NOVEL MOBILE AIR QUALITY "SNIFFER" MEASUREMENTS

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WHOLE COMMUNITIES WHOLE HEALTH
A UT Grand Challenge

TEXAS
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THE MISZTAL "SNIFFER" LAB

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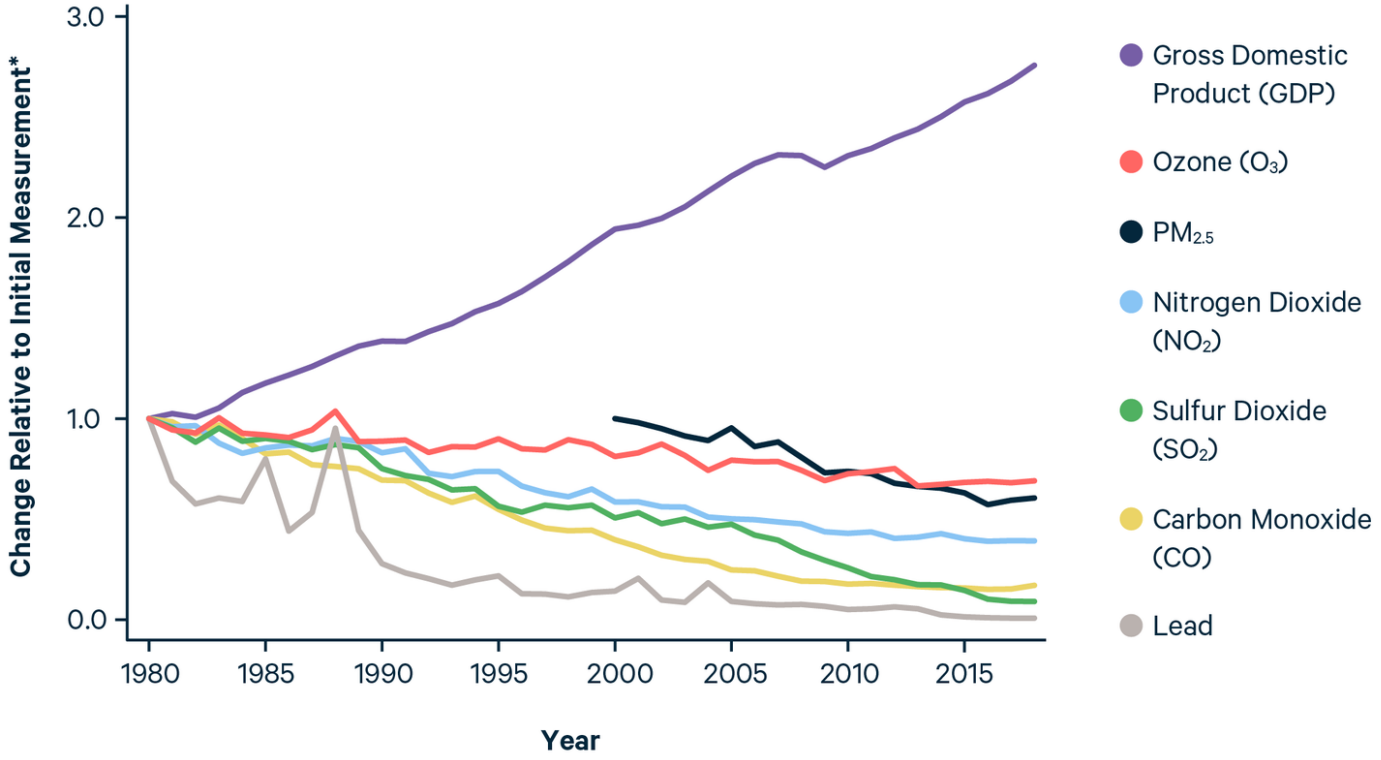
The air quality in the US has improved over the years!

The Clean Air Act of 1970

Figure credit:
shipandshore.com

Change in Gross Domestic Product and Six Common Air Pollutants, 1980-2018

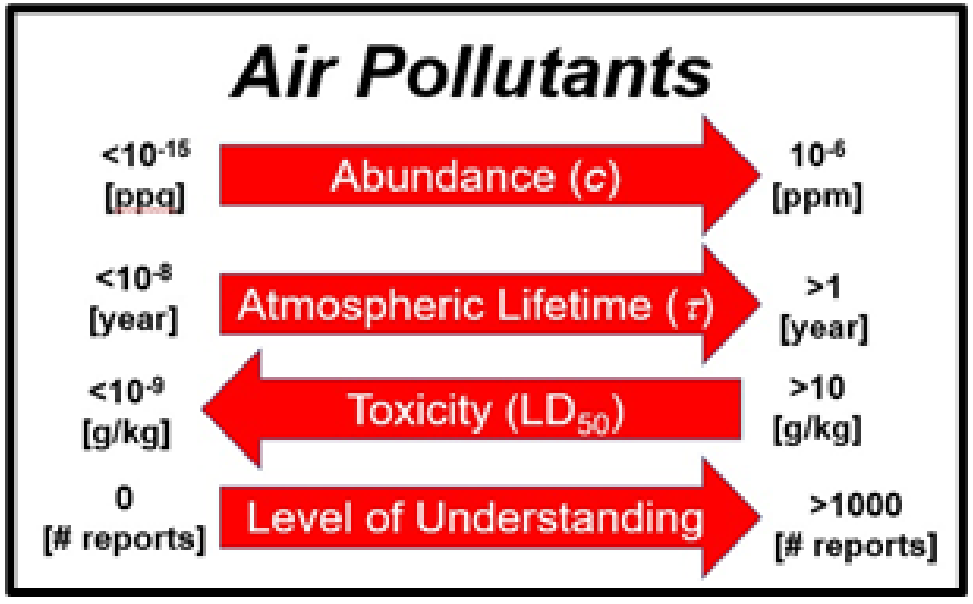
RFF



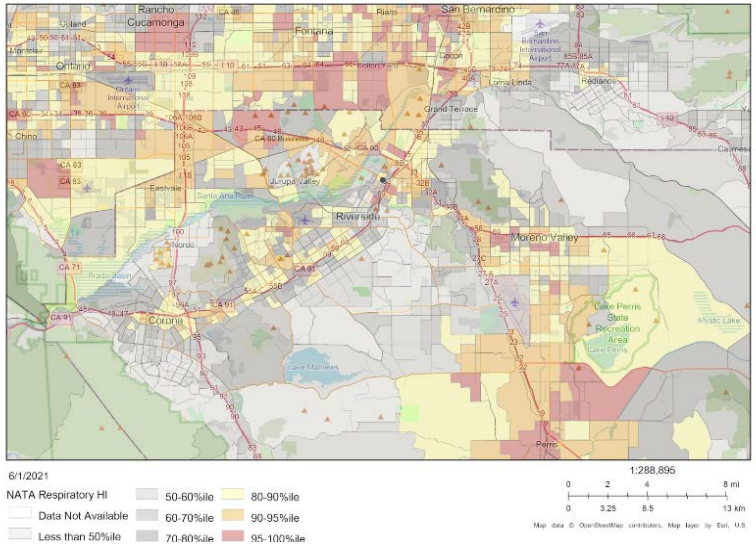
*The index begins at 1 in 1980, with the exception of PM2.5, which was measured beginning in 2000. The index for each year is the actual value divided by the initial value. Source: Federal Reserve Economic Data | Federal Reserve Bank of St. Louis

Figure credit: rff.org

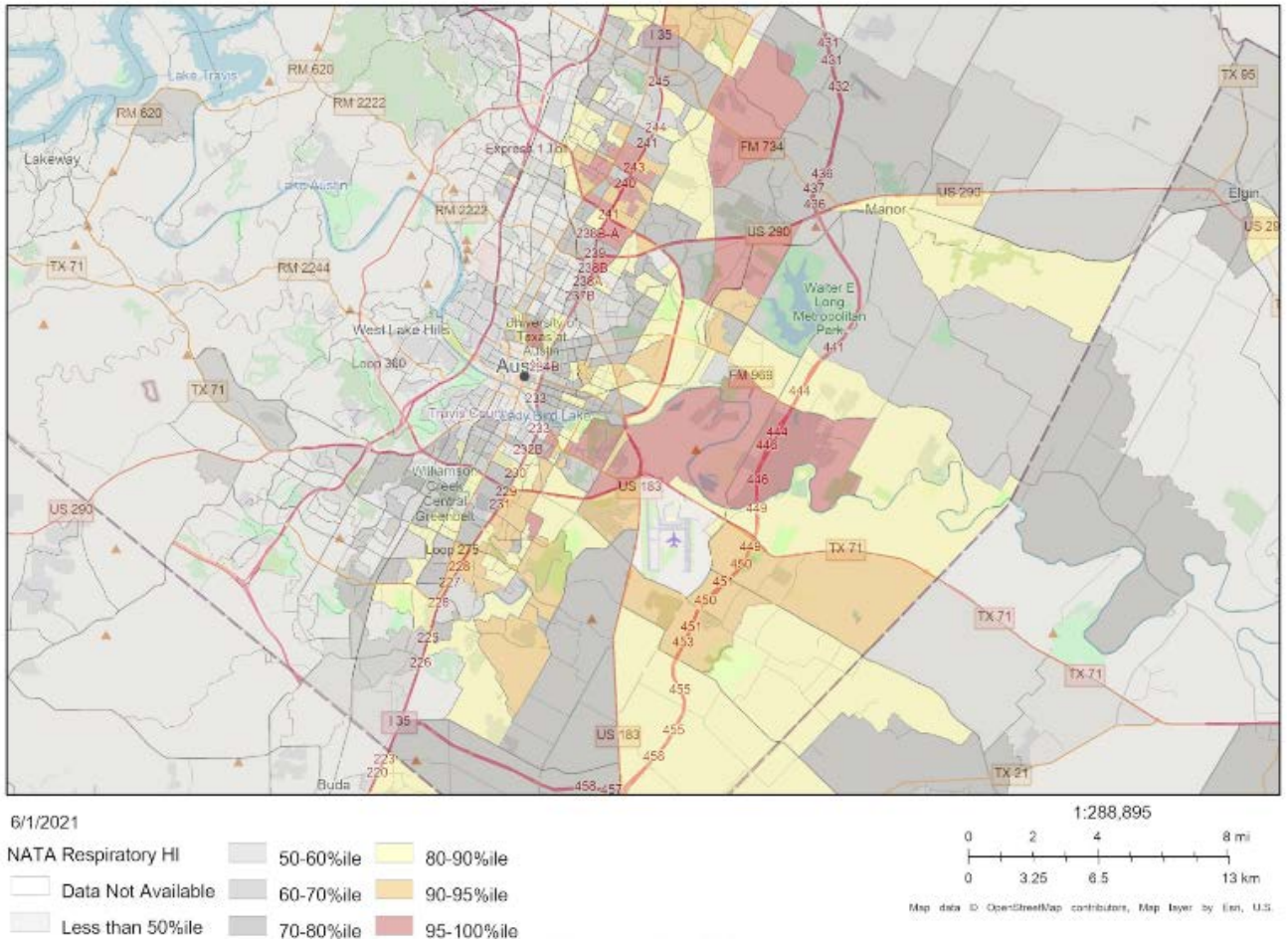
Why do we need novel air quality measurements?



