Some Considerations for Ocean Forecasting

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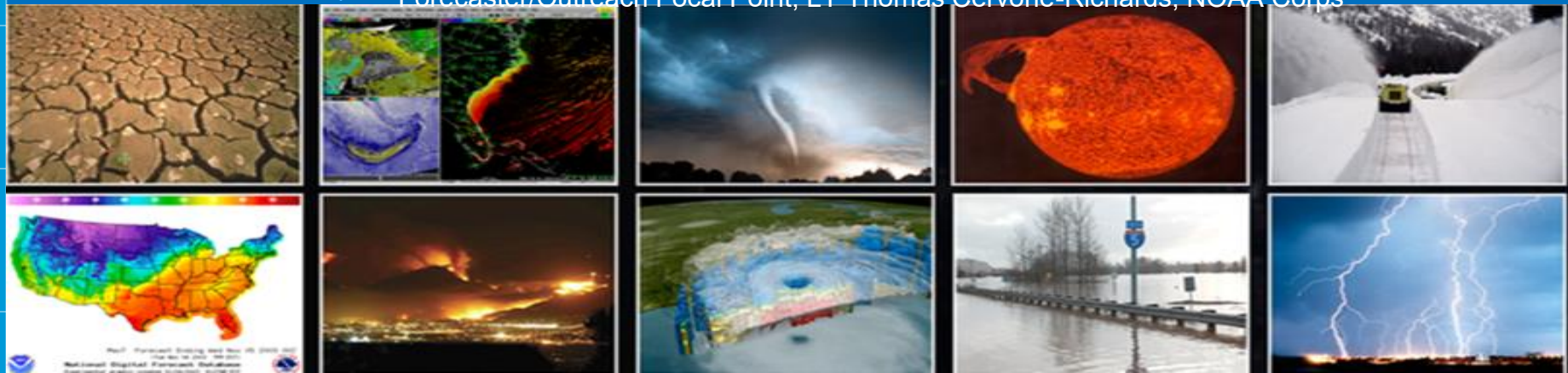
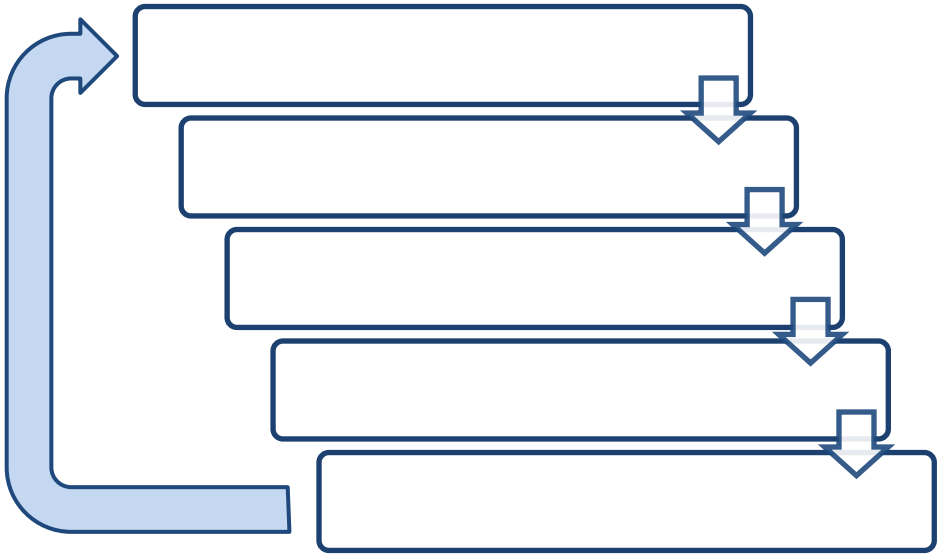
Special Thank You:
Darin Figurskey, Operations Forecast Branch Chief; Casey Joseph, Forecaster/Outreach Focal Point; LT Thomas Cervone-Richards, NOAA Corps

NOAA
National Weather Service



Forecasting Methodology



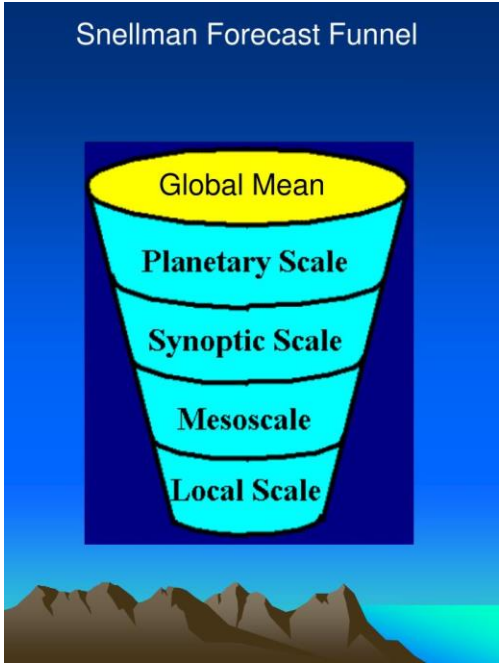
Assumption: Before the race the forecast problem is different than during the race.

Do we go?
When do we go?
When will we return?

What imminent adjustments will I need to make?
What course changes and sail plans needed next?

AI not that smart: Would you just stand there on the deck?

