



North Wayside Particulate Matter (PM) Update

March 5, 2024

Outline

- What is particulate matter (PM) and where does it come from?
- PM National Ambient Air Quality Standard (NAAQS) Overview
- Speciation Study Summary
- Positive Matrix Factorization (PMF)
- PMF Results
- Next Steps

What is Particulate Matter (PM)?

- PM is solid particles or liquid droplets that are in the air.
- Some particles are large/dark enough to be seen by the naked eye: dust, soot, dirt.
- Other particles can only be seen under a microscope.
- Based on the size PM can be classified as fine particulates or coarse particulates.
- PM can be directly emitted or formed in the atmosphere due to reactions.

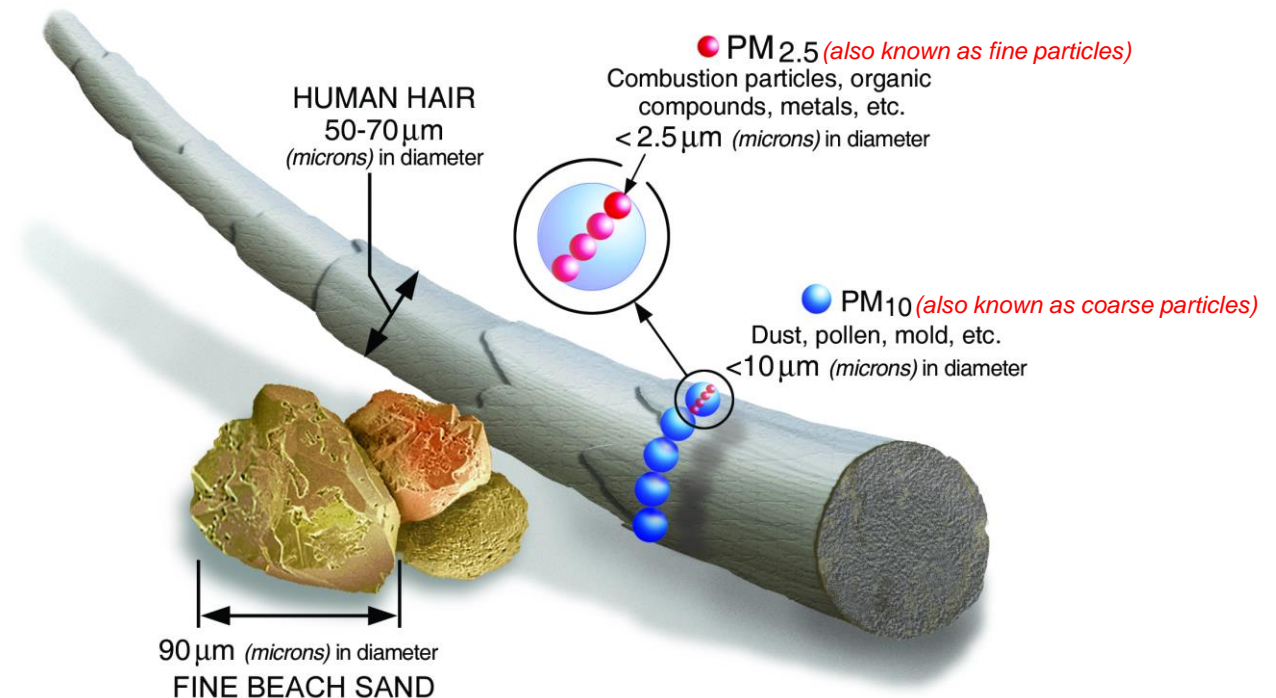
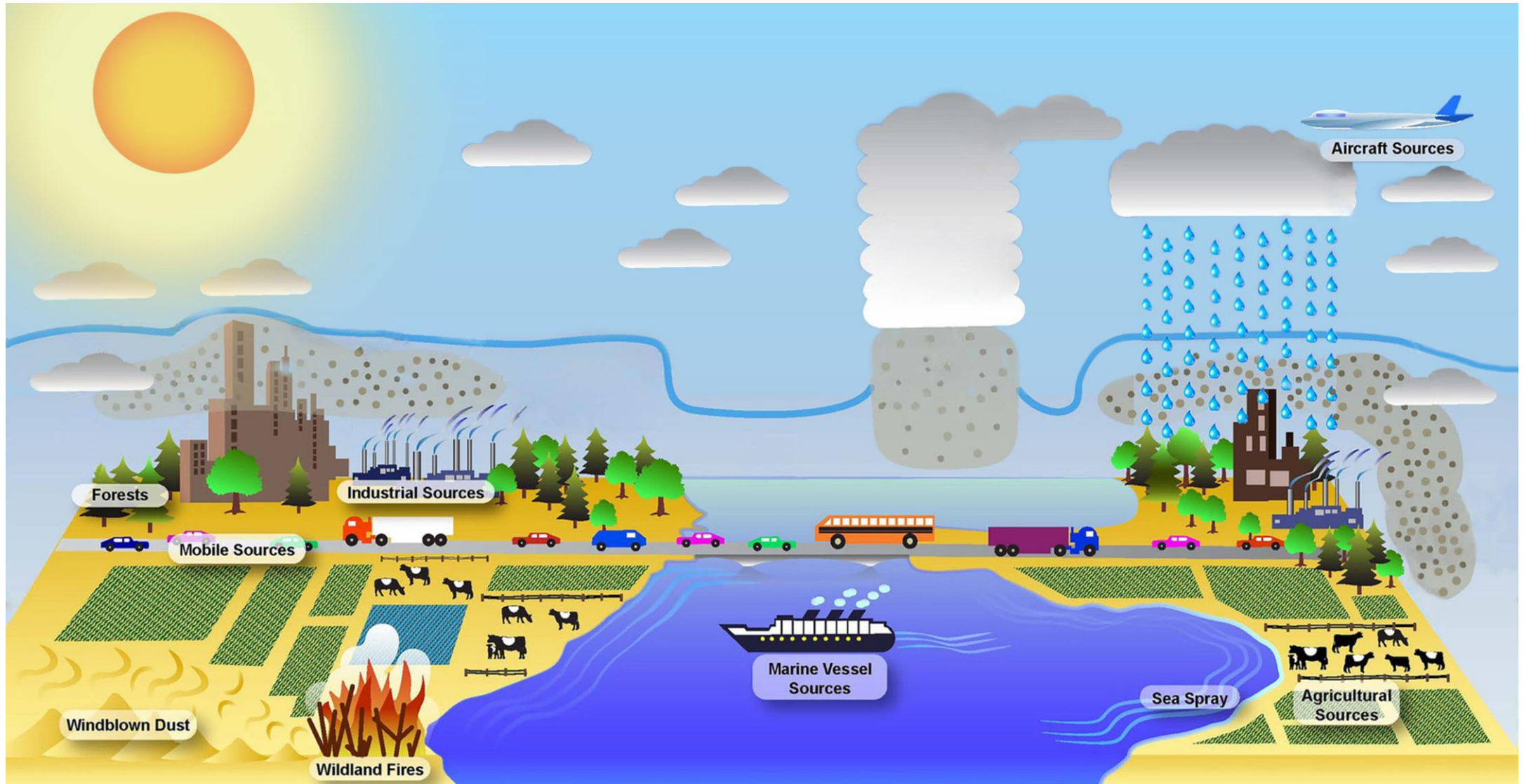


Image Courtesy U.S. EPA

Where does PM come from?



2012 PM NAAQS

- 2012 PM_{2.5} NAAQS
 - Primary Annual Standard: 12.0 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
 - Secondary Annual Standard: 15.0 $\mu\text{g}/\text{m}^3$
 - Primary and Secondary 24-Hour Standard: 35 $\mu\text{g}/\text{m}^3$
- 2012 PM₁₀ NAAQS
 - Primary and Secondary Standard: 150 $\mu\text{g}/\text{m}^3$

NAAQS Revision

- On February 7, 2024, the EPA took final action on the reconsideration of the PM_{2.5} NAAQS.
 - Lowered the primary annual standard from 12.0 to 9.0 µg/m³.
 - Retained the secondary annual standard of 15.0 µg/m³.
 - Retained the 24-hour standard of 35 µg/m³.
- The new primary 2024 PM_{2.5} annual standard is expected to become effective in April 2024.

Potential PM_{2.5} NAAQS Implementation Timeline

Date	Event
February 7, 2024	PM _{2.5} NAAQS revision finalized
February 7, 2025	State designation submittal
October 9, 2025	120-day Letter from EPA to Governor
March 2026	Final designations effective

Preliminary Design Values

PM_{2.5} Design Value

Standard	Value ^a (µg/m ³)	Standard (µg/m ³)
24-Hour	27	35
Annual	12.6	9.0 ^c

PM₁₀ Design Value

Value currently meets the NAAQS.^{a,b}

^a Values were calculated using preliminary data from May 4, 2021, through Dec 31, 2023.

^b Federal Reference Method sampling for PM₁₀ is currently not in place at this site.

A non-regulatory method of sampling was used to provide data for this calculation.

^c The new primary annual standard is expected to become effective in April 2024.

