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From Mobile to Stationary: Current and Emerging Technologies for Methane Measurements

June 6, 2016

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Director, California Oil and Gas Program

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Finding the ways that work

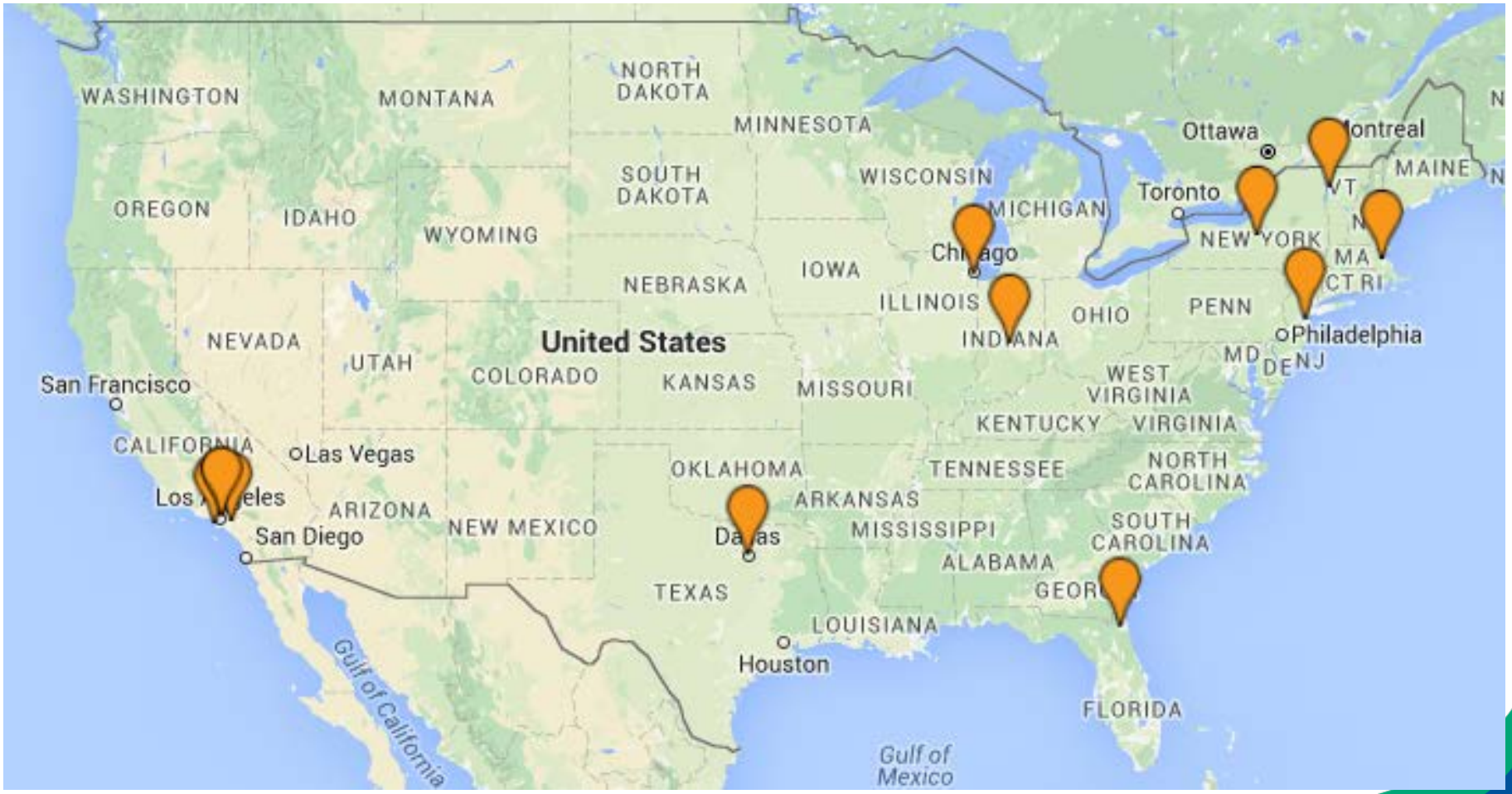
Technology Presentation Roadmap

- **Vehicular based sensing technology**
  - EDF mapping studies
  - Use in California and others
  - Where the technology is going
  - Why is it relevant?

- **Stationary continuous monitors**
  - Methane detectors challenge
  - Technology testing and rollout
  - Continuous monitoring rulemakings

