Next Generation Air Monitoring Techniques and Technologies

Moderator: Dr. Jason Low
Deputy Executive Officer
Monitoring Analysis Division

Governing Board Retreat
September 10, 2026

Dr. Jochen Stutz

Department of Atmospheric and Oceanic Sciences
University of California, Los Angeles

Dr. Jochen Stutz is a Professor in the Department of Atmospheric and Oceanic Sciences at the University of California, Los Angeles (UCLA), where his research focuses on atmospheric chemistry, spectroscopy, and environmental monitoring. His research focus includes urban air pollution at night; impact of halogen species on tropospheric ozone; development of new spectroscopic methods for atmospheric studies; atmospheric spectroscopy, including LP-DOAS, PhotoSpec, and CO_2 eddy covariance systems; and field studies on air pollution, wildfires, plant photosynthesis, and the influence of ground and snow on atmospheric composition.



Dr. Kent Johnson

University of California, Riverside

Dr. Kent Johnson has worked at University of California, Riverside for over 30 years and is internationally recognized as a leader in emissions from combustion sources, specifically under real world conditions. He directed, organized, and hosted an annual international conference on in-use testing for 15 years and has been a guest on two television programs (MythBusters) to serve as an expert witness for in-use testing. He has his Ph.D. in Chemical and Environmental Engineering, an MS Degree in Electrical Engineering, and a BS Degree in Mechanical Engineering



Dr. Sina Hasheminassab

Research Scientist
Jet Propulsion Laboratory

Sina Hasheminassab is a Research Scientist at the Jet Propulsion Laboratory (JPL) and Deputy Principal Investigator for NASA's Multi-Angle Imager for Aerosols (MAIA) mission, a satellite investigation focused on understanding the health impacts of particulate air pollution. He has over a decade of experience conducting applied air quality research in Southern California and globally, with a strong focus on integrating advanced monitoring techniques with data-driven methodologies to study air pollution sources, trends, and their societal impacts.

Prior to joining JPL, Sina spent over five years at the South Coast AQMD, where he led numerous air monitoring projects in disadvantaged communities across Southern California. He also holds a visiting appointment at Caltech and has served as an Air Quality Fellow with the U.S. State Department.

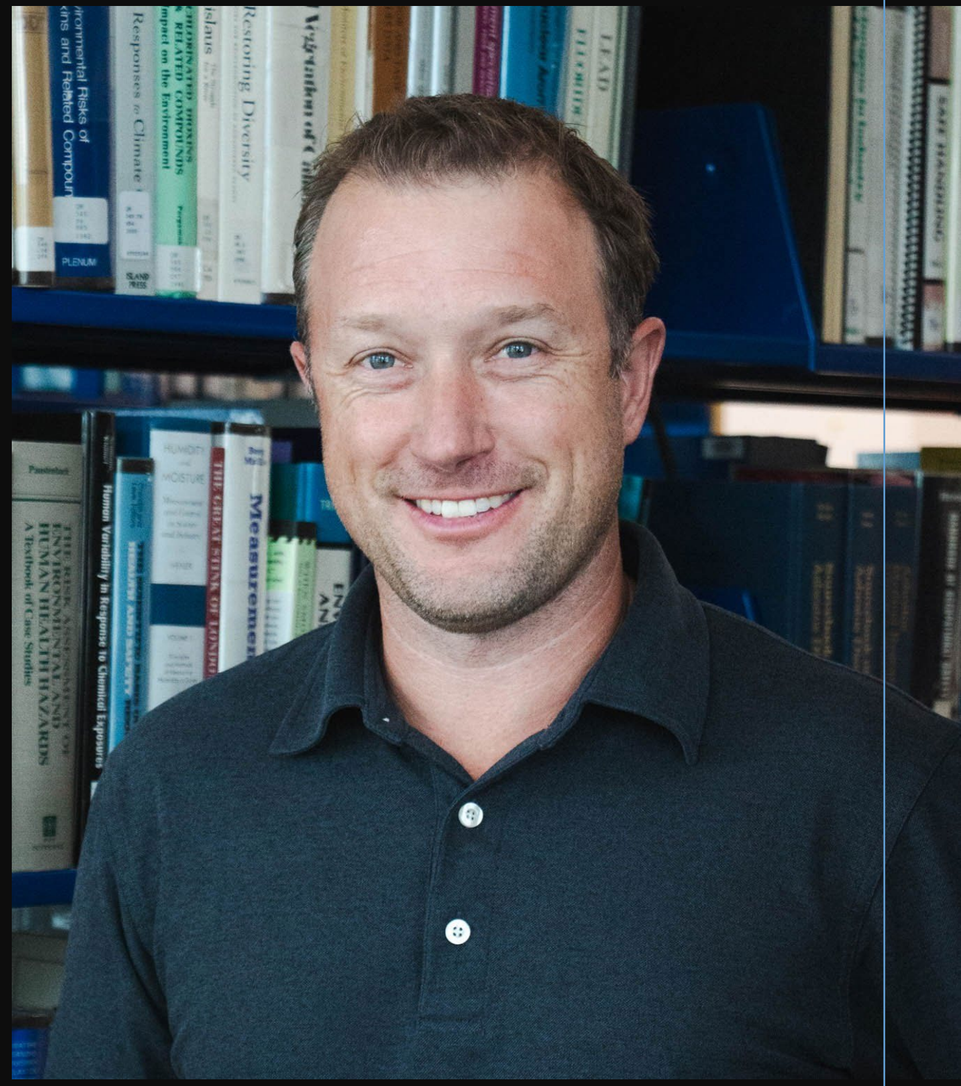


Dr. Brandon Feenstra

Atmospheric Measurements Manager
South Coast AQMD

Dr. Brandon Feenstra is an Atmospheric Measurements Manager in the Monitoring & Analysis Division at South Coast AQMD, overseeing the agency's Monitoring Network program.

He leads a team of Air Quality Instrument Specialists and manages more than 30 monitoring stations that produce high-quality regulatory data used to assess compliance with the National Ambient Air Quality Standards. Brandon has served as the Quality Assurance Manager and in the Air Quality Sensor Performance Evaluation Program (AQ-SPEC). Brandon also leads the development of AQ-Portal in collaboration with the Information Management team. AQ-Portal is designed to provide a single, unified access point for all data collected by the Monitoring & Analysis Division.



Attachment 1

The Optical Tent:
The Next Generation of Open Path Optical Remote Sensing

Jochen Stutz[1]

Santo F Colosimo[1], Sol Cooperdock[1], Olga Pikelnaya[2] and Andrea Polidori[2]

(1) University of California Los Angeles, Department of Atmospheric and Oceanic Sciences, Los Angeles, CA, United States,

(2) South Coast Air Quality Management District, Diamond Bar, CA, United States



contact: jochen@atmos.ucla.edu

Identification and mitigation of unwanted trace gas releases from industrial facilities remains a continuing challenge

We need a reliable system for measurement of trace gases including air toxics such as benzene, toluene, ethyl-benzene, xylenes (BTEX), monitoring to:

- Warn residents of unwanted releases
- Provide data to regulators on trace gas levels
- Help refineries to locate and fix equipment malfunctions.

Rapid identification, warnings, and mitigation of elevated pollutant levels reduces overall emissions and exposure

Residents Near Chevron's Richmond Refinery Face Higher Risk of Cancer, Air District Says

People living close to the Chevron Refinery in Richmond face an elevated risk of developing cancer over a lifetime, according to a preliminary assessment the air regulator released Tuesday.

Aug 25, 2026 Updated Aug 27, 2026

By **Julie Small**

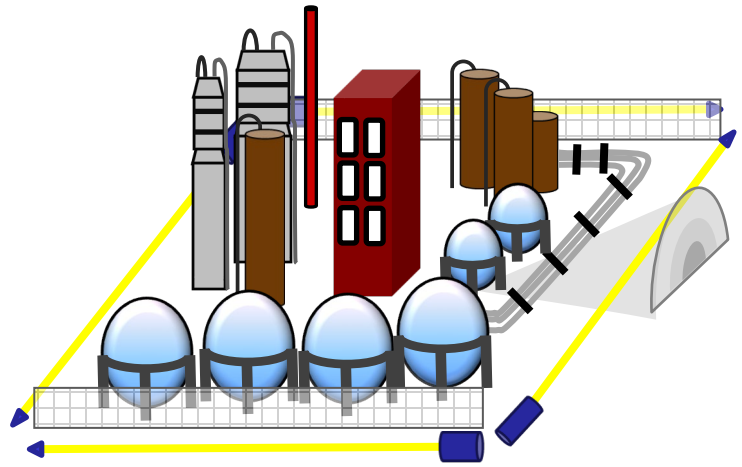


The Chevron Richmond Refinery seen from the Point Richmond neighborhood in Richmond on June 3, 2025. *(Beth LaBerge/KQED)*

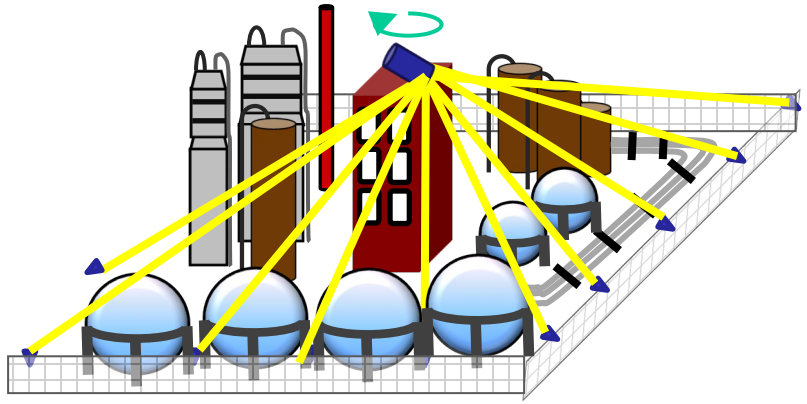
KQED, 6/27/2026

What if we could help communities, regulators and refineries better identify and control emissions?

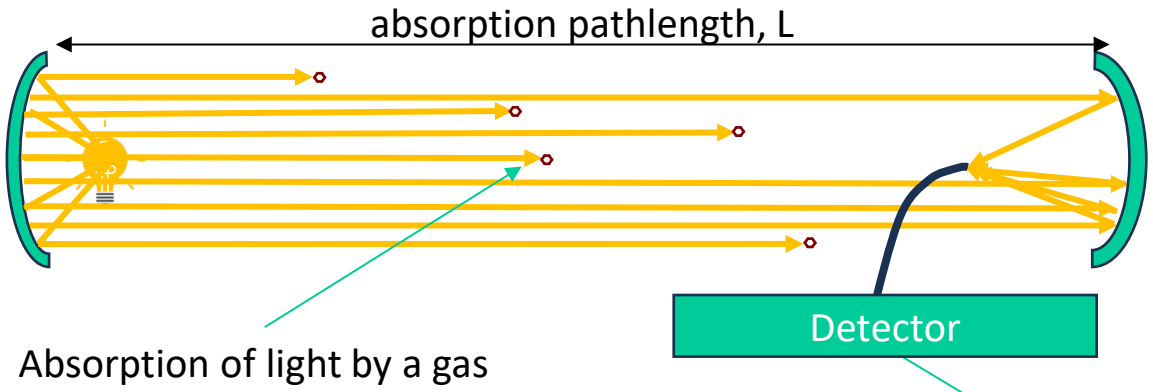
- Open-path optical remote sensing (OP-ORS) offers this opportunity.
- However,
  - There is a lack of trust in the data from commercial OP-ORS/ DOAS systems
  - Fenceline systems are limited in their ability to locate BTEX releases and help in their mitigation.



- The Optical Tent (OT) is a South Coast AQMD funded project to demonstrate the technical feasibility and reliability of such a system and to study its usefulness.



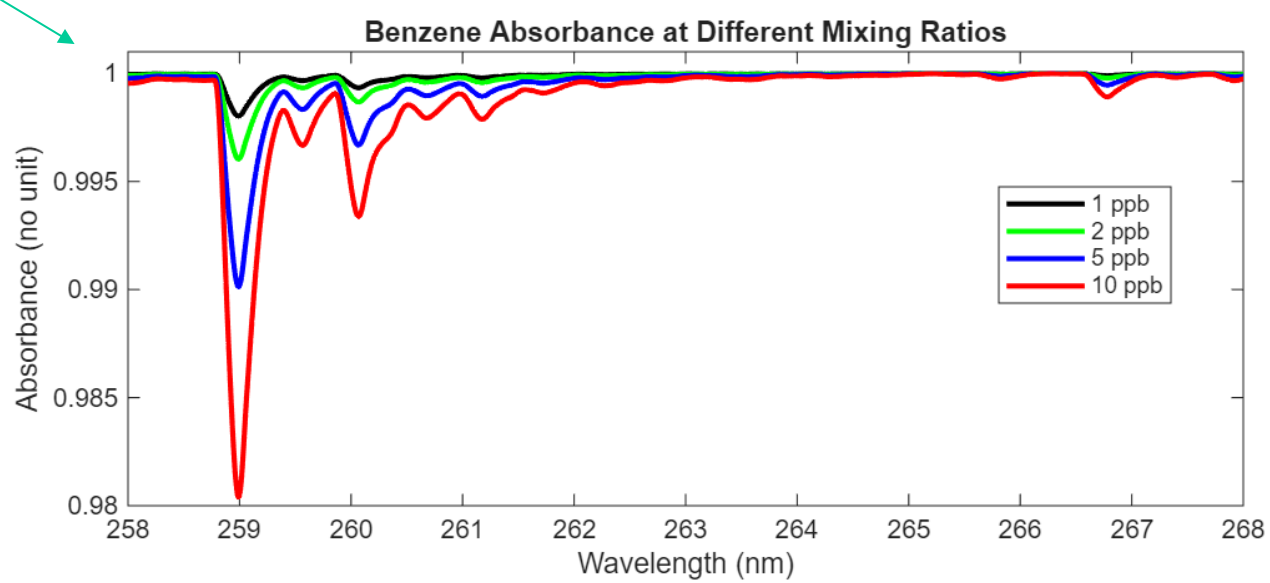
Principle of Open Path Optical Remote Sensing:



A beam of light is sent through the **open atmosphere**. Gases absorb light along the way.