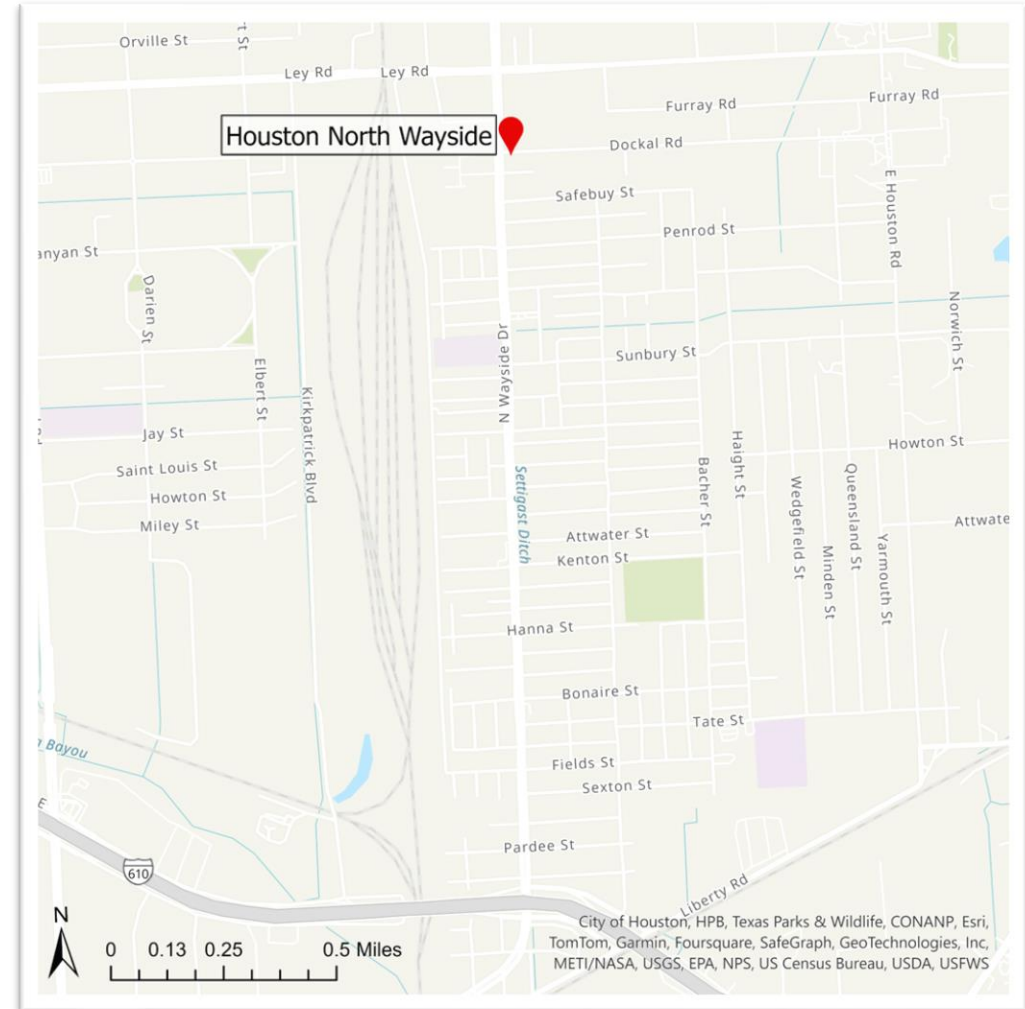
North Wayside Speciation Study

- Purpose: Investigate and, if possible, identify particulate sources that contribute to the high concentration at the Houston North Wayside monitor.
- Methodology:
 - Sampling occurred from July 2022 through June 2023.
 - Filter samples were taken daily; every third day was analyzed automatically. Additional days with a 24-hour average greater than 22 $\mu\text{g}/\text{m}^3$ were also analyzed.
 - Samples are 24 hours in duration.
 - Filters are analyzed for 64 compounds/species as well as additional optical carbon parameters.
 - A total of 133 samples were analyzed.
 - Data was further analyzed using EPA's Positive Matrix Factorization (PMF) model.

North Wayside Monitor Location

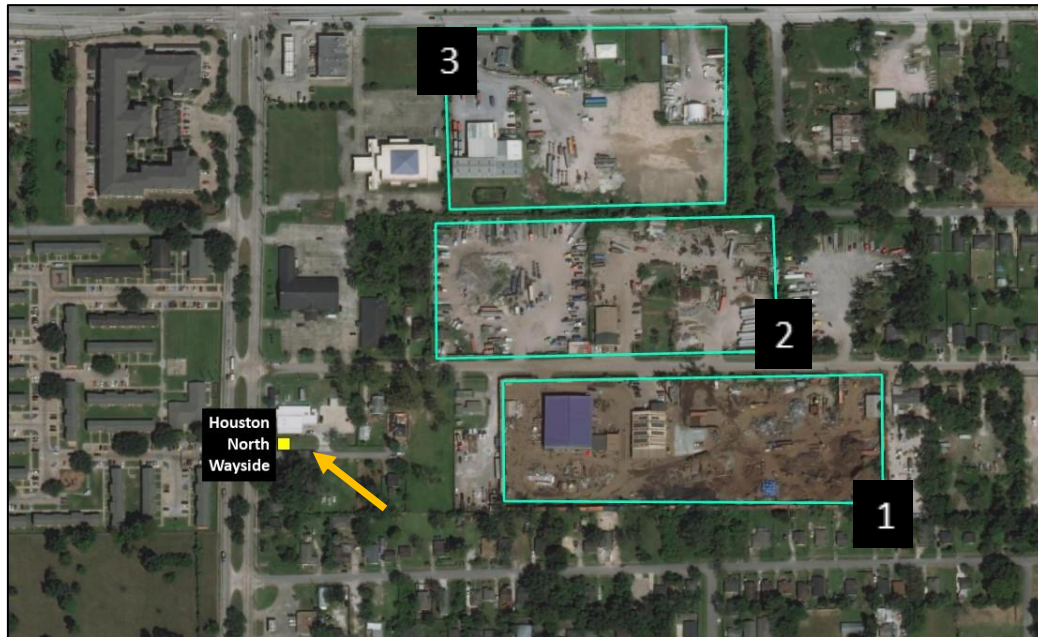


View of the North Wayside monitor location at 7330 ½ North Wayside, Houston, Texas 77028

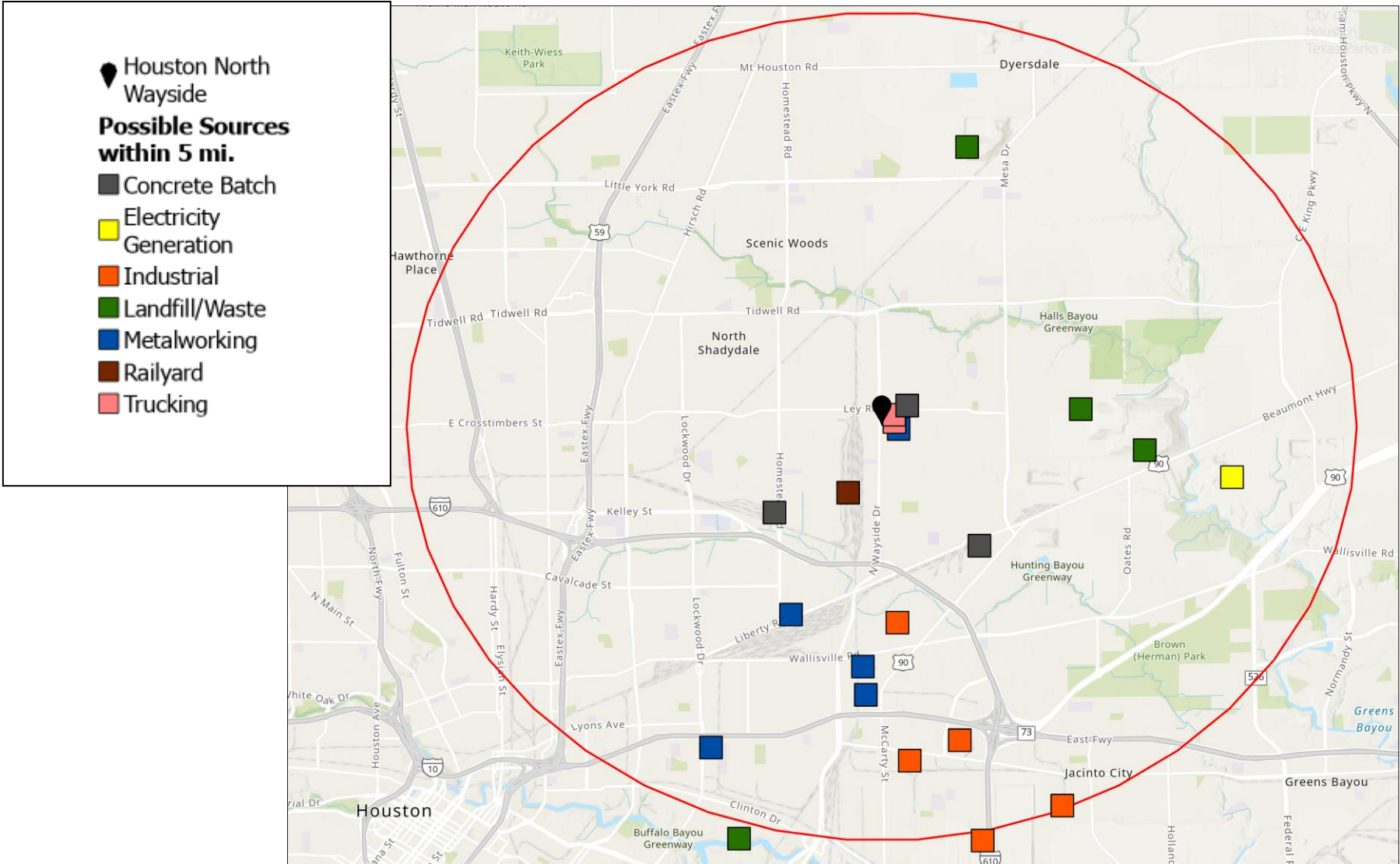


Potential Sources Near North Wayside

1. Gold Star Metals (0.12 miles E)
2. Invictus Transport (0.13 miles NE)
3. XLR8 Truck Lines (0.20 miles NE)
4. Five Star Ready Mix (0.37 miles NE)
5. Texas Concrete Ready Mix (0.75 miles SW)
6. Queen Ready Mix (1.75 miles SE)
7. Union Pacific Rail Yard (0.40 miles SW-W)

