LEVERAGING LOW-COST SENSORS FOR AIR MONITORING

Katheryn Kolesar, Air Sciences Inc.
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AIR SCIENCES INC.
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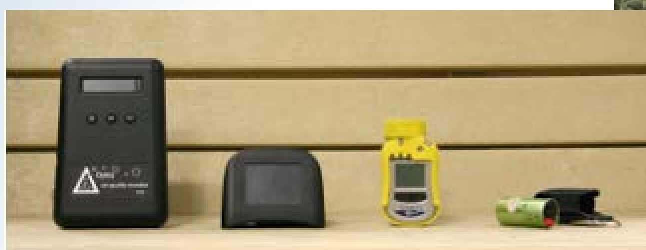
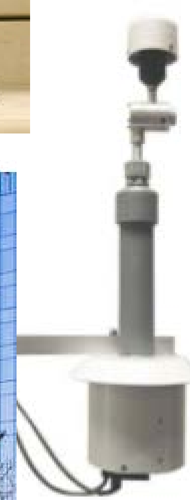
Overview

- The wild west of low-cost sensors
- Case Studies
- Interpret Data with Caution
- The original low-cost sensors (filters)
- Summary

Lots and lots and lots of options

- Particulate Matter
- Ozone
- NO2
- VOCs
- CO
- SO_2
- CO_2
- etc.





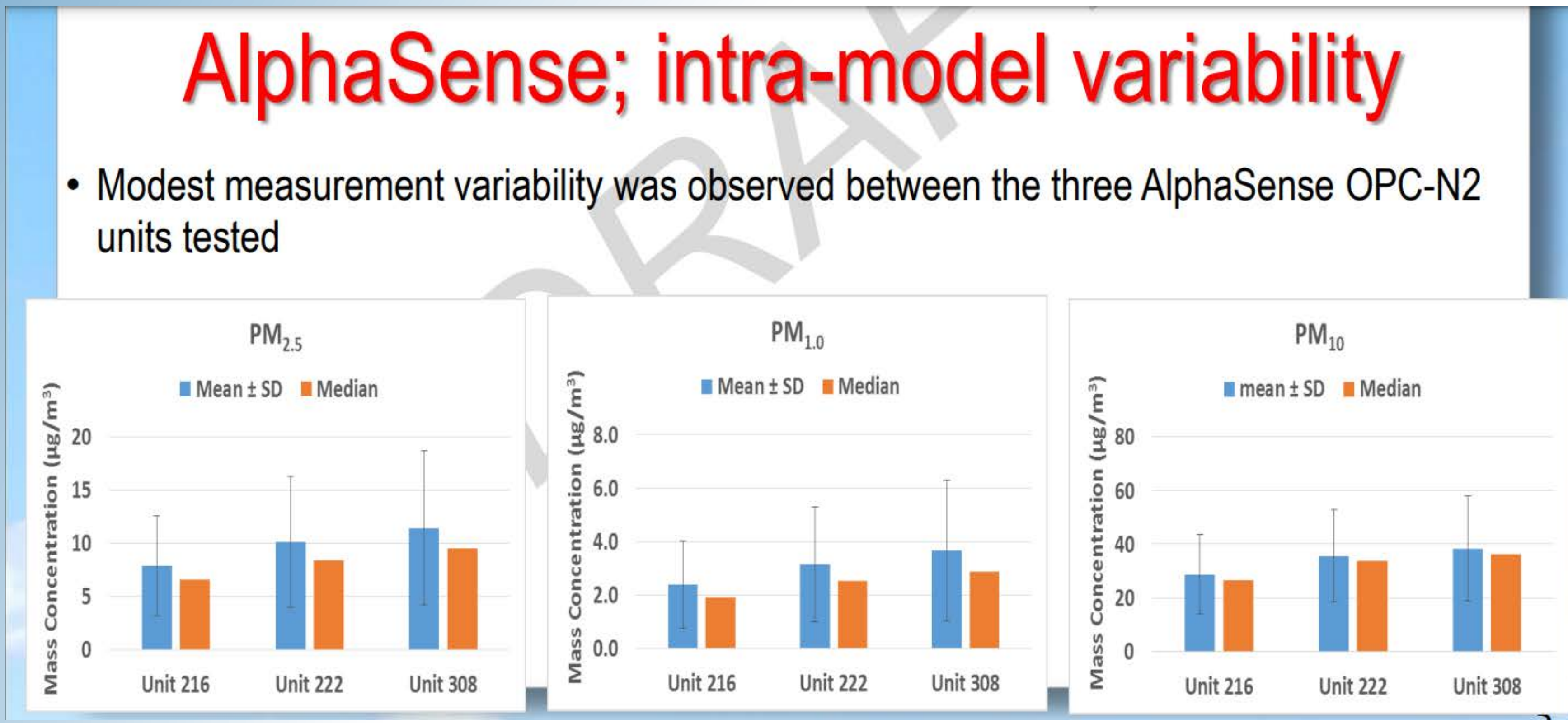
Even more non-Regulatory options

Where to find information

http://www.aqmd.gov/aq-spec/evaluations/field

- AlphaSense(*3 units tested*):
  - Particulate matter sensors (optical; non-FEM)
  - Each unit measures: $PM_{1.0}$, $PM_{2.5}$ and PM_{10} (µg/m³)
    Unit cost: ~$450
  - Time resolution: 15-sec
  - Units IDs: 216, 222, 308

