morris@noaa.gov or 703-298-8230)

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12:45 pm **OPTIONAL | Workshop Opens for Technical Testing**
(Optional for participants who want to test cameras or microphones)

1:00 pm **Welcome and Logistics**

1:05 pm **MARK OSLER | Keynote**

1:25 pm **Questions For Mark Osler**
Moderator: Tracy Fanara | Chat moderator: Cayla Dean

1:45 pm **JOHN WILKIN | How Community Modeling Can Support NOAA's Ocean and Coastal Missions**
Suggested pre-reading: Wilkin et al. 2017. Advancing coastal ocean modelling, analysis, and prediction for the US Integrated Ocean Observing System

2:05 pm **Questions For John Wilkin**
Moderator: Tracy Fanara | Chat moderator: Cayla Dean

2:25 pm **DERRICK SNOWDEN | NOAA Programs that Support Community- Developed Modeling**
Moderator: Tracy Fanara | Chat moderator: Cayla Dean

2:40 pm **Questions For Derrick Snowden**

2:55 pm **10-Minute Break**

3:05 pm **BRIAN GROSS AND DOROTHY KOCH | NOAA's Modeling Landscape for Community Model Developments**

3:20 pm **Questions For Brian Gross and Dorothy Koch**
Moderator: Charlie Stock | Chat moderator: Debra Hernandez

3:35 pm **DANA CARLIS AND MAOYI HUANG | Leveraging Community-Developed Models with EPIC and UFS**
Suggested pre-reading:

- Earth System Modeling Framework recommendations for High Performance Modeling Infrastructure
- Unified Forecast System (UFS) Strategic Plan 2021 - 2025
- EPIC Strategic Plan 2020 - 2025

3:50 pm **Questions for DaNa Carlis And Maoyi Huang**
Moderator: Charlie Stock | Chat moderator: Debra Hernandez

4:05 pm **10-Minute Break**

4:15 pm **COMMUNITY SHOWCASE**
(See Appendix A for abstract and presenter information)
Moderator: John Wilkin

	Speaker	Title
1	Jesse Lopez, Axiom Science	An on-demand cloud-based storm surge prediction system
2	Marjorie A.M. Friedrichs, Virginia Institute of Marine Science	Short-term forecasts of acidification metrics in the Chesapeake Bay
3	Panagiotis Velissariou, NOAA	CoastalApp: A NUOPC/ESMF coupling application based on Unified Forecast System best practices
4	Roger Griffis, NOAA	NOAA Climate and Fisheries Initiative: Building an end-to-end system for climate ready living marine resource management
5	Andrew Moore, University of California Santa Cruz	Quantifying the impact of ocean observing systems on model forecast skill

4:45 pm **CARL GOULDMAN | Reflections on Day 1 and Looking Ahead to Day 2**

5:00 pm **ADJOURN**

WEDNESDAY, OCTOBER 20TH | Coastal and Ocean Models (all times ET)

- Workshop convenes via Google Meet, or call-in via 224-505-3524 PIN: 108 698 896#
- If you are a NOAA participant and you are planning to listen in only, please join the Livestream (comment via via Gchat or text: Emily.Wallace@noaa.gov or 804-245-0320)

12:00 pm **BROWN BAG | Overview of Resources that Support Community Modeling**
Moderator: Tracy Fanara

12:30 pm **BROWN BAG SESSION ADJOURNS**

1:00 pm **WELCOME TO DAY 2**

1:05 pm **COMMUNITY SHOWCASE**
(See Appendix A for abstract and presenter information)
Moderator: John Wilkin

	Speaker	Title
1	Steven Meyers, University of South Florida	Predicting high cross-currents near south Florida ports using machine learning: Initial results
2	Z. George Xue, Louisiana State University	Assessing hydro- and sediment dynamics of hurricane-induced compound flooding using a dynamically coupled ocean-river modeling suite
3	David Johnson, Purdue University	Multi-model joint probability method for estimating compound flood risk
4	Peter Sheng, University of Florida	Best practice for actionable science: development of decision support tools for coastal flood vulnerability and adaptation
5	Youngjun Son, Georgia Institute of Technology	Flood inundation model development for coastal urban areas using the WRF-Hydro framework in Tybee Island, Georgia
6	Trey Flowers, NOAA	Next Generation Water Resources Modeling Framework: Open source, standards based, community accessible, model interoperability for large scale water prediction
7	Joannes Westerink, University of Notre Dame	Developments of global ESTOFS: NOAA's integrated multi-scale multi-process operational water level model
8	Changsheng Chen, University of Massachusetts - Dartmouth	Improving the Northeast Coastal Ocean Forecast System (NECOFS) with transition to upgraded models and new higher resolution simulation domain to address needs of the stakeholder community

9	Pengfei Xue, Michigan Tech	Assessment of alternative models for NOAA's Lake Erie HAB Forecast
10	Charles Stock, NOAA	Toward a Nation-wide seasonal to multi-decadal regional ocean prediction system to serve NOAA's living marine resource mandates
11	Fei Ye, Virginia Institute of Marine Science, William and Mary	Assessing the inland-coastal flooding operational guidance system with Hurricane Ida (2021)
12	John Krasting, NOAA	Ocean model diagnostics and pathways towards community engagement
13	Jia Wang, GLERL	Modeling the ice-attenuated waves in the Great Lakes
14	Parker MacCready, University of Washington	The LiveOcean daily forecast system
15	Robert Hallberg, NOAA	Self-consistency testing in the MOM6 ocean model in support of open development
16	Rodrigo Duran, National Energy Technology Laboratory	Modern Lagrangian Tools aid in predicting transport from an imperfect velocity
17	Juan Gonzalez-Lopez, CARICOOS	Latest developments of the CARICOOS ROMS 3D circulation model

2:30 pm **15-Minute Break**

2:45 pm **PANEL: NOAA'S OPERATIONAL REQUIREMENTS**

Moderator: Cayla Dean (NOS/CO-OPS) | Chat Moderator: Derrick Snowden (NOS/IOOS)
Panelists:

- Avichal Mehra (NWS/EMC)
- Trey Flowers (NWS/OWP)
- Greg Seroka (NOS/OCS)
- Pat Burke (NOS/CO-OPS)
- Jon Hare (NMFS/NEFSC)

3:55 pm **Stand-and-Stretch Break**

4:00 pm **PANEL: WHAT DOES IT MEAN TO BE OPERATIONAL?**

Moderator: Clarissa Anderson (University of California, San Diego)
Chat Moderator: Tracy Fanara (NOS/IOOS)
Panelists:

- Mike Jacox (NMFS/OAR)
- Chris Edwards (University of California, Santa Cruz)
- Joseph Sienkiewicz (NWS/OPC)
- Philip Chu (OAR/GLERL)

5:15 pm **RICH EDWING | Reflections on Day 2 and Looking Ahead to Day 3**

5:30 pm **ADJOURN**

THURSDAY, OCTOBER 21ST | Breaking Down Barriers and Maintaining Momentum (all times ET)

- Workshop convenes via Google Meet, or call-in via 224-505-3524 PIN: 108 698 896#
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12:00 pm **BROWN BAG | UFS Coastal Application Teams**
Suggested Pre-Reading: Unified Forecast System (UFS) Strategic Plan 2021 - 2025
With Shachak Pe'eri, Steven Earle, Joseph Sienkiewicz, Diego Arcas, and Andre Van der Westhuysen.

12:45 pm **BROWN BAG SESSION ADJOURNS**

1:00 pm **WELCOME TO DAY 3**

1:05 pm **STEVE THUR | NOAA's Coastal and Ocean Ecological Modeling Imperative**

1:20 pm **Questions For Steve Thur**
Moderator: Clarissa Anderson | Chat moderator: Peter Stone

1:45 pm **PANEL: Lessons Learned from Successfully Transitioning Community Models into NOAA**
Moderator: Pat Burke (NOS/CO-OPS) | Chat Moderator: Peter Stone (NOS/CO-OPS)
Partnerships and Panelists:

- External NOAA & NOS/OCS Partnership: ESTOFS
  - Joannes Westerink and Ed Myers
- External NOAA & NOS Partnership: Salish Sea
  - Tarang Khangaonkar, Lei Shi, and Machuan Peng
- NOS Partnerships: OCS and CO-OPS
  - Aijun Zhang and John Kelley

3:15 pm **15-MINUTE BREAK**

3:30 pm **PANEL: Breaking Down R2O2R Barriers**
Moderator: Debra Hernandez (SECOORA) | Chat Moderator: Charlie Stock (NOAA/OAR)
Panelists:

- Dwight Gledhill (NOAA/OAR)
- Marjy Friedrichs (VIMS)
- Arun Chawla (NOAA/NWS)

4:45 pm **KATIE RIES | Key Takeaways**

5:00 pm **ADJOURN**

APPENDIX A. SHOWCASE ABSTRACTS

(listed alphabetically by last name)

Changsheng, Chen[1], Tom Shyka[2], Alexander Prusevich[3], Joseph Salisbury[3]

Improving the Northeast Coastal Ocean Forecast System (NECOFS) with transition to upgraded models and new higher resolution simulation domain to address needs of the stakeholder community. Recent development of coupled atmosphere-ocean-freshwater models and higher temporal and spatial resolution in the input data improves quality of the forecast of the coastal ocean conditions that is being used for the Northeast Coastal Ocean Forecast System (NECOFS) supported by NOAA and NERACOOS. A set of models are coupled to near-real-time system that includes a regional Weather Research and Forecasting (WRF) model for the Northeastern U.S. and the coastal circulation model FVCOM (Finite Volume Community Ocean Model), NOAA National Water Model (NWM), and UNH Water Balance (WBM) model to provide 5-day operational forecast for the Land-Atmosphere-Ocean system for the NE coastal research community and stakeholders. The system had recently adopted a new substantially higher resolution coastal ocean lattice grid (GOM-6), newest version of FVCOM and its coastal inundation sub-model, and WBM transitioned from daily to hourly operation. The latter required a significant re-formulation of land surface hydrological processes, model calibration, performance assessment, and validation of the output data and forecast quality. The transition to a new simulation domain is now synchronized between all components of the NECOFS system providing a more reliable, stable, and much improved forecast product for the interested communities. The specific developments and changes to the model and their setup was guided by the feedback from the stakeholders and learning from the knowledge base of the NOAA Community Modeling work groups.

1. University of Massachusetts Dartmouth. 2. Northeastern Regional Association of Coastal Ocean Observing Systems. 3. University of New Hampshire.

Duran, Rodrigo[1]

Modern Lagrangian Tools aid in predicting transport from an imperfect velocity. Simulating oil transport in the ocean can be done successfully provided that accurate ocean currents and surface winds are available—this is often too big of a challenge. In this presentation, we focus on one of the main problems oil-spill modelers face, which is determining accurate trajectories when the velocity has localized errors that result in large trajectory errors. Advanced Lagrangian techniques that build on the theory of Lagrangian Coherent Structures can bypass localized velocity errors by identifying regions of attraction likely to dictate fluid deformation. The usefulness of Objective Eulerian Coherent Structures is demonstrated by revisiting the 2010 Deepwater Horizon accident in the Gulf of Mexico and predicting a prominent transport pattern from an imperfect altimetry velocity eight days in advance.

1. National Energy Technology Laboratory

Friedrichs, Marjorie A.M.[1]

Short-term forecasts of acidification metrics in the Chesapeake Bay. Increasing urbanization and eutrophication of coastal regions, together with increasing global atmospheric temperature and CO2 concentrations, are leading to acidification in many coastal aquatic systems across the globe. Such changes have been shown to impact shellfish growth and survival. The Chesapeake Bay region is particularly vulnerable to such changes due to the combined impact of multiple stressors (hypoxia and acidification) and the impacts on shellfish populations, as well as the communities that depend on the shellfish industry. Hatchery-based shellfish aquaculture has expanded in the Chesapeake region over the last several decades, however, early life stages of shellfish in hatchery and nursery settings are highly vulnerable to mortality events resulting from poor water quality. To address this problem, we have expanded our Chesapeake Bay Environmental Forecast System (www.vims.edu/hypoxia) to include nowcasts and short-term (2-day) forecasts of acidification metrics, such as pH and aragonite saturation state. Specifically, we use the Estuarine- Carbon-Biogeochemistry model based on the Regional Ocean Modeling System (ChesROMS-ECB) forced with real-time and forecasted environmental parameters such as atmospheric temperature, wind, humidity, solar radiation and riverine inputs. These short-term forecasts can be particularly useful to hatchery operators as an early warning system for poor water quality. For example, if a decline in saturation state is projected as a result of heavy rain conditions, a hatchery may delay spawning and/or avoid supplying spawning tanks with intake water from the Bay until conditions improve. Through our Shellfish Aquaculture Industry Advisory Committee, we are working closely with industry members, obtaining feedback from them on the information and visualizations we are providing, and helping them better incorporate this type of predictive capacity into decision-making practices at the hatcheries.

