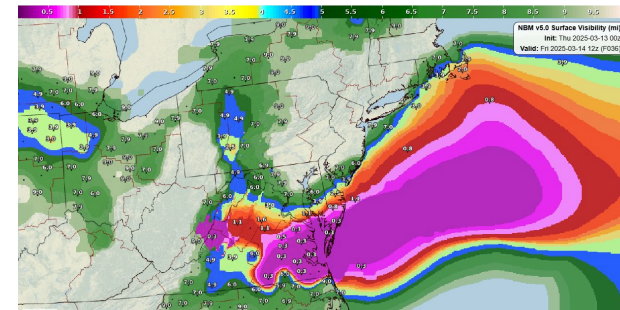
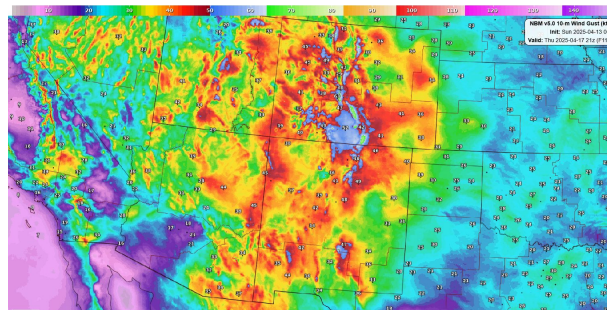
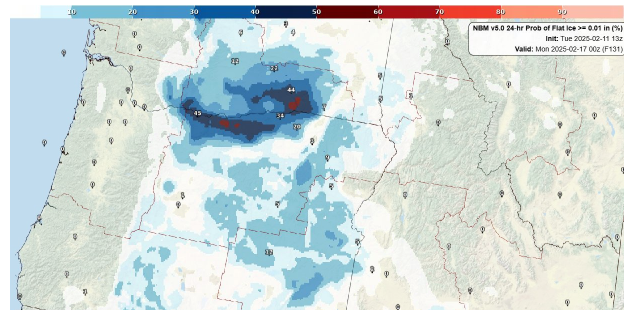




NBMv5.0 Overview

8 July 2025



Geoff Manikin and Dave Rudack
NWS/OSTI/MDL Silver Spring, MD



Contributors to NBMv5.0

- Dave Rudack - NBM Team Lead
- Robby James - NBM Core Blend Lead, maintenance of NBM parallels
- Adam Schnapp - NBM Aviation Products Lead, Co-Lead of NBM refactoring project
- Mike Baker - NBM Marine Products Lead, Blend Evaluation and Assessment Team (BEAT), Developer of additional elements
- Eric Engle - NBM QPF Lead, SMD Senior Software Analyst, Co-Lead of NBM refactoring project
- Scott Scallion - NBM Operations and Implementation Lead, Developer of new elements
- Carly Buxton - NBM Fire Weather Products Lead, BEAT
- Steve Levine - Subject Matter Expert for RTMA/URMA issues; BEAT
- Mark Antolik - BEAT
- Greg Leone - NBM Winter Weather Elements Development, BEAT
- Tim Cera - refactoring of NBM code, new PW element
- Brian Haynes - BEAT, Text Products
- Sidney Lower - QPF Development
- Jim Long - Refactoring of NBM code

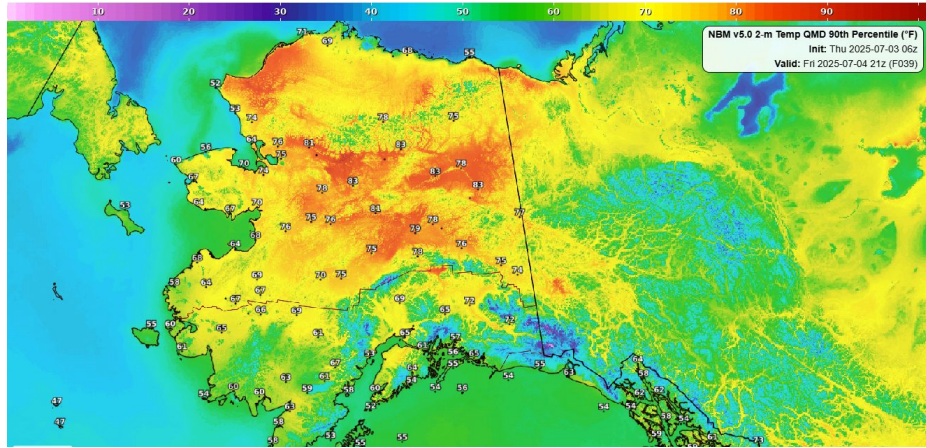
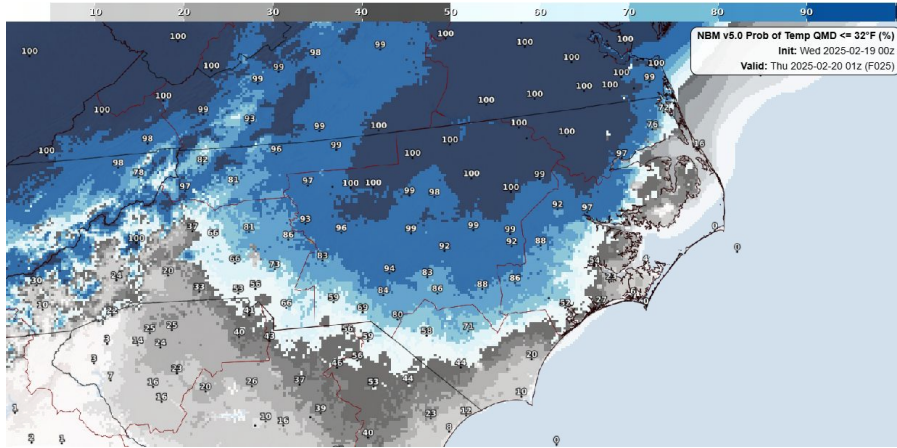


Product Changes in Version 5

- More probabilistic elements, especially for Fire Weather forecasting (inst. T, Td, RH, all quantile-mapped)
- Joint Fire Weather probabilities
- Probability-Matched Means for QPF and snowfall/ice
- Calibrated exceedance probabilities for snowfall
- Numerous OCONUS elements, including several to support vulnerable communities in Pacific Region
- New precipitable water and snow cover fields (coming soon)
- Addition of probabilistic apparent temperature
- Extension of most hourly products to F48 (currently F36)



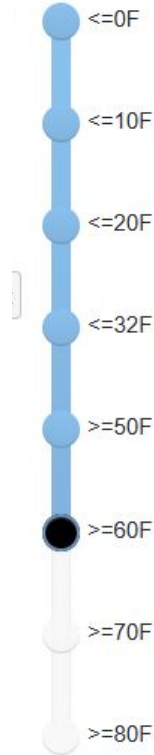
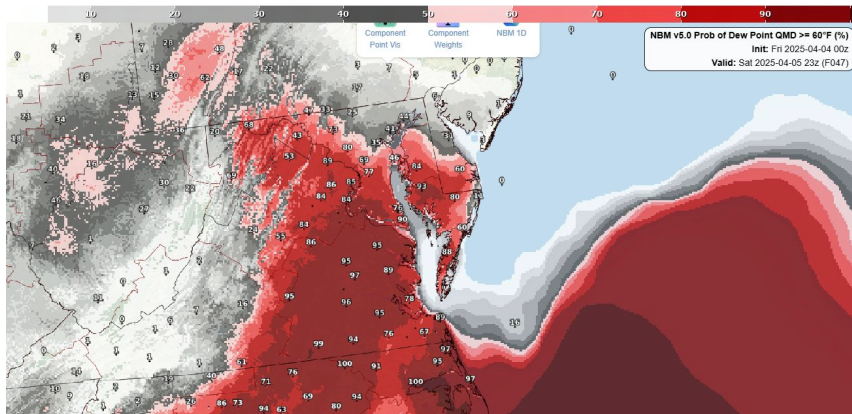
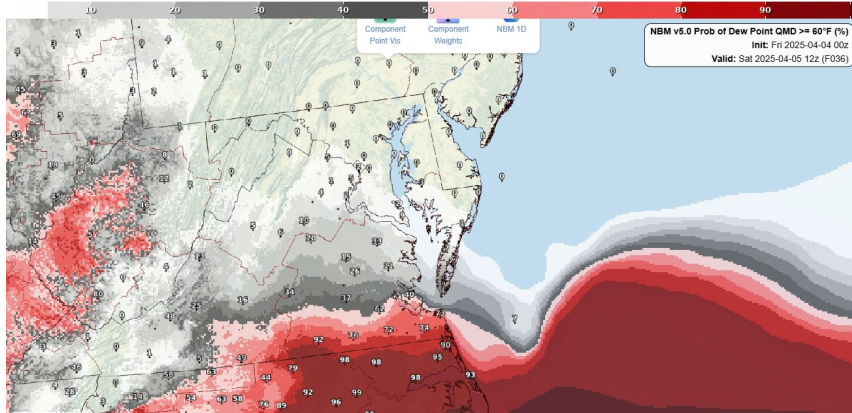
Probabilistic Instantaneous Temperatures



