GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Implementing the $PM_{2.5}$ NAAQS in GA

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

AAPCA 2024 Fall Meeting
Raleigh, NC
August 29, 2024

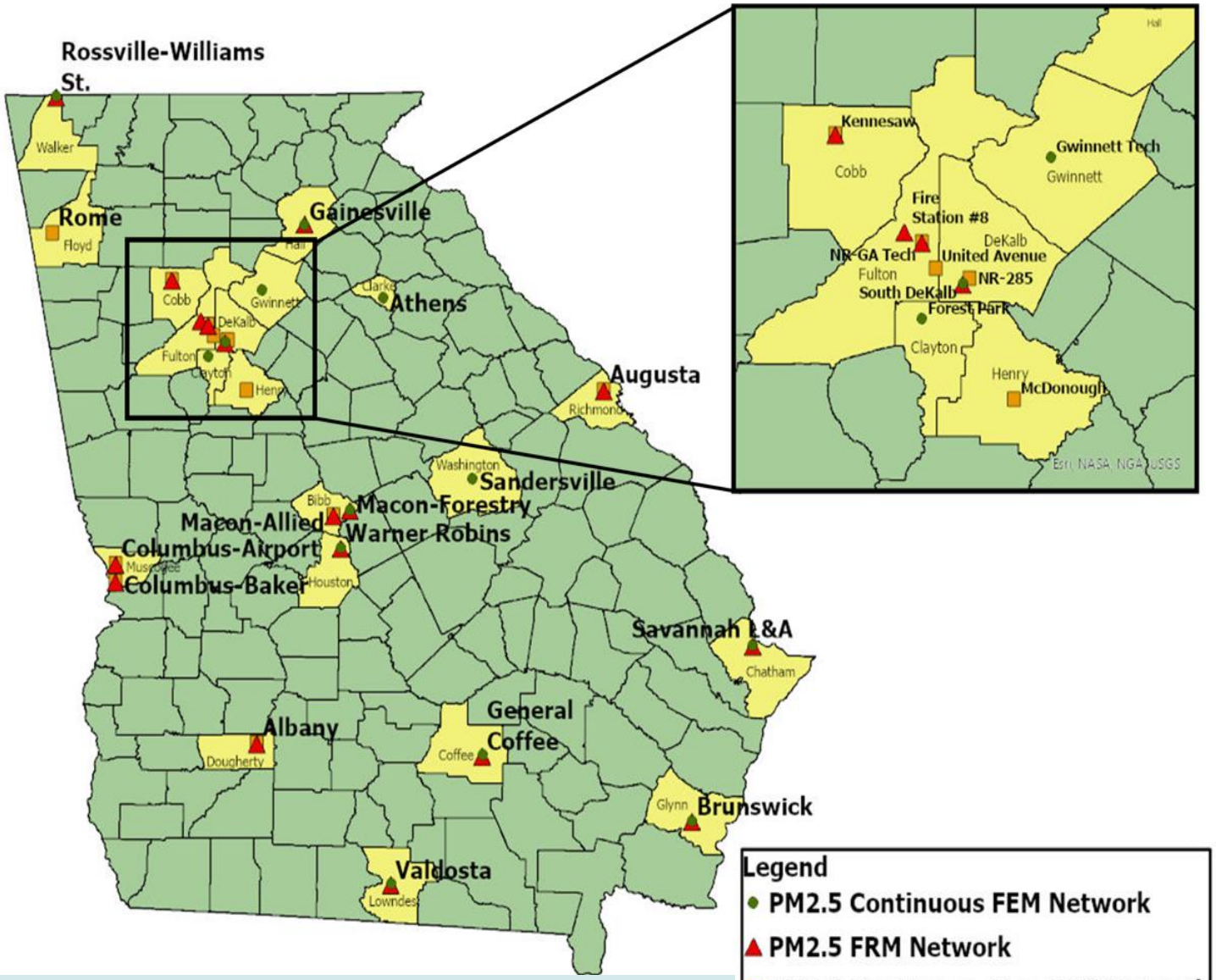
$PM_{2.5}$ DESIGNATIONS & EE DEMOS

DESIGNATIONS SCHEDULE

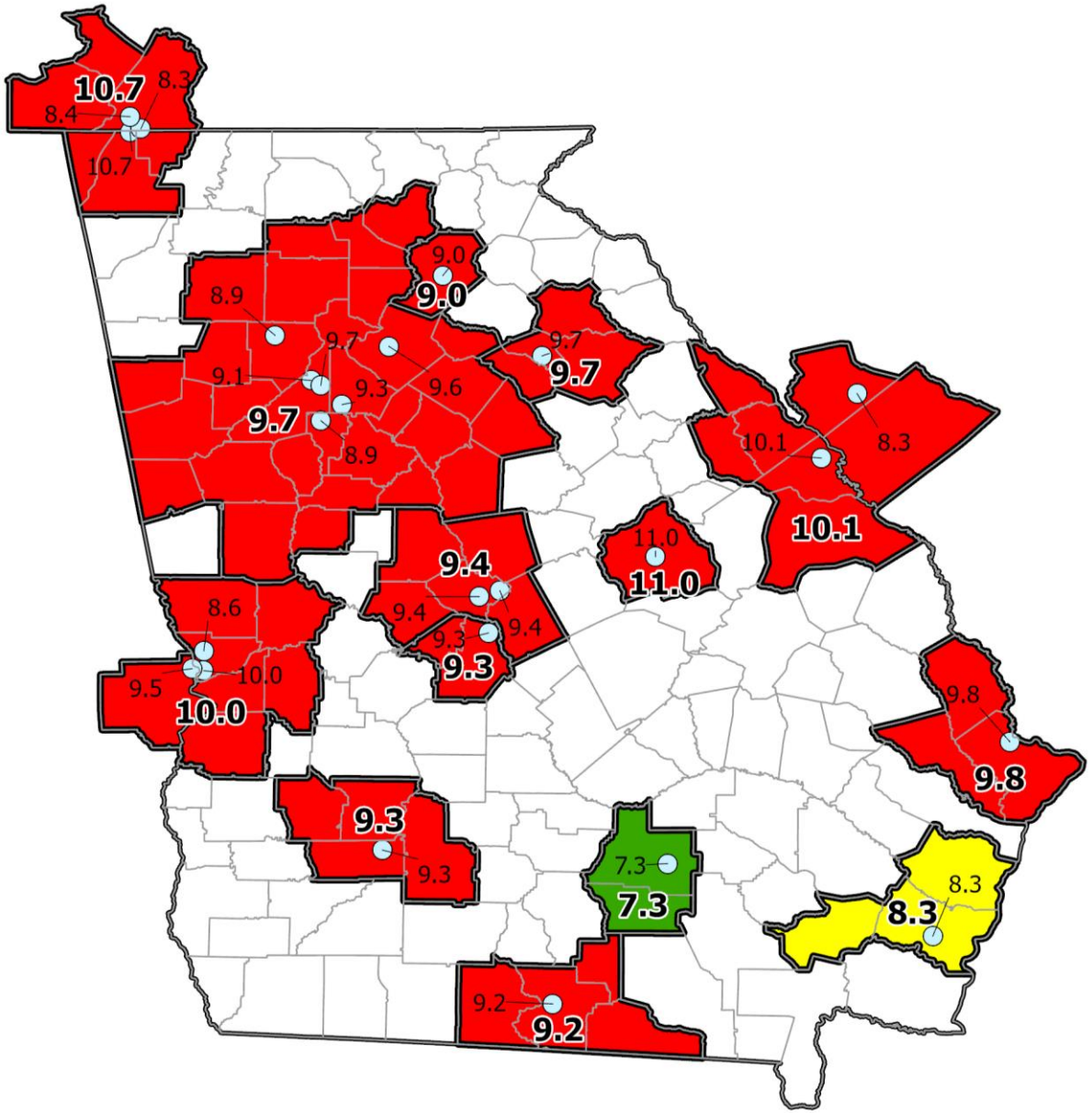
- **State's Designation Recommendations**
  - One year after promulgation date of NAAQS
    - February 7, 2025
    - Based on 2021-2023 $PM_{2.5}$ data

- **EPA's Final Designations**
  - Two years after promulgation date of NAAQS
    - February 6, 2026
    - Based on 2022-2024 $PM_{2.5}$ data