1. Virginia Institute of Marine Science.

Gonzalez-Lopez, Juan[1]

Latest developments of the CARICOOS ROMS 3D circulation model. Over the past years there has been an ongoing effort by the Caribbean Coastal Ocean Observing system (CARICOOS) to use HF-Radar current fields to aid in the development of a regional, operational ocean current model for Puerto Rico and the U.S. Virgin Islands. This region has proven to be a challenge for ocean current modeling, as a narrow and steep shelf interacts with eddies and jet-like features that meander from the Caribbean Current in the Eastern Caribbean. Given the spatial and temporal variability of these meanders that directly affect the coastal flow in the South of Puerto Rico, accurate boundary conditions along with data assimilation become a critical factor for developing a successful model. As such, HF-Radar has proven to be a valuable asset to capture observations at the range of spatial and temporal scales that are necessary given these regional and local flow features. In this lightning talk we present an overview of the latest developments of the CARICOOS ROMS 3D circulation model, including results and validation with the HF-Radar fields, as well as outlining opportunities of mutual collaboration with NOAA and the modeling community, such as two-way nesting of regional data-assimilated 3D models into global models, and availability/archival of RTOFS as boundary conditions for both operational and hindcasting purposes.

1.Caribbean Coastal Ocean Observing System.

Griffis, Roger[1], *David Detlor*[1], *Wayne Higgins*[1], *Anne Hollowed*[1], *Mike Jacox*[1], *Charlie Stock*[1], *Desiree Tommasi*[1]

NOAA Climate and Fisheries Initiative: Building an end-to-end system for climate ready living marine resource management. Climate change is significantly impacting the nation's valuable marine ecosystems, fisheries and the many people that depend upon them. These changes affect many parts of NOAA's mission, from fisheries management and aquaculture to conservation of protected resources and habitats. To prepare for and respond to these changes, the NOAA Climate and Fisheries Initiative

(CFI) will build a nation-wide integrated ocean modeling and decision support system to help decision-makers reduce impacts and increase resilience of fisheries and protected resources to changing conditions today, next year, and for decades to come. Working with existing programs, the cross-NOAA, end-to-end CFI system will use state-of-the-art climate, ocean and ecosystem modeling to provide robust future scenarios and actionable advice for climate-informed decision-making. The system is composed of three inter-linked components that ensure operational delivery of information, services, and feedback for sustained performance and innovation. The first component (Ocean Forecasts and Projections) will provide state-of-the-art ocean forecasts and projections for use in developing climate-informed management advice. The second component (Operational Decision Support Systems) provides the capacity to turn the ocean forecasts and projections into robust advice for climate-informed management. The third component (Climate Ready Decision-Making) provides the capability to incorporate climate-informed advice into fisheries management. Working with many partners, the CFI is a timely, efficient, and effective way to increase NOAA's ability to implement climate-ready fisheries management.
1.National Oceanic and Atmospheric Administration.

Hallberg, Robert[1]
Self-consistency testing in the MOM6 ocean model in support of open development. The Modular Ocean Model, Version6 (MOM6) is a community open-development ocean model. With open development, contributions are increasingly frequent, and come from a diverse group of collaborators. To accommodate open development, we have developed an extensive automated testing protocol for contributions to MOM6 in order to maintain ocean model code quality and to detect and eliminate many types of bugs; these self-consistency tests complement the traditional regression tests that are used to ensure that important configurations are never unwittingly changed. MOM6 code is automatically tested for exact reproduction of all solutions and diagnostics across parallel decomposition, restarts, exact rotational symmetry, memory usage patterns, and a wide range of compiler settings, with automated dimensional consistency tests being a particularly valuable and novel capability in MOM6. In each case, these tests unambiguously pass or fail. Together these tests prevent the introduction of many types of software bugs and algorithmic inconsistencies into the shared MOM6 code repository, and contributors can receive immediate automated feedback highlighting any such problems with their suggested code changes, which we think helps to encourage such contributions. These self-consistency tests can help provide the level of quality control required for a modern ocean model codebase to be rapidly developed under an open development paradigm without compromising its utility for research or operational applications.
1.National Oceanic and Atmospheric Administration.

Johnson, David[1]
Multi-model joint probability method for estimating compound flood risk. The Louisiana Watershed Initiative is a multi-agency integrated planning effort that aims, in part, to coordinate flood risk management across the entire state and from multiple sources of flooding: storm surge, rainfall, and riverine discharge. As part of a pilot study in the Amite River Basin, we have developed a multi-resolution, multi-model framework for estimating compound flood hazard. Estimates of the true compound flood risk have been hindered by the fact that studies of each source of flooding commonly

use different models and statistical approaches. Risk analyses also commonly face a tradeoff between the number of events that can be simulated and the resolution/fidelity of those simulations.
To address these issues, we extend the joint probability method with optimal sampling (JPM-OS) to characterize the joint probability not only of tropical cyclone parameters (e.g., central pressure deficit, radius of maximum windspeed), but also of the spatiotemporal distribution of rainfall (using a novel probabilistic rainfall generator) and antecedent conditions in the affected watershed. This compound JPM-OS procedure runs a large quantity of equiprobable rain fields for each storm through the computationally cheap HEC-HMS model of river discharge under different antecedent baseflow conditions. We apply principal component analysis and k-means clustering to select a reduced set of events to run through a high-resolution HEC-RAS model of inundation, also including storm surge forced by the ADCIRC model as a boundary condition, resulting in estimates of the compound flooding annual exceedance probability (AEP) distribution. We show that in areas of Louisiana's Amite River Basin at risk of storm surge inundation from tropical cyclones, accounting for variability in rainfall and antecedent conditions [in riverine baseflows and soil moisture] adds more than a foot to flood depth exceedances over a range of annual exceedance probabilities (i.e., return periods). This equates to substantial marginal vulnerability to inundation in populated areas. A major motivator for the modeling approach and statistical framework is that state-level planning efforts are constrained computationally, so the use of multi-fidelity modeling and optimal sampling lowers the cost of obtaining accurate estimates of compound flood hazard. When incorporating predicted rainfall into the design of protection systems, development of flood risk maps, or early-warning systems, it is critical to acknowledge and quantify uncertainty. We see major differences in estimated average annual losses to thousands of structures in the Amite River Basin; better procedures for estimating compound risk are needed to inform flood insurance policies, building codes, and other flood risk management mechanisms.
1.Purdue University.

Krasting, John[1], *Stephen Griffies*[1,2], *Raphael Dussin*[1,3], *Aparna Radhakrishnan*[1,2], *Alistair Adcroft*[1,2], *David Neelin*[4], *Gokhan Danabasoglu*[5], *Gustavo Marques*[5]

Ocean model diagnostics and pathways towards community engagement. Evaluating the fidelity of ocean model simulations and ensuring their suitability for different applications is an important part of the model development and data delivery processes. In addition to mean-state and variability benchmarks, the emergence of more process-based diagnostics are ensuring that models are increasingly producing the right results for the right reasons. Much of the existing body of process-based diagnostics exists for the atmospheric realm and more analysis of the ocean component of models is needed. Ocean models generate large streams of output data that pose a technical challenge to produce diagnostics efficiently. Here, we survey efforts on how engagement with the broader community through the development of the Modular Ocean Model version 6 (MOM6) and NOAA's Model Development Task Force (MDTF) can increase the breadth and depth of ocean-based diagnostics. As open-source community software packages, both MOM6 and the MDTF provide mechanisms for model developers to engage with the academic, operational, and private sector communities to leverage process-level expertise to improve model fidelity and performance. Currently under development and planned ocean model diagnostics will be discussed as we highlight important areas where additional efforts can be concentrated.

1. National Oceanic and Atmospheric Administration. 2. Princeton University. 3. University Corporation for Atmospheric Research. 4. University of California, Los Angeles. 5. National Center for Atmospheric Research.

Lopez, Jesse[1]

An on-demand cloud-based storm surge prediction system. The ability to better predict inland flooding resulting from hurricane induced storm surge and severe precipitation has been identified as a top priority by NOAA leadership. Here we describe a multi-institute effort to develop an on-demand storm surge modeling system capable of accurately resolving high fidelity inundation and compound inland-coastal flooding at 10 m horizontal resolution. The system is designed following code-as-infrastructure philosophy to dynamically generate boundary conditions and the computational mesh for the SCHISM coastal ocean modeling system for a given hurricane trajectory, perform the simulation, post-process the results, and disseminate the results and products in a seamless end-to-end manner. Designed with flexibility in mind, the modeling system is capable of running on traditional HPC systems and cloud infrastructures, or some combination thereof. The presentation will detail the system design, implementation, deployment strategies, and preliminary results.

1. Axiom Data Science.

MacCready, Parker[1]

The LiveOcean daily forecast system. LiveOcean is a computer model of ocean circulation and biogeochemistry that makes detailed, daily forecasts of currents and water properties in the Salish Sea and coastal waters of the Northern California Current System. It is widely used by a variety of stakeholders concerned with the effects of ocean acidification, hypoxia, harmful algal blooms, and larval transport on fisheries. The forecast system has been running pre-operationally for several years, and transition to operations is being funded by a new COMT grant.

1. University of Washington.

Meyers, Steven[1], *Mark Luther*[1]

Predicting high cross-currents near South Florida ports using machine learning: Initial results. Global economic expansion and competition has driven an increase in the number and size of commercial vessels for many years, putting pressure on operational safety margins. Management of dense, near-shore vessel traffic relies on knowledge of the water depth and currents in proximate waters. Near some ports, major ocean currents can generate hazardous cross-currents. In south Florida, at the Ports of Miami, Everglades, and Palm Beach, high cross-currents occur irregularly, and generally persist for hours to days as meanders in the Florida Current / Gulf Stream shift position westward into the port access channels. A proto-type algorithm based on logistic regression was developed to predict the probability of high cross-currents near the Port of Miami as represented in output from the HYbrid Coordinate Ocean Model (HYCOM) 1/12° global hindcast from early 2018 to mid-2020. For the highest current threshold examined (2 standard deviations above the mean) the 12-hour forecasts had an initial True Positive (TP) rate of ~90%, though the False Positive (FP) rate was ~30%. TP rates declined for lower thresholds, dropping to ~80% for 1.5 standard deviations above the mean, but the FP was essentially unchanged. Improvements in accuracy for lower thresholds are being pursued. A transition from the model-based algorithm to one based on observations and analysis of the Gulf Stream frontal position provided by U.S. Navy/FNMOC is underway.

1. University of South Florida

Moore, Andrew[1]

Quantifying the impact of ocean observing systems on model forecast skill. Community tools have been developed for the Regional Ocean Modeling System (ROMS) to quantify the impact and sensitivity of ocean analyses and forecasts to observations from the different platforms that are assimilated into ROMS using 4-Dimensional Variational (4D-Var) data assimilation. The approach used parallels that employed routinely in operational numerical weather prediction. These tools provide a quantitative measure of the "value added" by different components of the observing system, and can provide guidance on the efficacy of the current and future observing system. An example will be presented.

