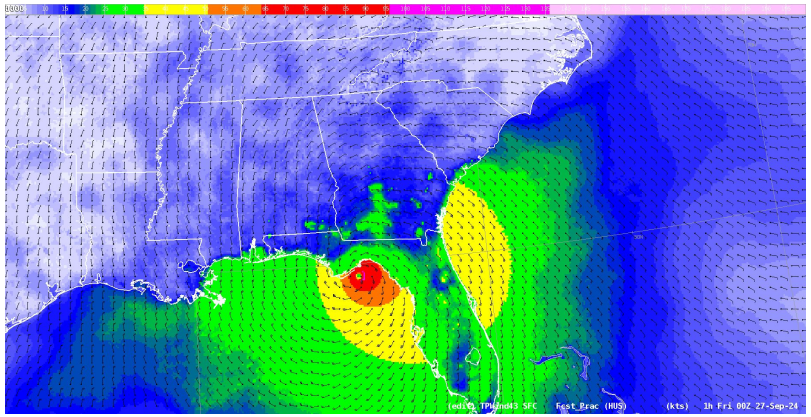
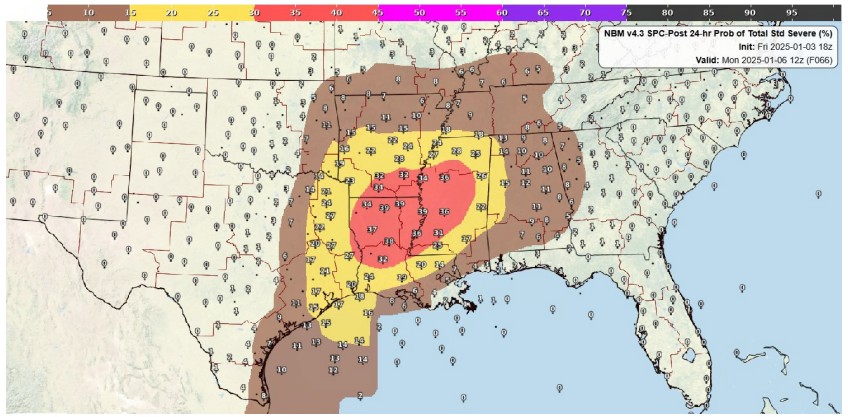
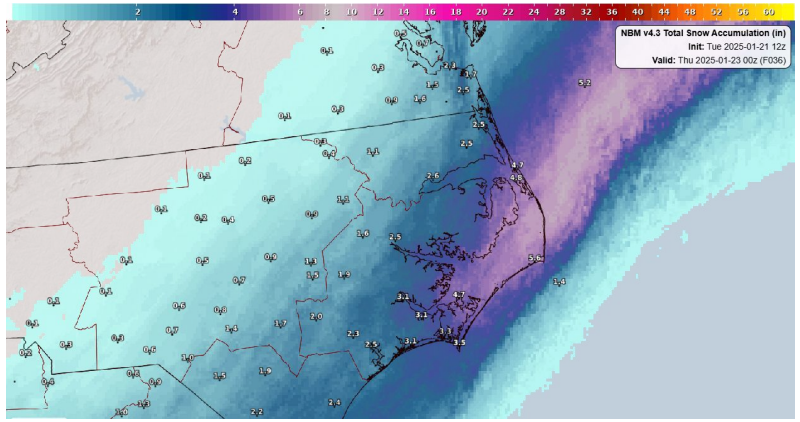






The National Blend of Models Version 4.3 Scientific Briefing to the NCEP Director

Geoff Manikin
NOAA/MDL/Statistical Modeling Division
27 January 2025

NBMv4.3 Developers

- Dave Rudack - NBM Team Lead
- Geoff Wagner - Tropical Cyclone Wind Feature Matching Work
- Robby James - Maintaining/Running NBM v4.3 on WCOSS
- Scott Scallion - Integrating SPC Products and Code Handoff to NCO
- Carly Buxton - Wet-Bulb Globe Temperature Work
- Greg Leone, Daniel Cobb - SLR Improvements to Snow product
- Adam Schnapp - Ceiling Change
- Brian Haynes - Evaluation and Web Page Support
- Mike Baker - Evaluation

Other Acknowledgements

- Dana Strom and Kevin McGrath - WSUP Viewer
- NBM Science Advisory Group (Jim Nelson, previous Lead; David Levin, current lead)
- Pablo Santos, Jessica Schauer, and Mark DeMaria (NHC)
- Many SOOs and field forecasters for valuable feedback
- Phil Shafer and Robby James (SBN coordination)
- Seth Binau, Logan Dawson, Matt Jeglum, Israel Jirak, Mark Klein, Eric Lau, David Levin, Gene Petrescu, Jordan Rabinowitz, and Pablo Santos - provided recommendations

Background on v4.3

- The major component of this upgrade is an update to the NBM Tropical Winds
- The original plan was to include those changes in NBM Version 5, but as the scope of v5 grew, the implementation target was pushed out to 2026
- To support the Days 4-7 Project, there was a need to get these tropical wind improvements into the NBM ahead of the 2025 hurricane season
- A new v4.3 upgrade was coordinated with NCO to include the tropical wind changes
- This v4.3 upgrade also gave us the opportunity to add new and updated probabilistic SPC severe weather products, including daily severe probabilities for the medium range. The SPC package just missed on being ready for the NBMv4.2 implementation in May 2024
- We were also able to add a few other very minor updates and bug fixes
- Pending a successful briefing today, implementation is targeted for April

Summary of v4.3 Changes

(1) Major improvements to the Tropical Cyclone Feature-Matched wind products. Instances of storms disappearing from the wind fields are removed, an adjustment based on the surface roughness length is used to create more realistic wind speeds over land, and wind direction is updated to be actually matched to the relevant feature

(2) Additional probabilistic severe weather products from the Storm Prediction Center

(3) Modifications to the snowfall to reduce too much melting in marginal temperature environments

(4) An updated wet-bulb globe temperature (WBGT) calculation to be consistent with NDFD

(5) A less heavy-handed approach to building ceiling when LAMP has cloud base height and the blended values do not

(6) A consistency check to ensure that deterministic wind speed cannot exceed the deterministic wind gust

Updates to Tropical Winds

- The NBM produces feature-matched tropical wind speed and direction products in which HAFS output is matched to the NHC track of the TC (WTCM)

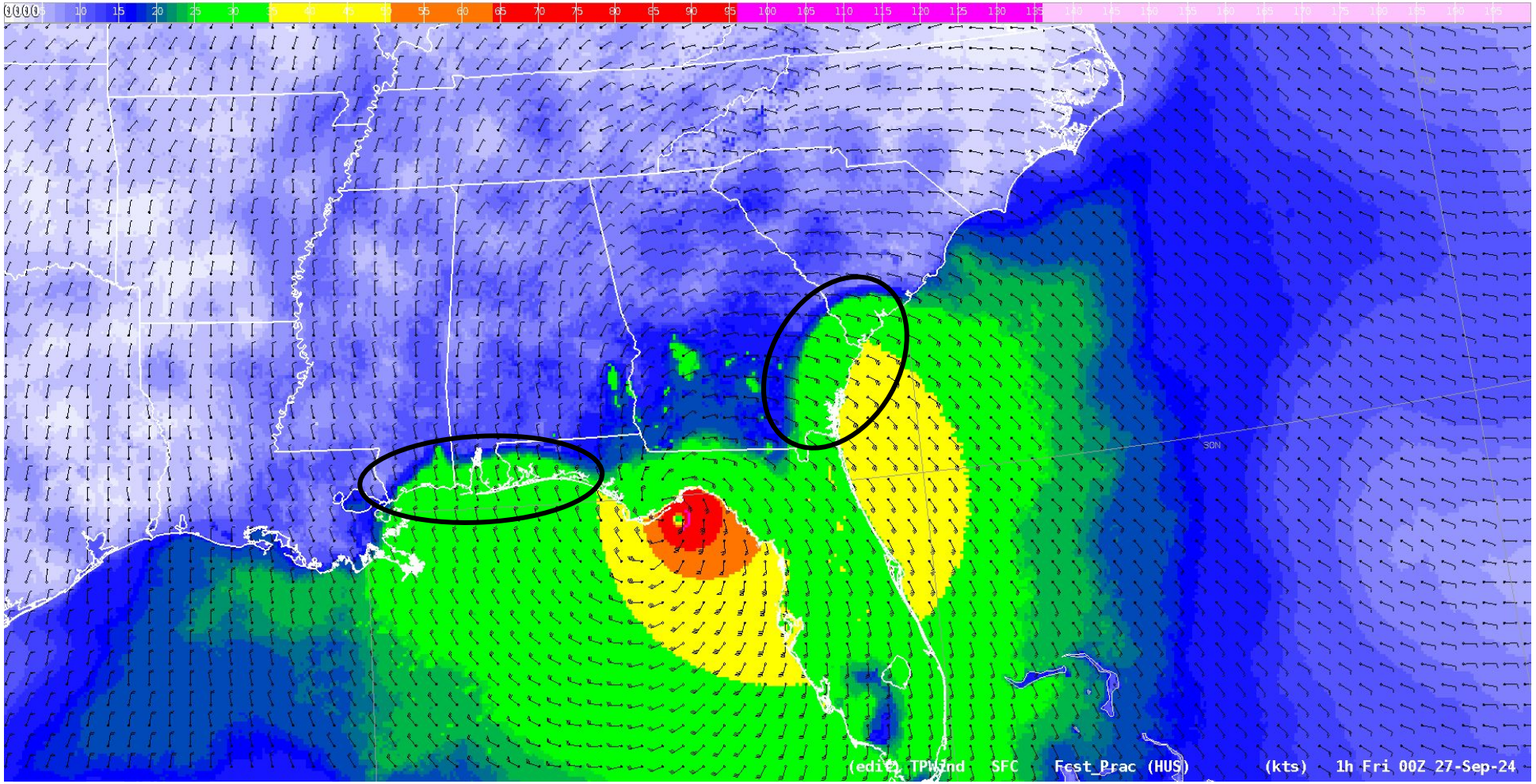
v4.3 CHANGES:

