2024 AIR QUALITY FORECAST ACCURACY FOR NORTHEAST OHIO

National Oceanic and Atmospheric Administration (NOAA) Air Quality Forecasters Workshop

October 9-10, 2024

Northeast Ohio Areawide Coordinating Agency (NOACA)

Joe MacDonald

Kirk Kallenborn

NOACA
Northeast Ohio Areawide Coordinating Agency

OVERVIEW

- What is NOACA?
- NAAQS History
- Air Quality Monitors
- NOAA Forecast Analysis
- 2024 Model Performance
- Questions?

NOACA
Northeast Ohio Areawide Coordinating Agency

WHAT IS NOACA?

Metropolitan Planning Organization (MPO) and Areawide Agency for Northeast Ohio

Transportation, air & water quality, economic development

Controls approximately $50M in spending per year

NOACA
Northeast Ohio Areawide Coordinating Agency

NOACA'S VISION STATEMENT

NOACA will STRENGTHEN regional cohesion, PRESERVE existing infrastructure, and BUILD a sustainable multimodal transportation system to SUPPORT economic development and ENHANCE quality of life in Northeast Ohio.

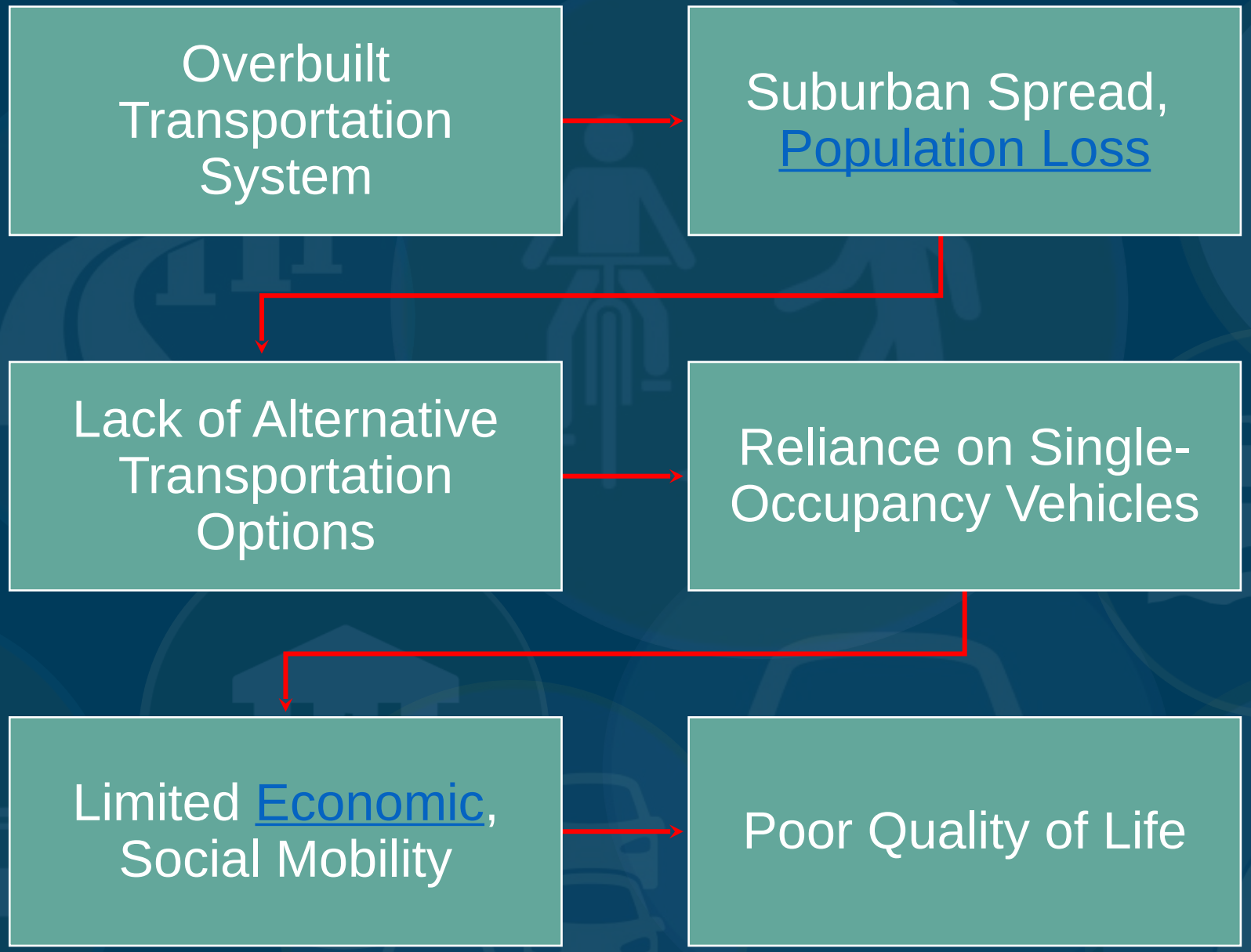
NOACA
Northeast Ohio Areawide Coordinating Agency

TRANSPORTATION CHALLENGES

NOACA established in 1968, developed first Long-Range Transportation Plan

- Assumed regional population would grow by one million
- 1970 Census: 2.32 million residents
- 2020 Census: 2.09 million residents

