The University of Texas at Austin
McKetta Department
of Chemical Engineering
*Cockrell School of Engineering*

**January 29, 2025**

## HEI Webinar: The TRACER Collaboration Part I

# Predictive, source-oriented modeling and **measurements** to evaluate community exposures to air pollutants and noise from unconventional oil and gas development

Lea Hildebrandt Ruiz, Associate Professor (lhr@che.utexas.edu)
Pawel Misztal, Assistant Professor (misztal@utexas.edu)
David Allen, Professor (allen@che.utexas.edu)

# UT Austin Team

Lea Hildebrandt Ruiz
**UT Austin**

**Measurements**
**Stakeholder Engagement**
**Modeling**

Pawel Misztal
**UT Austin**

**Measurements**

David Allen
**UT Austin**

**Modeling**
**Stakeholder engagement**

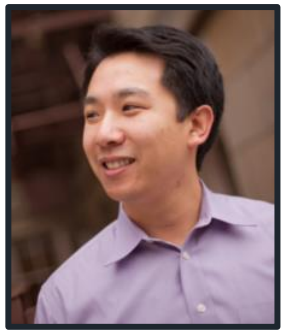
Lucas Henneman
**George Mason U.**

**Exposure modeling**

Elizabeth Matsui
**UT Austin**

**Public Health**

Roger Peng
**UT Austin**



**Biostatistics**

Dr. Yosuke Kimura, Dr. David Sullivan, Dr. Shannon Stokes, Dr. Elena McDonald-Buller, Dr. Leif Jahn, Dr. Mrinali Modi, Joel Graves, Kat Konon, Pearl Abue, Shihao Zhai, Austin Turner, Sewar Almasalha, Sam Lin, Evelyn Deveraux, Daniel Blomdahl, Daniel Sung, Munshi Md Rasel, Mohammadreza Bohloul, RoseAnna Goewey

# UT Austin Project Overview

**Main goal : to generate a broadly applicable community model which can assess exposures to air pollutants from UOGD and inform future health studies**

→ TRACER (TRAcking Community Exposures and Releases) model

Model combines fine-scale spatial-temporal **emission models**, molecular fingerprints of emission sources, and **dispersion modeling**

**Targeted field measurements**, in part to evaluate and refine the model

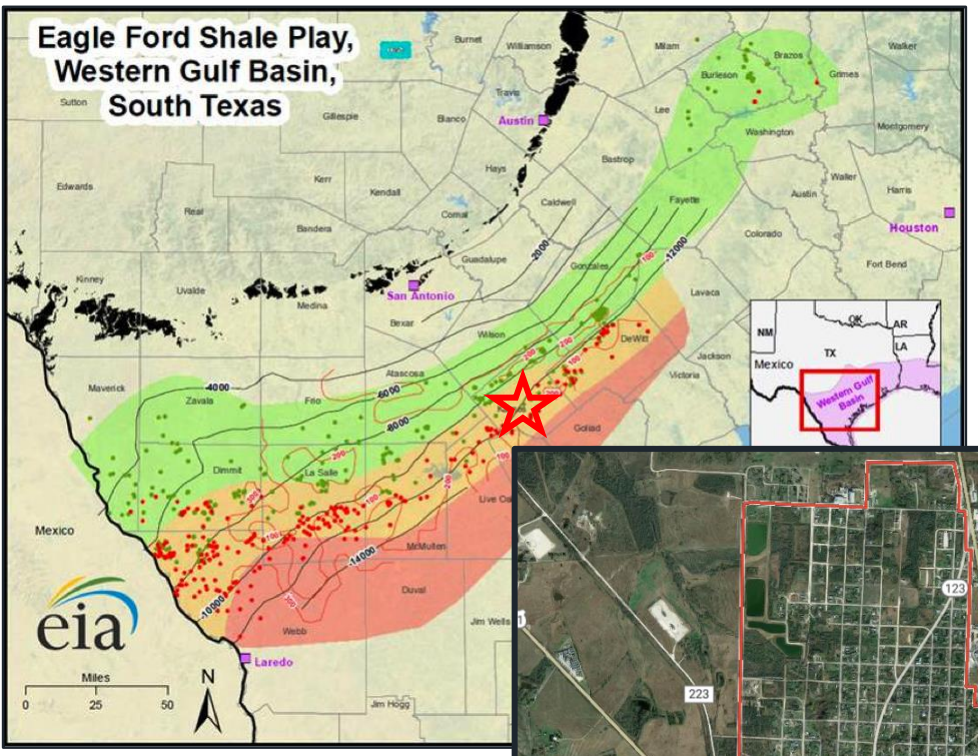
Evaluate exposures, inform future health studies

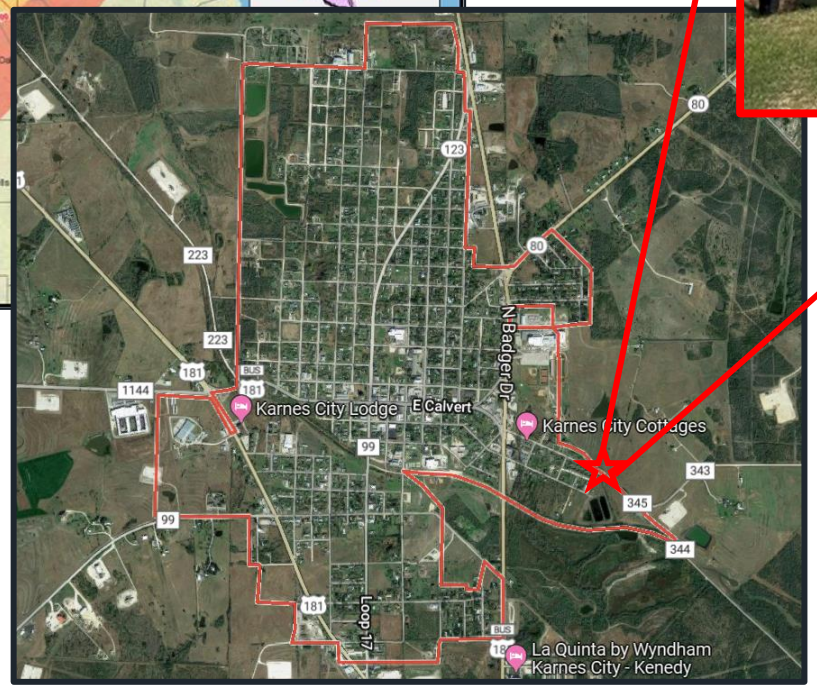
Initial focus on **Eagle Ford Shale**. Project was expanded to include modeling in the **Marcellus Shale** and measurements in the **Permian**

