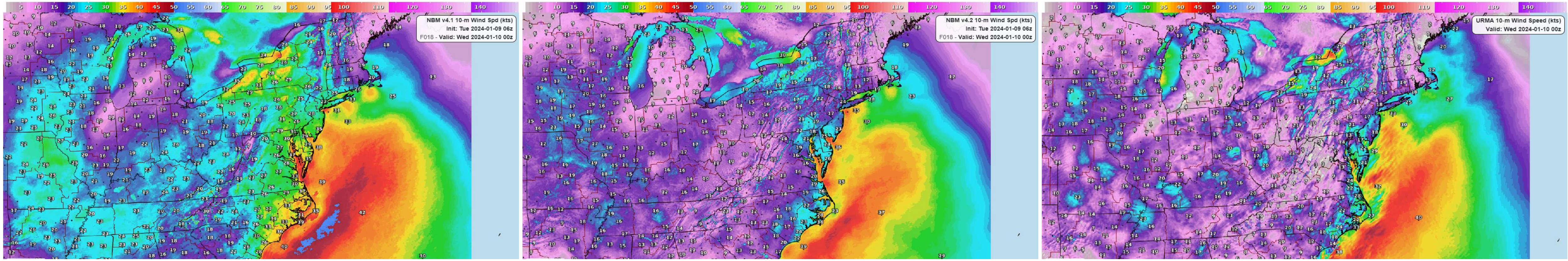


The National Blend of Models Version 4.2

Geoff Manikin and Dave Rudack
Statistical Modeling Division   NWS/OSTI/MDL

MEG Webinar

9 May 2024

NBMv4.2 Developers

- Dave Rudack - Project Lead
- Robby James - QMD Prob 10m instantaneous wind speed/gusts, Maintaining/Running parallel runs
- Carly Buxton - Fire Weather (Mixing height changes) and Evaluation
- Eric Engle - QMD PQPF Smoothing/Removing Lattice features in the snow/ice product
- Daniel Cobb - SLR Improvements to Snow product
- Scott Scallion - Operational NBM and NCO Code Handoff
- Greg Leone - SLR Improvements and Evaluation
- Mike Baker - Wet Bulb Downscaling for Snow/Ice product and Evaluation
- Adam Schnapp - Aviation Elements
- Geoff Wagner - Tropical Feature Matching timing improvements
- Steven Levine, Mark Antolik - Evaluation
- Brian Haynes - NBM Web Page Support and Evaluation

Other Acknowledgements

- Dana Strom - WSUP Viewer and Verification
- John Wagner and Tamarah Curtis - Verification
- NBM Science Advisory Group (Jim Nelson, Lead)
- Andy Just (formerly of CRH SSD)
- Brian Miretzky (AFS)
- Sarah Perfater (MDL Science Officer and Acting SMD Chief during part of v4.2 development period)
- Judy Ghirardelli (Acting SMD Chief during part of v4.2 development period)
- Bruce Veenhuis (WPC)
- Many SOOs and field forecasters for valuable feedback

Notable Changes in Version 4.2

(1) New probabilistic **Quantile Mapping-based (QM) 10m instantaneous wind speed and wind gust** percentiles and exceedance values (CONUS)

(2) **Elimination of “lattice-like” features in the NBM blended snow amount guidance** by introducing smoothing to the European Centre for Medium-Range Weather Forecasts, Ensemble (ECMWFE), Global Ensemble Forecasting System (GEFS), and Short-Range Ensemble Forecasting System (SREF) QM precipitation amount Cumulative Distribution Functions (CDFs) (CONUS, Alaska)

(3) **Modification of the Snow Liquid Ratio (SLR) calculation** by taking into account the melting of snow where temperatures are at or above freezing at the surface and removal of the 25% reduction factor to each model input SLR value (CONUS, Alaska)

(4) **Removal of blocky winter features** (removal of parent NAM from winter suite)

(5) **Improvement in Precip Type Probability** Fields

(6) Correction to **Mixing Height calculation, now dependent upon URMA surface terrain height** rather than the RAP model surface height (CONUS)

Quantile-Mapped Inst. Wind/Gust

- Instantaneous quantile-mapped wind and gust are added to the 00/06/12/18Z NBM cycles in response to a high speed bias in v4.1, as well as fire weather and IDSS needs
- **Scientific approval to handoff code to NCO was given by NCEP Director in early September**
- The full v4.2 wind and gust statistics looked great, but a significant low speed bias for higher thresholds was identified post-briefing
- Based on discussions with the NBM Science Advisory Group (SAG), **SMD decided to try to address the low wind speed / gust bias before handing off code to NCO**
- **Code changes were made, and a secondary evaluation period was conducted between October 2023 and mid-January 2024**
- The supplemental evaluation period was successful, and scientific approval for the updated package was obtained in late January
- Implementation is now set for 15 May

Winds

- **Quantile mapping of instantaneous wind speed and gust was introduced in NBMv4.2**
- Wind speed and gust stats were overall improved, but most of the improvement was for light wind speeds; a significant low speed bias was found for higher wind speeds

- The quantile mapping for wind speed used a single analysis CDF for each hour of the day, leading to small sample sizes, especially for stronger wind speeds during the late night / early morning
- Testing was performed with using a single analysis CDF covering the entire day, but this had the undesirable effect of reducing the wind speeds during “peak wind hours” (afternoon)
- SMD, with input from SAG members, instead decided to again create an analysis CDF for each hour, with flexible time windows (using obs from multiple hours) used to increase the sample size.

00z	01z	02z	03z	04z	05z	06z	07z	08z	09z	10z	11z	12z	13z	14z	15z	16z	17z	18z	19z	20z	21z	22z	23z
7	9	11	13	13	13	13	13	13	13	13	13	13	13	11	9	7	7	7	7	7	7	7	7

This chart shows how many hours are used to create the analysis CDF at each hour of the day. For example, at 09Z, a 13 hour window is used here, meaning that analysis data is used from 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, and 15Z to create the 09Z analysis CDF

Winds

- The wind speeds for the peak wind hours, however, were still too weak due to sampling too much into the morning and evening hours
- So, the time windows for the afternoon hours were reduced

00z	01z	02z	03z	04z	05z	06z	07z	08z	09z	10z	11z	12z	13z	14z	15z	16z	17z	18z	19z	20z	21z	22z	23z
5	7	9	11	13	13	13	13	13	13	13	13	13	11	9	7	5	3	3	3	3	3	3	3

- One final minor adjustment was made in December to try to get better speeds in the early morning: we wanted to retain the longer window at night and shorter window during the day to better capture higher speeds, with a more gradual transition in between

00z	01z	02z	03z	04z	05z	06z	07z	08z	09z	10z	11z	12z	13z	14z	15z	16z	17z	18z	19z	20z	21z	22z	23z
3	5	7	9	11	11	13	13	13	13	11	9	7	7	5	5	3	3	3	3	3	3	3	3

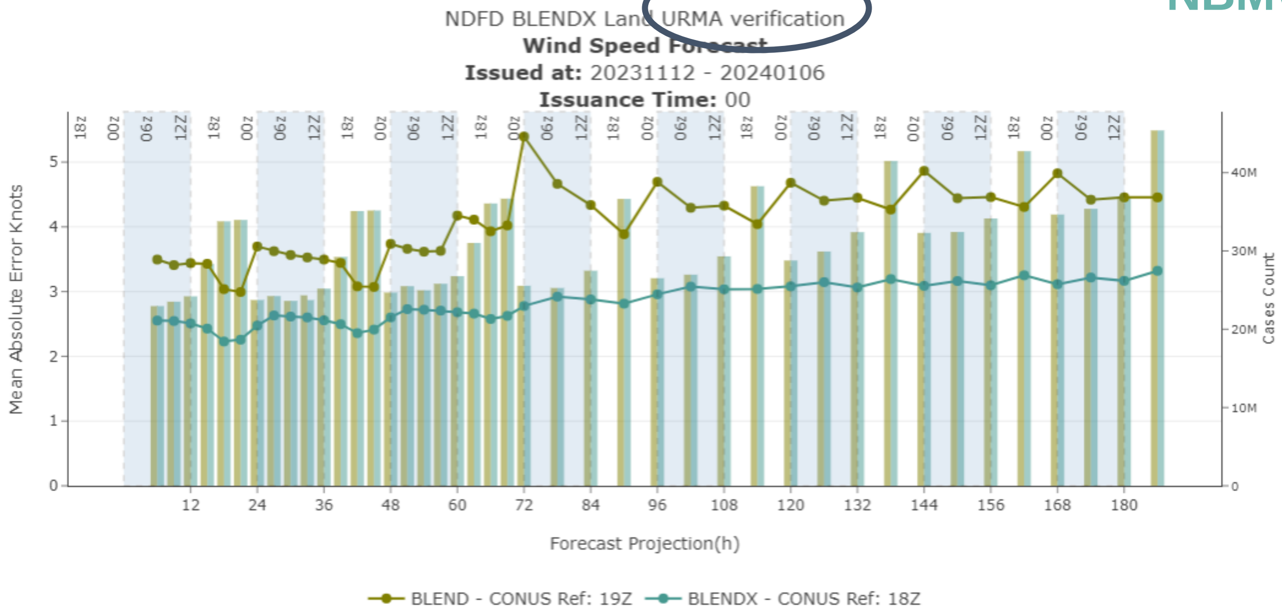
- This is the final configuration in the v4.2 parallel

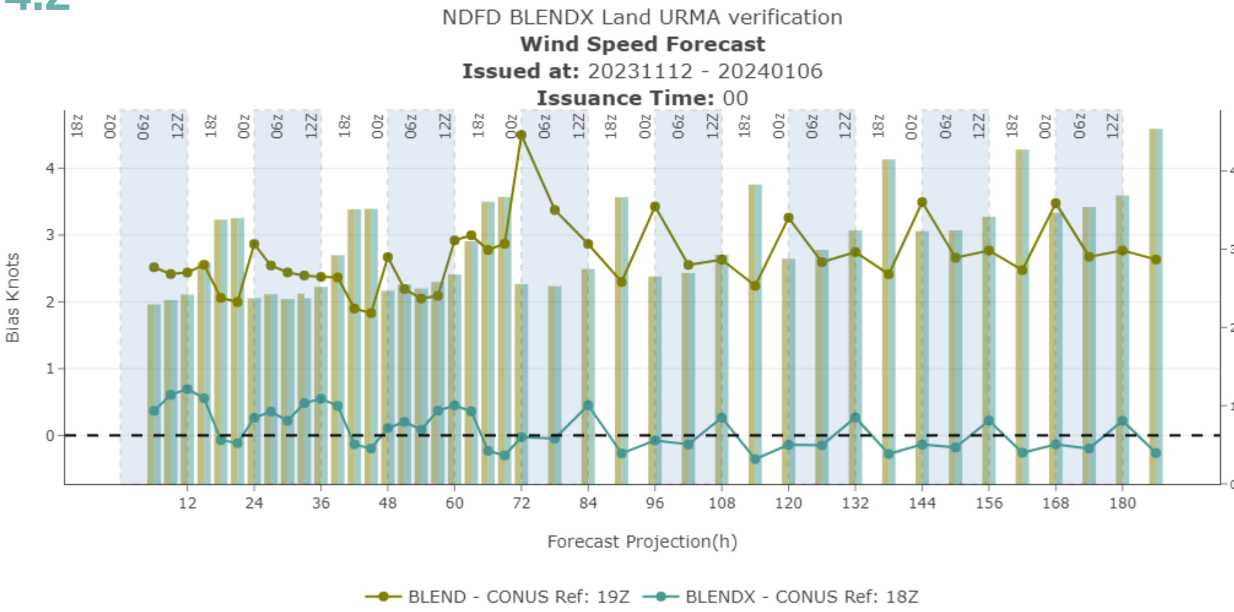
Wind Stats

MAE

NBMv4.1
NBMv4.2

BIAS





- Clear improvement in MAE and Bias for v4.2 across all wind speeds

CONUS

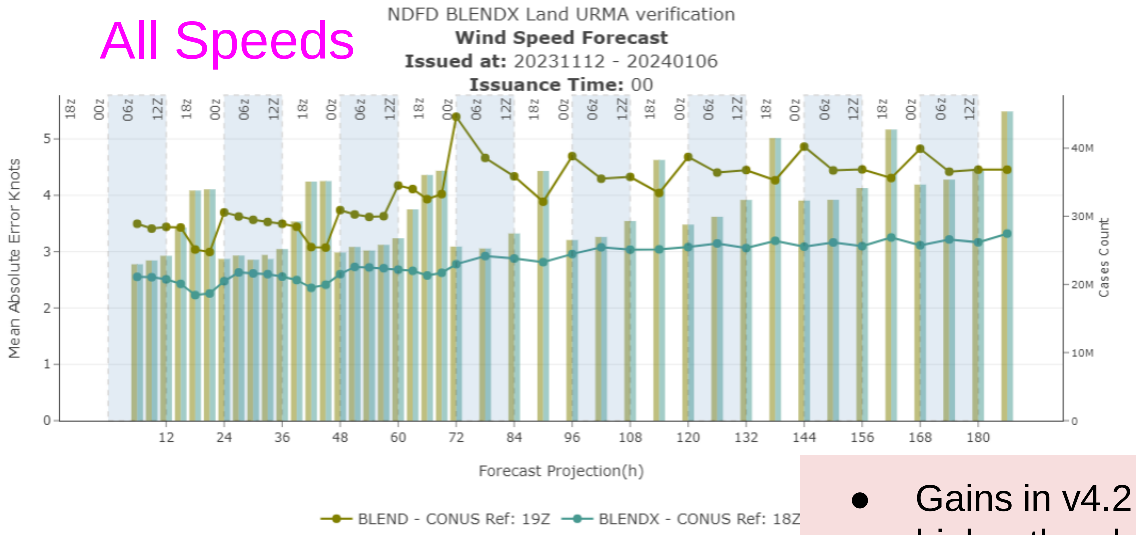
- The high speed bias in v4.1 (ops) is quite evident, and v4.2 bias looks great

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

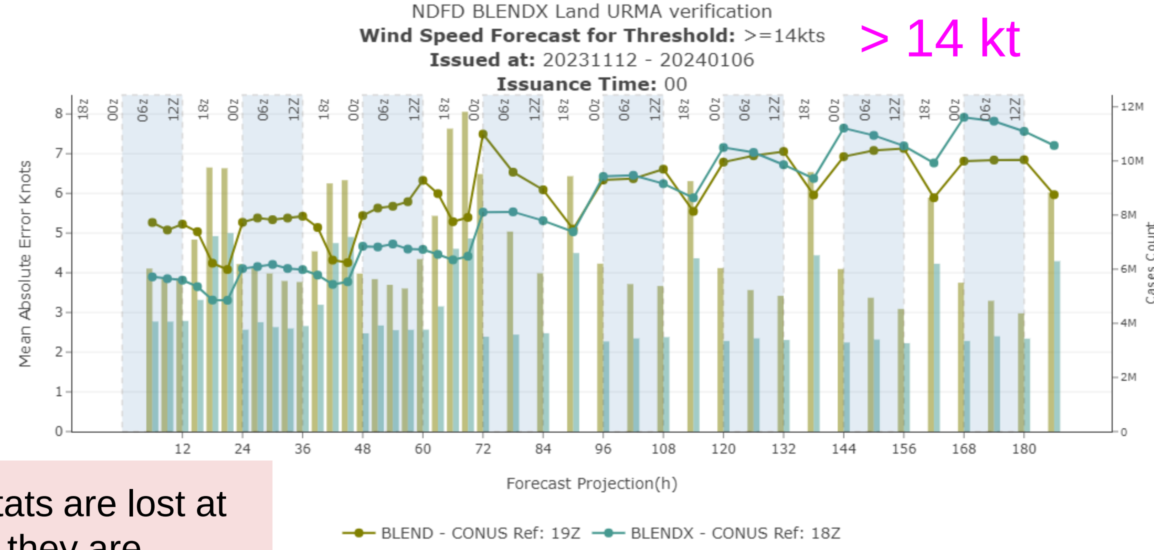
Wind Stats

MAE

All Speeds



> 14 kt

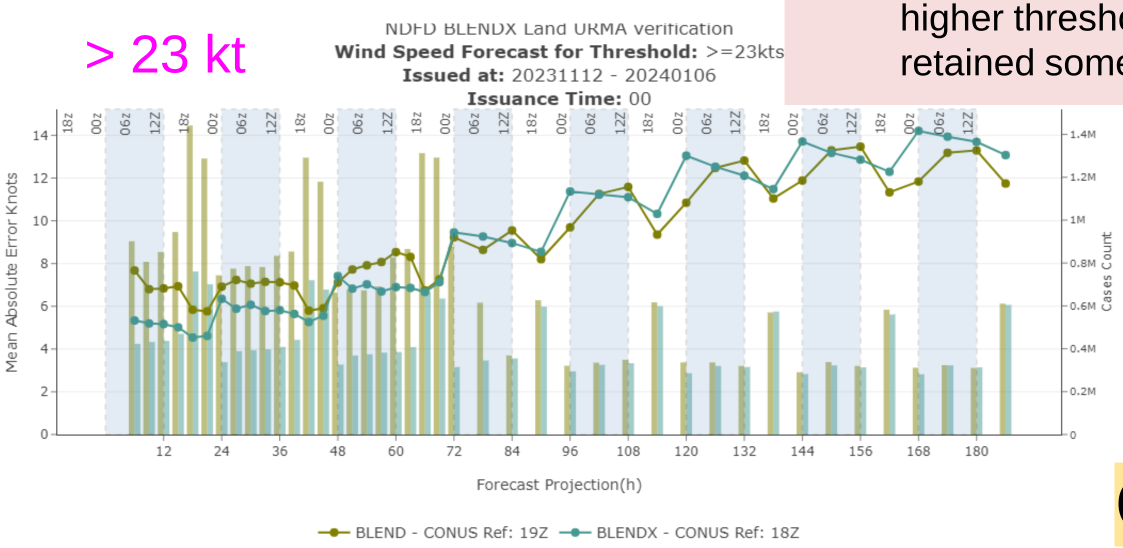


NBMv4.1

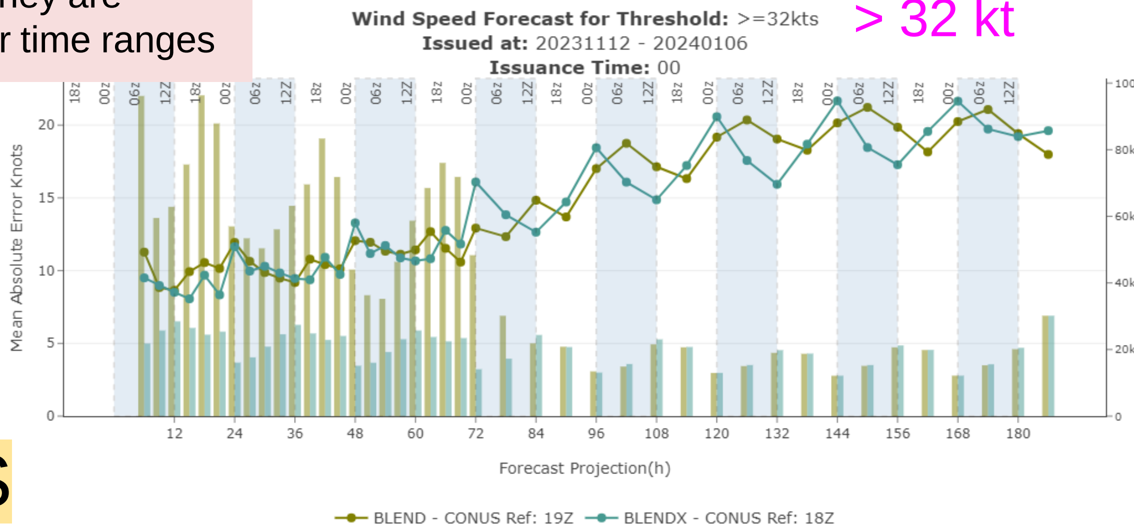
NBMv4.2

- Gains in v4.2 aggregated stats are lost at higher thresholds, although they are retained somewhat at shorter time ranges

> 23 kt



> 32 kt



CONUS

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Wind Stats

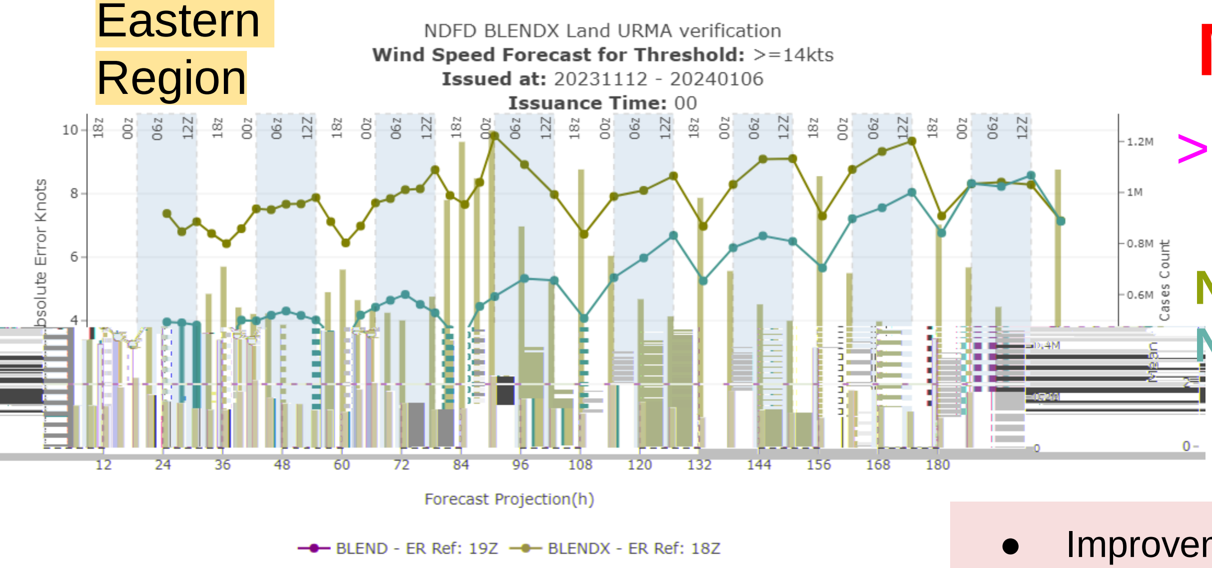
MAE

> 14 kt

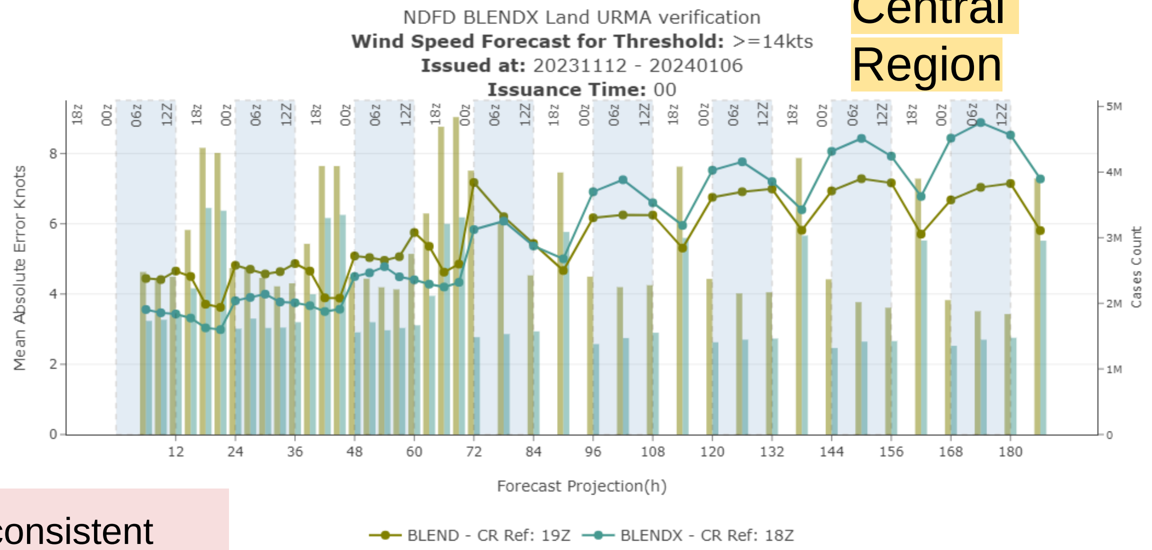
NBMv4.1

NBMv4.2

Eastern Region

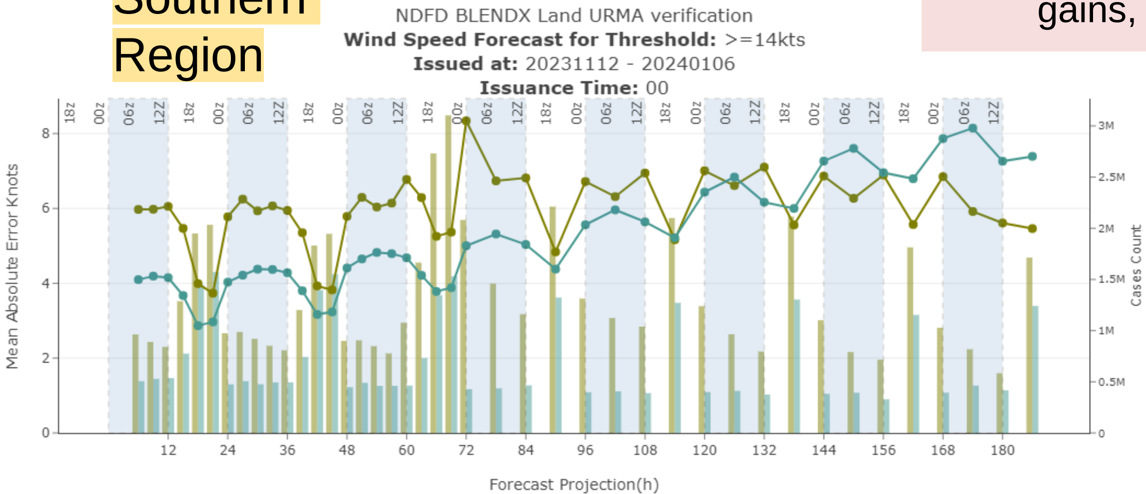


Central Region

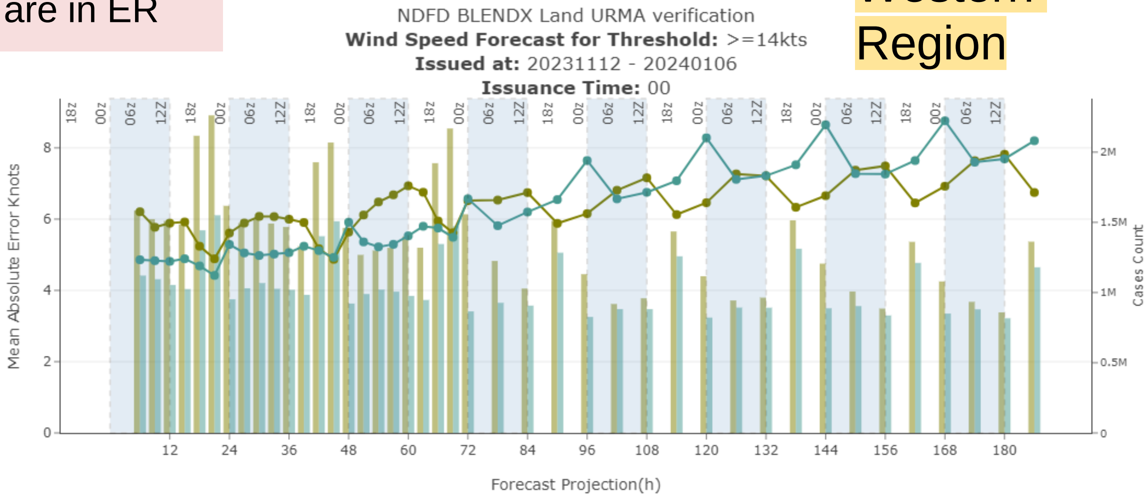


- Improvement is not consistent across NWS Region; the largest gains, lasting longer, are in ER

