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

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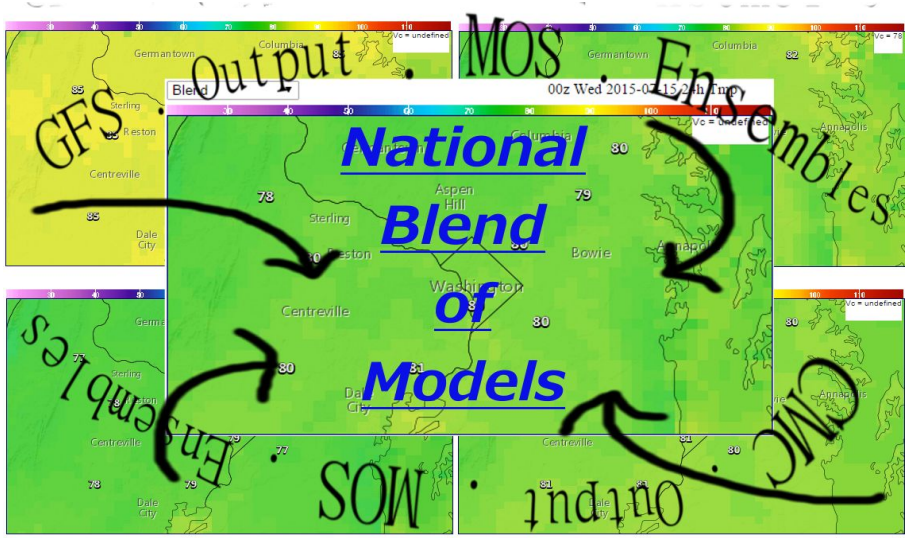

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NBM v4.1 Aviation Highlights

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?*

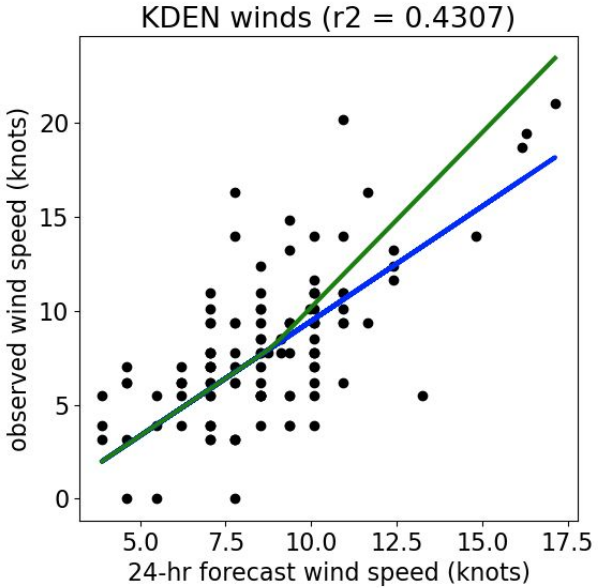
Inflated Wind Speed = ((Wind Speed - Observed Mean)/Correlation)+Observation Mean**