# Project Tasks and Objectives

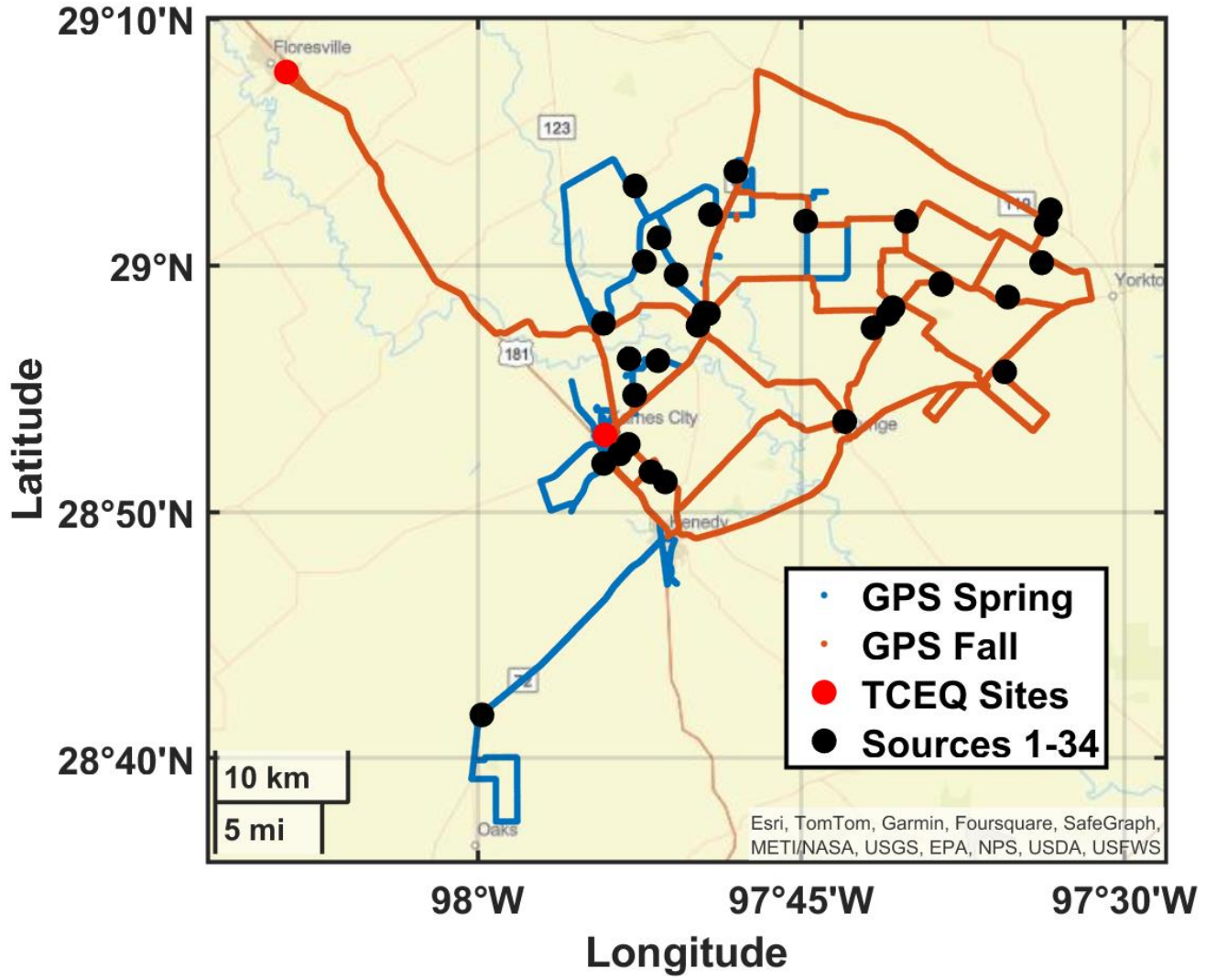
1. **Measurements in the Eagle Ford Shale (Spring and Fall 2023)**
2. **Measurements in the Permian (Spring 2024)**
3. Estimating emissions from UOGD
4. Coupling emissions with dispersion models
5. Coupling emissions with chemical transport models
6. Applying the modeling framework to the Marcellus Shale Region
7. Exposure analysis and implications for future health studies

# Measurements from Stationary and Mobile Platforms (2023)



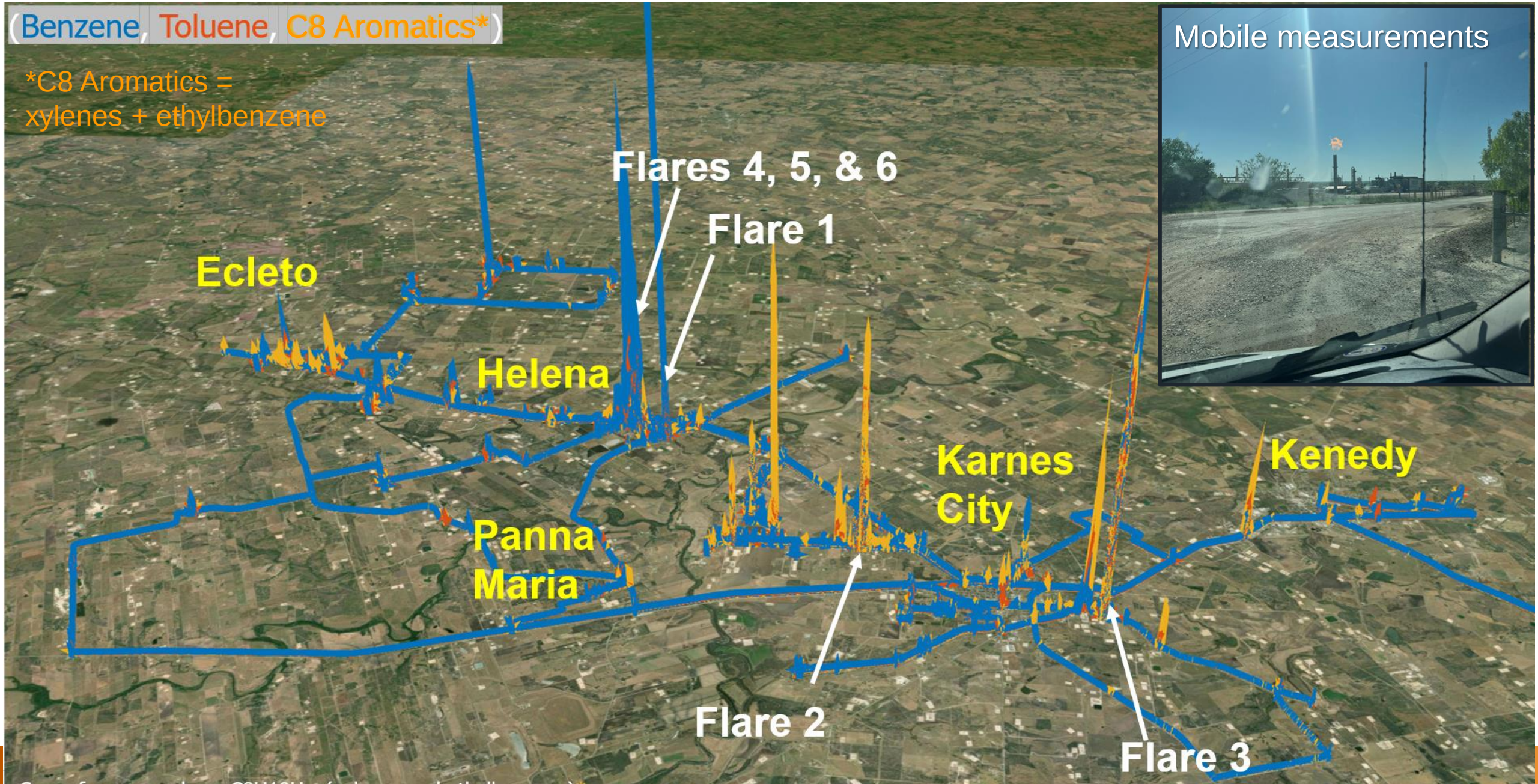




# EFF Measurements. Mobile Platform Took Measurements at 34 Sources (while temporarily stationary)




The 34 sources included active flares, dry and wet gas sources and a petrochemical waste facility.

