Air Sensors: Current Activities
AAPCA’s Personal Air Sensor Workgroup Presentation
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The Pigeon Air Patch — a joint project by tech companies Pume 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.

**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.

**Smart Citizen**
## Introduction

### 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
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 O$_3$, NO$_2$, 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.
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](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

#4: Data standards & data quality tiers

#5: Lean technology evaluation parameters
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

A fact sheet, FAQs, and other information available on the Air Sensors Toolbox
– [https://www.epa.gov/air-research/air-sensor-toolbox-citizen-scientists](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
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)

<table>
<thead>
<tr>
<th>55 ppb</th>
<th>70 ppb</th>
<th>85 ppb</th>
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<tbody>
<tr>
<td>Good</td>
<td>Moderate</td>
<td>Unhealthy for Sensitive Groups</td>
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### Potential Sensor Categories (1-min)

<table>
<thead>
<tr>
<th>?? ppb</th>
<th>?? ppb</th>
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<tbody>
<tr>
<td>Low</td>
<td>Medium</td>
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PM$_{2.5}$ Sensor Breakpoints

- For PM$_{2.5}$, the available 1-minute data is more limited than for O$_3$
  - 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/m$^3$

**Near-Source Concentrations**

1. Designated smoking areas:
   ~ 70 to > 500 µg/m$^3$
2. Near/on diesel buses:
   ~ 75 to > 1,000 µg/m$^3$
3. Near street paving operation:
   ~ 80 µg/m$^3$
4. Near candles/cooking:
   ~ 100 to > 1,000 µg/m$^3$
Low breakpoint (30 µg/m³):
– 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 µg/m³):
– 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
Discussion