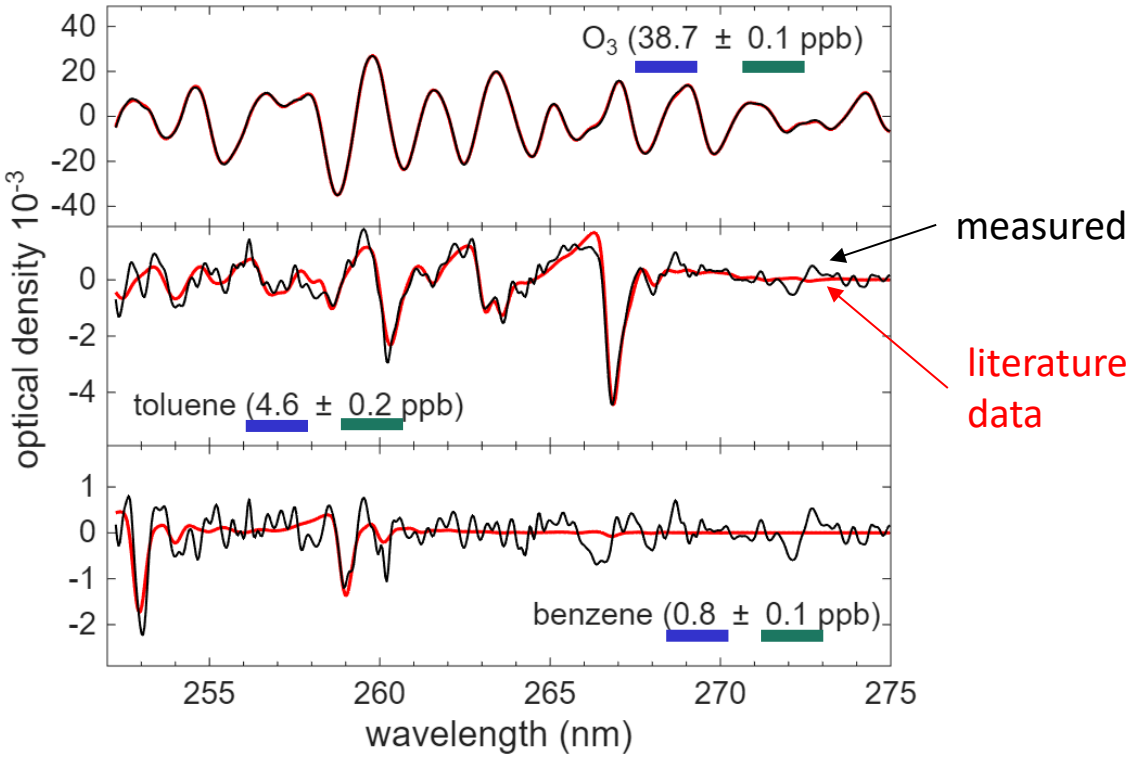
Identification: Absorption depends on wavelength (color) of light and is unique to each gas

Quantification: The strength of the absorption depends on the gas concentration

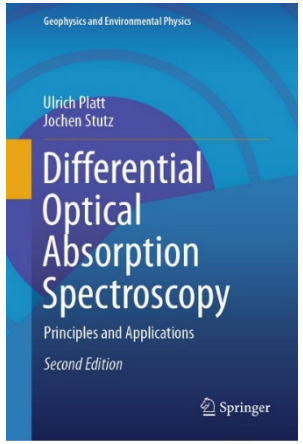


The OT uses research-grade Differential Optical Absorption Spectroscopy (DOAS) to measure BTEX

- Overlaying absorptions are mathematically separated to determine **concentration** and **uncertainties** for each absorbing gas.
- Absorption structure and strength is obtained from published literature: **No calibration is needed.**
- Gases with structured absorptions can be measured: **BTEX, ozone, naphthalene, phenol, furfural**, SO_2, NO_2, NH_3, …
- Known gases (oxygen) are used as QA/QC.



Research-grade* DOAS provides absolute, traceable BTEX measurements.

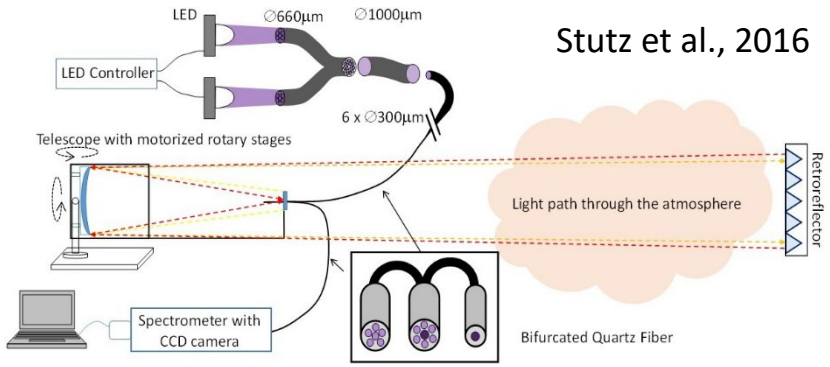


*Note that commercial "DOAS" systems use a different approach.

The Optical Tent



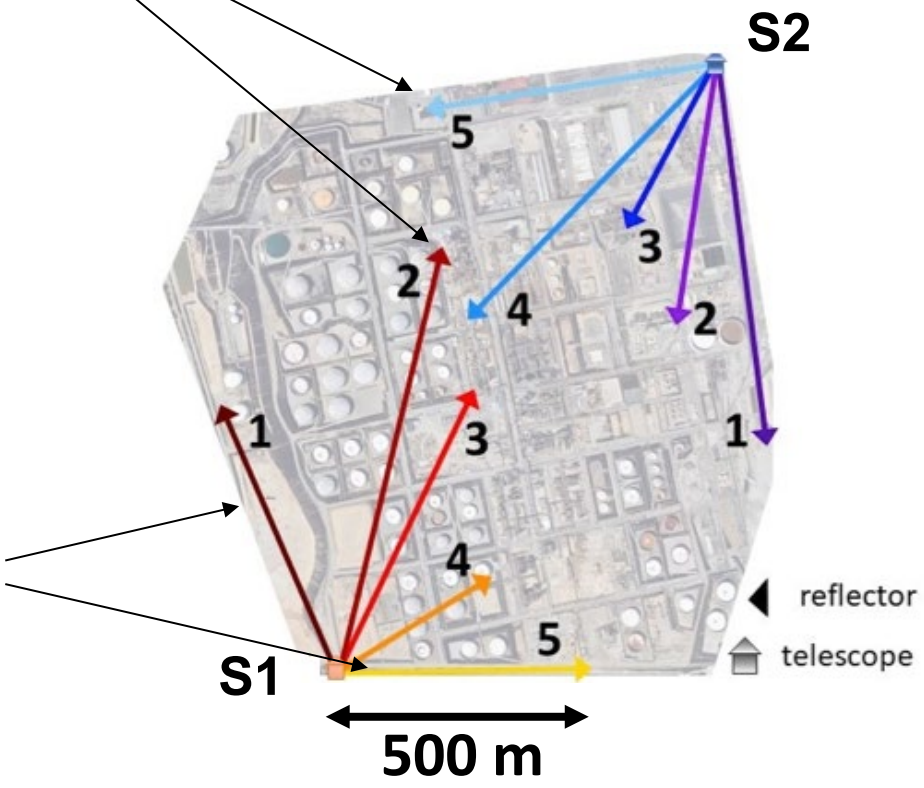
reflector



Stutz et al., 2016



telescope

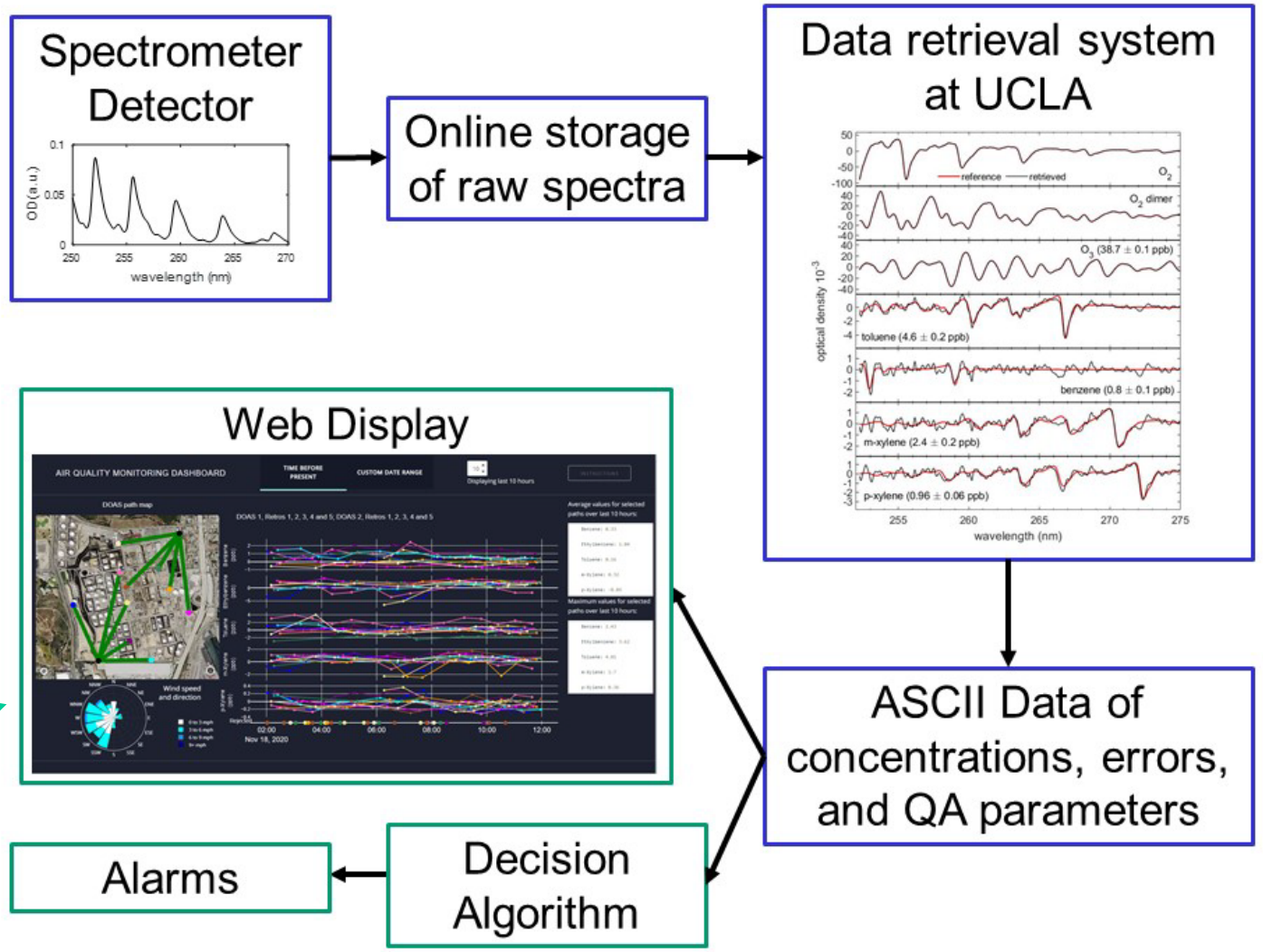


Fenceline

Each telescope sequentially aims at five reflectors

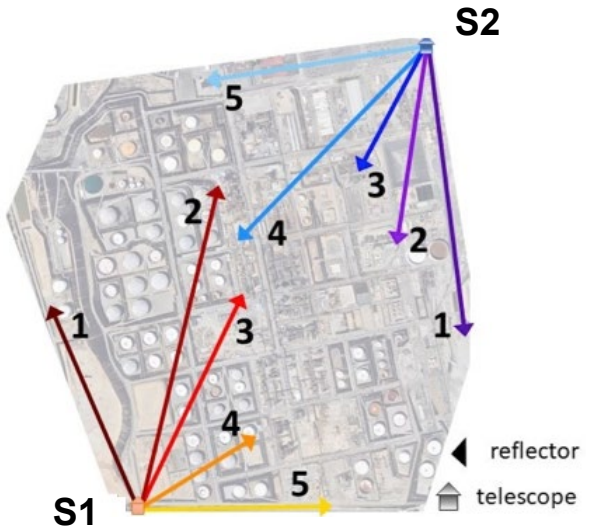
The Optical Tent (OT) has operated successfully since Summer 2020