Where to find information



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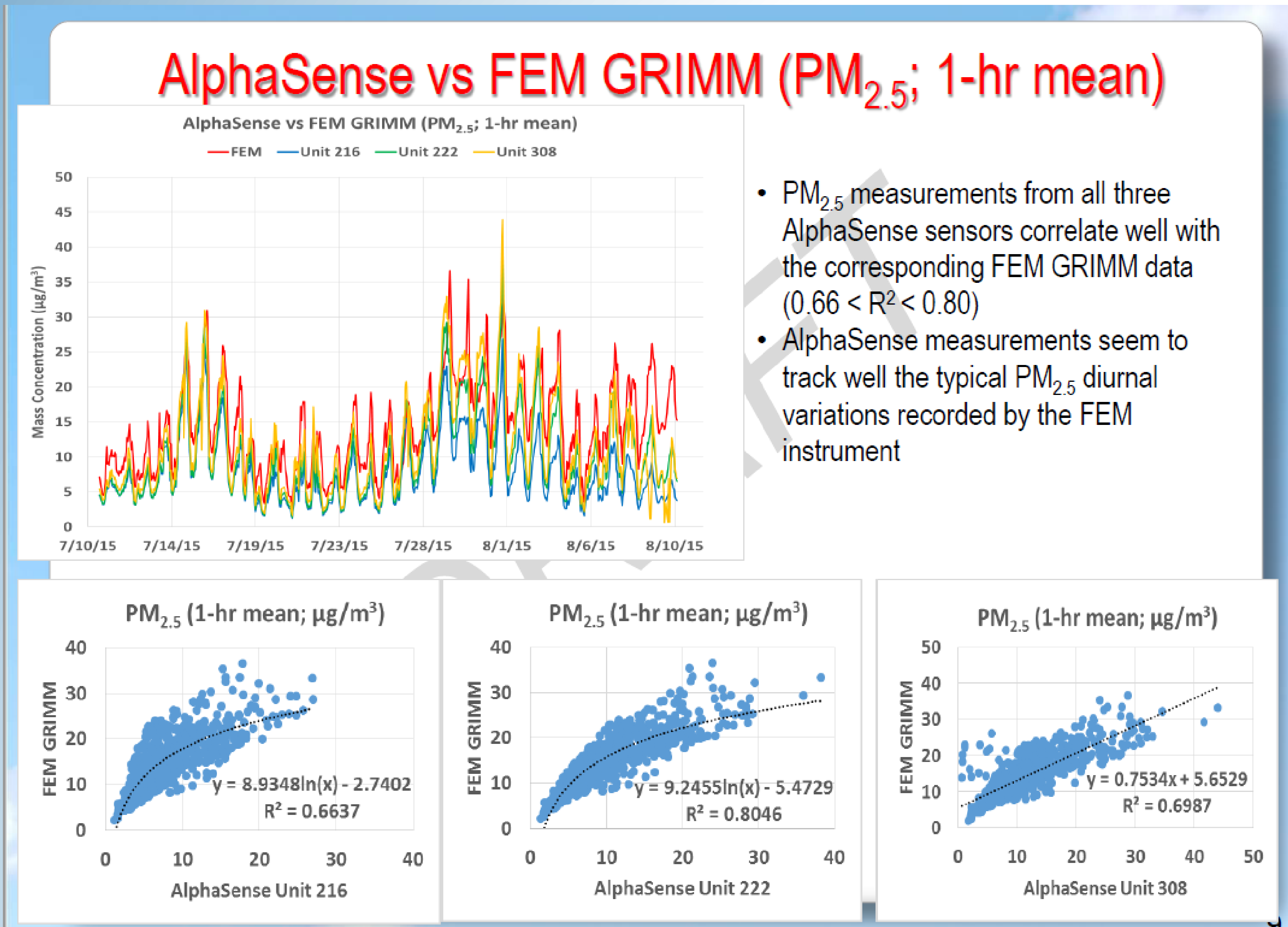
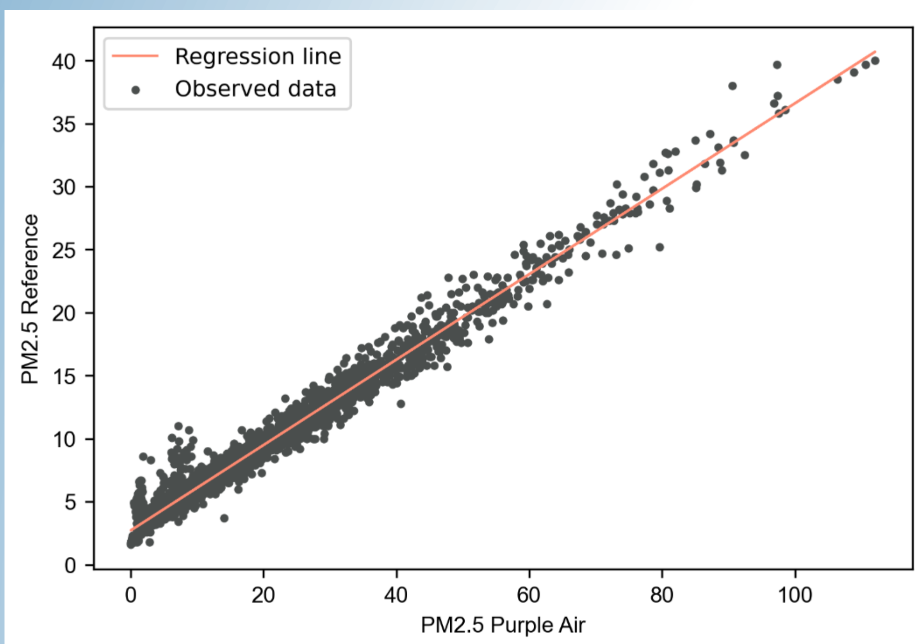


