PM Source Apportionment Modeling for PM NAAQS Implementation

CAPCA Fall Meeting
Myrtle Beach, SC
October 24, 2024

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ALPINE GEOPHYSICS

Designation and Wildfire Influence

Implementation Timeline: Designations, SIPs, and Permitting

EPA memo: “Initial Area Designations for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard” (February 7, 2024)

May 6, 2024: Rule effective date; PSD permitting

January 1, 2025: Air agencies must notify EPA of intent to submit exceptional events demonstration(s)

February 7, 2025: Deadline for states and tribes to submit attainment recommendations based on a five-factor analysis

February 7, 2025: Exceptional events demonstrations due with attainment recommendations

October 9, 2025: EPA ‘120-day letters’ with initial area designations

February 6, 2026: EPA formal attainment designations

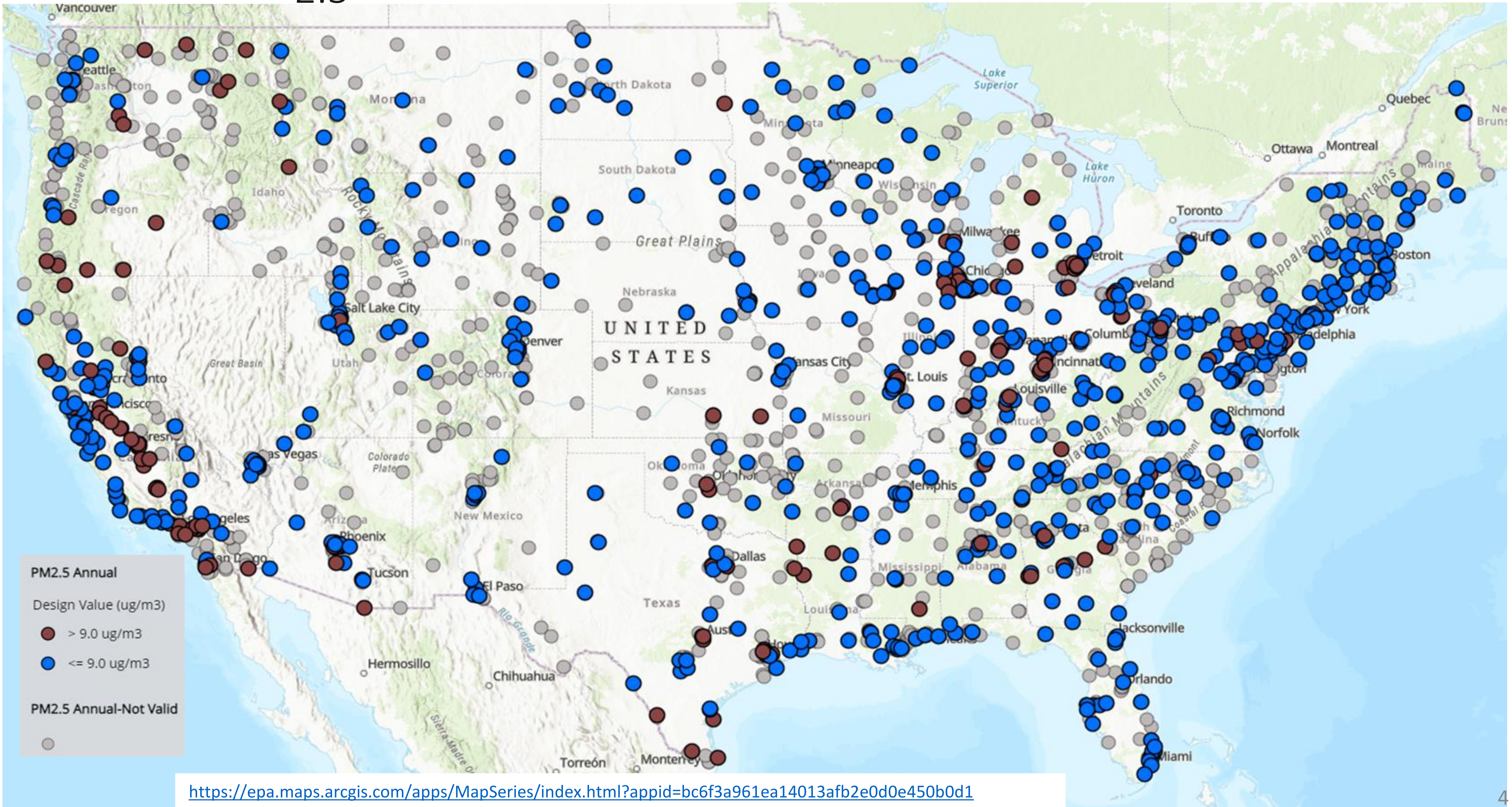
-> Option to extend designations process by up to one year

February 2027: ‘Infrastructure’ and Good Neighbor SIPs due

August 2027: Nonattainment area SIPs due

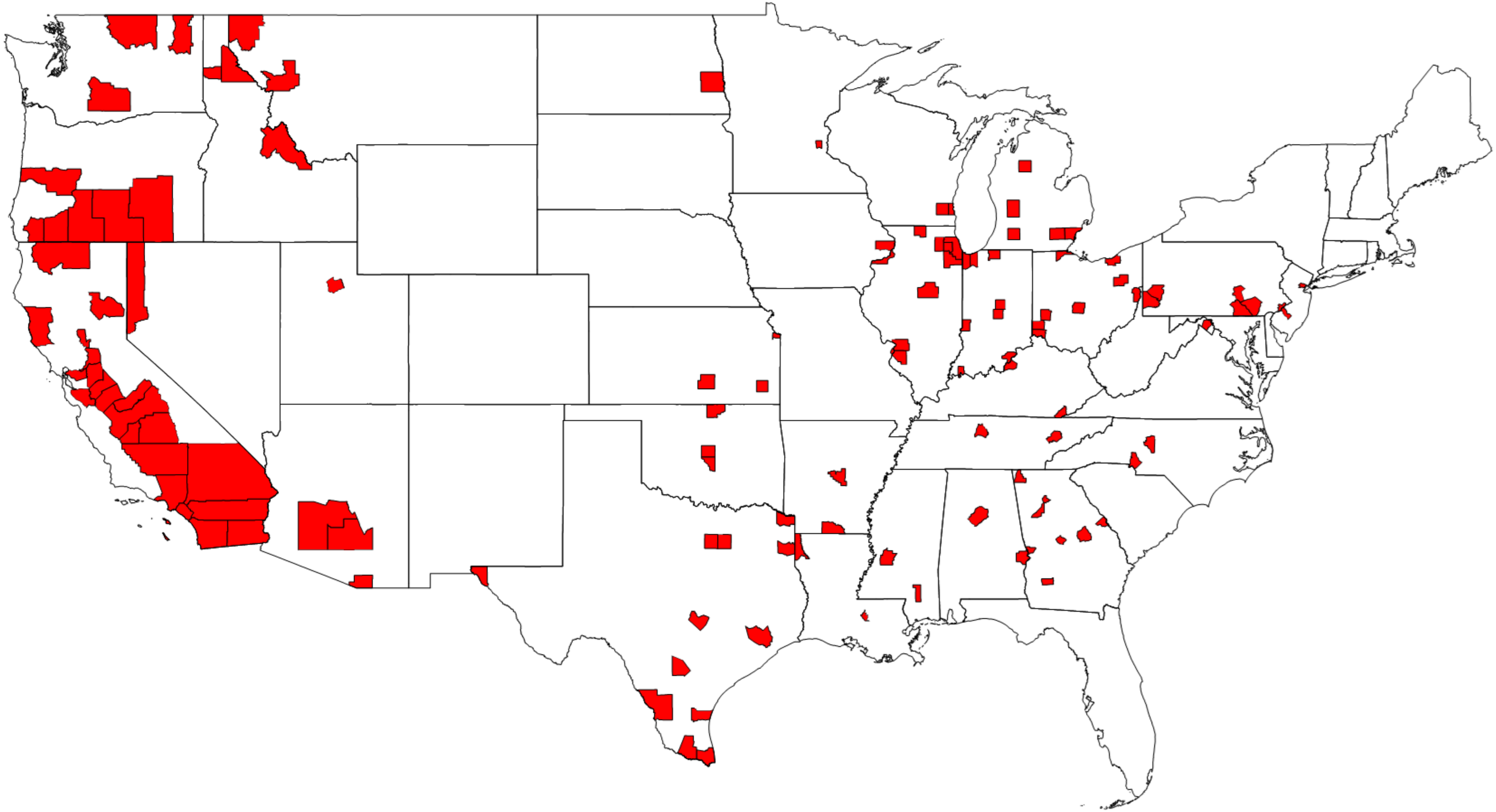
2032: Attainment deadline for Moderate nonattainment areas

2023 Design Value Interactive Map – Annual $PM_{2.5}$ Design Values

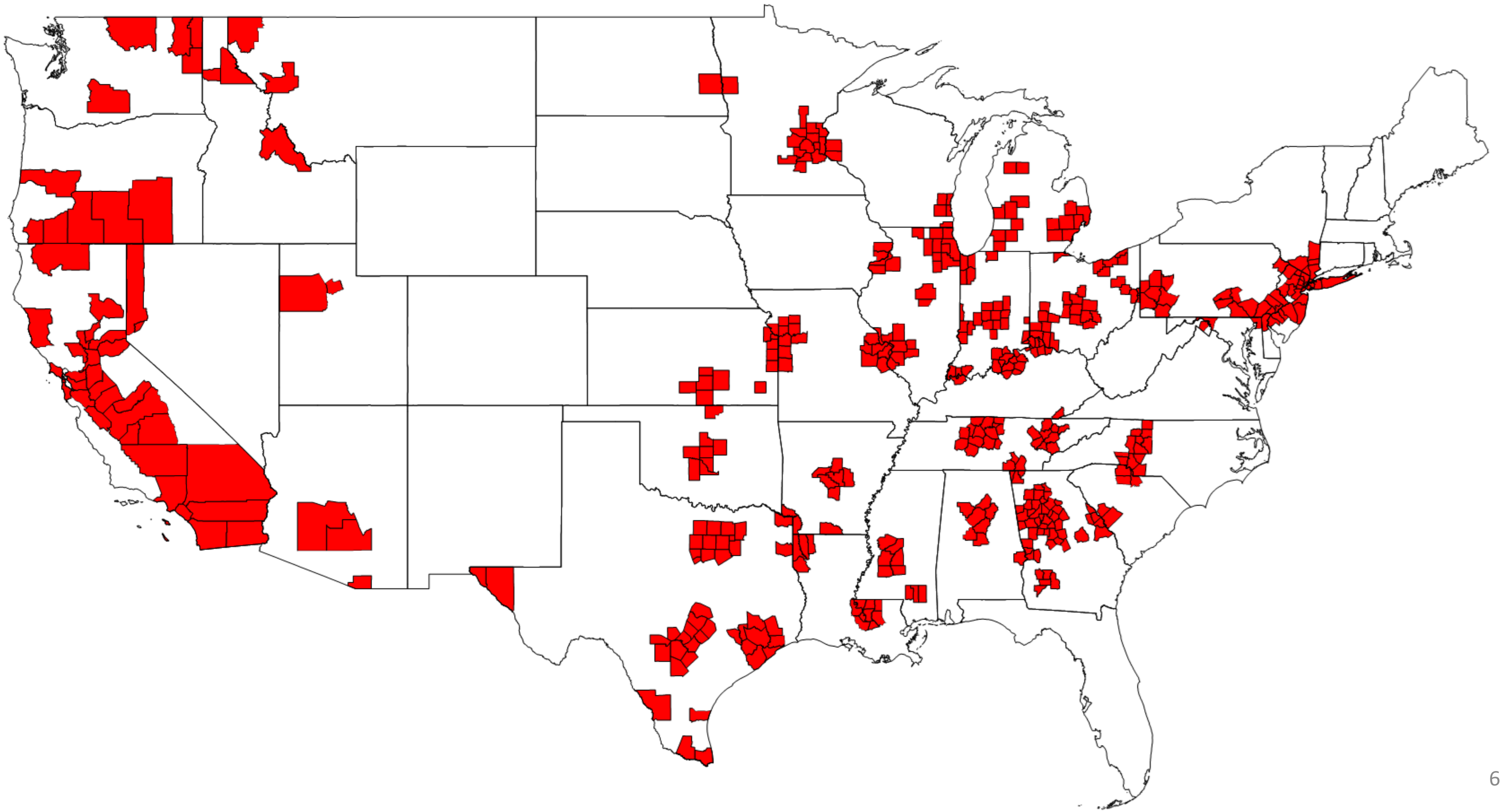


https://epa.maps.arcgis.com/apps/MapSeries/index.html?appid=bc6f3a961ea14013afb2e0d0e450b0d1

Counties with 2021-2023 Annual $PM_{2.5}$ DV > 9.0 μg/m^3



CBSA with 2021-2023 Annual $PM_{2.5}$ DV > 9.0 µg/m^3

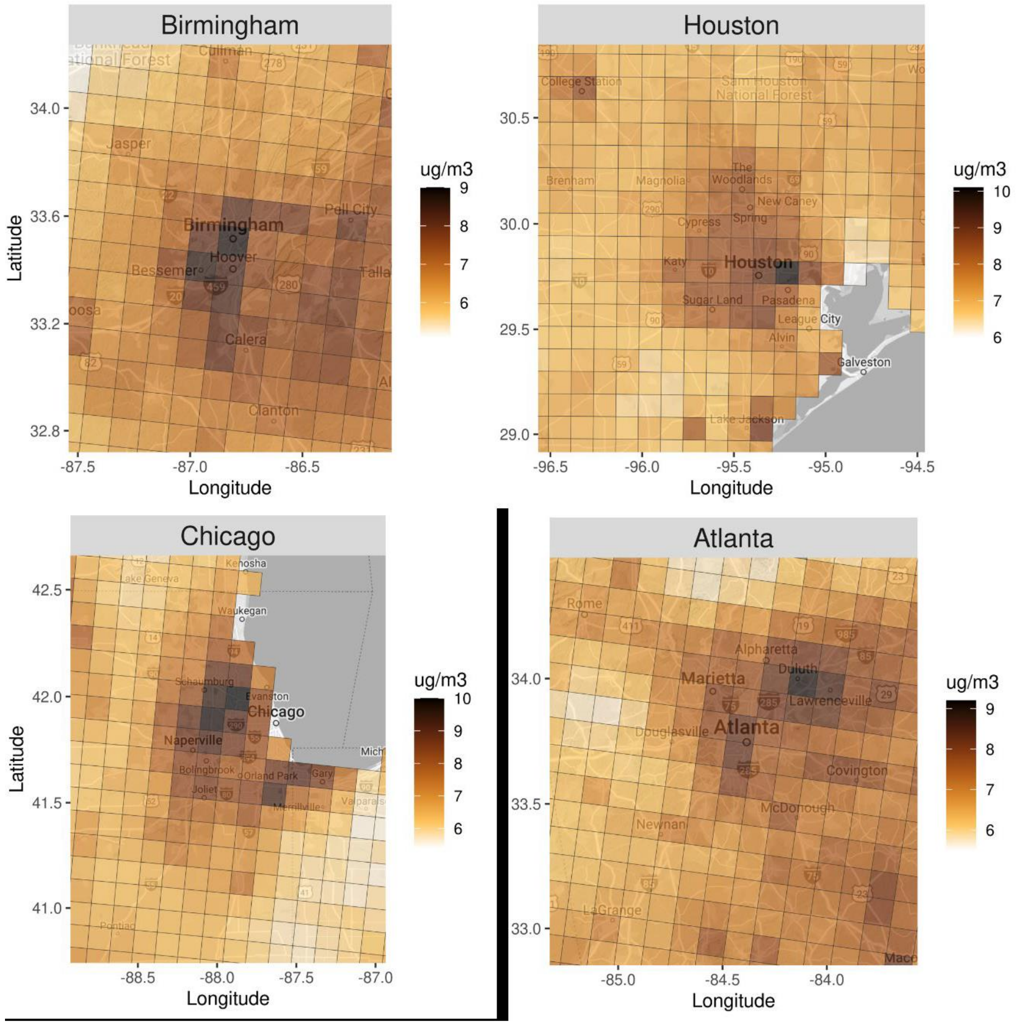


PM Nonattainment Designation

- Five Factor Analysis
  - Most recent three years of monitoring data
  - Emissions data from current sources
  - Meteorology
  - Geography/topography
  - Area boundaries

- Also cited are weight of evidence using
  - Air quality modeling
  - Source apportionment modeling

EPA Findings on Spatial Extent of Contribution



- Gridded $PM_{2.5}$ concentrations over selected urban areas based on the 2032 modeling case with the enhanced Voronoi Neighbor Averaging (VNA) approach
- A common feature of these diverse locations is the relatively high $PM_{2.5}$ concentrations over the urban area and lower concentrations just outside of the urban core
- $PM_{2.5}$ concentrations in the urban core of these Eastern U.S. areas exceed revised and alternative standards levels considered in the RIA, whereas concentrations surrounding the urban core are below the revised and alternative standard levels

Project Objective, Processing, Methods, Configuration, Documentation

- Alpine Geophysics adapted an EPA developed nationwide one-atmosphere photochemical grid modeling platform (2016v3 + projections) to assess identified source region and group combinations and to report the relative $PM_{2.5}$ impact from each of these combinations on downwind monitor locations

- We performed a PM source apportionment modeling run using the Comprehensive Air-quality model with extensions (CAMx) Particulate Matter Source Apportionment Technique (PSAT) algorithms

- *Particulate Source Apportionment Technology Analysis of $PM_{2.5}$ for Multiple Domains and Categories - Final Report*, Alpine Geophysics, July 2024

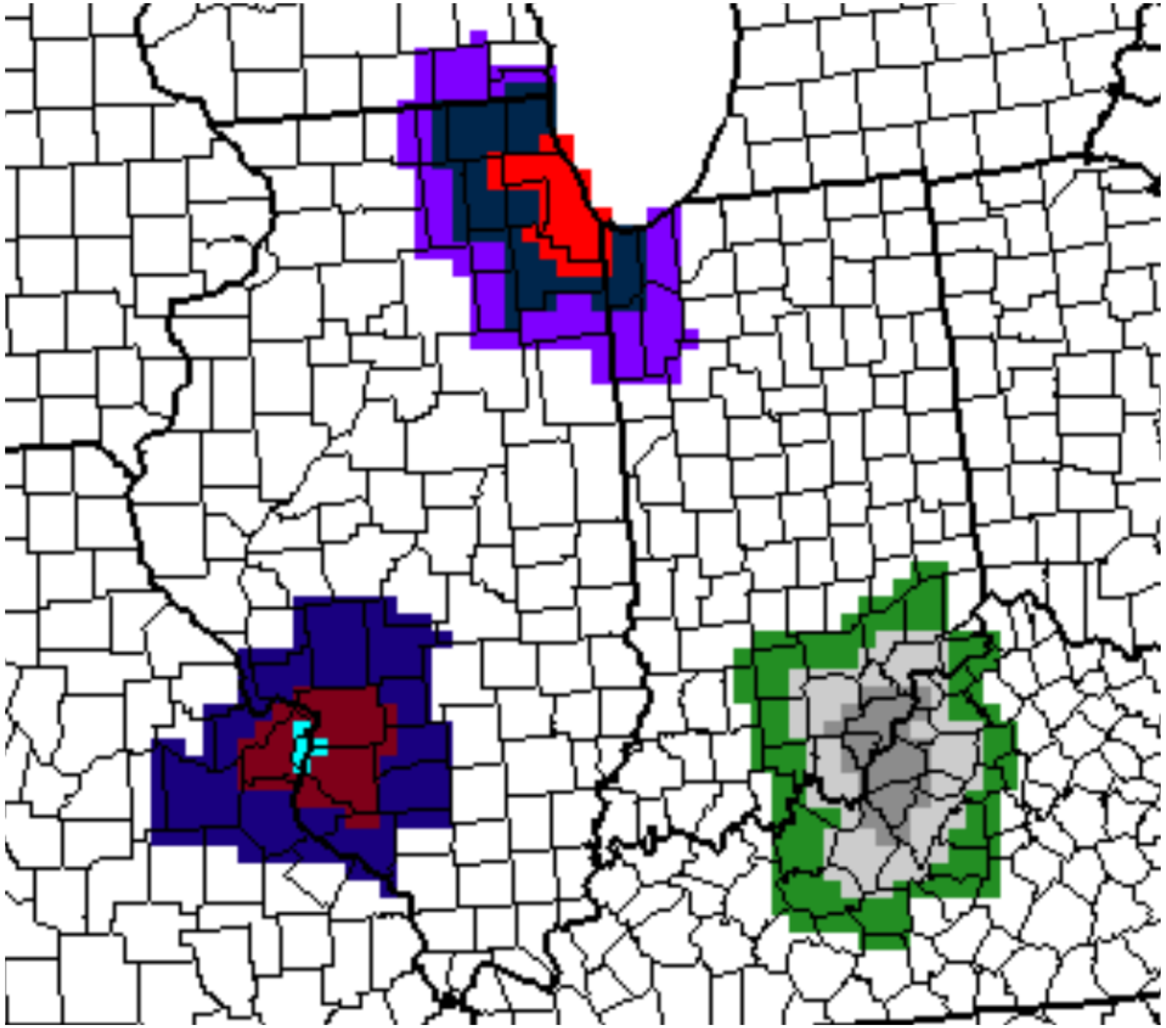
  https://www.midwestozonegroup.com/technical-support-documents

