Community Air Monitoring in California

California Air Resources Board

Monitoring and Laboratory Division

PQAO Training Conference

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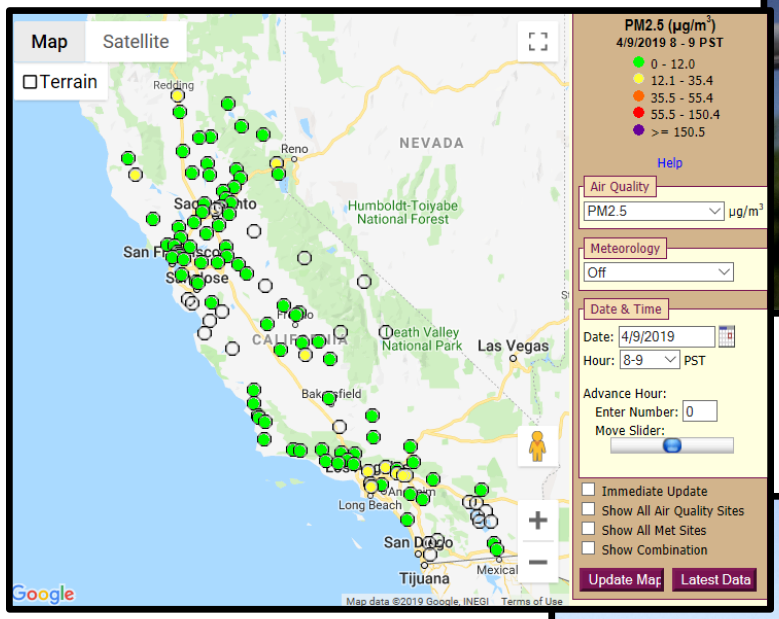
Community Air Monitoring at CARB

- **Regional air monitoring network**
  - Long standing monitoring network
  - Purpose: Demonstrate attainment with air quality standards

- **Community air monitoring**
  - Monitoring to determine pollutant concentration within communities



What is Community Air Monitoring?

Community Air Monitoring

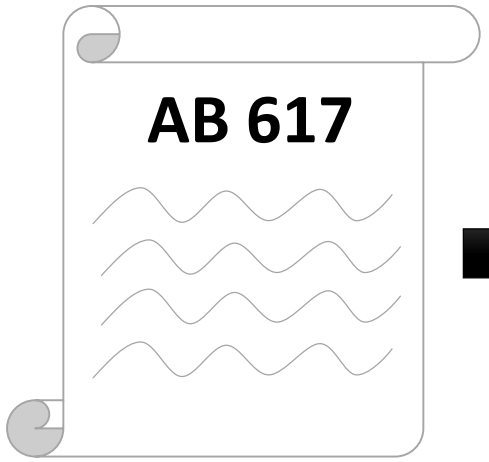
- Localized measurements
- Assist with estimating local exposure
- Non-uniform, community specific monitoring
- May include non-regulatory instrumentation or methodology - e.g. low-cost sensors

Regional Air Monitoring

- Regional measurements
- Focuses on criteria air pollutants and long term air quality trends
- Uniform monitoring structure
- Generally uses regulatory prescribed instrumentation or methodology

How can we leverage new monitoring technologies to characterize community level concentrations of toxics and criteria pollutants?

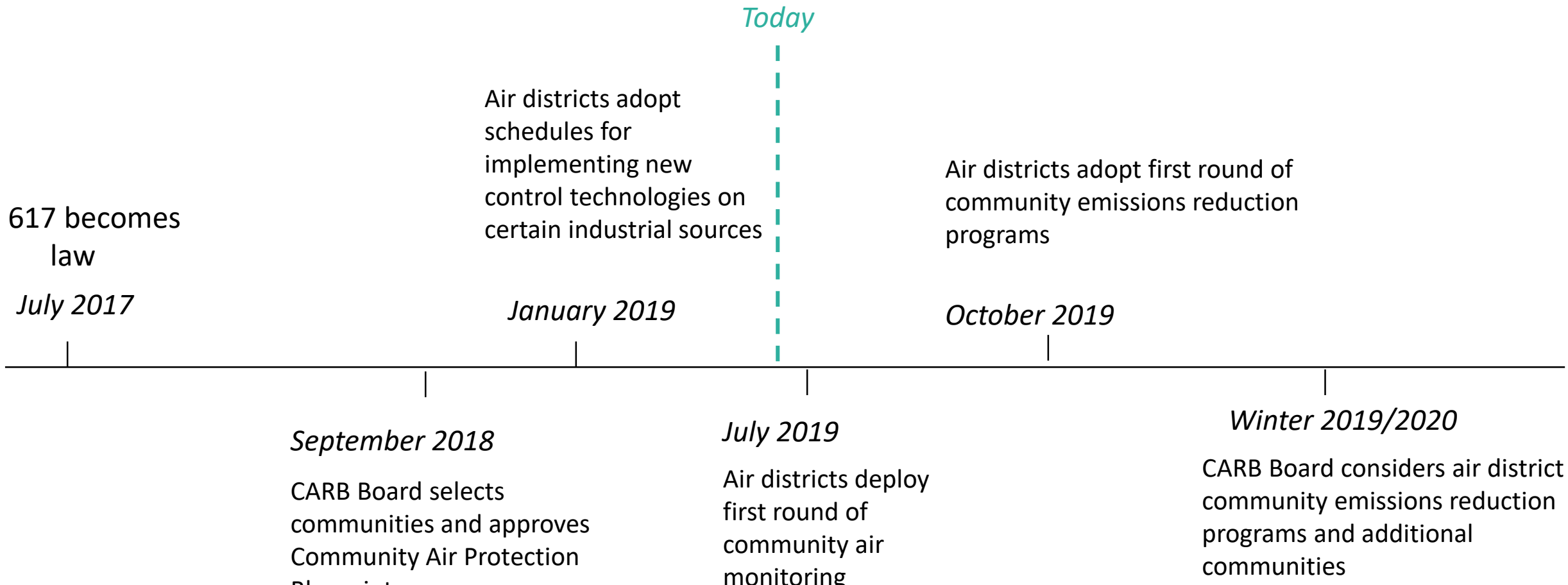
Assembly Bill 617 - AB 617



Community Air Protection Program

- PARTNERSHIPS WITH COMMUNITIES
- NEW STATEWIDE STRATEGIES TO REDUCE EMISSIONS
- TARGETED COMMUNITY CLEAN AIR PLANS
- METRICS TO TRACK & REPORT PROGRESS
- COLLABORATIONS WITH LAND USE & TRANSPORTATION AGENCIES
- CLEAN TECHNOLOGY INCENTIVE INVESTMENTS
- EXPANDED AIR MONITORING
- IMPROVED DATA ACCESSIBILITY

