10th International Workshop on Air Quality Forecasting Research

Operational Air Quality Model Version 6: New Updates and Performance Evaluation

NATIONAL WEATHER SERVICE

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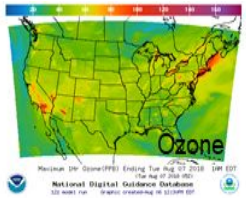
With contributions from the EMC evaluation team, State and local AQ forecasters, and other partners

National Air Quality Forecast Capability

We improve the basis of air quality alerts and provide air quality information to people at risk to further NWS mission of protecting life and property and the enhancement of the national economy.

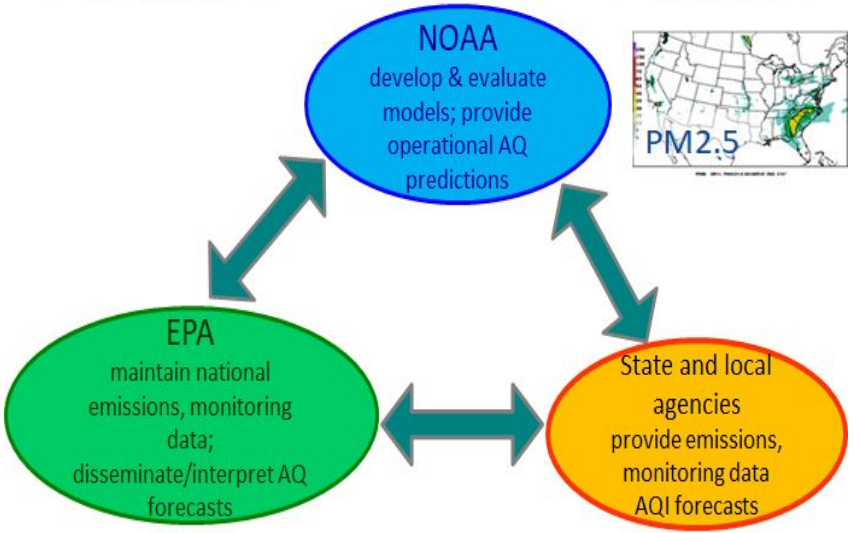
National Air Quality Forecast Capability (NAQFC) develops and implements operational air quality forecast guidance for the United States.



Operational Forecast Products (48/72 hours):

- Ozone nationwide (CMAQ)
- Fine particulate matter (PM2.5) nationwide (CMAQ)
- Smoke nationwide (HYSPLIT)
- Dust over CONUS (HYSPLIT)

Air quality forecasting relies on a strategic partnership with the Environmental Protection Agency (EPA) and state and local air quality forecasters.



Summary of AQMv6 Verification Statistics

R: Raw BC: Bias-Corrected

September 2020					
Region	**Parameter**	**Average Forecast**	**CSI**	**POD**	**FAR**
CONUS East	Ozone (8h Max for Skill Scores)	R: Slightly Improved BC: Improved	R: Slightly Improved BC: Improved	R: Improved BC: Improved	R: Neutral BC: Neutral
	PM2.5 (24h Avg for Skill Scores)	R: Notably Improved BC: Neutral	R: Neutral BC: Improved	R: Improved BC: Improved	R: Improved BC: Notably Improved
CONUS West	Ozone (8h Max for Skill Scores)	R: Slightly Degraded BC: Neutral	R: Degraded BC: Slightly Degraded	R: Degraded BC: Slightly Degraded	R: Improved BC: Neutral
	PM2.5 (24h Avg for Skill Scores)	R: Degraded BC: Slightly Degraded	R: Degraded BC: Improved	R: Degraded BC: Improved	R: Improved BC: Notably Improved