Southern Region



Western Region



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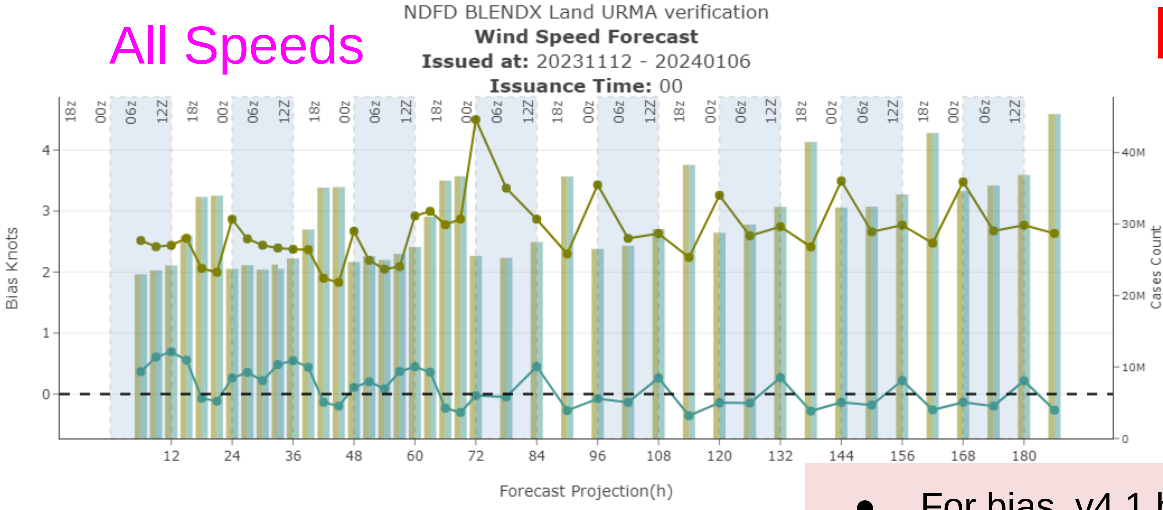
Wind Stats

BIAS

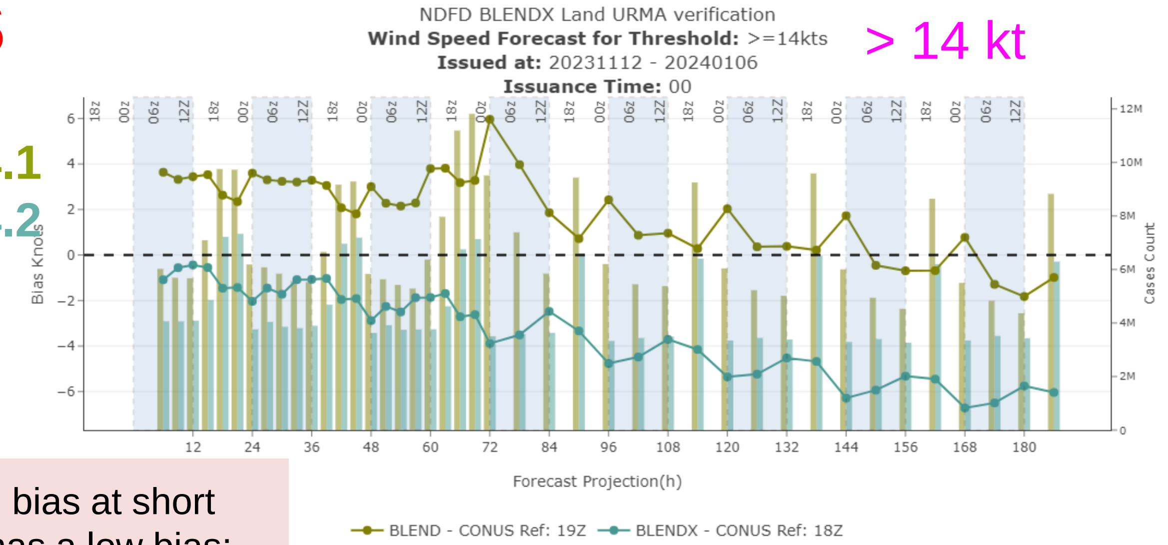
All Speeds



NBMv4.1

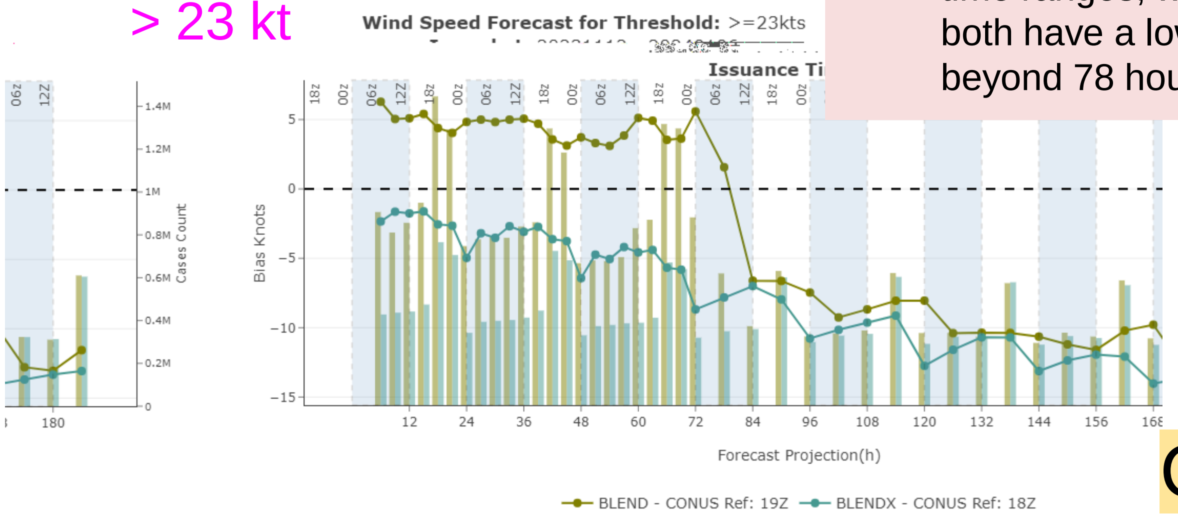
NBMv4.2

> 14 kt

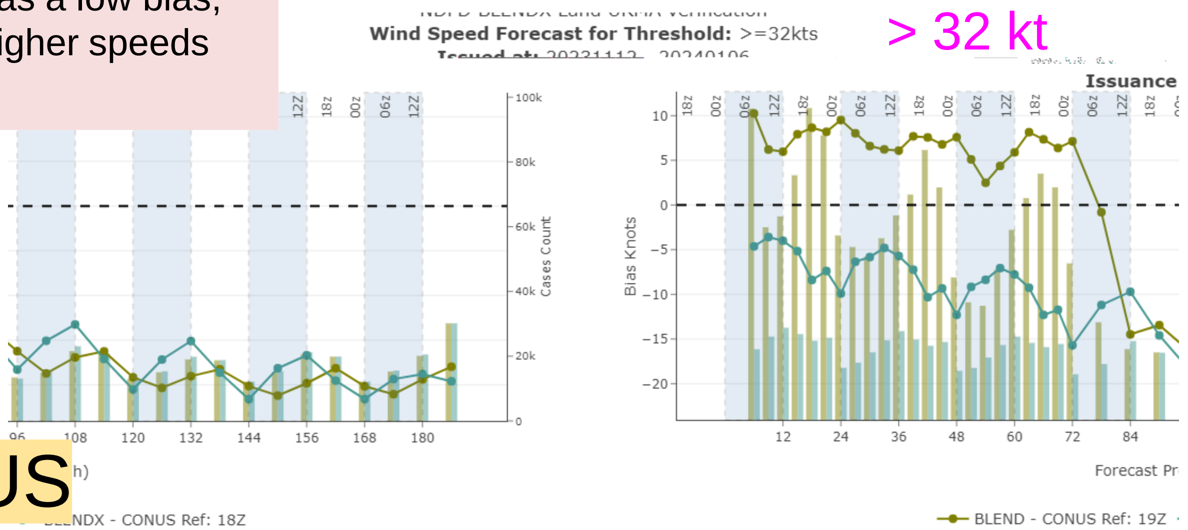


- For bias, v4.1 has a high bias at short time ranges, while v4.2 has a low bias; both have a low bias at higher speeds beyond 78 hours

> 23 kt



> 32 kt



CONUS

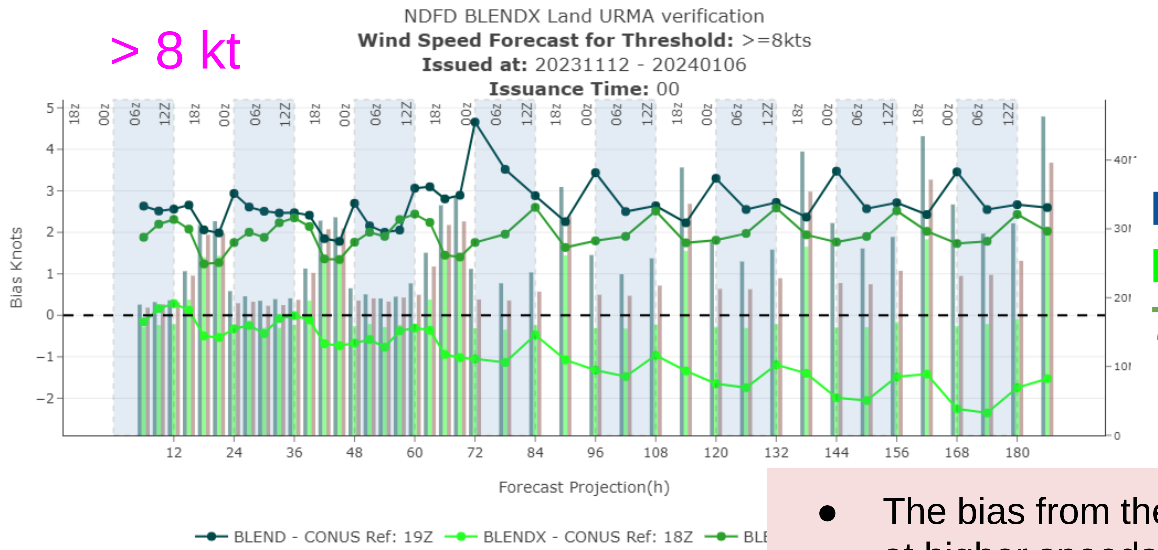
Key Points

- While “deterministic” winds in v4.2 have a notable low bias at higher speeds, part of the purpose of using quantile mapping is to have a full set of calibrated percentile values (in addition to having a larger sample size)
- If the middle percentile speeds are too low at higher thresholds, the higher percentiles should provide useful information
- Let’s see how the stats look when the 75th percentile from v4.2 is added

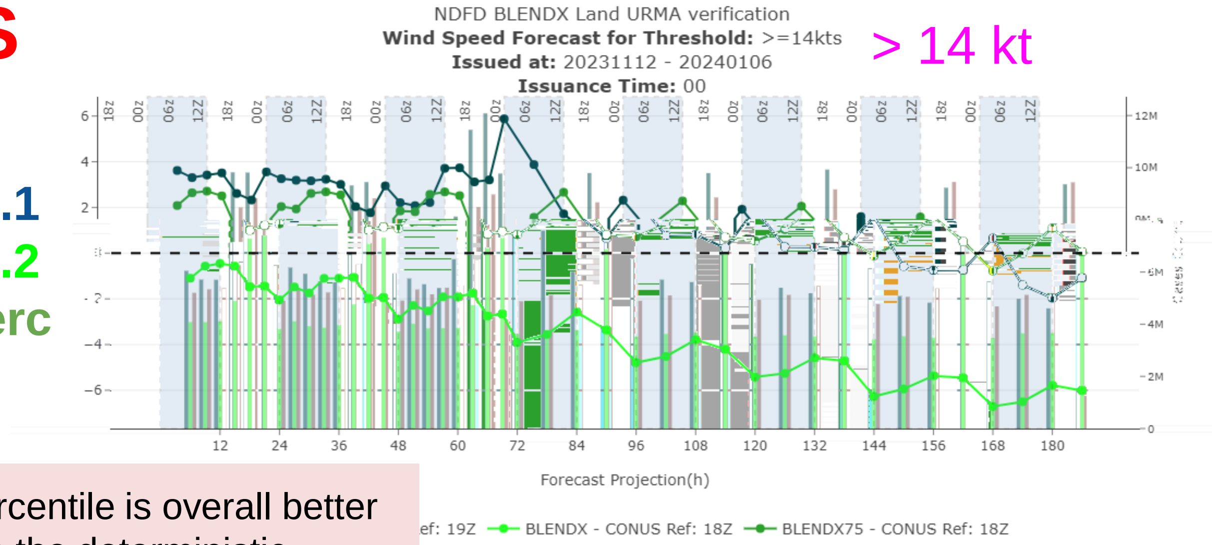
Wind Stats

BIAS

> 8 kt



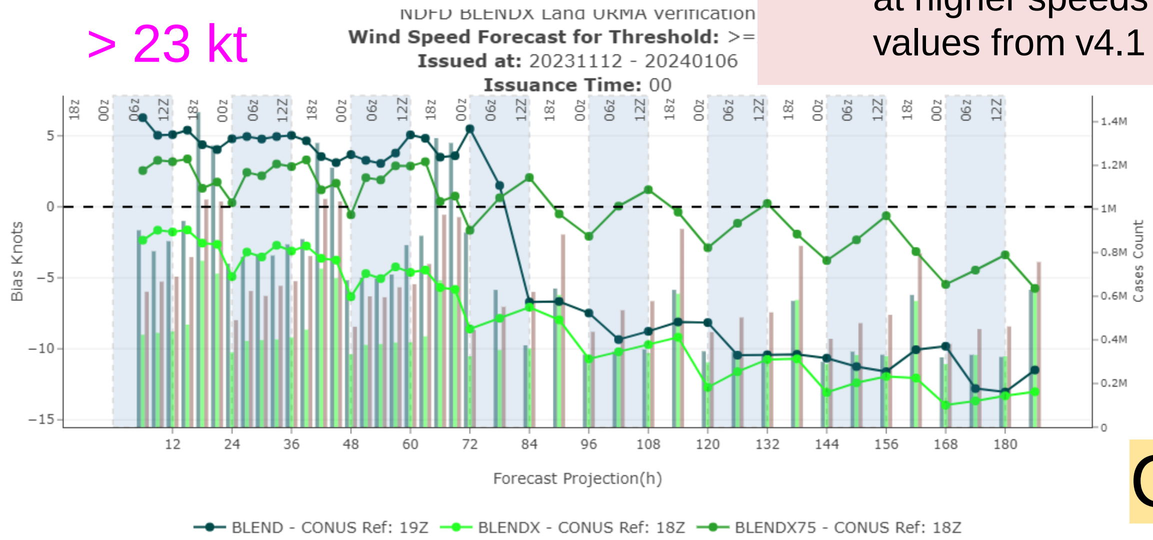
> 14 kt



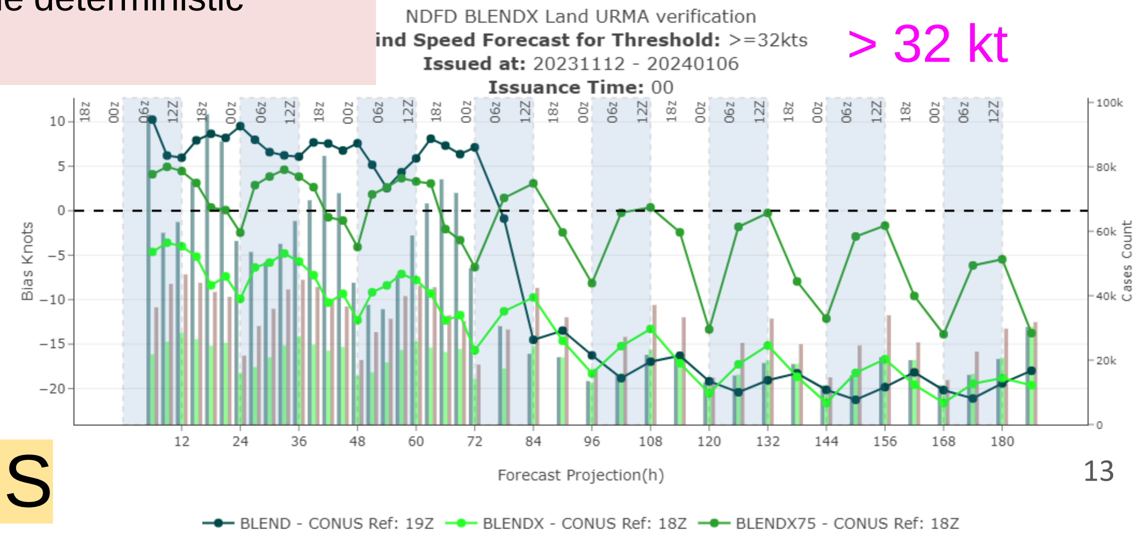
NBMv4.1
NBMv4.2
75th perc

- The bias from the 75th percentile is overall better at higher speeds than with the deterministic values from v4.1 and v4.2

> 23 kt



> 32 kt

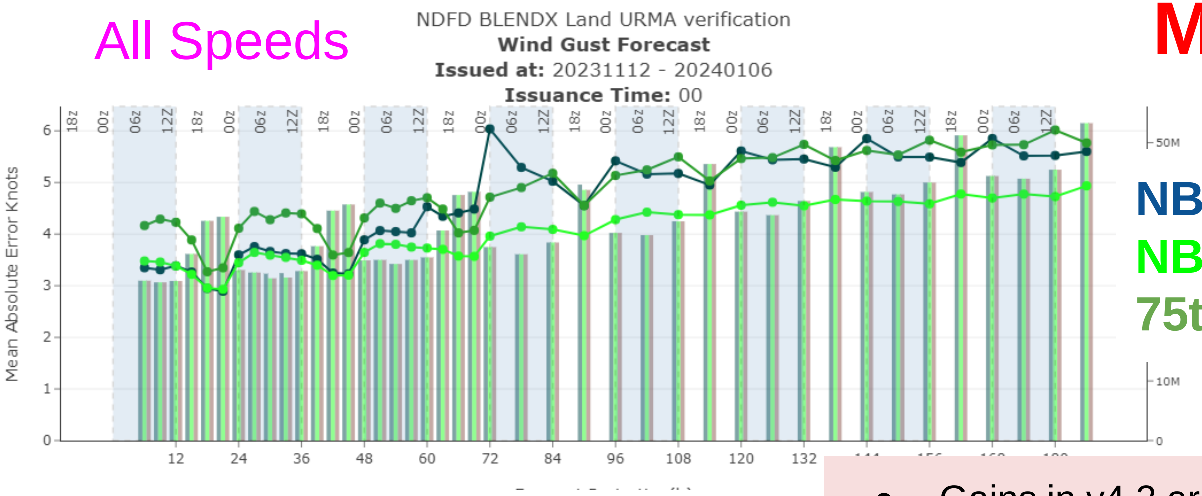


CONUS

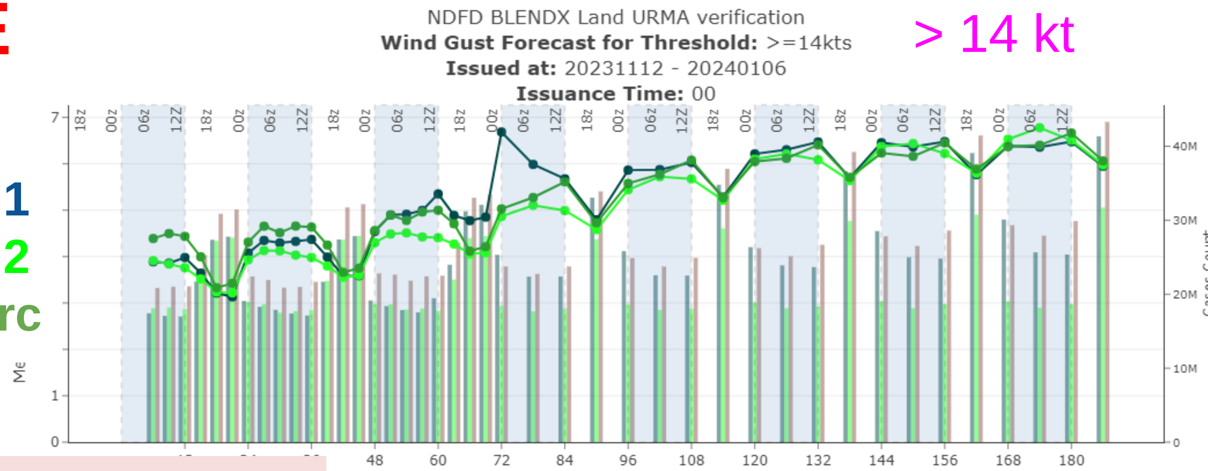
Gust Stats

MAE

All Speeds



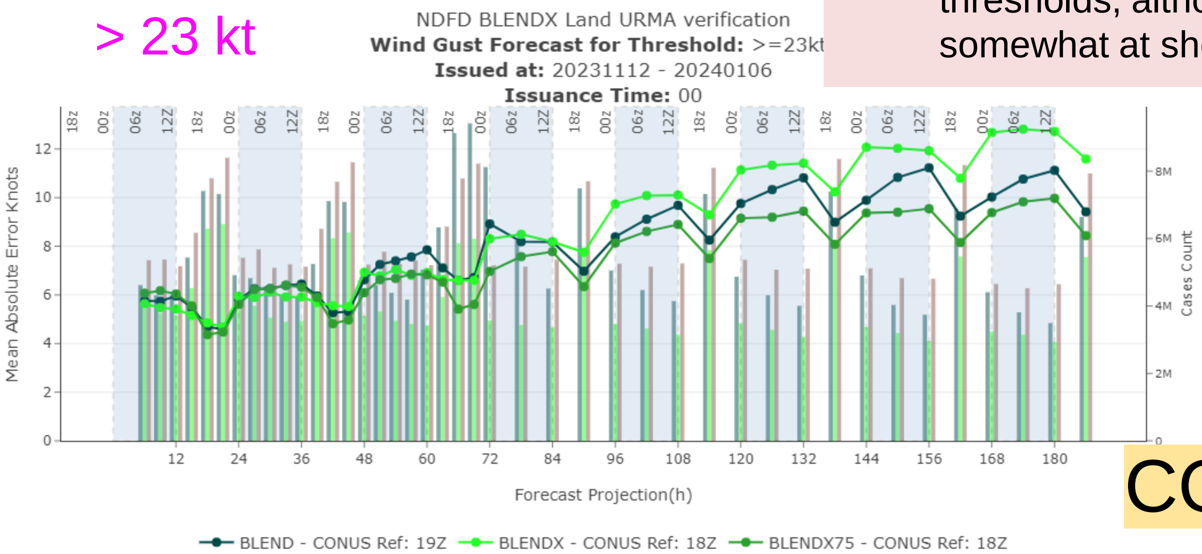
> 14 kt



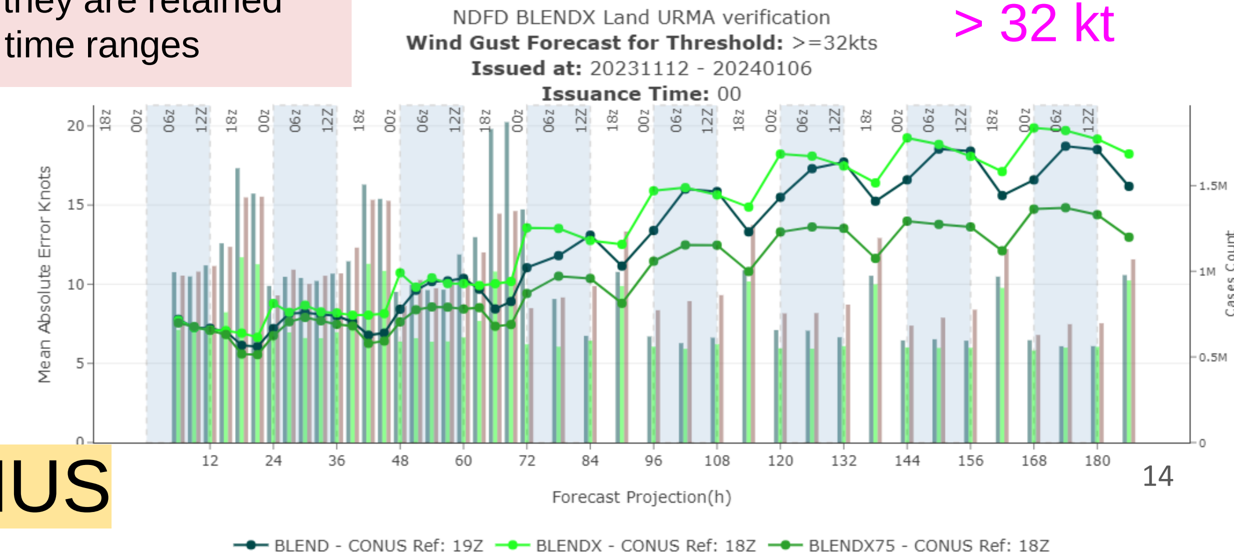
NBMv4.1
NBMv4.2
75th perc

- Gains in v4.2 are overall lost at higher thresholds, although they are retained somewhat at shorter time ranges

