Agenda No. 10

REFINERY FENCELINE MONITORING

Governing Board Retreat
May 15-16, 2014

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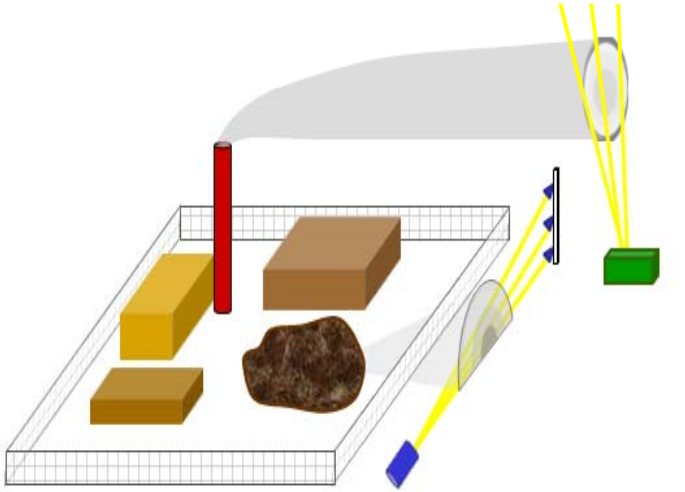
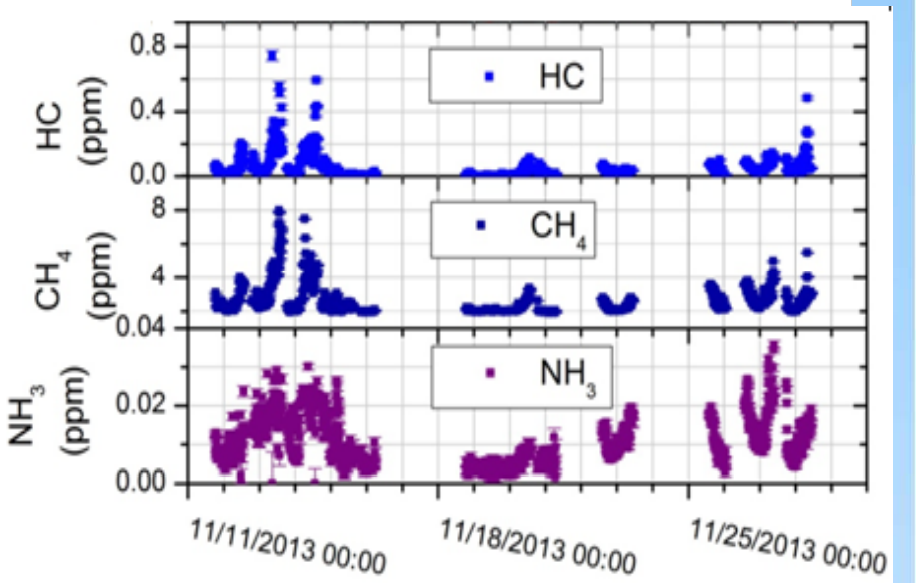
Science & Technology Advancement

