

THE PROBLEM WITH AIR POLLUTION

Professor Shelly L. Miller






Effects on Public Health

Air pollution, a preventable risk







PM2.5 is the leading cause of poor health and premature death and there is no safe level









PREMATURE DEATHS YEAR 2010
GLOBALLY, AIR POLLUTION IS RESPONSIBLE FOR:


-  **3,500,000** From **indoor** PM2.5 pollution
-  **3,200,000** From **outdoor** PM2.5 pollution
-  **150,000** From **ozone** pollution

DISEASES DUE TO:

-  PM2.5 AIR POLLUTION
-  O₃

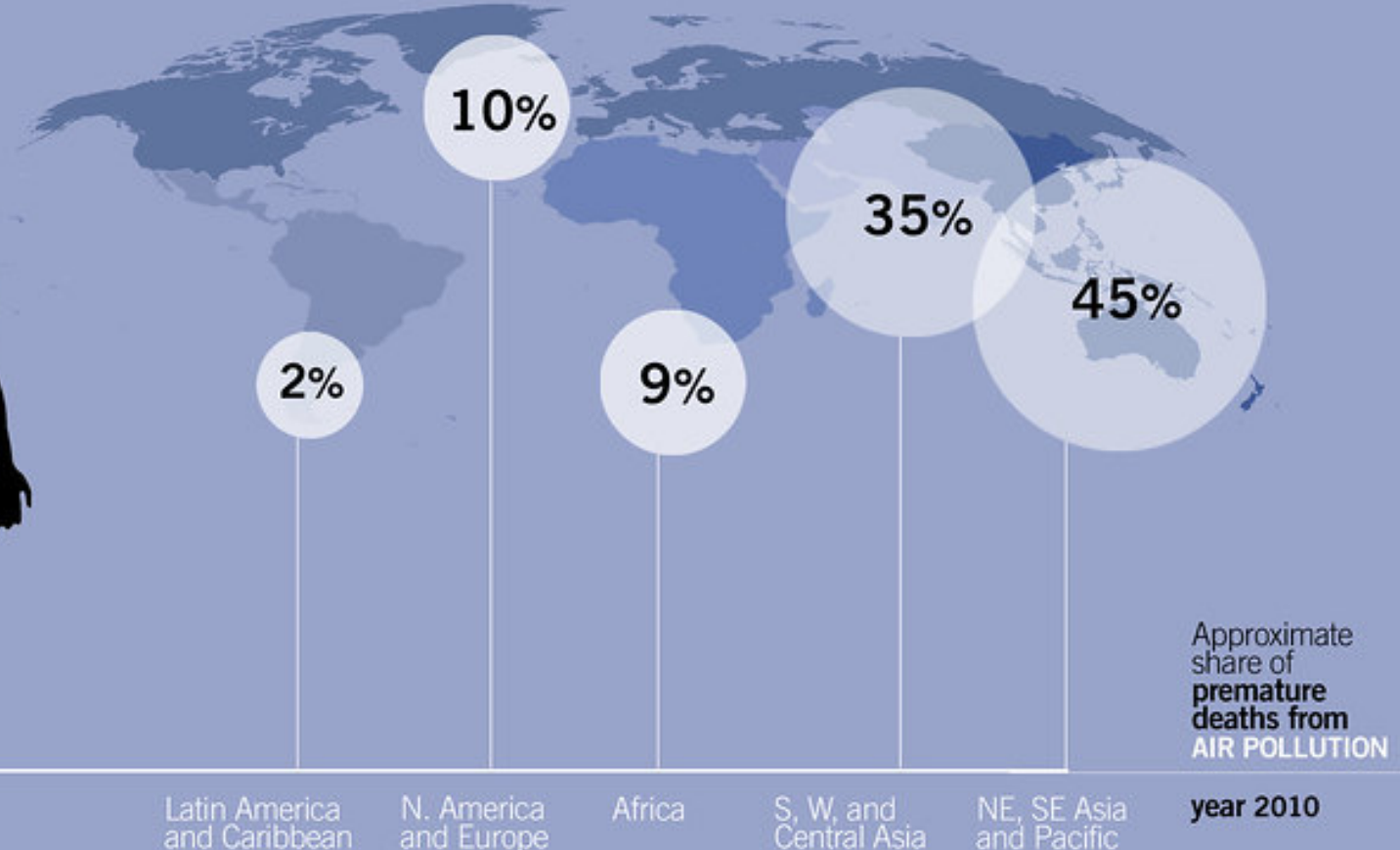
-    Heart attacks
-   Strokes, heart disease
-  Congestive heart failure

-   Lung cancer
-   Chronic bronchitis
-   Asthma
-  Emphysema
-  Scarred lung tissue

-   Low birth weight




Globally, **air pollution** is the **2nd leading risk factor** for the global burden of disease in 2010, behind high blood pressure, and together with **tobacco smoking**, including second hand smoke.



Approximate share of premature deaths from AIR POLLUTION

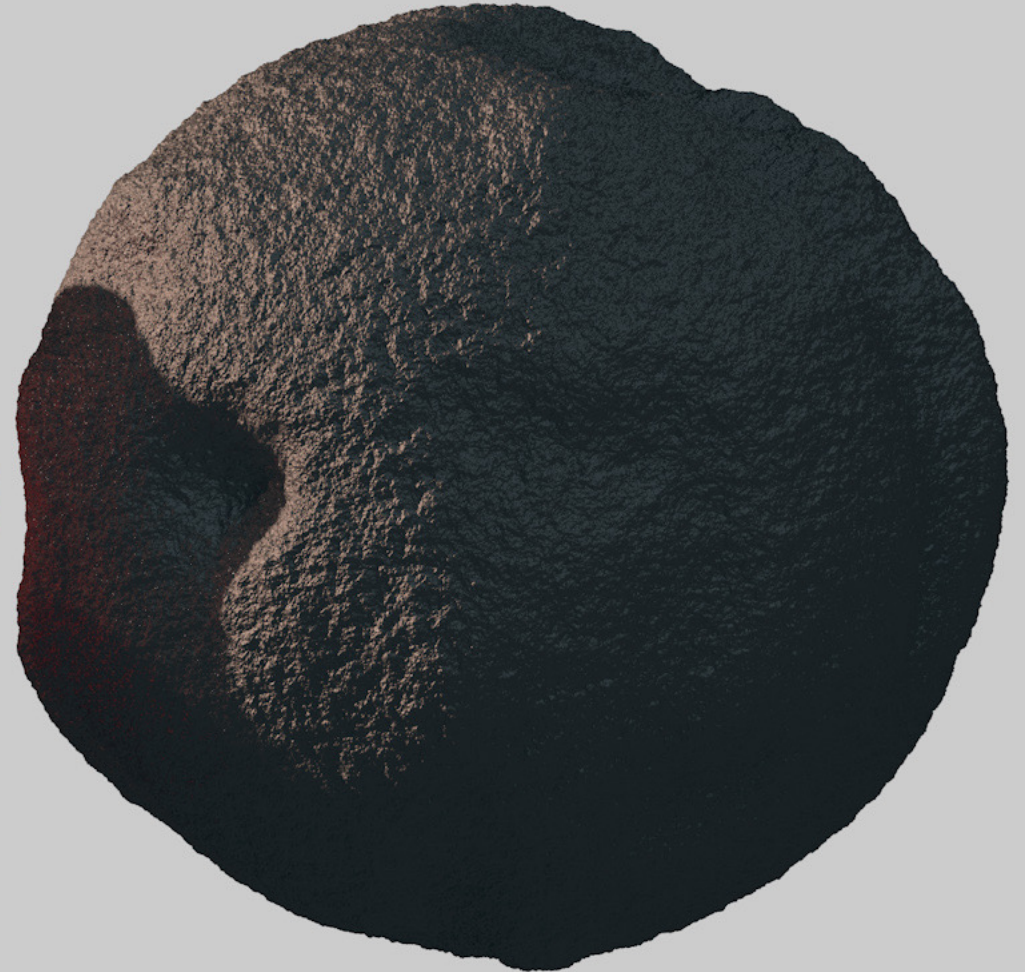
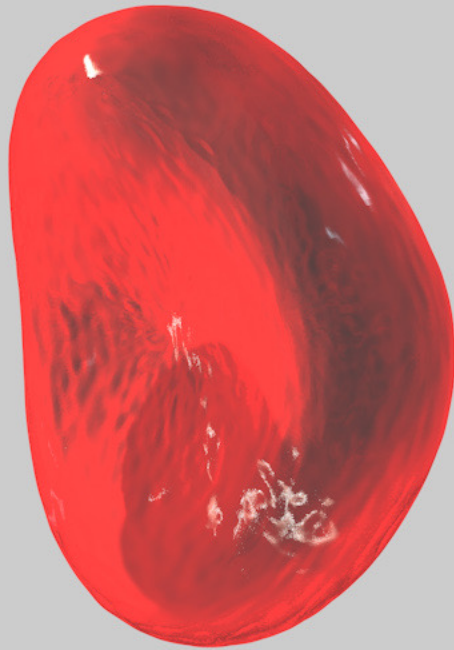
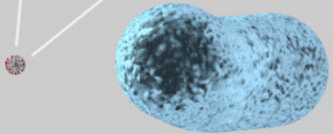
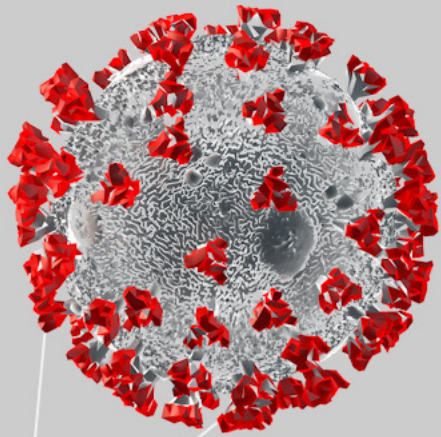
year 2010



Denver became known for its problematic air more than a century ago

The Denver Times reported in 1889 that “disease had started to spread to the entire population” and “bad air was hurting the city’s reputation.”