1. University of California, Santa Cruz.

Ogden, Fred[1*]

Next Generation Water Resources Modeling Framework: Open source, standards based, community accessible, model interoperability for large scale water prediction. The NOAA-National Weather Service, Office of Water Prediction (OWP), working with federal water prediction partners, has designed and developed the Next Generation Water Resources Modeling Framework (Nextgen). The motivating objectives of the Framework include increasing water resources model interoperability, intercomparison, testing of research hypotheses, and deploying into operations science-driven, evidence-based models while enabling rapid adoption of research advances. As of 2021, the current operational National Water Model (NWM) applies a single model formulation, using calibration and regionalization to emphasize stormflow generation process. At the time scale of individual events, the NWM performance varies regionally. Calibration has improved performance in some regions but not all. The literature supports the hypothesis that appropriately applied models formulated for specific dominant local processes consistently outperform general models (uniqueness of place); given the lack of a comprehensive stormflow generation theory, there is no “one model to rule them all”. By 2024, the NWM will consist of a particular configuration of the Nextgen framework. Nextgen is model agnostic with maximum flexibility, allowing the framework to adapt as models, data sources, and water prediction needs change. Nextgen uses unifying standards. The Basic Model Interface (BMI) model coupling standard for a common architecture that avoids duplication and promotes interoperability. The WaterML 2.0 HY_FEATURES data model provides standard description of surface water features. The framework, which is written in C++ and supports parallel computing, links models written in C, C++, Fortran and Python. Nextgen development occurs transparently using open-source practices that promote code reuse and development efficiency and encourages participation by our federal partners and the research community. The Nextgen Framework supports hydrologic, hydraulic, and land-surface specific models and process modules while facilitating coupling with other earth system models through modeling systems such as the UFS. The Nextgen code exists on the NOAA OWP GitHub repository, and we invite community involvement. The repository includes examples, sample data sets, and documentation explaining the step-by-step process to adapt models to use the BMI coupling standard and interoperate with the framework. User friendliness is a goal with a target of two weeks for a new employee or graduate student with programming skills to add new domain science capabilities to Nextgen.

1. National Oceanic and Atmospheric Administration.

*Presented by Trey Flowers, Director of the Analysis and Prediction Division at NOAA's National Water Center

Sheng, Peter[1]

Best practice for actionable science: Development of decision support tools for coastal flood vulnerability and adaptation. This presentation will showcase the recent developments of two decision support tools for coastal communities to plan for future coastal flood vulnerability and develop wetland restoration strategy to reduce future flood damage due to the compound effects of tropical cyclones (TCs) and sea level rise (SLR), with funding from the National Estuarine Estuarine Reserve program and the NOAA NCCOS, respectively. We will demonstrate two tools, one for the Village of Piermont about 15 miles north of NYC, another for Collier County, Florida, developed with the best available climate, coastal, ecological, and economic sciences and models. These tools include the probabilistic coastal flood maps for current and future climate (early and late 21st century), infrastructure maps, and coastal wetland maps. Using a dynamically-coupled vegetation-resolving hydrodynamic-wave model and the JPM-OS statistical method, we produced the probabilistic current and future coastal flood maps in the Piermont region (including the Village of Piermont and Piermont Marsh) and the large coastal flood plain in Collier County, Florida. Future tropical cyclone ensembles predicted by climate and downscaling models and probabilistic SLR scenarios predicted by NOAA were used. Simulation results show that future coastal flood hazard will increase substantially over time but coastal wetlands may maintain their values for flood protection, depending on the local storm and wetland conditions.

1. University of Florida

Son, Youngjun[1], *Emanuele Di Lorenzo*[1]

Flood inundation model development for coastal urban areas using the WRF-Hydro framework in Tybee Island, Georgia. An increasing number of urban areas located in coastal floodplains are threatened by multiple flooding drivers, including high tide, storm surge, intensive rainfalls, and groundwater inundation. Moreover, the built environment such as roads and stormwater drainage systems adds complexity to the evolution of these flooding mechanisms. The advances in the earth system models and their capability of integrating inland hydrology and hydraulics have facilitated a reasonable prediction of coastal inundation mostly in a regional scale. However, there are still constant demands from local government planners and emergency managers for more localized and detailed flooding information in a timely manner. To provide such information in the coastal city of Tybee Island, we use a hydrometeorological framework, known as Weather Research and Forecasting (WRF)-Hydro. To simulate multiple flooding drivers in coastal urban areas, we impose regional-scale boundary conditions from both coastal-scale models and local observations and also integrate a hydraulic flow solver for the stormwater drainage system, Storm Water Management Model (SWMM) 5. The city of Tybee Island in Georgia was chosen for our study as it has been experiencing a range of different flooding dynamics due to intensive rainfalls with high tide as well as storm surge. Our approach allows delineating the high-resolution (10 m) inundation depth, timing, and extents that are highly affected by the prevalent flooding drivers in a compounding case. We expect that local coastal communities can take advantage of the top-down transitions of the flooding information from a regional scale to a city or town scale to prepare seamlessly for future flooding events by different sources.

1. Georgia Institute of Technology.

Stock, Charles[1]. *Alistair Adcroft*[1,2,3], *Enrique Curchitser*[4], *Elizabeth Drenkard*[1], *Robert Hallberg*[1], *Matthew Harrison*[1], *Katherine Hedstrom*[5], *Dujuan Kang*[4], *Andrew Ross*[1,2,3], *Niki Zadeh*[1], *Mike Alexander*[1], *Brian K.*

Arbic[6], *Scott Bachman*[7], *Wei Cheng*[8,9], *Raphael Dussin*[1], *Philip Chu*[1], *Joseph Cermak*[4], *Fabian Gomez*[1,10], *Robert Helber*[11], *Albert J. Hermann*[8,9], *Enhui Liu*[2], *Brent Lofgren*[1], *Gustavo Marques*[7], *Kelly McGarry*[12], *Avichal Mehra*[1], *Jenna Pearson*[2], *Brian Powell*[13], *Laure Resplandey*[2], *Mark Rowe*[1], *Ed Rutherford*[1], *Samantha Siedlecki*[12], *James Simkins*[4], *Filippos Tagklis*[1,14,15], *Jia Wang*[1], *Marshall Ward*[1].

Toward a nation-wide seasonal to multi-decadal regional ocean prediction system to serve NOAA's living marine resource mandates. Meeting NOAA's mission to conserve and manage coastal and marine ecosystems requires climate-informed decisions across management time horizons. NOAA's Climate-Fisheries Initiative (CFI) has thus proposed development of a national system of regional ocean models to reliably provide high-resolution physical and biogeochemical predictions across seasonal to multi-decadal time horizons. The system will harness NOAA's Modular Ocean Model 6 (MOM6), High Performance Computing, and associated earth system components to robustly deliver coastal and marine resource focused predictions spanning the range of potential ocean futures. Prototype CFI configurations for the U.S. East Coast, U.S. West Coast, and Arctic have been developed. CFI implementations for the Pacific Islands and Great Lakes are in the design phase, and numerous other prototypes have been developed (Nordic Seas, Indian Ocean, Equatorial Pacific). CFI Configurations reflect desires to seamlessly address cross-boundary issues under climate change, to capture the ocean basin to shelf connections that underlie ocean predictability at longer time horizons, and to ease operation requirements by limiting the number of configurations. Efforts are moving from establishing regional MOM6 infrastructure toward optimization of model performance, exploration of shelf-scale process simulation within MOM6's flexible vertical coordinate system, and expansion to include comprehensive ocean biogeochemical dynamics. External partnerships are supported by open model development principles within MOM6, and these partnerships will continue to have a key role with the CFI. Regional CFI-associated MOM6 efforts are being coordinated across NOAA to synergize with parallel ocean prediction efforts on shorter time horizons and finer spatial scales, and to ensure that model outputs can be effectively translated to improved LMR decisions. More broadly, MOM6 will also be integrated with cross-NOAA data assimilation and initialization research to provide the ocean component of NOAA's global Medium Range Weather, Subseasonal to Seasonal prediction, and regional hurricane applications within NOAA's Unified Forecast System.

1. National Oceanic and Atmospheric Administration. 2. Princeton University. 3. Cooperative Institute for Modeling the Earth System. 4. Rutgers University. 5. University of Alaska, Fairbanks. 6. University of Michigan. 7. National Center for Atmospheric Research. 8. University of Washington. 9. Cooperative Institute for Climate, Ocean, and Ecosystem Studies. 10. Northern Gulf Institute. 11. Nuclear Regulatory Commission. 12. University of Connecticut. 13. University of Hawaii. 14. University of Miami. 15. Cooperative Institute for Marine and Atmospheric Studies.

Velissariou, Panagiotis[1,2], *Saeed Moghimi*[1,2], *Zachary Burnett*[1,2], *Andre Van der Westhuysen*[1], *Edward Myers*[1], *Shachak Pe'eri*[1], *Guoming Ling*[3], *Ayumi Fujisaki-Manome*[4], *Y. Joseph Zhang*[5], *Carsten Lemmen*[6], *Linlin Cui*[5], *Jianhua Qi*[7], *Changsheng Chen*[7], *Ali Abdolali*[1], *Rocky Dunlap*[1,2]

CoastalApp: A NUOPC/ESMF coupling application based on Unified Forecast System best practices. Coastal Marine Modeling Branch (CMMB) of the Office of Coast Survey (OCS) at NOAA/NOS, develops a fully coupled multi-model coastal application (CoastalApp: https://github.com/noaa-ocs-modeling/CoastalApp) to advance our understanding on the coastal processes and the land-sea interactions. The goal is to provide a flexible and portable modeling framework for coastal applications that includes storm surge modeling and inundation studies, wave modeling and wave-coast interactions, sediment transport and morphological changes, and water quality studies. In this presentation we will inform the community regarding the current status and future plans of the CoastalApp on the following areas:

- Application structure and usage
- Current modeling components and plans
- NUOPC/ESMF Coupling Infrastructure (current status and future plans)
- Plans for the inclusion of 3D modeling calculations
- Improve coupling experience
- Code management (github)
- Regression tests
- Automation of compile tests (github actions)

Partner institutions:, NOAA National Ocean Service, Office of Coast Survey (NOAA-OCS), University Corporation for Atmospheric Research (UCAR), NOAA Environmental Modeling Center (NOAA-EMC), University of Notre Dame (UND), Virginia Institute of Marine Science, College of William & Mary, USA (VIMS), Helmholtz-Zentrum Hereon, Germany (Hereon), University of Massachusetts – Dartmouth (UMASS-Dartmouth). Cooperative Institute for Great Lake Research (CIGLR)

References: S. Moghimi; A. Van der Westhuysen; A. Abdolali; E. Myers; S. Vinogradov; Z. Ma; F. Liu; A. Mehra; N. Kurkowski. Development of an ESMF Based Flexible Coupling Application of ADCIRC and WAVEWATCH III for High Fidelity Coastal Inundation Studies. J. Mar. Sci. Eng. 2020, 8, 308. https://doi.org/10.3390/jmse8050308.

S. Moghimi, S. Vinogradov, E. Myers, Y. Funakoshi, A.J. Van der Westhuysen, A. Abdolali, Z. Ma, F. Liu. Development of a Flexible Coupling Interface for ADCIRC Model for Coastal Inundation Studies. NOAA technical memorandum, NOS CS 41, 2019, https://doi.org/10.25923/akzc-kc14.

1. National Oceanic and Atmospheric Administration. 2. University Corporation for Atmospheric Research. 3. University of Notre Dame. 4. Cooperative Institute for Great Lakes Research. 5. Virginia Institute of Marine Science. 6. Helmholtz-Zentrum Hereon. 7, University of Massachusetts, Dartmouth.

Wang, Jia[1]

Modeling the ice-attenuated waves in the Great Lakes. A partly coupled wave-ice model with the ability to resolve ice-induced attenuation on waves was developed using the Finite-Volume Community Ocean Model (FVCOM) framework and applied to the Great Lakes. Seven simple, flexible, and efficient parameterization schemes originating from the WAVEWATCH III® IC4 were used to quantify the wave energy loss during wave propagation under ice. The reductions of wind energy input and wave energy dissipation via whitecapping and breaking due to presence of ice were also implemented (i.e., blocking effect). The model showed satisfactory performance when validated by buoy observed significant wave height in ice-free season at eight stations and satellite-retrieved ice concentration. The simulation ran over the basin-scale, five-lake computational grid provided a whole map of ice-induced wave attenuation in the heavy-ice year 2014, suggesting that except Lake Ontario and central Lake Michigan, lake ice almost completely inhibited waves in the Great Lakes under heavy-ice condition. A practical application of the model in February 2011 revealed that the model could accurately reproduce the ice-attenuated waves when validated by wave observations from bottom-moored acoustic wave and current (AWAC) profiler; moreover, the AWAC wave data showed quick responses between waves and ice, suggesting a sensitive relationship between waves and ice and arguing that accurate ice modeling was necessary for quantifying wave-ice interaction.