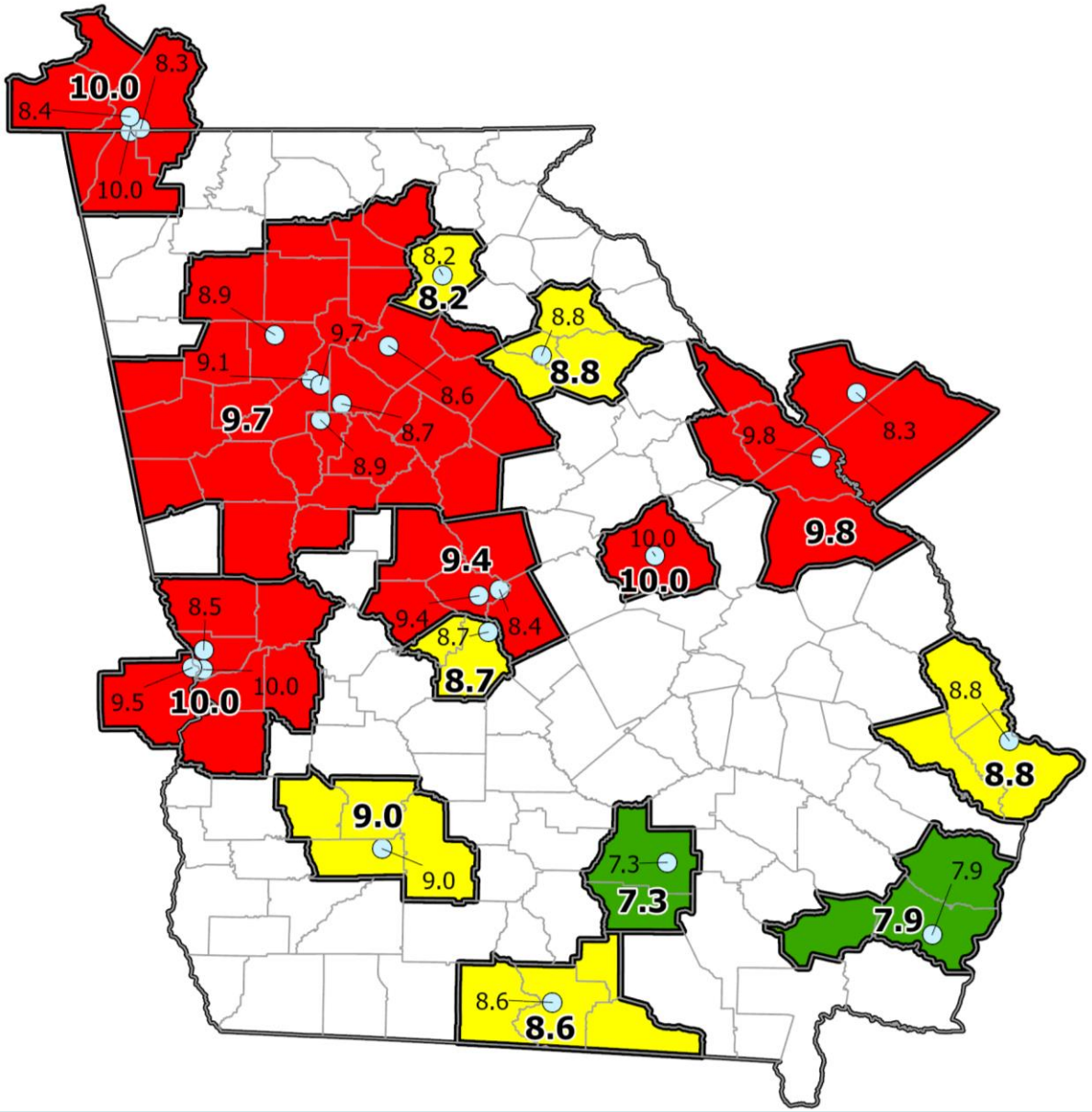
$PM_{2.5}$ MONITOR LOCATIONS



UNADJUSTED 2021-2023 DESIGN VALUES

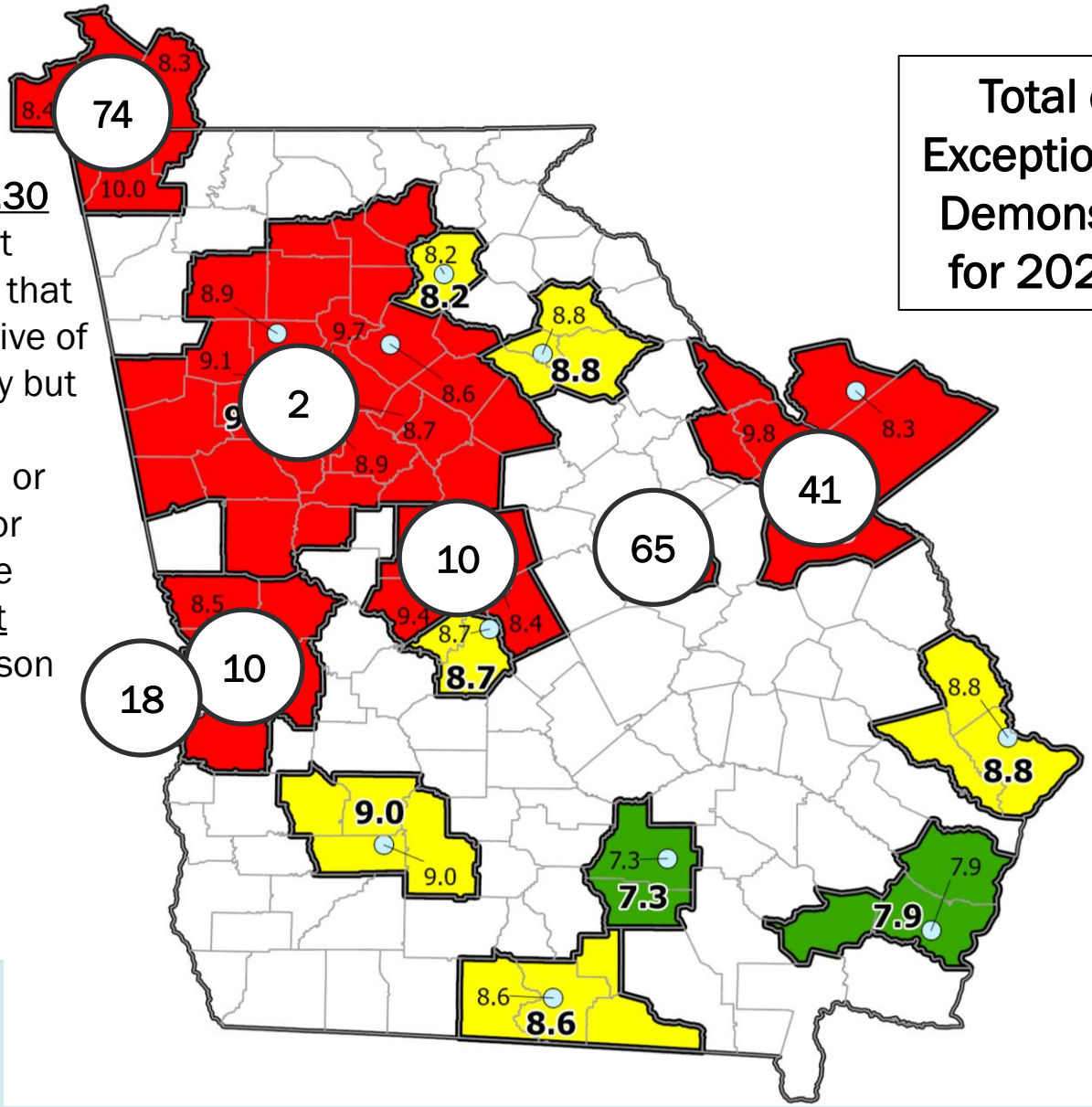


EPA ADJUSTED 2021-2023 DESIGN VALUES



NUMBER OF EE DEMONSTRATIONS

<u>40 CRF Section 58.30</u>
$PM_{2.5}$ 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 <u>not</u> eligible for comparison to the annual $PM_{2.5}$ NAAQS.



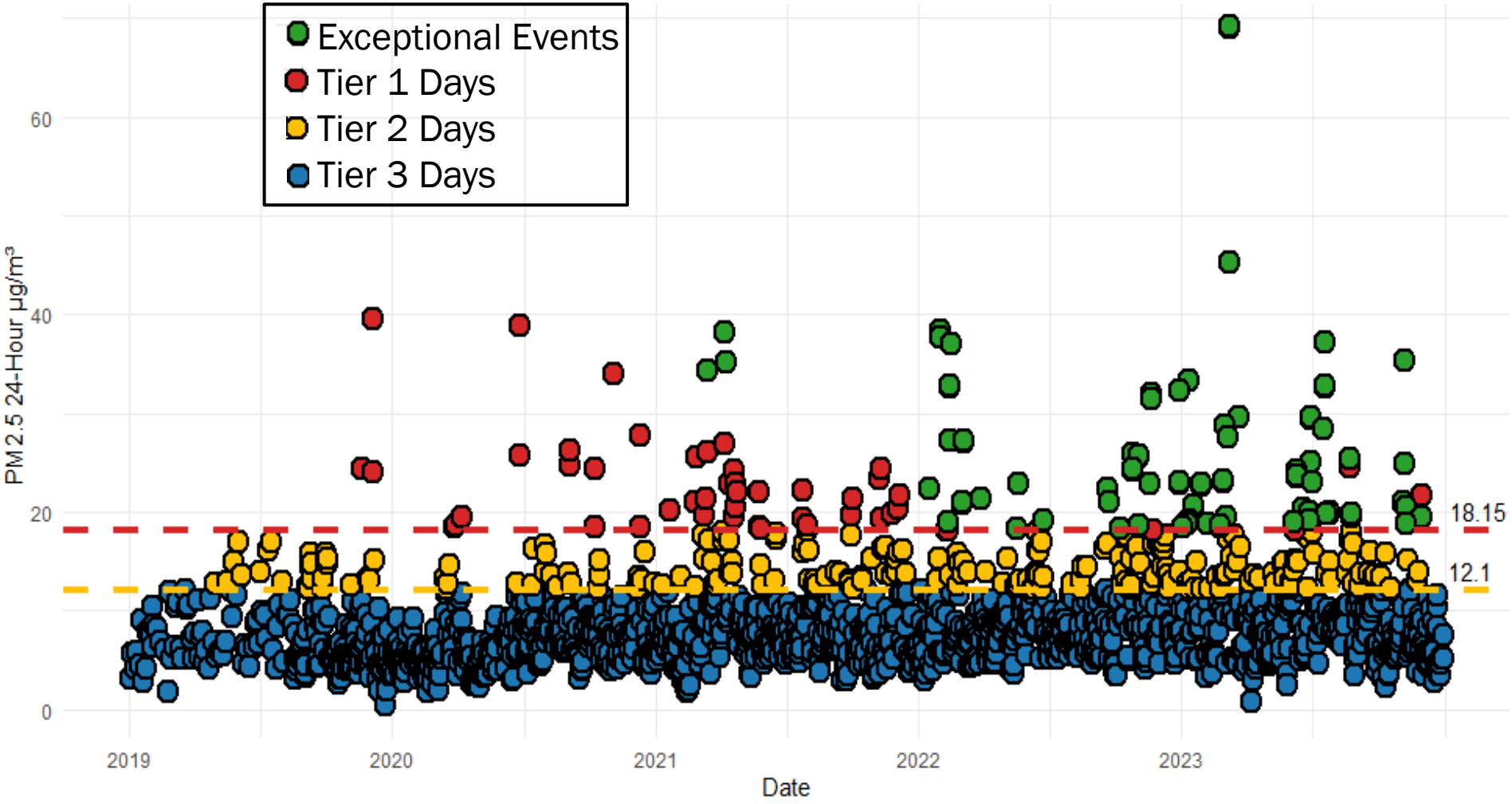
Total of <u>220</u> Exceptional Event Demonstrations for 2022-2023

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

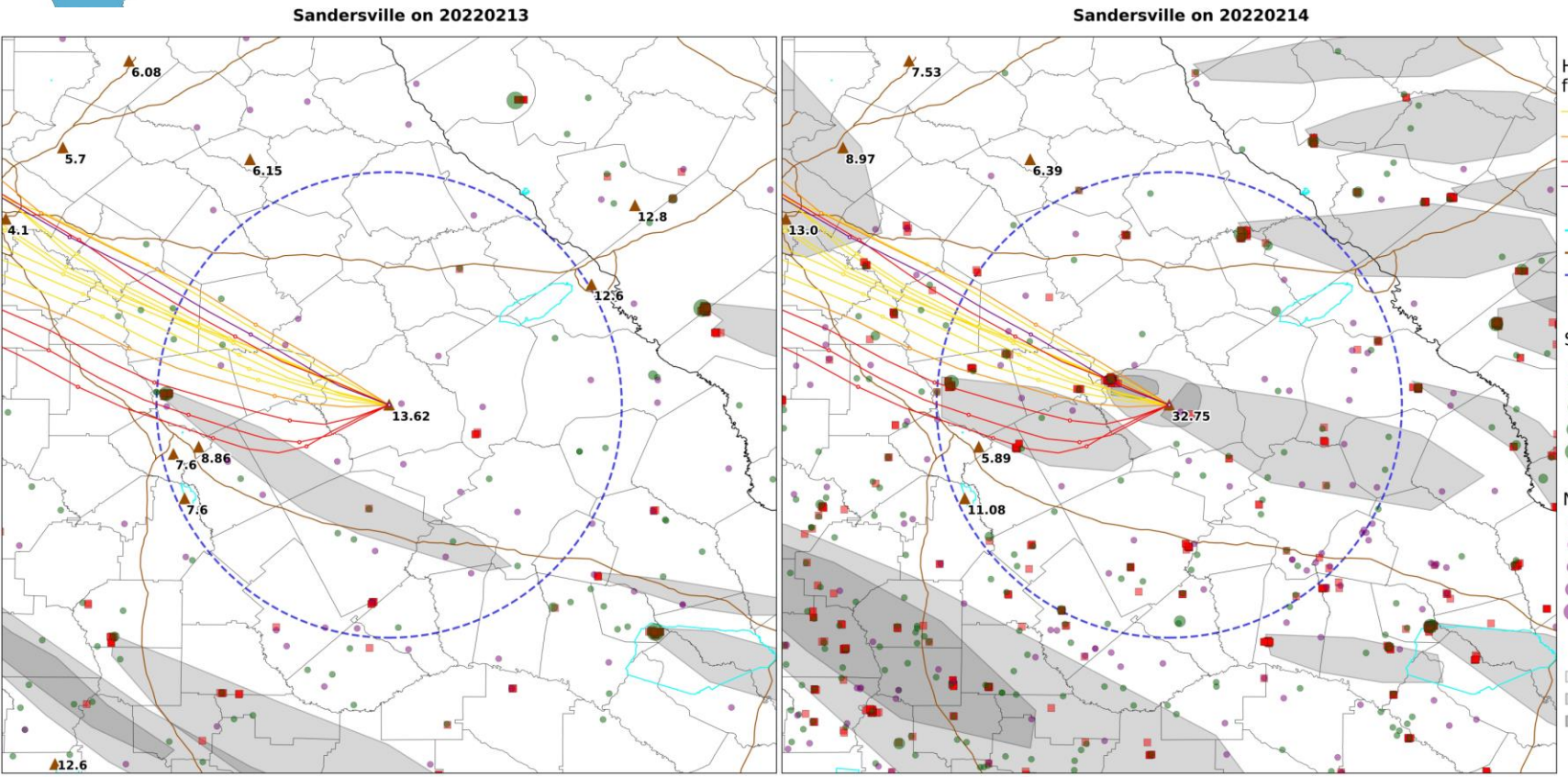
COUNTY	SIZE	Burn_Purpose	LATITUDE	LONGITUDE
Jones	610	Silviculture	33.05586996	-83.64946724
Mcduffie	513	Silviculture	33.62945556	-82.52864167
Wheeler	300	Silviculture	32.13085963	-82.76524669
Burke	178	Silviculture	33.0354647	-81.84254273
Houston	176	Silviculture	32.45871362	-83.50279312
Dodge	175	Silviculture	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
Tattnall	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

