

Winter Product Updates in Version 4.2 of the National Blend of Models

Geoff Manikin

NOAA/MDL/Statistical Modeling Division

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- Mike Baker - Wet Bulb Downscaling for Snow/Ice product and Evaluation
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Other Acknowledgements

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- Bruce Veenhuis (WPC)
- Many SOOs and field forecasters for valuable feedback



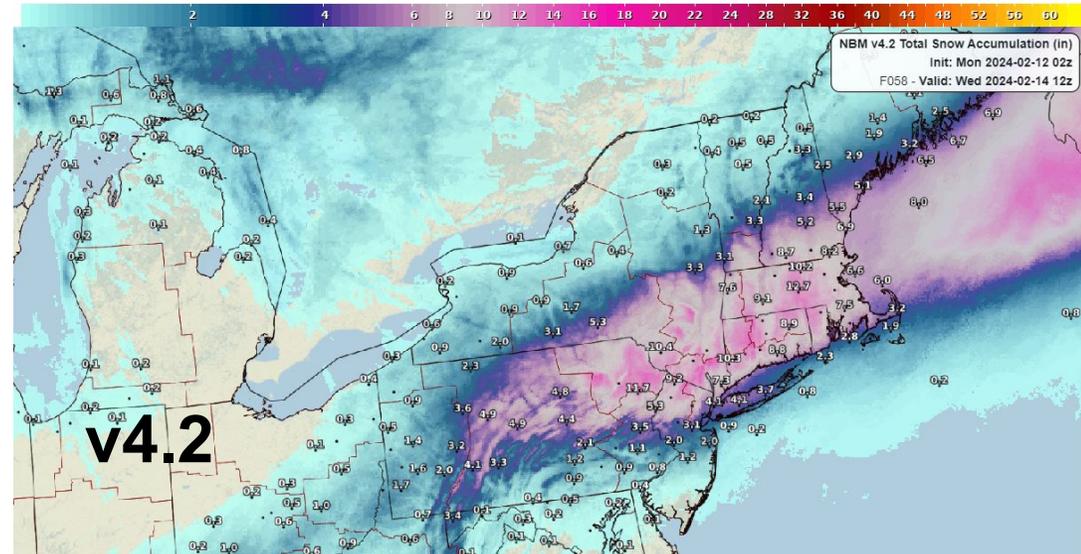
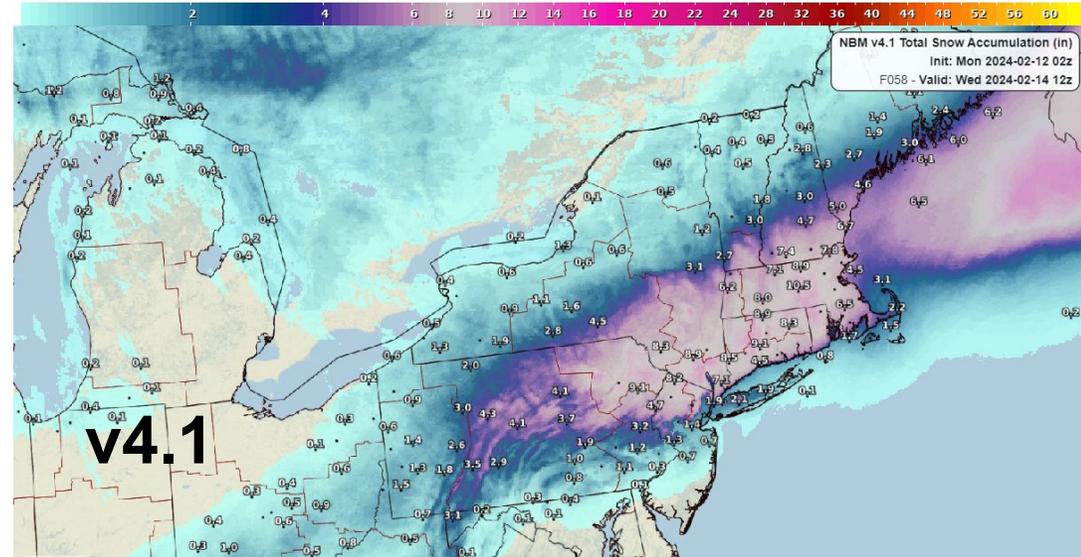
Winter Changes

- SLR changes
- Downscaled Wet-Bulb Temperature
- Lattice Issue
- Precip Type Probabilities



SLR

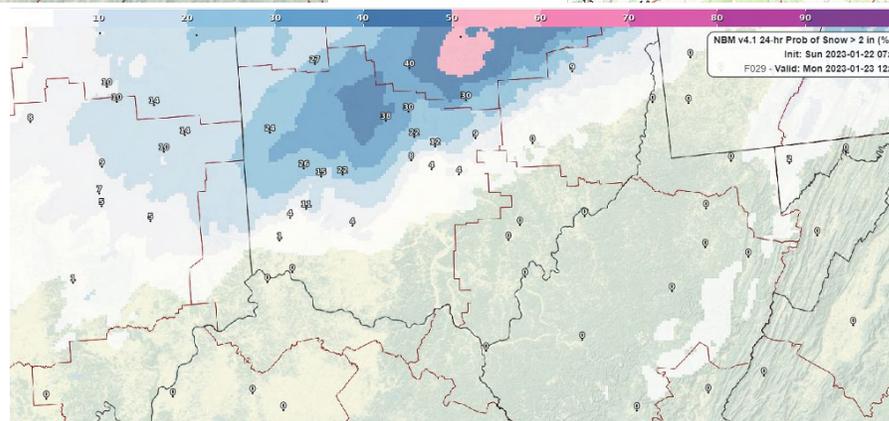
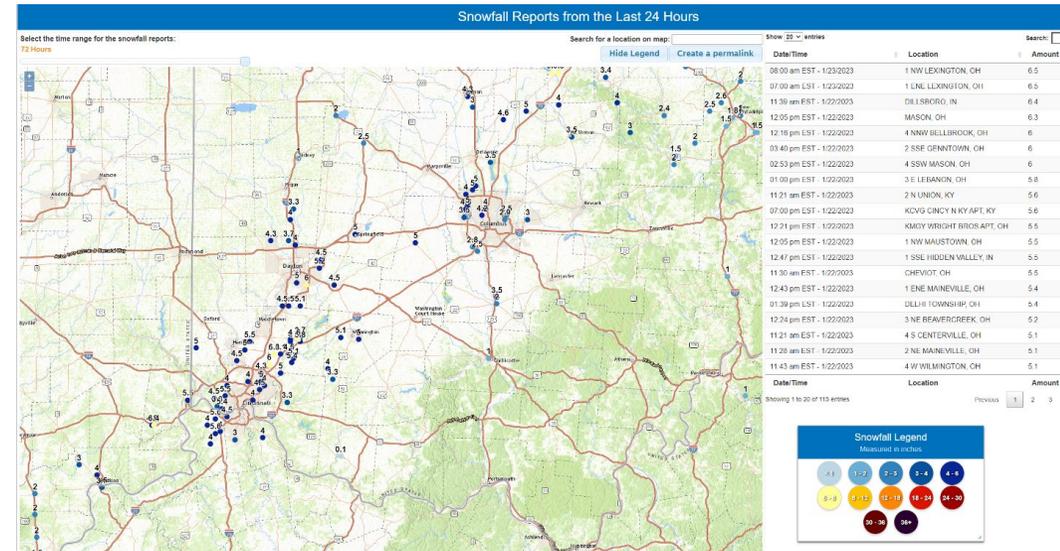
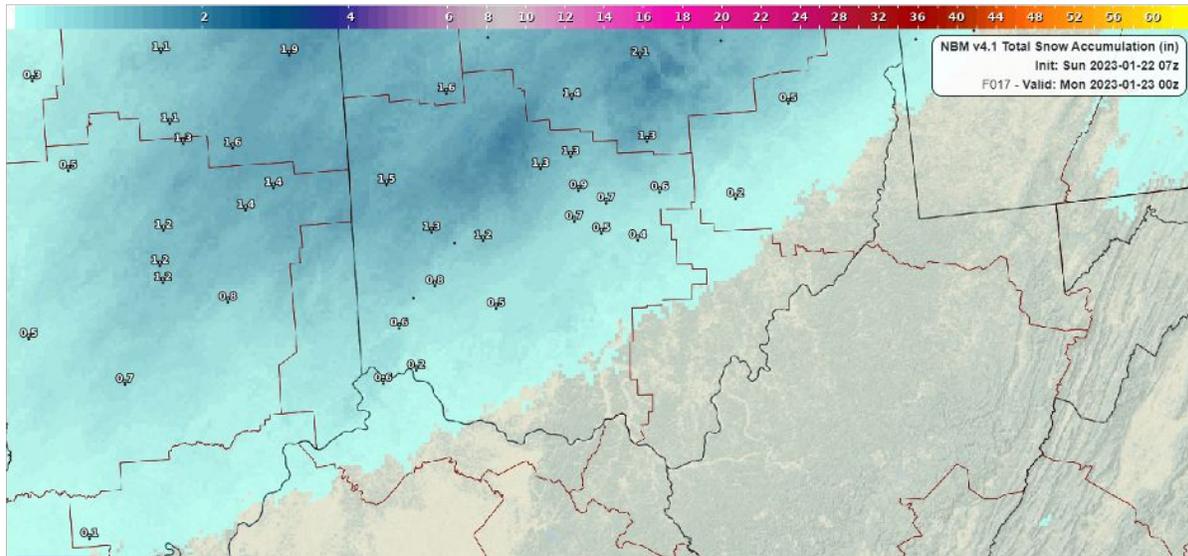
- The 25% reduction in the SLR computed for each member in the winter code, that has been in place for several versions of the NBM, is removed in v4.2





Cobb Methodology

Last winter featured multiple instances of the NBM showing low snowfall in environments with marginal temperatures





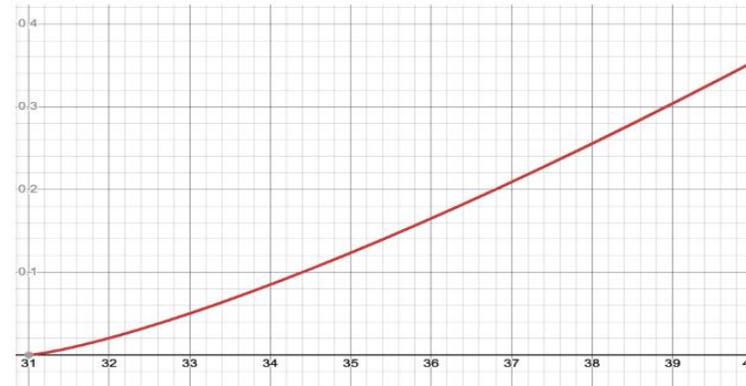
Cobb Methodology

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:

$$QPF_{melt} = \left[\frac{(0.5T_{sfc} - 15.50)}{10} \right]^{1.3}$$



- Revise the blended SLR as:

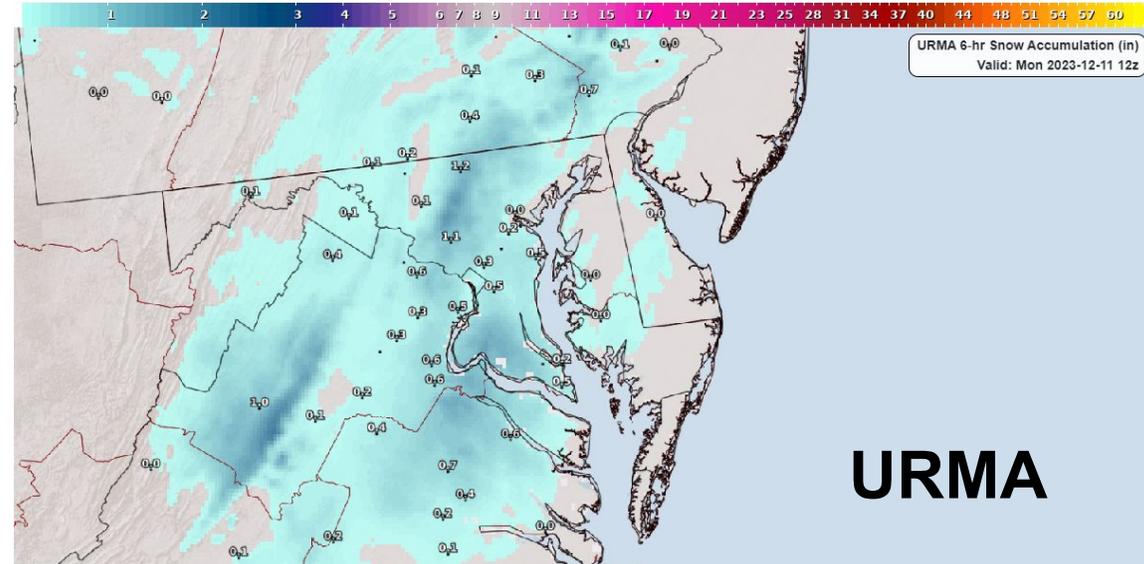
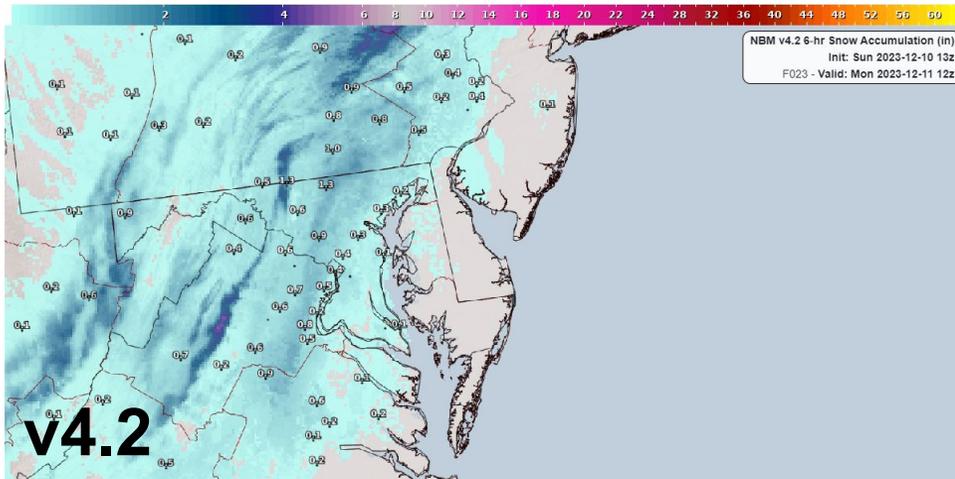
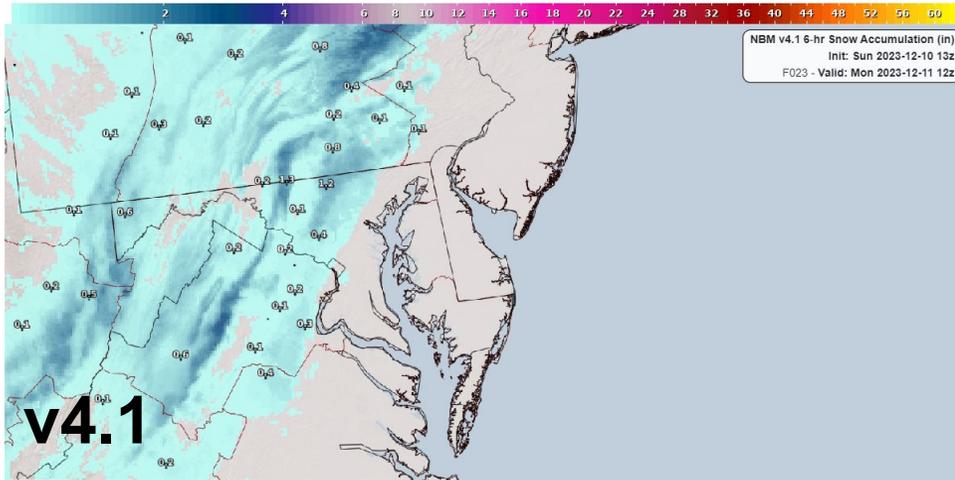
$$SLR_{new} = SLR \times \left[\frac{QPF - QPF_{melt}}{QPF} \right]$$

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.

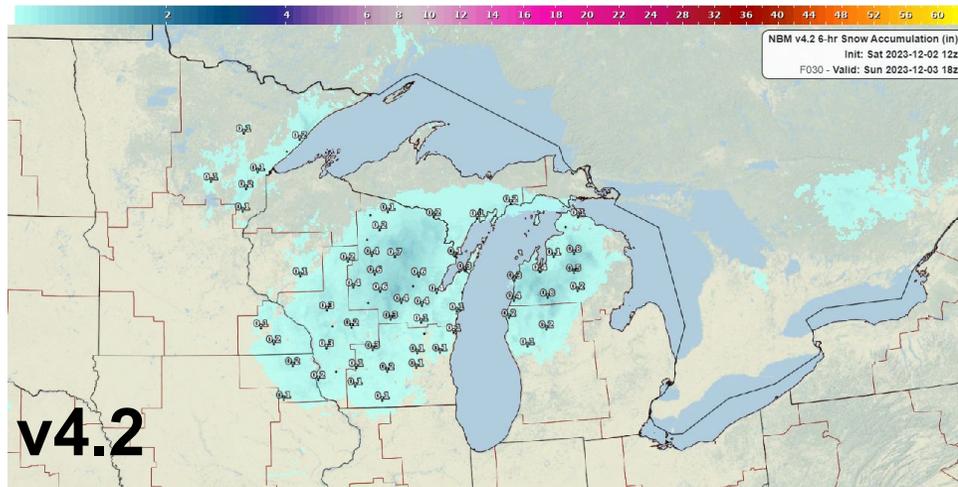
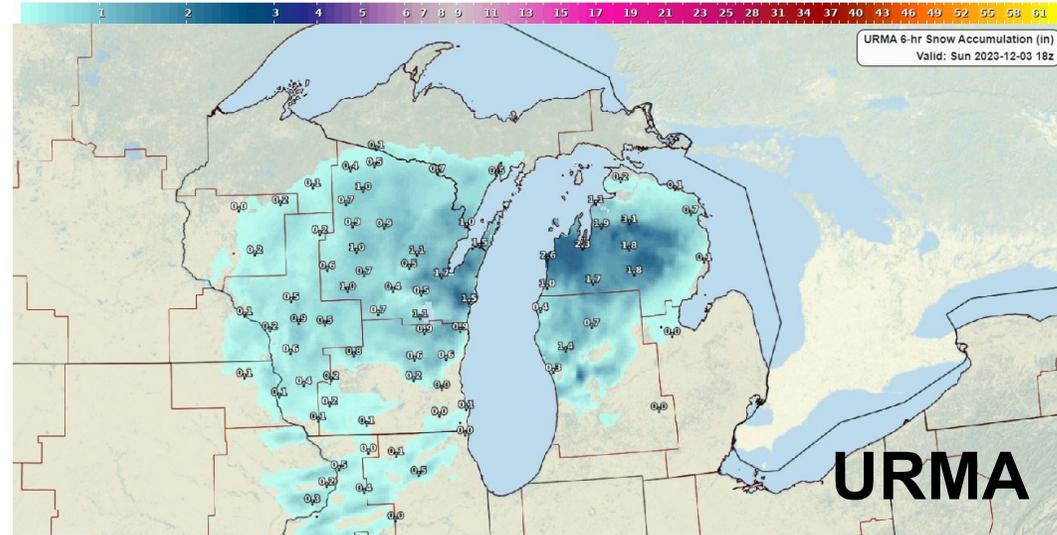
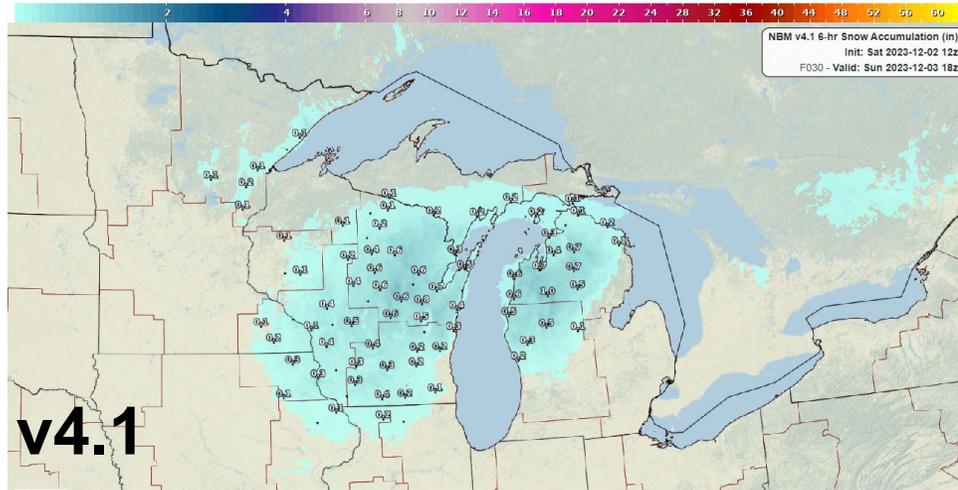
v4.1 sets SLR to 0 when $T_w > 33$

Snowfall Cases



- This case was a nice success for the updated Cobb approach
- Snow can accumulate in environments with marginal temperatures if rates are high

