

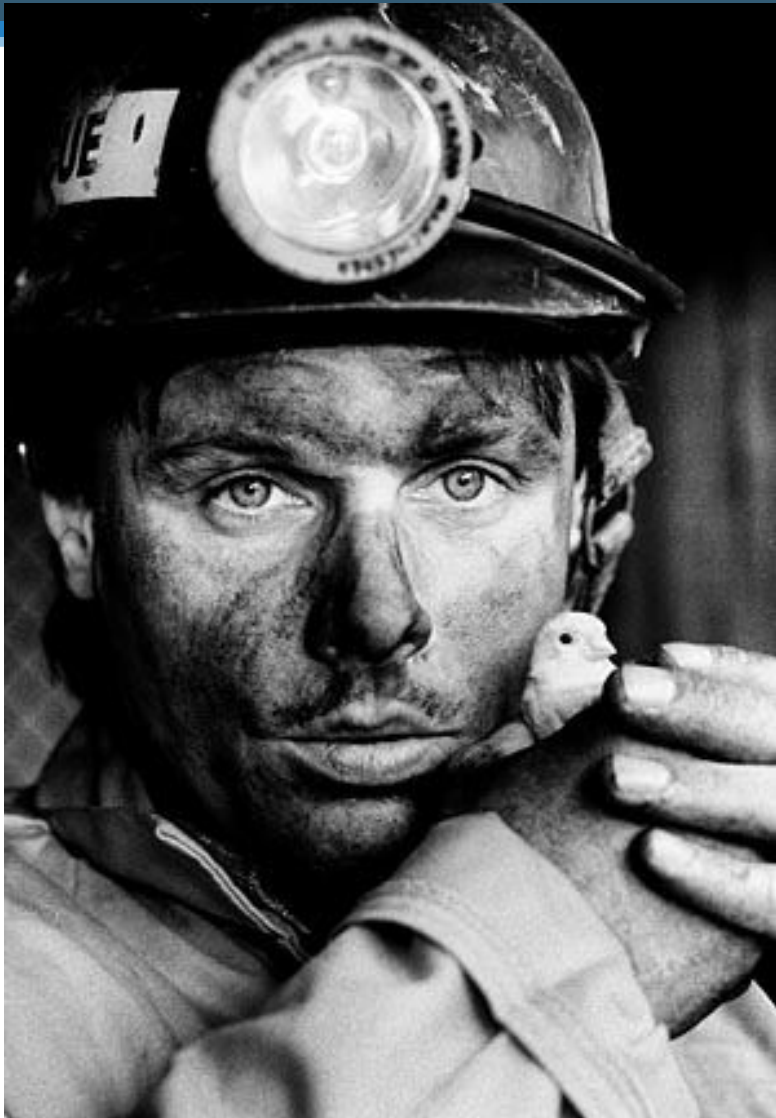
EPA Air Sensor Efforts: Activities & Highlights

Meredith Kurpius, PhD
U.S. Environmental Protection Agency, Region 9
Air Sensors International Conference
September 13, 2018



Changing Trends in Air Measurements





21st Century 'Canary in a Coal Mine'

The Pigeon Air Patrol — a joint project by tech companies Plume Labs and DigitasLBI — released pigeons outfitted with air-monitoring packs to record and report real-time air pollution levels in London. This three-day venture was used to spread awareness on London's smog problem.

WHAT IT IS
Racing pigeons wear a small fabric vest outfitted with a feather-light backpack.

Lightweight fabric harness



Air monitor detects ozone and nitrogen dioxide

One pigeon wore a GPS device instead of an air monitor.

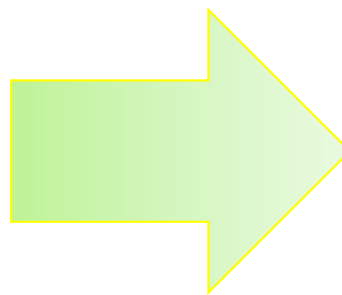
HOW IT WORKED
Londoners Tweeted their location to a Pigeon Air team member and received real-time results (via Twitter) of air quality in their area.



