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Integrating Regulatory, Community, and Personal Air Quality Data

Making Sense of the Changing Sensor Landscape

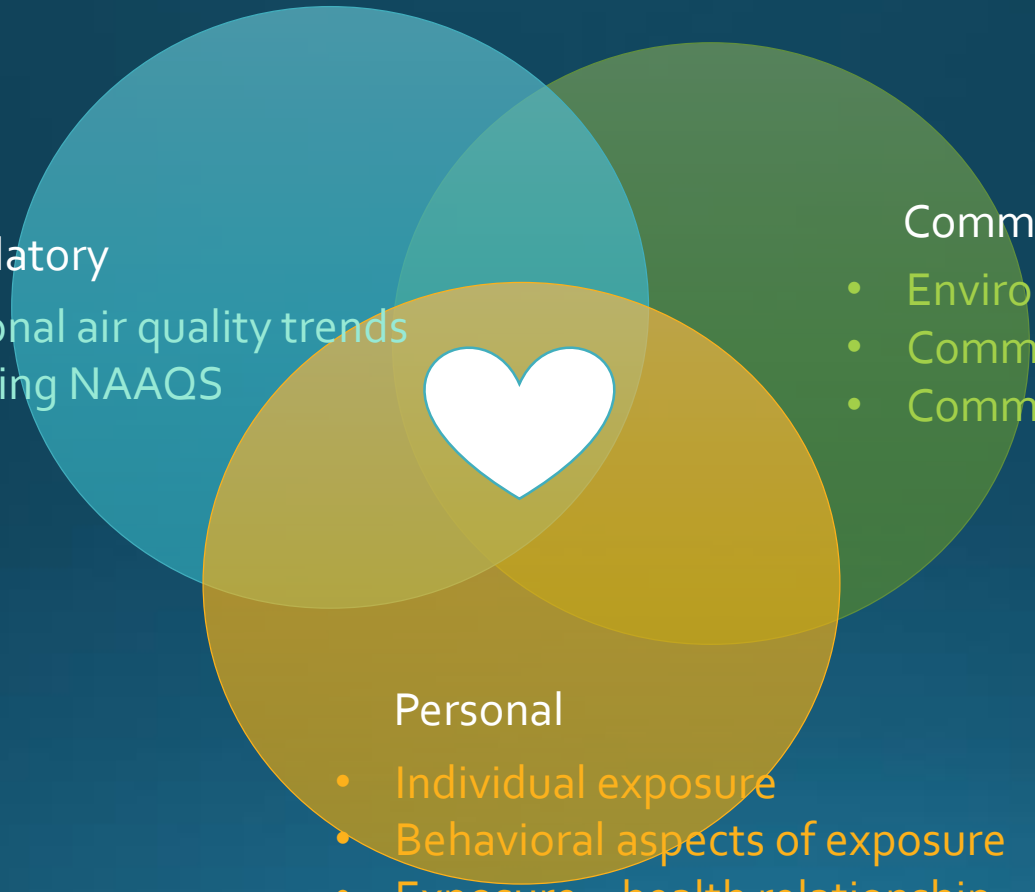
Air Quality Monitoring Designed for Specific Purposes

Regulatory Monitoring

Community Sensors

Personal Sensors

Repurposed Monitoring – Using ALL DATA



Regulatory

- Regional air quality trends
- Meeting NAAQS
- SIPs

Community

- Environmental Justice
- Community-engagement
- Community action

Personal

- Individual exposure
- Behavioral aspects of exposure
- Exposure – health relationship
- Citizen Science

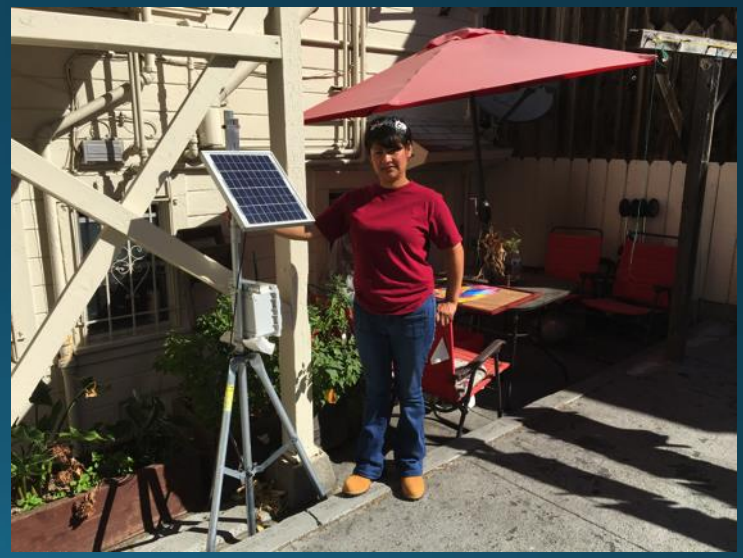
"Real World" Performance of Sensors

- Accuracy, precision, and reliability of sensors are important to understand, but it is also important to understand the ability of sensors to measure phenomena of real-world concern:

Air pollutant concentrations ⟷

2013 Bay Area Near Roadway Study (BANRS)

- Oakland, CA I-880 freeway



Evaluating Spatiotemporal Relationships

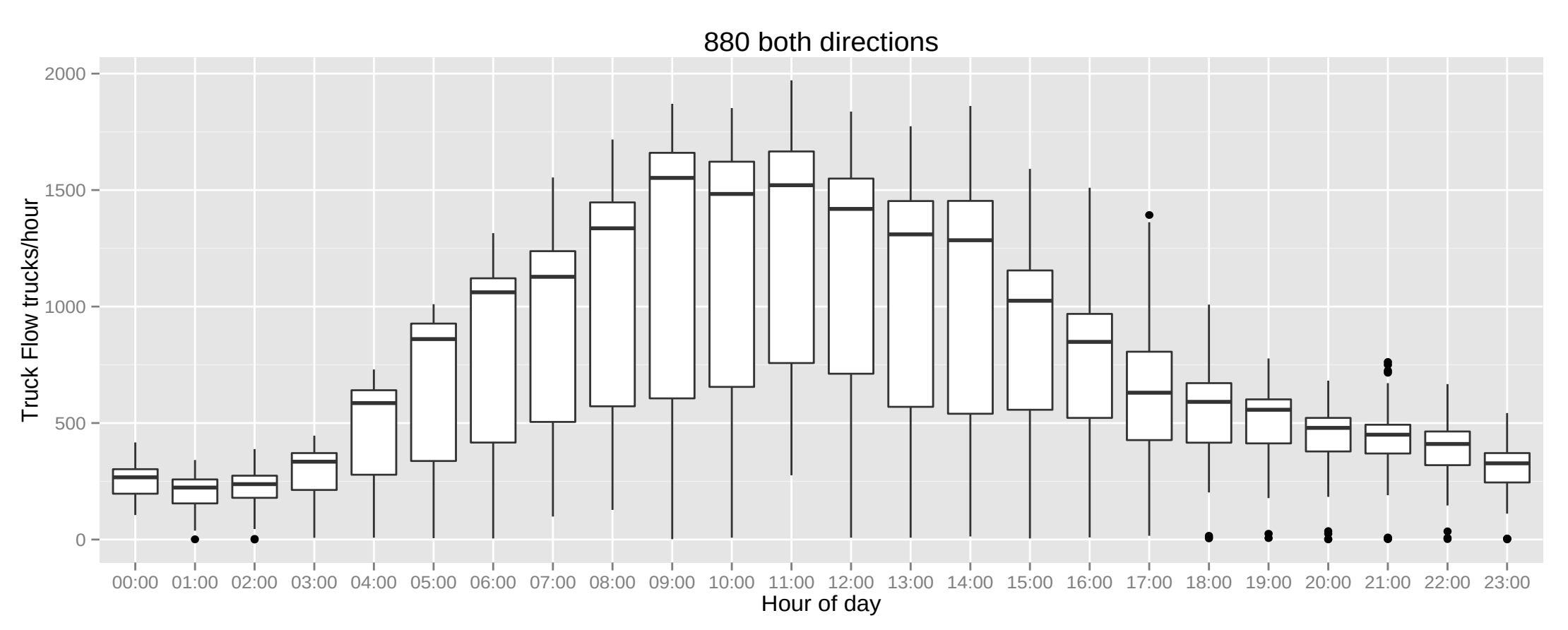
- 2013 BANRS Study, Oakland, CA I-880 freeway
- 10 month co-location of low-cost sensors at a regulatory near roadway monitoring site + hourly traffic monitoring data from Caltrans roadway sensors.

