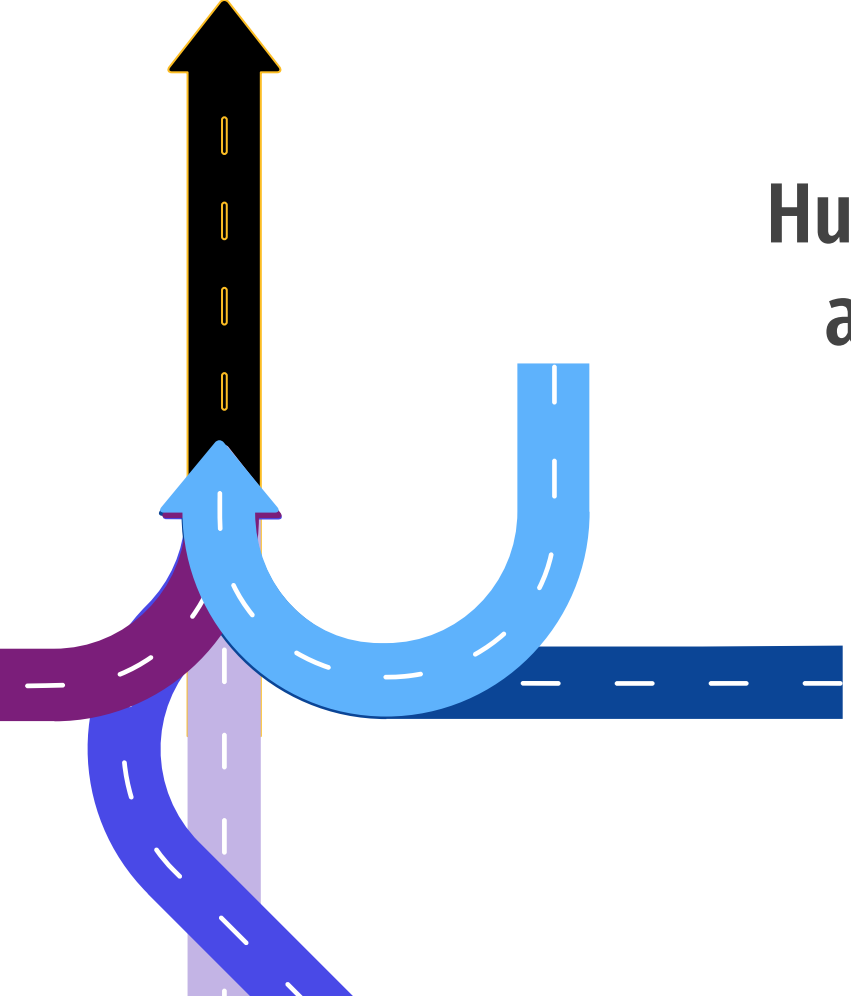


Hurricane Supplemental Projects and the NWS Tropical Roadmap

Jessica Schauer

NWS Tropical Services
Program Manager

VLab Forum
September 23, 2021

Weather Act & Disaster Supplemental Appropriations

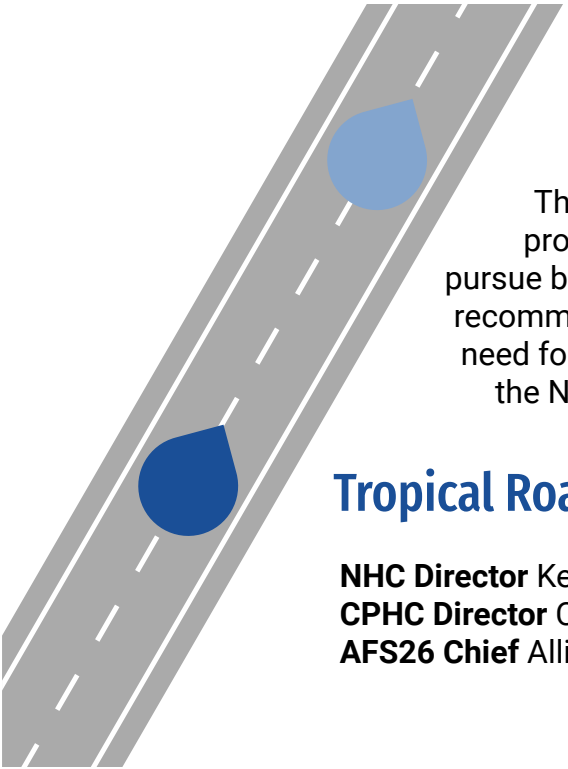
Section 104 of the Weather Research and Forecasting Innovation Act of 2017 (“Weather Act”) states:

In collaboration with the U.S. weather industry and appropriate academic entities, and through the National Weather Service (NWS), NOAA must plan and maintain a project to improve hurricane forecasting, including:

- *the prediction of rapid intensification and track of hurricanes,*
- *the forecast and communication of storm surges from hurricanes, and*
- *risk communication research to create more effective watch and warning products.*

Slide credit: Michele Olson, NOAA/OAR/WPO

Tropical Roadmap



Tropical Services Program Team

The SPT will determine the product/service changes to pursue based on Roadmap Team recommendations & validate the need for those changes through the NWS governance process

Tropical Roadmap Advisors

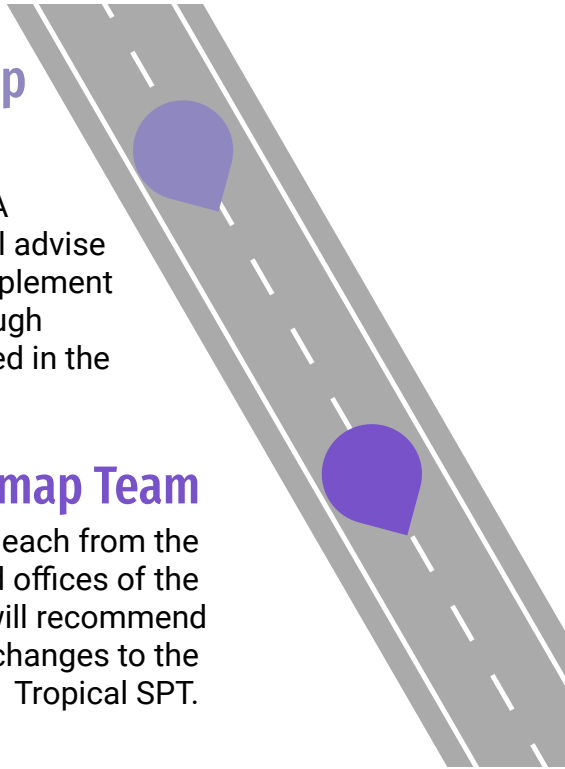
OPPSD and cross-NOAA representatives who will advise on and/or eventually implement changes approved through governance and captured in the AOP

Tropical Roadmap Sponsors

NHC Director Ken Graham
CPHC Director Chris Brenchley
AFS26 Chief Allie Allen

Tropical Roadmap Team

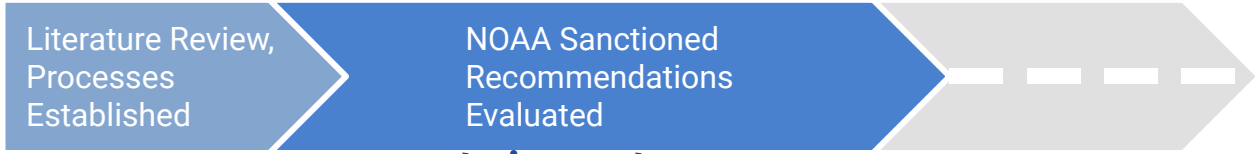
Up to 3 members each from the representative field offices of the Tropical SPT. They will recommend product/service changes to the Tropical SPT.



Tropical SPT - Tropical Roadmap Team

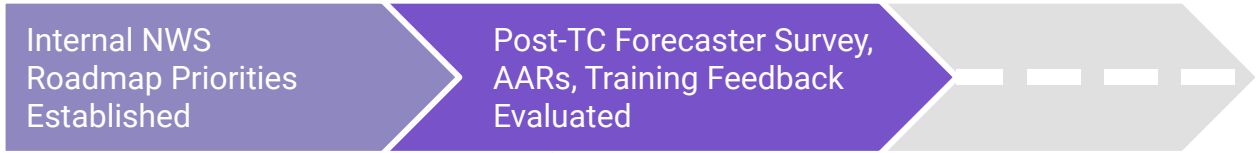
AFS - CPHC - ER - NHC - NWC - NWSEO - OCLO - OPC - PR - SR - WR - WPC

Where are we on the Roadmap?



2019

Foundation and Governance



2020

Internal Assessment

2021-22

Hurricane Supplemental Project Integration

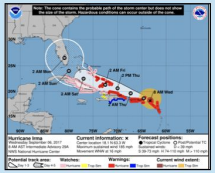
+ HFIP and Other STI or WPO Funded Projects

Top 10 Recommendations From the Literature Review

The recommendations below were taken from the review of numerous cited sources and were incorporated based on the frequency the recommendation was made in the literature and the spectrum of facets necessary for the production and provision of tropical services and IDSS.

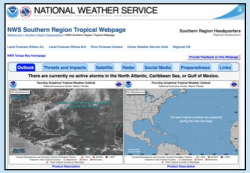
1. Product Clarity and Usability

Products should be clear, easily digestible by the user to determine the threats, impacts, and actions needed, and they must be delivered on a timeline that allows appropriate action to be taken.



2. Risk Perception

Users struggle to understand their risks from tropical cyclone hazards; NWS products should help users estimate potential impacts, their storm surge vulnerability and the shifting risk intrinsic to forecast changes.



3. Website Effectiveness

Websites should be interactive and easy to use on both desktop and mobile devices, and should highlight critical information

4. Graphics

Graphics were used considerably more than text-based products on the NHC website and should be readily accessible through as many dissemination channels as practical.

5. Internal Education

Internal training should include a tropical professional development series, annual operational readiness training and expansion of the Effective Hurricane Messaging course to include all NWS staff responsible for communicating tropical threats.

6. External Education/Outreach

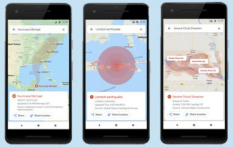
The NWS should focus on vulnerable populations in its outreach, create additional educational material on storm surge, and expand partner training to a year-round approach.

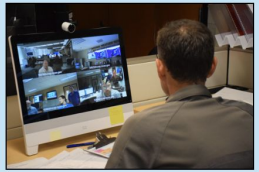
7. Consistency of the Message

Products and briefings should use consistent wording and should be consistent graphically at the local, regional, and national levels.

8. Dissemination and Reach

NWS forecast and warning information should reach people where they regularly get information and should better reach vulnerable populations.





9. Testing

The NWS should ensure proper and robust software design (including social science input), testing and evaluation is done throughout the product development process before national implementation.

10. Resources

Resources should be realigned to fully support a robust tropical program including personnel, product testing capability, and professional training.

