Developing Collaborative Solutions for Continental-Scale Integrated Water Prediction

COASTAL COUPLING COMMUNITY OF PRACTICE

MEETING SUMMARY
MAY 12-13, 2020

On May 12-13, 2020, nearly 100 participants gathered virtually for the second annual gathering of the Coastal Coupling Community of Practice (CC CoP). A summary of the meeting is below.

Meeting Goal

The goal of the meeting is to maintain engagement between Federal agencies and model developers that supports collaborative solutions for continental-scale integrated water prediction. To identify the priorities for engagement, participants will discuss technical advocacy points and data needs (Day 1). To continue the engagement efforts over the last year, participants will engage in a facilitated discussion informed by experience- and research-guided best practices (Day 2).

Objectives

1. Review the community progress to date.
2. Determine community needs and how to address them.
3. Discuss the need for shared consistent data sets, what data is needed, and the methods to achieve a centralized repository.
4. Discuss gathering stakeholder requirements and how to translate this into model requirements.
5. Identify future engagement opportunities and the timeline for sustained engagement.

MAY 12, 2020

JESSE FEYEN | Keynote: What's going on at GLERL (slides pending review)
Jesse Feyen noted that, as a closed system, the Great Lakes make a prime testbed for coastal coupling, including surges, seiches, circulation, waves, ice, river inflow, water quality, harmful algal blooms, and weather effects. To that end, the Great Lakes Operational Forecast System (GLOFS), which aims to provide improved predictions of water levels, water currents and water temperatures in the five Great Lakes, is preparing to couple with other NOAA products, including:

- High-Resolution Rapid Refresh-Finite Volume Community Ocean Model (HRRR-FVCOM), with 2-way coupling slated for June 2020 (HRRRv4 ops will read FVCOM-CICE for surface conditions);
- Harmful Algal Bloom Tracker, slated for June 2020;

- Finite Volume Community Ocean Model-Community Ice Code (FVCOM-CICE), slated for 2022; and
- National Water Model (NWM), FV3, Wave Watch III (WW3) are all yet to be scheduled.

For example, GLOFS is in the midst of being upgraded to include the first-ever ice forecasts for the lakes, which will support commercial navigation, U.S. Coast Guard ice cutting operations, U.S. Coast Guard Search and Rescue Optimal Planning System, and drinking water plants. Results from this project will support ongoing efforts on coastal coupling with the NWM and improvements to lake-effect precipitation in short-range weather forecast models (e.g., HRRR). GLOFS is also linked to the Lake Erie Operational Forecast System and Harmful Algal Bloom (HAB) satellite imagery, which is updated daily and provides information on the current extent and trajectory of HABs. This product is scheduled to transition to operations at NOAA CO-OPs in June 2020.

During the question and answer period, Dr. Feyen noted that some products are still in development (e.g., coupling GLOFS to the NWM, and coupling the HAB tracker to the NWM). Additionally, coordination is necessary between the U.S. Army Corps Water Management Tools and the NWM.

JOHN WARNER | Keynote: What's going on at USGS (slides 9-28 in the master slide set)
While the U.S. Geological Survey (USGS) has programs/projects that focus on the major stakeholder needs identified by the CC CoP, John Warner focused on the following USGS activities: data collection and modeling.

Data collection activities for coastal topography include structure from motion (SfM, a technique that utilizes a series of 2-dimensional images to reconstruct the 3-dimensional structure of a scene or object) and LiDAR. Using these two datasets, the USGS is (1) computing coastal change metrics for North and South Carolina including dune crest and toe, beach slope and width, shoreline change, and beach and dune volume change; (2) sharing this information with the Coastal National Elevation Database (CoNED) Applications Project, which develops enhanced topographic (land elevation) and bathymetric (water depth) datasets that serve as valuable resources for coastal hazards research and Earth science applications; and (3) developing Total Water Level at the coast, in association with NOAA products (e.g., ESTOFS).

USGS has developed the Coupled Ocean – Atmosphere – Wave – Sediment Transport (COAWST) Modeling System to investigate the impacts of storms on coastal environments. The concept for this coupled modeling system (which recently added hydrologic models) is to allow for the study of compound flooding. USGS is in the beginning stages of coupling ROMS to WRF-Hydro to increase its ability to predict compound flooding.

