



Air Sensors: Current Activities

AAPCA Fall Meeting Topical Session: *Preparing for Personal Air Sensors: Communication, Context and Perspectives*

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Proliferation of Sensors & Real-time Data

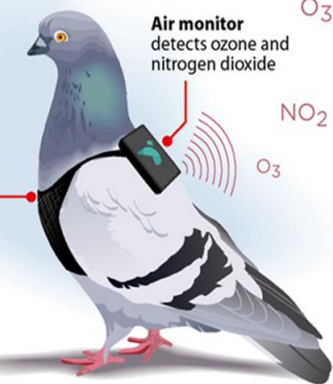


21st Century 'Canary in a Coal Mine'
The Pigeon Air Patrol — a joint project by tech companies Plume Labs and DigitasLBI — released pigeons outfitted with air-monitoring packs to record and report real-time air pollution levels in London. This three-day venture was used to spread awareness on London's smog problem.

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

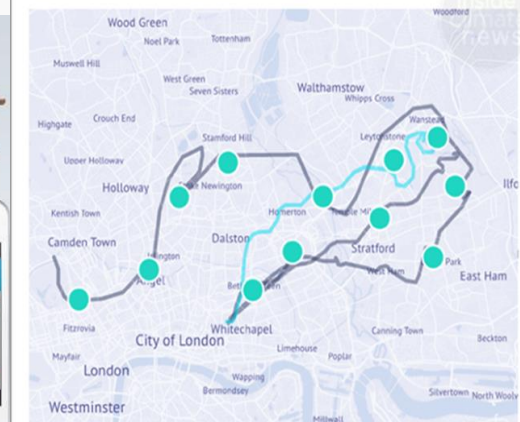
Air monitor
detects ozone and nitrogen dioxide

Lightweight fabric harness



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

Proliferation of Sensors – Current Events



Some recently launched projects include EPA involvement, others do not...

1) First Array of Things Sensors Installed on Chicago Streets

- <http://www.chicagotribune.com/bluesky/originals/ct-array-of-things-sensors-installation-bsi-20160829-story.html> (August 29, 2016)



2) Busiest U.S. Border Crossing Gets Community Air Monitoring Network (August 26, 2016)

- <http://www.calepa.ca.gov/PressRoom/Releases/2016/BorderMonitor.htm>

3) Six Organizations Receive \$4.5 Million in EPA Grants to Conduct Low-Cost Air Monitoring Research Projects (August 9, 2016)

- https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/recipients.display/rfa_id/587

4) EPA Offers up to \$80,000 to Communities to Develop Air Sensor Data Best Practices (August 30, 2016)

- <http://www.challenge.gov/challenge/smart-city-air-challenge/>





Current Technology

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

New Technology

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

Sensor Activities - Evaluations



- EPA and States are facing increased pressure to take action on non-regulatory data
- EPA is working across offices to evaluate emerging technologies:
 - ORD – Publication of sensor evaluation reports for O₃, NO₂, PM, and VOCs, the DISCOVER A-AQ project to test sensors collocated with reference instruments, fenceline sensor evaluations for VOCs, Village Green monitoring stations streaming real-time ozone and particulate matter data to the public, development of standard operating procedures for various handheld sensors, a citizen science toolbox to aid in the design of community based monitoring studies, Regional applied research efforts (RARE).
 - OAR – Tribal pilot study with the Leech Lake Band of Ojibwe to use three PM_{2.5} sensors and compare results with onsite FEM instrumentation.
 - OECA – Purchase of infrared cameras for Regions 1, 2, 3, 4, 5, 6, 8, and 10 for use in leak detection and repair.

Sensors – Moving Forward



E-Enterprise Advanced Monitoring Scoping Team (EEAMT) Recommendations

- E-Enterprise Leadership endorsed five recommendations in April 2016
- Members: States (organized by ECOS), OAR, ORD, OECA, OW, OEI, and EPA Regions 1 & 2

Recommendations:

#1: Feasibility study for a voluntary 3rd party certification program

#2: Technology screening and support network

- Recommendations 1 & 2 will build on lessons learned from sensor evaluations and pilot projects
<https://www.epa.gov/air-research/air-sensor-toolbox-citizen-scientists>

#3: Interpretation of data from advanced monitoring approaches

- Finalize & expand pollutant list for prototype website that messages short term, real-time measurements
<http://bit.ly/VillageGreenPilot>