Vehicular based sensing technology

- EDF mapping studies



Google Street View Car Instrumentation

Closed-path CH_4 analyzer

- 2Hz data = 15 feet @ 20mph
- Precision ±0.01ppm

GPS unit

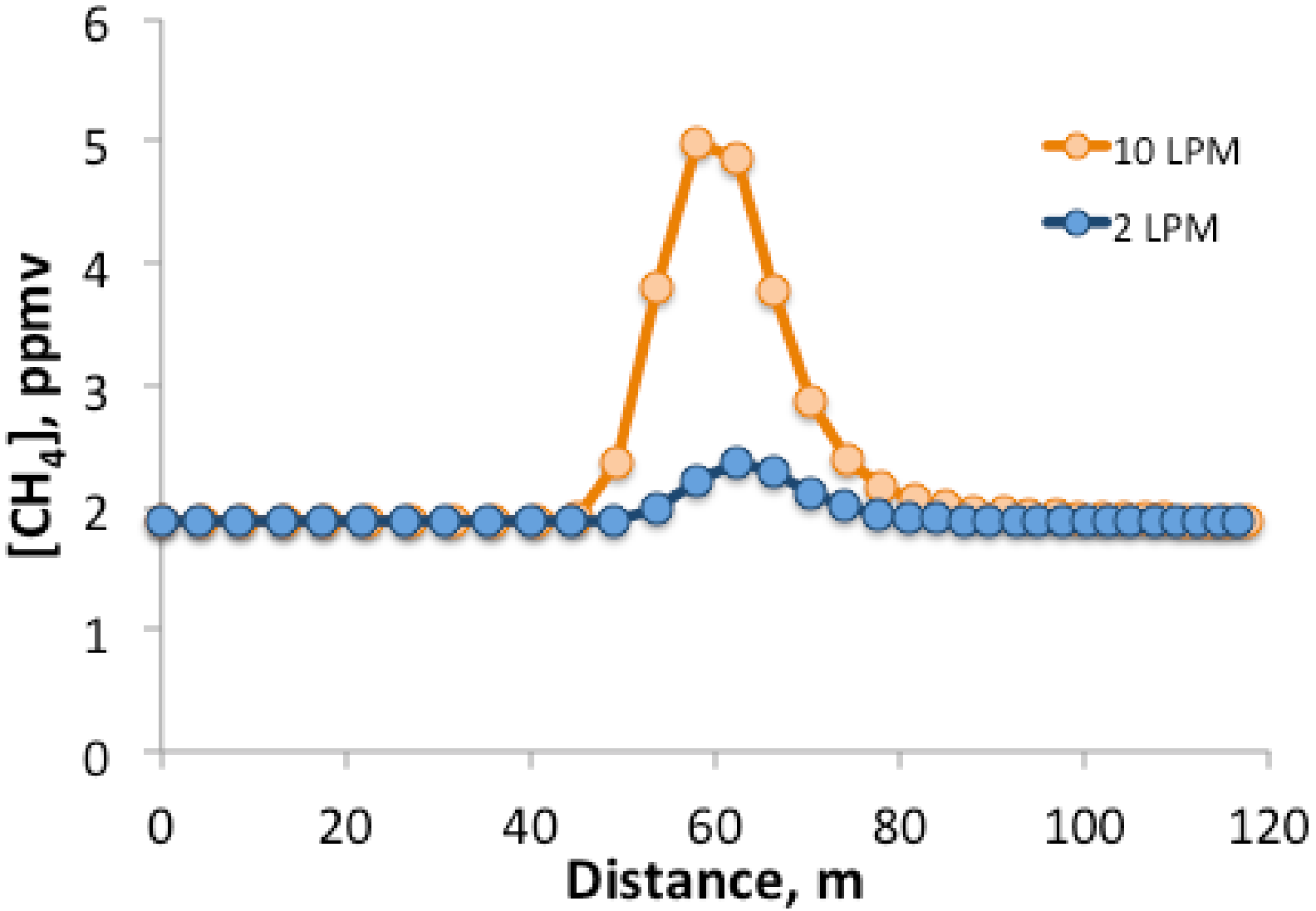
- 24 inch precision