Implementation Timelines



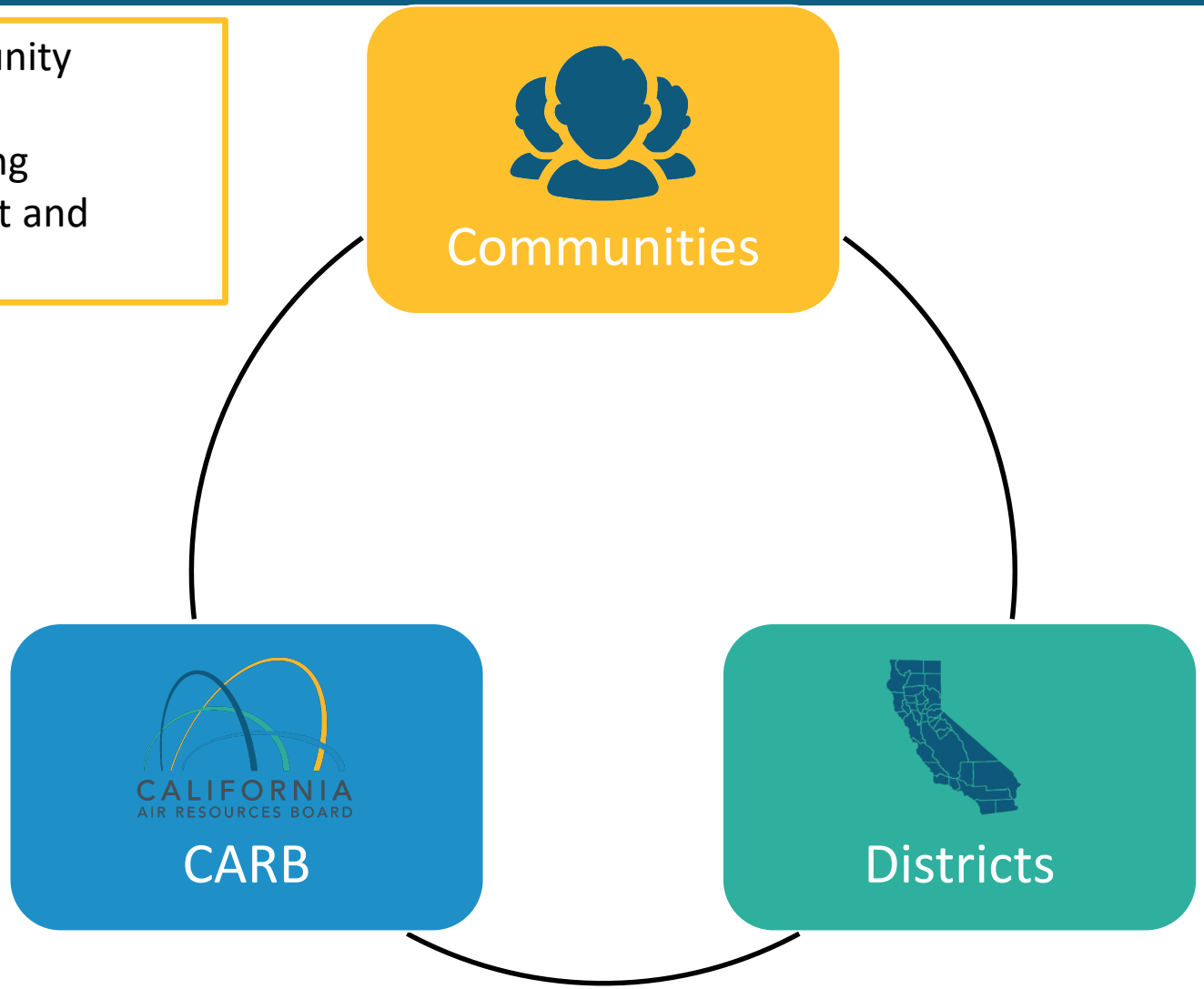
https://ww2.arb.ca.gov/our-work/programs/community-air-protection-program/community-air-protection-blueprint

First Year Communities

- 10 communities selected
- 7 communities selected for community emission reduction programs
- All communities except West Oakland include air monitoring

Key Roles and Responsibilities

- Provide direction on community concerns
- Serve on Community Steering Committees to provide input and guidance



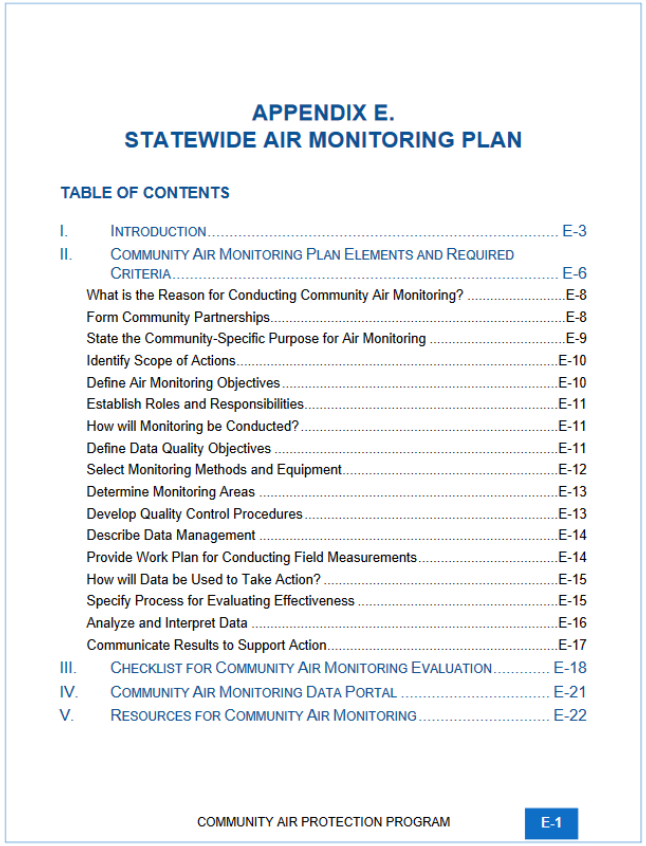
- Develop statewide strategies
- Design program requirements
- Provide program oversight, technical support, and resources
- Administer Community Air Grants

- Partner with communities to design and implement community air monitoring and community emissions reduction programs
- Administer incentive funding
- Regulate industrial sources

Criteria for Community Air Monitoring

14 Elements

for developing community air monitoring plans



APPENDIX E.
STATEWIDE AIR MONITORING PLAN

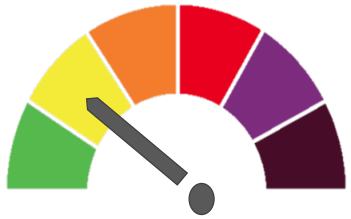
TABLE OF CONTENTS

I. INTRODUCTION E-3
II. COMMUNITY AIR MONITORING PLAN ELEMENTS AND REQUIRED CRITERIA E-6
What is the Reason for Conducting Community Air Monitoring? E-8
Form Community Partnerships E-8
State the Community-Specific Purpose for Air Monitoring E-9
Identify Scope of Actions E-10
Define Air Monitoring Objectives E-10
Establish Roles and Responsibilities E-11
How will Monitoring be Conducted? E-11
Define Data Quality Objectives E-11
Select Monitoring Methods and Equipment E-12
Determine Monitoring Areas E-13
Develop Quality Control Procedures E-13
Describe Data Management E-14
Provide Work Plan for Conducting Field Measurements E-14
How will Data be Used to Take Action? E-15
Specify Process for Evaluating Effectiveness E-15
Analyze and Interpret Data E-16
Communicate Results to Support Action E-17
III. CHECKLIST FOR COMMUNITY AIR MONITORING EVALUATION E-18
IV. COMMUNITY AIR MONITORING DATA PORTAL E-21
V. RESOURCES FOR COMMUNITY AIR MONITORING E-22

https://ww2.arb.ca.gov/resources/documents/final-draft-blueprint-appendix-e

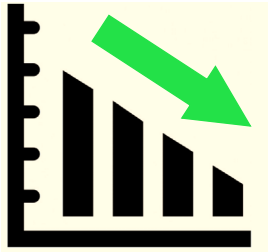
- What is the reason for conducting community air monitoring?
- How will monitoring be conducted?
- How will the data be used to take action?

