TDLAS Leak Detection – Fixed, Portable and Aerial Platforms

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HEATH CONSULTANTS
Your Safety...Our Commitment
www.heathus.com

PSI
PHYSICAL SCIENCES INC.

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certified WBENC WOMEN'S BUSINESS ENTERPRISE

Outline

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- Company overviews
- Laser-based leak detection technology background
- Current leak survey products –
  - RMLD®
  - RMLD-CS/FR
  - RMLD-UAV
  - RMLD-QGI
  - REM
- Leak Survey Analytics (LSA) cloud-based software

Heath History

- Founded in 1933
- 3rd Generation family-owned company
- Headquartered in Houston, Texas USA
- 1,800+ employees
- Services Business Unit (SBU) – Leak Survey, Contract Locating, Meter Services
- Products Business Unit (PBU) – Gas Detectors, Pipe Locators, Odorant Level Testers
- Norton Corrosion Limited – Corrosion Services

Vision

HEATH CONSULTANTS
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To be the safest services and technology leader for gas industry infrastructure asset management and provide select related products and services to other utilities.

Mission Statement

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In partnership with our customers and through the safe actions of all our employees, provide most valued, innovative, high quality solutions to enhance utility infrastructure asset safety, reliability and service quality, and contribute to our respective returns on investment.

Companies Heath Works With

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Sempra Energy

ENBRIDGE

PECO
An Exelon Company

UGI
Energy to do more®

DUKE ENERGY®

Piedmont Natural Gas

BGE
An Exelon Company

SDGE

New Mexico GAS COMPANY
A TECO ENERGY COMPANY

delmarva power
An Exelon Company

PG&E

nationalgrid

PSEG

New Jersey Natural Gas

TECO
AN EMERA COMPANY

KINDER MORGAN

Washington Gas™
A WGL Company

Southern Company

Physical Sciences Inc (PSI)

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- Founded 1973, 210 scientists, engineers, and administrative personnel
- Headquartered in Andover, MA
- Applied research and development
- Technology transition and prototyping
- Licensing to strategic partners and spin-outs

- With Heath, PSI introduced the RMLD® in 2004
  - *Exclusive License*
  - *Thousands of units sold worldwide*
  - *Joint R&D to advance RMLD® capabilities and applications*

Leak Detection Tools

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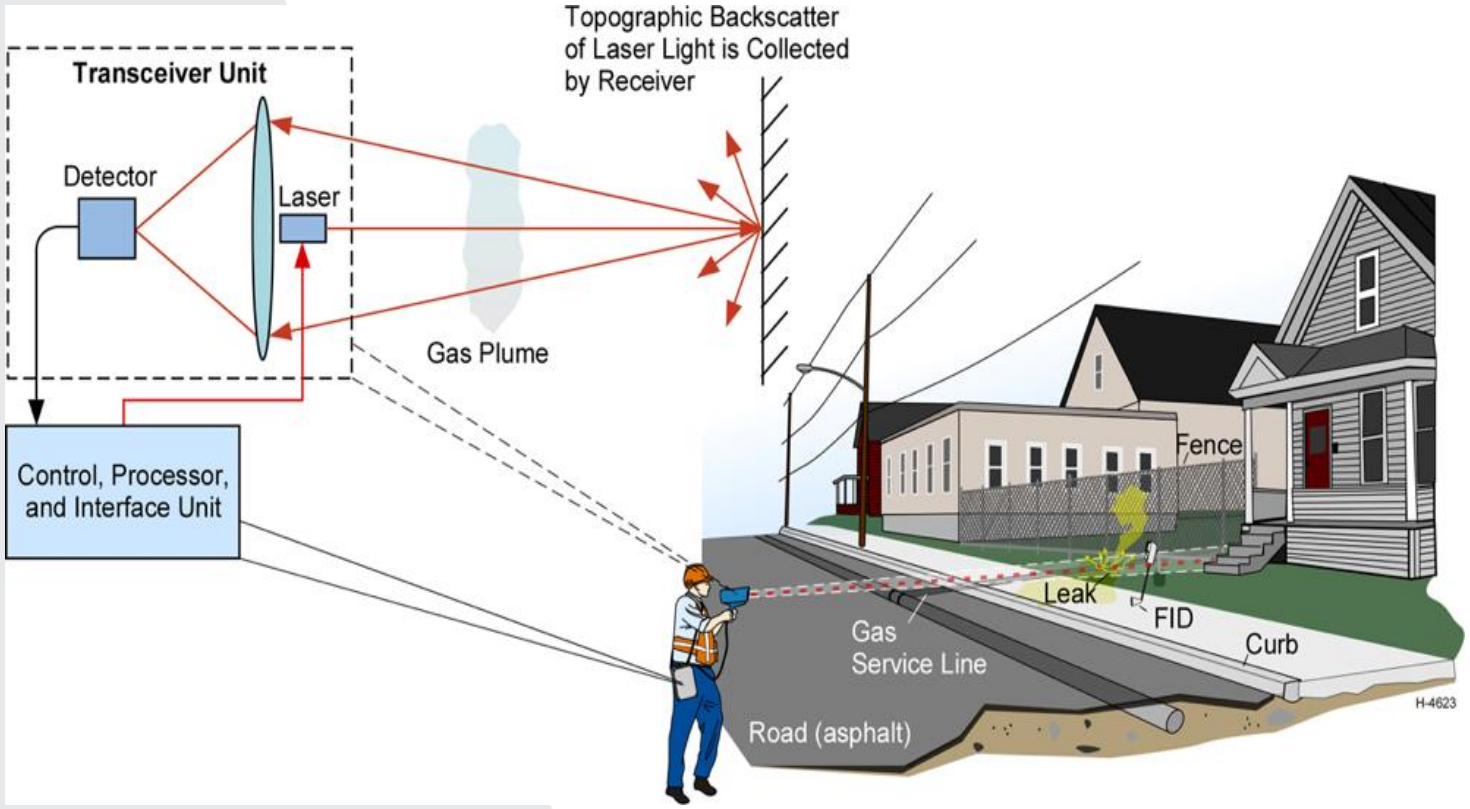
- Monitor, map, and measure methane emitted by leakage from Natural Gas infrastructure
  - Safety: Downstream Pipeline Leak Survey
  - Environment : Fugitive emission detection and measurement
    - Upstream gathering, storage, processing, and compression
- Tools include:
  - Handheld leak survey tools
  - Mobile and aerial survey, imaging, and quantification tools
  - Permanent continuous open-path fence line monitors