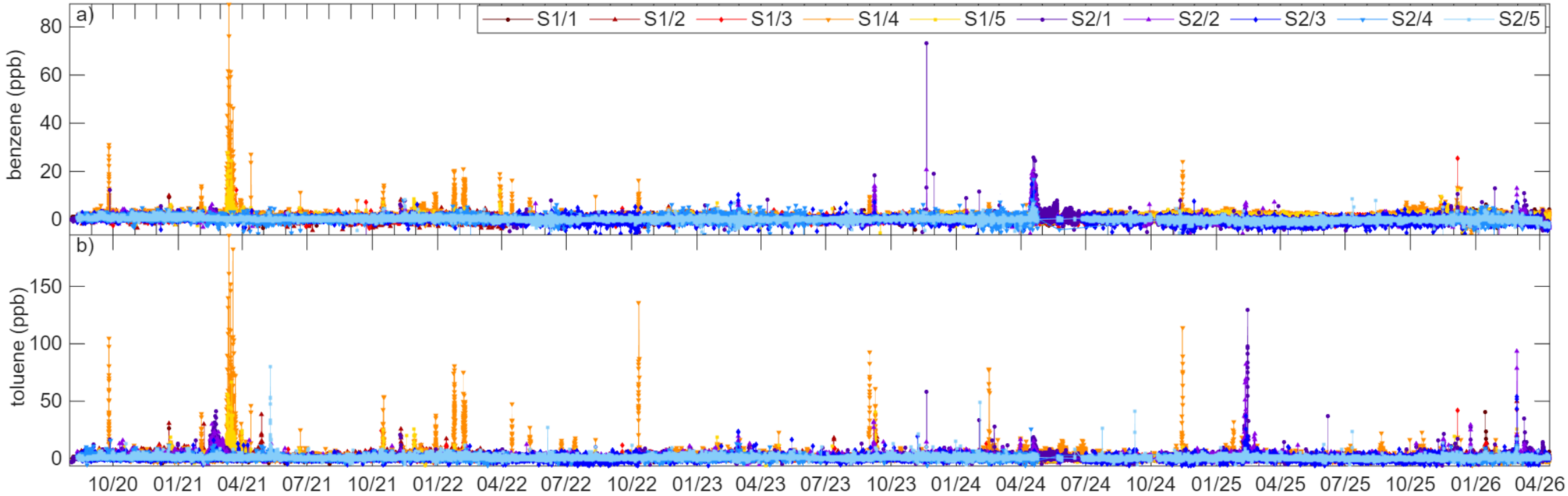
- Low maintenance and no major instrument failures.
- Data gaps are mostly due to reduced visibility (fog).
- BTEX detection limits below 1 ppb comply with Rule 1180.
- Fenceline data is reported to refinery public website.
- All data is visible to UCLA, South Coast AQMD, and the refinery in real time.



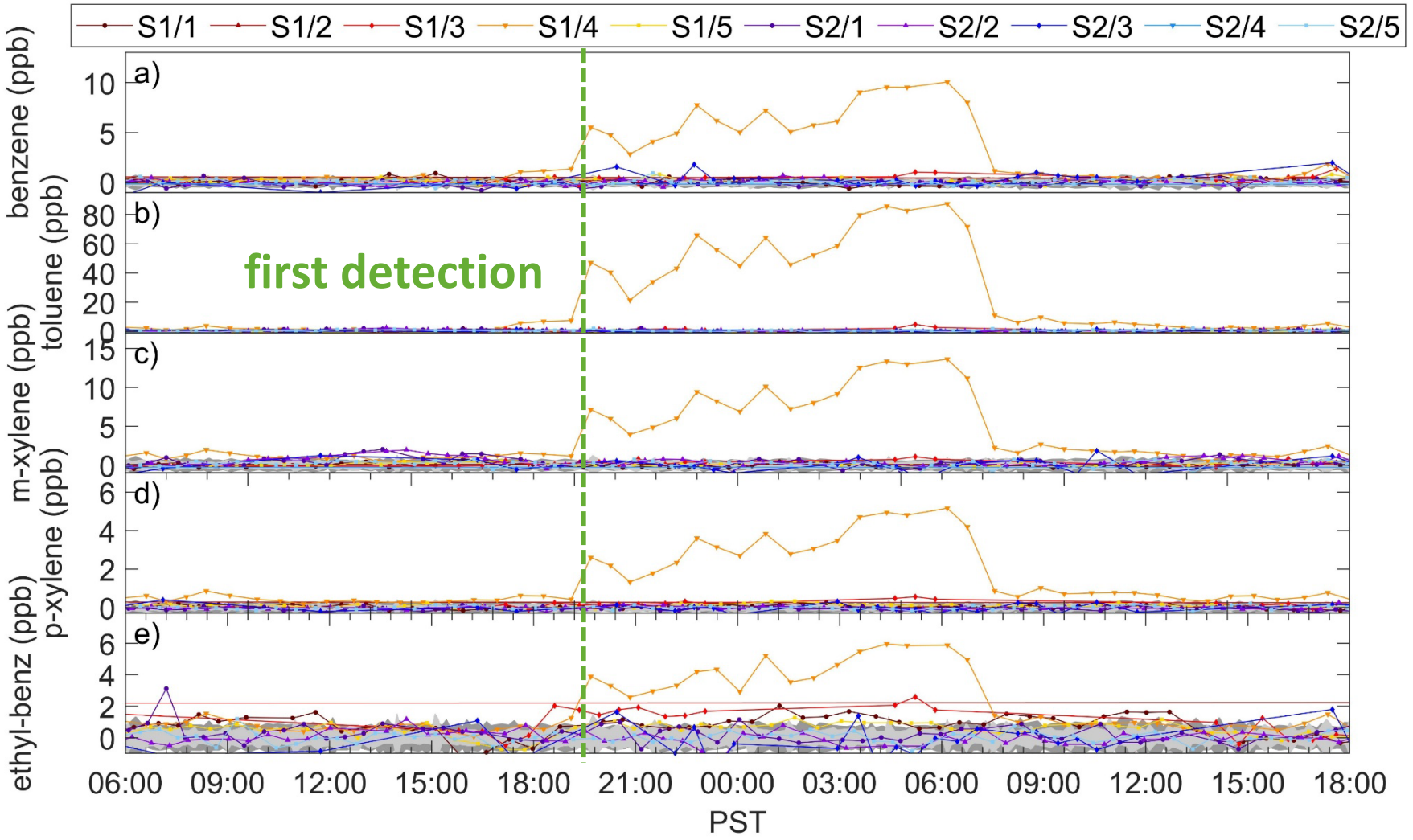
Long-term data provides unique insights into refinery BTEX

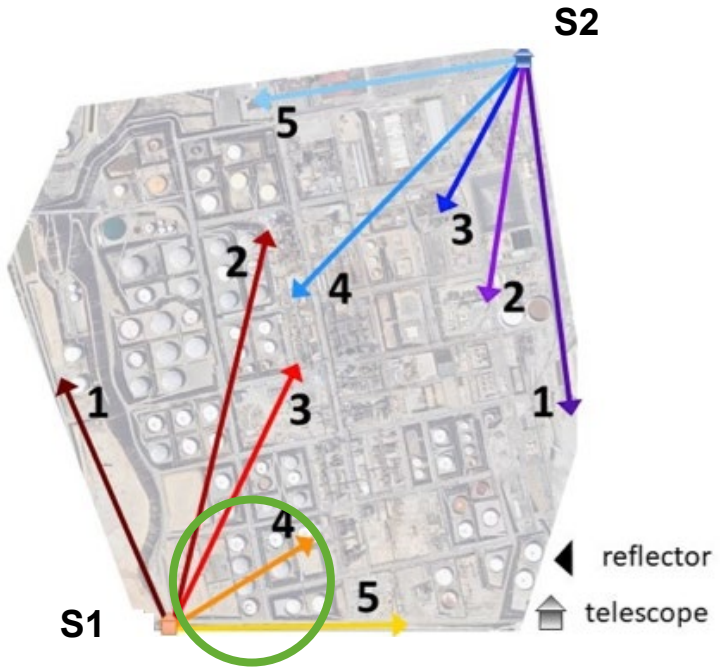
- Elevated BTEX in refinery is sporadic and in most cases due to equipment malfunctions.
- Several public alerts have been issued from fenceline data.
- 6 times more BTEX detects inside the refinery than at fenceline.
- The tank farms is the main area of elevated BTEX.