Riverside, CA



Austin, TX



Need to map out exposure zones to air toxics and odorous chemicals that may be toxic at low concentrations

HOUSTON CHRONICLE

LOCAL // ENVIRONMENT

Lubrizol smell in Harris County blamed on chemical that air monitoring couldn't detect

Emily Foxhall, Staff writer

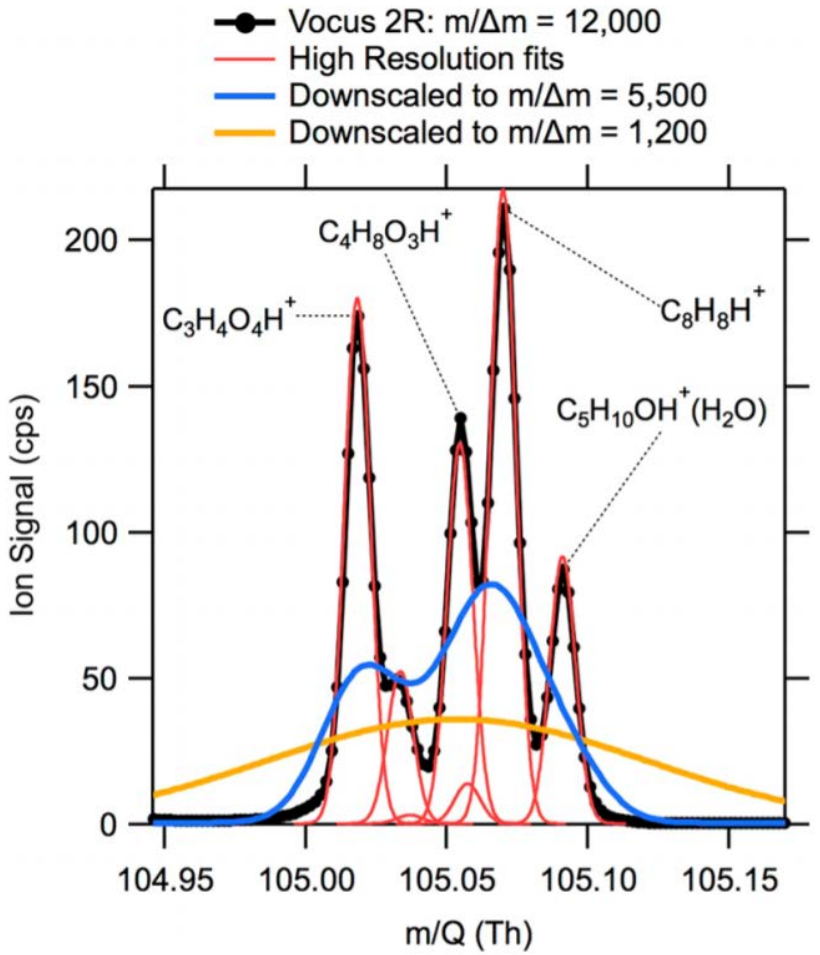
Aug. 24, 2021 | Updated: Aug. 24, 2021 2:44 p.m.

Novel methods of “sniffing” chemical composition

Vocus 2R PTR-ToF (The “Sniffer”)

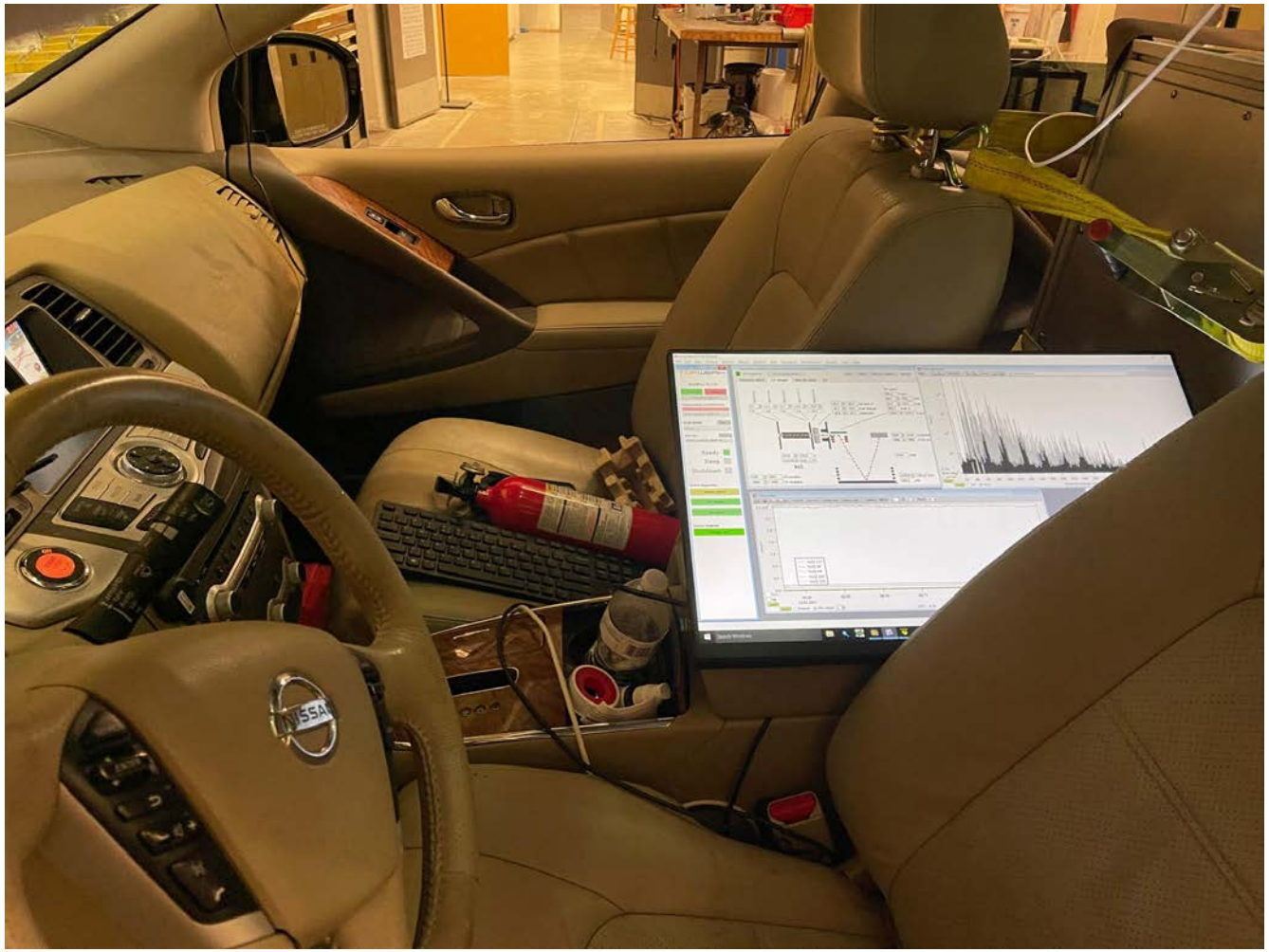
$H_3O^+ + R \rightarrow RH^+ + H_2O$
Soft chemical ionization (proton transfer)

- Real Time (<1 s)
- Ultra-high mass resolution
- Sensitive to a broad range of compounds
- Limit of detection <1 ppt
- >1000 compounds measured at once
- Revolutionary applications in medical, environmental and industry



Krechmer et al, Anal. Chem. 2018, 90, 20, 12011−12018

First Pilot Mobile Measurements
in Austin and region (Spring 2021)



May 14

¿Qué es ese olor?

