



Emerging Technology in Air Pollution Measurements for Oil & Gas



A Leading Provider of
Environmental Solutions

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Overview of Montrose



MONTROSE
ENVIRONMENTAL

The Premier Provider of Environmental Solutions

MEASUREMENT & ANALYTICAL SERVICES



ENTHALPY
ANALYTICAL

Environmental
Laboratory Services



MONTROSE
AIR QUALITY SERVICES

Air Measurement
Services

- LDAR
- Stack Testing
- Ambient
- Emerging Technology

ENVIRONMENTAL RESILIENCY & SUSTAINABILITY

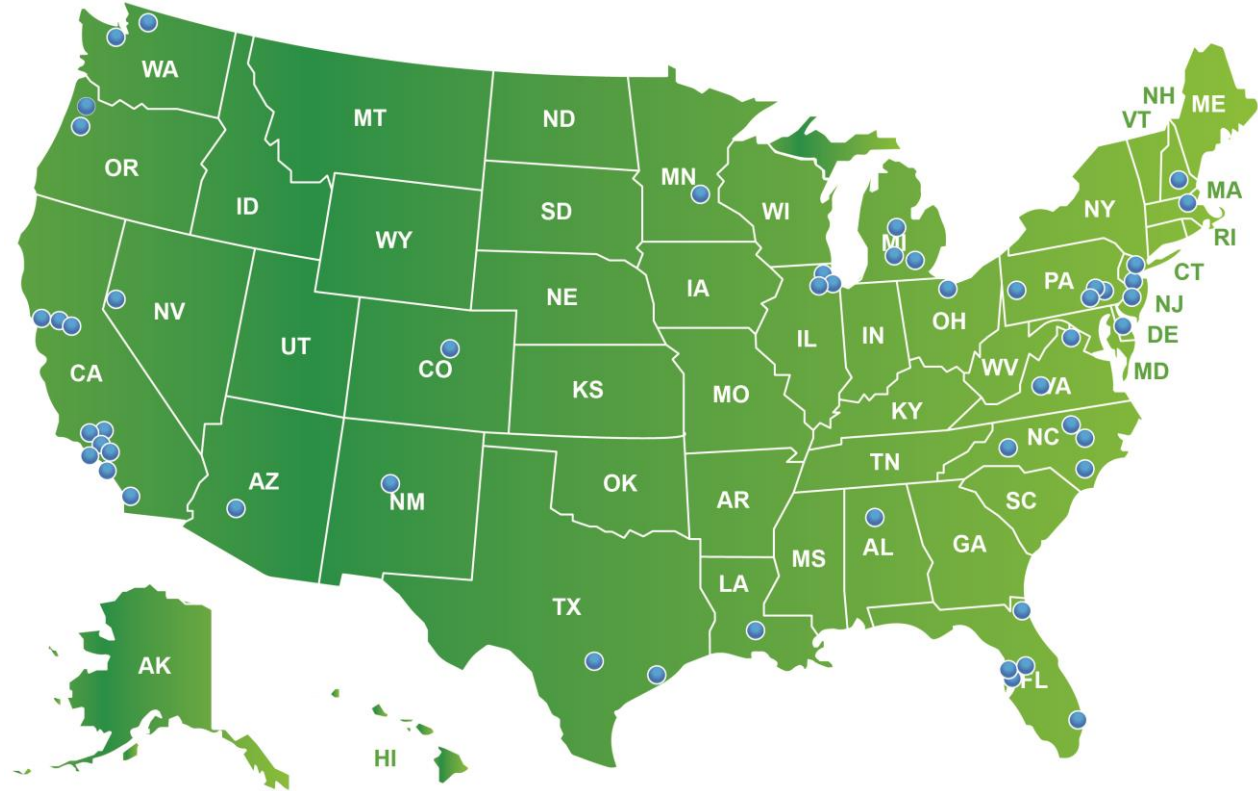


MONTROSE
ENVIRONMENTAL

Environmental Engineering,
Planning, Permitting,
Remediation & Waste to
Energy Resources

Montrose by the Numbers

- **50+ Offices**
- **100+ Mobile Labs**
- **1,200+ Employees**
- **5,000+ Clients**
- **National, State and Local Accreditations**



Today's Talk

- Part 1 – Combustion Efficiency; Flares and Combustors
- Part 2 – PTR-TOF-MS Mobile Van
- Part 3 – Using VOC Sensor Networks to Mitigate Risks to the Community

Part 1 – Flare and Combustor Testing

Problem: Oil & Gas production limited based upon VOC emissions

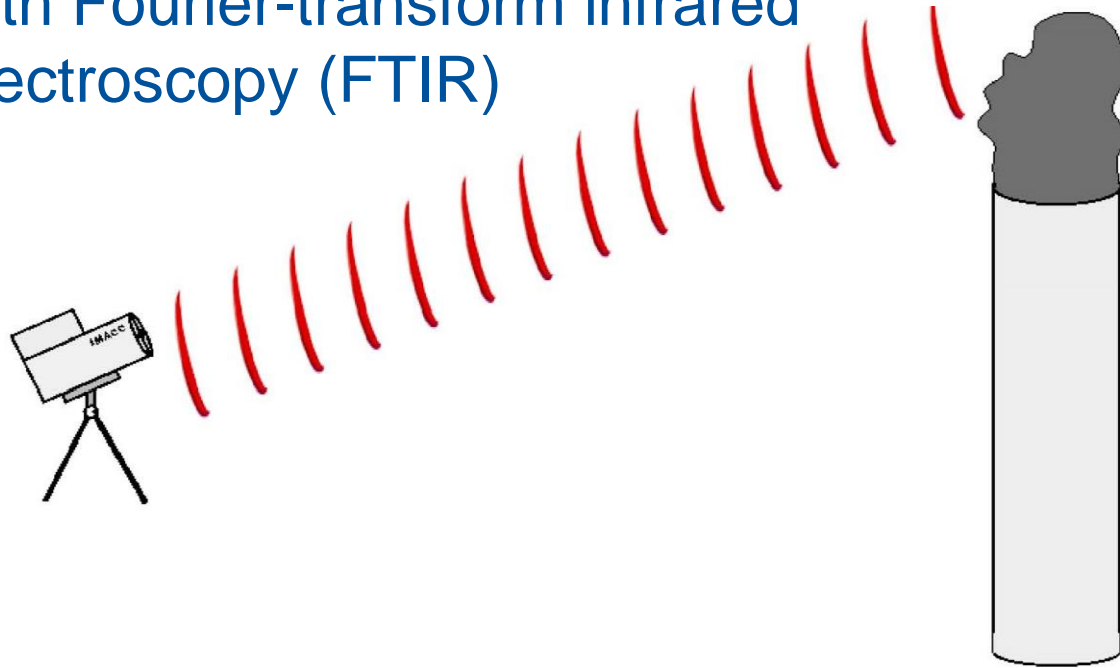
- VOC combustion efficiency of a flare is permitted at 98%
- If actually 99%, emissions are halved
- If emissions are lowered, production can be increased...



