Low-Cost Air Quality Monitoring: RAMPs in Pittsburgh, PA

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CAPS

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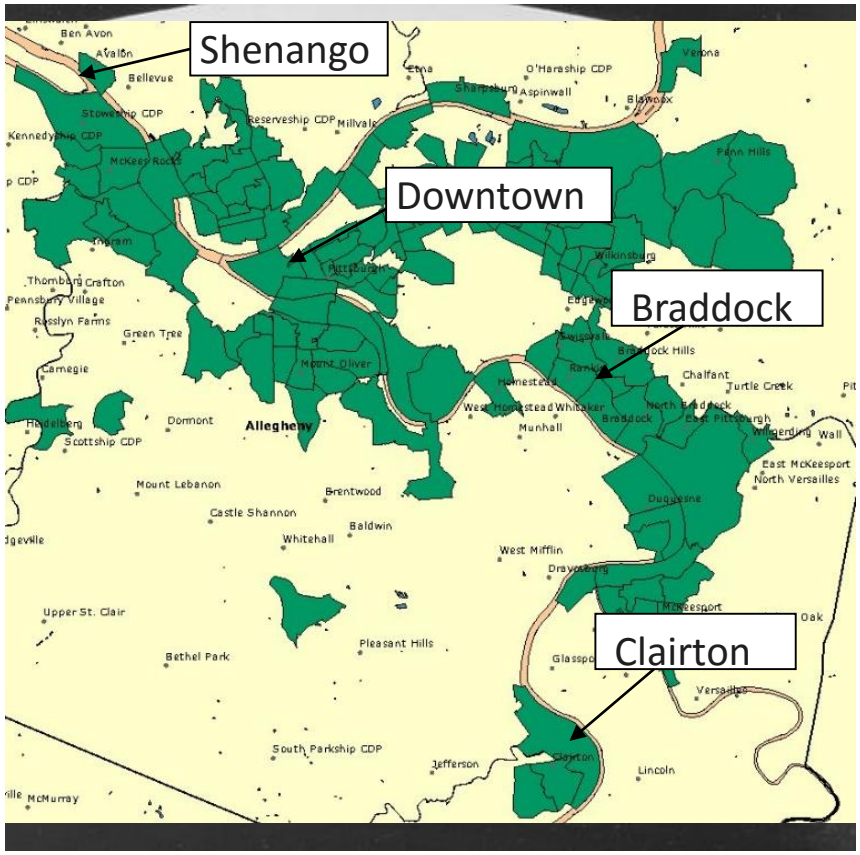
Air Quality in Pittsburgh: Then and Now

