



Air Quality and Health Impacts in three Cuyahoga Communities

Data Days 28th July 2026

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Cuyahoga County Board of Health

Tackling Pollution in Cuyahoga:

Project Aims, Goals and Health Impacts

- 2024 received \$ 1 million **EPA EJ G2G** collaborative grant for CCBH, OSU- HOPES and Northeast Ohio Black Health Coalition.
- Funding withdrawn in January 2025.
- Aim; to provide home hazard health impacts in 3 communities:
Maple Heights, East Cleveland and Euclid.
- 12 Community Advisory Board (CAB) meetings held with residents of the 3 cities to assess their environmental health needs.
- Education to confirmation the link between tree canopy, impermeable surfaces, albedo, heat, air quality and health impacts.
- Surveys conducted with residents to find out what they considered as most important health impacts.

Environmental and Health Burdens in Priority Communities

Index	East Cleveland		Euclid		Maple Heights	
	US	OH	US	OH	US	OH
<i>Environmental Justice</i>						
Particulate Matter 2.5	93	92	78	72	85	86
Ozone	95	89	88	91	84	61
Diesel Particulate Matter	97	98	72	74	85	88
Air Toxics Respiratory HI	79	96	68	87	67	86
Lead Paint	98	98	88	87	92	90
<i>Health Disparities</i>						
Low Life Expectancy	96	90	81	69	92	84
Heart Disease	>95	N/A	>90	N/A	>80	N/A
Asthma	>95	N/A	>95	N/A	>95	N/A

Environmental and Public Health Index Percentiles from 2022 for Each Priority Community vs the United States (US) and Ohio (OH)

Source: EPA EJSCREEN tool (v.2.11) <https://ejscreen.epa.gov/mapper/> **Bold** text indicates values >80th percentiles.



CAB Rational for Air Sensor Monitoring & Health Study

- Install a total of 24 air sensors across East Cleveland, Euclid, and Maple Heights
 - Purple Air and Simple AQ monitors – stopped using for technical difficulties.
 - Both types of sensors measure particulate matter (PM_{2.5}), humidity and temperature. Simple AQ also measures VOC, nitrogen and sulfur oxides.
- **How will this air pollution data be used?**
 - Anyone can see the data in real time by connecting to Wi-Fi.
 - Data from 2025 will be used as a baseline to test the effects by comparing data from years 2 and 3.
 - Information to be included in Healthy Homes Impact Assessments and for peer review.

Questions to the EJ-CAB

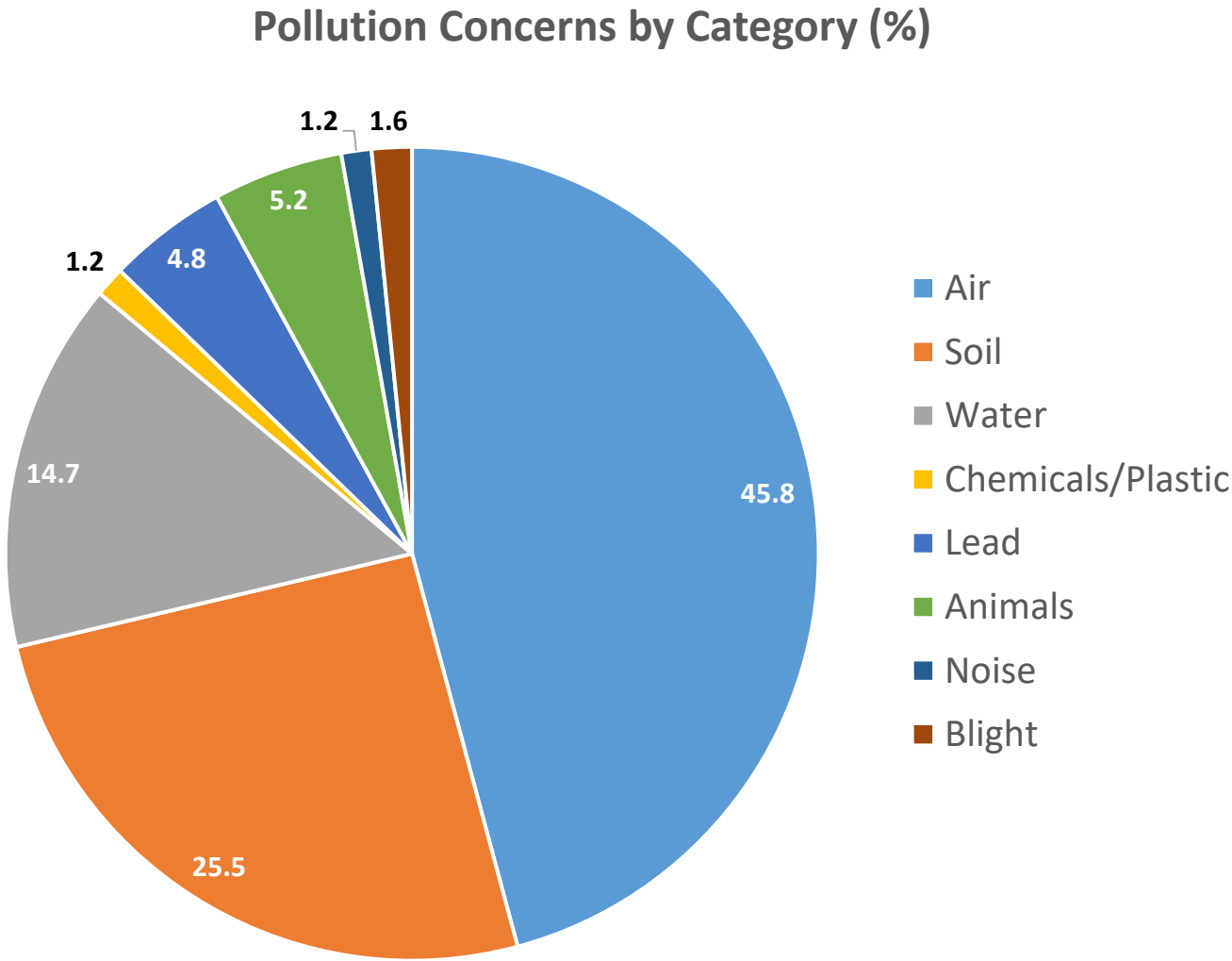
Directions: Please split into groups for East Cleveland, Euclid, and Maple Heights and write down your findings as a group and give to Yvonka or Dr. Brand.

Goal: We want to make sure we are capturing pollution data from areas that community residents are concerned about

1. Are there specific areas that you feel have poor air quality in each region (East Cleveland, Euclid, Maple Heights)?
2. The next slides show current information that has been collected.
 - Does this data make sense to you? What do you think is causing the high levels?
 - Are there specific sources like factories, traffic, etc. you think are causing these high levels?
 - Are there any areas you think are missing?
 - Do you feel like wind is a factor? Coming from which direction?
3. Are there any questions you have?

Questionnaire Results from CAB Meetings: Pollution Concerns in your Community?

Pollution Domain	N-value
Air	115
Soil	64
Water	37
Chemicals/Plastic	3
Lead	12
Animals	13
Noise	3
Blight	14

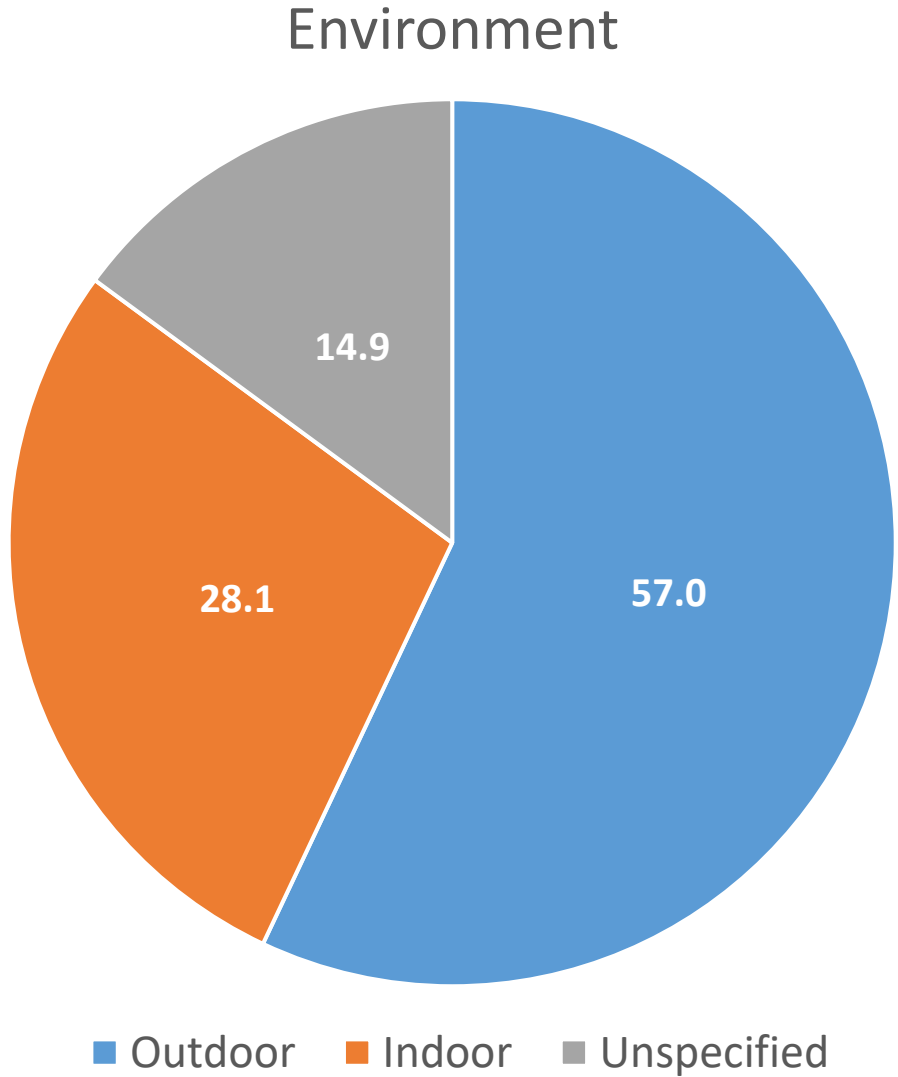


Air Pollution Concerns by Type

Environment	N-value
Outdoor	64
Indoor	32
Unspecified	17

Indoor Pollution Concerns (N=32)

- Air Quality: Circulation/Ventilation, 11 (34%)
- Mold 11 (34%)
- Carpet 5 (16%)
- Gas stoves 1 (3%)
- Asbestos 1(3%)
- Animals 1(3%)
- Chimney Buildup, 1(3%)
- Unspecified 1(3%)



Outdoor Pollution Concerns (N=64)

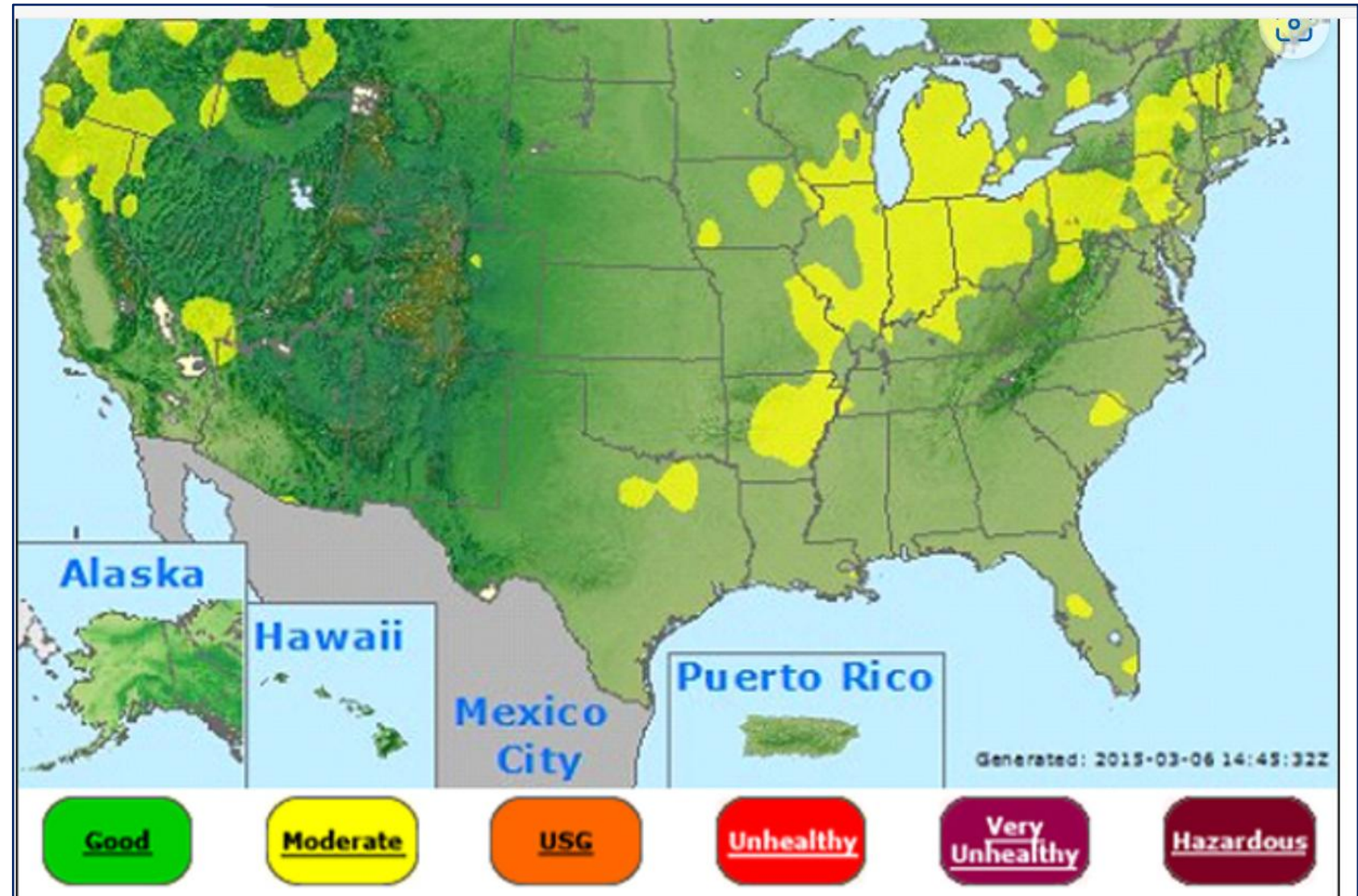
- Transportation: Buses, Highways 18 (28%)
- Industry 16 (25%)
- Railroad 8 (13%)
- Trees 7 (11%)
- Construction 4 (6%)
- Smell 1(1%)
- Trash burning 1(1%)
- Lead 1(1%)
- Grill 1(1%)
- Utilities 1(1%)
- Wildfire 1(1%)
- Unspecified 6(9%)

CAB Next Steps: Education on Air Pollution, Air Quality, & Health Impacts.

