Puget Sound Ports Air Quality Study

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NW-AIRQUEST Meeting

PROJECT MOTIVATION

- Updating The Northwest Ports Clean Air Strategy (NWPCAS)

- To decide on new goals and targets Northwest Seaport Alliance is looking for **the impacts of port-related emissions in the Puget Sound Airshed**

https://www.joc.com/technology/blockchain-theorys-path-reality-shipping-beset-details-and-distrust_20180516.html

THE RESEARCH QUESTION

- What is the relative importance of port-related emission sources to human health in the Puget Sound area?
- Restricting which port-related emission source would impact the public health the most?

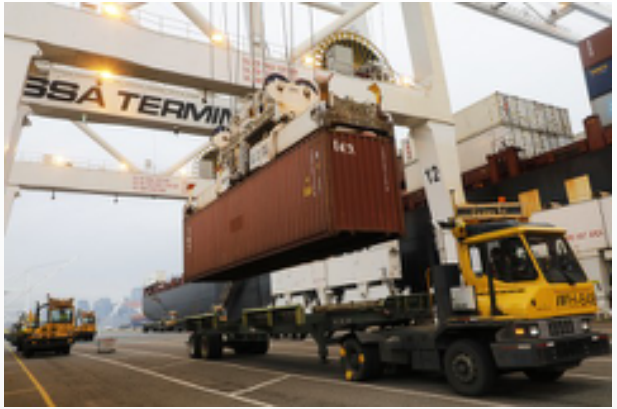
Main objective of the study:

- Determining each port-related source contribution to air quality of the Puget Sound area.

MAJOR SOURCES OF AIR POLLUTION IN THE PUGET SOUND AREA

- Ocean going vessels (OGVs)

- Heavy duty on-road vehicles



- Locomotives

- Cargo handling equipment (CHE)

THE RESEARCH METHODS

Method

Brute Force Zero-Out Source Contribution

Main components

Base case: simulations done using all port sources included

‘Knock-out’ cases: simulations done zeroing out one ports-related source category at a time.

Contribution of each port-related source: differences between the base case and the ‘knock-out’ case

STEP1: PORTS MODEL FRAMEWORK DETAILS

Core model	CMAQ5.2
Chemical mechanism	Cb05tucl_ae6_aq
Model resolution	1.33 km X 1.3 km gird cells
Initial condition to start each month simulation	AIRPACT 4-km results
Daily boundary conditions	AIRPACT 4-km results
Emissions	Updated Ocean-going vessels and harbor crafts emissions (base on data provided by department of ecology)
Modeling period	2018, one month representing each season, for four months

Puget sound airshed boundary

STEP2: EMISSION INVENTORY

	Emission inventory Update	Generating zero-out emission inventories
OGV	Removed high sulfur residual oil sources since they are now prohibited in the SECA area.	Zeroed out all emissions corresponding to OGV SCCs
CHE	Divided the two point sources at the Port of Seattle and the Port of Tacoma into seven and six locations respectively	Zeroed out all emissions corresponding to CHE SCCs
Locomotives	No updates	Using the ratio of the port-related locomotive emissions over total locomotive emissions
Trucks	No updates	Using the ratio of port-related trucks VMT over total trucks VMT values

STEP3: SIMULATION AND POST-PROCESSING

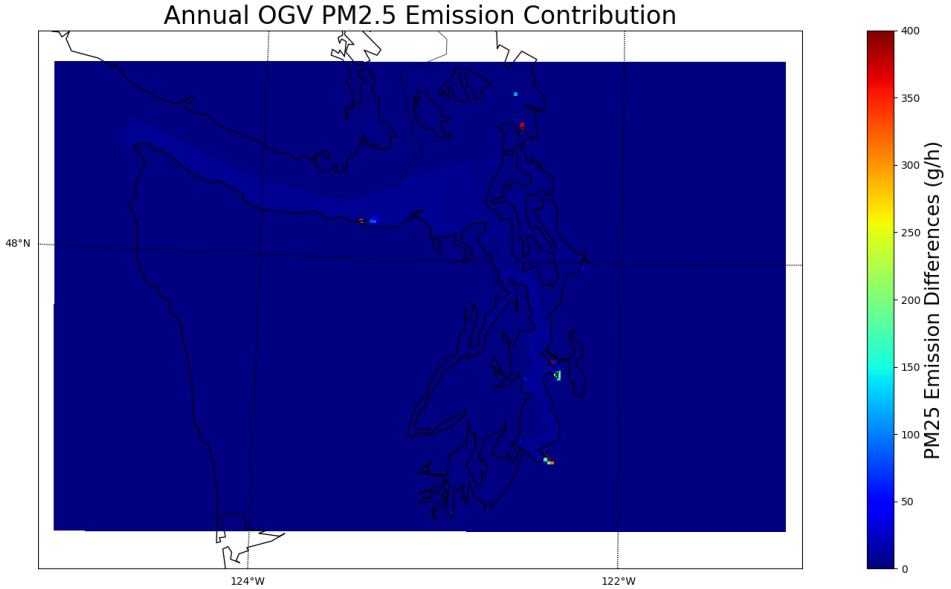
Contribution of each source = (absolute values) base case – 'knock-out case'