Both regulatory instruments and low-cost air sensors

Caltrans roadway traffic sensors

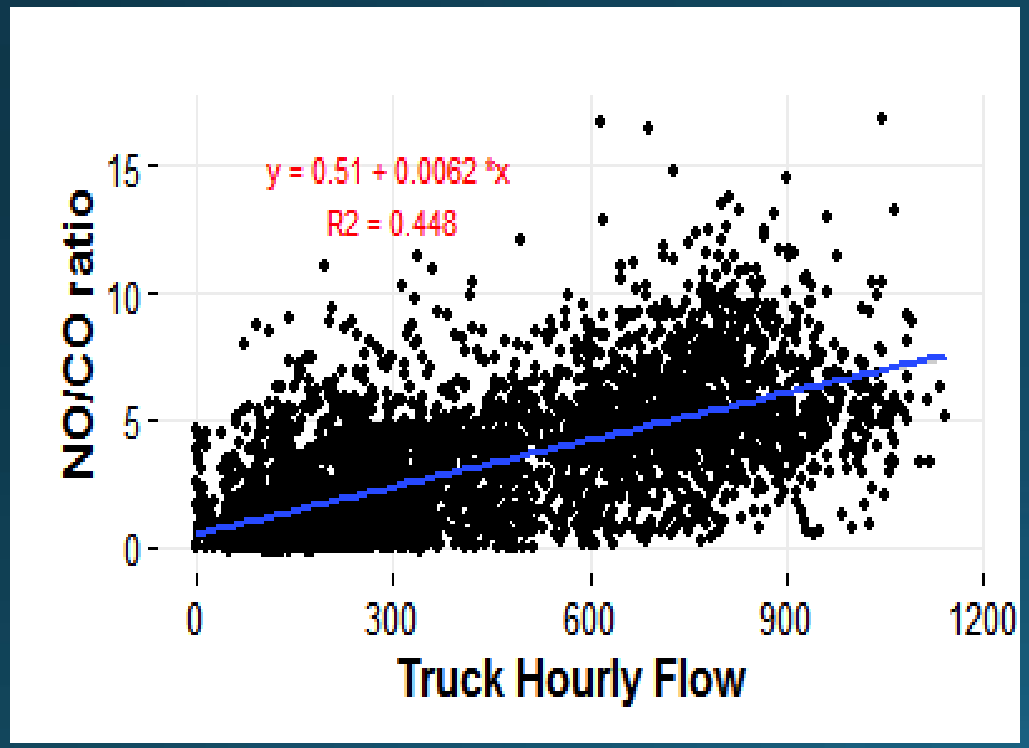
Traffic Diurnal Patterns

1-year of hourly traffic sensor data

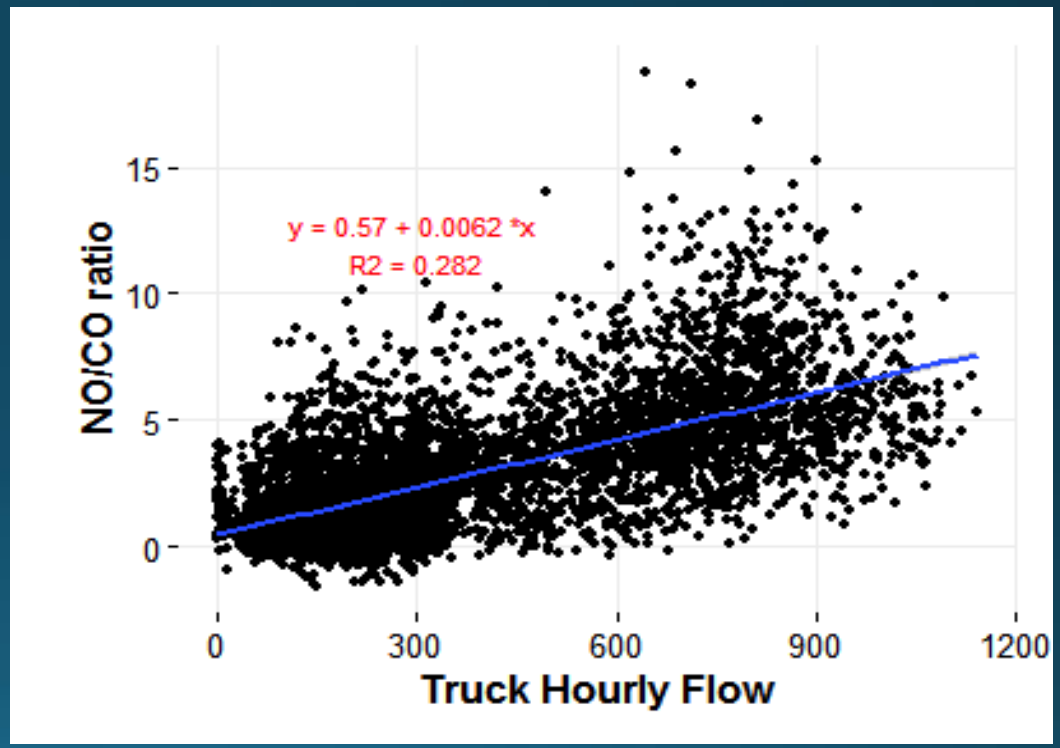


Truck Traffic vs Traffic Pollutant Levels

Regulatory Instrument Data



Low-Cost Sensor Data (after calibration)



Sensor data may help us characterize important spatiotemporal factors that affect air quality, such as mobile sources of air pollution.

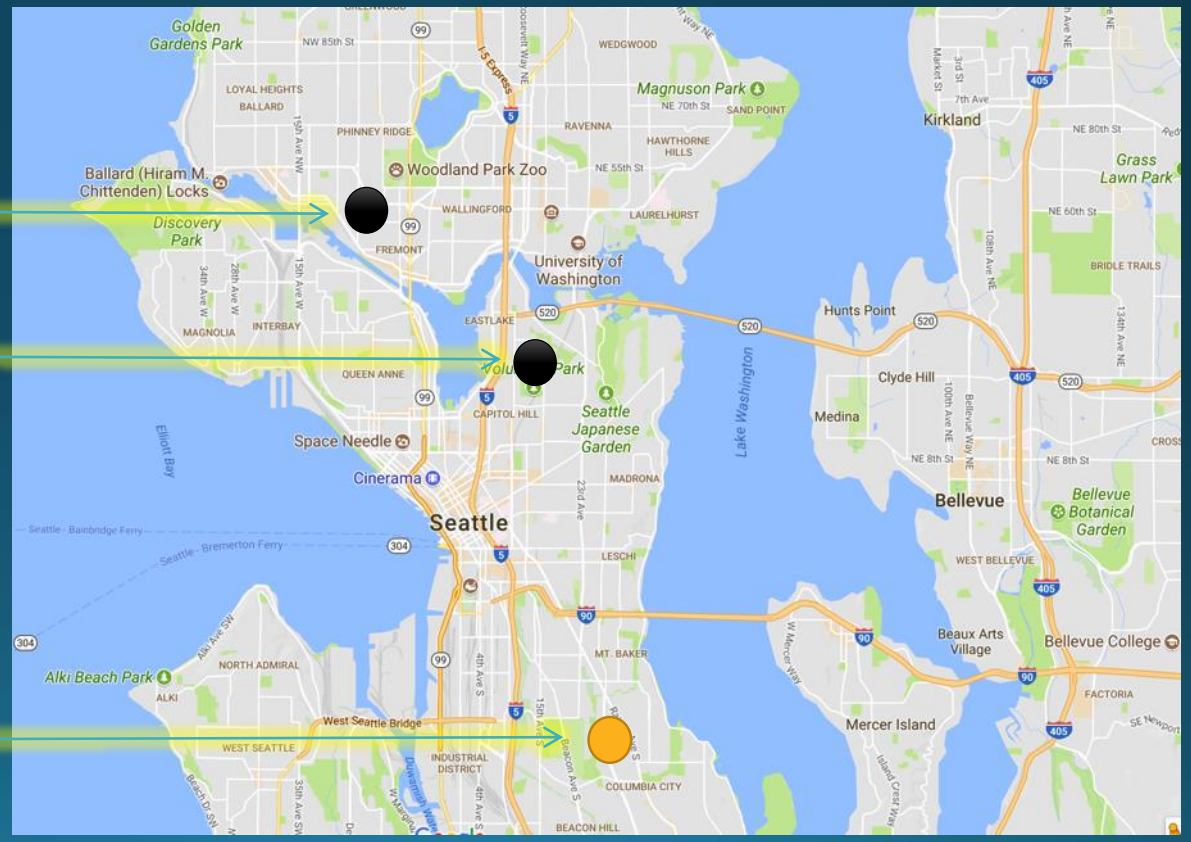
A Practical Question

- What's my exposure to air pollution?