Part 1 – Flare and Combustor Testing

Other Flare Methods For Determining CE

- Extractive
- Path Fourier-transform infrared spectroscopy (FTIR)



Part 1 – Flare and Combustor Testing

- Montrose Partner: Providence Photonics
- The Mantis™ measures flare combustion in real time
- ~\$500K+ instrument
- Portable, fast (~25 readings per second)
- Real time flare parameter tuning
- Video Imaging Spectro-Radiometry (VISR)



Part 1 – Flare and Combustor Testing

$$CE = 100 \times \left[\frac{CO_2}{(CO_2 + VOC)} \right]$$



Part 1 – Flare and Combustor Testing

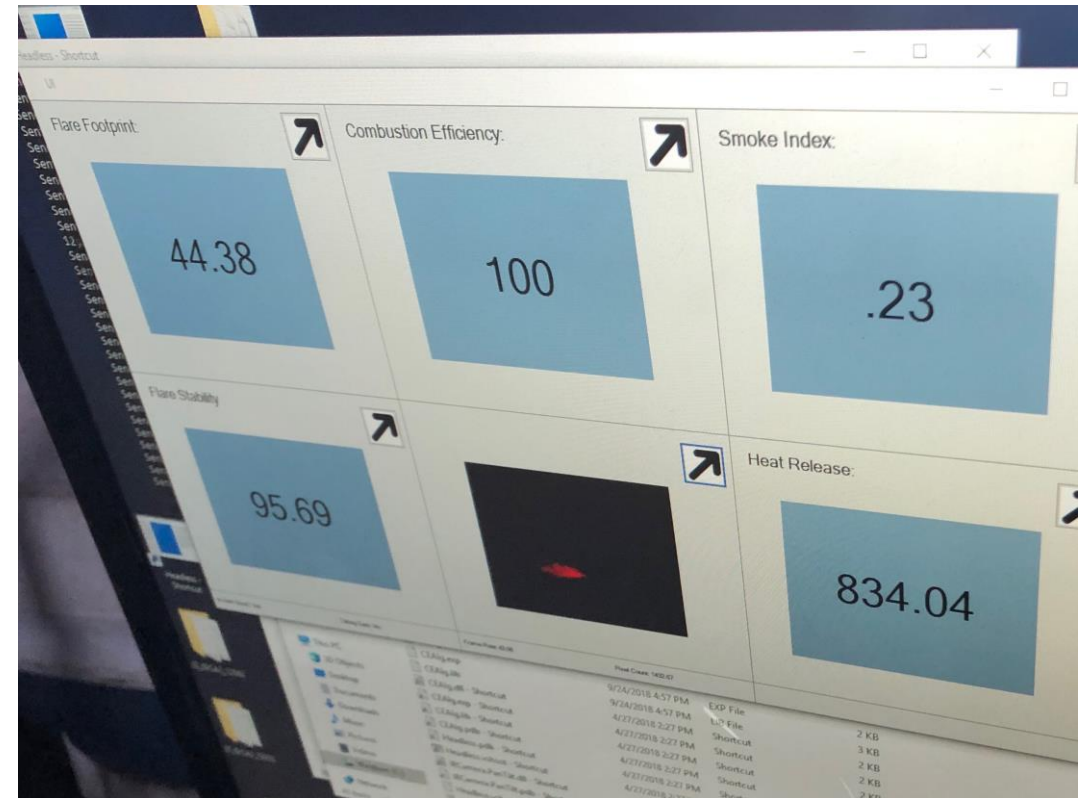


Demonstration
Test: 2 days -
~20 Flares

EPA Comparison
Tests Complete

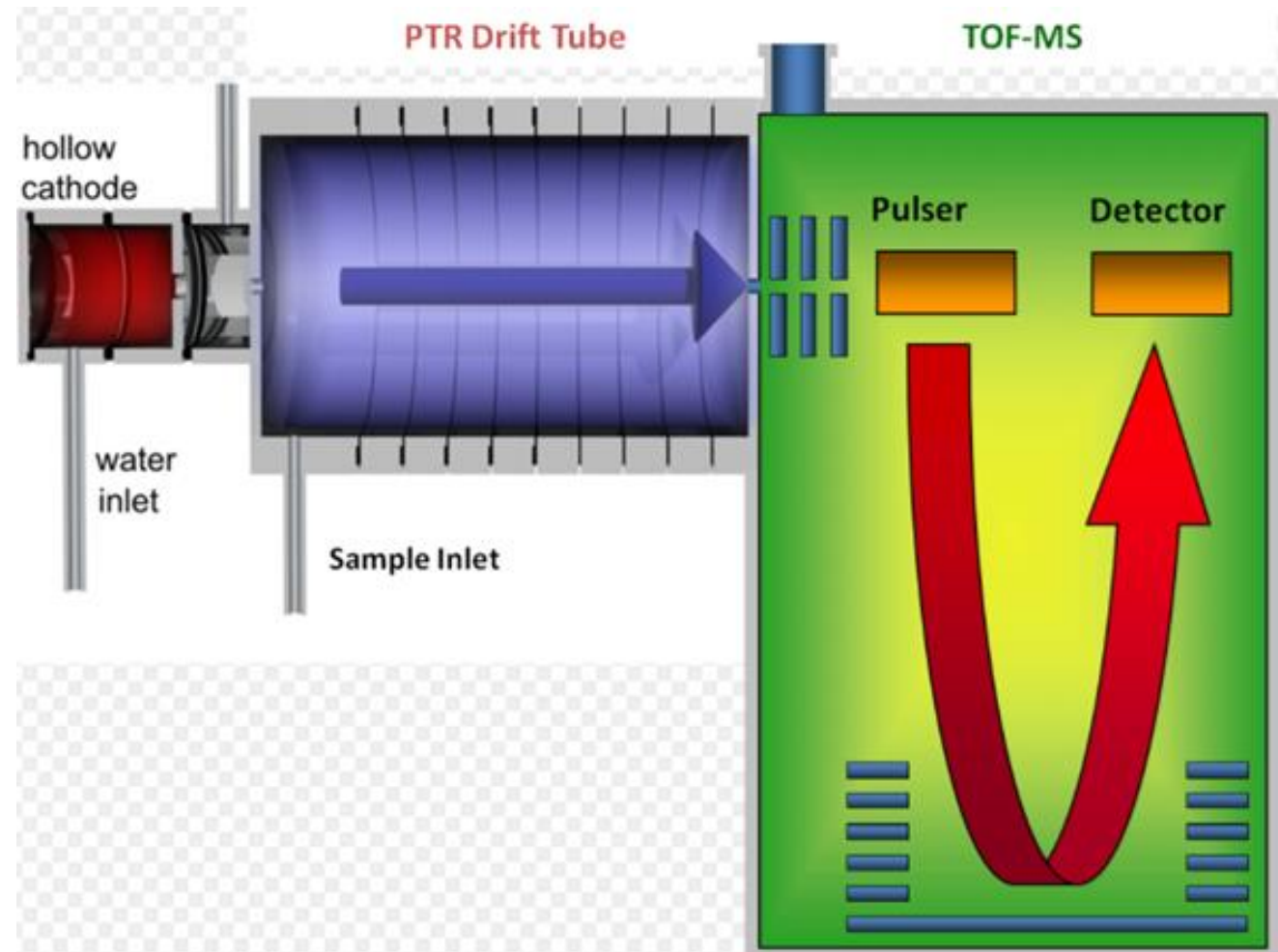
