Combined NCEP/FNMOC/EC Global Wave Ensemble

Joint Ensemble Wave Modeling Group

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North American Wave Ensemble System NAWES

- Outline
- Current NCEP Wave Ensembles System
- Current FNMOC Wave Ensembles System
- Planned EC Wave Ensemble System
- Previous evaluation of NCEP-FNMOC ES
- Scope
- Benefits
- External Evaluation Outcomes
- Outlook

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NCEP Ensemble Ocean Wave Forecast System

- Current NCEP Wave Ensembles System
  - Global Ensemble Ocean Wave Forecast System (GEOWaFS)
  - 1°×1° wave model grid
  - 20 ensemble members + 1 control
  - Continuous initial conditions per member from previous cycle
  - 10 day forecast using the GEFS bias corrected 10m wind
  - Outputs in ftpprd
    - Gridded mean, spread and probabilities of exceedence for Hs, Tp and U10
    - Gridded and point outputs for 20 + 1 ensemble members

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FNMOC Ensemble Ocean Wave Forecast System

Current FNMOC Ensembles System

- Shared wave model code (WAVEWATCH III)
- Shared 1°×1° wave model grid
- Same number of ensemble members (20)
- 10 day forecasts

- Above properties will facilitate combination of products
- Differences
  - Forcing wind fields (GEFS x NOGAPS EFS)
  - Ice concentrations and SST (GDAS vs NCODA)
- Combined system with improved mean ensemble products and better statistical information (probabilities of exceedence)