Scales



Predictability

Weeks/months

1 – 10 days

Hours to 2 days

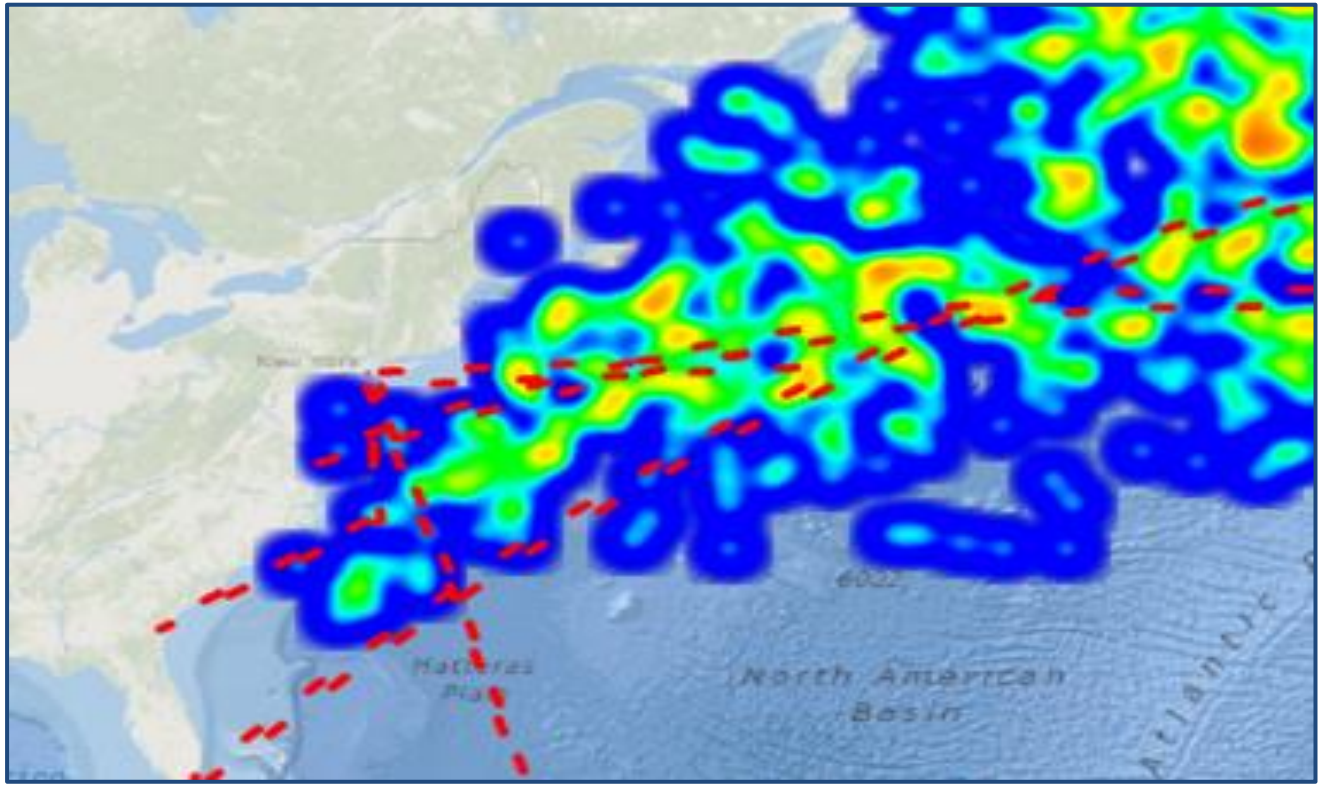
Minutes to hours**

** local refers to weather formed internally, not externally from mountains or islants.

Know your Climatology of Hazards: extratropical storms

A persistent temperature gradient spawns intense cyclones

But mostly not in the summer

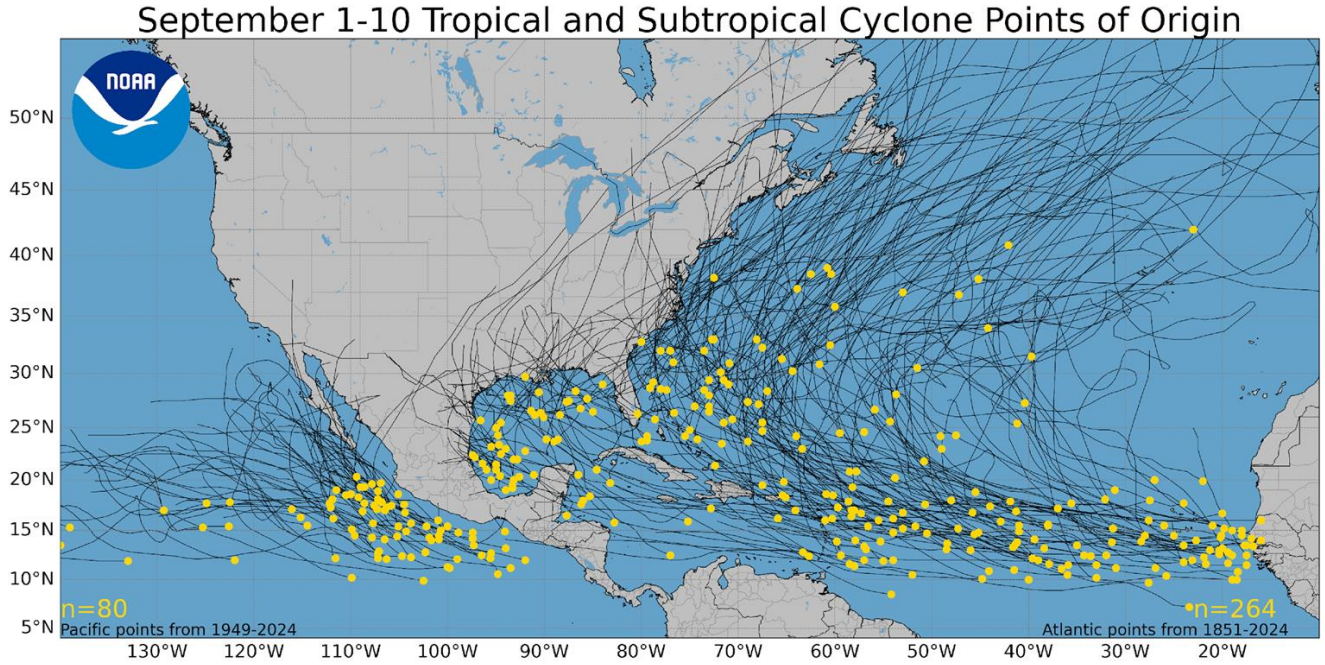


Know your Climatology of Hazards: June Tropical Cyclones

Most concern is in the Gulf with fewer in the west Atlantic.

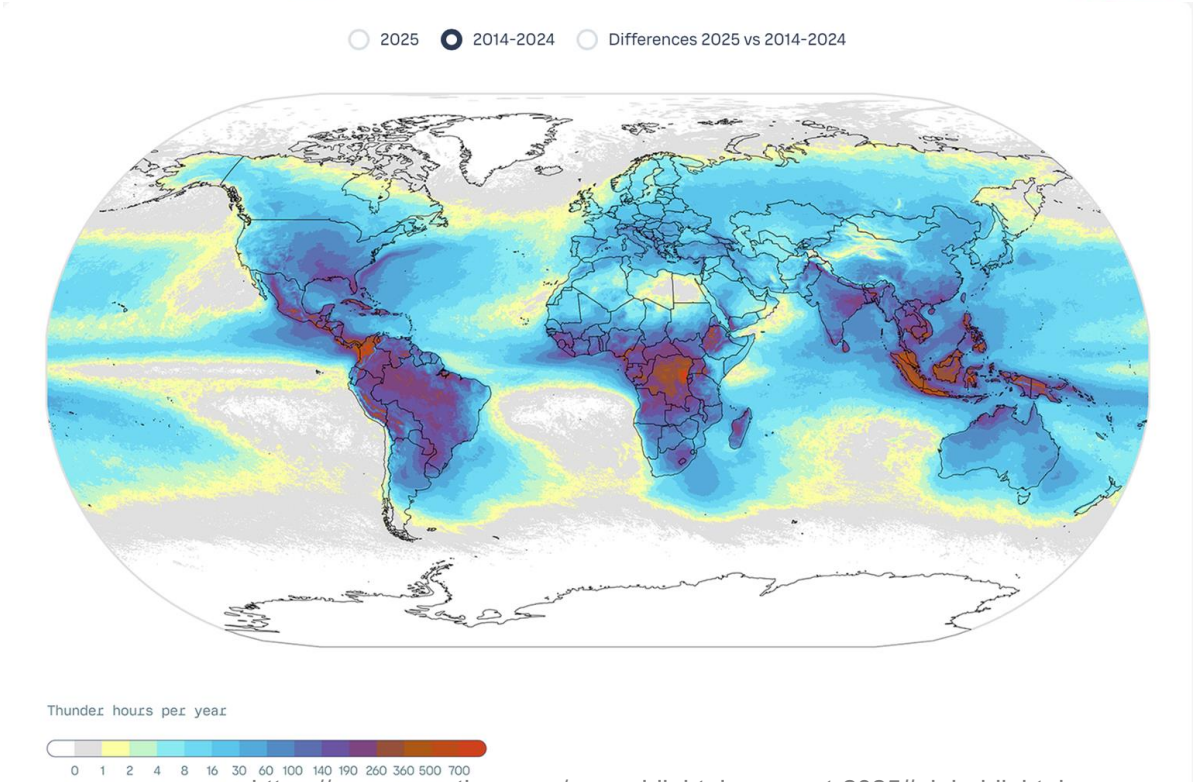
There seems to be a mid June peak.

These are low compared to September.



Know your Climatology of Hazards: Thunderstorms

Lightning maximum over the Gulf Stream



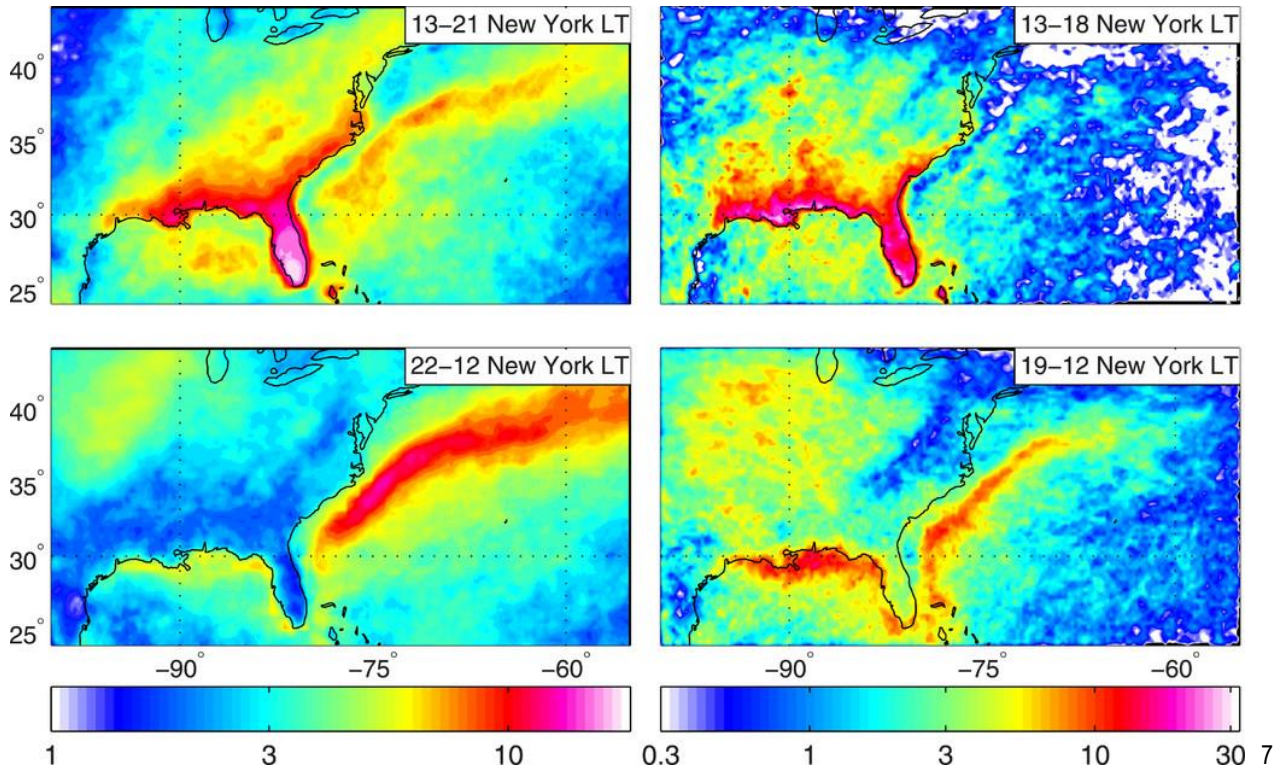
https://www.xweather.com/annual-lightning-report-2025#global-lightning-maps