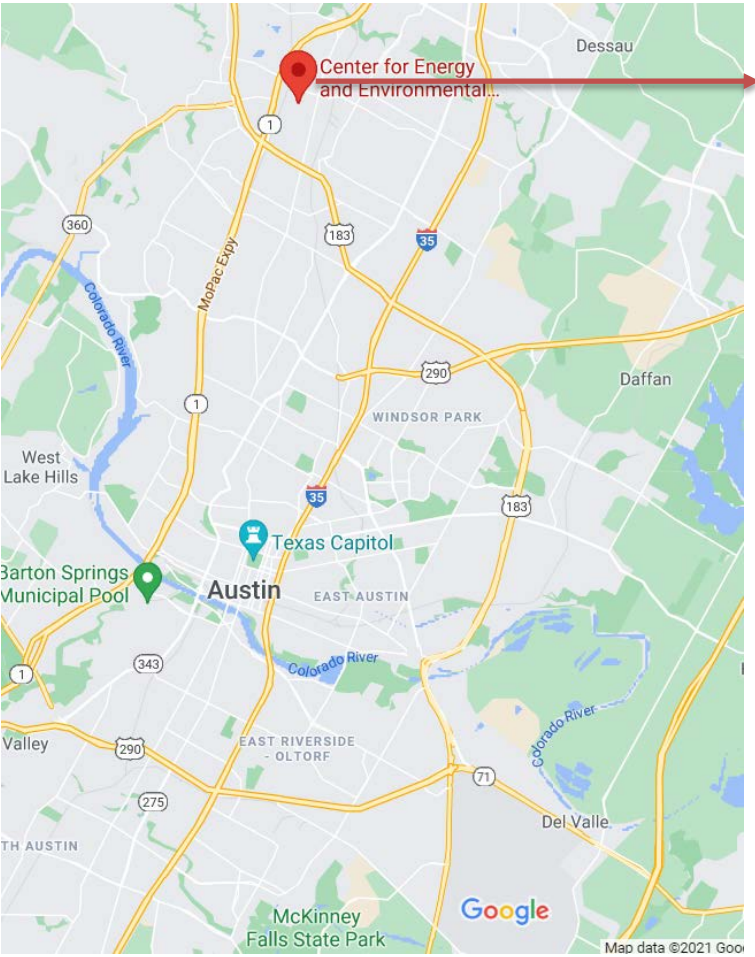
By Mary Huber

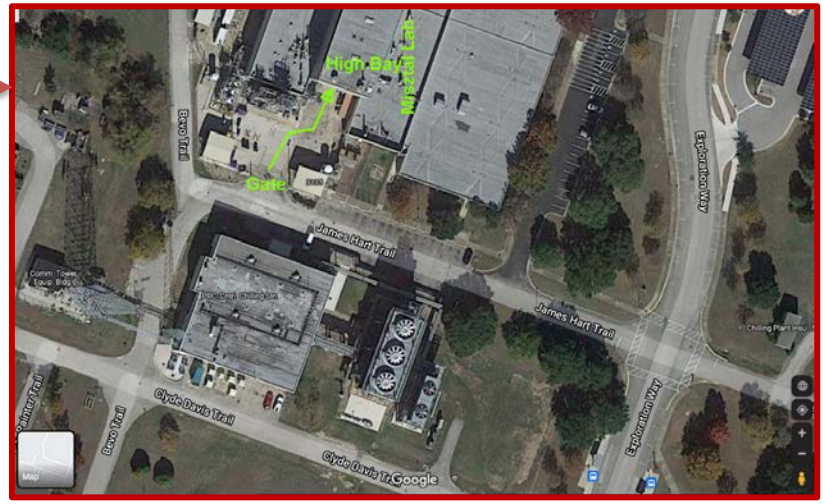
El nitrógeno y el oxígeno constituyen el 99 % del aire que respiramos, pero eso no es todo lo que da vueltas a nuestro alrededor mientras transcurre

https://medium.com/whole-communities-whole-health/whats-that-smell-f252621a420b

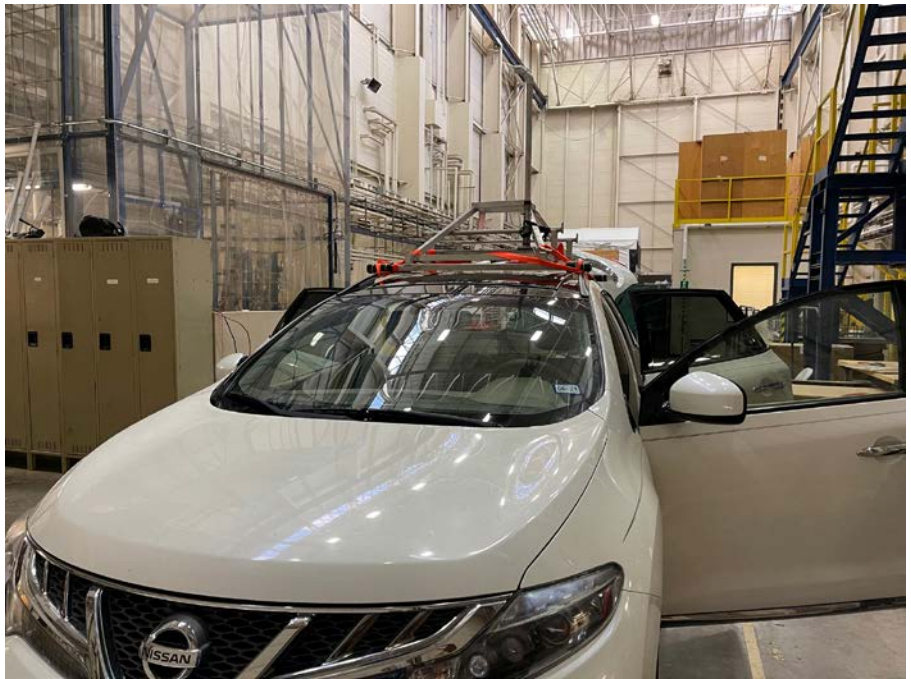
Misztal Sniffer Lab

Center for Energy and Environmental Resources (CEER)