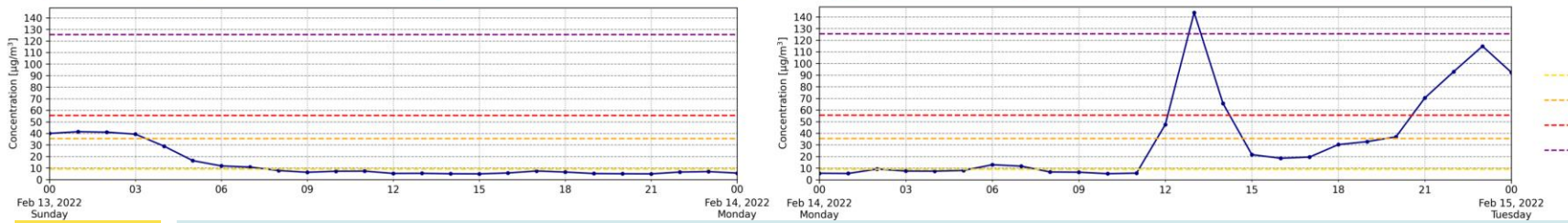
Bottom 20

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

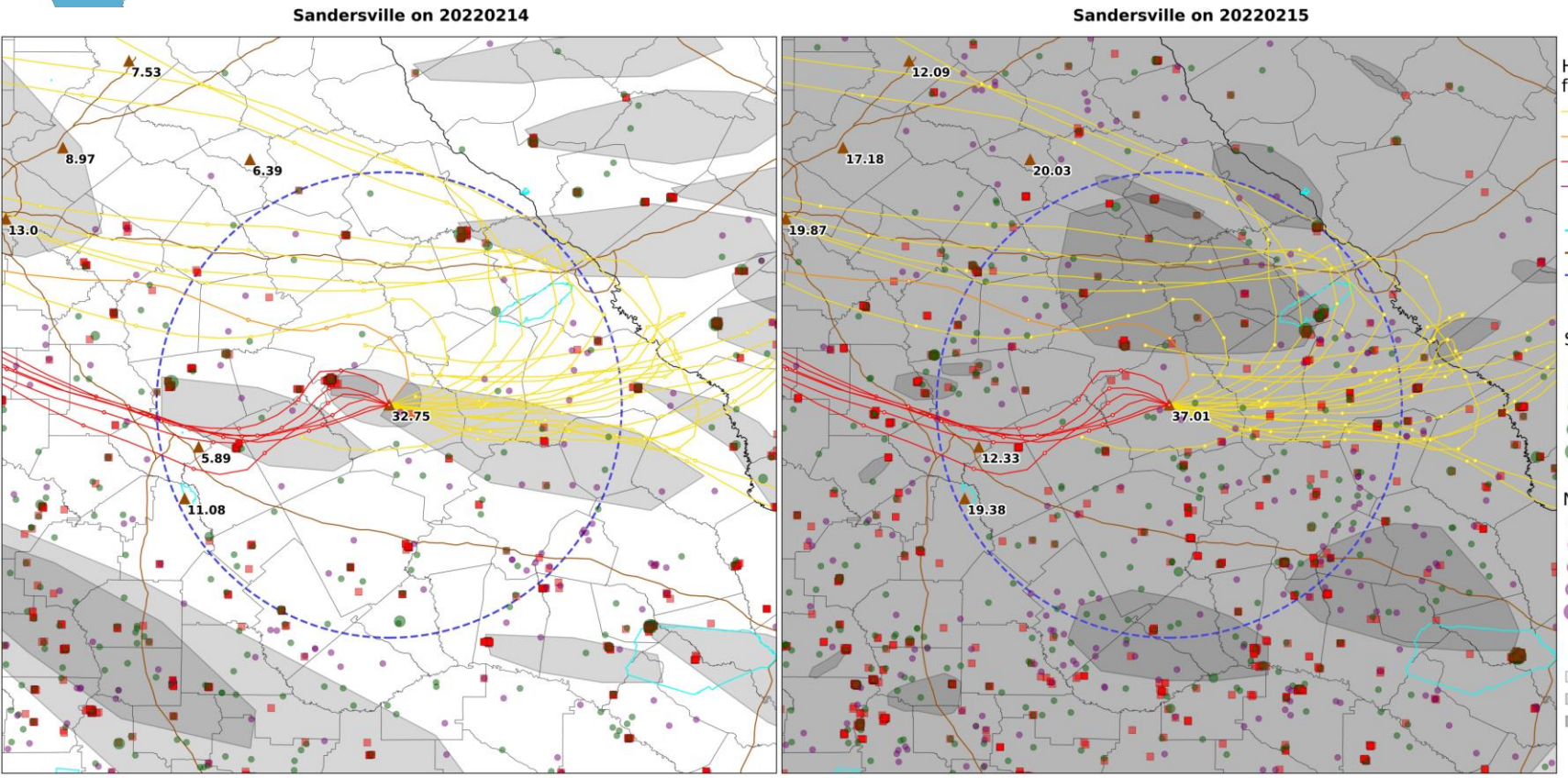
Total of 100 GFC permits issues in 100 km radius.

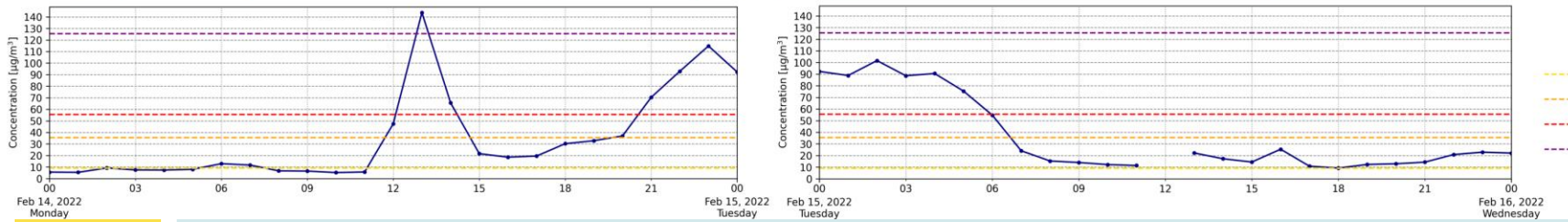
SANDERSVILLE – FEBRUARY 14, 2022





SANDERSVILLE – FEBRUARY 15, 2022





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:

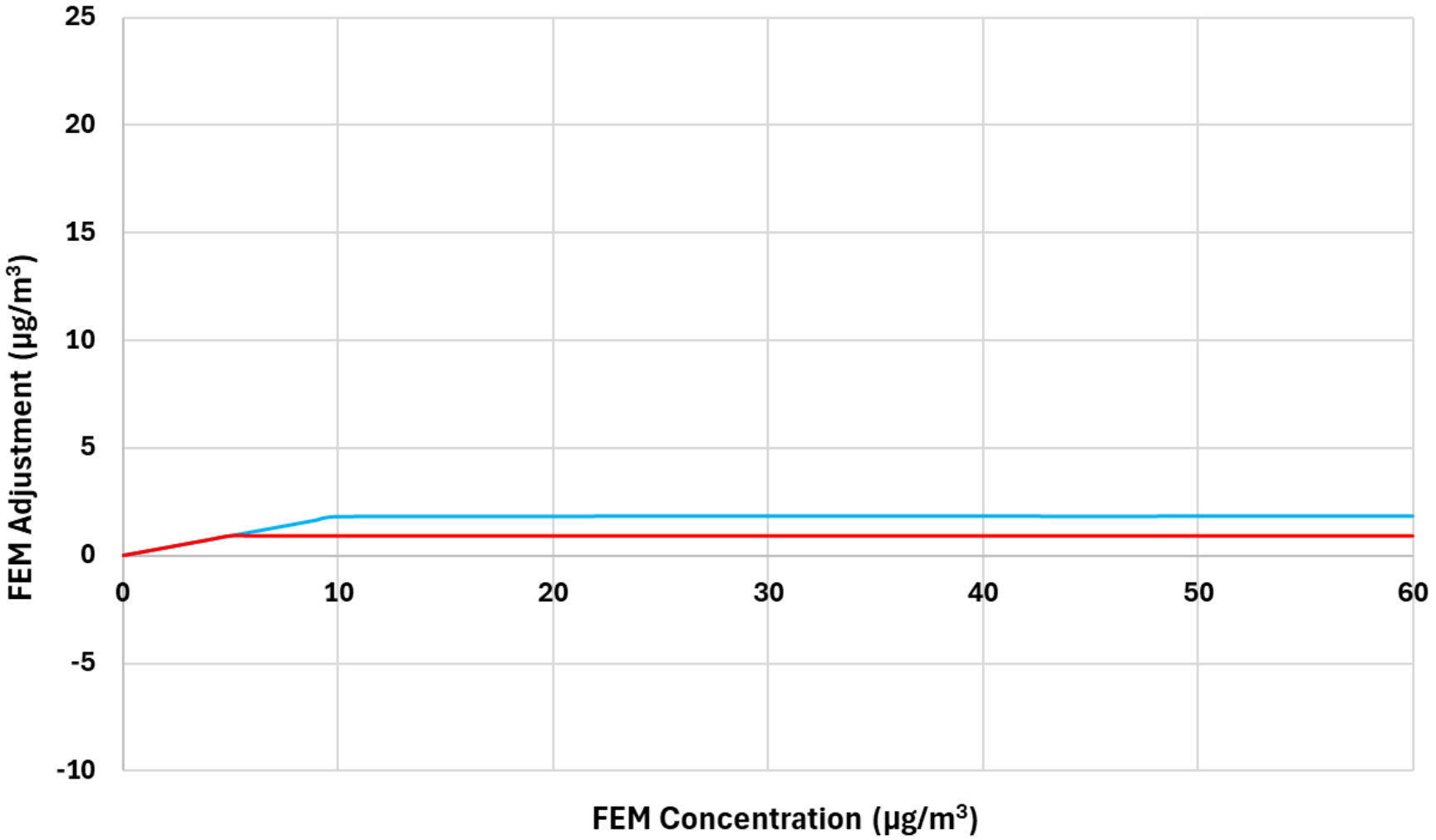
- If the ambient temperature is at or below 20°C
- - T640/x raw PM value is less than or equal to 10ug/m3, then multiply the T640/x raw PM value by 0.813233
- - T640/x raw PM value is greater than 10ug/m3, then use the equation (T640/x raw PM – 1.861)