Actionable Air Monitoring Data



Inform personal choices, e.g. activity

Evaluate source impacts (source attribution)



Track progress of community emissions reduction programs

Support enforcement activities, new rules and regulations

Air Monitoring Planning Elements

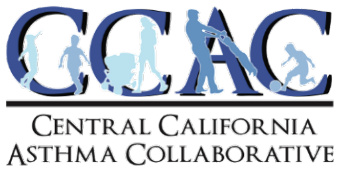
What is the reason for conducting air monitoring?	➢ Form community partnerships ➢ State the community-specific purpose ➢ Identify scope of actions ➢ Define air monitoring objectives ➢ Establish roles and responsibilities
How will monitoring be conducted?	➢ Define data quality objectives ➢ Select monitoring methods and equipment ➢ Determine monitoring areas ➢ Develop quality control procedures ➢ Describe data management ➢ Provide work plan for conducting field measurements
How will data be used to take action?	➢ Specify process for evaluating effectiveness ➢ Analyze and interpret data ➢ Communicate results to support action

Community Air Grants

- Awarded in May 2018
- 10 million dollars
- 28 total communities
- **22 have monitoring component**
- 2019 solicitation *available online*

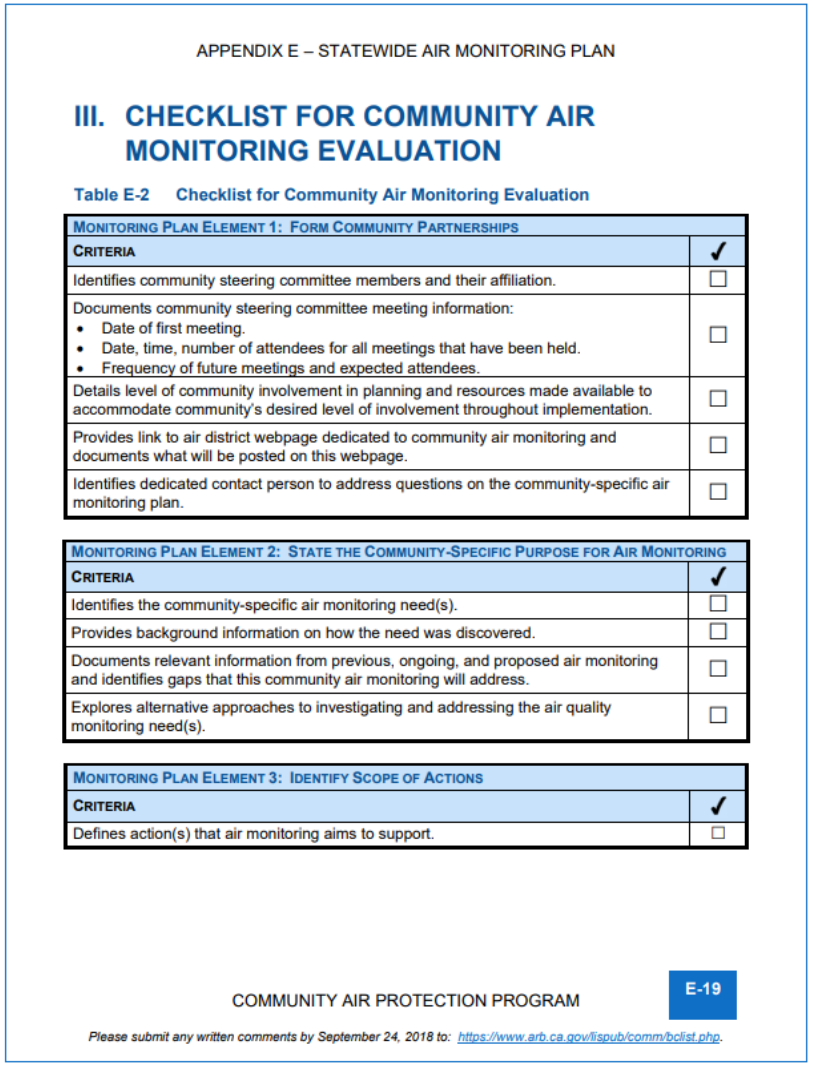
https://ww2.arb.ca.gov/our-work/programs/community-air-protection-program/community-air-grants

Air Grantee Air Monitoring



Community Air Grants

- **Purpose of air monitoring**
  - Capacity building within communities
  - Gaps in existing air monitoring
  - Replace or upgrade older equipment
  - Expand existing monitoring networks
- **Scope of actions data are intended to support**
  - Real-time monitoring data to inform community residents, businesses, and institutions for activity decisions
  - Inform future stationary monitoring or possible enforcement actions
  - Allow residents to become more involved in local air quality discussion/decision making
  - Training, education, and increased awareness



APPENDIX E – STATEWIDE AIR MONITORING PLAN

III. CHECKLIST FOR COMMUNITY AIR MONITORING EVALUATION

Table E-2 Checklist for Community Air Monitoring Evaluation

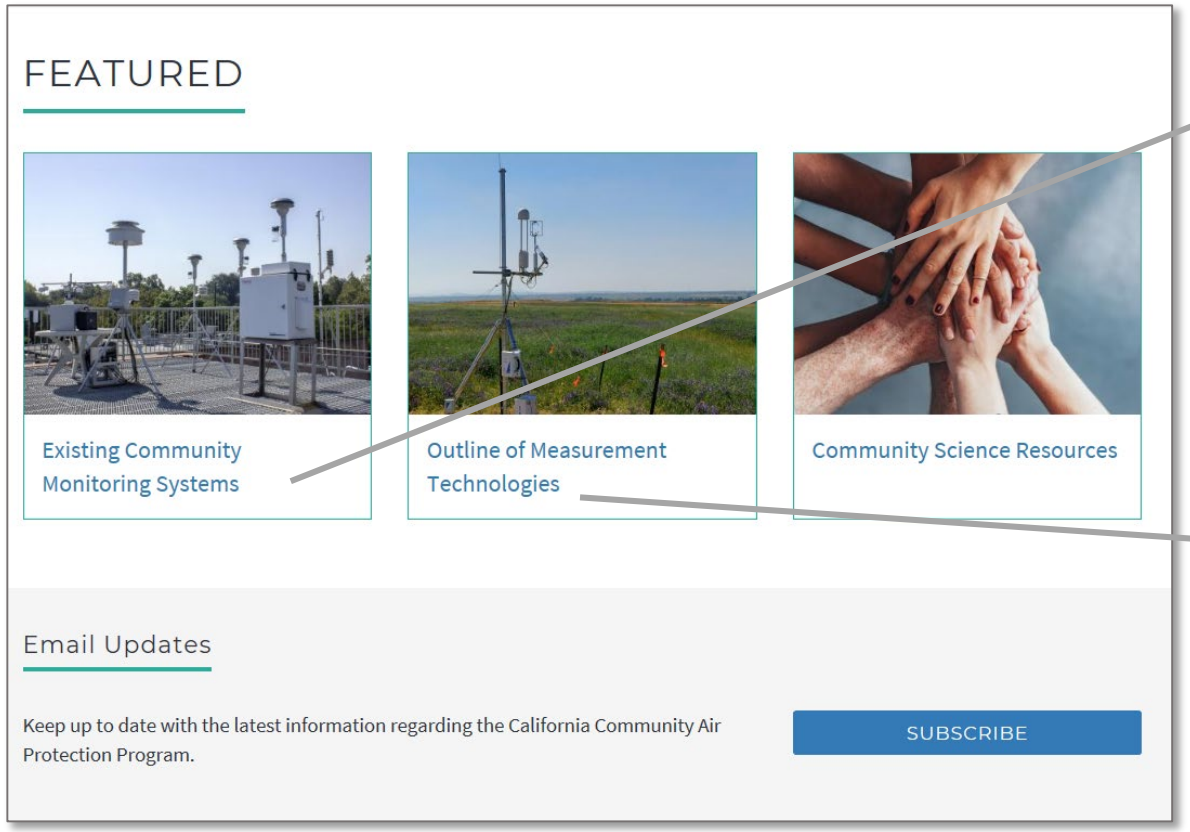
Monitoring Plan Element 1: Form Community Partnerships	
Criteria	**✓**
Identifies community steering committee members and their affiliation.	☐
Documents community steering committee meeting information: • Date of first meeting. • Date, time, number of attendees for all meetings that have been held. • Frequency of future meetings and expected attendees.	☐
Details level of community involvement in planning and resources made available to accommodate community's desired level of involvement throughout implementation.	☐
Provides link to air district webpage dedicated to community air monitoring and documents what will be posted on this webpage.	☐
Identifies dedicated contact person to address questions on the community-specific air monitoring plan.	☐

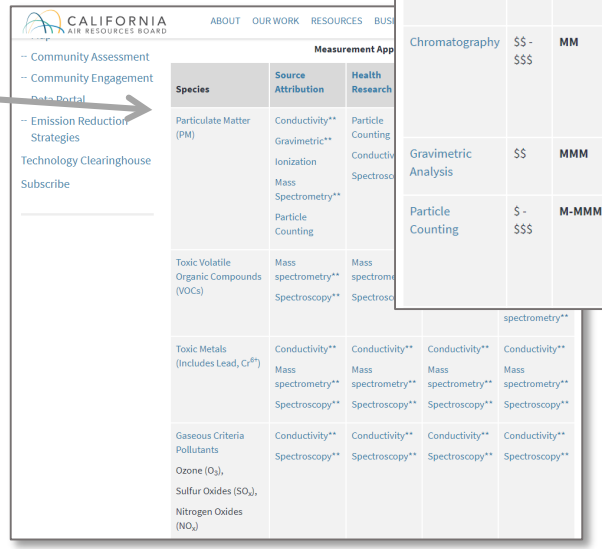
Monitoring Plan Element 2: State the Community-Specific Purpose for Air Monitoring	
Criteria	**✓**
Identifies the community-specific air monitoring need(s).	☐
Provides background information on how the need was discovered.	☐
Documents relevant information from previous, ongoing, and proposed air monitoring and identifies gaps that this community air monitoring will address.	☐
Explores alternative approaches to investigating and addressing the air quality monitoring need(s).	☐

Monitoring Plan Element 3: Identify Scope of Actions	
Criteria	**✓**
Defines action(s) that air monitoring aims to support.	☐

Please submit any written comments by September 24, 2018 to: https://www.arb.ca.gov/lispub/comm/bclist.php.

