

Community-scale air quality monitoring: The RAMP network

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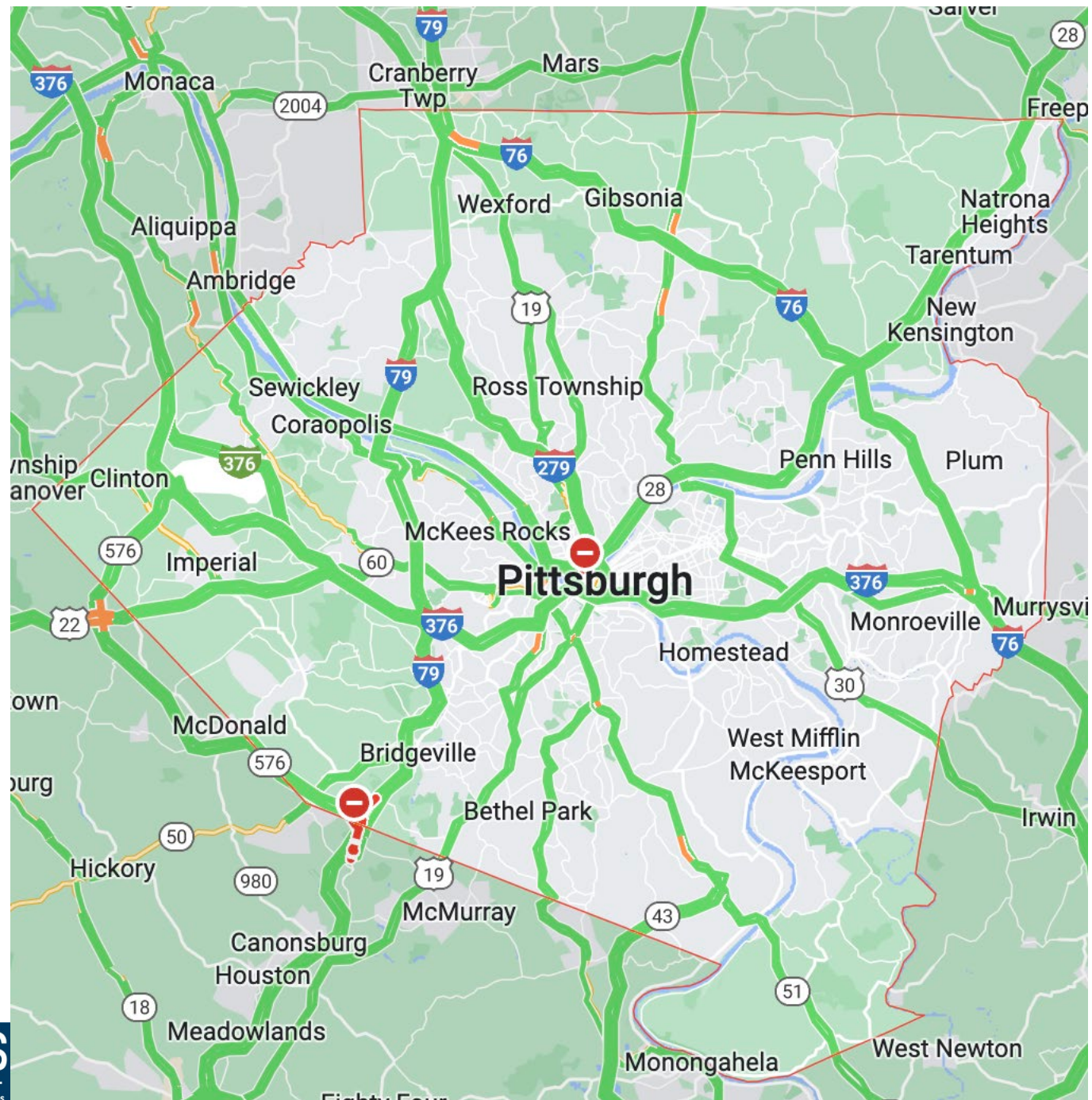


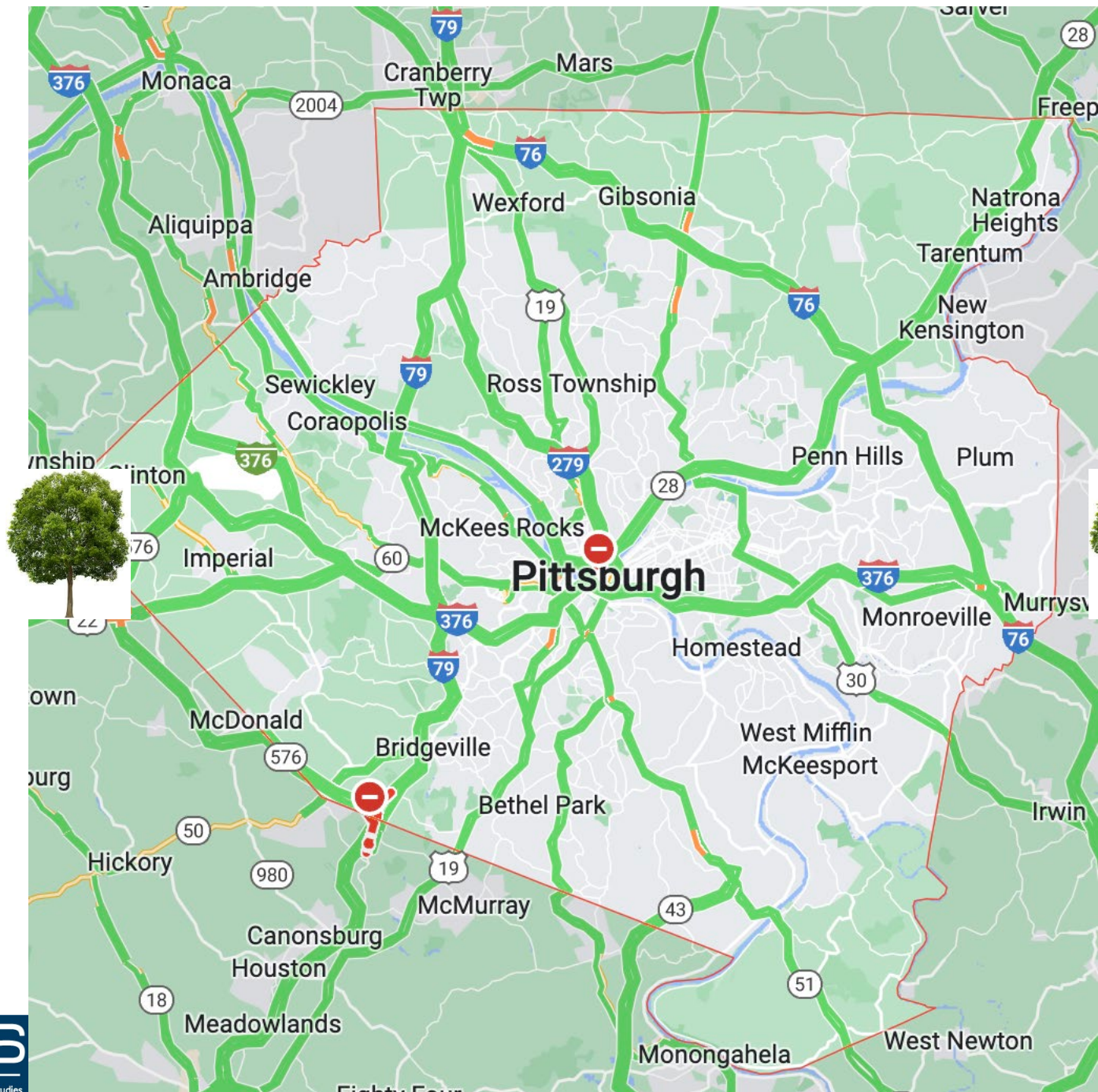
**Carnegie
Mellon
University**

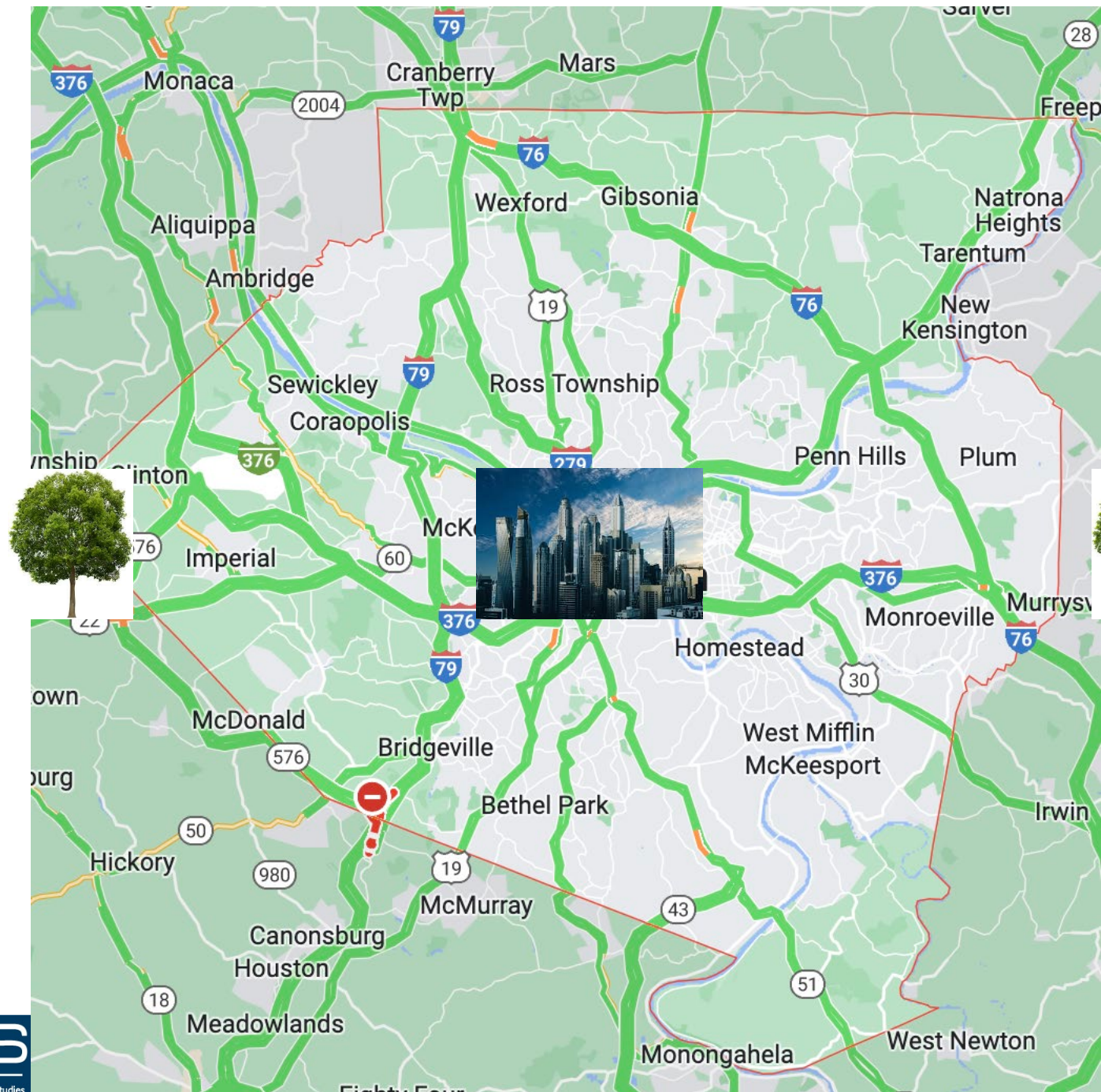
Take home points

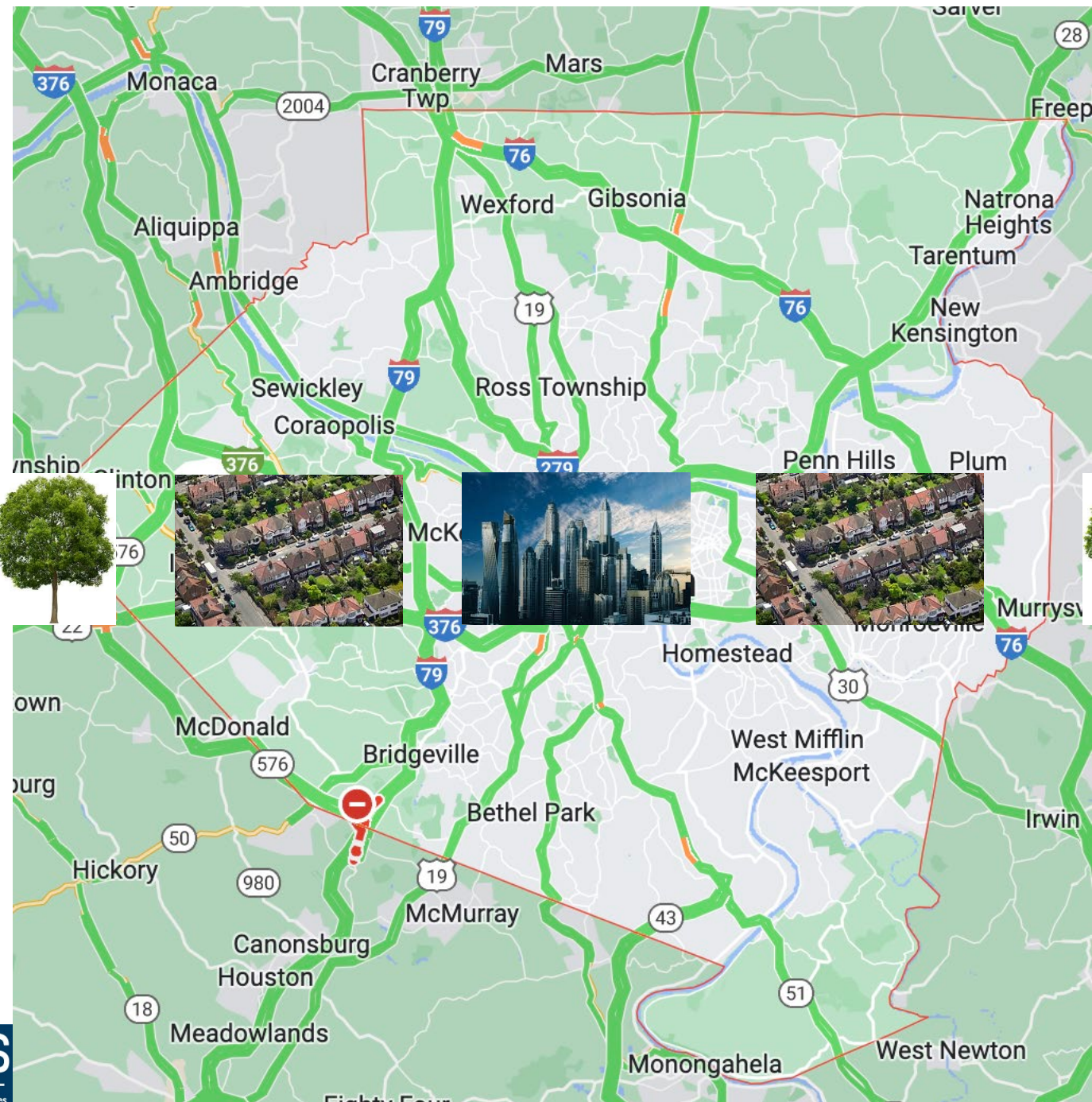
- We can use low-cost sensor networks to monitor local-scale variations in air pollution
- Partnering with local communities allows us to communicate air pollution data in a way that is relevant and actionable