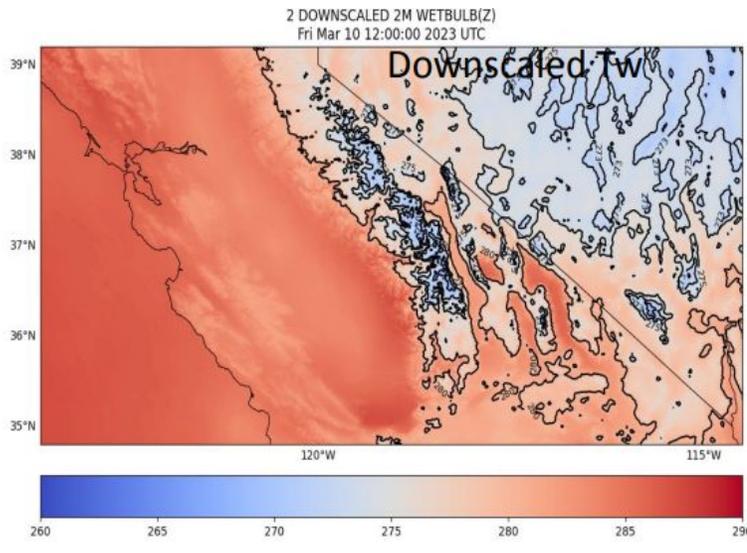
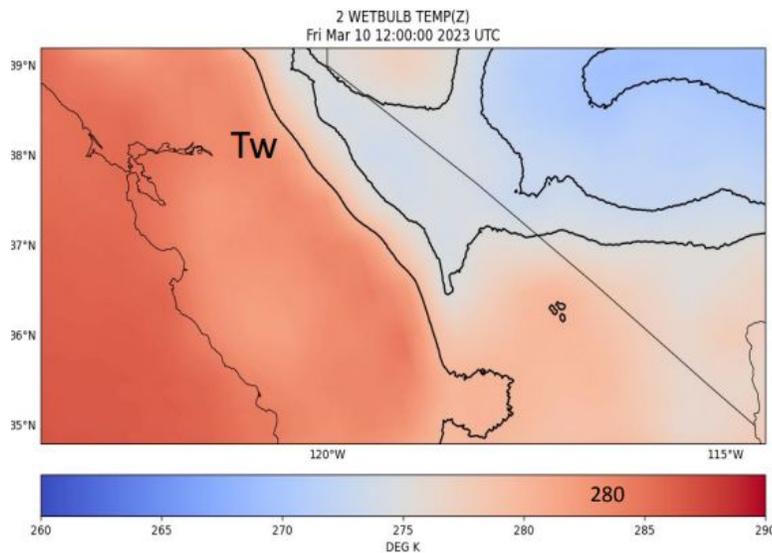
Snowfall Cases



- 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

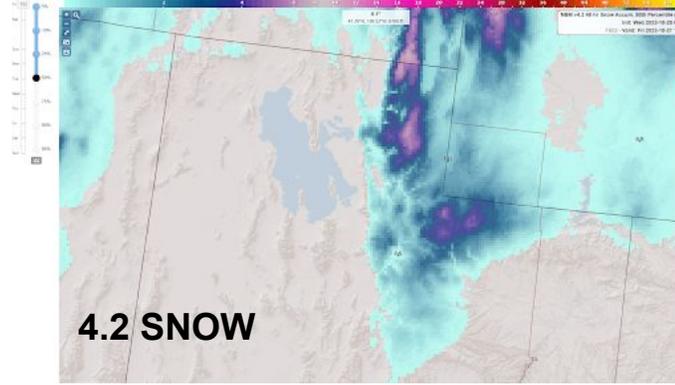
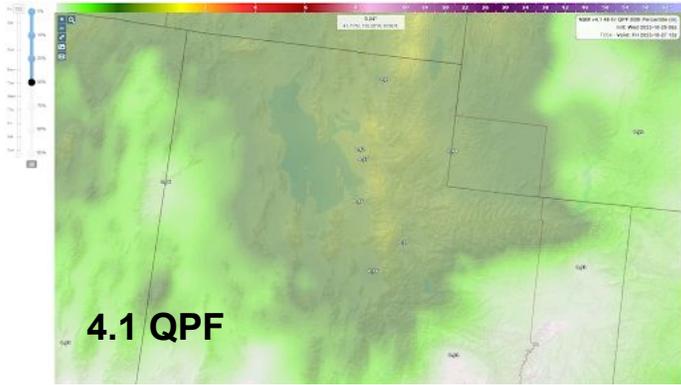
Downscaled Wet-Bulb Temperature

- Use a downscaled Tw for low resolution ice and snow accumulation inputs (EPS, GEFS, SREF), rather than their native resolution values
- The difference between the T and Tw is computed and saved. When the downscaled T is computed, that difference is used to compute a downscaled Tw

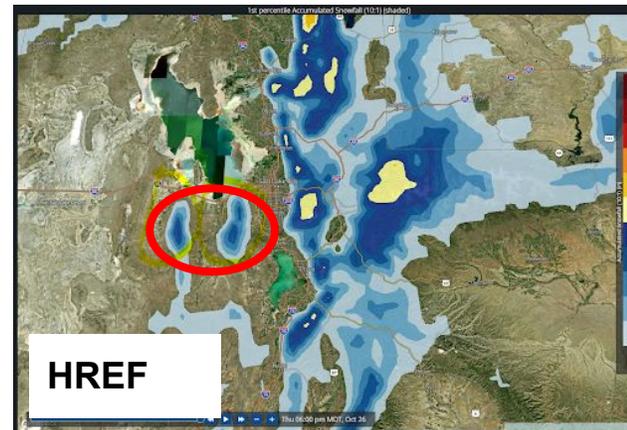
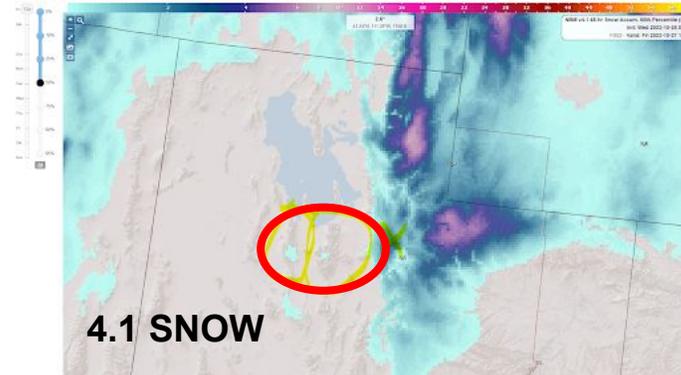


- This adjustment affects both SLR (and thus snow accumulation) as well as ice accumulation (per the Freezing Rain Accumulation Model)

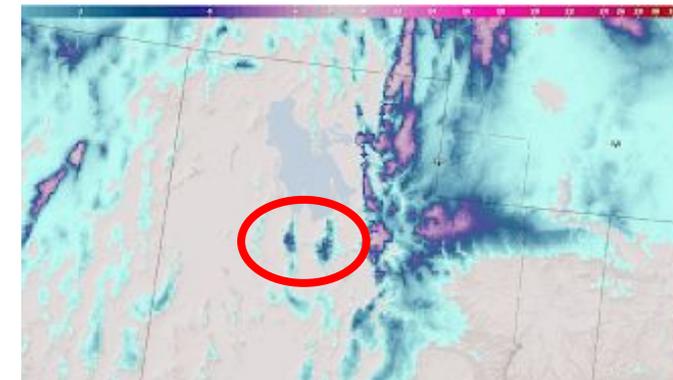
Snowfall Over Terrain



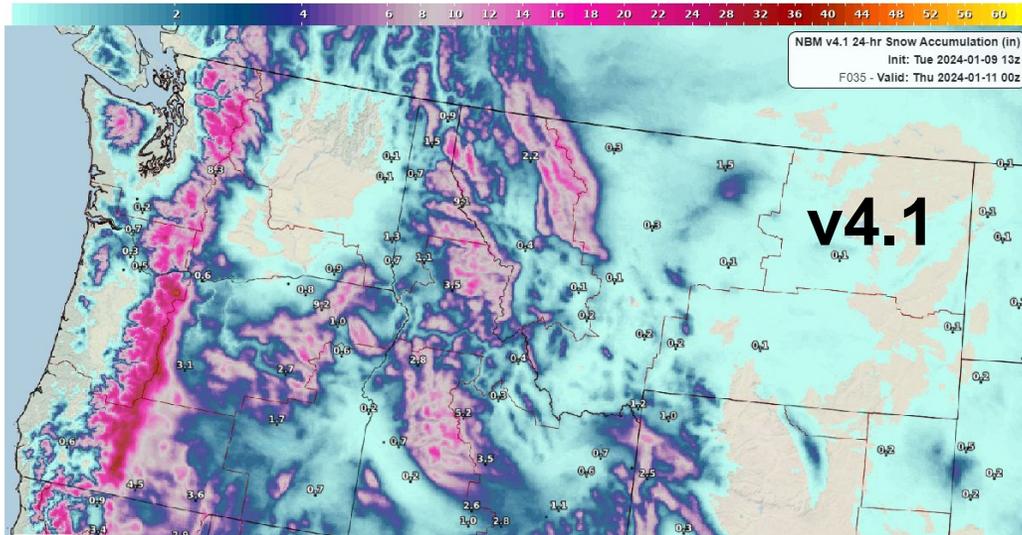
During the early fall, WR noted persistent issues with 4.2 not showing snow over higher terrain; it was expected that the new downscaled wet bulb temperature approach in 4.2 would show a significant improvement over ops



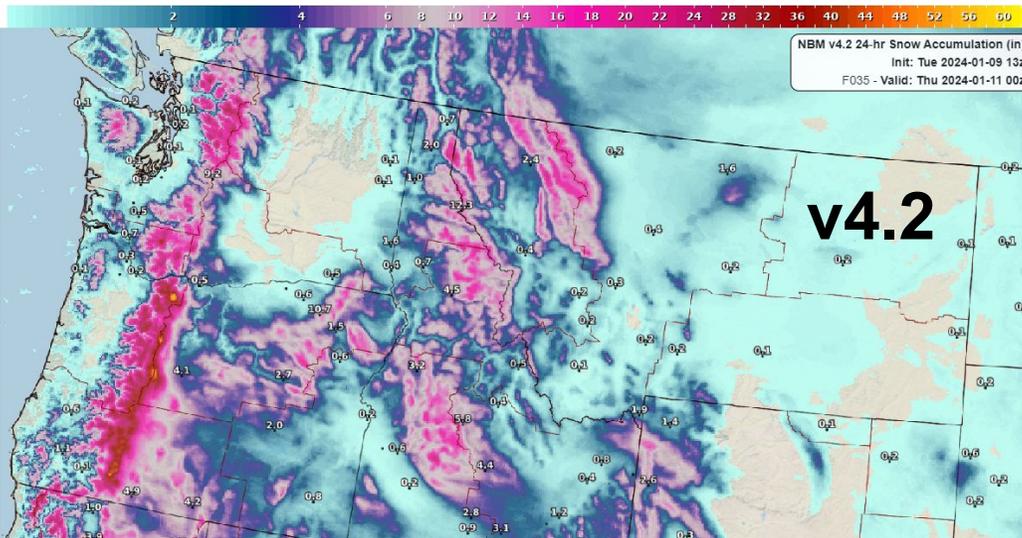
SMD found a bug that was causing the new downscaled wet bulb temperature to not be used for snow; correcting this shows a huge improvement (below)

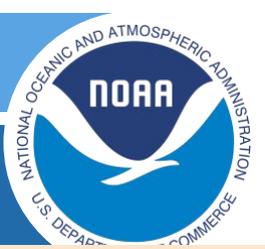


Impact of Snow Changes



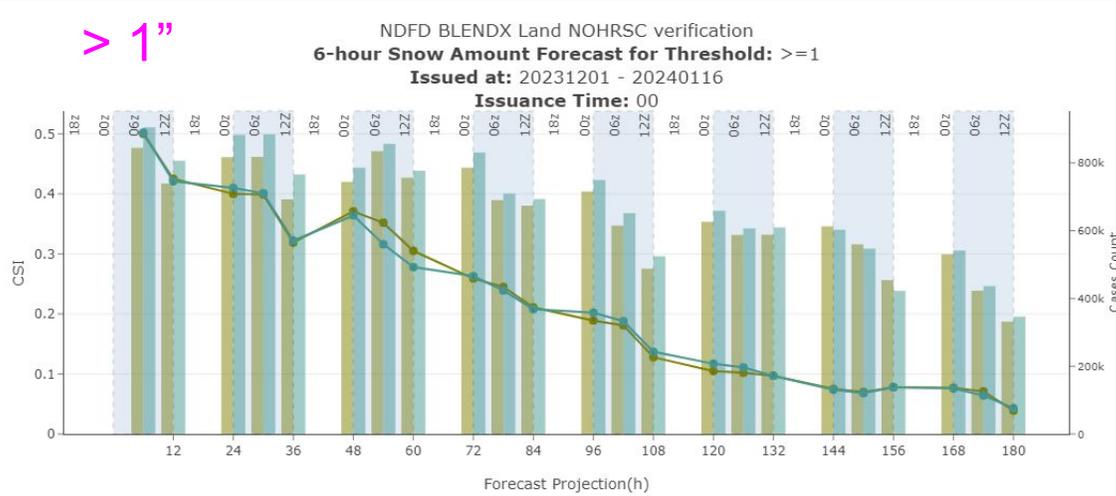
- Example of the impact of the usage of the downscaled wet bulb temperature to enhance snow totals over higher terrain and the elimination of the 25% reduction of each member's SLR that is used in v4.1





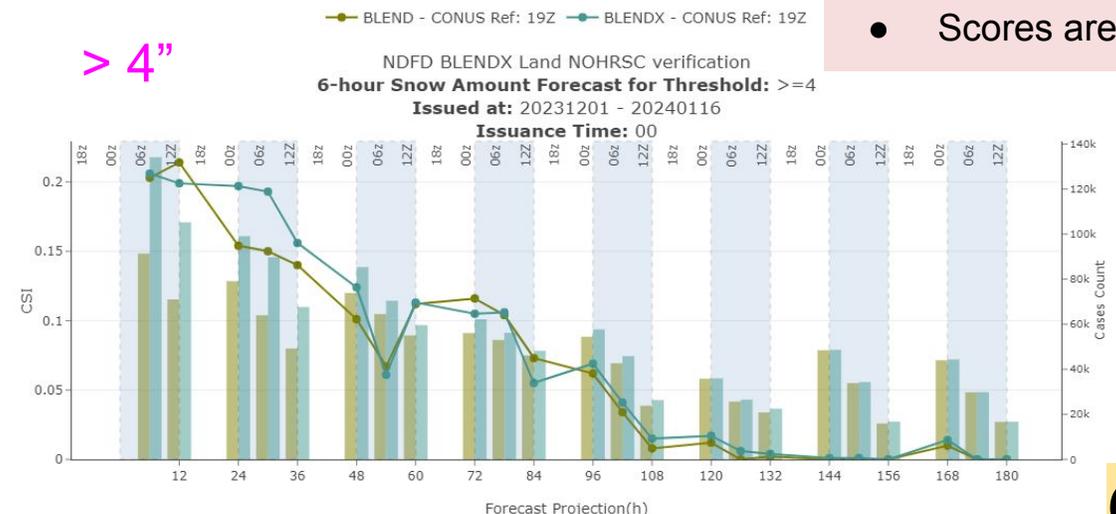
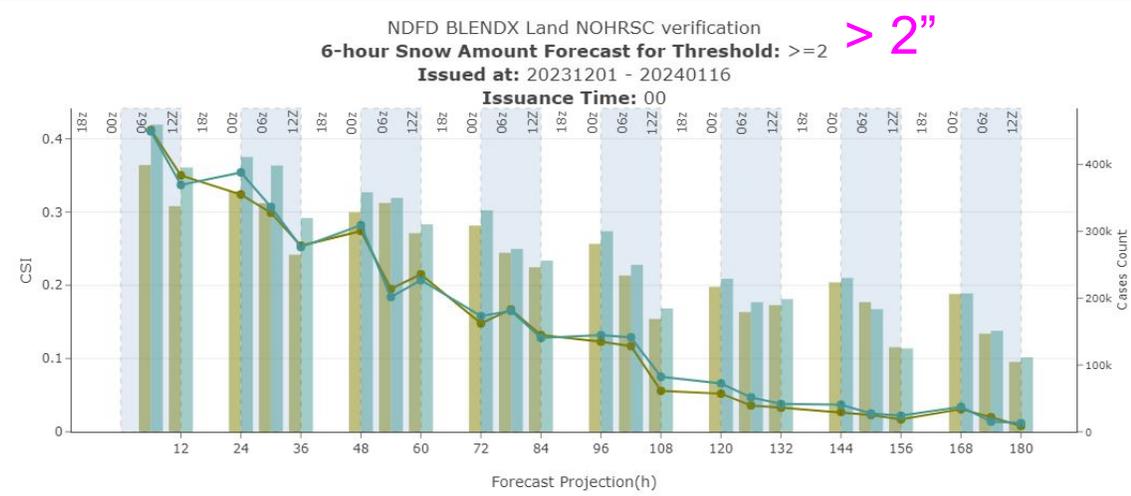
Snow Stats

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

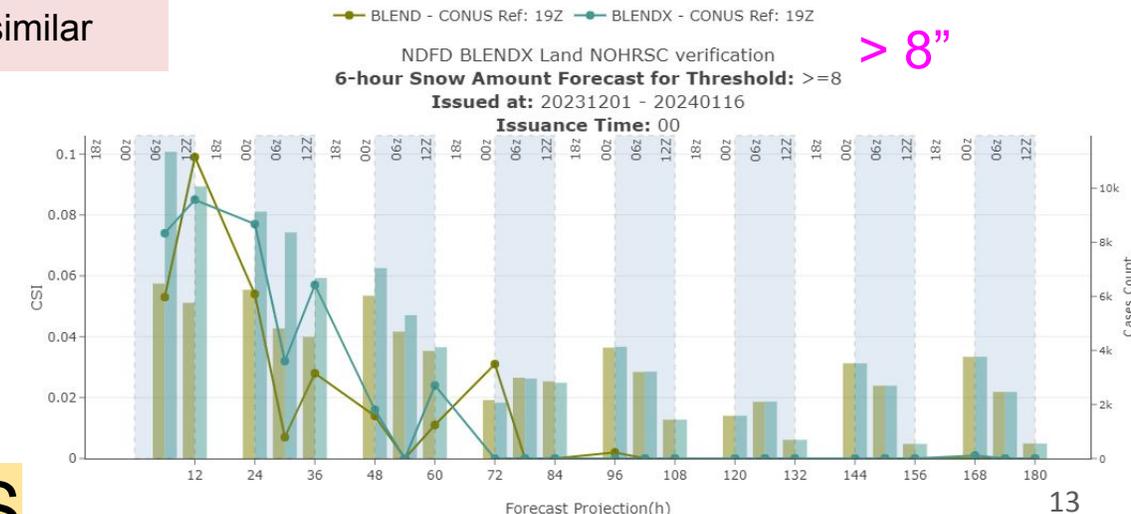


CSI

NBMv4.1
NBMv4.2



• Scores are overall quite similar



CONUS

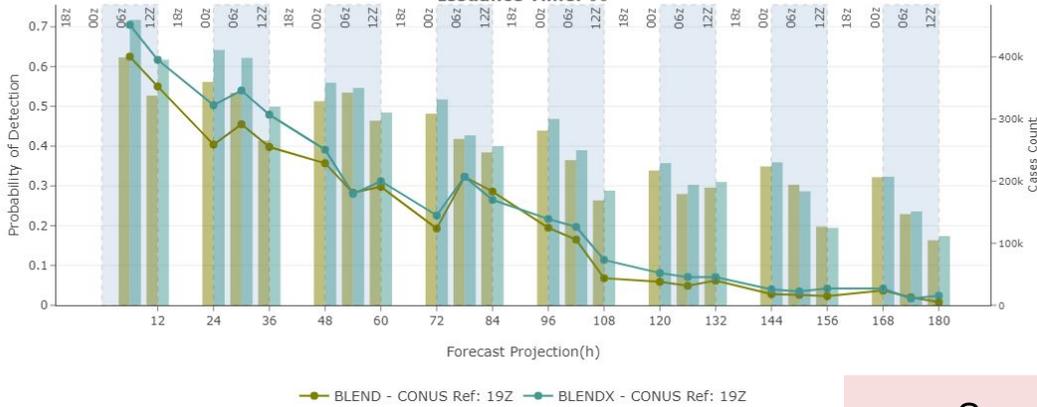


Snow Stats

POD

> 2"

NDFD BLENDEX Land NOHRSC verification
6-hour Snow Amount Forecast for Threshold: >=2
Issued at: 20231201 - 20240116
Issuance Time: 00

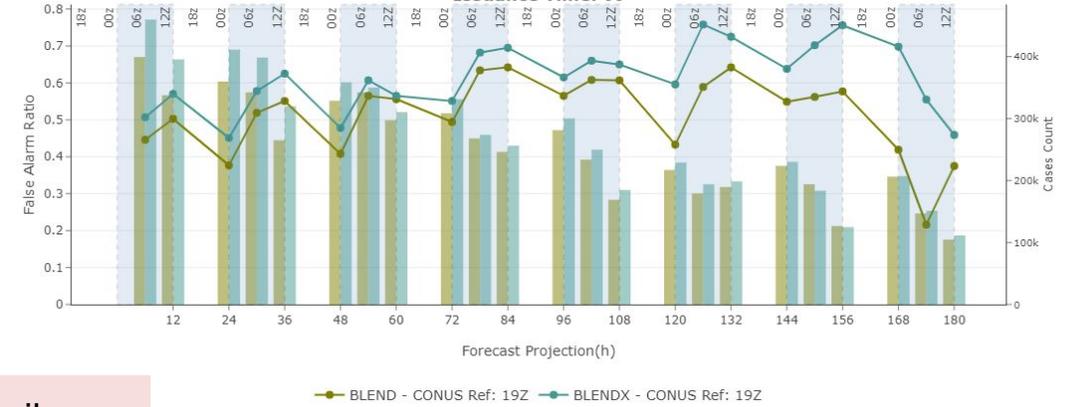


NBMv4.1
NBMv4.2

FAR

> 2"

