Community Air Monitoring

Technical Advisory Group Meeting
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Why Do We Monitor Air Pollution?

- Better understand sources, pollutants of interest and their levels, impact of emission reduction strategies, and human exposure

- Supporting and improving air pollution control programs and emissions reduction plans

- Provide information that may assist community members, policy makers, scientists and planners to make informed decisions on how to manage and improve air quality

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Potential Impact of Monitoring in Overall AB 617 Activities

Improve estimates of community level exposures

Improve facility leak detection capabilities

Validate emission inventories

Inform future policy and rule development

Guide incentive money choices

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AB 617 Community Air Monitoring

- Development of Community Air Monitoring Plan
  - Review of past and existing community monitoring deployments
  - Recommendations for additional monitoring
  - Use of advanced monitoring technologies
  - Community partnerships to conduct monitoring
  - Outreach to public to ensure proper communication and interpretation of monitoring data
- Goals of Community Air Monitoring
  - Enhance our understanding of pollution sources and their impacts within communities
  - Support effective implementation of emissions reduction programs

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Pollutants of Interest

Criteria Pollutants

Regional and local

- Carbon Monoxide (CO)
- Lead (Pb)
- Nitrogen Dioxide (NO_2)
- Ozone (O_3)
- Particulate matter ($PM_{2.5}$ and PM_{10})
- Sulfur Dioxide (SO_2)

Air Toxics

Local and source specific

- Arsenic
- Hexavalent Chromium
- Nickel
- Other metals
- VOCs (e.g., BTEX)
- Black Carbon
- Ultrafine Particles
- …other

- Both can cause health effects (different concentrations and exposure times)
- Both are monitored and regulated by state and local air districts
- **Local air toxics are becoming more and more relevant**

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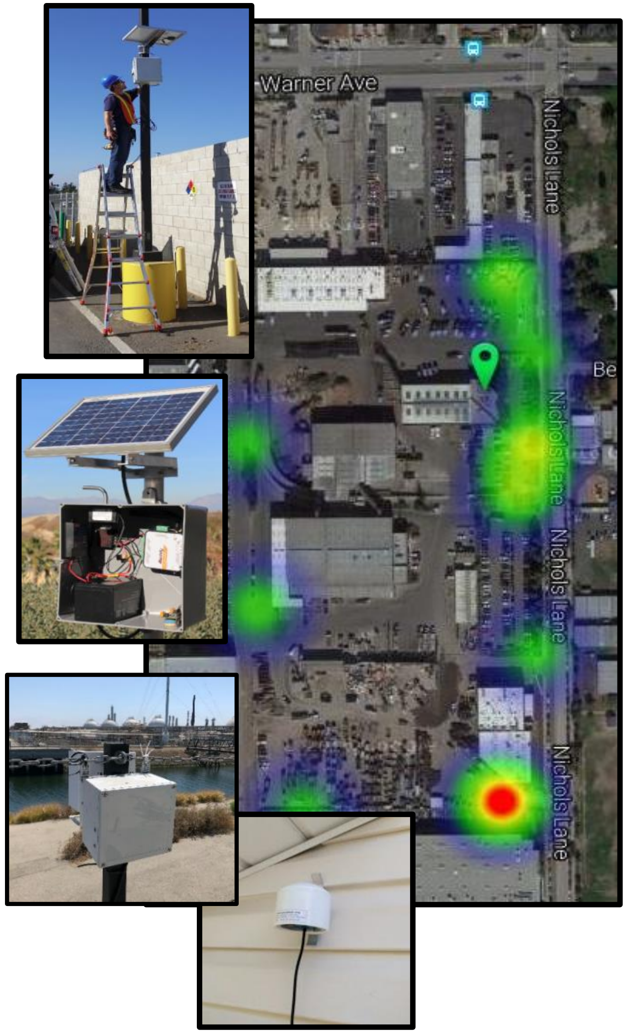
Main Technologies for Community Air Monitoring

Regulatory Monitoring Instruments

Mobile Platforms

Low-Cost Sensor Networks



Optical Remote Sensing

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Data Time Resolution and Data Access

Traditional Monitoring	Mobile Platforms	Optical Remote Sensing	Low-Cost Sensors
			
Time Integrated, Continuous, Continuous & Real-Time	Continuous	Continuous & Real-Time	Continuous & Real-Time
Near Real Time Data Display (except Laboratory Data), Scientific Reports & Summaries	Graphical Map Data, Scientific Reports & Summaries	Near Real Time Data Display, Scientific Reports & Summaries	Real Time Data Display

Regulatory Monitoring

Purpose: To support regulatory programs; Assess regional air quality; Track progress; Compliance monitoring; etc.

- FRM and FEM Instruments*
- Follows U.S. EPA designated methods and equipment

*FRM = Federal Reference Methods; FEM = Federal Equivalent Methods

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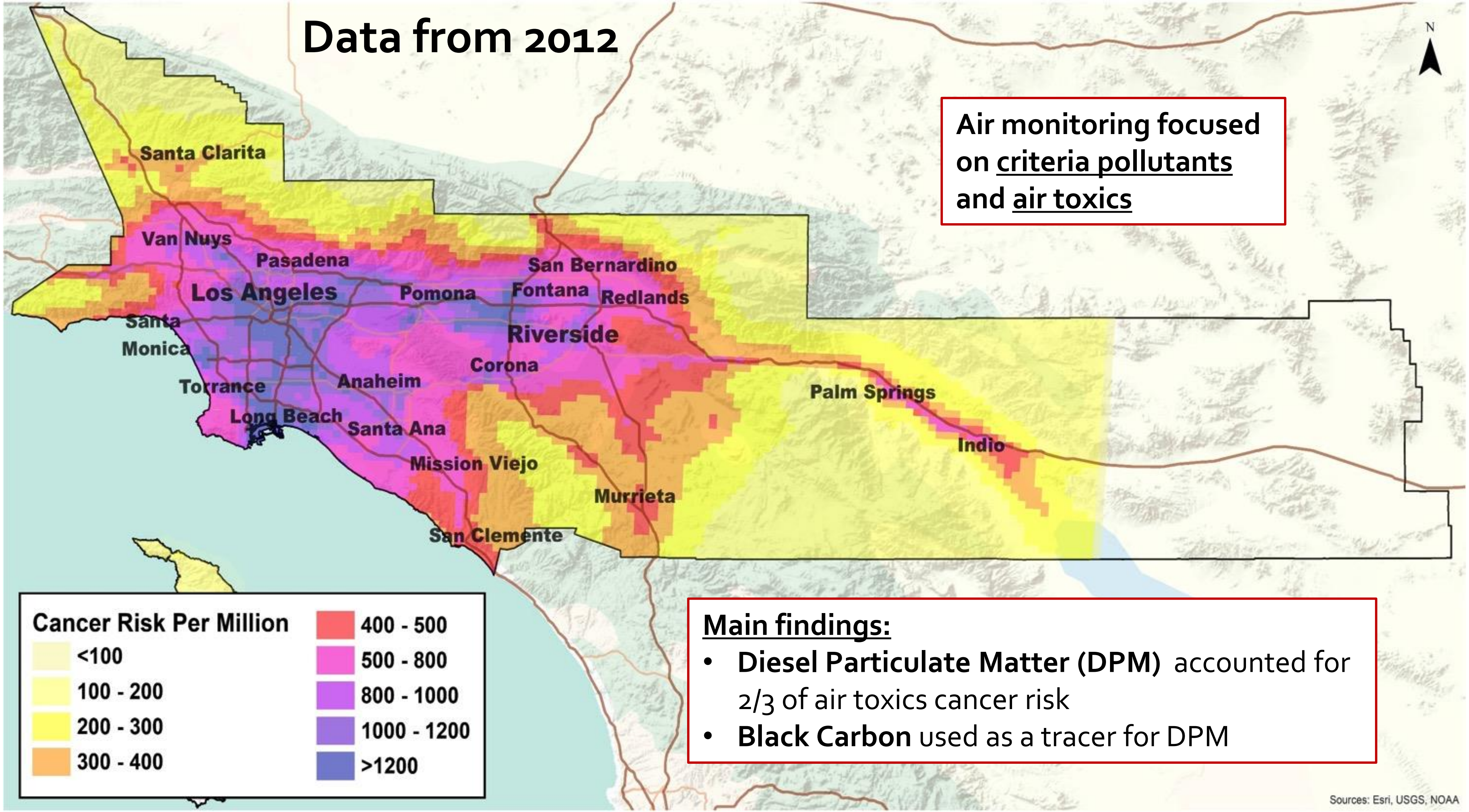
Traditional Air Toxics Monitoring Example: Cancer Risk Assessment