SOURCE: DigitasLBI

PAUL HORN / InsideClimate News

Portable low-cost sensors: we've come a long way



Current Technology for Ambient Air Quality Measurement

Fixed Air Monitors

- Reliable, defensible
- Established QA protocols
- Collected by gov, industry, researchers
- Data stored and explained on gov websites
- Expensive
- Often snapshot
- Big footprint with dedicated power source
- Instruments require expertise to operate
- Often delays for lab analysis



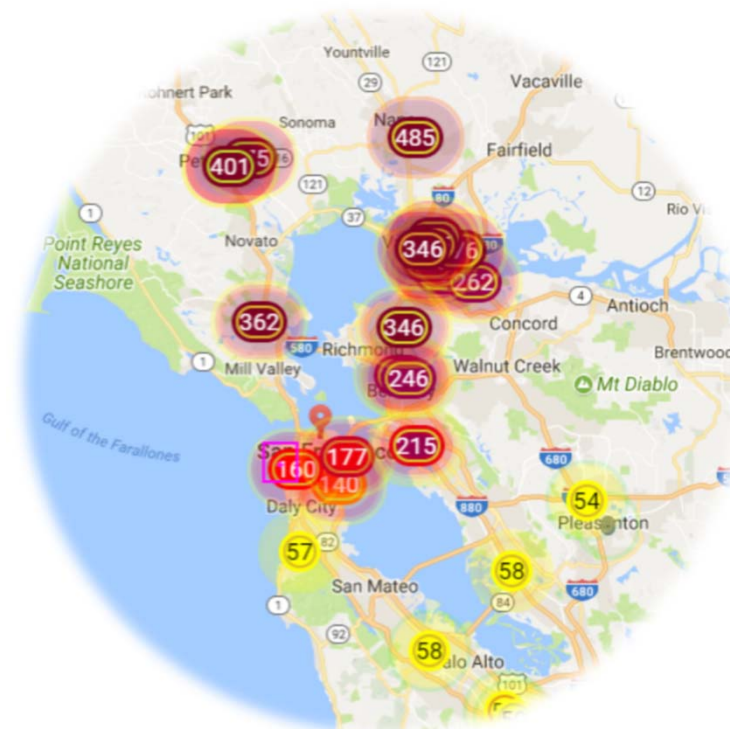
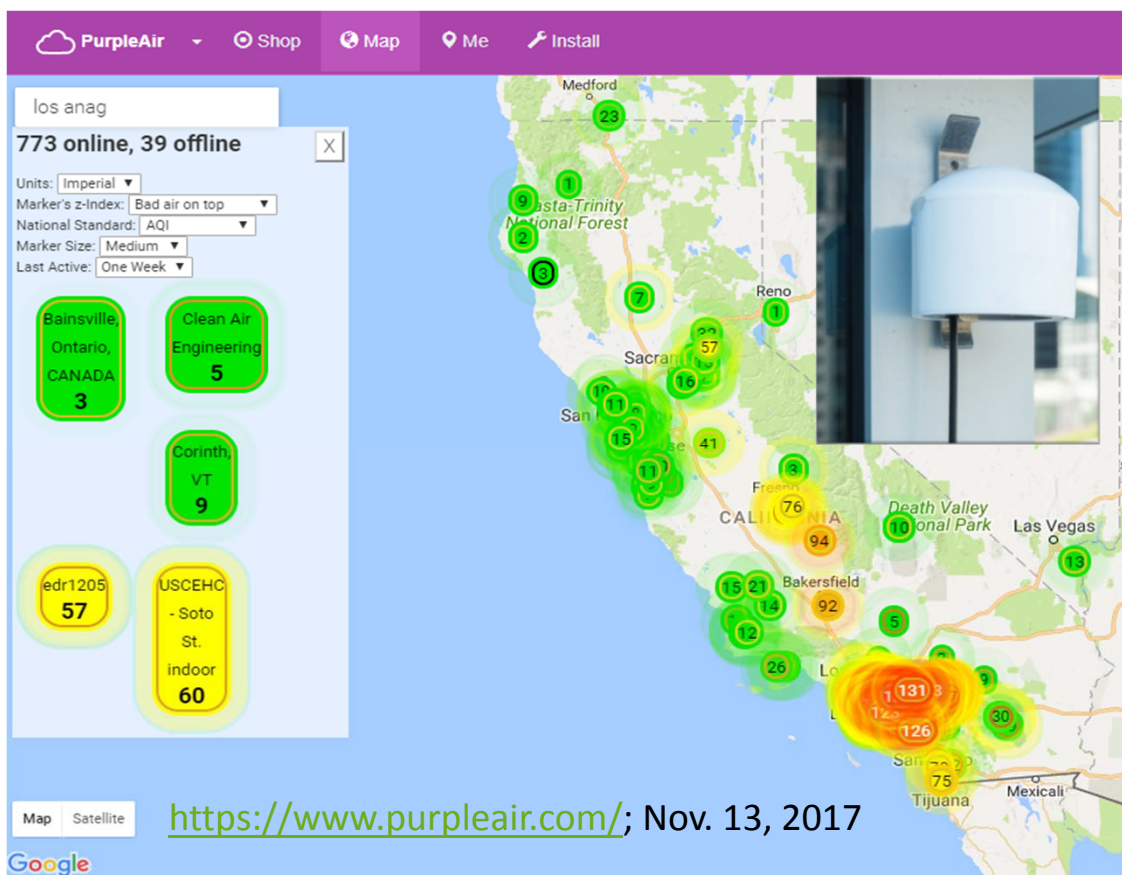
Emerging Technology for Ambient Air Quality Measurement