Online Resource Center

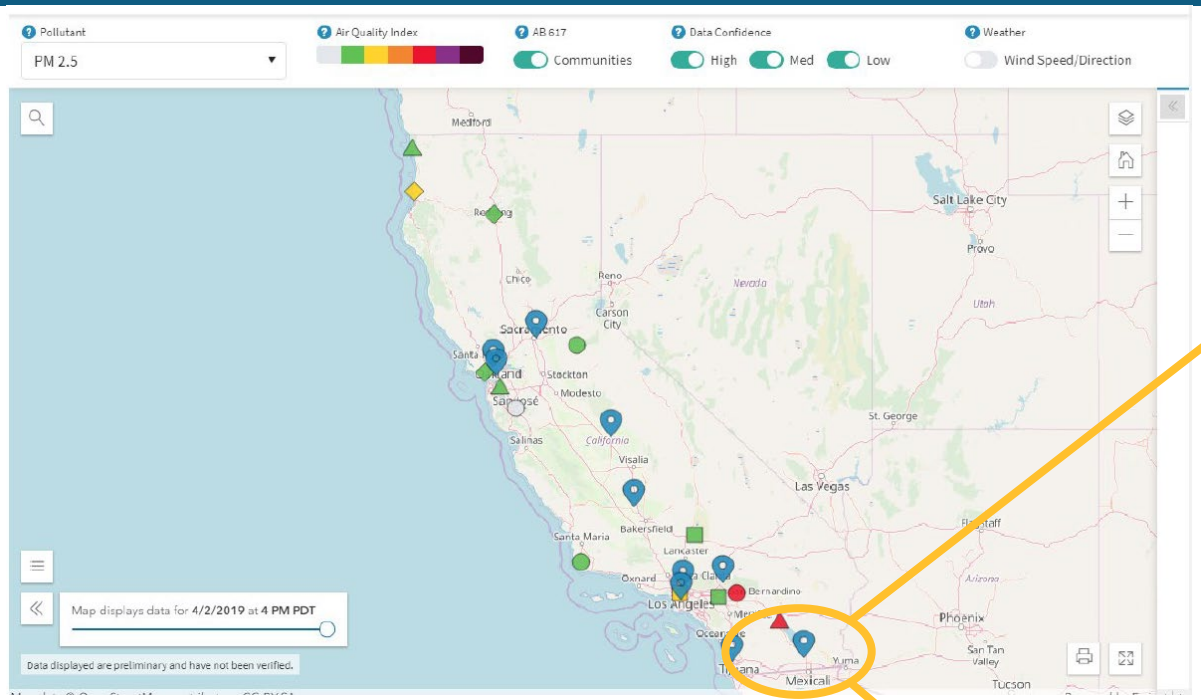


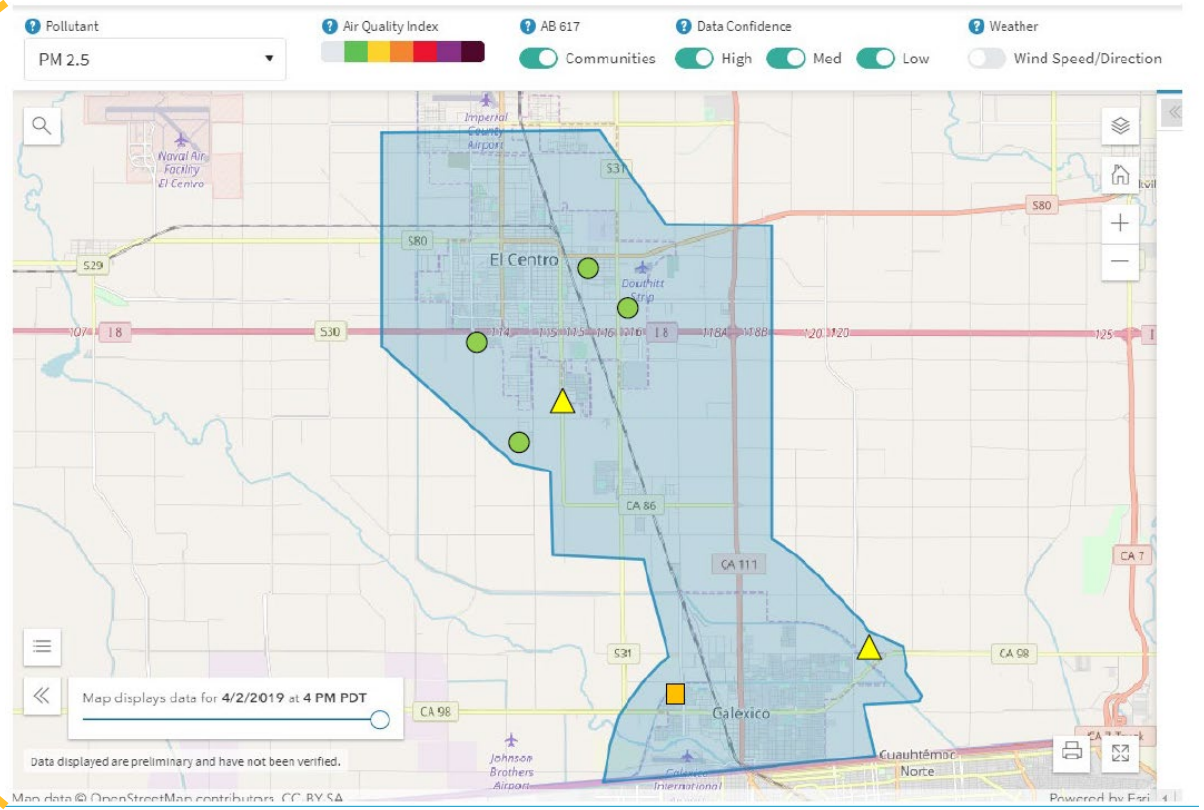


Measurement Technology	Cost*	Range of Manufacturers**	Expertise Level***	Air Monitoring Approach
Spectroscopy	$ - $$$$+	MMM-MMMM	2 - 3	• Air Toxics • Federal Reference or Equivalent Method (FRM/FEM) • Fence-line Monitoring • Mobile Monitoring • Remote Sensing (inc. Satellite)
Mass Spectrometry	$$$ - $$$$+	MM-MMM	3	• Air Toxics • FRM/FEM • Mobile Monitoring • Remote Sensing
Chromatography	$$ - $$$	MM	2-3	• Air Toxics • Fence-line Monitoring • FRM/FEM • Mobile Monitoring • Remote Sensing
Gravimetric Analysis	$$	MMM	1-2	• FRM/FEM
Particle Counting	$ - $$$	M-MMMM	1-2	• FRM/FEM • Fence-line Monitoring • Mobile Monitoring • Remote Sensing • Sensors/Sensor Networks