FACILITATED | Community Needs - Help Us Help You (slides 29-36 in the master slide set)
As pre-work, the CC CoP members completed a survey that was designed to better understand community needs. The members ranked each item on a scale of importance for 1 (high priority) to 3 (low priority). The averaged results are below, with those closest to 1.0 deemed as the highest priorities:

01. Easily accessible, open-source, quality-controlled data at high resolution that is updated with a regular frequency for model initialization, verification, and validation (1.27)

02. Governing framework to establish guidelines/best practices for cooperative methods and technical collaboration (1.42)
03. Collaborative environment (e.g., testbed) with interdisciplinary teams working together (1.44)
04. Stakeholder needs to inform model development (1.45)
05. Well-organized documentation of use or test cases (1.50)
06. Flexible architecture to add new models in a coherent framework (1.50)
07. Transparent pathway to transition models into operations (1.52)
08. 3D modeling in the coastal transition zone (1.68)
09. A well-defined grand challenge (1.71)
10. Common definitions for ambiguous terminology (1.82)

Ideas generated for next steps to address these priorities included:

- Priority #1: Approaching NOAA's National Centers for Environmental Information (NCEI) for data
- Priority #2: Receiving an update on the governance structure selected by NOAA's Earth Prediction Innovation Center (EPIC)
- Priority #4: Receiving an update from Ellen Mecray on the options being reviewed by NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) for managing stakeholder requirements
- Priority #5: Selecting 2-3 different regions for test cases (e.g., Great Lakes, Delaware Bay), noting that different areas may require different processes
- Priority #6: Reviewing NOAA's Office of Water Prediction test case using different models in a single data layer: https://github.com/NOAA-OWP/ngen
- Additional Needs: Securing additional rain gauges; in particular, precipitation measurements are lacking in the flood transition zone
- Additional Needs: Creating/leveraging training plans for model configuration and validation as well as the products and services that are developed as a result of model implementation
- Additional Needs: Developing model output visualization guides, including what are the different tools, under what circumstances these tools are effective, what kind of bandwidth is needed to produce these visualizations

BREAKOUT GROUP REPORTERS | Report Out

Based on the most commonly heard need of more/better/accessible data, the participants broke into five groups to discuss their data needs. A summary of the discussion questions and responses follows. The notes from each group are also available: Group 1, Group 2, Group 3, Group 4, Group 5.

What data are needed?

- River bathymetry/topography
- Stream gauge observations, including high data mark
- Validation and initialization data to support models
- Wave and water currents observations
- Land cover
- Precipitation/water level/streamflow/discharge data (including drought conditions)
- Water quality/temperature
- Wave data sets, especially in nearshore regions

- Wind
- Social science data

What of the identified data already exists?
Examples of data that already exist include:

- Bathymetric/topographic
    - NCEI (NOAA)
    - US Army Corps also has the eHydro database
    - Datums
- Land cover
    - NASA
    - https://coast.noaa.gov/digitalcoast/
- Water level/streamflow/discharge data
    - Coastal buoys from NOAA
    - NOAA PORTS- water current and water level datasets
    - Texas Coastal Ocean Observatory Network (TCOON)-NOAA CO-OPS
- Wave data sets
- Water quality
- Water currents
    - Coastal buoys from NOAA
    - NOAA High-frequency radar network for surface current
- Wind
    - NOAA CoastWatch includes this (surface winds): https://coastwatch.noaa.gov/cw/index.html

What doesn't?

- Metadata standard adoption
- Future precipitation data for modeling climate change impacts (probabilistic)
- Atlas 14 projected into the future

How can we address the needs identified in the first breakout session?

- Ensure discoverability of data sets (Too many repositories, no central search)
- Provide metadata standards and/or examples
- Reach out to specific groups for input (e.g., universities, state and local entities, IOOS and IOOS Regional Associations, Cloud and Big Data projects)
- Apply A.I. from imagery and other remotely sensed data to derive missing data (including uncertainty and confidence)
- Provide base funding for certain projects (i.e., data collection for non-named as well as named storms) that are currently only funded through supplementals

What are individual members willing to contribute (e.g., Community expectation to provide data)?

