Introduction to Community Air Monitoring Network

May 6, 2020
Air Sensors
International Conference

Tracking California
Informing Action for Healthier Communities

Comite Cucio Del Valle, Inc.
Virtual Series
WELCOME
Paul English, Tracking California
Mission: **Mobilize data to improve public health**

What we do:

- Data compilation and management
- Data access and visualization
- Health research and analysis
- Health communications
- Education and training

[www.trackingcalifornia.org](http://www.trackingcalifornia.org)
PM2.5, Annual Average Concentration, Micrograms Per Cubic Meter, 2016

Map
Satellite

Annual average concentration:
- 14.7-17.6
- 11.7-14.7
- 8.6-11.7
- 5.8-8.8
- 2.9-5.6
- N/A
The Imperial County Community Air Monitoring Project

- Imperial County
- 5 years, funded by the National Institute of Environmental Health Sciences
- Need identified by community members
- Network of 40 particulate matter monitors (IVAN AIR)
- Components: Community engagement, research, action
What will you learn today?

- Considerations for starting a community air monitoring project
  - How do you know if community air monitoring is right for you?
  - How to tailor your approach to your community needs

- General processes for setting up a community air monitoring project
  - Establishing partnerships and engaging community
  - Technical and scientific considerations
  - Ways to communicate and use air monitoring data

- Examples from the Imperial County Community Air Monitoring Project
Resources for Developing an Air Monitoring Network

Guidebook for Developing a Community Air Monitoring Network
Steps, Lessons, and Recommendations from the Imperial County Community Air Monitoring Project

Community Air Protection BLUEPRINT
For Selecting Communities, Preparing Community Emissions Reduction Programs, Identifying Statewide Strategies, and Conducting Community Air Monitoring
October 2018
1. INTRODUCTION TO COMMUNITY AIR MONITORING

Catalina Garzon-Galvis, Tracking California

Related resources
- Guidebook: Chapters 1-3
- CARB: Appendix E - 3-5
WHAT IS COMMUNITY AIR MONITORING?
Health effects of air pollution

- Mental Illness; Cognitive Decline
- Asthma
- Premature Birth; Infant Mortality
- Heart Disease
- Respiratory Illness; Lung Cancer
- Premature Death
What is community air monitoring?

At its broadest definition:

**Community air monitoring** is an effort to collect air quality data in which a local, community-based organization is:

- a *lead partner*
- has *decision-making power* throughout its implementation
- uses the data for *direct, positive impacts* in the community
Why community air monitoring?

- **Government air agencies have limitations**
  - Can’t measure everything, everywhere, all the time
  - Regulatory and research monitors can be very expensive
  - Data may not tell you what’s happening “on the ground”
  - Academic and private sector monitoring have their own limitations

- **Communities have air quality data needs**
  - Identify hot spots of pollution
  - Understand how air quality is changing at local level, real-time
  - Lead or guide scientific research
  - Make sure air quality data leads to action

- **Communities have important resources**
  - Local knowledge, capacities, experience
  - Relationships and networks
  - Advocacy and policy
Regulatory vs community air monitoring

Regulatory monitors are essential but limited

Community air monitoring can help
Different kinds of community air monitoring

- Fenceline
- Grab samples/ bucket brigade
- Personal
- Indoor
- Temporary stationary monitoring
- Mobile
- Community air monitoring network
What kind of community air monitoring project is right for you?

- What are the air quality issues?
- Do sensors exist?
- Concern about multiple sources?
- Community org that can lead?
- Clear uses and users for the data?
- Long term need?
A community air monitoring network is...
2. GETTING STARTED

Related resources
- Guidebook: Chapters 3-4, 7
- CARB: Elements 2-4
What can community air monitoring data be used for?

- Research and other analyses
- Inform policies and programs
- Document AQ trends
- Community outreach, education, advocacy
- Alert when AQ is poor to protect health
- But not regulatory action
General flow to set up a community air monitoring project

1. Develop a plan
   - Define goals and approach
   - Assess resources
   - Identify team
   - Engage community

2. Choose a monitor
   - Assess options

3. Ensure data quality
   - Calibrate monitors
   - Quality assurance and control

4. Set up monitors
   - Select locations
   - Recruit hosts
   - Deploy monitors

5. Share and use data
   - Collect and analyze data
   - Communicate information
   - Apply data for action
   - Ensure sustainability
DEFINING YOUR VALUES, GOALS, AND VISION
How important are these values in starting your project?

