

Low-Cost Sensing by Citizens and Community Groups – Current Status and Opportunities

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Sonoma Technology, Inc.

Air Quality Research and Innovative Solutions

Outline

- Background
- Specific project examples
- Next steps

Vision

A future where low-cost, easy-to-use air quality sensors allow us to

- Track the most common and hazardous air pollutants in every area
- Customize detailed, real-time information to meet local needs
- Create learning tools and graphics that make data easy to understand
- Connect health care to the whole environment
- Give the most vulnerable communities accessible tools for change

Technology

- Assess current state-of-the-science
- Understand and link efforts
- Characterize performance of existing sensors in real-world conditions
- Develop new sensor technologies
- Fund & catalyze research efforts
- Evaluate performance of new technologies
- Develop hardware platforms for low-cost/small sensors
- Develop appropriate interfaces & ergonomic properties

Usage

- Identify range of applications/uses
- Develop data distribution methods
- Establish & develop QA/QC
- Explore challenges of new data types
 - mobile vs. fixed
 - high temporal
 - high spatial density
- Develop new analytic methods
- Create new visualization techniques
- Establish SOPs & guidance
- Establish data governance & policies

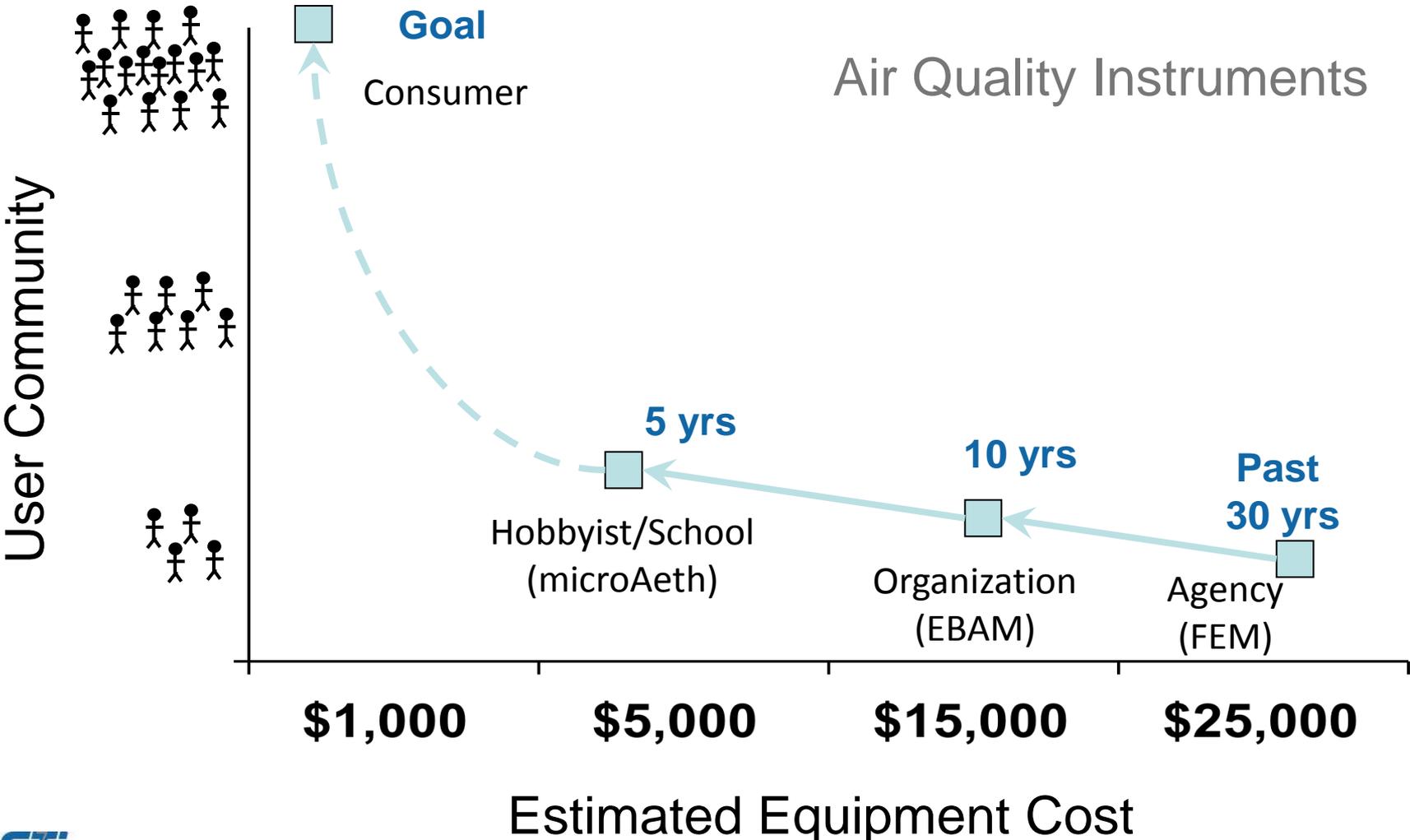
Community

- Establish a cooperative, participatory collaboration among
 - government
 - non-governmental organizations
 - citizens
- Develop software, systems, & tools to facilitate collaboration & participation
- Identify approaches for maintaining/increasing a community of interest