Flares - Ethylene
MACT

EPA Combustor
Meeting Friday



Part 2 – PTR-TOF-MS Mobile Van

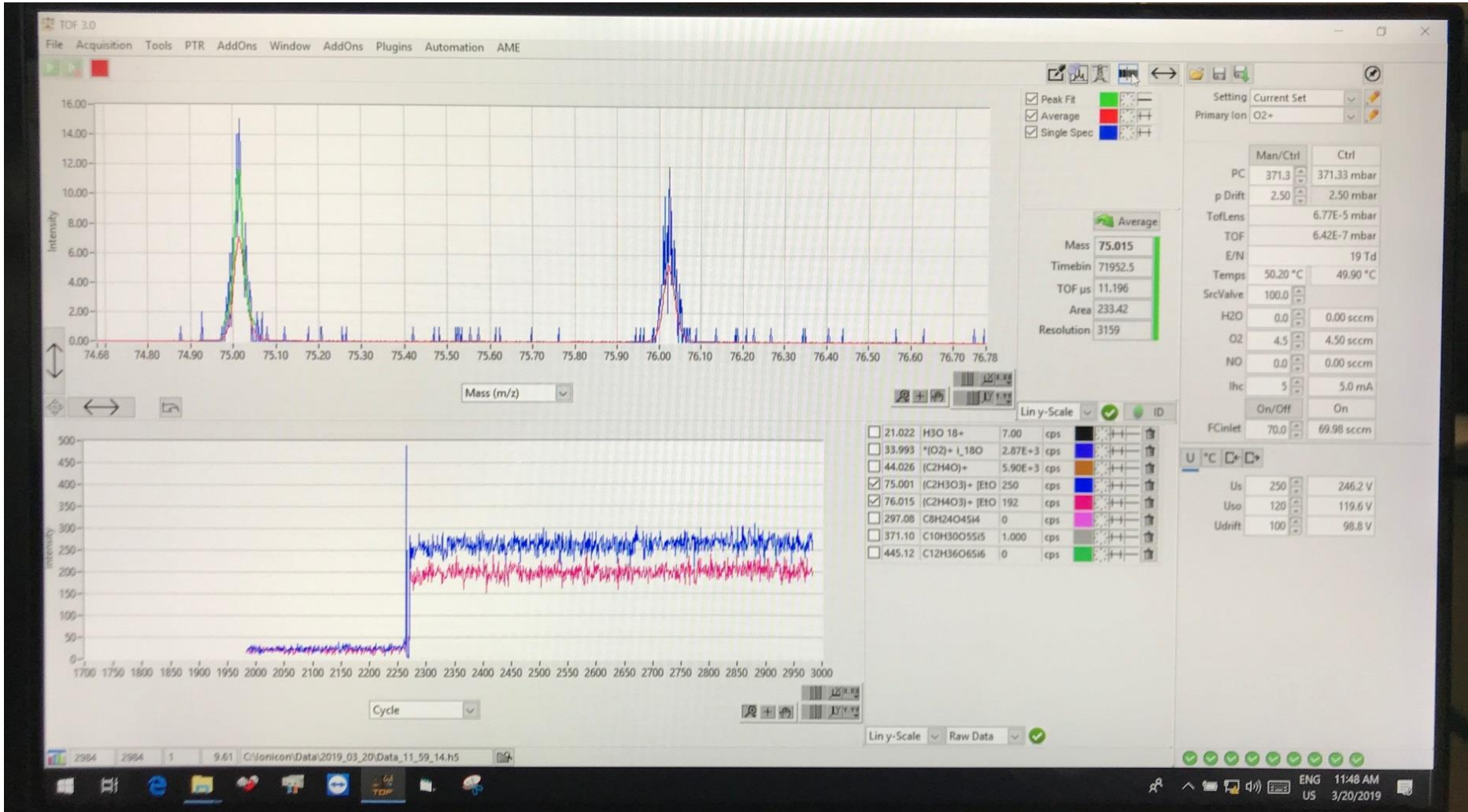
- PTR-TOF-MS: Proton Transfer Reaction - Time of Flight – Mass Spectrometry
- Fast and continuous
- Mobile
- Single digit PPT detection limit
- Many compounds at once
- Combine with Meteorological (MET) data for source



Part 2 – PTR-TOF-MS Mobile Van



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Part 2 – PTR-TOF-MS Mobile Van

Three (3) in the USA

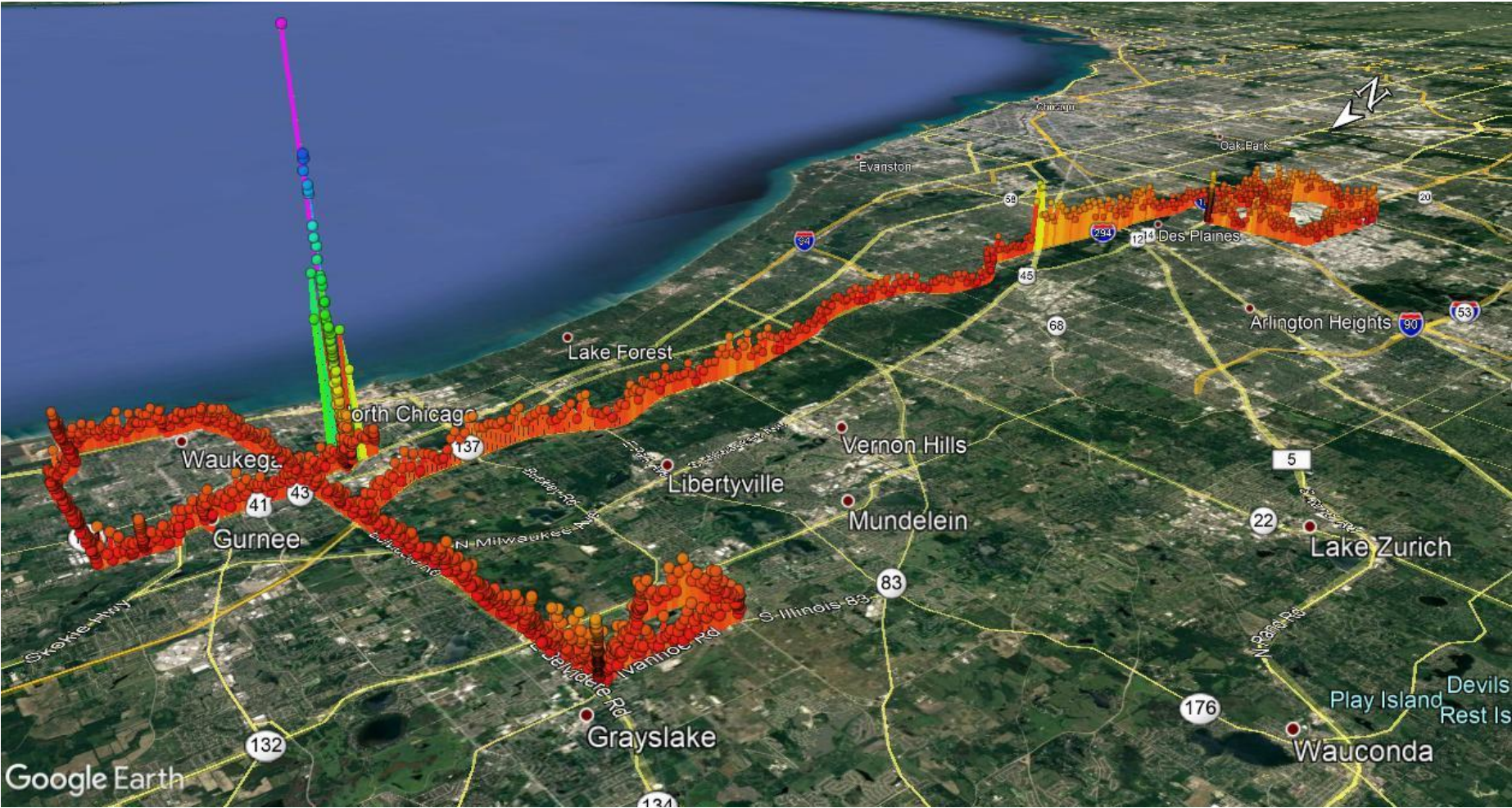
~\$950K each

Uses

- Ambient, process, source
- VOCs – BTEX
- Odor studies
- Industrial worker safety
- Vapor intrusion
- Defense, security, law enforcement
- Emergency response

Why Oil & Gas?