Cleaning the Air That We Breathe…

OPTICAL REMOTE SENSING TECHNOLOGIES

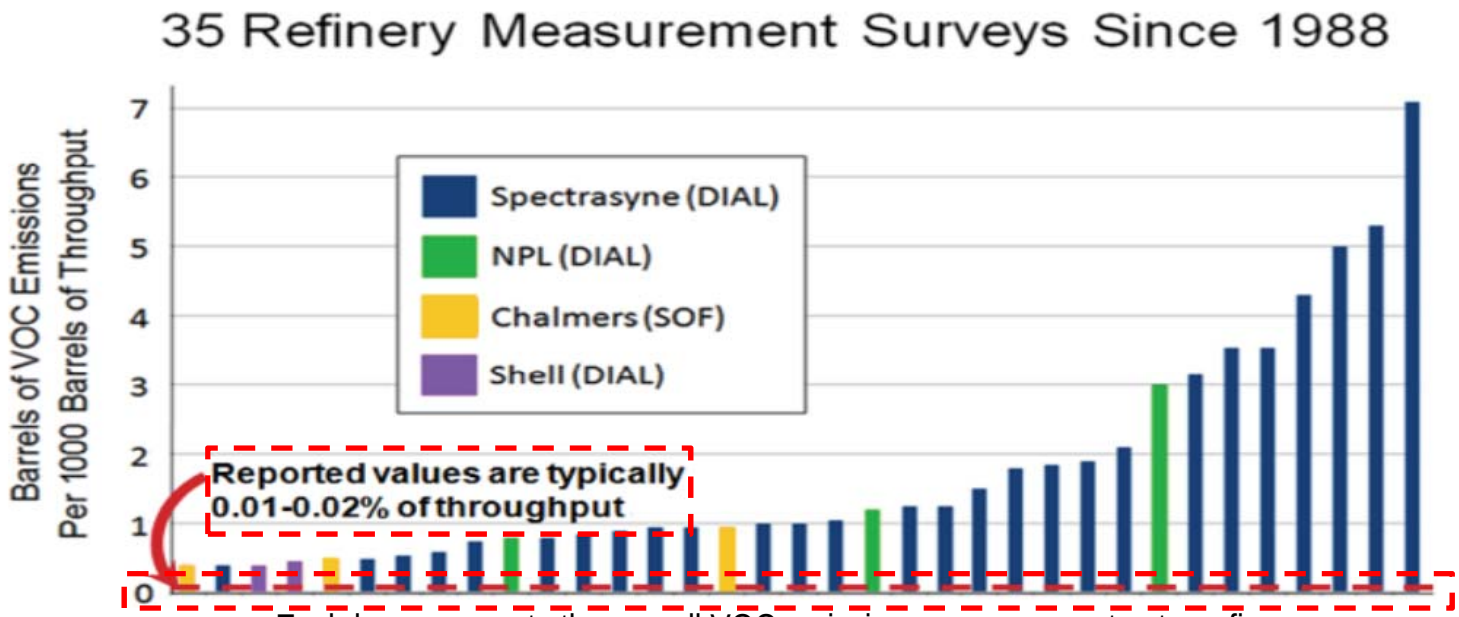
- Evolved significantly over last two decades
  -Rely on differential light absorption characteristics to ID gaseous pollutants
- Can be used to monitor / quantify emissions
- Fully automated / continuous





OPTICAL REMOTE SENSING TECHNOLOGIES

- Measurements around Houston Shipping Channel (TX)
  - -VOC emissions up to 11X higher than reported
- Similar observation with refineries around the world
  - -Actual VOC emissions much higher than those from current emission estimation / reporting techniques



Each bar represents the overall VOC emissions measurements at a refinery.
Each refinery measurement survey typically takes two weeks to complete.

SCAQMD FENCELINE AIR MONITORING PROGRAM

OBJECTIVES

- Demonstrate feasibility / effectiveness of fenceline monitoring and remote sensing technologies
- Can we measure actual facility-wide emissions?
  - Improve existing emission inventory estimates
  - Improve LDAR program and reduce emissions
- Can we provide real-time alerts to downwind schools and communities?

As part of this program the SCAQMD initiated two pilot studies…

SCAQMD's PILOT STUDIES

SCAQMD Fenceline Monitoring Laboratory

FluxSense Study

- FluxSense AB (Göteborg, Sweden)
- Mobile measurements
- Technology demonstration
- Facility-wide emission measurements

UCLA Study

- UCLA, EPA, SCAQMD collaboration
- Fixed measurements
- Technology demonstration

