COASTAL COUPLING
COMMUNITY OF PRACTICE

ANNUAL MEETING REPORT 2023

COASTAL COUPLING COMMUNITY OF PRACTICE
MAY 23-25, 2023
NATIONAL WATER CENTER AND GOOGLE MEET

INDEX

01 EXECUTIVE SUMMARY

WHAT HAPPENED?

From May 23-25, 2023, 196 representatives from 52 organizations discussed the latest breakthroughs in coastal coupling research and modeling and the necessary next actions.

WHAT'S NEXT?

Establish working groups for:

1. Co-developing consistent and complete data sources and standards, including data licensing and topography/bathymetry approaches.
2. Hosting hack-a-thons and other challenges.
3. Publishing a coastal coupling roadmap.

Communicate consistently and with agility, especially about funding opportunities and working group activities.

Figure: Graphic of the change in CC CoP numbers from 2019 to 2023. **Figure source:** Developed from data collected in 2019 and 2023.

02 ABOUT THE CC CoP AND THE ANNUAL MEETINGS

Over 100 million people living in coastal areas in the United States (U.S.) do not have access to accurate information about critical water-related issues such as floods, droughts, and water quality because contemporary operational forecast models do not fully capture the complexity of combined freshwater, estuarine, and ocean processes. Although these challenges are too great for any single organization to address alone, the community has the necessary knowledge and resources to make a difference.

THE RESPONSE

In 2019, scientists and modelers from the federal government and academia formed the Coastal Coupling Community of Practice (CC CoP) to address the following vision, mission, and goals via day-to-day activities and annual meetings:

CC CoP VISION

"By working together, the CC CoP will provide actionable water information at local, regional, and national scales that helps to protect the lives and property of those living in the coastal zone and that informs adaptation planning in coastal regions to account for a changing climate and rising sea levels" (Charter 2019).

CC COP MISSION

The mission of the CC CoP is to enable:

- "Coupling of models to better represent earth system processes across the coastal zone and provide improved predictions of quantities such as water levels, flow timing and duration, currents, sediment, water quality variables, geomorphic changes, etc.
- Actionable information on these quantities provided to stakeholders in timely, accessible, and user-friendly formats.
- Accelerated national coverage of integrated water prediction capabilities through the adoption of community research and models that acknowledge stakeholder-driven requirements" (Charter 2019).

CC COP GOALS

The CC CoP will therefore (Charter 2019; numbering added):

Goal #1 • Create a sustainable framework and vision for engagement between Federal agencies, academia, state and local governments, and private industry around model and tool development.	**Goal #2 • Develop and support** coastal coupling modeling best practices.	**Goal #3 • Work toward collaborative solutions** for continental-scale integrated water prediction using a unified modeling approach.	**Goal #4 • Advance science around modeling** that will result in better products and services that meet the needs of the operational use community (e.g., natural and water resources managers, water suppliers, planners, decision-makers).
Goal #5 • Encourage the adoption of standards including definitions, metadata, data access, and transition of models to operations.	**Goal #6 • Look for collaboration points** with partners outside of coastal coupling modeling (e.g., data providers, end-users, social scientists) and align priorities to advance the state of the science.	**Goal #7 • Identify unrecognized pockets** of related projects and share work openly with those projects.	**Goal #8 • Evaluate the success** of the CoP on a regular basis.

CC COP TODAY

Much has been accomplished over the last five years and yet much also remains to be done:

Figure: Timeline of CC CoP accomplishments since 2019. **Figure source:** Modified from the timeline developed by Brenna Sweetman of NOAA's Office for Coastal Management.

03 INSIGHTS AND OPPORTUNITIES

Five themes emerged from the work accomplished across the years, community members' feedback in meeting discussions, and responses to questionnaires:

CORE THEME **Actions, not words!** While participants appreciated the opportunity to meet, learn more, and share ideas, they noted that many conversations have already occurred across years of meetings and publications. Participants expressed tremendous enthusiasm for focused and funded activities that will further the Community's mission of "Coupling of models to better represent earth system processes across the coastal zone and provide improved predictions of quantities such as water levels, flow timing and duration, currents, sediment, water quality variables, geomorphic changes, etc." (Charter 2019).

THEME #2 **Get consistent access to consistent data.** What are the NOAA data standards? How might we have consistent data sets of geo-rectified digital elevation models? How might data and processing be co-located in the cloud?

THEME #3 **Host hack-a-thons and other challenges.** What might we learn from hack-a-thons and other challenges in which modelers, scientists, and policymakers play with code and solve challenges together?

THEME #4 **Co-develop a coastal coupling roadmap.** How might we use the co-development of a coastal coupling roadmap to make the agreements about upcoming priorities and to set up a structure for quarterly outcomes?

THEME #5 **Communicate consistently and with agility.** Although Annual Meetings are terrific, how might the real work happen between meetings? How might there be consistent communication about progress and funding opportunities?

Consistent with the preceding themes, there are two next steps between now and the Annual Meeting 2024:

NEXT STEP #1 **Establish working groups to lead activities and outcomes.** Develop working groups under the CC CoP focused on (1) Co-developing consistent and complete data sources and standards; (2) Hosting hack-a-thons and other challenges; and (3) Co-developing a coastal coupling roadmap and associated materials.

Data Sources and Standards Working Group: Develop the standards for shared data, regardless of initial source, consistent with the Charter (2019) including the effects of new NOAA Administrative Orders, data licensing opportunities, and topography and/or bathymetry needs. Intended outcome by May 2024: Initial content and a draft standard on a public webpage.

Hack-a-thons and Other Challenges Working Group: Host hack-a-thons and other challenges that allow community members to examine, test, and document the code and discuss results and difficulties with fellow coders. Intended outcome by May 2024: At least three sessions hosted and backbriefs are shared on a public webpage.

Coastal Coupling Roadmap Working Group: Co-develop the coastal coupling roadmap of who is doing what that includes a harmonized approach for: (1) Which models will, and won't, be one-way and two-way coupled, including the geographies and the timeline; (2) Making available a shared working environment or index of relevant GitHubs with co-located data and processing, ideally leveraging related Federal efforts; (3) Planning for workforce development. Intended outcome by May 2024: Make publicly available the draft roadmap and initial shared working environment and/or index to repositories and relevant GitHubs.

NEXT STEP #2 **Communicate consistently and with agility.** Especially for funding opportunities and working groups, the communications channels and ideal timing include:

LinkedIn group updates: weekly.

Emailed newsletter: quarterly and focused on funding opportunities and updates from working groups.

Working group meetings: quarterly and focused on outcomes.

Community meetings: annually.

Communications hub (e.g., website, LinkedIn): continually. At a minimum, this communications hub provides: information about funding opportunities; a structure for connecting user needs with integrated research and operations; and coordination about research results and conference sessions.

Intended outcome by May 2024: Communications were sent on the cadences above and the communications hub exists.

04 THE PATH TO 2024

PRINCIPLES The path to 2024 will be grounded in the principles of participation, transparency, responsiveness, equity and inclusiveness, effectiveness and efficiency, accountability, and community rules of engagement (Charter 2019).

NEXT STEP #1 **Establish working groups to lead activities and outcomes** that are focused on: (1) Sharing consistent/complete data sources and standards; (2) Hosting hack-a-thons and other challenges; (3) Co-developing a coastal coupling roadmap and associated materials.

NEXT STEP #2 **Communicate consistently and with agility,** especially about funding opportunities and working groups.

We have much to accomplish before the next Annual Meeting in 2024. Reach the program team with questions, ideas, or requests: tide.predictions@noaa.gov.

