



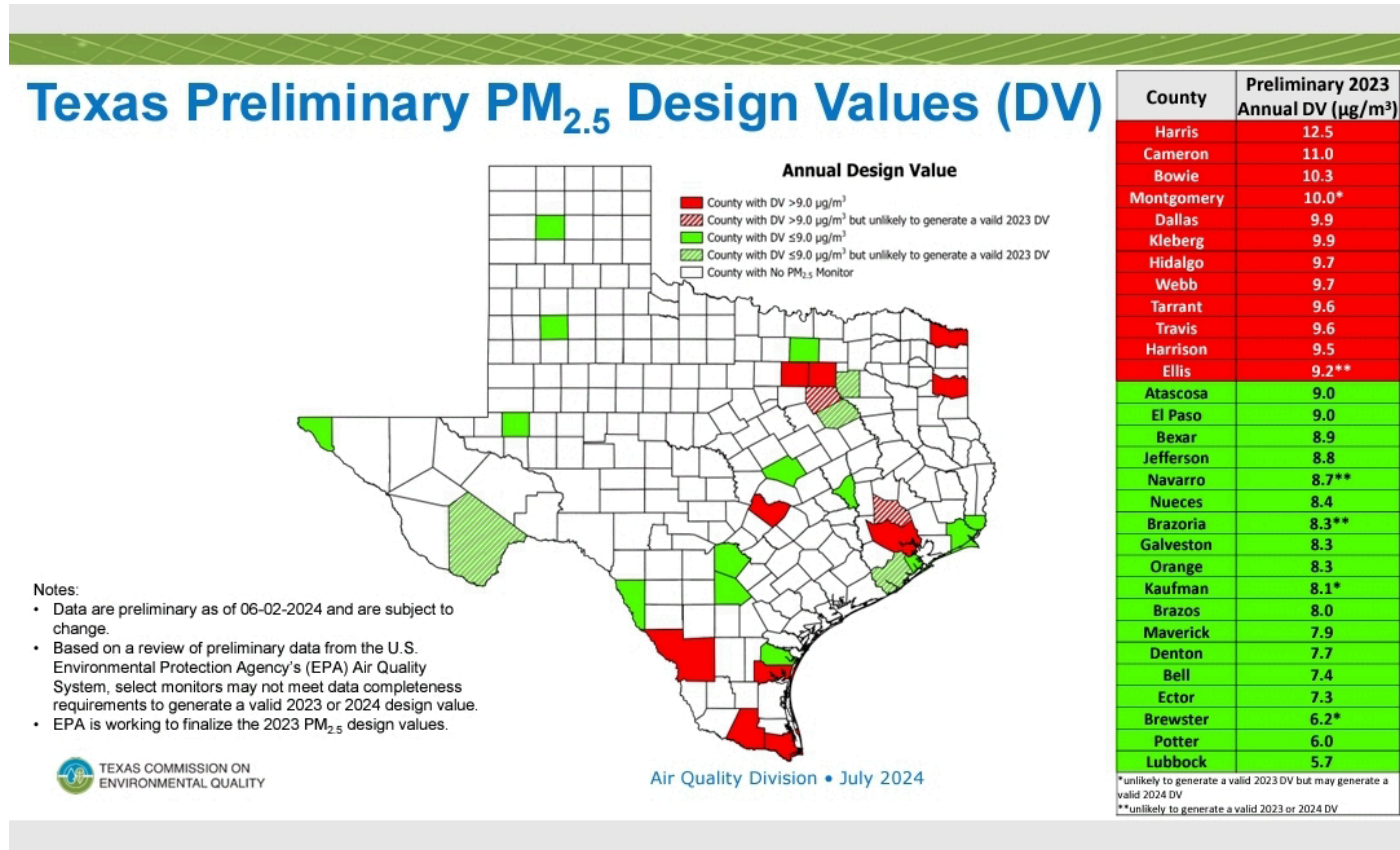
2025 AQRP Texarkana Field Campaign (24-007)
Aerodyne Research | Baylor University | University of Houston

This research presentation was supported by funding from the Texas Commission on Environmental Quality (TCEQ). The findings, opinions, or conclusions expressed do not necessarily represent those of the TCEQ.

Motivation

Texarkana PM value exceeds new standard

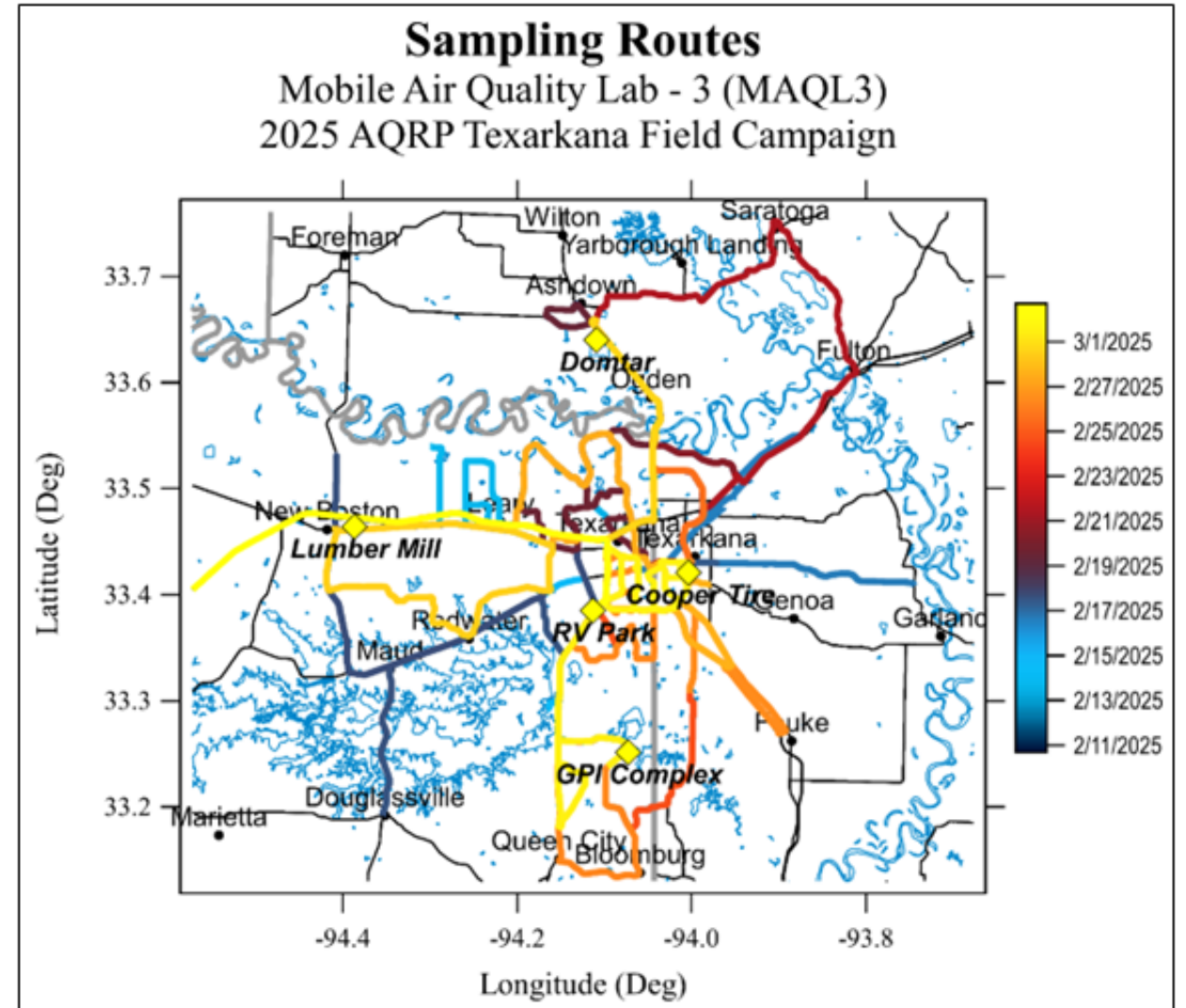
Priority is to determine what sources may be leading to these elevated PM readings



Motivation

Texarkana PM value exceeds new standard

Priority is to determine what sources may be leading to these elevated PM readings



Reason for paper mill focus

11 County area surrounding Texarkana TX (Texas Data Only)

GPI's Reported EI PM 2.5 TPY 2023

COMPANY	SITE	COUNTY	EGIC	NEAR CITY	LATITUDE	LONGITUDE	SIC DESCRIPTION	REP YEAR	NOX TPY	PM2.5 TPY	SO2 TPY	VOC TPY
GRAPHIC PACKAGING INTERNATIONAL LLC	TEXARKANA MILL	CASS	5	QUEEN CITY	33.25722	-94.0697	PAPER MILLS	2023	1645.8363	408.0777	293.9049	1333.519
WEST FRASER US EWP LLC	JEFFERSON OSB	MARION	5	JEFFERSON	32.77583	-94.3681	RECONSTITUTED WOOD PRODUCTS	2023	129.7961	81.6443	14.5289	258.475
LUMINANT GENERATION COMPANY LLC	PLANT	LAMAR	5	PARIS	33.6318	-95.5902	ELECTRIC SERVICES	2023	613.5615	78.6147	12.1436	10.2425
SOUTHWESTERN ELECTRIC POWER COMPANY	PLANT	MARION	5	AVINGER	32.84861	-94.5469	ELECTRIC SERVICES	2023	932.24	46.07	3.7509	33.933
WEST FRASER WOOD PRODUCTS	LUMBER MILL	BOWIE	5	NEW BOSTON	33.46556	-94.3862	SAWMILLS & PLANING MILLS GENERAL	2023	31.1974	36.5522	9.366	444.0672

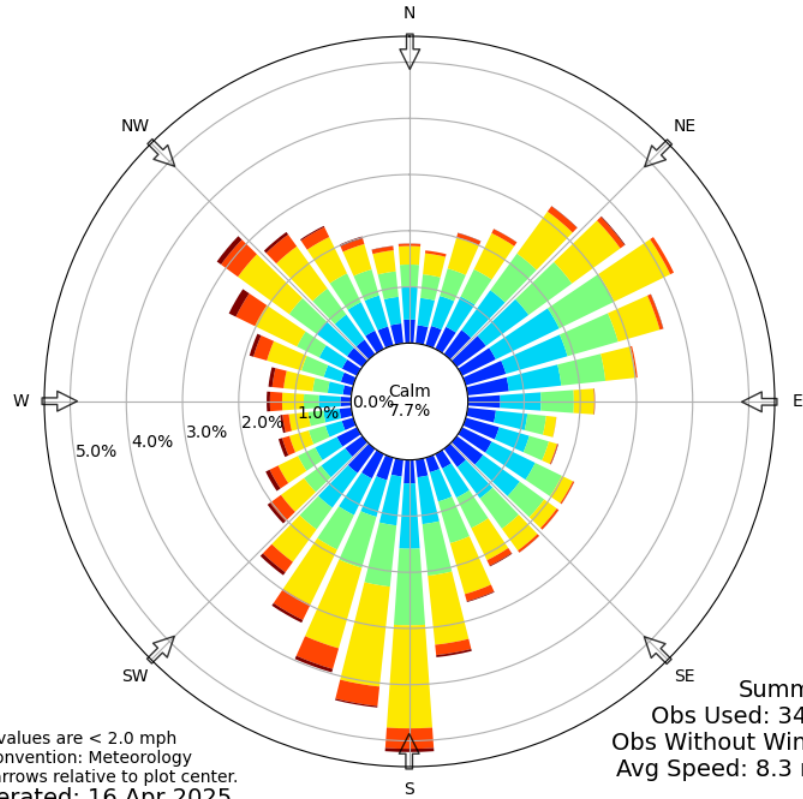
GPI's Reported EI PM 2.5 TPY 2022

COMPANY	SITE	COUNTY	EGIO	NEAR CITY	LATITUDE	LONGITUDE	SIC DESCRIPTION	REP YEAR	NOX TPY	PM2.5 TPY	SO2 TPY	VOC TPY
GRAPHIC PACKAGING INTERNATIONAL LLC	TEXARKANA MILL	CASS	5	QUEEN CITY	33.25722222	94.0697222	PAPER MILLS	2022	1743.74	384.1966	135.1418	1568.227
LUMINANT GENERATION COMPANY LLC	LAMAR POWER PLANT	LAMAR	5	PARIS	33.63179722	95.5902028	ELECTRIC SERVICES	2022	614.6773	76.227	11.8488	11.2896
SOUTHWESTERN ELECTRIC POWER COMPANY	WELSH POWER PLANT	TITUS	5	MOUNT PLEASANT	33.05542222	94.8411028	ELECTRIC SERVICES	2022	4696.007	40.17	10915.6	25.11
SOUTHWESTERN ELECTRIC POWER COMPANY	WILKES POWER PLANT	MARION	5	AVINGER	32.84861111	94.5469444	ELECTRIC SERVICES	2022	813.99	39.6	3.4706	29.45
WEST FRASER WOOD PRODUCTS	NEW BOSTON LUMBER MILL	BOWIE	5	NEW BOSTON	33.46556388	94.38615	SAWMILLS & PLANING MILLS GENERAL	2022	29.9399	35.23	9.2516	454.5613

Typical Conditions vs Actual Conditions



Windrose Plot for [TXK] TEXARKANA RGNL/WEBB
 Obs Between: 01 Feb 1973 12:00 AM - 28 Feb 2025 11:53 PM America/Chicago
 ↳ constraints: Feb

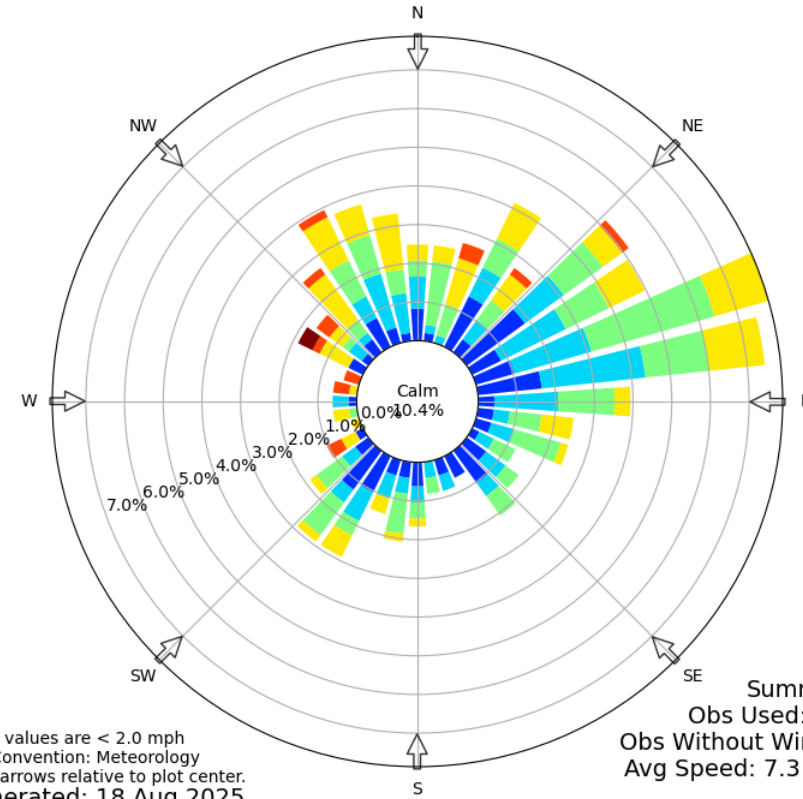


Calm values are < 2.0 mph
 Bar Convention: Meteorology
 Flow arrows relative to plot center.
 Generated: 16 Apr 2025

Summary
 Obs Used: 34211
 Obs Without Wind: 0
 Avg Speed: 8.3 mph

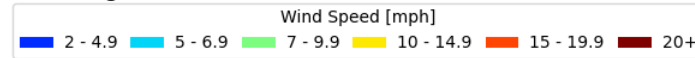


Windrose Plot for [TXK] TEXARKANA RGNL/WEBB
 Obs Between: 10 Feb 2025 12:53 AM - 02 Mar 2025 11:53 PM America/Chicago



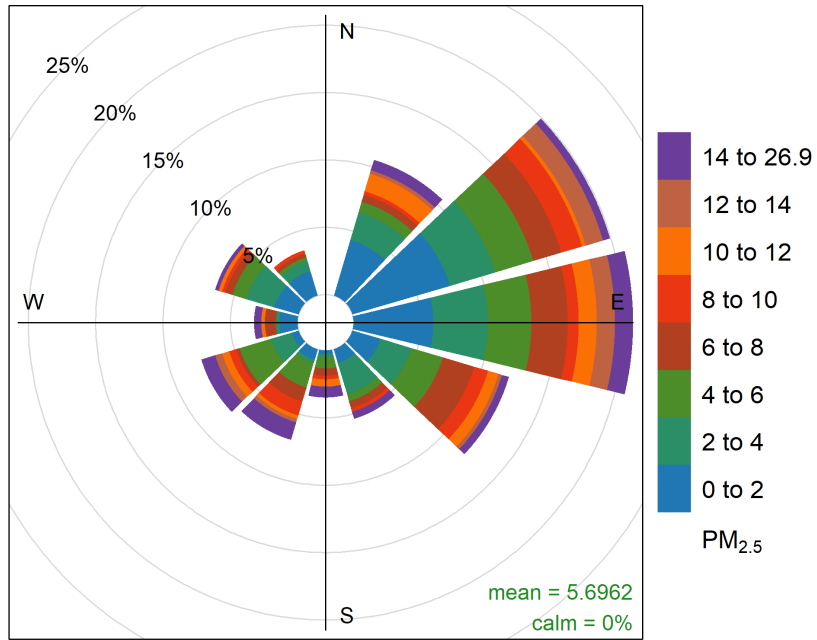
Calm values are < 2.0 mph
 Bar Convention: Meteorology
 Flow arrows relative to plot center.
 Generated: 18 Aug 2025

Summary
 Obs Used: 483
 Obs Without Wind: 0
 Avg Speed: 7.3 mph



Actual Conditions

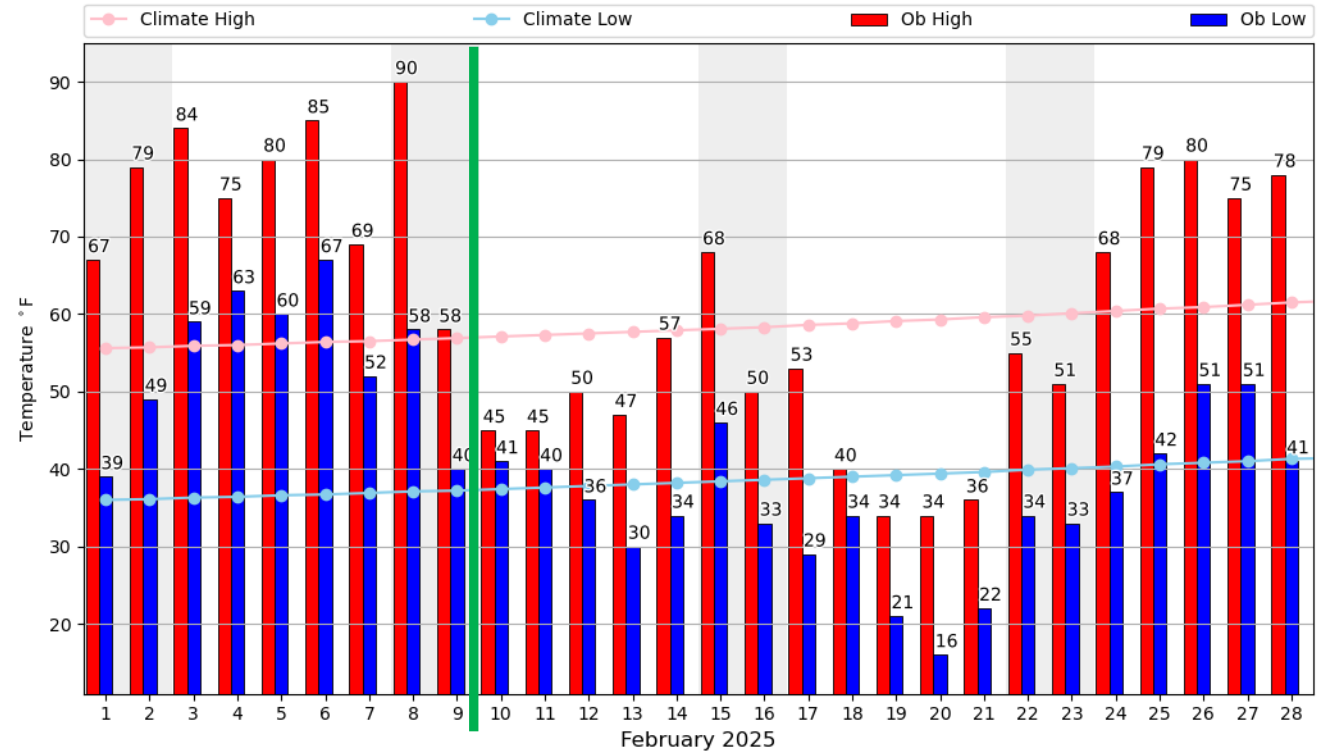
TCEQ CAMS 1031 PM2.5



Frequency of counts by wind direction (%)

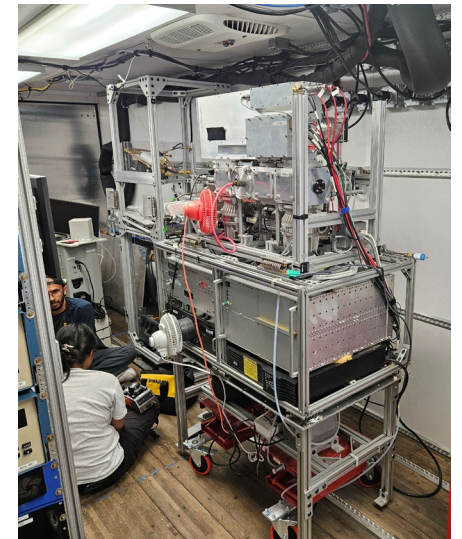


[TXK] TEXARKANA RGNL/WEBB :: High/Low Temperature for Feb 2025
NCEI 1991-2020 Climate Site: USW00013977



MAQL3 Instruments (UH)

Parameter	Instrumentation	Detection Limit (ppbv)	Uncertainty (%)
O ₃	Modified Thermo 42C	0.3	7
NO	Thermo 42C	0.6	5
NO ₂	Thermo 42C with UV photolytic NO ₂ converter	0.9	7
NO _y	Modified Thermo 42CT with heated molybdenum converter	0.3	4
SO ₂	Thermo 43i	0.6	4
CO	Los Gatos Research off-axis cavity ring down	<5	4
HCHO	Aerolaser	0.4	8
PM rate	Handix Portable Optical Particle Spectrometer (POPS).	-	-

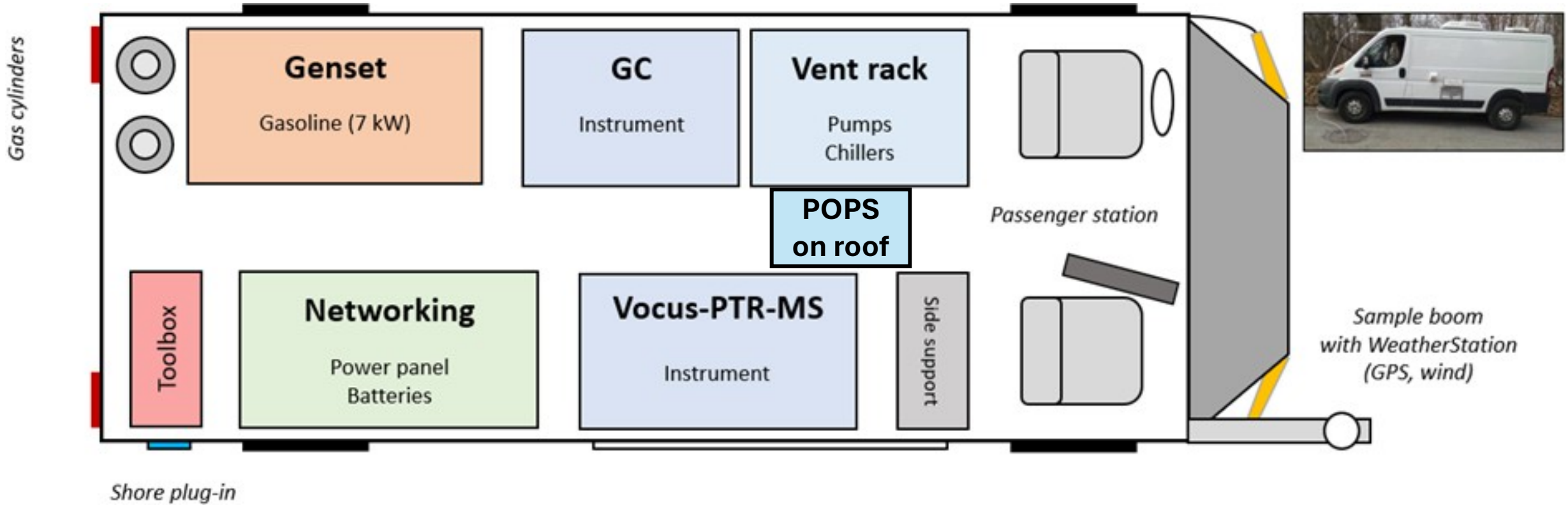


Baylor Contributions

Key Real-Time Instrumentation

- An Aerodyne High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS, V mode)
 - Sized-resolved observations of chemical composition of non-refractory submicron aerosols
 - Data Analysis – IGOR-based SQUIRREL and PIKA software
 - Data can support further PMI Analysis
- Aerosol Optical
 - Absorption – Tricolor Absorption Photometer (TAP, Brechtel)
 - Scattering – 3 wavelength Nephelometer (TSI, owned by UH)
 - Calculated Absorption Ångström Exponent and Scattering Ångström Exponent can be used to identify dust and smoke influence
- Condensation Particle Counter (CPC, TSI)

Aerodyne minAML



Instruments in the minAML

ARI Vocus PTR-TOFMS

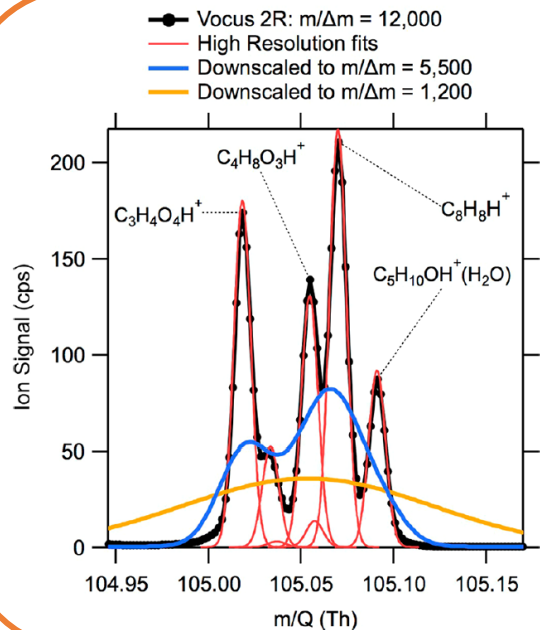
analytical chemistry

Cite This: *Anal. Chem.* 2018, 90, 12011–12018

Article
pubs.acs.org/ac

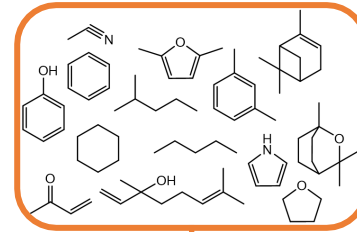
Evaluation of a New Reagent-Ion Source and Focusing Ion-Molecule Reactor for Use in Proton-Transfer-Reaction Mass Spectrometry