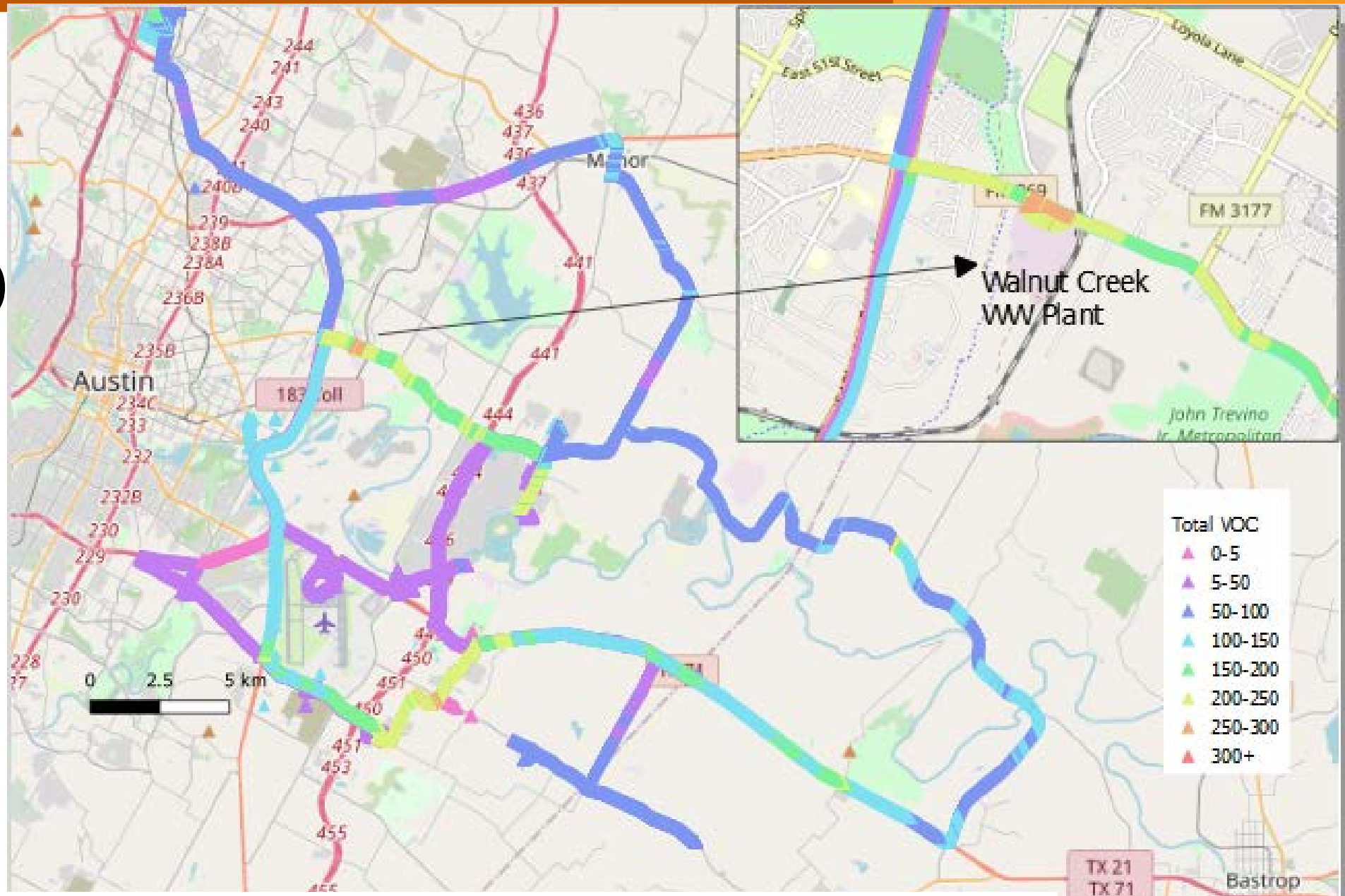


High Bay at CEER and Mobile Lab SUV



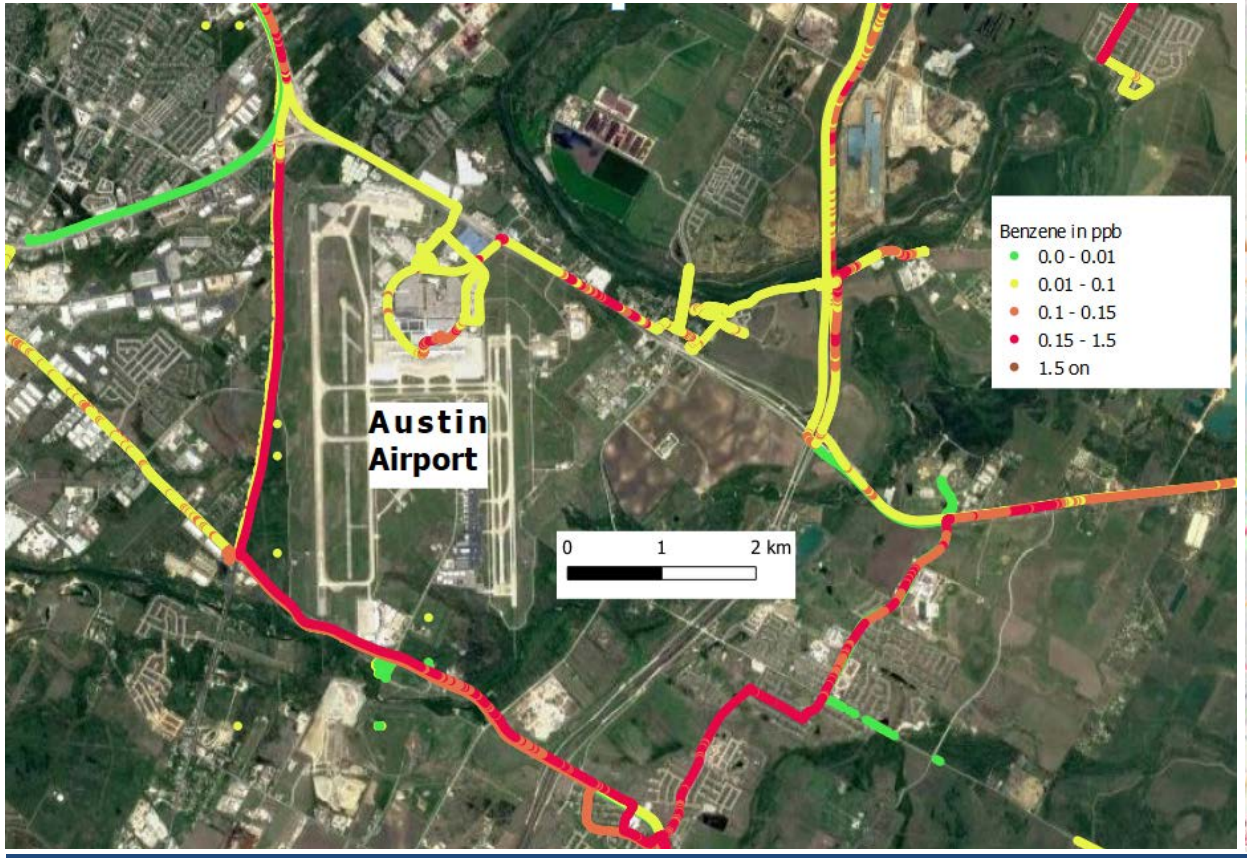
Total Volatile Organic Compounds (Σ of >1000 VOCs)

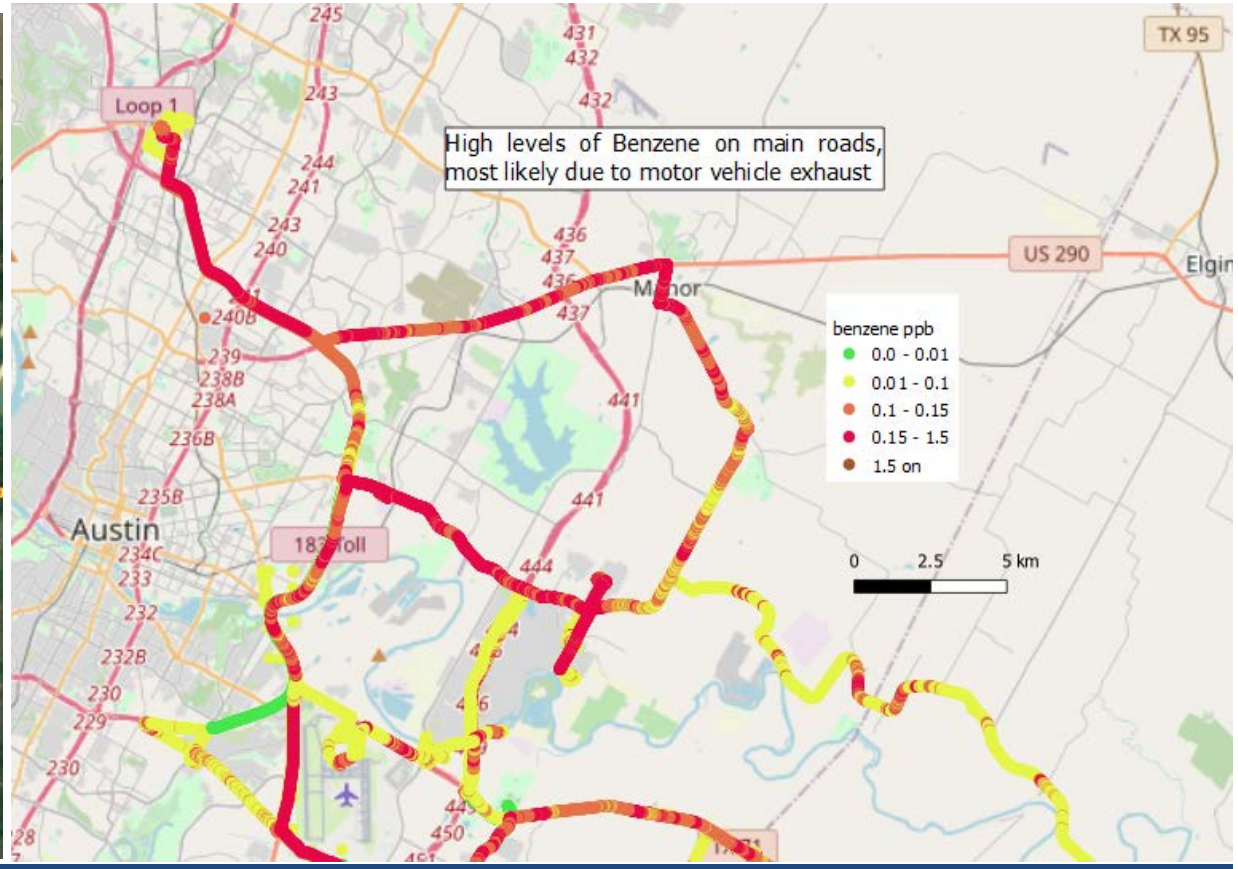
- Elevated VOCs WSE of the airport
- Major TVOC hotspot near WC WWTP
- Overall, the outdoor concentratrations lower than indoor concentrations (typically >1000 ppb)



UT Austin - Misztal Group – Preliminary data (Robertson et al., in prep.)

What are the sources of benzene in Austin?





Benzene emissions seem to originate from road sources, asphalt and tail pipe (cold engine). Jet fuel signature seen near the airport.