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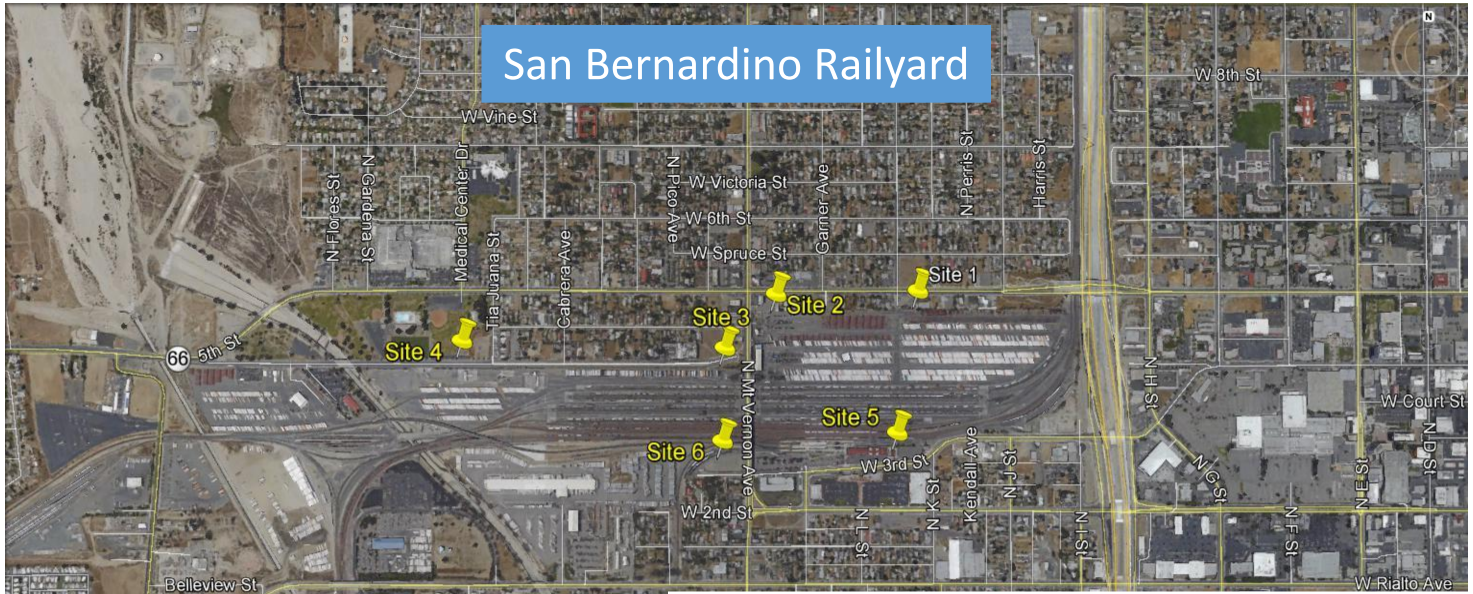
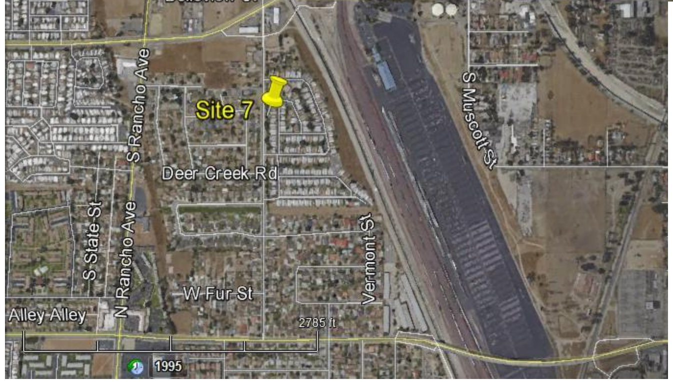
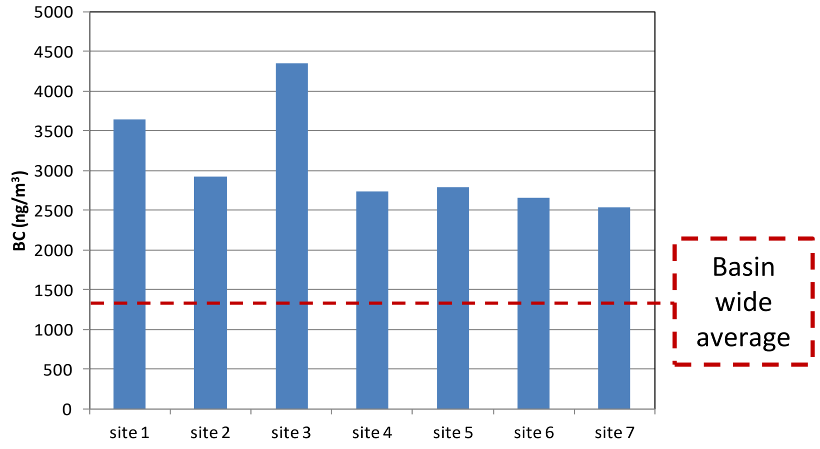
Diesel PM Source Monitoring

- San Bernardino Railyard Microscale Study (2013)
- Used a suite of field deployable air toxics monitoring platforms
  - Particle count (UFP)
  - Black Carbon (BC)
  - Meteorology