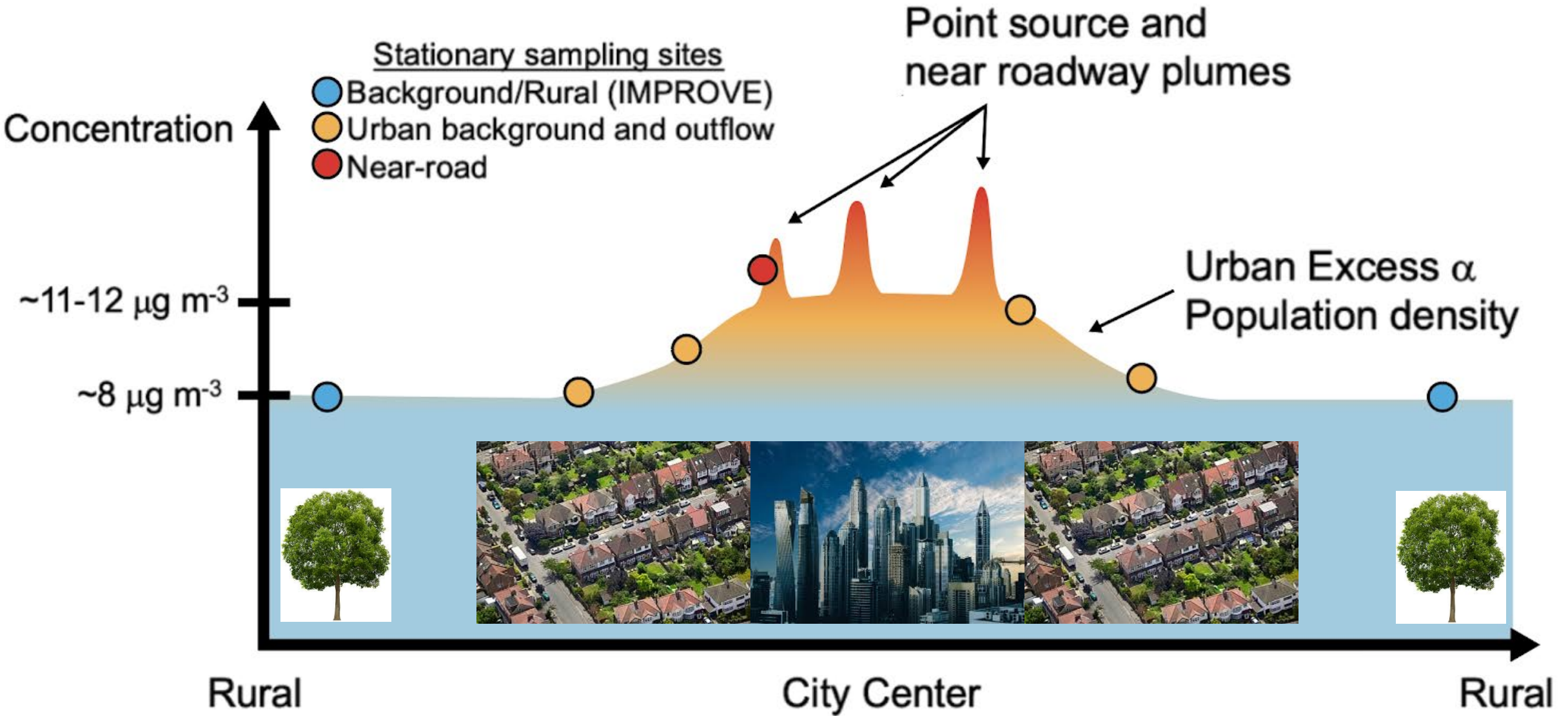
How much does air pollution vary at the neighborhood level?



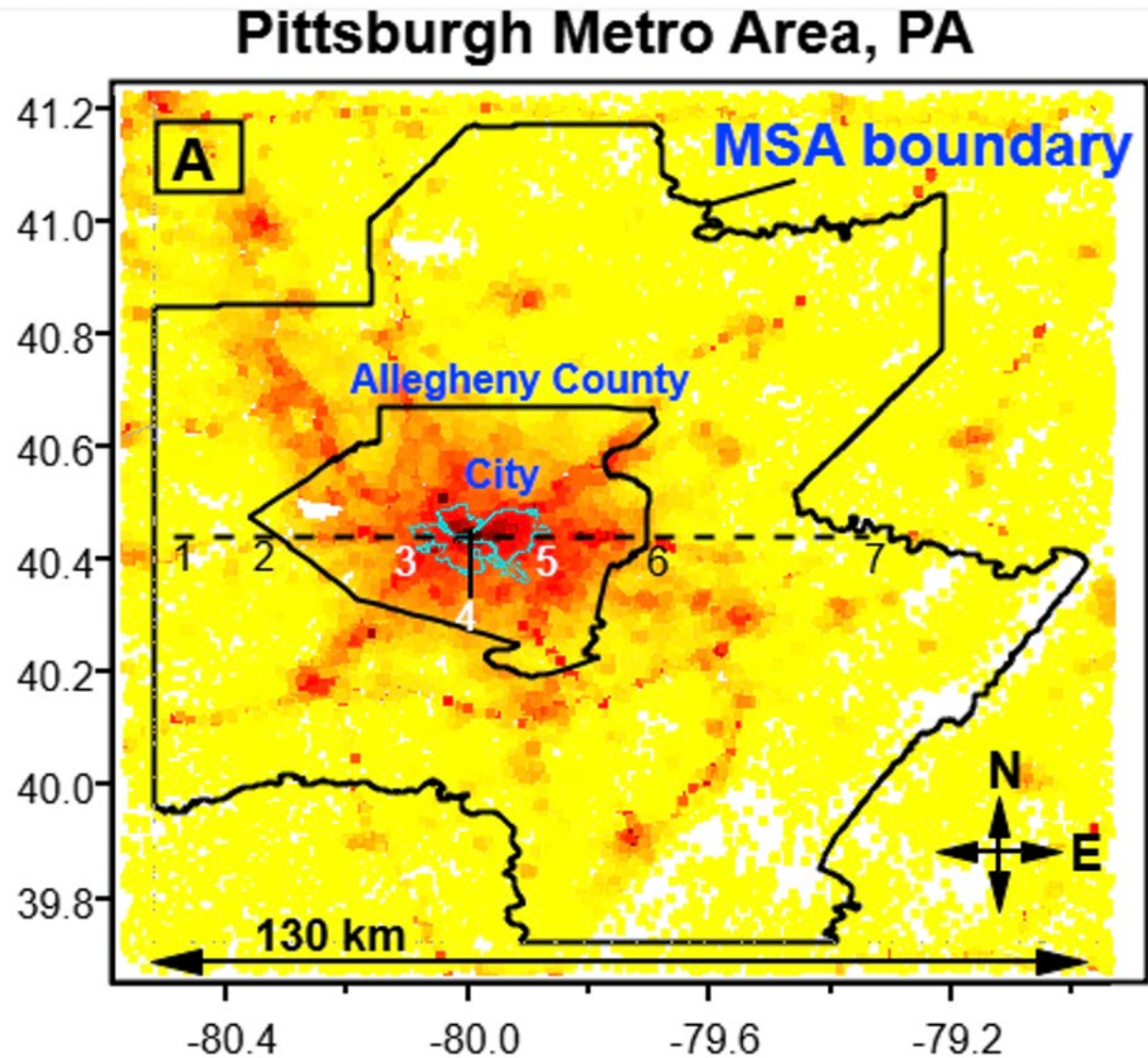






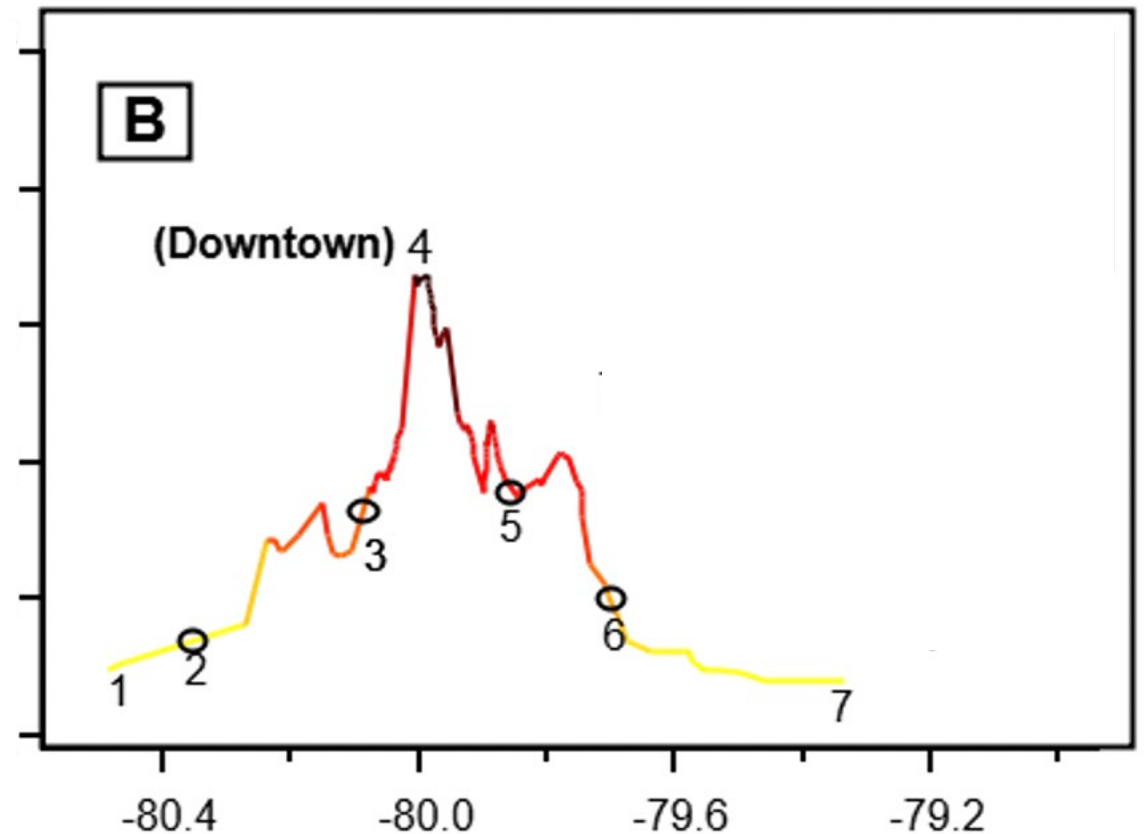
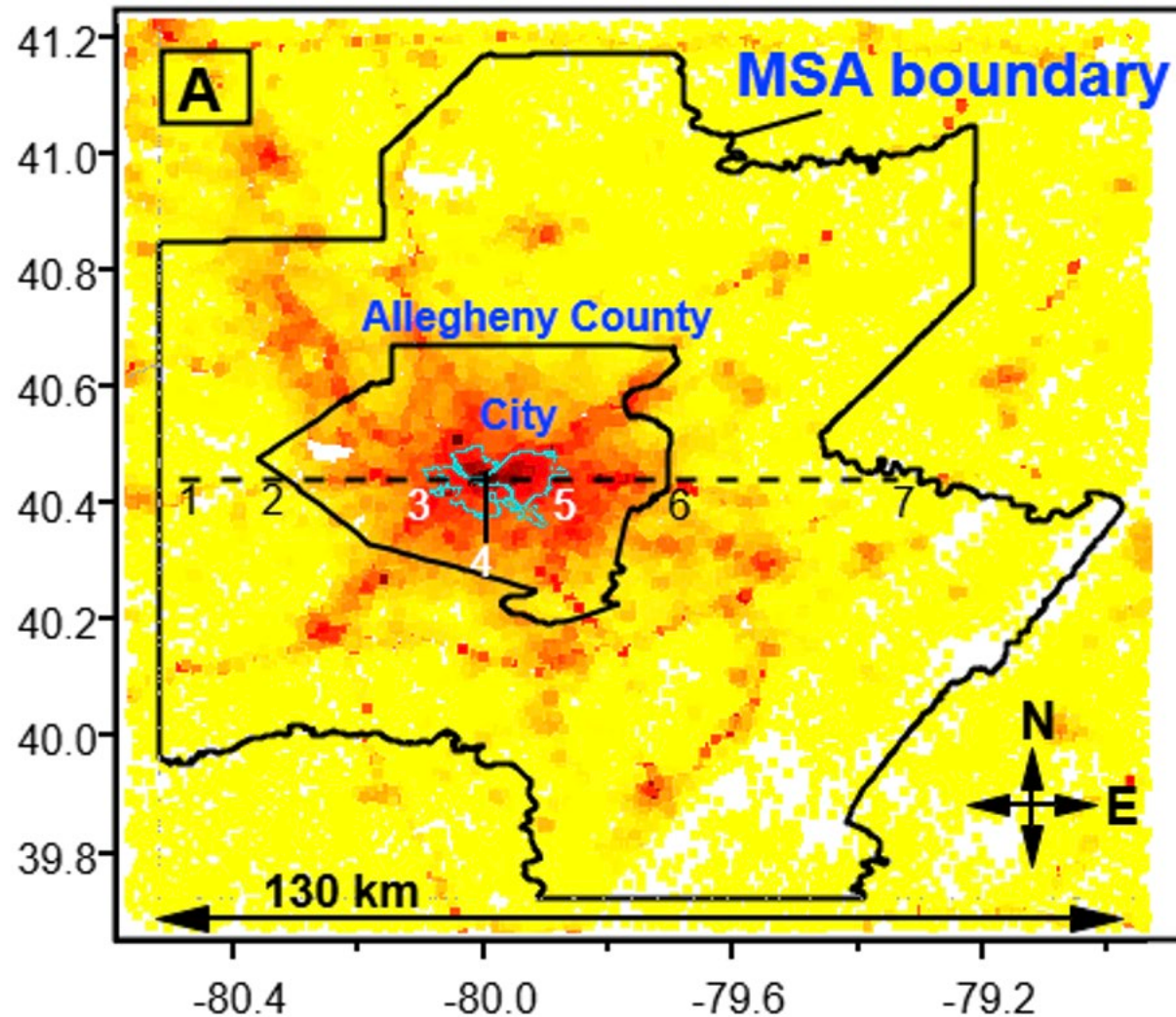


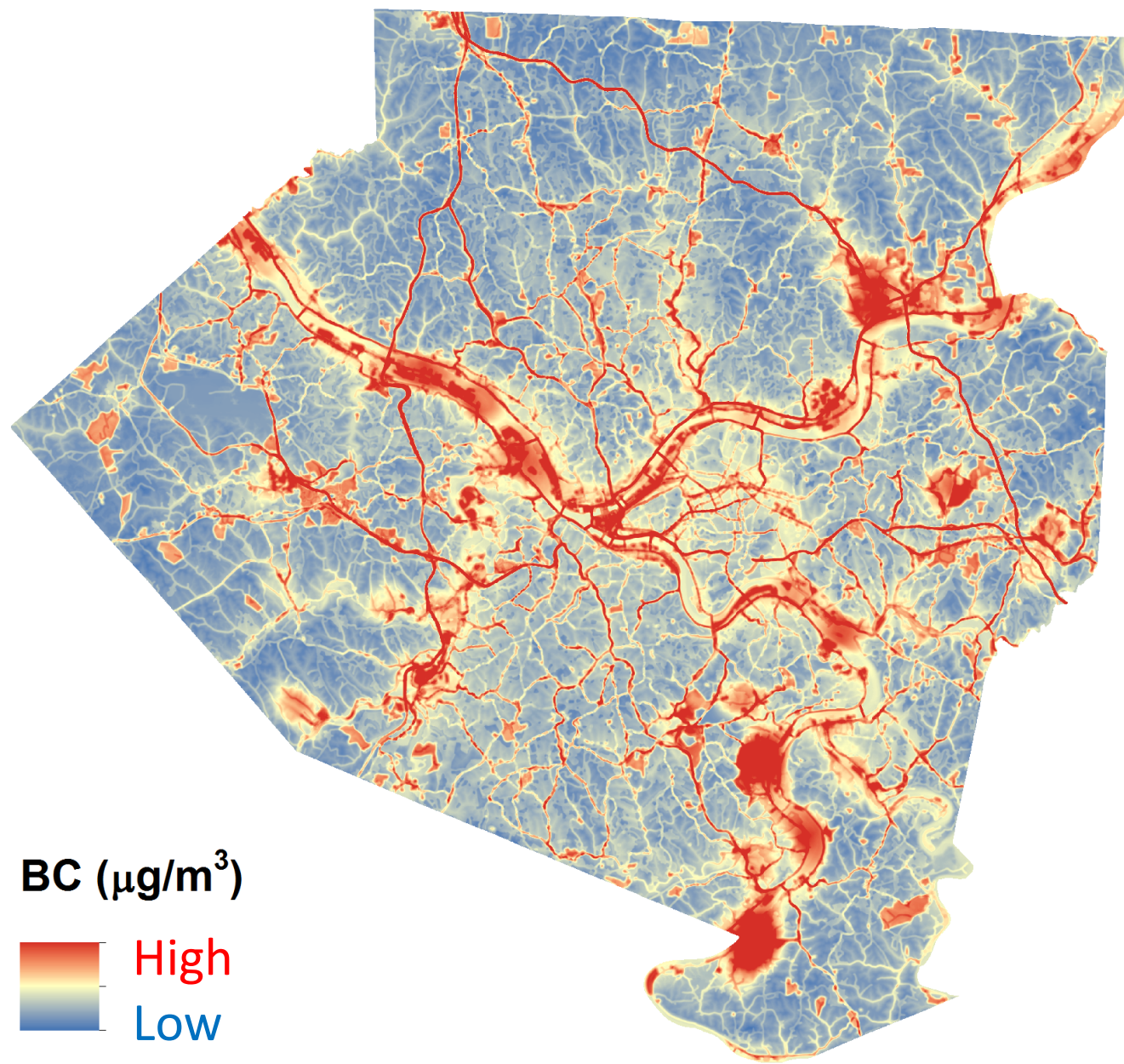
Urban areas have an air pollution “hump” with
spikes on top of it