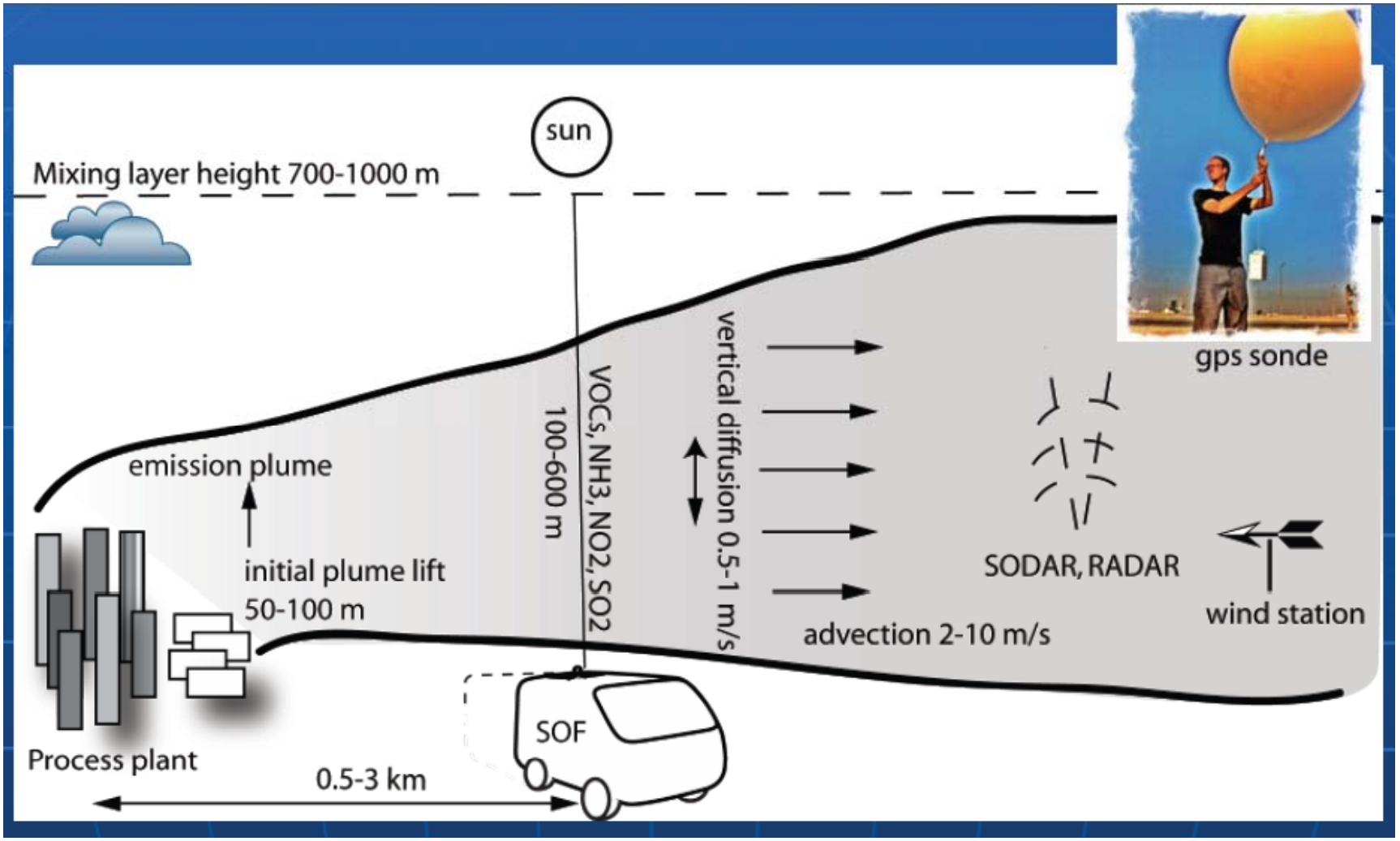
FluxSense

FLUXSENSE PILOT STUDY

- **Location**: Carson; Tesoro and Phillips 66 refineries
- **Technology used:** Solar Occultation Flux (SOF; proprietary technology). Measured mass and wind data are used to calculate emission flux (kg/s) from the refinery. Mobile technique
- **Duration:** ~10 days (early October 2013)
- **Cost:** $50K (~$150K - $200K for complete survey)

