

NOAA Storm Surge Modeling Gaps and Priorities

HFIP Meeting
November 7th, 2018

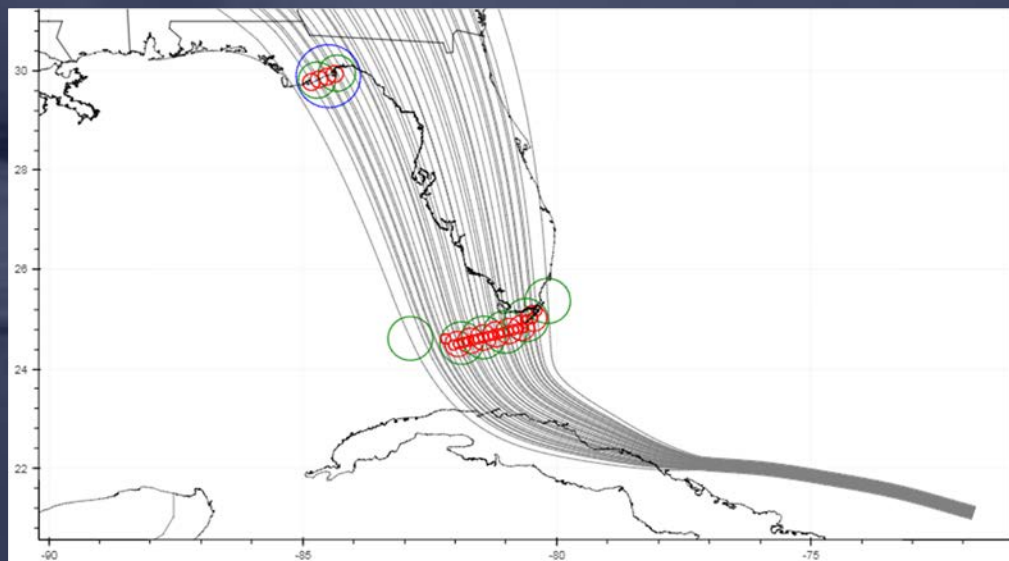
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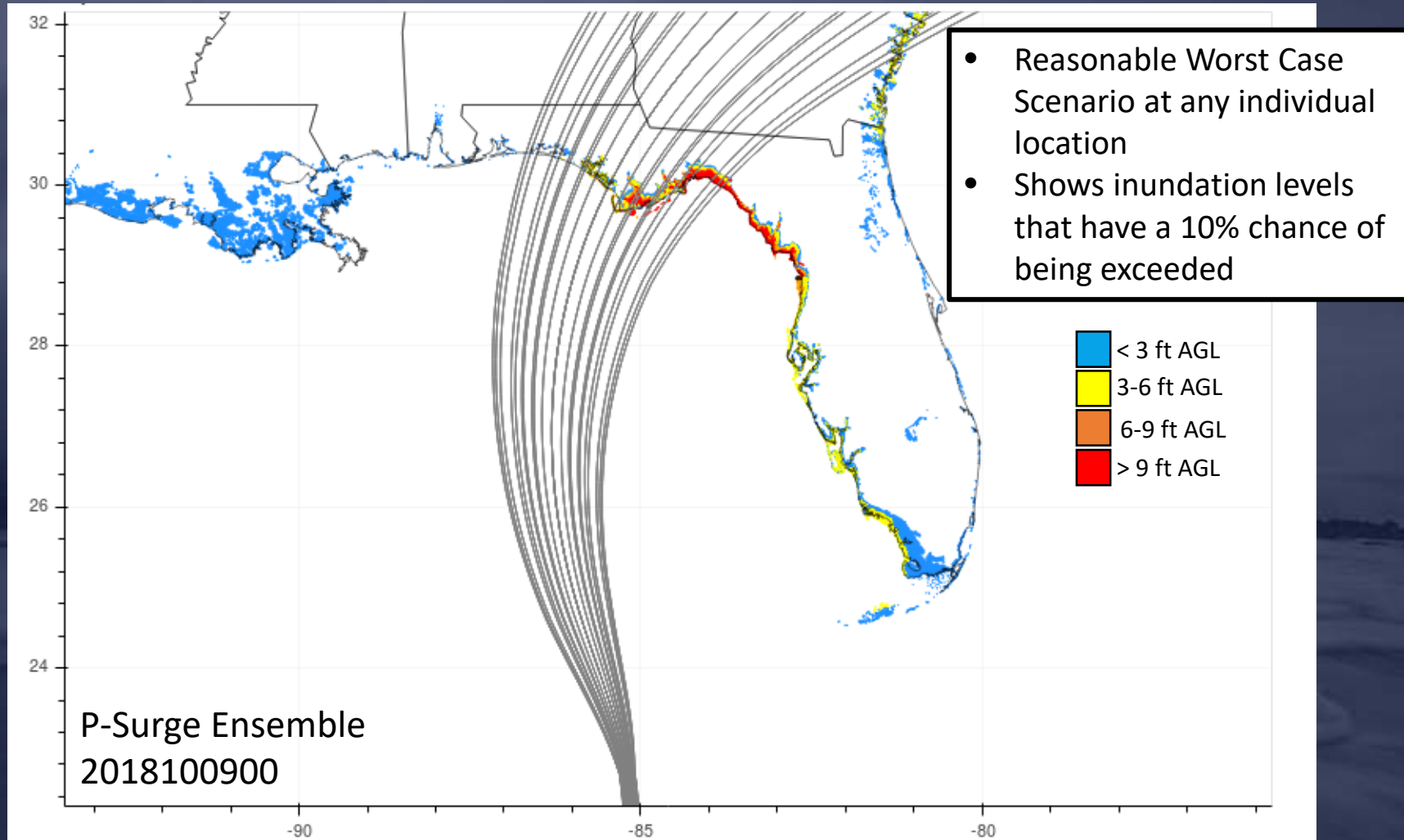
Introduction to Probabilistic Storm Surge