Considerations

- Timeframe
- Accessibility to reference monitors
- Proximity to reference monitors
- Spatial distribution
- Objective of measurements
- Do I need meteorological data?
- Is there a monthly contract? Hot swap? Data flow?

Calibrations

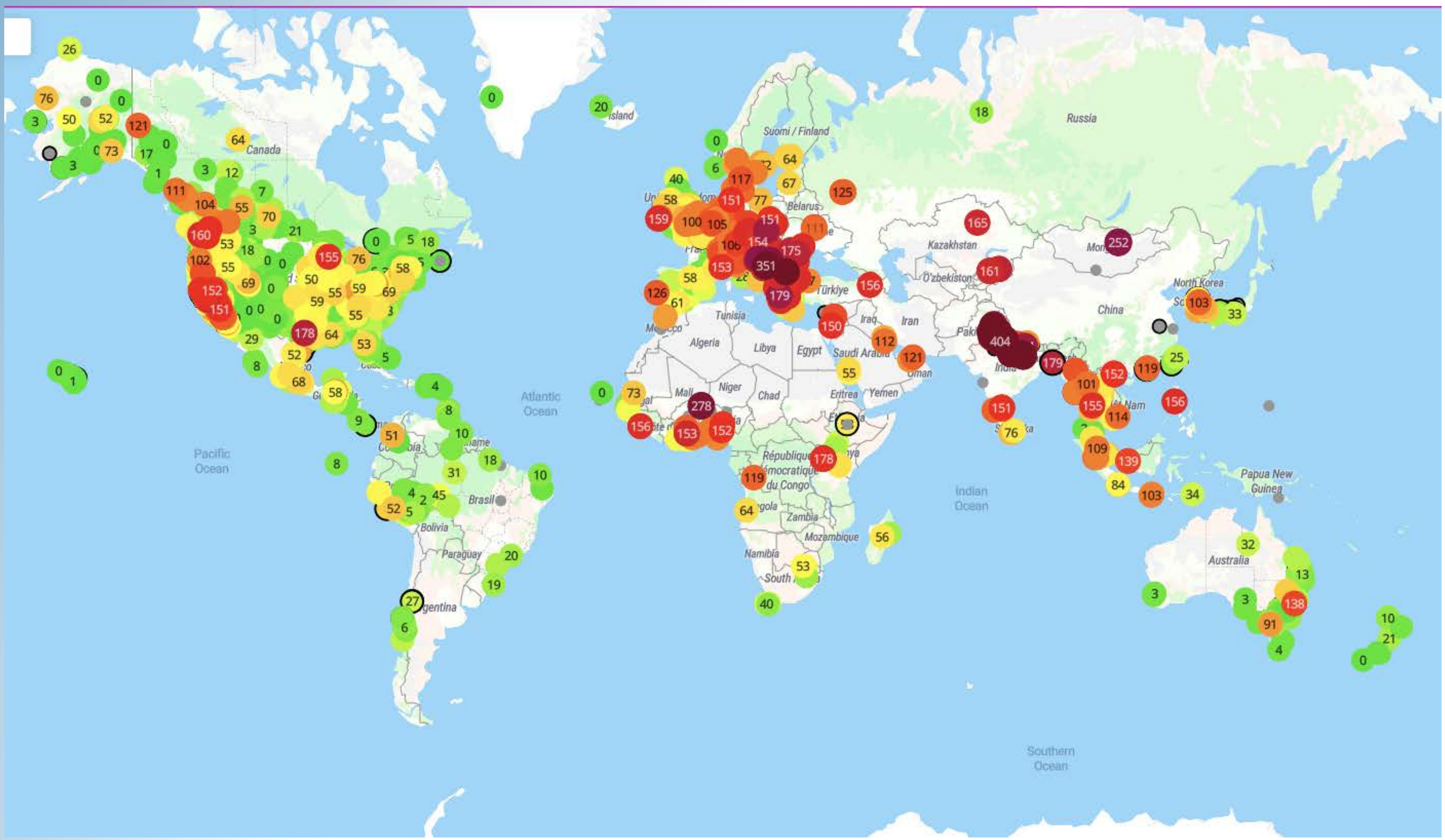
- Need to compare with a regulatory monitor
- Recommended to have collocations for at least a month, ideally once a year