PSAT Simulation Results

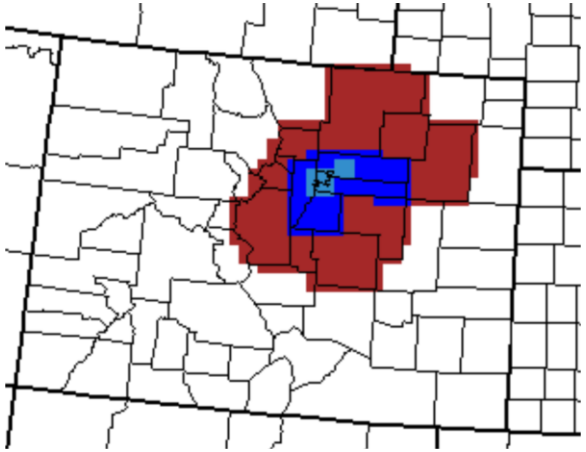
- Base case 2026 DV calculated used EPA methods
- Look at relative contribution of anthropogenic contribution at monitor from modeled concentrations by traced species and as whole
- Relative contribution using EPA attainment test tool (SMAT-CE) and ratio of averaged modeled tag concentration to base case total

- Traced Species = sulfate + nitrate + ammonium + OC + EC
- Non-Traced Species = secondary organic aerosols + sea salt + particle bound water + blank mass

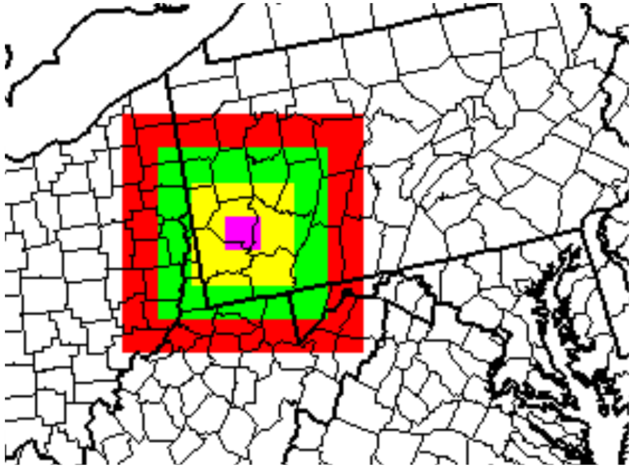
Seven Selected Source Regions



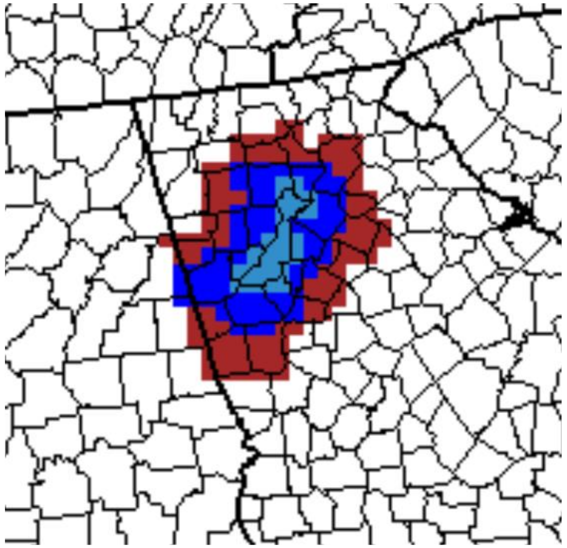
Chicago, St. Louis, and Louisville



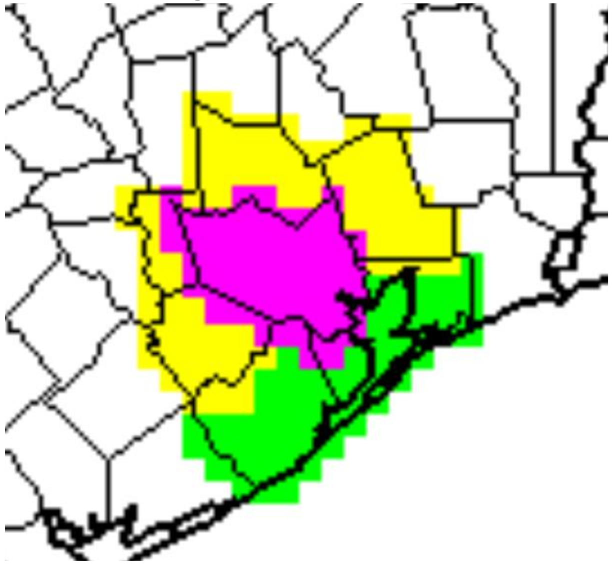
Denver



Pittsburgh



Atlanta

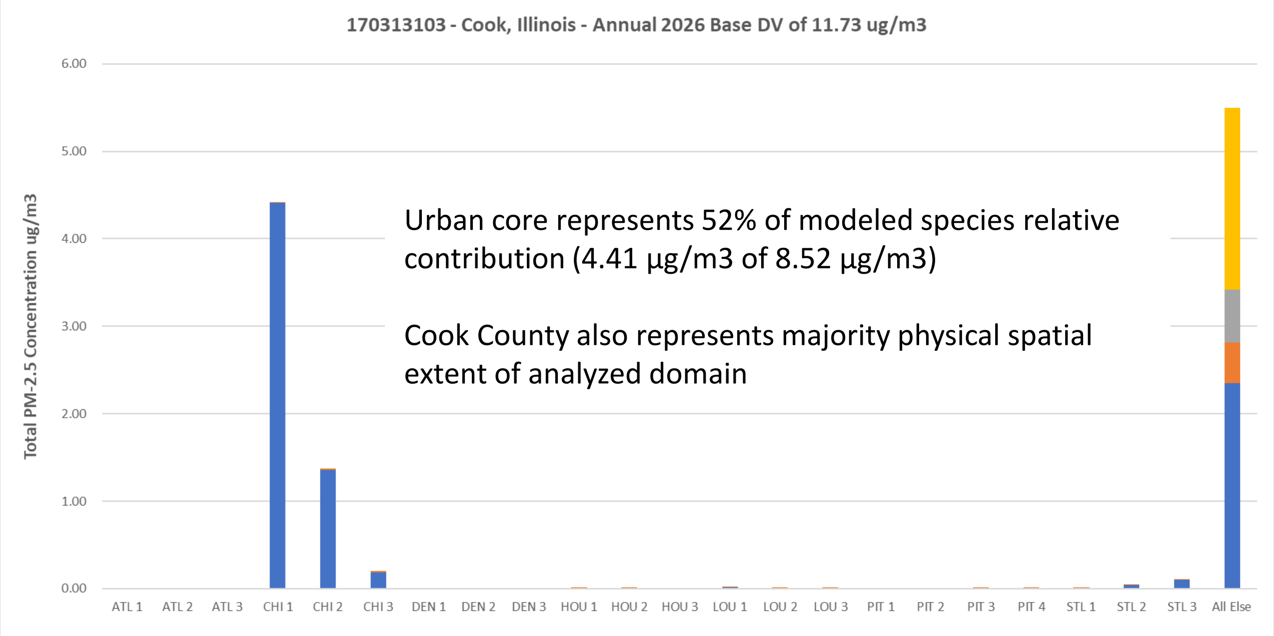


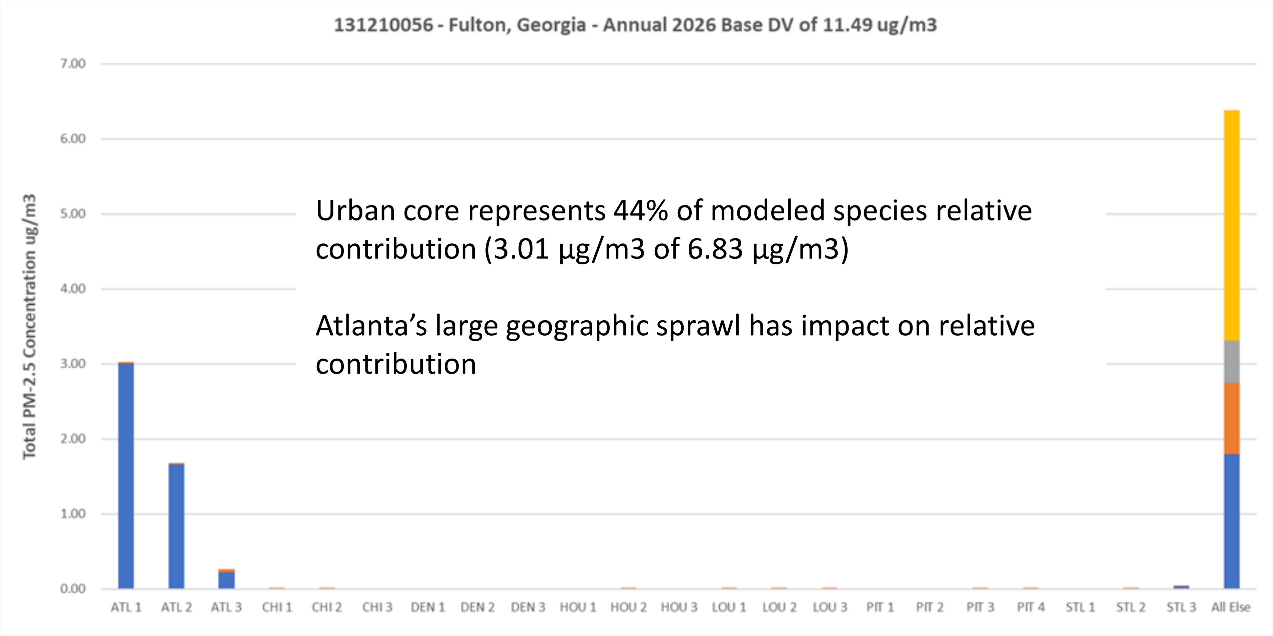
Houston

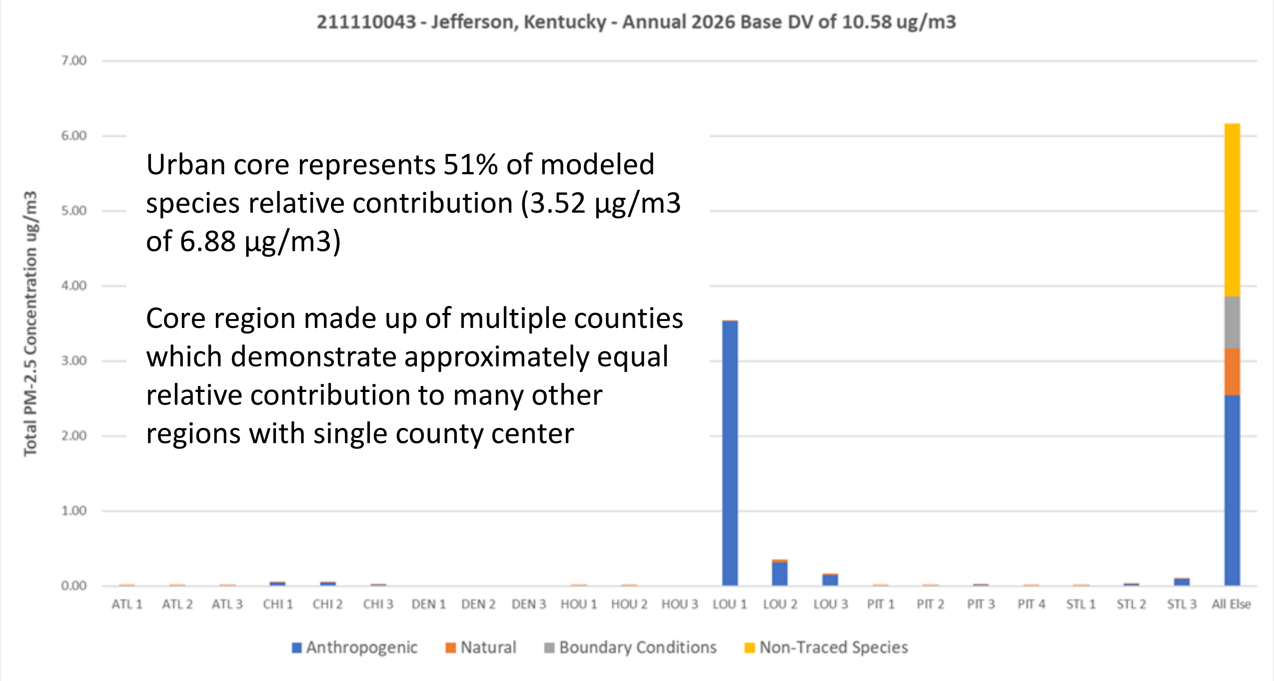
Reviewed Monitors

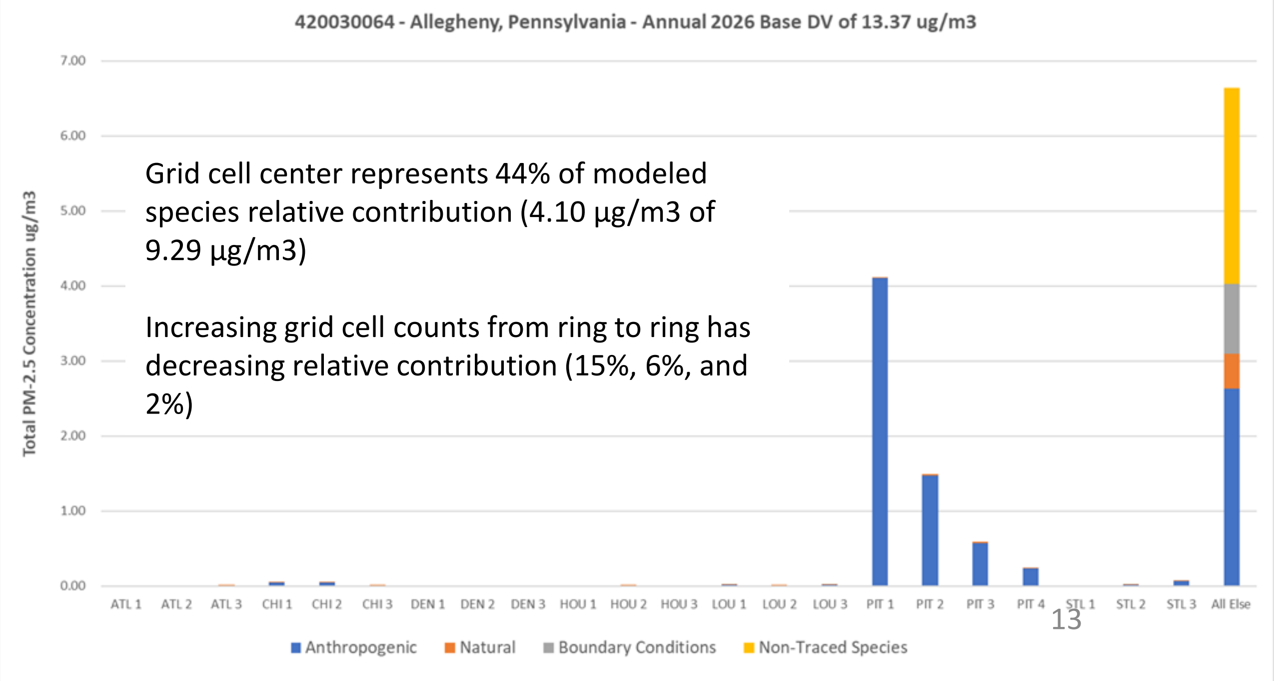
Monitor	Region	Monitor Location	2026 Base DV (µg/m³)
170313103	Chicago	Cook, Illinois	11.73
131210056	Atlanta	Fulton, Georgia	11.49
080310028	Denver	Denver, Colorado	11.36
482011035	Houston	Harris, Texas	11.63
211110043	Louisville	Jefferson, Kentucky	10.58
420030064	Pittsburgh	Allegheny, Pennsylvania	13.37
291893001	St. Louis	Saint Louis, Missouri	10.36

Relative Anthropogenic Contribution by Distance









Preliminary Observations

- In majority of regions, urban core dominates the modeled $PM_{2.5}$ concentration
- This is consistent with the NAAQS exceedances being driven by the urban $PM_{2.5}$ increment as documented in EPA's RIA, the relatively high responsiveness of $PM_{2.5}$ concentrations to primary $PM_{2.5}$ emission reductions, and the reductions in regional $PM_{2.5}$ concentrations from the large SO2 and NOx emission reductions in recent decades and in the 2032 projection
- Analysis supports that designation should focus on local areas around monitored exceedances
- The Alpine analysis appears informative in providing corroborating data to support $PM_{2.5}$ designations and distance from monitors with respect to relative contribution
  - Results could support 5-factor test within each domain

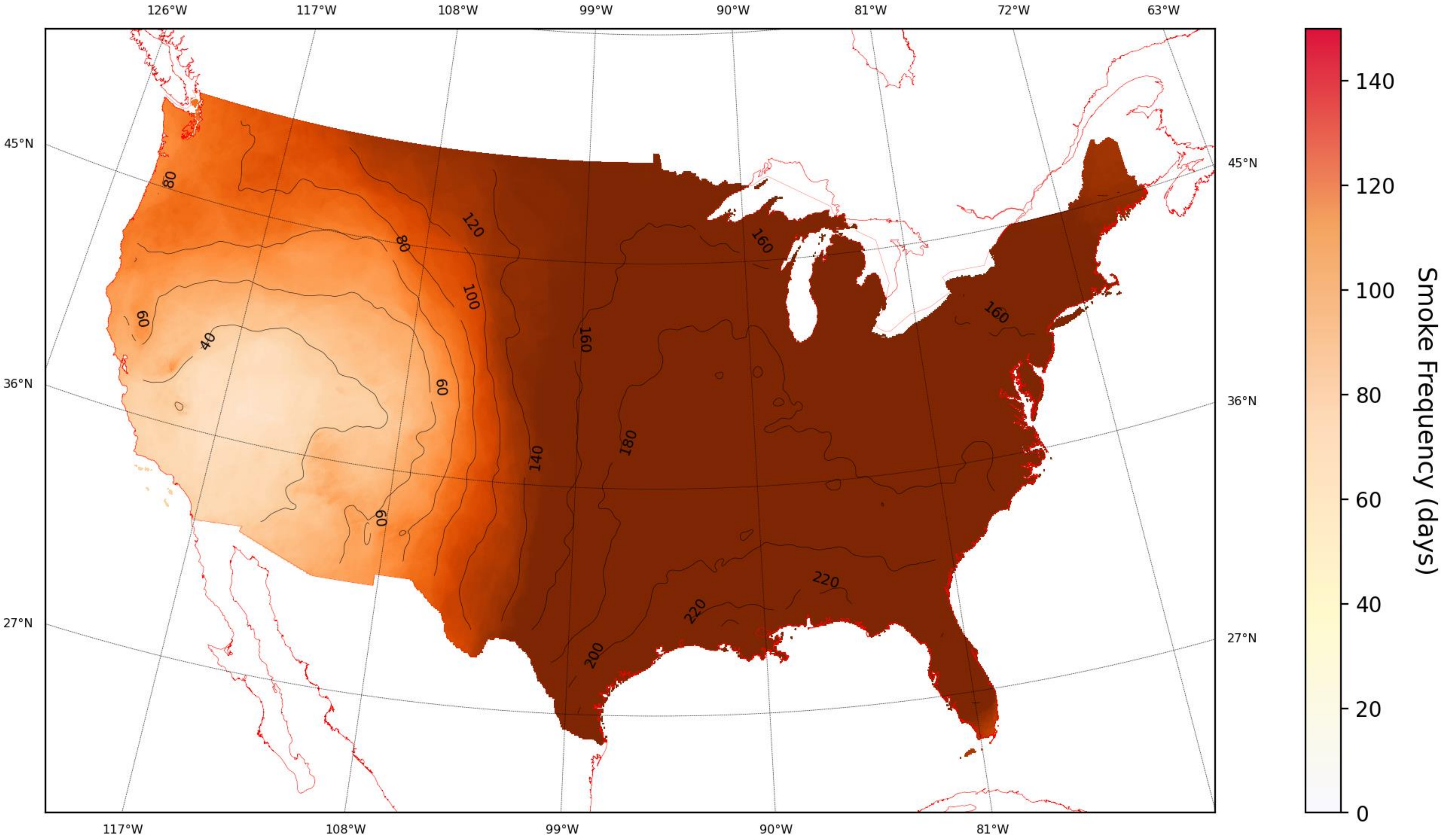
Influence of Wildfire Smoke on PM Concentrations

- 2023 and 2024 have measured exceedance days triggering the opportunity for exceptional events demonstrations to remove concentrations from design value calculations

- 2023 saw widespread influence of wildfire and prescribed fire smoke in eastern and Midwestern states