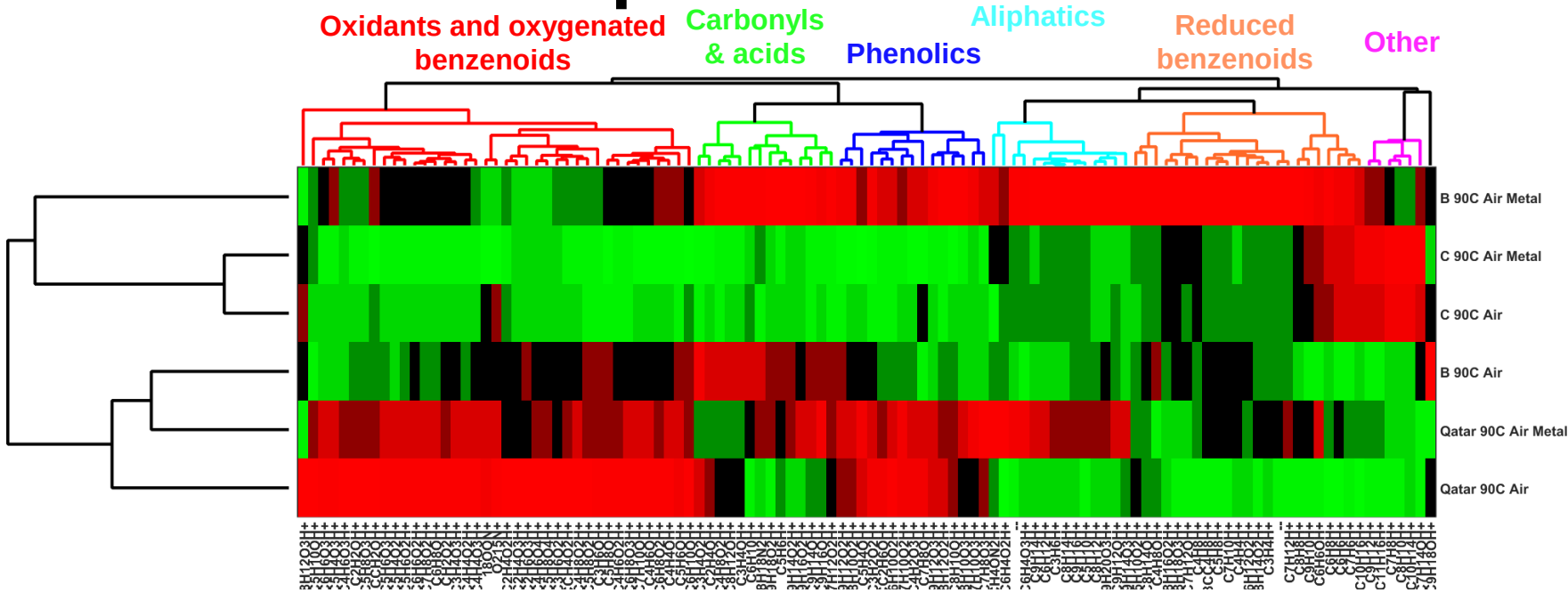
Science Advances

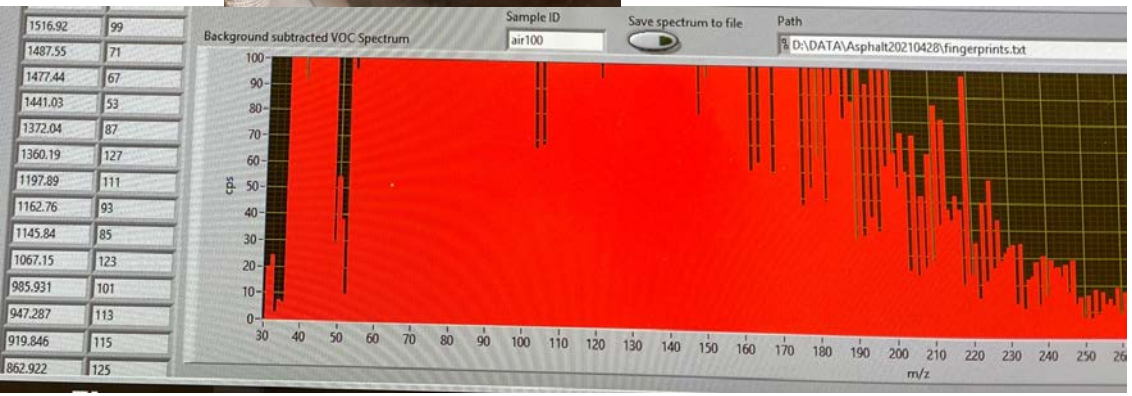
RESEARCH ARTICLE | ATMOSPHERIC SCIENCE

Asphalt-related emissions are a major missing nontraditional source of secondary organic aerosol precursors

PEEYUSH KHARE, JO MACHESKY, RICARDO SOTO, MEGAN HE, ALBERT A. PRESTO, AND DREW R. GENTNER Authors Info & Affiliations

What is the chemical “DNA” of asphalts?





- Fingerprinted emissions of many asphalts (collab. with Prof. Bhasin).
- Asphalt is one of the chemically most complex mixtures.
- Emissions exponentially dependent on temperature.

Asphalt Plant in Residential Zone Close to Communities?

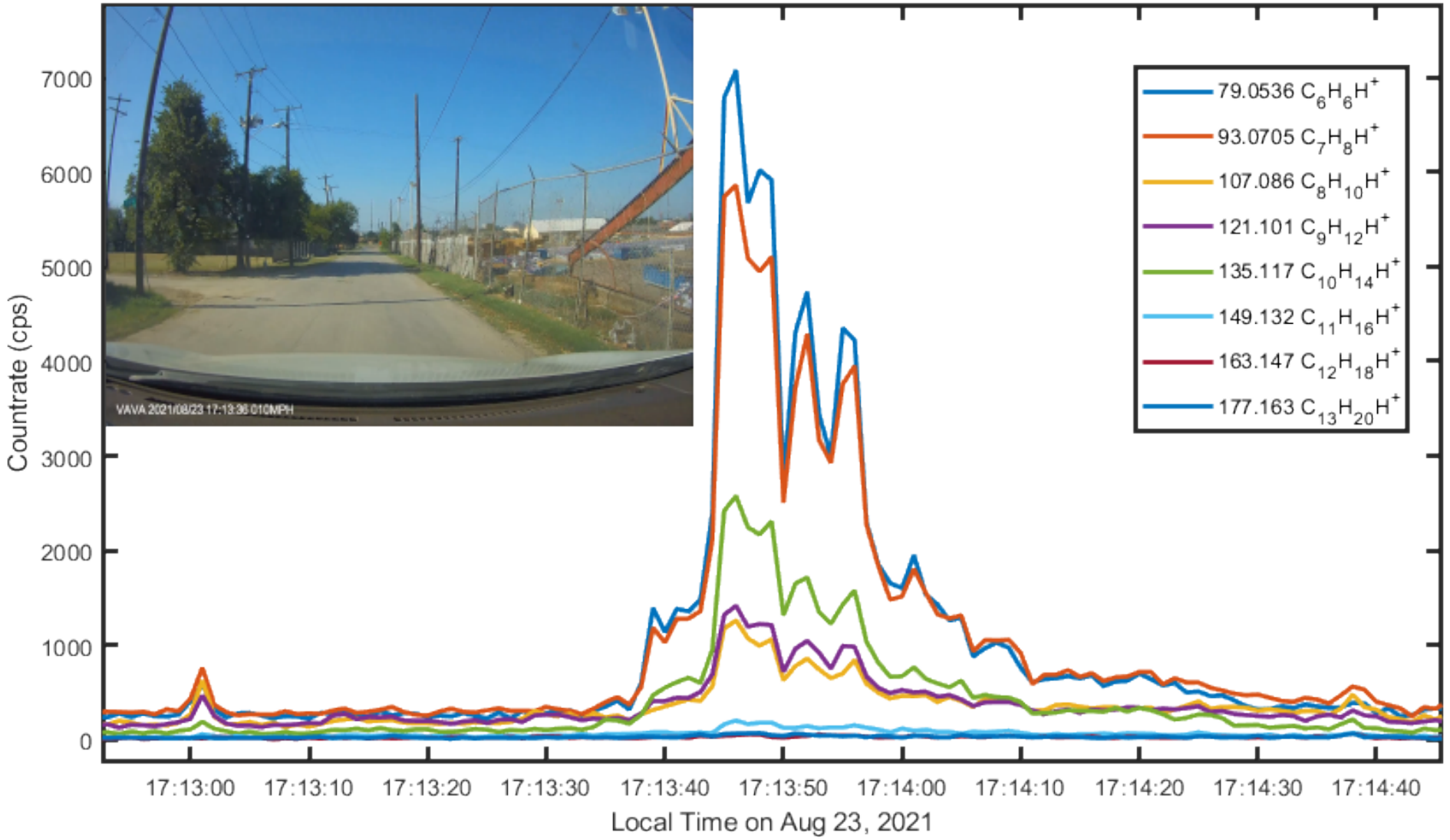
Search
The Dallas Morning News

Decades after closure of lead smelter, voices rise against other West Dallas polluters

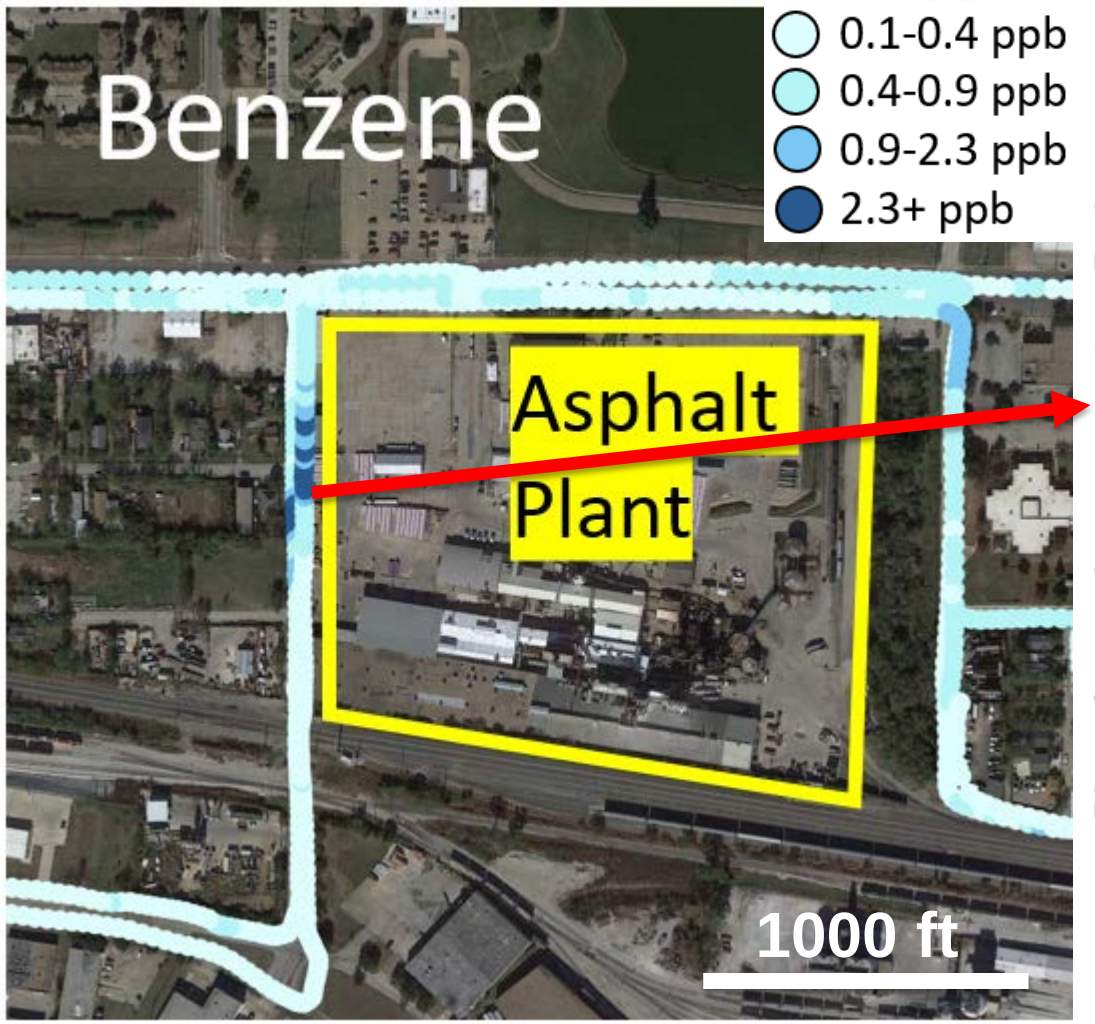
Residents say a shingle plant located near homes, a school and a library branch poses potential