- Updated Matching Algorithm - Implement distance thresholds for matches, duplicate check, and improve feature identification for further speedup
- Added Land/Water adjustment of Direct Model Output (DMO) wind speed when it's displaced to match WTCM center
- Added U/V output for calculation of Feature Matched Wind Direction

Helene Example - Operational 4.2

07Z cycle
9/25/25

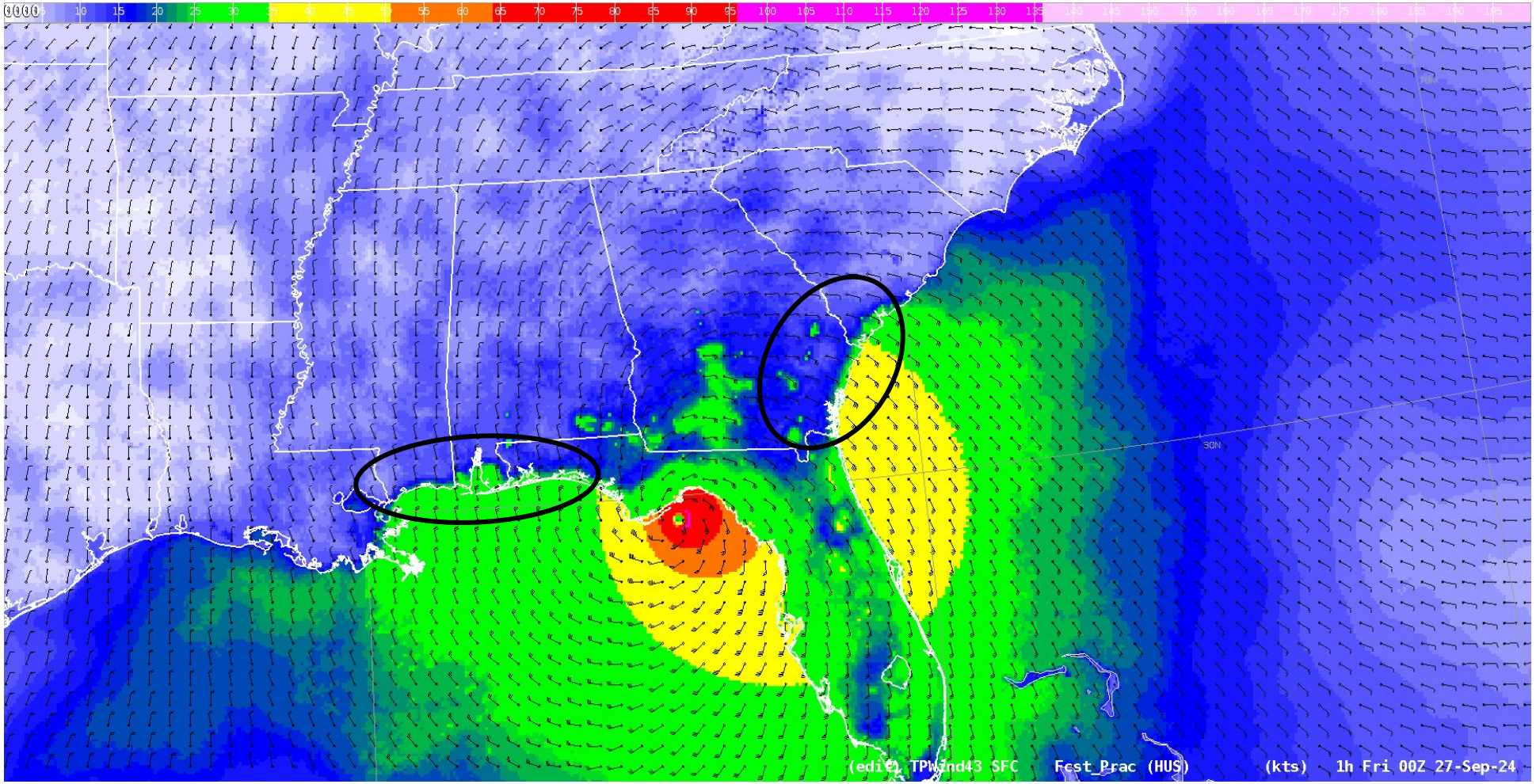
41h fcst
valid
00Z
9/27/25



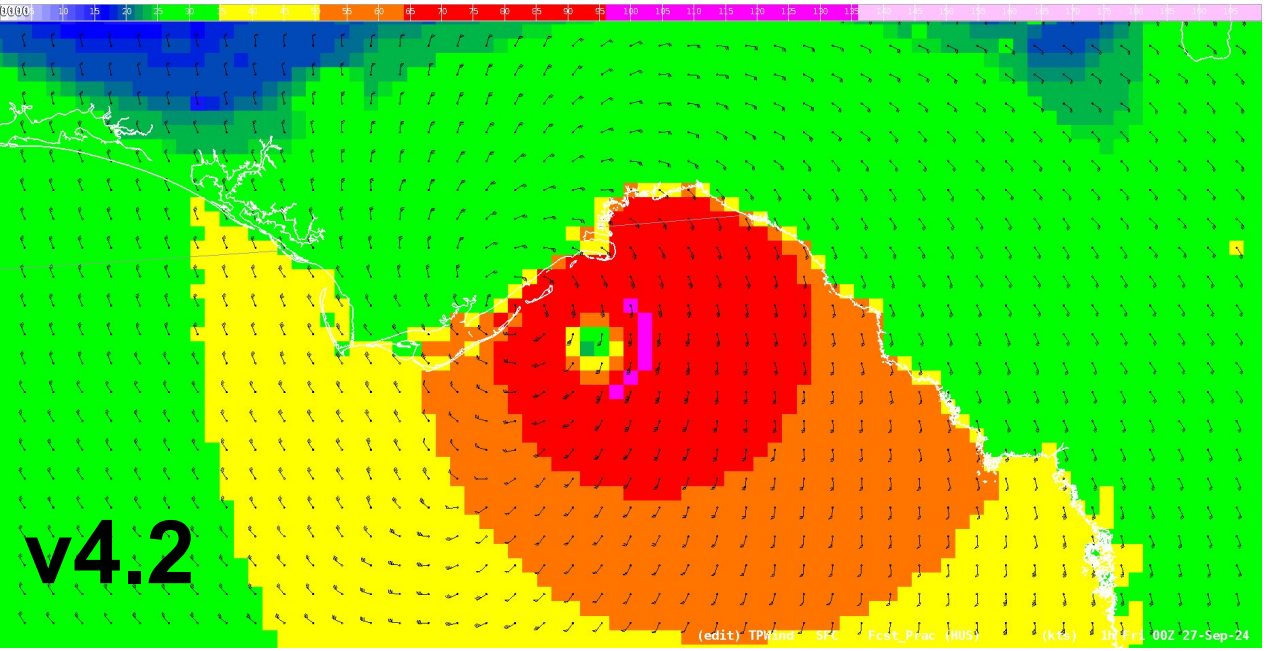
Helene Example - New 4.3

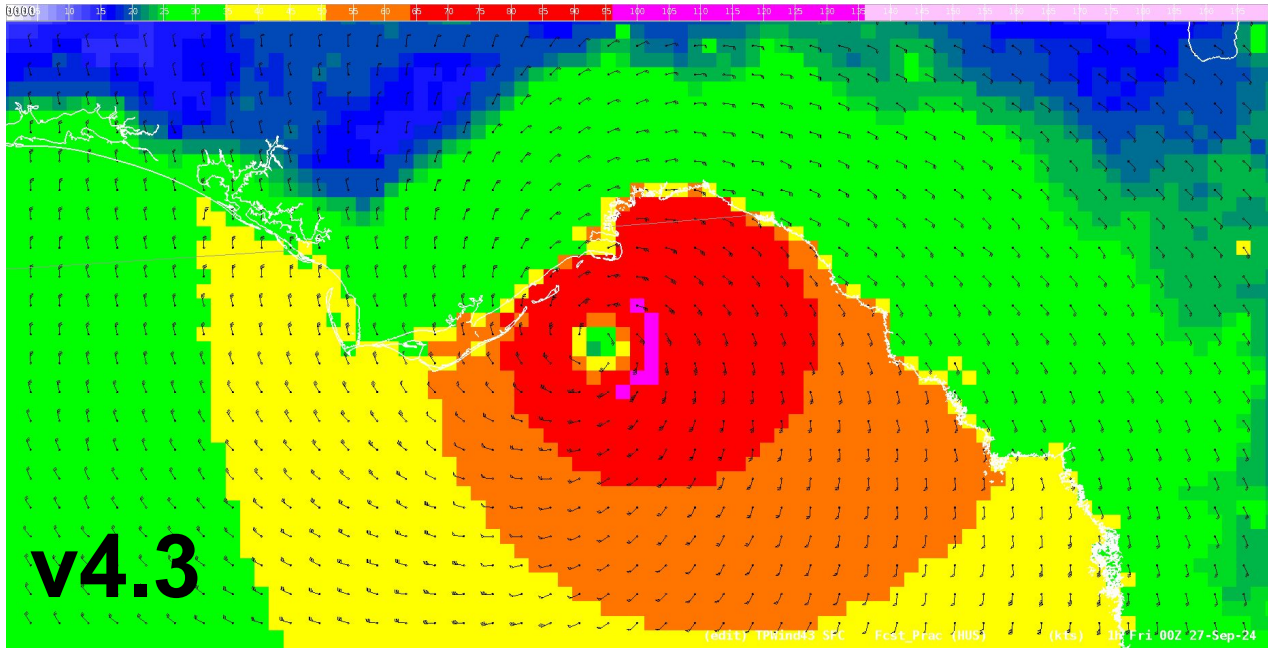
07Z cycle
9/25/25

41h fcst
valid
00Z
9/27/25



Tropical Wind Direction Example

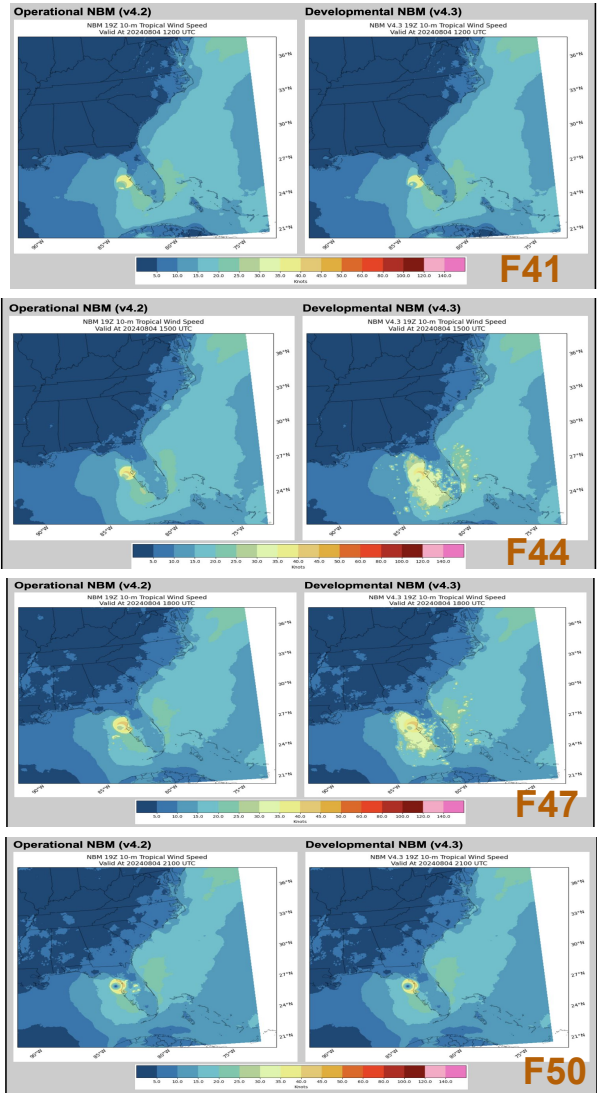




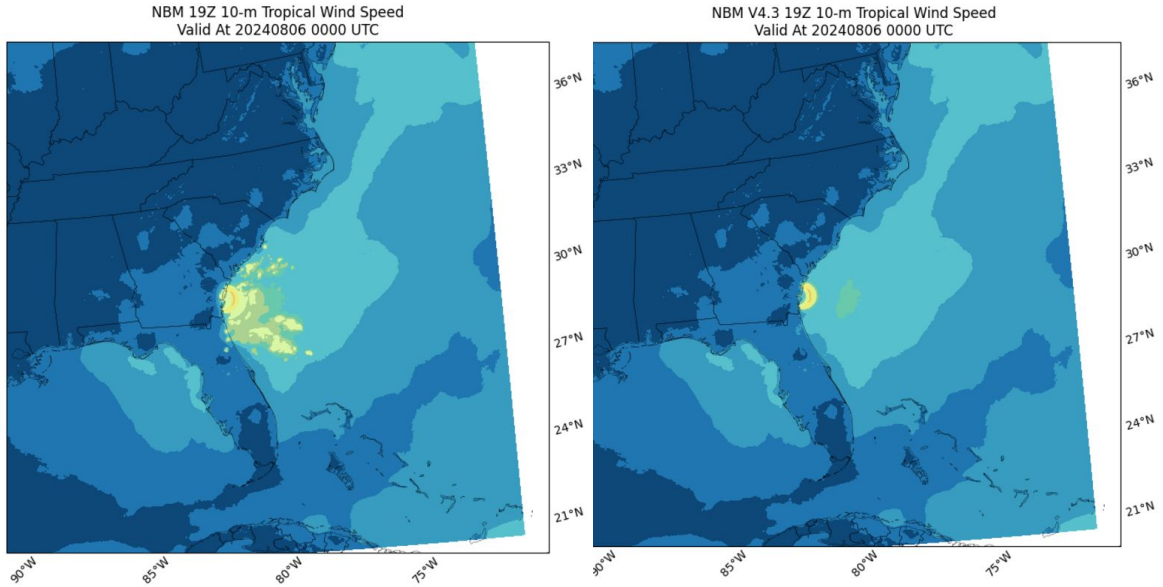
- Note the circulation in v4.2, displaced to the northwest of the eye
- The wind barb circulation in v4.3 is aligned with the eye

Updates to Tropical Winds

v4.2 **Debby** **v4.3**



Evaluators expressed concerns about 4.3 suddenly expanding the wind field around a TC, like in this example with Debby



But, we see also see examples in which the wind field suddenly expands in 4.2, while 4.3 remains more consistent

NHC noted that the issue of occasional unrealistic expansion of the wind field needs to be addressed in future versions, and MDL agrees

SPC Probabilistic Severe Guidance

- The NBM is used to disseminate SPC probabilistic severe weather guidance
- NBM currently outputs calibrated SPC probabilities for each severe weather hazard (wind, hail, tornadoes) for Day 1, covering 4 and 24-hour periods
- They are generated from SREF and HREF output and are generated for the 03, 06, 15, and 18Z cycles