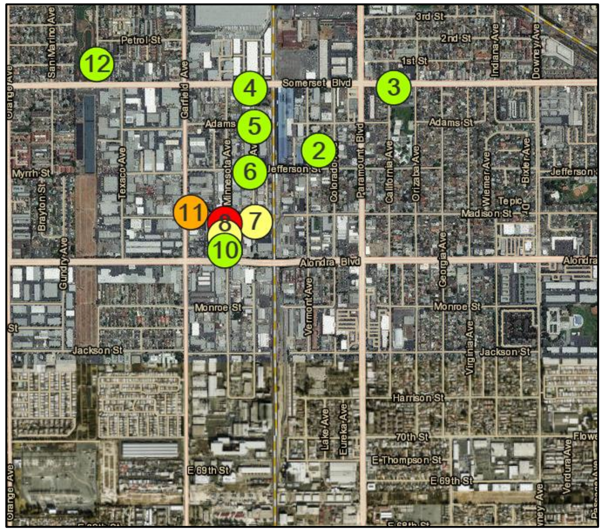




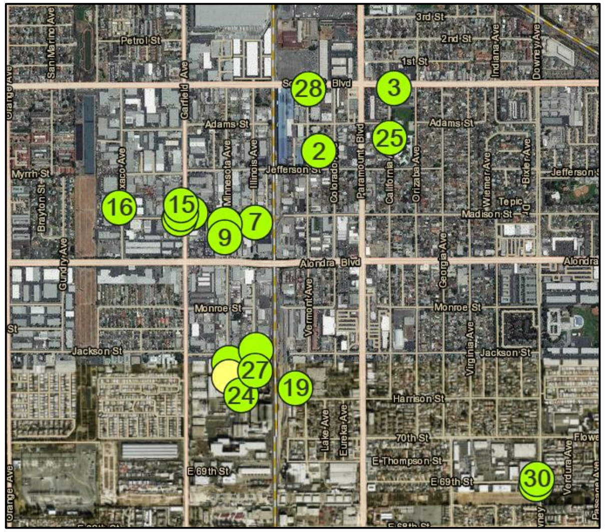


Toxic Metals Source Monitoring

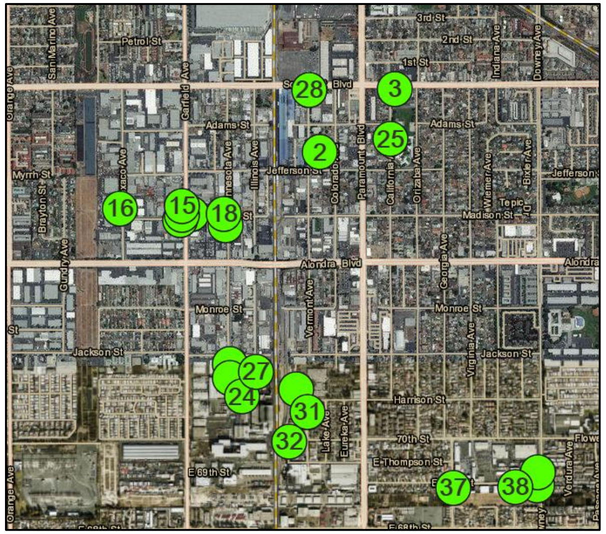
October 2016



May 2017



November 2017



As of February 1, 2019

4820 Samples analyzed for hexavalent chromium at 46 sites since Oct 2016

38 Sampling Locations

- Over 10 ng/m^3
- Between 5 to 10 ng/m^3
- Between 1 and 5 ng/m^3
- Less than 1 ng/m^3

Mobile Air Monitoring Platforms

Purpose: To identify unknown sources of emissions; identify “hot spots”; inform monitoring planning; and cover a larger area

Mobile Stationary Stations

Mobile Laboratory

FluxSense - Optical Remote Sensing (ORS)

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SCAQMD Latest Mobile Platform

- Ford Escape PHEV (MY 2010, SCAQMD fleet vehicle)
- Mobile measurements of NAAQS criteria pollutants and air toxics
- Fast response regulatory-grade, research-grade, consumer-grade
- Vehicle speed: 30 ± 3 mph
- Extended on-road sampling periods (> 4 hours)
- Additional data parameters collected
  - GPS Coordinates
  - Wind Speed/Direction
  - 340° Video

Instruments

Pollutant	Time Resolution
Black Carbon (BC)	1 sec
Particle Mass (FEM, near-FEM, sensor)	6, 60, 80 sec
Particle Count (UFP)	1 sec
CO (FRM)	1 sec
NO_2 (FEM, sensor)	6, 60 sec
O_3 (FEM, sensor)	10, 60 sec

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Additional Efforts to Find Metal Sources

- Real-time Mobile Monitoring of Total Metals (UCSD/ CARB)
- Real-time Mobile Monitoring of Total Metals and Cr6+ (Aerodyne Research/ Desert Research Institute)
- Concrete Construction Pilot Study
- Furnace Study to Characterize Sources of Cr6+ (UCR)

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FluxSense ORS Van

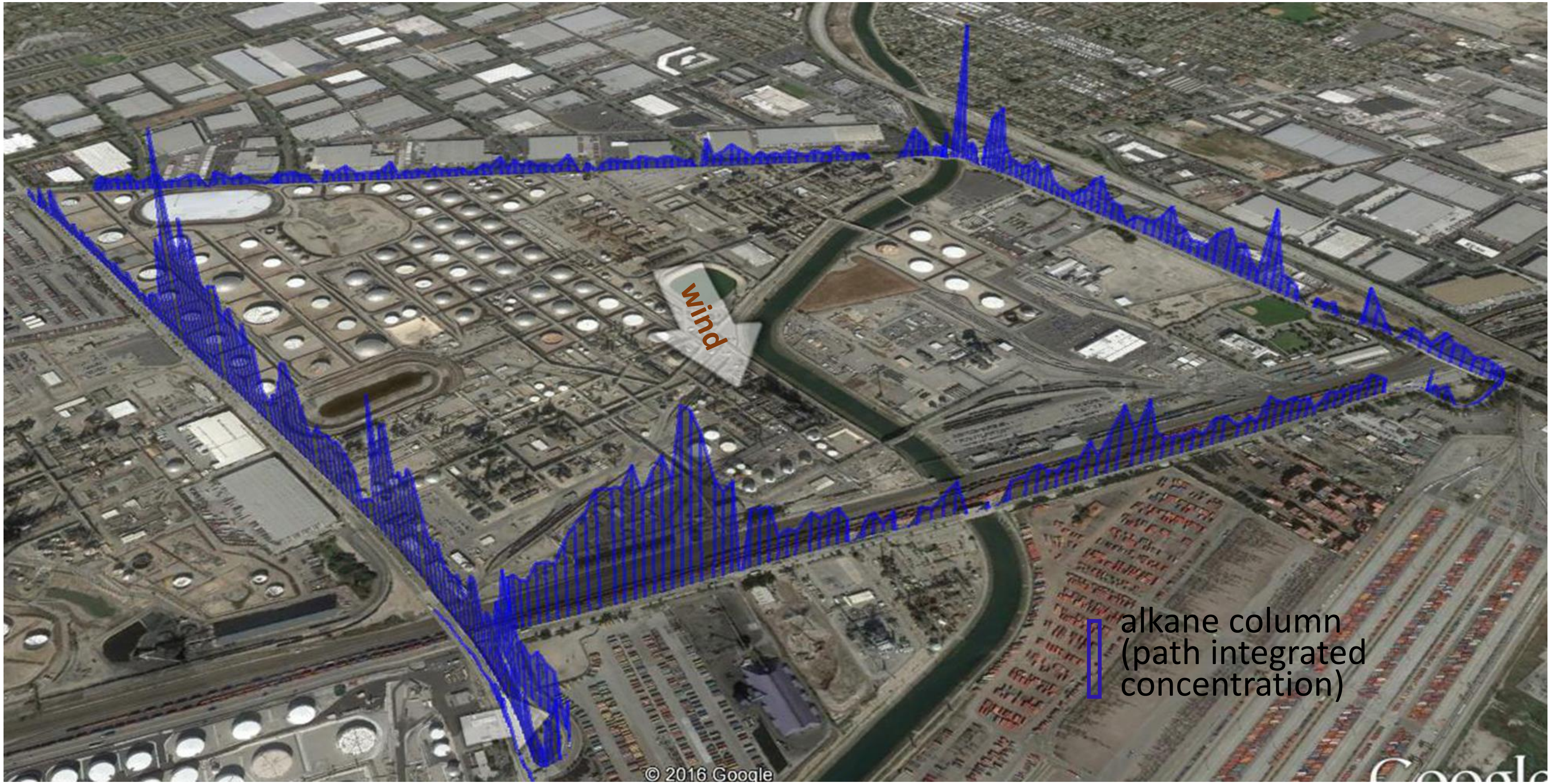
- Suite of optical instrumentation on a mobile platform

- Flux measurements* (sun as a light source)
  - Solar Occultation Flux (SOF) - alkanes
  - Sky DOAS - HCHO, NO_2, SO_2
  - Daytime measurements only

  *Accurate wind data for flux calculations obtained using SCAQMD's wind profiling LIDAR

- Concentration mapping (artificial light sources)
  - Mobile extractive FTIR (MeFTIR) - speciated alkanes, methane, ammonia, etc.
  - Mobile White Cell DOAS (MWDOAS) BTEX, phenol, styrene, tri-methylbenzene
  - <u>Daytime and night-time measurements</u>