I live here

I work here

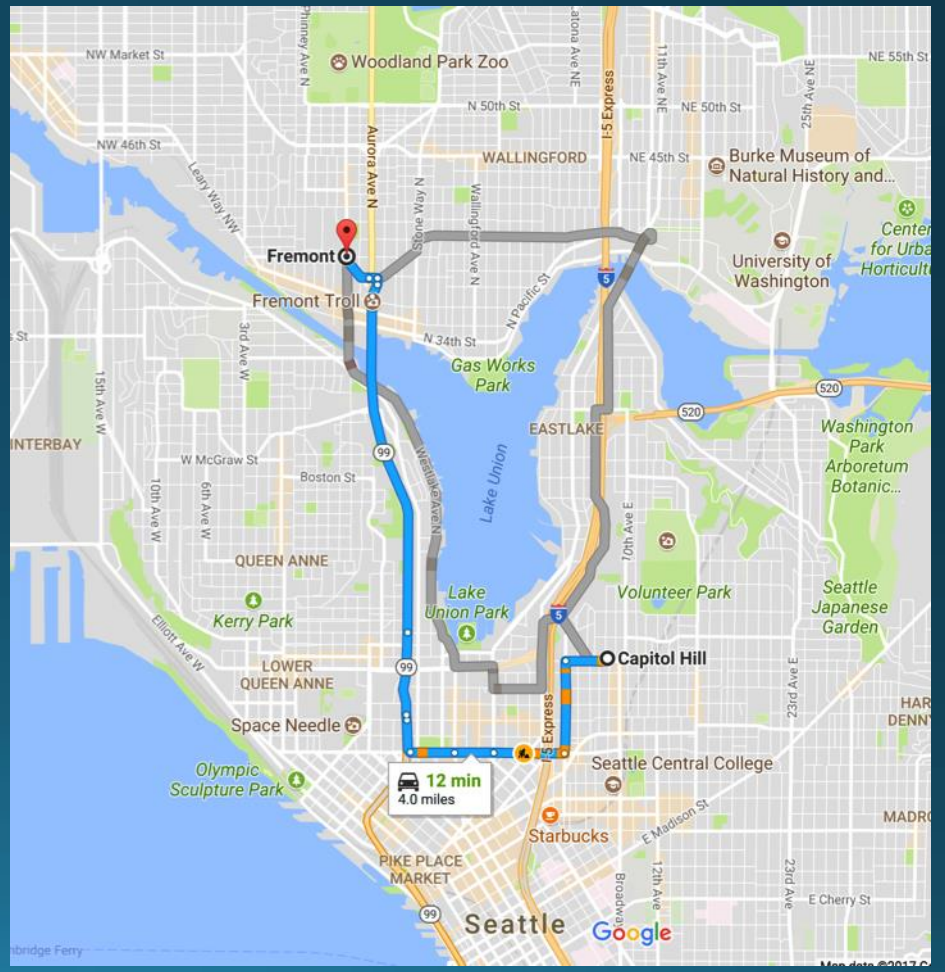
Regulatory monitor is here



A Practical Question

- What's my exposure to air pollution?

… and I move through space and time.



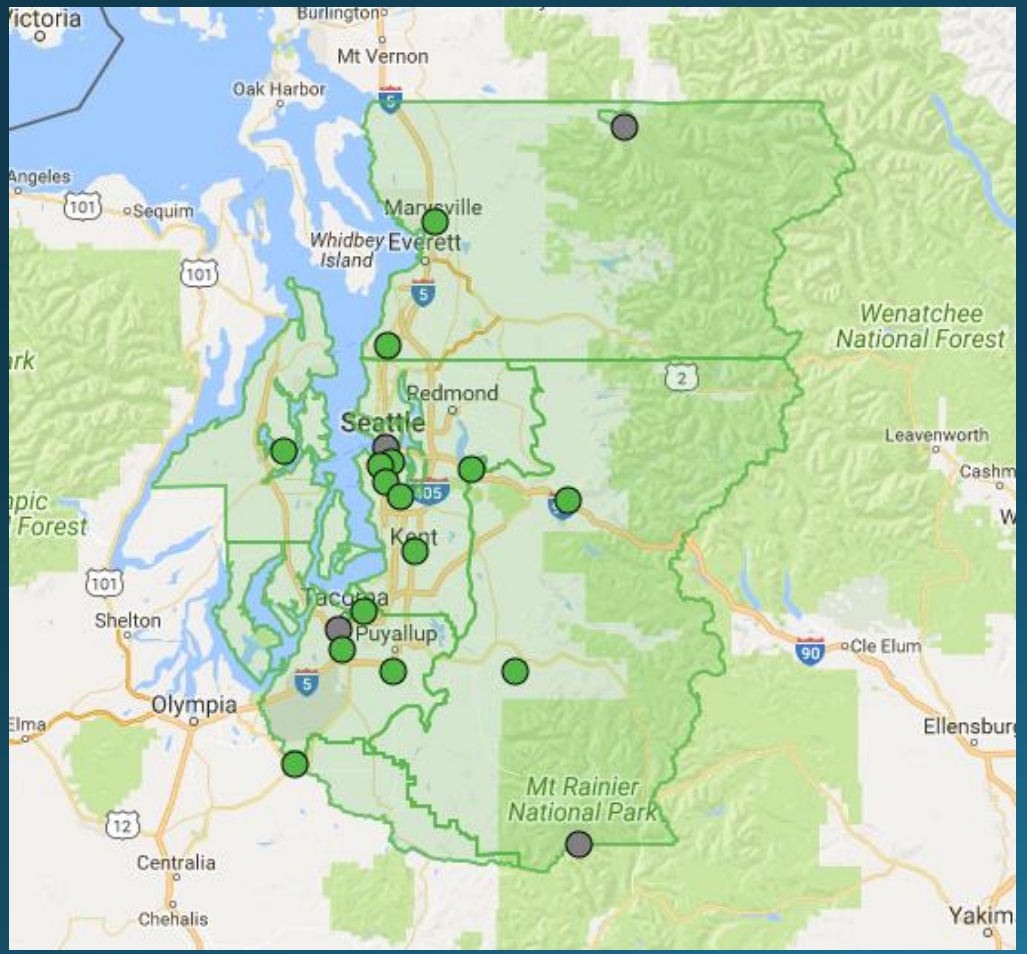
Integrated Air Quality Monitoring

- Seattle, WA
- Puget Sound Clean Air Agency and WA Dept of Ecology's Regulatory Monitoring Network (19 sites)
- 100 Community air sensor sites (ACT Study)
- 300 People using Personal Air Monitors with health outcome data (Twin PUWP Study)