Contribution of each source = (percentage) ((base case – 'knock-out case') /base case)*100

Contribution of each source in population exposure to PM2.5 = absolute value of each source PM2.5 contribution X population

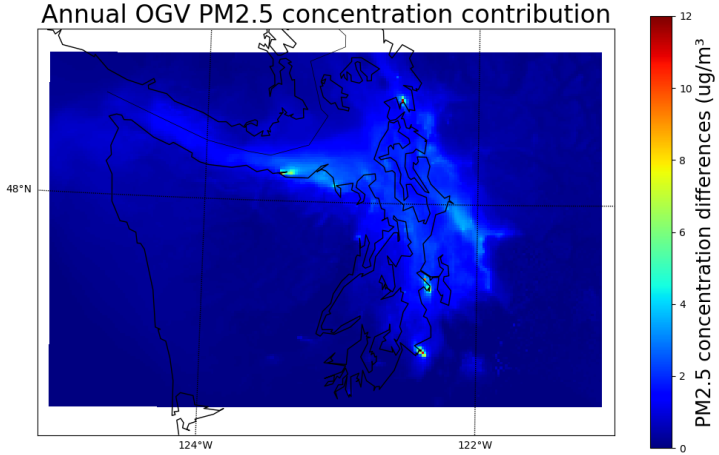
Ocean-Going Vessels

Emission

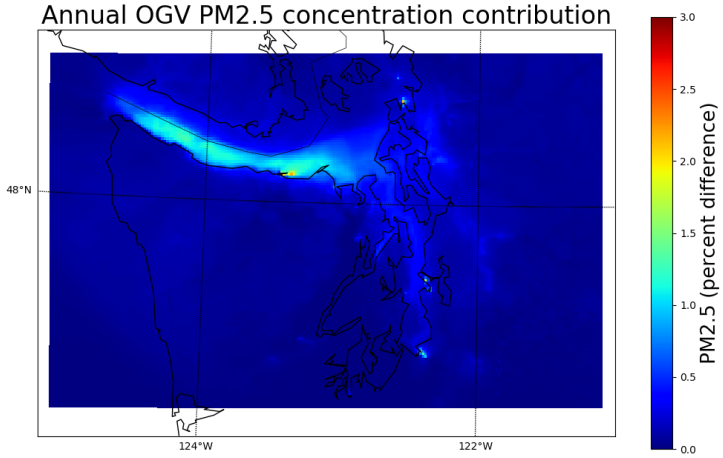