# Mobile Measurements – Observed Concentration Variations

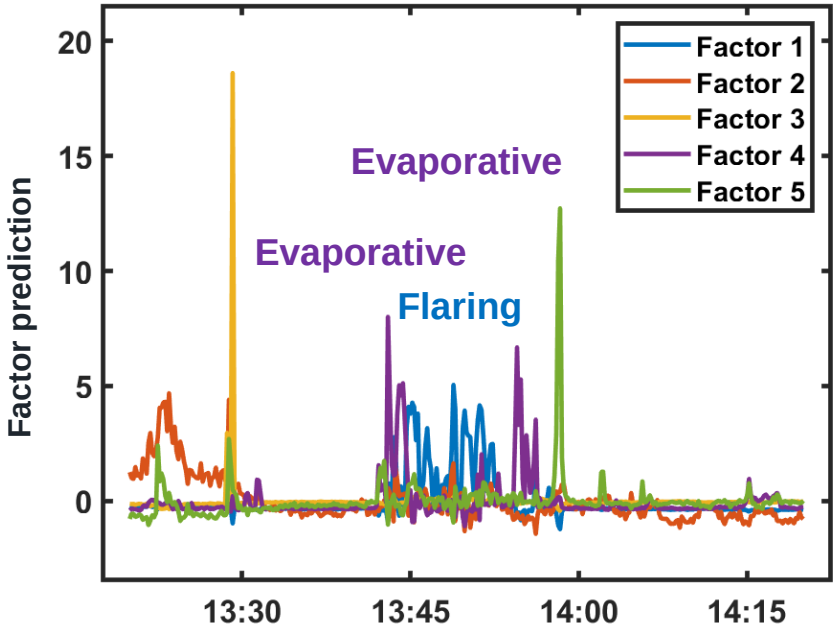


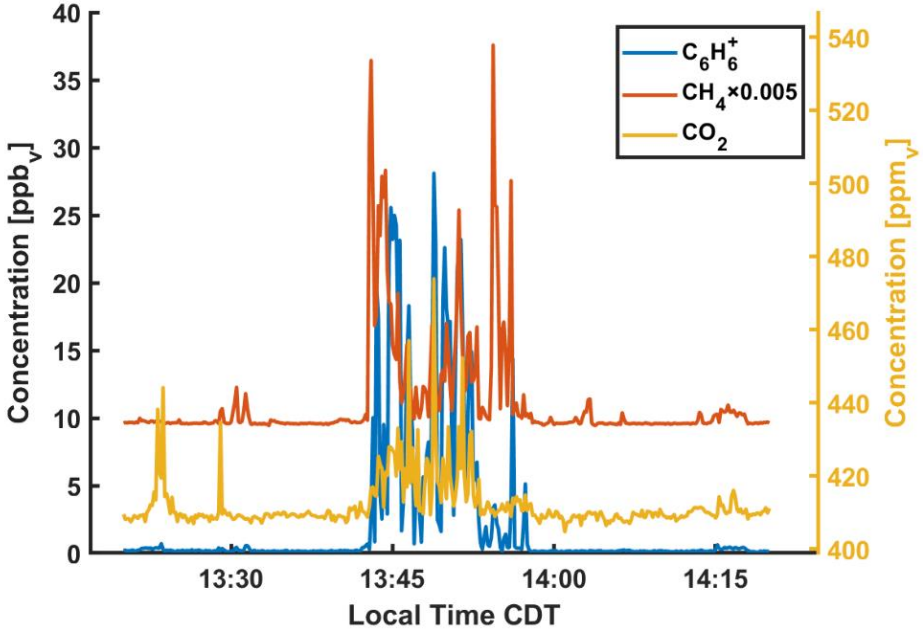
# Flaring vs evaporative emissions – Factor Analysis

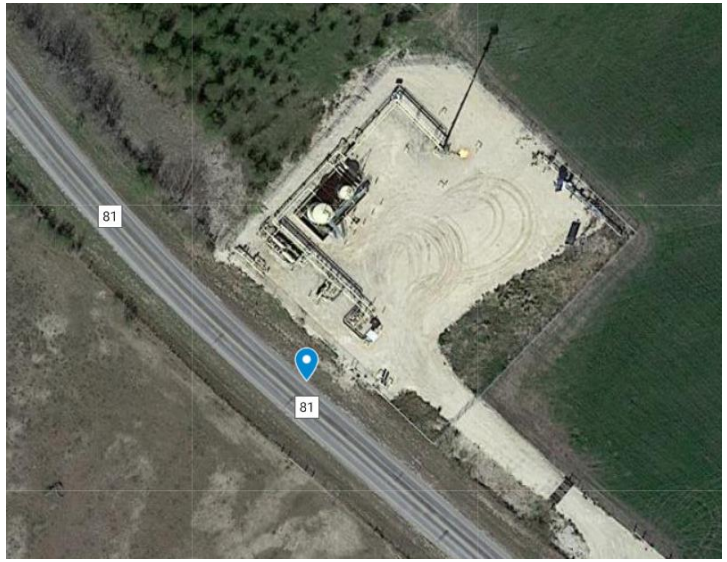
Factor 1 – Flaring
Factor 4 – Evaporative
Factors 2,3,5 – non OG sources

During evaporative plumes benzene and CH4 are correlated but CO2 is not enhanced.

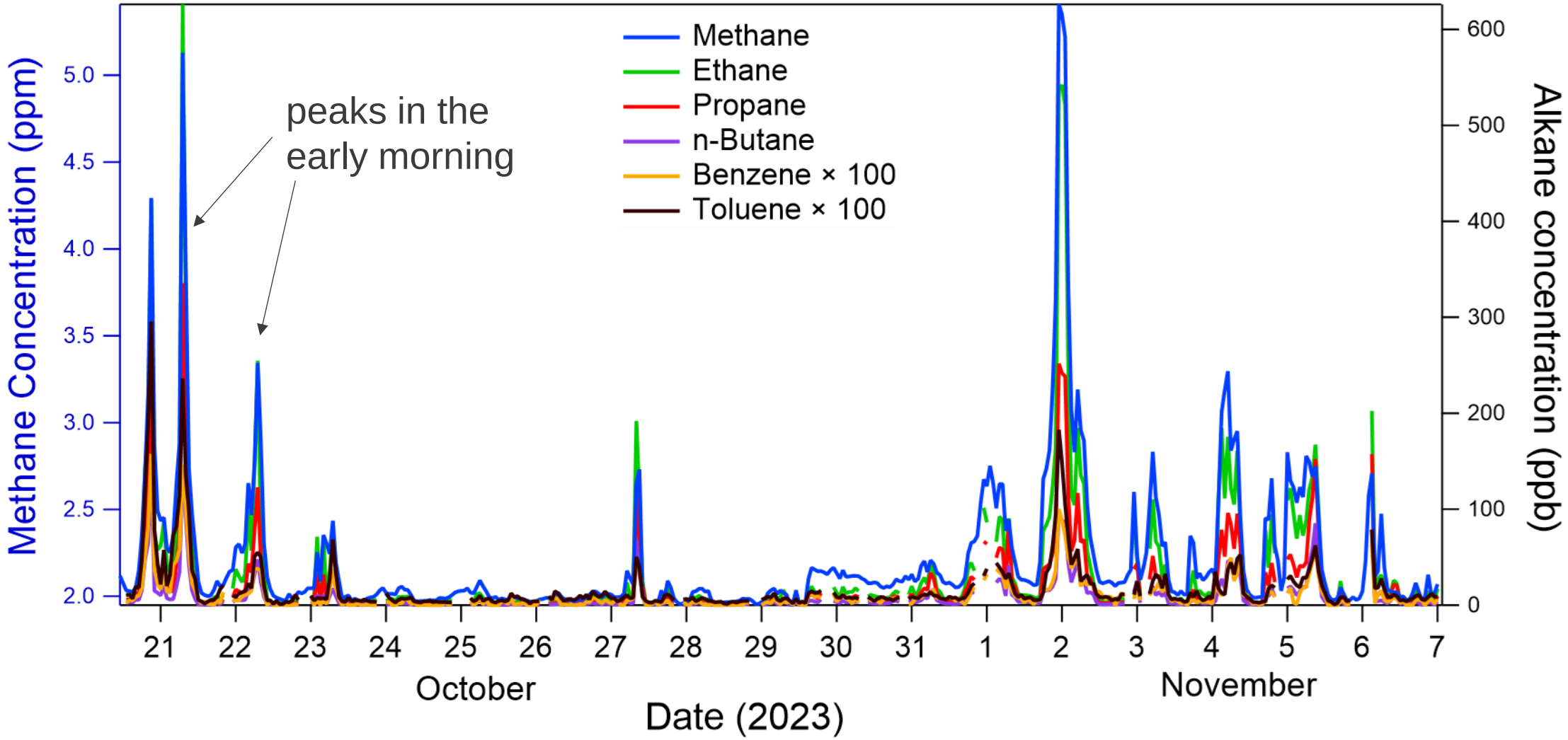
During flaring plumes Benzene, CH4 and CO2 are all correlated and group as distinct multivariate factor