1. National Oceanic and Atmospheric Administration.

Westerink, Joannes J.[1], *Coleman Blakely*[1], *Maria Teresa Contreras Vargas*[1], *Guoming Ling*[1], *Damrongsak Wirasaet*[1], *William Pringle*[2], *Edward Myers*[3], *Saeed Moghimi*[3], *Greg Seroka*[3], *Yuji Funakoshi*[3], *Greg Seroka*[3], *Michael Lalime*[3], *Andre van der Westhuysen*[3], *Ali Abdolal*[3]

Developments of global ESTOFS: NOAA's integrated multi-scale multi-process operational water level model. The operational version of Global ESTOFS has been running with finite element variable resolution between 120m and 24km. The model incorporates optimized high resolution along all U.S. coastlines and extends onto the coastal floodplain and is driven by tides and GFS-FV3 winds and atmospheric pressure. Developmental versions increase resolution down to 30m and suggest that it is only in select regions that the additional resolution is critical. These include complex inlet systems with jetties such as the St. Johns River entrance and Sabine Lake entrance, intricate shoal systems such as in Shinnecock Bay, and complex intra-tidal cross cut shoals such as the Biscayne Flats in Florida. In addition, as both inlet connections to the ocean and upland dendritic floodplain channel systems narrow, increased resolution becomes increasingly important. Further mesh developments include an optimized global shell and improvements in global and regional bathymetry. Bathymetry in key locations both globally and locally remain the most important controls of model fidelity. Process integration advances include coupling with WAVEWATCH III in order to account for wave radiation stress induced set up, particularly important during tropical storm events; coupling with G-RTOFS in order to include the impact of the ocean's baroclinic drivers including large current systems such as the Gulf Stream, cold core eddies impinging on the coast, and seasonal steric expansion and contraction, all significantly affecting coastal water levels; to the National Water Model in order to account for upland hydrology and stream flows into the coastal zone; and to CICE in order to account for the effects of sea ice which can dramatically increase or decrease air to sea momentum transfer and/or impact boundary layer dissipation.

1. University of Notre Dame. 2. Argonne National Laboratory. 3. National Oceanic and Atmospheric Administration.

Xue, Pengfei[1]

Assessment of alternative models for NOAA's Lake Erie HAB forecast. Lake Erie has experienced a re-emergence of cyanobacterial harmful algal blooms (CHABs) since the early 2000s. CHABs have significant socioeconomic and ecological costs, impacting drinking water, human health, fisheries, tourism, and water quality. Developing an operational short-term forecast system for CHABs abundance and spatial distribution is critical to decision-making for drinking water safety and water quality management. Current numerical methods for simulating CHAB transport use Lagrangian-based particle tracking models (e.g., NOAA's Lake Erie HAB Forecast), soluble tracer models in an Eulerian framework, or a combined Eulerian-Lagrangian approach to forecasting the Lake Erie CHAB transport. A comprehensive evaluation of the performance of these three types of models for 3-dimensional simulations of CHAB transport was conducted based on 24-240 hour forecast results for three consecutive CHAB seasons (2017-2019). Results were evaluated against the latest high-resolution satellite product from the European Space Agency's Sentinel-3 OLCI sensor. Analyses of the simulation results revealed the relative importance of physical processes, including horizontal transport, vertical

turbulent mixing, and algal buoyancy on the CHAB inter- and intra-day variability. Sensitivity analyses were conducted to examine the influence of the distribution of algae buoyant velocity on the model forecast performance. This effort represents a collaboration between NOAA and academic researchers, which revealed potential research pathways to improve NOAA's Lake Erie HAB Forecast.
1. Michigan Tech.

Xue, Z. George[1]

Assessing hydro- and sediment dynamics of hurricane-induced compound flooding using a dynamically coupled ocean-river modeling suite. We introduced WRF-Hydro to the Coupled-Ocean-Atmosphere-Wave-Sediment Transport (COAWST) Modeling System to simulate the water and sediment dynamics during the compound flooding caused by Hurricane Florence in 2018 in the Cape Fear River watershed. The river model (WRF-Hydro) is coupled with the ocean model component (ROMS) along the land-ocean boundary where water level information is exchanged dynamically. A newly developed physics-based, fully distributed soil erosion and sediment transport model, WRF-Hydro-Sed, was used to represent the sediment dynamics in the watershed. Calculated river and surface runoff from hurricane-induced precipitation is ten times the volume of the Cape Fear River Estuary. The model's performance in water-level simulation is largely improved (0.3-1.0 m) in the upper Cape Fear Estuary, NC. The spatial-temporal distribution of soil erosion was largely controlled by the rainband structure evolution and slow storm movement. Diagnostic analysis indicates that the compound flooding process can be categorized into four different stages: swelling, local wind dominated, transition, and river dominated.
1. Louisiana State University.

Ye, Fei[1]

Assessing the inland-coastal flooding operational guidance system with Hurricane Ida (2021). The performance of the preoperational Inland-Coastal Flooding Operational Guidance System (ICOGS) has been continuously assessed with hurricanes and tropical storms since its inception in Dec 2020. The most recent assessment uses data collected during Hurricane Ida in 2021, which was a Category 4 hurricane accompanied by heavy precipitation that caused extensive damage after its landfall in Louisiana, USA. Based on the hydrodynamic core of the Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM), ICOGS is specifically designed to simulate and forecast compound inland-coastal flooding events during wet storms. The regional model domain covers the Northwest Atlantic and Gulf of Mexico, with the land boundary along the U.S. East Coast and Gulf Coast set at 10 meters above the NAVD 88 datum to include inland floods. The upstream river flow beyond the land boundary is calculated by National Water Model (NWM) forecast and injected as volume sources at the intersections between NWM stream segments and ICOGS land boundaries, whereas the flow movement and wettings/dryings in a significant portion of the coastal watersheds (below 10 meter, NAVD 88) are directly handled by the hydrodynamic core. Fine structures such as levees are explicitly represented by meter-scale elements in the unstructured model grid. On a 2.5-million-node unstructured mesh, the 3D baroclinic forecast runs 110 times faster than real time (i.e., 50 minutes for a 3-day forecast) using 3360 cores on Texas Advanced Computing Center's Frontera supercomputer. This presentation shows some most important aspects of the assessment during Hurricane Ida, including coastal surges measured at NOAA stations near the landfall site, and inland flooding compared with the inundation map published by Louisiana Department of Transportation and Development. Sensitivity tests were also conducted to isolate the individual contributions of NWM river flow and precipitation to the observed compound flood. ICOGS 3D implementation for the Atlantic basin is planned to be included in current ESTOFS as its three-dimensional core to support disaster mitigation and safe navigation. ICOGS 2D/3D Atlantic and Pacific set-ups are planned to support the COASTAL Act program as one of the storm surge components to account for inland flooding on coastal inundation for post storm assessment studies.

1. Virginia Institute of Marine Science.

APPENDIX B. SPEAKER AND MODERATOR BIOGRAPHIES

(listed alphabetically by last name)

Clarissa Anderson, Ph.D.

Dr. Clarissa Anderson is a biological oceanographer with expertise in ecological forecasting and remote sensing. After receiving a B.A. in Biology and Art History at the University of California (UC) Berkeley and a Marine Science Ph.D. at UC Santa Barbara, she completed several postdoctoral appointments before transitioning into a professional research position at UC Santa Cruz. The majority of her research has focused on the prediction of harmful algal blooms and toxins in estuarine and coastal ecosystems as well as the fate and transport of harmful toxins to deeper waters and sediments. During her time as research faculty at UC Santa Cruz, she worked to establish the California Harmful Algae Risk Mapping (C-HARM) system. She is now at Scripps Institution of Oceanography directing the Southern California Coastal Ocean Observing System (SCCOOS) and continuing to conduct research on phytoplankton ecology in coastal California.

Pat Burke

Mr. Pat Burke is the Chief of the Oceanographic Division for the NOS Center for Operational Oceanographic Products and Services (CO-OPS). He oversees operational aspects of NOS' coastal modeling program, and works closely with other NOS and NOAA Program Offices and the external modeling community to transition and implement coastal modeling systems that support navigation and water quality applications. He has over 15 years of experience in physical oceanography, coastal modeling and operations management. Mr. Burke received his B.S. in Civil and Environmental Engineering from Rutgers University and his M.S. in Ocean Engineering from the Stevens Institute of Technology.

DaNa Carlis, Ph.D.

Dr. DaNa Carlis is a meteorologist and serves as the Deputy Director at NOAA's Global Systems Laboratory (GSL) since September 2020. He comes to GSL from the Weather Program Office (WPO) where he established the Earth Prediction Innovation Center (EPIC) Program. Dr. Carlis enjoys working between science, policy, and society to ensure better products and services for the American people. While spending over 18 years at NOAA, he began his career as a graduate student in NOAA's Office of Education Educational Partnership Program (EPP). Soon after joining NOAA, he was stationed in Honolulu, Hawaii for 3 years of intensive weather research, numerical model development, and dissertation writing. He has held positions at the National Weather Service Environmental Modeling Center as a research meteorologist developing the world's most widely used weather forecast model (Global Forecast System Model), and as a policy advisor to NOAA's Chief Scientist and NOAA's Assistant Secretary of Environmental Observations and Prediction.

Arun Chawla, Ph.D.

Dr. Arun Chawla is a physical scientist at the NOAA National Weather Service's Environmental Modeling Center.

Changsheng Chen, Ph.D.
Dr. Changsheng Chen is Professor of Physical Oceanography at the School for Marine Science and Technology, University of Massachusetts-Dartmouth and Adjunct Scientist at the Department of Physical Oceanography at Woods Hole Oceanographic Institution. Dr. Chen is a coastal oceanographer who is interested in modeling and observational exploration of coastal ocean circulation, oceanic frontal processes, turbulent mixing/bottom boundary layer dynamics, chaotic mixing, western boundary current, internal waves and tides, and biological/physical interaction. His recent research is mainly focused on the coastal and estuarine modeling and ecosystem dynamics in the U.S. eastern continental shelf. He is leader of the Marine Ecosystem Dynamics Modeling Research Laboratory, School for Marine Science and Technology, UMASS.

Philip Chu, Ph.D.
Dr. Philip Chu is the branch chief of the Integrated Physical and Ecological Modeling and Forecasting (IPEMF) branch at the NOAA Great Lakes Environmental Research Laboratory (GLERL) in Ann Arbor, MI. He also serves as NOAA/NESDIS CoastWatch manager in the Great Lakes region. His research interests include operational coastal forecasting systems, hydrodynamic modeling, satellite remote sensing, data assimilation, and Geographic Information Systems (GIS). Dr. Chu received both M.S. and Ph.D. degrees from the Civil and Environmental Engineering Department at The Ohio State University. He also received an MBA degree from Tulane University. Prior to joining NOAA, he was an oceanographer conducting research on coupled ocean models at the U.S. Naval Research Laboratory at NASA Stennis Space Center. Dr. Chu holds a patent for inventing an automated method for predicting tidal heights and currents in coastal and estuarine zones. He is also a licensed professional engineer in Ohio and an adjunct faculty member of six universities.

Cayla Dean, Ph.D.
Dr. Cayla Dean is an Outreach Specialist/Coastal Scientist with Lynker Technologies, Inc. on contract with NOAA’s Center for Operational Oceanographic Products and Services (CO-OPS). She is the collaborative lead for the Coastal Coupling Community of Practice. As such, Dr. Dean works closely with subject matter experts at CO-OPS, the Office for Coastal Management, the National Weather Service, U.S. Geological Survey, U.S. Army Corp of Engineers, academics, and others working toward the integration of coastal hydrodynamic models with inland hydrologic models, with the goal of advancing NOAA's water prediction tools and decision-support services. She holds a Ph.D. from Nova Southeastern University in Physical Oceanography. Her research was focused on computational fluid dynamics modeling, biologically-generated turbulence, and dynamics of small-scale processes in the near-surface layer of the ocean.

Rodrigo Duran, Ph.D.
Dr. Rodrigo Duran is a Research Scientist at the National Energy Technology Laboratory.