- IOOS has a national catalog
- Share knowledge and experience with low-cost observation solutions for R&D
- Share crowdsourcing data/techniques

How can the community own this data need?

- Select a central public repository for uploading data
- Set metadata standards

- Ensure discoverability of data sets
- Include industry in the CC CoP
- Engage research testbed partnerships across this community and external partners
- Involve the broader community to support data collection in areas with low population counts

CLINT DAWSON/JERAD BALES/DEBRA HERNANDEZ/DOUG MARCY (OCM) | Lightning talks on example data repositories (slides 41-76 in the master slide set)
To help the participants think about building out data infrastructure, four experts addressed the participants about how their platforms share files/data/results with collaborators.

- **Design Safe (Clint Dawson).** DesignSafe is the web-based research platform of the Natural Hazards Engineering Research Infrastructure (NHERI) Network that provides the computational tools needed to manage, analyze, and understand critical data for natural hazards research. (For more information, see https://www.designsafe-ci.org/)
- **SECOORA (Debra Hernandez).** The SECOORA Data Portal is a data exploration tool with a customized public web interface that allows scientists, managers, and the general public to discover and access Southeast U.S. coastal and ocean data. (For more information, see https://portal.secoora.org/)
- **HydroShare (Jerad Bales).** HydroShare is the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)'s web-based hydrologic information system for users to share and publish data and models in a variety of flexible formats, and to make this information available in a citable, shareable and discoverable manner. (For more information, see https://www.hydroshare.org/)
- **Digital Coast (Doug Marcy).** The Digital Coast website provides not only coastal data, but also the tools, training, and information needed to make these data truly useful. Content comes from many sources, all of which are vetted by NOAA. (For more information, see https://www.coast.noaa.gov/digitalcoast)

MAY 13, 2020

AUDRA LUSCHER | Path Forward
Audra Luscher noted that the CC CoP has nearly tripled over the last year, with membership now at ~150 members strong. Audra also laid out the big picture next steps stemming from Day 1 of the meeting. In particular, the needs expressed by the CC CoP, particularly those around data, will be brought to the CC CoP leadership team for their input and expertise on leveraging activities already underway that would respond to the needs expressed and/or potentially resourcing projects directly through the federal agencies or through revised granting mechanisms. Additionally, the leadership team will ensure that priorities identified by the CC CoP are priorities identified by the NOAA Water Initiative Objective Teams (especially the Observations Team and the Modeling Team).

FACILITATED | Developing Capabilities to Serve our Stakeholders (slides 87-105 in the master slide set)
Since the inception of the CC CoP, stakeholder requirements have been identified as the necessary starting point for future model development in the coastal zone. In this session, three experts provided different perspectives of gathering stakeholder feedback.

Digital Coast (Brenna Sweetman). The Digital Coast Partnership consists of eight national organizations that work with NOAA to ensure coastal managers have the relevant data, tools, and information they need in order to make informed coastal resource decisions. This partnership unifies groups that might not otherwise work together and supports forums that allow coastal professionals to learn and collaborate on key coastal issues. The Partnership is continuously evolving as it works with constituent groups to understand additional information needs

CASCaDE: Computational Assessments of Scenarios of Change for the Delta Ecosystem (Lisa Lucas). CASCaDE uses process-based computational models of hydrodynamic and ecological functioning in the San Francisco Delta to anticipate ecosystem response to changes in climate, water supply, and land use. CASCaDE Team members include multiple USGS offices, academia, and non-profit, all of whom are plugged into the regional science and management community in their own disciplines and beyond. The keys to stakeholder engagement include understanding the state of the system and the science; and knowing the players by engaging in long-term relationships and by being part of the community.