**Values of community engagement**

- Community leadership role
- Broad community engagement
- Equitable sharing of resources
- Shared capacity-building
- Awareness and education
- Community decision-making power
- Community data ownership

**Values of scientific integrity**

- Accuracy
- Utility
- Comprehensibility
- Accessibility
- Transparency
- Reliability
Imperial County example: IVAN AIR network

- Located throughout a large geographic region
- Established and operated by CCV with technical partners
- Long-term
- Measures outdoor PM across large county to provide real-time data for exposure reduction
- Collects data continuously
- Public is a direct user of the data
Some questions to help define your goals and choose your approach

- What do you want the air monitoring data to tell you about?
- What do you want to do with the data?
- What do you want others to do with the data?
- What type of monitoring project will help you collect this data?
- What resources, capacities, and technologies are available to do this?
### Who else will use the data?

<table>
<thead>
<tr>
<th>Who will use the data?</th>
<th>For what?</th>
<th>How will they get the data?</th>
<th>Data quality needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>School kids</td>
<td>Learning about their environment</td>
<td>On device or via website</td>
<td>Fair</td>
</tr>
<tr>
<td>School administrator</td>
<td>Keep kids indoors when air pollution is high</td>
<td>Website or alert</td>
<td>Good</td>
</tr>
<tr>
<td>Regulatory government staff</td>
<td>Investigate a pollution complaint</td>
<td>Website or dataset</td>
<td>Very Good</td>
</tr>
<tr>
<td>University or government researcher</td>
<td>Conduct study on air quality and health</td>
<td>Dataset</td>
<td>Very Good</td>
</tr>
</tbody>
</table>
Having a vision for your project will help with planning

- How involved should the community be?
- Who else should be involved?
- How much flexibility do you have?
- Which monitor to use?
- How much data quality is needed?
- Where do you put the monitors?
- How do you communicate the data?
PROJECT TEAM & PARTNERSHIPS
- Outreach and engagement
- Communication and dissemination
- Data management and analysis
- Air quality science and technology
- Meeting planning and facilitation
- Project and grants management
- Setting up partnership agreements
- Monitor assembly and maintenance
- Software development and web design
Who can be part of your project team?

Project team can be:
- Partners
- Contractors
- Consultants

These may be:
- Other community groups
- Non-governmental organizations
- Government agencies
- Universities
- Private companies
Building effective and equitable partnerships

- Clarify common and individual goals
- Clearly define roles, responsibilities, and other agreements
- Conduct ongoing check-ins and assessments
- Ensure adequate funding and resources
- Establish clear communication processes and structure for working together
ENGAGING COMMUNITY AND OTHER STAKEHOLDERS
Community Steering Committees (CSC) or Advisory Groups

- Clear roles and responsibilities
- Guidance and decisions on goals and activities
- Evaluate progress and impacts
- Participate in activities to carry out the project
Technical Advisory Group (TAG)

- Representatives from government, universities, private sector
- Not a decision-making body
- Guidance on technical aspects of the project
- Supports relationship-building and ongoing communications

Sensor selection
Monitor siting
Colocation and calibration
Quality control
Data analysis and interpretation of results
More ways to engage others

Who else may want to know that you’re setting up a community air monitoring project?

Who else may be able to provide support?
A technical advisory group can offer guidance on…
3. TECHNICAL CONSIDERATIONS FOR COMMUNITY AIR MONITORING

David Chang, Tracking California

Related resources

- Guidebook: Chapters 8-11
- CARB: Elements 6-7, 9
CHOOSING AIR MONITORS
Air sensor and air monitor often used interchangeably

Definitions for today...

Sensor
- The component that measures the air pollution
- Sold on its own or as part of a monitor

Monitor
- Contains everything needed to collect and transmit data
- May include additional sensors for temperature, humidity
- Can be custom-built or purchased ready-made

Remember: sensors measure for specific pollutants
Ready-made monitor examples

“Off the shelf”

“Plug-and-play”
Example of custom PM monitor

How is the monitor powered?
- AC power
- Solar power
- Battery

How does the monitor report data?
- Wi-Fi
- Ethernet connection
- Cellular modem
Which monitor to use?

This will depend on:
• Pollutant(s) of interest
• Project goals
• Data collection method
• Financial and technical resources
• Available technology

Custom-built?
If so, which sensor?

