Update on Air Sensors:
Latest EPA Perspective

National Association of Clean Air Agencies
Fall 2014 Meeting

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Defining “Sensor”

- Technologies that include small portable, low-cost, real time devices

Defining "Sensor"

Tier	Cost Range (instrument only)	Anticipated User
Tier V (most sophisticated)	$10 – 50 K	Regulators (supplement existing monitoring – ambient and source)
Tier IV	$5 – 10 K	Regulators (supplement existing monitoring – ambient and source)
Tier III	$2 – 5 K	Community groups and regulators (supplement existing monitoring- ambient and source)
Tier II	$100 – 2 K	Community groups
Tier I (more limited)	Less than $100	Citizens (education and personal health purposes)

http://www.epa.gov/research/airscience/docs/roadmap-20130308.pdf

State of the Science

- **FEM Applications**
  - AQMesh (measuring O_3, NO_2, SO_2, CO, and NO) applied for federal equivalent method (FEM) status in May 2014 ($10K)
  - 2B O_3 and Thermo 1500 PM expected to apply ($5K-$10K)
- **O_3 and NO_2 sensors**
  - Lab testing results in Sensor Evaluation Report (May 2014)
    - Good agreement between low cost ($500-$1000) sensors and FEM instruments
    - Issues with lifespan of sensor and interferents

  Electrochemical analyzers an alternative option to measure NO_x and CO in RICE rules ($5K-$15K)
- **Particulate Matter ($PM_{2.5}$ & PM_{10}) sensors**
  - Current lab and field performance evaluations in RTP, NC
  - Fair agreement between low cost ($300) sensors and FRM instruments
    - Temperature and relative humidity influencing factors




State of the Science

- **CO and SO_2**
  - NASA deployed AQMesh technology to measure O_3, NO, NO_2, **CO, and SO_2** in summer 2014
- **Lead**
  - No known advances for sensors to measure lead
- **VOC/Air Toxics**
  - Wide range of sensitivities/speciation challenges
  - ORD considering the purchase of a "FROG" - $25K GC instrument
- **NH_3 and Methane**
  - Not a lot of commercial movement in NH_3 sensors, better sensitivity needed
  - $30M DOE funding opportunity for methane observation networks with innovative technology to obtain reductions (closed June 2014)
  - Environmental Defense Fund – Methane Detectors Challenge for oil and gas industry

Data Application[1]

Tier	Application Area	Pollutants	Precision & Bias Error[2]	Data Completeness[2]
I	Education and Information	All	<50%	≥ 50%
II	Hotspot Identification and Characterization	All	<30%	≥ 75%
III	Supplemental Monitoring	Criteria pollutants, Air Toxics (incl. VOCs)	<20%	≥ 80%
IV	Personal Exposure	All	<30%	≥ 80%
V	Regulatory Monitoring	O_3 CO, SO_2 NO_2 $PM_{2.5}$, PM_{10}	<7% <10% <15% <10%	≥ 75%

1. These are guidelines only (Tier I- Tier IV), and are likely to evolve over time as technology continues to develop and the state of the science continues to advance. The amount of data needed for any air quality purpose is highly specific to that purpose and could range from minutes to even years of data measurements.

2. Precision, bias, and data completeness requirements in part were taken from Appendix D of the *EPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume II* (May 2013 edition). Refer to 40 CFR Parts 50, 53, 58, and the QA Handbook Volume II for all activities/criteria required for monitoring network data.

Data Application

- Informing Network Design
  - Locate monitor in high concentration areas
- Provide insight into near road concentrations (NO_2)
- Personal Exposure Monitoring
- Risk assessment
  - Characterization & Modeling
  - Fenceline/Community Monitoring
- Permitting
  - Help understand background pollutant concentrations