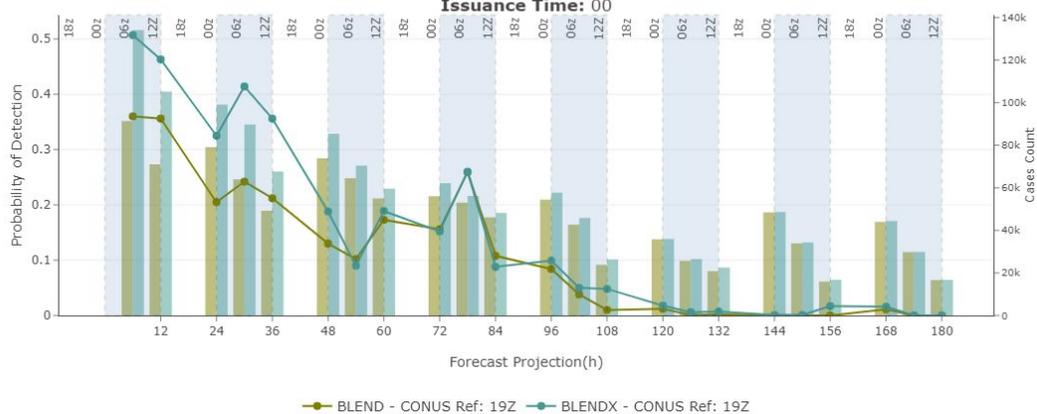
NDFD BLENDEX Land NOHRSC verification
6-hour Snow Amount Forecast for Threshold: >=2
Issued at: 20231201 - 20240116
Issuance Time: 00



- Scores are overall quite similar
- v4.2 overall has a higher POD, but also a higher FAR

> 4"

NDFD BLENDEX Land NOHRSC verification
6-hour Snow Amount Forecast for Threshold: >=4
Issued at: 20231201 - 20240116
Issuance Time: 00



> 4"

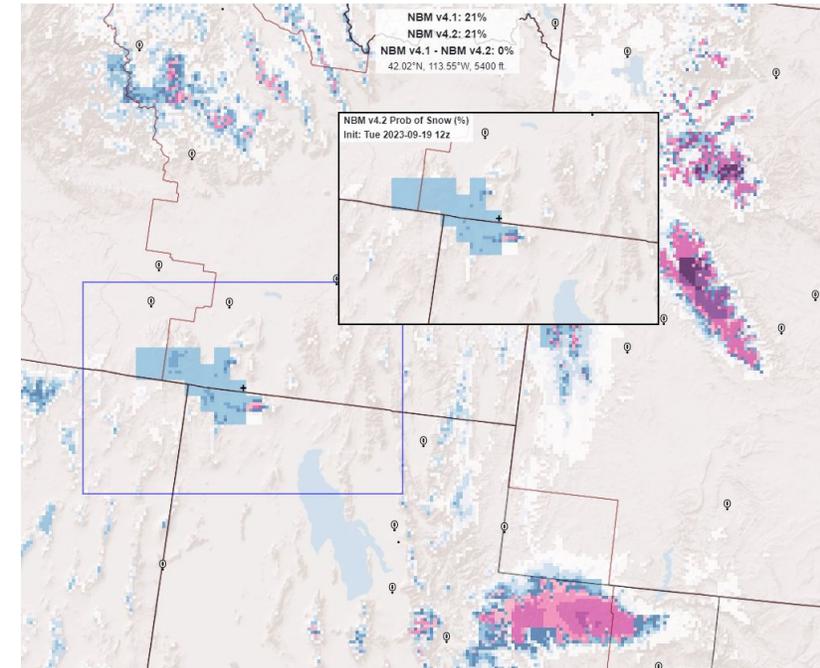
NDFD BLENDEX Land NOHRSC verification
6-hour Snow Amount Forecast for Threshold: >=4
Issued at: 20231201 - 20240116
Issuance Time: 00



CONUS

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) was getting a 15% weighting at this range in v4.1, and that percentage was higher if other inputs were unavailable; for comparison, the GFS got 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 slightly to the blockiness, we did not want to discard that input; the v4.2 winter suite 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 |

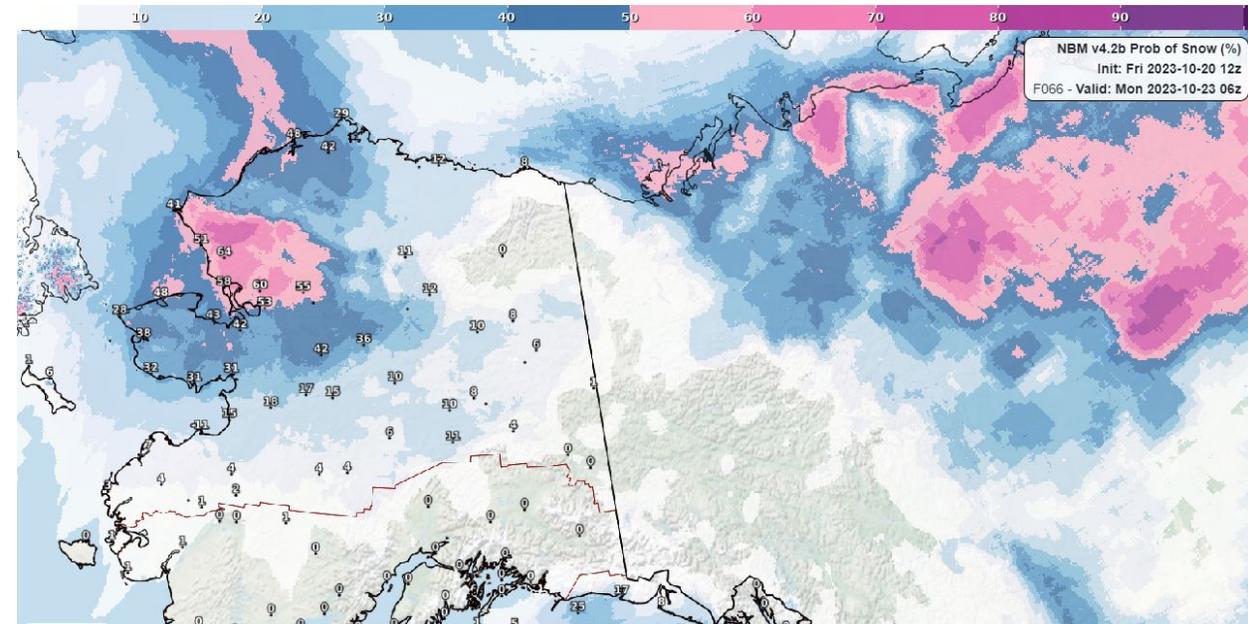
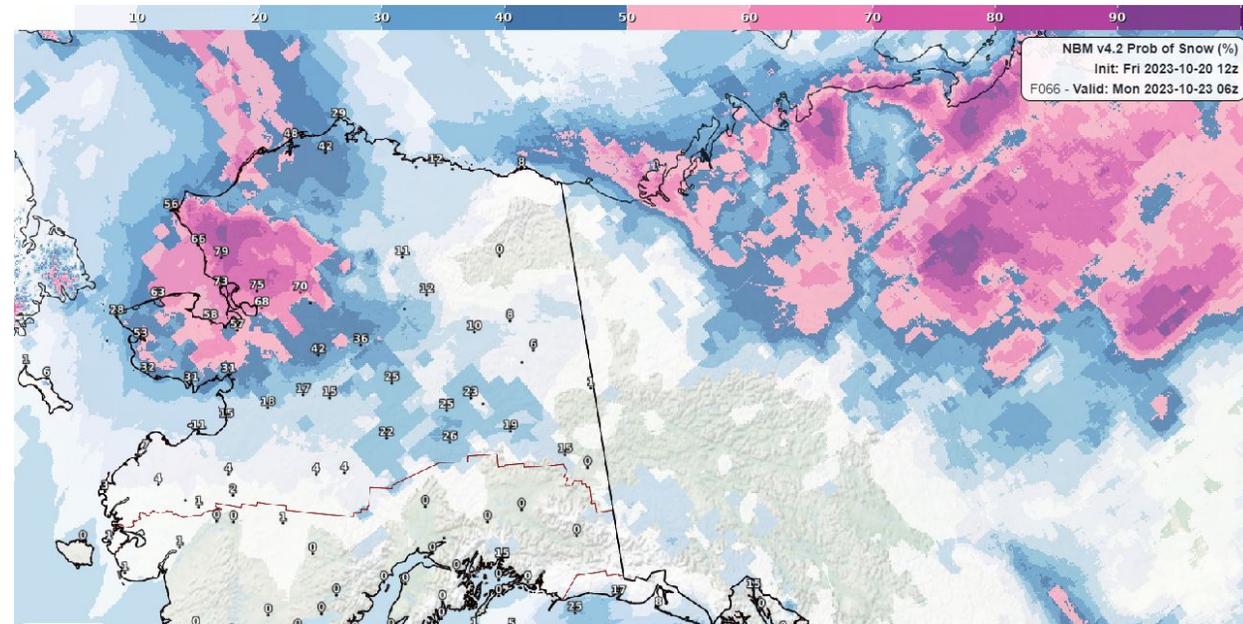
- A decision was made in October to remove usage of parent NAM for winter fields in v4.2 and redistribute weights to NAM Nest, GFS, and global ensembles



Removal of Blocky Features

v4.1

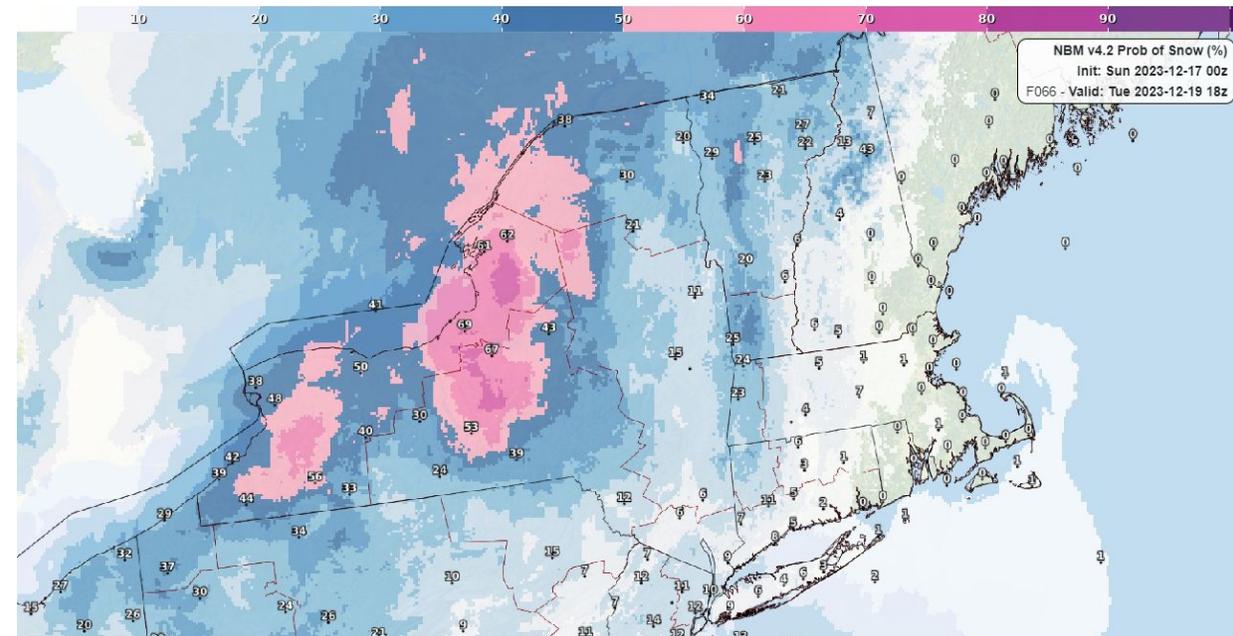
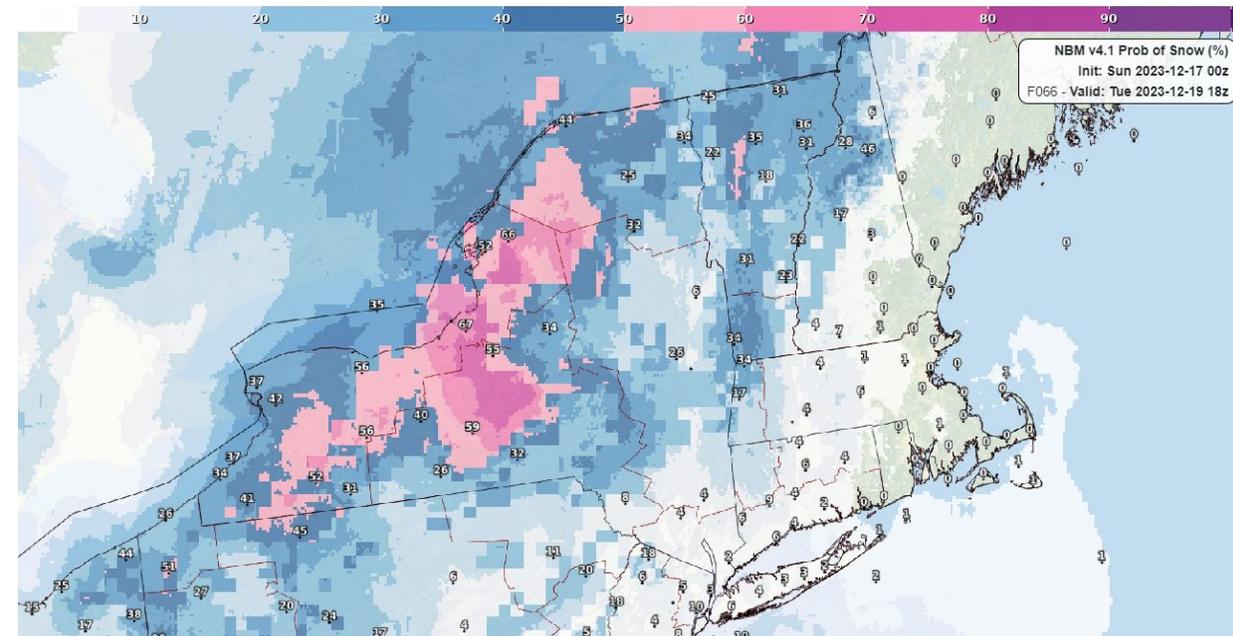
v4.2





v4.1

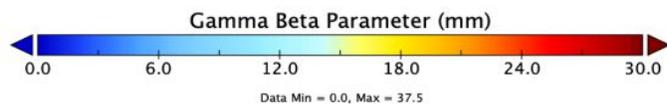
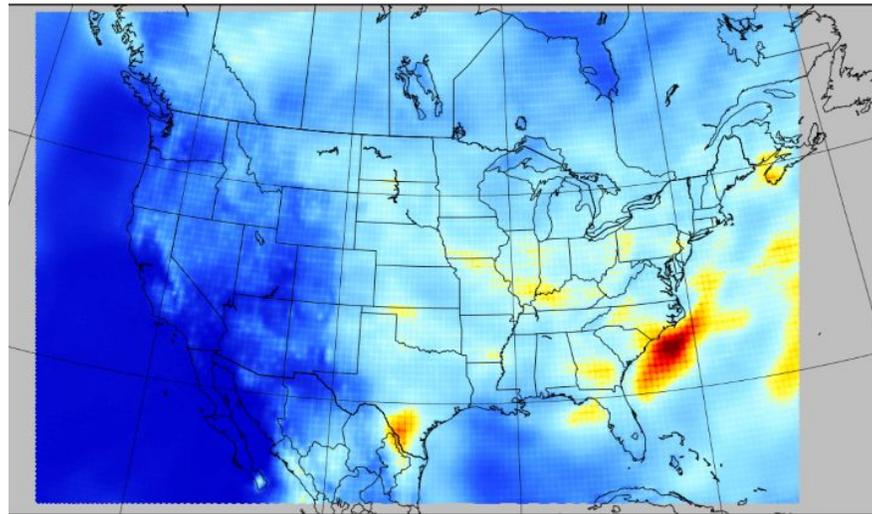
v4.2



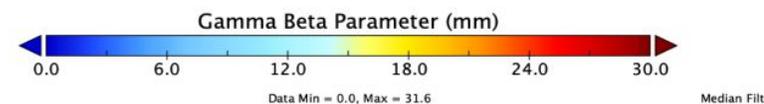
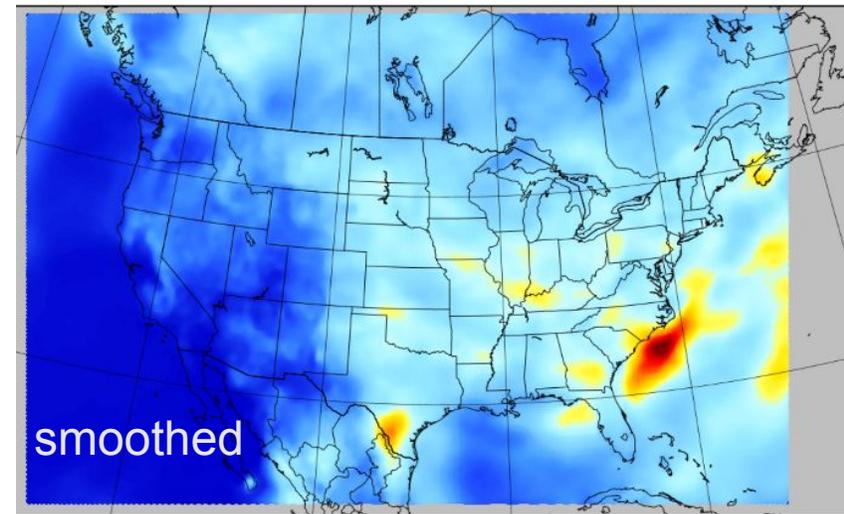
Mitigation of Lattice Features

- 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

Blend V4.1 – ECMWFE – Gamma (Beta) Shape Parameter for APCP24
Init: 20230708 06Z f048



Blend V4.2 – ECMWFE – Gamma (Beta) Shape Parameter for APCP24
Init: 20230708 06Z f048

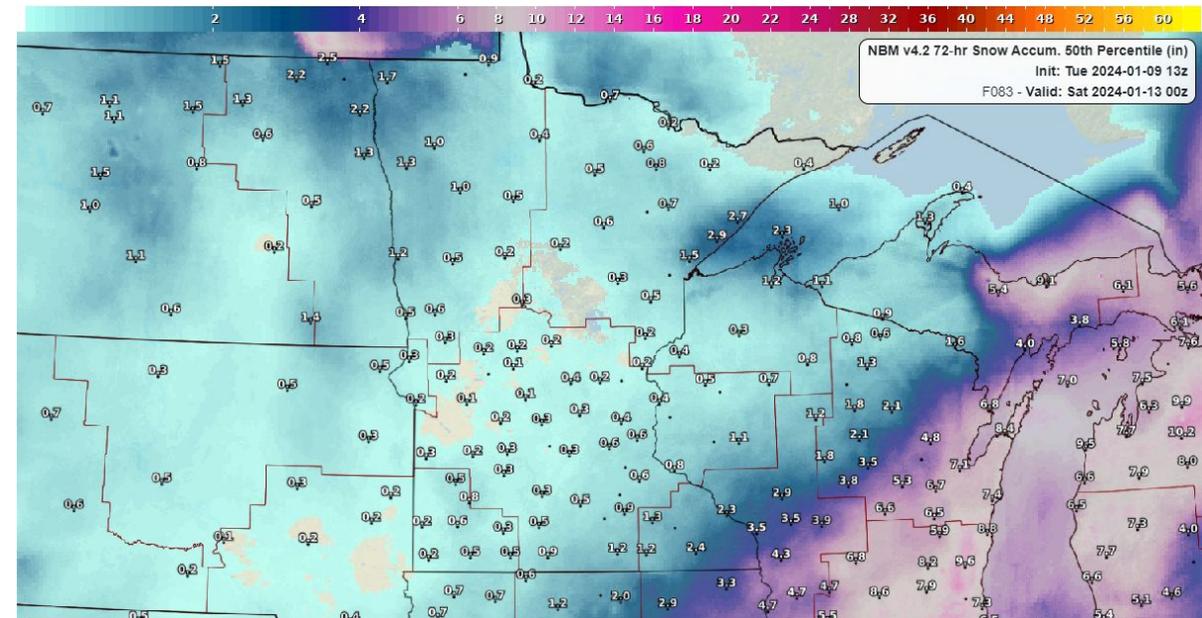
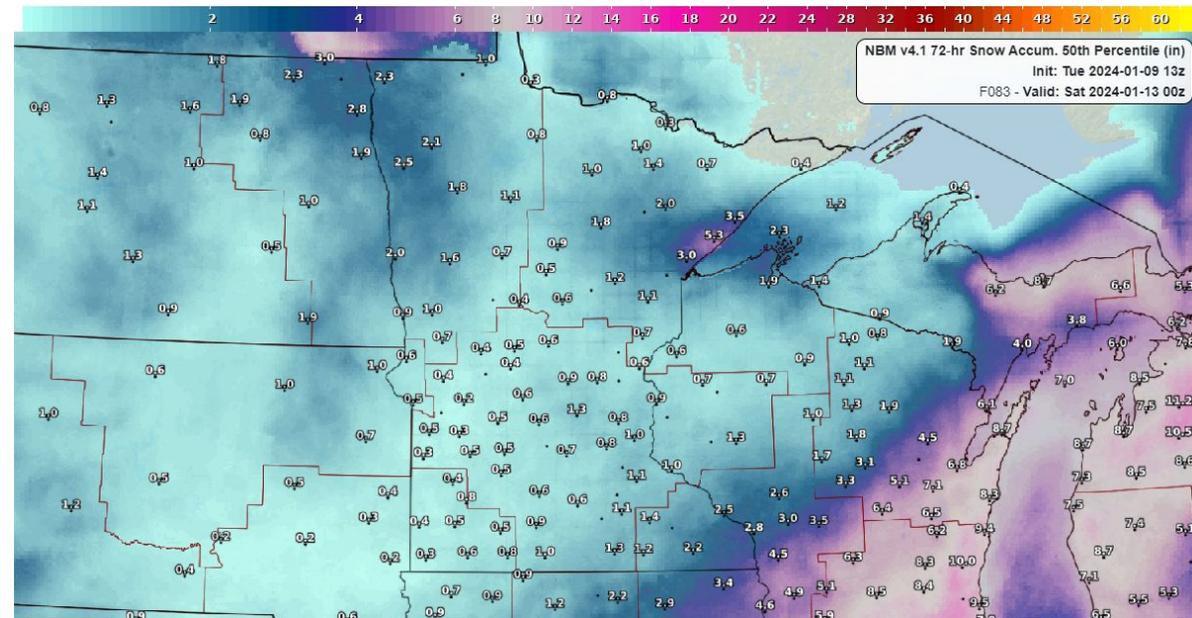