https://ww2.arb.ca.gov/capp-resource-center/community-air-monitoring

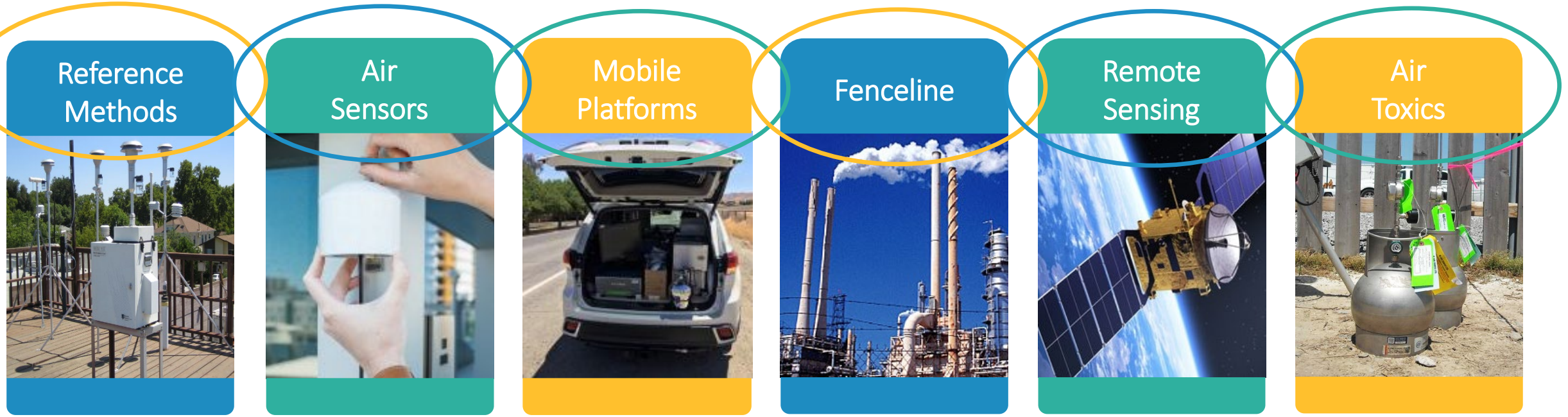
AQ-VIEW: Online Data Portal





Data portal currently in beta testing with full system going live July 1st

Air Monitoring Tools and Technologies



Monitoring plans define monitoring objectives that can be used to select appropriate tools for each community

https://ww2.arb.ca.gov/capp-resource-center/community-air-monitoring/outline-of-measurement-technologies