Ready made?
If so, which monitor?
Question #3

How do you know which monitor is right for you?
ENSURING DATA QUALITY
Why do we care about data quality?

Better informed community

More appropriate actions taken

More usable for government, researchers, technology developers

Increased credibility

Data quality should match your project goals and data needs
What can impact data quality?

1. Quality of the sensor and monitor
2. Calibration
3. Quality control
4. Monitor maintenance
<table>
<thead>
<tr>
<th><strong>How well does it estimate pollution levels?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• How accurate?</td>
</tr>
<tr>
<td>• How consistent?</td>
</tr>
<tr>
<td>• What levels can be detected (low and high)?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>How has it been tested?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lab testing</td>
</tr>
<tr>
<td>• Field testing</td>
</tr>
<tr>
<td>• Real-life environmental conditions</td>
</tr>
<tr>
<td>• In your community</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Who is doing the testing?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Manufacturer</td>
</tr>
<tr>
<td>• University researchers</td>
</tr>
<tr>
<td>• Government</td>
</tr>
<tr>
<td>• AQ-SPEC</td>
</tr>
<tr>
<td>• CARB</td>
</tr>
<tr>
<td>• EPA</td>
</tr>
</tbody>
</table>
What can impact data quality?

1. Quality of the sensor and monitor

2. Calibration

3. Quality control

4. Monitor maintenance
What is calibration?

- No monitor is completely accurate

- Calibration helps improve accuracy
  - Apply a math equation to monitor results to improve accuracy

  - Equation is developed by comparing your monitor’s results
    - With results from a high-end monitor
    - Or known amounts of pollutants in a lab setting

  - Equation should include other factors that impact monitor readings
    - Temperature, humidity, other pollutants

- Does your monitor need calibration?
  - Yes, unless you are only using it for personal, educational, or outreach purposes
What can impact data quality?

1. Quality of the sensor and monitor

2. Calibration

3. **Quality control**

4. Monitor maintenance
What is Quality Control (QC)?

- Removing bad data to prevent inaccurate results
  - "Data cleaning"

- When does QC happen?
  - Real-time as data are produced and displayed
  - Later when working with datasets

- Can include
  - Removing measurements known to be incorrect
  - Addressing incomplete measurements
  - Alerting when a monitor is not functioning well or is offline

- Who might do this?
  - Manufacturer
  - Project team
What can impact data quality?

1. Quality of the sensor and monitor
2. Calibration
3. Quality control
4. Monitor maintenance
Many things can impact monitor performance

- Heat
- Critters
- Loss of signal
- Cold
- Dust and dirt
- Loss of power
- Monitor “drift” over time
- Theft and vandalism

Monitor maintenance is essential for data quality
Data quality assurance and control is an ongoing process that

• should happen throughout the length of your project

• can be improved as more opportunities and resources become available
What else should you consider when selecting a monitor?

**How will data be stored?**
- On the monitor? Immediately uploaded to a server?
- Is the data secure? Backed up?

**Will you have access to the “raw” data free-of-cost?**
- Can you access the data easily?
- Can you make back up copies of the data?

**How are the data made available?**
- To you and to the public?
- How are results calculated? How are they displayed?
Question #4

How often should you perform data quality and assurance?
SETTING UP MONITORS
Why is the location of a monitor important?

- Locations should be **meaningful to the community**
  - Increase community awareness
  - Data more likely to be used
  - Data more likely to be impactful

- Locations should
  - align with **project goals**
  - consider **existing data & local knowledge**
Example – Process to engage community in choosing stationary monitoring locations

1. Define monitoring area
2. Identify colocation site
3. Recruit community residents
4. Identify and assess possible locations
5. Select final and alternate locations
What is the role of a monitor host?

- Can include:
  - Providing a secure location
  - Supplying the monitor with power and internet
  - Allowing access for installation and maintenance
  - Alerting you to any concerns or changes

- Additional information for monitor hosts can be found in guidebook pages 144-146
Before using a monitor

- Schedule a **site visit** with the monitor host or go on a **trial run** along your monitoring route

- Agree upon **where to install** the monitor

- Identify **tools and materials** that will be needed

- **Test connectivity** to the internet and GPS
What might installing a fixed monitor entail?

Example from Imperial Project:

- **Affix** a tripod or pole to the base/side of the roof of the building
- **Mount** the monitor
- **Connect** the power and network cables
- **Test** the monitor
- **Document** installation details, equipment used, passwords, and observations
What might using a portable monitor entail?