Jordan Krechmer,^{†,¶} Felipe Lopez-Hilfiker,^{‡,¶} Abigail Koss,^{§,||,⊥,♯} Manuel Hutterli,[‡] Carsten Stoerner,[‡] Benjamin Deming,^{§,⊥} Joel Kimmel,^{†,‡} Carsten Warneke,^{§,||} Rupert Holzinger,[†] John Jayne,[†] Douglas Worsnop,[†] Katrin Fuhrer,[‡] Marc Gonin,[‡] and Joost de Gouw^{*,§,⊥,Ⓞ}



ARI GC-Vocus PTR-TOFMS

VOCs in Ambient Air

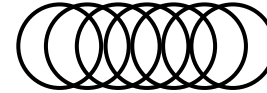


Pre-Concentration

Adsorbent Trap

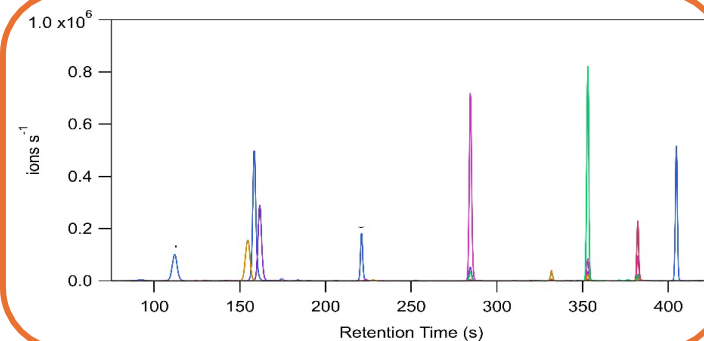
Separation

GC Column

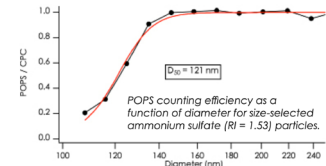
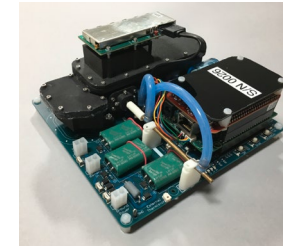


Detection

Vocus PTR-TOFMS



Handix POPS



AEROSOL SCIENCE AND TECHNOLOGY
2016, VOL. 30, NO. 1, 88–99
<http://dx.doi.org/10.1080/02786826.2015.1131809>



NEW GENERATION OF AEROSOL INSTRUMENTATION FOR DISTRIBUTED OR PERSONAL SAMPLING OPEN ACCESS

A light-weight, high-sensitivity particle spectrometer for PM2.5 aerosol measurements

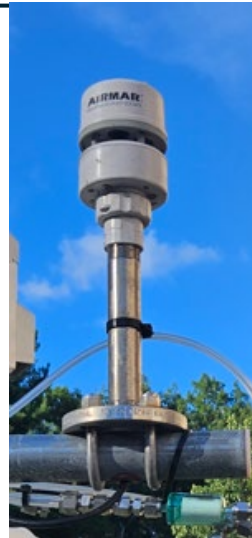
R. S. Gao[†], H. Telg[†], R. J. McLaughlin[†], S. J. Ciora[†], L. A. Watts[†], M. S. Richardson[†], J. P. Schwarz[†], A. E. Perring[†], T. D. Thornberry[†], A. W. Rollins[†], M. Z. Markovic[†], T. S. Bates[†], J. E. Johnson[†], and D. W. Fahey[†]

<https://handixscientific.com/pops/>

Met/GPS

Airmar
Anemometer

Hemisphere GPS
V103



Detection Limits and uncertainties

Ion of interest	Potential compound assignments	[ppb] Vocus PTR- TOFMS LOD	[ppb] GC PTRMS LOD	[%] GC PTRMS Uncertainty
C ₂ H ₆ OH ⁺	Ethanol	0.200	0.027	16
C ₂ H ₃ NH ⁺	Acetonitrile	0.04	0.004	13
C ₃ H ₆ OH ⁺	Acetone; propanal	0.05	0.005	10
C ₃ H ₃ NH ⁺	Acrylonitrile	0.008	<0.001	11
C ₂ H ₇ S ⁺	Dimethyl sulfide; ethyl mercaptan (<i>raw signal</i>)	-	-	-
C ₅ H ₈ H ⁺	Isoprene; <i>n</i> -aldehydes	0.02	0.003	9
C ₄ H ₆ OH ⁺	Methacrolein; <i>methyl vinyl ketone</i>	0.03	0.001	10
C ₄ H ₈ OH ⁺	Methyl ethyl ketone	0.15	<0.001	11
C ₆ H ₆ H ⁺	Benzene	0.03	0.002	9
C ₇ H ₈ H ⁺	Toluene (<i>raw signal</i>)	-	-	-
C ₈ H ₁₀ H ⁺	C8-aromatic species (e.g. o-Xylene)	0.014	<0.001	11
C ₁₀ H ₁₆ H ⁺	Monoterpenes (e.g. α-Pinene)	0.009	<0.001	11
C ₉ H ₁₂ H ⁺	C9-aromatic species (e.g. 1,2,4-TMB)	0.024	<0.001	15
[(CH ₃) ₂ SiO] ₄ H ⁺	D4-Siloxane	0.006	0.001	11
[(CH ₃) ₂ SiO] ₅ H ⁺	D5-Siloxane	0.005	<0.001	33

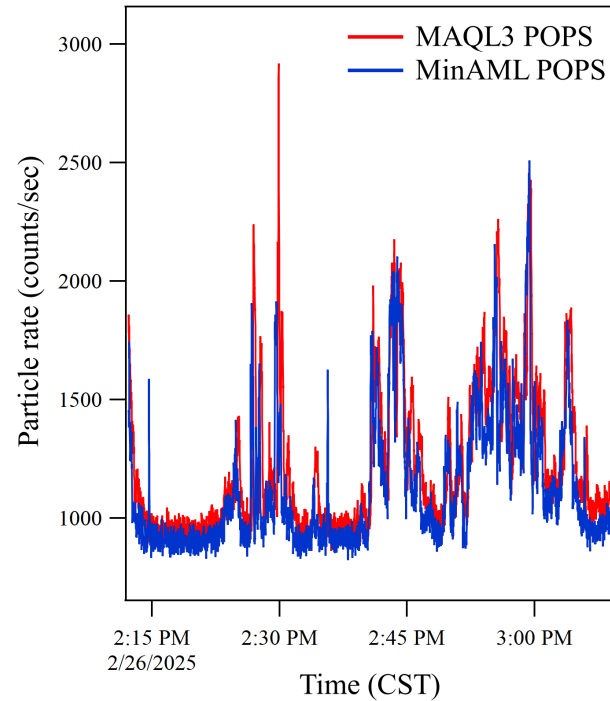
Italicized compounds were not reported by GC-PTR-TOFMS

Portable Optical Particle Spectrometers (POPS)

minAML



Sample of the Feb 26
Intercomparison at the RV Park



MAQL3



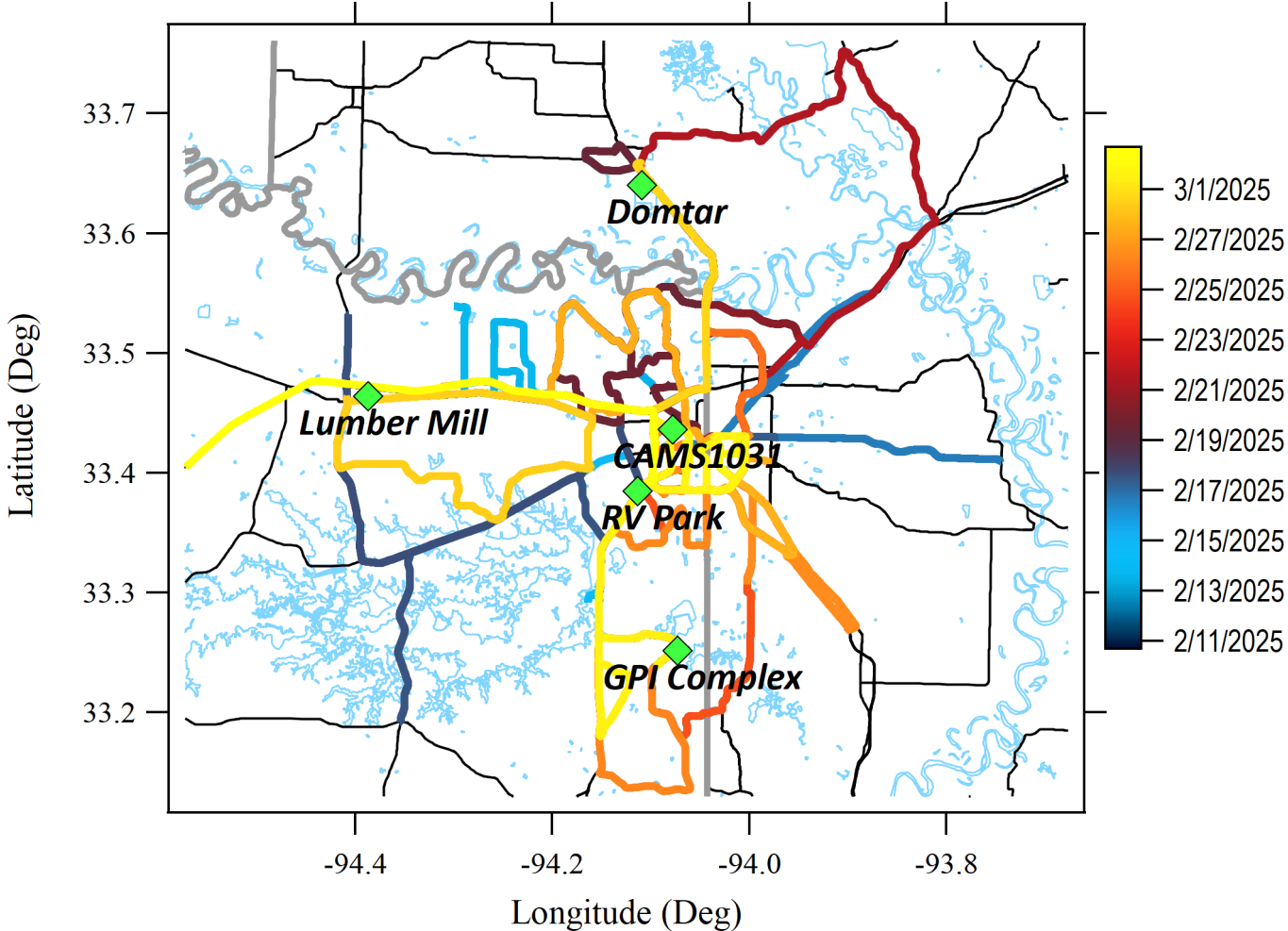
POPS were used to help each mobile lab identify PM plumes and provide an intercomparison

Sampling Strategy

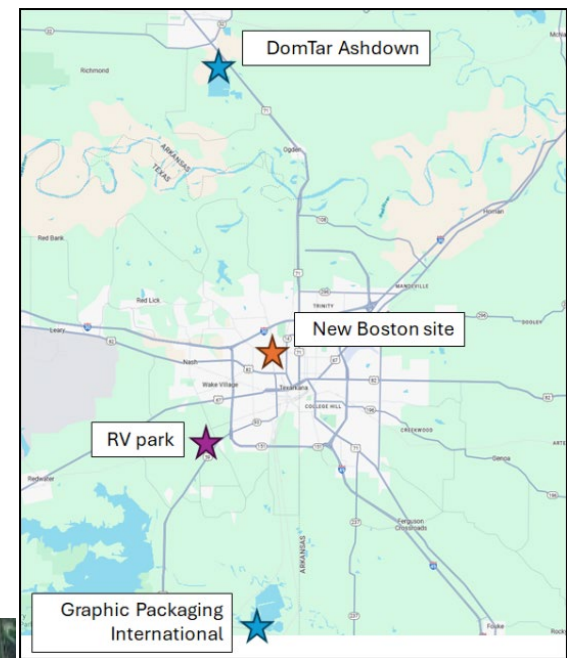
minAML leading MAQL3



Sampling Routes
Mobile Air Quality Lab - 3 (MAQL3)
2025 AQRP Texarkana Field Campaign



Graphics Packaging International GPI Paperboard and Pulp Mill



COMPANY	SITE	COUNTY	EGIC	NEAR CITY	LATITUDE	LONGITUD	SIC DESCRIPTION	REP YEAR	NOX TPY	PM2.5 TPY	SO2 TPY	VOC TPY
GRAPHIC PACKAGING INTERNATIONAL LLC	TEXARKANA MILL	CASS	5	QUEEN CITY	33.25722	-94.0697	PAPER MILLS	2023	1645.8363	408.0777	293.9049	1333.512
WEST FRASER US EWP LLC	JEFFERSON OSB	MARION	5	JEFFERSON	32.77583	-94.3681	RECONSTITUTED WOOD PRODUCTS	2023	129.7961	81.6443	14.5289	258.475
LUMINANT GENERATION COMPANY LLC	PLANT	LAMAR	5	PARIS	33.6318	-95.5902	ELECTRIC SERVICES	2023	613.5615	78.6147	12.1436	10.2425
SOUTHWESTERN ELECTRIC POWER COMPANY	PLANT	MARION	5	AVINGER	32.84861	-94.5469	ELECTRIC SERVICES	2023	932.24	46.07	3.7509	33.933



Note: There is a small chemical company, Affinity Chemical, that is also located in this area but is not listed as a major PM2.5 source.

Graphic Packing International Complex Pulp and Paper Plant

Integrated Bleached Kraft Paperboard Production

- Texarkana Mill manufactures solid bleached sulfate (SBS) using kraft pulping and bleaching processes, with associated LVHC/HVLC non-condensable gas handling systems.

Major Air Emission Sources & Controls

- Air-relevant operations include two recovery boilers (RB01/RB02, controlled with electrostatic precipitators), two lime kilns (LK01/LK02, controlled with wet scrubbers), and smelt dissolving tanks with scrubbers.

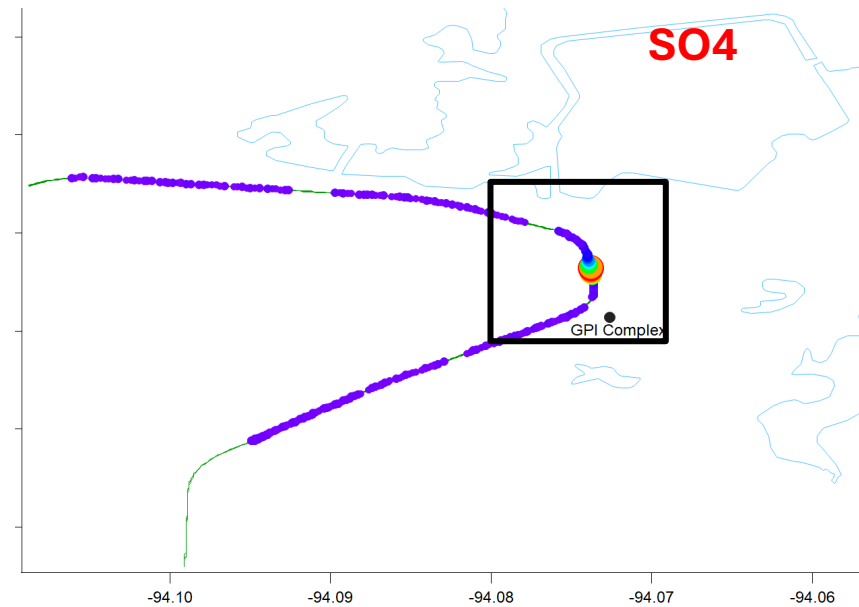
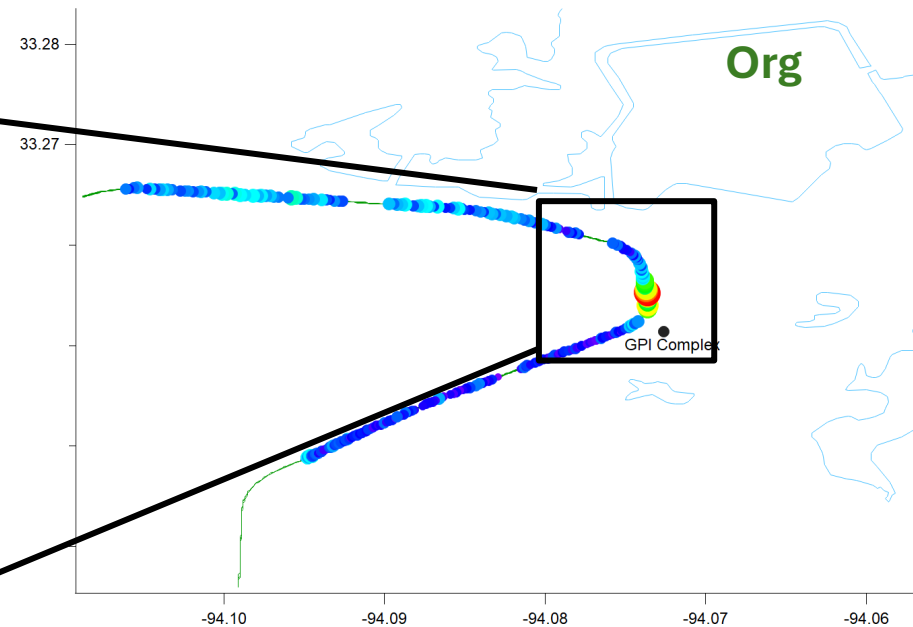
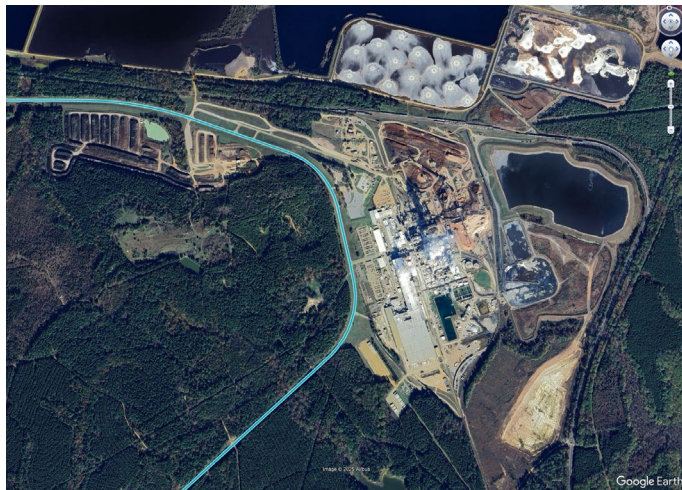
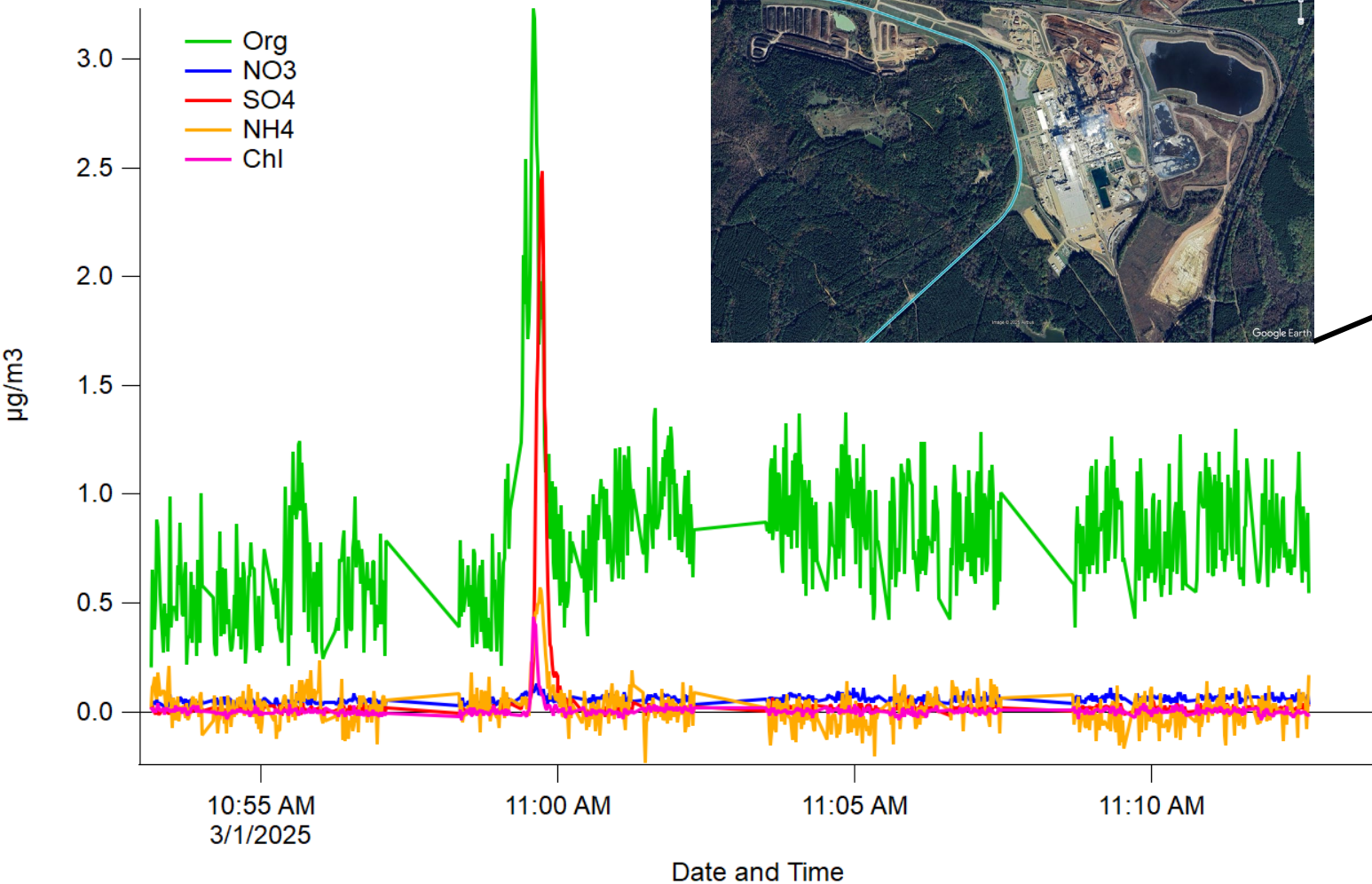
Environmental Systems Context

- Facility integrates chemical recovery, bleaching, and wastewater treatment systems consistent with the bleached kraft sector, with potential emissions of particulate matter, sulfur, and volatile organic compound emissions.



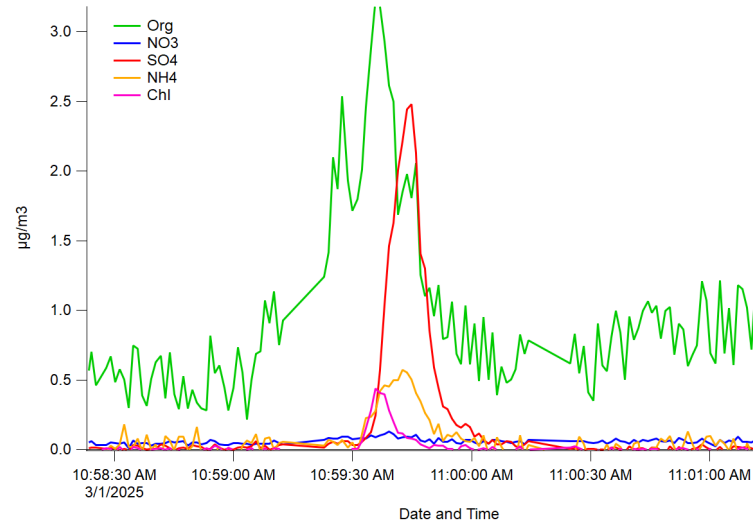
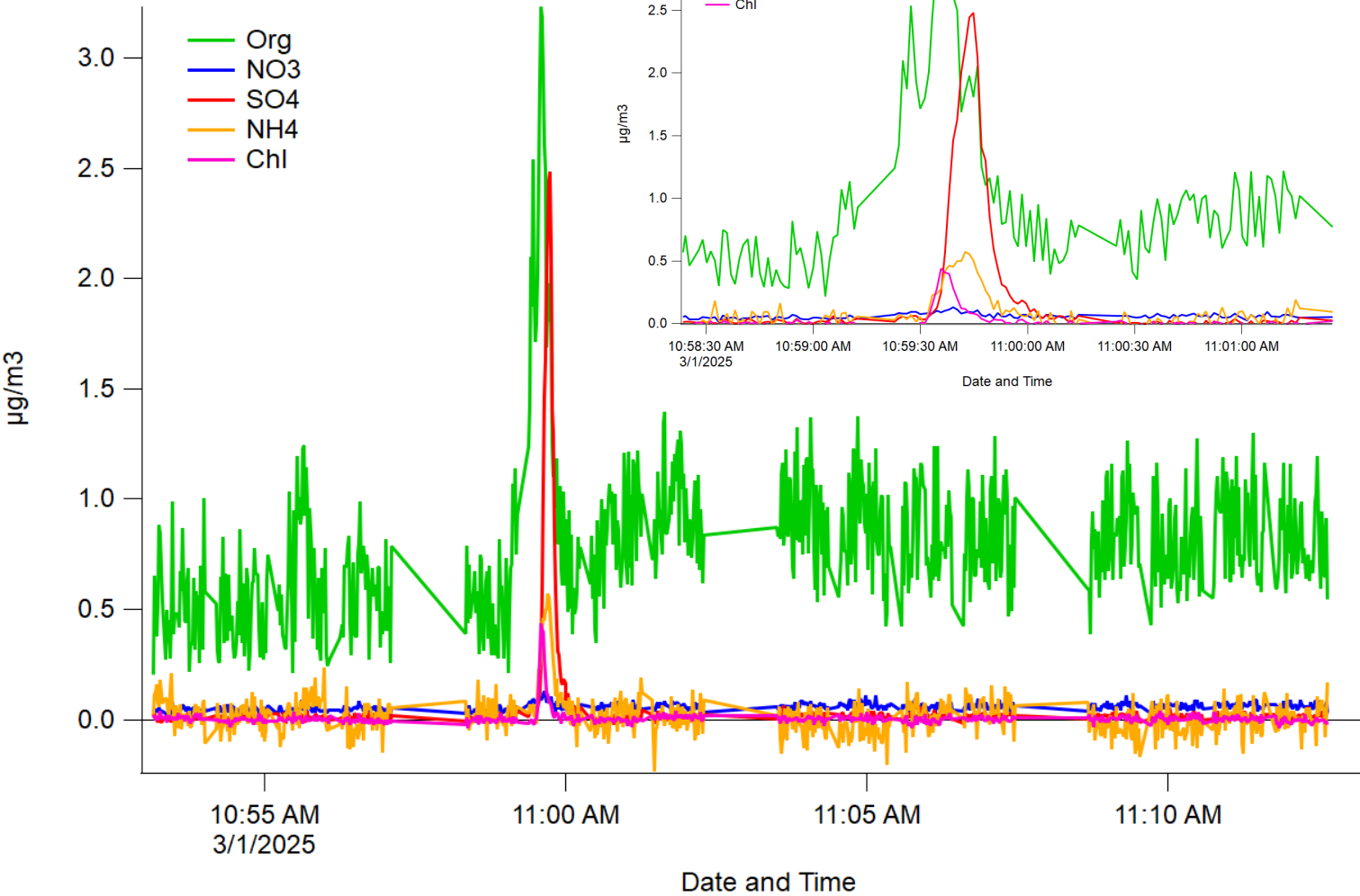
Transect near GPI