Mitigation of Lattice Features

v4.1

v4.2



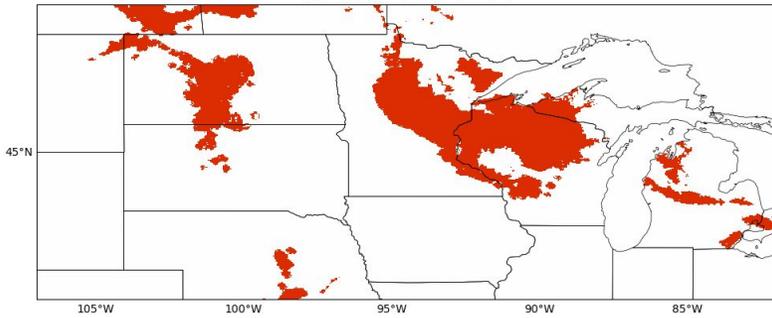
smoothed



High Freezing Rain Probs in Ops

HiResW ARW

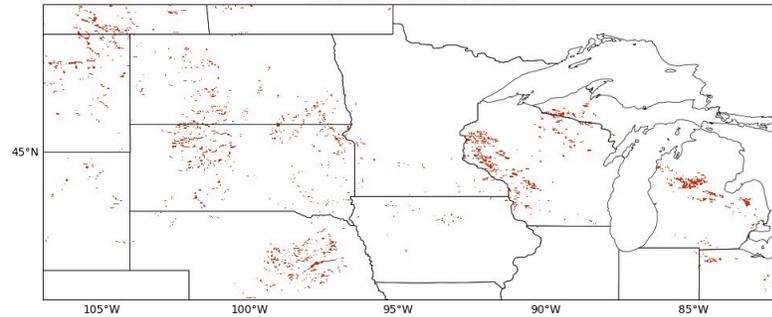
ARW
PTYPE CAT FRZ (BIN.)
Thu Dec 21 12:00:00 2023 UTC



clearly driven by HiResW ARWs

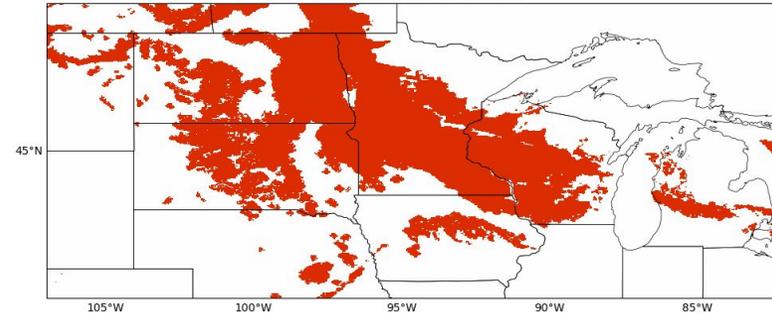
NAM Nest

NAMH
PTYPE CAT FRZ (BIN.)
Thu Dec 21 12:00:00 2023 UTC



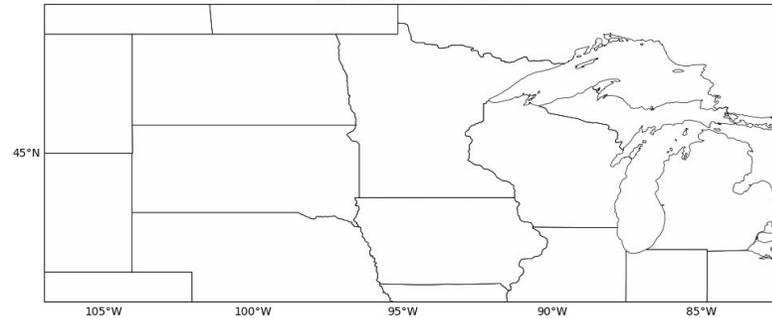
HiResW ARW2

ARW2
PTYPE CAT FRZ (BIN.)
Thu Dec 21 12:00:00 2023 UTC



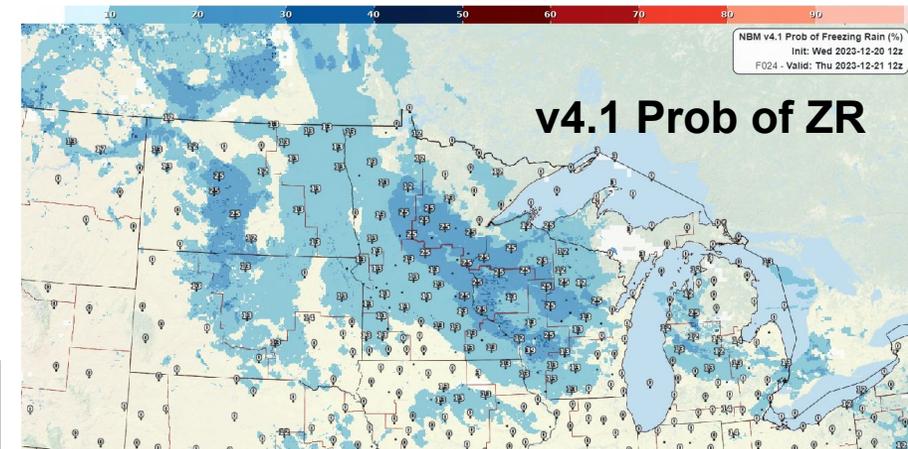
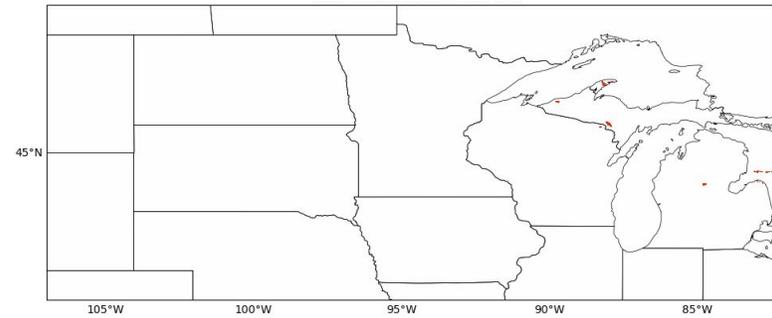
HiResW FV3

HFV3
PTYPE CAT FRZ (BIN.)
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HRRR

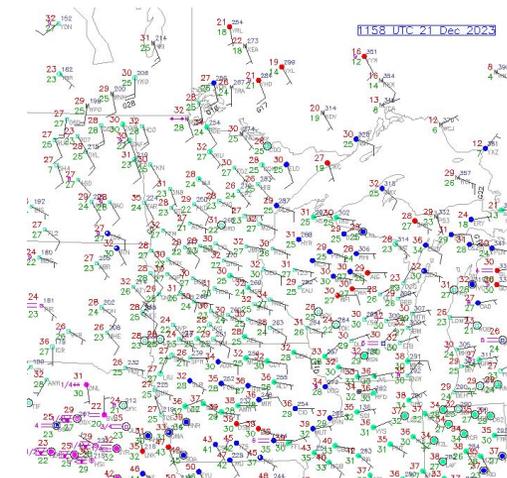
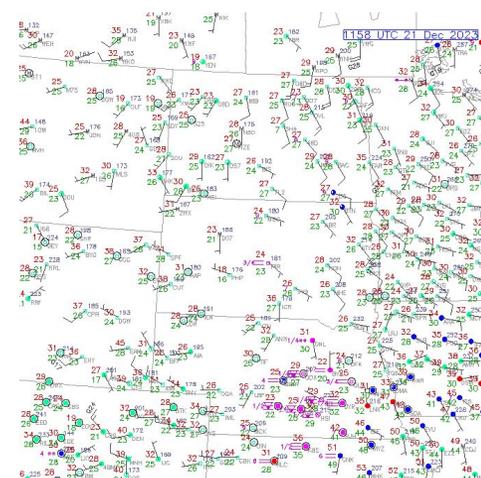
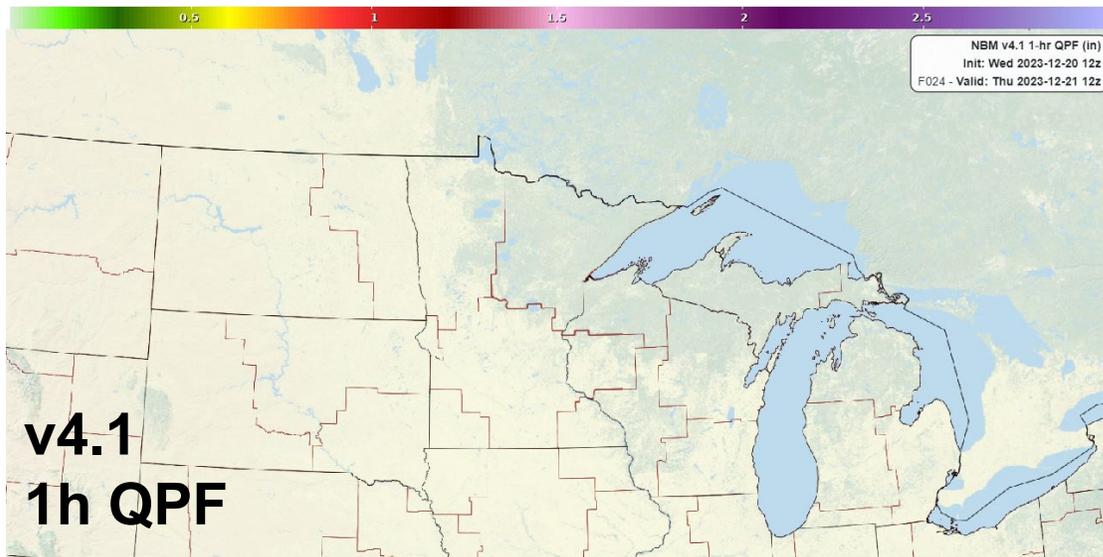
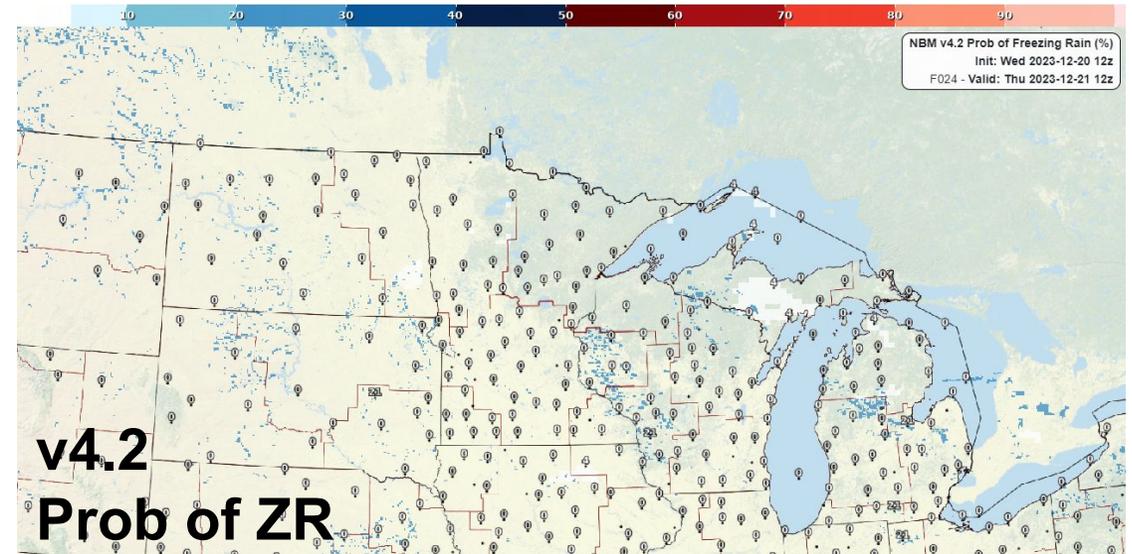
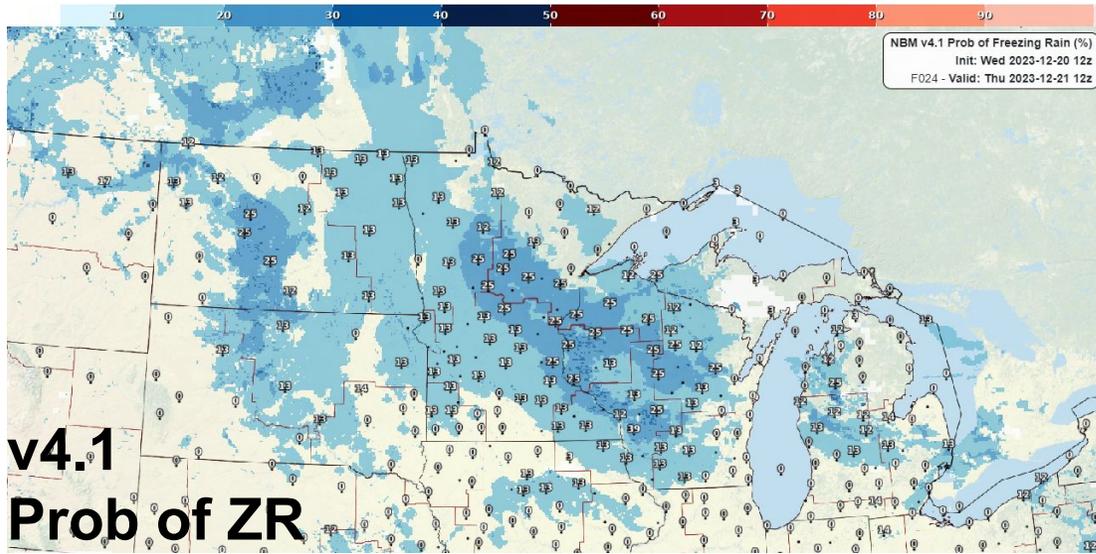
HRRRX
PTYPE CAT FRZ (BIN.)
Thu Dec 21 12:00:00 2023 UTC



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



4.1 vs 4.2 ZR Comparison

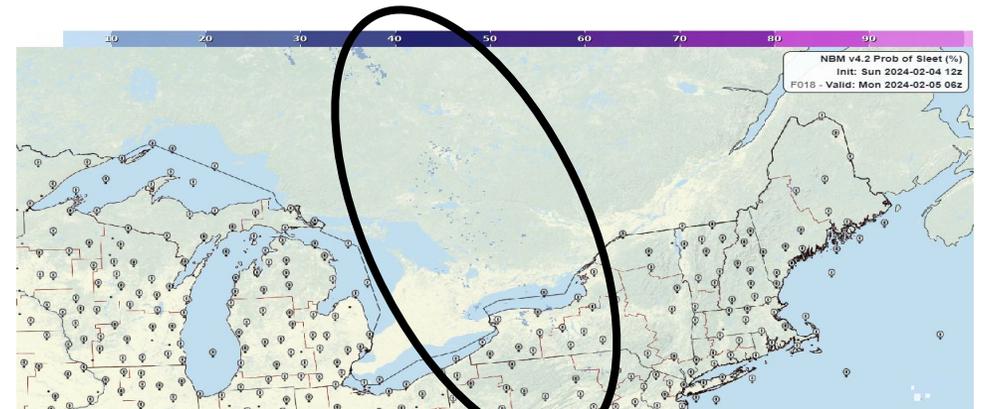
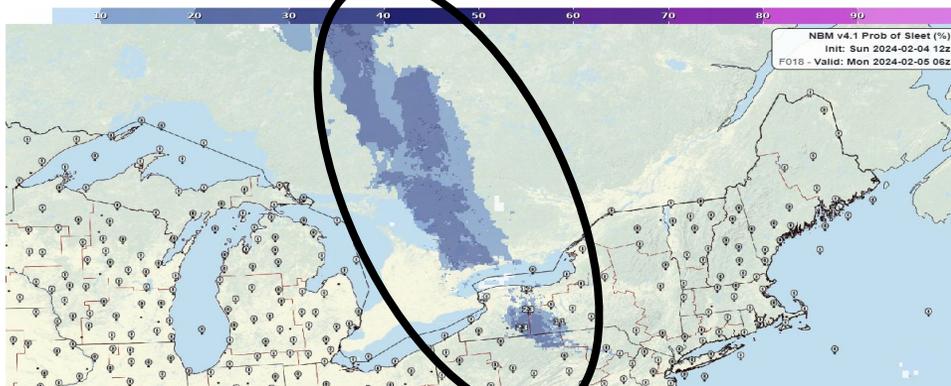


Sfc Obs show no ZL



ZR Discussion

- SMD is confident that this change significantly reduces the freezing drizzle footprint in the probability of ZR output, as the precip rate threshold needed for the ARW HiResWs to compute ptype is lower than for other inputs
- 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
- The change shows up for other types as well





Winds

- **Quantile mapping of instantaneous wind speed and gust is 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 initial quantile mapping for wind speed / gust 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 Science Advisory Group 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. After more trial and error, this was set as the final configuration

| | | | | | | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 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 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, 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



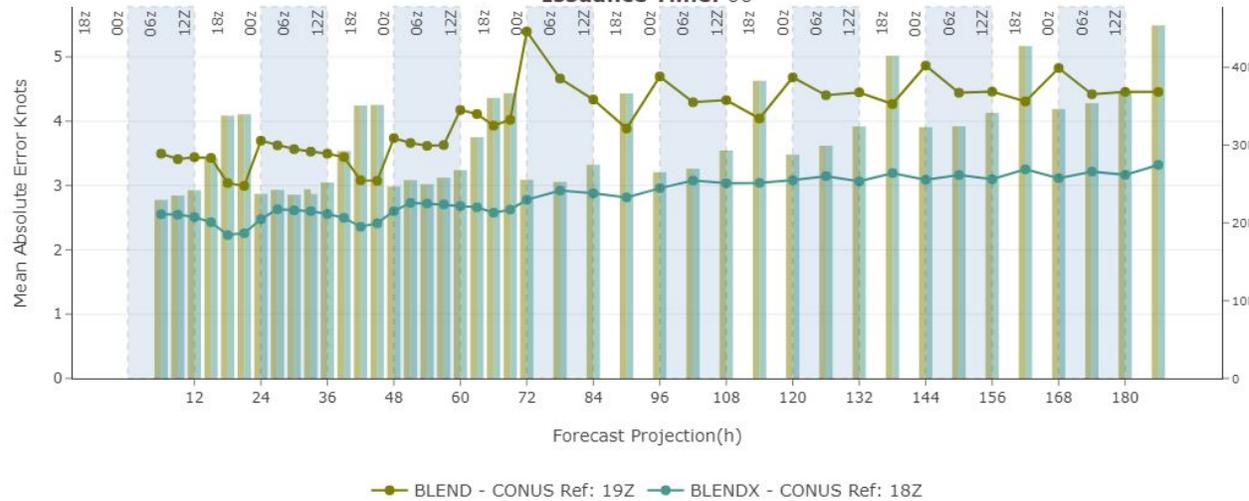
Wind Stats

MAE

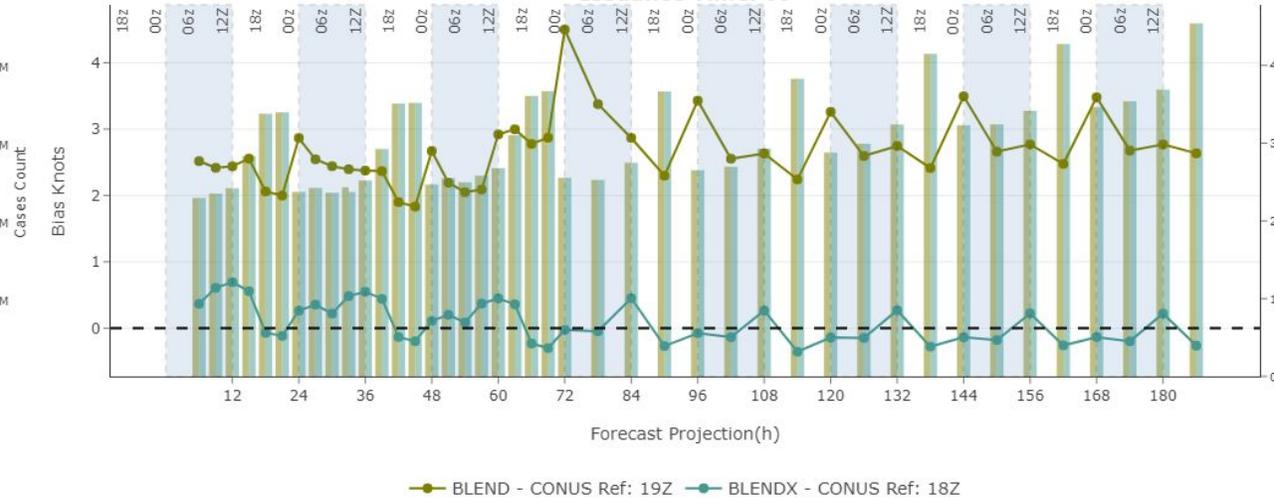
NBMv4.1
NBMv4.2

BIAS

NDFD BLENDX Land URMA verification
Wind Speed Forecast
Issued at: 20231112 - 20240106
Issuance Time: 00



