Atlanta Rail and Port Sensor (RAPS) Project:

An Air Quality Pilot Study - Results and Lessons Learned

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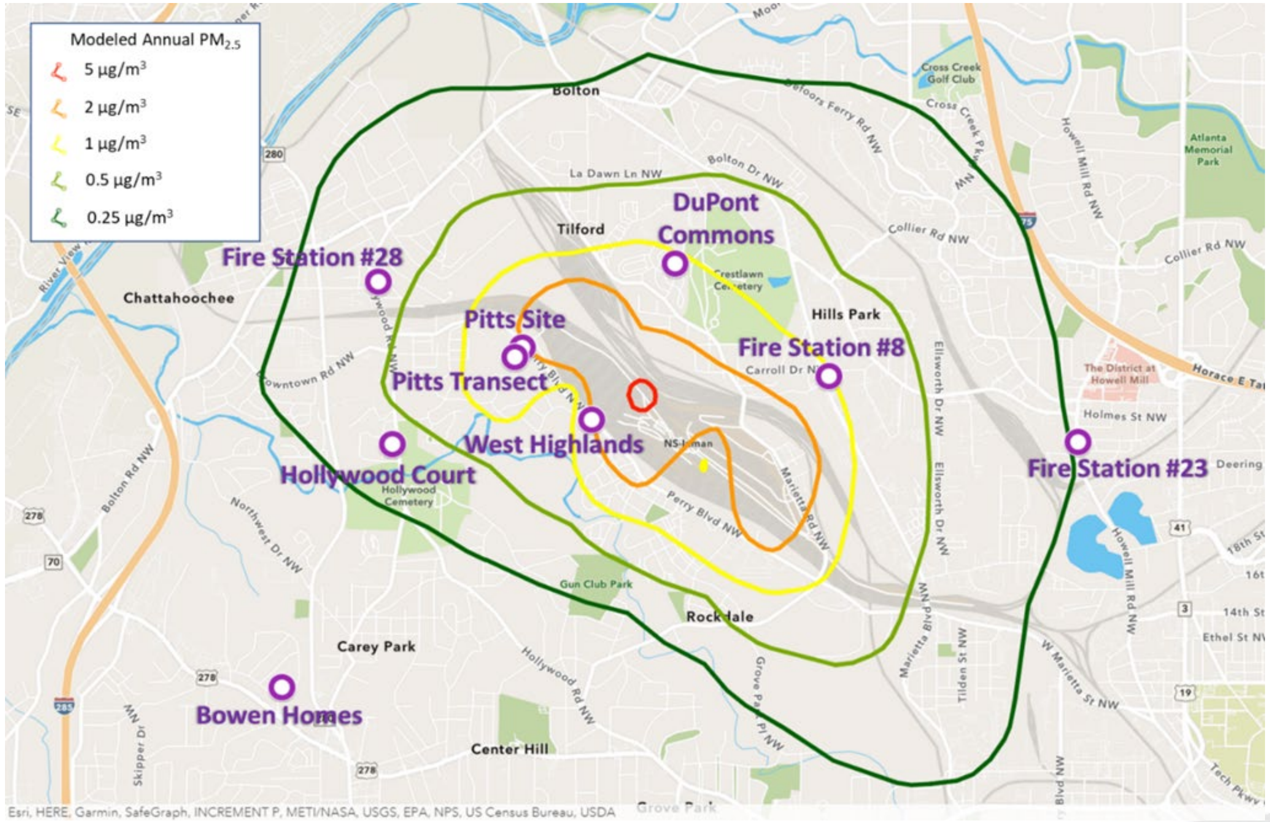
Atlanta RAPS Project: Overview and Objectives

- Collaboration between EPA Region 4 and the Georgia Environmental Protection Division (GA EPD)
- Objectives:
  - Conduct a pilot-scale air quality study in a port-like area, partnering with GA EPD.
  - Evaluate the utility of lower-cost air sensor technology in understanding near-source exposures from a port.
- Timeline: Sensor field deployment from May 2018 – December 2020
- Final report to be published Fall 2022.

