

# PermianMAP

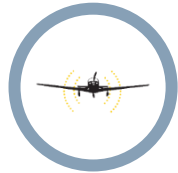
Methane Analysis Project

EDF Campaign Using Multiple Technologies to Measure Oil and Gas Methane Emissions and Facilitate Mitigation in the Permian Basin

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Senior Scientist  
Environmental Defense Fund

# EDF's approach: science-based advocacy

- Collaborate with leading scientists
- Use multiple methods to assess emissions
- Rapidly post data on [PermianMAP.org](https://PermianMAP.org)
- Publish results in peer-reviewed papers



**Scientific Aviation  
Carbon Mapper**  
Aerial mass balance  
and remote sensing



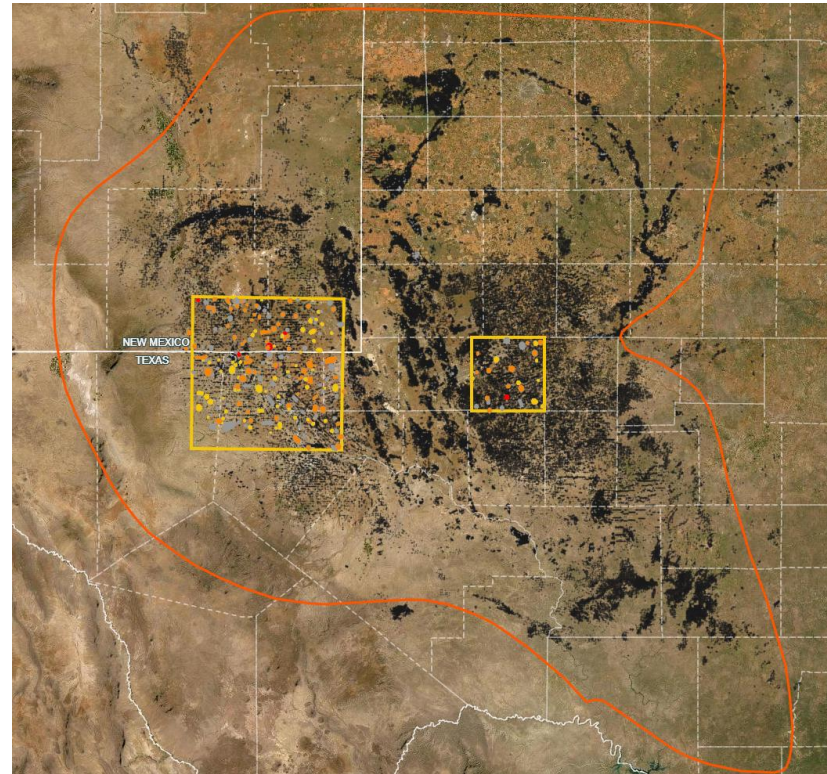
**Penn State U.**  
Tower-based,  
regional estimates



**U. of Wyoming**  
Vehicle-based,  
site-level estimates



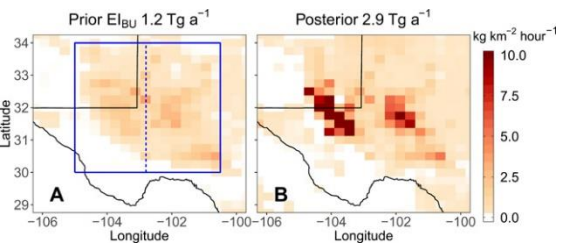
**Leak Surveys Inc.**  
Helicopter-based  
optical gas imaging



