Developing Collaborative Solutions for Continental-Scale Integrated Water Prediction

COASTAL COUPLING COMMUNITY OF PRACTICE

MAY 7-9, 2019
NATIONAL WATER CENTER
205 HACKBERRY LANE
TUSCALOOSA, ALABAMA

CONTENTS

Meeting Goal

The goal of the meeting is to create a sustainable framework for 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 requirements and transition approaches (Day 1). To create the engagement approach, participants will engage in a facilitated discussion informed by experience- and research-guided best practices (Day 2).

Objectives

1. Discuss national-scale coupling (freshwater to coastal forcing) enhancements and issues related to operational forecasting.
2. Develop a structure and strategy for information exchange through a Coastal Coupling Community of Practice (CCCoP).
3. Provide updates on case studies from current coastal coupling efforts.
4. Consider operational transition approaches to increase transparency with external audiences.
5. Identify future engagement opportunities and the timeline for sustained engagement.

Read-Aheads and Meeting Materials

1. National Coastal Coupling White Paper
2. NAO Policy on research and development transitions

Agenda

Tuesday, May 7th

12:30 ALL | Registration

1:00 ED CLARK | Welcome
The Challenge: Approximately 100 million people who live in coastal areas do not have useable flood forecasts because current models cannot skillfully and appropriately represent complex riverine, estuarine, and coastal hydraulic processes.

1:20 FACILITATED | Coastal Coupling Activities and Opportunities [Part 1 of 2]
Following lightning talks about coastal coupling activities and case studies [50 minutes], participants will reference the presented material and the pre-work to discuss:

- What does coastal coupling mean? What if coastal coupling refers to fully dynamically coupled systems with a two-way exchange of information, especially with the National Water Model (NWM). The current approach is mostly a one-way coupling in which the hydrodynamic model gets freshwater/discharge inputs from the NWM and there is no feedback to the NWM, atmospheric models, or ocean models.
- What techniques and technologies should be used to allow for development in the future? What are the drawbacks of the current techniques and technologies and how can we improve what we are doing?
- How might we decide the location to exchange boundary conditions? What happens if we choose not to decide?

- What are the hurdles around conducting collaborative coupling work?

2:45 ALL | Break

3:15 FACILITATED | Operational Transition Approaches
Based on the case study/lessons learned provided by Chris Massey (USACE) and Brian Blanton (RENCI), discuss current and preferred transition approaches, particularly:

- How might we improve early linkages between research and the likely operational end-user(s)? What's working now? What might we improve?
- How might we improve the balance between research agendas and changing operational requirements, especially for the research content and timelines?
- Given the necessity of producing transition plans and specifying Readiness Levels, what might we leverage in those processes?
- What are the opportunities for, and importance of:
    - Leadership support?
    - Defining future states (at what time horizons)?
    - Monitoring operational requirements and metrics?
    - Determining staffing?
    - Leveraging relationships?
    - Codifying any or all of this in transition plans?
    - Establishing processes for documentation, dissemination, and evaluation?
    - Other roles?

5:00 AUDRA LUSCHER | Day 1 Highlights

5:15 ALL | Adjourn

6:00 OPTIONAL | No-host Dinner (R Davidson Chop House)

Wednesday, May 8th

8:30 ALL | Registration and Light Refreshments

9:00 TREY FLOWERS & AUDRA LUSCHER | Recap from Day 1

9:15 FACILITATED | Establishing a Coastal Coupling Community of Practice [Part 1 of 2]
In a mix of plenary and small-group sessions, participants will reference the preceding conversations and the pre-work to:

- Discuss the proposed vision and mission of the Coastal Coupling Community of Practice:
    - The **vision** of the Coastal Coupling Community of Practice (CCCoP) is to build communication pathways and relationships to facilitate collaborative development of continental-scale solutions to integrated water prediction in the coastal zone.
    - The **mission** of the CCCoP is to enable:
        - Accelerated national coverage of hydrodynamic models through the adoption of 3rd party research and models.

- ○ Coupling of hydrologic and oceanographic models across the coastal zone to better predict water inundation from both freshwater and saltwater and their compounding effects.
- ○ Integrated prediction of coastal total water level, flow timing and duration, currents, waves, ice, and water quality accounting for both in-channel and overland water surface elevations.
- ○ Actionable information on these parameters provided to stakeholders in user-friendly formats.

- Discuss the **main pillars** of the Coastal Coupling Community of Practice:
  - **The domain:** Build relationships between the members that allow for open communication pathways that are needed to do the collaborative work of developing coastal coupling of models for integrated water prediction enabled by third party research and models.
  - **The community:** Identify the groups/people that would be helpful to this discussion (e.g., NOAA, USACE, USGS, academia, industry, local, state, and Indian-tribal governments).
  - **The practice:** Develop the framework to align members' goals and pull the work in the same direction, including:
    - ○ Identifying community member strengths, priorities, and resources;
    - ○ Identifying knowledge gaps;
    - ○ Identifying the available models and understanding their strengths and weaknesses;
    - ○ Determining the best strategies and requirements for coastal coupling including stakeholder needs; and
    - ○ Determining the best strategies and requirements for coastal coupling including science and operational requirements for implementation of the coupled models.

10:45 ALL | Break

11:00 FACILITATED | Establishing a Coastal Coupling Community of Practice [Part 2 of 2]
[Continuation of the previous session, including report-outs]

12:00 ALL | Lunch

1:15 FACILITATED | Engagement [Breakout Sessions]
Small groups will work together to identify engagement opportunities and processes. In particular, they will consider the following questions:

- How might CCCoP continue to be active in the upcoming year? Options include:
  - ○ In-person meetings (e.g., Summer Institute Capstone Meeting (Tuscaloosa, AL, July 26, 2019); 2019 AGU Fall Meeting (San Francisco, CA, December 9-13, 2019); 2020 Ocean Sciences Meeting (San Diego, CA, February 16-21, 2020)
  - ○ In-person technical meetings
  - ○ Newsletters

  - Webinars
  - Open source file archive
- Where else might the CCCoP put this into practice:
  - Funding opportunities, including research and reporting requirements
  - Transition documentation
  - Day-to-day best practices
- What is industry's role? What types of questions might we address with industry?
- When should the CCCoP start to bring end users (e.g., Jupiter, ESRI, First Street Foundation, etc.) into the conversation? What types of questions might we address with end users?

2:45 AUDRA LUSCHER | Consensus on Breakout Group Inputs
The goal of this session is to arrive at a consensus on the inputs from the 1) Establishing a Coastal Coupling Community of Practice; and 2) Establishing Ongoing Engagement for the Coastal Coupling Community of Practice breakout groups

3:15 ALL | Break

3:45 CELSO FERREIRA/TREY FLOWERS/EHAB MESELHE | With input from the participants, this panel will discuss the opportunities to connect the CCCoP with the Summer Institute, which this year is focused on the following themes:
- Coupled inland-coastal hydraulics;
- Scaling hydrologic and hydraulic models from small basins to regional watersheds;
- Utilizing hydroinformatics to address flood inundation; and
- Supporting remote sensing of water information through engagement with the computer science community.

