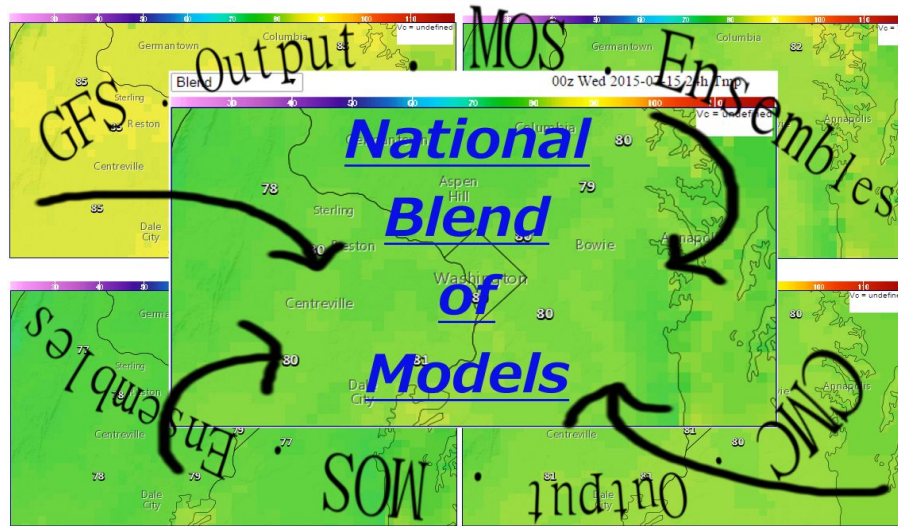


The National Blend of Models (NBM) for Aviation Decision Support

Adam Schnapp and Matt Brudy
NOAA/NWS/OSTI/MDL Silver Spring, MD



Pulling it all together to build a Weather-Ready Nation and to accomplish our mission to save lives and property



DRAFT/PRE-DECISIONAL

NBM v4.1 Aviation Highlights

Improvements to deterministic hourly wind guidance and introduction of probabilistic peak wind over 24-hour period

- Hourly wind speed and gust inheriting additional MOS postprocessing
- Distribution of peak winds created from ~200 unique model members from GFS, HREF, SREF, FNMOC, ECMWF, CMC, ACCESS

Hourly Winds blend v4.0 (operational)

1. Bias correct the model solutions based on analyzed truth (URMA)
2. Create weighted average, where models that had lower mean absolute error (MAE) over recent period have higher weight.

Called MAE weighted forecasts

NBM v4.0 has low bias for wind speeds and gusts, especially for events above 20 knots

Blend v4.1 inflation via MOS postprocessor

Treat the NBM v4.0 MAE weighted forecast as a model and add the same postprocessing step that has been used in GFS-MOS

Techniques:

Linear Regression: leverage static training period to develop relationship between v4.0 MAE weighted forecasts and observations

Partial inflation: increase in forecasts above the mean observation

How is MOS Wind Speed Inflation Calculated?*

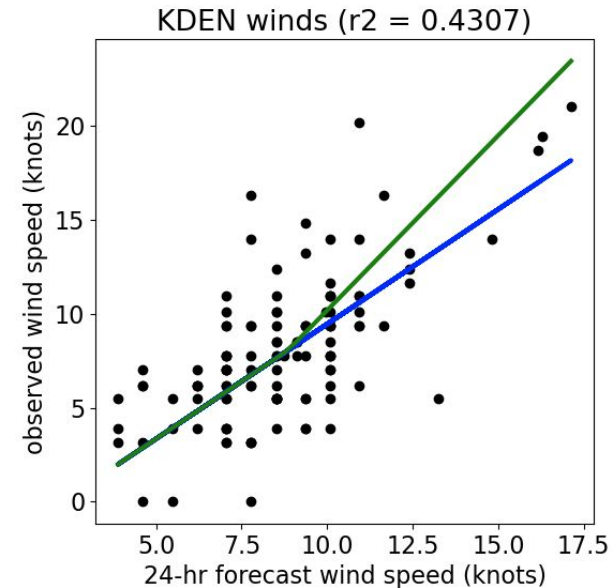
Inflated Wind Speed = ((Wind Speed - Observed Mean)/Correlation)+Observation Mean**

Where,

Wind Speed=NBM Wind Speed at a particular projection

Observed Mean=Observed wind speed relative frequency at the time of day for which the forecast is valid over the sample

Correlation=Multiple correlation coefficient between the predictor and predictand for that projection over the sample



*Glahn, H. R., , and R. A. Allen, 1966: A note concerning the “inflation” of regression forecasts. J. Appl. Meteor., 5, 124–126, doi:10.1175/1520-0450(1966)