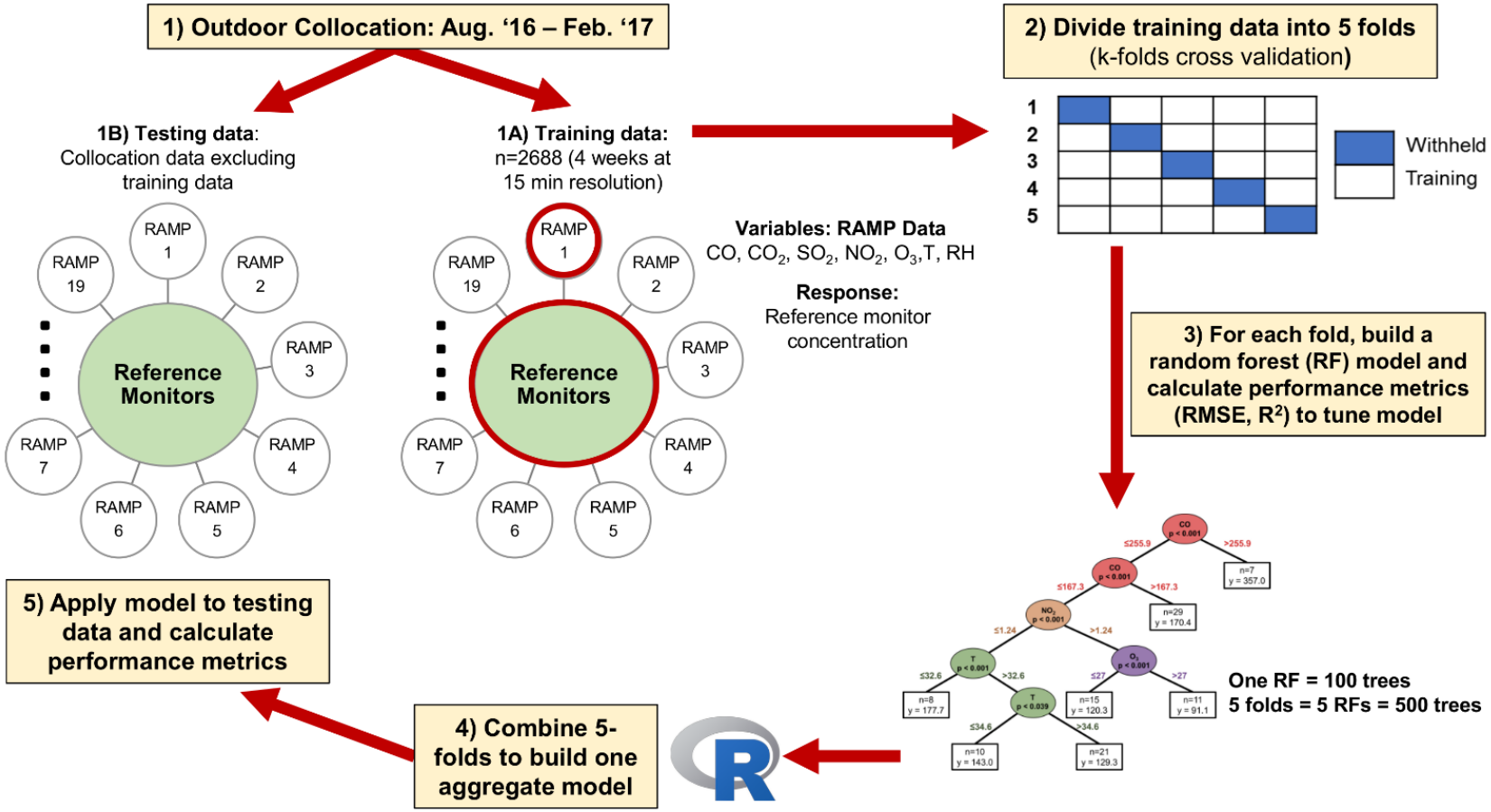


Real-time Affordable Multi-Pollutant (RAMP) monitor

- **C**enter for **A**tmospheric **P**article **S**tudies
- SenSevere
- CO, CO_2, O_3, NO_2, SO_2, T, RH.
- Met-One $PM_{2.5}$
- Data over GSM to central server
- Low cost (~$4,500)

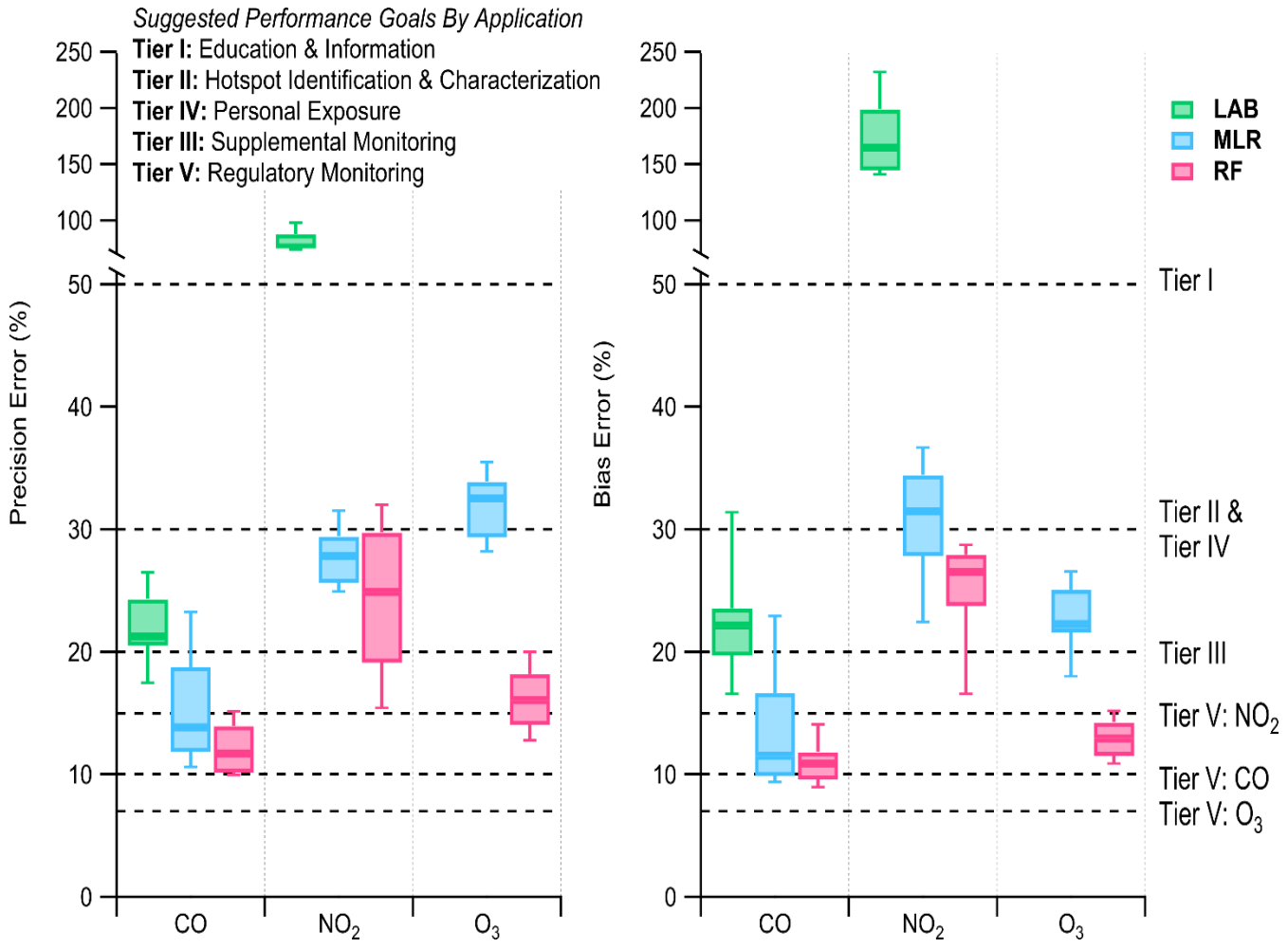
RAMP trees and Supersite: Collocation

RAMP Calibration: Machine Learning



Zimmerman et al. (2017): "Closing the gap on lower cost air quality monitoring…" Atmospheric Measurement Techniques