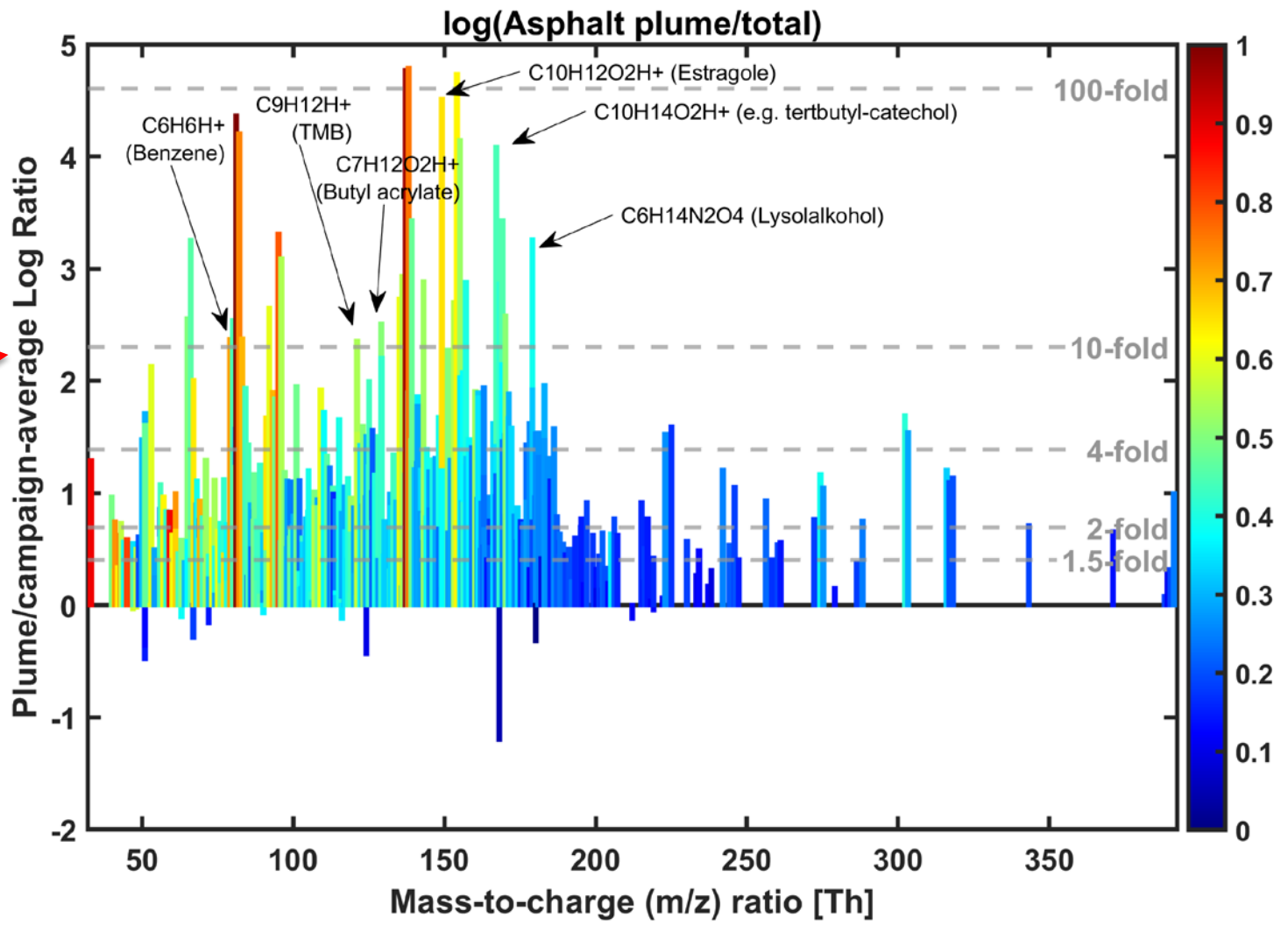
Fingerprinting Pollution Plumes Close to Communities

What is the chemical composition of asphalt plume?

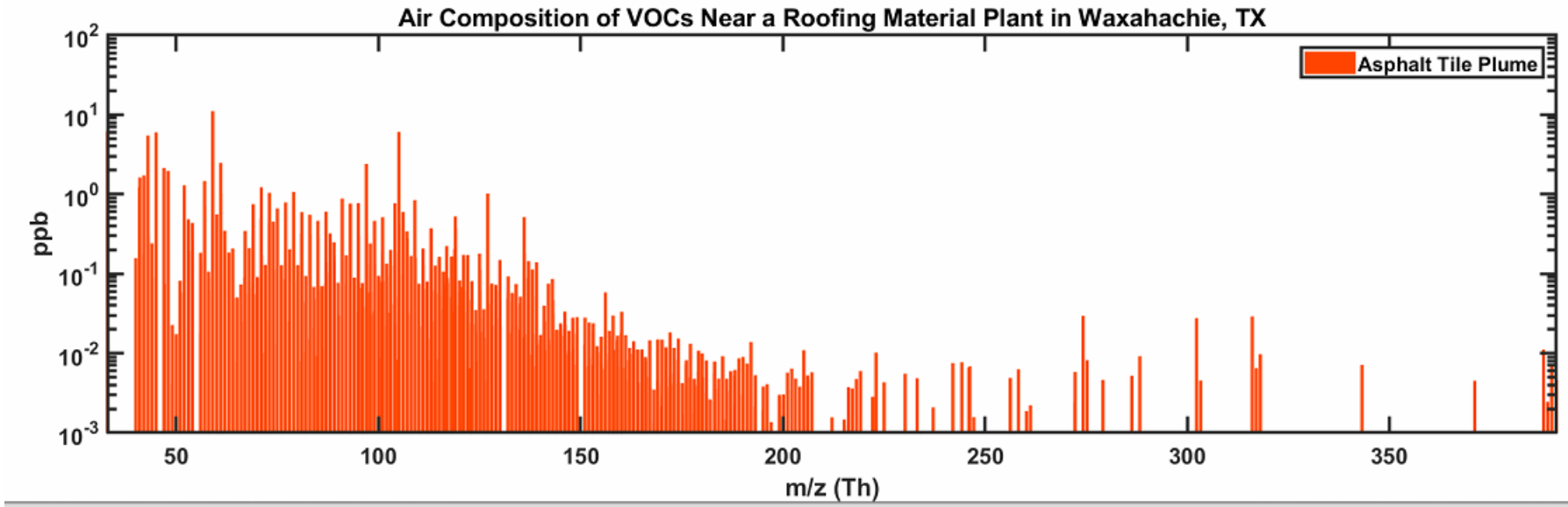


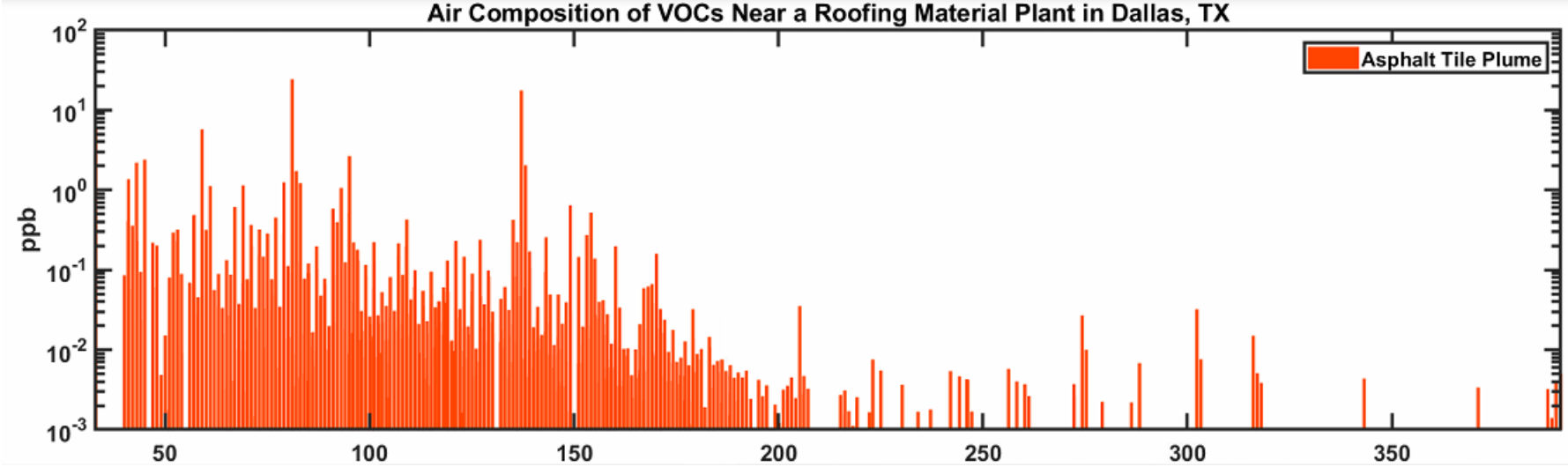
What is the chemical fingerprint of asphalt plume?