FluxSense

FLUXSENSE PILOT STUDY



FLUXSENSE PILOT STUDY CONCLUSIONS

- Best Available Technology in Europe
- Could provide refineries with additional information to further reduce emissions
- Measured emissions exceed reported emissions
- Tesoro (Carson) among better run refineries
- Longer study needed to better characterize annual emissions

UCLA
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UCLA PILOT STUDY

- **Location**: Carson; Tesoro refinery only
- **Technology used:** Differential Optical Absorption Spectroscopy (DOAS; UV-visible and IR ranges). Stationary techniques
  - I-DOAS
  - MAX-DOAS
  - LP-DOAS
  - FTIR
- **Duration:** Project began in 2011 (still ongoing)
- **Cost**: $300,000

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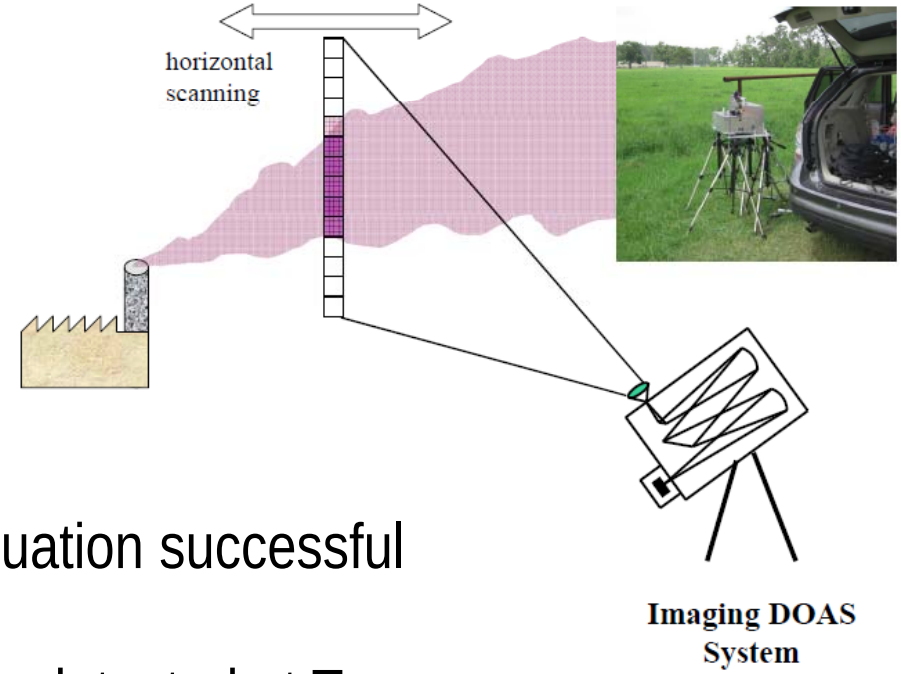
IMAGING DOAS (I-DOAS)

- Remote measurements of HCHO, NO_2, and SO_2 emissions from smoke stacks and flares
- Portable and battery operated



Imaging DOAS System

- Preliminary evaluation successful
- No flaring events detected at Tesoro. Additional measurements will focus on landfill flares
- Not commercially available

