Mobile ObserVations of Ultrafine Particles (MOV-UP) Advisory

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Seattle King County Board of Health

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WA State Proviso

- Study the implications of air traffic at Sea-Tac

- Assess the concentrations of ultrafine particulate matter (UFP) in areas surrounding and directly impacted by air traffic

- Distinguish between and compare concentrations of aircraft-related and other sources of UFP

- Coordinate with local governments, and share results and solicit feedback from community

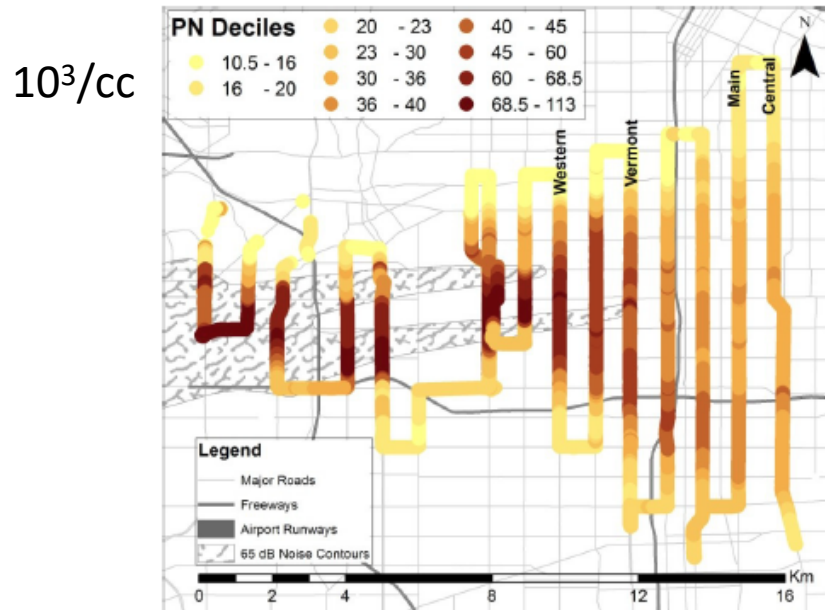- Produce study report by December 1, 2019

MOV-UP Study

Mobile ObserVations of Ultrafine Particles (MOV-UP) Study

A "mobile monitoring" approach...

This approach was used at LAX…

Area-weighted number concentration equivalent to ~ half the freeways in LA!

10^3/cc

Particle size between ~10 and 30 nm diameter are present at high concentrations at ground level

Hudda et al, ES&T 2014

Instruments used in MOV-UP sampling

| Parameter	Instrument
Mobile and Fixed sampling:	
Particle number concentration (35 nm – 1 μm)	P-Trak 8525, w/ diffusion screens
Particle number concentration (20 nm – 1 μm)	P-Trak 8525
Particle number concentration (10 nm – 1 μm)	Condensation Particle Counter 3007
Black Carbon PM	Micro-Aethalometer AE51
CO2	LI-850 Gas Analyzer
Temperature & Humidity	Hobo T, RH datalogger
Position & Time tracking	GPS Receiver DG-500
Fixed Location sampling:	
Particle size distribution, 13 bins	NanoScan 3910

TSI, Inc. model 3007 CPC

MOV-UP Monitoring Locations

Mobile Monitoring Transects + Stationary Sites
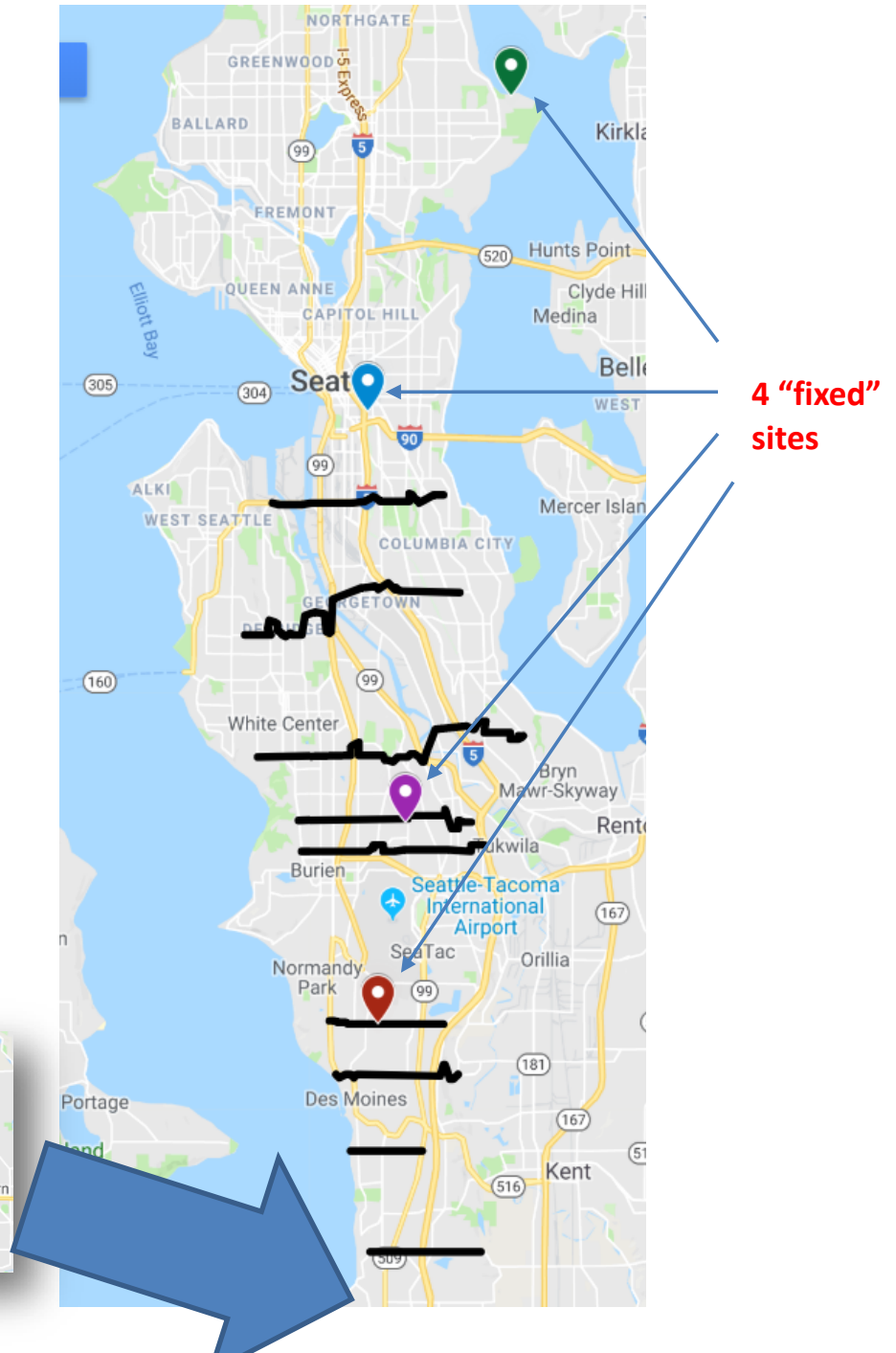
4 "fixed" sites

Fixed Site Monitoring Status

Fixed Site Monitoring	May 4th - May 11th	June 4th - June 13th	July 13th - July 16th	July 27th - Aug 1st	
10th & Weller	🟩				
Maywood		🟩		🟩	
SeaTac Community Center			🟩		
NOAA- Sand Point	🟩	🟩	🟩	🟩	→ *Background Site*

Data collection as of 2018

Season	Number of sampling days		
	Mobile monitoring	Airport fixed sites	Near highway fixed sites
Winter 2018	16		
Spring 2018	14	10	8
Summer 2018	16	15	
Autumn 2018	12	7	
Total finished	58	32	8

❖ Mobile monitoring typically occurs between 12 PM and 5 PM
❖ Typically monitoring consists of 2 concurrent cars (N and S of the airport)
❖ Another round of Mobile and Fixed site monitor was recently completed in January 2019.