Laser Backscatter Detection – RMLD®

- ***Measures methane (PPM-M) along laser path***
- ***Independent of ambient conditions***



Non-contact; **only the probe beam interacts with sample**

Selective; **little cross-species interference**

Sensitive; **sub-ppm detection**

Fast; **sub-second response time**

Configurable; **point, open-path, or standoff sensor**

RMLD-IS®

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- Perform surveys without physically walking service lines
- Can scan both sides of the street
- Safer to inspect busy street and intersections
- Pipeline on bridges
- Scan through windows
- Released 2005
- Intrinsically safe operation

RMLD-CS™

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- Single-handed version
- Released 2019
- Ergonomic
- GPS
- Data-Logging
- Camera
- Bluetooth

Flux Measurement

- Current gas leak survey tools do not directly quantify emission rates
- Measuring leak rate:
  - Enables prioritizing repairs based on leak rates rather than local (wind-dependent) concentration
  - Reduces cost to locate high-priority leaks
  - Enhances worker and public safety
  - Supports GHGI estimation and reduces GHG environmental impact
  - Reduces/eliminates loss of revenues from lost gas

RMLD-UAV

Technology	Methane detection, leak imaging and flux estimation via b-TDLAS adapted to small quadrotor UAV
Size (UAV + payload)	24” diameter, 9” depth
Weight	Approximately 3 lbs with battery
Flight Range	Within visual sight (<2000 ft) of base station
Survey altitude	30 ft typical
Endurance	30 min
Wind	30 mph
Control	• Handheld GCS • Optional computer for semi-autonomous flight w/ real-time way point updating • Automated vertical launch and land
User Interface	• Intuitive GUI w/ Google Maps API • User-defined waypoint missions • Transmits target waypoints to aircraft based on aircraft feedback
Methane and GPS Data	Class 1 Bluetooth

