

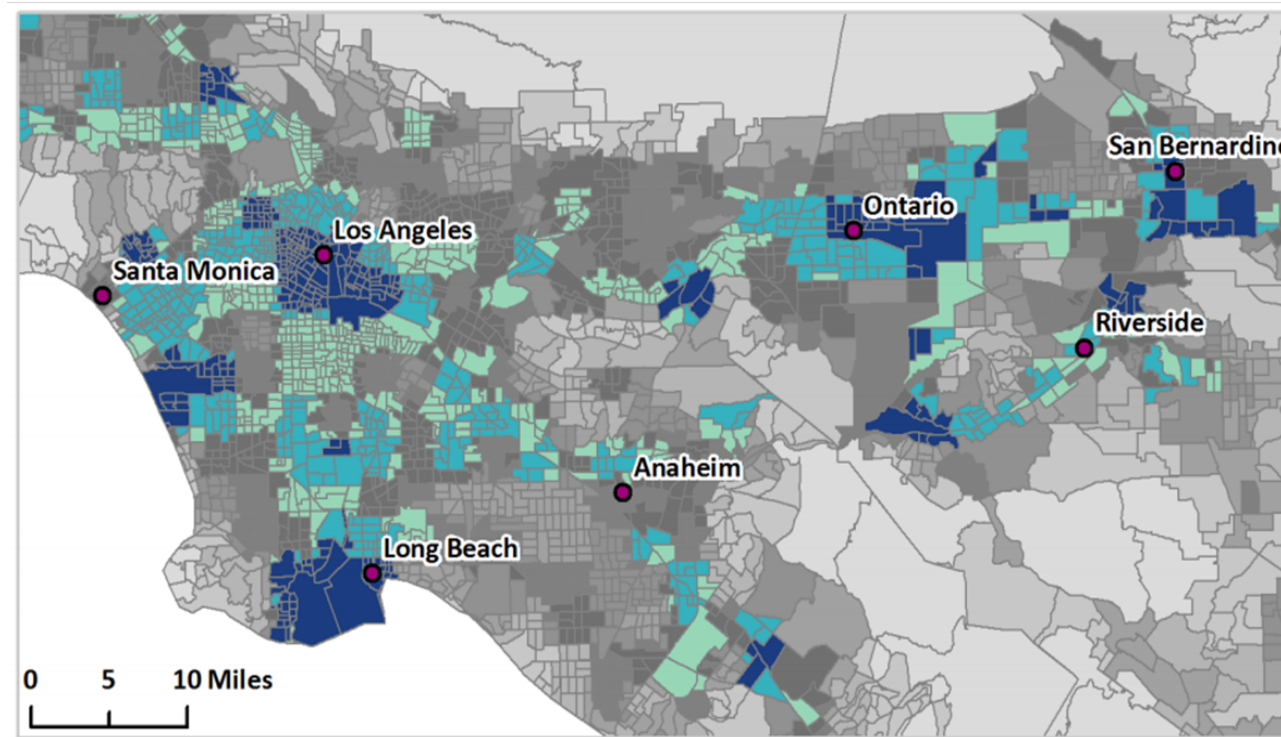
Community Monitoring - a shift to a local focus

NACAA Fall Meeting, October 21, 2021

Kate Hoag , Ph.D. Bay Area Air Quality Management District
Jason Low, Ph.D. South Coast Air Quality Management District

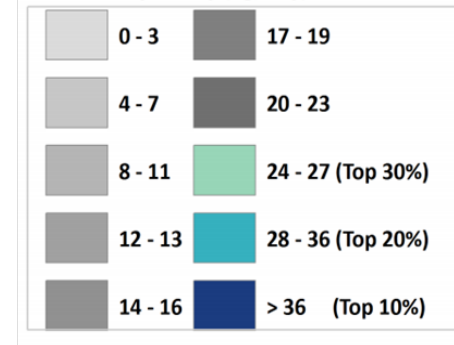
Motivation for Community-Level Efforts

- Historical focus on regional air quality
- Significant improvement, but disproportionate burdens remain
- Localized issues can still persist
- Need for community-level focus



Diesel PM

Diesel PM emissions from on-road and non-road sources for a 2012 summer day in July (kg/day)



Source: CalEnviroScreen 3.0

A Community Focus to Bridge Gaps



Regional



Community



Facility



Opportunities and Challenges

Working together to collect information to support action

- Understanding Communities
- Strengthen trust and communication
- Invest Time and Resources
- Building capacity



West Oakland Community Steering Committee maps air quality concerns



Community member narrations giving perspective of ports and refinery air quality issues during bus tour of Long Beach, Carson, and Wilmington areas

Signposts guiding the paradigm shift

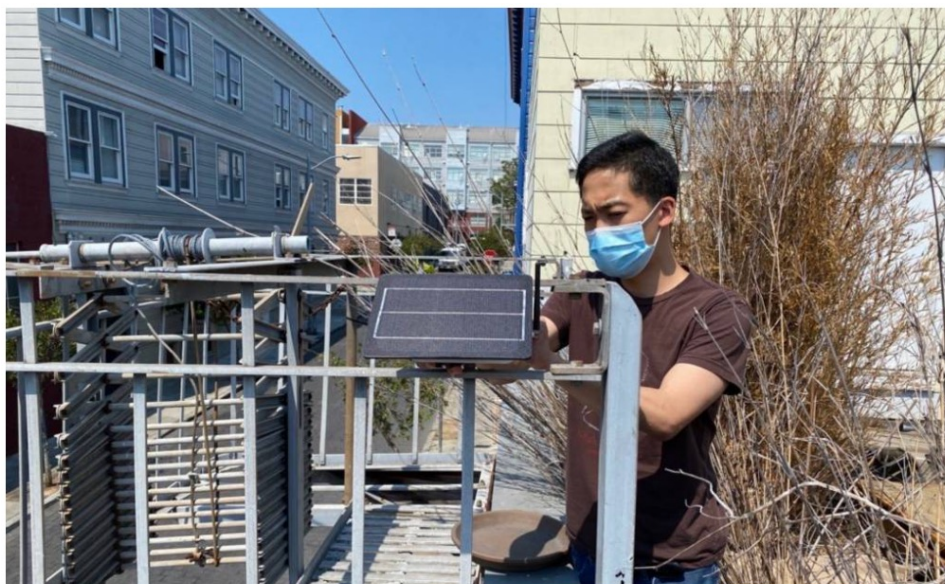
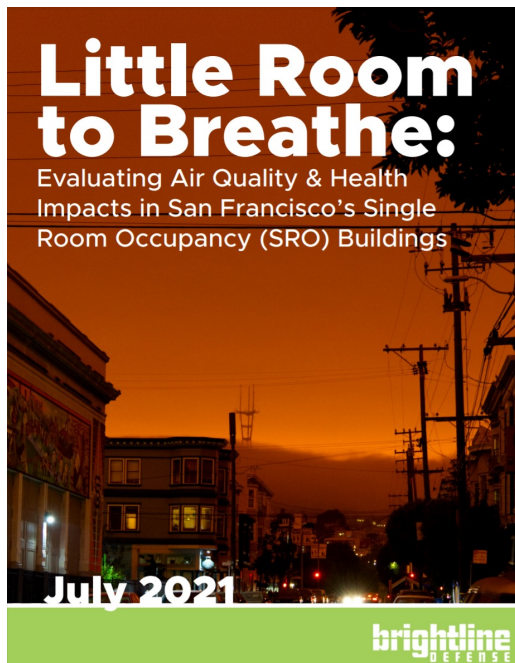
- Take time to **listen** and build relationships and trust
- Design and implement monitoring programs in **partnership** with community members
- **Community-specific** monitoring plans to match the monitoring or assessment tool to the community's need
- **Transparent** sharing of data and findings



A community summit in Richmond, CA (TOP) and East Los Angeles (BOTTOM) learning about the community's priorities for air monitoring

Community Monitoring Programs

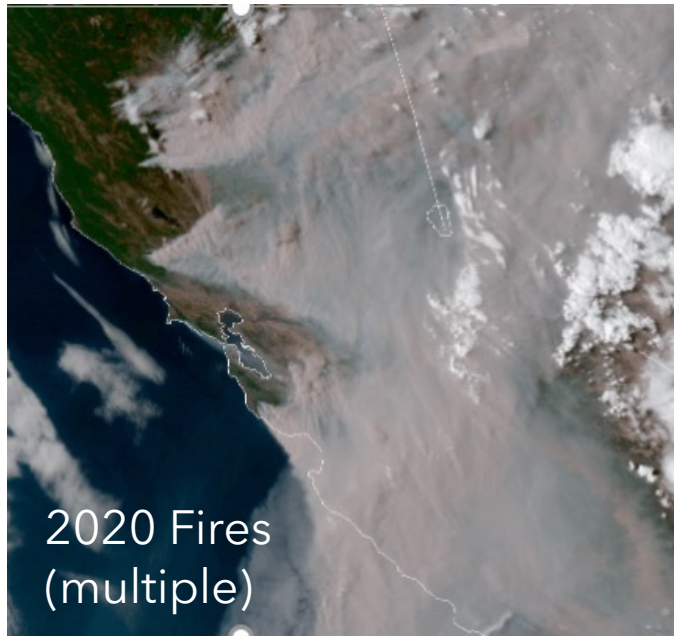
- Wildfire smoke response
- AB 617
- STAR Grant



Sensor network and traffic count projects by Brightline Defense



Wildfire Smoke Impacts



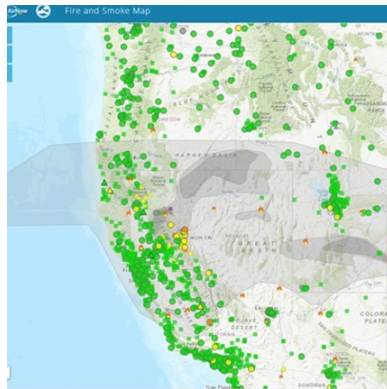
Where can the public get air quality data?

How bad is the air quality near where I am?

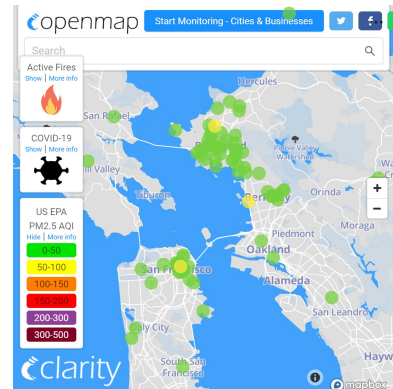
?

