OAR Perspective on Air Sensors

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Measurement Technology Workshop

January 28, 2015

Agenda

- Defining a “Sensor”
- State of the Science
- Data Application
- Messaging
- Questions

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

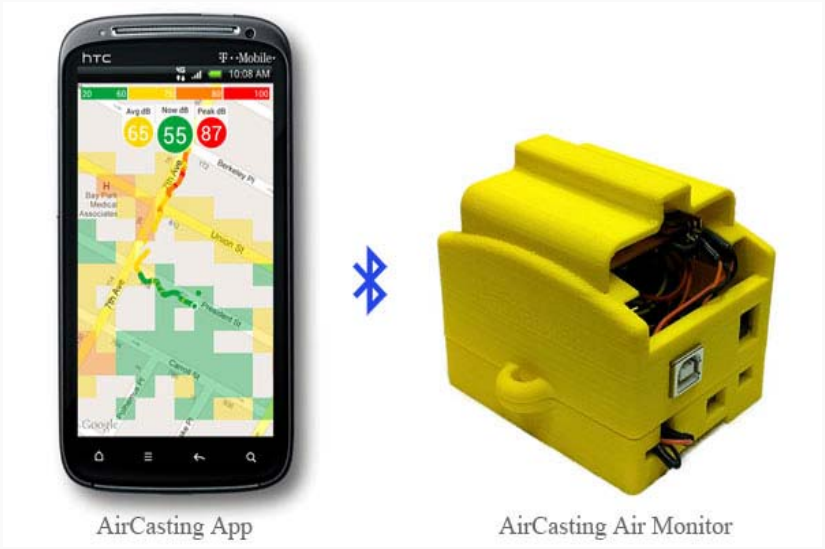
- Criteria Pollutants
  - Federal Reference Methods (FRM)/Federal Equivalent Methods (FEM)
- HAPs
  - Guidance Materials by Pollutant Class (e.g. VOCs)
- Source Testing
  - Test Methods/Alternative Test Methods

State of the Science

Citizen Science Toolbox

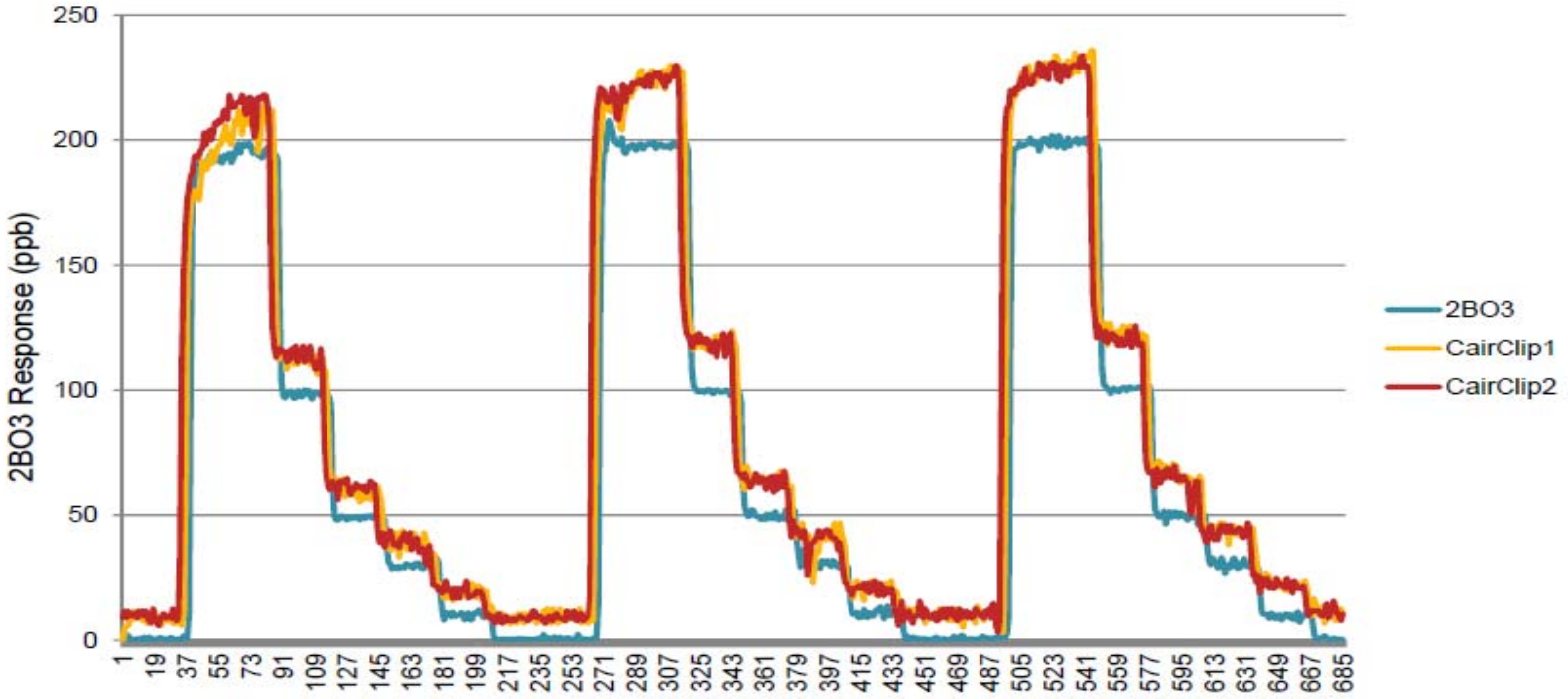
http://www.epa.gov/heasd/airsensortoolbox/