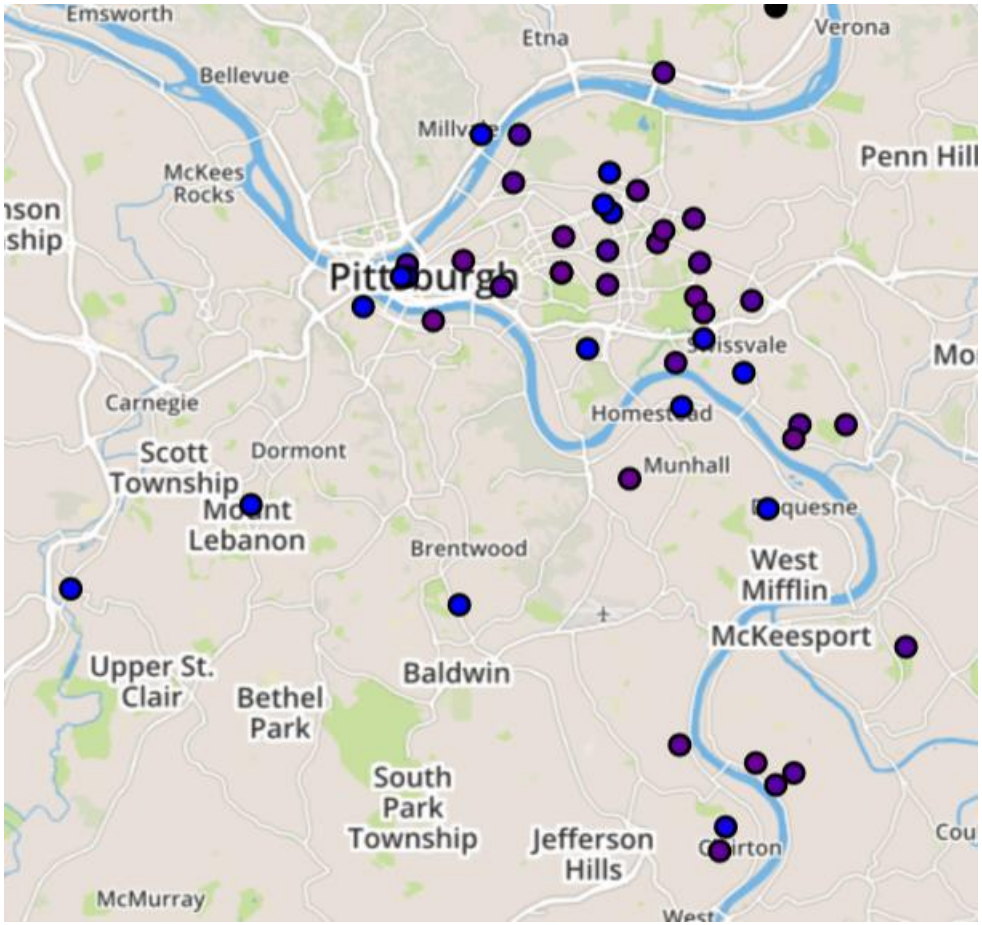
RAMPs meet EPA guidelines for Hot Spot Detection and Supplemental Monitoring



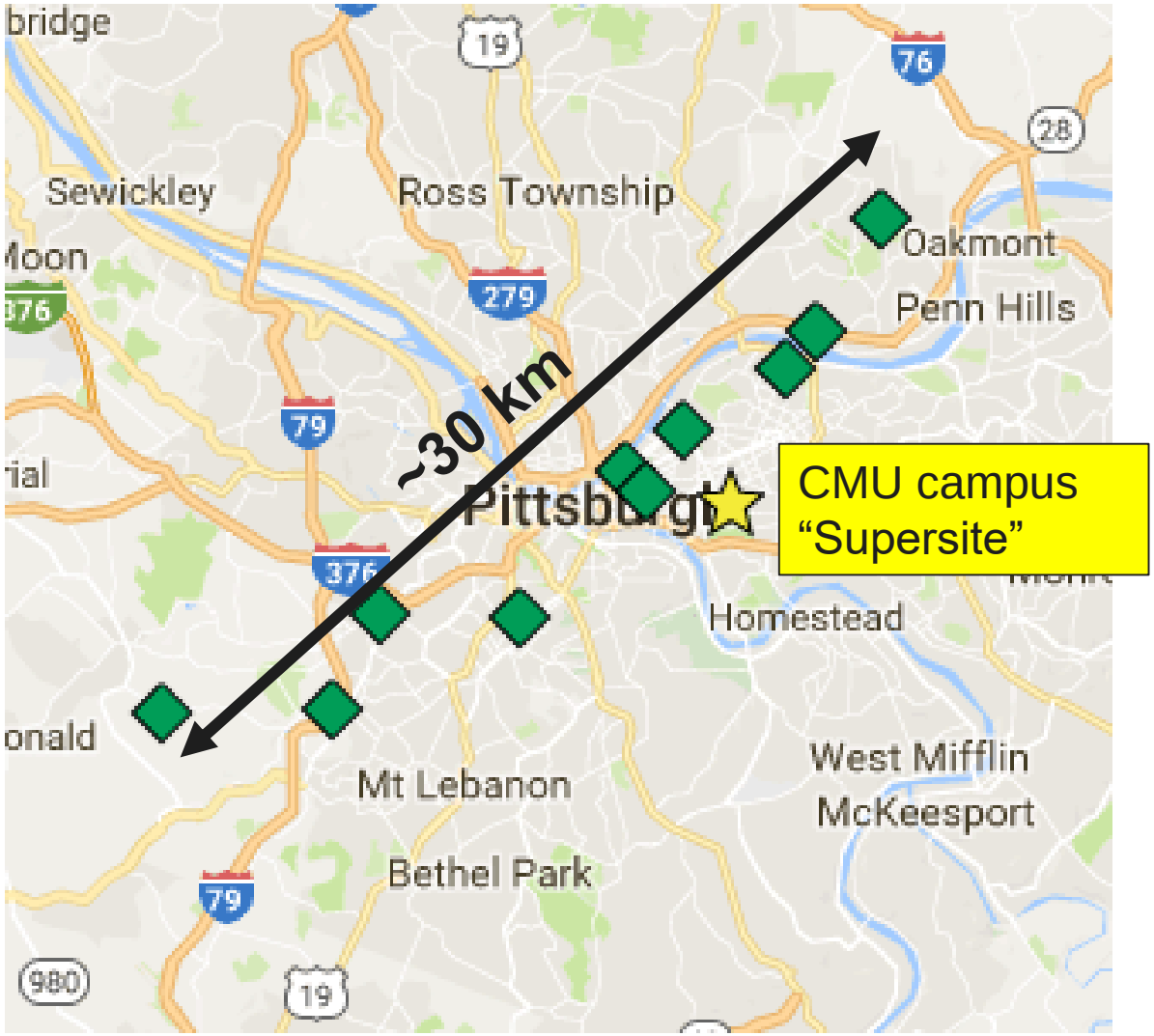
Zimmerman et al. (2017): https://doi.org/10.5194/amt-2017-260