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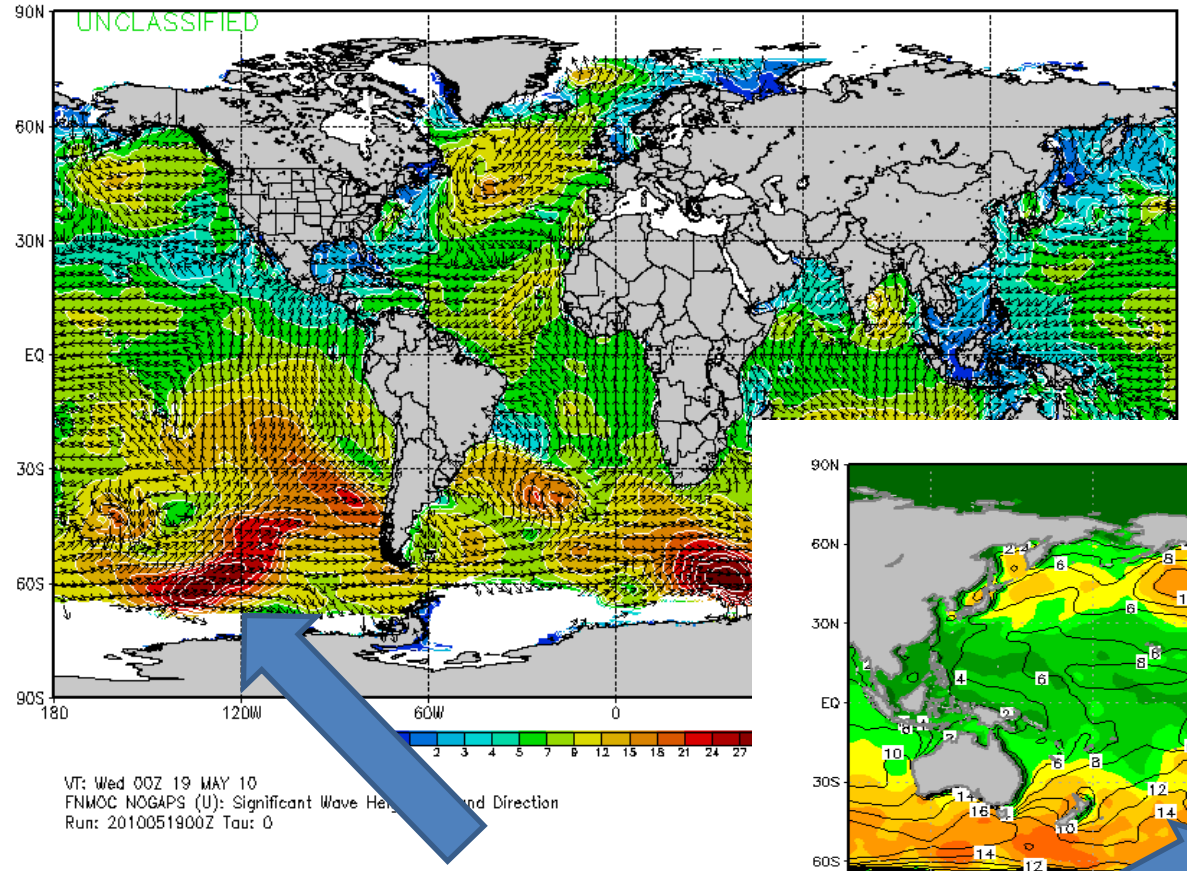
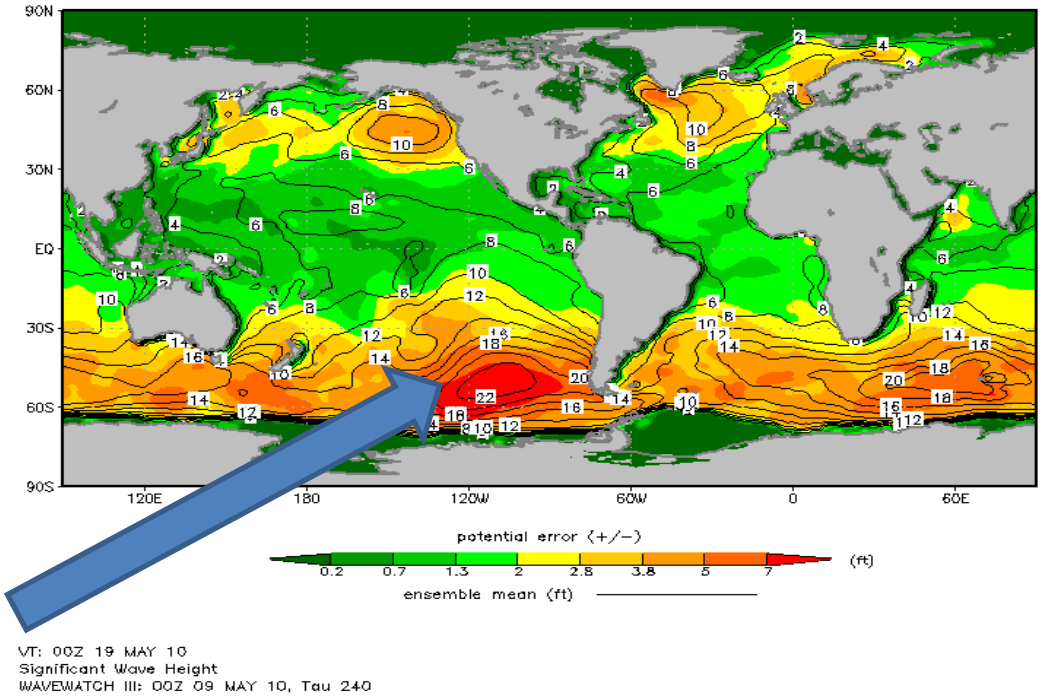


Comparison of 240hr WW3 EFS forecast with the verifing analysis from the deterministic WW3 , valid on May 19, 00GMT

Max >30ft



Max = 22ft

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EC's Global Ensemble Wave Prediction System (GEWPS)

- EC is currently developing its GEWPS and plans to contribute 20
- members to the NCEP/FNMOC ensemble under the NAEFS agreement

- EC's ensemble consists of 1 control plus 20 members, driven with hourly
- GEPS (Global Ensemble Prediction System, 0.6°x0.6°) winds for the first
- 168h of integration and three hourly thereafter

- Development is on a future Joint NCEP/FNMOC/EC Wave Ensemble
- grid (0.5°x0.5°) using the upgraded operational version of WW3

- In support of METAREA XVII/XVIII the Canadian Global Wave Ensemble
- will extend further north to cover all Arctic Ocean open waters

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EC's Global Ensemble Wave Prediction System (GEWPS)