2019 Roadmap Activities

Literature Review including

- NWS Service Assessments
- NOAA SAB, HFIP, and Other Recommendations
- SBES Journal Articles and Final Reports
- NOAA Hurricane Conference Items
- Web and Social Media Analysis

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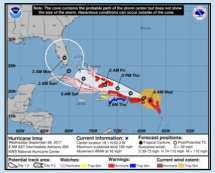

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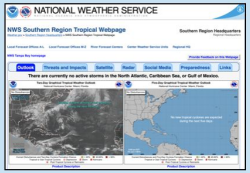

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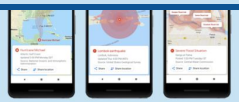

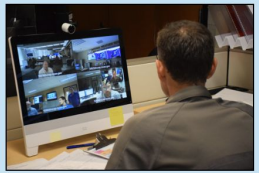

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2019 Roadmap Activities

Literature Review including

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- NOAA SAB, HFIP, and Other Recommendations
- SBES Journal Articles and Final Reports
- NOAA Hurricane Conference Items
- Web and Social Media Analysis

Social Sciences

Internal Feedback

External Feedback

Vetting New Tools

Roadmap Governance Established

- Charter
- Processes established for:
  - Integrating SBES
  - Gathering and Evaluating Feedback
  - Vetting New/Updated Tools and Guidance

2020 Roadmap Activities - Establishing NWS Internal Priorities

Streamline

Streamline the product suite and opt for more modern approaches when feasible

Simplify

A simpler product generation and issuance process for WFO forecasters

Address Gaps

Address known challenges & gaps
(e.g., maintaining proficiency, messaging D5+ TC hazards, understanding probabilities, etc.)

Collaboration

Hurricane Centers drive the forecast, messaging, and collaboration

Probabilities

Reliance on probabilistic information

Best Practices

Maintain best practices
(e.g., DSS Coordinator, WFO-NC product consistency, TC messaging training, etc.)

Hurricane Supplemental Project 3A3

Improve Storm Surge Modeling

Goal 1

Extend coupled hurricane model to surge, hydrology, waves and inundation (Total Water)

Goal 2

Extend storm surge forecast lead times to 3 days with same skill as 2-day

Goal 3

Accelerated storm surge model upgrades for OCONUS

Hurricane Supplemental Project 3A3

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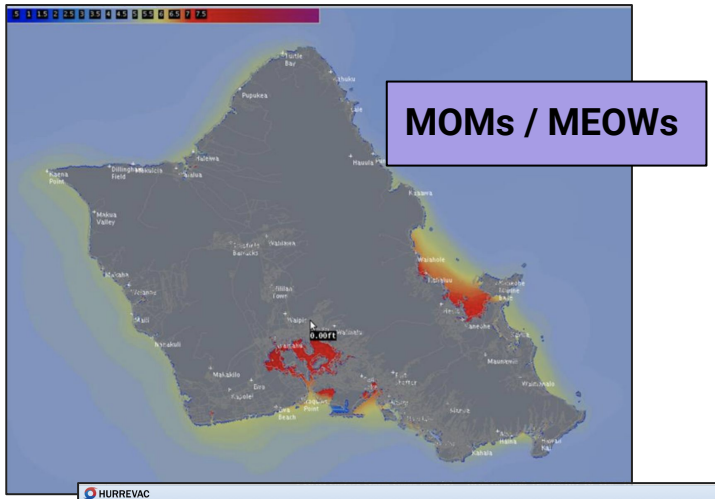
Goal 3

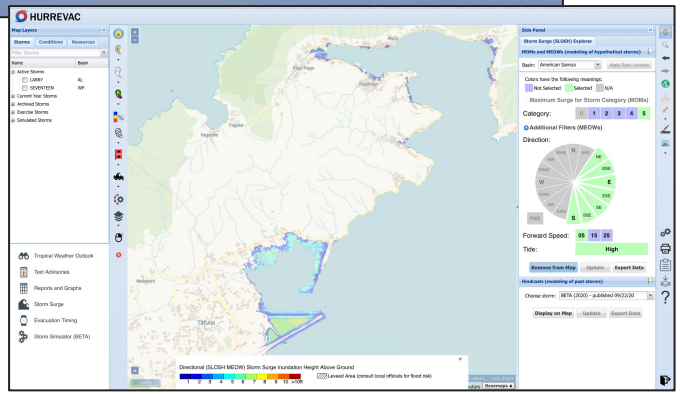
~~Accelerated storm surge model upgrades for OCONUS~~

Goal 3

Hindcast modeling in support of the COASTAL Act

Increased Consistency in the Level of Service Across the NWS AOR





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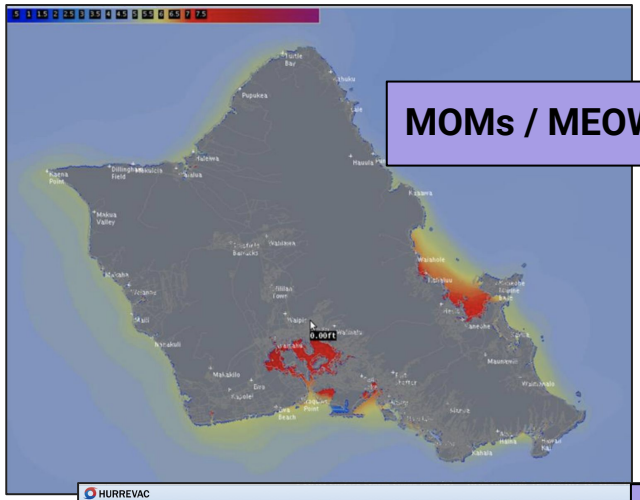
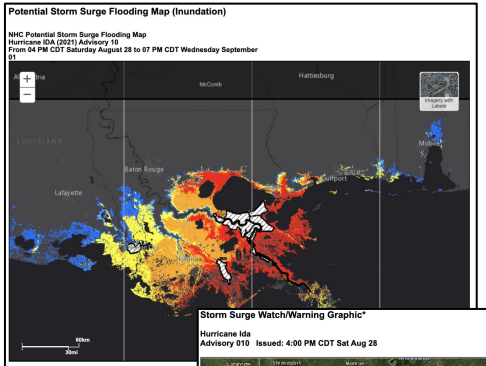
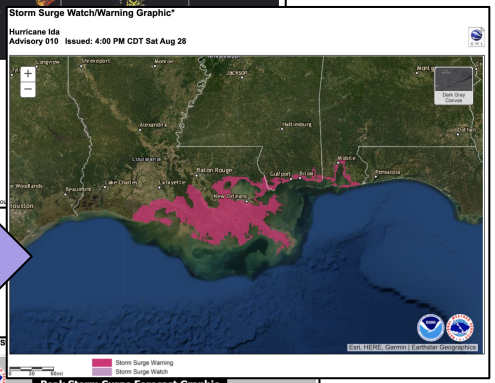
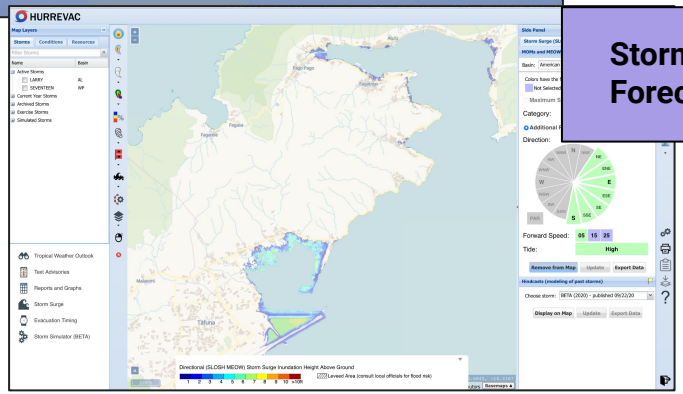


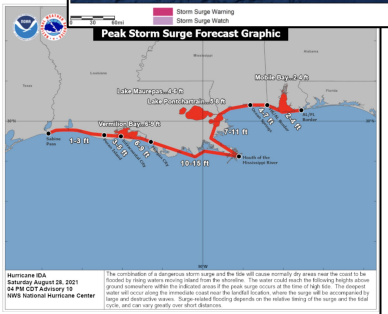
MOMs / MEOWs



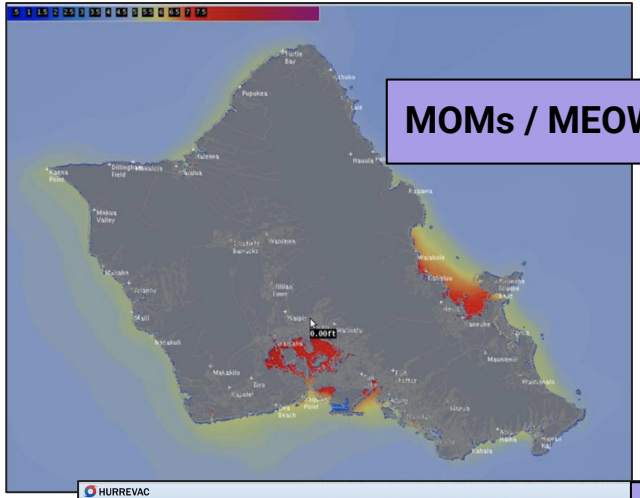




Storm-Specific Forecasts



Increased Consistency in the Level of Service Across the NWS AOR



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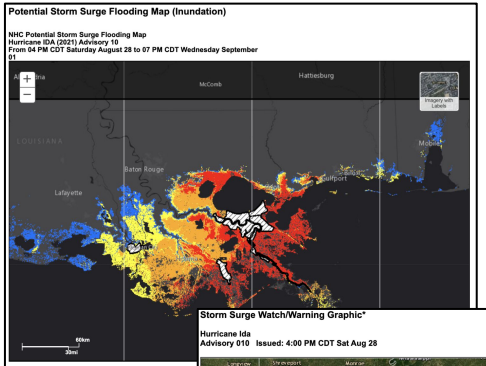

