



Community and Local Engaged Air Research (CLEAR): PurpleAir Network Expansion Through Community and Academic Partnerships

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What is CLEAR?

- CLEAR is a multidisciplinary team of environmental scientists, data scientists, and community liaisons collaborating to develop a more robust understanding of air quality in the Chicagoland area.
- The team is comprised of undergraduate students, graduate students, academic professionals, and community leaders.
- This project covers the entire Chicago city along with some suburban parts of broader Chicagoland.
- Air quality data spans 2018–2024 and we are actively requesting additional 2024 and 2025 data.

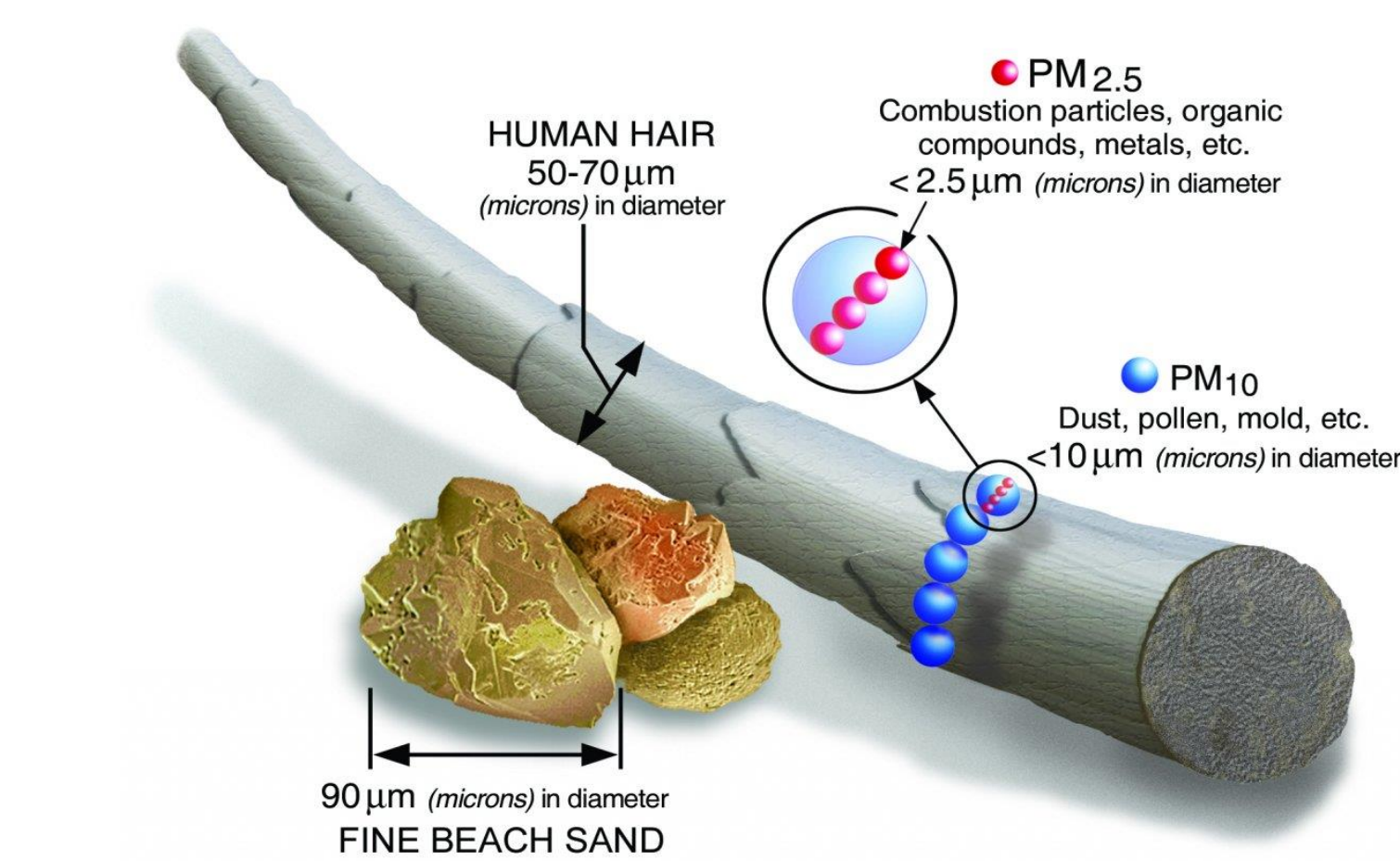


Fig 1. Particulate matter particle size comparisons (EPA, “Particulate Matter (PM) Basics”)



Fig 2. Loyola student from the CARE initiative installs a sensor

Motivation

Undergraduate research

- Opportunity for students to engage in multifaceted research.
- Hands-on interdisciplinary learning Experience.

Community Health and Engagement

- High $PM_{2.5}$ exposure is dangerous for individual and community health.
- Spatial and demographic gaps exist in PurpleAir public sensor network.
 - Underrepresented in Hispanic, Black, and lower-income neighborhoods
- Limited sensor placement in areas where health risks are high
- Lack of education on air quality