- Air quality in Cuyahoga County and Cleveland.
- What is the Air Quality Index (AQI)?
- What is the Air Quality Advisory?
- Six Types of Air Pollution.
- Sources of Air Pollutants.
- What is Particulate Matter; Why PM_{2.5}?
- Size & Source of Particulate Matter (PM).
- Health Effects of Various PM Sizes.
- Micro/nanoplastics: A New Threat to Lung Health.

Air Quality in Cleveland, Cuyahoga.

- Good: for May 23rd 2025
- The current air quality in Cleveland is Good:
- PM2.5 level of $7\mu\text{g}/\text{m}^3$
- PM10 level of $14\mu\text{g}/\text{m}^3$
- Note, there is an air-quality advisory for ground-level ozone in Ohio counties; Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, and Summit Counties.



Map NOAA: National Weather Service: <https://www.weather.gov/safety/airquality-aqindex>

What is the Air Quality Index (AQI)?

EPA tool showing outdoor air quality and health.

A scale from 0-500
Measures

Particulate Matter
(PM).

Size PM 0.1-10 μ m

Standard is PM_{2.5}

Air Quality Index		
0-50	Good	Enjoy your usual outdoor activities.
51-100	Moderate	Extremely sensitive children and adults should refrain from strenuous outdoor activities.
101-150	Unhealthy for Sensitive Groups	Sensitive children and adults should limit prolonged outdoor activity.
151-200	Unhealthy	Sensitive groups should avoid outdoor exposure and others should limit prolonged outdoor activity.
201-300	Very Unhealthy	Sensitive groups should stay indoors and others should avoid outdoor activity.
301-500	Hazardous	Everyone should avoid all outdoor exertion.

Image created by Greenerideal.com

What is the Air Quality Advisory?

- Air Quality Advisories warn residents of air pollution hazards which may harm their health. Clean Air Act created in 1974. The EPA created the Air Quality Index (AQI) in 1999.
- Daily information on air quality index from local weather forecast.
- Local radio, TV weather reports, newspaper or phone weather apps.
- The EPA issues year-round AQI forecasts and maps showing pollution levels changes.
- It is "real-time" information, to give current outdoor air quality.
- Maps are available at Airnow.gov
- For Cleveland: <https://www.accuweather.com/en/us/cleveland/44113/air-quality-index/350127>
- And our Purple Air monitors.

Air Pollutant Types

Six types of air
pollution
affecting health.

OZONE

- Made up of three oxygen atoms
- Occurs in Earth's upper atmosphere (good) and at ground-level (bad)
- Ground-level ozone is a harmful air pollutant and the main ingredient in smog

PARTICULATE MATTER

- Mixture of solid particles and liquid droplets found in the air
- Can be harmful due to the small size of the solids or droplets
- Droplets can be inhaled which may cause serious health problems

CARBON MONOXIDE

- Colorless, odorless gas that can be harmful when inhaled in large quantities
- Released when something is burned
- Cars, trucks and other vehicles, or machinery that burn fossil fuels are the main sources of outdoor CO pollution

SULFUR DIOXIDE

- Emitted to the air from the burning of fossil fuels by power plants and other industrial facilities
- Can be harmful to the human respiratory system and make it difficult to breathe
- Reacts with nitrogen dioxides, water, and other chemicals to create acid rain

NITROGEN DIOXIDES

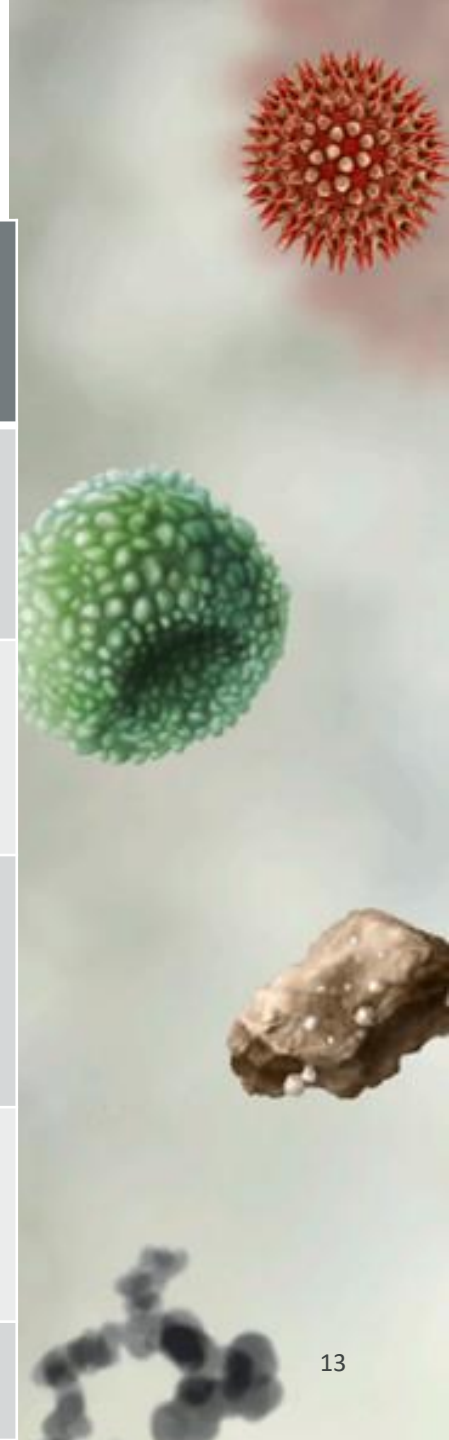
- Part of a group of highly reactive gases known as nitrogen oxides (NOx)
- Primarily emitted from the burning of fuel and forms from emissions from cars, trucks, buses, off-road equipment, and power plants
- Reacts with other chemicals in the air forming particulate matter, ozone, and acid rain

LEAD

- Emitted into the air from ore and metals processing and piston-engine aircraft operating on leaded aviation fuel; highest concentrations found near lead smelters
- Can negatively affect the nervous system, kidney function, immune system, reproductive and development systems, and the cardiovascular system

Potential Sources of Air Pollutants

Pollution Measure	Definition	Potential Sources of Pollution
Particulate Matter 2.5 (PM2.5)	Solid and liquid particles in the air. 2.5 is the size of the particle.	- Outdoor: Transportation, Combustions, Industry, Wind - Vehicles, burning wood, gas, or fuels, fires, construction, gravel pits, agriculture, dusty roads, mining, factories
Ozone	A colorless toxic gas with strong odor	- Pollutants: Vehicles, Industrial Plants and Factories, Consumer Products, Fossil Fuels, Combustion, Paint Evaporation - Sunlight: nitrogen oxide can react with hydrocarbons in sunlight. - Weather: hot, sunny, calm days
Nitrogen Dioxide (NO2)	A strong acidic, reddish-brown gas that is a major component of smog	- Burning fossil fuels from vehicles, power plants, and industrial plants and factories - Kerosene heaters, tobacco smoke, fireplaces, gas stoves
Toxic releases to air	Harmful toxic air pollutants released to the air that can cause health issues	- Humanmade sources: cars, buses, trucks, trains, planes - Stationary sources: Factories, refineries, power plants, small businesses - Industrial Facilities - Routine Activities: gas lawnmowers or tools, cleaning solvents
Traffic proximity and volume	Closeness to heavy traffic	Congested areas



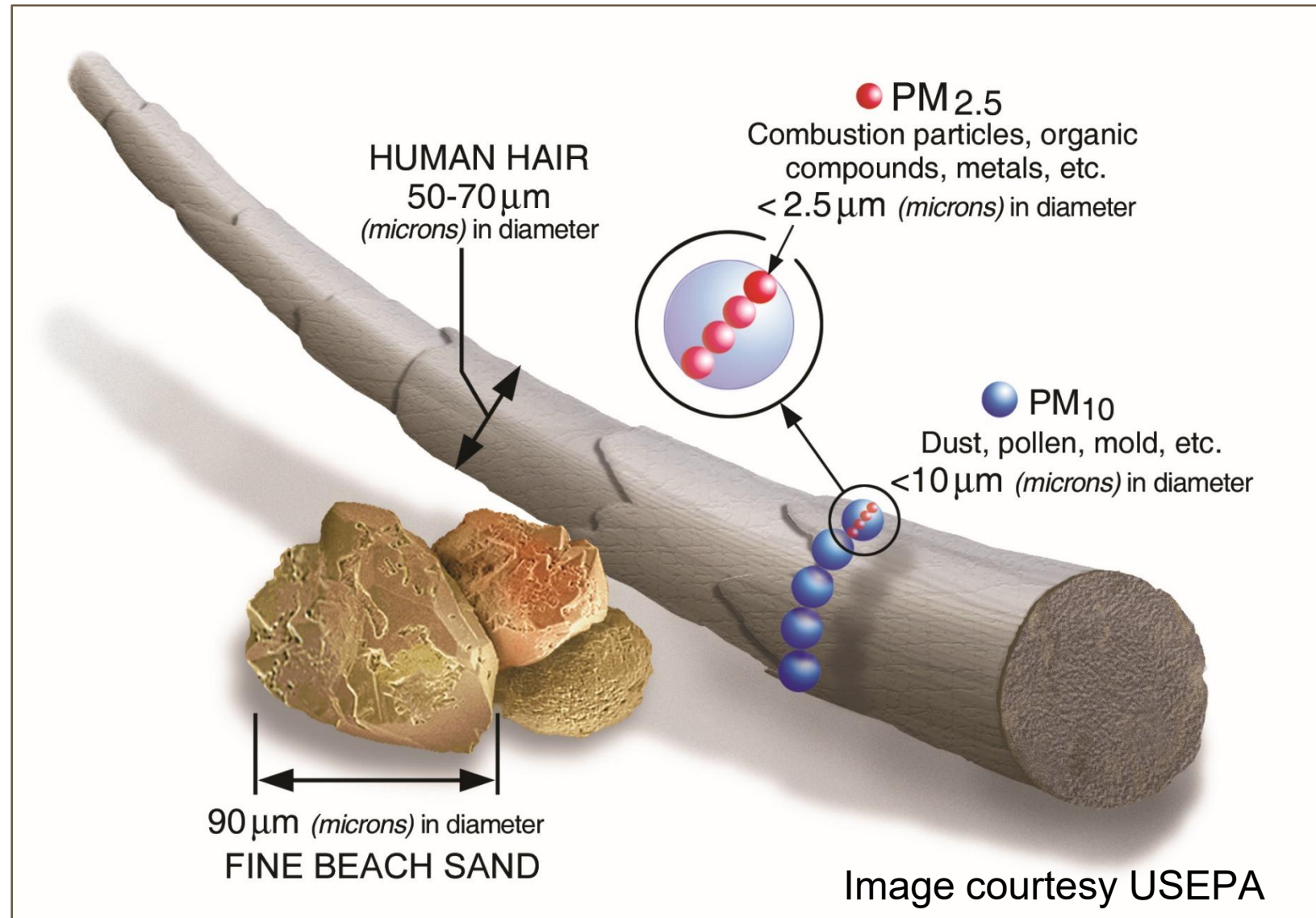
What is Particulate Matter; Why PM_{2.5}?

Various Particulate Matter = PM sizes measured in microns (μm)

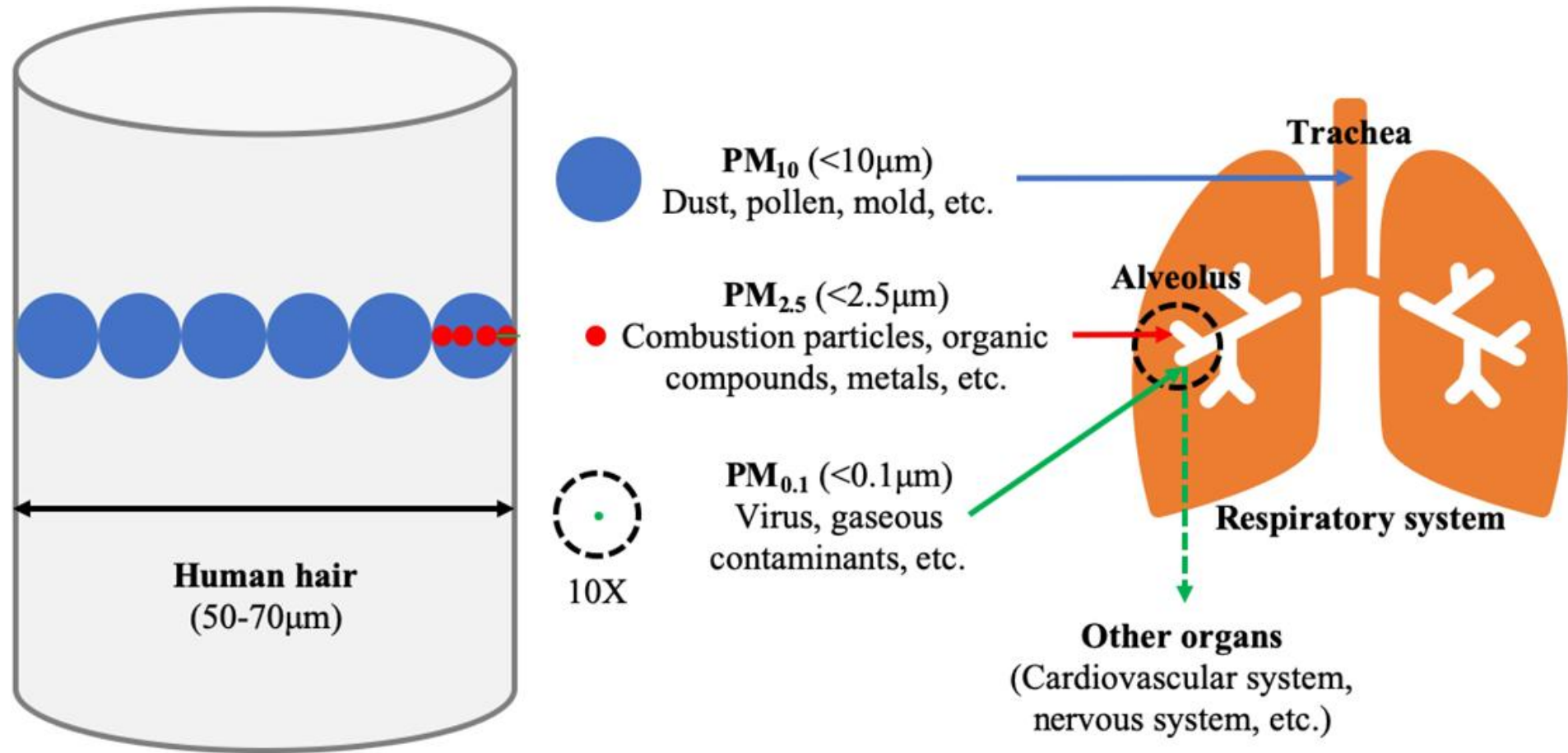
1 μm = 1,000.0 of mm

PM Scale used by EPA:

- PM 0.1
- PM 1.0
- PM 2.5
- PM 10

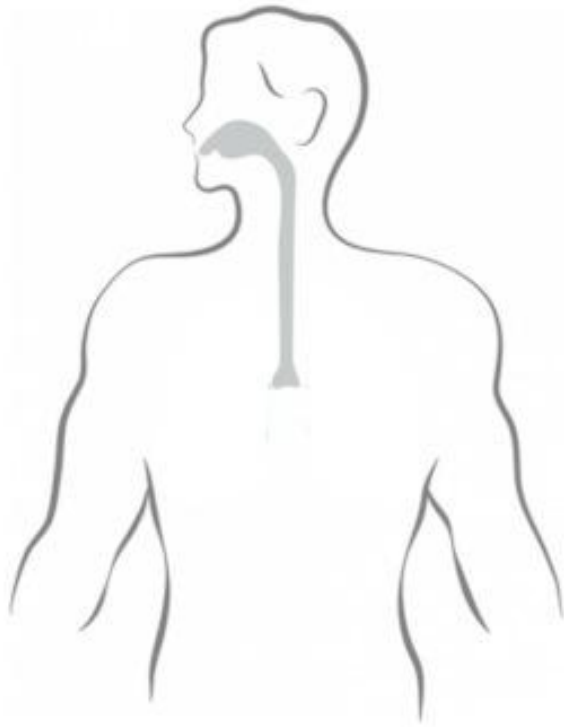


Size & Source of Particulate Matter (PM)



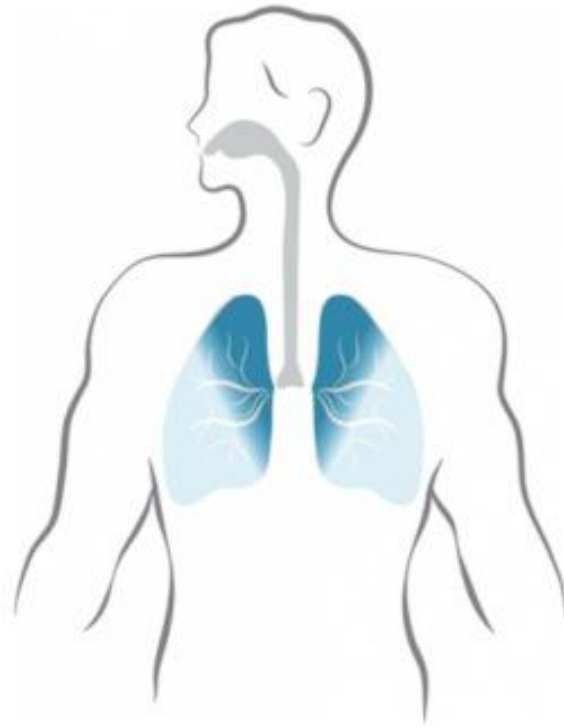
Health Effects of Various PM Sizes

PM10



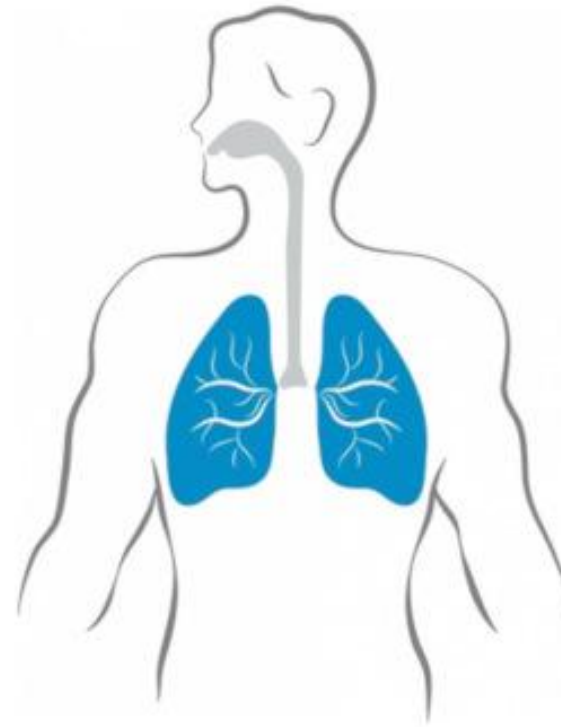
Coarse particles
Upper respiratory tract

PM2.5



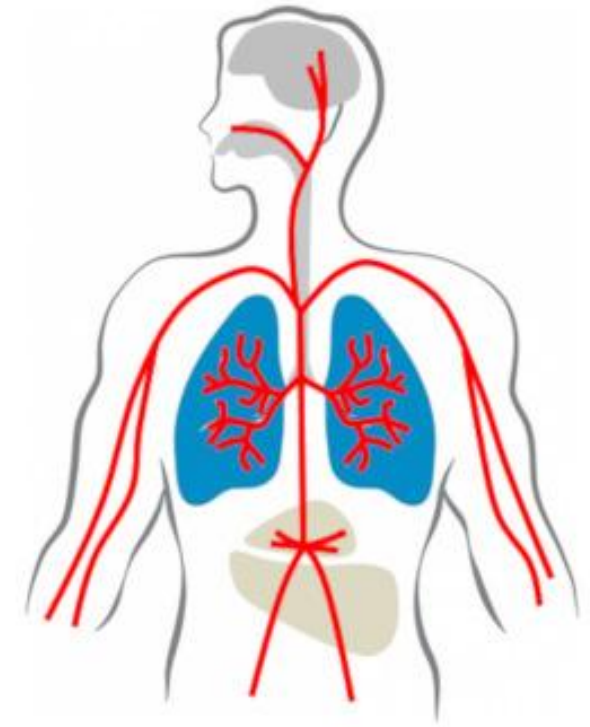
Fine particles
Lower respiratory tract

PM1



Very fine particles
Alveolus

PM0.1



Ultrafine particles
Blood/Whole body

Nanoplastics: A New Threat to Lung Health

Micro/nanoplastics everywhere!

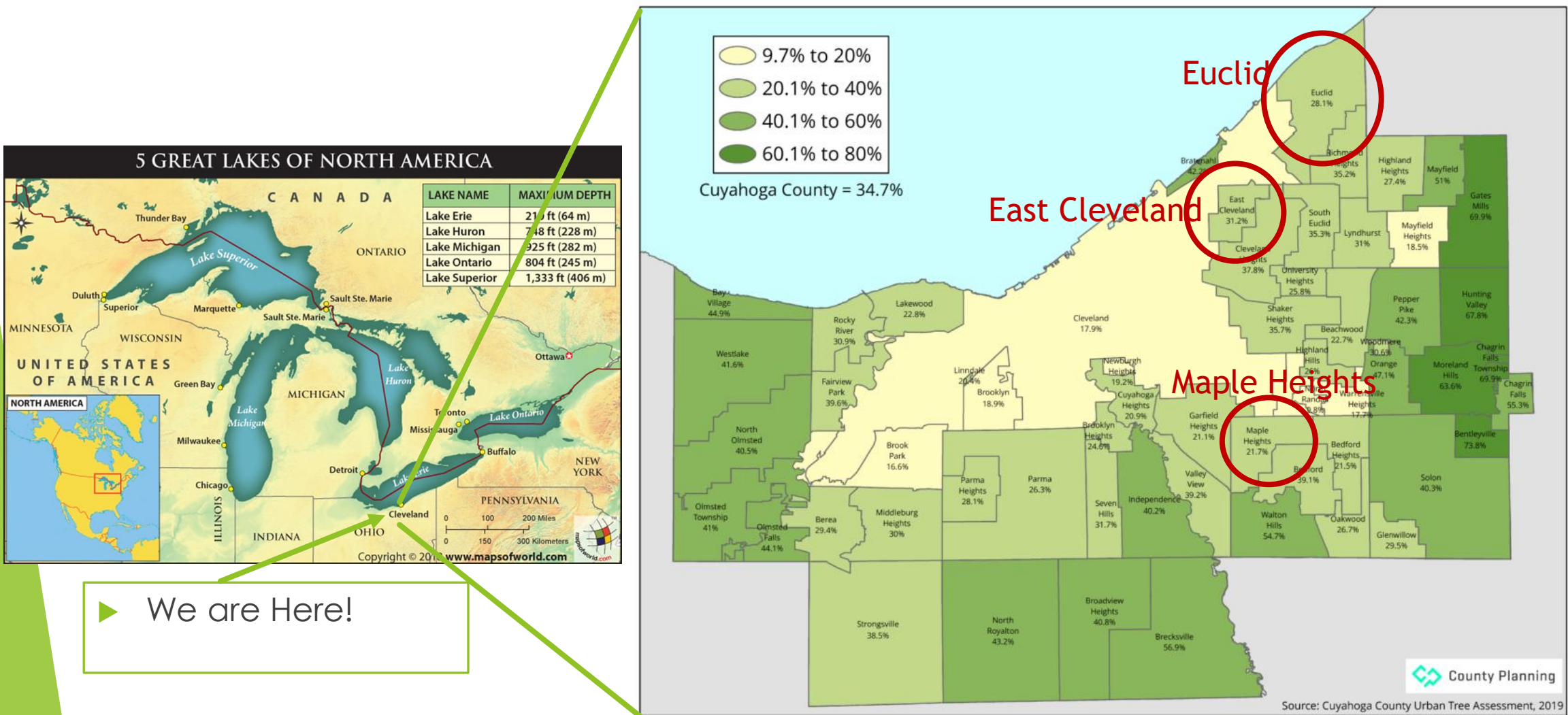
Why size matters.

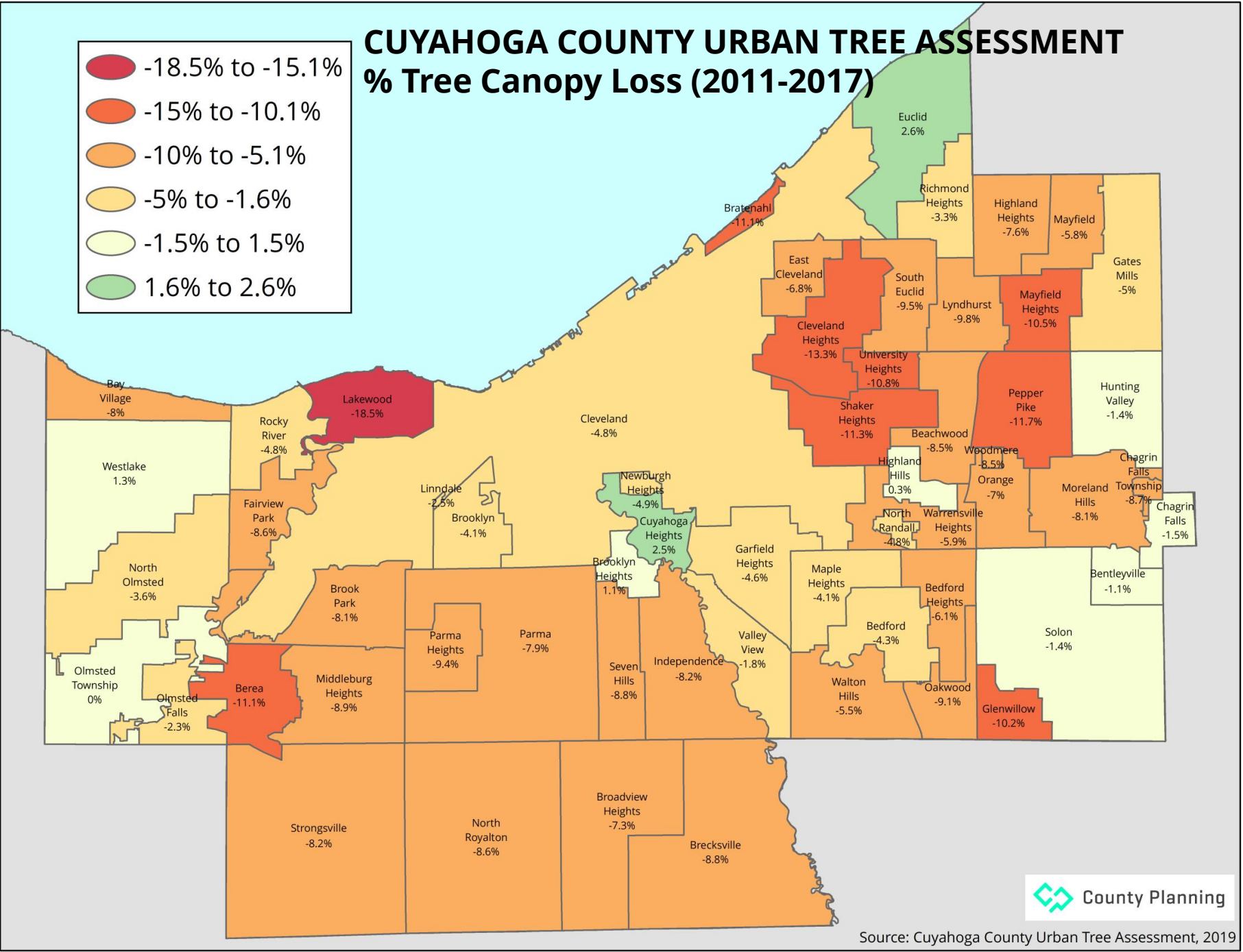
- air
- food
- waters
- soils
- In 98% of US population.
- Health concerns in blood,
- endocrine & reproductive system,
- liver, heart, brain, kidneys.