#SEETHEAIR



SARS-CoV-2
(COVID-19)

BACTERIA

PM2.5

RED BLOOD CELL

PM10

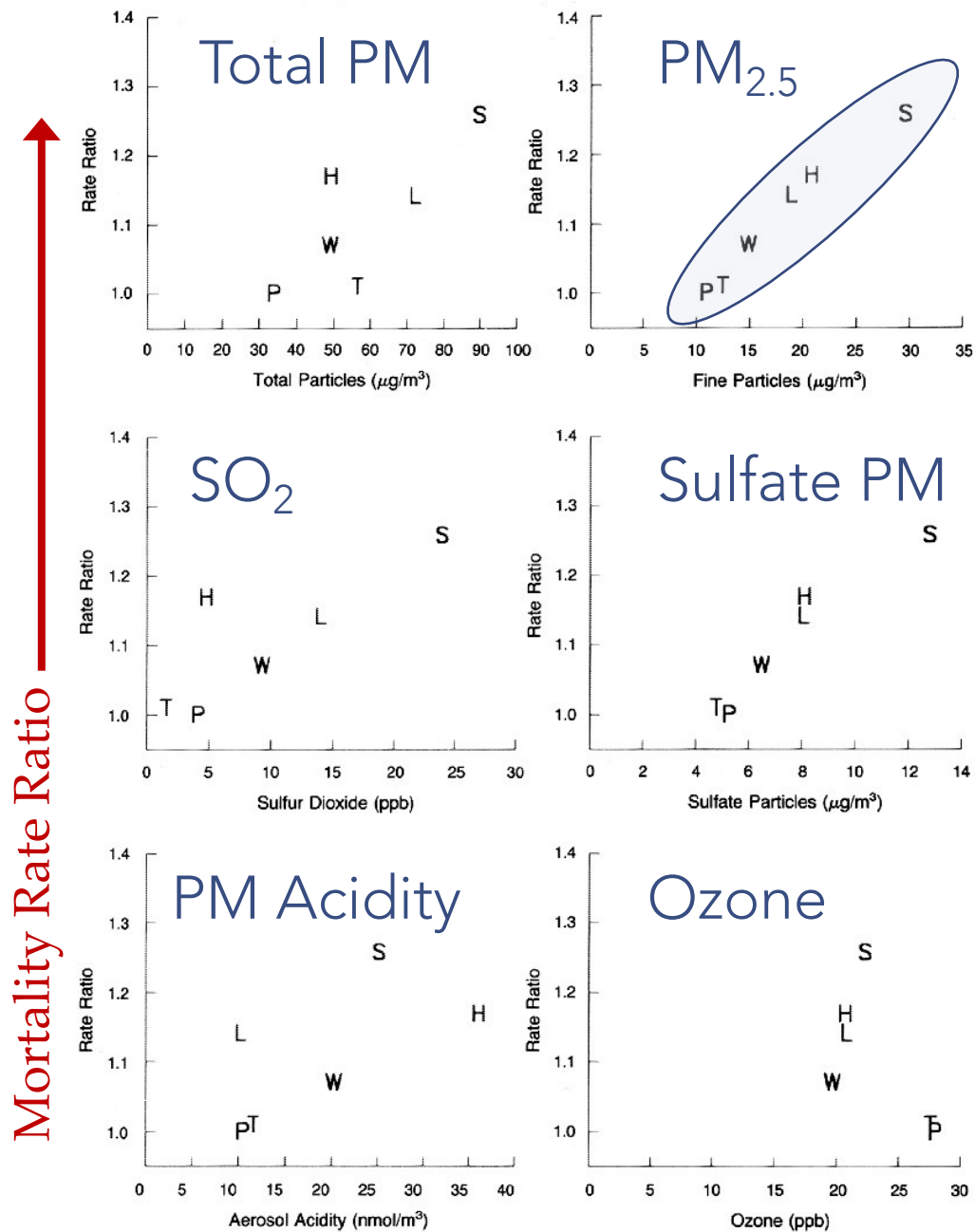
60–140nm

~1 μ m

<2.5 μ m

~7 μ m

≤10 μ m



Portage, WI
Topeka, KS
Watertown, MS
St. **L**ouis, MS
Harriman, TN
Steubenville, OH

Annual Average Air Pollution Level

HEALTH EFFECTS OF AIR POLLUTION

SHORT TERM EFFECTS

24-h PM_{2.5}
EPA Std
35 $\mu\text{g}/\text{m}^3$

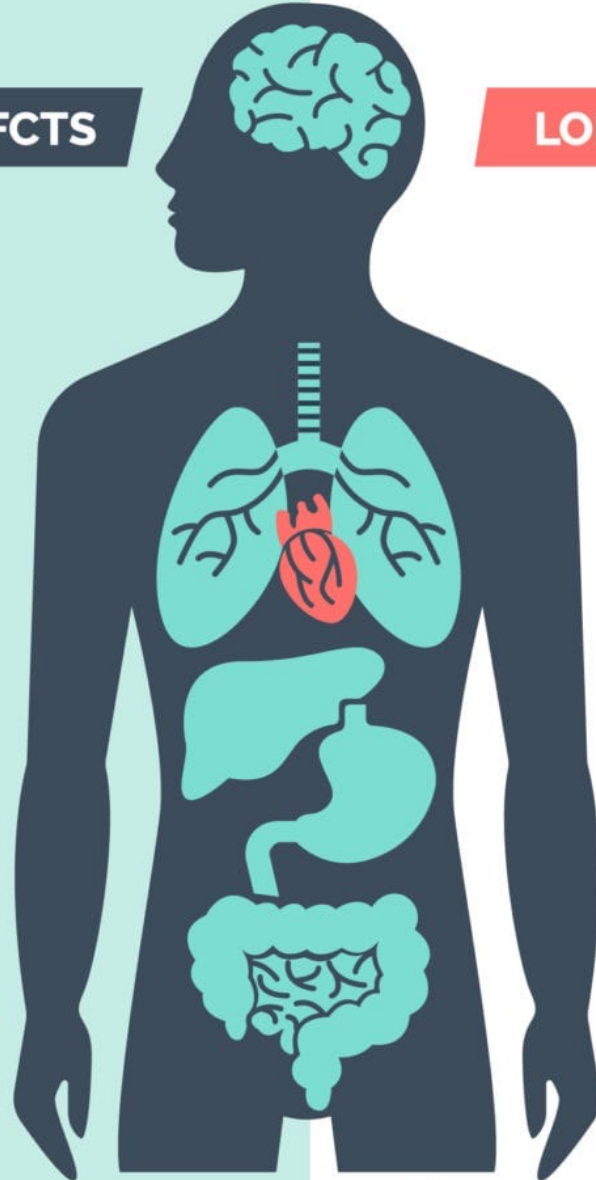
- HEADACHE
- ICE INFLAMATION
- COUGHING
- PAINFUL
- PNEUMONIA
- BREATHING
- BRONCHITIS
- SKIN IRRITATION



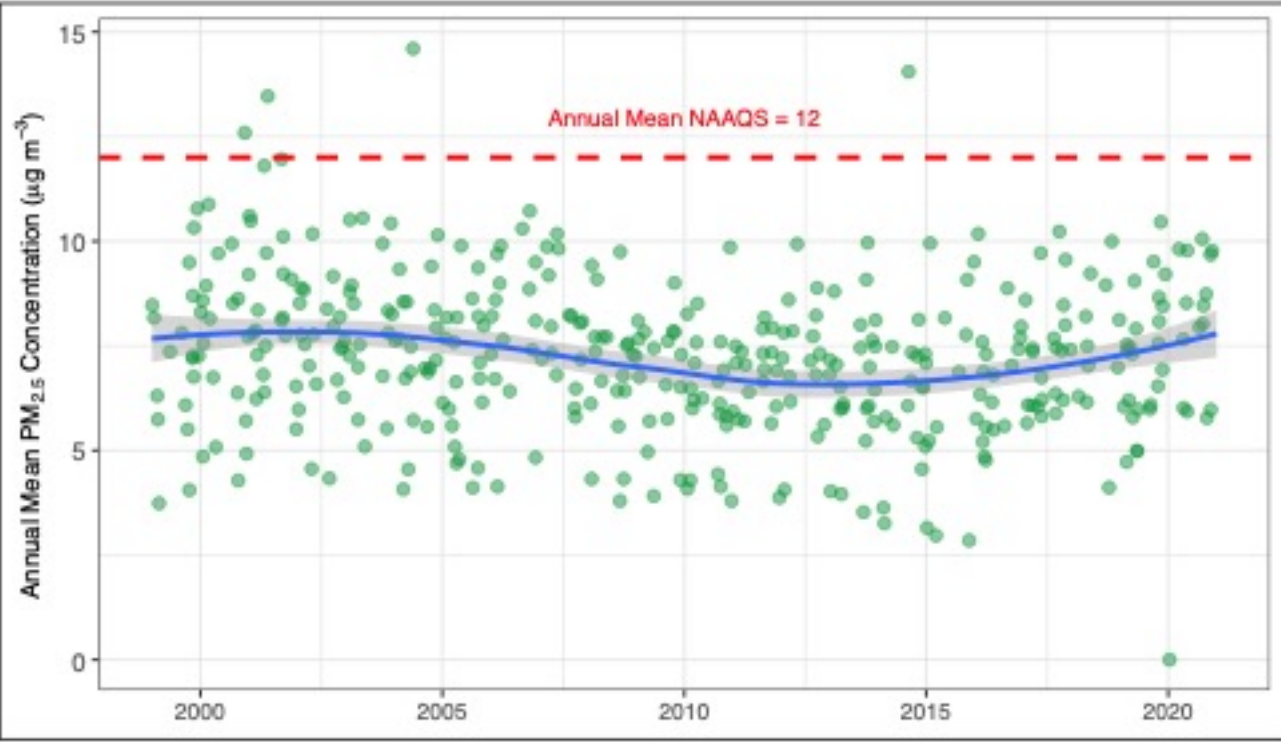
LONG TERM EFFECTS

Annual PM_{2.5}
EPA Std
12 $\mu\text{g}/\text{m}^3$

- AFFECTS CENTRAL NERVOUS SYSTEM
- CARDIOVASCULAR DISEASES
- RESPIRATORY DISEASES
- IMPACTS ON LIVER
- IMPACTS ON REPRODUCTIVE SYSTEM