- If the ambient temperature is above 20°C
- - T640/x raw PM value is less than or equal to 5ug/m3, then multiply the T640/x raw PM value by 0.813233
- - T640/x raw PM value is greater than 5ug/m3, then use the equation (T640/x raw PM – 0.925)

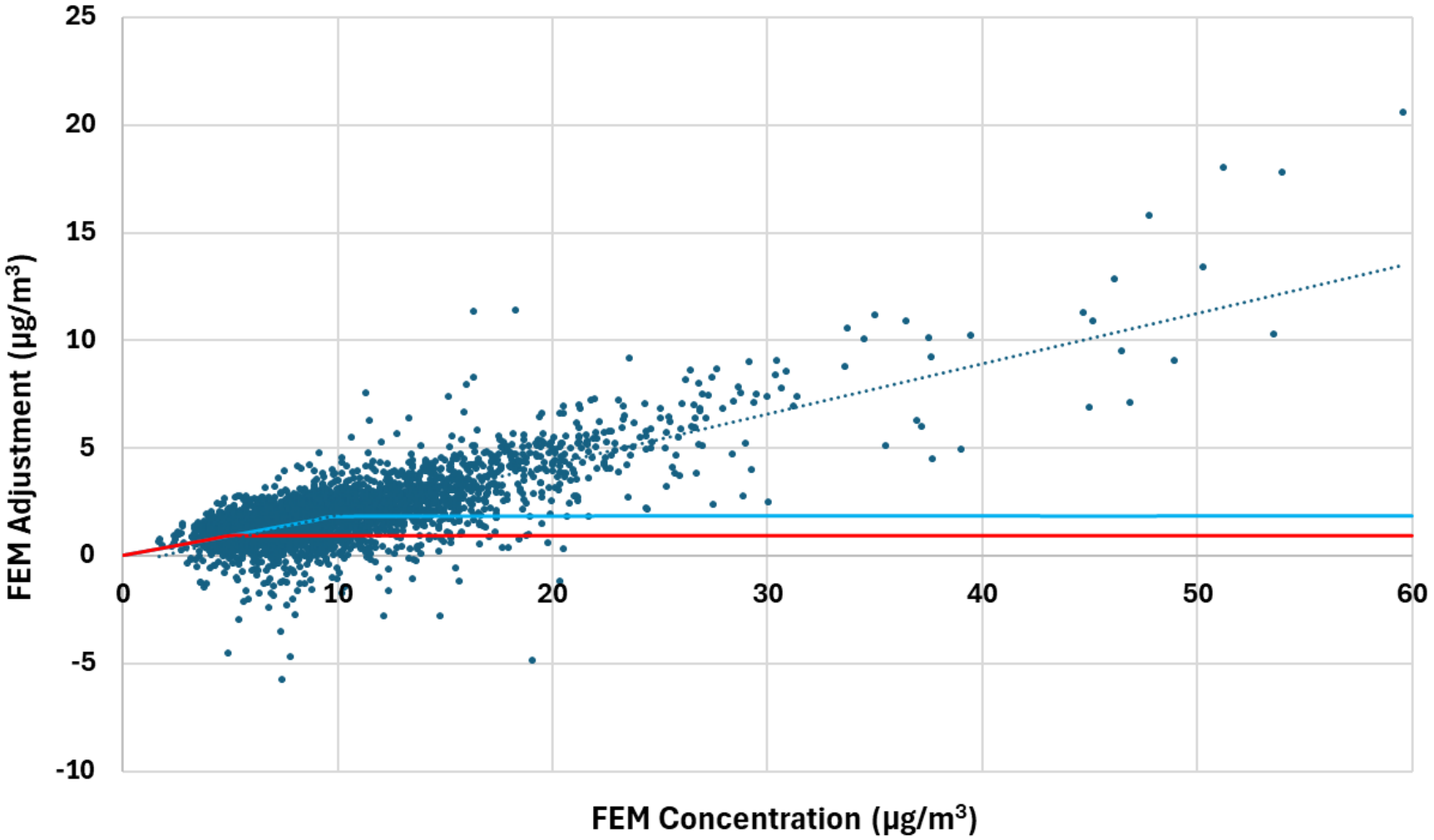
CASE	$PM_{2.5}$ Conc.	Temp. ≤ 20°C
A	≤ 10 µg/m³	T640/x * 0.813233
B	> 10 µg/m³	T640/x - 1.861

CASE	$PM_{2.5}$ Conc.	Temp. > 20°C
C	≤ 5 µg/m³	T640/x * 0.813233
D	> 5 µg/m³	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:

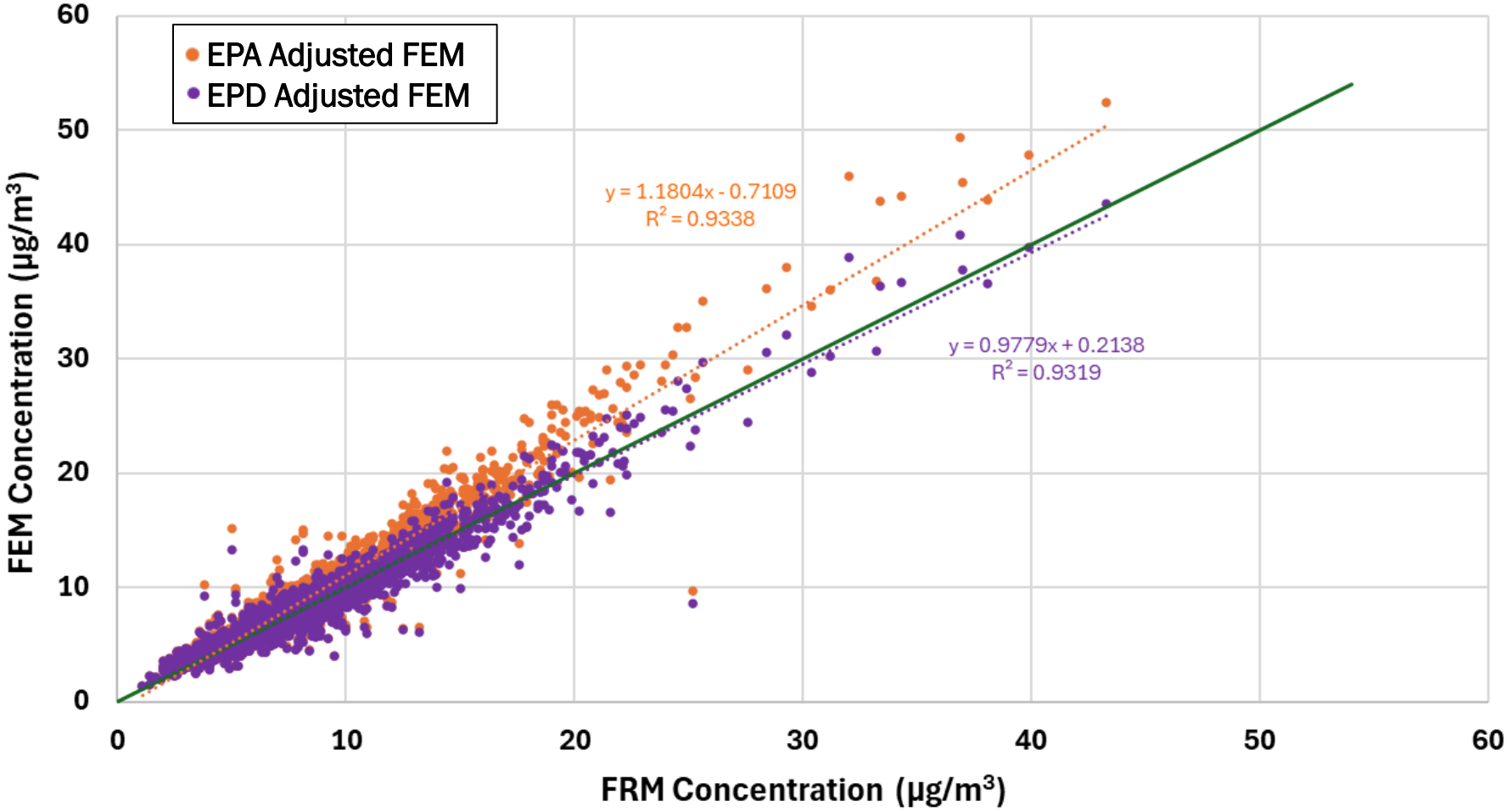
- ~~*If the ambient temperature is at or below 20°C*~~
  - ~~*T640/x raw PM value is less than or equal to 10ug/m3, then*~~ *multiply the T640/x raw PM value by 0.813233*
  - ~~*T640/x raw PM value is greater than 10ug/m3, then use the equation (T640/x raw PM – 1.861)*~~

- ~~*If the ambient temperature is above 20°C*~~
  - ~~*T640/x raw PM value is less than or equal to 5ug/m3, then*~~ *multiply the T640/x raw PM value by 0.813233*
  - ~~*T640/x raw PM value is greater than 5ug/m3, 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%
Columubus-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%
Statewide	**23.37%**	**9.59%**	**-0.24%**