Refinery Emissions



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Refinery Emissions

(Measured/Inventories)*				
	Alkanes+ BTEX	Benzene	NO_2	SO_2
Refinery A	6.4	43	1.0	1.2
Refinery B	8.3	33	0.8	1.5
Refinery C	11.8	202	1.1	2.7
Refinery D	10.5	39	1.1	1.7
Refinery E	5.4	38	0.8	1.7
Refinery F	2.7	3.2	0.3	1.1
Overall	**6.2**	**34**	**0.8**	**1.5**

*Median measured emissions (September 2015) / Reported annual emissions divided by 12

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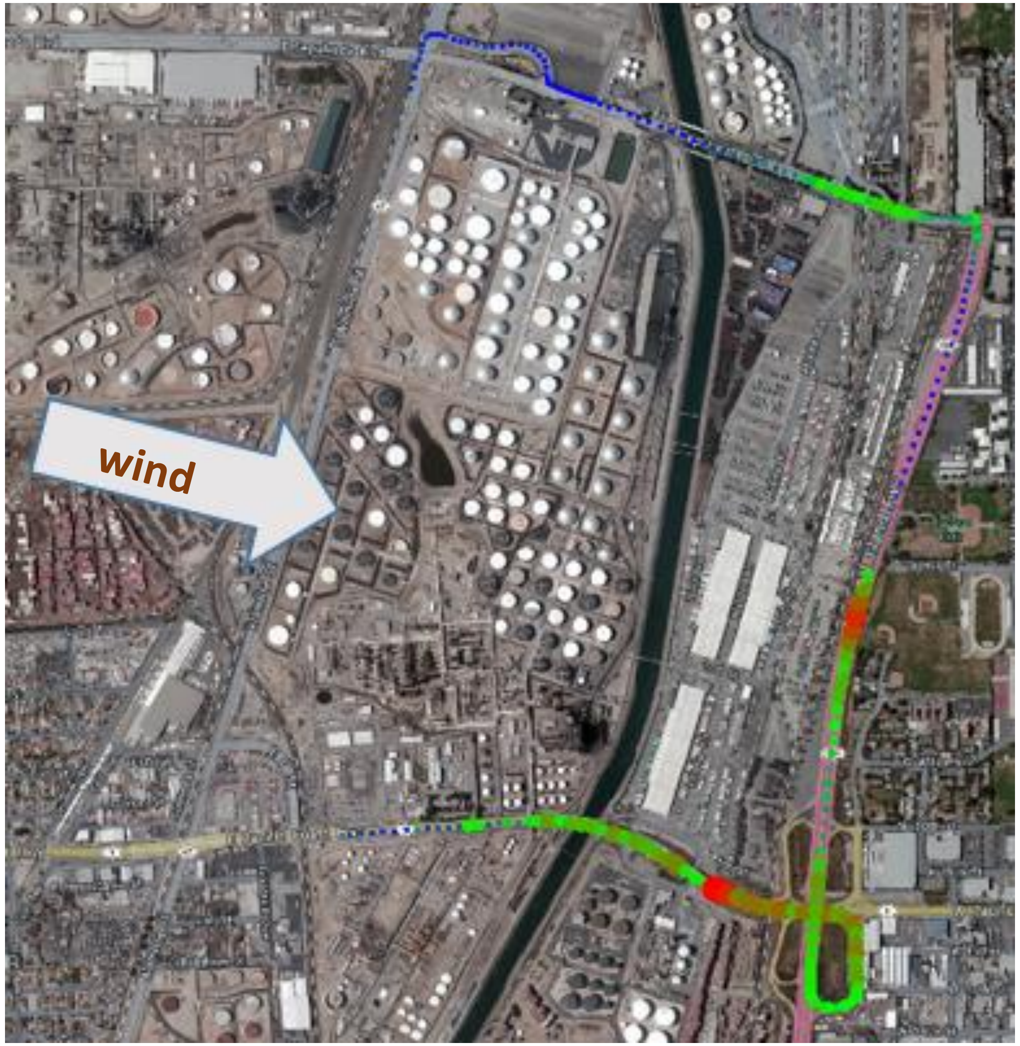
Community Impact

- Example of elevated alkanes column densities detected in the community downwind of a refinery

- Mobile ORS measurements are also an ideal tool for assessing the impact of refinery emissions on nearby communities



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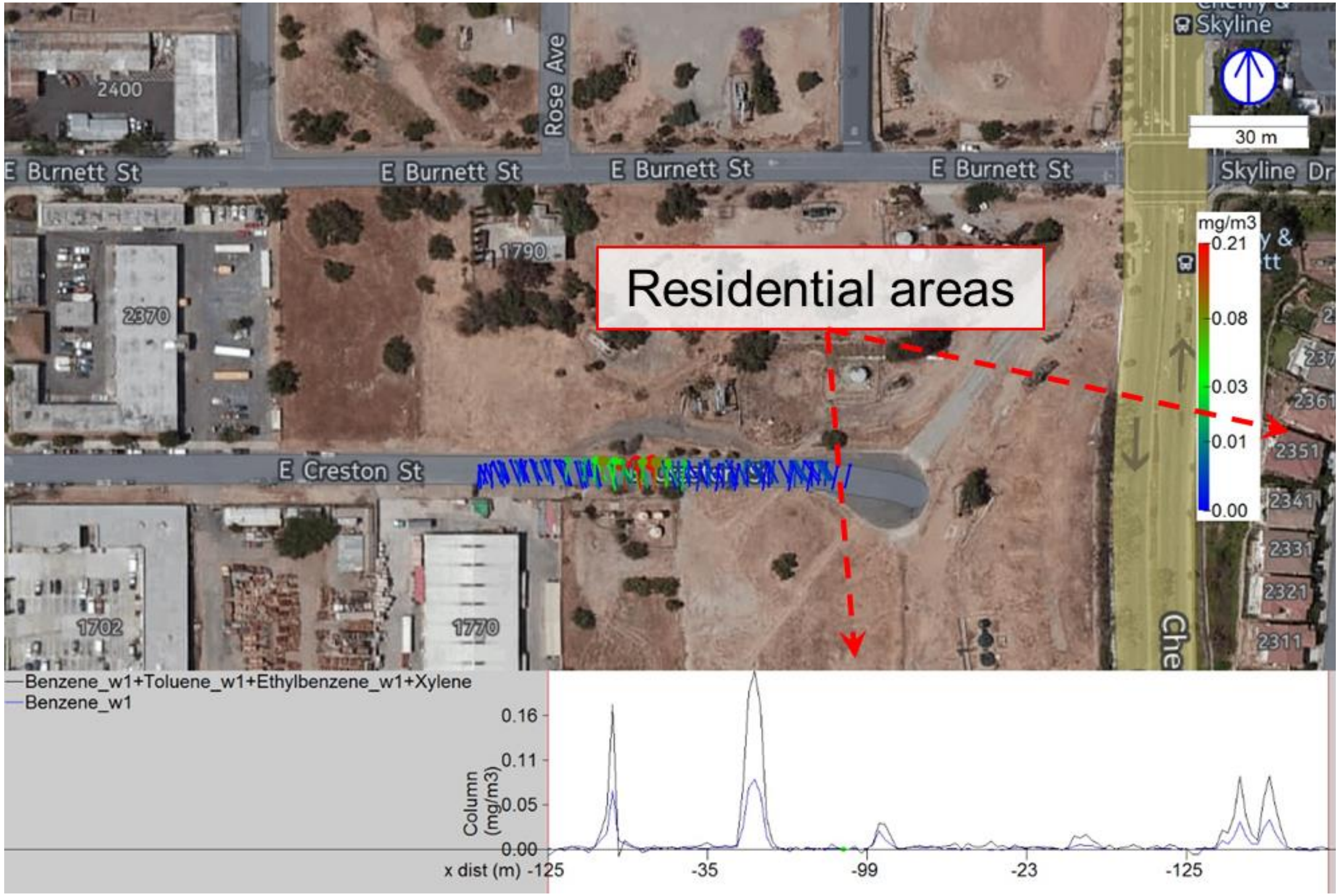
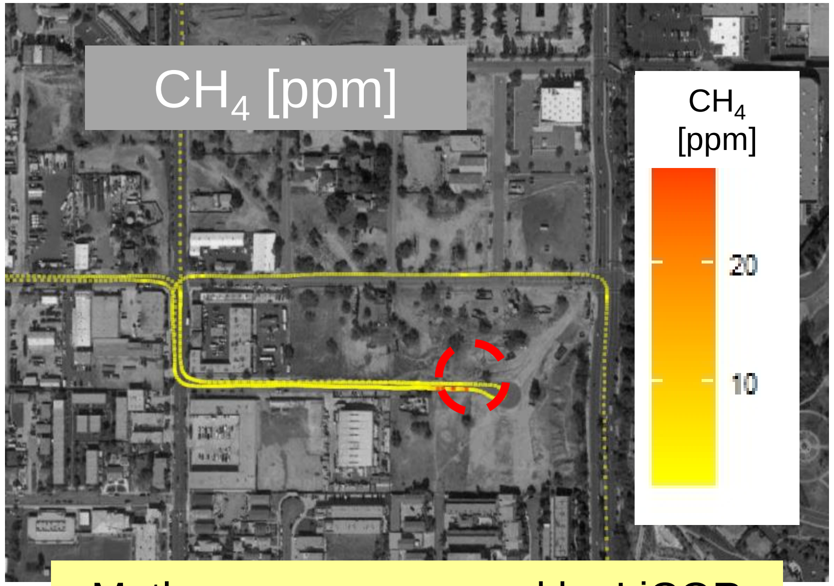
Oil Well Emissions