Max = 464.5 g/h

Concentration

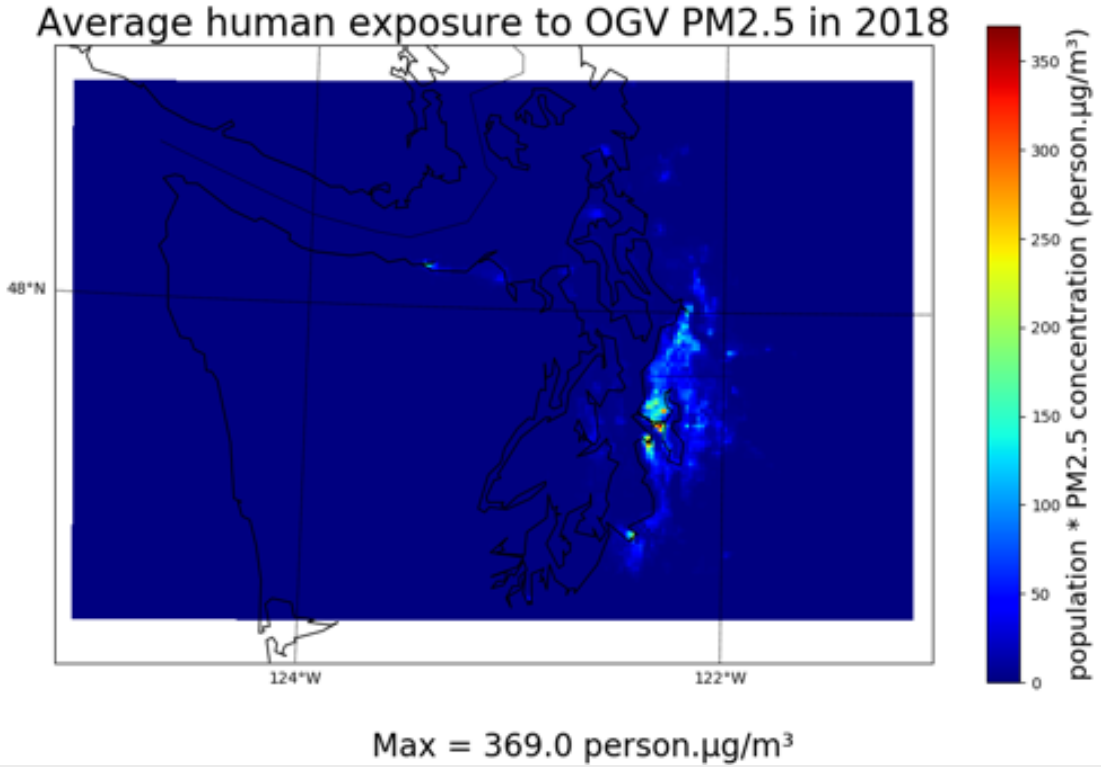


Max = 12.62 µg/m³



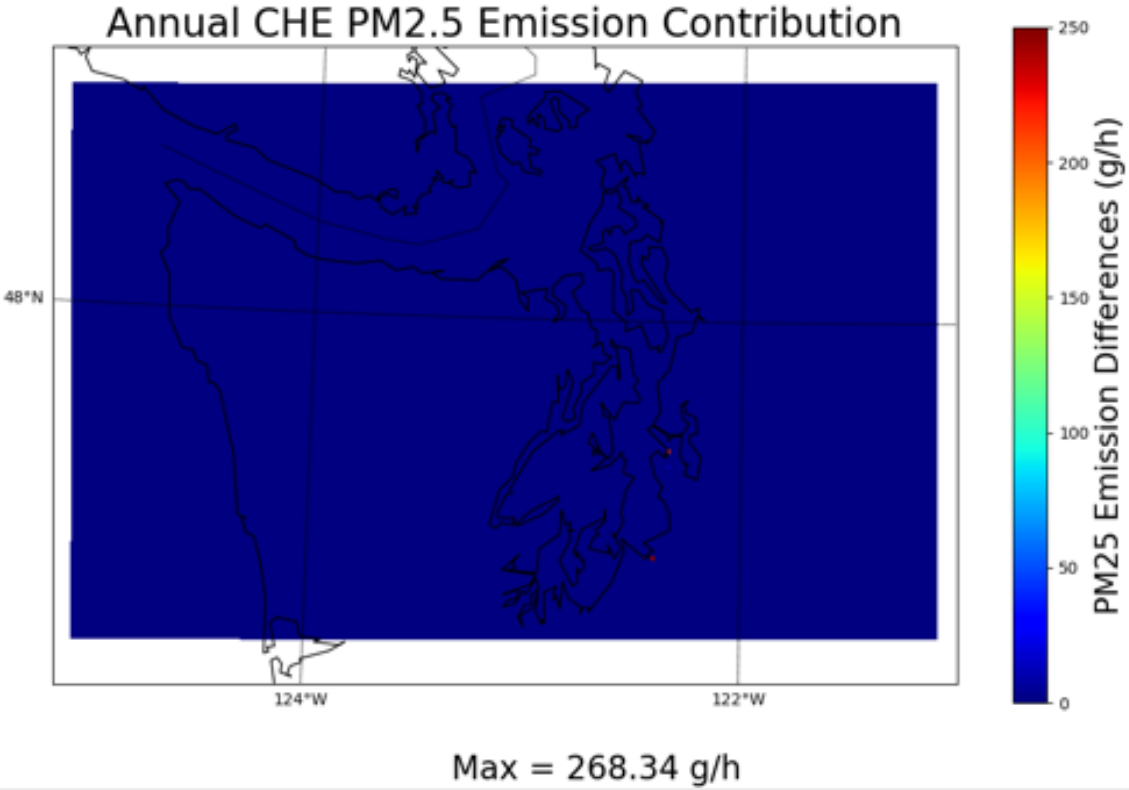
Max = 3.1%

Exposure


Average human exposure to OGV PM2.5 in 2018
48°N
124°W
122°W
population * PM2.5 concentration (person.µg/m³)
0
50
100
150
200
250
300
350
Max = 369.0 person.µg/m³