- Air Sensors Guidebook
- Sensor Evaluation Report
- Mobile Sensors & Applications



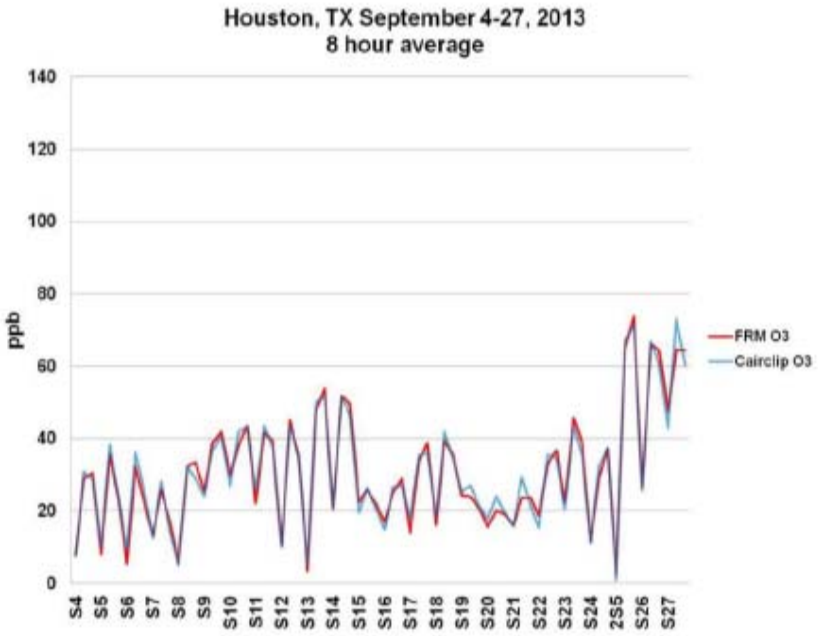
State of the Science

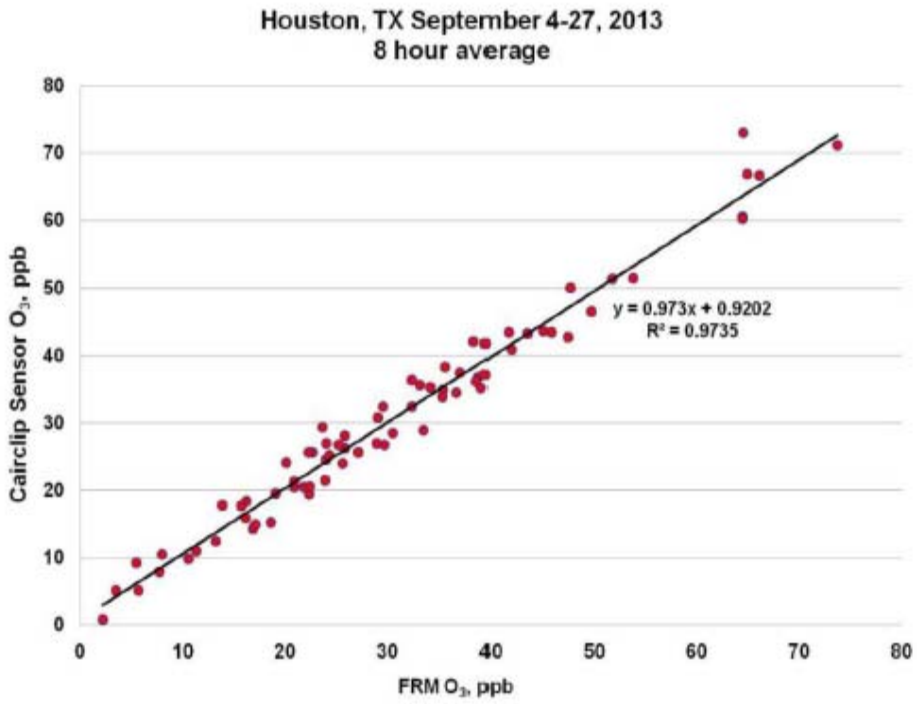
Example of Basic Performance Characteristics



(Slide courtesy of Ron Williams)

DISCOVER AQ Low Cost Sensor Comparison





- Cairclip sensor data corrected by subtracting NO_2 data (as measured by NO_2 FRM) to obtain sensor O_3 results
- Sensor and FRM O_3 results averaged to 8 hours (starting at midnight) for comparison to 8 hour O_3 NAAQS
- Excellent agreement between sensor and FRM results for O_3

(Slide courtesy of Ron Williams)

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

Sensor Concentration ≠ Air Quality Index

Sensor Reading
Concentration
Short term (e.g. 1 minute)
Data Quality Unknown

Air Quality Index
Index Color
Averaged (e.g. 8-hour, 24-hour)
Data Quality Assured