- Ops NBM has instantaneous temperature, but it is computed using a decaying average approach, so there is no probabilistic info
- Usage of quantile mapping in v5.0 allows for probabilistic output
- These fields allow the user to assess potential outcomes for temperature values at a particular time, as opposed to being just having probabilistic min/max values



Dew Point Exceedance Probabilities

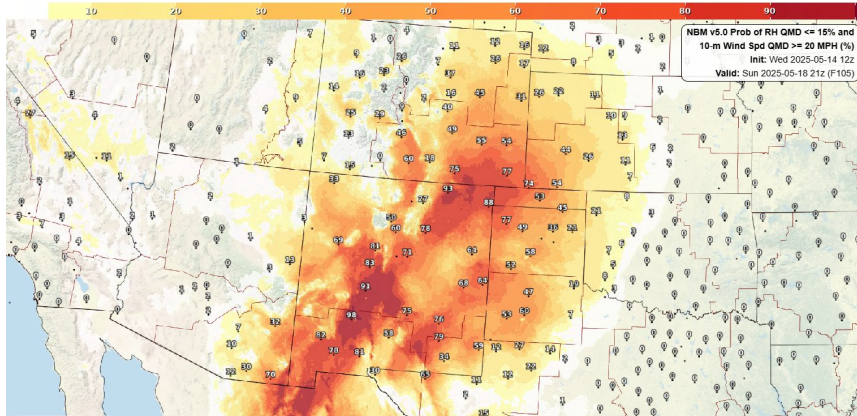


- Just like with temperatures, ops NBM has instantaneous dew points, but they're computed using a decaying average approach
- The switch to quantile mapping allows for the generation of percentiles and exceedance probabilities
- Likely significant utility in identifying frontal placement and leading edge of deeper moisture return

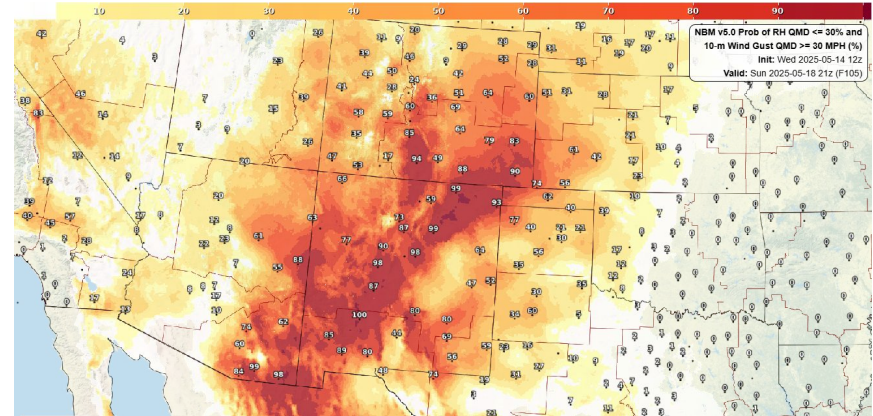


Joint Fire Weather Probabilities

Prob of RH $\leq$ 15% and wind speed $\geq$ 20 mph



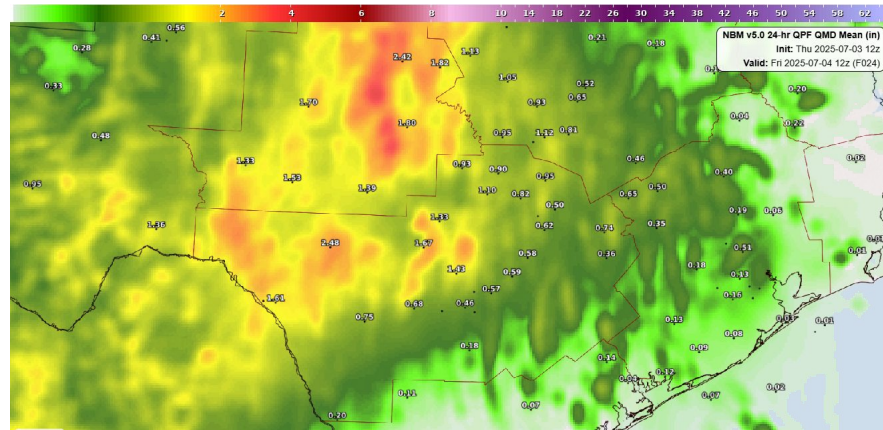
Prob of RH $\leq$ 30% and wind gust $\geq$ 30 mph



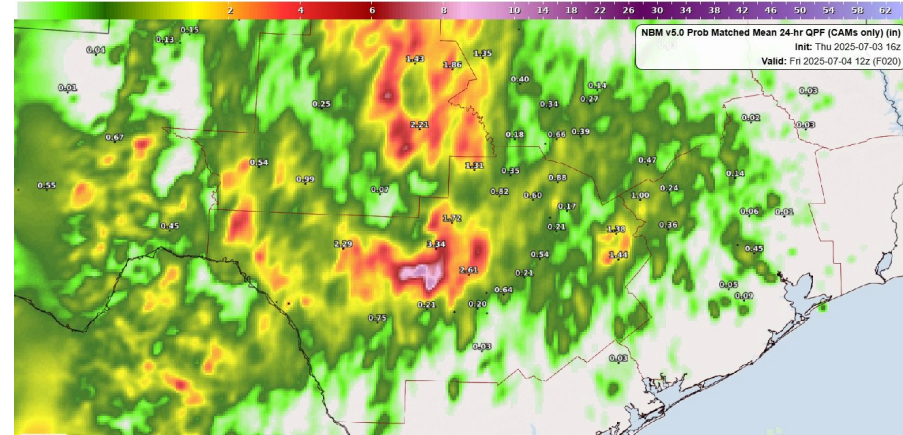
- Joint probs of various combination of RH and wind speed or gust
- Derived from quantile-mapped instantaneous RH (new in v5.0) and wind speed and gust (already in operational NBM)



Probability-Matched Mean for QPF



QMD Mean

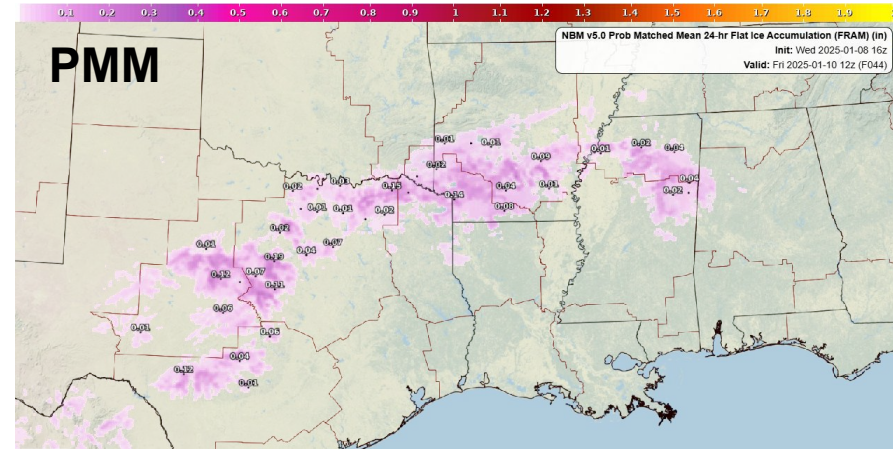
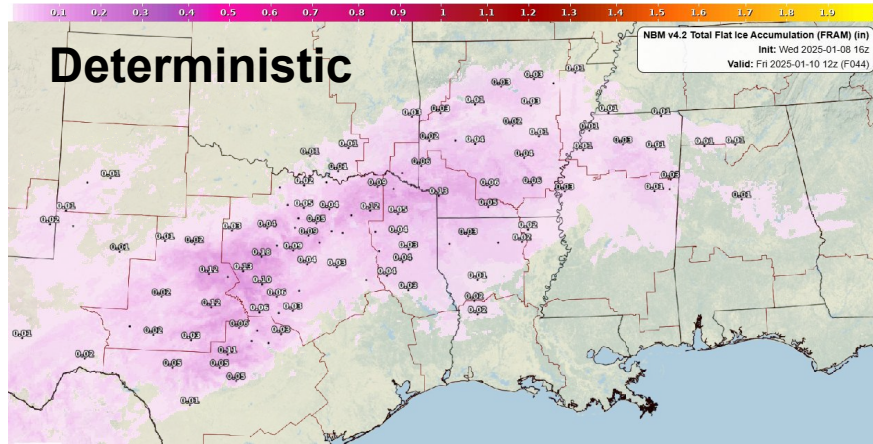


Probability-Matched Mean

- The PMM attempts to highlight the corridors with the most likely opportunity for localized significant QPF



