Clean Air Act Advisory Committee

EPA Research Overview: Sensors for Air Quality

Gail Robarge and Stacey Katz
Air-Energy Research Program
EPA Office of Research and Development (ORD)
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Air Sensors Research

Today

Sensor evaluations

Sensor development and application

Community air monitoring

Future directions

Involving:

ORD National Laboratories

ORD research grants and Challenges

Collaborations with EPA Program Offices, Regions, other Federal agencies, state/local/tribal agencies, industry, schools, and more….

https://www.epa.gov/air-sensor-toolbox

Air Sensor Toolbox for Citizen Scientists, Researchers and Developers

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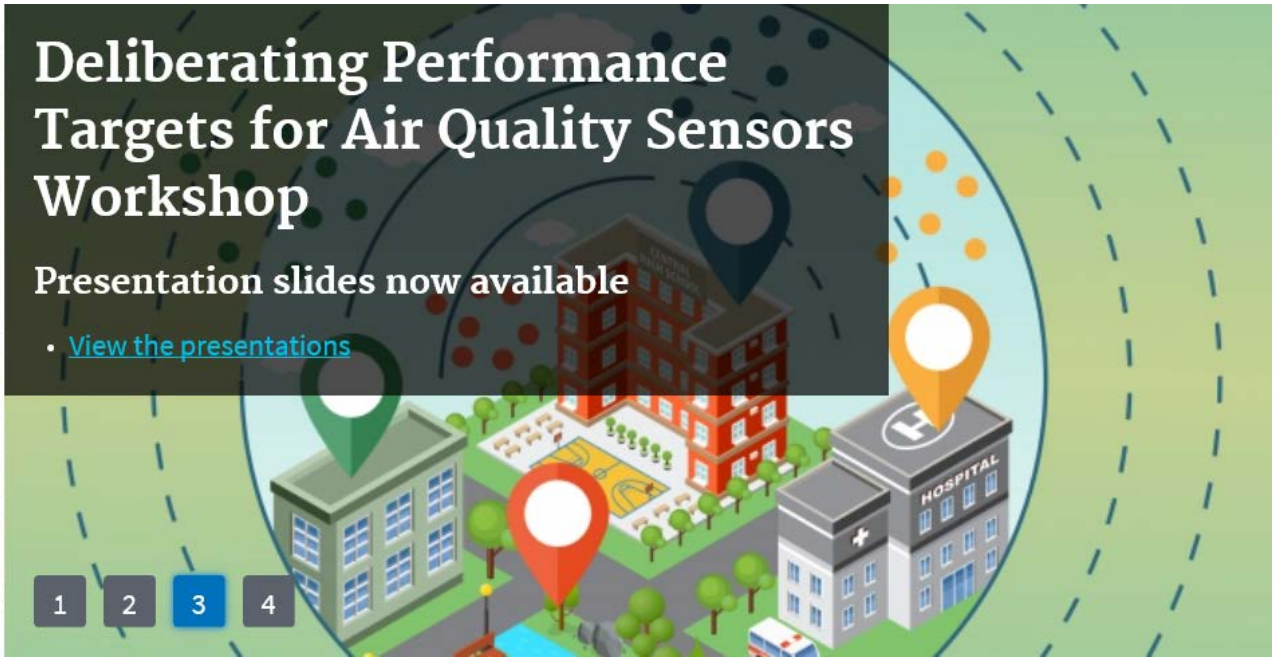


- What's New

This website provides information for citizen scientists and others on how to select and use low-cost, portable air sensor technology and understand results from monitoring activities. The information can help the public learn more about air quality in their communities.

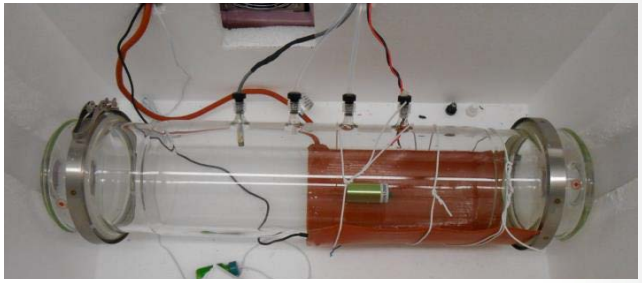
How to Use Air Sensors

What Do My Sensor Readings Mean?