Is air quality getting better or worse?

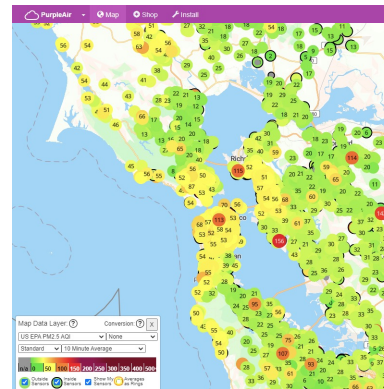
How do air quality levels compare to health-based standards?



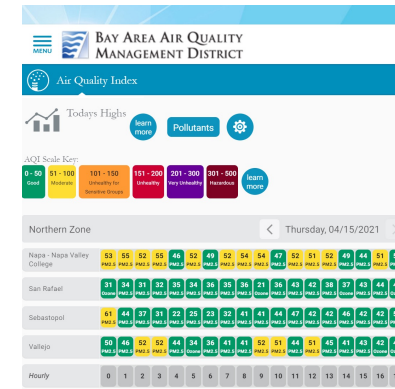
EPA Fire and Smoke Map



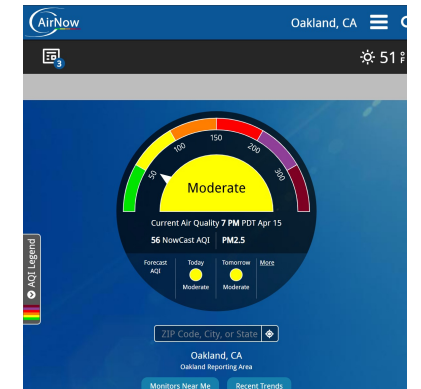
Clarity OpenMap



PurpleAir Map



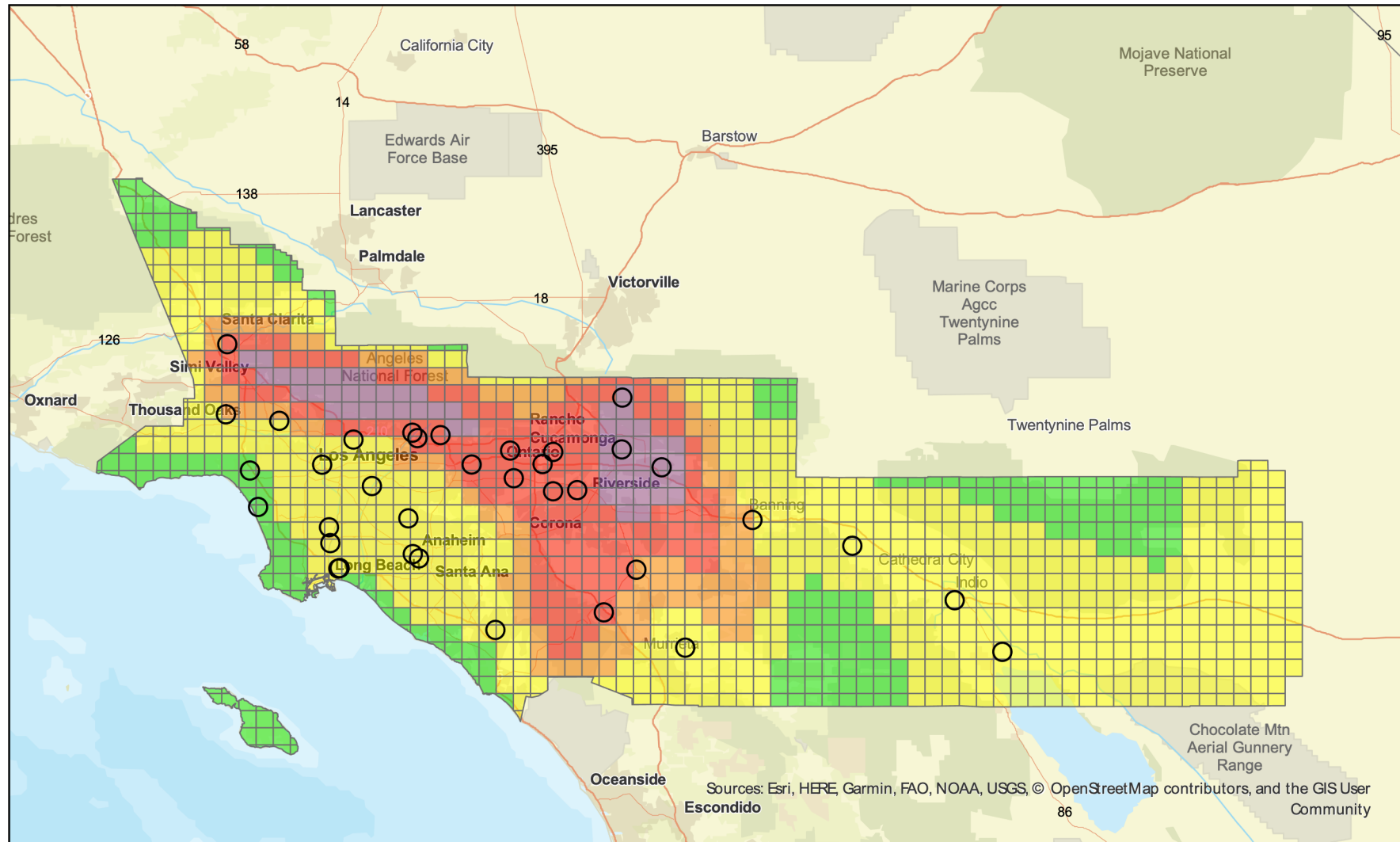
Air District Website



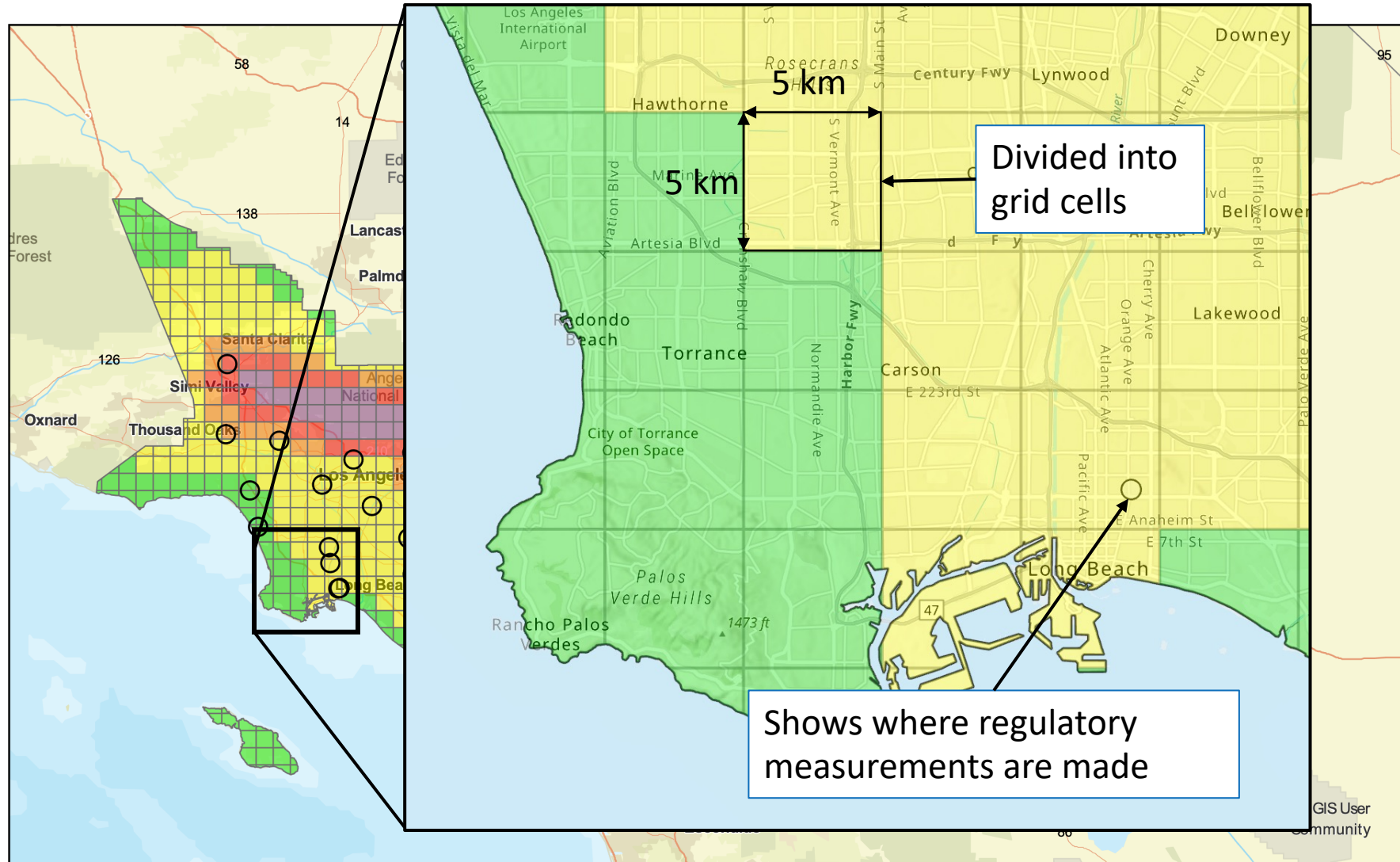
AirNow

Additional details available: <https://www.baaqmd.gov/~media/files/ab617-community-health/richmond/quarterly-report-documents/guide-to-air-quality-data-websites-pdf.pdf?la=en>

Real-Time AQI Map (www.aqmd.gov/aqimap)

