Urban Ultrafine Particles – Advisory Group Meeting

October 3, 2025

Agenda (9 AM to 12 PM)

1. Partner Updates & Opportunities (30 minutes)
2. UW Research Highlights (50 minutes)
3. Break (10 minutes)
4. Research & Policy Landscape (20 minutes)
5. Regional Monitoring Enhancements (10 minutes)
6. Open Forum (50 minutes)
7. Next Steps & Follow-Up (10 minutes)

Urban Nano-Particles – Advisory Group Meeting

- Foster Dialog
- Address knowledge gaps identified in the MOV-UP study
  - Identify priority research questions
  - Guide scientific research
  - Provide feedback on study design and methodology
- Time commitment: annual meetings, email updates and optional written or verbal review of study methods and outputs

Introductions & Updates

- Your name
- Organization/group
- Air quality related updates

Setting UW's Future Research Priorities on UFP

Help UW prioritize follow-up research from MOV-UP on aircraft ultrafine particles (UFP).

Research topics you'll rank based on what you think should drive future UW research priorities:

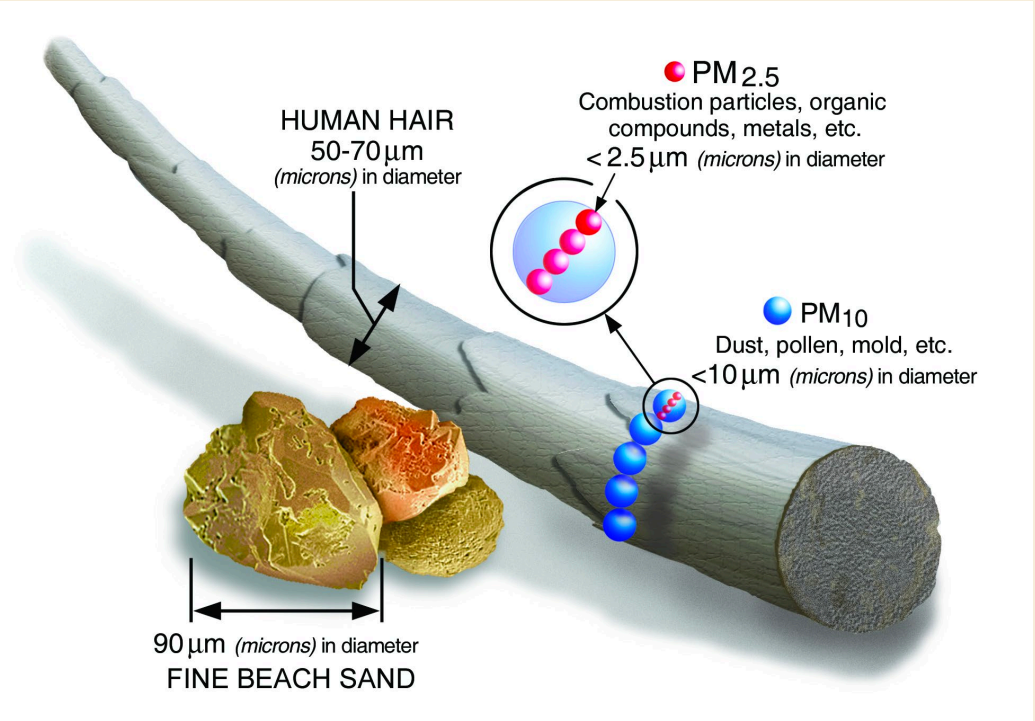
- Health effects
- Mitigation topics
- Exposure-science topics

Background – Air Quality

Air Pollution

What is particle pollution?

- Mixture of solid particles & liquid droplets (dust, soot, smoke).
- Outdoor $PM_{2.5}$ and PM_{10} sized particles are measured by mass. They are "criteria air pollutants" subject to the National Ambient Air Quality Standards under the Clean Air Act.
- Ultrafine particles (UFP) are measured by number of particles. They are not considered as "criteria air pollutants".
- Outdoor particles infiltrate indoors through windows, doors, ventilation. This is important because people typically spend most time indoors.



Ultrafine particles (UFP) are even smaller <0.1 µm *(microns)* in diameter

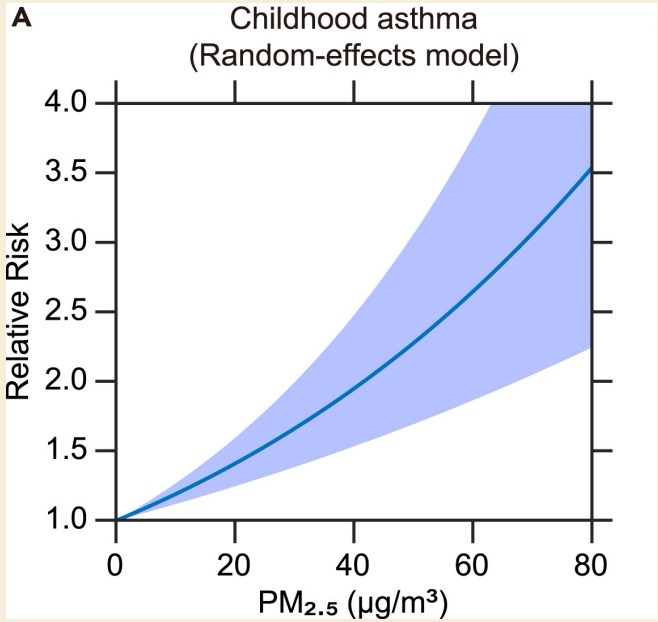
Health Impacts of Air Pollution ($PM_{2.5}$)

Short-term health

- Eye irritations
- Respiratory tract irritations
- Worsening asthma symptoms
- Heart attacks
- Cognitive performance

Long-term health

- Increased mortality
- Heart disease
- Stroke
- Asthma onset



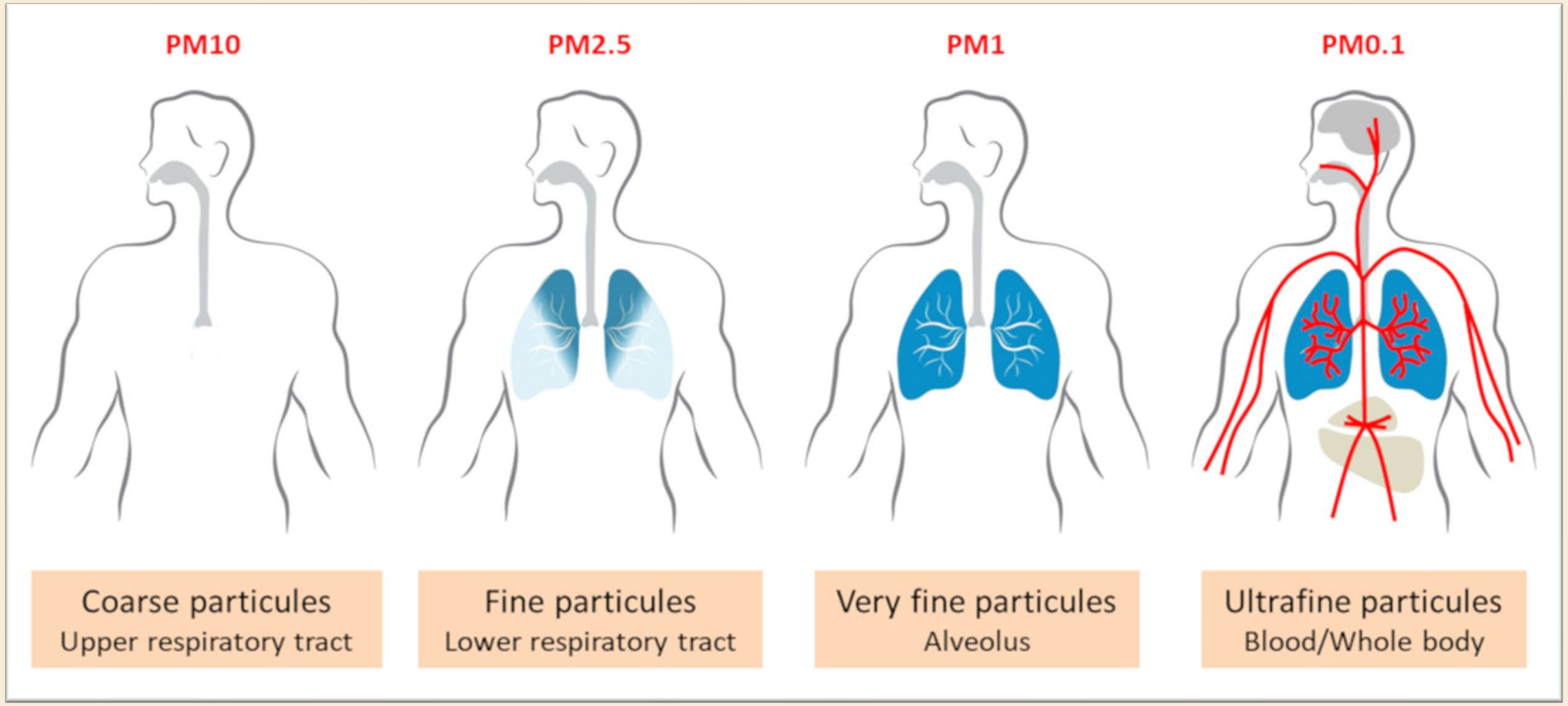
Ni, et al (2024)

Air pollution drives both immediate symptoms and long-term disease, impacts are unequal across age/income/gender etc.

Important Characteristics of Ultrafine Particles

Tiny size → Large surface area per particle

Health pathways → Can enter bloodstream, cross placenta, cross blood-brain barrier. **Health effects are uncertain.**



UFPs are uniquely small, biologically active, and not regulated under existing standards (lack of conclusive evidence).

Research Investments - Washington

- 2017 University of Washington “Mobile ObserVations of Ultrafine Particles (MOV-UP)”. A two-year study assessing UFP near Sea-Tac along flight paths. ($250,000)
- 2018 Washington State Department of Commerce “Sea-Tac Airport Impact Study” (ESSB 6032 proviso). Analyze impacts of current operations/expansions on public health, transportation, property values, and economic development. ($300,000 + *Local match required*)
- 2019 Public Health – Seattle & King County population health study focused on Sea-Tac Airport communities. ($125,000)
- 2021 University of Washington “Healthy Schools” pilot HEPA interventions to reduce exposure to air pollution and improve classroom air quality. ($940,000)

Mitigation Efforts – WA State Leadership

Monitoring & Data

PSCAA near-airport monitoring

2023: WA Legislature funds UFP equipment purchase for PSCAA.

2024–2025: Site planning & community siting; 2025: first fixed station near-Sea-Tac activated.

UW and Des Moines aviation-specific monitoring (planned)

2025: State budget included funding for a permanent aviation AQ monitor in Des Moines (south end flight path).

Community Mitigation

Airport-adjacent asthma mitigation

2023: UW DEOHS + King County Public Health. HEPA intervention near Sea-Tac; funded via Climate Commitment Act; ongoing.

King County purifier distributions

2025: $6M Ecology grant supports air purifier distribution to residents near airports.

Policy & Research Mandates

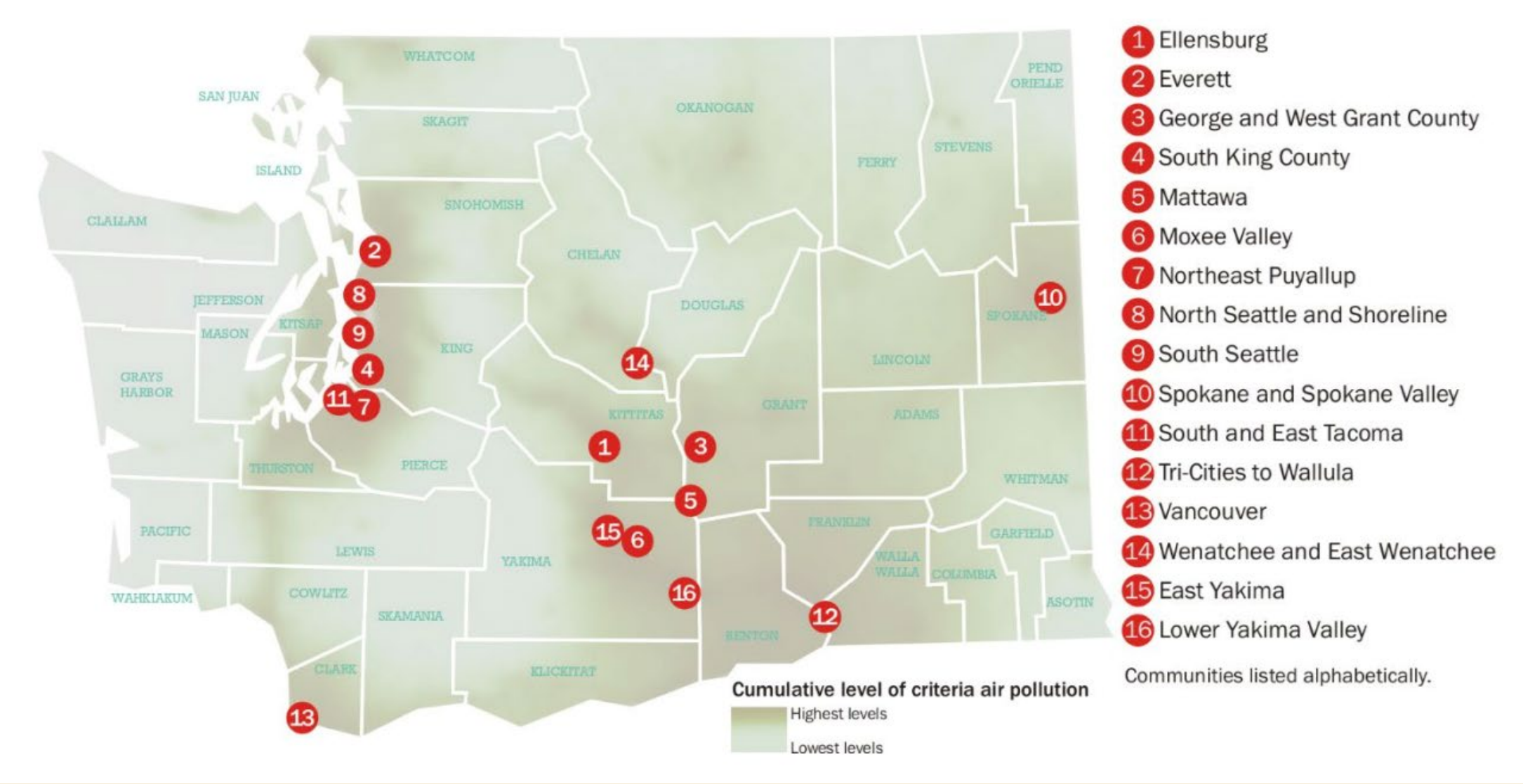
Alternative Jet Fuels (AJF/SAF)

2023: ESSB 5447 – per-gallon SAF incentives enacted.
2024+: RCW 28B.20.545 mandates UW DEOHS (with WSU) to quantify air quality benefits from AJF vs fossil annually and assess regional benefits.

Clean Fuels Program updates

2024–2025: Ecology proposes updates to expand SAF enablement/credits.