**NBM MOS wind speed is inflated only when Wind speed > Observed Mean Wind Speed

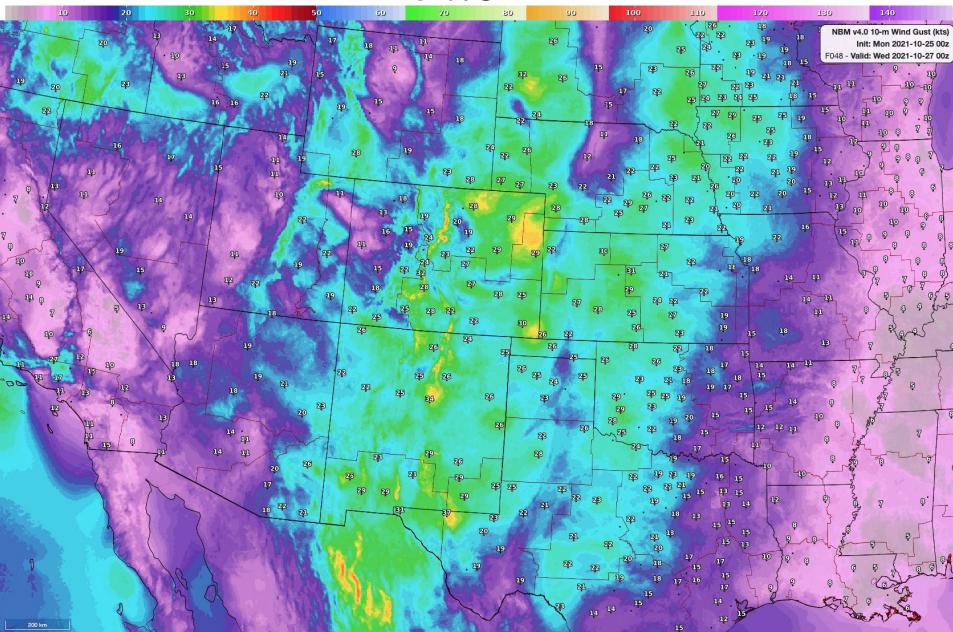
Verification of Hourly Winds

1200 UTC NBM 24-hour forecasts for February 2021 at CONUS METAR sites

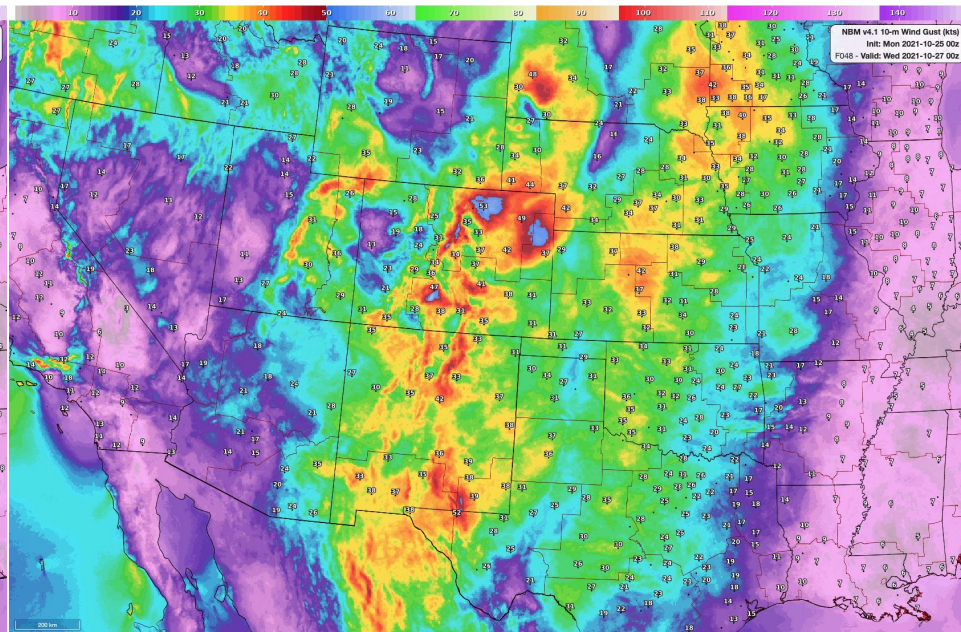
| blend v4.0 | thresh (knots) | csi | pod | far | bias | | obs | 0 | 10 | 20 | 30 | 40 | 50 |
|------------|----------------|----------|----------|----------|----------|------|------|-------|------|-----|----|----|-------|
| | | | | | | | fcst | | | | | | under |
| | 10 kt | 0.559978 | 0.646749 | 0.193281 | 0.840552 | | 0 | 50304 | 5576 | 61 | 3 | 0 | 0 |
| | 20 kt | 0.319645 | 0.353591 | 0.230975 | 0.474324 | | 10 | 2462 | 8600 | 962 | 23 | 3 | 1 |
| | 30 kt | 0.187879 | 0.208054 | 0.340426 | 0.310924 | | 20 | 11 | 161 | 442 | 79 | 9 | 0 |
| | 40 kt | 0.142857 | 0.166667 | 0.5 | 0.37037 | | 30 | 1 | 0 | 13 | 11 | 12 | 0 |
| | | | | | | | 40 | 0 | 0 | 2 | 3 | 3 | 2 |
| | | | | | | over | 50 | 0 | 0 | 0 | 0 | 0 | 0 |
| blend v4.1 | thresh | csi | pod | far | bias | | obs | 0 | 10 | 20 | 30 | 40 | 50 |
| | | | | | | | fcst | | | | | | under |
| | >= 10 kt | 0.585415 | 0.713454 | 0.23463 | 0.935621 | | 0 | 48935 | 4539 | 36 | 0 | 0 | 0 |
| | 20 kt | 0.430947 | 0.572744 | 0.364874 | 0.882432 | | 10 | 3444 | 9310 | 649 | 10 | 1 | 0 |
| | 30 kt | 0.310924 | 0.496644 | 0.546012 | 1.159664 | | 20 | 41 | 472 | 729 | 61 | 3 | 0 |
| | 40 kt | 0.341463 | 0.466667 | 0.44 | 0.703704 | | 30 | 5 | 16 | 66 | 39 | 11 | 1 |
| | | | | | | | 40 | 0 | 0 | 0 | 7 | 11 | 1 |
| | | | | | | over | 50 | 2 | 0 | 0 | 2 | 1 | 1 |

Blend 48-hour 10m gust forecast valid at 10/27/2021 at 00 UTC

v4.0



v4.1



24-hour Probabilistic Peak Wind

Bias correct ~200 model solutions/members from various modeling systems including GFS, HREF, SREF, FNMOC, ECMWF, CMC, ACCESS

Bias correction by quantile mapping based on fitted gamma distribution from previous 120 days

If a model forecast is at the 90th percentile of the fit model distribution, it gets bias corrected to the 90th percentile of the fit observation distribution