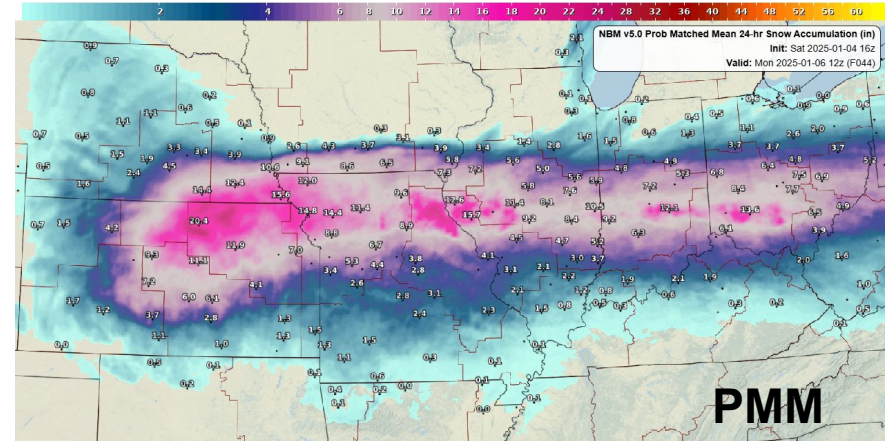
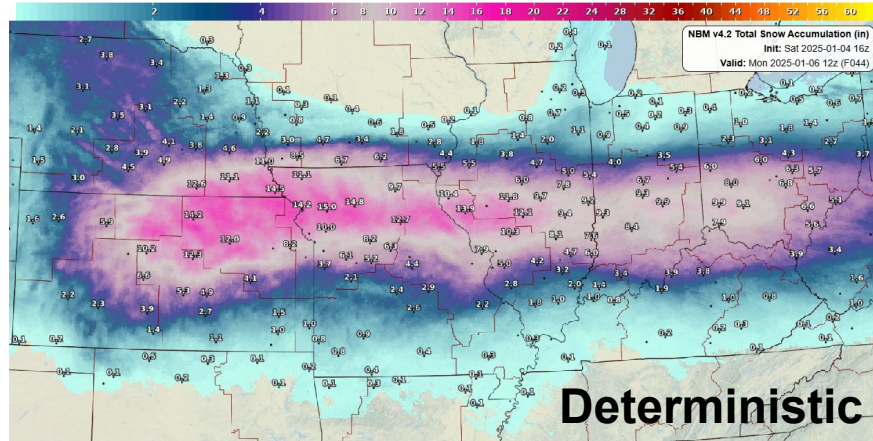
Probability-Matched Mean for ZR



- The PMM attempts to highlight the corridors with the most likely opportunity to accumulate freezing rain



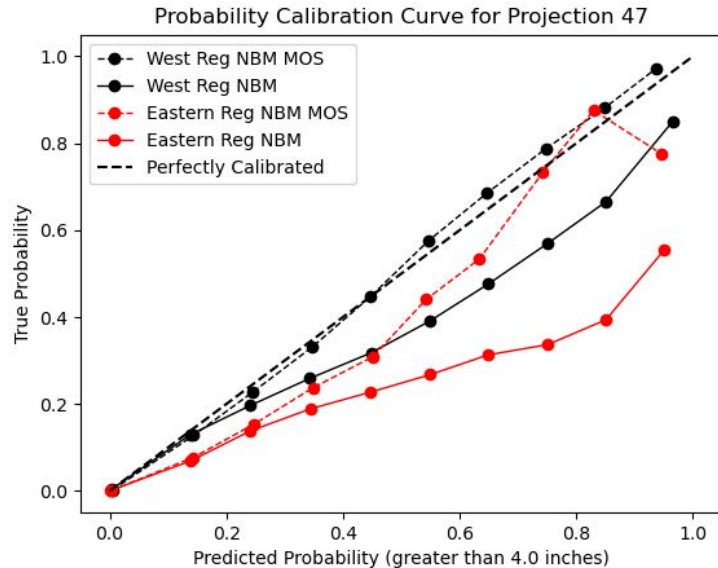
Probability-Matched Mean for Snow



- The PMM attempts to highlight the corridors with the most likely opportunity for higher accumulations of snow



Calibrated Snowfall Exceedance Probs



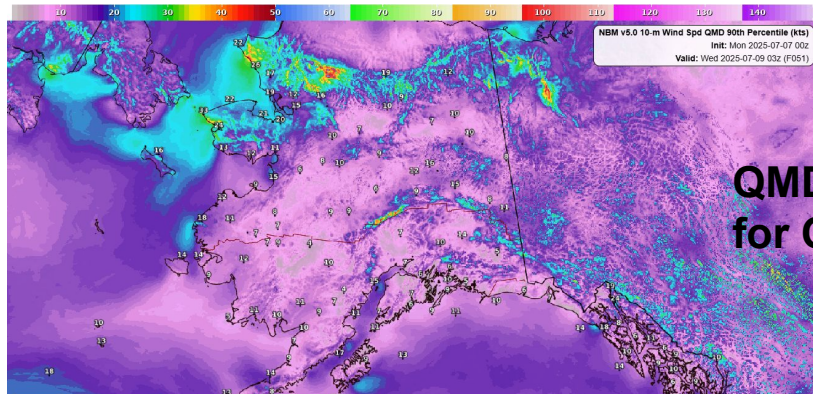
East West
Uncalibrated
Calibrated



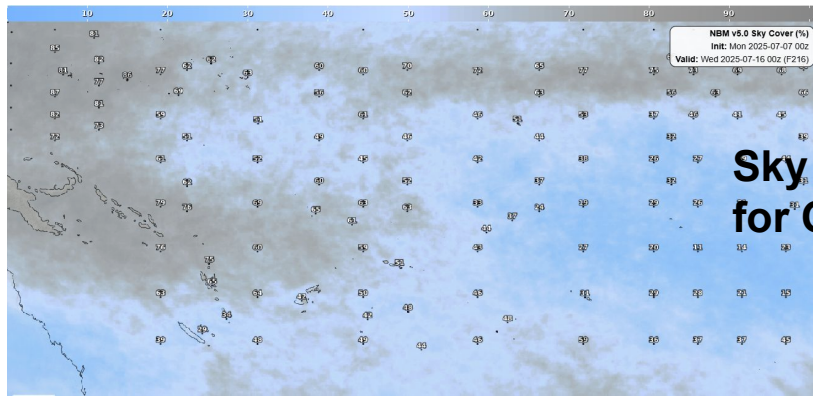
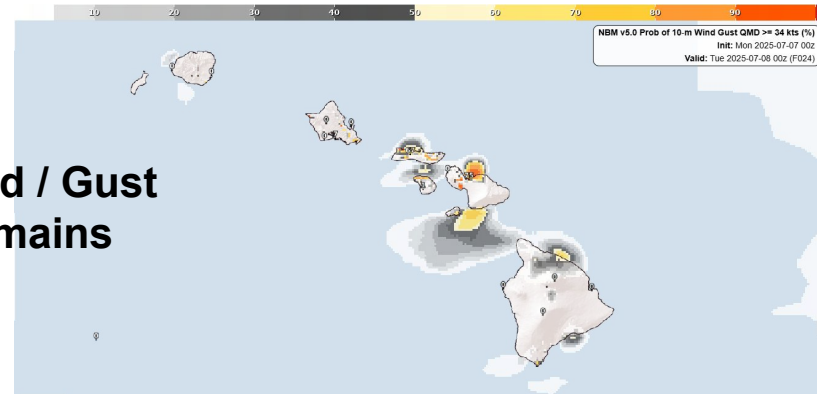
- The development was done on a winter with limited snow in the Eastern U.S., so a redevelopment after this winter was performed and will be in place for next winter. These stats are for the redevelopment.



