How can we Compare Methane Leak Detection Technologies and Work Practices?

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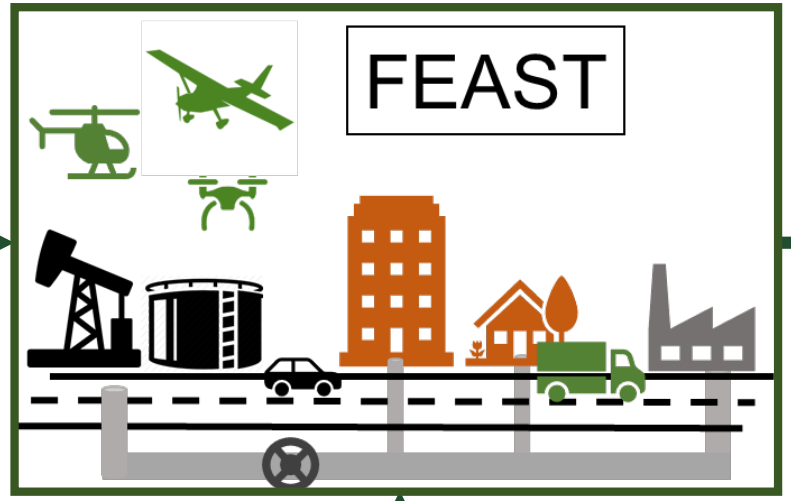
Fugitive Emissions Abatement Simulation Tool or FEAST models leak detection and repair programs



Emissions

MEET Model

Post-LDAR Emissions

Detection effectiveness
Mitigation Effectiveness
Cost Effectiveness

LDAR Program

Technologies
Survey frequency
Operating envelope
Dispatch rules

Weather
Site-density

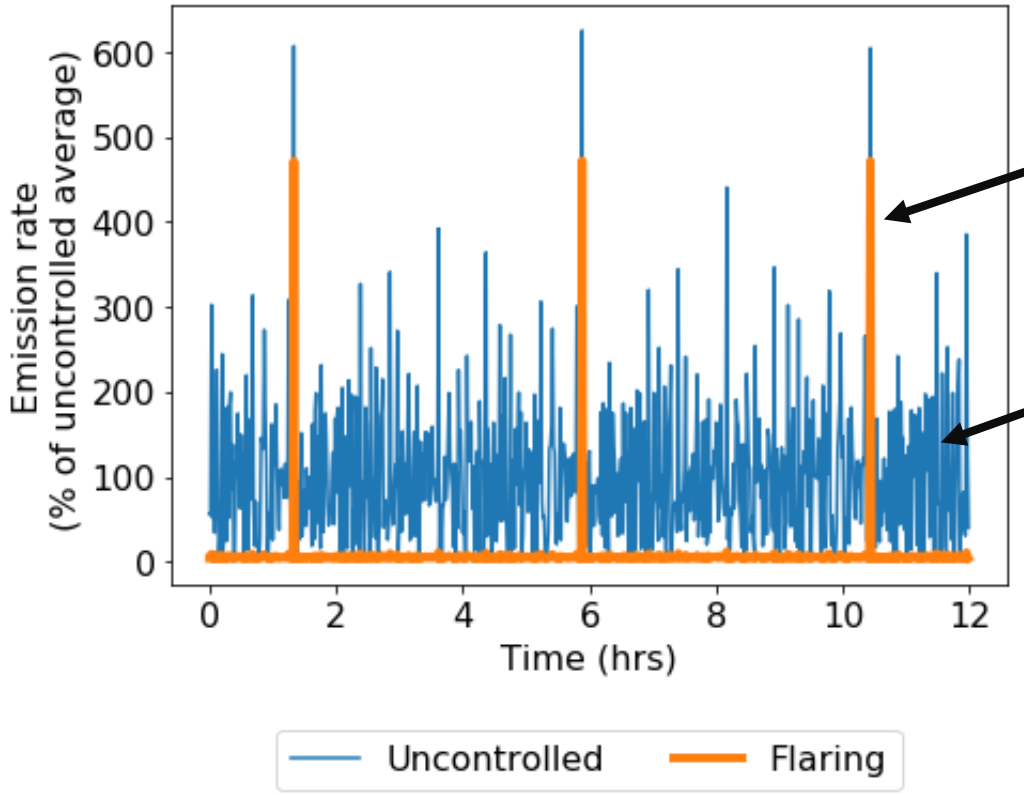
Choice of detection technologies depends on the type of intended and unintended emissions that occur at the facility.