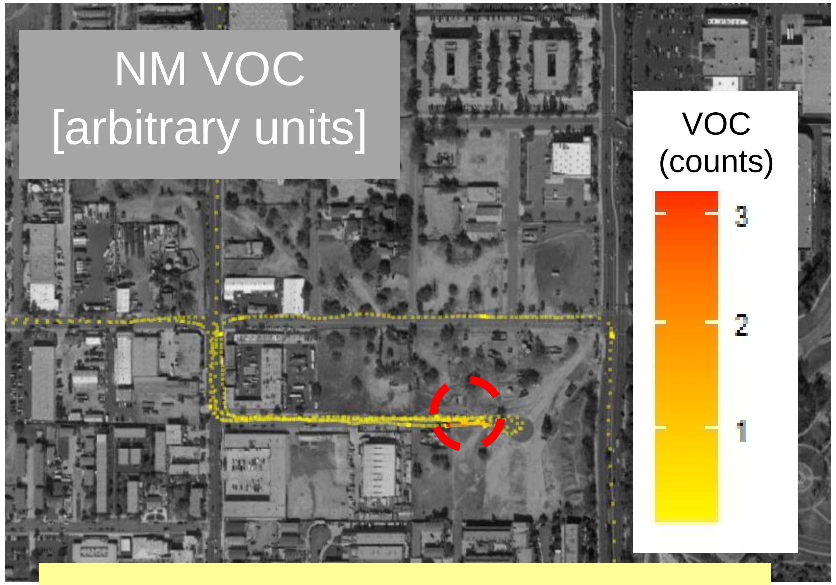


- Elevated BTEX concentrations measured downwind of urban oil well
- Maximum benzene concentration: 25ppb
- Distance to the nearest residence: 267ft

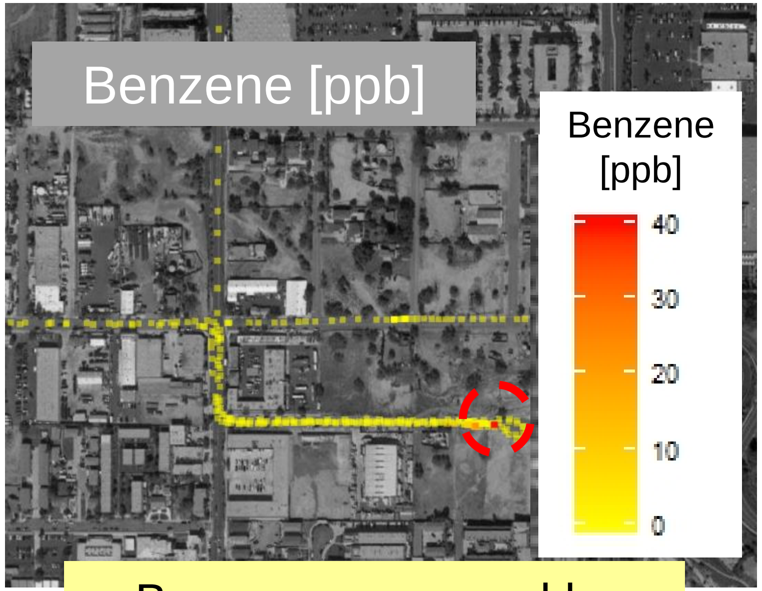
Storage Tank Emissions



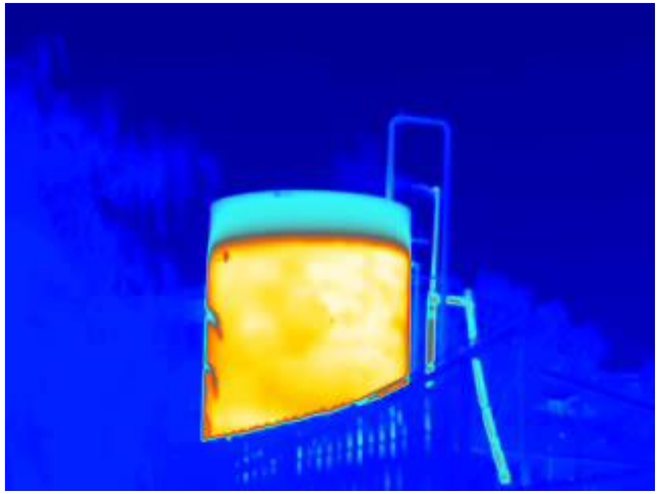
Methane was measured by LiCOR analyzer mounted on top of SUV



Non-methane VOC measured by “low-cost” sensor node



Benzene measured by MWDOAS



- Elevated VOC levels detected by a “low-cost” VOC node downwind of oil pump and storage tank
- Detection confirmed by mobile lab
- Emissions observed by FLIR camera

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Emission Characterization and Quantification (Refinery, Small Sources, Ports): 2013-present