Sample intake

Each component reports performance data that were used in QAQC screening

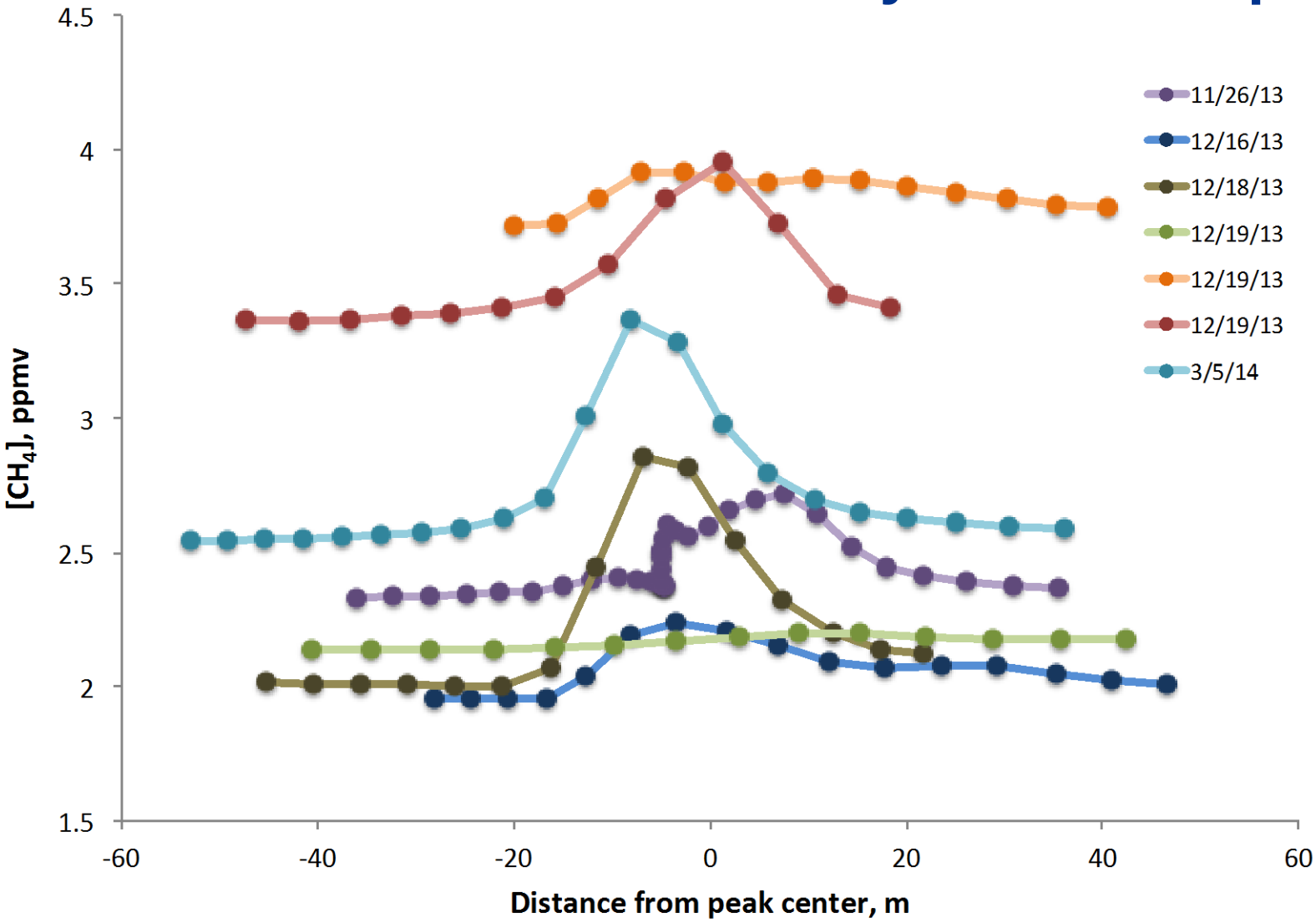
The Science Behind Methane Mapping

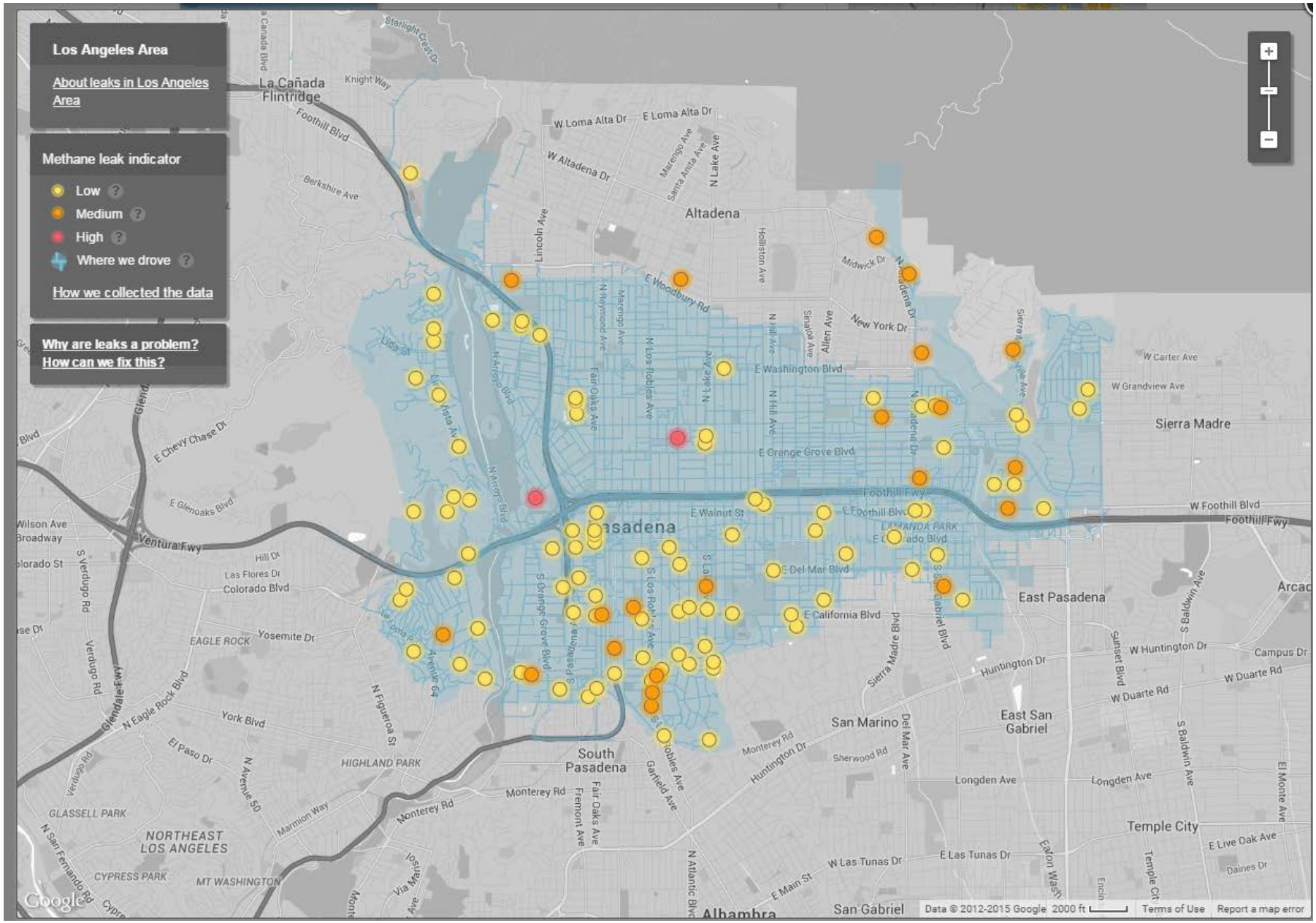
Controlled release experiments verify the technique