Portable Air Sensors

- Low cost
- Often continuous
- Small footprint or mobile, battery or solar power
- Perhaps easy-to-use
- Real-time w/o lab analysis
- Collected by communities and individuals
- Data shared and accessed on non-gov sites
- QA protocol gaps
- Reliability?
- What do the data mean?



Example of non-regulatory, low-cost air sensor technology with potential use for air quality monitoring during wildfire smoke events



Purple Air PM_{2.5} Sensor Map during North Bay Wildfires – Oct. 10, 2017



Disclaimer: Mention of companies, trade names, or products do not constitute endorsement by U.S. EPA.

Key Points for Air Sensor Measurements

- Not a replacement for regulatory grade, high quality monitors
- Should be selected to fit a purpose
- Requires human, institutional, and equipment systems
- Quality assurance is critical
 - Guidance is being discussed to clarify appropriate uses of secondary data from sensors
 - <https://www.epa.gov/air-research/presentations-deliberating-performance-targets-air-quality-sensors-workshop>



EPA Efforts on Air Sensors

- Promote Data Quality
- Workshops
- Literature and Market Review
- Technology Development and Evaluation
- Tool Development
- Training
- Local Projects



Promoting Data Quality

- Multiple sensor data uses and applications
- Need to systematically evaluate sensor performance and data quality
 - Accuracy, precision, durability and overall reliability
 - Calibration and drift
 - Other performance issues
- EPA ORD Sensor Evaluations & South Coast AQ-SPEC Program
 - <https://www.epa.gov/air-sensor-toolbox>
 - <http://www.aqmd.gov/aq-spec>
- EPA Performance Characterization Workshop



EPA Sensor Performance Target Workshop – June 2018

- What we heard...
 - Mixed performance findings in the literature
 - Desire for certification, but how and for whom?
 - Binary vs. tiered program?
 - Critical performance attributes
 - International perspectives & initiatives
- Next Steps
 - Publication of workshop findings at end of 2018
 - Performance targets and protocols for PM_{2.5} and O₃