4:30 AUDRA LUSCHER | Preview for Day 3

4:45 AUDRA LUSCHER | Meeting Highlights and Wrap-up

5:00 ALL | Adjourn

Thursday, May 9th (Optional)

8:30 ALL | Registration and Light Refreshments

9:00 ED MYERS/SAEED MOGHIMI | Welcome
The focus for this session is on some of the technical aspects of 2D and 3D model development.

9:30 ALL | Breakout Groups
Breakout groups will focus on 2D and 3D modeling, including addressing the questions raised at the end of the session on Day 2.

11:15 ALL | Review Breakout Group Reports
Reporters will provide the inputs from their groups, including future recommendations and strategy.

11:50 ED MYERS/SAEED MOGHIMI | Wrap-up Day 3

12:00 ALL | Adjourn

Invited Participants

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Coastal Coupling Activities and Opportunities: Pre-Work Responses

Q1. What does coastal coupling mean? What if coastal coupling refers to fully dynamically coupled systems with a two-way exchange of information, especially with the National Water Model (NWM). The current approach is mostly a one-way coupling in which the hydrodynamic model gets freshwater/discharge inputs from the NWM and there is no feedback to the NWM, atmospheric models, or ocean models.

- One integrated water solution for salt water, river flow and local precipitation.
- It should be coupled with feedback. Both heat and water (and other constituents) come off the land and may be involved in driving part of the atmospheric dynamic.
- Two independent modeling systems exchange output. That is, Model A runs generates output that Model B uses as a forcing condition to run. Model B generates output that moves back to Model A.
- Coastal coupling means the passing of water between coastal and hydrologic models so that we can predict all phases in the water cycle. The first step is to get hydrologic predictions flowing into a coastal model, but two-way coupling would enable water to flow upstream from the coast during high water conditions. It is part of the concept of a unified forecasting system wherein contributions of weather and precipitation, runoff, channel flow, coastal circulation, and wind waves call all interact.
- What products and guidance are we trying to provide with the coastal coupling piece? It shouldn't be limited to just water level and inundation, it should aim to also provide guidance for water quality/hazardous algal blooms, beach erosion/dune over topping, etc. Limiting it to one way coupling would likely limit the accuracy of the outputs these additional uses.
- Coastal coupling should be a two-way coupling as many systems have input both ways and that coupling can be important to questions related to salinity and other transport questions as well as flooding.
- Two-way coupling would communicate ocean information on high frequency (hourly?) sea level back to a NWM configured to use dynamic sea level in moderating groundwater discharge rate, and modified dynamic head in the outflow from coastal cells in the NWM. Coastal (and lake) circulation models would simulate inundation (wetting/drying) with river source points that adaptively move across the flooded terrain in accordance with a dynamic land/sea boundary in this case. We should not neglect biogeochemical export from watersheds to the coastal ocean as these are vital to water quality, health and ecosystem services.
- Coupling should mean a fully dynamically coupled system.
- I'm for two-way coupling eventually.
- The first scenario that comes to mind is a natural river system connecting with a larger open body of water such as a lake or the open coast. This scenario has perhaps the most straightforward and delineated flow paradigm with two well defined systems. The next scenario involves the river transitioning into a delta or bayou that goes into a wetland/marsh that merges into the larger body of water. Another scenario switches to an urbanized environment, where drainage networks route water to rivers that are managed (channelized, hardened banks, levees, floodwalls, gates) with well-defined boundaries and those rivers then connect in with larger bodies of water (lakes, estuaries, etc), perhaps with a wetland area in between. These scenarios are what first come to mind about coastal coupling and help to define the requirements of numerical models needed to model coastal environments and how those models interact. Coastal coupling is the interplay of all these relevant systems.
- My understanding is coastal coupling means the automatic transfer of information between coastal models and hydrological/atmospheric models. None or the minimum human intervention should be

required. All the transference of information should be automatic and the different processes simulated should affect the rest of the model, as the physics changes.

- Coastal coupling or coupling in the transition zone requires the 2-way exchange of information between the coupled models. The coastal model will provide solution on tide effects, storm surge inundation which affect the water levels in the rivers. NWM should receive these enhanced water level predictions (at certain riverine locations) and the water content in inundated areas (crucial in the cycle evaporation - precipitation) to re-evaluate its flowrate and surface runoff predictions that will be passed back to the coastal model. This is the dynamic coupling between NWM and coastal model.
- As a non-modeler, the definition suggested matches my understanding of what coastal coupling means.
- Coastal coupling means the areas where the water levels can be influenced by both changes in the riverine flows and storm surge effects of tropical storms. In terms of models, the coastal coupling means the connection between the hydrologic, hydraulic or hydrodynamic models in some fashion. Thus far, the one-way coupling may be a product of the limitation of the hydrology models, due to the predominant formulation based on the kinematic wave approximation, which precludes their abilities to handle the backwater profile from the storm surge propagating up in the upper reaches of the riverine areas. Additionally, the run time for both the hydrodynamic and hydrologic model vary greatly and it might be that these models would have to be under the same modeling framework to accurately pass information to one another at the correct times.
- At NRL we would like to pursue a 2-way exchange of water at the coupling interface of the coastal ocean and the hydrology model so that both, incoming surge and tides and outgoing river or overland fluxes are represented. Currently, full two-way coupling is already implemented between the atmosphere, the land surface and the hydrology overland flow/river routing through an ONR NOPP project that coupled the NRL COAMPS (Coupled Ocean Atmosphere Mesoscale Prediction System) to WRF-Hydro (with the NOAH-MP land surface model).
- I suppose there are many possible meanings, such as the one proposed above. In my world, it would probably refer to the coupling of models (one-way or two-way) representing different domains (e.g. watershed, estuary, coastal ocean) and/or sets of processes (e.g. hydrodynamic, suspended sediment, various water quality and ecological processes and parameters).

Q2. What techniques and technologies should be used to allow for development in the future? What are the drawbacks of the current techniques and technologies and how can we improve what we are doing?

- Standard infrastructure as outlined in NOAA-NCAR Memorandum of Understanding of Jan 2019. Define a set of acceptable community (component) models to work with, and focus on these.
- I do not know.
- Cloud computing to reduce limitations on HPC access and SVN to ensure proper code management techniques. Coupling techniques should be leveraged and account for the various types of coupling (e.g. 3D) that are necessary to take modeling into the future to satisfy a broad arrange of mission requirements while complying with the vision of Unified Modeling.
- Most important are modeling frameworks like NEMS so that models can "talk" to each other and datasets can be shared. One of the main challenges in connecting hydraulic and hydrodynamic models is that they both may provide valid predictions in streams and rivers, but based upon different assumptions around the underlying model equations and different model configurations. This means the model information may not match. Furthermore, providing accurate boundary conditions at the model interfaces, is critical to modeling accuracy.