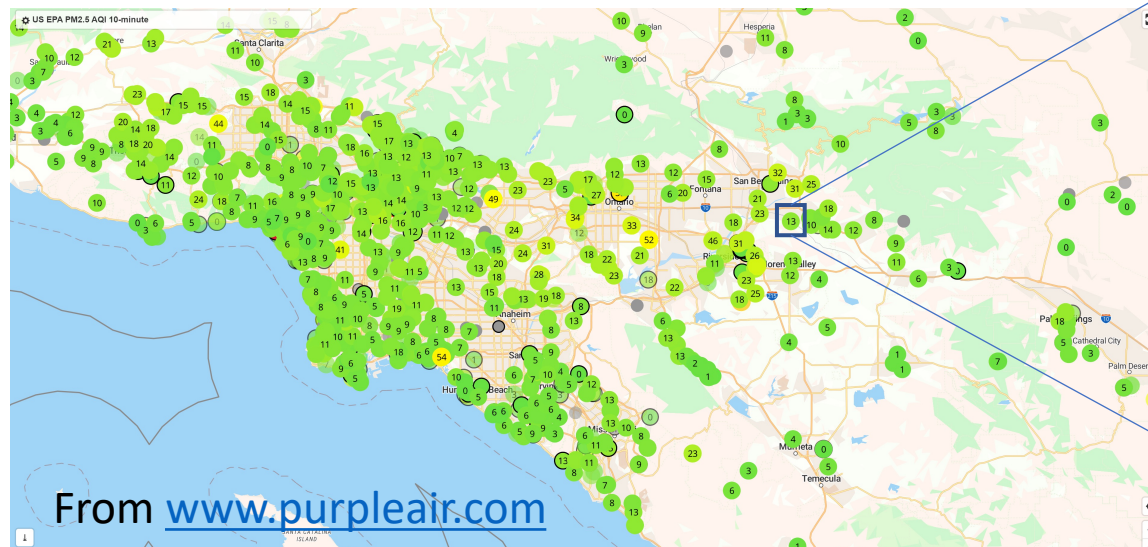


Real-Time AQI Map (www.aqmd.gov/aqimap)



Consumer-Grade Sensors

- About 700 PurpleAir PM2.5 sensors in 2021; Great spatial coverage
- **South Coast AQMD AQI Map** uses sensor data to fill in gaps between monitor measurements



PurpleAir Low-Cost sensor



Other types of sensors are also being deployed (aeroqual AQY) and will be integrated after testing
The AQI map also uses model data

Real-Time AQI Map (sanbernardino.gov/aqimap)

San Bernardino

AQI: 207

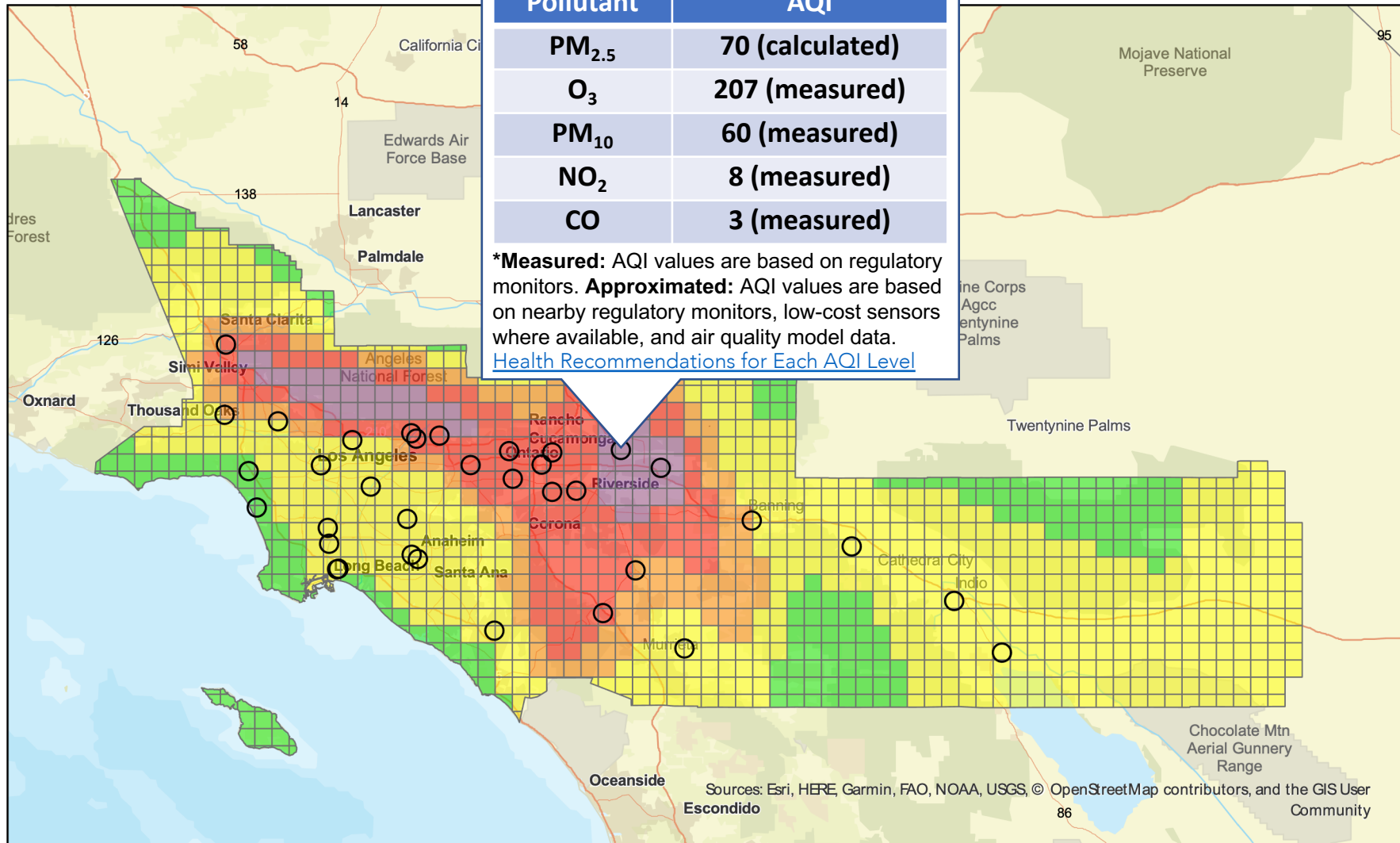
AQI Category: Very Unhealthy

Dominant Pollutant: Ozone | Updated: 4 PM

Pollutant	AQI
PM _{2.5}	70 (calculated)
O ₃	207 (measured)
PM ₁₀	60 (measured)
NO ₂	8 (measured)
CO	3 (measured)

***Measured:** AQI values are based on regulatory monitors. **Approximated:** AQI values are based on nearby regulatory monitors, low-cost sensors where available, and air quality model data.

[Health Recommendations for Each AQI Level](#)



Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

ASSEMBLY BILL (AB) 617

- Responds to history of environmental injustice in low-income, communities of color.
- Partner with community to address higher levels of air pollution in historically disadvantaged communities.
- Address exposure to harmful air pollutants in impacted communities.



ASSEMBLY BILL (AB) 617

- ▶ Statewide program enacted in 2017 to reduce air pollution in communities that are disproportionately impacted by air pollution
- ▶ Community partnerships and leadership are central to the program



Community Air
Quality
Monitoring



Community
Emissions
Reduction
Plans



Clean
Technology
Investments



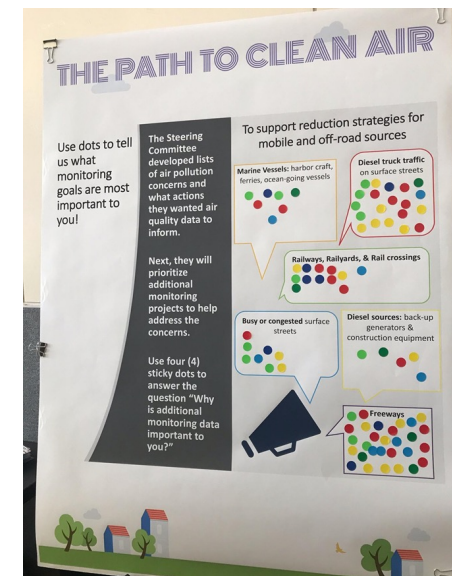
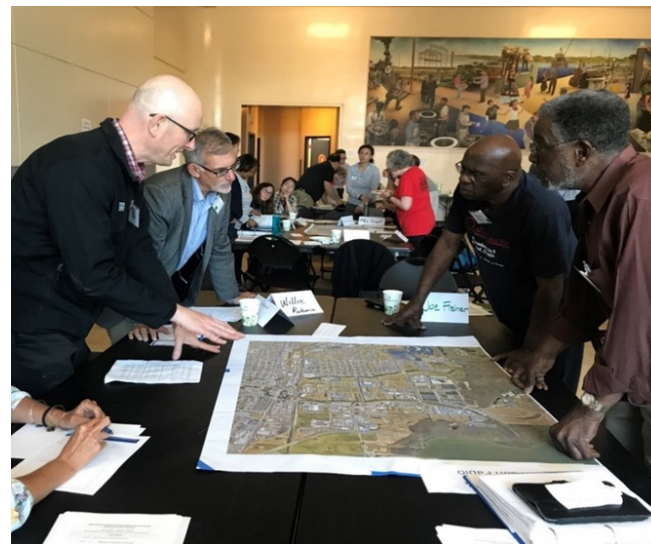
Best Available
Retrofit Control
Technology
(BARCT) Rules