- Time line:
- Development is expected to continue until early Fall 2012
- Validation and monitoring should continue until early Winter 2012/2013
- Parallel implementation (i.e., pre-operational) is expected Winter 2012/2013
- Operational implementation and arrival of Canadian members in the Joint
- NCEP/FNMOC/EC wave ensemble is planned for Spring 2013
- Addition of the Canadian members is expected to increase the overall
- forecast skill

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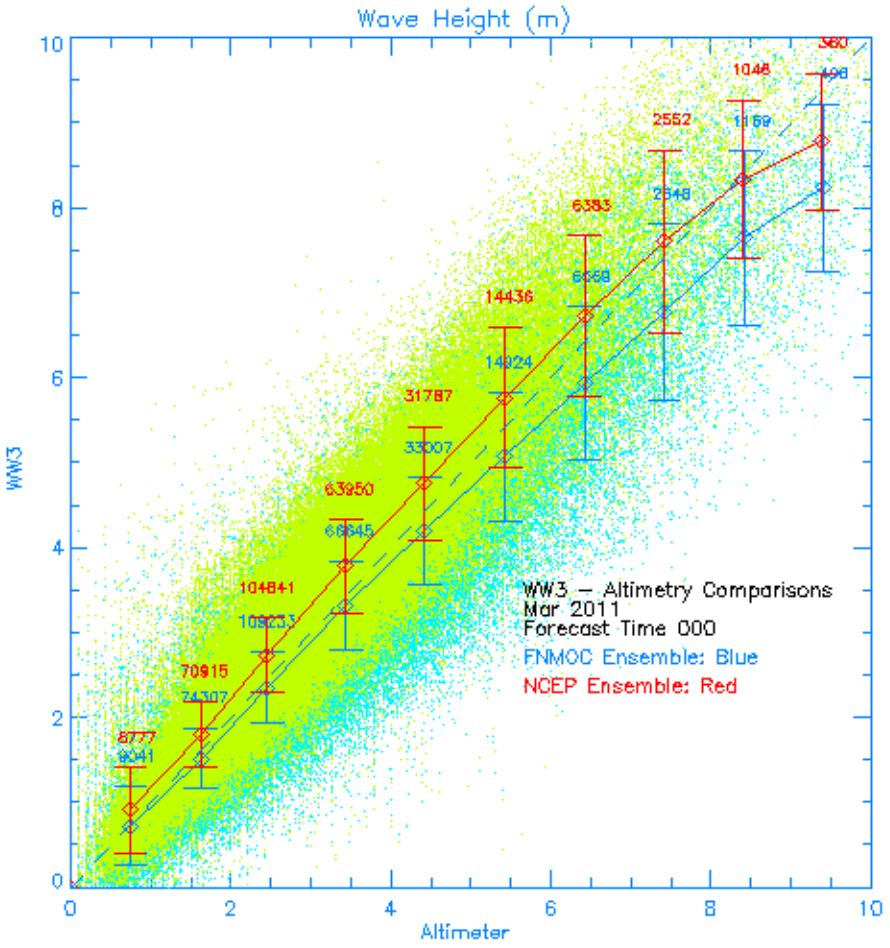
Combined Wave Ensembles Product

- Evaluation Mar 2011
  - WW3 vs Altimeters
  - Combination tracks well clou (more spread)
  - Hints that combined products would increase model skill ar improved statistics: NCEP biased high, FNMOC biased low.