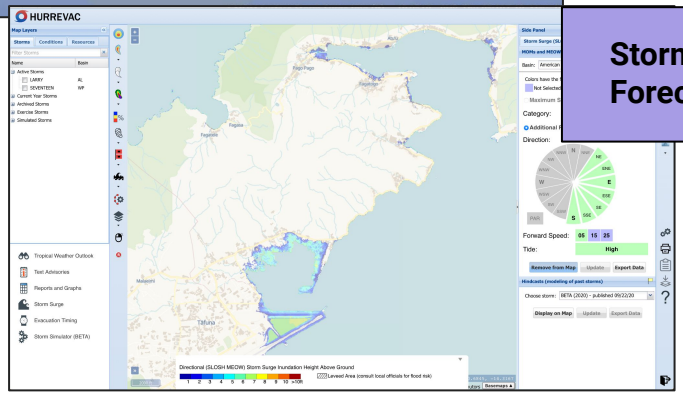

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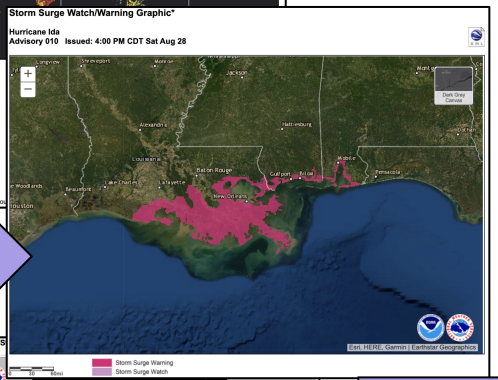
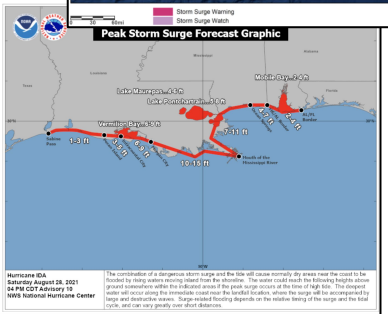
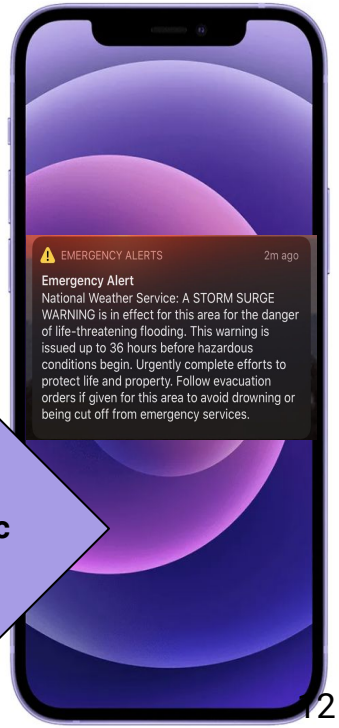


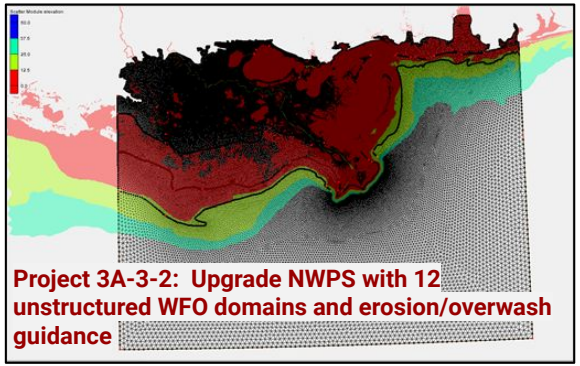


Actionable Storm-Specific Information

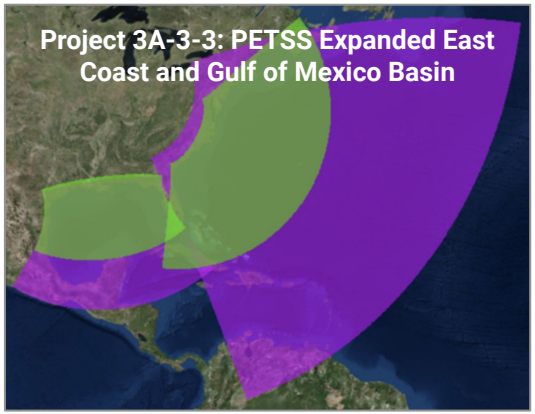


Total Water Applied Research

First Steps for Getting to a Real-Time Ensemble Forecast



Project 3A-3-2: Upgrade NWPS with 12 unstructured WFO domains and erosion/overwash guidance



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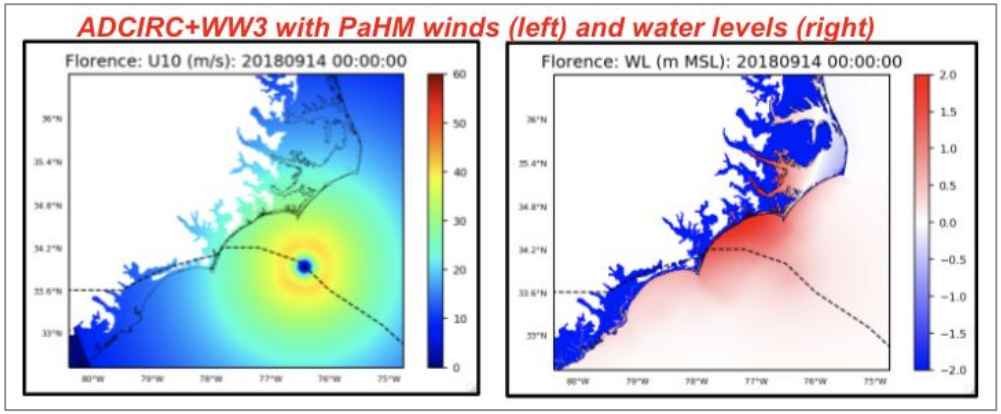
Project 3A-3-4b: Develop operational coupled ADCIRC-based HSOFS - WAVEWATCH III for Atlantic



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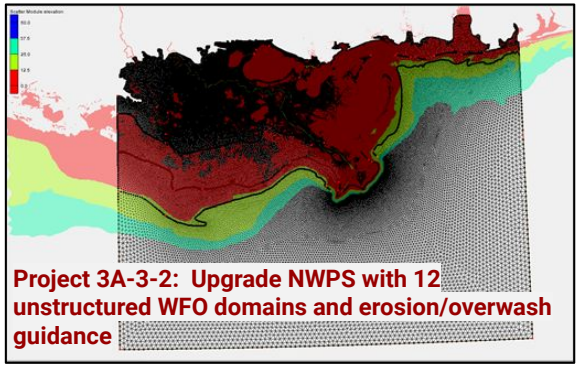

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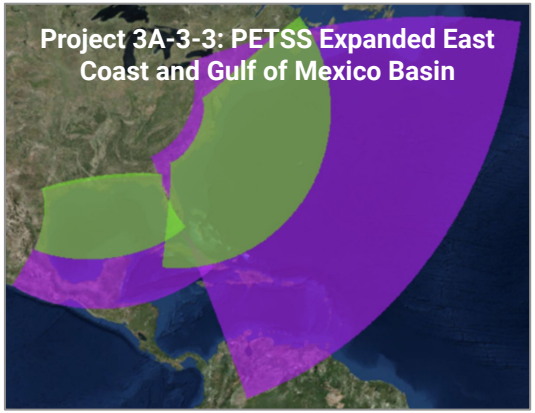

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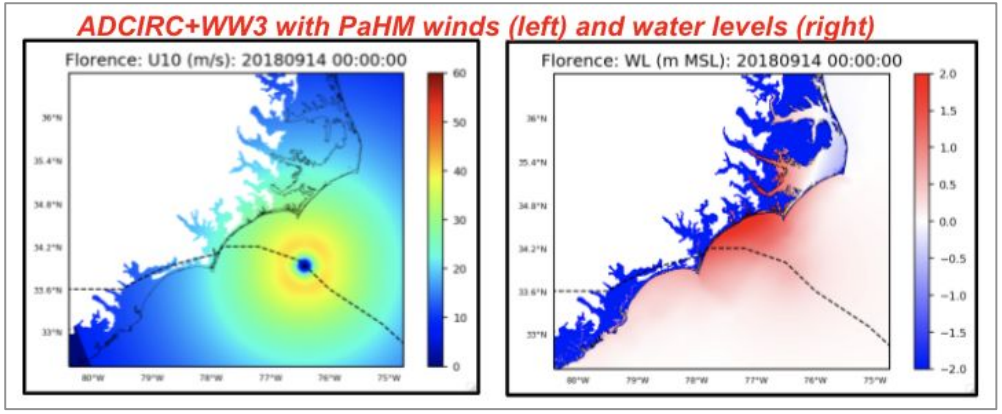
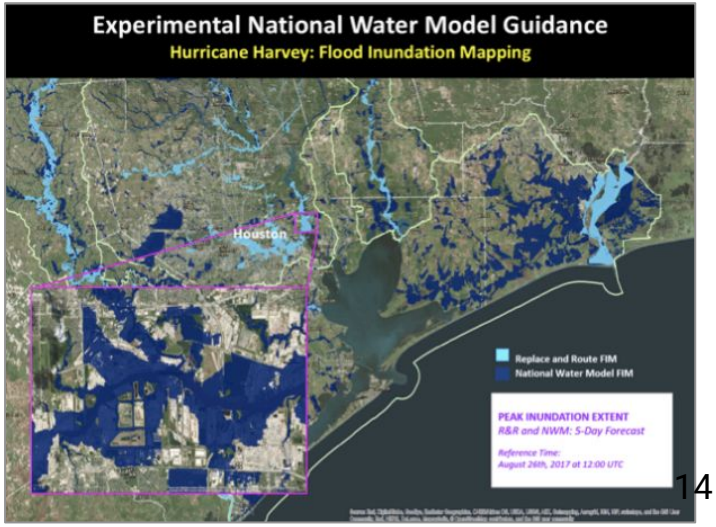
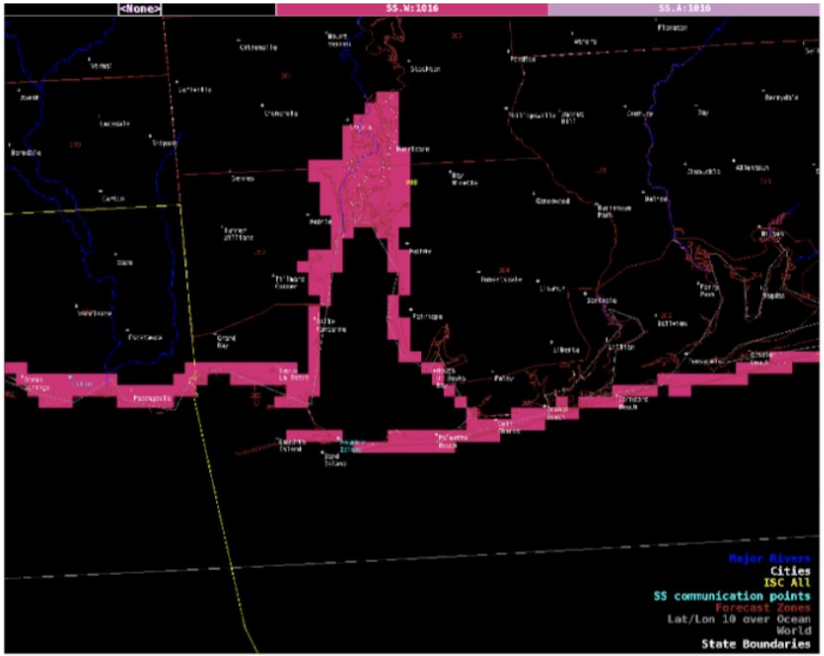
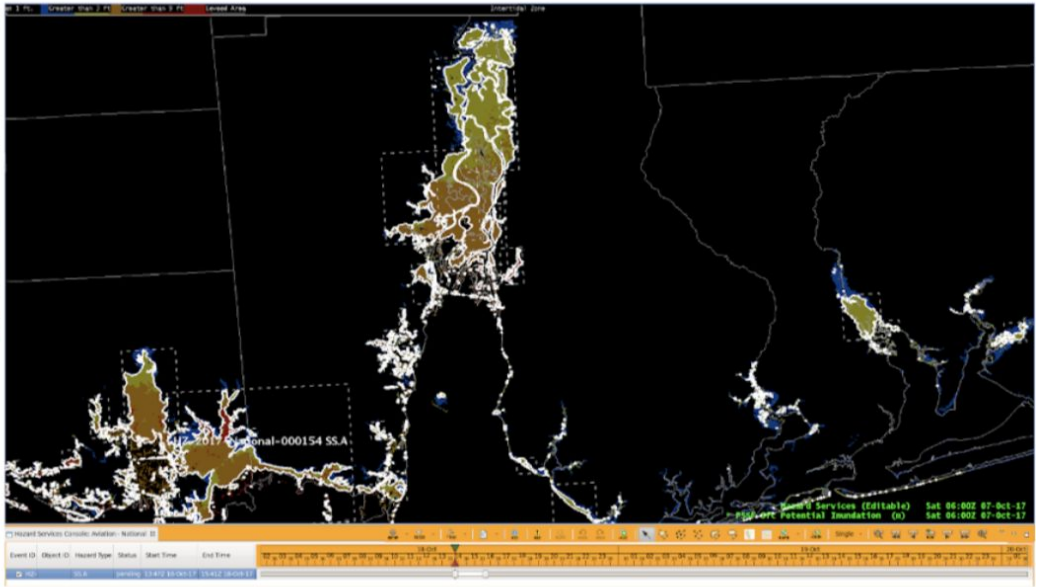




How Do We Make Total Water Forecasts Actionable?