Chris Edwards, Ph.D.
Dr. Chris Edwards is a professor in the Ocean Sciences Department at the University of California (UC), Santa Cruz. He received his B.S. from Haverford College in 1988 and his Ph.D. from the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution in 1997. He was a postdoctoral

researcher at UC Berkeley, and a research scientist at the University of Connecticut before becoming a faculty member at UC Santa Cruz in 2002.

Dr. Edwards' research centers on the development and analysis of regional ocean models and methods of data assimilation used for studying ocean circulation, biogeochemistry, and fisheries. His research presently focuses on physical and biological interactions within the California Current System, the collection of ocean currents off the U.S. West Coast that include both time-mean and temporally variable motions at many scales. His group has studied how ocean circulation creates and organizes biogeographic provinces and habitats that associate with marine organisms and contribute to their connectivity. His group has also pioneered application to marine ecosystems of a four-dimensional variational data assimilation method for state estimation that uses a logarithm transform to approximate the non-Gaussian statistics of biogeochemical variables in the ocean. Such methods enable accurate hindcasts of the physical and ecosystem state to understand how the ocean has changed in the past, and offer opportunities for modern ocean observing systems that focus on timely estimates and prediction of ocean properties.

Rich Edwing
Mr. Richard Edwing is the director of NOAA's Center for Operational Oceanographic Products and Services (CO-OPS), the nation's authoritative source for accurate, reliable, and timely water-level and current measurements. In his role, he oversees and continues to improve this 24-hour a day operation to provide mariners, coastal managers, and many other users with real-time data on ocean conditions along America's 95,000-mile coastline. Mr. Edwing's career with NOAA spans three decades with much of that time spent advancing NOAA's navigation services mission to provide the Nation with up-to-date ocean, weather, mapping and positioning data and tools for safe transits to and from U.S. ports.

He started with NOAA in 1976 in the Marine Boundary Program, a partnership between NOAA and coastal states to establish tidal data such as base elevations in sensitive wetland areas vulnerable to urban growth. He later advanced through various positions in the field and at NOAA headquarters, including several years as division chief of the National Ocean Service's policy, planning and analysis division, where he shaped NOAA's priorities for ocean issues, as well as identified budget needs to advance and modernize ocean science for the twenty-first century.

Tracy Fanara, Ph.D.
Dr. Tracy Fanara is the NOS Coastal Modeling Portfolio Manager. In this role she coordinates the portfolio of projects NOS conducts internally and through grant funding to the extramural community. Dr. Fanara is an engineer and research scientist with a B.S., M.E., and Ph.D. from the University of Florida's Department of Environmental Engineering. Dr. Fanara spent almost a decade modeling hydrodynamic systems with engineering consulting firms on projects around the world focused on watershed-scale integrated modeling to restore pre-development hydrology in urban areas. She was the design engineer/modeler on two nationally winning EPA design teams, was a National Science Foundation SPICE fellow, subcontracted for the U.S. Geological Survey, and was selected as a Presidential Management Fellow by the U.S. Government. For the past 6 years, Dr. Fanara has been managing the Environmental Health research program at Mote Marine Laboratory where she designed

and developed models, tools and programs to protect wildlife and water quality. Outside of work, she spends time communicating science (TV, podcasts, classroom visits and public speaking), was recently Xylem YSI's Mission: Water, Water Hero, and was featured in Marvel's Unstoppable Wasp which led to her co-produced comic series, Seekers of Science.

Trey Flowers, Ph.D.

Dr. Trey Flowers is the Director of the Analysis and Prediction Division at NOAA's National Water Center in Tuscaloosa, AL. Dr. Flowers leads the development of freshwater forecasting models for the National Weather Service, including the National Water Model, NOAA's first operational water prediction model running in a high performance computing environment.

Marjy Friedrichs, Ph.D.

Dr. Marjy Friedrichs is a research professor at the Virginia Institute of Marine Science (VIMS) at William & Mary. She received her undergraduate degree in Physics from Middlebury College, a Masters in Oceanography from the MIT/Woods Hole Joint program, and a Ph.D. in Oceanography from Old Dominion University. She uses interdisciplinary mathematical models together with monitoring data to better understand how human impacts, such as changes in global climate, urbanization and land use affect coastal water quality. Many of Dr. Friedrichs' current modeling projects involve studying long-term historical and future changes in coastal acidification and hypoxia in the Chesapeake Bay. She has also developed a forecasting system that produces short-term forecasts of hypoxia and acidification metrics for the Bay, and an annual hypoxia report card to track progress towards attaining water quality standards. Through her ongoing collaborative work with Chesapeake Bay Program managers as well as fisheries and aquaculture industry members, she continues to work to make her science relevant for Chesapeake Bay stakeholders.

Dwight Gledhill, Ph.D.

Dr. Dwight Gledhill serves as the Deputy Director of the NOAA Ocean Acidification Program office in Silver Spring, MD. Previously he was an associate scientist with the University of Miami/Rosenstiel School of Marine and Atmospheric Science (UM/RSMAS) Cooperative Institute of Marine & Atmospheric Sciences (CIMAS) with NOAA's Atlantic Oceanographic & Meteorological Laboratory Ocean Chemistry Division where he advanced ocean acidification research primarily related to monitoring and understanding the process of ocean acidification within coral reef ecosystems. He was instrumental in establishing the NOAA Coral Reef Conservation Program (CRCP) Atlantic Ocean Acidification Test-bed (AOAT) in La Parguera, PR, and recently another test-bed within the Florida Keys National Marine Sanctuary. He also has worked on the development of a satellite-based ocean acidification data synthesis product for the Greater Caribbean Region that scales up discrete ship-based observations of surface ocean carbonate chemistry. The model produces synoptic monthly fields of carbonate chemistry including aragonite saturation state and CO2 partial pressure that can be used to track regional and seasonal changes in carbonate chemistry related to ocean acidification and can be accessed at NOAA Coral Reef Watch. Dr. Gledhill has also been a contributor to numerous strategic planning documents related to ocean acidification within NOAA, including leading the development of the Southeast/GOM Regional Strategic Plan on ocean acidification and CRCP OA science plan. Dr. Gledhill received his M.S. and Ph.D. from the Department of Oceanography at Texas A&M University in

2005 where he primarily investigated carbonate mineral kinetics in complex electrolyte solutions as well the sediment biogeochemistry associated with methane clathrates in the Northern Gulf of Mexico.

Juan Gonzalez-Lopez, Ph.D.
Dr. Juan Gonzalez-Lopez is an Oceanographer and Modeler at the Caribbean Coastal Ocean Observing System (CARICOOS).

Carl Gouldman
Mr. Carl Gouldman took the helm as Director of the U.S. Integrated Ocean Observing System (IOOS) Program in February of 2017, after having served as the Deputy Director of the program since June 2014. Mr. Gouldman has been at NOAA since 2000; prior to which, he spent 3 years in the education department at the Chesapeake Bay Foundation where he led field programs teaching students about bay ecology and conservation. He holds a B.S. in political science from Duke University and a Masters (MEM) in Coastal Environmental Management from the Nicholas School of the Environment and Earth Sciences at Duke.

Roger Griffis
Mr. Roger Griffis is Climate Change Coordinator for NOAA's National Marine Fisheries Service (NMFS). A marine ecologist by training, he has been involved in the planning, building, and management of NOAA coastal and ocean stewardship programs since 1994. As part of the NMFS Office of Science and Technology, Roger is responsible for advancing the science and tools for climate-ready stewardship of fisheries, protected resources, habitats, and the many people and economies that depend on them. This includes working with many partners to evaluate needs, identify solutions and advance implementation. Current efforts include development of FY22-24 Regional Action Plans to implement the NMFS Climate Science Strategy, development of the NOAA Climate and Fisheries Initiative, implementation of the NOAA Climate and Fisheries Adaptation Program, and co-authoring the Ocean and Marine Resources Chapter of the 5th US National Climate Assessment.

Brian Gross, Ph.D.
Dr. Brian Gross is the Director of the Environmental Modeling Center at the National Weather Service. Previously, he was the Deputy Director of NOAA's High Performance Computing and Communications office in NOAA's Office of the Chief Information Officer. Prior to that, Dr. Gross was the Deputy Director of NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) for 13 years. He has also served as head of GFDL's software development group and as a research scientist there, modeling weather and climate with an emphasis on storm tracks. Before joining GFDL, Brian earned a doctorate in atmospheric science from the University of Colorado and was a Research Associate at NASA's Goddard Space Flight Center, then a Visiting Scientist in Princeton University's Program in Atmospheric and Oceanic Sciences.

Rober Hallberg, Ph.D.
Dr. Robert Hallberg is an Oceanographer and deputy head of the Oceans and Cryosphere group at NOAA's Geophysical Fluid Dynamics Laboratory, and a Lecturer on the faculty of Princeton University. He has a Ph.D. in Oceanography from the University of Washington and a B.A. in Physics from the

University of Chicago. He co-leads the development of the widely used Modular Ocean Model (version 6), which has become the de-facto nationwide standard for large-scale ocean models. MOM6 is central to NOAA/GFDL's latest coupled climate and Earth System models (CM4 and ESM4), and is also being used in distinct configurations by the National Center for Atmospheric Research (NCAR) as the ocean component of their next generation of coupled Earth System models. The National Weather Service is using MOM6 as the primary ocean component in its new Unified Forecast System, and the use of MOM6 to predict how marine ecosystems can best be managed in the context of a changing climate is at the heart of NOAA Fisheries' new Climate-Fisheries Initiative. Dr. Hallberg has used global-scale numerical ocean simulations to study topics as varied as the dynamics of Southern Ocean eddies and their role in the ocean's response to climate, the governing dynamics of the ocean's surface boundary layer, sources of steric sea level rise, and the fate of the deep plumes of methane and oil from the Deepwater Horizon oil spill. Dr. Hallberg has been actively involved in multiple ocean Climate Process Teams, studying topics such as Gravity Current Entrainment, Internal Wave Driven Mixing, and Mesoscale Eddy Mixing; these teams aim to improve the representation of these processes in climate-scale models, based on the best understanding that can be obtained from observations, process studies, and theory. He is currently working on coupling dynamic ice-sheet and ice-shelf models with high resolution versions of GFDL's coupled climate models for improved prediction of sea-level rise, and has led the effort to modernize GFDL's sea-ice models. From 2017 through 2019, Dr. Hallberg served as one of the Lead Authors of the chapter on changes in the ocean in the IPCC's Special Report on the Oceans and Cryosphere in a Changing Climate.

Jon Hare, Ph.D.
Dr. Jon Hare is the Science and Research Director of the Northeast Fisheries Science Center (NEFSC). He oversees science related to NOAA Fisheries mission in the Northeast region including fisheries, aquaculture, protected species, habitat, ecosystem science, and climate science. Dr. Hare earned a Ph.D. in Oceanography from SUNY Stony Brook, received a National Research Council Research Associate in 1994 to work at the NOAA Beaufort Laboratory, and was hired by NOAA in 1997. He moved to the NOAA Narragansett Laboratory in 2005, was appointed Oceanography Branch Chief in 2008 and Lab Director in 2012. He started as NEFSC Director in 2016 and is now located at the NOAA Woods Hole Laboratory. His research has focused on fisheries oceanography: understanding the interactions between the ocean environment and fisheries populations. Dr. Hare also examines the effect of climate change on fish and invertebrate population dynamics. He works to move new scientific information into assessment and management processes, supports the continuation and development of ocean ecosystem observing, and is committed to building regional science collaborations to address complex issues including climate change, offshore wind development, and watershed science.

Debra Hernandez
Ms. Debra Hernandez currently serves as executive director of the Southeast Coastal Ocean Observing Regional Association (SECOORA). Ms. Hernandez has over 25 years of experience in coastal and ocean management and policy. Her professional interests include improving the linkages between scientists and decision-makers and facilitating discussions of public policy issues related to the coast and environment. She recently served on the National Academies' Ocean Studies Board and the Ocean Research and Resources Advisory Panel, and currently serves on the South Carolina Sea Grant

Consortium Program Advisory Board and as vice-Chair of the IOOS Association. She graduated from Clemson University with a master's degree in civil engineering, and was a licensed professional engineer for many years.

Maoyi Huang, Ph.D.