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*

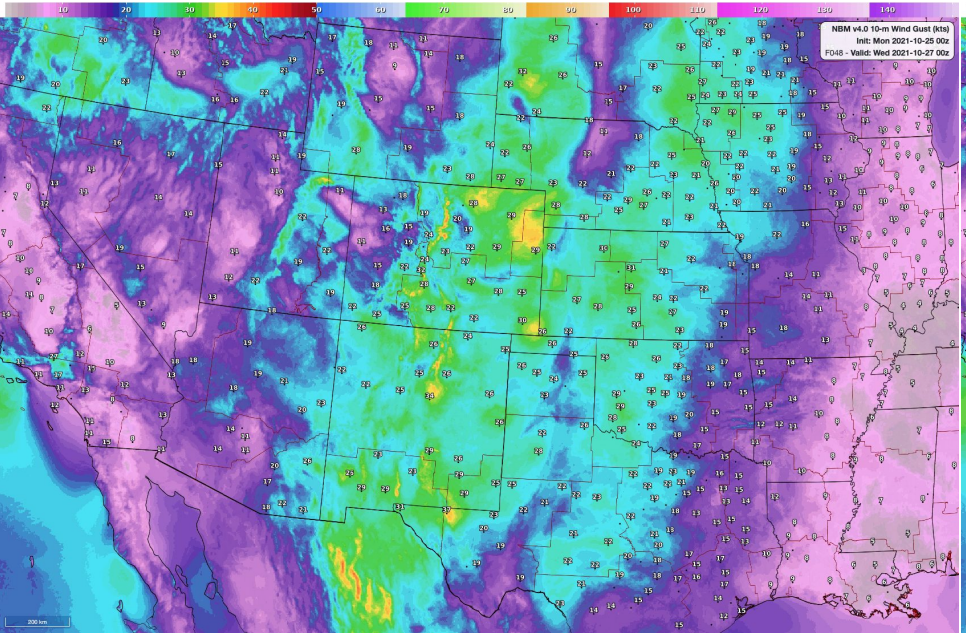
Verification of Hourly Winds

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

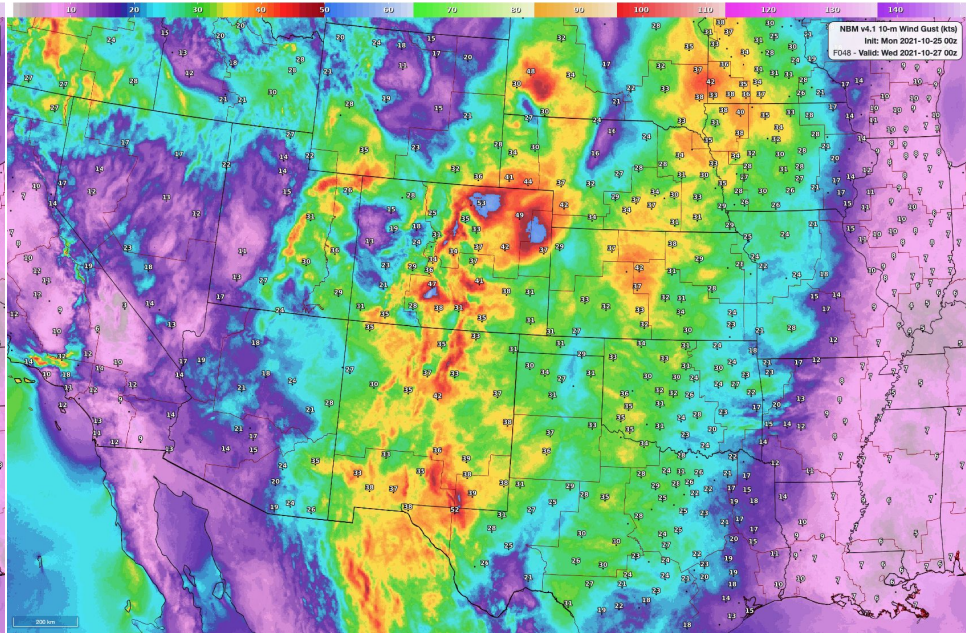
blend v4.0	thresh (knots)	csi	pod	far	bias		obs	0	10	20	30	40	50
							fcst						under
	10 kt	0.559978	0.646749	0.193281	0.840552		0	50304	5576	61	3	0	0
	20 kt	0.319645	0.353591	0.230975	0.474324		10	2462	8600	962	23	3	1
	30 kt	0.187879	0.208054	0.340426	0.310924		20	11	161	442	79	9	0
	40 kt	0.142857	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

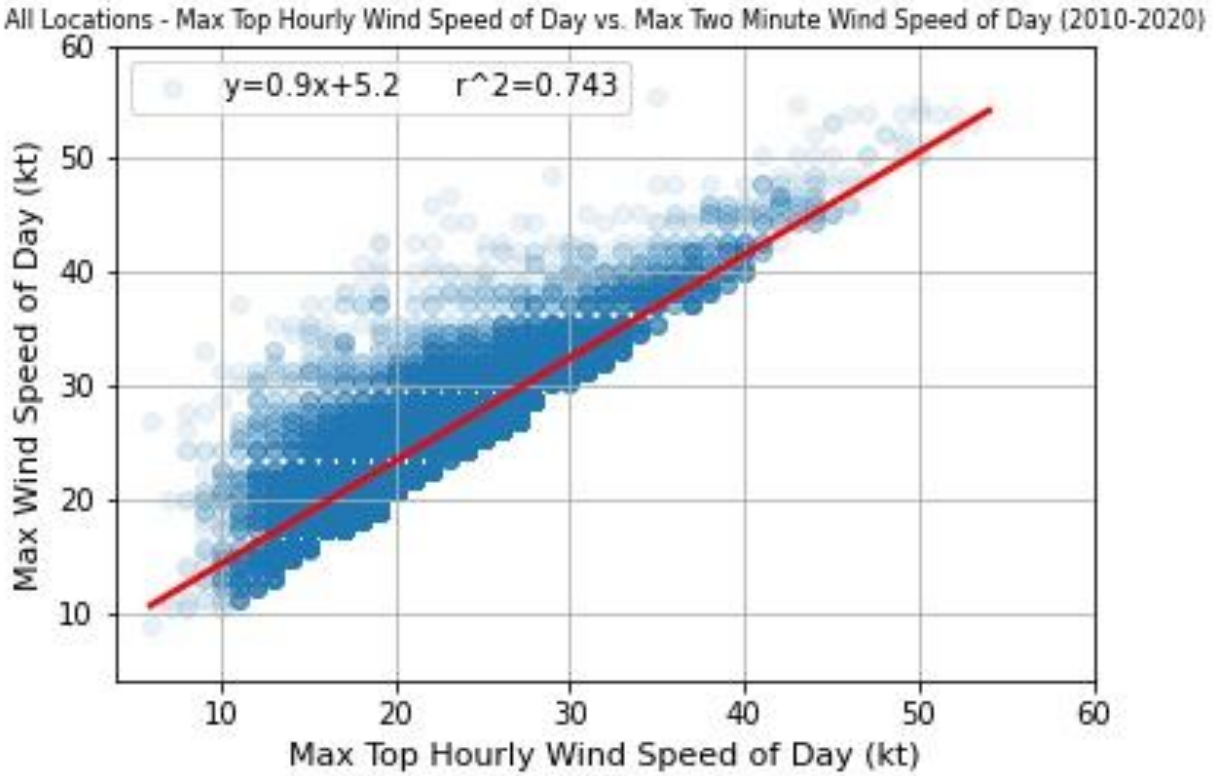
The 10th percentile exceeds ~20 of the bias corrected model solutions

