Assessing Methane Emissions from Stations using sUAS

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Compressor, Storage and M&R Stations

- PG&E operates:
  - 9 compressor stations
  - 3 underground storage facilities
  - 350 Transmission M&R stations
- They represent 27% of our total emissions as reported to the CPUC under SB 1371

California Pipeline/Storage Facilities

- PG&E Gas Service Territory
- PG&E Backbone
- PG&E Local Transmission
- Interconnection
- Compressor Station
- PG&E Gas Storage
- Independent Storage Providers
- Gill Ranch Storage LLC/PG&E
- SoCal Gas Storage
- SoCal Gas
- Kern/Mojave
- Kern River Gas Transmission
- KRGT High Desert Lateral
- Mojave
- North Baja
- Questar Southern Trails
- San Diego Gas & Electric

- Estimate the overall emissions of stations and their subsystems to prioritize maintenance

- Include fugitive leaks as well as emissions through vents

- Measure performance and demonstrate improvements

- Regulated under FAA 14 CFR part 107
  - Less than 55lb
  - Flies under 400 feet
  - Flies slower than 100 mph
  - Within visual line of sight only
  - In uncontrolled airspace
  - Day time only
  - Certified pilot

Methane Sensor

- Initially developed by Nasa for the Curiosity Rover

- Adapted to methane detection and quantification by PRCI and NYSEARCH

- Some characteristics:
    - 10 ppb sensitivity at 1Hz
    - 10 inches long
    - 150g
    - latency less than 200 ms.

Mounted on a 3DR Iris+.

Methane light absorption spectrum
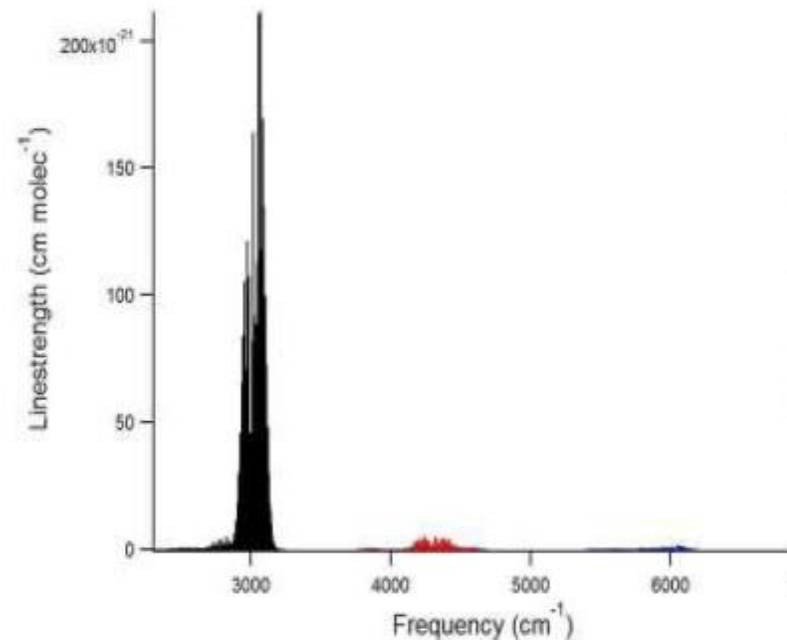
Tested on various sUAS