How do asphalt manufacturing plumes differ?



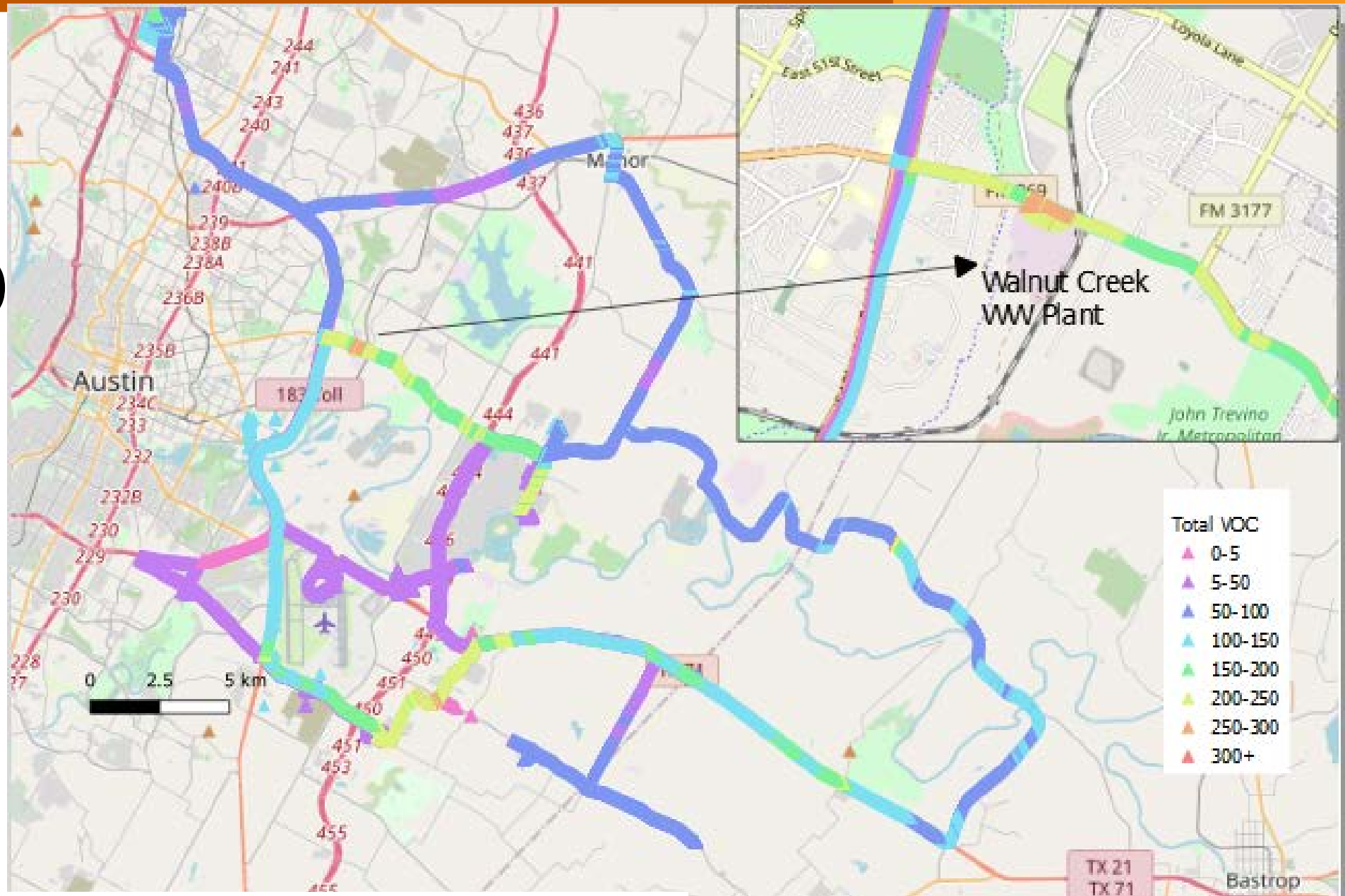


Similar chemical signatures of asphalt plumes in Dallas and Waxahachie. The Dallas plant fingerprint was richer in potentially cleaning product emissions

Total Volatile Organic Compounds (Σ of >1000 VOCs)

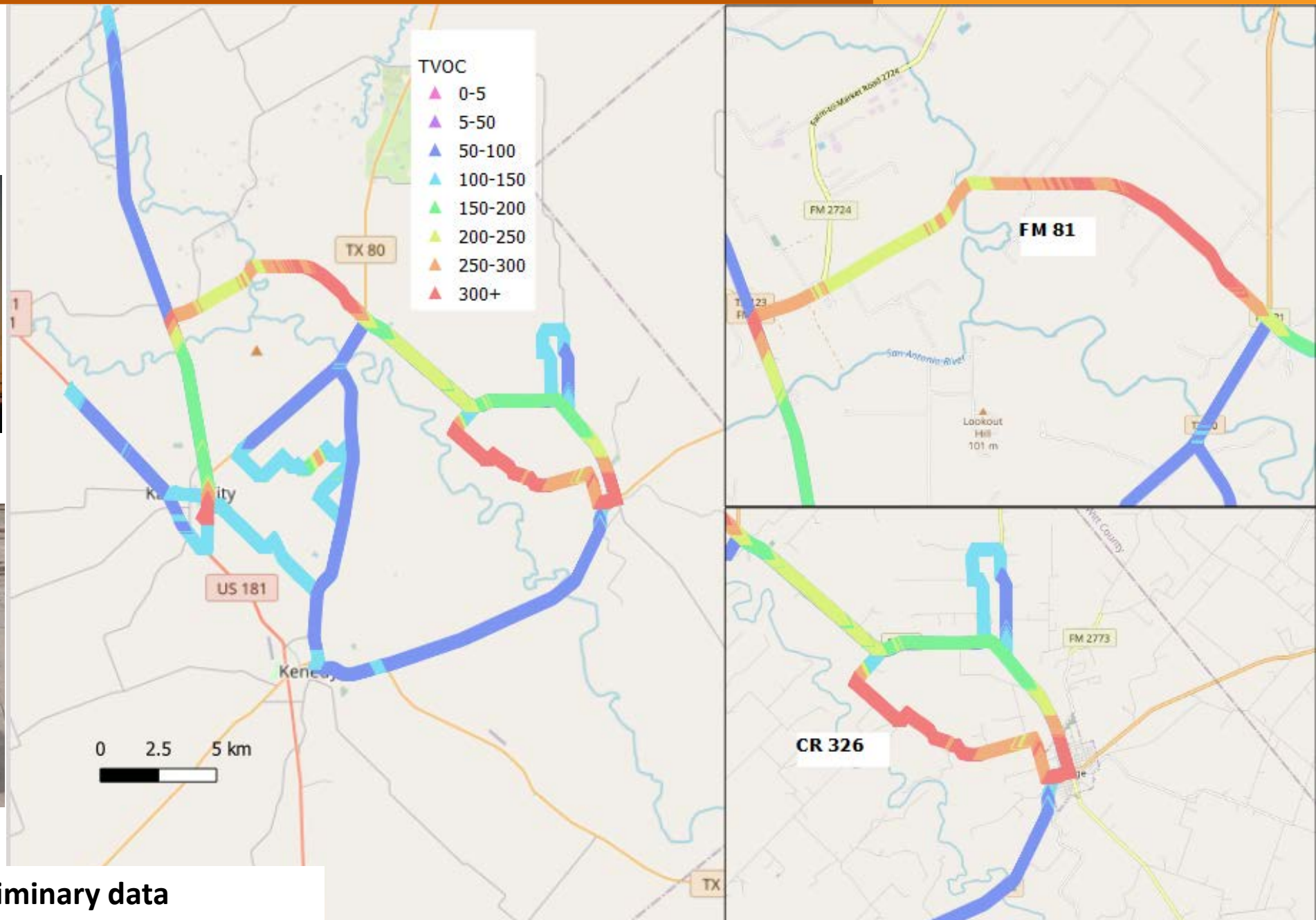
Much lower concentrations in Austin than at Karnes City close to oil and gas extraction activities

Needs to understand low concentration pollutants, O3, and PM precursors.