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



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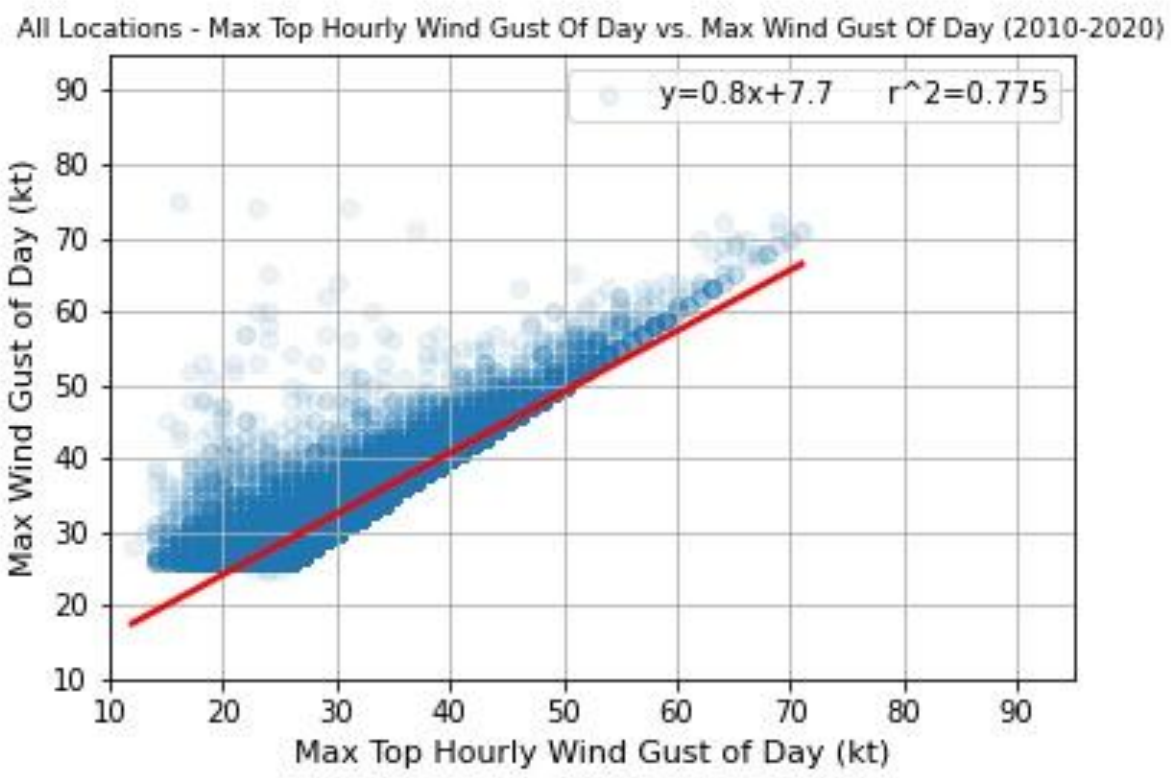


Speed factor - **1.18**

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
KATL	1.21	1.14
KBDL	1.19	1.11
KBOS	1.15	1.09
KCLE	1.17	1.09
KCLT	1.21	1.13
KCVG	1.21	1.22
KDCA	1.19	1.12
KDEN	1.17	1.12
KDFW	1.16	1.08
KDTW	1.17	1.11
KEWR	1.17	1.10
KFLL	1.17	1.11
KIAD	1.21	1.12
KIAH	1.19	1.12
KICT	1.15	1.09
KIND	1.18	1.10
KJFK	1.14	1.09
KLAS	1.17	1.10
KLAX	1.13	1.12
KLGA	1.16	1.09
KLVM	1.14	1.08

Location	Wind Speed Ratio	Wind Gust Ratio
KMEM	1.21	1.13
KMCO	1.21	1.14
KMDW	1.17	1.10
KMIA	1.18	1.13
KMKE	1.15	1.10
KMSP	1.16	1.09
KOAK	1.13	1.13
KONT	1.22	1.14
KORD	1.16	1.10
KPDX	1.18	1.12
KPHL	1.18	1.11
KPHX	1.23	1.15
KPIT	1.21	1.12
KSAN	1.24	1.13
KSDF	1.20	1.12
KSEA	1.16	1.10
KSFO	1.12	1.10
KSLC	1.18	1.12
KSTL	1.19	1.10
PANC	1.13	1.12
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