The 10th percentile exceeds ~20 of the bias corrected model solutions

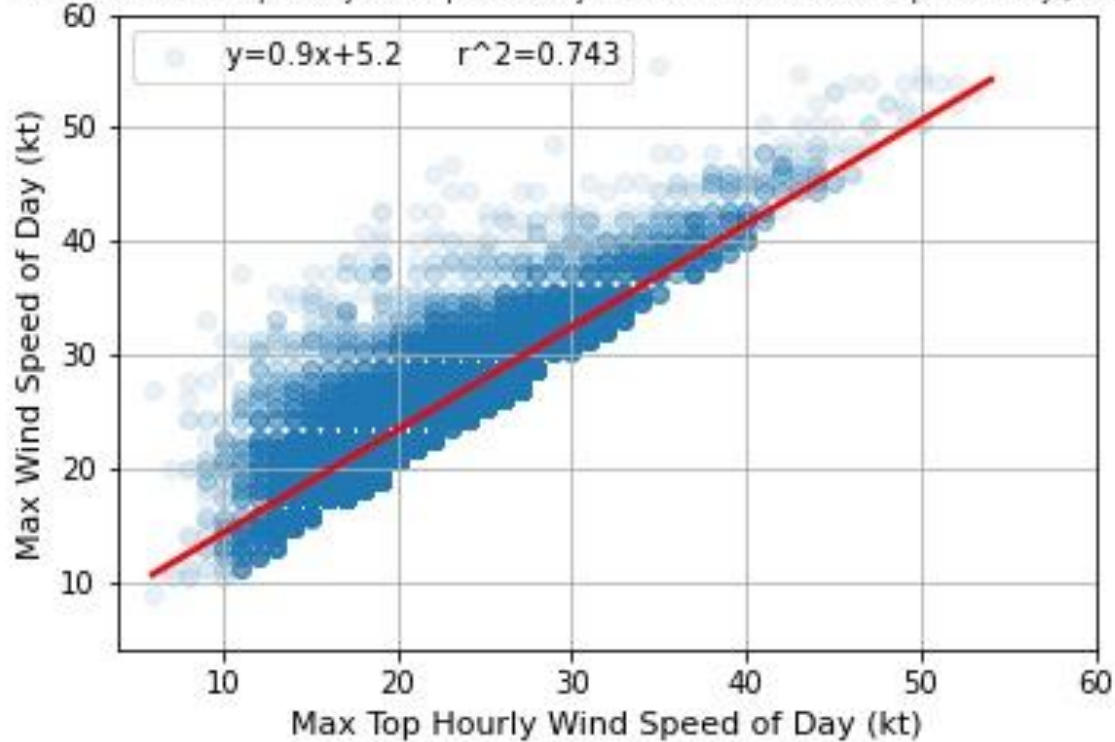
The 90th percentile exceeds ~180 of the bias corrected model solutions

24-hour Probabilistic Peak Wind

- Background
 - Top hourly in production and available
 - Chance that it doesn't always capture the daily max gust, this product will output the max daily gust based on available hourly observations
- Used 44 stations including major airports that receive 30 hour TAFs
- 10 years of historical data from CF6s and METARs (2010-2020)
- CF6s provide max wind speed and wind gust of the day from ASOS
- Hourly METARs provide max top hourly routine observations of wind speed and wind gust
- [Studied](#) the relationship between the max **top hourly** wind speed/gust and the max wind speed/gust **of the day**
- Created ratios between the two to produce probabilistic max wind speed and max wind gust of the day

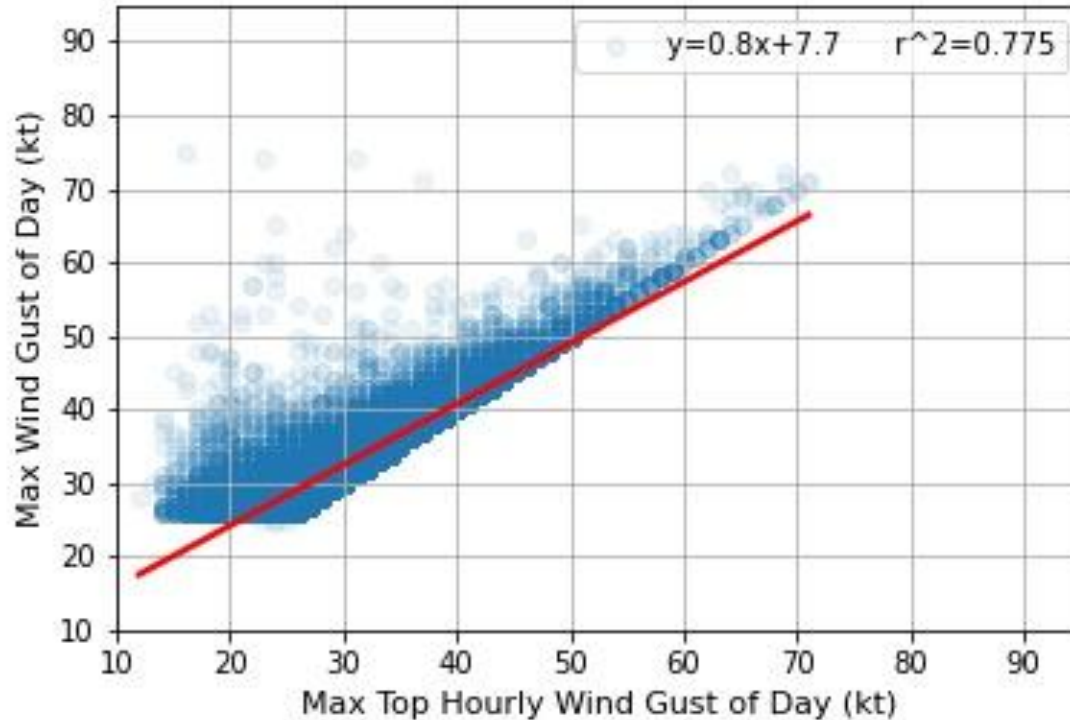
All Locations

All Locations - Max Top Hourly Wind Speed of Day vs. Max Two Minute Wind Speed of Day (2010-2020)



All Locations

All Locations - Max Top Hourly Wind Gust Of Day vs. Max Wind Gust Of Day (2010-2020)