Project 1: Quantify fugitive emissions from large refineries

Project 2: Quantify gaseous emissions from small point sources

Project 3: Quantify stack emissions from marine vessels/ports

http://www.aqmd.gov/fenceline-monitoring

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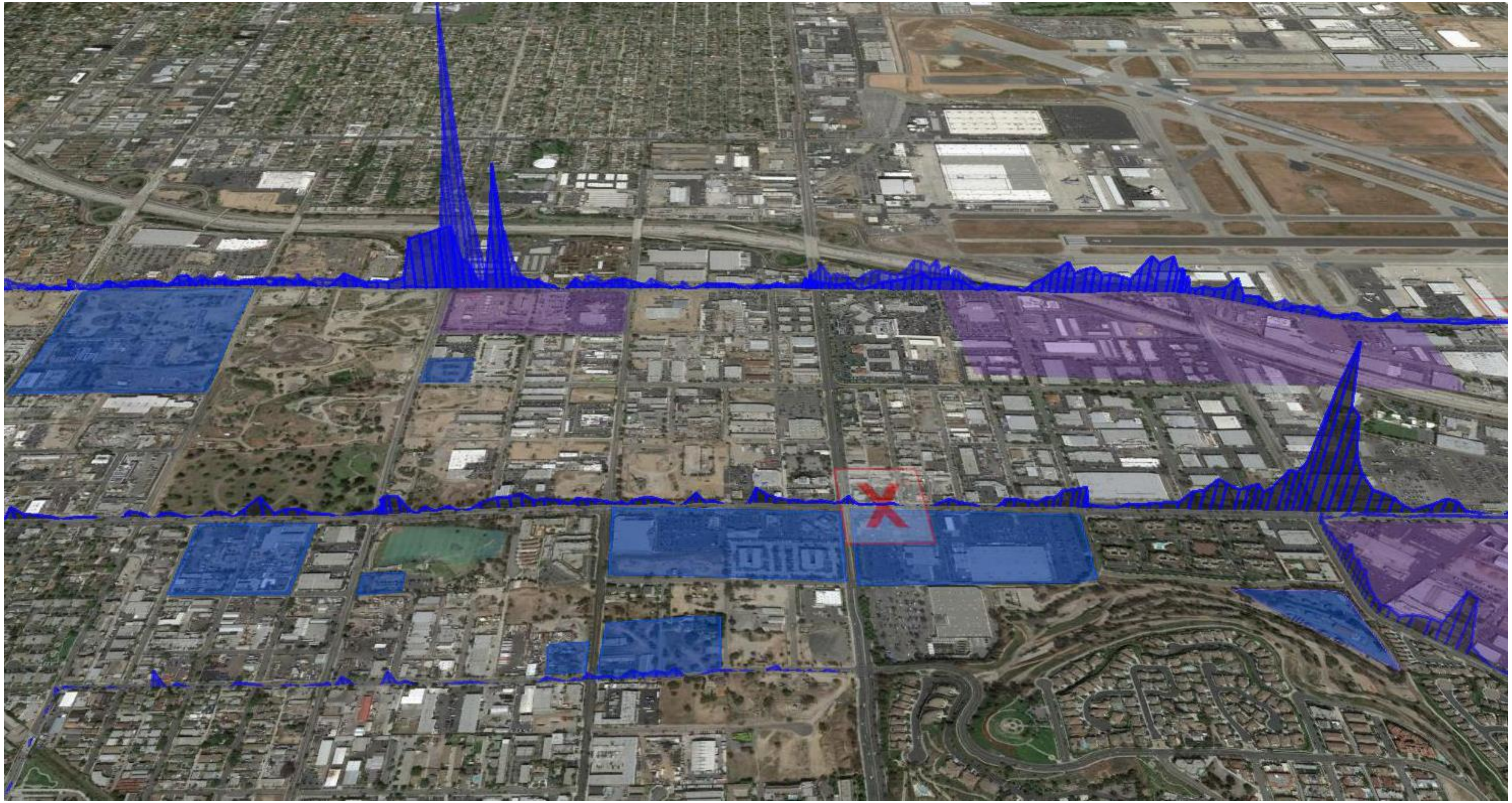
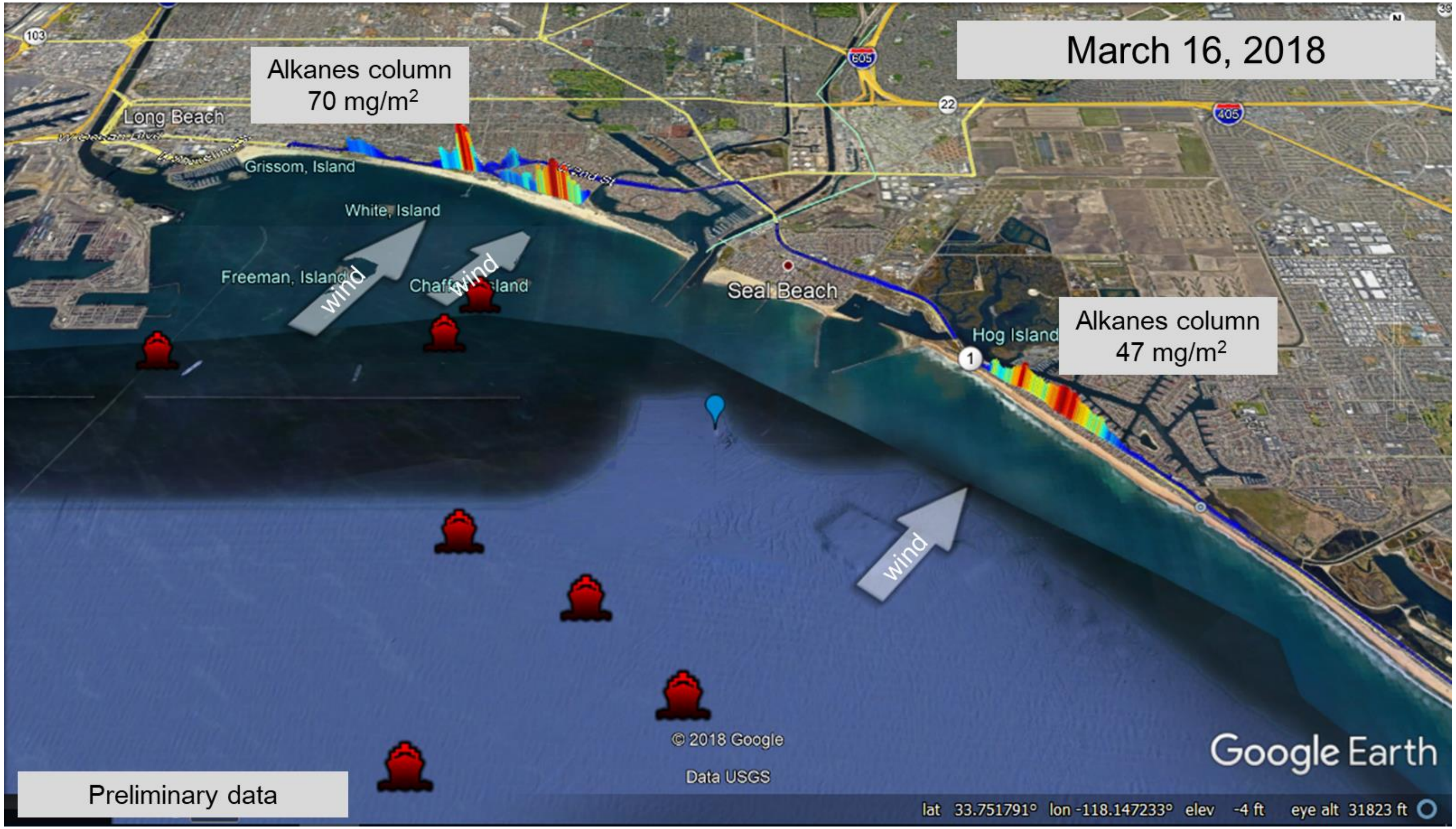
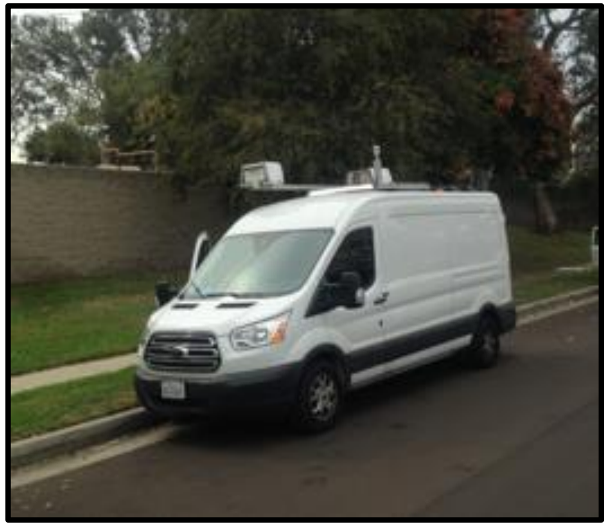
Concentration Mapping in Communities



SOF measurements of alkanes. Blue areas correspond to Oil wells, Cisterns and Derricks and purple areas to treatment plants (290-380 kg/h) and tank farms (10-380 kg/h)

Observation of VOC Plumes from Anchored Ships





Position of oil tanker ships identified in real-time using ships Automatic Identification System (AIS)

