



**GEORGIA**  
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

# Implementing the PM<sub>2.5</sub> NAAQS in GA

**James W. Boylan, Ph.D.**  
Chief, Air Protection Branch

**AAPCA 2024 Fall Meeting**  
Raleigh, NC  
August 29, 2024



# PM<sub>2.5</sub> DESIGNATIONS & EE DEMOS



# DESIGNATIONS SCHEDULE

- **State's Designation Recommendations**

- One year after promulgation date of NAAQS
  - **February 7, 2025**
  - Based on **2021-2023** PM<sub>2.5</sub> data



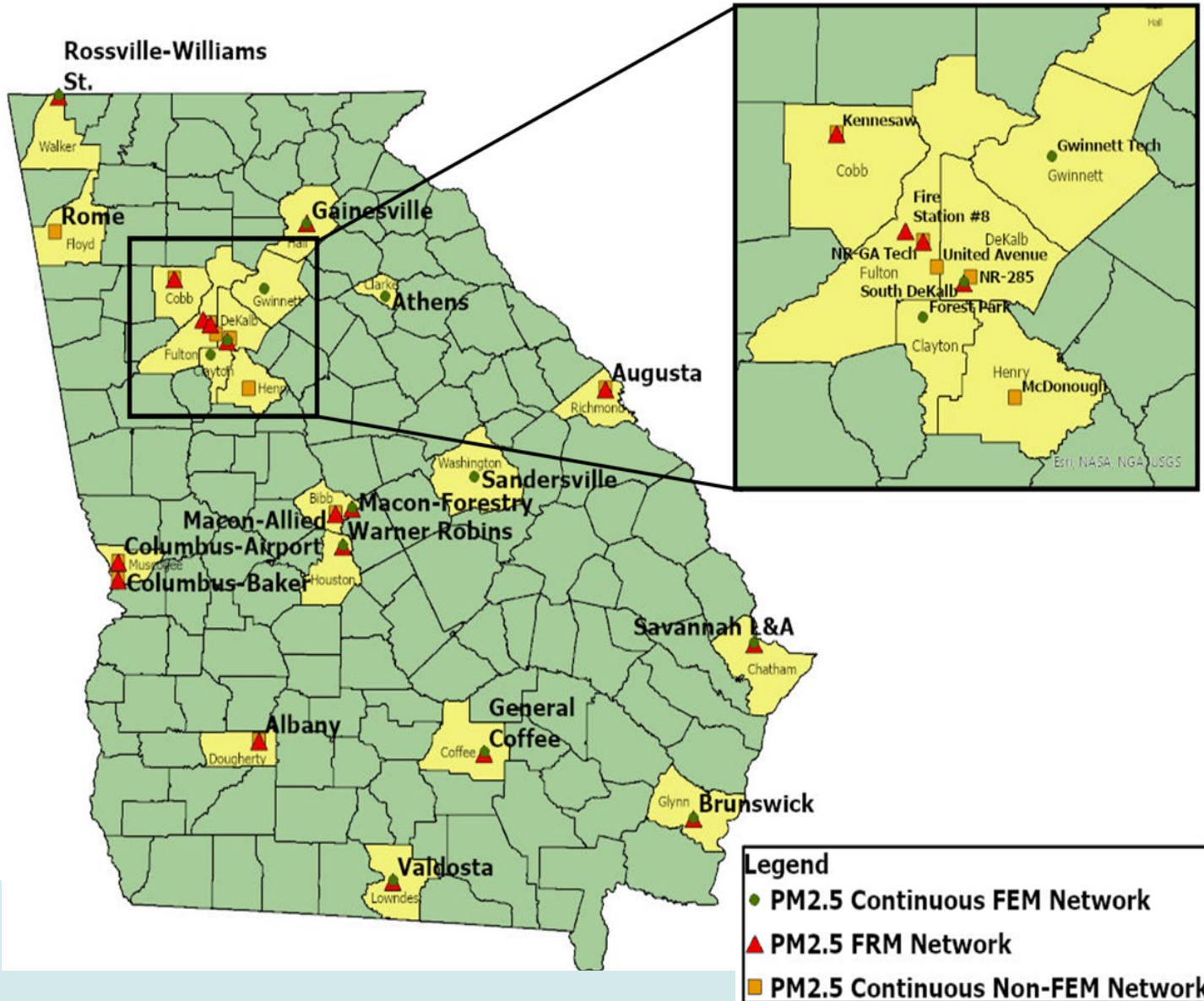
- **EPA's Final Designations**

- Two years after promulgation date of NAAQS
  - **February 6, 2026**
  - Based on **2022-2024** PM<sub>2.5</sub> data