March 1st

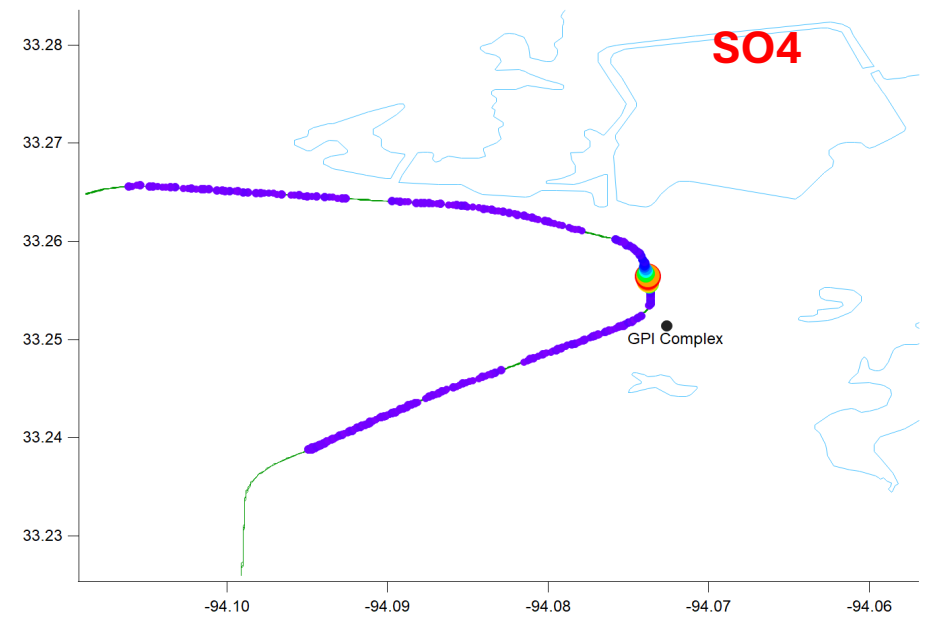
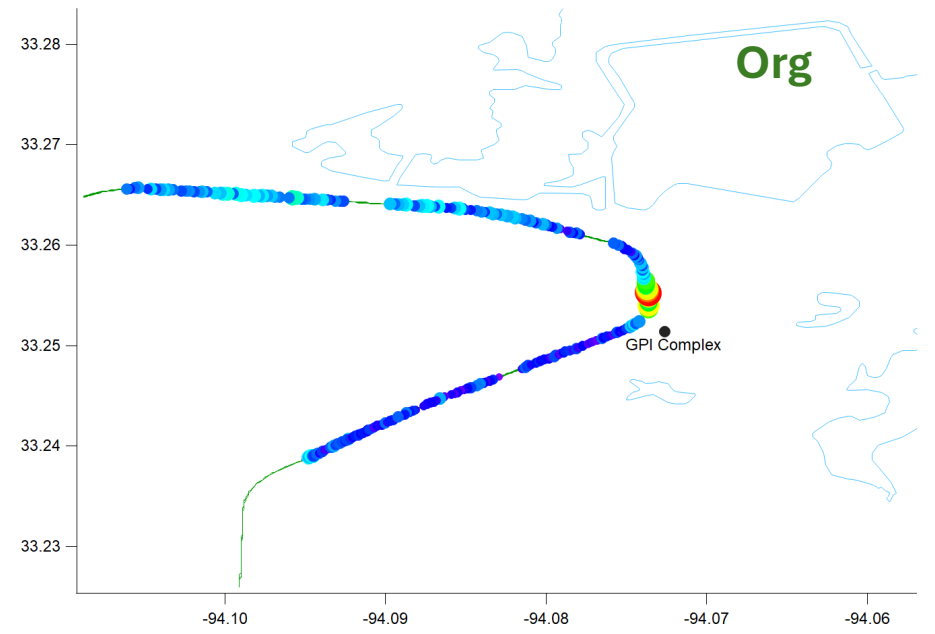


Transect near GPI

March 1st

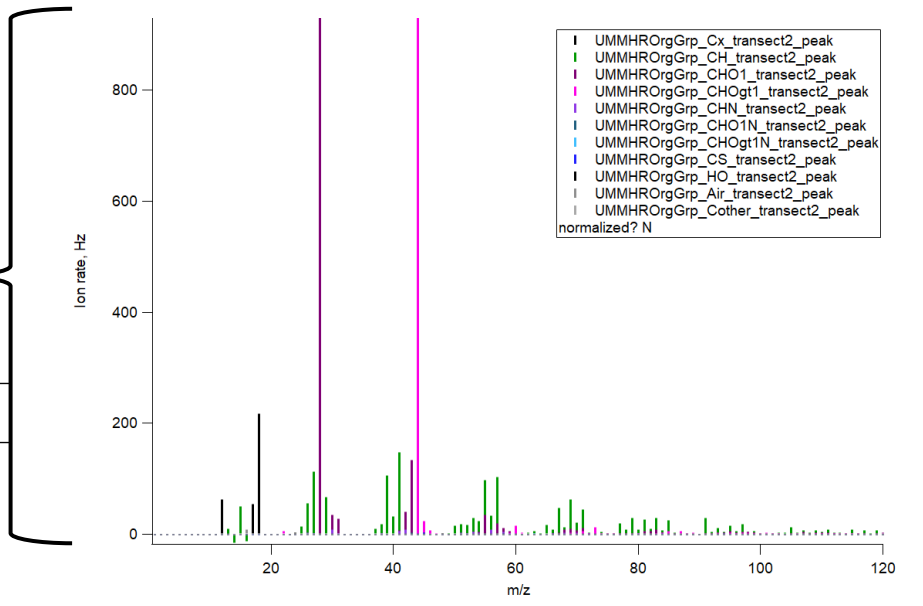
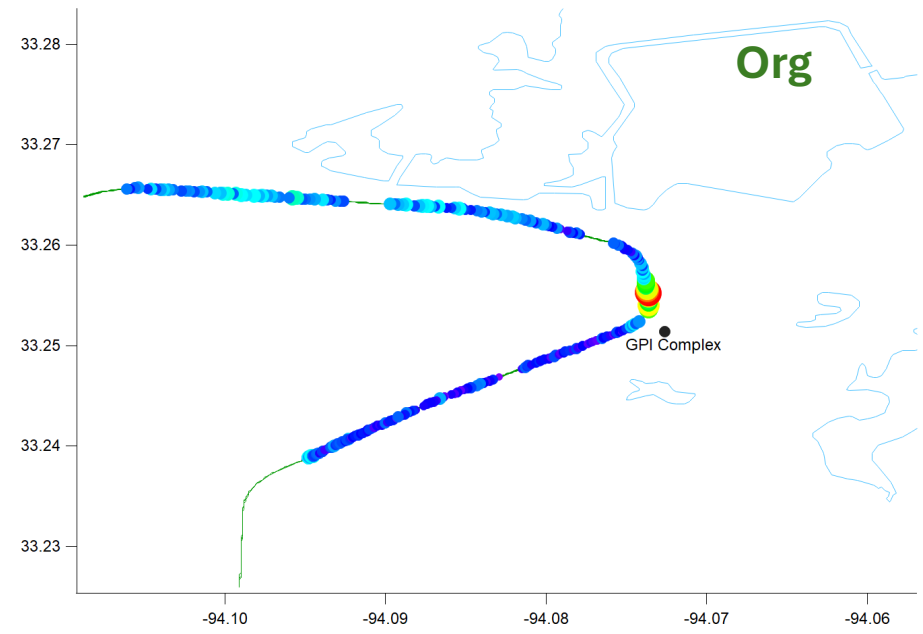
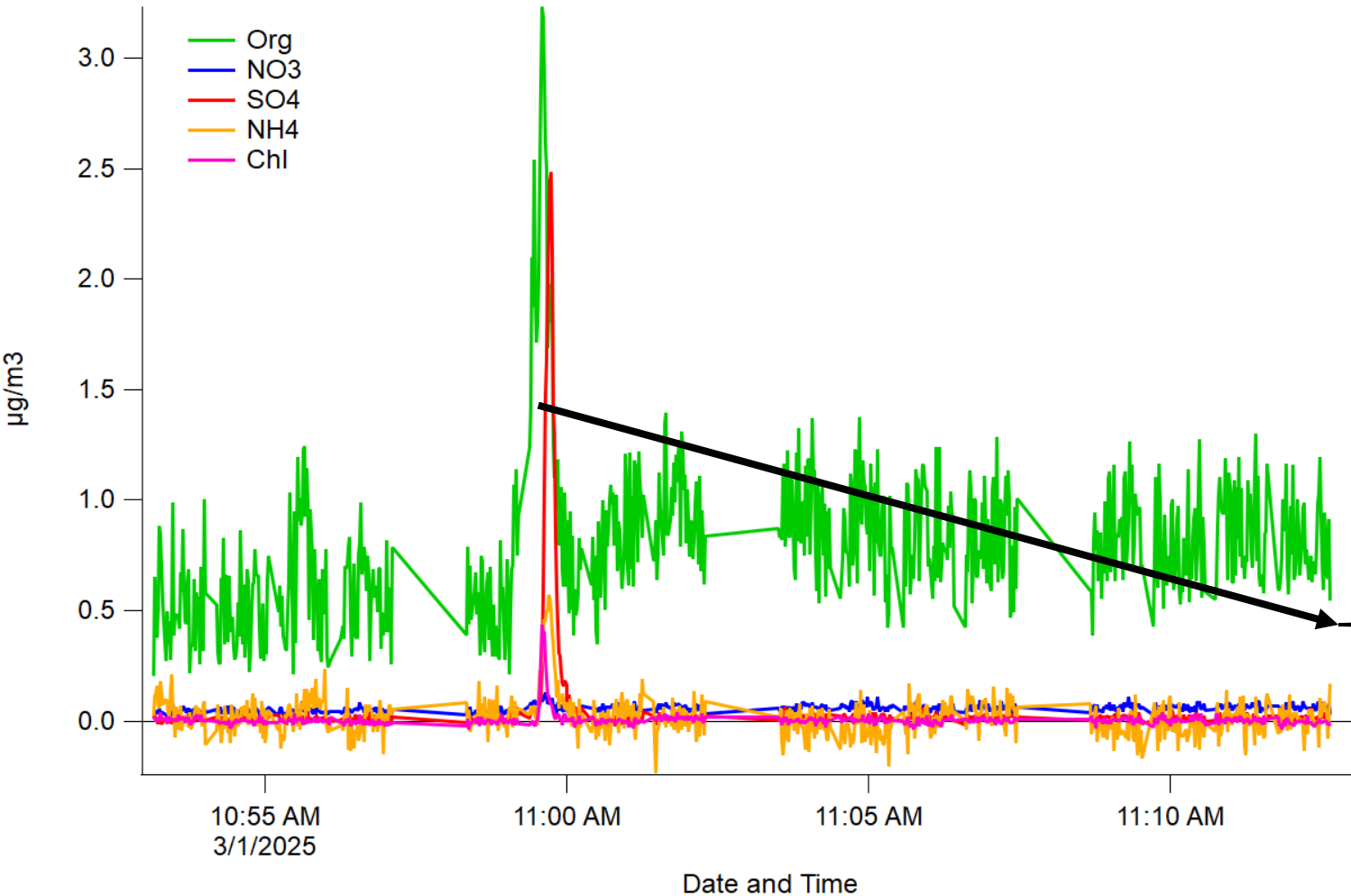


HR-ToF-AMS



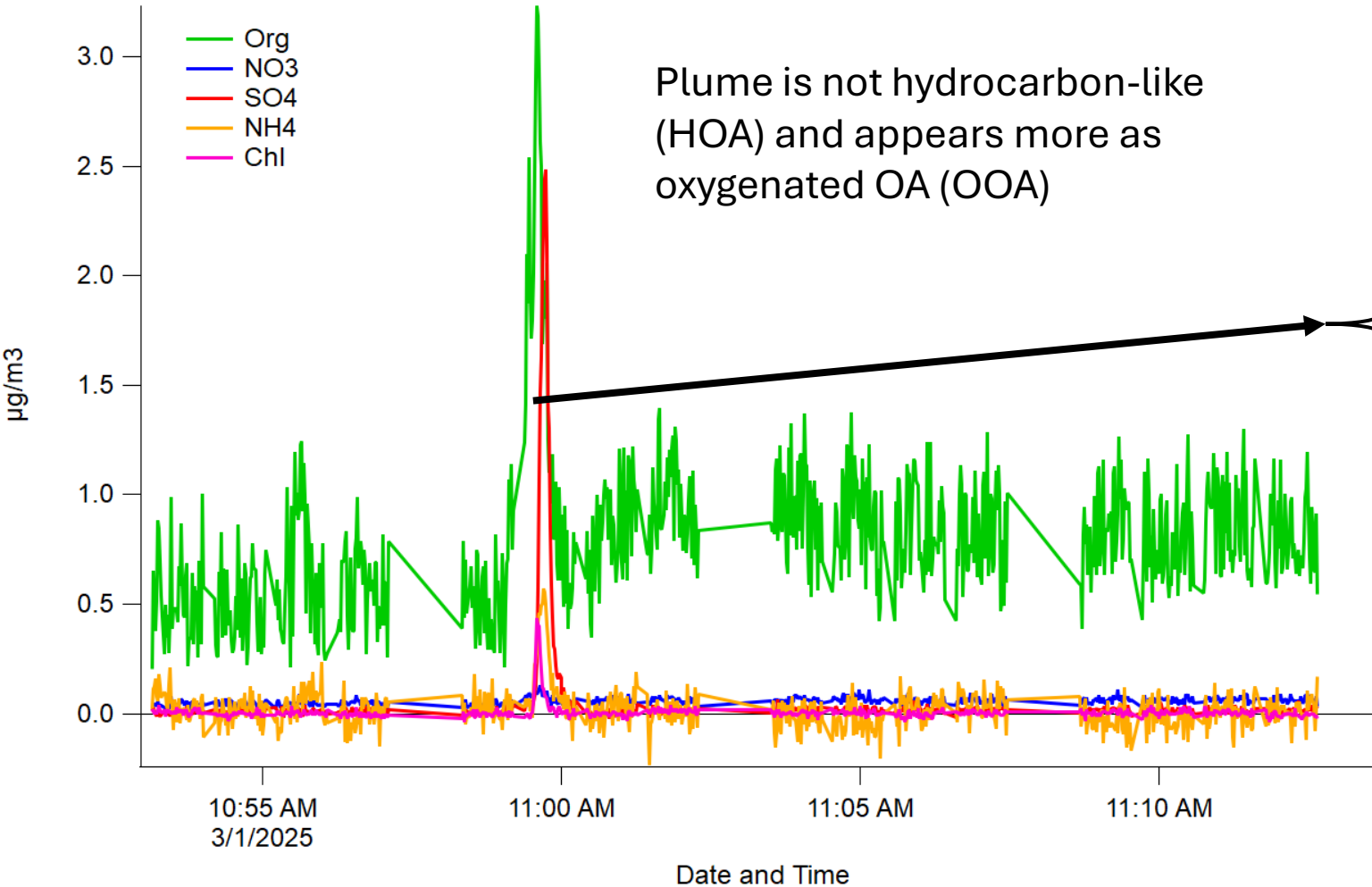
Transect near GPI

March 1st

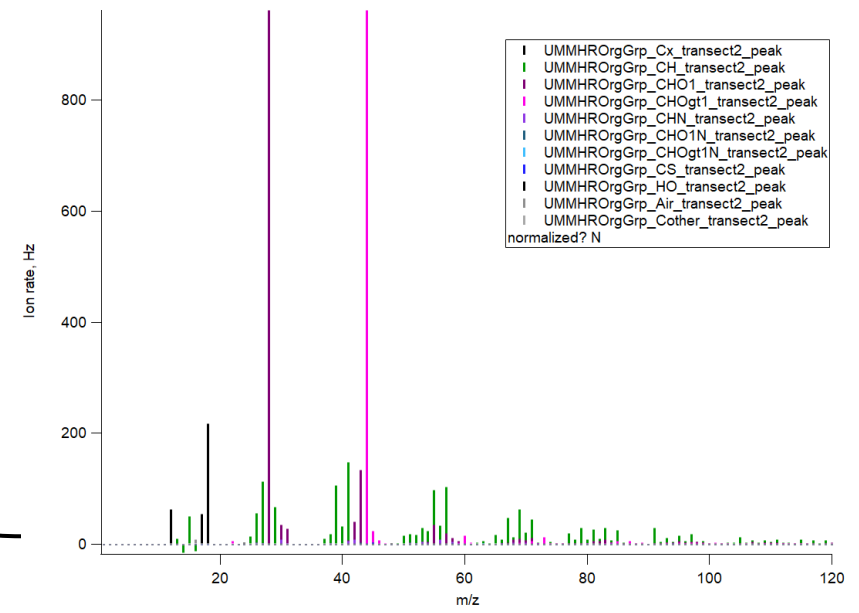
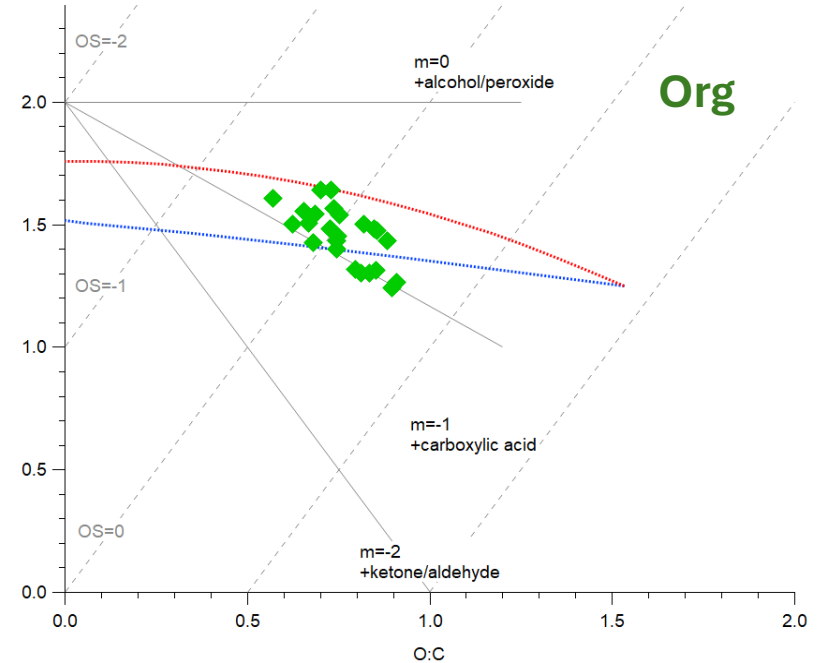


Transect near GPI

March 1st

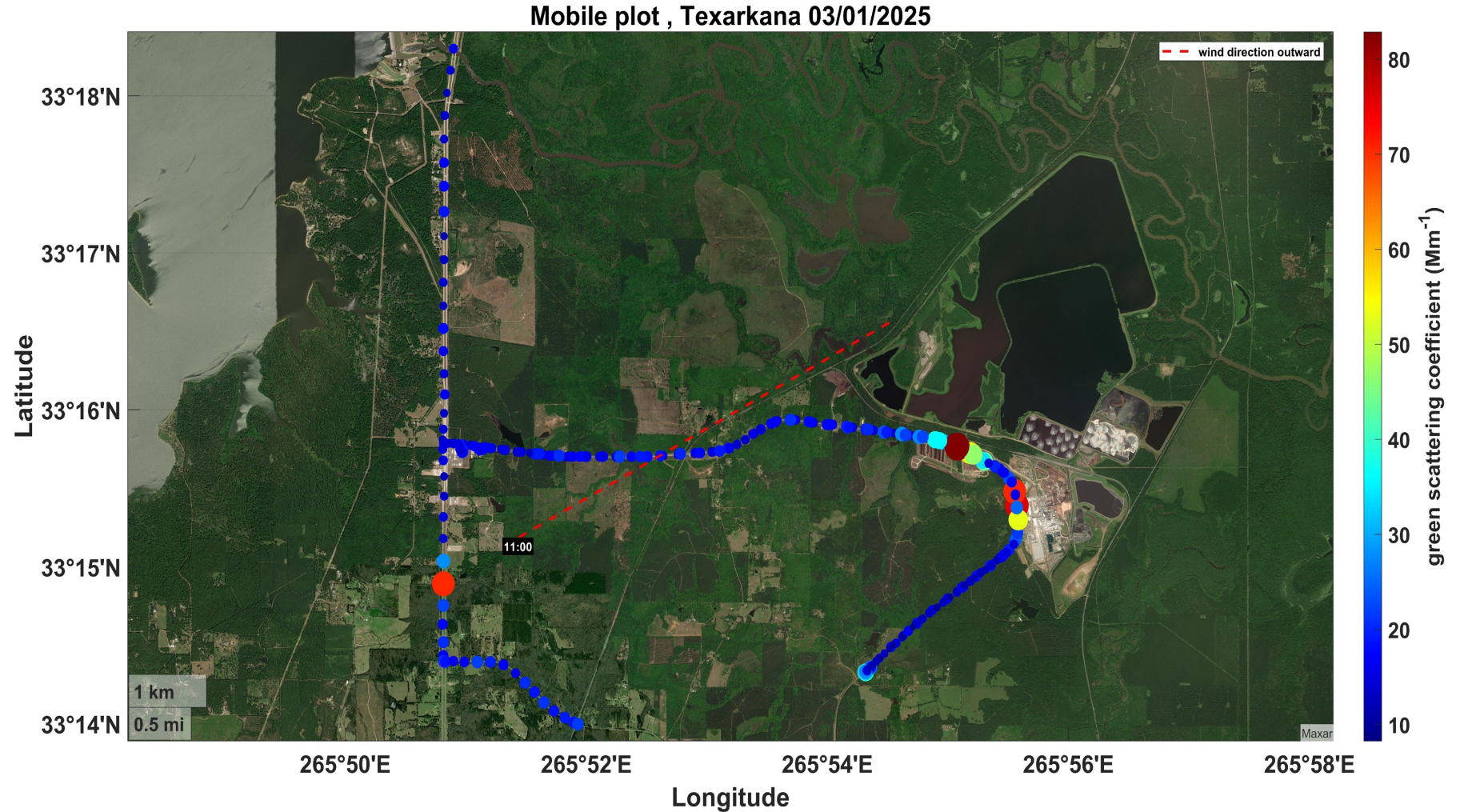


Van Krevelen diagram

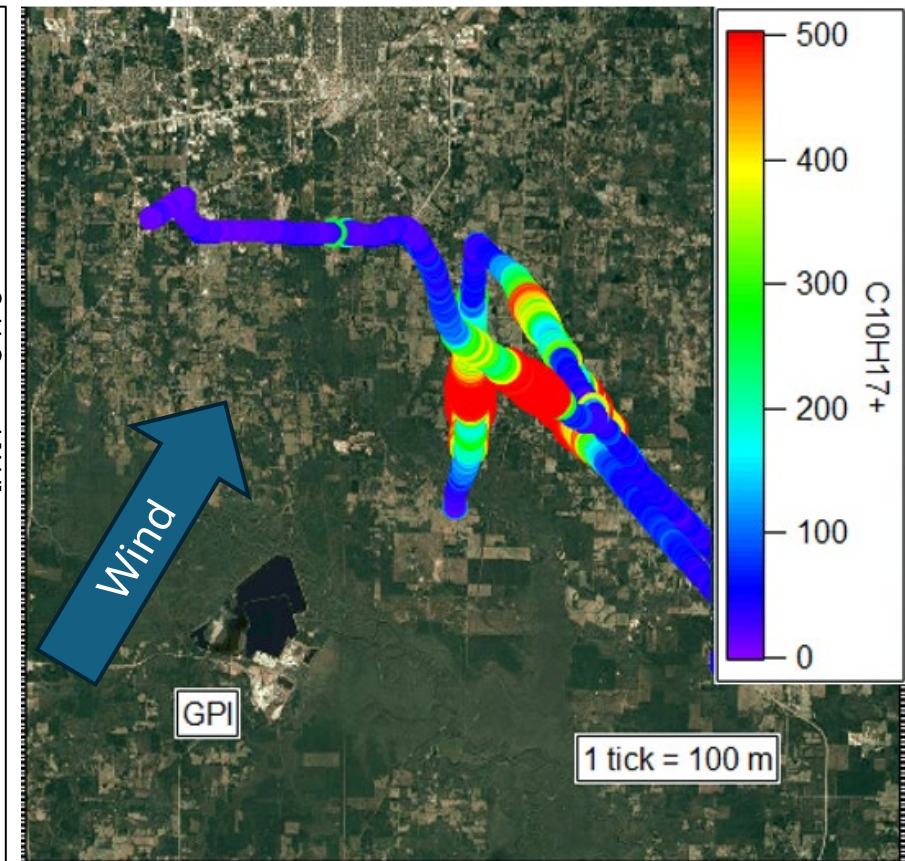
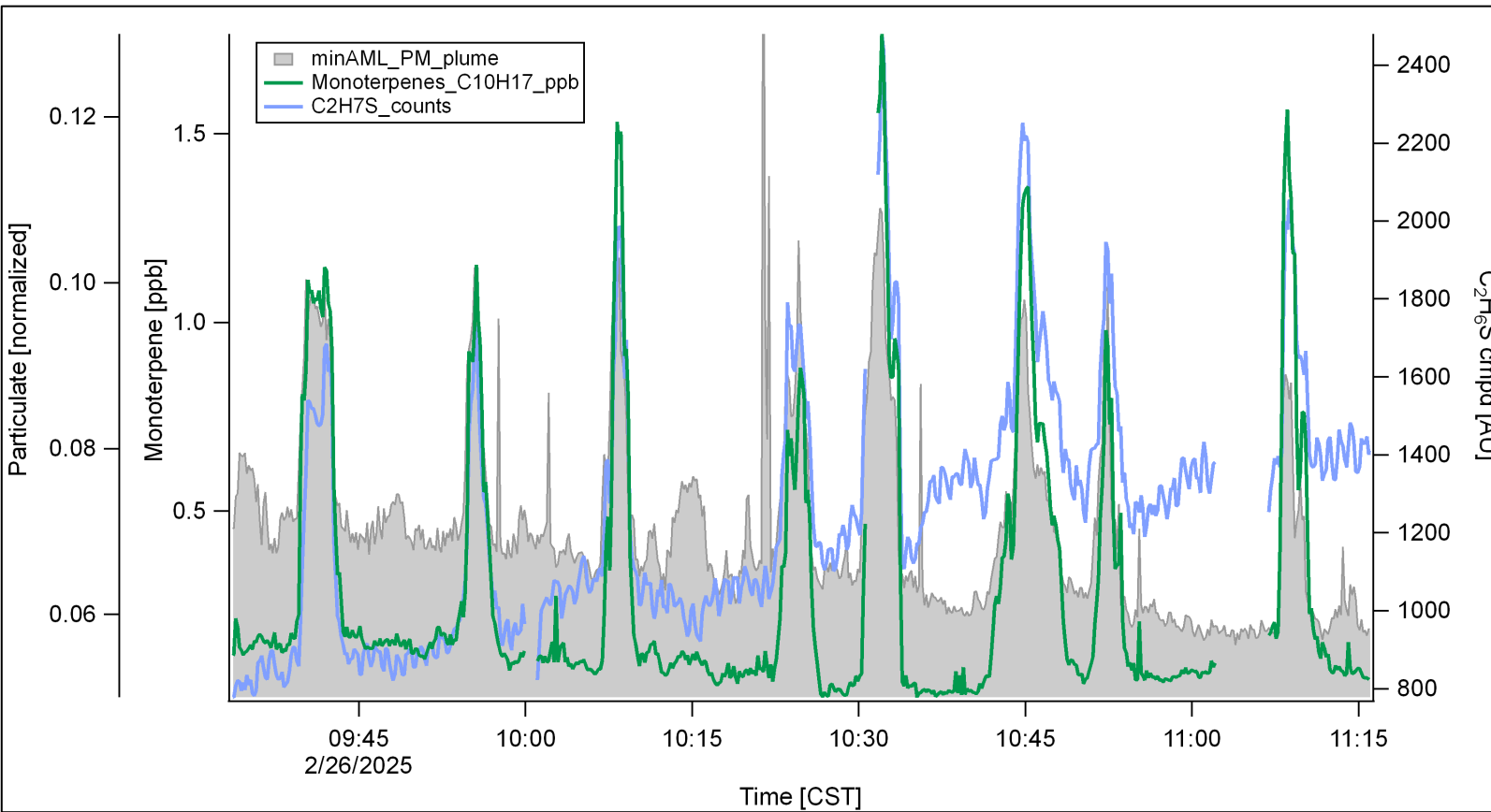