Example from Air Beams:

- **Calibrating or zeroing** the monitor to ensure fresh start

- **Connection** to an android device or GPS

- **Charge** the power of the air beam before going out on your route

- **Create** a log to track where you will be monitoring

- **Go out multiple** times to obtain baseline and capture different measurements when PM may be high
4. COMMUNICATING AND USING AIR MONITORING DATA FOR ACTION

Christian Torres, Comite Civico del Valle

Related resources

- **Guidebook**: Chapters 12-16
- **CARB**: Elements 8, 11-14
Real-time air quality data

- **What is it?**
  - Estimates of current air pollution levels at the monitor locations

- **Possible uses**
  - Increase awareness, knowledge, engagement
  - Personal exposure reduction
  - Inform school flag programs
  - Trigger additional monitoring

- **People may need to know**
  - It exists
  - Where to find it
  - What it means
  - How to use it
Historical air quality data

- **What is it?**
  - Air monitoring data collected over time
  - Includes raw data, calculated measures

- **Possible uses**
  - Document trends and hot spots
  - Respond to community concerns; investigate pollution events
  - Evaluate programs, policies
  - Conduct research
  - Inform planning and policy-making
  - Support advocacy

- **People may need to know**
  - How and where to get it
  - Data collection methods
  - Quality assurance and control measures
  - How to interpret different measures
Your goals should guide how data are communicated

- There are many ways to
  - Calculate measures and analyze data
  - Display results
  - Provide interpretation to give results meaning
  - Communicate caveats and limitations

- Will the information be appropriate for
  - Your project goals?
  - Your target audiences and their data needs?
<table>
<thead>
<tr>
<th>Who?</th>
<th>Community residents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Real time particulate matter (PM) data</td>
</tr>
<tr>
<td>What data?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>What do they want to know or do?</td>
<td>How safe is the air right now?</td>
</tr>
<tr>
<td></td>
<td>What should I do to protect my health?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Considerations</td>
<td>What air quality measures?</td>
</tr>
<tr>
<td></td>
<td>How to interpret their meaning?</td>
</tr>
<tr>
<td></td>
<td>Is this consistent with gov’t messaging?</td>
</tr>
</tbody>
</table>
What is understandable and useful for your community?

<table>
<thead>
<tr>
<th>Number range</th>
<th>Category</th>
<th>Color</th>
<th>Health Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>Low Risk</td>
<td>Green</td>
<td>It’s a good time to be active outside</td>
</tr>
<tr>
<td>51-100</td>
<td>Moderate</td>
<td>Yellow</td>
<td>If you are unusually sensitive to particle pollution, reduce physical activity outdoors. Watch for symptoms like coughing or breathing problems.</td>
</tr>
<tr>
<td>101-150</td>
<td>Unhealthy for Sensitive Groups</td>
<td>Orange</td>
<td>Sensitive groups* should reduce physical activity outdoors. Watch out for symptoms like coughing, breathing problems, unusual heartbeat, or unusual fatigue.</td>
</tr>
<tr>
<td>Above 150</td>
<td>Unhealthy</td>
<td>Red</td>
<td>Avoid physical activity outdoors.</td>
</tr>
</tbody>
</table>

Example from IVAN AIR
Question #5

Real Time air quality data can be used for all but the following…
Displaying data on the web

- Who operates the website where the data will be displayed?

- If you are not operating the website
  - How much influence will you have?
    - Data display, interpretation, messaging
  - How dependable is the website operator?
    - How long can they ensure the service?
    - Will you find out if it’s discontinued?
    - Can you take over?
Map of Monitors

Select a monitor location on the map for more information about current air quality at that location. Learn what the Community Air-Quality Level (CAL) colors mean. Gray monitors are offline.

Wednesday, December 20, 2017 at 10:00 AM

The current air quality at this monitor is

62

Moderate
Health recommendations: If you are unusually sensitive to particle pollution, reduce physical activity outdoors. Watch for symptoms like coughing or breathing problems.
Considerations

- Many ways to communicate and display data
- Which measures to use? Do they add useful information?
- What is the main reason people want this data?
- Is it easy to interpret the information?
- Test with your primary audience
- Can plan for future enhancements
When creating your community air monitoring project, cultivate partnerships, capacities, and relationships with a long-term focus.
Q&A
THANK YOU

Tracking California  |  A Program of the Public Health Institute

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