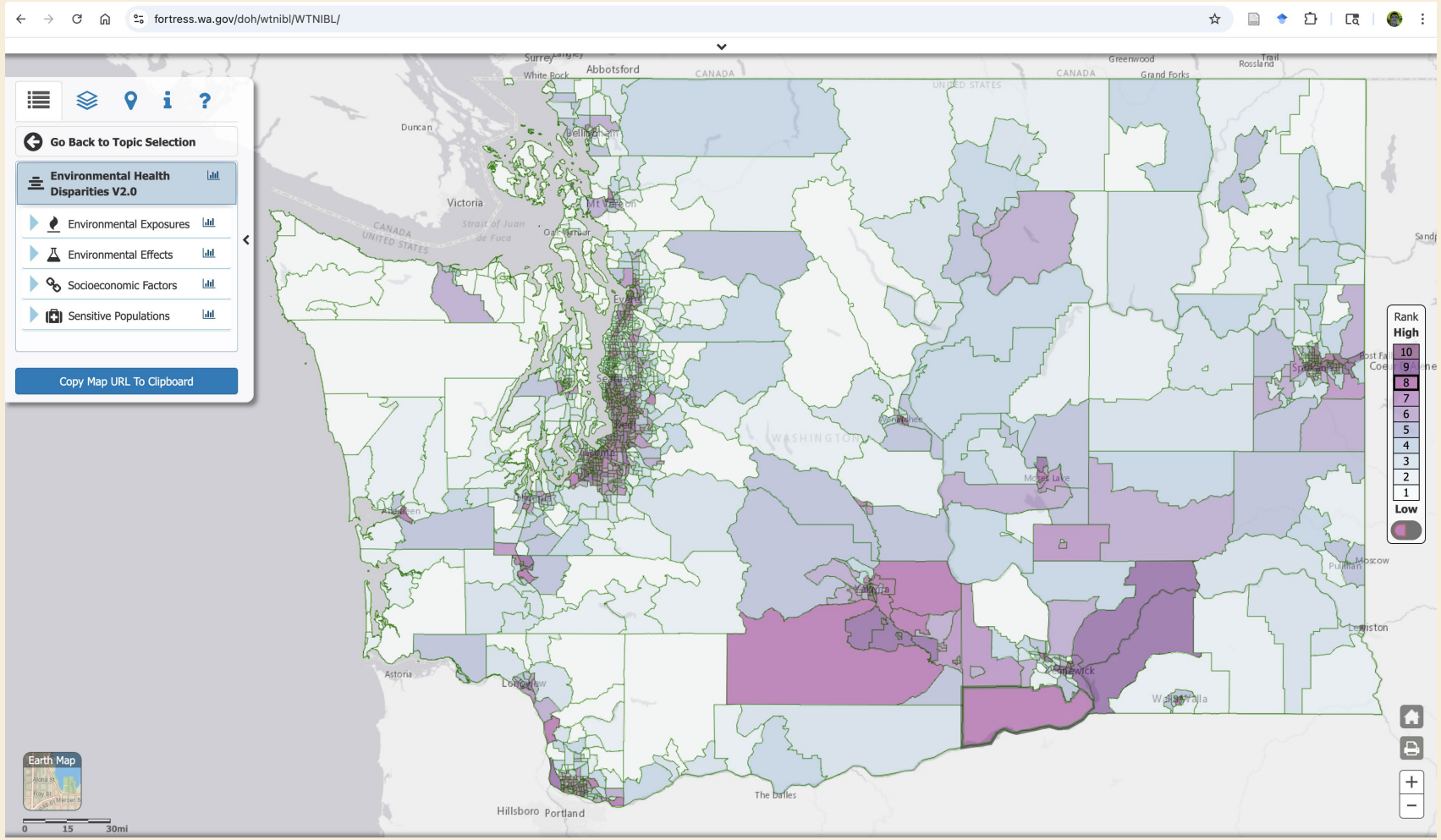
Overburdened Communities in Washington
Air Pollution



Department of Ecology, E., Rylie. 2023

Environmental Health Disparities Map

https://fortress.wa.gov/doh/wtnibl/WTNIBL/



Min et al., 2019 (WA EHD v2.0 shown above)

Census tracts are ranked from 1 to 10 based on:

- Environmental exposures
- Environmental effects
- Socioeconomic factors
- Sensitive populations

Areas with higher scores are considered when funding public health improvements.

EHD v2.0 considers air quality ($PM_{2.5}$, O_3, and diesel emissions)

UW Research Updates

Airport, Air Quality & Asthma (AAA) Study

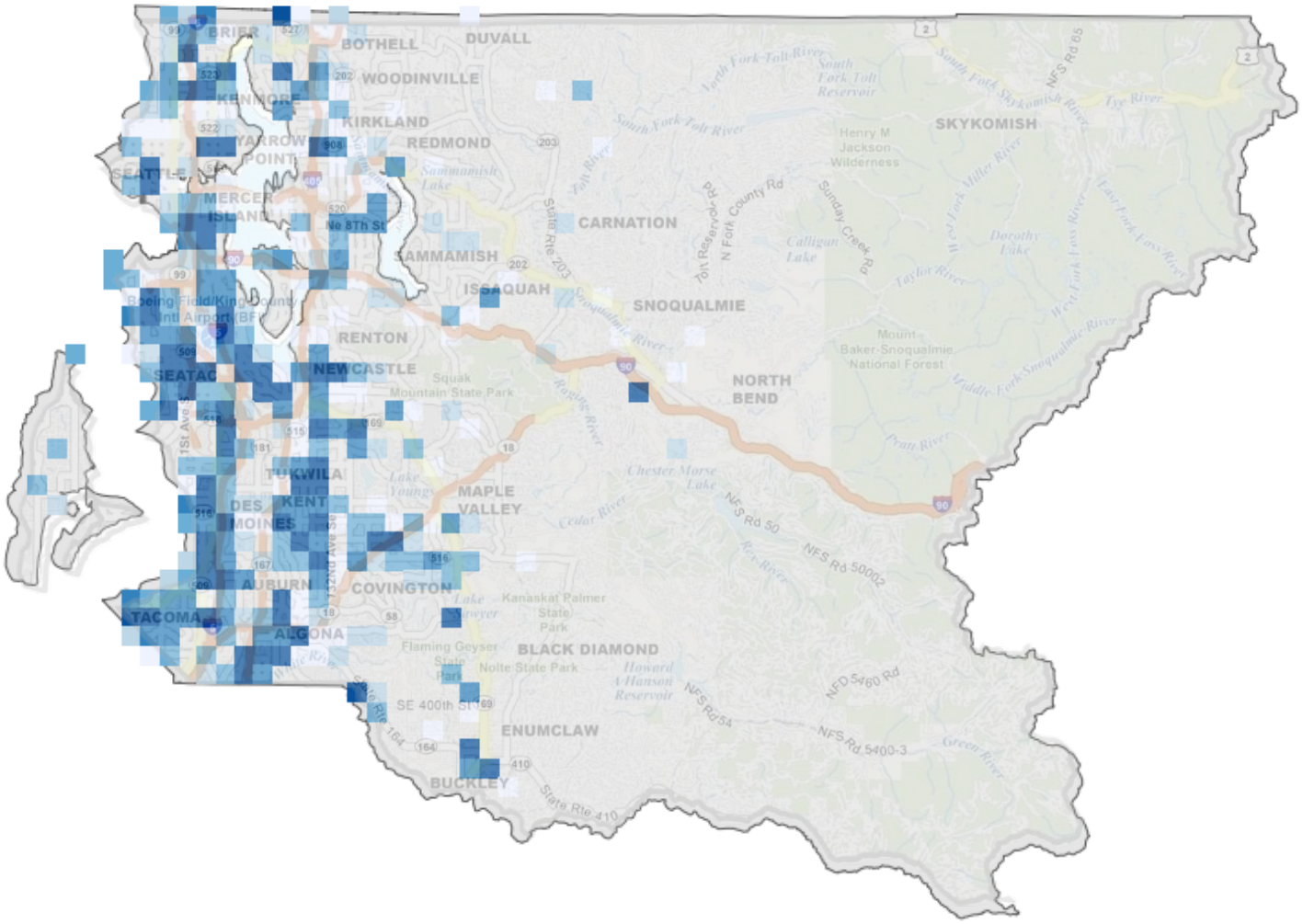
What is the Airport, Asthma and Air Quality Study?

Background

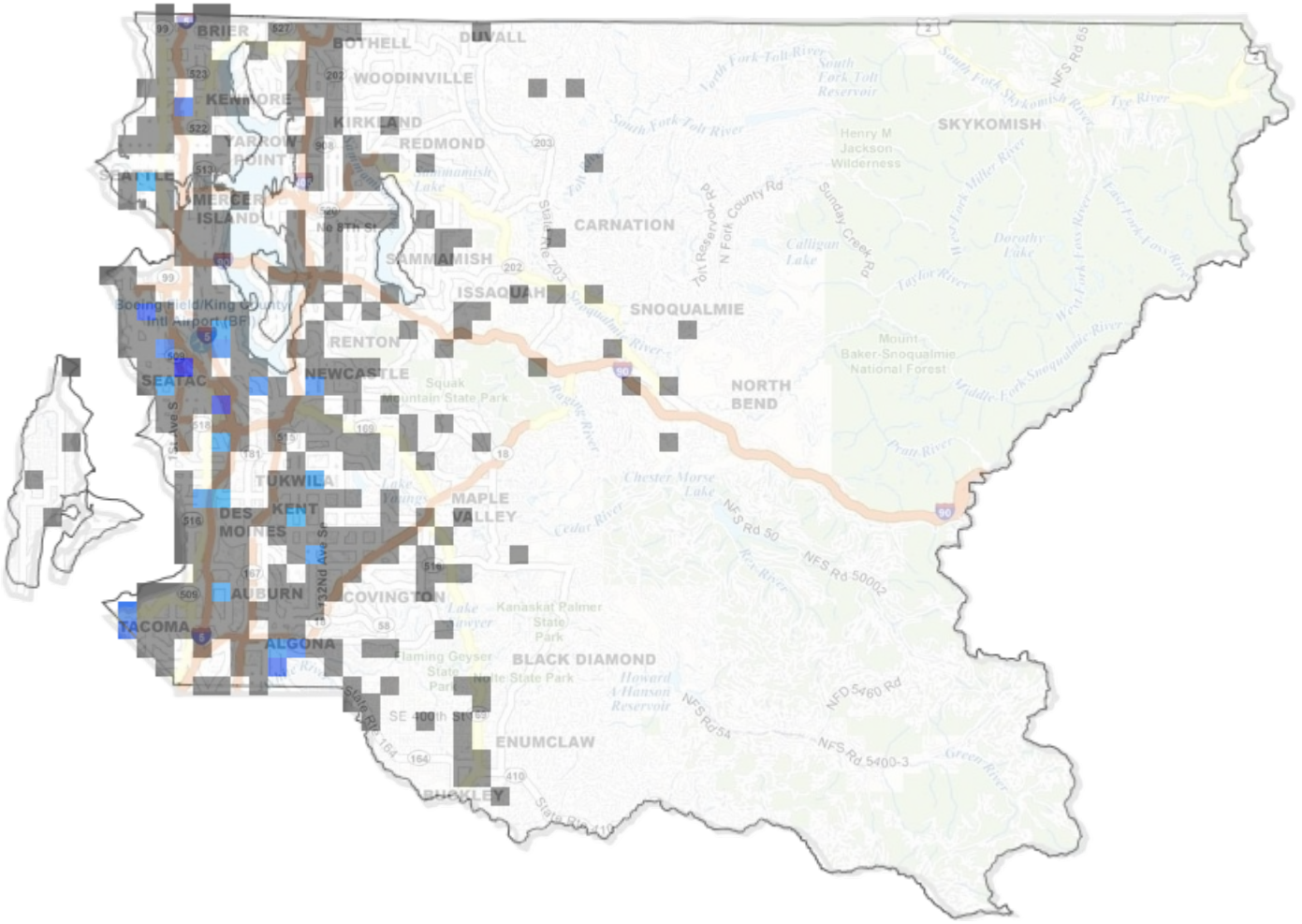
Funded by the WA State Legislature

- Support Asthma Education and research in the communities impacted by aircraft activities
    1. King County Asthma Education Program
    2. UW led Research Study (AAA)
    3. Asthma surveillance

Hospitalization Rates for Asthma ER & Inpatient (2020-2021)



Hospitalization Counts for Asthma ER and Hospitalizations (2020–2021)



Airport, Air Quality & Asthma (AAA) Study

Education program led by King County Public Health

> Serves ALL of King County

> Supplemented (~1 million dollars) to substantially increase services to airport (20 km) impacted communities

Community Partnerships: African Community Housing & Development, Lutheran Community Services Northwest and Villa Comunitaria

Airport, Air Quality & Asthma (AAA) Study

Intervention Study

> Focus: Children (6-12) living less than 10 miles from Sea-Tac Airport impact area.

> Design: participating families, randomized → HEPA filer vs less effective filter.

> After the study → All receive the King County 3-month asthma education program.

Provides information on reducing impacts of air pollution exposures on child asthma outcomes.

Clinical Trial Protocol Registered on clinicaltrials.gov

Recruiting

The Airports, Air Quality, and Asthma (AAA) Study

ClinicalTrials.gov ID NCT07047430

Sponsor University of Washington

Information provided by Elena Austin, University of Washington (Responsible Party)

Last Update Posted 2025-07-02

Download Save

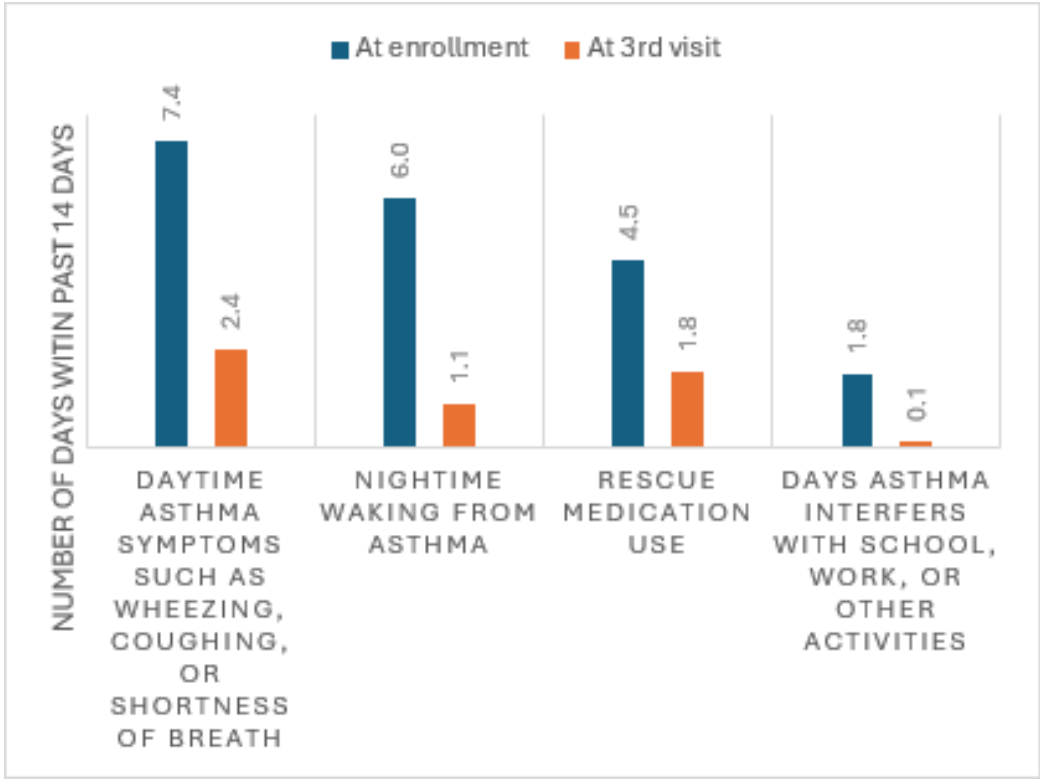
"If one little thing changes and the child's asthma improves, it brings a smile to my face. Seeing the confidence clients now have is amazing."

Maria Rodriguez, Community Health Worker
Public Health Seattle & King County

Impact of CHW education on Families

Completion of the 3-month CHW Asthma Education Program improved health:

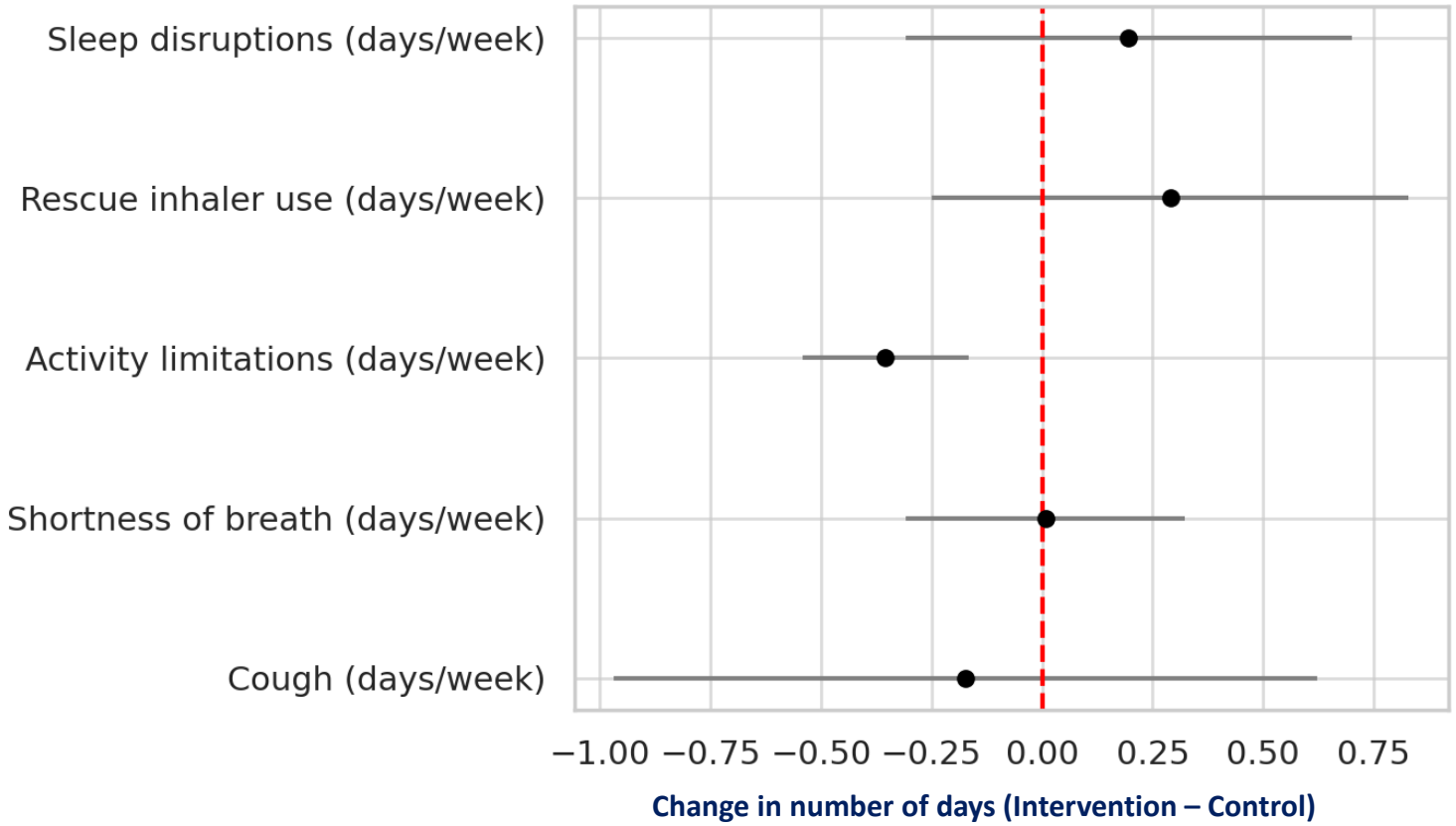
- +7.5 symptom-free days/month (+46%).
- ↓ Night awakenings by 64%.
- ↓ Rescue inhaler use (11%).
- ↓ Asthma sick days (–93%).
- 93% of caregivers would recommend.