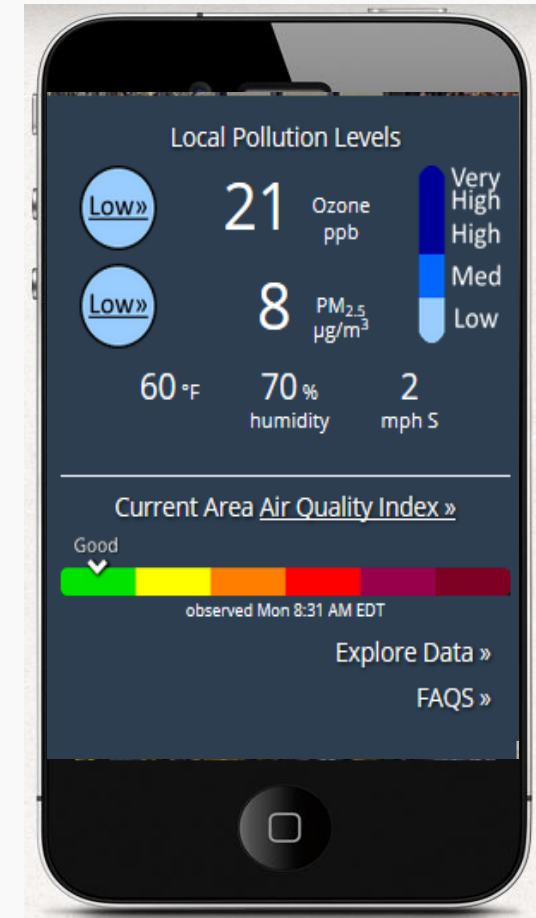
#4: Data standards & data quality tiers

#5: Lean technology evaluation parameters

Sensor Scale Pilot Project



- On May 6th, EPA launched a new “sensor scale”
 - EPA developed the scale to help the public understand 1-minute data from Village Green stations
- Pilot appears on existing Village Green data webpage
 - <http://bit.ly/VillageGreenPilot>
- A fact sheet, FAQs, and other information available on the Air Sensors Toolbox
 - <https://www.epa.gov/air-research/air-sensor-toolbox-citizen-scientists>
- EPA is testing the effectiveness of the scale and messages during a spring-summer 2016 pilot project



Previous Village Green Website





Village Green Project x

Environmental Protection Agency [US] <https://www.airnow.gov/index.cfm?action=airnow.villagegreen>

Apps G rrwebmail Google News wral weather OCASL ncdot Travel Rolling Stone TheAtlantic Dictionary.com http://villagegree

Select a City ▼ Durham, NC Menu



Most Recent Observations
Durham, NC


27	Ozone ppb	52.5 °F
0	PM _{2.5} µg/m ³	46% humidity
		3.1 mph W

observed Fri 9:06 AM EDT


Explore Durham, NC

Welcome to the Village Green Project

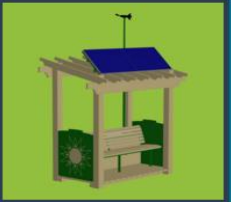
a research effort to discover new ways of measuring air quality and weather conditions in community environments.



Measuring and communicating on-the-spot air quality and weather conditions for research and awareness



Developing small and rugged data collection systems that can be powered by the wind and sun



Partnering with communities to pilot test the new technology in outdoor community spaces.

9:11 AM
4/8/2016

Enhanced Village Green Website



24.104.117.6/welcome

Search

Select a City Philadelphia, PA Menu

Local Pollution Levels

Low»	21	Ozone	ppb	Very High
Low»	8	PM _{2.5}	µg/m ³	High
				Med
				Low

60°F 70% humidity 2 mph S

Current Area Air Quality Index »


Good

observed Mon 8:31 AM EDT


Explore Data »

FAQS »


Welcome to the Village Green Project
a research effort to discover new ways of measuring air quality and weather conditions in community environments.



Measuring and communicating on-the-spot air quality and weather conditions for research and awareness



Developing small and rugged data collection systems that can be powered by the wind and sun




Partnering with communities to pilot test the new technology in outdoor community spaces.

About Village Green »

Data shown on these pages are preliminary and subject to change.


Ozone Breakpoints and Messages



Pilot version 1-Minute Ozone Readings <i>Not for regulatory purposes</i>	
Low 0-59 ppb	Enjoy your outdoor activities.
Medium 60-89 ppb	If medium readings continue, use the Air Quality Index to plan outdoor activities.
High 90-149 ppb	If high readings continue, consider adjusting outdoor activities, especially if you are sensitive to ozone. Check the Air Quality Index to find out.
Very High ≥150 ppb	If high readings continue, consider adjusting outdoor activities. Check the Air Quality Index to find out. Very high readings may mean the sensor is not working properly.
	Sensor may be offline. Check the Air Quality Index.