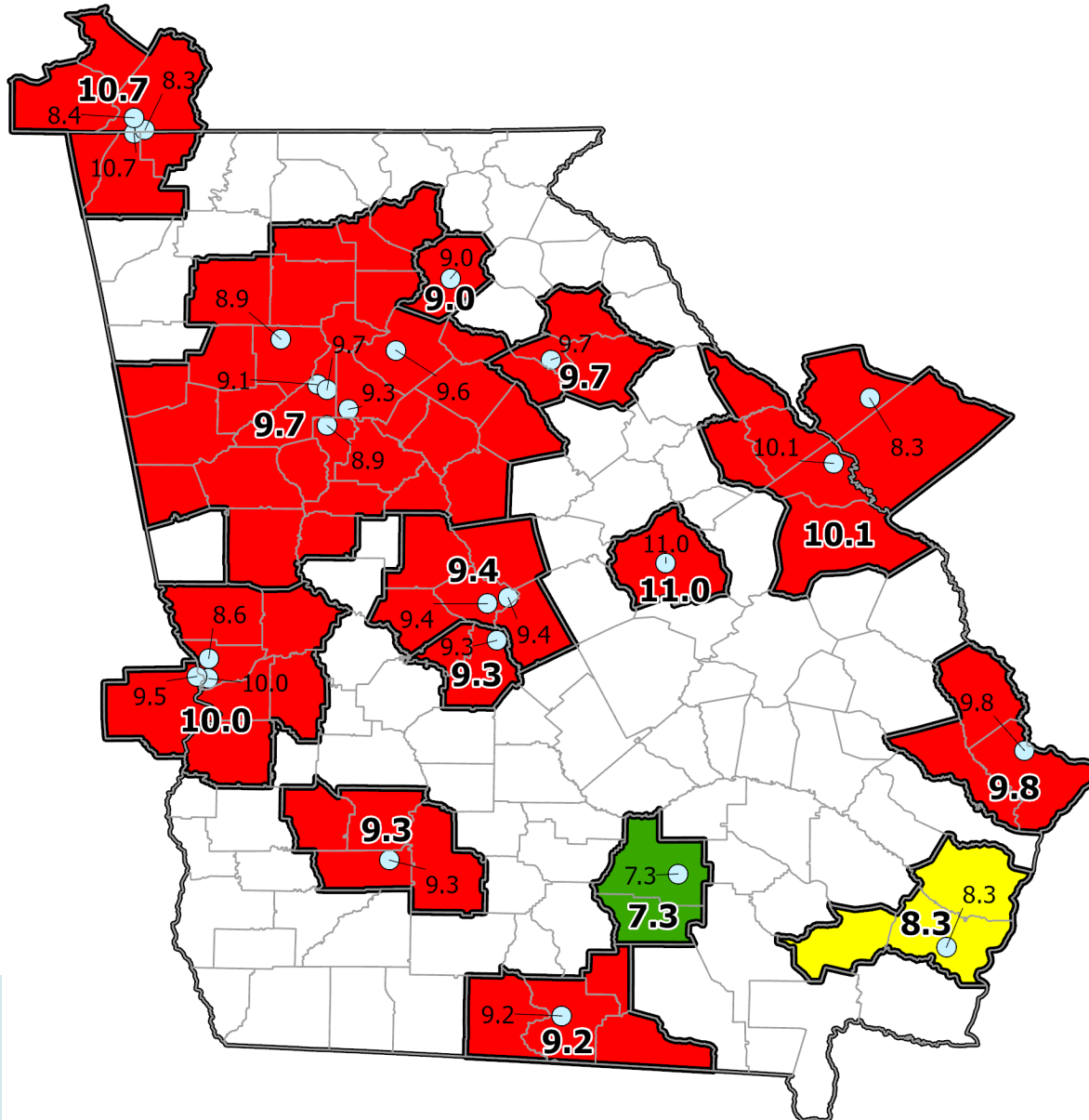


# PM<sub>2.5</sub> MONITOR LOCATIONS



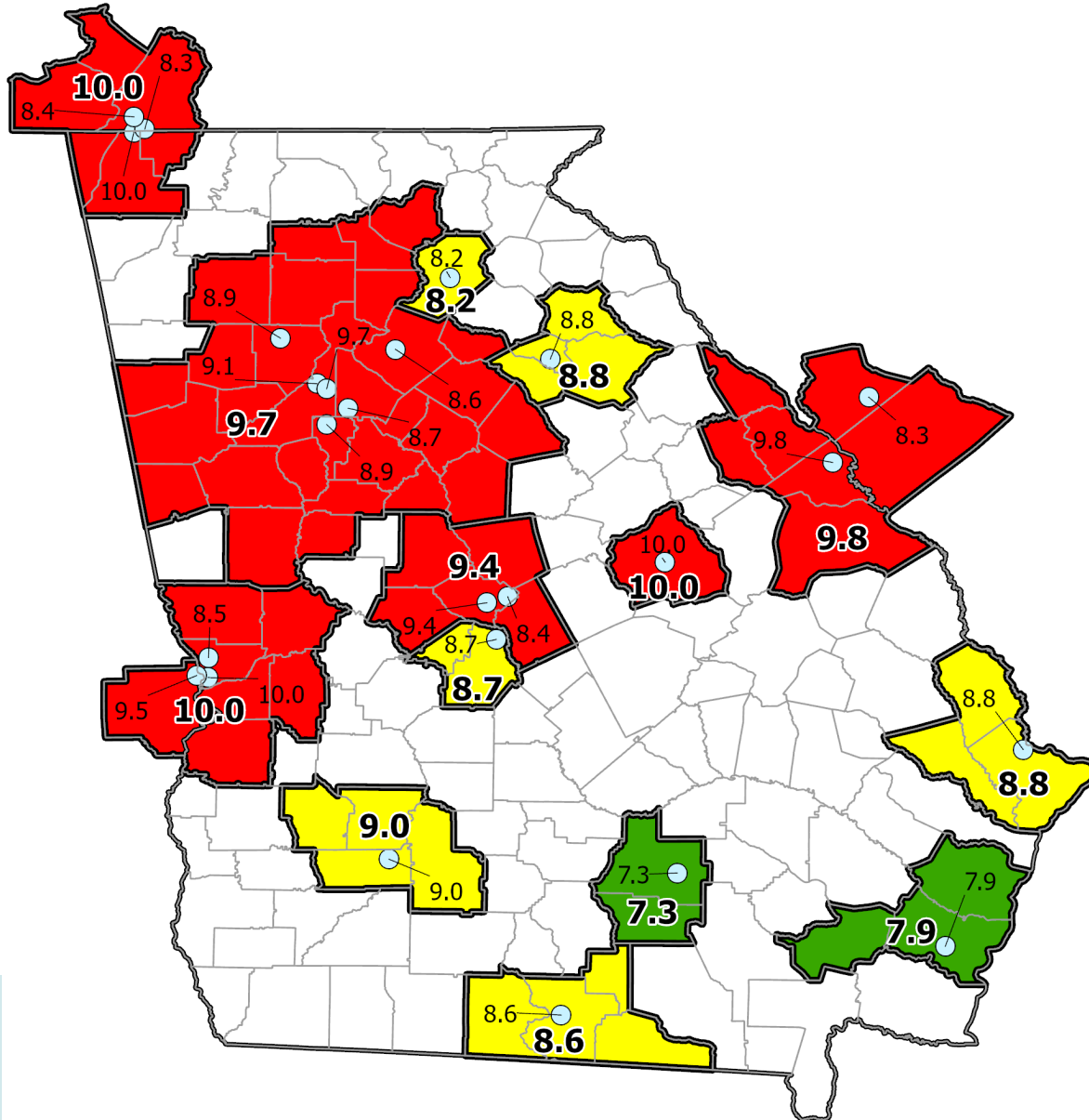


# UNADJUSTED 2021-2023 DESIGN VALUES





# EPA ADJUSTED 2021-2023 DESIGN VALUES

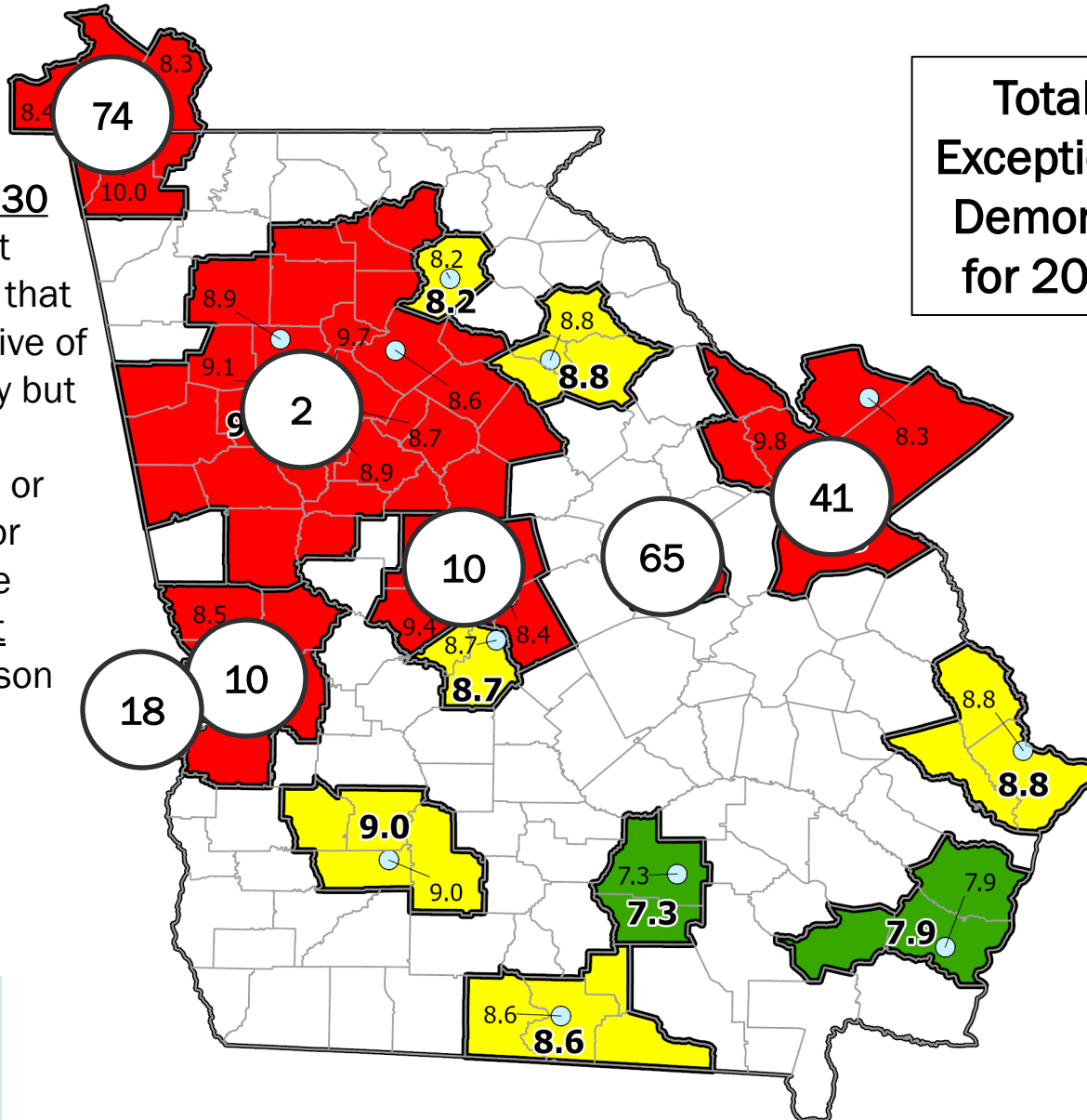




# NUMBER OF EE DEMONSTRATIONS

## 40 CRF Section 58.30

PM<sub>2.5</sub> measurement data from monitors that are not representative of area-wide air quality but rather of relatively unique micro-scale, or localized hot spot, or unique middle-scale impact sites are not eligible for comparison to the annual PM<sub>2.5</sub> NAAQS.



Total of **220**  
Exceptional Event  
Demonstrations  
for 2022-2023



# EXCEPTIONAL EVENTS ELEMENTS

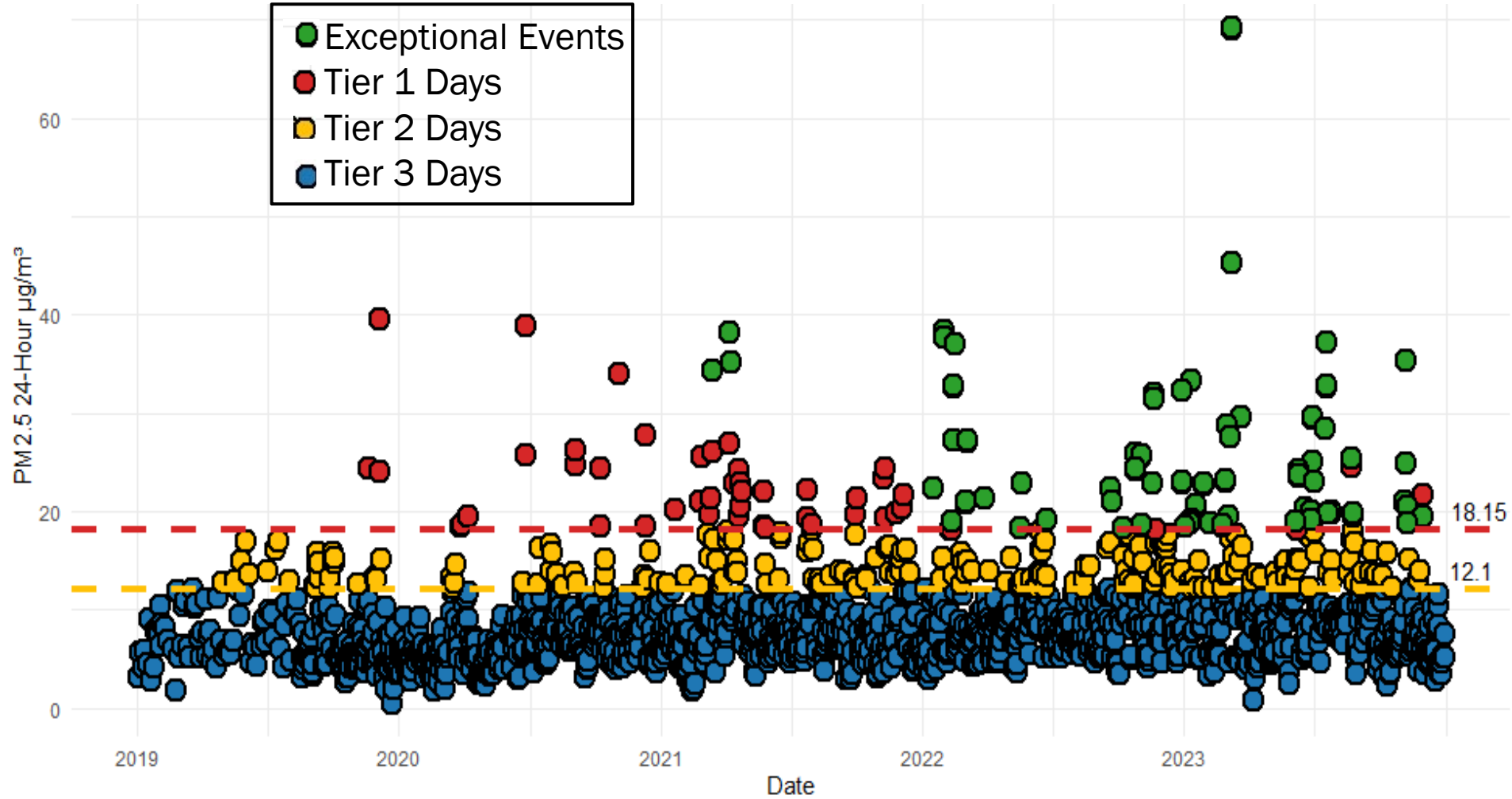
- **Conceptual Model of the Event**
- **Clear Causal Relationship**
  - Ambient measurements, modeling, satellite images, etc.
- **Human Activity Unlikely to Recur**
  - Natural fire return interval map
- **Not Reasonably Controllable/Preventable**
  - Certified Smoke Management Program
- **Public Comment Process**

“Exceptional Events Guidance: Prescribed Fire on Wildland that May Influence Ozone and Particulate Matter Concentrations”, EPA-457/B-19-004, August 2019.





# SANDERSVILLE - 65 EXCEPTIONAL EVENTS



Prescribed Fire Exceptional Event Days → 56 days  
Canadian Wildfire Exceptional Event Days → 9 days



# GFC PERMITS – FEBRUARY 14, 2022

## Top 20

COUNTY	SIZE	Burn_Purpose	LATITUDE	LONGITUDE
Jones	610	Silviculture	33.05586996	-83.64946724
Mcduffie	513	Silviculture	33.62945556	-82.52864167
Wheeler	300	Silviculture	32.13085963	-82.76524669
Burke	178	Silviculture	33.0354647	-81.84254273
Houston	176	Silviculture	32.45871362	-83.50279312
Dodge	175	Silviculture	32.17451051	-83.2241628
Jones	160	Silviculture	33.16473333	-83.43642778
Washington	150	Silviculture	33.0675871	-83.0321329
Mcduffie	110	Silviculture	33.58500983	-82.42389031
Tattnell	100	Agriculture	32.26333791	-82.1979173
Twiggs	100	Silviculture	32.7994666	-83.3775476
Monroe	100	Silviculture	32.8899525	-83.8283828
Jones	100	Silviculture	33.09904299	-83.5660269
Toombs	100	Silviculture	32.23339655	-82.31679178
Laurens	90	Silviculture	32.2853189	-82.9084566
Baldwin	81	Silviculture	33.02804769	-83.15559807
Emanuel	76	Silviculture	32.54512838	-82.45107522
Emanuel	75	Silviculture	32.60075505	-82.4454209
Putnam	65	Land Clearing	33.3905891	-83.3622145
Monroe	60	Silviculture	33.01961111	-83.76498611

## Bottom 20

COUNTY	SIZE	Burn_Purpose	LATITUDE	LONGITUDE
Hancock	2	Land Clearing	33.12209313	-82.94030162
Toombs	2	Silviculture	32.18670019	-82.33943488
Candler	2	Agriculture	32.47340351	-82.05904372
Jones	1	Land Clearing	33.1214944	-83.45910935
Laurens	1	Silviculture	32.29594504	-82.99188602
Candler	1	Land Clearing	32.5088926	-82.0194364
Laurens	1	Land Clearing	32.44466475	-82.94317169
Emanuel	1	Land Clearing	32.3275789	-82.2735341
Bibb	1	Land Clearing	32.91197664	-83.70384959
Burke	1	Land Clearing	33.16960301	-82.03784217
Jefferson	1	Land Clearing	33.06817504	-82.43631337
Greene	1	Land Clearing	33.6298167	-83.1682649
Jenkins	1	Land Clearing	32.81644766	-82.12885796
Pulaski	1	Silviculture	32.2938868	-83.4965858
Monroe	1	Land Clearing	32.90466884	-83.82116405
Laurens	1	Land Clearing	32.4308006	-82.7088315
Bleckley	1	Silviculture	32.34435074	-83.39492223
Emanuel	0.5	Agriculture	32.36934204	-82.32976799
Wilkinson	0.5	Silviculture	32.918108	-83.2997279
Emanuel	0.5	Agriculture	32.6578591	-82.0955841

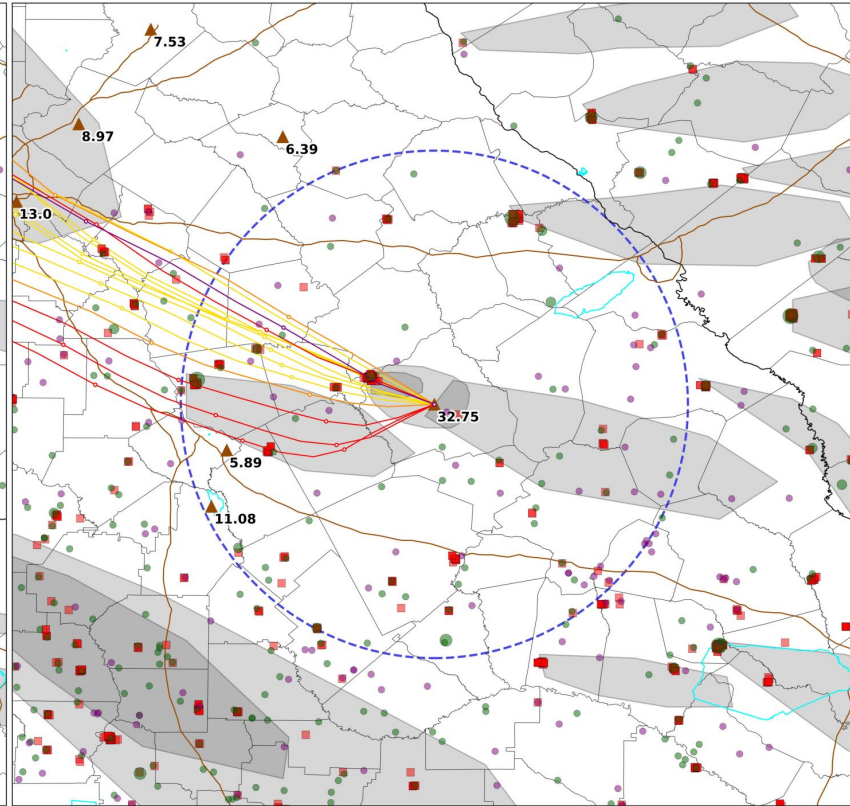
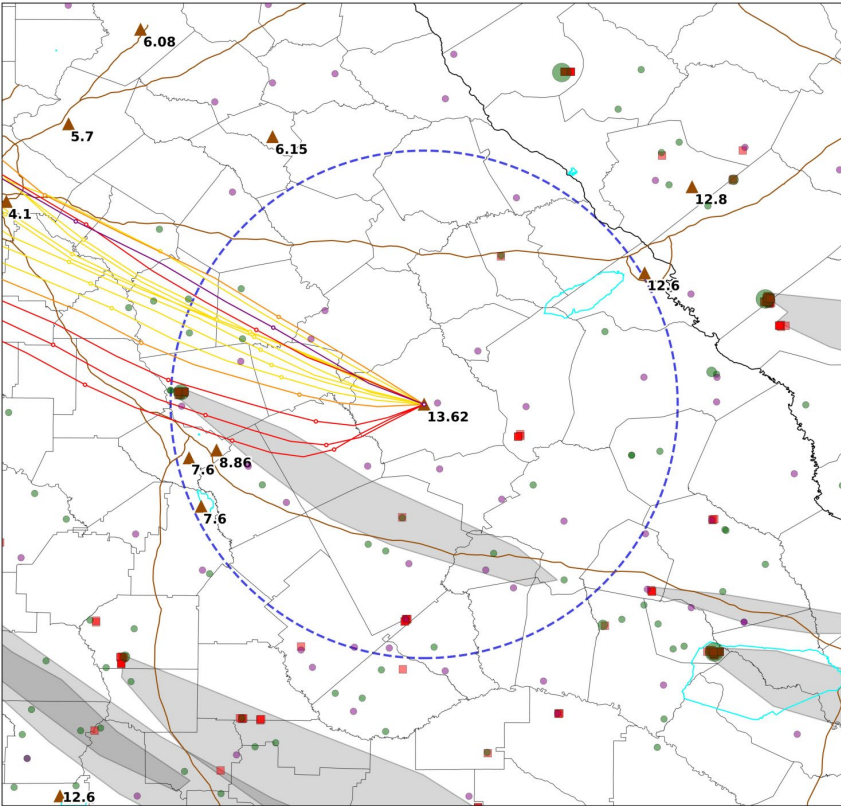
Total of 100 GFC permits issues in 100 km radius.