COLORADO PM2.5



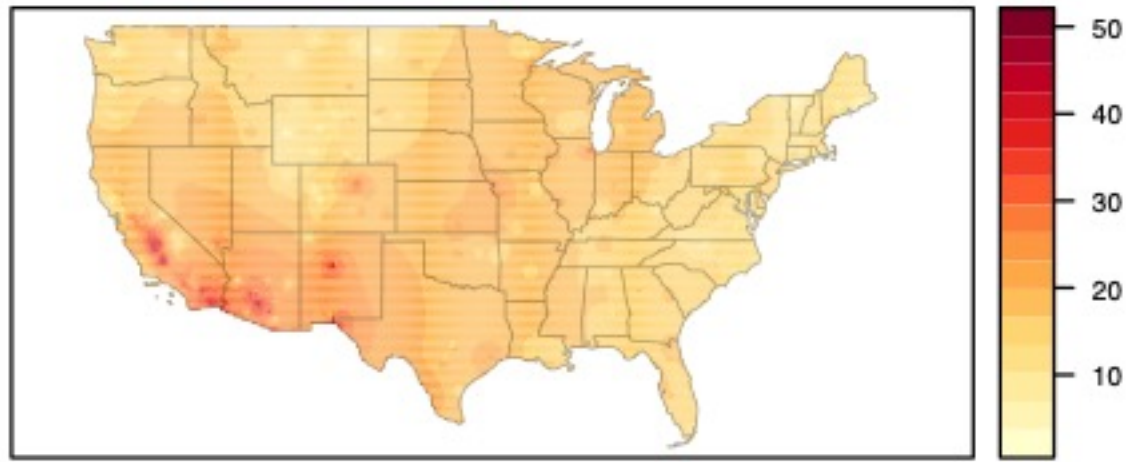
Long-term Annual Concentrations

Table 2.11: Historical maximum 24-hour PM₁₀ concentrations in Colorado

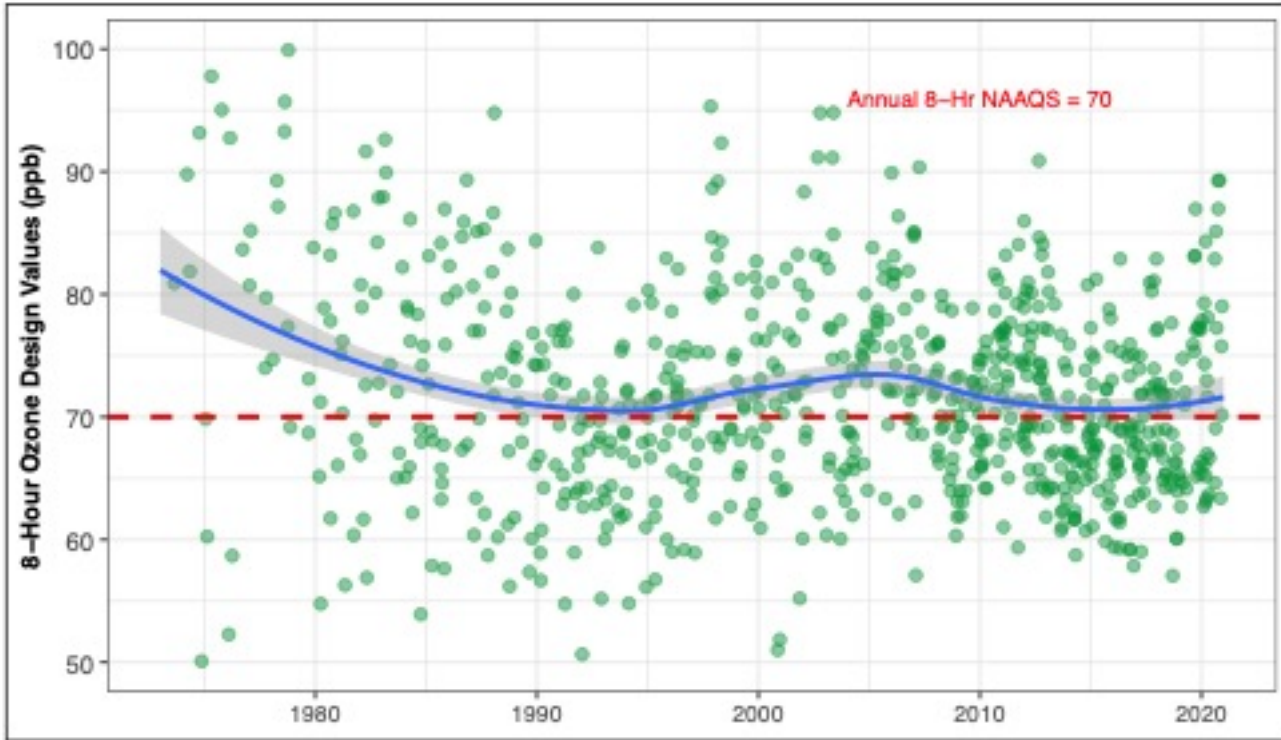
Site	Max 24-Hour PM ₁₀ (µg m ⁻³)	Year
Lamar	1,220	2013
Alamosa	635	2011
Denver	532	1985
Alamosa	494	2007
Montrose	491	1999
2021 Maximum		
Lamar	680	2021

Short-term Daily Concentrations

Median 24-Hour PM₁₀ (µg m⁻³)



COLORADO OZONE

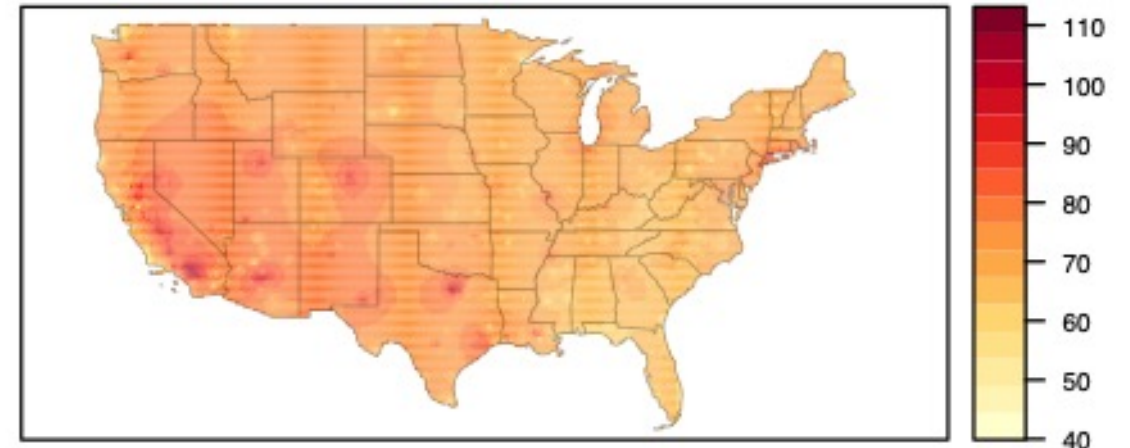


Long-term Annual Concentrations

Table 2.7: Historical maximum eight-hour O₃ concentrations in Colorado

Site	Max 8-Hour O ₃ (ppb)	Year
CAMP	310	1972
CAMP	264	1973
Arvada	198	1973
Denver	194	1973
Welby	156	1974
2021 Maximum		
Chatfield State Park	96	2021