Flight Patterns, Leak Maps, and Flux Calculation

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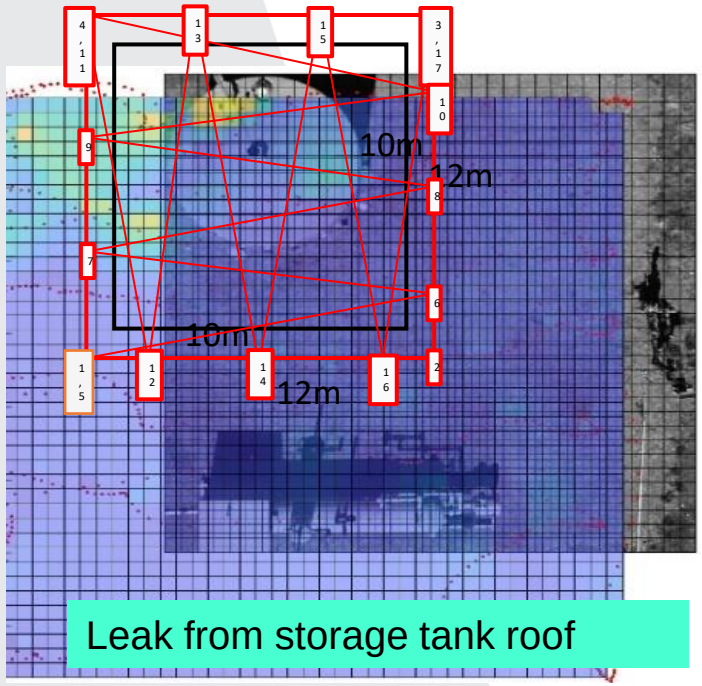
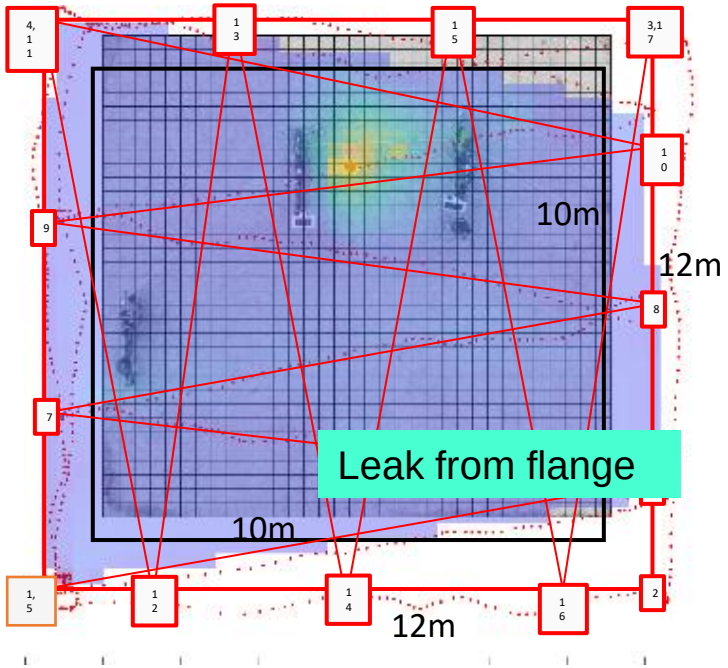
- Scanning the laser creates images and quantifies emission plumes

RMLD UAV



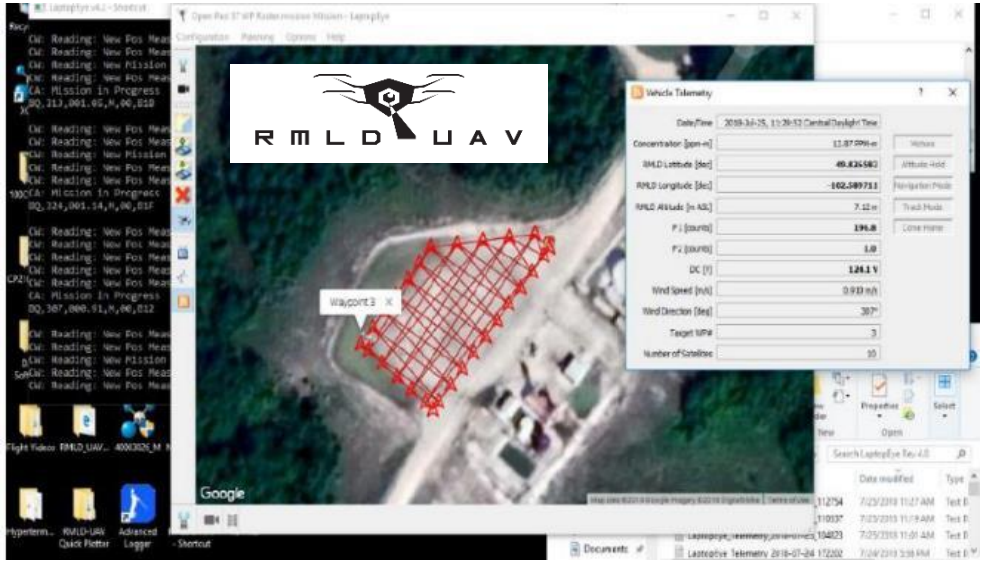


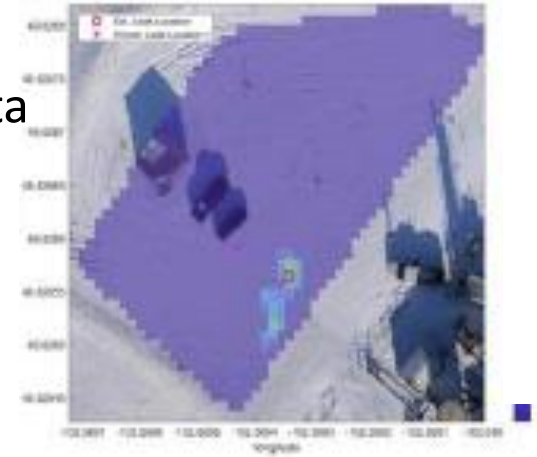
Wellpad views from above

- Each pixel measures ppm-m
- Deduces emission rates (flux)
- Fast: ~10m^2/min
- Sensitive: ~ 1 SCFH.

