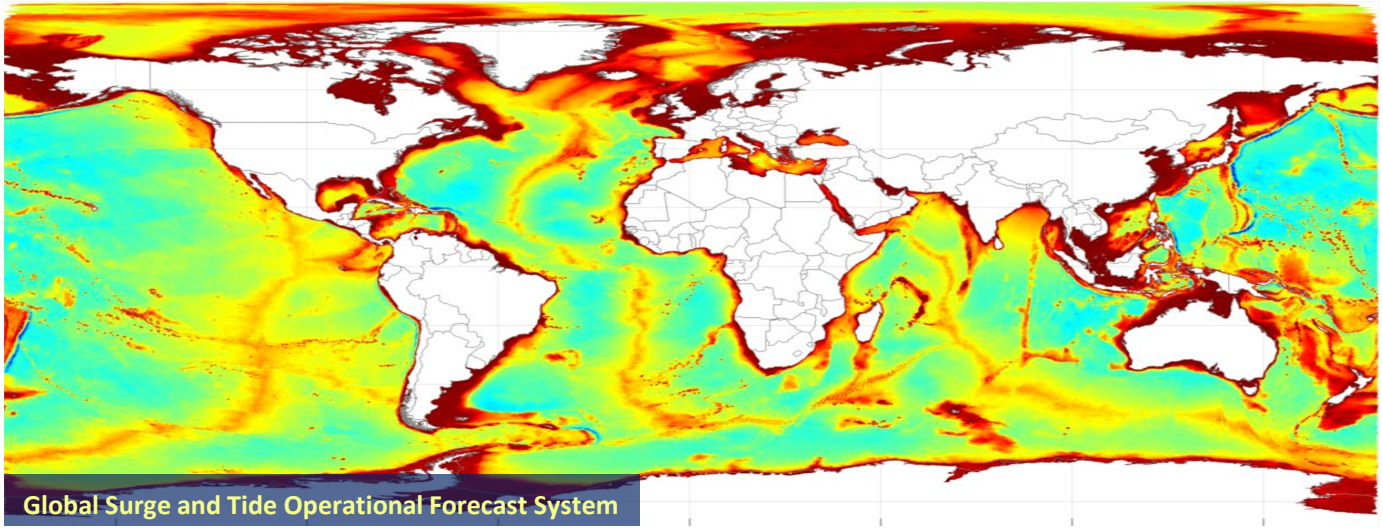
NOAA National Ocean Service Storm Surge Modeling

Saeed Moghimi, Greg Seroka, Panagiotis Velissariou, Soroosh Mani, Yuji Funakoshi, Georgios Britzolakis, Zizang Yang, Bahram Khazaei, Fariborz Daneshvar, Edward Myers

NOS Storm Surge Modeling Team
Coastal Marine Modeling Branch, Coast Survey Development Laboratory,
Office of Coast Survey, National Ocean Service



COSS-TT
May 2023

Contact: Saeed.Moghimi@noaa.gov

End users and stakeholders

- **Storm surge forecasters**, e.g.
  - NOAA Weather Forecast Offices (WFOs) to generate flood forecasts during winter storms
  - NOAA Ocean Prediction Center (OPC) for operational extratropical coastal storm surge forecasts

National Weather Service
Watches, Warnings & Advisories
weather.gov
Local weather forecast by "City, St" or zip code City, St Go

Coastal Flood Statement

```
Coastal Hazard Message
National Weather Service Boston/Norton MA
1239 PM EST Fri Dec 18 2020

MAZ024-182200-
/O.NEW.KBOX.CF.S.0015.201218T1800Z-201218T2200Z/
Nantucket MA-
1239 PM EST Fri Dec 18 2020

* WHAT...1 foot or less of inundation above ground level expected
  in low-lying areas near shorelines and tidal waterways
  (4.6 to 5.1 feet Mean Lower Low Water).

* WHERE...Nantucket MA County.

* WHEN...Until 5 PM EST this afternoon.

* IMPACTS...Some water on low lying roads and property.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Do not drive through flooded roadways.