Dr. Maoyi Huang earned her Ph.D. in Civil and Environmental Engineering in 2005 from the University of California at Berkeley, with a focus on surface water hydrology and land surface modeling. Her research at the Pacific Northwest National Laboratory (PNNL) focuses on studying carbon, water, and energy budgets at regional scale. She is developing land surface and hydrological models at watershed scales to implement them within coupled land and atmospheric systems.

Mike Jacox, Ph.D.

Dr. Mike Jacox is a physical oceanographer working at the NOAA Southwest Fisheries Science Center lab in Monterey, CA. His primary research focus is on physical-biological interactions in the ocean and their connections to climate, particularly in the northeast Pacific. Recently, he has focused on ocean variability and change off the U.S. West Coast, including extreme events such as marine heatwaves, and the response of marine ecosystems from phytoplankton to top predators. Dr. Jacox is currently leading new efforts to develop end-to-end assessments of climate impacts on U.S. West Coast fisheries, including seasonal forecasts and centennial-scale projections of ocean conditions, distributions of targeted and bycatch species of interest to U.S. fisheries, socio-economic impacts of changing living marine resources, and evaluations of fisheries management strategies in a changing climate. He holds a Ph.D. in Ocean Sciences from the University of California, Santa Cruz, and a B.S. in Aerospace Engineering from the University of Colorado.

David Johnson, Ph.D.

Dr. David Johnson is an Assistant Professor of Industrial Engineering and Political Science at Purdue University. His interdisciplinary research focuses broadly on decision-making under deep uncertainty with applications in environmental policy and climate change adaptation. He has presented and published on issues including coastal flood risk management, renewable energy policy, and water scarcity and quality management. He is lead developer of the flood risk model used to assess the impacts of a wide range of flood protection systems for Louisiana's $50-billion Comprehensive Master Plan for a Sustainable Coast. He has also assisted local levee districts with concept development for risk mitigation infrastructure projects. His work evaluating tradeoffs between cost-effectiveness, social vulnerability, and uncertainty in prioritization for nonstructural mitigation measures led to the state being awarded over $233 million by the U.S Department of Housing and Urban Development's National Disaster Resilience Competition. He recently was awarded an NSF INFEWS grant to explore multi-objective trade-offs and synergies associated with policies aimed at making the global agricultural system more sustainable.

Dr. Johnson holds a Ph.D. in Policy Analysis from the Pardee RAND Graduate School, with concentrations in quantitative methods and economics. He previously earned a B.S. in mathematics from North Carolina State University and a MASt in mathematics from the University of Cambridge, where he was a Gates Cambridge Scholar. Prior to joining Purdue, he worked for seven years as a policy analyst and mathematician at RAND Corporation.

John Kelley, Ph.D.

Dr. John Kelley is a meteorologist and coastal modeler with NOAA/National Ocean Service's Coastal Marine Modeling Branch within the Coast Survey Development Lab. He has a Ph.D. in Atmospheric Sciences from Ohio State University and M.S. in Meteorology and M.P.A. from Penn State University. Dr. Kelley is the project coordinator for the development, evaluation, and implementation of NOS's operational numerical ocean forecast modeling systems for the Great Lakes. He is the project manager for NOAA's nowCOAST, an operational GIS-based web mapping portal to real-time coastal observations, imagery, warnings, and forecasts. Dr. Kelly is also involved with NOAA's Precision Marine Navigation Data Dissemination Project, an effort to make NOAA's operational marine weather, oceanographic, and bathymetric dataset available to commercial mariners in the International Hydrographic Organization's S-100 framework. Before joining NOS, he was a postdoctoral scientist with the Environmental Modeling Center at the National Weather Service's National Centers for Environmental Prediction (NCEP) in Maryland and worked on the development and implementation of an ocean data assimilation system for NOAA's Coastal Ocean Forecast System, the processor of NCEP's Global Real-Time Ocean Forecast System. Dr. Kelley is located at the NOAA-University of New Hampshire Joint Hydrographic Center in Durham, NH.

Tarang Khangaonkar, Ph.D.

Dr. Tarang Khangaonkar is a Program Manager specializing in Integrated Coastal Ocean Modeling at the Pacific Northwest National Laboratory (PNNL) Marine Sciences Laboratory operated by Battelle for the U.S. Department of Energy. He provides senior leadership to PNNL's activities in numerical modeling studies related to coastal ocean hydrodynamics, water quality, sediment transport, and fate and transport analysis. He has over 28 years of experience with various types of models capable of circulation, and water quality kinetics and has been involved with a number of water quality management studies. These studies include simulations of temperature response, calculations of dissolved oxygen (DO) depletions, sediment deposition, long-term effluent flushing and pH buffering, and performing diffuser design optimization. Many of these studies have been water quality impact assessments in support of hydropower FERC relicensing, mixing zone analysis for National Pollutant Discharge Elimination System (NPDES) permitting, and total maximum daily load (TMDL) assessments.

Dorothy Koch, Ph.D.

Dr. Dorothy Koch serves as the director of the Weather Program Office (WPO). Prior to serving in this role, Dr. Koch spent two years as the Director of the Modeling Division within the Office of Science and Technology Integration. During her time in this role, she developed a deep and thorough understanding of the complex modeling and budget portfolios that intertwine NWS, OAR, and NESDIS. Dr. Koch is a versatile leader with a proven track record as a subject matter expert in innovating and launching complex, multidisciplinary atmospheric and environmental science programs. She solidified NOAA's support for the Unified Forecast System (UFS) by establishing the NWS-OAR-community Unified Forecast System Research to Operations (UFS R2O) Project. She also conducted activities to align research and development priorities with forecaster requirements, and strengthened several key interagency partnerships.

John Krasting, Ph.D.

Dr. John Krasting is a physical scientist at the NOAA Oceanic and Atmospheric Research's Geophysical Fluid Dynamics Laboratory (GFDL). His primary interests are in the realm of studying and modeling climate-carbon cycle interactions, the ocean's role in the climate system, and the development of climate models with a particular focus on inter-annual variability and future climate change. Dr. Krasting also develops "big data" diagnostics, metrics, and analyses to help benchmark and analyze climate model results.

Jesse Lopez

Mr. Jesse Lopez works as a computational scientist at Axiom Data Science where he helps ingest and manage scientific data, runs an Arctic sea ice forecast model, develops and implements Lagrangian studies for risk assessment including for oil spills, and develops and deploys ML/AI models for a variety of projects.

Parker MacCready, Ph.D.

Dr. Parker MacCready works to advance fundamental understanding of estuarine and coastal physical oceanography. He works closely with biologists and chemists to link patterns of circulation and mixing to biogeochemical processes such as ocean acidification, hypoxia, and harmful algal blooms. With his colleagues in the UW Coastal Modeling Group he creates realistic numerical simulations of coastal and estuarine waters, allowing an unprecedented exploration of these complex processes, particularly in the Pacific Northwest.

Avichal Mehra, Ph.D.

Dr. Avichal Mehra has about 25 years of experience leading and performing scientific development and research in the areas of operational forecasting, coupled atmosphere-land-ocean-wave models, numerical analysis, model diagnostics, and analyzing and interpreting geophysical data and model results. As Chief of the Dynamics and Coupled Modeling Group, Dr. Mehra has taken on the responsibility of providing key science and technical leadership/supervision to help build UFS-based coupled applications and frameworks for future operational systems at National Weather Service/National Centers for Environmental Prediction (NWS/NCEP). Dr. Mehra has been been involved with the development and transition of operational ocean forecast systems at NWS/NCEP for more than a decade and serves as a co-chair of a N-ESPC (now the Interagency Council for Advancing Meteorological Services (ICAMS)) working Group on Global Coupled Modeling, as a Science Team member of GODAE/OceanPredict (international) since 2013; and represents NWS/NCEP in WMO/IOC's Expert Team on Operational Ocean Forecast Systems (ETOOFS).

Steven Meyers, Ph.D.

Dr. Steven Meyers is the Chief Scientist at the Ocean Center for Maritime and Port Studies at the University of South Florida, College of Marine Science. He has over two decades of experience working with estuarine circulation models and observational data. His work includes studies of ocean wind, waves, tides, currents, fresh water influences, natural and anthropogenic climate variability, and large-scale human construction. His current work includes big data problems to enhance maritime domain awareness through the use of operational oceanographic data, and the interaction between maritime operations and the environment.

Andrew Moore, Ph.D.
Dr. Andrew Moore received a DPhil in Physical Oceanography from the University of Oxford in 1986 working on some of the earliest ocean data assimilation efforts in support of the TOGA program in the tropical Pacific. Since then, his work has encompassed many other research areas including coupled modeling, predictability of the ocean circulation, seasonal forecasting, stochastic forcing of climate variability, adjoint methods, and the development of advanced methods and tools for ocean data assimilation.

Dr. Moore has held positions at the University of New South Wales, Harvard University, the CSIRO Division of Atmospheric Research, the Australian Bureau of Meteorology Research Centre, Nova Oceanographic Center, and the University of Colorado, Boulder.

Since 2006, he has been a Professor in the Ocean Sciences Department at the University of California, Santa Cruz. For much of the last 10-15 years, Dr. Moore has been one of the leading co-developers of the Regional Ocean Modeling System (ROMS) 4-dimensional variational (4D-Var) data assimilation system. ROMS and ROMS 4D-Var are open source community tools made freely available to the international ocean modeling community. These days, his research interests are primarily concentrated on developing data assimilation and prediction systems for coastal ocean environments, and in particular the California Current system off the west coast of North America.

Ed Myers
Mr. Ed Myers is the chief of the Coastal Marine Modeling Branch (CMMB), which is located in the Coast Survey Development Laboratory (CSDL).

Mark Osler
Mr. Mark Osler is the Senior Advisor for Coastal Inundation and Resilience for NOAA. His leadership advances coastal inundation science and the ability of decision makers to prepare for and respond to changes affecting the nation's coastlines. He serves as senior advisor to NOAA leadership on defining research, applied science, and policy priorities related to understanding and reducing impacts of coastal risk to the public, our national security, and our nation's economy.

Mr. Osler's inter-agency leadership includes: U.S. Government representative to the G7's Ocean Risk and Resilience Action Alliance, and within various White House interagency fora including the National Security Council, Office of Science and Technology Policy, and the Council on Environmental Quality.

Prior to joining NOAA, Mr. Osler worked for 17 years in the private sector. He holds a bachelor's degree in civil engineering from Lehigh University and a master's degree in coastal engineering from the University of Delaware's Center for Applied Coastal Research.

Shachak Pe'eri, Ph.D.
Dr. Shachak Pe'eri is the chief of NOAA's Coast Survey Development Lab. With more than three years of experience as Coast Survey's Marine Chart Division Cartographic Support Branch chief and more than eleven years of experience as an associate research professor at the University of New Hampshire, Dr. Pe'eri has a deep knowledge of the current and emerging technologies critical for our mission. He has a Ph.D. in geophysics from Tel Aviv University, Israel and has extensive post-doctoral experience in coastal and ocean mapping including airborne lidar bathymetry, satellite and aerial remote sensing, and autonomous vessels. Dr. Pe'eri is also committed to the development of employees through the internationally accredited professional cartographic certification program (CAT-B) that he established (and for which he received a NOAA Administrator's Award last year).

Machuan Peng, Ph.D.
Dr. Machuan Peng is a Physical Scientist at Center for Operational Oceanographic Products and Services with NOAA's National Ocean Service.

Mark Rowe, Ph.D.
Dr. Mark Rowe works on developing models to understand and predict changes in the physical, chemical, and biological characteristics of the Great Lakes. His recent work has focused on development of linked hydrodynamic and biological models to simulate harmful algal blooms and hypoxia in Lake Erie, and impacts of invasive quagga mussels on primary production, nutrient cycles, and the lower food web of Lake Michigan. He has contributed to forecast models that provide timely and actionable information to public water systems, anglers, and recreational users of Lake Erie. Dr. Rowe received M.S. and Ph.D. degrees from Michigan Technological University where he conducted research on measurement and modeling of atmospheric deposition of persistent organic pollutants to Lake Superior.