PRELIMINARY RESULTS

Winter and partial Spring Mobile Monitoring (2018)

Date	Mean Temperature (F)	Predominant Wind Direction	Landing Direction (Field Notes)
7-Feb-18	53	South-east	N
8-Feb-18	52	South-west	N
9-Feb-18	48	South-west	N
12-Feb-18	44	North-west	S
13-Feb-18	46	South	N
14-Feb-18	42	South	N then S
15-Feb-18	43	South-west	N
16-Feb-18	46	South	N
7-Mar-18	48	West	S
8-Mar-18	50	South	N
9-Mar-18	49	South-west	N
12-Mar-18	71	East	S then N
13-Mar-18	51	South-west	N
14-Mar-18	50	South-west	N
15-Mar-18	54	West	S
16-Mar-18	54	South-west	S
18-Apr-18	55	South-west	S
19-Apr-18	60	West	S
20-Apr-18	59	South-west	N
23-Apr-18	66	North-west	S
24-Apr-18	74	West	S
25-Apr-18	69	North-west	S
26-Apr-18	76	North-west	S
27-Apr-18	55	South-west	N

Measurements
Primary Roadway (I-5) vs Transect
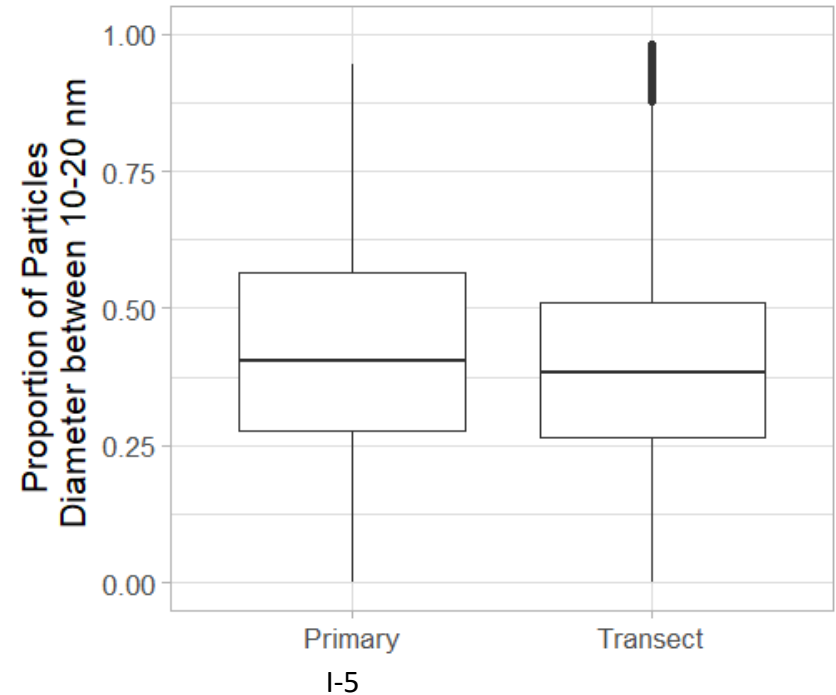### Winter - Spring Data
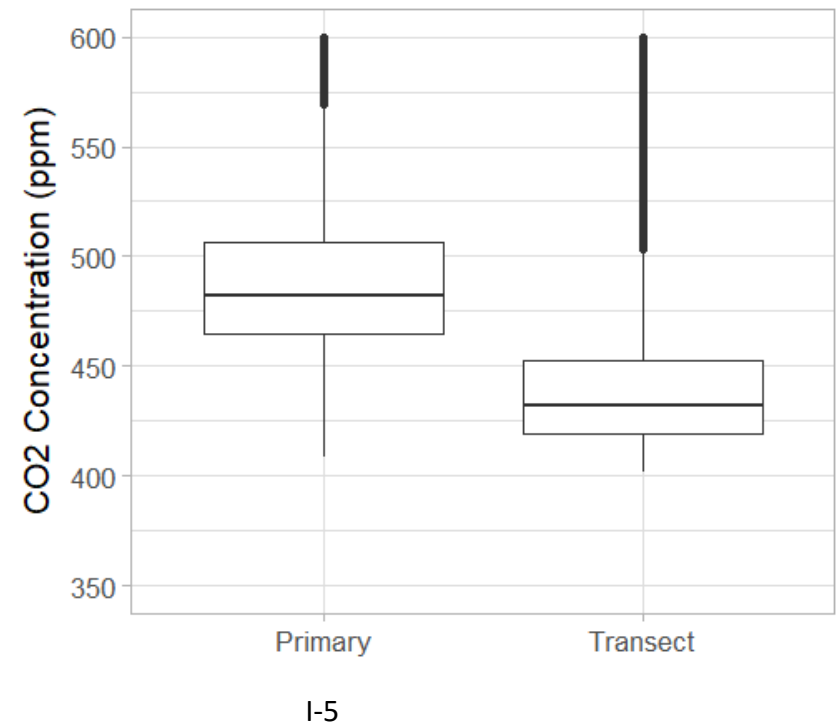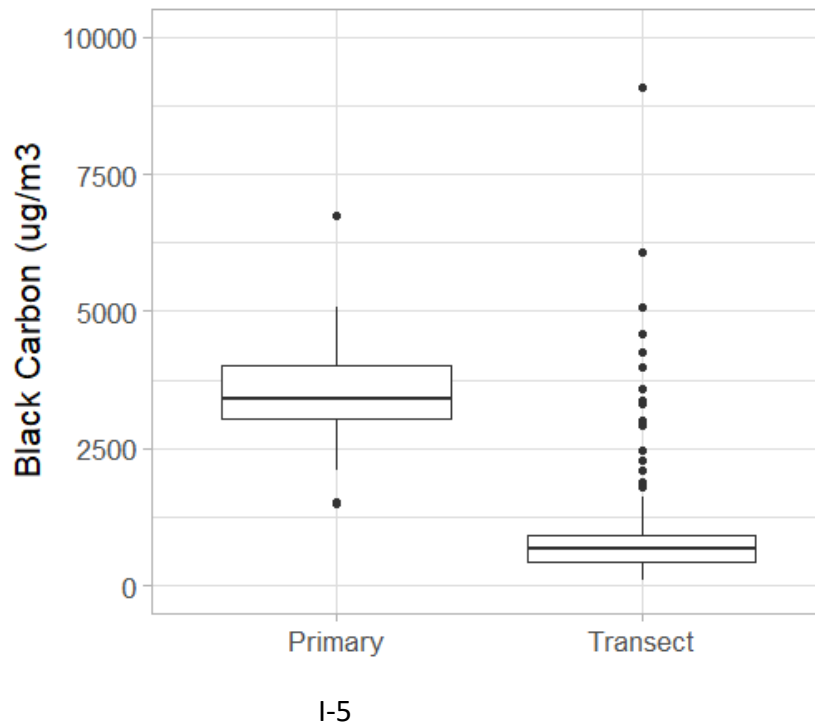
Measurements
Primary Roadway (I-5) vs Transect
Winter - Spring Data
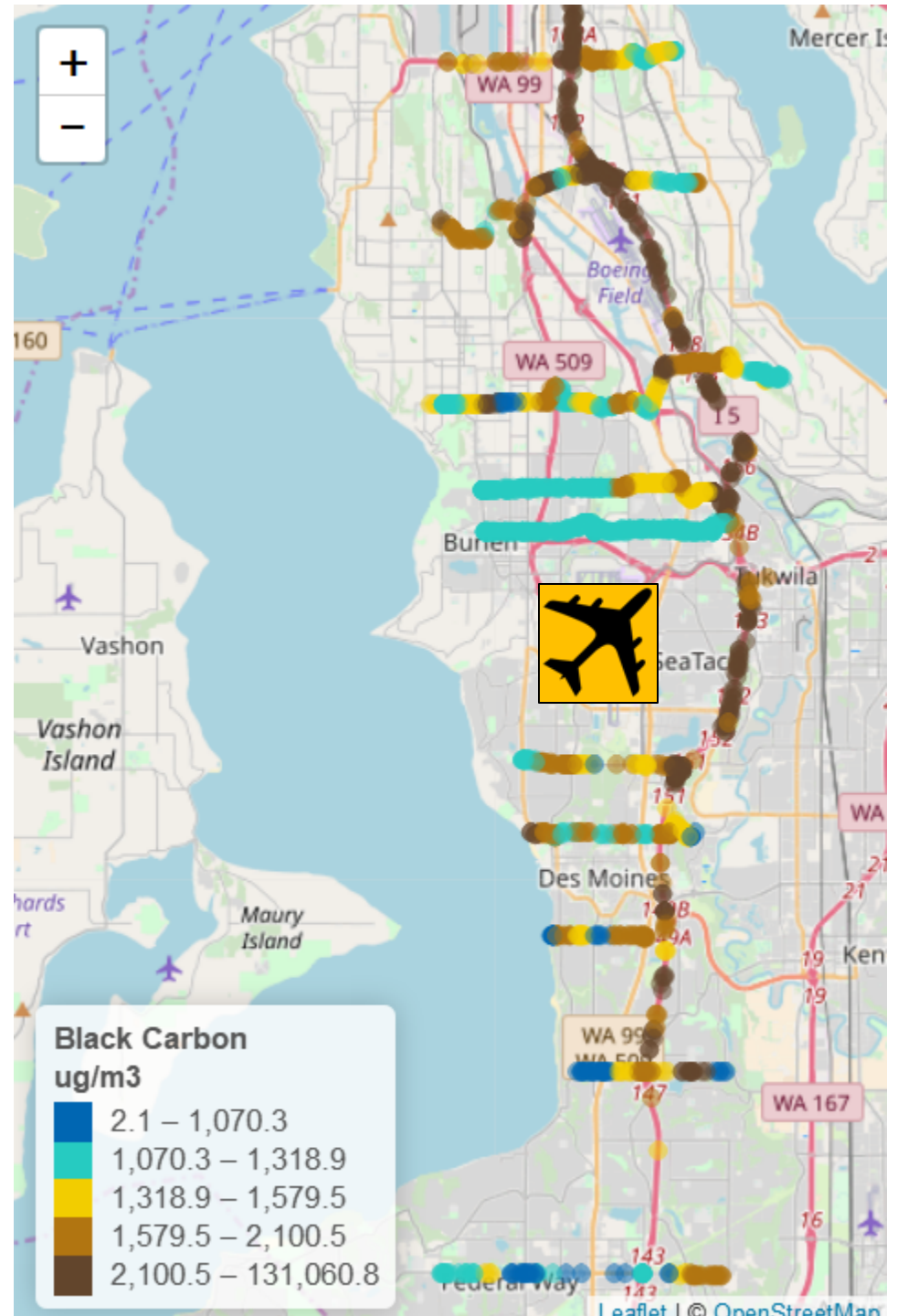