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

2021-2023 DESIGN VALUES

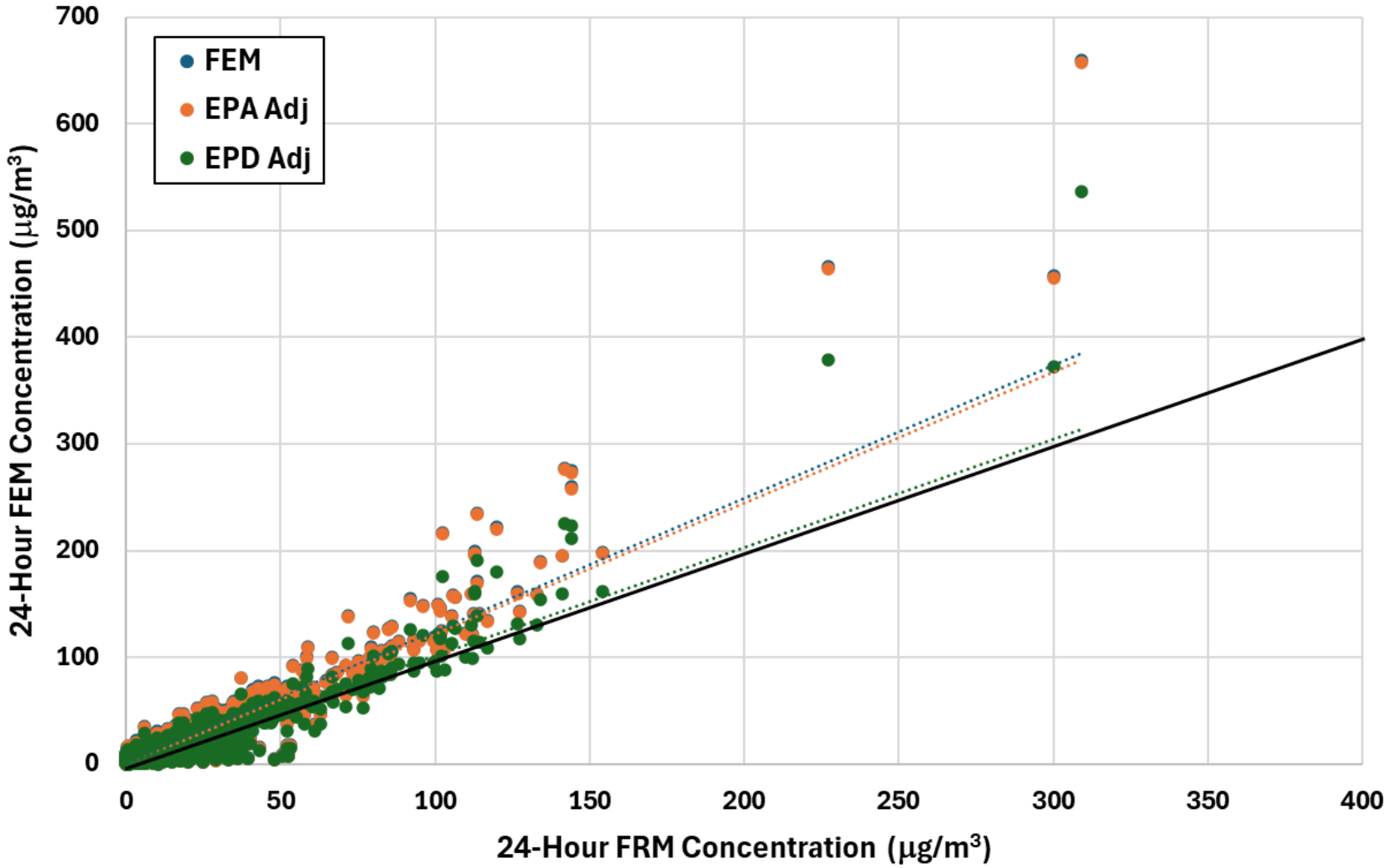
MSA	Site Name	Site ID	2021-23 PM2.5 Annual DV (Before EPA Correction)	2021-23 PM2.5 Annual DV (After EPA Correction)	2021-23 PM2.5 Annual DV (After EPD Correction)	Δ DV v1-v2
Macon-Bibb County MSA	Macon-Allied	13-021-0007	9.4	9.4	9.4	0.0
	Macon-Forestry	13-021-0012	9.4	8.4	7.9	0.5
Savannah MSA	Savannah-L&A	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 $\mu g/m^3$ (65 EE days)
2021-2023 DV with EPD bias correction ➔ 9.2 $\mu g/m^3$ (11 EE days)

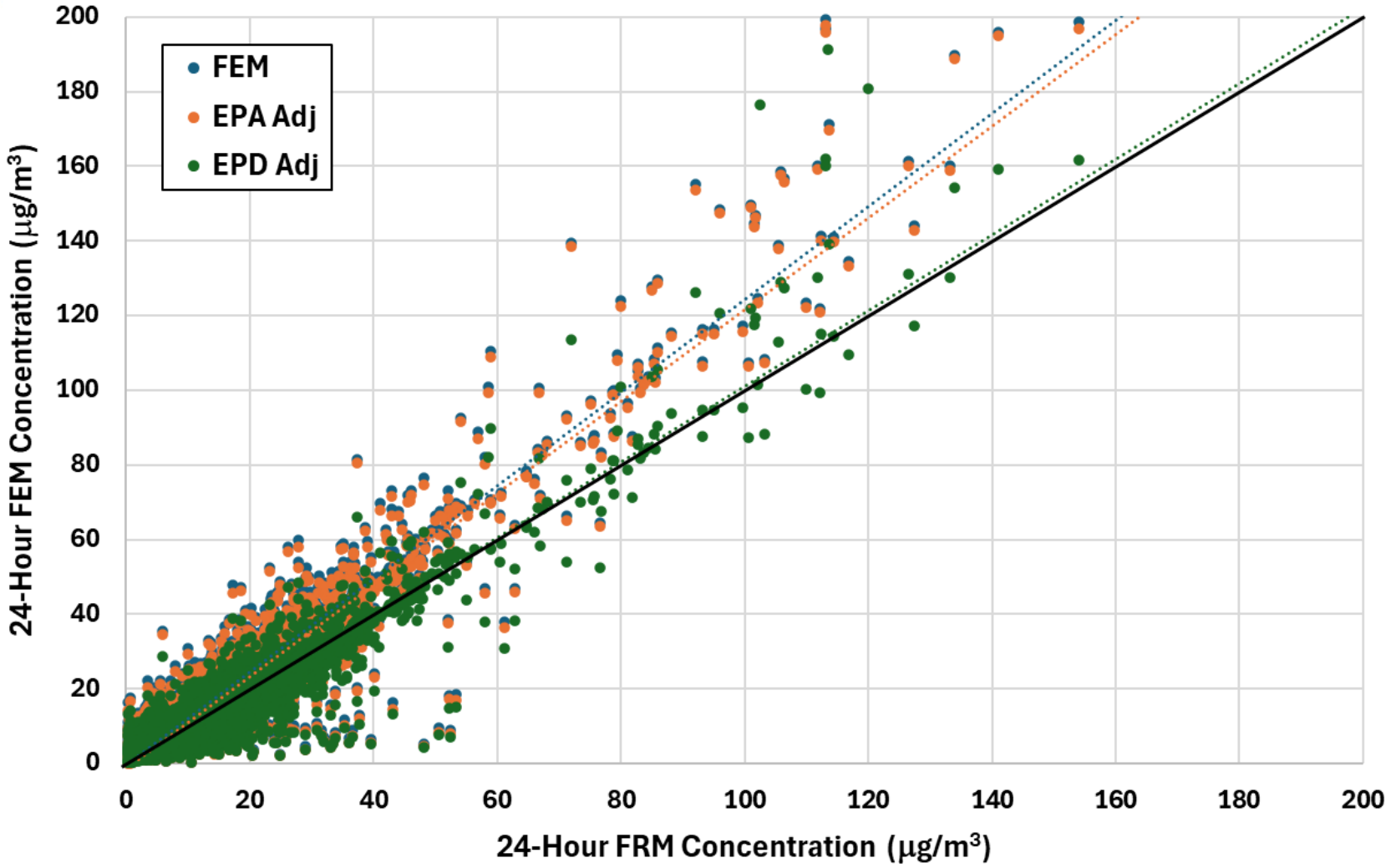
NATIONAL ANALYSIS

- 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

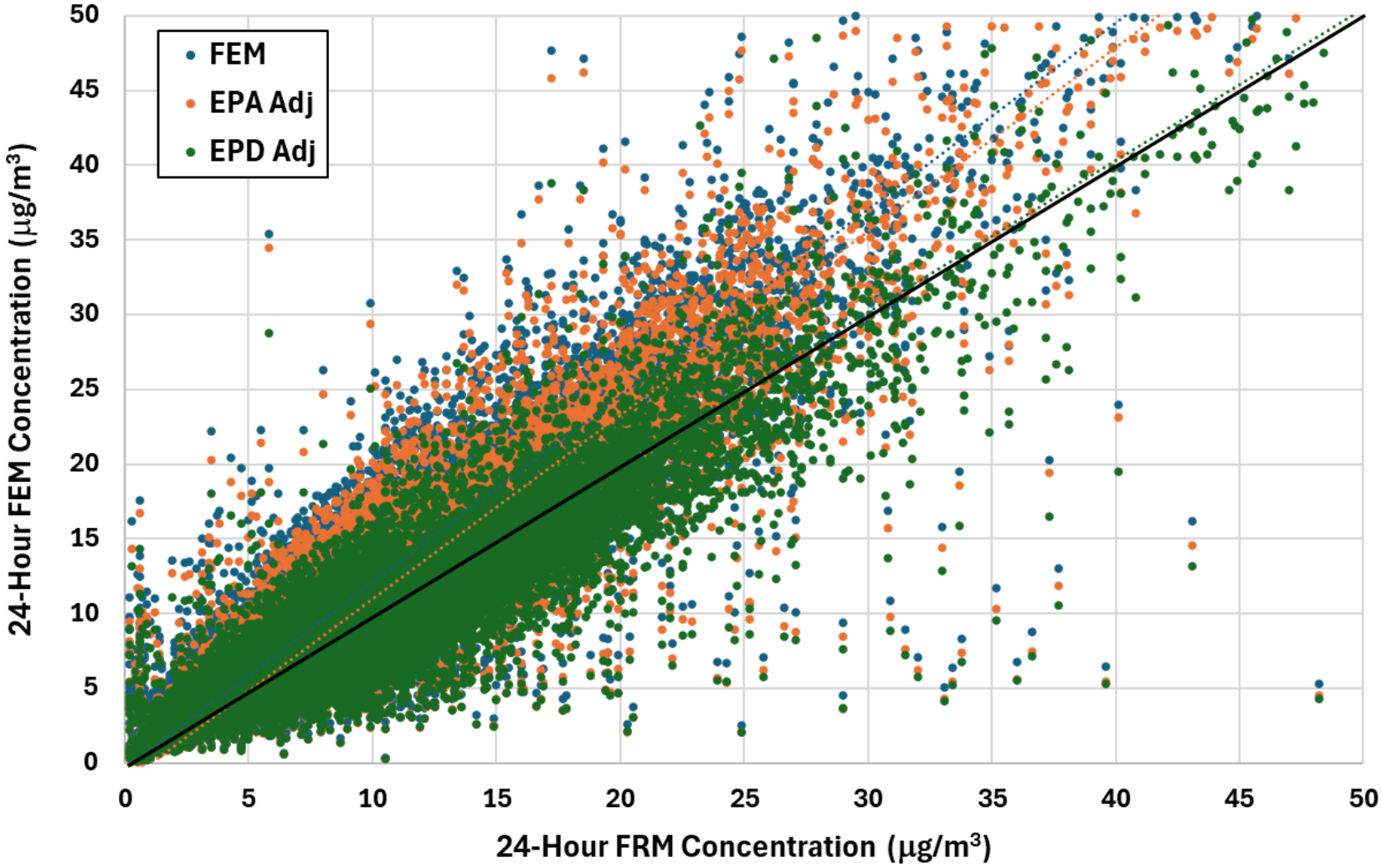
24-HOUR $PM_{2.5}$ (FRM vs. FEM)