NOACA
Northeast Ohio Areawide Coordinating Agency



NOACA
Northeast Ohio Areawide Coordinating Agency

NAAQS HISTORY

O_3 NAAQS TIMELINE

April 30, 2018: U.S. EPA designated Northeast Ohio counties “marginal nonattainment” for 2015 eight-hour ozone NAAQS (70 ppb)

August 3, 2021: Missed deadline (“bump up” to moderate nonattainment)

October 7, 2022: Determinations of Attainment posted to Federal Register

August 3, 2024: Missed deadline (anticipate “bump up” to serious nonattainment)

Source: *Chicago Tribune*

NOACA
Northeast Ohio Areawide Coordinating Agency

$PM_{2.5}$ NAAQS TIMELINE

2006: U.S. EPA strengthens $PM_{2.5}$ 24hr standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$

2012: U.S. EPA strengthens $PM_{2.5}$ annual standard from 15 $\mu g/m^3$ to 12 $\mu g/m^3$

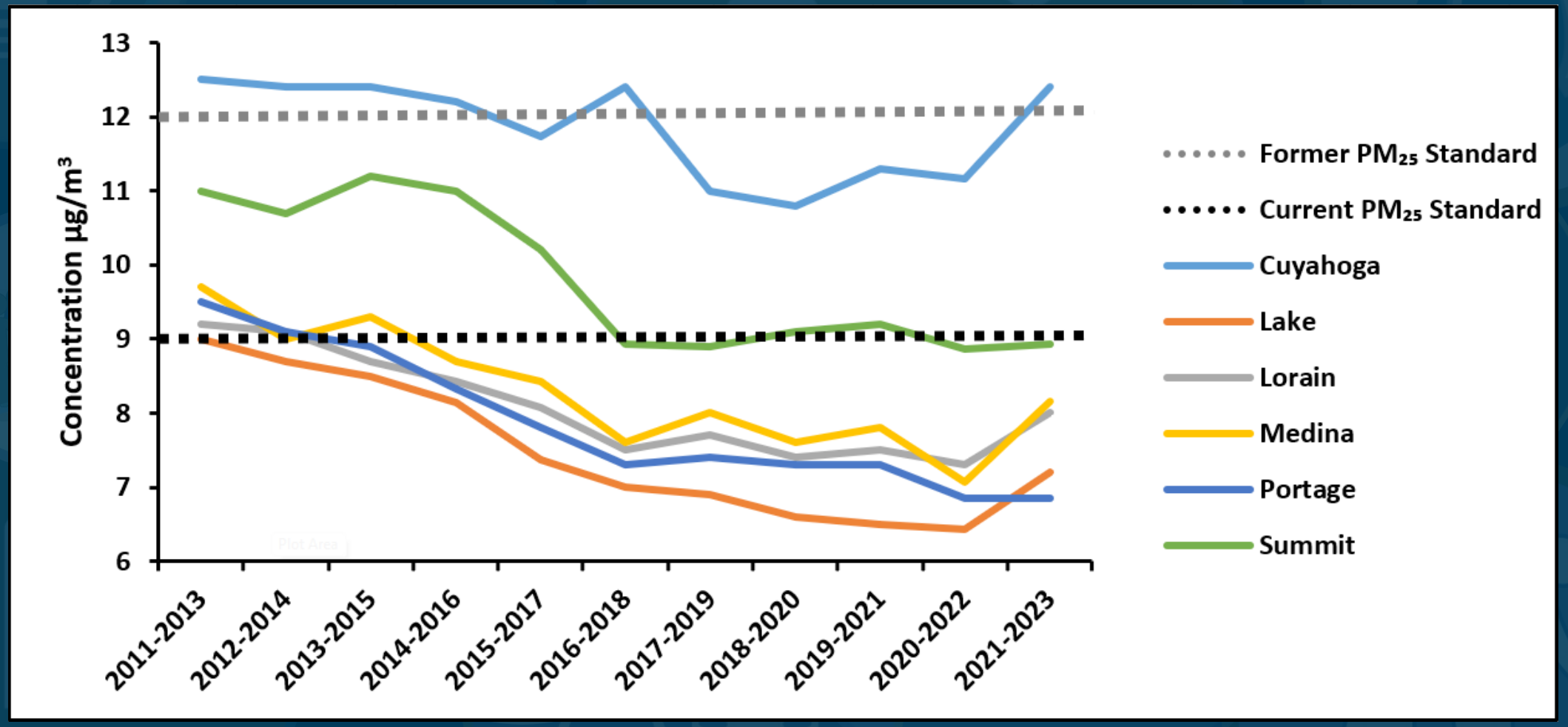
2024: U.S. EPA strengthens $PM_{2.5}$ primary annual standard from 12 $\mu g/m^3$ to 9 $\mu g/m^3$

May 6, 2024: $PM_{2.5}$ primary annual standard takes effect. Cuyahoga County to exceed the standard