Summary of AQMv6 Verification Statistics

R: Raw BC: Bias-Corrected

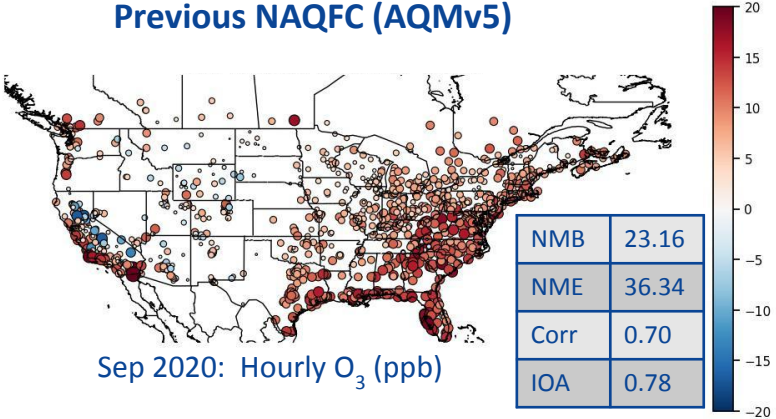
January 2021					
Region	**Parameter**	**Average Forecast**	**CSI**	**POD**	**FAR**
CONUS East	Ozone (8h Max for Skill Scores)	R: Degraded BC: Neutral	N/A (no high-end events)		
	PM2.5 (24h Avg for Skill Scores)	R: Improved BC: Improved	R & BC: Slightly Improved	R: Degraded BC: Neutral	R & BC: Slightly Improved
CONUS West	Ozone (8h Max for Skill Scores)	R: Degraded BC: Slightly Degraded	R & BC: Slightly Improved	R: Improved BC: Improved	R: Improved BC: Improved
	PM2.5 (24h Avg for Skill Scores)	R: Somewhat Improved BC: Somewhat Improved	R: Neutral BC: Slightly Improved	R: Improved BC: Improved	R: Improved BC: Slightly Degraded

Presented by Geoff Manikin, NWS/EMC/MEG

AQMv6 Performance vs. AQMv5

Summer (September) Surface Ozone

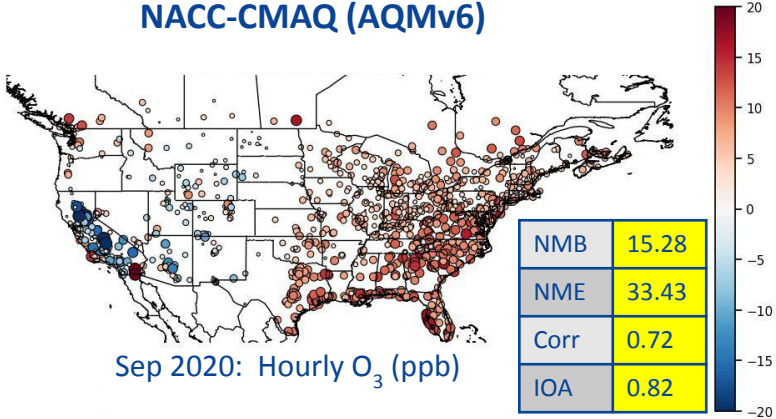
Previous NAQFC (AQMv5)



Sep 2020: Hourly O_3 (ppb)

NMB	23.16
NME	36.34
Corr	0.70
IOA	0.78

NACC-CMAQ (AQMv6)



Sep 2020: Hourly O_3 (ppb)

NMB	15.28
NME	33.43
Corr	0.72
IOA	0.82

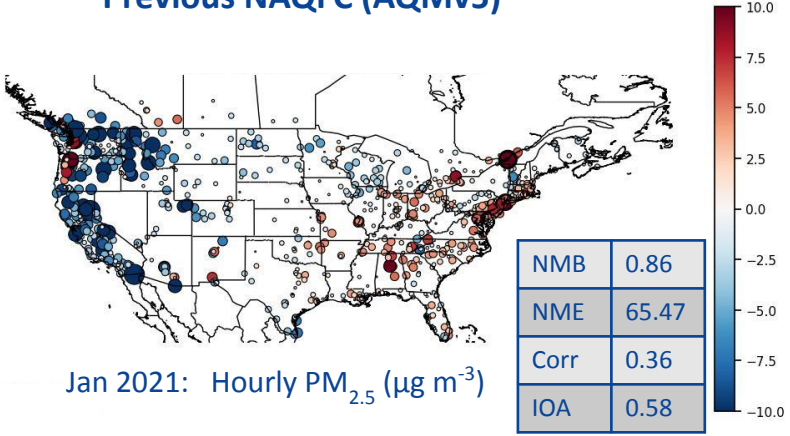
Overall improved model performance for the updated NAQFC, especially in the eastern U.S.

Campbell et al., *GMD*, submitted.