Transect near GPI – Nephelometer Scattering

March 1st



GPI plume crossings approx. 7 miles downwind minAML Key measurements



Avg. Winds
SSW
4 mi/hr

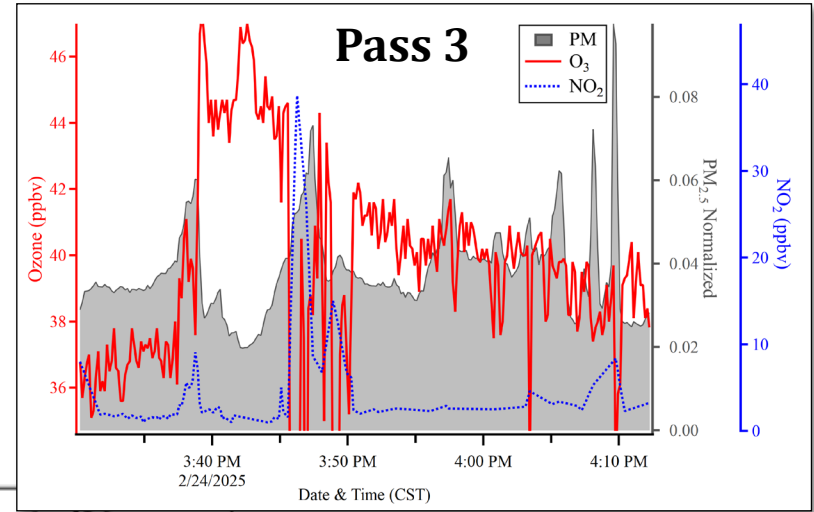
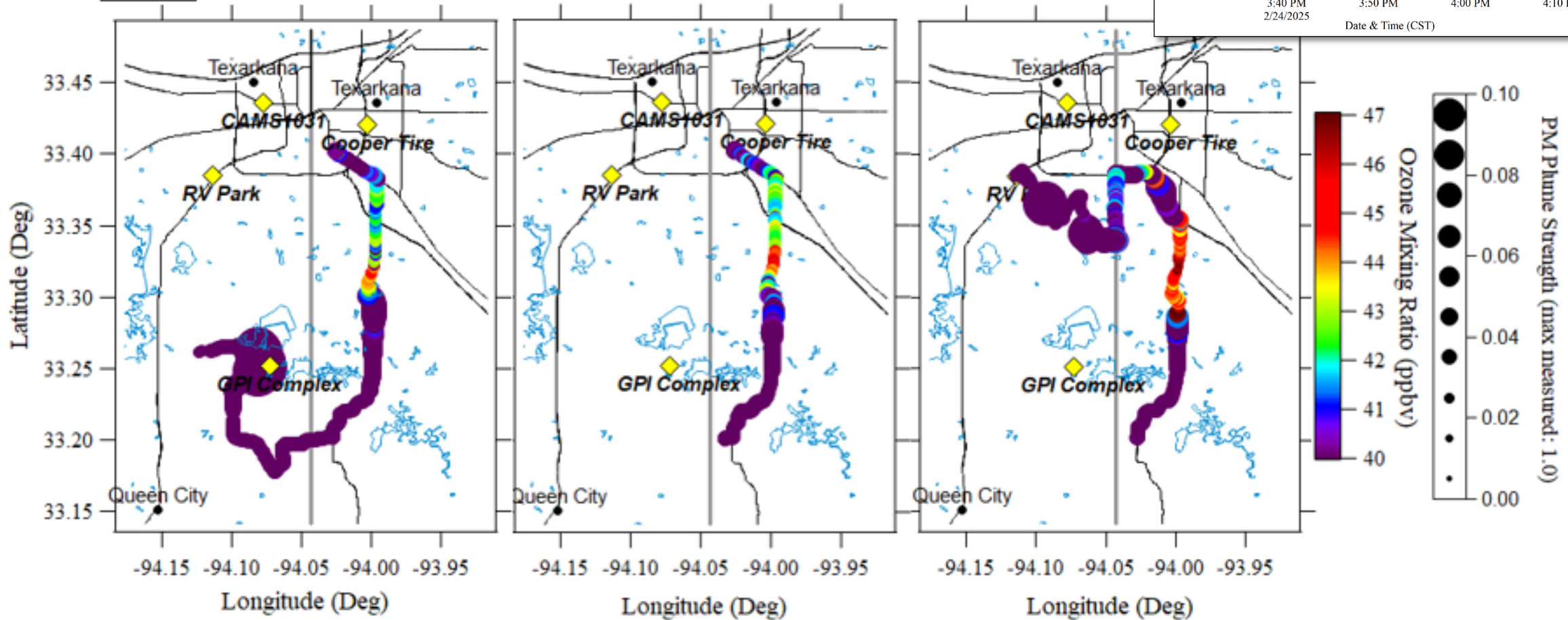
MAQL3 Ozone Enhancement Downwind of the GPI Complex

February 24th, 2025

Pass 1

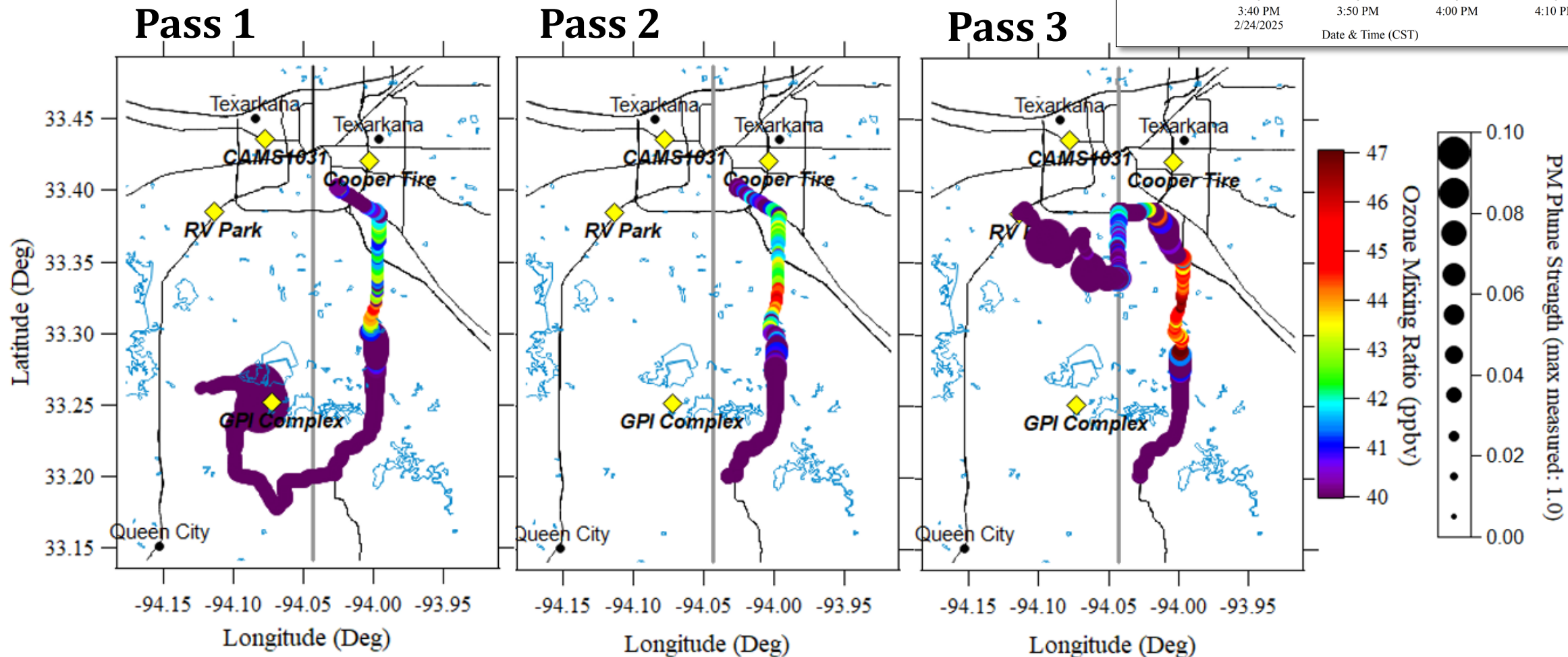
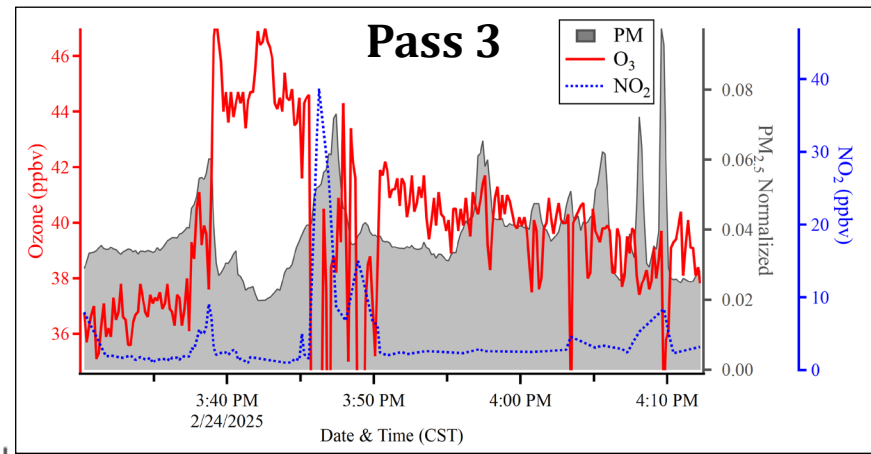
Pass 2

Pass 3



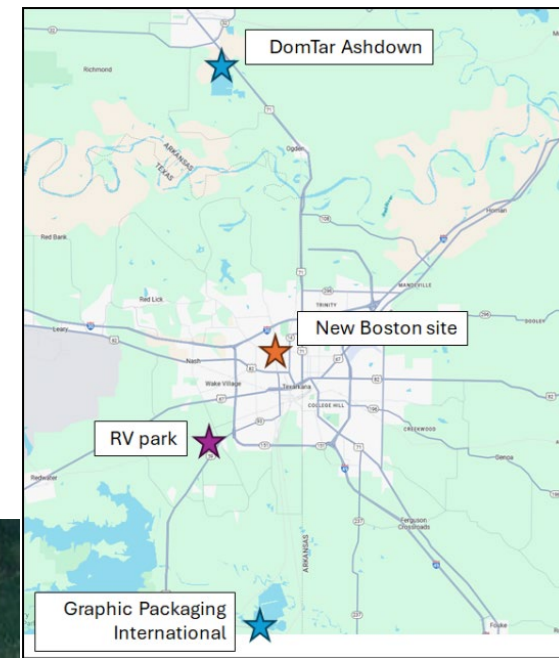
Avg.
Winds
SSW
4 mi/hr

MAQL3 Ozone Enhancement Downwind of the GPI Complex February 24th, 2025



Domtar Paper Mill Ashdown AR

Fluff pulp producer 775,000 dry metric tons annual pulp production capacity*



*<https://www.domtar.com/wp-content/uploads/2025/06/Domtar-Ashdown-Fact-Sheet.pdf>

Domtar Ashdown Mill- Pulp and Paper Plant

Large-Scale Integrated Kraft Mill

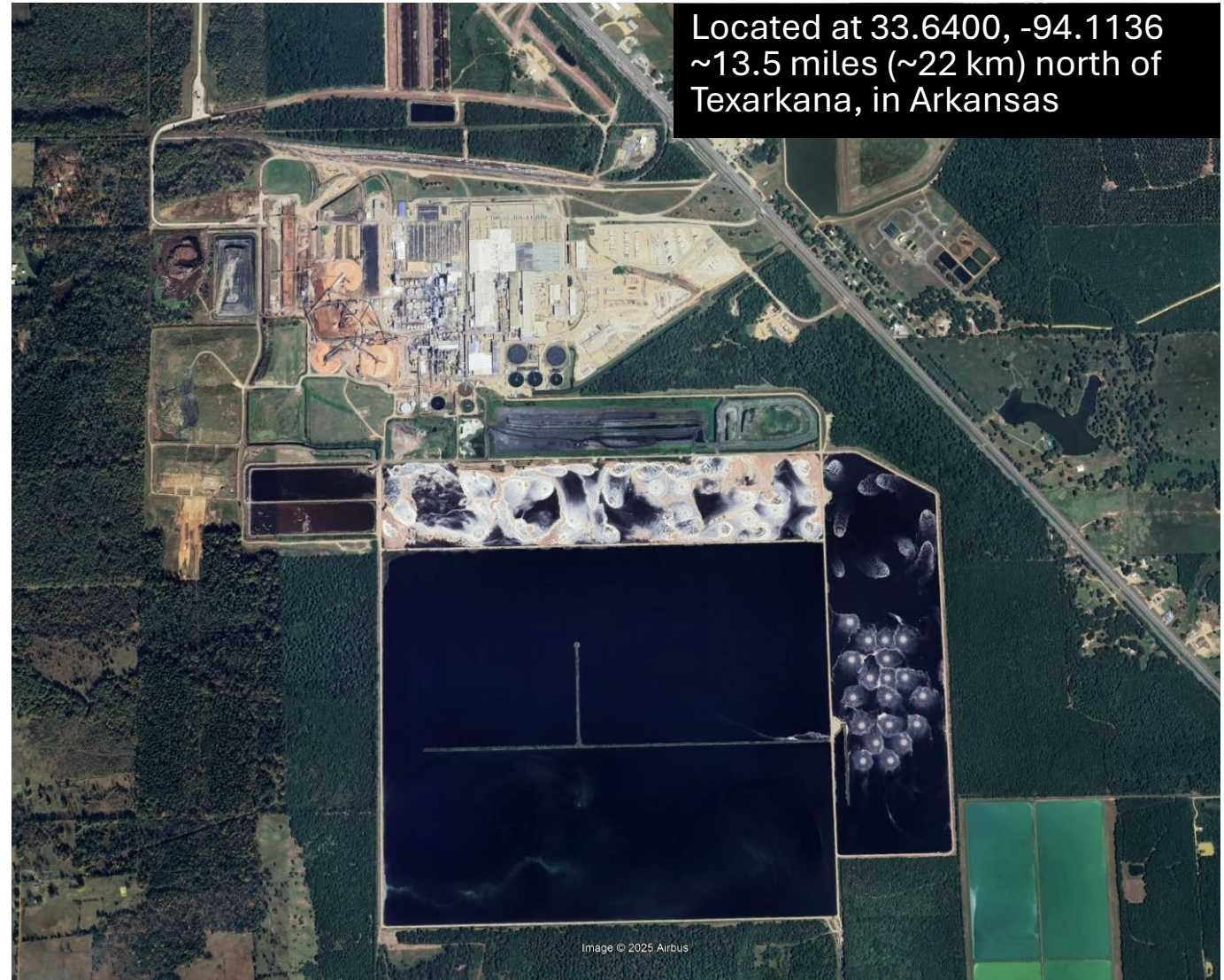
- Produces both market pulp and paper, operating kraft pulping, bleaching, chemical recovery, and power systems typical of a major integrated mill.

Key Emission Sources & Controls

- Air-relevant operations include recovery boilers with electrostatic precipitators, lime kilns with scrubbers, and smelt dissolving tanks with wet scrubbers—paralleling best available control technologies in the bleached kraft sector.

Regional Air Quality Significance

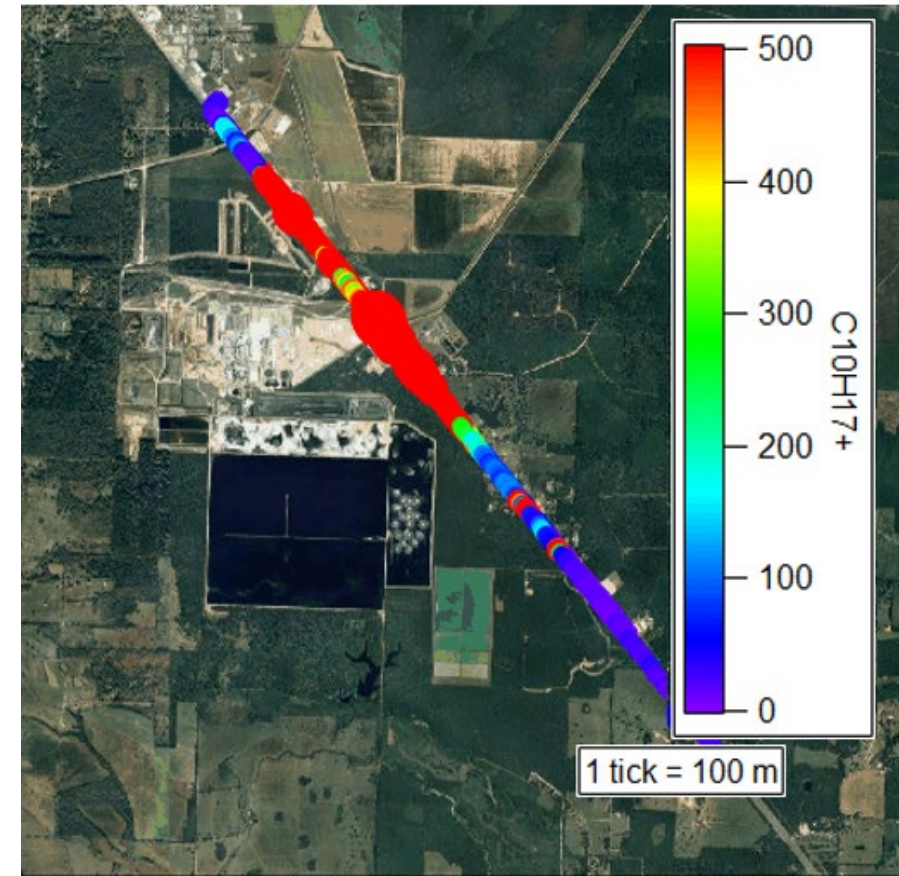
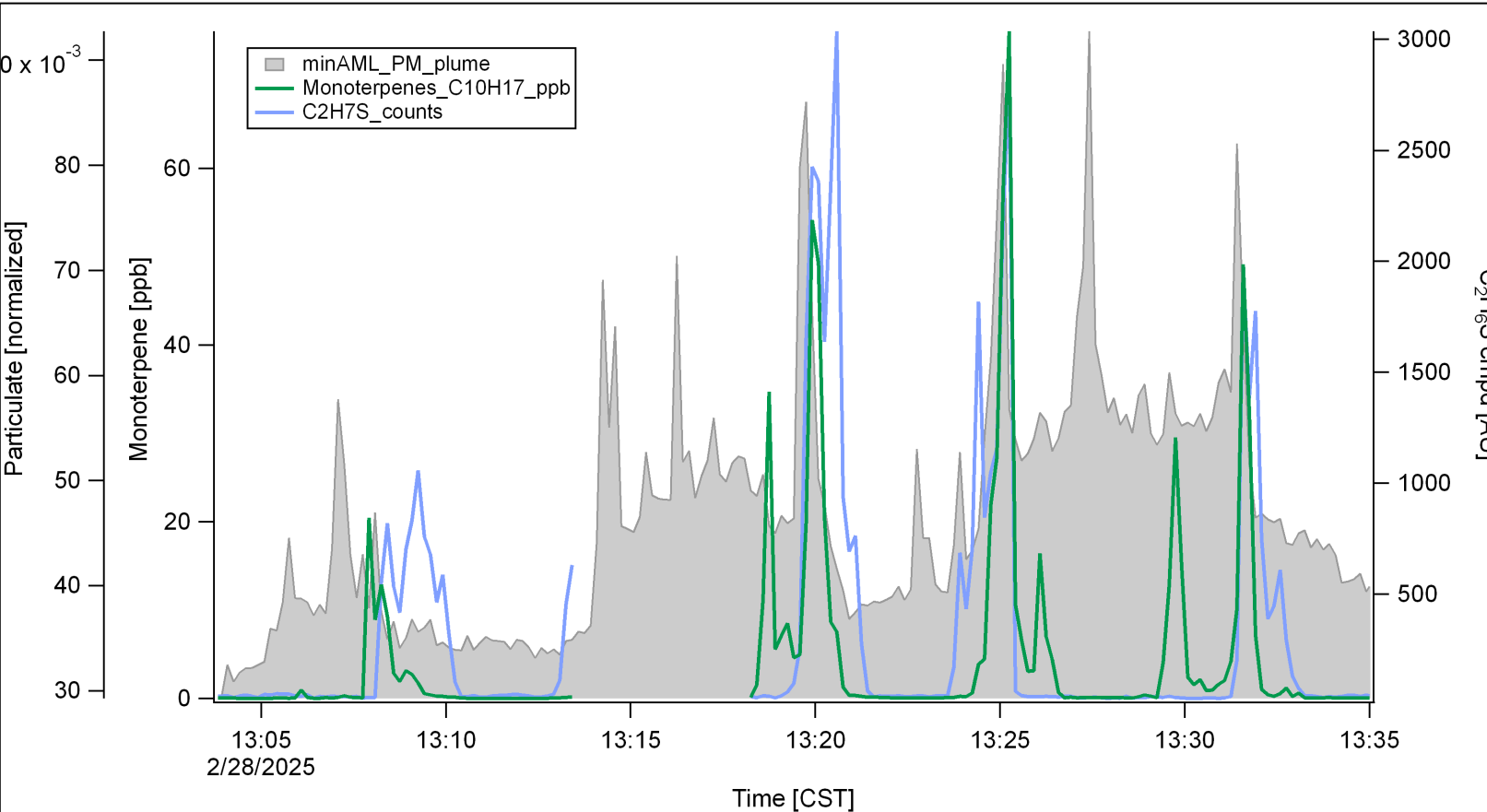
- One of the largest industrial sources in southwest Arkansas, the mill is a notable contributor to criteria pollutant (e.g., SO₂, NO_x, PM) and VOC emissions.



<https://www.domtar.com/our-location/ashdown-mill/>
Arkansas Department of Energy and Environment, 2022

Close Pass of Domtar Facility minAML Key Measurements

Driving SE Driving NW Driving SE



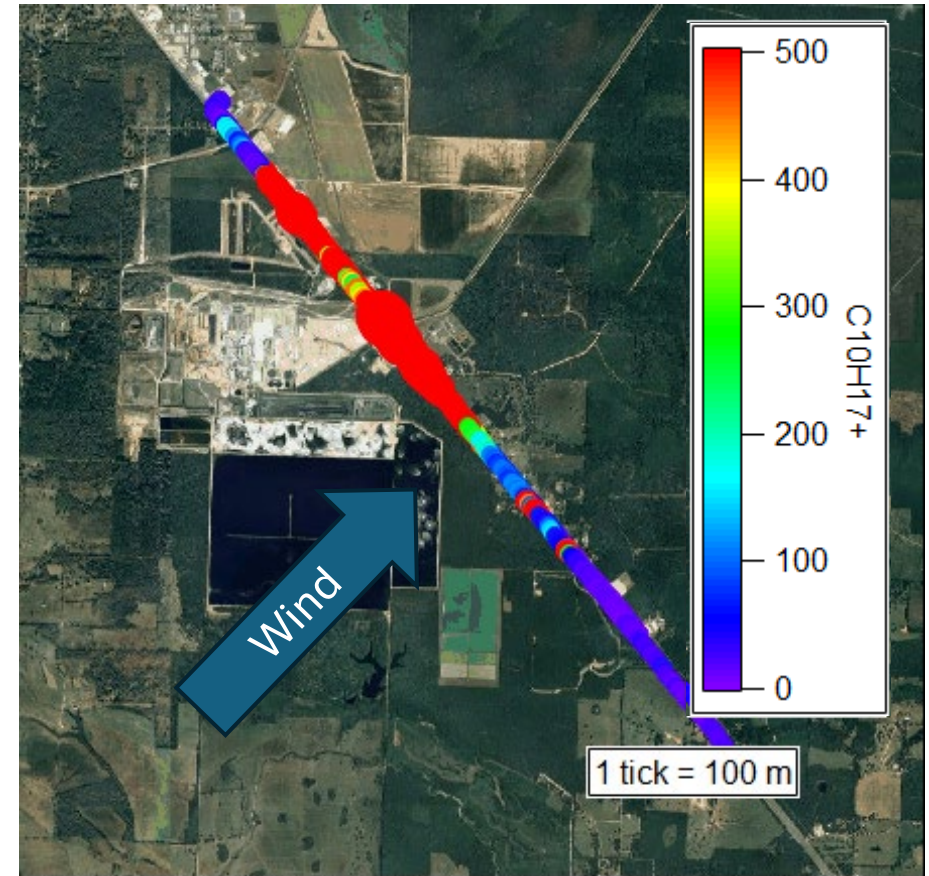
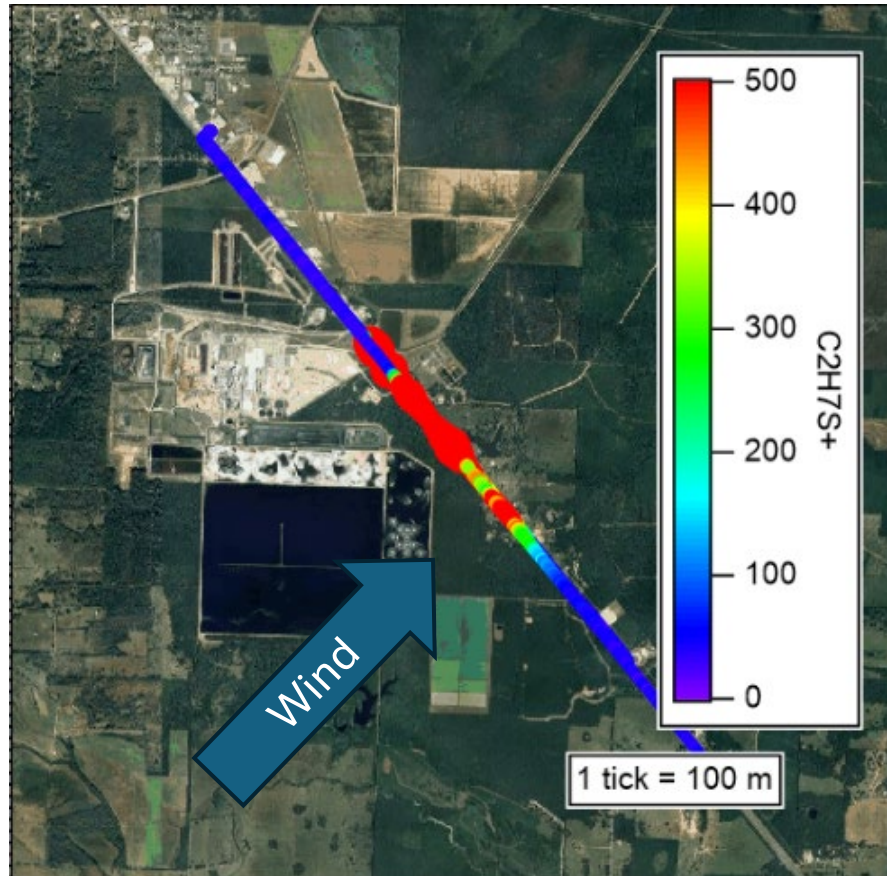
DomTar close passes – note bifurcation of sulfur emissions, MTs and primary PM track well.