PM_{2.5} Breakpoints and Messages



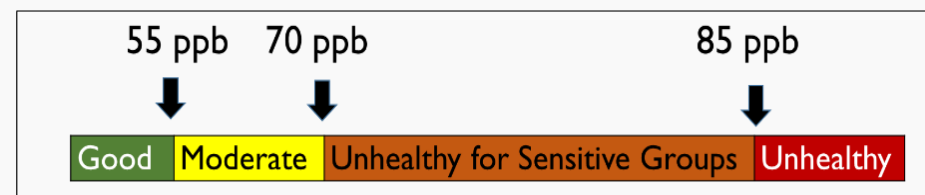
Pilot version 1-minute particle pollution (PM _{2.5}) readings <i>Not for regulatory purposes</i>	
Low 0-29 ug/m3	Enjoy your outdoor activities.
Medium 30-69 ug/m3	If medium readings continue (for an hour or more), use the Air Quality Index to plan outdoor activities.
High 70 - 499 ug/m3	You may be near a source of particle pollution like dust, smoke or exhaust. Check the Air Quality Index to plan outdoor activities.
Very High ≥500 ug/m3	You may be near a source of particle pollution like dust, smoke or exhaust. Check the Air Quality Index to find out if you should adjust outdoor activities. Very high readings may mean the sensor is not working properly.
	Sensor may be offline. Check the Air Quality Index.

Ozone Sensor Breakpoints

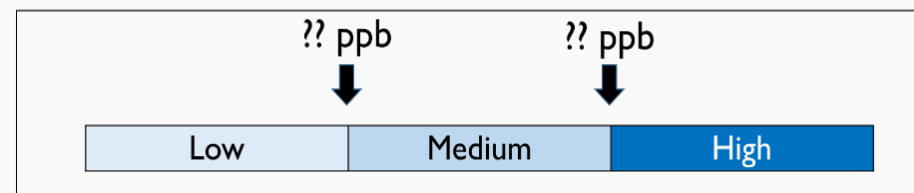


- Used available air quality data, together with judgments about the objectives for each sensor category
- Air quality analyses link 1-minute to 8-hour O₃ concentrations to inform sensor breakpoints without reinterpreting the health evidence
- ~7.6 million one minute ozone values from 18 sites (4 Village Green locations and 14 FRM)
- Numerous scenarios were analyzed to evaluate how 8-hour O₃ concentrations are distributed within various potential sensor categories

AQI Categories (8-hr)



Potential Sensor Categories (1-min)



PM_{2.5} Sensor Breakpoints



- For PM_{2.5}, the available 1-minute data is more limited than for O₃
 - **5 monitors provide 1-minute PM_{2.5} data (DC, PA, KS, NC, NY)**
- PM_{2.5} concentrations can exhibit sharp spatial and temporal gradients, with the potential for extremely high concentrations near sources
- PM_{2.5} AQI categories are based on 24-hour concentrations; 24-hour PM_{2.5} NAAQS is 35 µg/m³

Near-Source Concentrations

1. Designated smoking areas:
~ 70 to > 500 µg/m³
2. Near/on diesel buses:
~ 75 to > 1,000 µg/m³
3. Near street paving operation:
~ 80 µg/m³
4. Near candles/cooking
~ 100 to > 1,000 µg/m³

Analytical Approach for PM_{2.5}



Low breakpoint (30 $\mu\text{g}/\text{m}^3$):

- Considered relationship between 1-hour and 24-hour PM_{2.5} concentrations
- Much more data available to identify relationships with 1-hour concentrations – almost 400 monitors covering most states
- One-hour PM_{2.5} concentrations are better predictors of 24-hour concentrations

Upper breakpoint (70 $\mu\text{g}/\text{m}^3$):

- Identification of PM_{2.5} concentration ranges that have been measured near sources like bus terminals, smokers, cooking – high sensor readings should warn people that they may be near a PM source
- In response to high readings, people may be able to move away from sources and reduce their exposures



Next Steps: EEAMT Data Interpretation



- Critical Topics Discussed
 - Understand the relationship between short term measurements and longer term standards based on science and health effects information
 - Create visualization tools that make continuous and discrete data more accessible and understandable
 - Develop a standardized, centralized repository of environmental metrics



Discussion