RAMP deployments: current and planned

- 50 RAMPs deployed across Pittsburgh and nearby EJ communities
- ~1 km spatial resolution
- Data 4x/minute, averaged to 15-minute or 1-hour

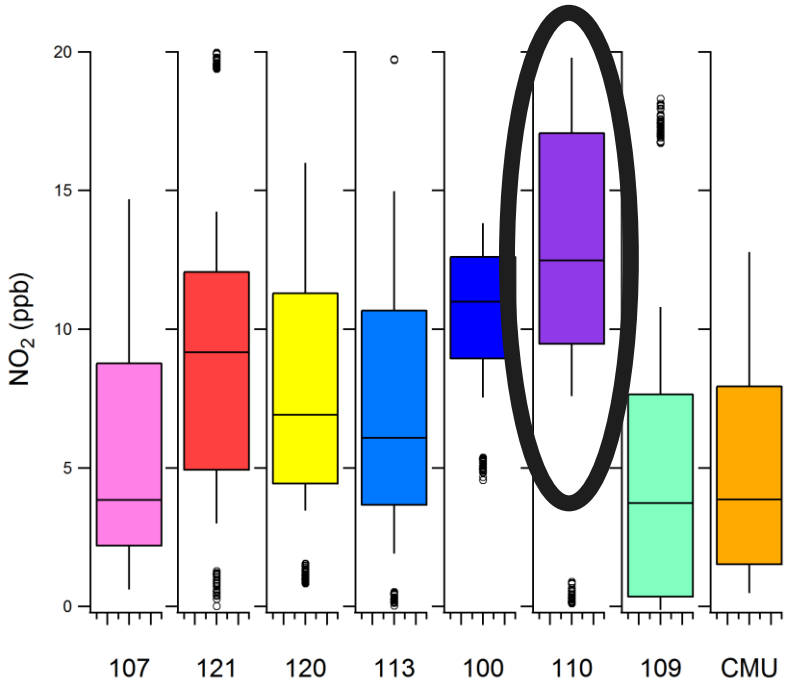


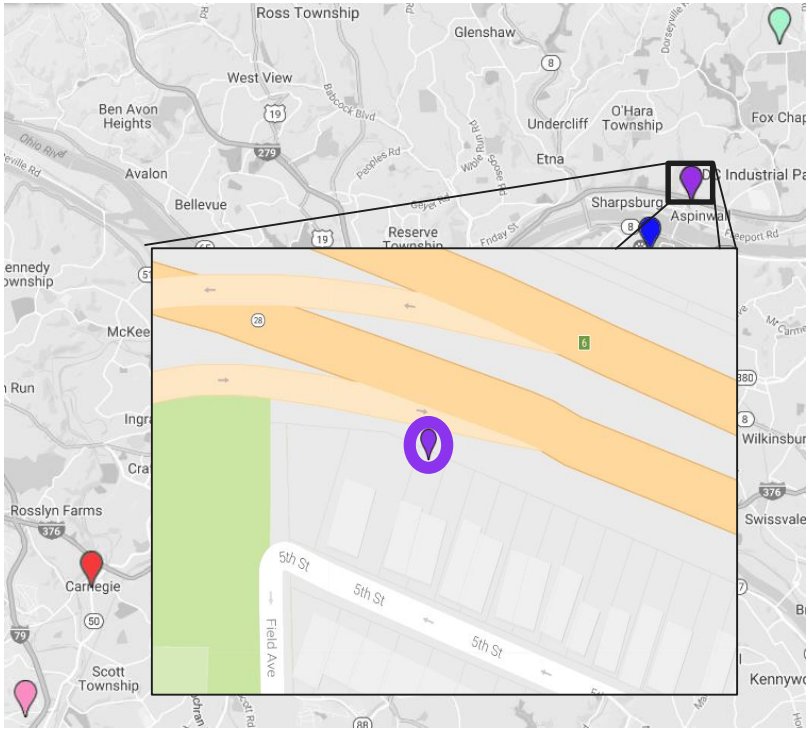
RAMP deployment: Summer 2016 Transect



Sensitivity to chemistry in the near-road microenvironment

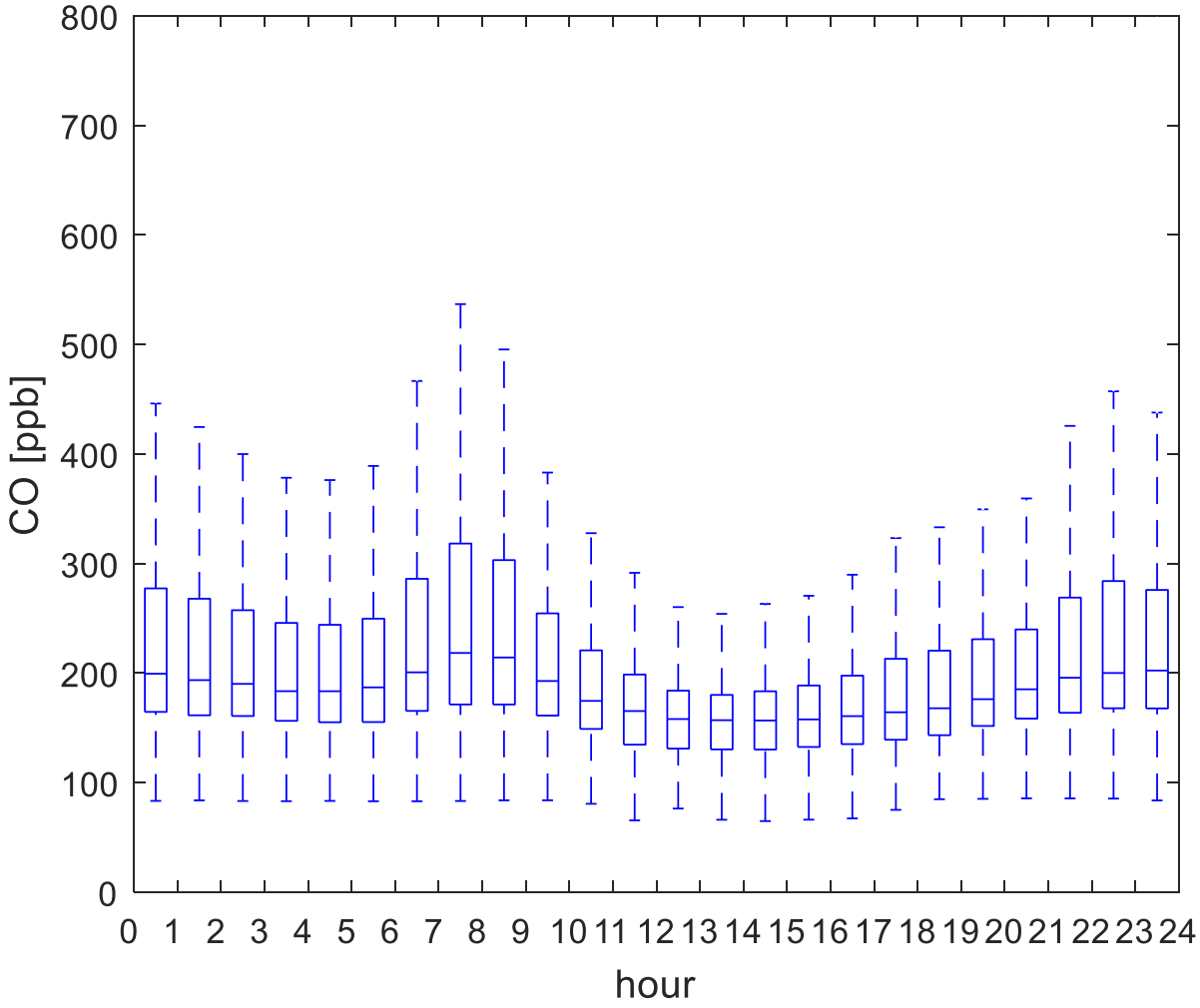
- Purple site is within 15 m of a highway
- Vehicles emit NO, $NO + O_3 \rightarrow$ form more NO_2 in near road