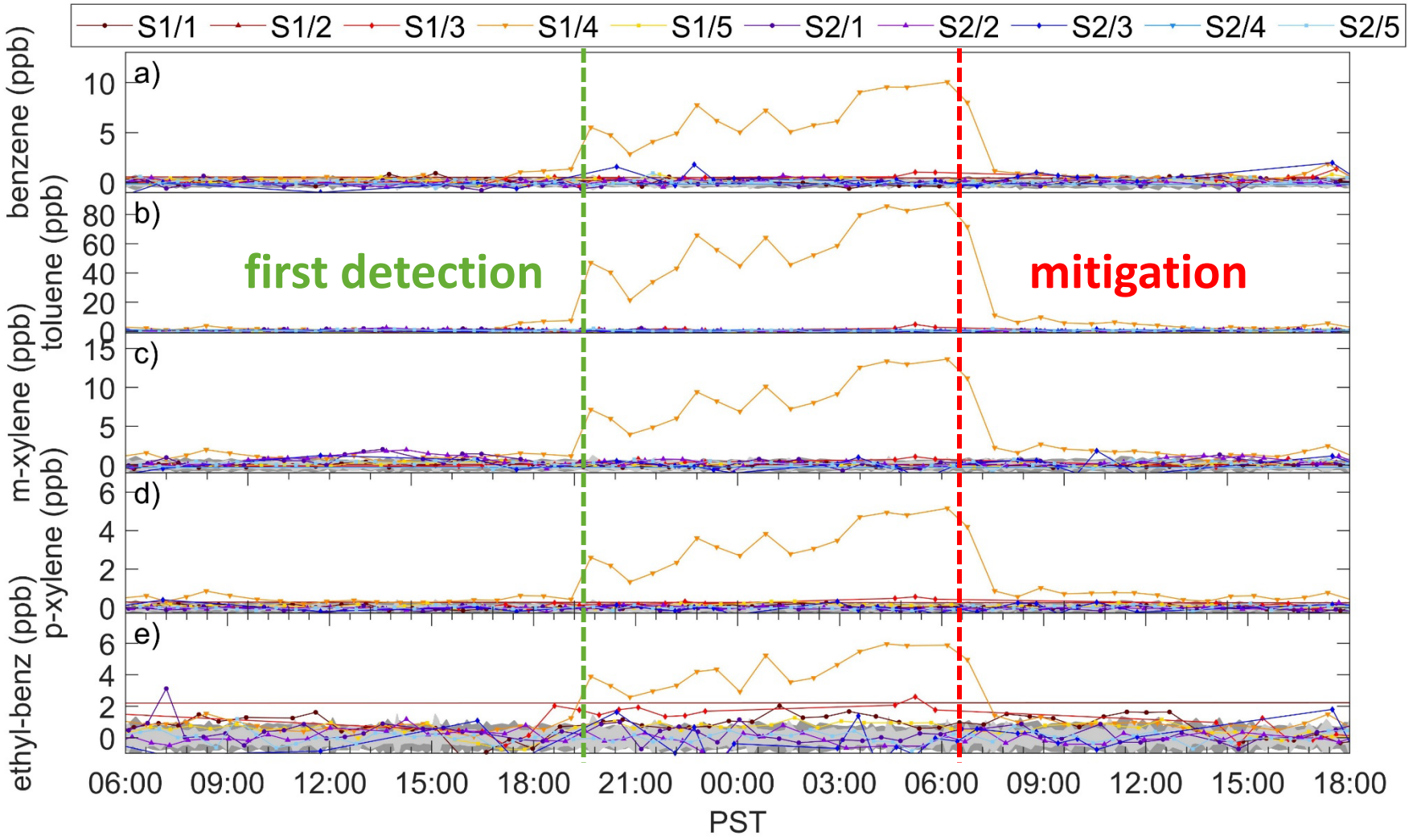


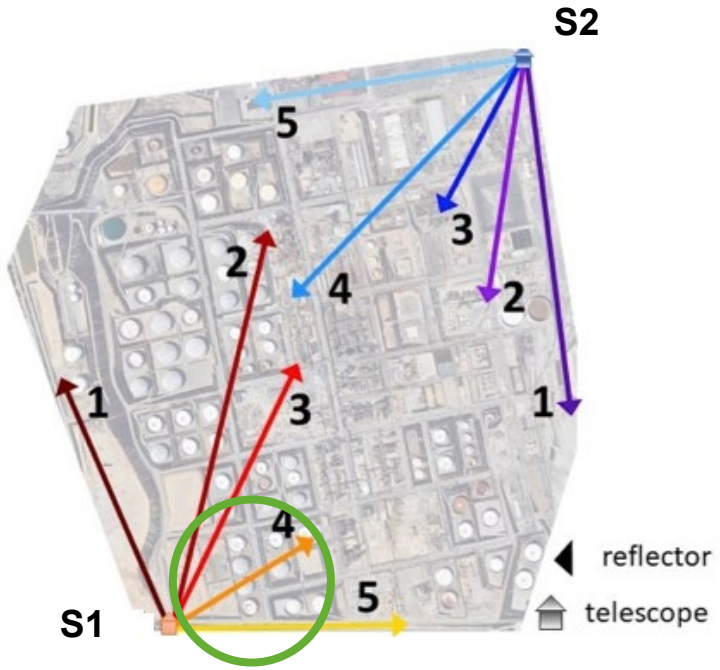
OT identifies and locates elevated BTEX



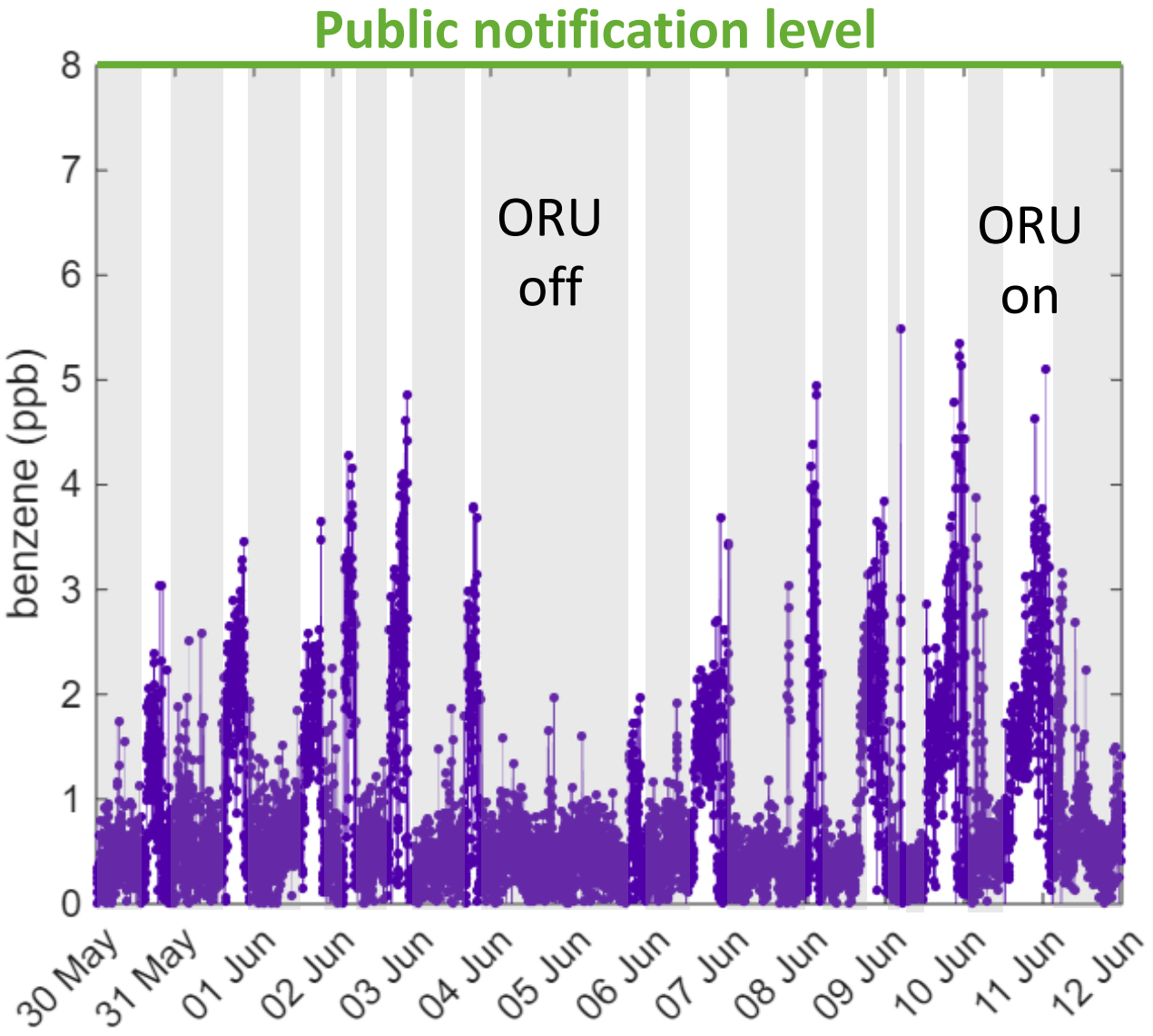


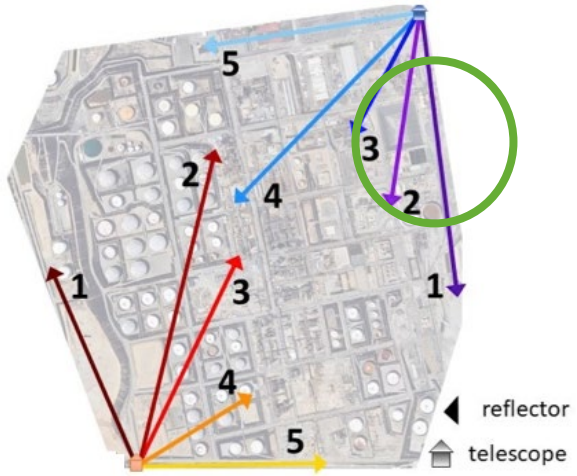
Refinery mitigates equipment issues quickly





Refinery operators have used the OT as a tool to manage BTEX level inside the facility





OT realtime data was used to regulate wastewater treatment (Oil Recovery Unit) to keep benzene below fenceline reporting threshold

Conclusions

- Research grade DOAS instrument measures BTEX reliably, sensitively, accurately, and in real time.
- OT observations inside a refinery allow faster source identification and mitigation, leading to lower overall emissions.
- The Optical Tent provides long-term BTEX data that is trusted by communities, regulators, and the refinery.
- Operation of the OT does not require much maintenance and no calibration, offsetting its cost of ~$400k.
- The OT has become a valuable tool to monitor and manage BTEX inside and around a refinery.

UCLA
Atmospheric Spectroscopy

What is next for OT and OP-ORS technology?

- Optimization of OT, for example by including the refinery operator in path arrangement, will further improve its usefulness.
- The optical tent scanning approach can be extended to other gases and other open path technology, such as open-path FTIR or TDLS.
- UCLA and South Coast AQMD are developing a reference UV-DOAS system to provide a much-needed validation method for commercial DOAS instruments.
- Scientific grade open path DOAS technology is now commercially available though a new startup using UCLA's technology: Syrionex.

UCLA
Atmospheric Spectroscopy

Attachment 2

A Real Time Portable Emissions Monitoring Project Using Drones

South Coast AQMD Board Retreat: September 10, 2026

Kent Johnson, Don Collins, GSR Minghao Han and GSR Yasaman Mohammadi

CE-CERT

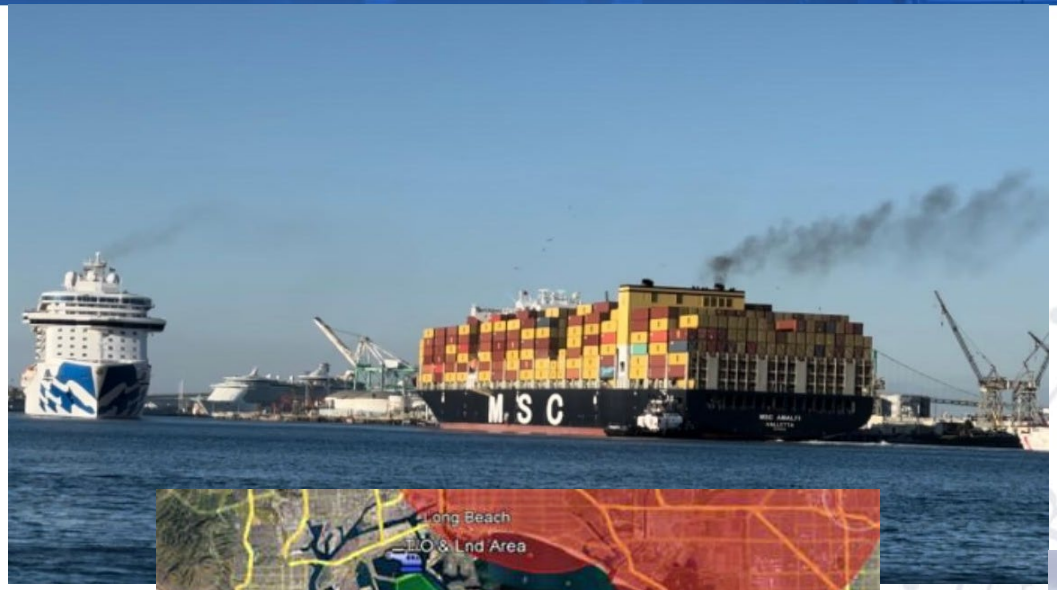
UC RIVERSIDE UNIVERSITY OF CALIFORNIA





The Ports of Los Angeles and Long Beach complex is one of the busiest parts in the world with over 15 million containers passing through each year. As a result, the port complex is a major source of air pollution, contributing to the levels of air quality issues in the region. The demand for effective air emission monitoring is needed and shipping companies are implementing reductions to their environmental impact.

Emission data is critical to understand and quantify changes to technology on ocean going vessels (OGVs) and their impact on the community





With advanced drones, the UCR team plans to gather real time emission data flying directly through plumes from ships and from the Ports of Los Angeles and Long Beach over a full year

This system will be able to screen emissions that were several times higher then their certified values.



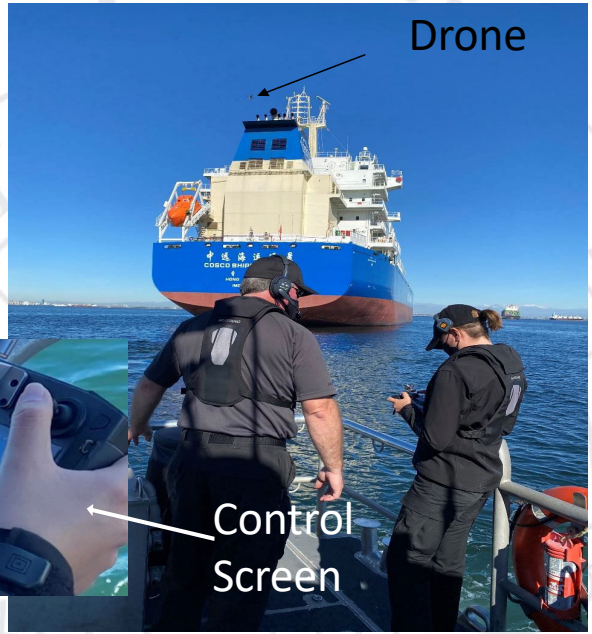
UC RIVERSIDE UNIVERSITY OF CALIFORNIA

Previous Experience

View from the Drone using Standard Video Camera

- Launch from land or from a vessel
- Access vessels was easy to complete and within the authority of the port area





- The previous sensor system was mounted to the drone
- This worked well, but was limited to some gaseous emissions.
- The revised system will capture a much broader range of species of interest to community exposure and health