- Are fugitive emissions hidden by intended emissions?
- Are the largest emissions intermittent or persistent?
- Do you want to detect infrequent, high-emitting events or persistent leaks?

Method	Scale of Detection	Ability to Detect Intermittency	Speed	Other Properties
Method-21/OGI	Component	Low	Low	~
Drone-based	Equipment	Low	Medium	~
Plane-based	Equipment/Site	Low	High	~
Continuous Monitor	Equipment/Site	High	~	~
Satellite	Site/Basin	Low	~	~

Example 1: Performance comparison of OGI, plane-based, and continuous monitoring systems at sites with tank control/flare

- Condensate tanks vented into a common header with a PRV and flared

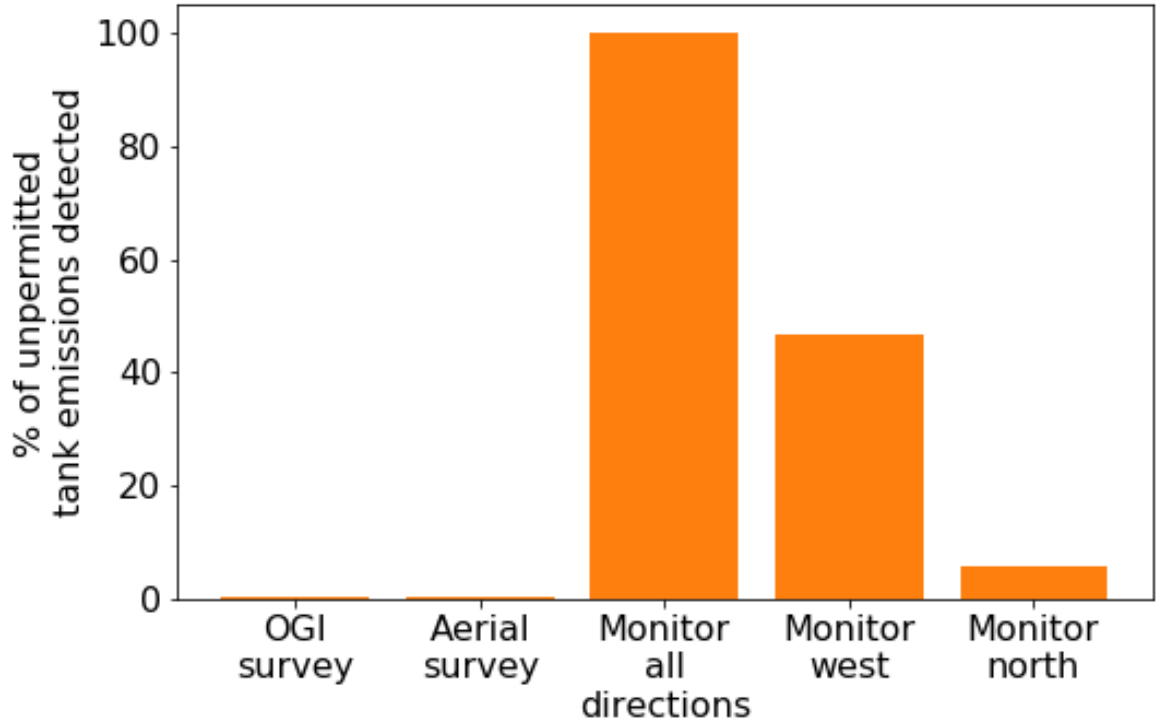


Emission rates above 500 kg/h overwhelm simulated flares.

Emissions occur randomly. Most emissions from tanks.

