ADCIRC Prediction System (APS)™ Development Coordination and Improved Connectivity with Hydrologic Models

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* Funding received: 50% yr 4 – Jan/Feb 2019; 50% yr 4 & 100% yr 5 - summer 2019

What is ADCIRC Prediction System™

Optimized for semi-continuous, hours – days forecast applications of total water level and inundation (wind, waves, velocity) in the coastal zone

1. Physics based models – ADCIRC + SWAN + ….
2. ADCIRC Surge Guidance System (ASGS)
3. Products - Visualization Tools - CERA

ADCIRC Prediction System – Status Overview

1a. Physics based models

1b. Grids / Meshes

2. ADCIRC Surge Guidance System

3. Products - Visualization Tools

Operations

Post CRC Sustainability

1a. Physics Based Models

- ADCIRC – tides, surge, inundation
- SWAN – waves (WWIII – NOAA, STWAVE – USACE)
- Hydrological models

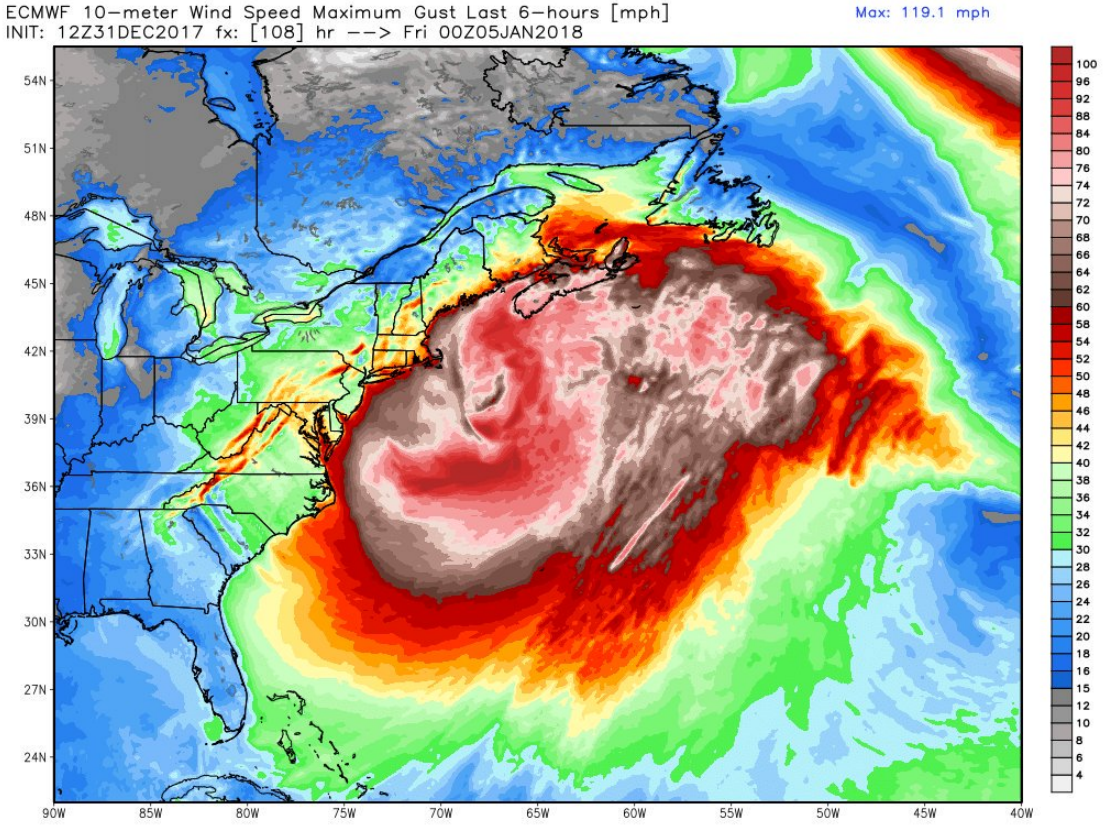
1a. Physics Based Models

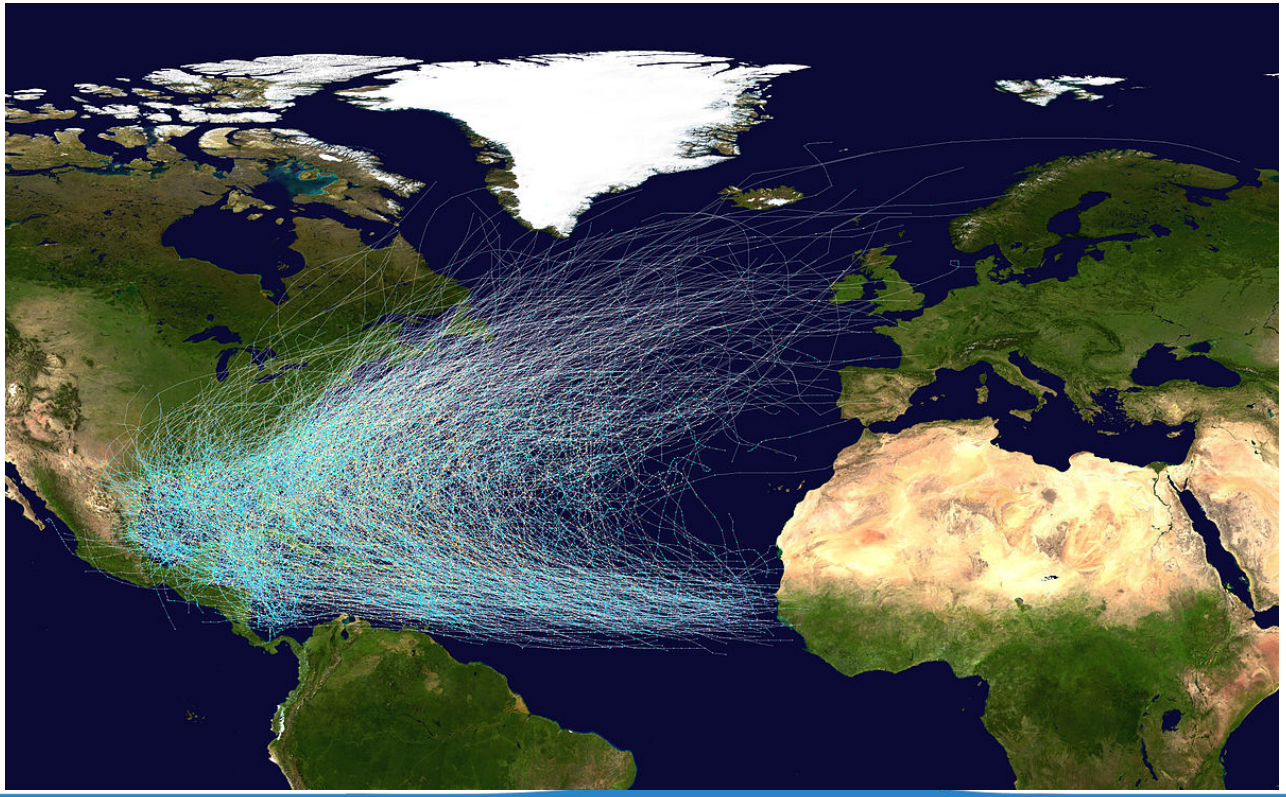
CRC YR 4/5 funding

- Re-evaluate mass conserving solution algorithm for ADCIRC (Dawson)
- Enhanced air – sea interaction physics (Ginis)
- Expand TC 3D boundary layer model to entire US coastal region (Ginis)
- Hydrologic - ADCIRC coupling (Resio, Atkinson, Luettich, Blanton, Ginis, Huang)
  - Southern New England (CT, RI, MA) impacts of compound flooding (Ginis, Huang)
  - Jacksonville, FL – Hurricane Irma compound flooding (Resio, Atkinson)
  - Eastern, NC – Hurricane Florence compound flooding (Luettich, Blanton)
  - NOAA National Water Model as hydrologic input to ADCIRC (Blanton, Luettich)

1b. Grids / Meshes

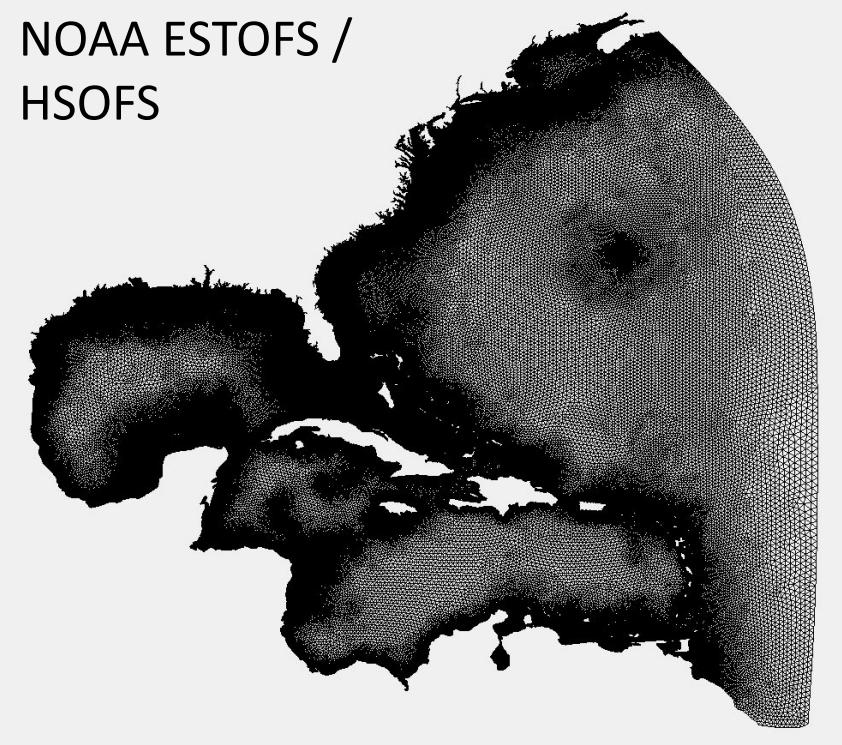
- Strategies to balance accuracy vs performance (computational effort)