POSTSCRIPT: AN UPDATE ON THE COASTAL RESILIENCE TO INUNDATION COMMUNITY OF PRACTICE: A SIBLING COMMUNITY OF PRACTICE

The Coastal Resilience to Inundation Community of Practice (CoP) is a new collaboration co-led by NOAA's Office for Coastal Management and the National Sea Grant Office with support from the American Society of Adaptation Professionals. The objective of this CoP is to support a trusted "boots on the ground" network of adaptation and resilience experts who engage with communities to learn from and advance reliable science that maximizes resilience to inundation hazards. Building upon existing efforts, the ultimate vision is that coastal communities will be engaged and empowered with knowledge, tools, and assistance to advance preparation, adaptation, and resilience to inundation hazards now and into the future. Engagement will include planners, floodplain managers, researchers, climate specialists, nonprofit organizations, and emergency managers. Reach Brenna Sweetman with questions, ideas, or requests related to this sibling community of practice: brenna.sweetman@noaa.gov.

IN MEMORIAM

CAYLA PAIGE DEAN
JULY 1986 TO JUNE 2023
In memory of our dear colleague

We will remember always Cayla's leadership in the water community and in the Coastal Coupling Community of Practice. Her kindness to each of us and her dedication to humanity live on.

APPENDIX A • LEARNING FROM THE PRESENTATIONS

From May 23-25, 2023, the community heard from 28 presenters about the state of coastal coupling science, models, initiatives, and funding opportunities. The following tables include highlights from each presentation and the discussions. For the full set of presentations, please see here (NOAA/NWS link). For an acronyms list, please see below (Appendix E).

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
ED CLARK NOAA Welcome 	**About:** The National Water Center (NWC) is the nation's center for water forecast operations and works to improve preparedness for water-related disasters and to inform high-value water decisions at the local, state, and national levels by collaboratively researching, developing, and delivering state-of-the-science national hydrologic analyses, forecast information, data, and decision-support services and guidance. **National Water Model:** The NWC hosts the operational center, now operating 13 hours a day, 7 days a week. The NWC also co-develops the National Water Model (NWM), version 3 is scheduled for release in Summer 2023.
MARK OSLER NOAA Keynote 	**The time is now** to use opportunities such as the Inflation Reduction Act, the Bipartisan Infrastructure Law, and the Cooperative Institute for Research to Operations in Hydrology to develop solutions for the benefit of all. **Why:** Amid the complexities of the inland hydraulic, the oceanic processes, and the other earth system processes, our simulations and models must reflect current and emerging realities in an ever-changing world. **The charge:** It's from this Coastal Coupling Community of Practice that the innovations, a sense of urgency, and collaboration will emerge that will power the breakthroughs that will address those complexities. **The future:** Our earth system observations are tuned to the predictive needs of the past. Due to the changing climate as well as the economic and human development along the coasts and Great Lakes, that needs to change to provide the skillful decision making needed at the coast.

<table>
<tr><th>SPEAKER, AFFILIATION, TITLE, KEY SLIDE</th><th>HIGHLIGHTS</th></tr>
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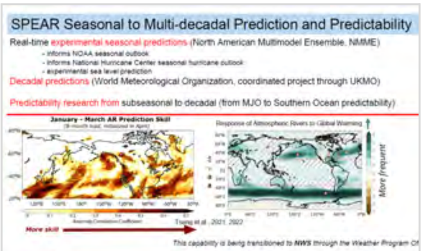
MATTHEW HARRISON
NOAA
Seasonal to Multidecadal Climate Variability, Predictability, and Change



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What: The Seamless System for Prediction and EArth System Research was developed as a next-generation Geophysical Fluid Dynamics Laboratory (GFDL) modeling system for seasonal to multidecadal prediction and projection.
Use: Real-time experimental seasonal predictions; decadal predictions; and predictability research from sub-seasonal to decadal.
Impact: Produces crucial information for a Climate-Ready Nation and climate risk assessments.
A discussion highlight: Mark Osler (NOAA): You mentioned work on sea-level prediction and coastal prediction, which is nice to see. To what level has surface-elevation data been assimilated? Matthew Harrison (NOAA): For sea level, we're focused primarily on the Argo observations, but NOAA's GFDL has its own data streams; has developed an ensemble filter; and more can be done in an operational sense. One of my personal goals has been to better integrate with Unified Forecast System (UFS) capabilities.

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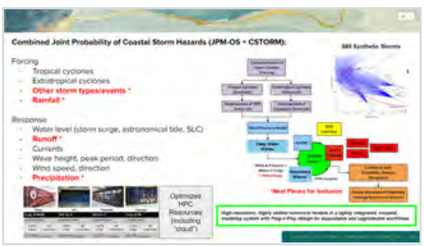
JASON CALDWELL
U.S. Army Corps of Engineers
Coastal Storm Modeling System



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USACE perspectives on compound flooding:

- There is a need for reliable, accurate, validated, and translatable tools and guidance about best practices that can be applied on projects. It is important to first quickly assess if (and to what extent) compound flooding is a consideration, and ONLY then, invest in analysis.
- There is a need for both loose and fully coupled (two-way dynamical coupling) coastal surge/wave and inland rainfall-induced flow models.
- Full coupling may be needed only in very specific geographic and physical settings for rapid forecasting needs. Present one-way coupled models may suffice from an engineering perspective.
- There is a need to extend present compound flooding considerations to antecedent and future conditions (e.g., climate change).
- Groundwater interactions are required for certain areas and projects.
- A national coastal/inland flood hazards system provides readily available standardized national-level data and statistics.

Coastal Storm Modeling System: Combined Joint Probability of Coastal Storm Hazards (JPM-OS + CSTORM): High-resolution, highly skilled numerical models in a tightly integrated, coupled, modeling system with plug-and-play design for expandable and upgradeable workflows.

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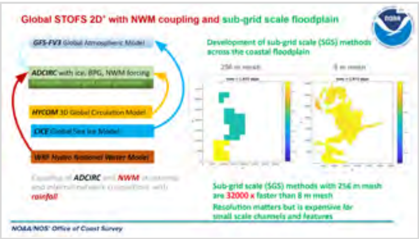
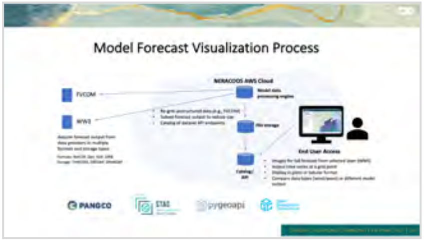
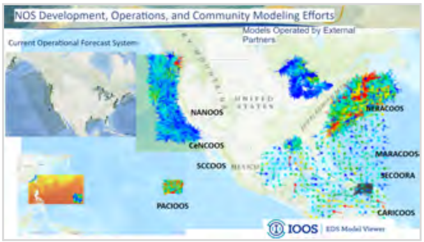
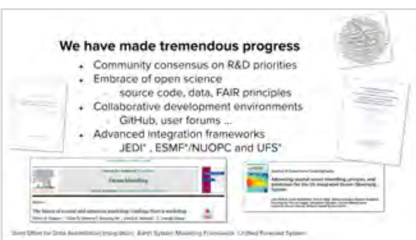
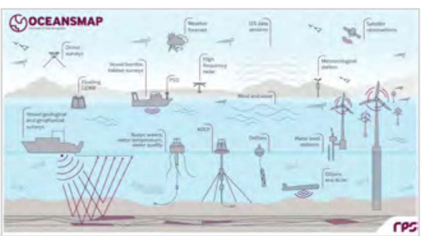
SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
JOANNES WESTERINK University of Notre Dame Advancing Global STOFS 2D+ 	**Global STOFS 2D // V1.0 currently in operation, noting the following:** ● Mesh resolution varies between 25 km to 2.5 km globally and 80 to 120 m in all U.S. coastal waters and floodplains. ● Most accurate published global model with an M2 tide deep water error of 1.95 cm. ● U.S. East/Gulf of Mexico coast M2 tide errors R2 = 0.9848, average absolute error = 2.5 cm, and a normalized RMS error = 0.089. ● Runs fast in 2.4 wall clock minutes per day of simulation on 2400 TACC Frontera cores. **Global STOFS 2D Thermohaline engine transitioning to operations:** Coupling of ADCIRC, GFS-FV3, CICE and G-RTOFS/HYCOM using downscaling over a unified domain on heterogeneous meshes/grids. **Global STOFS 2D with NWM coupling and sub-grid scale floodplain:** Coupling of ADCIRC and NWM at external and internal network connections rainfall.
TOM SHYKA Northeastern Regional Association of Coastal Ocean Observing Systems Piloting a Model Visualization System 	**Model forecast visualization process with Pangeo:** ● Acquire forecast output from data providers in multiple formats and storage types. ● In the cloud, re-grid unstructured data, subset forecast output to reduce size, and catalog dataset API endpoints. ● Provide users with images for full forecast from selected layer, time series at a grid point, display in plots or tabular formats, and compare data types or different model output. **Why Pangeo:** The number of stakeholders as well as their interests and demands are growing. They want a variety of forecast outputs and the Pangeo community helps make scientific research and programming easier.
TRACY FANARA NOAA NOS Modeling	**User needs at the coast:** Safe, efficient navigation; protecting human health; coastal resilience, managing living marine resources; mapping and coastal management; and spill response and search and rescue. **Goal:** To move from coastal and estuarine models to full model coverage of the contiguous U.S., up to head of tide, with additional coverage of priority ports in Alaska, Hawaii, and U.S. territories. **NOS Modeling Strategic Plan**: Provides support to the NOS vision of leading a team of modelers from all over the world that will deliver a national forecast capability that provides accurate, reliable, and