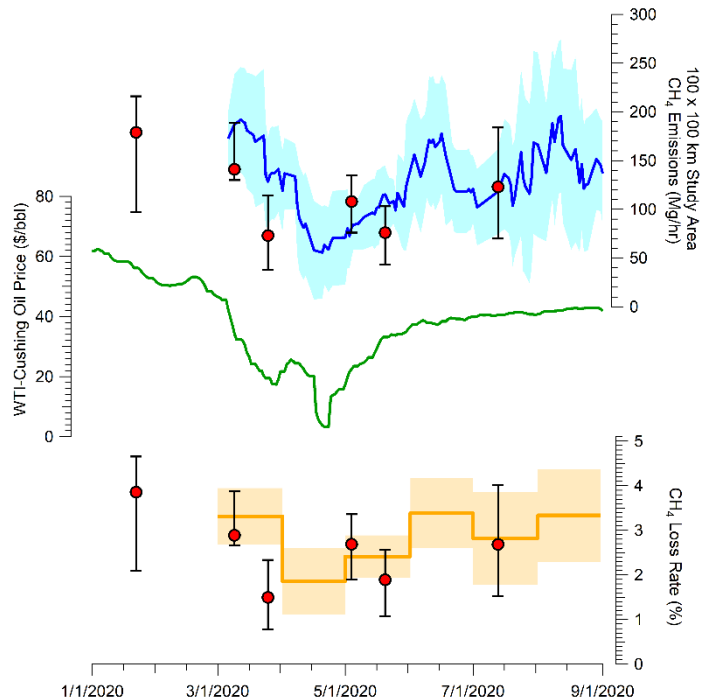
**What types of data does PermianMAP produce and how are they useful to stakeholders for characterizing and mitigating emissions?**



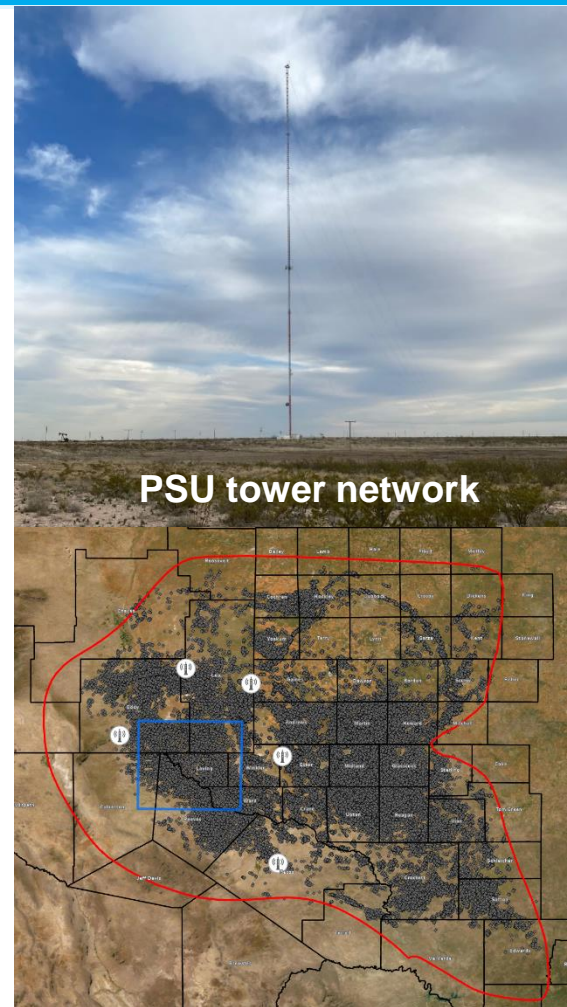
# Regional total methane emissions



Zhang et al 2020



Lyon et al 2021: [10.5194/acp-21-6605-2021](https://doi.org/10.5194/acp-21-6605-2021)



