



COASTAL COUPLING
COMMUNITY OF PRACTICE

ANNUAL MEETING

Coastal Coupling Community of Practice
May 25, 2023



Access to Meeting Materials
WiFi: Coastal Coupling
Password: co@\$t2C0@\$T!

Day 2 Highlights

Today we are building on what we heard on Day 2, including:

1. Excitement about the year ahead, including potential working groups for coastal modeling model repositories and strategic communications.
2. The ideas for specific activities and projects that will ensure we reach our Community's goals.
3. Discussions about the timeline for including NWM in UFS.

Day 3 Look-Ahead

Today we will build on our successes to focus on best practices, shared agreements, and next steps through lightning talks, subject matter presentations, and an open discussion about the next steps for this community.

Opportunities with JTTI



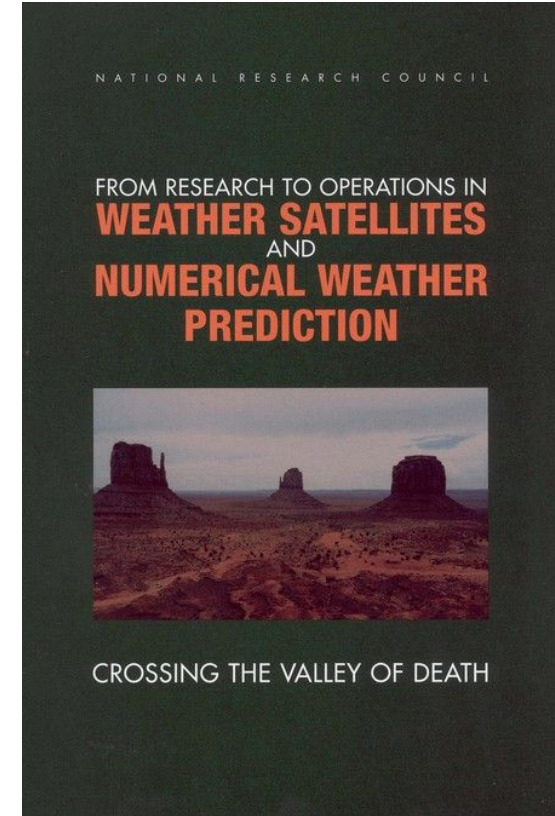
CHANDRA KONDRAGUNTA

Program Manager, Joint Technology Transfer Initiative (JTTI)
NOAA
chandra.kondragunta@noaa.gov

Coastal Coupling Community of Practice Annual Meeting
May 25, 2023

Joint Technology Transfer Initiative

- **Background:** JTTI was created by the US Congress in FY16 with a \$6M in NOAA/OAR's budget
 - In 2017, JTTI became part of the “Weather Research and Forecasting Innovation Act of 2017”
- **Mission:** Continuous development and cost-effective *transition of the latest scientific and technological advances into the NWS operations, while working in close coordination with the National Weather Service (NWS) and in cooperation with the American Weather Enterprise*
 - The Charge is to cross the “Valley of Death”



JTTI funding & Relevant Transitions

Total number of R20 projects funded to date :
152

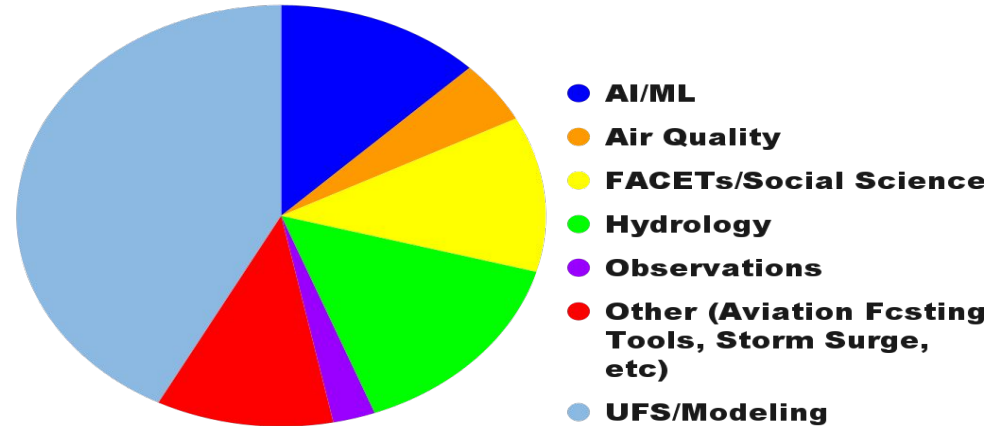
External = 116

- Academic sector = 106
- Private sector = 10

Internal (NOAA) = 36

Total number of transitions = 18

JTTI Funding by Topic Area (FY16-FY22)



Relevant Transitions to CC CoP:

- Project Title: Advancing ADCIRC U.S. Atlantic and Gulf Coast Grids and Capabilities to Facilitate Coupling to the National Water Model in ESTOFS Operational Forecasting
 - PI: Joannes Westerink, University of Notre Dame
- Project Title: Improving Water Cycle Prediction in the National Water Model through Regional Calibration, Meteorological Forcing Improvements, and Coastal Coupling
 - PI: Thomas Johengen, Cooperative Institute for Great Lakes Research, Univ. of Michigan



JTTI Funding Opportunities

JTTI runs two types of competitions:

- Notice of Funding Opportunity (NOFO) for **external** community (Academia and private sector)
 - Readiness Levels 4 and above (Developmental and Demonstration phases)
- **Internal** Competition for NOAA scientists
 - Readiness Levels 6 and above (Demonstration including pre-operational testing)

Future Funding Opportunity: FY25 JTTI funding cycle

- Internal Competition for NOAA Scientists
- Expected Funding Announcement Date: 3rd quarter of FY24
- Expected Project Start date: 3rd quarter of FY25
- Eligibility: Federal Scientists from OAR labs and NWS centers/operational units
- Eligible Readiness Levels: RL-6 and above (Previously funded NOFO projects from JTTI or one of other NOAA R&D programs)
- Areas of Interest: Weather Modeling, including DA, post-processing, coastal coupling etc.
- Funding Period: 2-3 years
- Funding Amount: Maximum funding limit = \$500K
- Proposal structure: Joint proposals between OAR labs and NWS Centers/operational units
 - Proposals must have NWS partners



COASTAL COUPLING
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THANK YOU

CHANDRA KONDRAGUNTA

Program Manager, Joint Technology Transfer Initiative (JTII)

NOAA

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Service Delivery and Training in CC CoP Activities



DAVID VALLEE

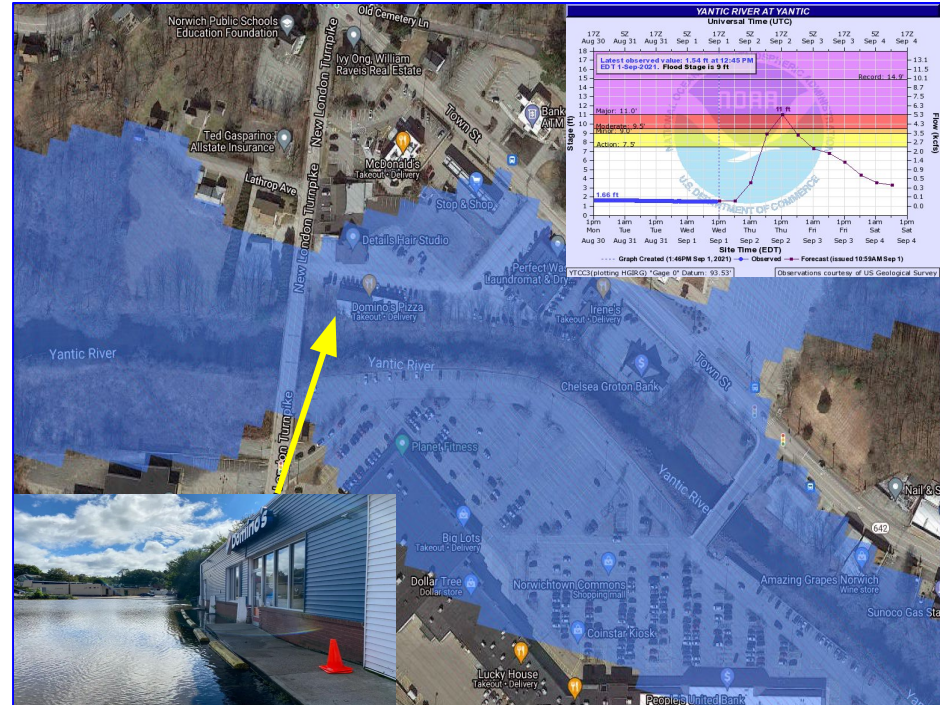
Director, Service Innovation and Partnership Division
Office of Water Prediction, NOAA
david.vallee@noaa.gov

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THE PROJECT:

The NWS Effort to Implement Forecast Flood Inundation Mapping

- FIM services will greatly improve our ability to provide Impact-based Decision Support Services (IDSS) to our core partners
- Coastal Coupling will drive a more accurate inundation solution along the coast
- We have requirements for such a solution to be most useful:
 - Guidance must be accurate to meet the warning mission (trusted source)
 - Modeling system must run efficiently and guidance/output delivered in timely manner
 - Drive toward probabilistic services - this is the direction the NWS is headed



TRAINING:

The key component to our success

- Tremendous investments by OWP to develop training to support the field!
- Combination of CBT, Webinars, and Workshops
- For Coastal Coupling integration - we need your help!
 - You are the Subject Matter Experts
 - The effort doesn't end with the implementation of the model...education is key
 - A successful training effort will lead to our success

Flood Inundation Mapping IDSS Workshop

The screenshot displays a workshop interface with three main sections: Day 01, Day 02, and Day 03. Each section includes a title, a brief description, and a list of activities or exercises. Day 01 focuses on 'FIM Review (Introduction and Tools)', Day 02 on 'FIM IDSS Process', and Day 03 on 'Collaboration & Customer Interactions for Scenarios'. There are also sections for 'FIM Reviewer Exercises' and 'Morning Exercises with Answer Keys'.

Day 01.
FIM Review (Introduction and Tools)

- FIM Reviewer
- Instructions for Display
- FIM Reviewer Exercises - Morning

Answer Keys to Morning Exercises:

- One
- Two
- Three

Day 02.
FIM IDSS Process

Day 03.
Collaboration & Customer Interactions for Scenarios

- FIM Tabletop Exercises
- Morning Exercises with Answer Keys:
 - Texas
 - Mid-Atlantic

Training Program Supporting NWS FIM Implementation

Required for SME's Only

National Water Model Part 1: Science and Products

National Water Model Services

NWM Flood Inundation Mapping Services

NWM for IDSS Support

National Water Center Public Products and Services - Pa...

National Water Center Public Products and Services - Pa...

Height Above Nearest Drainage Method (HAND) Method

Hydrography & DEMs Specifications Webinar

Water Surface and Rating Curves Webinar

HydroVIS Introduction Webinar

HAND FIM Performance Evaluation Module

Categorical FIM (CatFIM) Module

Using the FIM Reviewer v2 Webinar

FIM Quality Control Webinar

Required for Field Forecasters

National Water Model Part 1: Science and Products

National Water Model Services

NWM Flood Inundation Mapping Services

NWM for IDSS Support

National Water Center Public Products and Services - Pa...

National Water Center Public Products and Services - Pa...

Height Above Nearest Drainage Method (HAND) Method

HAND FIM Performance Evaluation Module

Categorical FIM (CatFIM) Module

THE RESULT: SAVING LIVES & PROPERTY

No more heartbreaking scenes like this →

The NWS Mission Statement:

Provide weather, water and climate data, forecasts, warnings, and impact-based decision support services for the protection of life and property and enhancement of the national economy.

The NWS Vision:

A Weather-Ready Nation: Society is prepared for and responds to weather, water, and climate-dependent events.

We need your help to truly fulfill our obligations to the Nation!



Residents of La Vita Bella, Dickinson, Texas - flooded during Hurricane Harvey, August 2017.



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THANK YOU

David R. Vallee
Director, Service Innovation and Partnership Division
Office of Water Prediction, NOAA
david.vallee@noaa.gov

An aerial photograph of a river with vibrant, swirling blue and green water. The water flows over dark rocks, creating a dynamic and colorful scene. The colors range from deep blues to bright greens, suggesting different depths or mineral content in the water.

Partnerships & Opportunities

LAURA REAR McLAUGHLIN ■ MAY 25, 2023

Branch Chief, Stakeholder Services Branch, NOAA/NOS/CO-OPS



Partnerships



Coastal Resilience COP

An aerial photograph of a coastline. The top half shows a rocky shore with waves crashing against it, creating white foam. The bottom half shows a sandy beach with several birds flying over the water. The overall color palette is a mix of blues, greys, and whites.

BIL & IRA Funding



And So Much More!

An aerial photograph of a river with vibrant, swirling blue and green water. The water flows over dark rocks, creating a dynamic and colorful scene. The colors range from deep navy blue to bright turquoise and emerald green. The water's surface is textured with ripples and small waves, giving it a sense of movement and depth. The overall composition is abstract and visually striking.