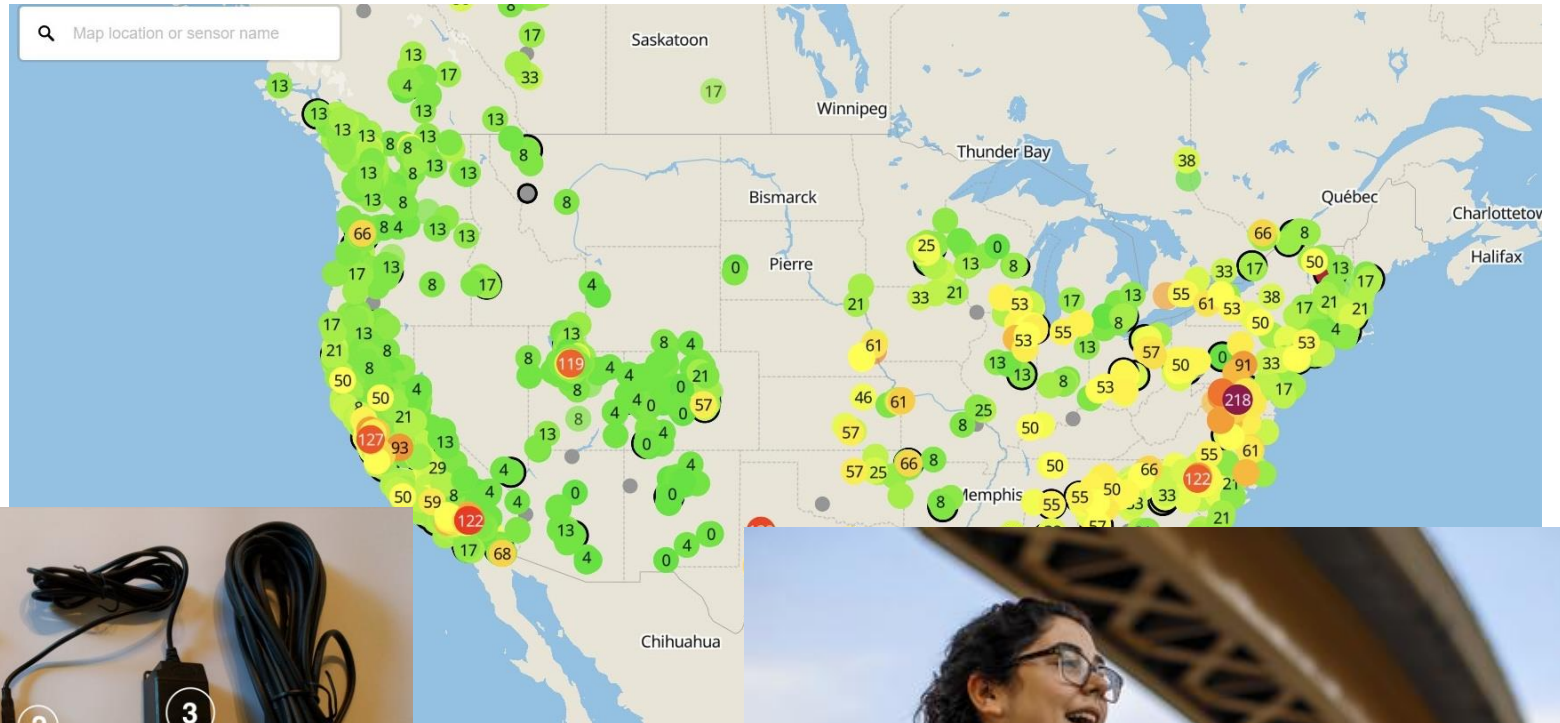
Part 2 – PTR-TOF-MS Mobile Van



Part 3 – Low Cost VOC Sensor Networks

Background...

- Low cost sensors are becoming commercially available
- Communities empowered to use them



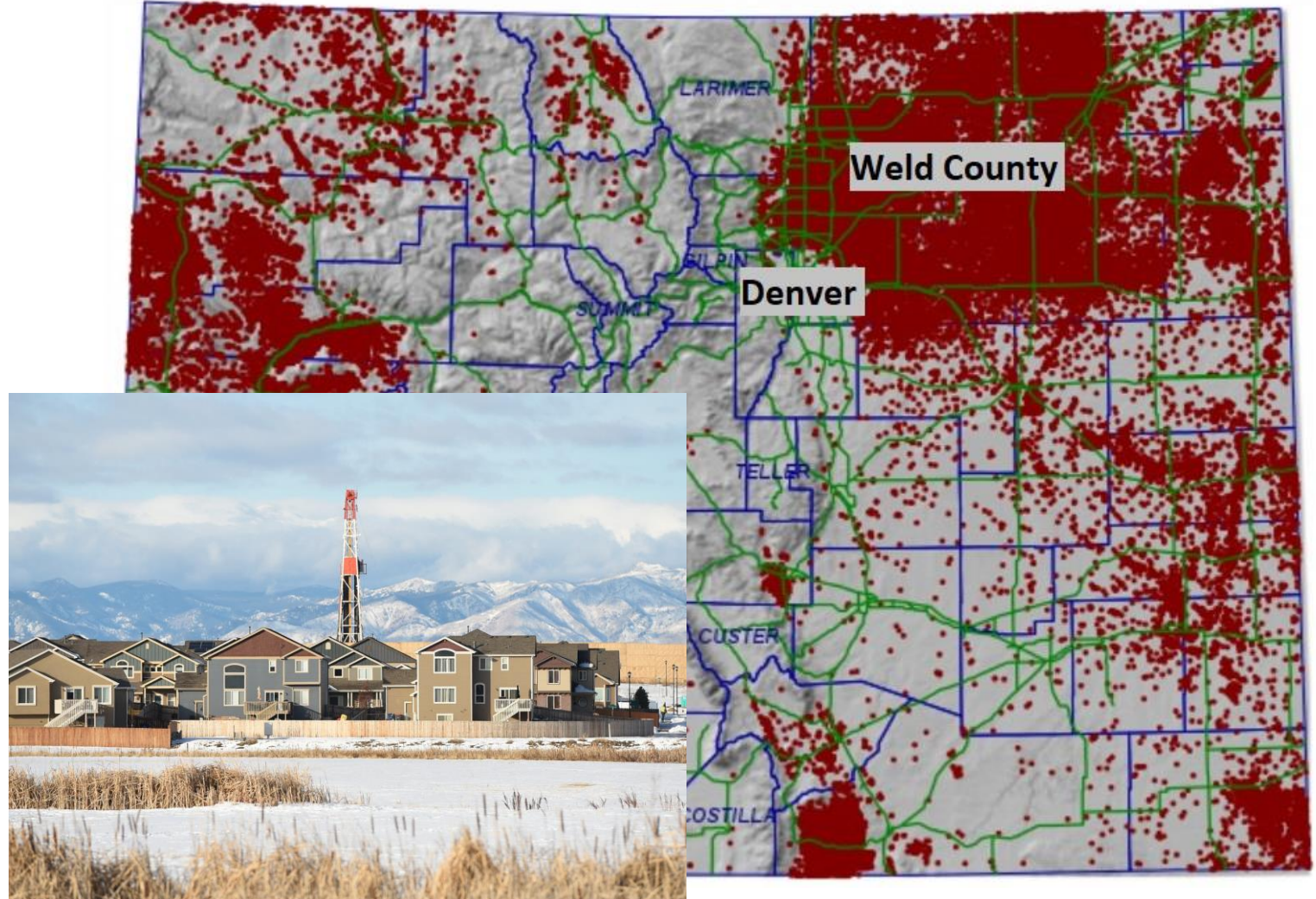
Purple Air
– PM
Sensors



Part 3 – Low Cost VOC Sensor Networks

Background...

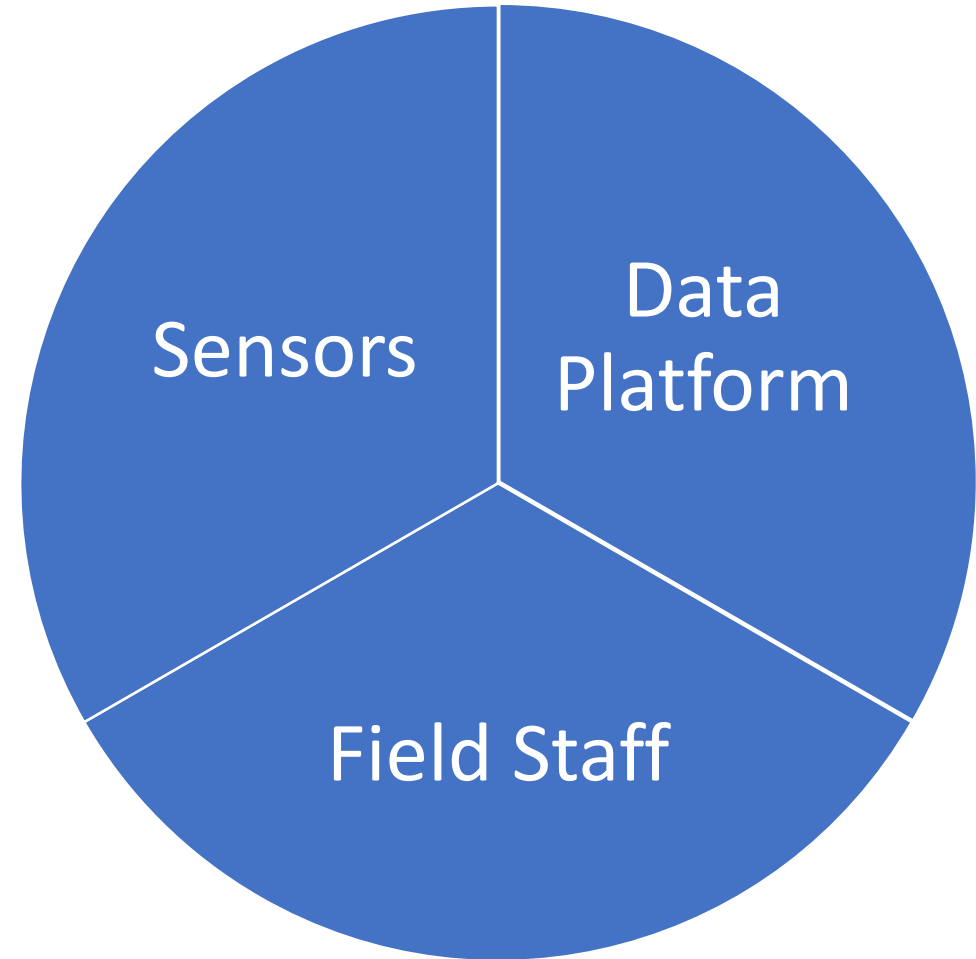
- Colorado 7th in the US for Oil Production
- 80% of that production is in the Denver-Julesburg Basin
- 20% population growth in Denver since 2010
- Denver housing prices have doubled since 2008
- Housing near Oil & Gas
- Senate Bill 181