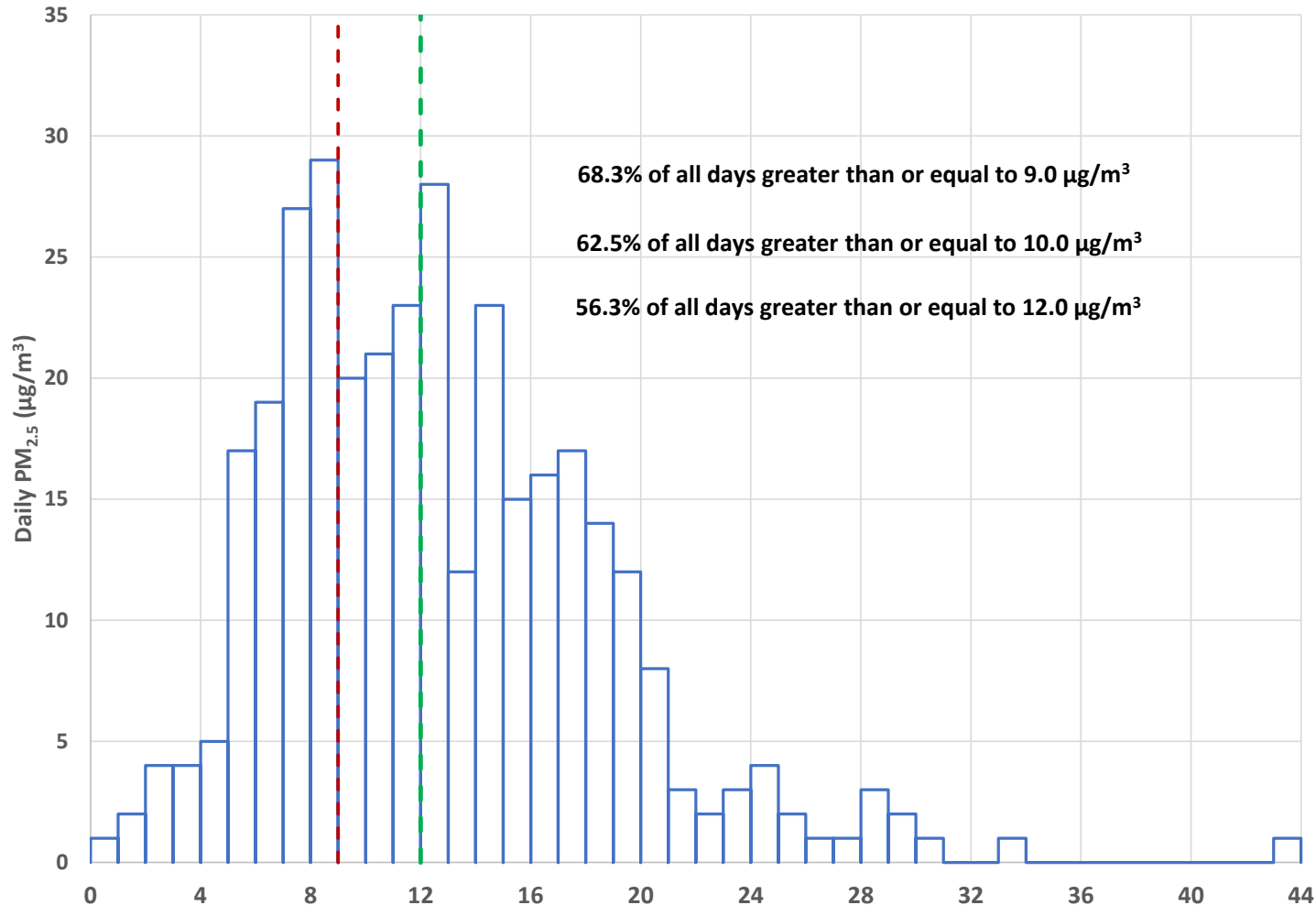


Potential Sources Within Five Miles



Histogram of 24-Hour PM_{2.5} Averages

Frequency of Daily 24-Hour PM_{2.5} Averages (July 2022 - June 2023)



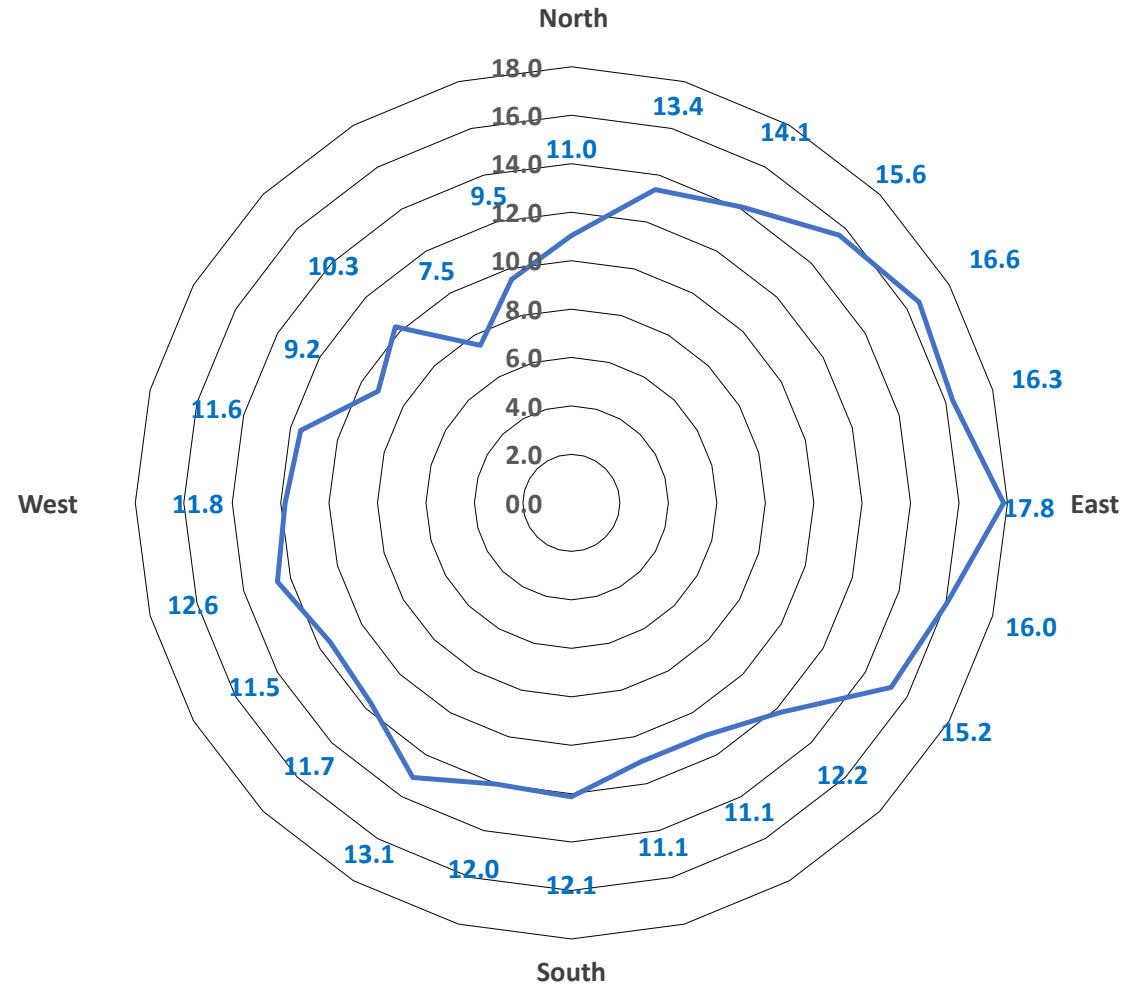
56% of all days are above the 2012 PM_{2.5} annual NAAQS of 12.0.

At least 68% of days are above the revised 2024 PM_{2.5} annual NAAQS of 9.0.