- 2024 is seeing influence of wildfire smoke in western states

Cumulative Smoke Distribution (CONUS) 2023

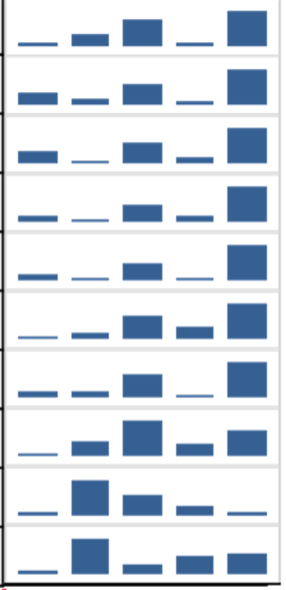


NOAA/NESDIS Hazard Mapping System

2023 Fires Dramatically Increase $PM_{2.5}$ Design Values

Annual Mean PM-2.5 Values (ug/m3)

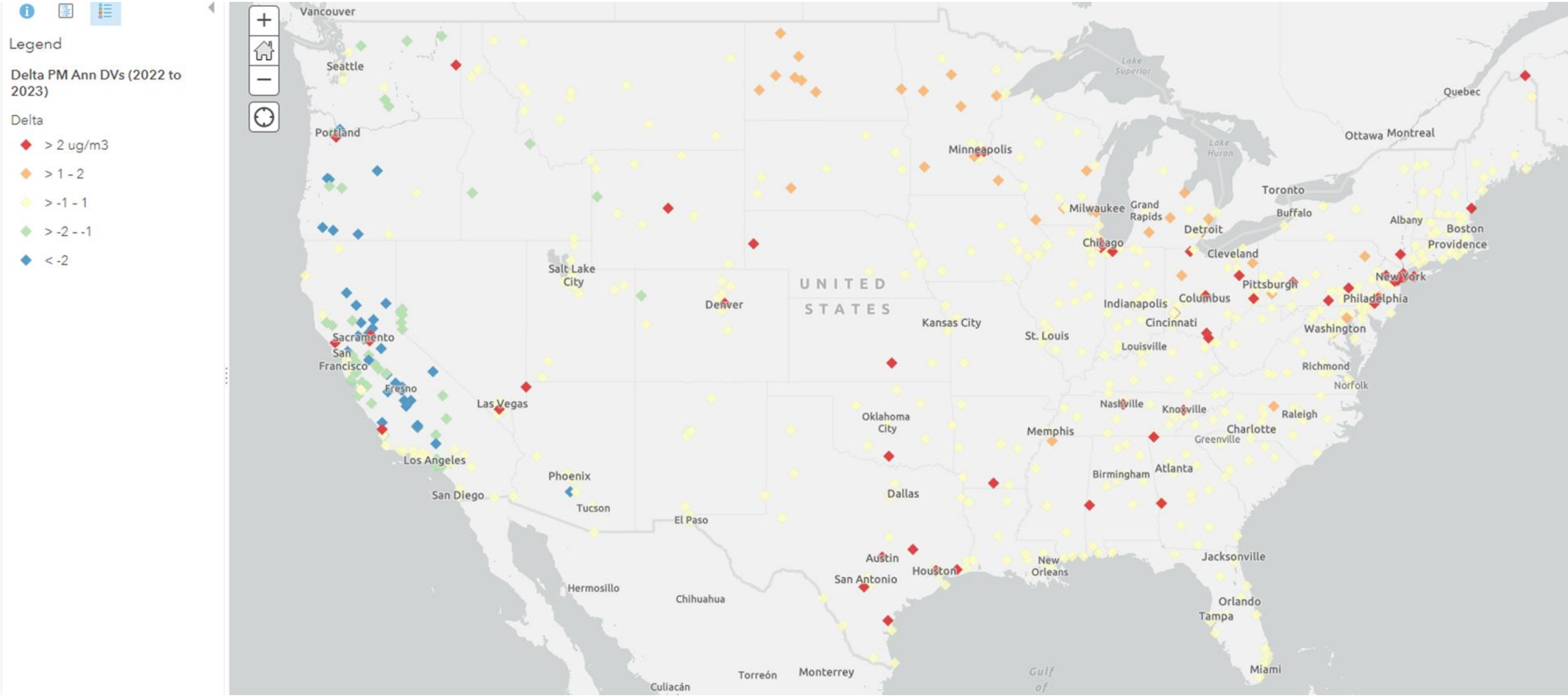
EPA Region	2019	2020	2021	2022	2023	5-Year Trend
1	5.9	6.2	6.7	5.9	7.0	
2	7.1	6.9	7.5	6.7	8.2	
3	7.8	7.1	8.4	7.5	9.2	
4	7.8	7.6	8.4	7.9	9.1	
5	8.2	7.8	8.9	7.9	10.3	
6	8.1	8.2	8.6	8.3	8.8	
7	7.5	7.4	8.5	7.2	9.1	
8	5.2	6.2	7.6	5.9	7.0	
9	6.9	10.7	9.1	7.8	7.3	
10	7.7	10.1	8.3	8.8	9.2	



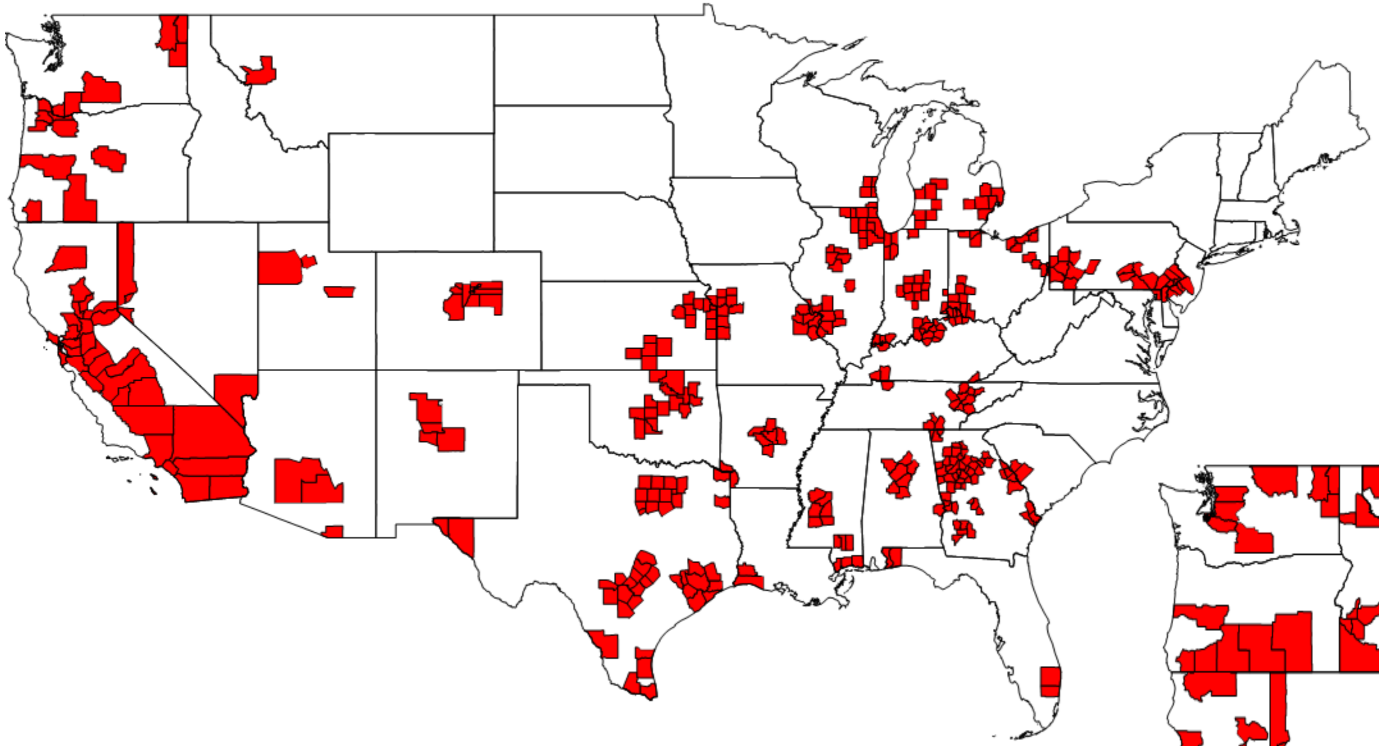
Used for 2021 DV

Used for 2023 DV

Change in Annual $PM_{2.5}$ DV (2022 to 2023)

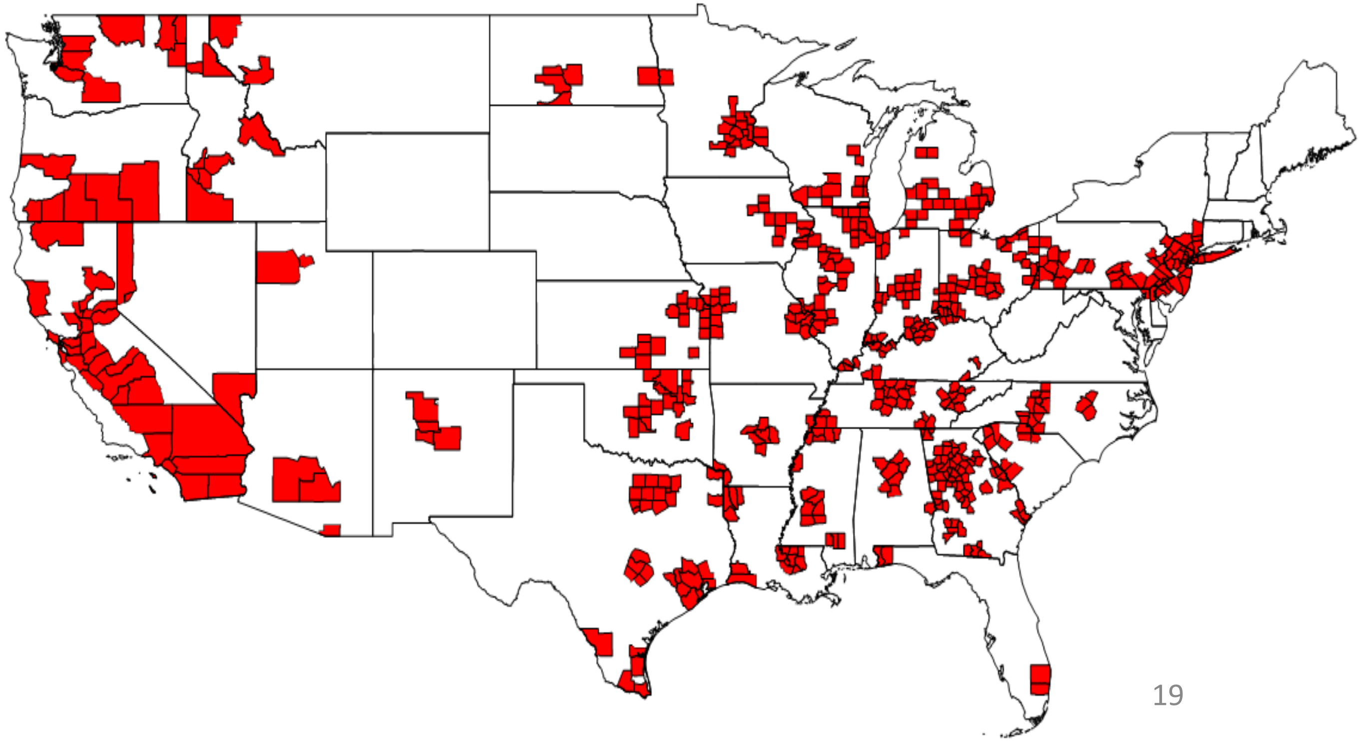


49% Increase in CBSA Counties Exceeding 9.0 µg/m^3 Standard Due to Recent Fires [Pre-Teledyne Adjustment]

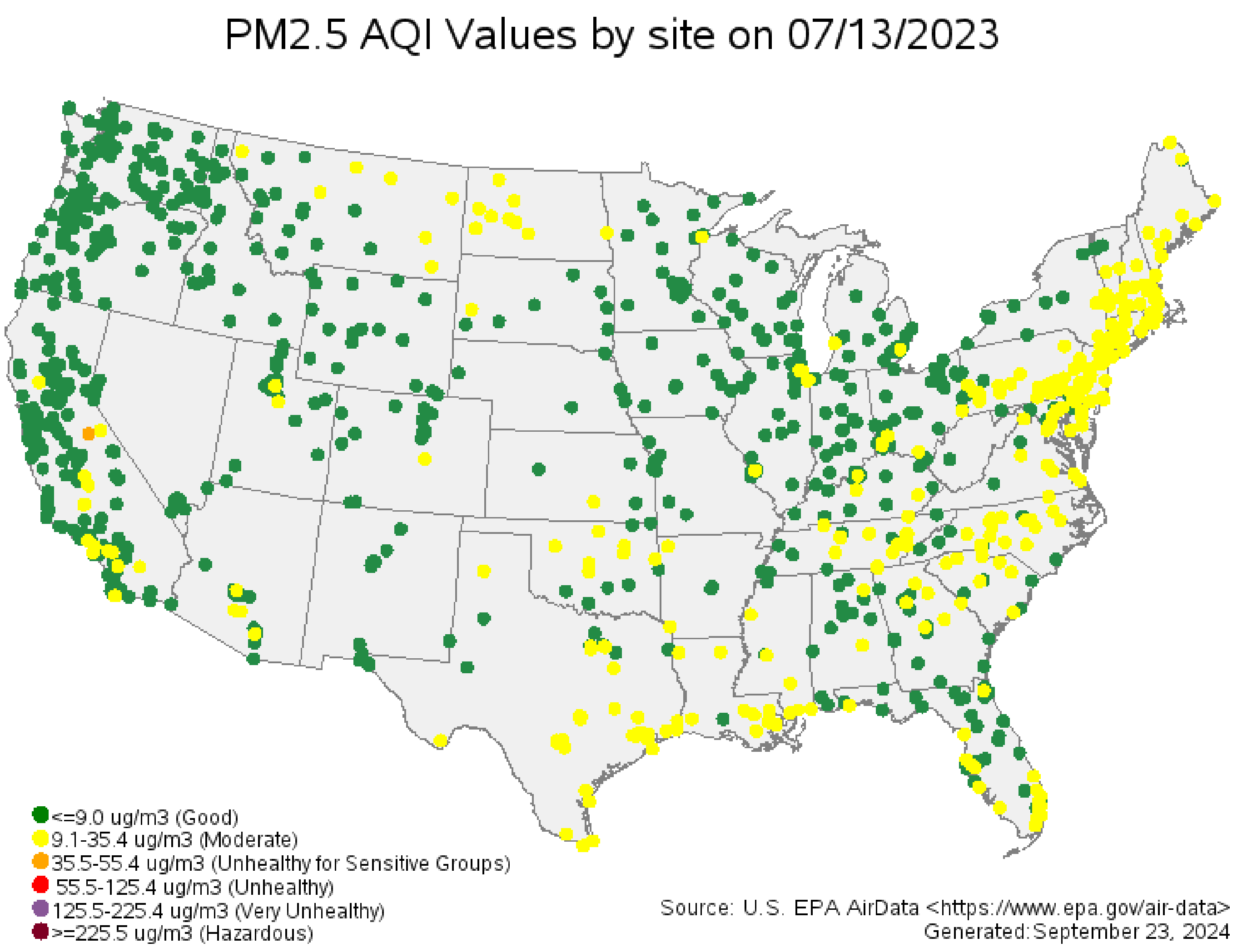


Red = Monitored County/CBSA Level (2022 DV)
[381 nonattainment counties]

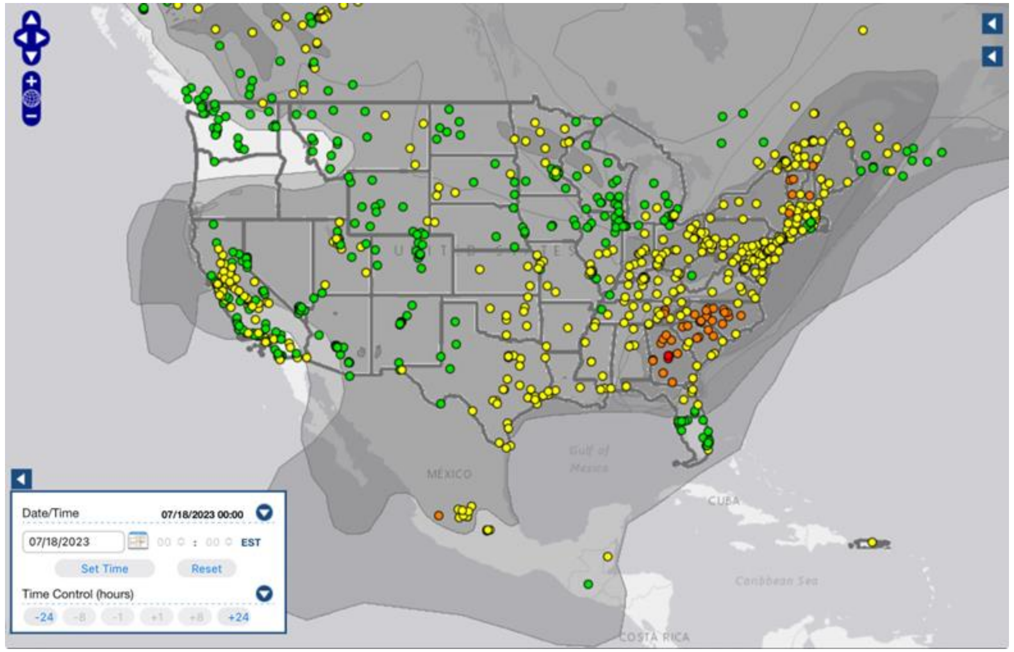
Red = Monitored County/CBSA Level (2023 DV)
[569 nonattainment counties]



Mid July 2023 Episode – Canadian Wildfires

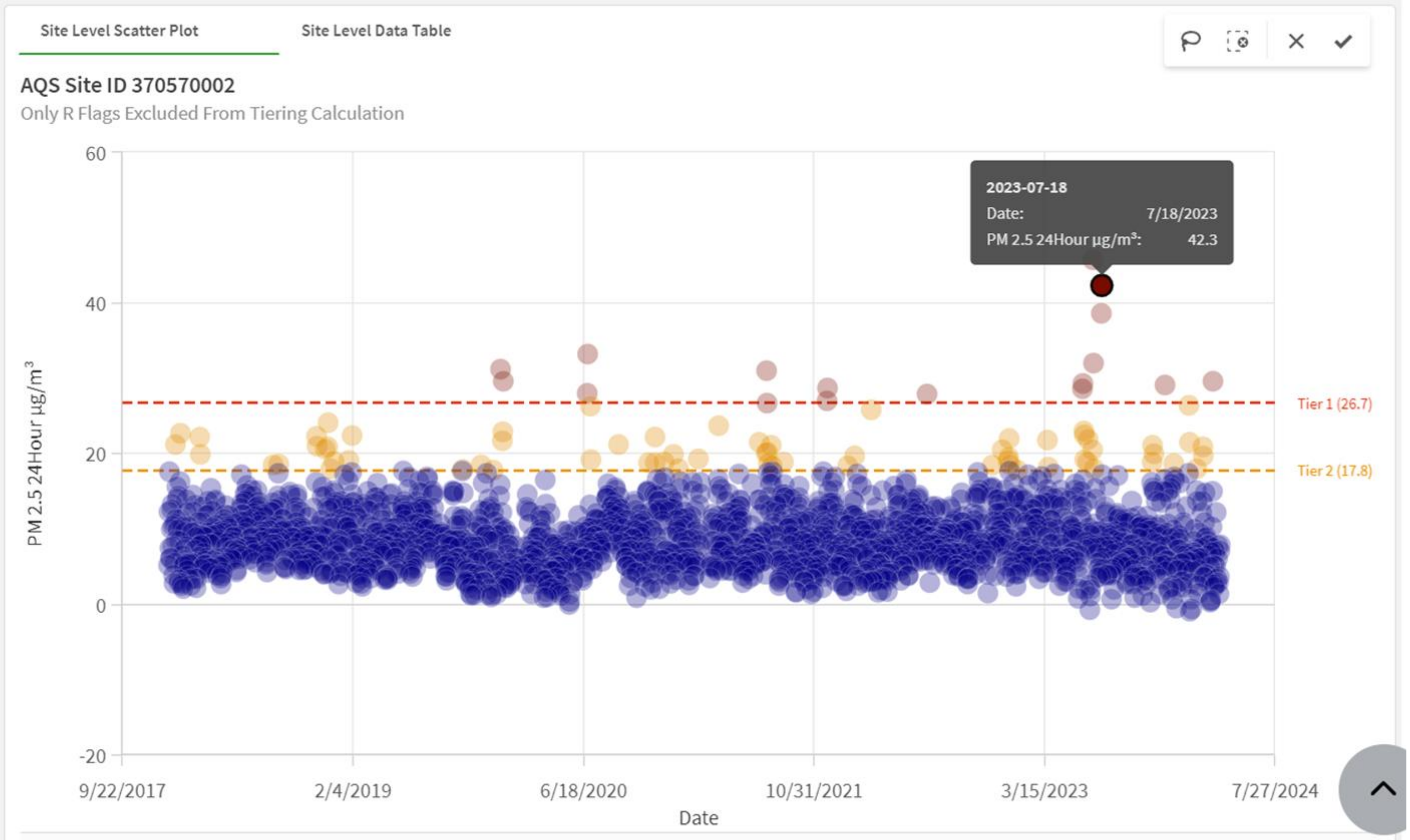


- July 16-19 we see Canadian wildfire smoke influence in PM concentration observations across northern Midwest and into southeastern states