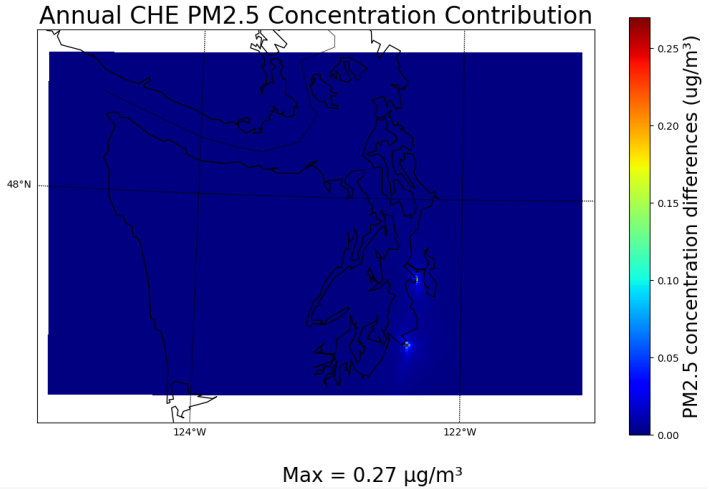
Cargo Handling Equipment

Emission

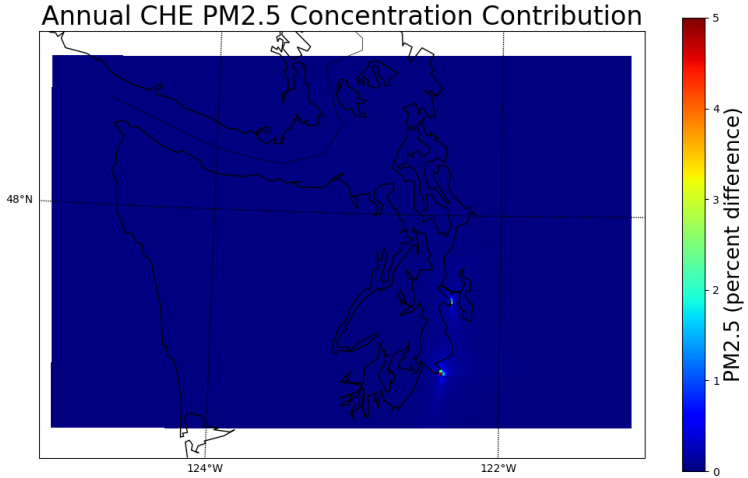


Max = 268.34 g/h

Concentration

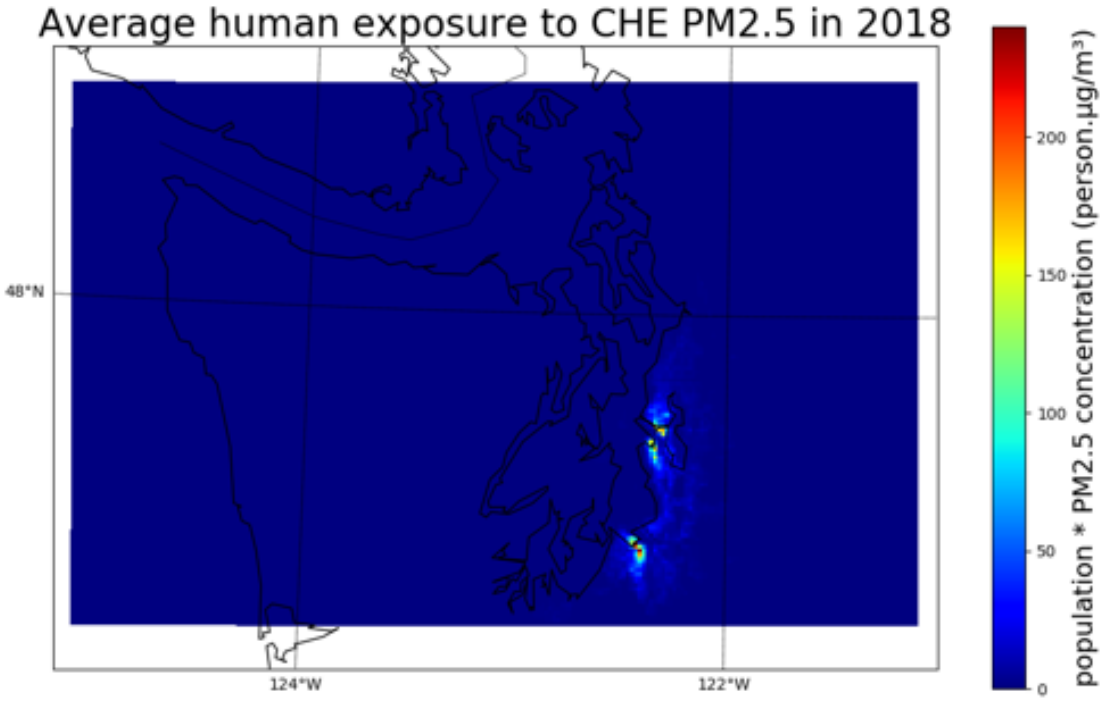


Max = 0.27 µg/m³