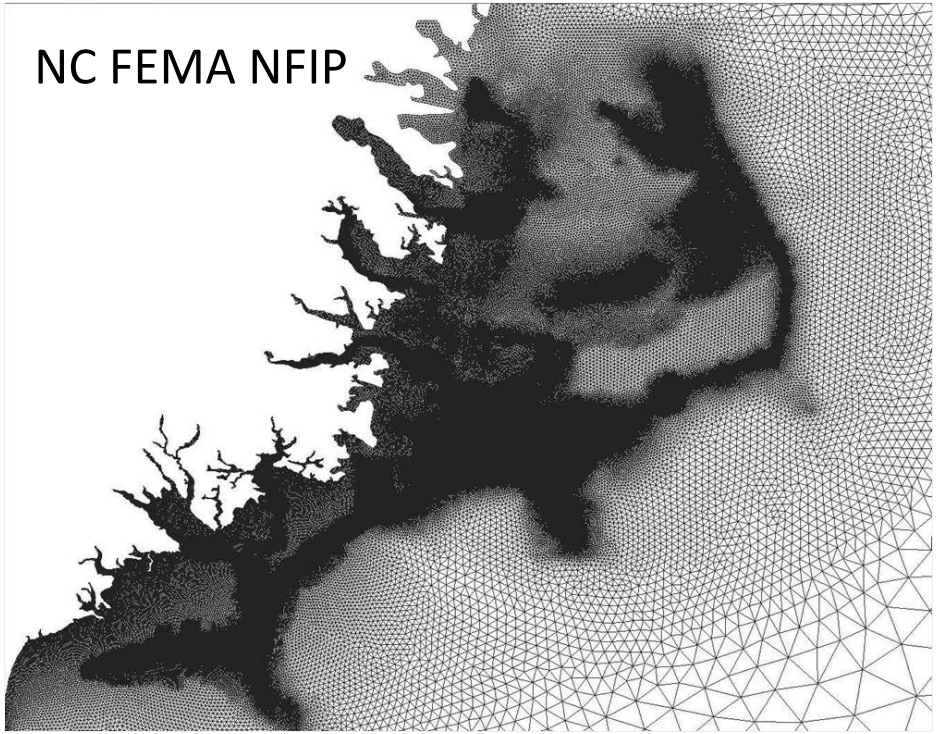




1b. Grids / Meshes

National vs Local



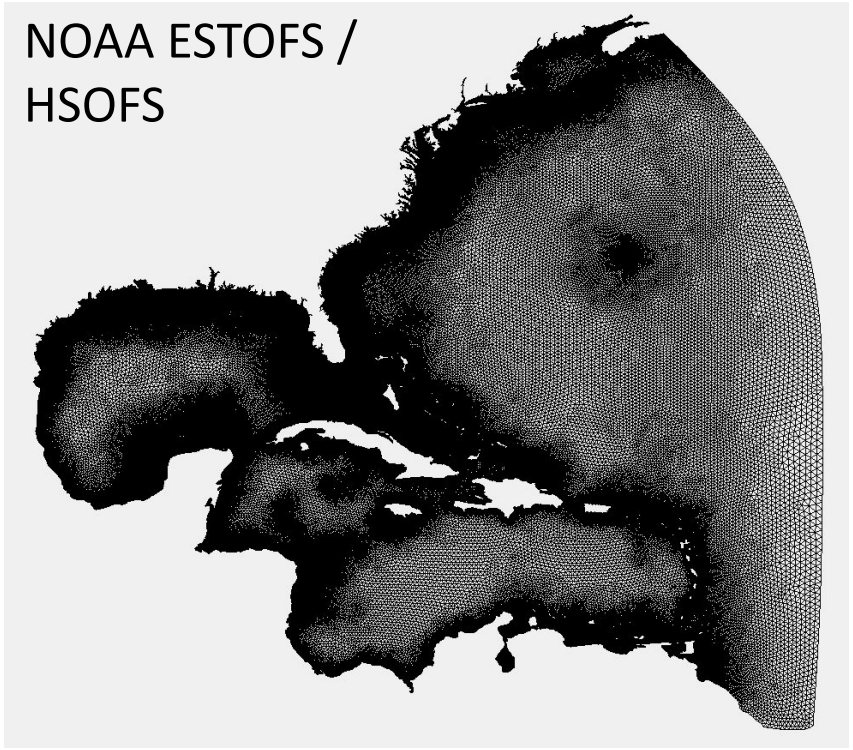


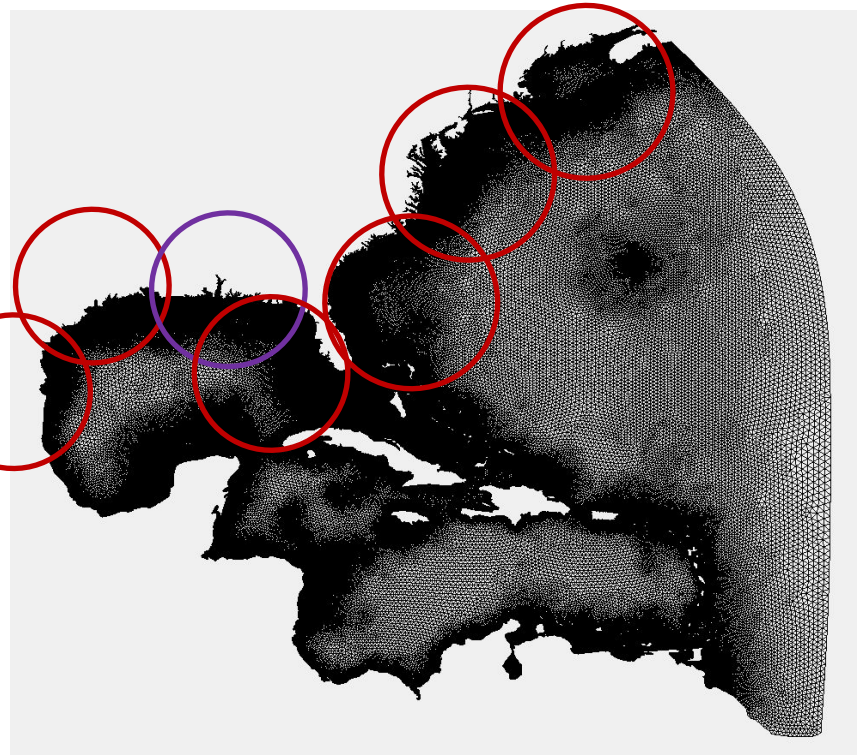
1.8 M nodes, nearshore resolution ~500m

0.5 M nodes, nearshore resolution ~20m

1b. Grids / Meshes

National vs Regional





1.8 M nodes, nearshore resolution ~500m

3-4 M nodes, nearshore resolution ~100m

1b. Grids / Meshes

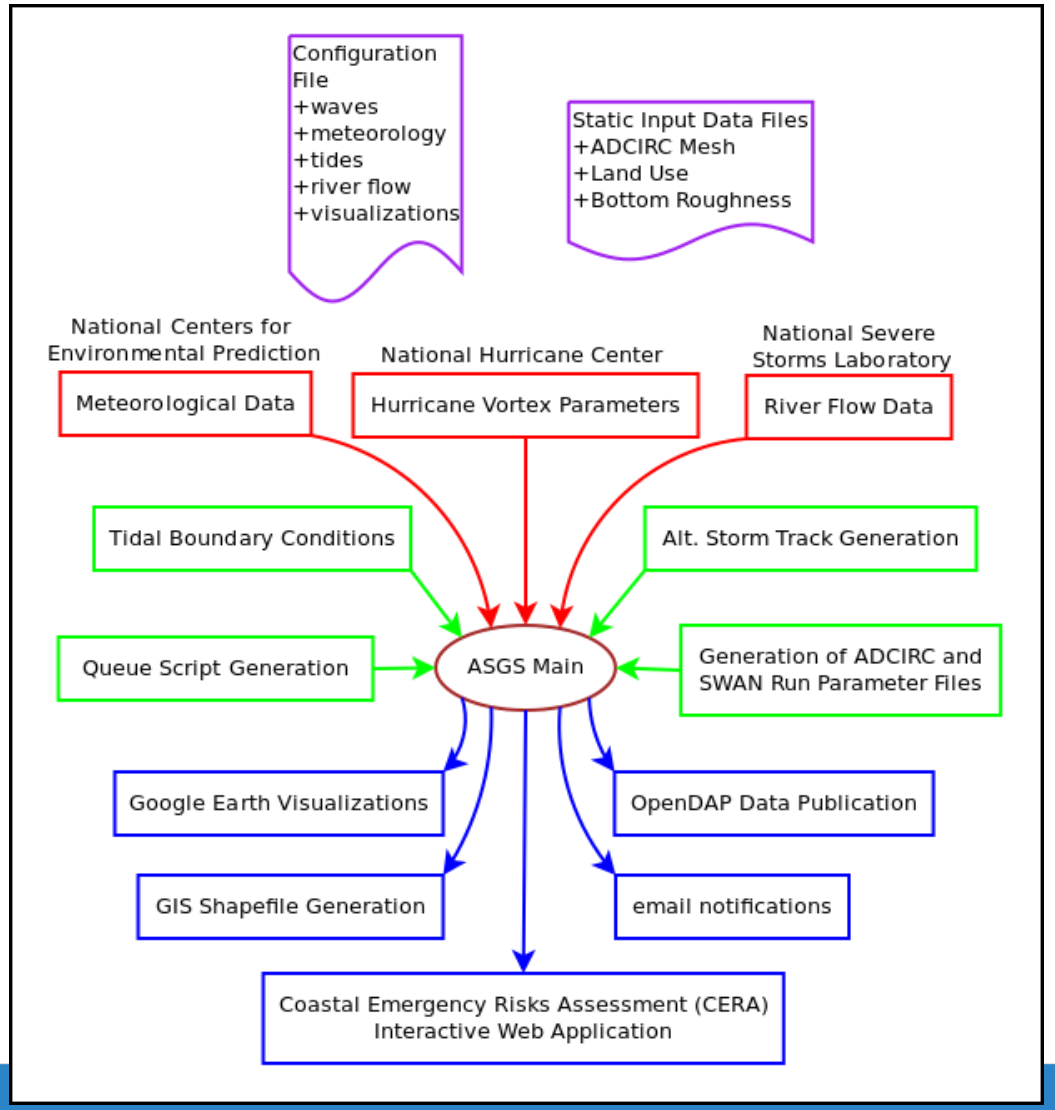
CRC YR 4/5 funding

- Build out full set of 6-8 regional model grids, test and select standard parameterizations (Dietrich, Dawson, Hagen, Ginis, Luettich)
- Stress testing of ADCIRpolate (Dietrich, Dawson)
- Dynamic load balancing (Dietrich)