Part 3 – Low Cost VOC Sensor Networks

Why Low Cost VOC Sensor Networks?

- Prevent issues before they reach the community
- Done right - could be good for community, regulators and industry
- Done wrong – bad data, wasted funds, lawsuits



Part 3 – Low Cost VOC Sensor Networks

Sensors

- Metal Oxide Sensors (MOX) – total VOCs w/methane
- Photo-Ionization Detectors (PIDs) - total non-methane VOCs
 - IonScience PID w/hydrophobic filter
- New technologies: absorption spectroscopy for methane, CU, Bioinspira (viruses)

Meteorological (MET) for source identification (we use ultrasonic)

Continuous vs Semi-Continuous

Accuracy - Calibration vs certification

Cost - \$750 to 2K (other technologies higher)

Detection limit - Low ppb VOC, to ppm methane + VOC

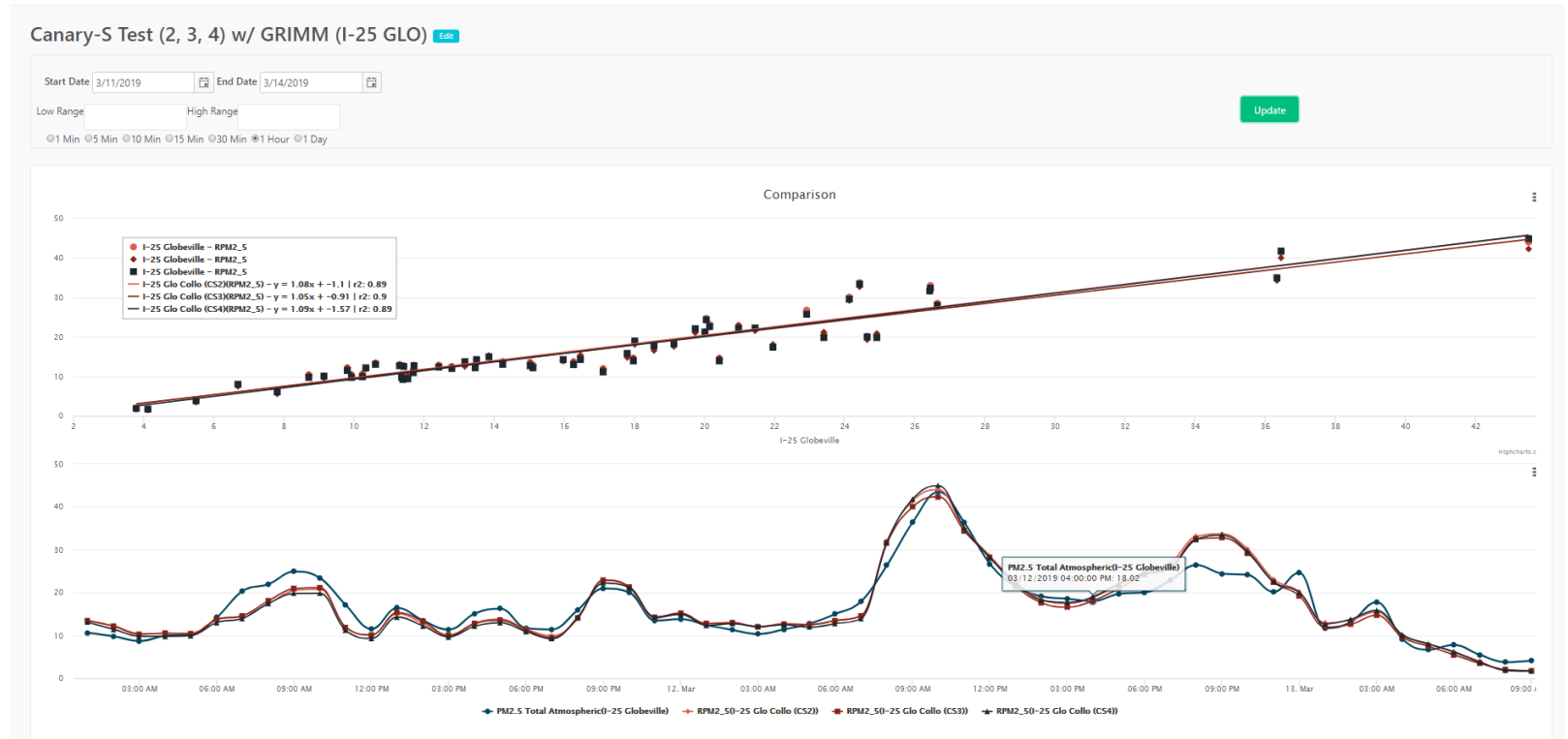
Part 3 – Low Cost VOC Sensor Networks

- Approach
 - Study 1 – Parking lots study to evaluate if sensors could identify real time leaks
 - Study 2 – Roof top study to evaluate data platform
 - Study 3 – Live study(s) on a well pad during drilling and fracking activities (in progress)