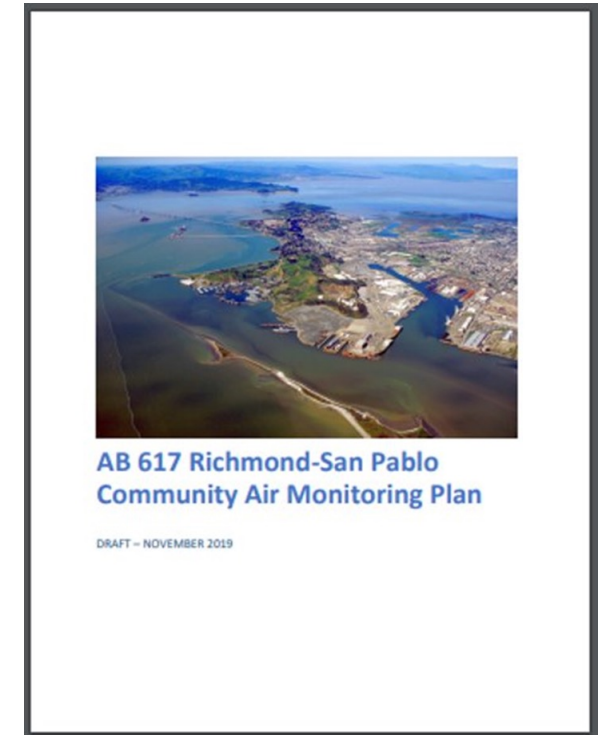
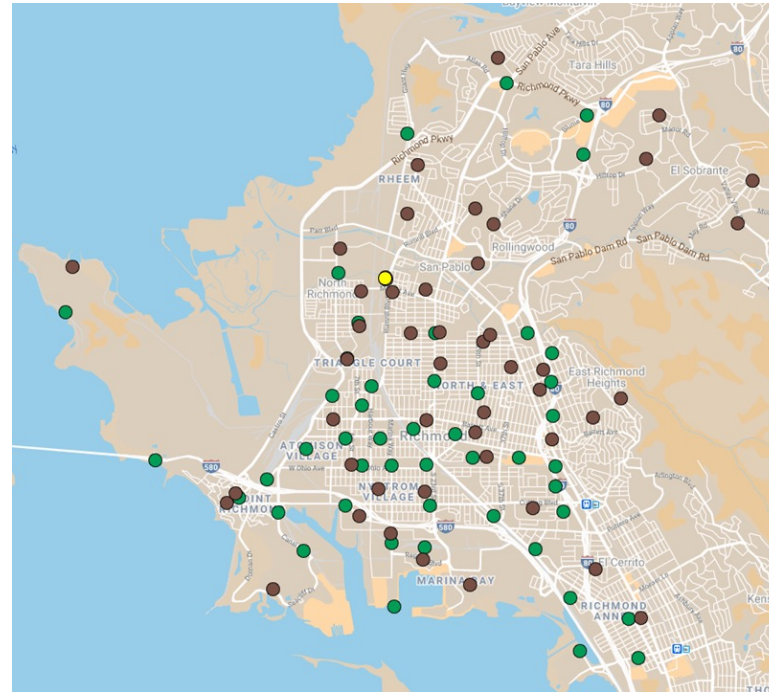
Easier
Access to
Data

Richmond-North Richmond-San Pablo Monitoring Community Steering Committee

- Designed the process
- Engaged the community
- Compiled lists of air quality concerns or places of interest

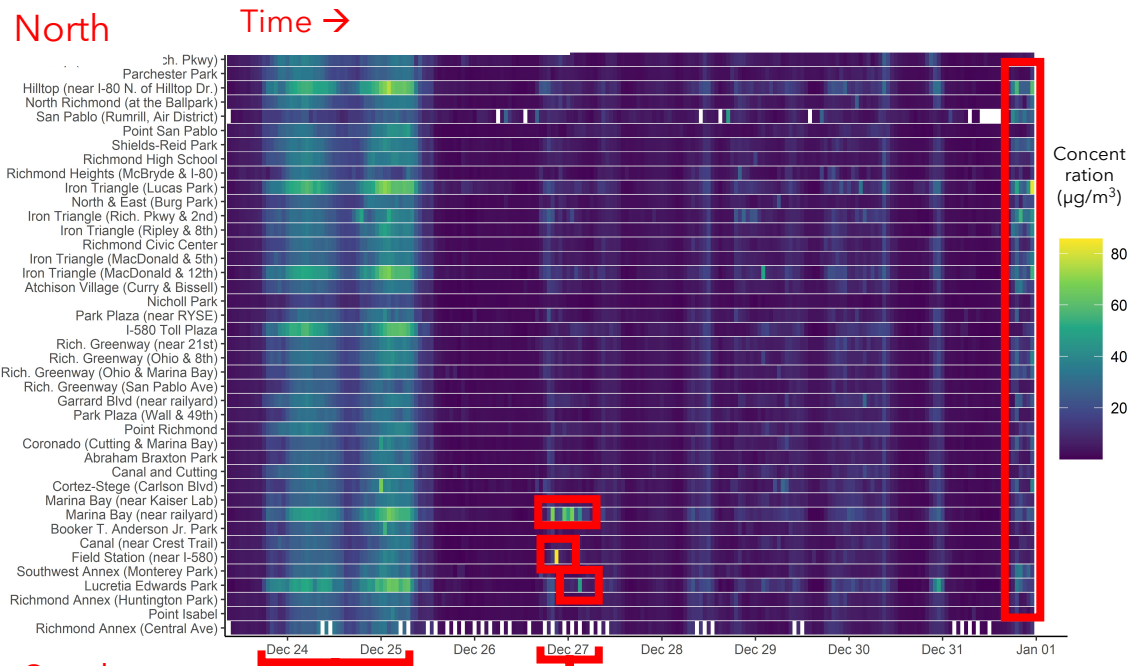


Plan monitoring projects to collect data for action



Analyzing data and preparing reports

Hourly PM_{2.5} concentrations within the community

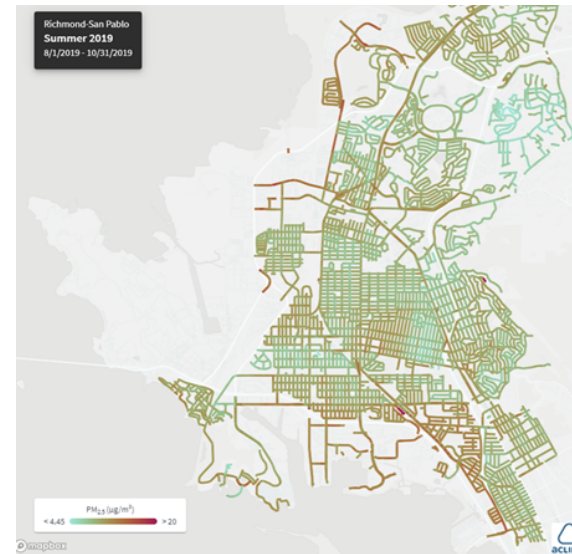


Regionally higher PM_{2.5} levels Dec 24

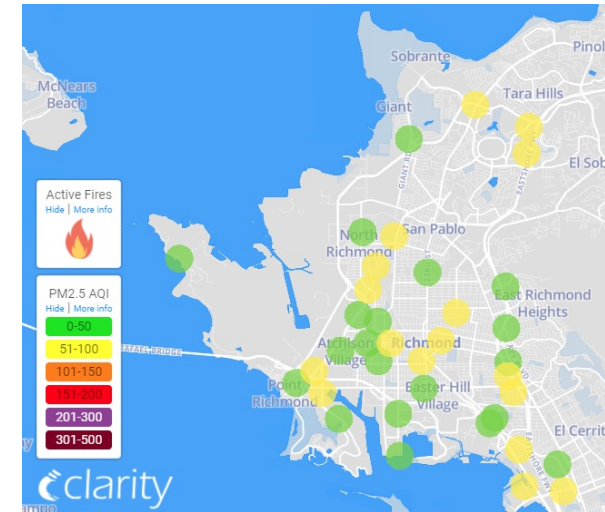
Locally higher PM_{2.5} around Marina Bay

NYE fireworks

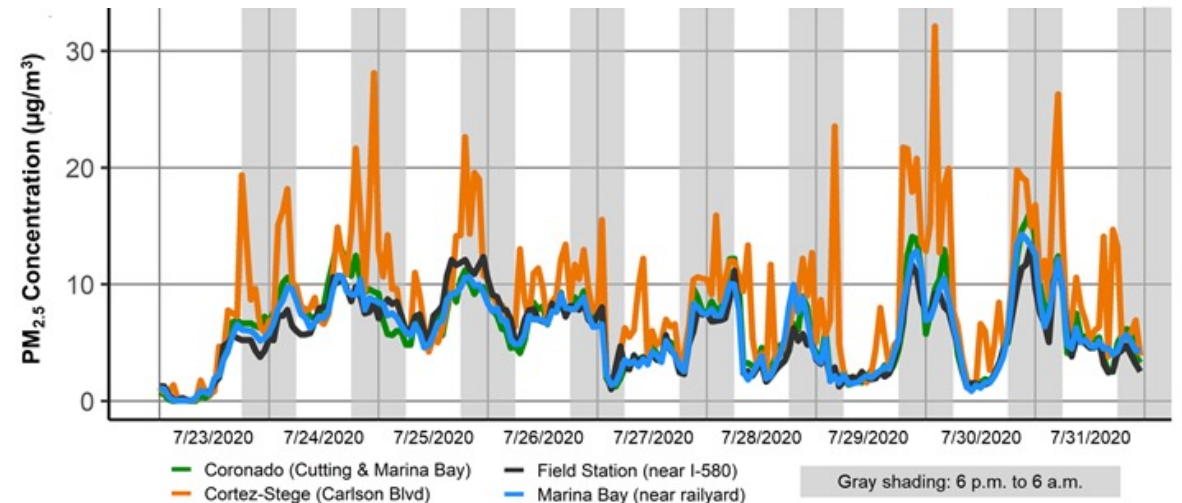
Estimated typical PM levels on all streets