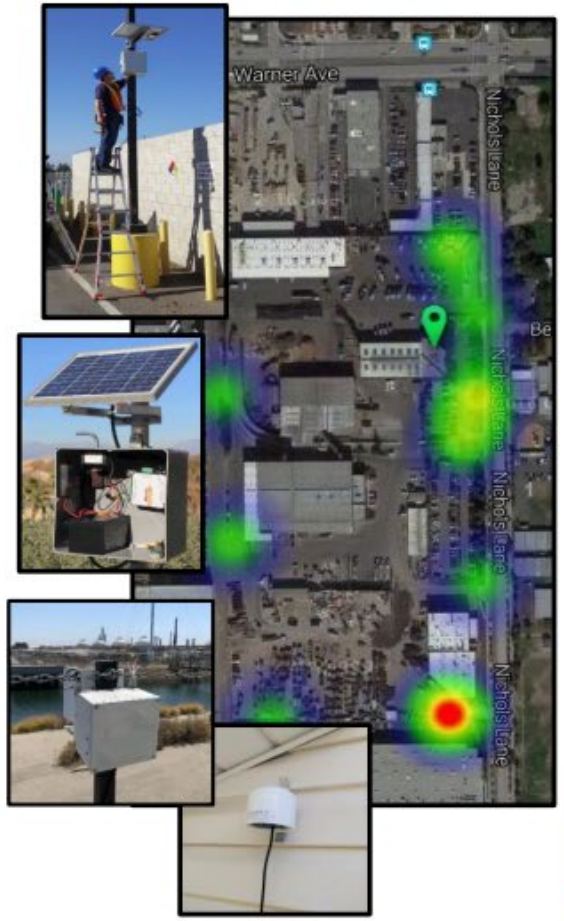
Monitoring Approaches

Regulatory Monitoring Instruments

Mobile Platforms

Optical Remote Sensing

Low-Cost Sensor Networks

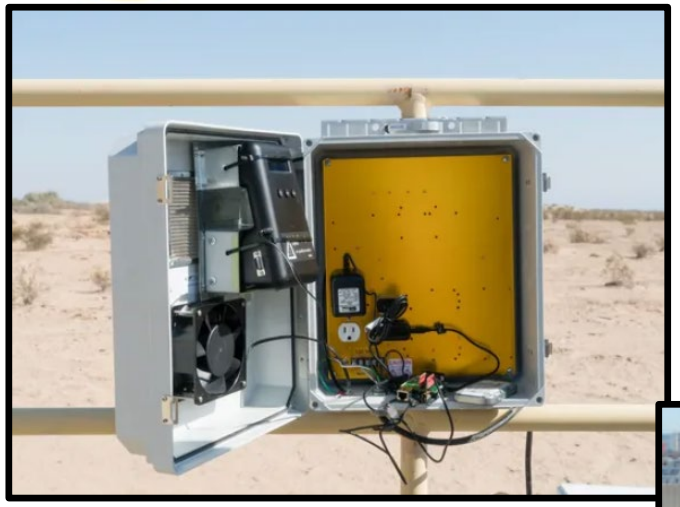


Monitoring Approaches

CALIFORNIA AIR RESOURCES BOARD

IMPERIAL COUNTY CALIFORNIA 1907

Air Pollution Control District

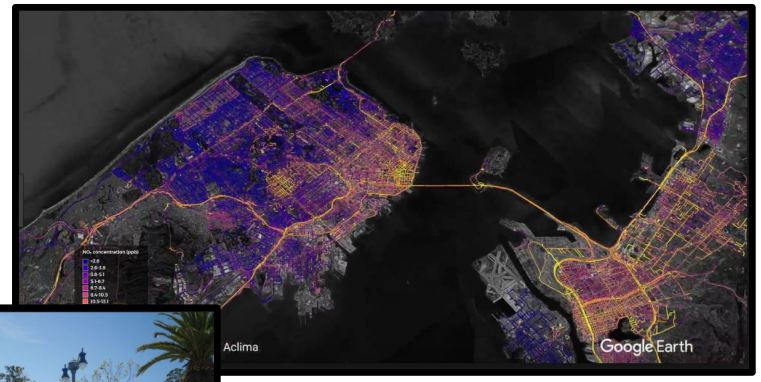


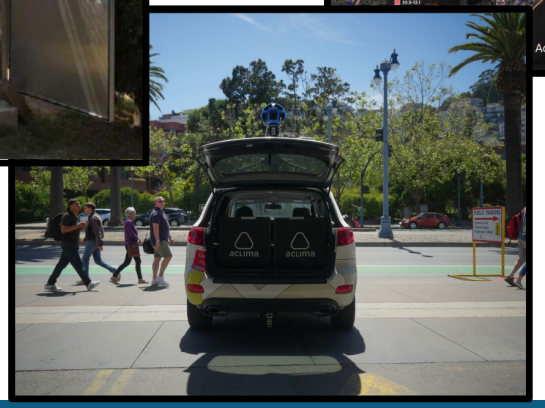
APCD

AIR POLLUTION CONTROL DISTRICT

COUNTY OF SAN DIEGO

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT





Monitoring Approaches

CALIFORNIA AIR RESOURCES BOARD

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

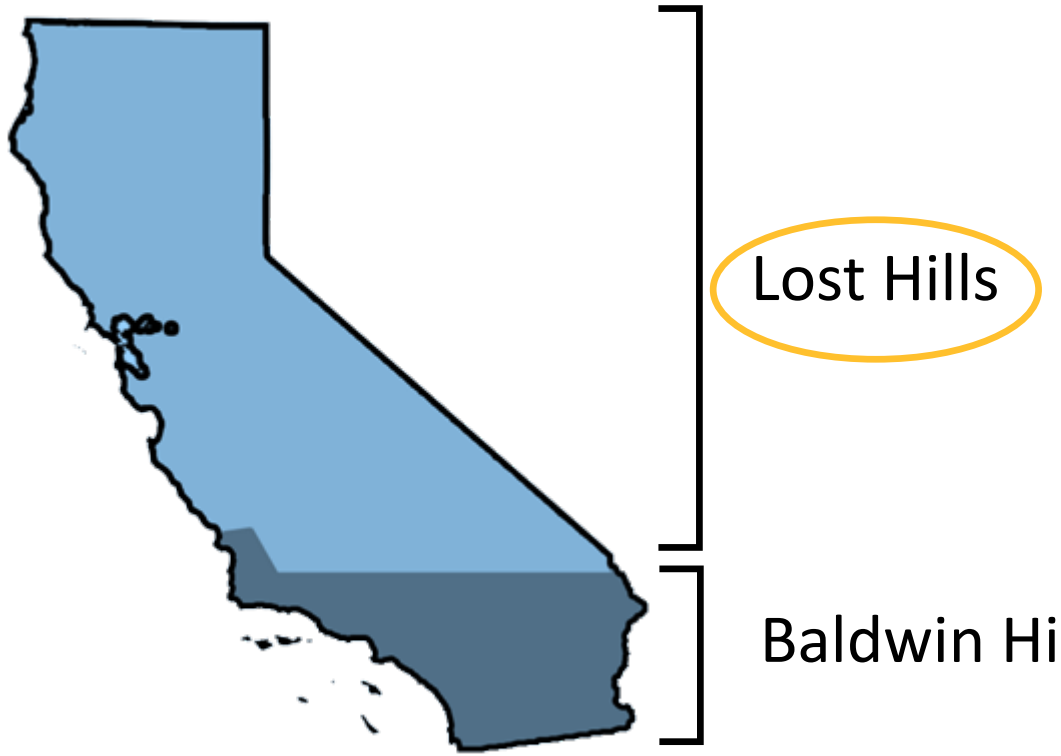
San Joaquin Valley AIR POLLUTION CONTROL DISTRICT

How is CARB engaging in community air monitoring?

CARB Community Air Monitoring: SNAPS

- **SNAPS:** Study of Neighborhood Air near Petroleum Sources
  - Monitoring of air quality in neighborhoods close to oil and gas extraction activities

Key Objective:
Provide information and context about local air quality with high temporal resolution



SNAPS Website: https://ww2.arb.ca.gov/our-work/programs/study-neighborhood-air-near-petroleum-sources

SNAPS Monitoring Scope

- Quantify criteria pollutants and air toxics in select communities
- Compare concentrations against health metrics
- Limited-term, intensive monitoring
  - 3-6 months duration

Continuous Measurements
Black carbon (BC)
Particulate Matter ($PM_{2.5}$)
Hydrogen Sulfide (H_2S)
Methane/Carbon Dioxide/Carbon Monoxide (CH_4/CO_2/CO)
Ozone (O_3)
Speciated Volatile Organic Compounds (VOCs)

Discrete Samples
Glycols
Sulfur-containing compounds
PAHs/Semi-volatile organics
Aldehydes
Speciated Volatile Organic Compounds (VOCs)
PM Bound Metals

SNAPS: Continuous Measurements

Continuous Measurements – Select average hourly concentrations are made available on the SNAPS website.

Analyte	Instrument	Measurement Frequency
$PM_{2.5}$	MetOne 1022	Hourly
Particulate Black Carbon - (BC)	MetOne BC-1054	Hourly
Hydrogen Sulfide (H_2S)	API 101	0.3 Hz
Ozone (O_3)	API T400	Variable
Carbon Monoxide (CO)	Picarro 2401	1 Hz
Methane (CH_4)	Picarro 2401	1 Hz
Carbon Dioxide (CO_2)	Picarro 2401	1 Hz
Particulate Metals* (TM)	Xact 625i	Hourly
Volatile Organic Compounds* (VOCs, ~60 compounds)	GC-FID	Hourly

*** Compounds will not be on SNAPS public website**

SNAPS: Discrete Measurements

Discrete Measurements

- Expanded pollutant set measured via a suite of field instrumentation, sampling media, and subsequent laboratory analysis.
- Data reported as 24-hr averages.

Analyte	Instrument	Sampling Frequency
Volatile Organic Compounds (VOCs)	GC-MS	1 every 6 days
Semi-volatile Organic Compounds (SVOCs) incl. PAHs	Hi-Vol + GC-MS	1 every 6 days
Carbonyls (HCHO, AcH, MEK)	HPLC-UV	1 every 6 days
Glycols	GC-FID	1 every 6 days
Metals - Particulate	XRF	1 every 6 days
Mercaptans*	GC + Chemiluminescence	1 every 6 days
Hexavalent Chromium* - Particulate (Cr^{6+})	Ion Chromatography	1 every 6 days

***Collection frequency will vary by study area and analytical support**

SNAPS MOBILE MONITORING

Analyte	Instrument	Sampling Frequency
Carbon Dioxide (CO_2)	Picaro G2401	1 Hz
Carbon Monoxide (CO)	Picaro G2401	1 Hz
Methane (CH_4)	Picaro G2401	1 Hz
BTEX (benzene, toluene, ethylbenzene, xylenes)	Tricorn GC - PID	30 minutes (2.5 minute sampling time, 27.5 GC analysis time)
Volatile Organic Compounds (VOCs)	Tricorn GC - PID	30 minutes (2.5 minute sampling time, 27.5 GC analysis time)
Volatile Organic Compounds (VOCs – Grab Samples)	GC-MS via MLD 058 Method	As Necessary

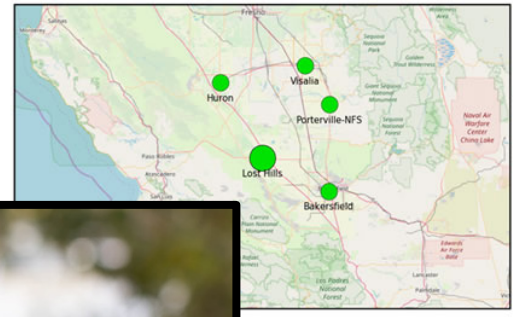
Increased measurement spatial resolution within communities

SNAPS: Data Display

Air Monitoring Snapshot

Air Quality Index (AQI)

Hourly AQI (combined $PM_{2.5}$ and O_3) for the SNAPS measurement site(s) and nearby regional air monitoring stations are shown below (AQI, see AirNow for more information and full calculation methods). A description of AQI colors and values are shown in the table.



Lost Hills Monitoring Traile

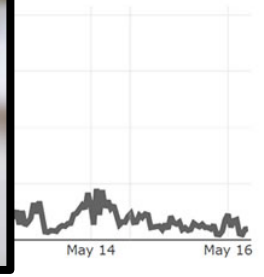
AQI

43

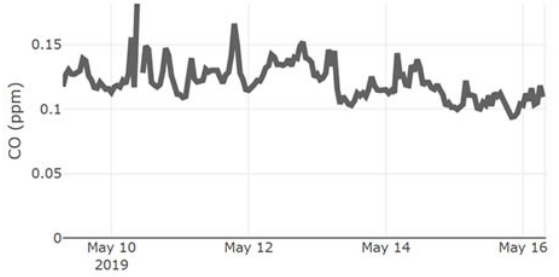
($PM_{2.5}$)

n (BC) particles, a subcomponent of PM2.5, are emitte
nonitors both these pollutants and the hourly

O_3	$PM_{2.5}$
Latest 8-hr Average: 33.0 ppb	Latest 24-hr Average: 10.3 ug/m³
8-hr standard: 70.0 ppb	24-hr standard: 35.0 ug/m³



BC
Latest 24-hr Average: 0.1 ug/m³
No ambient health standard



CO	CH_4	BC
Latest 8-hr Average: 0.1 ppm	Latest 24-hr Average: 1.9 ppm	Latest 24-hr Average: 0.1 ug/m³
8-hr standard: 9.0 ppm	No ambient health standard	No ambient health standard

CO
Latest 8-hr Average: 0.1 ppm
8-hr standard: 9.0 ppm

https://ww2.arb.ca.gov/our-work/programs/study-neighborhood-air-near-petroleum-sources/snaps-data-display