Average PM_{2.5} by Wind Direction

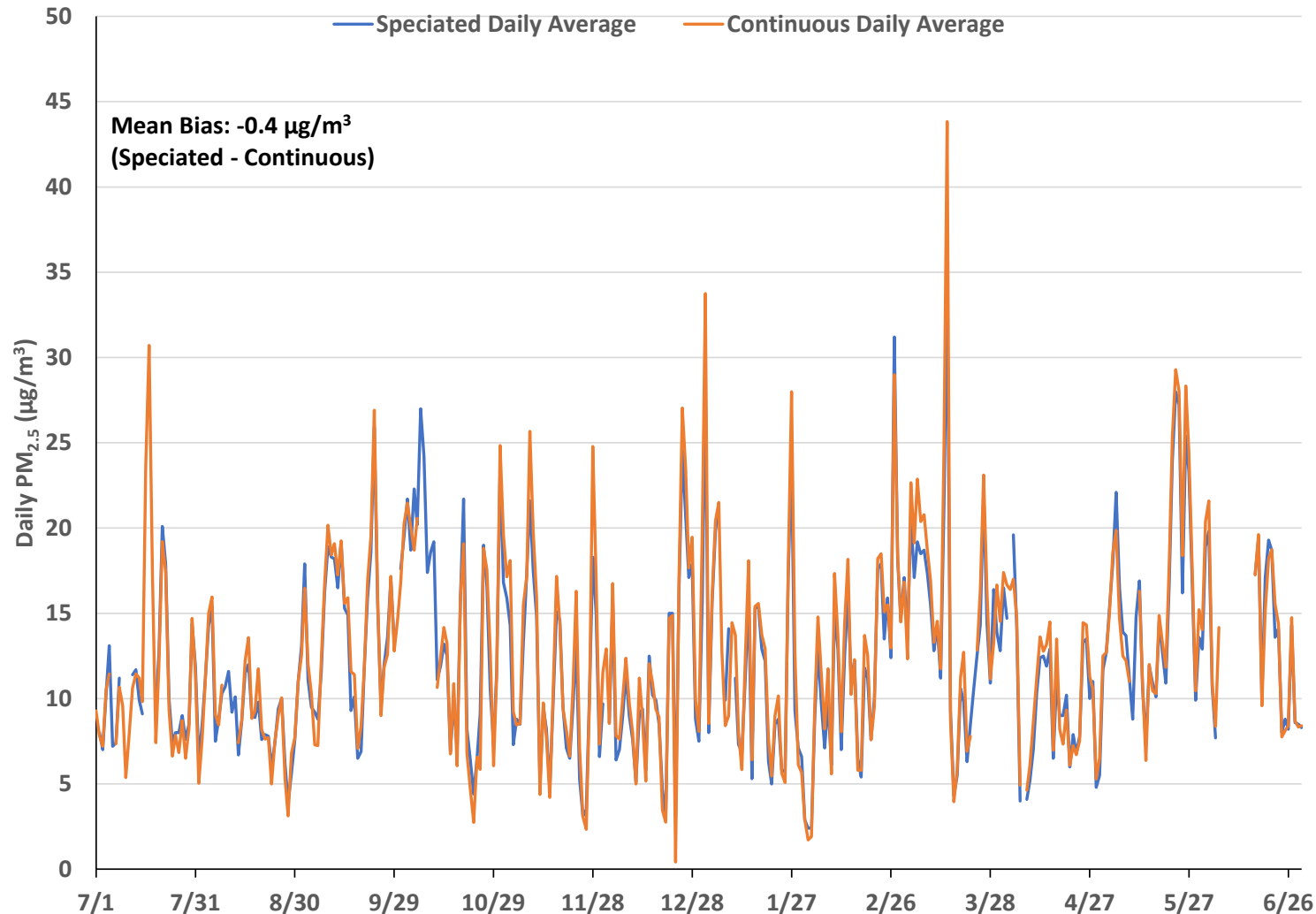
Average PM_{2.5} by Wind Direction (July 2022 - June 2023)

Highest averages come from the Northeast to Southeast.



Continuous versus Speciated

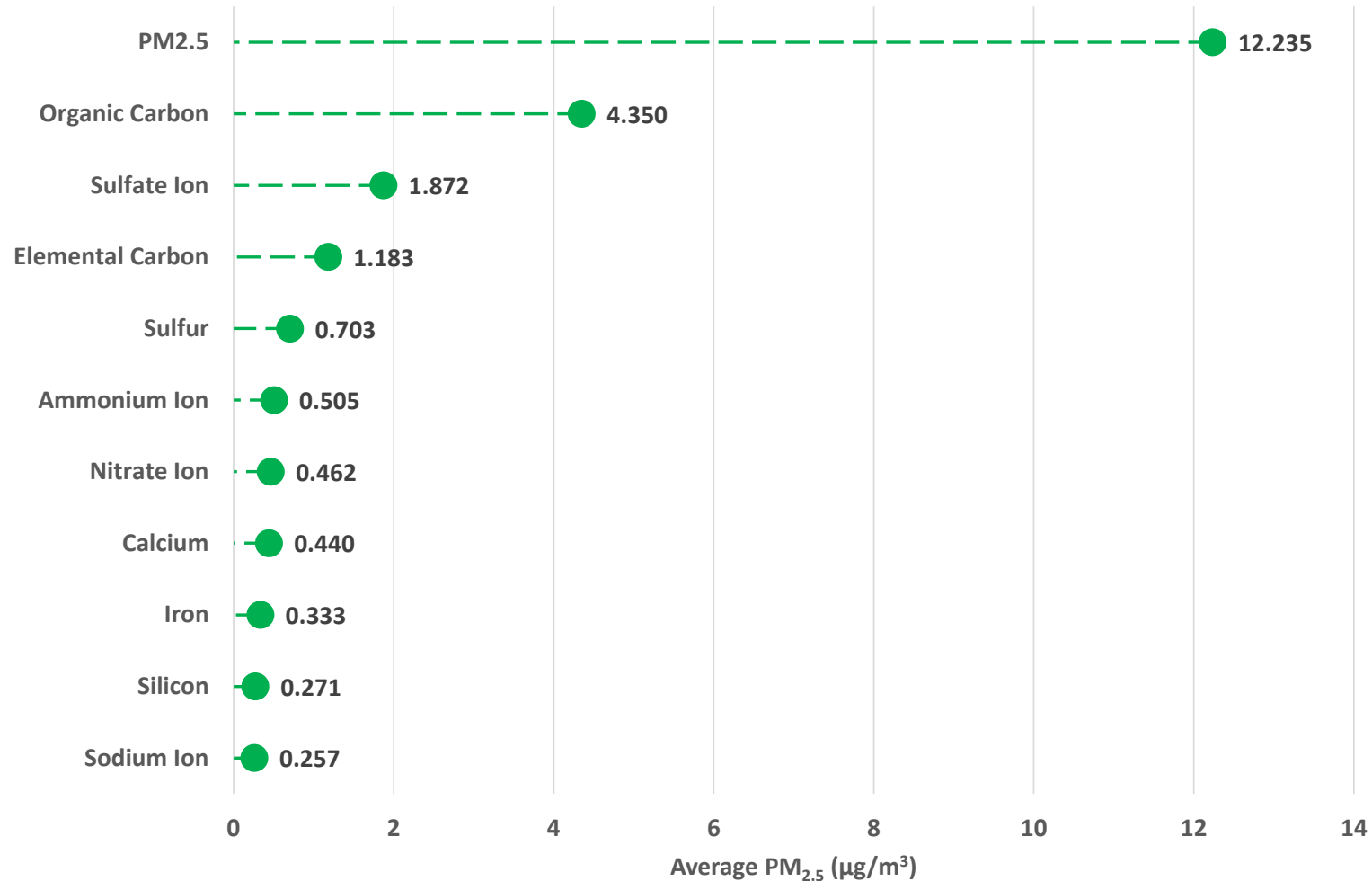
Comparison of PM_{2.5} Continuous versus Speciated Daily Averages (July 2022 - June 2023)



The two monitoring methods compare well to each other with a mean bias of only -0.4 µg/m³.

Top Ten Compounds/Species Observed

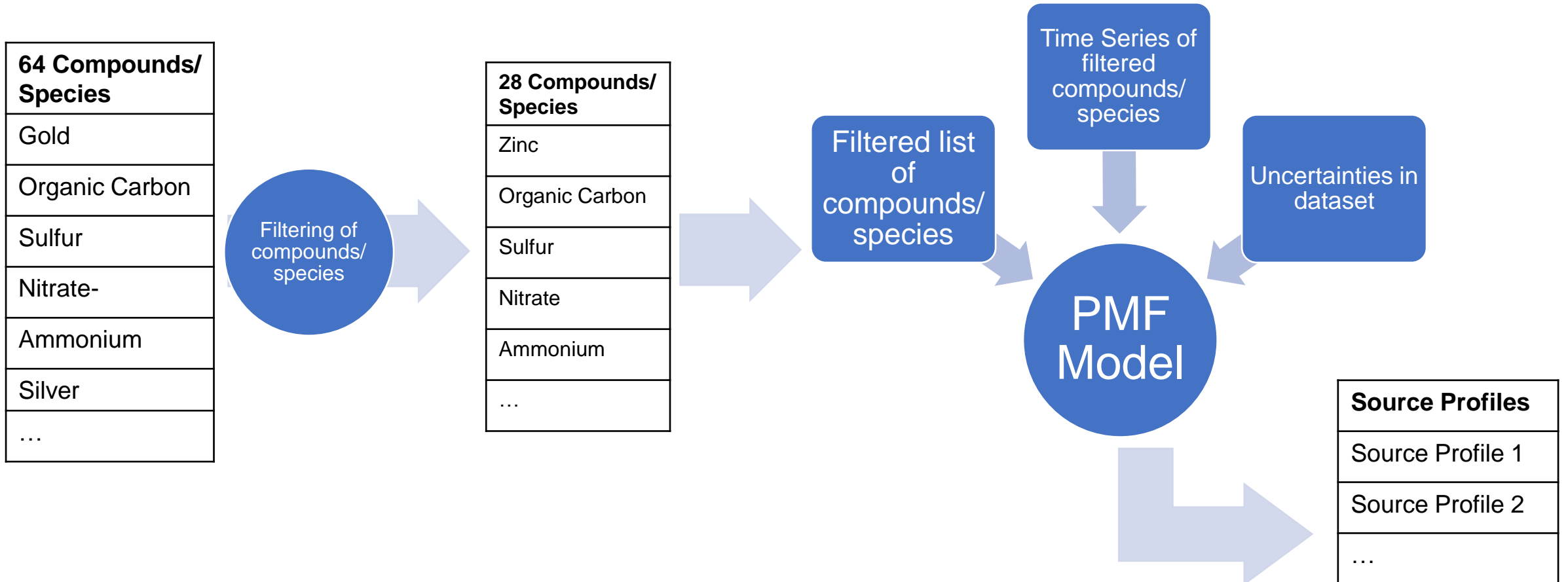
Average Measurements for Total Mass and Top Ten Species at North Wayside (July 2022 - June 2023)