# Vehicle-based, site-level quantification (EPA Other Test Method 33a)

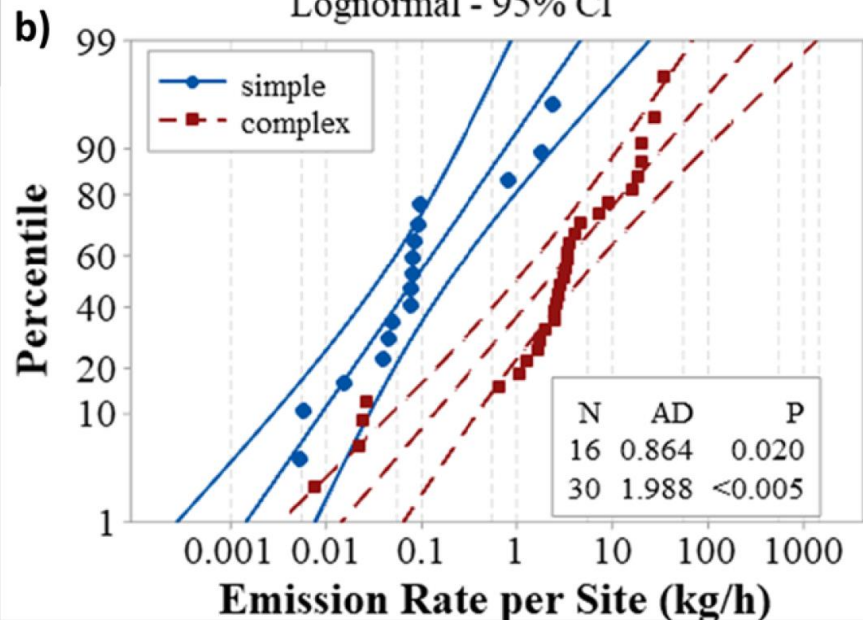


U. Wyoming Mobile Research Laboratory



## Probability Plot (with complex BDL sites)

Lognormal - 95% CI

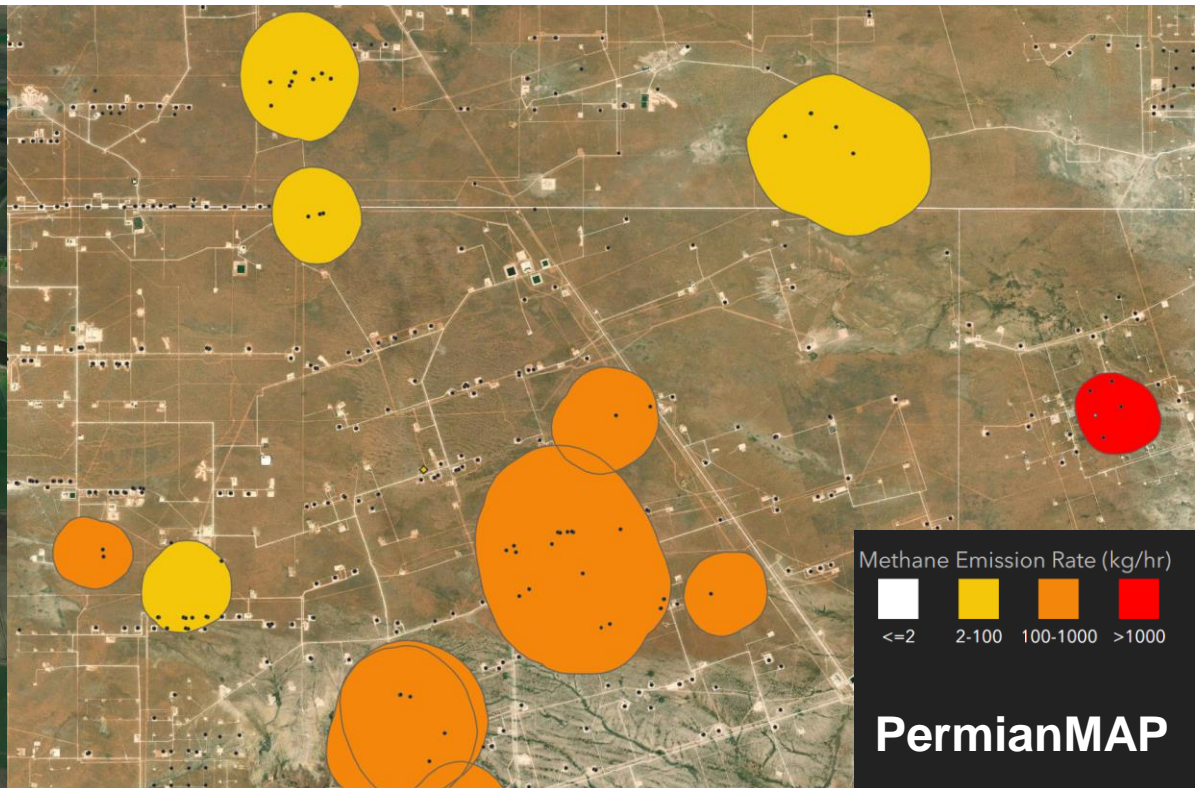
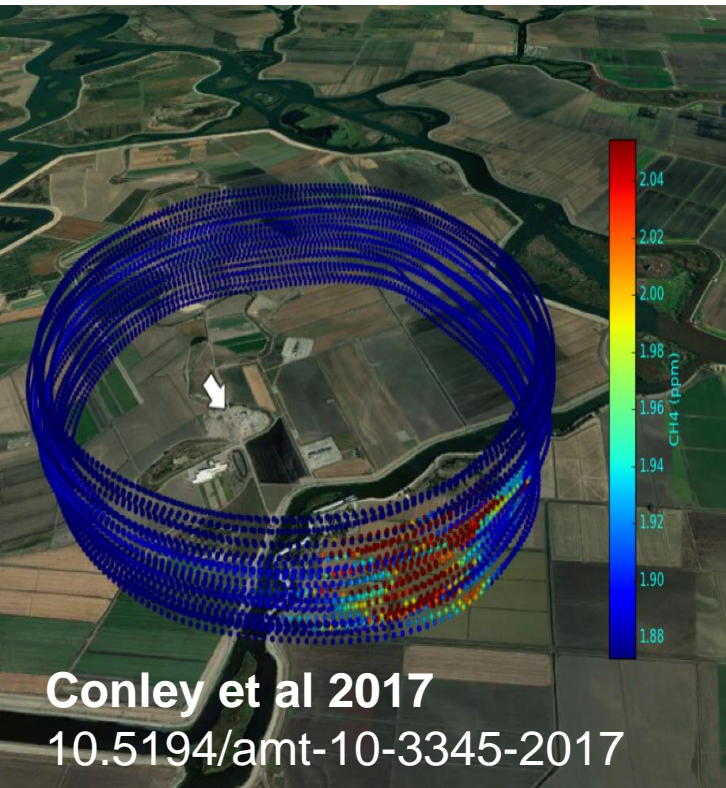