> 23 kt



> 32 kt



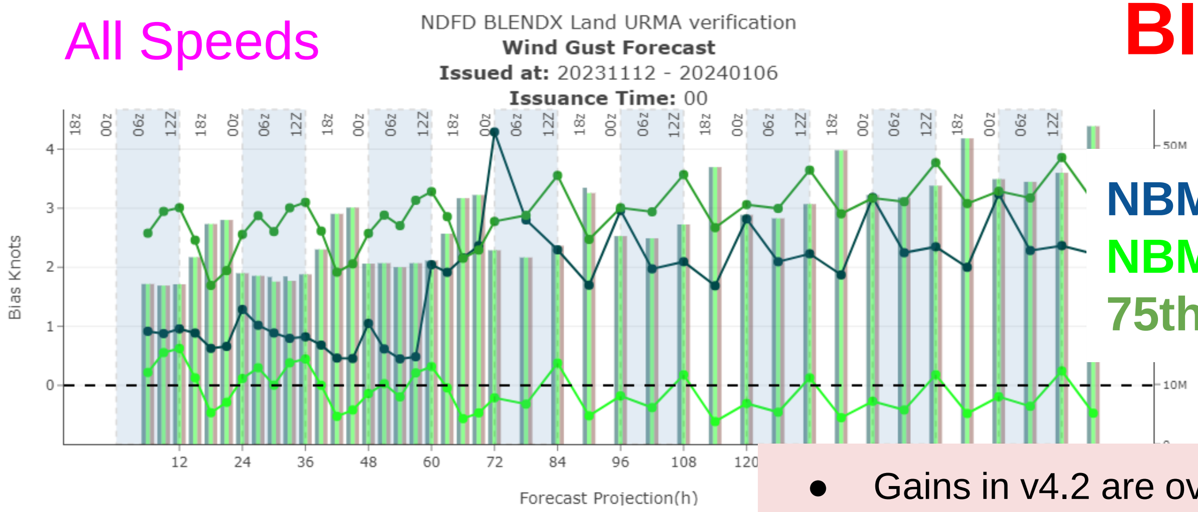
CONUS

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Gust Stats

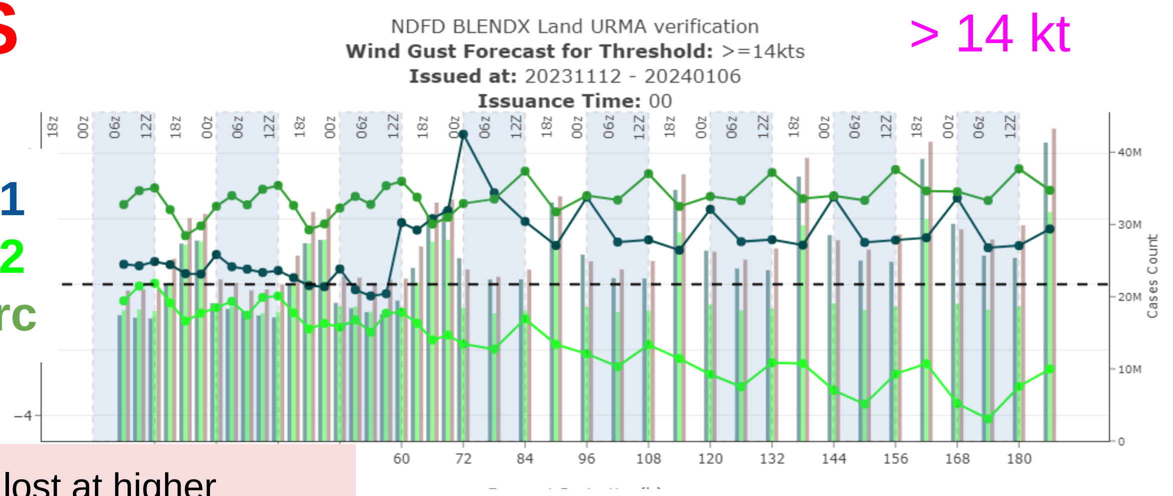
BIAS

All Speeds



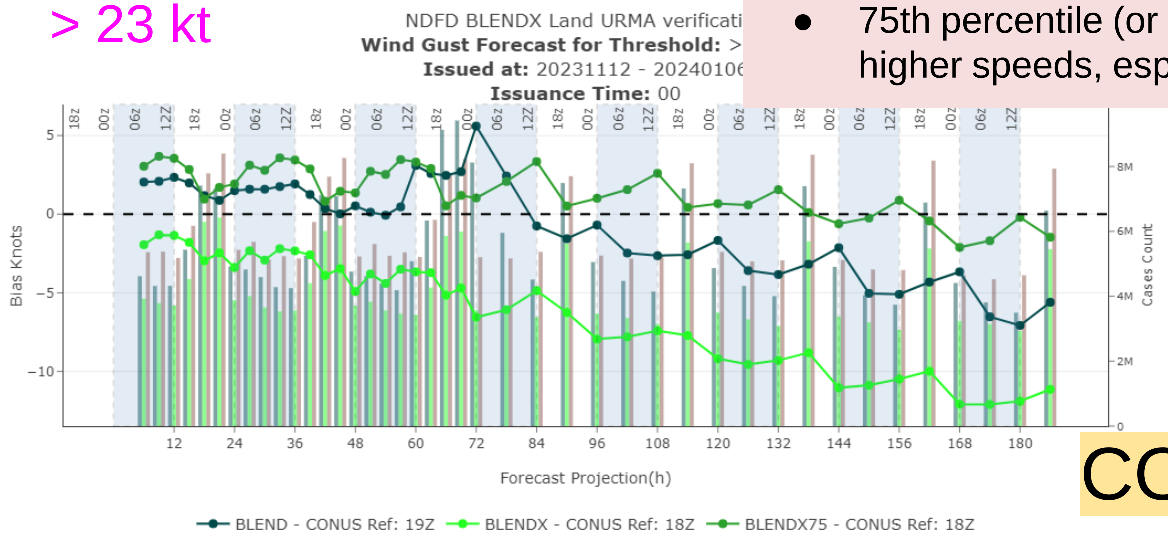
NBMv4.1
NBMv4.2
75th perc

> 14 kt

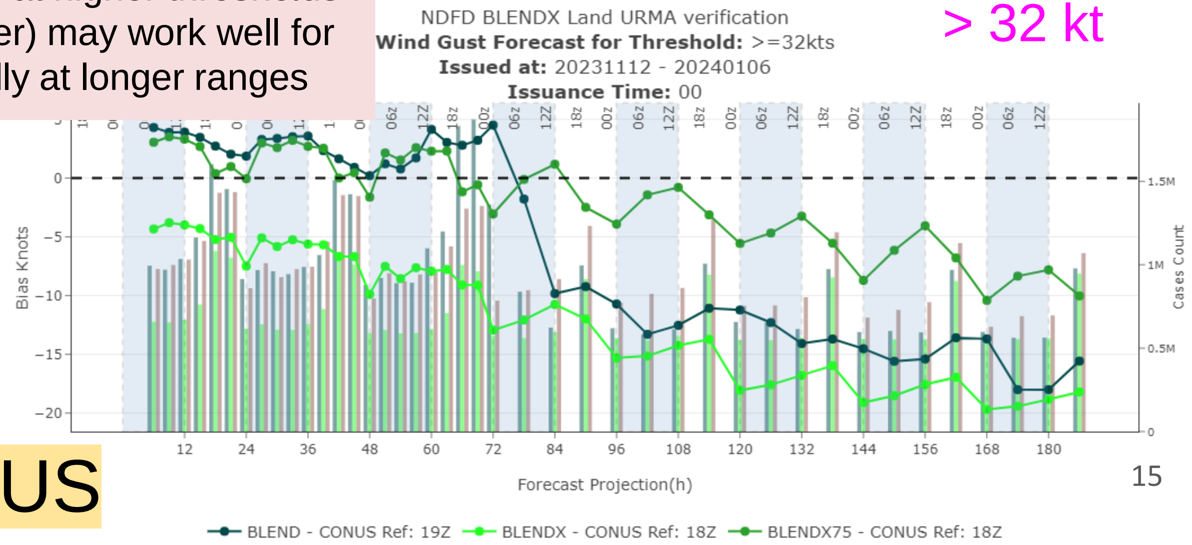


- Gains in v4.2 are overall lost at higher thresholds, most clearly at higher thresholds
- 75th percentile (or higher) may work well for higher speeds, especially at longer ranges

> 23 kt



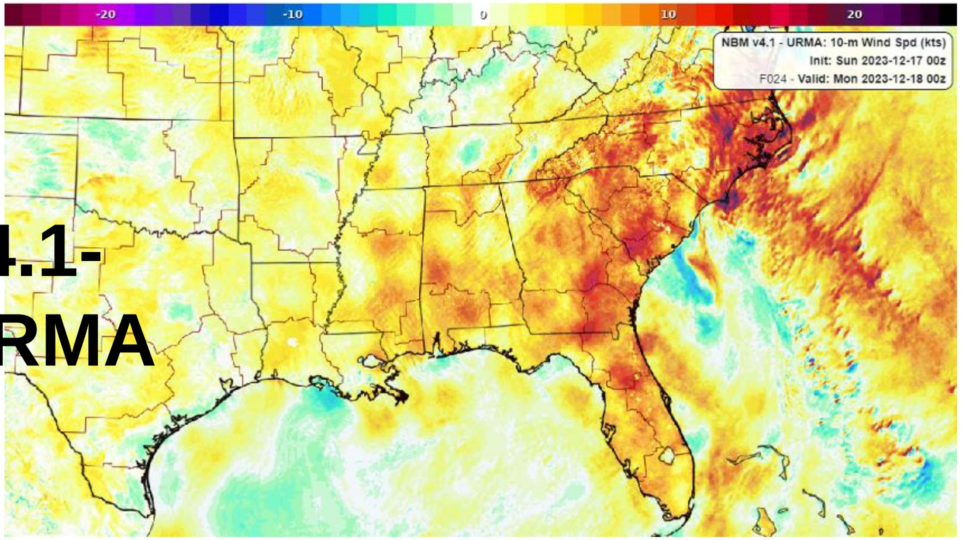
> 32 kt



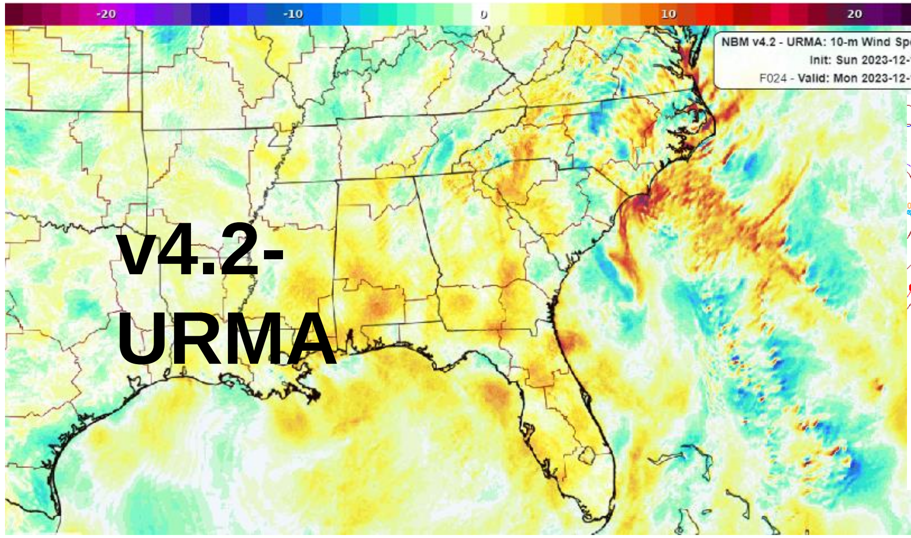
CONUS

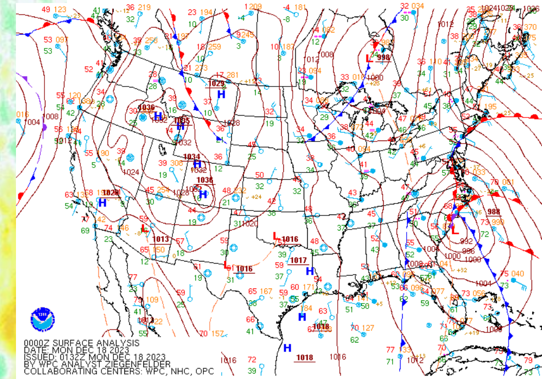
Wind Example

v4.1- URMA

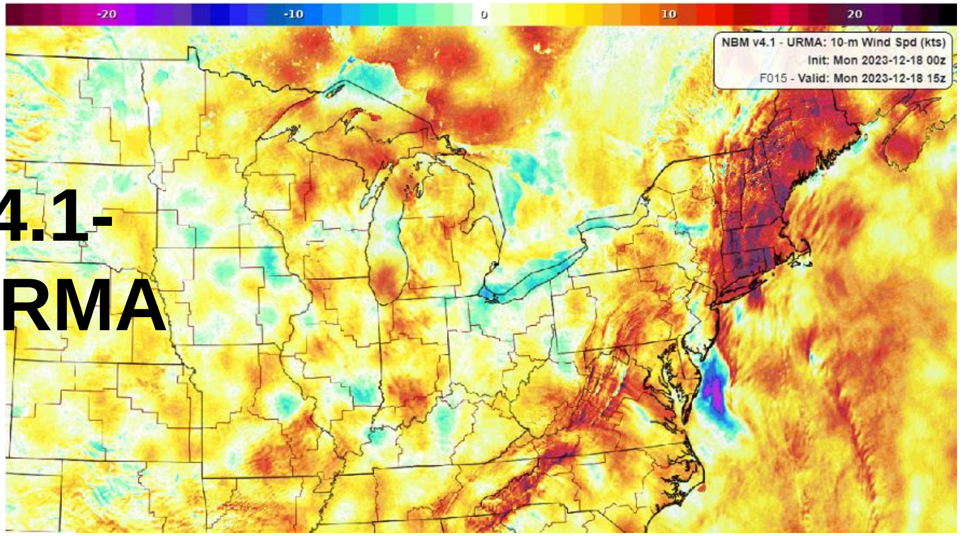


v4.2- URMA

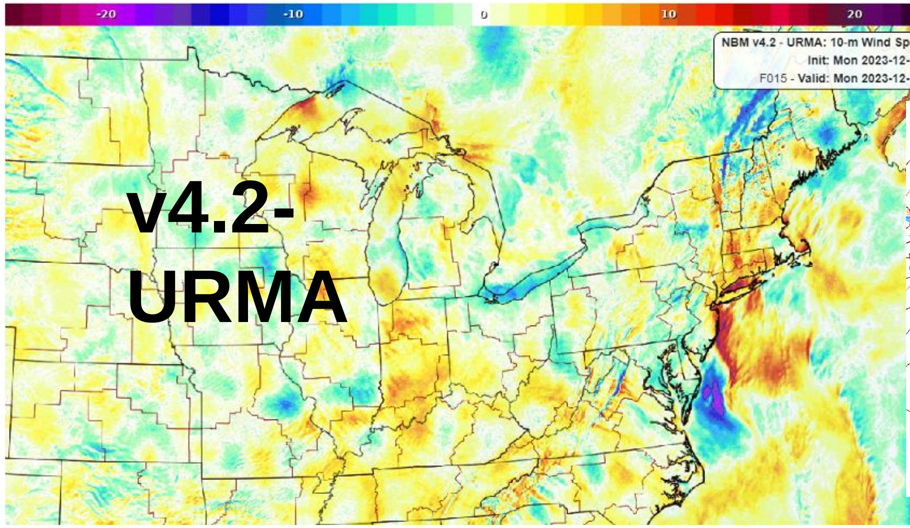


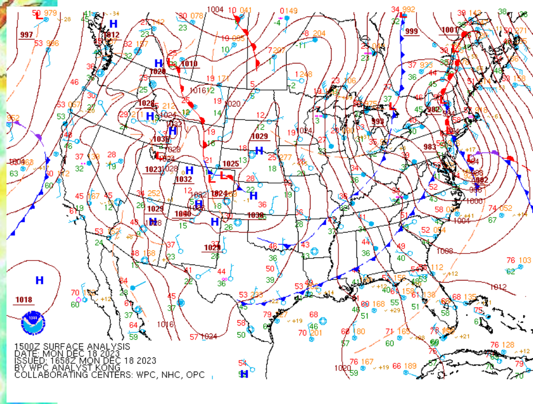


v4.1- URMA

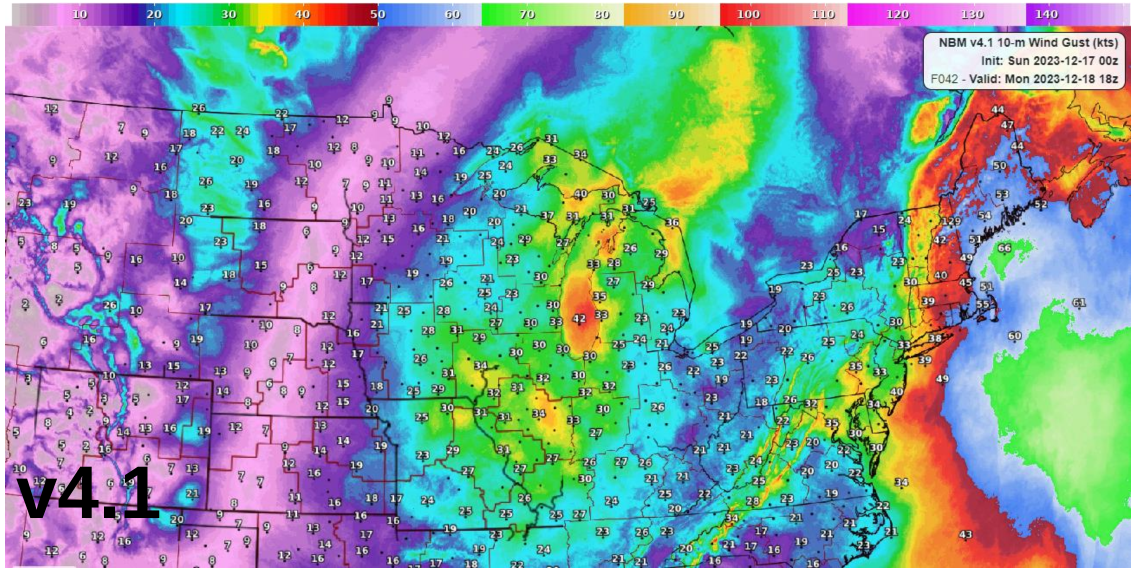


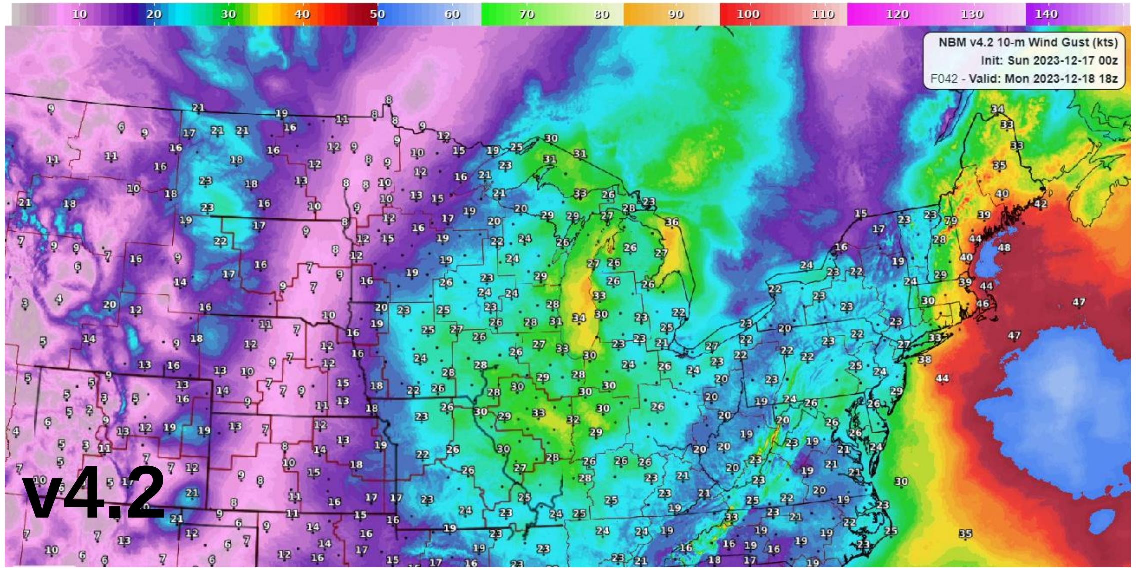
v4.2- URMA



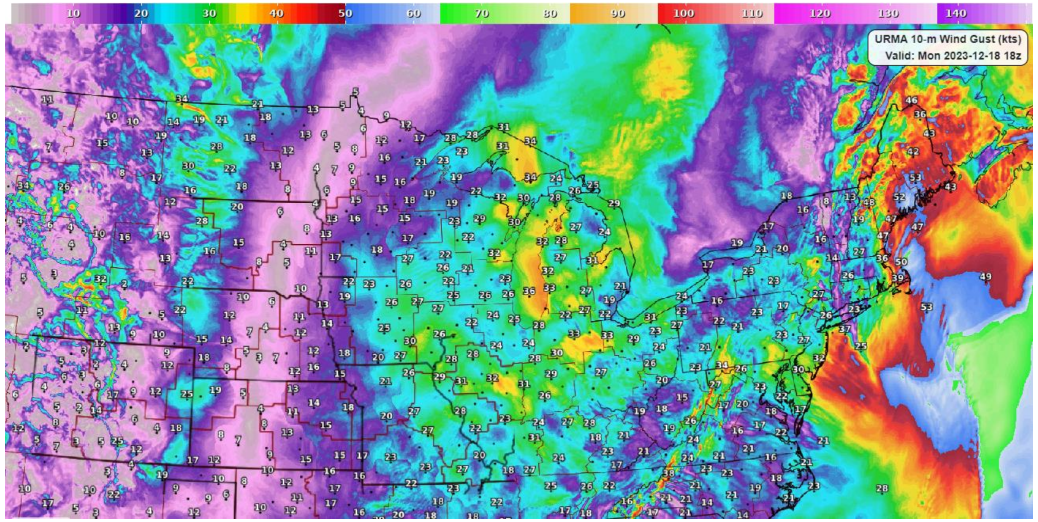


Gust Example





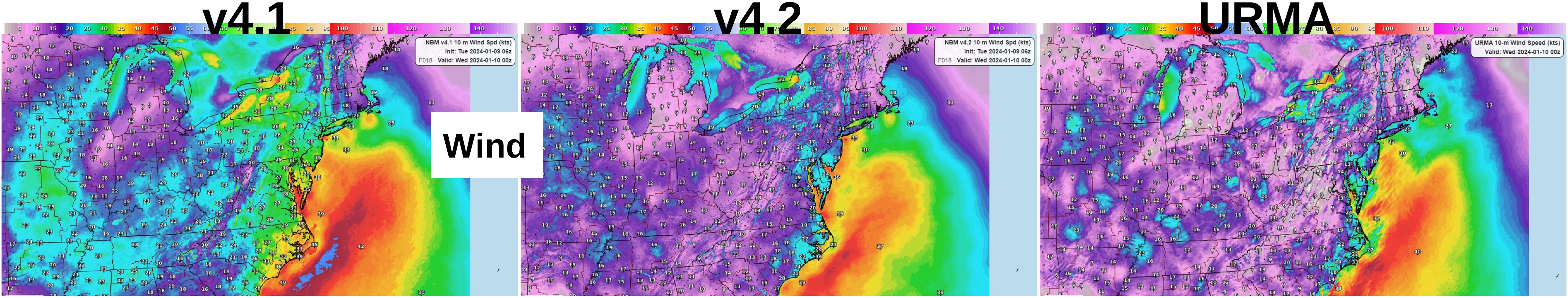
URMA



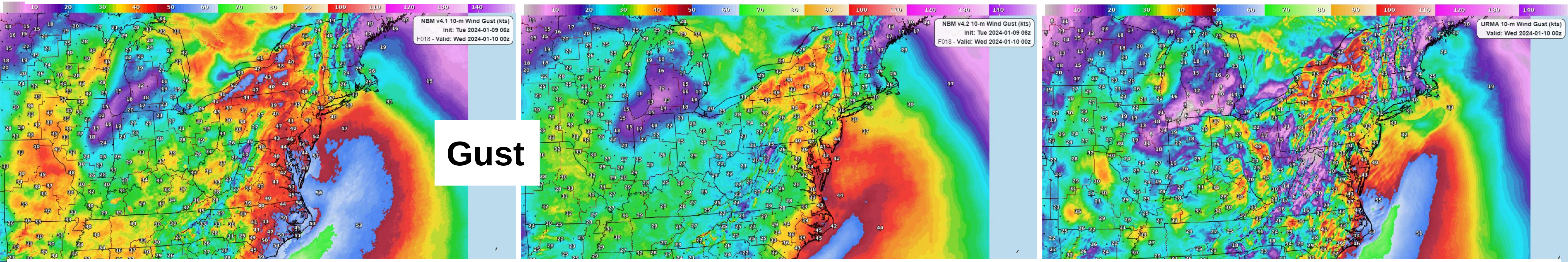
- Here at f42, v4.1 is far too strong with wind speeds over New England, and 4.2 is as well to a lesser degree; that said, v4.1 better captures the extremely high gusts over Maine and the Appalachians; performance is mixed over the Mid-Atlantic and Midwest

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

January 8 Storm Wind & Gusts



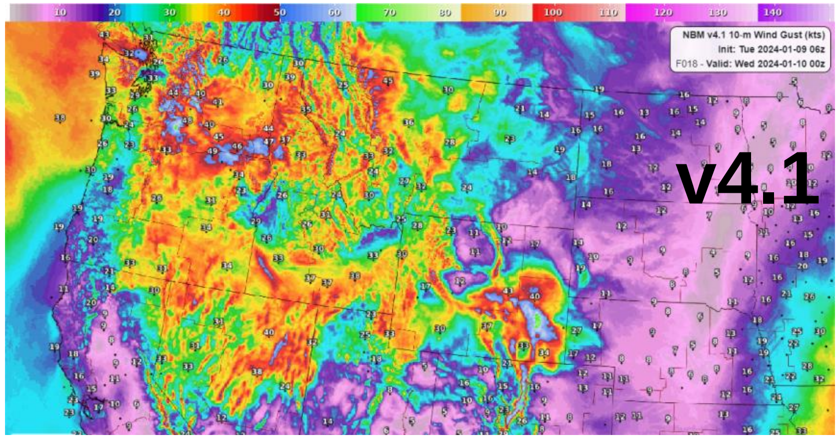
- for wind, 4.1 is too strong; 4.2 is a bit too weak in a few areas but is consistently closer to URMA

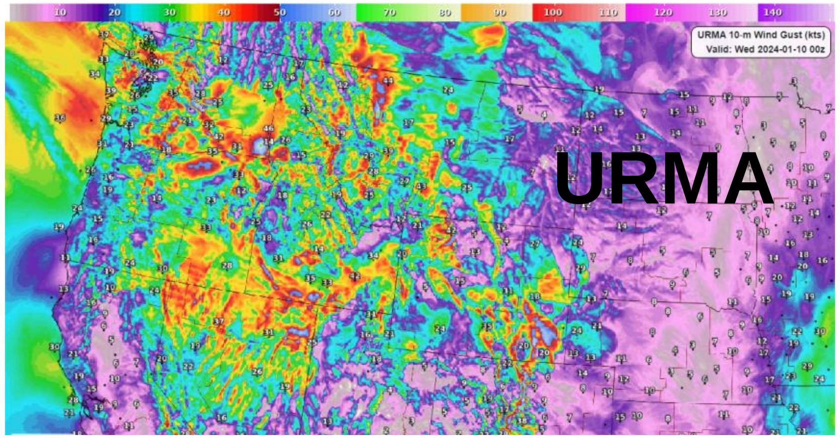


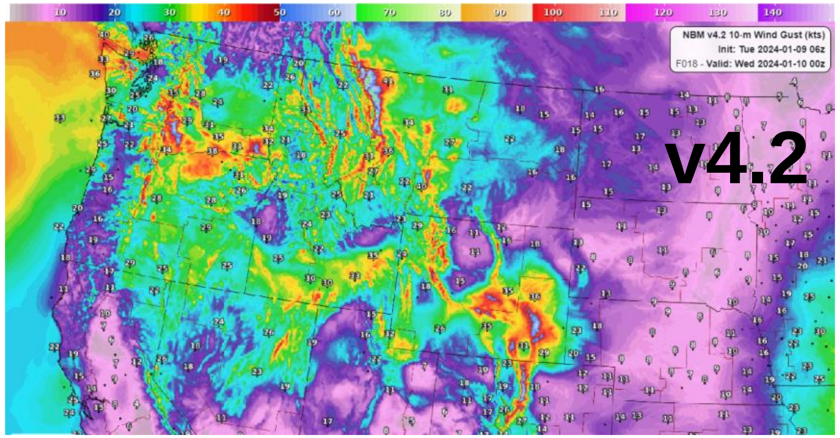
- for gust, 4.1 has too much coverage of high speeds, but 4.2 misses the higher end events, esp. over terrain