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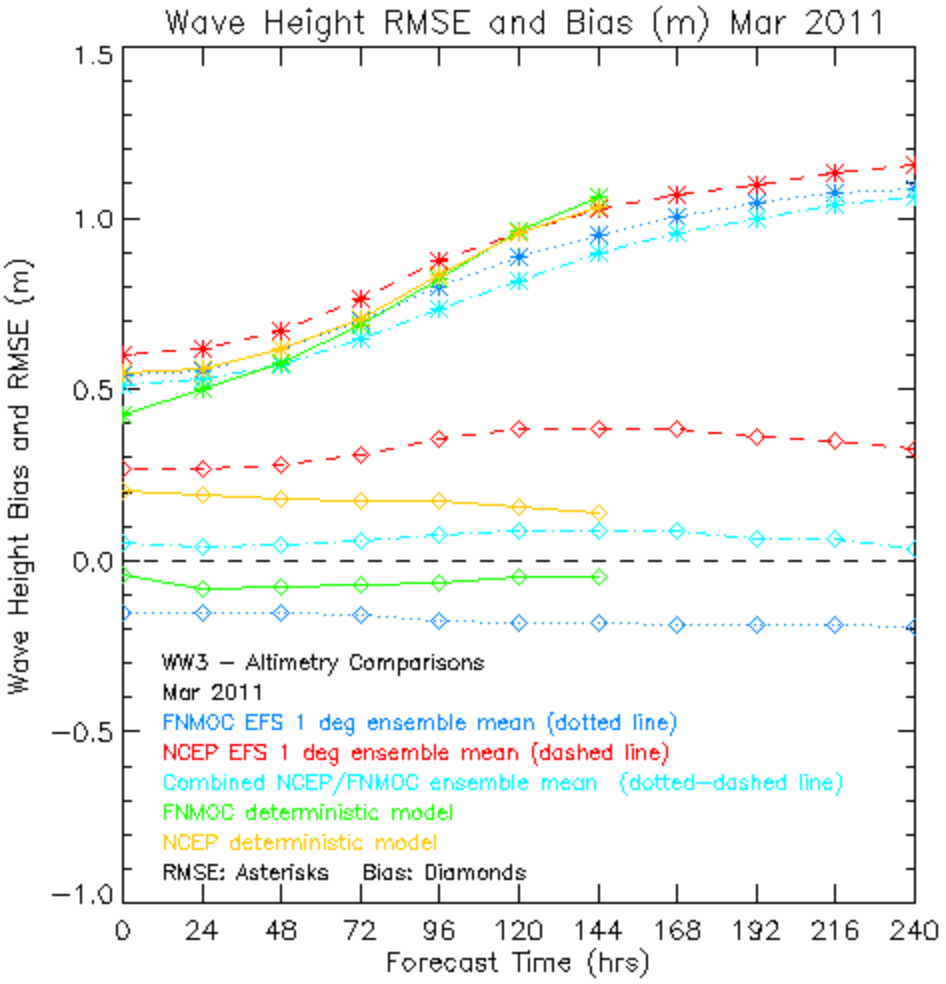
Combined Wave Ensembles Product

- Regression testing
  - WW3 vs Altimeters
  - Combination:
    - Reduces bias
    - Reduces RMSE



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Combined Wave Ensembles Product

- Summary of scope
  - New product
    - Why not integrate to existing NCEP product?
      - FNMOC only twice daily
      - FNMOC data arrives with 3h delay
  - Create data stream from FNMOC (done)
  - Single post script (no prep or fcst):
    - Combine FNMOC and NCEP grib2 data (Hs only)
    - Generate new products
      - Mean, Spread and Exceedence prob
  - Add Hs gridded data (grib2) from FNMOC ensemble members (with FNMOC and NCO approval)

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Combined Wave Ensembles Product

- Achieved Benefits
  - NCO parallel
    - Opportunity to fine tune timing: ensure availability of both data sets on time
  - Evaluators confirmed the expectations
    - Improved mean Hs ensemble product
    - Improved wave ensemble statistics for Hs

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EP/FNMOC NWNCW3 Ensemble Evaluation

- Scott Stripling and
- Jessica Schauer
- NHC/TAFB

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Limitations

- Time of arrival of the final ensemble member
  - NCEP/FNMOC NWW3 ensemble arrives T+ 0619-0631
  - NCEP NWW3 ensemble arrives T+ 0523-0531
-
- The NCEP/FNMOC NWW3 ensemble is only run twice a day as opposed to 4 runs a day of the operational NCEP NWW3
-
- Model domain continues to omit large areas around the coasts. This is especially noticeable in several zones of both the TAFB Atlantic and Pacific AORs, where strong orographic influences dominate boundary layer flow. High impact events such as gales in the the Gulf of Tehuantepec will not be accurately depicted.
-
- Both NWW3 and FNMOC NWW3 ensemble domains are of courser resolution than the operational MWW3, making model interpretation difficult in the lee of the Caribbean and Bahama Island chains