Speed factor - **1.18**

Gust factor - **1.11**

Inflate top hourly
speed of the day by
1.18 and top hourly
gust of the day by 1.11

| Location | Wind Speed Ratio | Wind Gust Ratio | Location | Wind Speed Ratio | Wind Gust Ratio |
|----------|------------------|-----------------|----------------|------------------|-----------------|
| KATL | 1.21 | 1.14 | KMEM | 1.21 | 1.13 |
| KBDL | 1.19 | 1.11 | KMCO | 1.21 | 1.14 |
| KBOS | 1.15 | 1.09 | KMDW | 1.17 | 1.10 |
| KCLE | 1.17 | 1.09 | KMIA | 1.18 | 1.13 |
| KCLT | 1.21 | 1.13 | KMKE | 1.15 | 1.10 |
| KCVG | 1.21 | 1.22 | KMSP | 1.16 | 1.09 |
| KDCA | 1.19 | 1.12 | KOAK | 1.13 | 1.13 |
| KDEN | 1.17 | 1.12 | KONT | 1.22 | 1.14 |
| KDFW | 1.16 | 1.08 | KORD | 1.16 | 1.10 |
| KDTW | 1.17 | 1.11 | KPDX | 1.18 | 1.12 |
| KEWR | 1.17 | 1.10 | KPHL | 1.18 | 1.11 |
| KFLL | 1.17 | 1.11 | KPHX | 1.23 | 1.15 |
| KIAD | 1.21 | 1.12 | KPIT | 1.21 | 1.12 |
| KIAH | 1.19 | 1.12 | KSAN | 1.24 | 1.13 |
| KICT | 1.15 | 1.09 | KSDF | 1.20 | 1.12 |
| KIND | 1.18 | 1.10 | KSEA | 1.16 | 1.10 |
| KJFK | 1.14 | 1.09 | KSFO | 1.12 | 1.10 |
| KLAS | 1.17 | 1.10 | KSLC | 1.18 | 1.12 |
| KLAX | 1.13 | 1.12 | KSTL | 1.19 | 1.10 |
| KLGA | 1.16 | 1.09 | PANC | 1.13 | 1.12 |
| KLVM | 1.14 | 1.08 | PAFA | 1.19 | 1.14 |
| | | | PHNL | 1.13 | 1.10 |
| | | | Average | 1.18 | 1.11 |