2. Production System

- Automates model execution process
  - Collects all forcing data
  - Creates initial conditions
  - Initiates run(s)
  - Transfers results into storage archive, notifies of completion
  - Some visualization
- 1-4 x daily, 365 days / year – Extratropical Storms
- When NHC issues TC advisories

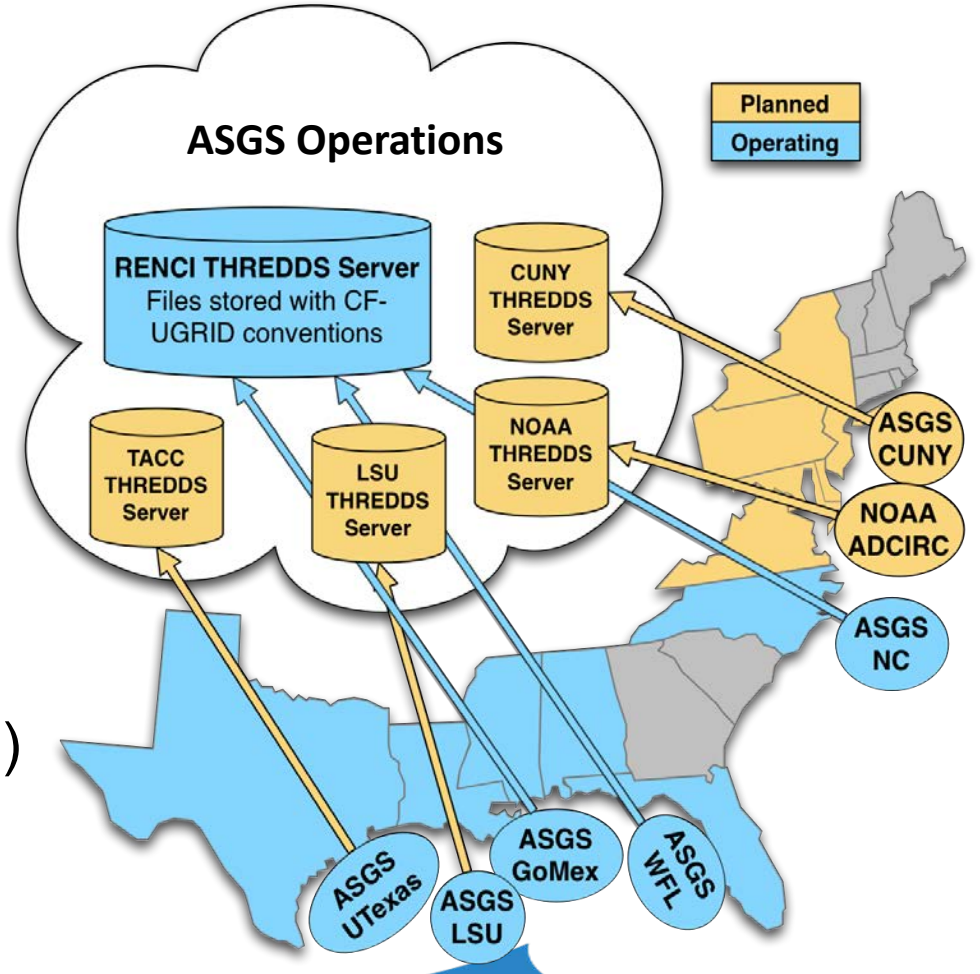
ADCIRC Surge Guidance System - ASGS



2. Production System

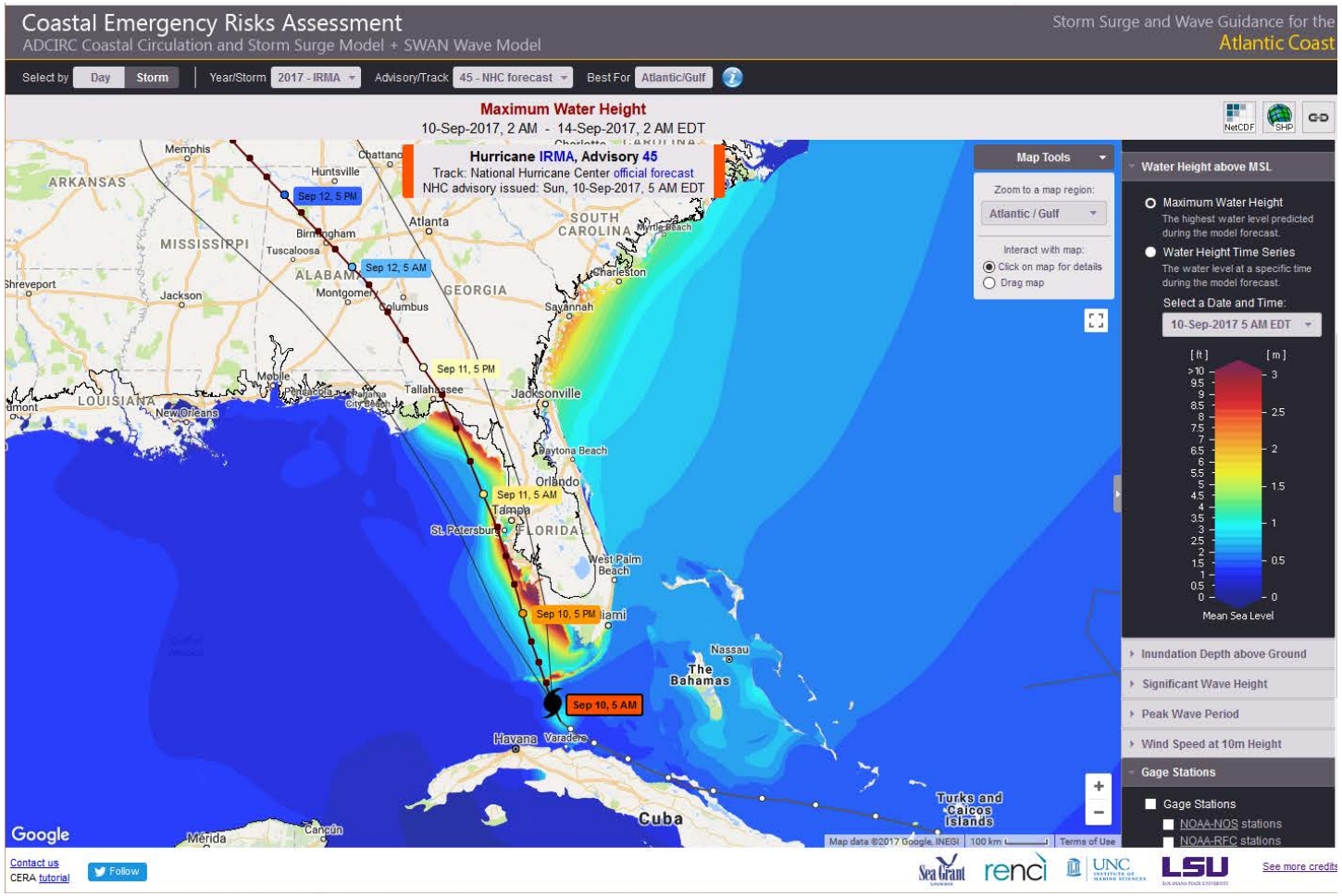
CRC YR 4/5 funding

- Additional ASGS capabilities (Fleming)
  - Dynamic water level corrections
  - Wind blending
- Improved communications within ASGS (Fleming, Estrade)
- ASGS Operational Awareness Dashboard (Blanton)



3. Products

- CERA
- GIS Shape files
- Downscaling to high resolution topography
- Hazard vulnerability



3. Products

CRC YR 4/5 funding

- CERA Enhancements (Kaiser, Twilley, Fleming)
- Expand CERA team (Kaiser, Twilley, Fleming)
- National downscaling capability & shape files (Dietrich)
- Expand hazard vulnerability visualizations in southern New England (Ginis)

Operations

CRC YR 4/5

- Year round operations (2018, 19) – USCG, NWS (Blanton, Kaiser, Fleming, Luettich)
- Tropical cyclones - Alberto, Gordon, Florence, Michael (2018); Barry, Dorian (2019) (Hagen, Bilskie, Fleming, Blanton, Kaiser, Luettich)
- Extratropical storms – March 2018 Nor'easter (Ginis)
- Cultivate the APS Corps - expand trained operators, establish roles (Fleming)