Positive Matrix Factorization (PMF)

- Statistical technique for identifying constituent source profiles – groups of compounds/species that occur together and are correlated (move up and down together over time).
- Source profiles are not real-world emissions sources.
- There may be more than one source type that maps to an identified source profile.
- Source profiles are not independent of each other and can overlap with each other.

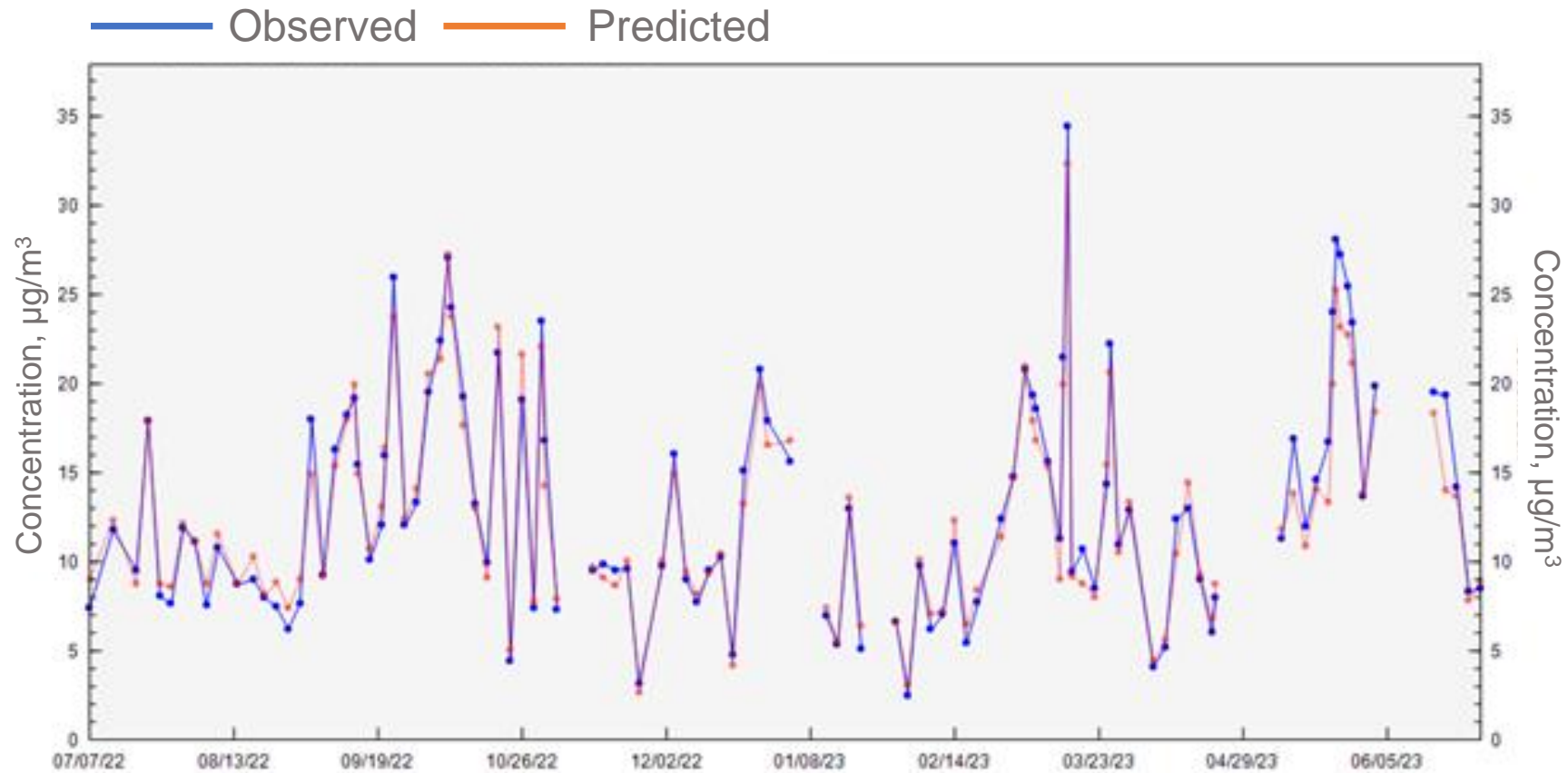
PMF Process



Speciation Data Issues & PMF Results

- 17 samples were not included in the PMF analysis because of incomplete monitoring data or outlier days such as July 4.
- 28 compounds/species chosen for PMF analysis after removing outlier/trace compounds such as rare earth metals.
- PMF modeling suggests there are eight source profiles that account for most of the PM_{2.5} at North Wayside.
- The modeled PM_{2.5} mass based on PMF results matched the observed PM_{2.5} mass very well providing confidence in the model and identified source profiles.

Observed Versus Predicted Mass at North Wayside



Identified Source Profiles, Average Contribution & Time Series

Source Profiles

Urban Biomass Burning (BB) Mix

Ammonium Sulfate (NH₄ SO₄) Aged

Crustal 2 Urban

Crustal 1

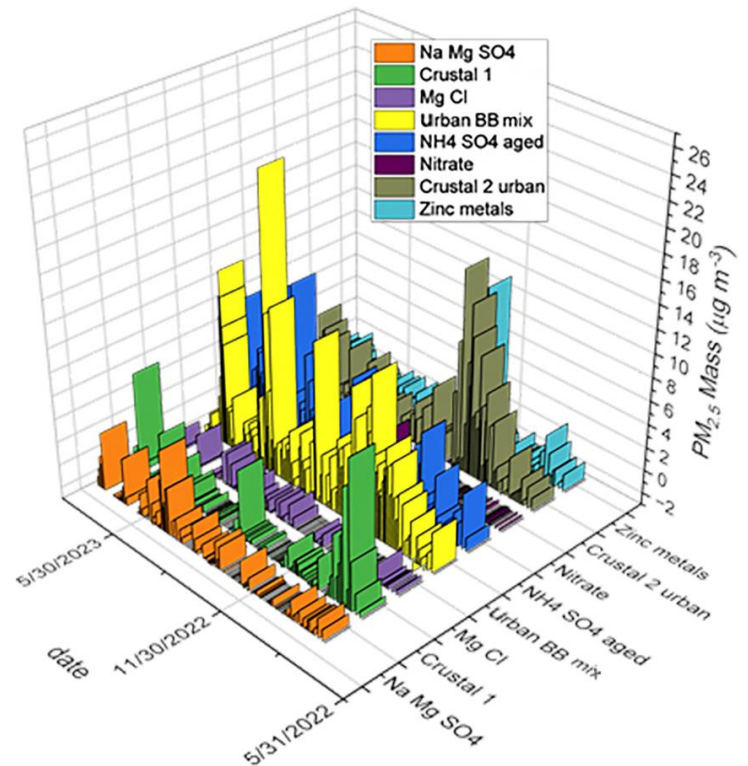
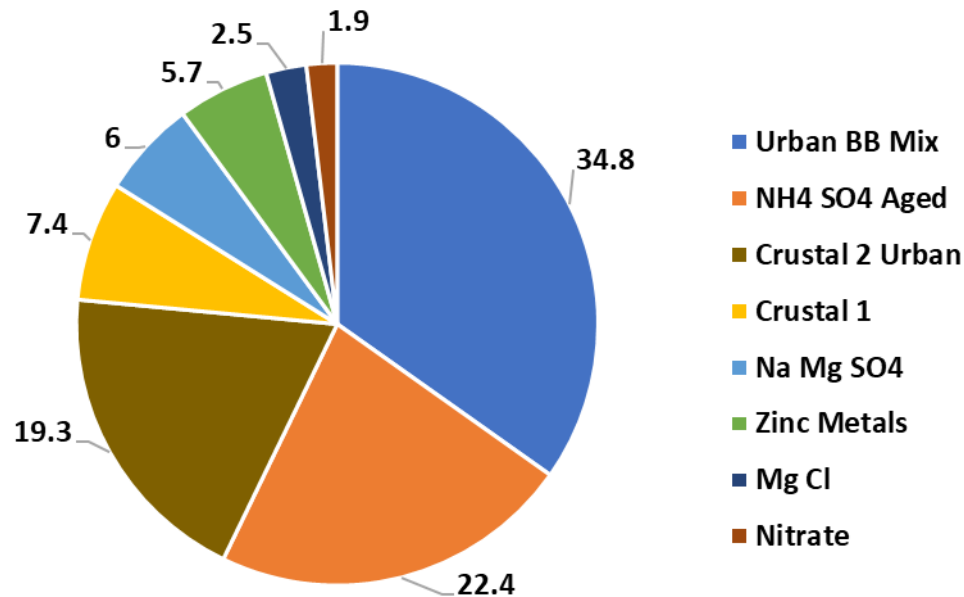
Sodium/Magnesium Sulfate (Na Mg SO₄)