Community-based asthma education improves health for children living near airports.

Preliminary Analysis (do not share)
Intervention Impact

Change in weekly reported symptoms
Over a 12-week period



- 31 participants have completed to date (34 enrolled in total)
- Early results show some improvement activity level for intervention participants.
- Analysis compares baseline (weeks 2–3) to follow-up (weeks 10–12).
- 93% of caregivers said they would recommend the study to friends or family

These results are preliminary – recruitment is ongoing.

KING COUNTY COMMUNITY HEALTH WORKER PROGRAM

For over 20 years Community Health Workers have been supporting families with asthma care in King County.

This free program includes:

- Comprehensive virtual home visits
- Educational materials
- Supplies (such as safer cleaning kits, mattress covers, HEPA vacuums, and air cleaner).

ELIGIBILITY:

- Poorly controlled asthma
- Resident of King County
- Children aged 6 to 12

TO ENROLL IN PROGRAM:

1. Input your information in database at: https://redcap.link/kingcountychwprogram

2. CHW will follow-up within 3 business days if eligible

SCAN ME

Public Health
Seattle & King County

PROGRAMA DE TRABAJADORES DE SALUD DE LA COMUNIDAD DEL CONDADO DE KING

Durante más de 20 años, los Trabajadores de Salud Comunitarios han estado apoyando a las familias con el cuidado del asma en el Condado de King.

ELEGIBILIDAD:

- **Asma no controlada**
- **Residente del Condado de King**
- **Niños de 6 a 12 años**

ESTE PROGRAMA GRATUITO INCLUYE:

- **Visitas virtuales**
- **Materiales educativos**
- **Suministros (kits de limpieza seguros, sabanas y fundas para colchones anti alergenos, aspiradoras HEPA y limpiadores de aire).**

PARA INSCRIBIRSE:

1. Ingrese su información en el enlace: redcap.link/kingcountychwprogram

2. Si es elegible su trabajadora de salud le llamará dentro de 3 días.

SCAN ME

Salud Pública
Seattle y el condado de King

Healthy Air, Healthy Schools

ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES
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Healthy Schools, Healthy Air

WA pilot study: 17 schools tested portable HEPA cleaners.

Goal: Reduce student exposure to wildfire smoke & traffic-related air pollution.

- Distributed nearly 100 HEPA air cleaners and over 300 filter replacement kits.
- Developed sophisticated outdoor air quality monitoring platforms.

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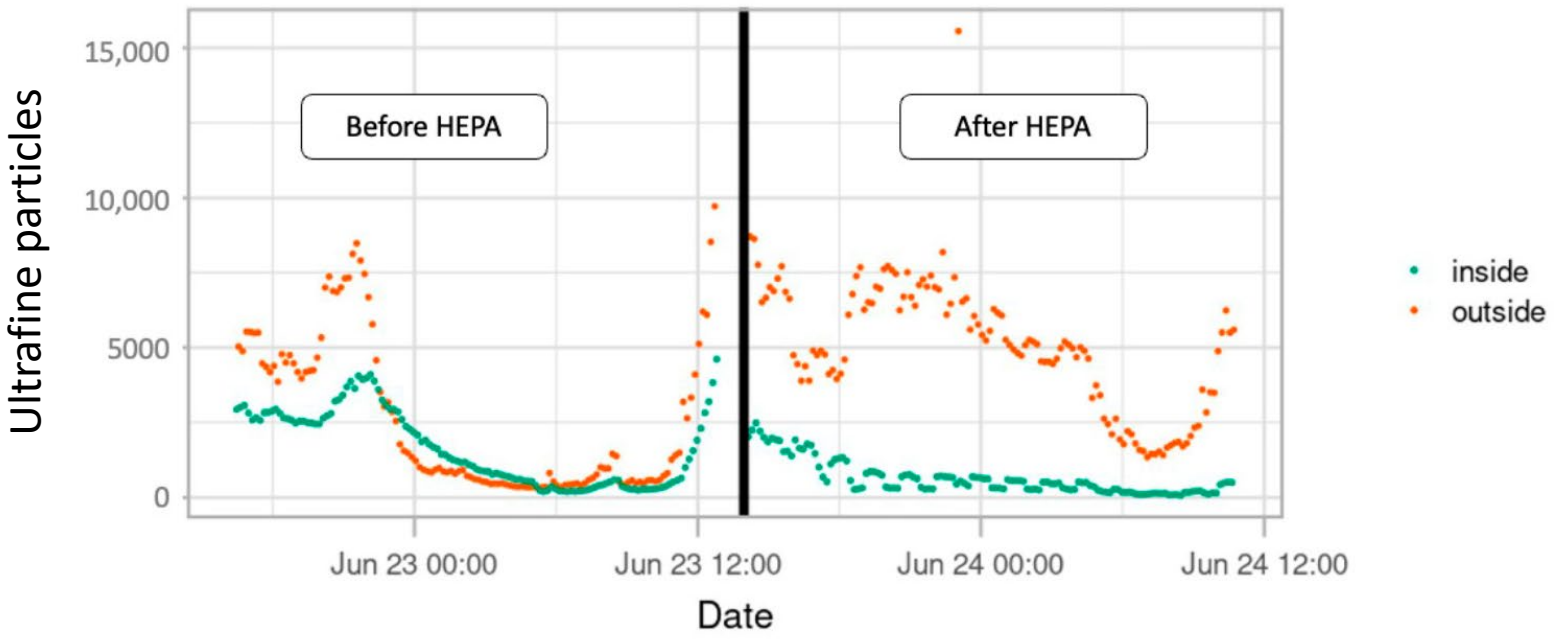
Key Findings & Implications Initial Pilot

- Some co-benefits from previous research (Holm 2021) include evidence of improved test scores.
- HEPA filters lowered indoor $PM_{2.5}$ during high outdoor air pollution periods.
- Barriers: noise, energy use, maintenance, filter replacement costs.
- Policy need: HVAC upgrades and funding to sustain HEPA filter interventions.



Carmona, et al., 2022

Key Findings & Implications
Deployment in Schools

Air Quality Outcomes

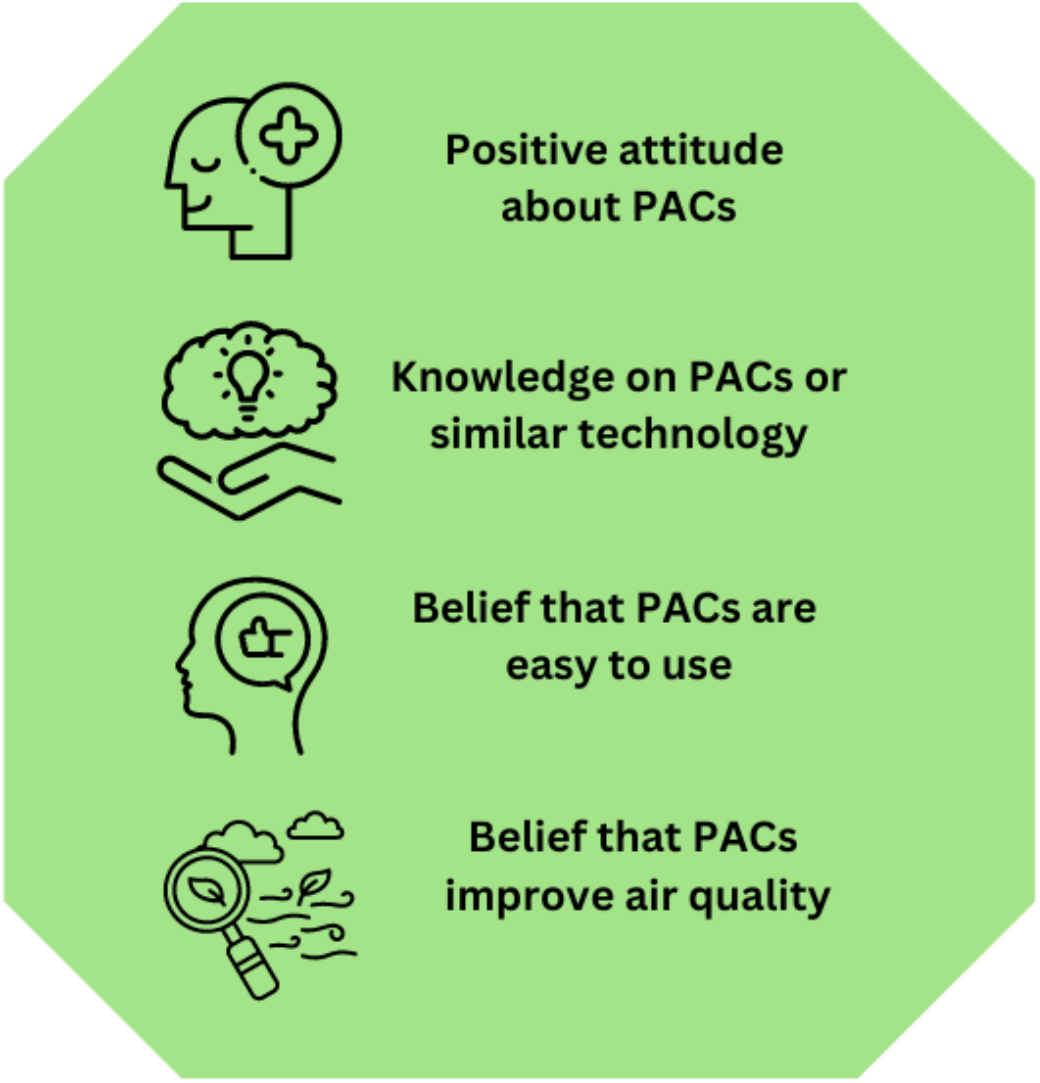
- Mean indoor $PM_{2.5}$ = 2.75 µg/m³ vs outdoor = 5.64 µg/m³ across deployment.
- During high pollution events, HEPA air cleaners reduced indoor air pollution 50%:
- I/O ratio HEPA off = 0.926 → HEPA on = 0.471.
- Not always a day-to-day improvement in air quality.

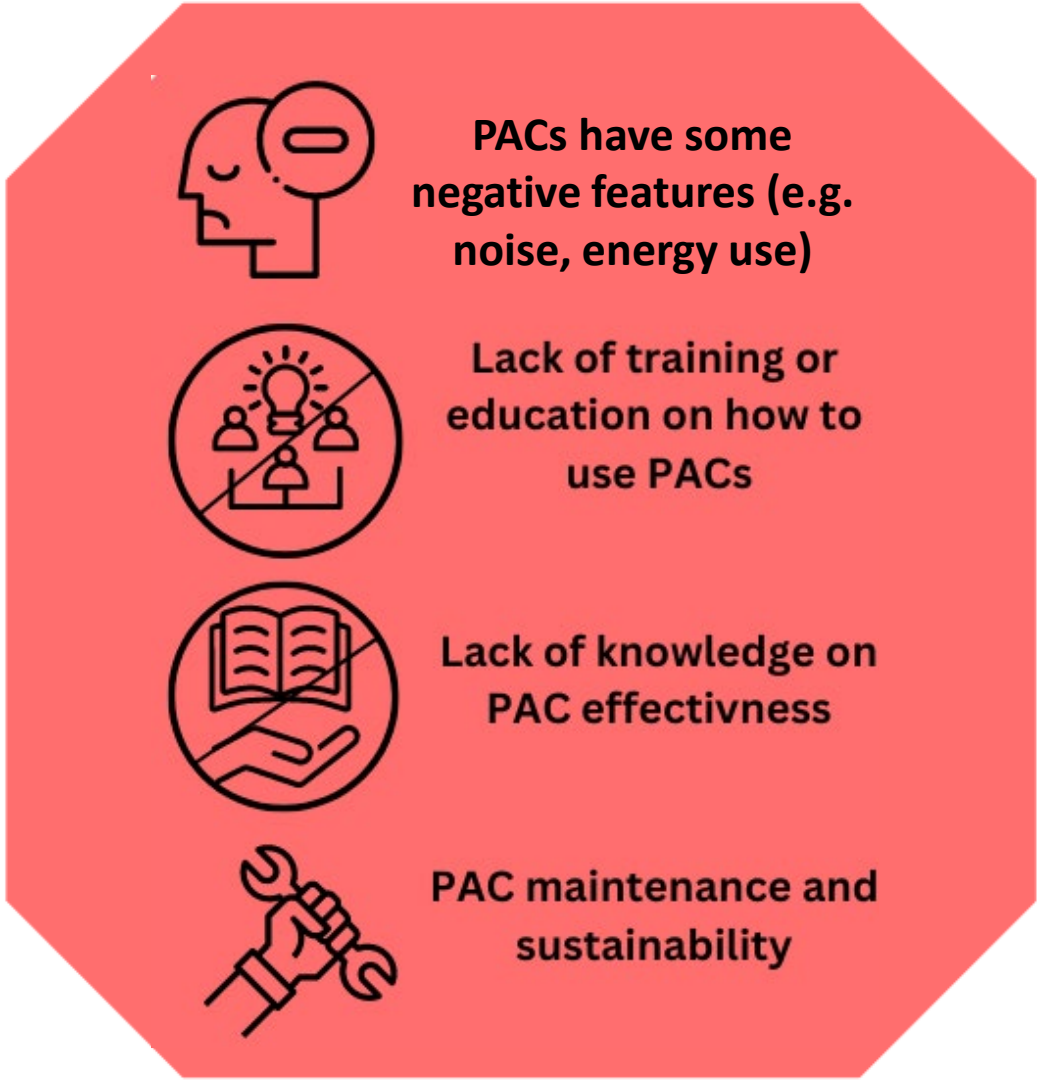
PAC Operation (82 classrooms; 494,910 device-hours)

- Levels 1 to 3: 48.5% of hours
- Standby: 32.4%
- Off: 17.9%
- Turbo: 1.3%

Even moderate settings substantially reduced indoor exposure during air pollution episodes.

Facilitators & Barriers to Portable Air Cleaner Use in WA Schools (Carmona et al., 2024)





Recommendations for Improving School IAQ

IMPROVING HVAC SYSTEMS

- Upgrade filters within system capacity
- Centralized control system
  - For example: QR codes

TESTING IAQ

- Financial support for: instruments, personnel, state funded testing program

Interviewee Quotes

"We also have a dedicated control software to read all the sensors and read everything that's happening on those package units."

Director of Operations

"It would be really nice to have an easier venue for testing air to find out...if I don't know [what] the problem is or how bad it is."

Maintenance Manager

Recommendations for Improving School IAQ

IAQ EDUCATION

- Education on improving IAQ
- Training on using portable air cleaners

INFORMATION MANAGEMENT

- Ticket system for IAQ concerns
- Track PAC maintenance and supply of filters

Interviewee Quotes

"It [PAC] only covers 100 square feet, but your classroom is 850 square feet.. I think it comes down to an education piece, and because of that it also gives a false sense of security to folks."

Facilities Planning Manager

"There's an indoor air quality complaint form that is shared with building operators and principals at the beginning of the year and multiple times throughout the year."