NDFD BLENDX Land URMA verification
Wind Speed Forecast
Issued at: 20231112 - 20240106
Issuance Time: 00



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

CONUS

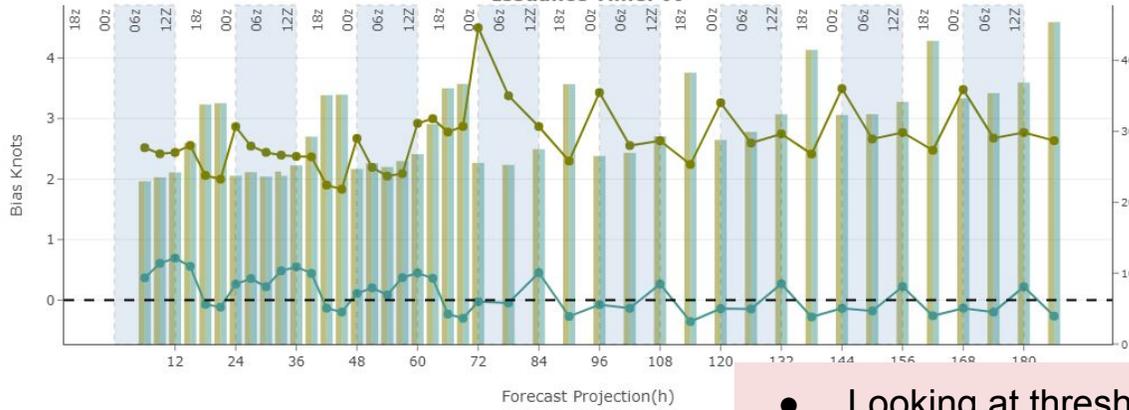
- The high speed bias in v4.1 (ops) is quite evident, and v4.2 bias looks great



Wind Stats

All Speeds

NDFD BLENDX Land URMA verification
Wind Speed Forecast
Issued at: 20231112 - 20240106
Issuance Time: 00

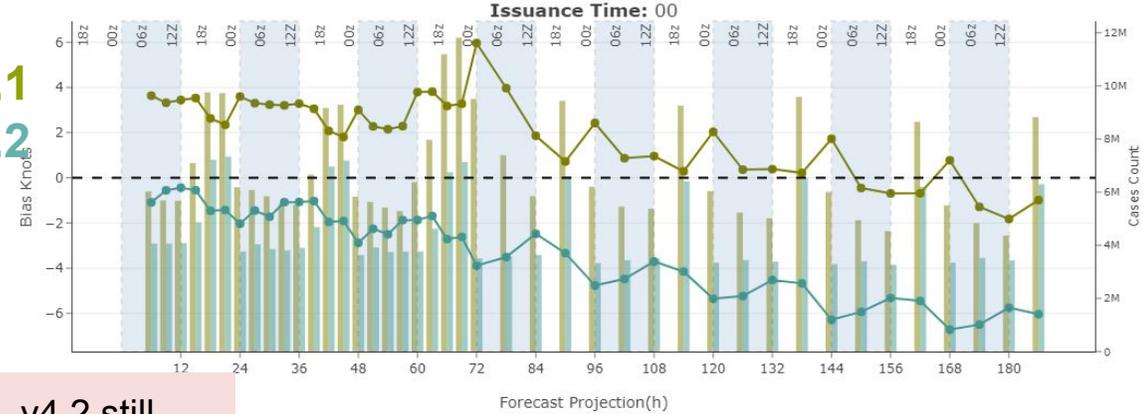


BIAS

NBMv4.1
NBMv4.2

NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=14kts
Issued at: 20231112 - 20240106

> 14 kt



> 23 kt

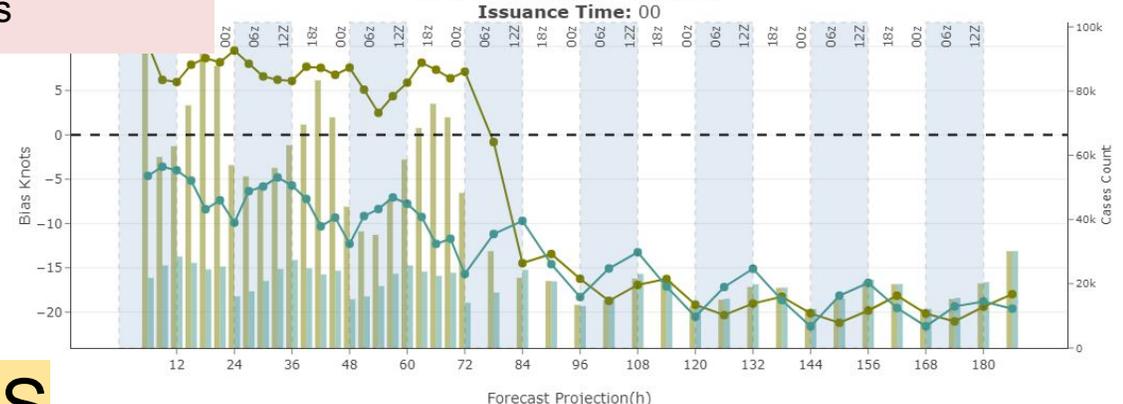
NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=23kts
Issued at: 20231112 - 20240106
Issuance Time: 00



- Looking at thresholds, though, v4.2 still has a low bias for higher speeds (v4.1 has a high bias); both have a low bias at higher speeds beyond 78 hours

NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=32kts
Issued at: 20231112 - 20240106

> 32 kt



CONUS

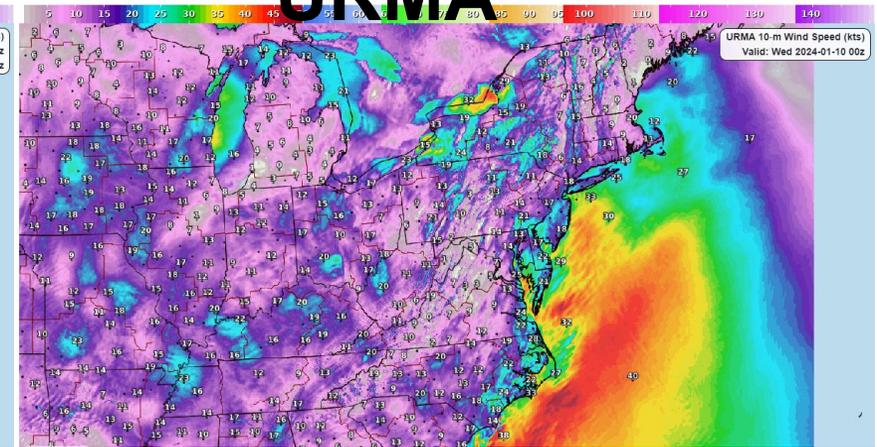
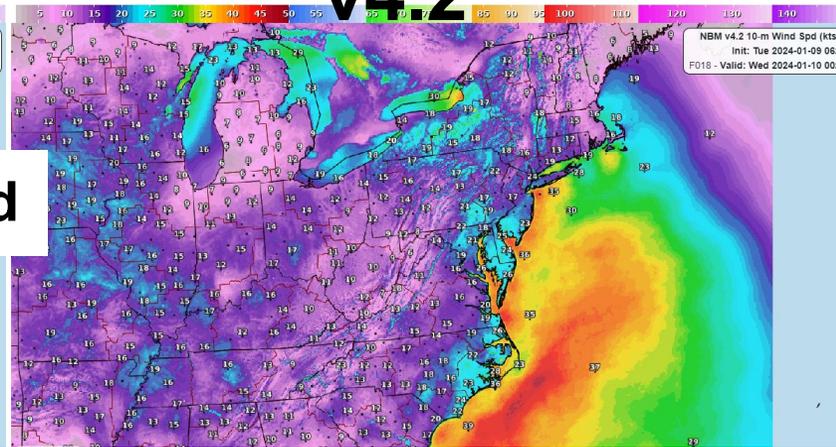
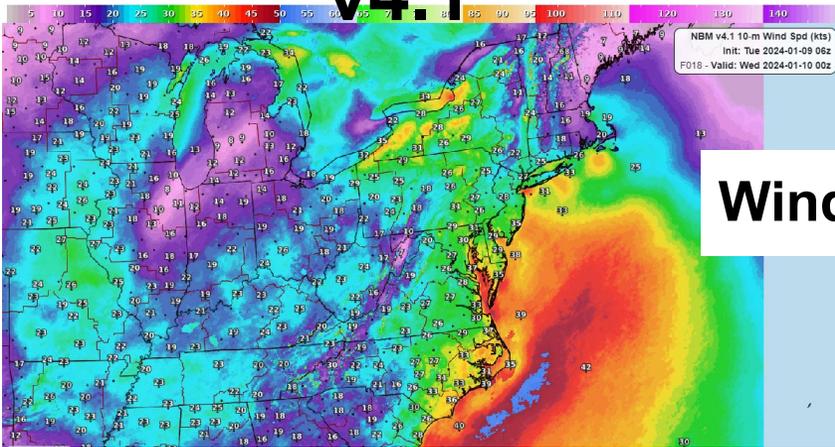


January 8 Storm Wind & Gusts

v4.1

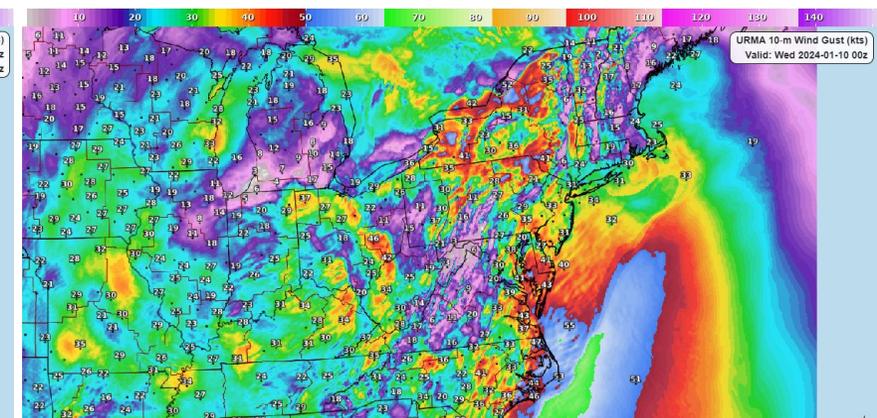
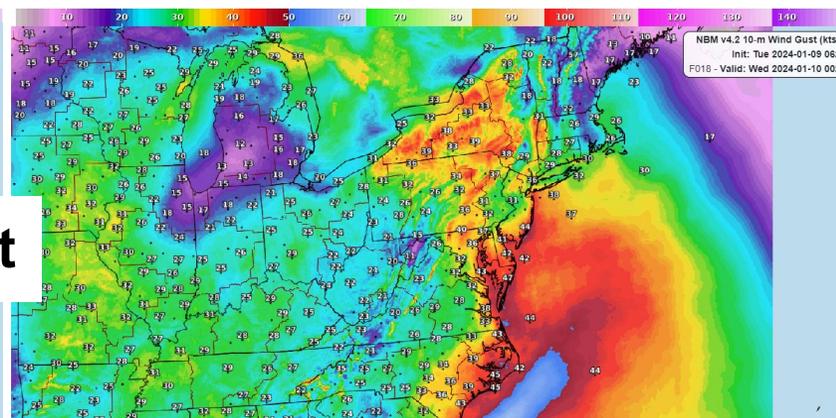
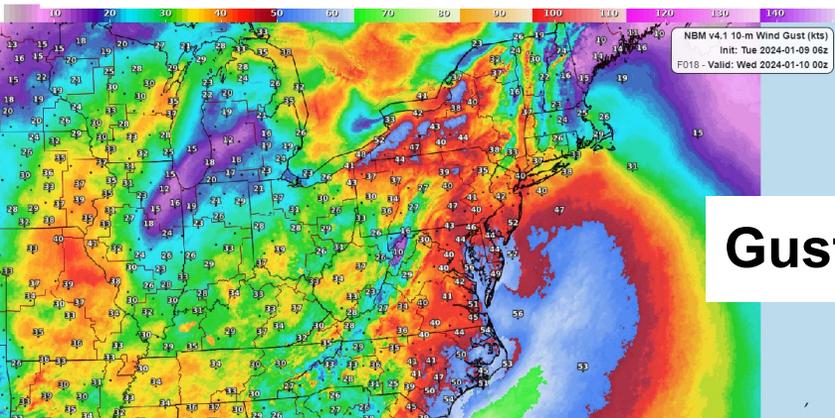
v4.2

URMA



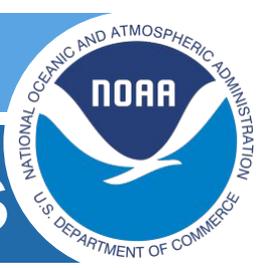
Wind

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

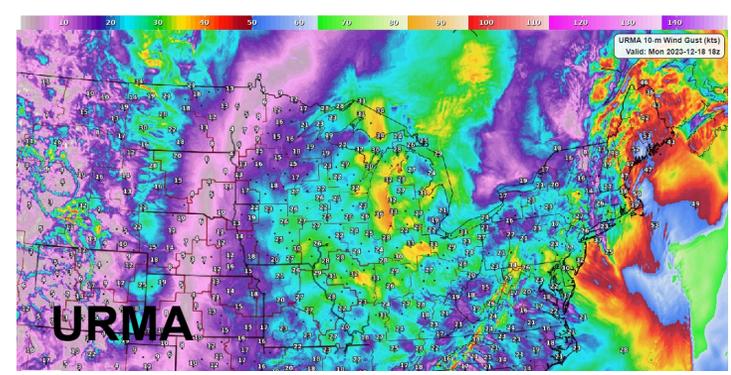
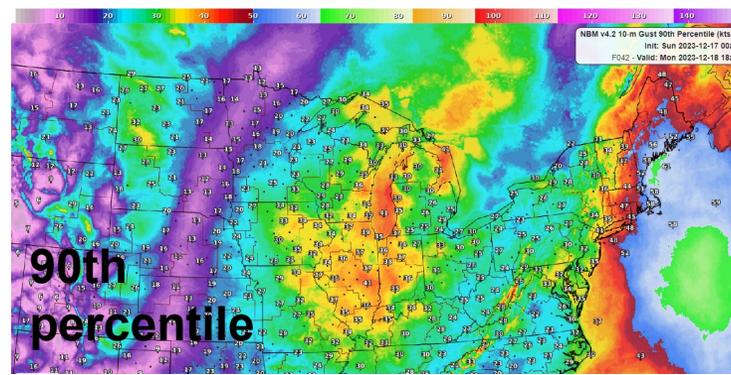
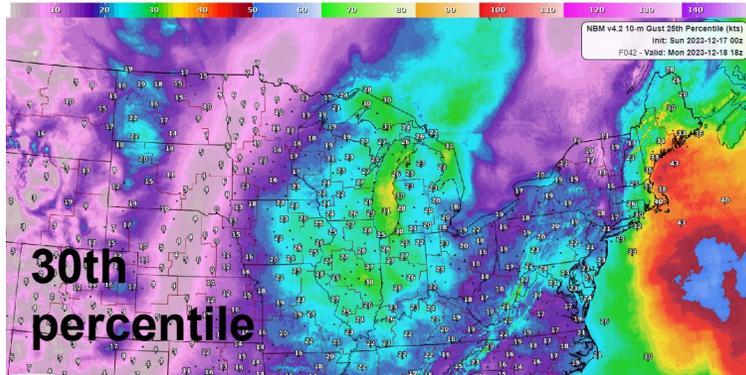
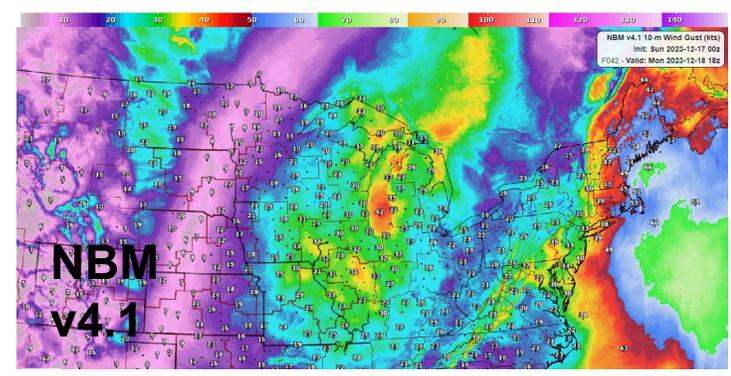
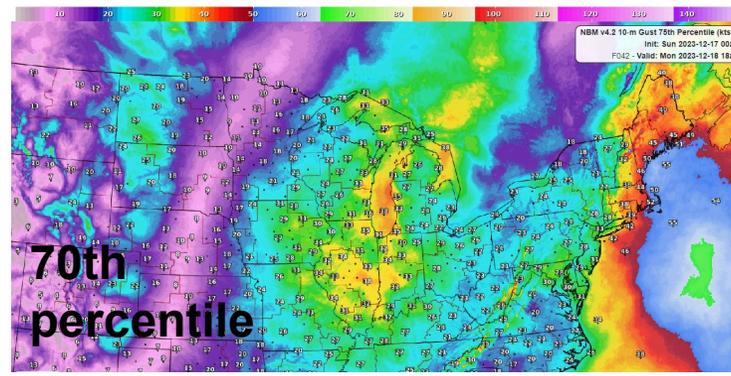
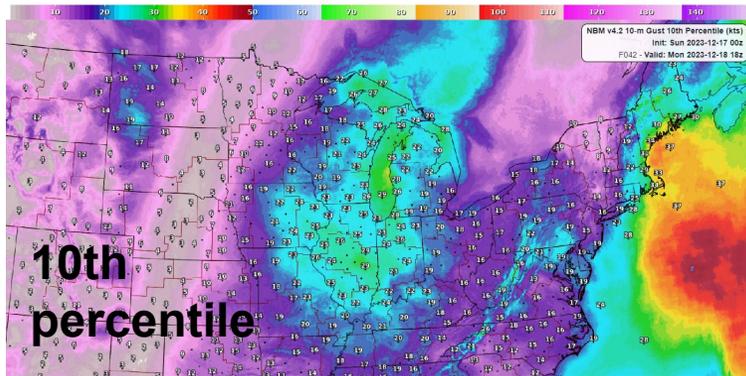
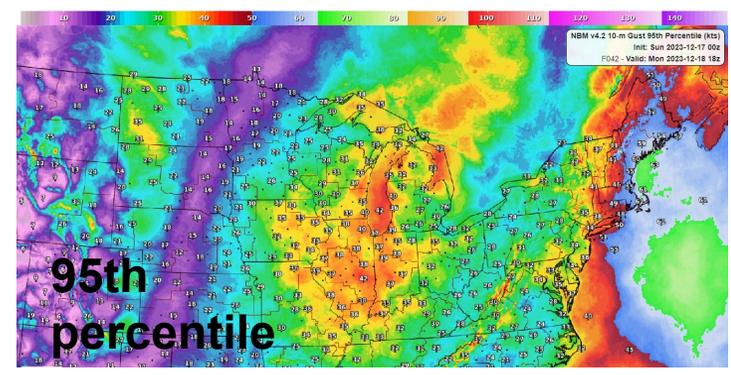
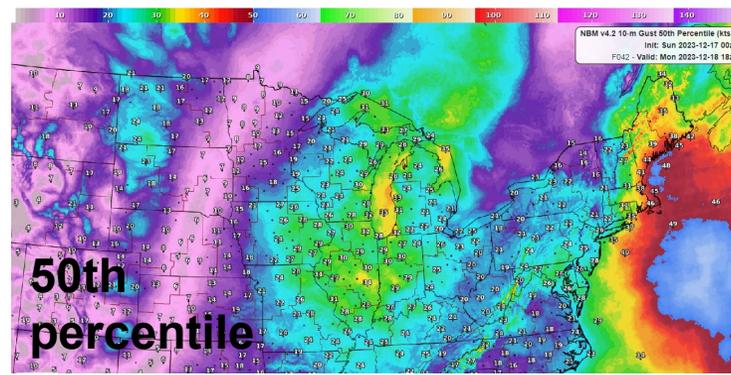
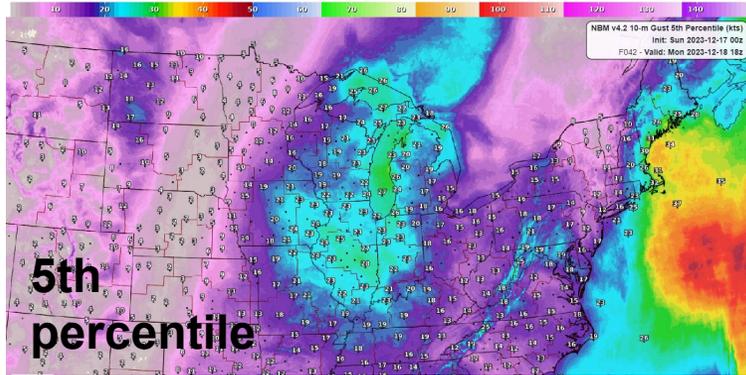