Robertson et al 2021: [10.1021/acs.est.0c02927](https://doi.org/10.1021/acs.est.0c02927)

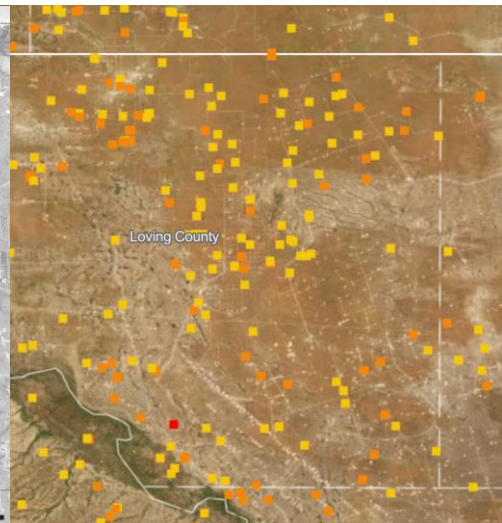
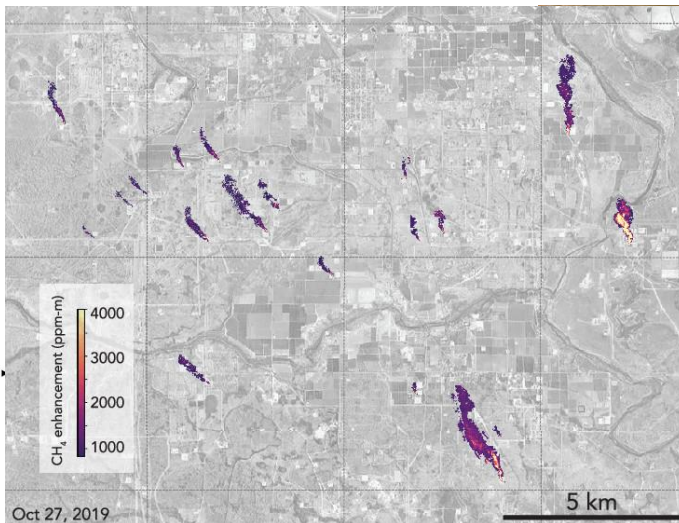
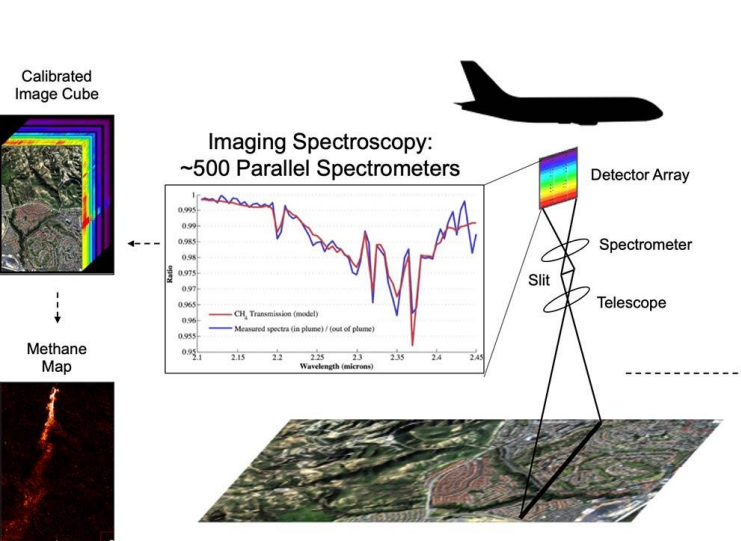
# Optical gas imaging of malfunctioning flares and other large emission sources