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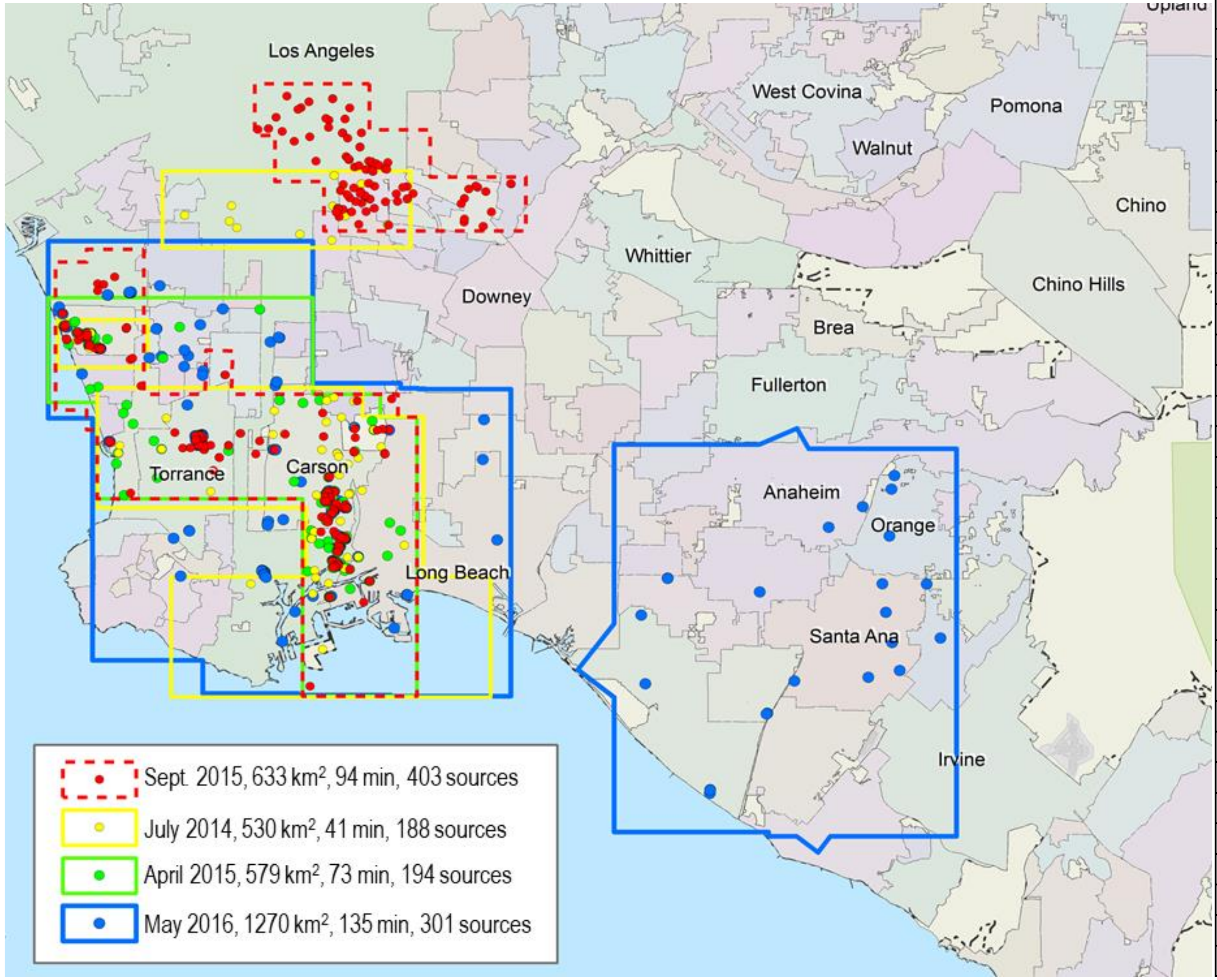
H_2S Emissions from Ship Coke Loading Operations in the Port

Plume from another source, most likely from Terminal Island Water Reclamation Plant

Flight-Based Air Toxics Measurements Aerospace Corporation



1,3-Butadiene
Acetylene
Ammonia
Benzene
Butane
Carbon dioxide
Carbonyl sulfide
Ethane
Ethanol
Ethene
Ethyl benzene
Formaldehyde
Formic acid
Hexane
Hydrogen cyanide
Hydrogen sulfide
Isobutane
Methane
Methanol
Naphthalene
Nitrogen dioxide
Nitrous oxide
Octane
Ozone
Pentane
Propane
Propene
Sulfur dioxide
Toluene
m-Xylene
o-Xylene
p-Xylene

- Survey large areas
- Detect plumes and emissions
- Identify hotspots and unknown sources
- Focus ground-based efforts

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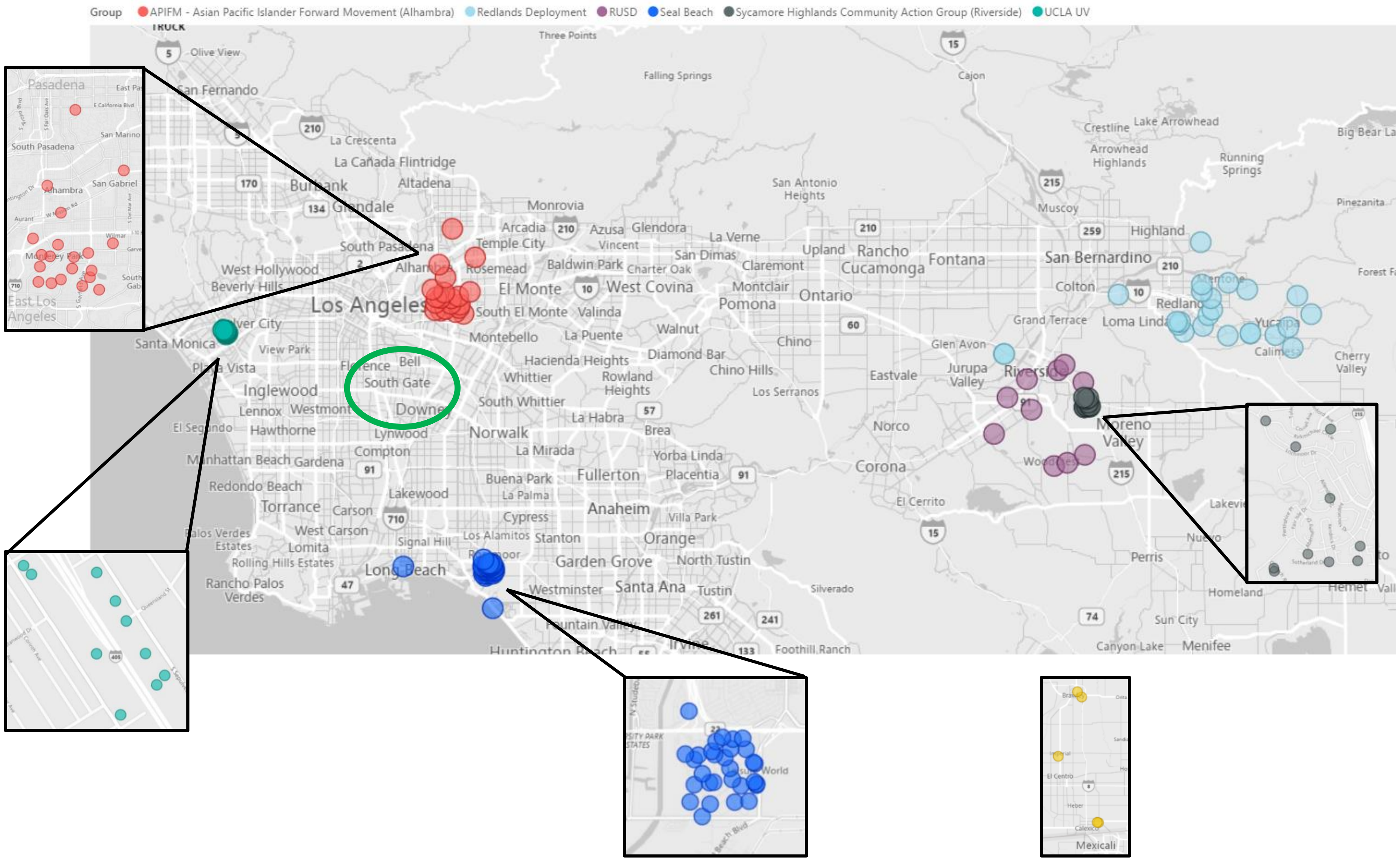
Low-Cost Sensor Networks - Community