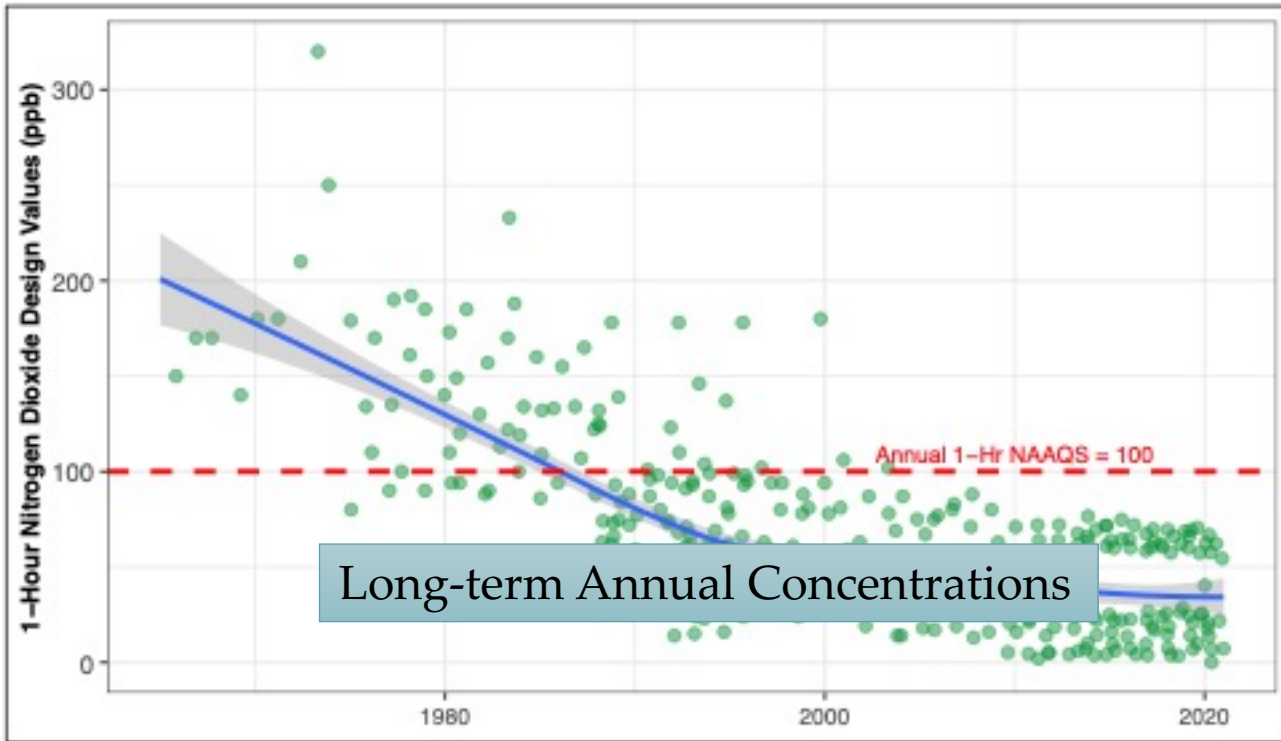
Short-term Daily Concentrations



DENVER NO₂

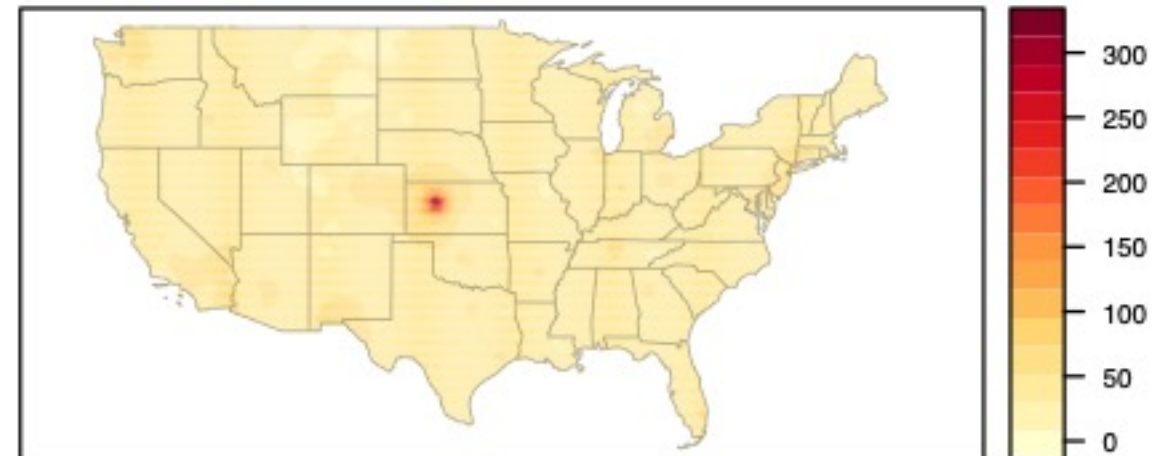
Table 2.10: National (left) and statewide (right) rankings of NO₂ monitors by maximum one-hour concentration in 2021

Nationwide (445 Monitors)					Colorado (seven Monitors)			
Rank	City	State	NO ₂ (ppb)	Exceedances	Rank	Site	NO ₂ (ppb)	Exceedances
1	Cedar Bluff S.P.	KS	315	2	8	I-25 Globeville	81	0
2	Fort Lauderdale	FL	95	0	15	CAMP	77	0
3	El Paso	TX	92	0	19	Welby	75	0
4	Long Beach	CA	92	0	22	I-25 Denver	75	0
5	Elizabeth	NJ	84	0	29	La Casa	72	0



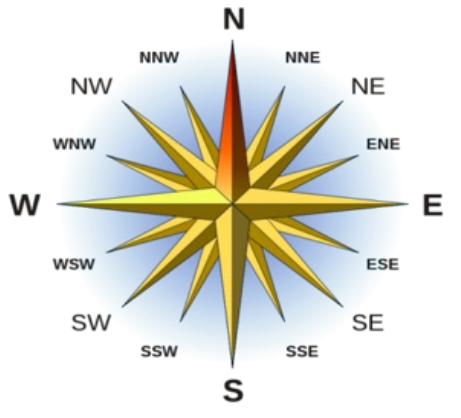
Short-term Daily Concentrations

Maximum One-Hour NO₂ (ppb)





Industrial Odors



Cherokee Generating Station
(Coal-fired power plant)

Metro Wastewater Reclamation

Koppers Industries (Wood Treatment)



Altogether Recycling

Darling International
(Rendering Facility)

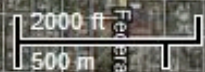
Owens Corning (Roofing Plant)

Owens Corning (Asphalt Plant)

National Western
(Stock Show)

Globeville

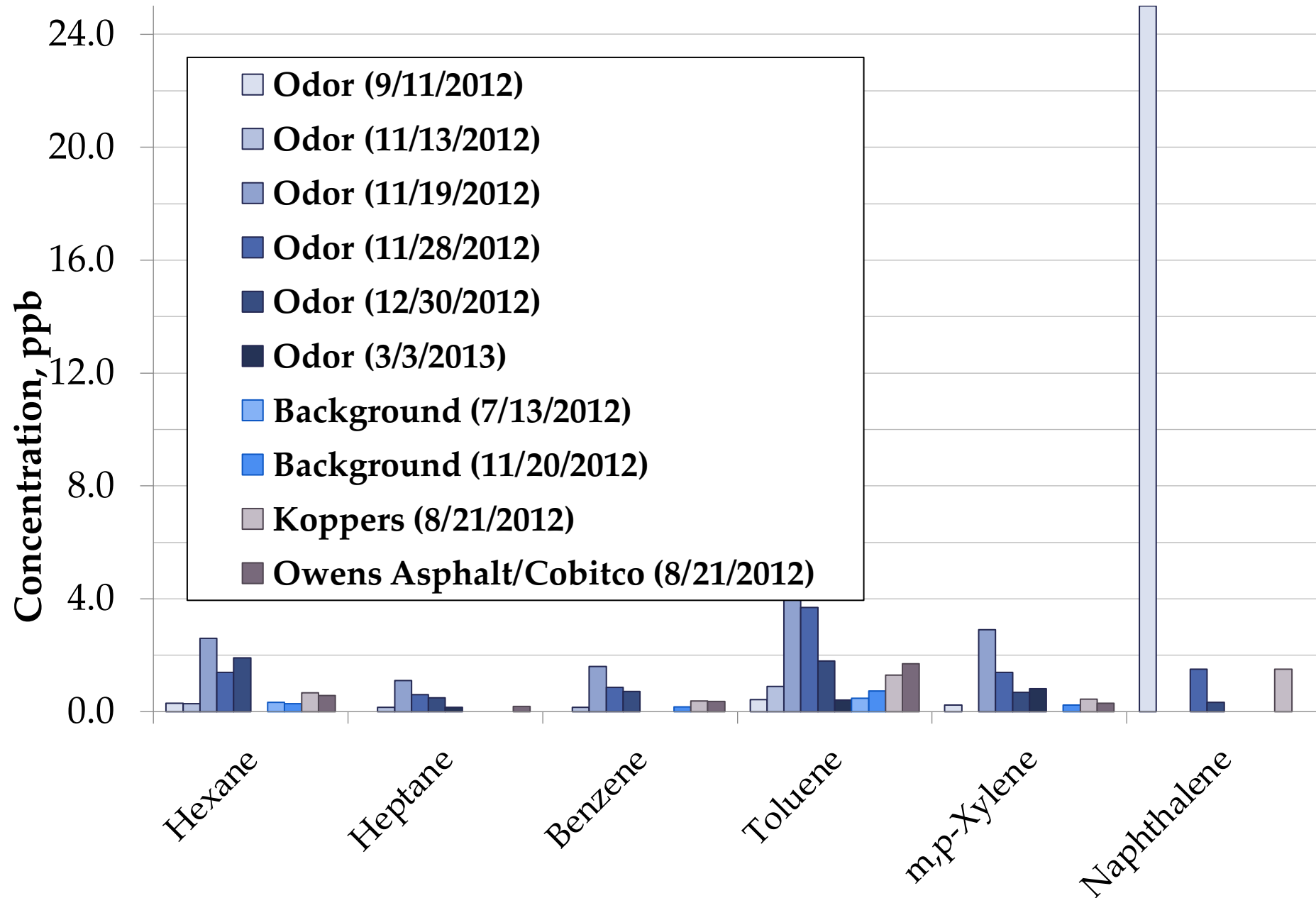
Nestle Purina Pet Care (Pet Food Production)