DJI Matrice-200
25 min, 4.1 kg

Procerus Indago
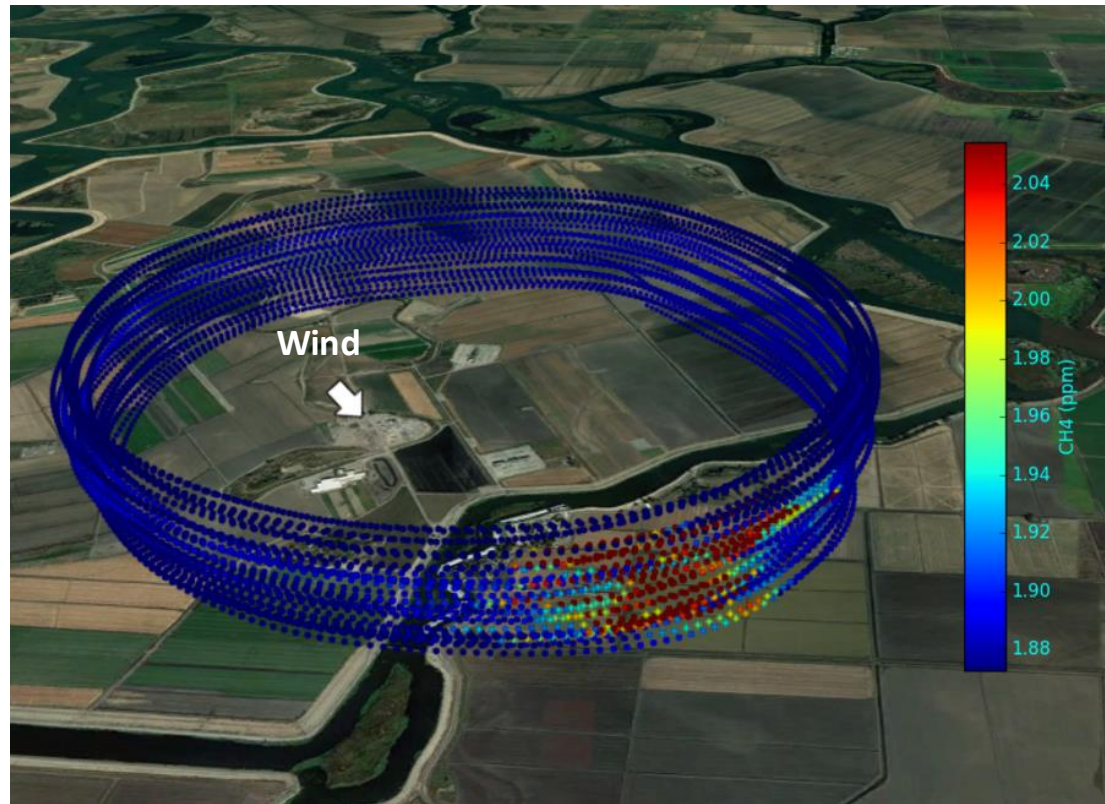38 min, 2.5 kg

3DR Iris+/Solo
14 min, 2.2 kg

Straight Up Imaging
34 min, 3.5 kg

DJI Matrice-600
23 min, 10 kg

Foxtech Hover 1
40 min, 800 g

Source: L. Christensen "Fast, Accurate, Automated System to Find and Quantify Natural Gas Leaks" PRCI June 2019

- By flying around a source, concentration enhancements measured downwind are combined with wind speed to estimate emissions

Source: S. Conley et al. "Application of Gauss's theorem to quantify localized surface emissions from airborne measurements of wind and trace gases" Atmos. Meas. Tech., 10, 3345–3358, 2017