Study Design

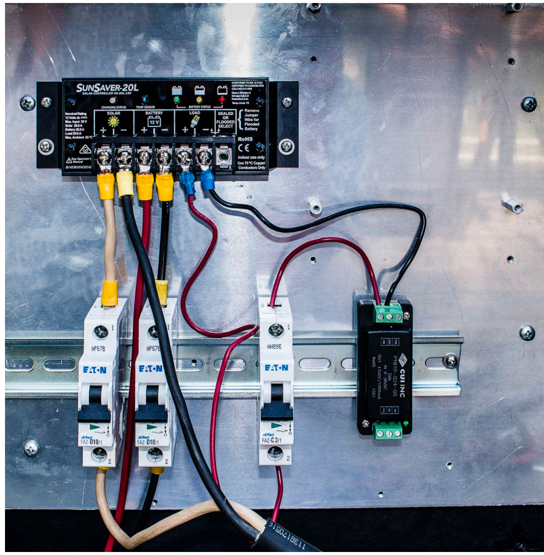
- PM sensors installed at 9 sites near the Inman Railyard in NW Atlanta for approximately 1 year.
- Variety of monitoring site objectives:
    - Expected higher $PM_{2.5}$ concentration areas
    - Populated areas
    - Background concentrations
    - Spatial representativeness
- Collocation with regulatory monitors
    - GA EPD South DeKalb NCore site before and after deployment (hourly)
    - GA EPD Fire Station 8 site during study (24-hr filter-based)