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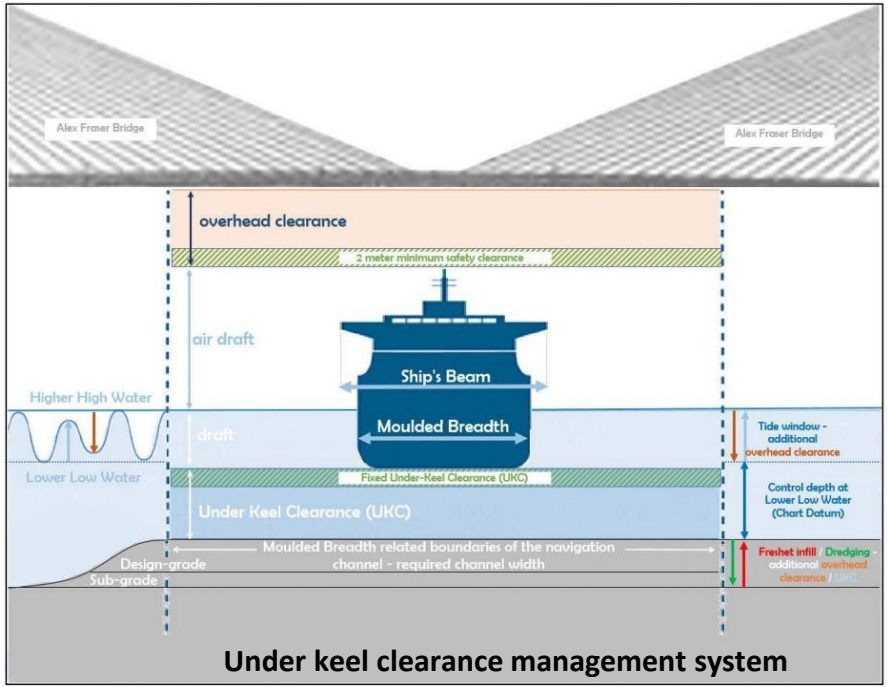
NOAA Coastal Flood Statement

- **Mariners**, e.g.
  - Pilots of ships to navigate into ports safely and efficiently based on tide, current forecasts



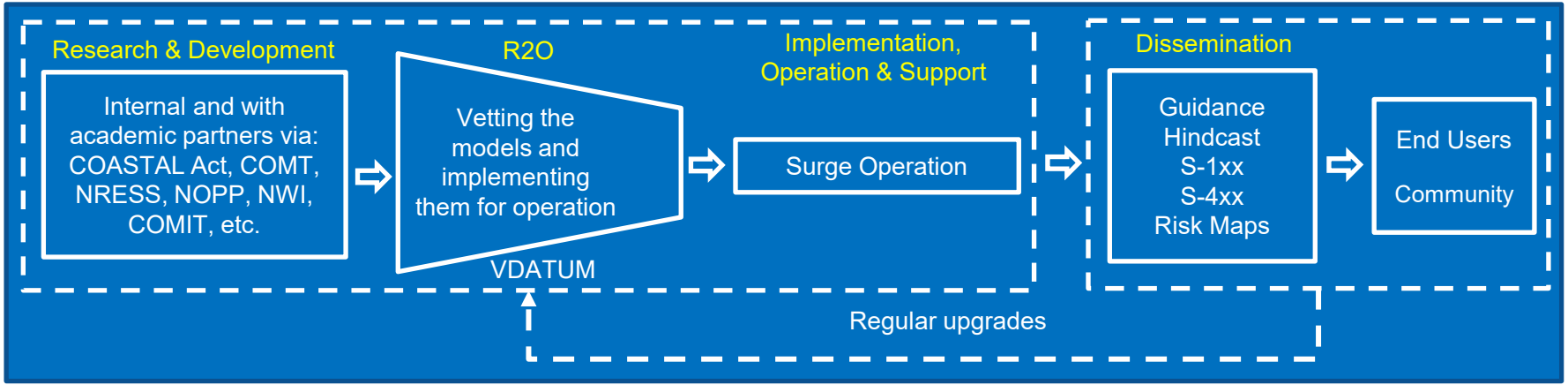
Under keel clearance management system

Contact: Saeed.Moghimi@noaa.gov

Our workflow

Planning, research, development, operation and maintenance of the NOAA National Ocean Service storm surge modeling portfolio including:

- Research and development;
- Research-to-operation (R2O);
- Operational implementation and support;
- Regular upgrades and maintenance;
- Dissemination



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NOS Storm Surge Modeling Team

Products and services

Operational

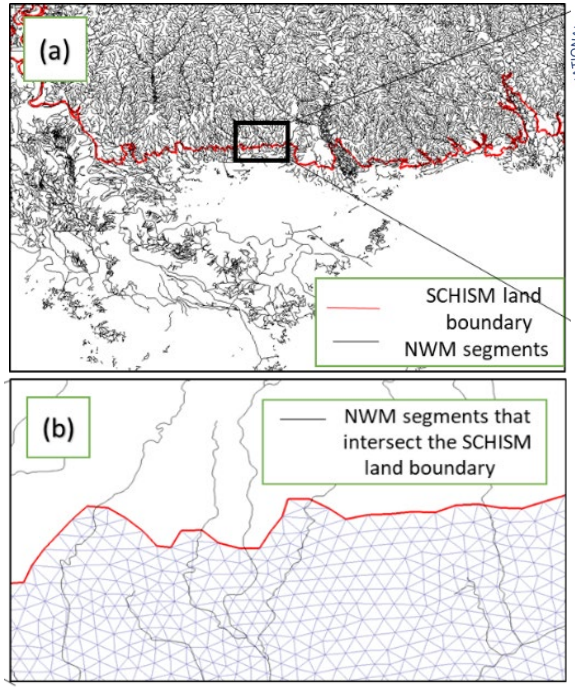
- **Surge & Tide Operational Forecast System (STOFS)**
  - Two-dimensional global ***(STOFS-2D-Global)***
  - Three-dimensional coastal storm surge including inland hydrology extremes ***(STOFS-3D-Atlantic)***

Pre-Operational

- **Surge & Tide Operational Forecast System**
  - Three-Dimensional Guidance System for Pacific Ocean in 2023 ***(STOFS-3D-Pacific)***

Research and development

- Hurricane Storm Surge On-Demand (Cloud / HPC)
- Automated on-demand unstructured mesh generation (OCSMesh)
- Coastal Ocean Model Coupling Application (CoastalApp)
- Sensitivity of the coastal ocean to bathymetry



The three-Dimensional Coastal storm surge including inland hydrology extremes (***STOFS-3D-Atlantic***). Part of model domain in the **Lower Mississippi** region. a) and b) overlaying of river network on model mesh. Red line is the 10m topography contour.