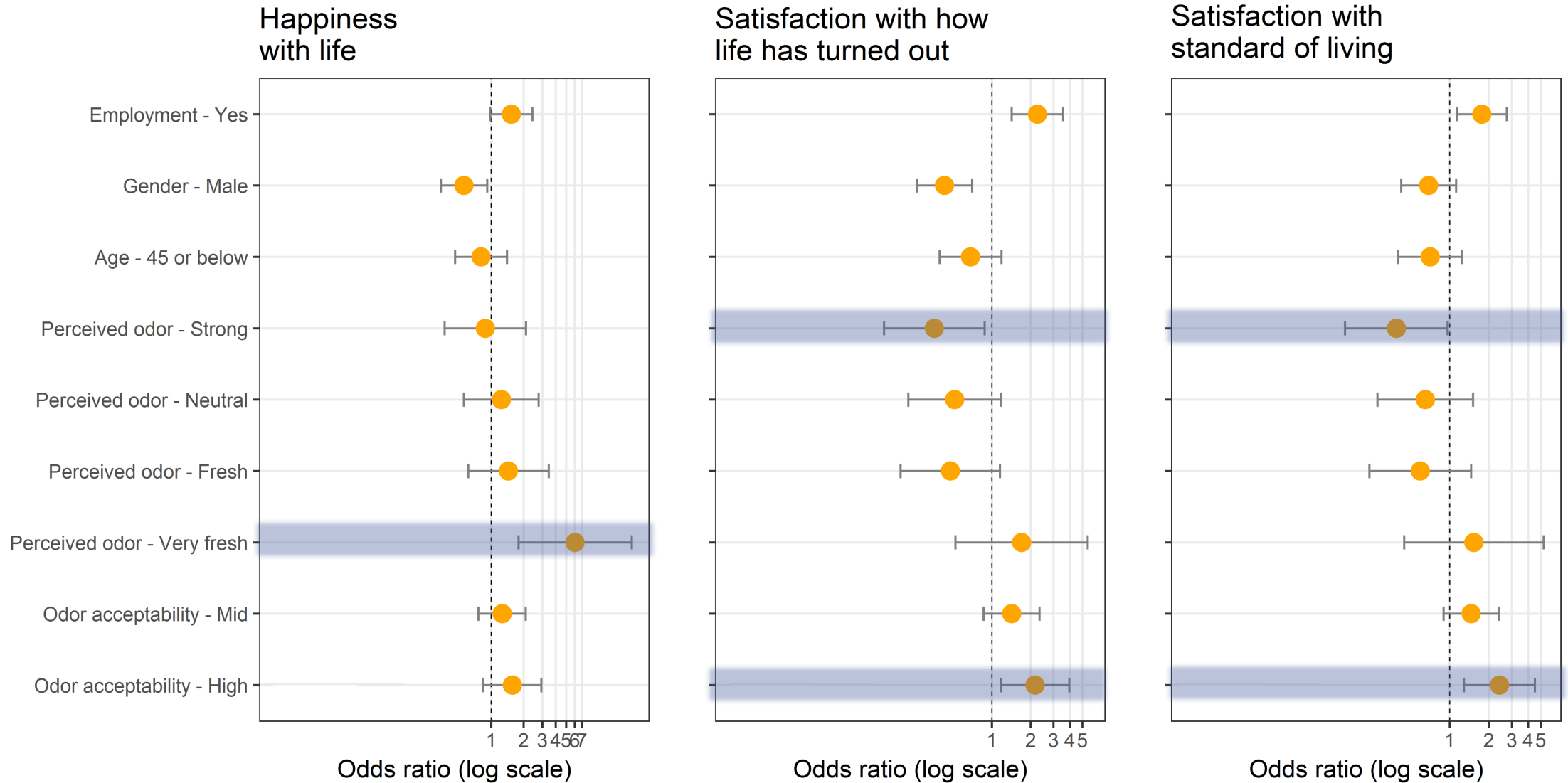
SUMMA
canister



Prevalent Compounds in Odor Samples



People are happier and more satisfied with life when the air is fresh and there are no odors





9:21 PM

If you like this to be an official complaint, please enter your name, address and phone number :

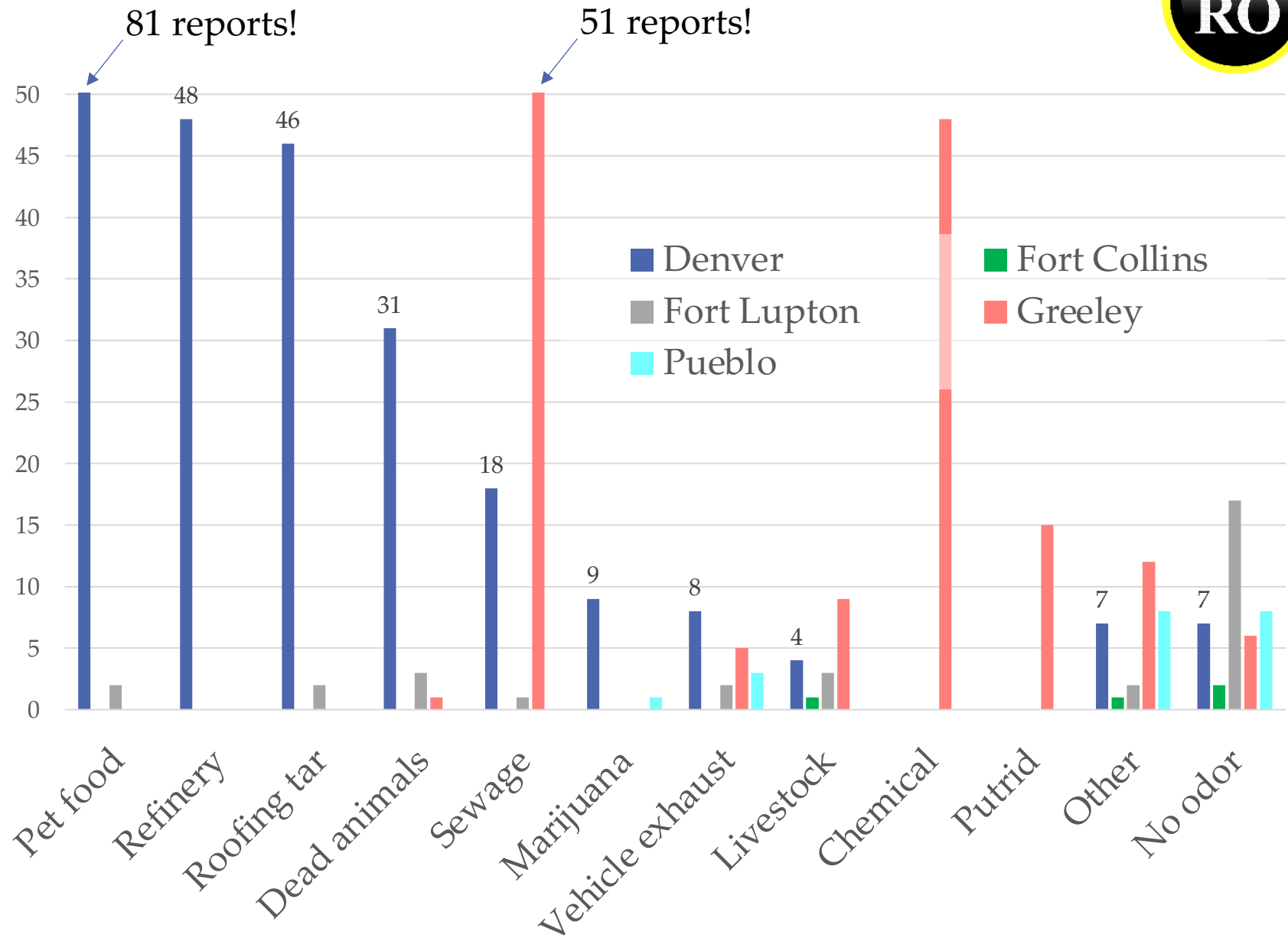
Your name

Your address

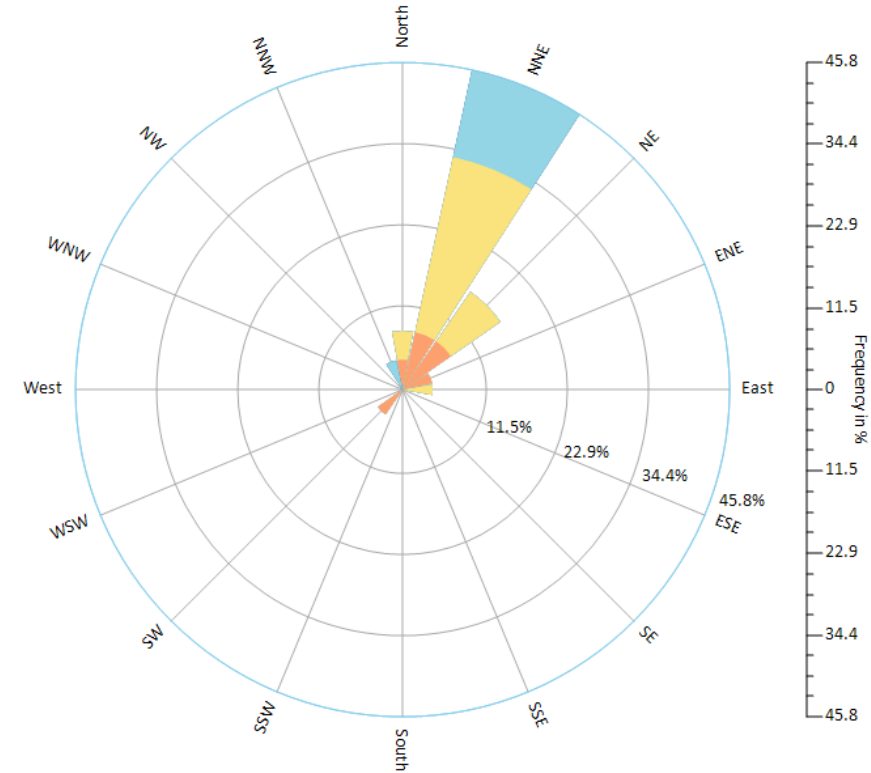
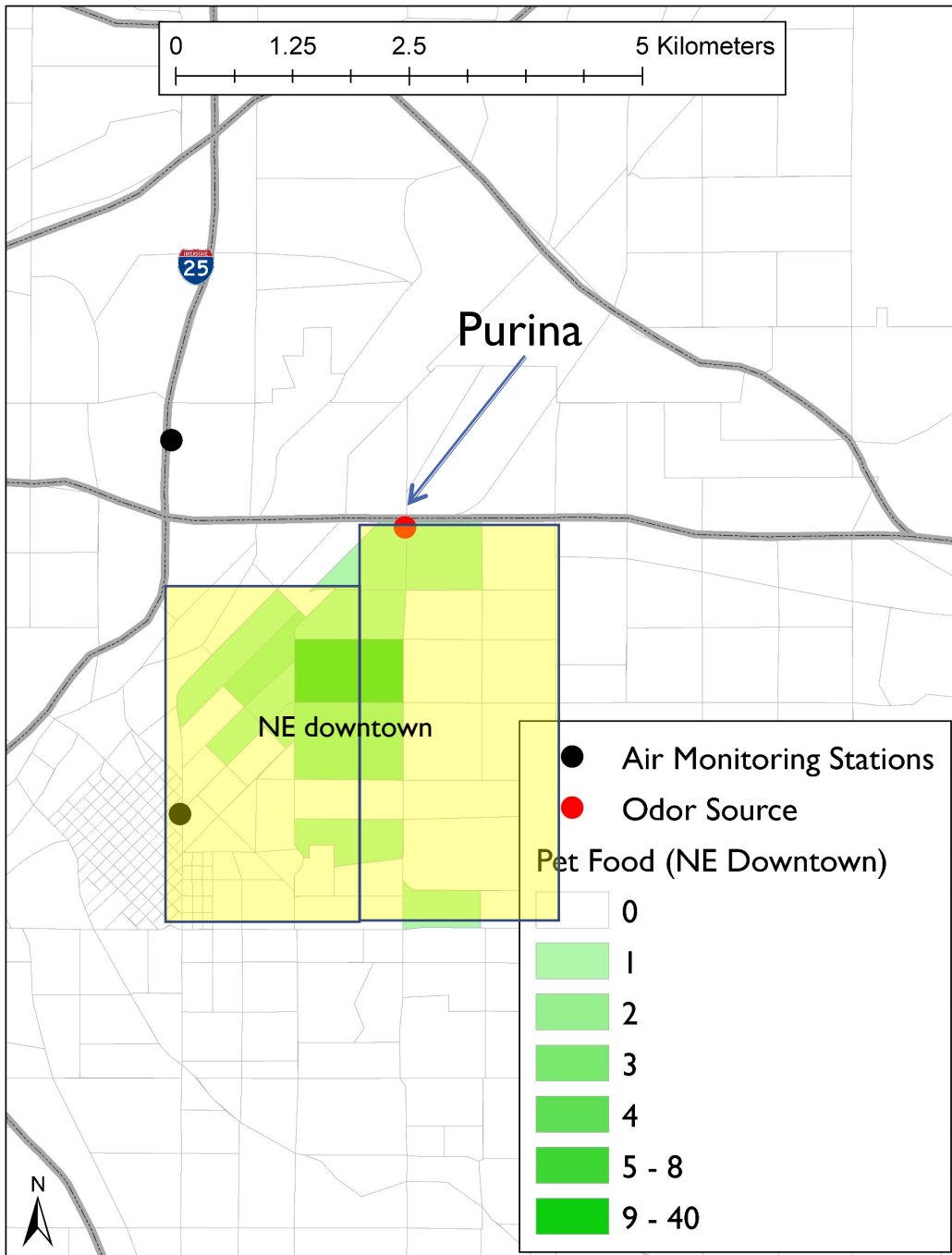
Your phone number