"Total" > 10 nm
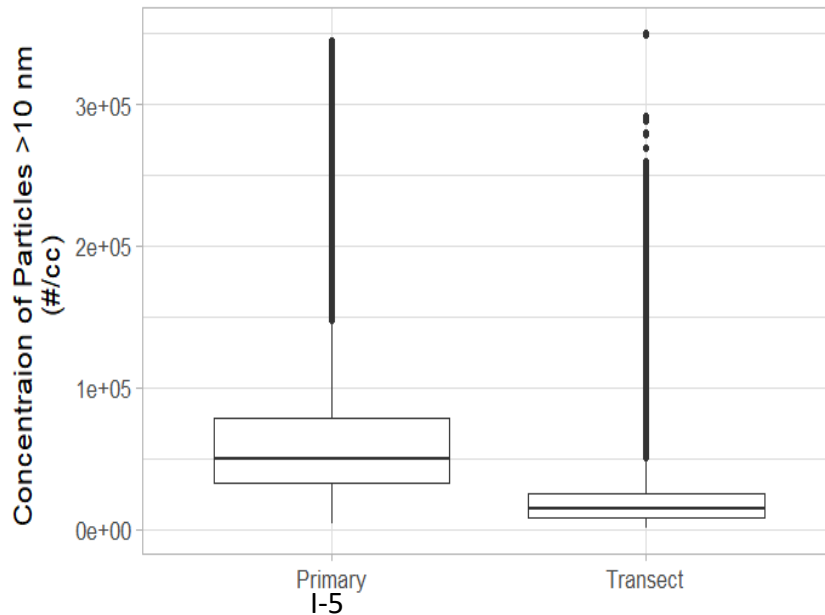
Proportion of "Small" 10-20 nm