UAV Survey Procedure

- **Pre-flight**
  - Position anemometer
  - Load flight plan
  - Mount RMLD payload
  - Collect one minute of pre-flight data
- **Flight**
  - Initiate autonomous flight plan
  - Land aircraft at “Home”
- **Post-Flight**
  - Collect one minute of post-flight data
  - Process data to create a colorized concentration grid map
  - Exercise software to estimate leak location and rate





Test 1A

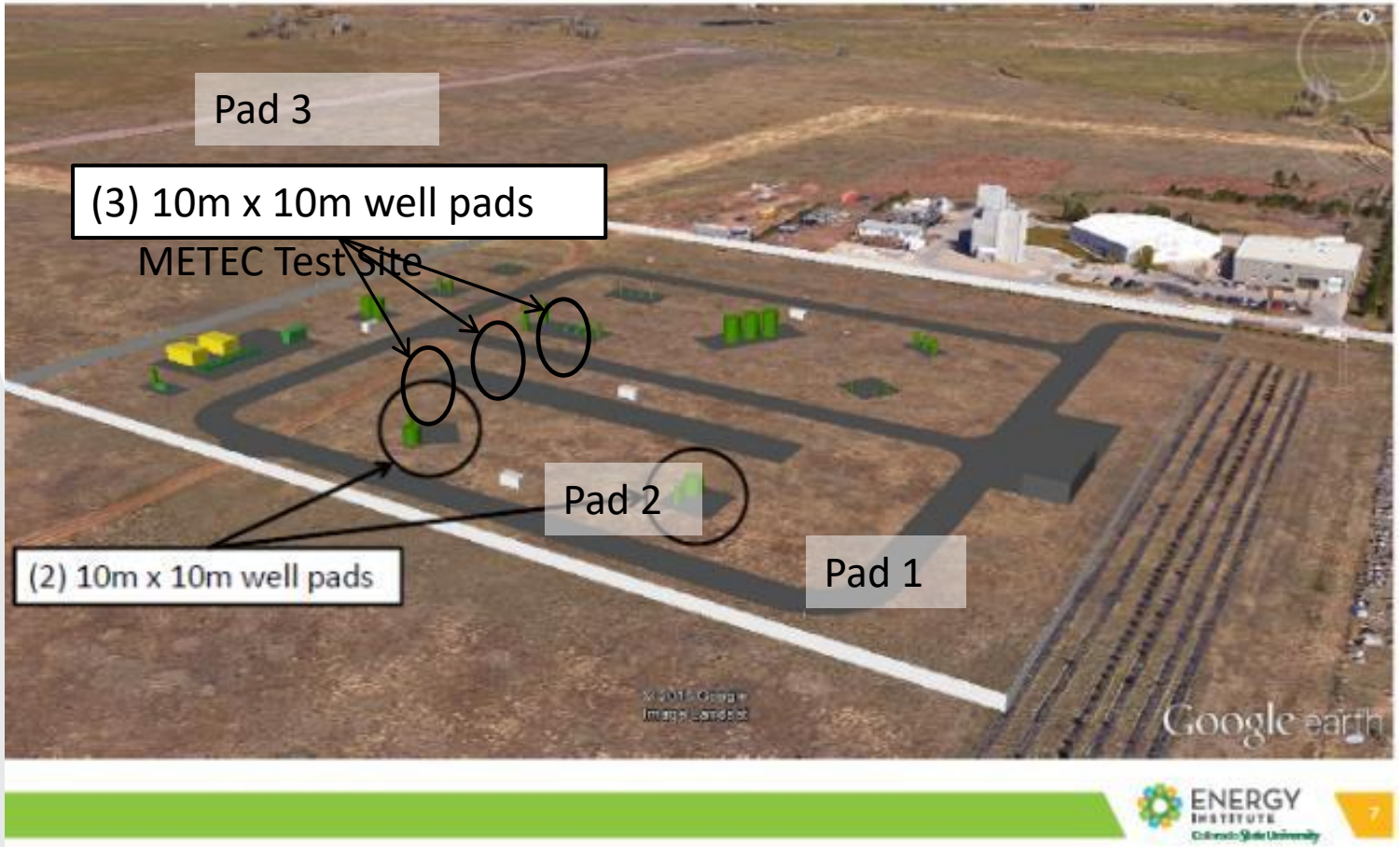
Actual Leak Rate: 10 LPM

Merged Flight Data

- **Estimated Leak Rate: 7.7 LPM**
- **Est. Leak Lat: 49.8265160**
- **Est. Leak Lon: -102.5893905**