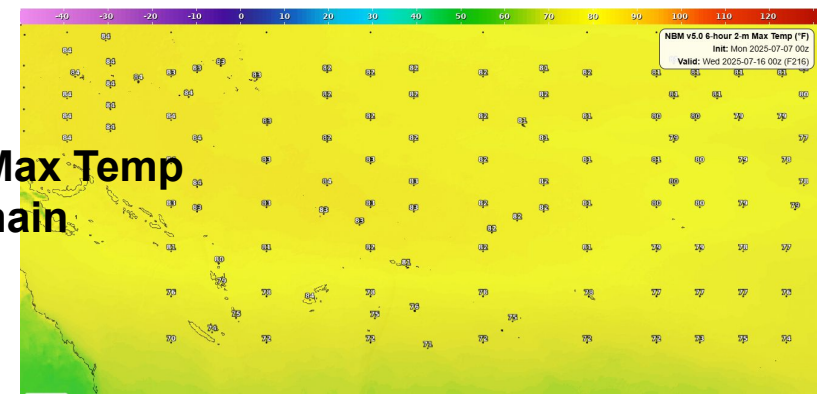
OCONUS Additions



**QMD Wind Speed / Gust
for OCONUS domains**



**Sky Cover and Max Temp
for Oceanic domain**





NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Precipitable Water

Images / Description will be available soon



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Snow Cover

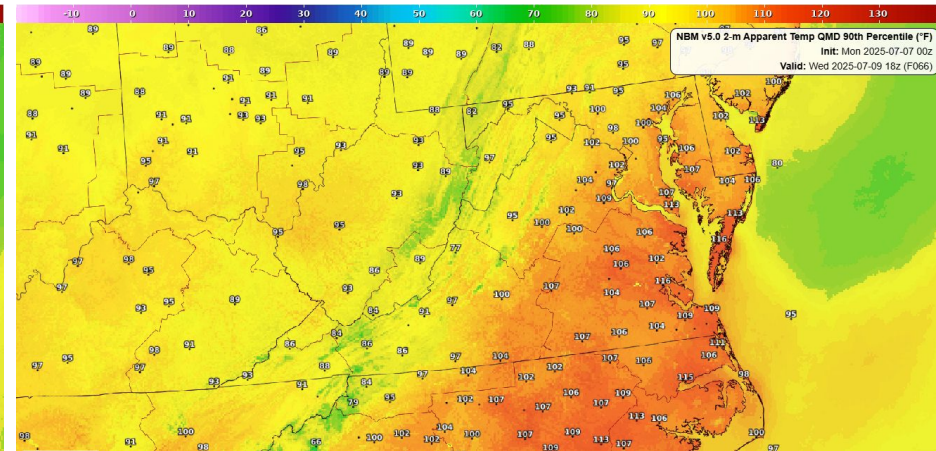
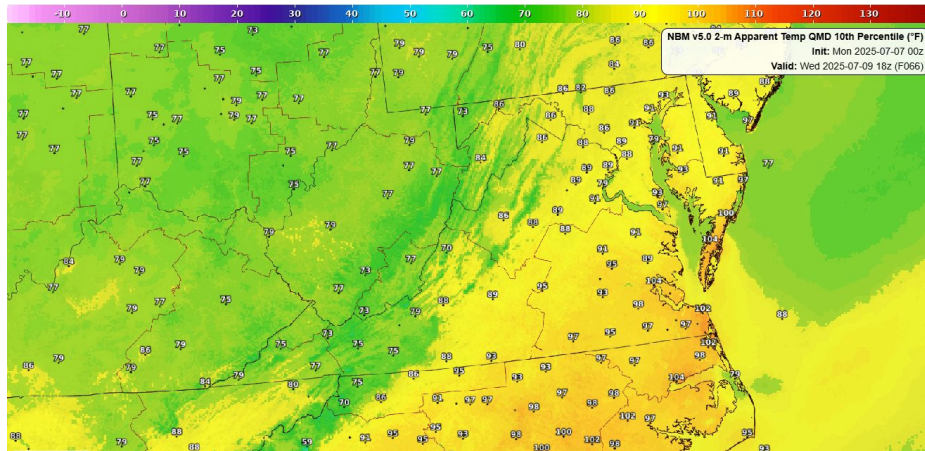
Images / Description will be available soon



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Probabilistic Apparent Temperature



- Generated from quantile-mapped elements



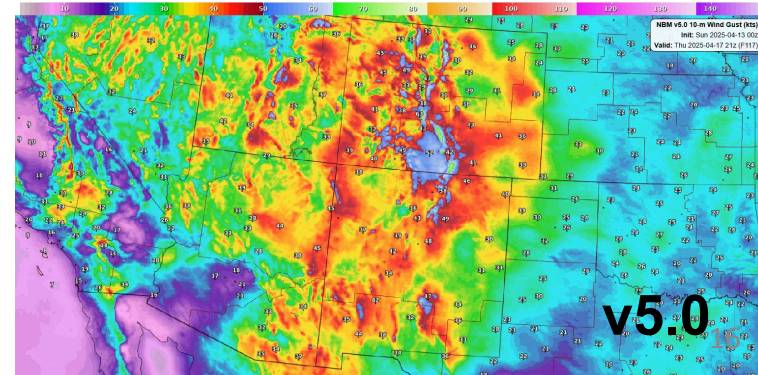
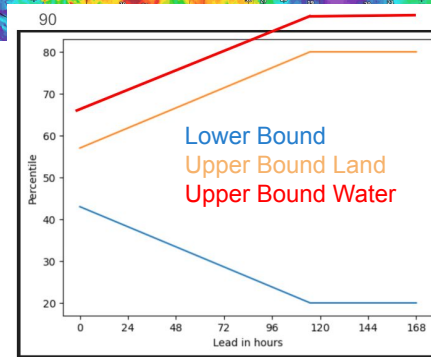
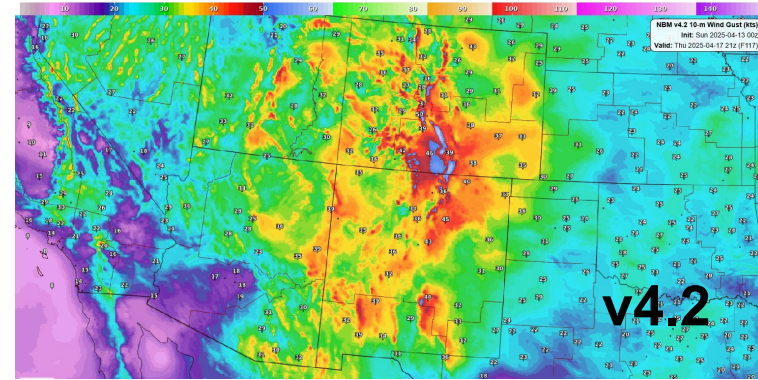
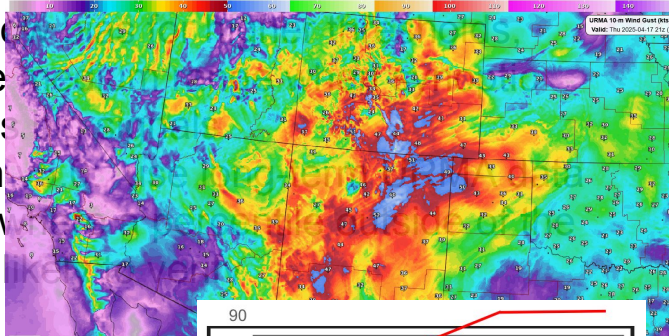
Science Changes in Version 5

- Improve wind forecasts over land and water
- Make deterministic and probabilistic products more consistent
- QPF improvements
- Winter suite changes (including addition of Canadian data)
- Sig Wave Height will be quantile-mapped (and new mask!)
- Start using high-resolution ECMWF forecasts
- Remove low skill inputs
- Use GLMP visibility at water points longer into the forecast
- Use a LAMP approach to improve ceiling and visibility (and possibly winds) over the Hawaii domain
- Remove SREF (due to impending retirement)



New Deterministic Wind/Gust Approach

- Inst. wind speed/gust are quantile-mapped, and the percentile mean is selected as the deterministic value
- There is a clear low bias in the deterministic value, particularly in the early hours of the event, and the uncertainty muted
- New approach in v4.2 to identify areas with a “middle” is more constrained
- Constrain the range at early hrs, and allow a wider range of options at later hrs



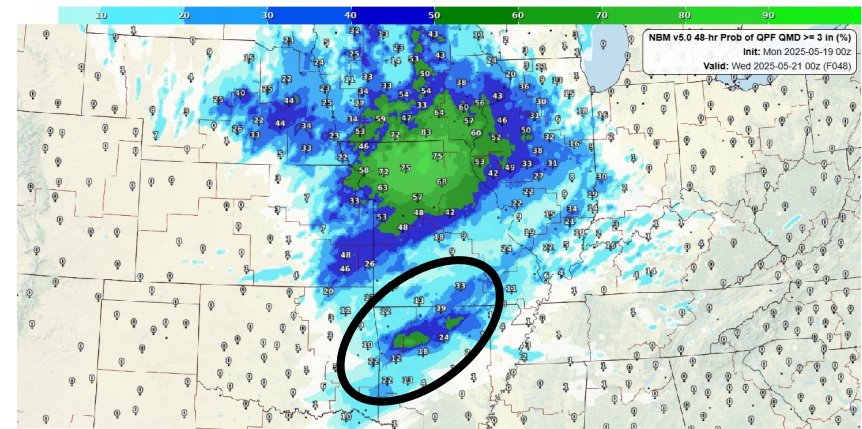
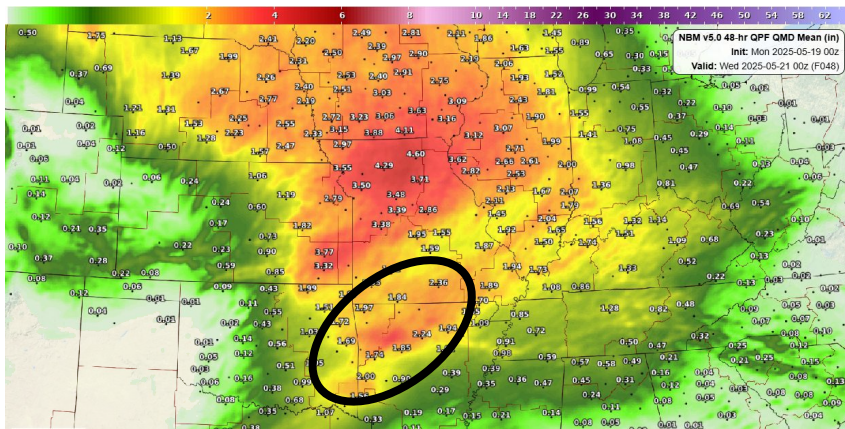
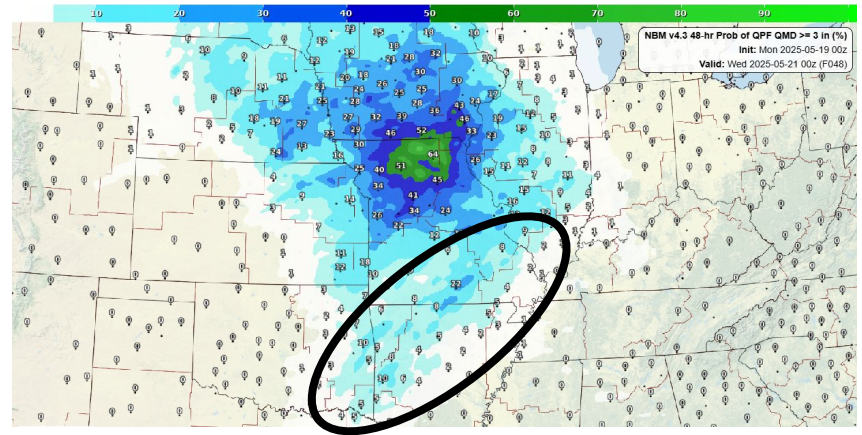
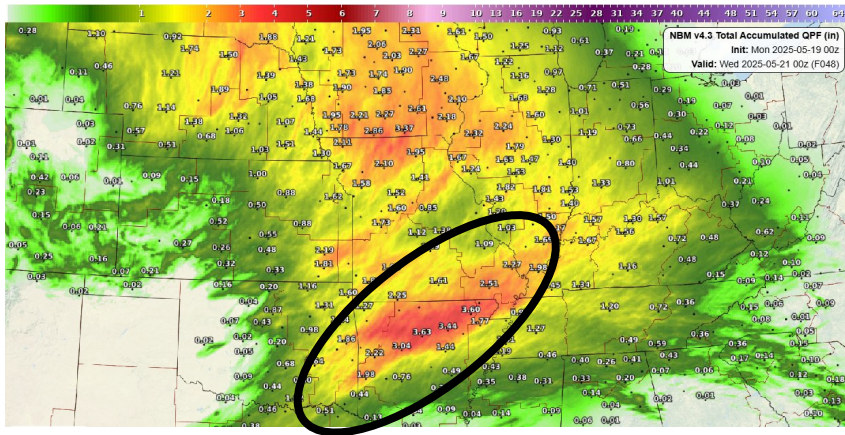