Source: *Newsweek*

NOACA
Northeast Ohio Areawide Coordinating Agency

THREE-YEAR ROLLING AVERAGES FOR ANNUAL $PM_{2.5}$ IN NORTHEAST OHIO COUNTIES



NOACA
Northeast Ohio Areawide Coordinating Agency

AIR QUALITY MONITORS

AIR QUALITY MONITOR LOCATIONS IN NORTHEAST OHIO

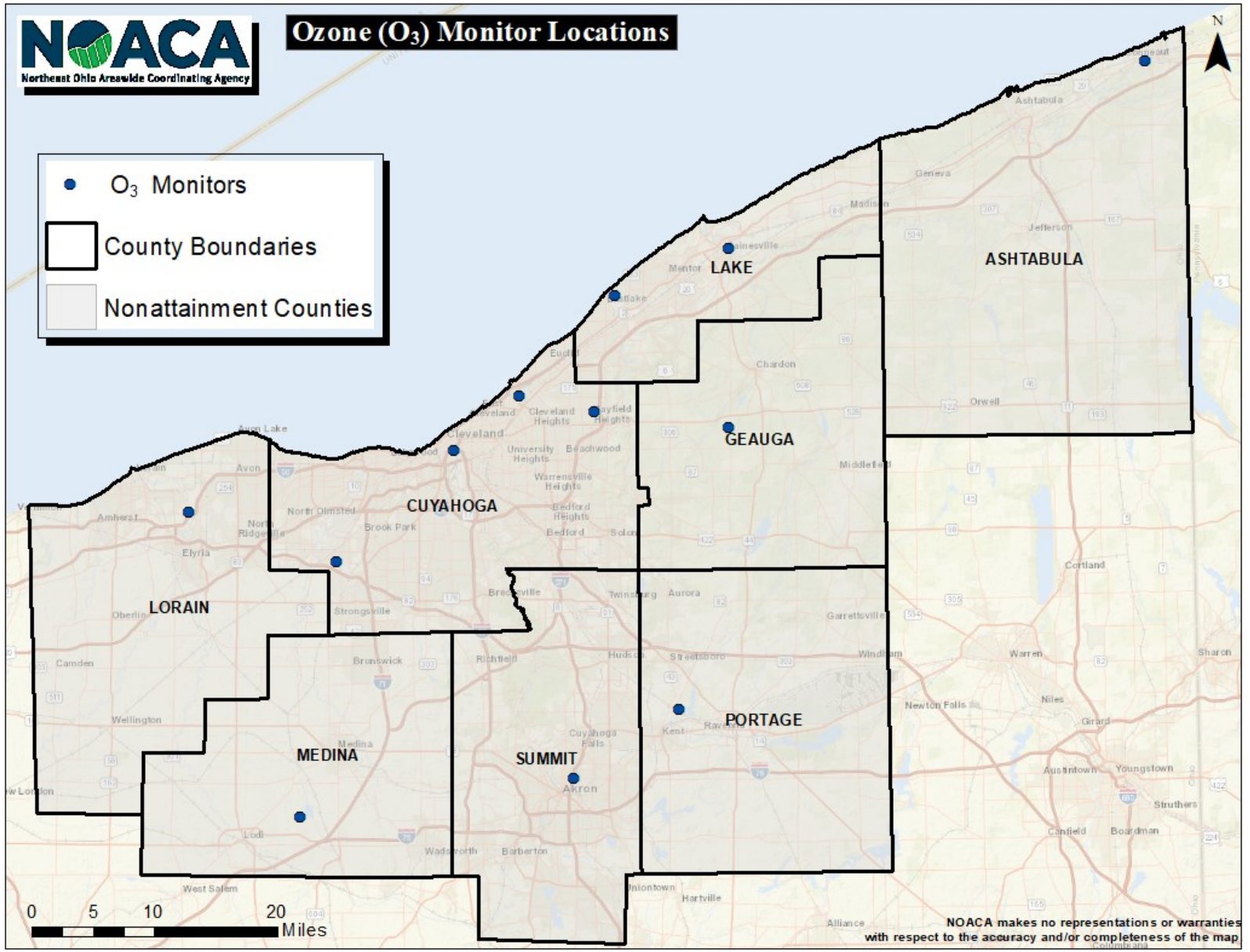
- Ohio Environmental Protection Agency (Ohio EPA) monitors in Northeast Ohio
  - O_3: 12 monitors for ground-level ozone
  - $PM_{2.5}$: Nine (9) monitors for fine particulate matter
- Air Quality Monitoring Region includes:
  - NOACA counties (5): Cuyahoga, Geauga, Lake, Lorain, Medina
  - AMATS counties (2): Portage and Summit
  - Ashtabula County

NOACA
Northeast Ohio Areawide Coordinating Agency

NORTHEAST OHIO O_3 MONITORS

Monitor	County	FIPS ID	Site ID	Latitude	Longitude	Site Name	Address
1	Ashtabula	7	1001	41.95	-80.57	Conneaut	770 Lake Rd., Conneaut
2	Cuyahoga	35	0034	41.55	-81.57	District	891 E. 152 St.
3			0060	41.49	-81.67	GT Craig	GT Craig, E. 14th St. & Orange Ave., Cleveland
4			0064	41.36	-81.86	Berea	Board of Education, 390 Fair St., Berea
5			5002	41.53	-81.45	Mayfield	6116 Wilson Road, Mayfield
6	Geauga	55	0004	41.51	-81.24	Notre Dame	Notre Dame School, Munson TWP.
7	Lake	85	0003	41.67	-81.42	Eastlake	Jefferson School, Eastlake
8			0007	41.72	-81.24	Painesville	177 Main St., Painesville
9	Lorain	93	0018	41.42	-82.09	Elyria	4706 Detroit Rd., Sheffield
10	Medina	103	0004	41.06	-81.92	Chippewa	Ballash Rd., Lafayette Twp.
11	Portage	133	1001	41.18	-81.33	Lake Rockwell	1570 Ravenna Rd., Kent
12	Summit	153	0026	41.10	-81.49	North High	985 Gorge Blvd., Akron