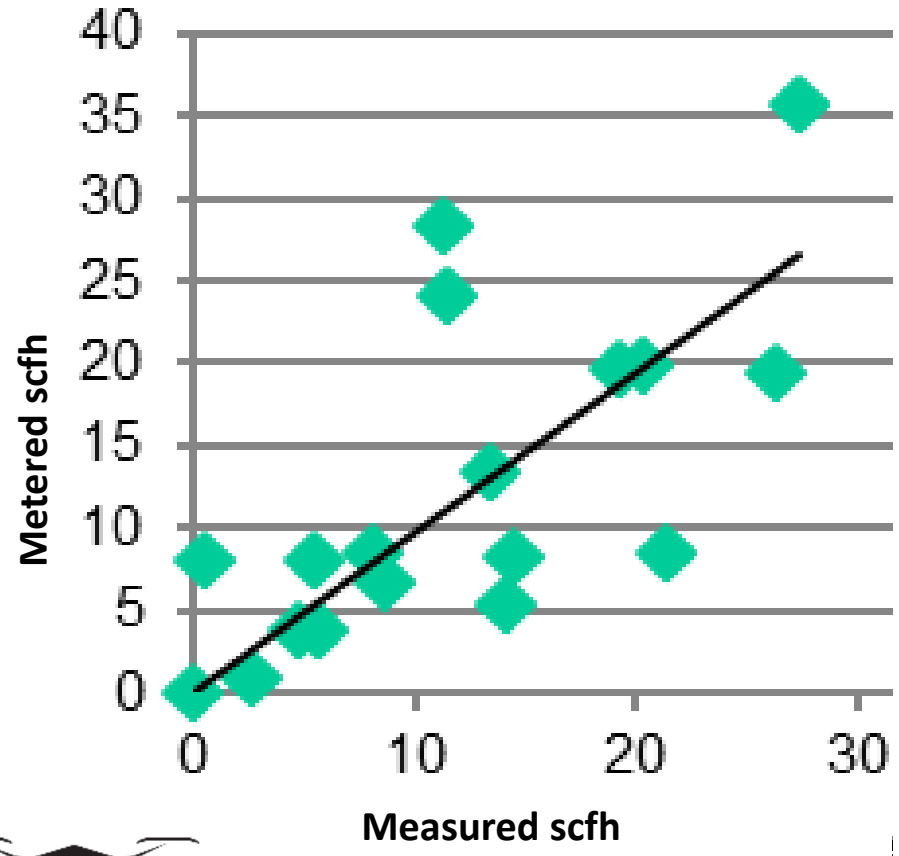
METEC TEST SITE

- Colorado State University, Fort Collins, CO
  - METEC: Methane Emissions Test and Evaluation Center



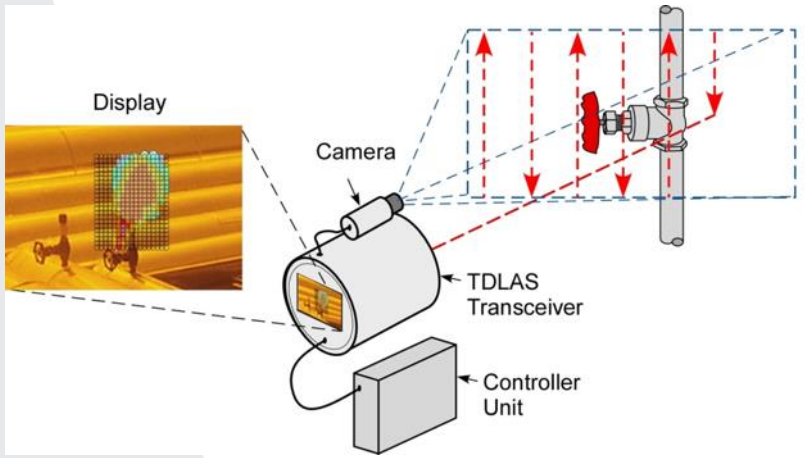
RMLD-UAV: METEC Leak rate and Localization Estimations (July 2017)

- 18 distinct blind test scenarios
  - Three or four ~15 minute flights per test
    - >100 flights without failure or incident
- Zero false negatives (all leaks detected)
- Zero false positives (all zeros correctly identified)
- Localization correct within 1 m for 77% of tests
- Deduced the flow rate within:
  - 20% accuracy for 28% of tests
  - 50% accuracy for 56% of tests
  - 70% accuracy for 83% of test
  - Max percentage error:
    - 1 scfh metered deduced as 4 scfh measured