Max = 5.38 %

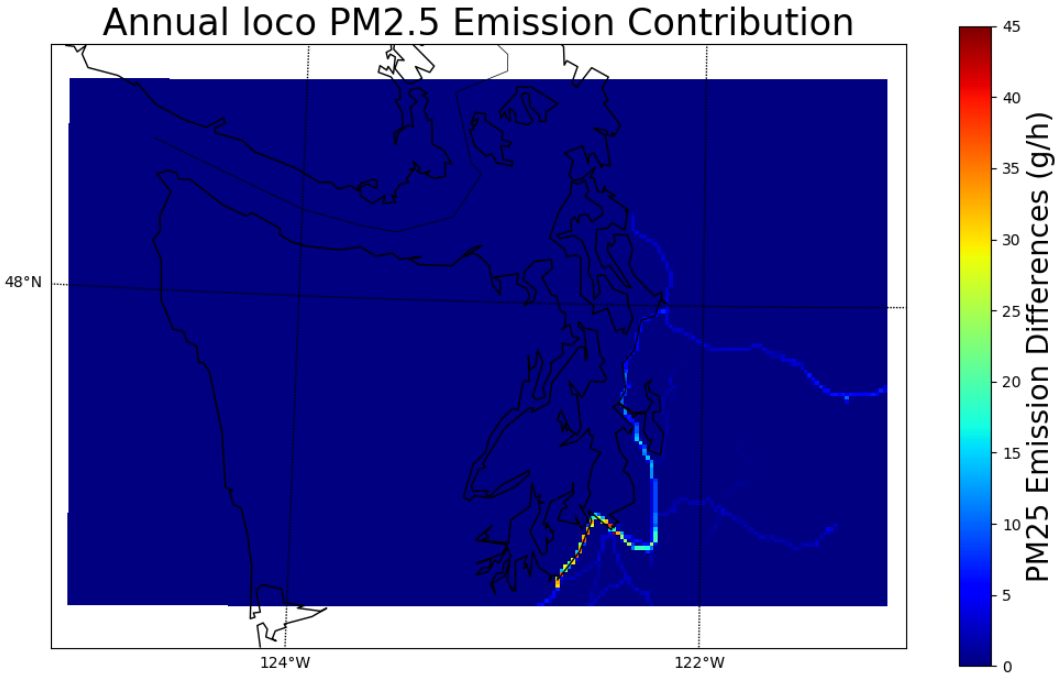
Exposure



Max = 240.0 person.µg/m³

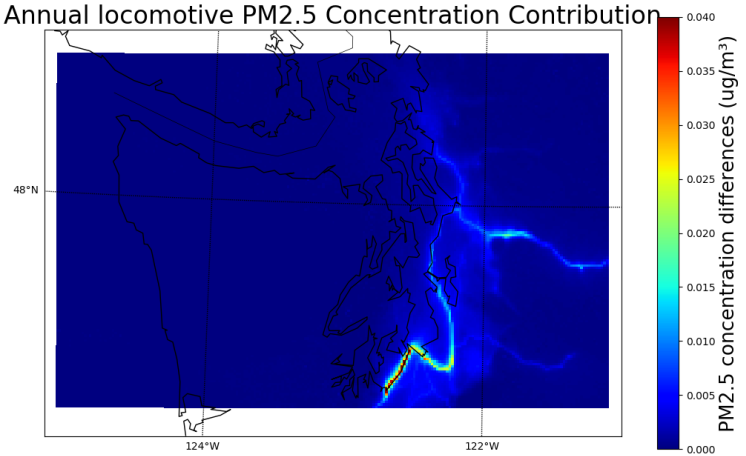
Locomotives

Emission

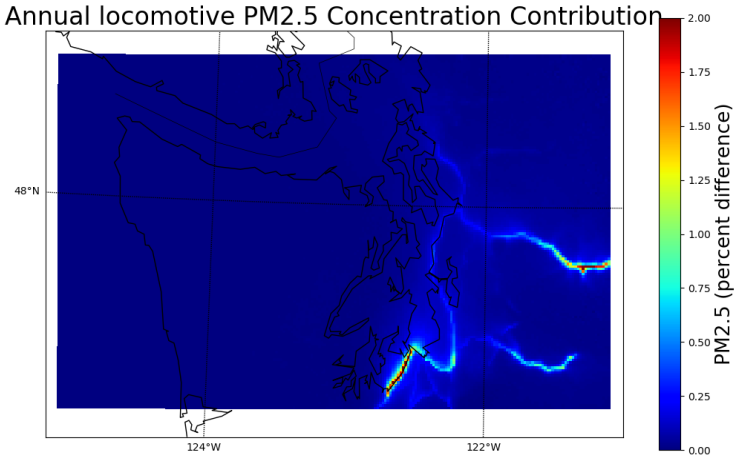


Max = 46.41 g/h