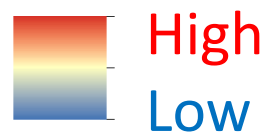
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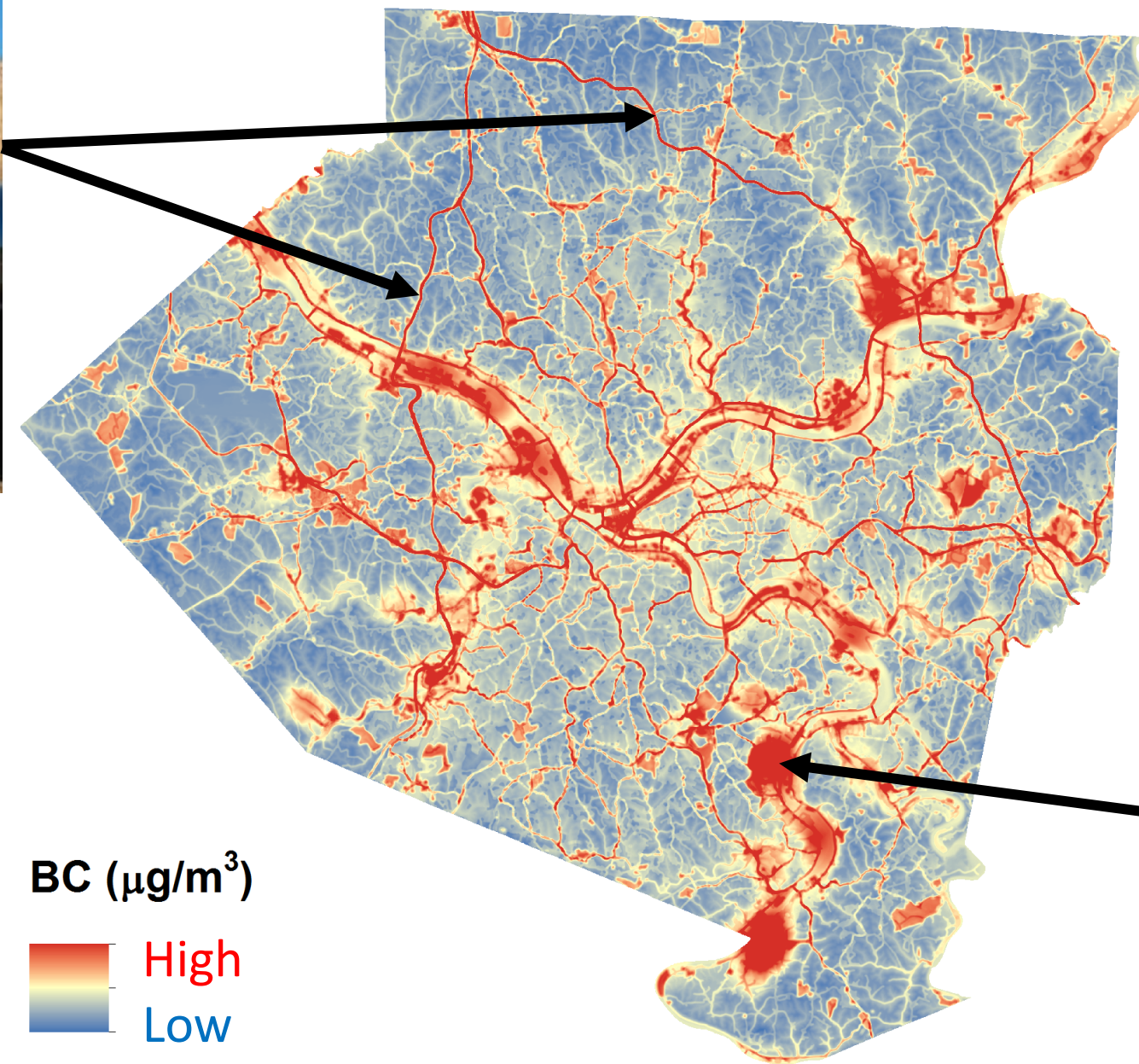
Pittsburgh Metro Area, PA





BC ($\mu\text{g}/\text{m}^3$)





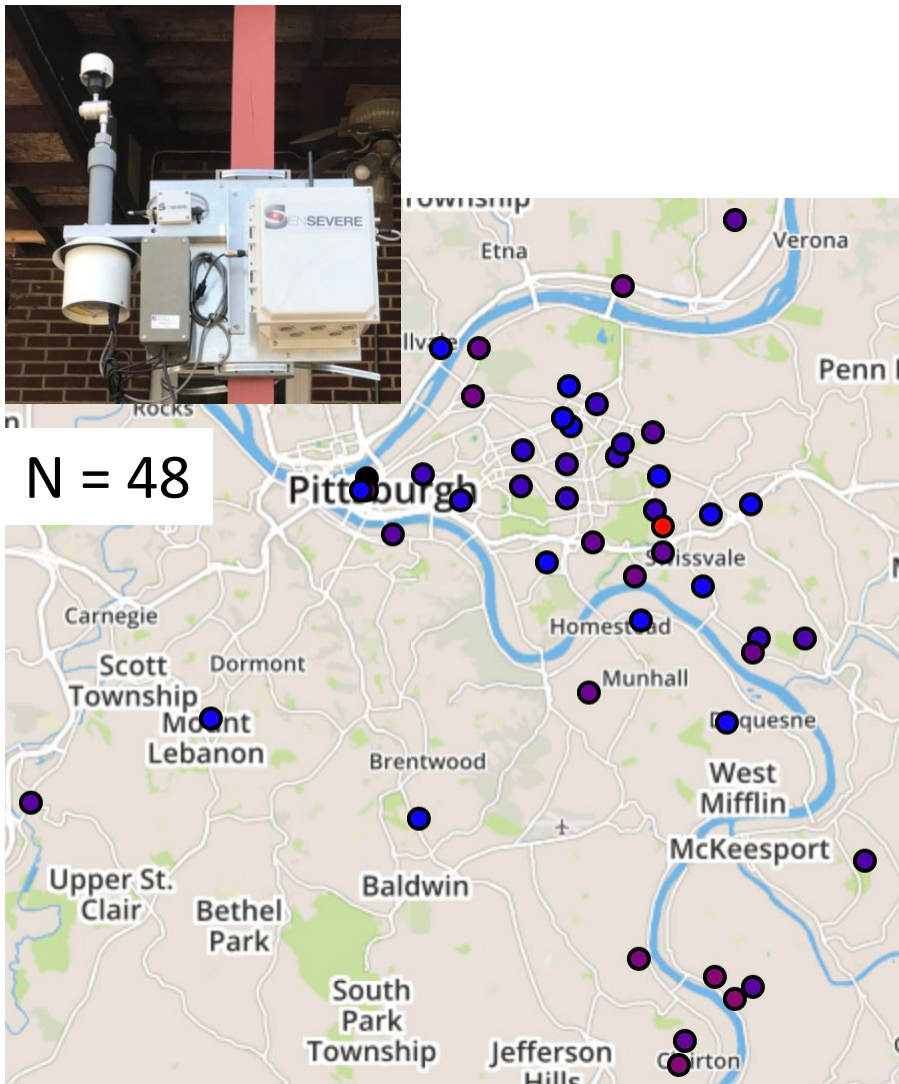
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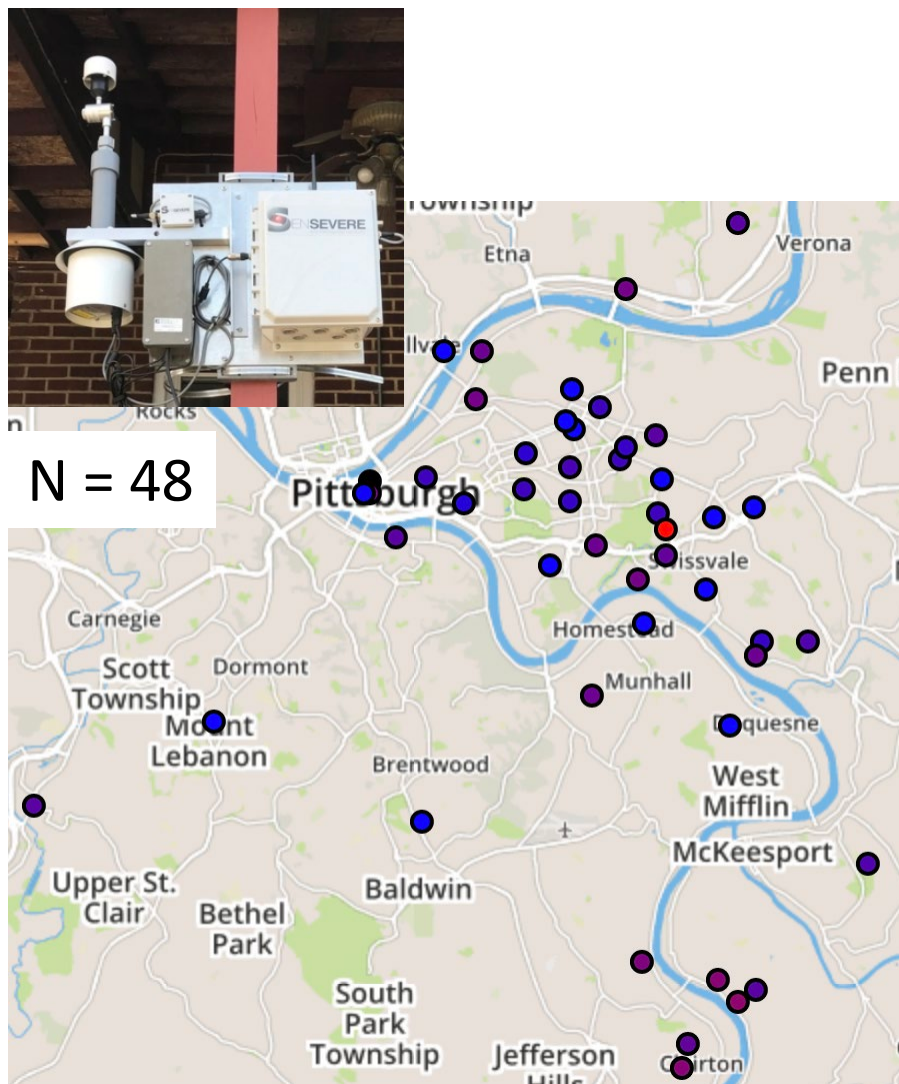
High