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
 	timely coastal predictions that inform a wide range of decision-support user needs across space and timescales. **NOS Operational Forecast Systems:** These OFS have primarily been developed for the navigation community; however, their use can be broadened to help coastal communities facing growing economic, public health, and quality of life challenges (e.g., life-threatening severe weather, congested seaports, harmful algae and pollutant loading, ecosystem changes, and risks to infrastructure) due to sea level rise and high tide flooding. **Next steps:** NOS needs to decide: What are we going to deliver? Where do we want to improve? What changes need to be made? Which products will be developed and with which partners? **COMT:** One answer to these questions is the Coastal and Ocean Modeling Testbed (COMT). This program seeks to engage the academic sector in research-to-operations and has included projects such as the West Coast Operational Forecast System (WCOFS), Live Ocean, and the Chesapeake Bay model with hypoxia. A Coastal and Ocean Modeling Testbed Notice of Funding Opportunity (NOFO) will be released later in 2023.

JOHN WILKIN
Rutgers, The State University of New Jersey
How Community Modeling Can Support NOAA's Ocean and Coastal Missions

 	
	ROMs: The Regional Ocean Model (ROM) community has championed open collaboration since 2004.
	What's next:
	● Coupled/integrated Earth System and Biosphere Modeling:
	  ○ Our communities of practice still lack a common lexicon, appreciation of peer science needs, and interoperable tool-set.
	  ○ Hydrology, waves, littoral zone, ocean, atmosphere, biogeochemical, ecosystems.
	● Facilitating external research should be an operational deliverable: Open parallel operational environments and/or sandboxes for experimentation.
	● Capacity development:
	  ○ Write students and postdocs into every proposal.
	  ○ Rescue the best undergraduates from particle physics.
	  ○ Host focused workshops, training, testbeds: Doing, not talking.
	Workforce: Bring new people into the community by: (1) Writing students into proposals and, (2) As a reviewer, looking favorably on such proposals and facilitating side events and job-fair-type exchanges at conferences to share about the community.

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
PAT BURKE NOAA Operational Forecast Systems  	**What:** Operational Forecast Systems (OFS), continually build and refine our nation's capacity for a true operational oceanographic system by combining observations, models, predictions, and projections with the ability to readily disseminate high-quality information (e.g., documented quality assurance and quality control procedures) based on documented user needs. **Where:** NOS has 15 OFS that span our nation's oceans and Great Lakes for critical use in ports, harbors, and estuaries, and to support NOS' national backbone of real-time data, tidal predictions, data management, and operational modeling. **Why:** OFS provide the fundamental information for activities as varied as navigation, emergency response, and coastal management while also filling observations gaps in temporal and spatial coverage. **Challenges and emerging requirements:** ● Lack of real-time observations within coastal waters for data assimilation and model skill assessment. ● Need for better connections with observing systems inside and outside NOAA. ● Challenge to adequately resolve physical phenomena for both shelf deeper waters and shallow estuaries within the same model domain (e.g., mixing, eddies, stratification). ● Inconsistent accuracy of forcing conditions of freshwater, precipitation, heat flux, and offshore ocean boundaries. This will help with our coastal coupling efforts with the NWM. ● Missing standard or common methodology of skill assessment for global and regional/basin and coastal OFS. ● Emerging requirements from ecological and ice forecasting with input from the community. ● Expansion of predictive capabilities from short time scales to seasonal time scales. Even for short time scales, there is a need to extend the time horizon to 7 days. **NOS is enhancing and expanding the OFS by:** ● Building a data inventory and interacting with observing entities to exploit new technologies (e.g., federal agencies, IOOS Regional Associations, research community, CIROH, academia, etc.). ● Supporting and leveraging research and development: ○ Providing NOAA funding opportunities (e.g., COMT, NWI, UFS, etc.). ○ Filling gaps in spatial coverage. ○ Enhancing coupling and data assimilation of observations from satellite, glider, high frequency radar, Argo, drifters, and conductivity-temperature-depth profiles, etc.

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
	• Leveraging Bipartisan Infrastructure Law funding, collaborating with the coastal modeling community to develop a comprehensive and standard methodology and criteria for coastal ocean model skill assessment across a host of applications. • Collaborating with IOOS, Great Lakes Environmental Research Laboratory, and NOAA's National Centers for Coastal Ocean Science (NCCOS) on ecosystem forecasting. **Input:** Users want to interact with the community that creates these models so that the modelers know about and deliver on their needs. To make this happen, NOS needs to be nimble and transparent while also engaging continually with users. **A discussion highlight:** Cristina Forbes (USCG): I was looking at Pat's map of operational models and can see exactly our problem for search and rescue: There are no operational models in Florida, up the east coast, southeast Alaska, the Pacific. How can the community that creates these models interact with stakeholders like us to be able to meet our needs? Pat Burke (NOAA): We've struggled with national coverage for a long time. We were just appropriated some funding to start development in Florida and cover that gap and we will work with you on requirements. Tracy talked about the strategy we just developed and the upcoming implementation plan. We need to be more nimble and more transparent. We need to engage continually.
KELLY KNEE RPS North America OCEANSMAP 	**What:** OCEANSMAP aggregates and manages global, regional, and local environmental data and forecasts from disparate sources, applies community standards, and ensures availability for visualization, analysis, and decision support. **Goals:** 1. Facilitate decision making: integrate real-time observations and model forecasts. 2. Provide consistency: data access and presentation. 3. Improve communication: validation and uncertainty. **Audience:** 1. NOAA's Center for Operational Oceanographic Products and Services' navigation customers. 2. Offshore wind energy industry. 3. Regional WFOs and their customers.
TREY FLOWERS NOAA National Water Model 3.0 (NWM) Updates and	**NWM 3.0:** The NWM v.3.0 will be operational this summer and will include: (1) Total water level; (2) Expansion to Alaska; (3) National Blend of Models (NBM) forcing; and (4) Improved runoff module, parameters, calibration, and hydrofabric upgrades. **NWM 4.0:** Version 4.0, expected in 2025, will use the NextGen Framework that:

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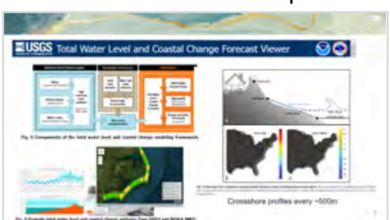
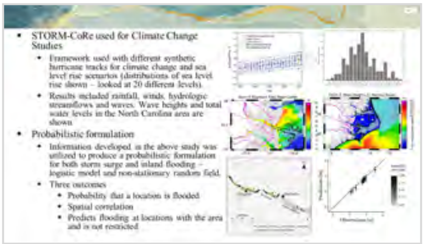
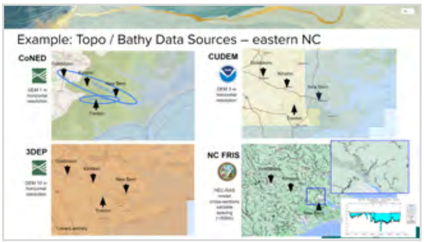
National Water Center (NWC) NextGen Coastal Modeling  	● Controls model runtime and execution; ● Reads input data and passes it to the models; ● Couples models via Basic Model Interface functions; and ● Writes output data from models. **NextGen** simplifies development, testing, calibration, and evaluation: ● Uses common resources to allow scientists to focus on the science rather than the tedium. ● Enables the right tool in the right location for the right reason. ● Thus, new models can be configured, calibrated, executed, and evaluated in minutes, not months. **Advantages:** (1) Saves time (run-times from months to minutes); (2) Reuses as much as possible (e.g., forcings and hydrofabric); and (3) Offers a reproducible, open-source workflow. **Outcomes:** ● Provides a single, guided interface for model setup, calibration, execution, and evaluation. ● Cleans up cognitive overhead so the user can focus on the domain science. ● Lets a user change the model for an experiment in mere minutes with a few clicks. ● Enables evidence-based decisions: right model, right place, for the right reason. ● Unlocks scientific investigations that were not previously possible.
SUDHIR SHRESTHA NOAA An Overview of the Current and Future Web and Data Service Program  	**What is coming:** In 2024, NOAA will unveil a greatly improved display of water resources information, which will include new tools to help partners and the public make critical water decisions. The National Water Prediction Service (NWPS) will be the primary source of NWS water resources information combining the functionality of two websites: Advanced Hydrologic Prediction Service (AHPS; water.weather.gov) and the National Water Center website (water.noaa.gov). When implemented, NWPS will be located at water.noaa.gov. **NWPS map features include:** ● Current/forecast status icons with gauge location pages. ● Quantitative Precipitation Estimate (QPE) display with pixel data values. ● NWM data, including stream reach, national land analysis, and national stream analysis anomaly. ● National snow analysis, including snow depth and snow water equivalent. ● Flood Inundation Map (FIM) forecast data, including River Forecast Center (RFC) 5-day forecast, NWM analysis, NWM 5-day forecast National Blend of Models (NBM) rainfall, NWM 5-day forecast Global Forecast System (GFS) rainfall. **API:** In addition, all NWPS data will be available via the new NWPS Application Programming Interface (API), which allows users to include NWPS information directly into their own applications and services.

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
PATRICK TRIPP + JONATHAN JOYCE RPS North America Related Insights and Opportunities 	**What:** In 2021 RPS was asked to create an API to provide access to the NWM forecast data. **The future:** ● RPS is committed to improving data access and updating the API. ● Improving data access using lessons learned from the NextGen Data Management and Cyberinfrastructure (DMAC) project prototyping. ● Upstream tracing. **Needs:** ● Feedback from the community regarding their needs: How do you use the data in your workflow? ● Users and testers: How can we improve things? Recommend capabilities and/or changes. ● Sharing of technical/implementation details: How do we go from point A to point B? **Enhance cloud data access:** ● Improve access to raw data by using "kerchunk" protocol to index data in buckets (https://github.com/fsspec/kerchunk). ● Keep optimized data up-to-date with the forecast output. ● Provide standardized (OGC-compliant) API access to subsetted data. ● Leverage community work (https://github.com/xpublish-community). ● Continue to test and optimize performance using real use cases from the community. **A discussion highlight:** Saeed Moghimi (NOAA): Do you also support the mesh structure? You're also looking into how we can efficiently kerchunk? Is your code shared so we can look and learn from it? Answer: Forecast data is point data. We have been able to kerchunk it. We do have DMAC NextGen repositories that are open to the public.
JOHN WARNER U.S. Geological Survey Coupled-Ocean-Atmosphere-Wave-Sediment Transport 	**What is new:** Developed a coastal coupled modeling system that can be used to study impacts of storms on coastal systems and to explore processes relevant to surge, flooding, morphological change. **What is needed:** To simulate coastal flooding and change, modeling systems need to consider: ● Riverine flooding. ● Urban storm drainage (sewershed). ● Wave breaking and setup. ● Groundwater elevations. ● Hydrologic processes (precipitation, infiltration, runoff, and evapotranspiration). ● Morphological change. ● Structures impacts. ● Small-scale features dominate the response.

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
KENDRA DRESBACK University of Oklahoma Development and Application of a Coupled Modeling System to Obtain Inland and Coastal Flooding for Coastal North Carolina Due to a Changing Climate for the NIST Community Resilience Project 	**What:** The goal of this research was to increase community resilience to natural hazards through integrated hazard and infrastructure modeling. **Outcome:** Results from validation showed good agreement between the best-track and optimized information. **What is needed:** ● More accurate bathymetry in the upland rivers. ● More encompassing statistical or empirical precipitation models that can capture the physics to drive hydrological responses for the climate change studies. ● Moving connections for the hydrologic/hydrodynamic models. **What is possible:** ● Brings in the inland areas to the probabilistic formulations when looking to elevate the coastal infrastructure. ● Land use changes in coastal areas can guide nature-based solutions to flooding and to development. ● Data, algorithms, and codes developed for the climate change studies can be optimized for efficiency and can be used by NOAA to fill a service gap in these flat coastal plain areas. ● Hazard work can be coupled to engineering models (like transportation) and social models (like who evacuates and why) to provide a more systematic approach for evacuation orders.
ASHLEY CHAPPELL NOAA Topography and Bathymetry Data Synergies 	**What:** Integrated Ocean and Coastal Mapping (IOCM) is the practice of planning, acquiring, integrating, and sharing ocean and coastal data and related products so that people who need the data can find it and use it easily: Map once, use many times. **Study results:** The 3D Nation Elevation Requirements and Benefits Study found that an improved national elevation program providing the elevation data needed by users has the potential to generate ~$13.5 billion in new benefits each year if fully operational. **Business uses:** The study also found the top businesses to be: ● Flood risk management. ● Water supply and quality. ● Coastal zone management. ● Natural resource conservation. ● Geologic assessment and hazard mitigation. **Status:** In 2022, 50% of the U.S. coastal, ocean, and Great Lakes seafloors remained unmapped at 100-meter resolution.

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
	Strategies for filling gaps: Partnerships, data sharing, and innovations in both data acquisition and processing continue to be critical elements for progressing U.S seafloor mapping goals. In particular, sharing your priorities, data, and funds by partnering on projects is critical: Contact Ashley Chappell: ashley.chappell@noaa.gov.
RICK LUETTICH University of North Carolina Topography / Bathymetry Challenges where Inland and Coastal Waters Meet 	**Problem:** ● Low slope coastal regions (e.g., Southeast U.S. and Gulf coasts). ● Flooding marine, hydrologic, or both. ● Hydrodynamics—bi-directional, compound. **Summary:** ● Models available / coming that can solve hydrodynamics of low slope coastal regions: ○ Flooding marine, hydrologic, or both. ○ Hydrodynamics—bi-directional, compound. ● High resolution topography DEMs seem reasonably accurate. ● Delineation of water centerlines (e.g., NHDPlus) needs improvement. ● Bathymetry is often either flat or reflects the water surface not the bottom (hydroflattening). ○ Currently hydroflattened areas are not identified in combined DEMs. ○ USGS CoNED group is working on shape file to identify hydroflattened areas. ○ NWM bathymetry also has limited accuracy—must be affecting results in these areas. ● States have bathymetry for river flood models that may provide help and should be integrated into DEMs. ● Additional data collection in gap areas—may not need bank-to-bank surveys.
COREY ALLEN + **SAEED MOGHIMI** NOAA Coastal Ocean Modeling and Coupling at NOAA's Office of Coast Survey	**OCS:** The work at the Office of Coast Survey (OCS) includes: ● Bathymetry. ● Coastal models. ● Coastal flooding and risk assessment. ● Coastal ocean model coupling.