- There needs to be a better balance between resolution and efficiency of model runs. We may have to sacrifice finer resolution to some degree in order for the model to run in a timely manner. Are there adequate observation networks in the coastal areas for validation/assimilation?
- This is a hard question to answer. Studying how current technology falls flat and how we can bridge the multi-scale nature of near-shore dynamics seems to be the core question though.
- (1) These communities speak different languages and do not presently serve respective data sets in formats that are readily usable for experimentation. For example, it is not a standard output product from the NWM to report streamflow (m3/s) as a set of lon/lat points that define the edge of the land - i.e. that would readily be adopted by a coastal ocean modeler as a line source of discharge. Similarly, groundwater discharge at the NWM coast is not a product. Many coastal modelers do not pay close attention to referencing their sea level to a recognized geodetic datum that would aid use in conjunction with surface water models to define ocean-driven inundation. These quantities must be defined unambiguously through the adoption of a controlled dictionary of data variables and standards in order to facilitate sensible model connections through some dynamic coupler or coupling toolkit. (2) Experimentation would be facilitated by establishing some common sandboxes in which non experts can easily run a pre-configured model without the need to duplicate all the codes and data sets. This may require establishing instances of NOAA models outside NOAA firewalls. This may be facilitated by adopting some cloud computing environments for the project members to utilize. This would also assist intercomparison of results. (3) The community needs to establish agreed metrics for model skill that will allow coupled experiments to demonstrate meaningful progress, and establish the data sets to inform those skill metrics.
- All options should be up for consideration.
- Obviously there are drawbacks in the current models; otherwise NOAA would not have engaged us. My suggestion for NOAA is to keep an open mind and embrace new technology in a timely fashion.
- The major water modeling systems: routing models to rivers, riverine flow models, overland flow models, open water models to include lakes, estuaries, oceans; all have very specialized functionality and underlying assumptions, which allows them to model successfully the well-delineated flow regimes. These models operate on different spatial and temporal scales, use different numerical discretization techniques to represent the systems, written in different computer languages, function in specialized computing platforms and require different kinds of data to parameterize their input. The zone where coastal coupling becomes important is where most of these model's assumptions fail or their computational efficiencies fall way off. It is very likely that the future successfully techniques and technologies (models and source functions) will need to be defined in such a way that in the case of models will allow them to be functionally called/controlled by other programs and in terms of source functions be written in a unified file format that has a well-documented API. Proprietary codes are going to be a drawback in many cases, particularly for a CCCoP comprised of such a wide array of necessary disciplines and institutions.
- Not sure that I really understand the question. I think techniques that allows to reduce the computational time of simulations should be a priority. That would allow to have a better representation of rivers farther upstream from the shoreline, which I think might help with coupling them to the regional ocean models.
- Need: 1) consistent approach approach to receive and analyze data to create model inputs (development of background programs and scripts should follow advances in technology - for example use evolving python scripting and libraries), 2) consistent protocols on maintaining models and model libraries, 3) development of gui interfaces to aid the development process (especially when multiple models are involved), 4) automation of the basic modeling tasks.

- I am not familiar with the current techniques. Community development of techniques and technologies (open code repositories, etc.) should allow for improvements and further development.
- One thing to be considered is using the full dynamic wave equations within the hydrology model in order to allow it to capture the backwater profiles produced by the storm surge propagating back upstream into the upland riverine areas. The downside to changing to the dynamic wave equation is the run times associated with the hydrology model would increase significantly due to increase in physics included in the model. Additionally, current hydrology models run with grids that have spatial scales on the order of 1 km over the CONUS; however, most run at much finer resolution at a regional scale. On the other hand, hydrodynamic models often run at scales of 10 to 50 m over the inland areas of their grids, which makes some of the riverine areas more refined in these models versus those in the hydrology model. Thus, they may not line up together when trying to pass information to one another (i.e., the connection points given to the hydrology model from the hydrodynamic model may not coincide with the river environment in the hydrology model). An issue for the hydrodynamic models is the availability of riverine shorelines and accurate depths in the riverine environments in the upper reaches of these coastal zones. This information is utilized to help define some of the hydrodynamic gridding in the riverine environment. This information can be obtained in some U.S. coastal areas due to extensive floodplain mapping programs or from hydraulic models that have already been developed in portions of these riverine areas. However, these are not always available in all the coastal rivers in every U.S. state.
- A standard set of tools should be developed and established as community resources for processing input and output files for the NWM. The lack of such tools has been a burden for the uninitiated user.
- Linkage pathways and processes between models are not always easy, efficient, or bug free and require person-power to accomplish.

Q3. How might we decide the location to exchange boundary conditions? What happens if we choose not to decide?

- Drawbacks today (for operations) :
    - Too many software packages do not allow for focus of work.
    - Pet projects lead to too many models.

  Ask the more important questions first. What are the service requirements.
    1. What kind of products are needed for serving these requirements (resolution, forecast range, cadence, accuracy).
    2. How does this fit with the "other" products (water versus weather etc.).
       a) If answers under 1) are similar, go to single fully coupled model.
       b) If clearly different then here will be models with boundary exchange "offline", and you can ask another set of questions.
- I do not know, but simple sensitivity studies (with and without feedback) could help decide the degree to which this is important.
- Does it have to be the same location for both systems? The output used for decision support should be based on the mission requirement.
- It can be easy to overconstrain these models by attempting to provide both water levels and flows at model boundaries. It can be difficult to define ideal locations for boundary conditions where information is well known due to observations. Additionally, in coastal rivers flow conditions can be defined by either upstream or downstream flows, depending on current conditions. This requires models to pass information back and forth each way.

- A flexible boundary condition would likely be more appropriate, especially in a two-way coupling approach.
- I have a strong suspicion that even for a given location the "optimal" exchange is going to be difficult to define and is probably situation dependent. Instead I might suggest developing a boundary that can either dynamically adapt to current conditions or overlaps far enough inland and into the coastal waters that the boundary location itself is not important.
- This deserves to be a subject of experimentation and will likely be handled differently by different ocean models depending on how they themselves define the coast. Intermediate models may be required, e.g. specialized models of flow through salt marshes/wetlands; addressing the role of subaquatic vegetation and the inundation of terrestrial vegetation.
- It's going to have to be a balance of finding the location which provides the best data while accounting for what we have the capacity to handle/process at the needed speeds.
- I'd leave that open as models should be flexible to handle that.
- Specialized models already have exchange boundaries that are often far enough away from the “main area of interest” that the imperfect forcing interactions occurring at those boundaries are damped out. However, for the coastal coupling paradigm this will not be the case. The boundaries between models are likely going to be overlapping and not at a delineated location as is the case in standalone models. Figuring out the respective domains of influence for each model under varying flow regimes is going to be a central research theme for the CoP. In some cases a simple hand-off of information can take place from one model to the next, allowing for both one-way and two-way data exchanges. Another approach would be to derive from the governing equations of the two models a new boundary condition type that would allow one model’s domain to actually shrink but still “feel” the effects as if the domain was still there, which is now being represented by the other model. These overlapping areas might be treated in a more probabilistic approach to “merging” the two models results in that area or even data assimilation techniques being applied in that area. Finally, an option that the different models could actually be reformulated and solved (partially solved) as a combined system of equations.
- I think that boundary should be defined dynamically as the physics changes. Non-dimensional parameters could be a good way to define the limit. Maybe minimum runoff, minimum velocities, water depth, or dependency on tides, could be another option.
- The decision of the location(s) of exchange of BCs depends upon many factors: 1) The physical processes that need to be incorporated in the BCs, for example the effects of the waves on the currents - you can not have a BC incorporated at the surf-zone where waves are breaking, 2) The extend of the overlapping domain areas between models, for example different models perform better in certain areas (coastal, riverine areas) which means that the receiving model has to have its BCs where the supplying model supplies the best possible data 3) riverine BCs in tidally affected rivers should be supplied at locations where backwater effects are minimal (ensures integrity of BCs)
- Again, from a non-expert perspective, I would expect that rules-of-thumb, i.e. guidance, would be helpful, but that specific answers would be location dependent.
- The decision on the location to exchange boundary conditions depends largely on the physics available in the different models. Many hydrologic models utilize the kinematic wave equation in their solution scheme, which allows for quick solution; however, this equation does not capture the backwater effects that can happen in the upper reaches of some of the riverine areas due to storm surge from hurricanes propagating up the riverine areas. For coupling to kinematic wave based models, the coupling location must be located above the area of backwater effects. In some locations and for certain storm characteristics, this can exceed the location where the tidal influences are no longer seen in the hydrographs. Thus, to determine the boundary condition exchange location you need to not only analyze the gauging station information in the riverine