- Changes in v4.3
  - The individual hazard probabilities now cover Day 2
  - The GEFS replaces the SREF as the lower-resolution contributor
  - The products are also available for 00 and 12Z (in addition to the other 4 cycles)
  - An ML combined hazard probability is available for each day covering the Days 3-8 period (available for the 06/18Z cycles)

- SPC notes that this update notably improves the POD at lower thresholds for the calibrated probabilities

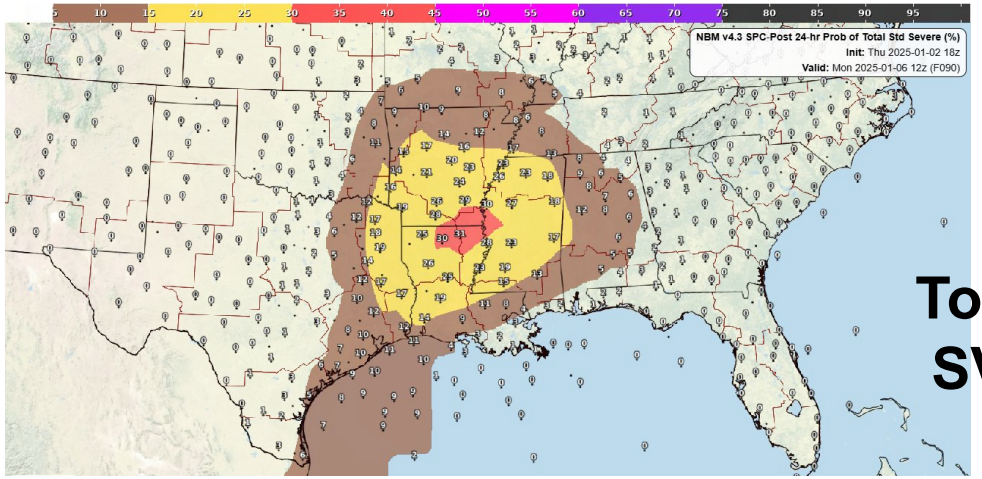
SPC Probabilistic Severe Guidance

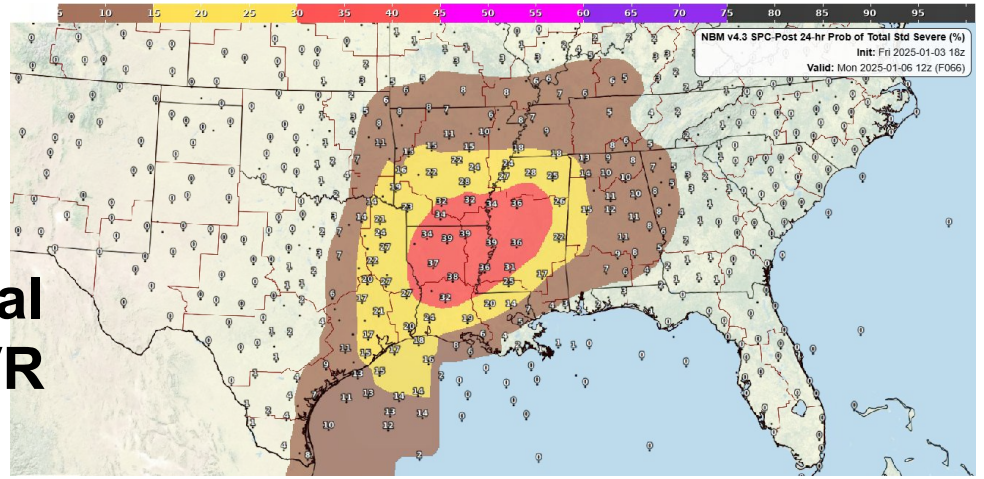
New Days 3-8 Product

Day 4

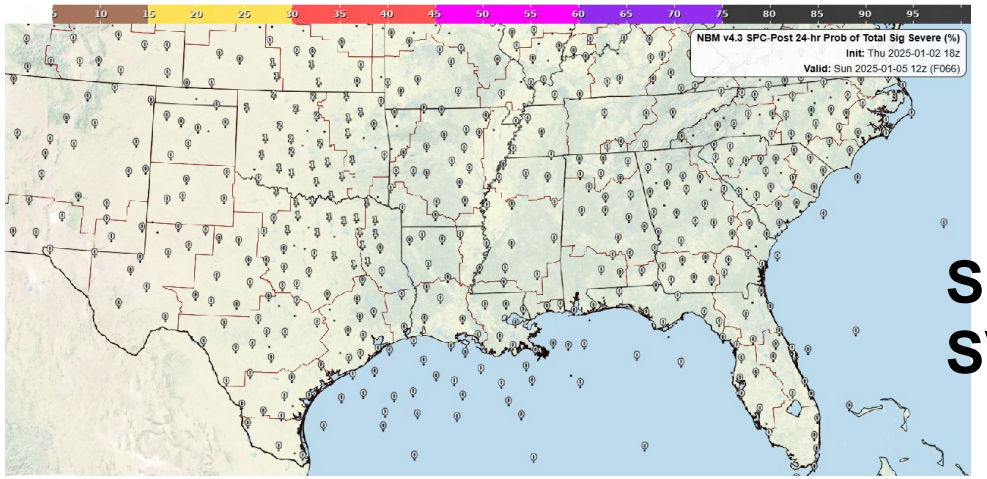
Day 3