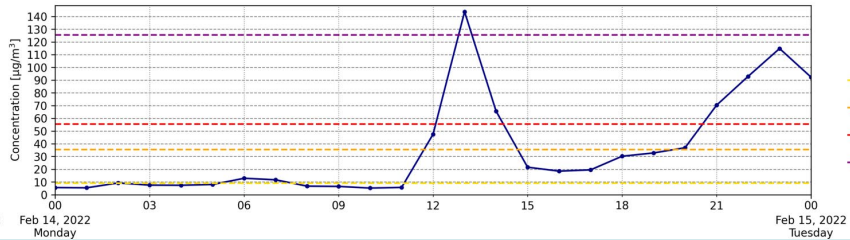
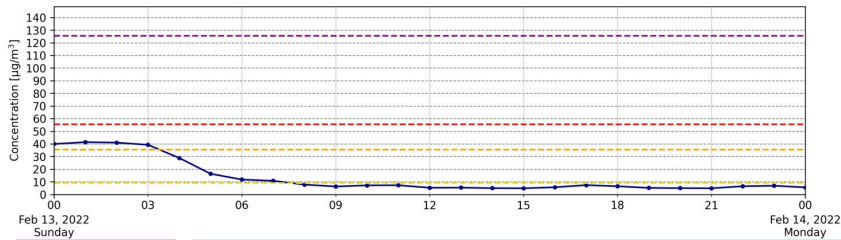
# SANDERSVILLE – FEBRUARY 14, 2022

Sandersville on 20220213

Sandersville on 20220214



- HYSPLIT trajectories from 02/14/22**
- 9.1 to 35.4  $\mu\text{g}/\text{m}^3$
  - 35.5 to 55.4  $\mu\text{g}/\text{m}^3$
  - 55.5 to 125.4  $\mu\text{g}/\text{m}^3$
  - $\geq 125.5 \mu\text{g}/\text{m}^3$
- Military Base**
- Interstate Highway**
- 100 km buffer**
- Monitor**
- Silviculture**
- $\leq 100$
  - 101 - 200
  - 201 - 500
  - 501 - 1000
  - $\geq 1001$
- Non-Silviculture**
- $\leq 100$
  - 101 - 200
  - 201 - 500
  - 501 - 1000
  - $\geq 1001$
- HMS fires**
- HMS smoke Light
  - HMS smoke Medium
  - HMS smoke Heavy



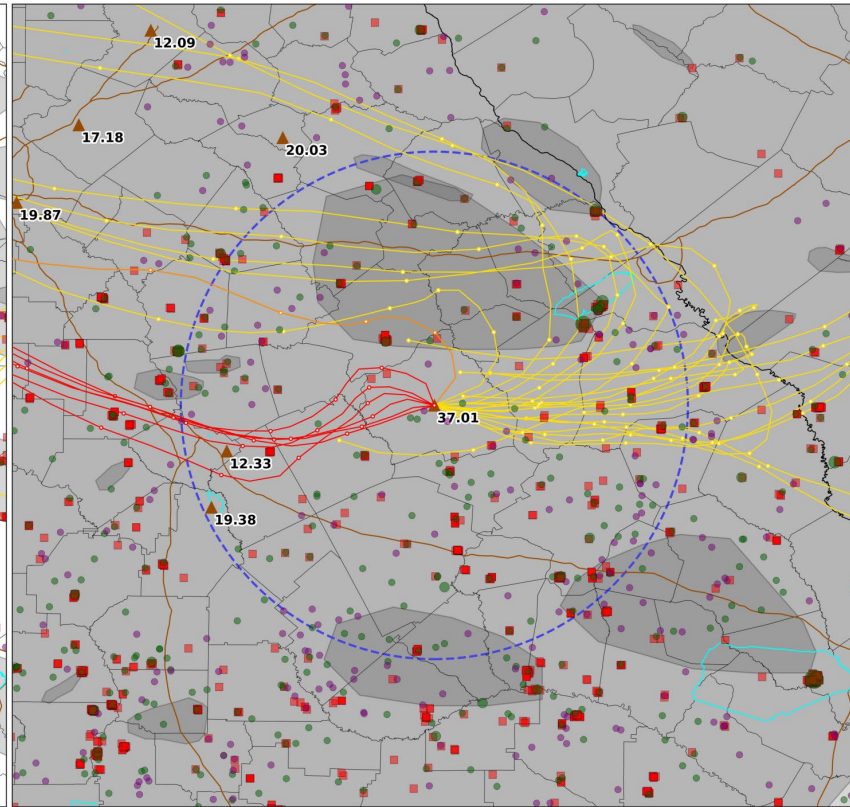
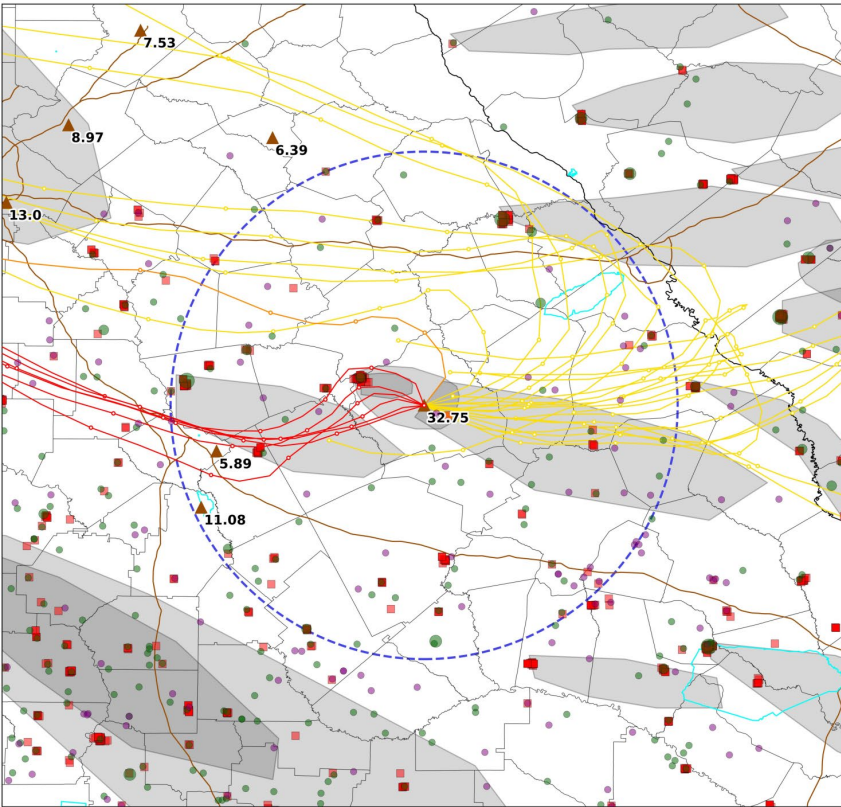
- 9.1 to 35.4  $\mu\text{g}/\text{m}^3$
- 35.5 to 55.4  $\mu\text{g}/\text{m}^3$
- 55.5 to 125.4  $\mu\text{g}/\text{m}^3$
- $\geq 125.5 \mu\text{g}/\text{m}^3$



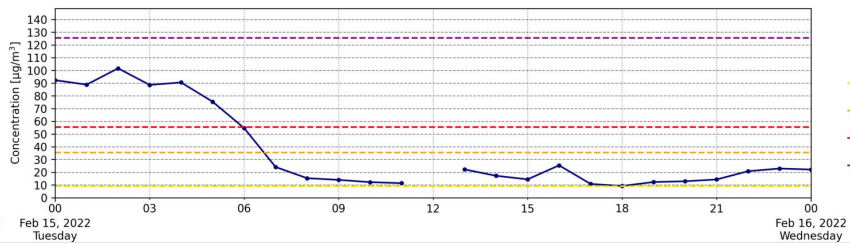
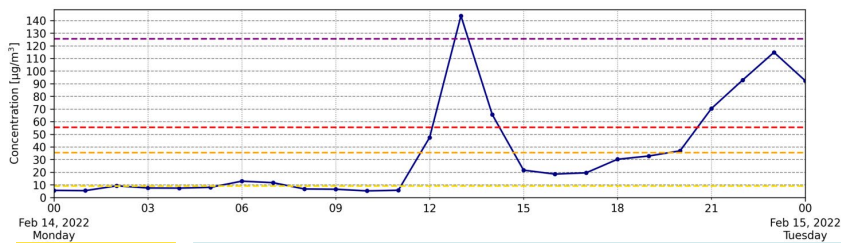
# SANDERSVILLE – FEBRUARY 15, 2022

Sandersville on 20220214

Sandersville on 20220215



- HYSPLIT trajectories from 02/15/22
- 9.1 to 35.4  $\mu\text{g}/\text{m}^3$
  - 35.5 to 55.4  $\mu\text{g}/\text{m}^3$
  - 55.5 to 125.4  $\mu\text{g}/\text{m}^3$
  - $\geq 125.5 \mu\text{g}/\text{m}^3$
- Military Base
  - Interstate Highway
  - - - 100 km buffer
  - ▲ Monitor
- Silviculture
- $\leq 100$
  - 101 - 200
  - 201 - 500
  - 501 - 1000
  - $\geq 1001$
- Non-Silviculture
- $\leq 100$
  - 101 - 200
  - 201 - 500
  - 501 - 1000
  - $\geq 1001$
- HMS fires
  - HMS smoke Light
  - HMS smoke Medium
  - HMS smoke Heavy



- - - 9.1 to 35.4  $\mu\text{g}/\text{m}^3$
- - - 35.5 to 55.4  $\mu\text{g}/\text{m}^3$
- - - 55.5 to 125.4  $\mu\text{g}/\text{m}^3$
- - -  $\geq 125.5 \mu\text{g}/\text{m}^3$



# FUTURE EE DEMONSTRATIONS

- The Georgia Forestry Commission would like to increase the acreage burned across the State.
- Estimate the need to submit ~100 EE demonstrations in 2025 (for 2024 data) and ~100 EE demonstrations in 2026, 2027, and every year after (forever) to remain in attainment with the PM standard.
- Georgia EPD is working with EPA R4 and the Georgia Forestry Commission to develop an Exceptional Events template for prescribed fires in the SE.



## NEXT STEPS

- **Need to work with neighboring states for multi-state designation recommendations.**
- **Need to better understand how fires at military bases will be treated under the Exceptional Events Rule.**
  - DoD facilities typically have Wildland Fire Management Plans
  - Military bases do not require a burn permit from GFC.
  - States do not have any authority to restrict burning at DoD facilities.
  - “Military readiness exemption” from environmental laws?