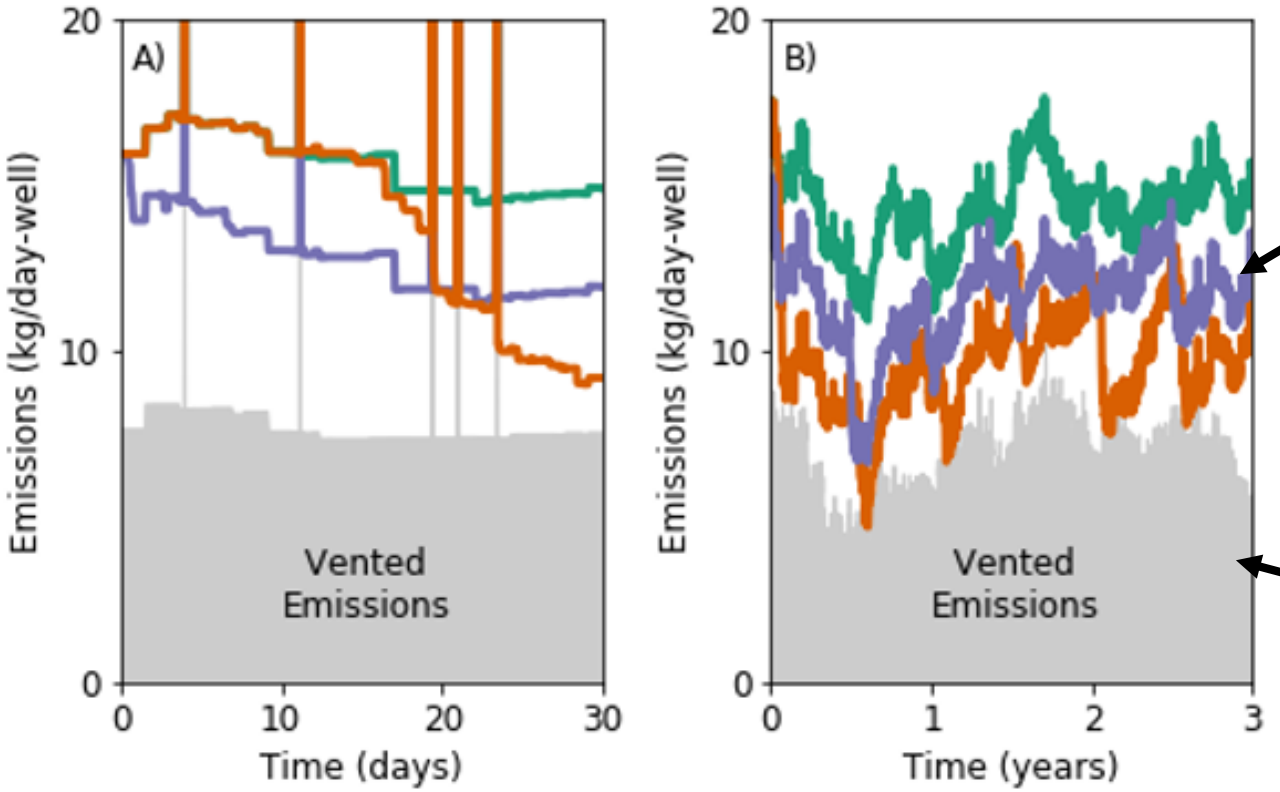
- Unintended tank emissions comprise majority of fugitive emissions
  - Short-duration, high-intensity events

Continuous monitoring systems are effective in detecting unintended, short-duration, high-intensity events



- OGI and plane-based surveys detect unintended tank emissions only when survey happens at the exact time of the event
- Effectiveness of continuous monitoring systems dependent on weather conditions and sensor configuration

Example 2: Performance comparison of OGI and plane-based systems at sites with large, persistent fugitive emissions