Thank You!

LAURA REAR McLAUGHLIN ■ MAY 25, 2023
Branch Chief, Stakeholder Services Branch, NOAA/NOS/CO-OPS

Earth Prediction Innovation Center (EPIC)



MAOYI HUANG

Earth Prediction Innovation Center Program Manager
NOAA
maoyi.huang@noaa.gov

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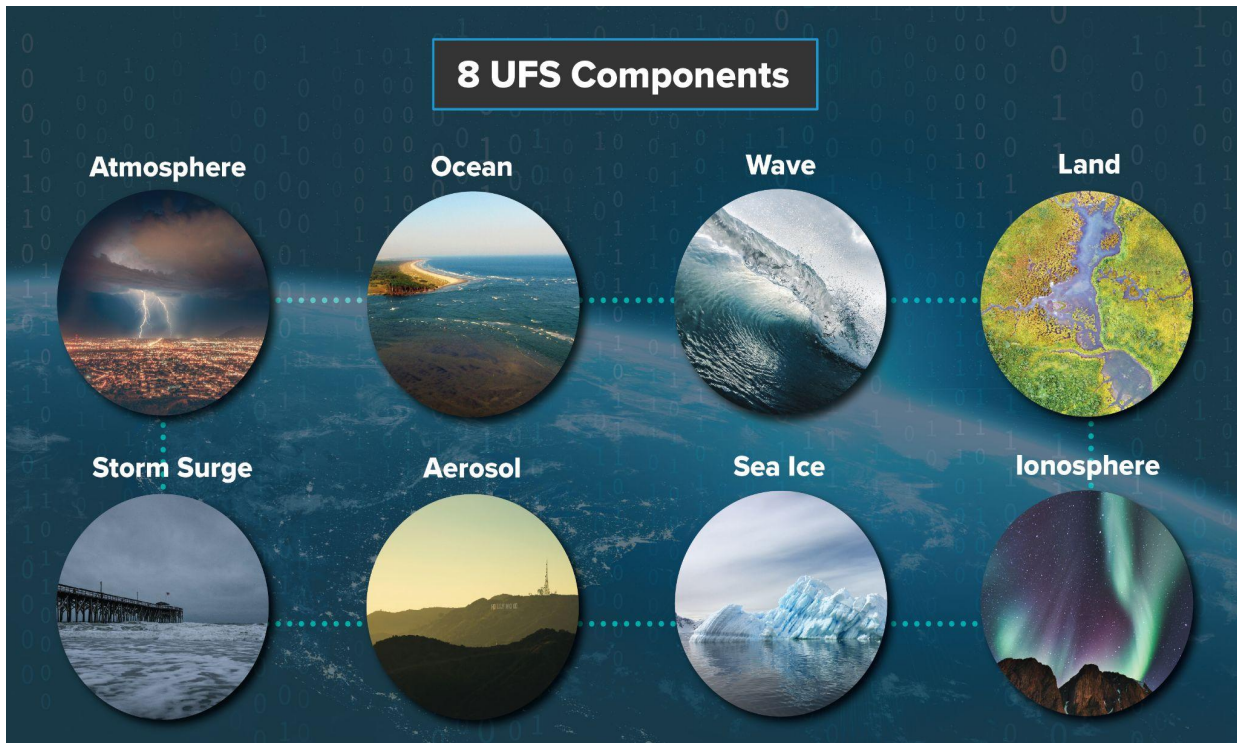
EARTH PREDICTION INNOVATION CENTER

EPIC AS A CATALYST *for NOAA's Future Earth Prediction System*

Maoyi Huang, Ph.D., EPIC Program Manager, Weather Program Office
Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration
Coastal Coupling Community of Practice Annual Meeting, 22 May 2023



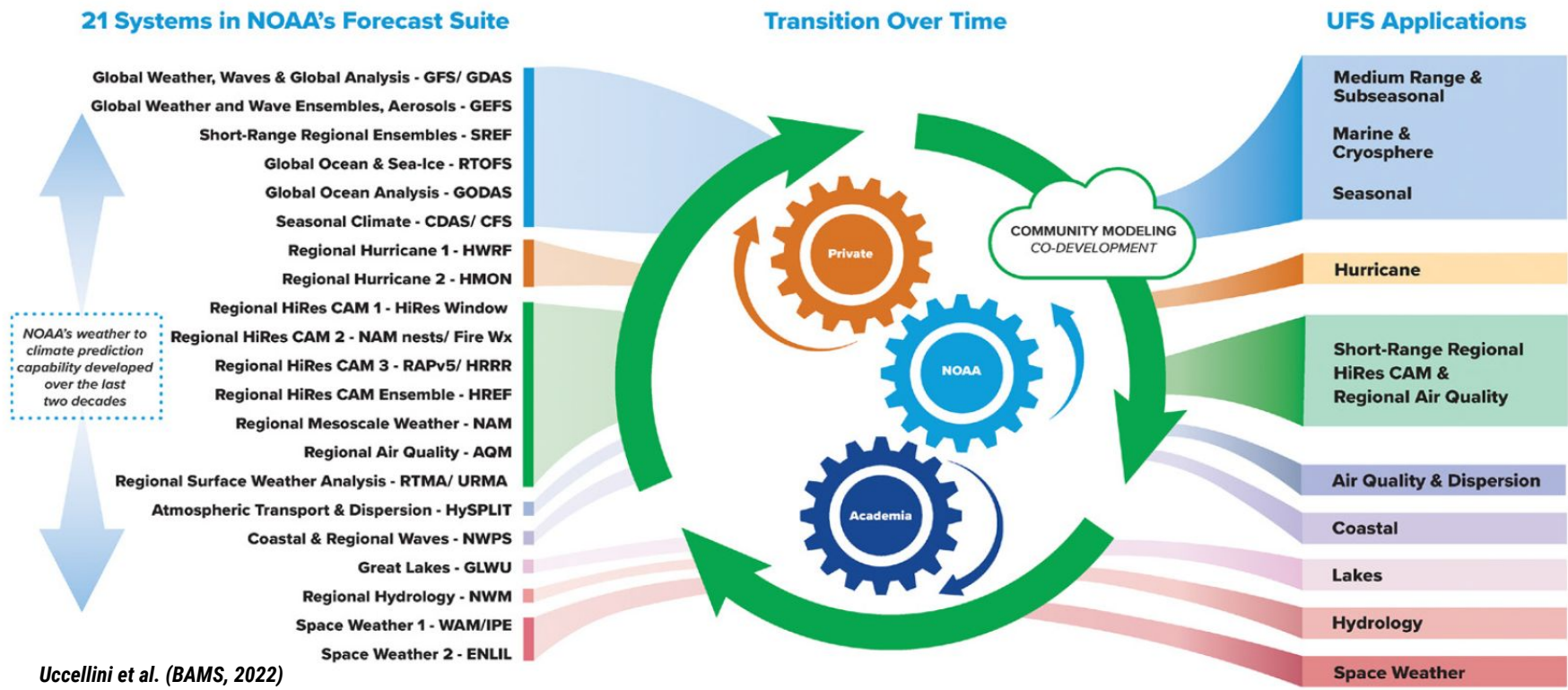
- The Unified Forecast System (UFS) is a **community-based coupled Earth modeling system**, designed to support the Weather Enterprise and also be the **source system for NOAA's operations**.
- UFS applications share agreed-upon numerical forecast system elements.
- Unified infrastructure at the application level allows for coupled interactions among components.



ufsccommunity.org

Simplifying NOAA's Operational Forecast Suite

Transitioning 21 of NOAA's Operational Forecast Systems into Eight Applications



PARTNERING WITH THE COMMUNITY FOR THE BENEFIT OF THE NATION

Vision

To enable the most accurate and reliable operational numerical forecast model in the world.

Mission

To be the catalyst for community research and modeling system advances that continually inform and accelerate advances in our nation's operational forecast modeling systems.



The Art of the Possible

Community Modeling,
Earth Prediction and Innovation



Students

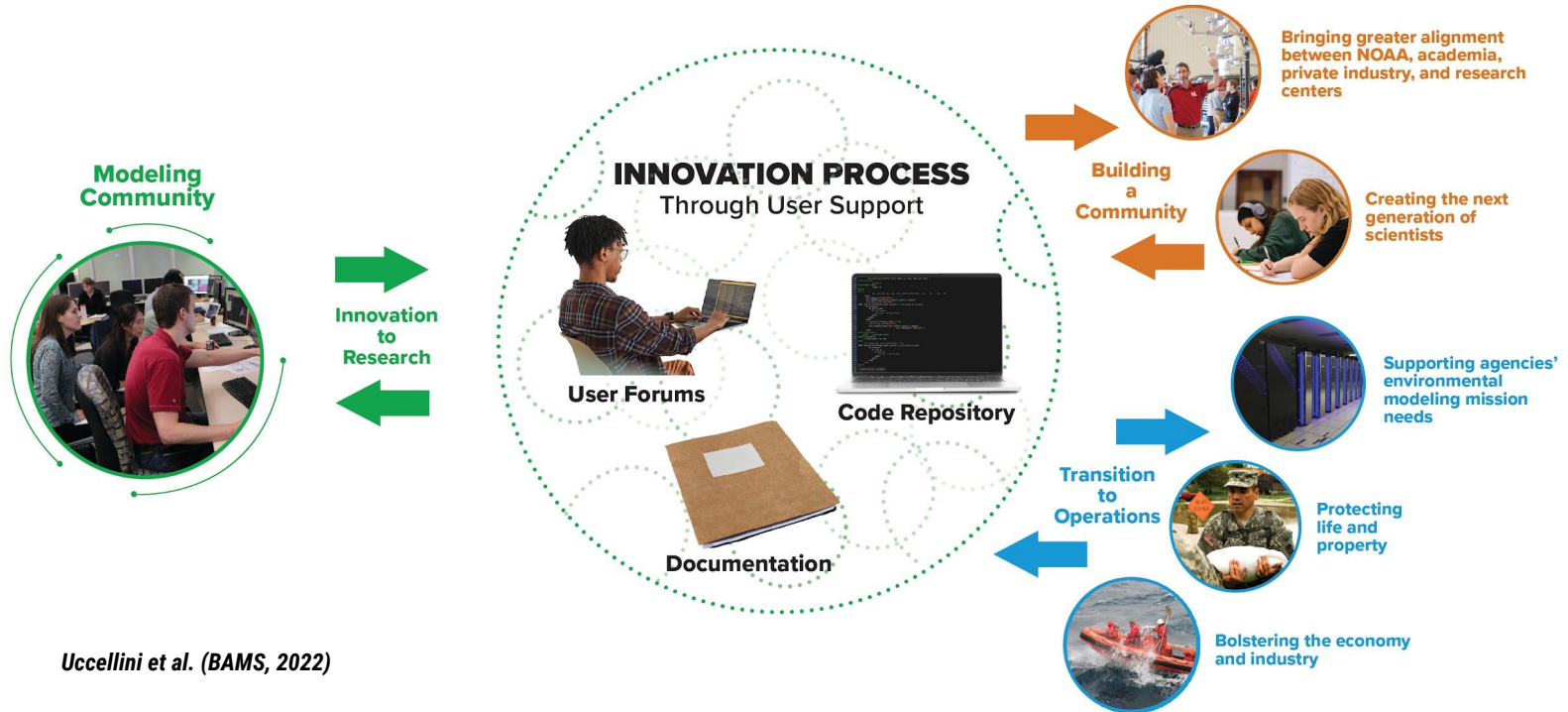
Government

Academia

Industry

EPIC Innovation Flow

Creating an Environment for Co-development and Inclusion

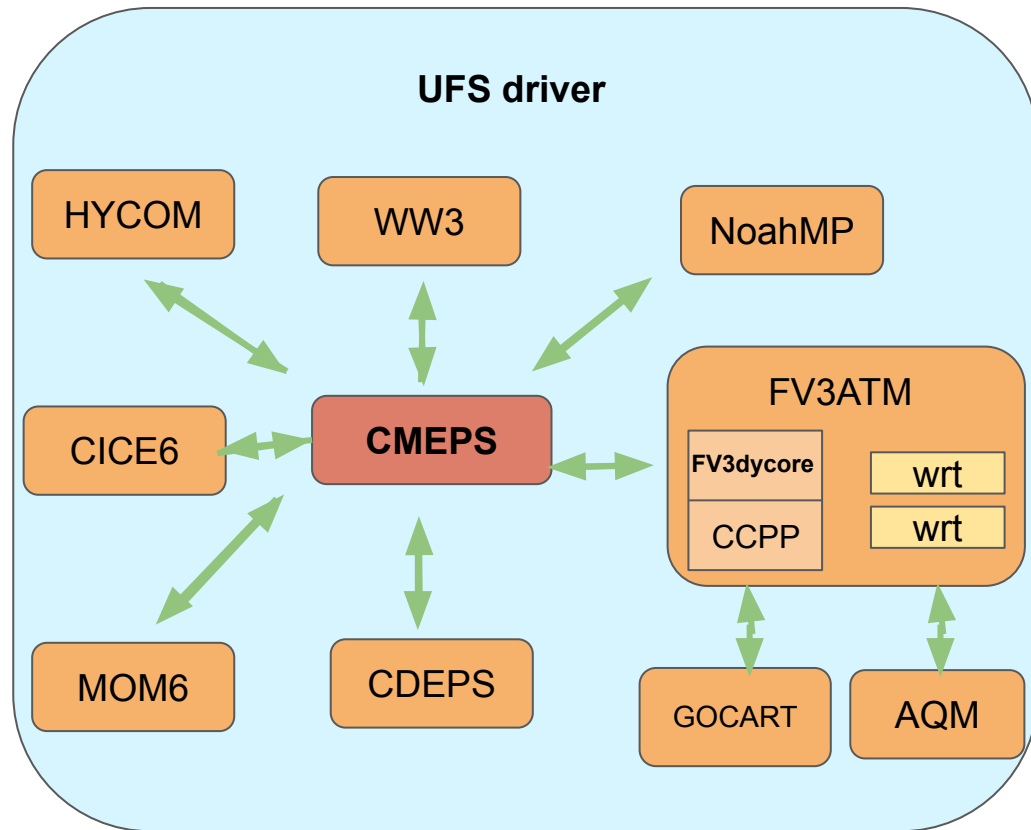


Uccellini et al. (BAMS, 2022)

UFS Weather Model

Model infrastructure has been developed to build the unified system to support applications with various levels of complexity.