# TELEDYNE BIAS ADJUSTMENT



# TELEDYNE ALIGNMENT ALGORITHM

The alignment factor calculation implemented in the new T640/x software is:

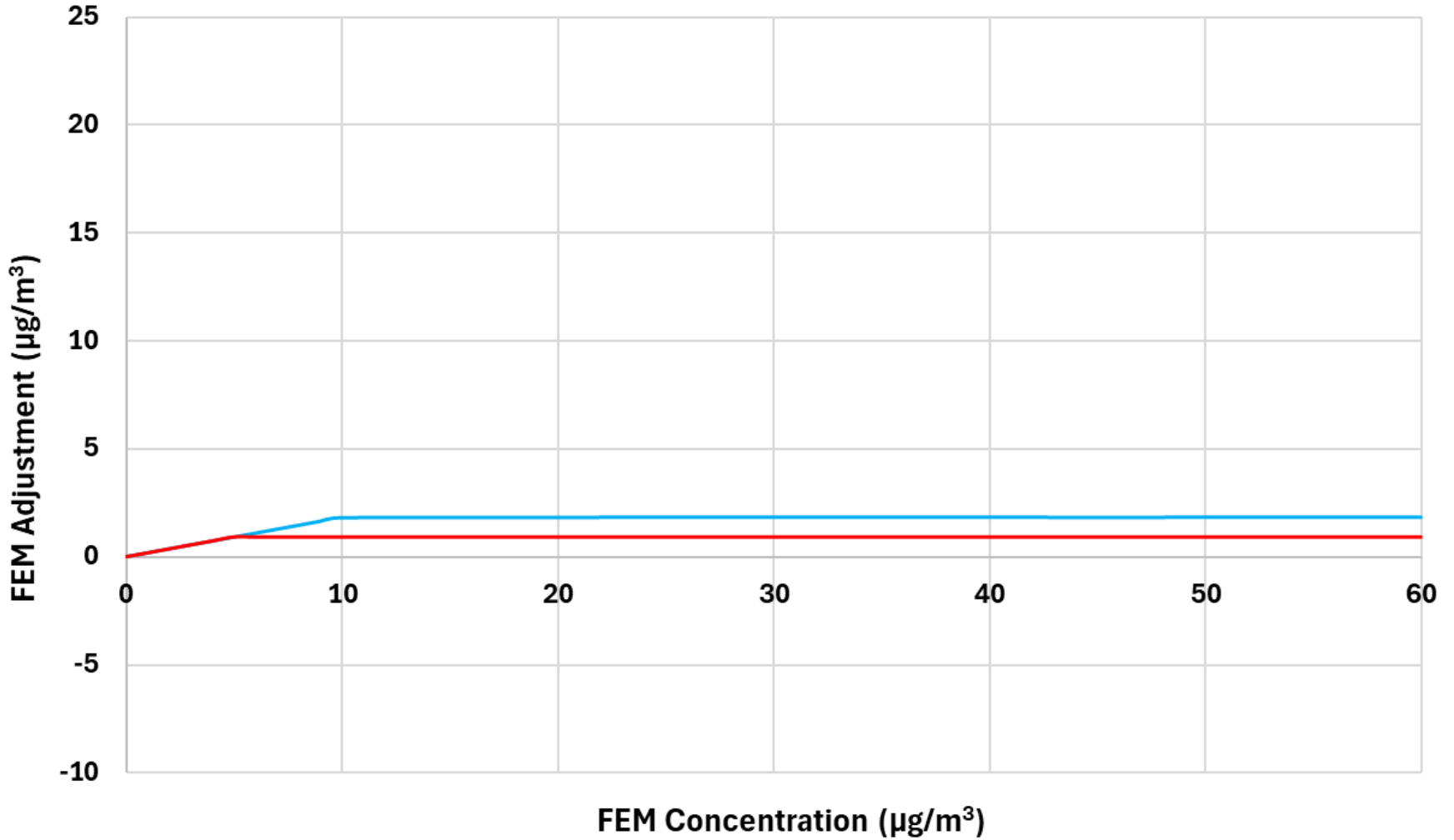
- If the ambient temperature is at or below 20°C
  - - T640/x raw PM value is less than or equal to 10ug/m<sup>3</sup>, then multiply the T640/x raw PM value by 0.813233
  - - T640/x raw PM value is greater than 10ug/m<sup>3</sup>, then use the equation (T640/x raw PM – 1.861)

- If the ambient temperature is above 20°C
  - - T640/x raw PM value is less than or equal to 5ug/m<sup>3</sup>, then multiply the T640/x raw PM value by 0.813233
  - - T640/x raw PM value is greater than 5ug/m<sup>3</sup>, then use the equation (T640/x raw PM – 0.925)

CASE	PM <sub>2.5</sub> Conc.	Temp. ≤ 20 °C	CASE	PM <sub>2.5</sub> Conc.	Temp. > 20 °C
A	≤ 10 µg/m <sup>3</sup>	T640/x * 0.813233	C	≤ 5 µg/m <sup>3</sup>	T640/x * 0.813233
B	> 10 µg/m <sup>3</sup>	T640/x - 1.861	D	> 5 µg/m <sup>3</sup>	T640/x - 0.925

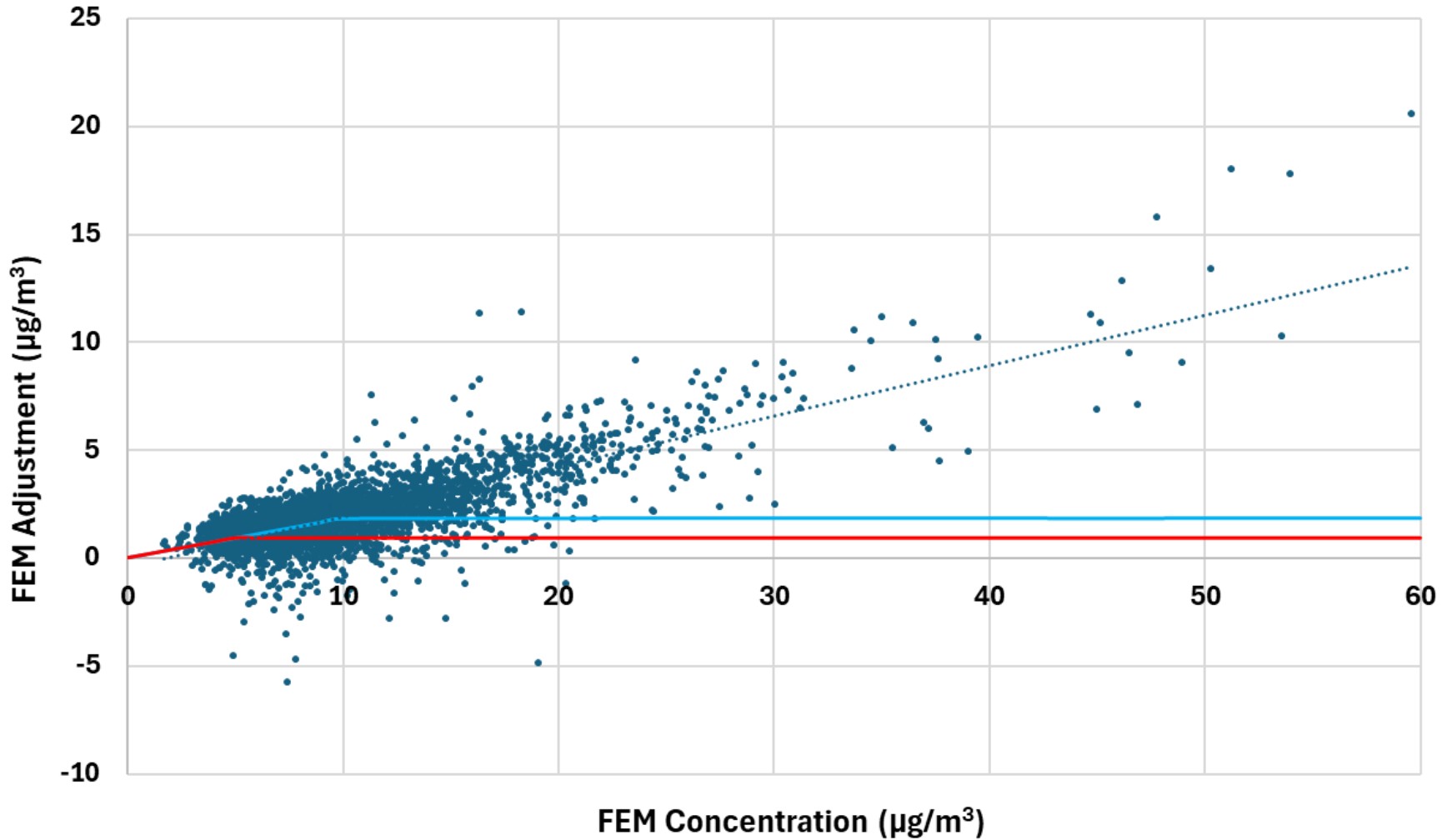


# TELEDYNE ADJUSTMENT





# TELEDYNE vs. ACTUAL ADJUSTMENT NEEDED



January 1, 2021 – July 31, 2023



# ALTERNATIVE ALIGNMENT ALGORITHM

The alignment factor calculation implemented in the new T640/x software is:

~~- If the ambient temperature is at or below 20°C~~  
~~-- T640/x raw PM value is less than or equal to 10ug/m<sup>3</sup>, then multiply the T640/x raw PM value by 0.813233~~  
~~-- T640/x raw PM value is greater than 10ug/m<sup>3</sup>, then use the equation (T640/x raw PM ~~1.861~~)~~

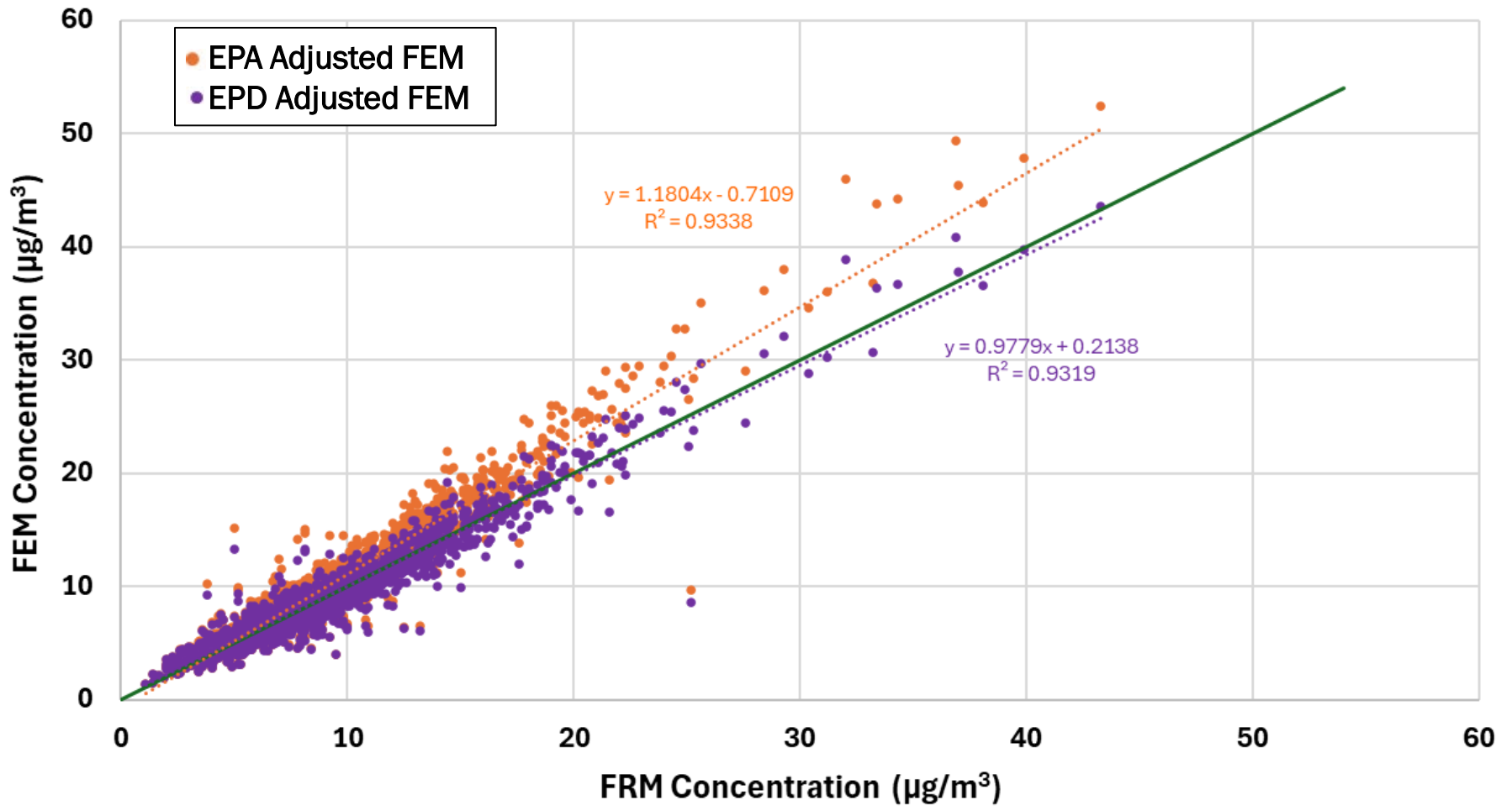
~~- If the ambient temperature is above 20°C~~  
~~-- T640/x raw PM value is less than or equal to 5ug/m<sup>3</sup>, then multiply the T640/x raw PM value by 0.813233~~  
~~-- T640/x raw PM value is greater than 5ug/m<sup>3</sup>, then use the equation (T640/x raw PM ~~0.925~~)~~

**-- Multiply the T640/x raw PM value by 0.813233**

On March 24, 2023, Georgia EPD submitted written comments to EPA on the proposed PM NAAQS. EPD recommended 0.82 as the statewide bias adjustment factor for GA.