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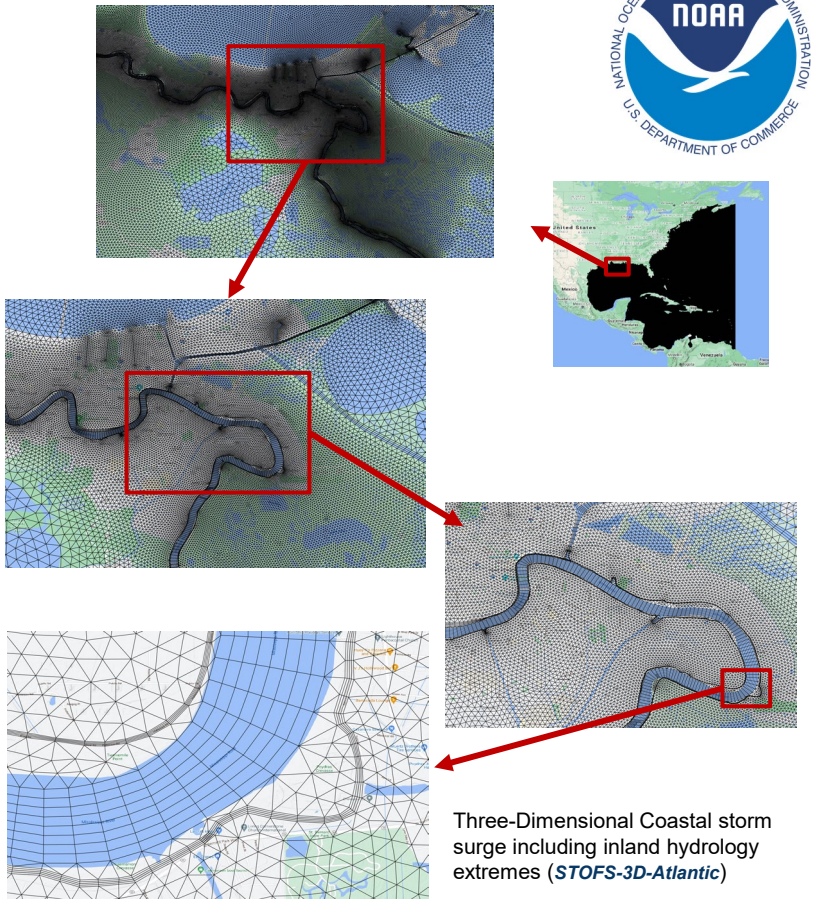
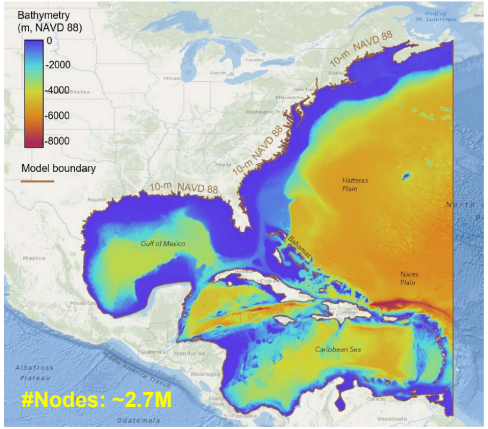


Three-Dimensional Coastal storm surge including inland hydrology extremes (***STOFS-3D-Atlantic***)

Contact: *Saeed.Moghimi@noaa.gov*

Surge & Tide Operational Forecast System (STOFS)

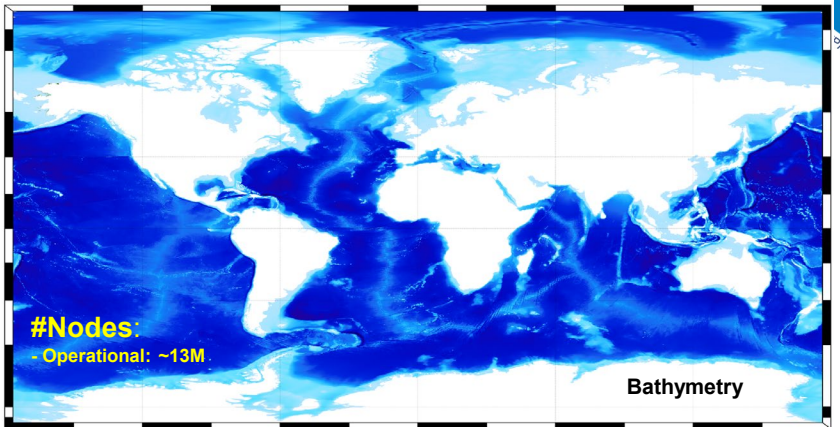


View output:

nowcoast.noaa.gov

https://polar.ncep.noaa.gov/estofs/

cera.coastalrisk.live



Model engine: SCHISM

- Driven by **GFS, HRRR** (Atm + precip) and **NWM**
- 1 cycle/day; 24 hr nowcast, **2 day forecast water levels, currents, temperature and salinity**
- **Grid resolution:** ~2-7 km in ocean; 50-200 m in main channels; down to <10 m in small streams & levees

https://registry.opendata.aws/noaa-nos-stofs3d/

STOFS-3D-Atlantic

In partnership with **Virginia Institute of Marine Science**

Model engine: ADCIRC

- Driven by **GFS**
- 4 cycles/day; 6 hour nowcast, **7.5 day forecast water levels**: **tides, surge, combination**
- **Grid resolution:** coastal resolution at least 1.5 km globally, up to ~30-120 m for US coasts, AK, HI

https://registry.opendata.aws/noaa-gestofs/

STOFS-2D-Global

In partnership with **University of Notre Dame**

NOS Storm Surge Modeling Team