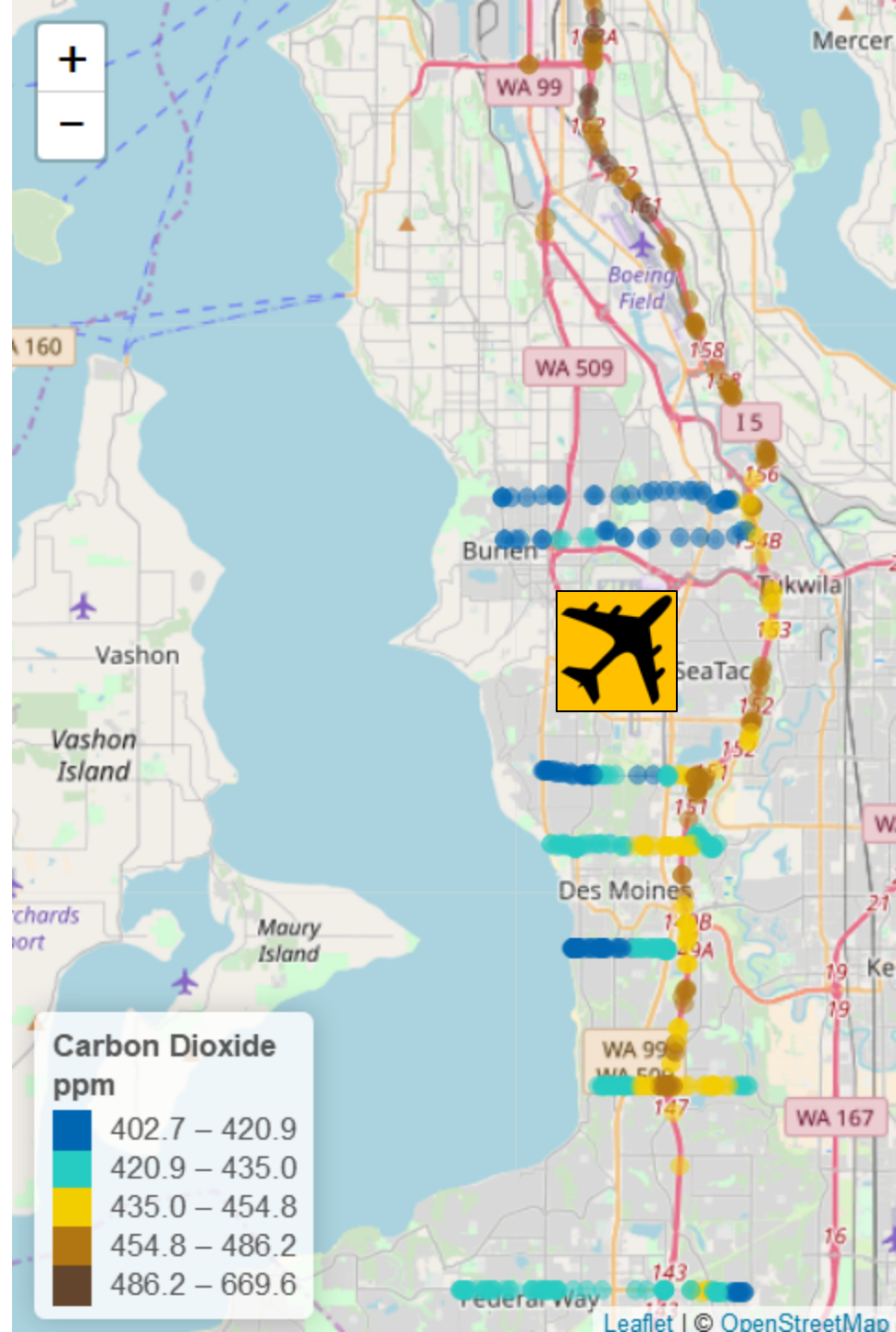# PRELIMINARY SPATIAL DISTRIBUTION OF POLLUTANTS

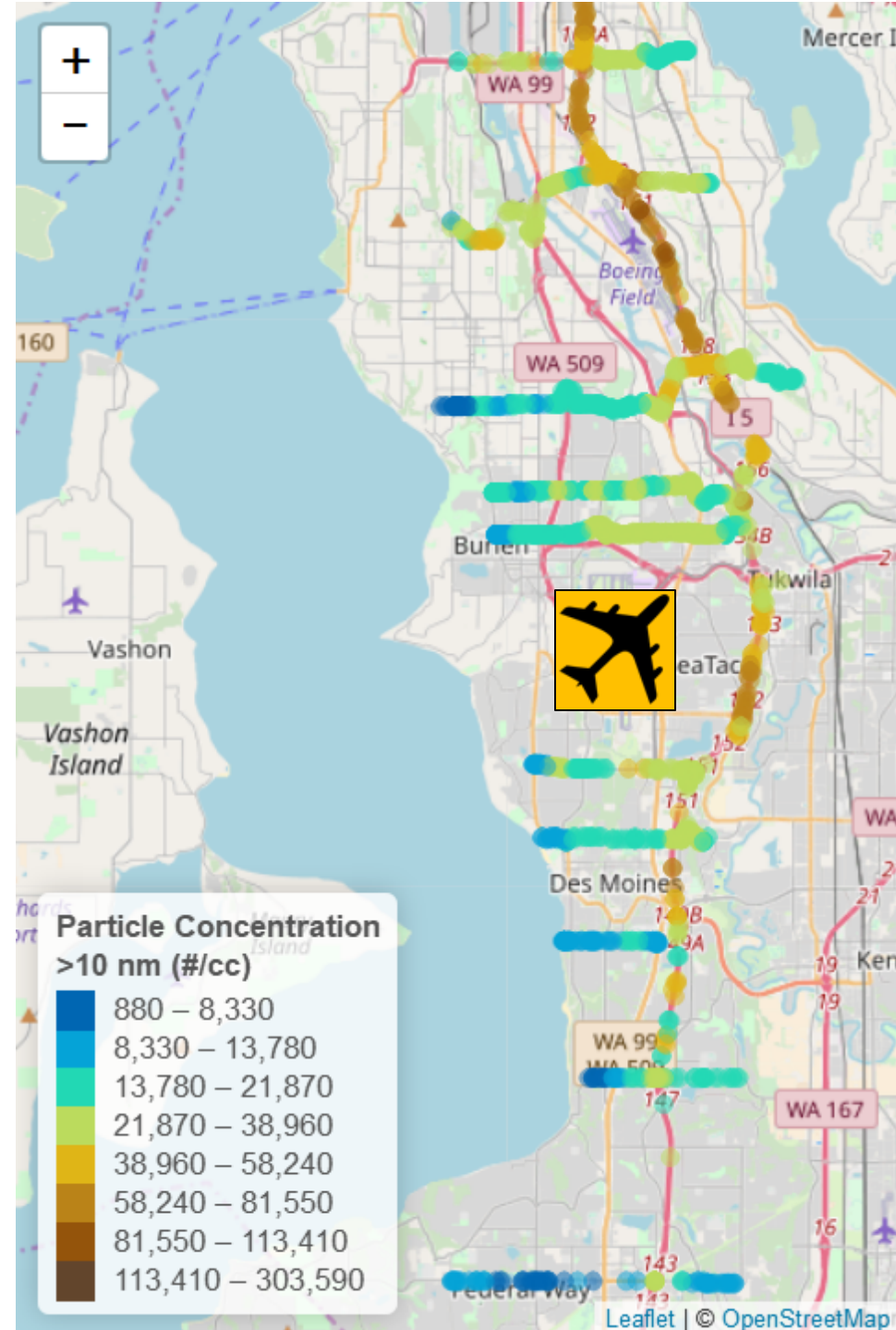# Black Carbon Spatial Distribution

Winter - Spring Data

Carbon Dioxide Spatial Distribution

Winter - Spring Data

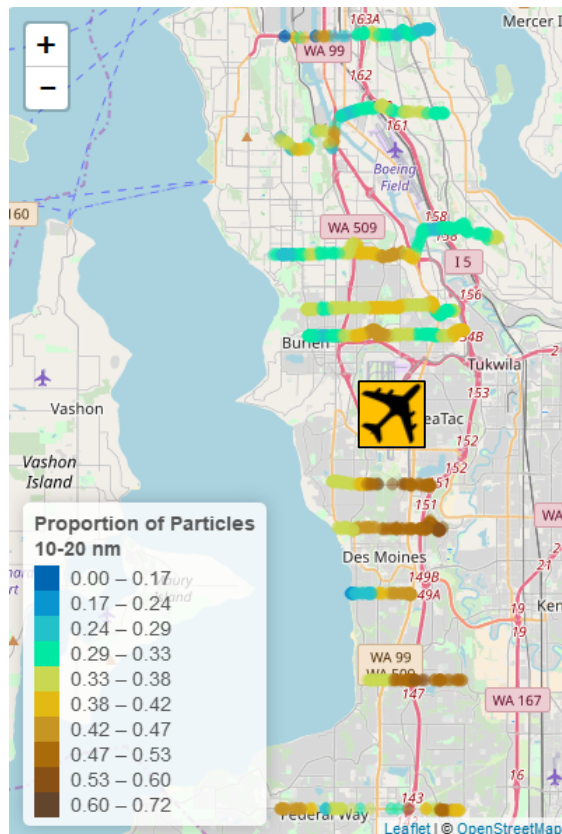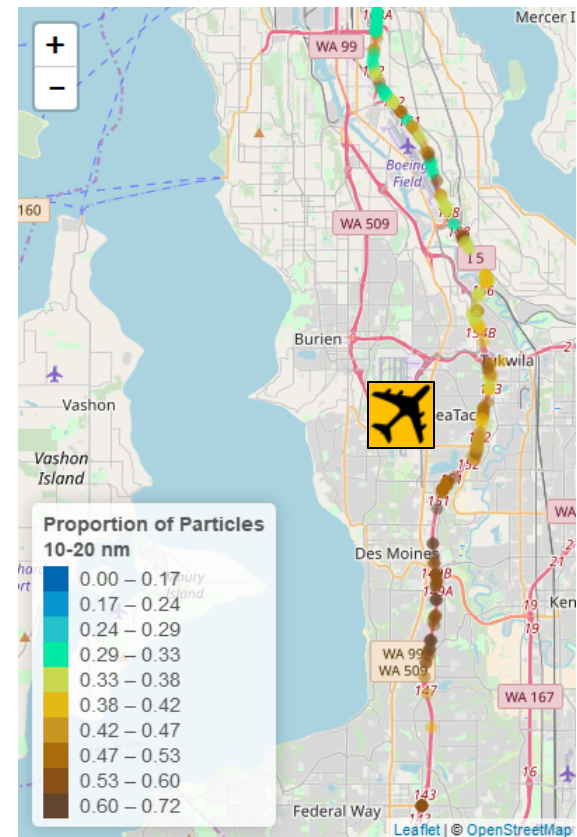# Particle Number Concentration ("Total" >10 nm) Spatial Distribution

Winter - Spring Data

Proportion of small 10-20 nm particles

Transects vs Primary Road (I-5)

Proportion of Small Particles (10-20 nm)