Summer Precip and Lightning: Night vs Day

The most frequent thunderstorm time is overnight.

Left column: precip in mm/day

Right column: lightning density in strokes/km^2/year



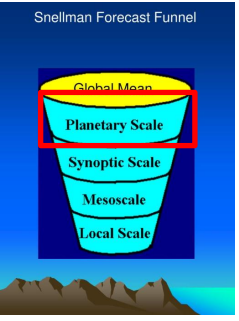
Virts and Co-authors 2015 - https://doi.org/10.1175/JAS-D-14-0233.1

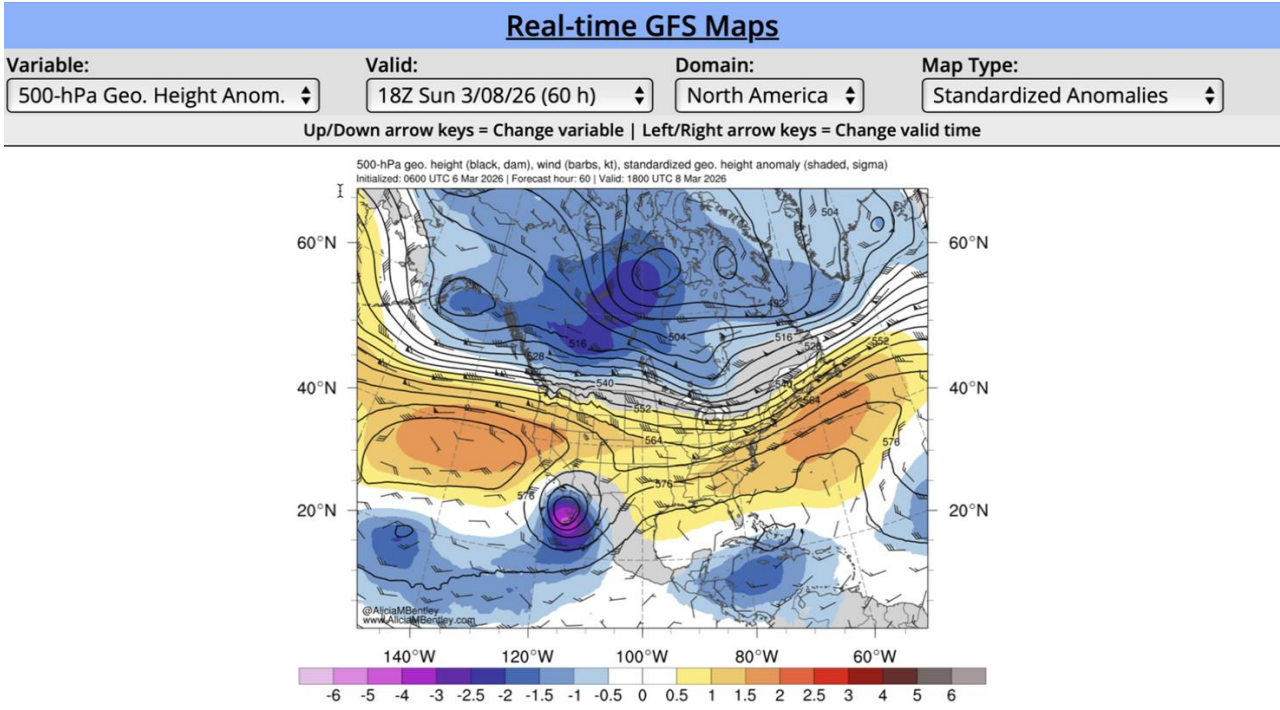
Before the Race: Getting the Big Picture

500 mb analysis and standardized anomalies

The more extreme the colors, the rarer the heights.

Heights are higher than normal, no major troughs near the course.





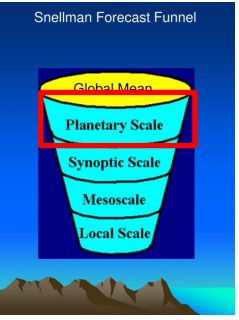
https://www.atmos.albany.edu/student/abentley/realtime/anom.php?domain=northamer&variable=500g_anom

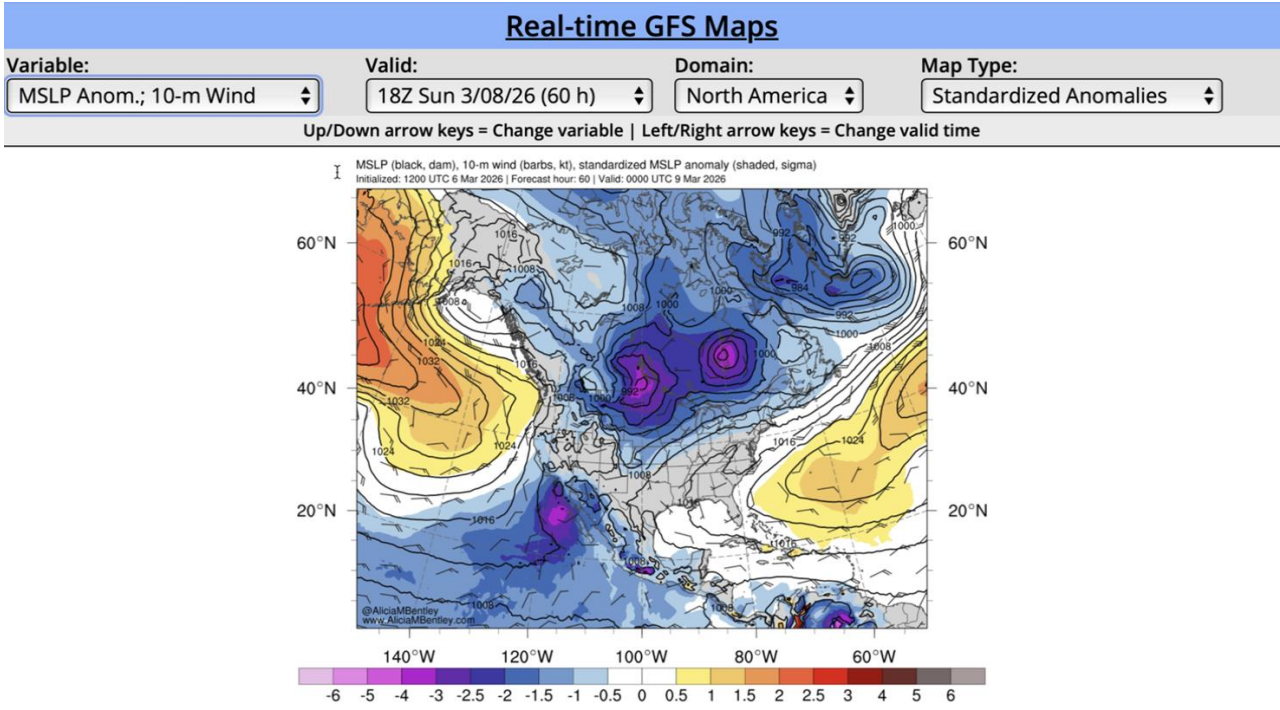
Before the Race: Getting the Big Picture

Large Scale Pattern Analysis

Sea level Pressure and Wind

Bermuda high is producing mildly higher than normal pressures. Very abnormally low pressure SC Canada.