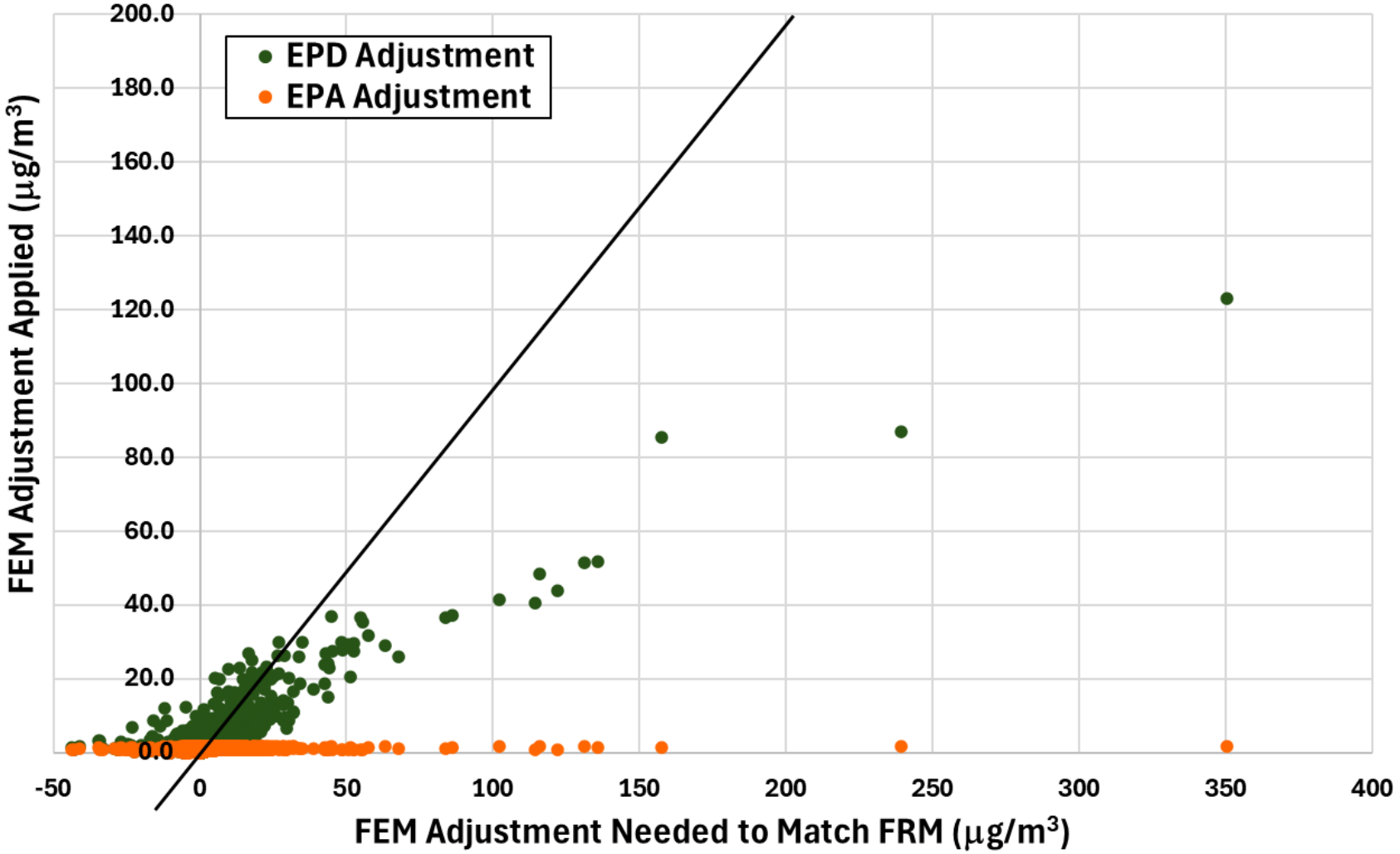
24-HOUR $PM_{2.5}$ (FRM vs. FEM)



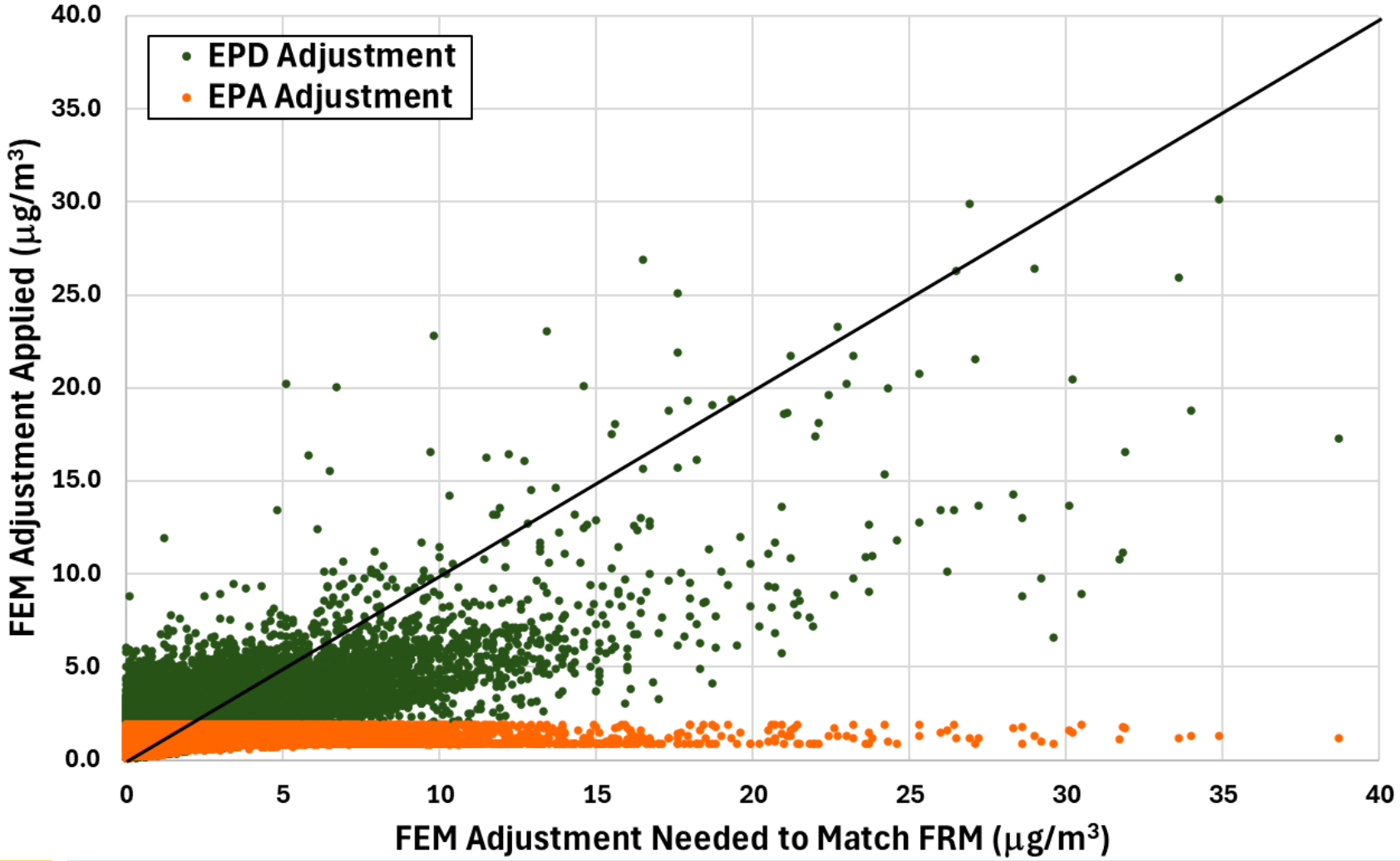
24-HOUR $PM_{2.5}$ (FRM vs. FEM)