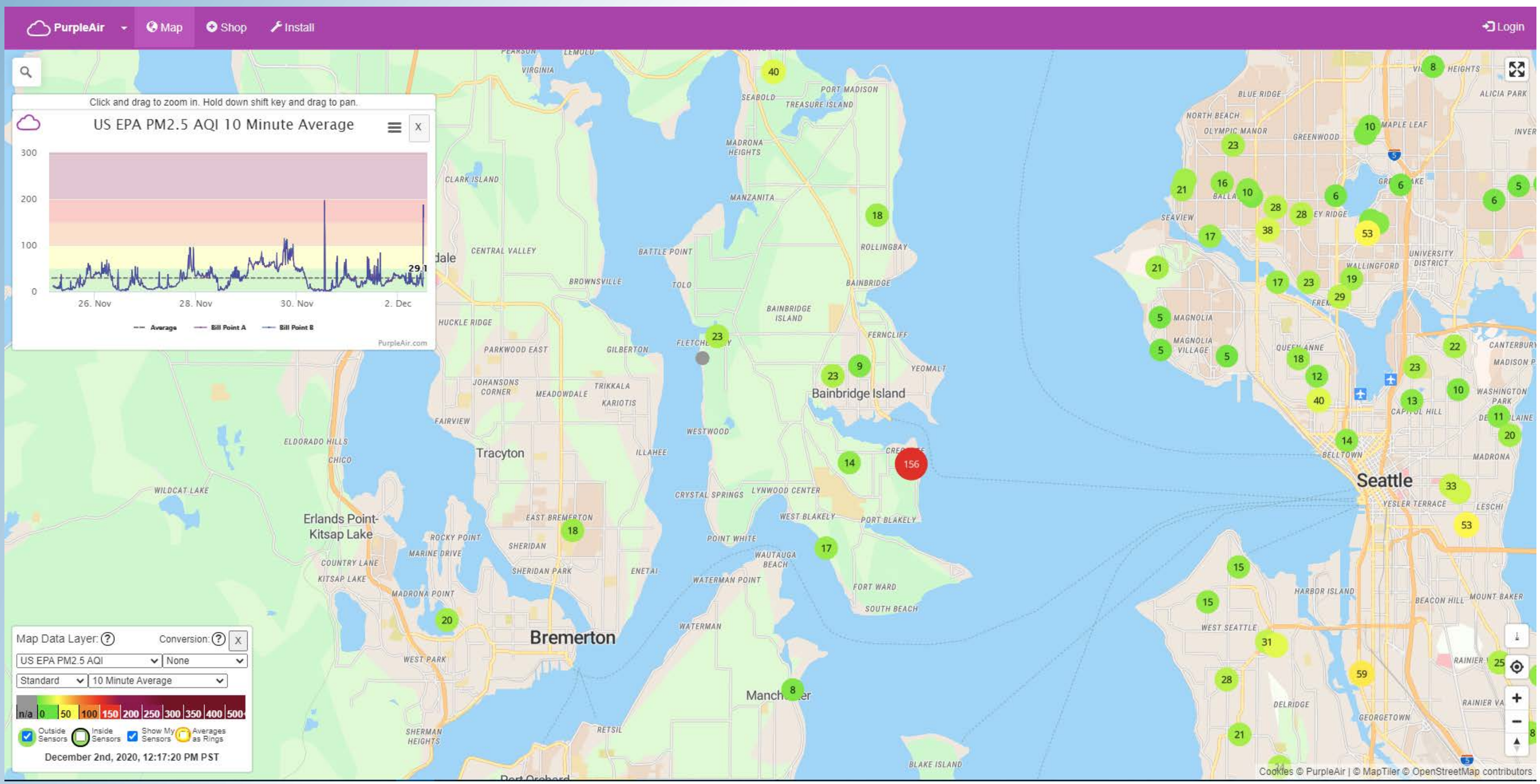
Using the Data

- Ensure proper siting
- Collocate early and often
- Purchase or rent a monitor to meet your needs
- Review data for quality