Outreach & Education

- Create a foundation of air quality & monitoring principles & methods
- Create education curriculum & materials
- Reach out to manufacturers & encourage “responsible use”
- Consider creating an “Environmental Monitoring Corps”

Background – Instrument vs. Cost



Background – Approaches to Low-Cost Monitoring

AQ Instrument Manufacturers

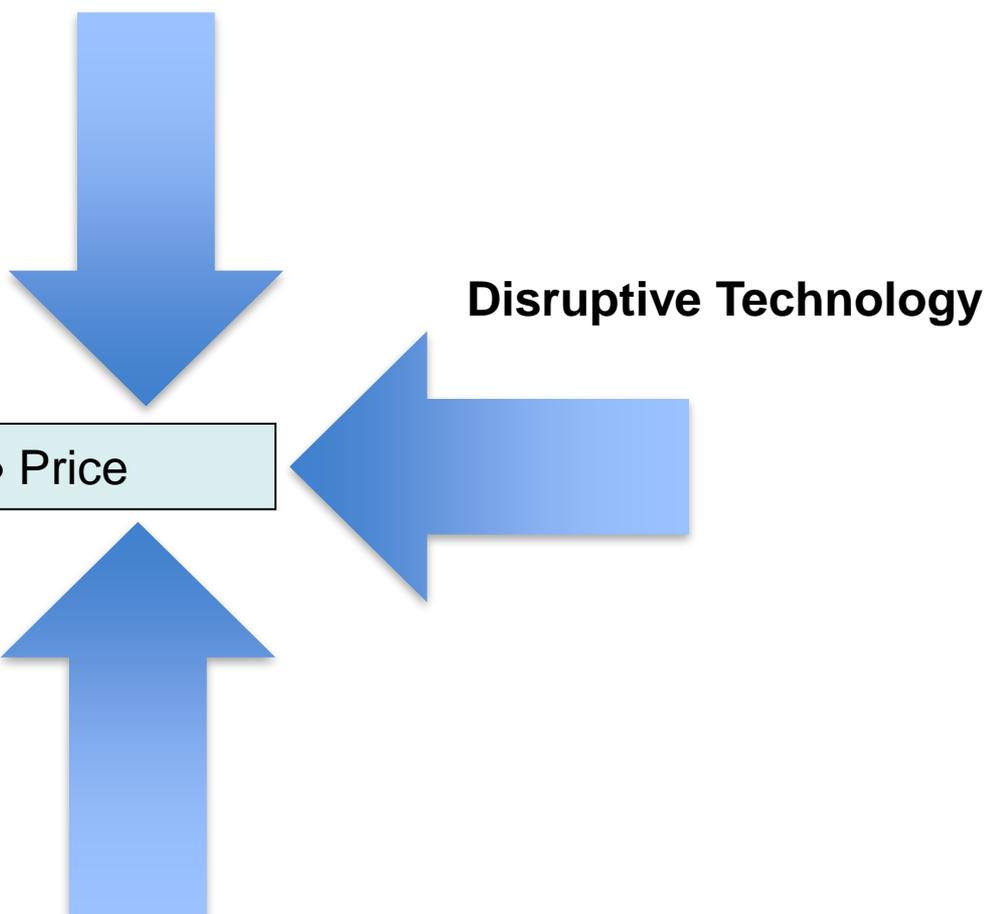
- Starting with proven technology
- Lowering costs
- Shrinking size

Quality • Capabilities • Size • Price

Industry, Universities, NGOs

- Starting with low-cost sensors
- Improving quality
- Designing packaging

Disruptive Technology



Mobile CO Monitoring

Sponsor: Intel Berkeley

- Measurements: CO, O₃, NO₂, temperature
- Electrochemical sensors
- Mounted on street sweepers
- Pilot conducted in San Francisco (SF)
- Schedule: 2009



Do It Yourself (DIY) Project

Sponsor: Carnegie Mellon University

- Electrochemical VOC sensor
- Installed with LEDs in balloons
- Published at Instructables.com

- Schedule: 2010



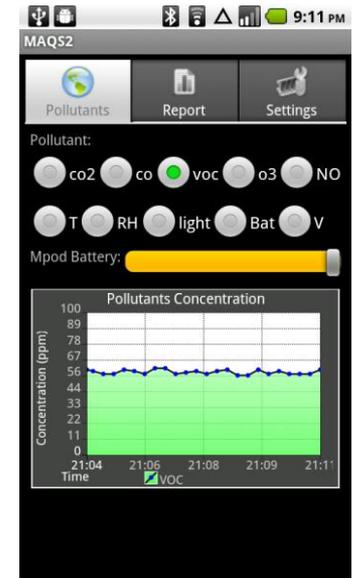
Stacey Kuznetsov
Carnegie Mellon University