Zinc Metals

Magnesium Chloride (Mg Cl)

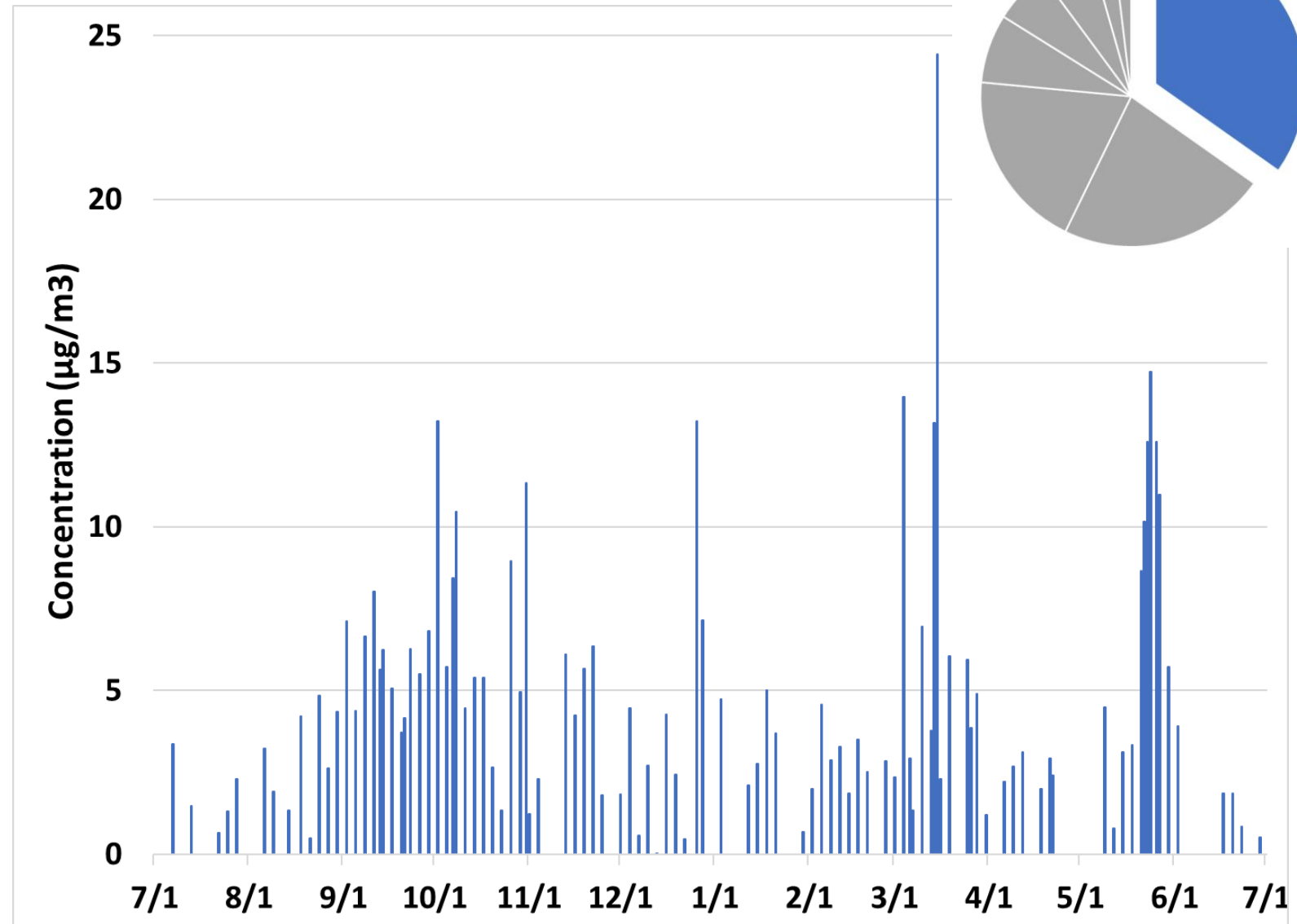
Nitrates

Source Profiles Contribution Percentage (%)



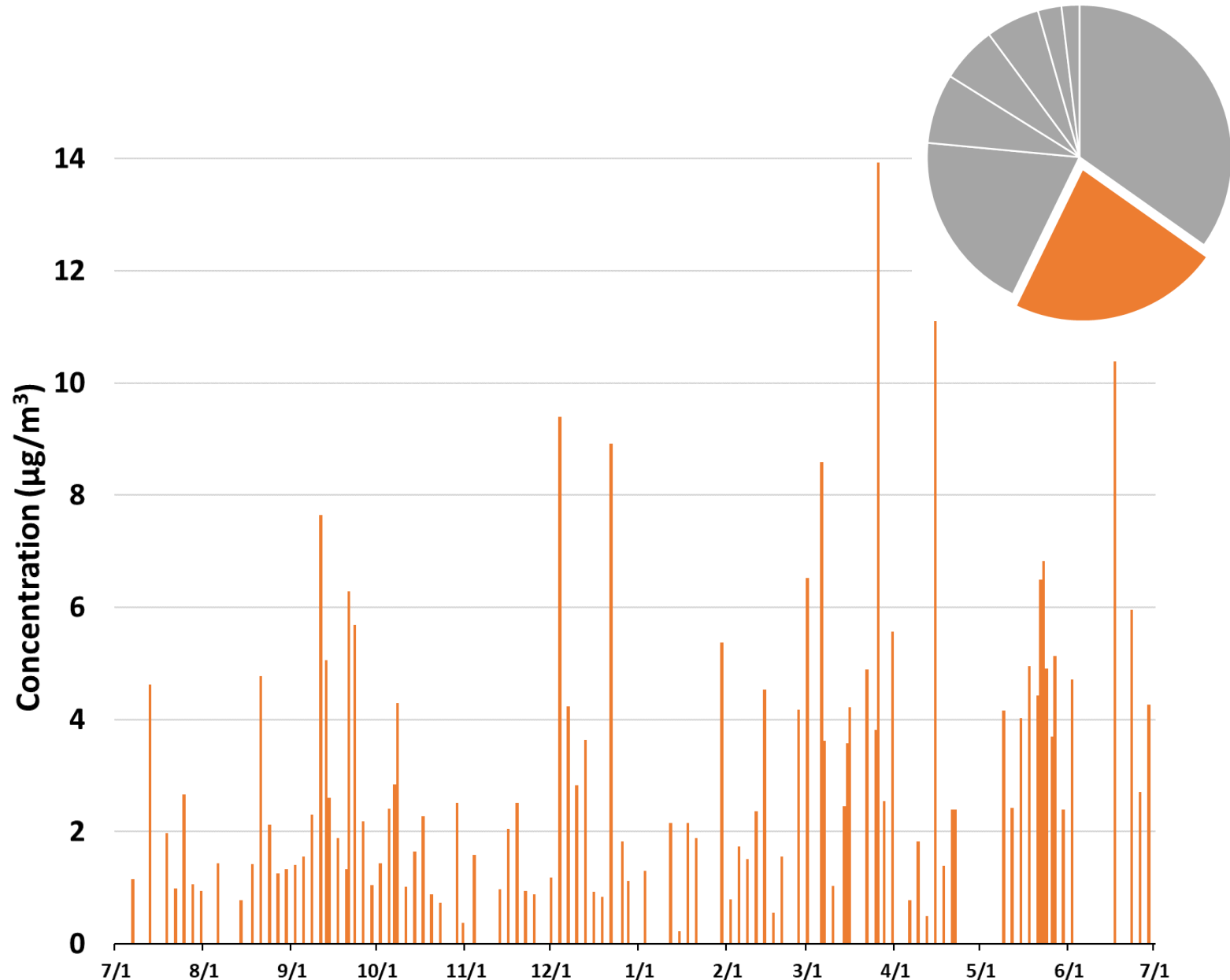
Urban Biomass Burning (BB) Mix Source Profile

- 34.8% contribution over the whole sampling period.
- Compounds/species contributions dominated by organic carbon but also contains elemental carbon, potassium, bromine, and copper.
- The signal for this source profile is present through the sampling period.
- Cannot be directly attributed to a specific source and is consistent with a mix of sources (eg. traffic emissions, biomass burning, food cooking, biogenic sources, etc.).