Literature Review Findings - Application Categories

- Air quality forecasting
- Air quality index (AQI) reporting
- Community near-source monitoring
- Control strategy effectiveness
- Data fusion
- Emergency response
- Epidemiological studies
- Exposure reduction (personal)
- Hot-spot detection
- Model input
- Model verification
- Process study research
- Public education
- Public outreach
- Source identification
- Supplemental monitoring





EPA Office of Research and Development Sensor Efforts

- Market research and technology evaluation
- Development and application of custom systems for research
- Development of data analytics, visualization, and quality assurance guidance
- Outreach and training
- NEW - Long term sensor performance evaluations

EPA United States Environmental Protection Agency

Environmental Topics Laws & Regulations About EPA Search EPA.gov

Air Sensor Toolbox for Citizen Scientists, Researchers and Developers

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Putting new ways to measure air quality into the hands of the public.

Air Sensor Citizen Science Toolbox
Measure · Learn · Share

- [Announcements](#)
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- **Related Links**
 - [Air Trends Report](#)
 - [AirNow - Current Air Quality](#)
 - [Air Research](#)

EPA Air Sensor Toolbox

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



Sensor Data Interpretation Challenges and Tools

- More real-time air quality data are available and may be helpful during air quality events
- How do we ensure sensor data is communicated with a scientifically-grounded approach?
- How do we better understand behavioral responses to sensor data?

EPA development of tools to help users understand sensor data quality and to visualize the results



Data Interpretation



- EPA's Erika Sasser will discuss:
 - Air quality and health
 - Data interpretation and communication
 - Research needs



EPA Air Sensor Projects

Overview of EPA's projects

- Smart City Challenge: 2 communities engaged (Baltimore/Lafayette)
- Village Green: 8 stations nationwide
- STAR Grant Program: Six academic/community partnership grants
- Community-specific research opportunities
- Multiple region-based citizen science projects
- Wildland Fire Sensors Challenge





Wildland Fire Sensors Challenge

<https://www.challenge.gov/challenge/wildland-fire-sensors-challenge/>
#WildlandFireSensors

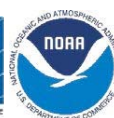
Advance air measurement technology through the development of sensors capable of rapid deployment and continuous real-time monitoring of air pollution levels during a fire event ($PM_{2.5}$, CO, O₃, CO₂)





Wildland Fire Sensors Challenge Winners

- **First Place:** Jason Gu and Bryan Tomko with SenSevere/Sensit Technologies with R. Subramanian with Carnegie Mellon University, Pittsburgh, Pa.
- **Second Place:** Scott Waller and Andrew Smallridge with Thingy LLC, Bellevue, Wash.
- **Honorable Mention:** Javier Fernandez with Kunak Technologies®, Pamplona, Spain.



R9/R10 Joint Wildfire Sensors Research Project

- PM_{2.5} sensors deployed during wildfires in Region 9 or Region 10 (ID/OR/WA) by Air Resource Advisors from the USFS's Wildland Fire Air Quality Response Program
- Coordinate with relevant S/L/T agencies for sensor deployment
- Anticipated Products:
 - Evaluation report comparing sensor performance data with reference monitors
 - Contribute to ORD's Air Sensor Toolbox and community air monitoring resources
 - Strategy for communicating sensor data to the public and first responders in impacted areas (<https://sites.google.com/firenet.gov/wfaqrp-external/smoke-monitoring>)





Smoke Outlook for 9/05 - 9/06 Shasta-Trinity Area - HIRZ FIRE

Issued at: 2018-09-05 07:01 PDT

Outlook for Shasta-Trinity Area

Fire

The Hirz fire is 46,142 acres with 91 new acres yesterday at 70% contained. The fire activity decreased as containment and rehabilitation of the fire line and interior continue. The few remaining islands and hot spots have continued to decrease emissions of smoke.