Post CRC Sustainability

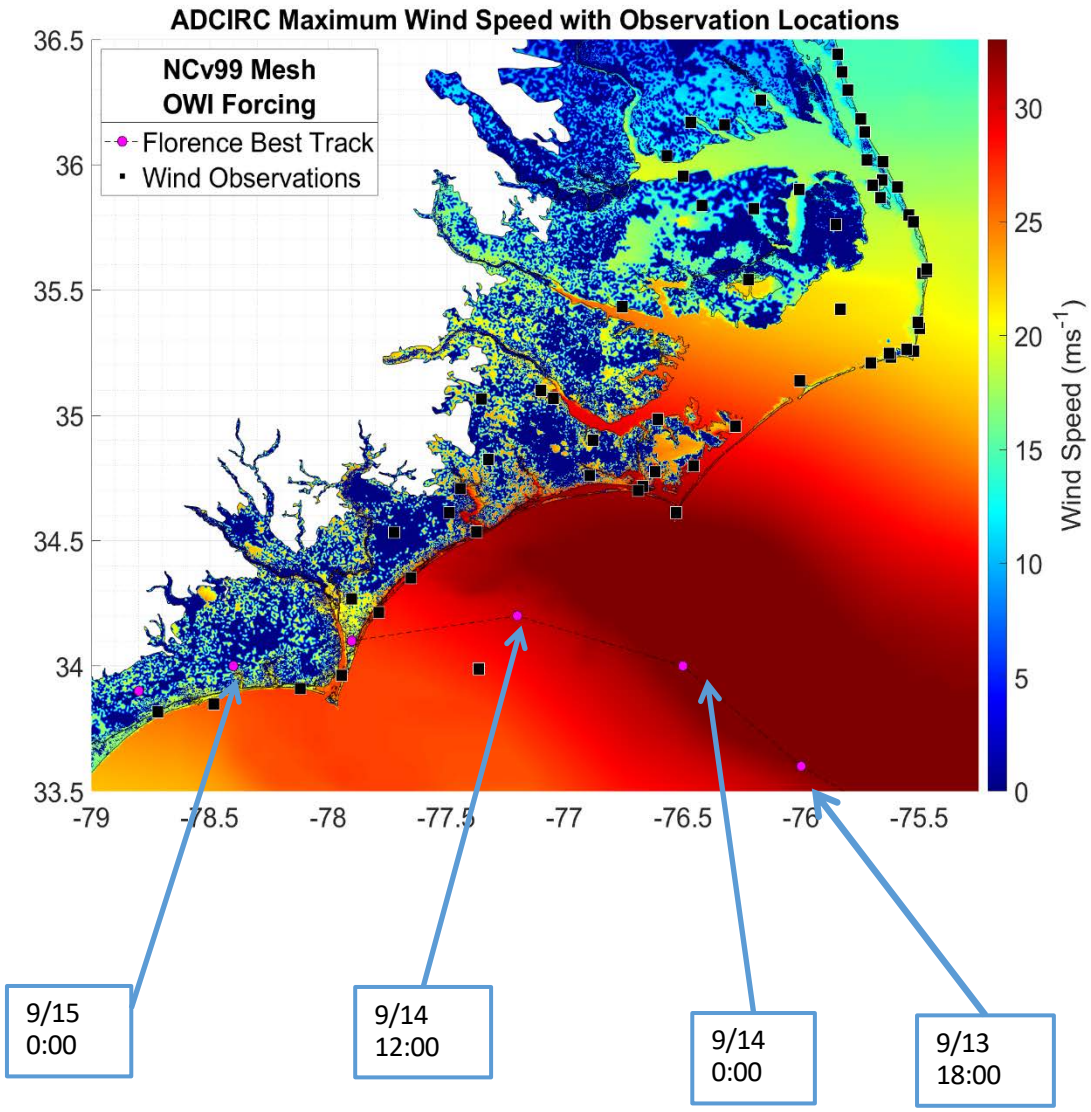
CRC YR 4/5 funding

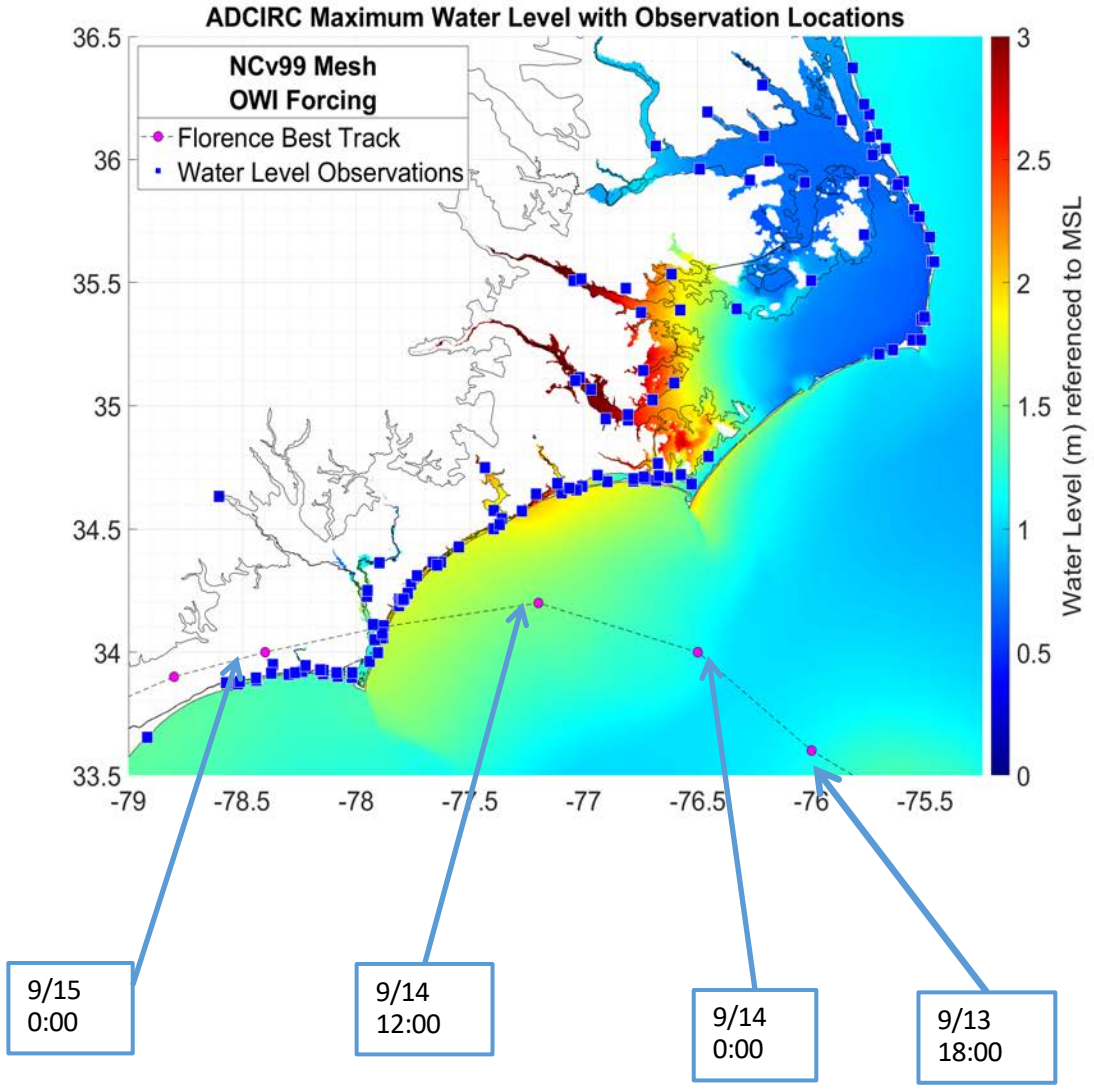
- APS Business Plan Development (Richardson, Maron, Fleming, Luettich, others)
- Model / mesh development
- Products development
- Expand human and computational resources
- Outreach - build base of paying clients
- Governance

ADCIRC Connectivity with Hydrologic Models
Hurricane Florence

Rick Luettich, Brian Blanton, John Ratcliff, Youcan Feng

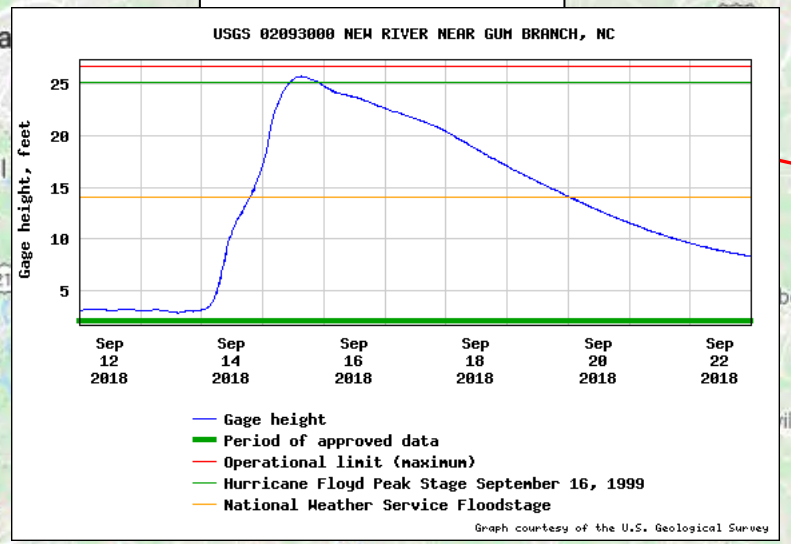
Simulated Max Wind and Water Level



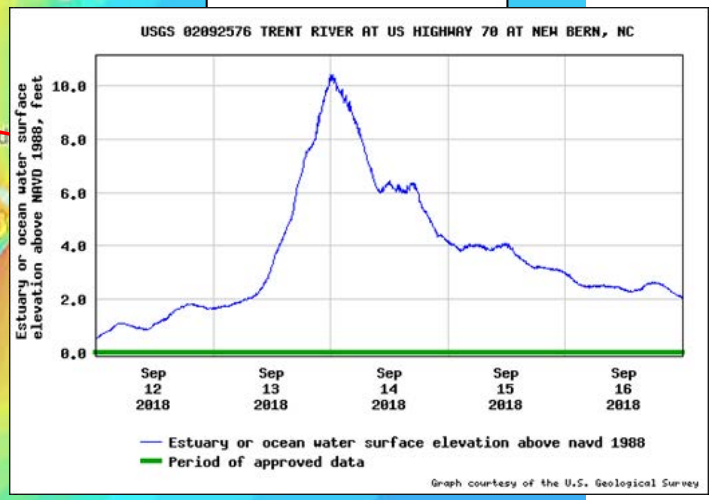


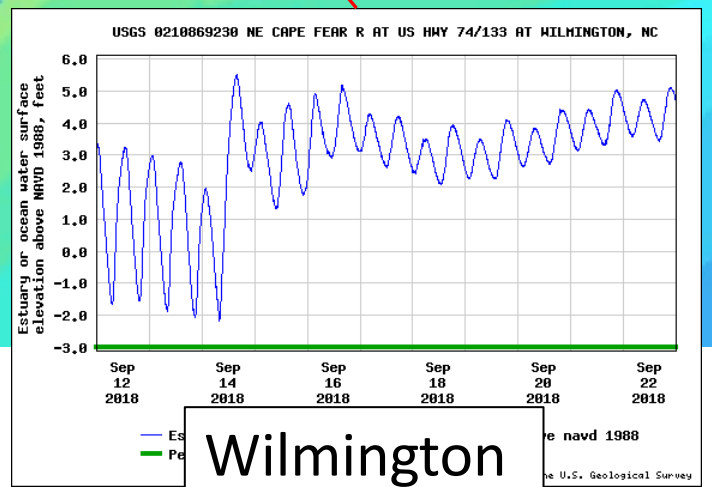
Historic Water Levels

Gum Branch



New Bern





Wilmington

Sep 14, 9:00
Sep 14, 3:00
Sep 14, 15:00
Sep 14, 21:00
Sep 15, 3:00
Sep 15, 9:00
Sep 15, 21:00
Sep 16, 3:00
Sep 16, 9:00
Sep 13, 21:00
Sep 13, 15:00