Low

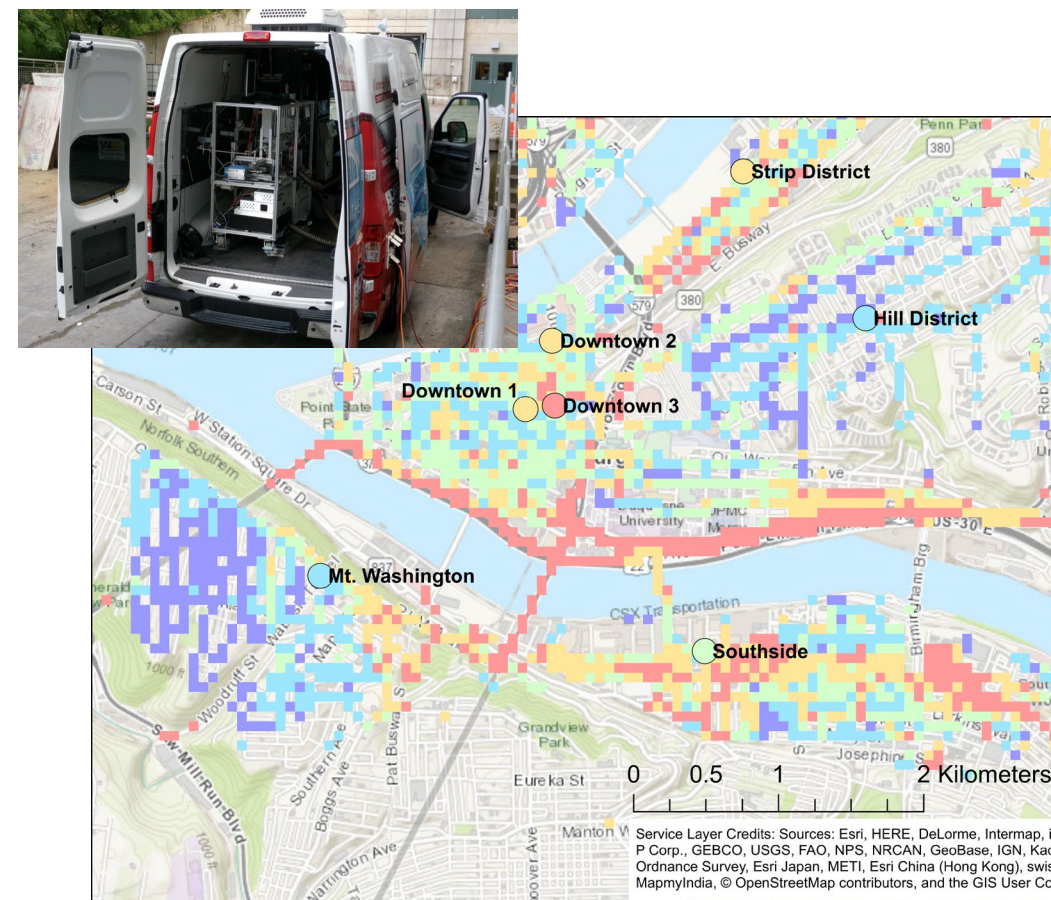




Dense network of **fixed sites**

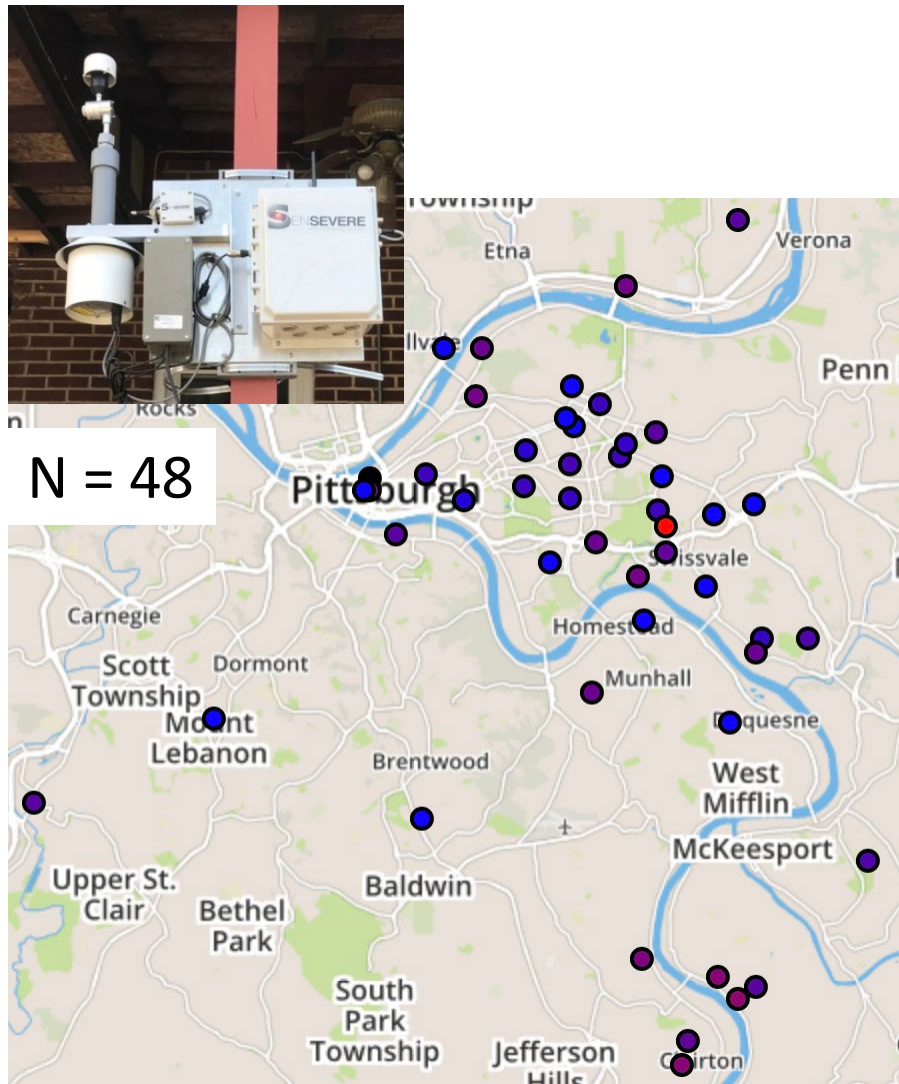


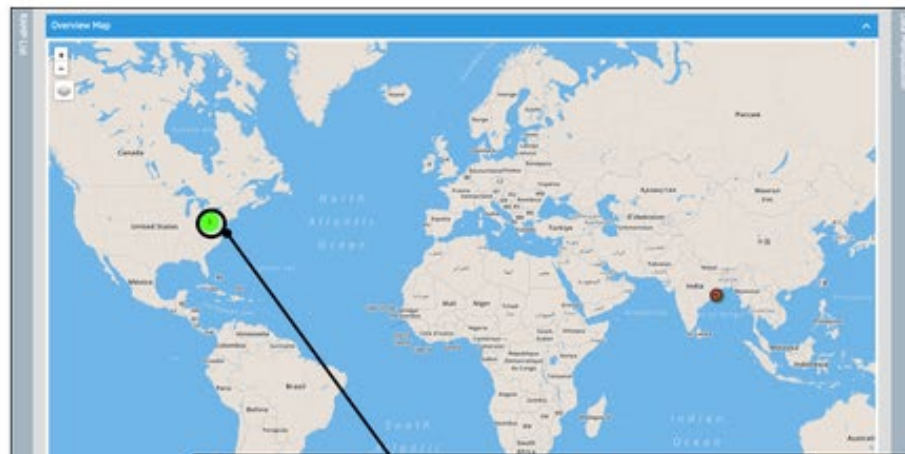
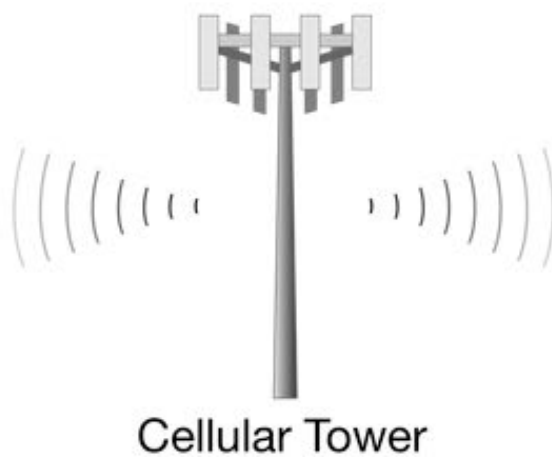
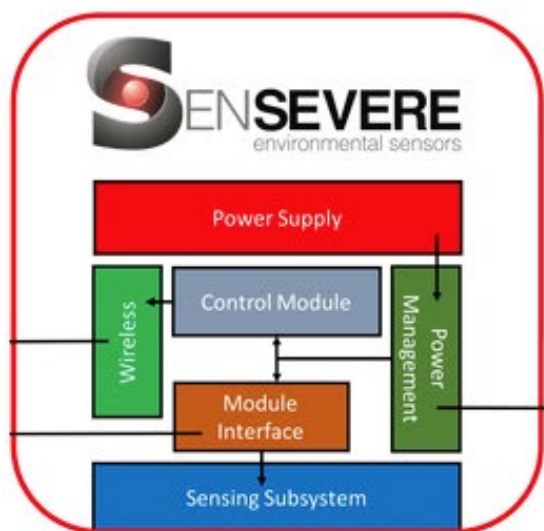
Dense network of **fixed sites**



Mobile sampling to quantify block by block ***sources*** and ***exposure***.

Real-Time Affordable Multi-Pollutant Sensor (RAMP)







On a rooftop pole



In a yard (we
provide the tripod)

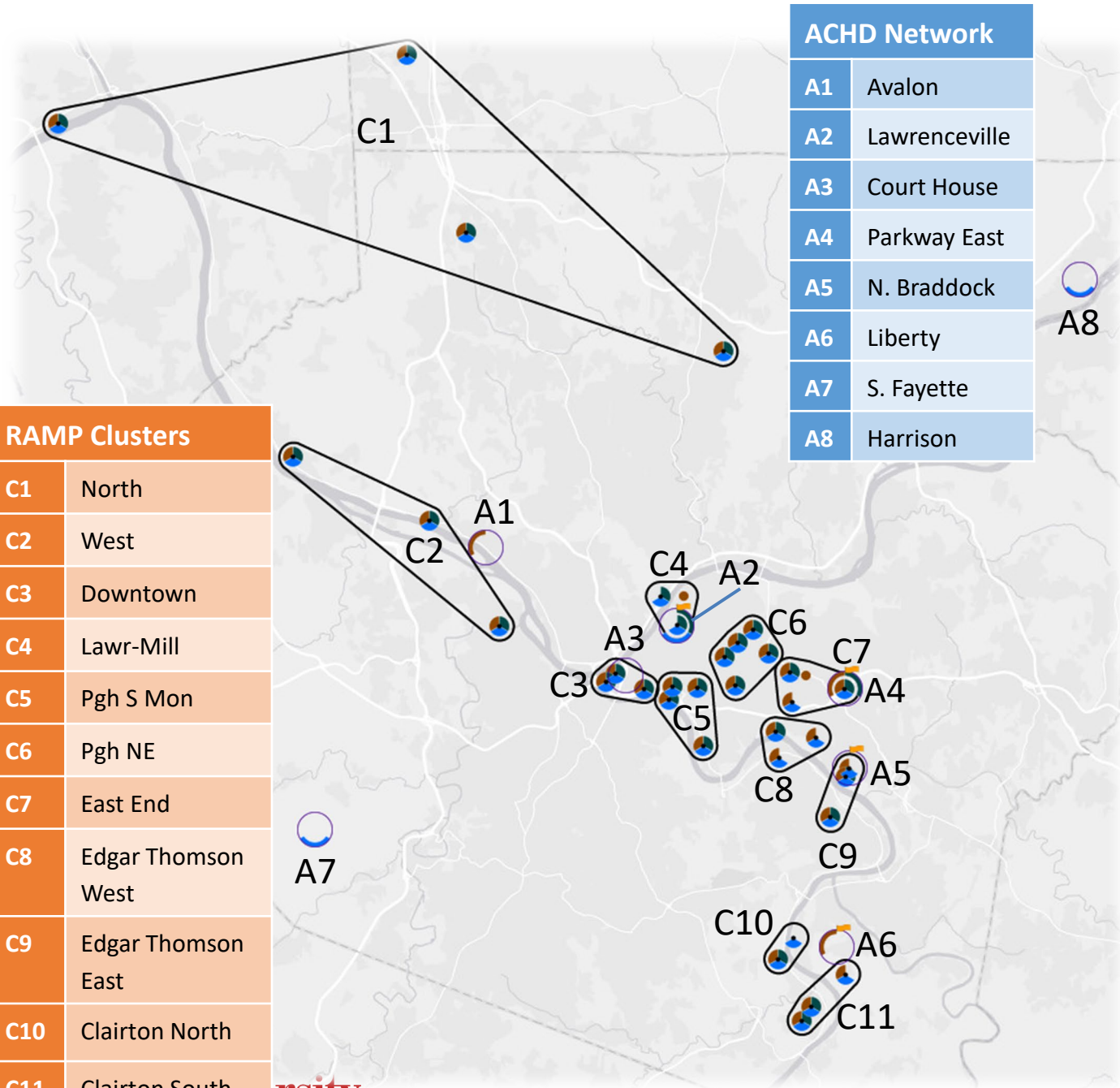


On a porch

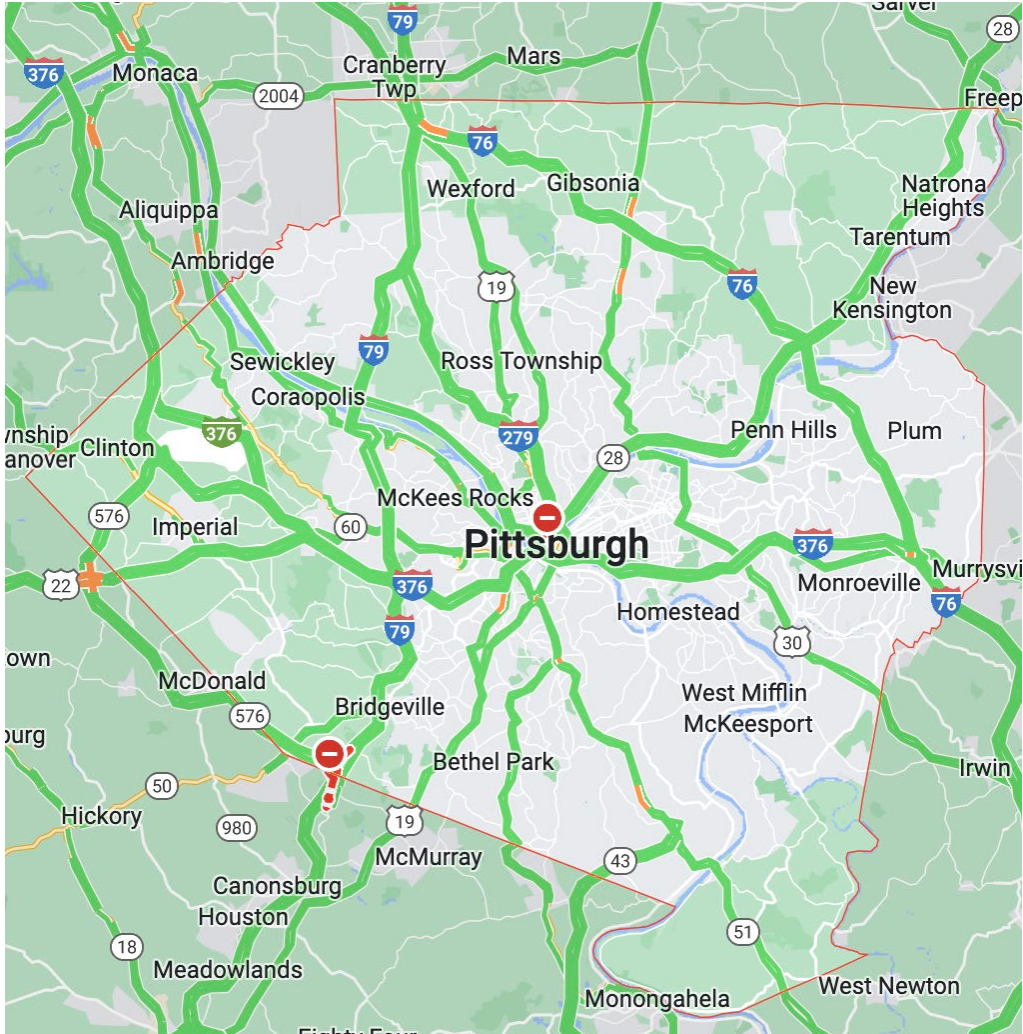
RAMP Network

RAMP Clusters	
C1	North
C2	West
C3	Downtown
C4	Lawr-Mill
C5	Pgh S Mon
C6	Pgh NE
C7	East End
C8	Edgar Thomson West
C9	Edgar Thomson East
C10	Clairton North
C11	Clairton South

ACHD Network	
A1	Avalon
A2	Lawrenceville
A3	Court House
A4	Parkway East
A5	N. Braddock
A6	Liberty
A7	S. Fayette
A8	Harrison