HMS Smoke Map July 18, 2023

Exceptional Events Tier Tool – July 18, 2023

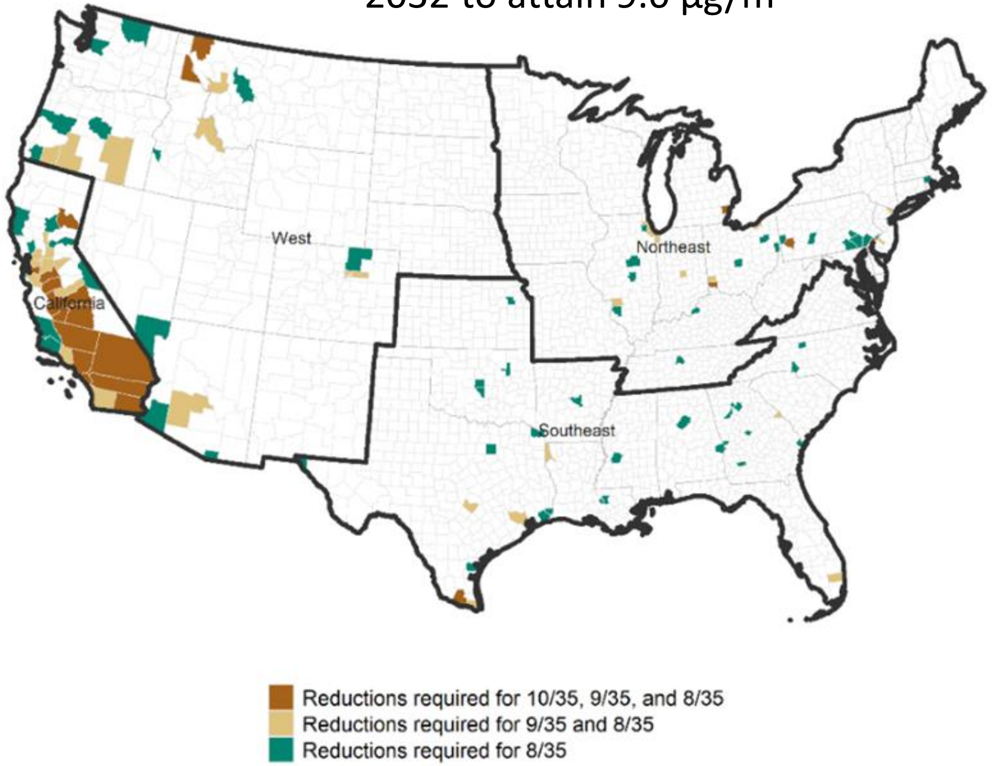


PM NAAQS Implementation

Nonattainment for $PM_{2.5}$ NAAQS at 9.0 µg/m^3

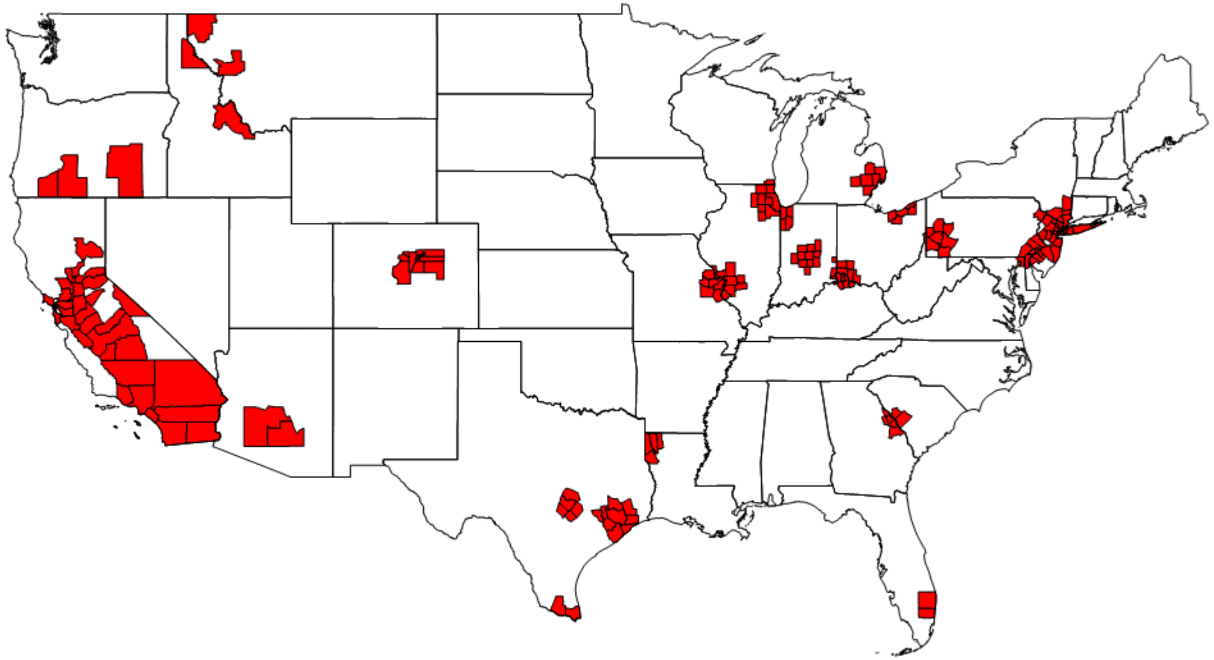
EPA's Monitored County Projection to 2032 (left) and Expanded to CBSAs (right)

EPA says 52 monitored counties would need additional control in 2032 to attain 9.0 µg/m^3



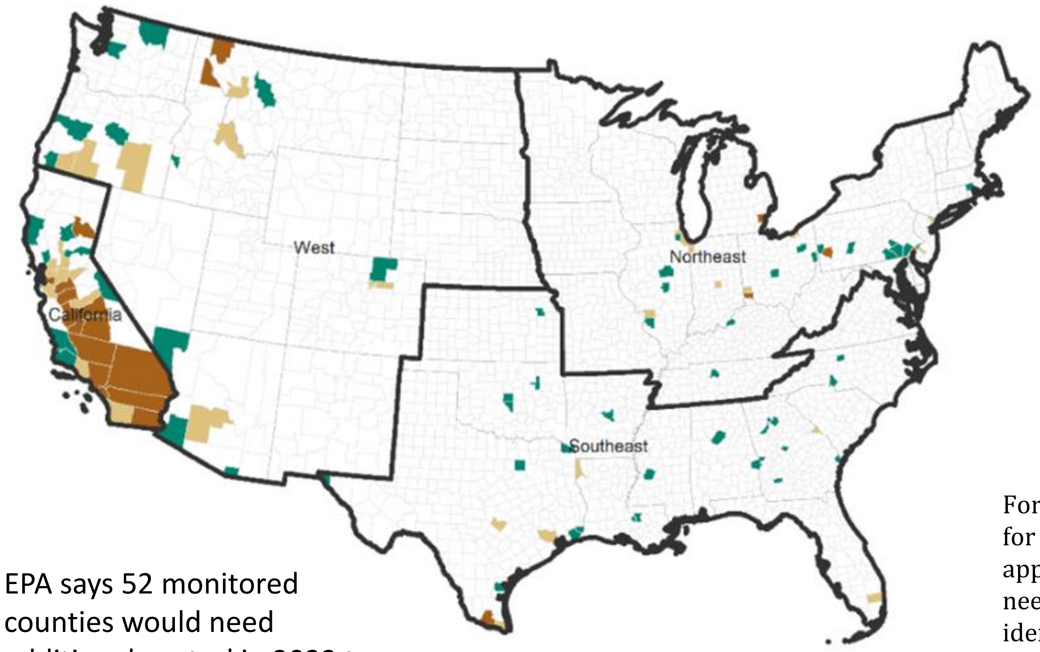
Counties Projected to Exceed in Analytical Baseline for the Revised and Alternative Standard Levels of 10/35 µg/m³, 9/35 µg/m³, and 8/35 µg/m³

187 counties in nonattainment when expanded to CBSA



Source: https://www.epa.gov/system/files/documents/2024-02/naaqs_pm_reconsideration_ria_final.pdf

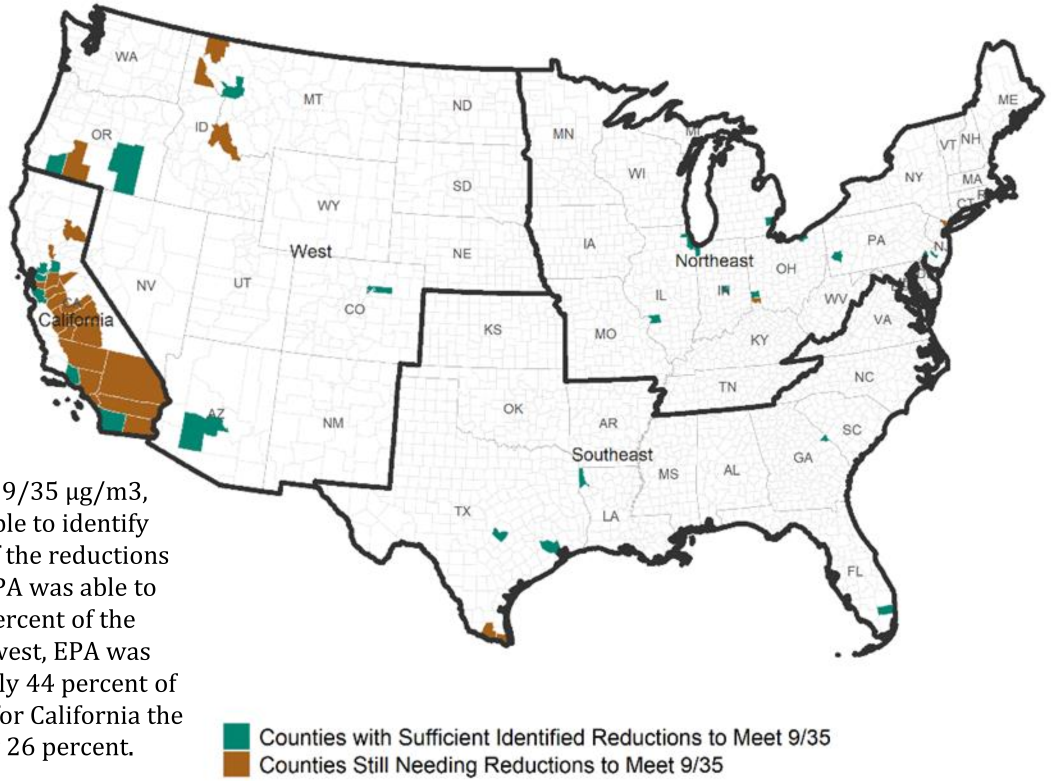
Counties That Will Still Need Controls in 2032 for $PM_{2.5}$ NAAQS at 9.0 μg/m³



EPA says 52 monitored counties would need additional control in 2032 to attain 9 μg/m³

Counties Projected to Exceed in Analytical Baseline for the Revised and Alternative Standard Levels of 10/35 μg/m³, 9/35 μg/m³, and 8/35 μg/m³

For the revised standards of 9/35 μg/m3, for the northeast EPA was able to identify approximately 98 percent of the reductions needed. For the southeast EPA was able to identify approximately 68 percent of the reductions needed. For the west, EPA was able to identify approximately 44 percent of the reductions needed, and for California the percentage is approximately 26 percent.



Counties that Still Need $PM_{2.5}$ Emissions Reductions for Revised Standard Levels of 9/35 μg/m³

Source: https://www.epa.gov/system/files/documents/2024-02/naaqs_pm_reconsideration_ria_final.pdf

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- *Particulate Source Apportionment Technology Analysis of $PM_{2.5}$ for Multiple Domains and Categories - Final Report*, Alpine Geophysics, July 2024

  https://www.midwestozonegroup.com/technical-support-documents

Modeled and Actual Annual $PM_{2.5}$ Concentrations in North and South Carolina

Monitor	State	County	Modeled 2016 Annual DV (ug/m3)	Actual 2023 Annual DV (ug/m3)	Modeled 2026 Annual DV (ug/m3)
370210034	North Carolina	Buncombe	7.42	6.3	7.60
370350004	North Carolina	Catawba	8.73	8.5	9.05
370510009	North Carolina	Cumberland	7.90	8.4	8.18
370570002	North Carolina	Davidson	8.69	9.2	8.95
370630015	North Carolina	Durham	8.70	7.6	9.62
370670022	North Carolina	Forsyth	7.73	8.1*	7.97
370810013	North Carolina	Guilford	8.10	8.6	8.30
370990006	North Carolina	Jackson	7.78	7.2*	7.78
371010002	North Carolina	Johnston	7.51	7.7	7.88
371190041	North Carolina	Mecklenburg	8.49	8.2	9.61
371190042	North Carolina	Mecklenburg	8.75	-	9.96
371190045	North Carolina	Mecklenburg	8.63	9.2	9.81
371210004	North Carolina	Mitchell	7.45	6.3	7.53
371230001	North Carolina	Montgomery	6.67	8.3	6.48
371290002	North Carolina	New Hanover	5.48	5.4	5.40
371470006	North Carolina	Pitt	6.92	6.8	7.02
371730002	North Carolina	Swain	8.16	6.4	8.12
371830014	North Carolina	Wake	8.76	8.3	9.96

Monitor	State	County	Modeled 2016 Annual DV (ug/m3)	Actual 2023 Annual DV (ug/m3)	Modeled 2026 Annual DV (ug/m3)
450190048	South Carolina	Charleston	7.18	7.3*	7.97
450190049	South Carolina	Charleston	7.17	6.7*	7.93
450250001	South Carolina	Chesterfield	7.47	7.0	7.49
450370001	South Carolina	Edgefield	8.37	8.1	8.61
450410003	South Carolina	Florence	8.63	8.2	9.07
450450015	South Carolina	Greenville	8.92	8.4	9.84
450450016	South Carolina	Greenville	8.25	7.9	8.90
450630008	South Carolina	Lexington	8.63	8.2*	9.33
450790007	South Carolina	Richland	8.10	7.4	8.67
450790019	South Carolina	Richland	8.86	8.1*	9.71
450830011	South Carolina	Spartanburg	8.35	8.4	9.07

*indicates invalid design value in 2023 due to data completeness issues

PSAT Simulation Results

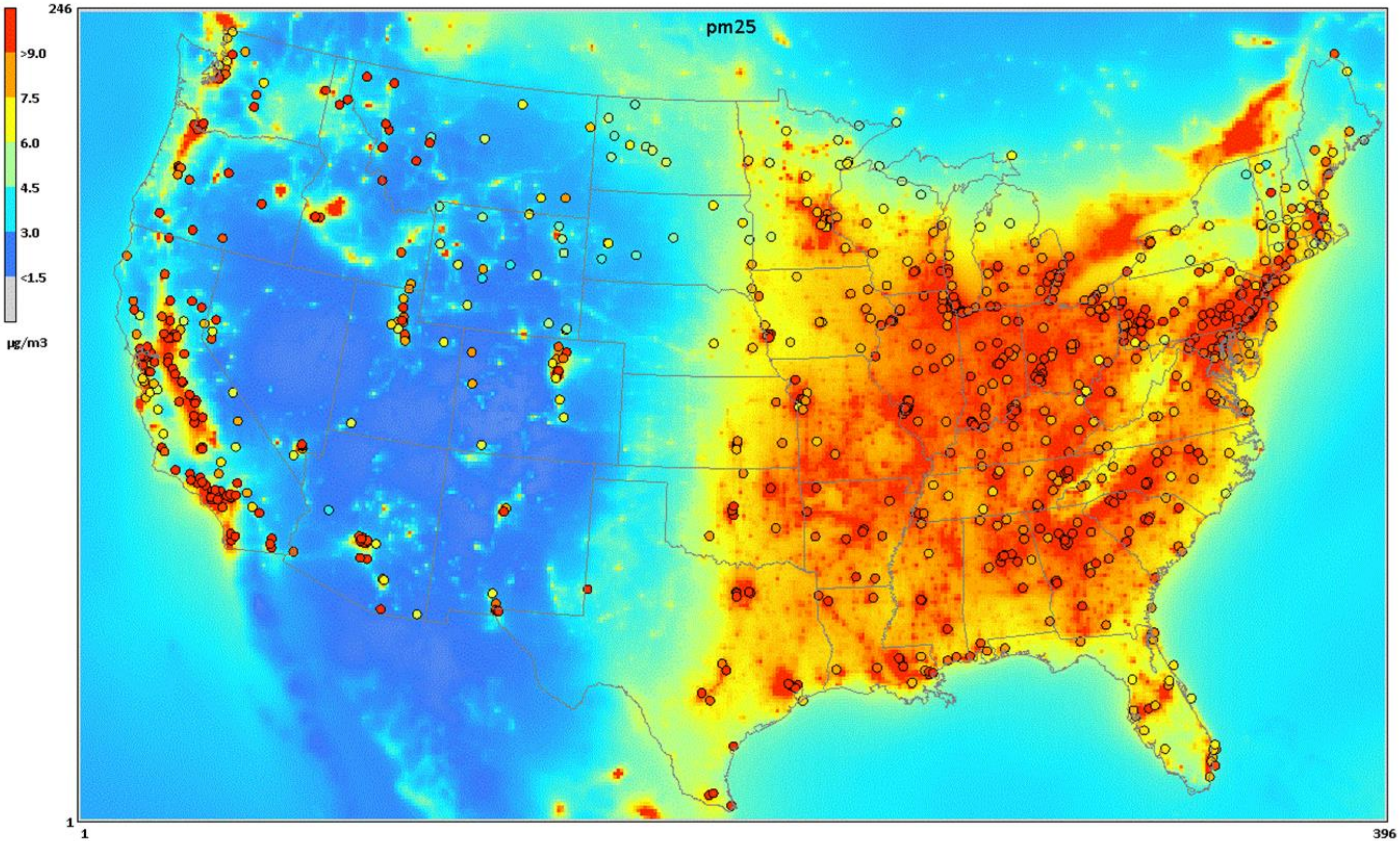
- Base case 2026 DV calculated used EPA methods
- Look at relative contribution of source sector at monitor from modeled concentrations by traced species and as whole
- Relative contribution using EPA attainment test tool (SMAT-CE) and ratio of averaged modeled tag concentration to base case total

- Traced Species = sulfate + nitrate + ammonium + OC + EC
- Non-Traced Species = secondary organic aerosols + sea salt + particle bound water + blank mass

Tagged Source Categories

- Ag dust (livestock)
- Ag dust (tilling)
- Ag Fires
- Ag Nonroad
- Airports
- All Other EGUs
- All Other Fuel Combustion
- Biogenics
- Biomass Fuel Combustion
- Boundary Conditions
- C1 & C2 & C3 Marine
- Canadian & Mexican Anthropogenic
- Canadian & Mexican Fires
- Cement Manufacturing
- Coal Fuel Combustion
- Coal-Fired EGUs
- Commercial Cooking
- Construction
- Construction/Industrial
- Diesel Vehicles
- Fertilizer
- Initial Conditions
- Lawn & Garden
- Livestock
- Mining
- Non-diesel Vehicles
- Oil & Gas
- Other Non-Point
- Other Nonroad
- Paved Roads
- Petroleum Refineries
- Prescribed Fires
- Pulp & Paper
- Railroads
- Rec Marine
- Residential Wood Combustion
- Stationary Non-EGU
- Unpaved Roads
- Waste Disposal
- Wildfires

2026v3 Projected Annual $PM_{2.5}$ DV ($\mu g/m^3$)



PSAT Results Analysis

- Processed 2026 data to provide relative contribution by species and category
- Data available for total $PM_{2.5}$, particulate sulfate, particulate nitrate, elemental carbon, organic carbon, and crustal material
- Presentation today focuses on result output which can be generated for all monitors in CONUS modeling domain
  - Appendix B of Alpine's PSAT TSD

Table 3-7 Summary of Estimated $PM_{2.5}$ Emissions Reductions from CoST by Inventory Source Classification Code Sectors for Alternative Primary Standard Levels of 10/35 µg/m³, 10/30 µg/m³, 9/35 µg/m³, and 8/35 µg/m³ in 2032 (tons/year)