Site locations and modeled annual avg. $PM_{2.5}$ gradient

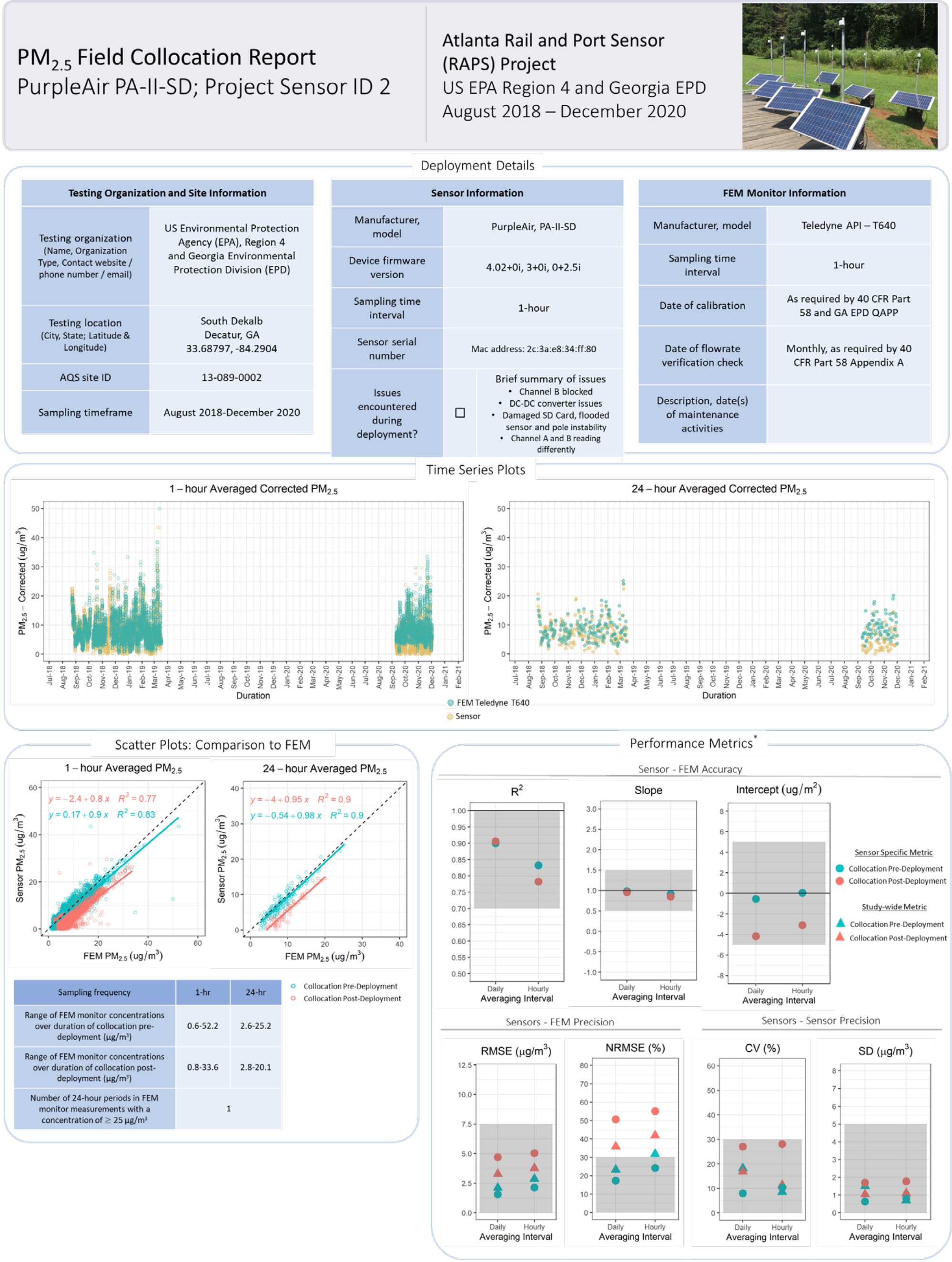
Materials and Methods

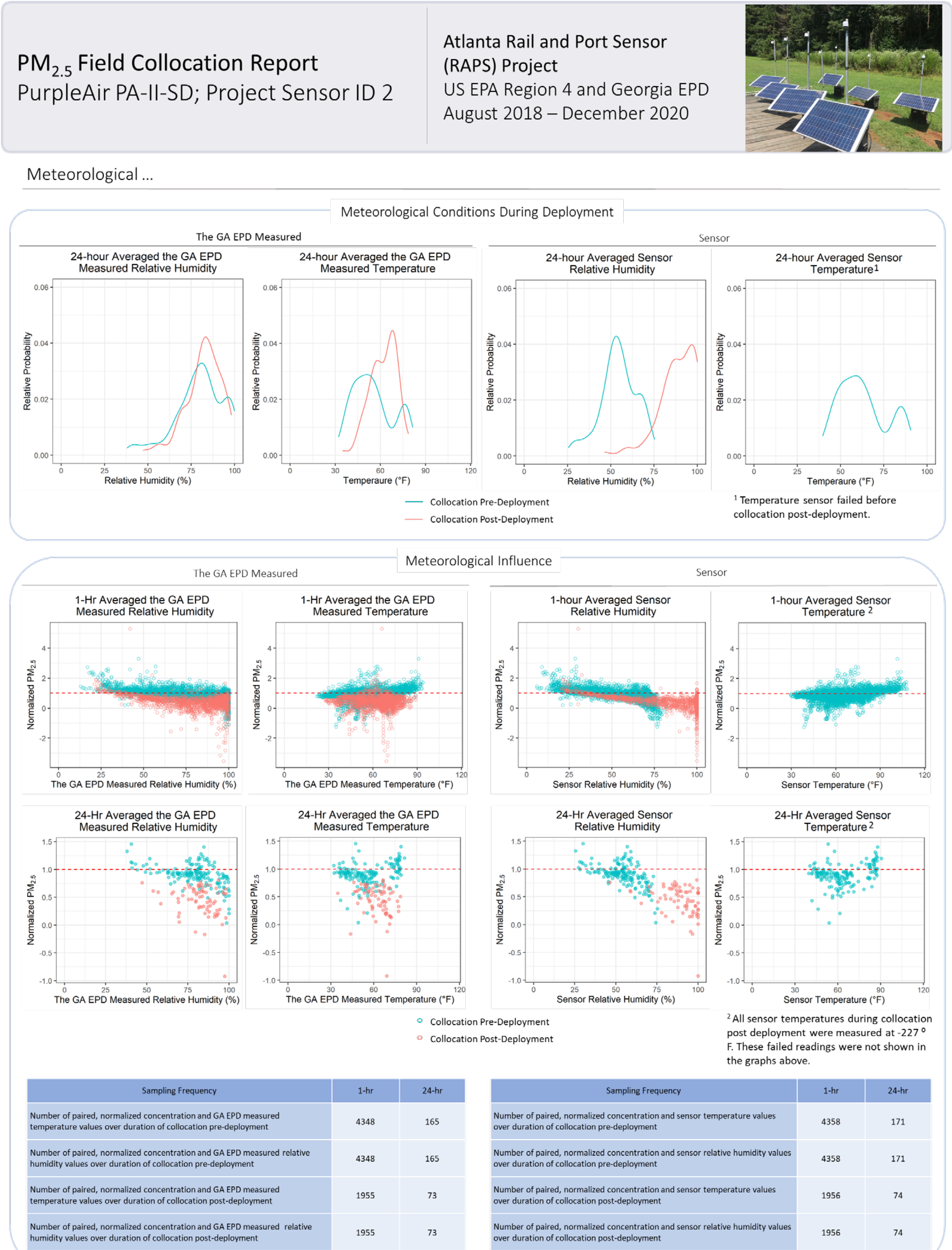
- Solar-powered PM sensor pods:
  - PurpleAir PA-II-SD
  - Manual data download from SD cards
- Aethlabs MA350 Black Carbon Sensors
- Data retrieved, cleaned, and analyzed using custom R and Python code



Example Atlanta RAPS Sensor Evaluation

Used sensor evaluation templates in *EPA Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Air Sensors*[2]