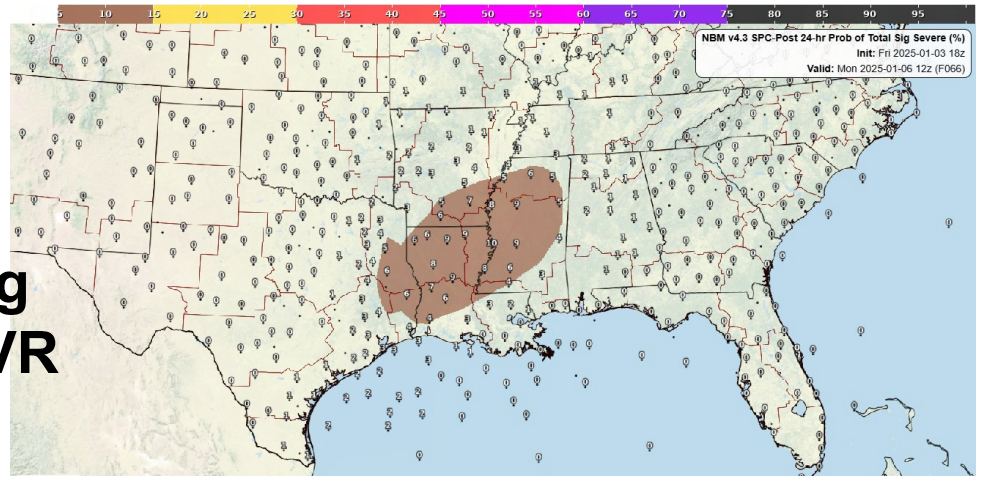
Total SVR

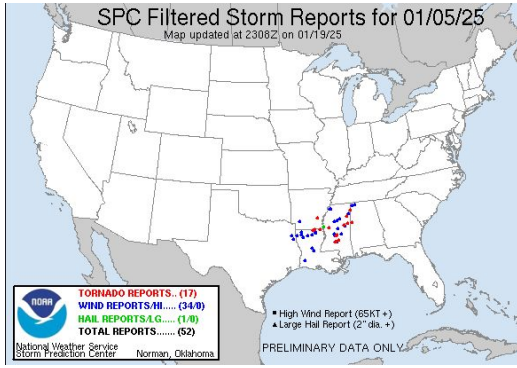




Sig SVR

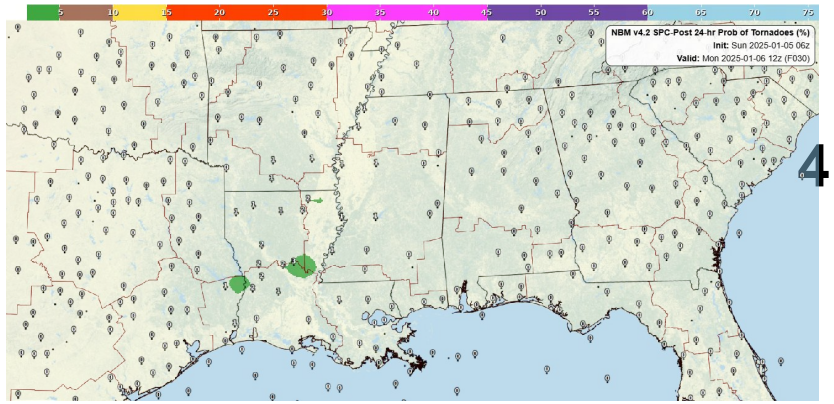




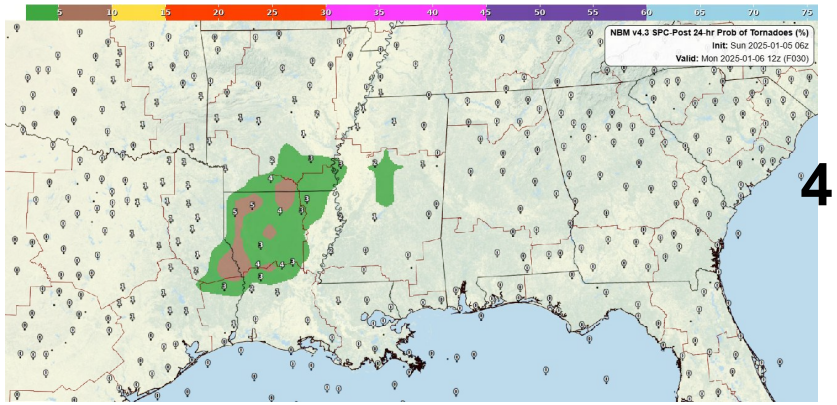


SPC Probabilistic Severe Guidance

TOR

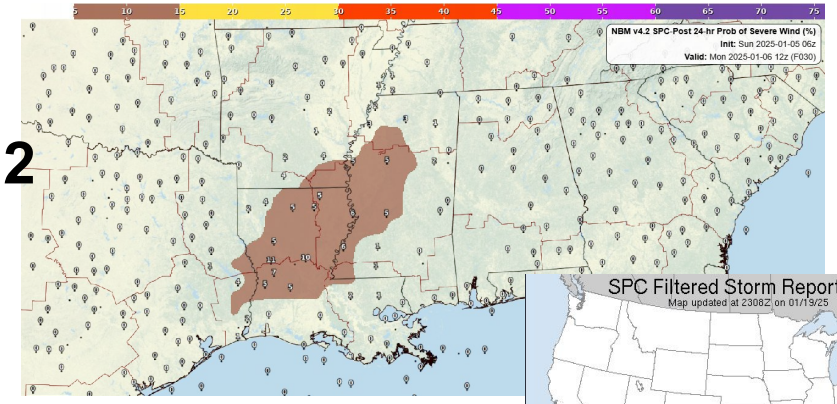


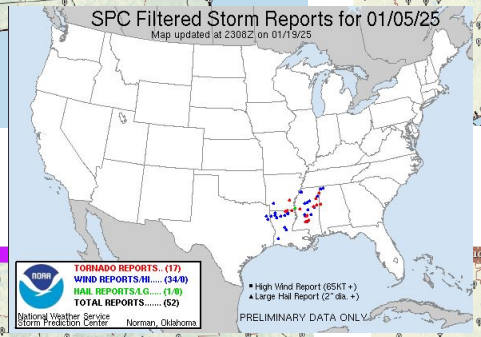
4.2

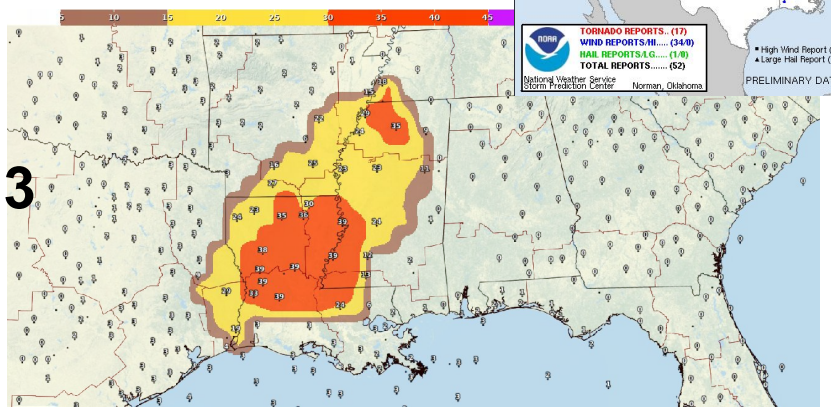


4.3

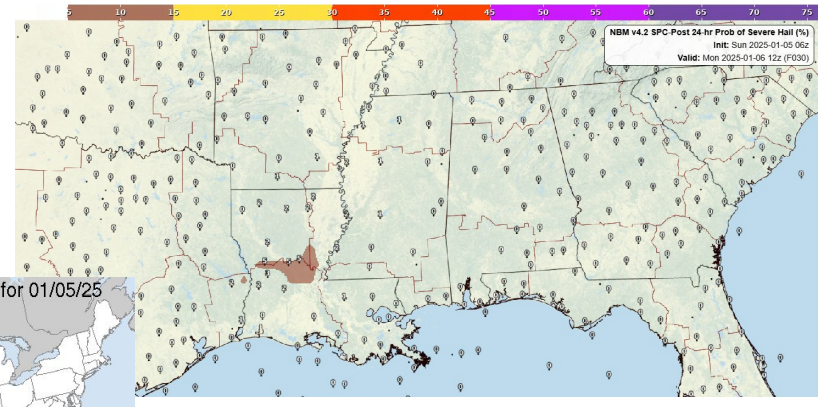
WIND

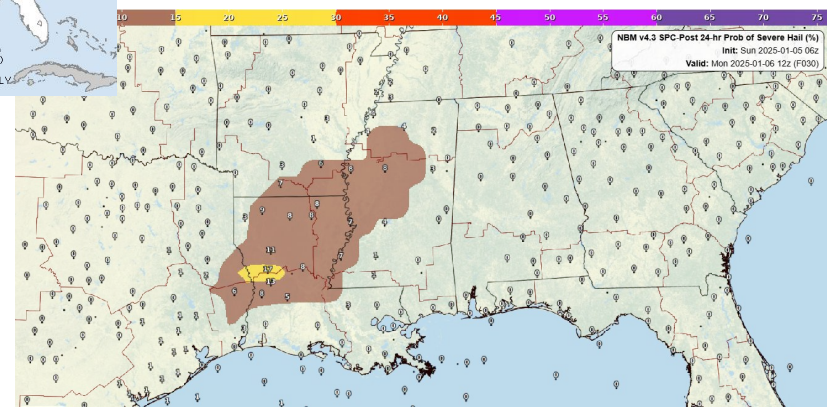






HAIL



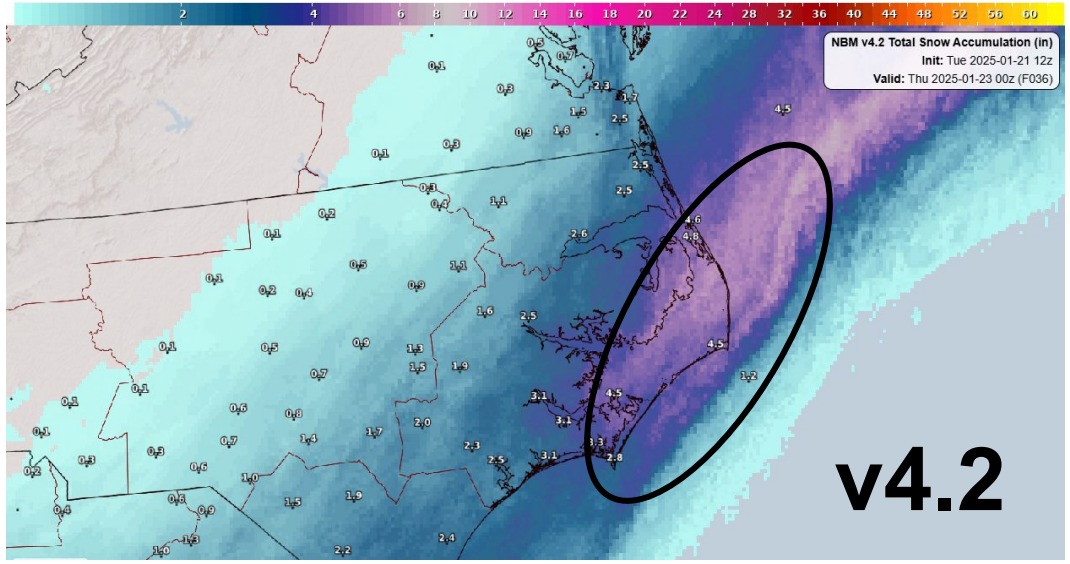


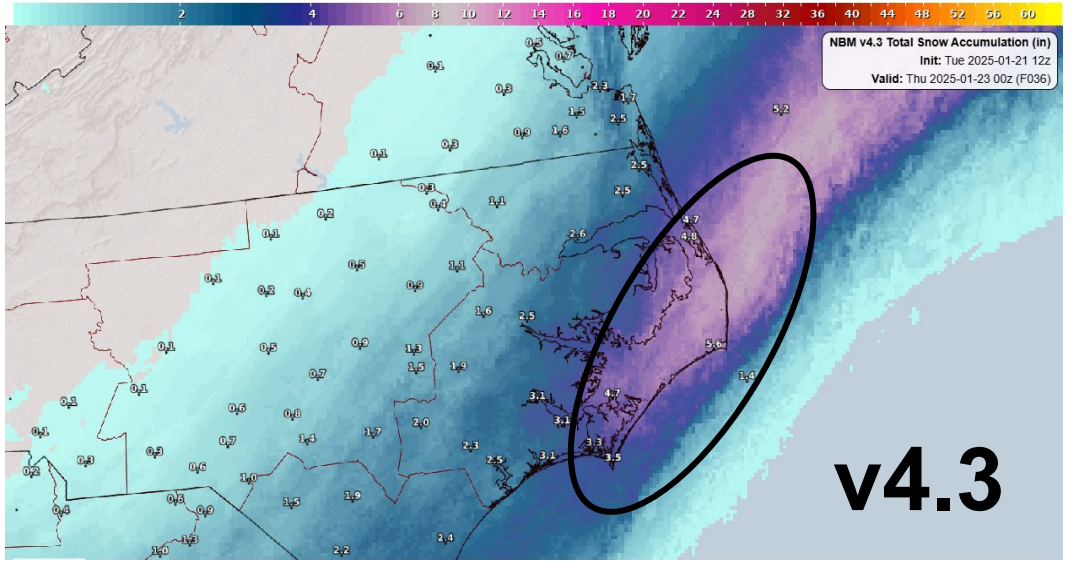
Revised Short Range Product

Snowfall Changes

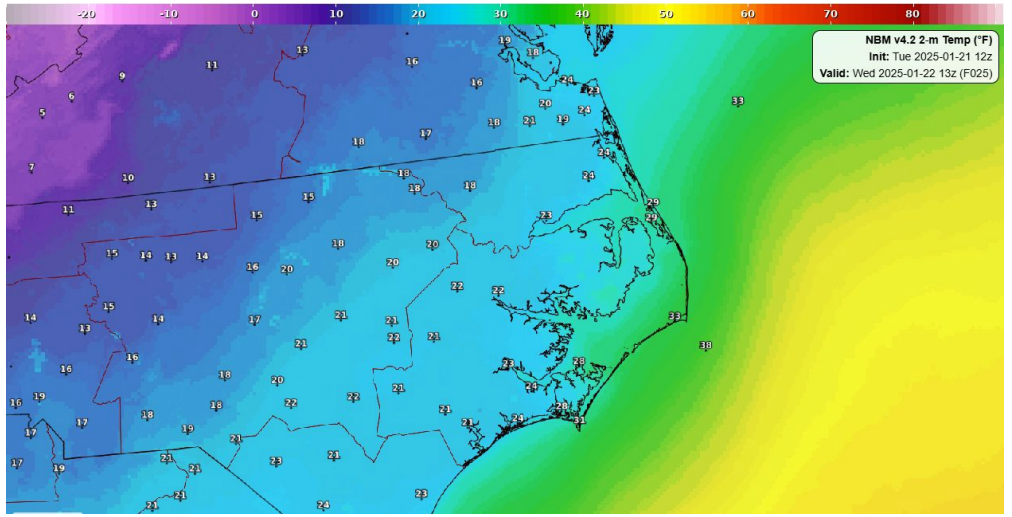