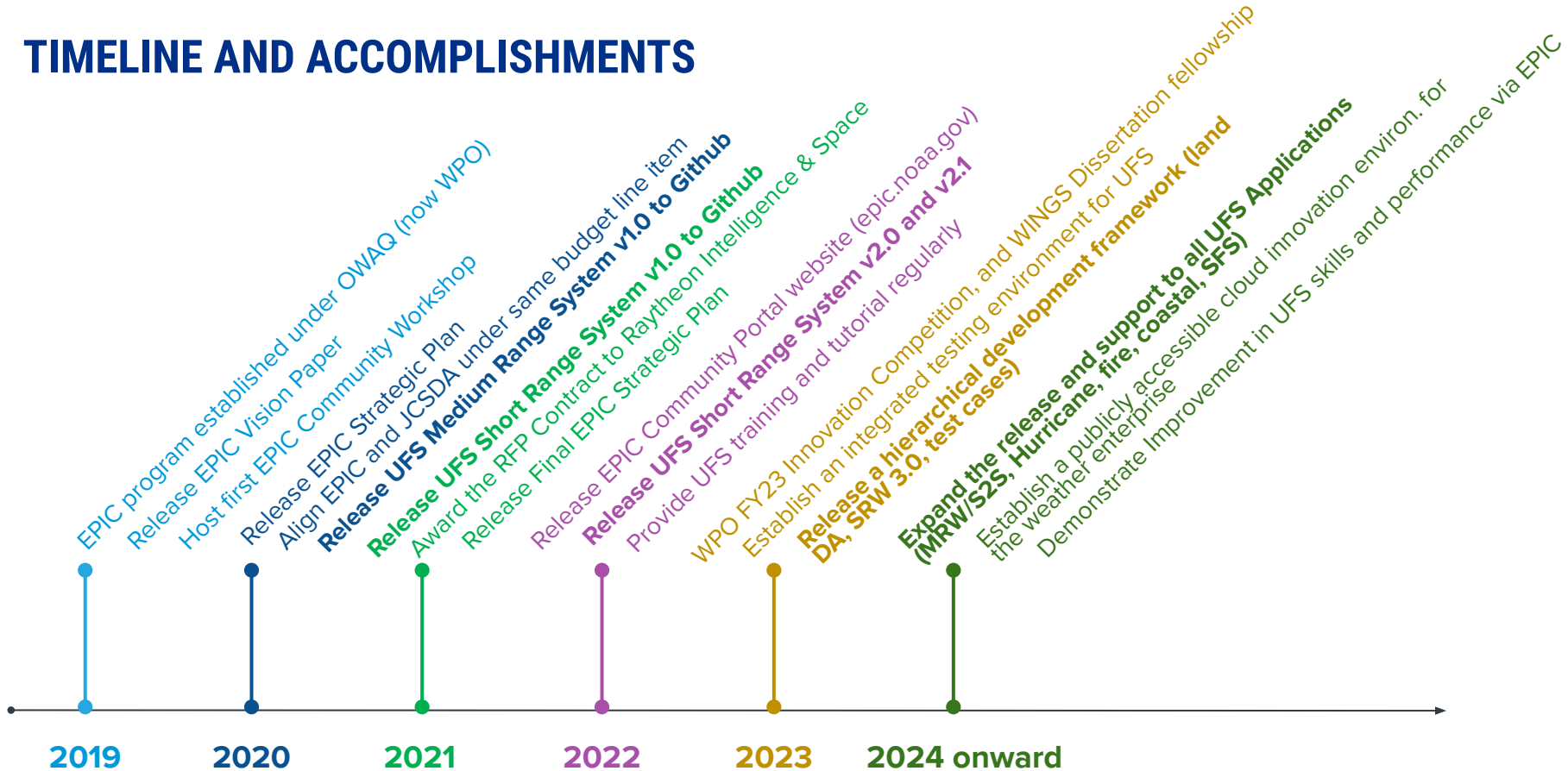
- Coupled model prototypes P1-P8
- GFSv17 high resolution experiments HR1
- GEFSv13 ensemble prediction experiments EP1-EP4
- RRF5 v1
- HAFS v1
- AQM v7
- Offline file-based coupling of FV3 within JEDI framework
- Marine DA forecast model
- Land DA forecast model



Courtesy: Arun Chawla (EMC)

Plus a number of libraries like FMS, MAPL, ESMF, NetCDF, HDF5 etc.

TIMELINE AND ACCOMPLISHMENTS





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THANK YOU

MAOYI HUANG

Earth Prediction Innovation Center Program Manager

NOAA

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



SAEED MOGHIMI

Storm Surge Modeling Team Lead
National Ocean Service, NOAA
saeed.moghimi@noaa.gov

Coastal Coupling Community of Practice Annual Meeting
May 25, 2023

UFS-Coastal Team

Saeed Moghimi (NOAA/NOS/OCS)
Maoyi Huang (NOAA/OAR/WPO/EPIC)

Panagiotis Velissariou (NOAA/NOS/OCS)
Yunfang Sun (NOAA/NOS/OCS)
Ed Myers (NOAA/NOS/OCS)
Corey Allen (NOAA/NOS/OCS)

Tracy Fanara (NOAA/NOS/IOOS)
Derrick Snowden (NOAA/NOS/IOOS)

Patrick Burke (NOAA/NOS/CO-OPS)
Carolyn Lindley (NOAA/NOS/CO-OPS)

Arun Chawla (NOAA/NWS/EMC)

Ufuk Turuncoglu (UCAR/NCAR)
Dan Rosen (UCAR/NCAR)

Carsten Lemmen (Hereon)
Joseph Zhang (VIMS)

Damrongsak Wirasaet (UND)
Joannes Westerink (UND)

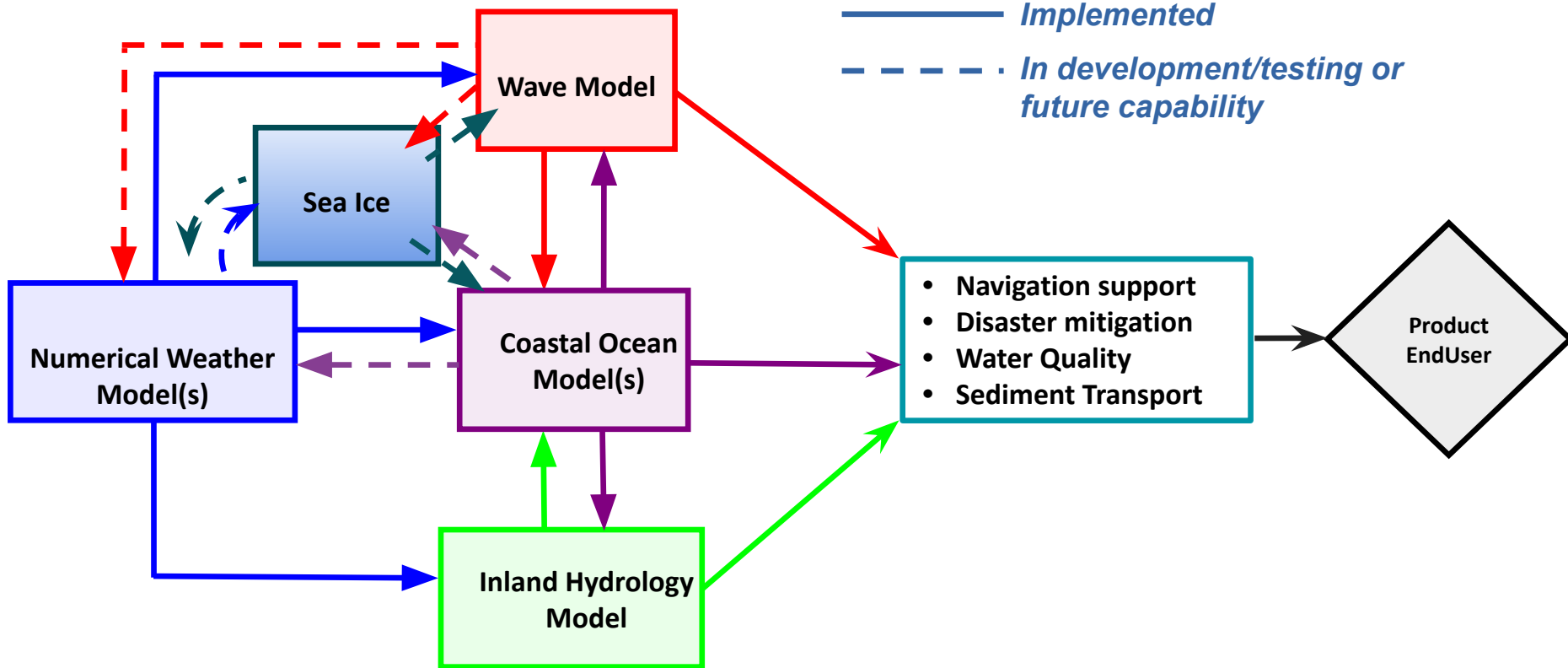
Jianhua Qi (UMASS-Dartmouth)
Changsheng Chen (UMASS-Dartmouth)

Hernan G. Arango (Rutgers)
John Wilkin (Rutgers)

Ayumi Fujisaki-Manome (CIGLR)

Chris Domanti (EPIC project team)
Keven Blackman (EPIC project team)

COASTAL OCEAN MODELS COUPLING FRAMEWORK



Current status - CoastalApp

noaa-ocs-modeling / CoastalApp Public

 pvelissariou1 NEMS: added the FVCOM component into the NEMS system ✖ ad067d3 2 days ago 🕒 275 commits

 .github/workflows create new GitHub Action to test submodule pointers (#72) 2 years ago

 ADCIRC @ bd62a3c updated ADCIRC on 02/13/2023 3 months ago

 ATMESH @ a337c93 modified the ATMESH submodule pointer 6 months ago

 BARDATA @ 8acb271 BARDATA: removed OC-GTSM/OGCM_DL-orig.f90 last year

 FVCOM @ 7789b4b FVCOM: initial commit 2 weeks ago

 NEMS @ e4648bb NEMS: added the FVCOM component into the NEMS system 2 days ago

 NWM @ 3bc401d update NWM and WW3 on linux file system 2 years ago

 PAHM @ c1f3870 added the ParallelWorks platform into the system 2 months ago

 SCHISM updated tp latest SCHISM sources on 02/13/2023 3 months ago

 WW3 @ de9a246 WW3: removed ParMETIS sources; fixed the GCC variable in cmplr.env 2 months ago

 WW3DATA @ beda5f2 update submodules to point to new pull request commits 2 years ago

 conf CoastalApp build script and gitmodule changes to allow for WW3 com... 7 months ago

CoastalApp is a NUOPC application implemented following UFS best practices to couple coastal ocean models and other domains (Sea Ice, Atmosphere, Wave, Inland Hydrology, ...)