Domtar Plume Location Differences (VOC's)

minAML

Sulfur Containing Ion

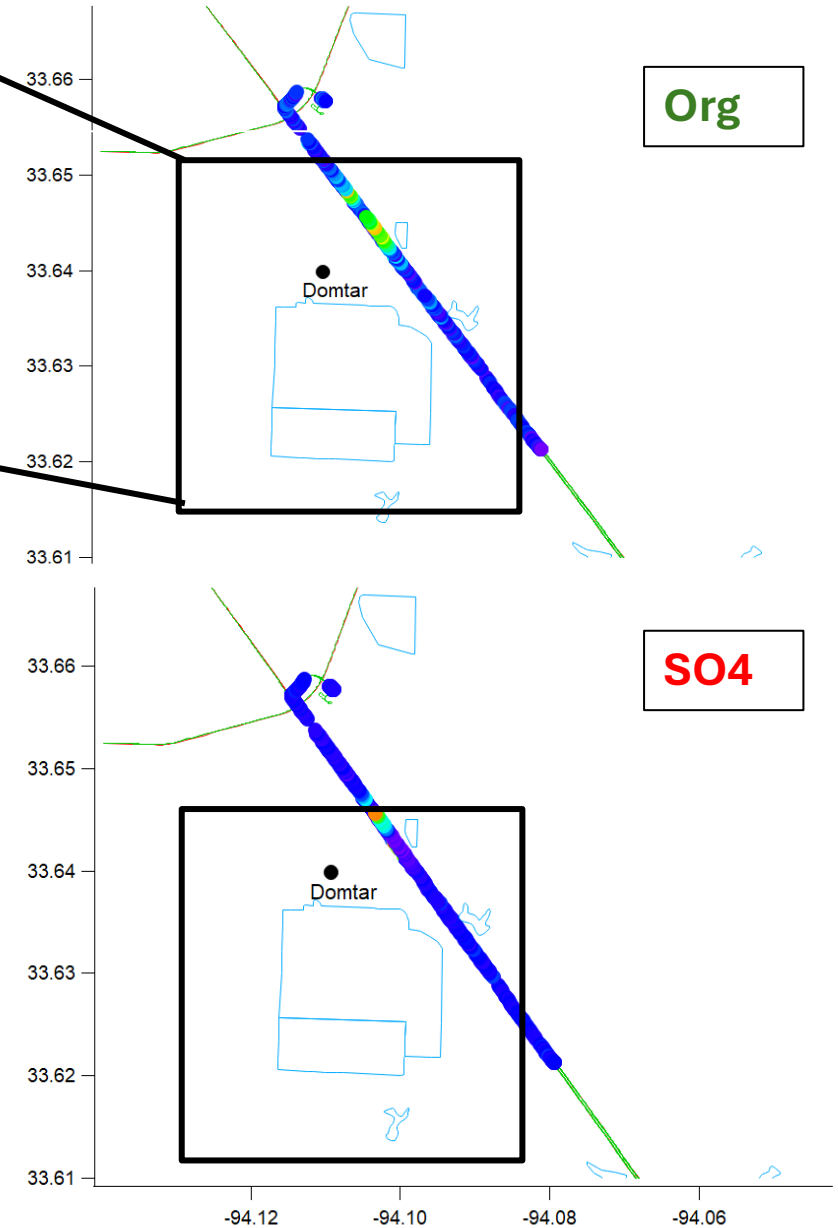
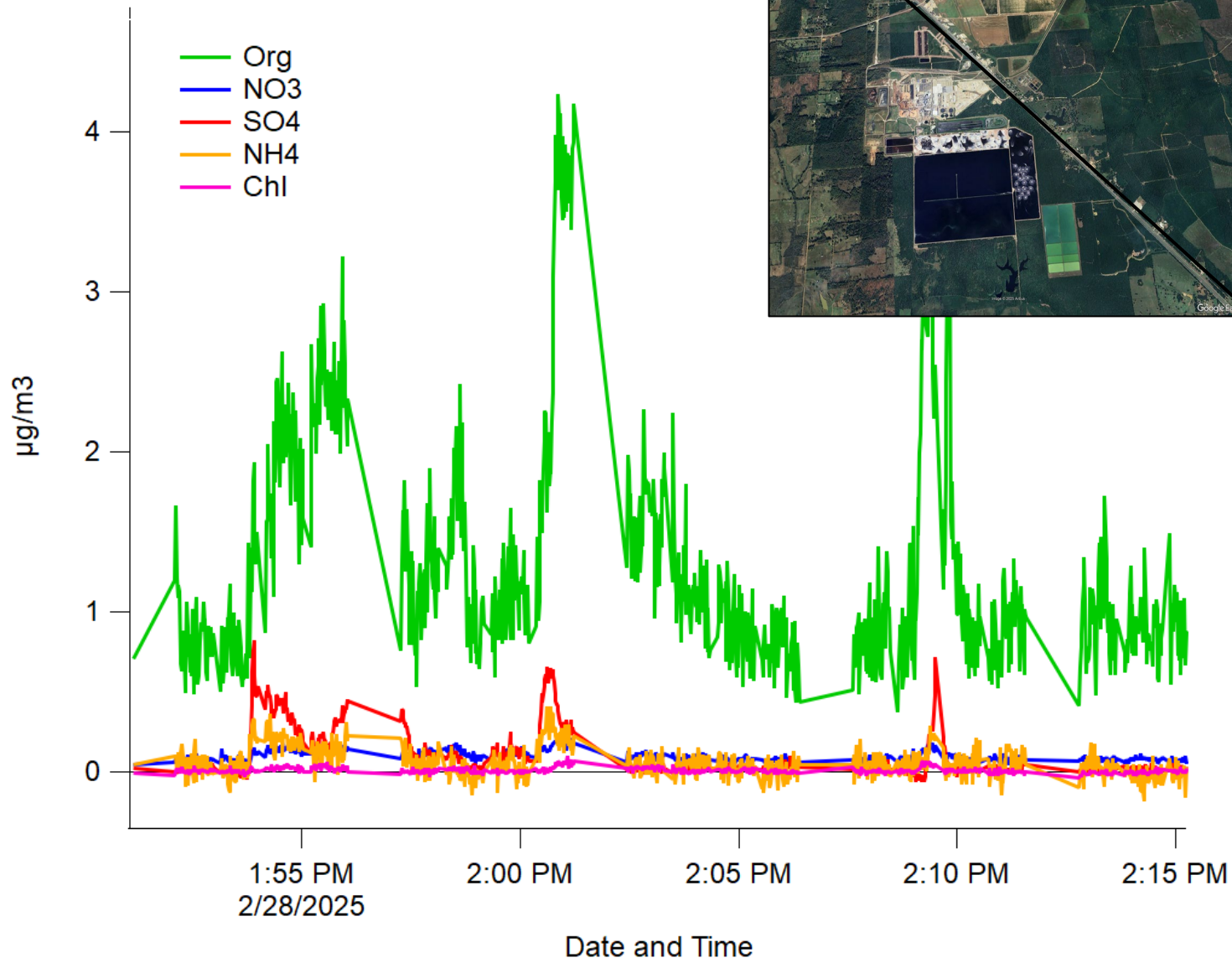
Monoterpene Ion



Transect near Domtar

HR-ToF-AMS

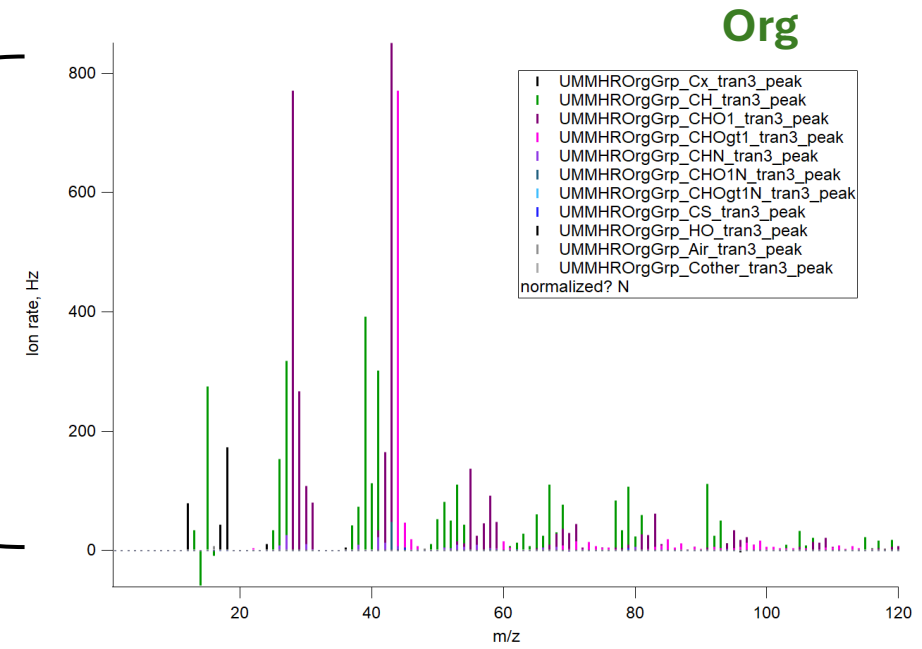
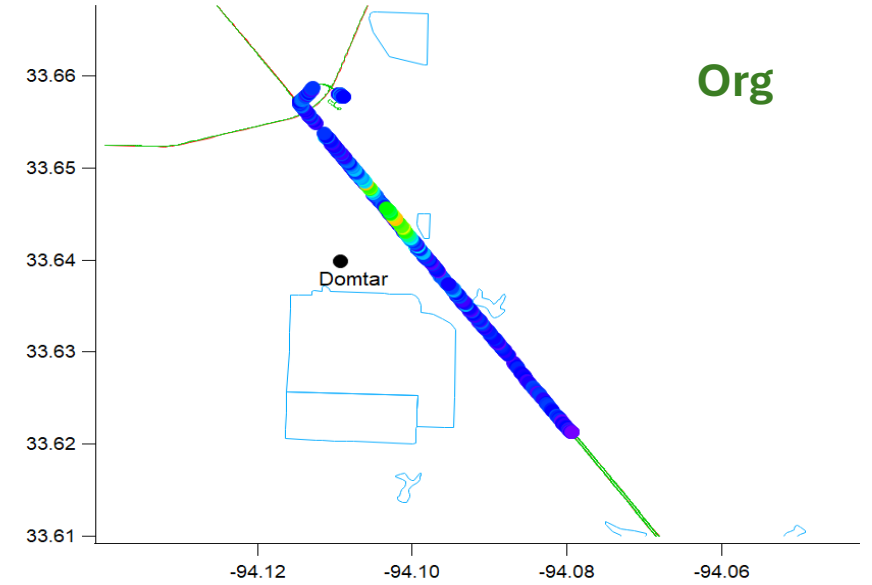
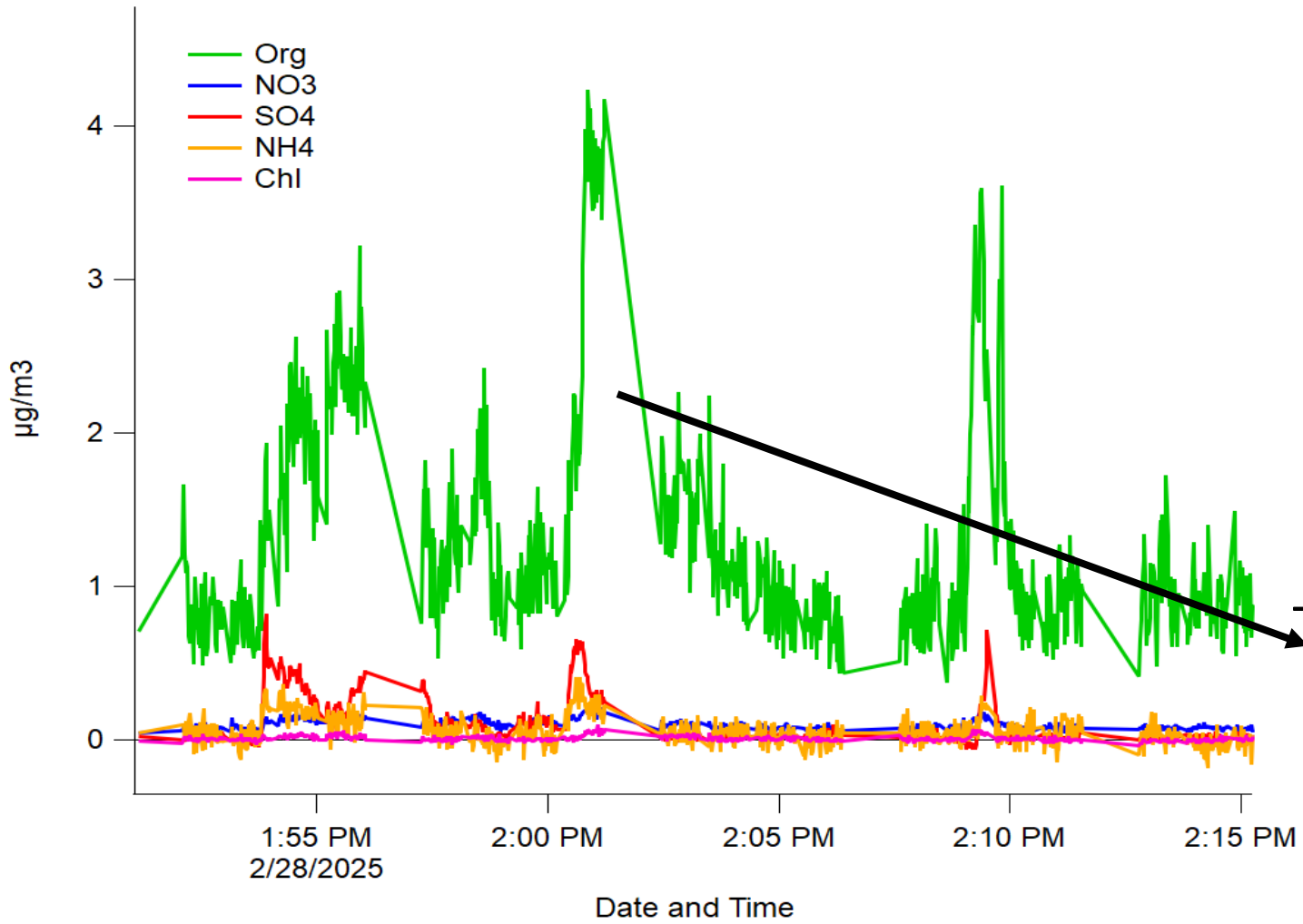
Feb 28th



Transect near Domtar

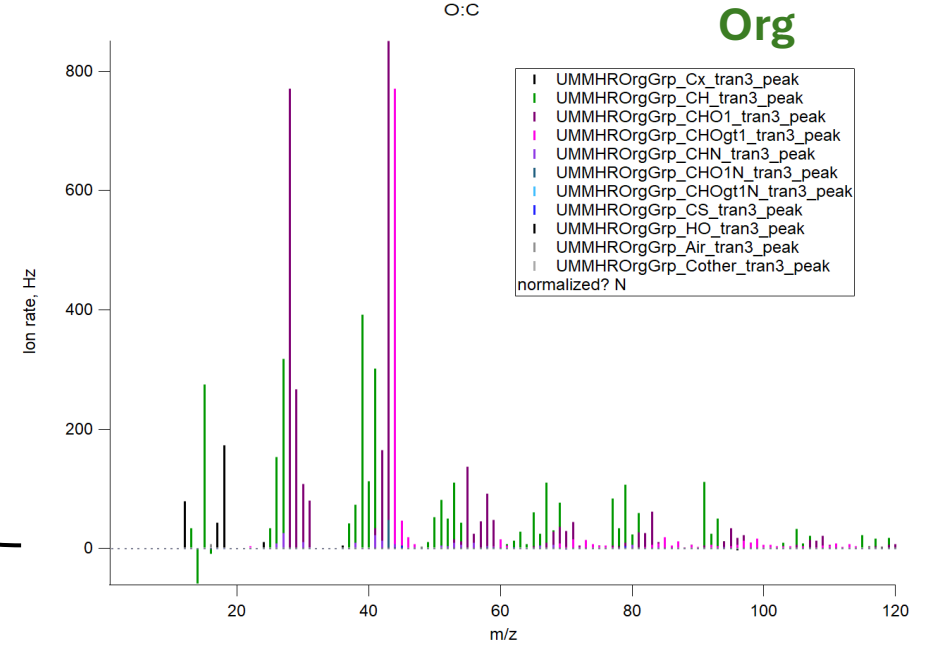
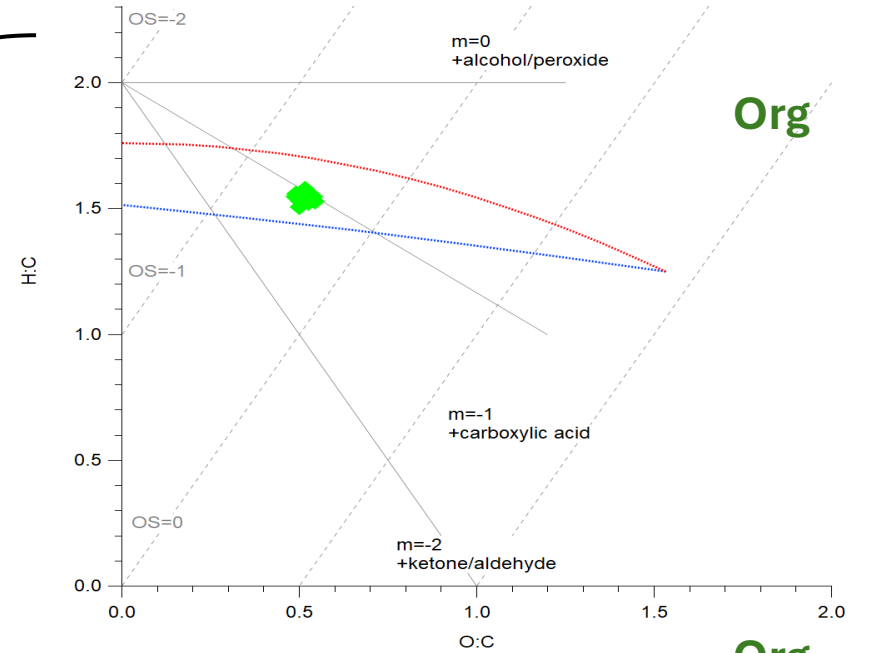
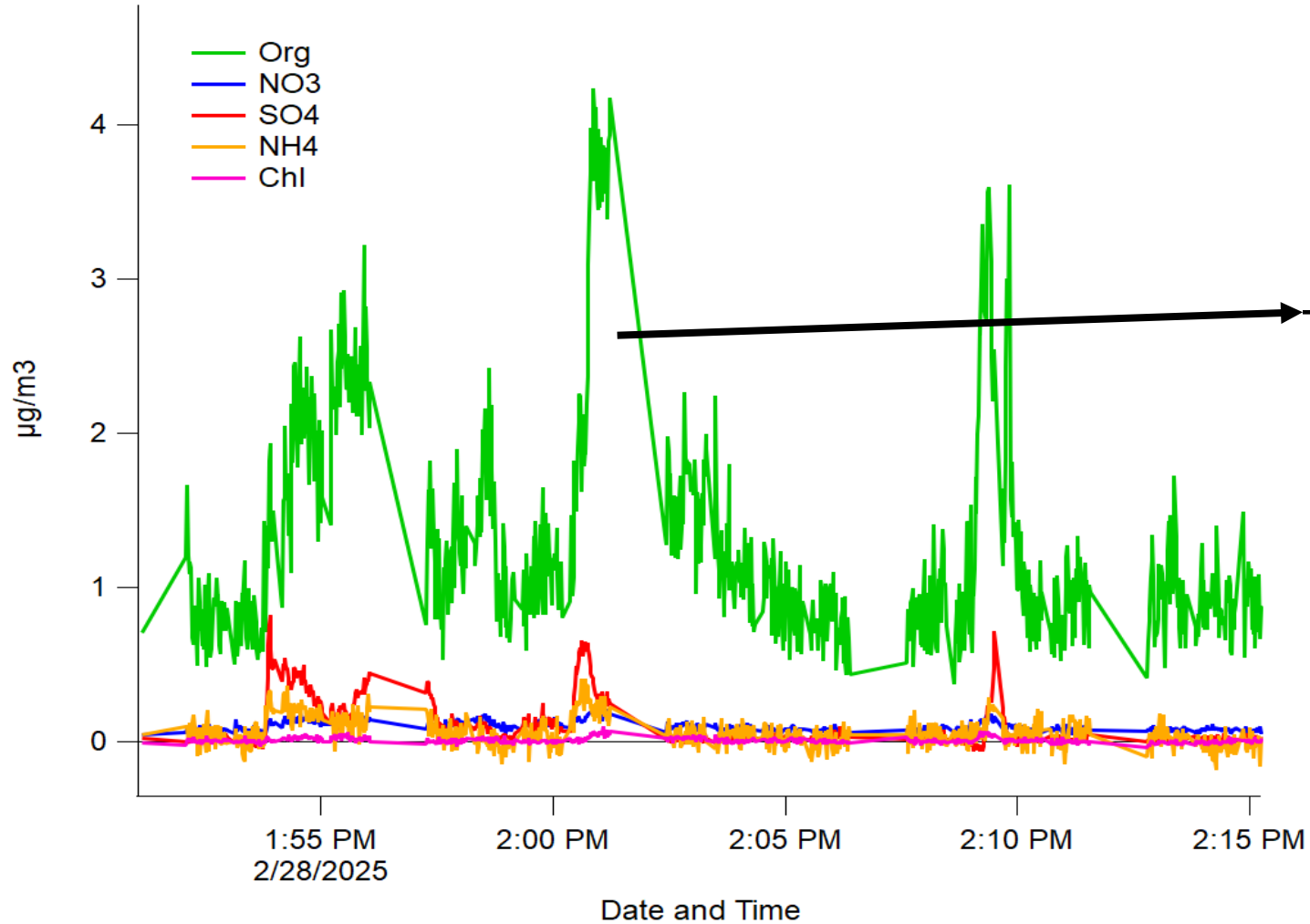
Feb 28th