Concentration

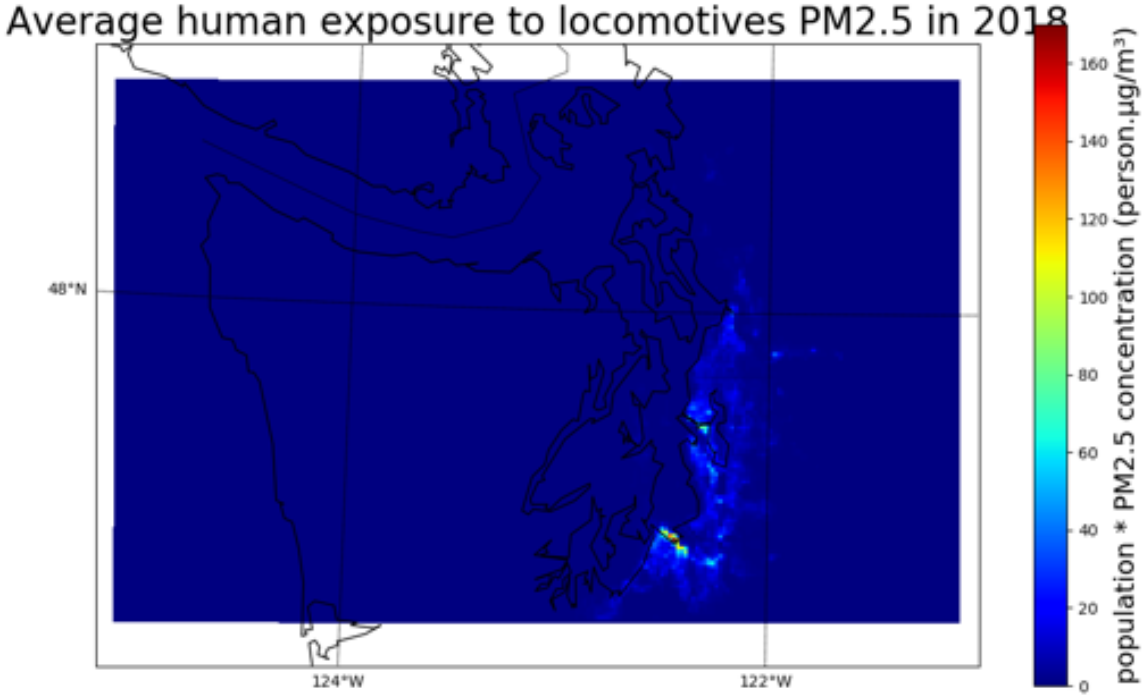


Max = 0.04 µg/m³



Max = 2.69 %

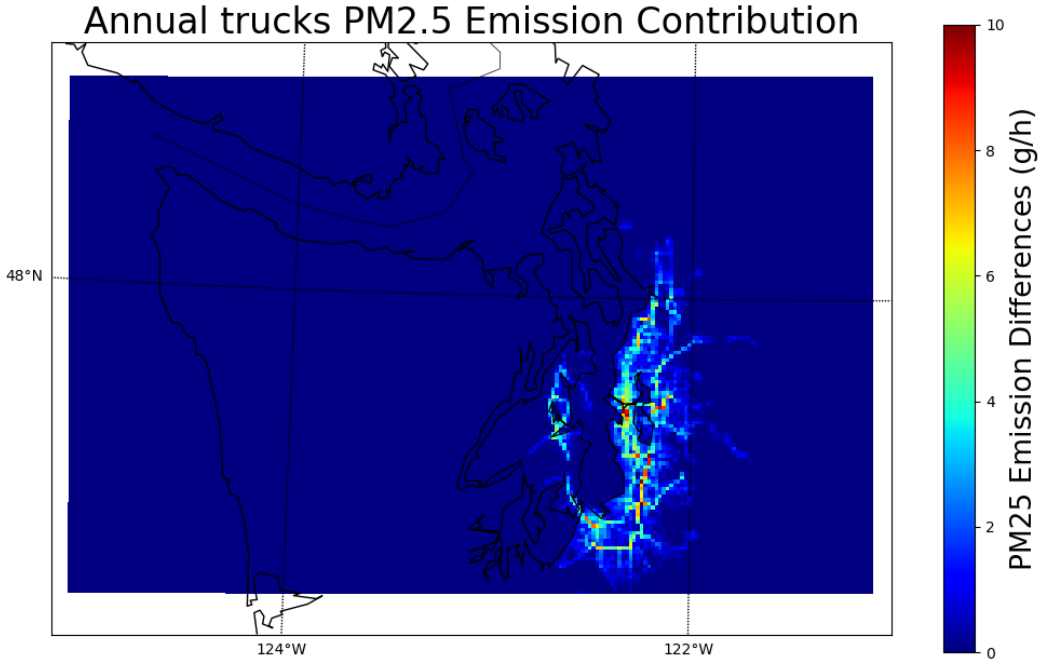
Exposure



Max = 169.0 person.µg/m³

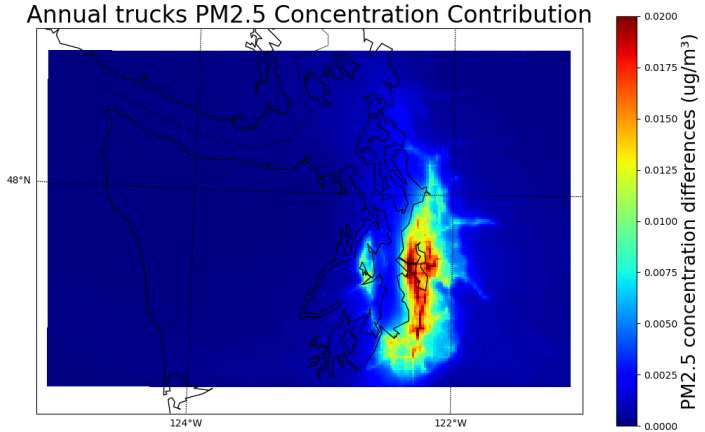