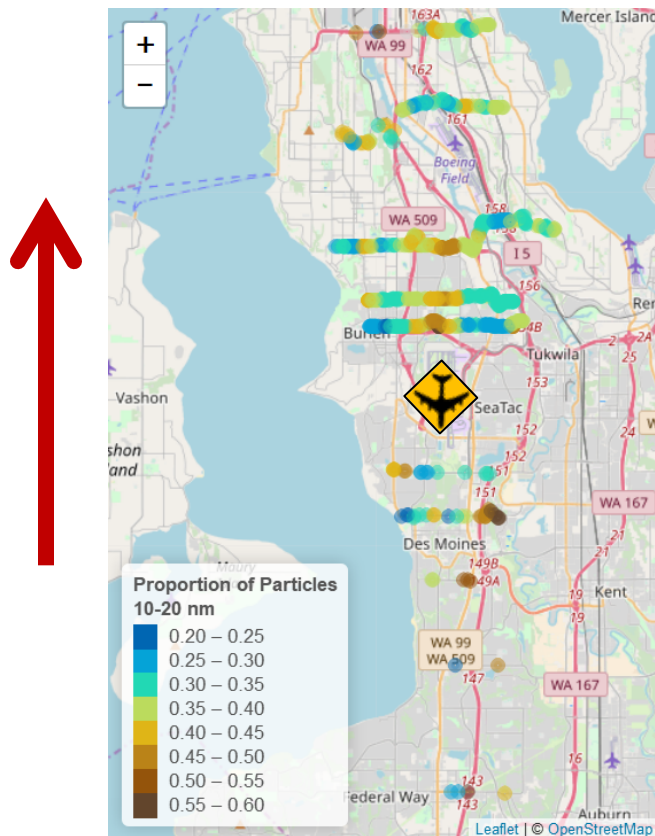
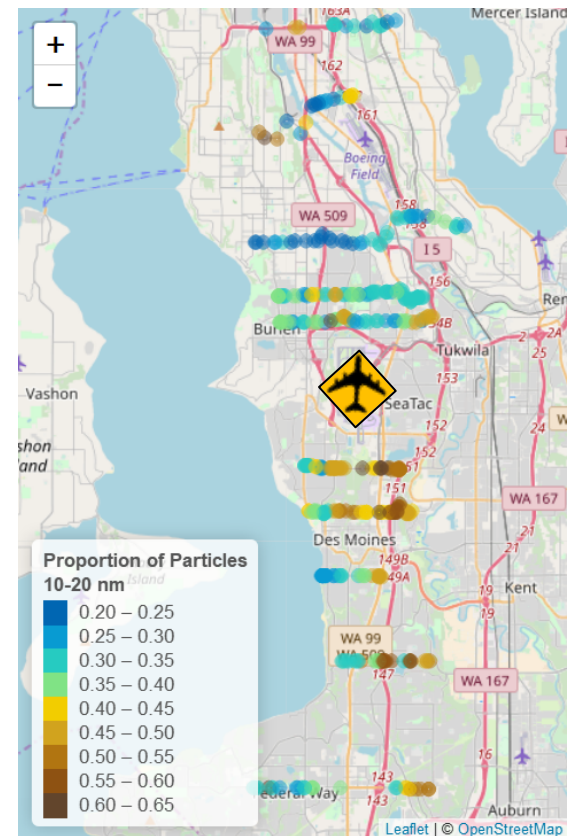**Proportion of Small Particles (10-20 nm)**

Winter – Spring Data

Proportion of small 10-20 nm particles
By Wind Direction

Wind from the SOUTH

Wind from the NORTH

Winter – Spring Data

# How can we make better use of the multi-pollutant data we've collected?

Principal Component Analysis (PCA)

PCA is a data reduction technique that allows for capturing the variance in the data in a smaller set of variables.