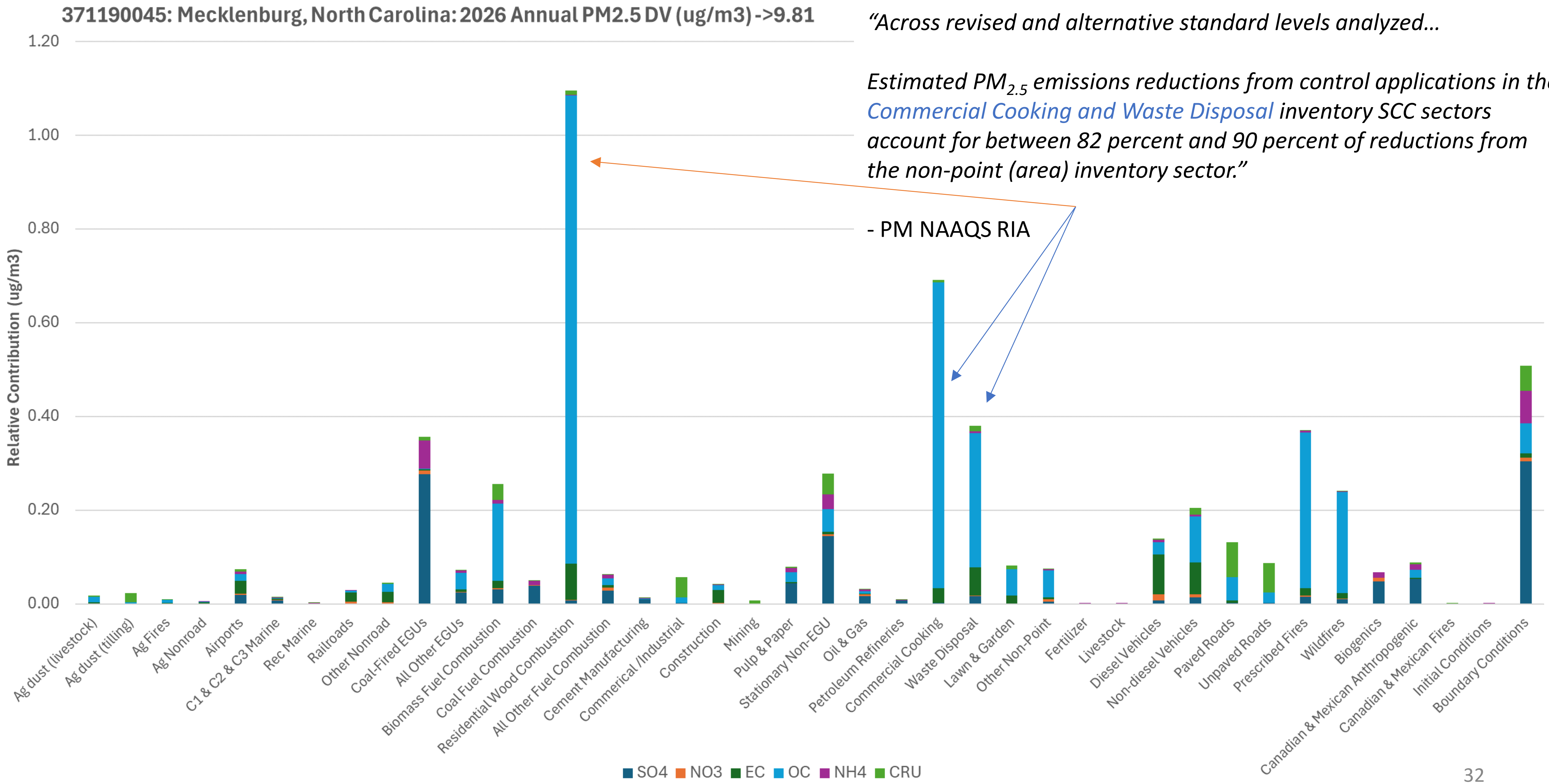
Sector	SCC Sector	10/35	10/30	9/35	8/35
Non-EGU Point	Agriculture - Livestock Waste	0	6.2	6.8	6.8
	Fuel Combustion - Commercial/Institutional Boilers - Biomass	0	0	0	15.6
	Fuel Combustion - Commercial/Institutional Boilers - Coal	0	0	8.0	8.0
	Fuel Combustion - Commercial/Institutional Boilers - Natural Gas	0	0	0	85.9
	Fuel Combustion - Commercial/Institutional Boilers - Other	64.7	64.7	64.7	69.8
	Fuel Combustion - Industrial Boilers, ICEs - Biomass	0	76.0	5.2	402.2
	Fuel Combustion - Industrial Boilers, ICEs - Coal	0	0	16.4	211.2
	Fuel Combustion - Industrial Boilers, ICEs - Natural Gas	6.1	75.4	81.7	405.8
	Fuel Combustion - Industrial Boilers, ICEs - Oil	0	0	0	18.1
	Fuel Combustion - Industrial Boilers, ICEs - Other	110.9	140.7	689.5	1,023.9
	Industrial Processes - Cement Manufacturing	0	0	89.8	688.5
	Industrial Processes - Chemical Manufacturing	29.3	40.3	136.5	953.8
	Industrial Processes - Ferrous Metals	142.8	150.1	836.0	2,378.0
	Industrial Processes - Mining	0	7.4	239.4	326.9
	Industrial Processes - Non-ferrous Metals	55.9	55.9	502.1	918.0
	Industrial Processes - Not Elsewhere Classified	304.3	456.1	2,169.9	6,818.0
	Industrial Processes - Petroleum Refineries	178.5	216.6	875.8	2,204.2
	Industrial Processes - Pulp & Paper	0	18.3	119.5	848.1
	Industrial Processes - Storage and Transfer	8.9	18.0	186.7	887.4
	Waste Disposal - Excavation/Soils Handling	0	0	0	5.8
	Waste Disposal - General Processes	0	0	7.0	7.0
	Waste Disposal - Landfill Dump	0	0	0	5.5
Oil & Gas Point	Industrial Processes - Not Elsewhere Classified	0	0	0	3.6
	Industrial Processes - Oil & Gas Production	0	0	0	54.9
	Industrial Processes - Petroleum Refineries	0	0	0	1.8

"For the revised standard levels of 9/35 µg/m³, the inventory sectors with the most potentially controllable emissions are the non-point (area) and area fugitive dust sectors. "
– PM NAAQS RIA

Sector	SCC Sector	10/35	10/30	9/35	8/35
Non-Point (Area)	Commercial Cooking	950.2	1,176.5	2,336.9	6,823.5
	Fuel Combustion - Commercial/Institutional Boilers - Biomass	16.3	20.2	52.8	258.6
	Fuel Combustion - Commercial/Institutional Boilers - Coal	0	0	0	0.5
	Fuel Combustion - Commercial/Institutional Boilers - Natural Gas	18.9	22.2	49.8	95.5
	Fuel Combustion - Commercial/Institutional Boilers - Oil	0	0	3.0	14.4
	Fuel Combustion - Industrial Boilers, ICEs - Biomass	66.0	103.3	345.0	1,499.0
	Fuel Combustion - Industrial Boilers, ICEs - Coal	0	2.4	17.8	39.1
	Fuel Combustion - Industrial Boilers, ICEs - Natural Gas	4.0	4.0	32.7	65.5
	Fuel Combustion - Industrial Boilers, ICEs - Oil	1.0	1.0	1.0	5.4
	Fuel Combustion - Industrial Boilers, ICEs - Other	2.0	2.0	2.0	2.0
	Industrial Processes - Chemical Manufacturing	0	0	77.4	199.1
	Waste Disposal - All Categories	603.2	880.0	2,641.3	14,623.5
	Waste Disposal - Residential	109.2	360.5	[illegible]	3,725.4
Residential Wood Combustion	Fuel Combustion - Residential - Wood	296.2	555.6	1,275.9	4,193.4
Area Source Fugitive Dust	Dust - Paved Road Dust	199.9	611.0	768.9	4,903.3
	Dust - Unpaved Road Dust	392.7	1,319.3	861.3	6,523.6
Total		3,561.0	6,383.7	15,210.0	61,320.7

Source: https://www.epa.gov/system/files/documents/2024-02/naaqs_pm_reconsideration_ria_final.pdf

Relative Contribution by $PM_{2.5}$ Species and Monitor



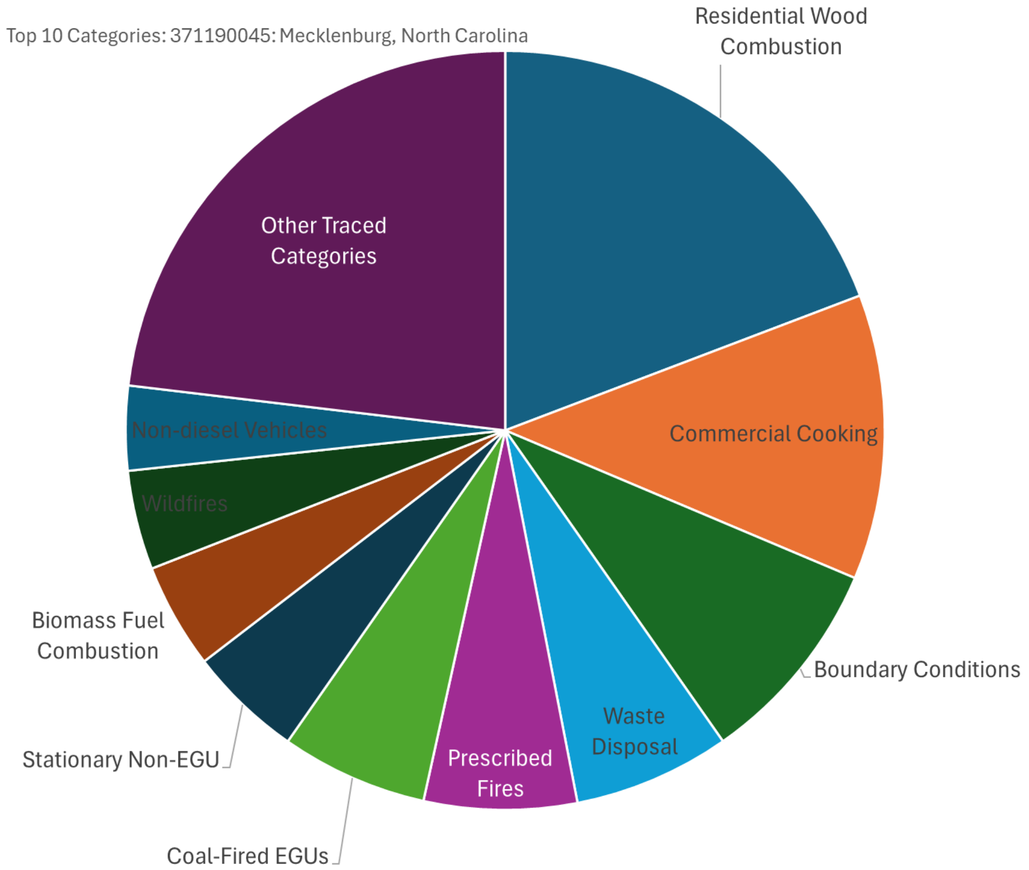
"Across revised and alternative standard levels analyzed…

Estimated $PM_{2.5}$ emissions reductions from control applications in the Commercial Cooking and Waste Disposal inventory SCC sectors account for between 82 percent and 90 percent of reductions from the non-point (area) inventory sector."

- PM NAAQS RIA

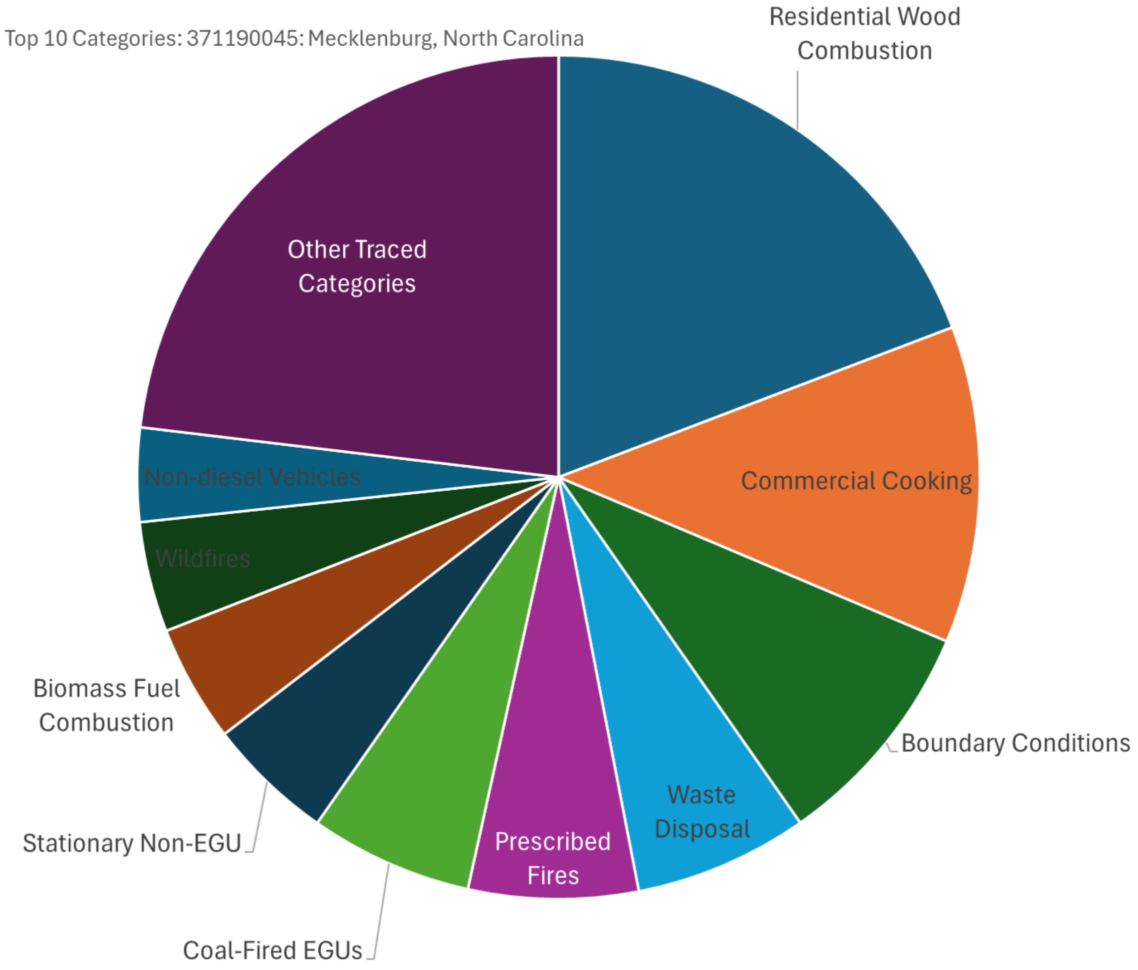
Top 10 Relative Contributing Categories and Traced $PM_{2.5}$ Species

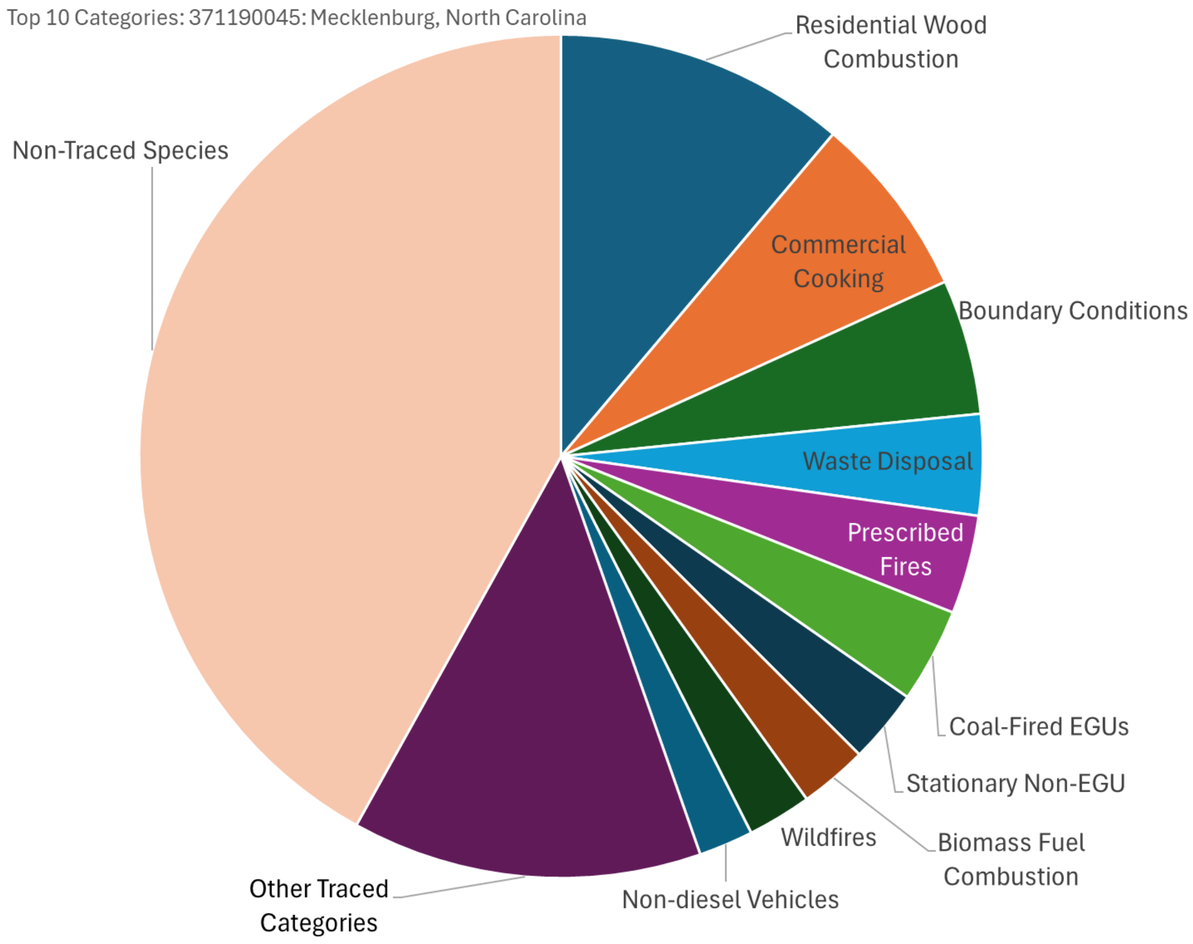
371190045: Mecklenburg, North Carolina			2026 Annual PM2.5 DV (ug/m3) ->					9.81
		Relative Traced Species Contribution (ug/m3)						
Top 10 Categories	**Species Total**	**SO4**	**NO3**	**EC**	**OC**	**NH4**	**CRU**	
Residential Wood Combustion	1.095	0.007	0.001	0.077	0.999	0.002	0.008	
Commercial Cooking	0.691	0.002	0.000	0.031	0.653	0.000	0.005	
Boundary Conditions	0.508	0.305	0.007	0.010	0.064	0.069	0.053	
Waste Disposal	0.380	0.016	0.001	0.060	0.287	0.004	0.011	
Prescribed Fires	0.371	0.016	0.002	0.016	0.332	0.004	0.001	
Coal-Fired EGUs	0.356	0.277	0.008	0.002	0.002	0.060	0.007	
Stationary Non-EGU	0.277	0.144	0.004	0.005	0.048	0.032	0.044	
Biomass Fuel Combustion	0.256	0.031	0.002	0.016	0.166	0.007	0.034	
Wildfires	0.241	0.010	0.001	0.012	0.216	0.002	0.000	
Non-diesel Vehicles	0.205	0.014	0.007	0.068	0.098	0.005	0.014	



Top three modeled anthropogenic traced categories are consistent with EPA categories identified with greatest emission reduction potential in 2032 to achieve 9.0 μg/m³ standard from base case conditions.