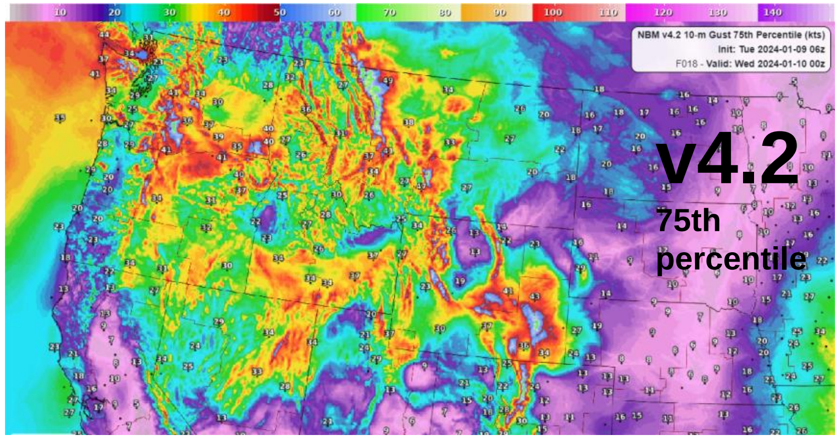
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Western Region Gust Case





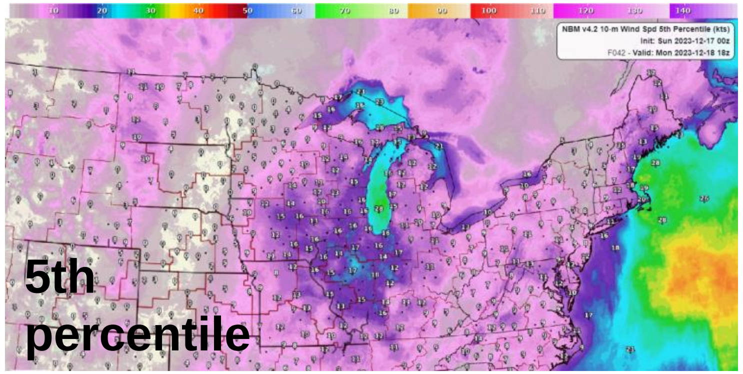


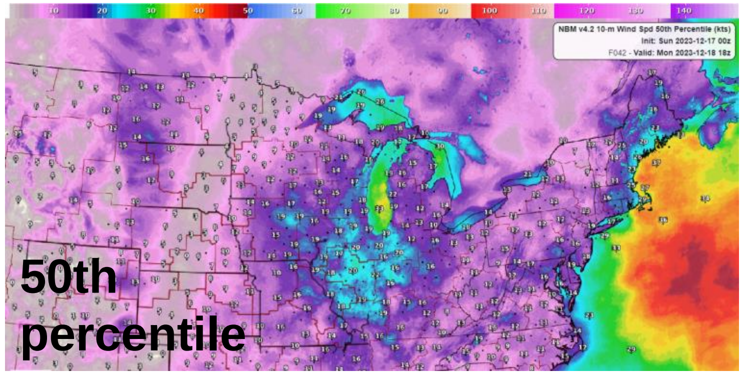


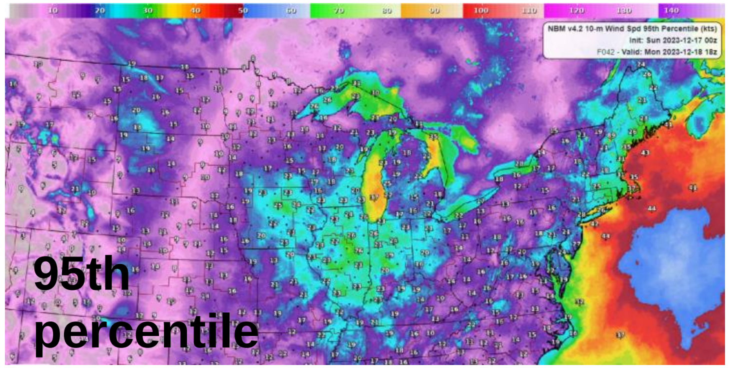
F18 Gust
Valid 00Z

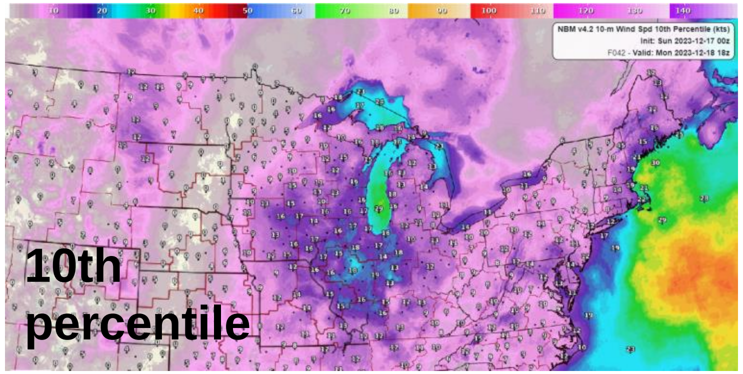
- Stats showed that for 00Z valid times, 4.2 gusts had a significant low bias, and this is clear in this case
- Stats also showed that the 75th percentile had little bias at 00Z in the short range, and that is also evident here

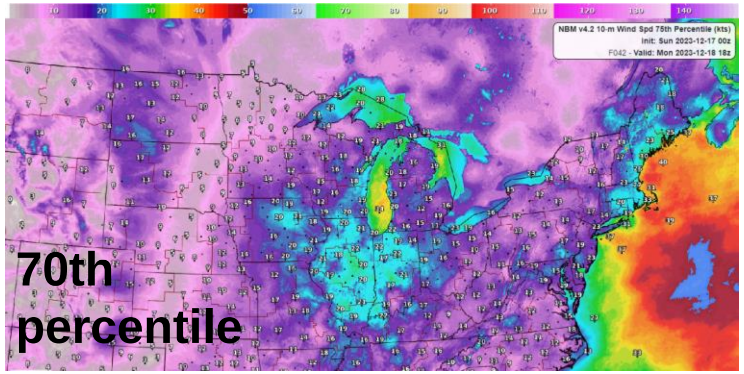
December Storm - Wind Percentiles

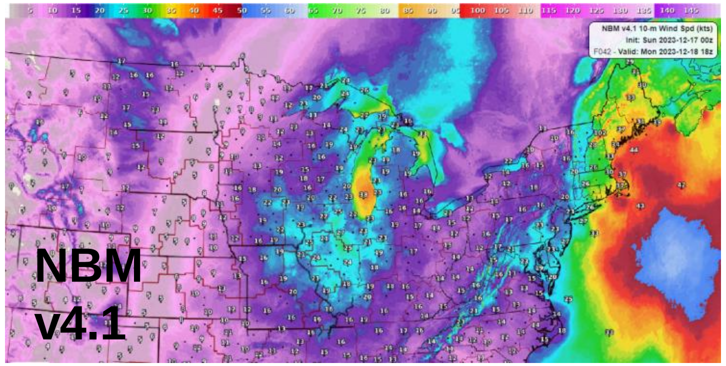


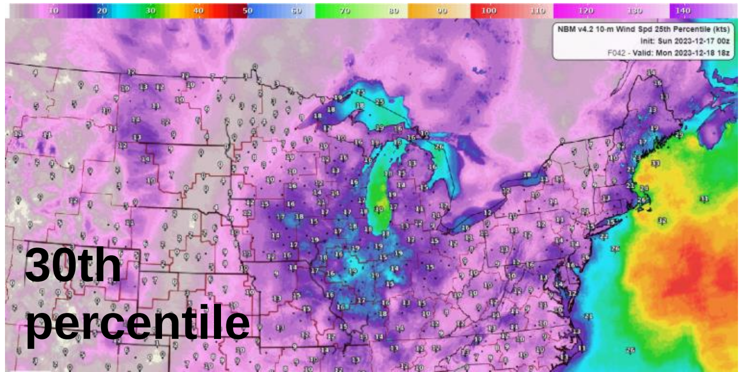


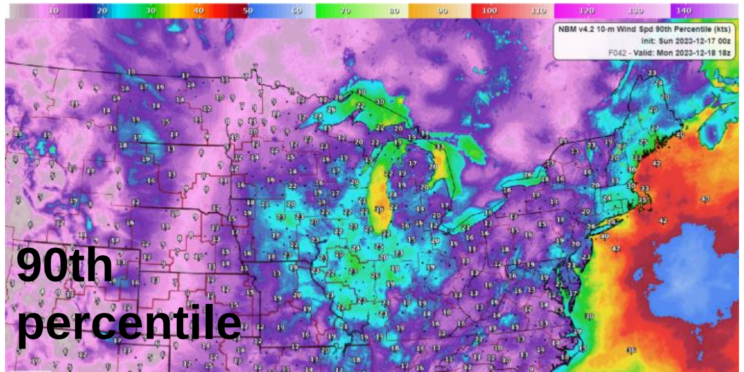


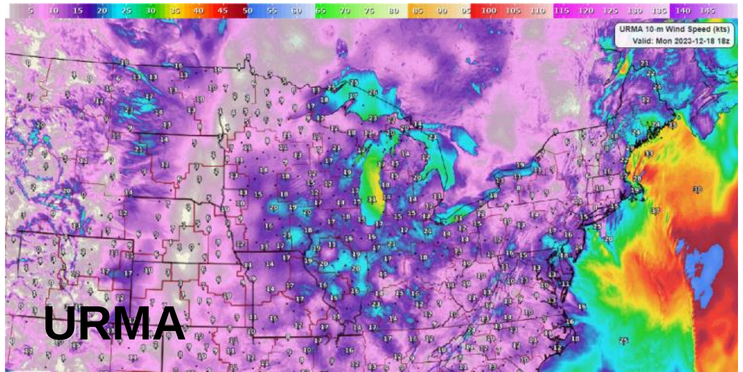




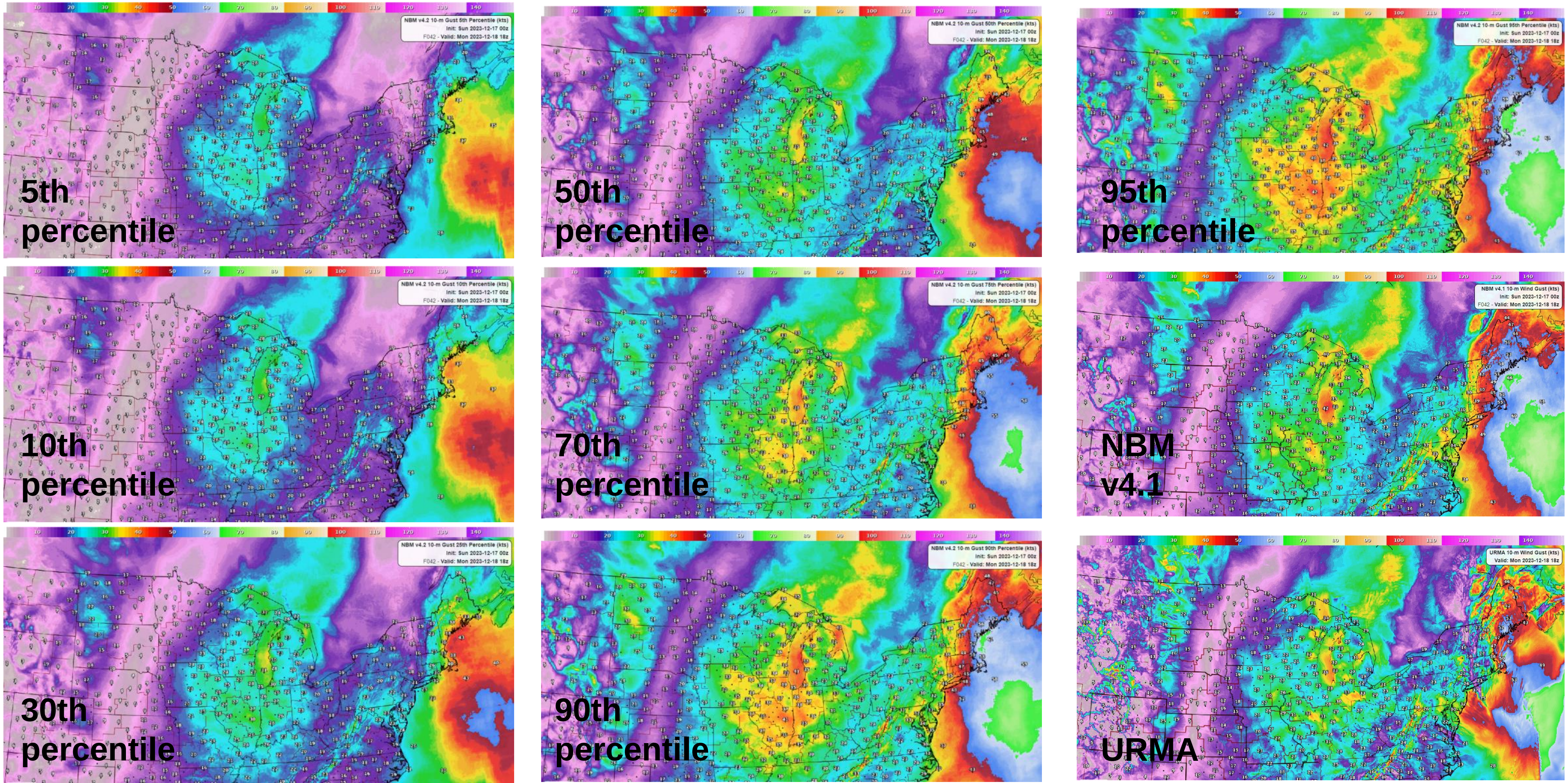




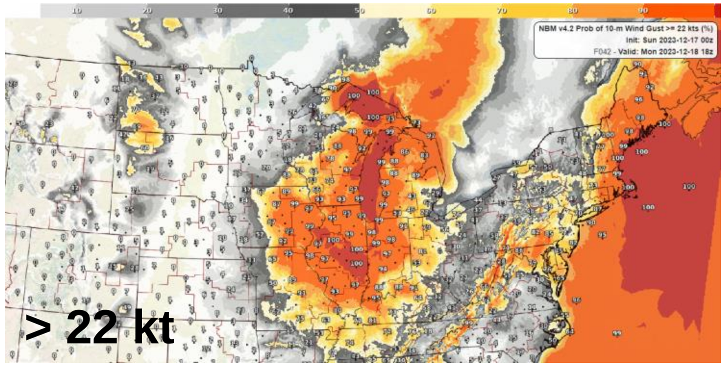


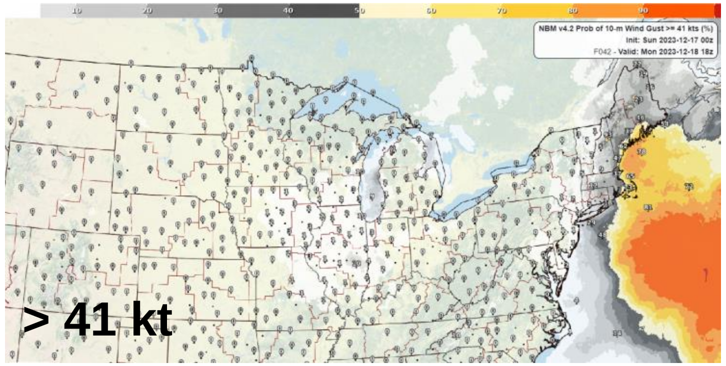


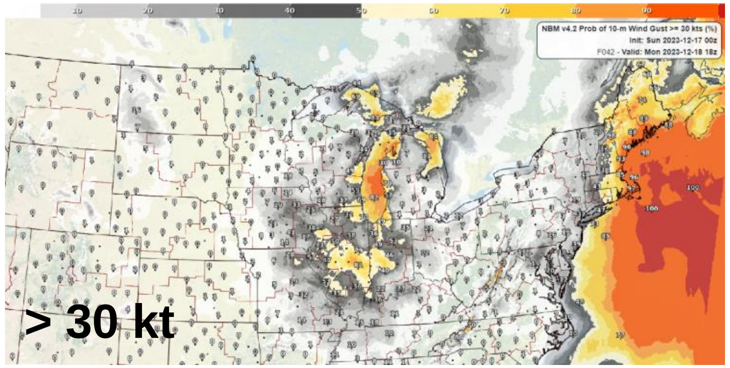
December Storm - Gust Percentiles

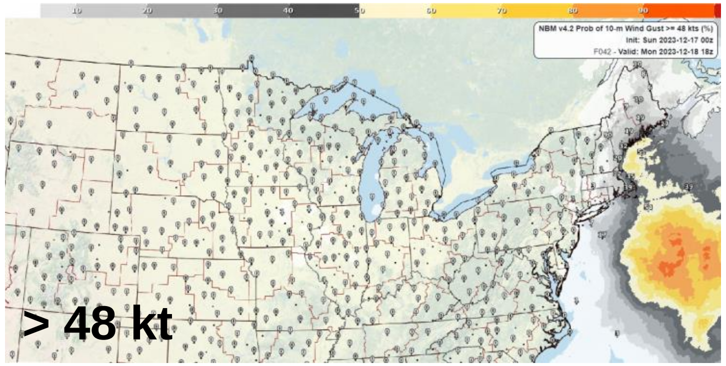


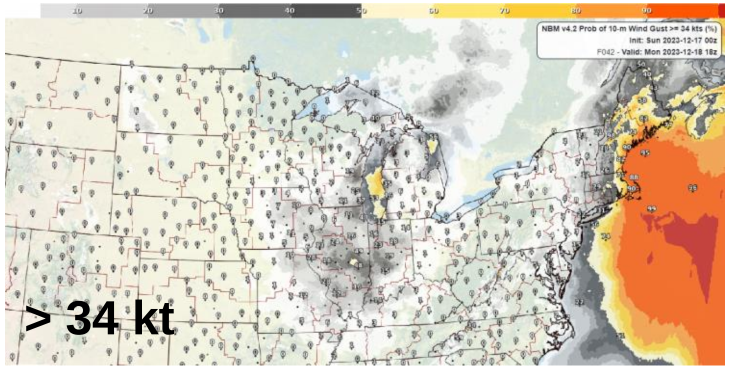
December Storm - Gust Probs

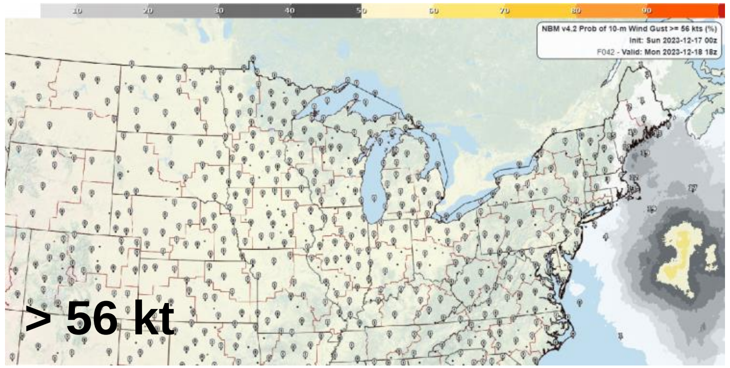




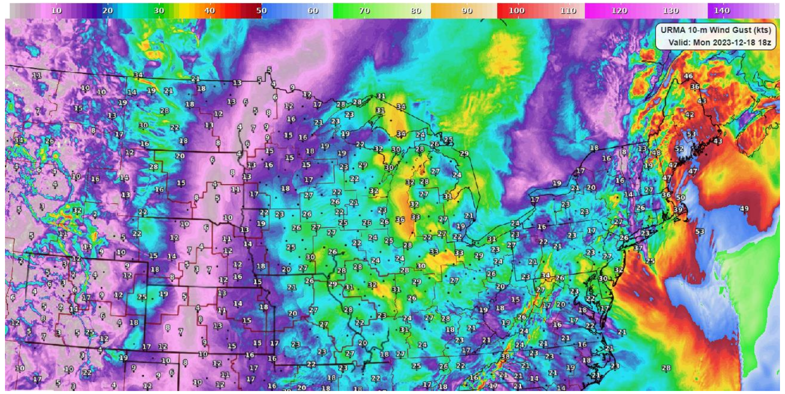








URMA



Overall Thoughts on v4.2 Winds

- Sustained wind speed appears to be significantly improved in v4.2; the winds in v4.1 have a notable high bias at shorter forecast lengths and have been called “unusable” by some forecasters

- That said, v4.2 wind speed has a clear very low bias for higher thresholds, especially at longer forecast lengths; the 75th (or so) percentile may be a good alternative for much higher thresholds, and even higher v4.2 percentiles may be needed for the very high end events, especially over higher terrain

- The same is true for gusts; there is a low bias, especially at longer forecast lengths, but higher percentiles should be usable to capture the observed values

- The stats show variation in error characteristics across Regions

- Overall, the changes made to v4.2 to address the low speed bias have been successful; there is still an overall low bias at higher thresholds, but it’s not as large as previously seen, and the percentiles can provide utility in instances in which the deterministic value is too low; **we still have work to do!**

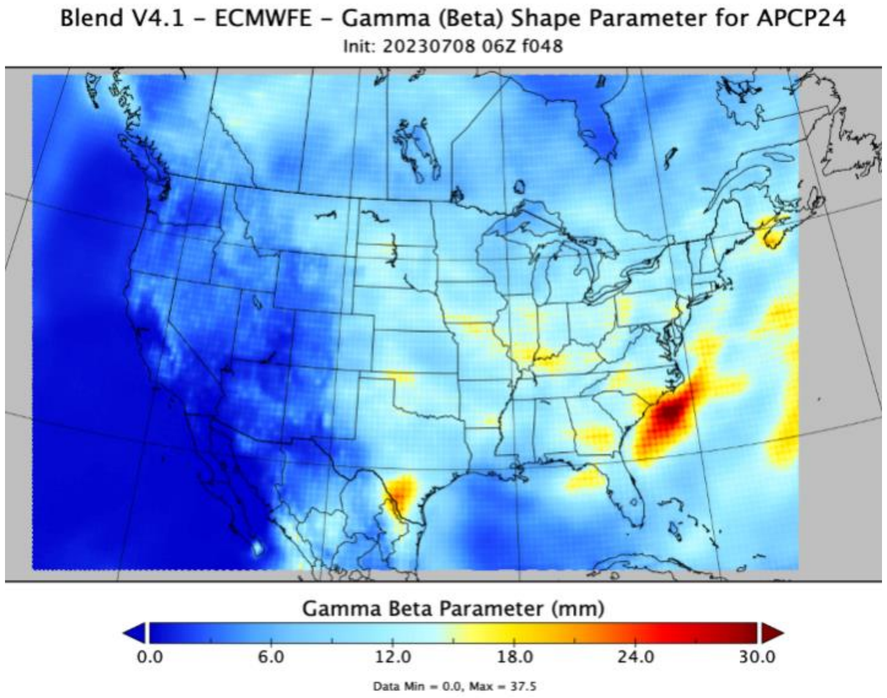
- There is concern that only the 10th, 50th, and 90th percentiles will be distributed over the SBN; regional LDM feeds can hopefully be leveraged to provide additional percentiles

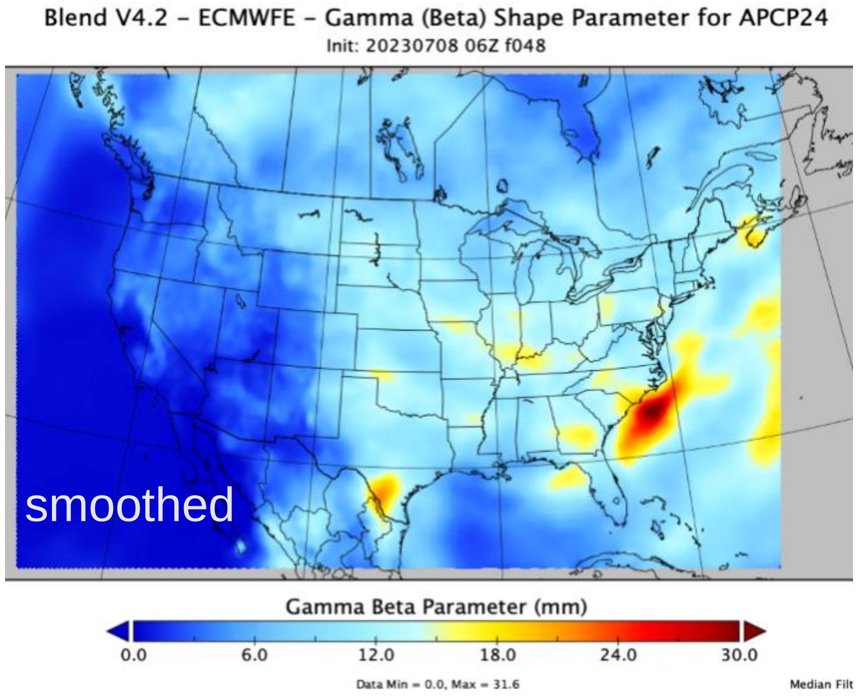
WINTER WEATHER ELEMENTS

Mitigation of Lattice Features

- Lattice features are attributable to the individual model QPF CDFs used to generate the quantile mapping for snowfall amounts

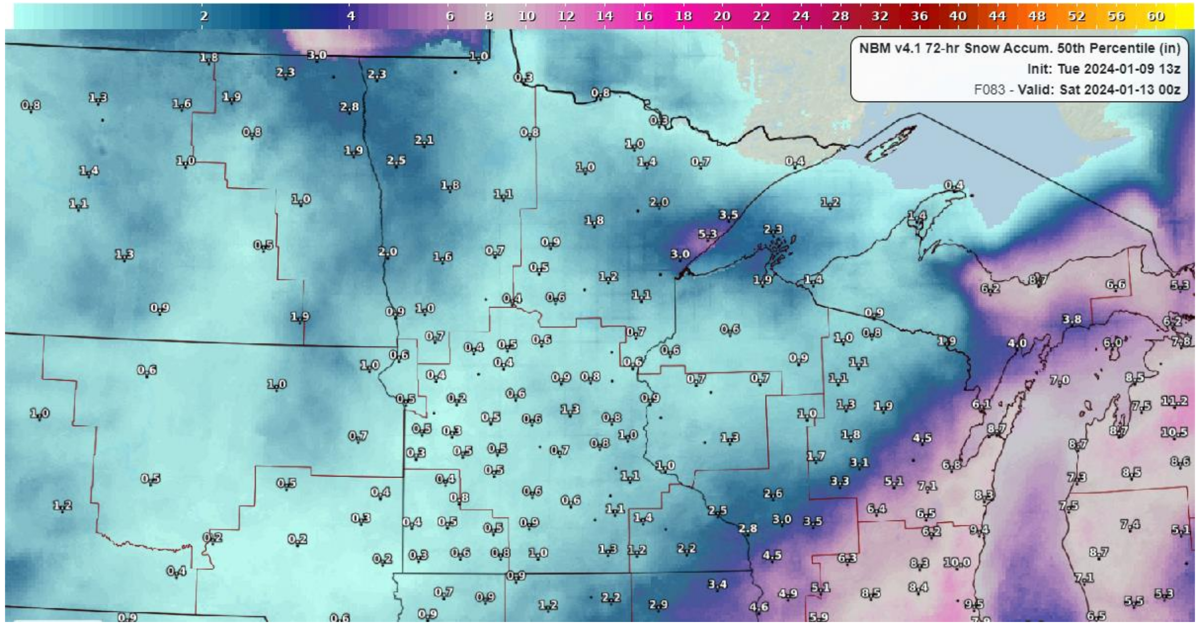
- The individual model QPF CDFs are now smoothed prior to the quantile mapping so that the snowfall probability distribution takes on a smoother appearance



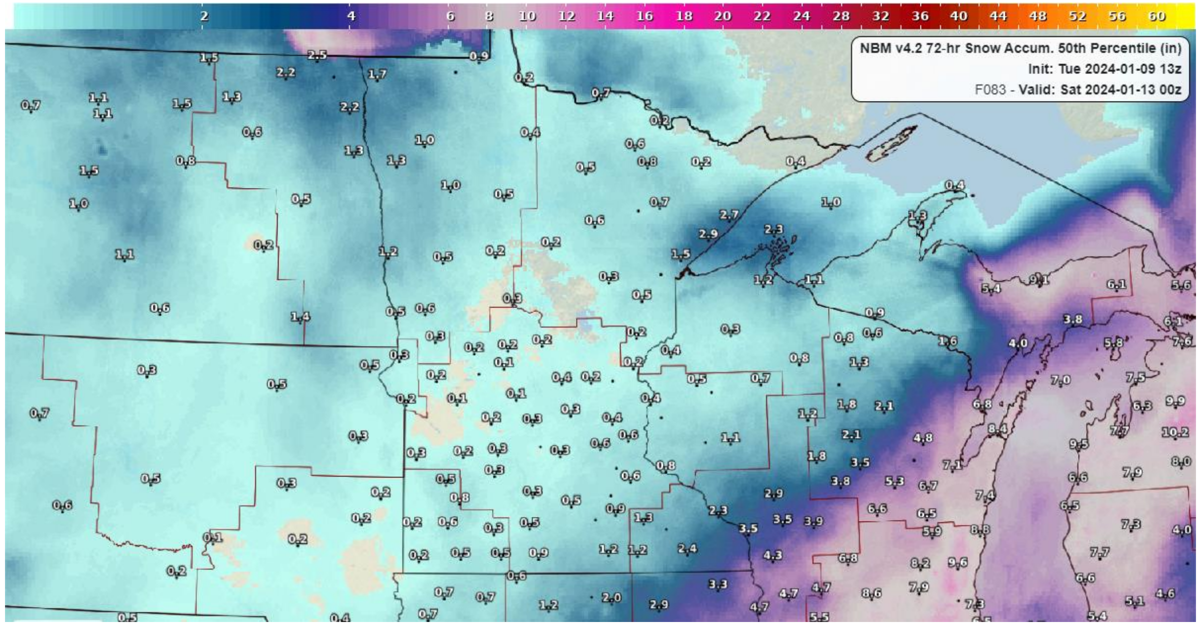


Mitigation of Lattice Features

v4.1



v4.2



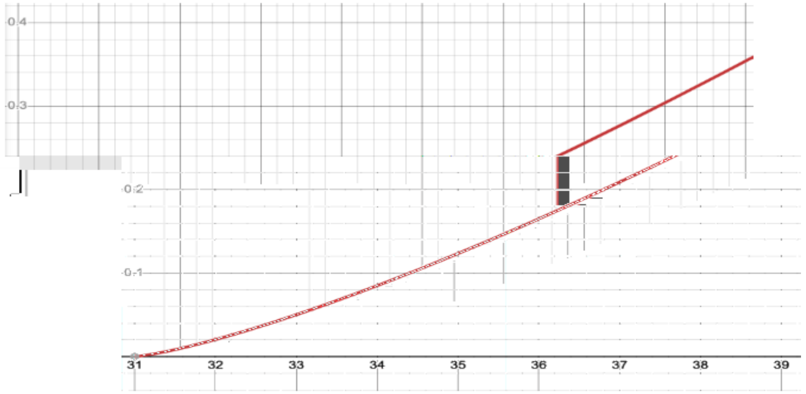
smoothed

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.