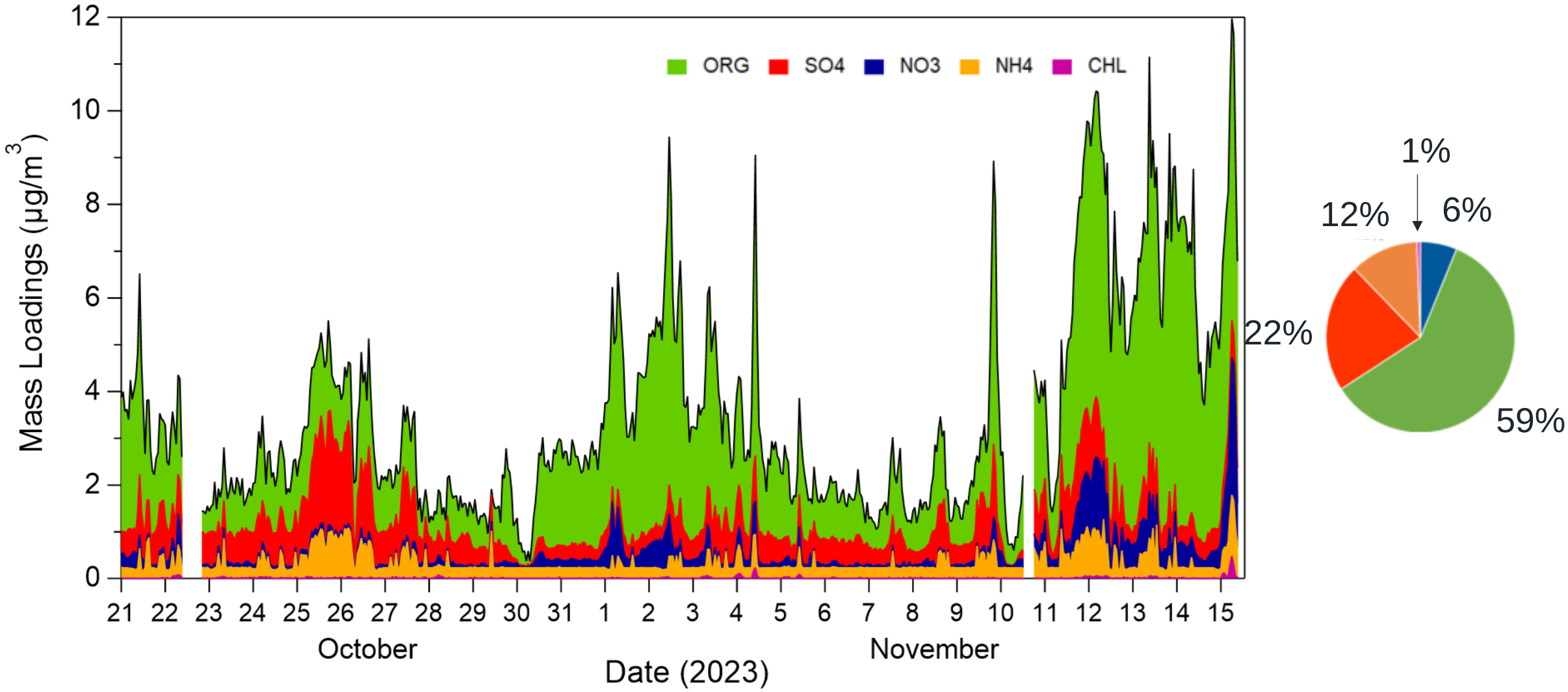



# Stationary Measurements – Periodic Influence of UOGD Emissions at Karnes City Polluted Background Site



# $PM_1$ Concentration and Composition Highly Variable; Higher Concentrations when Air from North/Northeast



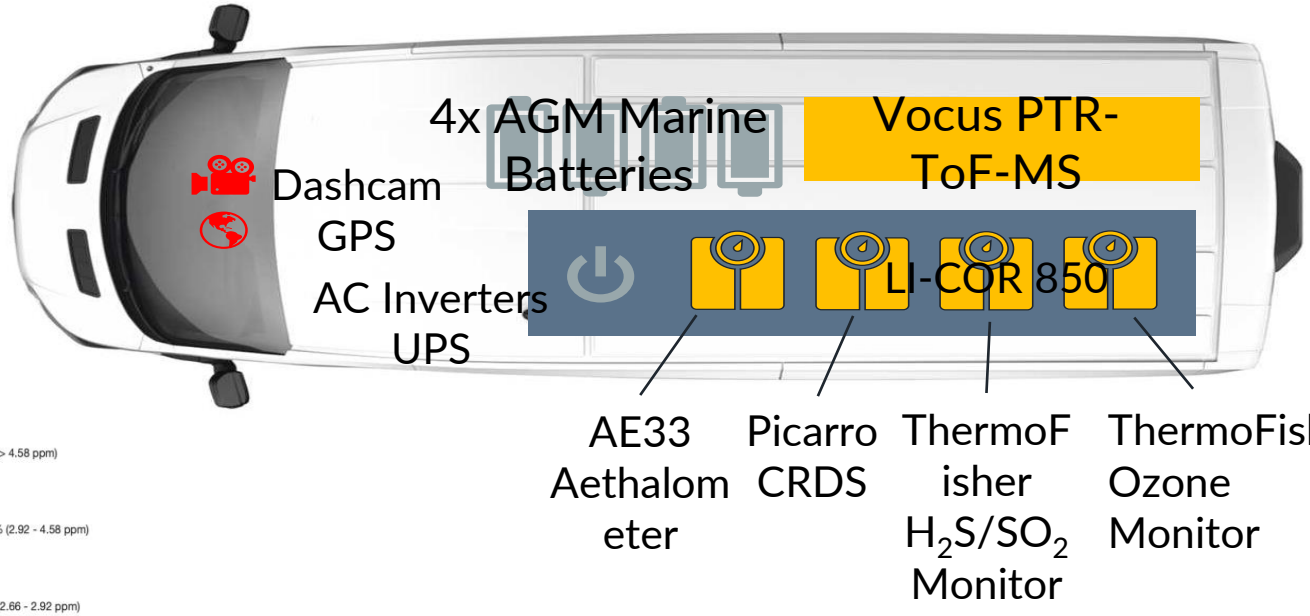
# Measurements in the Permian

Campaign overview

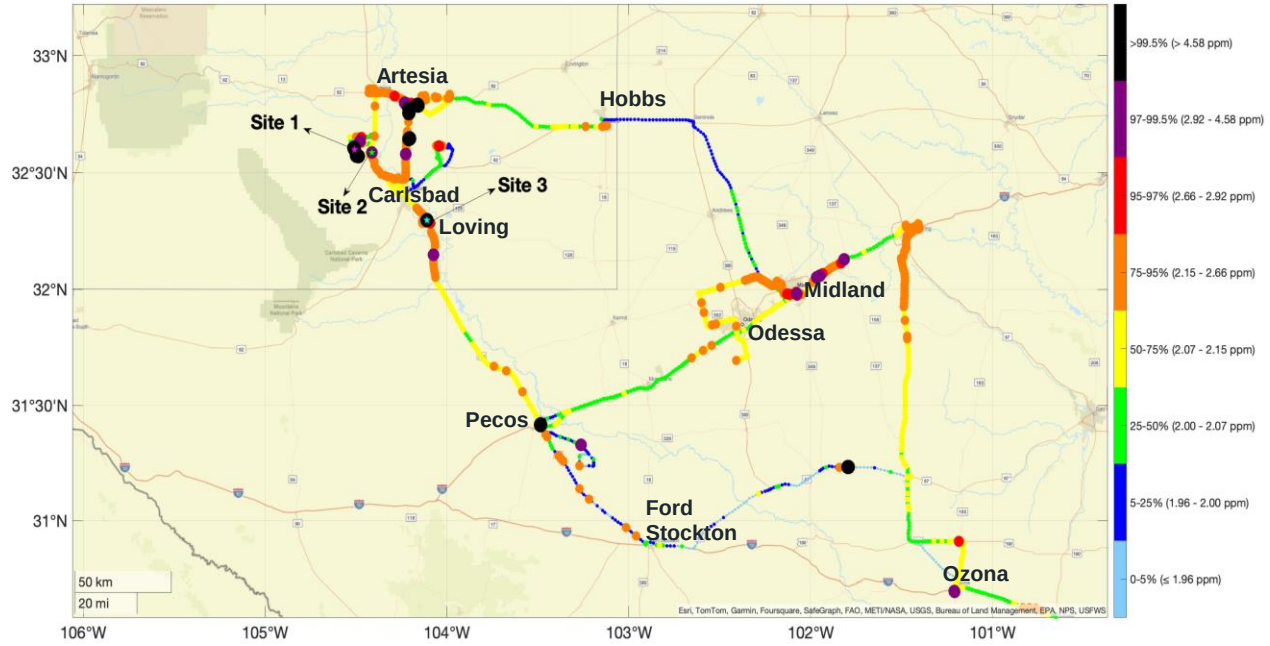