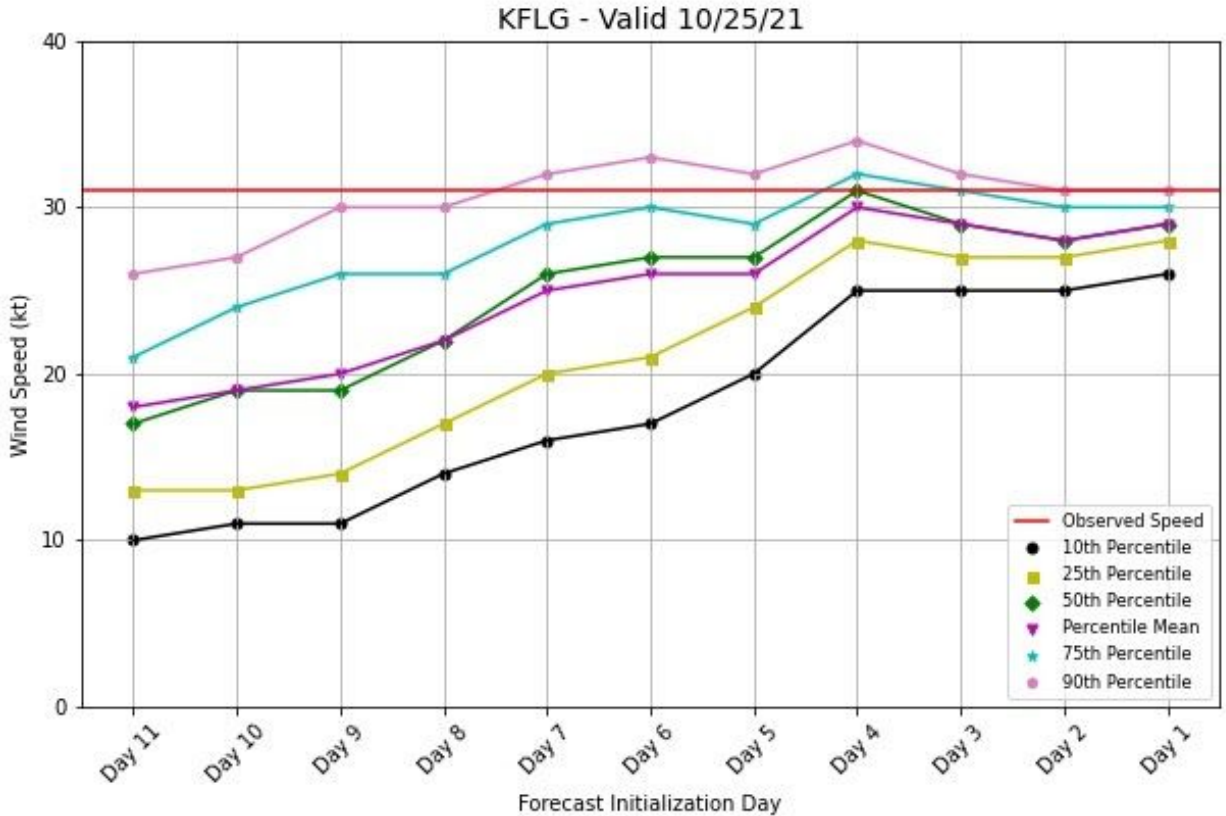
10/25/21

KFLG - Flagstaff, AZ

Probabilistic 24 hour max wind speed of the day

31G43 kt max daily

26G36 kt top hourly



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