The goal of PCA is to summarize the correlations among the observed variables with a smaller set of linear combinations – we refer to these as "principal components" or simply "features".
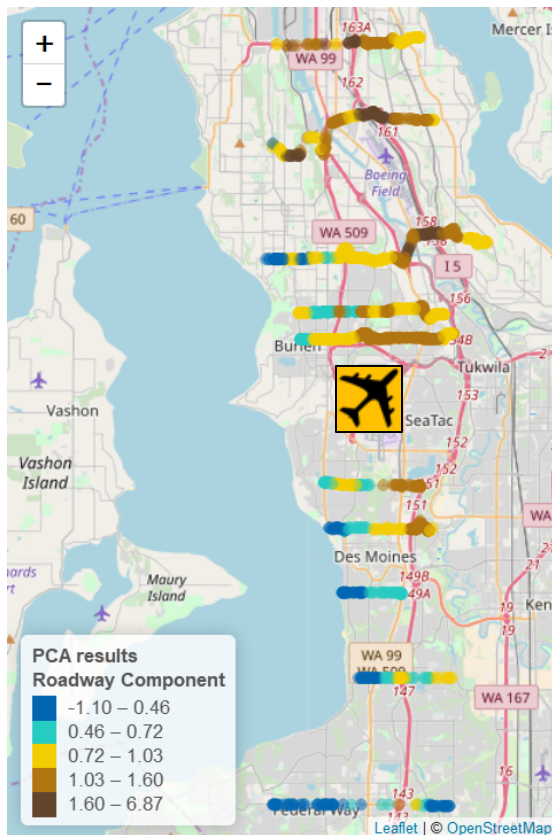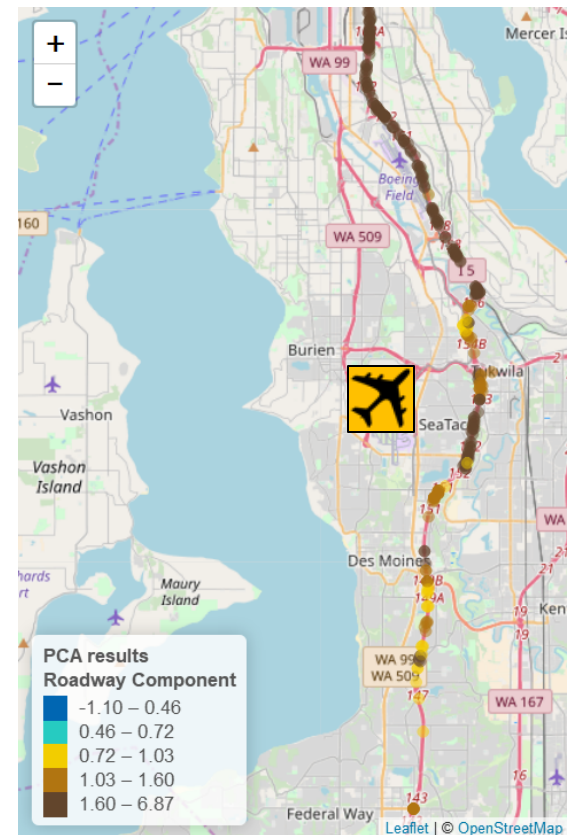
Preliminary PCA Results
Winter – Spring Data
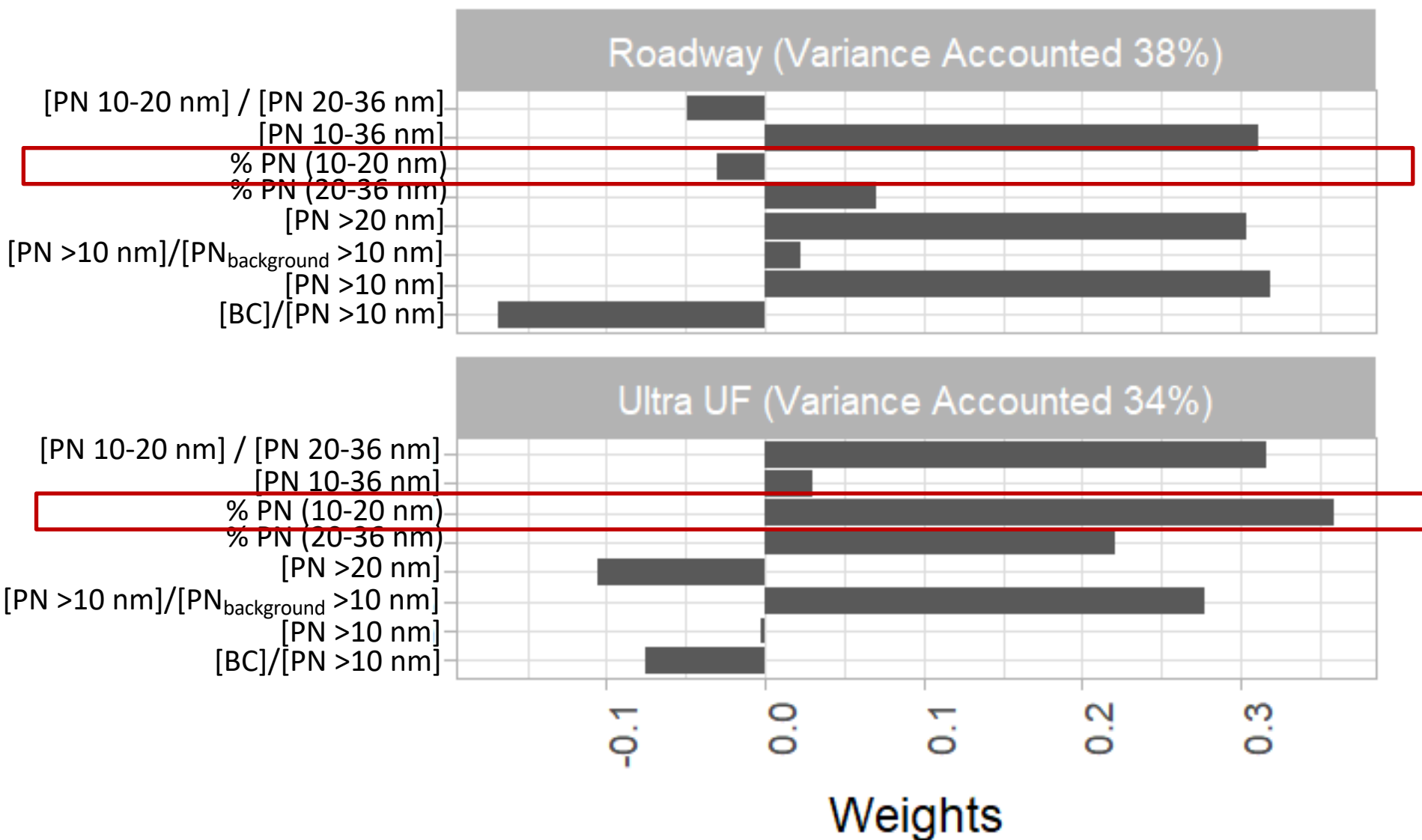
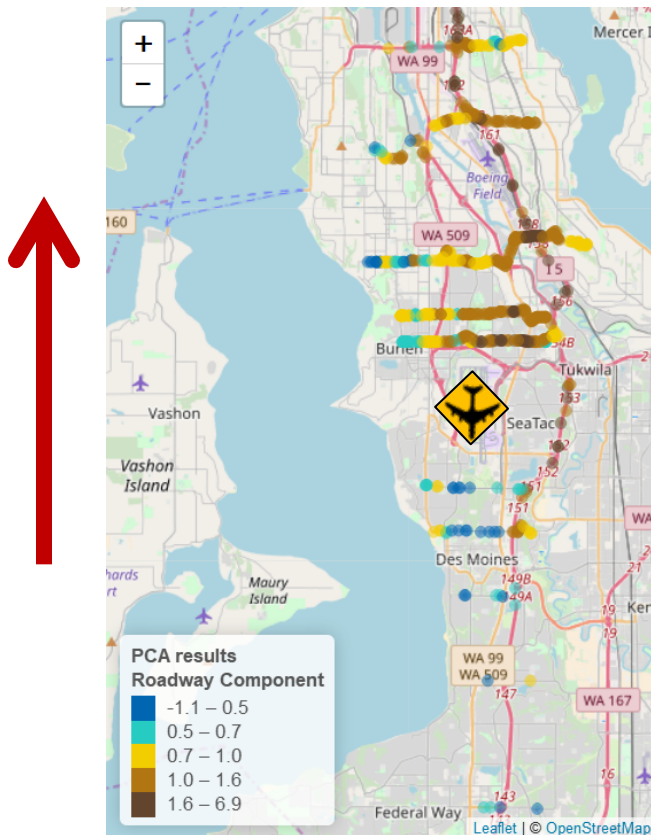# PCA Results
"Roadway" Feature