<u>Mobile measurements</u>

April 29 –May 12

2,915 km of data




**Methane Mixing Ratio**




<u>Stationary measurements</u>

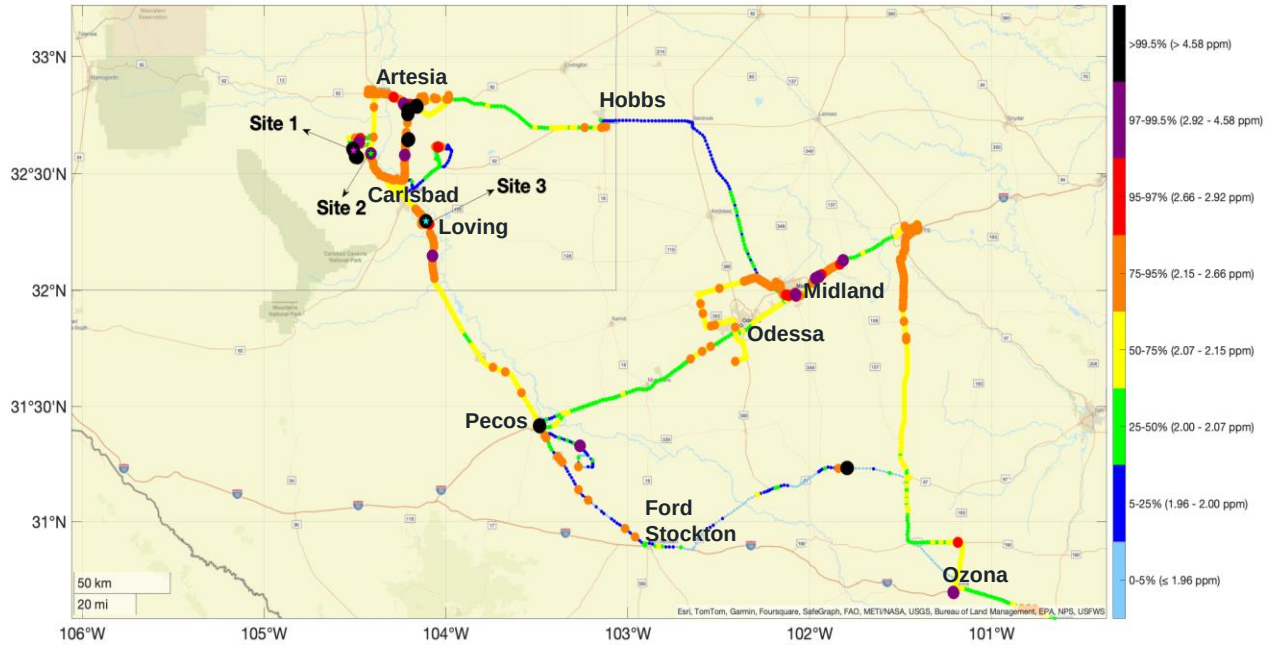
May 7 – May 8: Co-Location with Franklin Site (Site 3)

May 3 – May 4 Community Site – stationary (Site 2)

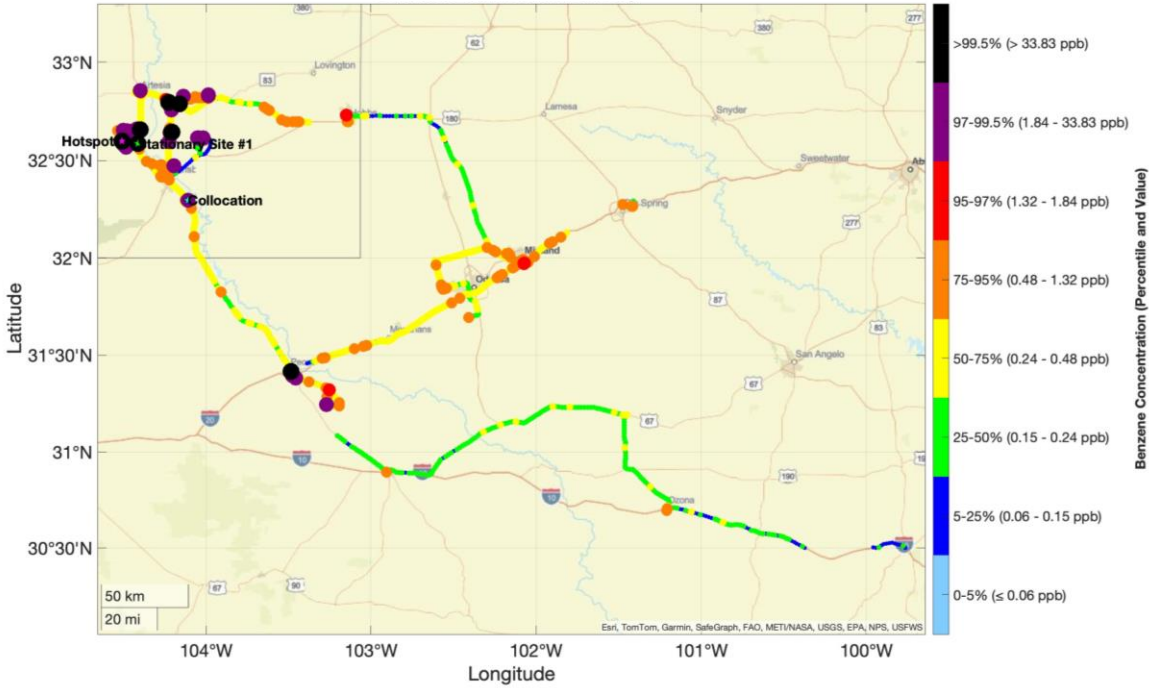
Overnight at Anchor points (Carlsbad, Odessa, Ozona, Pecos)