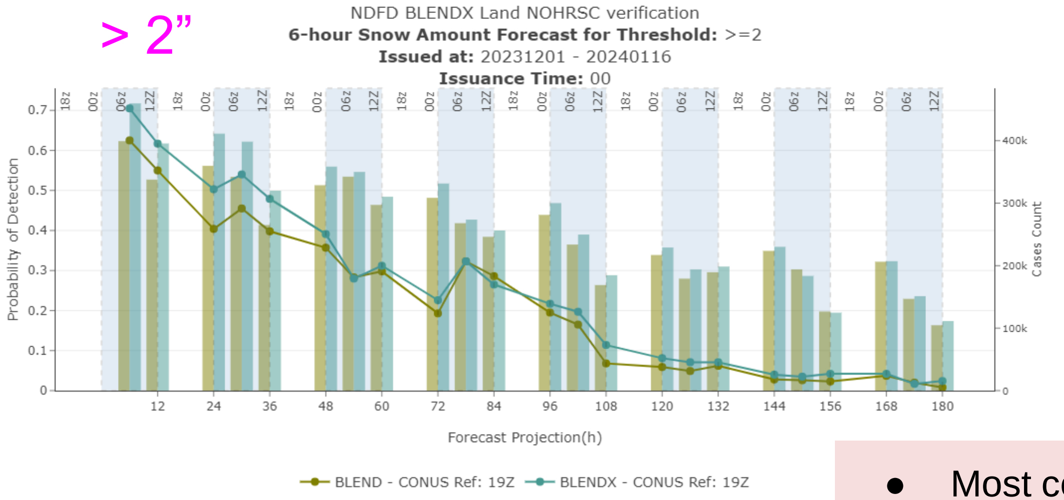
- Adjust logic to allow for a p-type of snow with temps ≤ 40F.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Snow Stats

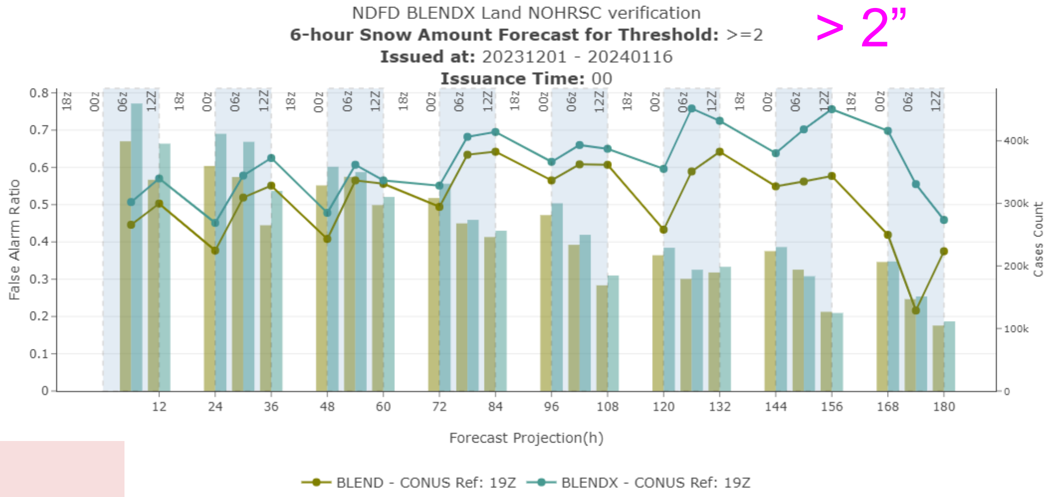
- note that a bug discovered in March may have caused erroneously low QPF to be used for snow computations in v4.2

> 2”



POD

> 2”



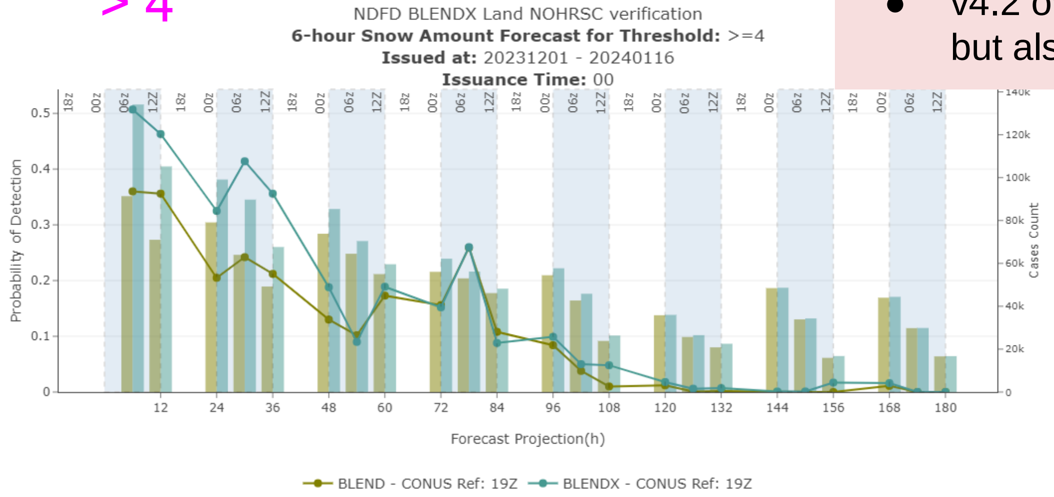
FAR

NBMv4.1

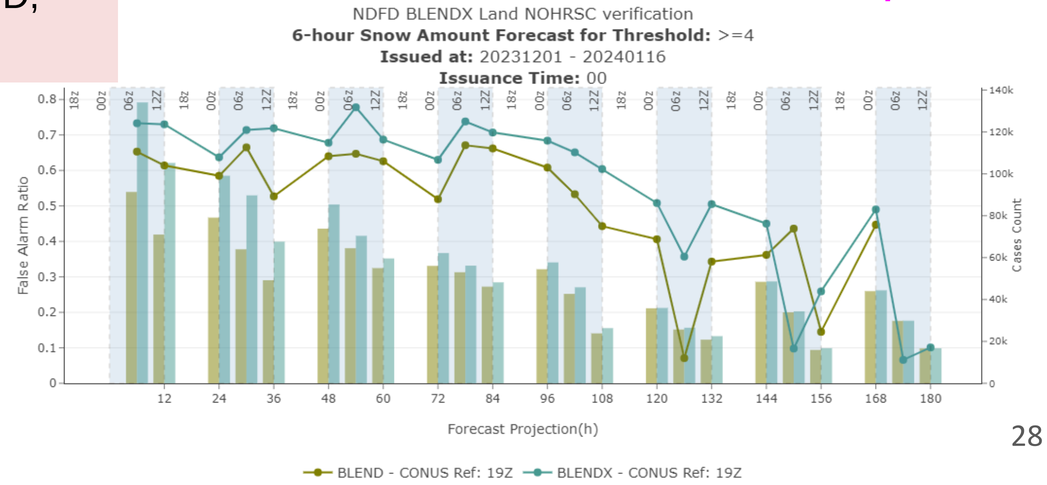
NBMv4.2

- Most cores are overall quite similar, including CSI (not shown)
- v4.2 overall has a higher POD, but also a higher FAR

> 4”



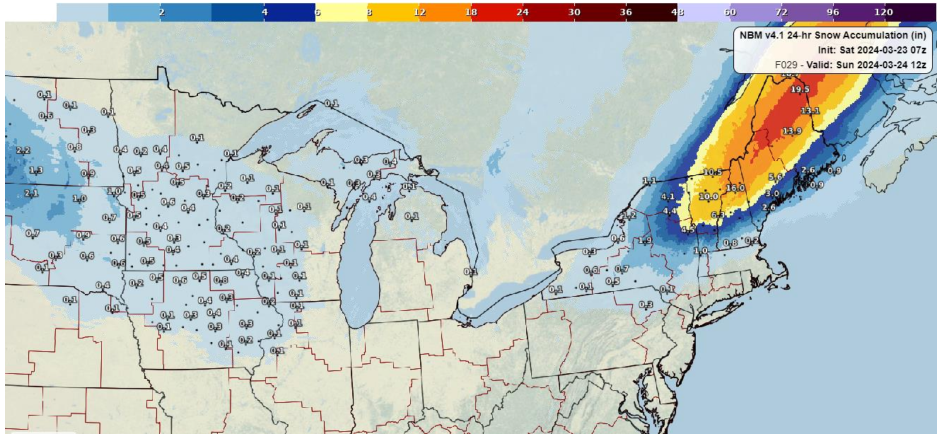
> 4”



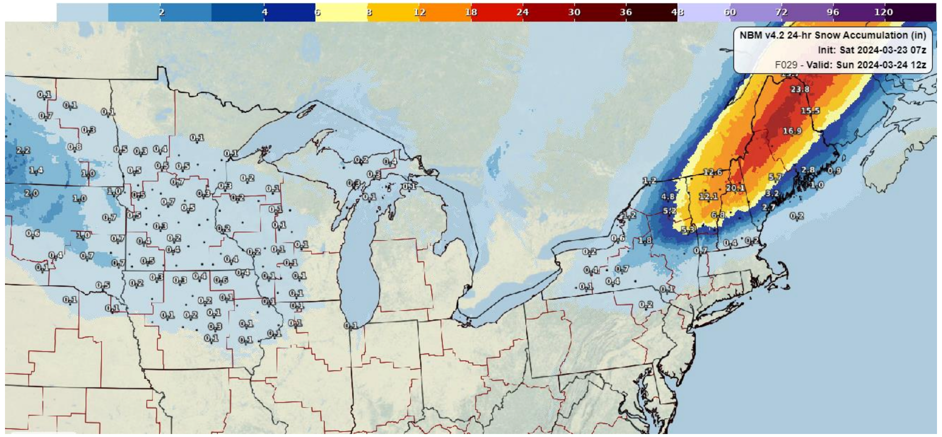
CONUS

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

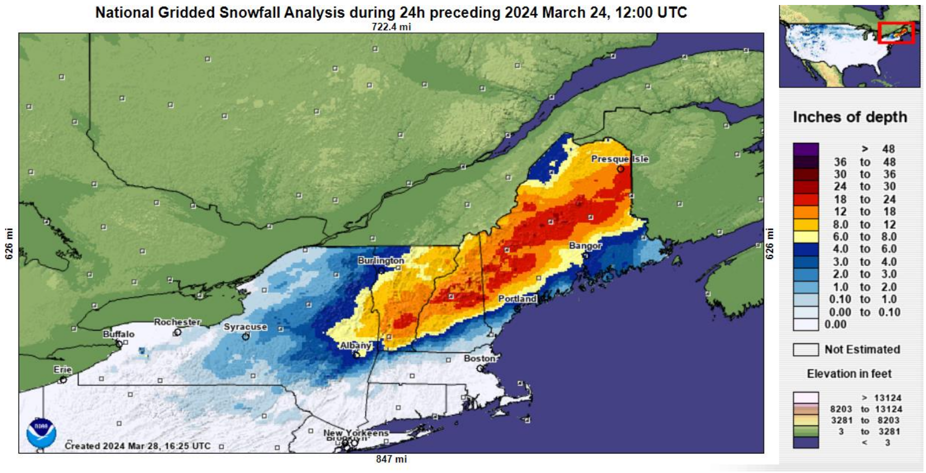
Snowfall Cases



v4.1



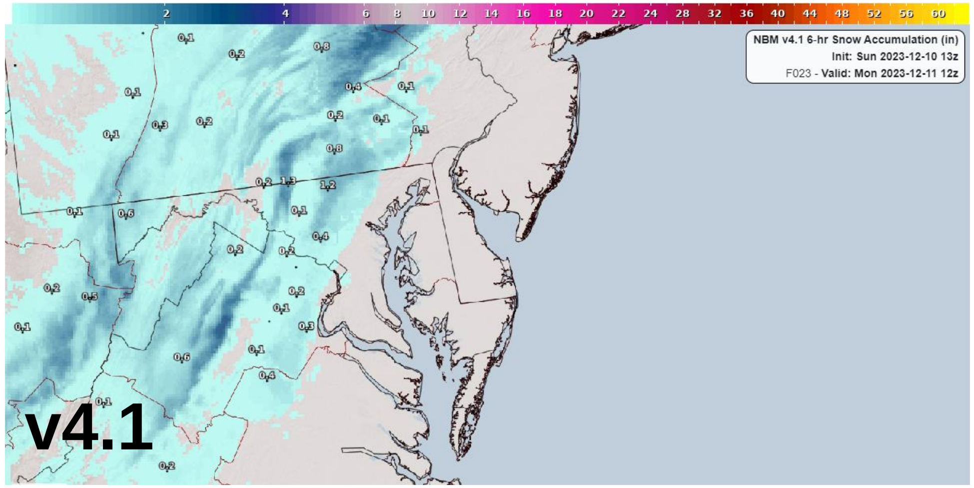
v4.2

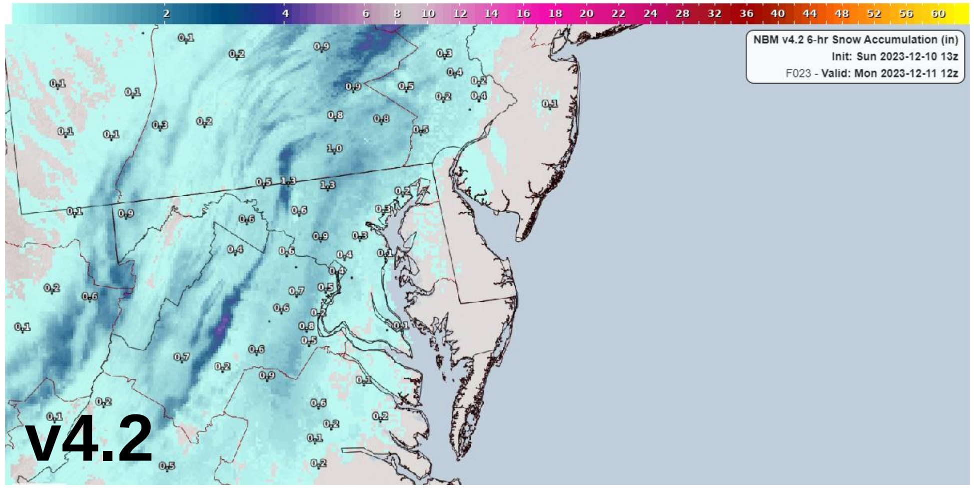


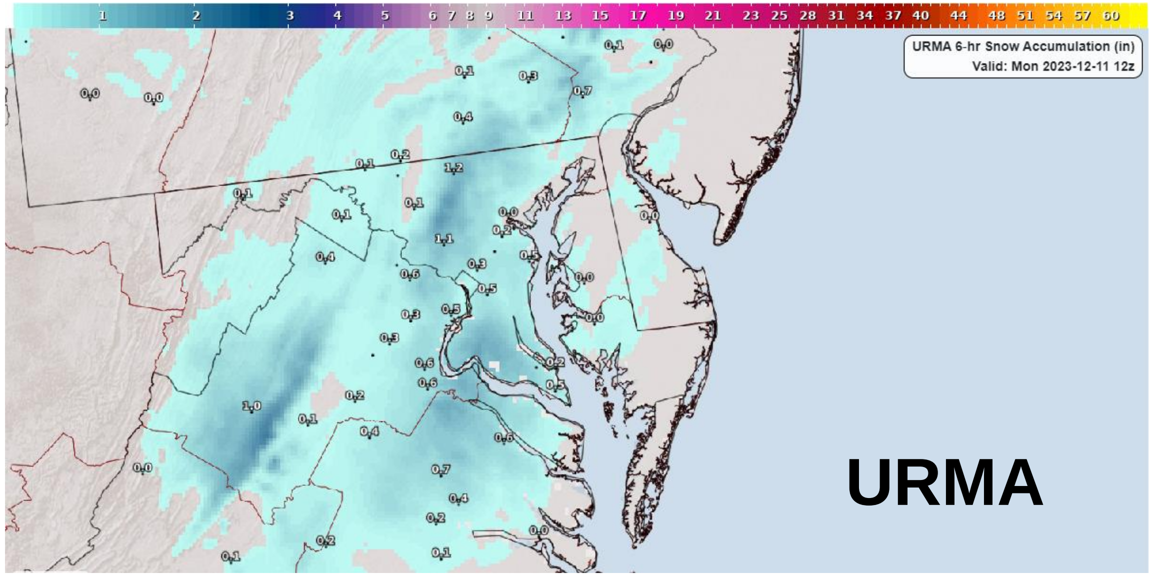
NOHRSC

- Example of the impact of the usage of the downscaled wet bulb temperature to enhance snow totals over higher terrain and the elimination of the 25% reduction of each member's SLR that is used in v4.1

Snowfall Cases

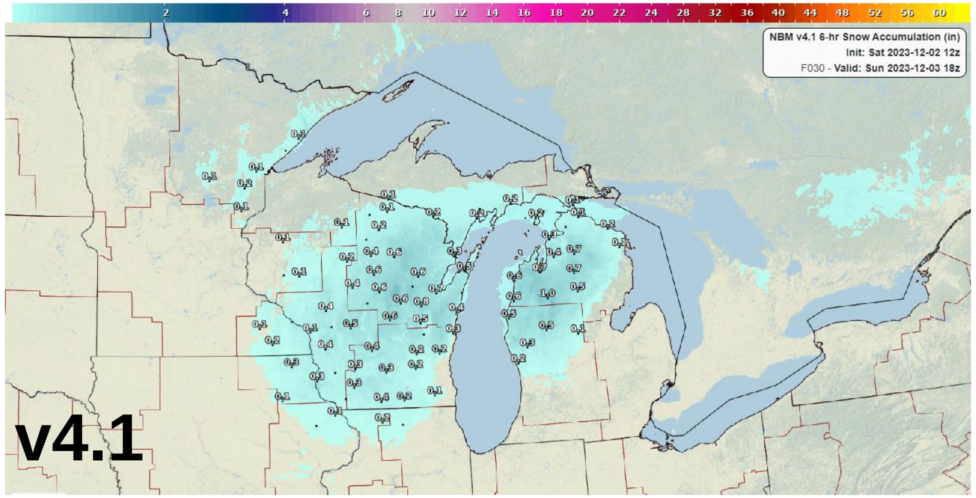


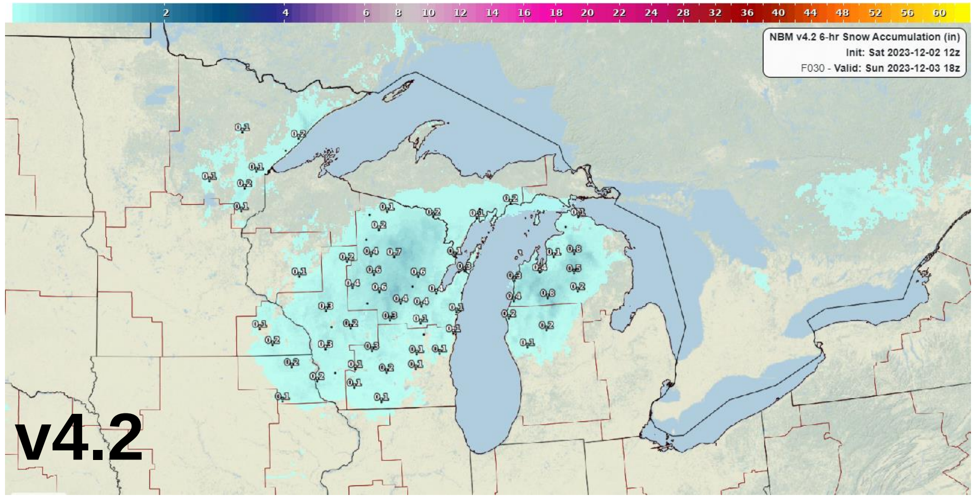


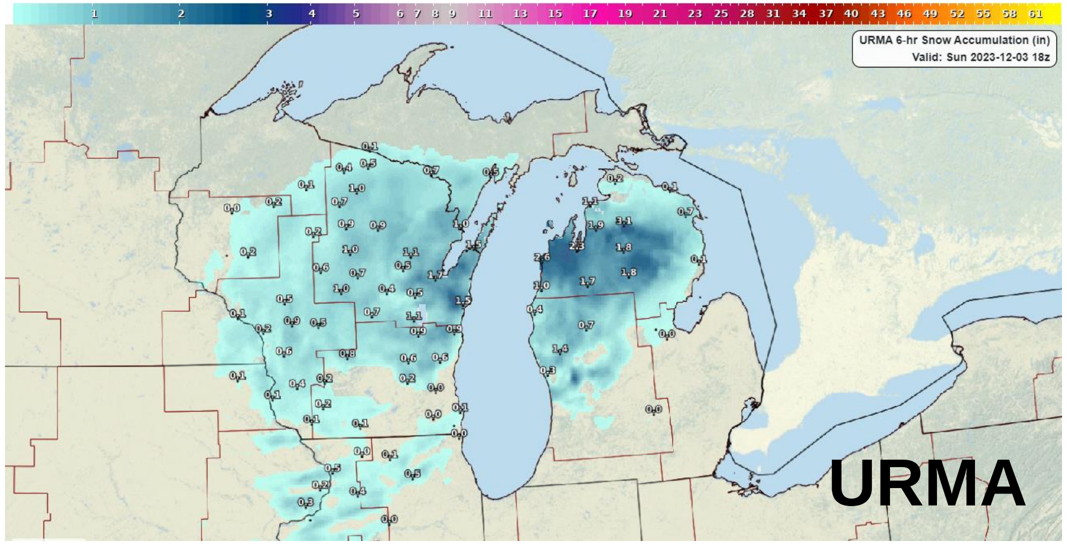


- v4.2 has an updated function for melting of “warm“ snowfall
- This case was a nice success for the updated Cobb approach
- Snow can accumulate in environments with marginal temperatures if rates are high

Snowfall Cases



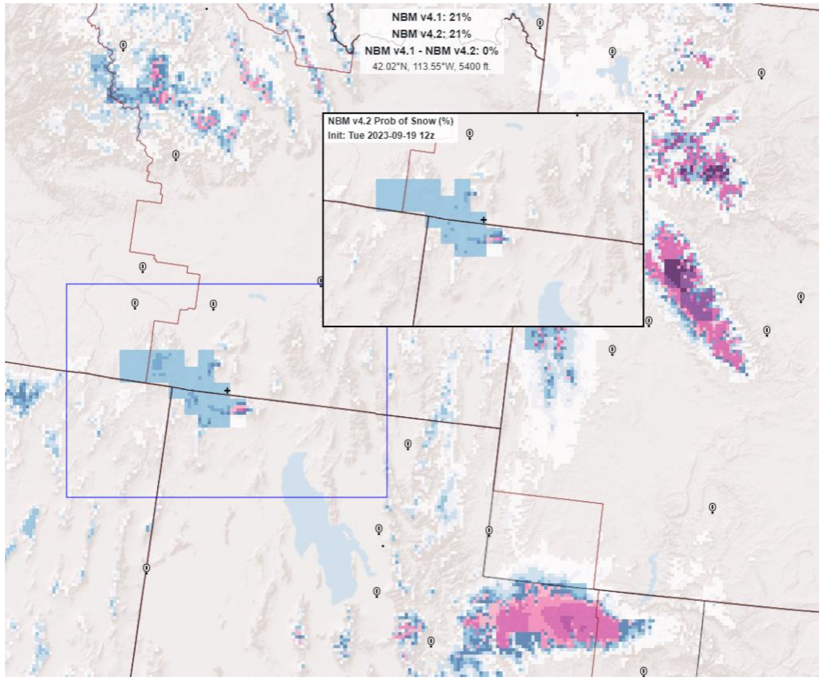




- This was also a light event with marginal temperatures, but the forecasted rates were lighter
- It shows that the melting can be too aggressive in events with marginal temperatures and light rates
- Forecast Builder already has an update to the snow melt factor to address this issue