The Science Behind Methane Mapping

Field observations also verify the technique




Los Angeles Area
About leaks in Los Angeles Area
Methane leak indicator
Low
Medium
High
Where we drove
How we collected the data
Why are leaks a problem?
How can we fix this?
La Cañada Flintridge
Altadena
Sierra Madre
Pasadena
East Pasadena
South Pasadena
San Marino
East San Gabriel
Temple City
San Gabriel
Alhambra
EAGLE ROCK
HIGHLAND PARK
GLASSELL PARK
NORTHEAST LOS ANGELES
CYPRESS PARK
MT WASHINGTON
Foothill Blvd
Ventura Fwy
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Colorado Blvd
Huntington Dr
Monterey Rd
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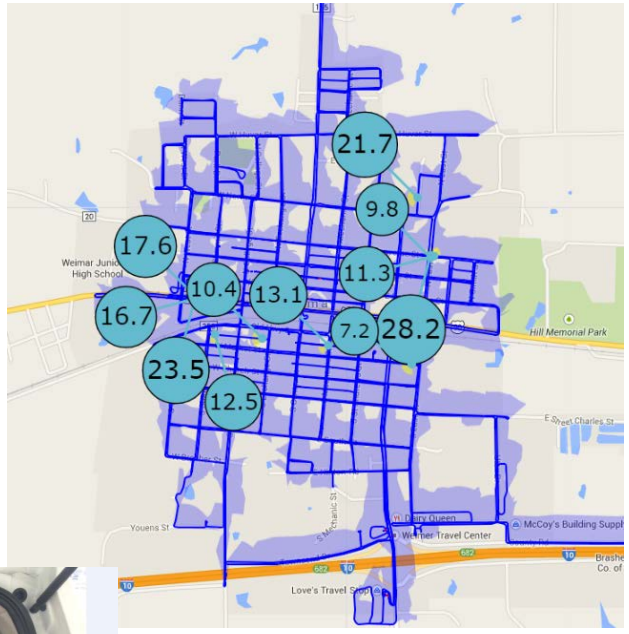
Vehicular based sensing technology

- Use in California and elsewhere



Vehicular based sensing technology

- Where the technology is going:

Integration into better overall infrastructure management programs using GIS enabled spatial analytics and predictive modelling

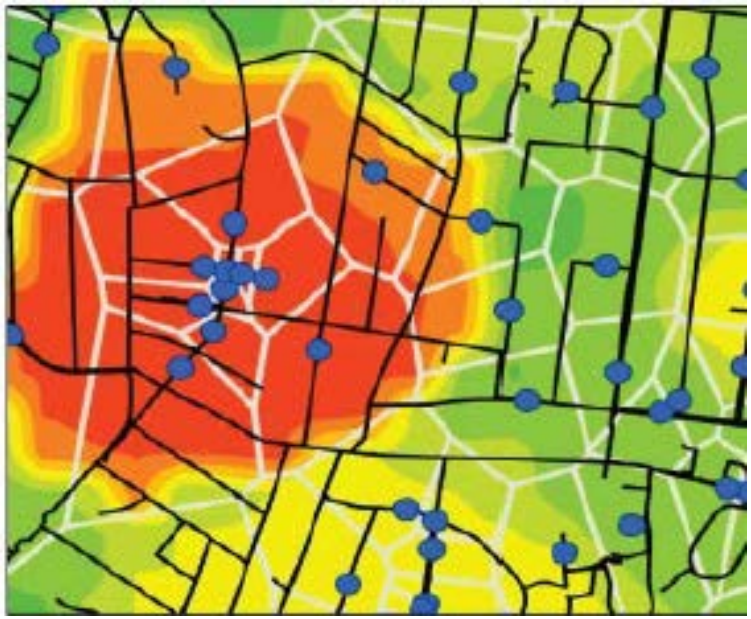
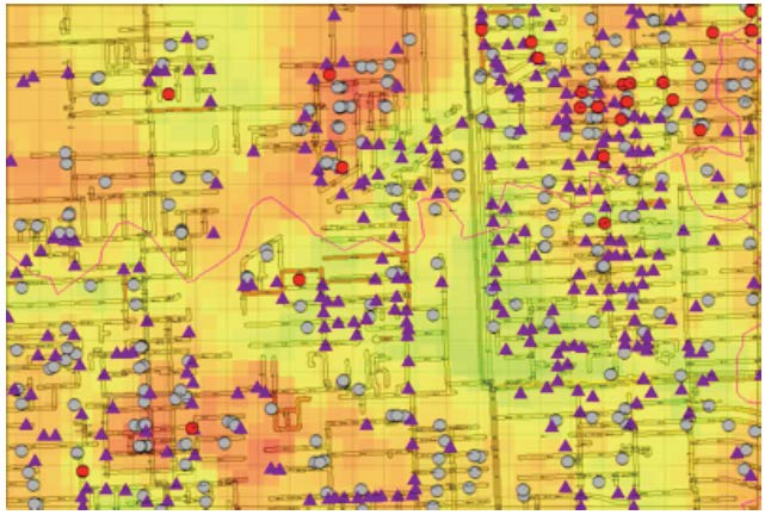