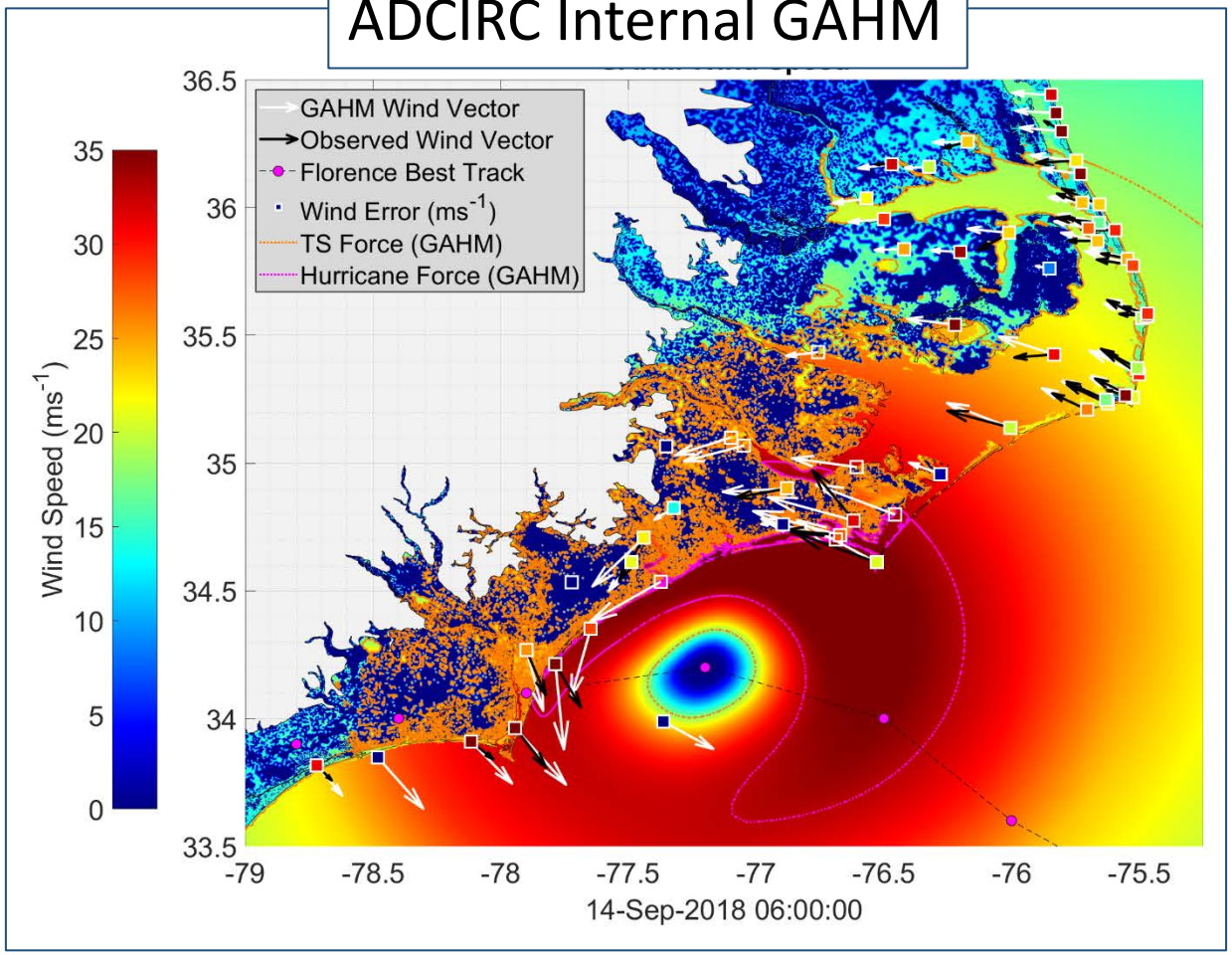
Opportunities

- Compound flooding
  - Identify whether compound event or independent surge / hydrologic events?
  - Rigorous model skill assessment – substantial observational data sets
  - hydrologic – coastal model interactions

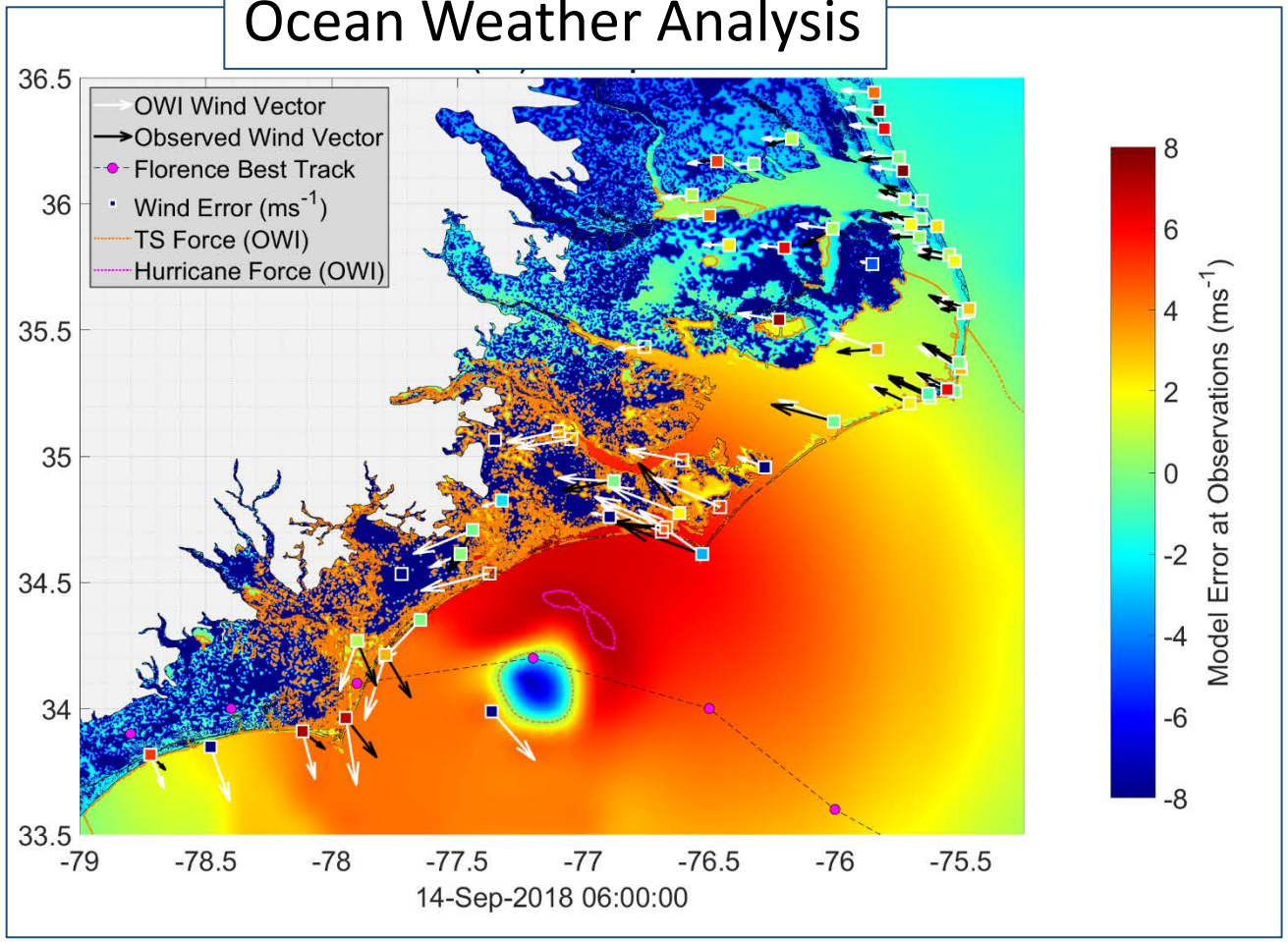
- Model development
  - Evaluate multiple hydrological models as inputs to ADCIRC (GSSHA, WRF-Hydro, NWM)
  - Idealized studies for potential new features in ADCIRC