- P-Surge is based on an ensemble of Sea, Lake, and Overland Surge from Hurricane (SLOSH) model runs
 - SLOSH: numerical-dynamic tropical storm surge model
 - SLOSH requires bathymetry and is applied to a 'basin'
 - SLOSH requires meteorological driving forces: "Wind model is just as important– if not more so– as a surge model" (Jelesnianski et al. 1992)
- P-Surge ensemble incorporates uncertainty using a statistical method based on NHC historical errors of:
 - Cross track (landfall location) : includes 90% of possible cross track
 - Along track (forward speed)
 - Intensity
 - Storm size

2017090900 P-Surge Tracks

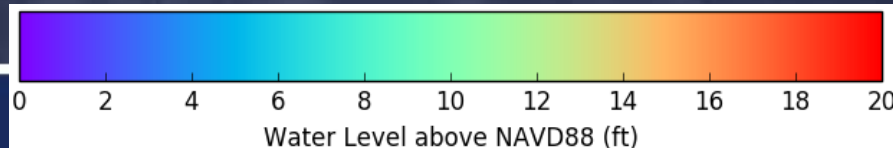
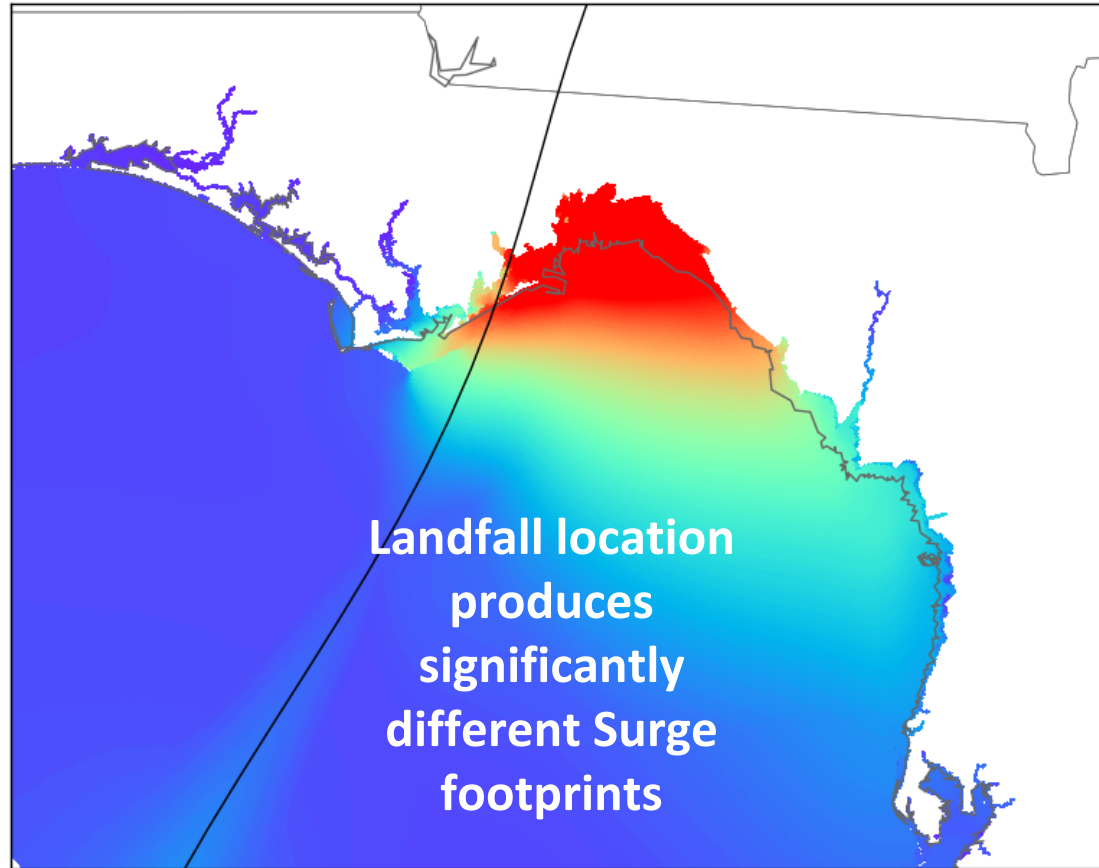