AQMv6 Performance vs. AQMv5

Winter (January) Surface $PM_{2.5}$

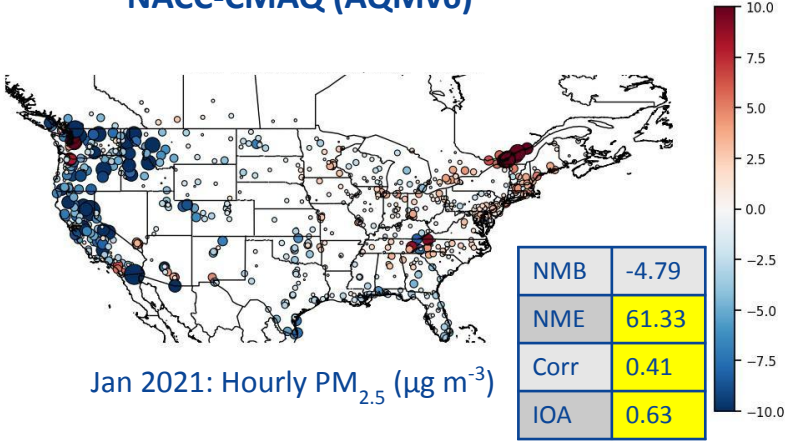
Previous NAQFC (AQMv5)



Jan 2021: Hourly $PM_{2.5}$ ($\mu g\ m^{-3}$)

NMB	0.86
NME	65.47
Corr	0.36
IOA	0.58

NACC-CMAQ (AQMv6)



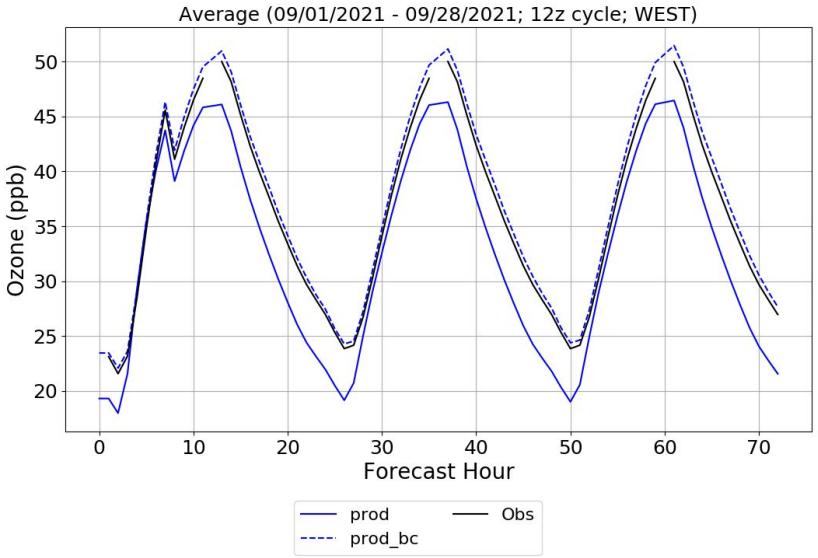
Jan 2021: Hourly $PM_{2.5}$ ($\mu g\ m^{-3}$)

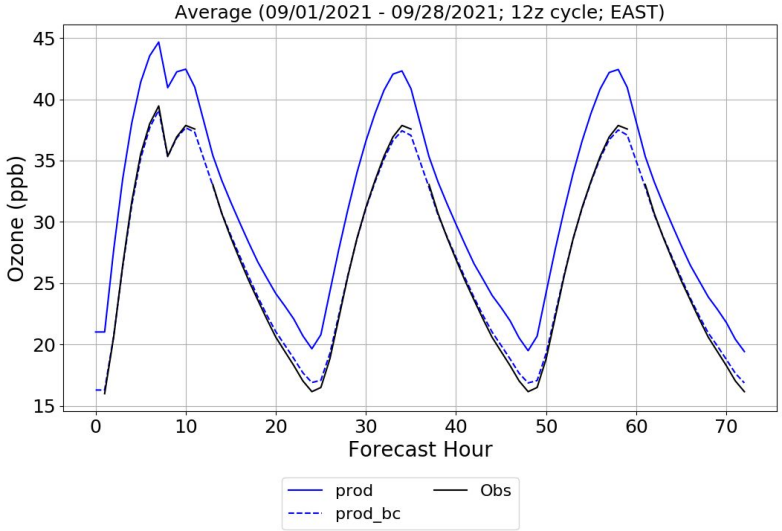
NMB	-4.79
NME	61.33
Corr	0.41
IOA	0.63

Overall improved model performance for the updated NAQFC, especially in the eastern U.S.

Campbell et al., *GMD*, submitted.