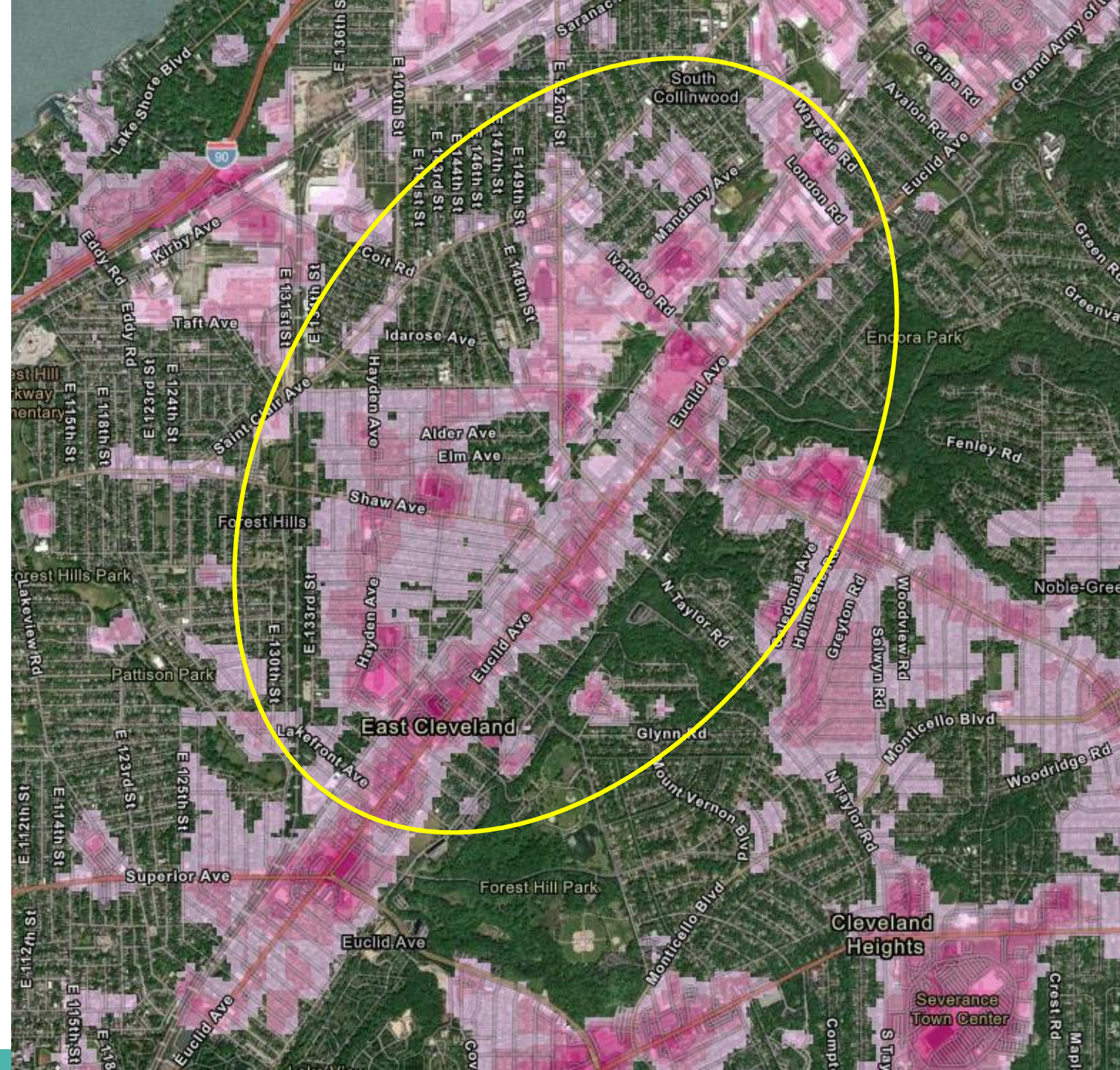


Image Louisville.edu.

EPA EJ G2G Study Rational: Air Monitor Site Selections, Cuyahoga County.







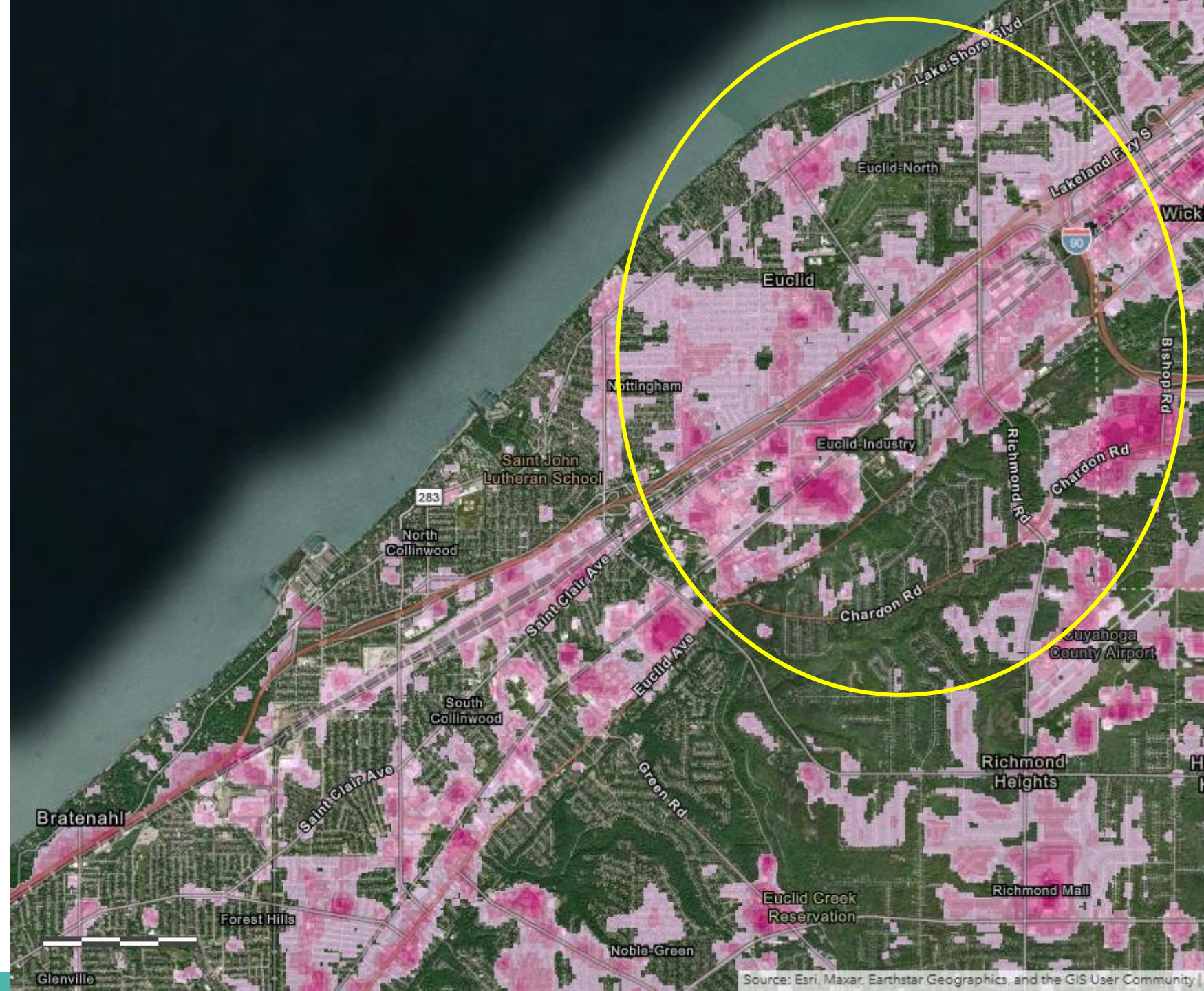
Euclid (circled in yellow)

Deep purple; temp > 30°C
Green; <24°C

On average, cities tend to be 10-25 °C warmer. Areas afflicted with higher temperatures are urban heat islands. Do not cool off at night.

People living in urban heat islands are especially vulnerable to the effects of climate change.

Map credit: Cuyahoga
Greenprint Explorer.
Data 2025



Maple Heights

(yellow circle)

Green spaces:

Trees & parks

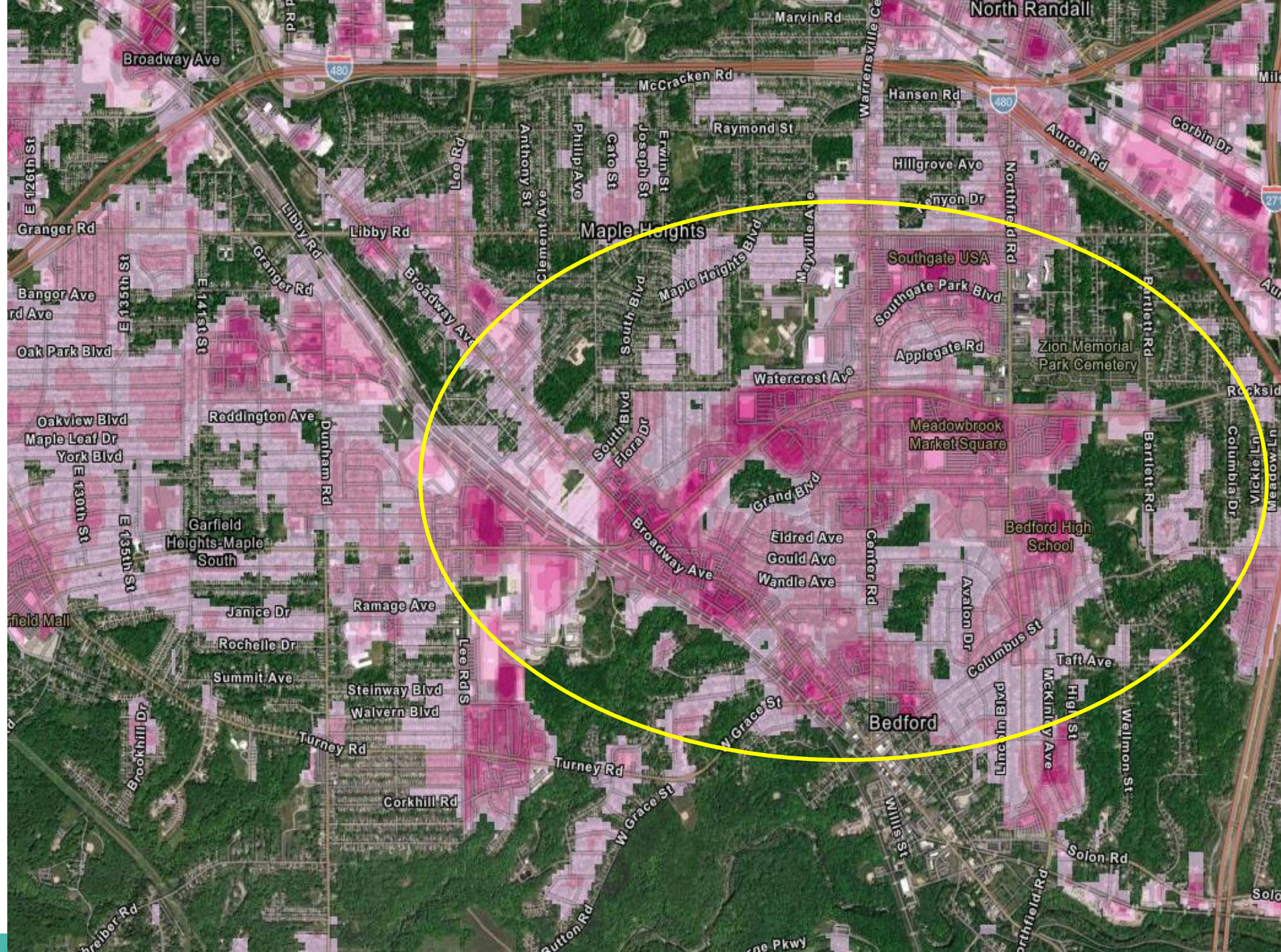
reduce heat

lowers temperature

increase humidity

cool urban, industrial
& commercial areas.

Map credit: Cuyahoga
Greenprint Explorer. Data 2025



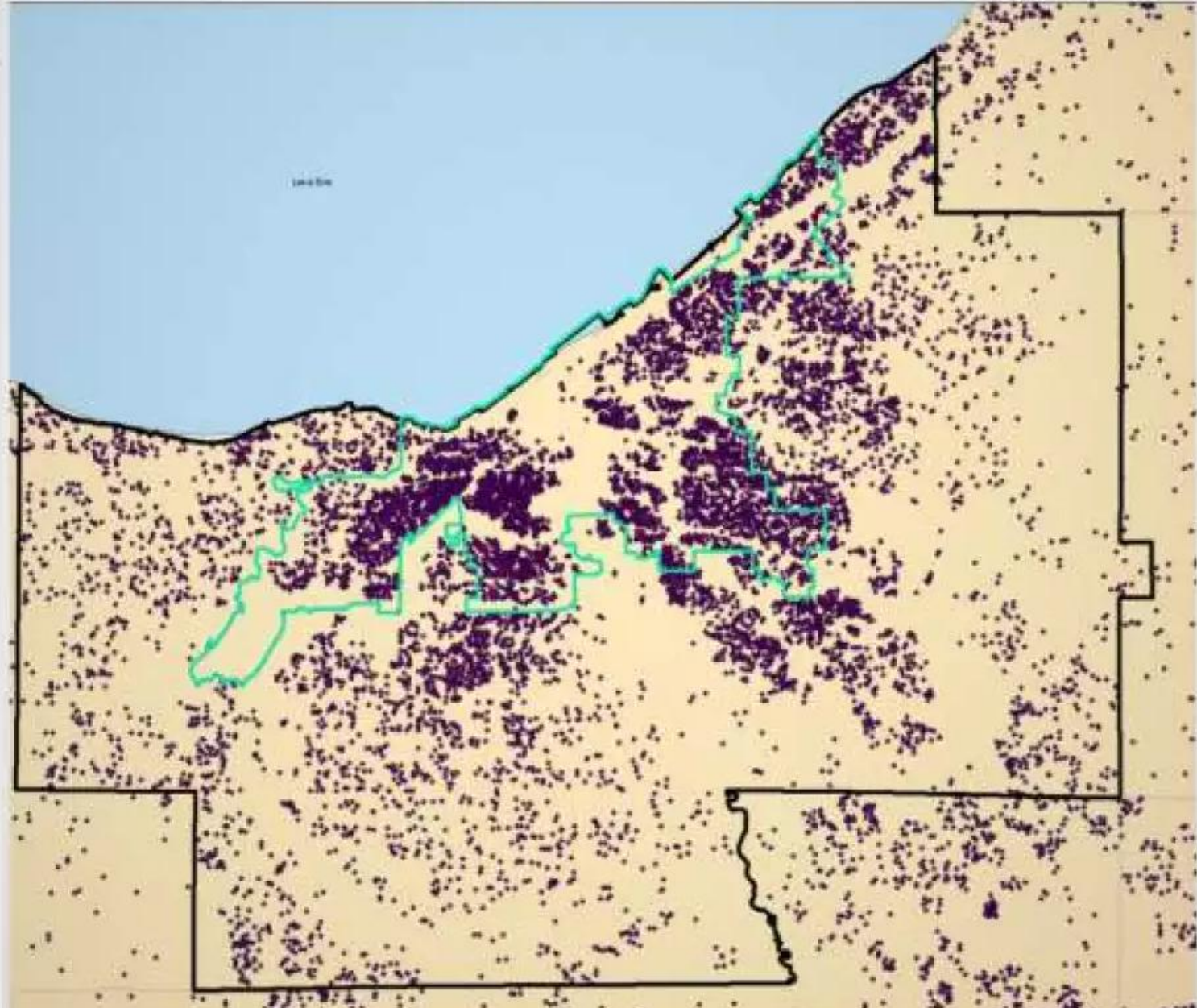
Air Quality & Asthma

Each dot
represents a case
of childhood
asthma.