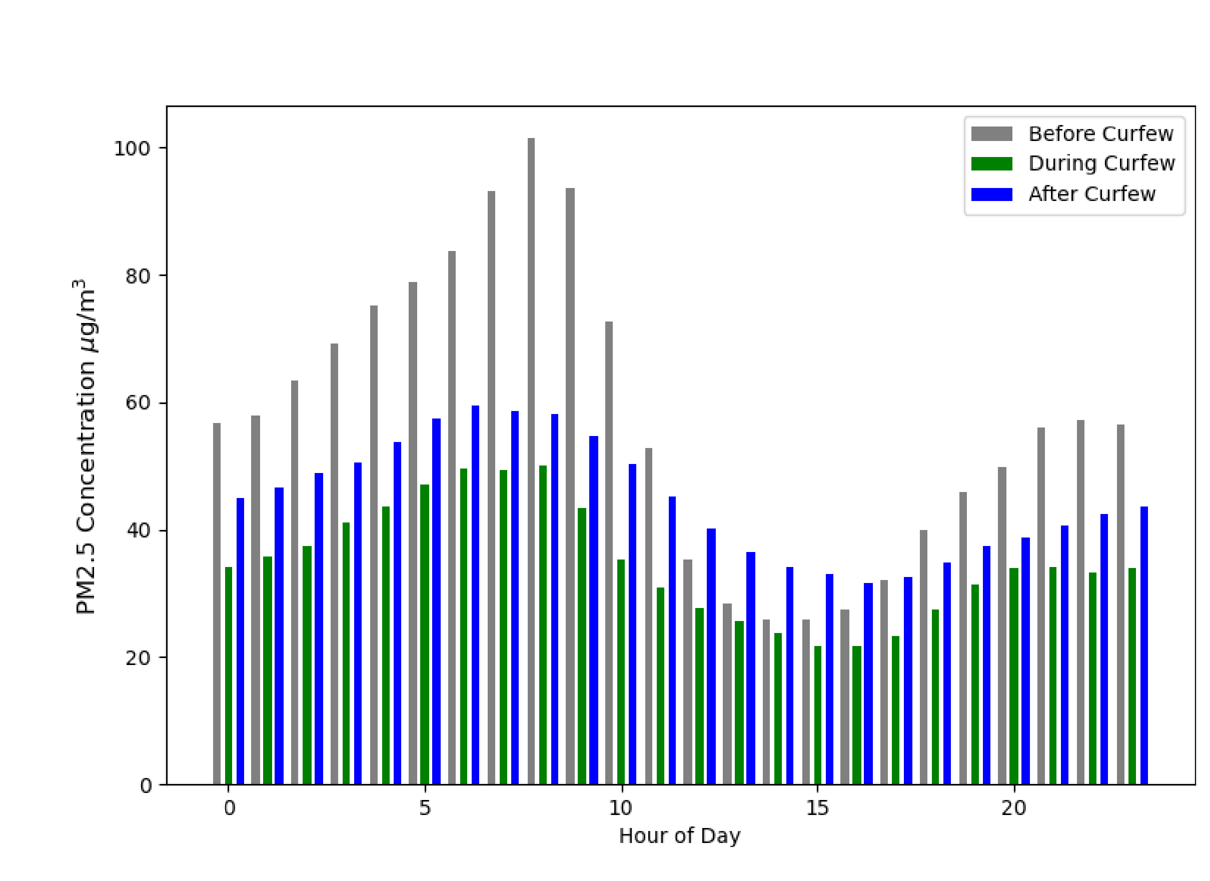
PM2.5 Data Example



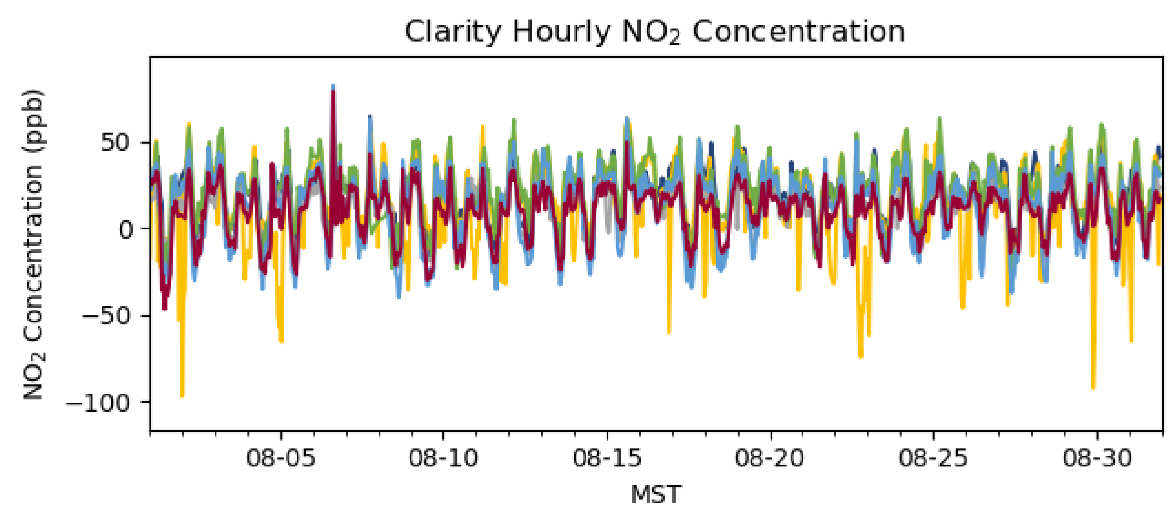
Hot Spot Determination

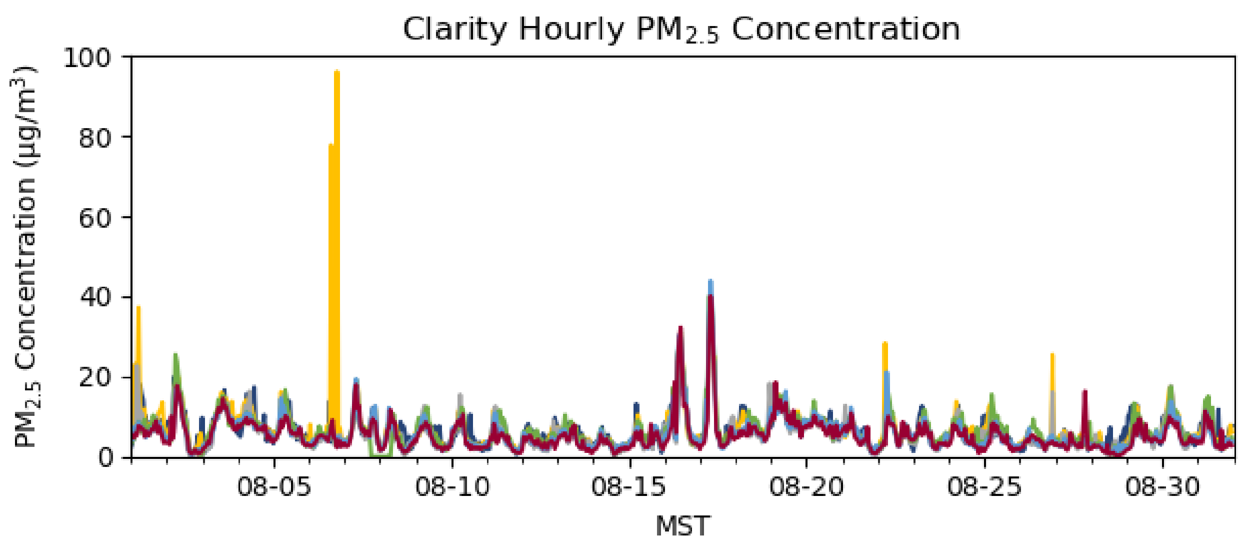


Trend Analysis – Impact of COVID-19 Curfew



NO_2 Data Example



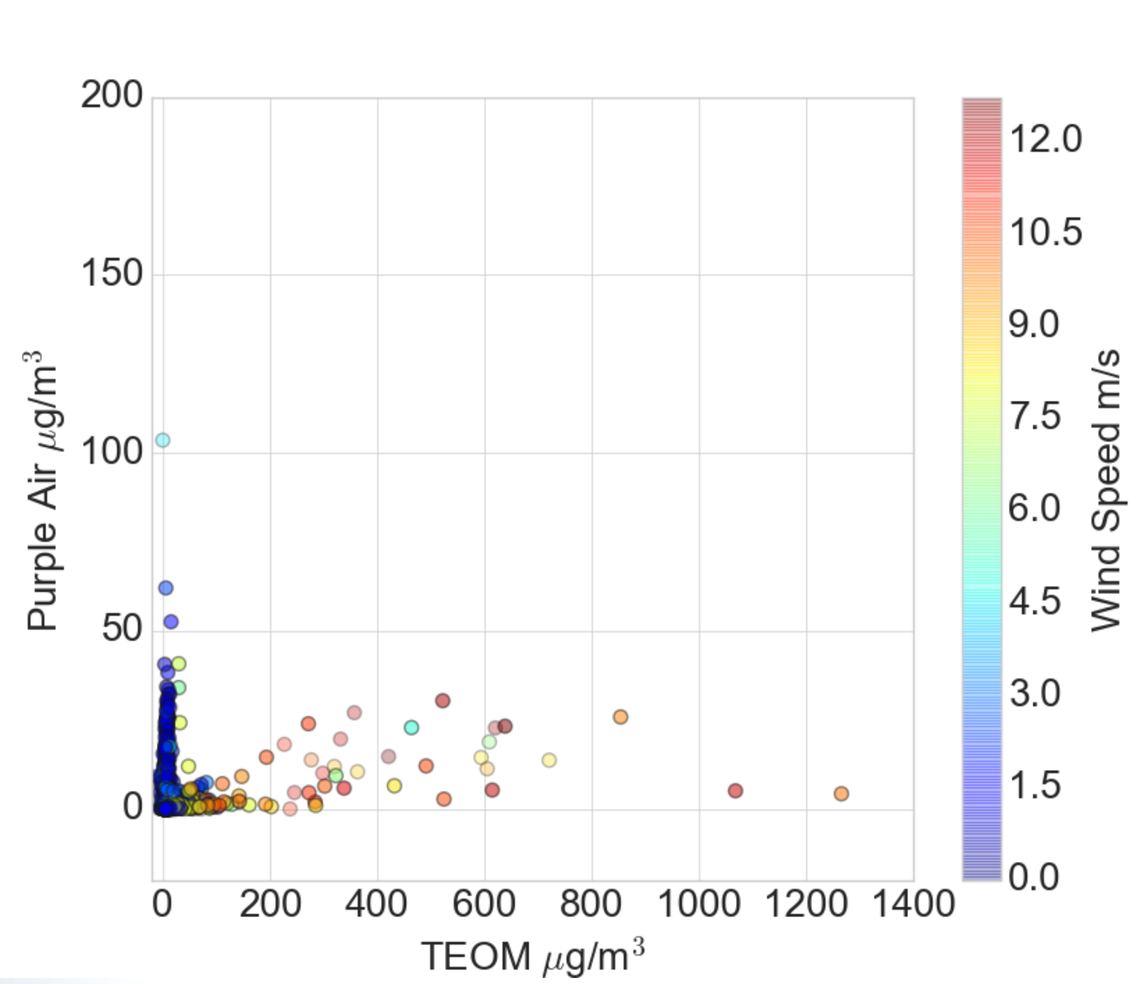


Limitation : Flow Rate and Inlet Design