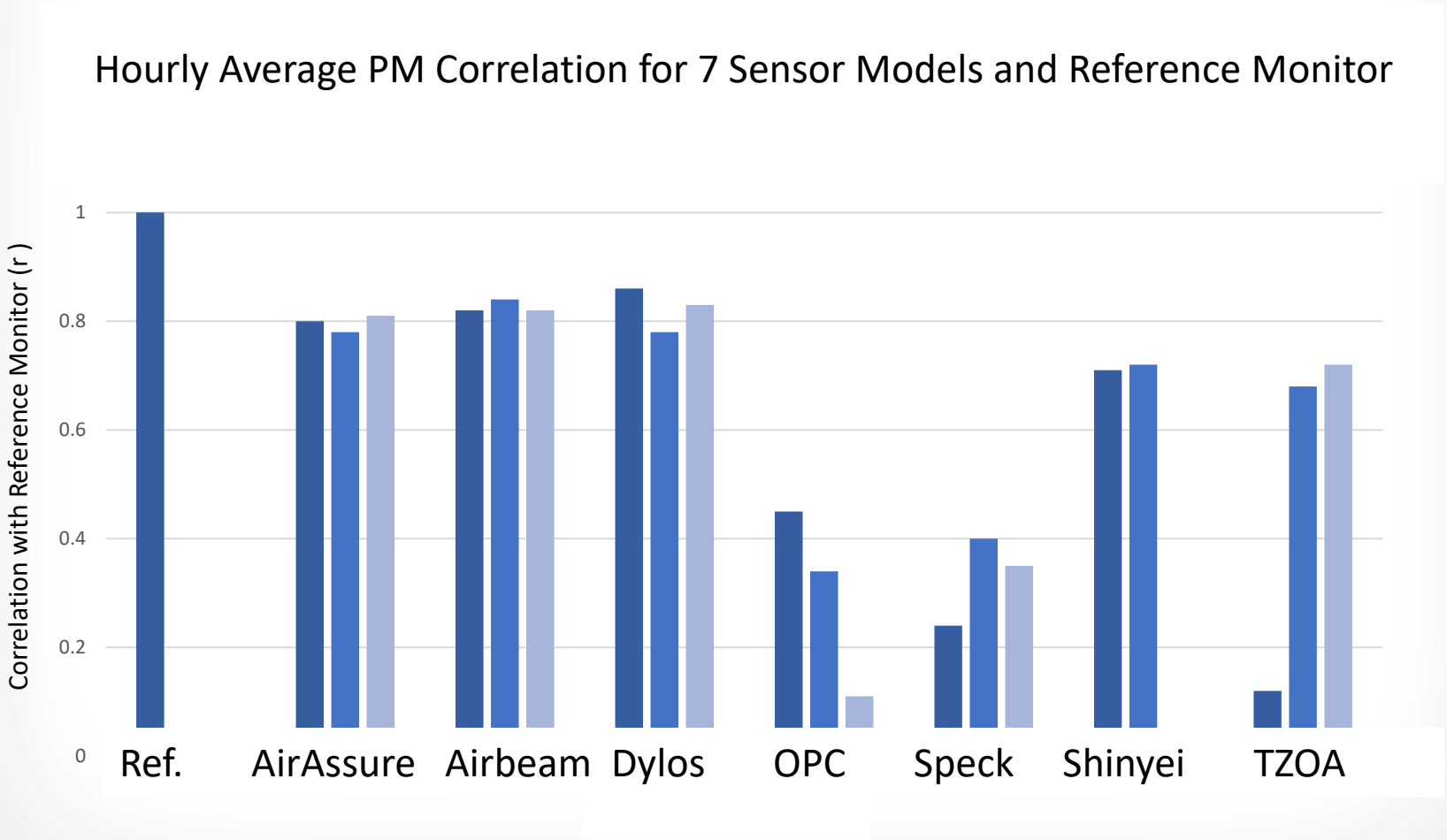
Evaluations: Understanding Sensor Performance

Co-location of sensors with reference monitors

- Laboratory-controlled environments
- Field studies



Field Evaluation in Denver



(Feinberg et al, 2018)

Some Key Findings from Sensor Performance Testing

- Surprisingly good performance from some sensors on the market
  - Others have highly variable results
  - May have high correlation with reference monitor, but may report different values (e.g., report higher concentrations) – calibration needed
- Sensor performance can be better in the lab than the field
  - Affected by temperature, humidity, high pollutant concentrations
- Good performance seen for some pollutants (PM, O_3, NO_2) but not yet for others (SO_2, VOCs)