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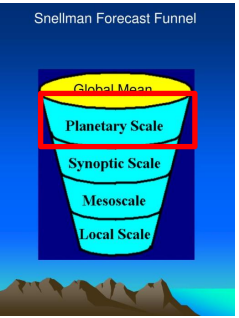
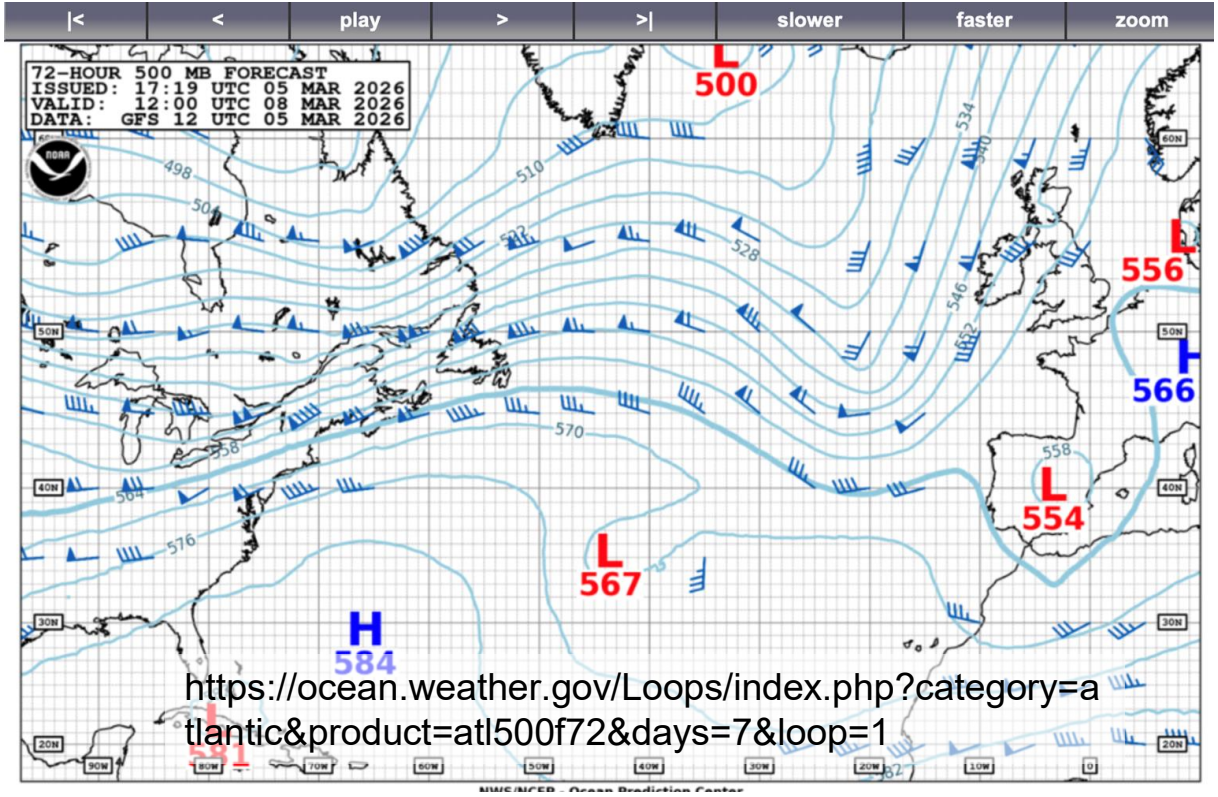
Before the Race: Getting the Big Picture

Large Scale Pattern Analysis from OPC

500 mb forecast

Another view of the 500 mb ridge for March.



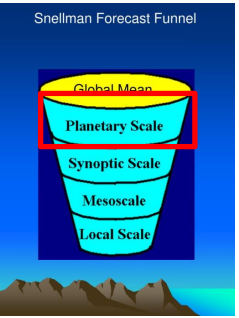


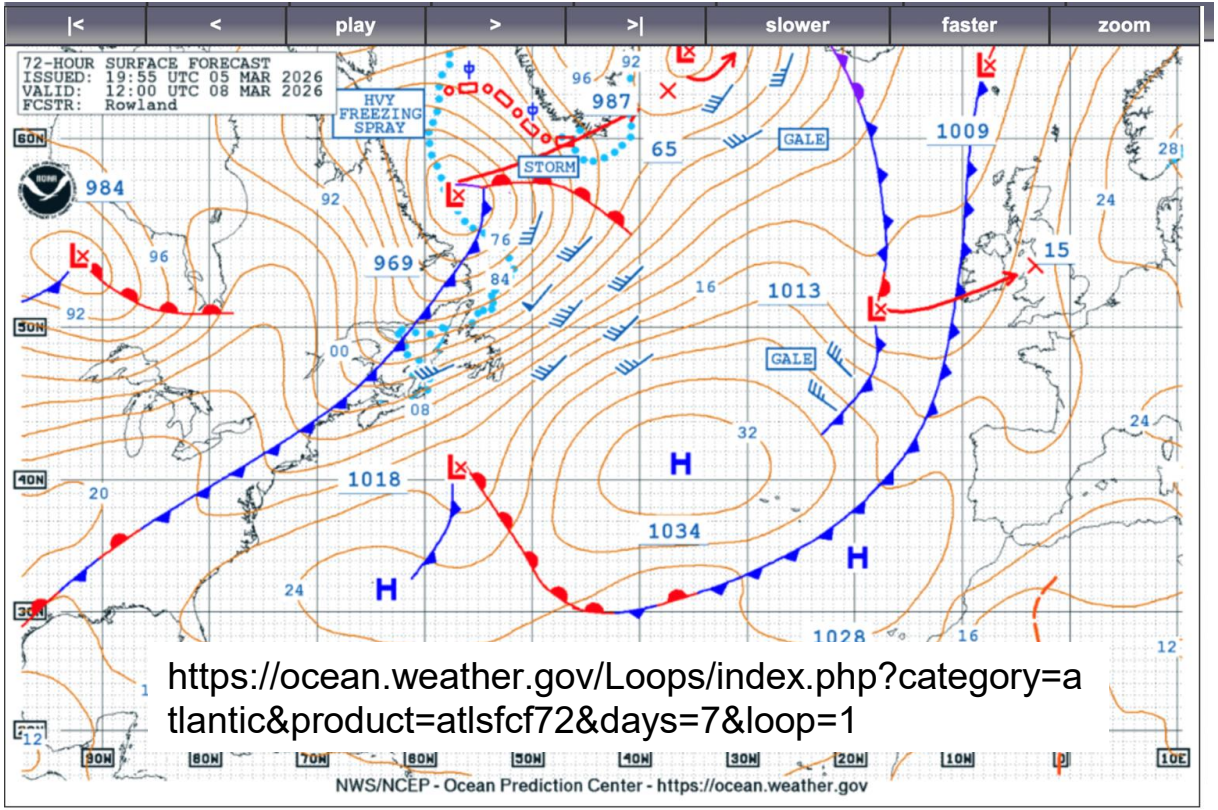
Before the Race: Getting the Big Picture