M-Pods

Sponsor: University of Colorado

- Measure O₃, CO, CO₂, NO₂, Temp, RH
- Deployed in Colorado and rural Uganda
- Working on calibration/validation

- Schedule: 2011+

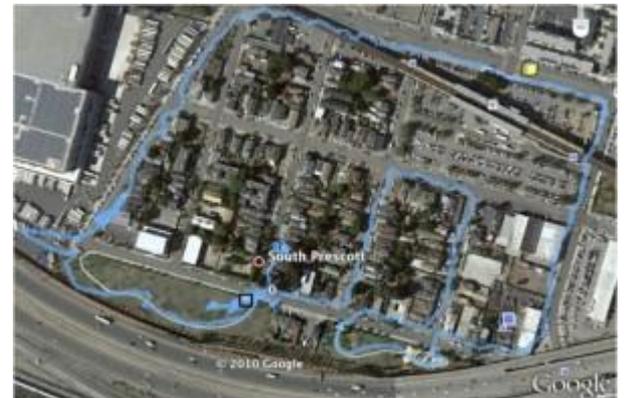


Community Group Application

Sponsor: West Oakland Environmental Indicators Project

- Use DUSTTRAK instruments to measure PM_{2.5}
- Citizens walk a fixed route daily
- Citizens process and quality-assure data
- Use to detect hot spots
- Developed innovative display software

- Schedule: 2010–2012

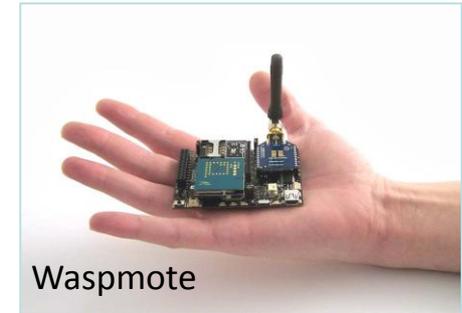


European Environmental Agency (EEA) Low-Cost Sensor Evaluation

Sponsor: EEA

- Demonstration project
- Seeking to collect data and post online through the EEA geospatial platform by any interested parties
- Purchased five Waspmites and sensor boards from Libelium
- Focusing on ozone, CO, and CO₂
- Examining how sensors perform
- Discovered calibration issues

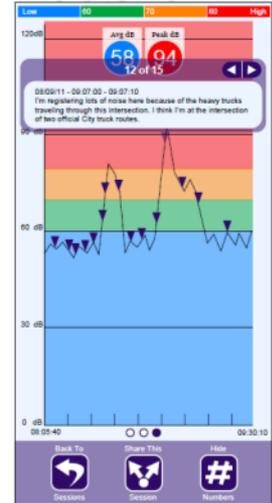
- Schedule: 2011–2012



Citizen Crowd Sourcing

Sponsor: Habitat Map and Google.org

- Developed Android application and data system
- Called “AirCasting”
- Citizens broadcast information about the air
- Started with sound; planning for pollutants (NO₂)
- Focus is New York City
- Schedule: 2012



WeatherBox Pilot

Sponsor: NOAA/National Weather Service

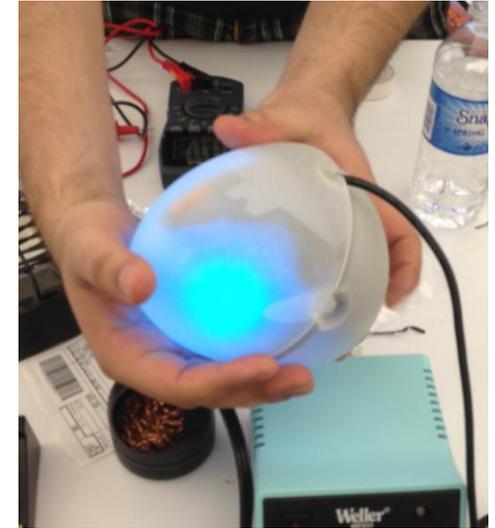
- 1,500 delivery vehicles
- Measuring temperature and humidity
- Developed data exchange format
- Organizations involved:
 - Global Science and Technologies
 - WeatherTelematics
- \$5M program
- Schedule: 2012



Air Quality Egg

Sponsor: Pachube

- Community-driven effort
- Raised \$144k on Kickstarter
- Measures NO₂, CO, temp, and RH
- Add-ons: Particles, radiation, O₃, and VOC
- Producing 1300+ eggs by late summer
- Schedule: 2012



RH = relative humidity
VOC = volatile organic compound

Summary

- Dozens of efforts
- 1,000–2,000 systems running by summer 2012
- Few standards exist
- Many unresolved issues exist
 - Technology
 - Usage
 - Community
 - Outreach and education

Next Steps

- Workshop at RTP (completed)
- Created www.CitizenAir.net
- Open Labs at EPA RTP (June 2012)
- Tech expo/demo – city TBD (October 2012)
- Conference (Spring 2013)

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