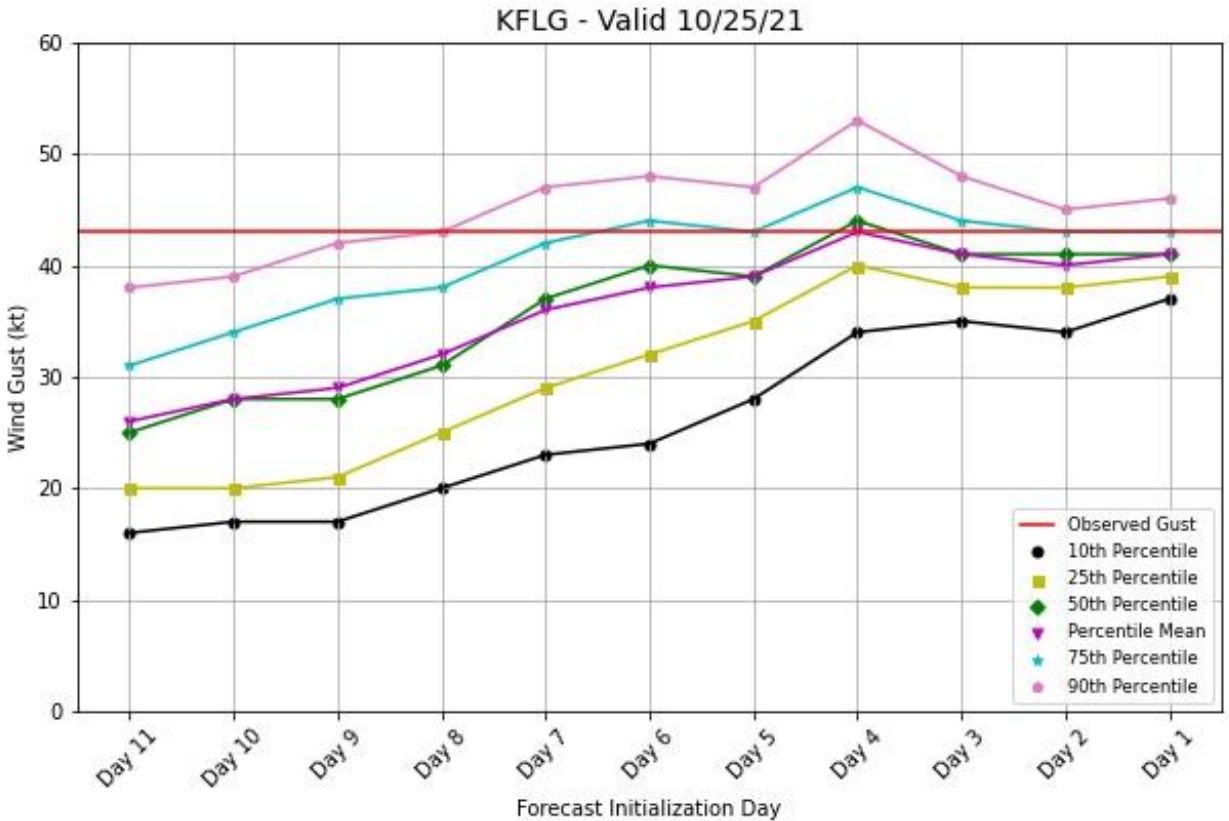
Probabilistic 24 hour max wind gust of the day

31**G43** kt max daily

26G36 kt top hourly



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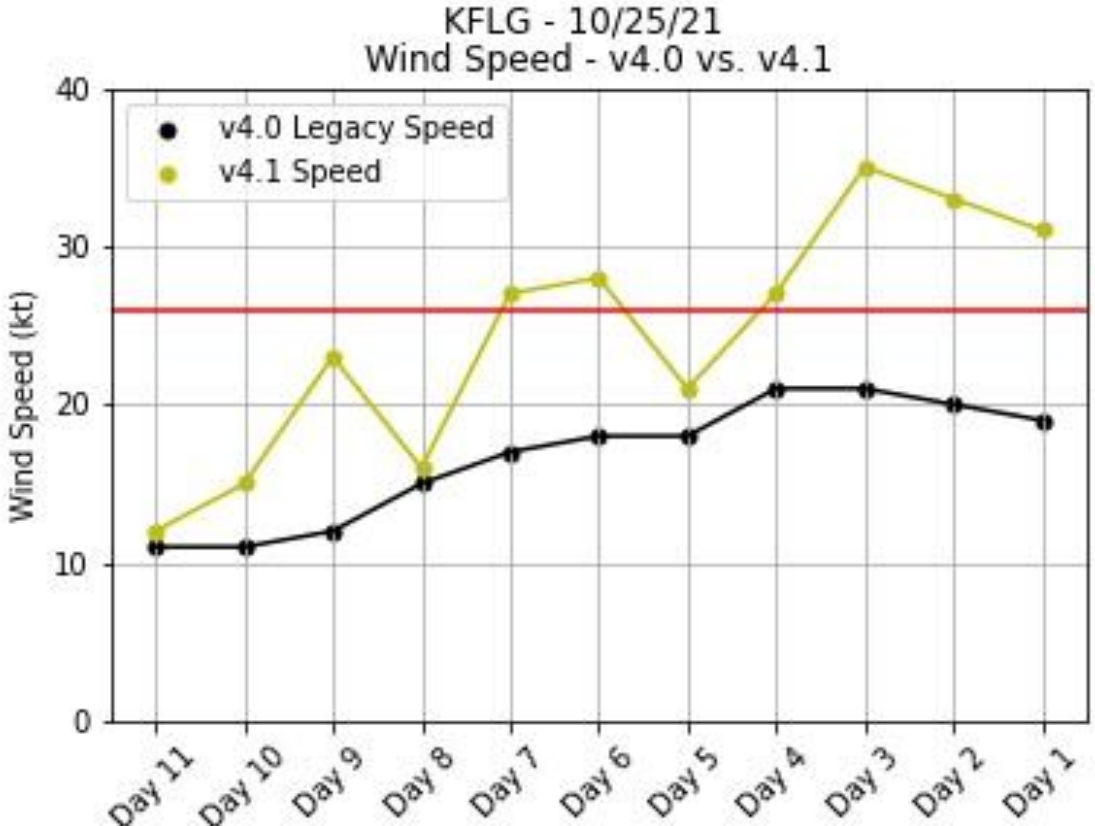