HR-ToF-AMS



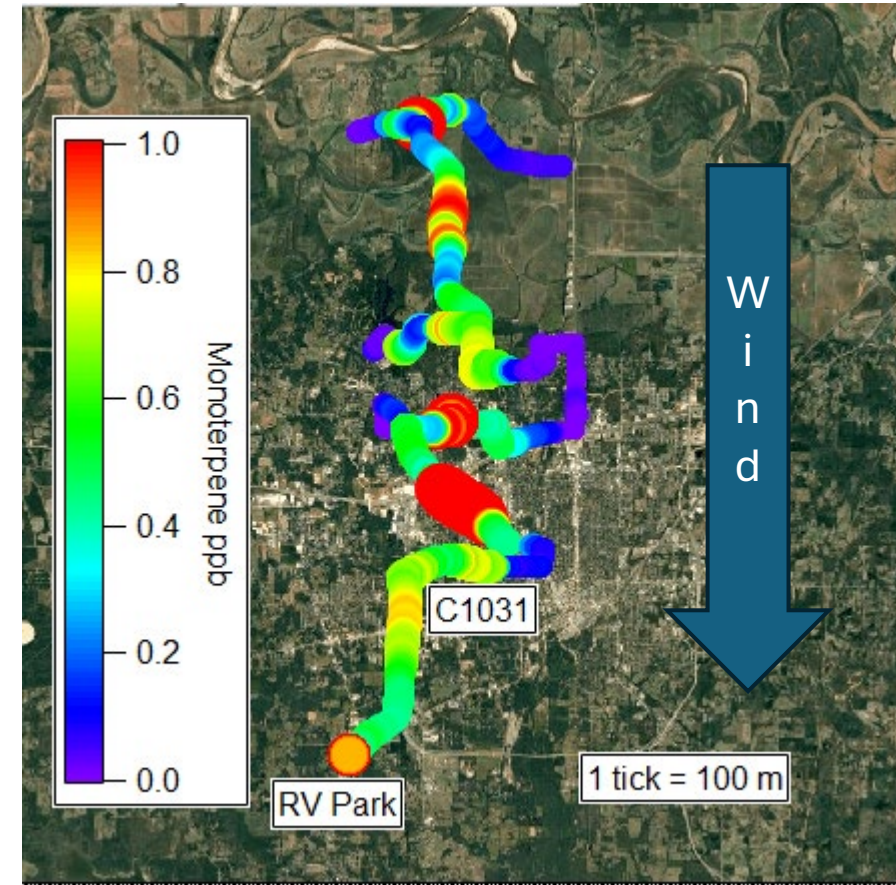
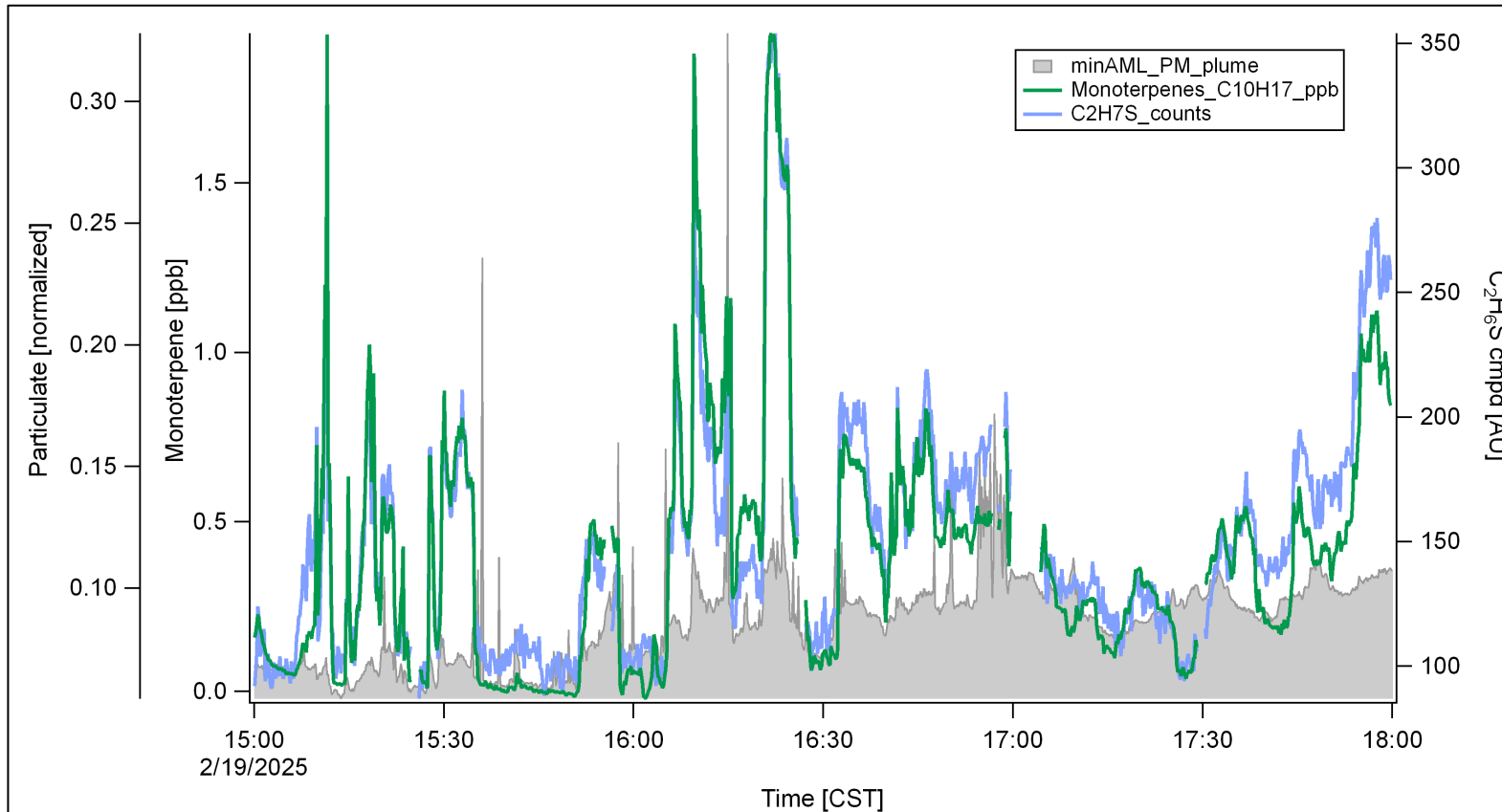
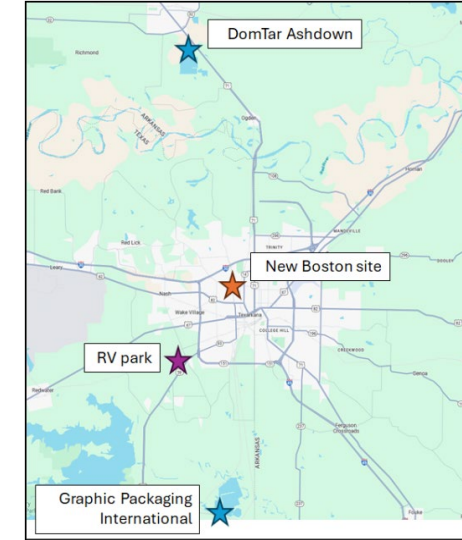
Transect near Domtar

Feb 28th

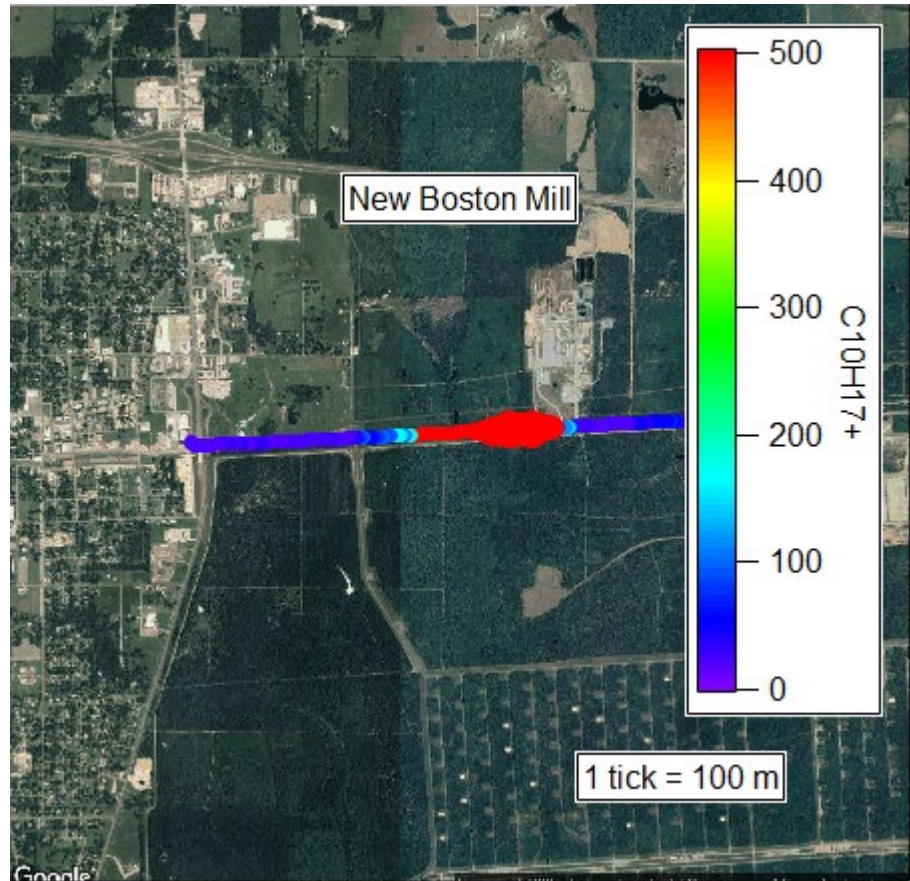


Domtar Plume Tracked from Facility into Texarkana Feb 19

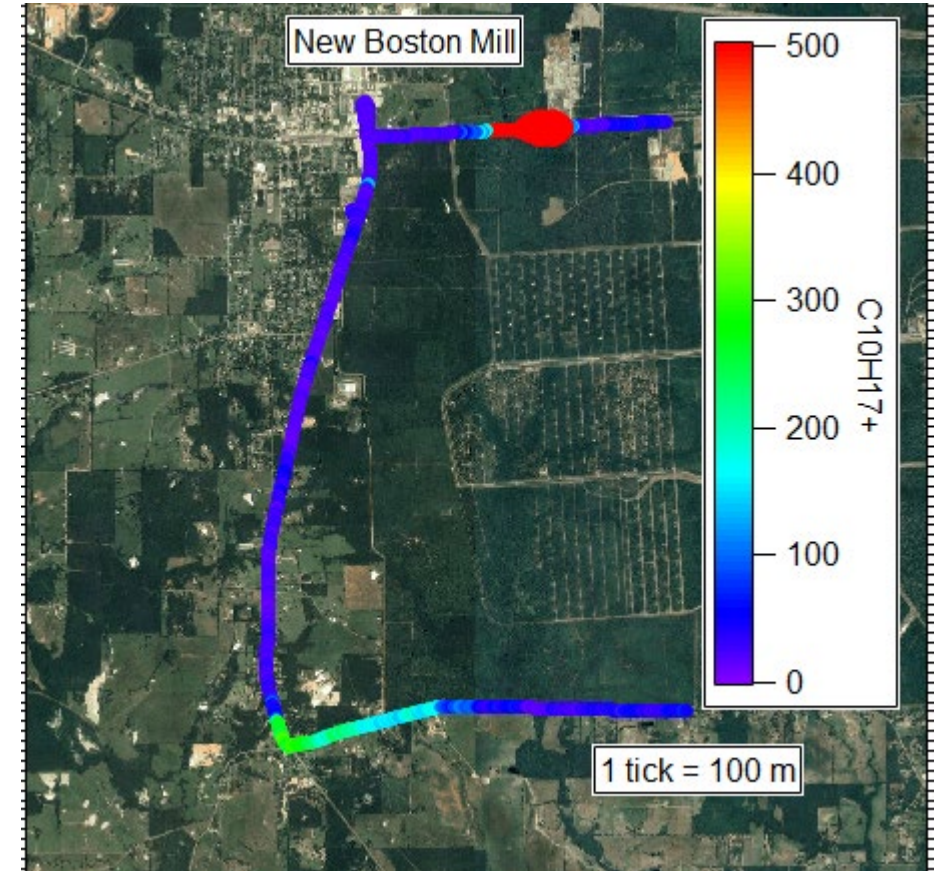
minAML Key Measurements



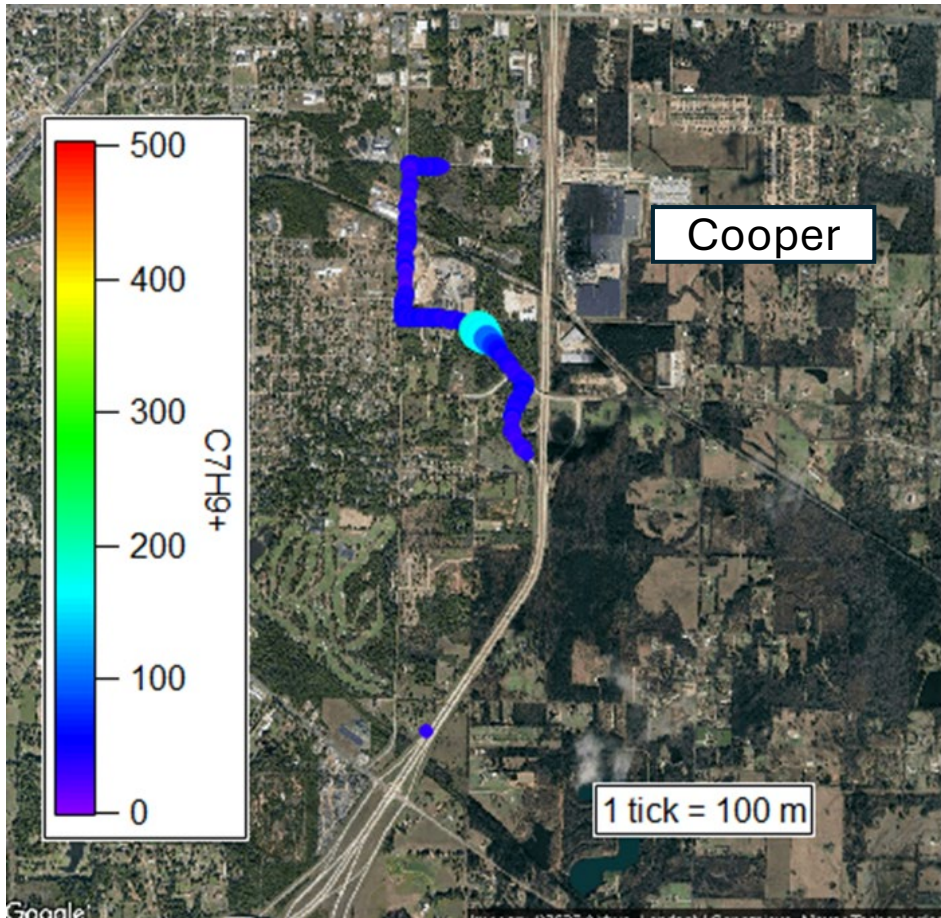
Other Sources: Lumber Mill in New Boston Minor Particulate Source; minAML Key Measurements



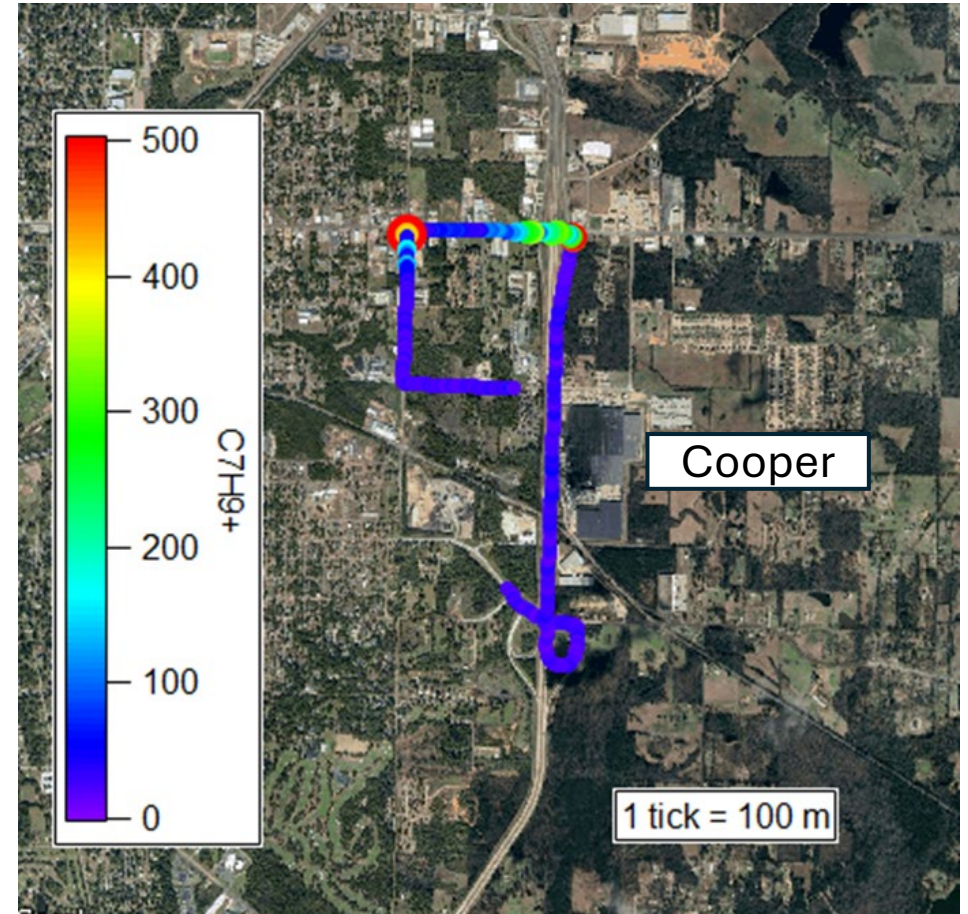
Wind Direction



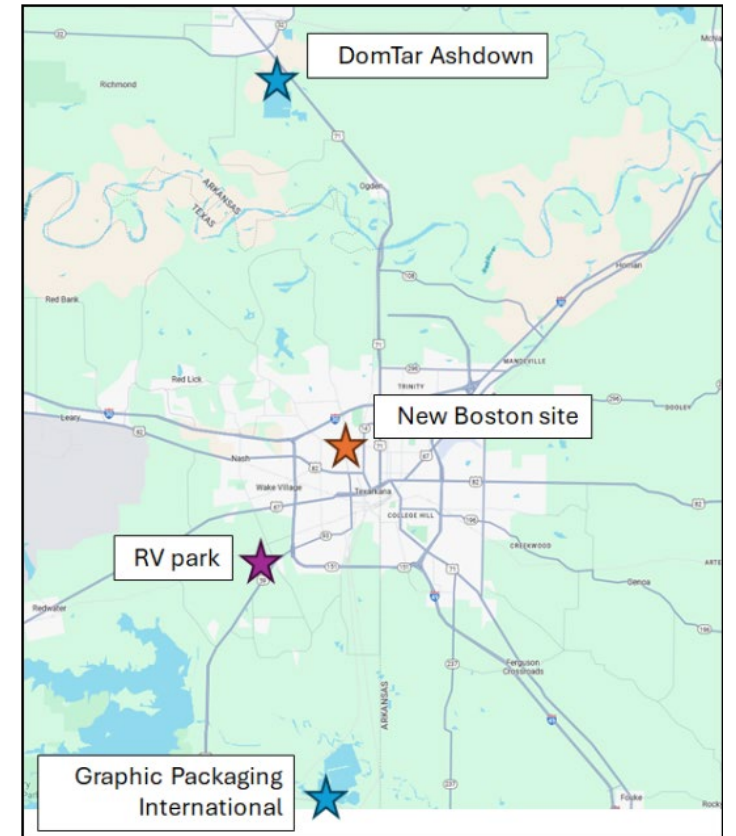
Other Sources: Cooper Tire Plant minAML Measurements of Toluene



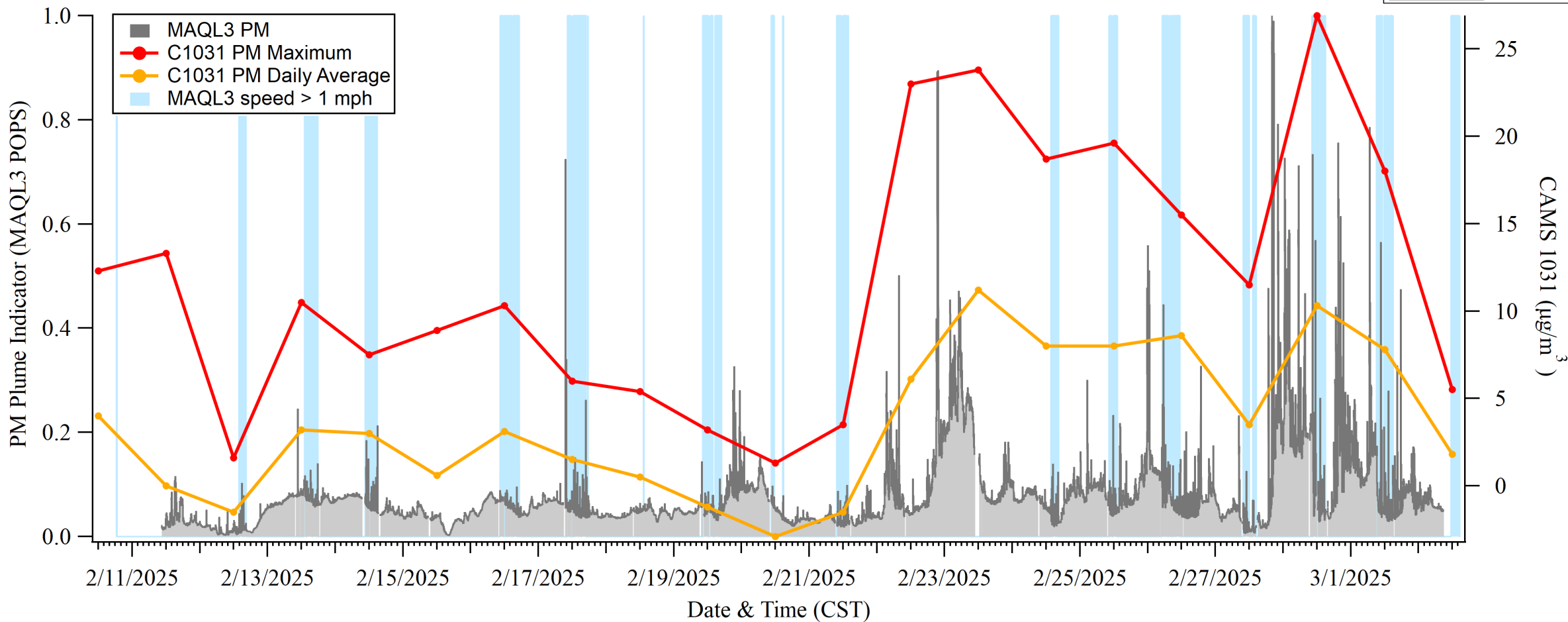
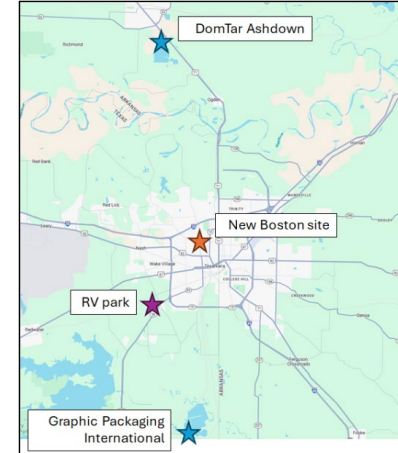
Null Result very little VOC or particulate enhancement found