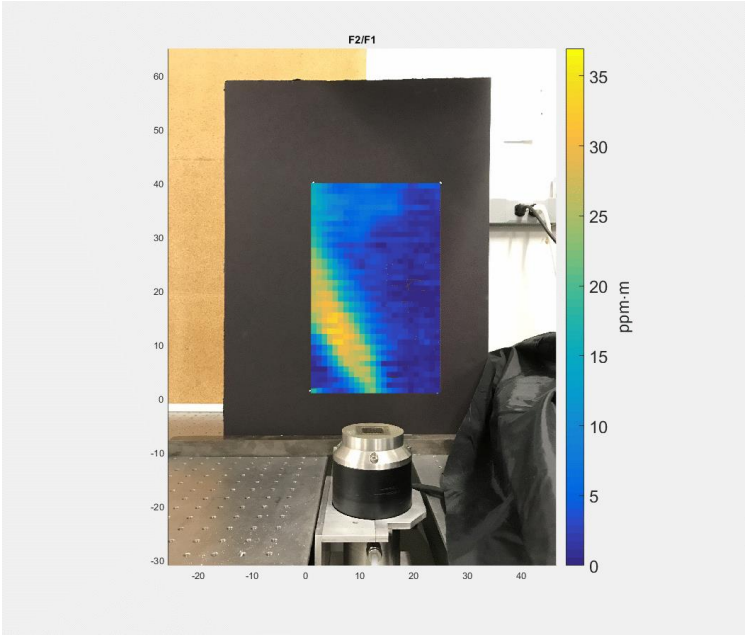


RMLD UAV

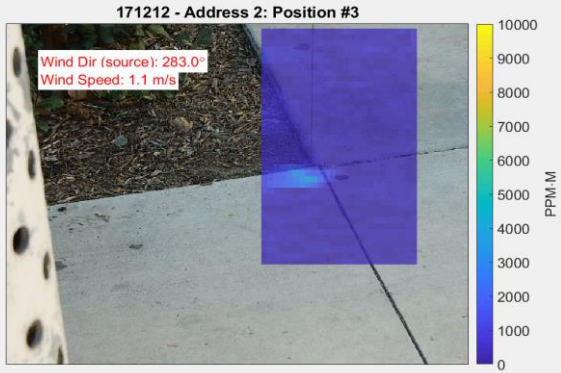
Handheld Quantitative Gas Imager (QGI)



- Raster-scan laser
- Measure/deduce wind
- Process data
- Visualize leak on display
- Compute leak rate

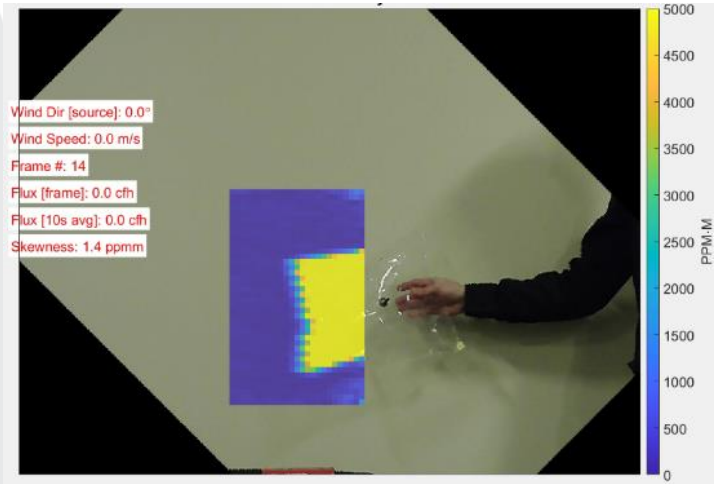


15 scfh methane @ 10 ft

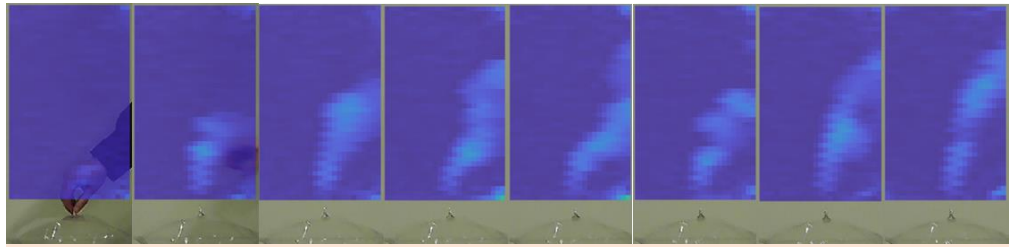


<5 scfh sidewalk leak

QGI Handheld Transceiver Package



Clear plastic bag contains methane.