Real-time PM data in more locations



Hourly PM_{2.5} concentrations within the community



Analyzing data and preparing reports

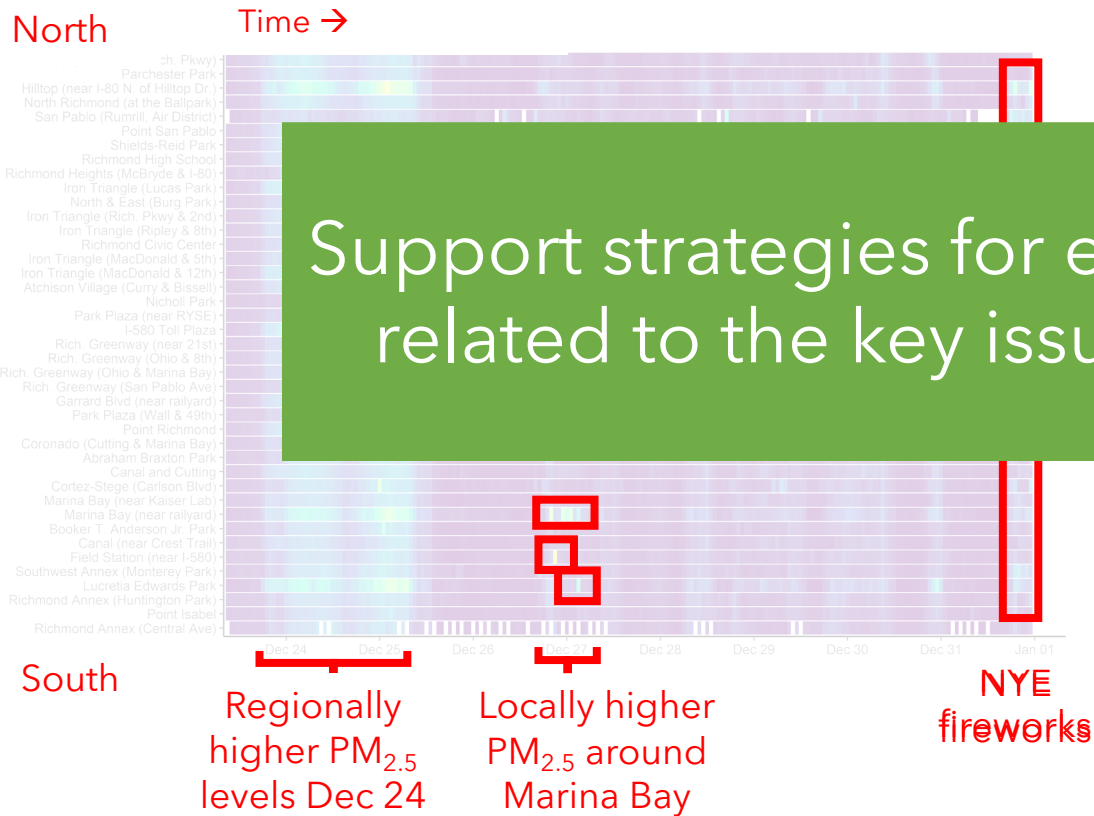
Estimated typical PM levels on all streets



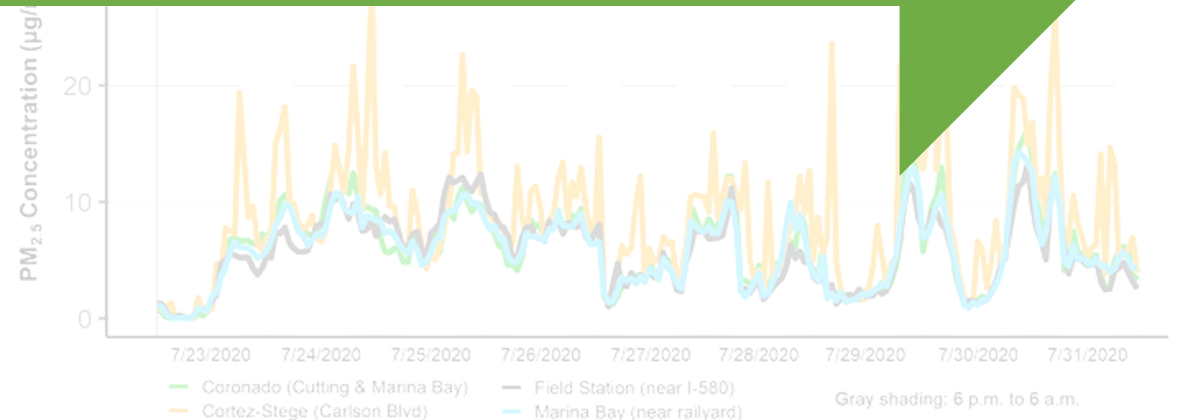
Real-time PM data in more locations



Hourly PM_{2.5} concentrations within the community



Support strategies for emission and exposure reductions related to the key issues identified by the community



Air Quality Concerns and Priorities

Diesel Exhaust



Truck Traffic

Air Toxics



Refineries



Metal Processing
Facilities

Odorous Compounds



Rendering
Facilities

Criteria Pollutants



Cement Batch
Plants



Railyards



Sensitive Receptors



Oil Wells



Auto Body Shops



Waste Transfer
Stations



Dust

...and more!

General Air Monitoring Approach

Mobile Monitoring

- Survey large areas
- Identify hotspots and unknown sources
- Support inspections and enforcement actions
- Inform emission reduction efforts

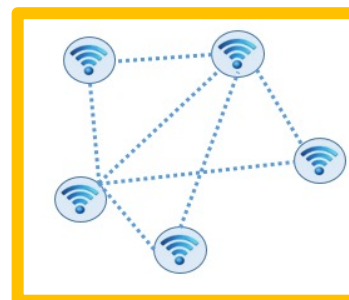
Fixed Monitoring

- Provide more information about possible sources
- Assess levels in community
- Support emission reduction strategies
- Track progress

Sensors

- Provide more information about how levels vary within the community
- Complement other monitoring strategies
- Engage the community in air pollution measurement

Comprehensive and Purposeful Air Monitoring

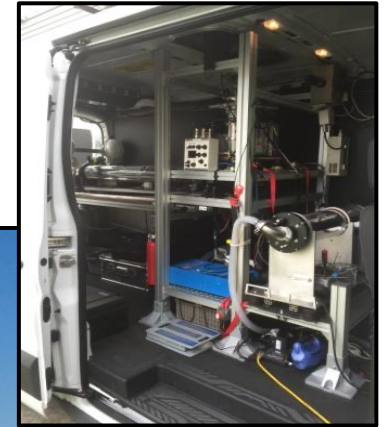




Oil Wells

Wilmington, Carson, West Long Beach Community

- ▶ Target Air Pollutants
 - ▶ Methane, VOCs, Alkanes
- ▶ Purpose of Air Monitoring
 - ▶ Identify Leaks and High Emitting Oil Wells
 - ▶ Support Enforcement Actions
 - ▶ Assess Community Impact
- ▶ Air Monitoring Solution
 - ▶ Optical Remote Sensing Van
 - ▶ Optical Gas Imaging Camera
 - ▶ Partner with Community (CFASE) that Uses Hand Held devices

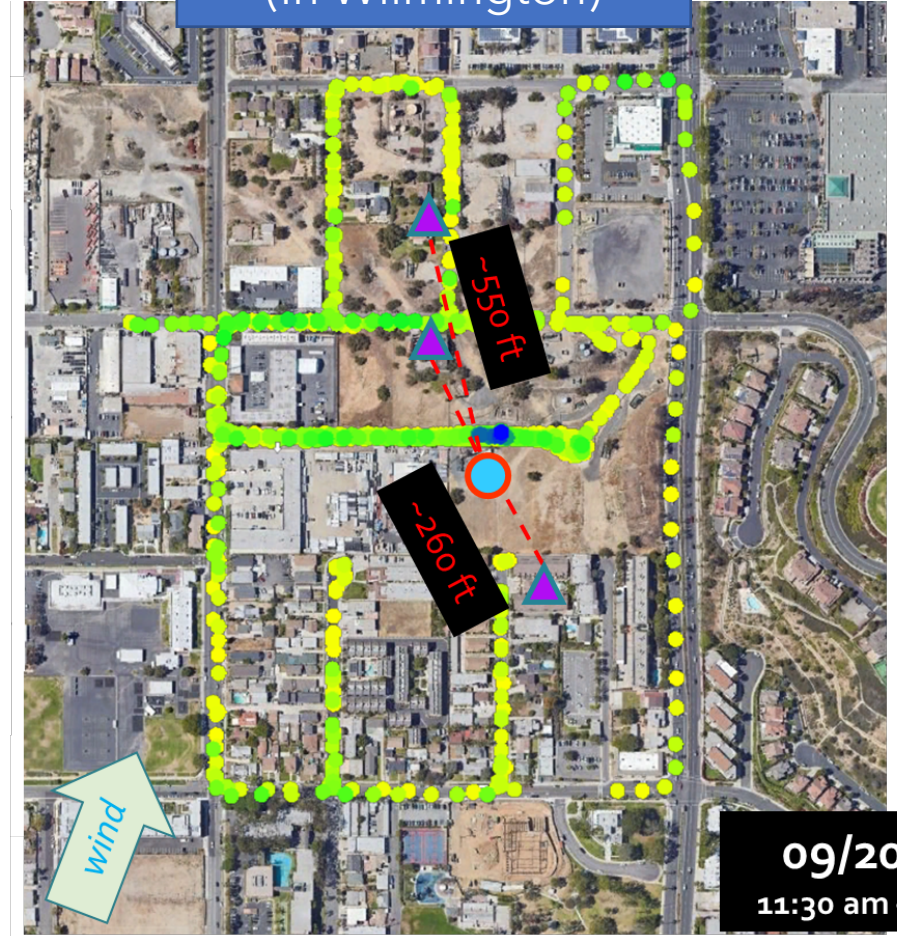
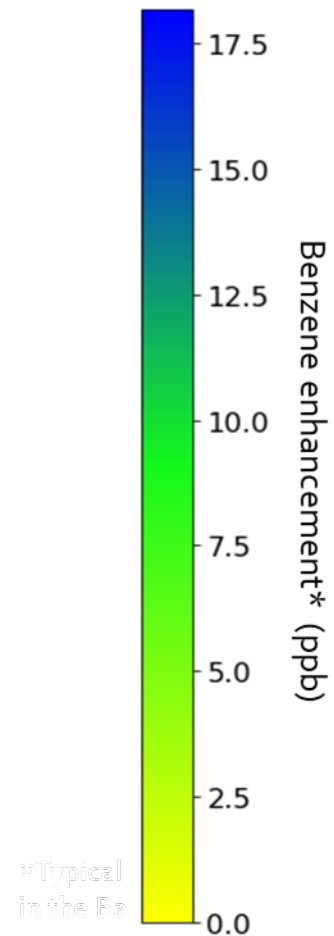




Oil Wells

Wilmington, Carson, West Long Beach Community

Termo Nakamura #63
(In Wilmington)