# EPA ADJUSTED FEM vs. EPD ADJUSTED FEM



January 1, 2021 – July 31, 2023



# FEM NORMALIZED MEAN BIAS

Monitor Name (AQS Number)	Unadjusted FEM	EPA Adjusted FEM (POC 23)	EPD Adjusted FEM
Albany (13-095-0007)	28.41%	14.03%	4.43%
Augusta (13-245-0091)	X	X	X
Brunswick (13-127-0006)	18.18%	4.06%	-3.89%
Columbus-Airport (13-215-0008)	X	X	X
Columbus-Baker (13-215-0012)	12.47%	5.61%	-8.54%
Gainesville (13-139-0003)	26.50%	15.68%	2.88%
Macon-Allied (13-021-0007)	25.24%	17.41%	1.85%
Macon-Forestry (13-021-0012)	25.57%	10.26%	2.11%
Rossville-Williams St (13-295-0004)	27.21%	14.18%	3.45%
Savannah-L&A (13-051-1002)	11.43%	-0.14%	-9.38%
South DeKalb (13-089-0002)	22.11%	7.63%	-0.70%
Valdosta (13-185-0003)	25.27%	10.60%	1.87%
Warner Robins (13-153-0001)	23.78%	9.47%	0.66%
<b>Statewide</b>	<b>23.37%</b>	<b>9.59%</b>	<b>-0.24%</b>

$$\text{Normalized Mean Bias (\%)} = \frac{\overline{\text{FEM}} - \overline{\text{FRM}}}{\overline{\text{FRM}}}$$



# 2021-2023 DESIGN VALUES

MSA	Site Name	Site ID	2021-23 PM2.5 Annual DV (Before EPA Correction)	2021-23 PM2.5 Annual DV (After EPA Correction)	2021-23 PM2.5 Annual DV (After EPD Correction)	Δ DV v1-v2
Macon-Bibb County MSA	Macon-Allied	13-021-0007	9.4	9.4	9.4	0.0
	Macon-Forestry	13-021-0012	9.4	8.4	7.9	0.5
Savannah MSA	Savannah-L&A	13-051-1002	9.8	8.8	8.4	0.4
Athens-Clarke County MSA	Athens	13-059-0002	9.7	8.8	8.1	0.7
Atlanta-Sandy Springs-Alpharetta MSA	Forest Park	13-063-0091	8.9	8.9	8.9	0.0
	Kennesaw	13-067-0003	8.9	8.9	8.9	0.0
	South DeKalb	13-089-0002	9.3	8.7	8.5	0.2
	Fire Station #8	13-121-0039	9.1	9.1	9.1	0.0
	NR-GA Tech	13-121-0056	9.7	9.7	9.7	0.0
	Gwinnett Tech	13-135-0002	9.6	8.6	8.1	0.5
Coffee County	General Coffee	13-069-0002	7.3	7.3	7.3	0.0
Albany MSA	Albany	13-095-0007	9.3	9.0	8.8	0.2
Brunswick MSA	Brunswick	13-127-0006	8.3	7.9	7.6	0.3
Gainesville MSA	Gainesville	13-139-0003	9.0	8.2	7.8	0.4
Warner Robins MSA	Warner Robins	13-153-0001	9.3	8.7	8.3	0.4
Valdosta MSA	Valdosta	13-185-0003	9.2	8.6	8.1	0.5
Columbus, GA-AL MSA	Columbus-Airport	13-215-0008	8.6	8.5	8.5	0.0
	Columbus-Baker	13-215-0012	10.0	10.0	10.0	0.0
Augusta-Richmond County, GA-SC MSA	Augusta	13-245-0091	10.1	9.8	9.4	0.4
Chattanooga, TN-GA MSA	Rossville-Williams St.	13-295-0004	10.7	10.0	9.5	0.5
Washington County	Sandersville	13-303-0001	11.0	10.0	9.2	0.8

For Sandersville monitor:

2021-2023 DV with EPA bias correction → 10.0  $\mu\text{g}/\text{m}^3$  (65 EE days)

2021-2023 DV with EPD bias correction → 9.2  $\mu\text{g}/\text{m}^3$  (11 EE days)

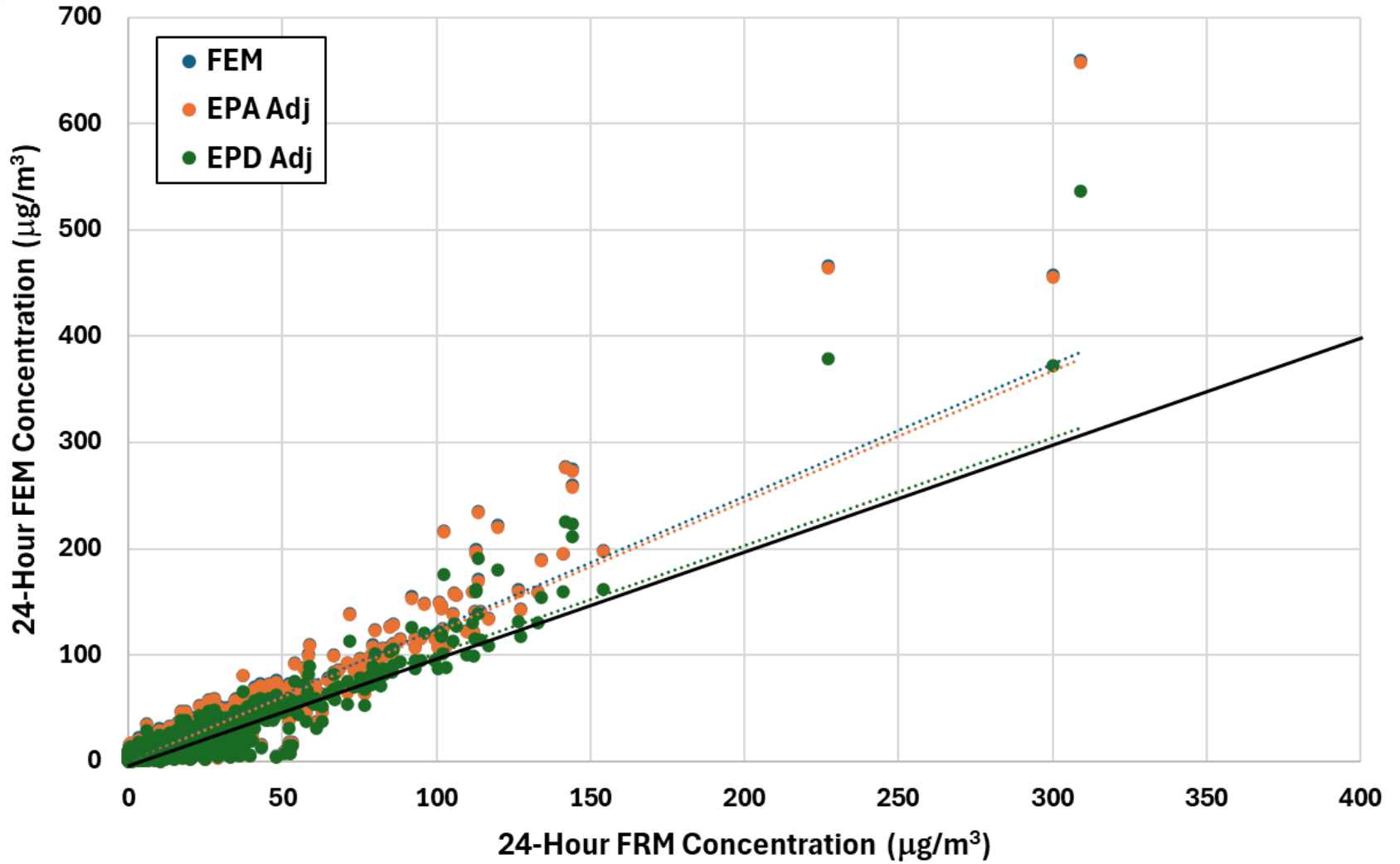


# NATIONAL ANALYSIS

- Examined collocated FRM and Teledyne T640 FEM 24-hour  $PM_{2.5}$  measurements.
  - Calendar years 2018-2023
  - 217 different monitoring sites
  - 68,096 data pairs
- Compared concentrations from:
  - FRM
  - Unadjusted FEM
  - EPA bias adjusted FEM
  - Georgia EPD bias adjusted FEM



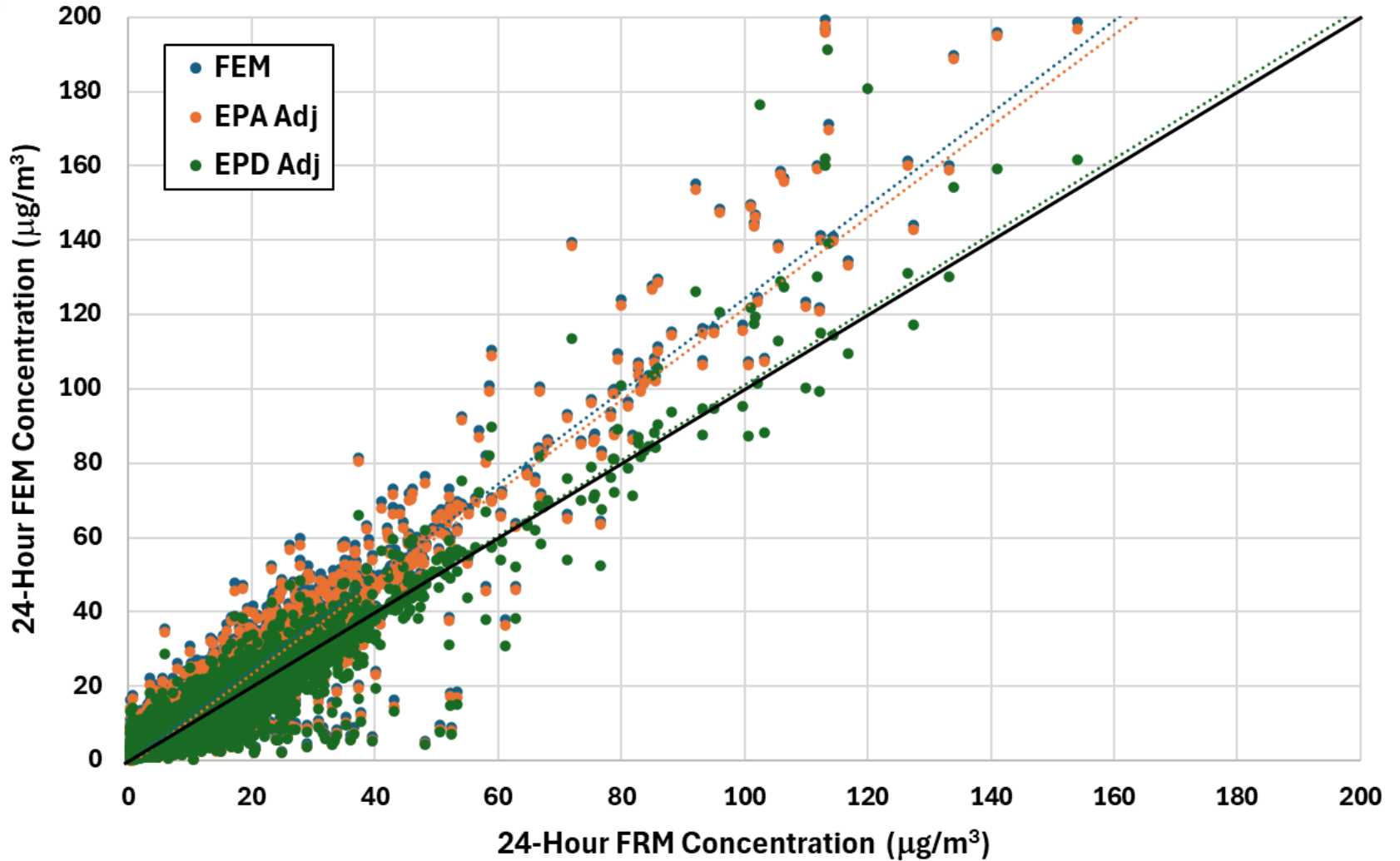
# 24-HOUR PM<sub>2.5</sub> (FRM vs. FEM)