 Readme

 CC0-1.0 license

 8 stars

 8 watching

 24 forks

Number of reg tests: 20

Model components:






















- ADICRIC
- SCHISM
- FVCOM
- WW3
- PaHM
- ATMESH
- WW3DATA

Platforms Tested:

- RDHPCS - Hera, Orion, Cloud, ...
- NSF - TACC (Frontera, Stampede)
- Various institutions HPC/Clusters
- Local Clusters/Desktops

Job Scheduling:

- Slurm
- PBS
- Plain mpirun/mpixec

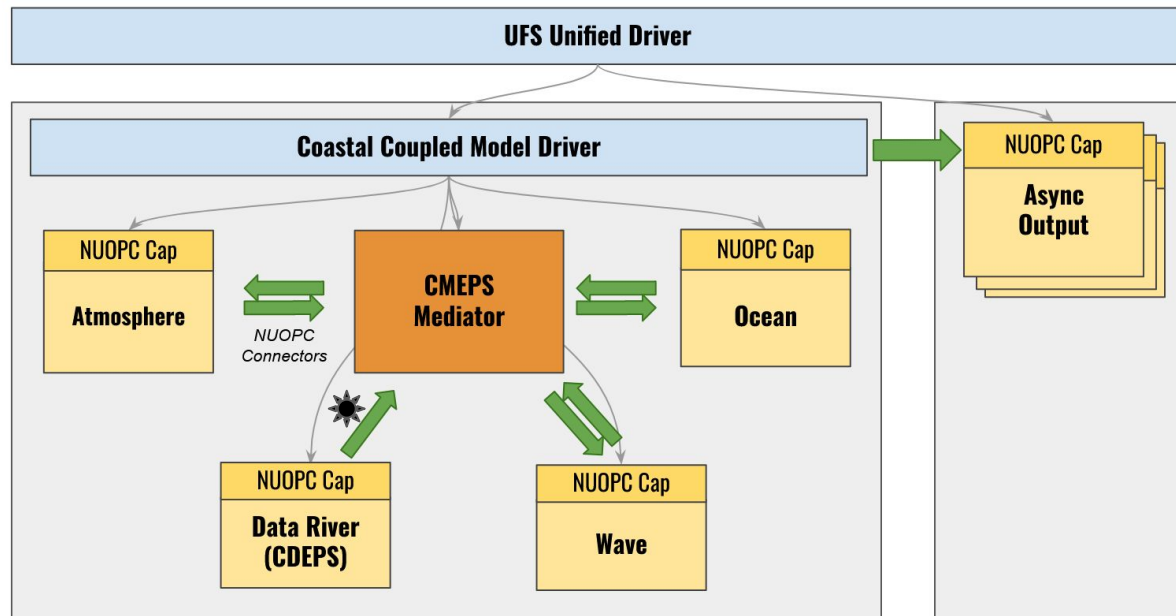
 florencia_hsofs.adc_spinup	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 florencia_hsofs.atm2adc	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 florencia_hsofs.atm2adc2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 florencia_hsofs.atm2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 florencia_hsofs.ww3_multi	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 florencia_hsofs.ww3_nems	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.adc_spinup	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.atm2adc	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.atm2adc2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.atm2sch	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.atm2sch2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.atm2sch2ww3data	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.atm2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.sch	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 ike_shinnecock.ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 images	fixed the slurm/pbs scripts to allow additional options from the comm...	3 months ago
 sandy_shinnecock.pam2adc	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 sandy_shinnecock.pam2adc2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 sandy_shinnecock.pam2ww3	fixed job submission scripts (SLURM, PBS) and added the SCHISM cases;...	last week
 scituateharbor.atm2fvc2ww3	added FVCOM test cases for Scituate Harbor (MA).	5 days ago
 scituateharbor.fvc	added FVCOM test cases for Scituate Harbor (MA).	5 days ago

UFS-Coastal Infrastructure

🔗 [oceanmodeling / ufs-coastal](#) Public

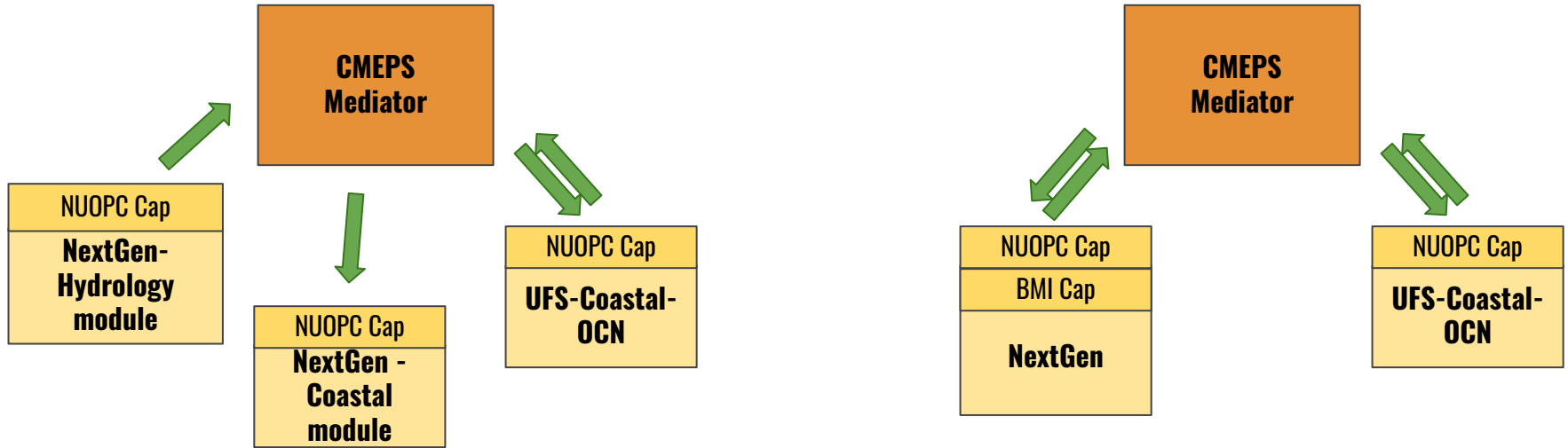
forked from [ufs-community/ufs-weather-model](#)

- “Data” models for integrating forcing datasets
- Component-level testing and cap optimization
- Configurable driver
- Coastal Mediator component
- Asynchronous output & regridding
- Computational performance optimization



https://github.com/oceanmodeling/ufs-coastal/tree/feature/coastal_app Courtesy to Rocky Dunlap (NCAR team)

UFS-Coastal and NextGen: Two-way coupling scenarios!?



1) UFS-Coastal to be connected to NextGen modules to exchange information *similar to Coastal Act project*.

2) UFS-Coastal and NextGen connection through NUOPC cap that wraps entire NextGen.

Inland-hydrology and coastal ocean models coupling (for BIL/CIFIM) - draft

Phases	Action items	Coupling modes	Expected time
Phase 1	<ol style="list-style-type: none"> OWP develop and validate the first version of NextGen NOS develop and validate the first version of ufs-coastal 	Stand alone model development	2024
Phase 2	<ol style="list-style-type: none"> NextGen develops BMI data models to import NOS coastal ocean models to enable one-way coupling from ufs-coastal to NextGen The ufs-coastal to develop CDEPS NUOPC data wrapper to enable one-way coupling from NextGen to ufs-coastal The ufs-coastal team to support NextGen team in designing NextGen NUOPC cap / BMI connection 	One-way coupled	2025
Phase 3	<ol style="list-style-type: none"> NOS team will support OWP to start implementing NUOPC connectivity to BMI system Basic testing of two way exchange among ufs-coastal and NextGen will be done Prototype testing of the two-way coupled system Preoperational testing of the two-way coupled system 	Two-way coupled	2026 and beyond (in accordance with NextGen and ufs-coastal milestones)





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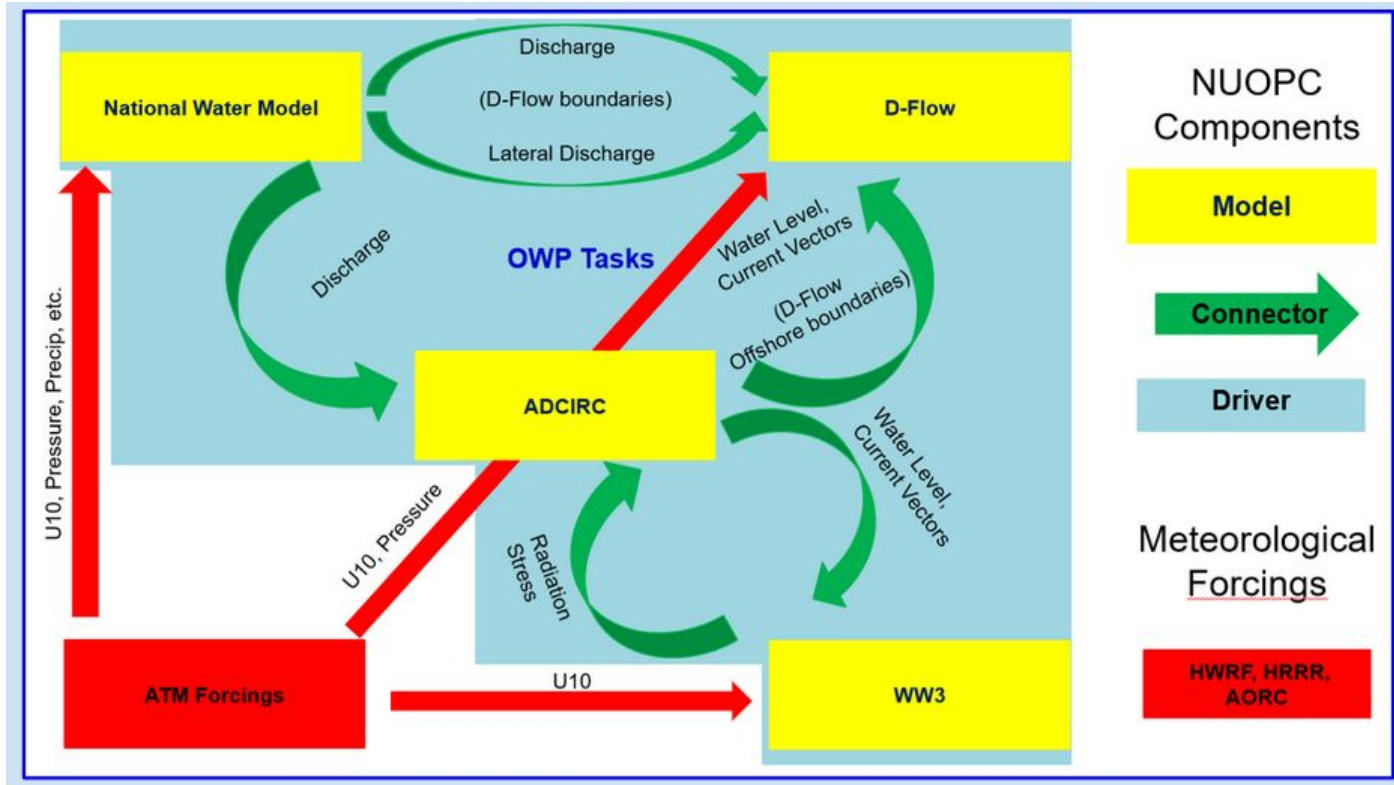
THANK YOU

SAEED MOGHIMI

NOS Storm Surge Modeling Team Lead

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Coastal Act- Coastal ocean models & Inland-Hydrology



Credit: OWP presentation on September 28, 2022, Coastal Act 2022 annual meeting

Demonstrating the Coupling Architecture with the University of Massachusetts-developed Northeast Coastal Ocean Forecast System (NECOFS)



CHANGSHENG CHEN

Montgomery Charter Chair Professor
University of Massachusetts Dartmouth
c1chen@umasd.edu

Coastal Coupling Community of Practice Annual Meeting
May 25, 2023



Coupling Architectures of NECOFS and NWM

Changsheng Chen¹, Siqi Li¹, Tom Shyka², Alexander Prusevich³, Jake Kritzer², Joe Salisbury³, Qichun Xu²

University of Massachusetts-Dartmouth¹

NERACOOS²

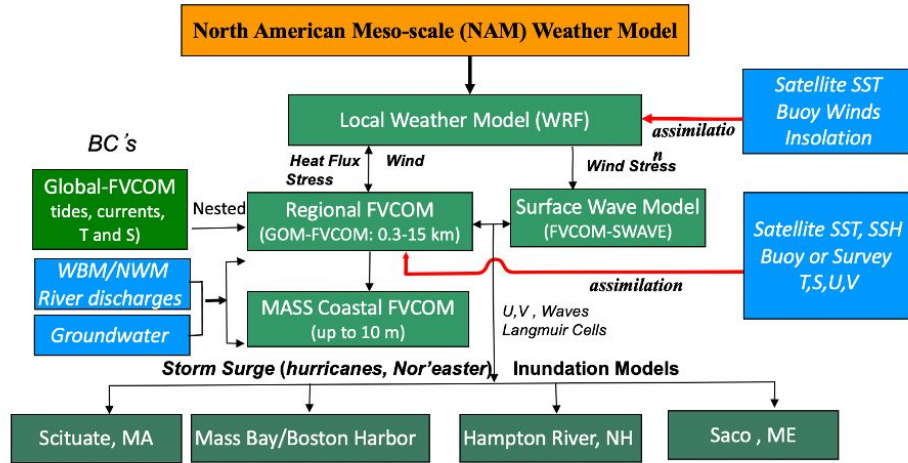
University of New Hampshire³



Outline

- ❖ Current NEOFS-NWM/WBM forecast/hindcast system
- ❖ Designs of NEOFS-NWM-WRF coupling with hydrostatic and non-hydrostatic dynamics
- ❖ Preliminary accomplishments