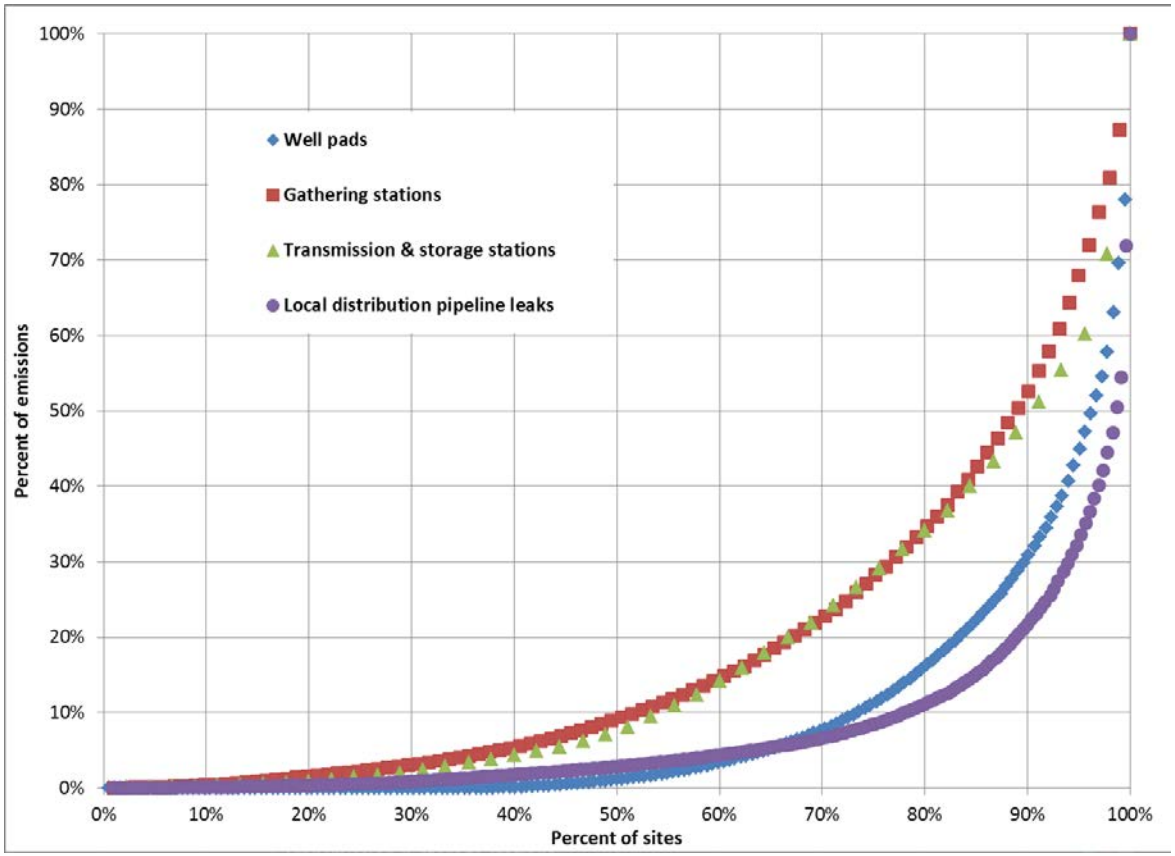
Figure 1: Predictive Heat map shows data sources indicated by symbols below, which illustrates, i.e. historical leaks, customer calls, and condition-assessment data clustering.



Vehicular based sensing technology

- What's the overall relevance?

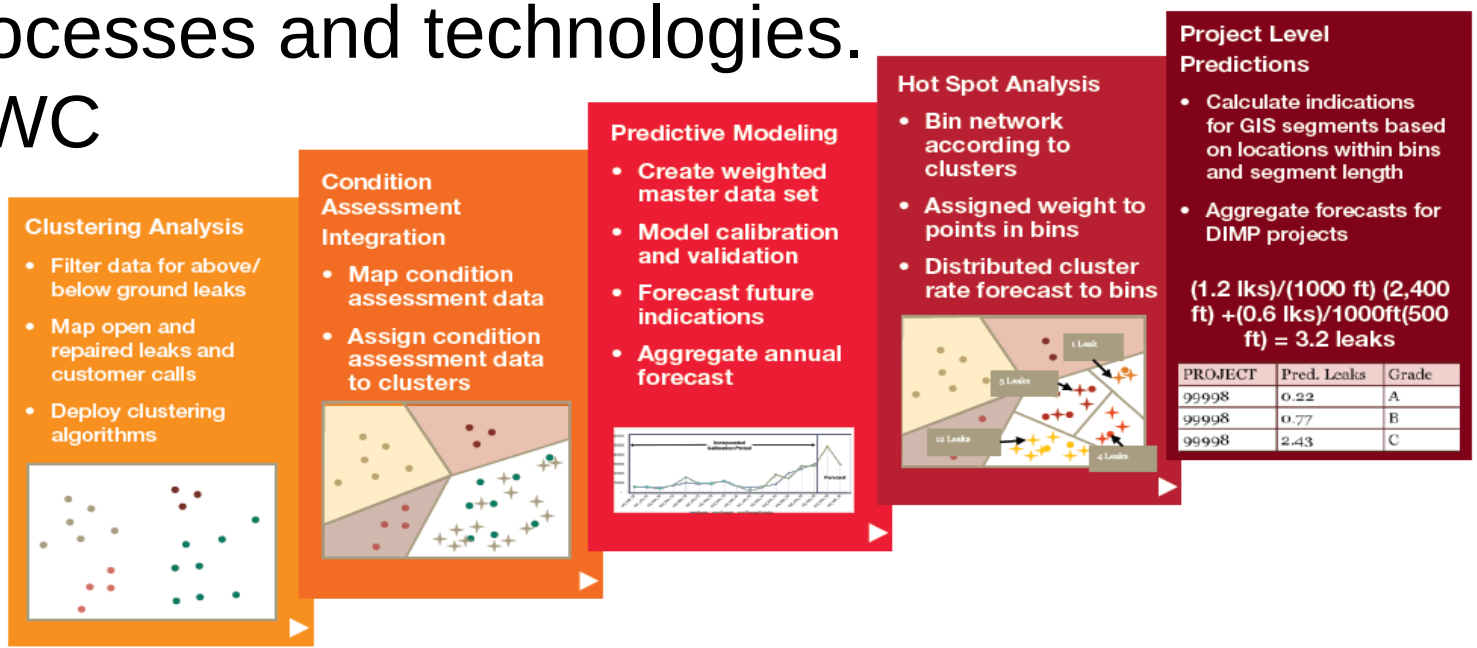
A small fraction of sites and components contributes the majority of emissions