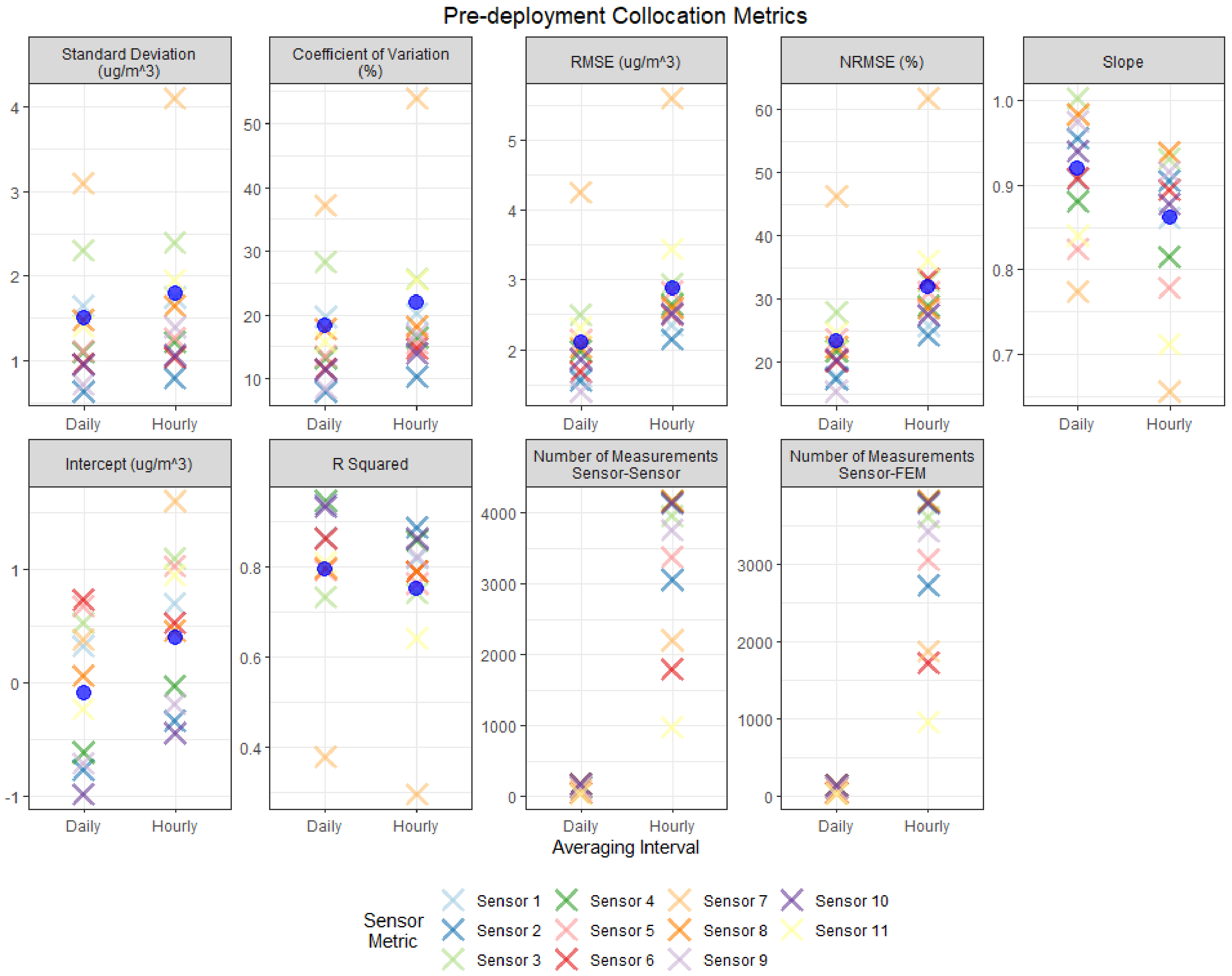
2. Duvall, R., A. Clements, G. Hagler, A. Kamal, Vasu Kilaru, L. Goodman, S. Frederick, K. Johnson Barkjohn, I. VonWald, D. Greene, and T. Dye. *Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Air Sensors: Use in Ambient, Outdoor, Fixed Site, Non-Regulatory Supplemental and Informational Monitoring Applications.* U.S. EPA Office of Research and Development, Washington, DC, EPA/600/R-20/280, 2021. URL

RAPS $PM_{2.5}$ Sensor Performance

- Applied US-wide EPA correction equation[1] to PurpleAir sensor data.
- Most performance targets[2] met after sensor data was corrected.
  - Humidity sensor drift may have contributed to lower accuracy in certain sensors
- Sensor accuracy generally:

  < ±20%, ±2 μg/m³ sensor to sensor (CV and standard deviation)

  < ±30%, ±3 μg/m³ sensor to regulatory monitor (NRMSE, RMSE)

