Validating low-cost sensors to supplement local air quality monitoring

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Introduction

Air quality affects human health, and urban communities often experience health disparities related to air quality. Low-cost sensor networks may offer a solution to assessing local to regional variation in air quality (Eanes et al. 2020). We seek to measure air quality in the City of Petersburg, VA, and better understand how air quality patterns differ among more and less urbanized spaces. We use low-cost sensors to measure particulate matter (PM) at sizes relevant to human health (2.5 micron diameter or smaller; **PM2.5**).

Prior to establishing a network of sensors, we aimed to test sensor accuracy and precision relative the best known standards available from VA's Dept. of Environmental Quality (**DEQ**). We asked whether low-cost PurpleAir™ sensors could reliably replicate the DEQ sampling.


map.purpleair.com
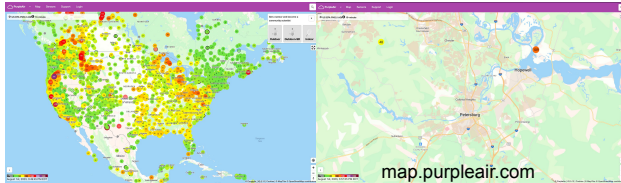
Methods

- 3 **PurpleAir™** sensors installed at Shirley Plantation
- PM2.5 highly correlated among PurpleAir sensors (r ≈ 1; data not shown). Average PM2.5 compared with DEQ data
- Data and code on github (scan QR code)

Air quality station at Shirley Plantation

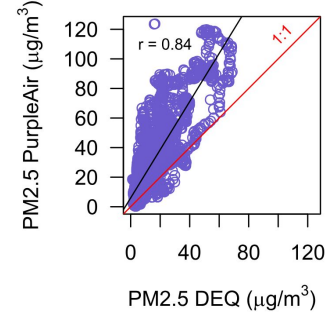**VA DEQ air intake**
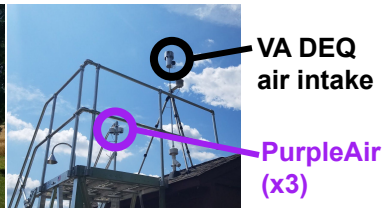
PurpleAir (x3)

Results

Key result(s)!

- Purple Air overestimates calculation of particulate matter
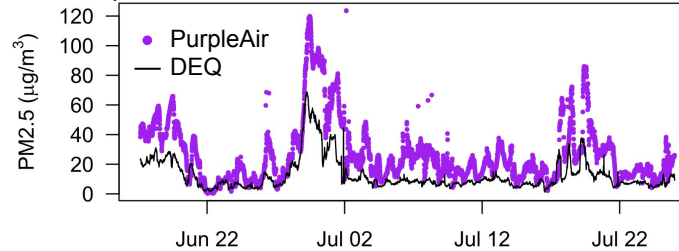
Figure 1. Time series of PM2.5 data from averaged PurpleAir data (purple points) and VA DEQ (black line) during the study period (12 June - 27 July 2023)

Figure 2. PurpleAir and DEQ PM2.5 data are strongly correlated, but PurpleAir data tends to overestimate PM2.5 at higher values

Conclusions & Next Steps

- DEQ is not as reliable as PurpleAir but with some data correction we can make it more reliable
- Refine a correction for PM data using PurpleAir (Barkjohn et al. 2021)
- Establishing a more permanent air quality monitoring system in Petersburg

Acknowledgements

References

Barkjohn, Karoline K., Brett Gantt, and Andrea L. Clements. "Development and Application of a United States-Wide Correction for PM$_{2.5}$ Data Collected with the PurpleAir Sensor." *Atmospheric Measurement Techniques* 14, no. 6 (June 22, 2021): 4617–37. ttps://doi.org/10.5194/amt-14-4617-2021.

Eanes, Andre M., Todd R. Lookingbill, Jeremy S. Hoffman, Kelly C. Saverino, and Stephen S. Fong. "Assessing Inequitable Urban Heat Islands and Air Pollution Disparities with Low-Cost Sensors in Richmond, Virginia." *Sustainability* 12, no. 23 (January 2020): 10089. https://doi.org/10.3390/su122310089.