Gust

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



December Storm - v4.2 Gust Percentiles





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; higher percentiles should be a good alternative for much higher thresholds, and even the highest 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
- 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



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

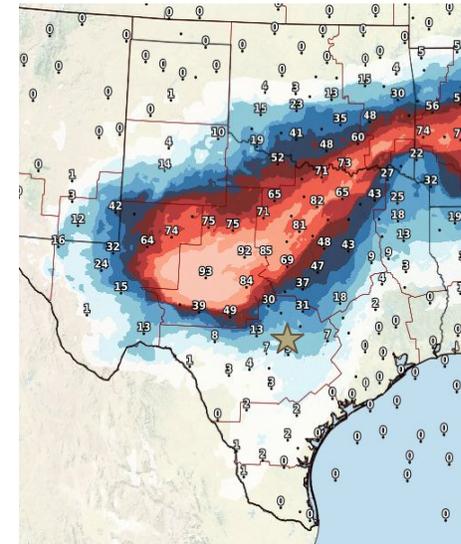
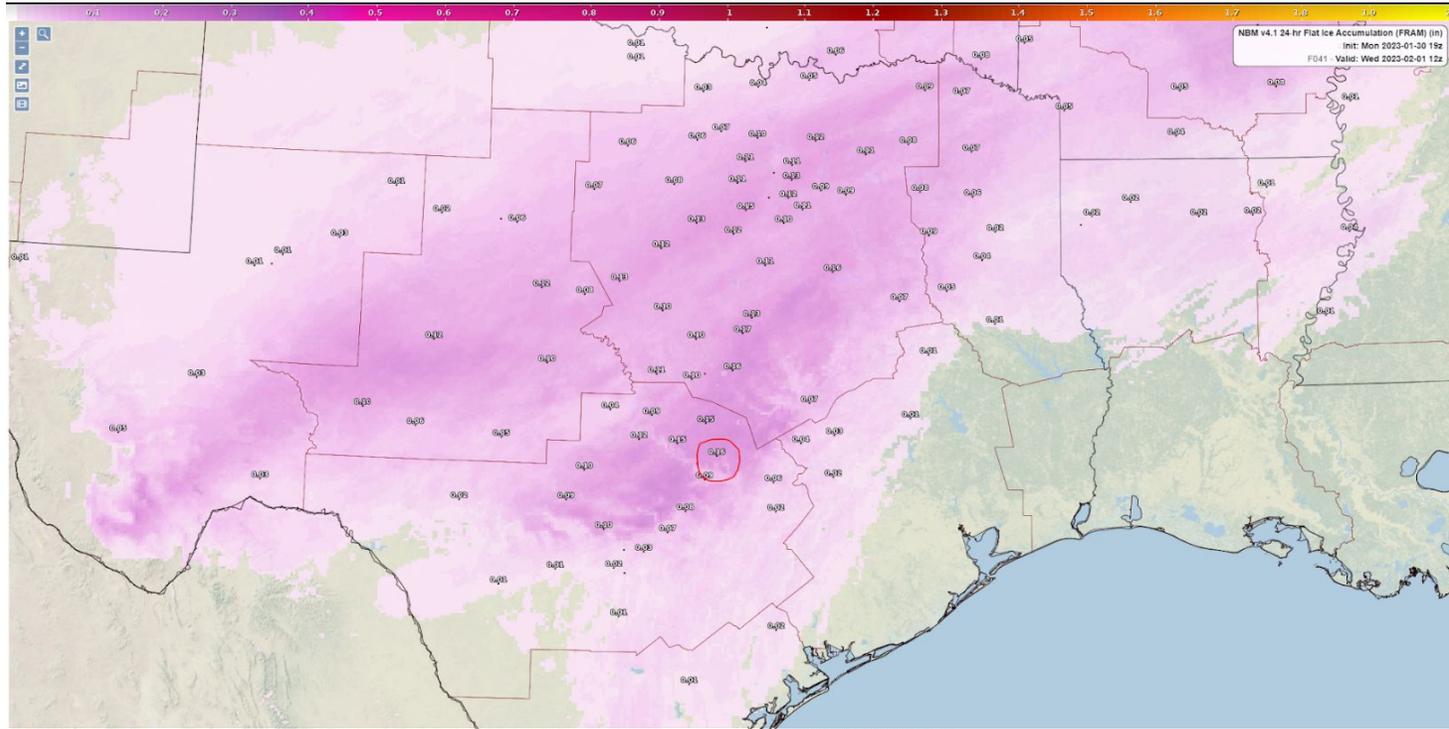


Winter Product Inconsistencies

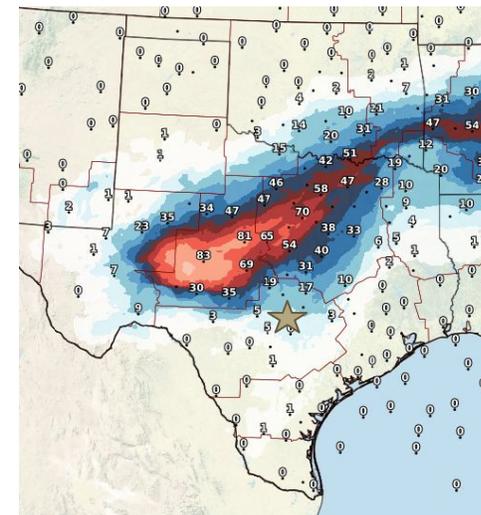


Austin, TX 2023 Ice Storm

19Z 1/30/24 Deterministic ZR Total at F41



Prob > .01" ZR

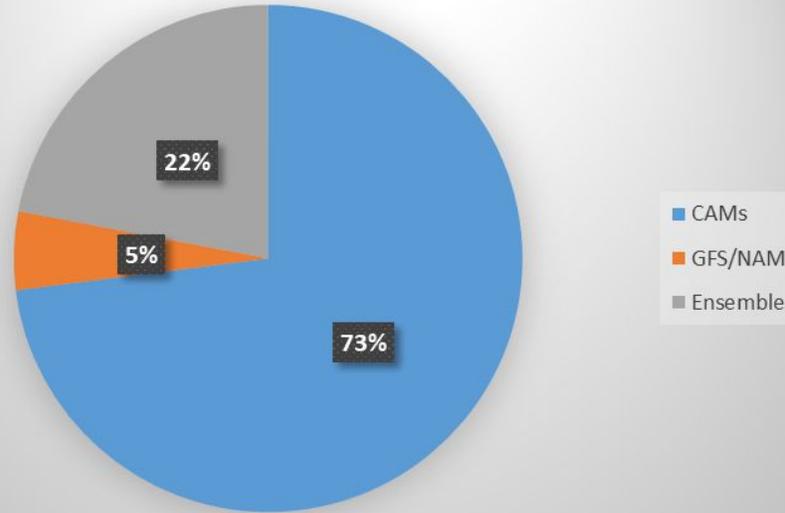
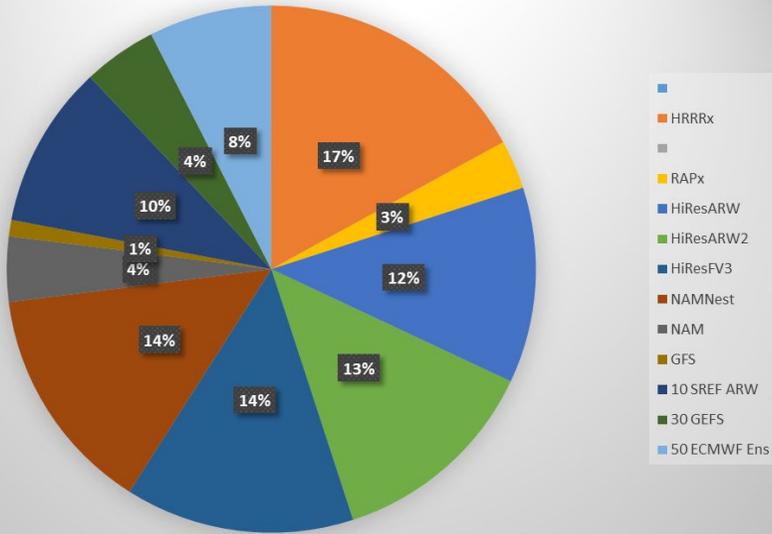


Prob > .1" ZR

credit: Andy Just, CRH



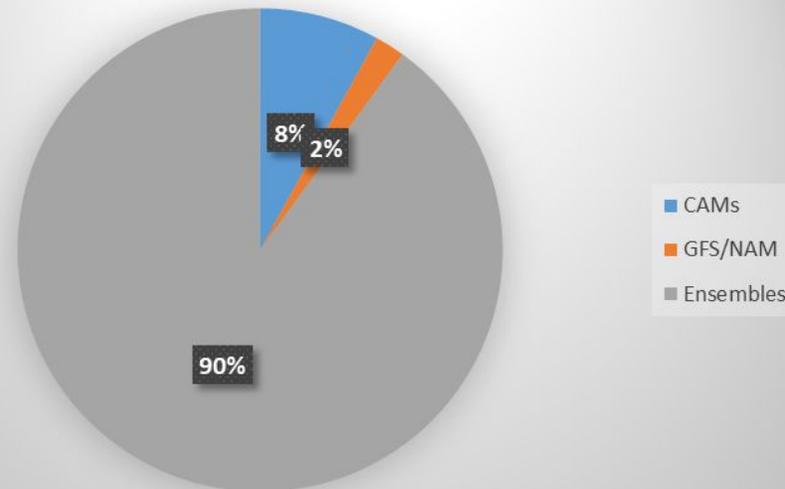
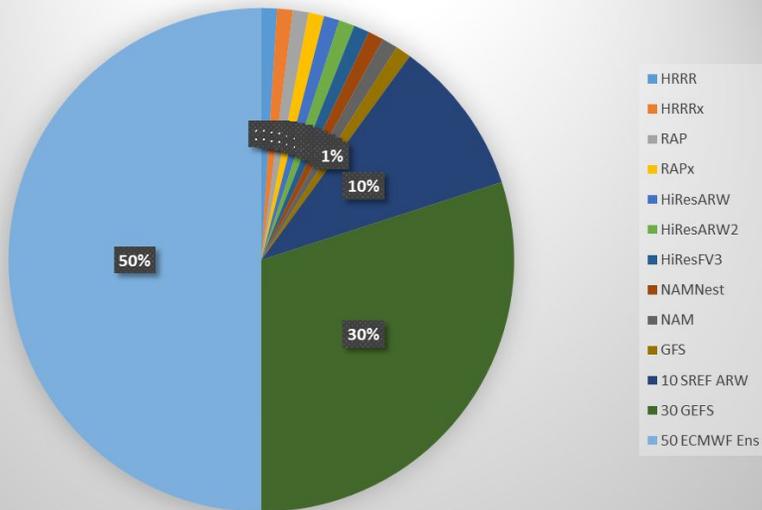
Austin, TX 2023 Ice Storm



Deterministic Hours 20-41

largest influence is from the hi-res guidance

remember that the percentages are slightly different now in v4.2 (see slide 16)

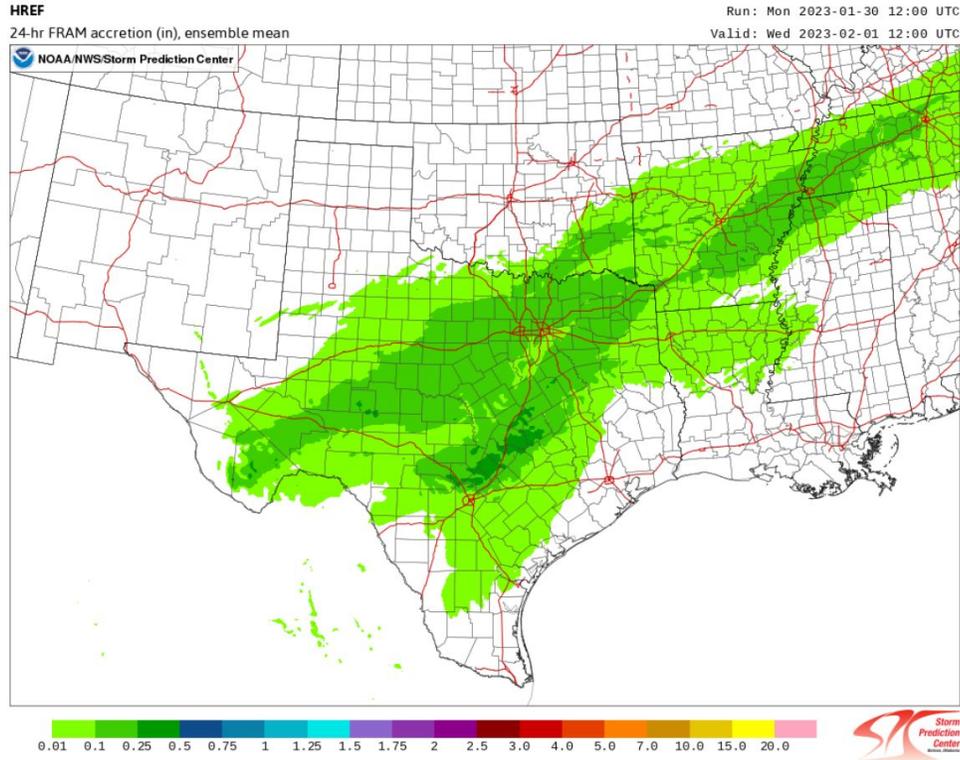


Probabilistic All Fcst Hours

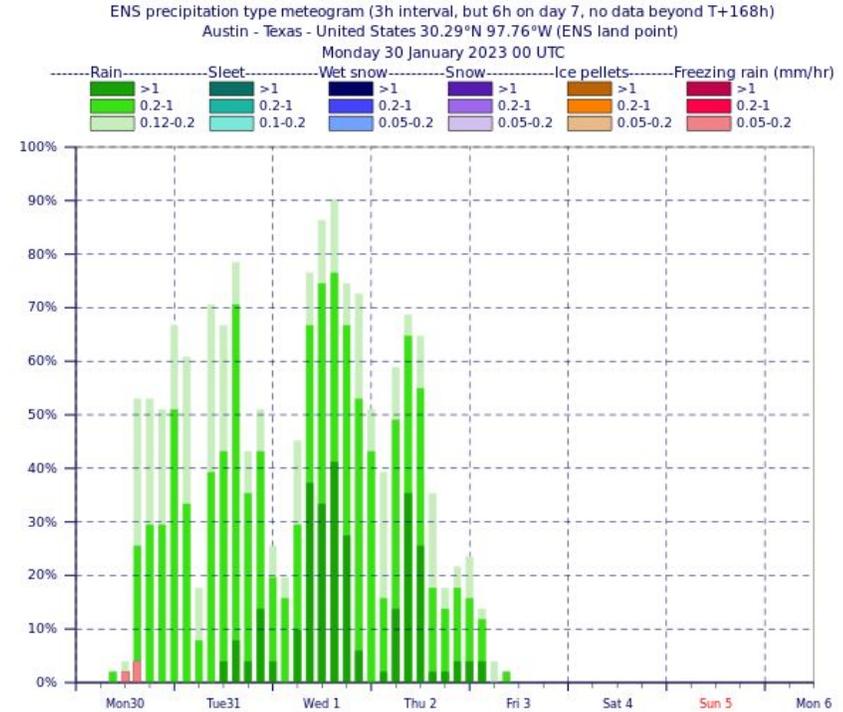
largest influence is from the ensembles



Austin, TX 2023 Ice Storm



CAMs had strong signal for significant ice accumulations near Austin



But the global ensembles, especially the EPS, showed mostly rain near Austin at this range



Austin, TX 2023 Ice Storm

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y |
|----|------------|-------------|-------------|--------------|-------------|--------------|-------------|----------------|------------|-------------|------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-----------------|-----------------|---------------|---------------|
| 1 | NBM | HRRR | RAP | GLMP | NAM | HRRRX | RAPX | NAMNest | ARW | ARW2 | FV3 | HWRF | HMON | RDPS | REPS | SREF | GFS | GEFS | GMOS | GDPS | GEPS | NAVGEEMD | NAVGEOME | ECMWFD | ECMWFE |
| 2 | Res | 3km | 13km | 2.5km | 12km | 3km | 13km | 3km | 3km | 3km | 3km | 1.5km | 1.5km | 10km | 15km | 16km | 13km | 25km | 2.5km | 25km | 50km | 50km | 50km | 25km | 50km |
| 3 | 00z | 22z | 22z | 23z | 18z | 18z | 21z | 18z | 12z | 12z | 12z | 18z | 18z | 18z | 12z | 15z | 18z | 18z | 12z | 25z | 12z | 18z | 12z | 12z | 12z |
| 4 | 01z | 23z | 23z | 00z | 18z | 18z | 21z | 18z | 12z | 12z | 12z | 18z | 18z | 18z | 12z | 21z | 18z | 18z | 12z | 12z | 12z | 18z | 12z | 12z | 12z |
| 5 | 02z | 00z | 00z | 01z | 18z | 18z | 21z | 18z | 12z | 12z | 12z | 18z | 18z | 18z | 12z | 21z | 18z | 18z | 12z | 12z | 12z | 18z | 12z | 12z | 12z |
| 6 | 03z | 01z | 01z | 02z | 00z | 00z | 21z | 00z | 12z | 12z | 12z | 18z | 18z | 18z | 12z | 21z | 18z | 18z | 12z | 12z | 12z | 18z | 12z | 12z | 12z |
| 7 | 04z | 02z | 02z | 03z | 00z | 00z | 21z | 00z | 00z | 00z | 00z | 18z | 18z | 00z | 12z | 21z | 18z | 18z | 12z | 12z | 12z | 18z | 12z | 12z | 12z |
| 8 | 05z | 03z | 03z | 04z | 00z | 00z | 21z | 00z | 00z | 00z | 00z | 18z | 18z | 00z | 12z | 21z | 00z | 18z | 12z | 00z | 12z | 18z | 12z | 12z | 12z |
| 9 | 06z | 04z | 04z | 05z | 00z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 12z | 21z | 00z | 00z | 12z | 00z | 12z | 00z | 12z | 12z | 12z |
| 10 | 07z | 05z | 05z | 06z | 00z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 12z | 12z |
| 11 | 08z | 06z | 06z | 07z | 00z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 12z |
| 12 | 09z | 07z | 07z | 08z | 06z | 06z | 03z | 06z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z |
| 13 | 10z | 08z | 08z | 09z | 06z | 06z | 03z | 06z | 00z | 00z | 00z | 00z | 00z | 00z | 06z | 00z | 03z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z |
| 14 | 11z | 09z | 09z | 10z | 06z | 06z | 03z | 06z | 00z | 00z | 00z | 00z | 00z | 06z | 00z | 03z | 06z | 00z | 00z | 00z | 00z | 00z | 00z | 00z | 00z |
| 15 | 12z | 10z | 10z | 11z | 06z | 06z | 09z | 06z | 00z | 00z | 00z | 06z | 06z | 06z | 00z | 03z | 06z | 06z | 00z | 00z | 00z | 06z | 00z | 00z | 00z |
| 16 | 13z | 11z | 11z | 12z | 06z | 06z | 09z | 06z | 00z | 00z | 00z | 06z | 06z | 06z | 00z | 09z | 06z | 06z | 00z | 00z | 00z | 06z | 00z | 00z | 00z |
| 17 | 14z | 12z | 12z | 13z | 06z | 06z | 09z | 06z | 00z | 00z | 00z | 06z | 06z | 06z | 00z | 09z | 06z | 06z | 00z | 00z | 00z | 06z | 00z | 00z | 00z |
| 18 | 15z | 13z | 13z | 14z | 12z | 12z | 09z | 12z | 00z | 00z | 00z | 06z | 06z | 06z | 00z | 09z | 06z | 06z | 00z | 00z | 00z | 06z | 00z | 00z | 00z |
| 19 | 16z | 14z | 14z | 15z | 12z | 12z | 09z | 12z | 12z | 12z | 12z | 06z | 06z | 12z | 00z | 09z | 06z | 06z | 00z | 00z | 00z | 06z | 00z | 00z | 00z |
| 20 | 17z | 15z | 15z | 16z | 12z | 12z | 09z | 12z | 12z | 12z | 12z | 06z | 06z | 12z | 00z | 09z | 12z | 06z | 00z | 12z | 00z | 06z | 00z | 00z | 00z |
| 21 | 18z | 16z | 16z | 17z | 12z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 00z | 09z | 12z | 12z | 00z | 12z | 00z | 12z | 12z | 00z | 00z |
| 22 | 19z | 17z | 17z | 18z | 12z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 00z | 00z |
| 23 | 20z | 18z | 18z | 19z | 12z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 00z |
| 24 | 21z | 19z | 19z | 20z | 18z | 18z | 15z | 18z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z |
| 25 | 22z | 20z | 20z | 21z | 18z | 18z | 15z | 18z | 12z | 12z | 12z | 12z | 12z | 18z | 12z | 15z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z |
| 26 | 23z | 21z | 21z | 22z | 18z | 18z | 15z | 18z | 12z | 12z | 12z | 12z | 12z | 18z | 12z | 15z | 18z | 12z | 12z | 12z | 12z | 12z | 12z | 12z | 12z |