24-hour Probabilistic Peak Wind and Deterministic Max Top Hourly Wind Case Study

KFLG - Flagstaff, AZ

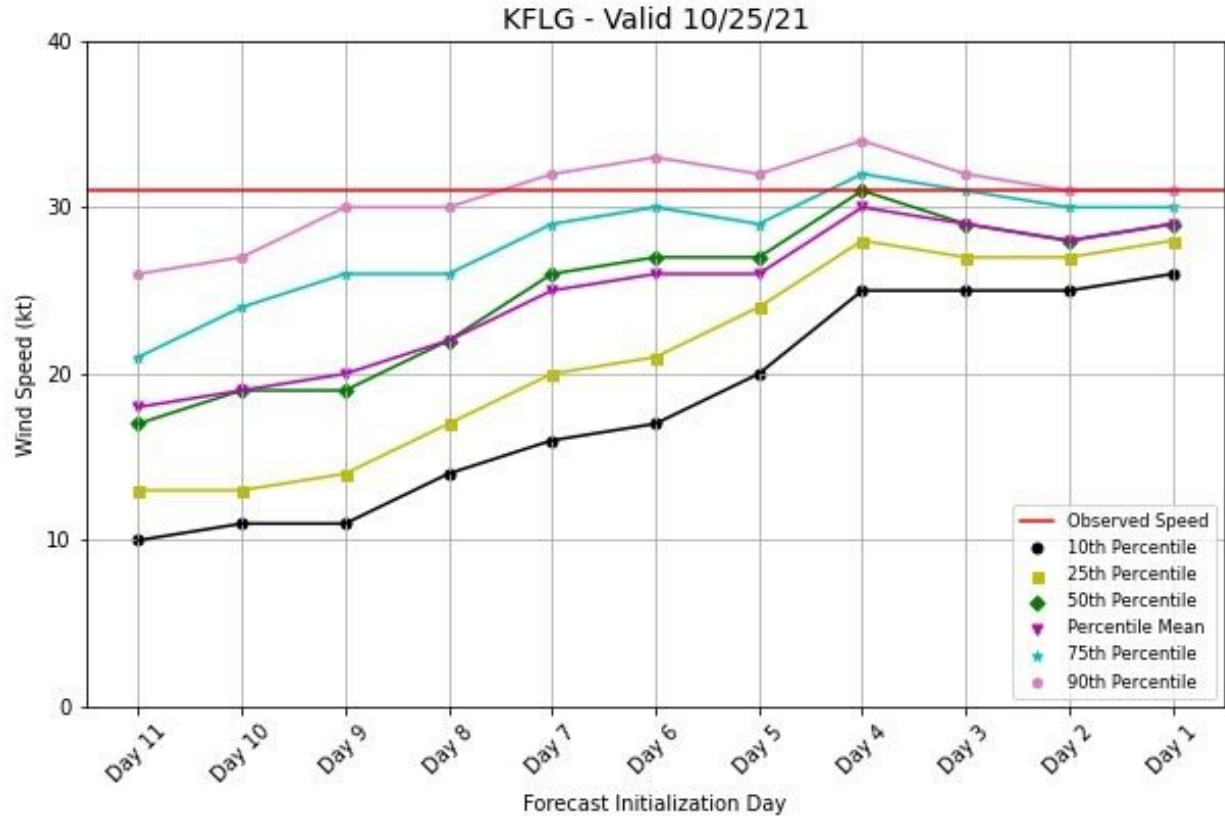
10/25/21

KFLG - Flagstaff, AZ

Probabilistic 24 hour max
wind speed of the day

31G43 kt max daily

26G36 kt top hourly

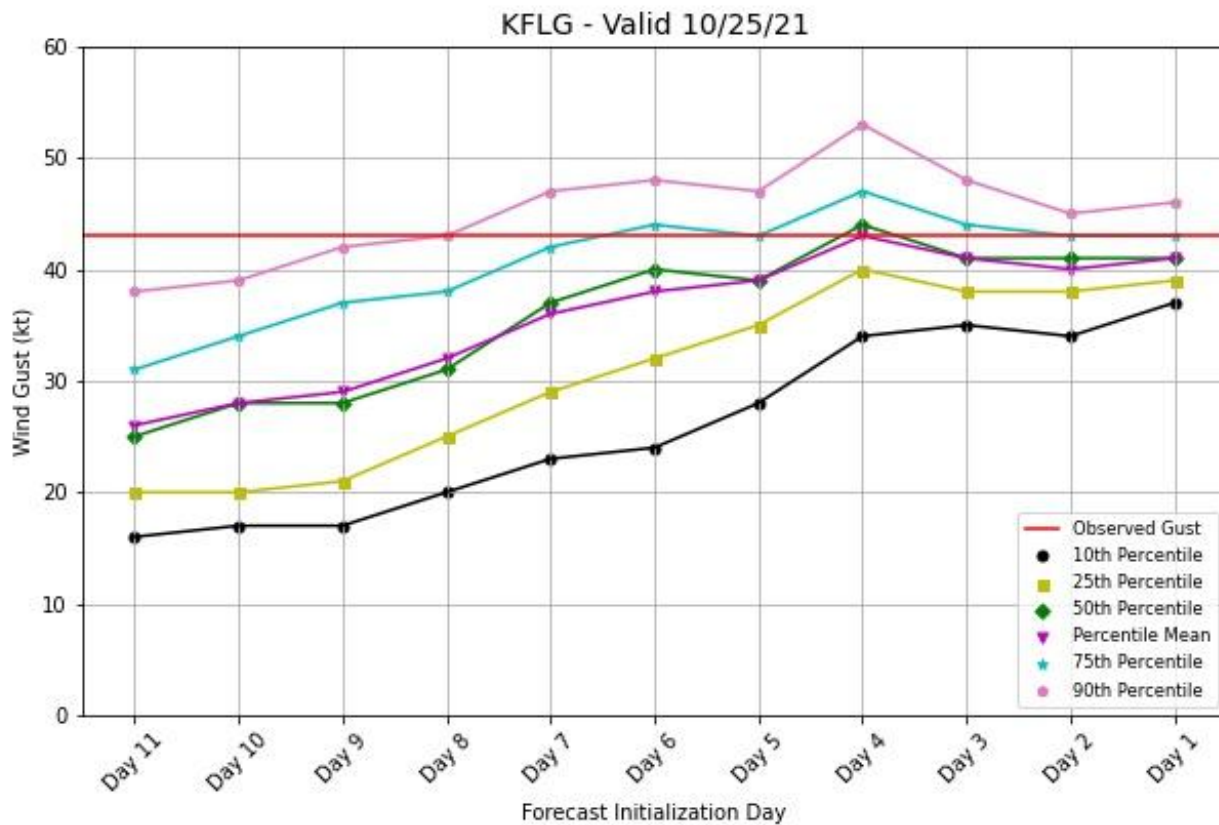


KFLG - Flagstaff, AZ

Probabilistic 24 hour max
wind gust of the day

31**G43** kt max daily

26**G36** kt top hourly

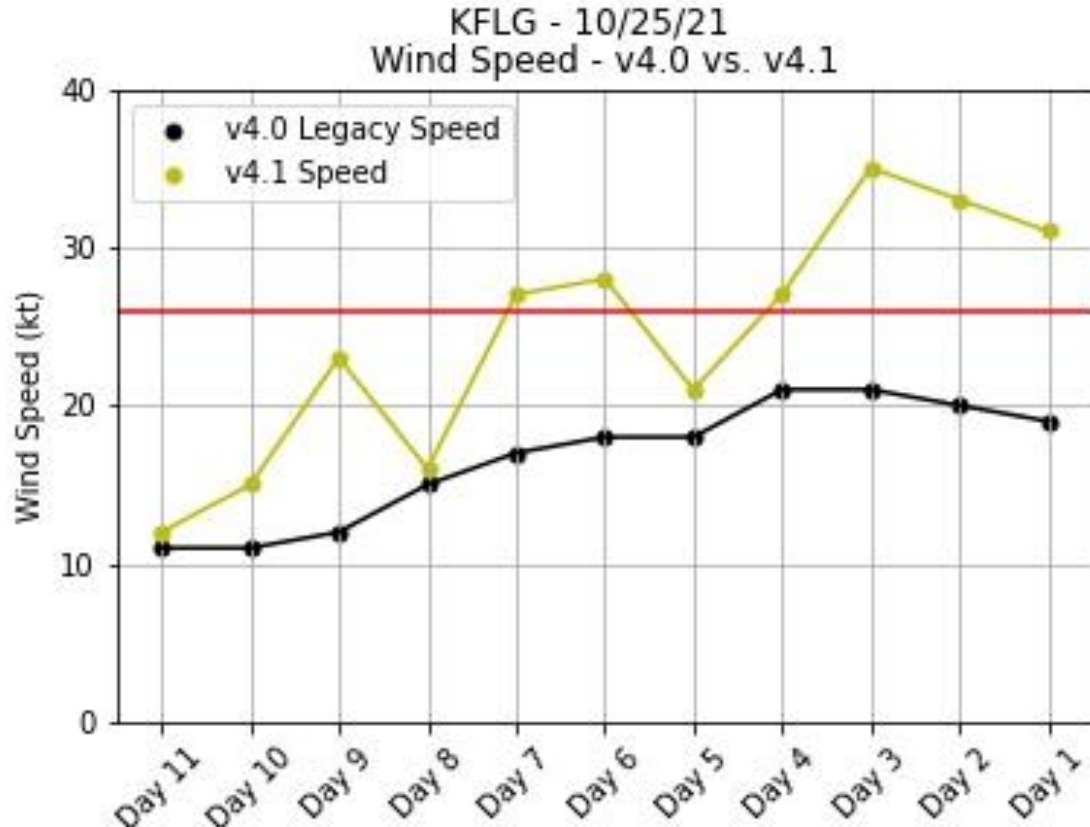


KFLG - Flagstaff, AZ

Deterministic max top hourly wind speed of the day

31G43 kt max daily

26G36 kt top hourly

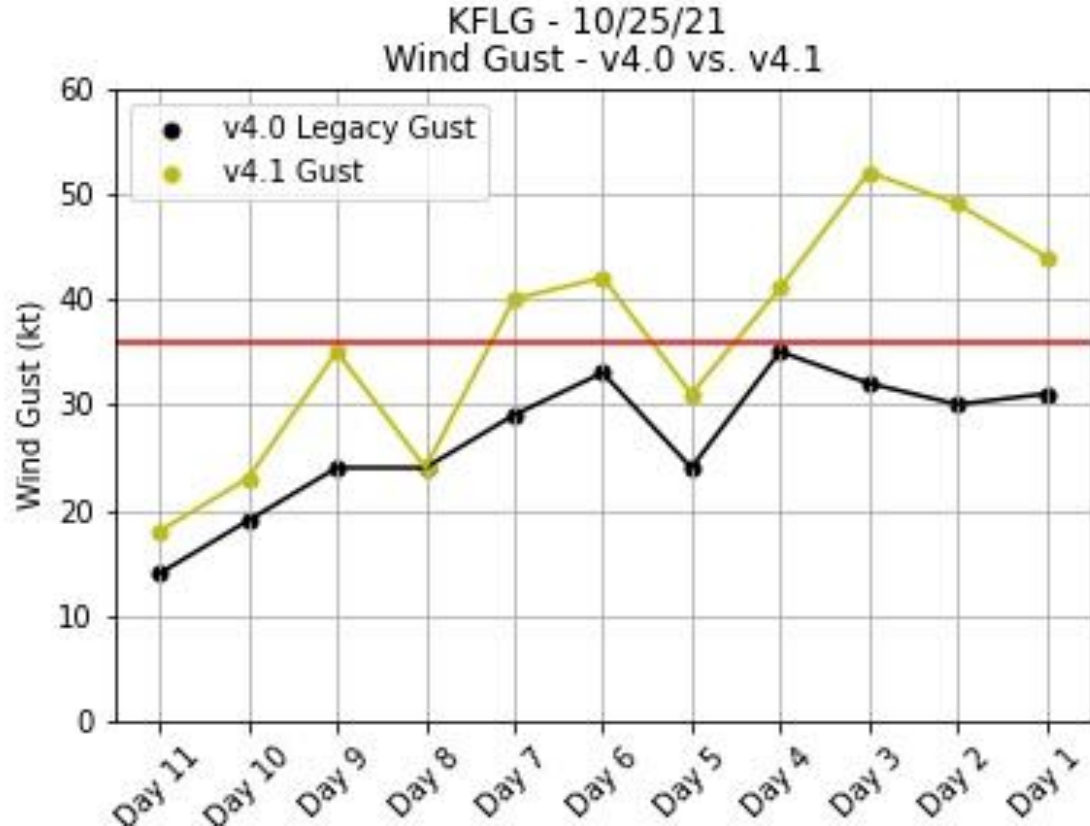


KFLG - Flagstaff, AZ

Deterministic max top hourly wind gust of the day

31G43 kt max daily

26**G36** kt top hourly



24-hour Probabilistic Peak Wind and Deterministic Max Top Hourly Wind Case Study

KRTN - Raton Airport, NM

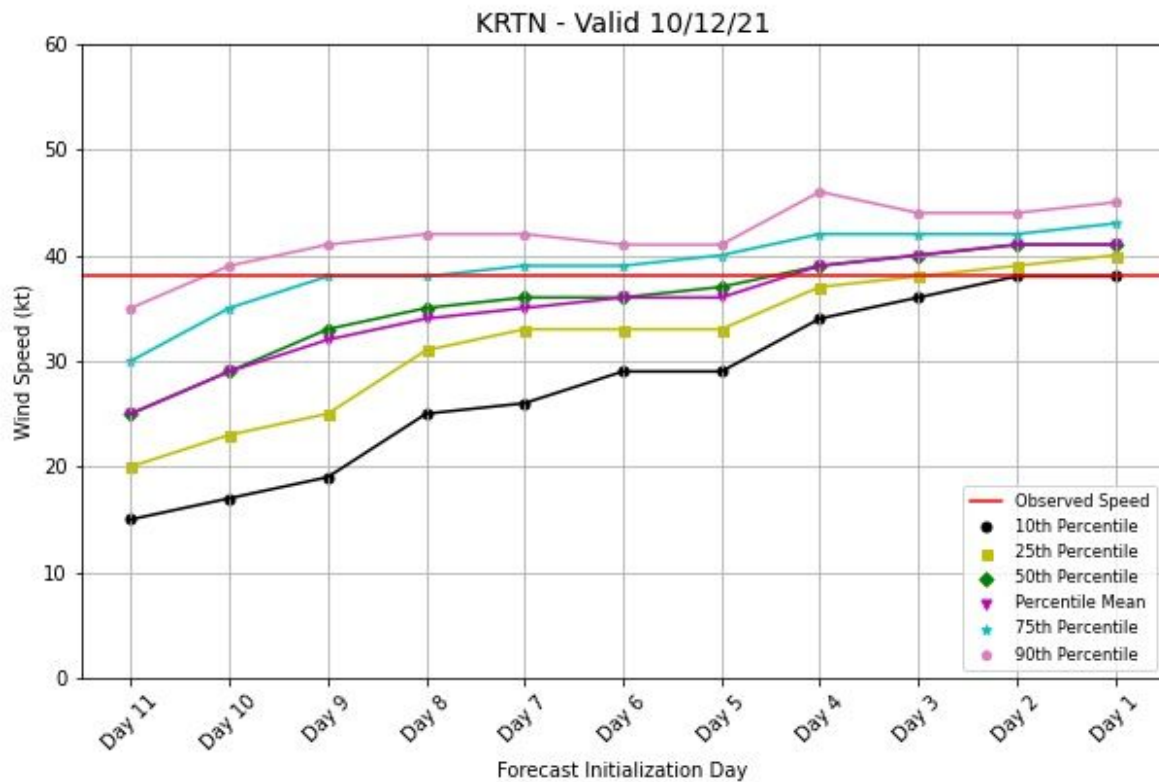
10/12/21

KRTN - Raton Airport, NM

Probabilistic 24 hour max
wind speed of the day

38G51 kt max daily

32G46 kt top hourly

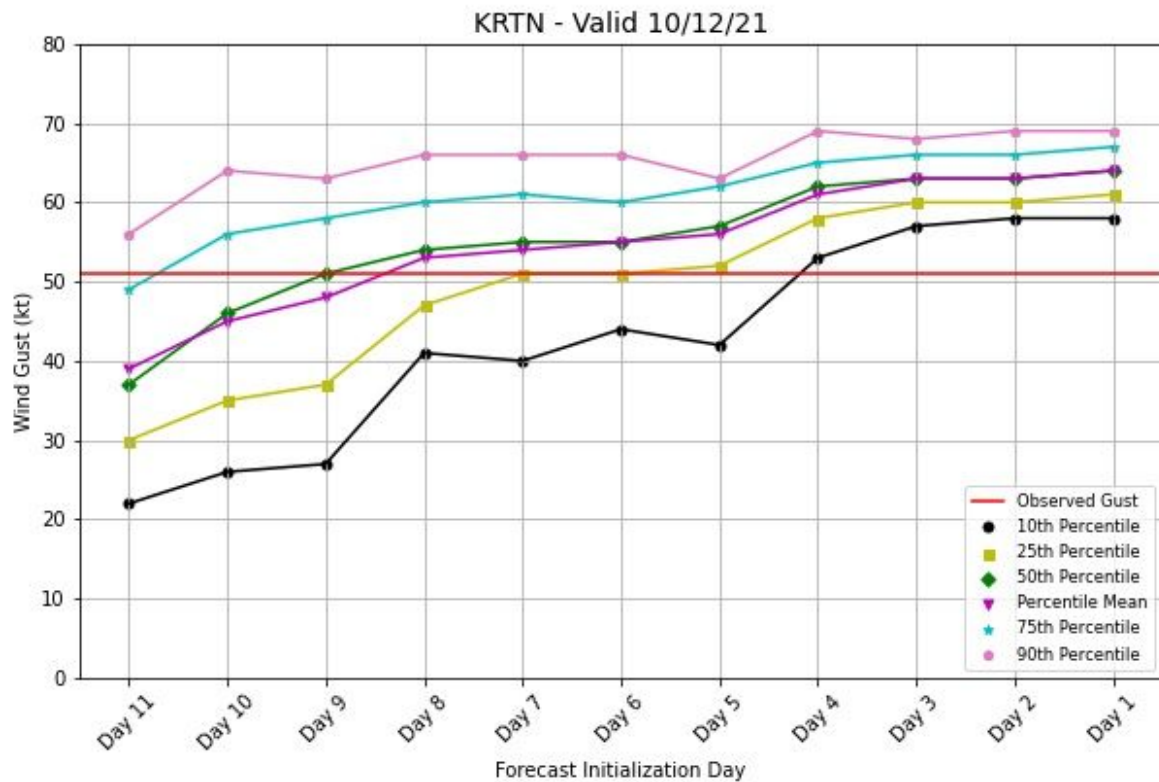