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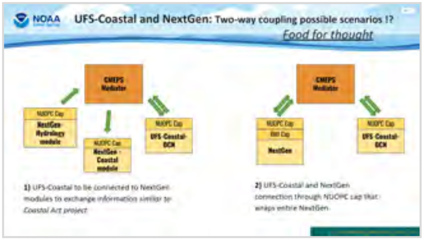

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Coastal ocean modeling includes:
<table>
<tr><th>Teams</th><th>Products and Services</th><th>Model</th><th>Geographic Domain</th></tr>
<tr><td>Operational Forecast System (OFS)</td><td>Hindcast, nowcast and forecast guidance of water levels, currents, salinity, and water temperature</td><td>Three Dimensional (3D)</td><td>Specific ports and bays</td></tr>
<tr><td>Storm surge modeling</td><td>Forecast guidance of total water levels, inundation, and currents</td><td>Three & two Dimensional (3D & 2D)</td><td>Global Ocean Basin</td></tr>
<tr><td>VDatum</td><td>Tidal datums and spatially varying uncertainty</td><td>Two Dimensional (2D)</td><td>Regional / Basin</td></tr>
<tr><td>Dissemination</td><td>Integrate data and information across NOAA and other federal agencies via web mapping services and map viewer</td><td></td><td>All of above</td></tr>
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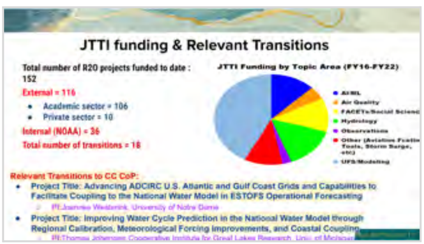
CHANDRA KONDRAGUNTA
NOAA
Opportunities with JTTI


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NOAA's Joint Technology Transfer Initiative (JTTI) charge: To transition the latest scientific and technological advances into the NWS operations.
FY2025 funding opportunities: Internal NOAA competition to be released in the third quarter of FY2024, noting that NOAA scientists can collaborate with cooperative institute scientists who can compete in the internal competition. The focus will be on weather modeling, including data assimilation, post-processing, and coastal coupling, etc.
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DAVID VALLEE
NOAA
Service Delivery and Training in CC CoP Activities

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What: Flood Inundation Mapping (FIM) services will greatly improve NOAA's ability to provide Impact-based Decision Support Services (IDSS) to core partners and coastal coupling will drive a more accurate inundation solution along the coast.
Requirements:

- Guidance must be accurate to meet the warning mission and must be from a trusted source.
- Modeling systems must run efficiently; and output must be delivered in a timely manner.
- Drive toward probabilistic services.

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LAURA REAR MCLAUGHLIN
NOAA
Partnerships & Opportunities

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About: The CC CoP is now more than 500 members strong.
Opportunities that have emerged so far:

- Develop wholly, or through partnerships with developments in progress, an approach for community members to find and access relevant model code and documentation.
- Develop wholly, or through partnerships with developments in progress, the framework to exchange information, share perspectives, and better align members' goals, and move our collective work in the same direction.
- Work with the new Resilience to Coastal Inundation Community of Practice.
- Amplify funding opportunities from the Bipartisan Infrastructure Law (BIL), Inflation Reduction Act (IRA), Cooperative Institute for Research to Operations in Hydrology (CIROH), and the Brennan Fund, among others.

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<tr><th>SPEAKER, AFFILIATION, TITLE, KEY SLIDE</th><th>HIGHLIGHTS</th></tr>
<tr><td>

MAOYI HUANG
NOAA
Earth Prediction Innovation Center (EPIC)

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What: EPIC has 3 major groupings of activities and objectives:

1. Community building.
2. Providing a testing environment where that community can go to contribute to the UFS research in the cloud, from pre- to post-processing.
3. Bringing innovations to the UFS—forecast skill and computational efficiency to determine whether these improve upon the forecast skill using an EPIC dashboard.

EPIC + UFS: NOAA is using a community modeling framework to develop their operational modeling systems. The UFS is composed of component systems—either model components or infrastructure components—and applications to make a computational model bundled with an end-to-end workflow.

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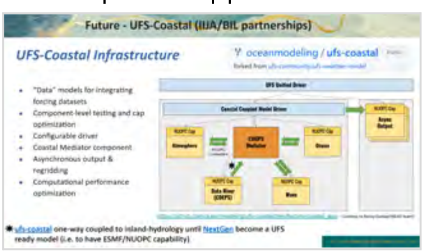
SAEED MOGHIMI
NOAA
NOAA National Ocean Service Coastal Ocean Models Coupling Infrastructure:
A Community-driven Development Approach



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What: CoastalApp is a National Unified Operational Prediction Capability (NUOPC) application implemented following UFS best practices to couple coastal ocean models and other domains (e.g., sea ice, atmosphere, wave, inland hydrology).

Potential timeline, pending agreements and alignment:

1. Stand-alone model development (~2024):
   - OWP would develop and validate the first version of NextGen.
   - NOS would develop and validate the first version of ufs-coastal.
2. One-way coupled (~2025):
   - NextGen develops Basic Model Interface (BMI) data models to import NOS coastal ocean models to enable one-way coupling from ufs-coastal to NextGen.
   - ufs-coastal would develop a CDEPS NUOPC data wrapper to enable one-way coupling from NextGen to ufs-coastal.
   - ufs-coastal team would support NextGen in designing NextGen NUOPC cap and/or BMI connection.
3. Two-way coupled (~2026):
   - NOS team will support OWP to start implementing NUOPC connectivity to BMI system.
   - Basic testing of two-way exchange between ufs-coastal and NextGen.
   - Prototype testing of the two-way coupled system.
   - Preoperational testing of the two-way coupled system.

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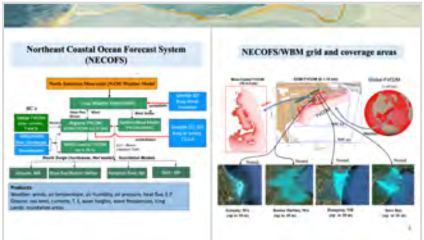
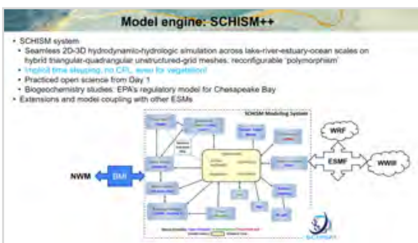
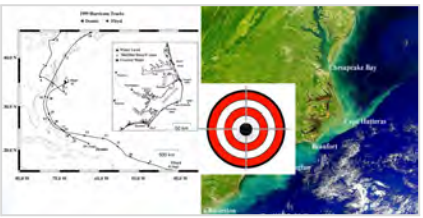
SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
CHANGSENG CHEN University of Massachusetts, Dartmouth Coupling Architectures of Northeast Coastal Ocean Forecast System (NECOFS) and the NWM 	**What:** This project will produce a two-way coupling of FVCOM and the NWM under a NUOPC framework. **How:** A three-stage development has been designed: 1. NWM-FVCOM. 2. NWM-FVCOM-WRF. 3. NWM-FVCOM-WRF-WW3. **Where:** Saco Bay, ME is the first testbed site for development. The coupler system will be applied to the Hampton River, NH, and then to the entire northeast U.S. Northeast Coastal OFS domain. **Other uses:** The two-way-coupling prototype developed in this project could be used for other unstructured grid models.
JOSEPH ZHENG Virginia Institute of Marine Science Demonstrating the Coupling Architecture with the Virginia Institute of Marine Science-developed Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM) 	**What:** SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) is an open-source community-supported modeling system based on unstructured grids, designed for seamless simulation of 3D baroclinic circulation across creek-lake-river-estuary-shelf-ocean scales. It uses a highly efficient and accurate semi-implicit finite-element/finite-volume method with Eulerian-Lagrangian algorithm to solve the Navier-Stokes equations in hydrostatic form to address a wide range of physical and biological processes. The numerical algorithm judiciously mixes higher-order with lower-order methods, to obtain stable and accurate results in an efficient way. Mass conservation is enforced with the finite-volume transport algorithm. It also naturally incorporates wetting and drying of tidal flats. **The future with UFS:** ● The team completed the implementation of SCHISM's NUOPC cap and NEMS driver in collaboration with NOAA within the CoastalApp NEMS/NUOPC GitHub repository. ● Validation with Shinnecock Inlet shows that the SCHISM cap and driver worked as expected (also included in the CoastalApp-testsuite GitHub repository). ● On-going work: working with the WaveWatch III (WW3) team to finalize the coupling with WW3. **Preparation for two-way coupling:** ● Hydrologic flow over complex topography can generate undesirable high elevations near the land boundary (injection points) especially under high flow conditions. ● Adding feeder channels near the boundary alleviates the high elevations.