- A Cobb method for melting snowfall was added to NBMv4.2; it allows snow to accumulate in environments with marginal temperatures but good snowfall rates
- There were examples last winter, however, of snowfall being erroneously reduced when forecasted temperatures were warmer than observed
- A Cobb update allows for the possibility that the forecasted temperature is too warm and is less aggressive with melting
- This change was made in ForecastBuilder (FB) towards the end of last winter; this update makes the NBM consistent with FB

Snowfall Examples





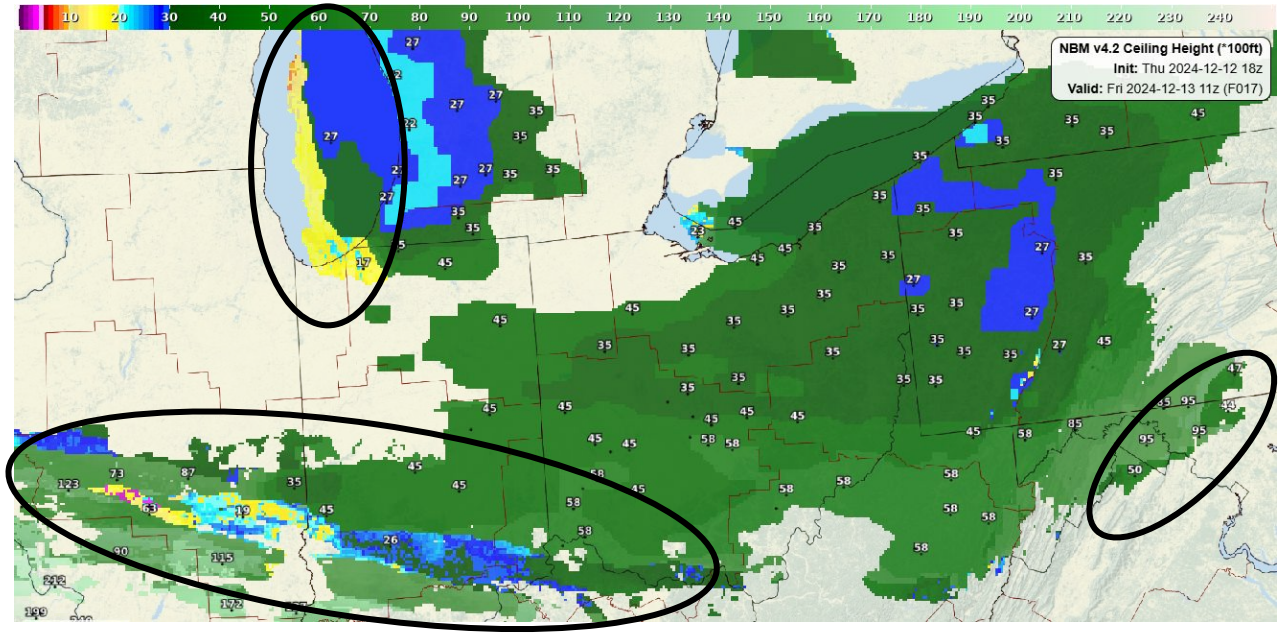
- Amounts are increased in 4.3 where the temperatures are marginal