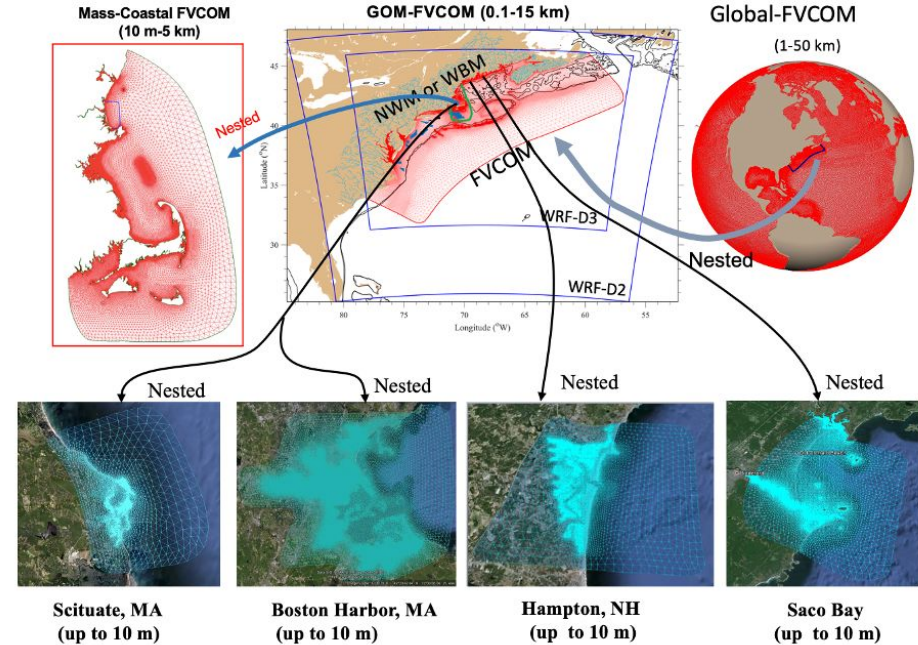
Northeast Coastal Ocean Forecast System (NECOFS)



Products:

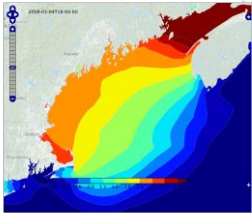
Weather: winds, air temperature, air humidity, air pressure, heat flux, E-P
 Oceans: sea level, currents, T, S, wave heights, wave frequencies, icing
 Lands: inundation areas

NECOFS/WBM grid and coverage areas

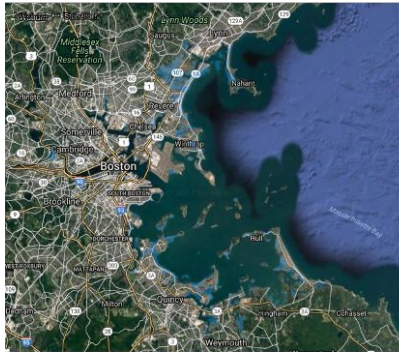


The Nor'easter storm Forecast

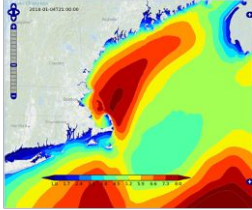
Surface elevation



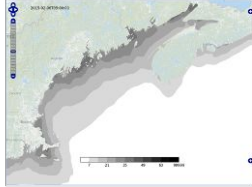
Coastal inundation



Significant wave height

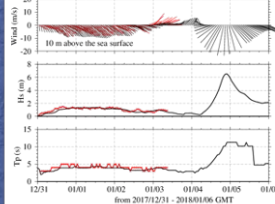


Icing risk

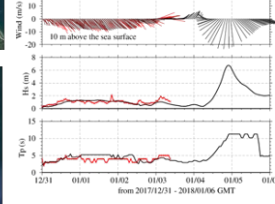


Data comparison

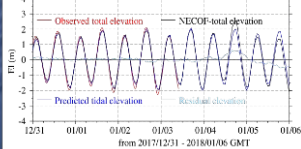
Buoy wind and waves



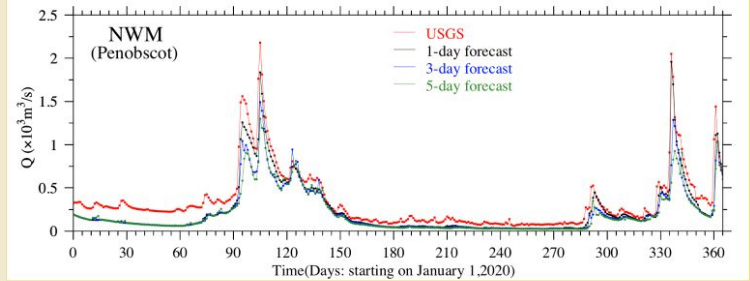
Buoy wind and waves



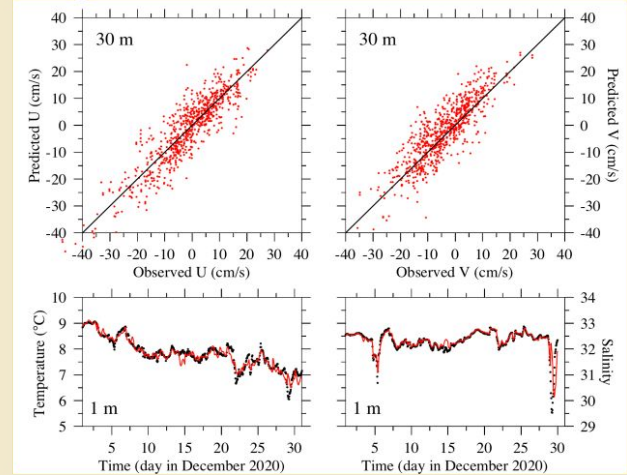
Elevations



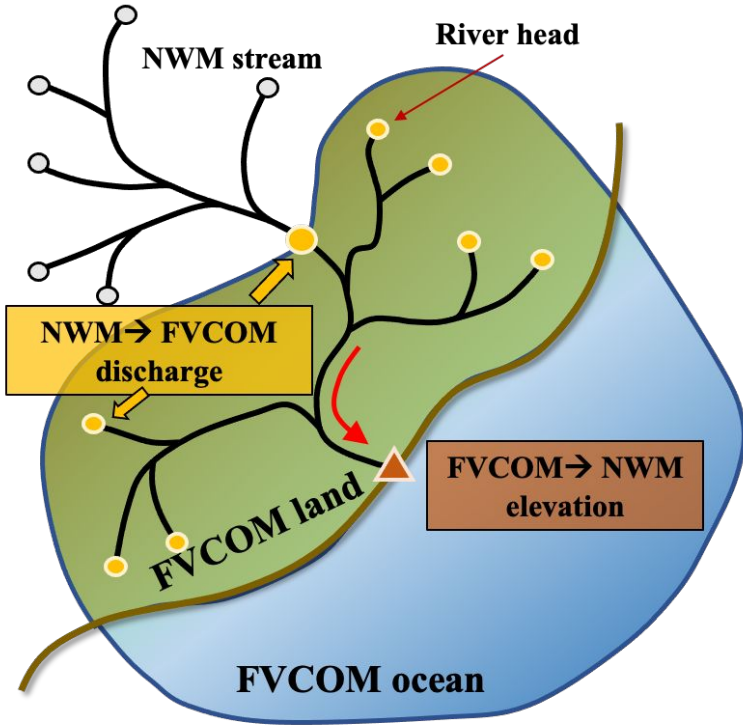
Comparison of NWM with USGS data



Comparison of NECOFS with observations



Designs of Two-way Coupling of FVCOM and NWM



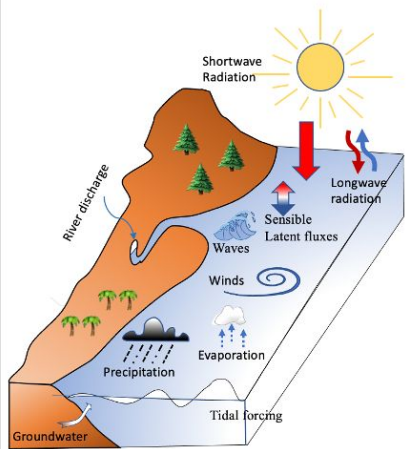
- Extend the FVCOM grid to cover the land.
- Divide the FVCOM grid to FVCOM-land and FVCOM-ocean. FVCOM-land overlaps the NWM domain.

Two-way online coupling

- **NWM to FVCOM: freshwater discharges at**
 - river heads in FVCOM-land domain
 - jointed points between NWM streamlines and FVCOM-land boundary.
- **FVCOM to NWM: water elevation at**
 - FVCOM-NWM main stream intersected sites at the coast.

Forced by meteorological data

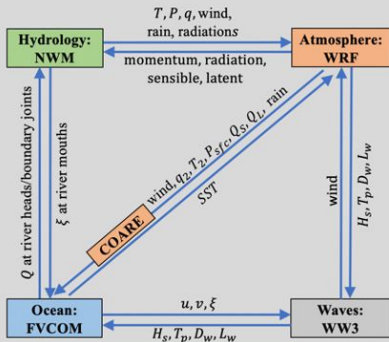
- NWM: forced in the whole domain
- FVCOM: forced only in the ocean region, to prevent precipitation from being counted twice.



Working Plan

- Select Saco Bay as an initial test site to develop a coupled FVCOM-NWM-WRF-WW3 system prototype under NUOPC. The coupler used in NUOPC is ESMF.
- Apply the coupled prototype to the Hampton River, NH.
- Extend the coupling to cover the entire NECOFS domain.

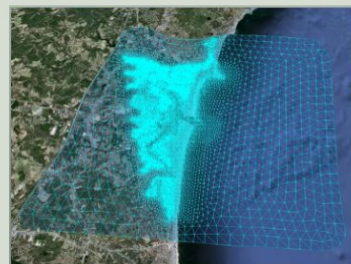
Coupler: ESMF



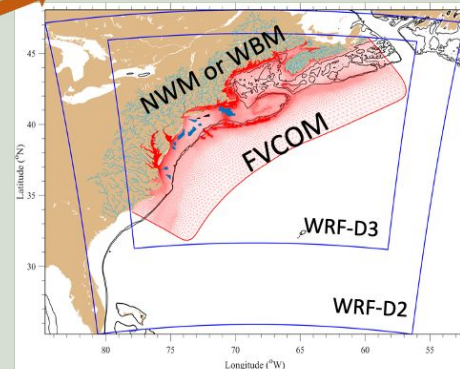
Saco Bay, ME



The Hampton River, NH



The Northeast US (NECOFS)



Code: NWMv2.1.3

https://github.com/NCAR/wrf_hydro_nwm_public/releases/tag/nwm-v2.1-beta3

Startup: cold start

• 2022-01-01 to 2023-01-01

Forcing:

- CFSv2 climatological dataset
- 6-hour interval
- $\sim 1^\circ$ resolution
- Interpolated to CONUS domain

TBL files:

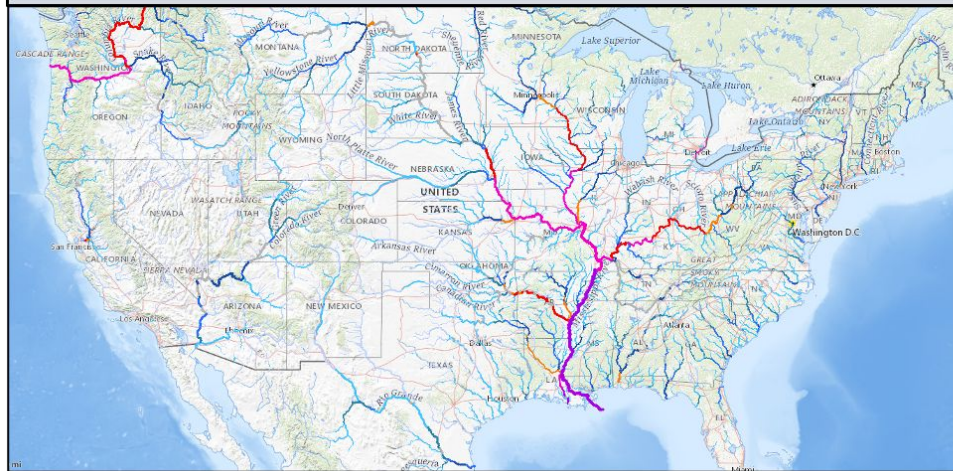
- CHANPARAM.TBL
- GENPARAM.TBL
- MPTABLE.TBL
- SOILPARAM.TBL

Static inputs:

- Fulldom_CONUS_FullRouting.nc
- geo_em_CONUS.nc
- GEOGRID_LDASOUT_Spatial_Metadata_CONUS.nc
- GWBUCKPARAM_CONUS_FullRouting.nc
- hydro2dtbl_CONUS_FullRouting.nc
- LAKEPARAM_CONUS.nc
- reservoir_index_AnA.nc
- RouteLink_CONUS.nc
- soilproperties_CONUS_FullRouting.nc
- spatialweights_CONUS_FullRouting.nc
- wrfinput_CONUS.nc