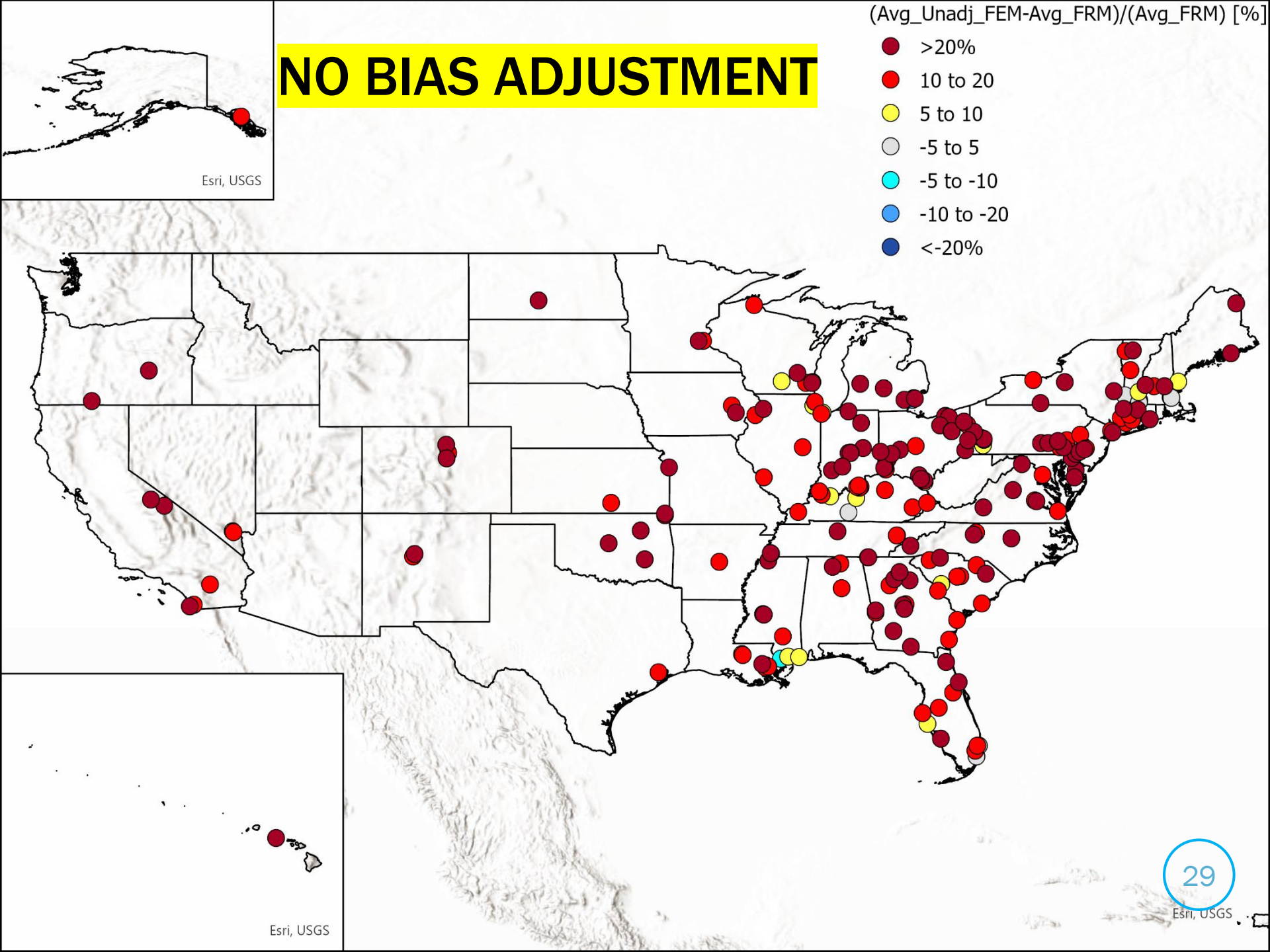


FEM ADJUSTMENT NEEDED vs. APPLIED

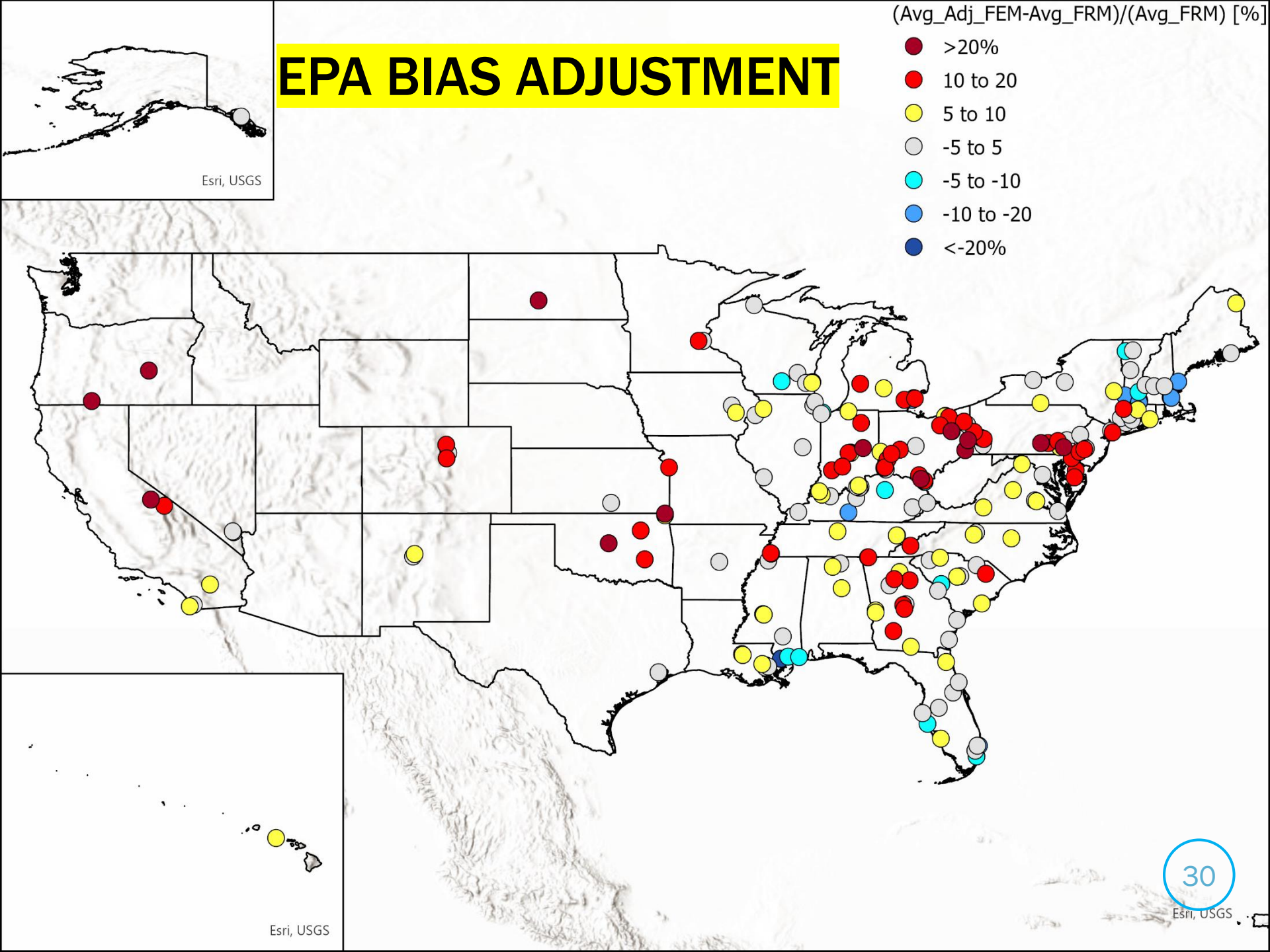


FEM ADJUSTMENT NEEDED vs. APPLIED

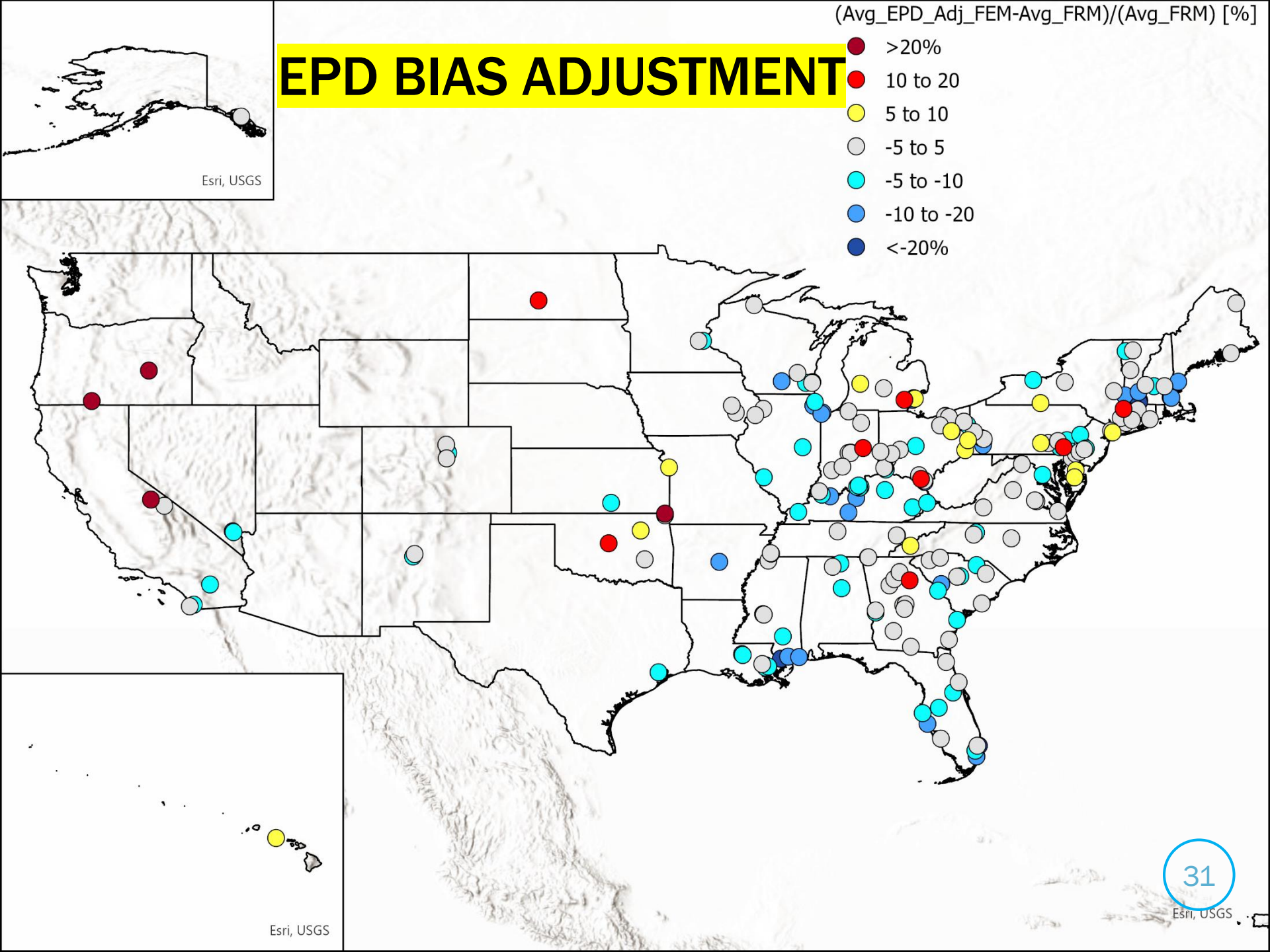


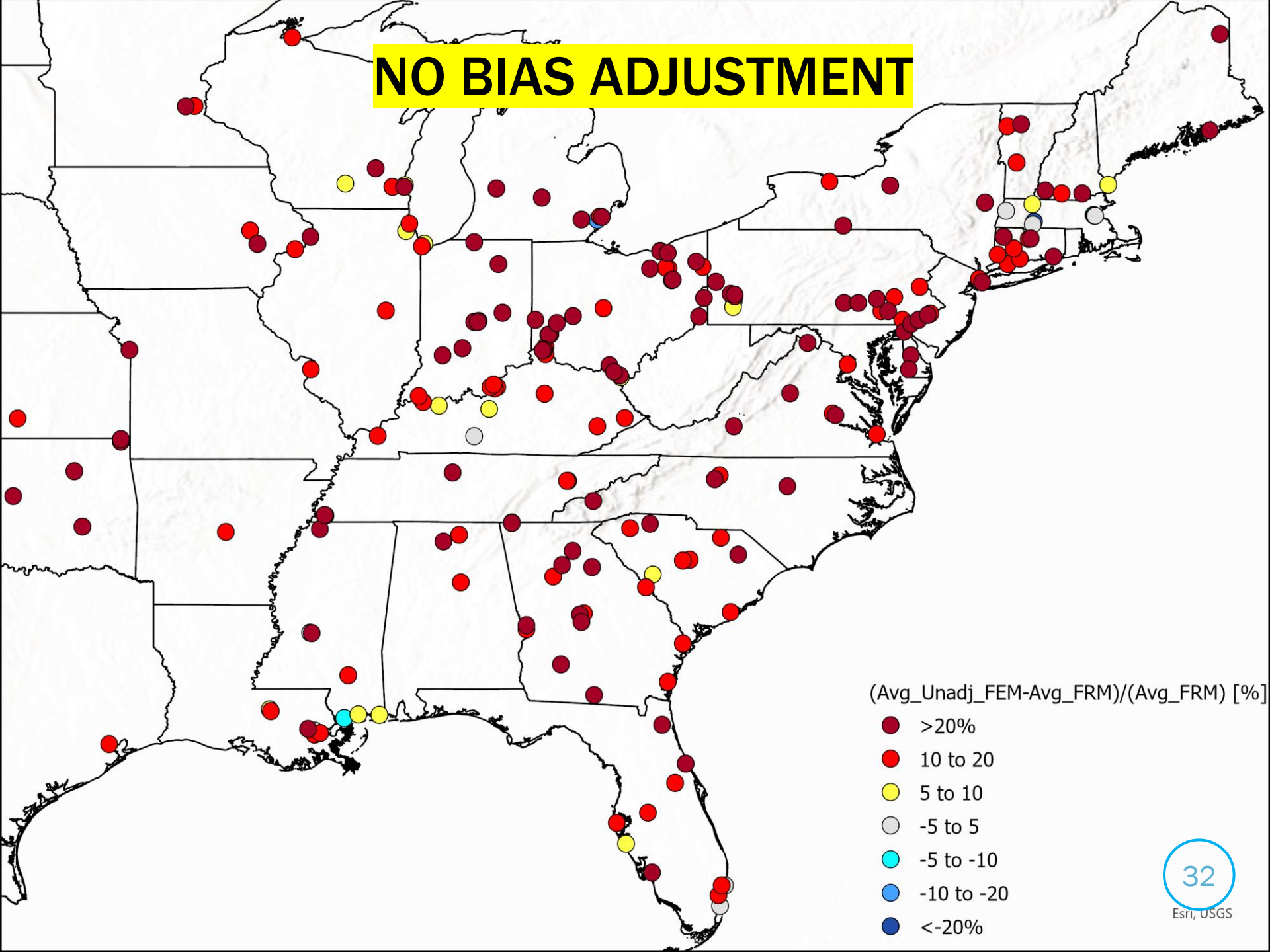

NO BIAS ADJUSTMENT
(Avg_Unadj_FEM-Avg_FRM)/(Avg_FRM) [%]
>20%
10 to 20
5 to 10
-5 to 5
-5 to -10
-10 to -20
<-20%
Esri, USGS
Esri, USGS
Esri, USGS