2018 Camp Fire Monitoring

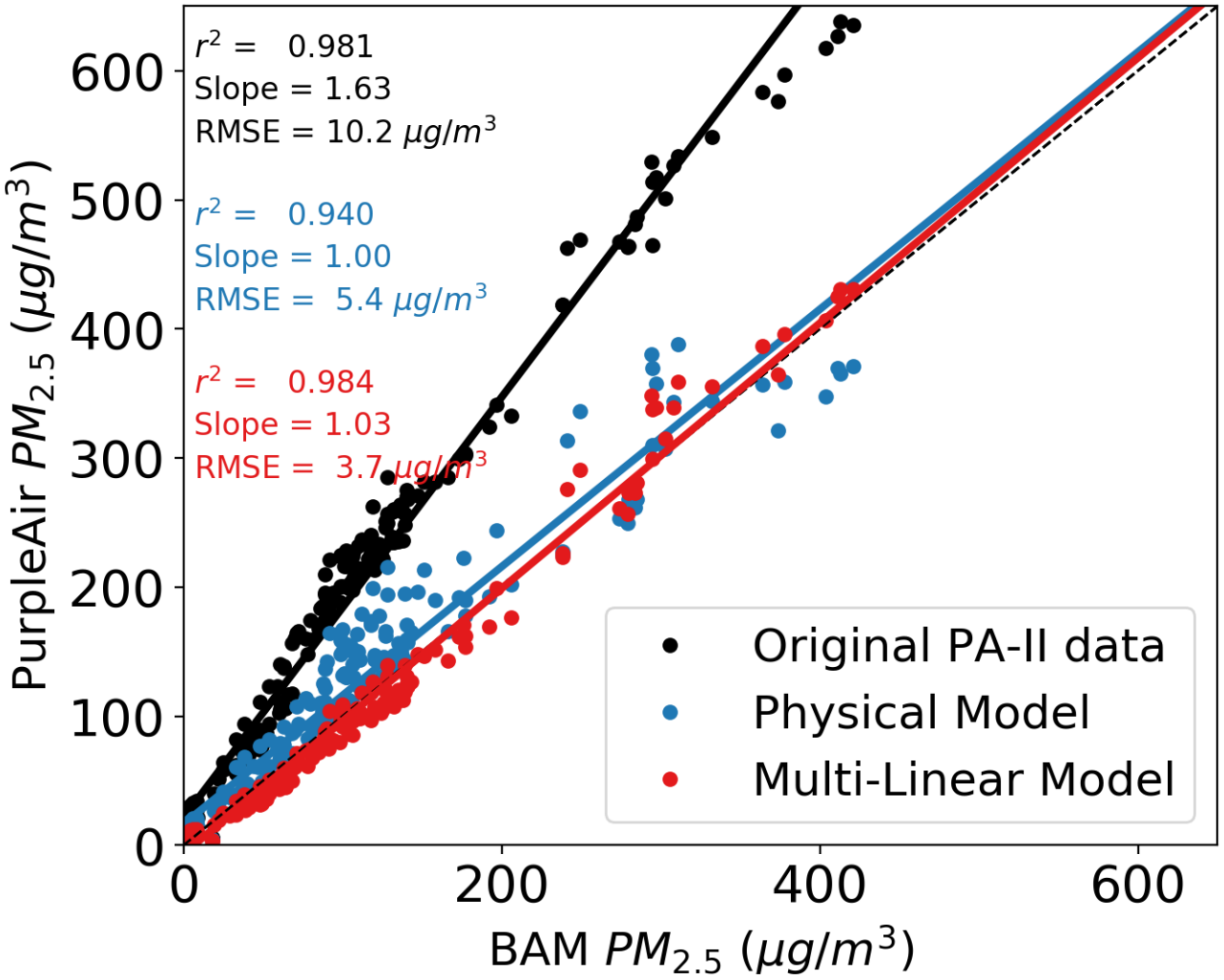
- Camp Fire was the deadliest and most destructive fire in California history
  - November 8 – 25th 2018

- Weather conditions caused Sacramento air quality to rapidly deteriorate on November 14th

- CARB staff used sensors to assess indoor air quality impacts

Images: CBS Sacramento, and KTLA 5

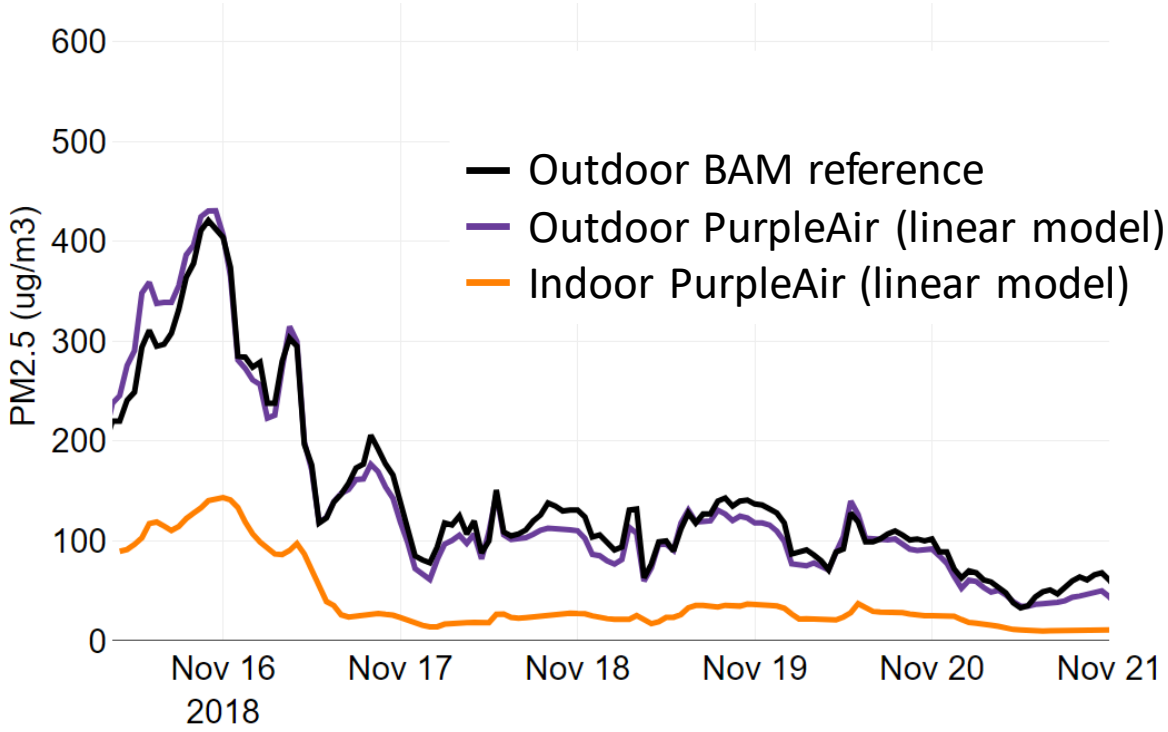
Sensor Adjustments



- Collocation of low-cost sensors with BAM 1020 over several months
- PA overestimates $PM_{2.5}$ ~1.6 of BAM (FEM) with high r^2
- Important to understand sensor behavior