NOACA
Northeast Ohio Areawide Coordinating Agency

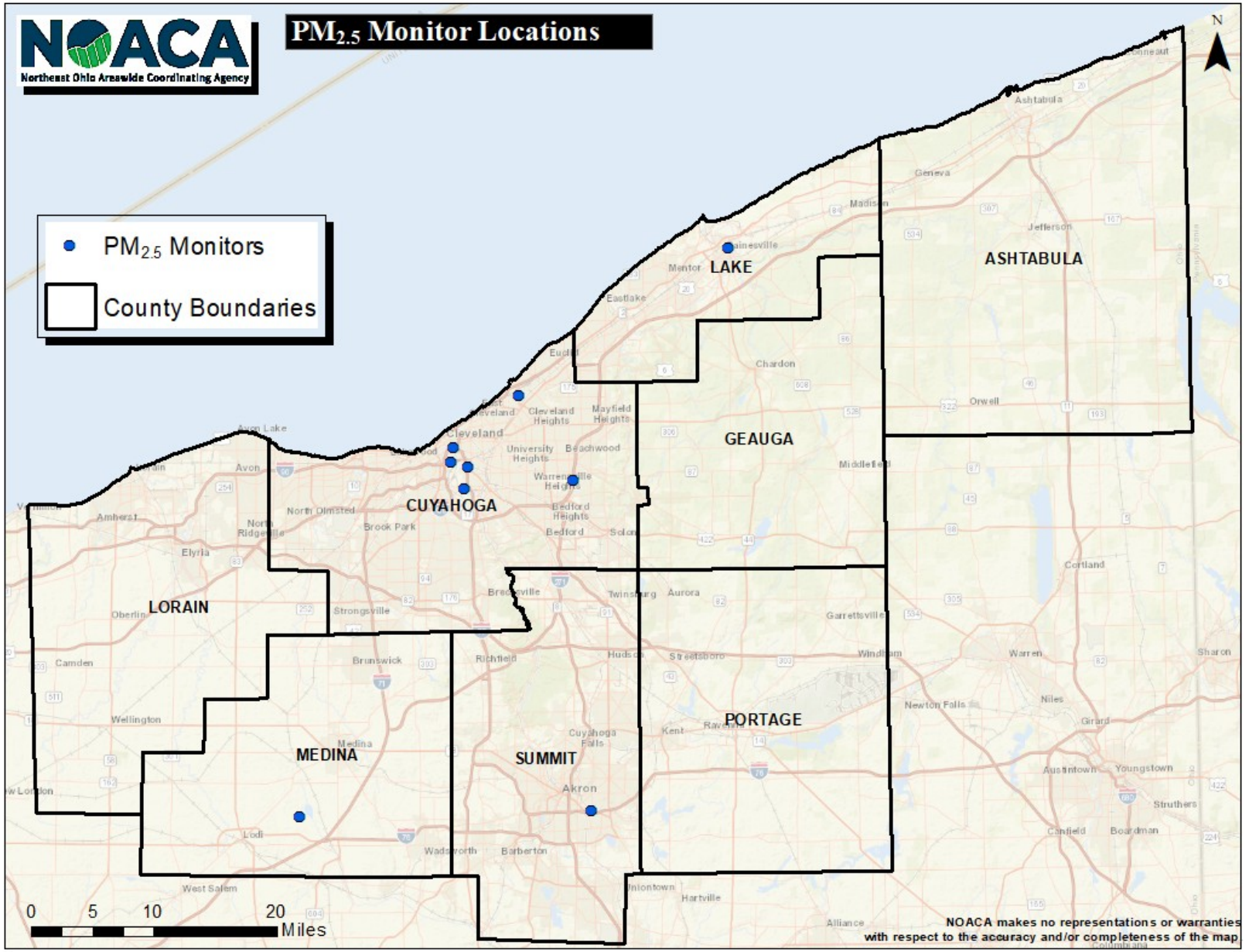


NOACA
Northeast Ohio Areawide Coordinating Agency

NORTHEAST OHIO $PM_{2.5}$ MONITORS

Monitor	County	FIPS ID	Site ID	Latitude	Longitude	Site Name	Address
1	Cuyahoga	035	0034	41.55	-81.57	District 6	891 East 152nd St., Cleveland
2			0038	41.47	-81.68	St. Theodosius	St. Theodosius, St. Tikhon Ave., Cleveland
3			0045	41.47	-81.65	Cleveland Fire	FS 13, 4950 Broadway Ave., Cleveland
4			0060	41.49	-81.67	GT Craig	GT Craig, East 14th St. & Orange Ave., Cleveland
5			0065	41.44	-81.66	Harvard Yards	4600 Harvard Ave., Newburgh Hts.
6			0073	41.44	-81.49	Cleveland Near Road	2506 Emory Rd., Warrensville Hts.
7	Lake	085	0007	41.72	-81.24	Painesville	177 Main St., Painesville
8	Medina	103	0004	41.06	-81.92	Chippewa	Ballash Rd., Lafayette Twp.
9	Summit	153	0017	41.06	-81.46	East HS	East High School, Akron

NOACA
Northeast Ohio Areawide Coordinating Agency



NOACA
Northeast Ohio Areawide Coordinating Agency

NOAA FORECAST ANALYSIS

AIR QUALITY FORECASTS IN NORTHEAST OHIO

NOACA forecasts daily peak fine particulate matter concentrations eight-hour ground-level ozone concentrations.