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

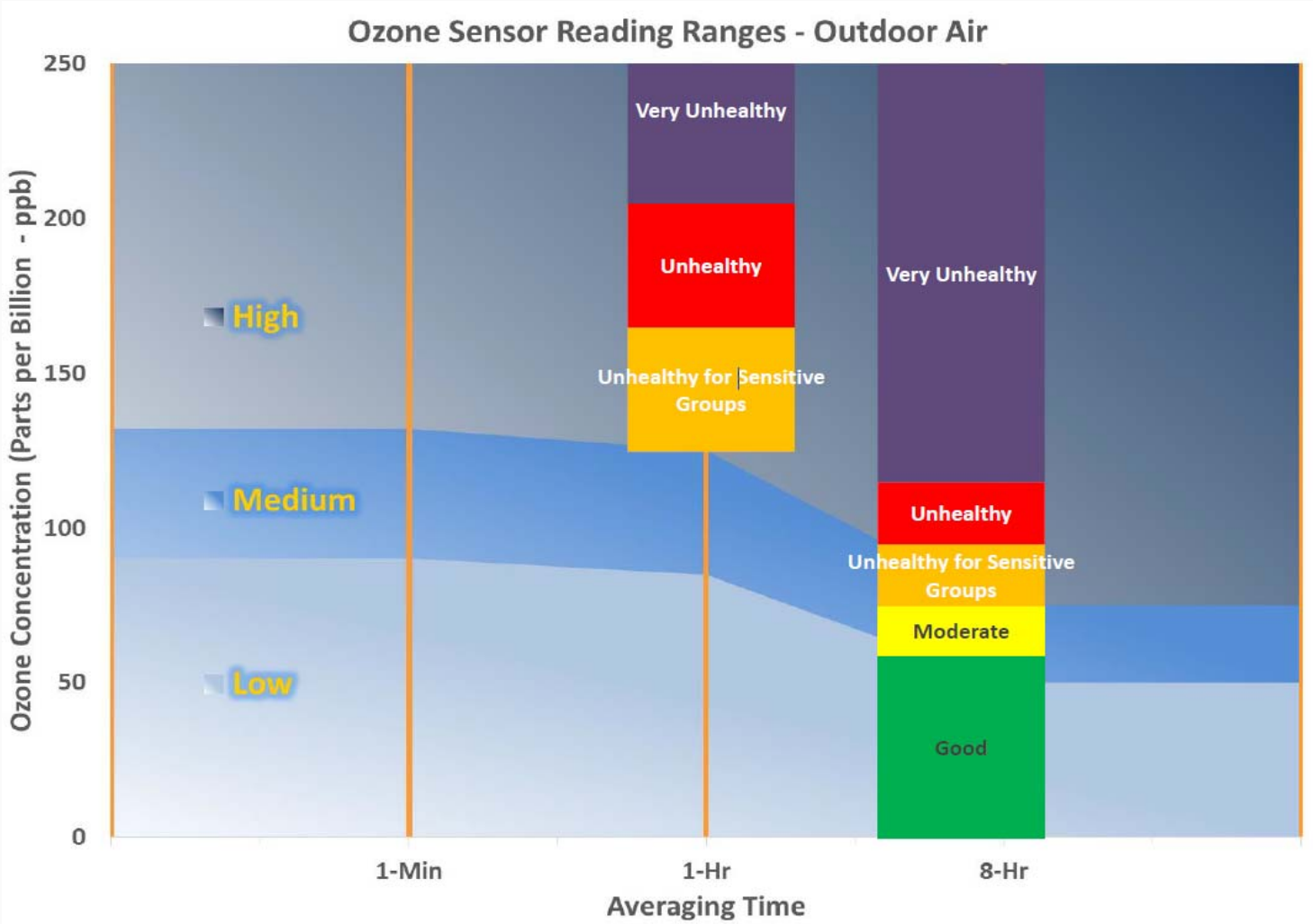
AQI focuses on health effects experienced within a few hours or days

Messaging