# Aerial mass balance quantification of multi-site areas (~1 - 4 square miles)



# Aerial remote sensing quantification and plume imaging of large emission sources



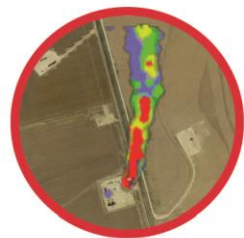
<https://carbonmapper.org/our-mission/technology/>

Cusworth et al 2021 [10.1021/acs.estlett.1c00173](https://doi.org/10.1021/acs.estlett.1c00173) PermianMAP



# Carbon Mapper completed two weeks of aerial surveys in the Permian Basin in early August 2021

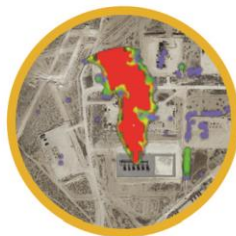
- Measured ~900 methane plumes from 500 sources
- Many sites had plumes detected over multiple surveys
- Emissions detected from diverse sites and equipment



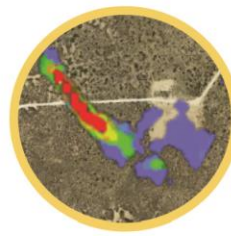
Tank



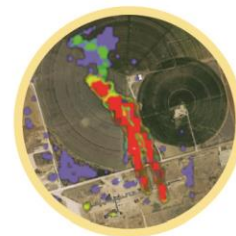
Well pad



Compressor



Pipeline



Processing

# Lessons learned from PermianMAP

- Each approach has its own advantages and limitations and often is most useful in combination with other methods.
- Site-level attribution and plume imaging facilitates emission reductions by identifying specific mitigation opportunities.
- Area-level quantification can track aggregate emissions and prioritize deployment of finer scale approaches.
- Lower detection limit approaches are necessary to account for the substantial fraction of emissions from marginal wells.

# Opportunities for effective policy

- Emissions detection and quantification approaches are evaluated with a transparent, technology-neutral process.
- Regulations adaptively incorporate multiple approaches to effectively reduce emissions across diverse infrastructure.
- Emissions reporting programs allow and incentivize the use of approved measurement approaches.
- Emissions data are transparent and accessible to facilitate operator accountability and public trust.

# Example of a program integrating multiple approaches: comprehensive surveys + screening



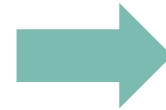
Periodic  
comprehensive  
surveys

Operator regularly inspects all their sites for any emissions with approach such as ground-based OGI.



Frequent  
screening  
surveys

Operator frequently screens all their sites for high emissions with approach such as aerial remote sensing.



Targeted  
comprehensive  
surveys

Operator performs comprehensive follow-up surveys at their sites where screening detects high emissions.