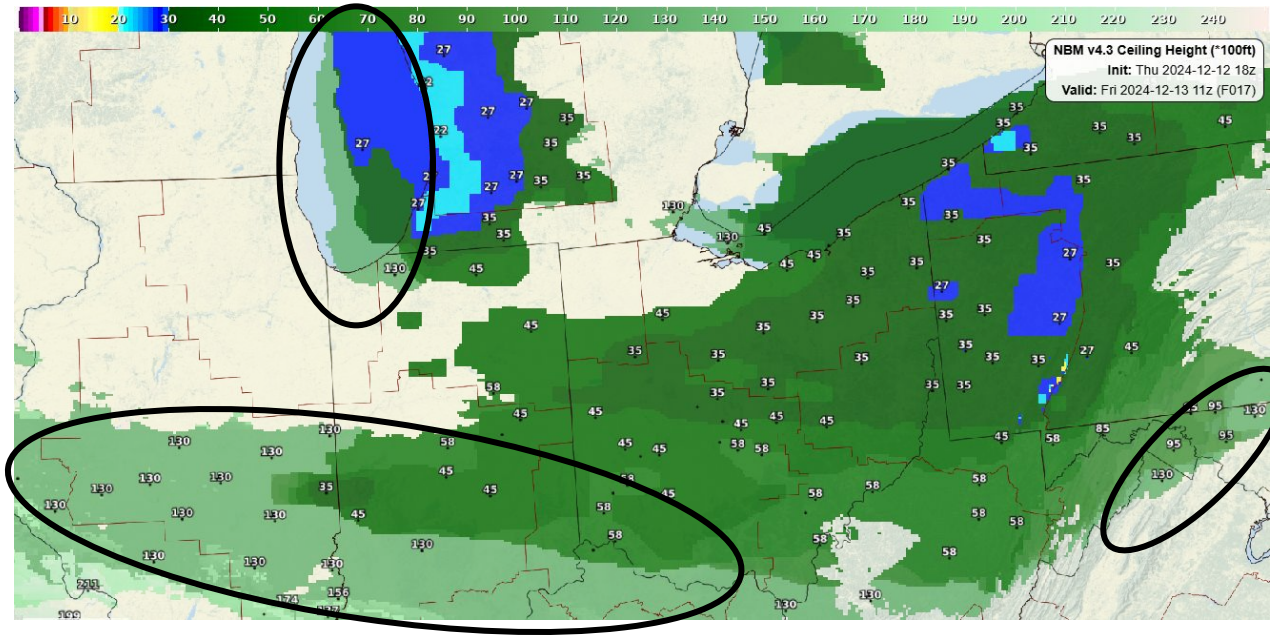


Cloud Ceiling Consistency Check

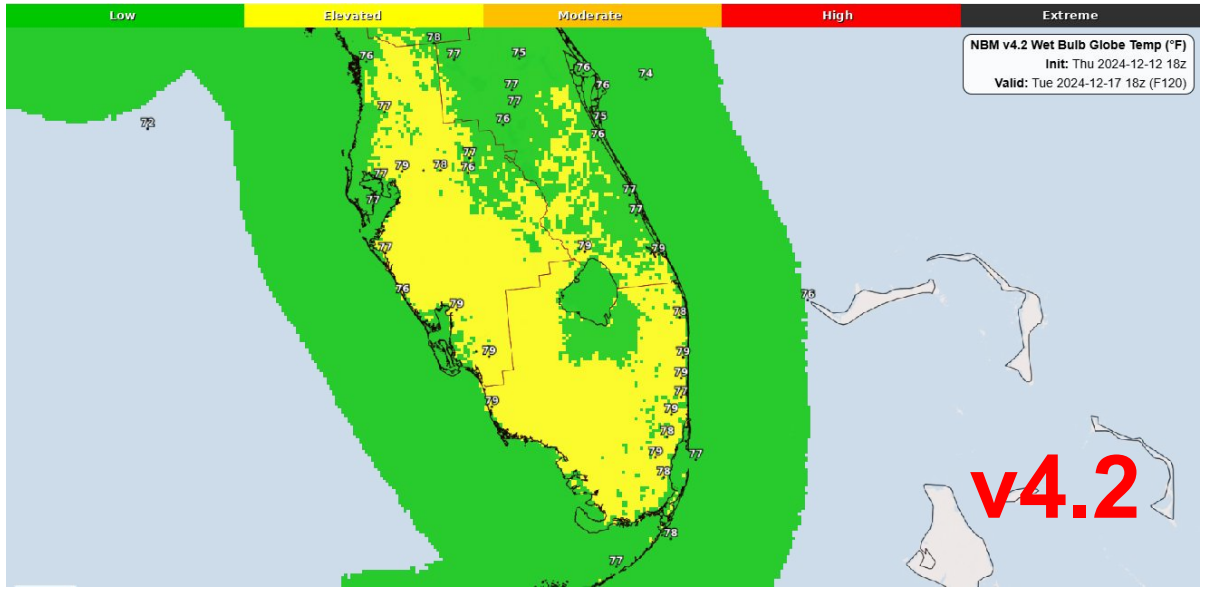
- NBM Cloud Ceiling over CONUS is the GLMP product through forecast hour 36 and then a mix of NAM and GFS MOS through forecast hour 84
- A check, however, is performed against the sky cover field, and if that value is greater than 57% at a point with no GLMP ceiling, the cloud base height field is used to build a ceiling at that point
- Based on feedback, we do not want to introduce low ceilings at a point where the GLMP product shows no ceiling
- A check is therefore added in v4.3 to not allow an introduced ceiling value to be lower than 13,000 feet

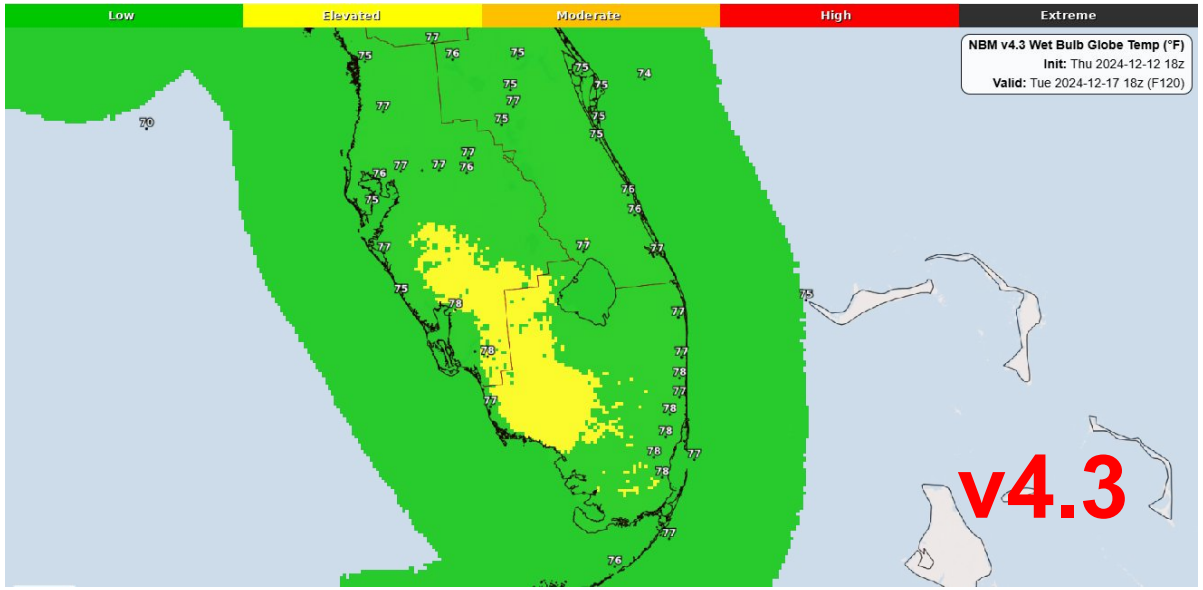
Ceiling Check Example





Wet Bulb Globe Temperature Example

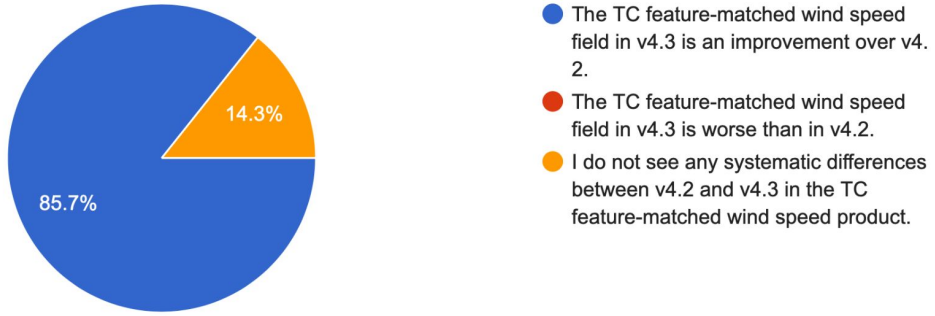




Field Recommendations - Tropical

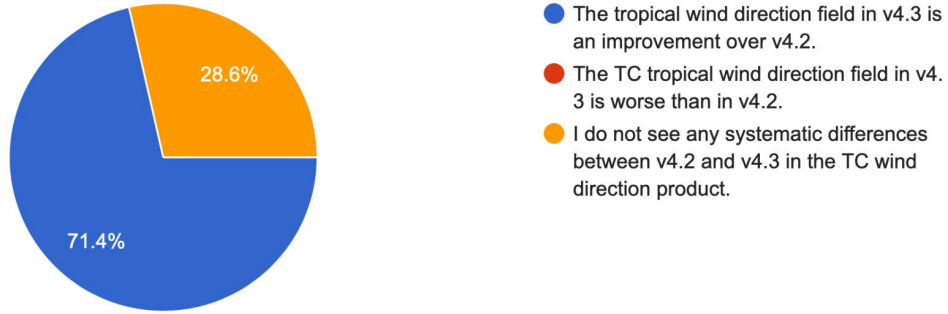
With regards to the updates to the tropical cyclone feature-matched winds, based on the available case studies on the TC graphics site, please assess the changes.