Large Scale Pattern Analysis from OPC

Surface

Frontal Forecast





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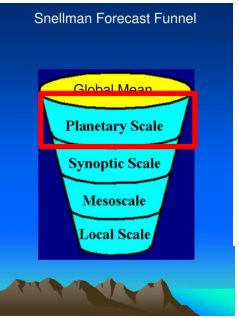
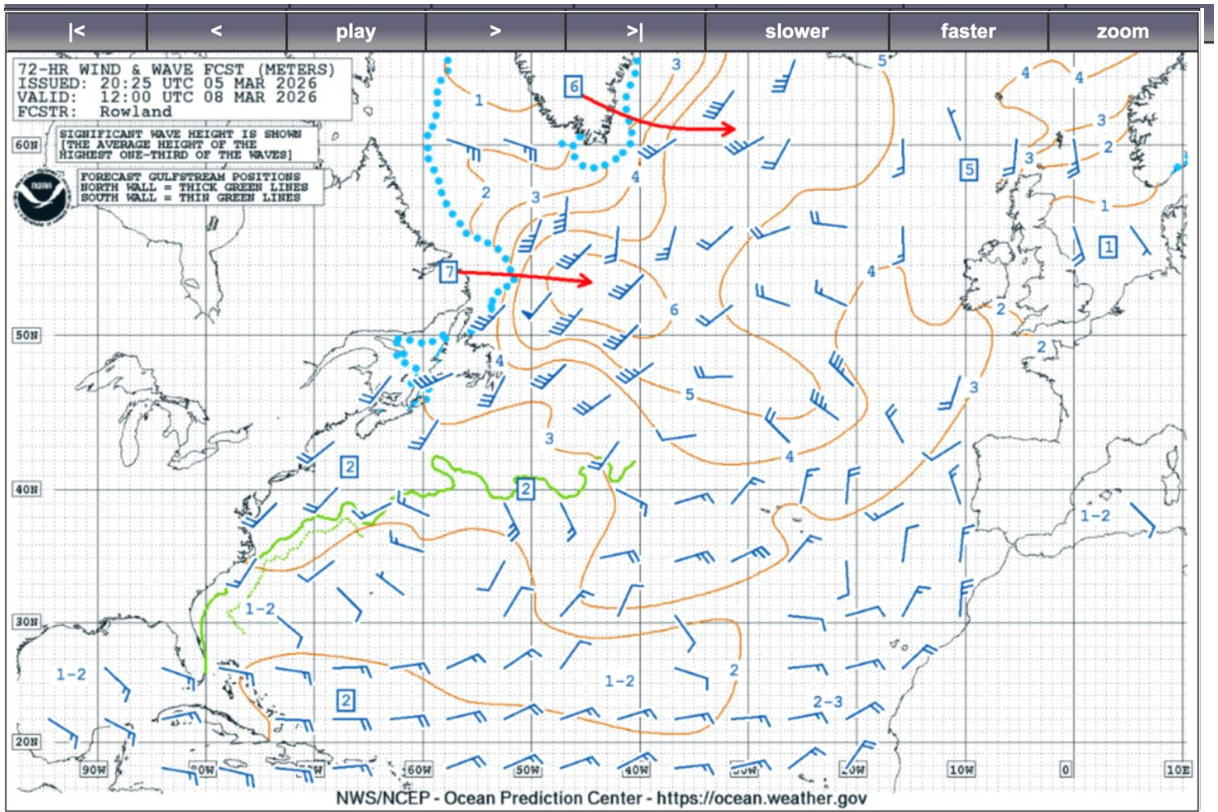


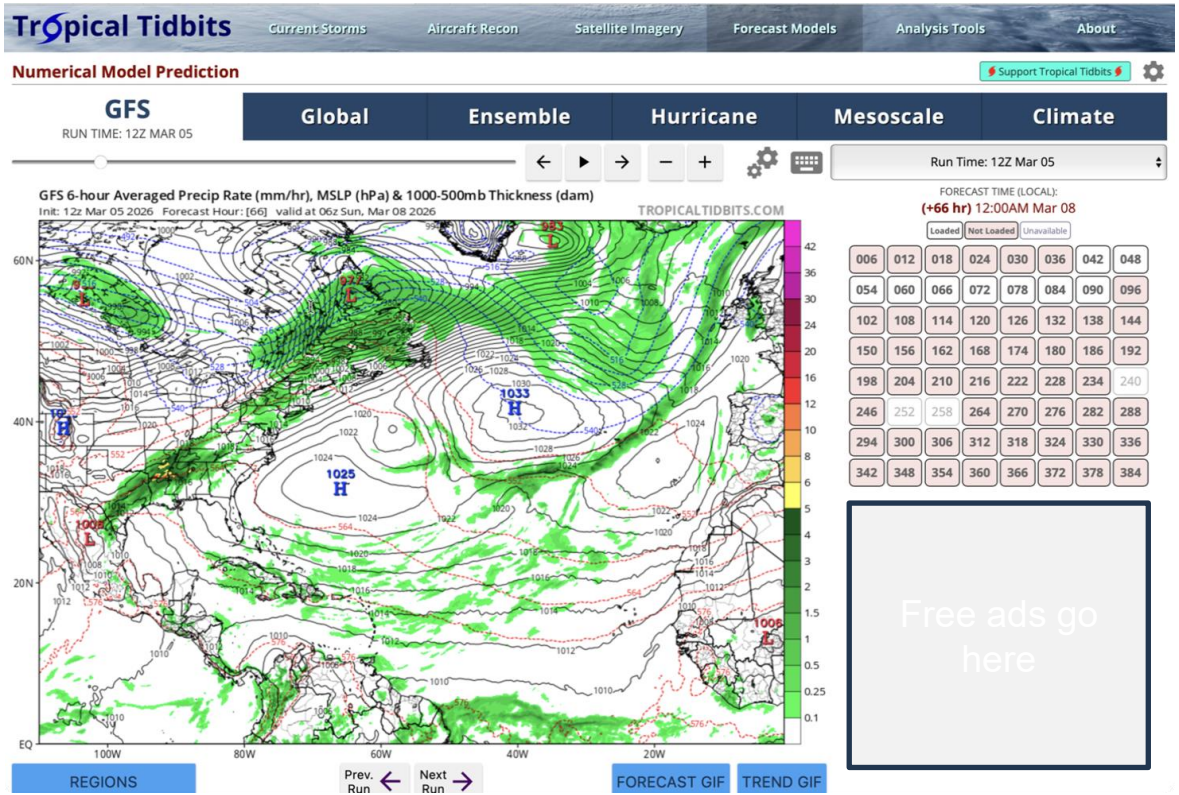


Before the Race: Getting the Big Picture

Other Great Sites

Tropicaltidbits.com

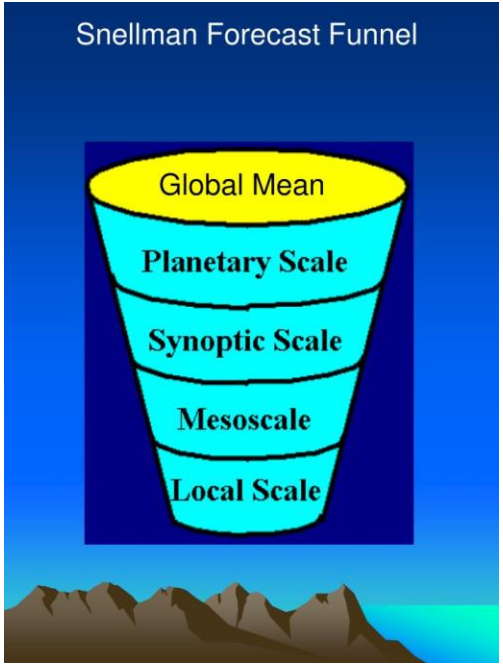
- All models
- Ensembles
- 10m wind, wave forecasts,
- Tropical cyclone info



Before the Race: Understand your Uncertainty

Forecast error increases with time

Error increases faster for smaller scales than larger scales



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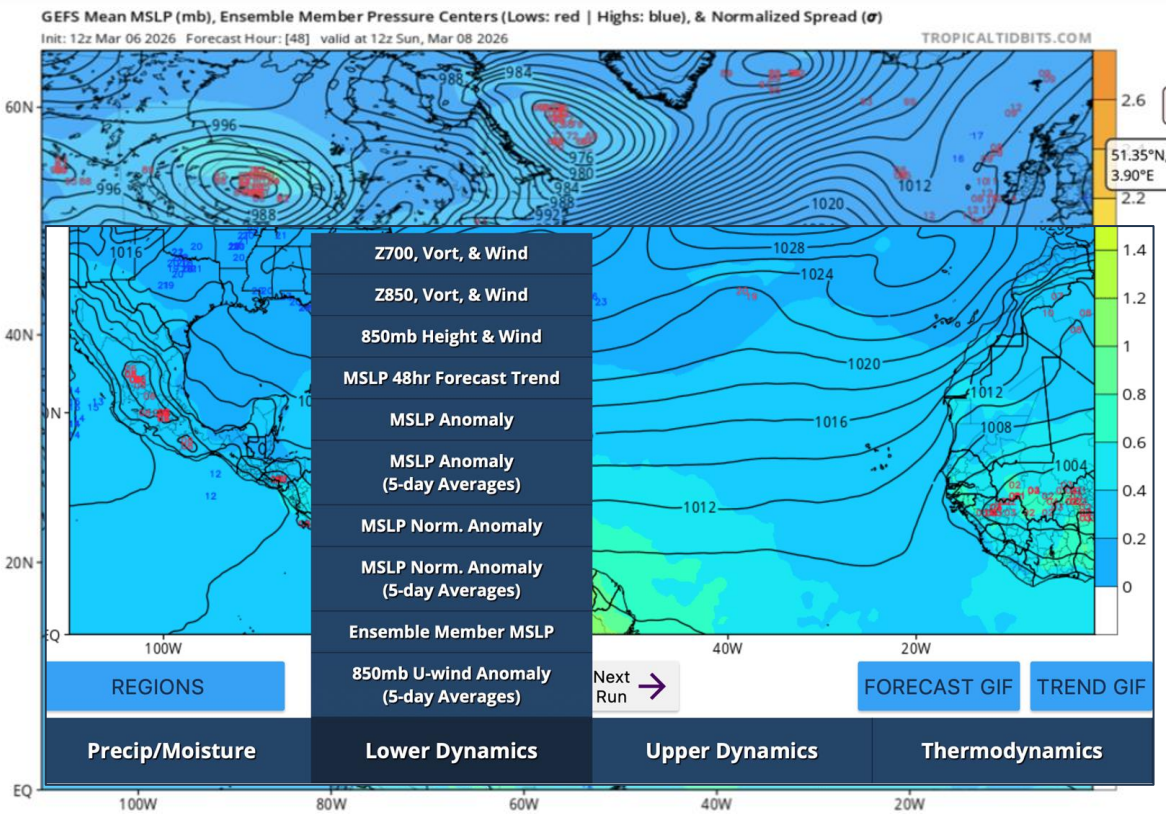
Before the Race: GEFS Ensemble Mean Sea Level Pressure