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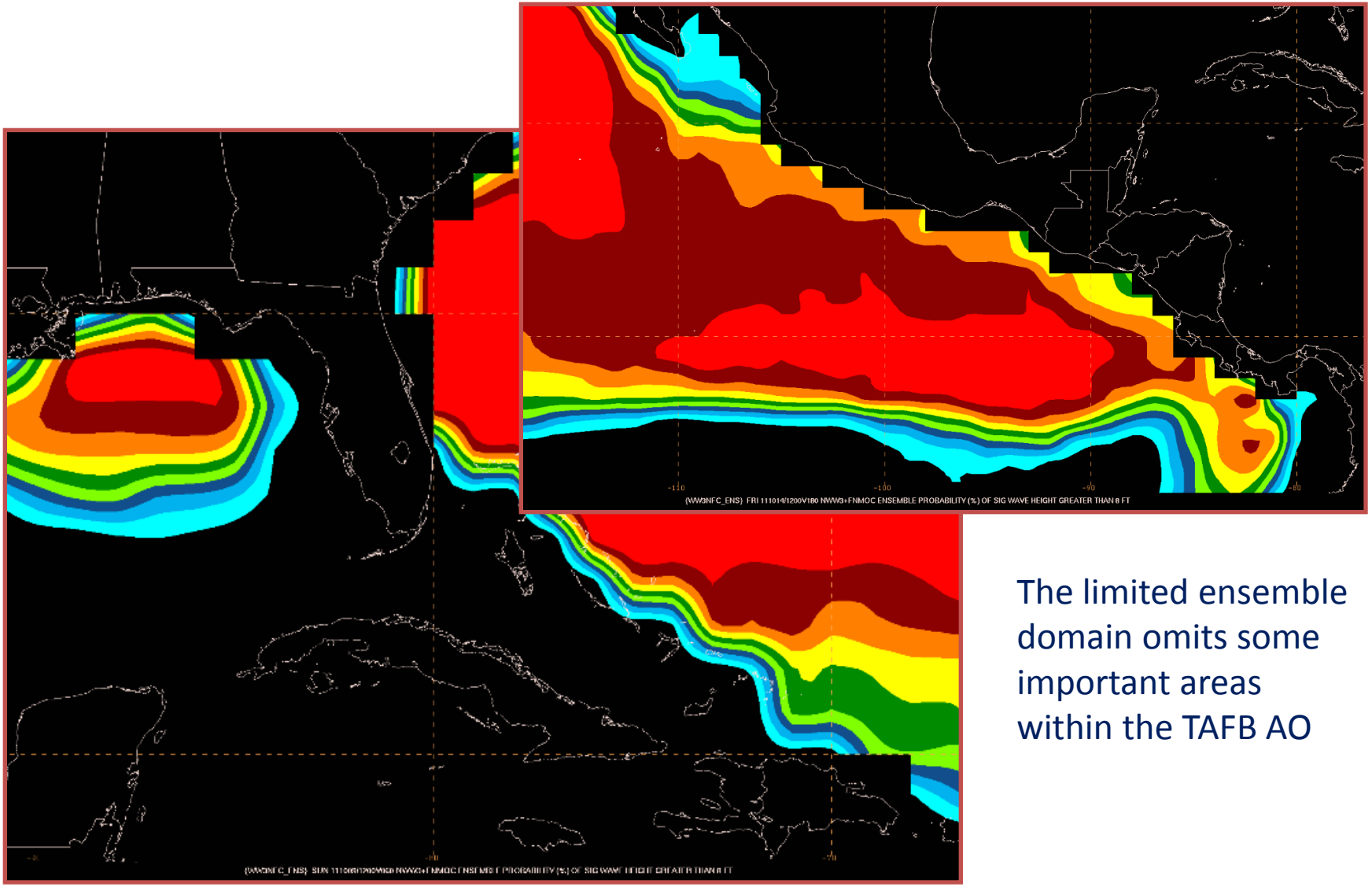