Wind Comparison

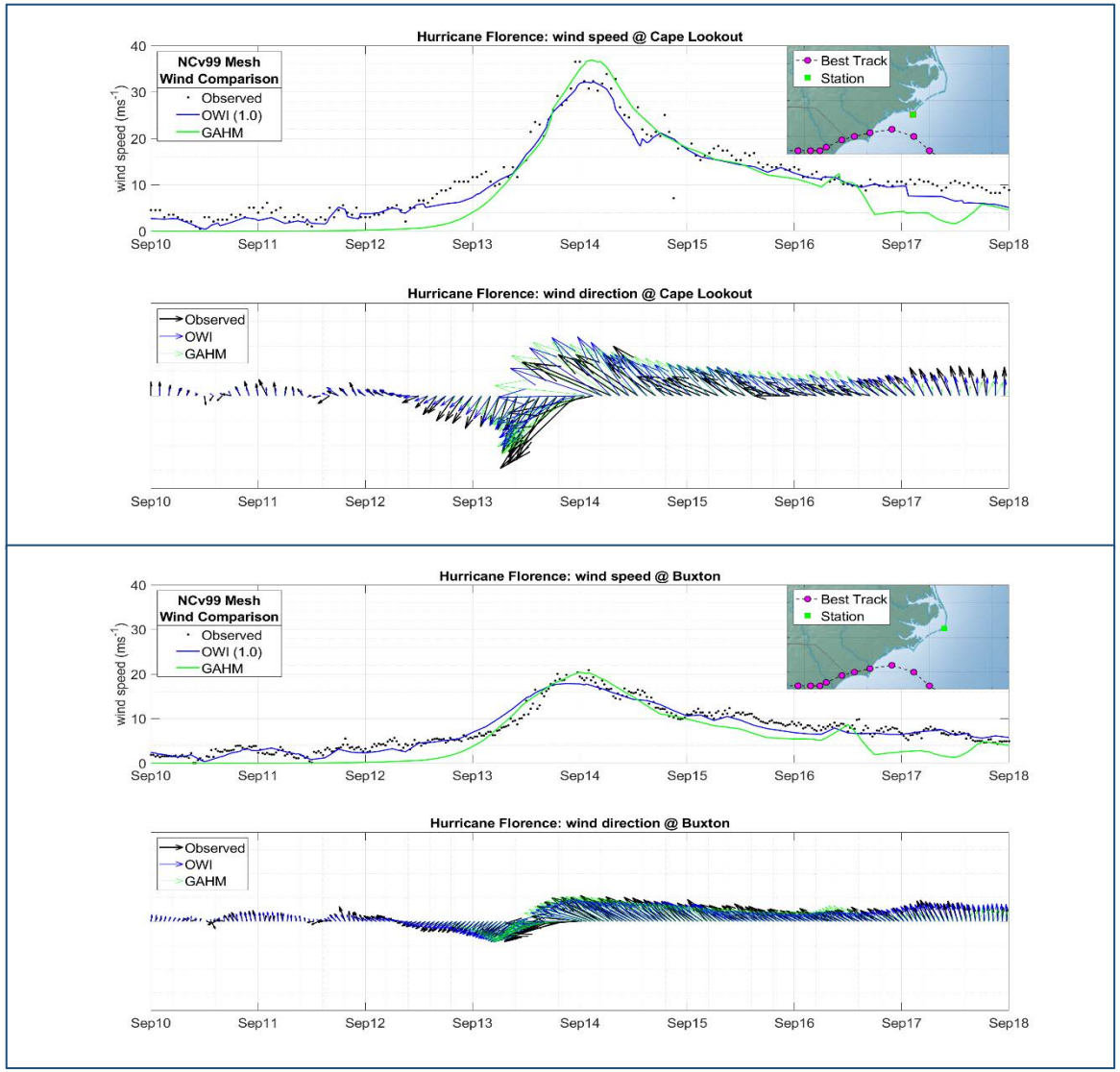
ADCIRC Internal GAHM

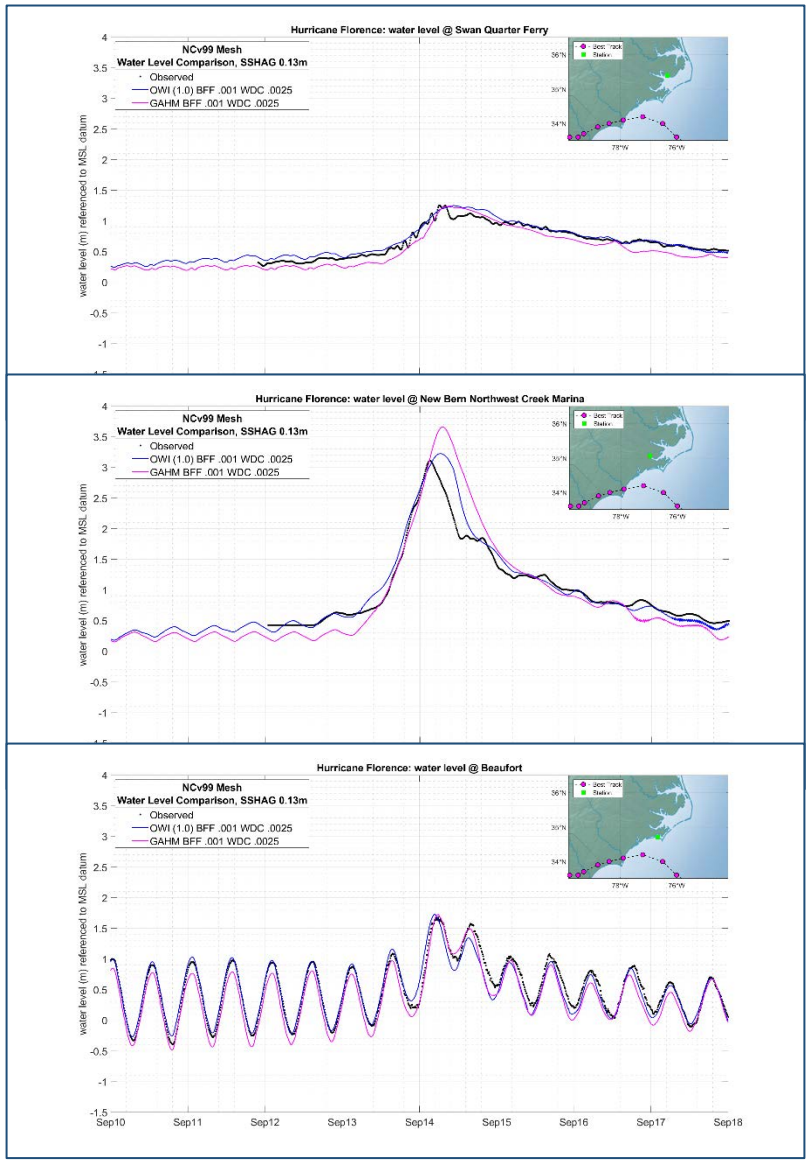


Ocean Weather Analysis

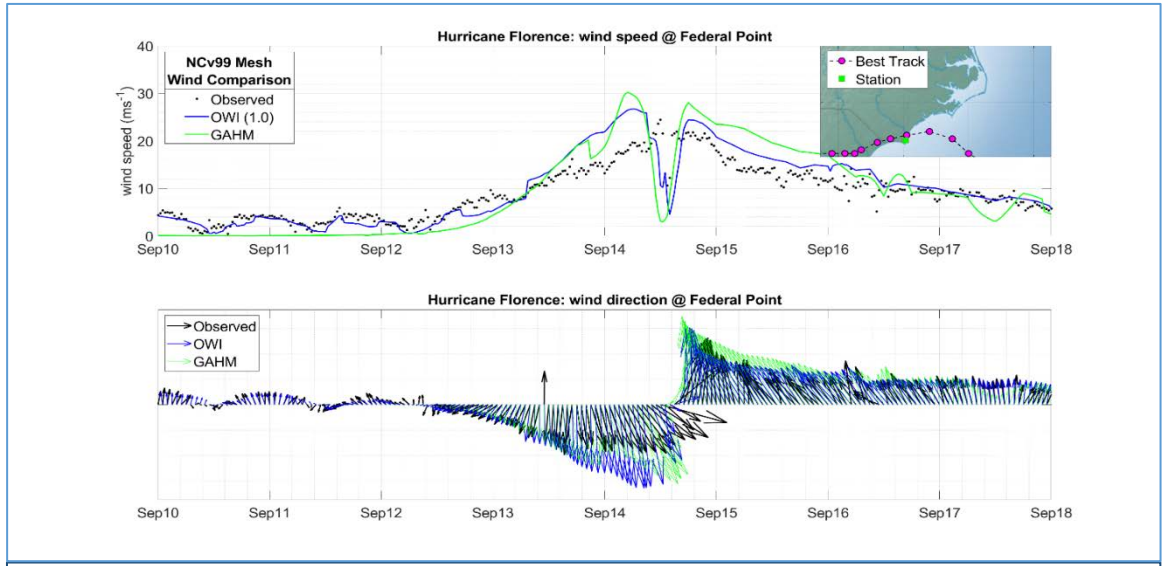


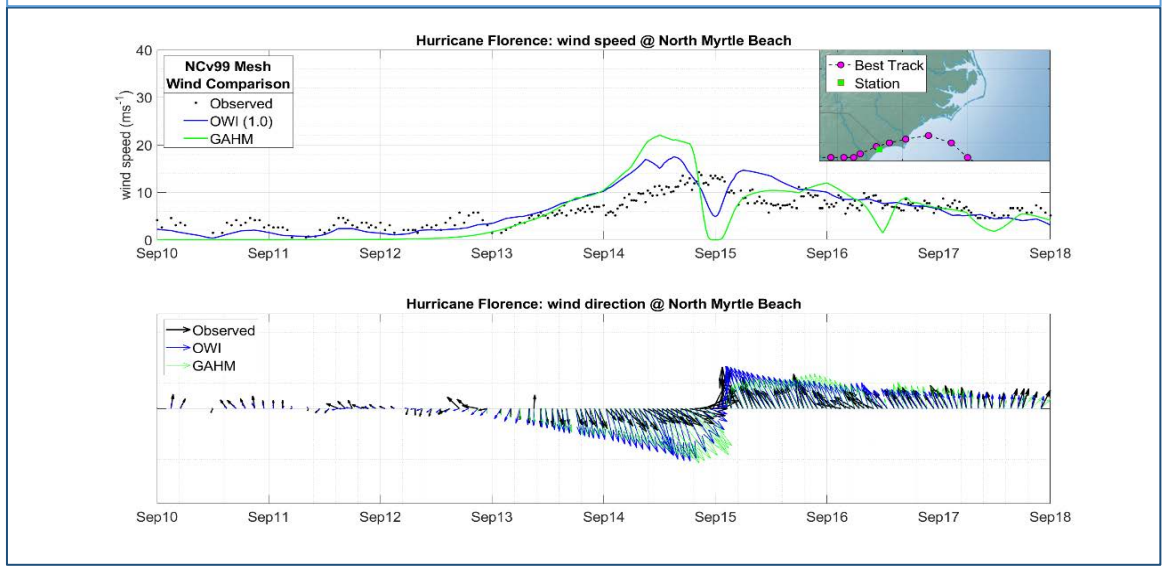
Wind/Water Comparison – Central coast/Sounds