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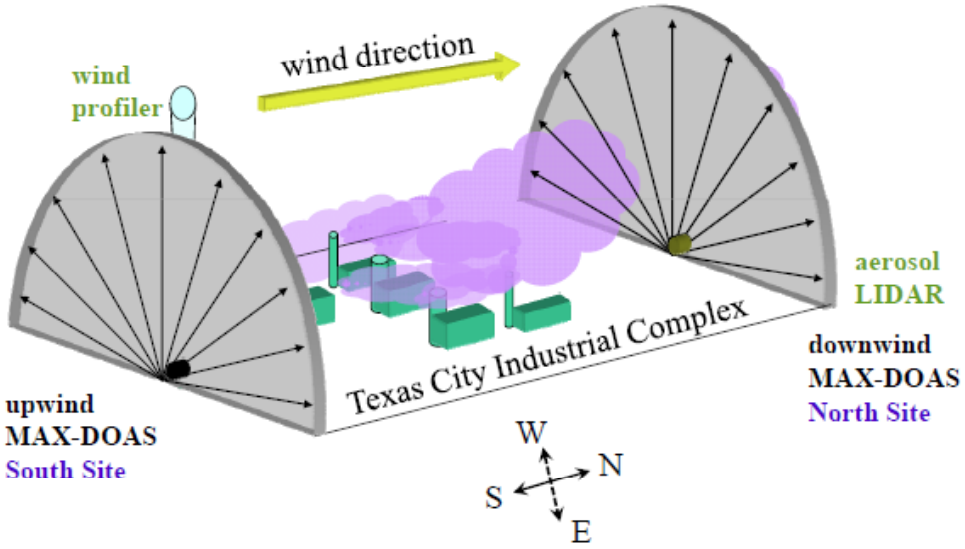
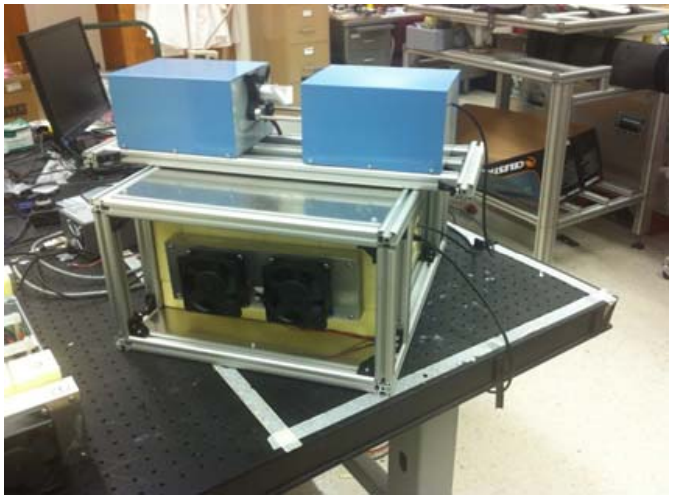
MULTI-AXIS DOAS (MAX-DOAS)





- Remote quantification of facility wide emissions of HCHO, NO_2, and SO_2
- Preliminary evaluation of one unit was successful
- Measurements at Tesoro will be completed in 2014
- Not commercially available
  - SCAQMD will retain permanent ownership of two MAX-DOAS