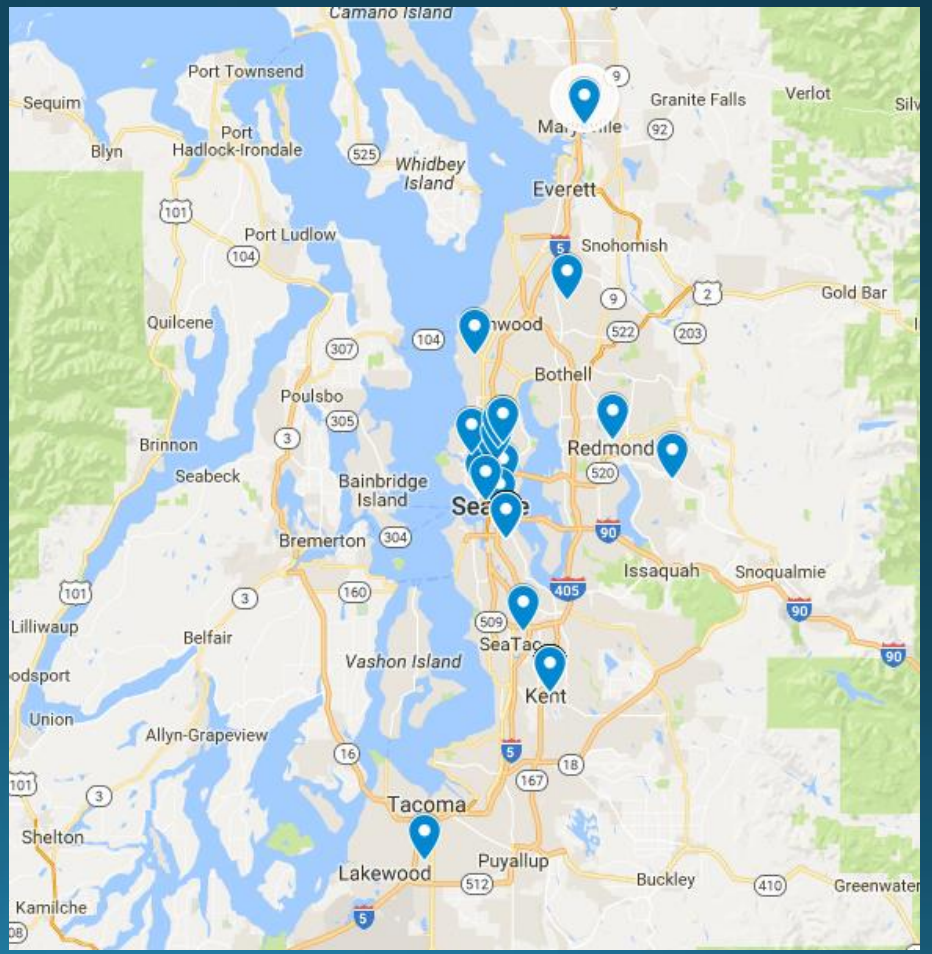
- New: UW Mobile Monitoring Platform with high-end research instruments

Combined Regulatory and Community Sites

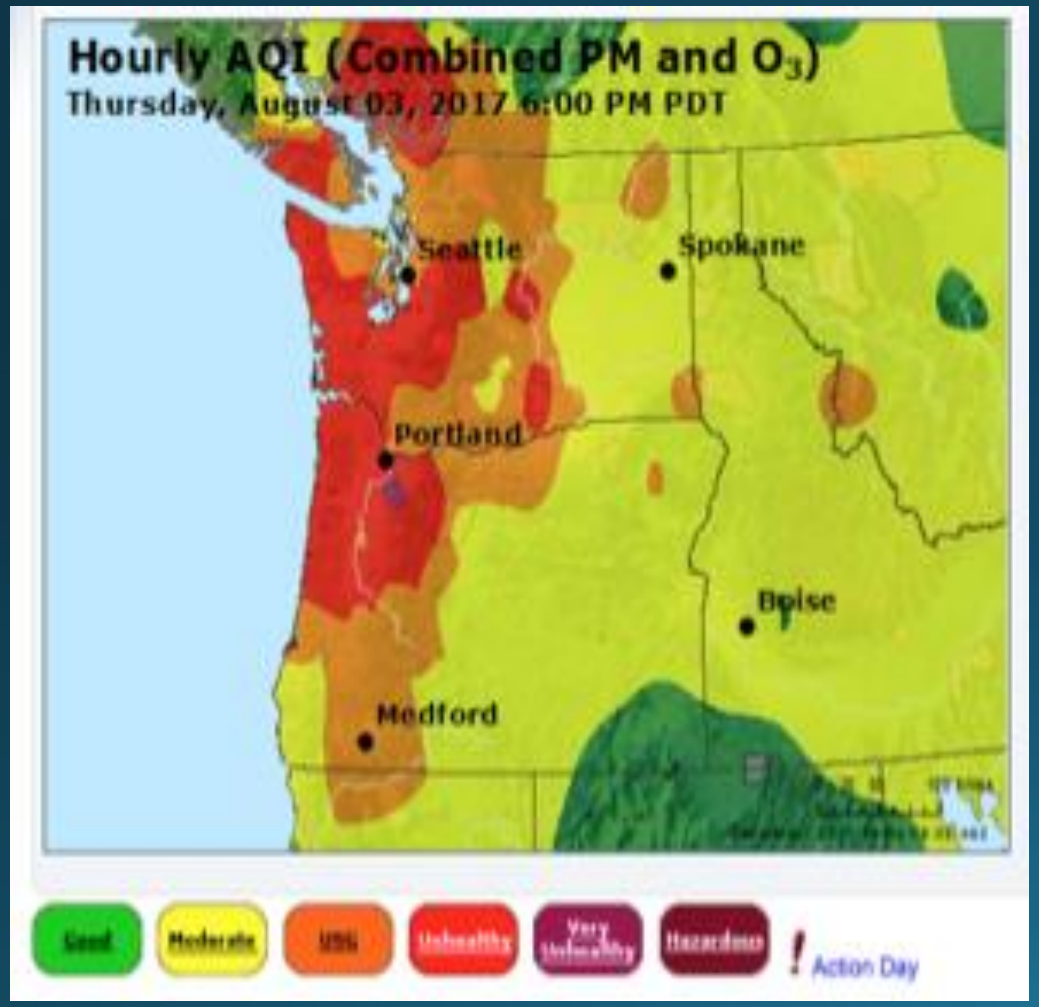
19 PSCAA / WA DoE Sites



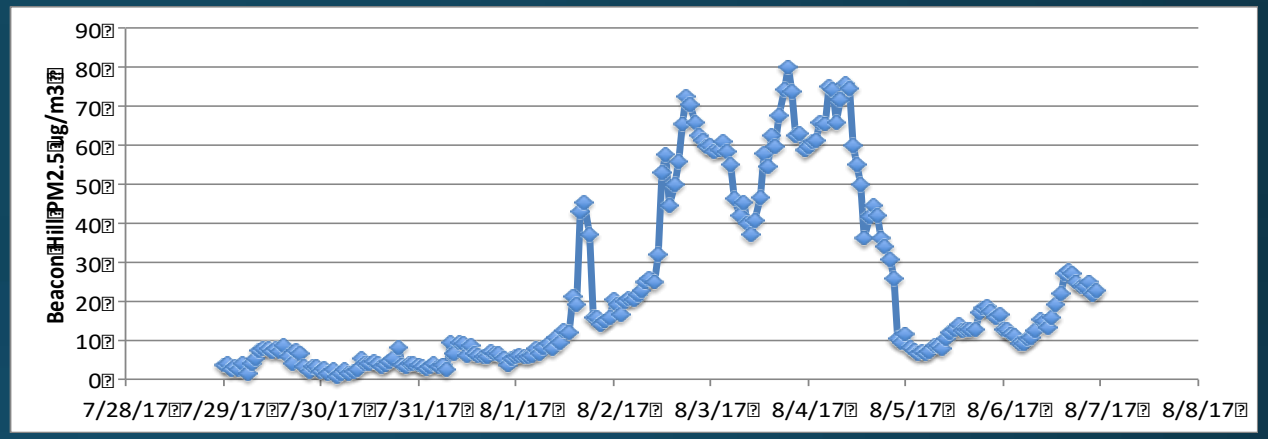
100 Community Monitoring Sites
(some doubled up for calibration)