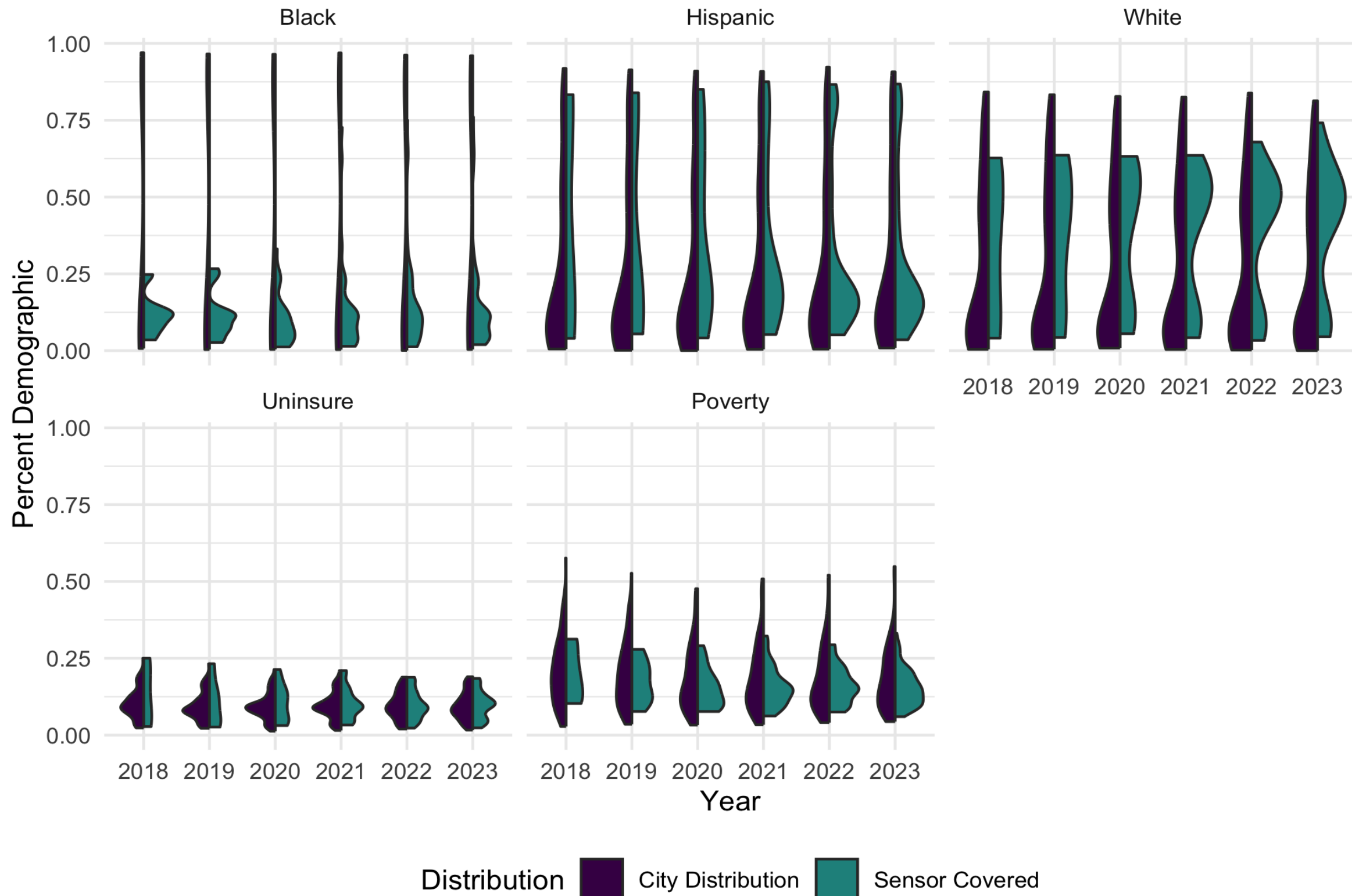


Fig 3. Side-by-side violin plots showing the demographic distribution for community areas compared to those with a PurpleAir sensor from 2018 to 2022

Next Steps

Community Engagement

- Work with community partners to deploy and maintain sensors in targeted neighborhoods
- Organize community events and workshops to discuss air quality, particulate matter, mitigation strategies, and available resources
- Maintain ongoing community engagement through regular evens and feedback session
- Adapt sensor deployment and outreach based on real-world feedback

Dashboard and Data

- Develop a user-friendly dashboard to ensure sensors and data models functions as intended
- Continue installing additional sensors in new locations based on data gaps and community needs

Long-Term Goals

- Measure sustained changes in neighborhood air quality and health impacts
- Create a transferable framework for equitable monitoring in other cities
- Address the ever-growing concerns of wildfire smoke in different Chicago communities

References

- PurpleAir (2023, July). *Using the PurpleAir Data Download Tool*. <https://community.purpleair.com/t/using-the-purpleair-data-download-tool/5399>.
- EPA (2025, May 30). *Particulate Matter (PM) Basics*. Particulate Matter (PM) Pollution. <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>.
- Whalen, M. C. R., Peer, A., DeRango, L., Ghorbani, N., Kraus, L., Post, J., & Jing, P. (In review). *Closing demographic gaps in air quality monitoring: Community-deployed PurpleAir sensors and PM2.5 data in Chicago*. *Air Quality, Atmosphere & Health*.

Current Work

Database Expansion

- Updated air quality readings from all sensors to train model
- New sensors were identified and updated (2024–2025) data is currently being requested

$PM_{2.5}$ Modeling

- Gaussian distribution with family of functions predicting $PM_{2.5}$ across the entirety of Chicago
- Variables include humidity, temperature, wind gust, longitude, latitude, and more
- Three primary layers of interest: poor air quality, uncertainty, and health disparities
- The model provides localized estimates that can indicate where the greatest rates of uncertainty are in the city

Community Outreach

- Partner with local nonprofits to place the additional sensors
- Identify and contact potential community partners for collaboration to place sensors and partner on events and educational opportunities