(2017 data)

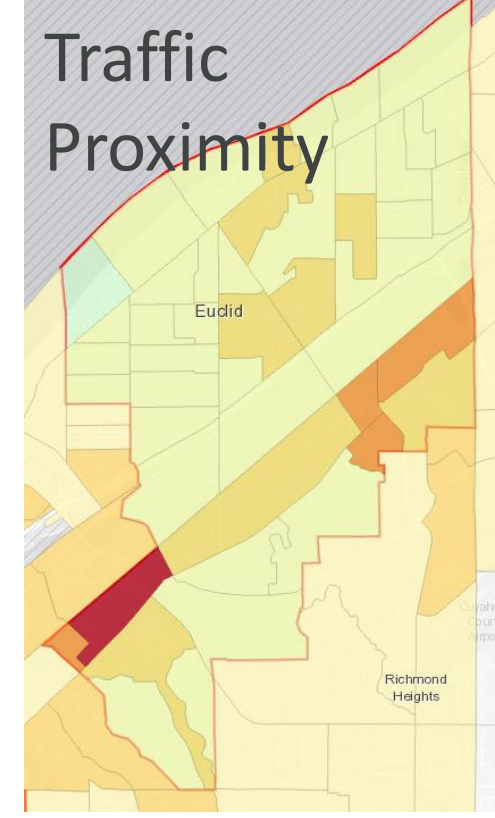
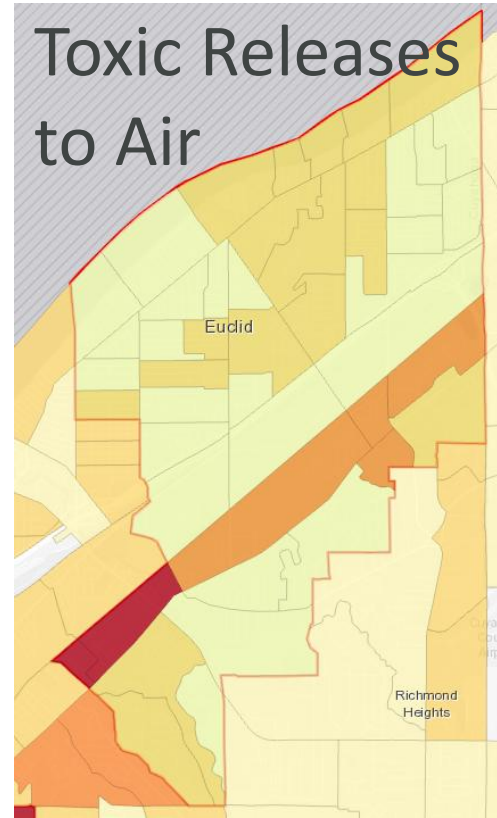
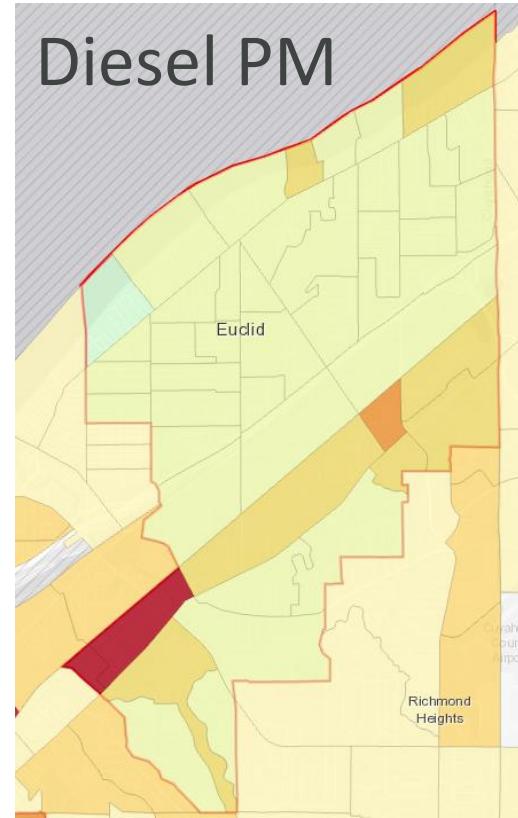
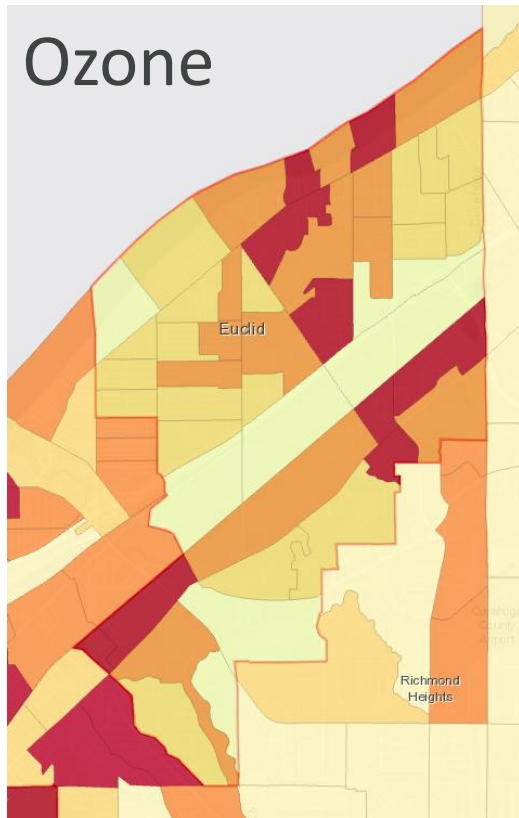
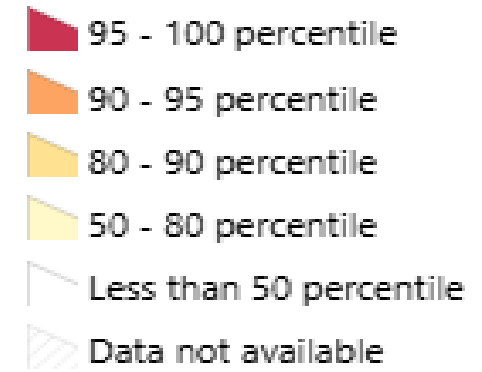
Map credit:
Children's
Health Initiative

Individual Children ages 2-18 with an Asthma Diagnosis
Cuyahoga County (approximately 95,958 patients)



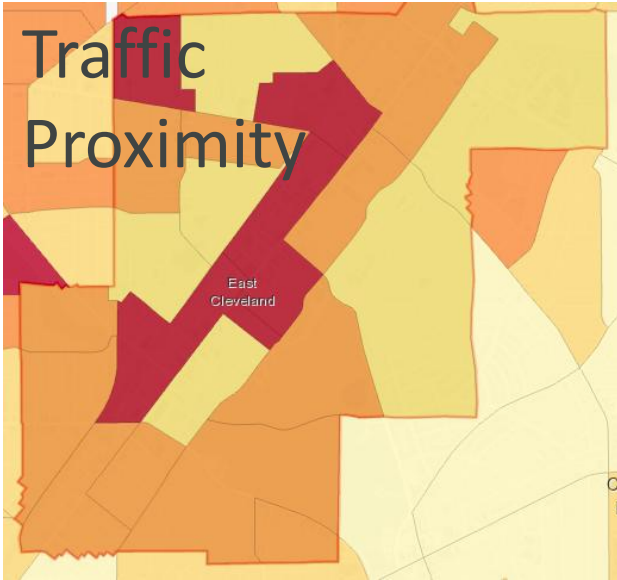
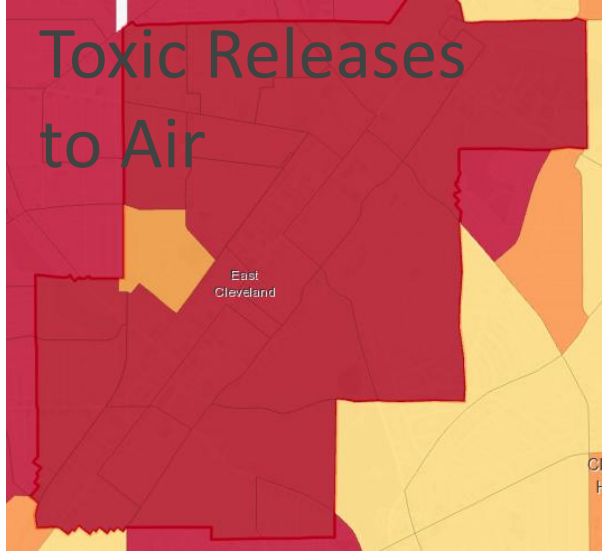
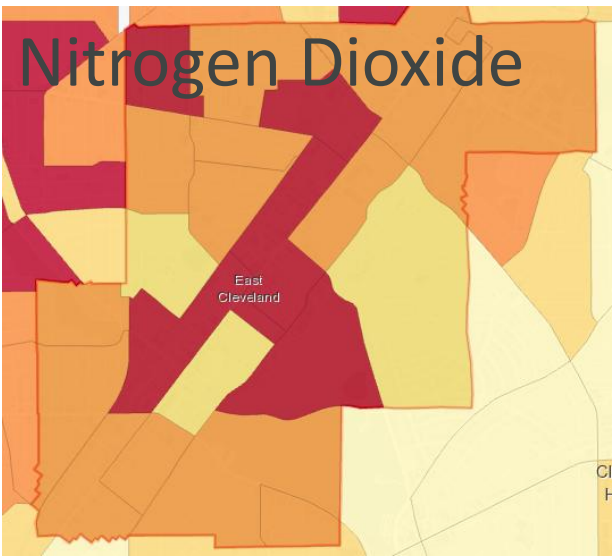
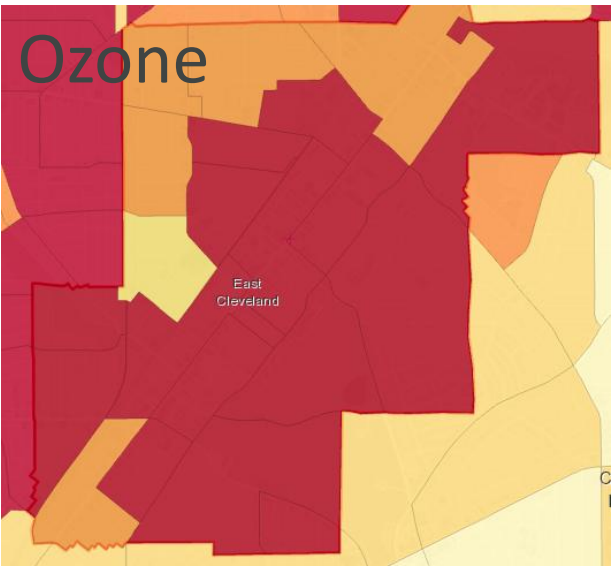
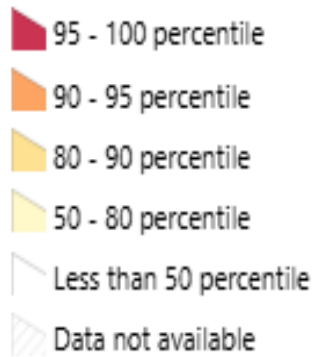
Pollution In Euclid