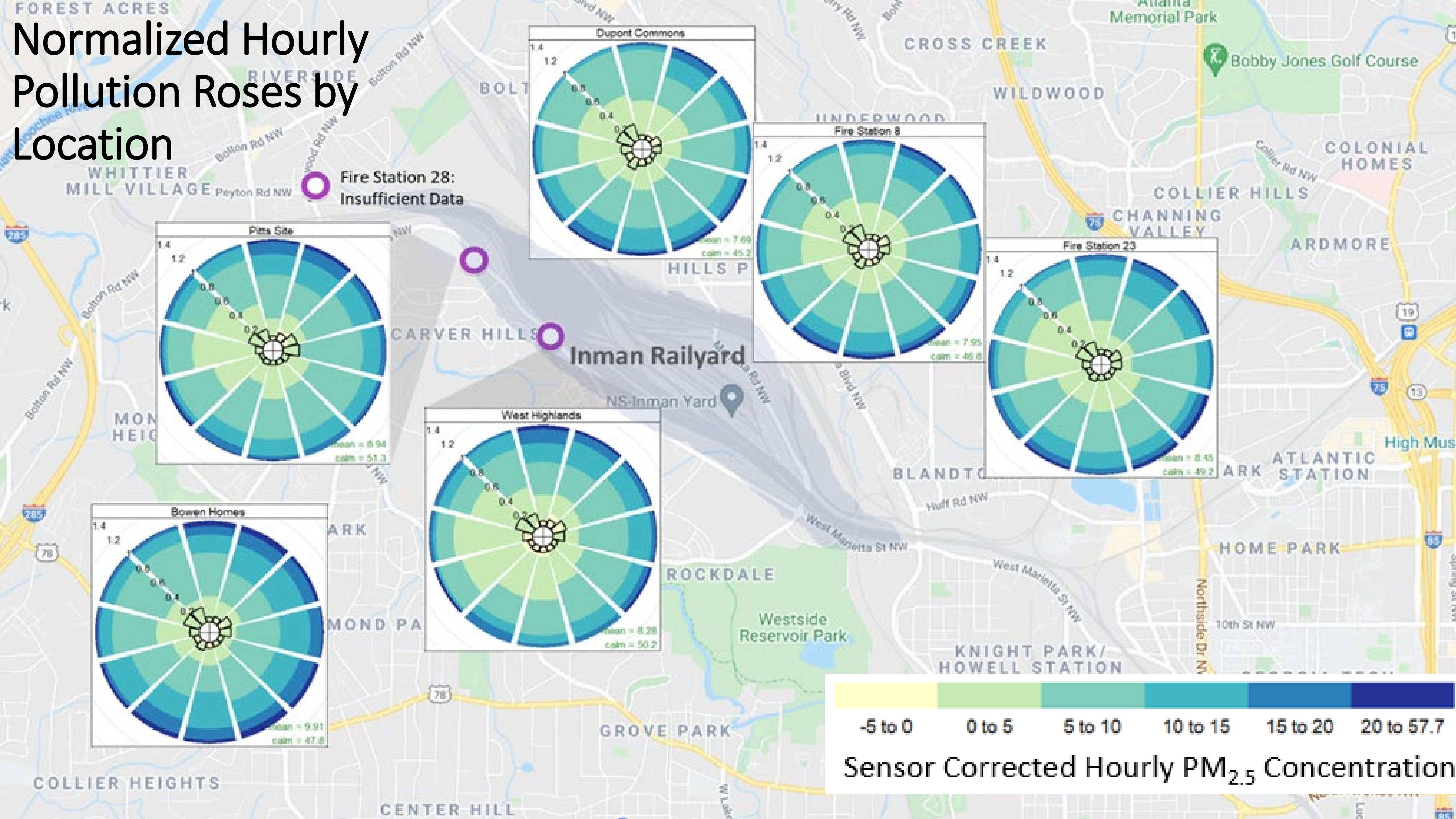


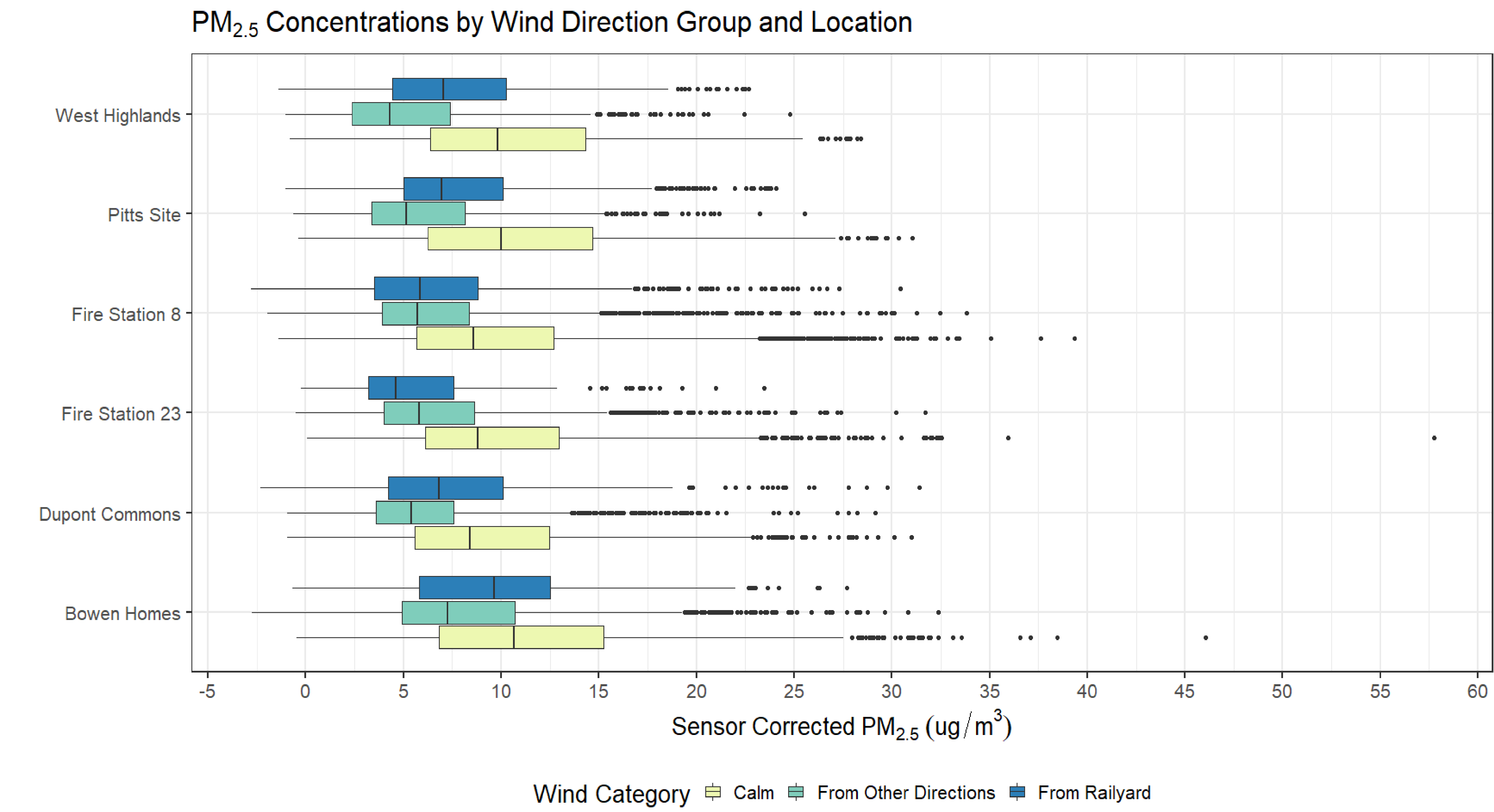
1. Barkjohn, K. K., Gantt, B., and Clements, A. L.: *Development and application of a United States wide correction for $PM_{2.5}$ data collected with the PurpleAir sensor*, Atmos. Meas. Tech., 14, 4617 4637, https://doi.org/10.5194/amt 14 4617 2021, 2021.

Results and Conclusions

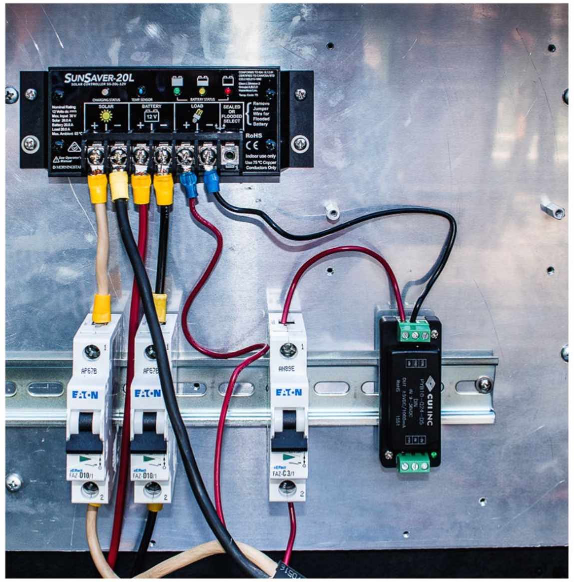
- Some sensors indicated a small $PM_{2.5}$ contribution from railyard emissions.
- Other factors (local meteorology and other urban sources) also contributed to hourly $PM_{2.5}$ variations between sites.
- Hourly $PM_{2.5}$ sensor data showed the expected 24-hour pattern (higher concentrations at night, lower during the day)
- Data quality likely sufficient to quantify impacts from significant, local $PM_{2.5}$ sources.
- Quality assured and corrected sensor measurements indicate that railyard contributions at some sites were potentially smaller than other influences on the $PM_{2.5}$ concentrations (meteorology and other urban sources).