Kathryn Ries
Ms. Kathryn Ries has served as deputy director of NOAA's Office of Coast Survey since 2001, co-leading the workforce of 235 employees and managing the day-to-day operations of Coast Survey's $83 million national program. She also serves as a senior adviser to the director in his role as U.S. representative to the International Hydrographic Organization (IHO), and works to advance U.S. positions in IHO policy deliberations. From 2003 to 2012, she chaired the IHO's MesoAmerican Caribbean Hydrographic Commission's Electronic Chart Committee, where she led the development and execution of regional charting plans in Caribbean and Central America. Ms. Ries began her career in NOAA as a Presidential Management Fellow in the International Affairs office. She earned a Bachelor of Science from the University of California at Berkeley, and a Master of Art in international public administration from the Monterey Institute of International Studies in 1986.

Greg Seroka, Ph.D.
Dr. Greg Seroka is an oceanographer and meteorologist with the Office of Coast Survey in NOAA, where he supports marine navigation and disaster mitigation through several projects. He recently led

an effort to operationalize and upgrade a state-of-the-art global model for forecasting storm surge and tides, and serves as Project Manager for an effort to improve its performance in the Pacific region. These forecast tools are essential for safe and efficient marine navigation and for protecting coastal communities during storms. Dr. Seroka is also involved with an international effort to standardize oceanographic data for mariners, such as water levels and surface currents, which are important for developing a coherent navigation system across international waters.

Prior to his work at NOAA, Dr. Seroka earned his Ph.D. in physical oceanography from Rutgers University with a Graduate Certificate in Energy, where his research improved hurricane intensity forecasts and assessed offshore wind energy resources in the U.S. Mid-Atlantic. He received his Master's in atmospheric science from Texas A&M, where he worked on improving lightning forecasts, and his Bachelor's (honors) in meteorology from Penn State where he served as President of the Campus Weather Service.

Peter Sheng, Ph.D.
Dr. Peter Sheng is a researcher specializing in climate impact on coastal hazard and ecosystem dynamics. Since he joined University of Florida in 1986, he has studied coastal and estuarine hydrodynamics and ecosystem dynamics, storm surge modeling, coastal flooding in future climate, and use of green infrastructure for coastal flood protection. He has led several multidisciplinary multi-institutional studies to understand the future coastal flood vulnerability and use of coastal wetlands to reduce flood damage in coastal communities in Florida, New York, and New Jersey.

Joseph Sienkiewicz
Mr. Joseph Sienkiewicz is the Chief of the Ocean Applications Branch of the U.S. National Oceanic and Atmospheric Administration's (NOAA) Ocean Prediction Center (OPC). The OPC has international responsibility for weather warnings and forecasts for large portions of the North Atlantic and North Pacific. Mr. Sienkiewicz has worked in operational marine meteorology with NOAA for over 30 years. His professional interests include the use of satellite derived information to improve marine weather forecasts, explosively developing storms, and the application of weather information in marine operations. He serves on an international team with NOAA and European scientists to train marine meteorologists from across the globe on the application of satellite sensed ocean winds and waves to operational marine forecasting. Mr. Sienkiewicz is a graduate of the State University of New York Maritime College (B.S.) and University of Washington (M.S.). He held a U.S. Coast Guard Unlimited Third Mate License and limited tonnage Master's License and worked 5 years as mate and relief captain on tugboats based in New York Harbor.

Derrick Snowden
Mr. Derrick Snowden is Chief of the NOAA Integrated Ocean Observing System (IOOS) Operations Division and manages the Coastal and Ocean Modeling Testbed program, which is currently focused on community modeling to expand 3-D hydrodynamic models and experimenting with coastal coupling with the NOAA Water Model. Mr. Snowden is involved in the NOAA Water Initiative working to make boundary-spanning partnerships across multiple sectors to create and deliver water information.

Youngjun Son
Mr. Youngjun Son is a Ph.D. student in the Ocean Science and Engineering Program at Georgia Institute of Technology working in the areas of coastal hydrology and hydrodynamics. His research seeks to contribute to building a sustainable future of coastal cities and towns that are at risk of flooding by better understanding the compounding effects of multiple flooding drivers under climate change. He earned a Bachelor of Science in 2010 and a Master of Science in 2012, both in Naval Architecture and Ocean Engineering, from Seoul National University in South Korea. Prior to joining his current Ph.D. program in 2017, Mr. Son spent several years as a research engineer at Hyundai Heavy Industries in South Korea to transform knowledge in ocean engineering into technology development and application for the industry. He is passionate about exploring and integrating new knowledge, which motivated him to obtain two additional master's degrees in Civil Engineering and Mechanical Engineering in 2020 during his Ph.D. study.

Charles Stock, Ph.D.
Dr. Charles Stock is a research oceanographer at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL). His research focuses on interactions between climate and marine ecosystems. He is one of the primary developers of the ocean biogeochemical component of GFDL's Earth System Model 4.1, simulations from which were contributed to the 6th Coupled Model Intercomparison Project (CMIP6) in support of the IPCC's 6th climate change assessment report. Dr. Stock has also collaborated extensively with partners within NOAA and academia to understand and anticipate the impacts of climate change and variability on living marine resources. Most recently, Dr. Stock served as a member of the implementation planning team for NOAA's Climate and Fisheries Initiative, and has been engaged in adapting NOAA's global ocean and earth system modeling capabilities for regional fisheries applications on seasonal to century-scale time horizons.

Peter Stone
Mr. Peter Stone earned a B.S. degree from the University of Rhode Island and an M.S. in Marine Science from the University of Maryland. He started working at NOS in 1985, conducting tidal current surveys that primarily supported NOAA Tide and Tidal Current Tables. He also worked on early PORTS demonstration projects in Charleston, SC, Galveston Bay, TX, and Tampa Bay, FL. For over 15 years he has installed, analyzed, and created user products from current meters and other oceanographic/meteorological sensors throughout the country to support safe marine navigation. For six years in the middle of his career, he worked for the Smithsonian's Environmental Research Centers maintaining, and analyzing the data from a suite of environmental sensors which were part of a long term local climate observation network.

After returning to NOS, he has served as the chief of the Oceanographic Division with NOS' Center for Operational Oceanographic Products and Services (CO-OPS). In this role he oversaw quality control and data dissemination for all of CO-OPS observing systems and products including PORTS,National Water Level Observation Network (NWLON), National Current Observation Network (NCOP), Tide and Tidal Current Tables, tidal datums and benchmark sheets, Operational Forecast Systems (OFS) hydrodynamic models and Harmful Algal Bloom Operational Forecast System

(OFS). Over this time the PORTS system has grown to include 24 ports, NCOP has expanded from 20 current meter deployments to 70 installations per year, the number of operational OFS forecast models has more than doubled and are now running on NOAA's High Performance supercomputer which increases their reliability and allows for high resolution forecasts of water levels and currents in navigational channels. Recently, CO-OPS has also developed fully electronic tide and tidal current tidal predictions on its website (http://tidesandcurrents.noaa.gov/) which provide greater accuracy and faster updates over the traditional printed Tables.

Since February 2015, Mr. Stone has worked as the Technical Director for CO-OPS, formulating strategy and policy on technical issues for the organization.

Steve Thur, Ph.D.
Dr. Steve Thur is the Director of NOAA's National Centers for Coastal Ocean Science (NCCOS) and was the NCCOS Deputy Director from 2013 to 2017. His works has a particular emphasis on how both the biophysical and social sciences are used to sustain coastal ecosystems and the vibrant human communities that depend upon them for livelihoods, recreation, and as a place for connecting with nature. Dr. Thur oversees the work of approximately 260 staff in nine states and the operations of five marine laboratories with an annual budget of $55 to $60 million. NCCOS's four priority research areas include marine spatial ecology, environmental stressors and their impacts, change along our coasts, and social science. From 2007 to 2013, Dr. Thur was the Coordinator of NOAA's Coral Reef Conservation Program (CRCP). From 2003 to 2007, Dr. Thur was an Economist for the NOAA Office of Response and Restoration.

Dr. Thur received his Ph.D. in marine policy from the University of Delaware's Graduate College of Marine Studies in 2003. His dissertation research was on sustainable financing mechanisms for coral reef marine protected areas. He holds Bachelor's degrees in biology and economics from St. Mary's College of Maryland.

Panagiotis Velissariou, Ph.D.
Dr. Panagiotis Velissariou is a coastal engineer and modeler with scientific interests in coastal processes, sediment transport, wave-current interactions, storm surge modeling, coastal/regional forecasting and the development of coupled modeling systems. A Greek native, Dr. Velissariou received his B.Sc. in Agricultural Engineering from the Aristotle University of Thessaloniki, Greece, his M.Sc. in Water Resources Engineering from the Ohio State University, Columbus, Ohio and his Ph.D. in Coastal and Ocean Engineering from the Ohio State University, Columbus, Ohio. He was a member of the group that developed and maintained the award winning Great Lakes Forecasting System (GLFS). In 2011, Dr. Velissariou moved to Tallahassee, Florida where he accepted a research scientist position at the Center of Oceanic and Atmospheric Administration (COAPS) at Florida State University (FSU), and worked on model coupling using HYCOM, ROMS, SWAN, WAVEWATCH III, WRF, and the Community Earth System (CESM) models. While at FSU, he developed the Gulf of Mexico Earth Forecasting System (GoM-EFS) a three dimensional prediction system for the Gulf of Mexico that links coastal/ocean processes with the atmosphere using multi-model components and algorithms. In 2018, Dr. Velissariou joined the National Water Center (NOAA/NWS/OWP), Tuscaloosa, Alabama as a senior coastal scientist

where he worked in the development of a coupled modeling system between the National Water Model (NWM), and the DFlow FM and ADCIRC hydrodynamic models to create a comprehensive and efficient numerical framework for total water and flood inundation forecasting at the Eastern US. Coast that simulates interactions of inland hydrologic processes, freshwater stream-flows, tides, surges and winds under normal and extreme event conditions. He is currently a senior coastal scientist and modeler at the Coastal Marine Modeling Branch (CMMB) of the Office of Coast Survey (OCS) at the National Oceanographic and Atmospheric Administration National Ocean Service (NOAA/NOS) where he is leading the development efforts of the HSOFS forecast system and the development of the CoastalApp framework a fully coupled, NUOPC/ESMF enabled modeling system for coastal studies. Dr. Velissariou can be contacted by email: panagiotis.velissariou@noaa.gov or by phone at (205) 227-9141.

Jia Wang, Ph.D.
Dr. Jia Wang is a physical scientist with the NOAA Oceanic and Atmospheric Research's Great Lakes Environmental Research Lab (GLERL).

Joannes Westerink, Ph.D.
Dr. Joannes Westerink develops high resolution heterogeneous unstructured mesh, multi-physics, multi-scale hydrodynamic codes and models for the hydrodynamics of the coastal ocean and has successfully transitioned these to practitioners for a wide range of applications including the analysis and design of major flood control projects and coastal ocean water level forecasting systems. Dr. Westerink has pioneered the successful use of global to channel scale highly heterogeneous unstructured mesh coastal ocean models with mesh resolution varying by up to four orders of magnitude. This encompasses the optimization of algorithms; development of high performance codes in vector and parallel computing environments; the linkages of circulation models to weather and short wind wave models; model verification, validation, and uncertainty quantification; and the application of codes to oceans, continental shelf regions, estuaries, rivers, and coastal flood plains. Dr. Westerink is the co-developer, with Dr. Rick Luettich of the University of North Carolina at Chapel Hill and Dr. Clint Dawson of the University of Texas at Austin, of the widely used ADCIRC finite element based shallow water equation code. ADCIRC has evolved into a community based coastal hydrodynamics code with wide ranging applications within academia, government, and the private sector worldwide. The U.S. Army Corps of Engineers, the Federal Emergency Management Agency, and NOAA all use ADCIRC in support of coastal water level and flooding analyses and forecasts.

John Wilkin, Ph.D.
Dr. John Wilkin is an experienced coastal oceanographer who develops model-based analysis systems for interdisciplinary applications (nutrient and carbon cycling; larval dispersal; ocean forecasting) in coastal and adjacent boundary current waters. Most recently, these projects emphasized data assimilation of in situ and remotely sensed observations, sensitivity and predictability analysis, and the design of observing networks. He is a developer of the Regional Ocean Modeling System (ROMS) and co-convenes the quasi-annual international ROMS User Workshops. Dr. Wilkin is a member of the International Ocean Surface Topography Science Team and is active in the Coastal Altimetry community promoting uses of altimeter data in coastal ocean analysis. He serves on NASA's Physical Oceanography Data Center (PO-DAAC) User Working Group, the NSF Ocean Observatories Initiative

(OOI) Facilities Board, and is past co-chair of the UNESCO/IOC Global Ocean Observing System (GOOS) Ocean Observations for Physics and Climate panel (OOPC).