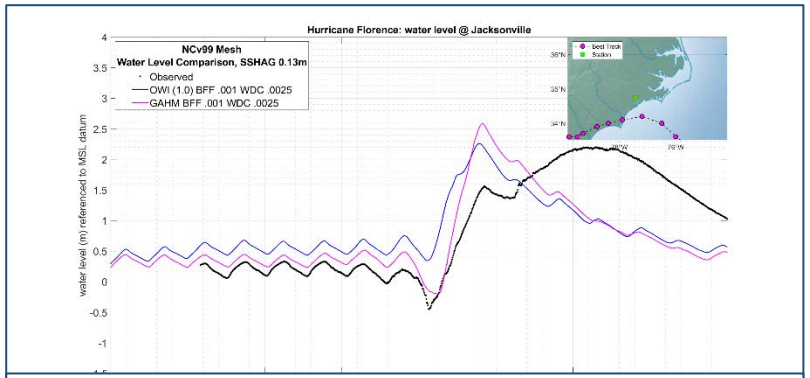


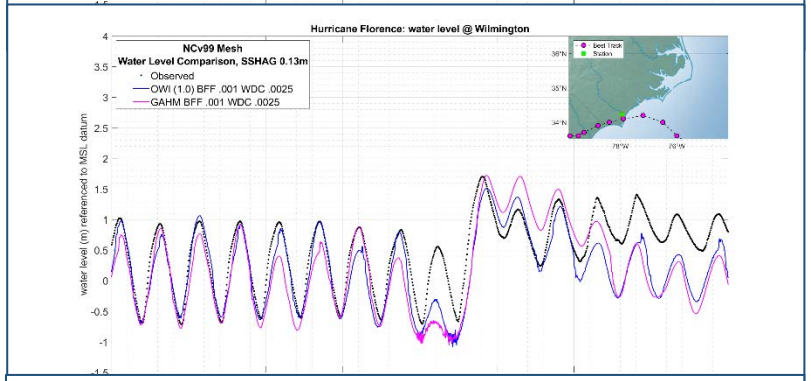


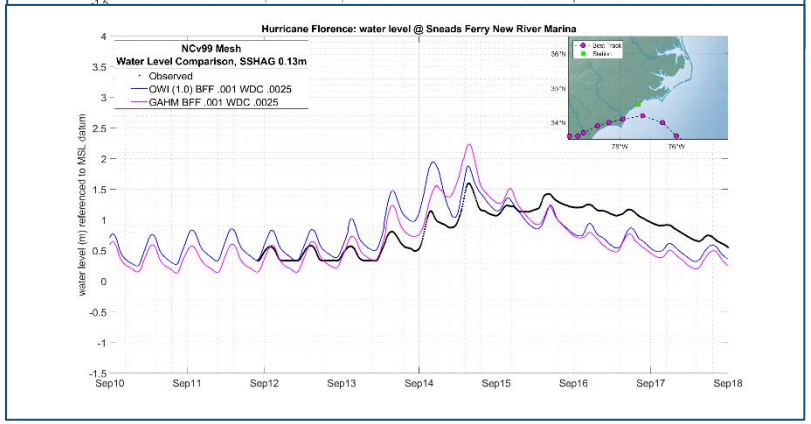
Wind/Water Comparison – toward NC/SC border