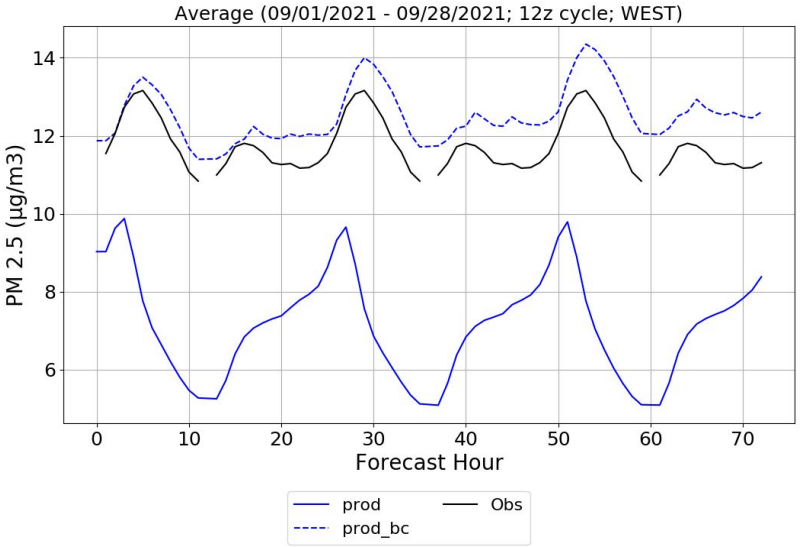
Performance of Ozone predictions:
Observed vs predicted 1 hr averaged Diurnal variability, September 2021

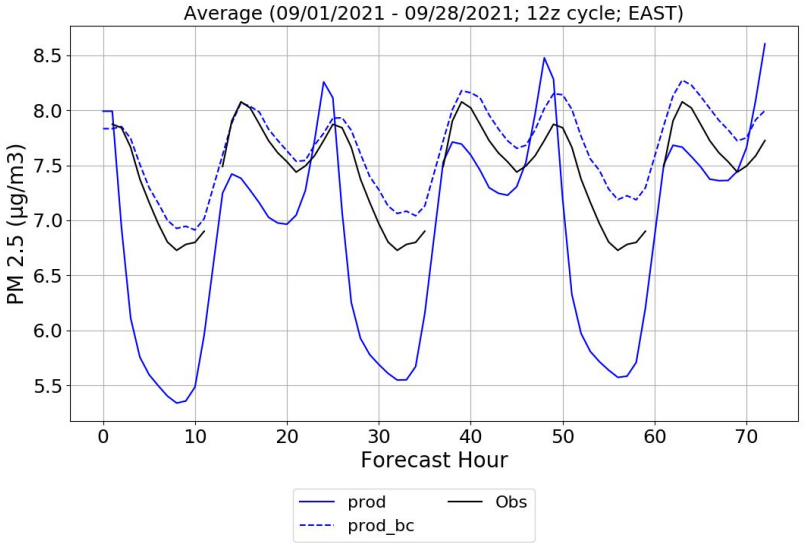




- Underpredicts on the west and overpredicts on the east, bias correction improve significantly all sectors

Performance of PM predictions:
Observed vs predicted 1 hr averaged Diurnal variability, september 2021