SPEAKER, AFFILIATION, TITLE, KEY SLIDE	HIGHLIGHTS
LEN PIETRAFESA North Carolina State University A Brief History of Forecasting in the USA and the Goal of Establishing Validated, Reliable Operational Forecasts of Interactively Coupled – Compound Coastal, Inland & Upland Flooding: Thus, Connecting the NWC to CIROH and the NWM to the Ocean 	**About:** CIROH has the potential to establish the totality of operational hydrologic forecasting within the NWS and NOAA. **To be determined:** Can CIROH cross the “valley of death” (i.e., make the transition from research to operations) related to compound coastal-inland-upland flooding?
STEVE BURIAN University of Alabama Leveraging the Cooperative Institute for Research to Operations in Hydrology (CIROH) 	**Goals of the Cooperative Institute for Research to Operations in Hydrology (CIROH):** ● Support the NWC’s mission to deliver a new generation of water data and services. ● Advance research supporting NOAA’s vision of a climate-ready nation. ● Mobilize a community of practice to co-produce innovative research and education. **CIROH research themes:** ● Advancing water prediction systems and workflows. ● Developing community water modeling frameworks. ● Water data science and hydroinformatics solutions. ● Designing forecasts for community resilience. **Participating:** Everything CIROH is doing is open-source, which provides opportunities for institutions from outside of the institute to participate. **Communities of practice:** CIROH is going to establish four communities of practice, ideally in partnership with the Coastal Coupling Community of Practice.

APPENDIX B • LEARNING FROM THE FACILITATED SESSIONS AND QUESTIONNAIRES

Facilitated discussions, in plenary and breakout sessions, occurred throughout the meeting and questionnaires were distributed periodically. The responses below were synthesized, abridged, and lightly edited from discussions and questionnaires. Bolded subheads were inductively derived.

B.1 CHALLENGES IN COASTAL COUPLING

Question #1.1 (in plenary): If you could solve any one challenge in coastal coupling, which would you pick?

PLENARY, INCLUDING CHAT		
Data: Consistent observational data requirements and uncertainty definitions. Consistent topography/bathymetry data quality/resolution across domains, all global coasts, that is available to and used by the whole community. Reliable and accurate vertical datum information for every model, gauge, tidal station. **Computing:** Scalable big data computing resources. Solving pre-emption speeds for real-time tsunami inundation modeling. Accessible shared working environment for data and processing (physical and high-performance computing).	**Modeling:** Better and modern coupling software interfaces. Generating high-quality meshes. Addressing uncertainty with coastal coupling across all time scales from now to multi-decadal. Ability to provide precipitation characteristics by storm type (historical and future), freshwater transition zone predictions, and water-quality information. **Service delivery:** Moving to probabilistic services for coastal inundation prediction. Process to understand how different end users want to interact with model output. Total water level accuracy in accessible, user-friendly services.	**Funding:** Solve the challenge of baseline funding support from research and development through operations to maintain sufficient capability. Continued and stable research-to-operations-to-research sources of funding. Sufficient base funding (e.g., non-supplemental) to sustain current and future models, developments, developers. **Workforce:** Hiring and maintaining the right people. Skilled, numerate students and postdocs to join in the work. **Strategy:** Know which models are getting coupled given the numerous extant models. Connect CC CoP with other coastal- and hazard-focused programs such as the U.S. Coastal Research Program and the natural hazards engineering research infrastructure (e.g., National Science Foundation-funded facilities, both experimental and modeling).

Question #1.2 (per questionnaire): In particular, if one challenge in coastal coupling could be instantaneously resolved, which challenge would you select?

QUESTIONNAIRE		
CLEAR TIMING, SCHEDULE, AND CAPABILITIES OF OPERATIONAL MODELS **Big picture:** Everyone in the coastal and ocean modeling and UFS Coastal Applications communities need to know the timing and schedules for the next implementation of coastal and ocean models operationally AND they need to know the development needs AND they need know the schedule for development upgrades AND they need know the way to participate new capabilities AND these players need connections to users on an ongoing basis. **Advocacy:** Overcoming the task of having to persuade others about the importance and complexity of coastal modeling.	**COMPLETE AND CONSISTENT DATA** **Bathymetric source:** Singular bathymetric source with uncertainties—accurate and comprehensive topography/bathymetry (e.g., digital elevation models, stream vectors). Accurate delineation of streams/rivers and associated bathymetry. **Contributing data:** Knowing the NOAA standards for incorporating data collections from non-NOAA organizations. **Vertical datums:** Accurate vertical datums for all gauges and bathymetry/topography datasets, in an orthometric datum with a specified geoid (e.g., NAVD88 with Geoid18). **Modeler requirements:** Meeting the data needs of modelers.	**FOCUS ON TWO-WAY COUPLING** **Optimization:** Optimization of model coupling. **Couple:** Couple current-wave models; Dflow-FM with hydrologic and ocean models; and near-real-time river discharge with coastal hydrodynamics. Couple NWM into an estuary model. **Improve models:** Include or improve information about landfast ice extent and duration; near-real-time freshwater discharge to the coastal ocean (~10 km scale) from hydrological routing analysis of operational weather forecasts (similar to Copernicus GloFAS); total water level; water quality model; automated flux exchange between hydrology and coastal models without double counting. Appropriate online tidal self-attraction and loading in regional ocean models. Addressing transition zones. **Two-way coupling architectures agreement:** Concurrence on which architecture to use for dynamic (two-way) coupling so it can be leveraged to improve operational skill before becoming obsolete. **One-stop shop:** Content in one publicly-available online location, especially data and processing. **Notional standards for a coupling framework:** Transparent information flow among components. Reliable and easy-to-use coupler. Unified coupling platform that works for various operational systems. Share coupling program among different modeling teams.
CONSISTENT STANDARDS FOR OPTIMIZATION, EVALUATION, VERIFICATION, AND VALIDATION **Optimized code:** Optimization of code, especially to run efficiently on NOAA's Weather and Climate Operational Supercomputing System. **Verification:** Standards and data.	**ALSO** **Wind prediction given wind farms:** Adding algorithms and parametrizations to accurately predict winds and currents in wind farm areas that will be constructed offshore along the U.S. coasts. **Funds to buy out homes:** Increased funding for grants to coastal communities to buy out homes and businesses and remove populations from high-risk coastal areas. **Precipitation forecasts:** Storm-type-based precipitation-frequency and precipitation forecasting and handling mixed distributions. **Coastal prediction:** Increasing confidence in long-term coastal prediction and projection incorporating information from global climate models.	

B.2 PRIORITY ACTIVITIES FOR COASTAL COUPLING

Question #2.1 (in plenary): Who heard activities that the community should take on? Any activities to stop?

PLENARY, INCLUDING CHAT	
Potential activities to begin: Code management standards, location, communication, version control, and/or master index. Data access.	**Potential activities to end:** Overlapping research. Facilitators' note: Participants were invited to offer specific examples of overlap, but none were provided.

Question #2.2 (in plenary): Given the meeting so far, what would you pick as the top priorities for coastal coupling?