areas but also examine these gauging stations for influences of storm surge during previous historical storms. In some instances, a full dynamic hydraulic model has been placed “in-between” the hydrologic and hydrodynamic models (so-called middleware) in order to capture the fluid dynamics in the “backwater” region due to the storm surge propagating into the upper reaches of the riverine areas. However, some of the difficulties with coupling these models in a real-time framework is the exchange of boundary information from the hydrology and hydrodynamic models; also the downstream hydrodynamic model requires boundary information from the hydraulic model. Thus, to accurately compute the water levels, one approach would be to run the hydrodynamic twice or place the hydraulic model into the estuarine areas in order to eliminate the overlapping areas where the riverine flows influence the hydrodynamic models. However, because not all hydraulic models employ the full Navier-Stokes equations that are necessary for capturing the dynamics in estuarine areas, it is incumbent upon the developer/user to not choose a model that is ill-equipped to capture the dynamic in these areas.

- The location for boundary exchange would seem to depend on your modeling objectives. Are you interested in representing the dynamics or small scale geometry of the river channels, or just the using river channels as a means to propagate surge and tides inland for flooding? Does the ocean model include inundation and recession over topography, or are you largely just interested in getting freshwater to the coastal ocean? The modeling objectives I think will dictate the best location for the coupling interface. It would seem that protocols for the exchange boundary location should be adopted for various types of applications. It is unclear to me what it means to "not decide" a coupling interface locations.
- It may make sense to exchange boundary conditions just beyond where a major governing process (e.g. tides) becomes insignificant or zero.

Q4. What are the hurdles around conducting collaborative coupling work?

- Culture, culture, culture.
- Not sure, but I suspect the usual funding hurdles and dependance on models with limitations are in play.
- Ensuring consistent communications. Ensuring that development decisions take into account mission requirements.
- In addition to finding resource support, it should be recognized that experts are distributed around the organization. Many have a piece of the puzzle to solving this problem. A unified plan to develop, test, and transition this capability to operations should be developed where all can collaborate and contribute according to the primary function they fulfill (research, development, transition, operations).
- We would need to create an operating platform that would allow the different community members access for development.
    - Where would this be hosted and what are the computing resources needed?
    - How the model results will be evaluated during the development will also need to be considered. Will the end users be provided with products to evaluate? If so, how will they be disseminated?
    - Will the coupling work start with a smaller test areas, or will there be a push to try for larger coastal reaches? What are the data networks available for validation and assimilation
    - What are the end goals? Beyond water level and inundation, will there be a way to provide modeling results for the water quality, beach erosion/dune over topping.

  - How will this handle consistency with the National Hurricane Center during tropical events? Will there be an ensemble run using p-surge guidance? There has to be consistency with other NWS products, especially during the high impact events.
- The number of different codes and coupling them in a consistent way is probably the biggest hurdle.
- (1) The respective modeling communities are presently highly siloed. Topic specialists generally have little exposure to the other modeling community. (2) See my comment at Q2: these communities do not routinely speak of the same quantities in the same units with common definitions, conventions or metadata. (3) At the scales necessary for realistic coupling these models are large and expensive to run. To a novice they are complex to experiment with at the sophisticated level at which coupling occurs. This hampers experimentation. This hurdle could be lowered by early on in this project promoting the adoption of coupling interfaces (e.g. NUOPC) wherein the topic experts develop the output interface for the quantities that the other modelers need, and that these needs are clearly articulated (there will not be a single set of variables to exchange, there will be some redundancies, but a modest subset of model state variables should be within reach to define).
- Ownership, territoriality, and lack of open communication.
- NOAA needs to open up, period. If it claims to only support a few models, how can we collaborate? In our case, we have not been part of the discussion until recently (and I heard there is still some push-back from some groups). Ultimately, NOAA managers need to make informed decisions based on nothing but solid science.
- The biggest hurdle will be the researchers being able to dedicate sufficient time/resources to the work in balance with their own funding and research directives. The second problem will be researchers wanting to keep their own models (codes) for use and not being willing to use other models. Another problem will be on select groups concentrating too much on a particular aspect of the coupling problem or a particular application of the coupled models.
- Today the hydrological and coastal modeling communities are totally disconnected. Some of the vocabulary and the system of coordinates (total water depth for river, and depth+water elevation) used are just the first example of these two worlds.
- Collaborating coupling work assumes that data are shared and scientific issues are discussed. Data sharing can be a time consuming task that might need to involve additional resources other than just the requester and the sharer of data. Hurdles: 1) time constraints - request need to be submitted in advance to allow for timely deliverance, 2) usage of data should be clearly defined (eliminates a lot of issues political, inter-agency, ...), 3) many times credit is not attributed at all to the people that share/create the data.
- Egos, computing architecture and infrastructure, funding.
- Some of the hurdles around conducting collaborative coupling work might be as follows:
  - must have a team that agrees on the objective and approach and models to be coupled (or multi-model)
  - need to include end-users/stakeholders in the decision-making process
  - coordination, especially across institutions, can be challenging at times, given busy schedules, so project delays are more frequent than single investigator projects
  - common access to similar computing resources
- Establishing community test cases for various types of coupling could be quite instructive and helpful. A method should be established for software exchange and version management for contributed software and developments. Such a repository should be open to the community with documentation a required component.
- See my answer to #2. Also, everyone is busy and is invested in the models that they use.