- Well Site
- Residences

* Typical benzene range in the Basin:
0.1 - 1.8 ppb

09/20/2019
11:30 am - 12:50 pm



Oil Wells

Wilmington, Carson, West Long Beach Community



09/19/2019
11:32 am

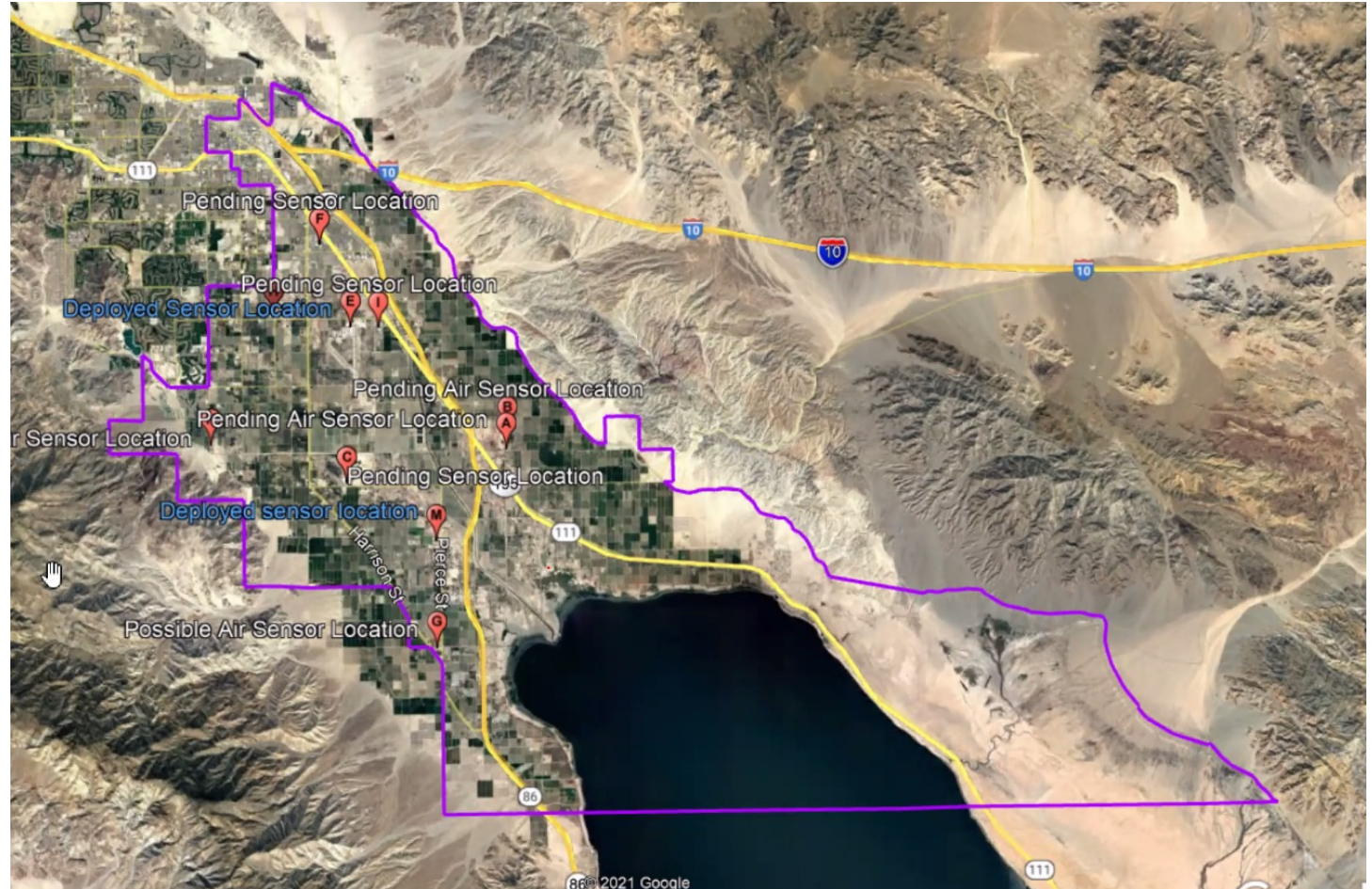


Eastern Coachella Valley: Community Sensor Network

- A. Paseo De Los Heros #1
- B. Paseo De Los Heros #2
- C. School Complex - 3 Schools*
- D. North Shore Park*
- E. Airport
- F. Bobby Duke School*
- G. Borrego Health Facility*
- H. Coachella Valley High School*
- I. Coachella Valley Unified School District HQ*
- K. Key Key Tum Park*
- M. Mission San Jose Church

- AQY sensor already deployed
- Potential locations for deployment (pending approval)

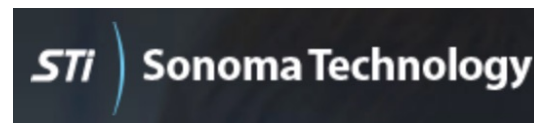
*Assistance needed



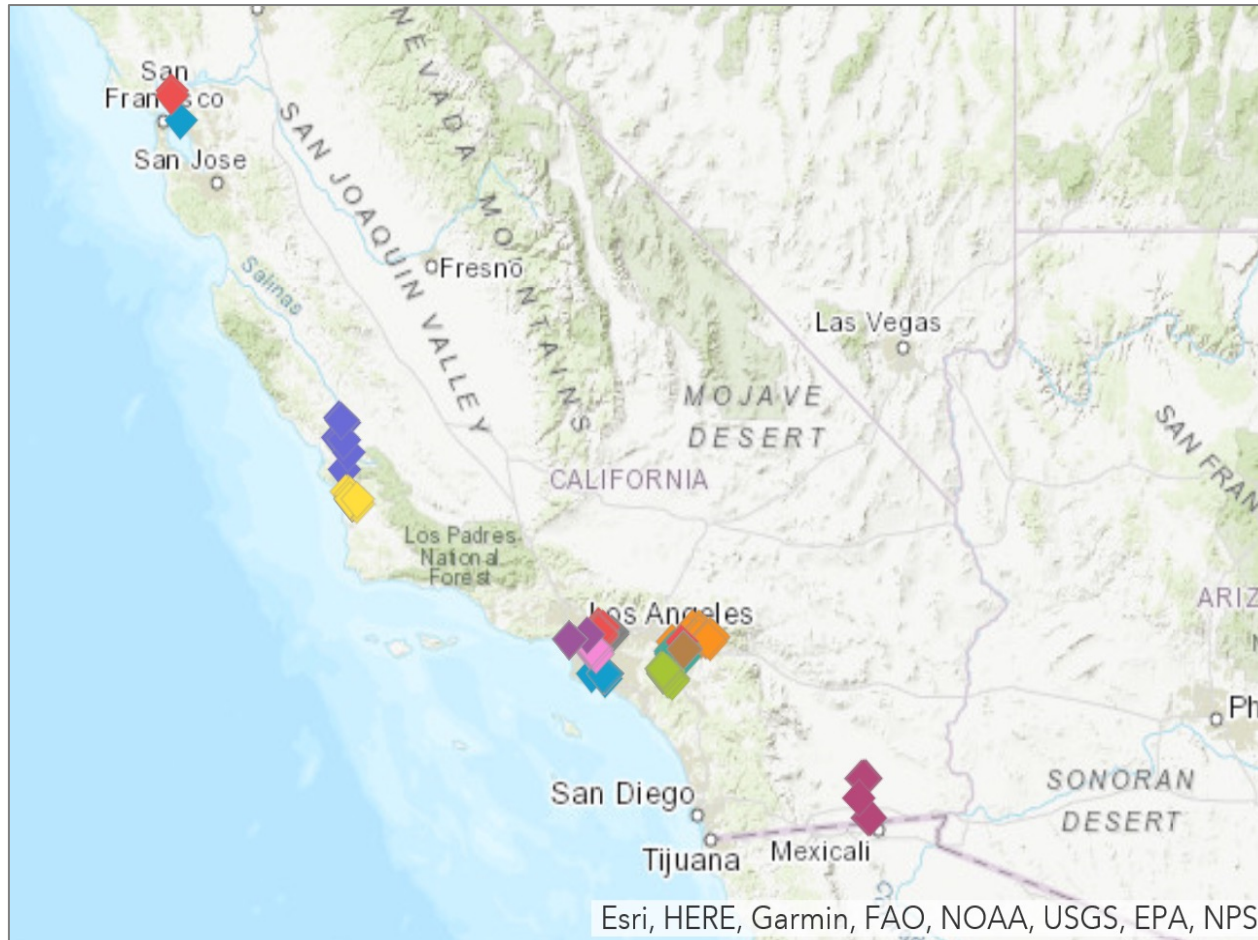
U.S. EPA Science To Achieve Results (STAR) Grant

"Engage, Educate, and Empower California Communities on the Use and Applications of Low-Cost Air Monitoring Sensors"

- Main Objective: Provide communities across California with the knowledge necessary to appropriately select, use, and maintain "low-cost" sensors and to correctly interpret the collected data
- In 2015 the South Coast AQMD was awarded funding from the U.S. EPA under their "Science to Achieve Results" (STAR) Program ("Air Pollution Monitoring for Communities")
- Collaboration:



STAR Project Outcomes



- **14** California communities
- **300** PurpleAir PA-II sensors
- **100** Aeroqual AQY sensors
- **3** years of data
- **33** community workshops
- **86** installation surveys
- **113** surveys collected
- **3** Reports for/by STAR Grant communities
- **7** peer-reviewed publications
- **1** Master's Thesis
- **2** Conference Training Workshops
- **16** Conference Presentations

STAR Project: Educational Toolkit

All outcomes, products, and interaction with the communities informed and shaped the development of the Educational Toolkit

- Guidebook on Air Quality Sensors
- Training videos (3)
- Installation guides
- Surveys and project forms
- Data analysis/visualization tools
- Infographic examples
- Community reports & analysis



- ✓ Accessible to public
- ✓ Visually engaging
- ✓ One or more languages
- ✓ Decision-making to reduce exposure
- ✓ Data collection practices
- ✓ Resources for additional info