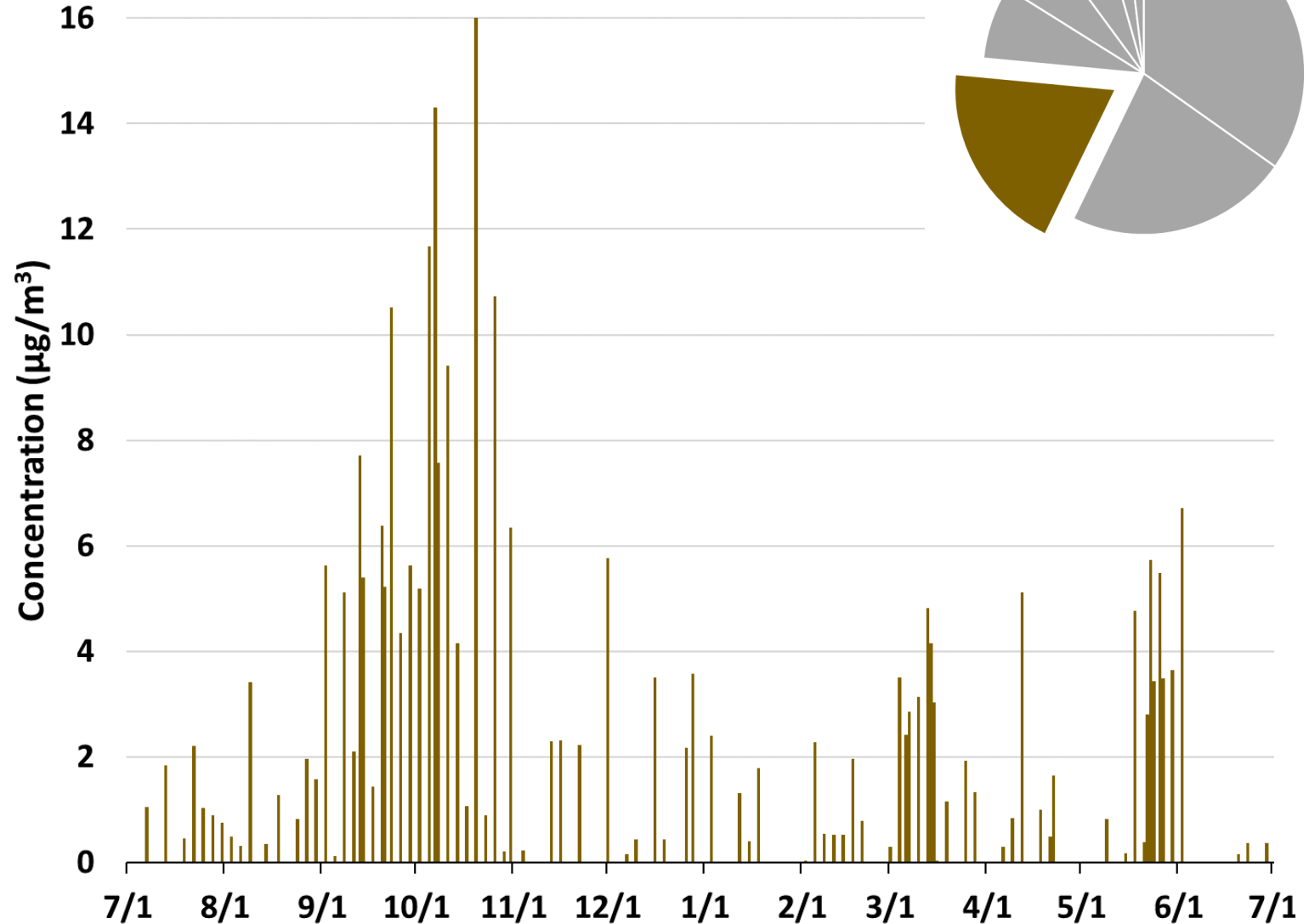
Ammonium Sulfate (NH₄ SO₄) Aged Source Profile

- 22.4% contribution over the whole sampling period.
- Compounds/species contributions may include organic carbon (the contribution is uncertain) in addition to ammonia and sulfate.
- The signal for this source profile is present through the sampling period.
- Aged ammonium sulfate is produced in the atmosphere from separate emissions of sulfur dioxide and ammonia. The ammonia and sulfur emissions do not have to come from the same emission source.
- This is consistent with industrial sources.



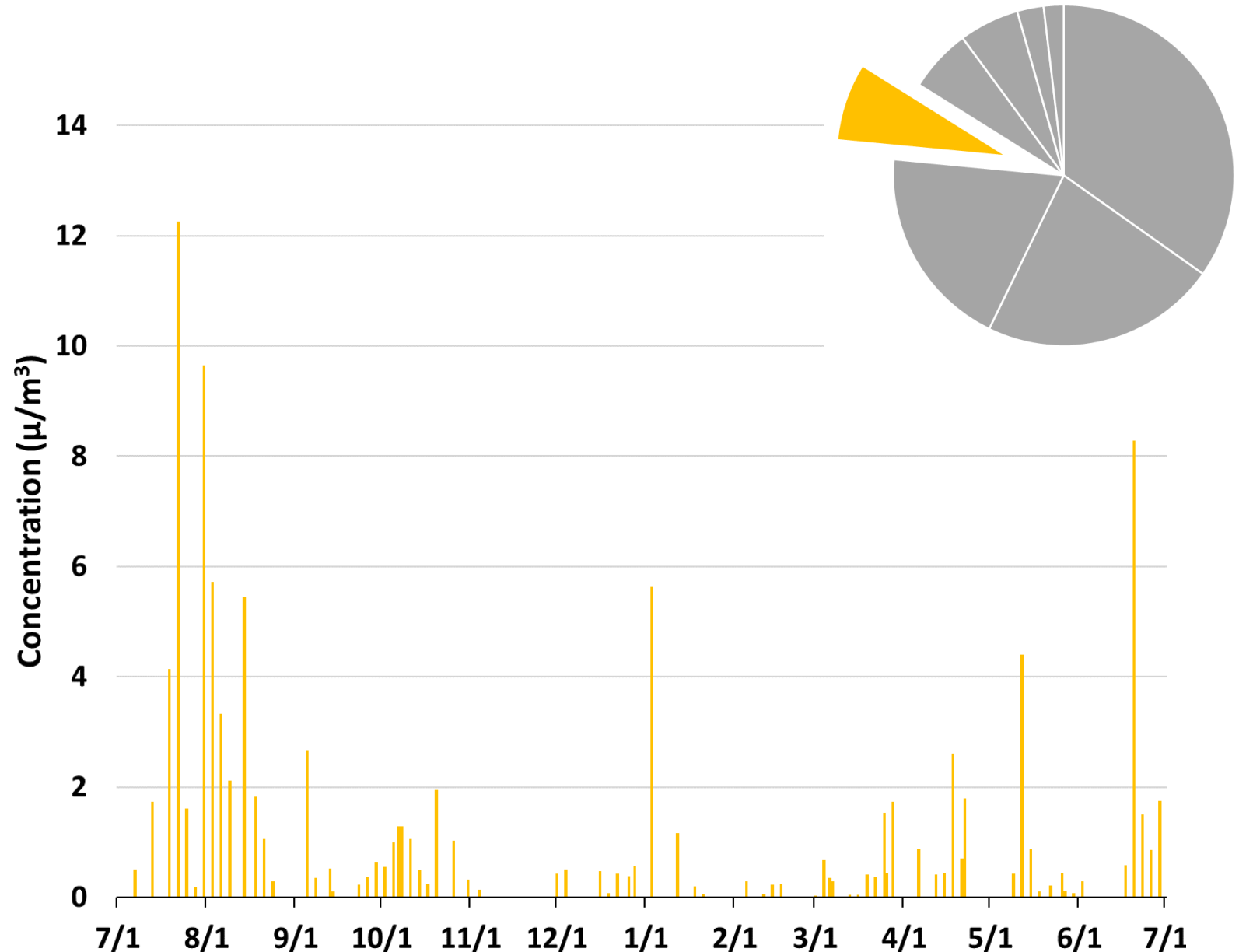
Crustal 2 Urban Source Profile

- 19.3% contribution over the whole sampling period.
- Compounds/species contributions dominated by calcium, includes an enhancement of copper and elemental carbon.
- The signal for this source profile is present after the end of the Saharan dust season (Jul-Aug).
- Consistent with more local contribution (e.g. road dust) as both copper and elemental carbon are present in traffic emissions.