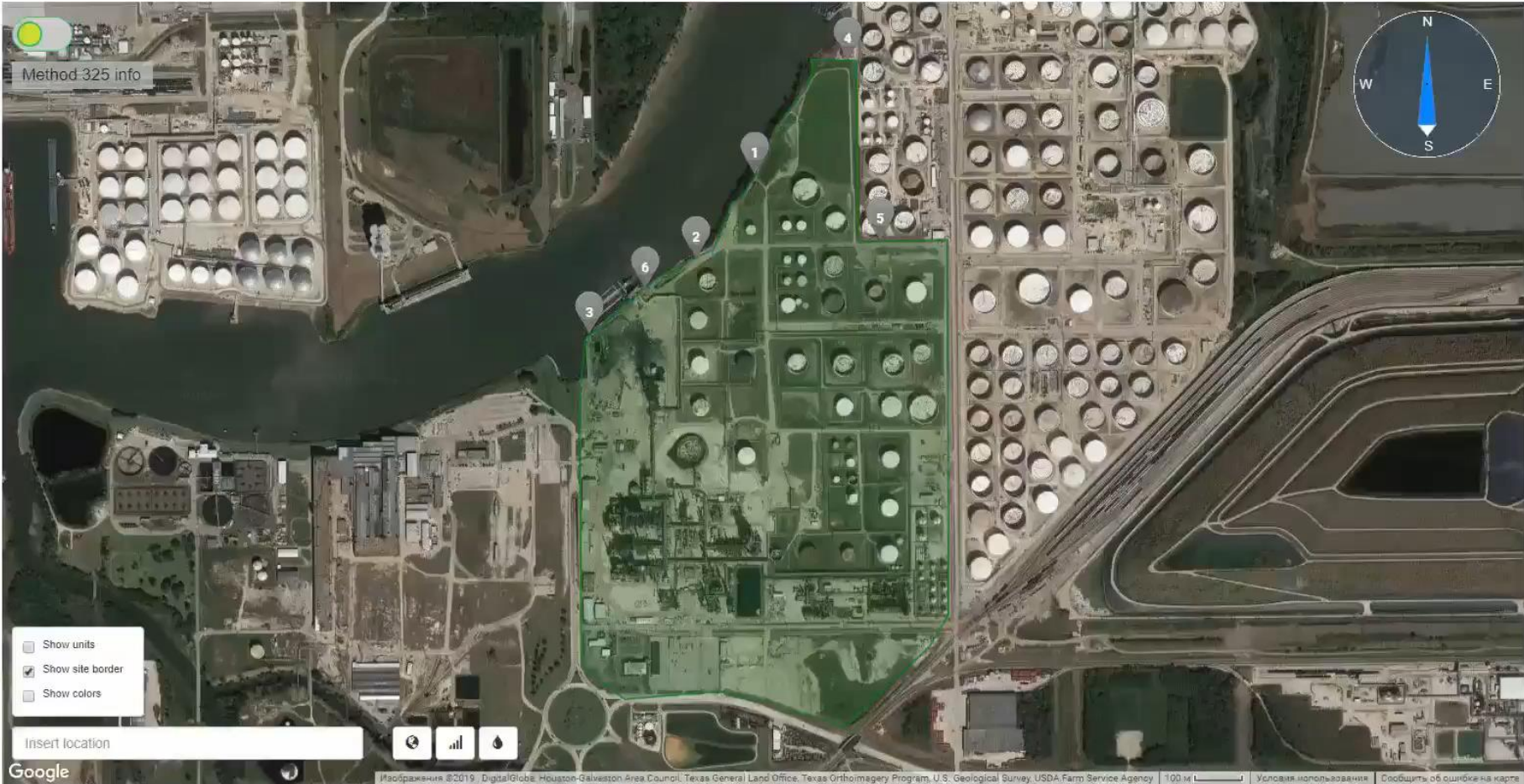
Part 3 – Sensor Networks Data Platform

- Incorporate all manners of sensors
- Incorporate fixed and mobile sensors
- Perform real time Quality Control on data (e.g. min/max, sticking, etc.)
- Reporting functions (averages, QA summary, monthly reports generation)
- Provide real time alerts via text and/or e-mail
- Mobile app

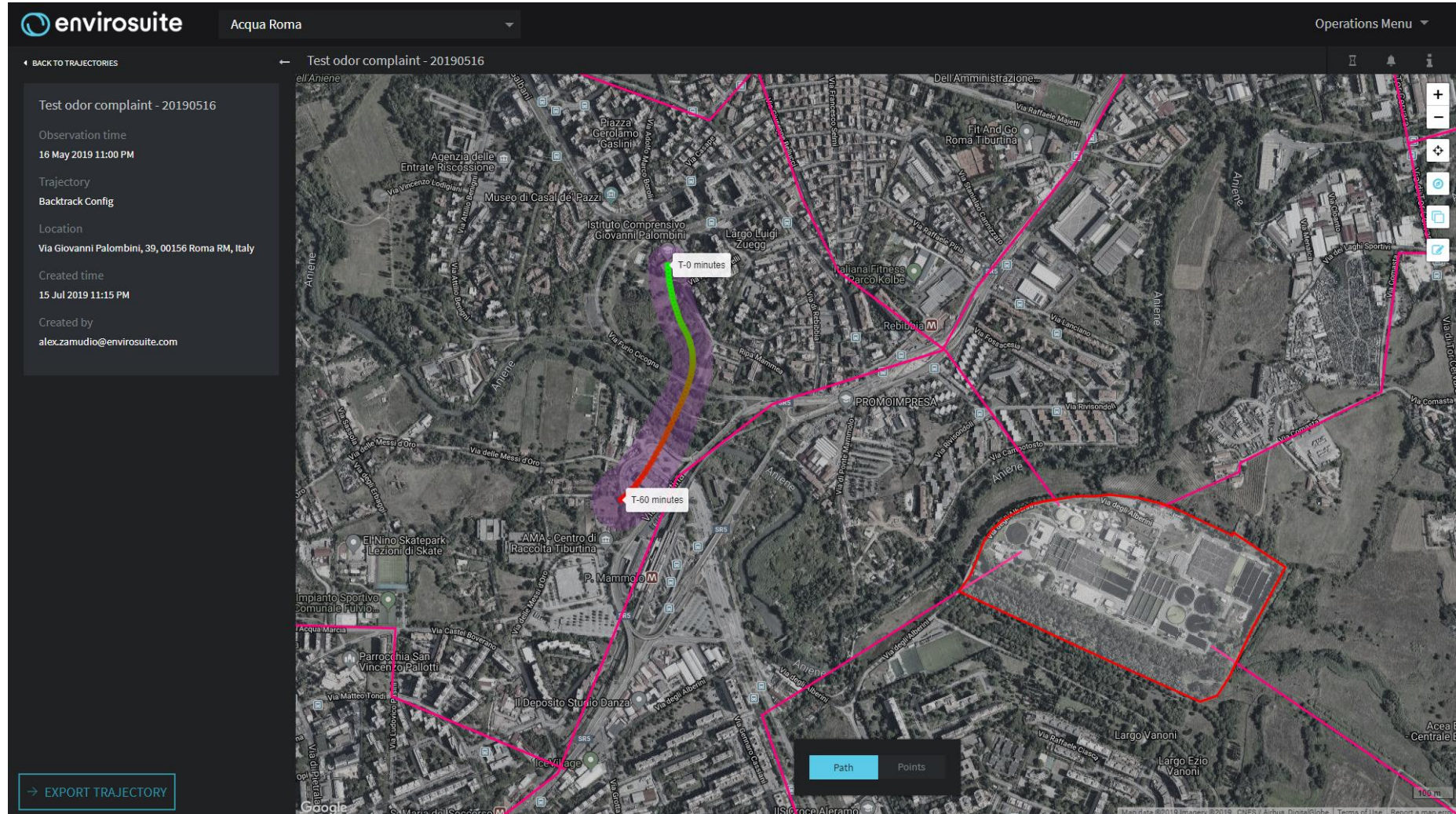


Part 3 – Sensor Networks Data Platform

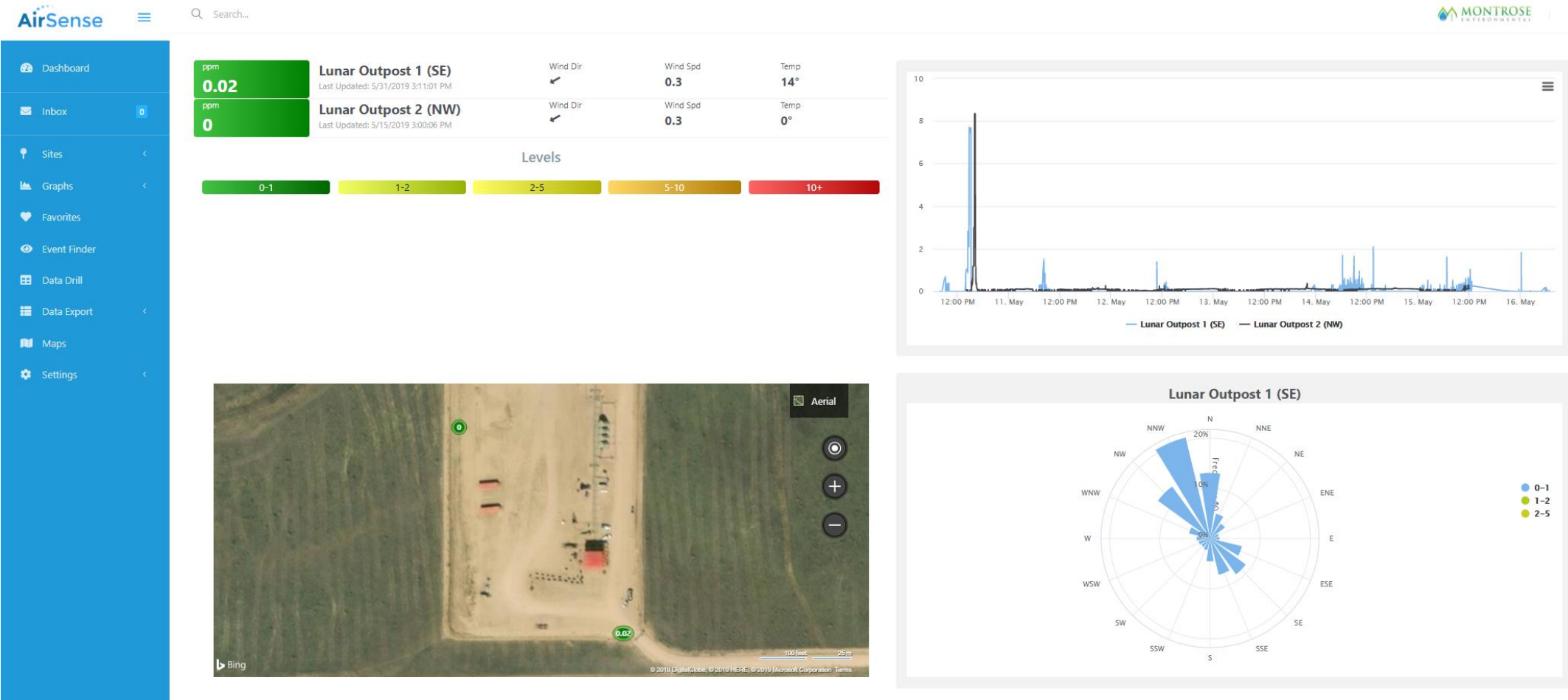
Pasadena Refining System, Inc.