Hazard Services - Inundation Hazard Polygon JTTI Project





GOAL: Use probabilistic total water guidance to recommend polygon-based inundation hazards

Hurricane Supplemental Project 3A4

Accelerate Improvements in Hazard Guidance and Risk Communication

Goal 1

Accelerate development of new and existing algorithms to create TC hazard-specific threat forecasts

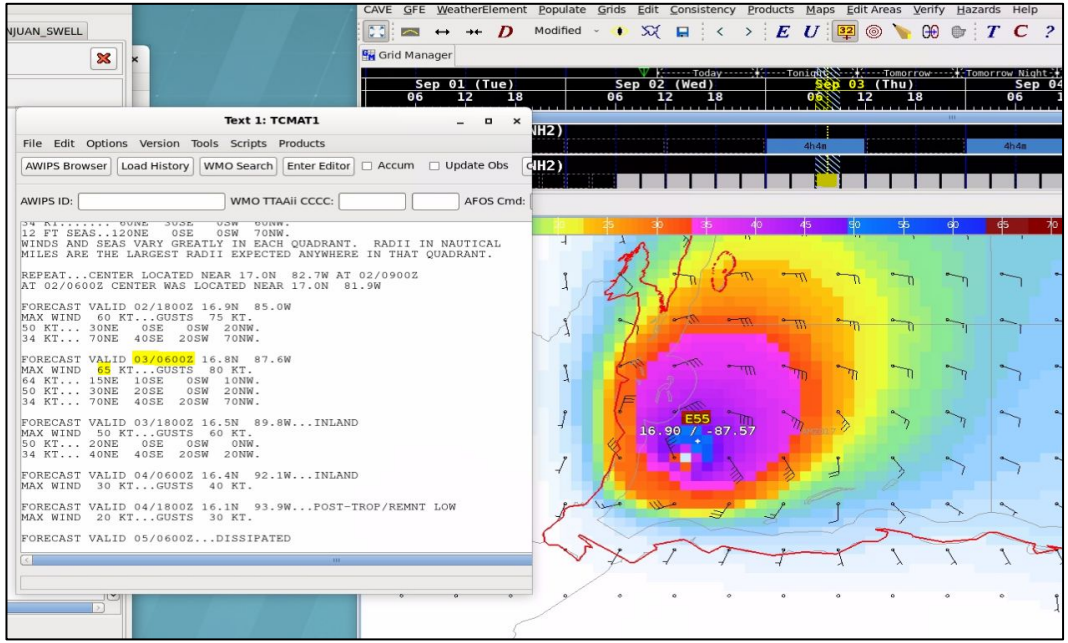
Goal 2

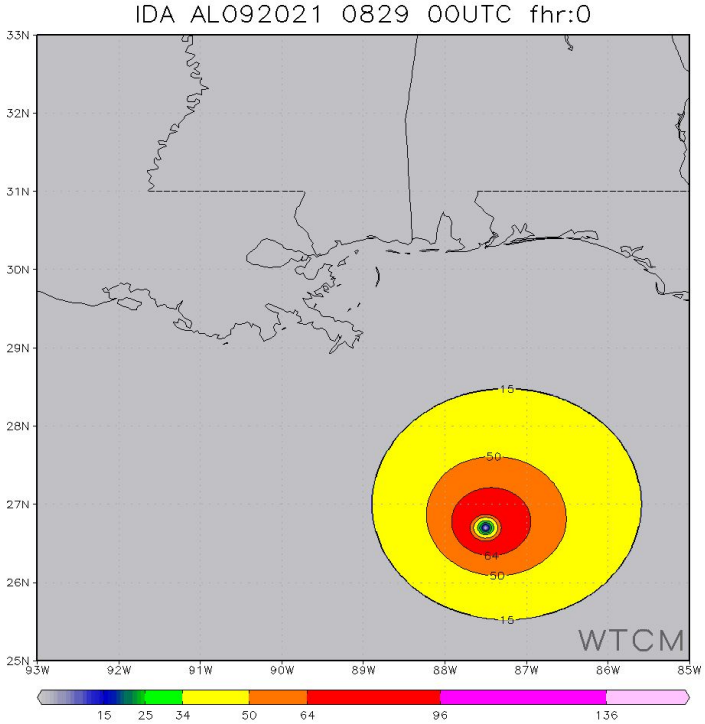
A more closely matched TC forecast between NDFD and NHC/CPHC TCM forecasts by the incorporation of NBM guidance

Goal 3

Develop national capability for PQPF guidance to better convey flooding rain threat

TCMWindTool versus WTCM

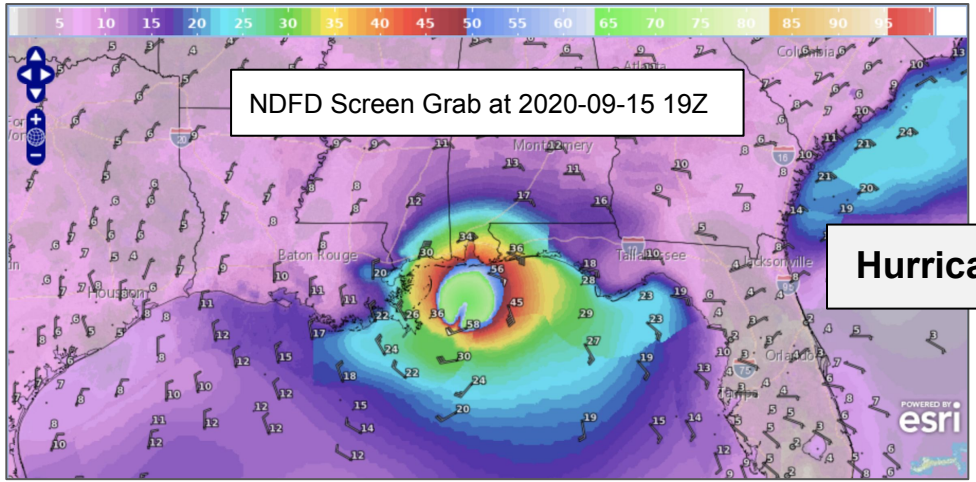




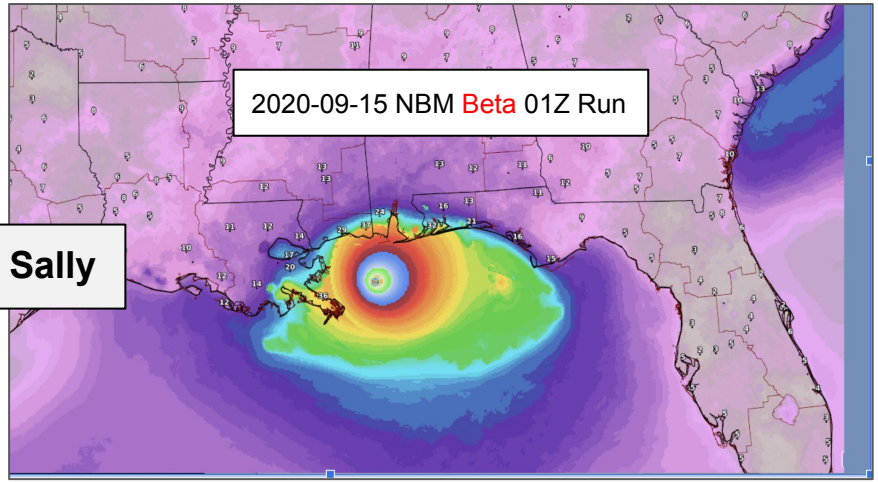
Slide credit: Mark DeMaria (CIRA) and Pablo Santos (NWS)

WFO Wind Forecast: Consistency with NHC/CPHC

HSup 3A-3b-2: Determine viable scientific techniques that ensure a more closely matched tropical cyclone forecast between official WFO/NDFD and NHC/CPHC TCM forecasts by the incorporation of NBM guidance.



Hurricane Sally



NBM "Tropical Speed" parameter:

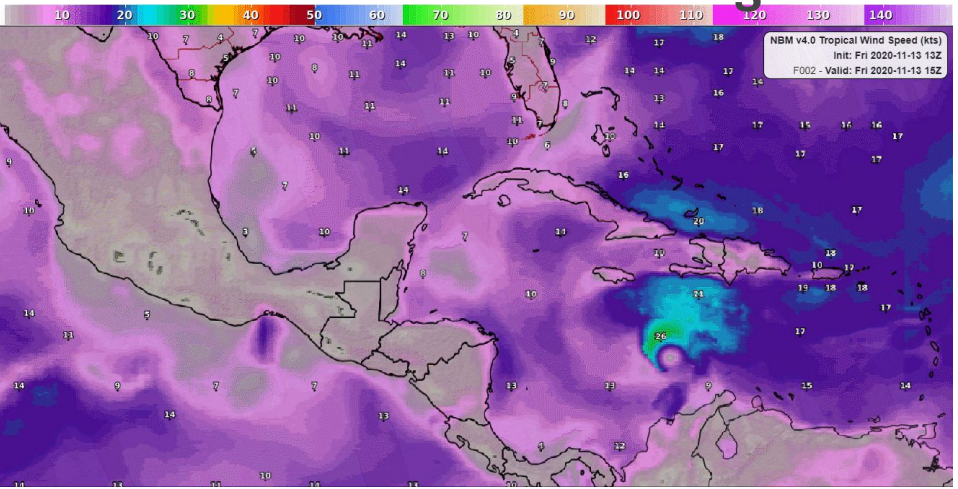
- 35% HWRF
- 35% HMON
- 30% Blend Background
- Wherever the wTCM is present, it is 100% of the forecast for the grid points it impacts.
- No feature matching.

