EPA’s Efforts on Discovery, Evaluation, and Application of Emerging Air Sensor Technologies

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Making Sense of Sensors Conference
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Ultimately, air sensor technology has promise to reduce pollution exposure and improve public health through

- Improved knowledge on exposure to air pollution at a community and individual level
- Identification and investigation of emission sources within a community
- More extensive data supporting public health communication – e.g., sensors for Air Resource Advisors during wildland fires
EPA/ORD activities involve

- Air sensor market research and technology evaluation
- Development and application of custom sensor systems for specific research studies
- Development of sensor data analytics, visualization, and real-time quality assurance measures
- Outreach and training

Air Sensor Toolbox: [https://www.epa.gov/air-sensor-toolbox](https://www.epa.gov/air-sensor-toolbox)
Development and application of custom sensor systems

Village Green Project

Drop-in-place sensor pods

Mobile sensors

Fenceline monitoring

Aerial systems

Most common measures:
- PM$_{2.5}$
- Ozone
- NO$_2$
- VOCs
- Black carbon

Wildland Fire Sensors Challenge
Community-based research project designed to

- Demonstrate the capabilities of new real-time monitoring technology
- Provide first real-time streaming of air quality data by EPA
- Help residents and citizen scientists learn about local air quality

**Key Features:**
- Mid-cost pollutant sensors (PM, ozone, etc.)
- Meteorological sensors (temp, RH, WS, WD)
- Power supply (solar panels & battery)
- Microprocessor and cellular modem

**Ongoing Work:**
- Full design, operational specifications, and access to historical data - expected in 2018
Village Green Partners

City of Philadelphia and National Park Service

State of Kansas, Wyandotte County, and School District

District Department of the Environment and Smithsonian

State of Oklahoma and Myriad Botanical Gardens
The data website allows users to:

- Access real-time pollutant data in their community
- Explore historical data to understand the variability in pollutant concentrations
- Access the health-based Air Quality Index for their area
- Better understand the pollutant concentration based on the sensor scale categorization

Real-time data and interactive exploration available online at: [airnow.gov/villagegreen](http://airnow.gov/villagegreen)

More information on the sensor scale categories and the development process is available at: [www.epa.gov/air-sensor-toolbox/what-do-my-sensor-readings-mean-sensor-scale-pilot-project](http://www.epa.gov/air-sensor-toolbox/what-do-my-sensor-readings-mean-sensor-scale-pilot-project)
The AirMapper collects real-time data about pollutants and the environment:

- Portable, small, and lightweight allowing it to be carried to mounted to a bicycle
- Allows citizen scientists and students to explore the community and learn about factors that influence air quality

**Key Features:**
- Low-cost pollutant sensors (PM, CO₂)
- Other environmental sensors (temp, RH, noise)
- Accelerometer and GPS
- Rechargeable battery power
- On-board data storage
- Touchscreen interface
The CSAM is an evolving portable monitor collecting real-time data about pollutants and the environment:

- Numerous community applications through the country
- Allows citizen scientists to establish a small network of monitors to investigate community air quality issues

**Key Features:**
- Low-cost pollutant sensors
- Meteorological sensors (temp, RH, etc.)
- On-board data storage + cellular modem
- Power options including solar
- Portable and easy to use
Development of a variety of tools to help users understand the quality of their sensor data and to visualize the results.

Sensor Evaluation and Collocation Instruction Guide

Macro Analysis Tool

RETIGO

How to Evaluate Low-Cost Sensors by Collocation with Federal Reference Method Monitors

National Exposure Research Laboratory
Office of Research and Development

Data Interpretation Tools
Instructional guide for conducting a successful collocation evaluation of air sensors with regulatory grade instruments:

- Provided as a PowerPoint presentation for easy reading for a wide audience with visuals, examples, and links
- Helps users evaluate collocation data and to interpret the quality of the measurements for communication to others
- Public release to the Air Sensors Toolbox – expected late 2017

Topics Covered:
- Low-cost sensors vs reference
- Introduction to collocation
- Planning collocation
- Making measurements
- Data recovery and review
- Data comparison
- Using sensors
Macro Analysis Tool

Easy-to-use spreadsheet-based macro tool for performing data comparisons and interpreting the results:

- Tackles a big hurdle for citizen-led community air monitoring projects – working with the data
- Public release to the Air Sensors Toolbox – expected late 2017

The tool will
- Time match the sensor and reference data
- Average data into longer averaging times
- Plot a time series of selected data
- Plot sensor versus reference data and develop a regression equation

Correlation

Time Series

Macro Analysis Tool - MAT
Use this tool to process sensor data, reference data, or both!

This tool can
- time match the sensor and reference data streams.
- average selected data into longer time averages.
- plot a time series of selected data.
- plot sensor versus reference data and develop a regression equation.

This tool cannot
- process time stamps expressed as fractions.
- process input time intervals that vary.
- run reliably using Excel versions XX and Windows versions XX.
Real Time Geospatial Data Viewer (RETIGO) is a free, web-based tool that can be used to explore stationary or mobile environmental data:

- Adds data from nearby air quality and meteorological stations
- Added functionality in Version 3 – expected early 2018

Online at:
www.epa.gov/retigo
Acknowledgements

Contacts:

- Air Sensors Toolbox: [www.epa.gov/air-sensor-toolbox](http://www.epa.gov/air-sensor-toolbox)
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- AirMapper – Sue Kimbrough, Ron Williams, Gayle Hagler
- CSAM – Ron Williams
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