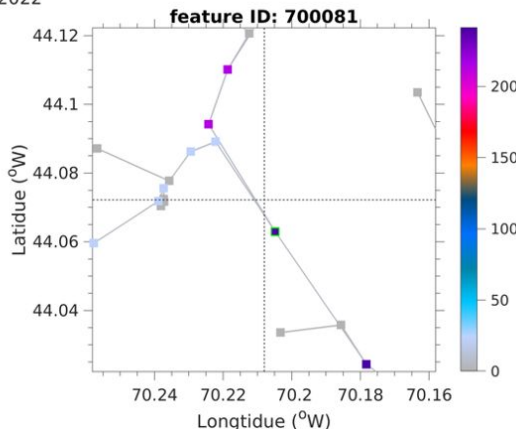
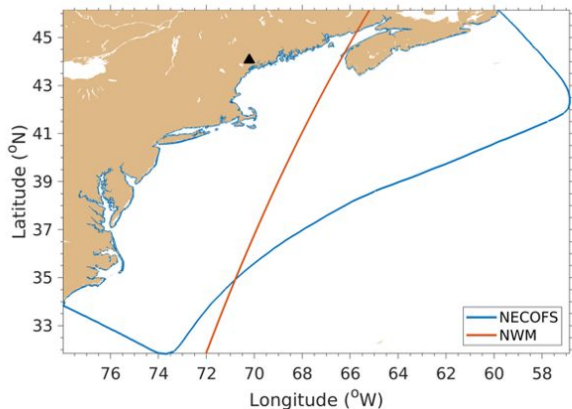
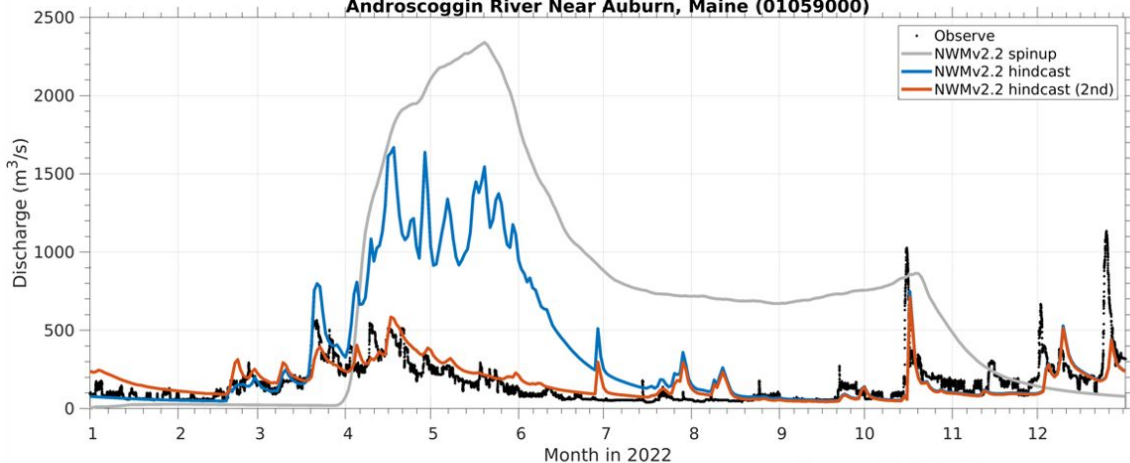
Domain: CONUS

- 1.0-km resolution (18,432 x 15,630)





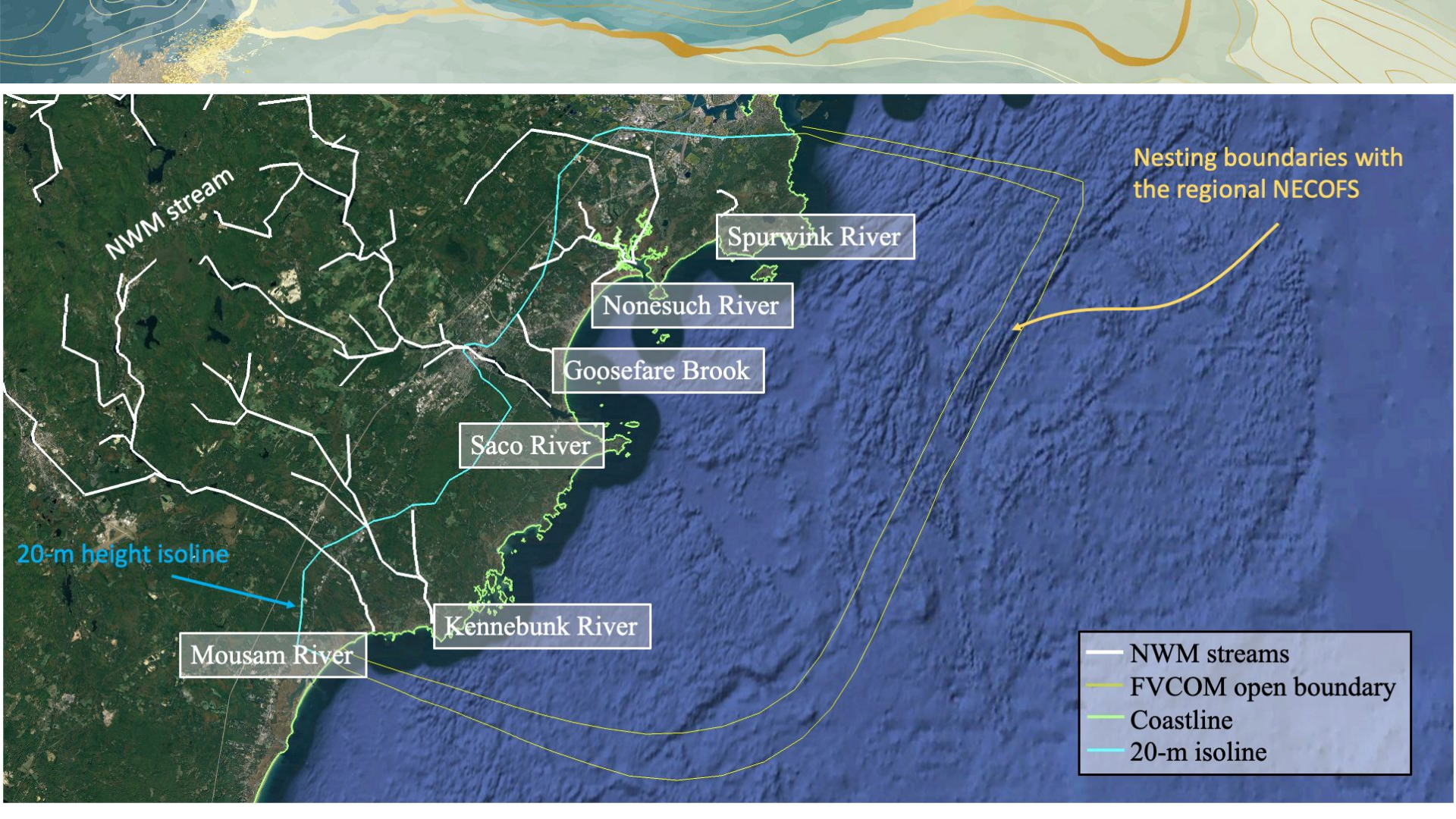
Androscoggin River Near Auburn, Maine (01059000)



Spin-up run of NWM-2.13:

- Year 1: initial spin up. Warming up with CFSv2 climatological meteorological forcing
- Year 2: Hindcast run. Treadmill running with HRRR forcing of 2022
- Year 3: Repeat hindcast run for 2022 without data assimilation.

Hindcast run for the second year started capturing the observed river discharge.



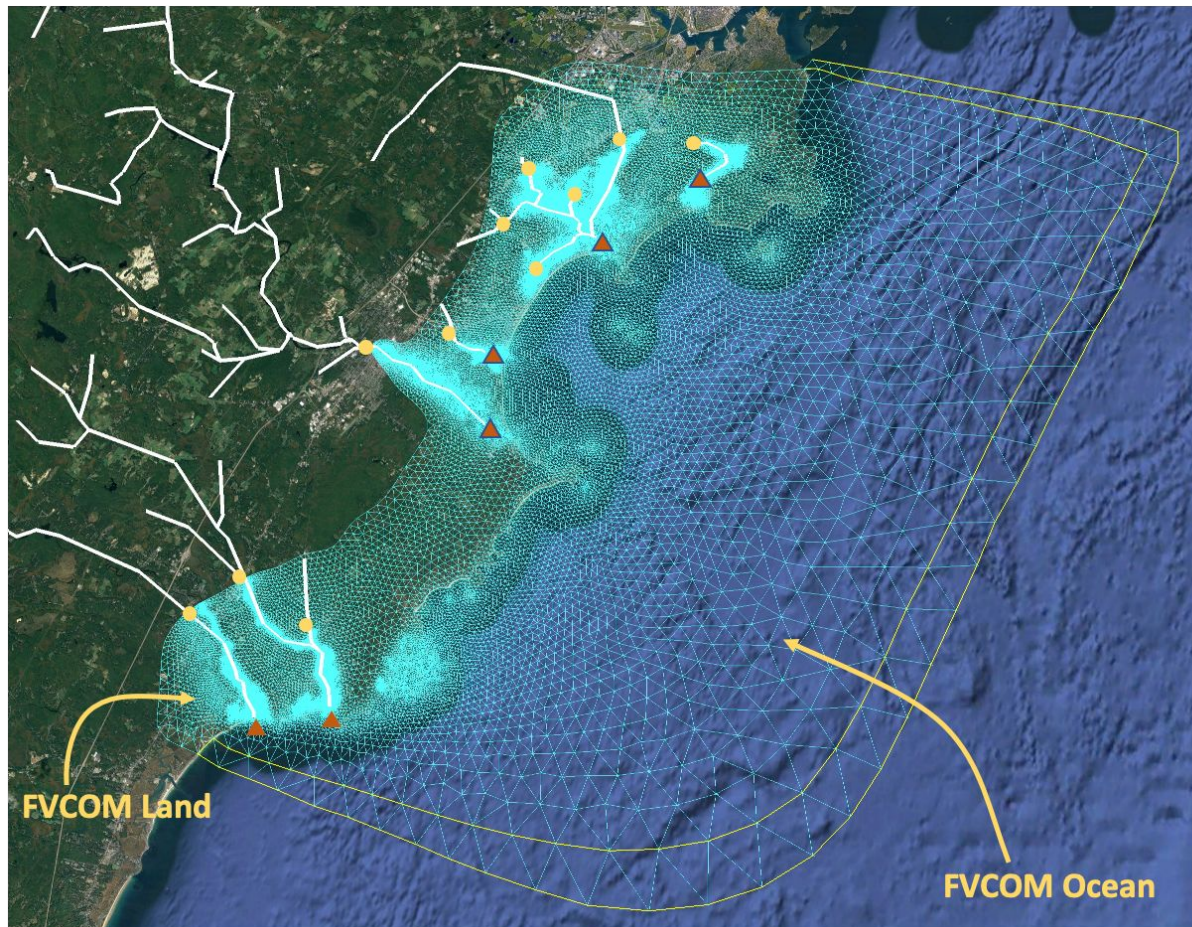


Illustration of the two-way NWM-FVCOM coupled grid and setting in Saco Bay, ME

- FVCOM-land boundary is determined based on the route geometry.
- Initial setup for FVCOM-Land varies from ~ 8 to ~ 500 m.

The FVCOM code is upgraded to allow to add the freshwater discharges at the river head where the water depth is negative (above the mean sea level).

● NWM \Rightarrow FVCOM

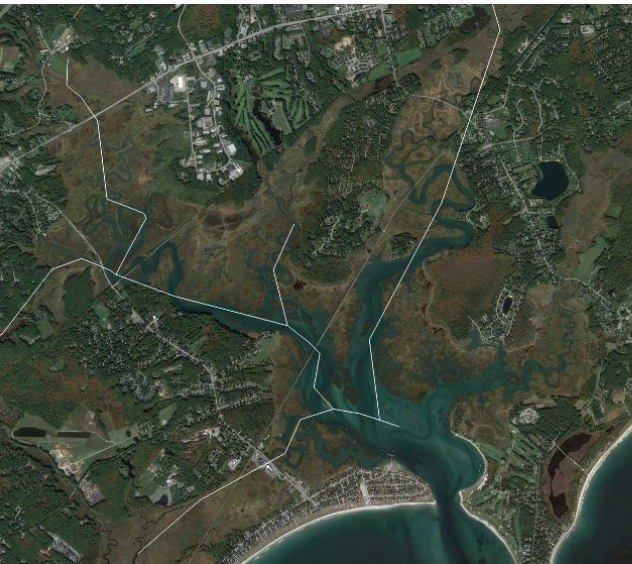
▲ FVCOM \Rightarrow NWM

— NWM stream
 — FVCOM open boundary
 — FVCOM grid
 — 20-m isoline



Zoom-in view of the Nonesuch River

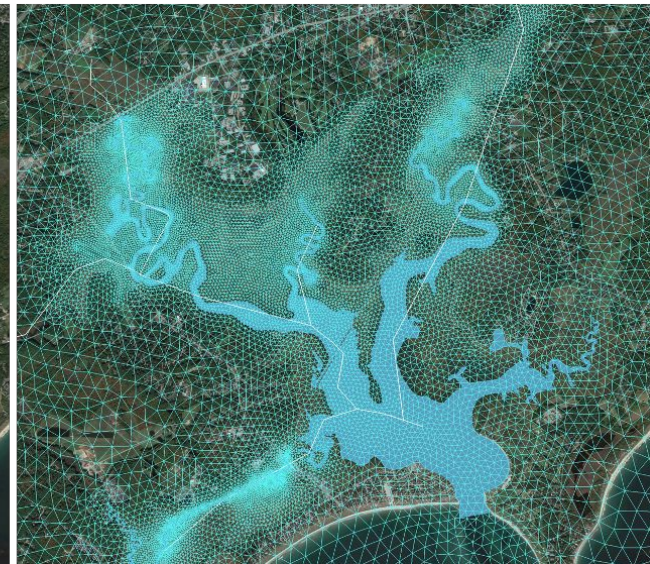
Satellite image



River + Marsh/wetland area



FVCOM-Land grid





Summary

This project will produce a two-way coupling prototype of FVCOM and NWM under NUOPC framework. A three-stage development is designed, first NWM-FVCOM, second NWM-FVCOM-WRF, and third NWM-FVCOM-WRF-WW3.