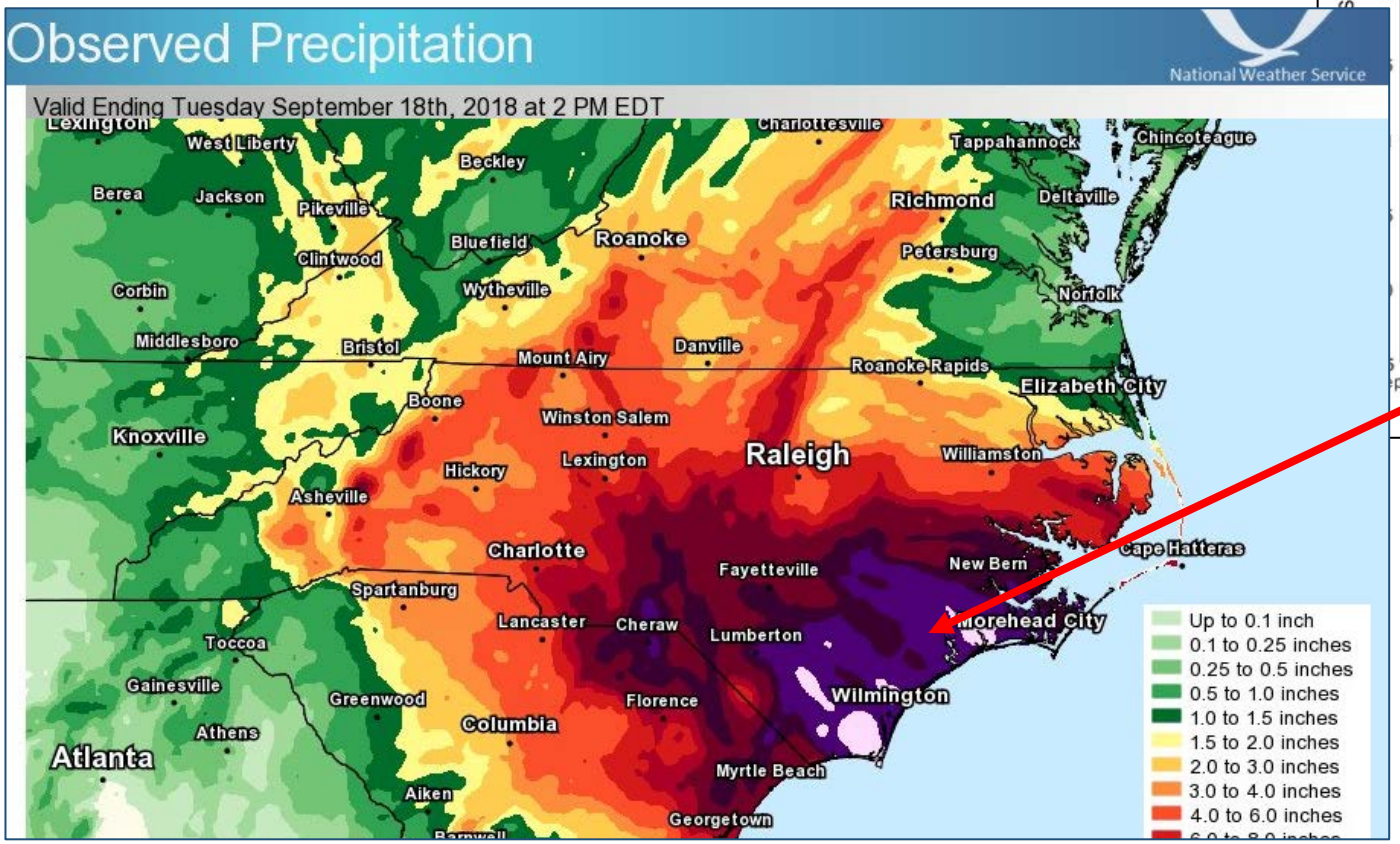


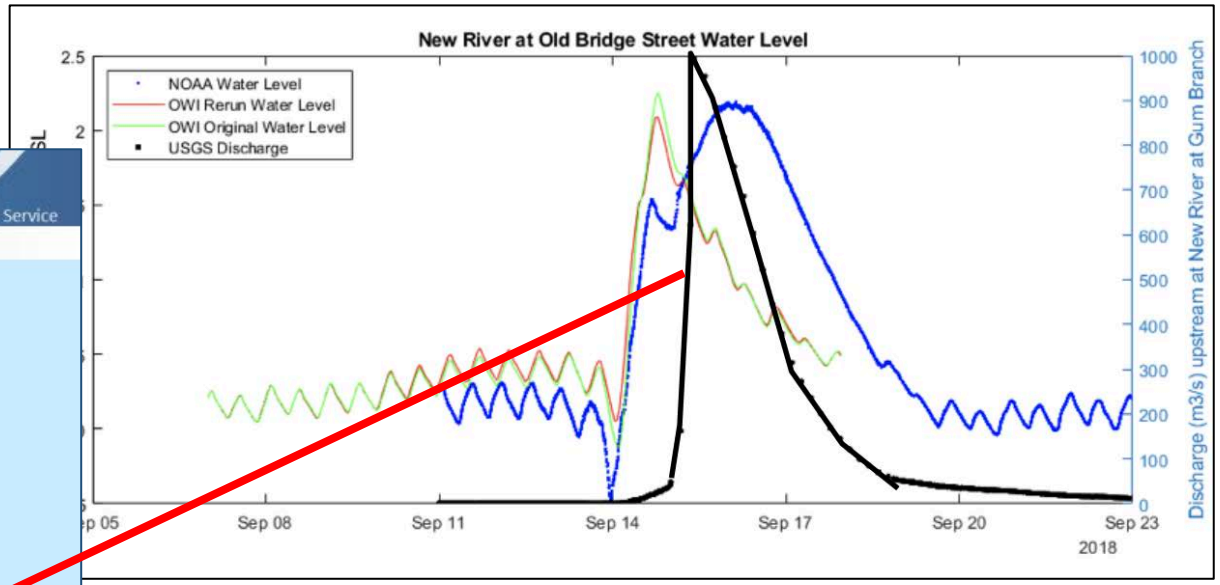




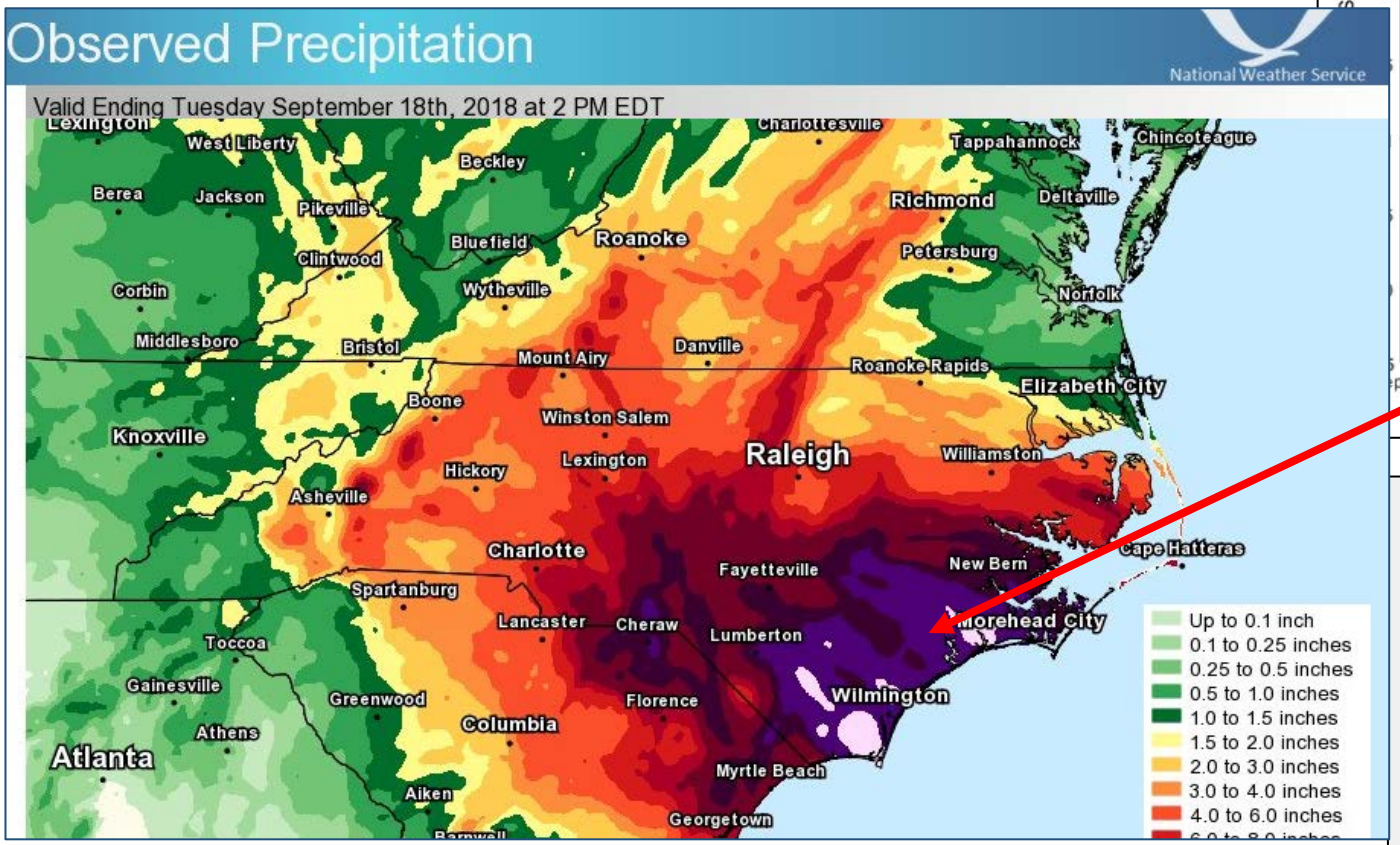


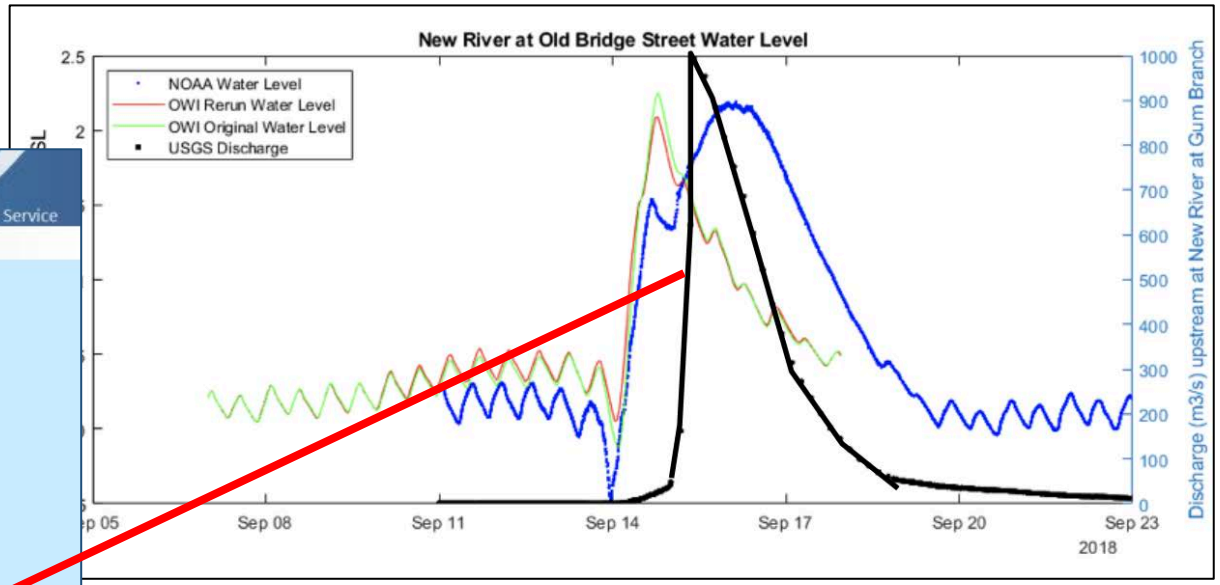
Riverine Considerations

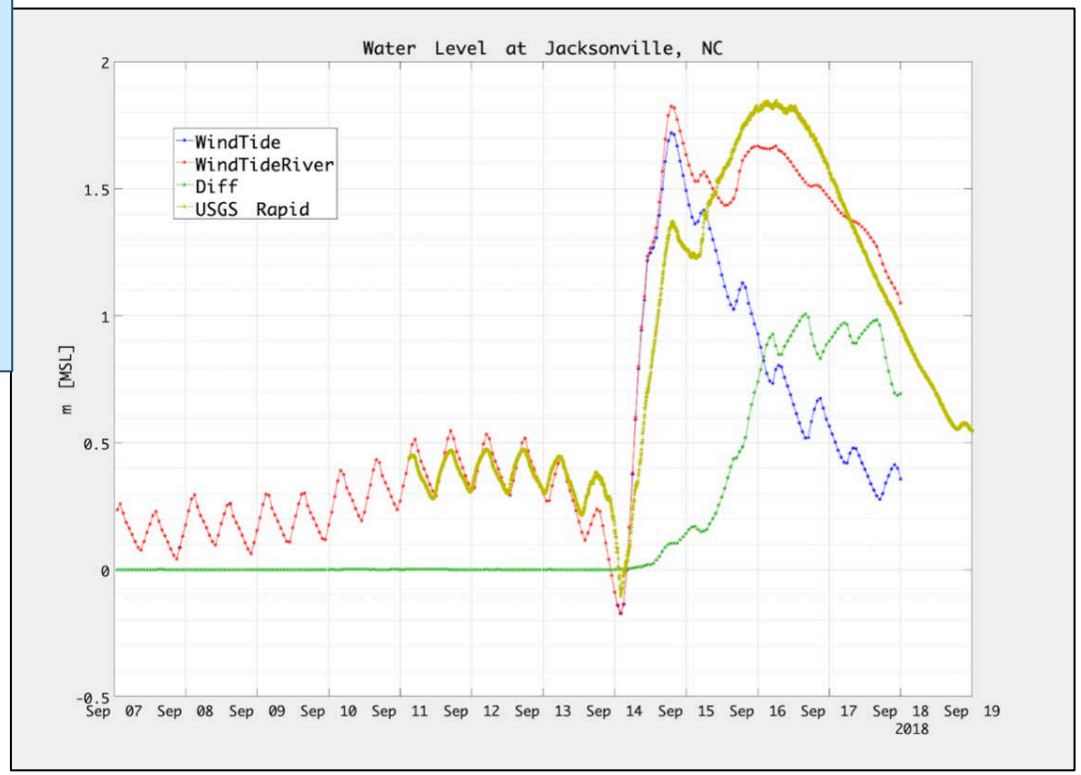




Riverine Considerations







Year 4-5 Research Milestones:

Y4 2019 ADCIRC Users Group meeting – May 20-21

Participated, although minimal hydrology progress to report

Y5 Presentation of findings from research activities at national conference

Florence results presented at American Meteorological Society annual meeting (Luettich, Blanton) and Ocean Sciences meeting (Blanton, Feng)

Y5 Presentation of findings from research activities at ADCIRC Week

Will occur at end of March (virtual meeting)

Y5 Submission of manuscript about hydrological model – ADCIRC coupling for peer review

Behind due to late start

Year 4-5 Transition Milestones:

Y4 Dynamic offset capability included in ASGS

- Manual offsets used in hurricanes (2018) Florence, Michael (2019) Barry, Dorian
- Automated offsets still being implemented (conversion from Matlab to Python, evaluation of robustness) – Blanton
- Not yet ready for handoff to ASGS – (Fleming)
- Dynamic offset manuscript published in Ocean Modeling Sept 2019

Y4 Version 1 of high resolution grids included in APS

- Hagen/Bilskie regional grid of NE Gulf of Mexico performed spectacularly for hurricane Michael (2018)
- New England grid currently under testing (Ginis, Blanton)
- Others, see Dietrich, Hagen/Bilskie/Medeiros

Year 4-5 Transition Milestones:

Y4 Version 1 of ADCIRC / ASGS run monitoring portal is operational

- Monitoring portal used extensively during Matthew (2018) – see Blanton presentation

Y4/Y5 V1 / V2 of revised ADCIRC website and documentation available online

- wiki.adcirc.org

Y5 Inclusion of URI HBL wind model in ADCIRC/ASGS

- Feasibility of this remains under evaluation

Y5 version 2 of high resolution gris included in APS

- Missed version 1 / 2 cycle due to funding issues

Y5 Version 2 of ADCIRC / ASGS run monitoring portal is operational

- Enhancements to portal based on year 1 feedback used during Dorian (2019) – see Blanton presentation