KRTN - Raton Airport, NM

Probabilistic 24 hour max
wind gust of the day

38**G51** kt max daily

32**G46** kt top hourly

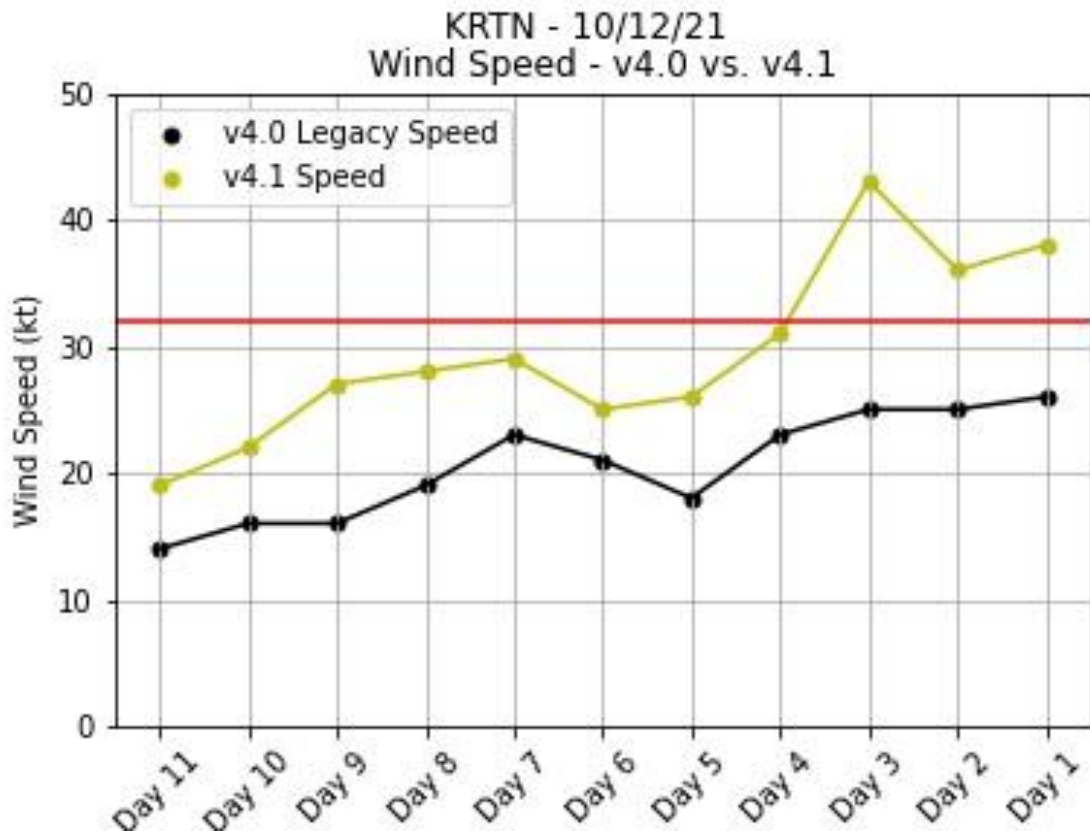


KRTN - Raton Airport, NM

Deterministic max top
hourly wind speed of the
day

38G51 kt max daily

32G46 kt top hourly

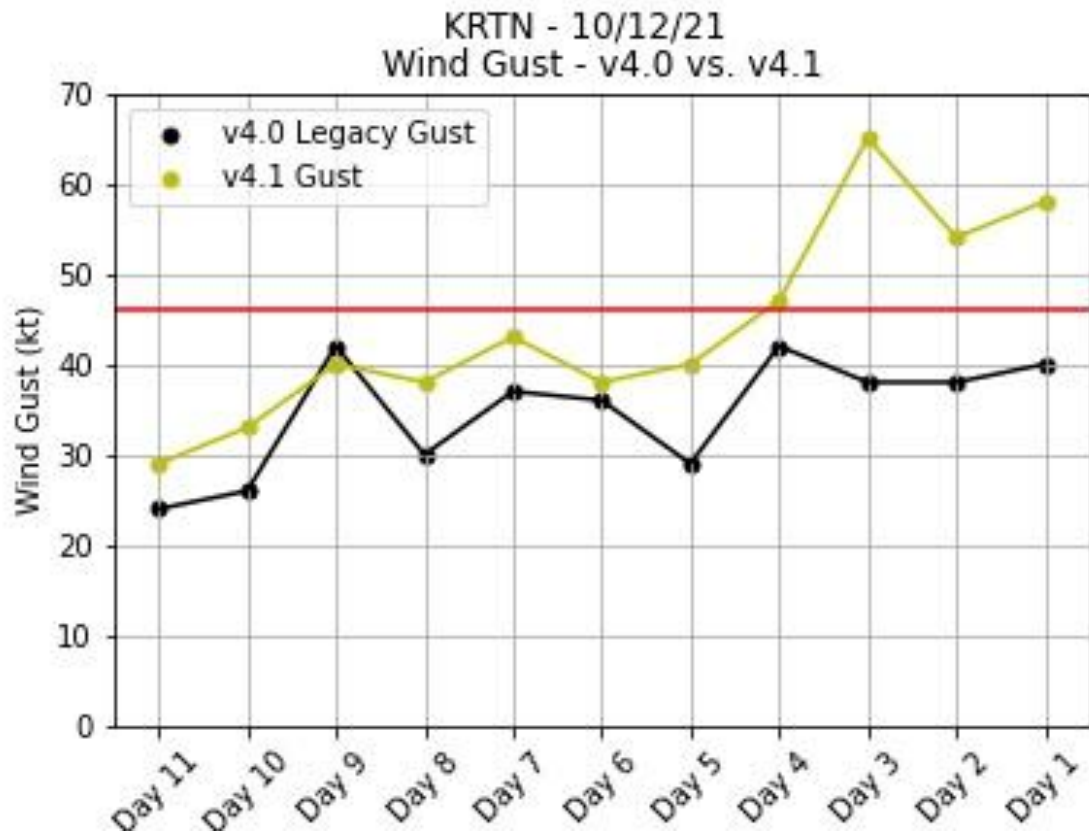


KRTN - Raton Airport, NM

Deterministic max top
hourly wind gust of the
day

38G51 kt max daily

32G46 kt top hourly



24-hour Probabilistic Peak Wind

- Still a developmental product
- On many days, max wind speed/gust of the day does not occur at the top of the hour observation
- Useful product to gain sense of best case, worst case, and most likely scenarios
- Not developed to capture convective events (thunderstorms, tropical) and will not give the time of the max wind speed/gust
- Initial case studies show that this product is performing very well, especially with about four days or less of forecast lead time

Take Away

NBM v4.1 formal evaluation begins in January 2022