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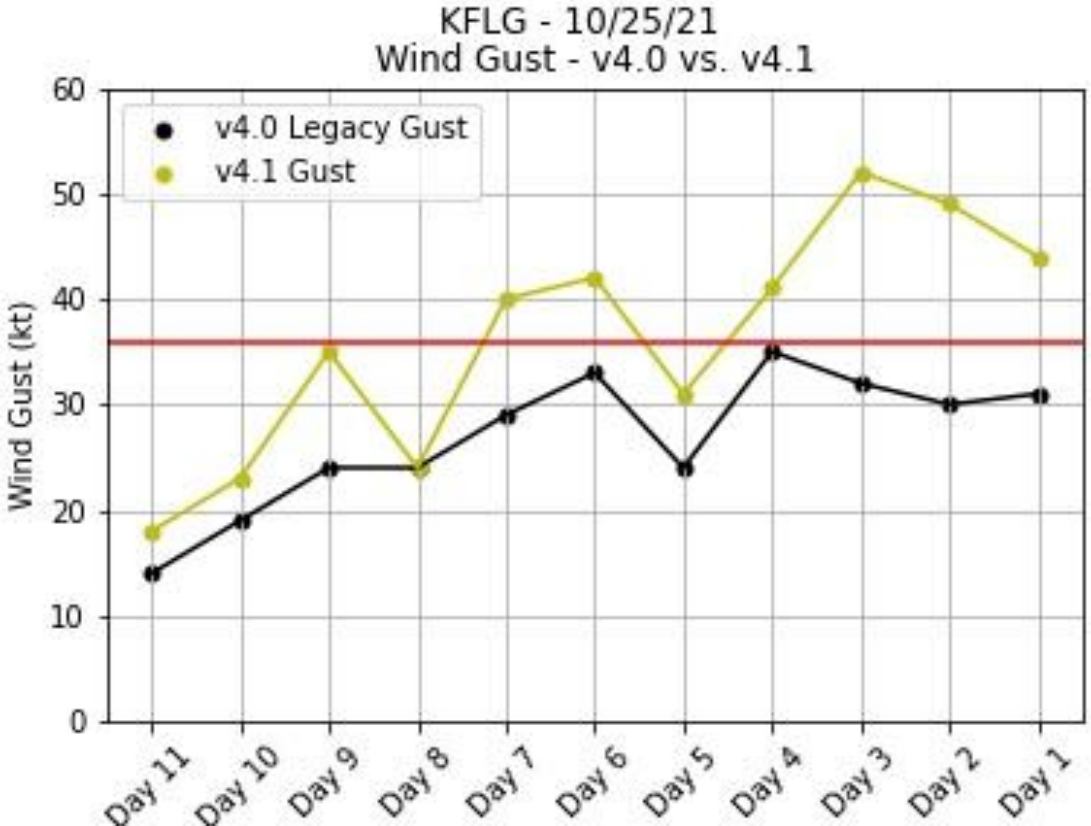

24-hour Probabilistic Peak Wind and Deterministic Max Top Hourly Wind Case Study

KRTN - Raton Airport, NM

10/12/21

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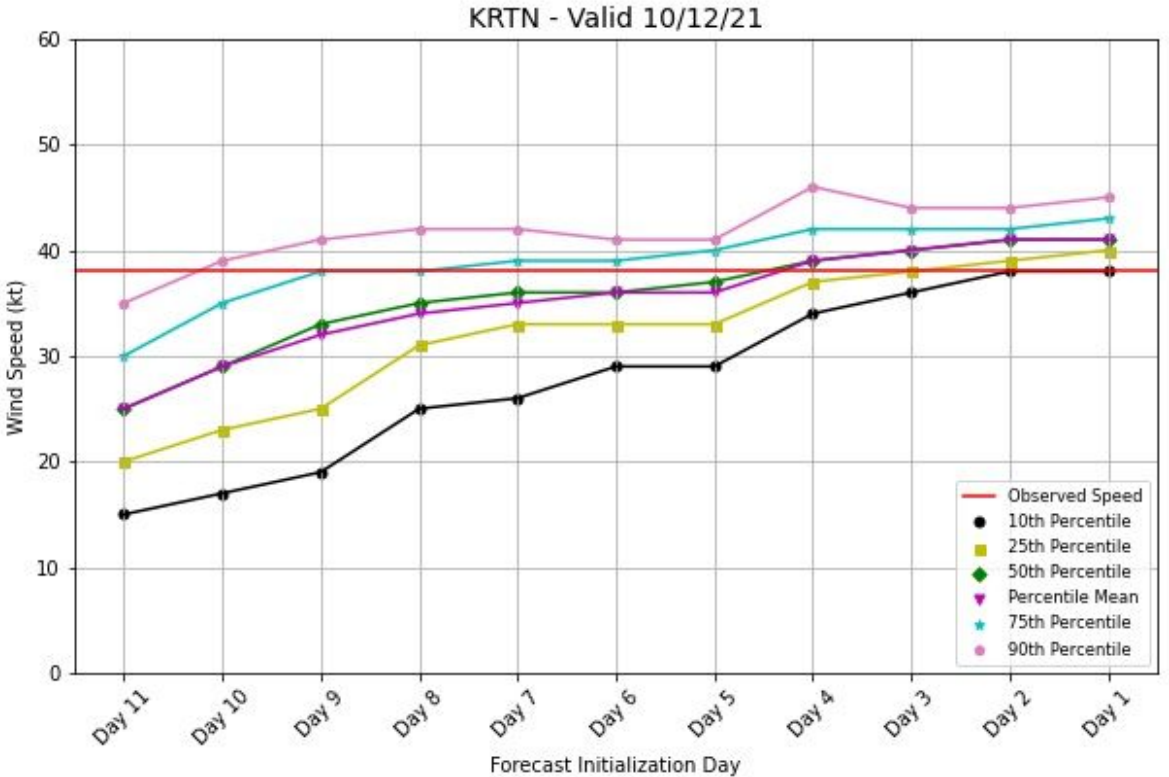
Probabilistic 24 hour max wind speed of the day