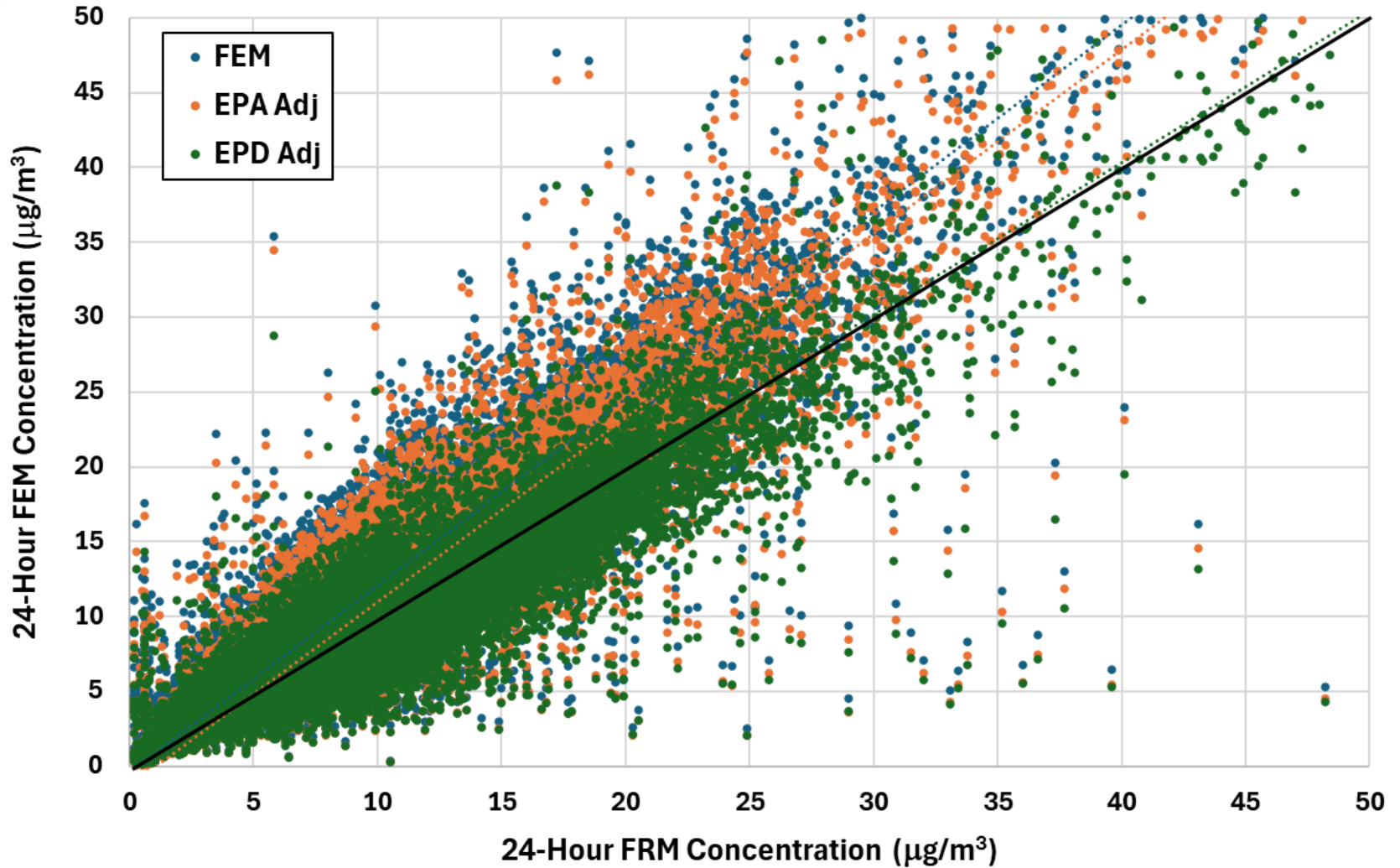


# 24-HOUR PM<sub>2.5</sub> (FRM vs. FEM)



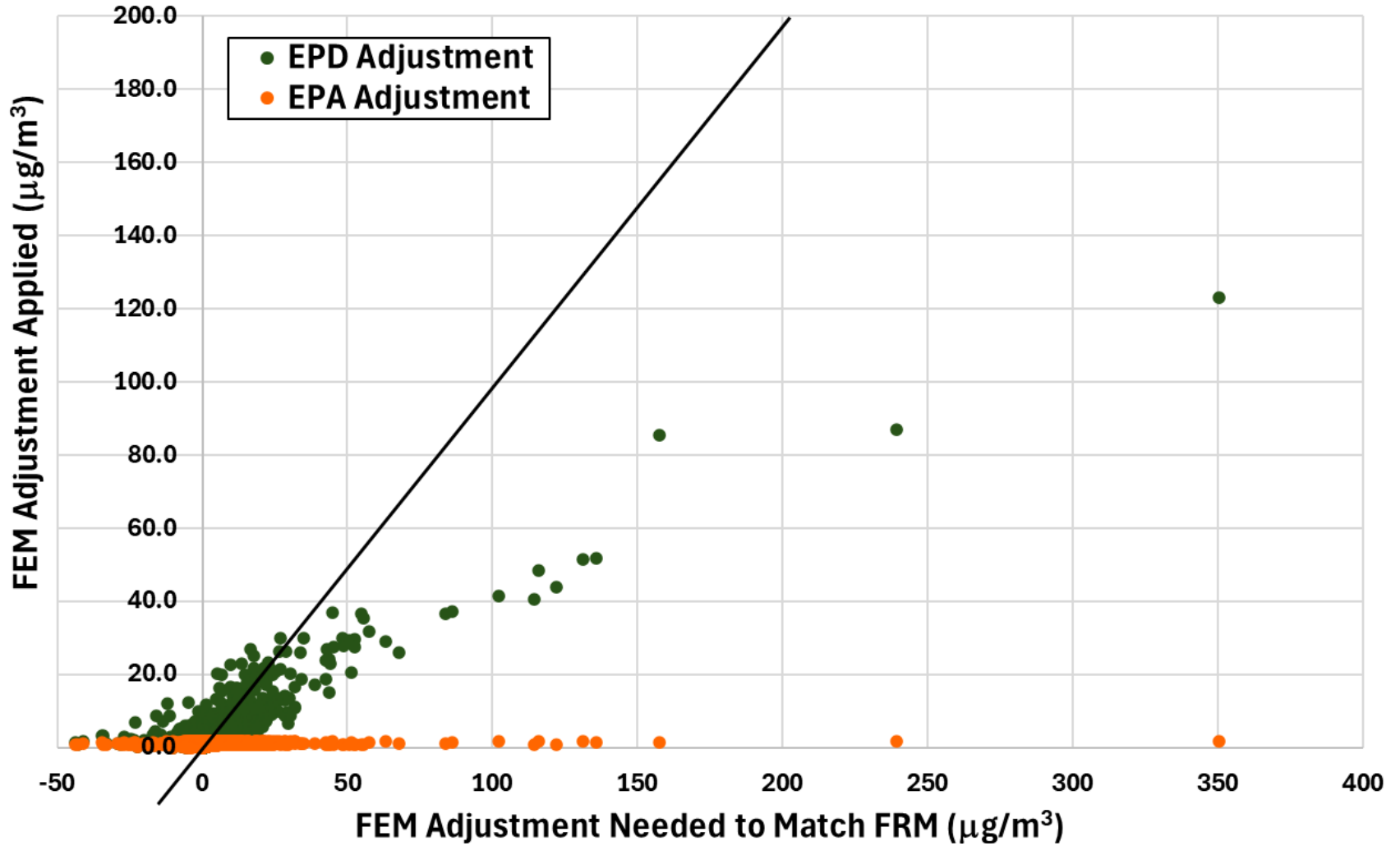


# 24-HOUR PM<sub>2.5</sub> (FRM vs. FEM)



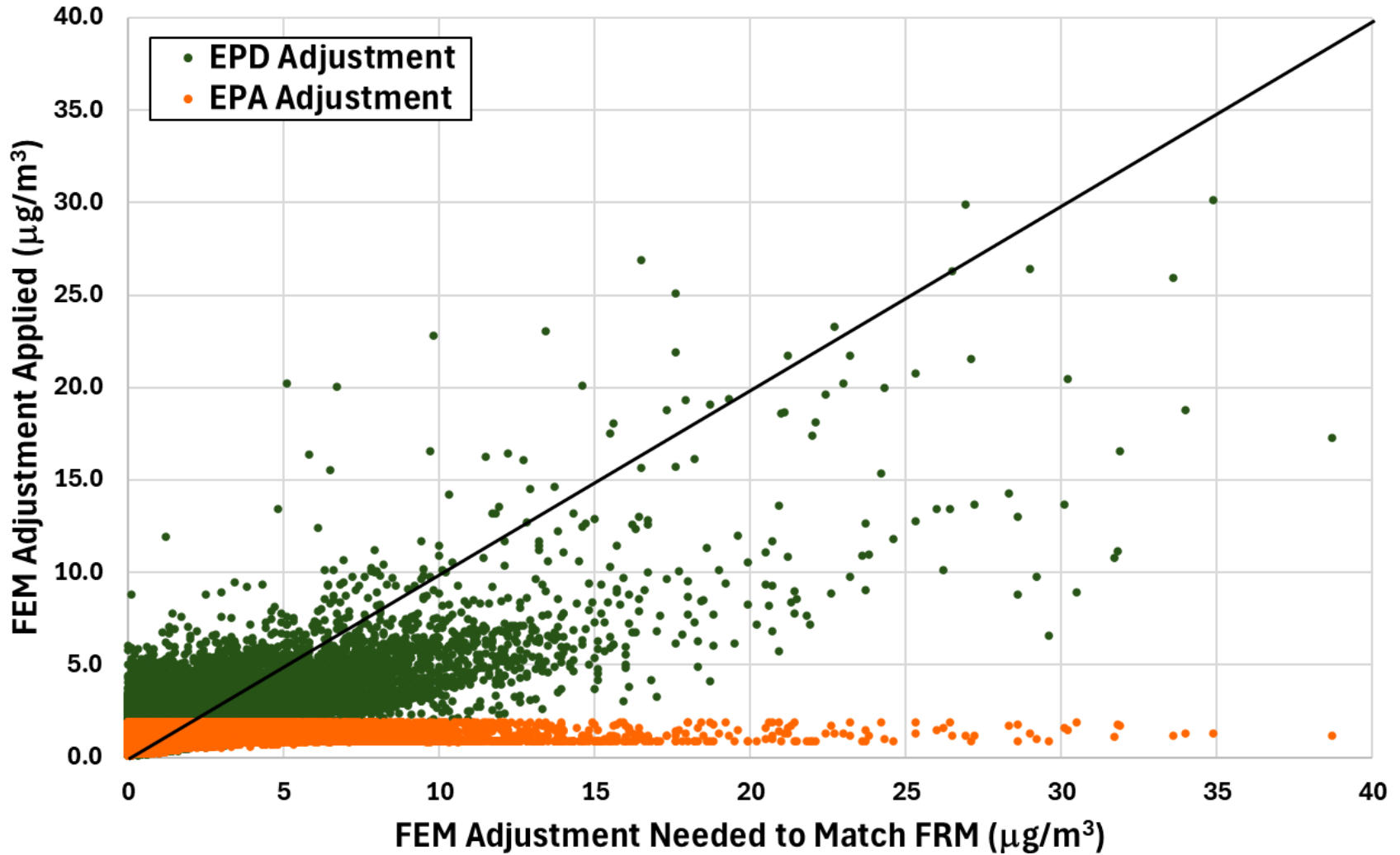


# FEM ADJUSTMENT NEEDED vs. APPLIED





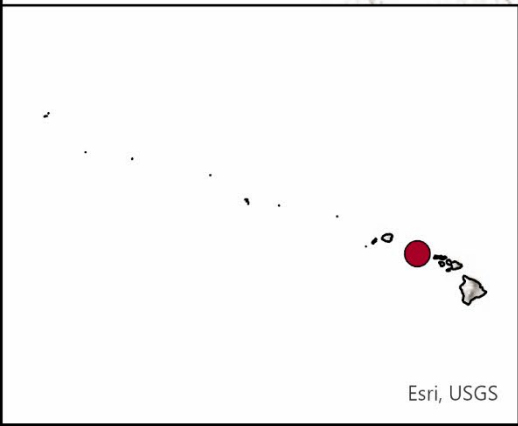
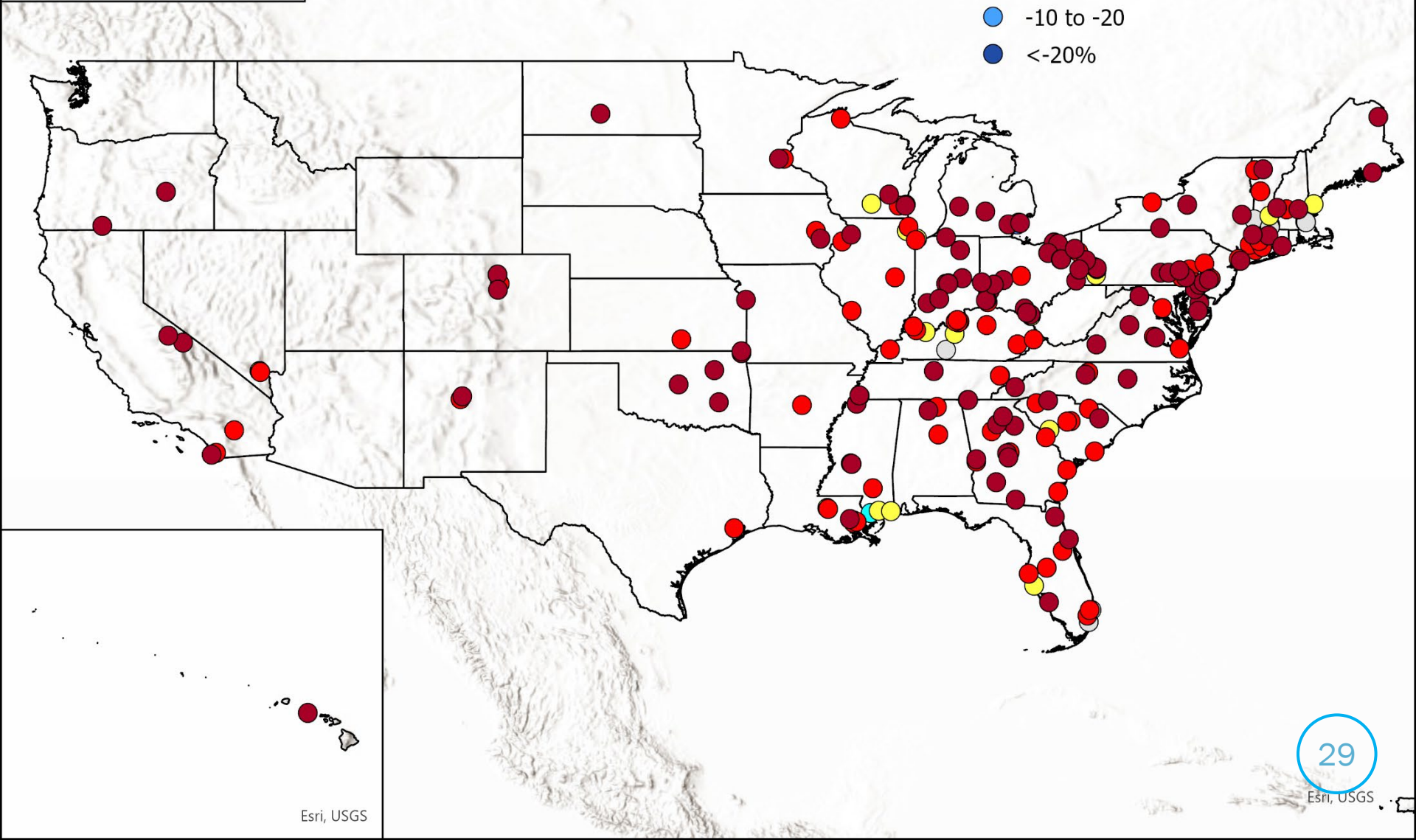
# FEM ADJUSTMENT NEEDED vs. APPLIED