Data from 2025



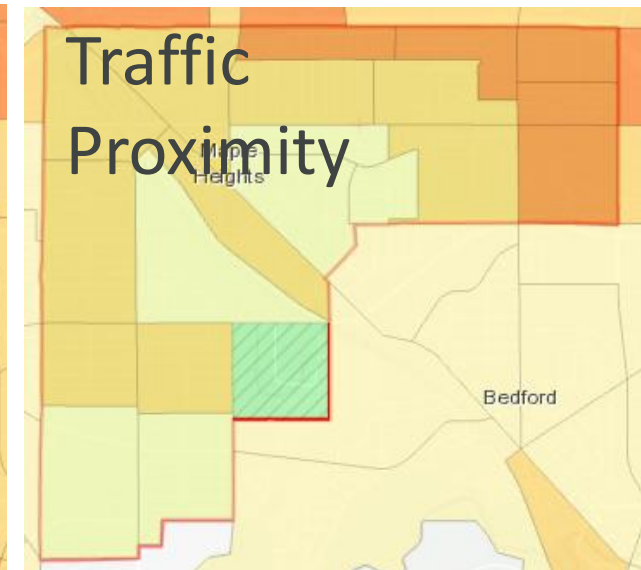
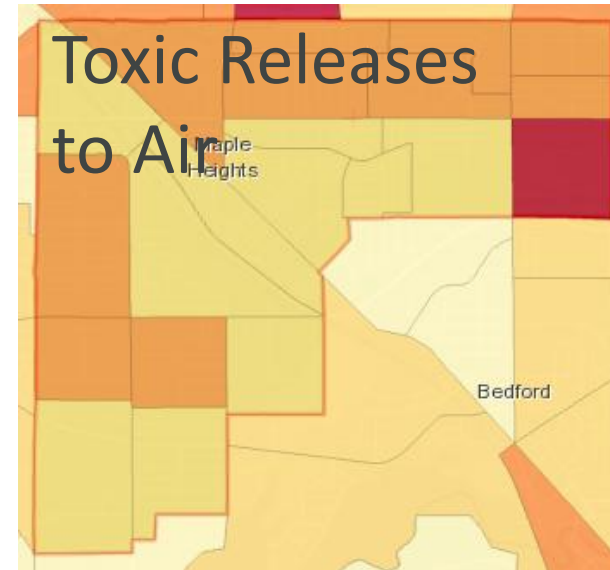
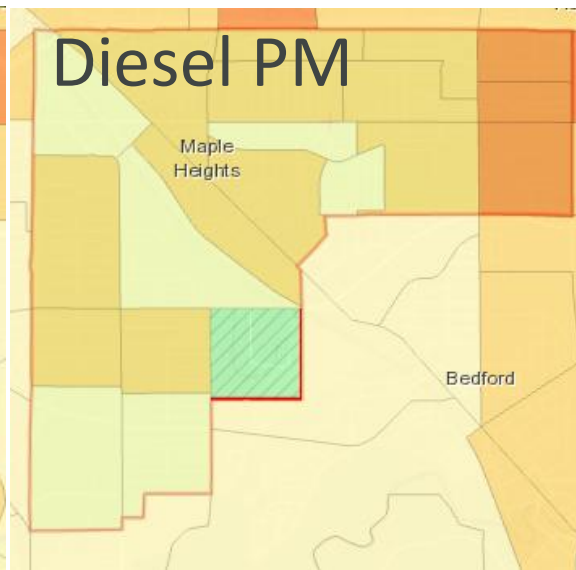
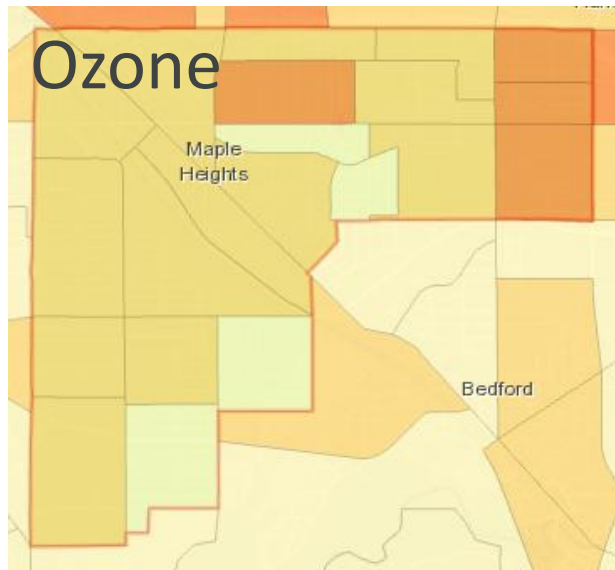
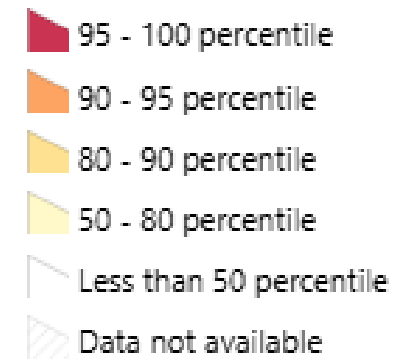
Pollution In East Cleveland

Data from 2025



Pollution In Maple Heights

Data from 2025



Project Site Selection: 100m from Rail line



- Front Porch Constantly being swept due to particulate matter from nearby railroad tracks in East Cleveland

Installing Air Monitors: Sign a Waiver

- ▶ Waivers signed are written consent to install an Air Quality Monitor on the property.
- ▶ To guard against liability concerns.
- ▶ Must have Wi-Fi.
- ▶ Must have outdoor power supply.
- ▶ CCBH must have access as needed.



Waiver and Release of Liability

Name; Print:

Address for installation:

Cell Phone:

Home Phone:

Email Address:

Date:

Wi-Fi Password: It will be necessary to have the Wi-Fi password to set up both Purple Air and Simple AQ monitors.

I have received environmental monitoring equipment from the Cuyahoga County Board of Health, to be installed on my property. I understand that no promises have been made to me regarding the condition of the equipment. I agree to hold harmless and release Cuyahoga County Board of Health and its respective employees, volunteers, and contractors from any and all claims for injuries, damages, or liability related in any way to the acceptance, installation, and use of the equipment, for myself and on behalf of my heirs, attorneys, assignees, and dependents, whether known or unknown. I understand that this waiver is intended to be as broad and inclusive as permitted by the laws of Ohio.

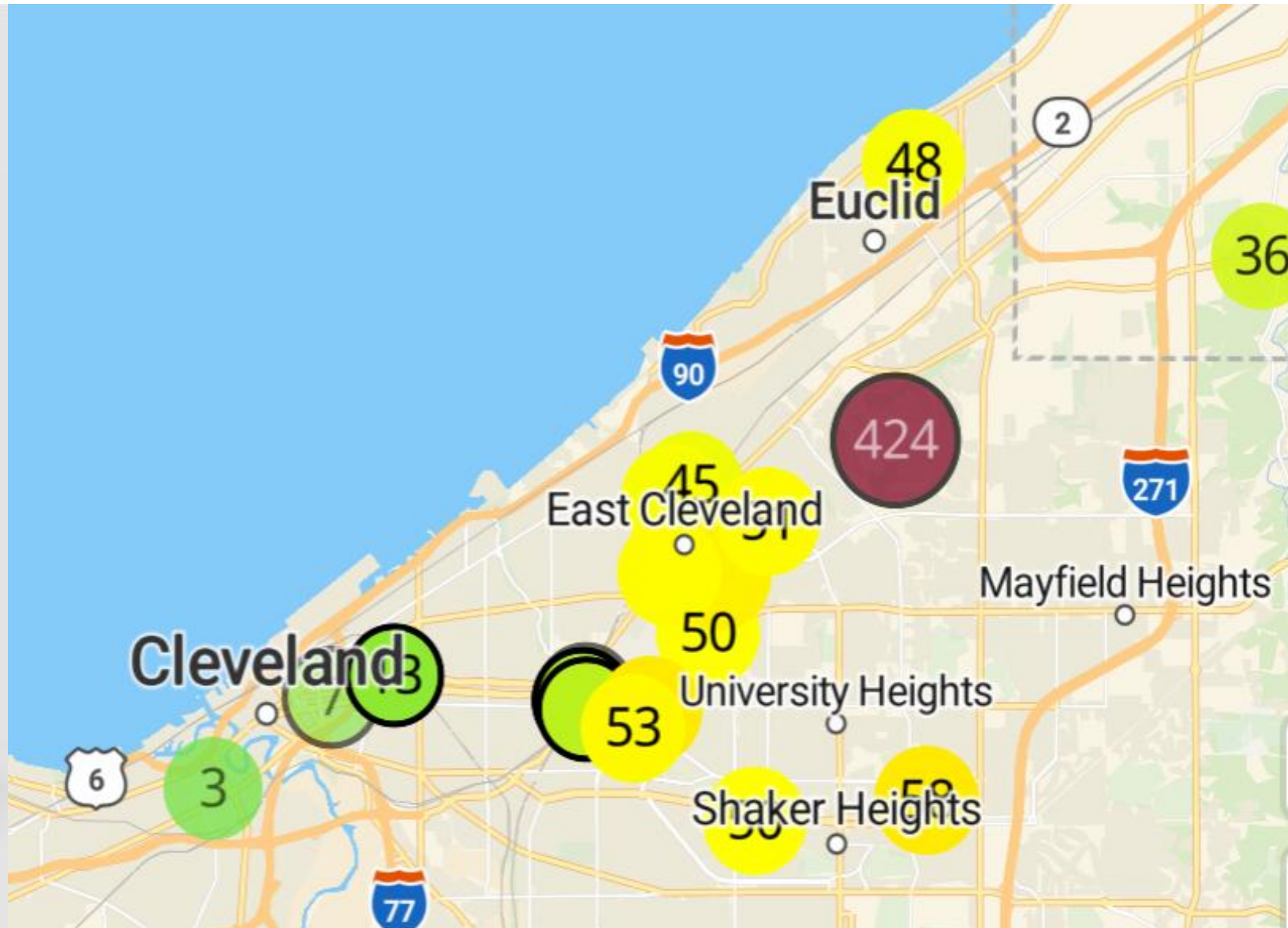
I have read this Waiver and Release of Liability and agree to its terms.

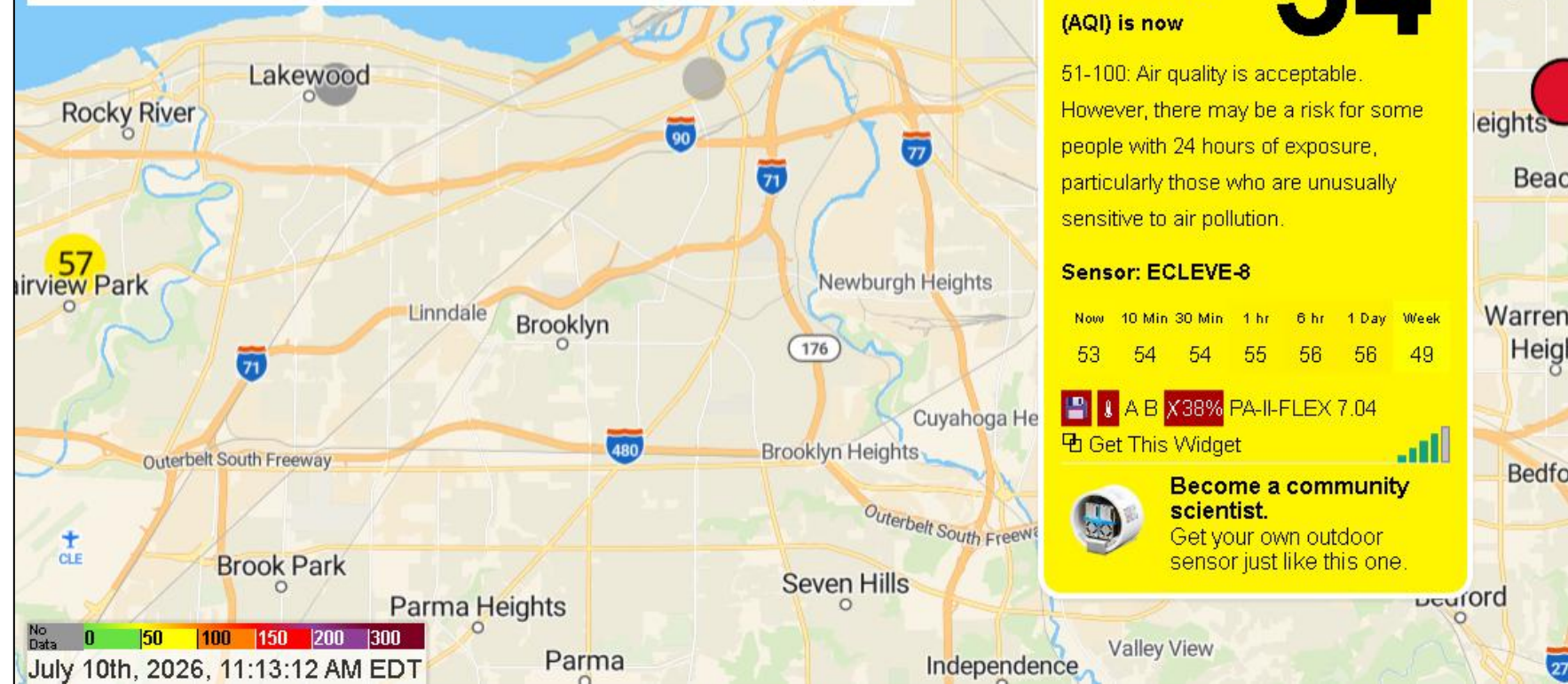
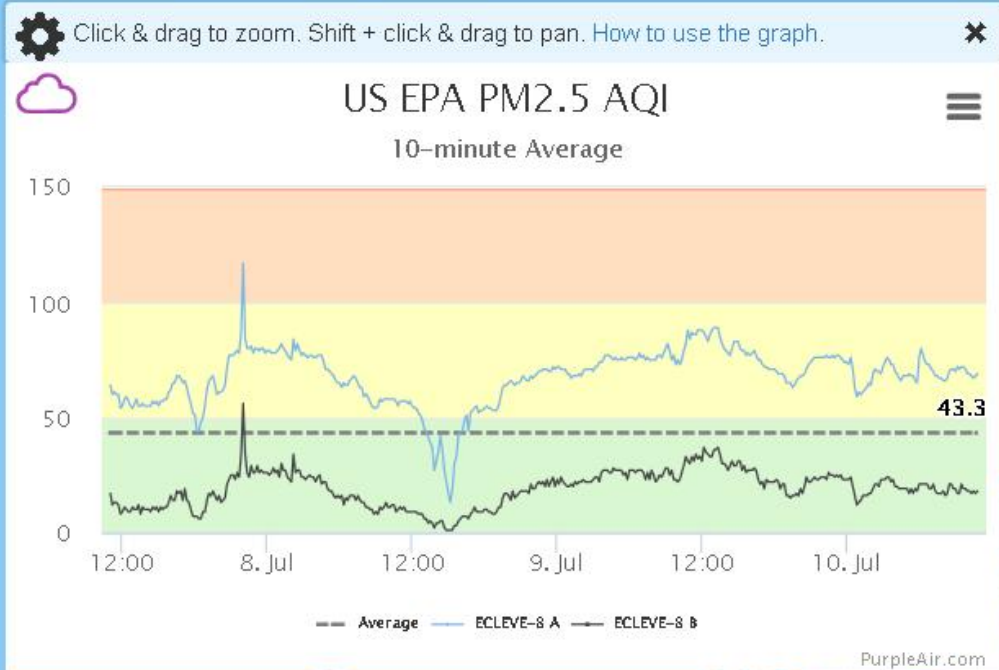
Signature: _____ Date: _____

Why Purple Air monitors?