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

Brainstorming Sensor Messaging

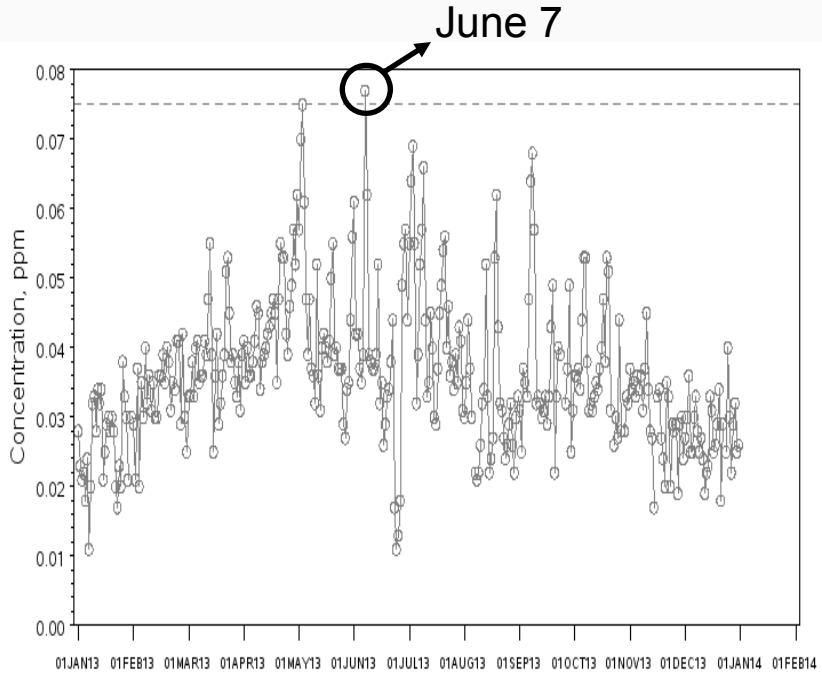
NCEA, HEID, PACS, OID and AQAD Collaborative Effort