UT Austin - Misztal Group – Preliminary data

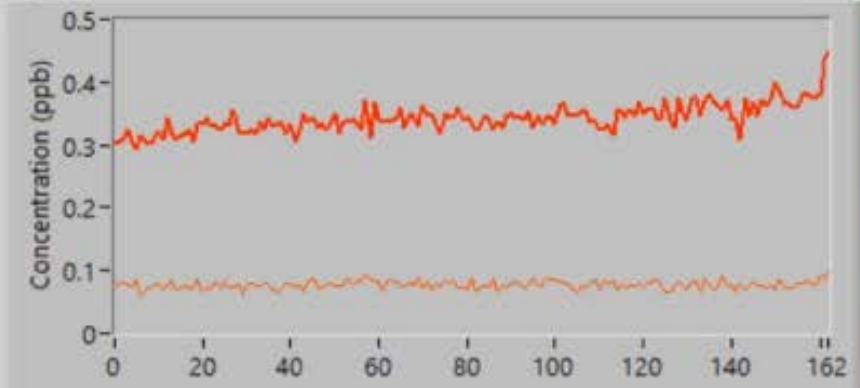
Total Volatile Organic Compounds (ΣVOC) at Karnes City Oil & Gas Extraction region



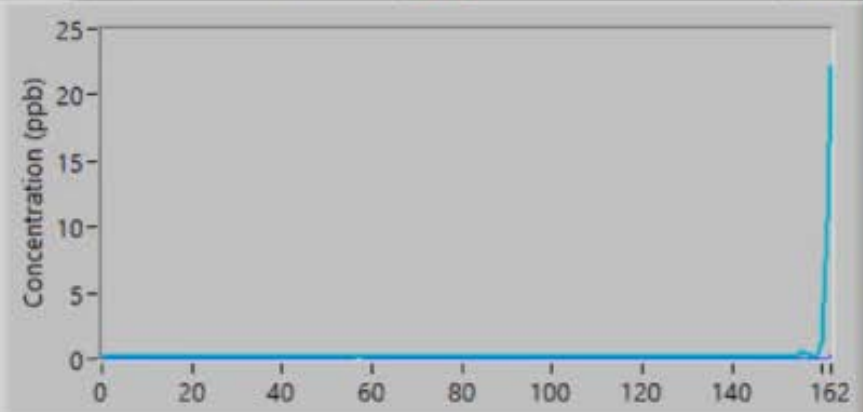
UT Austin - Misztal Group – Preliminary data

Mobile Sniffer Dashboard v.1

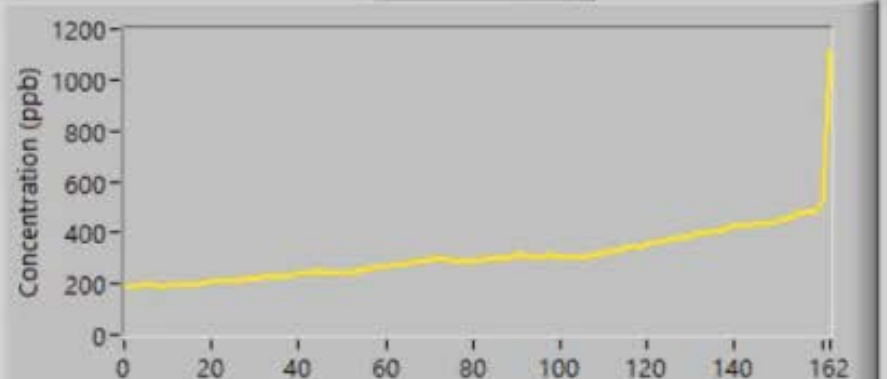
C2H6SH+(DMS) C4H4O2H+ (Dioxin)

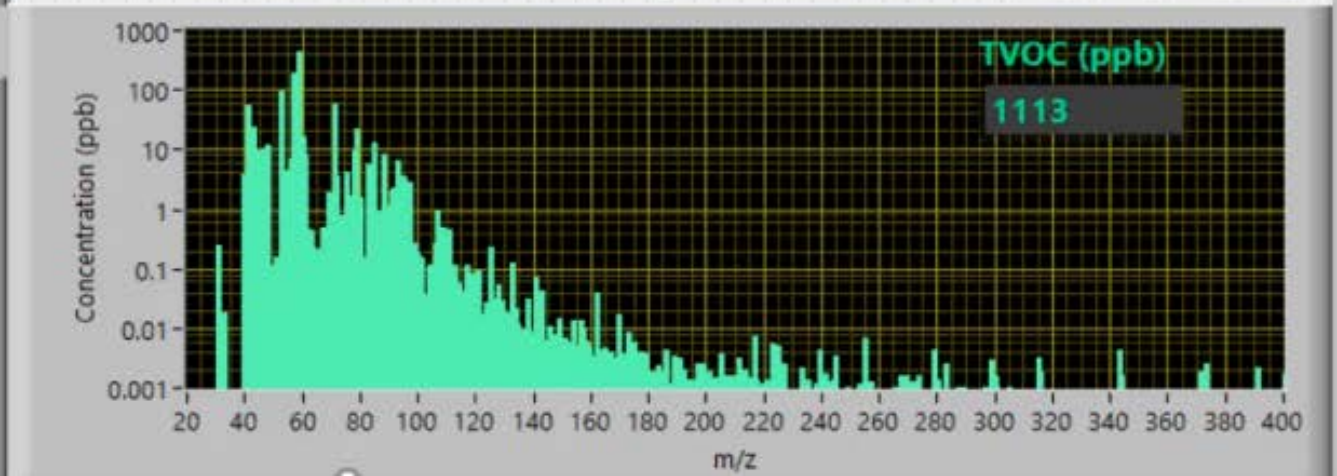


C6H6H+ (Benzene) C8H8H+ (Styrene)



TVOC



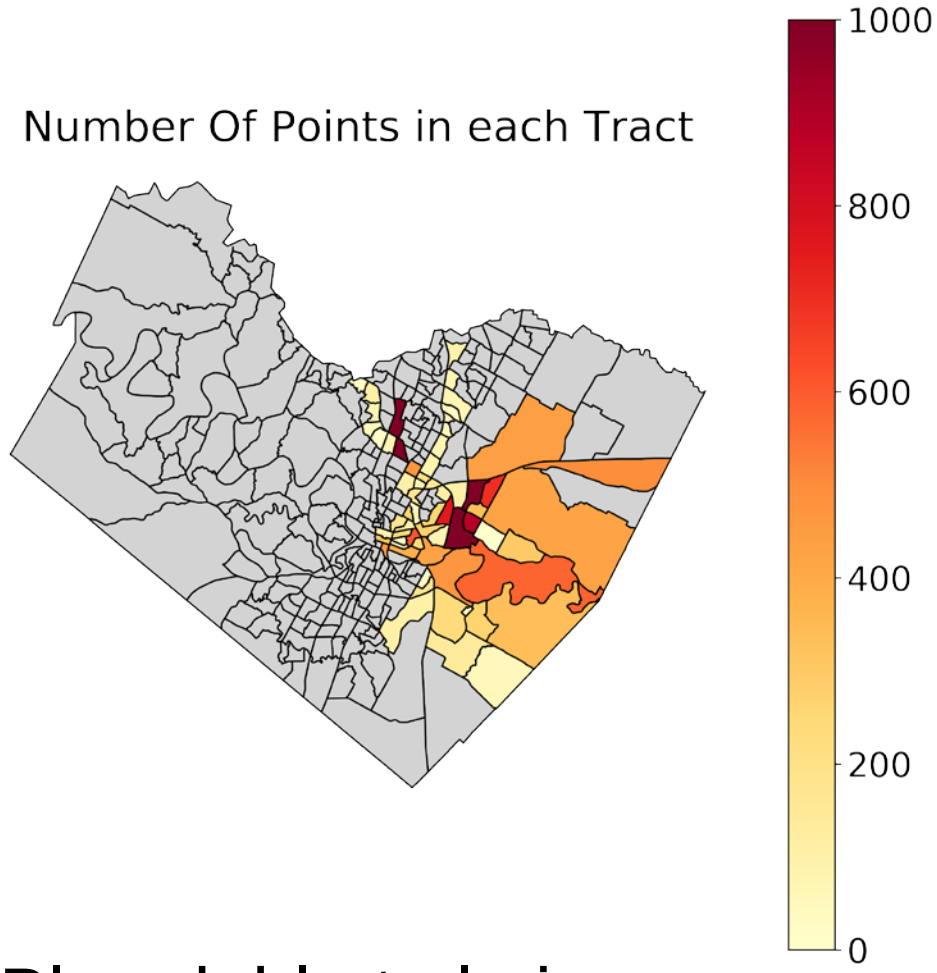


Current Most Abundant

m/z	ppb
59.049	437.891
57.070	186.239
53.003	95.346
71.086	59.015
41.039	55.928
57.034	36.511
43.018	24.016
79.056	22.168
60.053	16.332
71.013	13.185
85.102	12.475
47.997	11.576
46.990	10.191
45.033	9.643
78.048	9.224
58.074	8.514
61.029	8.109
88.041	7.996
56.059	6.825
93.071	6.401
83.087	5.636
42.010	5.351
54.006	4.326
75.045	4.019
40.026	3.852
60.021	3.705
72.090	3.480
95.050	3.450
97.103	2.738
44.023	2.325
92.063	2.277
91.055	2.001
58.040	1.906
69.071	1.881
77.061	1.662

The future directions to understand air quality, EJ, and health

Average mobile sniffer data per census tract



Blomdahl et al., in prep.

Summary and open questions

- **Conducted first spatiotemporal mapping of VOC composition from a mobile platform in Austin and the region. Air quality differs spatially and temporally.**

- **What is the role of heated asphalts for AQ and health?** Our data are consistent with Khare et al. (2021, Science Adv.) suggesting that asphalt emissions exceed those from motor vehicles on national scale. Asphalt plants, and other pollution sources, should be located far from residential communities.

- **Where are the pollution hotspots in Austin and where do they correlate with adverse health effects?** → Census tract averaging.

- **Not the compound but the dose makes the poison.** Needs to analyze the detected compounds for toxicity (e.g. COMPTOX) and quantify community exposure.

- **We are looking forward to synergies with AQPF, CAPCOG, the City of Austin, WCWH. Suggestions for pollution hotspots to fingerprint are welcome.**

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Thank You!

ACKNOWLEDGEMENTS

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Mobile Sniffer team: Daniel Blomdahl, Rileigh Robertson, Mitch Thompson, Sam Lin
Kerry Kinney, Clint Leysath, Darla Castelli, Shirene Garcia, and others
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BEE and ChemE colleagues
Atila Novoselac
Dev Niyogi for WRF met data
Lea Hildebrandt-Ruiz and group

Building Energy Environments

WHOLE COMMUNITIES WHOLE HEALTH
A UT Grand Challenge




We are happy to collaborate!

UT Austin Building Energy and Environments (BEE)