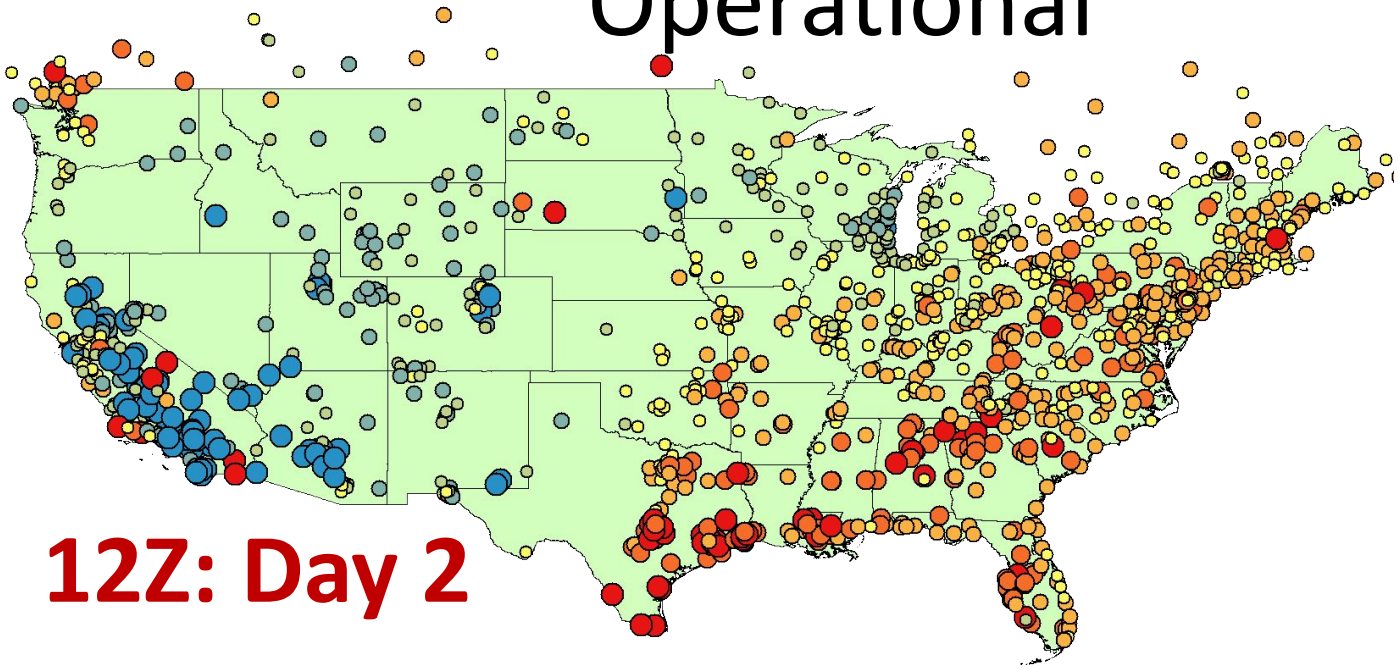




- Under Predictions for PM2.5
- many challenges during extreme events like wildfires and dust episodes

Seasonal BIAS – 8hr Ozone

Operational



12Z: Day 2

- = Model Under predicted

+ = Model Over predicted

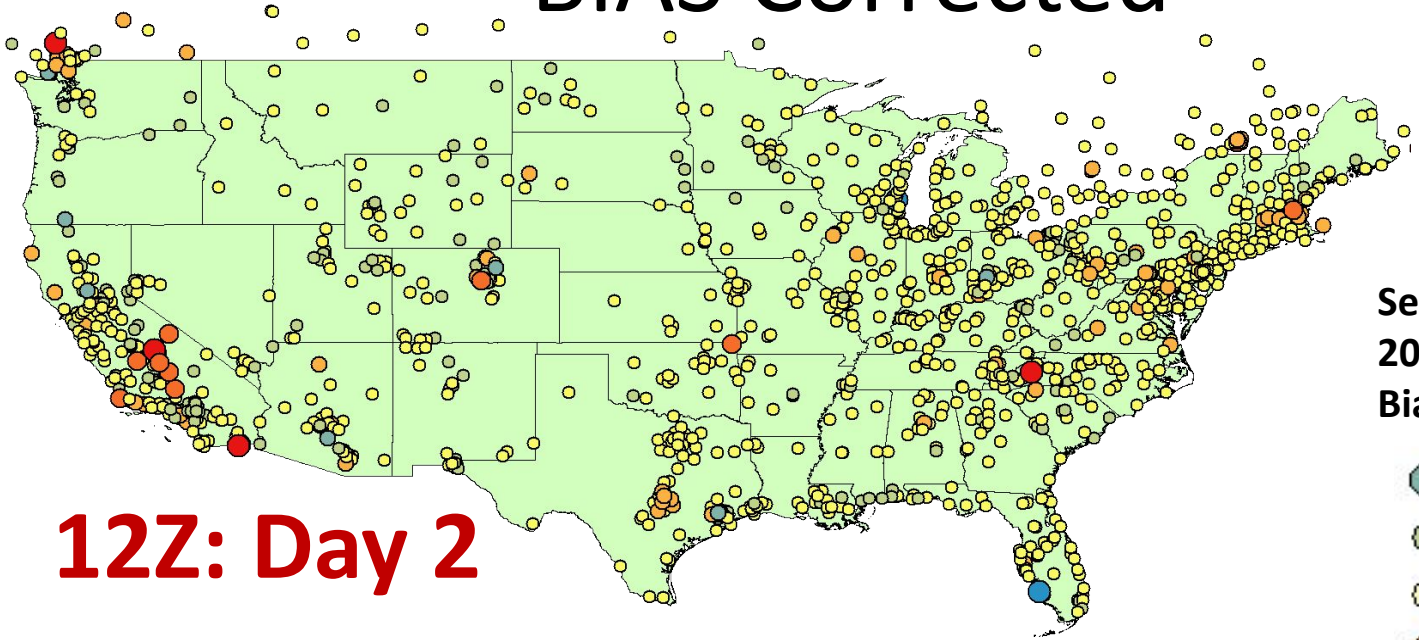
Seasonal 4/01 – 9/16
2021
Bias (ppb)