Saco Bay, ME is chosen as a first testbed site for the development. The coupler system will be applied to the Hampton River, NH, and then to the entire Northeast US NECOFS domain.

The two-way coupling prototype developed in this project could be used for other unstructured-grid models.



COASTAL COUPLING
COMMUNITY OF PRACTICE

THANK YOU

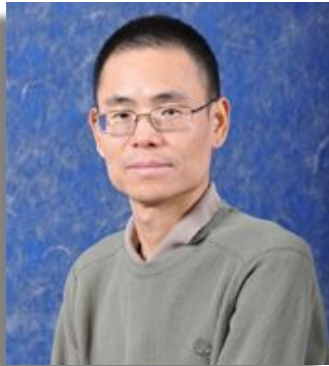
CHANGSHENG CHEN

Montgomery Charter Chair Professor

University of Massachusetts Dartmouth

c1chen@umassd.edu

Demonstrating the Coupling Architecture with the Virginia Institute of Marine Science-developed Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM)



JOSEPH ZHANG

Professor of Marine Science
Virginia Institute Of Marine Science
yjzhang@vims.edu

Coastal Coupling Community of Practice Annual Meeting
May 25, 2023



COASTAL COUPLING
COMMUNITY OF PRACTICE

THANK YOU

JOSEPH ZHANG

Professor of Marine Science

Virginia Institute of Marine Science (VIMS)

yjzhang@vims.edu

10:00

10:00



20:00

10:00
Life of Solwache

Leveraging the Cooperative Institute for Research to Operations in Hydrology (CIROH)



STEVE BURIAN

Professor of Hydrology and Water Resources
University of Alabama
sburian@ua.edu

Coastal Coupling Community of Practice Annual Meeting
May 25, 2023

Opportunities to connect with NOAA's Cooperative Institute for Research to Operations in Hydrology (CIROH)



The screenshot shows a NOAA news article. At the top left is the NOAA logo and the text 'National Oceanic and Atmospheric Administration U.S. Department of Commerce'. To the right is a search bar labeled 'Search NOAA sites'. Below the header is a breadcrumb trail: 'Home / News & Features'. The main headline reads 'University of Alabama to lead NOAA institute to advance water and flood prediction'. A sub-headline states 'New institute will receive up to \$360 million over five years'. At the bottom left, it says 'Focus areas: Research Topics: water'. At the bottom right, there is a 'Share:' button with icons for Twitter, Facebook, Email, and Print.

CIROH Goals

1. Support the **NWC's** mission to deliver a new generation of water data and services
2. Advance research supporting **NOAA's** vision of a climate-ready nation
3. Mobilize a **community of practice** to co-produce innovative research & education

CIROH's Unique Features

1. Connected to Ops
2. Consortium

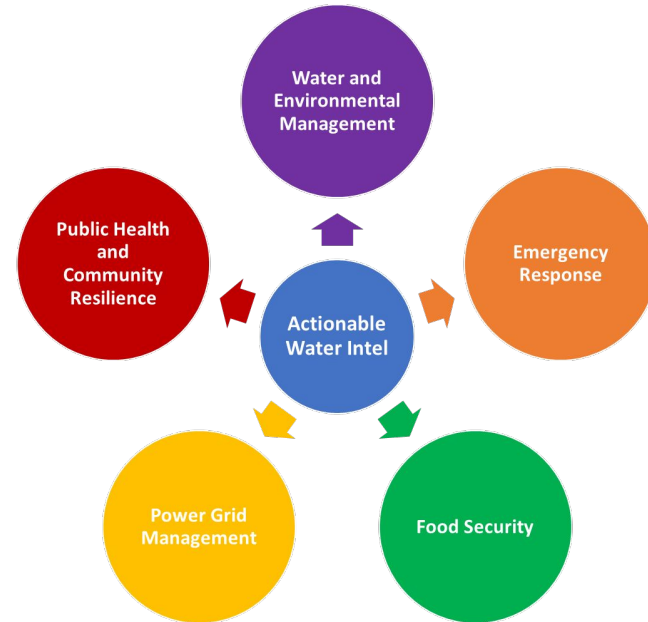
OWP
OFFICE OF
WATER
PREDICTION

NWC | NATIONAL
WATER
CENTER



CIROH's Vision

Research enabling delivery of actionable water intelligence



CIROH's Research Themes

RT1: Advancing Water Prediction Systems and Workflows

- Prediction system testbed
- Inputs, forcings, data assimilation
- Remote sensing and sensor technologies
- Model and forecast evaluation

RT2: Developing Community Water Modeling Frameworks

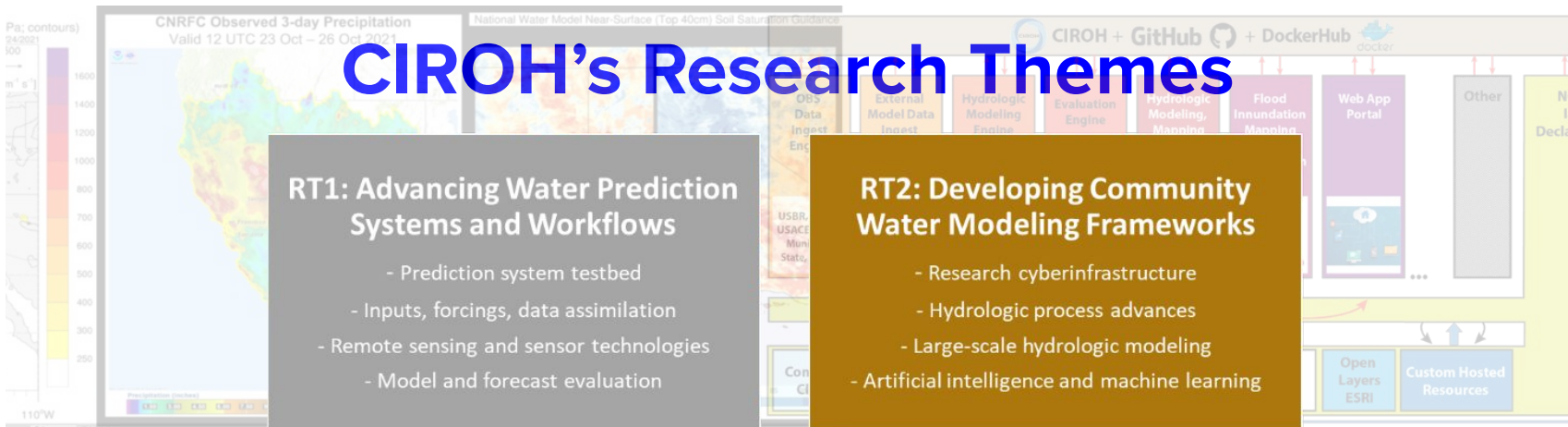
- Research cyberinfrastructure
- Hydrologic process advances
- Large-scale hydrologic modeling
- Artificial intelligence and machine learning

RT3: Water Data Science and Hydroinformatics Solutions

- Extreme data management
- User interactions and apps
- Flood inundation mapping
- Impact assessment and risk analytics

RT4: Designing Forecasts for Community Resilience

- Risk perceptions and behaviors
- Impact-based decision science
- Improving forecasts for underserved
- Building community resilience



CIROH's Education and Outreach

Mobilized Research
Community Connected
to Operational Impact

- Science Meeting
- Developers Conference
- Water Tech Forum
- Visiting Scholars
- National Webinar
- Think Tanks
- Research Synthesis

Strengthened
Workforce

- REU
- Summer Institute
- Experiential Learning
- Study Tours
- Courses / Training
- Programs / Degrees
- Hackathons

Inspired Next
Generation

- K-12 Camps, Research, and Curriculum
- Youth Summit
- Public Outreach & Education
- Community Engagement

CIROH's R2O Enabling Cyberinfrastructure



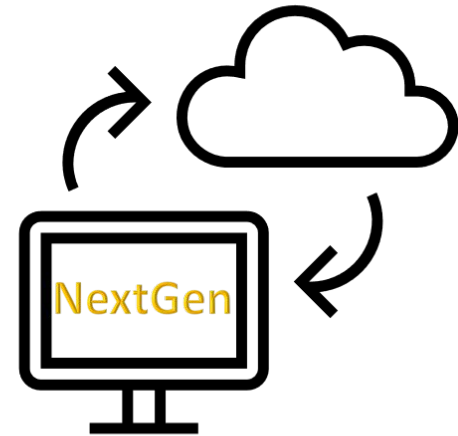
Big Data Access
and Handling



JupyterHubs for
Experiments

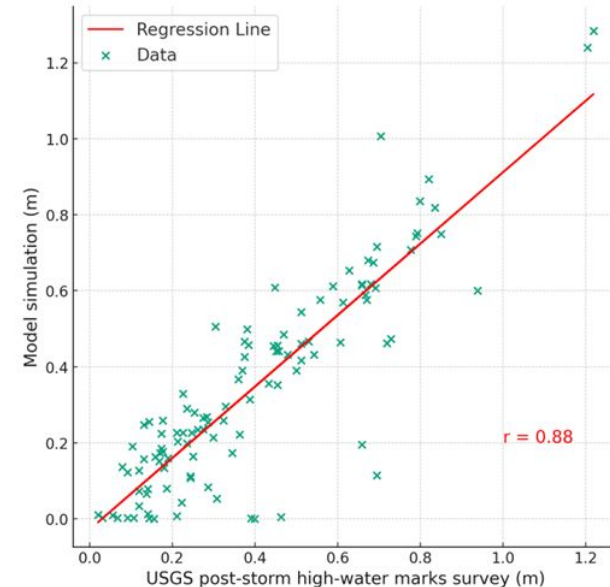
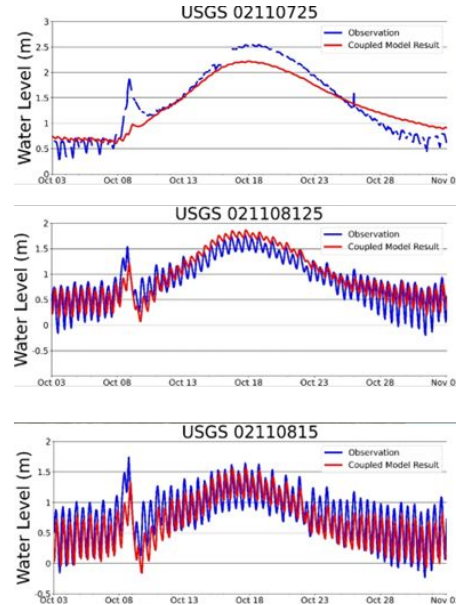
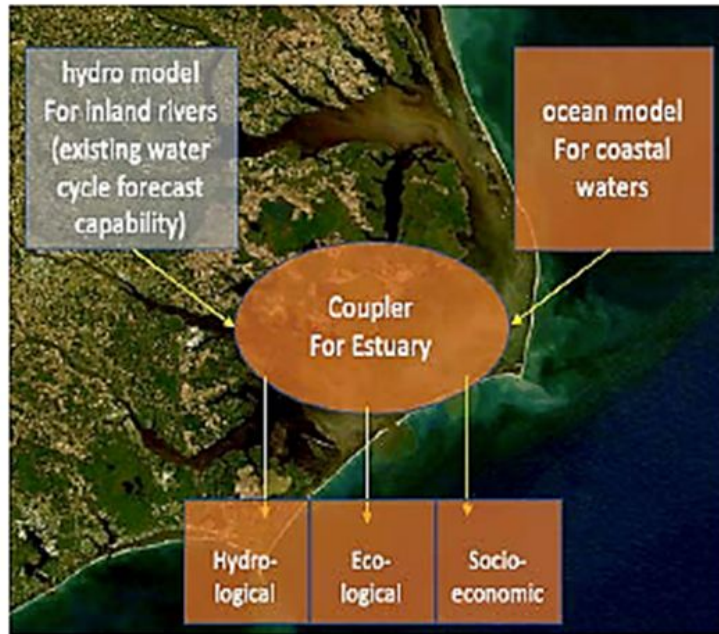