- RISE Community Training at Cincinnati University.
- Tacit approval by EPA.
- 35 000 Purple Air monitors globally for reference and comparison.
- Excellent technical assistance with Purple Air staff.
- Real-time Air quality data updates by individually set time periods.
- Monitors data settings can be individually customized per project.
- Relatively easy to install; require power and Wi-Fi.
- Two sensors provide redundancy.
- Data provided via graphs and text showing EPA air quality index, levels of PM2.5 and site location.

Observation & Data Collection - Purple Air





On July 10th, 2026, 11:11:44 AM EDT

10-minute Average
US EPA PM2.5
(AQI) is now

54

51-100: Air quality is acceptable. However, there may be a risk for some people with 24 hours of exposure, particularly those who are unusually sensitive to air pollution.

Sensor: ECLEVE-8

Now	10 Min	30 Min	1 hr	6 hr	1 Day	Week
53	54	54	55	58	58	49

PA-II-FLEX 7.04

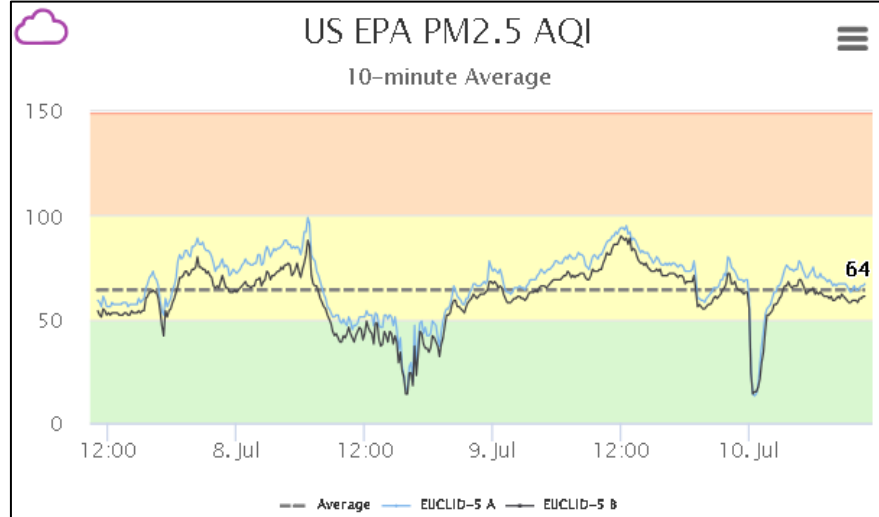
Get This Widget

Become a community scientist.
Get your own outdoor sensor just like this one.

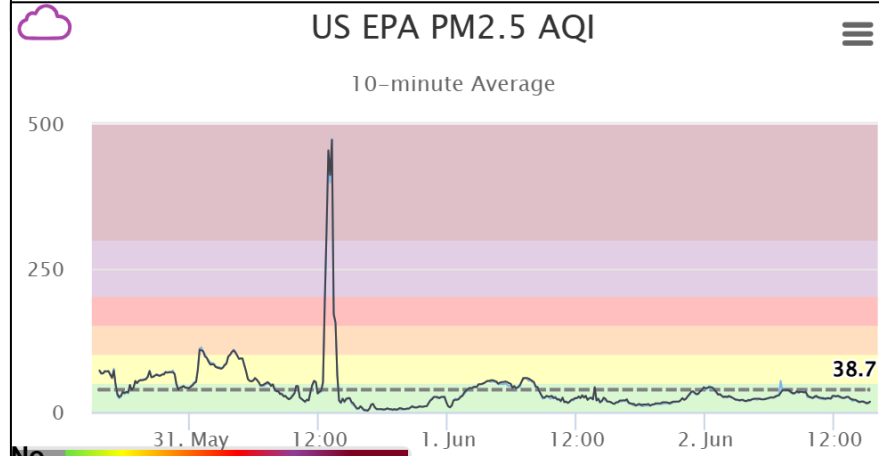
Purple Air

Data: Hourly Levels, Concentrations

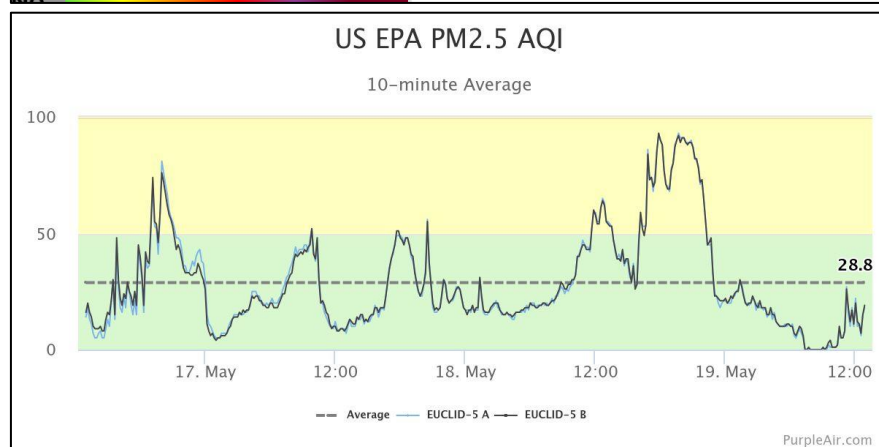
- Data for East Cleveland sensor ECLEVE-8, July 10th, 11.10AM.
- Blue and black graph lines show temperatures recorded by both monitors for redundancy.
- 54 is the number of PM2.5 particles in the air.



Friday July 10, 11:00, 2026



Monday June 2nd 2025

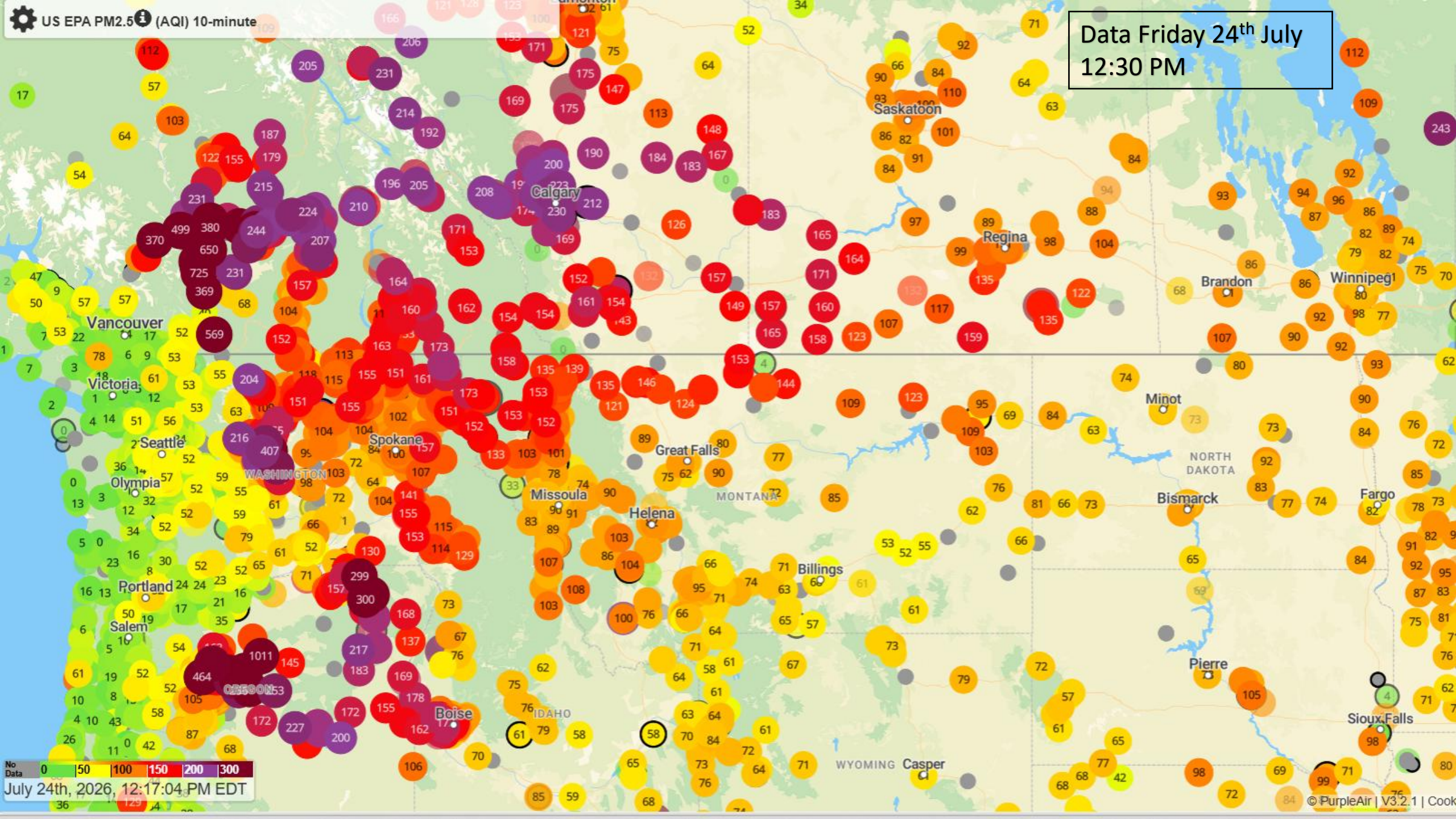


Thursday 21st May 2025

Euclid: Greenbrier Golf Course Data

- Graph colours are the air Quality Index Scale (PM_{2.5} particles), showing:
- **Green**; good (0-50),
- **Yellow**; moderate (51-100),
- **Orange**; unhealthy for sensitive groups (101-150)
- **Purple**; hazardous (301->500)

Data Friday 24th July
12:30 PM



Instillation of Purple Air monitors

- 12 PurpleAir monitors providing results.
- Photo: Installation of PurpleAir Monitor in Maple Heights at the City Maintenance Office



Installed **Purple** Air Monitors

- Photos Clockwise: East Cleveland Farmer's Market.
- Maple Heights, Warrensville Ctr. Rd. Purple Air Monitors circled in Red & Yellow.

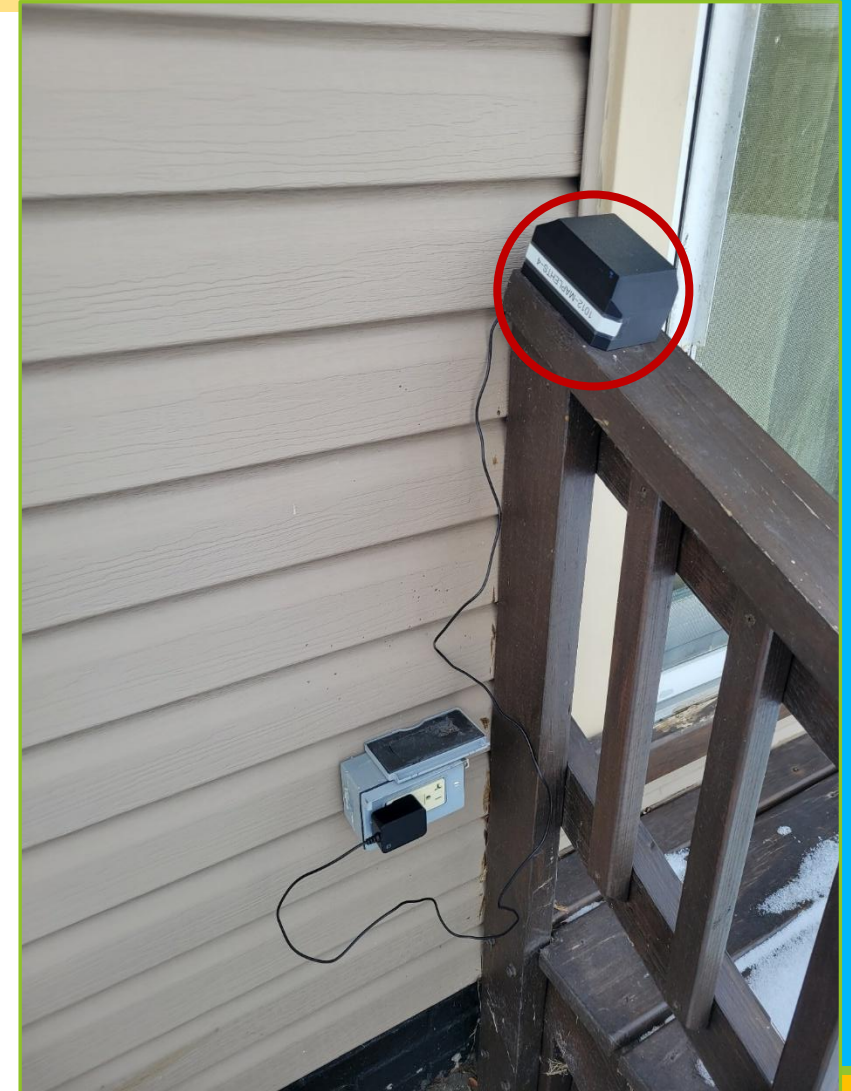


SimpleAQ Monitors: Failed Experiment

- SimpleAQ Sensors - OSU Experimental Models
- Measures PM 2.5
- Volatile Organic Compounds.
- Barometric Pressure
- Nitrous Oxide
- Ozone

Problems

- Only one sensor
- Kept failing
- No technical backup
- Photos Right & Below: Maple Heights, & Euclid.



Student Poster, Pilot Analysis. Utilizing Cluster Analysis to Examine Air Sensor Data: A Concept Evaluation to Respond to Community Needs, July 2025.