Top 10 Relative Contributing Categories and $PM_{2.5}$ Species



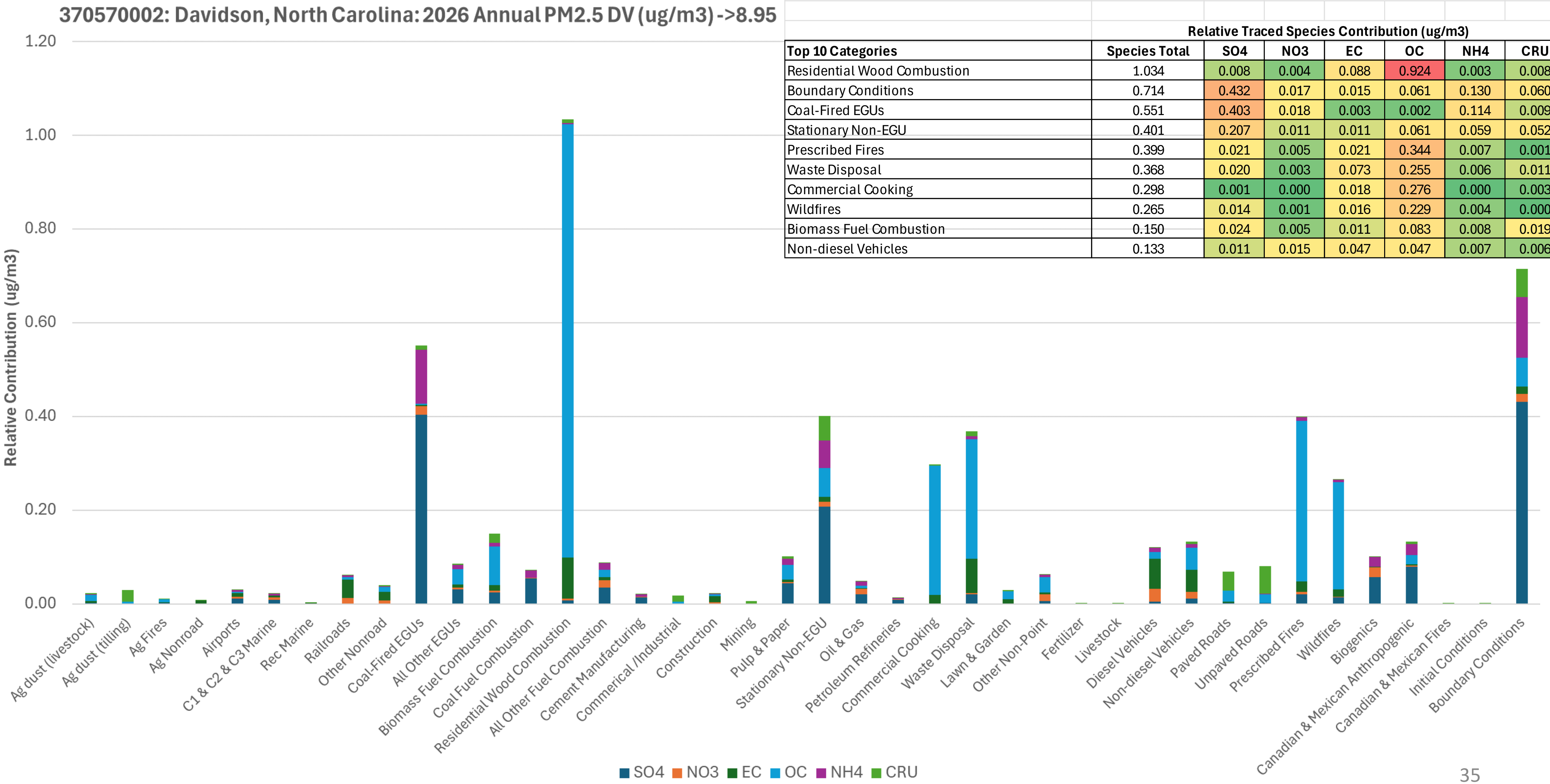


Non-Traced Species = secondary organic aerosols + sea salt + particle bound water + blank mass

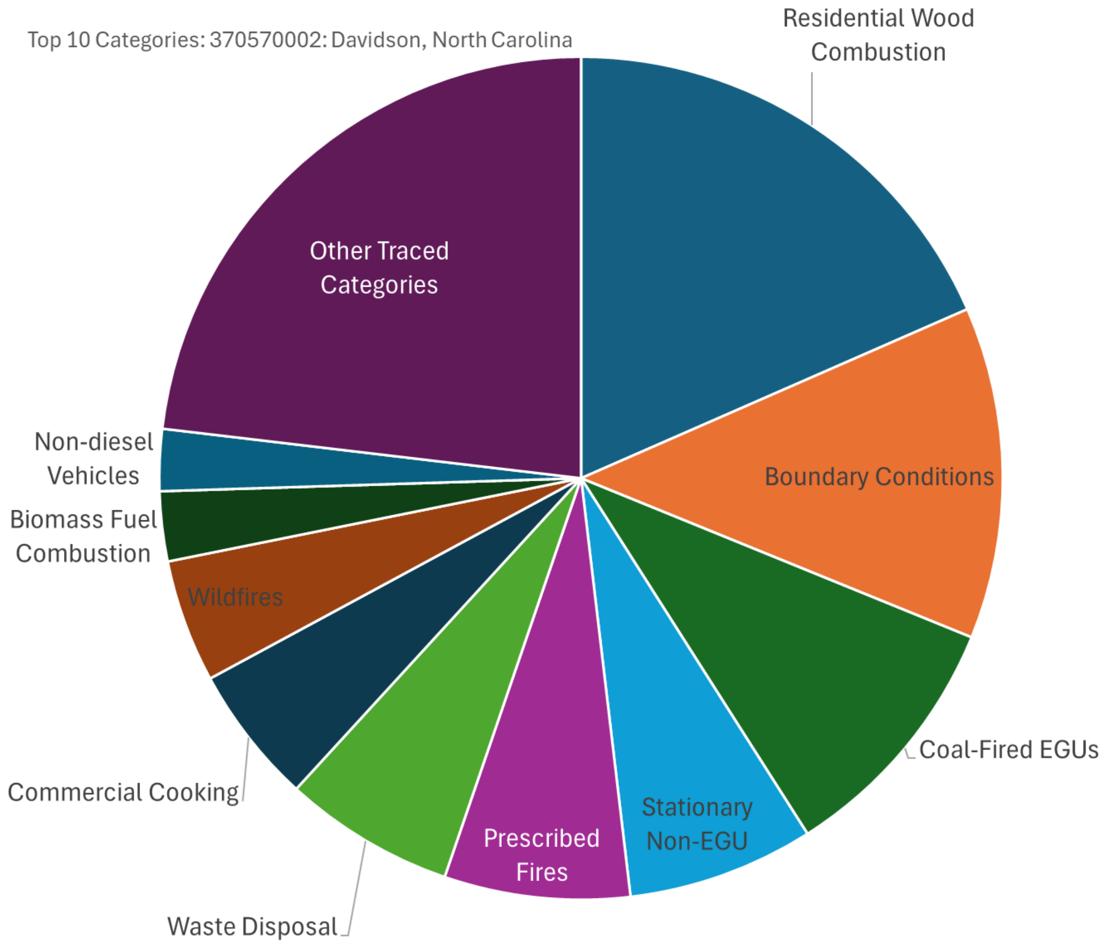
In the Southeastern U.S., organic carbon concentrations are relatively high due to the abundance of biogenic VOC emissions that contribute to SOA formation following oxidation in the presence of anthropogenic emissions.

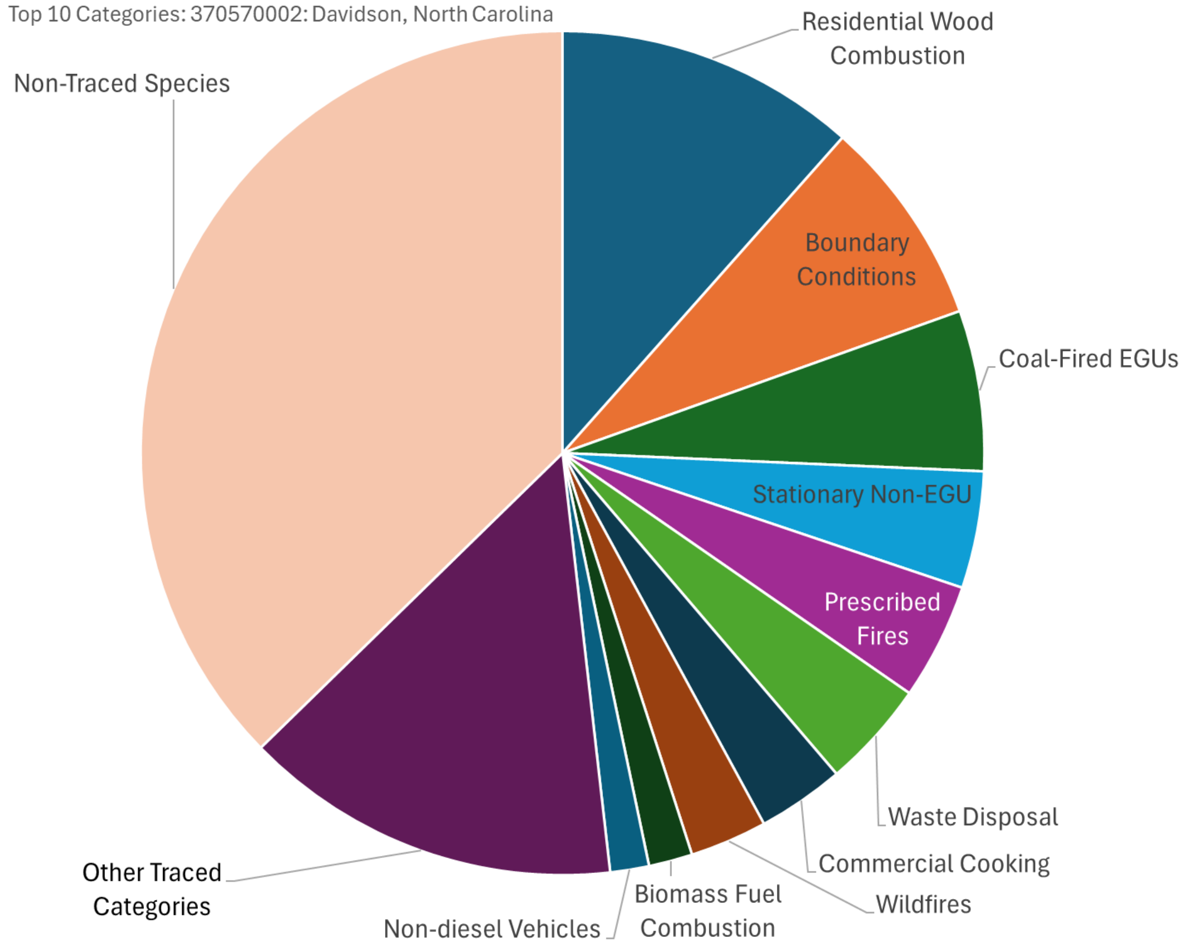
Relative Contribution by $PM_{2.5}$ Species and Monitor

370570002: Davidson, North Carolina				2026 Annual PM2.5 DV (ug/m3) ->			8.95
		Relative Traced Species Contribution (ug/m3)					
Top 10 Categories	**Species Total**	**SO4**	**NO3**	**EC**	**OC**	**NH4**	**CRU**
Residential Wood Combustion	1.034	0.008	0.004	0.088	0.924	0.003	0.008
Boundary Conditions	0.714	0.432	0.017	0.015	0.061	0.130	0.060
Coal-Fired EGUs	0.551	0.403	0.018	0.003	0.002	0.114	0.009
Stationary Non-EGU	0.401	0.207	0.011	0.011	0.061	0.059	0.052
Prescribed Fires	0.399	0.021	0.005	0.021	0.344	0.007	0.001
Waste Disposal	0.368	0.020	0.003	0.073	0.255	0.006	0.011
Commercial Cooking	0.298	0.001	0.000	0.018	0.276	0.000	0.003
Wildfires	0.265	0.014	0.001	0.016	0.229	0.004	0.000
Biomass Fuel Combustion	0.150	0.024	0.005	0.011	0.083	0.008	0.019
Non-diesel Vehicles	0.133	0.011	0.015	0.047	0.047	0.007	0.006

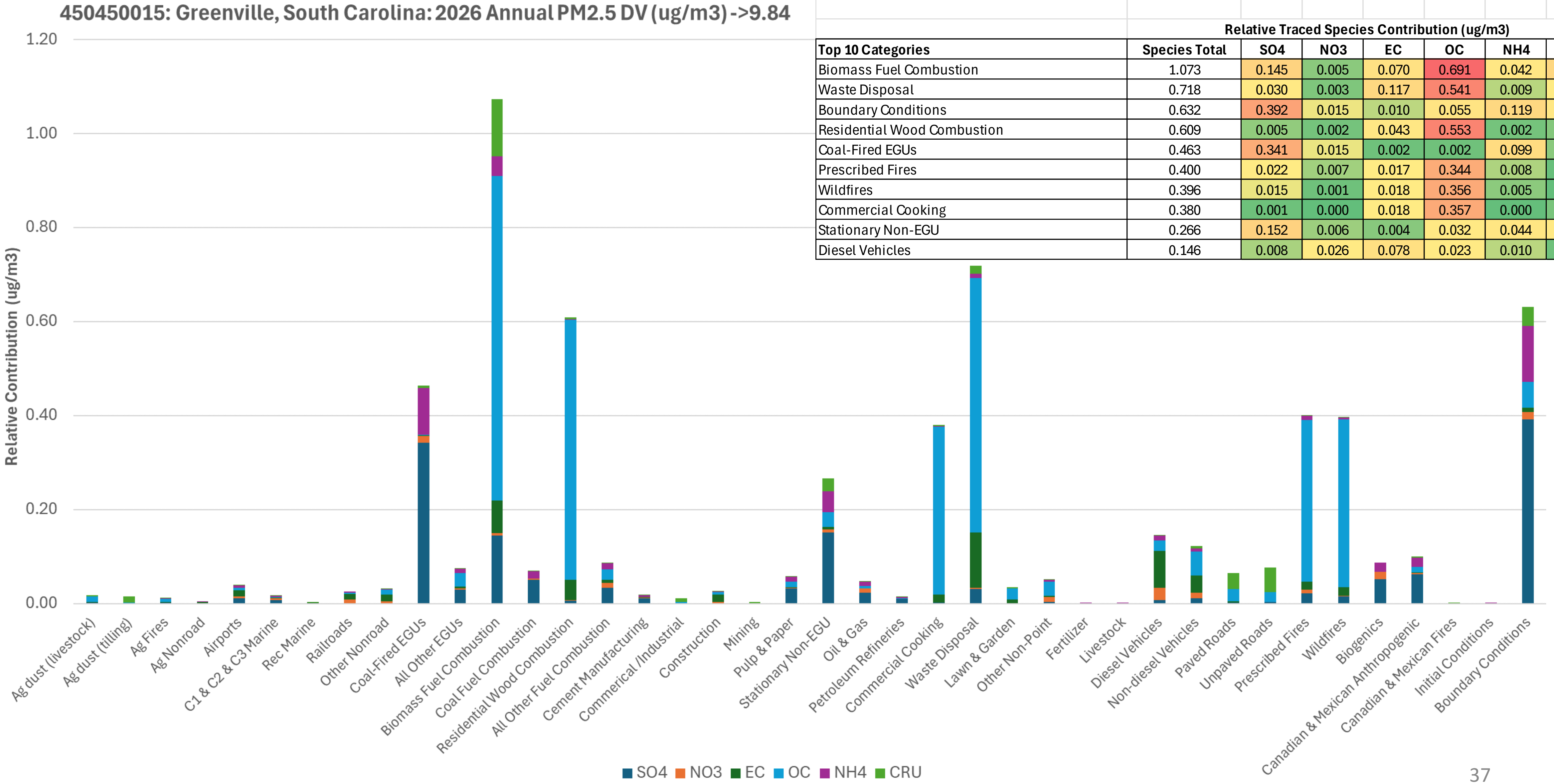


Top 10 Relative Contributing Categories and $PM_{2.5}$ Species



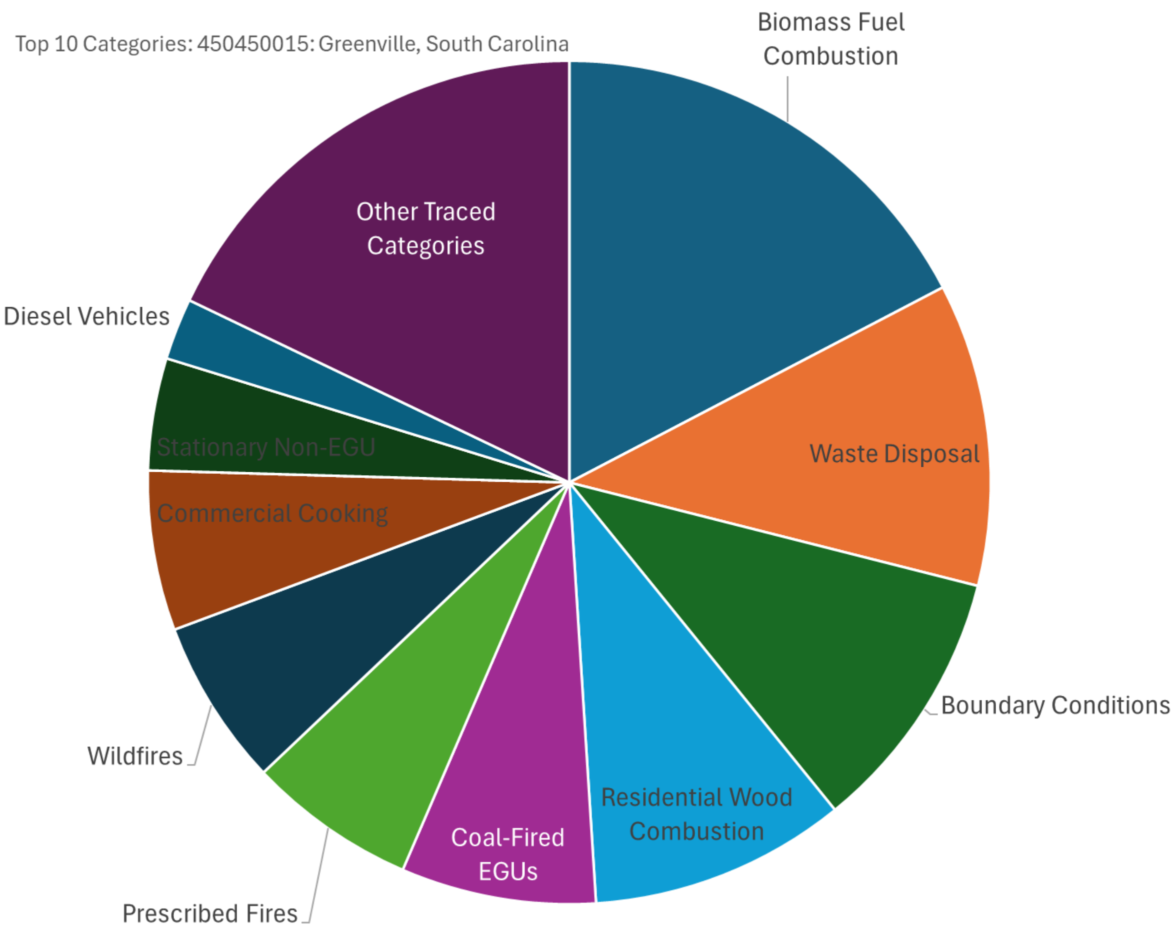


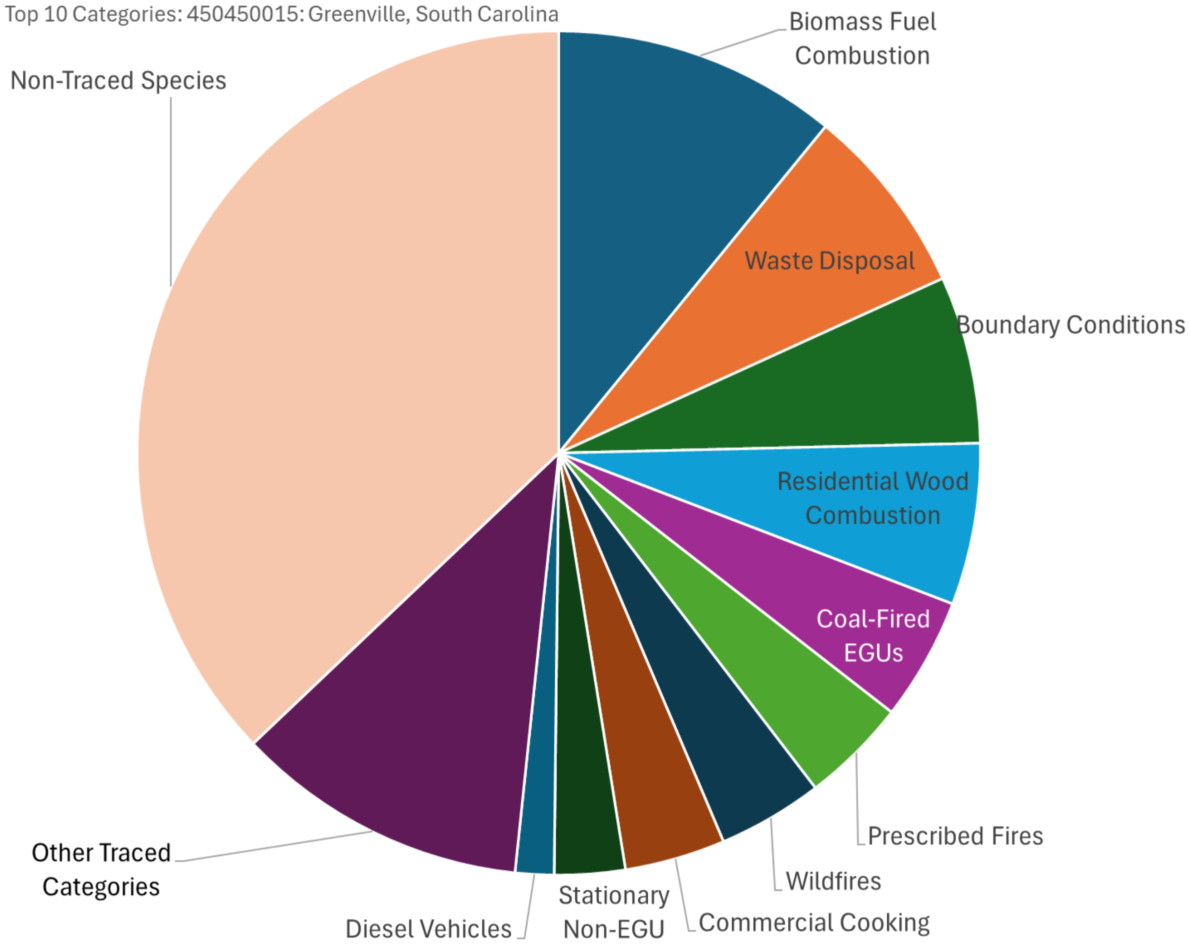
Relative Contribution by $PM_{2.5}$ Species and Monitor