Smoke

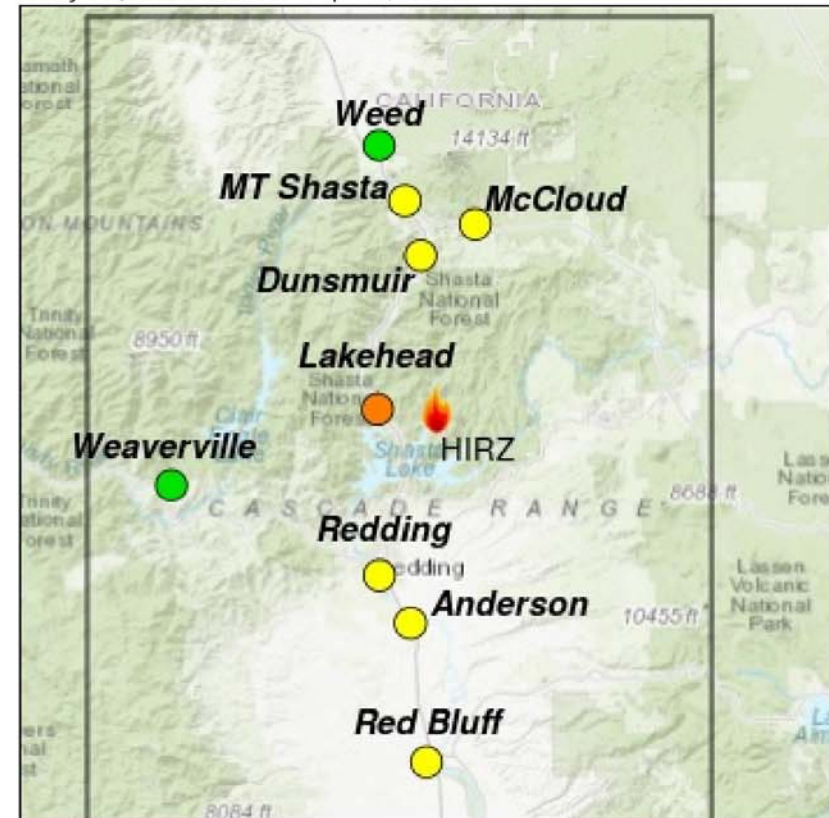
The southwest winds assisted with clearing out of the remaining smoke that had held up in the drainages around Red Bluff, Anderson, Redding and Lakehead. The reduction of smoke in the areas led to better air quality index readings in the later part of the afternoon. Most of the area will see reduction of smoke throughout the day. McCloud area will see hazy skies increasing smoke aloft as the southwest winds push the smoke north. We should see moderate to good conditions improving in the coming days.

Others

The Hirz fire has reduced the amount of personnel on the fire and will end unified command today. They will continue recovery and rehabilitation efforts through the week.

