Citizen Science Air Monitoring

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Emerging Technologies & Environmental Monitoring

- Lower cost sensors → greater access to air pollution data at more local scales
- Potential new applications for air monitoring:
  - Personalized health information → Inform individuals about their personal exposures to air pollutants, particularly susceptible populations
  - Empower communities to gather information about exposures
  - Raise awareness and educate individuals and communities about air pollution issues
  - Supplement national, state and local monitoring networks
The Role of Sensor Technology in the Changing Paradigm

**How data is collected?**
- Limited Mostly to Governments, Industry, and Researchers

**Who collects the data?**
- Compliance Monitoring, Enforcement, Trends, Research
- Government Websites, Permit Records, Research Databases
- Expanded Use by Communities and Individuals

**Why data is collected?**
- New Applications and Enhancement of Existing Applications
- Increased Data Availability and Access

**How data is accessed?**
- Snyder et al., 2013
PM Sensors on the Market

- Dylos
- Speck
- Met One
- Shinyei
- Airbeam
- TZOA
Gas Sensors on the Market

- Sensaris
- Air Casting
- Cairclip
- Aeroqual
- Air Quality Egg
- Air Visual Node
VOC Sensors on the Market

UniTech

ToxiRae

Atmotube
Multipollutant and “others”

Elm

Haz-Scanner

AQ Mesh

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**

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.
• Common hurdles:
  • Uncertain data quality
  • Data interpretation
  • Acceptance and application

• How to best address hurdles:
  • Discussions with manufacturers
  • Continued evaluation of sensors
  • Standards for sensor performance
  • Work with more experienced partners (EPA, Universities, others)
  • Pilot efforts
Air Sensor Toolbox web page launched in June 2014 provides citizen scientists and others resources on air sensors.

- Air Sensor Guidebook is one of the most popular resources in the Toolbox.
- [https://www.epa.gov/air-sensor-toolbox](https://www.epa.gov/air-sensor-toolbox)
On May 6th, 2016 EPA launched a new “sensor scale”
- EPA developed the scale to help the public understand 1-minute data from Village Green stations
- EPA is working to finalize messaging for $O_3$ and PM$_{2.5}$ and plans to develop messaging for additional pollutants (CO, NO$_2$, and SO$_2$)
- Messages and cutpoints were supported by robust statistical analysis relating short term measurements to longer term standards

Pilot appears on existing Village Green data webpage
Questions to Consider when Designing a Citizen Science Study

- Why am I doing this?
- How am I going to do this?
- What type of useful and valid data do I need to collect or use?
- Where should I collect my data?
- What resources (equipment, people, money) do I need to do this?
- What will I do with this information?

Check out EPA’s Citizen Science webpage for more information: https://www.epa.gov/citizen-science
Basic Elements of Study Design

- Study/survey protocol development
  - Location, frequency, equipment, methodology
  - Quantity of data
  - Quality of data
- Selecting and recruiting citizen scientist and experienced partners
- Technology requirements and use (web, computational resources and capacity)
- Supporting materials and mechanisms (e.g. central site, labs)
- Plans for analyzing data, results and information
- Project/study evaluation
- Lessons learned and next steps
There are still a lot of questions about low cost sensors:

- Does the data provided have the quality and accuracy to achieve your project design?
- Is the equipment reliable enough?
- What other things issues can impact the data quality (humidity, other pollutants, etc.)?
EPA/Community Collaboration Example: Ironbound Community Collaboration

 Overall goal was to characterize urban pollution using portable sensors, especially near roadways
 EPA provided full day of citizen training on air sensor setup and use
 Four sensors were deployed by citizens in the Ironbound community – 21 locations over 6 months
 Study results empowered residents to address air quality concerns with local officials
EPA/Community Collaboration Example: DISUR (Desarrollo Integral del Sur) Puerto Rico

• Overall goal was to analyze local pollutant levels and determine the area’s main sources of pollution
• EPA provided full day of citizen training on air sensor setup and use
• Ten sensors were deployed by citizens in the Tallaboa-Encarnación community
Lessons Learned

• A number of things could go wrong with a study...
  o Citizen scientists can drop out of a study
  o Data quality could be compromised
  o Sampling and analytical equipment can fail or get damaged
  o Data loss
  o Other unforeseen circumstances

• Always good to have an alternative plan for the “what-ifs”
• Clear roles and responsibilities
• What questions can and can’t be answered by the collected data
Citizen Science: Getting There from Here

- How do we make the best use of citizen science as a tool in protecting public health and the environment?

- Keys to success:
  - Embracing the community needs and issues
  - Outreach and mentorships to build trust
  - Collaborative mentality
  - It’s not just “data” – it’s understanding
Thank you!

Online Resources Available at:

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