ADVANCED TECHNOLOGIES FOR REFINERY MONITORING IN THE SOUTH COAST AIR BASIN

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Cleaning the Air That We Breathe…

GOALS OF SCAQMD OPTICAL REMOTE SENSING MONITORING PROGRAM

- Demonstrate feasibility and effectiveness of optical remote sensing (ORS) methods for
  - Fenceline monitoring
  - Emissions measurements
- Improve Leak Detection and Repair (LDAR) program
- Provide exposure information to neighboring communities

EVOLUTION OF SCAQMD OPTICAL REMOTE SENSING MONITORING PROGRAM

2008

Commercial LP-DOAS for fenceline monitoring – Contractor failed to fulfill its obligations

2013 – 2014

Two successful technology demonstration projects aimed on refineries monitoring

FluxSense

AOS UCLA Atmospheric & Oceanic Sciences

2015

ORS measurement campaign to study emissions from refineries, small sources, and ships

2016 – 2018

Combine ORS and "low-cost" sensors to study affects of HAPs emissions on communities

SUMMARY OF 2015 REFINERY PROJECT

- ORS techniques provide:
  - Rapid identification of potential leaks
  - Reliable fenceline monitoring
  - Real-time alarm system for communities
  - Good characterization and quantification of certain industrial emissions
- SCAQMD fenceline monitoring projects demonstrated that:
  - Refineries in the SCAB are well operated and maintained (compared to other places in the US/world)
  - There may be a discrepancy between measured and reported inventory emissions for VOCs
  - Results from the ORS methods used for this study are in very good

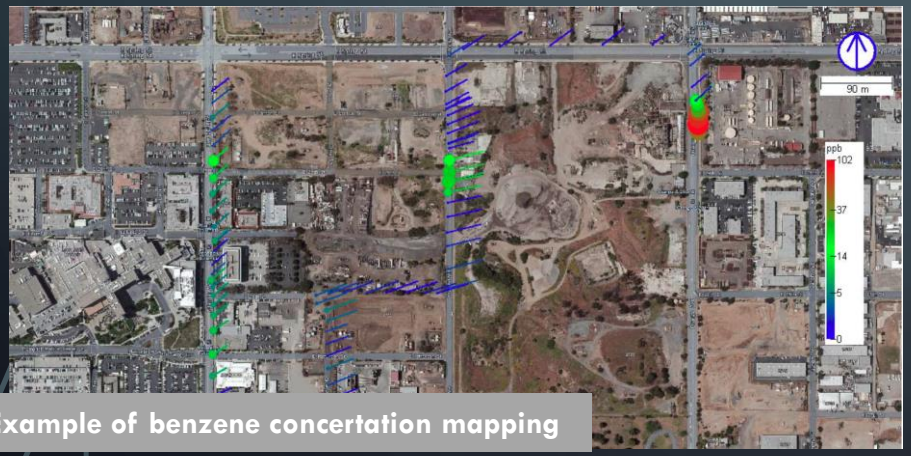
CURRENT PROJECTS: COMMUNITY-SCALE AIR TOXICS AMBIENT MONITORING

3-year study aiming to

1. Use of ORS methods to monitor HAP emissions from industrial facilities and to estimate their annual VOC emissions
2. Use of ORS methods in combination with "low-cost" sensors for assessing the impact of industrial HAP emissions on surrounding communities.

Mobile ORS – detailed understanding of emissions and concentrations mapping (quarterly surveys)

"Low-cost" sensors network – long-term monitoring of VOC and PM2.5 at facility fenceline and inside the community



Example of benzene concertation mapping

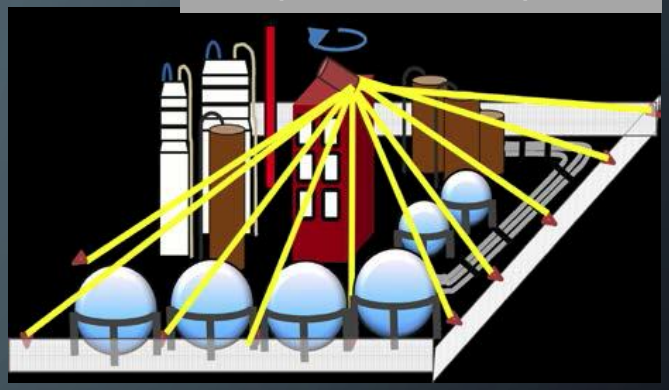
UPCOMING PROJECTS: TORRANCE COMMUNITY MONITORING

- Collaborative project between
  - Sonoma Technology – monitoring
  - City of Torrance – integrated alert and notification
- Monitoring components:
  - Open-path fenceline network – real-time monitoring for hydrogen cyanide, benzene, sulfur dioxide and other pollutants of concern
  - Community monitoring stations – four air monitoring stations to obtain in-community concentrations of air toxics, including HCN, HF, H_2S, benzene, SO_2, and other pollutants
  - Deployment of ~50 "low-cost" particulate matter sensors with local residents

POTENTIAL FUTURE PROJECTS: OPTICAL TENT (UCLA)

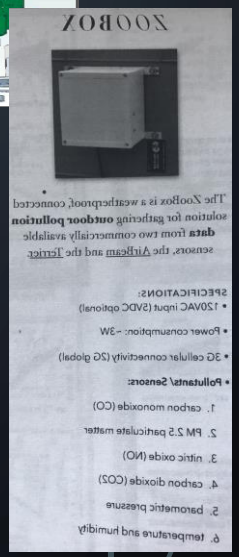
- Develop and deploy an optical tent for one of the refineries in the SCAB
  - Long Path Differential Optical Absorption Spectroscopy (LP-DOAS)
  - Light source 0 UV LED
  - Monitoring for benzene, toluene, xylenes, and other aromatic hydrocarbons (BTEX), HCHO, SO_2
  - 24/7 measurements
  - Real-time feedback for facility operator(s)
  - Community alarms for accidental releases
- Previous successful deployment
  - Similar experimental setup - 2015 BEE-TEX experiment in Houston, TX
  - Measurements of 2D concentration fields of BTEX over residential neighborhood adjacent to a refinery

Conceptual illustration of optical tent



BEE-TEX measurement setup

POTENTIAL FUTURE PROJECTS: COMMUNITY DEPLOYMENT OF "LOW-COST" SENSOR NETWORK (QSENSE)



- Deploy various sensors with community volunteers
  - "Low-cost" sensor node for monitoring PM10/2.5, NO, CO, CO_2, P, T, RH
  - S-Pod for monitoring VOCs
  - Personal weather station for measuring wind speed and wind direction
  - Incorporate data from PM monitoring network(s) deployed by other community groups
- Data from all monitors to be integrated into to the Qsense cloud
  - Capability to ingest and centralize data from multitude of air monitoring devises
  - Capability to apply "cloud calibration" methods designed to address unique challenges of "low-cost" sensor data
  - Implement interface specific to the monitoring area, giving the ability for interested persons to log in and navigate geospatial and temporal data

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