Investigating Impact of Sources on Local Air Quality

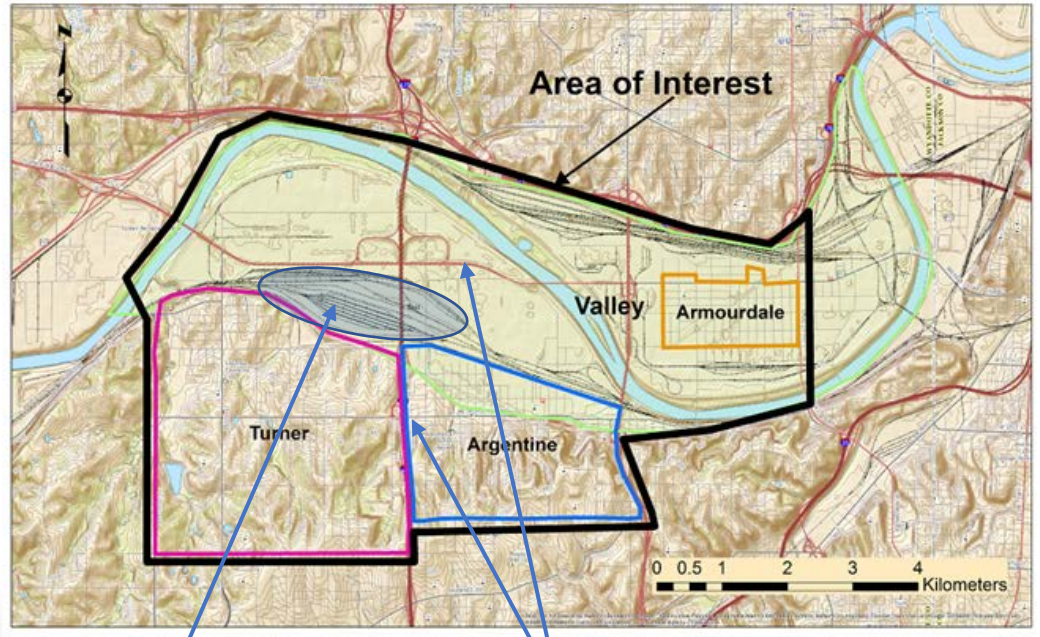
Kansas City Transportation and Local-Scale Air Quality Study

Research Questions

- What is the spatial and temporal extent of local air pollution sources in neighborhoods near the Kansas City railyard?
- What is the impact of these sources on local air quality?

Ongoing Oct 2017 – Oct 2018

- Measurements: $PM_{2.5}$, black carbon, local meteorology
- Reference monitors
- Lower-cost sensors (Purple Air)
- Mobile measurements
- Citizen science



Wildland Fire Sensors Challenge

Shared vision by partnering organizations:

A desire to advance air measurement technology to be **easier to deploy**, suitable to use for **high concentration events**, **durable** to withstand difficult field conditions, and able to report data **continuously and wirelessly**. Desired measurements: $PM_{2.5}$, O_3, CO, CO_2.

- Challenge launched April 2017
- 10 systems tested
- Interagency judging panel

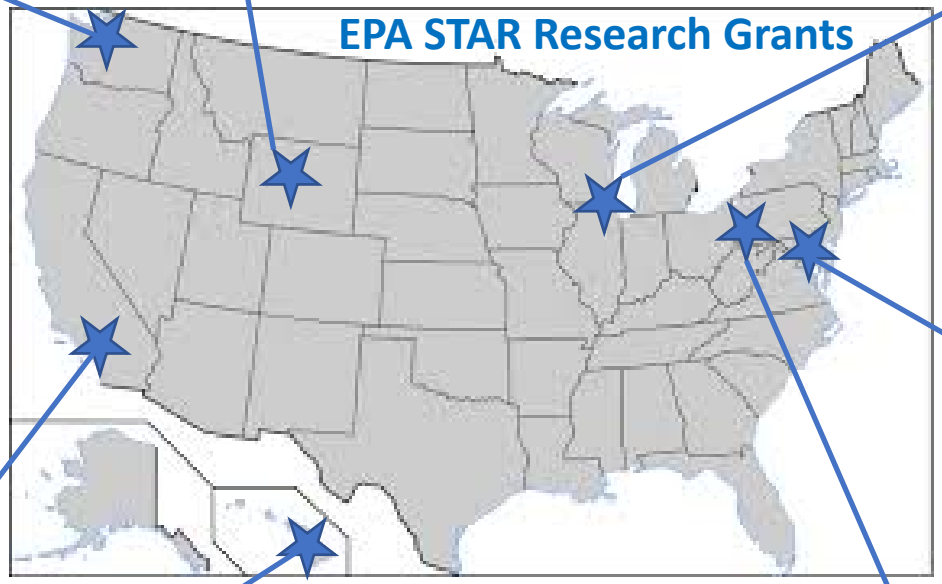
- $60,000 in prizes
- 1st & 2nd Place, and honorable mention, announced Sept.12, 2018 at Air Sensors International Conference