Products and services

Operational

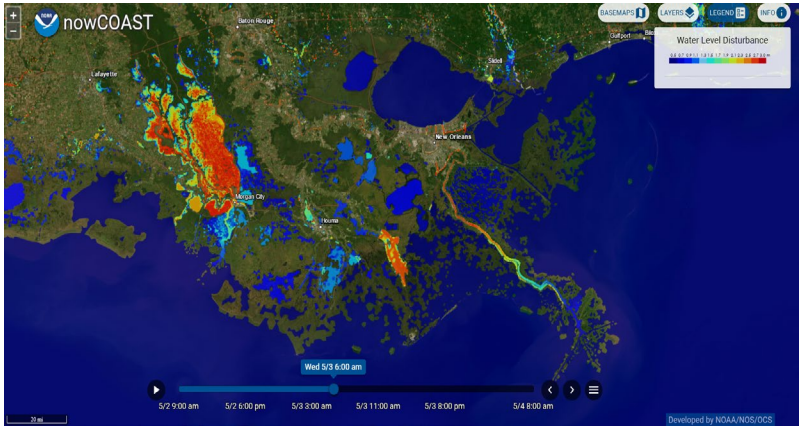
- **Surge & Tide Operational Forecast System (STOFS)**
  - Two-dimensional global ***(STOFS-2D-Global)***
  - Three-dimensional coastal storm surge including inland hydrology extremes ***(STOFS-3D-Atlantic)***

Pre-Operational

- **Surge & Tide Operational Forecast System**
  - Three-Dimensional Guidance System for Pacific Ocean by early 2023 ***(STOFS-3D-Pacific)***

Research and development

- Enhancing Northern Pacific Ocean Modeling
- COASTAL Act: Named Storm Event Model
- Hurricane Storm Surge On-Demand
- Automated on-demand unstructured mesh generation (OCSMesh)



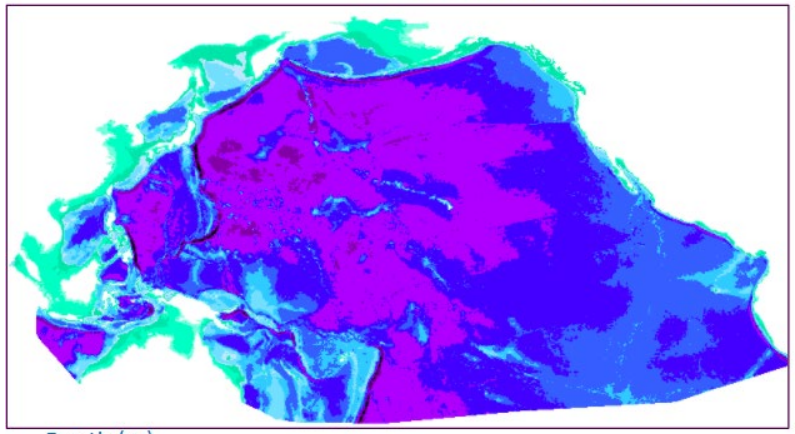
NowCoast visualization of the three-Dimensional Coastal storm surge including inland hydrology extremes (***STOFS-3D-Atlantic***) – Lower Mississippi region

Contact: Saeed.Moghimi@noaa.gov

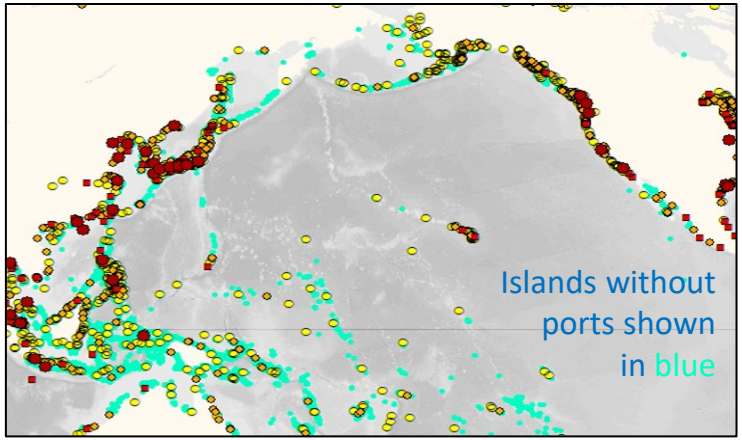
STOFS-3D-Pacific in development

The goal is to obtain **extended coverage** and **improved skill**, both at basin-scale and along the US coast and estuaries. Anchoring the modeling is high-resolution implementation of the unstructured-grid code **SCHISM**, to allow for **3D modeling** and support **S-111** surface current model forecast guidance.