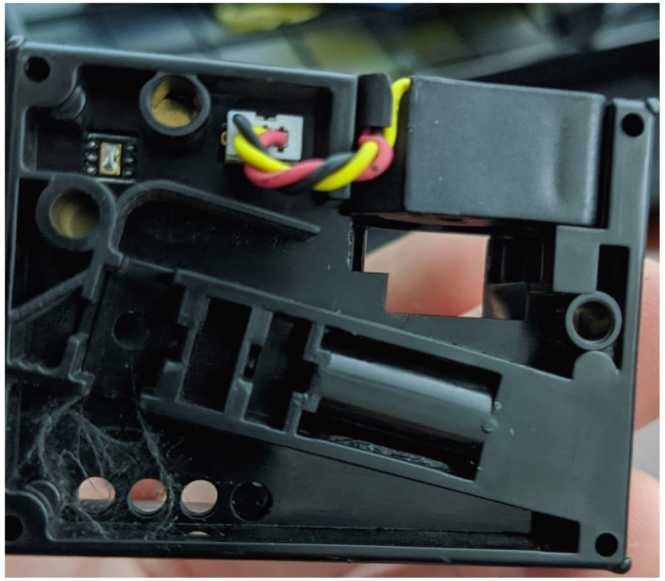
Normalized Hourly Pollution Roses by Location

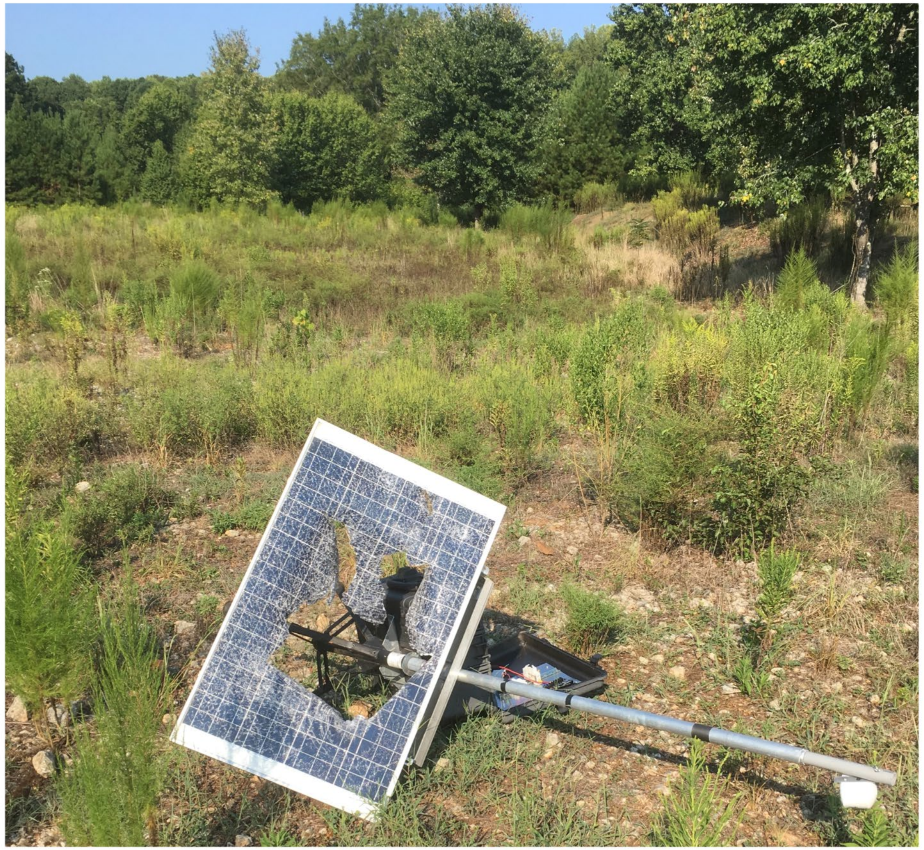



PM2.5 Concentrations by Wind Direction Group and Location
West Highlands
Pitts Site
Fire Station 8
Fire Station 23
Dupont Commons
Bowen Homes
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Sensor Corrected PM2.5 (ug/m3)
Wind Category
Calm
From Other Directions
From Railyard

Lessons Learned







LESSONS LEARNED:
Study Planning

- Allow several months for negotiating site access agreements
- Present project fact sheets and access agreement forms to property owners
- Conduct additional public/community outreach about future projects before monitoring
    - May help facilitate more opportunities to obtain site access from a wider variety of stakeholders