Efforts to Reduce Inconsistencies

- Need to reduce inconsistencies between deterministic and probabilistic NBM products
- Revise the distribution, giving higher weight to hi-res inputs, when computing percentiles and probabilities, particularly for QPF / snowfall / wind
- End the separate “core blend” (deterministic) computation of fields like temperatures, and have deterministic values be derived from the quantile-mapped distribution



Efforts to Reduce Inconsistencies





Changes to QPF

- Reintroduction of monthly supplemental locations for CONUS
 - MSWEP climatology (2002-2023)
 - Inflate recent 60-day training sample for **analysis and model** CDF generation
 - Replaces current method of equally weighting climatology with most recent 60-day data for **analysis only**
- Removal of negligible precipitation amounts
 - Values $< 0.245\text{mm}$ are set to 0.0 for analysis and model CDF training data (also used in supplemental location workflow)
- Removal of 9-point stencil
 - Legacy feature used when there were fewer models; used to artificially increase multi-model ensemble members
- Incorporation of WPC MMEBC (into the distribution; it's already used in 6h NBM QPF)
 - Assist with higher-end precipitation events
- **Introduction of model weighting scheme**
 - Dependent on model resolution relative to NBM grid and ensemble size relative to MME
 - Resolution component decays as lead time increases

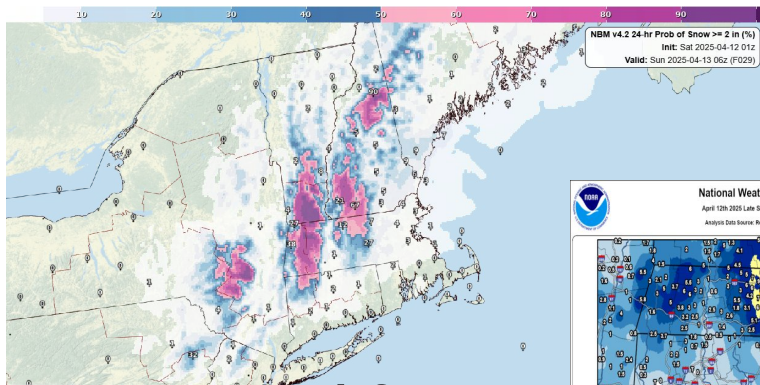


Changes to Winter Suite

- High Resolution ECMWFE data
 - 0.2 deg for all 50 members, hourly resolution through 72 hours
- Removal of SREF inputs, replaced with 10 various Canadian members
 - Combination of GDPS, GEPS, RDPS, REPS
- GEFS surface variables increased resolution to 0.25 deg through 240 hrs (vertical profile still at 0.5 deg)
 - Tmp, RH, Ugrd, Vgrd, MSLP, Sfc Pressure, Snow Depth, ****PTYPE****
- QMD QPF modifications impact winter suite
 - Supplemental locations (CONUS only), setting amounts <0.254 mm per 6 hr to 0, hi-res ECMWF, removal of SREF, removal of 9 point stencil
- When computing downscaled Temperature (DsT), if an inversion near the surface is detected, and DMO 2m Temp is less than the computed DsT, use DMO 2m Temp instead of DsT.
 - Intended to help inversion scenarios retain freezing rain signals
- Ice/Snow flagging routine threshold changed to 38F from 33.8F AND uses DsTW instead of DsT
 - DsTW <= DsT, by definition
 - This change allows Cobb melting code to do the heavy lifting to melt snow

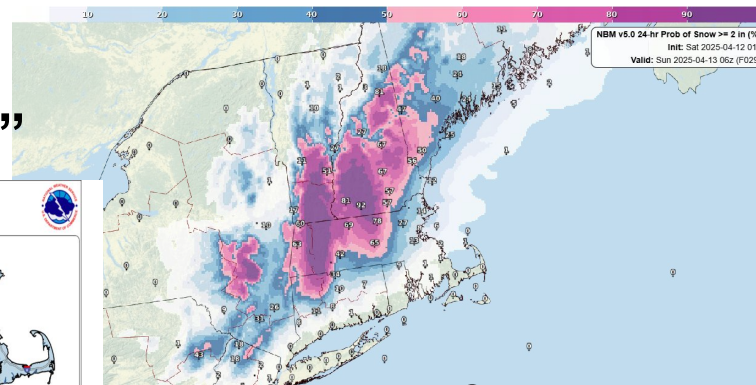


April Northeast Snow

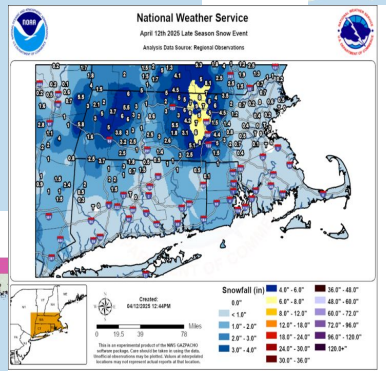


v4.2

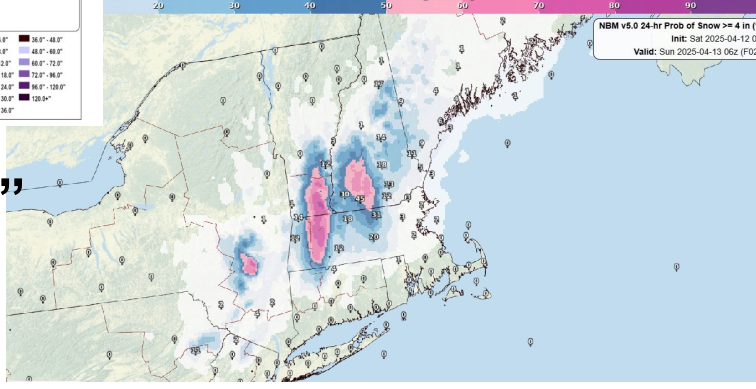
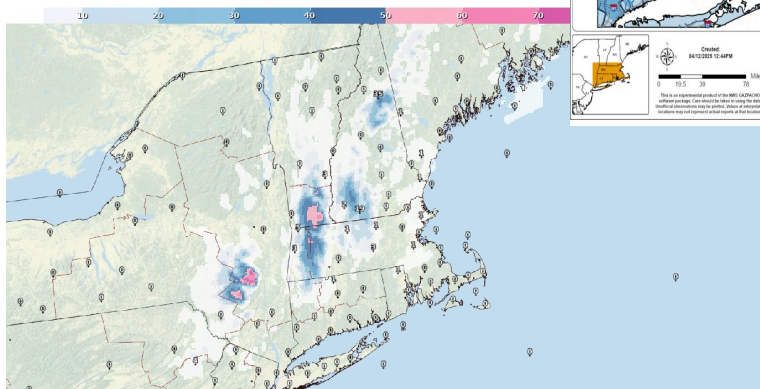
> 2"



v5.0

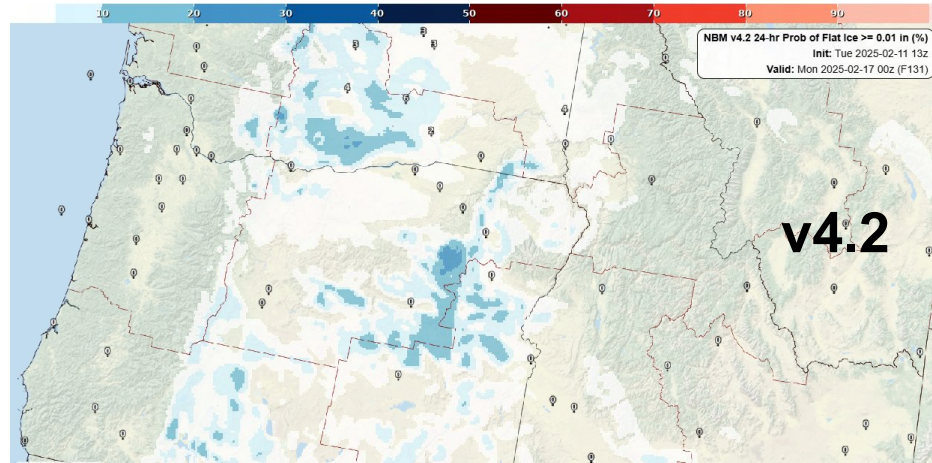


> 4"