- PM_{10} Inlet heads
  - Size selective with 50% cut-point diameter near 10 µm at designated flow rate
  - Omni-directional
  - Sampling efficiency not affected by ambient wind speeds
- $PM_{2.5}$ impactors
  - Size selective with 50% cut-point diameter near 2.5 µm at designated flow rate

Limitation : Flow Rate and Inlet Design

Limitation : PM_{10} Measurements

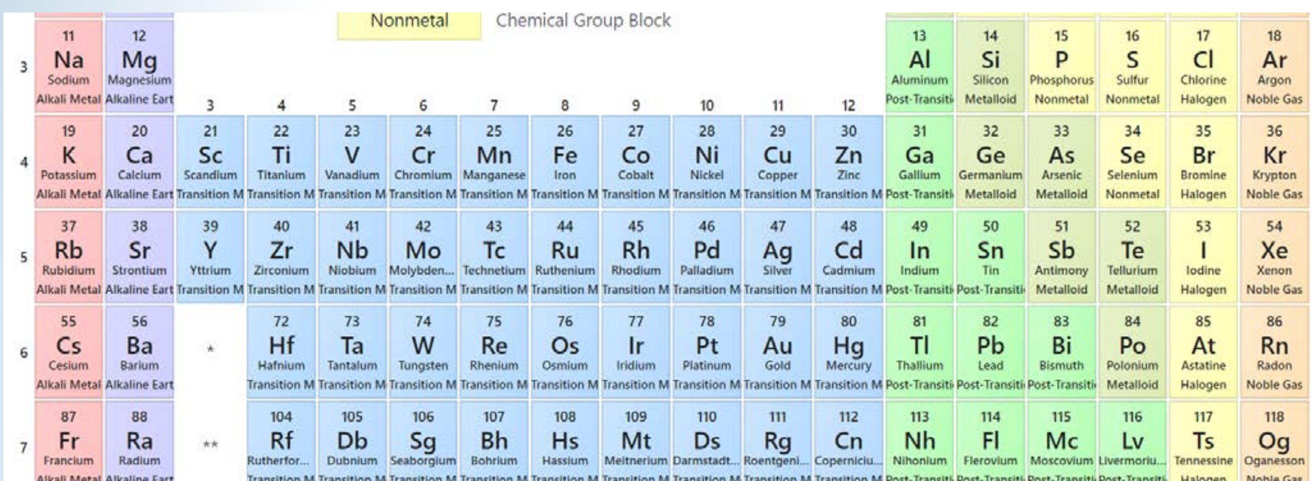


In my opinion

- Lots of great measurements of PM2.5 – still need calibration
- Some good options for PM10 – at low wind speeds
- NO2 measurements are starting to become reliable
- Ozone – 2B tech always had a ‘low-cost’ option
- Others – still in early stages