Pacific Basin model bathymetry



Ports of the Pacific, colored by size



In partnership with **Virginia Institute of Marine Science** and **Columbia River Inter-Tribal Fish Commission**

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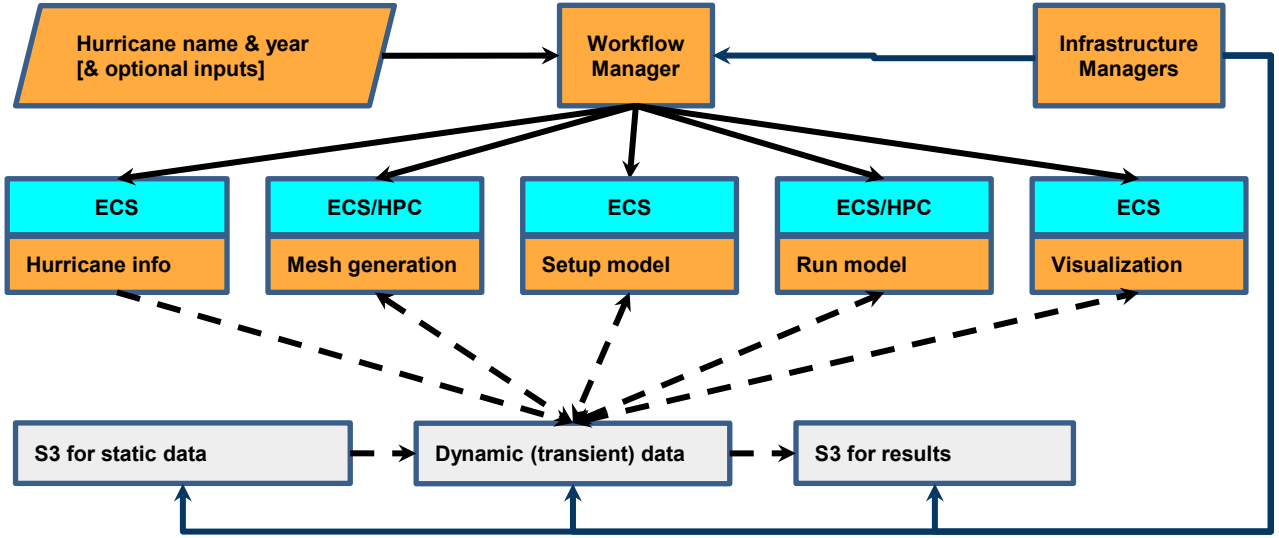
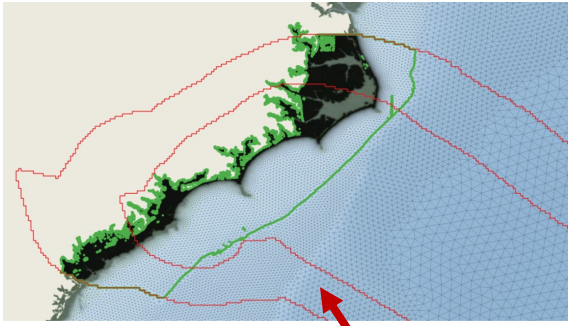
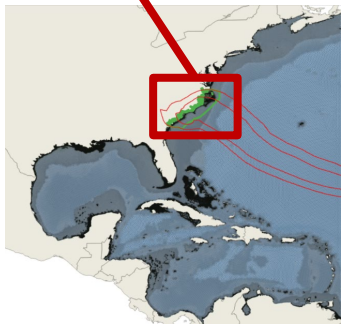
Hurricane Surge On-Demand – Cloud / HPC implementation

Provisioning, Workflow and Data Access







Florence 2018

- Wind swatch contours are in **red**
- Impacted area in **green**

Workshops and community engagement

- UN Global Geospatial Information Management (UN-GGIM) workshop Kiribati, Tarawa (Nov 2022)

- Integrated Marine Geospatial Information Management held in conjunction with the launch of the **Joint IHO-Singapore Innovation and Technology Laboratory** (October 2021)
- International workshop (building capacity effort) under the IHO South West Pacific Hydrographic Commission (SWPHC) for educating **Pacific Island communities** on navigation products & services that NOAA provides (Sep 2021)
- Workshop for the **Coast Survey Navigation Managers and the Navigation Response Teams** on how to use the model products (Summer 2021)
- Planned NOAA National Weather Service trainings for **Weather Forecast Offices (WFOs)** along the Atlantic
- Organizing a "**Coastal Ocean Modeling in Support of Marine Navigation and the Blue Economy**" session at AGU and AMS