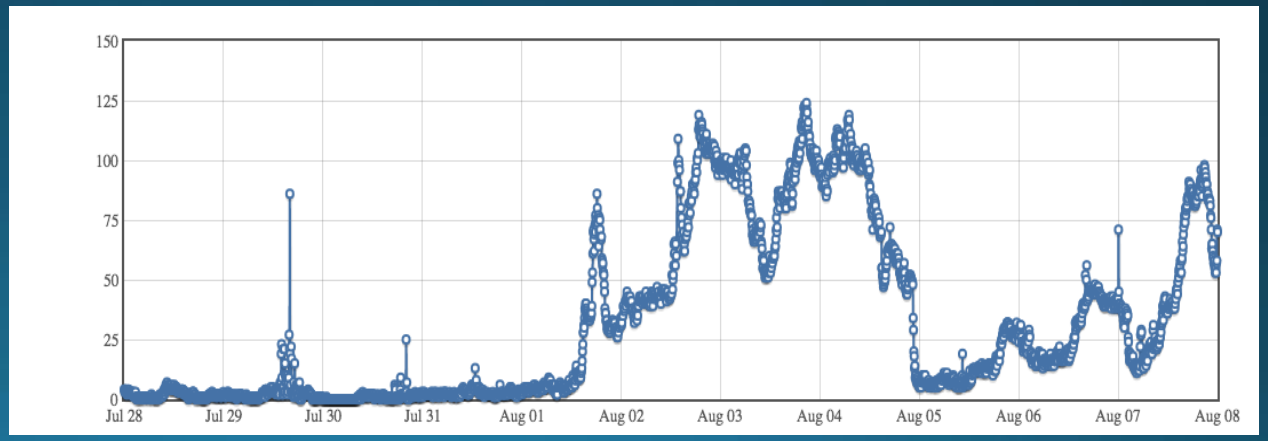
BC Wildfire Event in Seattle, Summer 2017