Tropicaltidbits.com

Over 16 members of the Global Ensemble Forecasting System contribute to

- the mean sea-level pressure
- Low and high positions,
- and the spread or uncertainty (shaded)

- The “High” pressure areas have very low spread hence high certainty for this forecast hour.



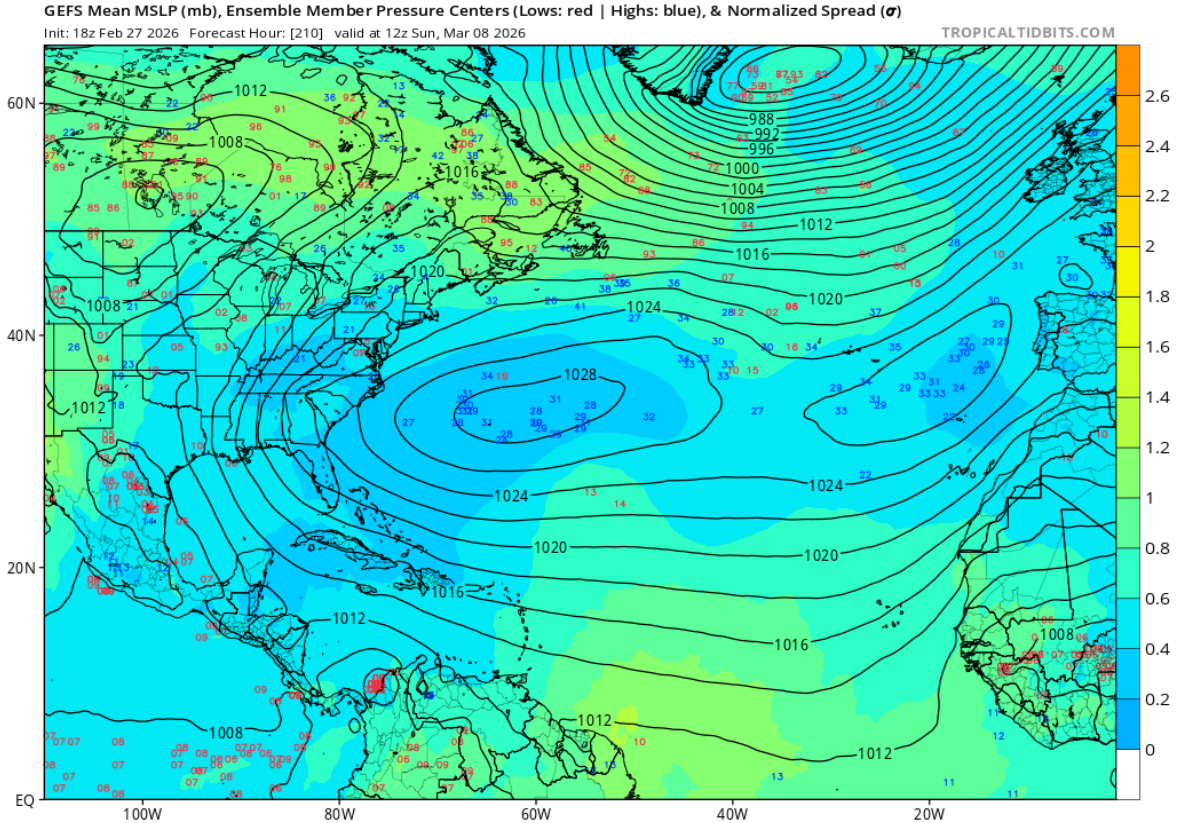
Before the Race: GEFS Ensemble Mean Sea Level Pressure

Let's go back 120 hours and see if the certainty is this high.

There is more uncertainty but still good enough.

Now 210 hours back.

The "high" pressure is still there with high confidence. But look at the splatter of low pressure centers to the north!



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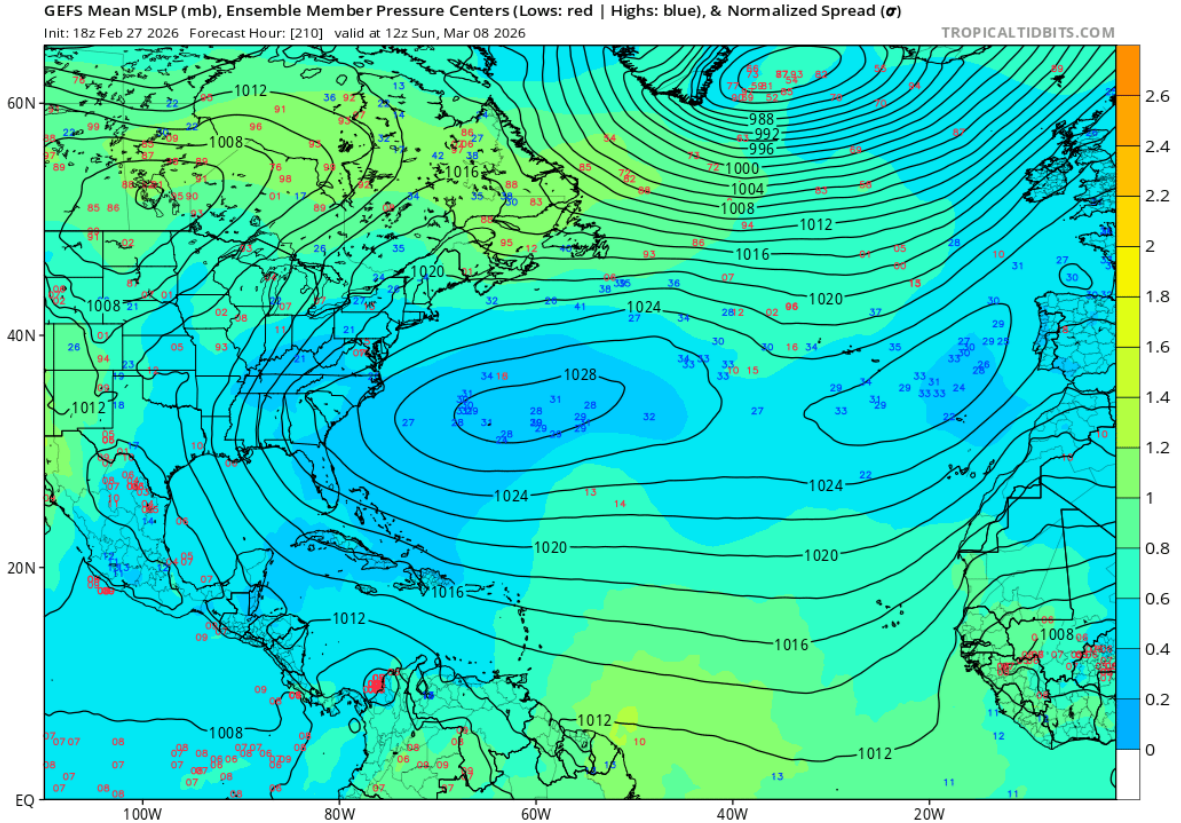
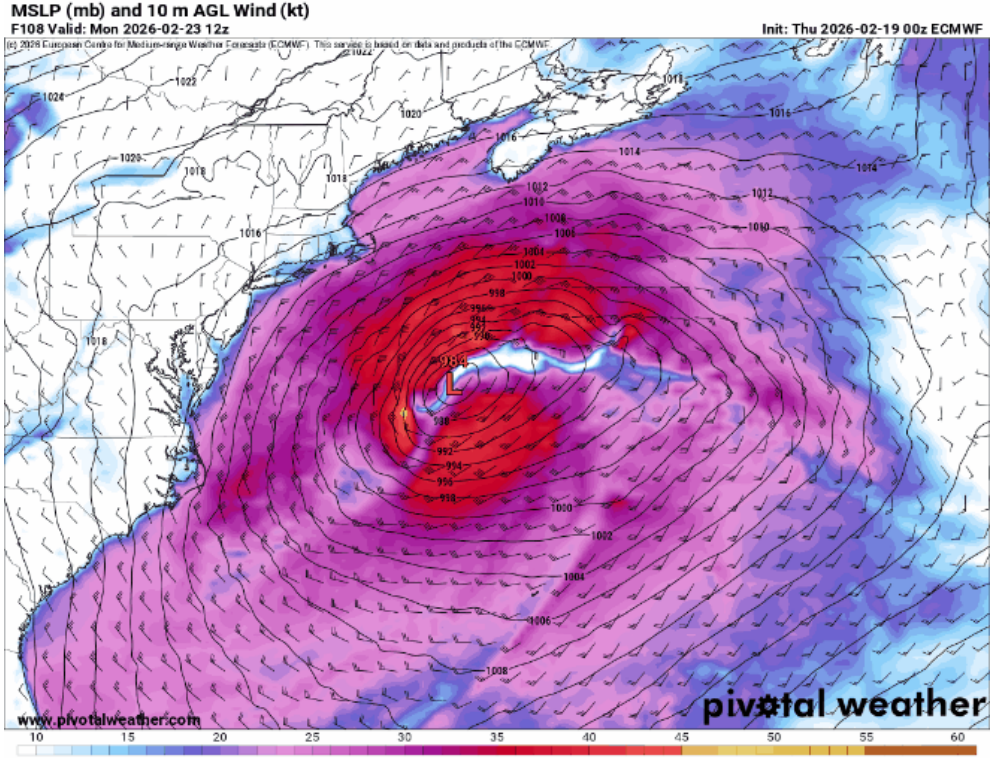