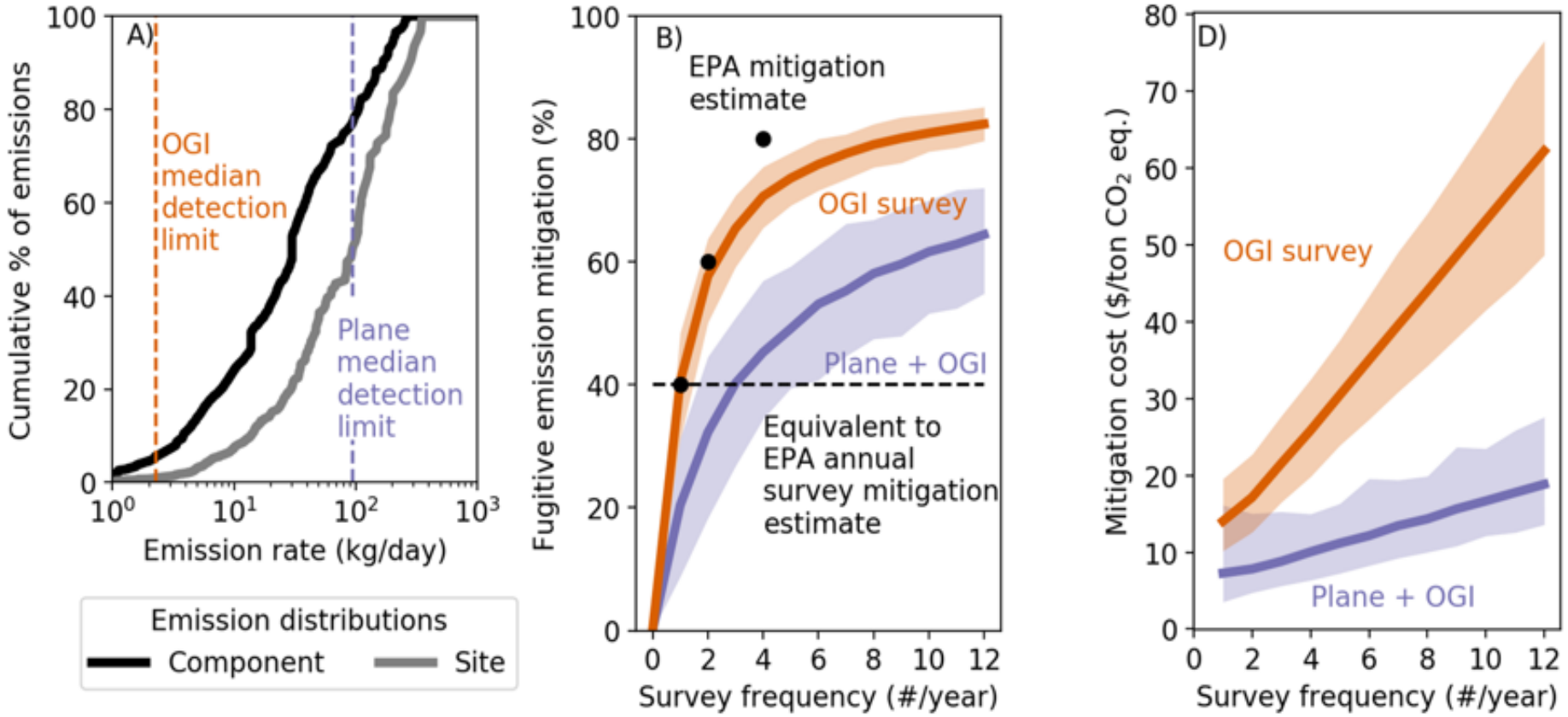


Skewed emissions: technologies with higher sensitivity detect more emissions

Fugitive and vented emissions are roughly 50% - 50%

Cost-effectiveness of emissions mitigation depends on several variables – higher survey frequency may not mean higher cost

- Plane-based system quickly finds persistent super-emitters, but does not find small emissions sources



Kemp et al. (2020) in review

Summary and Key Messages

1. Choice of detection technologies (and performance of an LDAR program based on that technology) depends on the type of intended and unintended emissions that occur at the facility.

2. Temporal variation in emissions play a critical role in field testing of new technologies, particularly those based on discrete leak detection surveys.

3. Equivalence is determined at a program level based on several variables (mitigation target, survey frequency) and not a simple comparison of detection thresholds.

4. FEAST-based modeling helpful to understand efficacy of new technologies under different emissions scenarios