# Measurements in the Permian

## Methane Mixing Ratio

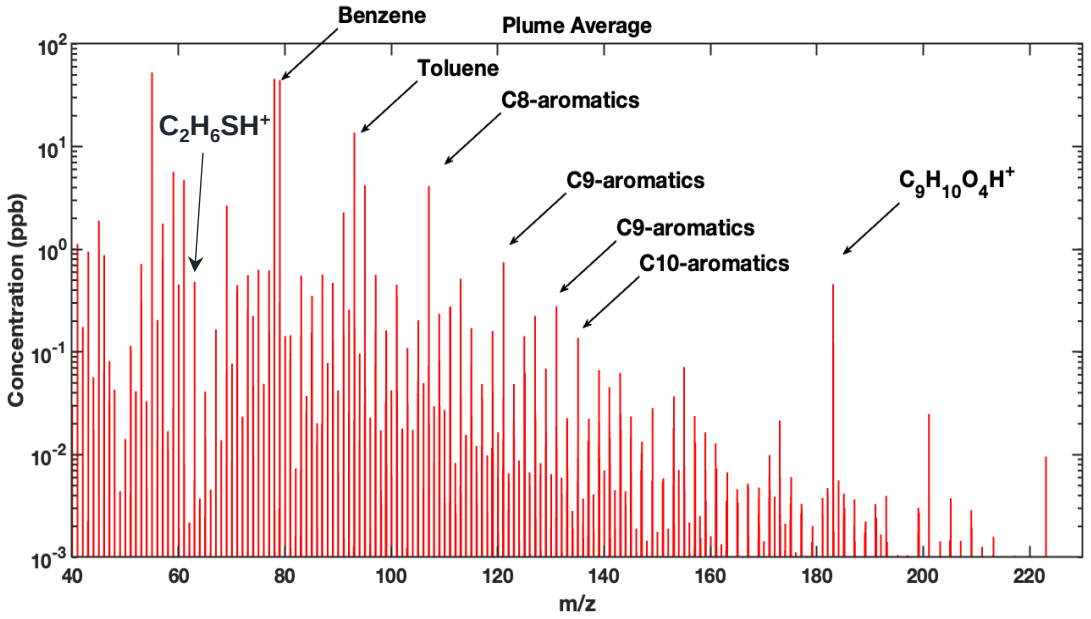


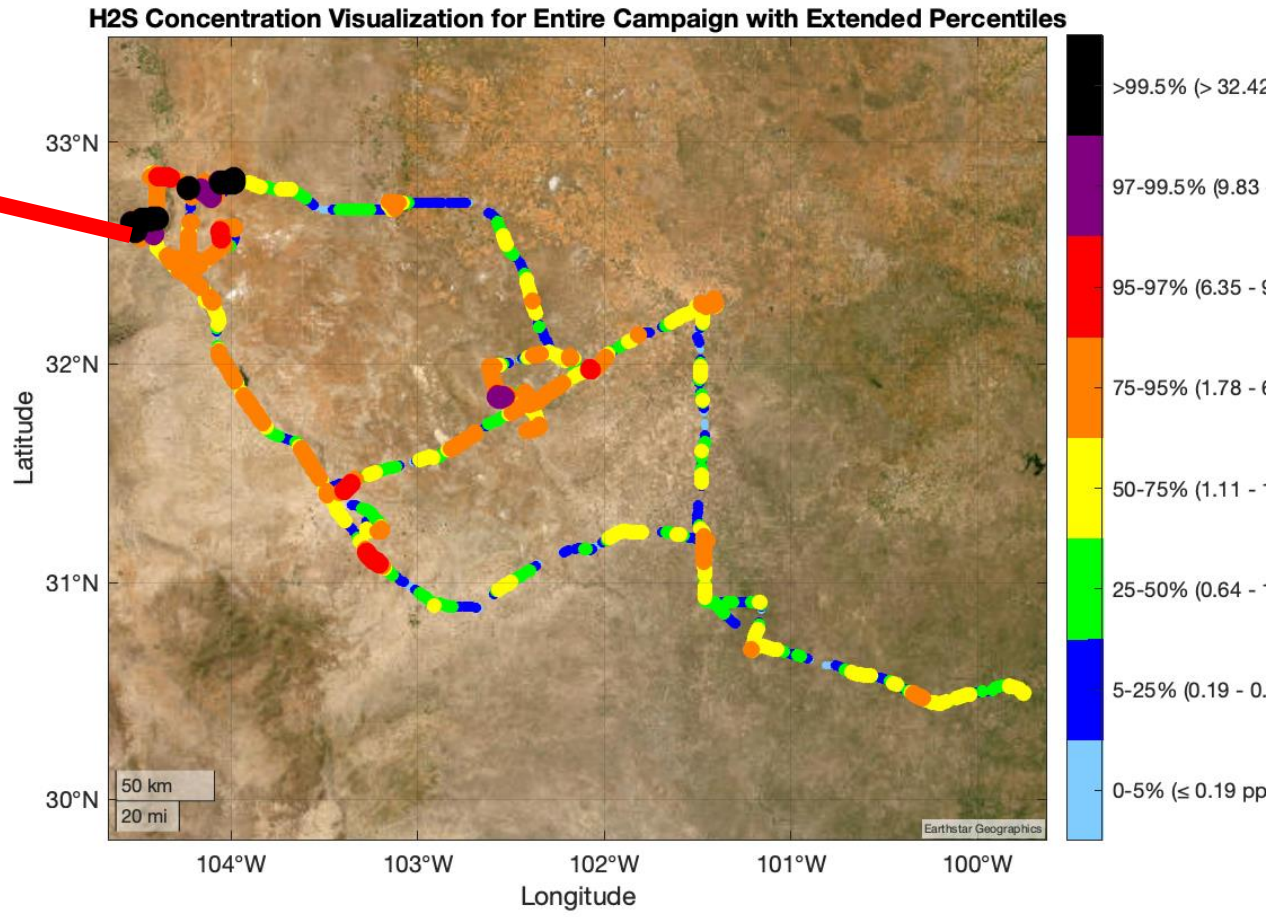

## Benzene Mixing Ratio



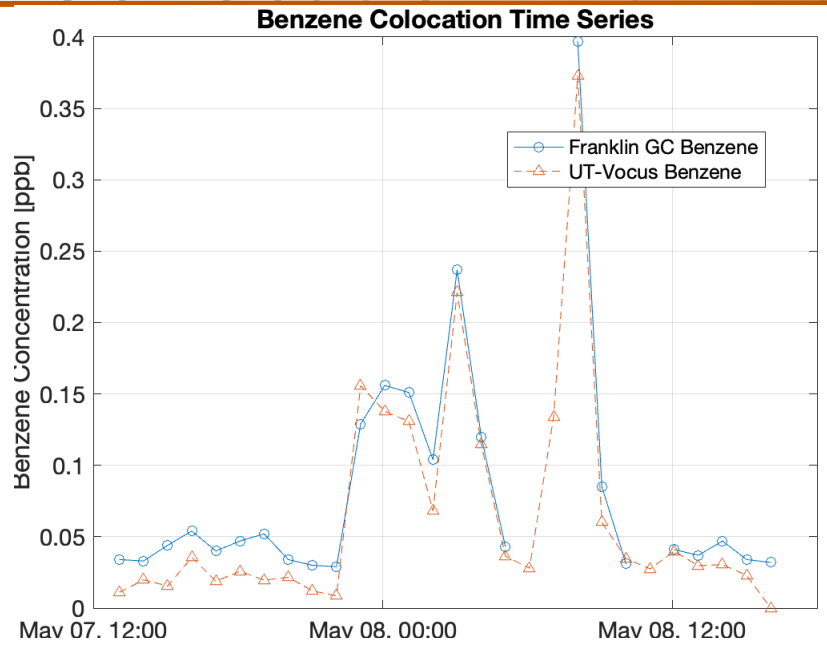

Observed methane mixing ratios spatially correlate with benzene mixing ratios. Hotspots observed downwind the UOGD activities.

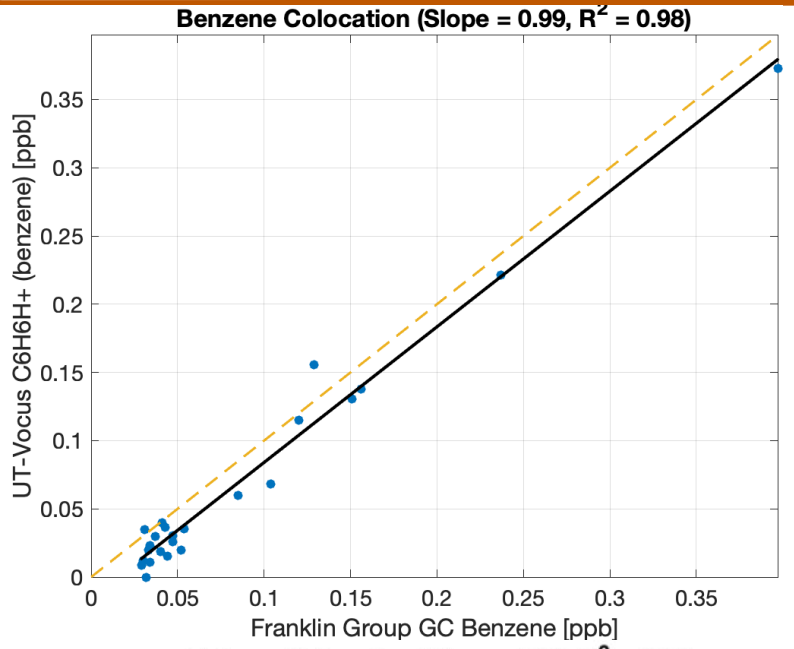
# Measurements in the Permian – UOGD Hotspot #1