Michael Ensembles



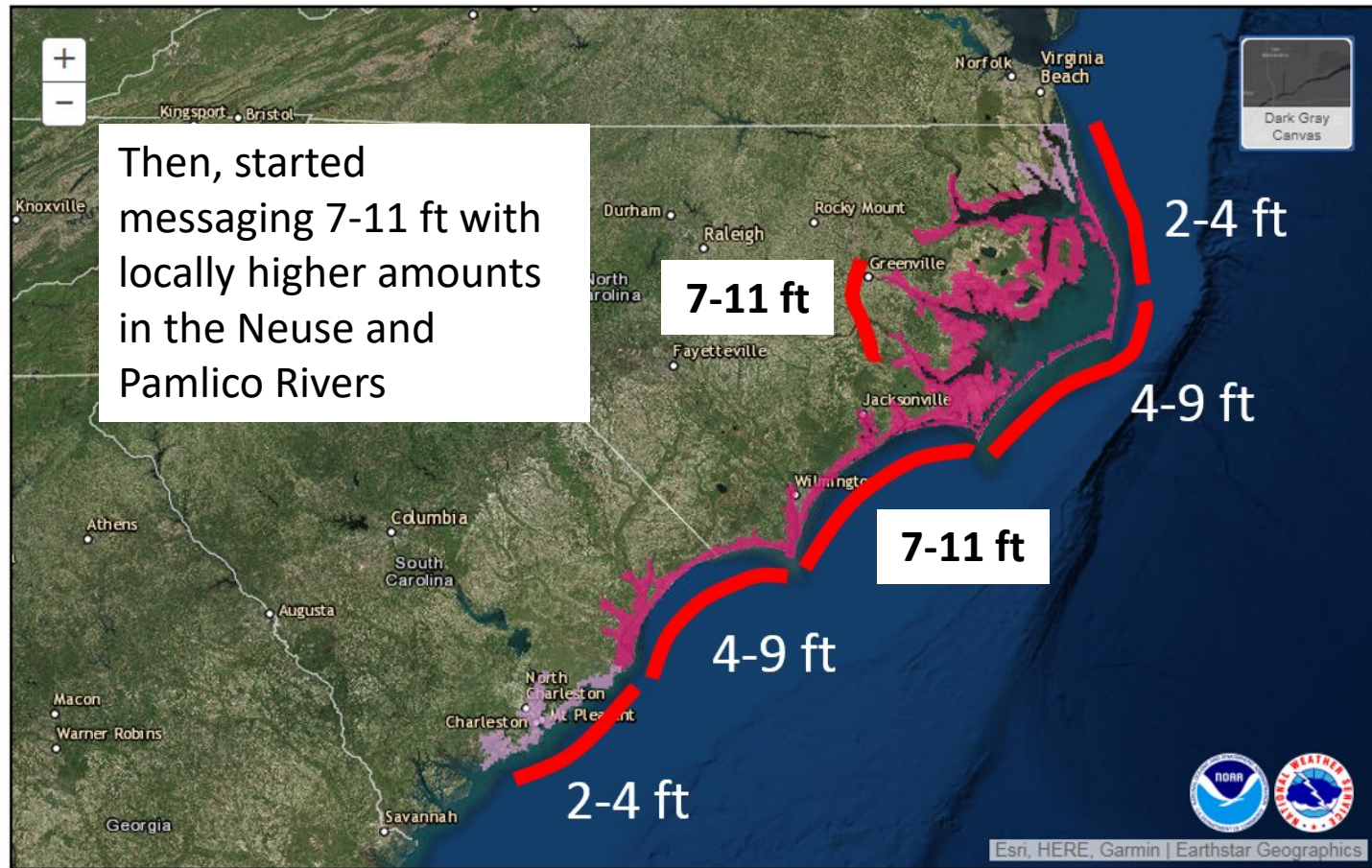
Michael: Track Matters

SLOSH Deterministic Shifted Track



Florence: Structure Matters

Storm Surge

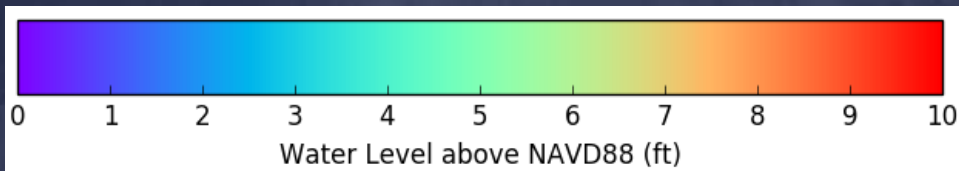
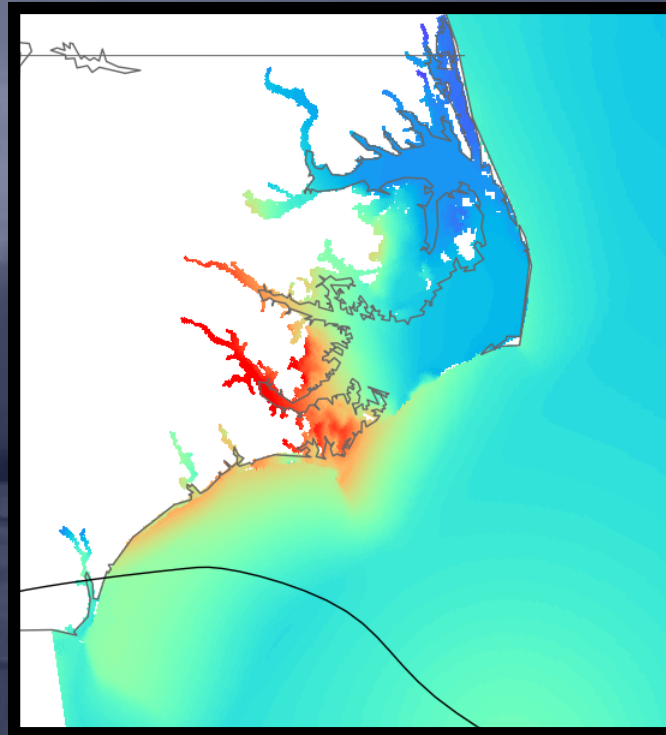
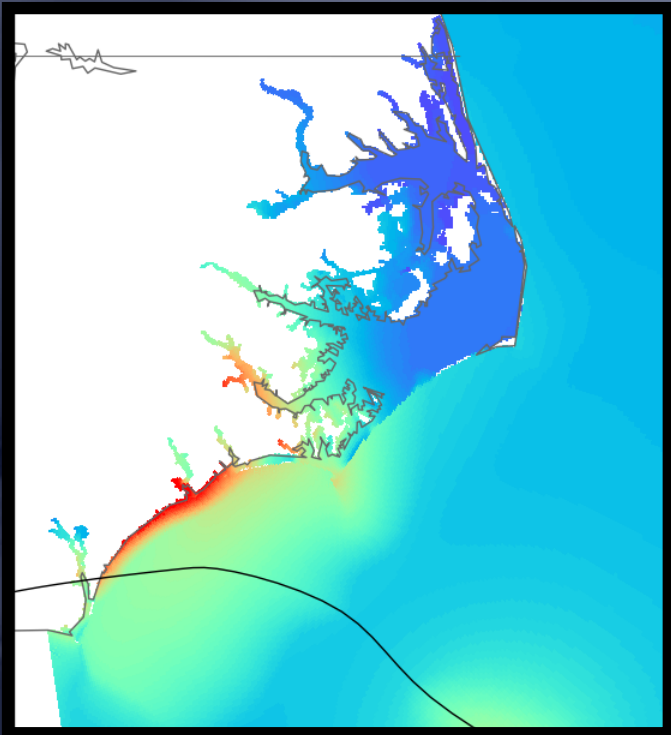