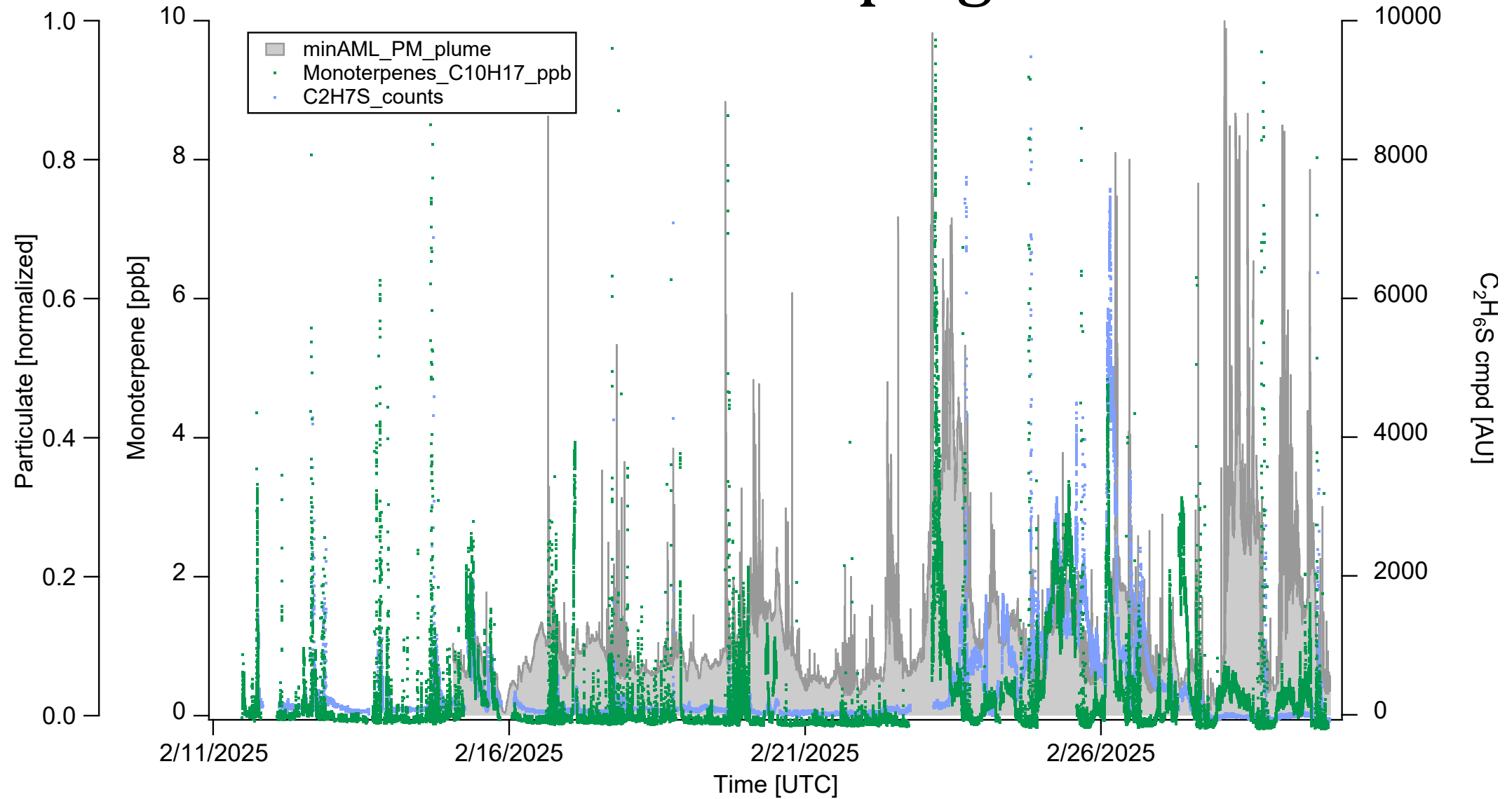
Rv Park/Stationary Measurements



MAQL3 POPS Stationary Measurements vs. C1031 PM_{2.5}



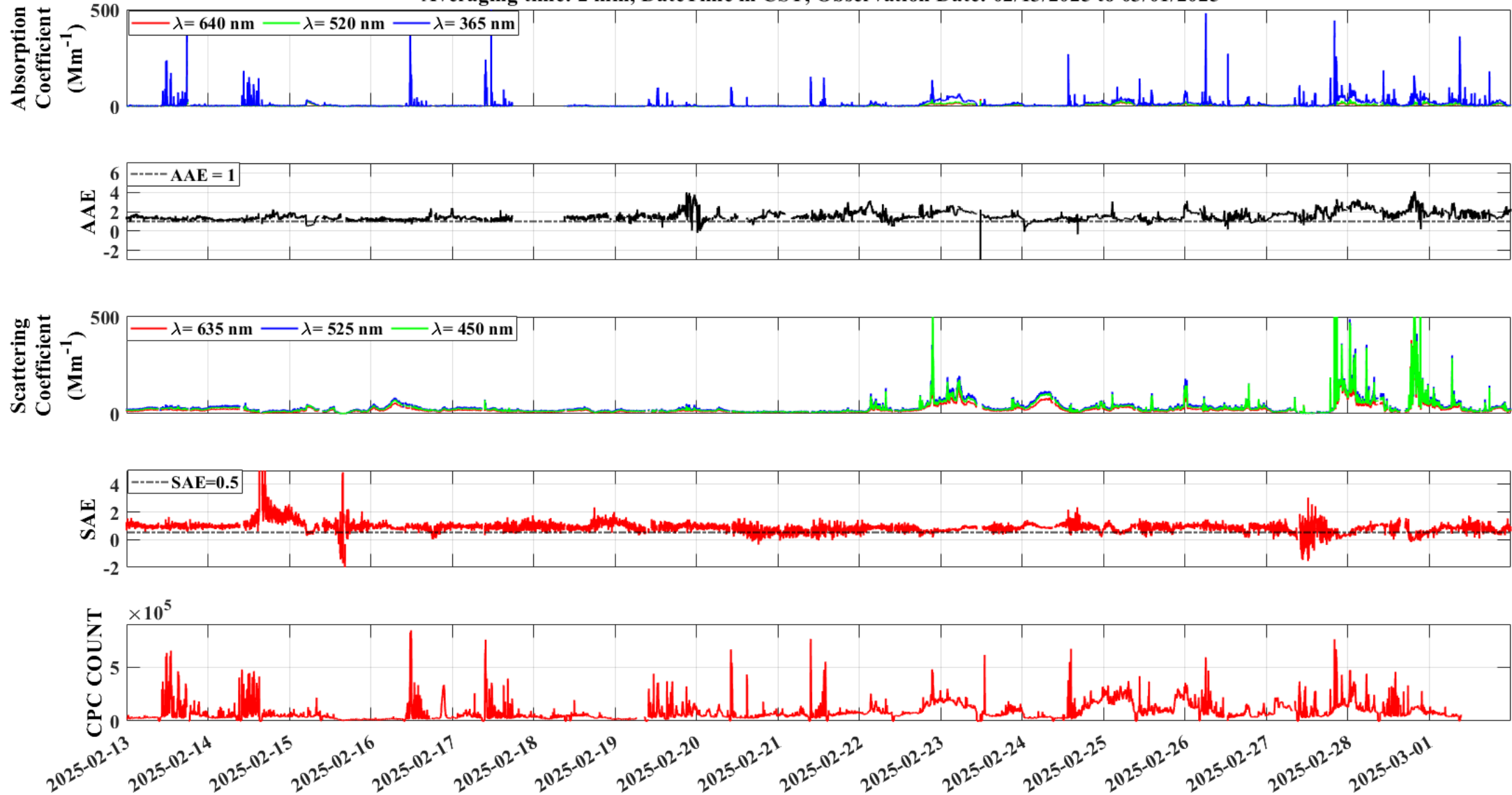
minAML Key Measurements Entire Campaign



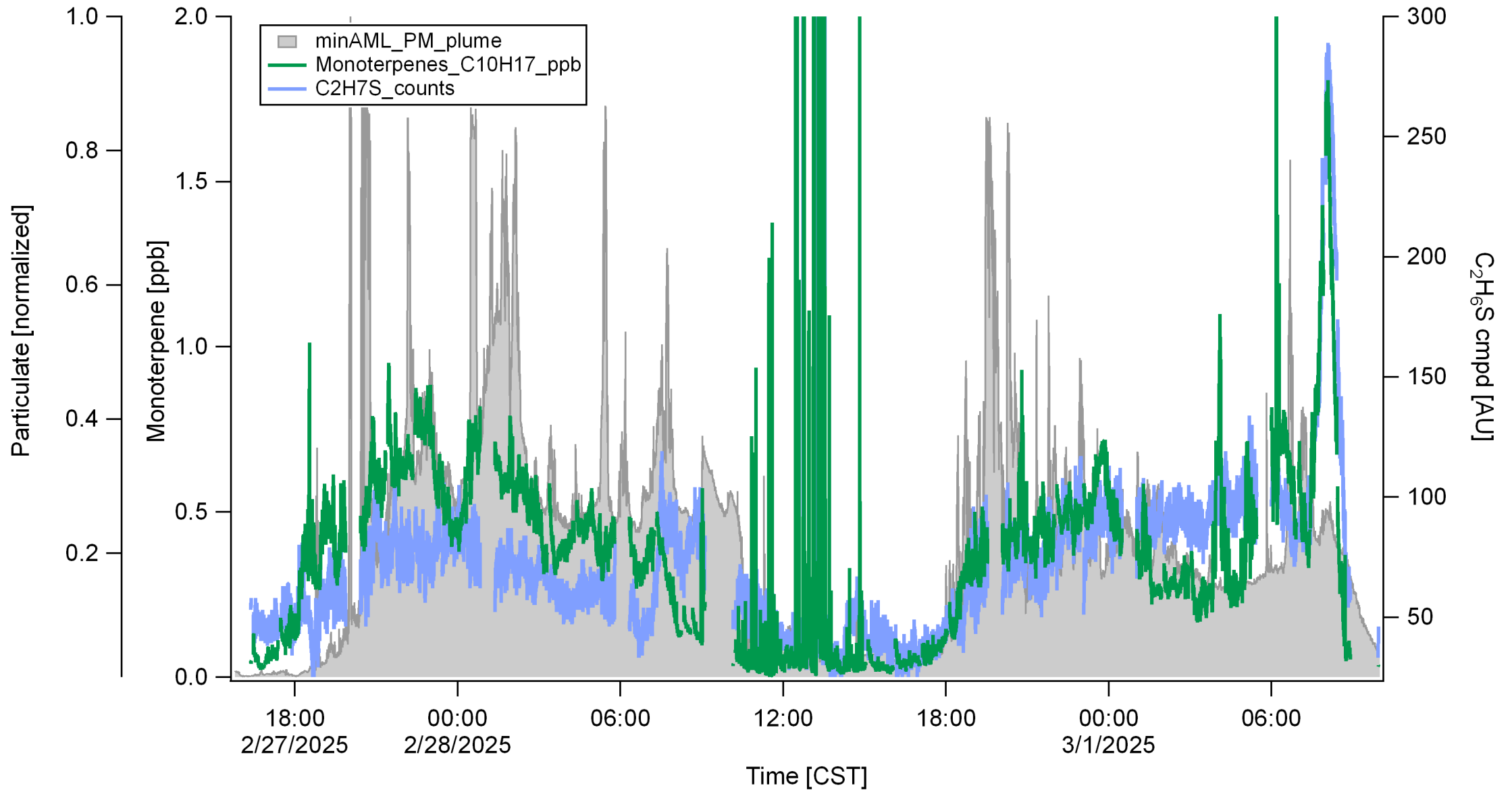
Aerosol Optical and CPC Time Series

Stationary and Mobile Measurements

Averaging time: 2 min, DateTime in CST, Observation Date: 02/13/2025 to 03/01/2025

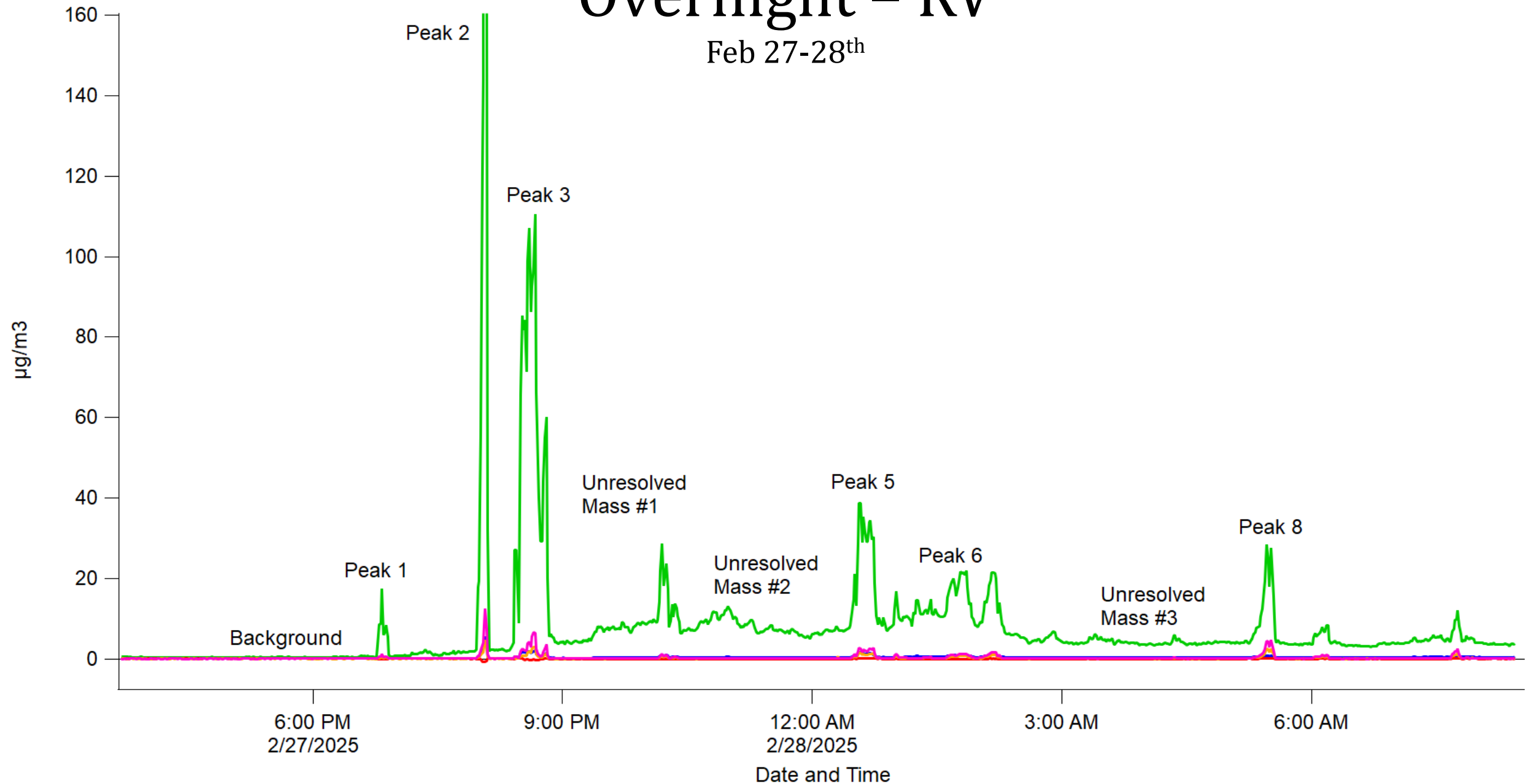


minAML Key Measurements 27-28, 28-1

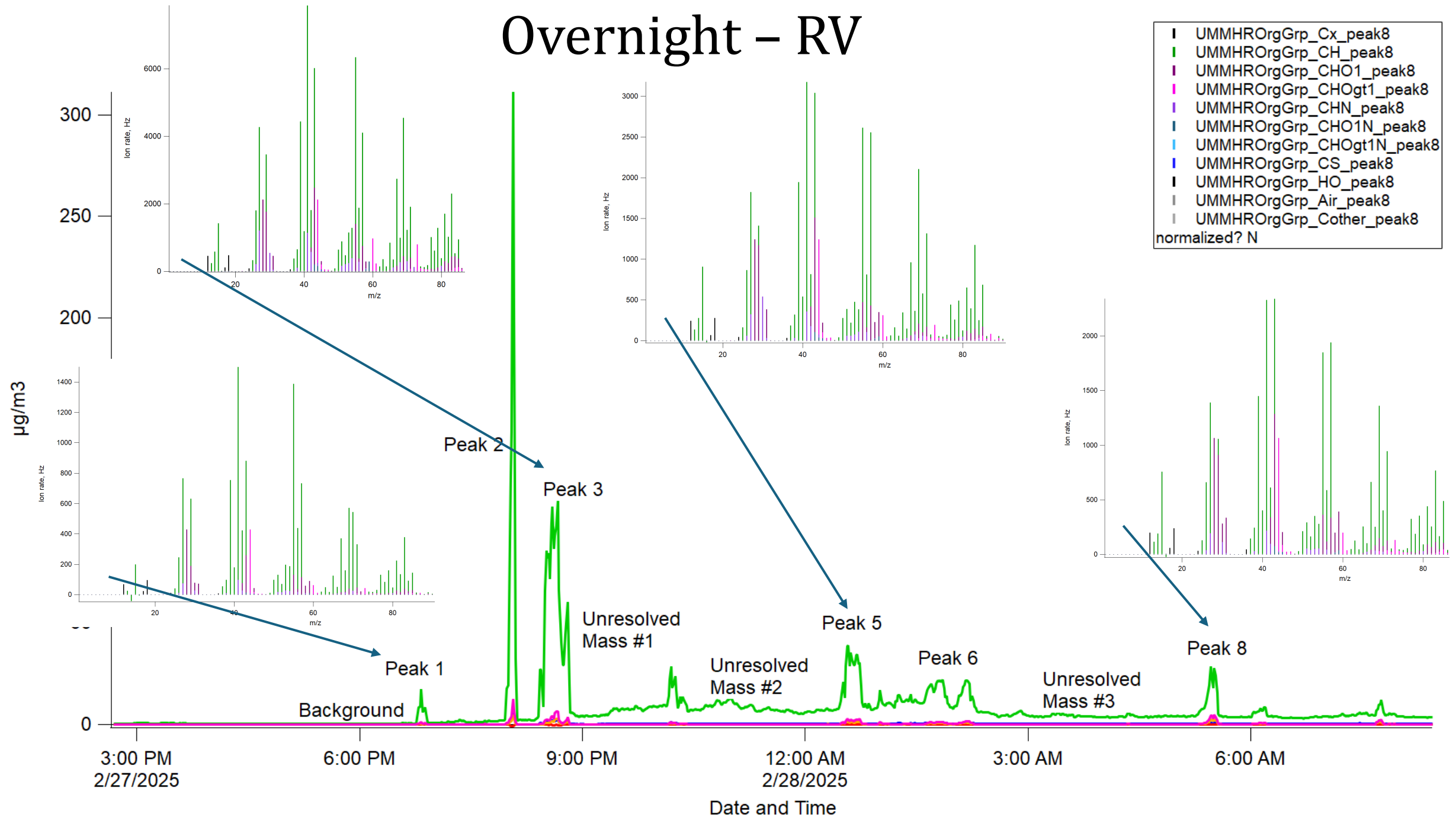


Overnight - RV

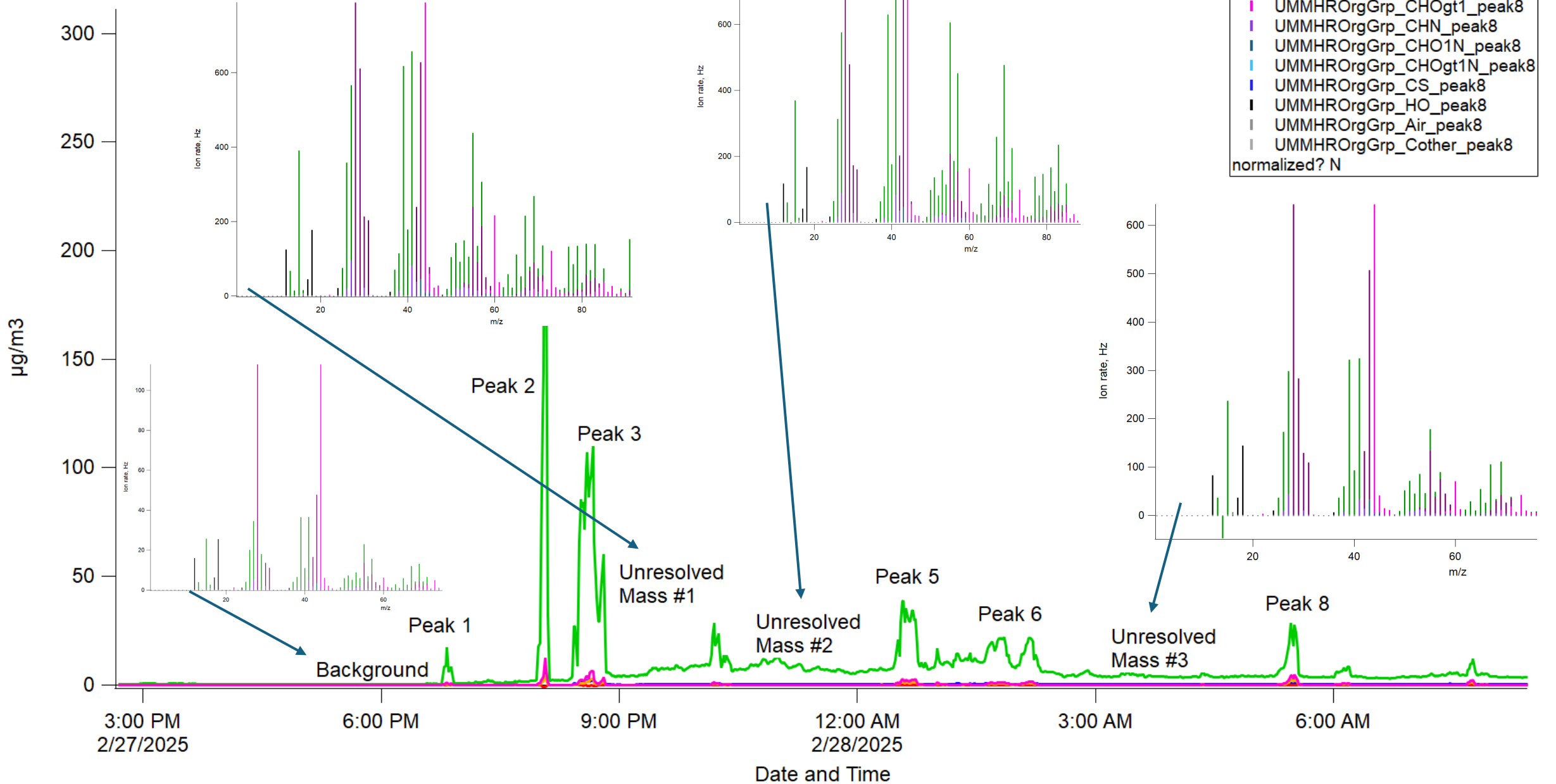
Feb 27-28th



Overnight - RV



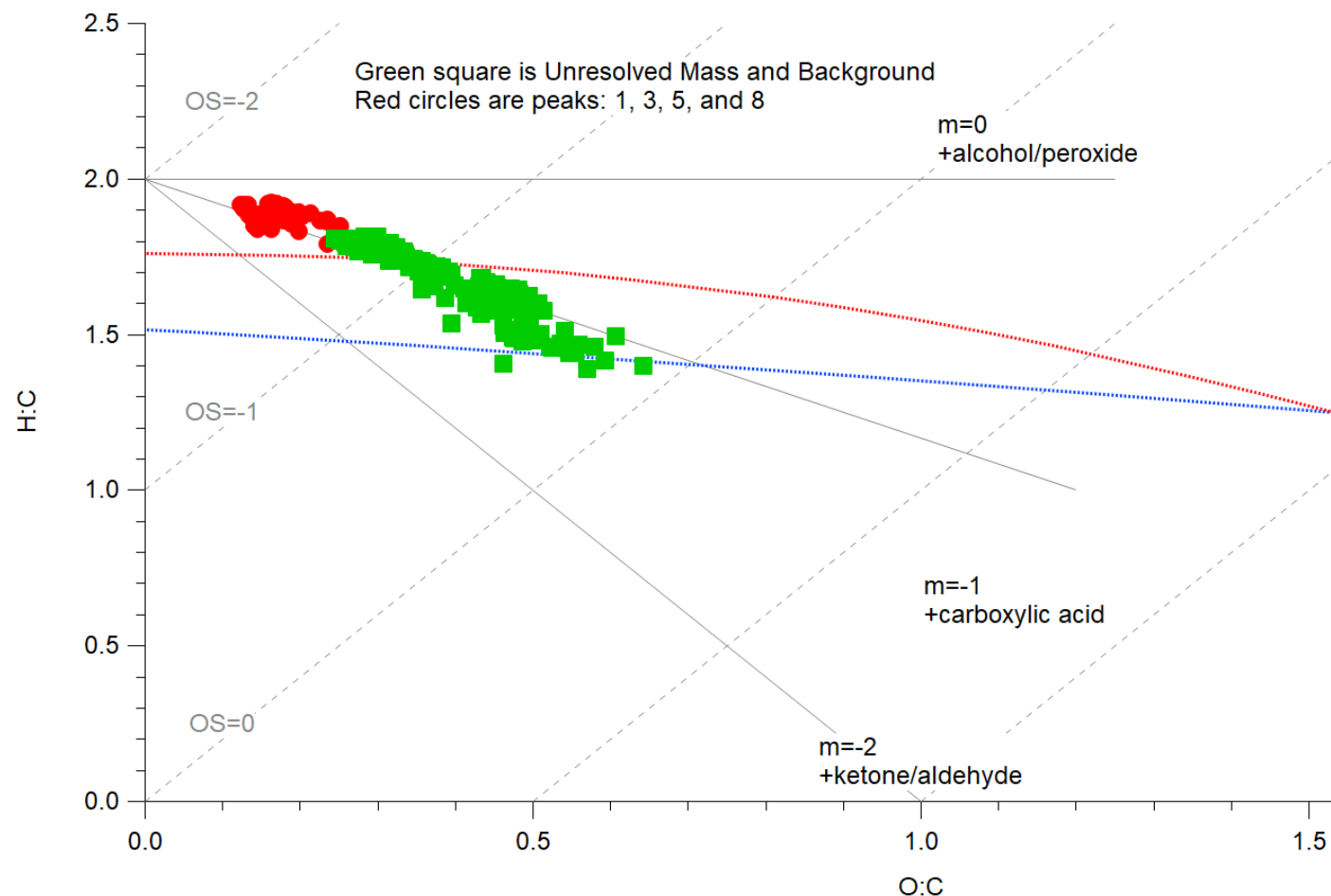
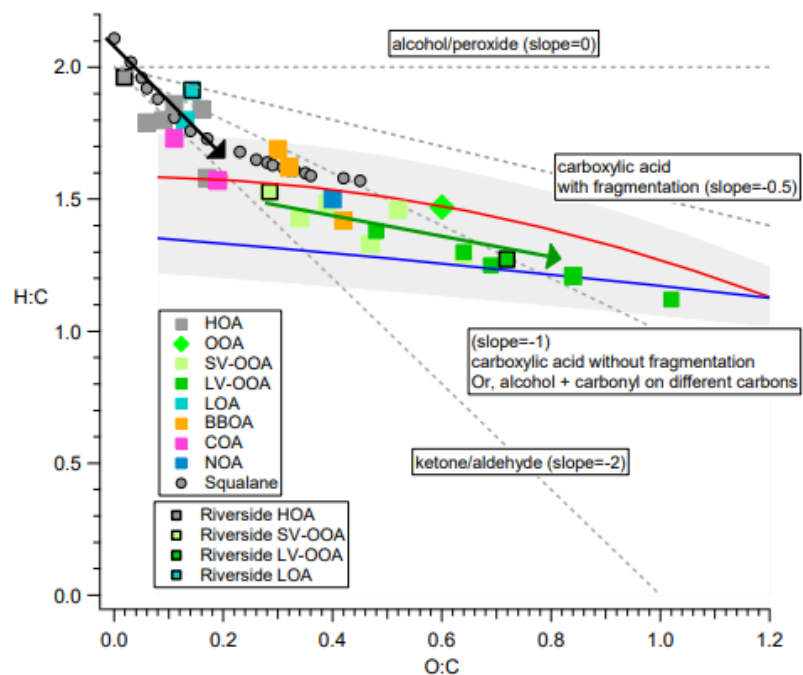
Overnight - RV



Overnight - RV - Van Krevelen Plot

Feb 27-28th

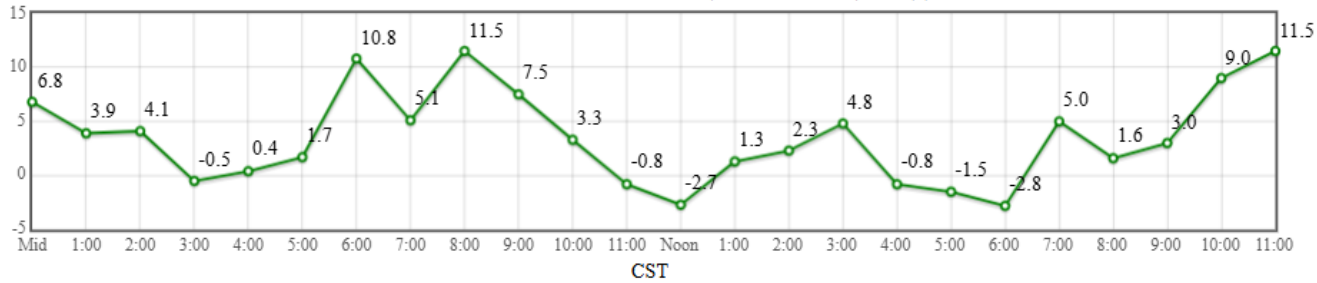
H:C vs O:C



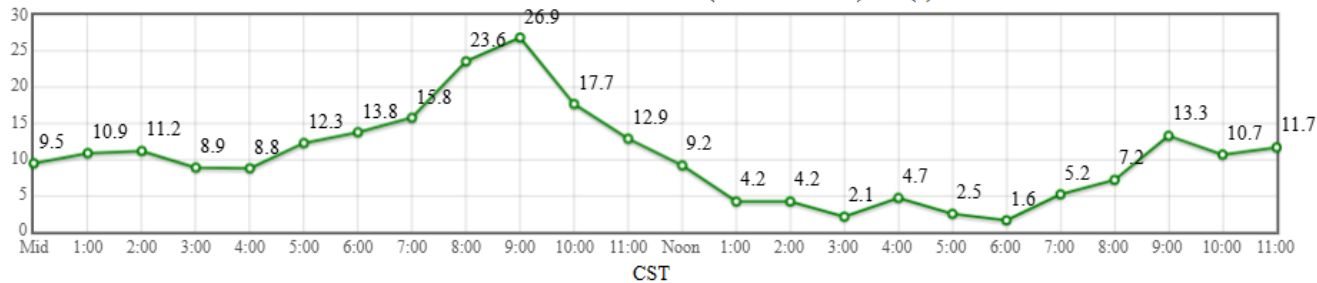
NOAA HYSPLIT Dispersion Model - 2.27.2025

C1031 PM2.5 Data (2.27-28.2025)

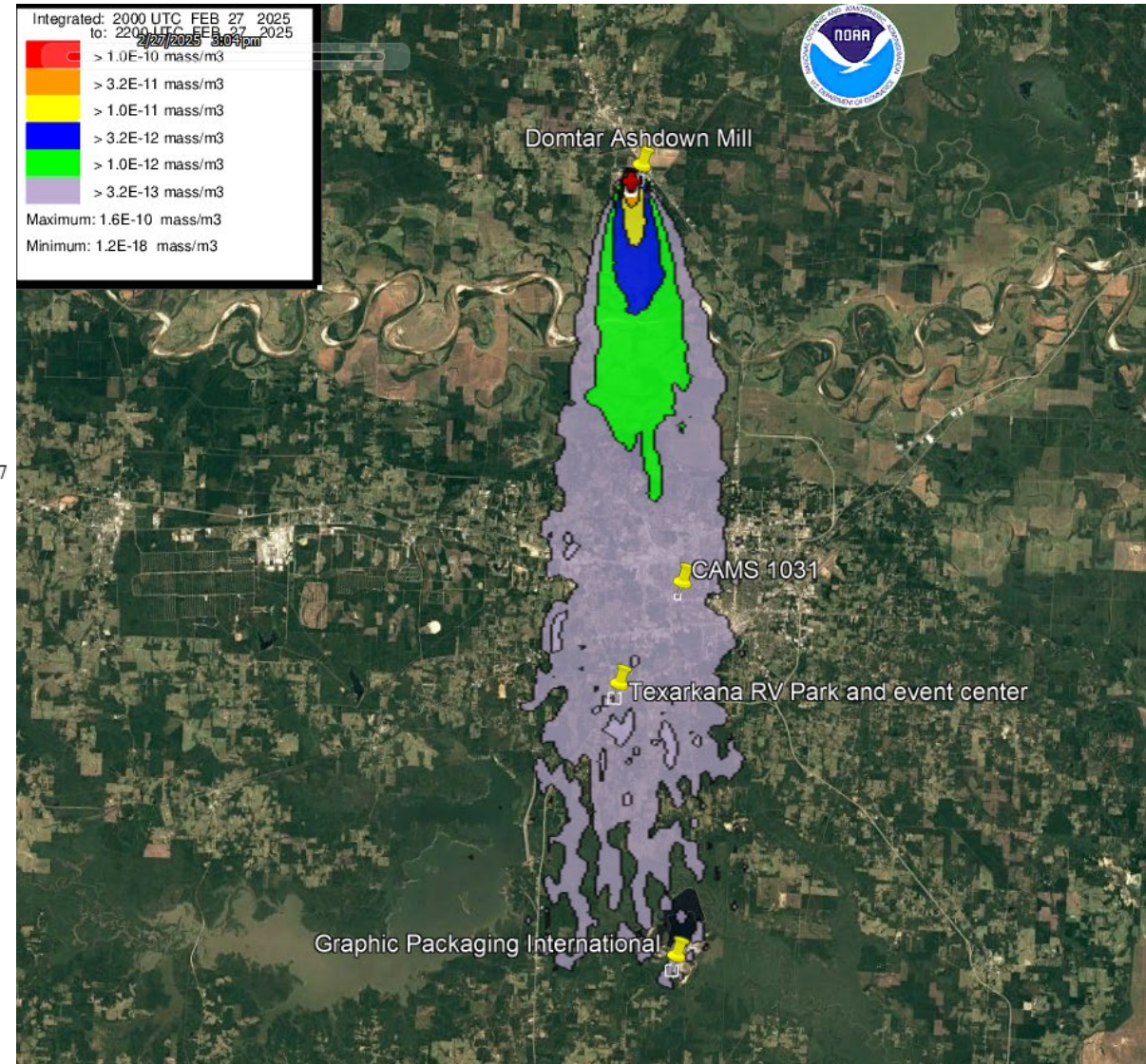
Texarkana New Boston C1031 - PM-2.5 (Local Conditions) POC(2)



Texarkana New Boston C1031 - PM-2.5 (Local Conditions) POC(2)



This is not a NOAA product. It was produced by: unknown
 Meteorology: 0000Z 27 Feb 2025 - GFSOp25
 Dry Deposition rate: 0 cm/s Wet Removal: None #Part: 20000
 Pollutant Averaging/Integration Period: 2 hrs and 0 min
 Release Quantity: 1 mass Start: 25 02 27 18 0 Duration: 4 hrs, 0 min
 Pollutant: Unit - Unspecified
 Release: lat.: 33.639864 lon.: -94.112645 Hgt: 20 to 50 m
 Job ID: 28877 Job Start: Fri Aug 22 01:49:43 UTC 2025



Conclusions

- Characterized and tracked emissions from paper mill facilities located North and South of Texarkana
- Successfully coordinated two mobile platforms to provide complimentary information both in tandem and separately
- Followed these plumes downwind as they moved towards Texarkana and at least in one case (Feb 19th) tracked the plume to the C1031 monitoring site
- Monitored air while parked overnight at a location in Texarkana during periods of enhanced particulate loading enabling better characterization of these events and comparisons with C1031 data

Future Work

- Enhanced analysis of the gas and particulate phase measurements conducted during this campaign will assist in determining the evolution of the chemical speciation and SOA formation potential of the airmasses sampled.
- Certain instrumentation deployed for longer time periods at the C1031 site would help in characterizing the airmasses impacting Texarkana over time (e.g., routine filter sampling paired with aerosol optical measurements).