Environmental Safety Coordinator

Pre-filter during quarterly site visit

Pre-filter after project staff measurement

Results: Indoor and Outdoor $PM_{2.5}$ during wildfire events

Significantly higher infiltration with HEPA off

	HEPA Off (N=472)	HEPA On (N=4595)	Overall (N=5067)
Calibrated Indoor $PM_{2.5}$ ($\mu g/m^3$)			
Mean (SD)	12.8 (14.2)	6.79 (7.06)	7.35 (8.18)
Median [Min, Max]	6.15 [2.65, 83.7]	3.83 [2.50, 73.6]	3.98 [2.50, 83.7]
Calibrated Outdoor PM2.5 (µg/m3)			
Mean (SD)	17.1 (18.0)	17.3 (19.8)	17.3 (19.7)
Median [Min, Max]	9.08 [2.72, 155]	10.2 [1.97, 181]	9.94 [1.97, 181]
Indoor/Outdoor			
Mean (SD)	0.944 (0.860)	0.508 (0.242)	0.548 (0.372)
Median [Min, Max]	0.697 [0.0755, 4.70]	0.506 [0.0157, 5.45]	0.517 [0.0157, 5.45]

Healthy Air, Healthy Schools Takeaways

HEPA filters improve school air quality and reduce $PM_{2.5}$ particles and ultrafine particles, but they are not a stand-alone solution.

- Stakeholder feedback highlights benefits as well as barriers (Carmona et al. 2024).
- **Key challenges:**
  - Longevity, use and maintenance of equipment.
  - Possible shifts in indoor air chemistry (e.g., VOCs, CO_2; Choe et al. 2022).
  - Filter replacement schedules unclear at high pollution levels; UW research suggests longer use may be feasible.
  - Classroom noise, power demands, and vulnerability during outages.
  - Need for stronger evidence on cost-effectiveness.

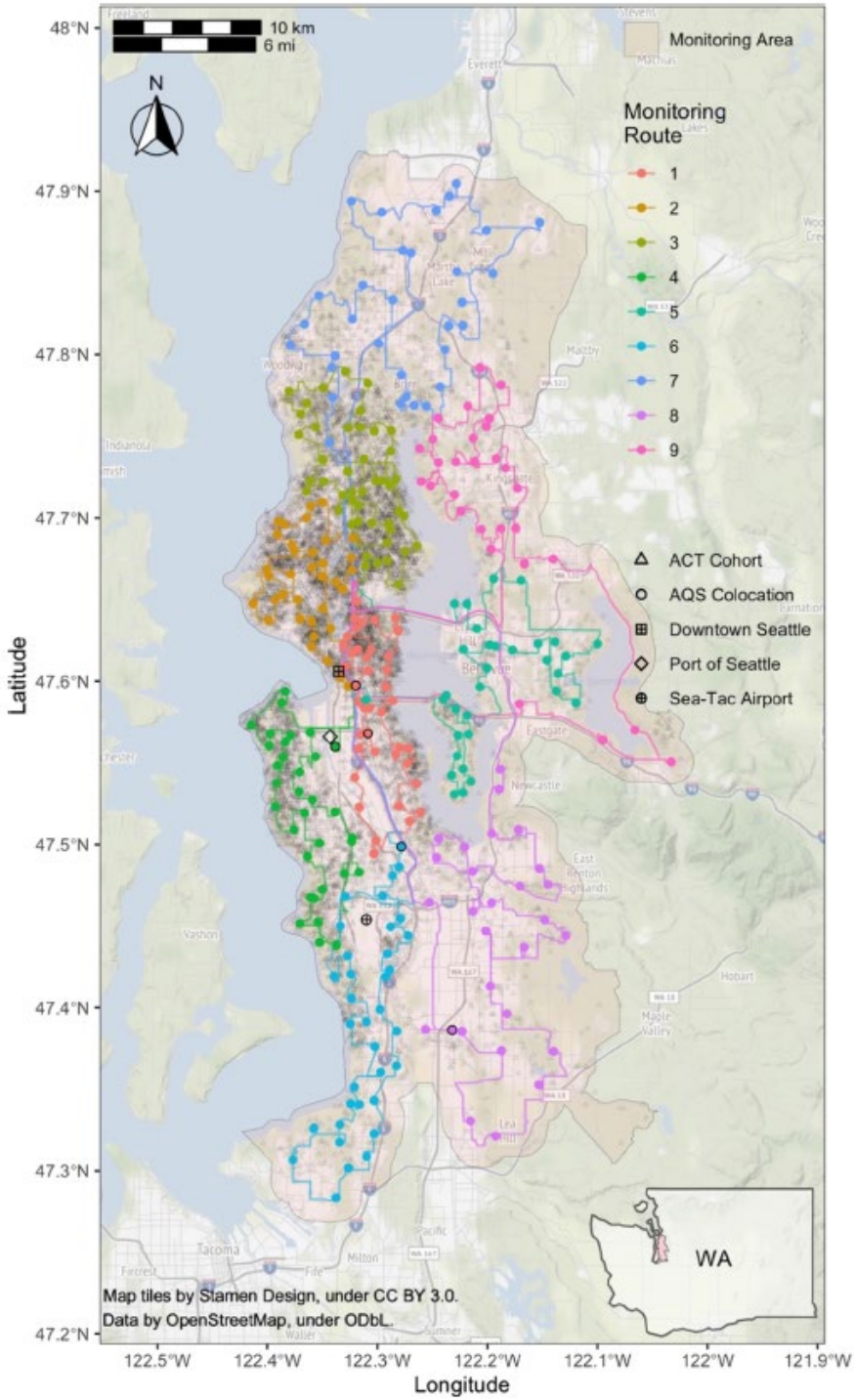
Source Apportionment of Air Pollutants through a Mobile Monitoring Campaign

More details in this paper

UNIVERSITY of WASHINGTON

Mobile monitoring campaign – understanding mixtures of outdoor sources

- **Purpose:** Provide high-spatial-resolution air pollution exposure estimates for epidemiological analysis about dementia
- **Pollutants:** Size-resolved ultrafine particle number concentration (PNC), $PM_{2.5}$, black carbon (BC), total carbon (TC), NO_2, and CO_2
- **Location:** 309 sites in Seattle, WA
- **Time:** ~29 repeated measures of air pollutants with a **time-balanced design** from 2019 to 2020
- A total of 8152 visit-level data were obtained.



Blanco et al., *ES&T*, 2022, 56 (16): 11460-11472.

Positive matrix factorization (PMF) analysis

- **PMF model:** EPA PMF 5.0

$$x_{ij} = \sum_{k=1}^{K} g_{ik} f_{kj} + e_{ij}$$

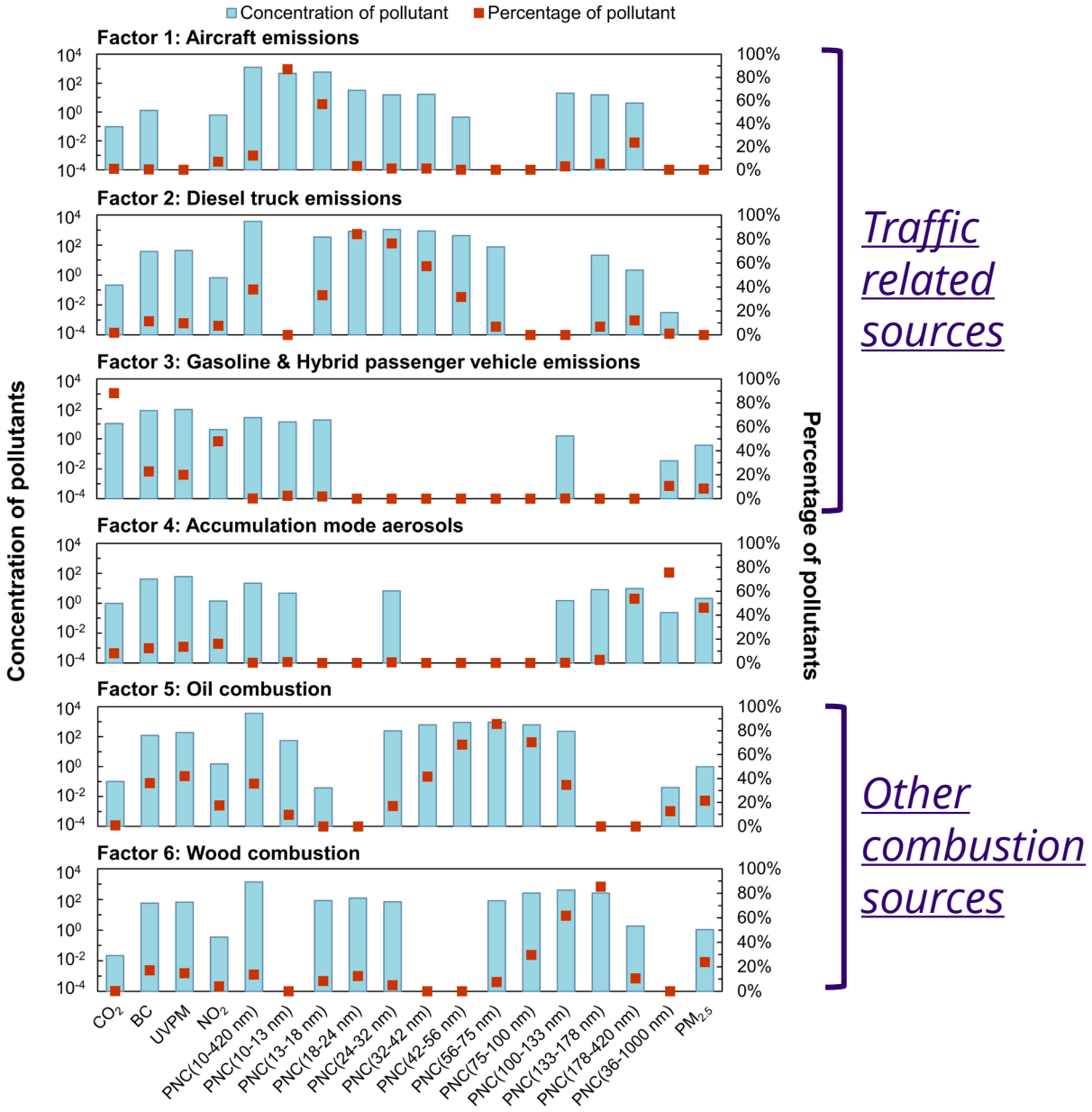
i=1,2,…,I; j=1,2,…J
I = 8125 visits, J = 18 species

  - x_{ij} means the concentration of species j in sample i (i=1,2,…,I; j=1,2,…,J)
  - g_{ik} means the **contribution** of source/factor k in sample i (k=1,2,…,K)
  - f_{kj} means the species **profile** of source/factor k, i.e., the concentration of species j in factor k

- **Factor interpretation:**
  - **Particle size distribution**
  - **Mapping annual average site-specific factor contribution with** seasons, rush hours, wind directions, and ambient temperatures
  - **Land use regression (LUR) model**
  - **Ratios between different pollutants:** BC/CO_2, BrC/CO_2, NO_2/CO_2, PNC/CO_2, and $PM_{2.5}$/BC

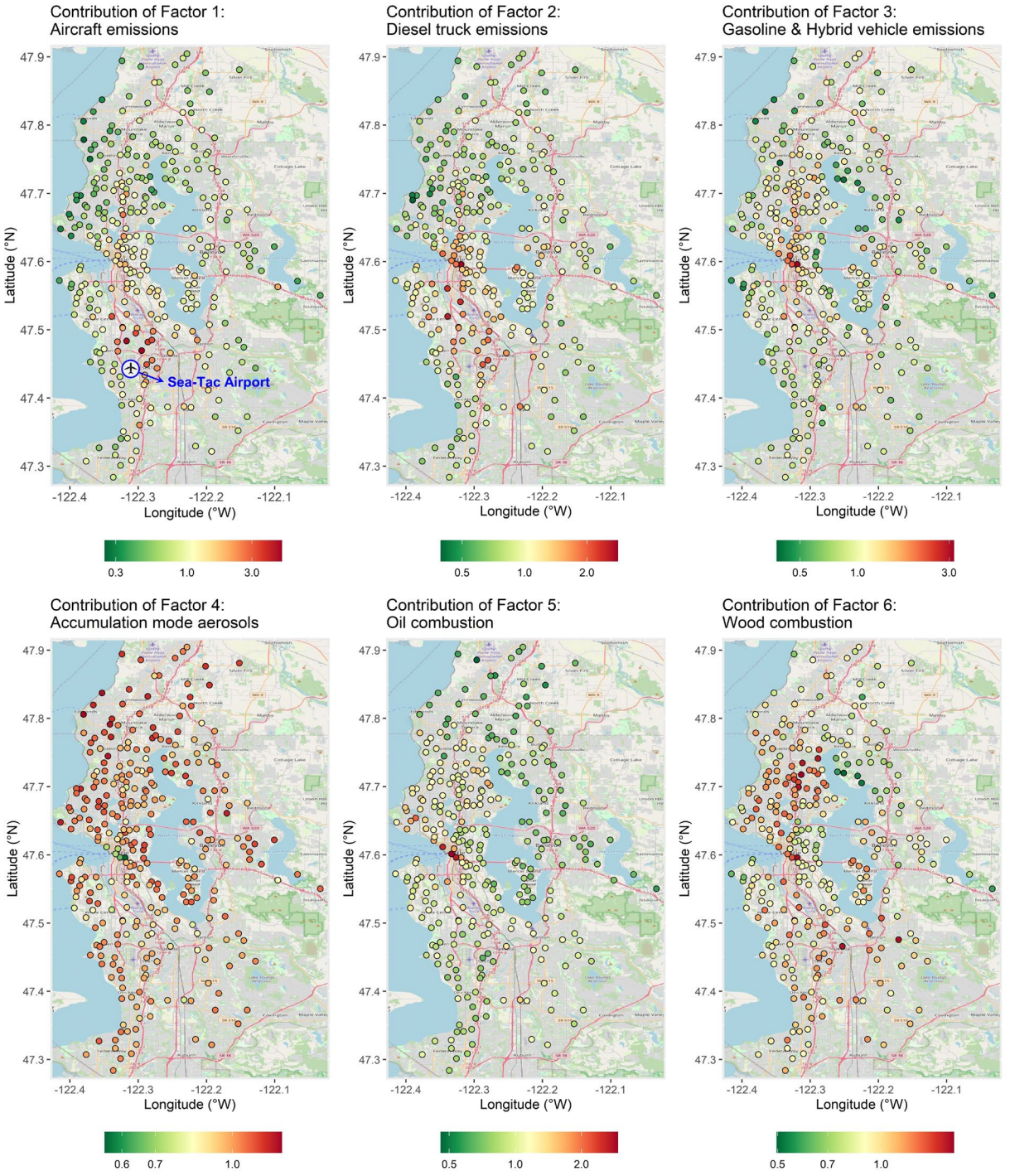
Liu et al., *ES&T*, 2025, 59, 3443−3458.

PMF results: Source info

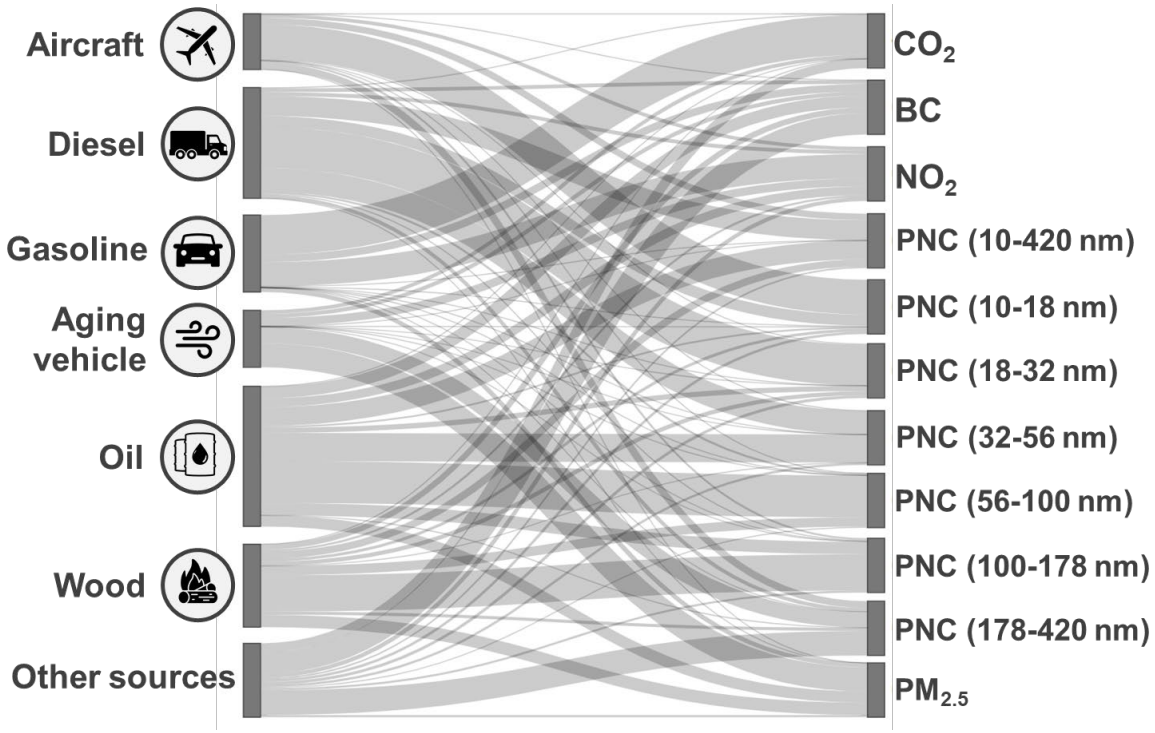


Traffic related sources

Other combustion sources



PMF results: Source-specific exposure



Pollutant	1st source	2nd source
CO_2	Gasoline (75%)	Aged (8%)
BC	Oil (22%)	Gasoline (14%)
TC	Oil (29%)	Gasoline (14%)
NO_2	Gasoline (44%)	Oil (16%)
PNC		
Total (10-420 nm)	Diesel (37%)	Oil (35%)
10-18 nm	Aircraft (64%)	Diesel (20%)
18-32 nm	Diesel (76%)	Oil (10%)
32-56 nm	Oil (52%)	Diesel (43%)
56-100 nm	Oil (77%)	Wood (17%)
100-178 nm	Wood (67%)	Oil (23%)
178-420 nm	Aged (38%)	Aircraft (15%)
$PM_{2.5}$	Aged (45%)	Wood (23%)

Liu et al., *ES&T*, 2025, 59, 3443−3458.