Heavy Duty On-Road Vehicles

Emission

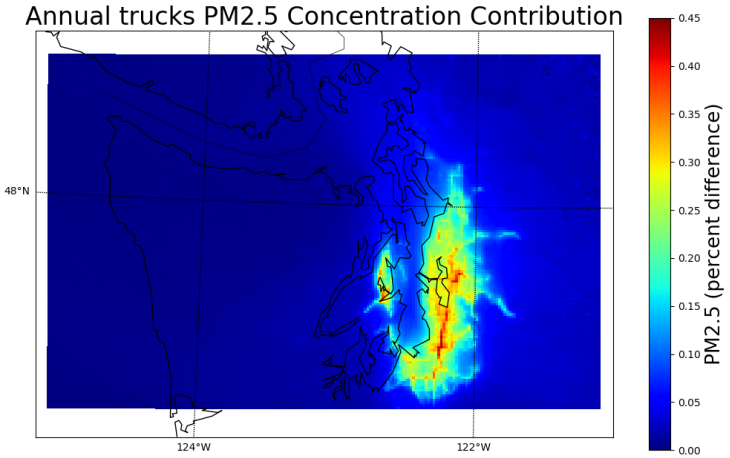


Max = 10.87 g/h

Concentration

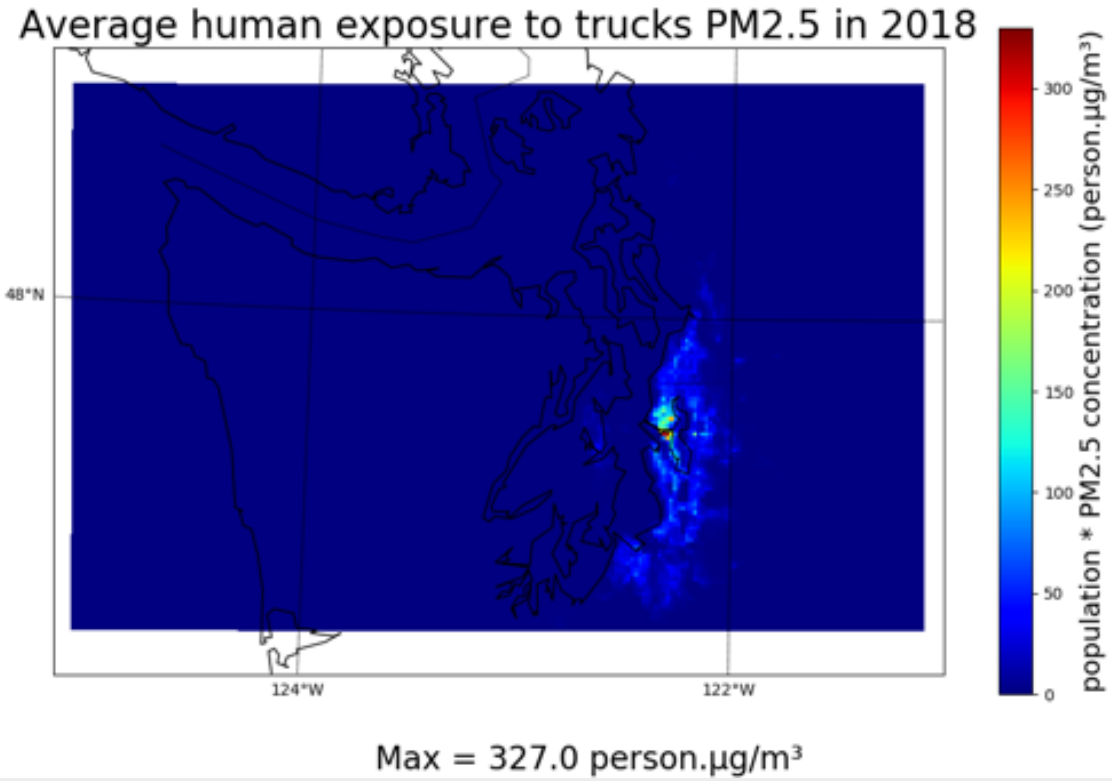


Max = 0.02 µg/m³



Max = 0.44 %

Exposure



Max = 327.0 person.µg/m³

SUMMARY AND CONCOLUSION

Source	Total exposure to PM2.5 (conc.*pop.)	Total PM2.5 emission contribution (tons/year)
OGV	50,285	157.81
trucks	39,025	25.76
locomotives	16,172	22.75
CHE	14,334	9.66

Thank you