Educational Toolkit Versatility

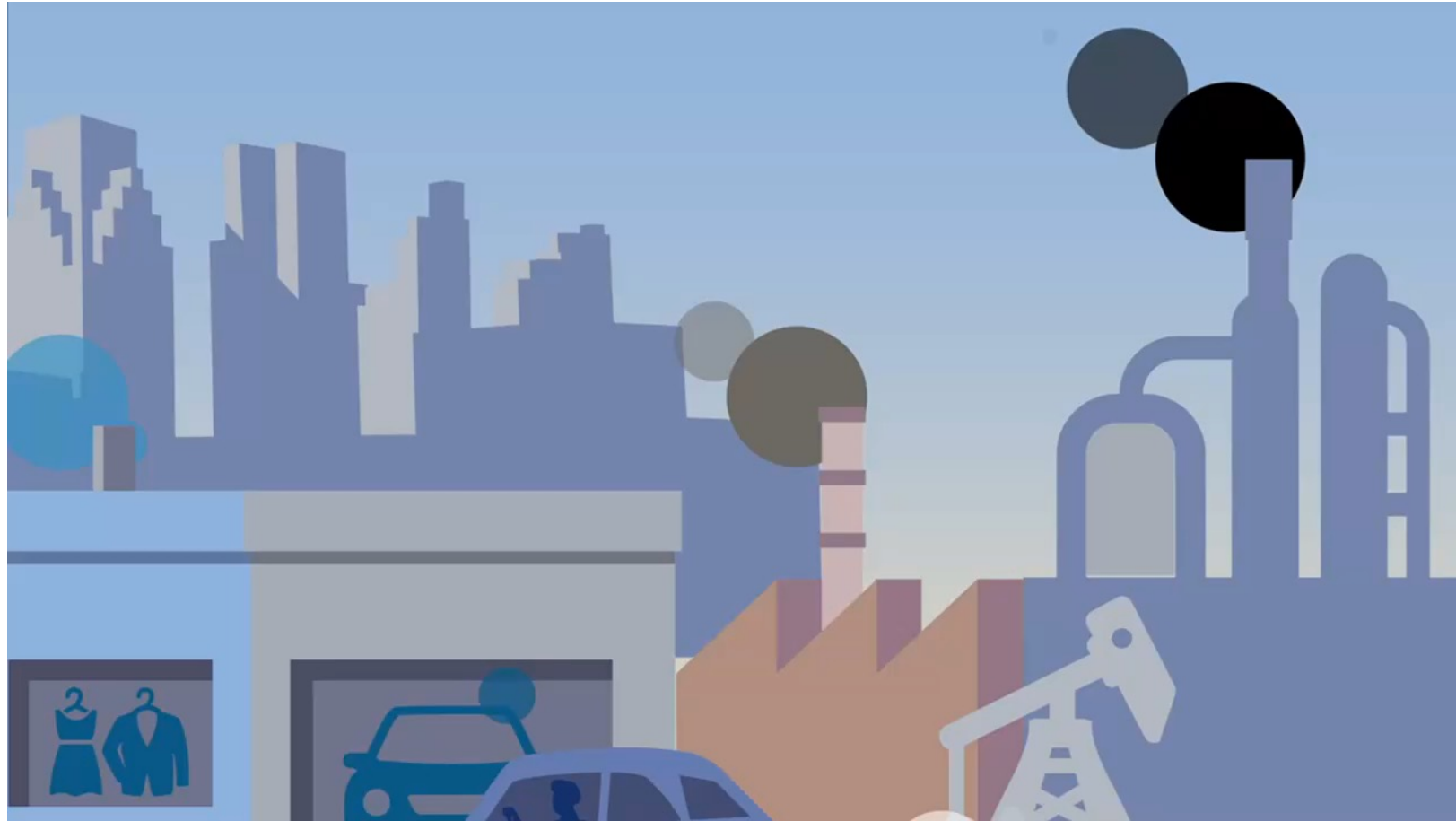
- Guidebook and other resources are designed to meet the needs of a broad range of users and projects
- For example, users could include:
 - An academic researcher new to community-based work
 - A community leader new to air quality and concerned about local sources
 - Staff from a government agency experienced in working with the public, but new to sensors
 - An individual interested in using sensors to better understand their own air quality

Table 1-1. A roadmap of the guidebook for users with different responsibilities and interests.



	Organizer	Participant	Individual	Partner	Academic	Industry	Government Agency
Chapters	Community organizer or project lead for an air quality sensor project	Participant using a sensor in a community led project	Individual member of the public using a sensor	New to using sensors	New to air quality monitoring		New to community-based research
2 Learn Valuable information about air quality	•	•	•		•		
3 Plan Plan a successful project	•		•	•	•		•
4 Deploy Deploy and maintain your sensors	•	•	•	•	•		•
5 Act Move from results to action	•	•	•	•	•		•
Appendices							
A Air Quality Index	•	•	•			•	
B FAQs	•		•	•	•		•
C Purple Air Sensor	•	•	•	•	•		
D Data Analysis	•		•	•	•		
E Infographic	•						•
F Install Template				•			
G Project Template	•						•
H Log Notes	•	•	•		•		
I Liability Form	•			•	•		•
J Agency Contacts	•						•
K Sensor Tests	•			•	•		
L DataMewer	•	•		•	•		•
M Community Reports	•	•		•	•		•

Educational Toolkit Guidebook

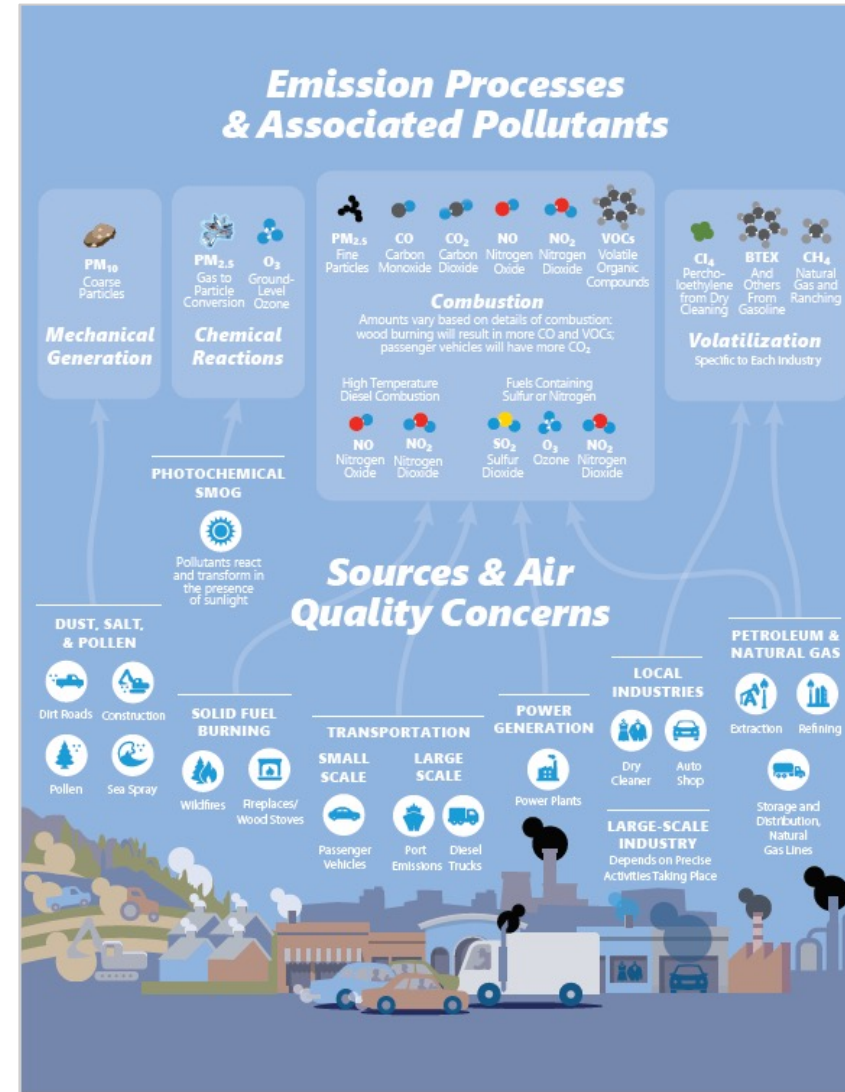


<http://www.aqmd.gov/aq-spec/special-projects/star-grant>₃₀

Educational Toolkit: Understanding Air Quality and Monitoring

Table 2-2. Summary of characteristics of fine and coarse particulate matter (adapted from Seinfeld and Pandis, 1998).²¹

PM _{2.5} Fine Particles	PM ₁₀ Coarse Particles
Chemical Process <i>How the particles are formed</i>	
Reaction, nucleation, condensation, coagulation, cloud/fog processing	Suspension of dust or sea salt, mechanical process
Sources <i>Where the particles come from</i>	
<ul style="list-style-type: none"> Coal Combustion Gasoline Combustion Diesel Combustion Wood Combustion Motor Vehicles Industry Fires Gas to Particle Conversion 	<ul style="list-style-type: none"> Industrial Dust Farming Dust Mining Dust Unpaved Roads Biological Sources Construction/Demolition Ocean Spray Road Salt
Composition <i>What the particles are made of</i>	
<ul style="list-style-type: none"> Sulfates and Nitrates Elemental Carbon Other Organics Water Metals 	<ul style="list-style-type: none"> Crustal Elements Salt Pollen Mold Plant and Animal Debris
Formation <i>When the particles are formed</i>	
Primary (directly emitted) and Secondary (formed in the atmosphere)	Primary (directly emitted)
Atmospheric Lifetime <i>How long the particles stay in the air</i>	
Days to Weeks	Minutes to Days
Travel Distance <i>How far the particles travel</i>	
100 to 1000+ km (about 60 to over 600 miles)	Generally < 100 km (< about 60 miles)



Educational Toolkit: Planning Guidance

Figure 3-1. Project planning is a process that may need to be repeated to adjust for realities such as budget limitations.



Educational Toolkit: Sensor Selection

HOW TO CHOOSE AN AIR QUALITY SENSOR

1 WHY? FRAME THE PROBLEM

What nearby pollution sources concern you?

DISTURBED SOIL	WOOD COMBUSTION	SMALL-SCALE TRANSPORT	LARGE-SCALE TRANSPORT	LIGHT INDUSTRY	HEAVY INDUSTRY
Dirt Roads Farming	Fireplaces Restaurants	Passenger Vehicles Small Engines	Diesel Trucks Shipping	Dry Cleaner Auto Shop	Extraction Refining
Construction Windblown Dust	Wildfires		Airplanes Trains	Fabrication	Factories Distribution

2 WHAT? IDENTIFY THE POLLUTANTS

What pollutants are being created by those sources?