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It takes a village to raise a child …

Academic partners (>20 PIs, Scientists, Postdocs and PhD students)

- University of Notre Dame
- Virginia Institute of Marine Science
- Argonne National Laboratory
- National Center for Atmospheric Research
- Texas Advanced Computing Center
- Columbia River Inter-Tribal Fish Commission
- Louisiana State University
- Sandia National Laboratories
- University of Massachusetts – Dartmouth
- University of North Carolina at Chapel Hill
- Cooperative Institute for Great Lake Research
- Oregon State University

International partners

- Helmholtz-Zentrum Hereon, Germany
- Laboratório Nacional de Engenharia Civil, Portugal
- European Commission Joint Research Centre, Belgium
- International Hydrographic Organization
  - South-West Pacific Hydrographic Commission
- United Nations

NOAA and agency partners

- National Ocean Service
  - The U.S. Integrated Ocean Observing System
  - Center for Operational Oceanographic Products and Services
  - National Geodetic Survey
- National Weather Service
  - National Hurricane Center
  - Office of Science and Technology Integration
  - Environment Modeling Center
  - Office of Water Prediction
- Oceanic and Atmospheric Research
  - Great Lakes Environmental Research Laboratory
- U.S. Geological Survey
- U.S. Environmental Protection Agency

Industrial and cooperative partners

- UCAR
- Spatial Front Inc

Thanks for your attention !