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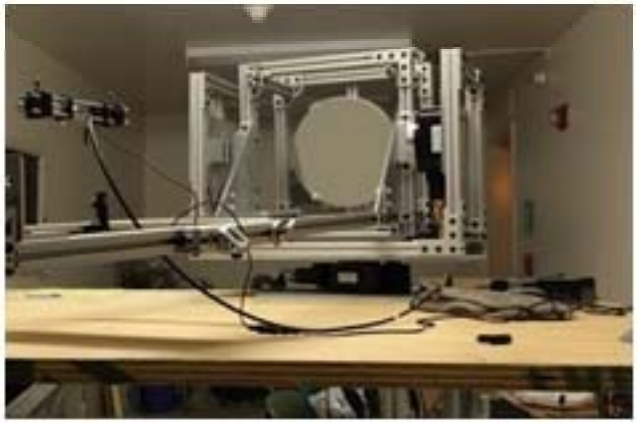
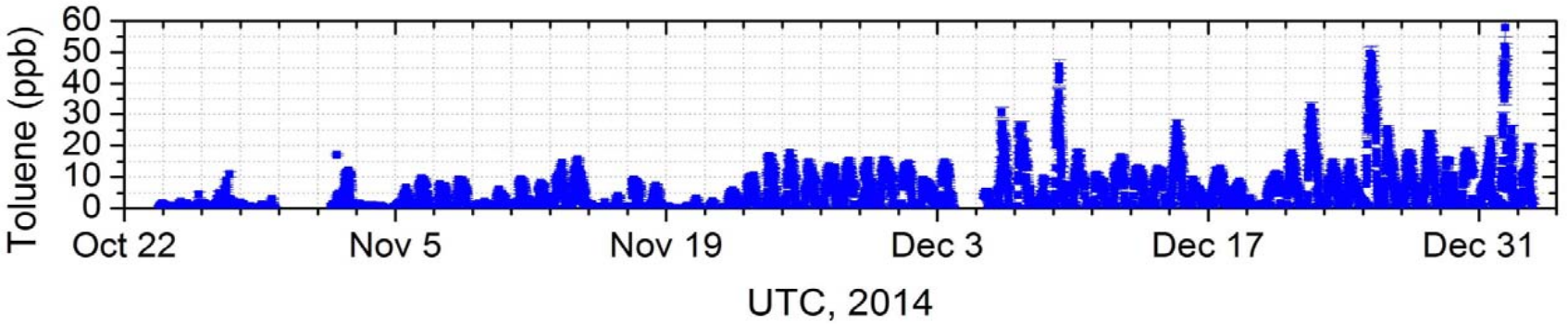
LONG PATH DOAS (LP-DOAS)

- Aromatic hydrocarbons monitoring
- Good alarm tool for accidental releases
- Developed by UCLA
- High stability and full automation
- Successful demonstration
- Not commercially available





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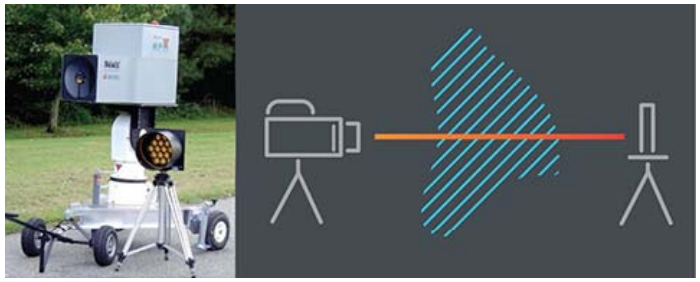
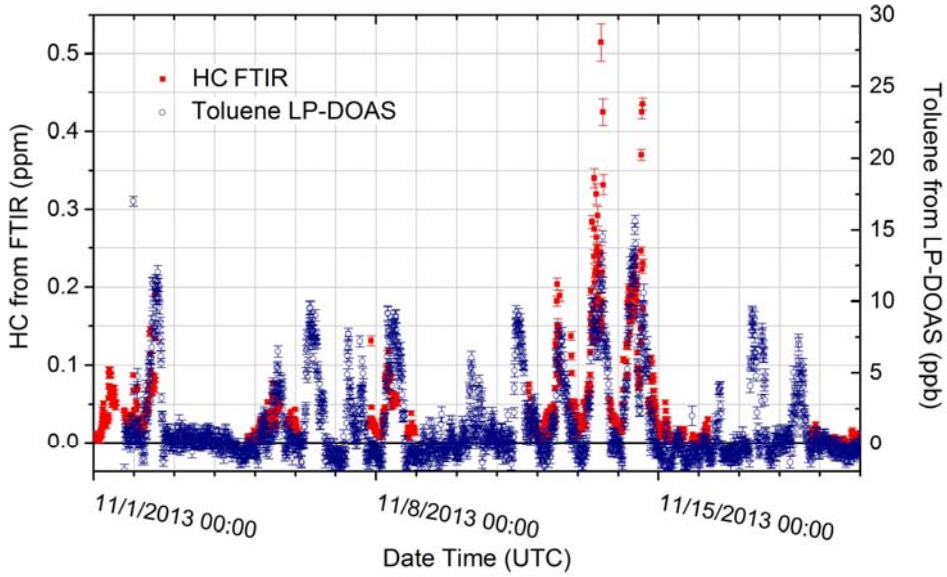
FTIR