Blocky Winter Fields

- Users started point out the issue of blocky precip fields in the NBM VLab forum in early October
- It was not a new issue, but it started getting attention as we moved into the winter precip season
- The issue was most pronounced in the F60-F84 time range
- NAM parent (12 km) gets a 15% weighting at this range in v4.1 and that percentage is higher if other inputs are unavailable; for comparison, the GFS gets 3%
- The parent NAM input is not downscaled in v4.1 (neither is the GFS), and this was identified as the primary cause of the blockiness
- The parent NAM is not part of the QPF QMD, so downscaled QPF output for the NAM does not exist
- The SAG recommended removing the *parent* NAM from the winter suite in October in v4.2 to try to address the blocky features
- Downscaled QMD QPF does exist for the GFS, so while the GFS may currently be contributing a bit to the blockiness, we did not want to discard that input; the v4.2 winter suite also switched to using downscaled GFS QPF in October to improve the blockiness



Winter Weighting

4.1

Input Models	1-16	17-19	20-42	43-60	61-84	84+
HRRR	16					
HRRRX	6	17	17			
RAP	5	5				
RAPX	3	3	3			
HiResARW	10	11	12			
HiResARW 2	12	12	13			
HiResFV3	12	13	14	14		
NAM	3	3	4	7	15	
NAMnest	10	13	14	14		
10 SREF ARW	1/mem	1/mem	1/mem	3/mem	3/mem	
GFS	1	1	1	3	3	4
30 GEFS	0.15/mem	0.15/mem	0.15/mem	0.4/mem	0.65/mem	1.2/mem
50 ECMWF	0.15/mem	0.15/mem	0.15/mem	0.4/mem	0.65/mem	1.2/mem

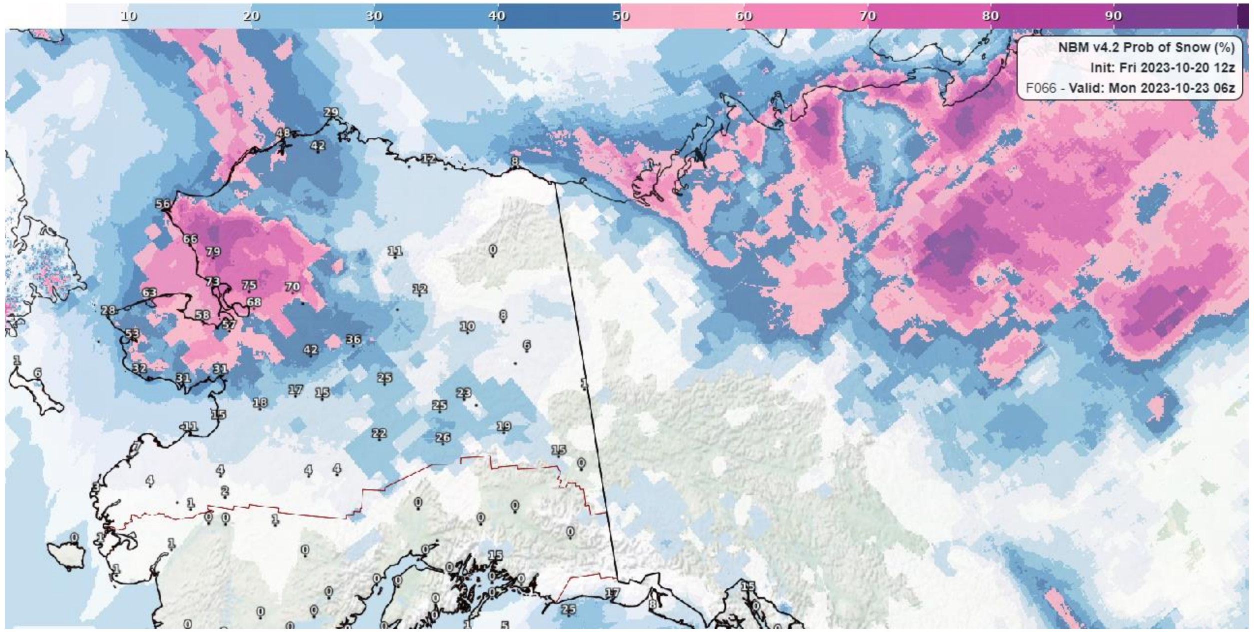
4.2

Input Models	1-16	17-19	20-42	43-60	61-84	84+
HRRR	16					
HRRRX	6	17	17			
RAP	5	5				
RAPX	3	3	3			
HiResARW	10	11	12			
HiResARW 2	12	12	13			
HiResFV3	12	13	14	17		
NAM	0	0	0	0	0	
NAMnest	12	15	16	17		
10 SREF ARW	1/mem	1/mem	1/mem	3/mem	3/mem	
GFS	2	2	3	4	4	4
30 GEFS	0.15/mem	0.15/mem	0.15/mem	0.4/mem	0.825/mem	1.2/mem
50 ECMWF	0.15/mem	0.15/mem	0.15/mem	0.4/mem	0.825/mem	1.2/mem

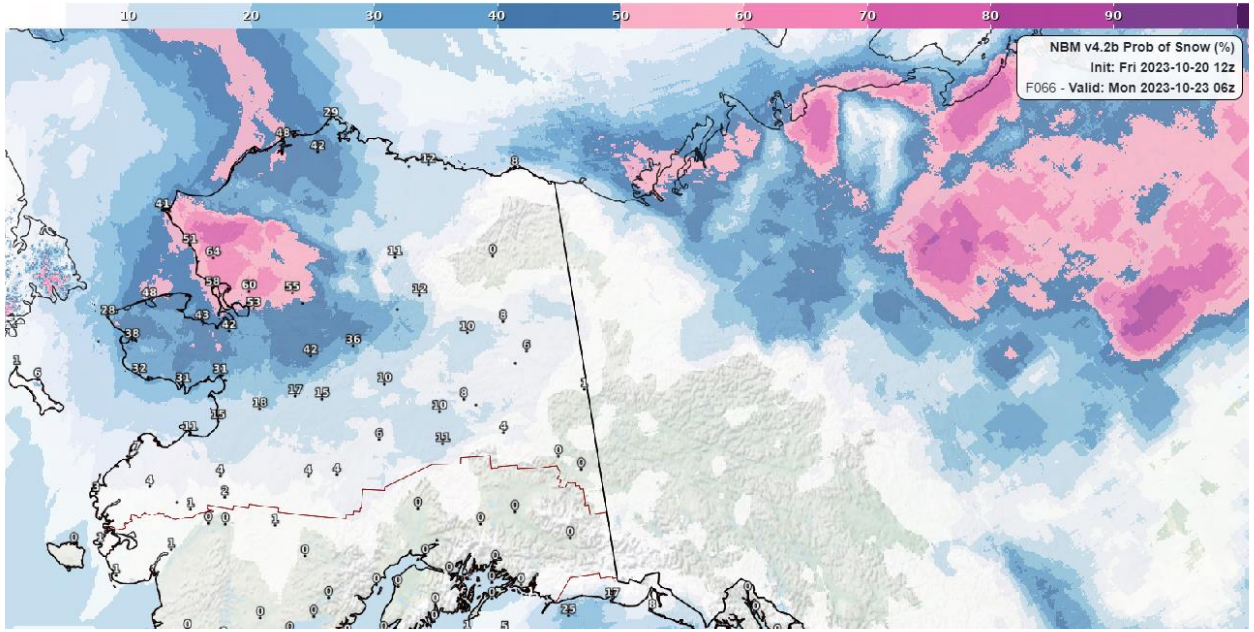
- A decision was made in October to remove usage of parent NAM for winter fields in v4.2 and redistribute weights to NAM Nest, GFS, and global ensembles

Removal of Blocky Features

v4.1

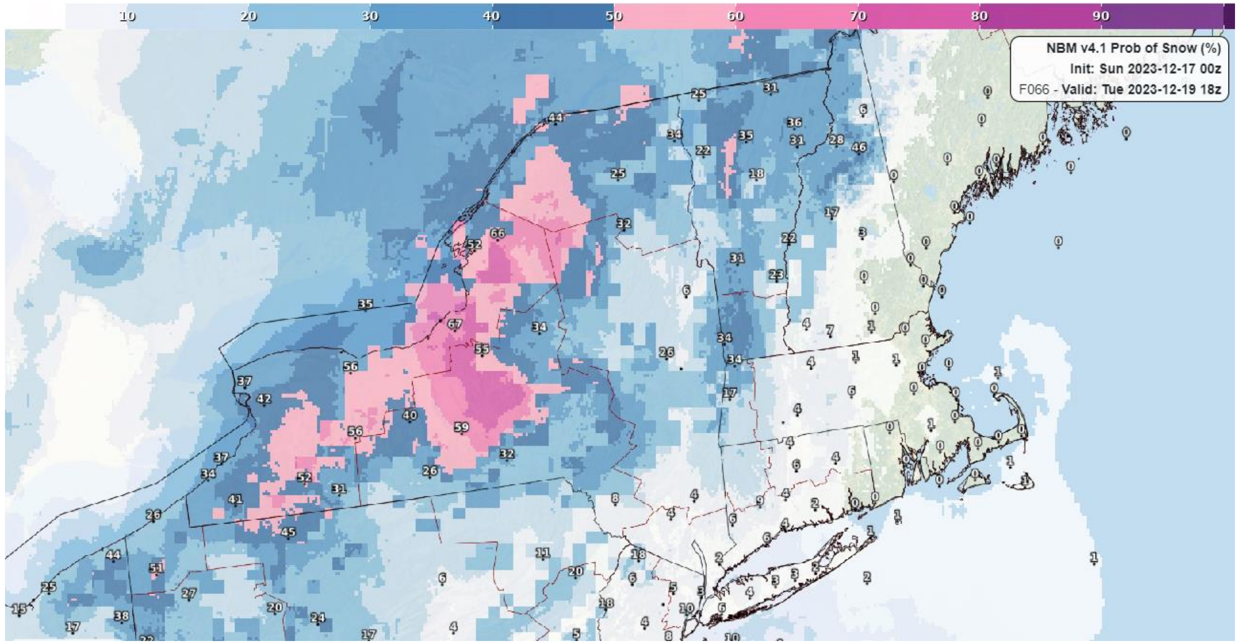


v4.2

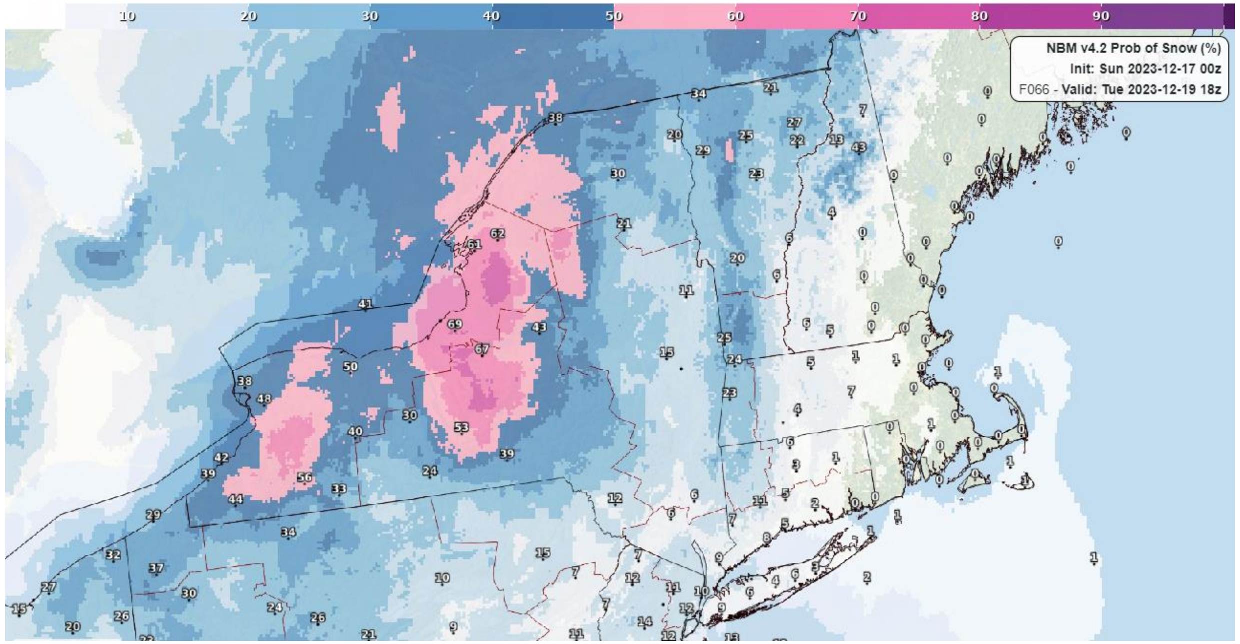


Removal of Blocky Features

v4.1

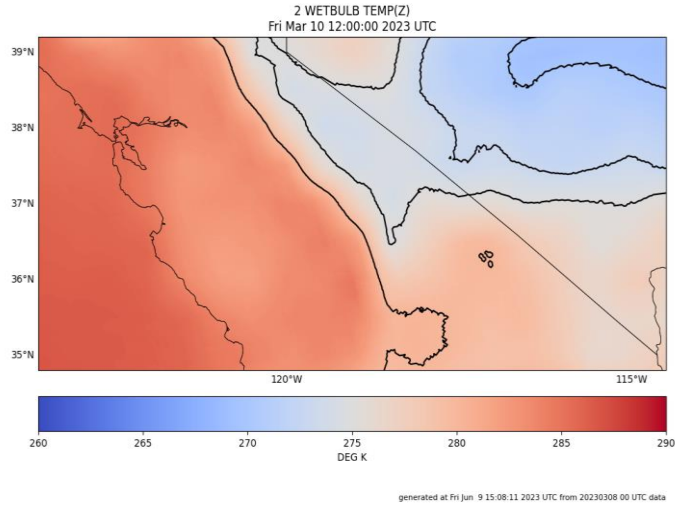


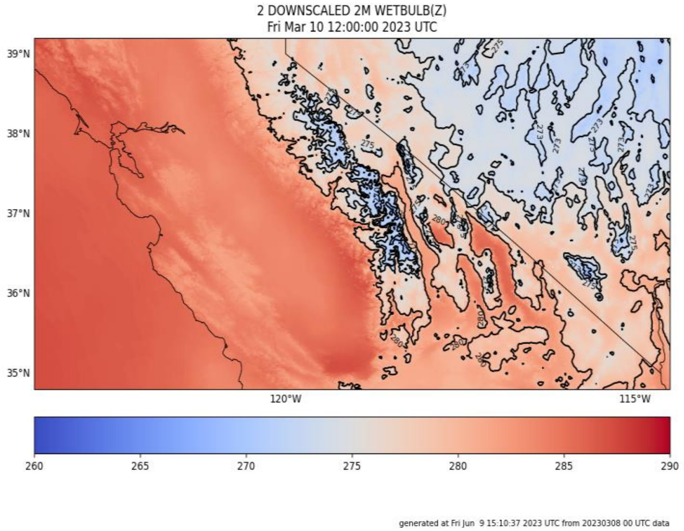
v4.2



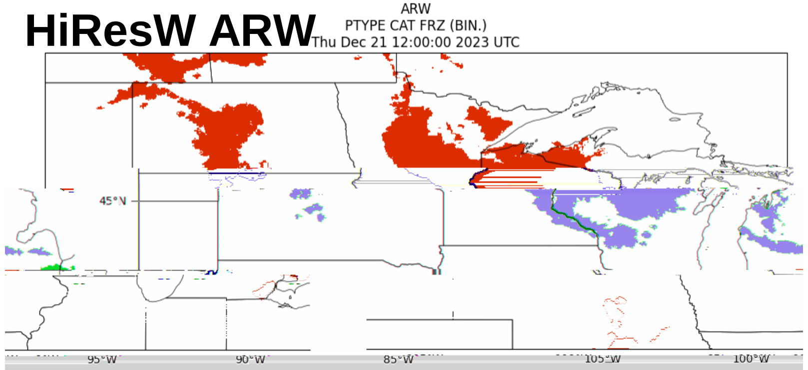
Downscaled Tw

- Downscaled wet bulb computed by subtracting the difference between the non-downscaled temperature and downscaled temperature from the non-downscaled wet bulb (per communication with Dr. Daniel Cobb). That is:
  - delta=(T - DST)
    - T=non-downscaled temp
    - DST=downscaled temp (obtained from WPC's algorithm based on thermal lapse rates)
  - DSTw=(Tw - delta)
    - DSTw=downscaled wet bulb
    - Tw=non-downscaled wet bulb (from model or computed)
- Subtracting the temperature difference from the wet bulb should be a reasonably accurate estimate of a downscaled value at least near wet bulb temperatures within +/- 10 degrees F of freezing (~ +/- 5.6 deg K).
- Downscaled wet bulb is applied to the ECMWFE, GEFS, and SREF ensembles only (coarser model resolution)
- The downscaled Tw assists with freezing rain events

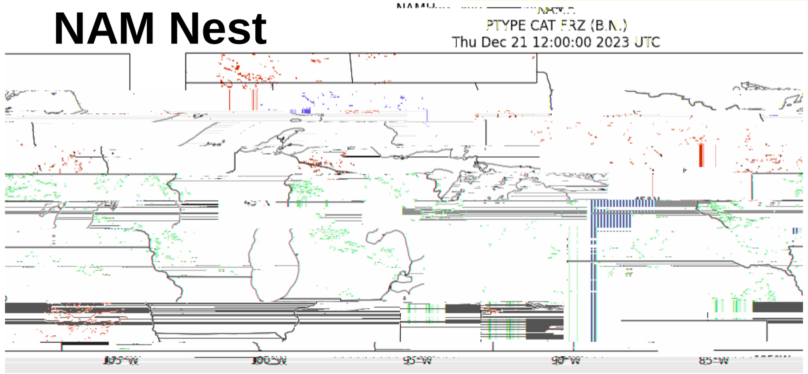


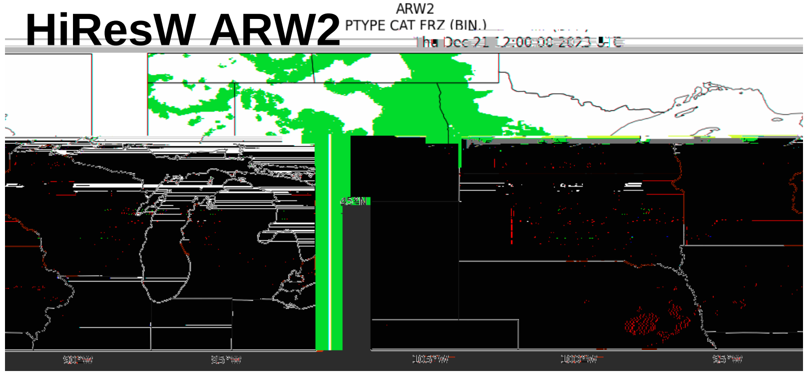


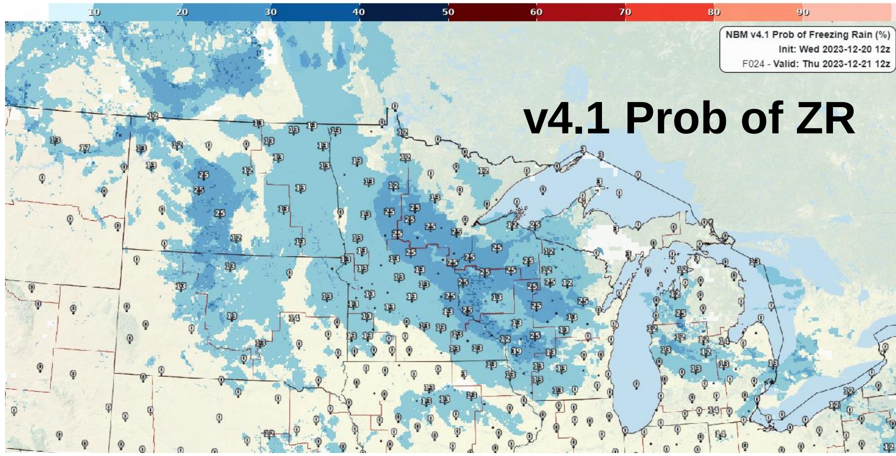
High Freezing Rain Probs in Ops

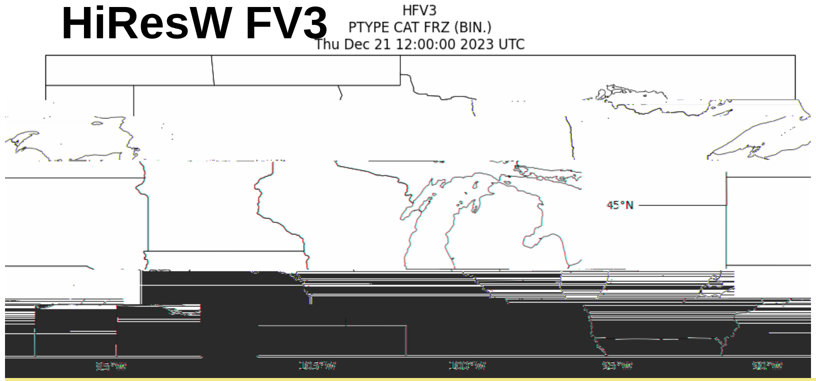


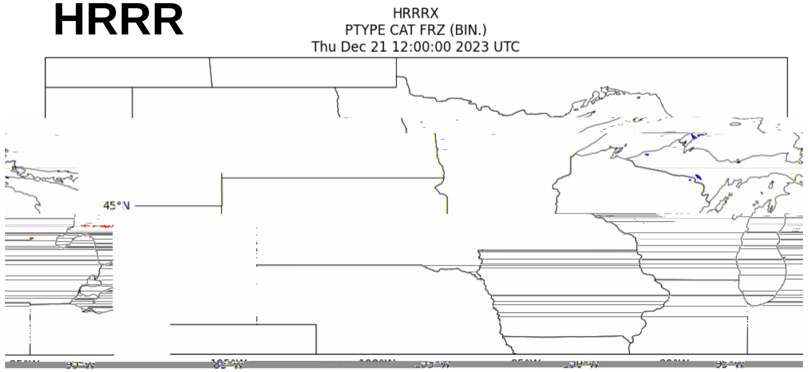
clearly driven by HiResW ARWs







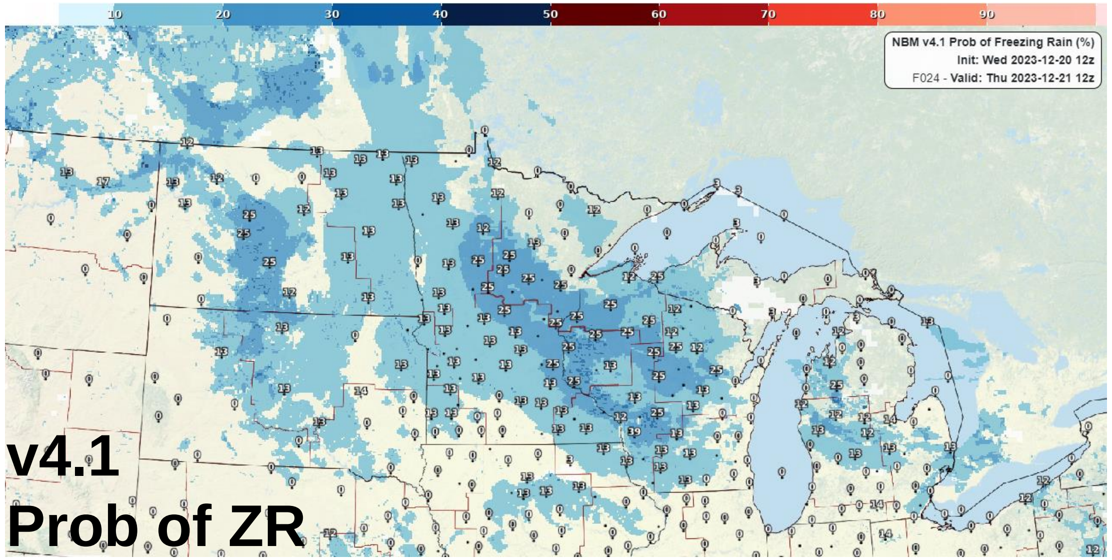


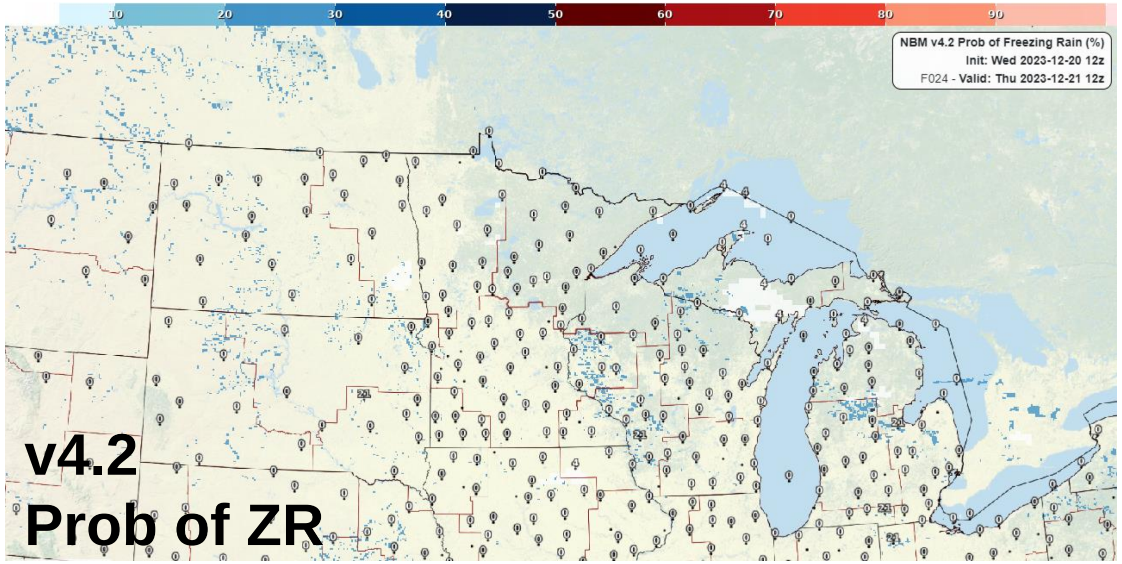


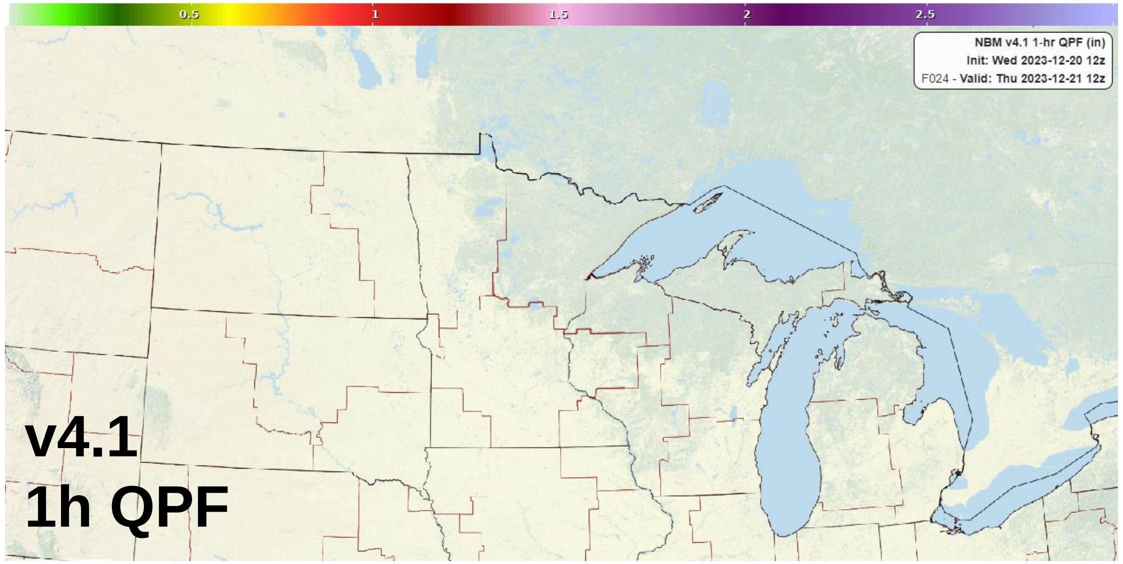
change was made to zero out HiResW ARW precip type if hourly QPF < 0.01”