Messaging

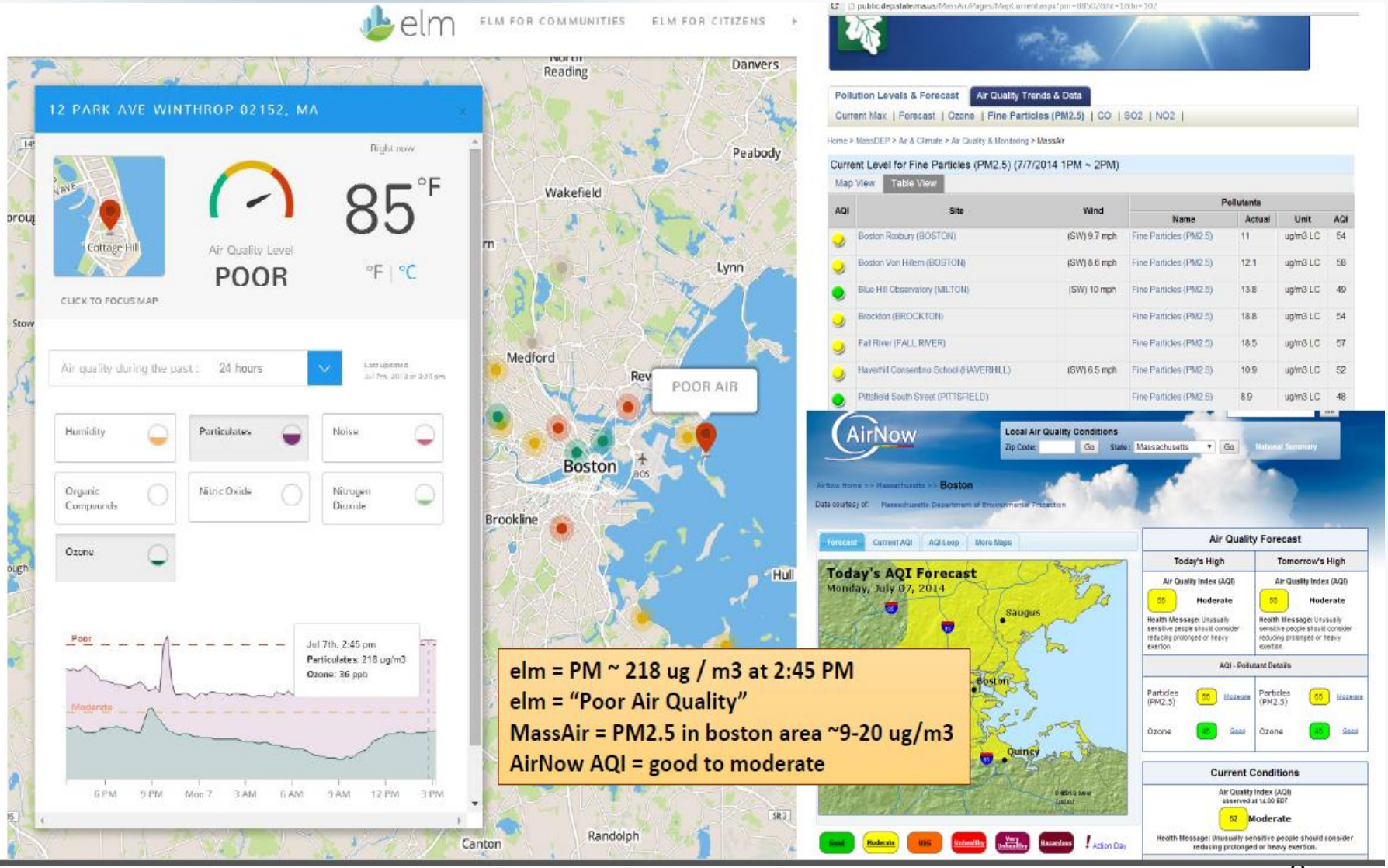
The Air Quality Index

Not for use to interpret sensor data

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*..air quality conditions are:*	*...as symbolized by this color:*
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