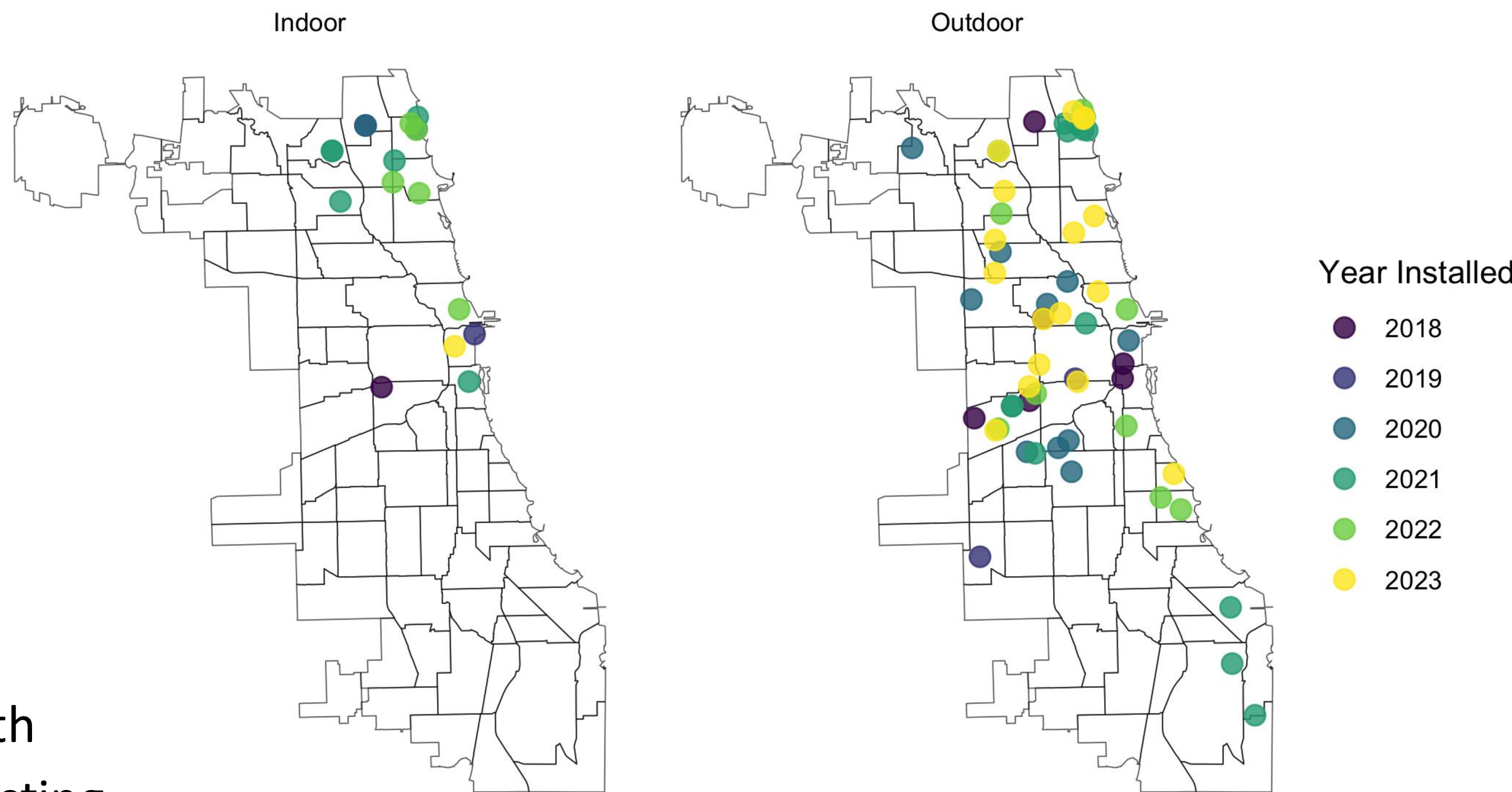


Fig 4. Chicago’s PurpleAir sensor placements from 2018-2023 with color indicating the year it was placed, separated by if the sensor is indoor or outdoor, overlaid on Chicago’s community areas.

Anticipated Challenges

Data Access

- Increasingly challenging and costly to access data
- Identifying and applying for funding opportunities to support this project
- More frequent troubleshooting than expected
- Shorter sensor lifetime than expected

Community Partnerships

- Finding sensor hosts in regions of greatest need as identified by our model
- Communicating about research and results in formats and language accessible to end users in local communities
- Coordinating with partners to organize educational events to communicate project results and important action steps

Acknowledgements

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