On Transect
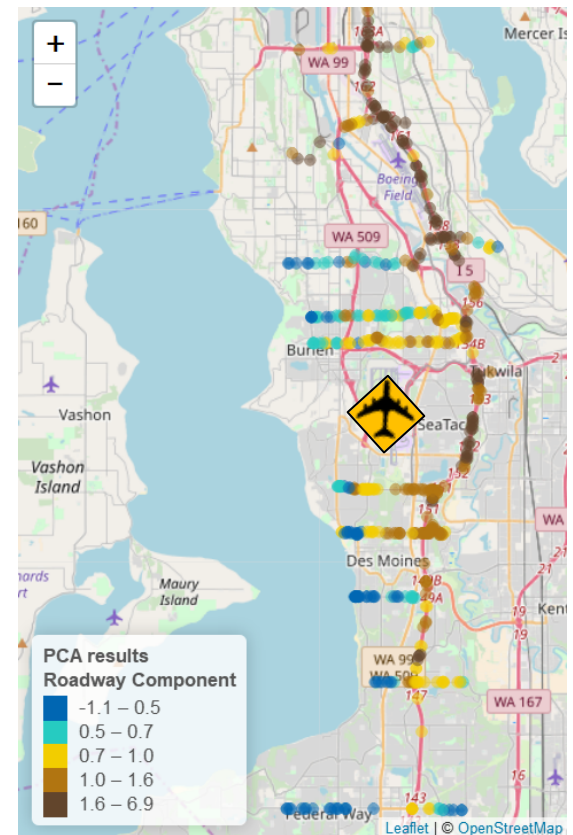

On I-5

Winter – Spring Data

PCA
"Roadway" Feature

Wind from the SOUTH
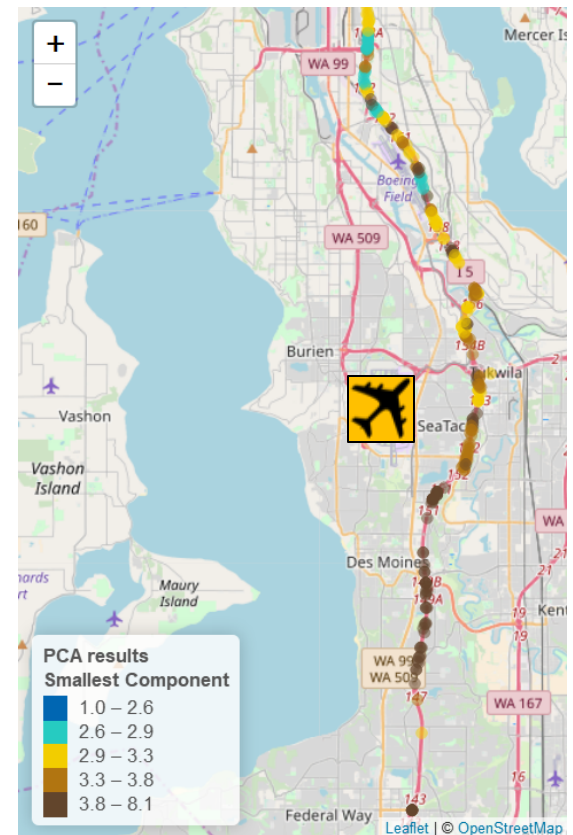
Wind from the NORTH

Winter – Spring Data

PCA Results
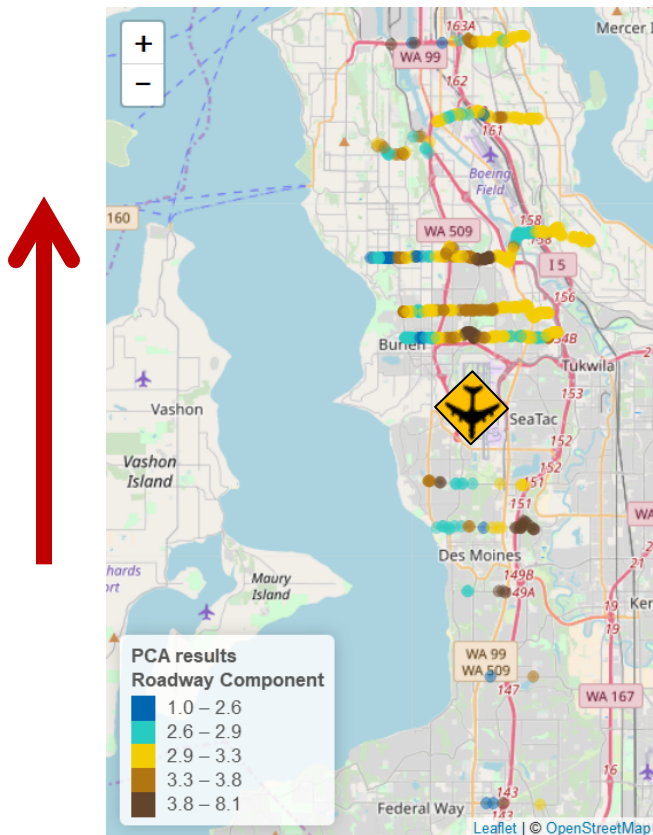# "Ultra-UF" Feature

Transects
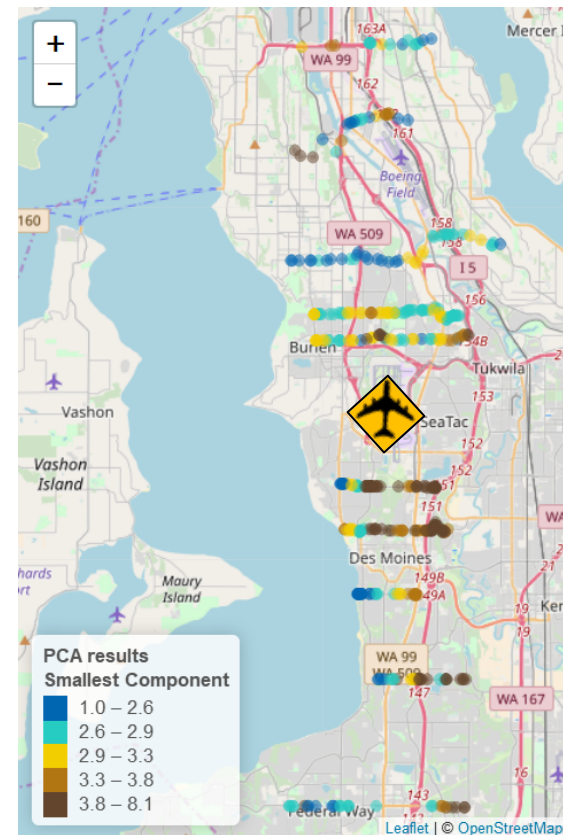
I-5
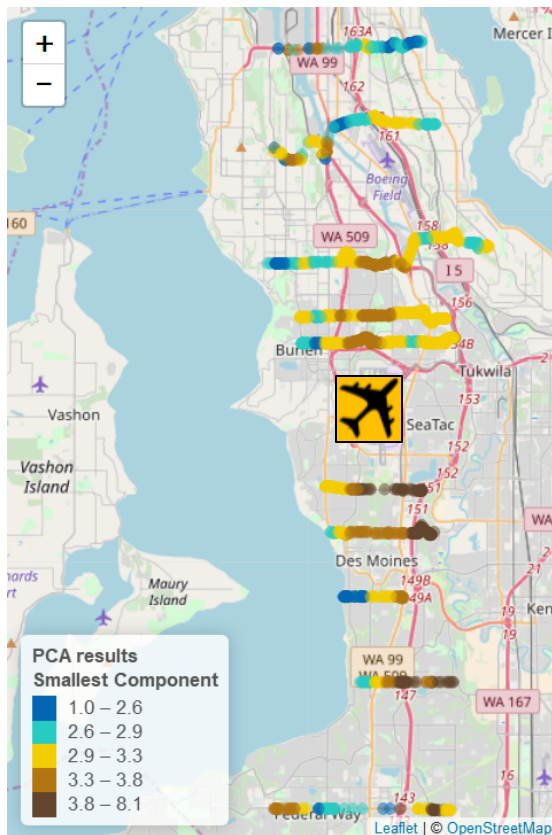
Winter – Spring Data

PCA
"Ultra-UF" Feature

Wind from the SOUTH

Wind from the NORTH

Winter – Spring Data

Preliminary Fixed Site
Small Particles (~15.4 nm)
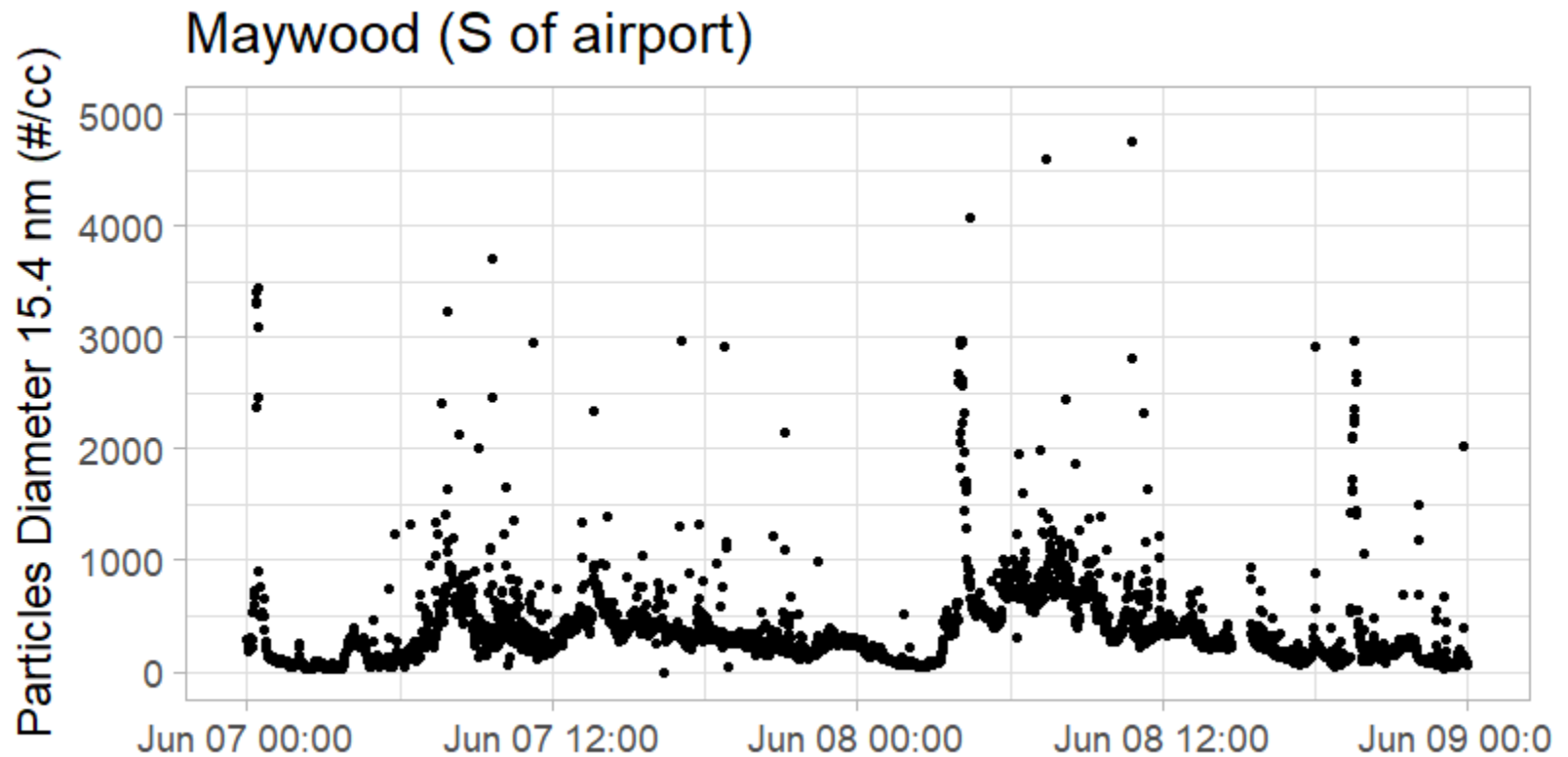
Maywood (S of airport)

ELSEVIER

Short-term effects of airport-associated ultrafine particle exposure on lung function and inflammation in adults with asthma

Rima Habre[a,*], Hui Zhou[a], Sandrah P. Eckel[b], Temuulen Enebish[a], Scott Fruin[a], Theresa Bastain[a], Edward Rappaport[a], Frank Gilliland[a]

[a] Division of Environmental Health, Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA
[b] Division of Biostatistics, Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA

- Randomized crossover study of 22 non-smoking adults with mild to moderate asthma

- 2-hr scripted, mild walking activity both inside and outside of the high LAX UFP impact zone (avg. difference ~30,000 /cc)

- Mean particle size at LAX impact zone was 29 nm

- *"We found significant increases in markers of systemic inflammation associated with 'Airport UFPs' (IL-6) and 'Traffic' (sTNFrII) exposure and a significant decrease in FEV1 associated with measured PM and BC and modeled 'Traffic' exposure. **The robust IL-6 effects we found with the 'Airport UFPs' source, which would have been masked by considering PN alone**…"*

Submitted NIH Proposal in Nov 2018 for Further Study

Develop a "Selective Ultrafine Particle Respirator" (SUPR)

Selectively filters out the smallest ultrafine particles so that we can use it in controlled experiments to measure short-term health effects.

We should find out about the status of this proposal by summer 2019.

Next Steps

- Repeat analyses on full data set
- Analyze fixed site data
- Estimate daily Emission Rates for roadways and airport
- Report by December 2019

QUESTIONS