AQI focuses on health effects experienced within a few hours or days

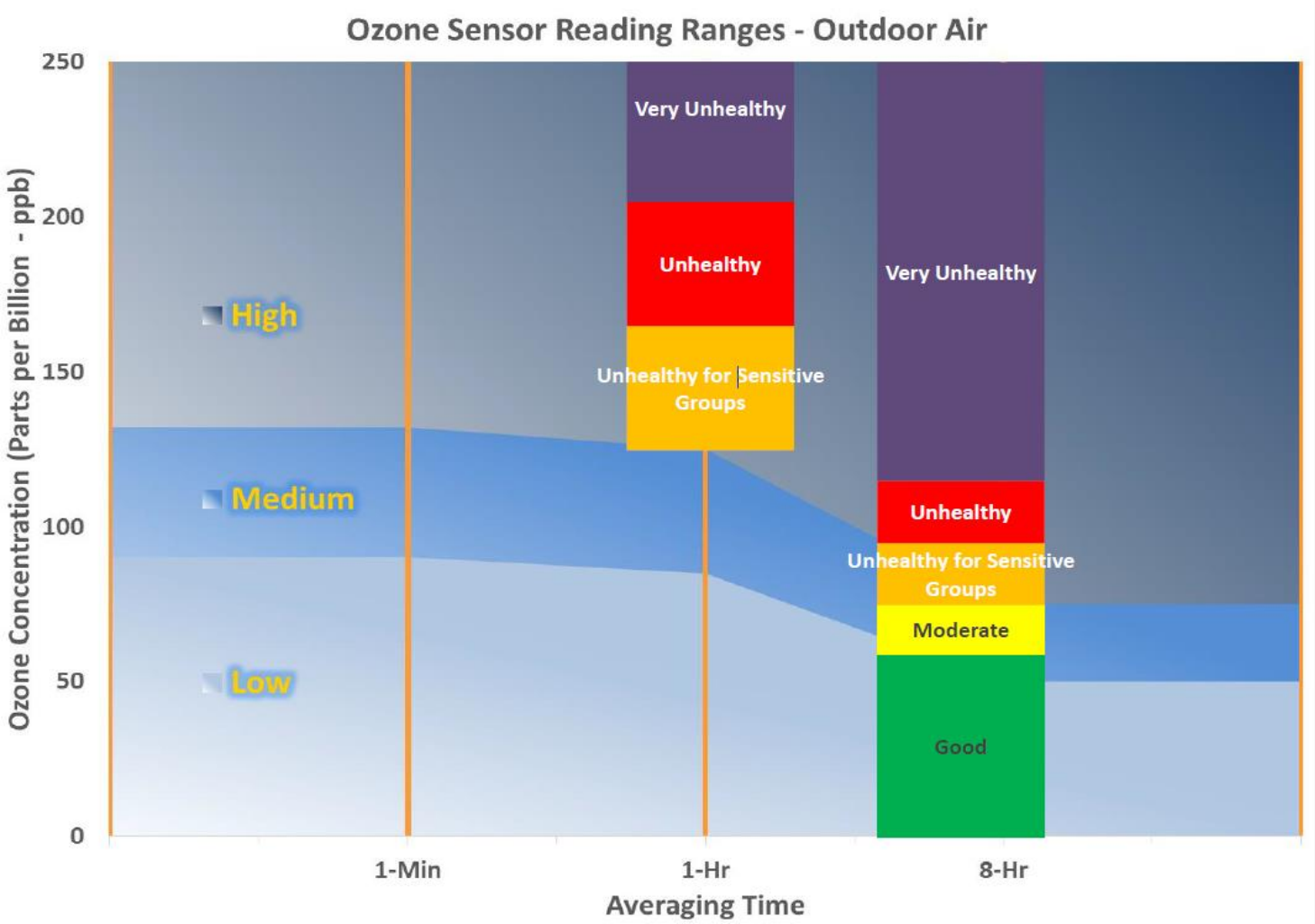
Messaging



http://www.eenews.net/climatewire/2014/07/07/stories/1060002399 (http://elm.perkinelmer.com/)

Brainstorming Sensor Messaging

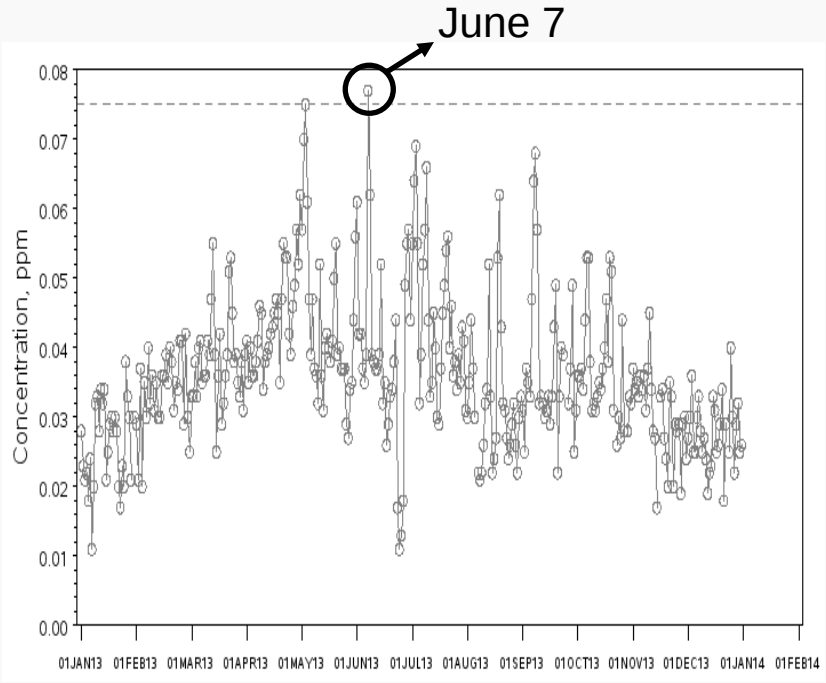
Collaborative Effort between OAR and ORD