Vehicular based sensing technology

- What's the overall relevance?

By integrating spatial analytics' predictive modelling with risk-based integrity management programs, utilities can meaningfully improve their asset integrity, investment decisions and deployment of people, processes and technologies.
Source: PWC



Stationary monitoring technology

- EDF Methane Detectors Challenge

The goal of MDC is to bring to market **low-cost continuous** methane detection systems to help reduce unintentional methane emissions from oil and gas operations.

Methane Detectors Challenge – Innovation Driver

Demand
Buy and Use

Market Maker
Convene and Catalyze

Supply
Innovate

- Colorado start-up
- Colorado academic
- Chinese coal mine safety co.
- Swedish sensor co.

Advise

…and more…

Phase II results show strong detection capabilities for tested sensors

Two systems, both based on tunable laser diodes, tested with **high accuracy and reliability** during San Antonio outdoor testing

MDC System Specifications

- Detect 1 ppm change / 1 scfm leak from over 80 feet away
- All weather / rugged
- Solar powered: suitable for remote, unmanned locations
- Low-cost: hardware target in pilot $5,000

Need to refine

- Communicate to SCADA or wirelessly
- Automatic alerts and data analysis
- Distinguish on-site from off-site methane

Lab results show accuracy for two technologies

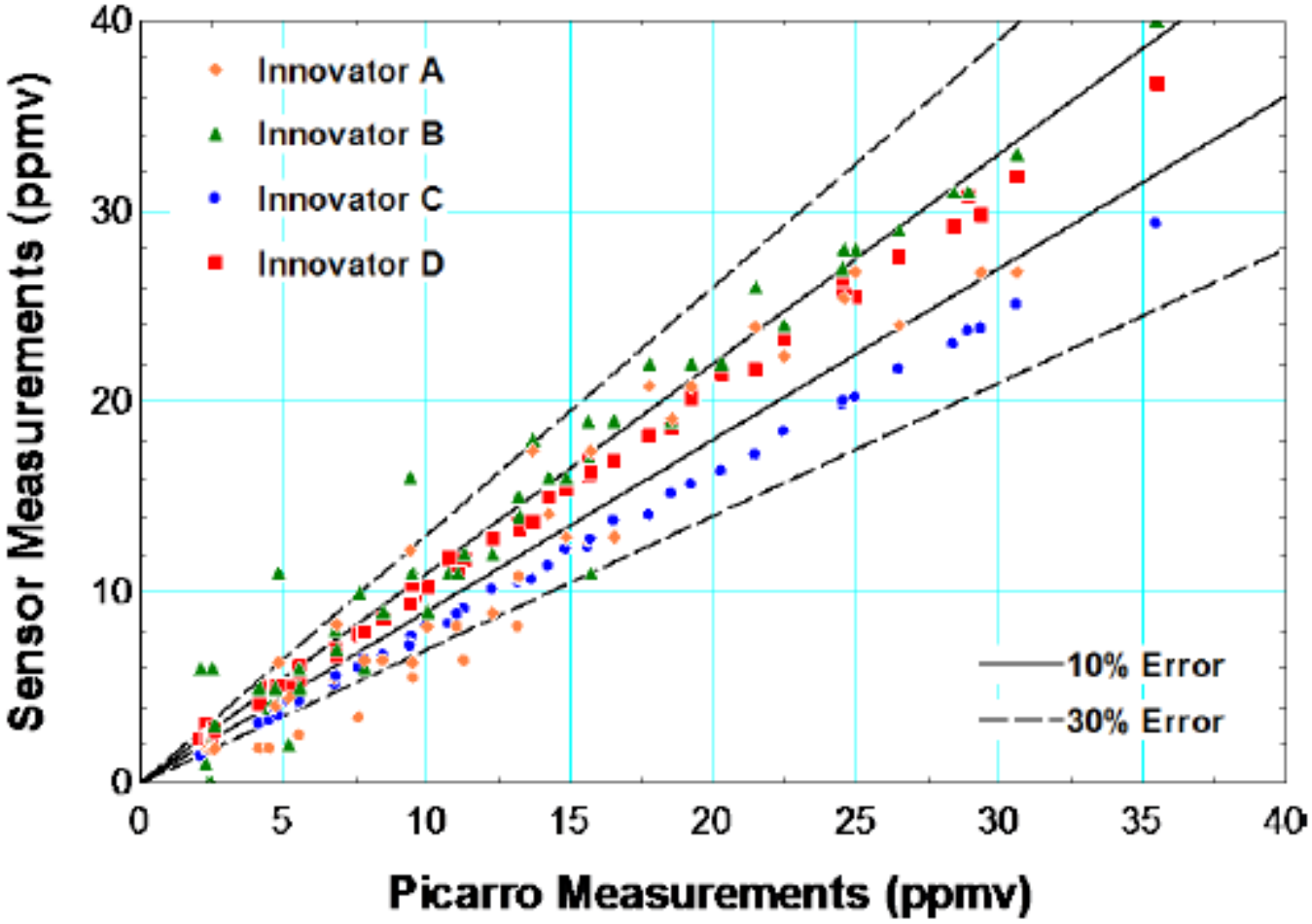
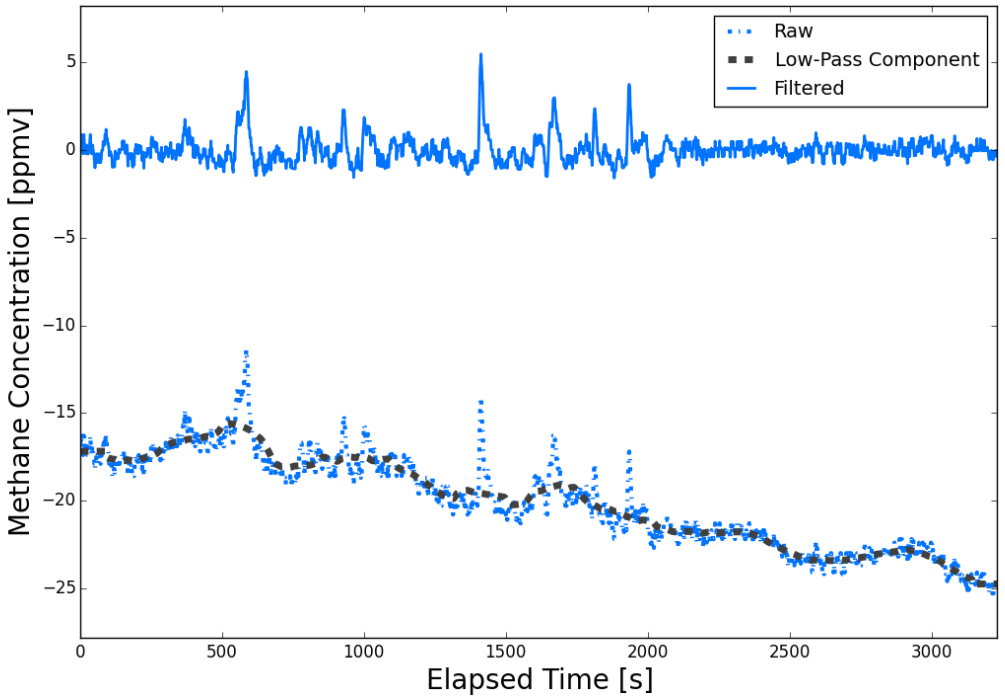


Figure 4.1. Sensor Measurements for Tests 1 and 2 of the Ambient Test.

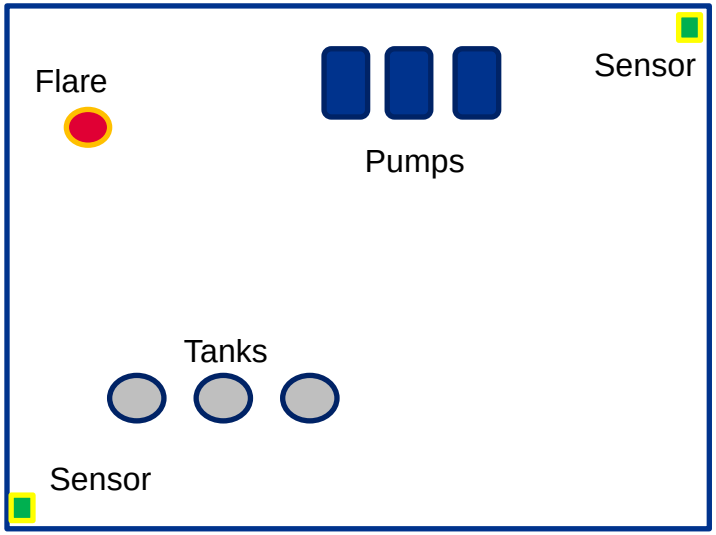
Stationary continuous monitors – need baselines and algorithms to evaluate leaks

In the beginning, the systems may have to "learn" baselines and refine algorithms. This is due to temperature changes throughout the day, on-site activities like pneumatics, prevailing winds, and methane conditions outside the site.