Regulatory Monitoring Data

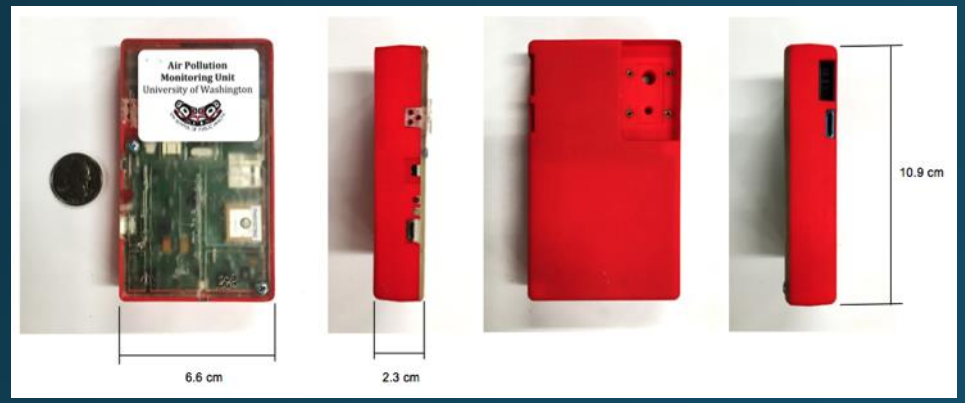


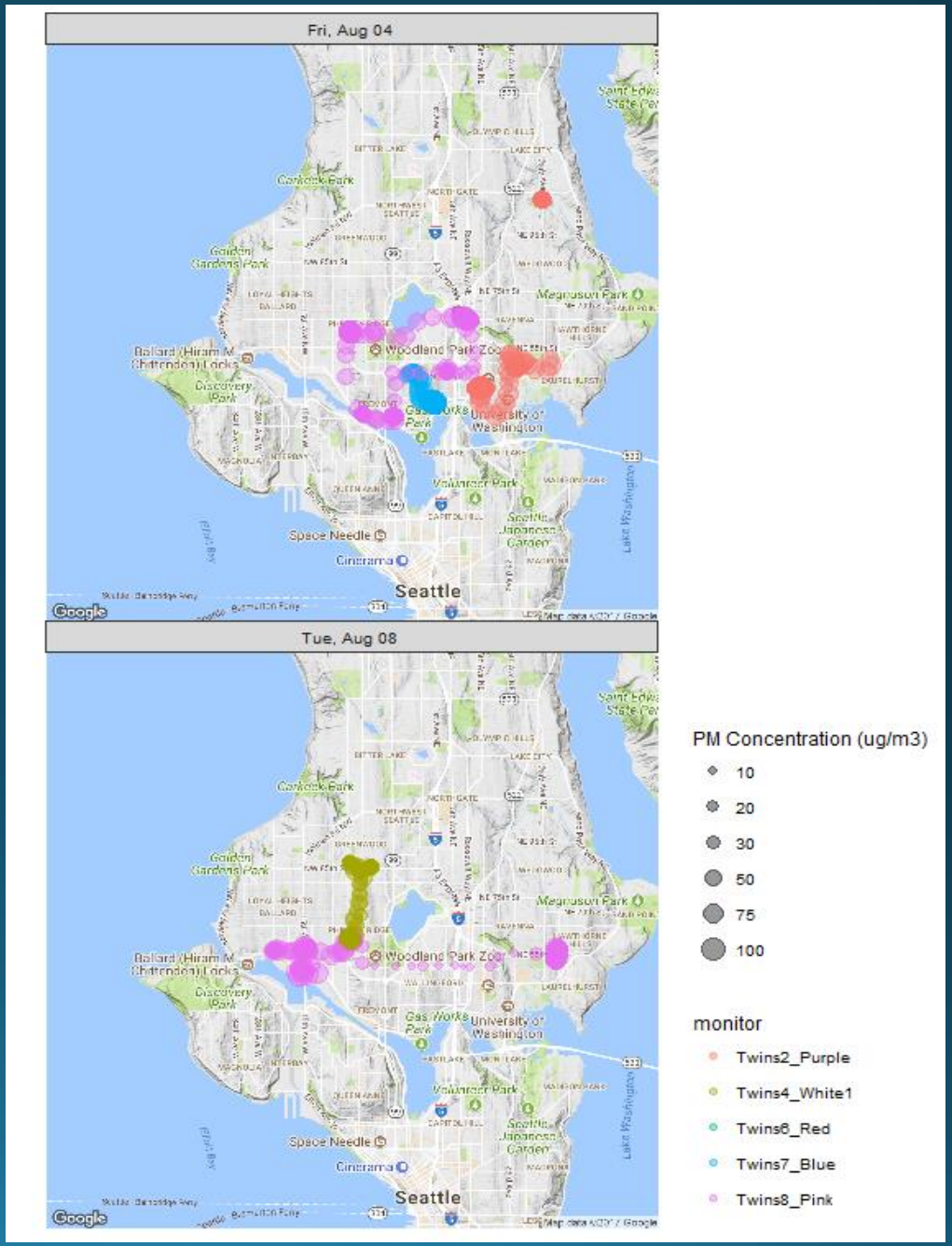
Community Sensor Data



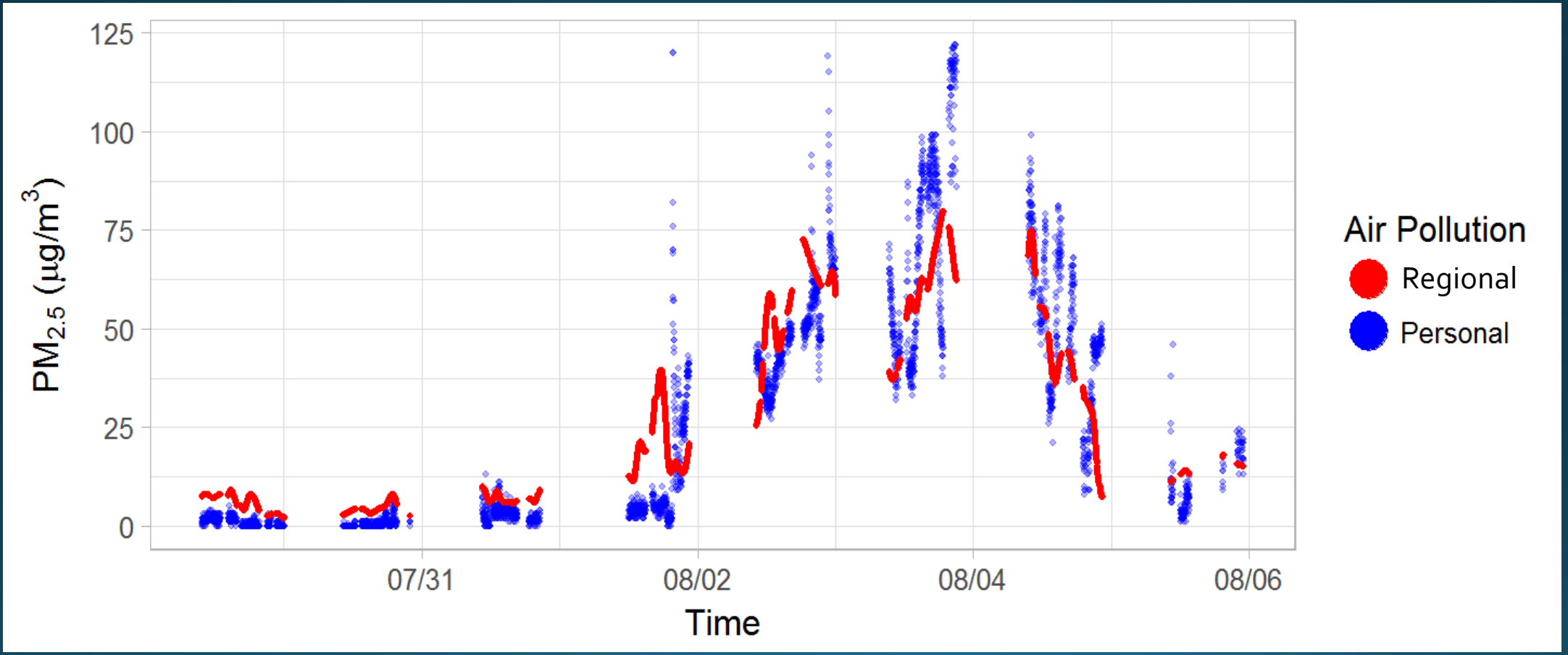
Study of 300 Twins

PUWP Personal Monitors





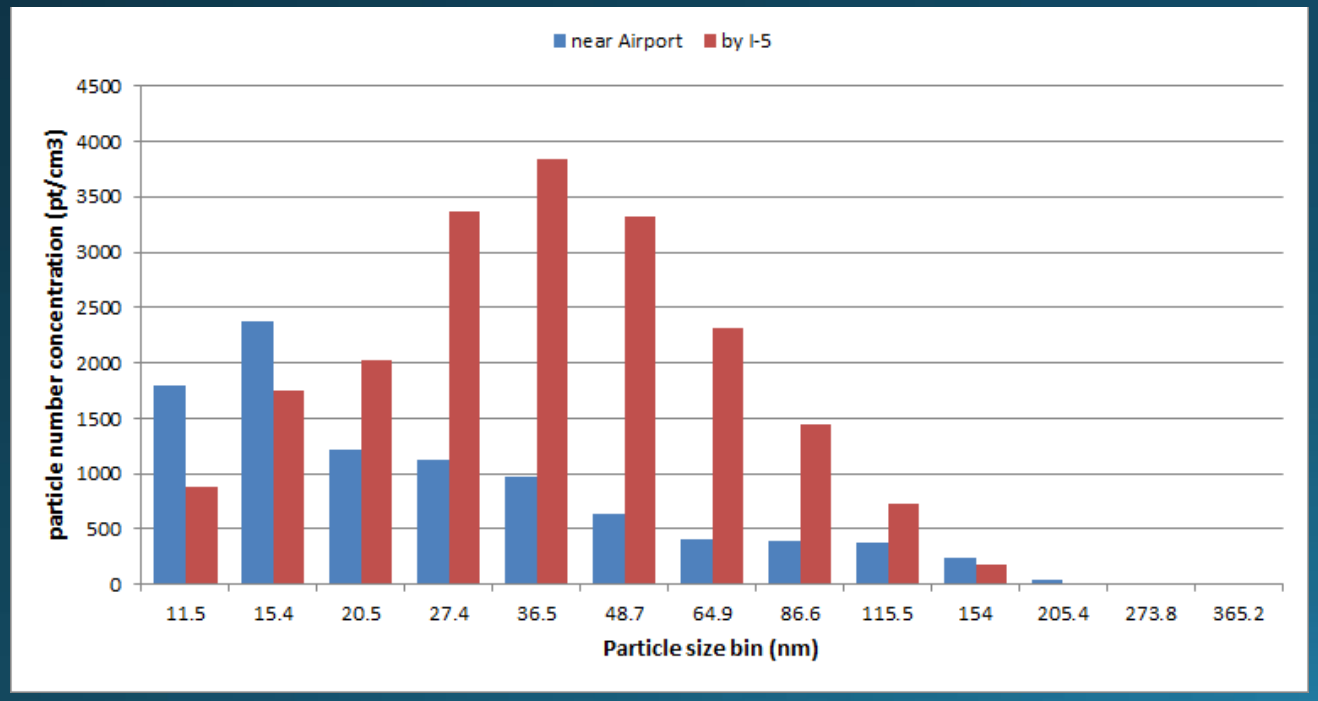
Personal Exposure vs Regional Air Quality

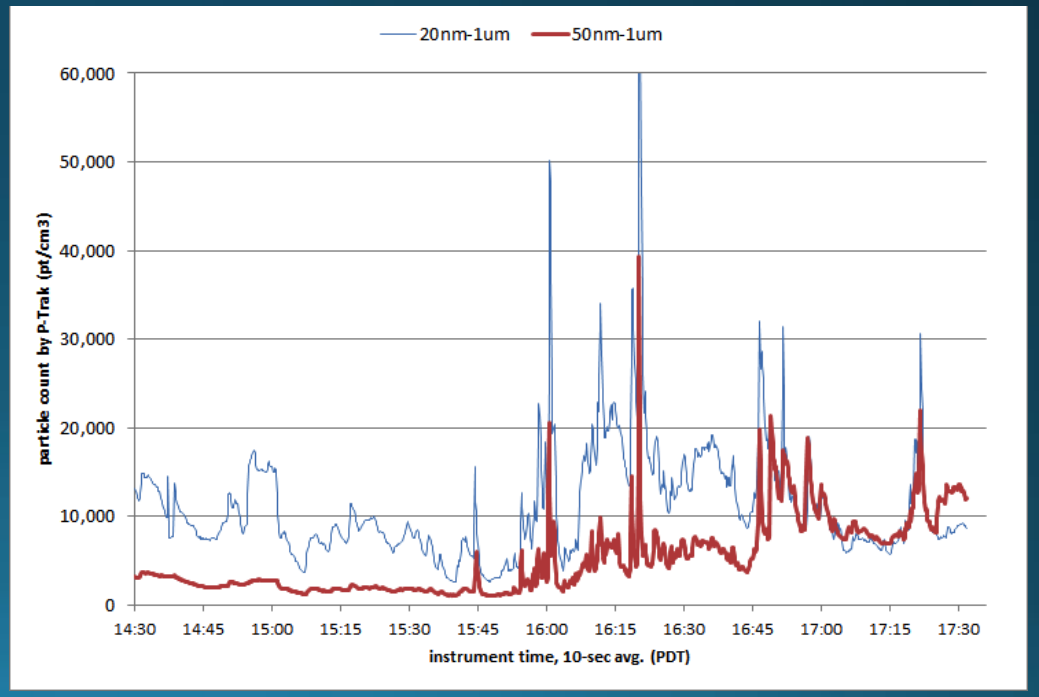


Integrating data from regulatory, community, and personal air monitoring can be useful for understanding air pollution events and exposures at multiple scales..

Seattle Mobile Monitoring

- UW Mobile Monitoring Platform
- Ultrafine SMPS, 16-channel particle sizer, aethalometer, gas analyzer, and vehicle tracking.





Needed Frameworks for Data Integration

- Sensor evaluation (against reference instruments, and also evaluation of particular use cases)
- Open data and data Interfaces
- Metadata
- Harmonization
- Intelligent data repurposing (ambient air monitoring, personal exposure, microenvironments, health studies?)
- QA/QC
- Visualization / Interpretation

Summary

- Increasingly we are finding uses for mixtures of regulatory, community, and personal air quality monitoring data.
- Accuracy, precision, and reliability of sensors are important to understand, but it is also important to understand the ability of sensors to measure phenomena of real-world concern.