Background

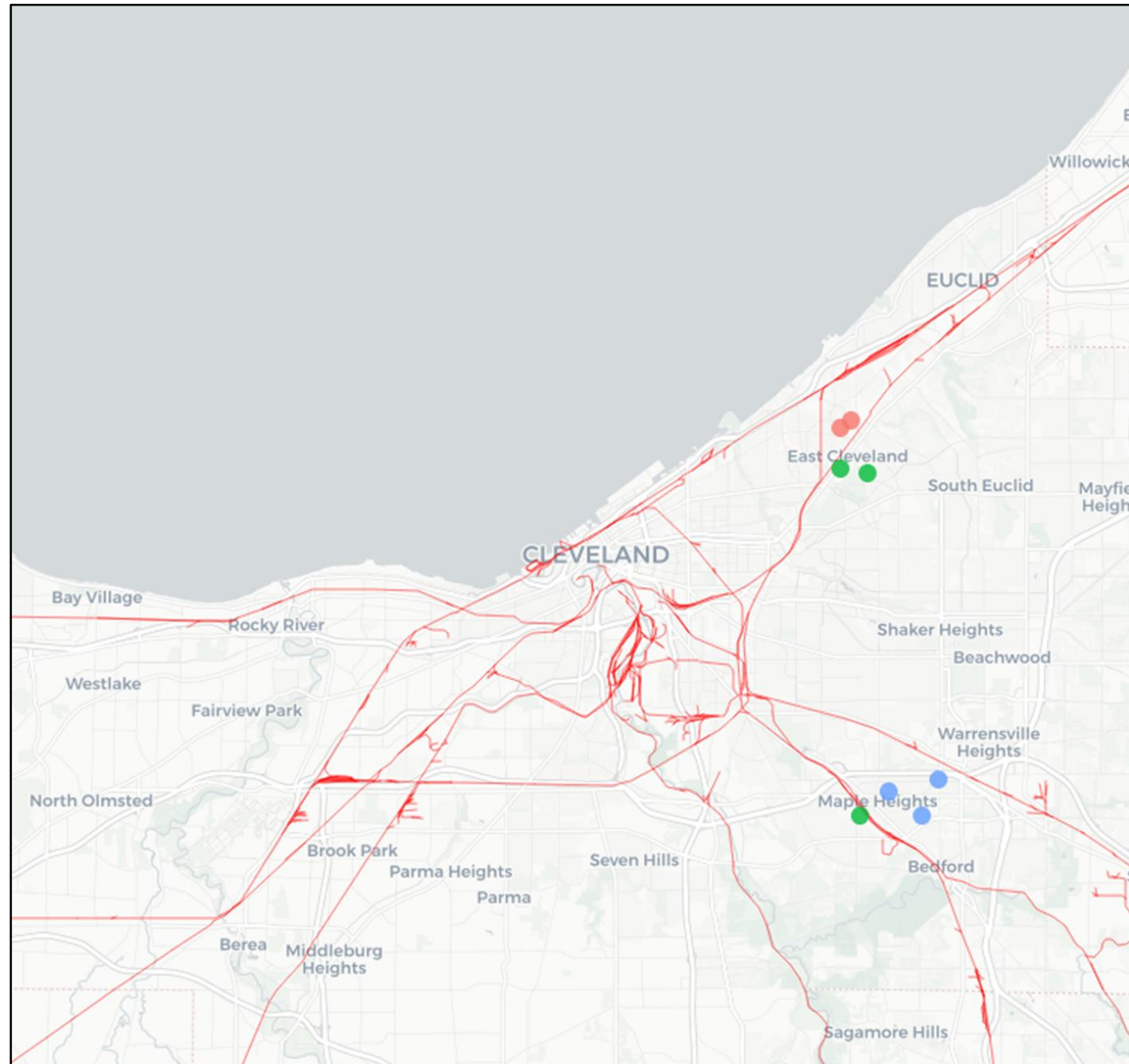
- Through an EPA EJG2G grant community needs were identified centered around concerns of train pollution in Cuyahoga. Residents are concerned about soot being observed in their homes and its impacts on their health.
- Air sensors are deployed to monitor the air pollution in these areas.
- As train movement is not publicly available, advanced machine learning methods may give clues to respond to these concerns.
- The aim was to perform analysis on existing sensor data.

Methods

- Air sensor data from 8 PurpleAir sensors collected in East Cleveland and Maple Heights (Figure 1).
- Dynamic Time Warping Cluster Analysis (DTWCA) was used to evaluate similarity between time series data (Figure 2).
- Variables for DTWCA included PM 2.5, PM 1.0, PM 10.0, Volatile Organic Compounds (VOC), Humidity, Temperature, and Pressure.

Purple Air Sensors East Cleveland, Maple Heights. Red are rail lines.

- Figure 1. CCBH Purple Air Monitors in Cuyahoga County.
- The 8 sensors are depicted in red, green and blue circles, all functioning normally.
- Rail lines are show in red.



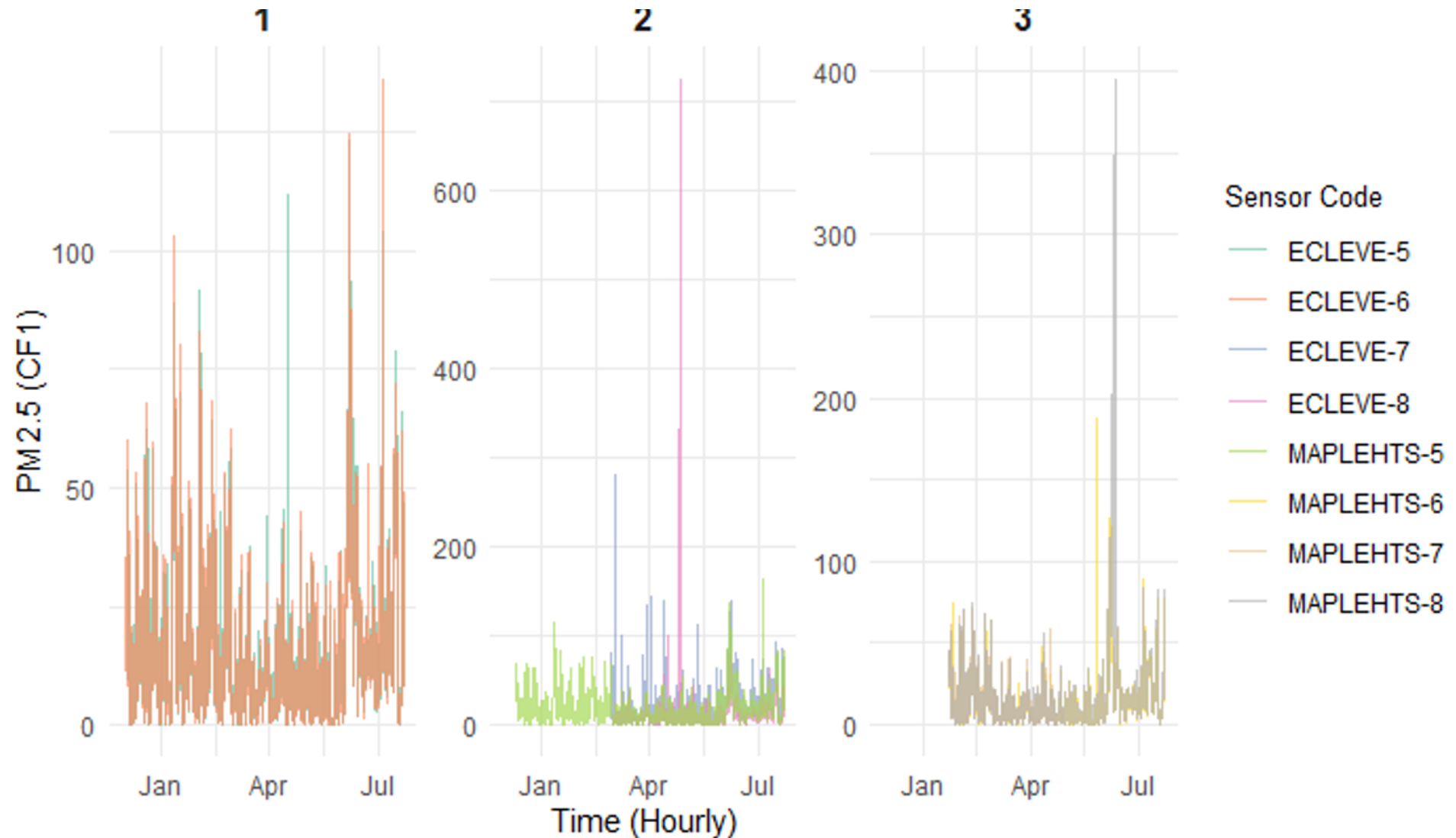
Time Series

PM 2.5

Grouped by Clusters

Figure 2. Multivariate Dynamic Time Warping (DTW), is an algorithm measuring similarity between two or more chronological/time-based sequences, varying in speed. It groups similar air sensor data.

PM 2.5 data for each cluster is between January to July 2025.



Multivariate DTW Cluster Summary

Cluster 1. VOC's high

ECLEVE-5

ECLEVE-6

Cluster 2.

ECLEVE-7

ECLEVE-8

MAPLEHTS-5

Cluster 3. PM2.5 higher

MAPLEHTS-6

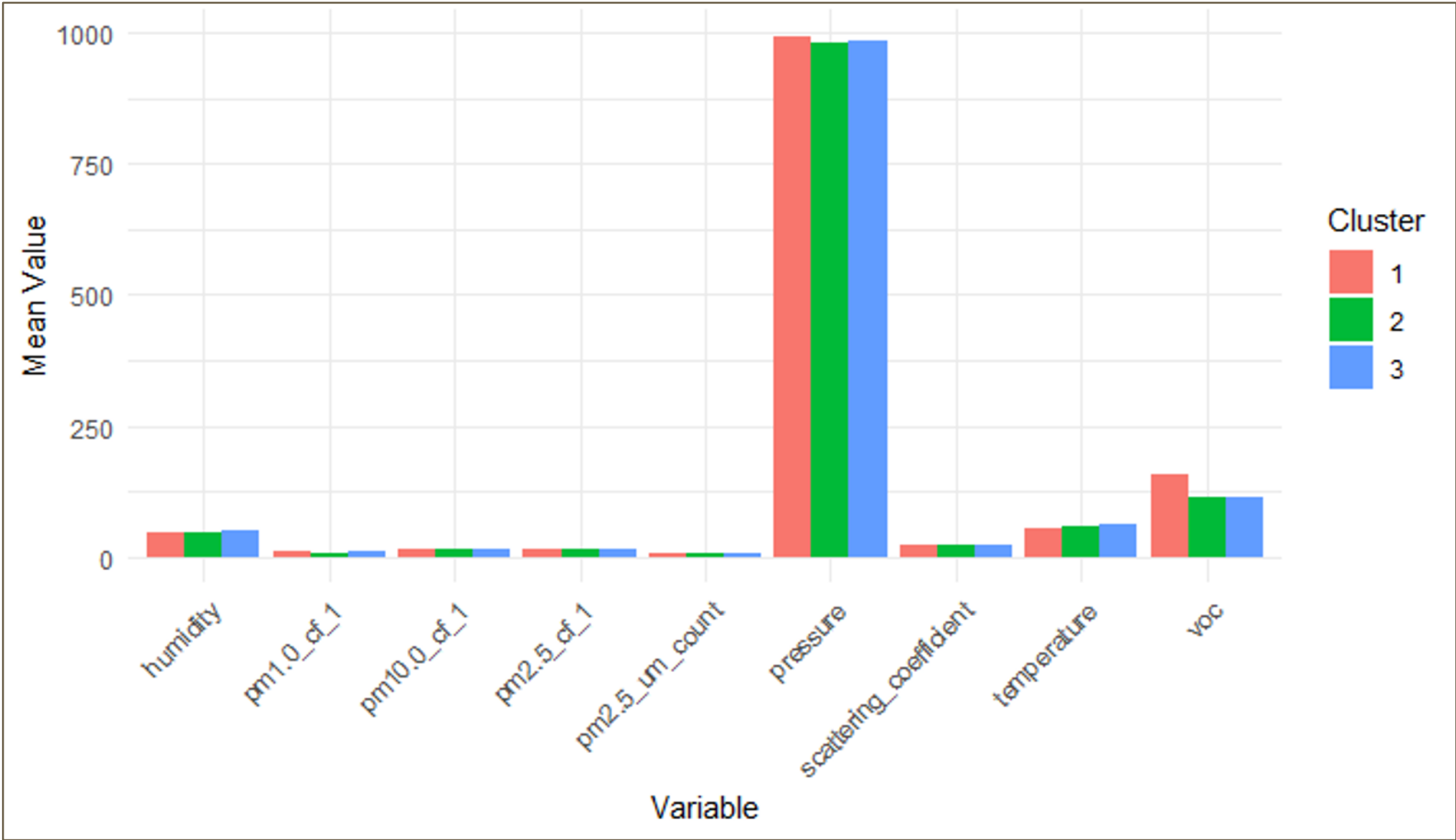
MAPLEHTS-7

MAPLEHTS-8

Multivariate DTW Cluster Summary			
Mean and Standard Deviation by Variable (Grouped Together)			
Sensors per Cluster: Cluster 1: ECLEVE-5, ECLEVE-6 Cluster 2: ECLEVE-7, ECLEVE-8, MAPLEHTS-5 Cluster 3: MAPLEHTS-7, MAPLEHTS-6, MAPLEHTS-8			
Variable / Statistic	Cluster 1	Cluster 2	Cluster 3
PM2.5 (CF1) Mean	15.31	14.38	15.15
PM2.5 (CF1) SD	15.50	15.62	17.51
PM1.0 (CF1) Mean	9.77	8.96	9.78
PM1.0 (CF1) SD	9.11	9.85	12.04
PM10.0 (CF1) Mean	16.63	15.49	16.72
PM10.0 (CF1) SD	16.70	16.52	19.15
VOC Mean	156.89	115.39	116.21
VOC SD	145.84	67.21	75.36
Humidity Mean	46.10	48.81	49.56
Humidity SD	12.12	13.63	13.42
Temperature Mean	56.32	57.36	61.07
Temperature SD	20.57	19.81	19.45
PM2.5 µm Count Mean	7.65	7.80	8.39
PM2.5 µm Count SD	9.71	10.39	12.05
Scattering Coefficient Mean	24.06	22.22	24.90
Scattering Coefficient SD	20.29	19.29	21.38
Pressure Mean	993.37	981.31	985.80
Pressure SD	7.74	7.31	7.28

Comparison of Mean Values by Cluster.

Figure 3. Sensors in Cluster 1 have a higher VOC value. Further investigation is needed to determine potential sources and cause(s).



Conclusion and Future Research

Summary

- Sensors in Cluster 1 have higher VOC metrics (Table 1 and Figure 3).
- Sensors in Cluster 3 have higher PM variability
- In all sensors, humidity, temperature, and pressure are all comparable.
- Other factors and causes need to be investigated to explain these findings.
- Data from all 12 sensors need to be analysed.

Future Study

- Continue exploratory analysis methods
- Include metrics for proximity to railroads -> may give clues to high variation in PM
- Examine potential sources of high VOC in Cluster 1. May be due to increased vehicle emissions, industrial processes, burning fossil fuels.
- More GHG emissions by industrial and transportation data needed.

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Thank you for your time

For more questions,
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