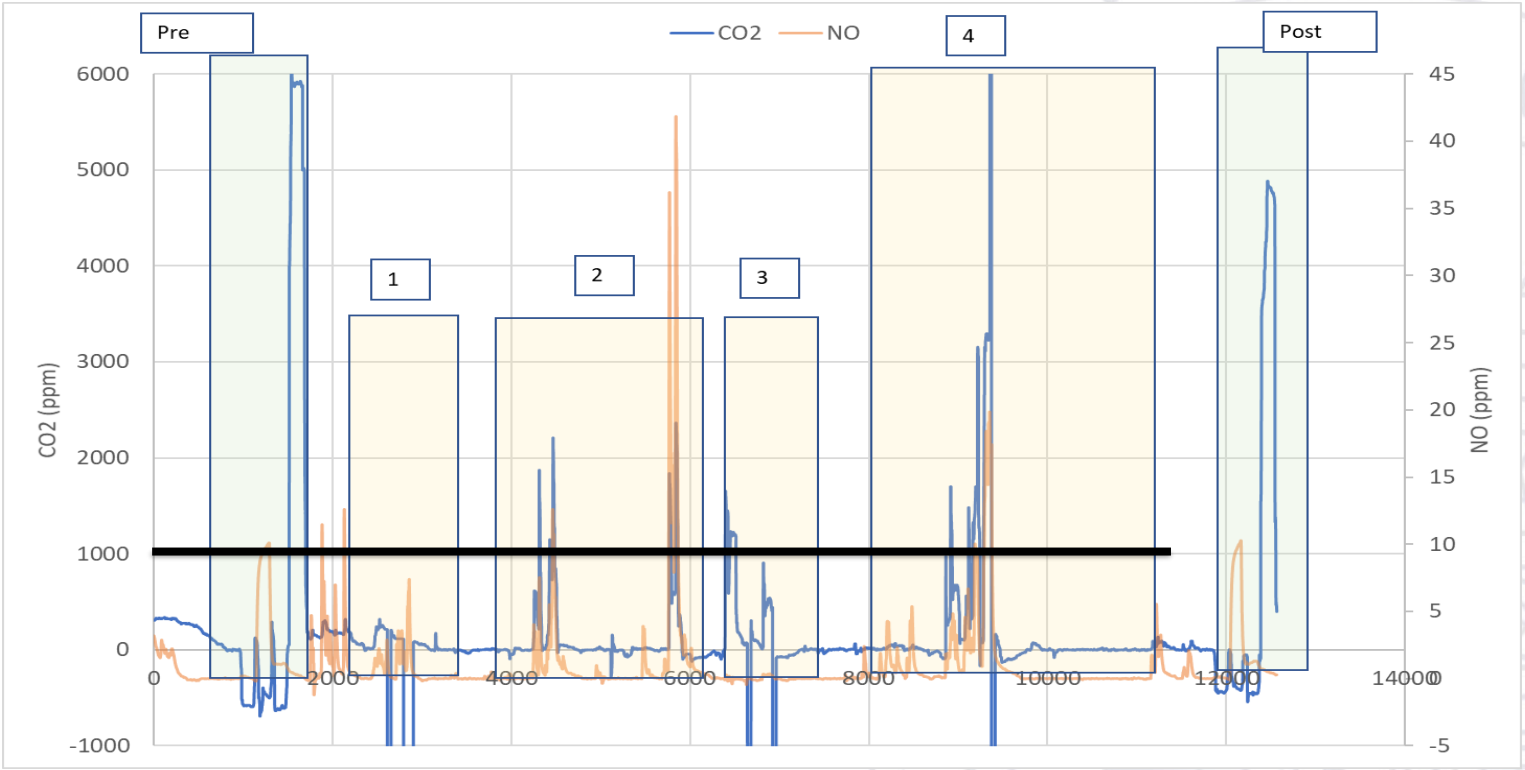


Sensor Package (NO, NO2, CO2 and SO2)



- Exhaust plume easy to see
- Main engine and auxiliary engines can be sampled separately with small drone
- In transit emission did not work. The issue was a limitation of the sensor antenna and larger distances to manage the in-transit testing.

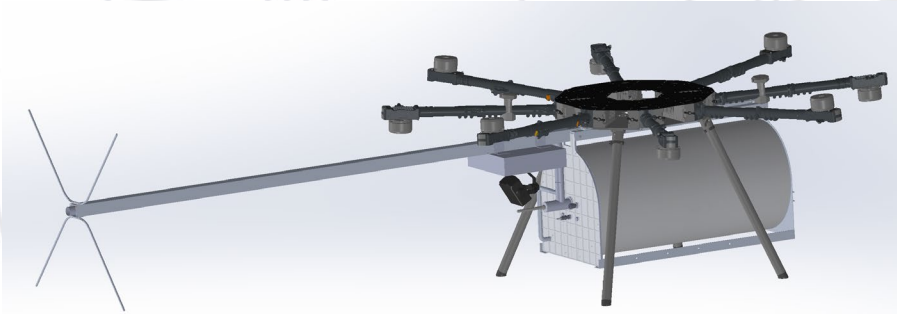
The sensor package worked well for the full day and provided valuable information. The grab sample improvements will allow for improvements between shipping emissions and community exposure



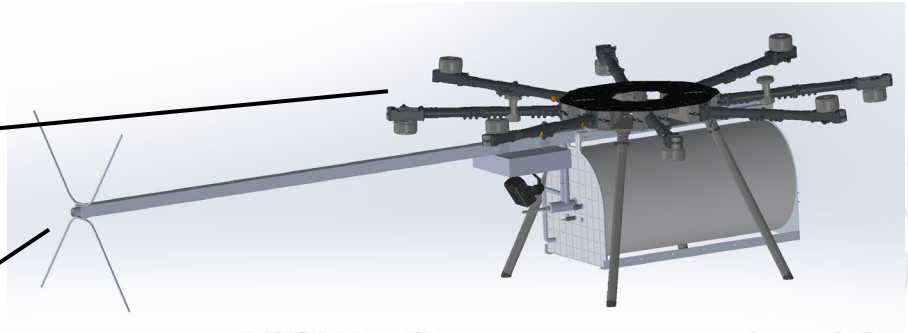


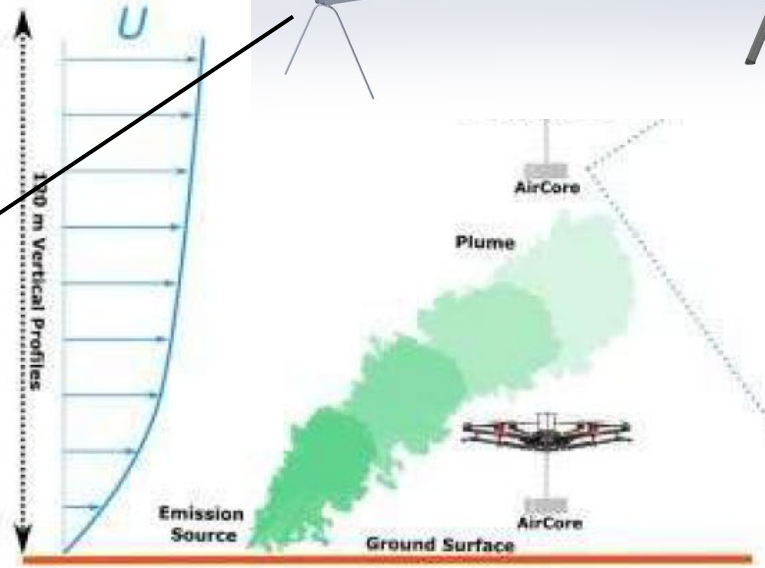
UCR learned from previous drone testing and has improved on the sampling methodology to better characterize the emissions resulting from OGVs exiting and entering the port











The revised approach uses a grab sample and not just in-flight sampling.

Improved ability to collect high-quality data while applying laboratory-grade methods not feasible for in-situ measurement

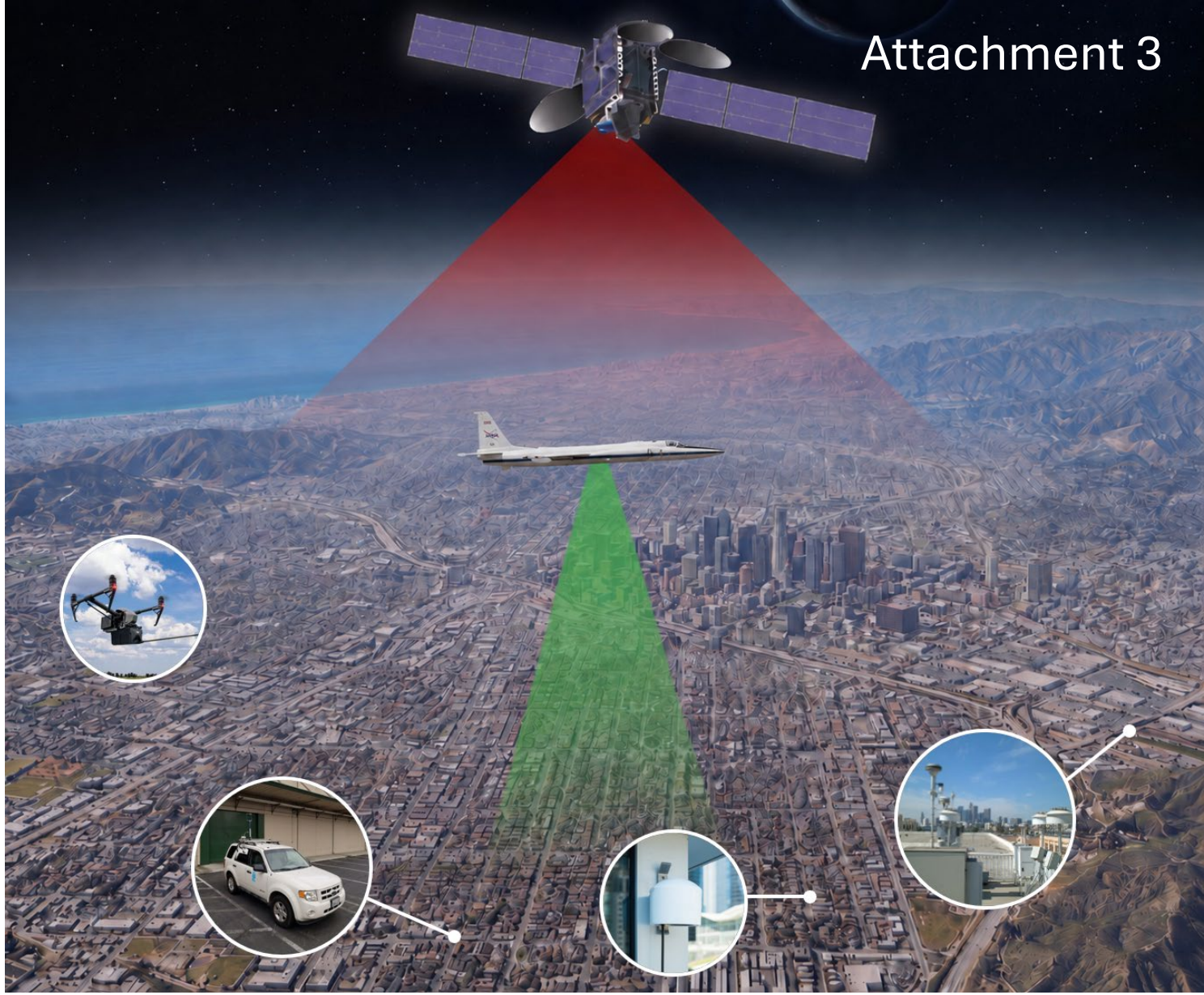
***Figure 15**. Example of sample collection and return using a drone during a prior UCR project that was focused on methane emissions from dairies*

- Our team has had discussions with the ports and authorities for conducting these drone operations
- The time frame for this work is expected to start in 2027 and continue for one year with weekly sampling.



Satellite and Airborne Observations for Air Quality Monitoring

Attachment 3



Sina Hasheminassab, PhD
NASA Jet Propulsion Laboratory

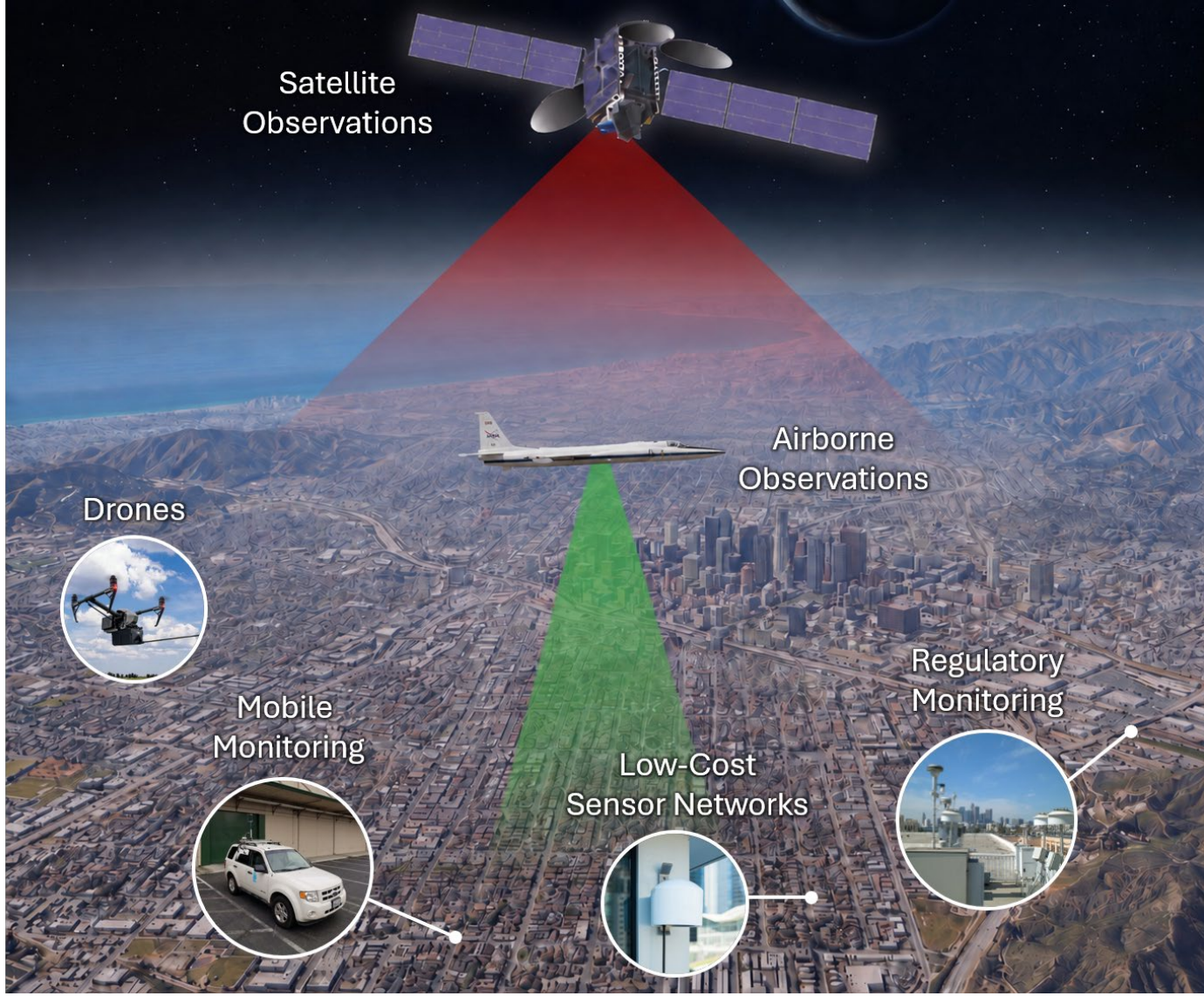
10 Sep 2026

© 2026 California Institute of Technology.
Government sponsorship acknowledged.