Optional, what is the dominant wind direction you noticed :

9:21:59 pm



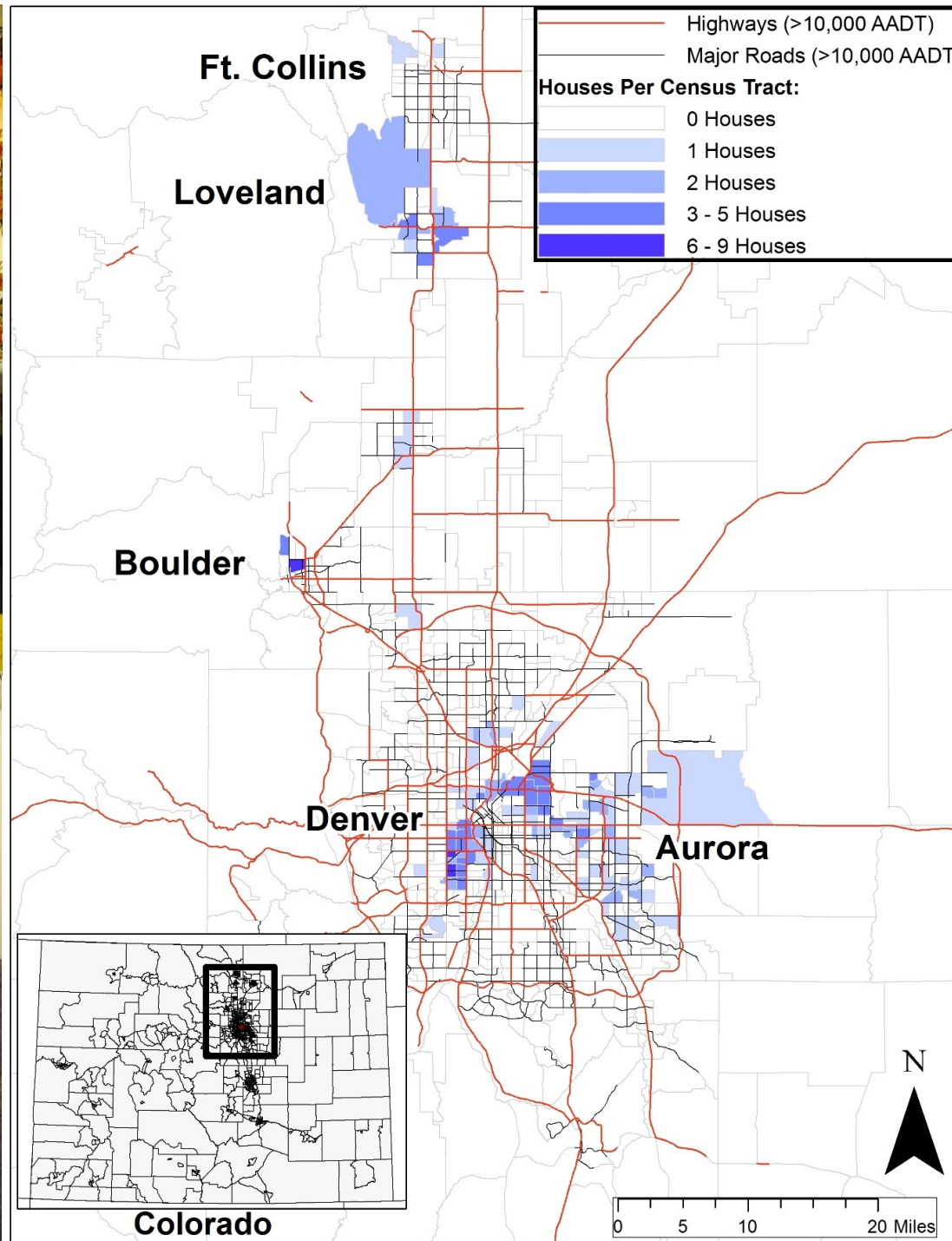
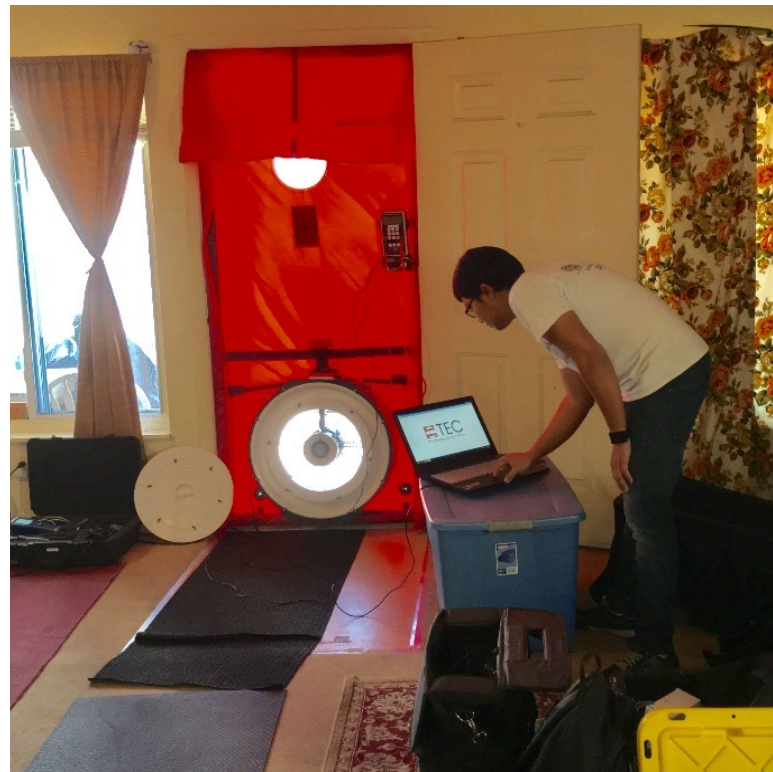
Pet food odor