38G51 kt max daily

32G46 kt top hourly



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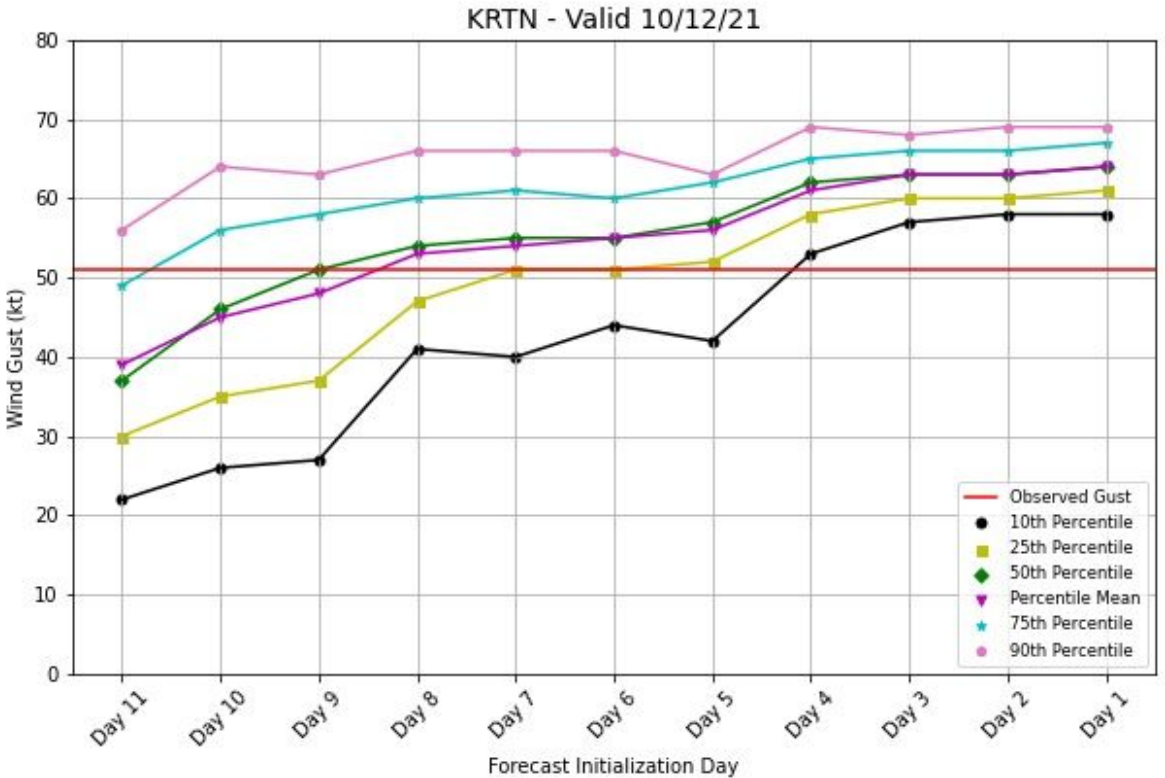