Northeastern Regional Association of Coastal Ocean Observing Systems (Tom Shyka). One key function of the Integrated Ocean Observing System Regional Associations is to understand regional stakeholder needs so that observation systems can be designed and operated that respond to those needs. For example, the Coastal Ocean and Modeling Testbed gathers together NWS regional forecasters, state coastal zone managers, emergency managers, U.S. Coast Guard response personnel, and agency and academic modelers to document stakeholder requirements, develop transition plans, and improve delivery and use of model products. The benefits to stakeholders from this type of coordination include streamlined access to predictions they need and in the format they can use; the benefits to modelers include additional feedback on model skill, and more interest, use, and support for model development and operations.

FACILITATED | Annual CC CoP Engagement Plan

While the CC CoP has hosted a number of scientific and town hall sessions over the past year, the membership agreed that, without an engagement plan in place, the possibility of multiple groups attempting to conduct similar sessions and/or meetings that overlap in scope could result. The participants discussed ways to continue being active in the upcoming year, including conferences, seminars, and technical meetings. Out of those submissions, the draft Annual Engagements Plan is available online.

Appendix A: Meeting Actions

Action	Lead	By When
Discuss coordination with the USACE Water Management Tools (most likely with the NWM)	CC CoP Leadership Team	
Receive a briefing on the data resources available from NESDIS/NCEI and IOOS	CC CoP Leadership Team	
Receive a briefing on EPIC from DaNa Carlis	CC CoP Leadership Team	
Receive a briefing on collecting, cataloging, and managing stakeholder requirements from Ellen Mecray	CC CoP Leadership Team	
Develop a list of options for addressing how to establish well-organized documentation of use cases, including selecting 2-3 different regions for testing whether different regions require different processes	CC CoP Leadership Team	
Send publications to the CC COP Secretariat for addition to the website	CC CoP Members	
Brief the CC CoP leadership on the actions and outcomes from this annual meeting and identify areas where they may be helpful in moving forward with the needs identified	CC CoP Leadership Team	
Cross-connect with the NOAA Water Initiative Objective Teams (especially the Observations Team and the Modeling Team) and ensure that the priorities identified by the CC CoP are priorities for NOAA	CC CoP Leadership Team	
Distribute the CC CoP Engagements Calendar	CC CoP Leadership Team	

Appendix B: Participants

- Aijun Zhang - NOAA
- Alfredo Aretxabaleta - USGS
- Andrea O'Neill - USGS
- Babak Tehranirad - USGS
- Beheen Trimble - NOAA
- Brian Blanton - UNC/RENCI
- Carolyn Lindley - NOAA
- Cayla Dean - NOAA
- Cheryl Ann Blain - NRL
- Chris Massey - USACE
- Coraggio Maglio - USACE
- David Vallee - NOAA
- Debra Hernandez - SECOORA
- Derrick Snowden – NOAA
- Donxiao Yin - LSU
- Ed Myers - NOAA
- Ellen Mecray - NOAA
- Evan Turner - TWDB
- Gina Martinez - USACE
- Hamed Moftakhari - UA
- Hassan Mashriqui - NOAA
- James Kessler - NOAA
- Jesse Feyen - NOAA
- John Haines - USGS
- John Warner - USGS
- JS Allen - NOAA
- Jungwoo Lee - TWDB
- Karen Bareford - SeaGrant
- Kelley DePolt -
- Kyle Mandli - Columbia
- Lei Shi - NOAA
- Lisa Lucas - USGS
- Maoyi Huang - NOAA
- Mary Culver - NOAA
- Melissa Lupher - TWDB
- Murielle Gamache-Morris - Thrivner
- Panagiotis Velissariou - NOAA
- Patrick Kerr - USACE
- Qi Shi - NOAA
- Alexander Prusevich - UNH
- Ali Abdolali - NOAA
- Audra Luscher - NOAA
- Ben Hodges - UT Austin
- Brenna Sweetman - NOAA
- Camaron George - NOAA
- Cary Talbot - USACE
- Changsheng Chen - UMass
- Chiara Zuccarino-Crowe - SeaGrant
- Clint Dawson - UT Austin
- Daoyang Bao - LSU
- David Welch - NOAA
- Derek Giardino - NOAA
- Dina Sang - NOAA
- Doug Marcy - NOAA
- Ehab Meselhe - Tulane
- Eric Anderson - NOAA
- George Xue - LSU
- Greg Steyer - USGS
- Harry Jenter - USGS
- Hendrik Tolman - NOAA
- Jerad Bales - CUAHSI
- Joannes Westerink - UND
- John Schmidt - NOAA
- John Wilkin - Rutgers
- Joseph Zhang - VIMS
- Juzer Dhondia - NOAA
- Katie Landry - NOAA
- Kendra Dresback - OU
- Landon Knapp - SeaGrant
- Lianyuan Zhang - NOAA
- Liv Herdman - USGS
- Maria Teresa Contreras-Vargas - UND
- Matt Bilskie - LSU
- Melissa Moulton -
- Nels Frazier - NOAA
- Pat Burke - NOAA
- Philip Chu - NOAA
- Rick Luettich - UNC