Part 3 – Sensor Networks Data Platform

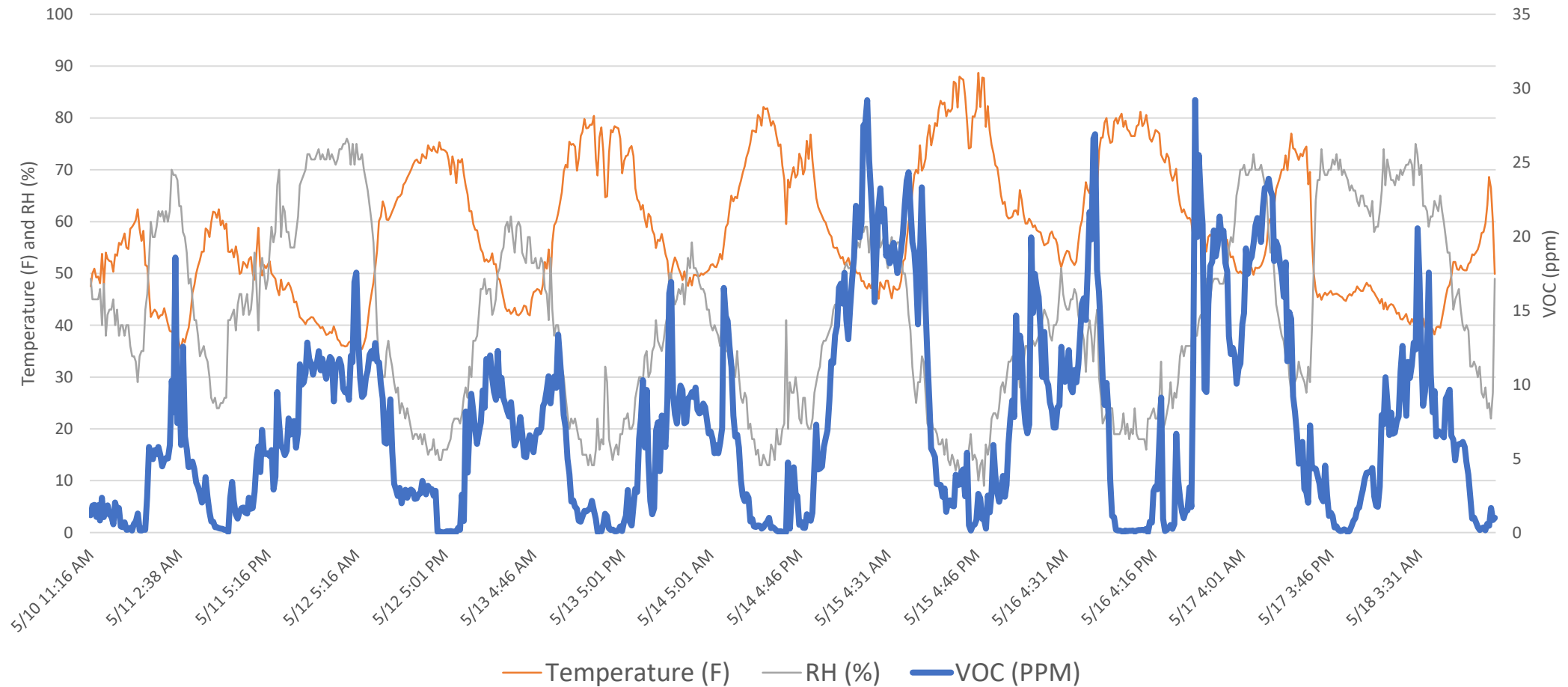


Part 3 – Sensor Networks Data Platform



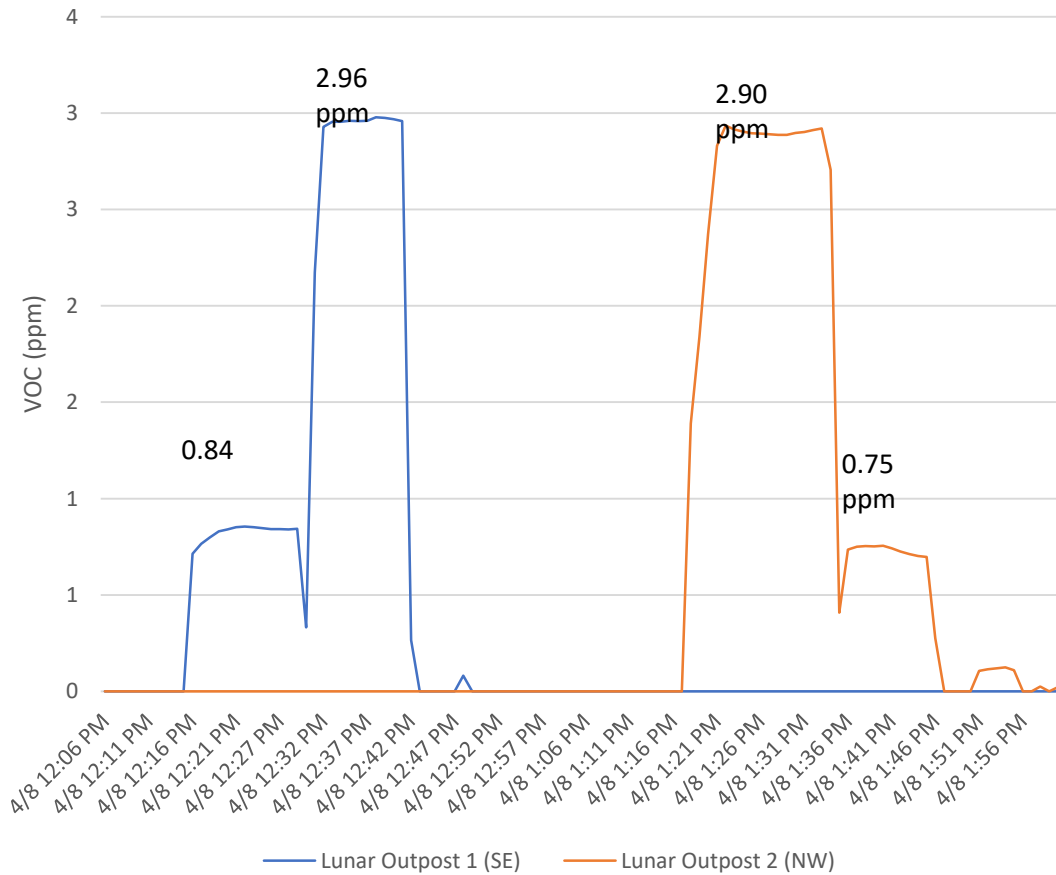
Part 3 – VOC Sensor Networks, Well Study