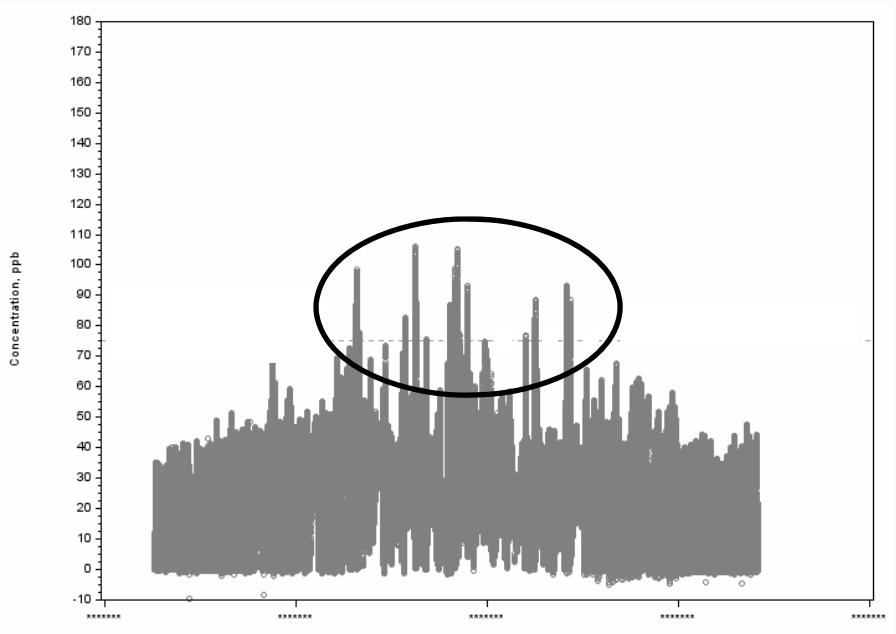


Brainstorming Sensor Messaging

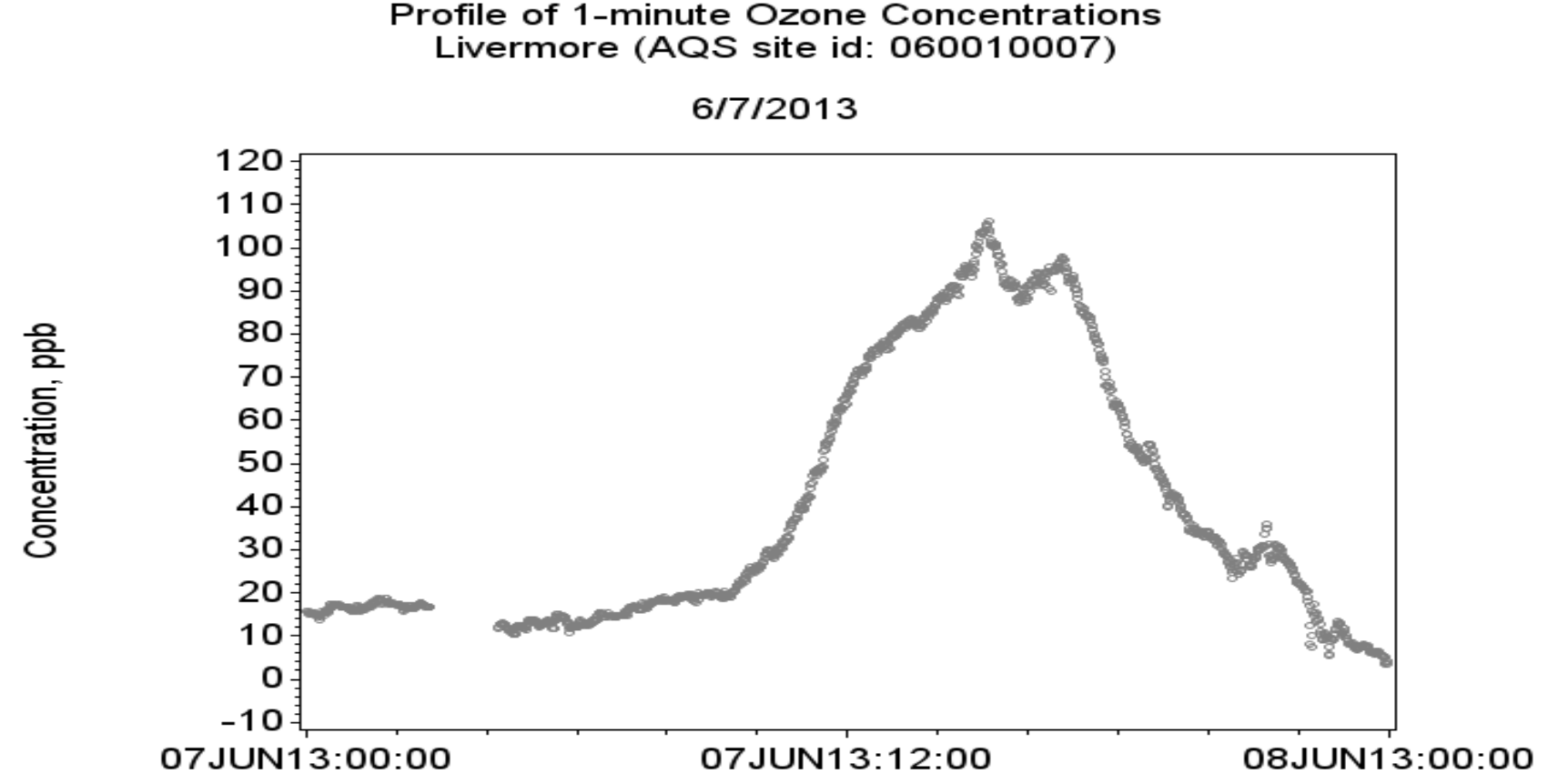
Profiles of Max 8-Hour and 1-Minute Ozone Concentrations