Traffic-related emission factors

$$EF_{j,k} = \frac{\Delta C_{j,k}}{\Delta CO_{2,k}} \times \omega \times 10^3 = Ratio \times \frac{44}{12} \times \omega \times 10^3$$

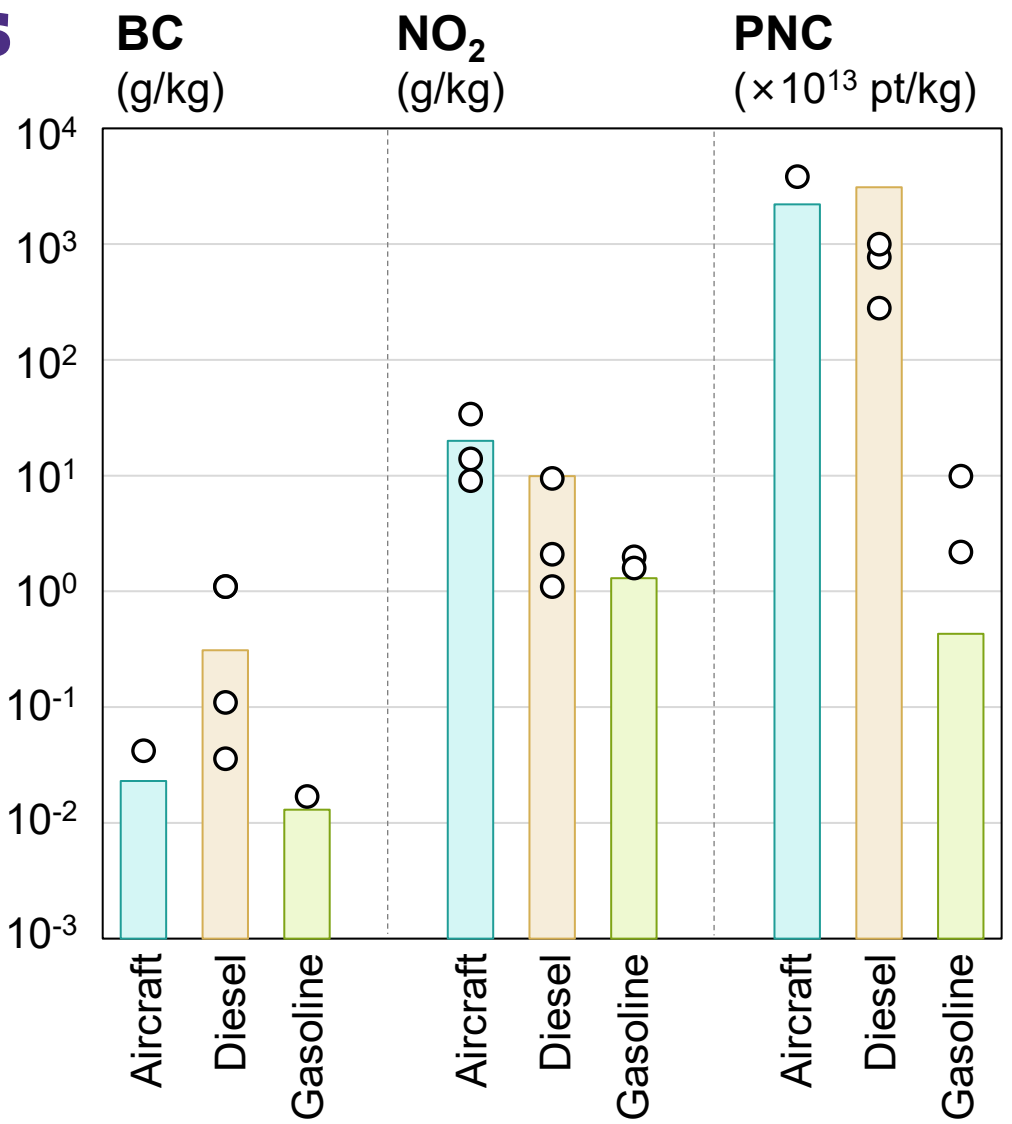
- $EF_{j,k}$ is the fuel-based EF of pollutant j for source k, g/kg fuel
- $\triangle C_{j,k}$ is the concentration of pollutant j in the profile of source k, g/m^3 (#/m^3 for PNC)
- $\triangle CO_{2,k}$ is the **background subtracted CO_2 concentration** in the profile of source k, g carbon/m^3
- ω is the carbon mass fraction in the fuel, set as 0.85 in this study

Background CO_2 is defined as the minimum CO_2 among all sites that day.

Traffic-related emission factors

- **EFs in this study were consistent with reported values in the literature.**
- **Comparison between vehicle types:**
  - **BC:** Diesel truck >> Aircraft > Gasoline car
  - **NO_2:** Aircraft > Diesel truck > Gasoline car
  - **PNC:** Diesel truck > Aircraft >> Gasoline car

Aircraft & Diesel truck > Gasoline car



Liu et al., *ES&T*, 2025, 59, 3443−3458.

Impacts of Aviation Emissions on Community Health

UNIVERSITY of WASHINGTON

Aviation and Public Health: Why it Matters for King County

Aviation activities generate a range of air pollutants with established health effects. Two major fuel types of concern: **Leaded aviation gasoline** (avgas) for piston-engine aircraft; **Jet A fuel** for turbine and jet aircraft.

Populations living or working near airports may experience higher exposures to lead, ultrafine particles, nitrogen oxides, and other pollutants. **King County has multiple airports with both piston-engine and jet traffic near residential areas, schools, and community spaces.**

Understanding local emission sources and exposures is important for assessing public health impacts. Airborne pollutants from aviation harm neurological, cardiovascular, and respiratory health (US EPA, 2023).

Leaded Avgas: The Largest Remaining Source of Airborne Lead

- Piston-engine aircraft account for ~70% of airborne lead emissions in the U.S. (Klemick et al., 2022).
- Even very low blood lead levels (BLLs) are linked to adverse neurodevelopmental and cardiovascular outcomes (PEHSU, 2024).
- The U.S. EPA (2023) determined that aircraft lead emissions endanger public health and welfare.
- Lead persists in soil, dust, and bone long after emissions stop (WHO, 2023).

Figure 1: Piston engine aircraft (source: proaviationtips.com).

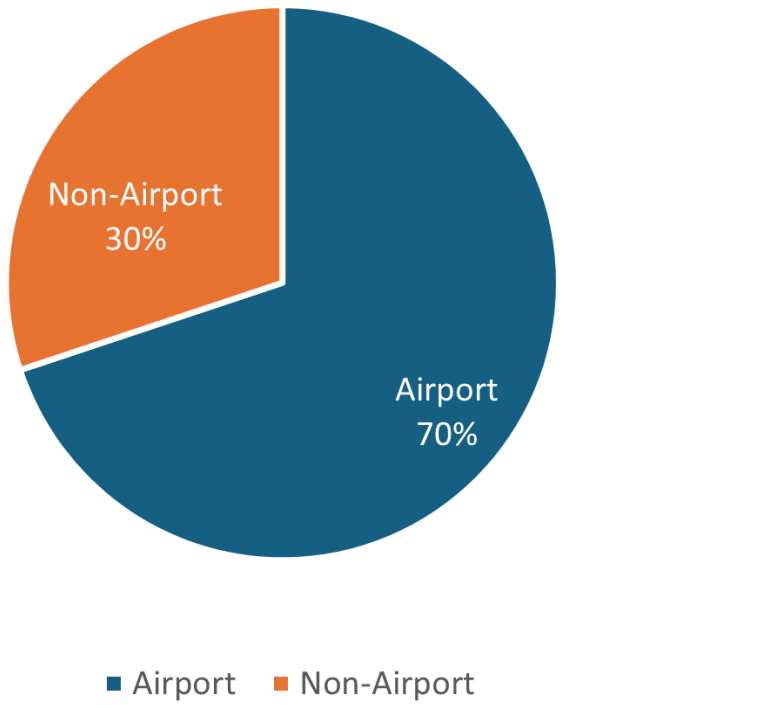
Technical Assistance Request

- The University of Washington Center for Environmental Health Equity received a technical assistance request from the King County International Airport Community Coalition
  - Literature search on the impact of Leaded Aviation Gasoline
  - Description of current lead emissions in air
  - Identification of possible mitigation strategies

Airport lead emissions in King County

Facility Type	KC Facilities (Count)	KC Facilities (%)	Emissions (Tons)	Emissions (%)
Airport	15	**58%**	1.23	**70%**
Non-Airport	11	**42%**	0.53	**30%**
Total	26	100%	1.76	100%

Airports comprise **58%** of all facilities emitting lead in King County, and they are accountable for **70%** of the airborne lead emissions in the county.



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Source: Out Nation's Air: Status and Trends Through 2021

Evidence from Multiple States: Elevated Child Blood Lead Near Airports

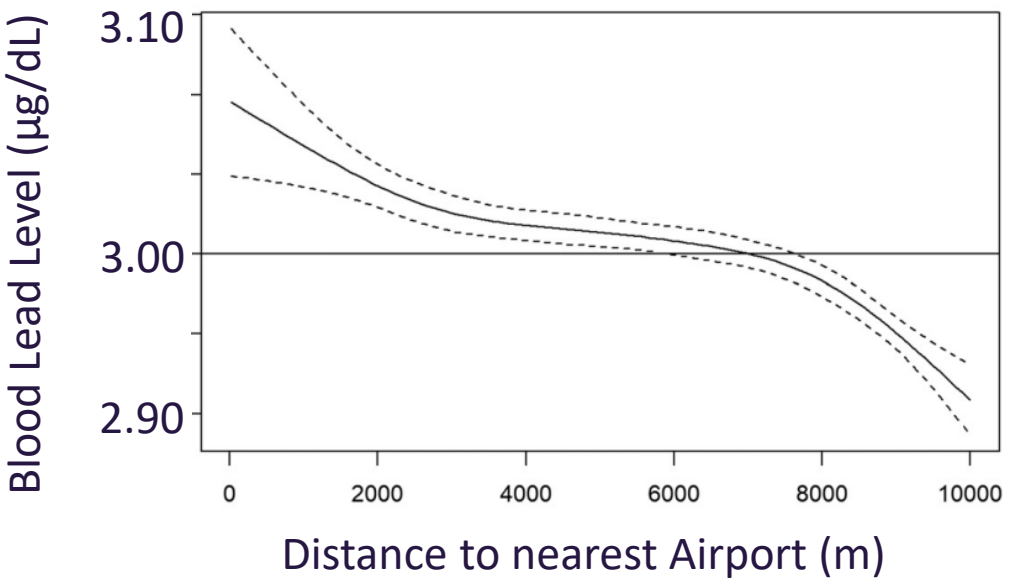


Figure 2: Average modeled blood lead level (BLL) in North Carolina children by residential distance to nearest piston-engine airport (adapted from Saole et al., 2024)

- Multiple studies report higher blood lead levels (BLLs) among children living closer to airports with piston-engine traffic.
  - California: Higher BLLs with proximity, downwind location, and higher traffic volumes (Zahran et al., 2022).
  - North Carolina: Elevated BLLs up to 1.5 km; stronger effects downwind (Soale et al., 2024).
  - Colorado: Increased distance from airports associated with lower BLLs (Berg et al., 2024).

Local context:

- Bellingham WA: Downwind lead deposition sampling doubled background levels (Shull et al., 2025).

Health Risks in Adults: More Limited Evidence

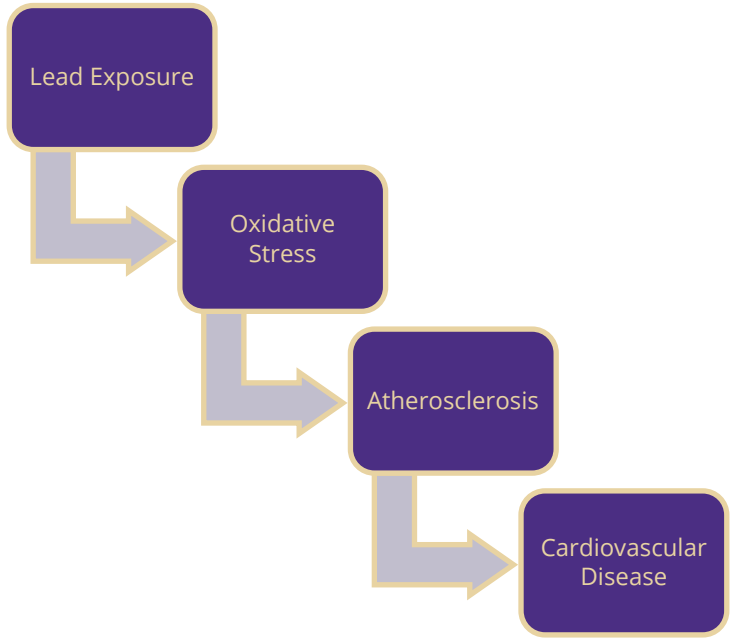


Figure 3: Mechanistic pathway linking lead exposure to cardiovascular disease, adapted from the U.S. EPA Integrated Science Assessment (ISA) for Lead 2020.

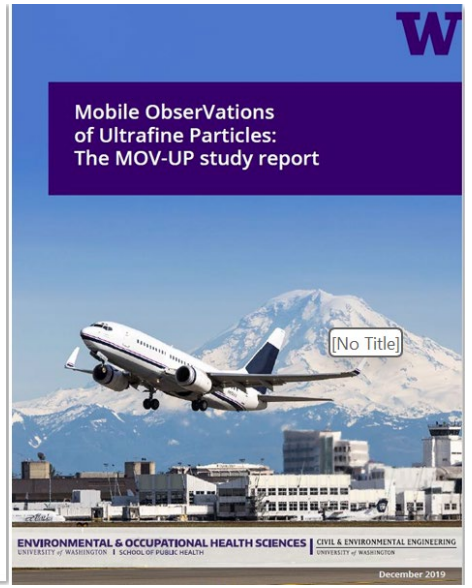
- Among older adults, living within 1–3 km downwind of single-runway airports was associated with higher cardiovascular mortality in years with more piston-engine traffic (Klemick et al., 2022).
- Biological pathway is described by the EPA and includes oxidative stress and atherosclerosis (EPA ISA, 2020).

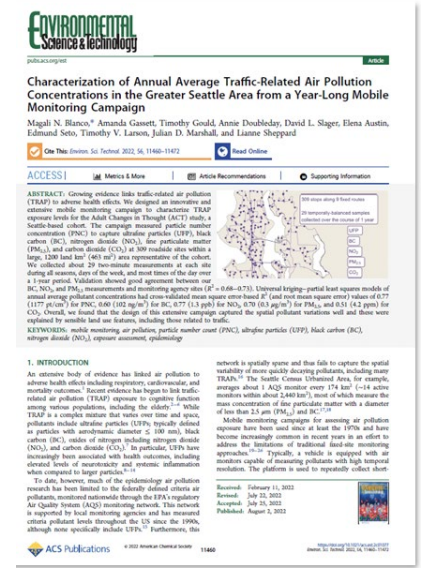
Jet A and Non-Lead Aviation Emissions

- Jet A exhaust contains ultrafine particles (UFP), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs).
- UFPs can penetrate deep into the lungs, cross into the bloodstream, and have been linked to cardiovascular, neurological, and respiratory outcomes. (EPA ISA $PM_{2.5}$ 2019).
- Elevated UFP levels have been measured several kilometers downwind of airports, including near Sea-Tac (Larson et al., 2017; Austin et al., 2021; Blanco et al., 2022; Liu et al., 2025).