NBM v4.1 planned implementation for January 2023

NBM v4.1 hourly winds include additional postprocessing to mitigate low bias

NBM v4.1 probabilistic winds available for IDSS and situational awareness

Thank You

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See website for NBM documentation and data.

https://www.weather.gov/mdl/nbm_home

National Blend of Models (NBM) Meteorological Development Laboratory
National Program, MDL

[Weather.gov](#) > [Meteorological Development Laboratory](#) > [National Blend of Models \(NBM\)](#)

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Contact

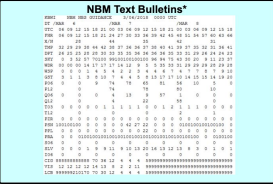
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The National Blend of Models (NBM)

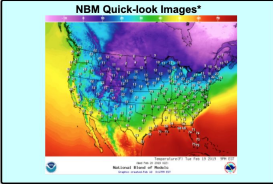
The National Blend of Models (NBM) is a nationally consistent and skillful suite of calibrated forecast guidance based on a blend of both NWS and non-NWS numerical weather prediction model data and post-processed model guidance. The goal of the NBM is to create a highly accurate, skillful and consistent starting point for the gridded forecast. This new way to produce NDFD grids will be helpful providing forecasters with a suite of information to use for their forecasts. The NBM is considered an important part of the efforts to evolve NWS capabilities to achieve a Weather-Ready Nation.

NBM Product Pages

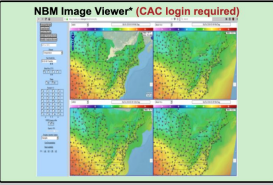
NBM Text Bulletins*



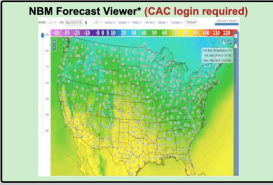
NBM Quick-look Images*



NBM Image Viewer* (CAC login required)



NBM Forecast Viewer* (CAC login required)



NBM Data Download

Operational Products (NBM v3.2)

NBM Grib2 Files

The master files contain all available elements in Grib2 format (specifications can be found on the [NBM v3.2 Grib Specifications Page](#)). Files are in directories where YYYYMMDD is the run datestamp, and CC is the cycle. File names are as follows: `blend.ICC2.master.IXXX.RR.grib2`, where CC is the cycle, XXX is the forecast hour, and RR is the region. (Example: `blend.1002.master.1001.co.grib2`) These files are available for 1-2 days.