Slide credit: Geoff Wagner and Samantha Camposano NWS/MDL

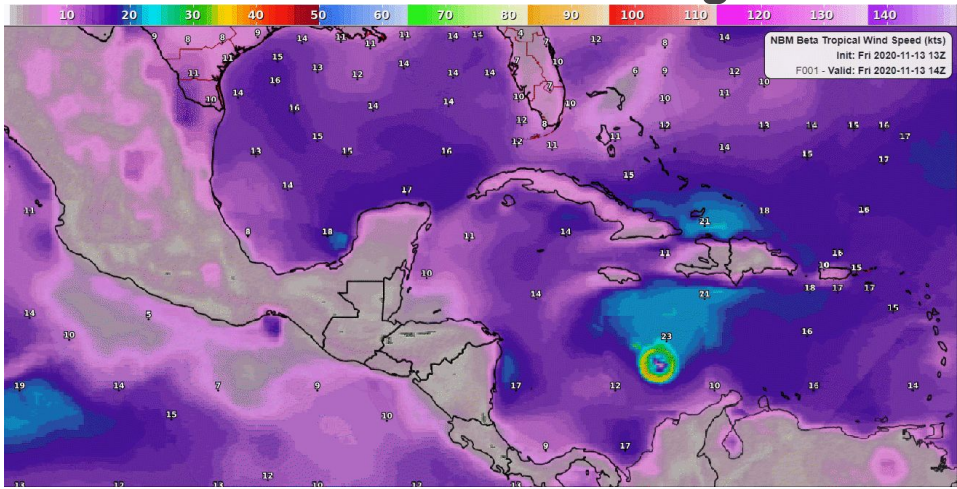
NBM TC Feature Matching

HSup 3A-3b-2: Determine viable scientific techniques that ensure a more closely matched tropical cyclone forecast between official WFO/NDFD and NHC/CPHC TCM forecasts by the incorporation of NBM guidance.

Without Feature Matching



With Feature Matching



Operational implementation planned for Jan 2023

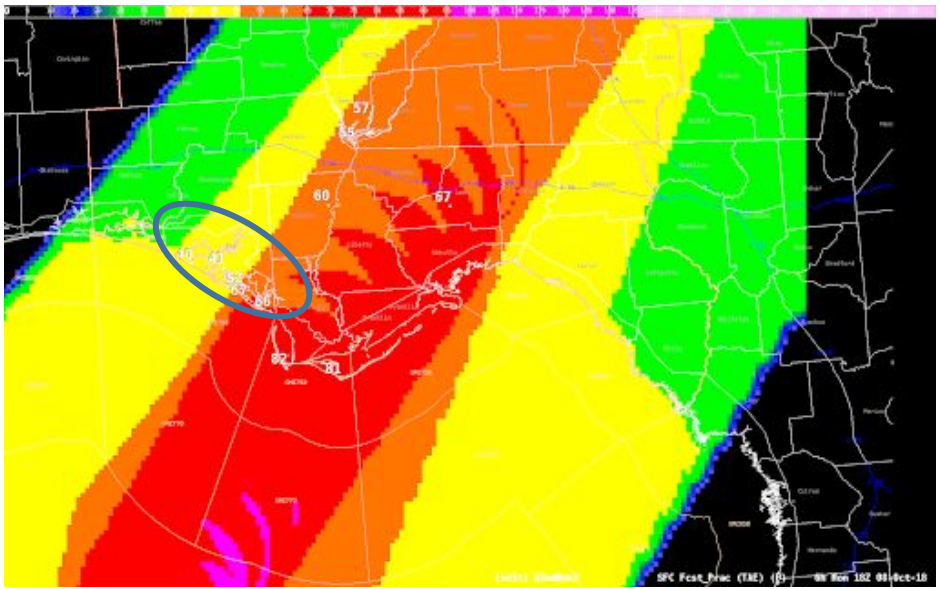
Slide credit: Geoff Wagner and Samantha Camposano NWS/MDL

A Closer Look: Coastal Bay County

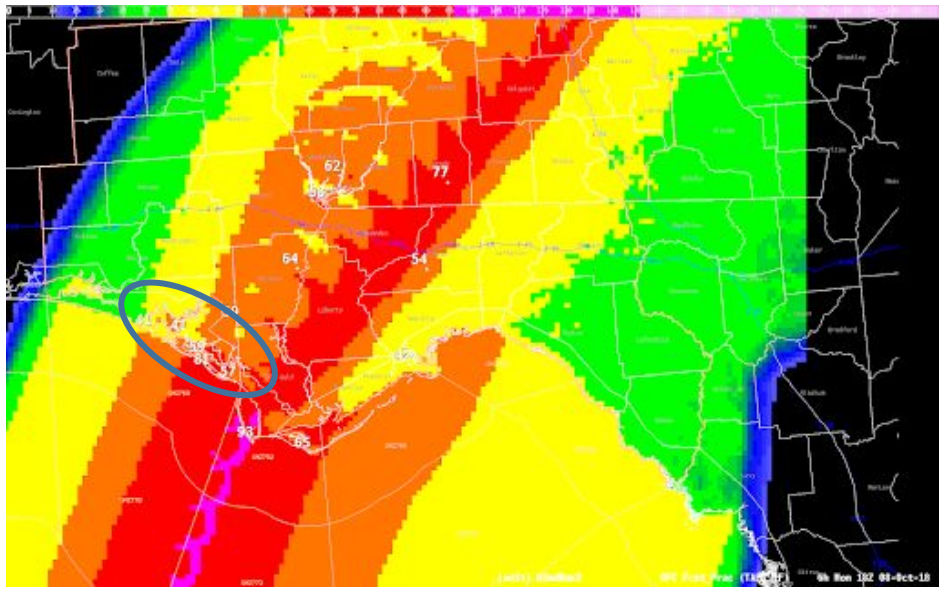
3A-3b-1c: Improvements to TC hazard-specific threat forecasts within AWIPS II

Wind Legend
Wind > 110 mph
Wind 74 to 110 mph
Wind 58 to 73 mph
Wind 39 to 57 mph
Wind < 39 mph

TCMWindTool



WTCM



Both wind fields result in weather.gov Point and Click output at the arrow locations of "***Hurricane Conditions Possible***" with below TS-force winds for landfall period and a Hurricane Watch in effect

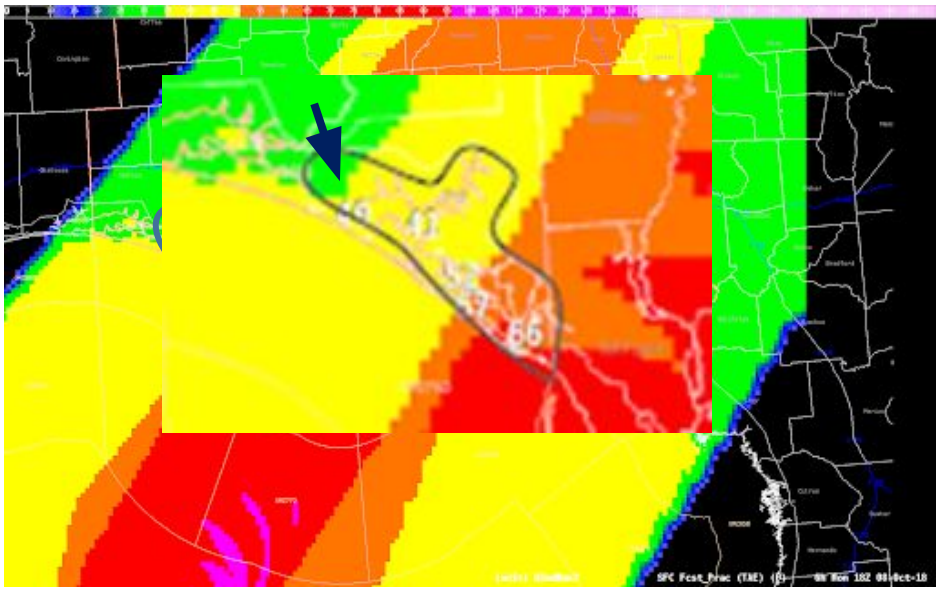
Slide credit: Pablo Santos (NWS)

A Closer Look: Coastal Bay County

3A-3b-1c: Improvements to TC hazard-specific threat forecasts within AWIPS II

Wind Legend
Wind > 110 mph
Wind 74 to 110 mph
Wind 58 to 73 mph
Wind 39 to 57 mph
Wind < 39 mph

TCMWindTool



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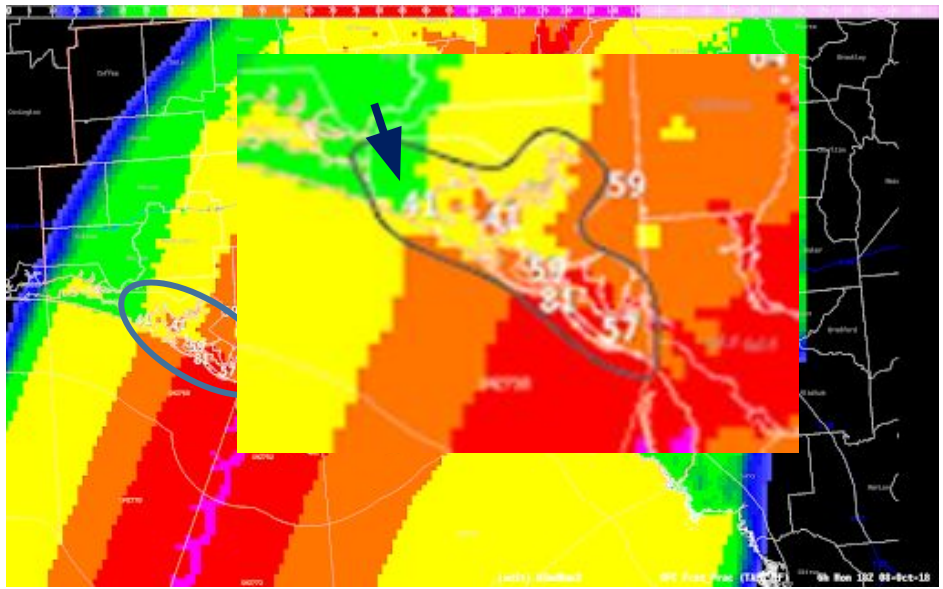

Both wind fields result in weather.gov Point and Click output at the arrow locations of "***Hurricane Conditions Possible***" with below TS-force winds for landfall period and a Hurricane Watch in effect

Slide credit: Pablo Santos (NWS)

Coastal Bay County TCV Output

(85th percentile: current sampling threshold across an NWS zone)

Using TCMWindTool MaxWind

* WIND
  - LATEST LOCAL FORECAST: Equivalent Strong Tropical Storm force wind
    - Peak Wind Forecast: 55-70 mph with gusts to 95 mph
    - Window for Tropical Storm force winds: early Wednesday morning until Wednesday evening

  - POTENTIAL THREAT TO LIFE AND PROPERTY: Potential for wind greater than 110 mph
    - PLAN: Plan for extreme wind of equivalent CAT 3 hurricane force or higher due to possible forecast changes in track, size, or intensity.
    - PREPARE: Efforts to protect life and property should now be underway. Prepare for catastrophic wind damage.
    - ACT: Act now to complete preparations before the wind becomes hazardous.