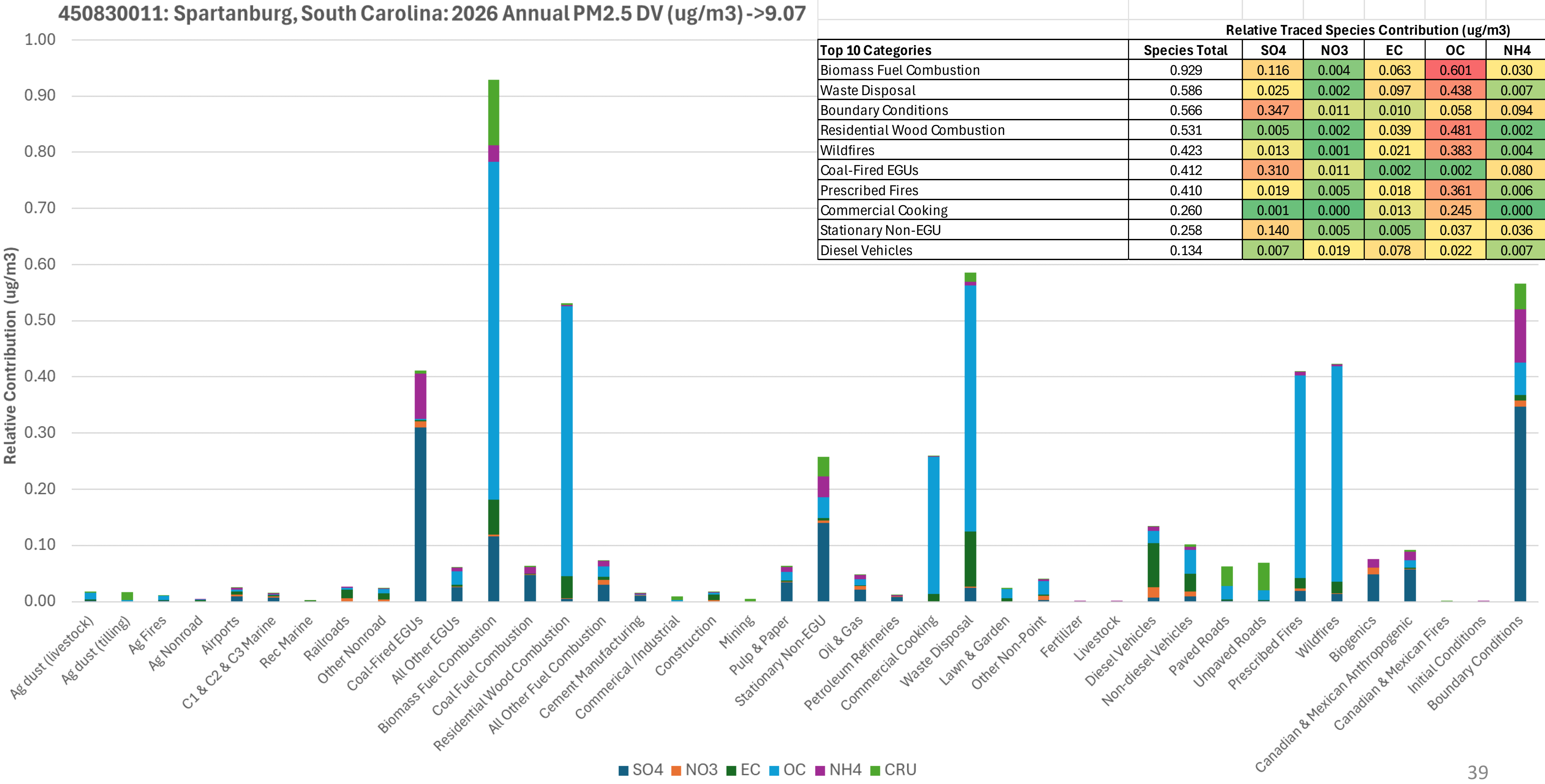
450450015: Greenville, South Carolina			2026 Annual PM2.5 DV (ug/m3) ->				9.84
		Relative Traced Species Contribution (ug/m3)					
Top 10 Categories	**Species Total**	**SO4**	**NO3**	**EC**	**OC**	**NH4**	**CRU**
Biomass Fuel Combustion	1.073	0.145	0.005	0.070	0.691	0.042	0.122
Waste Disposal	0.718	0.030	0.003	0.117	0.541	0.009	0.017
Boundary Conditions	0.632	0.392	0.015	0.010	0.055	0.119	0.042
Residential Wood Combustion	0.609	0.005	0.002	0.043	0.553	0.002	0.004
Coal-Fired EGUs	0.463	0.341	0.015	0.002	0.002	0.099	0.004
Prescribed Fires	0.400	0.022	0.007	0.017	0.344	0.008	0.001
Wildfires	0.396	0.015	0.001	0.018	0.356	0.005	0.000
Commercial Cooking	0.380	0.001	0.000	0.018	0.357	0.000	0.003
Stationary Non-EGU	0.266	0.152	0.006	0.004	0.032	0.044	0.028
Diesel Vehicles	0.146	0.008	0.026	0.078	0.023	0.010	0.002

Top 10 Relative Contributing Categories and $PM_{2.5}$ Species



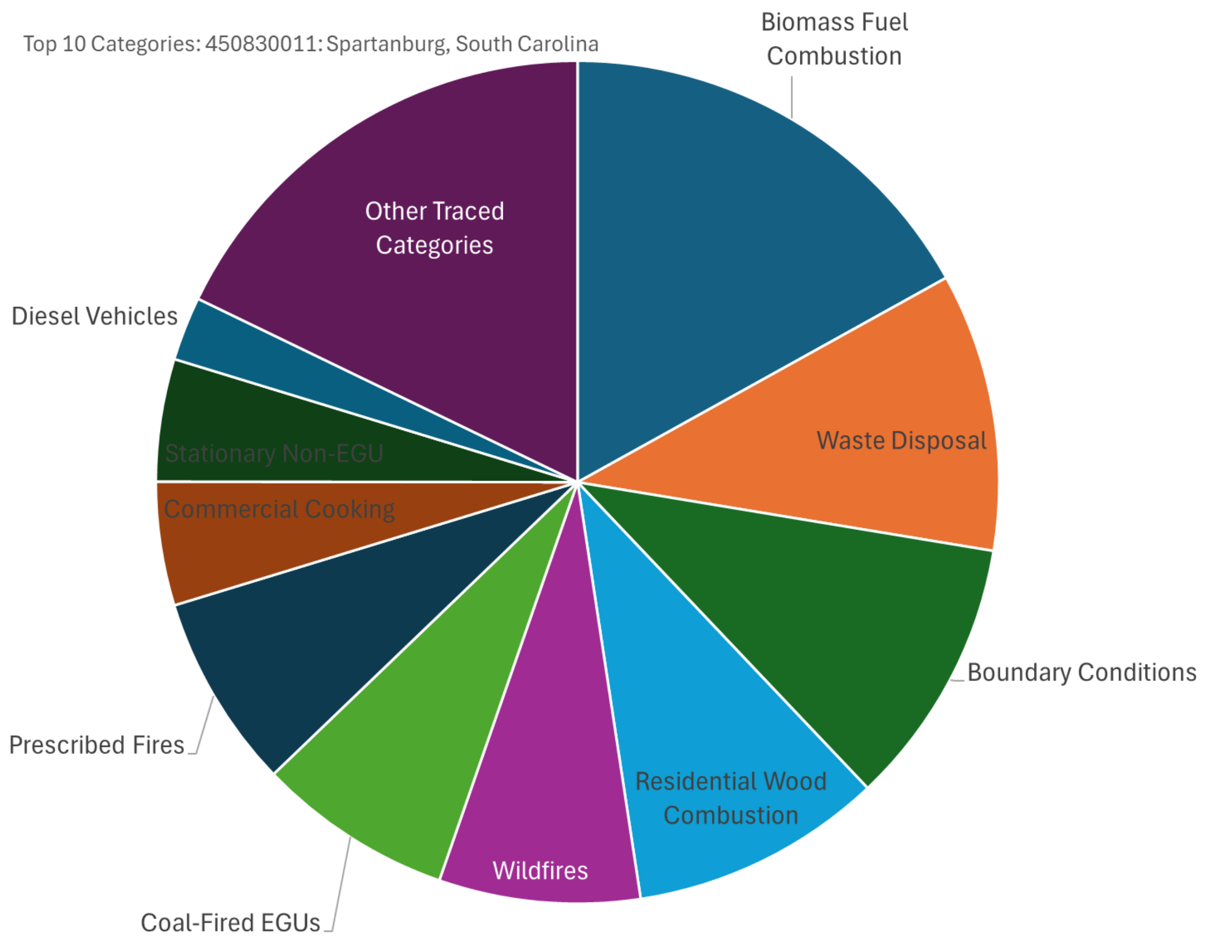


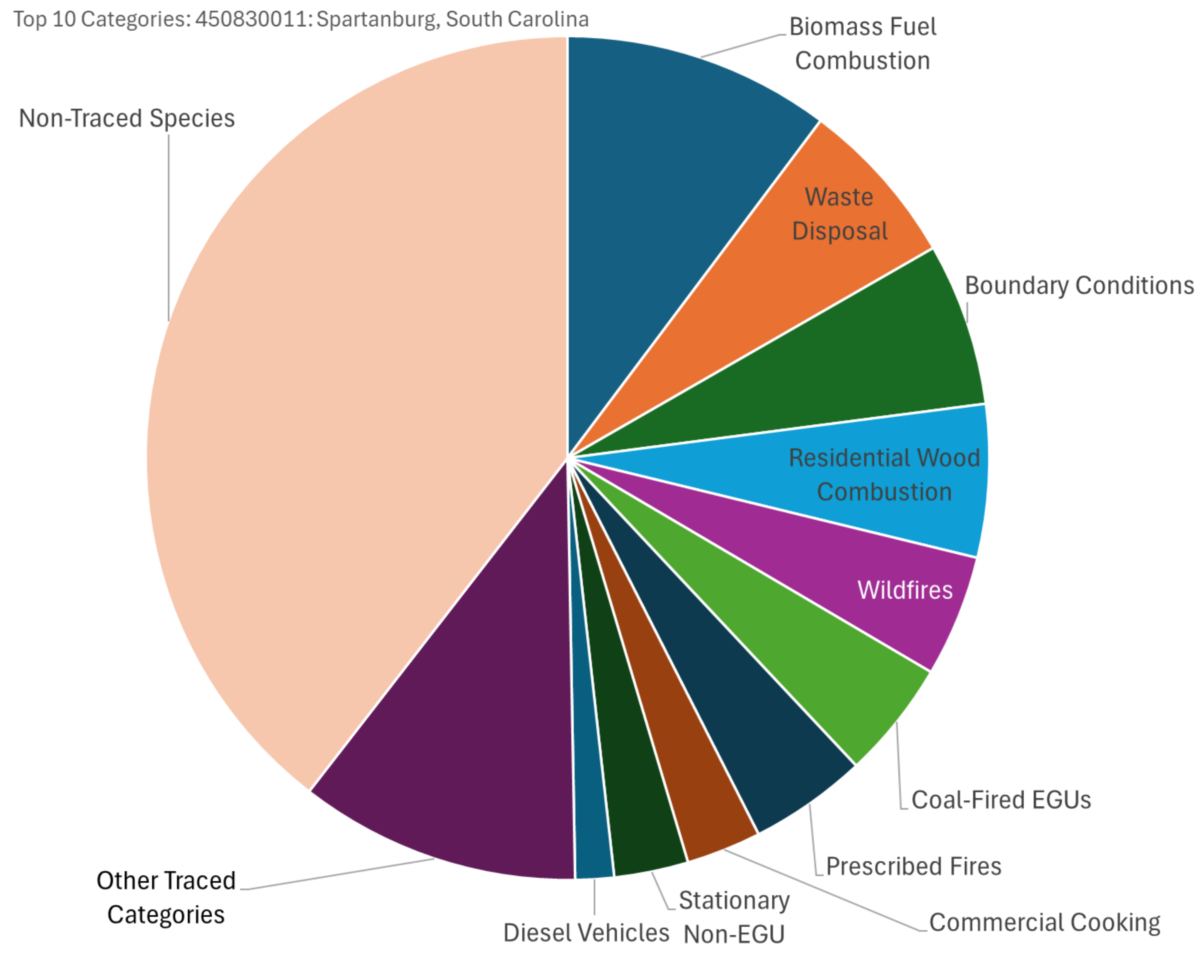
Relative Contribution by $PM_{2.5}$ Species and Monitor



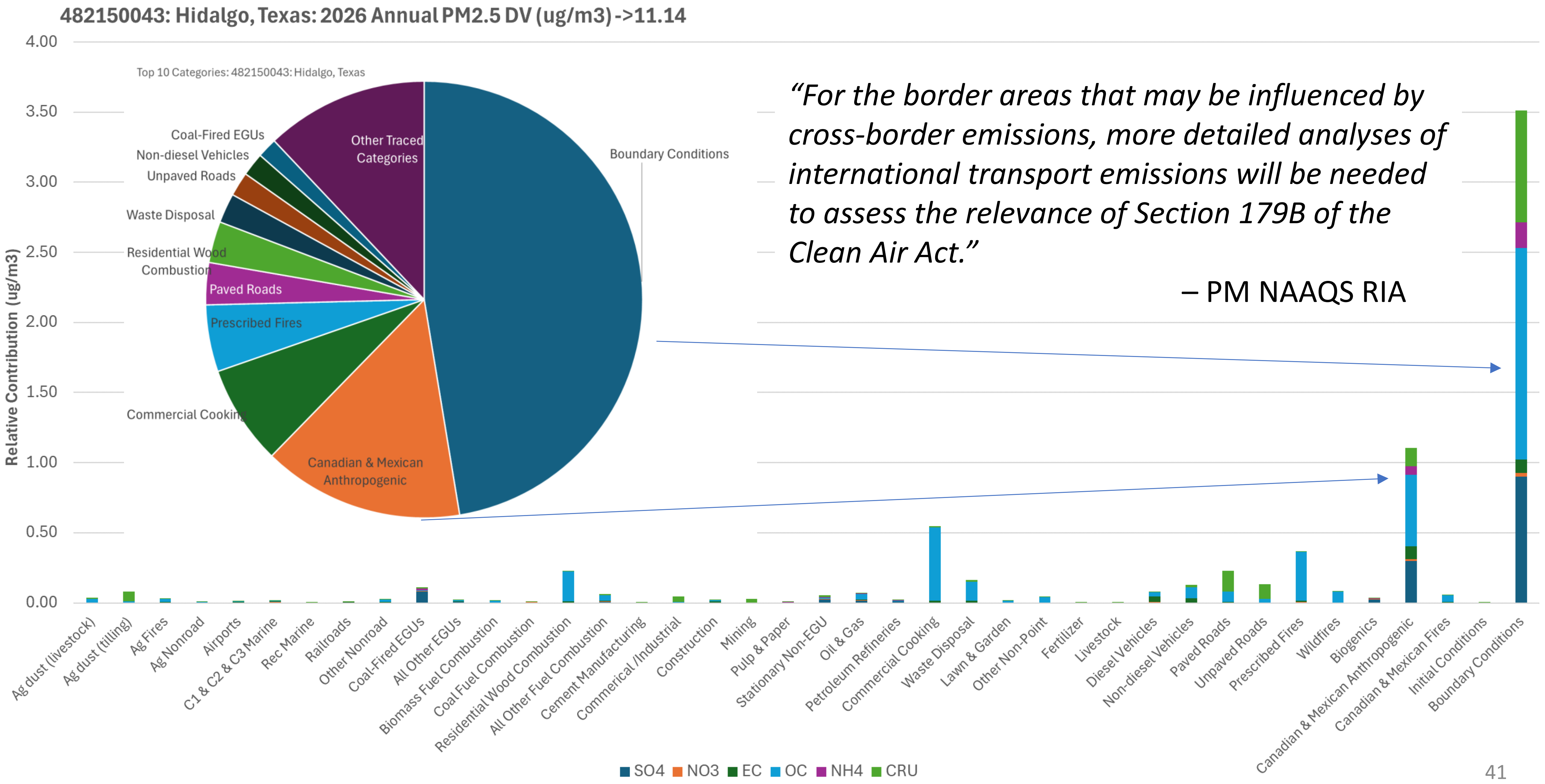
450830011: Spartanburg, South Carolina			2026 Annual PM2.5 DV (ug/m3) ->				9.07
		Relative Traced Species Contribution (ug/m3)					
Top 10 Categories	**Species Total**	**SO4**	**NO3**	**EC**	**OC**	**NH4**	**CRU**
Biomass Fuel Combustion	0.929	0.116	0.004	0.063	0.601	0.030	0.117
Waste Disposal	0.586	0.025	0.002	0.097	0.438	0.007	0.016
Boundary Conditions	0.566	0.347	0.011	0.010	0.058	0.094	0.046
Residential Wood Combustion	0.531	0.005	0.002	0.039	0.481	0.002	0.004
Wildfires	0.423	0.013	0.001	0.021	0.383	0.004	0.000
Coal-Fired EGUs	0.412	0.310	0.011	0.002	0.002	0.080	0.006
Prescribed Fires	0.410	0.019	0.005	0.018	0.361	0.006	0.001
Commercial Cooking	0.260	0.001	0.000	0.013	0.245	0.000	0.002
Stationary Non-EGU	0.258	0.140	0.005	0.005	0.037	0.036	0.035
Diesel Vehicles	0.134	0.007	0.019	0.078	0.022	0.007	0.001

Top 10 Relative Contributing Categories and $PM_{2.5}$ Species





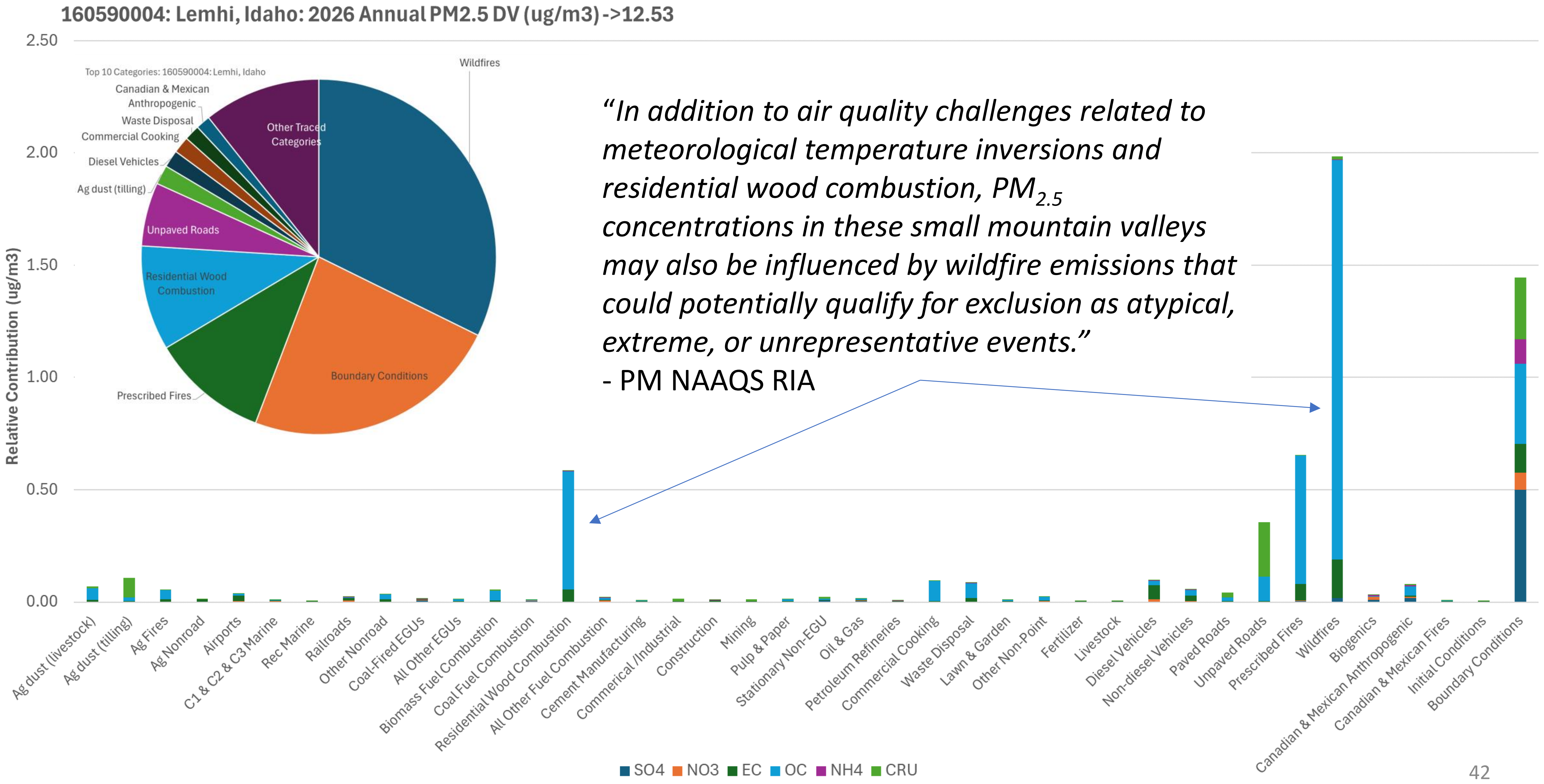
Relative Contribution by $PM_{2.5}$ Species and Monitor



"For the border areas that may be influenced by cross-border emissions, more detailed analyses of international transport emissions will be needed to assess the relevance of Section 179B of the Clean Air Act."