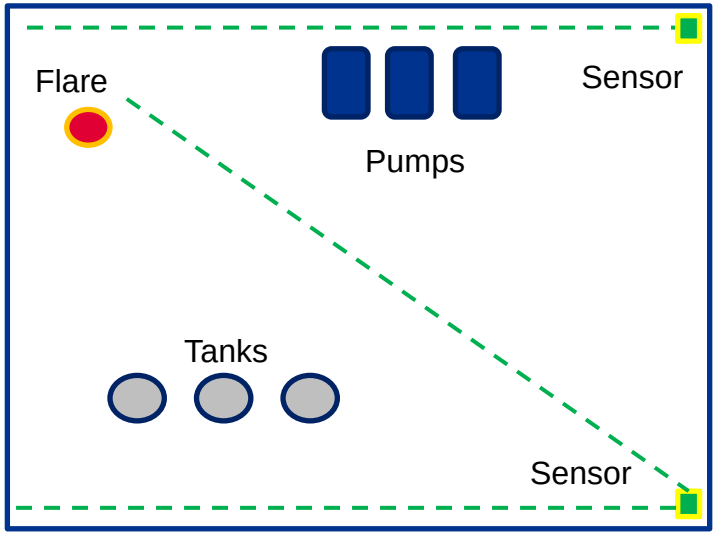


Examples of how continuous methane monitors could be deployed

Example 1 – point sensors



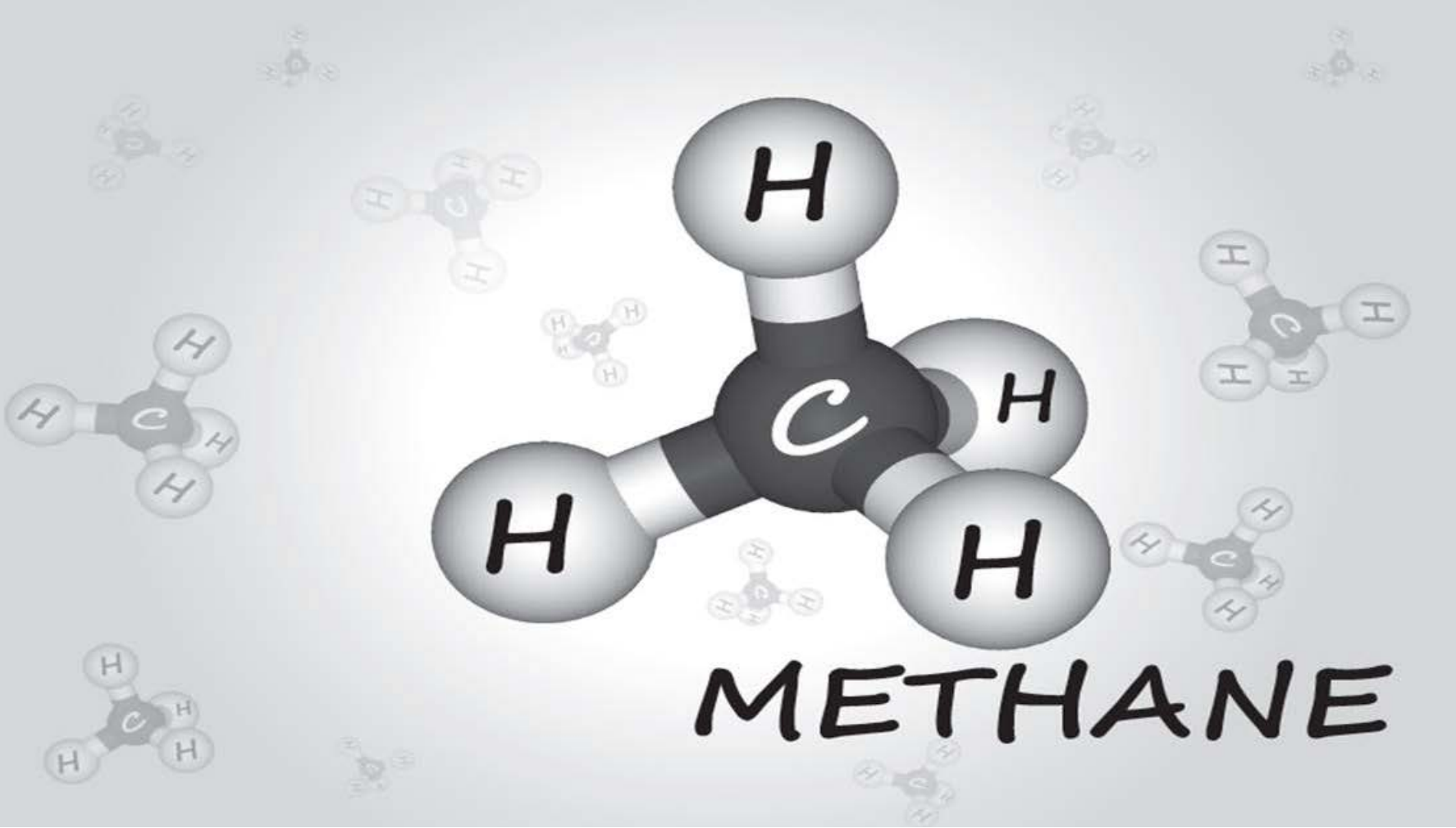
Example 2 – open path



- Multiple sensors cover entire field, and distinguish on-site from off-site methane
  - Diagonal open path sensor can be aimed up, e.g., at 45 degrees
- Additional anemometers would help estimate leak rates and location at very low cost

Stationary monitoring technology

- Why is it relevant?
  - Faster, automated leak detection
  - Use in communities and high consequence facilities
  - New technology is much less expensive
  - Reduced product waste
  - Reduced greenhouse gases
  - Reduced regulatory and reputation risk
  - Rules are starting to require it



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