Jet Propulsion Laboratory
California Institute of Technology

Integrated Observing System

- **No single observing system answers every air quality question**. Platforms differ in coverage, resolution, frequency, and accuracy.
- **Satellites provide the regional picture** of pollution patterns, transport, and change over time, but near-surface concentrations are derived rather than directly measured.
- **Airborne measurements provide finer spatial detail** for facilities, neighborhoods, and plumes, but coverage is episodic and resource intensive.
- **Ground networks provide continuous, well-characterized measurements** at specific locations, but with limited spatial coverage.



Satellite
Regional Context/ Transport

Airborne
Targeted facilities/ neighborhood scale

Ground
Community exposure/ regulatory evidence

Tropospheric Emissions: Monitoring of Pollution (TEMPO)

(a geostationary satellite)

- TEMPO observes **North America hourly** during daylight at approximately **2 x 4.75 km^2** spatial resolution.
- Measures key air pollutants and precursors, including **nitrogen dioxide (NO2)**, **ozone (O3)**, **formaldehyde (HCHO)**, **sulfur dioxide (SO2)**, and **aerosols**.
- Routine science operations began in **2023**.
- During the January **2025 Los Angeles fires**, TEMPO captured enhanced tropospheric NO2 and its transport across the region.



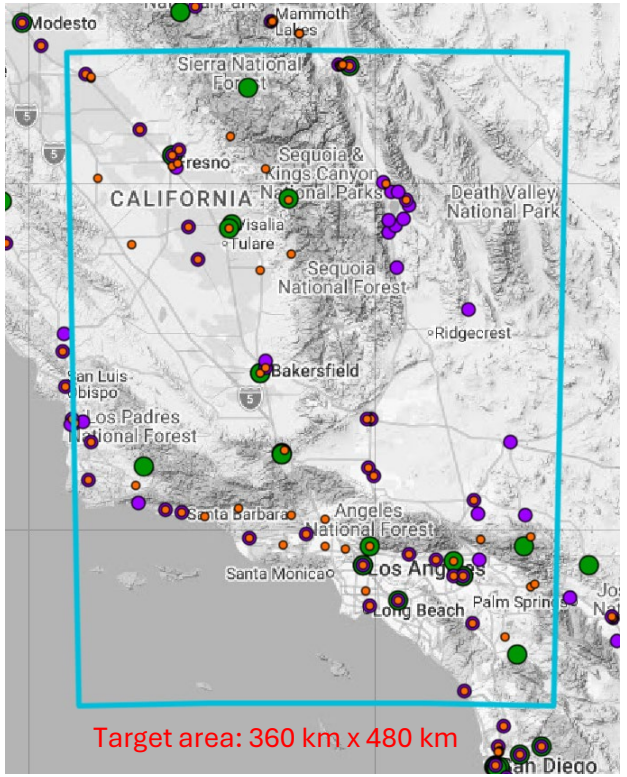
Multi-Angle Imager for Aerosols (MAIA)

(a low earth orbit satellite)

- MAIA is a planned NASA–Italian Space Agency mission, with satellite launch currently expected between **2027 and 2028**
- MAIA's objective is to link exposure to **different PM types** (mixtures of particles having different sizes, shapes, and compositions) with **human health**
- MAIA will combine satellite observations, surface measurements, and atmospheric models to produce **daily 1-km** concentration maps of **total** and **speciated PM** (elemental carbon, organic carbon, sulfate, nitrate, dust)
- MAIA is a **targeted-observation** mission. **Southern California** is one of MAIA's 12 Primary Target Areas



Southern California Target Area

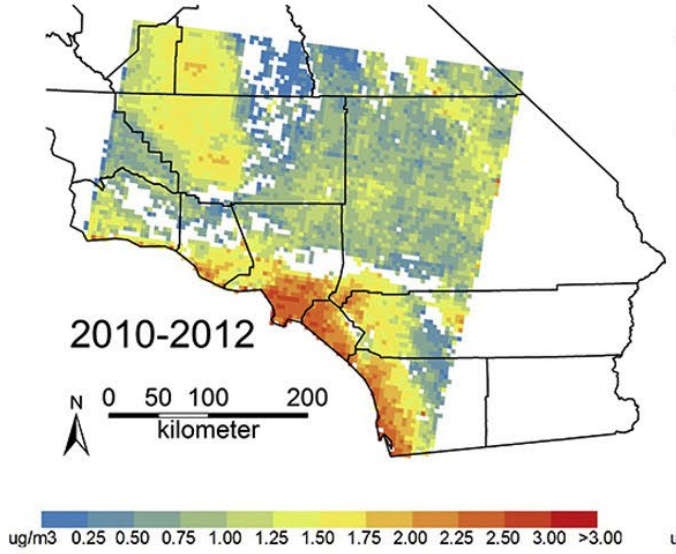


- PM10 Sites
- PM2.5 Sites
- Speciated PM2.5 Sites

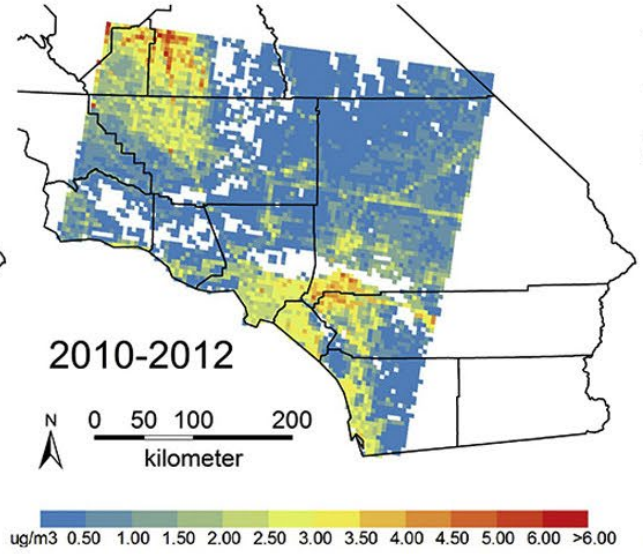
Target Area Bounding Box

Example of Satellite-Derived Ground-Level Speciated PM2.5 Mapping

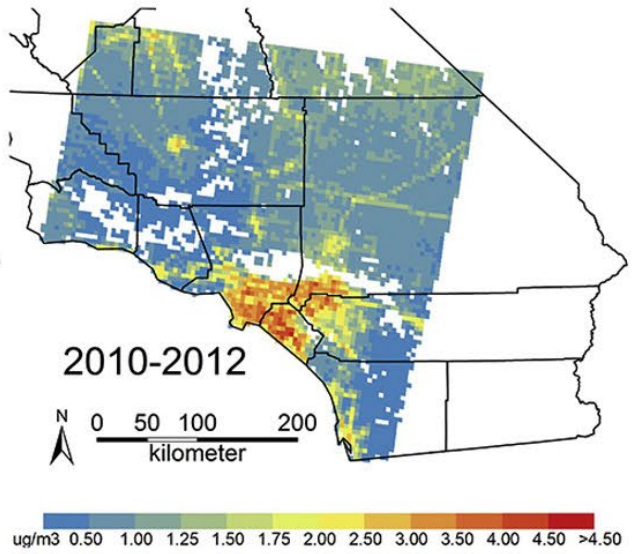
Sulfate



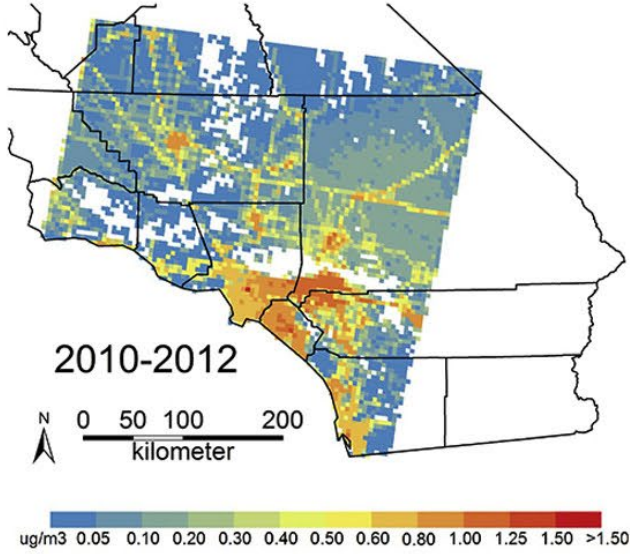
Nitrate



Organic Carbon



Elemental Carbon



Source: Meng, Xia, et al. Atmospheric Environment 181 (2018): 70-81.

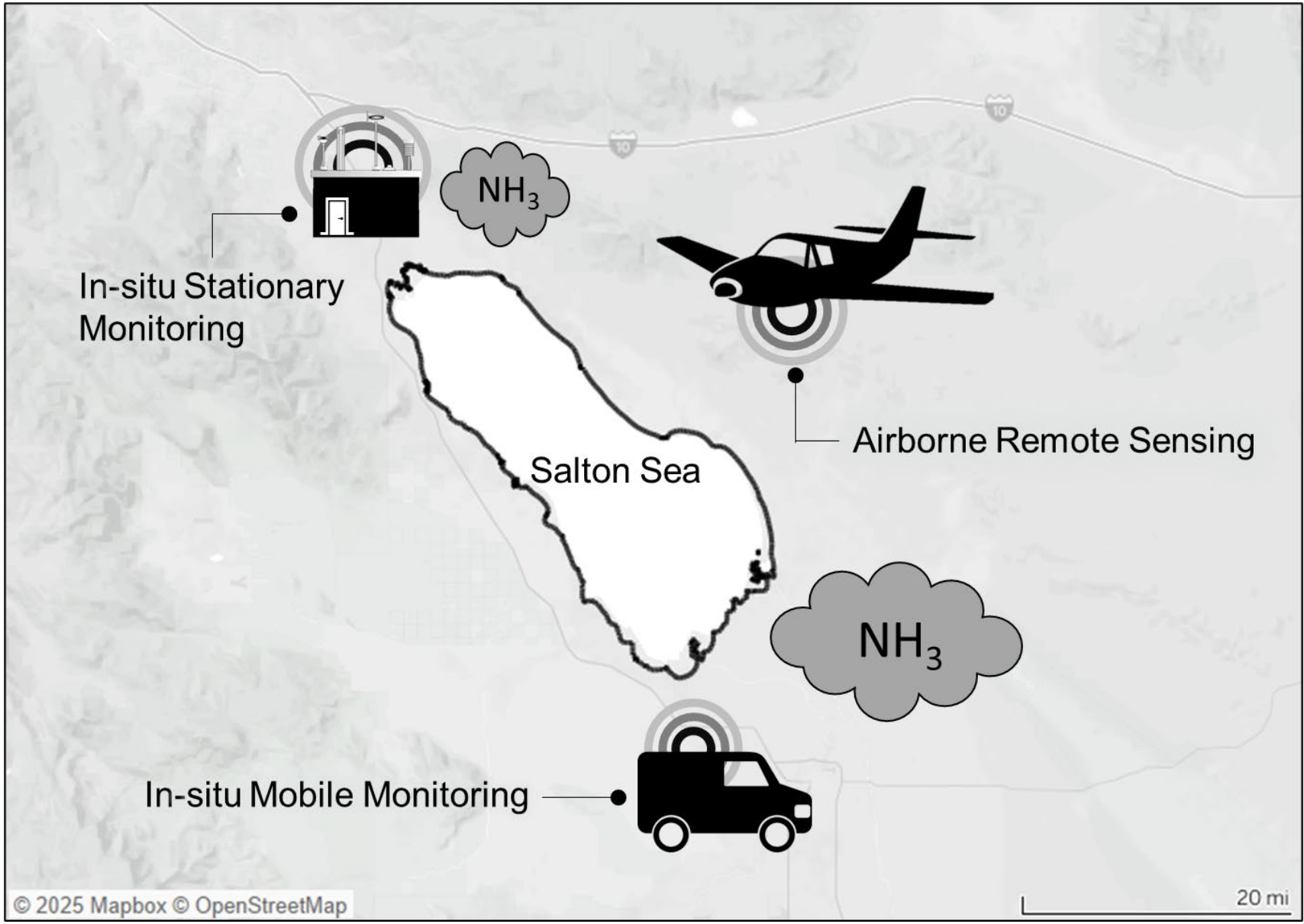
- **Satellite-derived** PM2.5 composition maps reveal **spatial gradients** and support **health research**, **exposure assessment**, and **air quality management**.