George Xue, Ph.D

Dr. George Xue got his Ph.D. in 2010 from North Carolina State University. Now Dr. Xue is an Associate Professor at the Dept. of Oceanography and Coastal Sciences at LSU with a joint appointment at Center for Computation and Technology. Dr. Xue is a broadly-trained numerical modeler specialized in the sediment, nutrient, and carbon dynamics in the coastal ocean as well as the coupling between ocean and river, air and sea, and physics and biogeochemical processes.

Pengfei Xue, Ph.D.

Dr. Pengfei Xue is an associate professor in the Department of Civil, Environmental, and Geospatial Engineering at Michigan Tech. Dr. Xue's research centers around developing and applying numerical models to hydrodynamic, climate, and environmental problems in the Great Lakes. His research focuses on understanding and predicting how the Great Lakes system responds to long- and short-term natural and anthropogenic disturbances, such as climate variability, extreme events, coastal hazards, and lake biophysical processes. Dr. Xue's doctoral study in Oceanography at the University of Massachusetts Intercampus Marine Science program, his post-doctoral work at the Massachusetts Institute of Technology, as well as his current research also provided him with exposure to several marine systems, including the Maritime Continent, the Persian/Arabian Gulf, the East China Sea, the Changjiang Estuary, the Gulf of Maine, and Massachusetts Coastal Waters.

Fei Ye, Ph.D.

Dr. Fei Ye is an assistant research scientist at Virginia Institute of Marine Science, College of William and Mary. He is a core developer of the SCHISM model development team. His research includes: cross-scale modeling of river-estuarine-plume-shelf systems; compound flood modeling; developing numerical schemes for cross-scale baroclinic modeling; non-hydrostatic modeling; interdisciplinary studies concerning aquatic/riparian ecosystem and marsh evolution.

Aijun (AJ) Zhang, Ph.D.

Dr. AJ Zhang is a hydrodynamic ocean modeler, and lead of the NOS/CO-OPS modeling team. He primarily focuses on transition and implementation of NOS coastal ocean operational forecast systems and operational applications and products. His biggest achievement in the past years is the development of a Coastal Ocean Modeling Framework (COMF). COMF is a set of standards and tools for developing and maintaining NOS's hydrodynamic model–based coastal ocean operational forecast systems (OFS) by providing a standard and comprehensive software infrastructure to handle multiple hydrodynamic models for any geographic domain. It facilitates ease of operations and interoperability; minimizes redundant efforts and ensures a high time-and-cost efficiency for OFS development, transition, and provides standard tools for real time data handling; maintenance; provides standard tools for graphics and web products and standard skill assessment and evaluation tools. Dr. Zhang has led modeling teams transitioning 15 forecast systems to operations on NOAA High Performance Computing System (HPCS).

APPENDIX C. STEERING COMMITTEE MEMBERS

(listed alphabetically by last name)

Clarissa Anderson (cra002@ucsd.edu) is the Executive Director of the Southern California Coastal Ocean Observing System (SCCOOS) at Scripps Oceanography

Eric Bayler (eric.bayler@noaa.gov) is the Satellite Ocean Data Assimilation Program Manager at NOAA's Center for Satellite Applications and Research (STAR)

Cayla Dean (cayla.dean@noaa.gov) is an Outreach Specialist/ Coastal Scientist at NOAA

Tracy Fanara (tracy.fanara@noaa.gov) is a Coastal Modeling Portfolio Manager at NOAA

Dwight Gledhill (dwight.gledhill@noaa.gov) is the Deputy Director of NOAA's Ocean Acidification Program

Debra Hernandez (debra@secoora.org) is the Executive Director of the Southeast Coastal Ocean Observing Regional Association (SECOORA)

Maoyi Huang (maoyi.huang@noaa.gov) is the EPIC Program Manager at NOAA

Libby Jewett (libby.jewett@noaa.gov) is the Director of the Ocean Acidification Program at NOAA

Emily Landeen (emily.landeen@noaa.gov) is the Executive Secretariat for the Coastal and Ocean Community Modeling Workshop

Ed Myers (edward.myers@noaa.gov) is the Chief of the Coastal Marine Modeling Branch at NOAA

Katie Robinson (katelyn.robinson@noaa.gov) is an Ocean Portfolio Advisor at NOAA

Tom Shyka (tom@neracoos.org) is the Product and Engagement Manager at the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS)

Derrick Snowden (derrick.snowden@noaa.gov) is the Chief of the Operations and Communications Division at NOAA/U.S. Integrated Ocean Observing System

Charlie Stock (charles.stock@noaa.gov) is a Research Oceanographer at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL)

Peter Stone (peter.stone@noaa.gov) is an Oceanographer at NOAA

Emily Wallace (emily.wallace@noaa.gov) is the Executive Secretariat for the Coastal and Ocean Community Modeling Workshop

John Wilkin (jwilkin@rutgers.edu) is a Professor of Marine and Coastal Sciences at Rutgers University

APPENDIX D. WORKSHOP PARTICIPANTS

(listed alphabetically by last name)

Alistair Adcroft (alistair.adcroft@noaa.gov) is a Research Oceanographer at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL)

Alison Agather (alison.agather@noaa.gov) is the Forecasting a Continuum of Environmental Threats (FACETs) Program Coordinator at NOAA's Weather Program Office (WPO)

Michael Alexander (michael.alexander@noaa.gov) Meteorologist at NOAA's Physical Sciences Laboratory (PSL)

Allison Allen (allison.allen@noaa.gov) is the Chief of the NWS Marine, Tropical, and Tsunami Services Branch at NOAA

Alper Altuntas (altuntas@ucar.edu) is a Software Engineer for the Climate and Global Dynamics - Oceanography section at the National Center for Atmospheric Research (NCAR)

Clarissa Anderson (cra002@ucsd.edu) is the Executive Director of the the Southern California Coastal Ocean Observing System (SCCOOS) at Scripps Oceanography

Eric Anderson (ericjamesanderson@gmail.com) is an Associate Professor at the Colorado School of Mines

Brian Arbic (arbic@umich.edu) is a Professor of Earth and Environmental Sciences at the University of Michigan

Diego Arcas (diego.arcas@noaa.gov) is the Director of the NOAA Center for Tsunami Research

Alberto Azevedo (albertocarlosazevedo@gmail.com) is a Researcher at the Laboratório Nacional de Engenharia Civil (LNEC)

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APPENDIX E. ACRONYMS

ACRONYM	DEFINITION
4D-Var	4-Dimensional Variational
ADCIRC	ADvanced CIRCulation model
AEP	Annual Exceedance Probability
AFSC	Alaska Fisheries Science Center
AOML	Atlantic Oceanographic and Meteorological Laboratory
AOOS	Alaska Ocean Observing System
ARL	Air Resources Laboratory
AWAC	Acoustic Wave and Current
BMI	Basic Model Interface
CARICOOS	Caribbean Coastal Ocean Observing System
CBEFS	Chesapeake Bay Environmental Forecast System
CBOFS	Chesapeake Bay Operational Forecast System
CDIP	Coastal Data Information Program
CeNCOOS	Central and Northern California Ocean Observing System
CFI	Climate-Fisheries Initiative
CHAB	Cyanobacterial Harmful Algal Blooms
ChesROMS-ECB	Chesapeake Bay Regional Ocean Modeling System–Estuarine Carbon Biogeochemistry model
CI	Cooperative Institute
CICE	Sea Ice Model
CICOES	Cooperative Institute for Climate, Ocean, and Ecosystem Studies
CIGLR	Cooperative Institute for Great Lakes Research
CIMAS	Cooperative Institute for Marine and Atmospheric Studies
CIMES	Cooperative Institute for Modeling the Earth System
CMMB	Coastal Marine Modeling Branch
CO-OPS	Center for Operational Oceanographic Products and Services
COAWST	Coupled-Ocean-Atmosphere-Wave-Sediment Transport
COMT	Coastal and Ocean Modeling Testbed
CPO	Climate Program Office

CSDL	Coast Survey Development Lab
CSDL	Common Schema Definition Language
DOE	Department of Energy
EMC	Environmental Modeling Center
EPIC	Earth Prediction Innovation Center
ESMF	Earth System Modeling Framework
ESTOFS	Extratropical Surge and Tide Operational Forecast System
FNMOC	Fleet Numerical Meteorology and Oceanography Center
FP	False Positive
FVCOM	Finite Volume Community Ocean Model
G-RTOFS	Global Real-Time Ocean Forecast System
GCOOS	Gulf of Mexico Coastal Ocean Observing System
GFDL	Geophysical Fluid Dynamics Laboratory
GFS-FVS	Global Forecast System Forecast Verification System
GLERL	Great Lakes Environmental Research Laboratory
GLOS	Great Lakes Observing System
GOMO	Global Ocean Monitoring and Observing
GSL	Global Systems Laboratory
HAB	Harmful Algal Bloom
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HF Radar	High Frequency Radar
HPC	High Performance Computing
HYCOM	Hybrid Coordinate Ocean Model
ICOGS	Inland-Coastal Flooding Operational Guidance System
IOOS	Integrated Ocean Observing System
JEDI	Joint Effort for Data assimilation Integration
JPM-OS	Joint Probability Method with Optimal Setting
JRC	Joint Research Centre
JTTI	Joint Technology Transfer Initiative
LMR	

LNEC	Laboratório Nacional de Engenharia Civil
MARACOOS	Mid-Atlantic Coastal Ocean Observing System
MDTF	Model Development Task Force
MOM6	Modular Ocean Model, Version 6
MEMP	Marine Ecosystem Modeling and Prediction
NAVD	North American Vertical Datum
NCAR	National Center for Atmospheric Research
NCCOS	National Centers for Coastal Ocean Science
NCEI	National Centers for Environmental Information
NCEP	National Centers for Environmental Prediction
NECOFS	Northeast Coastal Ocean Forecast System
NERACOOS	Northeastern Regional Association of Coastal Ocean Observing Systems
NGGPS	Next Generation Global Prediction System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRDD	NOAA Research and Development Database
NRL	Naval Research Laboratory
NUOPC	National Unified Operational Prediction Capability
NWFSC	Northwest Fisheries Science Center
NWM	National Water Model
NWS	National Weather Service
OAP	Ocean Acidification Program
OAR	Office of Oceanic and Atmospheric Research
OCFO	Office of the Chief Financial Officer
OCS	Office of Coast Survey
OGSSD	Oceanographic and Geophysical Science and Services Division
OPC	Ocean Prediction Center
OSAAP	Office of System Architecture and Advanced Planning
OSS	Office of Science Support
OSTI	Office of Science and Technology Integration

OTT	Ocean Technology Transition
OWP	Office of Water Prediction
PacIOOS	Pacific Islands Ocean Observing System
PMEL	Pacific Marine Environmental Laboratory
PNNL	Pacific Northwest National Laboratory
PRSSO	Performance, Risk, and Social Science Office
PSL	Physical Sciences Laboratory
R2O2R	Research-to-Operations-to-Research
RENCI	Renaissance Computing Institute
RISA	Regional Integrated Sciences and Assessments
ROMS	Regional Ocean Modeling System
RTOFS	Real-Time Ocean Forecast System
SCCOOS	Southern California Coastal Ocean Observing System
SCHISM	Semi-implicit Cross-scale Hydroscience Integrated System Model
SECOORA	Southeast Coastal Ocean Observing Regional Association
SLR	Sea Level Rise
STAR	Center for Satellite Applications and Research
SWFSC	Southwest Fisheries Science Center
SWMM	Storm Water Management Model
TC	Tropical Cyclones
TP	True Positive
UCAR	University Corporation for Atmospheric Research
UFS	Unified Forecast System
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WBM	Water Balance Model
WHOI	Woods Hole Oceanographic Institution
WPO	Weather Program Office
WRF	Weather Research and Forecasting