  - POTENTIAL IMPACTS: Devastating to Catastrophic

Using WTCM MaxWind

* WIND
  - LATEST LOCAL FORECAST: Equivalent Strong Tropical Storm force wind
    - Peak Wind Forecast: 50-65 mph with gusts to 90 mph
    - Window for Tropical Storm force winds: early Wednesday morning until early Thursday morning

  - POTENTIAL THREAT TO LIFE AND PROPERTY: Potential for wind greater than 110 mph
    - PLAN: Plan for extreme wind of equivalent CAT 3 hurricane force or higher due to possible forecast changes in track, size, or intensity.
    - PREPARE: Efforts to protect life and property should now be underway. Prepare for catastrophic wind damage.
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  - POTENTIAL IMPACTS: Devastating to Catastrophic

Slide credit: Pablo Santos (NWS)

Coastal Bay County TCV Output

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    - PREPARE: Efforts to protect life and property should now be underway. Prepare for catastrophic wind damage.
    - ACT: Act now to complete preparations before the wind becomes hazardous.

  - POTENTIAL IMPACTS: Devastating to Catastrophic

This does not take into account future changes to the Wind Speed Probabilities that may change the “potential threat to life and property” assessment

Slide credit: Pablo Santos (NWS)

Coastal Bay County TCV Output

(85th percentile: current sampling threshold across an NWS zone)

Using TCMWindTool MaxWind

```
* WIND
   - LATEST LOCAL FORECAST: Equivalent Strong Tropical Storm force
     wind
      - Peak Wind Forecast: 55-70 mph with gusts to 95 mph
      - Window for Tropical Storm force winds: early Wednesday
        morning until Wednesday evening

   - POTENTIAL THREAT TO LIFE AND PROPERTY: Potential for wind
     greater than 110 mph
      - PLAN: Plan for extreme wind of equivalent CAT 3 hurricane
        force or higher due to possible forecast changes in track,
        size, or intensity.
      - PREPARE: Efforts to protect life and property should now be
        underway. Prepare for catastrophic wind damage.
      - ACT: Act now to complete preparations before the wind
        becomes hazardous.

   - POTENTIAL IMPACTS: Devastating to Catastrophic
```

Possible messaging
Using WTCM MaxWind & new WSPs

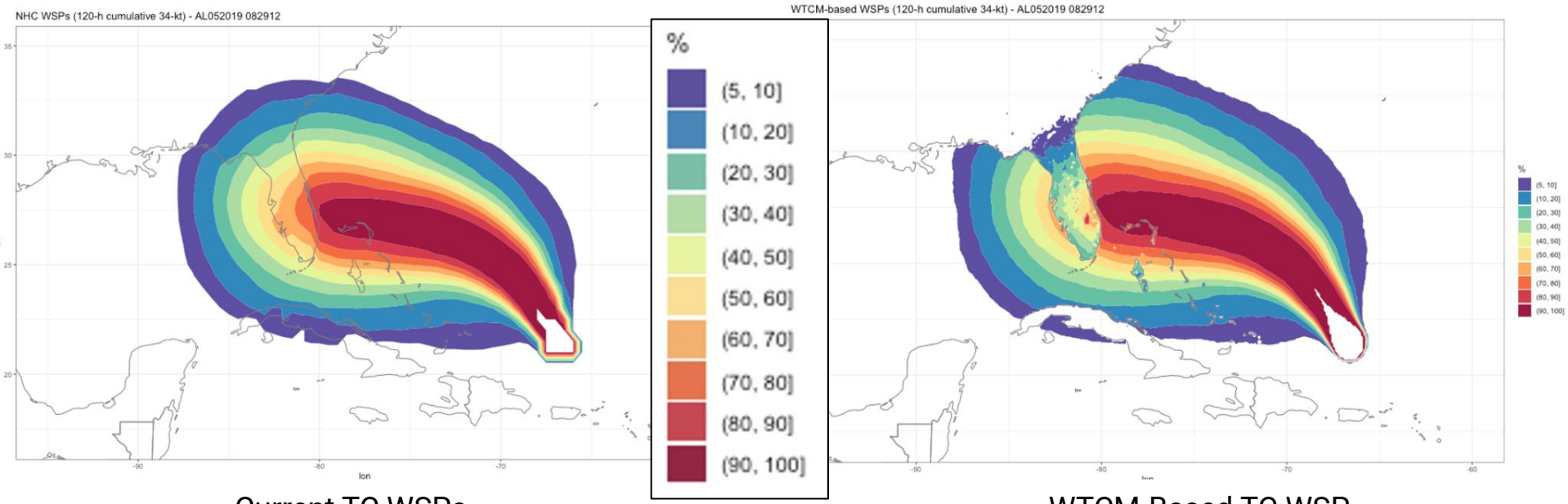
```
* WIND
   - LATEST LOCAL FORECAST: Equivalent Strong Tropical Storm force
     wind
      - Peak Wind Forecast: 50-65 mph with gusts to 90 mph
      - Window for Tropical Storm force winds: early Wednesday
        morning until early Thursday morning

   - POTENTIAL THREAT TO LIFE AND PROPERTY: Potential for wind 74
     to 110 mph
      - PLAN: Plan for life-threatening wind of equivalent CAT 1
        or 2 hurricane force.
      - PREPARE: Last minute efforts should solely focus on
        protecting life. The area remains subject to considerable
        wind damage.
      - ACT: Now is the time to shelter from life-threatening
        wind.

   - POTENTIAL IMPACTS: Extensive
```

Wind Legend
Wind > 110 mph
Wind 74 to 110 mph
Wind 58 to 73 mph
Wind 39 to 57 mph
Wind < 39 mph

Will adjustments be needed to the sampling thresholds?

How do we ensure the messaging properly accounts for the uncertainty?

WTCM-Based TC Wind Speed Probabilities - JTTI Project



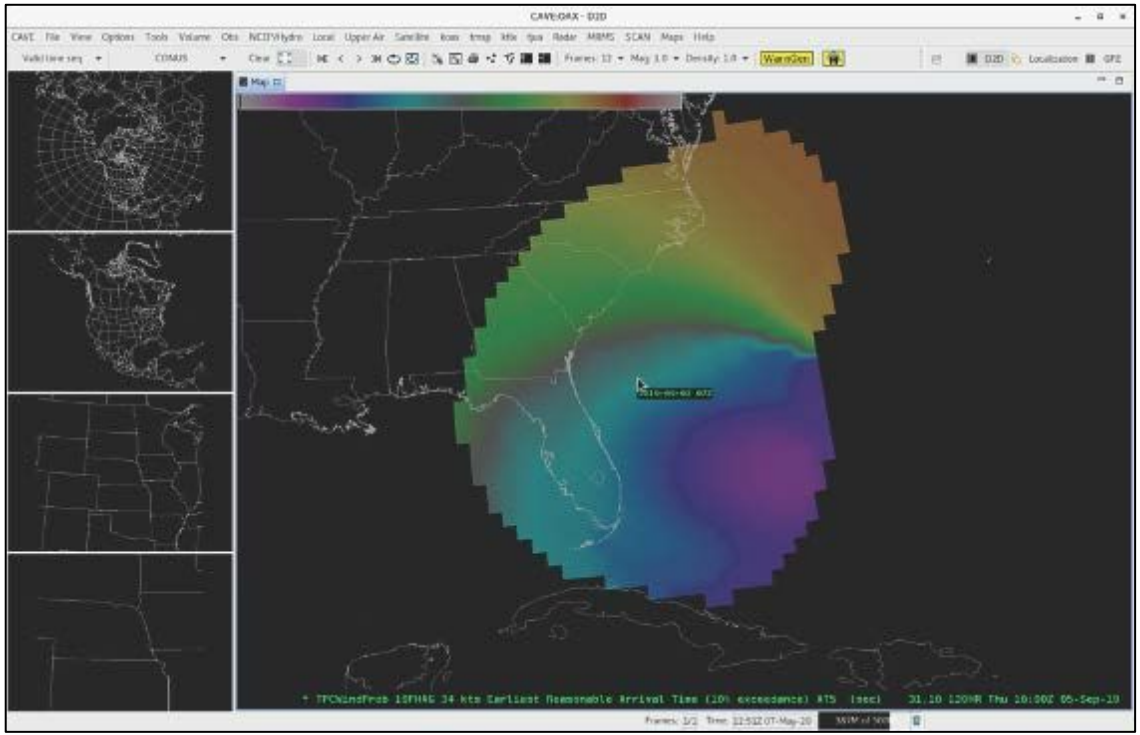
Current TC WSPs

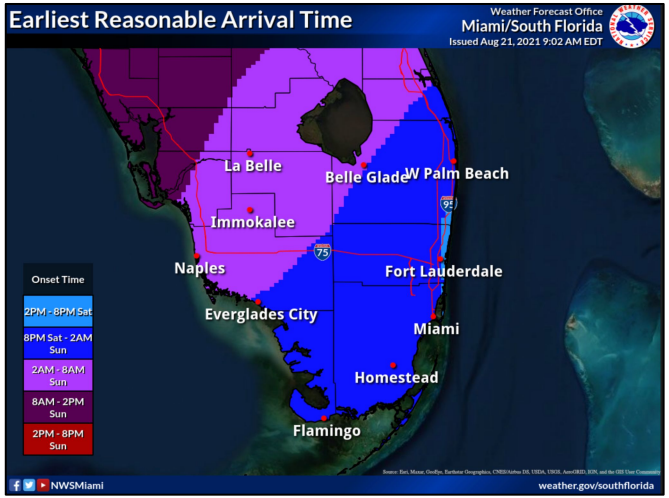
WTCM-Based TC WSP

Slide credit: Andrea Schumacher and Mark DeMaria (CIRA)

Time of Arrival/Departure of TS-Force Winds

3A-3b-1b: Assist forecasters in the evaluation of AWIPS display and use of time of arrival (ToA) and time of departure (ToD) of tropical-storm-force wind data.