PM ₁₀	PM _{2.5}	VOCs	CO ₂	CO	NO	NO ₂	O ₃	SO ₂
Coarse Particles	Fine Particles	Volatile Organic Compounds	Carbon Dioxide	Carbon Monoxide	Nitrogen Oxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide

3 HOW? ASSESS YOUR RESOURCES

MONEY VOLUNTEERS TIME

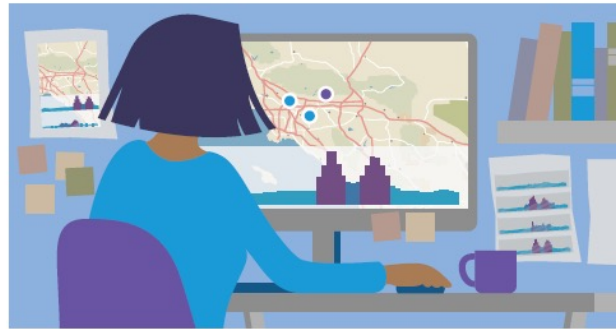
4 WHERE AND WHEN?

What is your plan for taking measurements?

5 CHOOSE YOUR SENSORS

What will you measure? PM _{2.5} CO O ₃	How will you view the data? ON THE SENSOR WEB APP
Does it need to be Weatherproof? RAIN COLD HEAT	How many do you need? ONE SMALL NETWORK LARGE NETWORK
How will it be powered? PLUG BATTERY SOLAR	How will the data be stored and transmitted? WIFI CARD CLOUD
	How much will it cost? TO BUY TO MAINTAIN

Educational Toolkit: Sensor Deployment



Visualizing your data is key. Visual data review is focused on patterns to verify that data are reasonable.

Understanding Your Data

Interacting with Your Data

The first step to successful data analysis

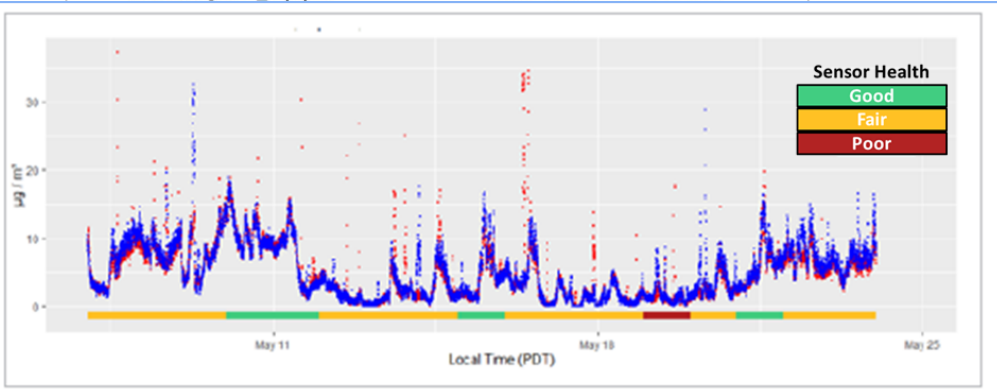
PurpleAir Sensor Data Processing Guides in Appendix C.

Spreadsheets (e.g., Excel): Microsoft Excel is fairly easy to use for basic data

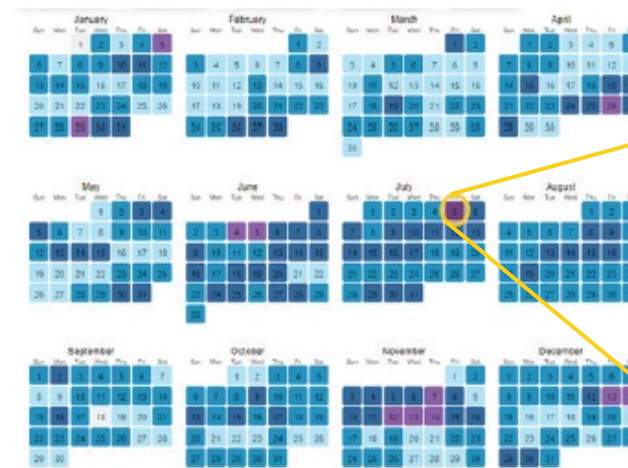


Sensor hosts will need training if they will be installing and

Using and Troubleshooting Sensors



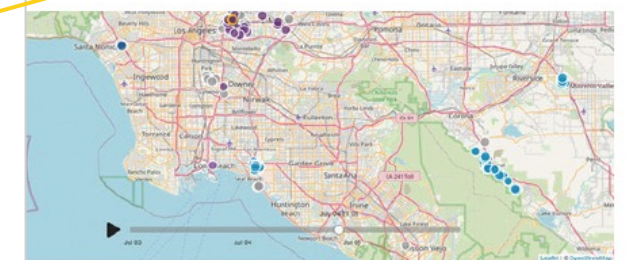
- Practical advice for siting, installing, and maintaining sensors
- Introduction to different plot types, assessing accuracy, and useful quality control (QC) metrics/algorithms
- Ways to monitor the “State-of-Health” of deployed sensors
- Description of tools and resources available for data analysis
- Step-by-step example analysis of an air quality event (using the AirSensor DataViewer)



inspection. Defining and implementing a QA/QC procedure can help you to identify and remove questionable data

Calendar Plots

Calendar plots are useful for showing



4-8. elevated pollutant levels associated with the 4th of July event circled.

Color Hex # (RGB)	PM _{2.5} Concentration (µg/m ³) 24-hour averages	PM _{2.5} Concentration (µg/m ³) 1-hour averages
#A8E3F3 (171,227,244)	PM _{2.5} ≤ 8	PM _{2.5} ≤ 12
#1518C8 (17,140,184)	8 < PM _{2.5} ≤ 20	12 < PM _{2.5} ≤ 35
#733996 (116,56,150)	20 < PM _{2.5} ≤ 35	35 < PM _{2.5} ≤ 55
#D851A5	35 < PM _{2.5} ≤ 55	55 < PM _{2.5} ≤ 75

Figure 4-9. Map and time series from the AirSensor DataViewer tool¹⁶ showing high PM_{2.5} concentrations on July 4th. The time series at the bottom is for the site

Maps and Time Series

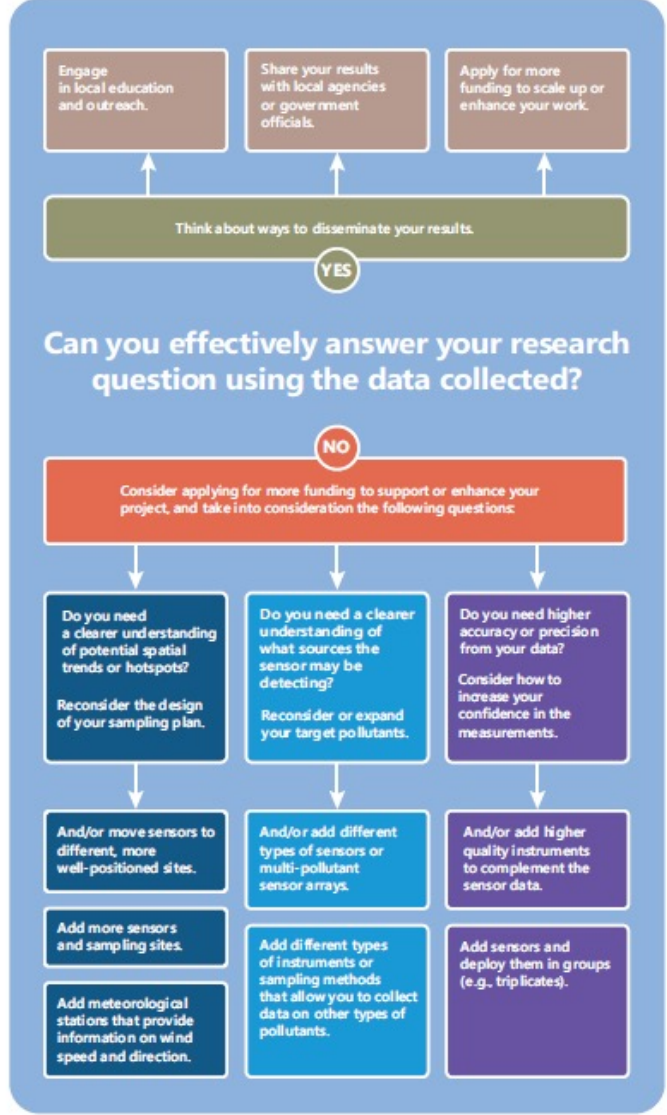
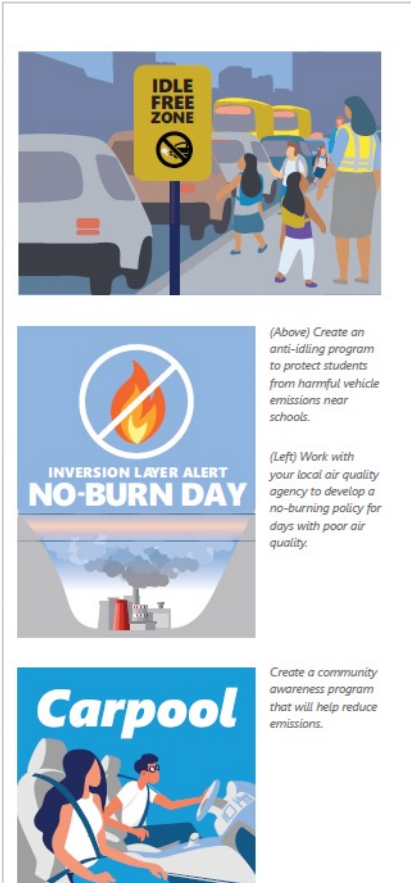
Maps provide a spatial view of pollutant concentrations while time series

Educational Toolkit: Taking Action

- Ideas for and examples of “local action”
- Advice to help determine whether additional data should be collected
- Strategies for communicating with local government agencies and/or the broader community (e.g., sharing results)



Flow chart to help those leading a project consider potential “next steps”



Questions?

<https://www.baaqmd.gov/community-health/community-health-protection-program>

<http://www.aqmd.gov/nav/about/initiatives/environmental-justice/ab617-134>

<https://www.aqmd.gov/aq-spec/special-projects/star-grant>

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