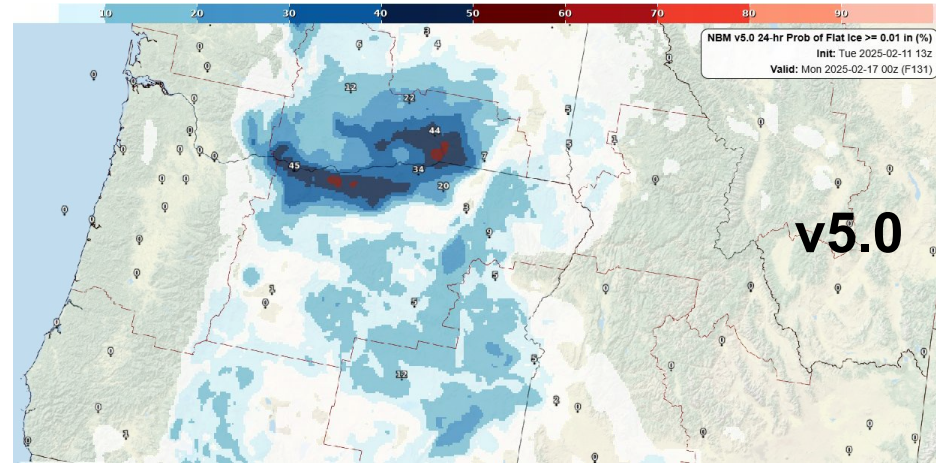




Pacific Northwest ZR Case



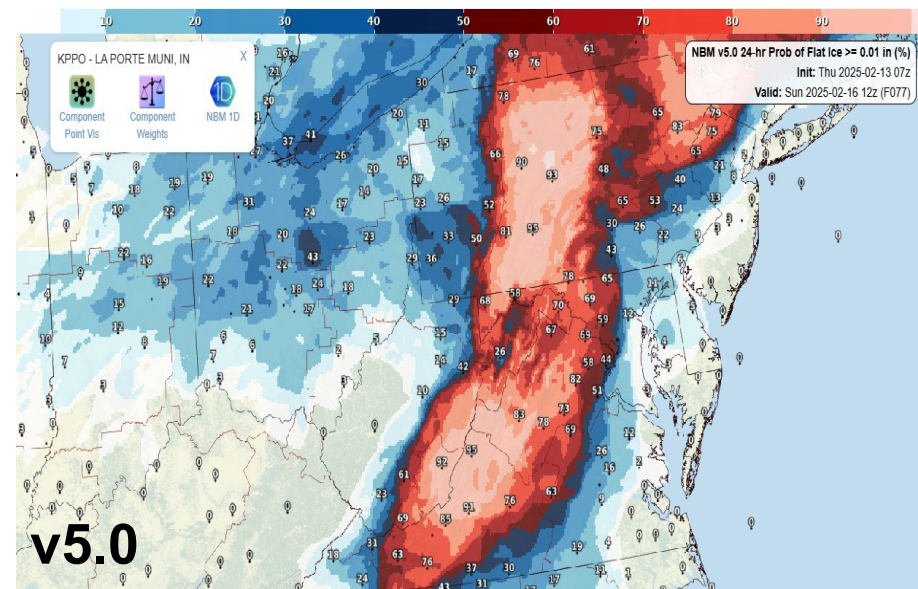
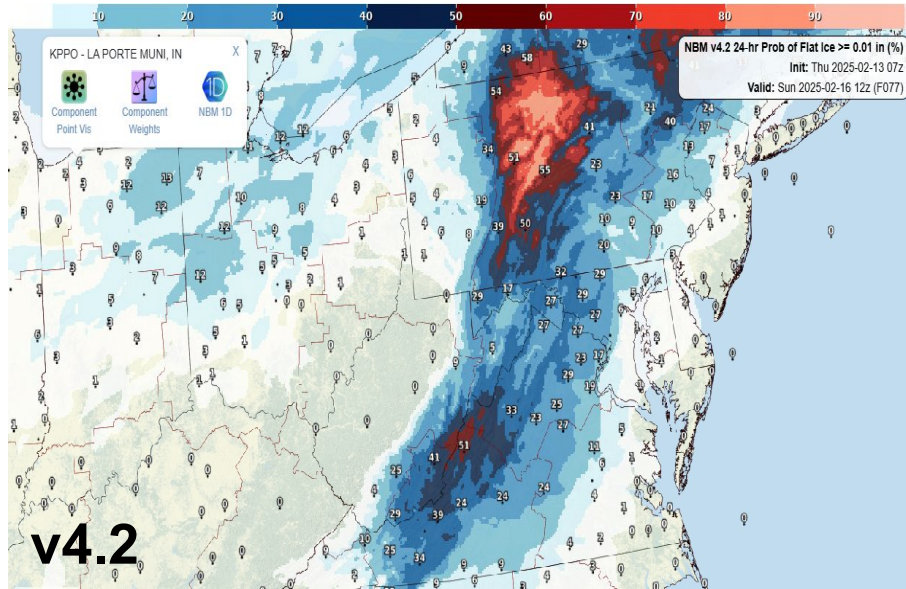
Initial example noted by WR,
showing low operational NBM
probs for ZR in a favorable setup



v5.0 forecast, following changes
to preserve inversions



Mid-Atlantic ZR Case



- These updated ZR probabilities may be too high in some cases



Sig Wave Height

NBMv4.2

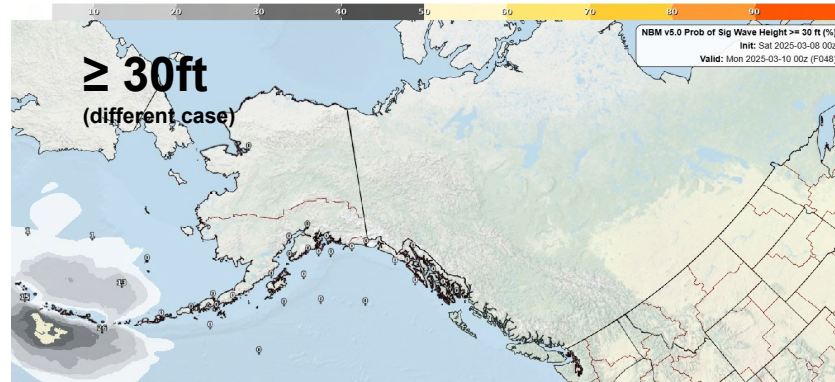
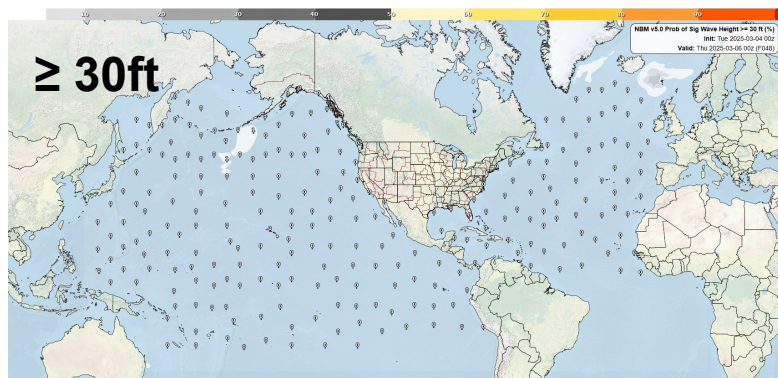
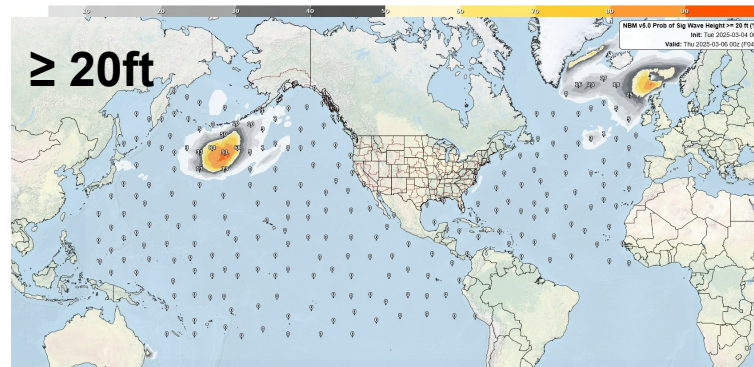
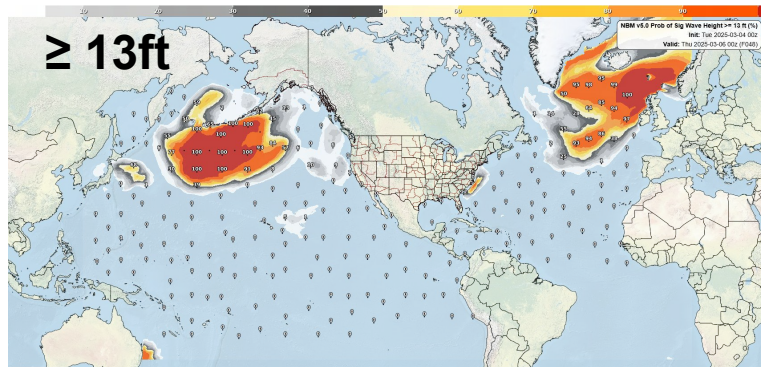
- Uses decaying average approach
- Uses URMA as truth (RTMA for Guam), GFS for Oceanic region
- Uses only the mean of ensemble inputs
- Products are 3-hrly to f192 and 6-hrly to f240
- Generates 10/50/90th percentiles