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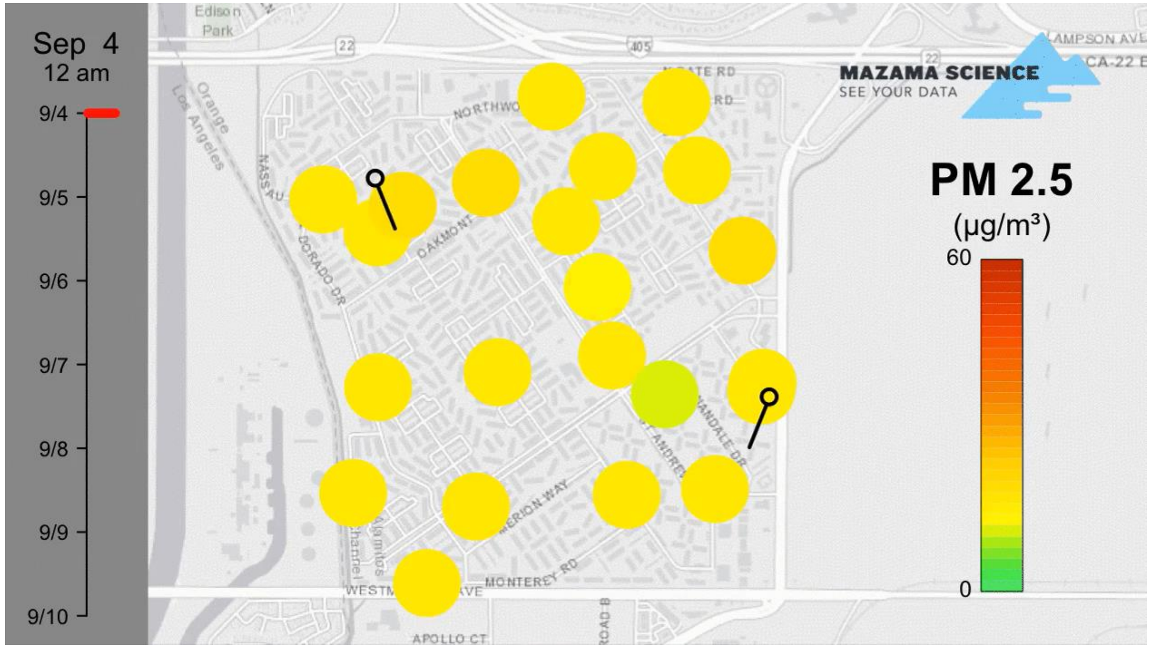
Low-Cost Sensor Networks
Example in Seal Beach Community

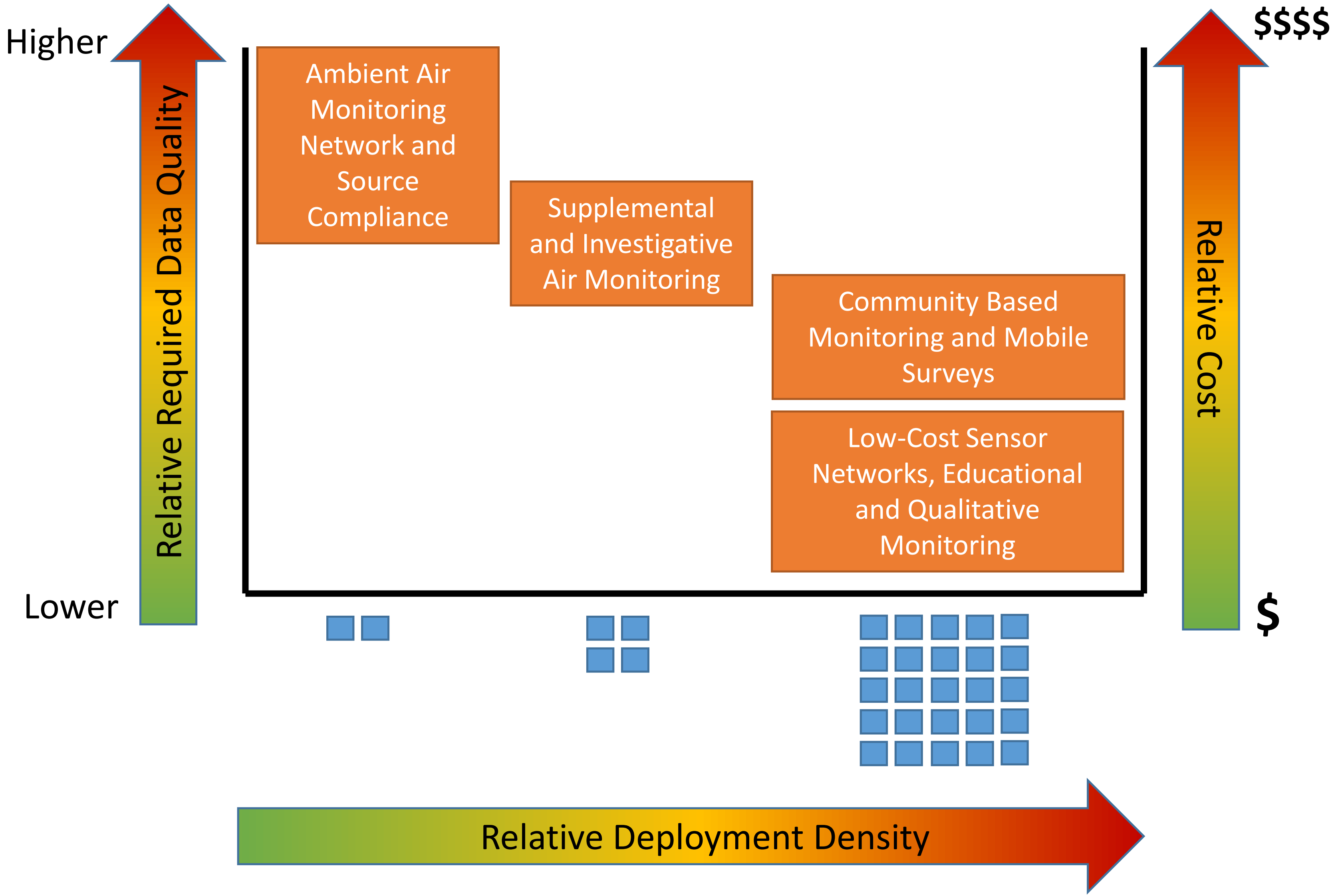
- 10,000 residents (average age 70 yrs)
- 1 km^2 area
- Borders the 405 freeway (in its most congested section)
- Borders the LADPA and AES electric generating stations
- Few miles from Port of Long Beach
- In landing path for Long Beach Airport
- Two military installations nearby

What can one do with this data?

- Assess spatial and temporal variability
- Identify potential nearby PM sources
- Evaluate impact of wind speed/direction



Relative Data Quality, Deployment Density, and Cost by Application



Timeline

Further Define Goals and Objectives of Air Monitoring

CSC Meeting #4

Recommend Appropriate Monitoring Technologies

April Board Meeting

Develop Community Air Monitoring Plan

Submit Community Air Monitoring Plan to CARB

May 1st, 2019

Begin Air Monitoring in Priority Areas

July 1st, 2019

Questions?