NATIONAL COASTAL COUPLING WHITE PAPER

INTRODUCTION - A Community of Practice (CoP) is defined as "a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise by interacting on an ongoing basis."[1] Three pillars central to fostering interaction within the CoP are:

- ***Domain*** - the specific area of focus; here, coastal coupling of models for integrated water prediction enabled by 3rd party research and models
- ***Community members*** - leadership team, core modeling scientist members, coastal practitioners, end users of model outputs, etc.
- ***Practice*** - sharing experiences, stories, techniques, methods, tools, and ways of addressing problems, enabling practitioners to focus on sharing knowledge and solving problems

A CoP is dynamic and organic by nature. The interests, goals, and members can evolve over time as the CoP develops and needs change. Typically, CoPs are long-term activities that require careful cultivation and last as long as there is interest or value in maintaining the group.

VISION AND PURPOSE - The vision of the Coastal Coupling Community of Practice (CCCoP) is to build communication pathways and relationships to facilitate collaborative development of continental-scale solutions to integrated water prediction in the coastal zone.

This CCCoP should enable:

- Accelerated national coverage of hydrodynamic models through the adoption of 3rd party research and models.
- Coupling of hydrologic and oceanographic models across the coastal zone to better predict water inundation from both freshwater and saltwater and their compounding effects.
- Integrated prediction of coastal total water level, flow timing and duration, currents, waves, ice, and water quality accounting for both in-channel and overland water surface elevations.
- Actionable information on these parameters provided to stakeholders in user-friendly formats.

The CCCoP is envisioned to serve as a platform to foster greater dialogue on the challenges that will arise in coupling these models such as the location of boundary information handoff between models, differences in model mesh resolution, boundary condition and forcing requirements, and how to provide user-friendly model outputs to stakeholders.

The CCCoP will be designed as a tool for engagement and collaborative learning so that all members will interact, contribute and learn from one another's perspective, experience, and expertise on a routine basis. It will help the community learn from experts from different organizations including NOAA, USGS, USACE, academia, and the private sector with different

[1] (Wenger et al. 2002)

viewpoints. By advancing coastal coupling efforts, the CCCoP is working toward the eventual goal of developing the products and services that society needs to provide actionable water information at local, regional, and national scales. Ultimately, the CCCoP will allow water professionals to collaboratively work toward the shared objective of protecting communities, economies, and ecosystems from critical water challenges.

SCOPE - The CCCoP will develop a framework to align members goals and pull the work in the same direction. The scope of work for the CCCoP includes, but is not limited to, identifying groups that would be helpful to this discussion (e.g., NOAA, USACE, USGS, academia, industry, local, state, and tribal governments), identifying knowledge gaps, identifying the available models and understanding their strengths and weaknesses, determining the best strategies and requirements for coastal coupling including stakeholder needs, and science and operational requirements for implementation of the coupled models. As the CCCoP members and needs continue to evolve, the scope of the CCCoP may also evolve.

ROLES AND RESPONSIBILITIES - **Team -** The CCCoP is based on an interagency framework, involving academia, industry, and end users. The CCCoP team will include leadership and practitioners.

- ***Leadership*** - needed to advance and sustain the CCCoP in the long term. The leadership team will consist of NOAA line office representatives in executive positions who will be responsible for developing a charter that outlines the mission, vision, scope, and priorities of the CCCoP. This team will also ensure that the CCCoP remains aligned with these priorities. Additionally, the leadership is responsible for allocating funding for support staff, travel, or other necessities.
- ***CoP Practitioners*** - an interdisciplinary team with members from various NOAA line offices and the external audience. These team members should consist of key thought leaders and subject matter experts of modeling and water information. These individuals will be responsible for developing a charter that outlines the mission, vision, scope, and objectives of the CCCoP.

Engagement methods - The CCCoP first meeting will be held at the National Water Center in Tuscaloosa, AL on May 7-8, 2019. This meeting will serve to establish communication pathways and develop the relationships needed to do collaborative work. Proposed ongoing engagement activities include:

- Annual in-person meetings, biweekly or monthly teleconferences to provide updates on progress and determine the best course of action moving forward.
- Communications externally through conference panels and Town Halls.
- Listserv emails providing updates on new tools, projects, etc., and a website or other forum to maintain open communication.
- Open dialogue amongst members to facilitate knowledge gathering on specific topics of interest.

Rules of interaction - Some rules of interaction must be established to facilitate a productive, innovative discussion to further the vision, purpose, and goals of the CCCoP. Some proposed rules are as follows:

- Members contribute to the community through their personal experiences and skills by sharing challenges, lessons learned, and successes in an organized fashion that contributes to the atmosphere of problem-solving.
- The topics, discussions, and work remain pertinent to the CCCoP scope.
- Members strive to create an environment of trust and respect by participating in insightful discussions of ideas and experiences and listen to each other with open and constructive minds.
- Members will not be afraid to respectfully challenge one another by asking questions but will refrain from personal attacks.

NAO 216-105B: POLICY ON RESEARCH AND DEVELOPMENT TRANSITIONS

Issued 10/17/2016; Effective 10/17/2016 Reviewed Last: 02/26/2019

NAO 216-105B: Policy on Research and Development Transitions PDF

Handbook_NAO216-105B_03-21-17

SECTION 1. PURPOSE AND SCOPE.

01 The National Oceanic and Atmospheric Administration (NOAA) is a science-based service agency. NOAA's ability to meet its mission through the delivery of continually improved products and services relies on the conversion of the best available research and development (R&D) endeavors into operation and application products, commercialization, and other uses. NOAA therefore requires an integrated transition enterprise linking research, development, demonstration, and deployment that is efficient and effective in identifying and using significant new R&D products to meet NOAA's mission needs.

02 This Order establishes the process for identifying, transitioning, and coordinating R&D output to operations, applications, commercialization, and other uses. This Order outlines the roles and responsibilities of various officials, including Line Office Transition Managers (LOTMs), associated with the transition of R&D. Additionally, this Order identifies those entities with the authority to implement this policy and those who are accountable for transitioning R&D.

03 This Order applies to all NOAA funded R&D activities, including those conducted by non-NOAA entities.

04 This Order defines the transition of R&D to any operation, application, commercialization, or other use, and includes products such as 24 hours/7days weather forecasts (typically referred to as research to operations), information products used in resource management (research to application), commercially-available sensors (research to commercialization), or government policies, regulations, synthesis of research, public education and outreach (research to other uses).

05 This Order does not replace any directive, policy, statute, or other guidance that applies to the prosecution of patents by NOAA or its employees for inventions made in the course of research, the licensing of government owned inventions in the custody of NOAA, or Cooperative Research and Development Agreements and Small Business Innovative Research awards. Such activities are addressed by NAO 201-103: Cooperative Research and Development and Invention Licensing Agreements Under the Federal Technology Transfer Act of 1986 (Public Law 99-502) and other applicable laws, regulations, and related policies. However, this NAO does apply to the identification of potential or realized uses of NOAA's R&D.

06 Transition projects for which funding or R&D originate outside of NOAA are included in this policy, at the discretion of the respective LOTM.

07 This Order recognizes that transitions can be either incremental improvements to existing products or applications, or entirely new products or applications.

SECTION 2. DEFINITIONS.

01 **Application:** The use of NOAA R&D output as a system, process, product, service, or tool. Applications in NOAA include information products, assessments, and tools used in decision making and resource management.

02 **Commercialization:** The process of introducing a NOAA product or technology (e.g., invention) into the commercial market, including licensing.