## **Develop a technology-neutral and transparent approval process: programs**

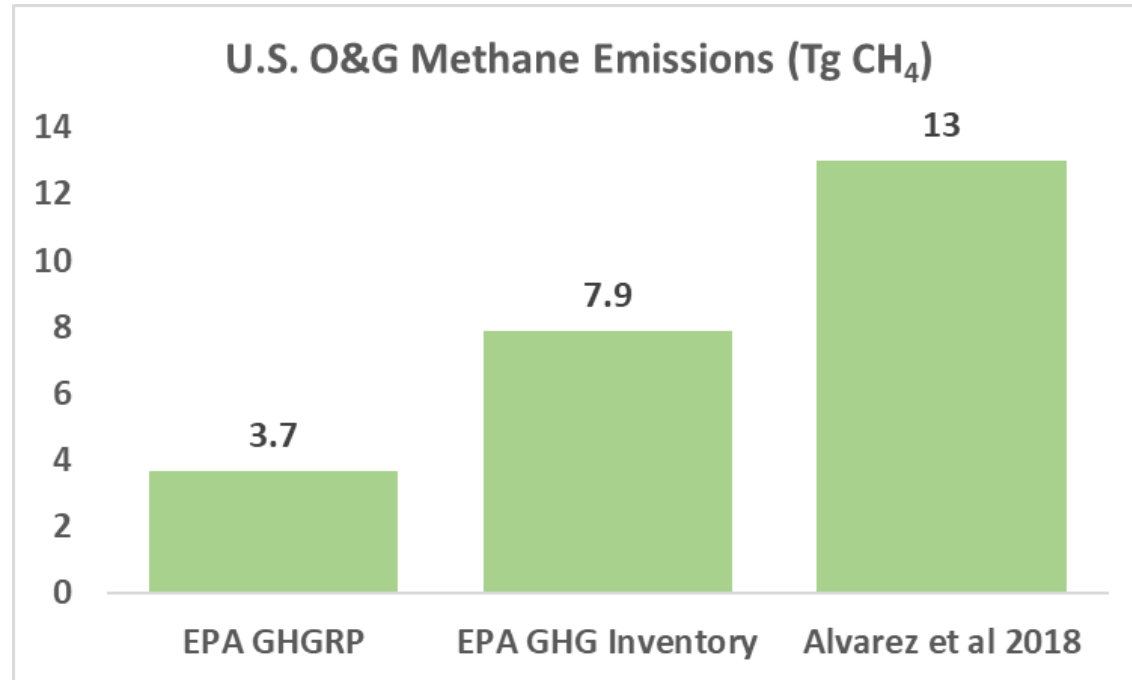
- Assess potential emissions reduction of implementing programs combining methane detection and/or quantification approaches with work practice standards
  - Emissions and mitigation simulation models or field testing
- Allow alternative programs with demonstrated equivalent or better emission reductions
- EPA initially could provide a list of approved, technology-agnostic programs based on performance criteria metrics

# Develop a technology-neutral and transparent approval process: approaches

- Categorize approaches by purpose of data, such as:
  - Rapidly screen for large emissions across multiple sites
  - Comprehensively detect all emissions at a single site
- Set performance metrics for each approach
  - Spatial and temporal resolution
  - Minimum detection limit (may depend on deployment frequency)
- Define protocols for certifying measurement approaches
  - Controlled release testing under realistic conditions

# Update GHG Reporting Program to incorporate approved measurement approaches

- Companies should submit the same measurement data for compliance and reporting purposes
- Allow companies to submit measurement data that aggregates multiple sources



# Summary

- Regulations should require emissions detection and/or quantification approaches to be used in adaptive, technology-neutral programs that incorporate multiple methods.
- Measurements are technically feasible and cost-effective: PermianMAP's two year science budget is less than the average cost of developing a single new well.
- To reduce the climate impact of oil and gas and meet the country's GHG emission goals, it is critical to mitigate both the largest sources and numerous smaller sources including marginal wells.



**Thank you!**

# References

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- Alvarez, Ramón A., et al. "Assessment of methane emissions from the US oil and gas supply chain." *Science* 361.6398 (2018): 186-188.