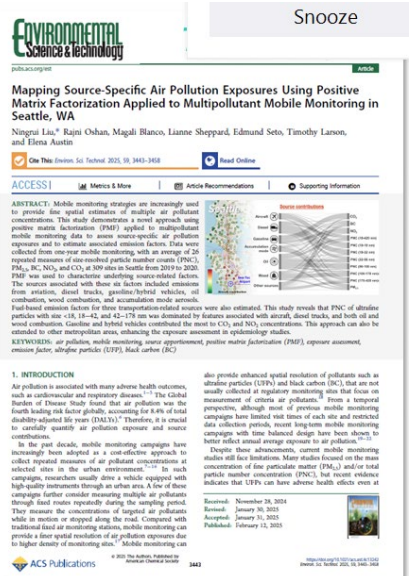

Atmospheric Environment

Ambient air quality measurements from a continuously moving mobile platform: Estimation of area-wide, fuel-based, mobile source emission factors using absolute principal component scores



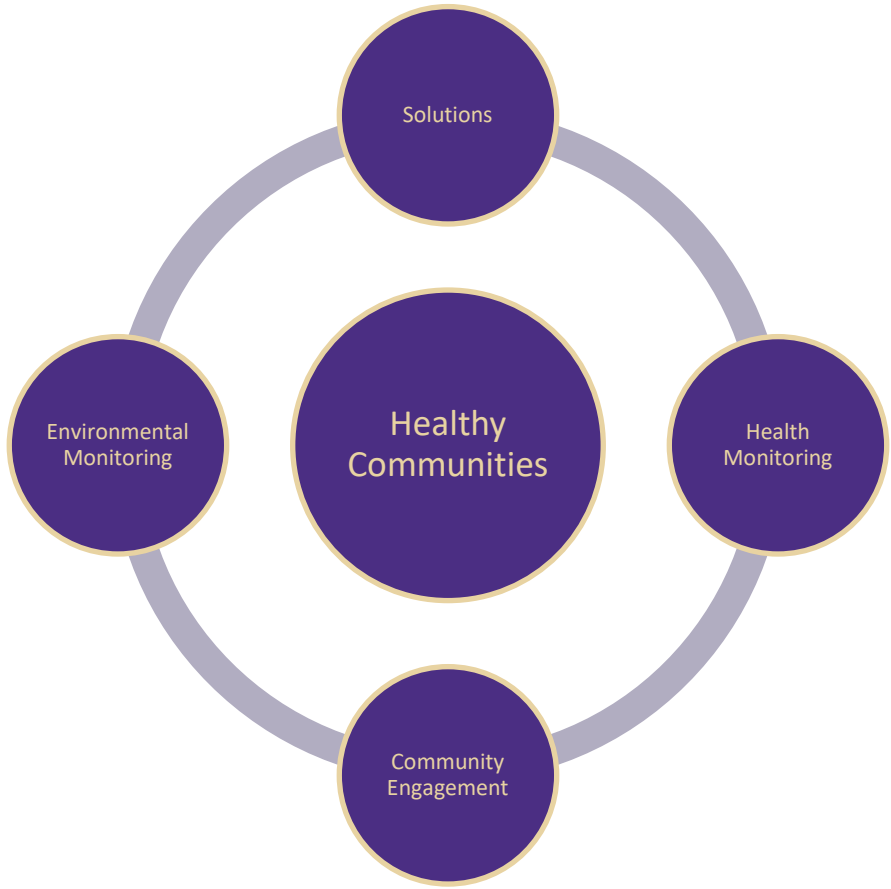

Characterization of Annual Average Traffic-Related Air Pollution Concentrations in the Greater Seattle Area from a Year-Long Mobile Monitoring Campaign

Snooze


Mapping Source-Specific Air Pollution Exposures Using Positive Matrix Factorization Applied to Multipollutant Mobile Monitoring in Seattle, WA

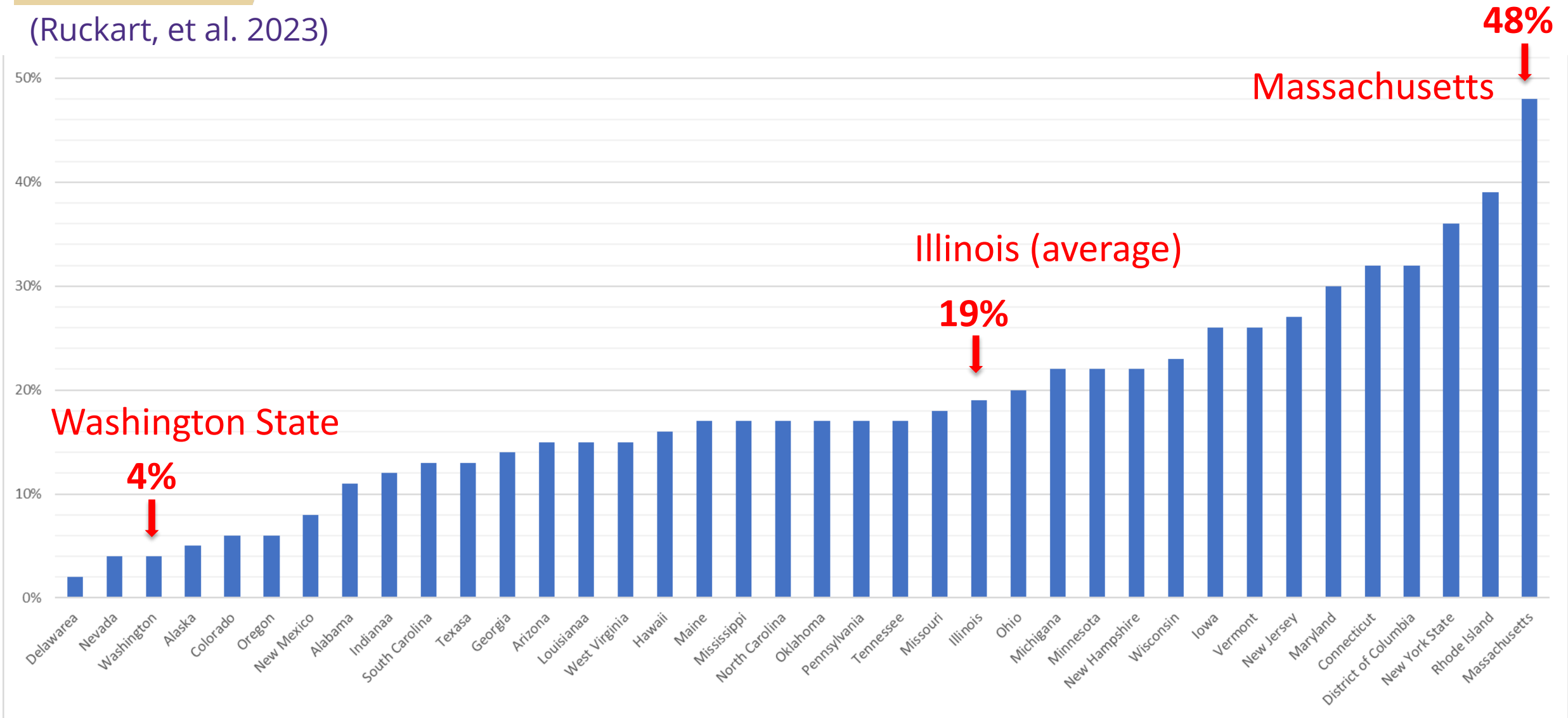
Strategies to Address Airport-Related Air Pollution and Health Risks

- **Environmental Monitoring**: Evidence supports the value of expanding measurement of airborne lead, ultrafine particles, and other pollutants to better characterize air quality around local airports.
- **Health Monitoring**: Data suggest that exposure reductions solutions, targeted blood lead testing for children living near airports and cardiovascular health assessments for adults in higher-exposure areas may help identify and mitigate risk for at-risk populations.
- **Community Engagement**: Partnering with local communities to share information on air quality, support voluntary testing, and discuss potential solutions can strengthen public understanding and participation.
- **Solutions**: Studies indicate that unleaded aviation gasoline, sustainable aviation fuels, adjustments to ground operations, and implementation of HEPA filtration interventions are shown to reduce impact of aviation emissions.



Proportion of Children Tested for Blood Lead Levels in 2017–2018, by State

(Ruckart, et al. 2023)



UFP Research and Policy Update

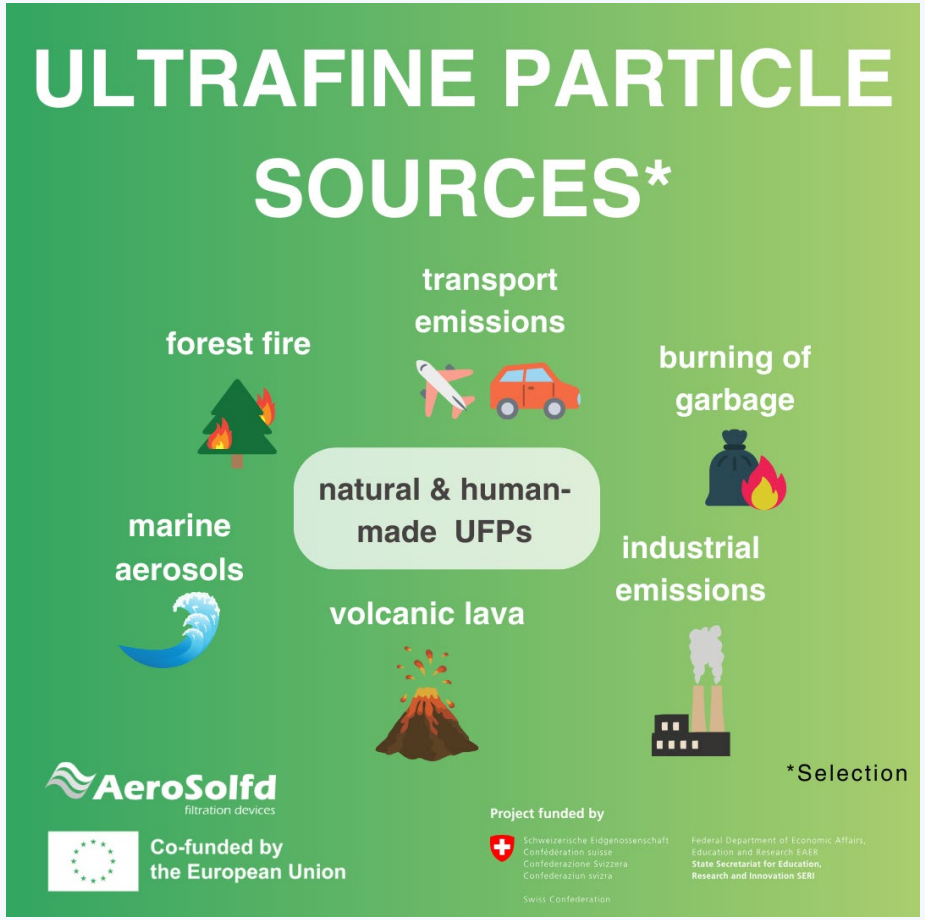
UNIVERSITY of WASHINGTON

Ultrafine Particles: Ambient Exposure Monitoring and Standards

No U.S. ambient ultrafine particle (UFP; ≤100 nm) standard, NAAQS regulate PM2.5 and PM10 only.

WHO (2021) issued qualitative “good practice” statements for UFPs; no numeric guideline value.

EU Ambient Air Quality Directive (2024) mandates ambient monitoring of particle number (≥10 nm) at representative sites; **no regulatory thresholds yet.**



EU: Infographic on sources

Ultrafine Particle – Relevant Policies

Aviation: ICAO adopted non-volatile PM (nvPM) mass/number standards (2017); FAA finalized adoption in U.S. rulemaking (2024).

Vehicles: U.S. remains mass-based (no PN limit); EU continues PN source standards.

Occupational: No generic OEL for “UFP” class, but agent-specific limits exist:

- NIOSH REL: ultrafine TiO_2 = 0.3 mg/m³ (10-h TWA)
- NIOSH REL: carbon nanotubes/nanofibers = 1 µg/m³ (EC, 8–10 h TWA)
- MSHA underground metal/nonmetal mines: 160 µg/m³ total carbon (8-h TWA) as DPM.

Ultrafine Particle Number Concentration (PNC)—Interpretive Bands

Based on WHO 2021 Good Practice Statement (UFP)

LOW PNC

< 1,000 particles/cm³

24-hour mean

HIGH PNC

> 10,000 particles/cm³

24-hour mean

OR

≥ 20,000 particles/cm³

1-hour mean

World Health Organization. WHO Global Air Quality Guidelines. Geneva: WHO; 2021. Box 4.2 (Good practice—UFP).

References

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8. National Institute for Occupational Safety and Health (NIOSH). Occupational Exposure to Carbon Nanotubes and Nanofibers. DHHS (NIOSH) Publication No. 2013-145. Accessed September 19, 2025. https://www.cdc.gov/niosh/docs/2013-145/pdfs/2013-145.pdf

9. 30 CFR §57.5060. Limit on exposure to diesel particulate matter. Accessed September 19, 2025. https://www.law.cornell.edu/cfr/text/30/57.5060

SAF Report Update

UNIVERSITY of WASHINGTON

SAF Research and Future Directions

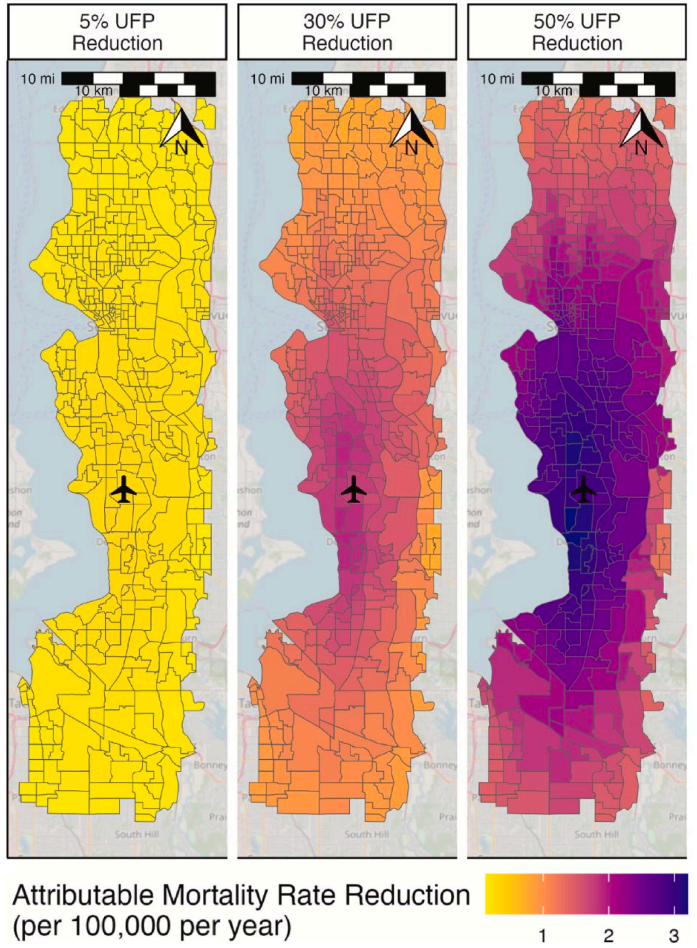
- **Washington State Legislature SB 5447** mandates University of Washington to quantify the benefits of alternative jet fuels (AJFs) compared to fossil jet fuel.
- **Recent report** explores potential regional air quality benefits of adopting sustainable aviation fuels (SAF) at Sea-Tac International Airport (submitted on December 1, 2024).

Austin et al., 2024

Scan the QR code for the full report!

Potential Impacts of SAF Use

- **Emissions:** SAFs reduce UFP and SO_x emissions, particularly effective during low thrust operations (e.g., idle, taxi, landing).
- **Air quality:** SAFs could lead to lower UFP concentrations but negligible impact on NO_x.
- **Health impact:** SAF-emitted UFP show reduced cellular toxicity; health risk assessment greater mortality rate reduction with higher SAF blend ratio scenarios.