CALIFORNIA AIR RESOURCES BOARD

NASA satellite helps collect 15 years of Southern California air pollution data; results show air pollution controls working

Airborne Mapping of Ammonia in the Salton Sea Region

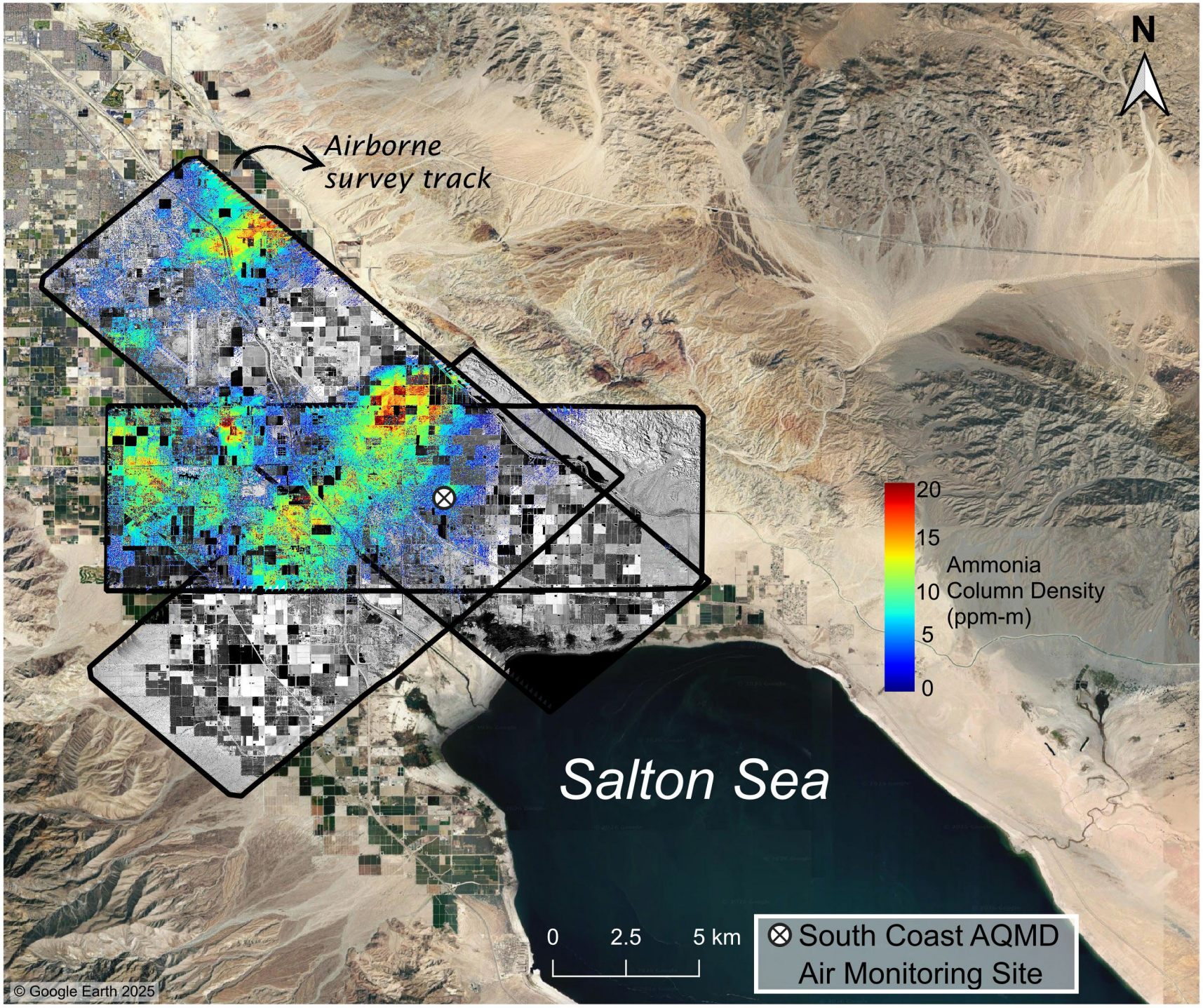
- **Ammonia (NH3)** is a key **precursor of secondary PM2.5**, but its emissions are poorly characterized.
- The **Salton Sea region** is an area of elevated ammonia in California.
- A 2023 campaign combined **airborne** and **ground measurements** to characterize ammonia in the region.



JPL AEROSPACE South Coast AQMD UC RIVERSIDE

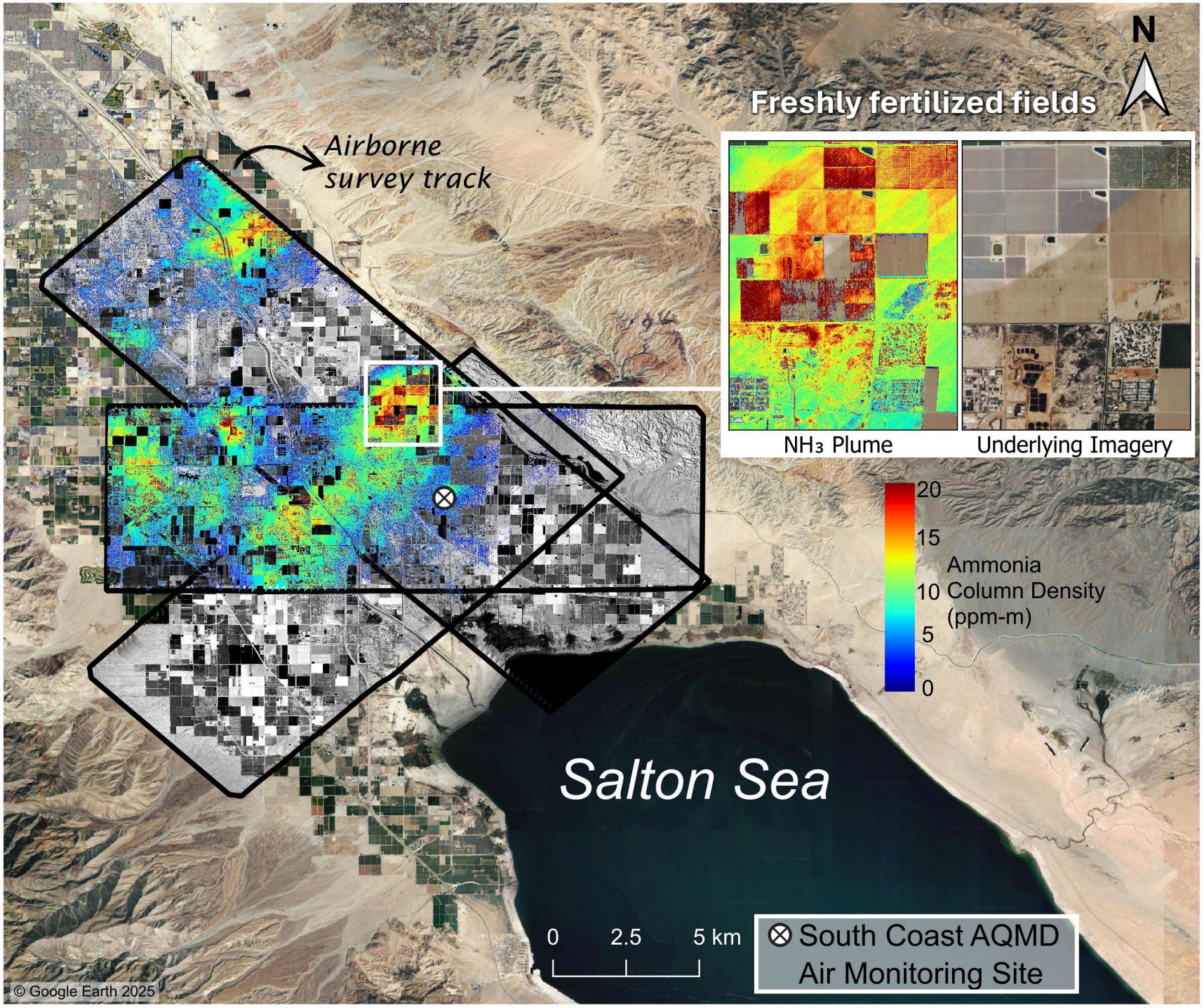
Airborne Mapping of Ammonia in the Salton Sea Region

- **Airborne observations** mapped ammonia column density at **~2 m** spatial resolution.
- Ammonia in the **Eastern Coachella Valley** was primarily associated with **diffuse agricultural sources**.
- Airborne observations **were consistent** with South Coast AQMD's **ground measurements** in Mecca.



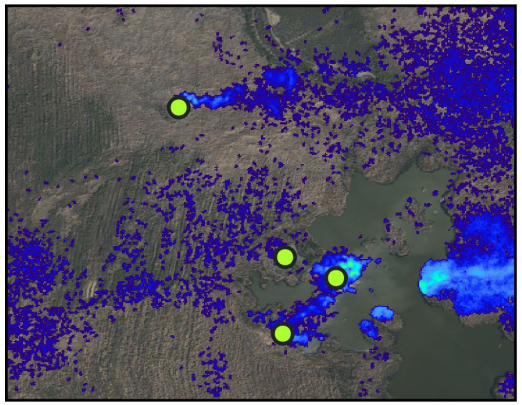
Airborne Mapping of Ammonia in the Salton Sea Region

- **Airborne observations** mapped ammonia column density at **~2 m** spatial resolution.
- Ammonia in the **Eastern Coachella Valley** was primarily associated with **diffuse agricultural sources**.
- Airborne observations **were consistent** with South Coast AQMD's **ground measurements** in Mecca.



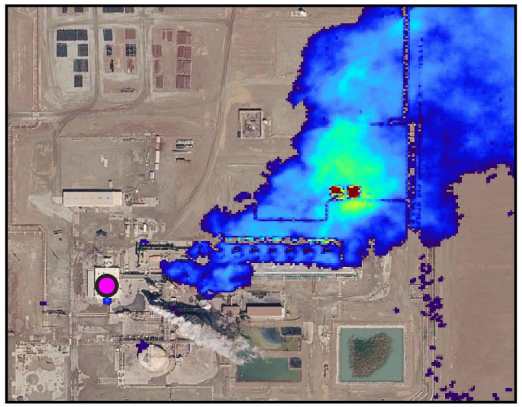
What High-Resolution Airborne Measurements Can Reveal

Fumaroles



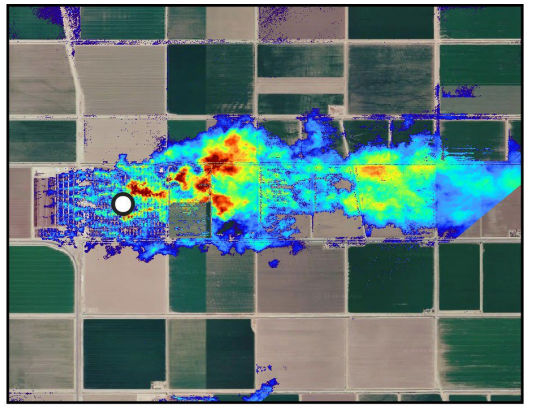
0 100 200 m

Power plant



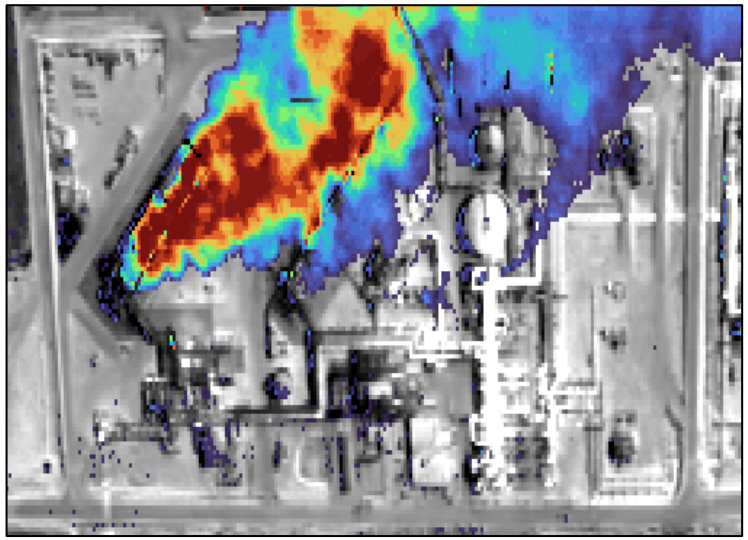
0 50 100 m

Cattle Feedlot



0 1,000 2,000 m

- **Detect localized plumes** from small sources, such as individual fumaroles.
- **Locate emission origins within facilities**, such as power plants.
- **Map the spatial extent of large plumes**, like those extending downwind of cattle feedlots.



- **Use repeated views of a facility's plume** to estimate emission rates.

Thank you!