- Sensor data may help us characterize important spatiotemporal factors that affect air quality, such as mobile sources of air pollution.
- Integrating data from regulatory, community, and personal air monitoring can be useful for understanding air pollution events and exposures at multiple scales.

Acknowledgements

- **Bay Area Near Roadway Study (BANRS)**
  Elena Austin, Jeff Shirai, Michael Jerrett, Alan Hubbard, Katherine Hammond, Ron Cohen
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  West Oakland Environmental Indicators Project (WOEIP)
  Communities for a Better Environment (CBE)
  Health Effects Institute
- **Twin PUWP Study**
  Graeme Carvlin, Jeff Shirai, Elena Austin, Jiayang He, Byron Ockerman, Igor Novosselov, Nicola Beck, Scott Meschke, Michael Yost, Ally Avery, Michael Oie, Glen Duncan
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  Lianne Sheppard, Gail Li, Paul Crane, Eric Larson, Graeme Carvlin, Jeff Shirai, Elena Austin, Elizabeth Spalt, Logan Piepmeier, Amanda Gassett, Tim Larson
  Puget Sound Clean Air Agency (PSCAA)
  Kaiser Permanente
  National Institutes of Health
- **WA SeaTac Ultrafine Mobile Monitoring Study**
  Tim Larson, Tim Gould, Elena Austin, Jeff Shirai, Michael Yost

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