RAMP Network



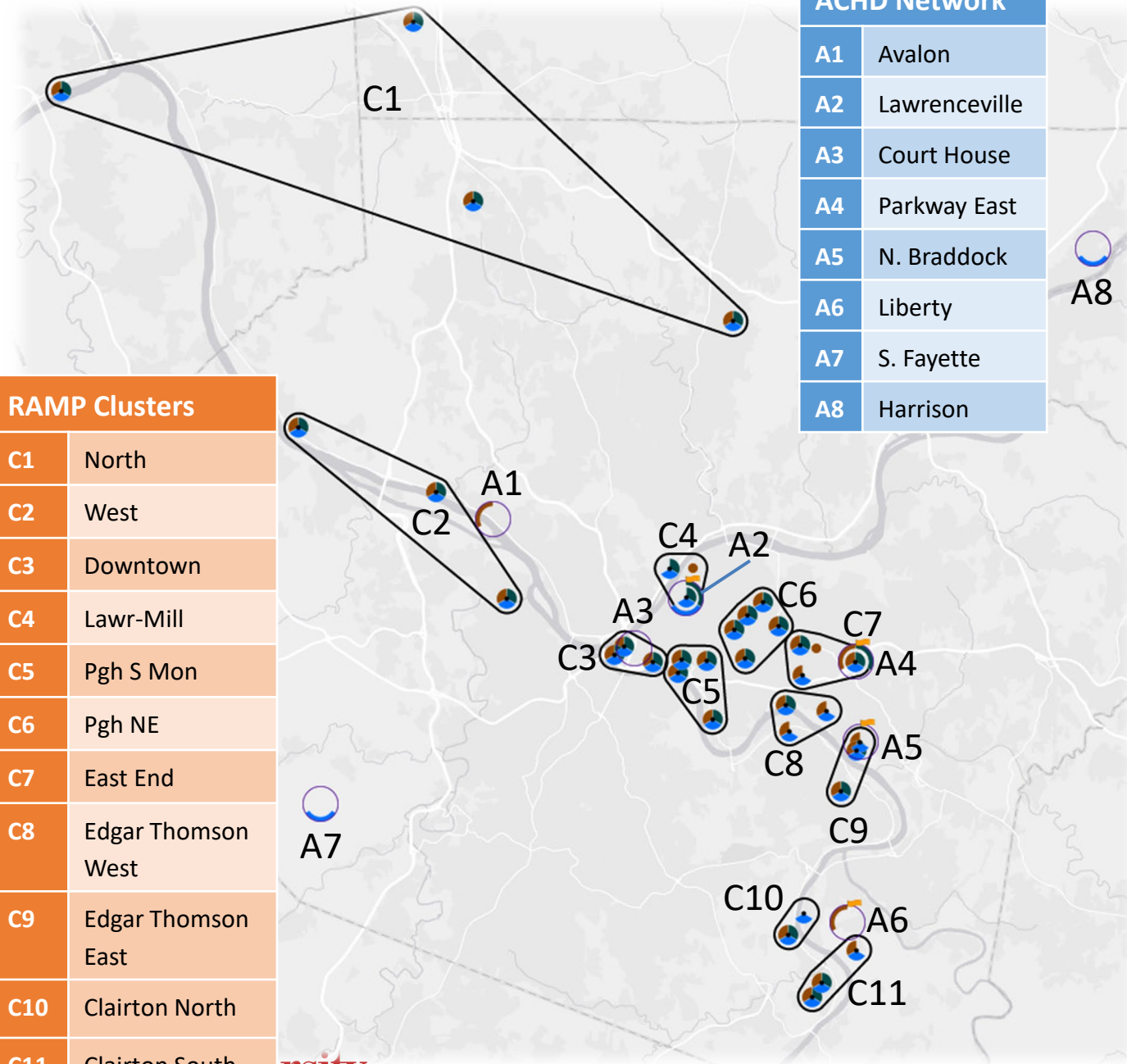
Carnegie Mellon University

RAMP Clusters

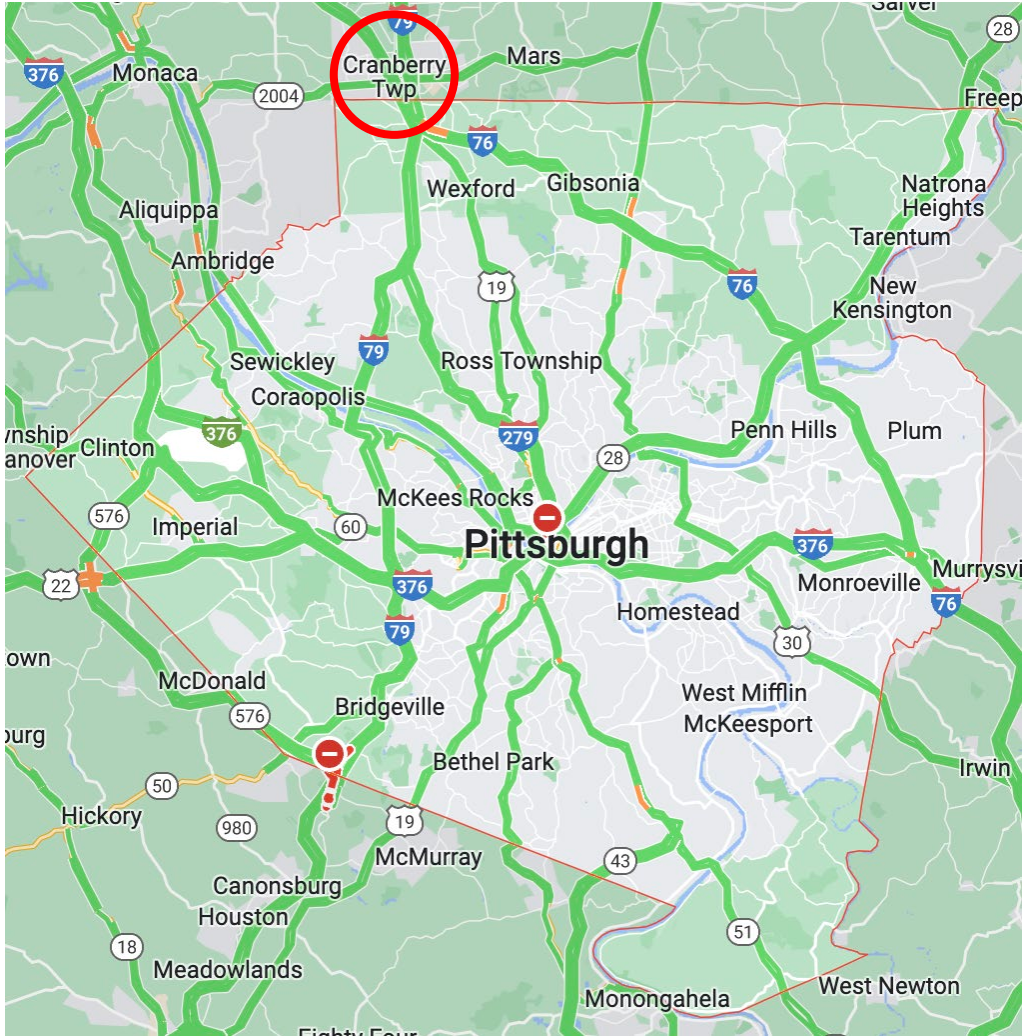
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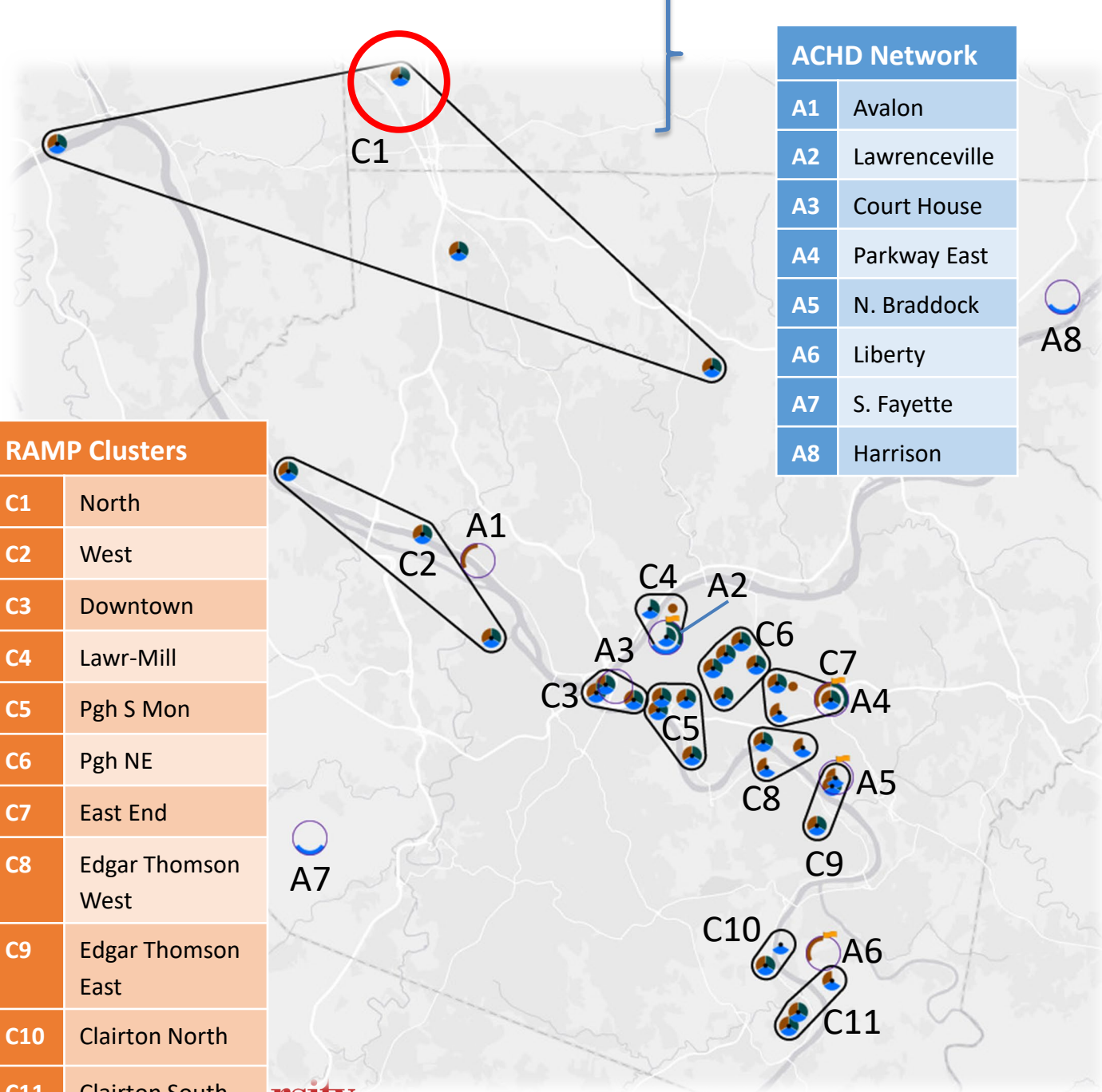
Carnegie Mellon University

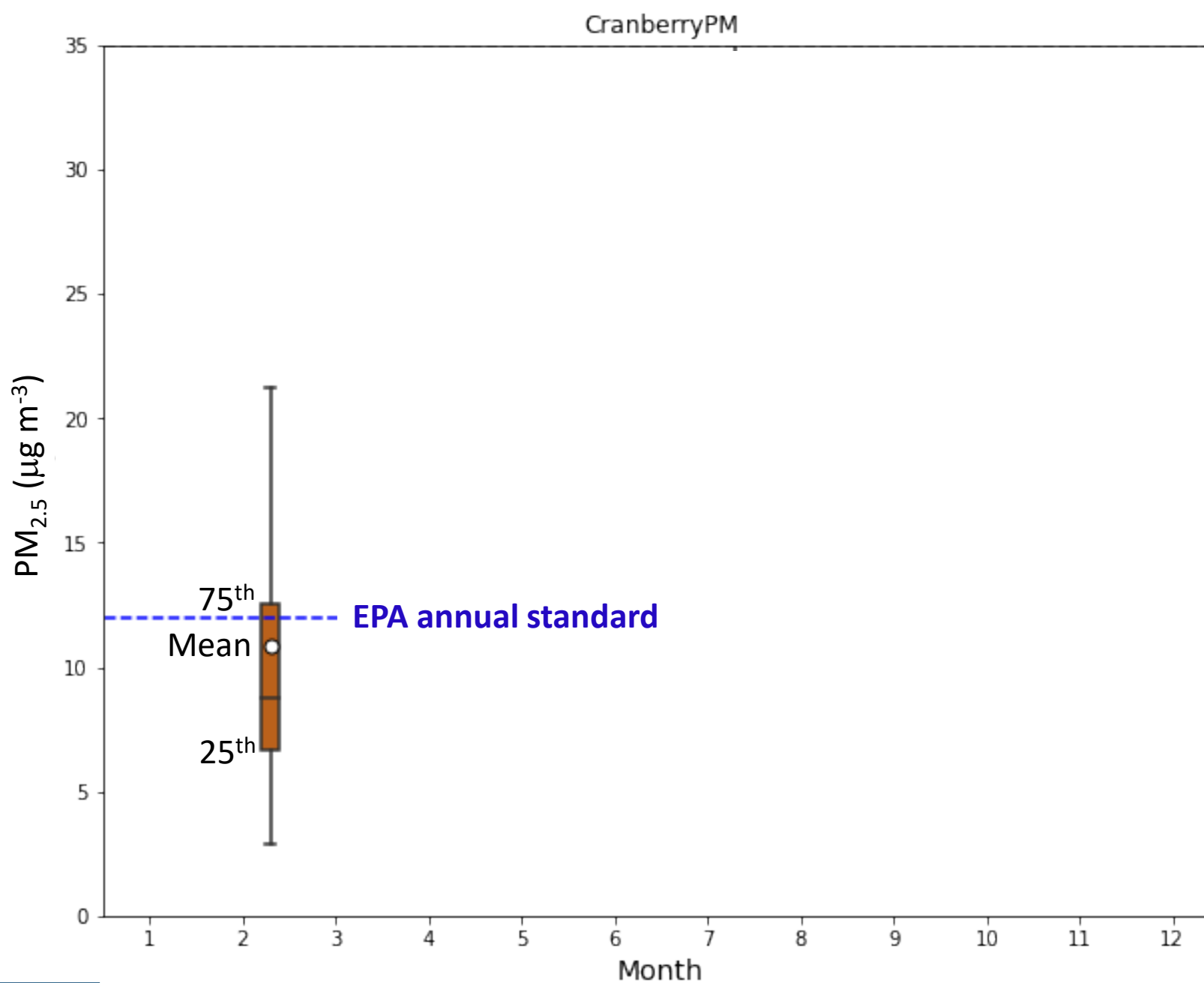
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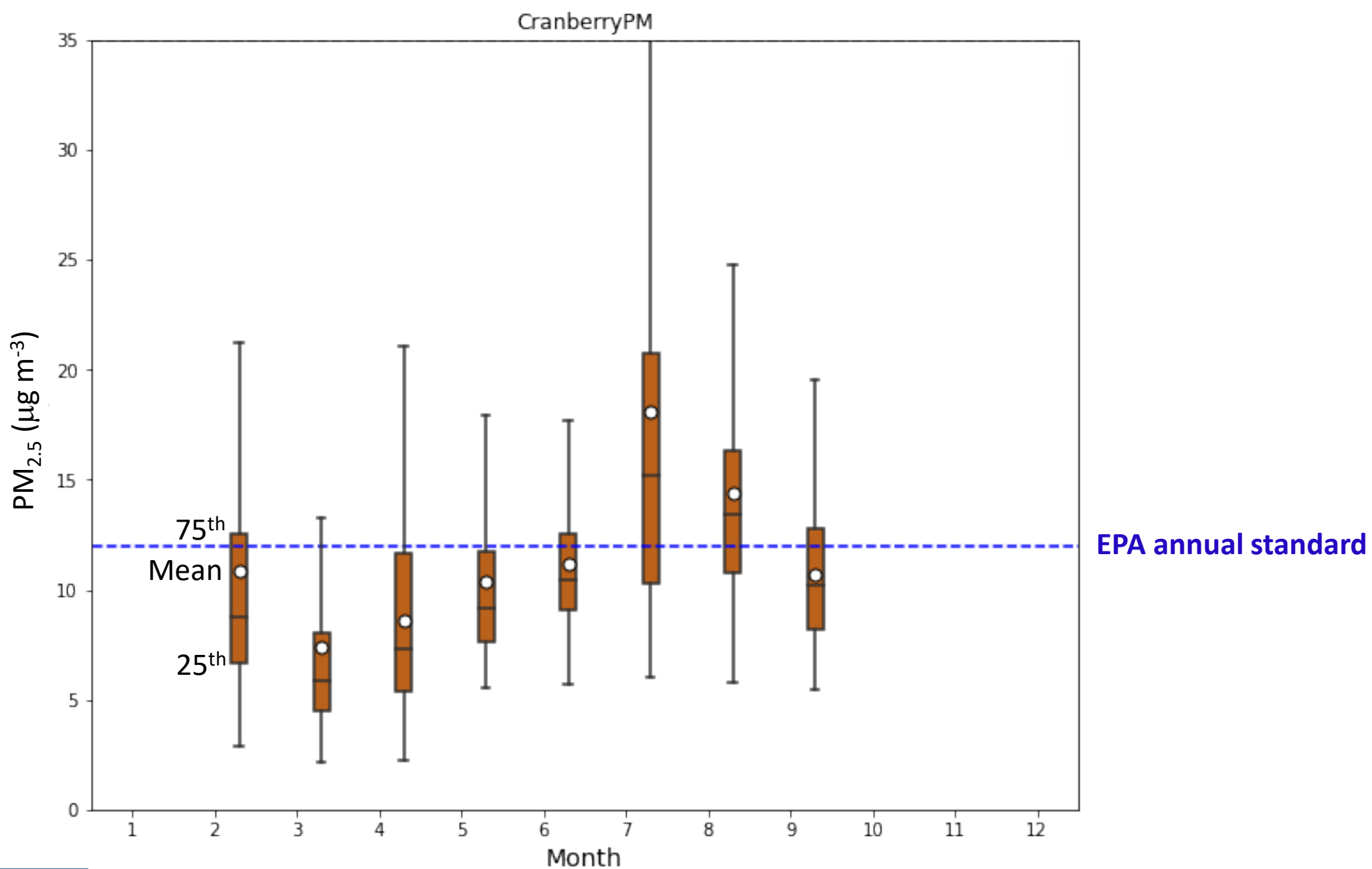
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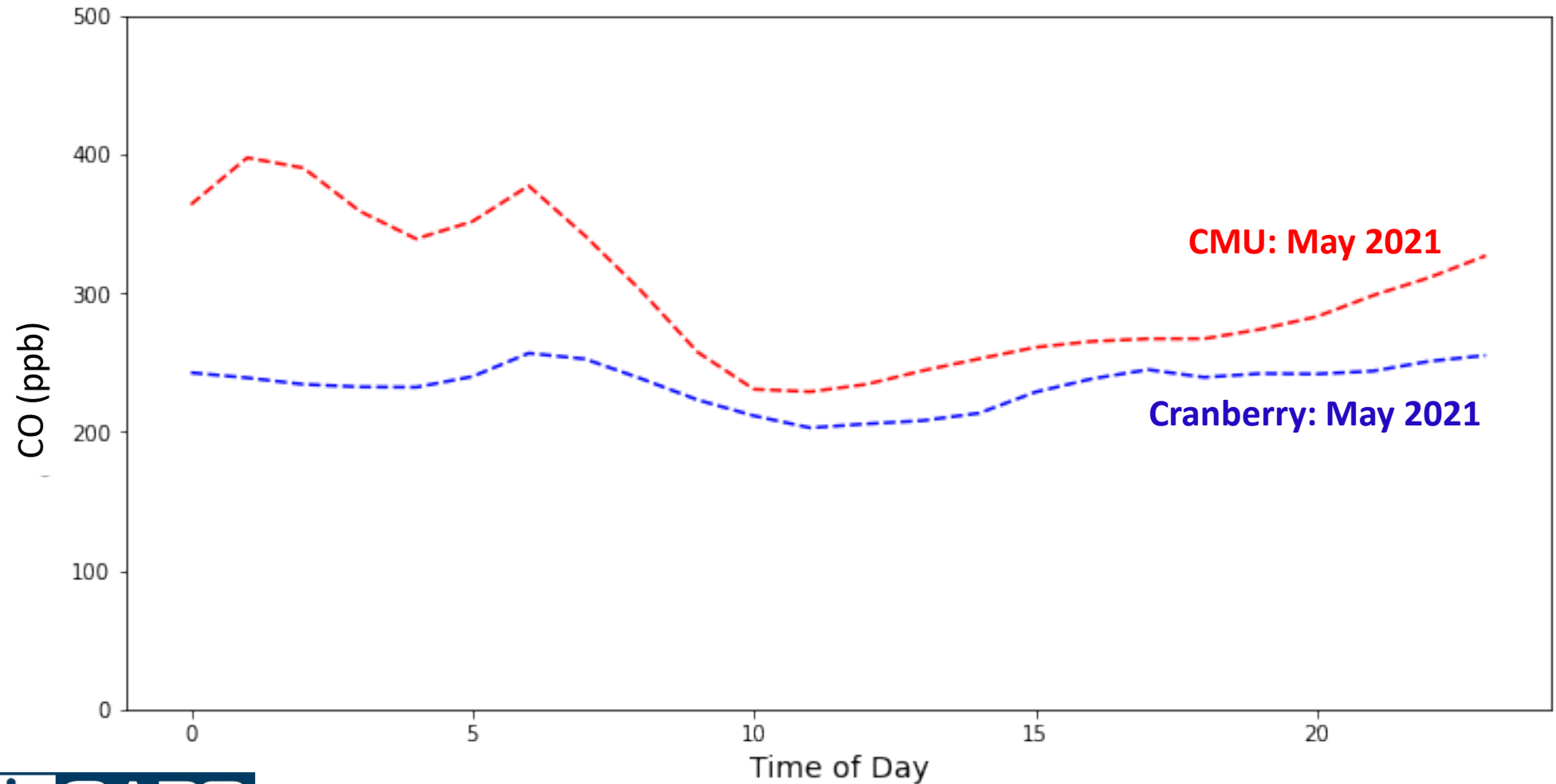
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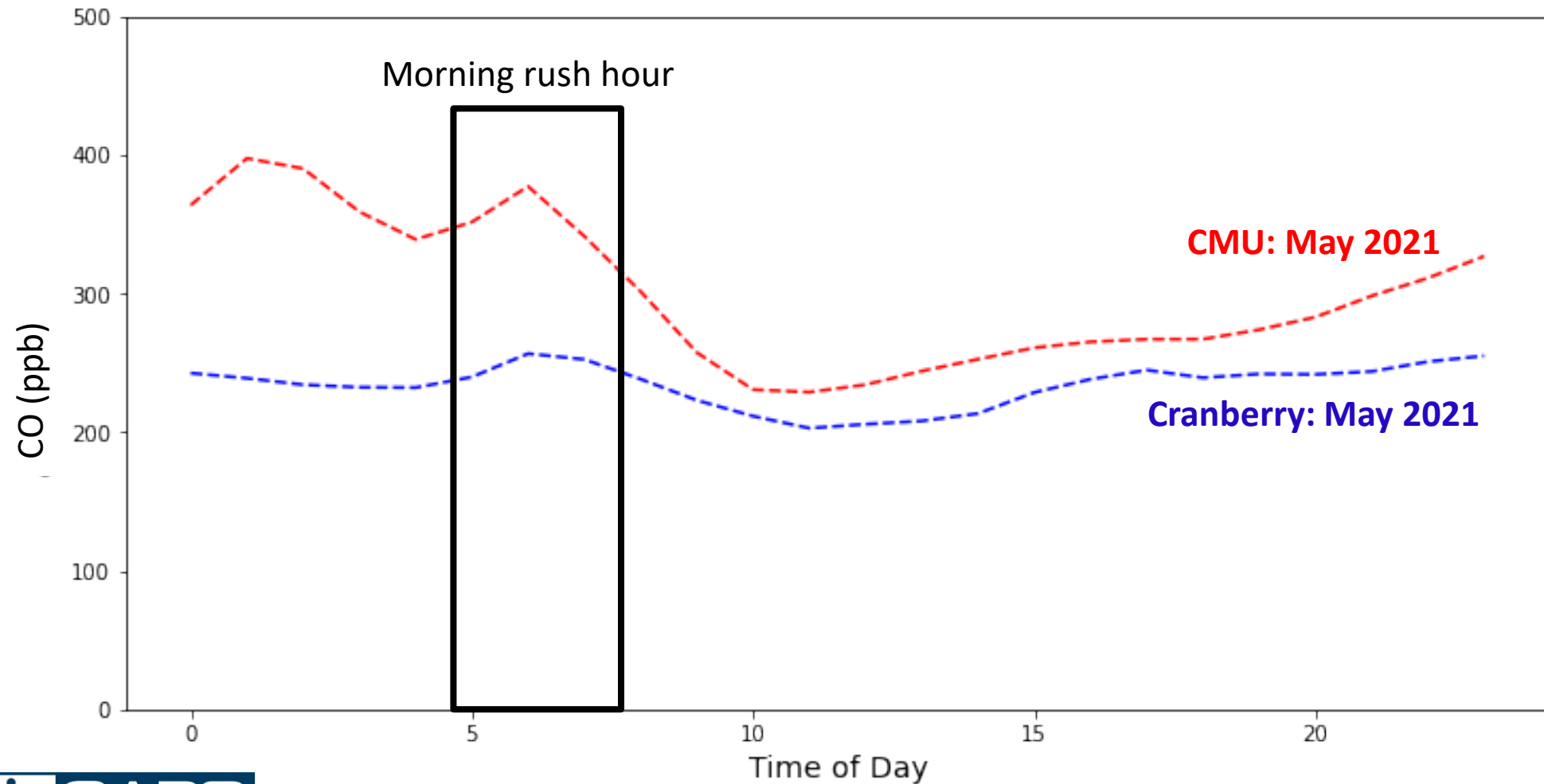