MOX Sensor Diurnal Pattern

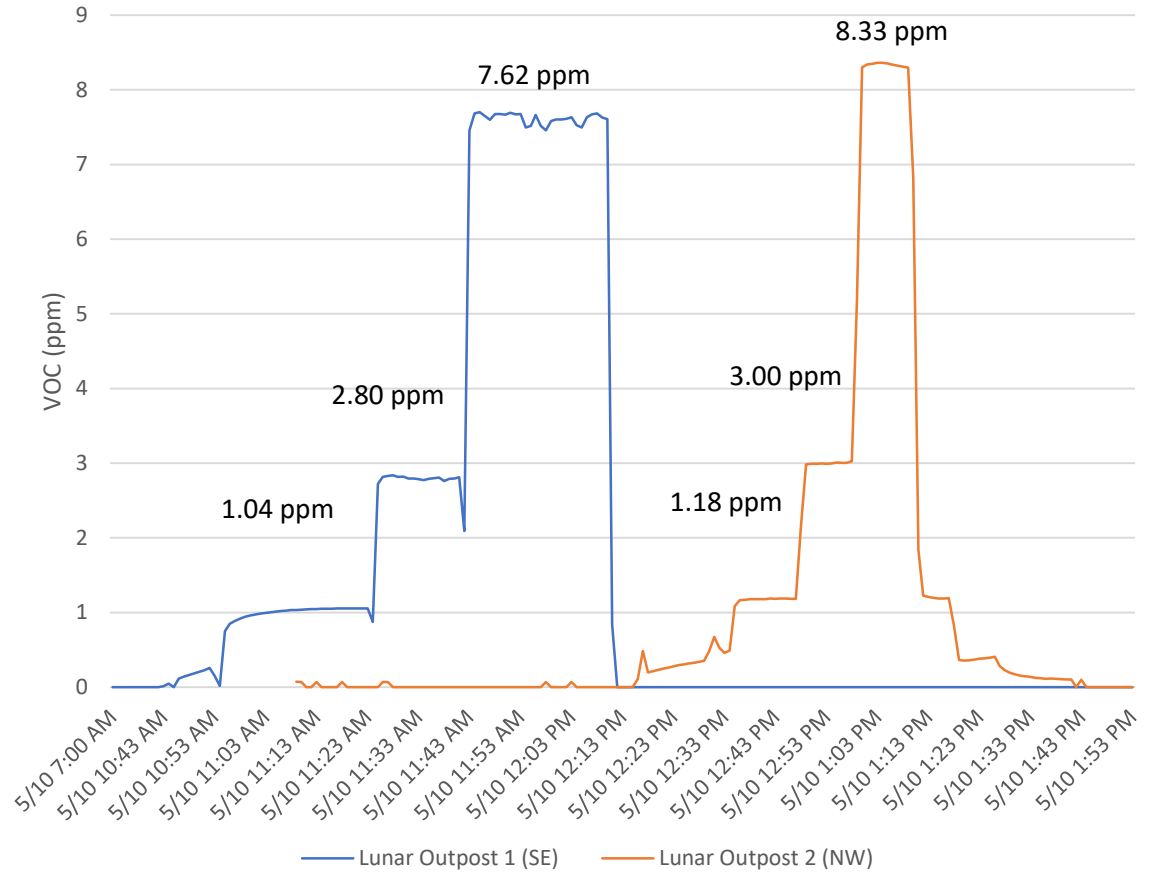


Part 3 – VOC Sensor Networks, Well Study

4/8/19 Calibrations

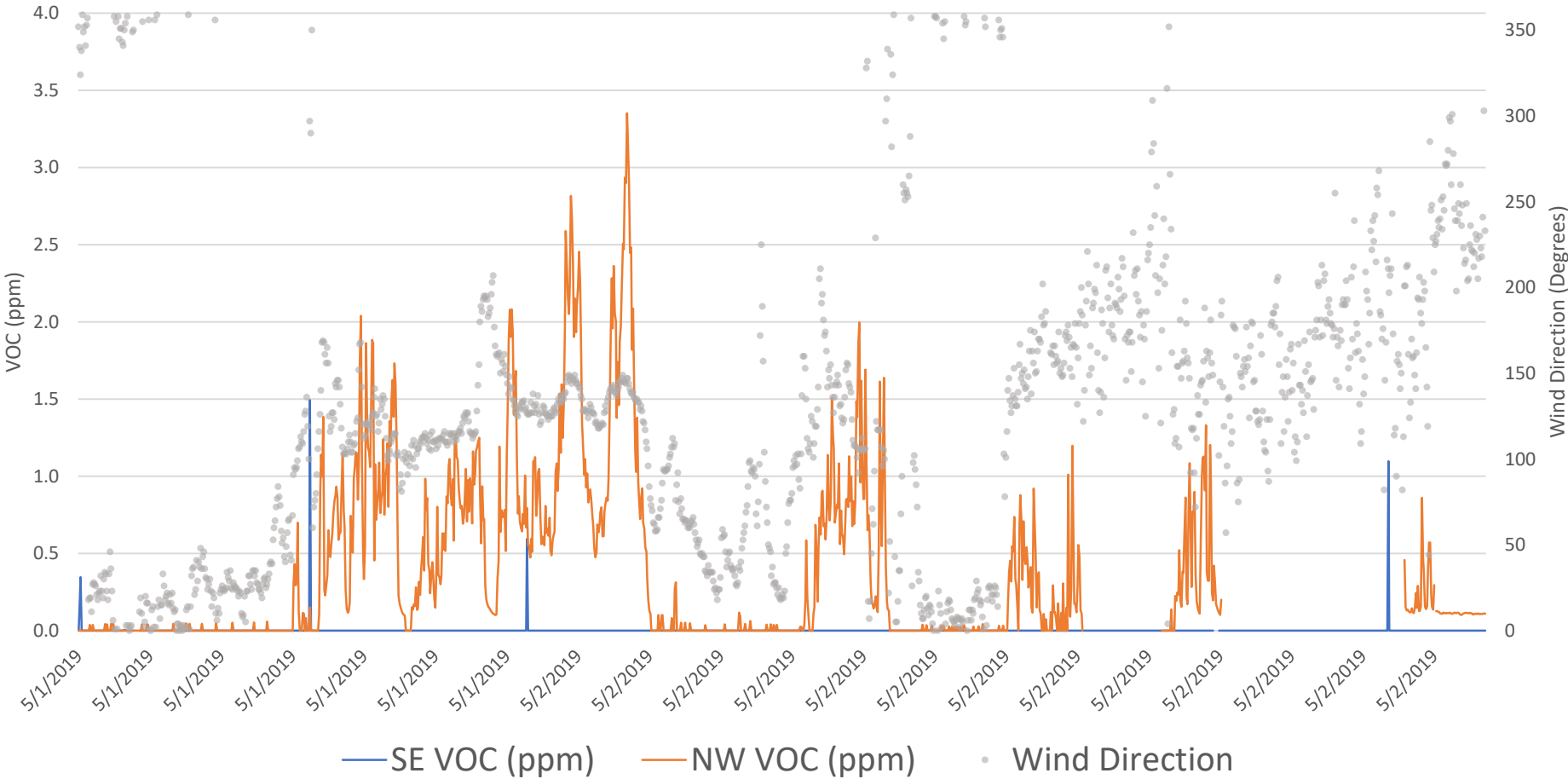


5/10/19 PID Calibrations



Part 3 – VOC Sensor Networks, Well Study

May 1-2, 2019 Event Observed (PID)



Part 3 - VOC Sensor Networks: Final Thoughts

Data Platform

- Define
 - Alert threshold and duration?
 - Quality Assurance Project Plan
 - Incorporate notes, O&M Logs and other features
- Customize to each use case
- Critical for large scale deployment

Sensors

- AQ SPEC for certification
 - <http://www.aqmd.gov/aq-spec>
- EPA 2020 Performance Specification
- Data capture and down time
 - On the two PIDs was 29% and 71% (data com big issue)
 - 50% on a 1000 sensor study
 - Lost data – no local storage
- Sensors will continue to evolve and will evolve quickly
- How to calibrate/certify

Special Thanks to Enerplus

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