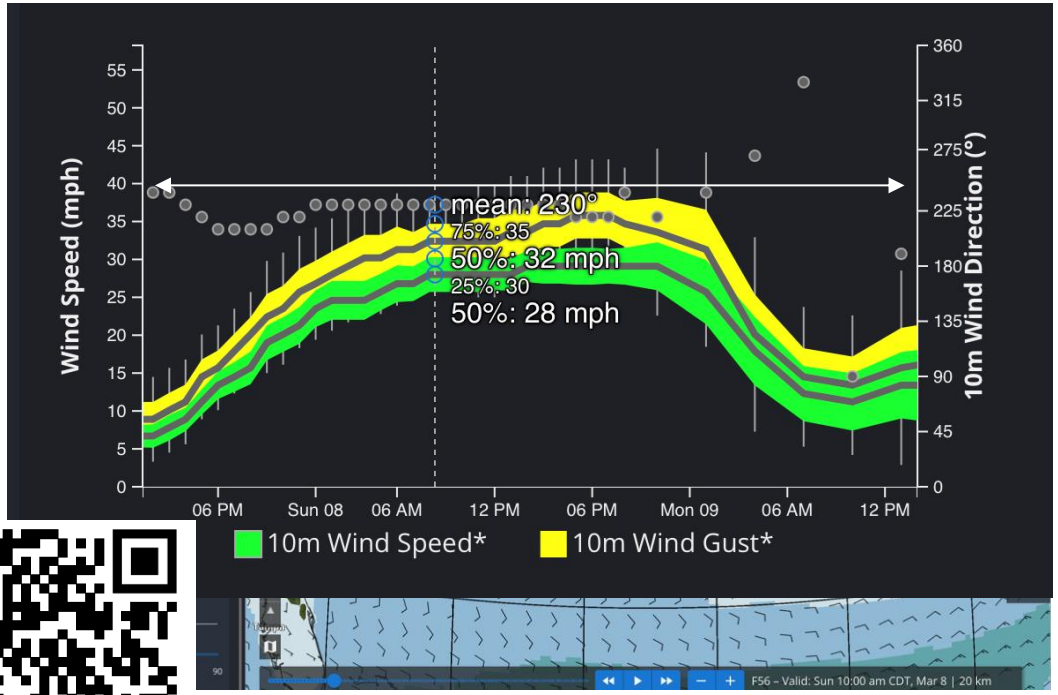
Watch Uncertainty Resolve as Forecast Hour Decreases

ECMWF model forecasts for Feb 23 12 UTC from forecast hour 108 to 24.



Risk Assessment with Ensembles

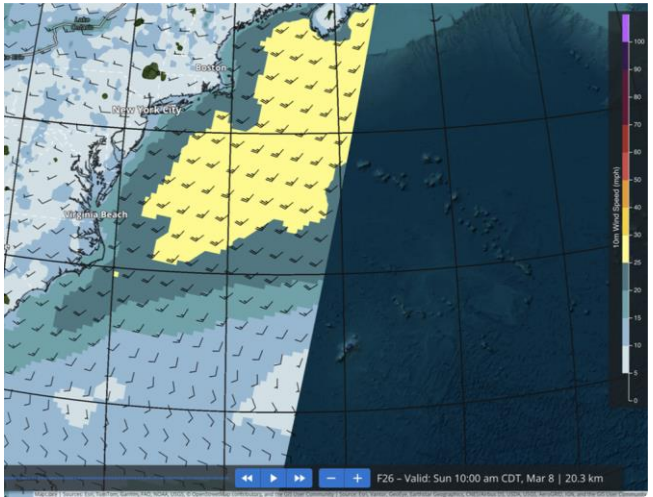
- Using Dynamic Ensemble Viewer
- Mean forecast wind : 25 kts
- What's the likelihood of >35 kts?
- https://sites.gsl.noaa.gov/desi



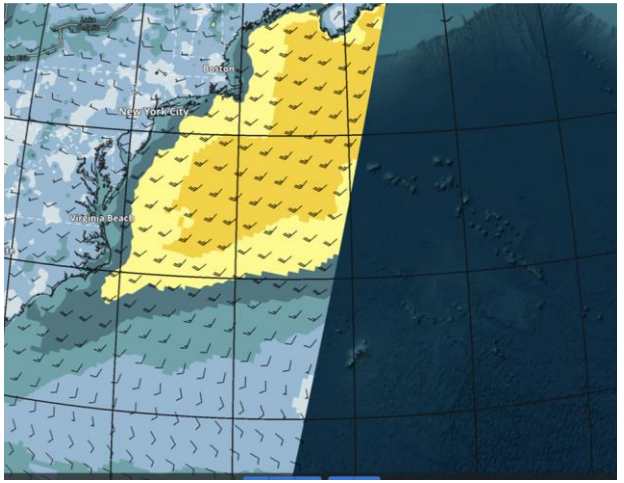
Using Ensemble Forecasts

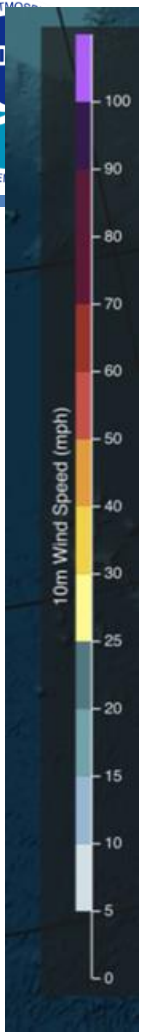
- Establish forecast confidence
- Quantify likely range of hazard magnitudes
- Risk vs reward: what's your probability of concern?