7 responses



With regards to the updates to the tropical cyclone feature-matched wind direction, based on the example in the overview presentation, please assess the changes.

7 responses



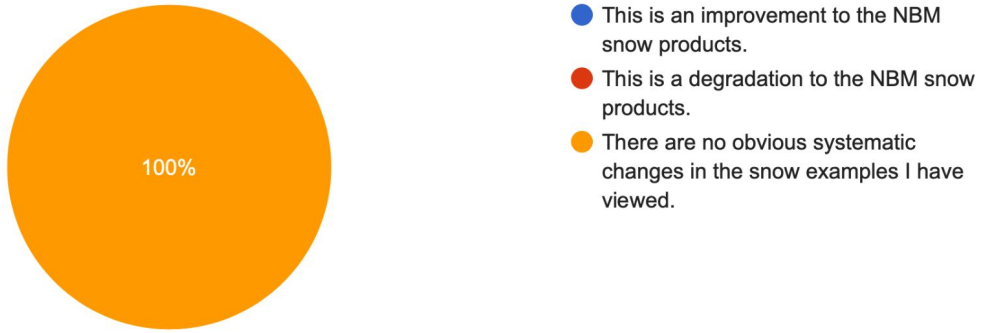
From NHC: The aligning of the storm vector circulation with the wind speed center, and the adjustment of the land/water masks in the feature matched hurricane models/GTCM Tropical wind are **two huge deficiencies in version 4.2 that have been addressed with version 4.3**. This alone is reason enough for us to vote in favor of this moving to operations in NBM 4.3. The tropical feature matched wind field still needs work to address sometimes unrealistic expansions of the wind field that can happen from one cycle to the next. Or to address the fact that sometimes between the regular blended Wind Field and the feature matched tropical wind you can end up with multiple centers. When that happens those using it to initialize their wind grids might need to do substantial editing or go with an alternative to the NBM. But these issues were there with 4.2 too. They are not new. But **the two issues above that have been fixed with 4.3 make 4.3 Tropical Wind a viable option for use operationally** when the regular blended Wind and the tropical wind are closely aligned. **Before it was not at all viable to use with version 4.2. Therefore, we vote in favor of this moving to operations.**

From WPC: The tropical wind field improvements are very important as WPC transitions to creating the operational grids for the Day 4-7 forecast period.

Field Recommendations - Winter

Minor updates to the Cobb melting technique have been introduced in the computation of snow accumulation and snow-to-liquid ratio, to account f...der.) What are your impressions of this change?

6 responses



From Central Region: Events that were analyzed by myself and a field SOO did not show substantial changes or improvements in snow accumulation, but **in general feel this change is indeed an improvement to better align with ForecastBuilder output (important), and should provide some necessary improvements in marginal thermodynamic environments if rates are heavier (an area of needed improvement in past NBM versions)**. I did see an event from outside our region where it appeared some minor improvements were being seen with this change.

From WPC: We didn't notice much substantial difference with the winter weather fields, and since the change makes it in line with ForecastBuilder, we don't have a problem with it.

Field Recommendations - Ceiling

NBM v4.3 introduces a qualifier on the ceiling height consistency check with NBM sky cover to no longer reduce ceiling heights to below 13,000 ft wh...eiling. What are your impressions of this change?

6 responses

From Eastern Region: As for the NBM ceiling product, **this appears to be an improvement, especially in areas of model uncertainty with sky cover preventing erroneous areas of low ceilings surrounding higher ceilings.** This was observed in a few lake effect events with a swath of ~3500 ft ceilings flanked by 500-1500 ft ceilings on either side (with lower sky cover). While these low ceilings may still be possible but no longer visible in the v4.3 output, this could still be accounted for with probabilistic output.

Field Recommendations - Summary

Region	Recommendation	Key Remarks
NHC	Implement	The alignment of the storm vector circulation with the wind speed center, and the adjustment of the land/water masks in the tropical wind are two huge deficiencies in version 4.2 that have been addressed with version 4.3 and make 4.3 a viable option for operational use. The tropical feature matched wind field still needs work to address sometimes unrealistic expansions of the wind field and other issues
WPC	Implement	No noted substantial difference with the winter weather fields, and fine with making the computation consistent with ForecastBuilder. The tropical wind improvements are very important as WPC transitions to creating the operational grids for the Day 4-7 forecast period.
SPC	Implement	This update removes the dependency on the soon-to-be-retired SREF. The NBM addition of the GEFS machine-learning probabilities (MLP) for severe weather brings the widely used and popular CSU MLP products into NWS operations. This is an example of a successful research-to-operations transition.
OPC	Implement	OPC supports the v4.3 upgrade and looks forward to the continued development towards NBM Version 5

Field Recommendations

Region	Recommendation	Key Remarks
Eastern Region	**Implement**	There are improvements in snow accumulation, but overall changes to headlines would likely be minimal. While they don't have a large data sample to say that it does or does not add value, it is believed that these are good changes that will assist forecasters going forward.
Central Region	**Implement**	Consistency checks for wind gust being less than speed is a needed consistency.
Western Region	**Implement**	Proposed ceiling change is an improvement to the product.
Southern Region	Unable to Participate	

Field Recommendations

Region	Recommendation	Key Remarks
Alaska Region	**Implement**	Winter changes have made improvements in the probability fields in the mid range.
Pacific Region	**Implement**	Hopes that the tropical wind improvements will translate to TCs in the Pacific.

- That said, a common theme on the evaluation forms was that while the NBM stakeholders recommend implementation of v4.3, there is a need to make significant improvements to wind and gust in v5.0
- SMD completely understands this charge and will make this a priority

The Floor is Open

Opportunity for evaluators to briefly speak

Beyond v4.3

- Version 5.0 is targeted for Spring 2026 and will feature many science improvements and added products
- 5.0 will be a huge step towards making the NBM fully probabilistic
- PRO-GUIDES team is working to plan Next-Gen MDL post-processing system

Summary

- There is clear support for the tropical wind changes to support the Days 4-7 Project
- This implementation gets them into operations for the 2025 TC Season and gets the severe wx probabilities into operations for much of the 2025 Severe Wx Season
- The smaller changes all earned either positive or neutral feedback

• OD Briefing	1/27/25
• Code Delivery	1/28/25
• SCN Issuance	3/17/25
• Implementation	4/26/25

MDL requests the NCEP Director to approve proceeding with the planned implementation of NBMv4.3

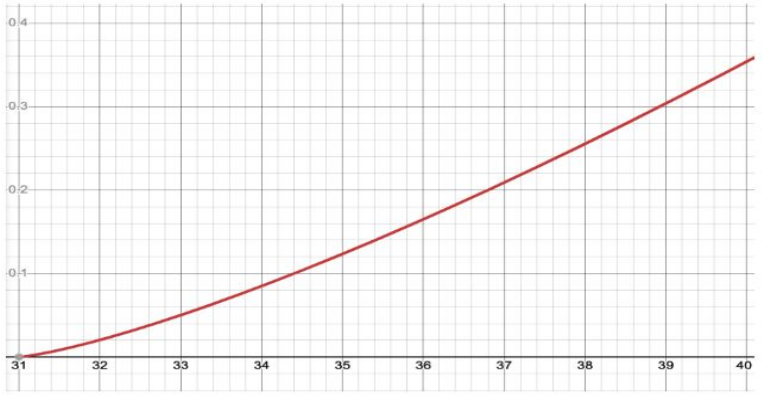
Extra Slides

NBM V4.2 Snow Melt Function for “Warm” Snowfall

Experiment 1: Steps to incorporate SLR correction to account for melting snow:

- Calculate each “cloud base” SLR and blend as previous.
- Calculate potential snow melt for falling snow based on the following equation:

$$QPFmelt = \left[\frac{(0.5Tsfc - 15.50)}{10}\right]^{1.3}$$



- Revise the blended SLR as:

$$SLR_{new} = SLR \times \left[\frac{QPF - QPFmelt}{QPF}\right]$$

If QPF_{melt} > QPF set SLR_{new} to zero, i.e. there will be no snow accumulation.

- Adjust logic to allow for a p-type of snow with temps ≤ 40F.