Out of 81 Odor Reports 24 reports (30%) were from from NE downtown

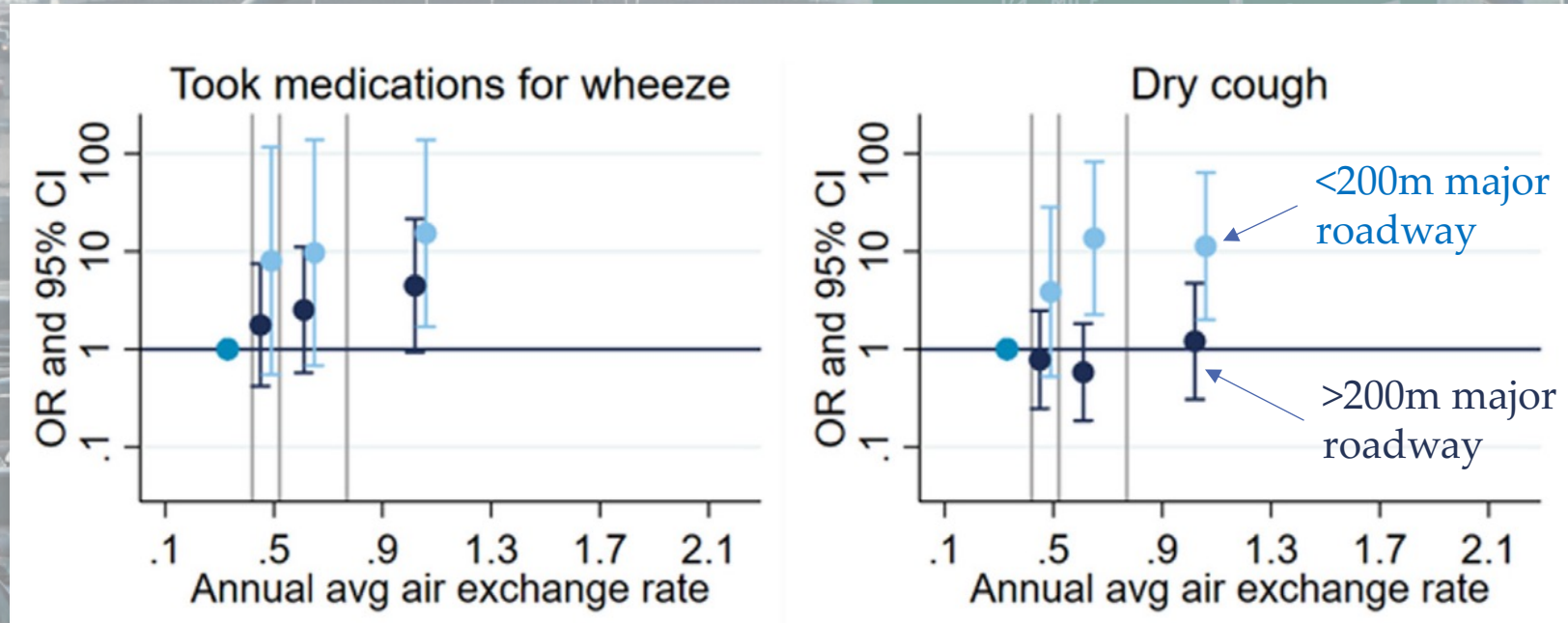


Traffic related air pollution and respiratory health



Home Weatherization
INDOOR AIR QUALITY & HEALTH

TRAFFIC RELATED AIR POLLUTION



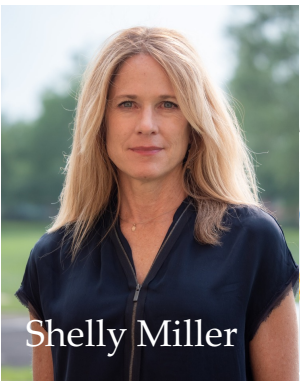
Relationships between home ventilation rates and respiratory health in the Colorado Home Energy Efficiency and Respiratory Health (CHEER) study

Elizabeth J. Carlton^{a,*}, Kelsey Barton^a, Prateek Man Shrestha^b, Jamie Humphrey^b,
Lee S. Newman^{a,c}, John L. Adgate^a, Elisabeth Root^d, Shelly Miller^b

Carlton, E.J., et al., 2019. *Environmental research*, 169, pp.297-307.



SJEQ Denver



Shelly Miller

EVEN Team



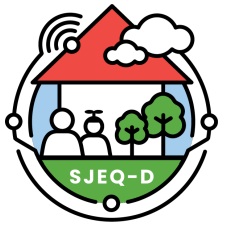
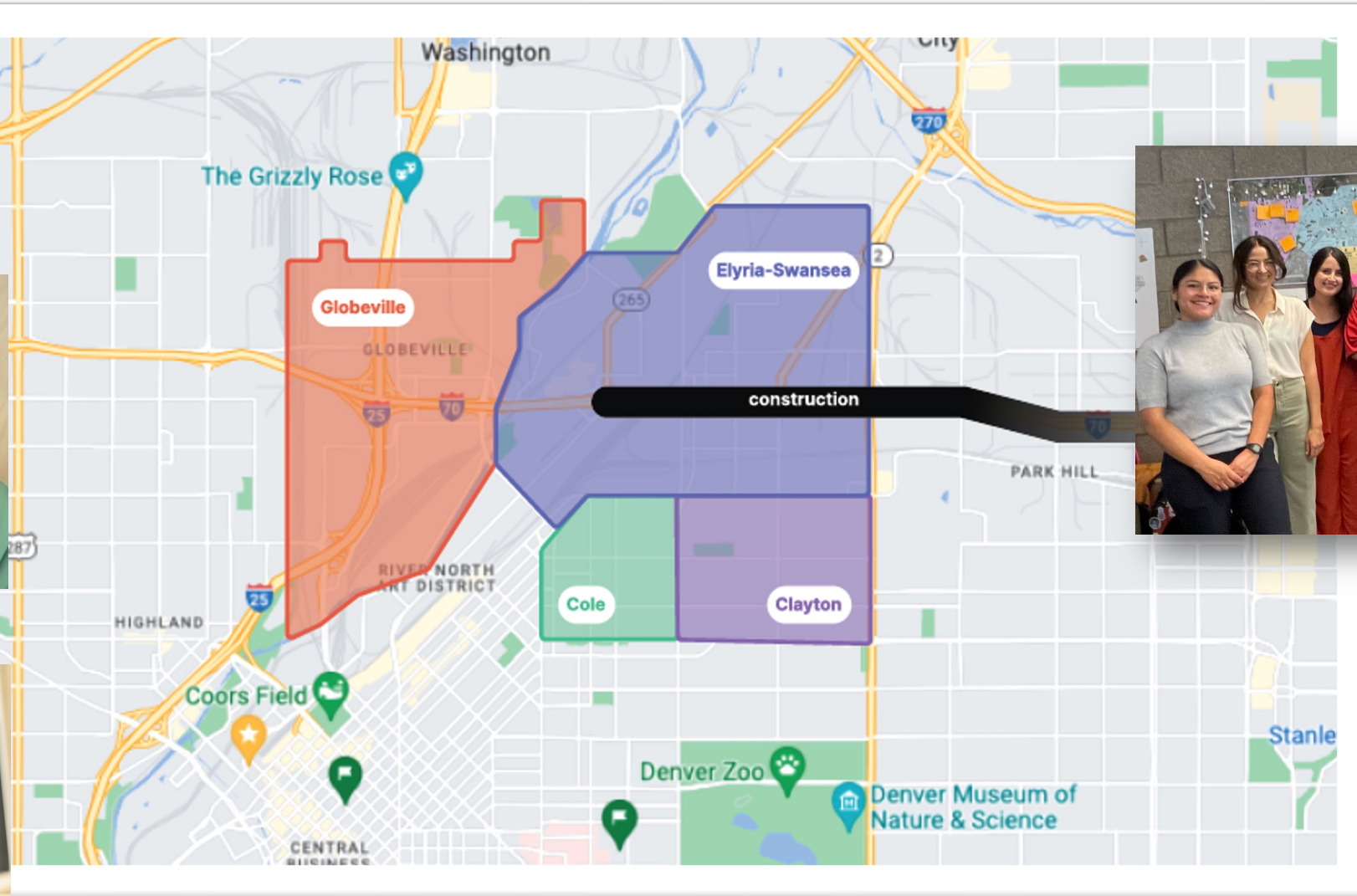
Shiv Mishra