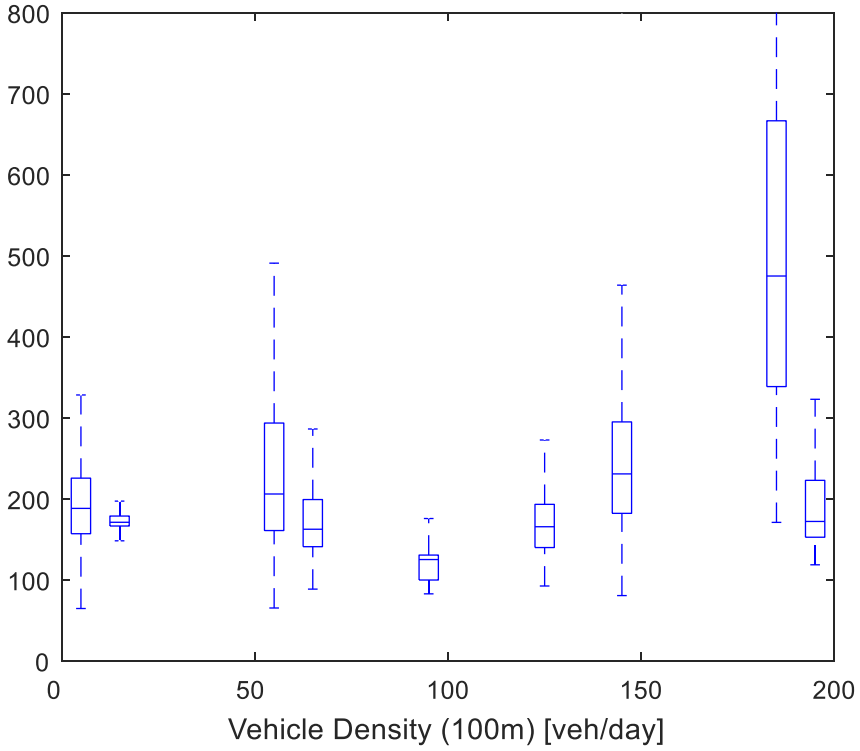


Sites ordered along prevailing wind direction

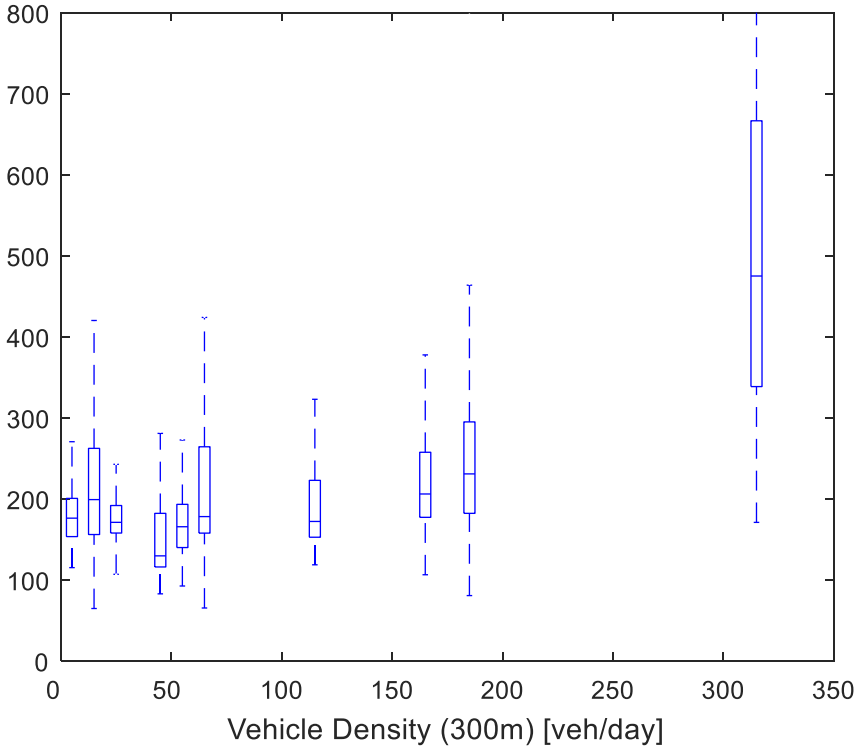
Carbon Monoxide from the RAMP network: Summer 2017