0 30 60mi

Florence: Structure Matters

**SLOSH Deterministic
Stronger, Smaller Storm**

**SLOSH Deterministic
Best Track**



**Structure
produces
significantly
different Surge
footprints**

2017: The Gaps and Priorities

1. Improve the Probabilistic Ensemble

- Replace SLOSH's parametric wind model
- Incorporate wind structure information into P-Surge Ensemble
- Move from a Statistical to a Dynamical Ensemble

2. Provide Real-time Storm Surge Forecasts Sooner

- Increase use of P-Surge from 48- to 72-hours before landfall

3. Extend Probabilistic Method to OCONUS

- Support wave modeling in real-time probabilistic guidance for Puerto Rico, Virgin Islands, and Hawaii

2018 Updates

1. **No significant updates made to Operational P-Surge for 2018 Season**
2. **Working on validation of current version to quantify future improvements**
 - Headed towards reliability diagrams depicting the Forecast Probability vs the Observed Relative Frequency
 - Must have a large, accurate observation set
 - USGS Stormtide Sensors
 - USGS High Water Marks
 - NOAA tide stations

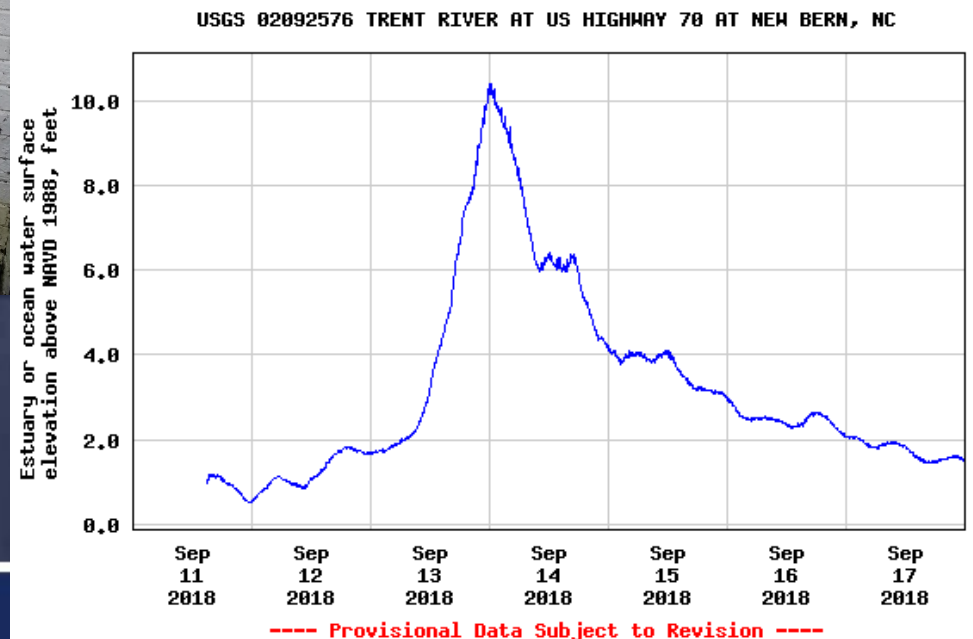
P-Surge Evaluation Florence



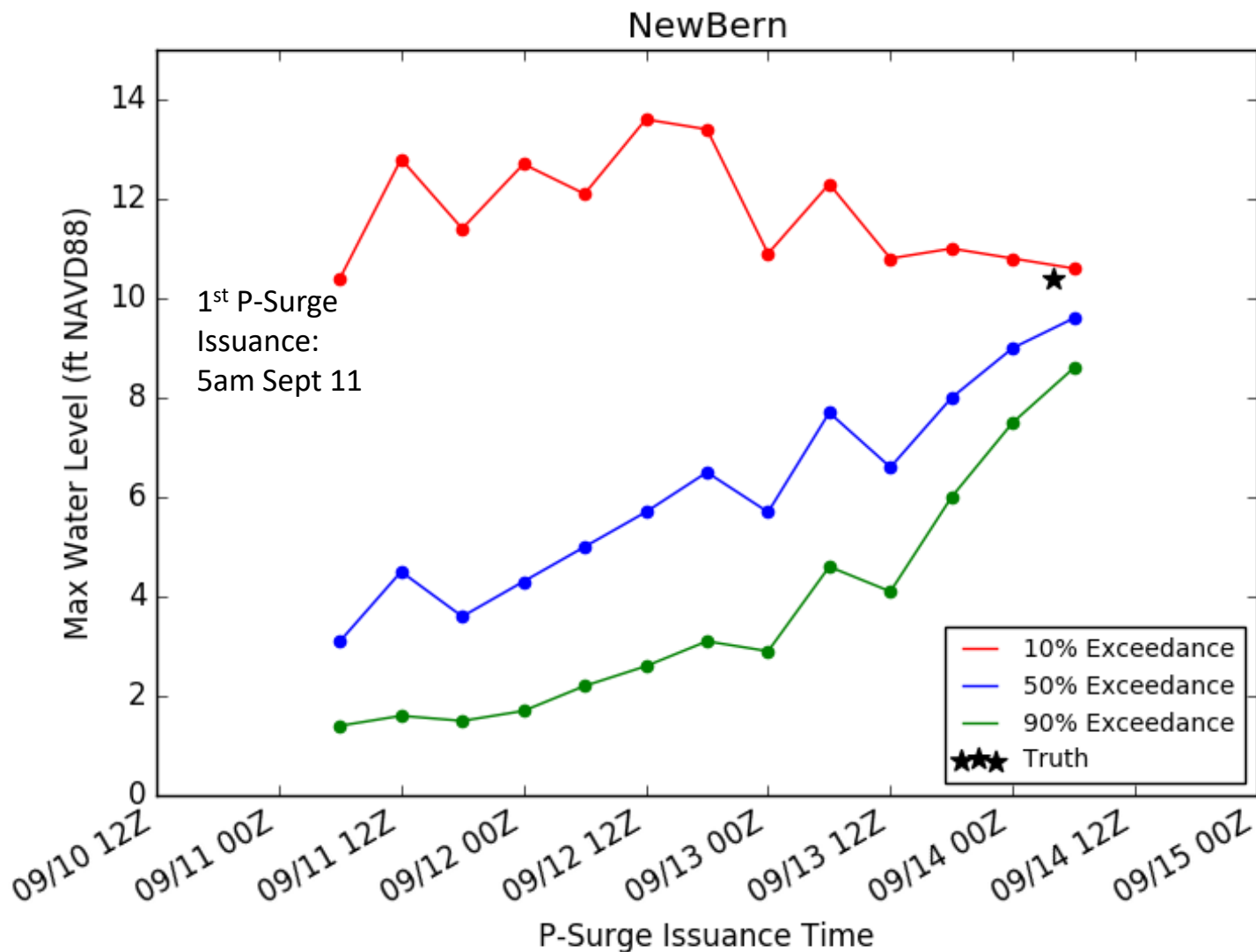
USGS High Water Mark, 3.25 ft AGL/
10.38 ft NAVD88



The Union Point Park Complex in New Bern, North Carolina.
Photo by Eduardo Munoz/Reuters

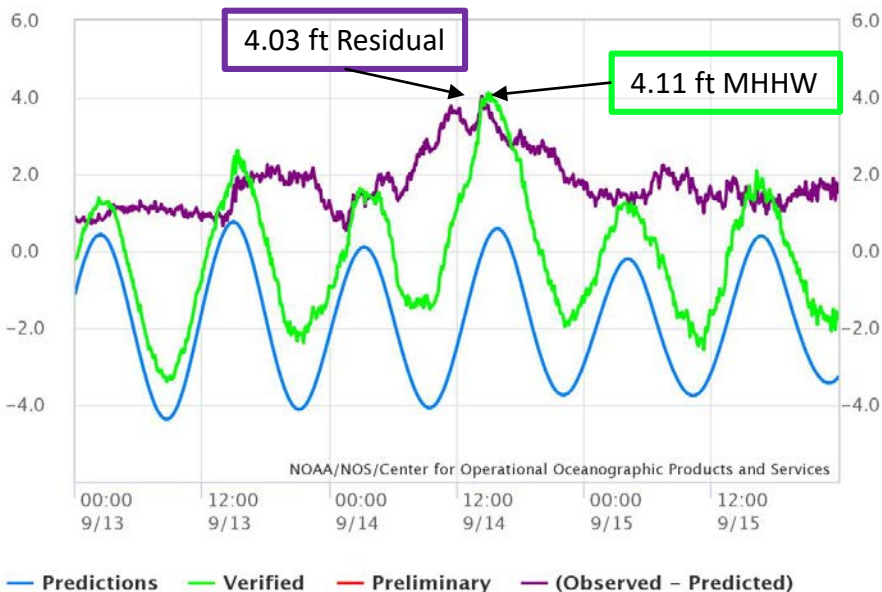


P-Surge Evaluation Florence

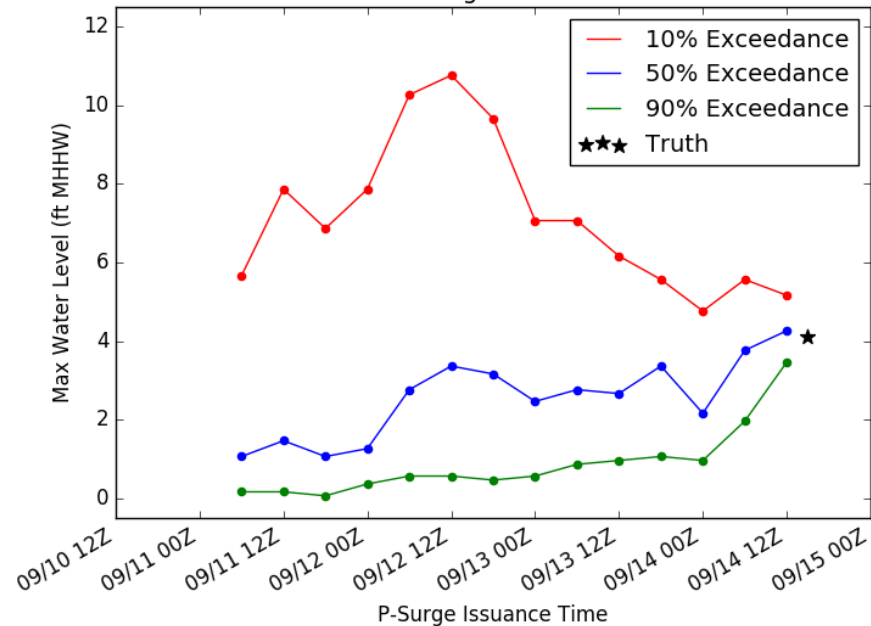


P-Surge Evaluation Florence

NOAA/NOS/CO-OPS
Observed Water Levels at 8658163, Wrightsville Beach NC
From 2018/09/13 00:00 GMT to 2018/09/15 23:59 GMT