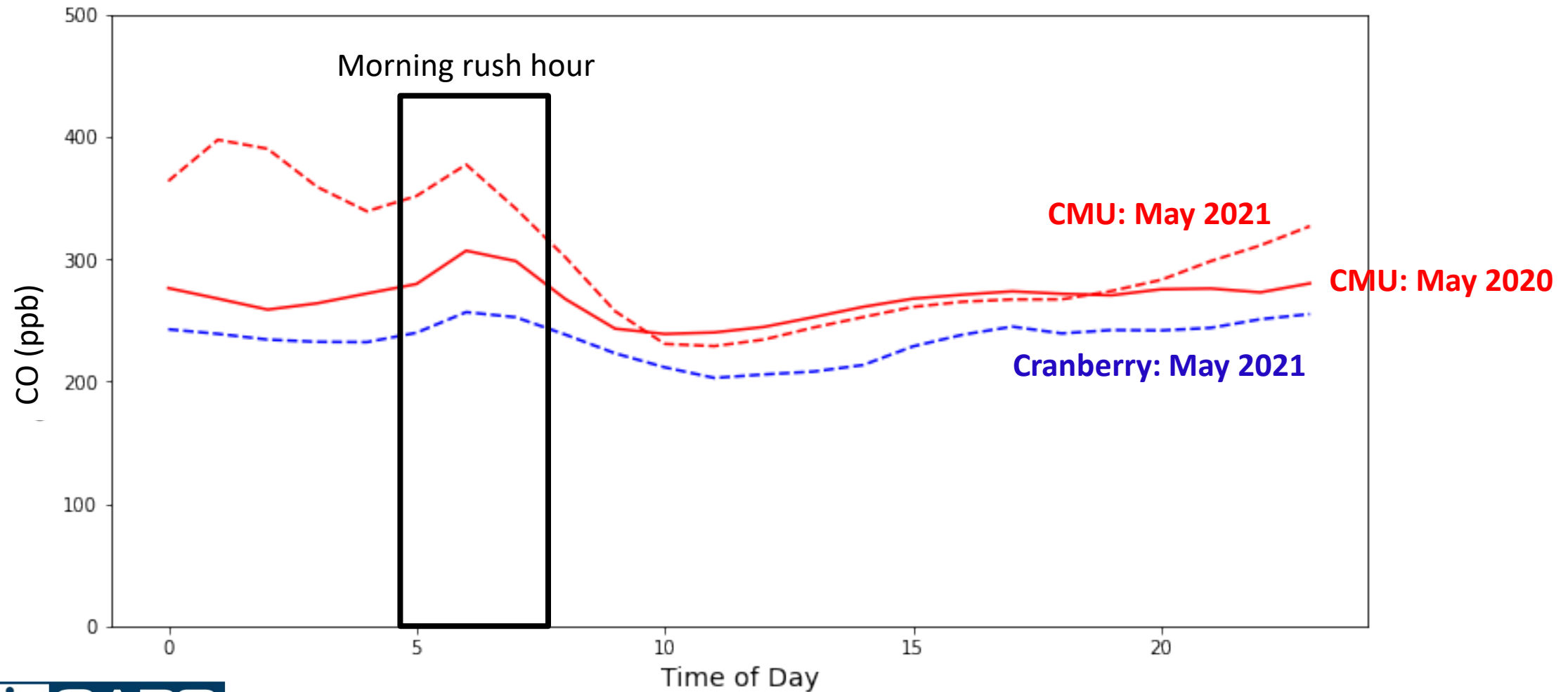
There is less traffic in Cranberry than Pittsburgh



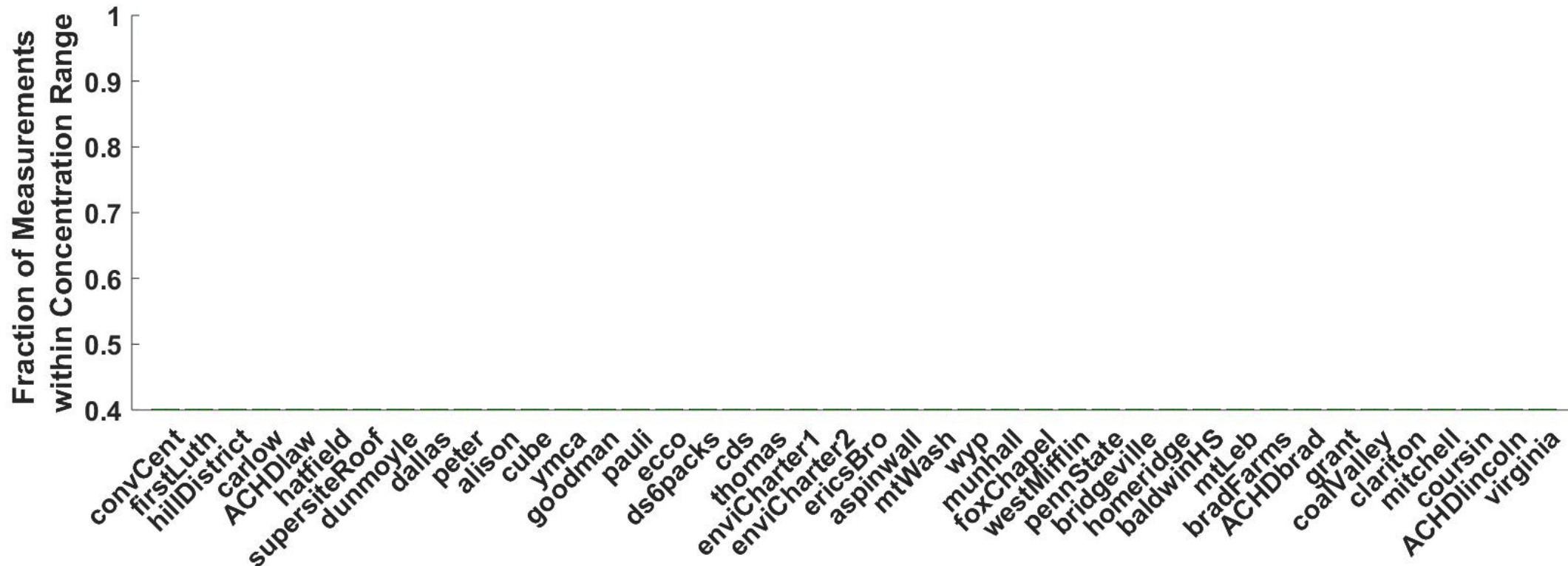
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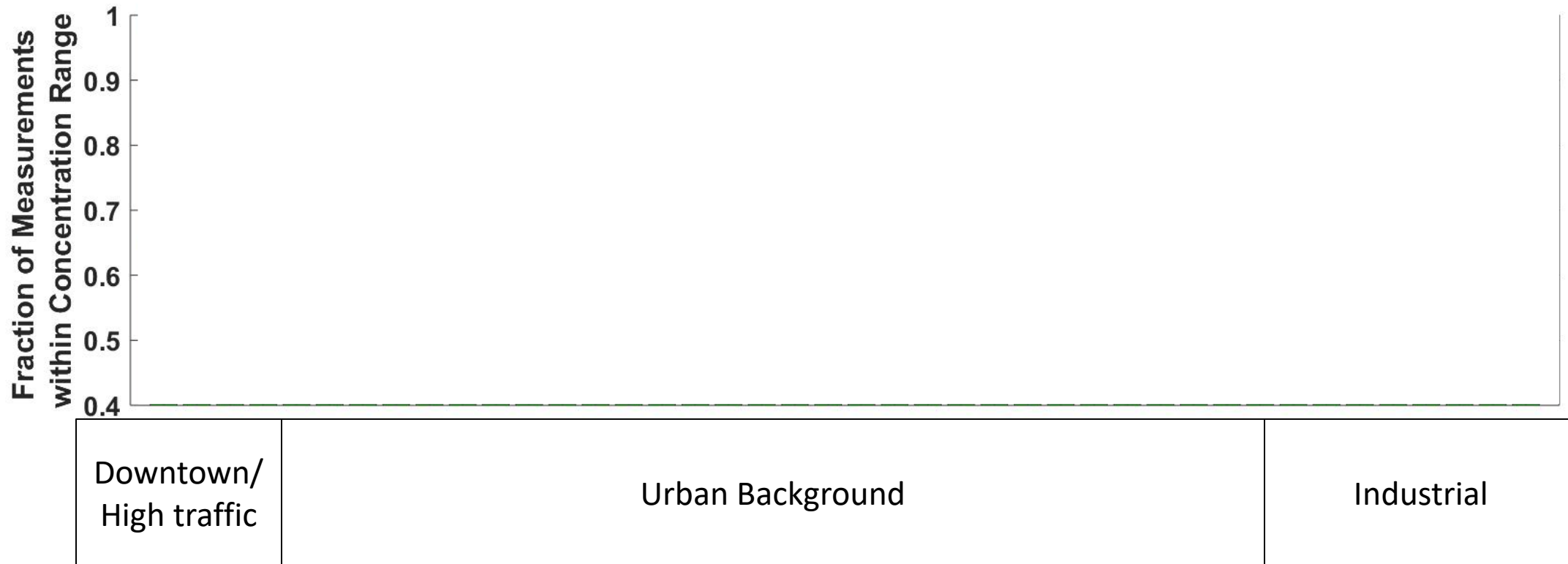
The data show the impacts of COVID shutdowns