Tech Team



Esther Sullivan

Social Sci Team



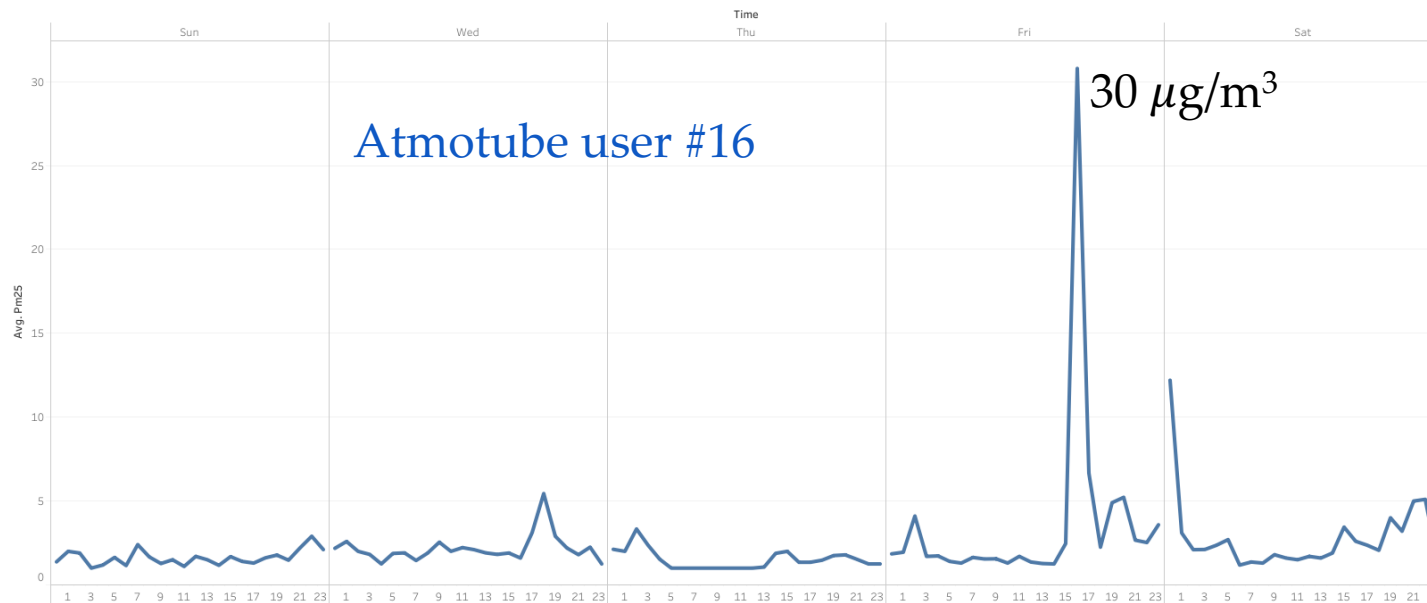
University of Colorado
Boulder



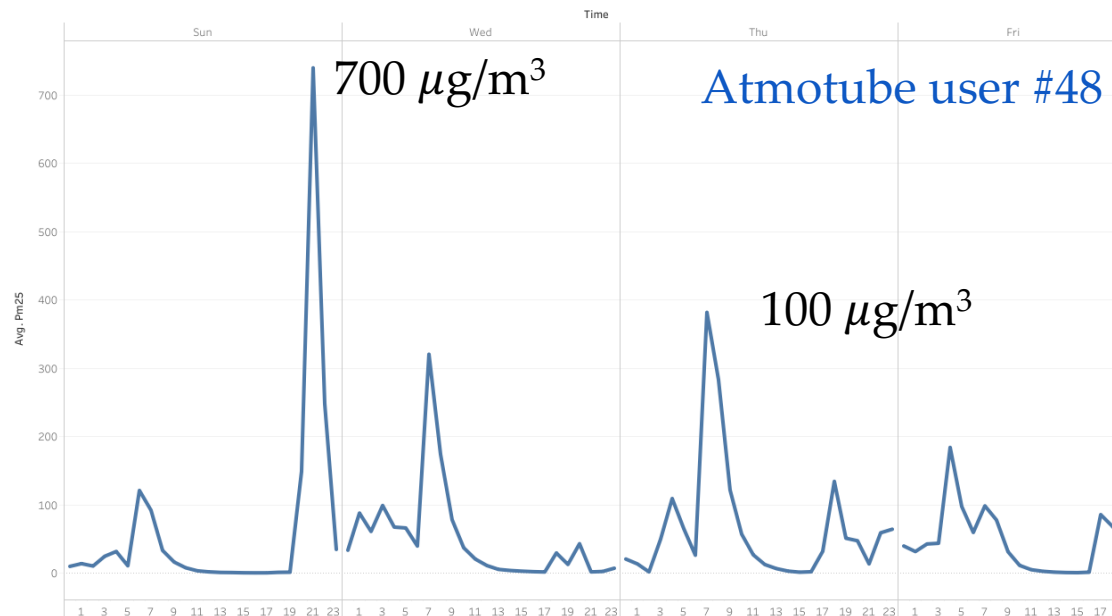




Hourly Averaged PM2.5 Time Series From 3/12/23 - 3/18/23



Hourly Averaged PM2.5 Time Series From 3/12/23 - 3/18/23



10:37

Atmotube PRO

CONNECTED 82%

AIR QUALITY SCORE & VOC



VOC	0.10	ppm
PM1	1.8	μg/m3
PM2.5	1.9	μg/m3
PM10	1.9	μg/m3

Air is Good

Air quality is considered satisfactory, and air pollution poses little or no risk.

BAROMETER & ALTIMETER

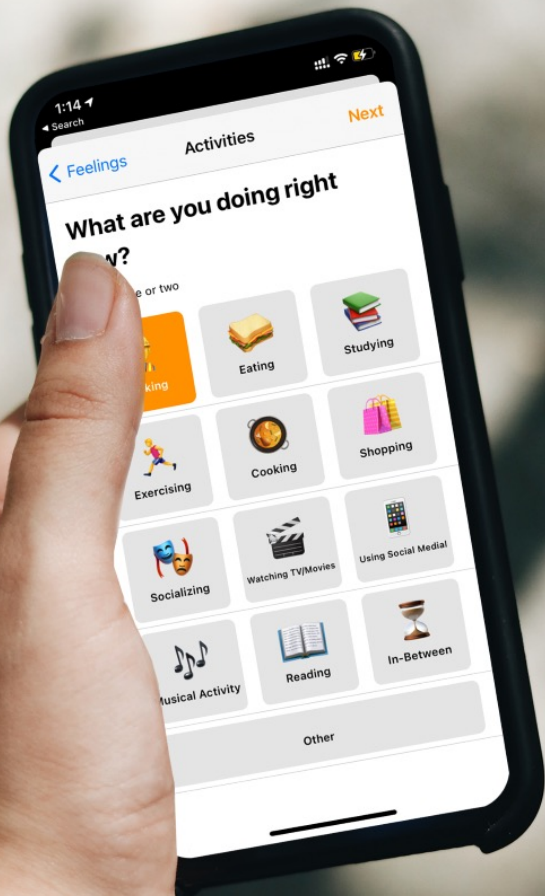


Comfort zone




1023.3

hPa



16:48

← Search

 **PUREmotion: Wellbeing Trac...**
omar Hammad

GET

AGE: 4+ Years Old | CATEGORY: Education | DEVELOPER: omar Hammad

9:32

PUREmotion

Daily Weekly

05 DEC

At 06:39, I was Indoors at/near Work

WELLBEING

- Happy
- Distressed
- Irritable
- Alert/Awake
- Lonely

ENVIRONMENT

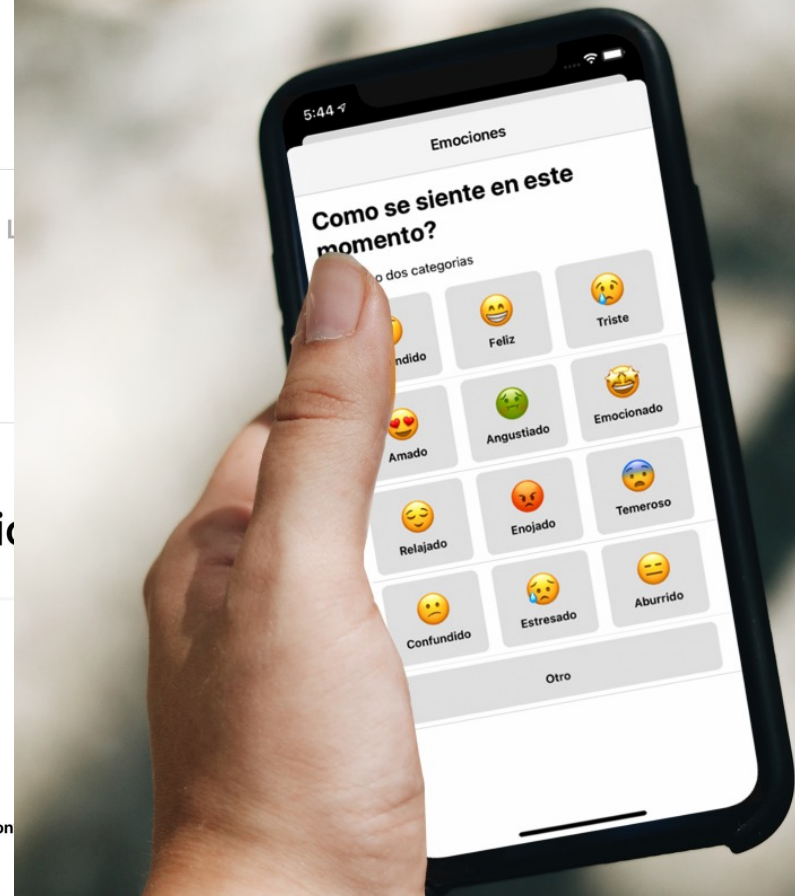
- Smell/Odor: 5/5
- Air Quality: 2/5
- Noise: 3/5

12:21

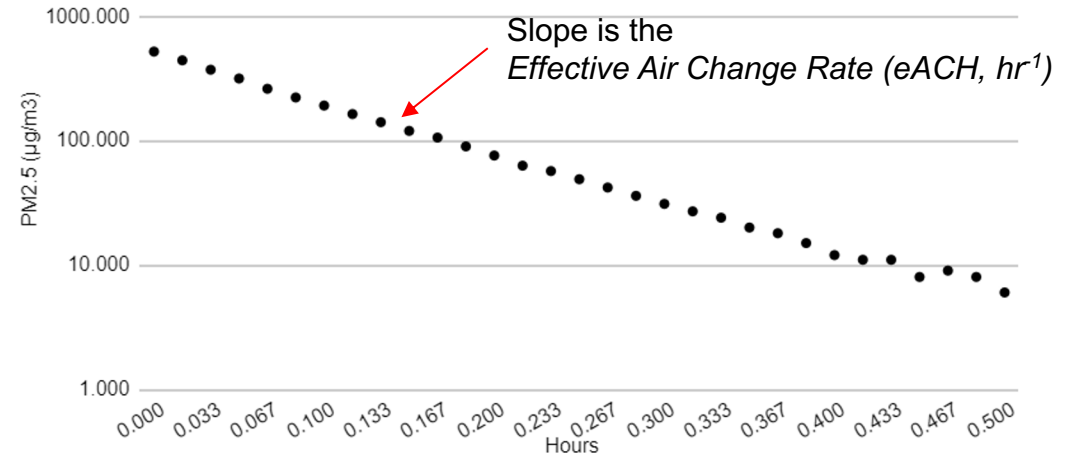
Puremotion

- Home
- About Us
- Reminders
- Useful Resources
- How to use PUREmotion
- Send feedback

Today Games Apps Arcade Search



DIY Air Cleaner Intervention



	1-MERV13 Filter, 20x20x1" (shroud)	1-MERV13 Filter, 20x20x2" (shroud)	1-MERV13 Filter, 20x20x4" (shroud)	1-MERV13 Filter, 20x20x4" (no shroud)	2-MERV13 Filters, 20x20x2" (shroud)	4-MERV13 Filters, 20x20x2" (shroud)
CADR (PM _{2.5}) [ft ³ /min]	108 😞	127 😞	127 😞	149 😊	230 😊	415 😊
Ease of Build	Medium 😊	Medium 😊	Medium 😊	Easiest 😊	Hardest 😞	Hard 😞
Size	Small 😊	Small 😊	Small 😊	Small 😊	Medium 😊	Large 😞
Initial (Annual) Cost (\$)	\$59 (\$20) 😊	\$65 (\$32) 😞	\$72 (\$46) 😊	\$72 (\$46) 😊	\$81 (\$64) 😞	\$113 (\$184) 😞
CADR/Initial Cost [ft ³ /min-\$]	1.8 😞	2.0 😊	1.8 😞	2.1 😊	2.8 😊	3.7 😊
CADR/Annual Cost [ft ³ /min-\$]	5.4 😊	4.0 😊	2.8 😞	3.2 😊	3.6 😊	2.3 😞

Middle School Summer Camp Outreach