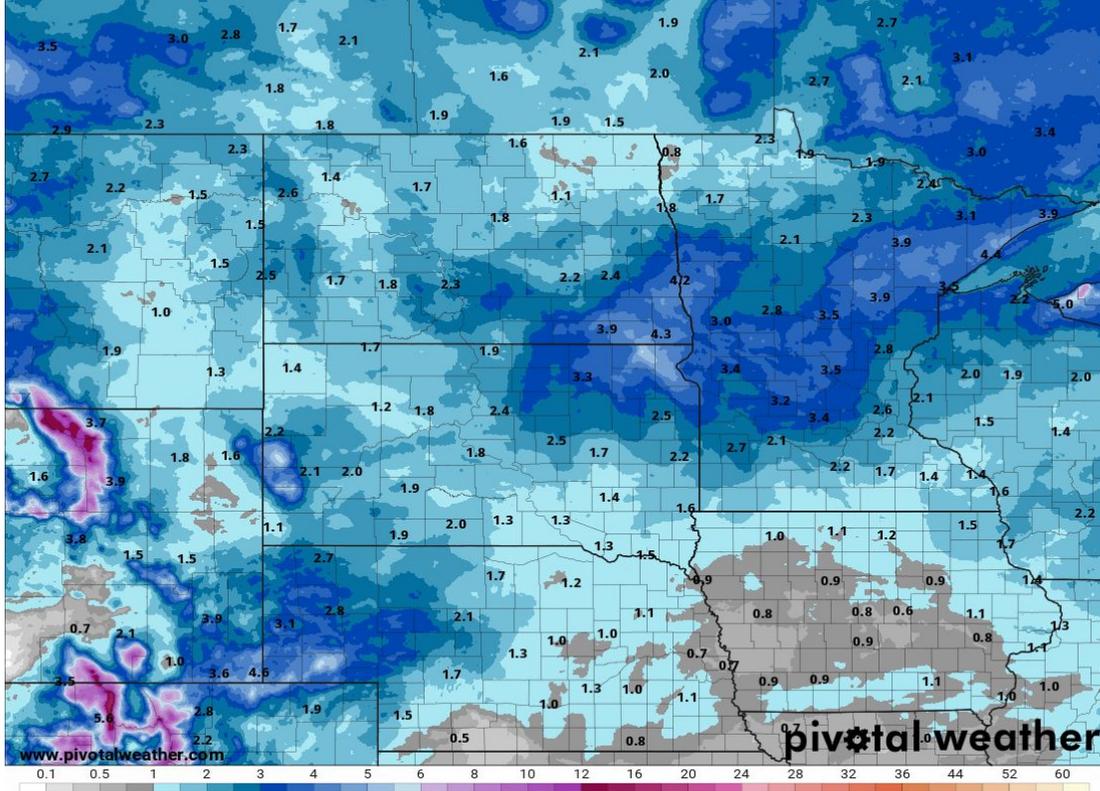
The 19Z NBM cycle uses the 00Z EPS for input

- Currently constructing ways to avoid this type of deterministic vs probabilistic inconsistency

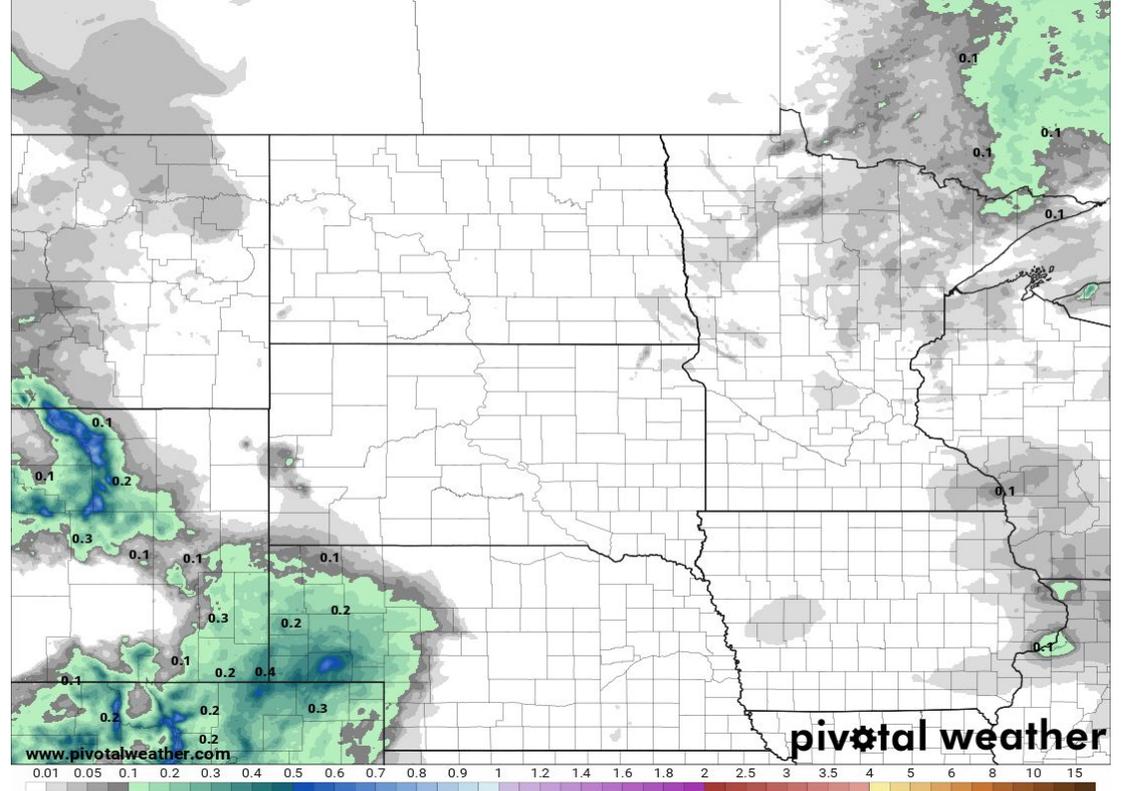


Recent Product Confusion

Total Snowfall, Model Ratio (in)
F233 Valid: Mon 2024-02-19 00z



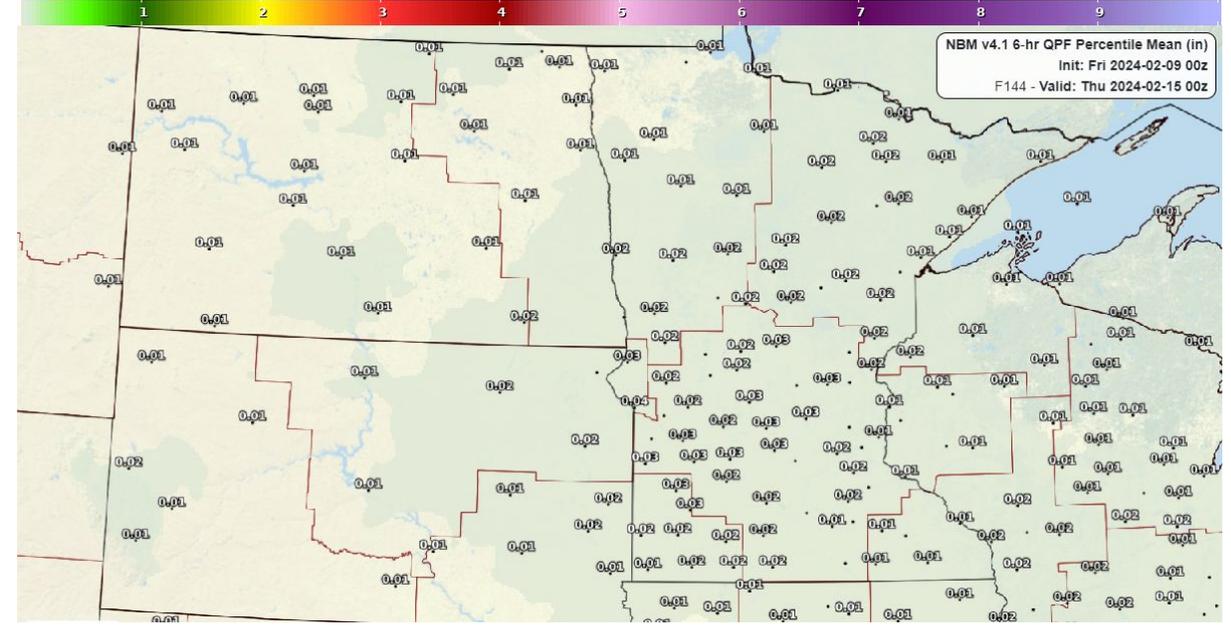
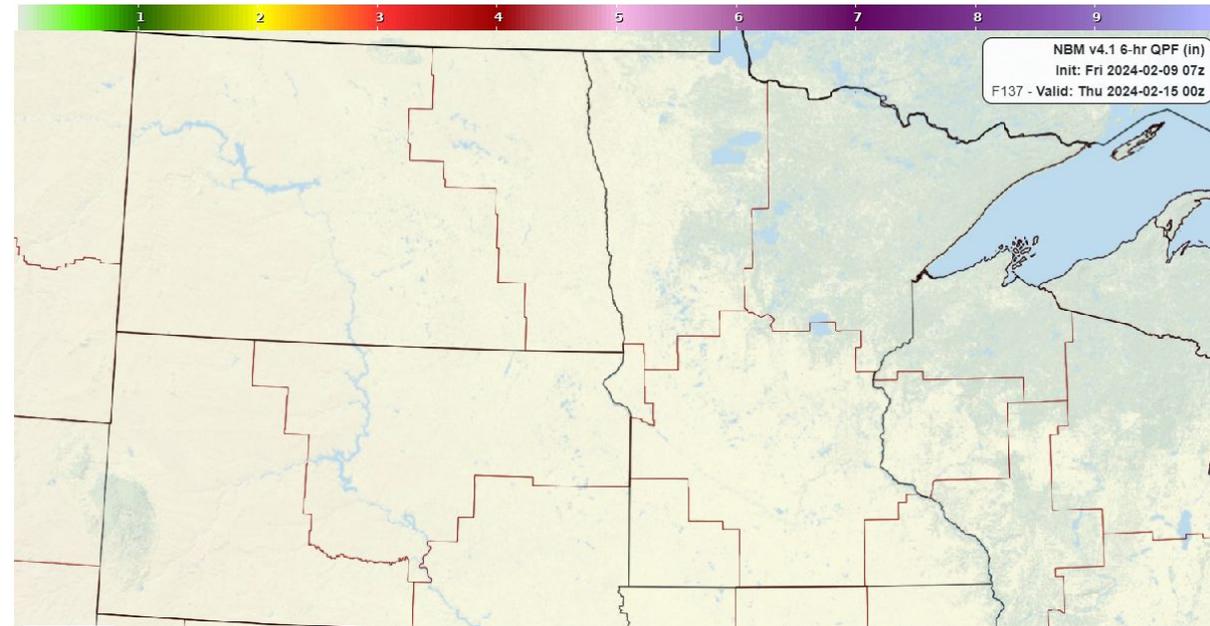
Total QPF (in)
F233 Valid: Mon 2024-02-19 00z



Recent Product Confusion

Let's pick a representative 6h period with 0 hr QPF

Quantile-Mapped QPF percentile mean has lots of area with non-zero QPF



- QPF06 at this range is 50/50 mix of Quantile-Mapped and WPC QPF
- With decent coverage of QM QPF $\geq .02$ ", the QPF06 should not be 0 everywhere



Calibrating Snow Exceedance Probs

- Work by Dave Rudack to improve NBM Snow Exceedance Probabilities
- Uses these NBM 24h snow exceedance probabilities in the regression predictors:
 - **Exceedance amounts greater than a Trace:**
 - > Trace, > 1.0 inch, > 2.0 inches, > 4.0 inches, daily snowfall climatology.
 - **Exceedance amounts greater than one inch:**
 - > Trace, > 1.0 inches, > 2.0 inches, > 4.0 inches, > 6.0 inches, daily snowfall climatology.
 - **Exceedance guidance for > 2.0, > 4.0 inches, > 6.0 inches, > 8 inches, > 12 inches, > 18 inches:**
 - > Trace, > 1.0 inch, > 2.0 inches, > 4.0 inches, > 6.0 inches, > 8 inches, > 12 inches, > 18 inches, daily snowfall climatology.
- NOHRSC 24h snowfall analyses (from 1200 UTC - 1200 UTC) covering the sample period are used as the predictand in the multiple linear regression.

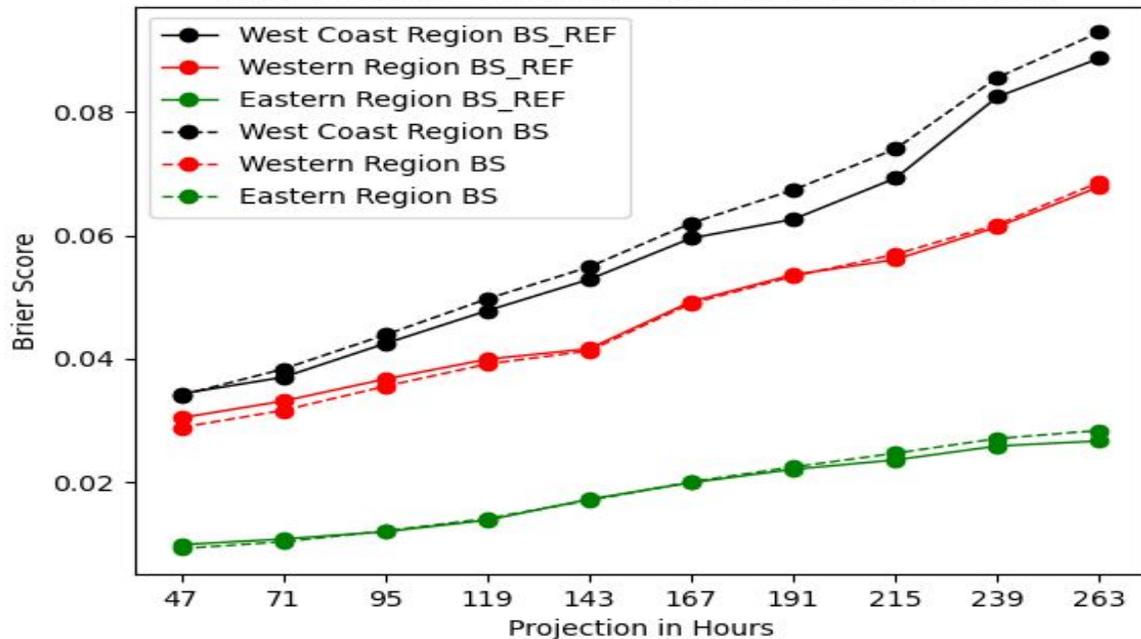


Calibrating Snow Exceedance Probs

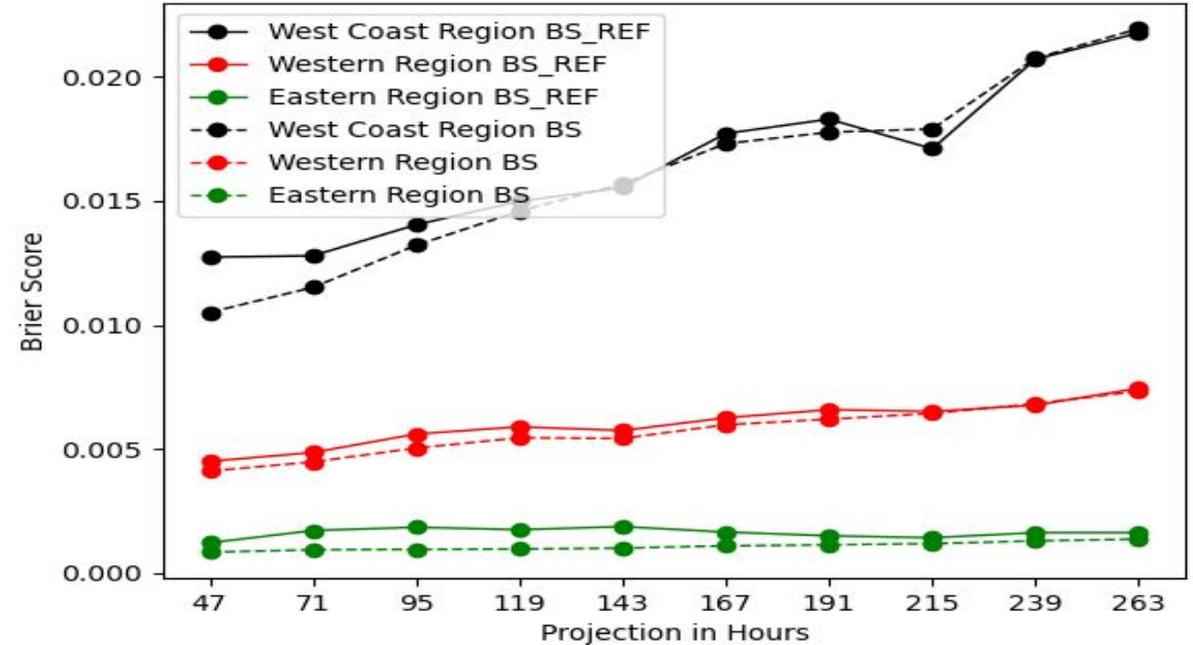
Solid Line is Ops NBM

Dash is the output from the Regression Technique

Brier Score for snow amounts greater than 2.0 in



Brier Score for snow amounts greater than 8.0 in



- improvement is mixed for lower thresholds, particularly along the West Coast, possibly due to an underforecast of lower amounts (regression generally does not “correct up”)
- improvement is more substantial for higher amounts



Takeaways from this Study

- Based on the findings, performing a seasonal regression analysis using the NBM snow percentiles and daily snow climatologies as predictors further improves upon both the accuracy and reliability of the NBM v4.1 snowfall exceedance forecasts
- Leveraging predictors such as QMD QPF and Ptype may help improve the equations in the West
- This additional multiple linear regression post-processing step provides confidence to forecasters that the NBM guidance is properly calibrated and can be used in IDSS without much apprehension
- Care must be taken to not use equations for some of the higher threshold values as the reduction of variance drops considerably especially in the extended range. In those instances, the uncalibrated NBM products should be used



Summary

- NBMv4.2 is on track for implementation in May 2024
- There are several winter weather improvements in this package including SLR changes, the downscaled wet-bulb temperature, mitigation of the lattice effect, and reduction of ARW HiResW-driven probabilities of winter precip
- Instantaneous quantile-mapped winds and gusts will be available; the high bias at lower speeds is reduced, but a low bias at higher speeds will now exist
- Removing product inconsistencies, especially with regard to snow/ice vs QPF, is a major goal for v5.0
- Calibration of snow exceedance probabilities may also be included in v5.0, especially given the need for good probabilistic guidance to support IDSS
- Preparations are also underway for upcoming changes to the NPS



Extra Slides



Extra Slides

NBM Snow Liquid Ratio (SLR) Blends

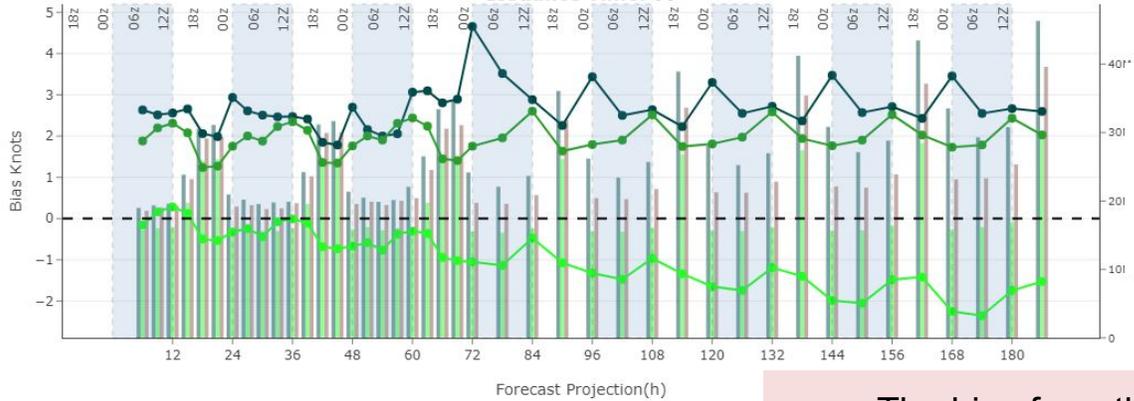
| Model | Snow Ratio Techniques |
|--------------|--|
| HRRR | 50% Cobb, 50% MaxTAloft |
| HRRRX | 50% Cobb, 50% MaxTAloft |
| RAP | 50% Cobb, 50% MaxTAloft |
| RAPX | 50% Cobb, 50% MaxTAloft |
| HiResARW | 50% Cobb, 50% MaxTAloft |
| HiResARW2 | 50% Cobb, 50% MaxTAloft |
| HiResFV3 | 50% Cobb, 50% MaxTAloft |
| NAM | 33% Cobb, 33% MaxTAloft, 33% Roebber |
| NAMNest | 50% Cobb, 50% MaxTAloft |
| 10 SREF ARW | 50% Cobb, 50% MaxTAloft |
| GFS | 33% Cobb, 33% MaxTAloft, 33% Roebber |
| 30 GEFS | 33% Cobb, 33% MaxTAloft, 33% 850-700mb thickness |
| 50 ECMWF Ens | 33% Cobb, 33% MaxTAloft, 33% 850-700mb thickness |