Accessible
NextGen

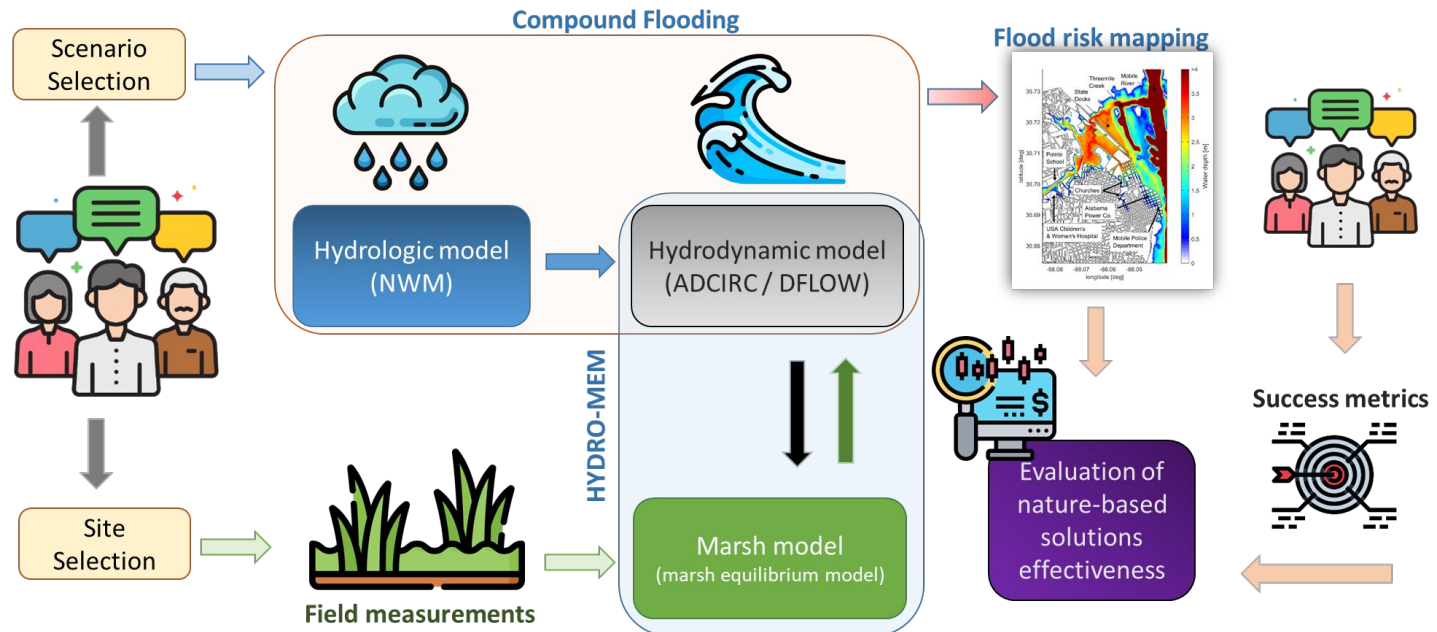


<https://github.com/AlabamaWaterInstitute/CloudInfra>

CIROH Project Spotlight: Advance riverine-coastal model coupling and forecast verification for total water quantity and quality (Bao and Pietrafesa, Coastal Carolina University)



CIROH Project Spotlight: Coastal Nature Based Solutions to Mitigate Flood Impacts and Enhance Resilience (Moftakhari, University of Alabama)





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THANK YOU

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Dr. Len Pietrafesa, PhD

Professor Emeritus, North Carolina State University

Burroughs & Chapin Scholar, Coastal Carolina University

Chair Emeritus, NOAA Science Advisory Board (the NOAA SAB)

Fellow, American Meteorological Society (the AMS)

Commissioner Emeritus, The AMS Weather, Water, Climate Enterprise

Chair Emeritus, APLU Board on Oceans, Atmosphere & Climate

A Brief History of Forecasting in the USA and the GOAL of establishing Validated, Reliable **Operational Forecasts of Interactively Coupled - Compound Coastal, Inland & Upland Flooding: thus, connecting the NWC to CIROH and the NWM to the Ocean**

1st, Some History on Weather Forecasting in the United States:

- Rapid exchanges of weather data first became feasible with the development of the electric telegraph in 1837 by Samuel Morse of the USA.
- In 1869 Cleveland Abbe at the Cincinnati Observatory began to provide regular atmospheric weather forecasts using data received telegraphically
- The 1st “national weather service” in the USA, was established in 1870 by the 41st US Congress & President Ulysses S. Grant. The Weather Bureau (WB), was assigned to the U.S. Army Signal Corps, then moved in 1890 to the Dept. of Agriculture. It became responsible for issuing public flood “warnings” in 1891
- The WB became the National Weather Service in 1970 and moved to the DoC
- In 2001, the NOAA SAB recommended that NOAA issue Flood Forecasts after NCSU studies [1,2,3] showed that ~ 75% of deaths & destruction from TCs were Caused by flooding and not by winds.
- The NOAA SAB shared this with Bill Simpson of the Saffir-Simpson Scale ;
- Bill concurred

- **But I digress: Following WWII, in 1945, the Question arose: What was the most urgent Issue that challenged the USA, its Allies and The US Military at the beginning of WWII?**

- **The Answer: When to Cross the English Channel and invade Europe and fight Hitler and the Fascist/Nazi Axis**

- **The next Q was: What was required of the US Government?**

- **The Answer was “R2O” in the Atmospheric & Oceanic Sciences**

- **So the Office of Naval Research was created in 1946 with \$\$\$**

- **The AtSci. created mainly UG programs to educate Forecasters**

- **The OcSci. created GS programs to buy Ships and study Ocean Basins**

- **We Note here that Hydrological Systems were not even considered**

- **So, R2O was weak on the AtSci side and O2R was absent in the OcSci**

In 1999, Hurricane Floyd was blamed by NOAA for the huge coastal and inland flooding and inundation along the NC coast resulting in 56 deaths by drowning

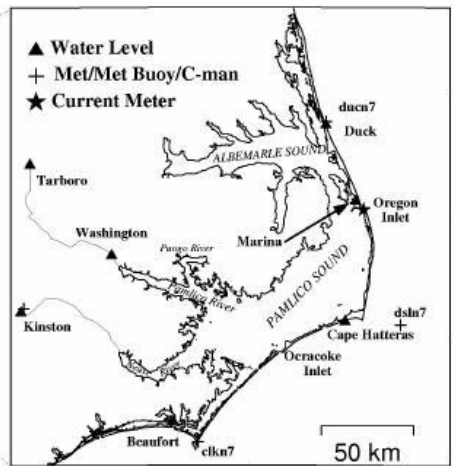
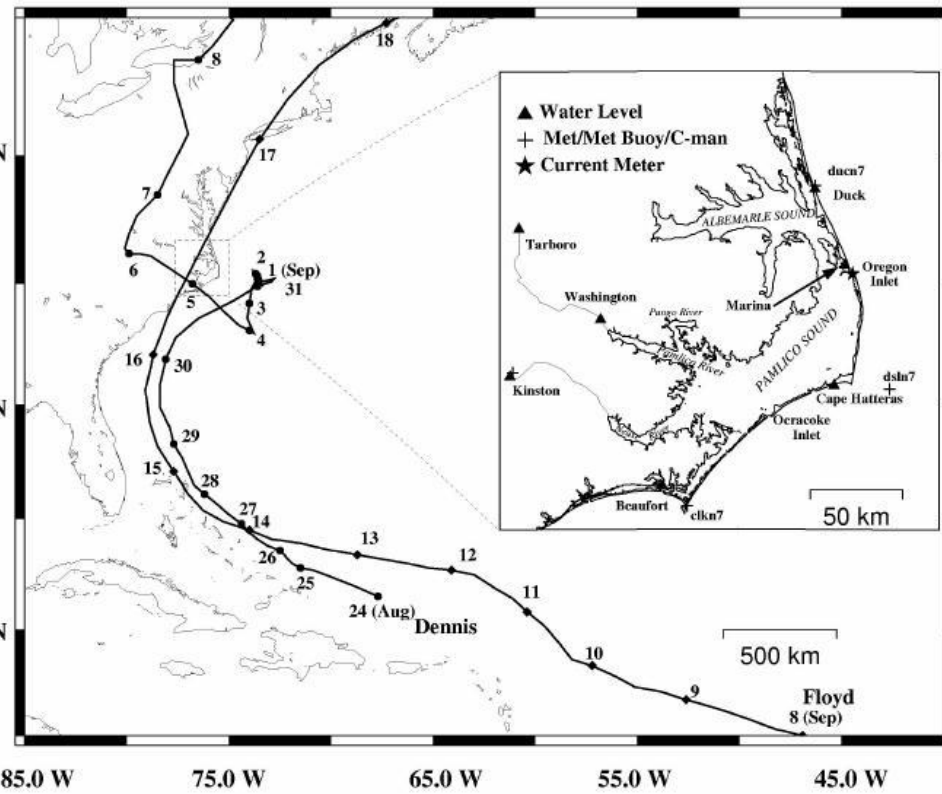
- But We at NC State did not accept the hypothesis that Floyd was singularly responsible for the massive coastal and inland flooding that occurred [1]**
- We looked at the USGS River time series data and the NOAA-NOS coastal and inland water level time series**
- And made a Discovery @ the Floyd Flood which reached ~ 100 miles inland**
- There were => two consecutive events, Hurricane Dennis and then 10 days later, Floyd passed by (Dennis & Floyd were wet events of 2 feet of rain**

- BTW, NCSU studies showed that Damage statistics from all direct land-falling Hurricanes that 25% was due to Wind and 75% to Flooding [2]**

- More recently, [3], “Compound Flooding” has been introduced**

1999 Hurricane Tracks

● Dennis ◆ Floyd



- However, in 1999, there were 26 Offices in Wash - DC that claimed that they owned the rights to the Water; an untenable situation....VP A. Gore committed to get this resolved in 2000 and 2001 but he lost. And so, No US Agency did real-time flood forecasting. But, the NOAA SAB recommended a NOAA Water Center in 2001=>

In 2003, NOAA created an Office of Hydro (OoH) and **this led to the Coastal and Inland Flooding Act passed by the U.S. Congress in 2002**

- The bill was introduced by NC Cong. Bob Etheridge in the 107th Congress and passed by the House of Reps & the Senate
- It appropriated \$6.25M in federal funds to be used to develop a **Flood Forecast Warning System Scale**; like the SS Cat Scale with \$3.5M for NOAA and \$2.75M was supposed to go to the Universities
- I have a **Red Line Copy of the Bill on my Office Wall (signed by Byrd and Bush)**
- But the Director of NOAA's Office of Hydrology sequestered the money and when queried by the NOAA SAB about it, He said
- "we were able to create a new Risk Scale of **"High, Moderate and Low' Risk"** (!!!)

- Thus, a new window of opportunity emerged and the NWC was created @UAL (at the time it was TBD'd)
- But, to address that void, a new kind of NOAA CI was envisioned (via visionaries such as Uccellini, Graziano & Rayder)
- You see, up to then all of NOAA's CI's were housed in NOAA's Office of Oceanic & Atmospheric Research (OAR) for O2R
- But then through efforts within the NWS, the UAL, and an AL Senator, the NOAA NWS was granted a CI, with the dual Missions of coupling O2R and R2O (with the leadership of Rayder & Burian)
- And thus, CIROH was spawned

- Today, across the CIROH Constellation, the Atmospheric, Oceanic, Hydrologic and Socio-Economic Sciences, must be coupled, some Interactively and 2-Way, and some 1-Way in order for success
- This is TBD'd and will require Hand's On, Visionary Leadership and Not "Business As Usual", which, unfortunately, has been

NOAA's

traditional way of doing things and is difficult to overcome

- The NAS/NRC Study "Fair Weather" in 2001 addressed this and called R2O in NOAA "Crossing the Valley of Death" However,
- For the Record, the constellation of NOAA CI's have been amongst the most prominent and productive Parts of the NOAA Empire
- **So, CIROH has the Potential to establish the totality of Operational Hydrologic Forecasting to the fore within the NWS and thus, NOAA**

**So, the “Q” now is: Can CIROH Cross the Valley of Death
as relates to Compound Coastal-Inland-Upland Flooding?
The “Answer” is: That “It is To Be Determined”**

Thank You! ljpietra@ncsu.edu, 704-910-7047

References:

- 1. Pietrafesa and Dickey, 2001. Interactively coupled Coastal & Inland Flood Forecasting of Hurricanes Dennis & Floyd. ECU Press.**
- 2. Pietrafesa and Hamilton, 2001. The Need for a Flood Risk Scale, Chpt. In Hazards in the Natural Environment, Conference Proceedings, Sintra, Portugal.**
- 3. Pietrafesa, Zhang, Bao and Gayes, 2019.
On Coastal, Inland and Upland Flooding During Extreme Compound Flood Events.
Journal of Marine Science & Engineering.**

A topographic map background with teal and gold colors. The map features contour lines and a central area with a gold-colored cluster of dots.

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FACILITATED DISCUSSION



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THANK YOU!

Please provide us with your feedback and reflections
The information you submit will be incorporated into
the meeting summary