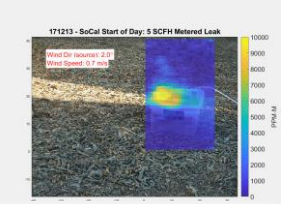


- **Bag valve opened**
- **Plume imaged at 1Hz overlaid on visible camera video**

QGI Performance

Sandbox Validation Tests

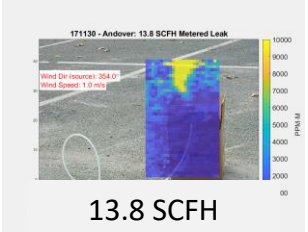
1.0 SCFH



5.0 SCFH

Pico Rivera, CA
w/SoCal Gas
December 2017

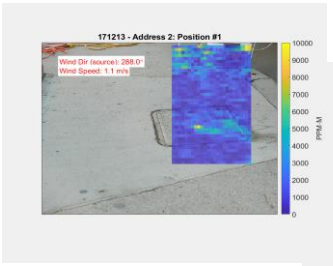
Metered Leak Rate [scfh]	Measured Leak Rate [scfh]
27.5	26.6
13.8	14.7
5	7
1	1.2
0.5	4.7



13.8 SCFH

PSI, Andover, MA
December 2017

Municipal Leaks



Pico Rivera, CA w/SoCal Gas
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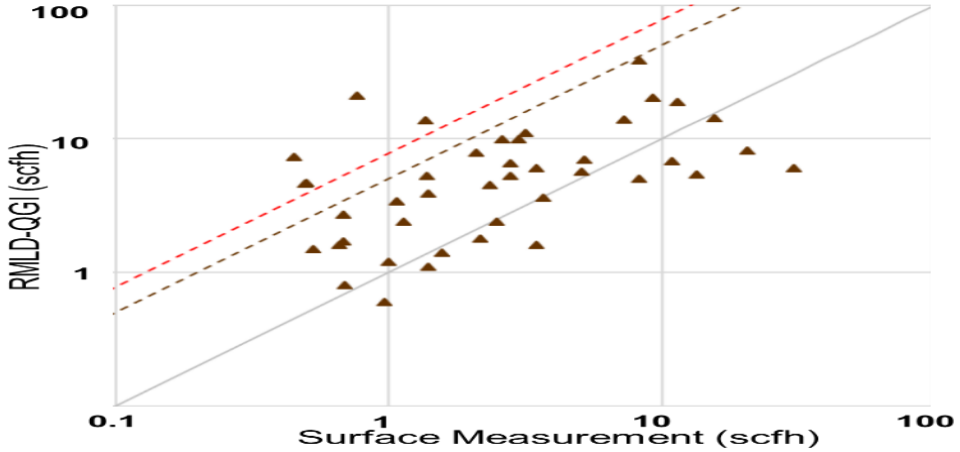
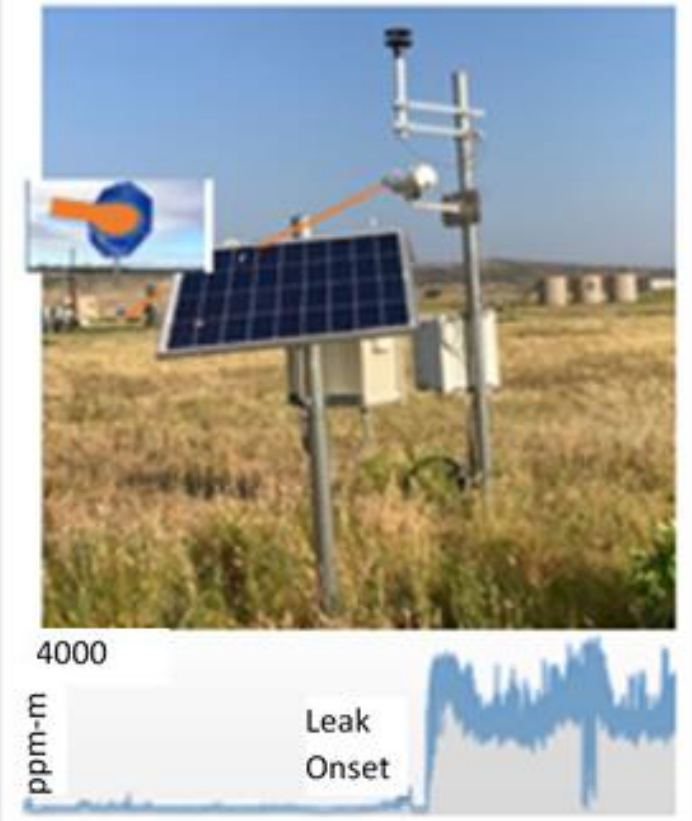