50% chance of exceedence



10% chance of exceedence





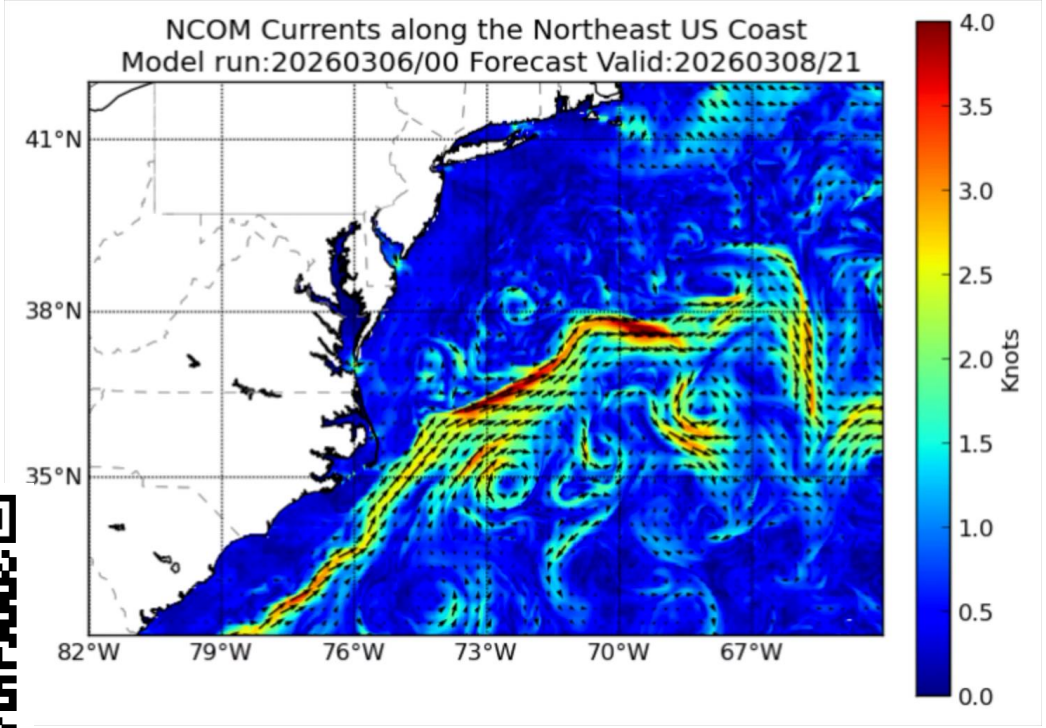
Adding the Details

Oceanweather.gov has great current forecasts from the NCOM.

https://ocean.weather.gov/Current_fcasts.php

Key is comparing to wave forecast direction and your route

At this point, no ensembles are available



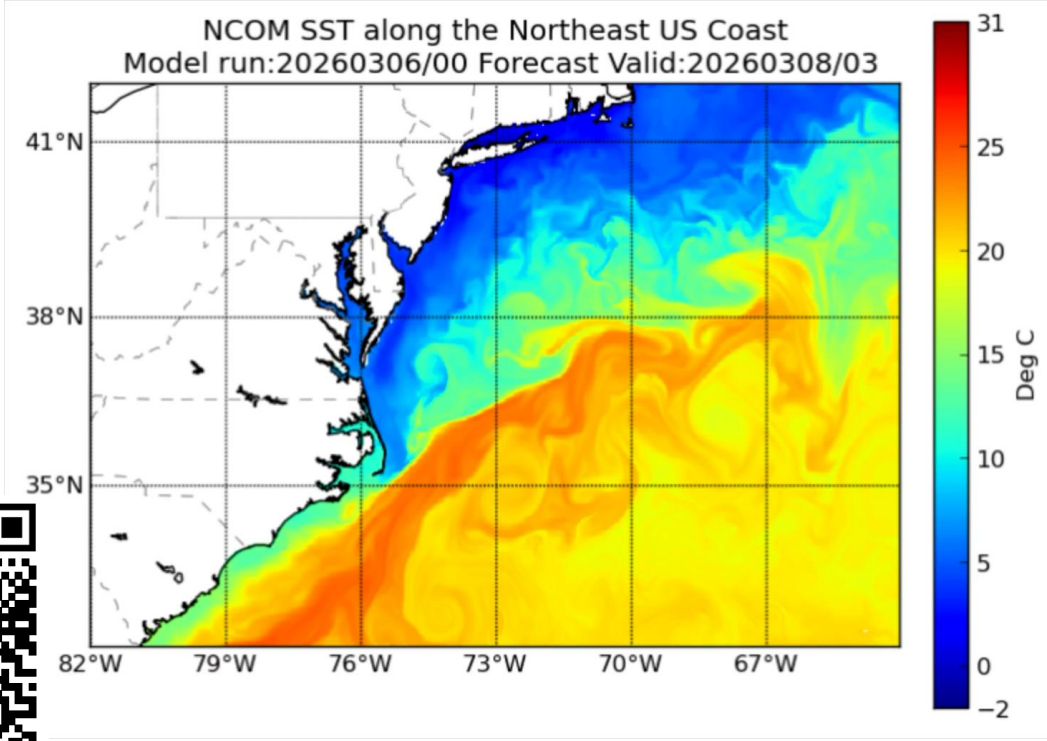
Adding the Details: SSTs

SST prediction from NCOM.

https://ocean.weather.gov/Current_fcasts.php

High Detail compared to other sites.

The key is comparing this with the temperatures aloft: the lapse rate



Adding the Details: SSTs

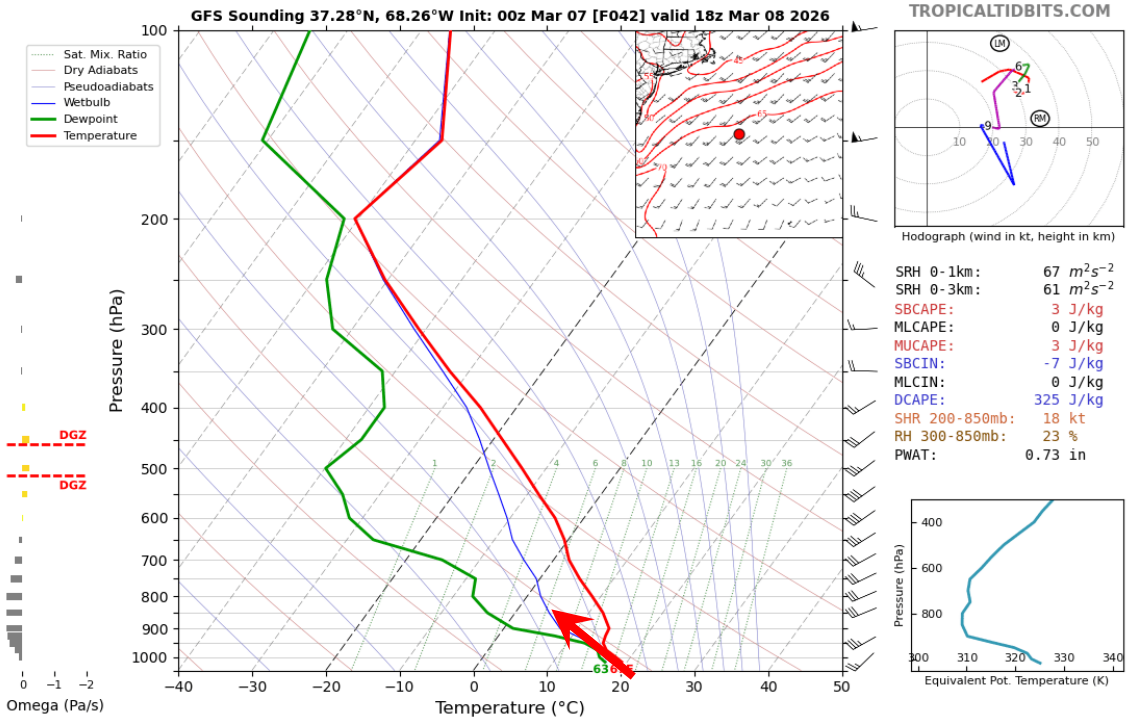
Take a 3D view of the forecast with soundings (in tropicaltidbits.com).

Note lapse rates:

Change in temperature with height.

Low lapse rates resists mixing higher winds aloft to the surface.

High lapse rates encourage mixing higher winds aloft to the surface.



Main points

- Know your climatology
- Consider the big picture with what you're used to viewing
- Consider the uncertainty - great sites for model output and ensembles
  - https://www.tropicaltidbits.com
  - https://sites.gsl.noaa.gov/desi
- Think 3-D (e.g., your lapse rate, stronger winds mixing down)
  - Tropicaltidbits.com
- Detailed ocean current and SST forecasts from Ocean Prediction Center
  - https://ocean.weather.gov/Current_fcasts.php

Thank you

- James.G.LaDue@noaa.gov