$(\text{Avg\_Unadj\_FEM} - \text{Avg\_FRM}) / (\text{Avg\_FRM}) [\%]$

# NO BIAS ADJUSTMENT

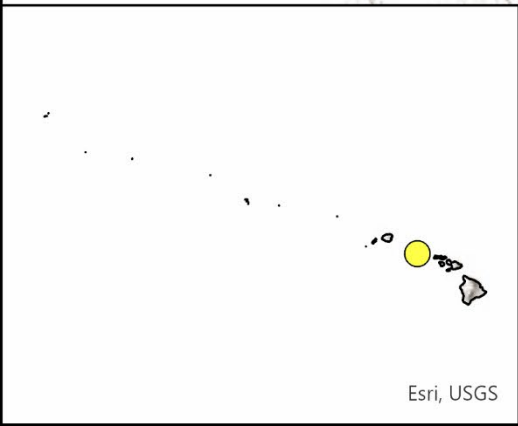
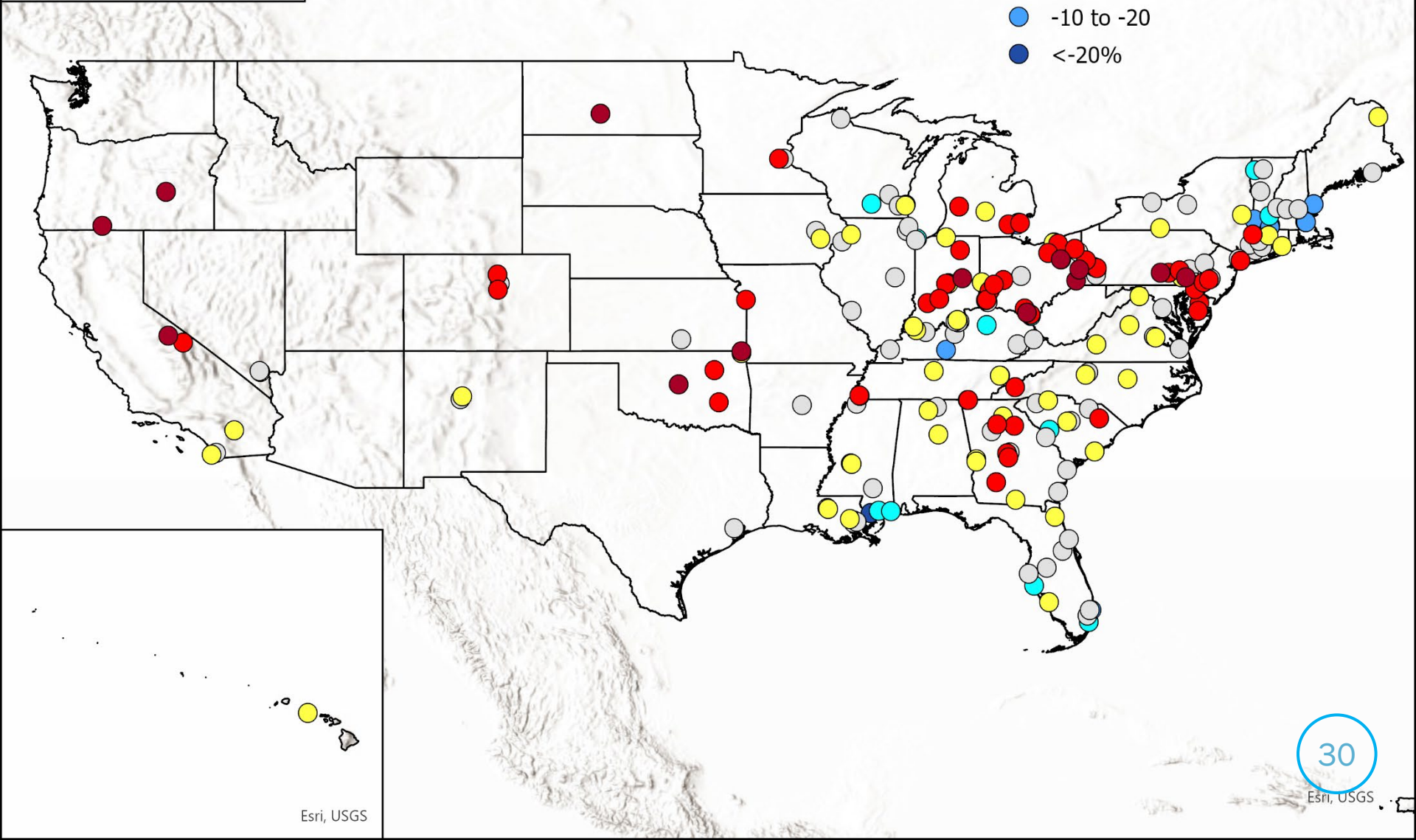
- >20%
- 10 to 20
- 5 to 10
- -5 to 5
- -5 to -10
- -10 to -20
- <-20%



# EPA BIAS ADJUSTMENT

$(\text{Avg\_Adj\_FEM} - \text{Avg\_FRM}) / (\text{Avg\_FRM})$  [%]

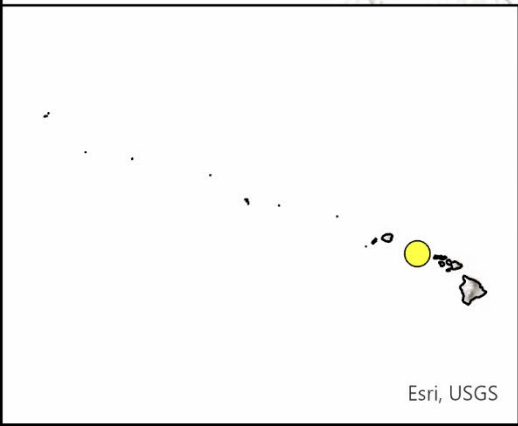
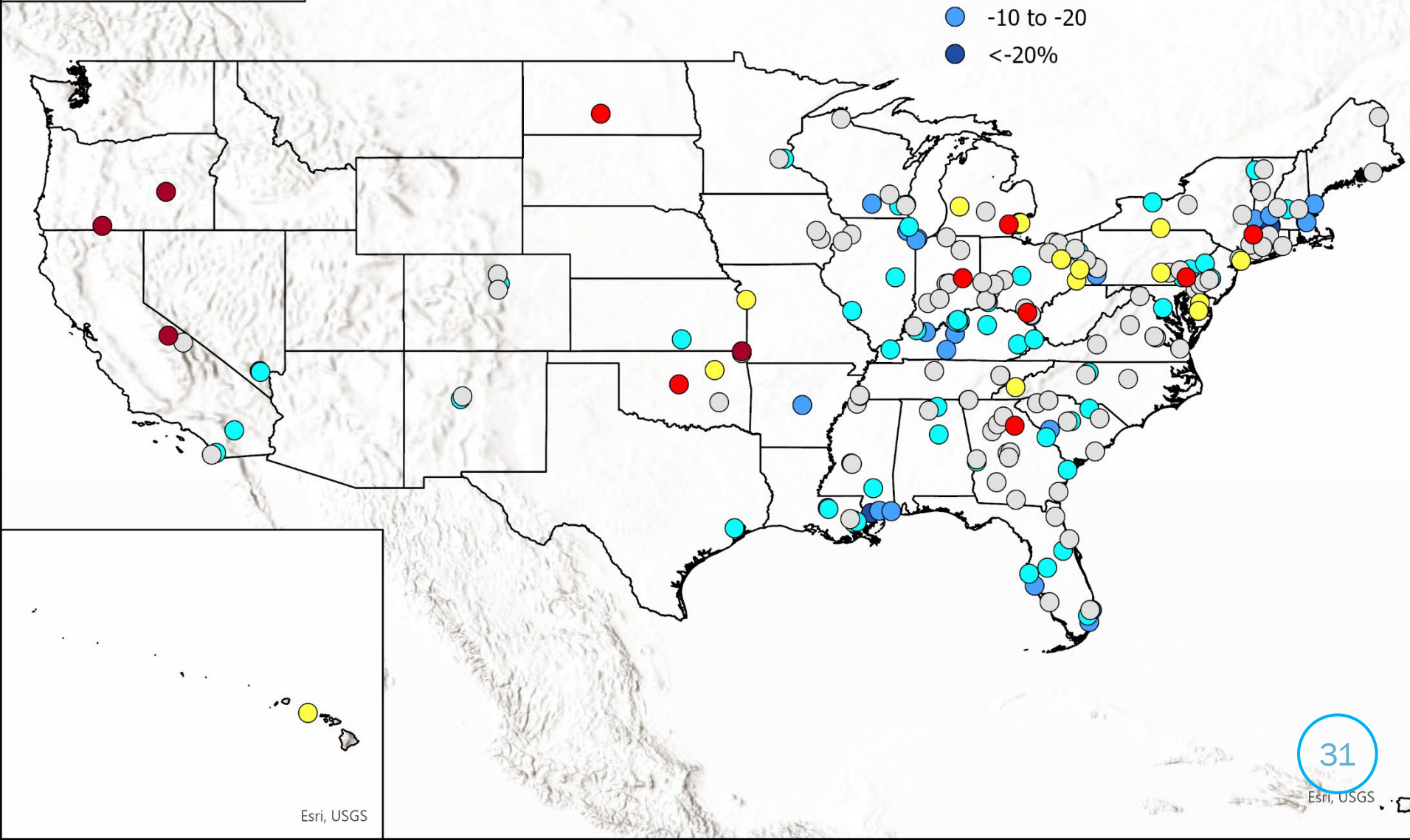
- >20%
- 10 to 20
- 5 to 10
- -5 to 5
- -5 to -10
- -10 to -20
- <-20%



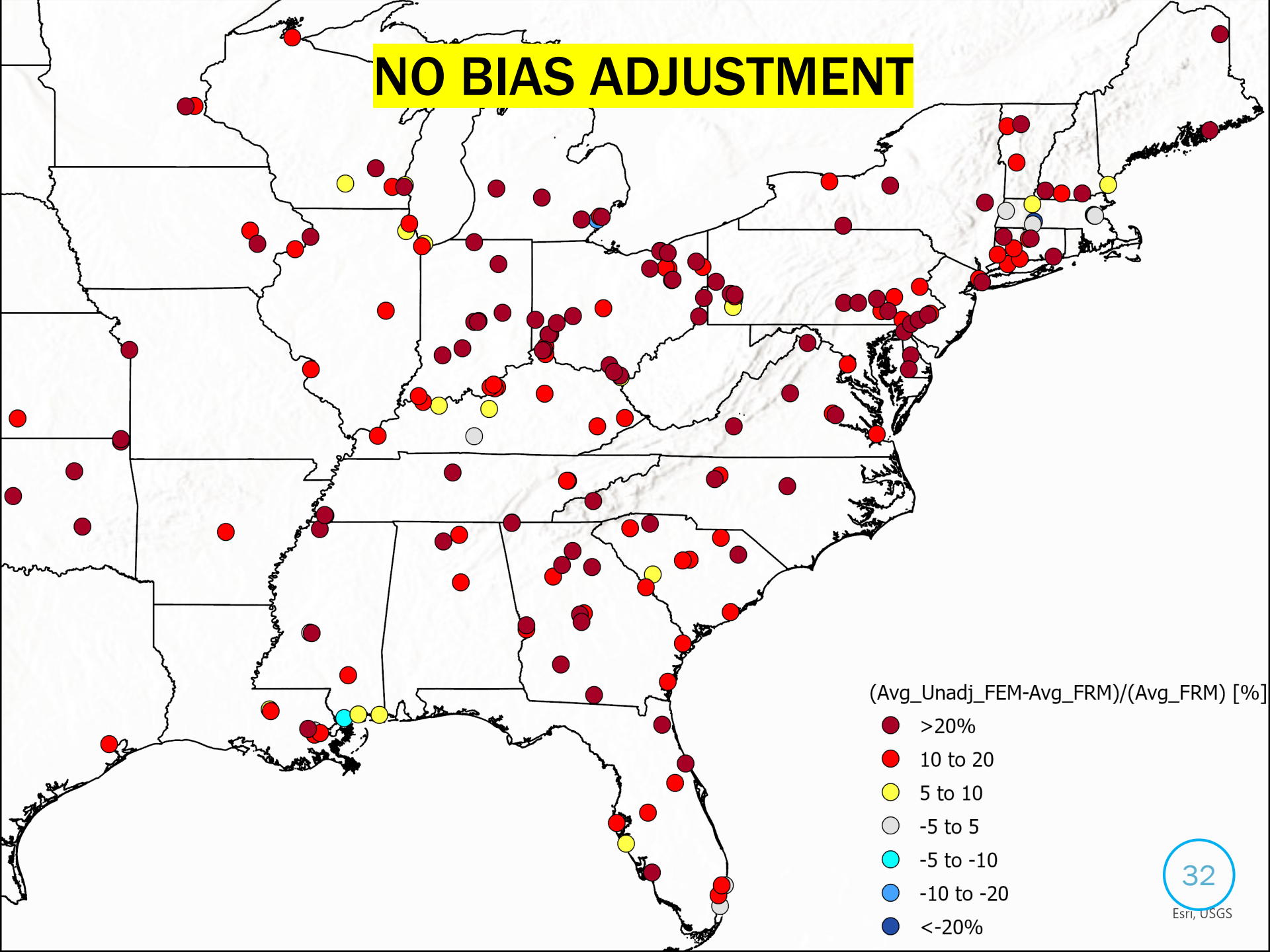
$(\text{Avg\_EPD\_Adj\_FEM} - \text{Avg\_FRM}) / (\text{Avg\_FRM})$  [%]