- Daily forecasts for fine particulate matter are year-round
- In 2024, daily forecasts for ozone began March 1 and will conclude October 31

NOACA posts daily air quality forecasts through AirNowTech, in affiliation with the United States Environmental Protection Agency (U.S. EPA)

NOACA
Northeast Ohio Areawide Coordinating Agency

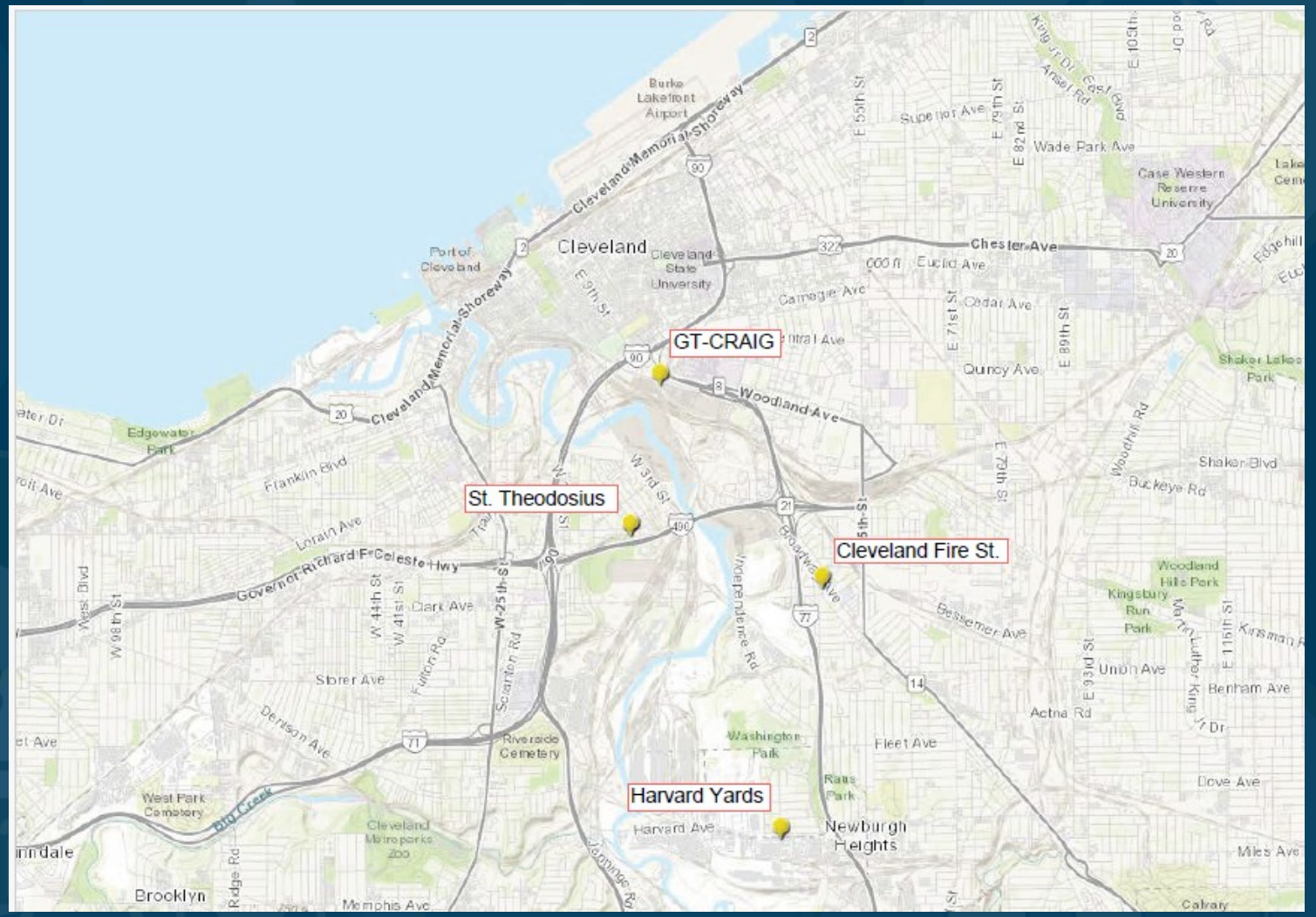
O_3 AND $PM_{2.5}$ ANALYSIS METHODOLOGY

- Analyzed O_3 and $PM_{2.5}$ monitoring locations
- Technical support from NOAA and Division of Air Pollution Control within Tennessee Department of Environment and Conservation
- Staff previously collected NOAA forecast data manually
- Technical support helped staff develop scripts that automatically retrieve NOAA's daily forecast data
- Retrieved archived forecast data from the National Centers for Environmental Information (NCEI)
- Collected daily Ohio EPA observation data
- Compared and analyzed forecast versus observation data

NOACA
Northeast Ohio Areawide Coordinating Agency

$PM_{2.5}$ MONITOR CHALLENGES

- Duplicate data for multiple sites
- Number of significant figures in latitude/longitude coordinates affects results



2024 MODEL PERFORMANCE

NOACA AND NOAA 2024 FORECAST PERFORMANCE: O_3

FORECAST		THRESHOLD	
		50ppb	70ppb
AGENCY	NOACA	81%	93%
	NOAA 6Z (M/B) NOAA 12Z (M/B)	(77/76)% (78/77)%	(94/93)% (93/93)%