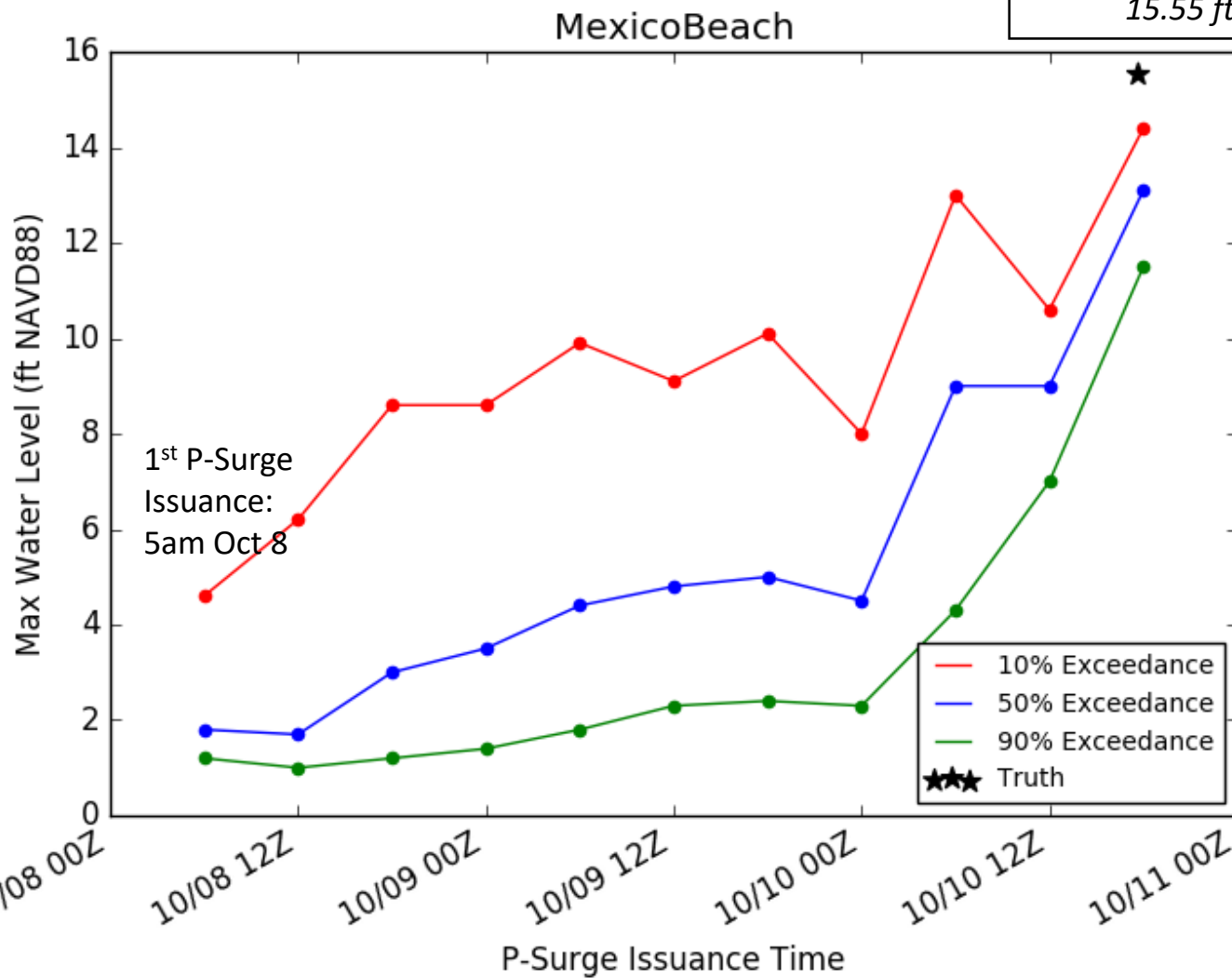


Wrightsville

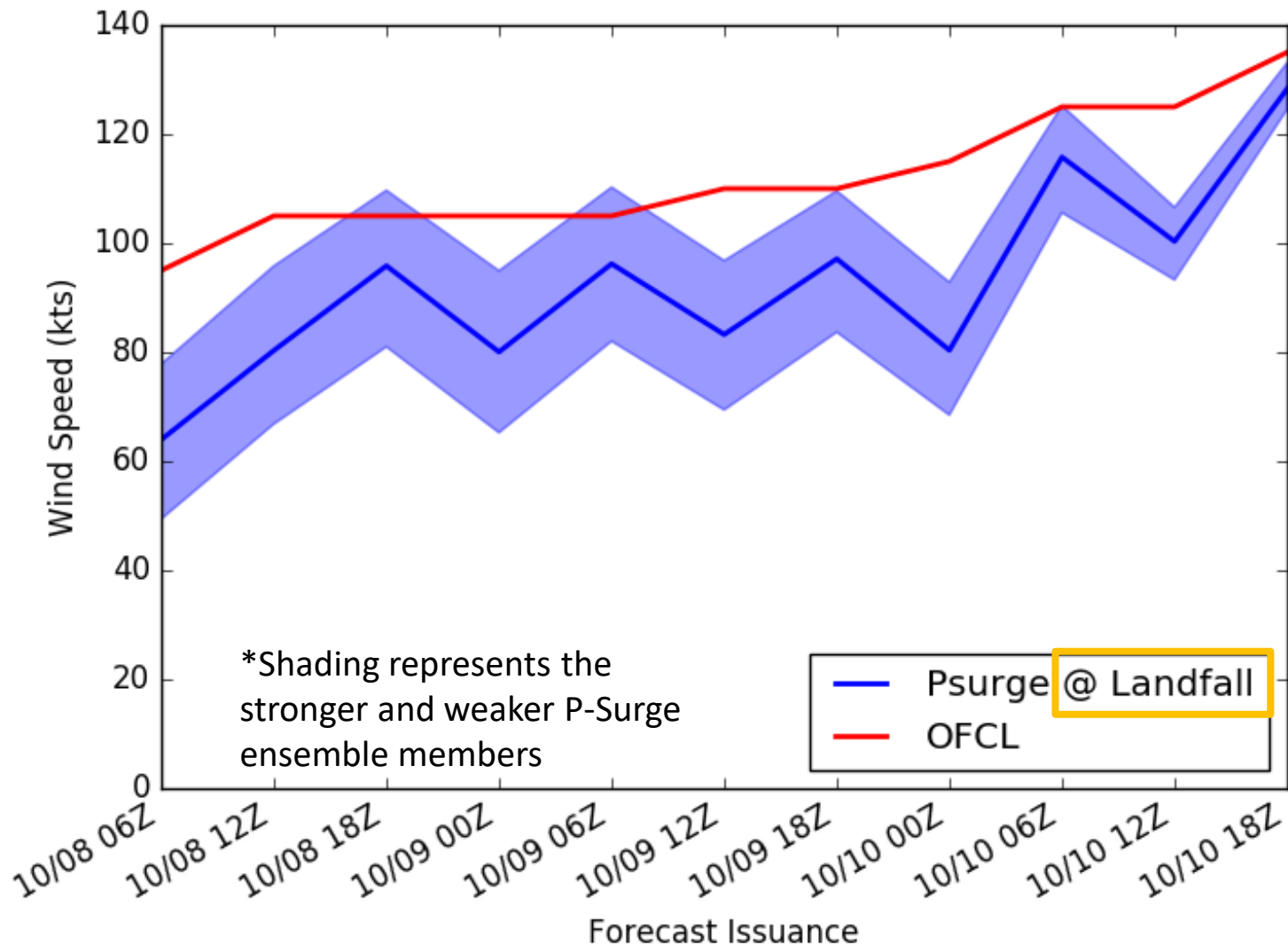


P-Surge Evaluation Michael

Preliminary USGS Storm Tide
Sensor, Filtered Observation:
15.55 ft NAVD88

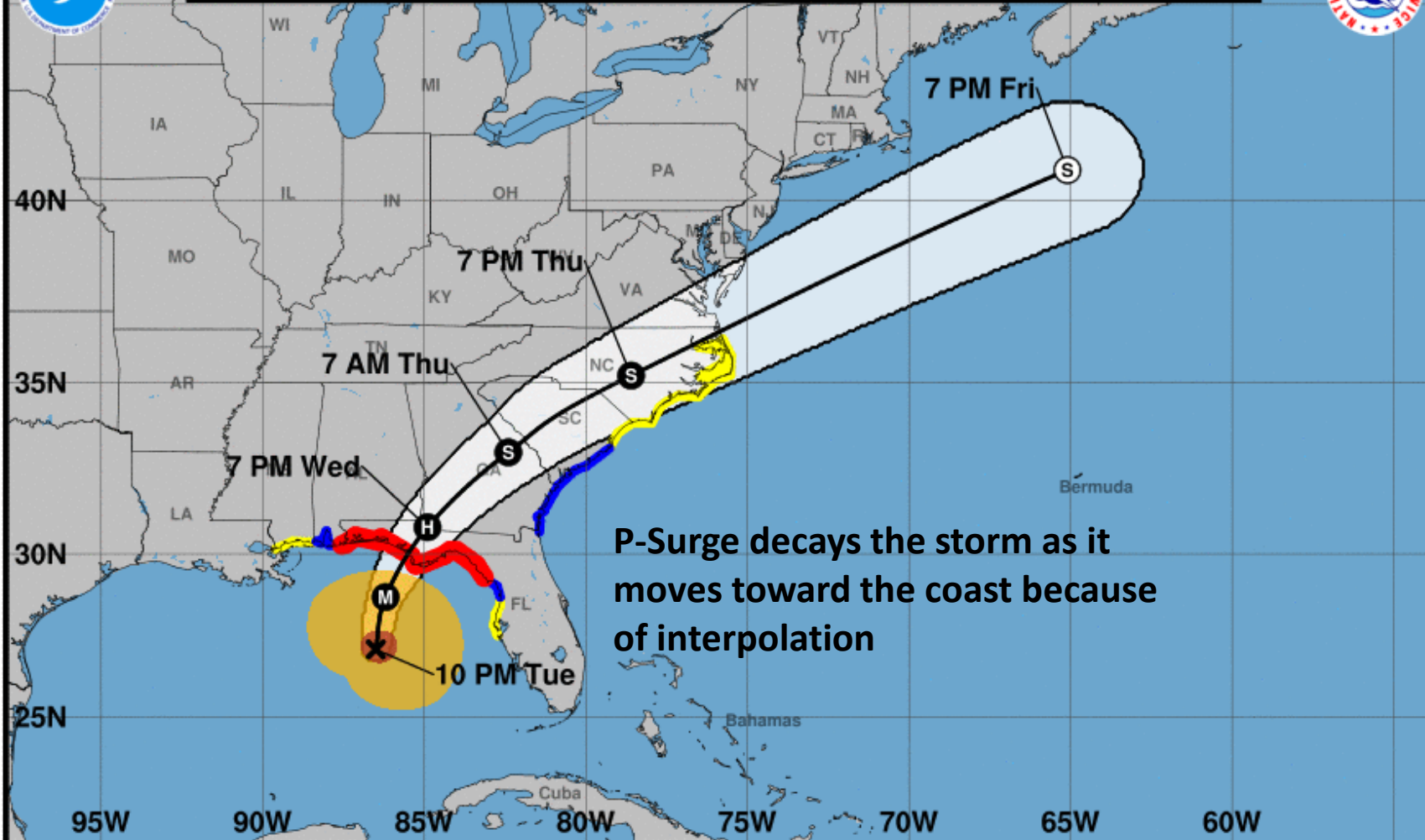


P-Surge Evaluation Michael





Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



P-Surge decays the storm as it moves toward the coast because of interpolation

Hurricane Michael

Tuesday October 09, 2018
 10 PM CDT Advisory 14
 NWS National Hurricane Center

Current information: x