NBMv5.0

- Uses quantile mapping (120 day training sample, assumes Gamma distribution)
- Uses URMA as truth (RTMA for Guam), GDAS for Oceanic region
- Uses every member of ensemble inputs
- Products are hourly to f60, 3-hrly to f192 and 6-hrly to f240
- Generates every 5th percentile and max/min, has probabilistic output (exceedance probabilities for 3, 4, 5, 6, 8, 10, 13, 20, 30, and 46')



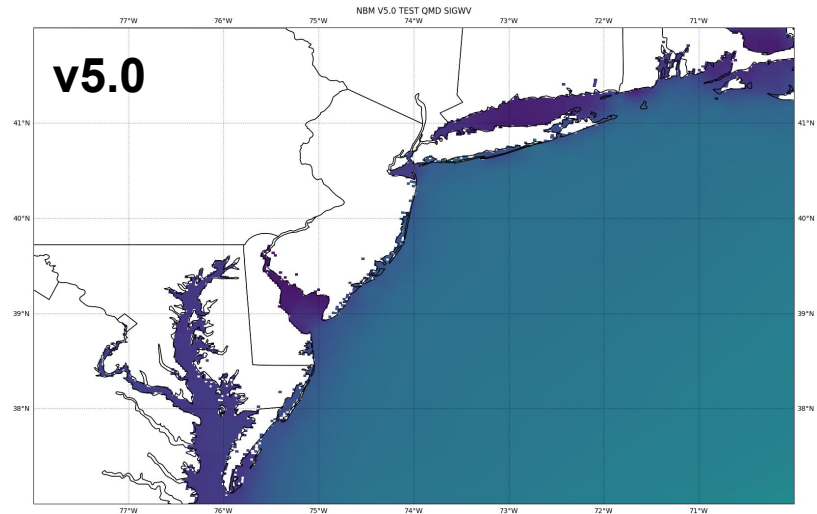
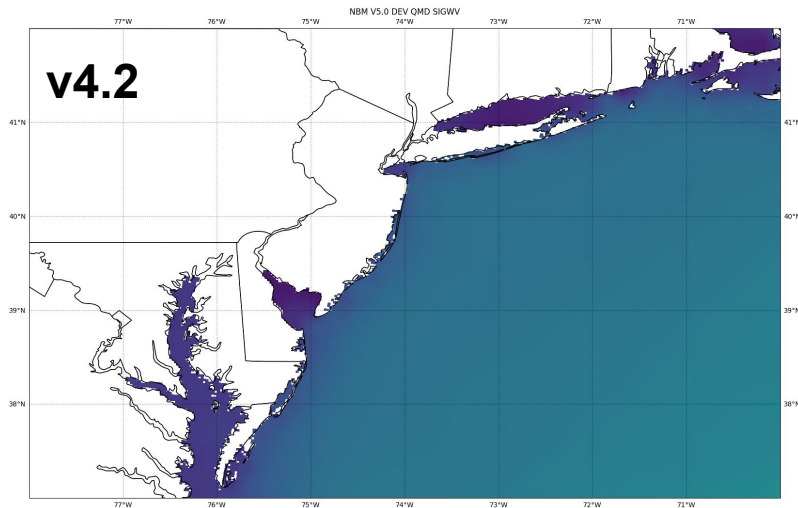
Sig Wave Height Exceedance Probabilities





Sig Wave Height Mask

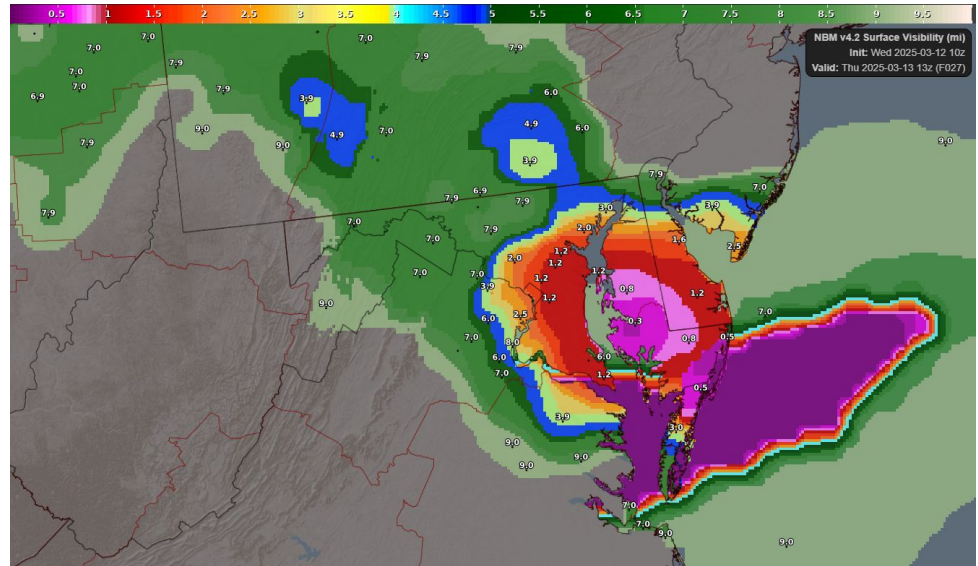
- Current Sig Wave Height (SWH) products have missing points along coastlines and in bays and other smaller bodies of water due to URMA mask
- V5.0 uses the NDFD mask to fill in missing values in the SWH products





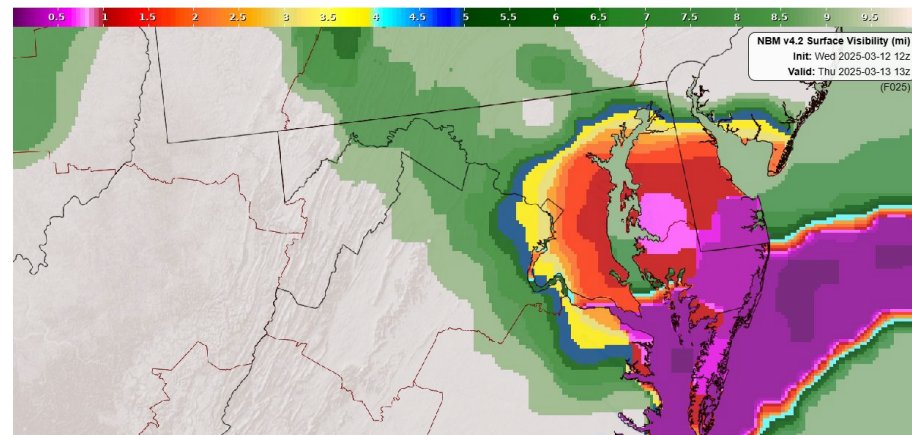
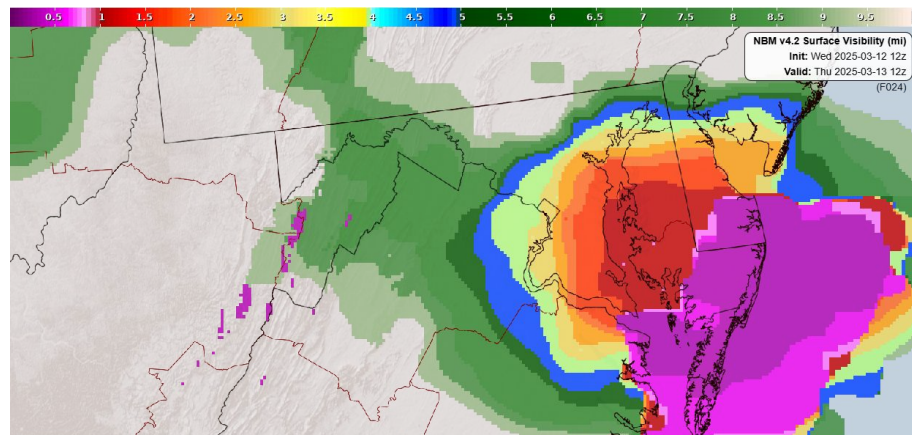
NBM Visibility

