Multi-pollutant and multi-sensor strategies for understanding the sources and spatial variation of VOCs in an urban oil drilling setting



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Las Cienegas oil field in Los Angeles, CA



Health impacts related to oil extraction:

- Cancer
- Liver damage
- Respiratory and neurological symptoms
- Immunodeficiency

Johnston et. al., 2019.

Investigating the local air quality impacts of oil extraction here requires an ability to distinguish sources





We deployed a low-cost air monitoring network near sites of interest





Q Pod data analyzed today

• Pods deployed but not analyzed today

Multi-sensor and multi-pollutant approach to understanding VOC sources and impacts

VOC sensors: Four metal oxide sensors

- Figaro TGS2600
- 2 Figaro TGS2602, at different temperatures¹
- Figaro TGS2611

Other pollutants measured: Methane, carbon monoxide, nitrogen oxides, particulate matter, carbon dioxide, ozone





Two-step calibration process

Harmonization



Colocation





Okorn, K., Hannigan, M. Atmosphere **2021**, 12, 645.

Two-step calibration process

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Harmonization stats

• Linear model for each sensor, with an added Elapsed Time feature



R² range for all sensors:
0.79 - 1

Colocation to SCAQMD TVOC measurements

- FTIR multi-pollutant optical analyzer
- Oct. 2023 Mar. 2024, 5-minute
 - Only measurements above the detection limit (15 ppb) are included in the calibration model (n = 29,000)
- Gradient boosting machine learning model worked best to capture peaks in the data
 - Model includes all four Figaro sensors, temperature, and humidity

	Data set	R ²	RMSE	MBE
	Training data	0.67	60.2	0.05
Iniversity of Colorado Boulder	Testing data (20%)	0.63	50.3	0.64



Decreased TVOC concentrations:

- Closer the active site compared to further away
- Near the idle compared to deconstructed site



Investigating why:

- Methane levels are higher further from the active site; CO levels are not.
 - Elevated TVOC might still be associated with oil and gas activity.



We will look into how wind plays a role in TVOC dispersion

• Regional prevailing winds are from west















What's next

- Explore wind impacts
- Collect more pod data
 - Improve colocation models, especially for estimating peak values
 - Investigate longer term trends in VOC spatial variability
- Tie the air quality data directly to local health impacts research

Thank you!

Collaborators:

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