GROUP 1	GROUP 2	GROUP 3
Repository: Store and make data available in one place. **Data:** Make more data available, including historical datasets, in standardized formats with proper quality control and quality assurance protocols. **Ownership:** The coastal community needs an independent and trusted voice for the coastal modeling community and the public who reside in coastal areas.	**Models:** ● Coupling hydrological coastal models and modeling in the transition zone. ● Systematic approach for model validation and performance evaluation that is also helpful for inter-model comparison. ● Data assimilation (DA): (1) How would shelf-wide DA inform coastal downscaling? and (2) Where is the research on DA in estuaries? ● Water quality and implications and impacts on estuaries, ecosystem, fisheries, etc. **Workforce** and scientific training for the next generations of students and cross-over career development.	**Communications:** ● Feedback from users on their model needs and requirements is needed to drive model updates. ● Need an interactive interface to address the varying scope of stakeholder needs. ● Need a repository of tools to better share with the public. **Models:** Need: 3D models and more observations (especially water temperature) to feed into the models and for model validation; to adjust the coupling community beyond coupling to hydrologic models; and to add wind farms into the coastal forecast models.

Question #2.3 (in breakouts): For your work, who do you think of as your primary beneficiaries and/or stakeholders? Who cares about your work? Who depends on the data, analysis, or information you provide?

GROUP 1	GROUP 2	GROUP 3
Primary stakeholders/beneficiaries include floodplain managers, state departments of transportation, planners, wastewater treatment facilities, and individuals and businesses in harm's way.	**Well-served stakeholders** include emergency responders, weather forecasters, NOAA's Office of Response and Restoration. **Need improved solutions for:** ● Coastal operational forecast models.	**Shared platforms** for work, data, and/or processing. **Clear approach** for transitioning.

B.2 PRIORITY ACTIVITIES FOR COASTAL COUPLING

Building trust and confidence with stakeholders by: (1) Bearing in mind their questions, issues, and concerns; and (2) Communicating regularly on information related to their questions, issues, and concerns.	• Hydrologic-marine transition zone models. • Service delivery/decision support. • Communication about the models available.	

B.3 BEST PRACTICES AND OPPORTUNITIES FOR TRANSITIONS

Question #3.1 (in breakouts): Given the meeting so far, what do you pick as the top priorities for integrating community-developed innovations into operations?

GROUP 1	GROUP 2	GROUP 3
Infrastructure: Refine research priorities to avoid too many priorities and then agencies need to make funding available for those priorities. **Attachment points:** Need people in agencies who are actively soliciting and creating a pipeline of innovations. Need a champion of the pipeline and a process in each agency. **Communications** need to happen early and often in the transition process. Technology can help improve that process.	**Communications:** Use transition plans as communications tool to bridge the gap between the research and operations communities. Be active and intentional about these communications, including being clear about what NOAA intends to do and not do. **Integrated research and operations:** Improve transition planning to connect research and operations communities. **NWM:** Coupling the NWM to the UFS.	**Communications:** Need to use: (1) A platform like GitHub to facilitate collaboration, including code sharing in step with NOAA's changes while ensuring that stakeholder needs are routed to the right place so they can be wrapped into research-to-operations; and (2) LinkedIn to attract people to the CC CoP activities. **Integrated research and operations:** Transitioning to NOAA is a huge undertaking when the researchers are outside of the NOAA system.

Question #3.2 (in breakouts): Which activities and projects would ensure ongoing progress on integrating community-developed innovations

B.3 BEST PRACTICES AND OPPORTUNITIES FOR TRANSITIONS

into operations?

GROUP 1	GROUP 2	GROUP 3
Sample potential activities: ● Improve the use of transition plans as a communication tool to bridge the gap between research and operations communities. ● Offer shared communication tools (e.g., a wiki or Slack channel).	**Sample potential activities:** ● Testbeds. ● Coastal flooding and inundation mapping. ● Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA)-funded projects. ● Committed capacity for code management and version control. ● Ongoingly, consistent community relationships to continually improve code.	**Sample potential activities:** ● Leverage the EPIC work. ● Build from the UFS-coastal projects. ● Include wind farms in coastal models.

APPENDIX C • LEARNING ABOUT THE COMMUNITY

As one of the sponsors for the Coastal Coupling Community of Practice (CC CoP), the National Oceanic and Atmospheric Administration (NOAA) is celebrating the community's 5th anniversary by learning more about the current state of the community.

The inquiries and analyses described in this document were intended to: (1) Understand how community members are connecting with each other; and (2) Identify the models, challenges, and/or projects members are collaborating on. The resulting information makes it possible to prioritize strategic engagements, communications, and activities that address the CC CoP's mission: "Coupling of models to better represent earth system processes across the coastal zone and provide improved predictions of quantities such as water levels, flow timing and duration, currents, sediment, water quality variables, geomorphic changes, etc...." (Charter 2019).

CONTEXT Participants in the Coastal Coupling Community of Practice Annual Meeting 2023 were queried via an emailed link: Surveyed = 424 • Responded = 46 • Response Rate = 11%. The responses, below, are synthesized, abridged, and lightly edited; bolded subheads were inductively derived.

WHAT WAS DONE Participants answered via a Google Forms questionnaire.

CAUTIONS Response rates were high compared to current standards but low for generalizability.

TAKEAWAY #1 • THE NUMBERS: In just 5 years, the community has grown by a factor of 7, from 69 to 515 individual members.

TAKEAWAY #2 • PER RESPONDENTS, SAMPLES OF BIGGEST CHALLENGES GENERALLY:

Modeling challenges such as knowing which goals, standards, and models will have National Unified Operational Prediction Capability caps, and when; getting water temperature outputs from the NWM; having high-quality, reliable, up-to-date topography/bathymetry data everywhere, including sub-grid parameterization and tools for bathymetry generation, especially for small rivers.

Data challenges such as having accurate historical and verification data; data assimilation tools and standards; and open access to data that are continuously updated and available without storage constraints.

Funding and policy challenges such as maintaining baseline funding for research and development through operations and maintenance; funding data acquisition; and having a holistic understanding of the work going in this space and how it interconnects.

Workforce challenges such as finding more skilled students and additional labor.

Societal challenges to answer decision maker questions such as identifying which coastal communities and cities will be inundated in the next 25-30 years; having flooding thresholds that are feature-based not impact-based; and having accurate short-term inundation forecasts.

TAKEAWAY #3 • PER RESPONDENTS, SAMPLES OF BIGGEST CHALLENGES RELATIVE TO COASTAL COUPLING:

Need a clear big picture, including ensuring that everyone in the coastal and ocean modeling community knows the timing and schedules for the next implementations of coastal and ocean models operationally and the development needs and upgrade schedules. Everyone agrees about the importance and complexity of coastal modeling.

Need complete and consistent data, including a singular topographic/bathymetric source with uncertainties, and accurate and comprehensive topography/bathymetry (e.g., digital elevation models, stream vectors).

Need to focus on two-way coupling, including coupling among hydrologic and hydrodynamic processes; optimizing and improving models; and making agreements about two-way coupling architectures and/or notional standards for coupling frameworks.

Need consistent standards for optimization, evaluation, verification, and validation, including optimization of code and verification standards and data.