03 **Construction Projects:** The development, construction, or installation of equipment/asset that is not real property; or the development or modification to software, which will be used internally. The project must equal $200,000 or more; the service life is estimated to be 2 years or more; the project will provide a long-term future economic benefit to the NOAA organization that maintains or obtains control; and it is not intended for sale.

04 **Demonstration:** Activities that are part of R&D and are intended to prove or to test whether a technology or method does, in fact, work as expected.

05 **Deployment:** The sustained operation, maintenance, and use of the product of R&D.

06 **Development:** The systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, that is directed to producing new products or processes, or to improving existing products or processes (OECD, 2015).

07 **Line Office Transition Manager (LOTM):** An individual appointed by each Assistant Administrator (AA) and the Director of the Office of Marine and Aviation Operations (OMAO), who is responsible for managing the Line Office (LO) transition portfolio (collection of transition projects).

08 **NOAA Invention:** A new, useful process, machine, manufacture, or composition of matter, or any new and useful improvement to a process, machine, manufacture, or composition of matter, developed by NOAA.

09 **Operations:** Sustained, systematic, reliable, and robust mission activities with an institutional commitment to deliver specified products and services. Examples of operations in NOAA include weather and climate forecast models run on a routine basis to provide forecast guidance or seasonal outlooks, stock assessments conducted to determine changes in the abundance of fishery stocks, and sustained observations for public services and for Earth-System research in the public interest (NSTC 2014).

10 **Proving Ground:** A framework for NOAA to conduct testing of advanced operations, services, and science and technology capabilities that address the needs of both internal and external users. Successful testing demonstrates readiness to implement into operations.

Capabilities to be tested in operational proving grounds have already passed developmental testing. Such capabilities include advanced observing systems, better use of data in forecasts, improved forecast model, and applications for improved services and information with demonstrated economic/public safety benefits.

11 **Readiness Levels (RLs):** A systematic project metric/measurement system that supports assessments of the maturity of R&D projects from research to operation, application, commercial product or service, or other use and allows the consistent comparison of maturity between different types of R&D projects. (Note: NOAA RL's are similar to Technology Readiness Levels developed by NASA (Mankins, 1995) and embody the same concept for quantifying the maturity

of research). A project achieves a readiness level once it has accomplished all elements described within a readiness level. A program may include projects at different RLs depending on the goals of each project. Inventions may be generated at any RL. The nine readiness levels are as follows:

1. RL 1: Basic research, experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a range of future applications (OECD, 2015).
2. RL 2: Applied research, original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. Applied research is undertaken either to determine possible uses for the findings of basic research, or to determine new methods or ways of achieving specific and predetermined objectives (OECD, 2015).
3. RL 3: Proof-of-concept for system, process, product, service, or tool; this can be considered an early phase of experimental development; feasibility studies may be included.
4. RL 4: Successful evaluation of system, subsystem, process, product, service, or tool in a laboratory or other experimental environment; this can be considered an intermediate phase of development.
5. RL 5: Successful evaluation of system, subsystem process, product, service, or tool in relevant environment through testing and prototyping; this can be considered the final stage of development before demonstration begins.
6. RL 6: Demonstration of a prototype system, subsystem, process, product, service, or tool in relevant or test environment (potential demonstrated).
7. RL 7: Prototype system, process, product, service or tool demonstrated in an operational or other relevant environment (functionality demonstrated in near-real world environment; subsystem components fully integrated into system).
8. RL 8: Finalized system, process, product, service or tool tested, and shown to operate or function as expected within user's environment; user training and documentation completed; operator or user approval given.
9. RL 9: System, process, product, service or tool deployed and used routinely.

12 **Research:**Research can be classified as basic research or applied research.

1. Basic Research: Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a range of future applications (OECD, 2015).
2. Applied Research: Applied research is the original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. Applied research is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives (OECD, 2015).

13 **Testbed:** A NOAA testbed is a working relationship for developmental testing in a quasioperational framework among researchers and operational scientists/experts (such as measurement specialists, forecasters, IT specialists) including partners in academia, the private sector, and government agencies, aimed at solving operational problems or enhancing

operations, in the context of user needs. A successful testbed involves physical assets as well as substantial commitments and partnerships.

14 **Transition:** The transfer of an R&D output to a capability ready for an operation, application, commercial product or service, or other use.

15 **Transition Plan:** A document that represents an agreement between clearly identified researchers and potential recipients, organizations, or other users of the product resulting from the transition of an R&D output.

16 **Transition Project:** A collective set of activities necessary to transfer R&D output to a capability ready for an operation, application, commercial product, or service, or other use (RL 9).

17 **Transition Project Lead(s):** Individual(s) responsible and accountable for ensuring that the transition project is planned, programmed, budgeted, and executed per the Transition Plan.

SECTION 3. POLICIES.

01 To meet mission needs, NOAA will optimize the timely and efficient use of R&D, including but not limited to that conducted by and funded by NOAA. To fulfill this goal, NOAA shall maintain:

1. A mission-oriented enterprise capable of quickly identifying and applying demonstrated R&D outputs to provide new and improved products, services, or more efficient operations while continuing to maintain reliable, cost-effective services for users;
2. An R&D enterprise that routinely provides proven R&D outputs to serve NOAA's mission while adapting its portfolio to address new research frontiers; and,
3. Project management, planning, and oversight processes that include routine identification of new opportunities/needs for research, development of Transition Plans, status reporting, and test and evaluation procedures.

02 Transition Plans are essential for describing and facilitating the transition of R&D to potential end use, and represent an agreement between researchers, operators and/or users that describes a feasible transition pathway and potential Concept of Operations (CONOPS).

03 Transition Plans should be developed as early as possible to reflect the relationship between R&D and NOAA's mission and the commitment by the entities involved to the potential transition of R&D.

04 Transition Plans are recommended for projects that seek to progress beyond RL 4.

05 The determination of whether a transition project shall have a written transition plan is at the discretion of the AA(s), or their designees, from the affected LO(s). In making this determination, factors that may be considered include but are not limited to the following:

1. The risks associated with, and the sensitivity of, the transition;
2. The organizations involved in the transition, and their history of implementing transition activities together;
3. The duration of the transition activities;
4. The cost of transition activities;
5. Potential societal impact; and
6. The complexity of the transition, including whether the project is novel or a routine update to existing operations or applications.

For transitions that involve multiple LOs, if any of the AAs or their designees determine that a written transition plan is justified then one shall be developed.

06 Transition Plans shall incorporate the following:

1. A description of the activities necessary to transfer an R&D output;
2. Clearly defined goals for the new/revised product or service, milestones, schedule, and transition success/acceptance criteria;
3. To the best estimate, the amount and source of funds needed to cover the costs associated with the transition, as well as the cost of future operations as necessary, including relevant requirements for equipment, upgrades, staff training, and maintenance of redundant application capabilities during the transition period;
4. A clear designation of potential researcher(s), operational entity(ies) and/or end user(s), and a description of when they will engage and as often as necessary to ensure all parties are fully invested in the R&D transition process;
5. A mechanism for providing clear communication among all participants concerning the transition, including routine engagement of the management chain in the affected LO(s) and partner organizations; and
6. A mechanism for updating the plan as necessary to reflect changes in the plan warranted by results of the transition process or unforeseen events (e.g., updated budgets).