2018 Camp Fire: Indoor Air Quality

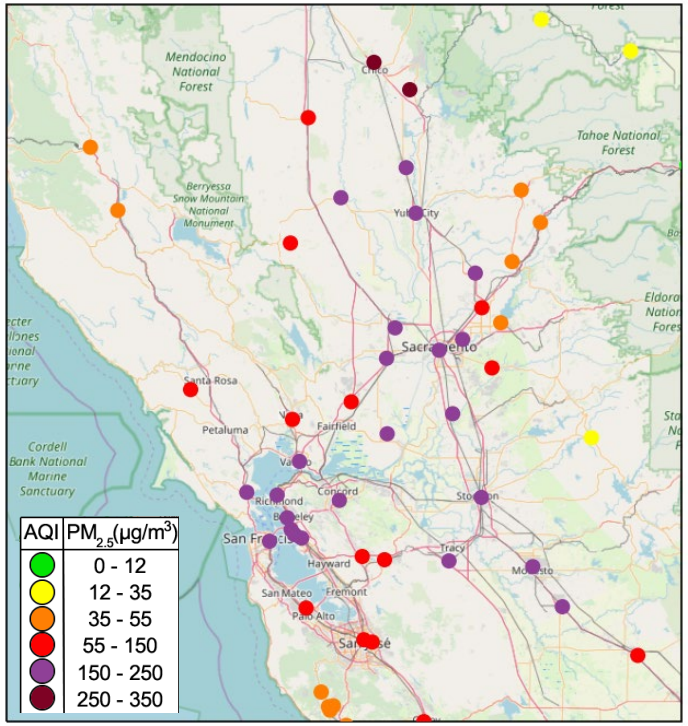
- Purple Air sensors placed indoors in work areas



- Sensor adjustment algorithms improve sensor performance
- Sensors appear to be useful for assessing indoor air quality

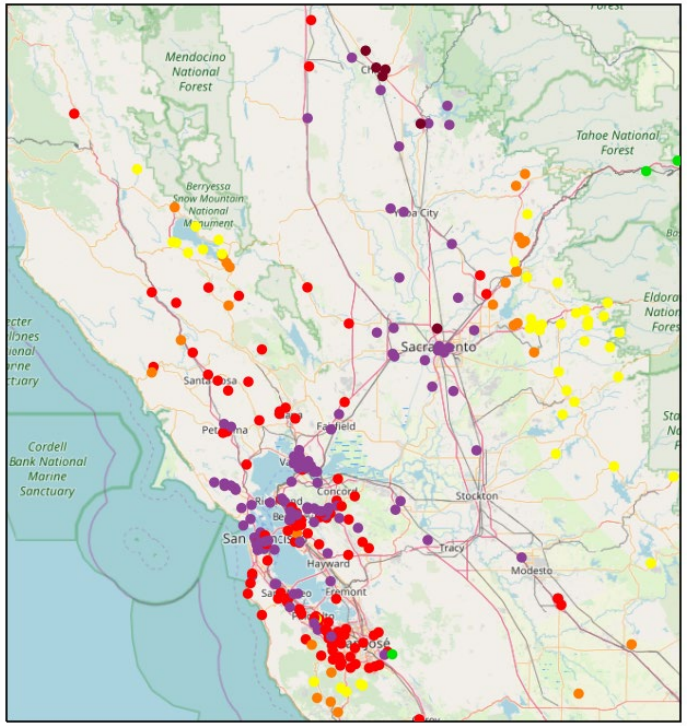
2018 Camp Fire: Regulatory, Sensor and Satellite Data

AQI, 16th November 2018



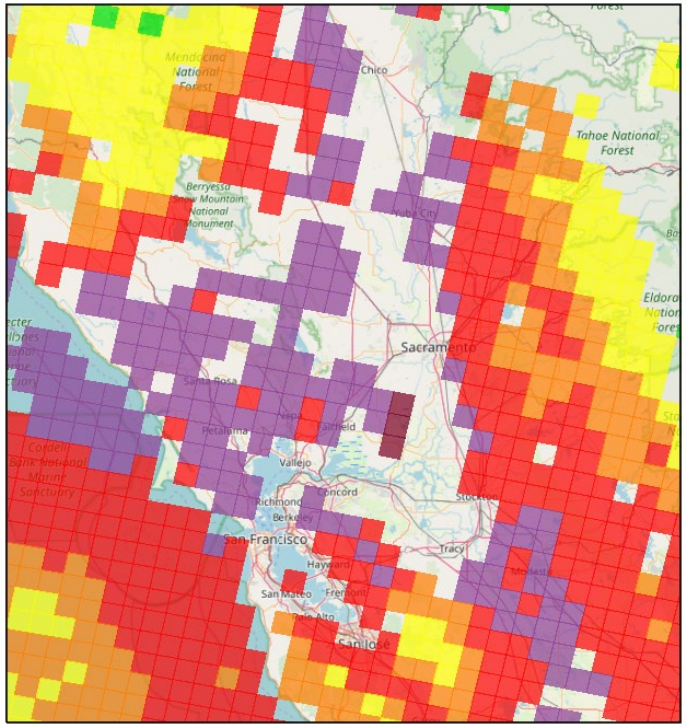
Regulatory networks track elevated $PM_{2.5}$ using reliable, federally-accepted methods

Hourly averages



Sensors expand the coverage, but data quality is uncertain

Minute-to-minute



Satellite measurements provide wider coverage but requires modeling and in-situ data to constrain the surface $PM_{2.5}$

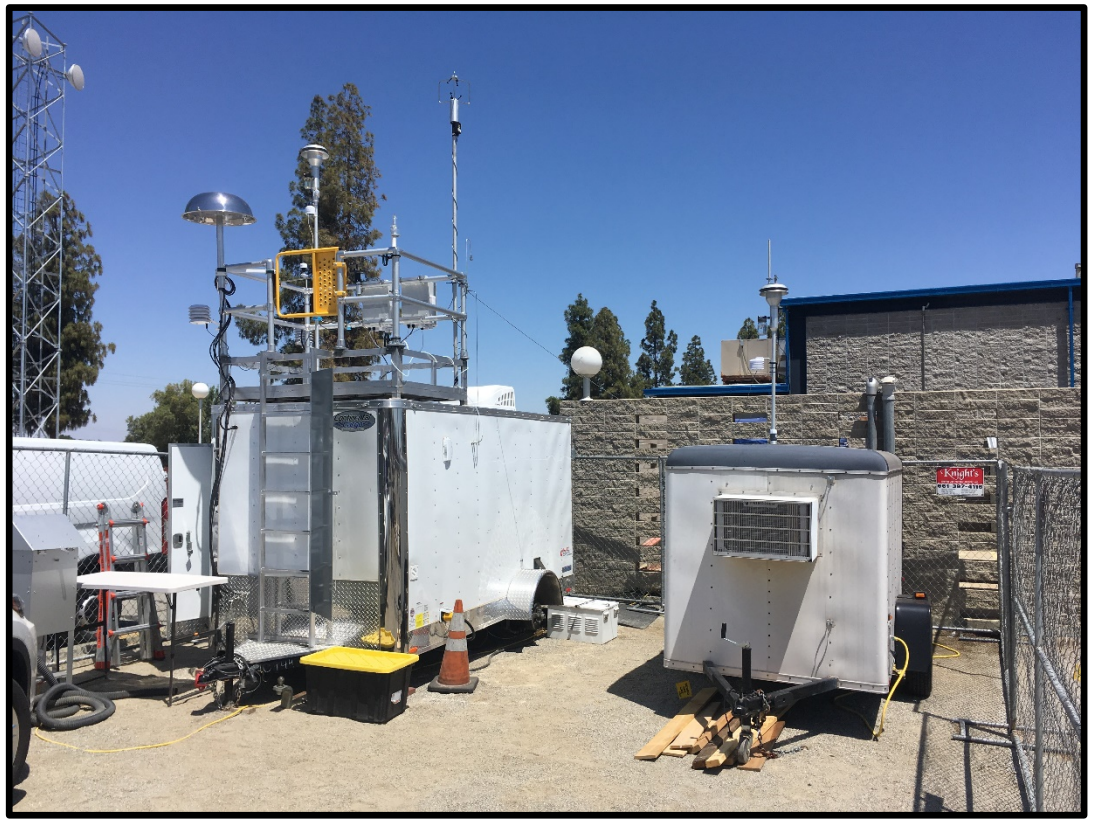
Daily snapshot

Utility for gap filling between regulatory site PM, along with sensor data

Looking Forward

- Community air monitoring is a paradigm shift in air quality
  - Adds local-scale monitoring to the existing regional monitoring network
- AB 617 monitoring is just beginning
  - Monitoring begins July 1st 2019
- How can we leverage new monitoring technologies to characterize community level concentrations of toxics and criteria pollutants?
  - There is not one-size-fits all approach using a single method
  - Combination of technology and coordination between community residents, air districts, and CARB

Questions or Comments?



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