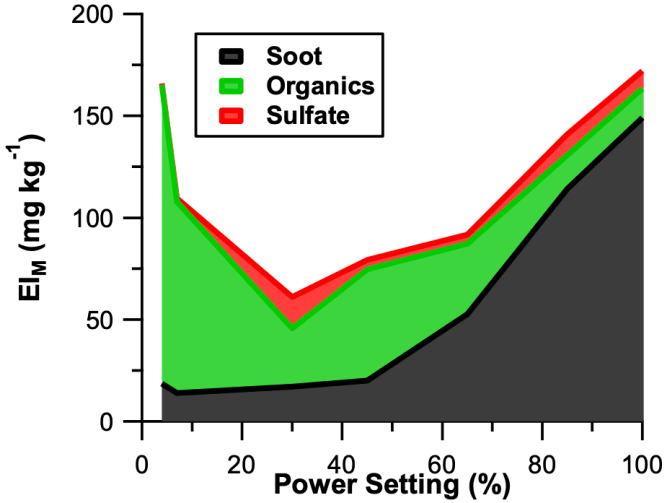


Attributable mortality rate reduction by SAF blend ratios (figure adopted by Blanco et al., 2025)

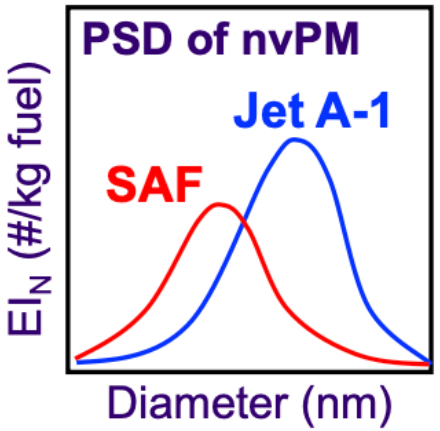
Substantial benefits when SAF is used during low-thrust operations

Community Relevance

- Highest impacts on communities occur during aircraft **idle/taxi**, **landing**, and **takeoff**.
- Relatively **low proportions** of SAF blends (e.g., ~10%) offer meaningful emission reductions.
- Adopting SAFs for **landing aircraft** would likely yield substantial community benefits, but local ports control only the **fueling for takeoff**.
- **SAF usage** and extensive **monitoring efforts** are needed to quantify the community health benefits of SAFs.



Chemical composition of nvPM by thrust (figure adopted from Beyersdorf et al., 2014)



Particle size distribution of nvPM by fuel type

The FAA's Neighborhood Environment Survey

Updated aviation noise annoyance curves

EDMUND SETO, PHD

Motivation for the FAA Neighborhood Environment Survey (NES)

- Historically the relationship between aviation noise levels and population annoyance has informed federal policies (e.g., the "Schultz Curve")
- Federal Interagency Committee on Noise (FICON) 1992 suggested that 12.3% of population are highly annoyed by Day-Night Average Sound Level (DNL) of 65 dB.
- However
  - More recent studies outside of the US suggest higher annoyance at a given noise level than indicated by FICON 1992
  - Previous FICON 1992 were not aviation-specific
  - Need for updated US-based and aviation-specific noise annoyance curves

FAA Neighborhood Environmental Survey

- **Sampling:**
  - **Airports in the US with >100 annual average daily jet operations**
  - **At least 100 people exposed to DNL >65 dB and at least 100 people exposed to DNL between 60 – 65 dB**
  - **From an initial list of 95, 20 airports selected**
- **Noise contours modeled using FAA Integrated Noise Model (INM)**
- **Residents surveyed via mail/telephone in 2015:**
  - *"Thinking about the last 12 months or so, when you are here at home, how much does [noise from aircraft] bother, disturb or annoy you?"*
- **Over 10,000 people responded**

Miller, et al., 2021 Analysis of the Neighborhood Environmental Survey, DOT/FAA/TC-21/4

FAA Neighborhood Environmental Survey

Table 3-3. The 20 Airports in the Sample

Identifier	Airport Name	Identifier	Airport Name
ABQ	Albuquerque International Sunport	LAX	Los Angeles International
ALB	Albany International	LGA	LaGuardia
ATL	Hartsfield-Jackson Atlanta International	LIT	Bill and Hillary Clinton National Airport / Adams Field
AUS	Austin-Bergstrom International	MEM	Memphis International
BDL	Bradley International	MIA	Miami International
BFI	Boeing Field / King County International	ORD	Chicago O'Hare International
BIL	Billings Logan International	SAV	Savannah / Hilton Head International
DSM	Des Moines International	SJC	Norman Y. Mineta San Jose International
DTW	Detroit Metropolitan Wayne County	SYR	Syracuse Hancock International
LAS	McCarran International	TUS	Tucson International

Miller, et al., 2021 Analysis of the Neighborhood Environmental Survey, DOT/FAA/TC-21/4

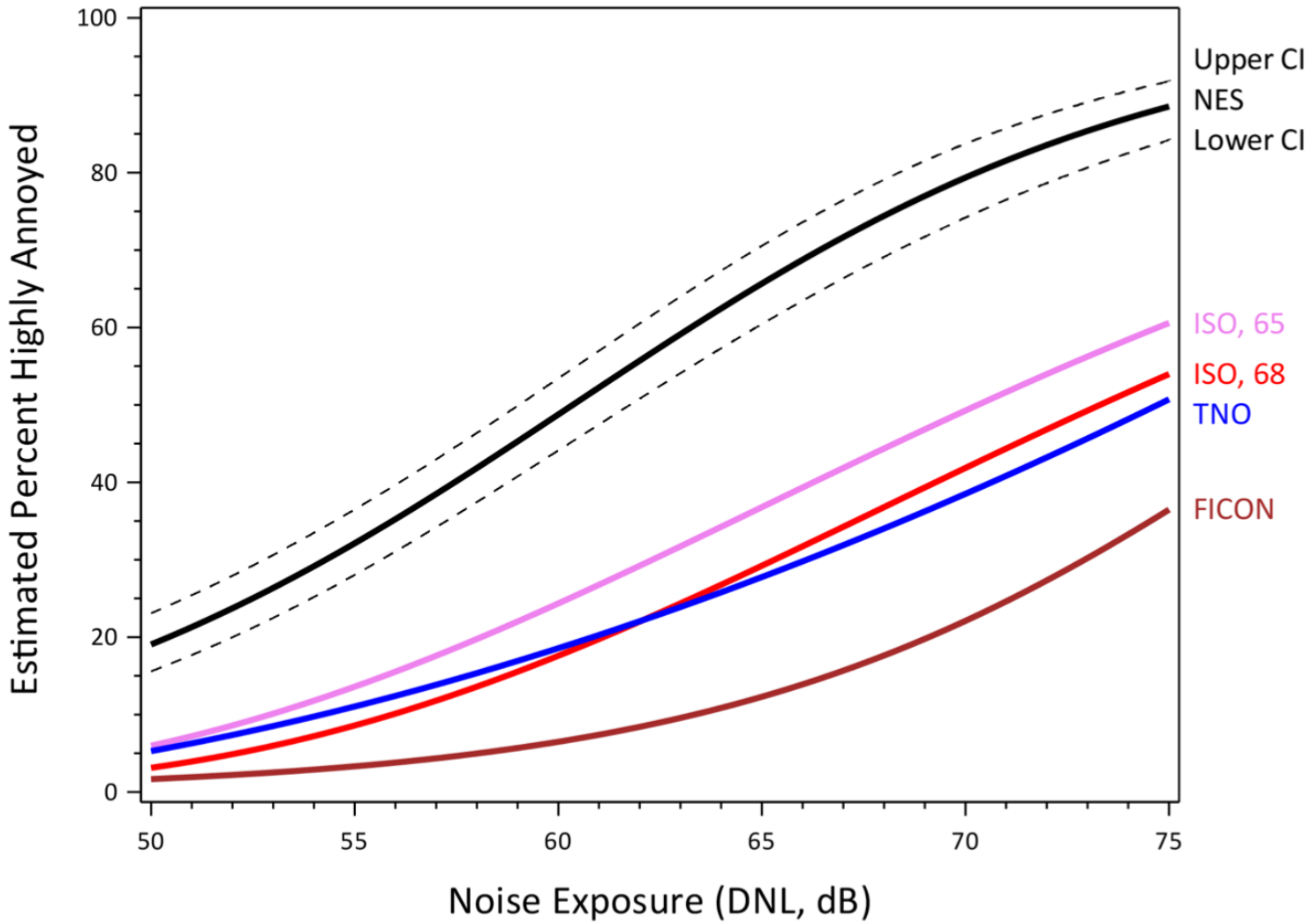


Figure 8-4. National Dose-Response Curve (NES), with 95 Percent Confidence Intervals (CI) on Annoyance for a given DNL. TNO, FICON and ISO Curves with Constants 65 and 68 are Shown Below the National Curve

Miller, et al., 2021 Analysis of the Neighborhood Environmental Survey, DOT/FAA/TC-21/4

FAA NES & Non-Acoustic Factors

5. Thinking about the last 12 months or so, when you are here at home, how much does each of the following bother, disturb or annoy you?

	Not at all	Slightly	Moderately	Very	Extremely
a. Noise from cars, trucks or other road traffic	☐	☐	☐	☐	☐
b. Smells or dirt from road traffic	☐	☐	☐	☐	☐
c. Smoke, gas or bad smells from anything else	☐	☐	☐	☐	☐
d. Litter or poorly kept up housing	☐	☐	☐	☐	☐
e. Noise from aircraft	☐	☐	☐	☐	☐
f. Your neighbors' noise or other activities	☐	☐	☐	☐	☐
g. Any other noises you hear when you are here at home If this bothers or annoys you, what is the noise? _____	☐	☐	☐	☐	☐
h. Undesirable business, institutional or industrial property	☐	☐	☐	☐	☐
i. A lack of parks or green spaces	☐	☐	☐	☐	☐
j. Inadequate public transportation	☐	☐	☐	☐	☐
k. The amount of neighborhood crime	☐	☐	☐	☐	☐
l. Poor city or county services	☐	☐	☐	☐	☐
m. Any other problems that you notice when you are here at home If this bothers or annoys you, what is the problem? _____	☐	☐	☐	☐	☐

Miller, et al., 2021 Analysis of the Neighborhood Environmental Survey, DOT/FAA/TC-21/4

Noise from other sources may act cumulatively on aviation noise annoyance

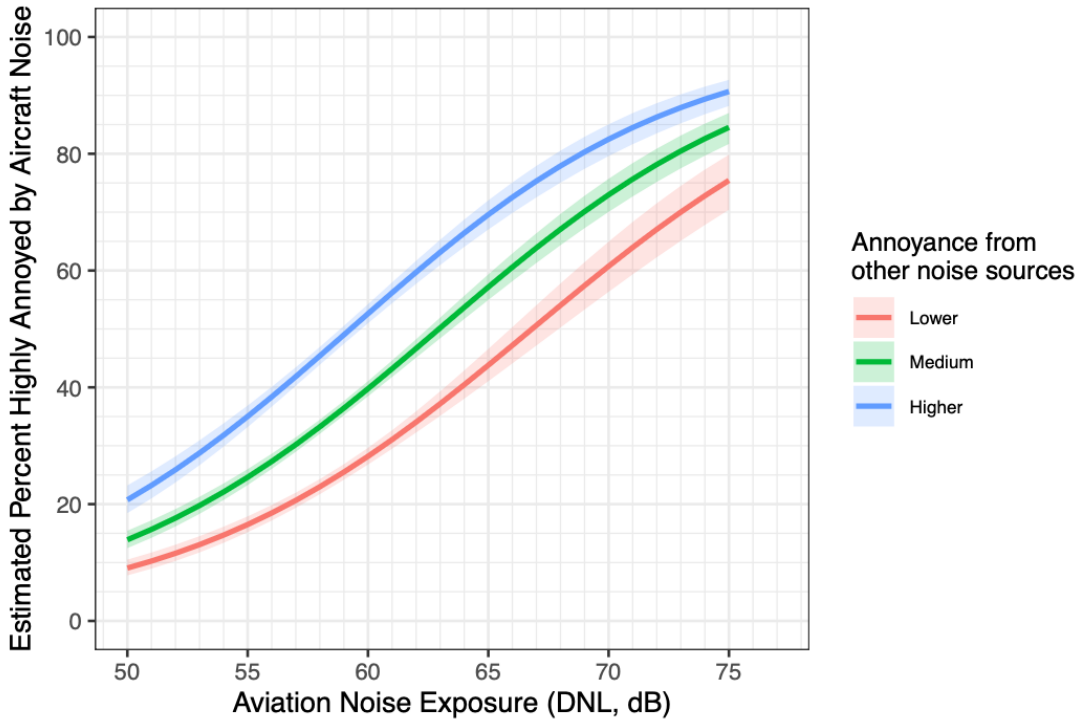
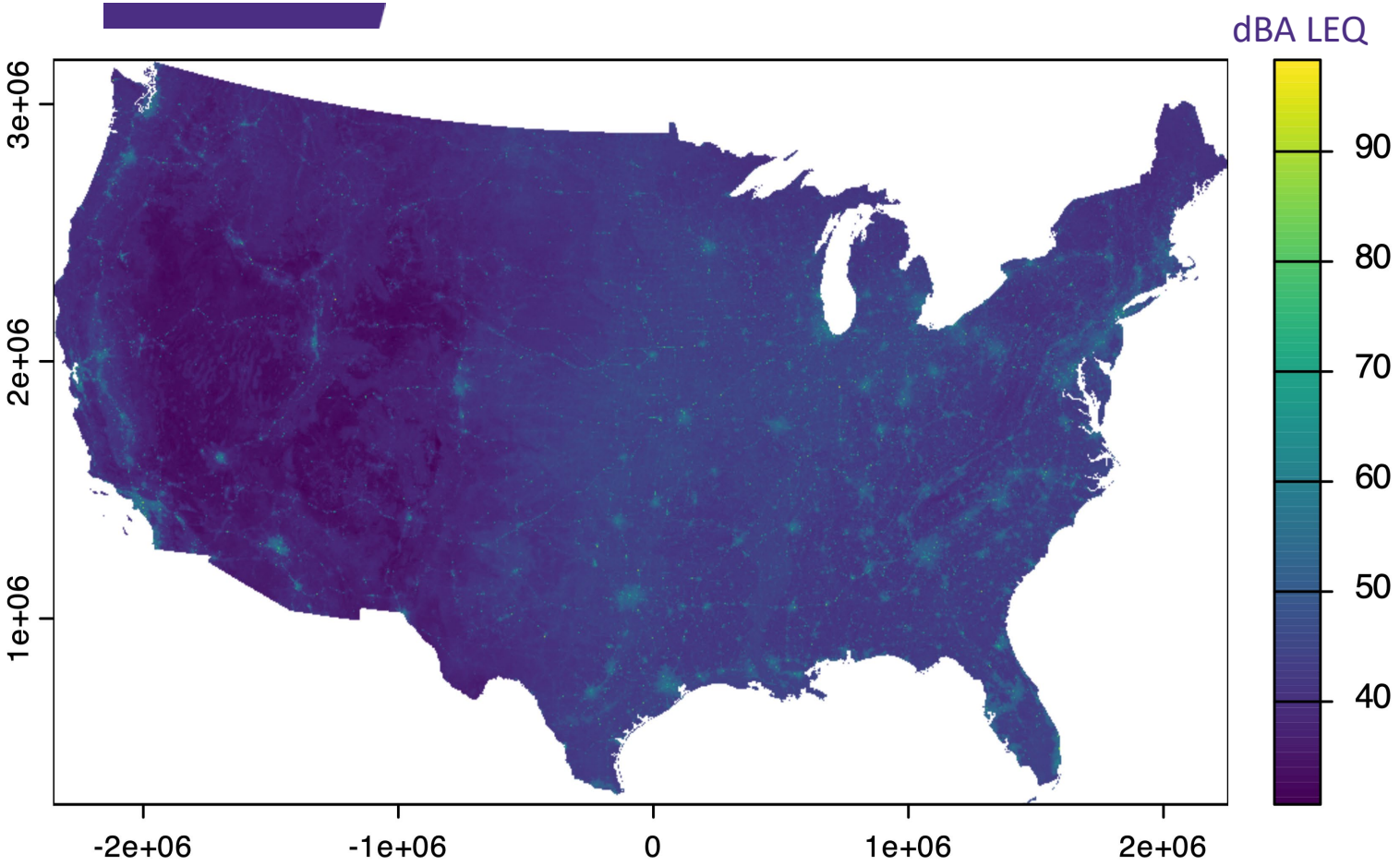


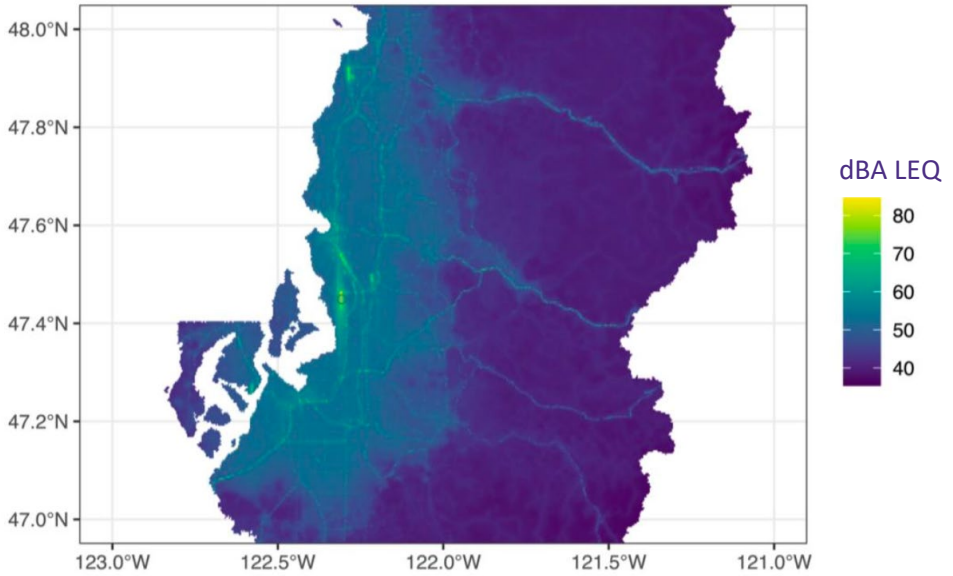
Figure 3. Dose-response for percent highly annoyed by aircraft noise for aviation DNL noise exposure, for those reporting low, medium, or high annoyance to other noise sources (e.g., roadway traffic, neighbors, or other noise). Levels for lower, medium, and higher were based on 25th, 50th, and 75th percentiles of the other (non-aviation) noise sources annoyance score. Shaded regions indicate the 95% CI estimated from a pooled, not airport-specific model. Model coefficients provided in Table S2.