Livermore California (2013)





Brainstorming Sensor Messaging



Messaging

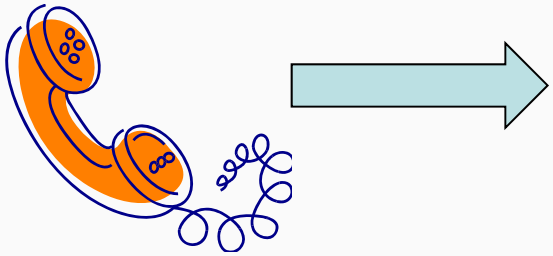
2015 Sensor Messaging Activities

- O_3/$PM_{2.5}$ data analysis
- Sensor messaging webpage development
- Mobile website development
- Focus group studies

Messaging

CONTACTS:

- Local/State Air Agencies
  - NACAA
  - AAPCA
- EPA
- Others



RESPONSE:

- Not FEM/FRM Quality (ambient)
- Not an approved test/alternative method (source)
- No action
- Check the AQI

Inconsistent/inaccurate information without guidance

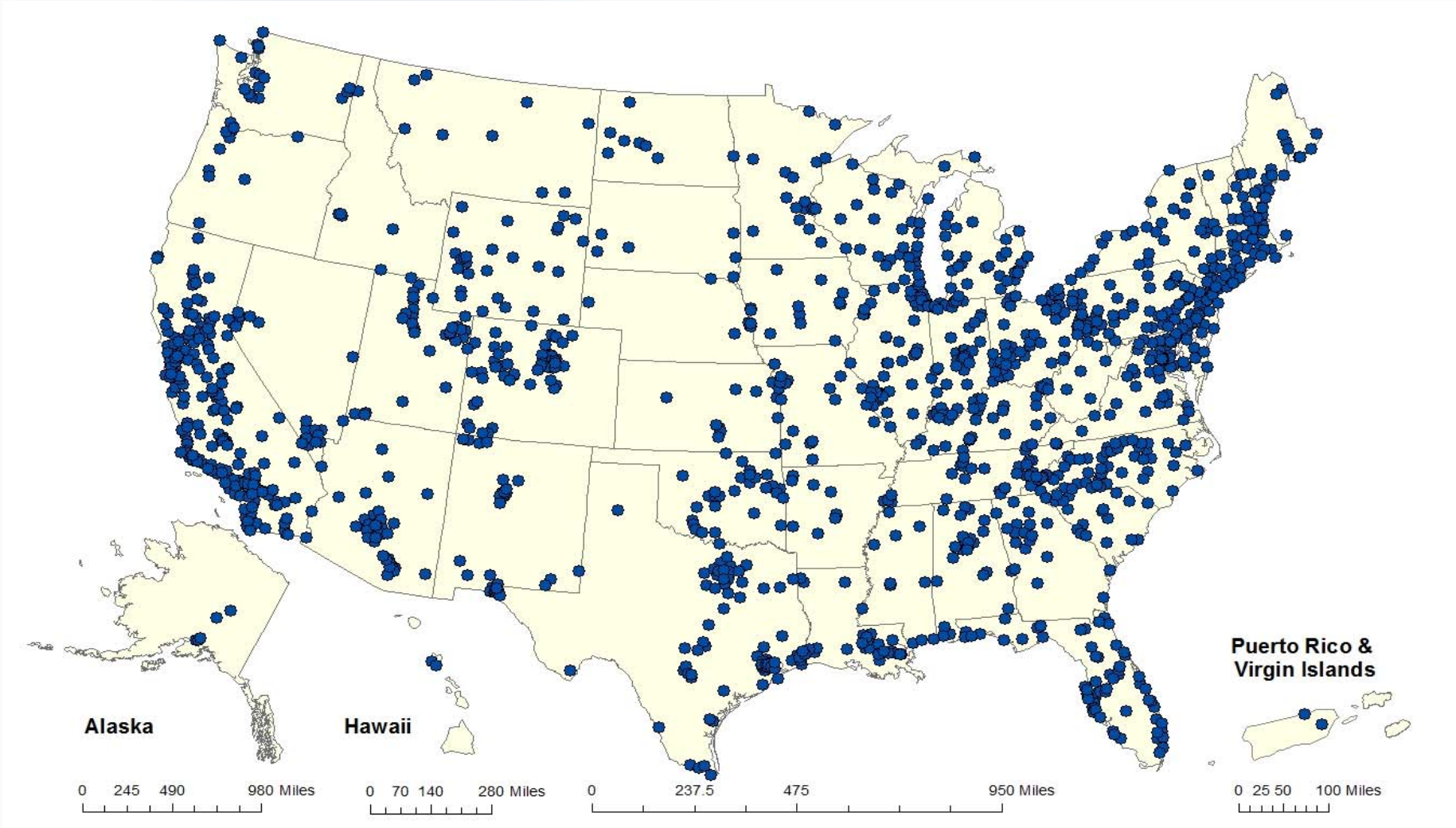
Messaging

Example FAQ and Response

How can we measure pollution using small sensors to ensure that facilities are meeting regulatory limits? Who do I call with my concerns?

- Facilities are generally subject to emission limits measured at the stack (not the fenceline) of a facility
- While sensors may indicate an elevated presence of a pollutant, the facility may still be within emission or permit limits
- Local and State Agency contact information can be found through national associations for air pollution agencies

Messaging


Alaska
Hawaii
Puerto Rico &
Virgin Islands
0 245 490 980 Miles
0 70 140 280 Miles
0 237.5 475 950 Miles
0 25 50 100 Miles

Acknowledgements

OAQPS Team

- Kristen Benedict *(Team Lead)*
- Bryan Hubbell
- Michael Stewart
- Alison Davis
- Holly Wilson
- Susan Stone
- Phil Lorang
- Nicholas Swanson
- David Mintz
- Michelle Wayland
- Melissa Dreyfus
- Mike Papp
- Jason DeWees
- Kirk Baker
- James Hemby
- Ron Evans
- Chris Chapman
- Brad Johns
- John White
- Phil Dickerson
- Richard Wayland
- Melissa Payne

Collaborations