M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

EXCEEDANCE DAYS FOR 2024 (O_3)

	FORECAST AQI		OBSERVED AQI	
DATE	NOAA 6Z(M/B)/ 12Z(M/B)	NOACA	PEAK (ppb)	# STATIONS
MAY 20	2/2/2/2	3	3 (81)	3
MAY 21	2/2/2/2	3	3 (73)	2
MAY 24	2/3/2/3	2	3 (72)	2
JUNE 19	3/2/3/2	2	3 (71)	1
JUNE 20	2/2/3/2	2	3 (74)	2
JUNE 21	2/2/2/2	2	3 (73)	2
JUNE 22	2/2/2/2	2	3 (73)	2
JULY 31	2/1/2/1	2	3 (71)	1
AUGUST 24	2/2/2/2	2	3 (77)	2

AIR QUALITY INDEX	
CATEGORY	HEALTH CONCERN LEVEL
1	GOOD
2	MODERATE
3	UNHEALTHY FOR SENSITIVE GROUPS
4	UNHEALTHY
5	VERY UNHEALTHY
6	HAZARDOUS

M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

NOAA VERSUS NOACA EXCEEDANCE FORECAST PERFORMANCE: O_3

- "Missed Opportunities" – Seven (7) days NOACA did not forecast observed categorical exceedance of 2015 eight-hour ozone standard (70 ppb); NOAA missed opportunities eight (8) days with 6Z M/B; seven (7) days with 12Z M; and eight (8) days with 12Z B.
- "False Alarms" – Eight (8) days NOACA forecast categorical exceedance of 2015 eight-hour standard (70 ppb) when observed concentrations did not exceed. NOAA had false alarms four (4) days with 6Z M; seven (7) days with 6Z B; and six (6) days with 12Z M/B.

M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

EXCEEDANCE STATIONS

- 39 exceedance stations (events when either the forecast, the observation, or both exceeded the 2015 O_3 NAAQS at individual monitors).
- "Missed Opportunities" – **Both the M and B Models missed observed exceedance at a station 15 times (39%).**
- "False Alarms" – **At least one model falsely predicted exceedance at a station 22 times (56%)**
- "Success" – **Both M and B models predicted exceedance at a station two (2) times (5%)**

M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

EXCEEDANCE STATIONS

	SUCCESSFUL PREDICTIONS		
YEAR	SUCCESS	TOTAL	%
2020	5	39	12.8%
2021	2	20	10.0%
2022	4	37	10.8%
2023	11	65	16.9%
2024	2	39	5.1%

M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

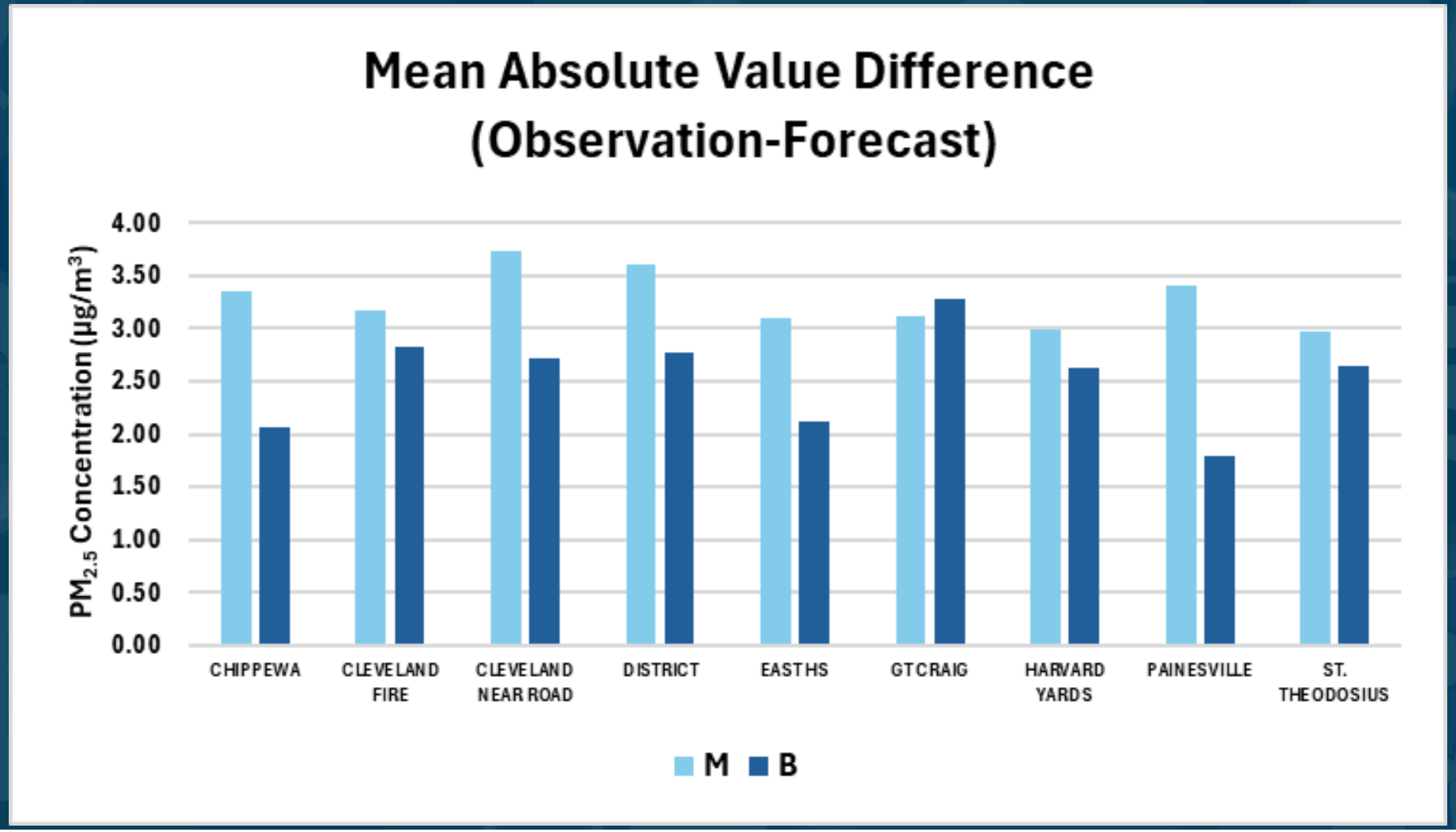
NOACA AND NOAA 2024 FORECAST PERFORMANCE: $PM_{2.5}$