- Richard Signell - USGS
- Saeed Moghimi - NOAA
- Shahidul Islam - USACE
- Tom Shyka - NERACOOS
- Tyler Miesse - GMU
- Wei Yu - Weather Tech Services, Inc.
- Yu Zhang - UT Austin
- Sadiq Khan - NOAA
- Sam Rendon - USGS
- Suzanne Van Cooten - NOAA
- Trey Flowers - NOAA
- Victor Hom - NOAA
- Yi Hong - NOAA
- Zach Wills - NOAA

Appendix C: Poll Anywhere Q&A

Clarification questions for Jesse Feyen (GLERL)?

- Yu Zhang: Can you elaborate on 2-way coupling between Fvcom and NWM?
- Cary Talbot: How is coordination with the USACE water management tools accomplished?
- Audra Luscher: How do you anticipate the NWM would work in conjunction with the HAB Tracker. What's the time frame for that work?
- Matt Bilskie: This probably is too technical for now, but how is model calibration handled for operational models when you have unknown future conditions such as the high stages? Thanks!

Clarification questions for John Warner (USGS)?

- Yu Zhang: what channel routing option was used for WRF-Hydro?
    - Diffusive wave is not set for NWM due to computational demand. What is the concept of operation for the coupling scheme?
    - Diffusive wave cannot propagate downstream boundary condition upstream
- John Wilkin: You say 1-way coupling: sea level from ROMS informs WRF. So does WRF river flow not discharge in ROMS?
- Brian Blanton: Does WRF-HYDRO have a dynamic routing capability?
- James Kessler: You mentioned that the information passes through the "coupling toolbox"... Maybe I missed it, but can you elaborate on what this toolbox is? ...is this something like NUOPC?

Brenna Sweetman (OCM) presentation questions:
Which of these organizations do you interact with in your work?

Organization	Number of Responses
NOAA Office for Coastal Management	29
The Nature Conservancy	15
Association of State Floodplain Managers	15
National Estuarine Research Reserve Association	14
Coastal States Organization	5
American Planning Association	3
Urban Land Institute	1
National Association of Counties	1
Total	83
Distinct participants	33

How can the Digital Coast and the CC CoP engage to support each other's missions?

- Gathering modeling requirements from your partners
- Hassan Mashriqui: provide data for model applications.
- Rick Luettich: Digital Coast could expand its mission space to include data needs/provisions of CC CoP

- Chris Massey: The CC CoP can provide user feedback to Digital Coast on how it is being used for numerical model development/applications.
- Chiara Zuccarino-Crowe: Develop training modules related to coastal coupling; improve tagging/links to different data sources and metadata; develop surveys to enhance stakeholder input to model development and outputs/integration into flood inundation mapping tools.
- Debra Hernandez: Designate an official rep to each program, with responsibility for linking and collaborating
- Doug Marcy: Decision Support Tool Development / Elevation data - Mapping requirements.
- Tools and training to support stakeholder engagement
- Clint Dawson: For a given watershed, does Digital Coast have all available data for that watershed, or can point to which agency or group might have it?
- John Schmidt: Leverage experience in effective visualization of static data layers to emerging real-time forecast products.
- Nels Frazier: consider documenting/linking/hosting/running tools for data transformation to/from/between models and applications
- Cary Talbot: Suggested by Rick Leuttich from yesterday's breakout: Digital Coasts plus Streams. Move further inland.
- Debra Hernandez: Coordination takes work/effort. It needs to be someone's job to coordinate the programs.
- Greg Steyer: All federal agencies that have data or data visualization tools like Digital Coast that can support CC COP needs should be linked to

Lisa (USGS) presentation questions:
How structured versus organic is your engagement with stakeholders?