- Commercial IMACC FTIR system loaned from EPA
- Wide variety of compounds detected with one measurement (e.g. greenhouse gases and criteria pollutants)
- Successful demonstration
- Approximate cost: $150K - $200

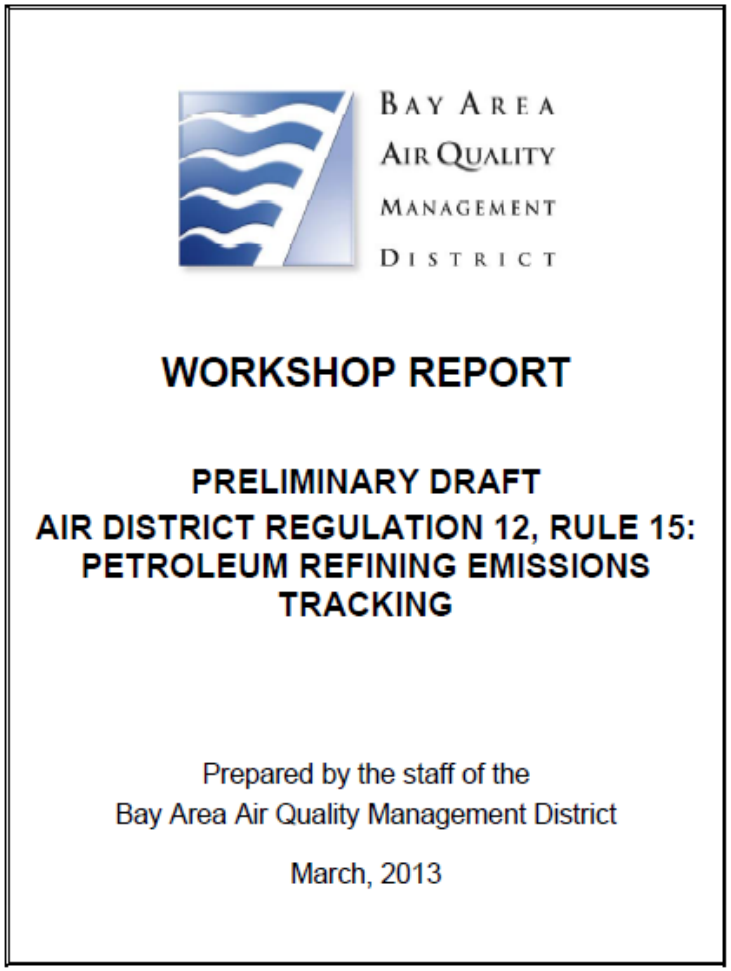




Bay Area AQMD

Actions following the Chevron refinery fire in Richmond (August 6, 2012)

- Review current air monitoring capabilities (DRI report)
- Convene an “expert panel” to recommend advanced monitoring tools
- Develop a new rule “Petroleum Refining Emissions Tracking”
  - Refineries to propose and operate fenceline and community air monitoring systems
  - Rely on remote sensing (open-path) technology
  - Refineries to provide monitoring results to the community
  - Fenceline results not actionable
  - Draft rule by end of 2014



RECOMMENDATIONS

- Issue RFPs:
  - Procure equipment or services to conduct a more comprehensive mobile emission survey to better characterize refinery emissions
    - *Longer duration*
    - *Better wind data*
  - Procure I-DOAS after successful completion of current pilot study
  - Technical assistance in developing a low-cost remote sensing optical "tent"
    - *24-hr operation*
    - *Leak ID/Community alert system*