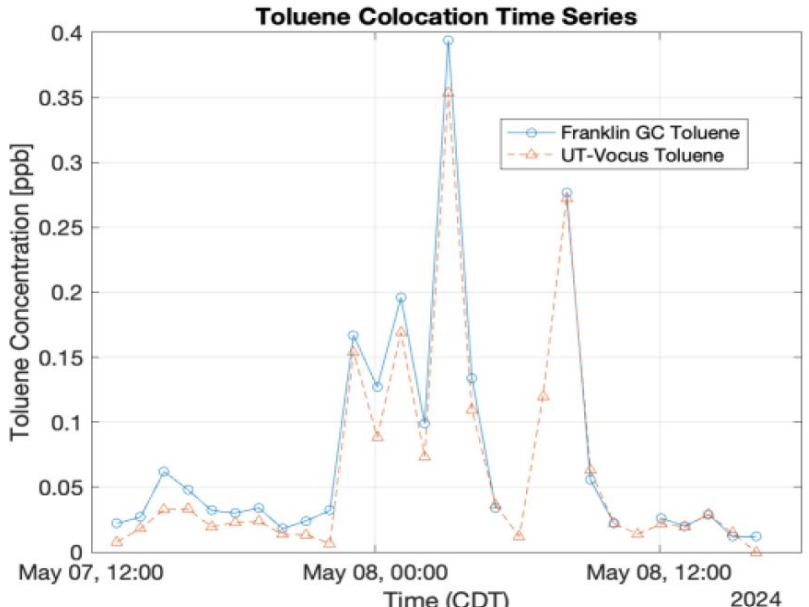


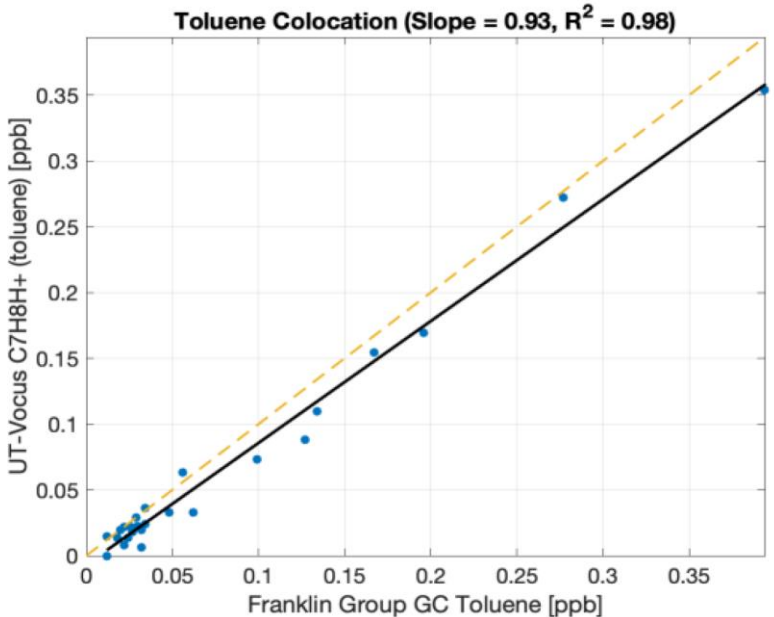



# Measurements in the Permian
# Co-location with Franklin group measurements



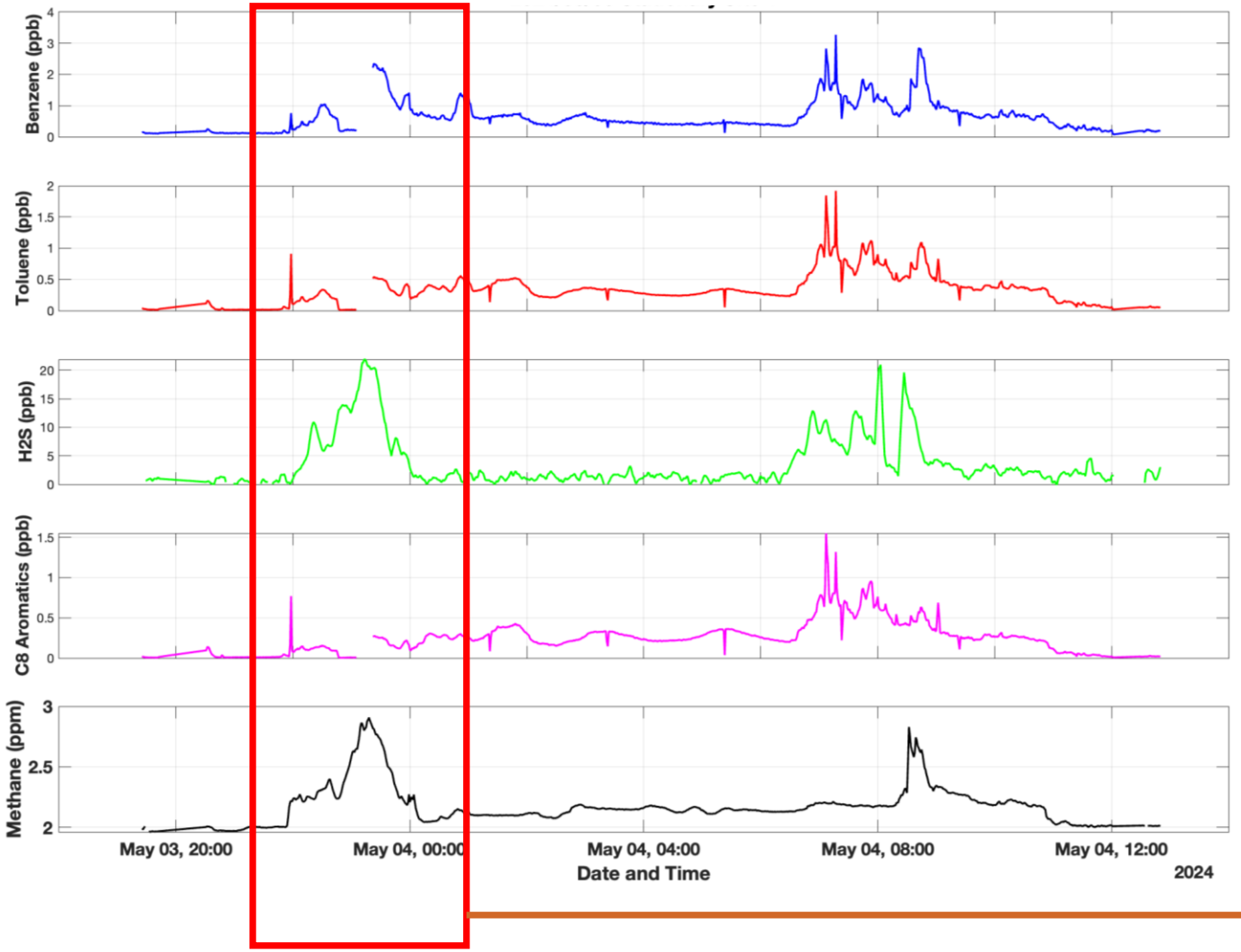



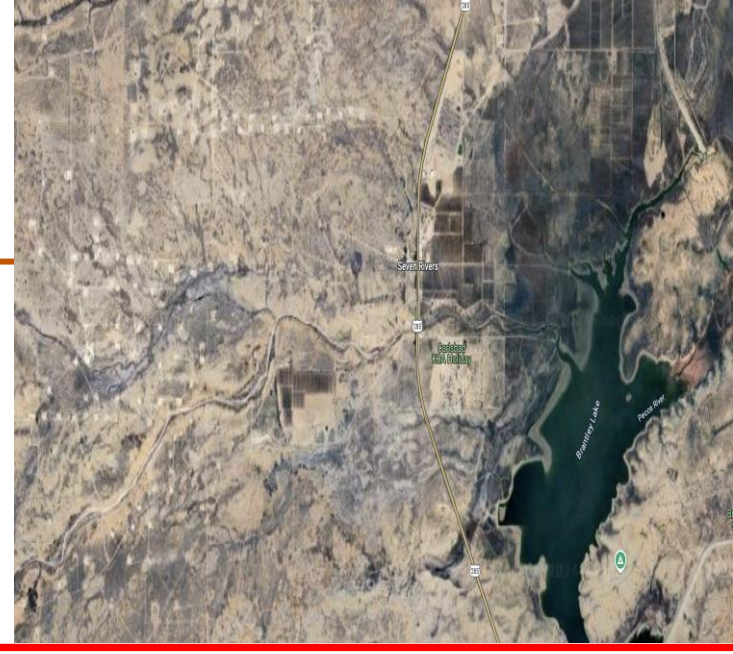



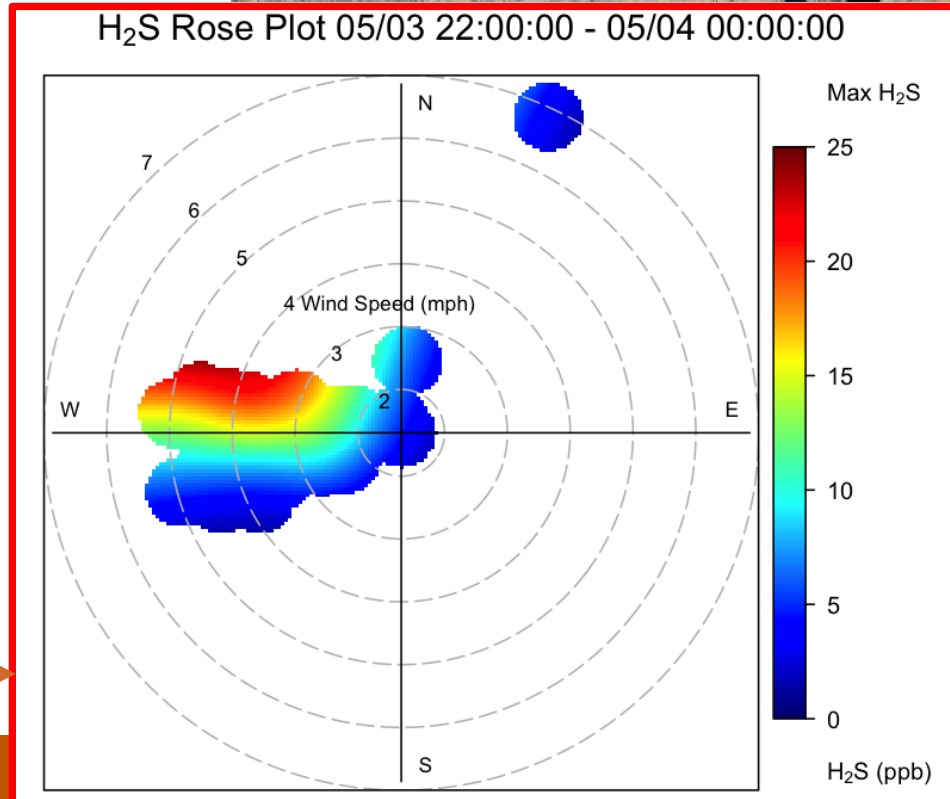




Good agreement between the GC and Vocus measurements!

# Measurements in the Permian Stationary Anchor Point (Site 2) Carlsbad



# Key Findings –Measurements

- High diurnal variability of VOCs, with highest concentrations at night. Sometimes due to routine emissions and favorable meteorology (low wind speed and BLH); sometimes due to non-routine emissions.
- Emission factors and destruction efficiencies from flares are variable, factor analysis to separate influence of other sources.
- Emissions in the Permian have higher sulfur content (observed $H_2S$ and $SO_2$ concentrations) compared to EFS.

The University of Texas at Austin
McKetta Department
of Chemical Engineering
*Cockrell School of Engineering*