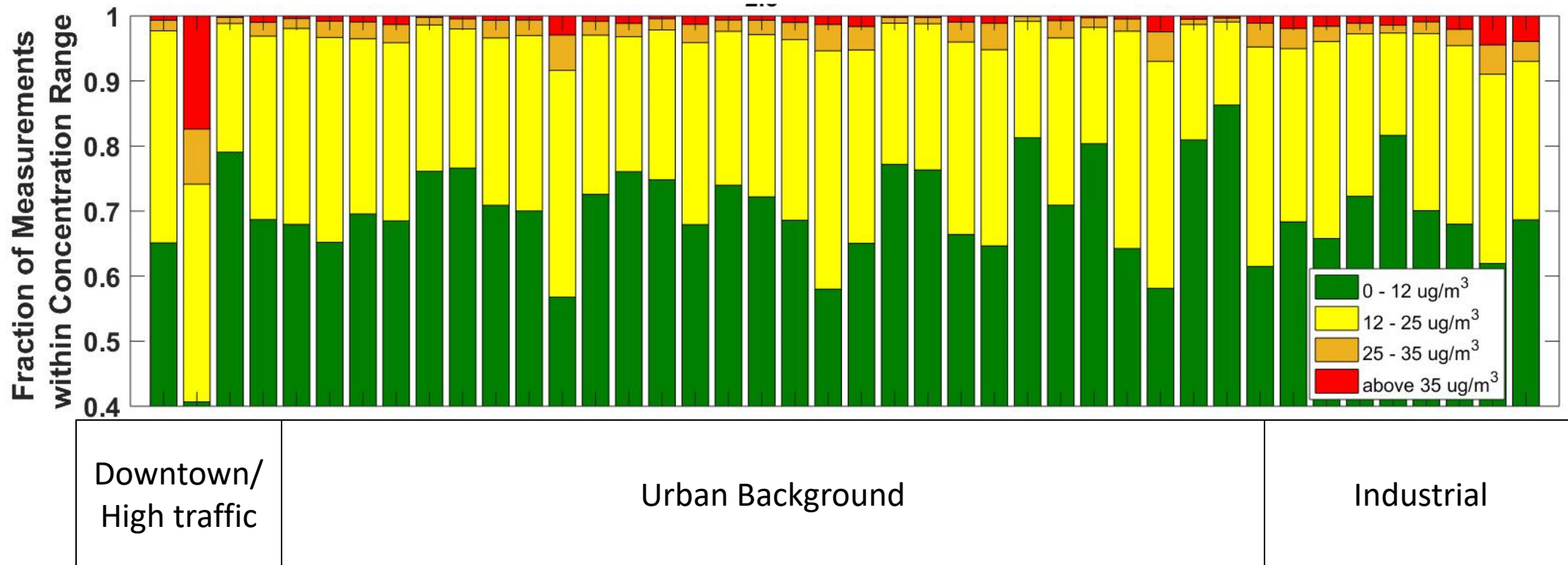
The low-cost sensor network lets us examine details of certain locations



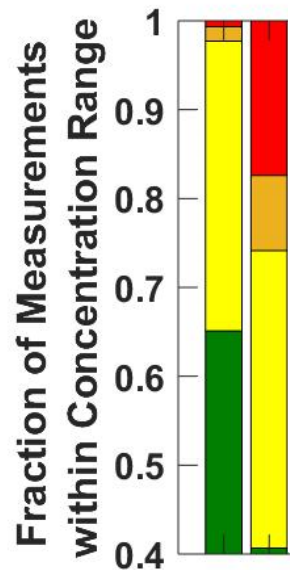
The low-cost sensor network lets us examine details of certain locations



The low-cost sensor network lets us examine details of certain locations



PM_{2.5} spatial variability is largely driven by emissions spikes



Downtown/
High traffic



Industrial

PM_{2.5} spatial variability is largely driven by emissions spikes



The fires are impacting air quality across North America

Western wildfire smoke is contributing to New York City's worst air quality in 15 years

By [Hollie Silverman](#), Michael Guy and [Joe Sutton](#), CNN

🕒 Updated 10:30 PM ET, Wed July 21, 2021

<https://www.cnn.com/2021/07/21/weather/us-western-wildfires-wednesday/index.html>