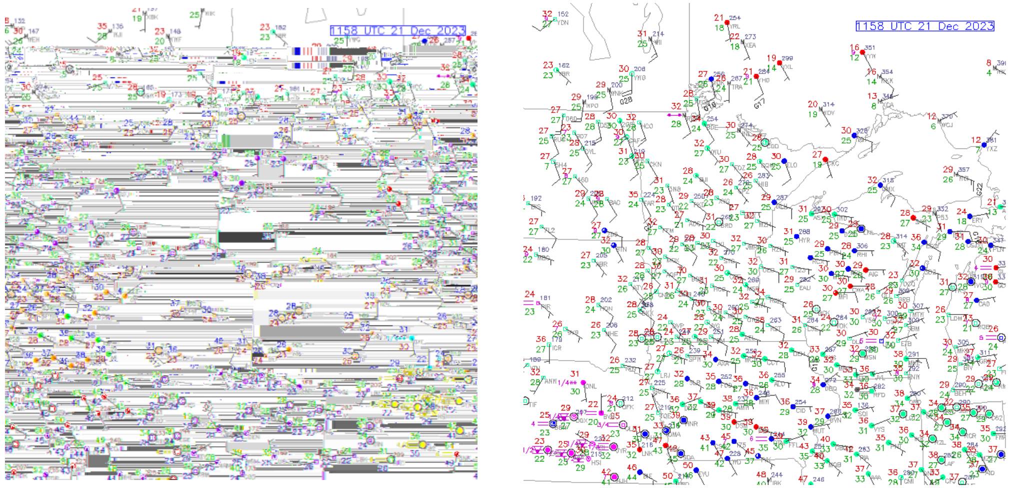
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

4.1 vs 4.2 ZR Comparison









Sfc Obs show no ZL

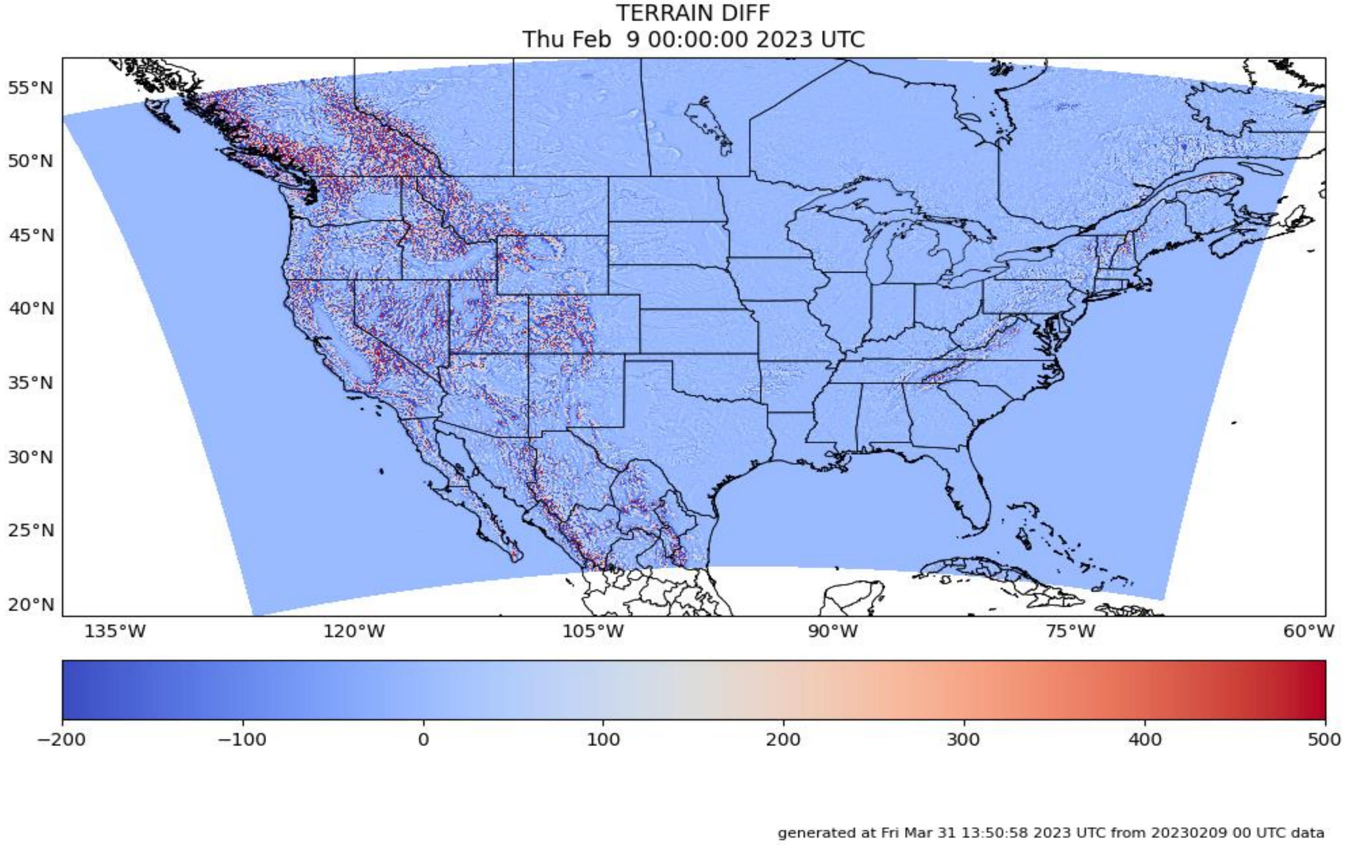
ZR Discussion

- SMD is confident that this change significantly reduces the freezing drizzle footprint in the probability of ZR output
- SMD and the SAG believes that this change is an overall improvement
- SMD believes that the NAM Nest covers the freezing drizzle threats fairly well, although the coverage is spotty (generally not a continuous field)
- This change was noted as a positive by several evaluators

Mixing Height Adjustment

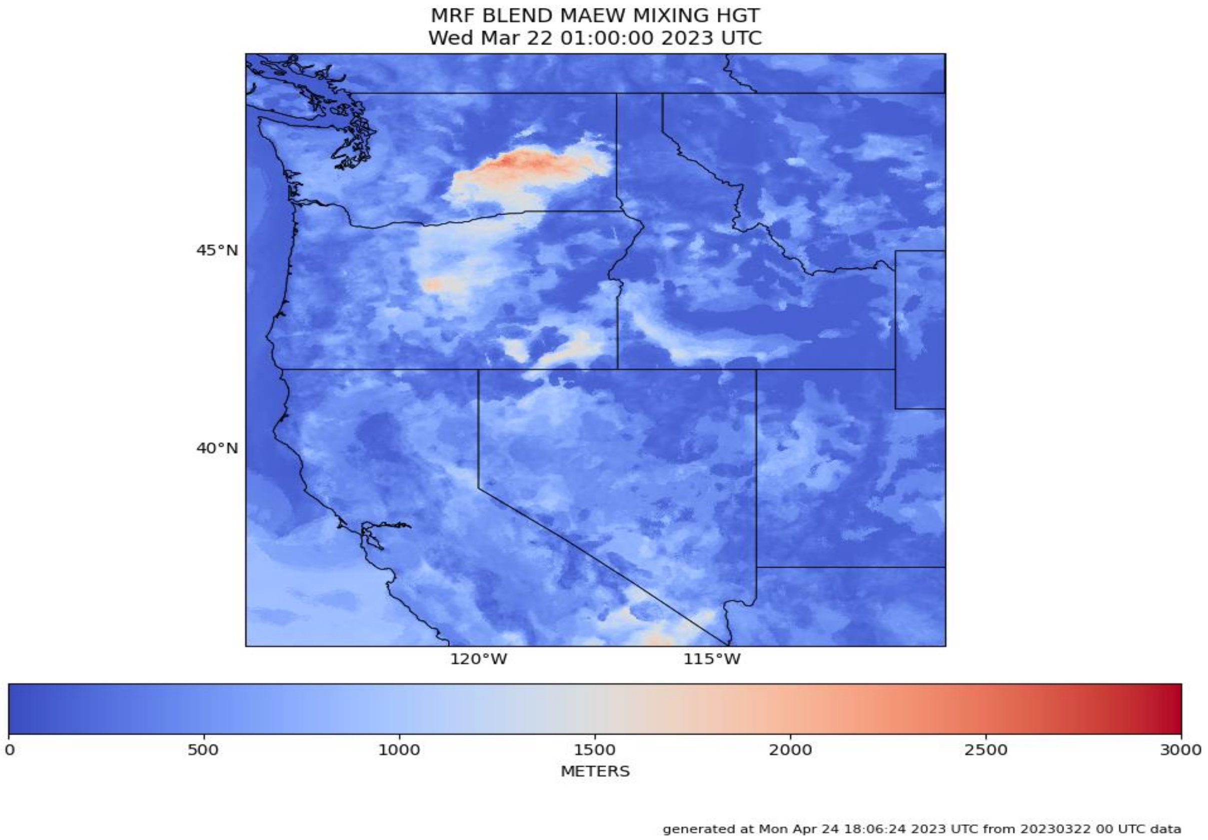
Terrain Difference between RAP and the URMA Unified Terrain

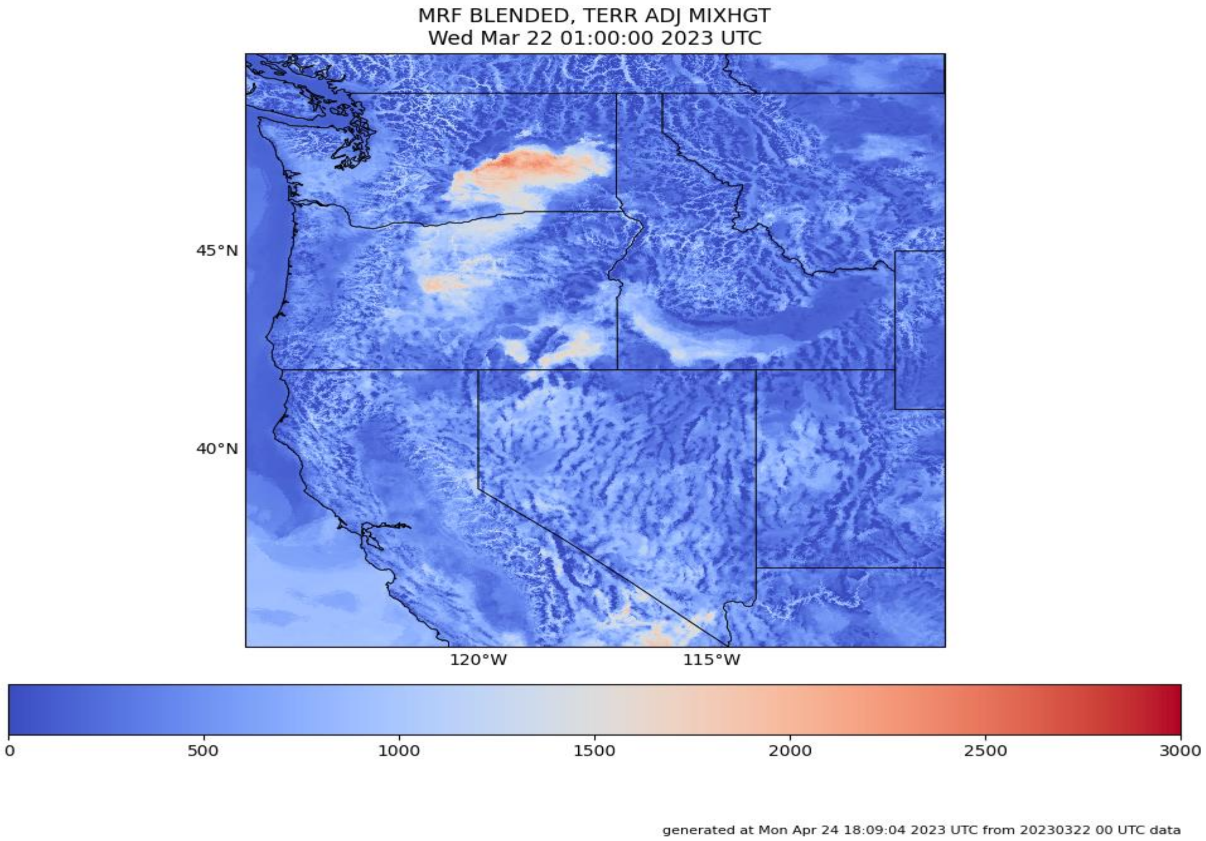
NBM v4.2 is now incorporating the difference between the RAP and URMA Unified terrain height in the calculation of Mixing Heights. This is a more accurate depiction of the true Mixing Height above the surface. Note the terrain detail in the subsequent slides.



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Mixing Height Adjustment





NBM Weather Elements Content Page

NBM V4.2 SURFACE WEATHER ELEMENTS

Surface Weather Elements	CO	AK	PR	HI	GU	OC	Definition
TEMPERATURE							
MaxT	x	x	x	x			Maximum Temperature; 12z to 06z except in Guam 18z to 12z
MinT	x	x	x	x			Minimum Temperature; 00z to 18z except in Guam 06z to 00z
MaxT SD	x	x	x	x			Standard Deviation (SD) of Maximum Temperature; 12z to 06z except in Guam 18z to 12z
MinT SD	x	x	x	x			Standard Deviation (SD) of Minimum Temperature; 00z to 18z except in Guam 06z to 00z
PMaxT	x	x					Percentiles from 1-99 of Maximum Temperature; 12z to 06z except in Guam 18z to 12z
PMinT	x	x					Percentiles from 1-99 of Minimum Temperature; 00z to 18z except in Guam 06z to 00z
PMaxT Mean	x	x					True mean of Maximum Temperature percentiles; 12z to 06z except in Guam 18z to 12z
PMinT Mean	x	x					True mean of Minimum Temperature percentiles; 00z to 18z except in Guam 06z to 00z
PMaxT SD	x	x					Standard Deviation (SD) of Maximum Temperature percentiles; 12z to 06z except in Guam 18z to 12z
PMinT SD	x	x					Standard Deviation (SD) of Minimum Temperature percentiles; 00z to 18z except in Guam 06z to 00z
Temp	x	x	x	x	x	x	Top of hour value of temperature; hourly through 36 hours, then 3 hourly to 192 hours, then 6 hourly to 264.
Temp SD	x	x	x	x	x		Top of the hour value Temperature Standard Deviation (SD)
AppT	x	x	x	x			Apparant Temperature; derived parameter from Temp, Td, and wind speed
WBGT	x		x	x	x		Wet Bulb Globe Temperature; measure of heat stress using NBM Temp, Td, Sky, Wspd, and MSLP
PRECIPITATION							
QPF01	x	x	x	x	x		Quantitative Precipitation Forecast; hourly rainfall or melted liquid equivalent to 264 hours
QPF06	x	x	x	x	x		Quantitative Precipitation Forecast; 6-hour forecast

- This page contains tables featuring a description and weighting and region information for Surface, Aviation, Fire, Winter, and Marine elements
- For Upper Air, it contains pressure levels instead of region
- Highlighting weather element provides tooltip for long name of variable and highlights cell

NBM Weather Elements Table

TEMPERATURE							
MaxT	x	x	x	x	x		Maximum Temperature; Time Window: 12z to 06z except 18z to 12z in Guam
MinT	x	x	x	x	x		Minimum Temperature; Time Window: 00z to 18z except 06z to 00z in Guam
Weighting/Calculation: *Various model inputs based on dynamic MAE weighted scheme* **Models Used in NBM:** *CONUS Alaska Puerto Rico Hawaii Guam Oceanic* **Models Used in Latest NBM Run:** *CONUS Alaska Puerto Rico Hawaii Guam Oceanic*							
MaxT SD	x	x	x	x			Standard Deviation (SD) of Maximum Temperature; Time Window: 12z to 06z except 18z to 12z in Guam

PRECIPITATION							
QPF01	x	x	x	x	x		Quantitative Precipitation Forecast; hourly rainfall or melted liquid equivalent of frozen/freezing precipitation to 264 hours
QPF06	x	x	x	x	x		Quantitative Precipitation Forecast; 6-hour forecast
Weighting/Calculation: *Expert Weights (%): CONUS Alaska Puerto Rico Hawaii Guam Oceanic* **Models Used in NBM:** *CONUS Alaska Puerto Rico Hawaii Guam Oceanic* **Models Used in Latest NBM Run:** *CONUS Alaska Puerto Rico Hawaii Guam Oceanic*							

- Clicking on element name toggles row to provide information on weighting scheme
- For expert weighted elements, links are provided per region (or if upper air, per pressure level)

NBM Dashboard

Date and Cycle | Regions
Select Date: Thursday, Sep 14, 2023 2 | Select Region: CONUS
Weather Elements | Projection
Select Element: Max Temperature | Select Projection: 90

Members for NBM v4.2 - Reference Time 2023-09-14 21:00 UTC

For Max Temperature (CONUS) - 90 hour Projection

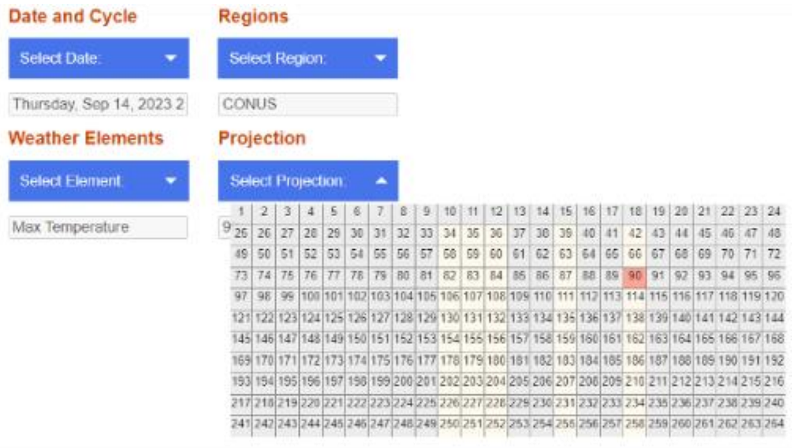
Model	Date	Cycle	Valid Date	Expected	Used
ACCESSE	20230914	12	2023091806	1	0
NAMMOSSTN	20230914	12	2023091806	1	1
HIRESW FV	20230914	12	2023091806	0	0
GMOS	20230914	12	2023091806	1	1
GFSMOSSTN	20230914	12	2023091806	1	1
GFS	20230914	12	2023091806	1	1
GEFS	20230914	12	2023091806	1	1
ECMWFE	20230914	12	2023091806	1	1
ECMWFD	20230914	12	2023091806	1	1
ECMOSE	20230914	12	2023091806	1	0
ECMOSD	20230914	12	2023091806	1	1
CMCE	20230914	12	2023091806	1	1
CMC REPS	20230914	12	2023091806	0	0
CMC RDPS	20230914	12	2023091806	0	0
CMC GDPS	20230914	12	2023091806	1	1
ACCESSG	20230914	12	2023091806	1	0
WRF ARW	20230914	12	2023091806	0	0
WRF MEM2	20230914	12	2023091806	0	0

Weather Elements | Projection
Select Element: Surface CAPE, Sea Surface | Select Projection: 12

M v4.2 - Reference Time 2023-09-14 21:00 UTC

For Surface CAPE (CONUS) - 12 hour Projection

Model	Date	Cycle	Valid Date	Expected	Used
ACCESSG	20230914	12	2023091500	0	0
SREF	20230914	15	2023091503	1	0
RAPX	20230914	15	2023091503	1	1
RAP	20230914	19	2023091507	1	1
NAVGEME	20230914	12	2023091500	1	1
NAVGEMD	20230914	12	2023091500	0	0
NAML	20230914	18	2023091506	1	1
NAMH	20230914	18	2023091506	1	1
HRRRX	20230914	18	2023091506	1	1
WRF ARW	20230914	12	2023091500	1	1
HRRR	20230914	19	2023091507	1	1
GFS	20230914	12	2023091500	1	1
GEFS	20230914	12	2023091500	1	1
ECMWFE	20230914	12	2023091500	1	0
ECMWFD	20230914	12	2023091500	1	1



This tool allows users to see which input members made it into a specified run of the NBM

1. Left: Example of models available/unavailable to 21Z run of NBM for MaxT at t=90hr, CONUS
2. Middle: Example of dropdown being used to select new element (SfcCAPE)
3. Right: Example of selecting available projections (highlighted if available, red is current selection)

Plans for NBMv5.0 (Summer 2025)

- Extension of hourly products from 36 to 48 hours
- Use quantile mapping to generate probabilistic fire weather elements
- Generate quantile-mapped probabilistic wave products
- Add Precipitable Water and Lifted Index
- Add direction and gust to tropical cyclone feature-matched wind products

- Continue to work on improving winds over land
- Improve winds over water
- Use archive of URMA data for bias correction
- Use a single reanalysis source for QPF and other QPF improvements
- Make QPF and snowfall output more consistent
- Use higher resolution ECMWF data
- Prepare for model retirements (SREF, NAM, Hi-Res Windows) and introduction of RRFS
- Potentially remove low skill and unreliable inputs
- Calibrate 24, 48, and 72h snow exceedances
- Revisit inputs to quantile-mapped QPF
- Continue to improve mixing height

Beyond 2025

- Achieve greater consistency across NBM elements
- Continue to add probabilistic products in support of Probabilistic IDSS
- Build a next-generation MDL post-processing system that incorporates Local Aviation MOS Program (LAMP) and Model Output Statistics (MOS) products
- Explore AI/ML approaches, especially for leveraging use of long reforecast datasets

Thank You!

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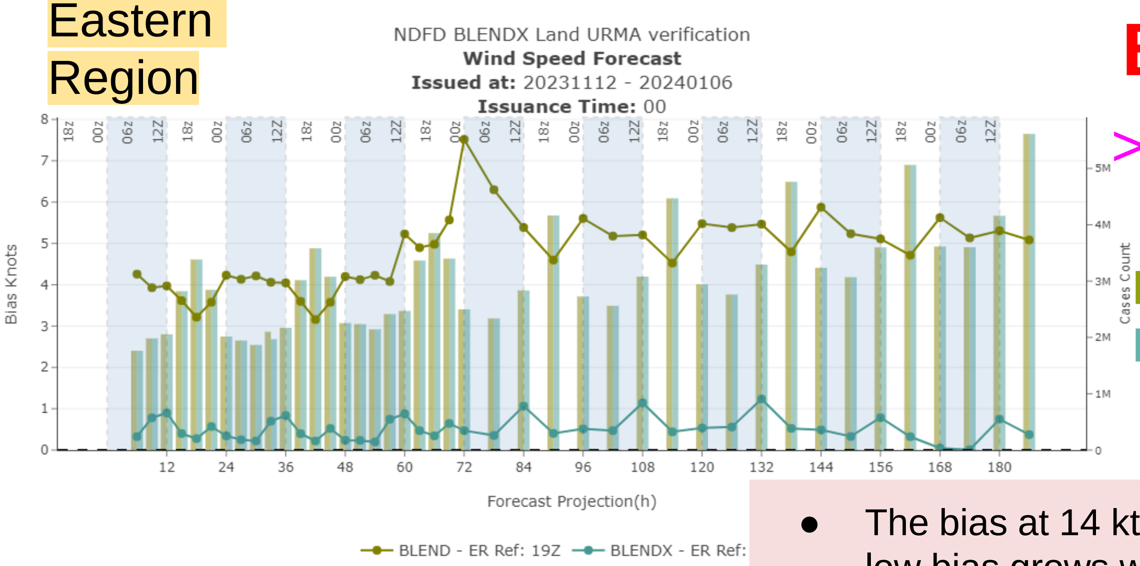
- david.rudack@noaa.gov