Community Air Monitoring

University of Washington
Next Generation Sensors and Scientists to Reduce Wood Smoke

Research Triangle Institute *Monitoring the Air in Our Community*

Kansas State University
Shared Air/Shared Action: Community Empowerment through Low-cost Air Pollution Monitoring



South Coast Air Quality Management District
Engage, Educate, and Empower California Communities

Yale Research Center
Novel High-Resolution Ambient Air Monitoring Networks and Personal Monitors

Massachusetts Institute of Technology *Hawaii Island Volcanic Smog Sensor Network*

Carnegie Mellon University
Tools for Community Action on Air Quality

Next: Sensor Performance over Longer Time Frames

- Compare sensor performance across diverse locations
  - Six sites, including Phoenix, Atlanta, Delaware
  - Six different PM sensors (Purple Air, AriSense, others TBD)
  - Year-long study

- Phoenix Testbed Project:
  - Deploy $PM_{2.5}$ sensors at 3 regulatory monitoring sites
    - Hot, arid, dusty conditions; pilot and year-long deployment
  - Sensor network to look at local $PM_{2.5}$ sources of woodsmoke
  - Partnership with Maricopa County and AZ DEQ

On the Horizon

ORD Air and Energy Strategic Plan expected Fall 2018

Anticipating…

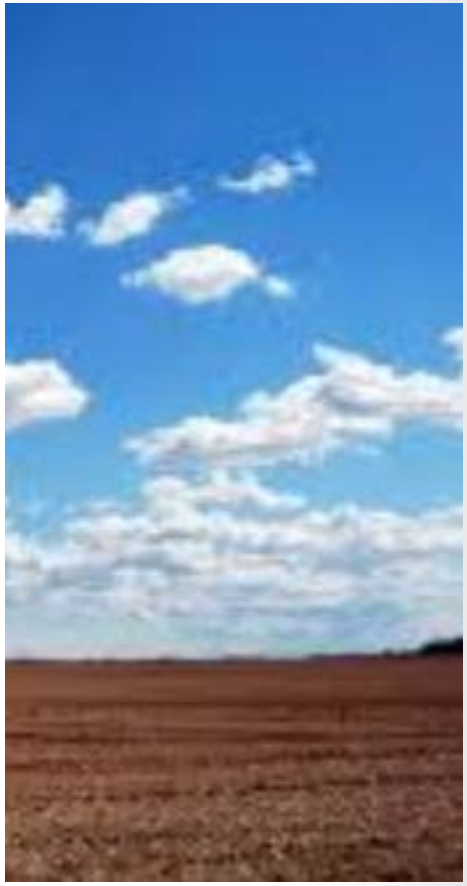
- Continued strong emphasis on air measurement methods

  …from low cost sensors to regulatory methods

- Support for state and local agencies

  …providing R&D in solving complex air pollution challenges

- Special focus: wildfire emissions and impacts



Many EPA Staff Involved

- Air Sensor Project Lead. Ron Williams (NERL)
- Big data considerations, data standards and infrastructure. Vasu Kilaru (NERL)
- Village Green. Sue Kimbrough (NRMRL), Gayle Hagler, Terri Conner (NERL), Rachelle Duvall (NERL/NRMRL)
- Kansas City TRAQS. Sue Kimbrough (NRMRL)
- Sensor evaluations. Ron Williams, Teri Conner, Andrea Clements (NERL)
- Sensor evaluations data analytics. Steven Feinberg (NRMRL/ORISE)
- Citizen Science. Rachelle Duvall (NERL/NRMRL), Maribel Colon (NERL), Stephen Reese (NERL/ORISE), Amanda Kaufman (OAQPS)
- Time activity and APP model development. Michael Breen (NERL)
- Aerial sensor platforms. Brian Gullett (NRMRL)
- Black carbon detection and analysis. Amara Holder (NRMRL)
- Sensor development & evaluation, stationary & mobile platforms. Paul Solomon, Surender Kaushik (NERL)
- Ground and aerial-based ammonia detection. Jesse Bash (NERL)
- Ground, aerial, ship-based environmental measures. Jim Szykman (NERL).
- Data fusion. David Holland (NERL)
- Data visualization/RETIGO. Gayle Hagler (NERL)
- STAR Research Grants. Richard Callan and Sherri Hunt (NCER)
- Wildland Fire Sensors Challenge. Matt Landis (NRMRL) and Kirk Baker (OAQPS)
- Policy and Innovation. Stacey Katz and Gail Robarge (Air-Energy Team)

+ Many additional team members in ORD, EPA Regions, Program Offices, state / local / tribal agencies, private sector and other federal agencies!