<https://wildlandfiresmoke.net/outlooks/>

Daily AQI Forecast for Sep 05, 2018



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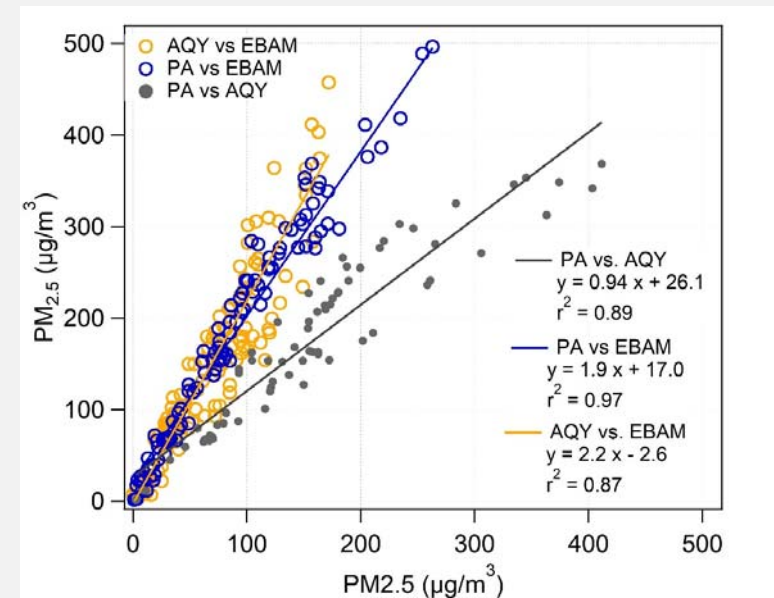
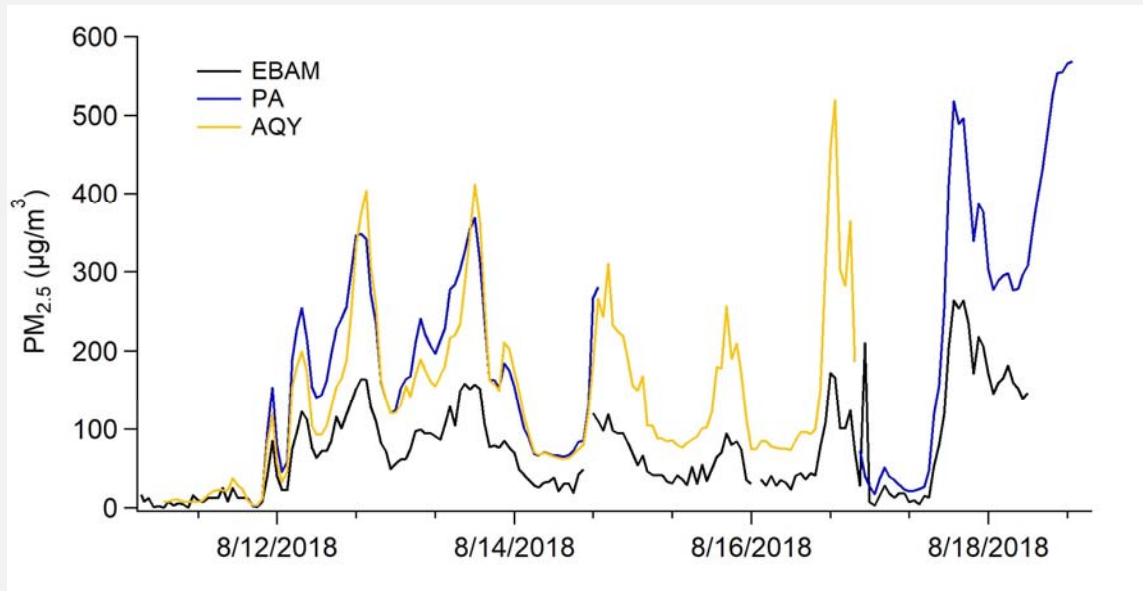
82

Performance Testing of Next Generation Air Sensors During Wildfires

Presenter: Anna Mebust, U.S. EPA Region 9



Results from preliminary sensor deployment in Happy Camp (Siskiyou County, CA) during the Natchez Fire:



Additional EPA Region 9 Sensor Projects


Several research projects aimed at testing the performance of air sensors under a variety of applications (wildfire smoke events, tribal woodsmoke impacts, localized, near-road and urban pollution sources)



Path forward – Advanced Monitoring E-Enterprise Initiatives

- E-Enterprise for the Environment is a model for collaborative leadership among environmental co-regulators. Working together, environmental leaders at EPA, the states and tribes, are utilizing the E-Enterprise model to simplify, streamline and modernize the implementation of our environmental programs.
- Example Project: Sensor Certification – exploring the development of a third party sensor evaluation/certification program
 - PM_{2.5} and ozone sensors are the main candidates
 - Based on performance (e.g., star rating system)
 - Based on application (e.g., multi-tier system)
- Example Project: Data Standards - identification of data and metadata standards for air and water sensors for consideration by the EPA.





The best way to predict the future is to create it
(Abraham Lincoln)