Extra Slides

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Wind Stats

Eastern Region



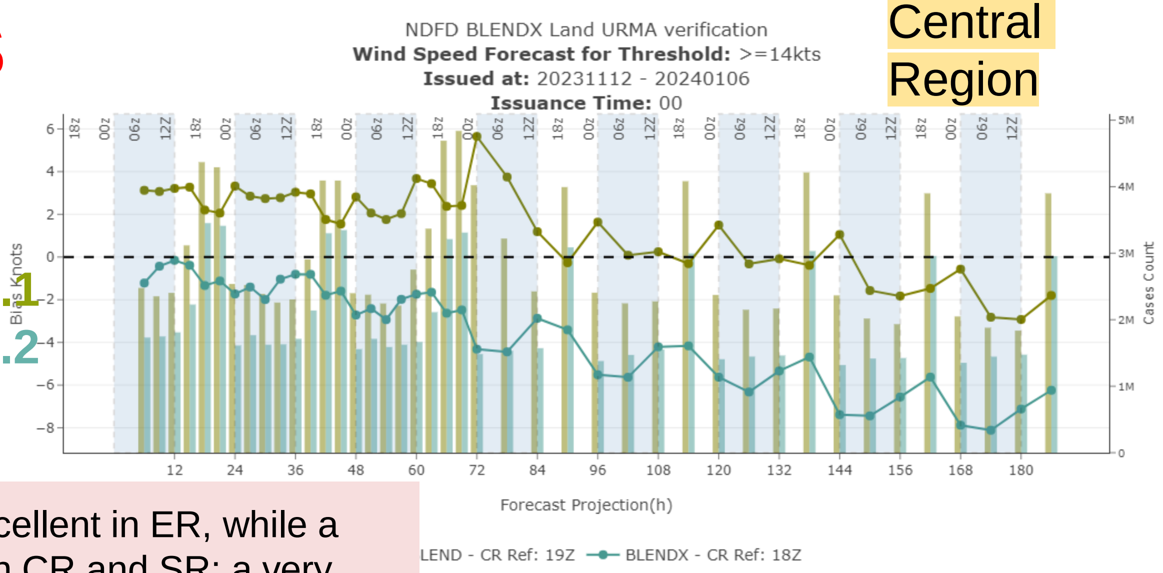
BIAS

> 14 kt

NBMv4.1

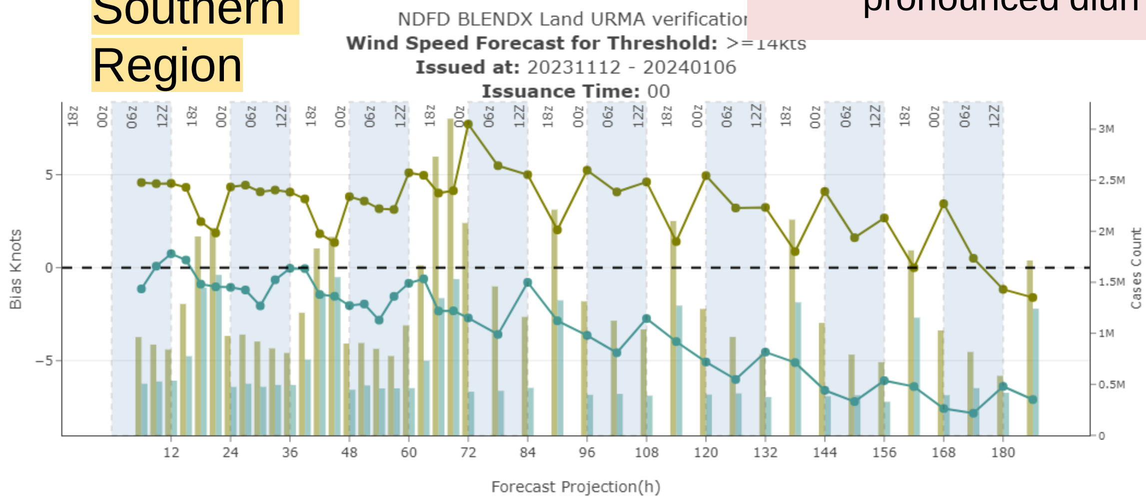
NBMv4.2

Central Region

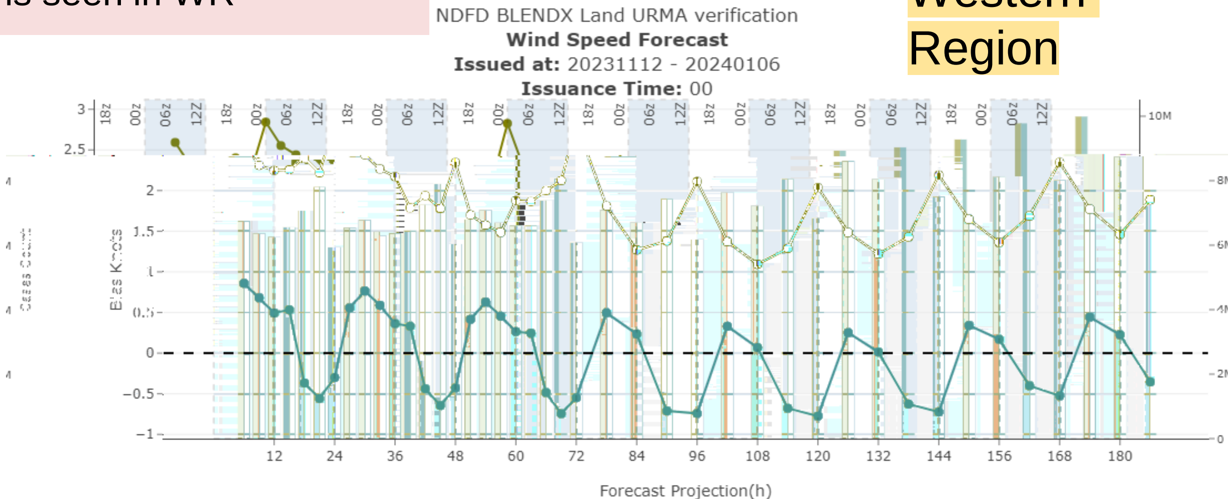


- The bias at 14 kt looks excellent in ER, while a low bias grows with time in CR and SR; a very pronounced diurnal cycle is seen in WR

Southern Region



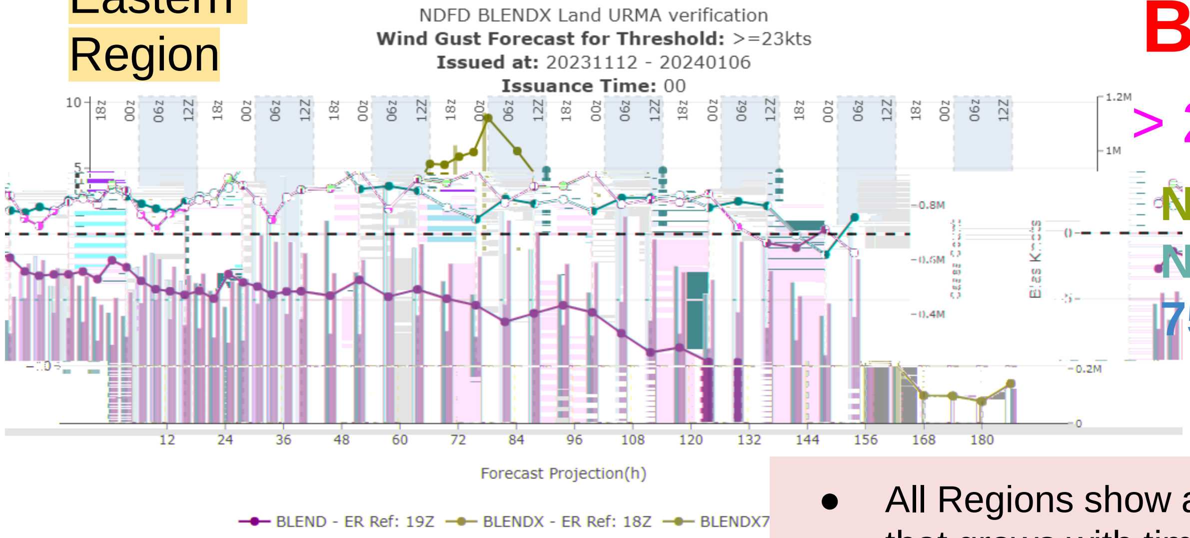
Western Region



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Gust Stats

Eastern Region



BIAS

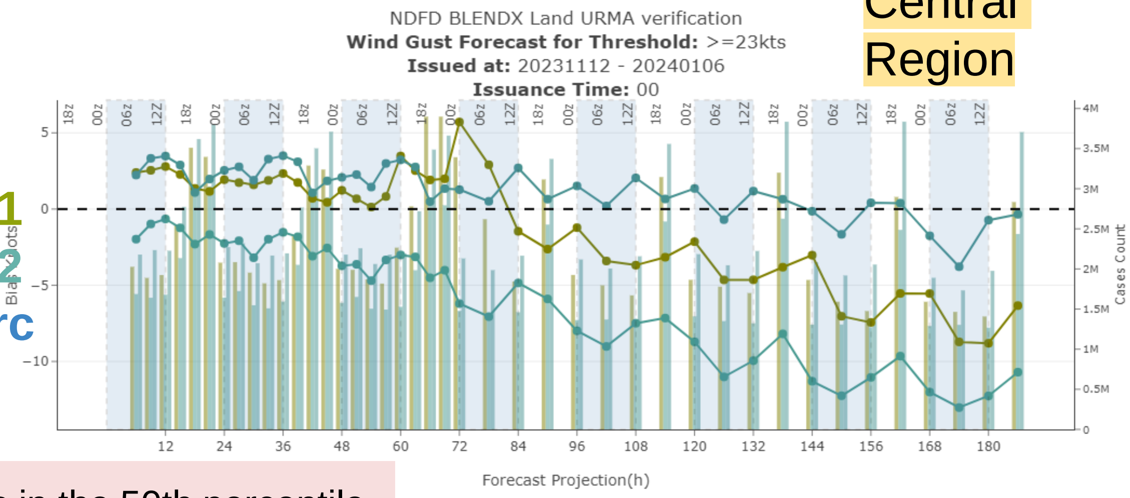
> 23 kt

NBMv4.1

NBMv4.2

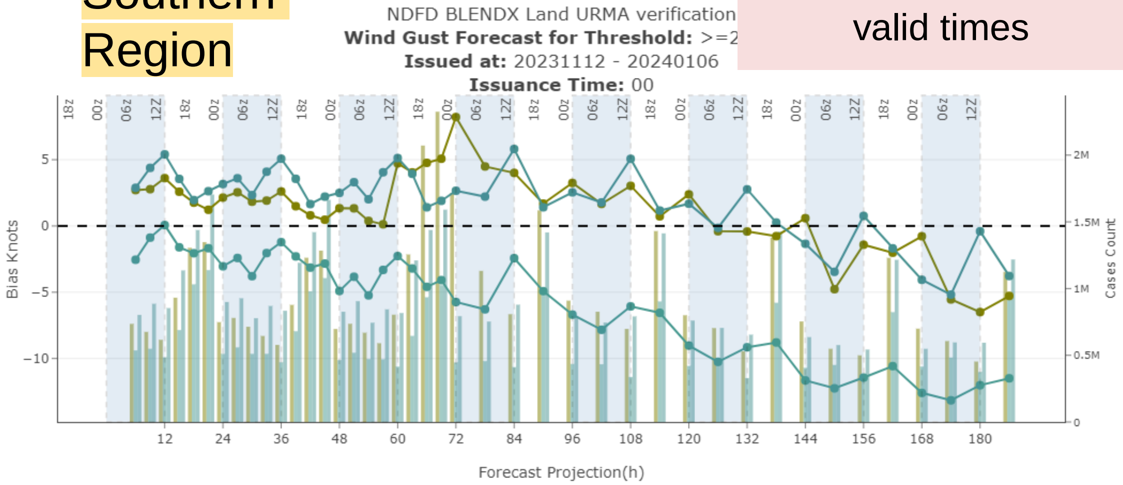
75th perc

Central Region

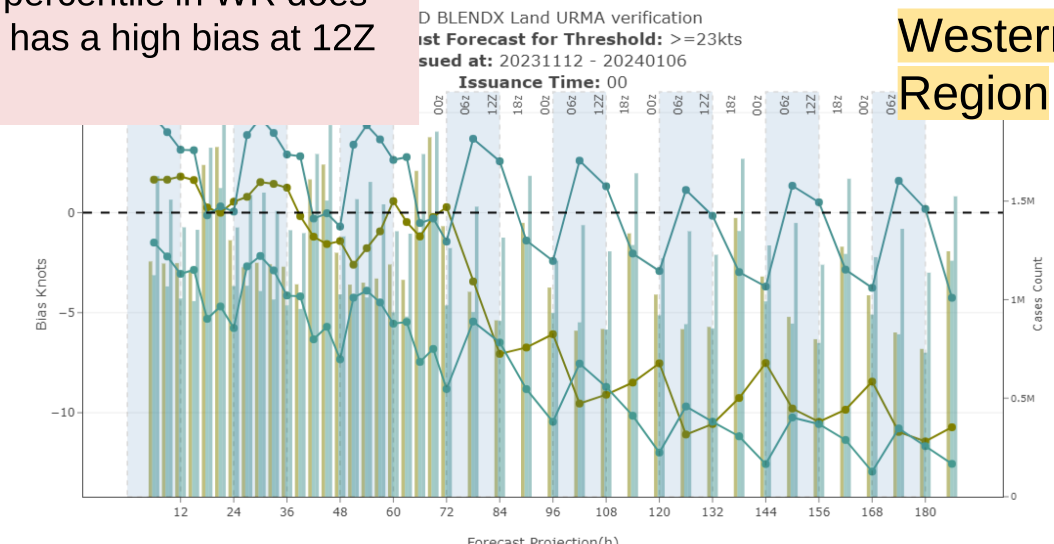


- All Regions show a low bias in the 50th percentile that grows with time; 75th percentile in WR does well at 00Z valid times but has a high bias at 12Z valid times

Southern Region

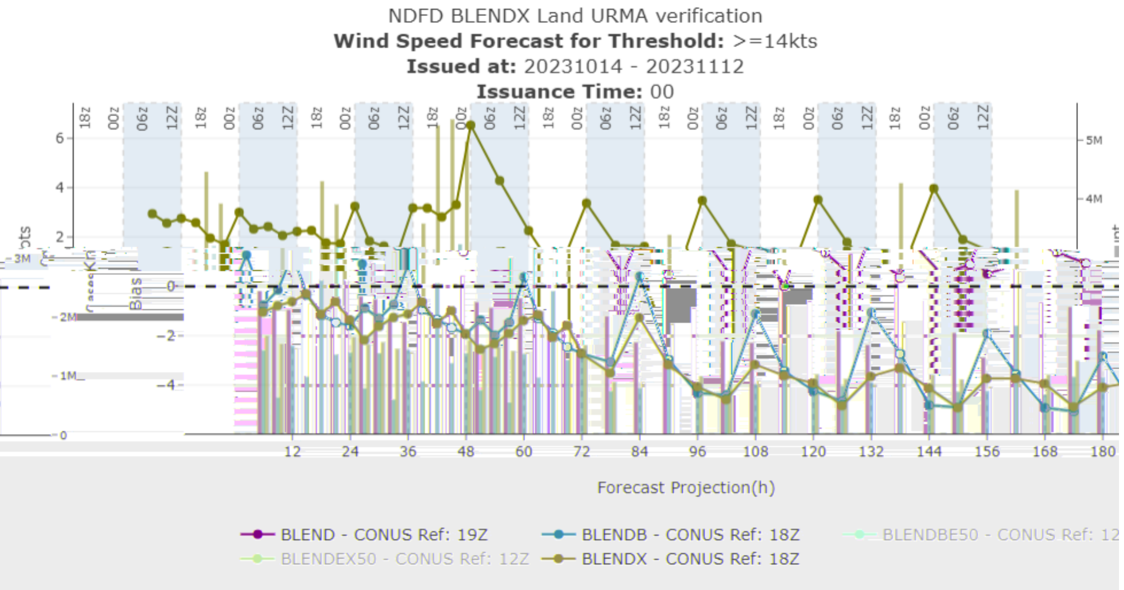


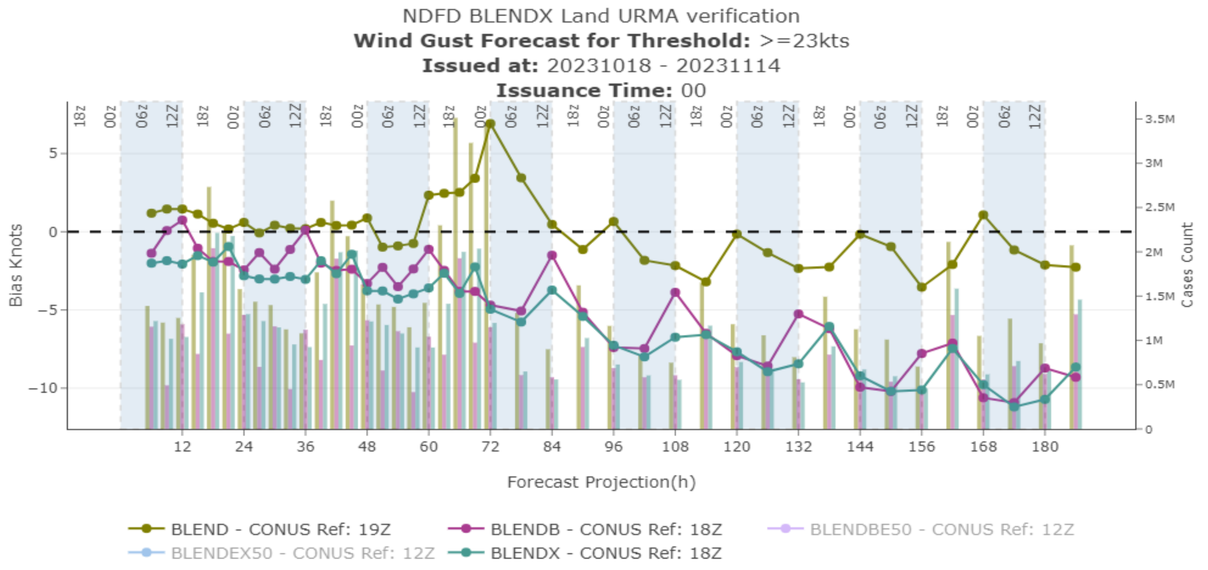
Western Region



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Examples of Statistical Improvement



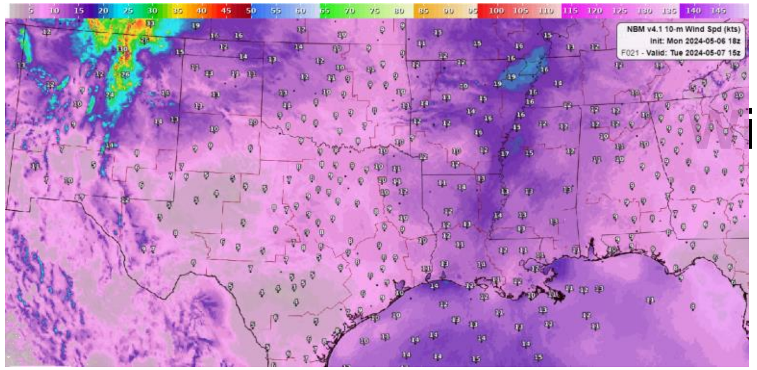


4.1 4.2 4.2B

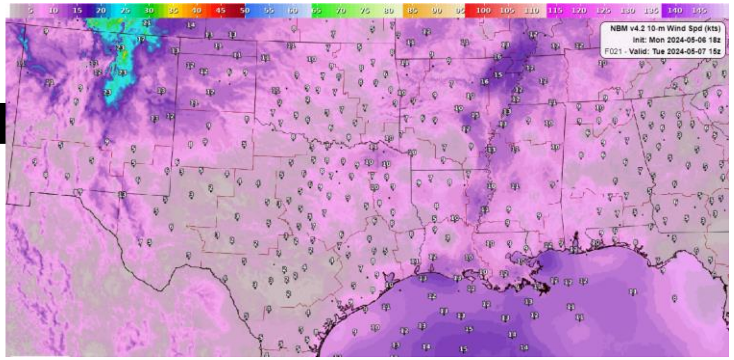
Stats from the period during which changes to generation of the wind analysis CDF were initially tested as v4.2B

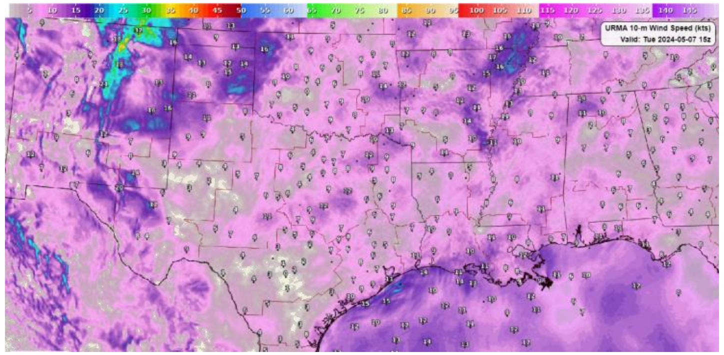
Recent Southern Region Case

v4.1 | **v4.2** | **URMA**

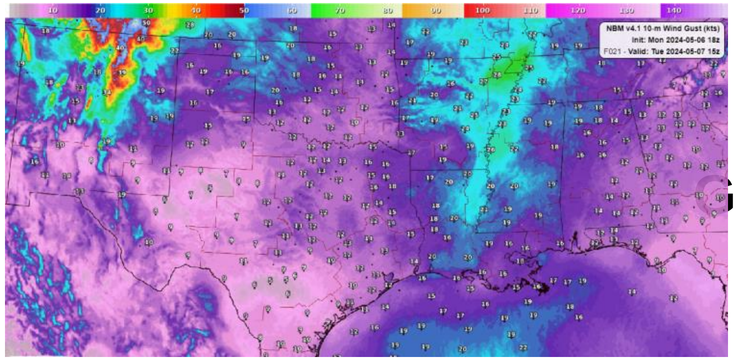


ind

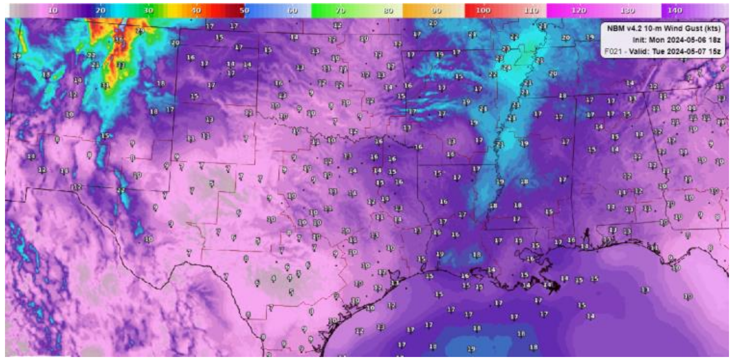


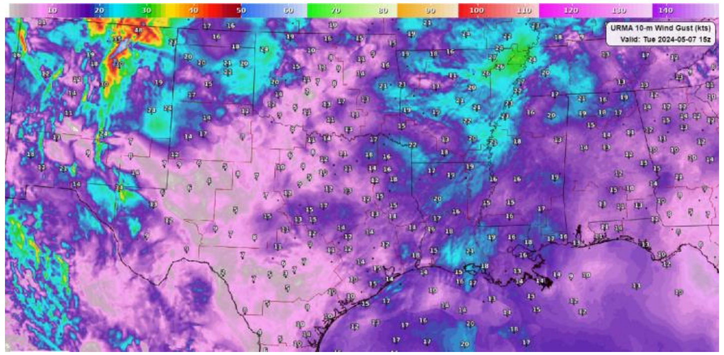


- for wind, 4.1 is too strong; 4.2 is a bit too weak in a few areas but is consistently closer to URMA



ust

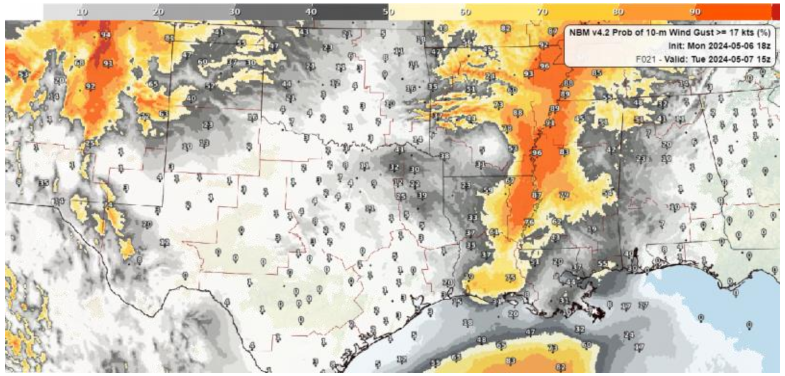




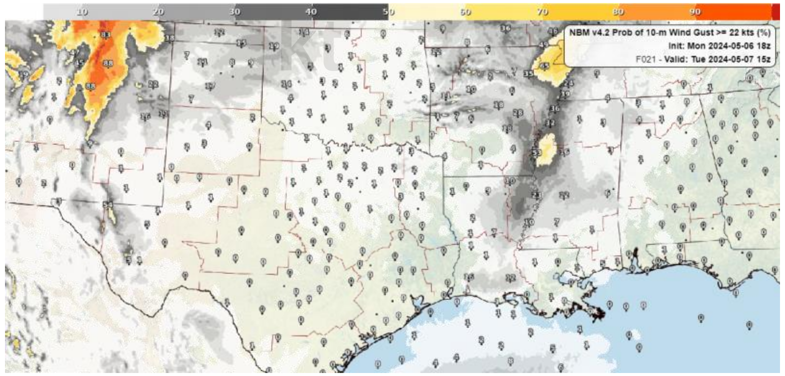
- for gust, 4.1 has too much coverage of high speeds, but 4.2 misses the higher end events, esp. over terrain

Gust Probabilities

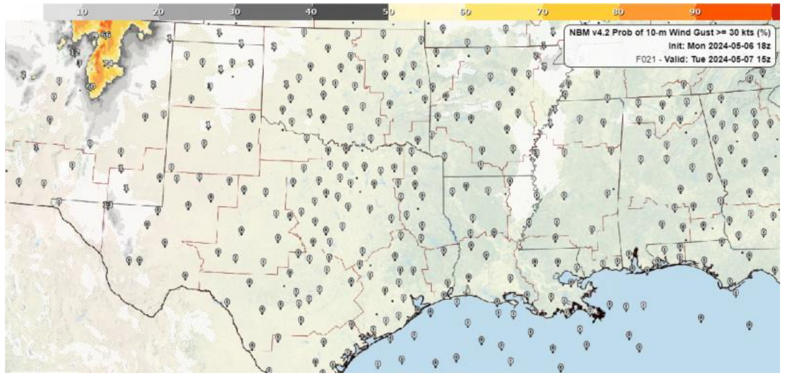
>= 17 kt



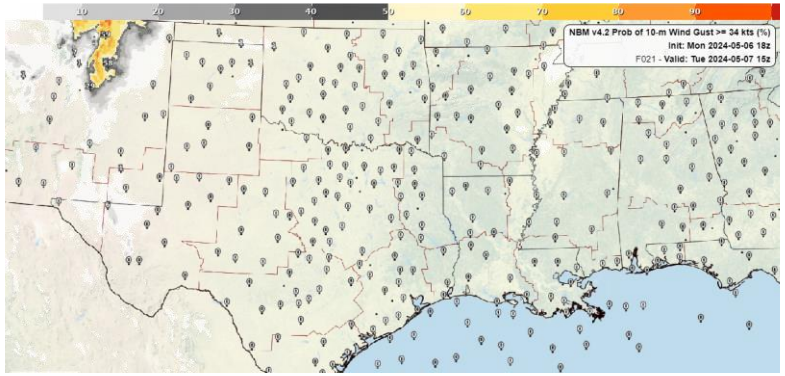
>=22



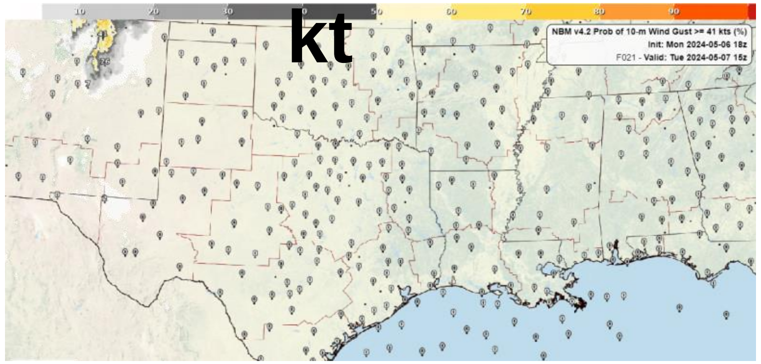
>=30 kt



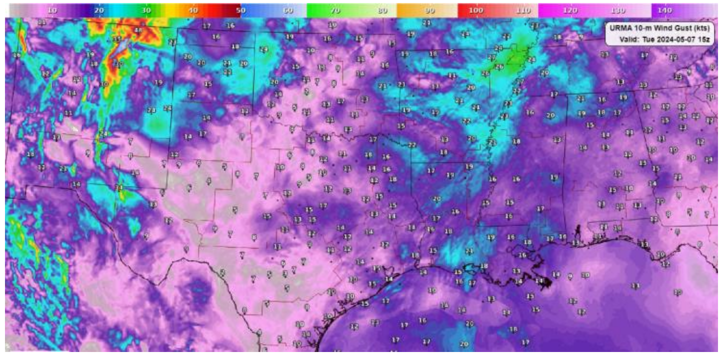
>= 34 kt



>=41 kt



URMA



- for gust, 4.1 has too much coverage of high speeds, but 4.2 misses the higher end events, esp. over terrain

Gust Percentiles