LESSONS LEARNED:
Fieldwork and Data Collection

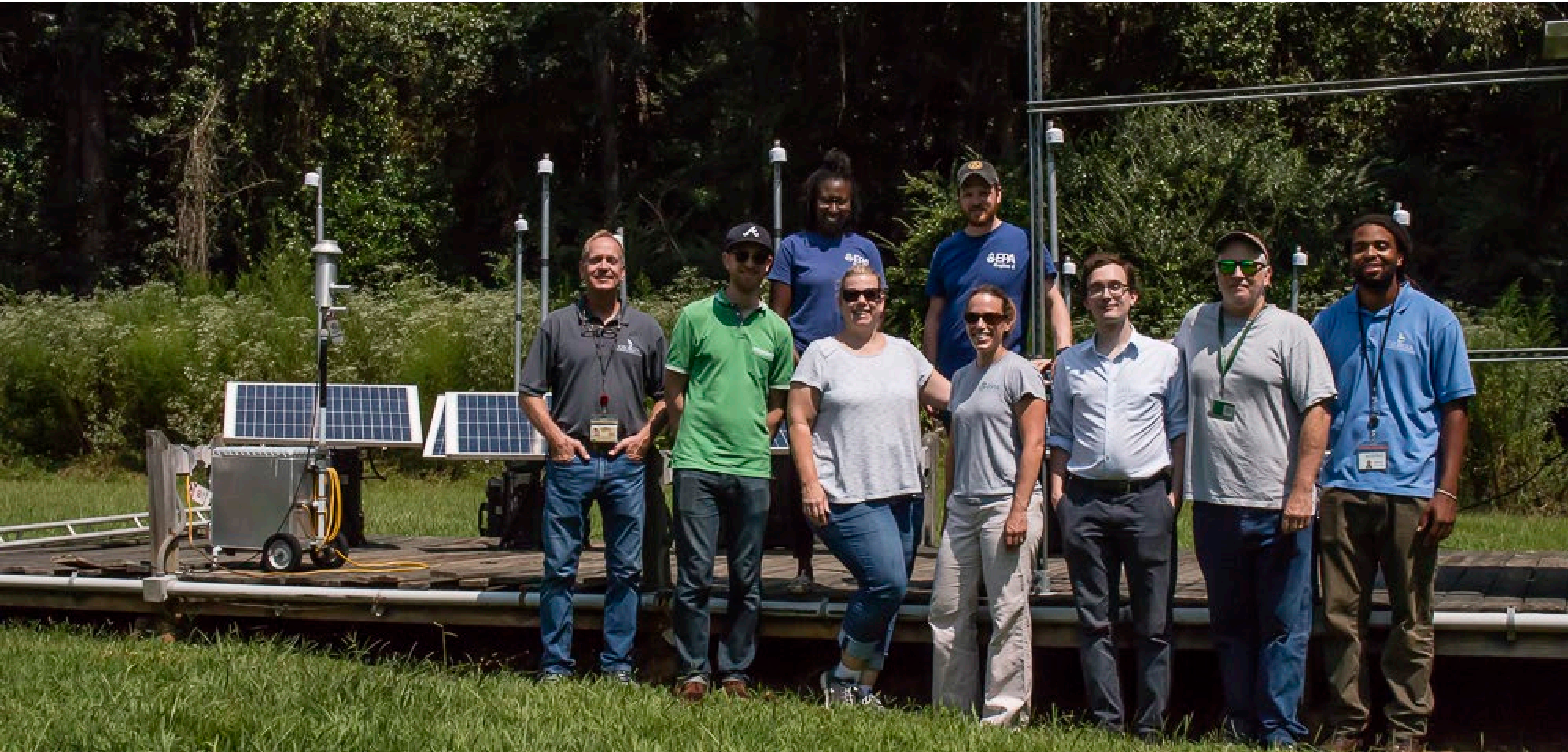
- Consider wireless data transmittal for future projects (WiFi or cellular)
- Use grid power or commercially available solar power if possible
- If using custom-built power supply, test extensively before deployment

LESSONS LEARNED:

Data Management & Analysis

- Plan data storage and analysis procedures and roles early in the project
- Attempt to use existing tools
    - Air sensor toolbox
    - Sensor manufacturer
- Consider partnering with academia or an air pollution agency for customized data analysis
- Consider using an existing weather station (e.g. airport, NOAA) if representative of the project area
- Recommend using the EPA national correction equation or developing a sensor-specific correction equation
- Check for humidity drift, since if undetected it could affect the final data interpretation

Questions?



References

1. Barkjohn, K. K., Gantt, B., and Clements, A. L.: *Development and application of a United States-wide correction for $PM_{2.5}$ data collected with the PurpleAir sensor*, Atmos. Meas. Tech., 14, 4617–4637, https://doi.org/10.5194/amt-14-4617-2021, 2021.
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