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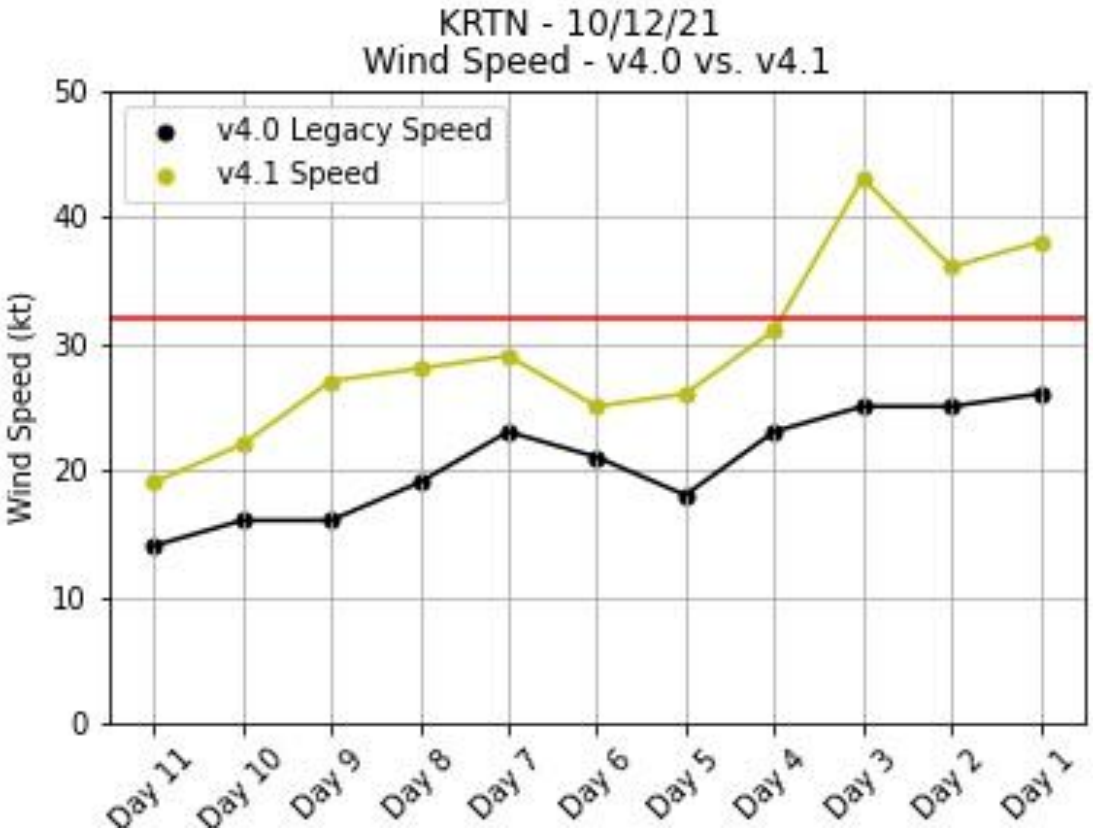

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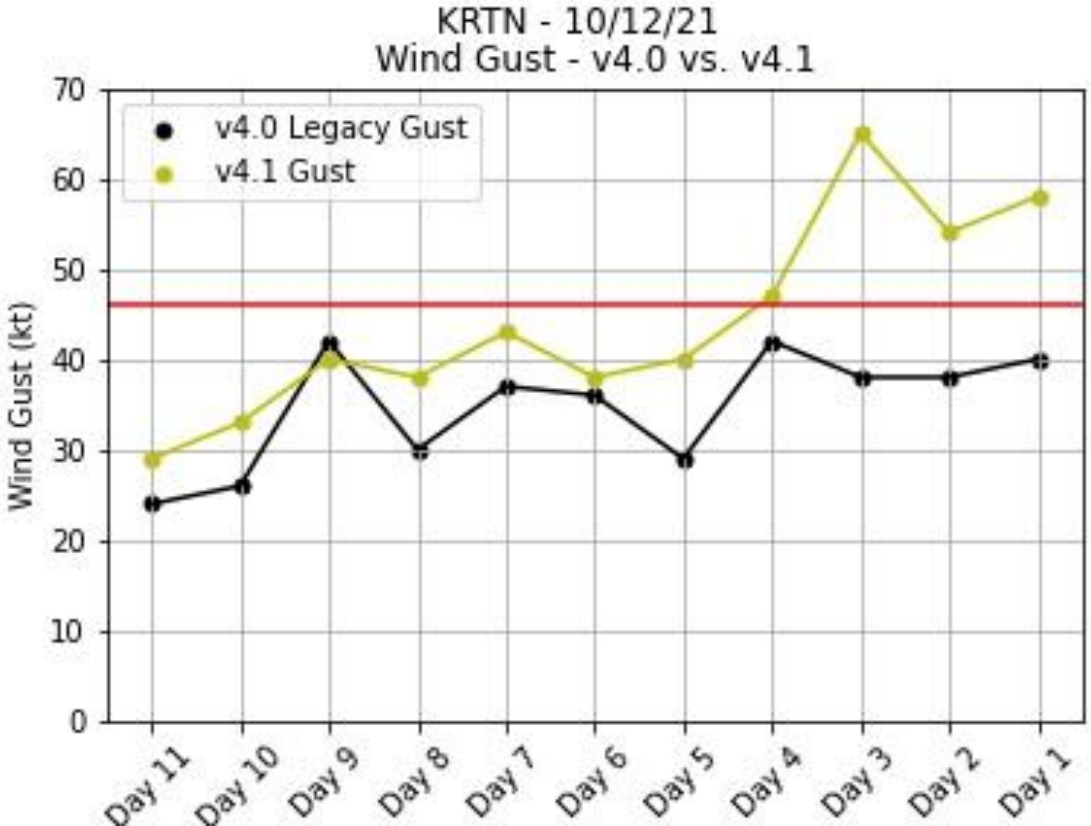

24-hour Probabilistic Peak Wind

- 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