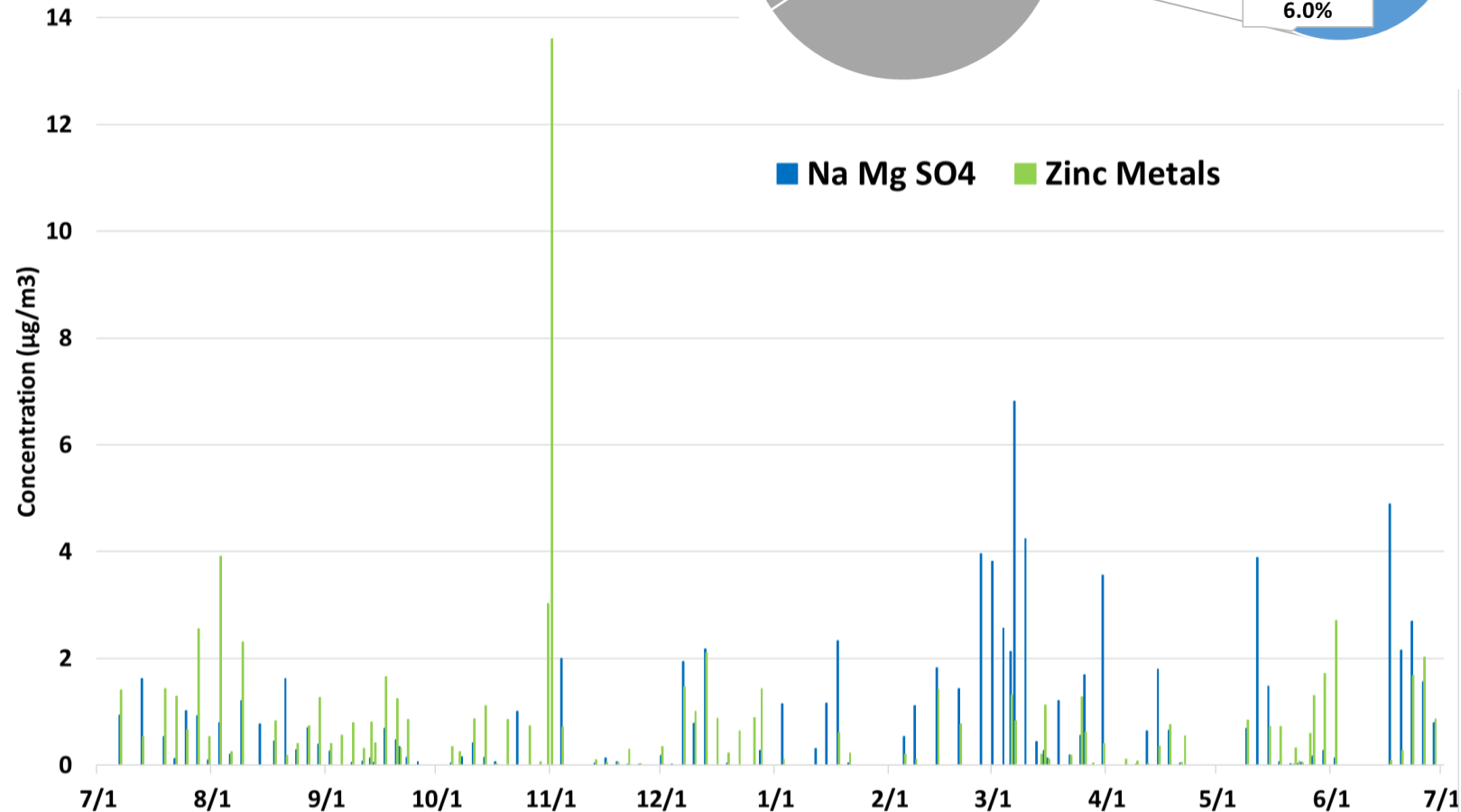
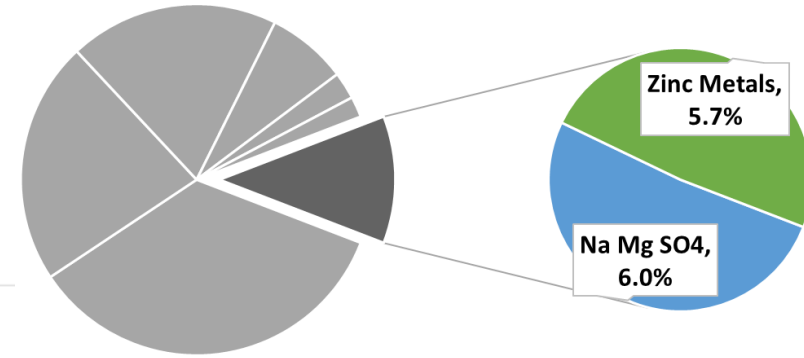
Crustal 1 Source Profile

- 7.4% contribution over the whole sampling period.
- Compounds/species contributions from aluminum, iron, magnesium, silicon, and titanium.
- The signal for this source profile is predominantly present in Jul-Aug timeframe.
- Source profile consistent with Saharan dust which often impacts the Houston area during the Jul-Aug time frame.



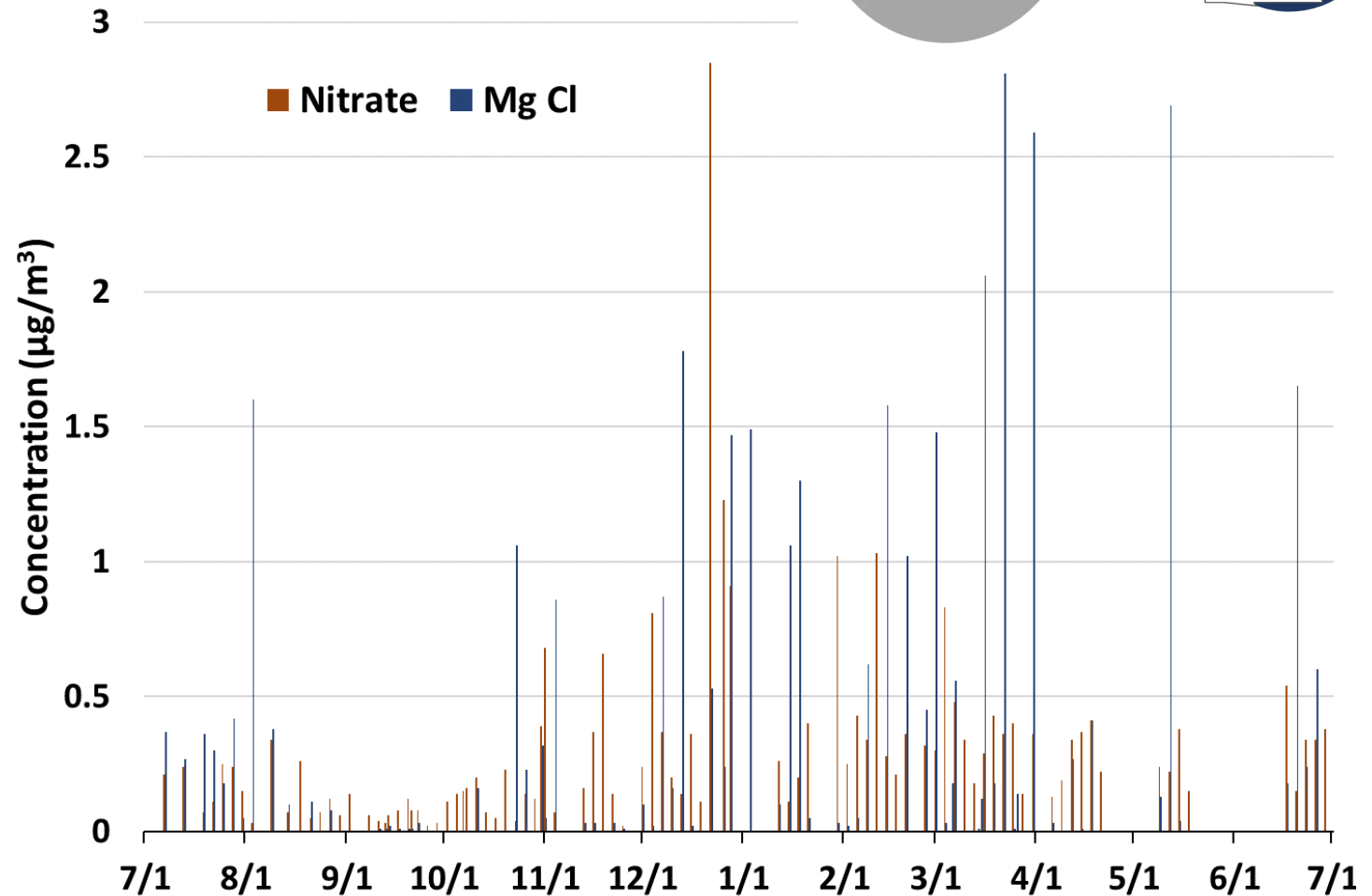
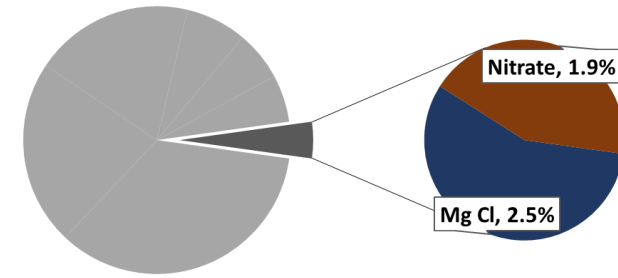
Sodium/Magnesium Sulfate (Na Mg SO₄) & Zinc Metals Source Profiles

- Na Mg SO₄ Source Profile:
 - 6% contribution over the whole sampling period.
 - The signal for this source profile is present intermittently throughout the year.
 - Consistent with marine emissions.
- Zinc Metals Source Profile:
 - 5.7% contribution over the whole sampling period.
 - Contributions are from metal compounds/species only (iron, copper and zinc).
 - Consistent with metal industry sources.



Magnesium Chloride (Mg Cl) & Nitrate Source Profiles

- Mg Cl Source Profile:
 - 2.5% contribution over the whole sampling period.
 - The signal for this source profile is present intermittently throughout the year.
 - Consistent with marine source emissions.
- Nitrate Source Profile:
 - 1.9% contribution over the whole sampling period.
 - The signal for this source profile is present throughout the sampling period.
 - Consistent with agricultural emissions.



Next Steps

- The implementation of the new PM_{2.5} standard.
 - Designations
 - Conceptual Model Development
- Potential outreach meeting as part of designation process in Fall 2024/Spring 2025.

Questions?

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