Seto and Huang, 2025. https://doi.org/10.1101/2025.08.02.25332879

New UW National Noise Map



King County



Huang and Seto, 2025. https://doi.org/10.1101/2025.09.23.25336495

Regional Monitoring Enhancement

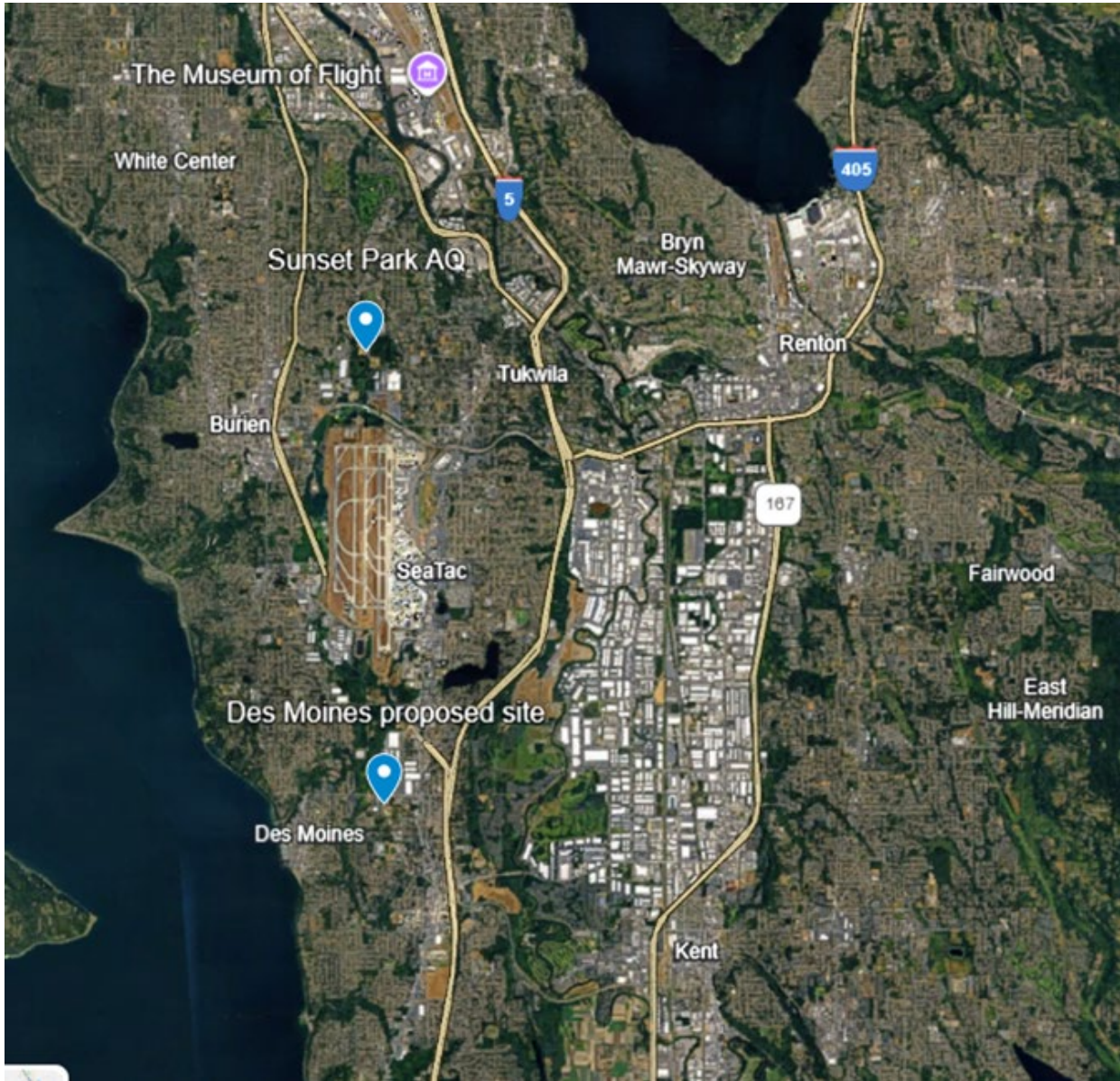
Air Monitoring for UFPs near Sea-Tac

Purpose

Characterize aircraft and regional air pollution sources

Monitoring Objectives

- Track long-term air quality trends
- Evaluate airport operation impacts
- Assess mitigation efforts (e.g., changes in flight volume, trajectory, SAFs)



Support for UFP Monitors, Expected Results

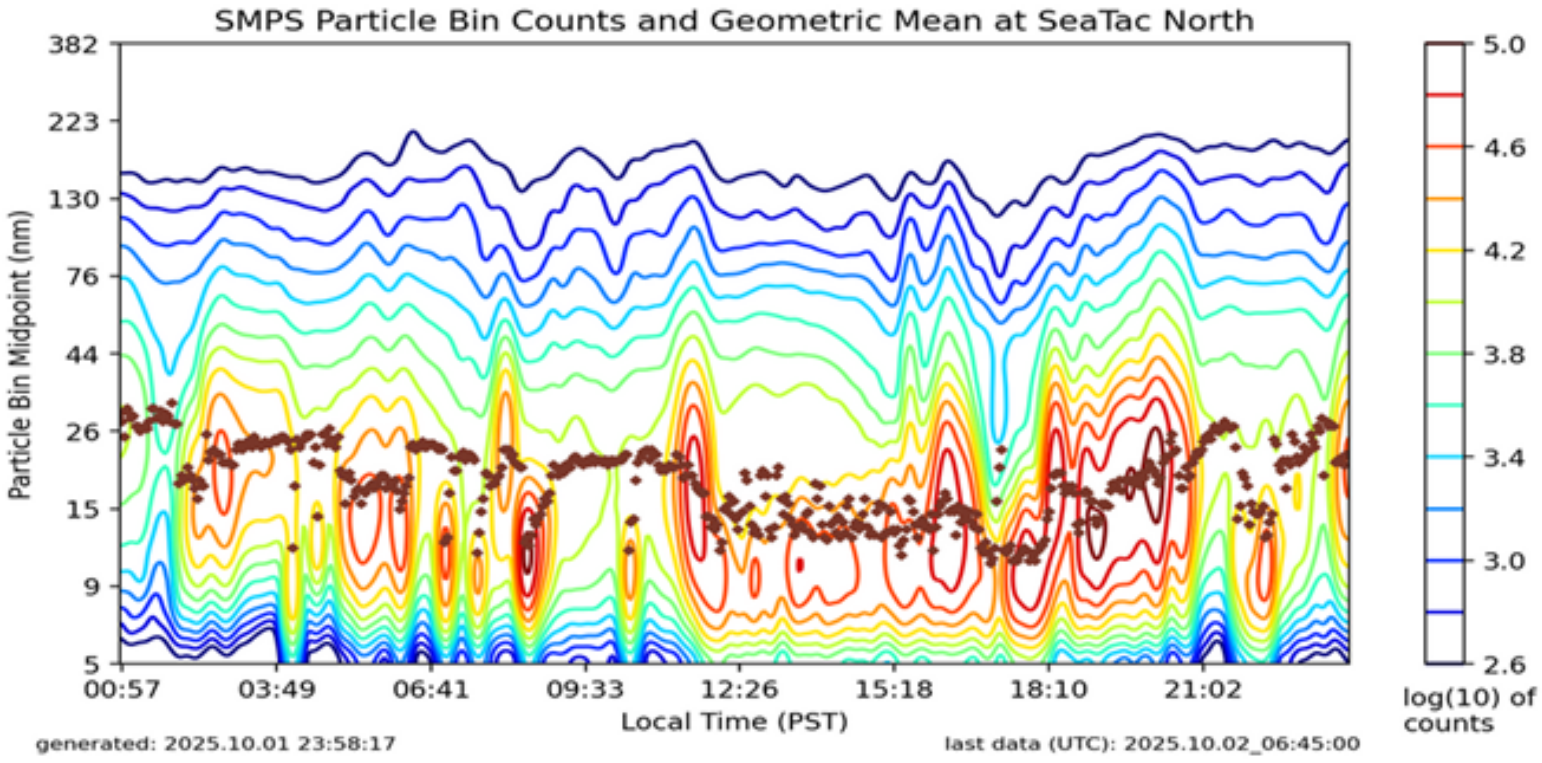
- PSCAA SeaTac (North) site supported by EPA grant; UFP monitors from State budget proviso
- Contract arrangement with Dept. of Commerce via Capital Budget ’25-’27 funds Des Moines (South) site
- Enhanced scientific understanding
- Community engagement
- Public Health benefits

Air Quality Data Analysis and Reporting

Evaluate Trends
Account for weather, airport traffic, and fuel changes

Source Apportionment
Identify and quantify pollution sources, with emphasis on transportation emissions

Regional Context
Compare Des Moines station data with other King County sites



Communication
Share findings in accessible ways with local residents

Mitigation Strategies
Provide data to support practical solutions for affected communities

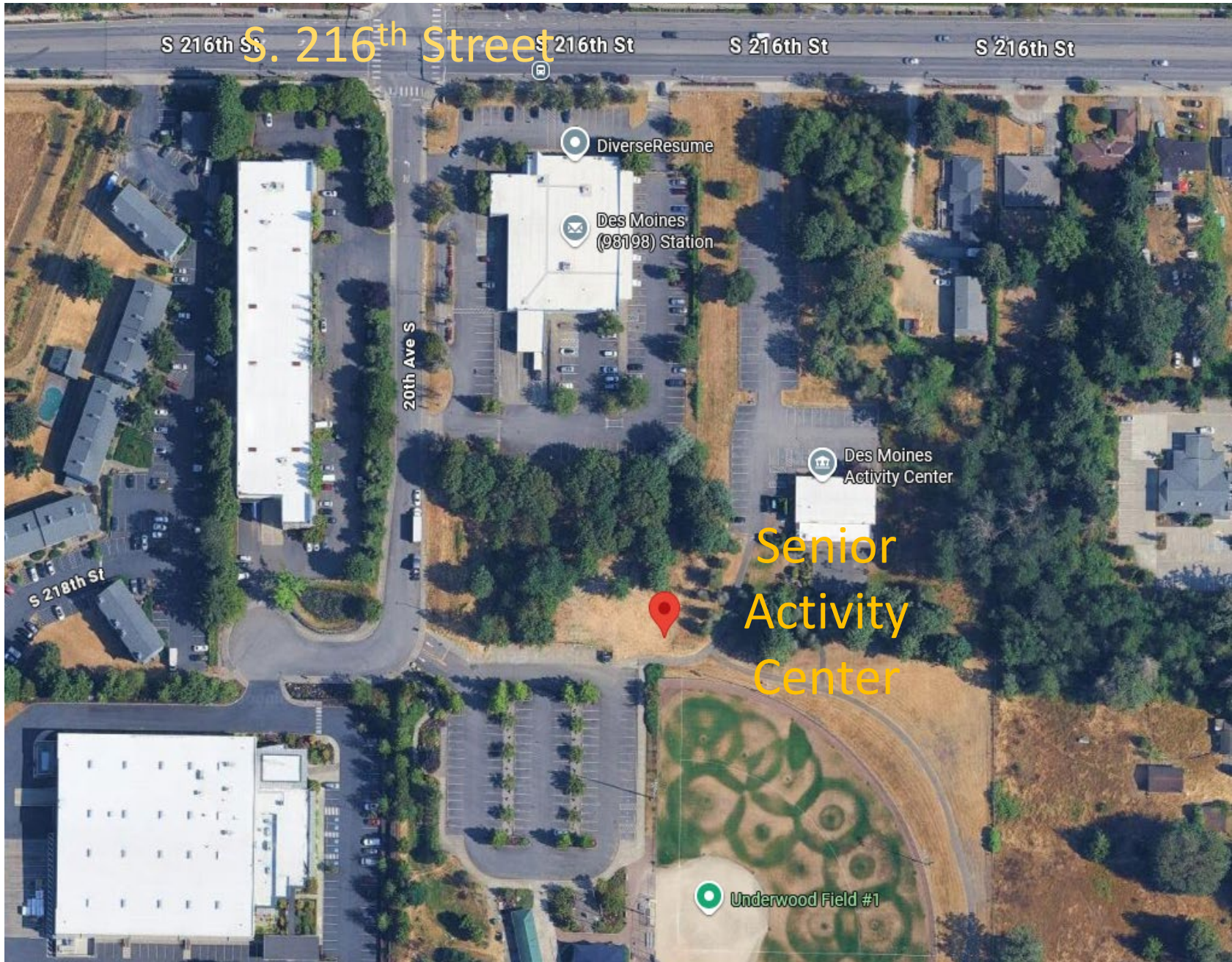
Implementation of Des Moines Sampling System

Site: Underwood Park near Senior Center

UW instruments: UFP size distribution, $PM_{2.5}$, black carbon, NO_2, CO_2

Shelter acquisition from PSCAA

Design of secure site layout



Setting UW's Future Research Priorities on UFP

Help UW prioritize follow-up research from MOV-UP on aircraft ultrafine particles (UFP).

Research topics you'll rank based on what you think should drive future UW research priorities:

- Health effects
- Mitigation topics
- Exposure-science topics

Using Mentimeter

We will answer each question 1 at a time after describing the possible answers.

Scale: Drag to rank; #1 = highest priority (most important to you)
Timing: ~5 minutes per question. Please submit before the timer ends.

Anonymity: Responses are anonymous; aggregated results will be shown live.

How results will be used: To set near-term UW priorities (12–24 months) and identify items for longer-term planning.

Focus on actionability, feasibility, and community relevance when ranking.

Access Survey

https://www.menti.com/

Access Code: **5361 2246**

We will answer each question one at a time.

Question 1: Which Health Effects Study Designs Should UW Prioritize?

- Short-term human health study (*e.g.*, daily asthma symptoms & UFP exposure)
- Long-term human health study (*e.g.*, dementia risk with chronic UFP exposure)
- Experimental human health study (*e.g.*, respiratory health while exercising under a flight path with and without filtration)
- Cumulative impacts e.g combined effects of UFP + noise + housing quality
- Toxicology (*e.g.*, animal or lab studies on brain & cardiovascular impacts)
- Health tracking (*e.g.*, linking UFP to trends in health and vulnerability)
- Other → suggested by you

Question 2: How should we prioritize UW future research to mitigate and reduce human exposures to UFP?

- HEPA filter interventions → effectiveness of portable air cleaners in schools, homes, clinics
- Emission reduction → impact of sustainable aviation fuel (SAF) blends on UFP emissions
- Infrastructure changes → building ventilation upgrades, noise/air barriers, vegetation buffers
- Mitigation of cumulative impacts → pairing strategies for air + noise exposures
- Vulnerable locations → targeted protection for schools, health centers, parks etc.
- Other

Question 3: How should we prioritize UW future research on exposures to UFP?

- Trends over time → long-term UFP changes linked to flight operations
- Spatial variations → mobile monitoring in neighborhoods, fixed-site comparisons
- Communication of exposure → public dashboards, community-friendly reports
- Comparison to other airports → benchmarking Sea-Tac against other airports
- Distinguishing sources → separating roadway, Jet A, SAF and regional contributions
- Chemical composition → lead, bromine, 6-PPD-quinone in airport-related UFP
- Linkage to operations → matching UFP patterns with flight tracks and schedules
- Other

What we heard today

> For these top priorities, what kinds of studies would be most impactful?

> Where are the biggest opportunities and challenges?

> What partnerships or communities should we engage?

Where We Go From Here

- UW team will synthesize today's input → summary shared back with group.
- Feedback will directly inform near-term research planning and proposals.
- Advisory group will be re-engaged at key milestones (e.g., new findings, funding, policy windows).

Thank You & Continued Engagement

> Your expertise ensures UW research is actionable, feasible, and community-relevant.

What final advice or cautions would you leave us with today?