- < -6
- -6 - -3
- -3 - 0
- 0 - 3
- 3 - 6
- 6 - 9
- > 9

Courtesy of James Boyle and Joel Dresen, MDE

Seasonal BIAS – 8hr Ozone

BIAS Corrected



12Z: Day 2

Seasonal 4/01 – 9/16
2021
Bias (ppb)

- -6 - -3
- -3 - 0
- 0 - 3
- 3 - 6
- 6 - 9
- > 9

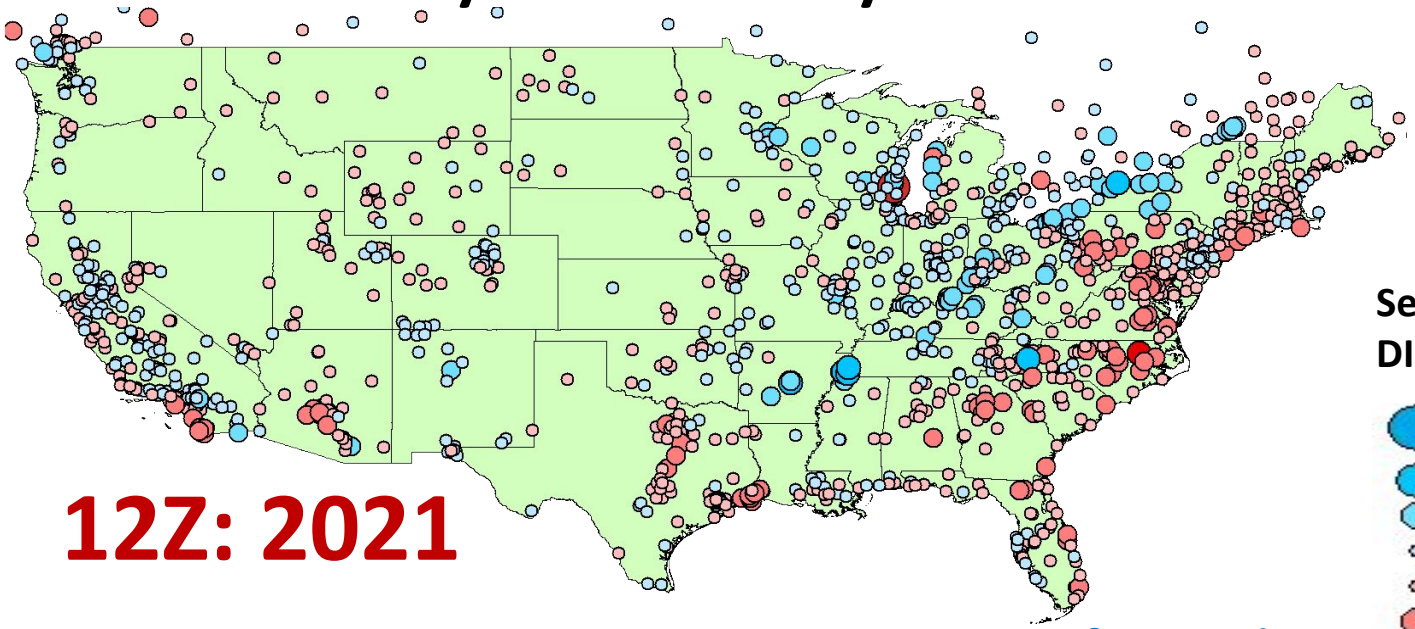
\+ = Model Over predicted

\- = Model Under predicted

Courtesy of James Boyle and Joel Dresen, MDE

Seasonal BIAS – 8hr Ozone

Day 2 vs. Day 3 Forecast



12Z: 2021

Seasonal 4/01 – 9/16
DIFF (ppb)