– PM NAAQS RIA

Relative Contribution by $PM_{2.5}$ Species and Monitor



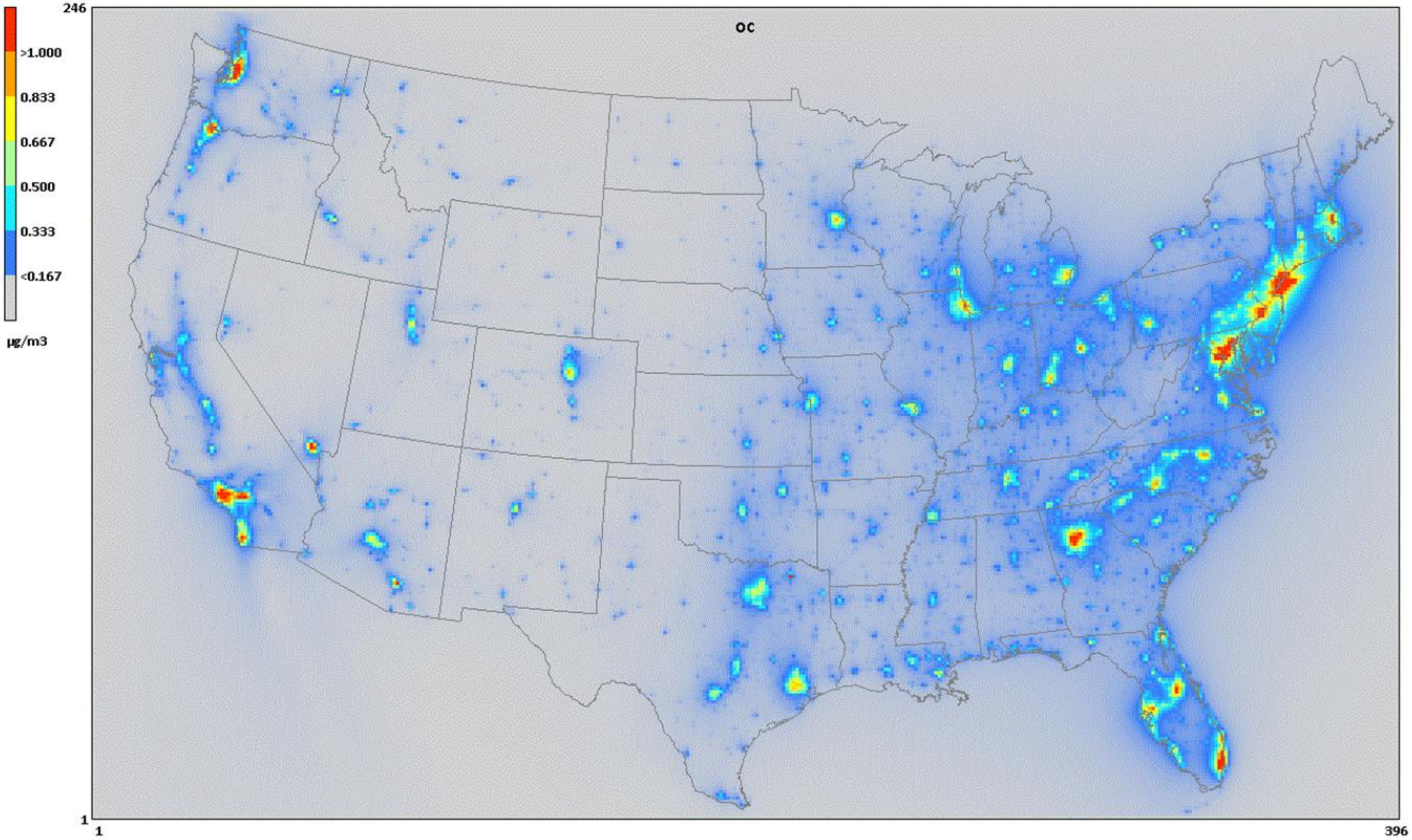
"In addition to air quality challenges related to meteorological temperature inversions and residential wood combustion, $PM_{2.5}$ concentrations in these small mountain valleys may also be influenced by wildfire emissions that could potentially qualify for exclusion as atypical, extreme, or unrepresentative events."

\- PM NAAQS RIA

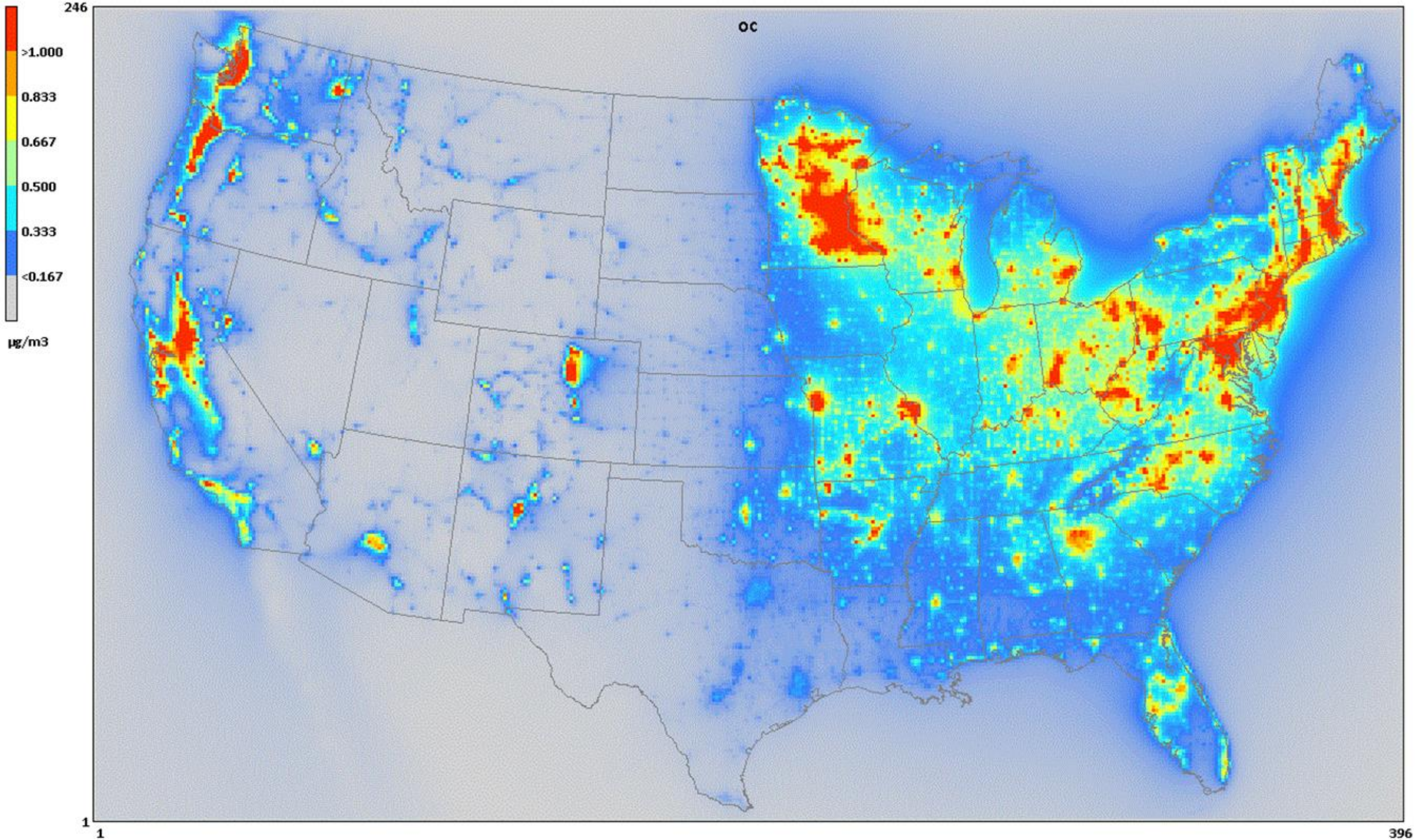
Frequency of Category Modeled in Top 10

	Number of Times in Top 10			
Category	**All Conc #**	**All Conc %**	**> 9.0 µg/m³ #**	**> 9.0 µg/m³ %**
All Monitors	834	-	306	-
Boundary Conditions	834	100%	306	100%
Residential Wood Combustion	818	98%	303	99%
Commercial Cooking	669	80%	296	97%
Waste Disposal	643	77%	216	71%
Coal-Fired EGUs	614	74%	196	64%
Prescribed Fires	582	70%	186	61%
Stationary non-EGUs	555	67%	188	61%
Wildfires	480	58%	182	59%
Can/Mex Anthopogenic	432	52%	111	36%
Biomass Fuel Combustion	373	45%	147	48%
Diesel Vehicles	373	45%	170	56%
Non-Diesel Vehicles	318	38%	163	53%

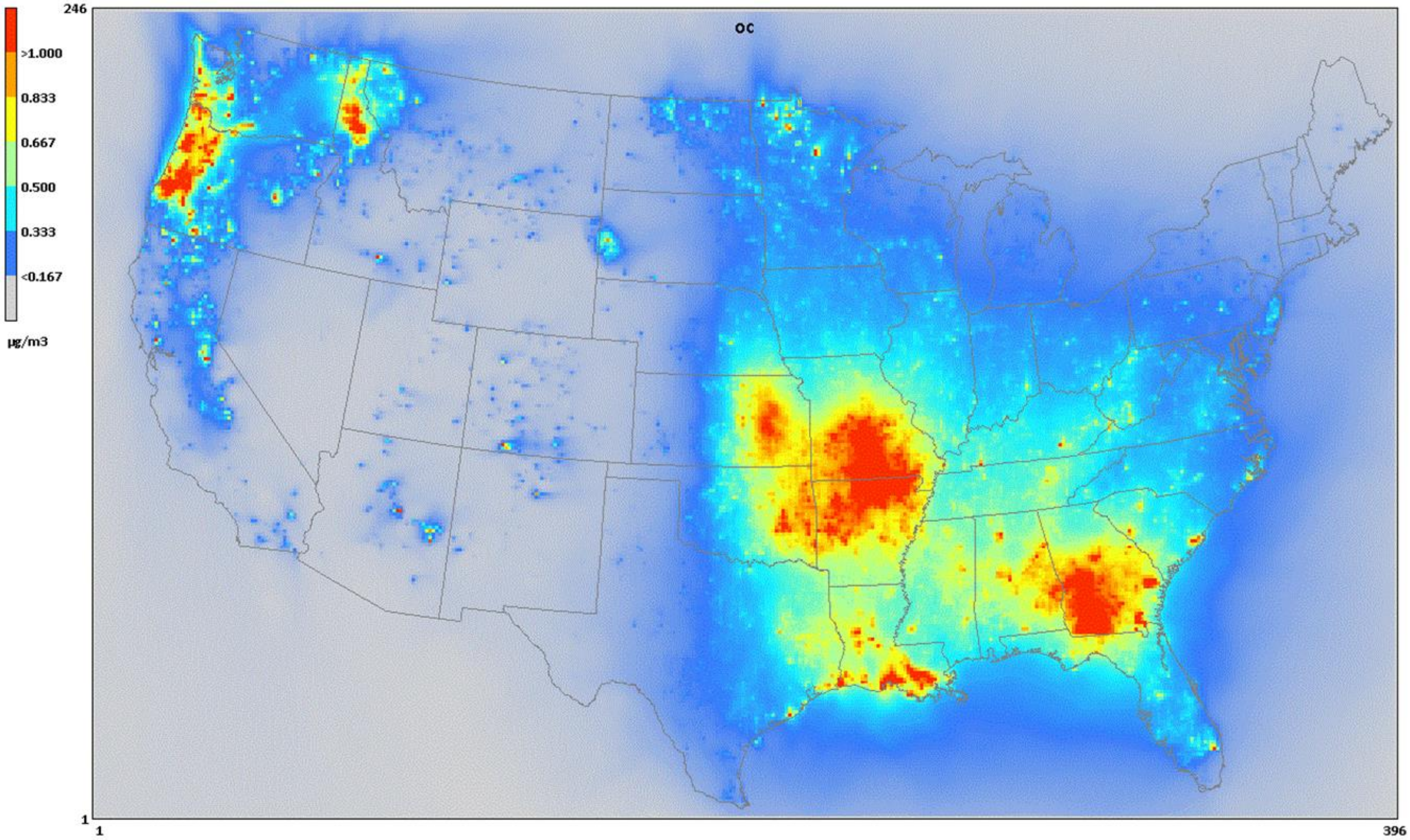
Species-Category Specific Relative Modeled Contribution Example: Organic Carbon from Commercial Cooking



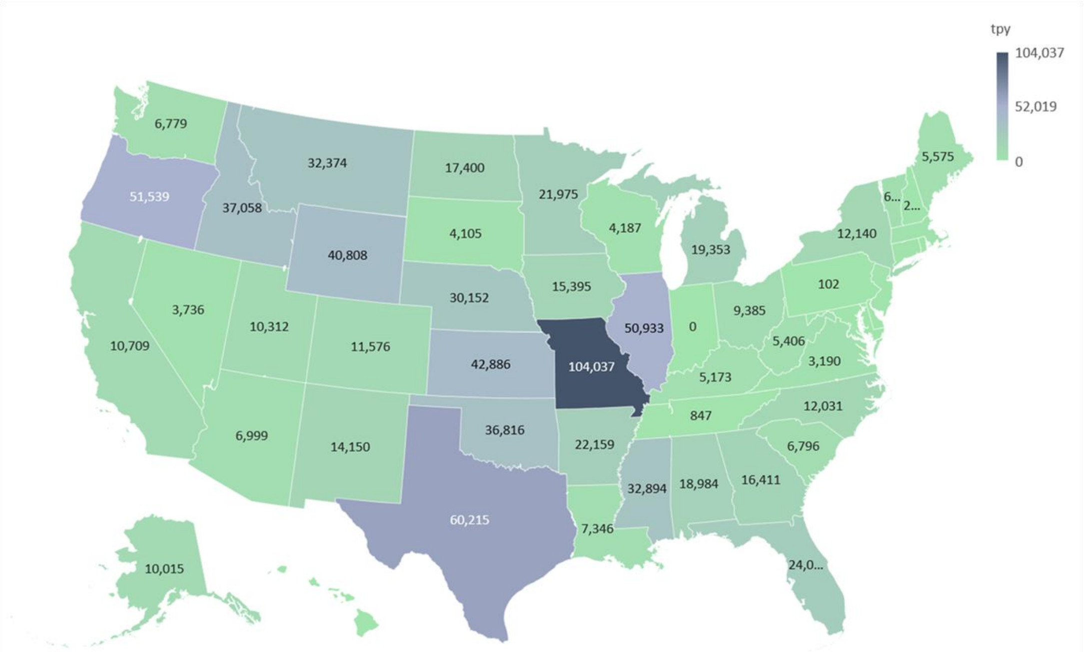
Species-Category Specific Relative Modeled Contribution Example: Organic Carbon from Residential Wood Combustion



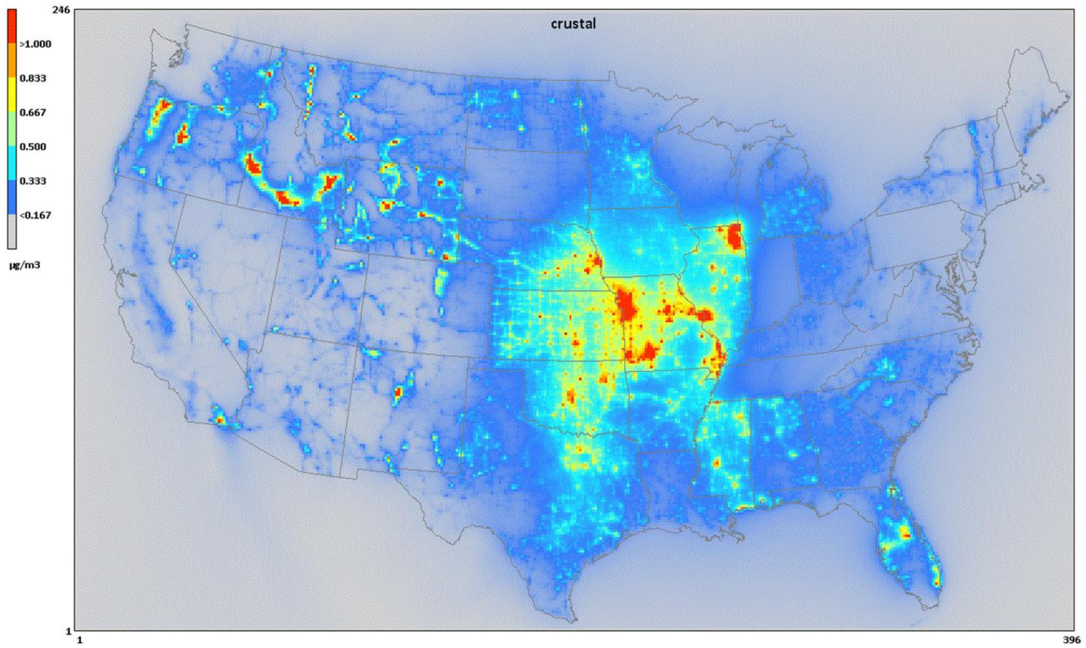
Species-Category Specific Relative Modeled Contribution Example: Organic Carbon from Prescribed Fires



Inventory Issues
Example: Unpaved Roads – Consistency in Reporting



Annual $PM_{2.5}$ Emissions- 2023v2 Projections



Crustal $PM_{2.5}$ Concentrations - 2026v3 Projections

FIPSST 18, Indiana, still missing in EPA's 2022 NEI

See also: MO, PA, TN

State FIP	State	EIS Sector	Pollutant	2016	2017	2018	2019	2020	2021	2022
1	Alabama	Dust - Unpaved Road Dust	PM25-PRI	5,199	4,582	4,090	4,709	3,125	4,442	4,681
2	Alaska	Dust - Unpaved Road Dust	PM25-PRI	1,148	1,191	1,275	1,959	627	3,738	11,352
4	Arizona	Dust - Unpaved Road Dust	PM25-PRI	4,296	4,445	4,476	4,395	1,265	4,220	3,775
5	Arkansas	Dust - Unpaved Road Dust	PM25-PRI	5,859	6,070	5,289	4,951	3,750	6,201	6,247
6	California	Dust - Unpaved Road Dust	PM25-PRI	5,410	5,484	5,901	5,387	5,293	6,194	5,945
8	Colorado	Dust - Unpaved Road Dust	PM25-PRI	5,043	5,234	5,476	4,829	2,534	5,563	4,613
9	Connecticut	Dust - Unpaved Road Dust	PM25-PRI	148	145	123	134	108	153	145
12	Florida	Dust - Unpaved Road Dust	PM25-PRI	12,211	12,479	12,716	12,902	1,880	3,751	3,441
13	Georgia	Dust - Unpaved Road Dust	PM25-PRI	4,252	4,084	3,364	3,853	2,779	3,848	4,203
15	Hawaii	Dust - Unpaved Road Dust	PM25-PRI	166	169	168	155	181	159	245
16	Idaho	Dust - Unpaved Road Dust	PM25-PRI	17,578	16,740	18,068	17,590	6,776	15,505	11,512
17	Illinois	Dust - Unpaved Road Dust	PM25-PRI	16,535	19,253	15,807	13,501	10,072	16,996	17,547
19	Iowa	Dust - Unpaved Road Dust	PM25-PRI	5,069	6,353	4,274	3,877	3,222	6,255	6,005
20	Kansas	Dust - Unpaved Road Dust	PM25-PRI	21,787	23,289	21,406	19,355	8,241	20,358	20,237
21	Kentucky	Dust - Unpaved Road Dust	PM25-PRI	1,134	1,087	860	1,016	734	1,016	1,294

Observations

- In urban area locations, anthropogenic emissions from commercial cooking, residential wood combustion, and waste disposal have the highest percentage of modeled $PM_{2.5}$ concentrations
- At monitors near international borders, total traced species from boundary conditions and Canadian and Mexican anthropogenic categories dominate the modeled contribution to the overall annual $PM_{2.5}$
- At remote mountain monitors, wildfire, boundary conditions, prescribed fires, and residential wood combustion dominate the composition to the total annual $PM_{2.5}$ concentrations

Observations (con't)

- Modeled attainment of 9.0 µg/m^3 annual NAAQS may prove challenging in areas where limited anthropogenic control options are available
- Current, available modeling may prove to be best option in determining relative contributing categories until (and if) EPA generates category-specific PM source apportionment modeling with 2022v1 platform

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