07 Transition Plans shall be approved by the AA(s), or their designees, from the affected LO(s).

08 Transition Planning integrated into Agency Planning: LOTMs shall strive to include transition projects within their portfolio as appropriate into NOAA planning documents, including NOAA strategic plans and LO Annual Operating Plans.

09 Transition Budgeting integrated into Agency Budgeting: LOTMs shall work towards ensuring that the resources needed to transition R&D outputs to sustainable applications, operations, construction projects, commercialization or other uses are appropriately addressed and included in the Line Office submissions in the appropriate NOAA budget processes.

10 Evaluation: All Transition Projects shall be reviewed on a periodic basis using the evaluation criteria identified in respective Transition Plans to ensure progress towards readiness levels, goals and milestones.

11 Reporting: LOTMs will work with Transition Project Leads to report on execution status of transition projects on a regular basis.

12 This Order follows the guidelines established in NOAA Administrative Order 216-115A, Research and Development in NOAA.

13 This Order supports the policies and procedures contained in the Paperwork Reduction Act, the Government Paperwork Elimination Act, the Federal Technology Transfer Act, the BayhDole Act, Office of Management and Budget (OMB) Circular No. A-130, Management of Federal Information Resources, the NOAA Information Quality Guidelines, and other applicable relevant laws, regulations, and policies. These authoritative requirements apply government resources to activities in support of the agency's mission, outline procedures to ensure and maximize the quality, utility, and integrity of resultant information, and seek to maximize the benefits of resultant information and intellectual property to society.

14 NOAA shall be cognizant of and observe the valid rights of patent holders and owners of other intellectual property.

15 NOAA Invention Disclosure: Prior to any public disclosure (including but not limited to presentations at a public meeting, or publications on a public-facing webpage or in scientific literature), a NOAA invention shall be reported to the NOAA Technology Partnerships Office (TPO) for:

1. Rights determination;
2. Evaluation of patentability and commercial potential; and
3. Inclusion in the NOAA technology and innovation portfolio.

SECTION 4. GOVERNANCE & RESPONSIBILITIES.

01 The Under Secretary of Commerce for Oceans and Atmosphere (NOAA Administrator), the Deputy Under Secretary/Operations, and the NOAA Chief Scientist shall provide top management oversight for implementation of this policy, and the development and implementation of associated procedures.

02 The AAs, the OMAO Director and appropriate NOAA Staff Offices (SOs) support the implementation of this policy through their roles in the NOAA Organizational Handbook.

03 LO AAs and the Director, OMAO are responsible for the following:

1. Promoting the goals and implementing the requirements of this policy;
2. Appointing LOTMs;
3. Determining, or delegating determination of, whether specific transition projects require written transition plans;
4. When appropriate, approving, or delegating approval of, Transition Plans;
5. Ensuring that Transition Teams are appropriately resourced to carry out their responsibilities;
6. Providing or delegating oversight for all transition projects in their LO;
7. Ensuring LO Transition Project reviews are conducted as appropriate; and
8. Reporting on the execution status of transition projects per instructions provided by the Deputy Under Secretary for Oceans and Atmosphere.

04 LOTMs include representatives of the LO AAs and the Director, OMAO. The LOTMs are responsible for the following:

1. Collectively monitoring the NOAA transition portfolio (collection of transition projects);
2. Incorporating applicable LO transition projects into NOAA's planning, budget, execution, and evaluation processes;
3. Tracking and providing timely reports to the NOAA Research Council on the status of the portfolio (collection of transition projects);
4. Ensuring the development of appropriate Transition Plans; and
5. Evaluating transition projects with respect to Transition Plans.

The collective LOTMs form a standing committee of the NOAA Research Council. As such, they are expected to report to the Council at least annually on the status of NOAA's transition activities and:

1. Inform the Council on issues of concern related to the transition of research; and
2. Respond to guidance and direction from the Council.

05 The TPO Director is responsible for:
1. Providing the LOTM committee with updates on TPO activities;
2. Maintaining a database of transitions occurring under TPO purview;
3. Informing the LOTMs of transition opportunities to NOAA application; and
4. Informing the LOTMs of potential intellectual property issues pertaining to specific technology projects.

06 Transition Project Leads are responsible for managing the transition projects and all associated activities. For transition projects that include construction projects (as defined in 2.03), Transition Project Leads are responsible for providing planning and budgeting documents to a designated Line Office Construction Work-In-Progress Project Manager, who will follow the process and procedures for constructed projects detailed in the NOAA CWIP Policy (**http://www.corporateservices.noaa.gov/finance/docs/CWIP/CWIPPolicy--May2016FINAL.pdf**).

07 Transition Teams should include representatives from both the research output and operations or end-user communities. Transition Teams are responsible for the following:
1. Coordinating transition activities; and
2. Identifying, reporting, and responding to significant deviations in the execution of the Transition Plan.

08 The NOAA Research Council is responsible for the following:
1. Overseeing the LOTM committee;
2. Providing guidance and advice to the NOAA Chief Scientist as pertains to research transition policy, process and practice; and
3. Establishing or overseeing the establishment of policies and processes to foster effective transitions.

09 Other applicable Councils, such as the NOAA Observing Systems Council and the NOAA Ocean and Coastal Council, are responsible for participating in the NOAA's planning, budget, execution, and evaluation processes and providing comments regarding the identification and readiness of projects for transition and the relative priority of these projects.

SECTION 5. REFERENCES .

01 Working through the LOTM Committee, the Research Council will develop and disseminate written procedures, plans, and reports as necessary to implement this Order, including but not limited to:
1. Procedural Handbook covering, but not limited to, the following topics:
    1. Use and interpretation of readiness levels in NOAA; and
    2. Guidance for developing effective Transition Plans.

02 Existing documents referenced in this policy are as follows:
1. Mankins, John C. (6 April 1995). "Technology Readiness Levels: A White Paper" (PDF). NASA, Office of Space Access and Technology, Advanced Concepts Office. **http://www.hq.nasa.gov/office/codeq/trl/trl.pdf**
2. NSTC (2014). "National Plan for Civil Earth Observations", **https://www.whitehouse.gov/site/default/file/microsites/ostp/NST/national_plan_for_civil_earth_observations_-_july_2014.pdf**
3. NOAA Invention Disclosure and Rights Questionnaire Instructions,

4. NOAA Invention Disclosure and Rights Questionnaire http://ocio.os.doc.gov/s/groups/public/@doc/@os/@ocio/@oitpp/documents/content/dev_01_002431.pdf
5. OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris. DOI: http:/ldx.doi.org/10.1787/9789264239012-en

SECTION 6. EFFECT ON OTHER ISSUANCES.
01 This Order supersedes NOAA Administrative Order (NAO) 216-105, Policy on Transition of Research to Application issued July 31, 2008 .