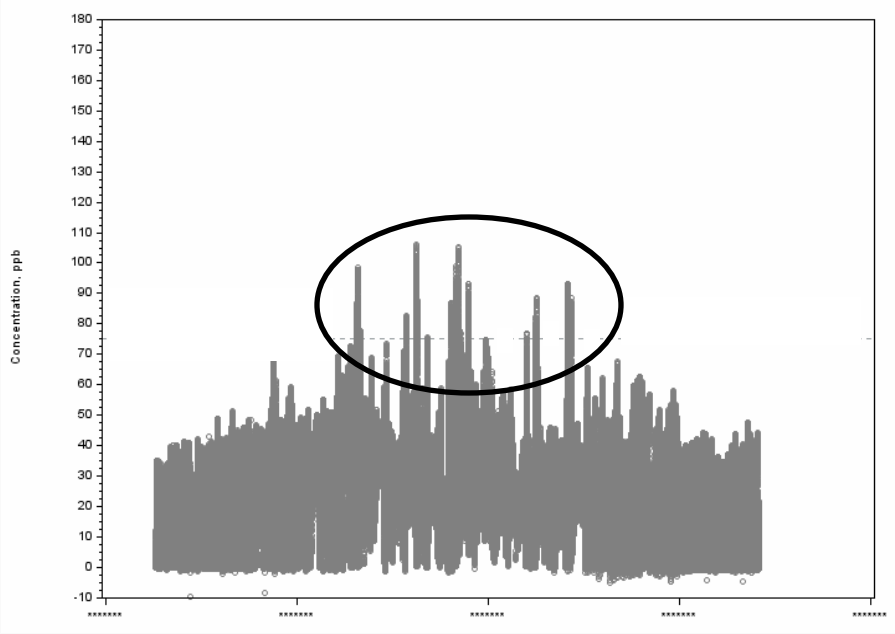


Brainstorming Sensor Messaging

Profiles of Max 8-Hour and 1-Minute Ozone Concentrations

Livermore California (2013)

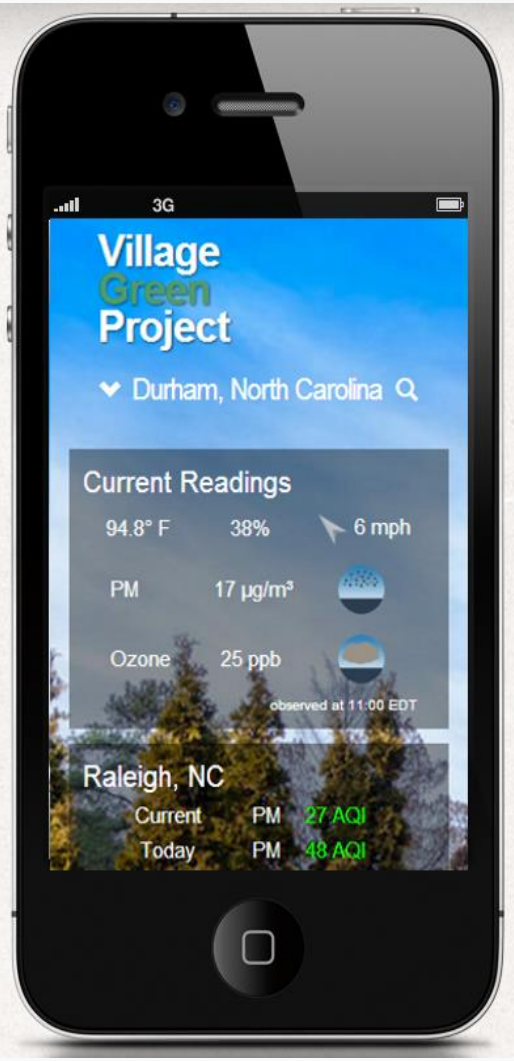




Current Project

- Village Green II
  - Incorporate real-time, 1-minute ozone and $PM_{2.5}$ sensor data into AIRNow tech
  - Fulfill FY15 EPA Agency Priority Goal for two real time air quality data streams to the public
  - Expand number of sites (4-5)
  - Monitor additional pollutants (VOCs and NO_2)

Brainstorming Sensor Messaging



Date Presented: 7/18/14

Next Steps

FY14-15 Plans

- Leverage E-Enterprise funding (tied to VGII project)
  - O_3/$PM_{2.5}$ data analysis
  - Sensor messaging webpage development
  - Mobile website development
  - Focus group studies
  - Data fusion

Next Steps

Advanced Monitoring Proposal for FY16

Joint ORD, OAR, OW, and OECA

- Develop technical guidance to interpret short-term monitoring data
- Create criteria/technical guidance for Sensor Seal - a voluntary certification program
  - Coordinate with work planned by SCAQMD
- Explore “Big Data” issues and role of EPA and S/L/Ts

Summary

- Sensor technology continues to improve, but there is a need to define “sensors” versus generic “advanced monitoring”
- EPA is focused on three key areas for sensors
  - Evaluation – ongoing and FY16 plans
  - Communication - ongoing
  - Data – work in progress