Carbon Monoxide and Vehicle Density

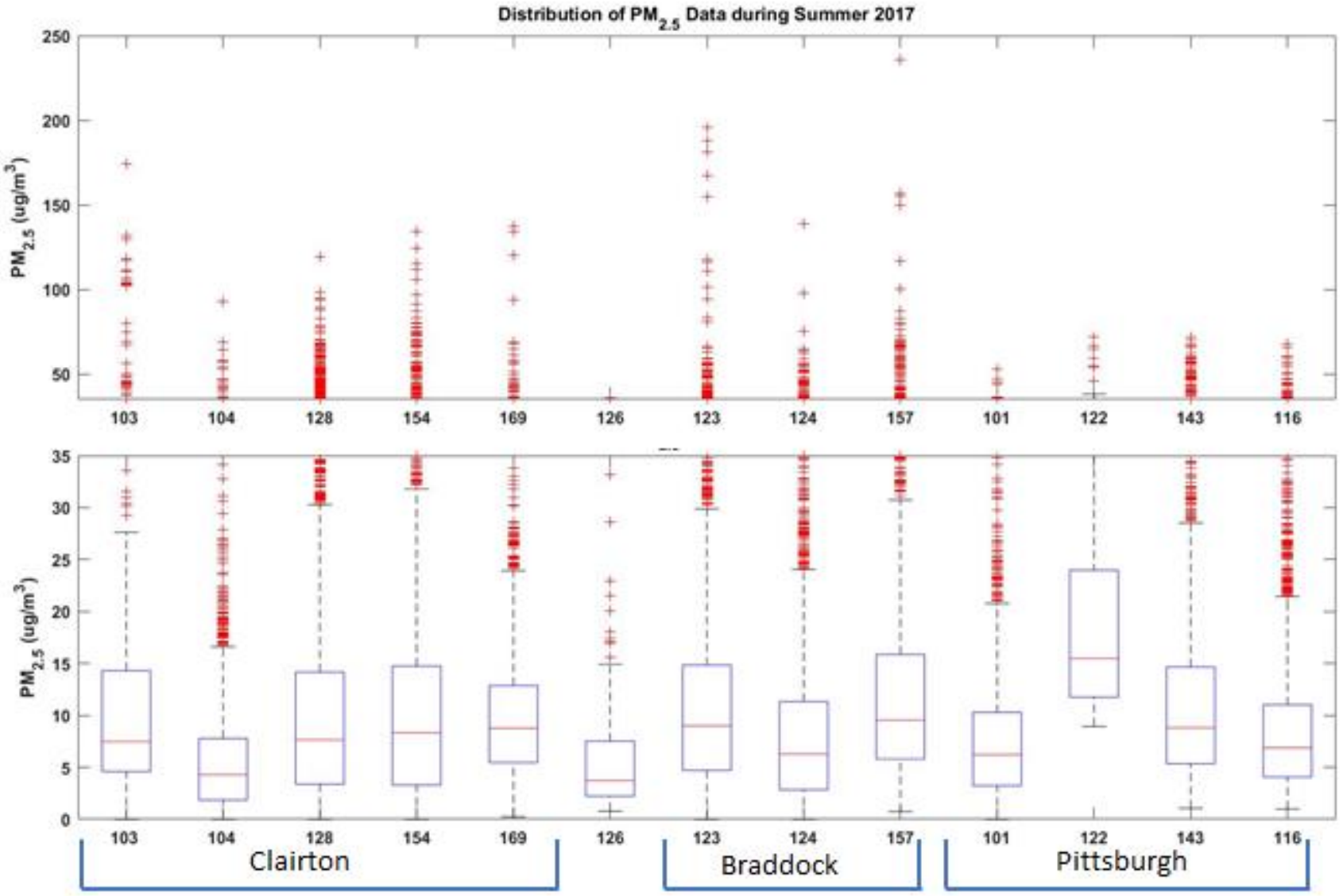


100-m vehicle density

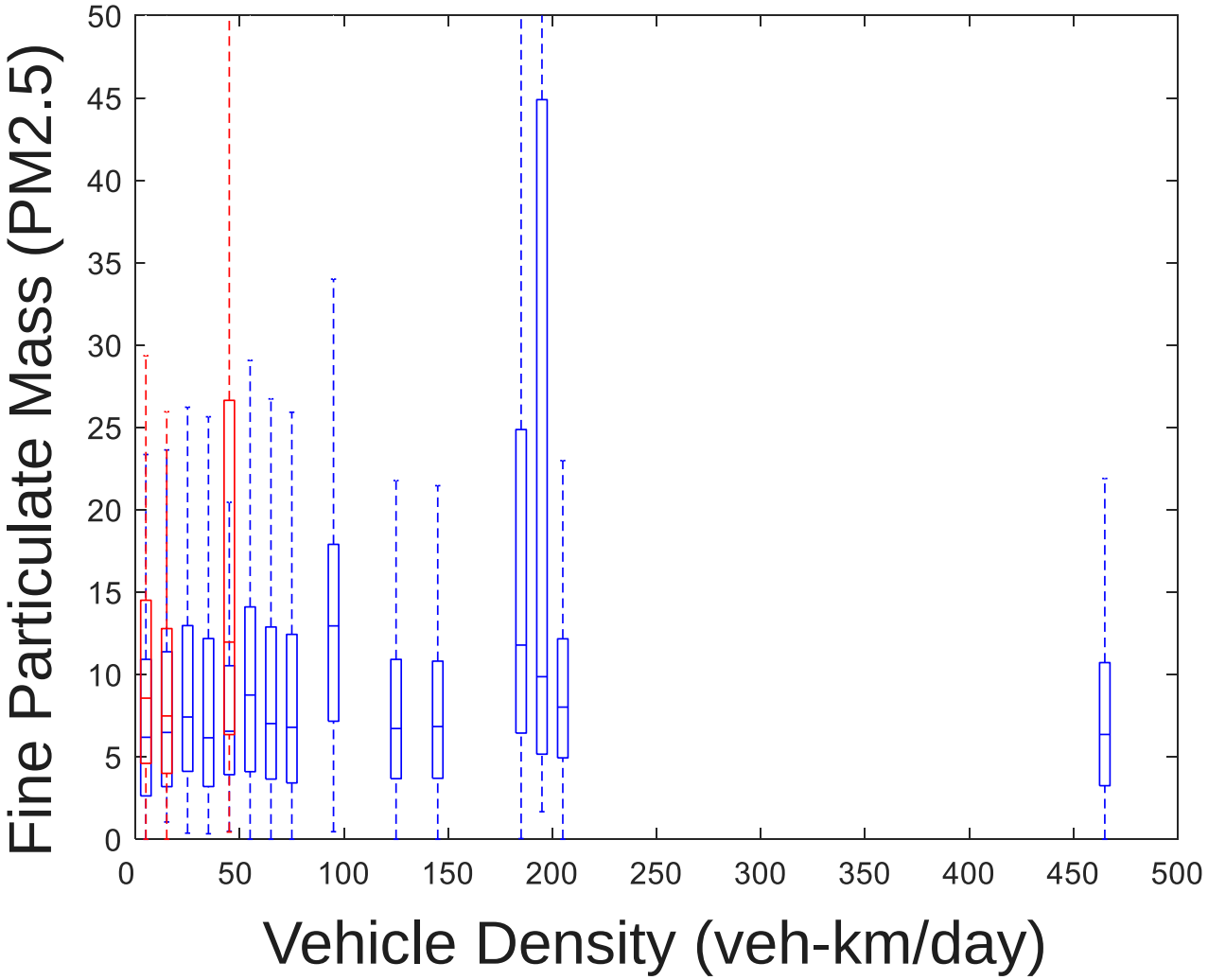


300-m vehicle density

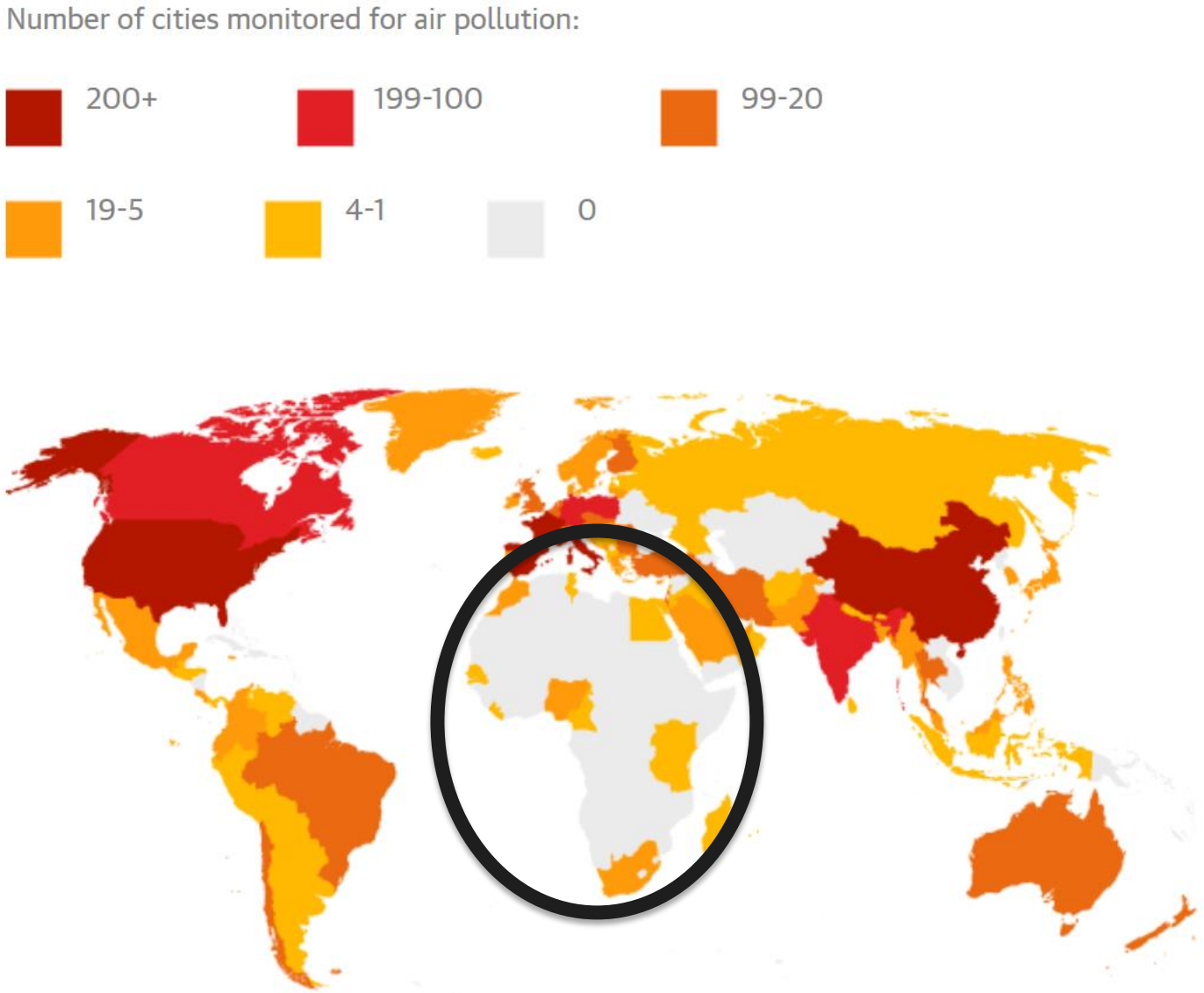
Summer 2017: $PM_{2.5}$ across Allegheny County



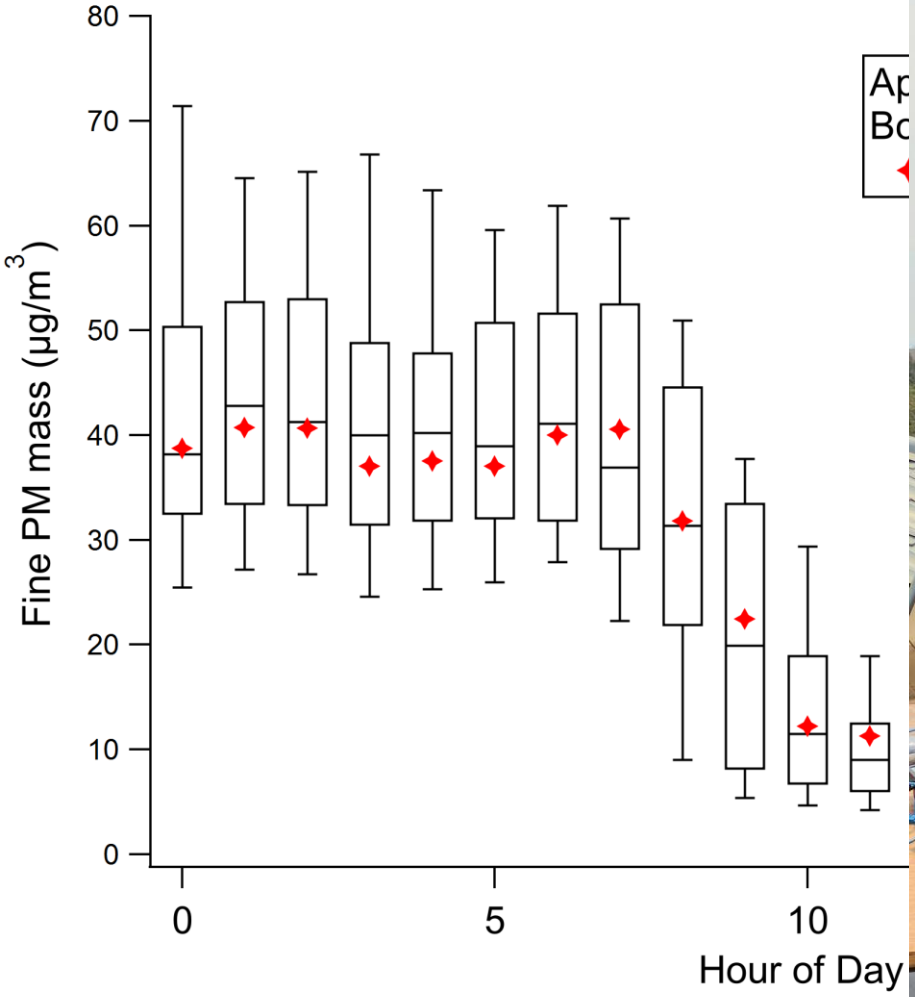
Preliminary Results: $PM_{2.5}$ in Summer 2017



The global air pollution 'blindspot' affecting 1 billion people (The Guardian, May 17, 2016)



Air Quality Monitoring in Rwanda



Food for thought…

- Hyperlocal monitoring, chemistry, filling monitoring gaps in developing regions
- Sensor evaluation critical
- Deploying and maintaining a large network of low-cost sensors takes a lot of effort
  - Data may be open, but data is not free
- Community volunteers key to hosting sensors: residents, businesses, schools
- Connectivity: GSM painful, others N/A
- Need to measure at low cost (~$500):
  - Particle number, including ultrafines
  - Aerosol composition, specific VOCs