TAKEAWAY #4 • PER RESPONDENTS, CONNECTIONS AMONG ORGANIZATIONS AND MODELS: The 46 respondents connect with the models as depicted in this sociogram:

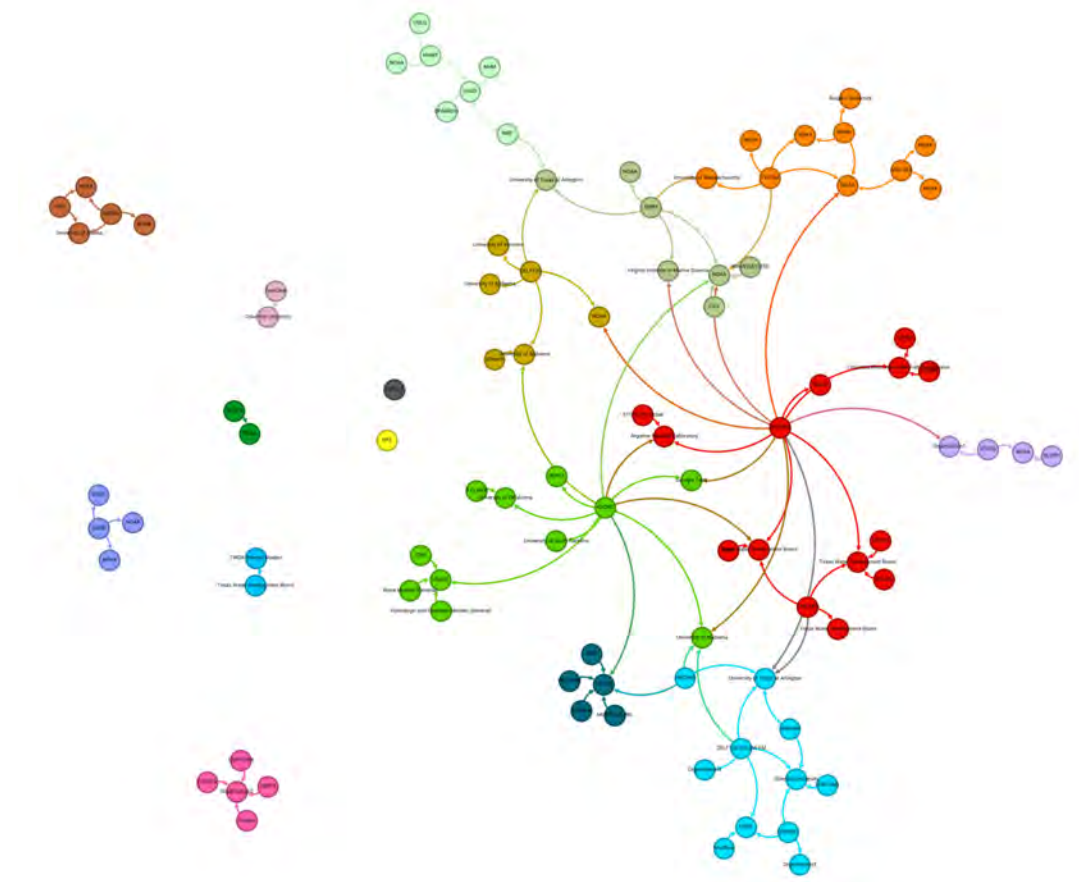


Figure: Sociogram of self-reported organizational connections to models (Surveyed = 424 • Responded = 46 • Response Rate = 11%). Generated in Gephi version 0.10.1.

TAKEAWAY #5 • GEOGRAPHIES: Per the 46 respondents, their work and models are focused on the following areas:

Figure: Map of self-reported geographies studied (Surveyed = 424 • Responded = 46 • Response Rate = 11%). Generated in Tableau version 2023.2.

APPENDIX D • PARTICIPANTS

(in alphabetical order)

NAME	ORGANIZATION
Ali Abdolali	NOAA
Curtis Alexander	NOAA
Michael Alexander	NOAA
Jose Algarin	NOAA
Corey Allen	NOAA
Jon Allen	NOAA
Alper Altuntas	University Corporation for Atmospheric Research (UCAR)
Hernan Arango	Rutgers University
Krisa Arzayus	NOAA
10 Rebecca Atkins	NOAA
Taylor Barnhart	NOAA
Daniele Bianchi	University of California, Los Angeles
Cheryl Ann Blain	U.S. Naval Research Laboratory
Maureen Brooks	NOAA
Steve Burian	University of Alabama
Pat Burke	NOAA
Jason Caldwell	United States Army Corps of Engineers
Kemal Cambazoglu	University of Southern Mississippi
Degui Cao	NOAA
20 Jessie Carman	NOAA
Meredith Carr	U.S. Army Engineer Research and Development Center (ERDC)
Felicio Cassalho	NOAA
Ashley Chappell	NOAA
Arun Chawla	NOAA
Changsheng Chen	University of Massachusetts, Dartmouth
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APPENDIX E • ACRONYMS

ACRONYM	TERM
ADCIRC	ADvanced CIRCulation Model
AHPS	Advanced Hydrologic Prediction Service
API	Application Programming Interface
BIL	Bipartisan Infrastructure Law
BMI	Basic Model Interface [of the National Water Model]
BOR	Bureau of Reclamation
CBEFS	Chesapeake Bay Environmental Forecasting System
CC CoP	Coastal Coupling Community of Practice
CDEPS	Community Data Models for Earth Prediction Systems
CHS	Coastal Hazards System
CICE	The Los Alamos Sea Ice Model
CIROH	Cooperative Institute for Research to Operations in Hydrology
COAWST	Coupled-Ocean-Atmosphere-Wave-Sediment Transport Modeling System
COMT	Coastal and Ocean Modeling Testbed
CoNED	Coastal National Elevation Database [Applications Project]
CO-OPS	NOAA's Center for Operational Oceanographic Products and Services
CRI CoP	Coastal Resilience to Inundation Community of Practice
DA	Data Assimilation
DEMS	Digital Elevation Models
DoD	Department of Defense
DMAC	Data Management and Cyberinfrastructure [Project]
ECCOFS	East Coast Community Ocean Forecast System [per Rutgers]
EMC	NOAA's Environmental Modeling Center
EPIC	NOAA's Earth Prediction Innovation Center
FEMA	Federal Emergency Management Agency
FIM	Flood Inundation Map
FVCOM	Finite Volume Coastal Ocean Model
GFDL	NOAA's Geophysical Fluid Dynamics Laboratory
GFS	Global Forecast System
GLOFS	Great Lakes Operational Forecast System
HABs	Harmful Algal Blooms
HEC HMS	Hydrologic Engineering Center Hydrologic Modeling System
HEC RAS	Hydrologic Engineering Center River Analysis System
HFR	High Frequency Radar
ICAMS	Interagency Council for Advancing Meteorological Services

ACRONYM	TERM
IOOS	Integrated Ocean Observing System
IRA	Inflation Reduction Act
JCSDA	Joint Center for Satellite Data Assimilation
JEDI	Joint Effort for Data Assimilation Integration
LISFVCOM	Long Island Sound Finite Volume Coastal Ocean Model
MOM	Modular Ocean Model
NASA	National Aeronautics and Space Administration
NBM	National Blend of Models
NECOFS	Northeast Coastal Ocean Forecast System
NEMS	NOAA Environmental Modeling System
NHDPlus	National Hydrography Dataset Plus
NHM	National Hurricane Models
NOAA	National Oceanic and Atmospheric Administration
NOFO	Notice of Funding Opportunity
NOS	NOAA's National Ocean Service
NRL	Naval Research Laboratory
NSF	National Science Foundation
NUOPC	National Unified Operational Prediction Capability
NWC	National Water Center
NWM	National Water Model
NWPS	National Water Prediction Service
NWS	NOAA's National Weather Service
OFS	NOAA's Operational Forecast Systems
OWP	NOAA's Office of Water Prediction
PI	Principal Investigator
PQPF	Probabilistic Quantitative Precipitation Forecasts
R2O	Research to Operations
R2O2R	Research-to-Operations-to-Research
RFC	River Forecast Center
ROMS	Regional Ocean Modeling System
SCHISM	Semi-implicit Cross-scale Hydroscience Integrated System Model
SFINCS	Super-Fast INundation of CoastS
SIS2	Sea-Ice Simulator
SLOSH	Sea, Lake, and Overland Surges from Hurricanes
SPARROW	SPAtially Referenced Regression On Watershed [attributes]
SPEAR	Seamless System for Prediction and EArth System Research
STOFS	Surge and Tide Operational Forecast System

ACRONYM	TERM
STWAVE	Steady-State Spectral Wave Model
SUNTANS	Stanford Unstructured Non-hydrostatic Terrain-following Adaptive Navier-Stokes Simulator
TWDB	Texas Water Development Board
UFS	Unified Forecast System
UNC	University of North Carolina
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
WCOSS	Weather and Climate Operational Supercomputing System
WFO	Weather Forecast Office
WRF-HYDRO	Weather Research and Forecasting Hydrologic [model]
WW3	WaveWatch III