# EPD BIAS ADJUSTMENT

- >20%
- 10 to 20
- 5 to 10
- 5 to 5
- 5 to -10
- 10 to -20
- <-20%



# NO BIAS ADJUSTMENT

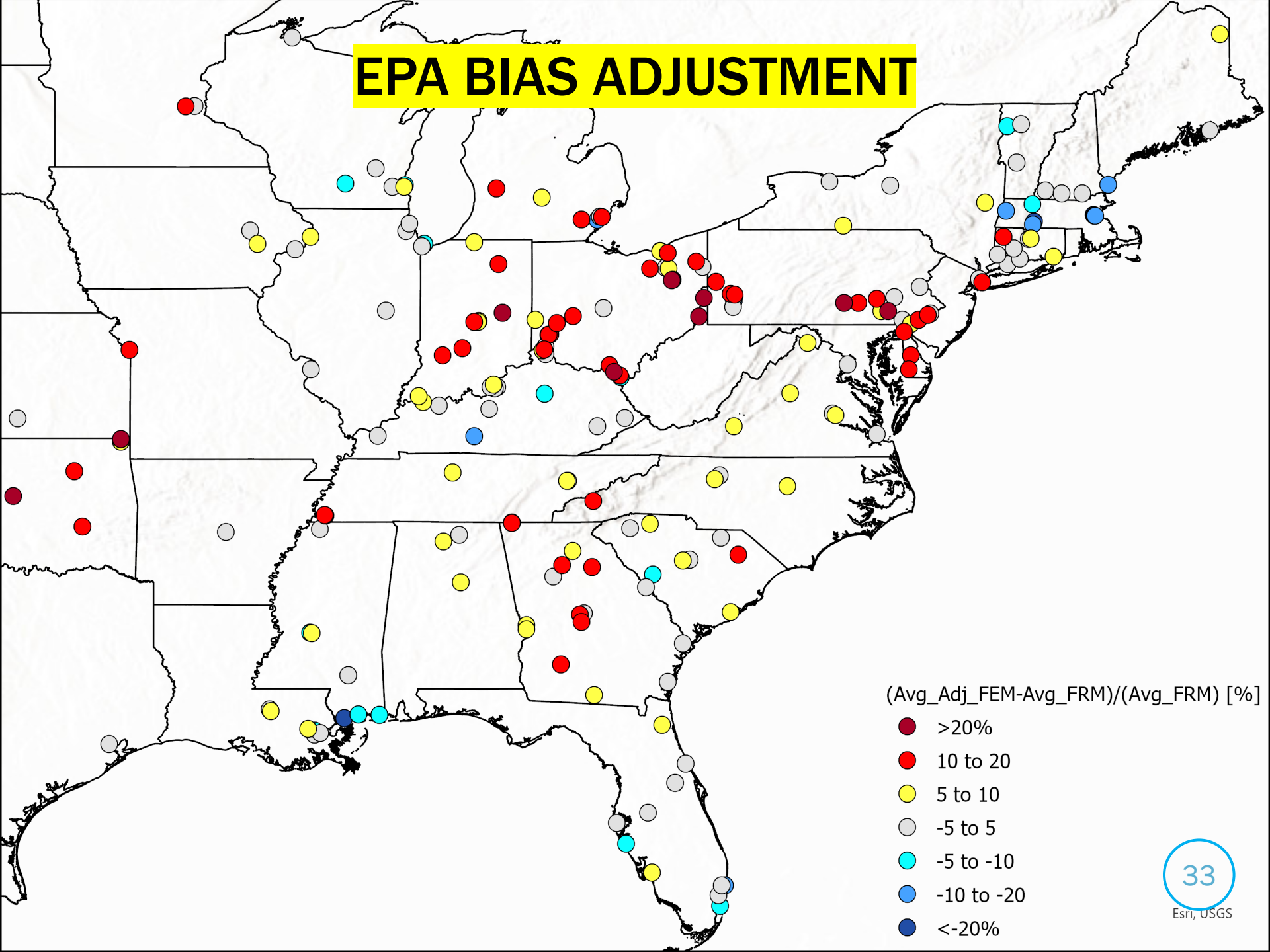


$(\text{Avg\_Unadj\_FEM} - \text{Avg\_FRM}) / (\text{Avg\_FRM})$  [%]

- >20%
- 10 to 20
- 5 to 10
- -5 to 5
- -5 to -10
- -10 to -20
- <-20%



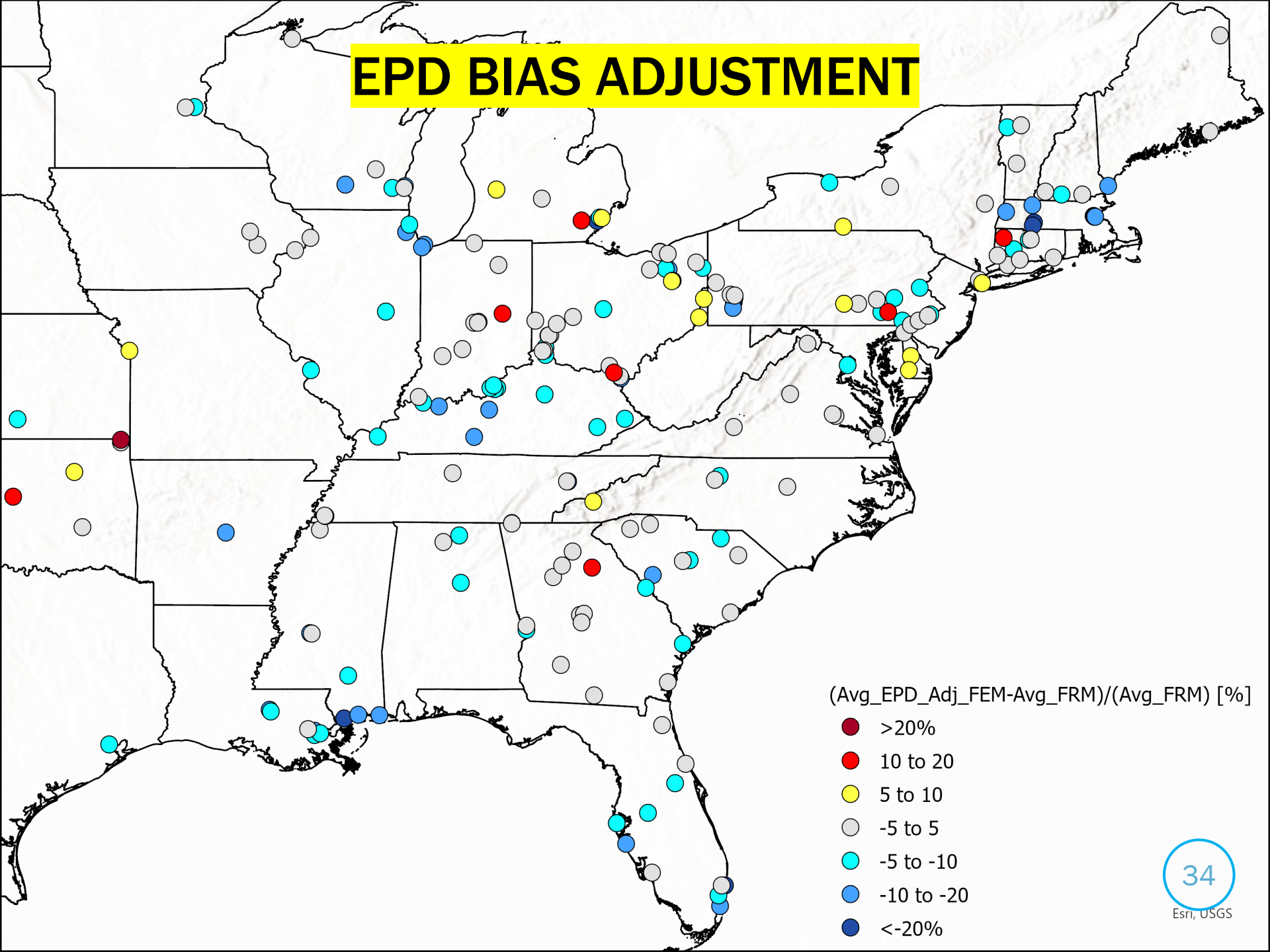
# EPA BIAS ADJUSTMENT



$(\text{Avg\_Adj\_FEM} - \text{Avg\_FRM}) / (\text{Avg\_FRM})$  [%]

- >20%
- 10 to 20
- 5 to 10
- 5 to 5
- 5 to -10
- 10 to -20
- <-20%

# EPD BIAS ADJUSTMENT



$(\text{Avg\_EPD\_Adj\_FEM} - \text{Avg\_FRM}) / (\text{Avg\_FRM})$  [%]

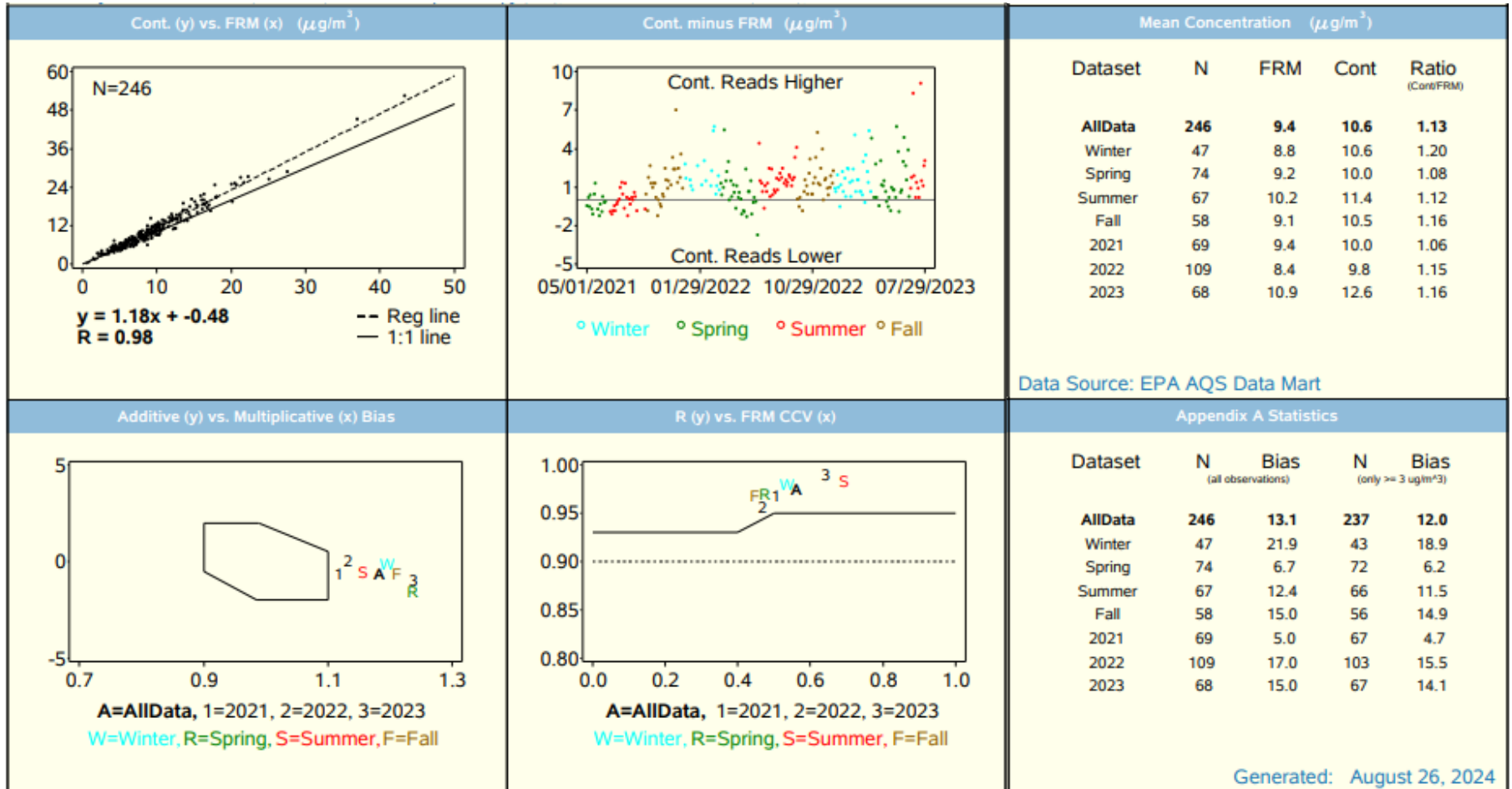
- >20%
- 10 to 20
- 5 to 10
- -5 to 5
- -5 to -10
- -10 to -20
- <-20%



# PM<sub>2.5</sub> Continuous Monitor Comparability Assessment

Site 13-295-0004: Rossville, GA

FRM: R & P Model 2025 PM-2.5 Sequential Air Sampler w/VSCC - Gravimetric (145), PM2.5 - Local Conditions (88101), POC=1  
 Cont: Teledyne T640 at 5.0 LPM (Corrected) - Broadband spectroscopy (736), PM2.5 - Local Conditions (88101), POC=23



Generated: August 26, 2024

FRM is 1-in-3 days, FEM covers the other 2 days:  
 2021-2023 DV with FRM and FEM data → 10.0  $\mu\text{g}/\text{m}^3$  (74 EE days)  
 2021-2023 DV with only 1-in-3 FRM data → 9.3  $\mu\text{g}/\text{m}^3$  (7 EE days)



# GEORGIA PM<sub>2.5</sub> NETWORK CHANGES

- Purchased **16** new FRMs since **2021** at a total cost of **\$380K**.
- Deployed several new FRMs at locations that only had FEMs. Most FRMs will run daily with co-located FEM.
- Additional cost of **\$270K/year** for filters, analysis, shipping, and **2** additional FTEs.
- Other Options?
  - Shut down all Teledyne PM<sub>2.5</sub> monitors?
  - Replace Teledyne PM<sub>2.5</sub> monitors with alternative continuous PM<sub>2.5</sub> monitors?
  - Run FRM as 1-in-3 days monitor?

*Evaluation of Fine Particulate Matter (PM<sub>2.5</sub>) Concentrations Measured by Collocated Federal Reference Method and Federal Equivalent Method Monitors in the U.S.* by Tanvir R. Khan, Zachery I. Emerson, and Karen H. Mentz (Atmosphere 2024, 15(8), 978; <https://doi.org/10.3390/atmos15080978>).



# CONTACT INFORMATION

**James Boylan, Ph.D.**

**Georgia Dept. of Natural Resources  
4244 International Parkway, Suite 120  
Atlanta, GA 30354**

**James.Boylan@dnr.ga.gov**

**470-524-0697**