Acknowledgements

- **University of Houston**

- Alexandra Ulinski
- Sergio Alvarez
- Jimmy Flynn
- Eugenia Velasco
- Travis Griggs
- Tanzina Akther

- **Baylor University**

- Prakash Sharma
- Sujan Pokhrel
- Sascha Usenko

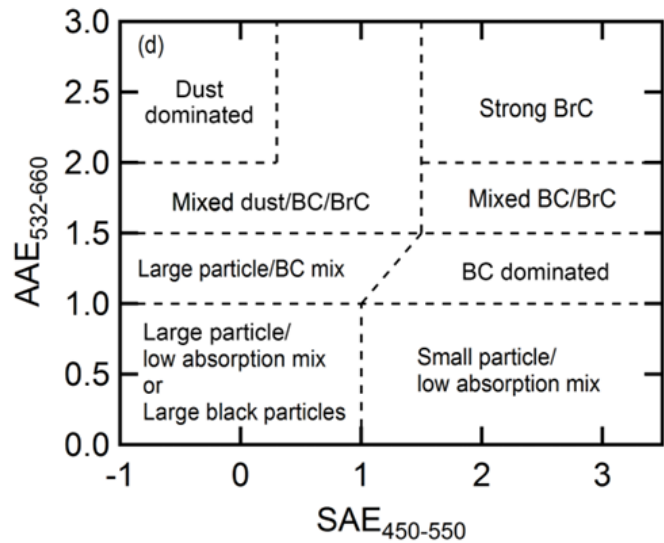
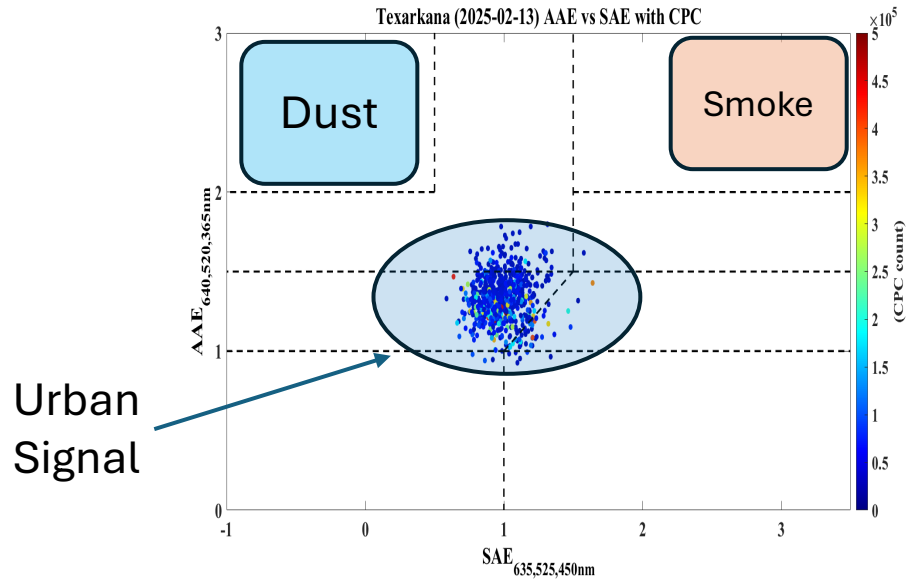
- **Aerodyne**

- Ed Fortner
- Brian Lerner
- Connor Daube

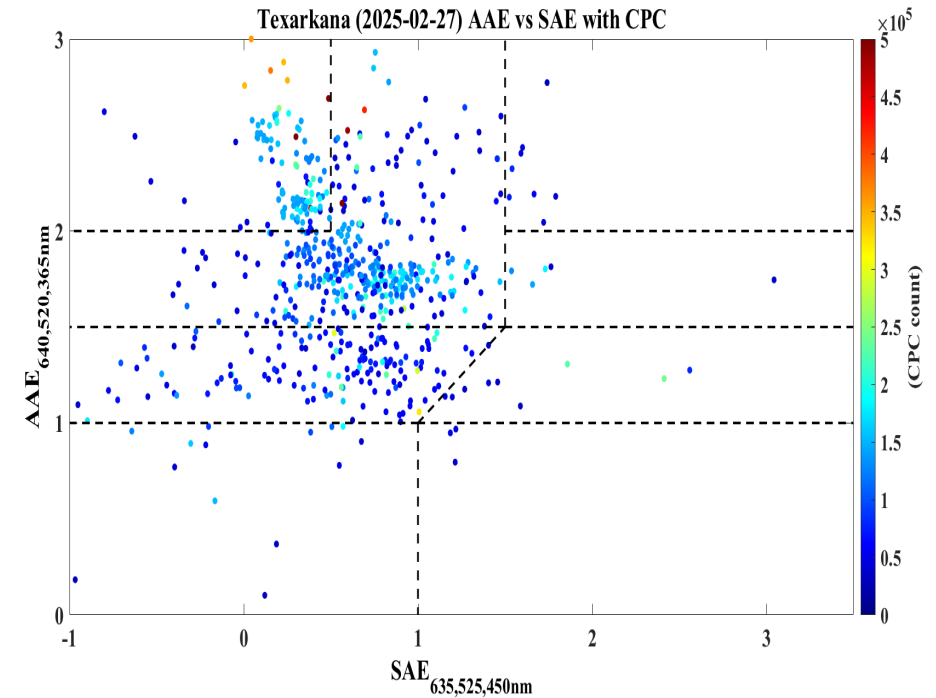
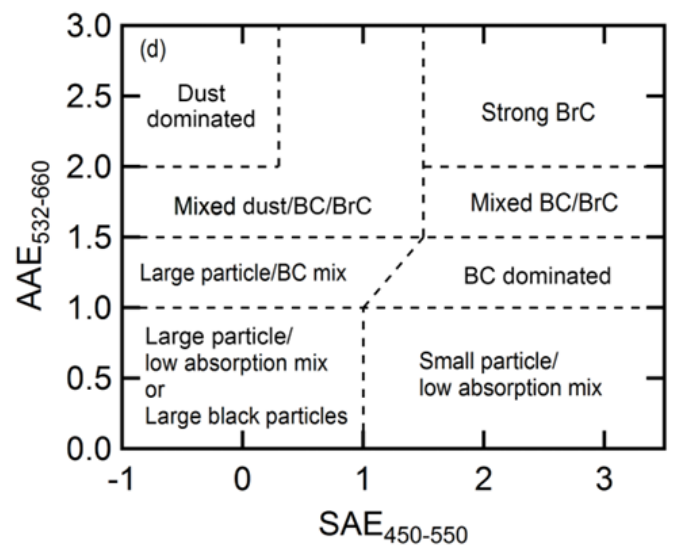
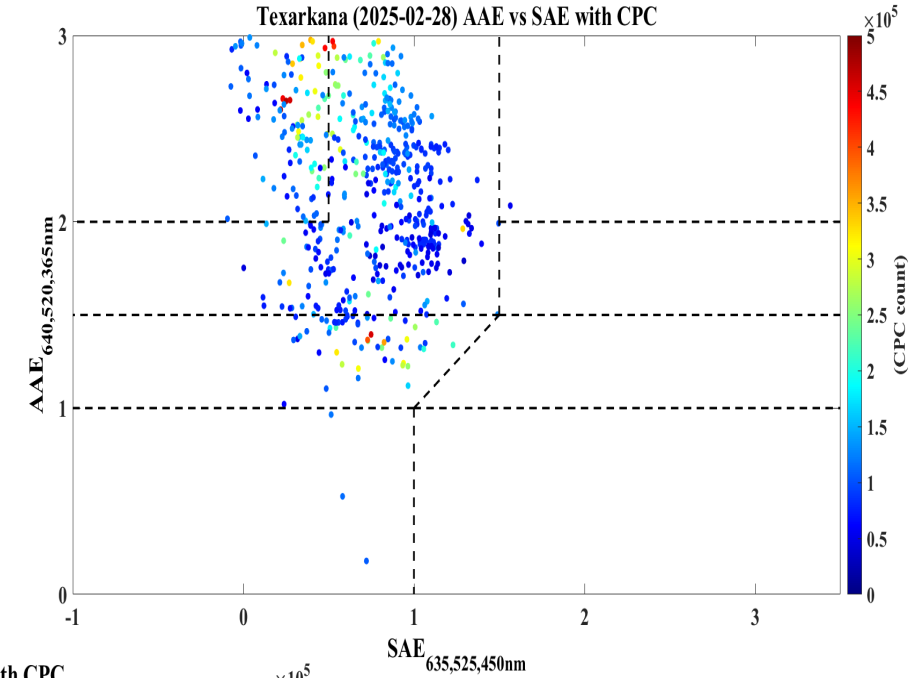
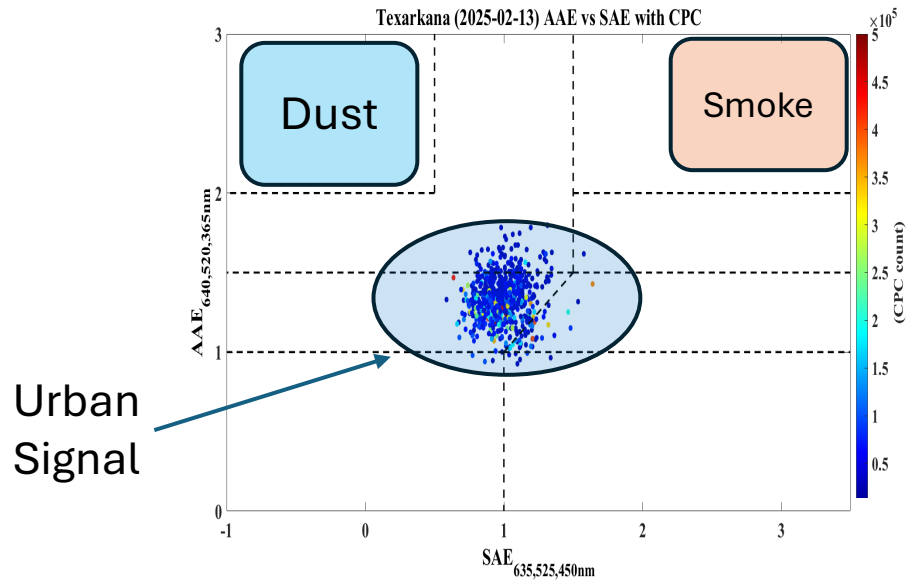
- **Texas Commission on Environmental Quality (TCEQ)**

- **Air Quality Research Program (AQRP)**

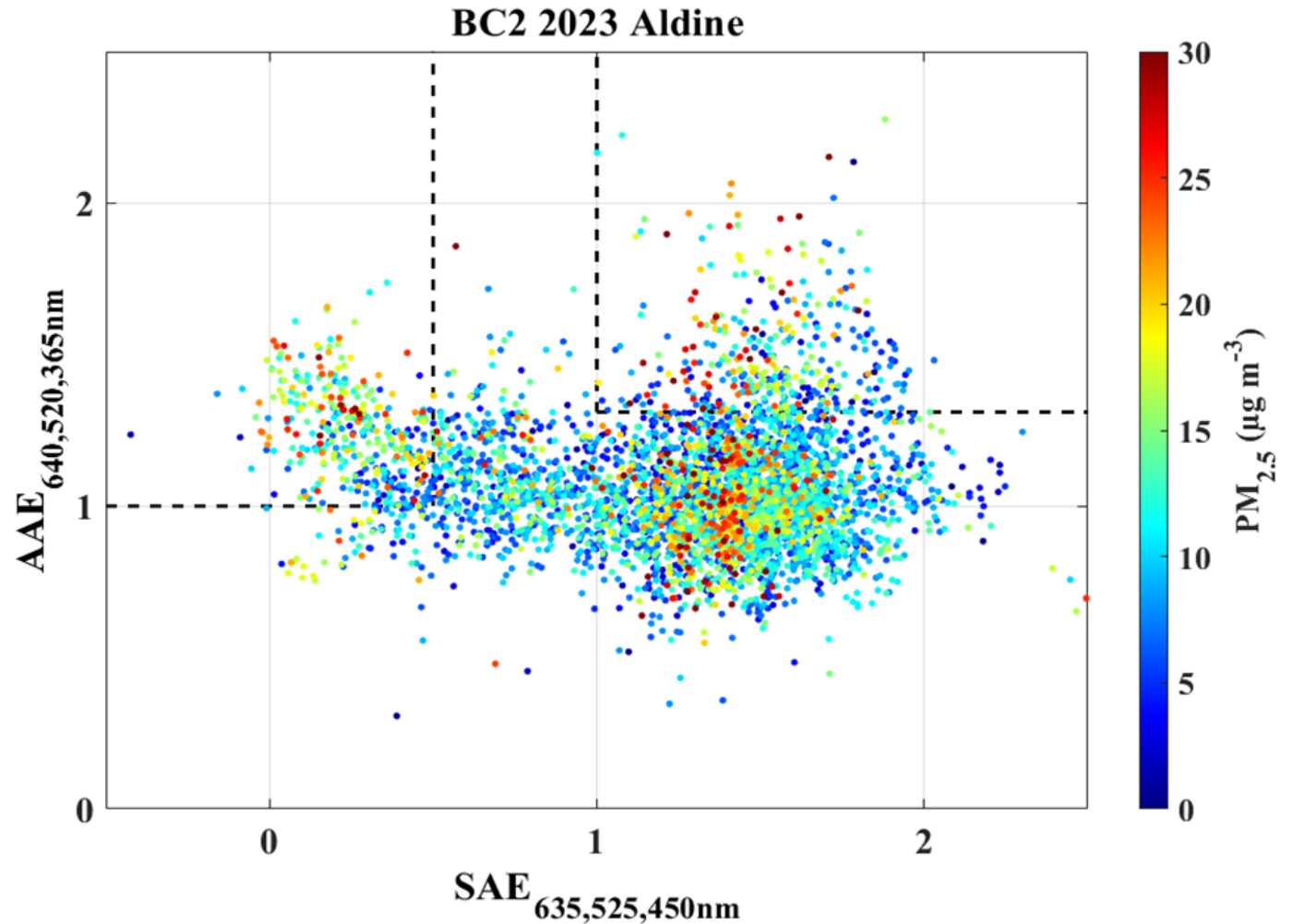
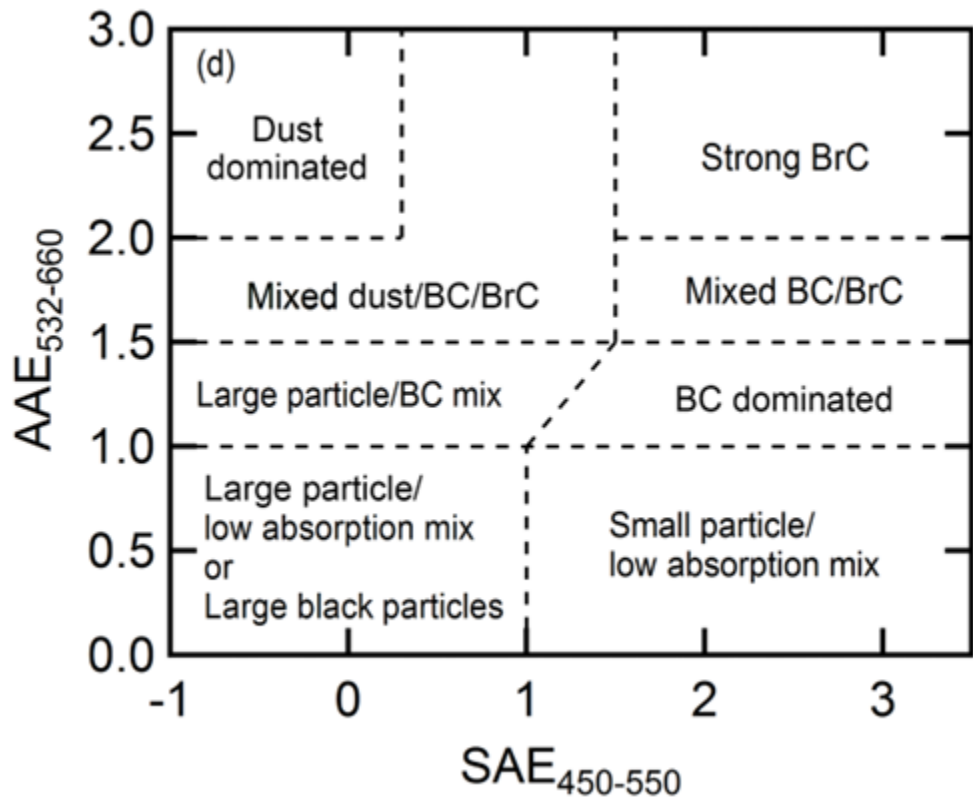
Aerosol Optical Observations



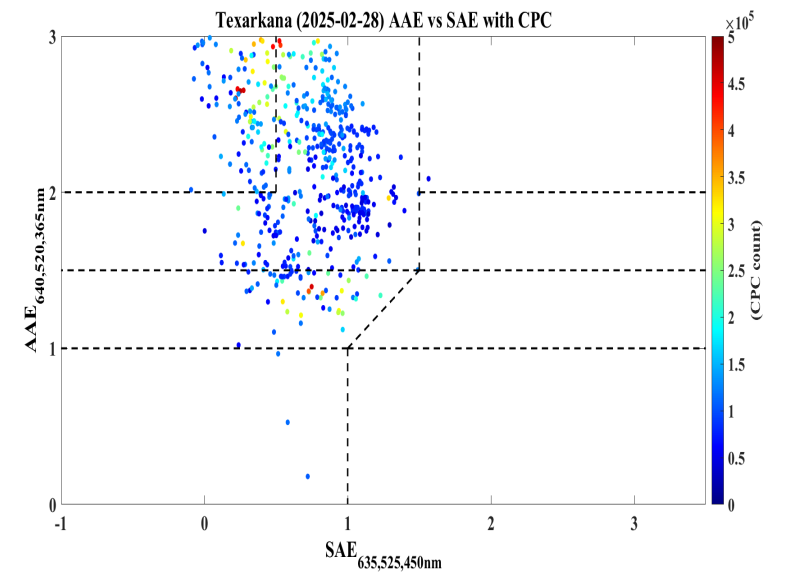
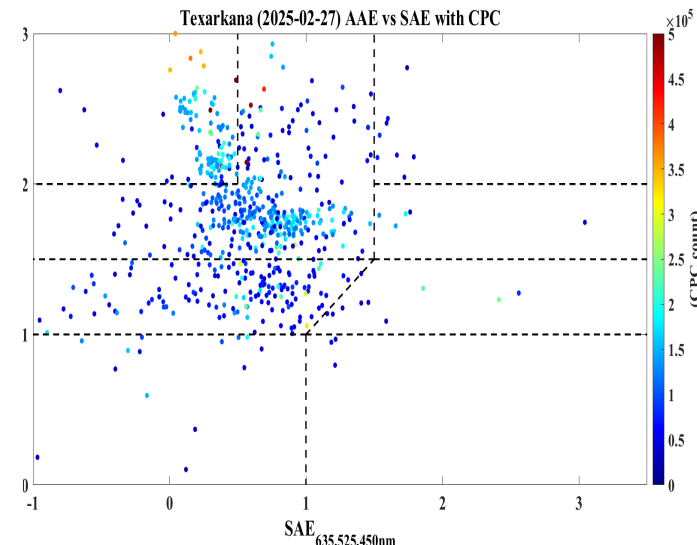
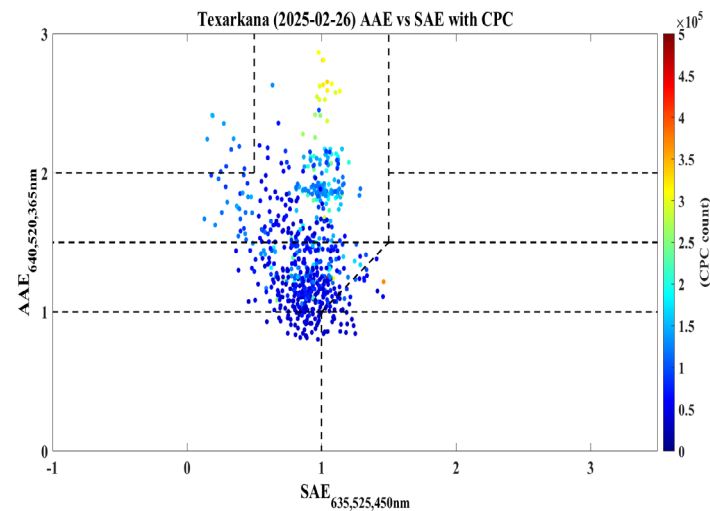
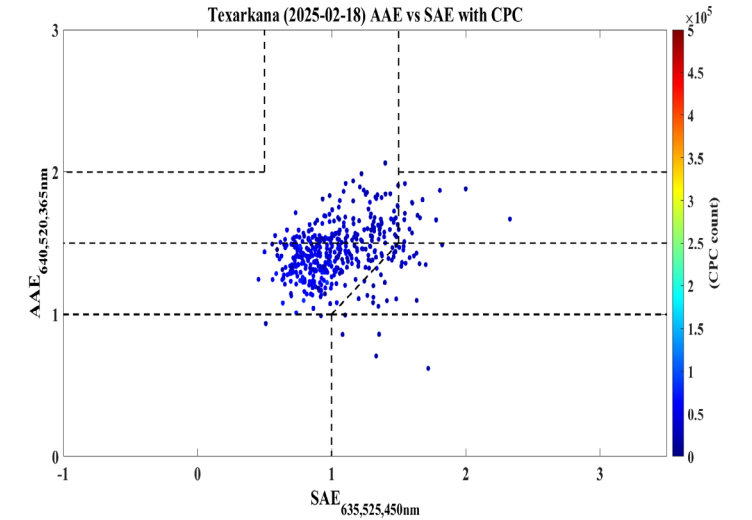
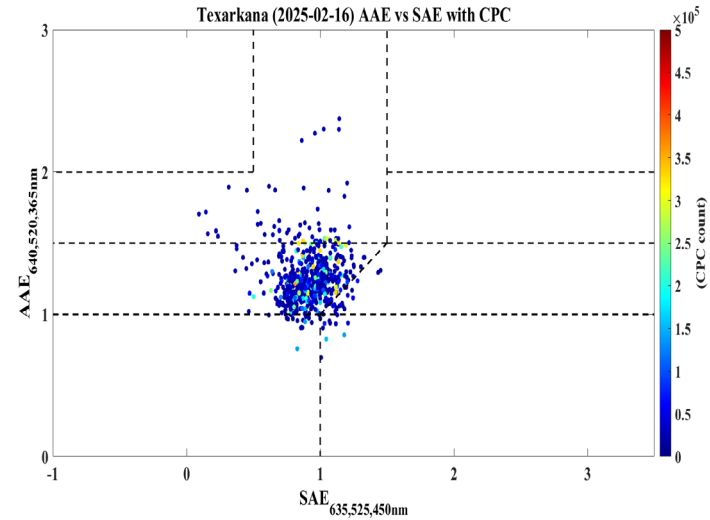
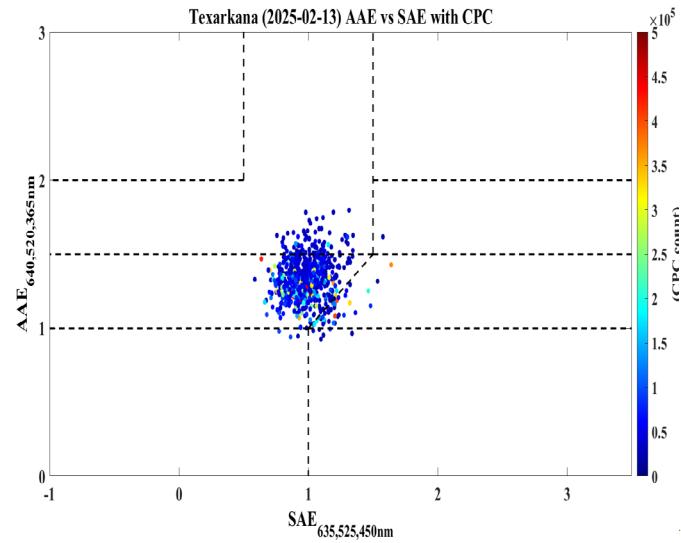
Aerosol Optical Observations



TCEQ BC2 Project



AAE vs SAE (Top: 2.13, 16, and 18 – Bottom: 2.26-28)



NOAA HYSPLIT Dispersion Model - 2.27.2025