02 The Under Secretary of Commerce for Oceans and Atmosphere signs because the matter has not been delegated.

An electronic copy of this Order will be posted on the NOAA Office of the Chief Administrative Officer website under the NOAA Administrative Issuances Section.
Signed,
Under Secretary of Commerce
for Oceans and Atmosphere
Office of Primary Interest:
Office of Oceanic & Atmospheric Research

Logistics

When: May 7-8, 2019

Where: The National Water Center (NWC), Auditorium, 205 Hackberry Lane, Tuscaloosa, AL 35401. **For building access, present your Federal badge, or state-issued drivers' license.**

1. **Getting to Tuscaloosa.** Birmingham-Shuttlesworth International Airport (BHM) is located 60 miles northeast of Tuscaloosa. Want to carpool? Send your flight arrival/departure times to Murielle (murielle.gamache-morris@noaa.gov or 703-298-8230); that information will be compiled into a spreadsheet and distributed approximately a week prior to the meeting so that participants may make carpooling matches.

   NOTE: You will experience traffic delays due to construction on the Interstate 59/20 bridges through downtown Birmingham. The bridges are being rebuilt as part of a $475 million project that will require the highway to be closed for an estimated 14 months (see here for more information). While there are detour signs, plan to use your GPS extensively. Expect to add at least 30-minutes to the normal 60-minute drive. Alternatively, use I-459 to I-20/59. This adds approximately 10 minutes.

2. **Staying in Tuscaloosa.** A room block at the Hotel Indigo has been arranged. Make your reservations today!
   - Book Here: Coastal Coupling Community of Practice
   - Phone number: 877-270-1392 (ask for the Coastal Coupling Community of Practice Meeting block)
   - Reserve by: Friday, April 26, 2019

3. **Being social in Tuscaloosa.** Get to know your colleagues in a less formal setting by attending a no-host dinner at R Davidson Chophouse (2330 4th Street, within walking distance from the Hotel Indigo) on Tuesday, May 7th at 7:00 p.m. CT.

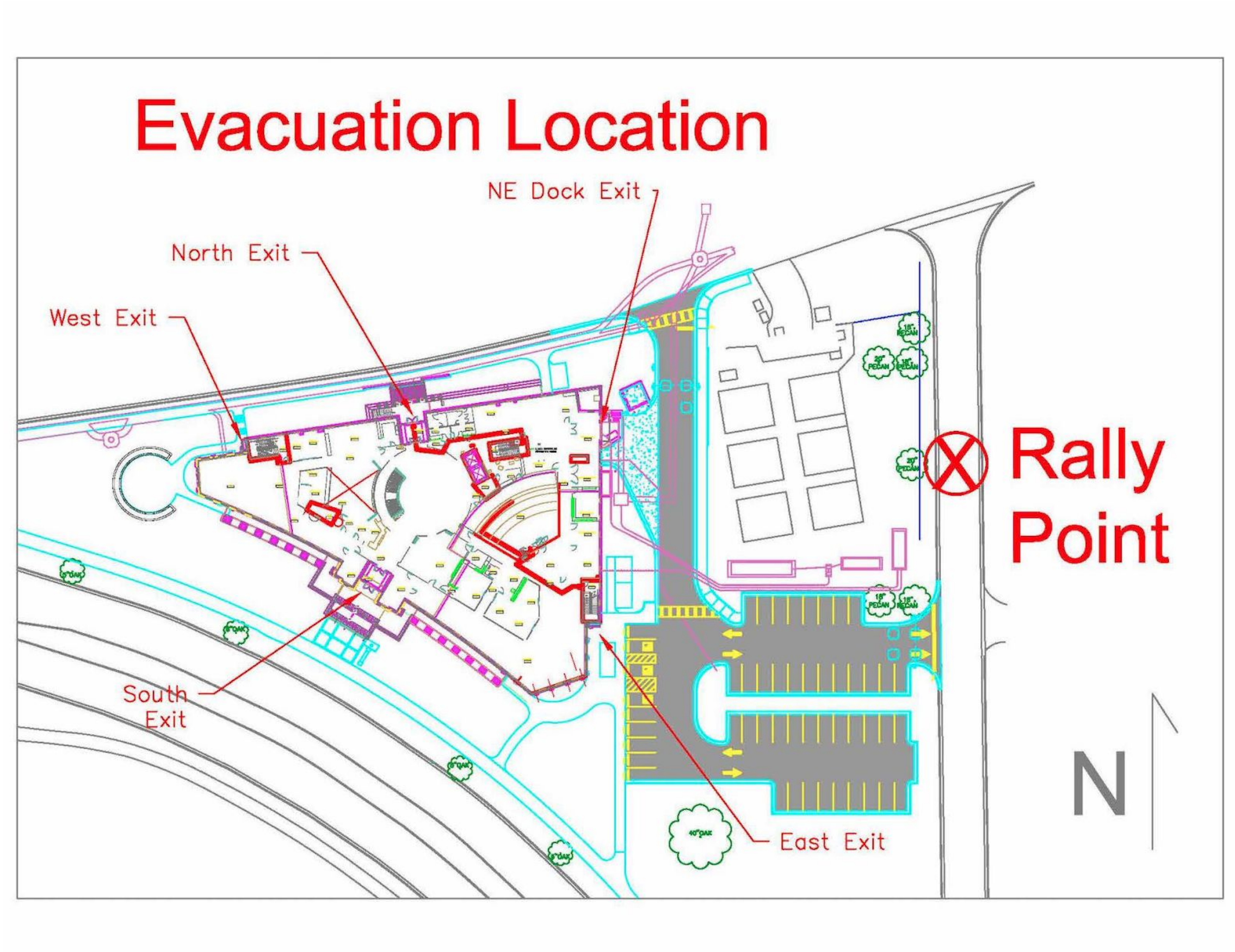
4. **Meals in Tuscaloosa.** Food and beverages will be provided each day of the conference, including:
   - All day coffee, tea, and other beverages (Note: Bring your reusable water bottle; individual bottles of water will not be available);
   - Light breakfast on Wednesday and Thursday (if attending the optional Thursday session);
   - Boxed lunch on Wednesday; and
   - Snacks each day.

   NOTE: By **COB on April 29th**, please make your lunch selections for Wednesday, May 8th here. For federal employees, the food and beverage cost for attending the Tuesday and Wednesday sessions is $35; the cost for all three days is $45. Payments will be accepted on site or electronically (Venmo (@Dori-Stiefel); Apple Pay (703-593-5755)).

5. **Gaining access to the National Water Center.** Each participant must sign in at the front desk of the National Water Center for each day in attendance.

NOTE: The National Water Center is a secure Federal facility. As a result, any permanent residents (green card holders) or non-U.S. citizens will need to complete additional paperwork. Please contact Cayla Dean (cayla.dean@noaa.gov or 205-347-1361) for details.

National Water Center Evacuation Plan



Contact: We welcome your questions and are good at solving problems.

- Cayla Dean: 205-347-1361 or cayla.dean@noaa.gov
- Murielle Gamache-Morris: 703-298-8230 or murielle.gamache-morris@noaa.gov