Quantification Accuracy

- More data are needed to assess accuracy

- Results from METEC's blind tests provide a first estimate

- As for other mobile systems, quantification of the order of magnitude seems achievable
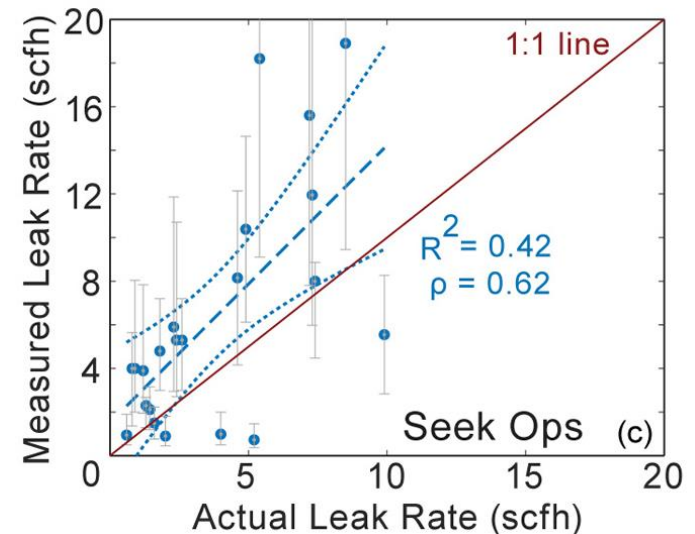
Source: Arvind P. Ravikumar et al. "Single-blind inter-comparison of methane detection technologies – results from the Stanford/EDF Mobile Monitoring Challenge" Elem Sci Anth, 7: 37, 2019
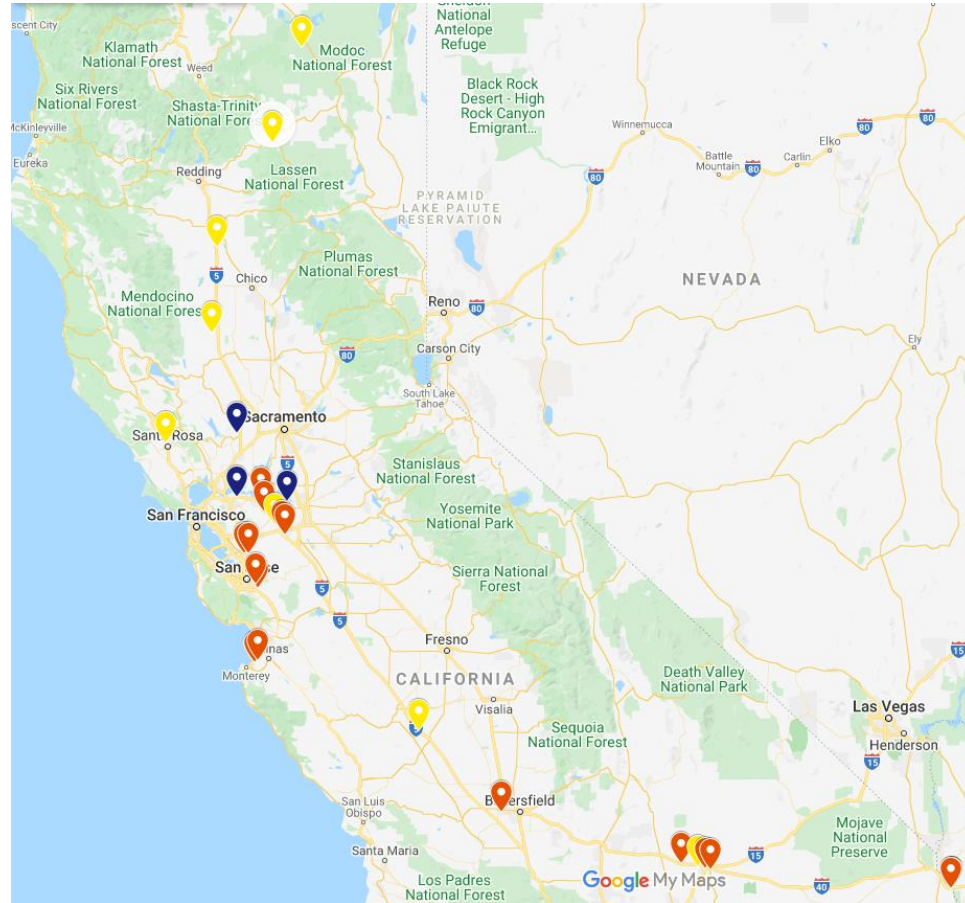
Transmission M&R Stations (10)
Compressor Station (9)
Compressor Station/Storage (3)

- Emergence of high sensitivity sensors adapted to sUAS

- Facilities can easily be surveyed with sUAS under FAA regulation

- Assessment of the whole station and its sub-systems

- Quantification techniques help prioritize methane sources

- Confirm prioritization

- Improve survey strategy and productivity

- Operationalize the process

- Improve quantification accuracy

- Automate flights

Thank you

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a Better California