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GitHub

CoastalApp

https://github.com/noaa-ocs-modeling/CoastalApp

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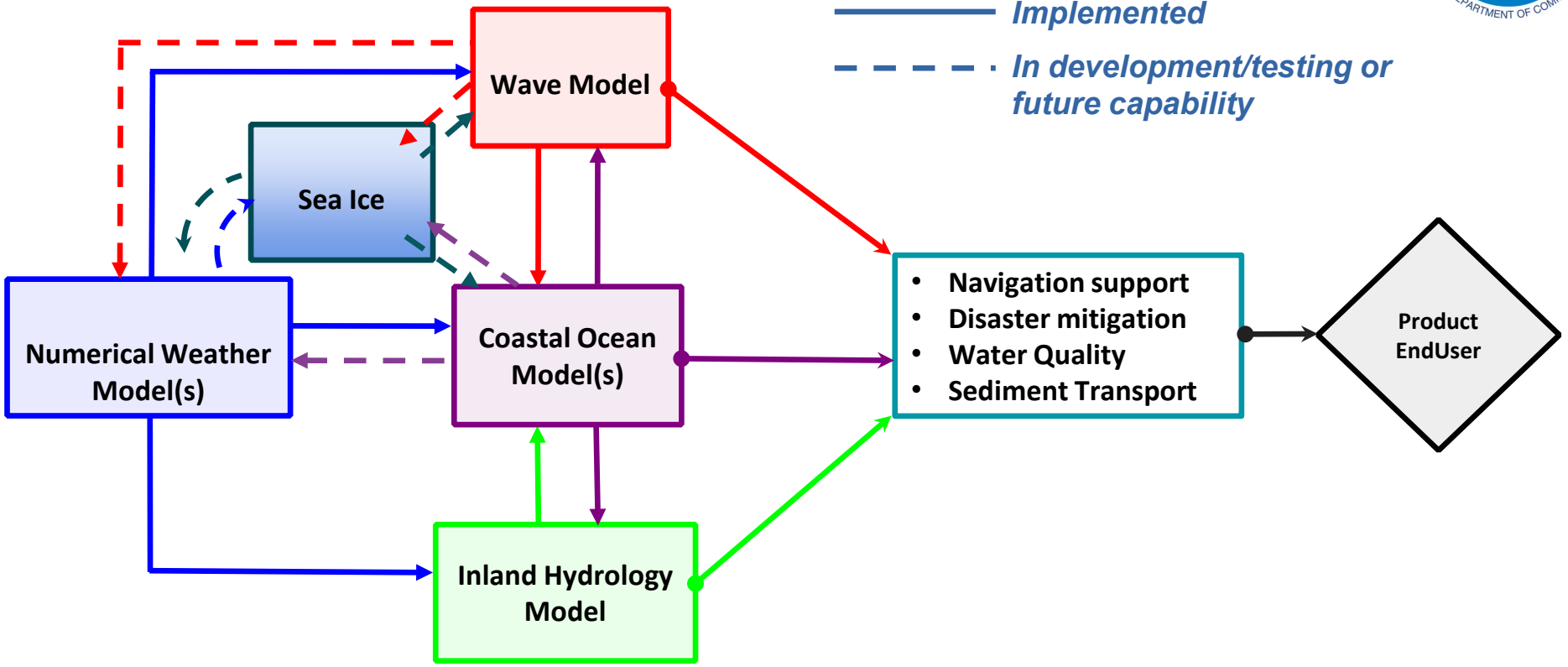
NOAA Unified Forecast System &

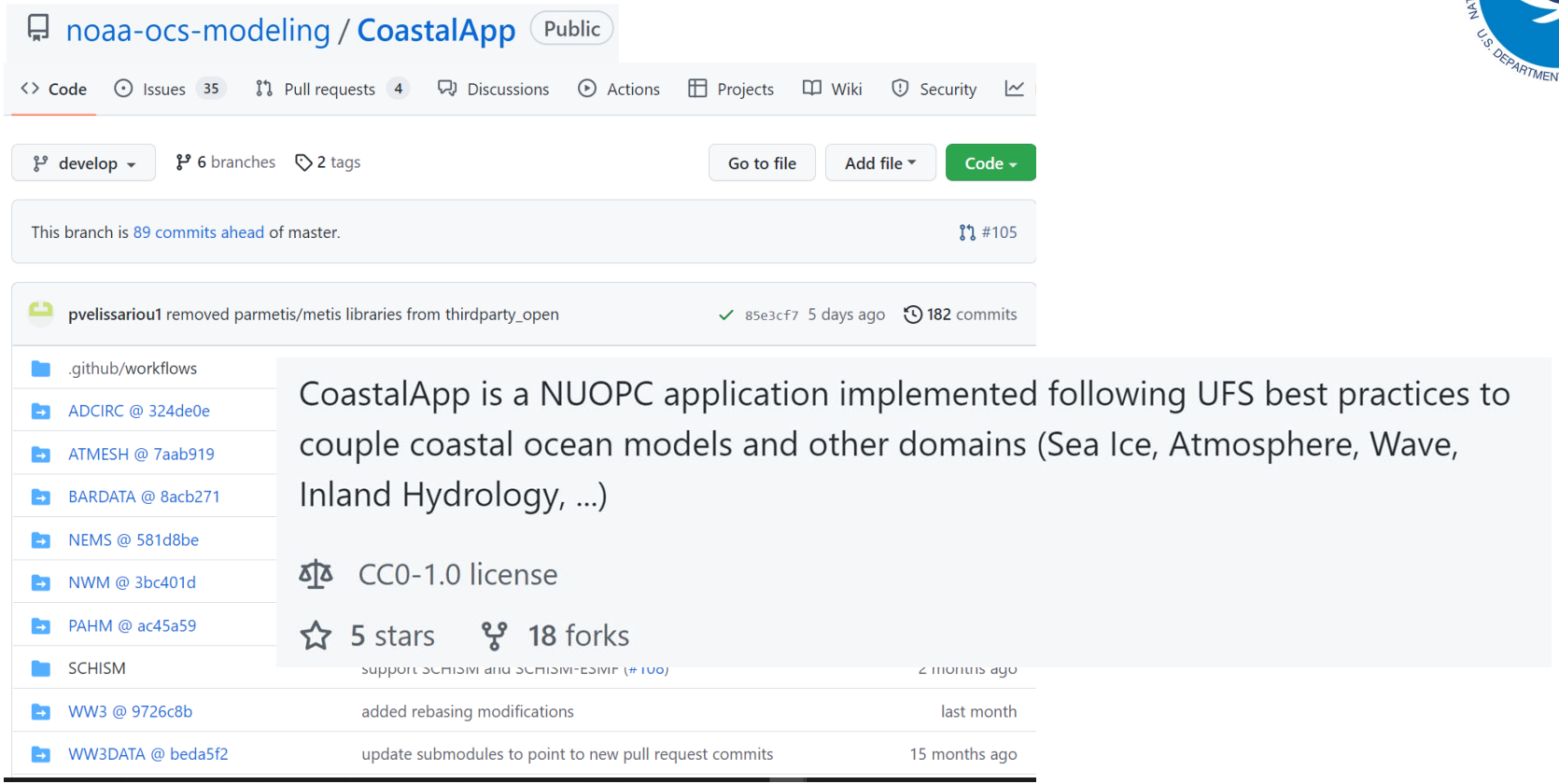
Coastal ocean modeling



tests passing | license CC0-1.0

https://github.com/noaa-ocs-modeling/CoastalApp

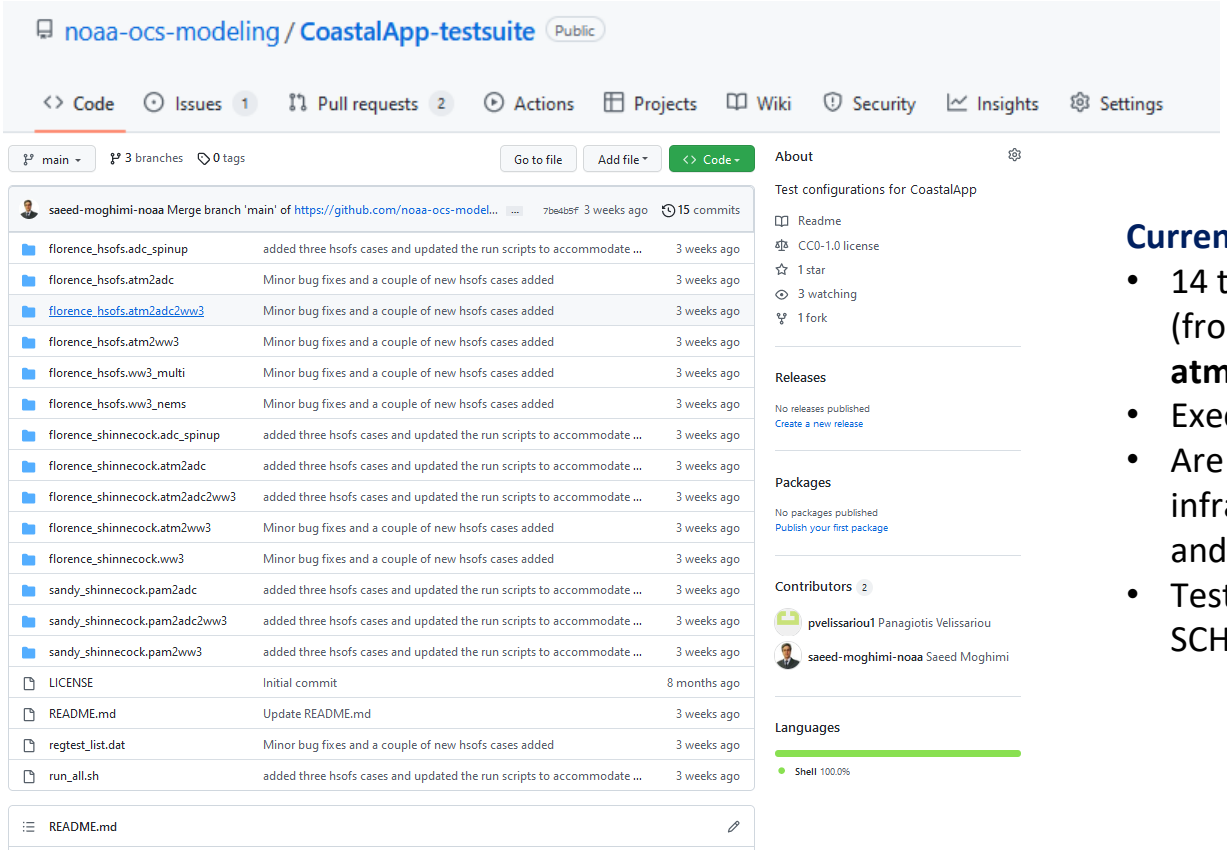
Coastal Ocean Coupling Application (CoastalApp)



tests passing | license CC0-1.0

https://github.com/noaa-ocs-modeling/CoastalApp

CoastalApp Automated regression testing



noaa-ocs-modeling / CoastalApp-testsuite Public

Code | Issues 1 | Pull requests 2 | Actions | Projects | Wiki | Security | Insights | Settings

main | 3 branches | 0 tags | Go to file | Add file | Code

saeed-moghimi-noaa Merge branch 'main' of https://github.com/noaa-ocs-model... 7be4b5f 3 weeks ago 15 commits

florence_hsofs.adc_spinup	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
florence_hsofs.atm2adc	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
florence_hsofs.atm2adc2ww3	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
florence_hsofs.atm2ww3	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
florence_hsofs.ww3_multi	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
florence_hsofs.ww3_nems	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
florence_shinnecock.adc_spinup	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
florence_shinnecock.atm2adc	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
florence_shinnecock.atm2adc2ww3	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
florence_shinnecock.atm2ww3	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
florence_shinnecock.ww3	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
sandy_shinnecock.pam2adc	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
sandy_shinnecock.pam2adc2ww3	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
sandy_shinnecock.pam2ww3	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago
LICENSE	Initial commit	8 months ago
README.md	Update README.md	3 weeks ago
regtest_list.dat	Minor bug fixes and a couple of new hsofs cases added	3 weeks ago
run_all.sh	added three hsofs cases and updated the run scripts to accommodate ...	3 weeks ago

README.md

About

Test configurations for CoastalApp

Readme
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1 star
3 watching
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Releases

No releases published
Create a new release

Packages

No packages published
Publish your first package

Contributors 2

pvelissariou1 Panagiotis Velissariou
saeed-moghimi-noaa Saeed Moghimi

Languages

Shell 100.0%

Current Status:

- 14 tests are implemented (from component level to **atm-> ocn** <--> **wav**)
- Executed on Hera-RDHPCS
- Are being tested on other infrastructures (in Germany and academic partners)
- Tests for FVCOM and SCHISM are to be included