- We have a structured approach for some projects but also have a lot of organic engagement
- Greg Steyer: have used structured decision-making (SDM) processes when we specifically wanted stakeholder values incorporated into initial problem statement and objectives development
- Derek Giardino: Intent is to have a structured way to interact with stakeholders, but during emergencies and extreme events you tend to find new stakeholders organically
- Chiara Zuccarino-Crowe: both; it depends on the stakeholder and the context. In some cases, such as when informing a management decision, a needs assessment, or developing an end product, we use surveys. In situations with informal interactions (and when the stakeholder is with a group in which we are developing a new relationship or partnership), it's more organic.
- Jesse Feyen: We have some specific projects with a stakeholder focus that conduct outreach efforts led by social scientist staff
- Doug Marcy: OCM has a pretty structured approach for formal input, but we work in project teams with partners pretty organically.
- Clint Dawson: most of our engagements have happened organically, either through meeting at conferences, through other connections, through word of mouth, etc.
- John Schmidt: in our operational setting, as we are dependent on some of our stakeholder's data, the engagement becomes more structured, but as we identify stakeholders that we believe may benefit from our data/forecasts the engagement can be organic and sometimes accidental.
- Brian Blanton: It is both. It depends on the specifics of the stakeholder.

- Debra Hernandez: Participation in regional meetings and events enables organic opportunities. We also regularly engage formally with stakeholders, i.e. via surveys, project funded engagement activities, etc.
- Brenna Sweetman: Both- structured engagement (needs assessments and in-person meetings to gather feedback) and organic (informal conversations at workshop)
- Joseph Zhang: organic/unstructured, but highly dynamic and 2-way in nature
- Liv Herdman: Depends on the project... the more "operational" the project the more structured it is

How much of your work is driven by stakeholder requests versus proactive anticipation of their needs?

- Brenna Sweetman: probably 50/50- regular engagement with our partners and stakeholders provides a continual feedback loop to hear requests and anticipated
- John Wilkin: Stakeholder requests rarely drive the work - really only through formal projects where they engage and are co-funded

Tom (NERACOOS) presentation questions:
What system or tool do you use for capturing and managing requirements?

- Lisa Lucas: up until now, our brains. starting a spreadsheet.
- Nels Frazier: Also a lot of "word of mouth" trickle down requirements
- Ali Abdolali: VLAB/Github
- Pat Burke: we are exploring the use of VLab (internal NWS tool) for modeling requirements
- Nels Frazier: Use Trello/canban development and try to capture requirements as feature/work items. Also to a smaller extent repository issues
- Audra Luscher: We have set up a google sites for larger projects and house requirements within the larger project.
- Brenna Sweetman: No, we would greatly benefit from this too... across NOAA this has been identified as a strong need
- Liv Herdman: google docs spreadsheet

Have you heard similar requests? (in response to slide 102)

- Nels Frazier: Common interpretation for forecast terminology (i.e. issue time, lead time, etc)
- Doug Marcy: probabilistic forecasts are useful - gives you the certainty. Users can select exceedance probability based on risk tolerance.
- Greg Steyer: Ability to visualize uncertainties in spatial model output
- Pat Burke: How often do you need to provide an update to the forecast?
- John Wilkin: We have had success teaching people how to use ERDDAP (which supports GIS) and THREDDS which then opens them up to many data streams
- Brenna Sweetman: communicating uncertainty is a common need
- Doug Marcy: NOAA NowCoast ingests model output.
- Liv Herdman: a lot of users also just want raw data... for their proprietary models
- David Vallee: Yes - uncertainty & confidence, served in multiple formats, and with easy-to-use user interfaces are a few examples.
- Derek Giardino: GIS and GIS Online Rest Services
- John Wilkin: GIS is definitely a recurring request
- Liv Herdman: Uncertainty bands are very important