- Uses the GLMP visibility at all points through f24
- Continues to use GLMP visibility at land points between f25 and f36 but uses the RAP at water points between f25 and f36, causing land/water discontinuities (Note: the start of the usage of RAP at water points was at f18 in previous NBM versions before v4.2)
- Uses a GFS MOS - NAM MOS combo at land points beyond f36 and uses GFS at water points beyond f36





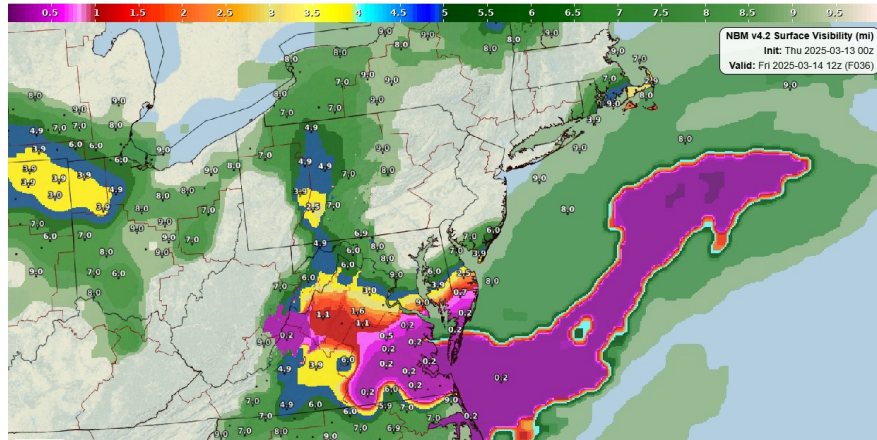
F24 and F25



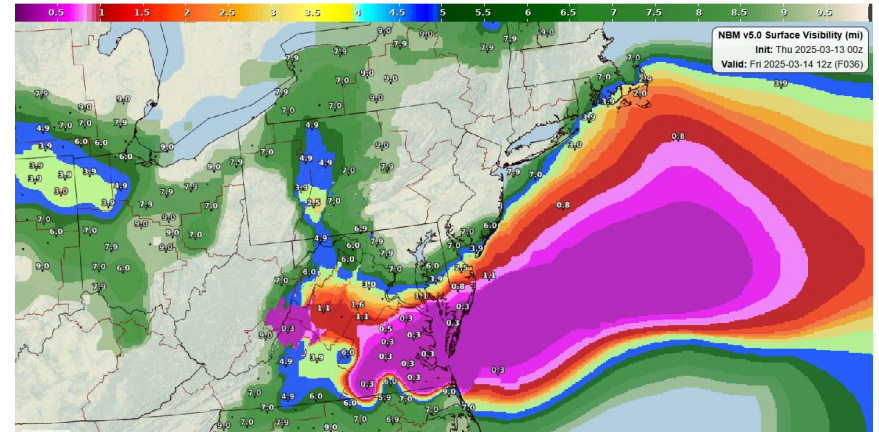


Change in v5.0

v4.3



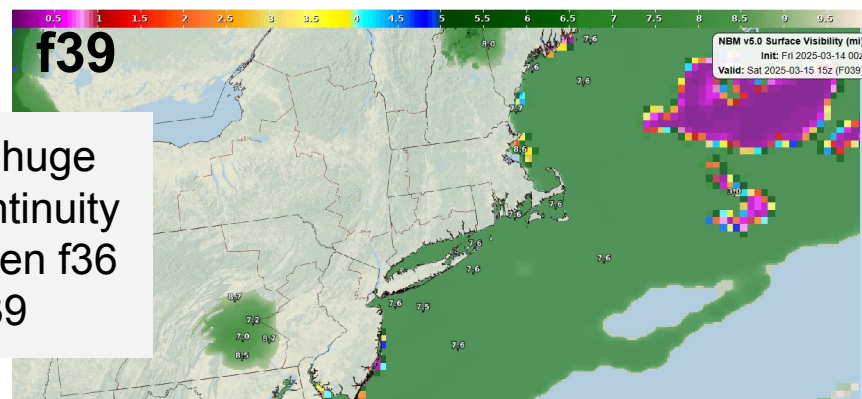
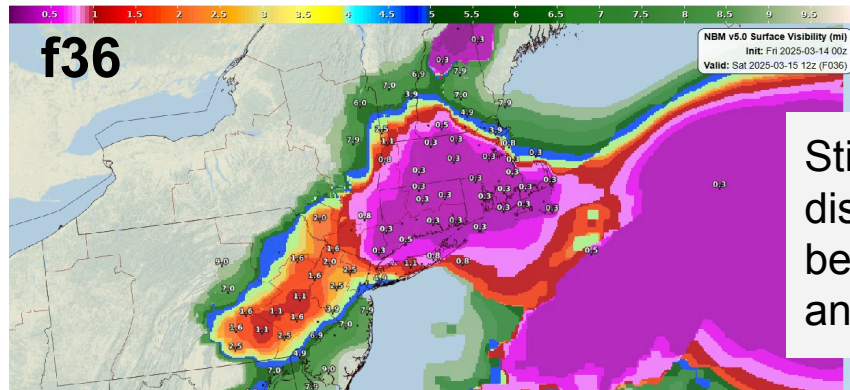
v5.0



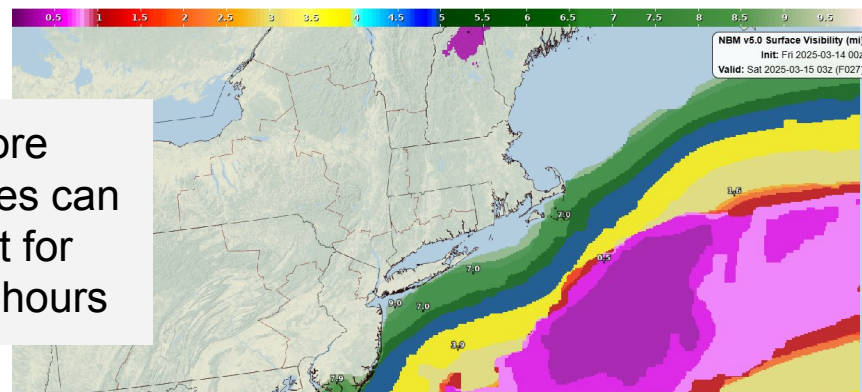
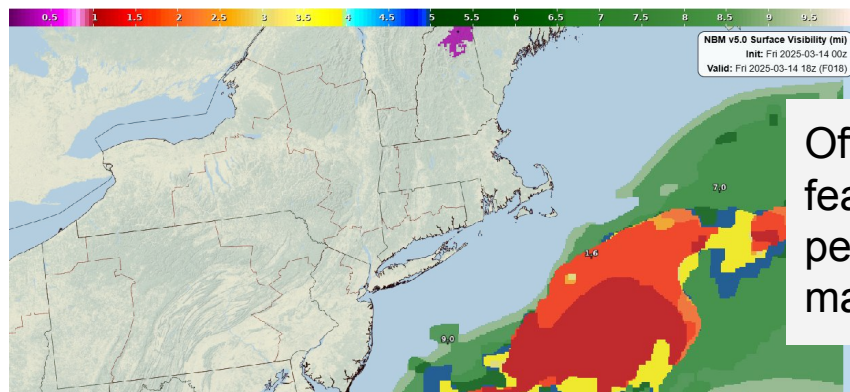
- Use GLMP visibility at all points through f36



Lingering Issues



Still a huge
discontinuity
between f36
and f39



Offshore
features can
persist for
many hours



Production Suite Changes

- Potential major changes are coming to the NCEP Production Suite (NPS) in the next 1-3 years
- The RRFS will likely be added to the NPS, and the NAM, HiRes Windows, and SREF are slated for retirement
- SREF retirement appears certain within the next 1-3 years, so we are preemptively ending its usage in NBMv5.0
- We will wait for results of the RRFSv1 field evaluation this spring. Once a decision has been made on that proposed implementation, we will prepare any necessary changes to the NBM
- The ongoing v5.0 work, however, means that we will not have available resources to isolate and assess the impact of the NPS changes on the NBM



Timeline

- Beta Evaluation: Ongoing
- Formal Field Evaluation: July 8 - November 30
- Code Delivery to NCO: Mid-December or early January
- Implementation: April 2026

Keep track of which parameters are ready to be assessed in the v5.0 parallel and which ones are coming in our NBMv5.0 [WSUP graphics tracker](#)



Thank you!

For more information please contact:

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Dave Rudack, NBM Team Lead

David.Rudack@noaa.gov

For more information on the National Blend of Models (NBM) please visit our NBM Web page:

<https://vlab.noaa.gov/web/mdl/nbm>