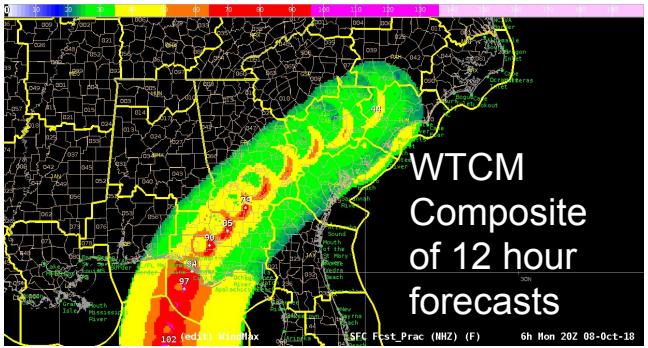


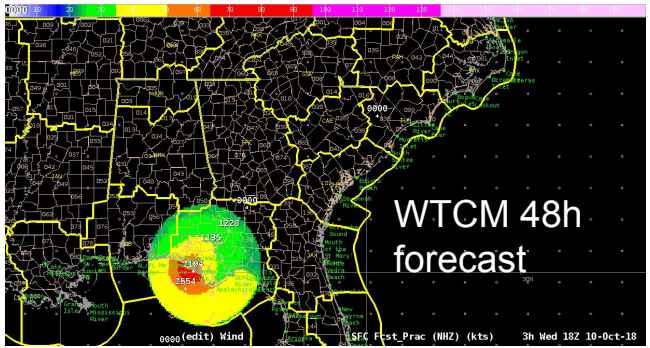


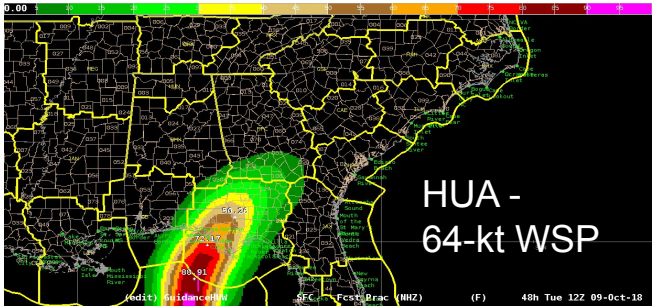
Slide credit: Pablo Santos (NWS)

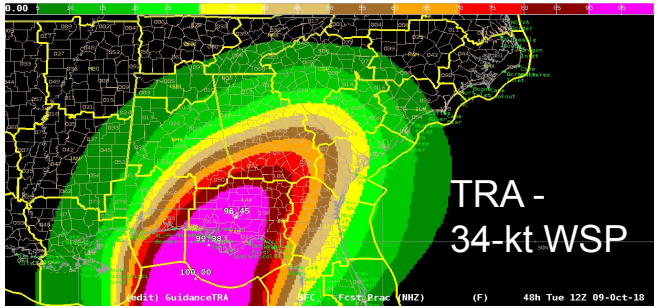
TC Wind Hazard Recommender

3A-3b-1a: Assessment of gaps in the hazard-based algorithms and need for/feasibility of new algorithms to support tropical cyclone forecasts









Slide credit: Pablo Santos (NWS)

TC Wind Hazard Recommender

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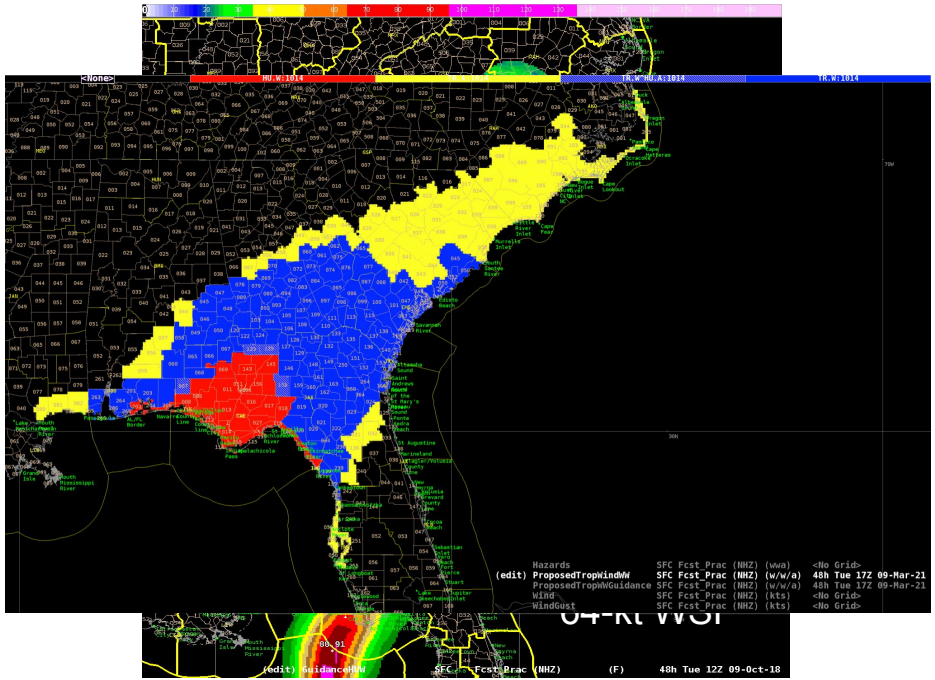

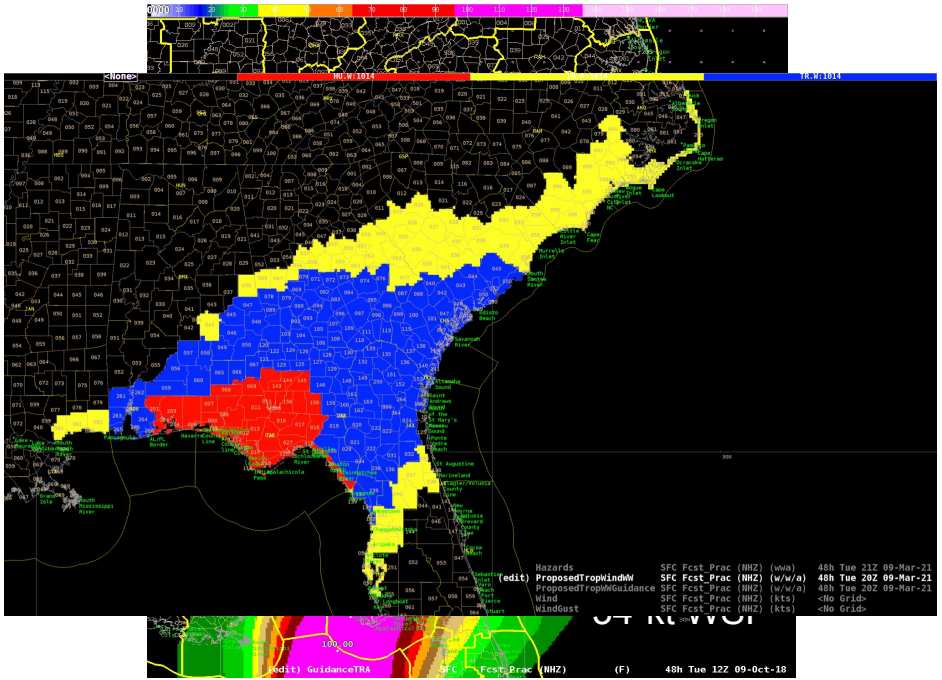

TC Wind Hazard Recommender

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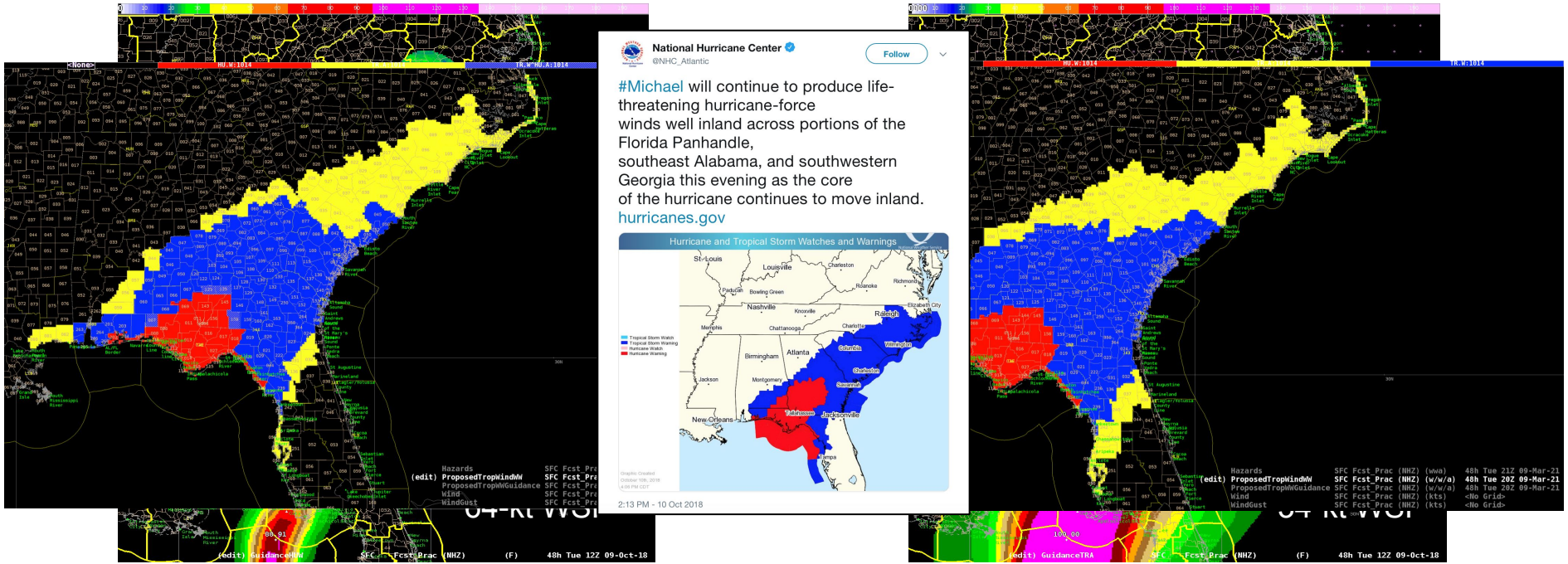
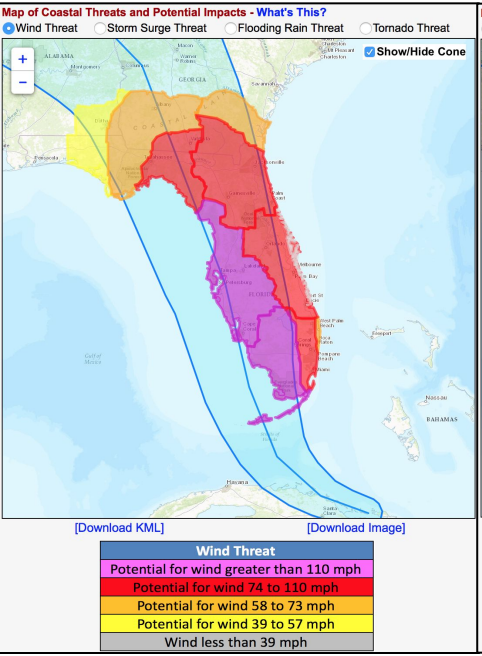
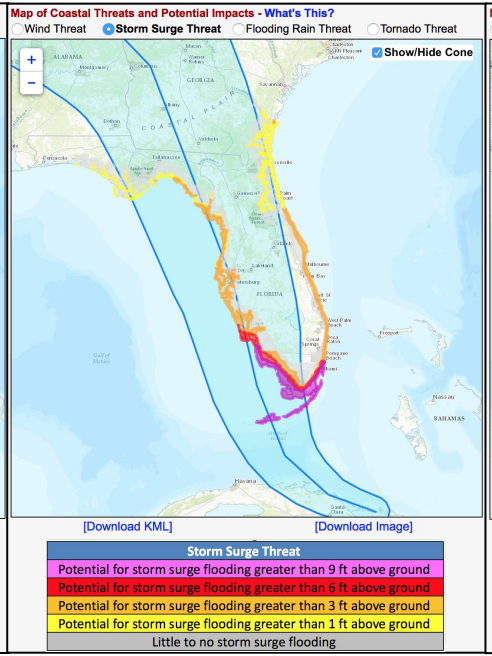
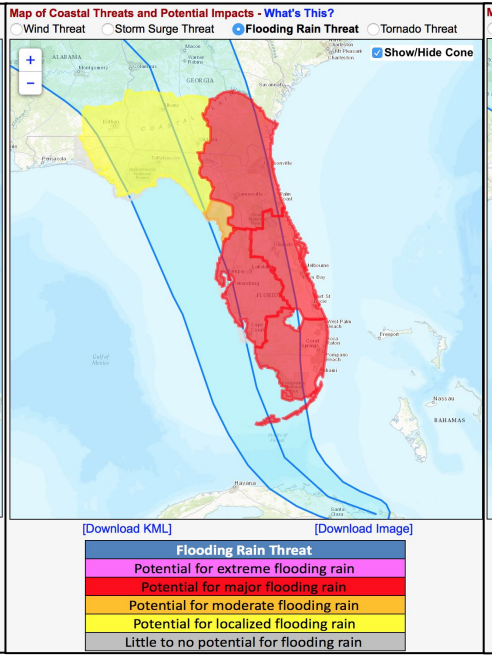