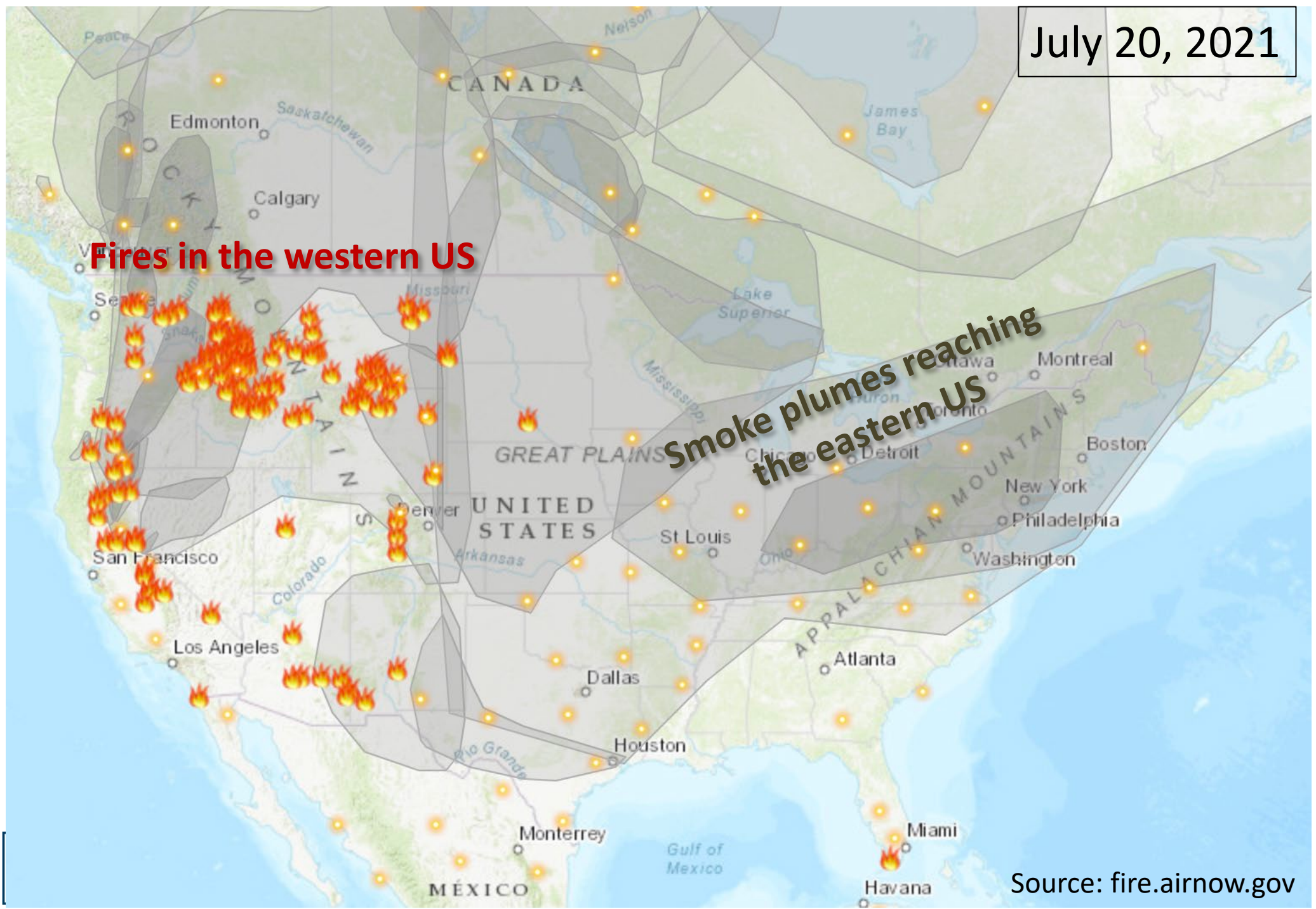


Carnegie Mellon University

July 20, 2021

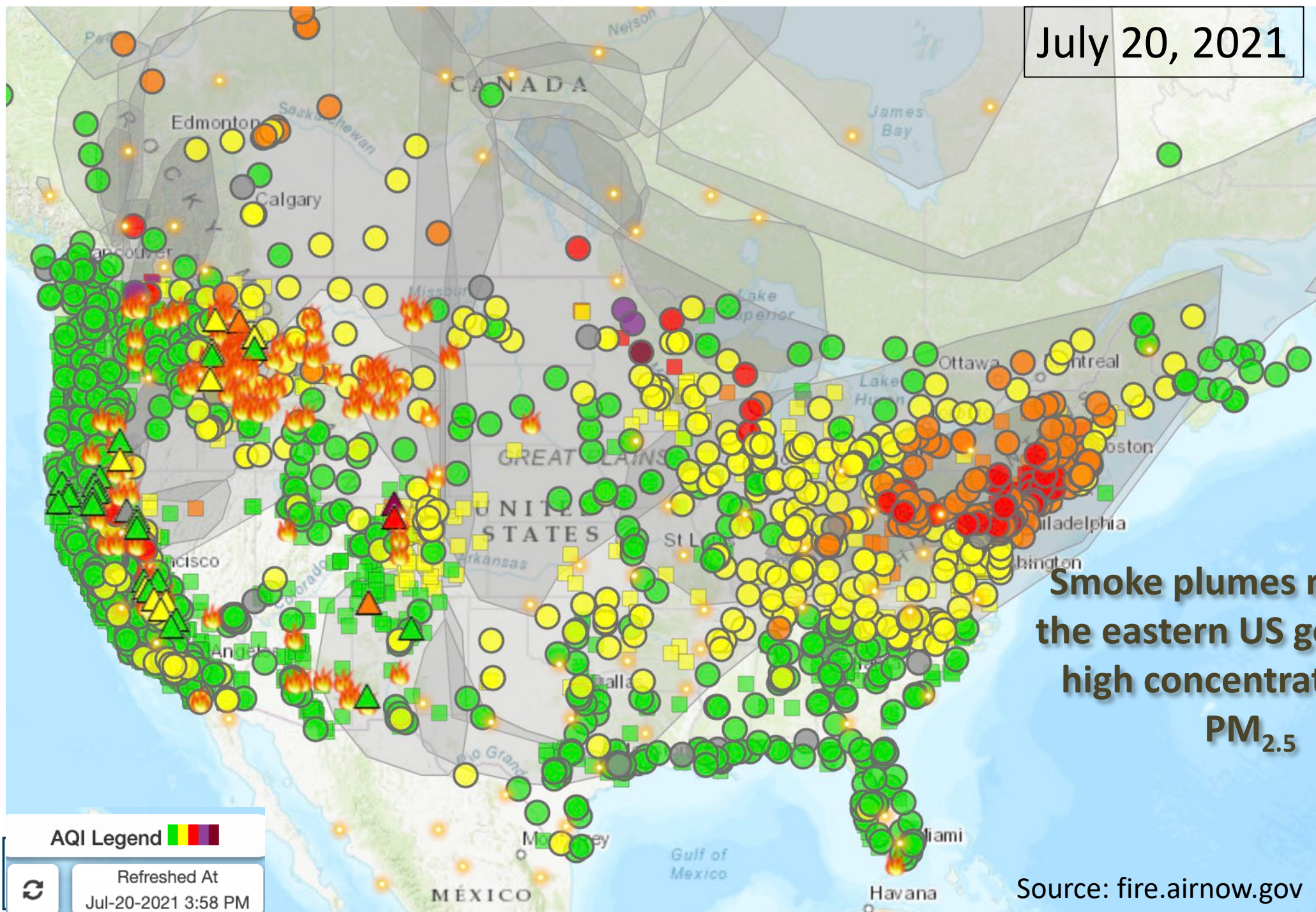
Fires in the western US

**Smoke plumes reaching
the eastern US**

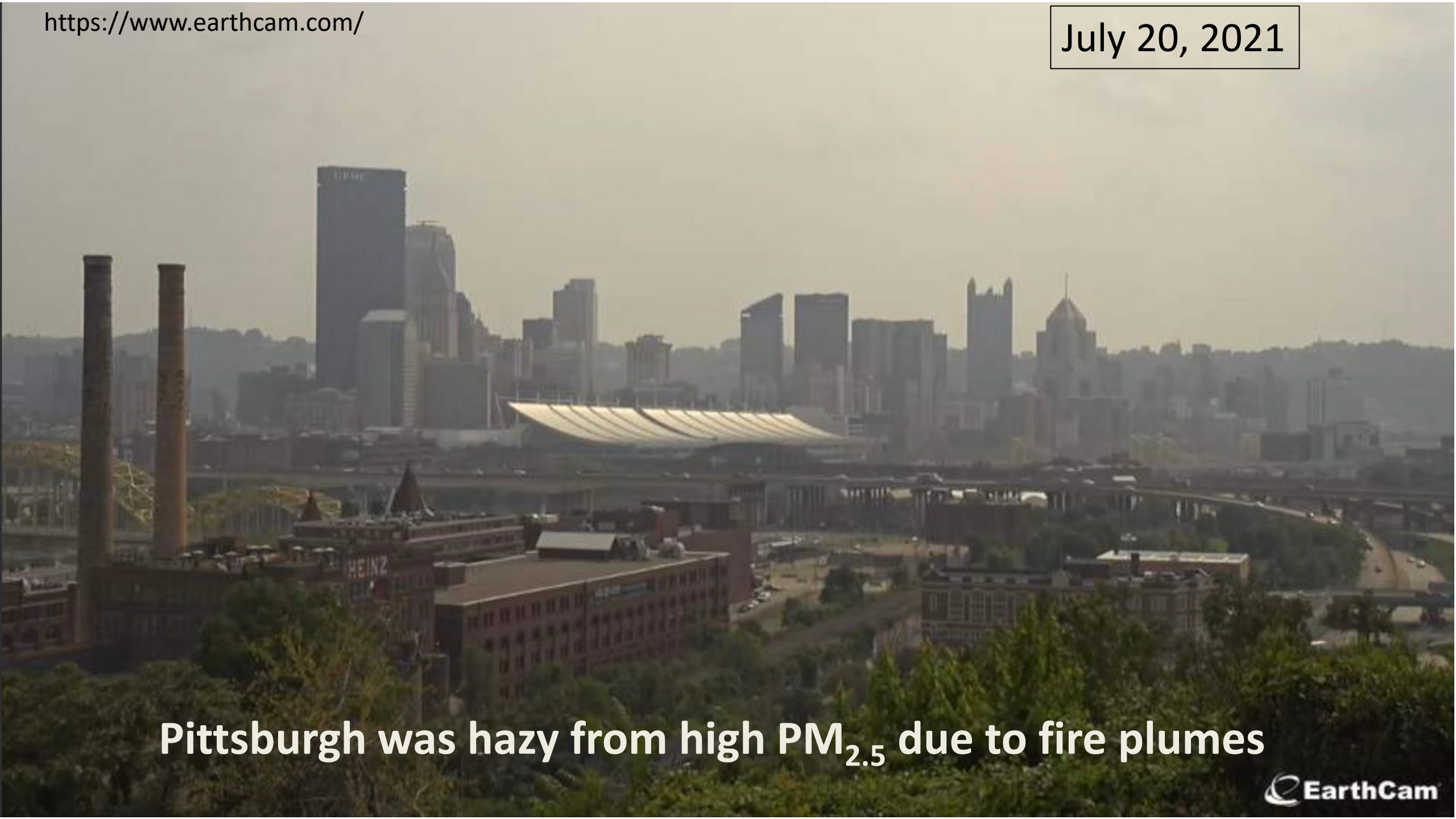


Source: fire.airnow.gov

July 20, 2021

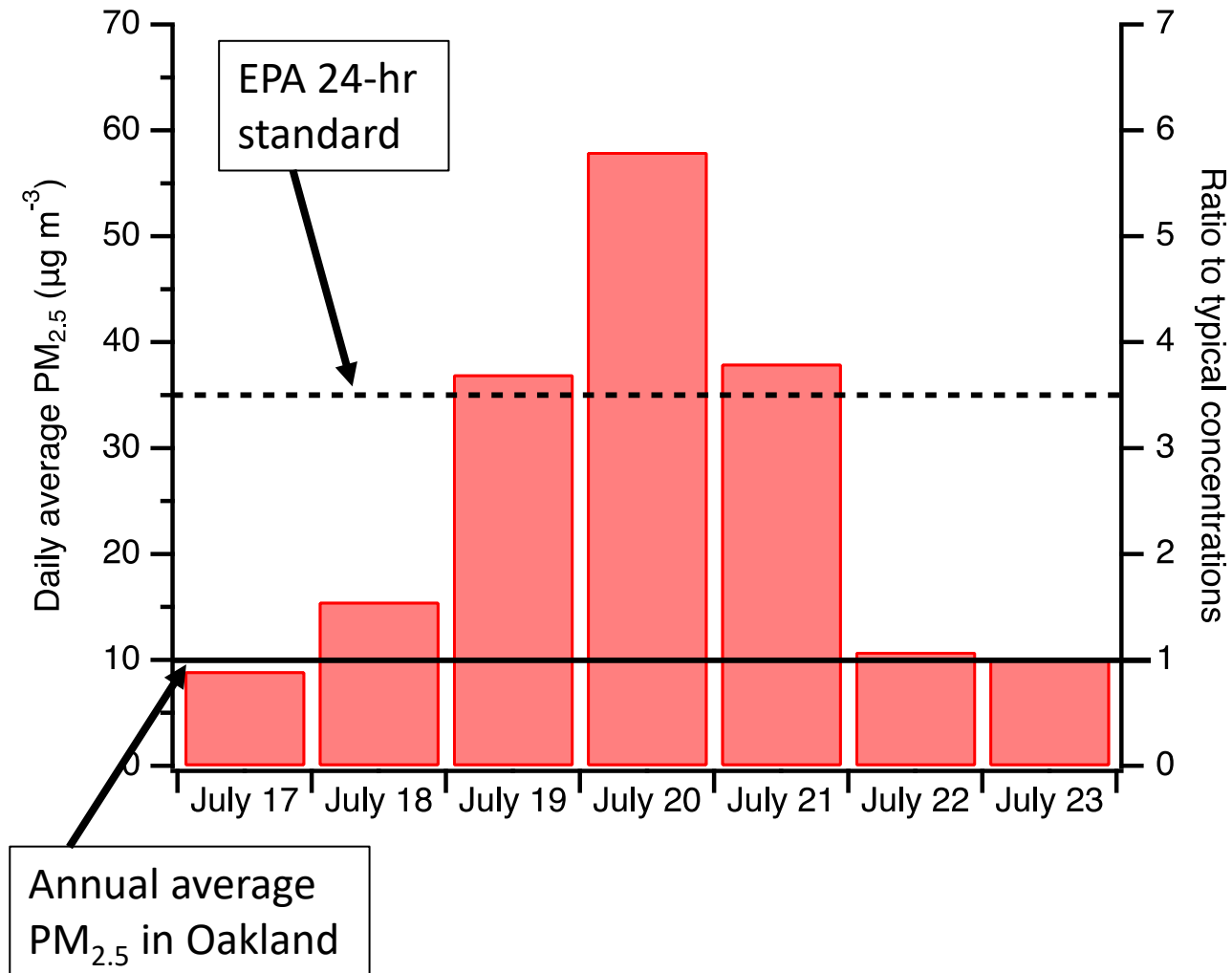


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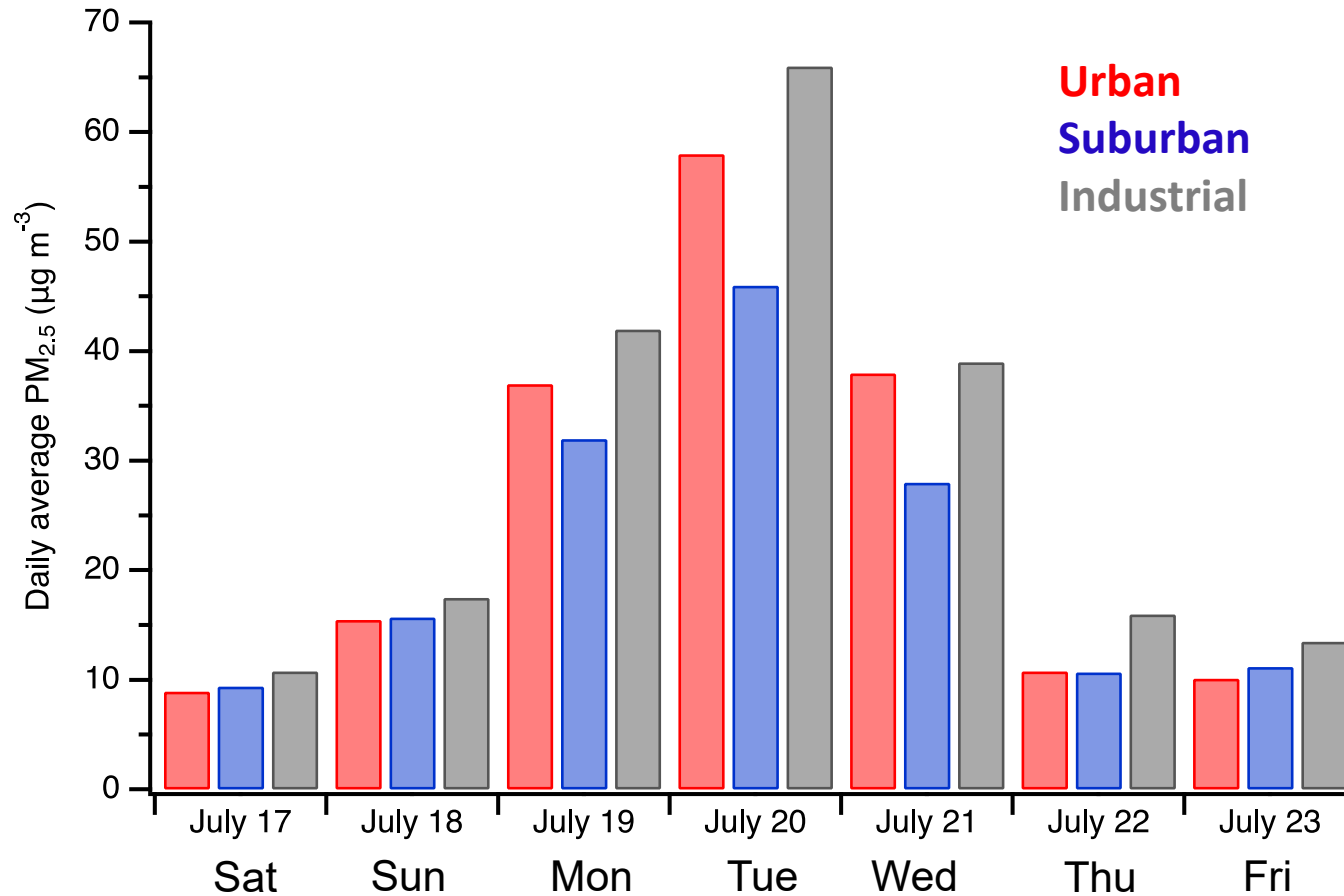


Pittsburgh was hazy from high $\text{PM}_{2.5}$ due to fire plumes

The sensor network also captured the impacts of wildfire smoke in Pittsburgh



We can compare multiple RAMPs to examine the interaction of fire smoke with local emissions



More information:





We publish RAMP reports

Greater Pittsburgh RAMP Network Report January 2022

(RAMPs data were missing between January 19-January 27 due to a server issue)



2022-01.pdf

Special RAMP Report: April 2021 Metalico Fire



2021-Metallico Fire.pdf

Special RAMP Report: Do fireworks cause air pollution?



2021-Fireworks.pdf

Special RAMP Report: Wildfire smoke pollution event, July 2021



2021-Fire smoke.pdf

Greater Pittsburgh RAMP Network Report December 2021



2021-12.pdf

Greater Pittsburgh RAMP Network Report November 2021



2021-11.pdf

Greater Pittsburgh RAMP Network Report October 2021



2021-10.pdf

Greater Pittsburgh RAMP Network Report September 2021



2021-09.pdf

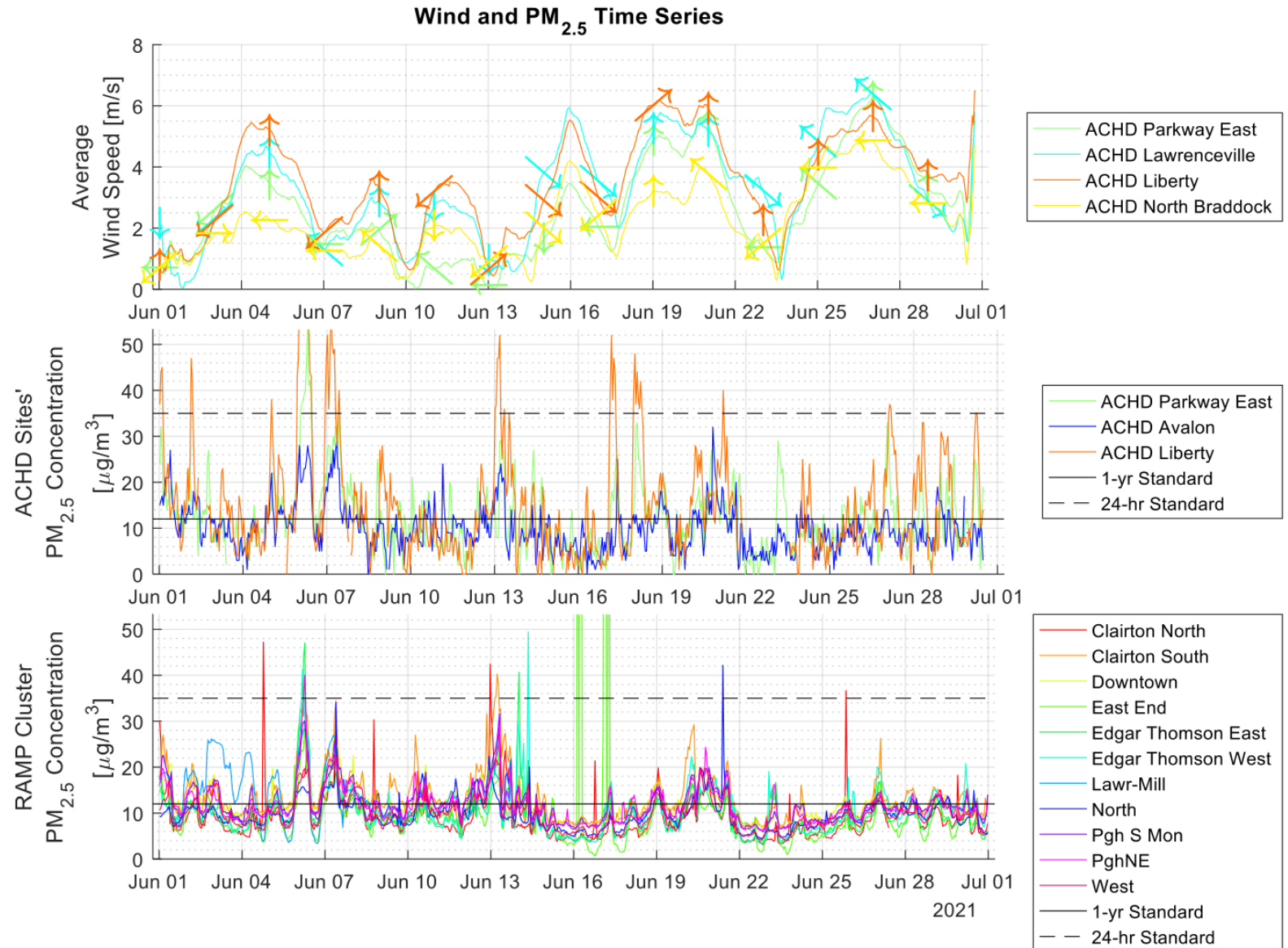


We publish monthly reports for the RAMP network

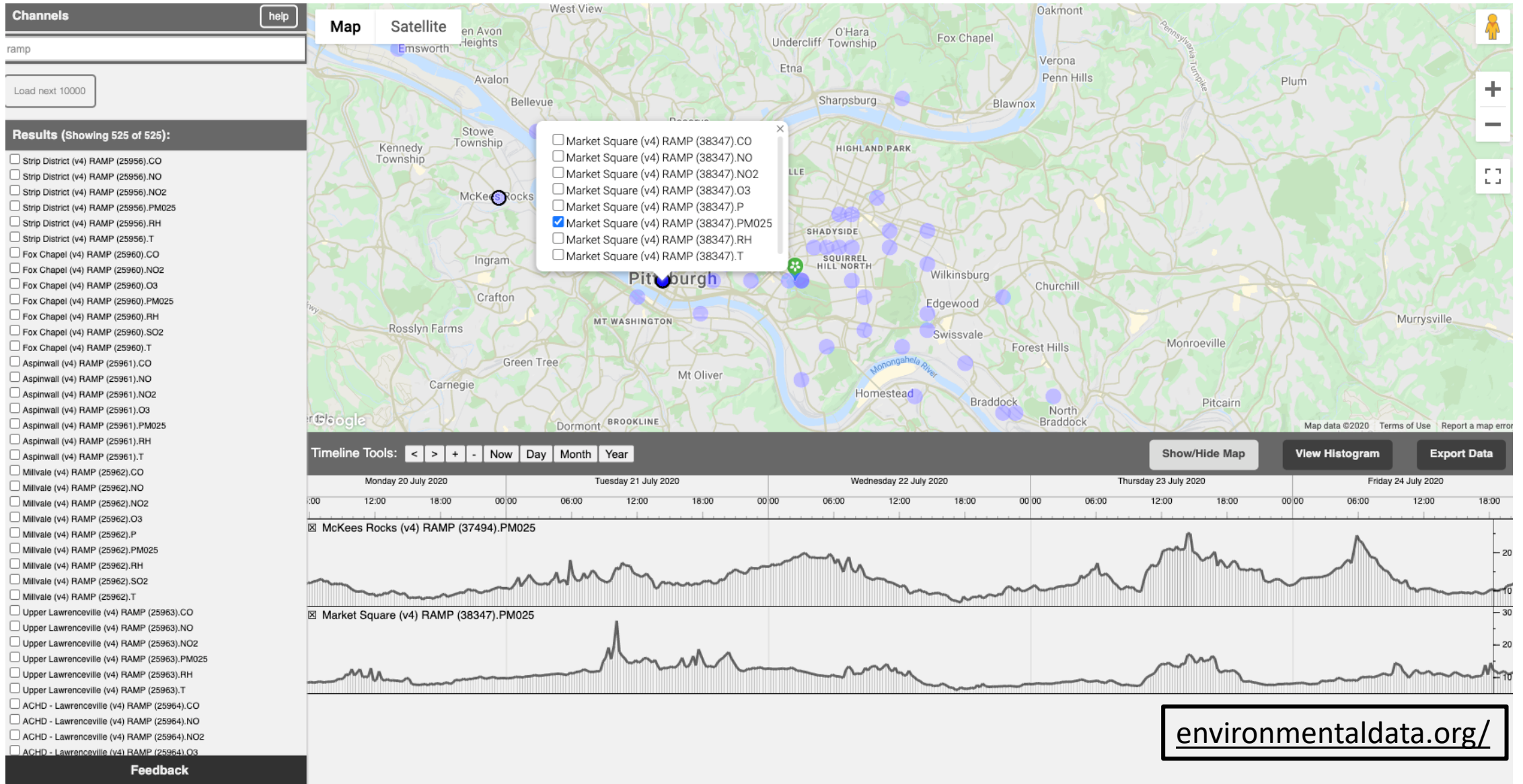
The top plot shows the 6-hour average wind speed in m/s as well as its bearing, normalized to eight cardinal directions.

The bottom two plots show $PM_{2.5}$ levels at ACHD stations (recorded hourly) and averaged across RAMP clusters. The horizontal lines represent annual and daily EPA limits on $PM_{2.5}$.

Maximum Hourly $PM_{2.5}$ Levels				
	Max. $\mu g/m^3$	Site	Time	Wind from
ACHD site	75	Liberty	Jun-06 4:30 AM	3.7 m/s SE
RAMP Cluster	232	East End	Jun-17 3:30 AM	1.8 m/s E



We also make data available in real time



Take home points

- We can use low-cost sensor networks to monitor local-scale variations in air pollution
- Partnering with local communities allows us to communicate air pollution data in a way that is relevant and actionable