EPA BIAS ADJUSTMENT

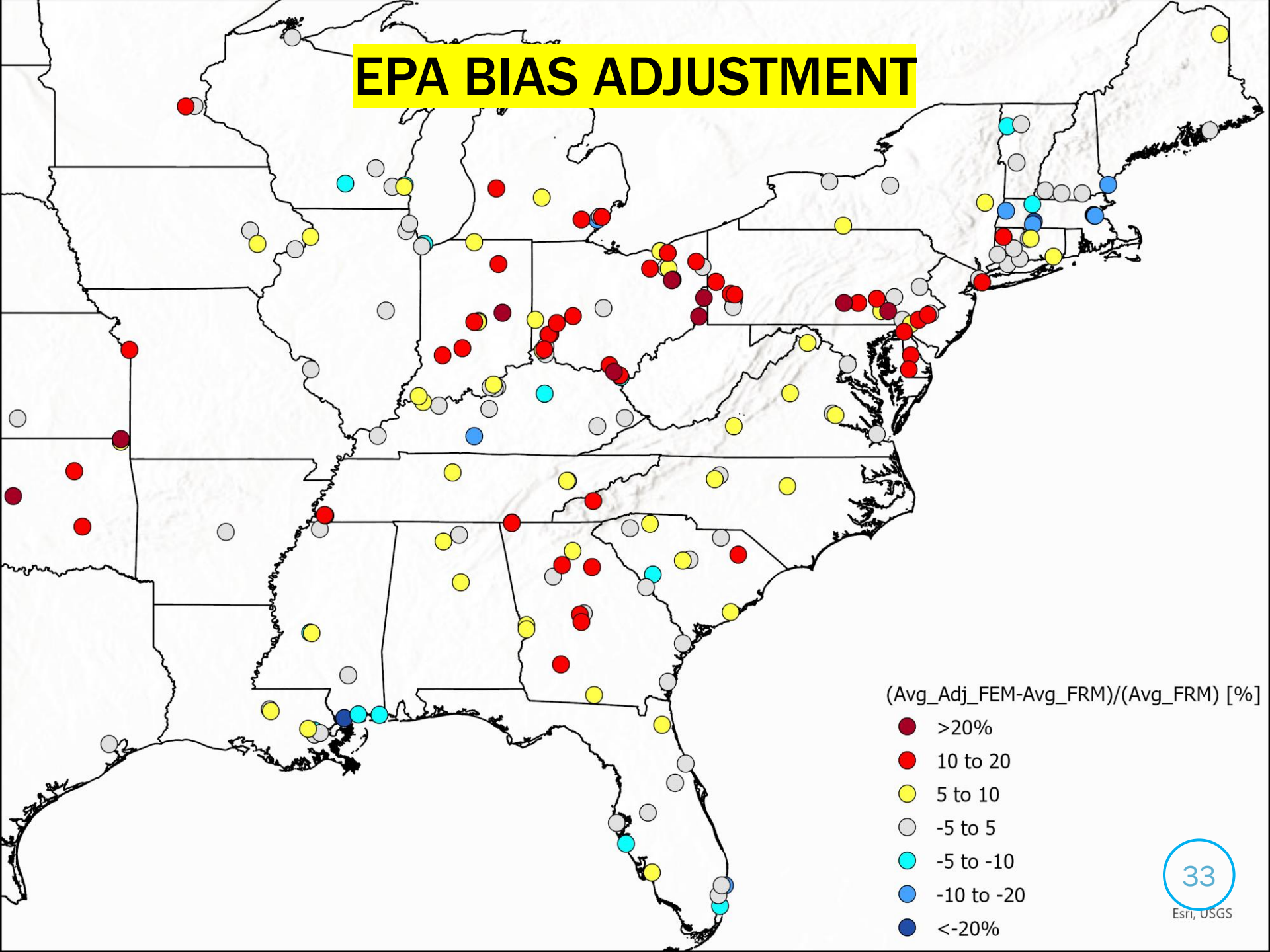


EPD BIAS ADJUSTMENT

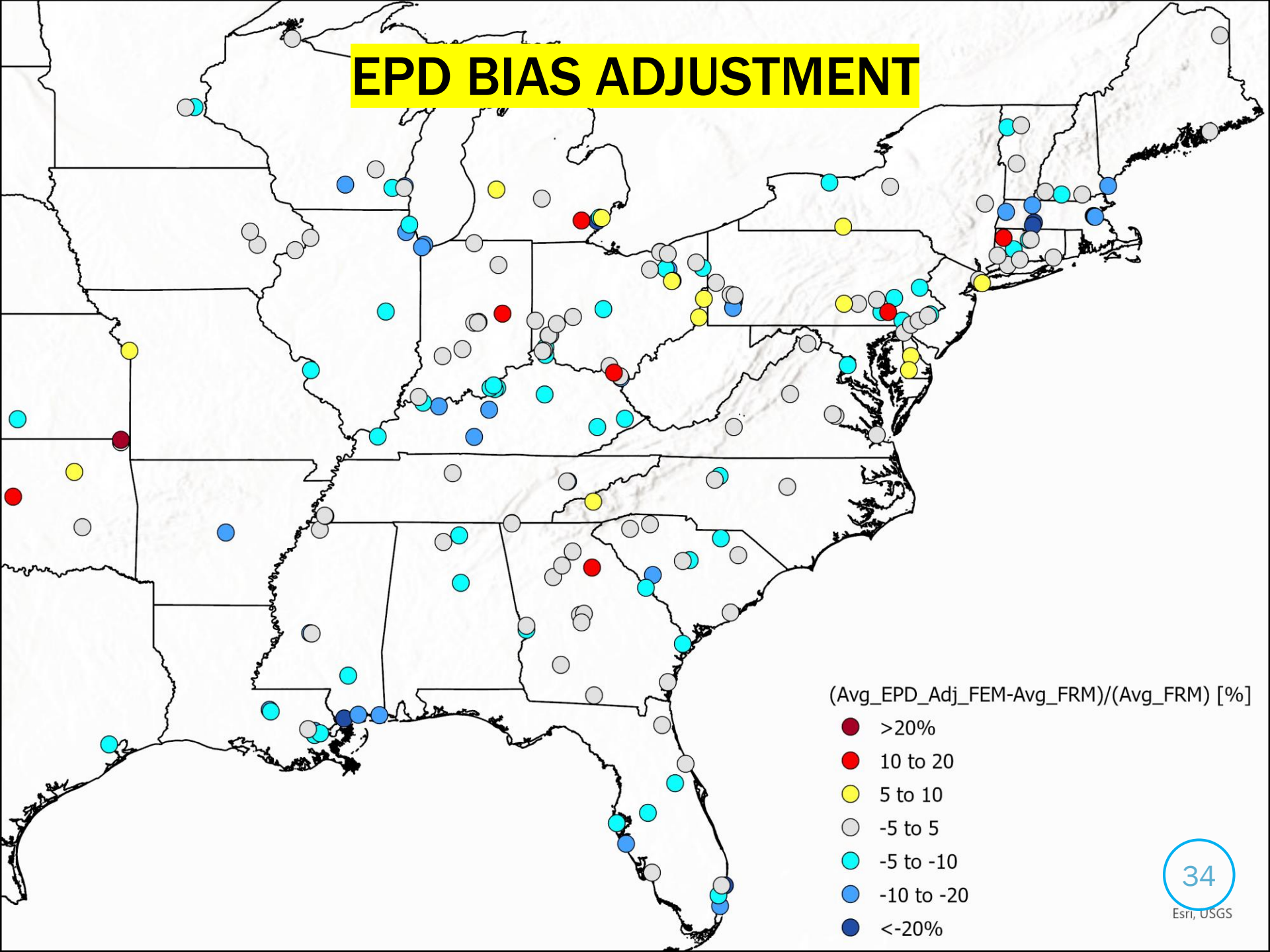



NO BIAS ADJUSTMENT
(Avg_Unadj_FEM-Avg_FRM)/(Avg_FRM) [%]
>20%
10 to 20
5 to 10
-5 to 5
-5 to -10
-10 to -20
<-20%
Esri, USGS

EPA BIAS ADJUSTMENT



EPD BIAS ADJUSTMENT

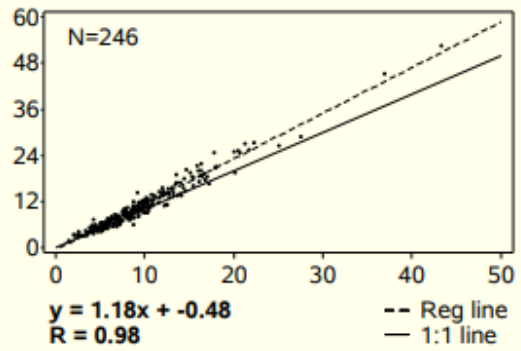


$PM_{2.5}$ Continuous Monitor Comparability Assessment

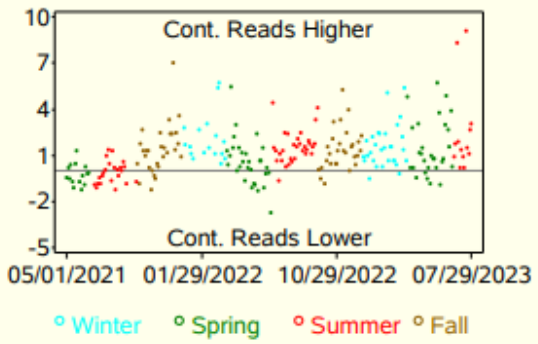
Site 13-295-0004: Rossville, GA

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

Cont. (y) vs. FRM (x) ($\mu g/m^3$)



Cont. minus FRM ($\mu g/m^3$)

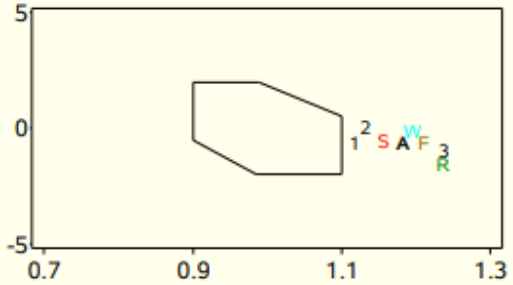


Mean Concentration ($\mu g/m^3$)

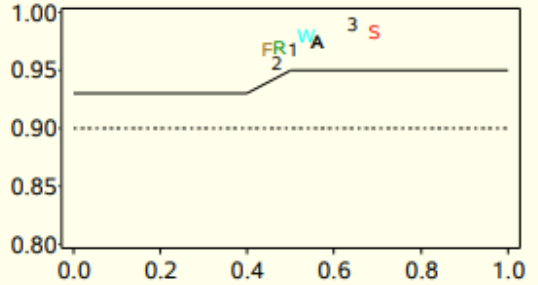
Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**246**	**9.4**	**10.6**	**1.13**
Winter	47	8.8	10.6	1.20
Spring	74	9.2	10.0	1.08
Summer	67	10.2	11.4	1.12
Fall	58	9.1	10.5	1.16
2021	69	9.4	10.0	1.06
2022	109	8.4	9.8	1.15
2023	68	10.9	12.6	1.16

Data Source: EPA AQS Data Mart

Additive (y) vs. Multiplicative (x) Bias



R (y) vs. FRM CCV (x)



Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**246**	**13.1**	**237**	**12.0**
Winter	47	21.9	43	18.9
Spring	74	6.7	72	6.2
Summer	67	12.4	66	11.5
Fall	58	15.0	56	14.9
2021	69	5.0	67	4.7
2022	109	17.0	103	15.5
2023	68	15.0	67	14.1

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 $\mu g/m^3$ (74 EE days)**
2021-2023 DV with only 1-in-3 FRM data ➔ **9.3 $\mu g/m^3$ (7 EE days)**

GEORGIA $PM_{2.5}$ 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 $PM_{2.5}$ monitors?
  - Replace Teledyne $PM_{2.5}$ monitors with alternative continuous $PM_{2.5}$ monitors?
  - Run FRM as 1-in-3 days monitor?

Evaluation of Fine Particulate Matter (PM2.5) 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