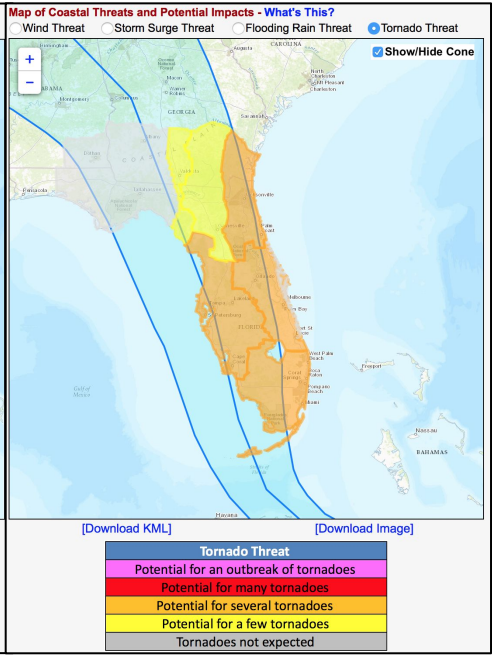
Hurricane Threats & Impacts

3A-3b-1c: Improvements to TC hazard-specific threat forecasts within AWIPS II





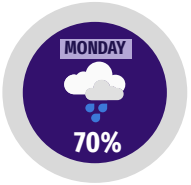




Wind Threat	Storm Surge Threat	Flooding Rain Threat	Tornado Threat
WFO Wind Grids + NHC WSPs	PSurge or P-ETSS	WPC ERO	SPC Severe Probabilities

There's a Chance for What? Assessing numeracy skills of forecasters, partners, and publics

Dr. Joe Ripberger (PI)



Set of 4 studies that mapped comprehension and communication of probabilistic information by surveying weather forecasters, emergency managers, and members of the public.

Minding the Gap: Modernizing the TC product suite by evaluating NWS partner info. needs

Drs. Rebecca Morss & Ann Bostrom (PIs)

Used semi-structured interviews and survey methods to understand how broadcast meteorologists and emergency managers currently use the tropical cyclone product suite.

Wait, the forecast changed? Assessing how publics consume/process changing TC forecasts

Drs. Rebecca Morss, Leysia Palen, & Gabrielle Wong-Parodi (PIs)

Deployed a longitudinal survey before, during, and after Hurricanes Laura and Marco (2020) and analyzed Twitter data during Hurricane Harvey.

Optimizing TC information: An NHC web user experience study from a public perspective

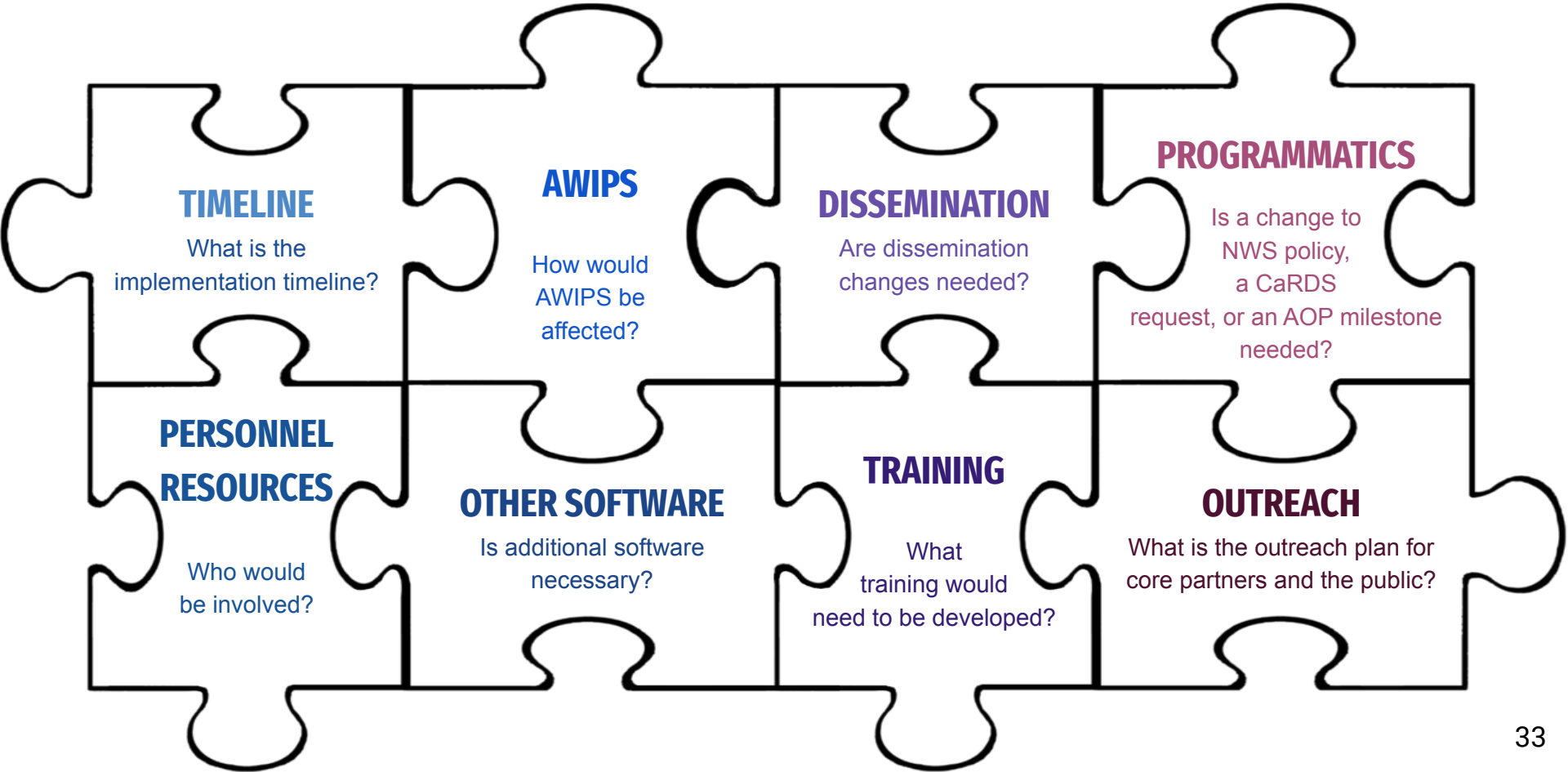
Dr. Scott Miles (PI)

Used a variety of usability and user-centered design methodologies (e.g., interviews, heuristic analysis, card sorting, etc.) to identify four design opportunities for modernizing the NHC website.

Slide credit: Castle Williams, NOAA/OAR/WPO

Integrating Social Science

Transition Plan Components



The “2” Gap in R2O

- The Hurricane Supplemental projects emphasized the Weather Act mandates to improve:
  - forecast and communication of storm surges from hurricanes
  - risk communication research to create more effective watch and warning products.
- How do we translate guidance improvements (“R”) into messaging improvements using the NWS’ current operational platforms (“O”)? Who does it?
- The “2” Gap includes:
  - Getting the data into AWIPS, on the web, etc.
  - Running experiments to find any issues with the guidance/tool/SBES recommendation
  - Generating prototypes and getting partners to evaluate them
  - Adapting the current software to work with new/improved guidance

Tropical Roadmap Plan

Subtopic R2O Plans

The Roadmap Team will propose R2O transition plans for the major subtopics for SPT approval

FY22-23

- S1 WFO AWIPS Products/Services
- S2 NHC/WFO AWIPS Collaborated Products
- S3 WFO Non-AWIPS Products/Services
- S4 NHC/CPHC Graphics/Text Product Suite
- S5 NWS Tropical Web Presence

MDC-Validated Tropical Roadmap

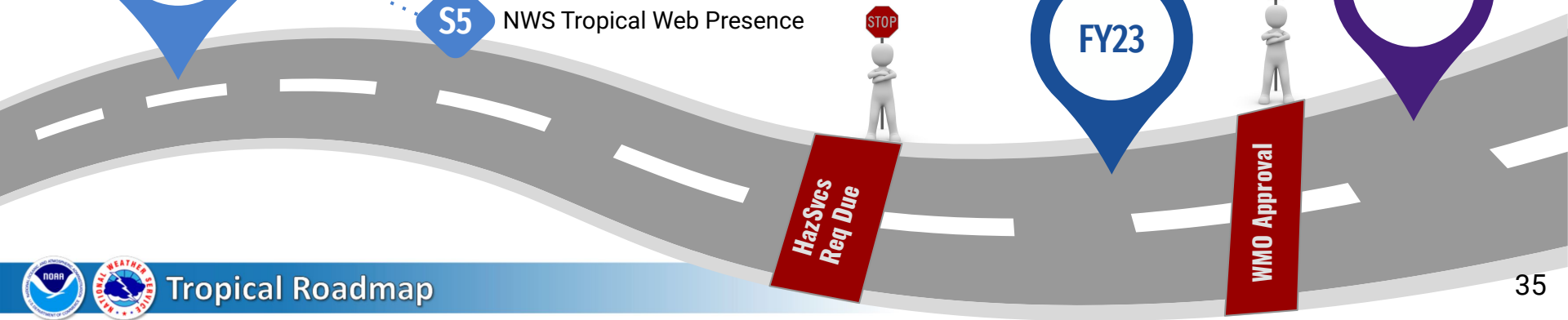
A plan that proposes how the NWS can best operationalize the research & recommendations

FY23

PIC Assessment

OPPSD assessment of their ability to support the Tropical Roadmap

FY24+



Thank You!

A huge thank you to everyone involved in the Hurricane Supplemental and other projects mentioned here as well as to the Tropical Roadmap Team

Graphics Credit: *This presentation template was created by Slidesgo (http://bit.ly/2PfT4lq) including icons by Flaticon (https://www.flaticon.com/) and infographics & images by Freepik (https://bit.ly/2AB5gGa)*

Questions?

Jessica Schauer
NWS Tropical Program Manager

Tropical Roadmap Goal

A suite of highly accurate, scientifically validated tropical products and services that is efficiently produced, clearly communicated, consistent, and effective in providing actionable forecast and impact information that is relevant to partners and the public.