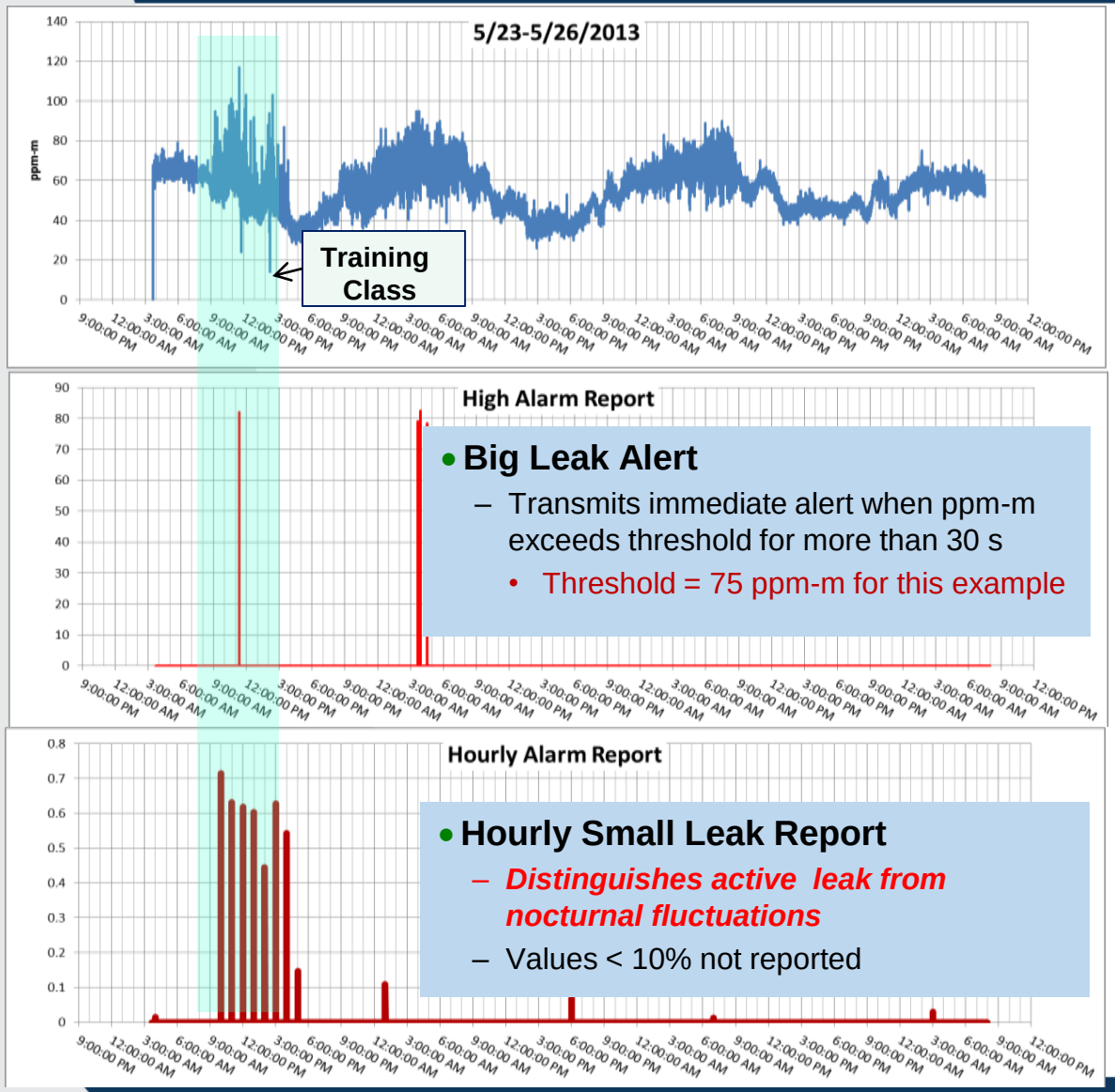
RMLD-REM: Continuous Monitoring



REM pole-mounted transceiver, simulated laser beam to distal target (~200m), and example leak data

- Permanent laser-based open-path alarms to detect and mitigate small to potentially explosive leaks
- Wireless
- Solar-powered
- Easy installation and alignment
- Heath Leak Survey Analytics (LSA) cloud software:
  - Real-time alarm notification
    - Operator alert within one minute of urgent leak detection
    - Hourly notification of non-urgent leaks, enabling proper operator assessment and response
    - Continuous data logging
    - Secure access
    - Data analytics

Automated Leak Alerts



- Alarm algorithm uses fast-sampling statistics to identify leaks despite normal background day/night fluctuations
- Provides high-probability of detection and low false alarm rate
- Alerts and status reports automatically transmitted to operators

Technical Contributors

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