Filter-based monitoring

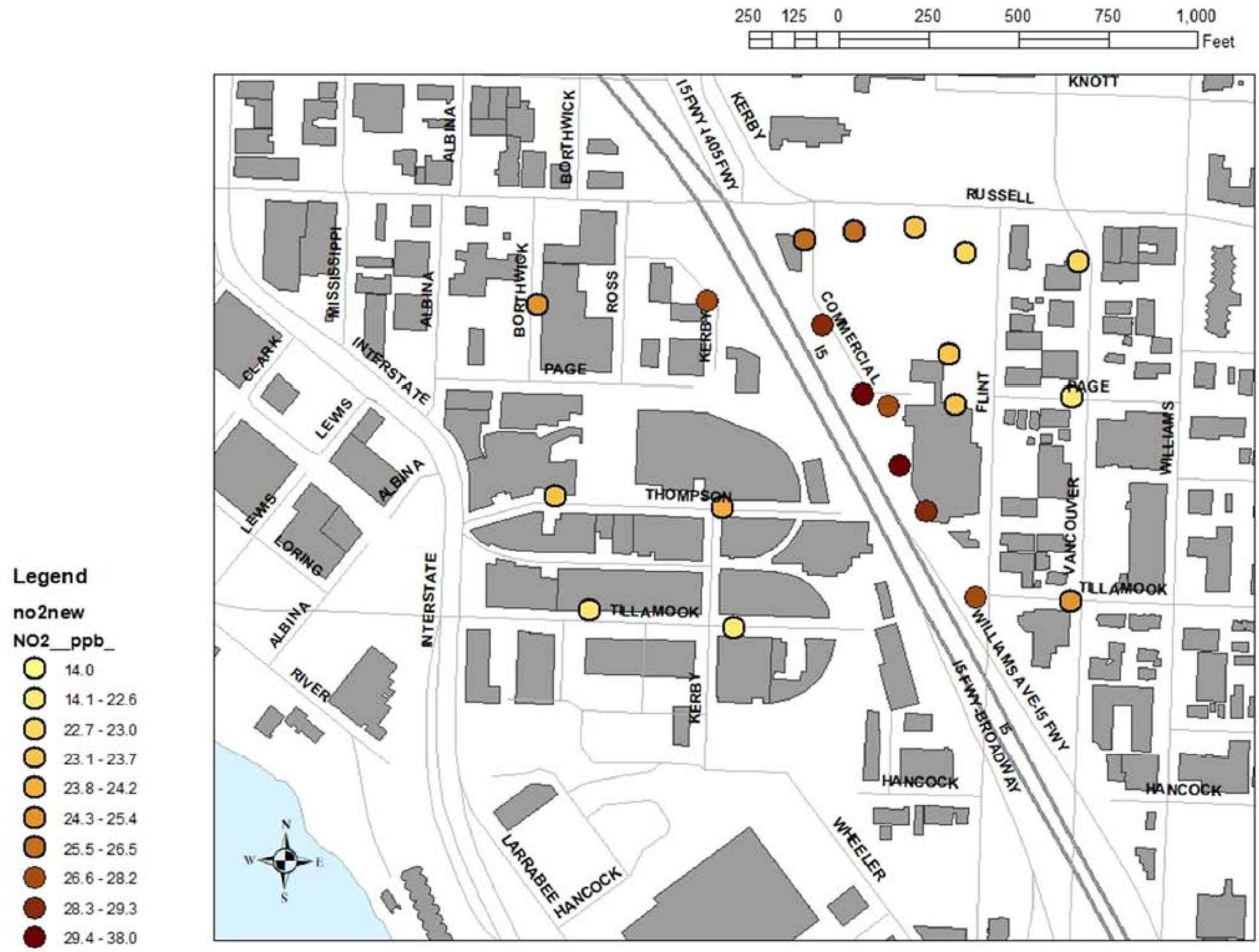
- Not as flashy, easy to use, provides hands on experience
- Filter samples with MiniVol or ARA
- Filter samples for gases with Ogawa or Radiello



Filter-based monitoring

- Ogawa - NO, NO_2, NO_x, SO_2, O_3, NH_3
- Radiello – Aldehydes, NH_3, BTEX/VOCs, HCl, HF, NO_2, SO_2, H_2S, O_3, Phenols, 1,3-butadiene
  - Ammonia Deposition Network

Case Study



250 125 0 250 500 750 1,000
Feet
KNOTT
RUSSELL
KERBY
I5 FWY I405 FWY
ALBINA
BORTHWICK
MISSISSIPPI
ROSS
PAGE
COMMERCIAL
I5
FLINT
WILLIAMS
VANCOUVER
CLARK
LEWIS
INTERSTATE
THOMPSON
LORING
TILLAMOOK
RIVER
HANCOCK
WILLIAMS AVE-I5 FWY
I5 FWY-BROADWAY
WHEELER
LARRABEE
Legend
no2new
NO2__ppb_
14.0
14.1 - 22.6
22.7 - 23.0
23.1 - 23.7
23.8 - 24.2
24.3 - 25.4
25.5 - 26.5
26.6 - 28.2
28.3 - 29.3
29.4 - 38.0
N
W
E
S

Summary

- Pick a monitoring technology suited to the project objectives
- Research types of monitoring available
- Be prepared to apply calibrations to data every year