The limited ensemble domain omits some important areas within the TAFB AO

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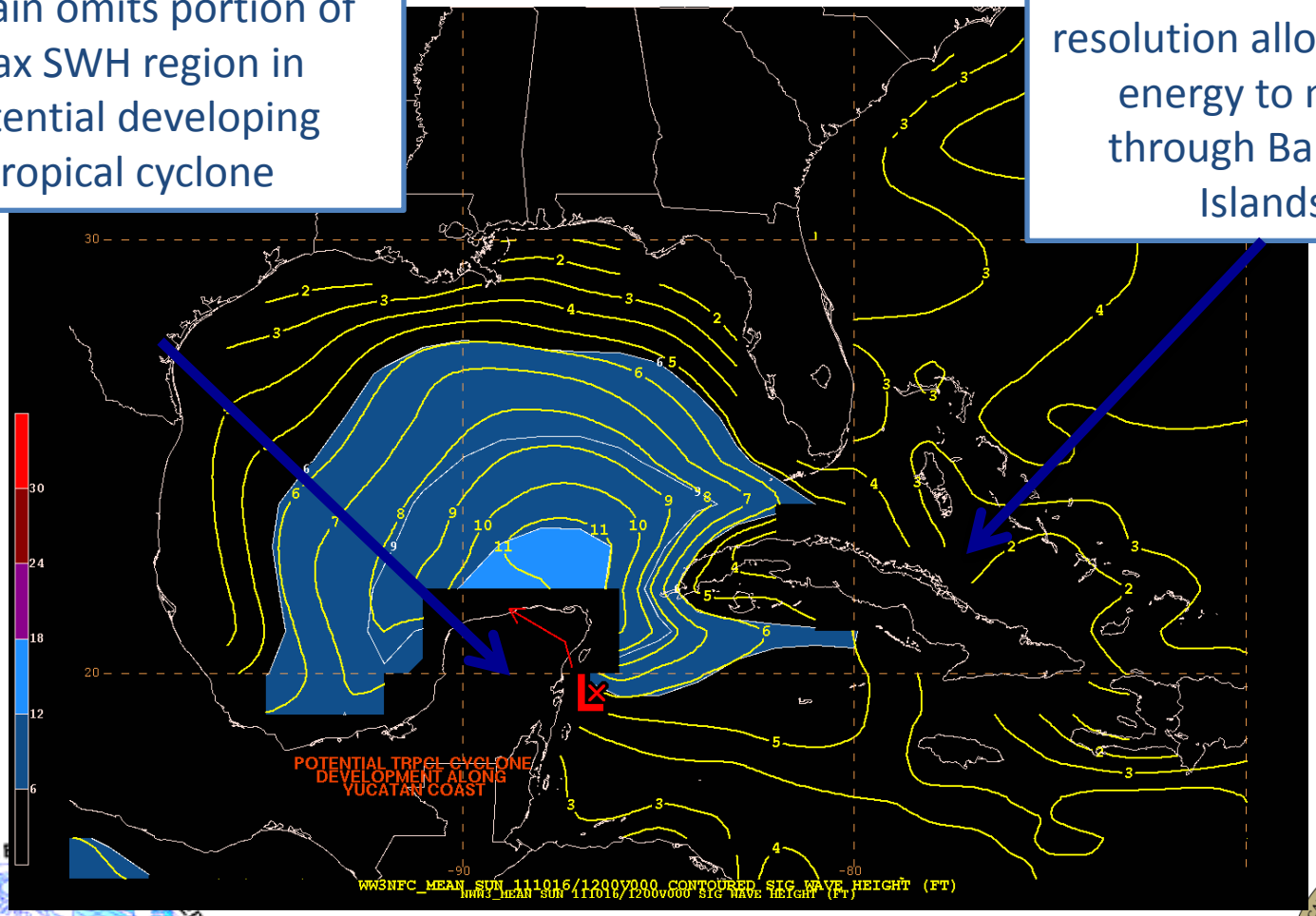
Limitations - Domain

Truncated ensemble domain omits portion of max SWH region in potential developing tropical cyclone

Course ensemble resolution allows wave energy to move through Bahama Islands



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Strengths

- The new NCEP/FNMOC NWW3 ensemble probabilistic forecasts show significantly more variability (uncertainty) than the operational NWW3 ensemble

- The new NCEP/FNMOC NWW3 ensemble varies more from the operational MWW3 output than the operational NWW3 ensemble
-
- The new NCEP/FNMOC NWW3 ensemble mean showed frequent improvement over both the operational MWW3 and the NWW3 ensemble when compared to observations

- The introduction of the FNMOC ensemble members to the NCEP NWW3 ensemble suite seems to have toned down the slight high SWH bias TAFB forecasters have noted in our AOR

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Questions?