FORECAST		THRESHOLD	
		12 µg/m³	35 µg/m³
AGENCY	NOACA	68%	100%
	NOAA 6Z (M/B) NOAA 12Z (M/B)	(75/72)% (75/74)%	(100/100)% (100/100)%

M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

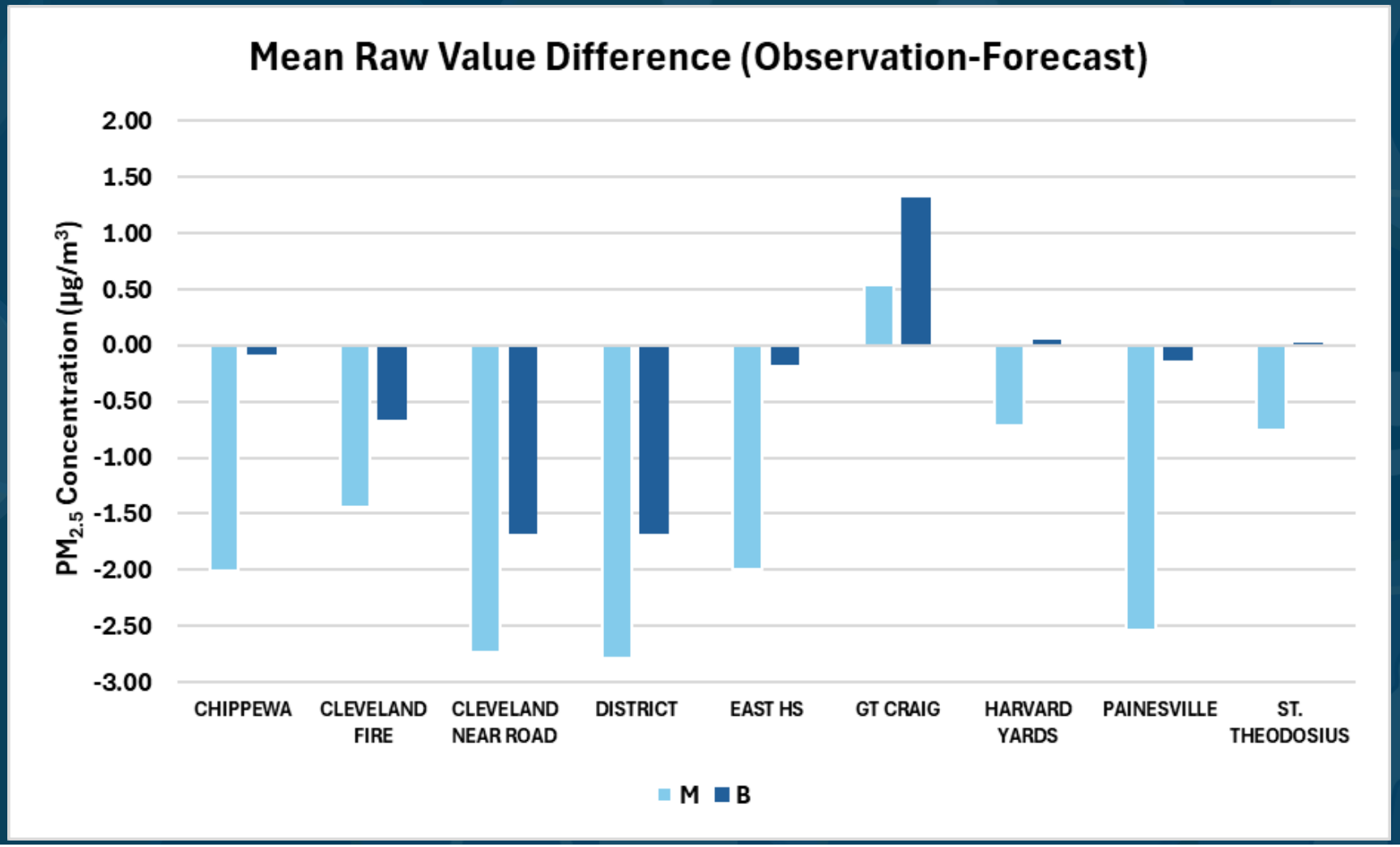
$PM_{2.5}$ MONITOR PERFORMANCE



M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

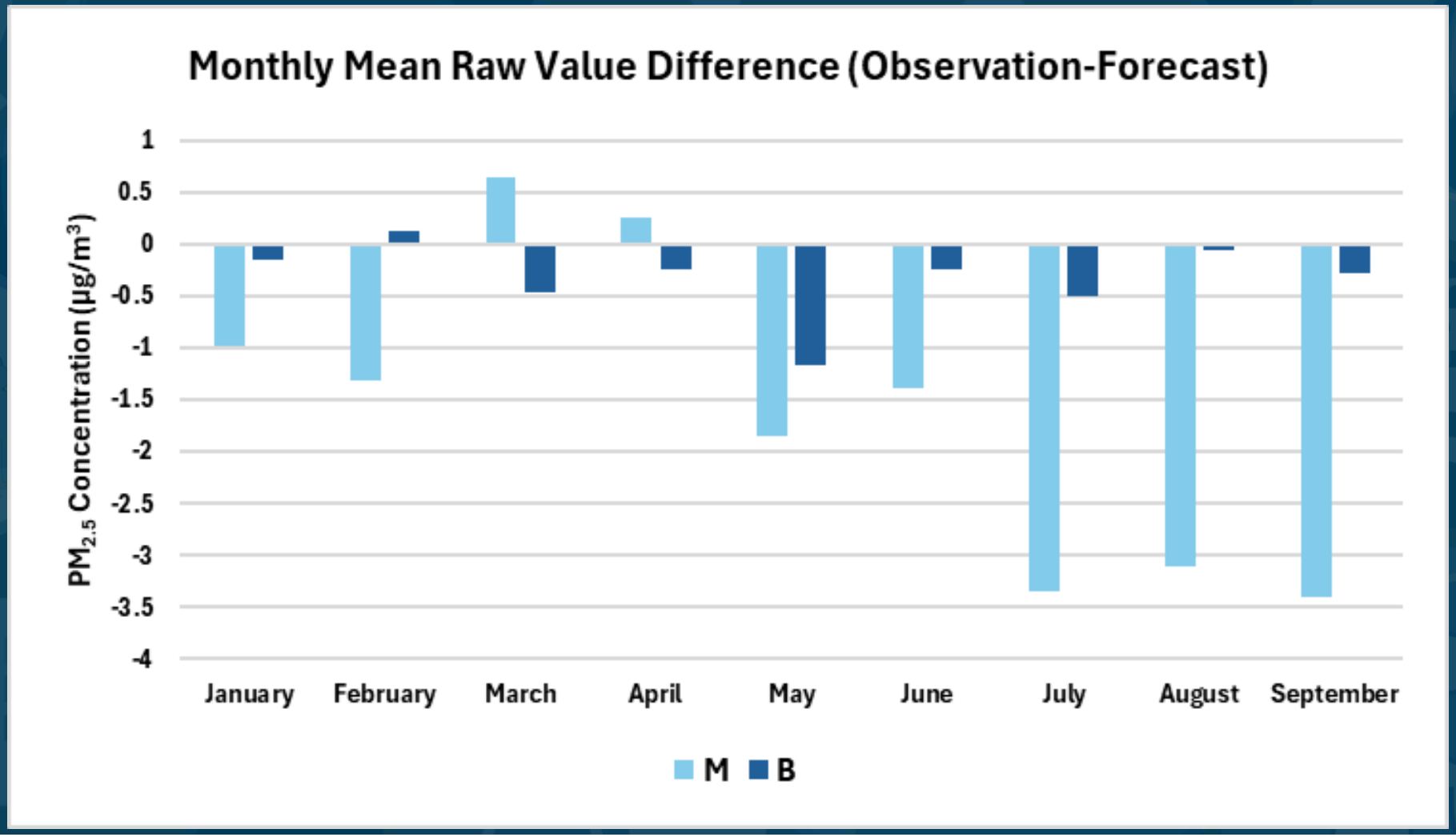
$PM_{2.5}$ MONITOR PERFORMANCE



M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

$PM_{2.5}$ MONITOR PERFORMANCE



M = Model; B = Bias-Corrected Model

NOACA
Northeast Ohio Areawide Coordinating Agency

CONCLUSION

- NOAA models did not forecast ozone concentrations around the exceedance threshold quite as well this season
  - Numerous, isolated, low-level exceedance events
  - Low accuracy of exceedance prediction at individual stations (5%)
- NOAA's $PM_{2.5}$ bias-corrected model (B) produced more accurate forecasts than the raw model (M)
- NOAA's $PM_{2.5}$ model forecast concentrations were generally higher than the observed concentrations
- NOAA's $PM_{2.5}$ model forecast concentrations were substantially higher than observed concentrations during the warmer months (May-September)

NOACA
Northeast Ohio Areawide Coordinating Agency

ACKNOWLEDGEMENTS

- Dave Miller, Research Associate, Programmer
- Jack Kain, Senior Technical Program Manager
- Youngsun Jung, Program Manager

- Kyle Spangle, Environmental Consultant within the Division of Air Pollution Control

NOACA
Northeast Ohio Areawide Coordinating Agency

QUESTIONS?

FOR MORE INFORMATION:

www.noaca.org

NOACA
Northeast Ohio Areawide Coordinating Agency