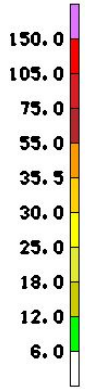
- < -2
- -2 - -1
- -1 - -0.5
- -0.5 - 0
- 0 - 0.5
- 0.5 - 1
- 1 - 2
- > 2

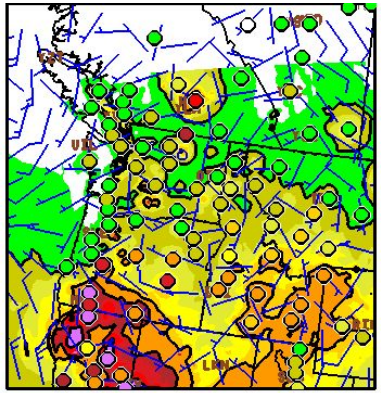
\- = Day 2 Outperformed

\+ = Day 3 Outperformed

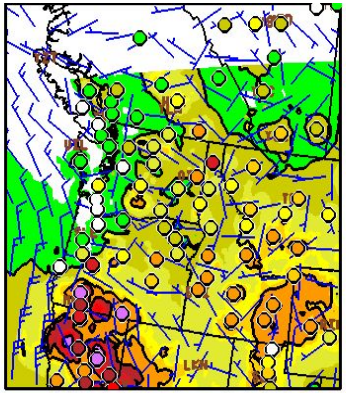
Courtesy of James Boyle and Joel Dresen, MDE

Day one, two and three daily max PM forecast
fire event 8/25/2021

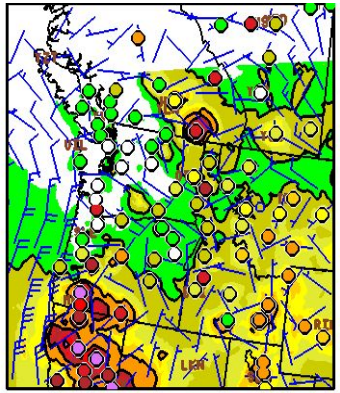




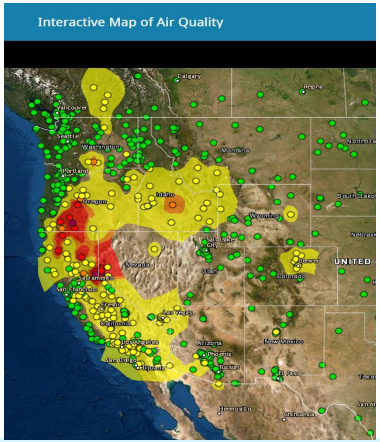
PROD BIAS COR PMMXO1 (UG/M3) 12Z CYC DAY1 VALID 20210825

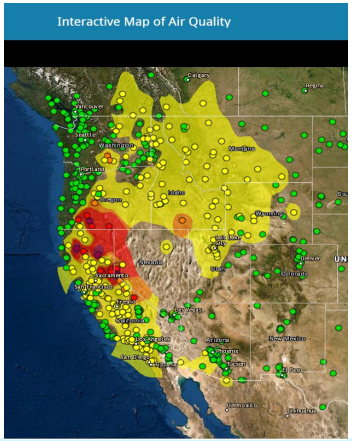


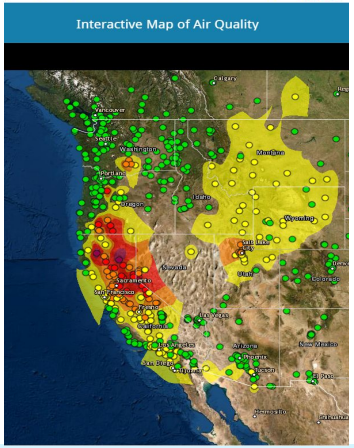
PROD BIAS COR PMMXO1 (UG/M3) 12Z CYC DAY2 VALID 20210826



PROD BIAS COR PMMXO1 (UG/M3) 12Z CYC DAY3 VALID 20210827







Summary

- AQMv6 was implemented at NOAA/NWS on July 20, 2021.
- The performance of AQMv6 is overall equivalent to AQMv5.
- Overprediction of ozone in the eastern US and underprediction of PM2.5 in the western US persist.
- AMQv6 maintains reasonable forecasts skills up to Day 3.
- More extended period data is needed for a more comprehensive evaluation.
- Additional evaluation and improvements are planned.

Thank you for your attention

Questions?