Center location 27.1 N 86.5 W
 Maximum sustained wind 125 mph
 Movement N at 12 mph

Forecast positions:

● Tropical Cyclone ○ Post/Potential TC
 Sustained winds: D < 39 mph
 S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:

Day 1-3 Day 4-5

Watches:

Hurricane Trop Stm

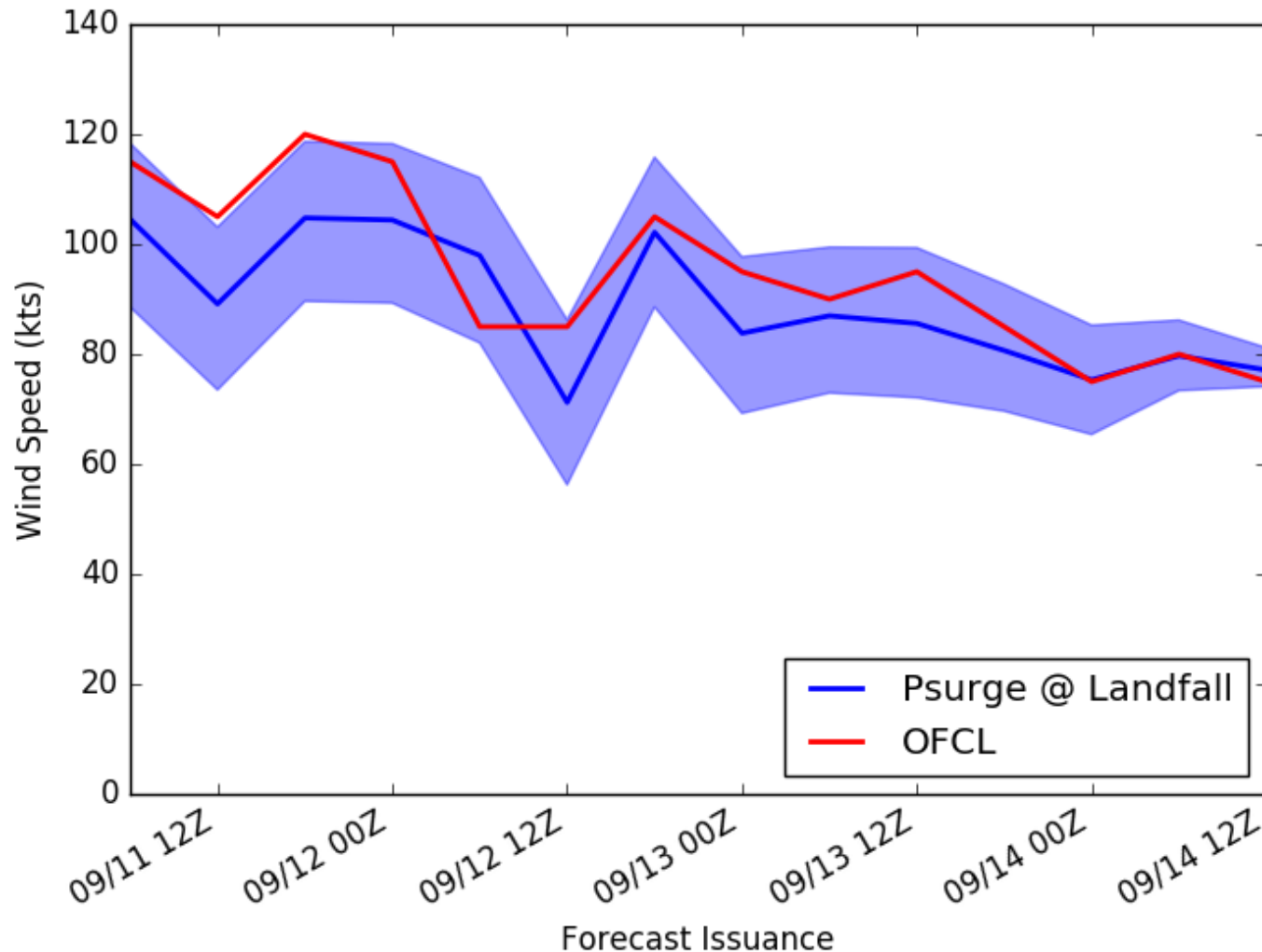
Warnings:

Hurricane Trop Stm

Current wind extent:

Hurricane Trop Stm

P-Surge Evaluation Florence



2018 Summary

1. Exact Track and Structure matter
2. P-Surge captured the storm surge risk at New Bern, NC
3. Michael's storm surge at Mexico Beach, FL was close the worst case scenario for this location; P-Surge suggested a significant event from early lead times, but did not show catastrophic levels (>10 ft NAVD88) until within 12 hrs of landfall
4. P-Surge landfall intensities were too low during Michael due to interpolation issues
5. Working on verification in order to evaluate future P-Surge upgrades
 - Improving the probabilistic ensemble
 - Provide real-time surge forecasts sooner (extending to 72-hours before landfall)