Sina Hasheminassab
Sina.Hasheminassab@jpl.nasa.gov

Attachment 4

AQ PORTAL

A unified platform for air quality data, analytics, and public access

Brandon Feenstra, Ph.D.
Monitoring Network Manager
Monitoring and Analysis Division
South Coast AQMD

Board Retreat | September 10, 2026

Background

Many data sources → Many Points of Access

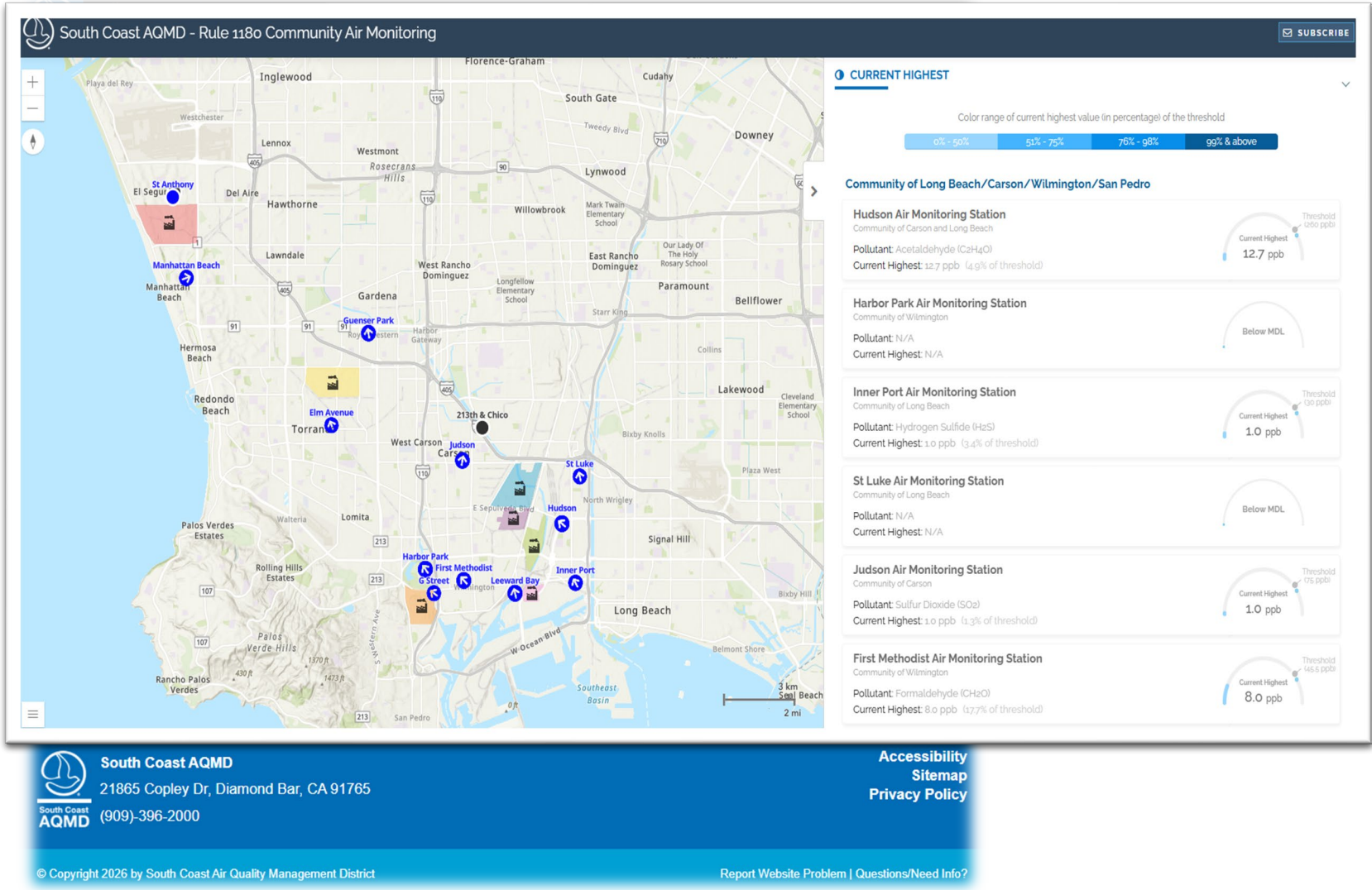
Data Sources

Internal sources

- Air Quality Index Data
- Monitoring Network
- Laboratory Sample
- Air Quality Sensors
- AB 617 Community Monitoring
- Rule 1180 Community Monitoring
- Special Monitoring Projects
- Incident Response Monitoring
- Mobile Air Quality Data

External Sources

- Air Quality Sensors
- Rule 1180 Refinery Monitoring
- Traffic count
- Meteorological
- NASA satellite Data



THE PLATFORM

Many data sources → One point of access

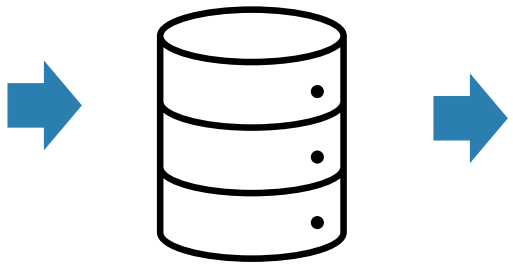
AQ Portal brings diverse air quality data together so staff and the public can access, analyze, and visualize information more easily.

AQ PORTAL

Harmonize & process

Azure cloud infrastructure

- Organize and manage data
- Apply QC and display logic
- Support analytics and APIs



ACCESS & INSIGHT

Make the data useful

Public + staff dashboards

- Interactive visualization
- Custom data export
- Diagnostics & advanced analysis

A single platform reduces fragmentation and creates a scalable foundation for future data sources and dashboards.

PROGRESS

Phase 1 | Foundation built

Established the core architecture and capabilities needed to operate AQ Portal.

Platform foundation

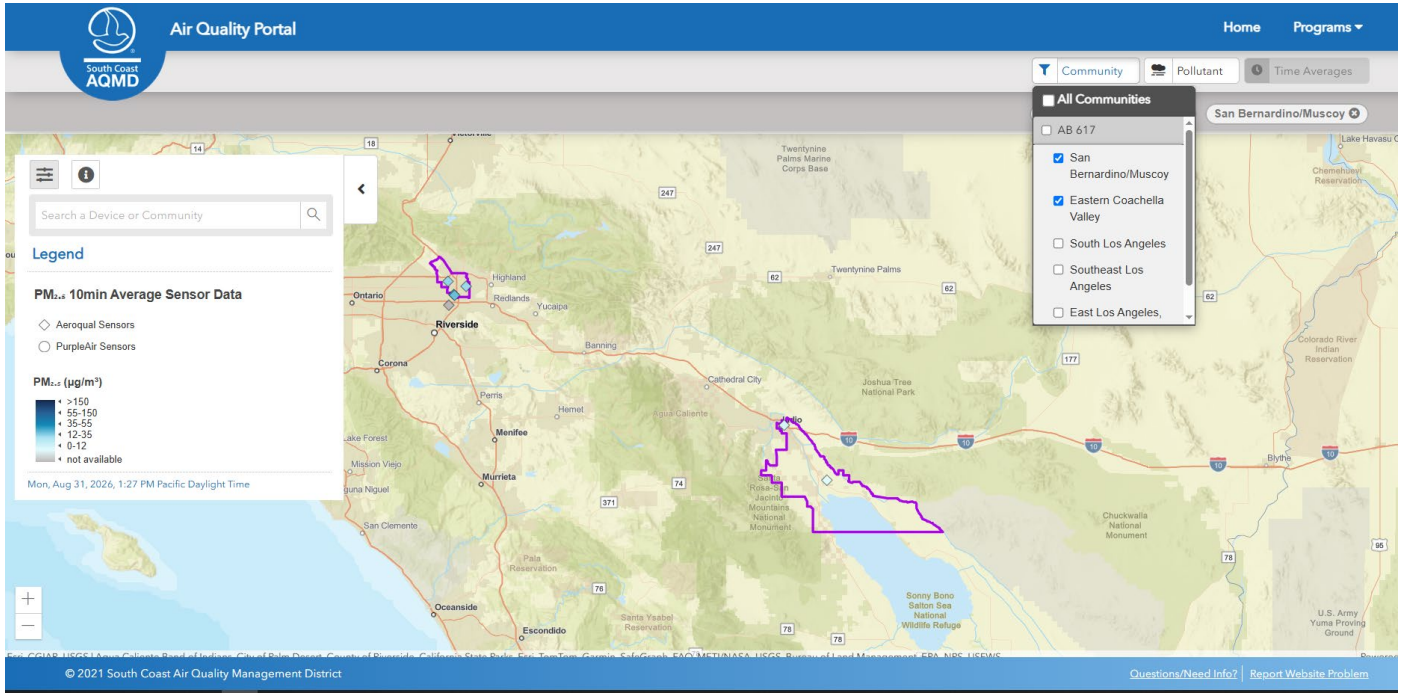
System architecture • device & data management

Data quality & display

QC rules • display logic • analytics/query capabilities

Web & integration

Websites • Microsite Builder • API access



Available at: https://aqportal.aqmd.gov/

CURRENT DEVELOPMENT & FUTURE EXPANSION

Phase 2 | Scale, expand, and unify

Focus the next phase on broader coverage, stronger public access, and deeper analytics.

1 Expand data coverage

Integrate all additional stationary monitoring databases

2 Expand public access

Global dashboard – single point of access

Standardize Monitoring Station Dashboard

3 Strengthen analytics

Enhance data visualization

Integrate advanced analytical tools

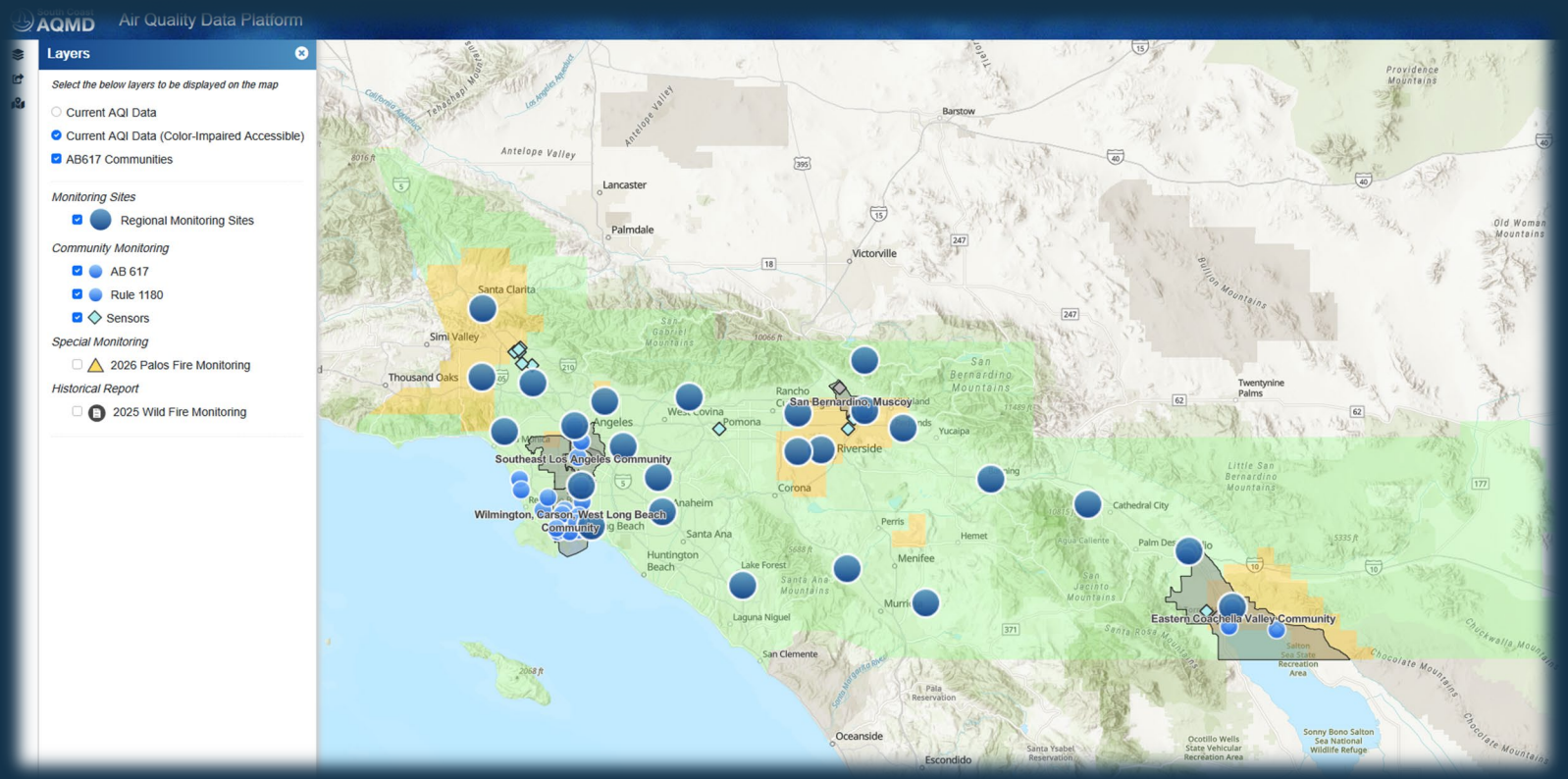
Improve data processing and display capabilities

Future expansion

Mobile monitoring • Satellite • Drone Monitoring • Traffic • Demographics

AQ PORTAL

One platform.
Many data sources.
Greater access.



Thank you