Wind Stats

> 8 kt

NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=8kts
Issued at: 20231112 - 20240106
Issuance Time: 00

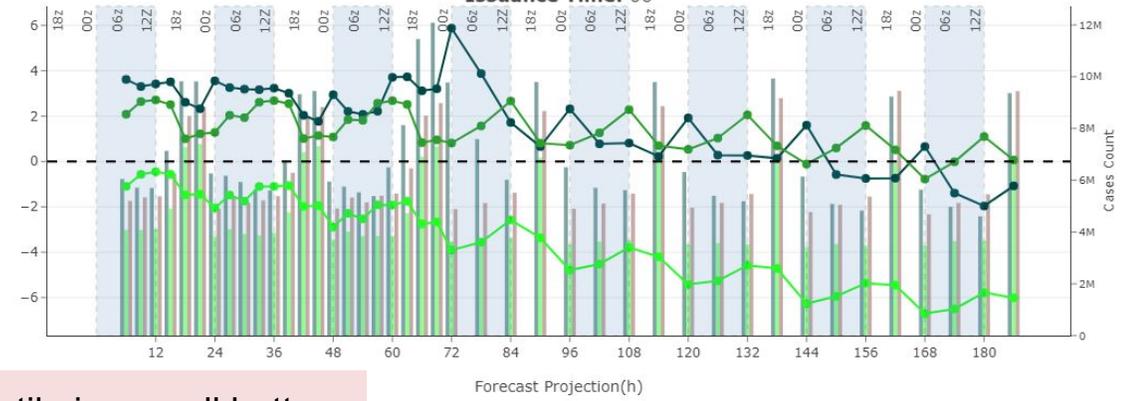


BIAS

NBMv4.1
NBMv4.2
75th perc

> 14 kt

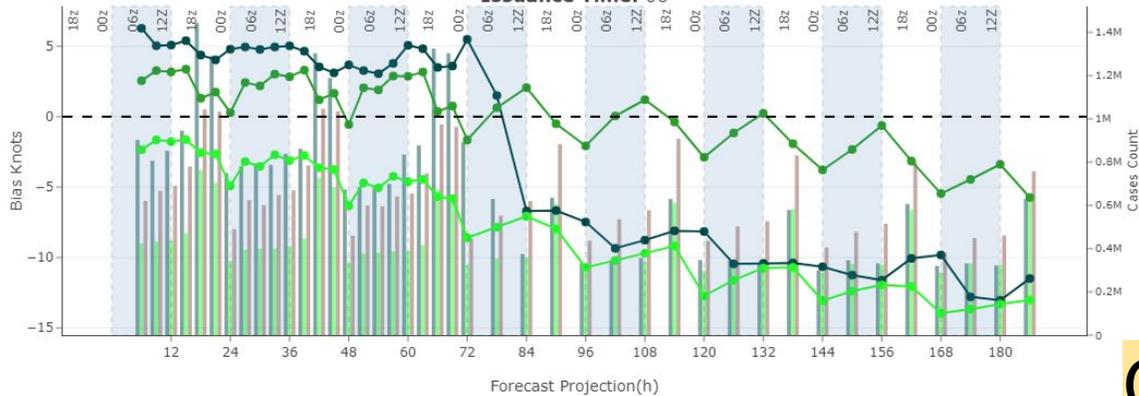
NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=14kts
Issued at: 20231112 - 20240106
Issuance Time: 00



- 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

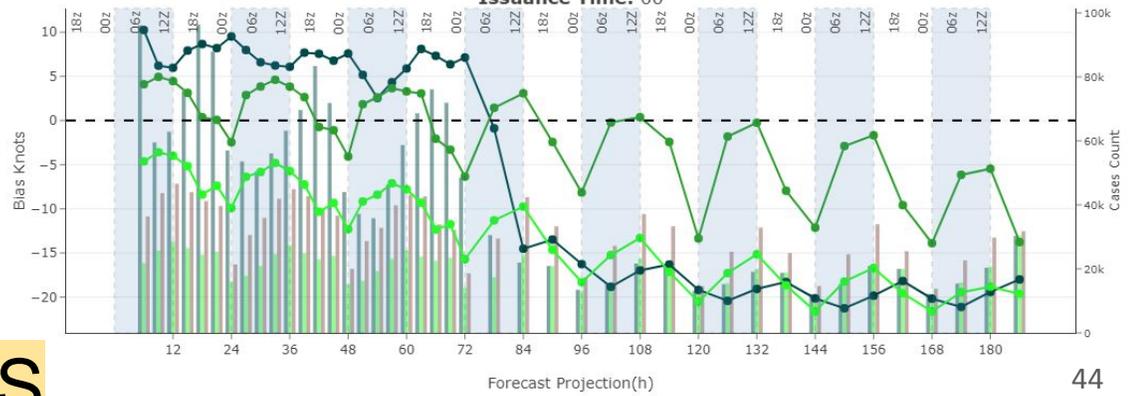
NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=23kts
Issued at: 20231112 - 20240106
Issuance Time: 00



CONUS

> 32 kt

NDFD BLENDX Land URMA verification
Wind Speed Forecast for Threshold: >=32kts
Issued at: 20231112 - 20240106
Issuance Time: 00

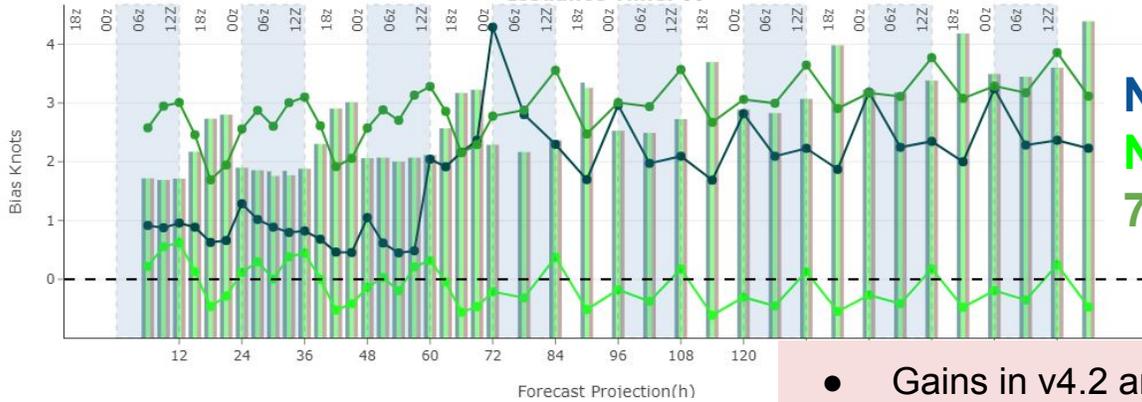




Gust Stats

All Speeds

NDFD BLENDEX Land URMA verification
Wind Gust Forecast
Issued at: 20231112 - 20240106
Issuance Time: 00

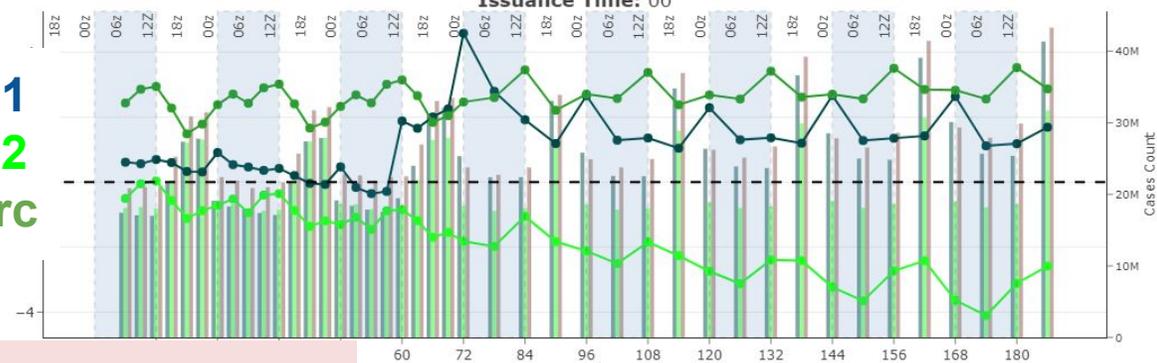


BIAS

NBMv4.1
NBMv4.2
75th perc

NDFD BLENDEX Land URMA verification
Wind Gust Forecast for Threshold: >= 14kts
Issued at: 20231112 - 20240106
Issuance Time: 00

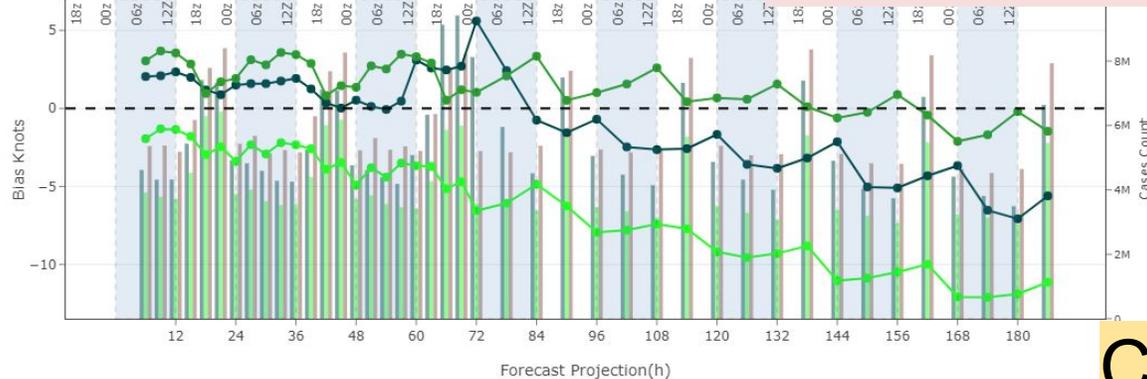
> 14 kt



- 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

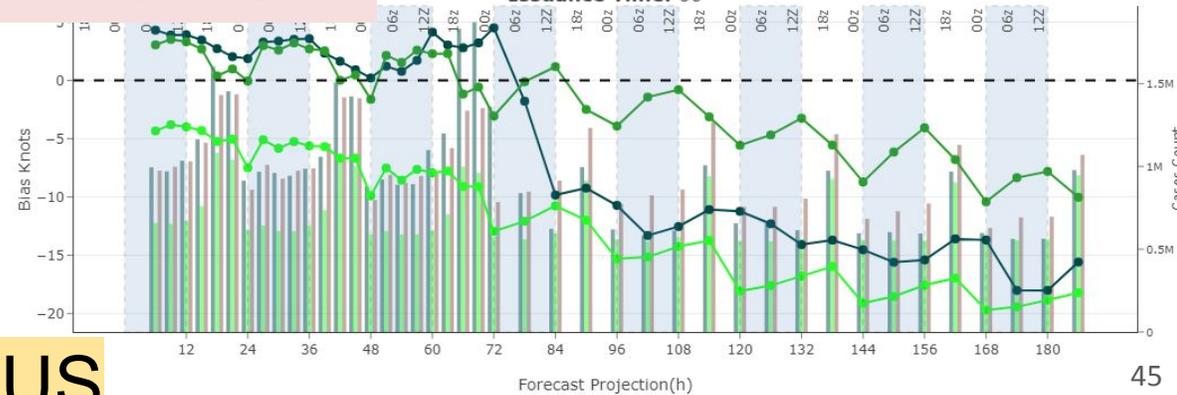
> 23 kt

NDFD BLENDEX Land URMA verification
Wind Gust Forecast for Threshold: >= 23
Issued at: 20231112 - 20240106
Issuance Time: 00



NDFD BLENDEX Land URMA verification
Wind Gust Forecast for Threshold: >= 32kts
Issued at: 20231112 - 20240106
Issuance Time: 00

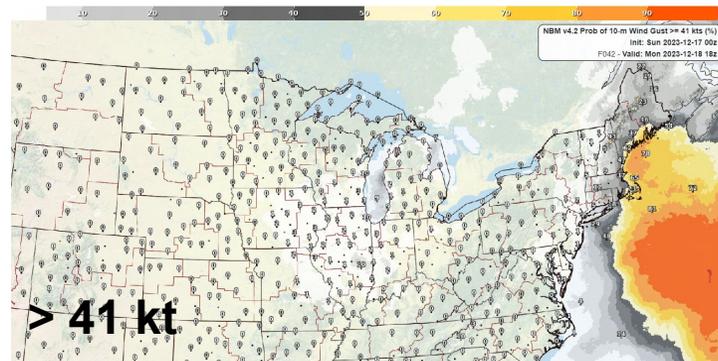
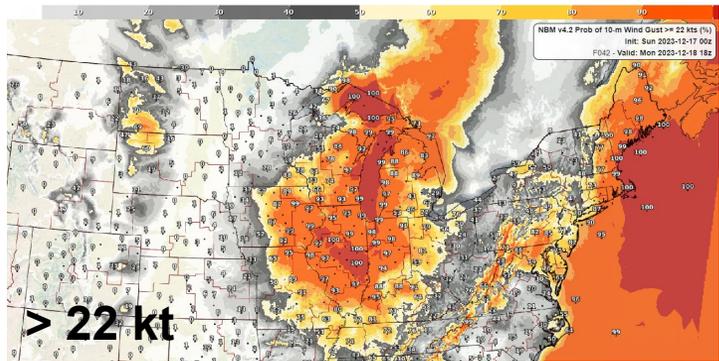
> 32 kt



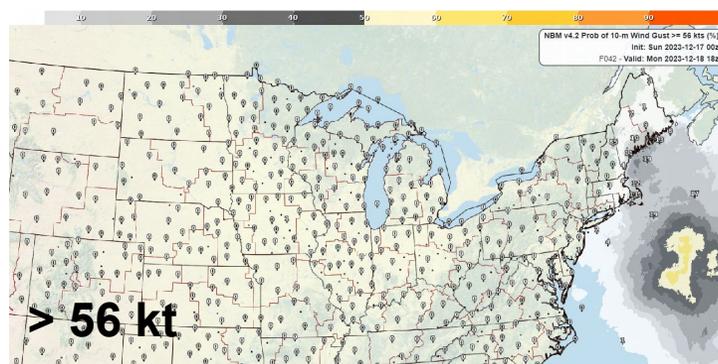
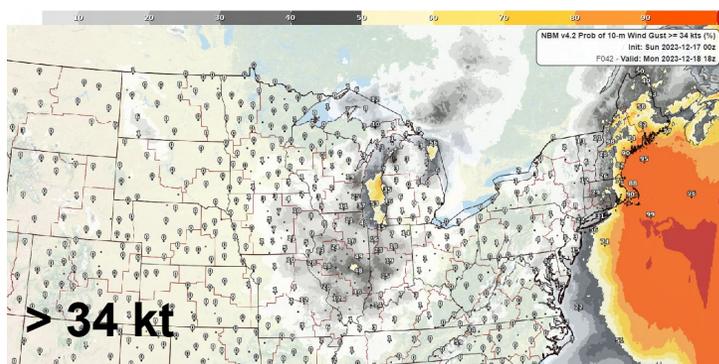
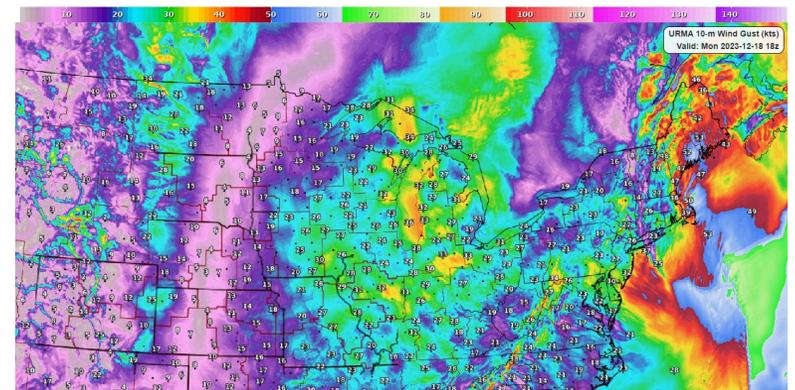
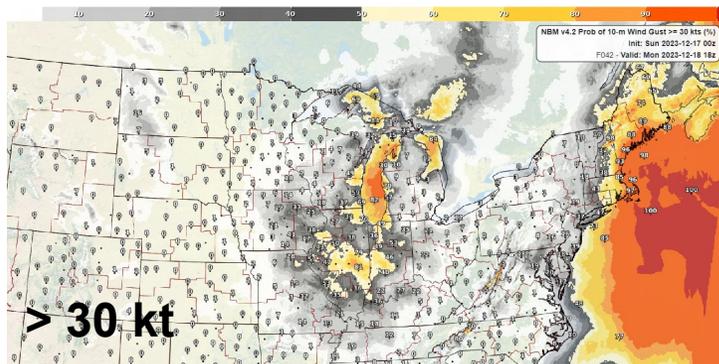
CONUS



December Storm - Gust Probs

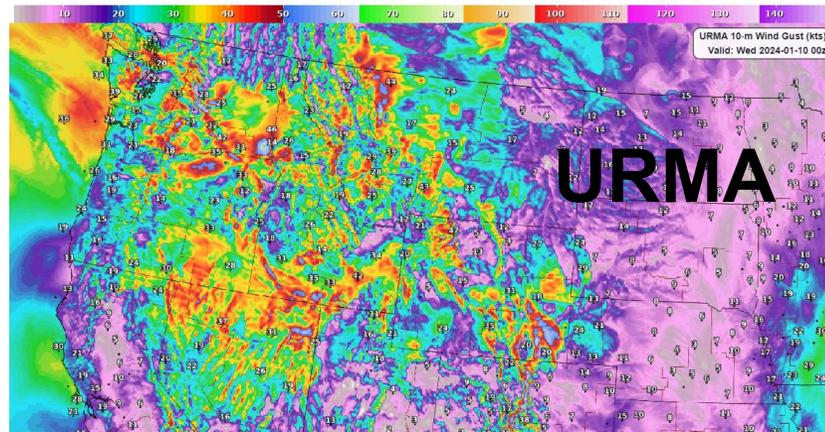
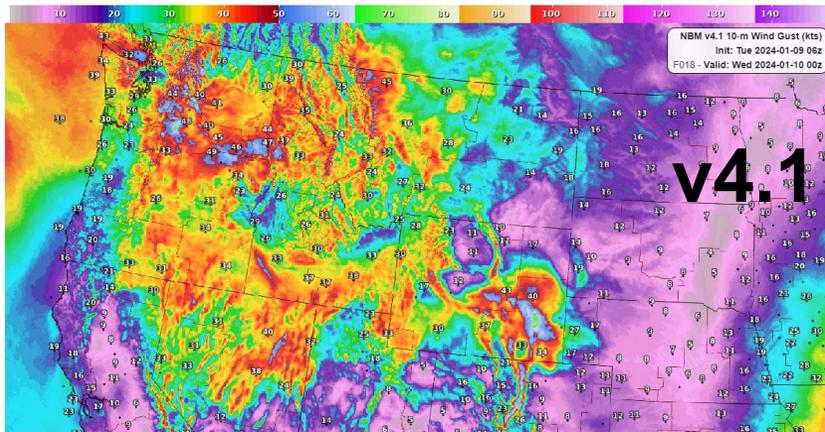


URMA

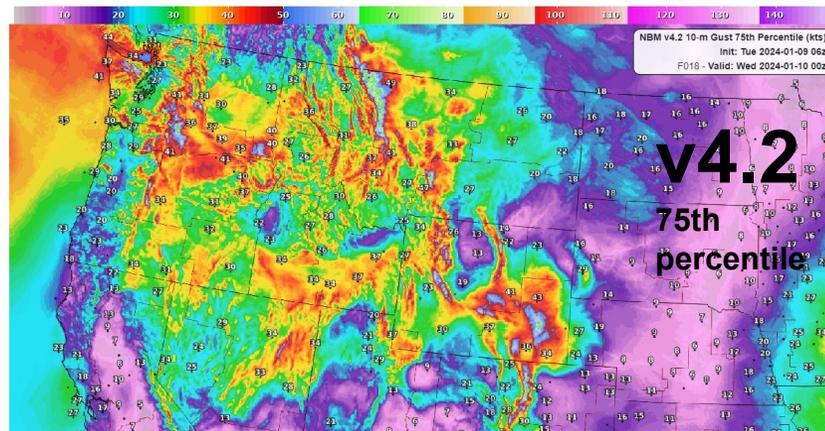
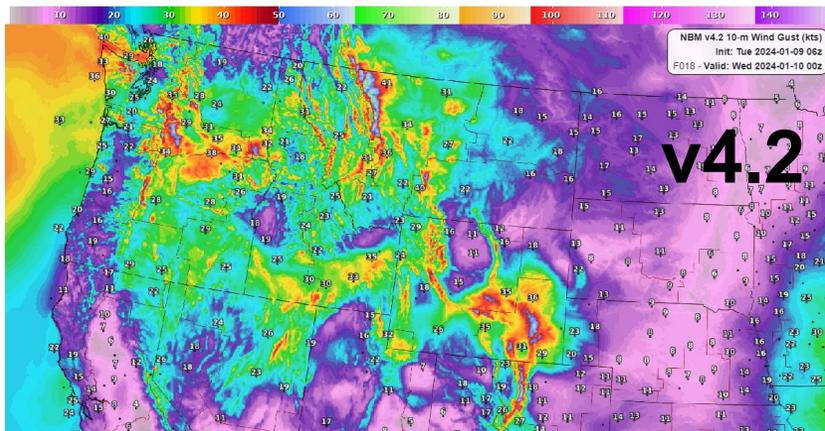




Western Region Gust Case



**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 near 0 bias at 00Z in the short range, and that is also evident here