

Roll, Ride, Stride: The Ultimate School Commute Showdown



Fred Feng, Natalie Minda, Oliver Meek, Yuchao Niu, Jinze Zhu,
Judi Ashri, David Guo

Urban Air Pollution: What, Where, How and Why?

What: A mixture of atmospheric gases: O₃, CO₂, CO, PM_{2.5}, SO₂, NO_x and PM₁₀

Where: In and around cities - Population density and economic growth linked to worsened air quality

How: Pollutant sources include manufacturing, combustion engines, vehicles, interior heating, construction, and dust

Why: A considerable threat to human health - cardiovascular and respiratory problems

A Component of Urban Pollution: Road Dust

Source: Mainly cars: tires, gasoline, brakes, lubricants, etc.

Agents: Metals in dust, PM_{2.5}, organic contaminants

Metals: Bind to sediments, kicked up or washed into water systems during wet events

Toxicity: Many are classified carcinogens

Road Dust Permissible Limits

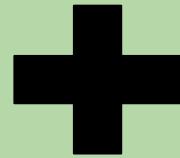
Heavy metal ions	Permissible limits (ppm)	
	WHO ¹⁸	US EPA ¹⁹
As(III)/As(V)	0.05	0.01
Pb(II)	0.05	0.015
Cd(II)	0.005	0.005
Cr(VI)/Cr(III)	0.05	0.05
Hg(II)	0.001	0.002
Zn(II)	5.0	5.0
Cu(II)	1.5	1.3
Co(II)	0.01	—

Mahmud et. al, RSC Adv., 2016

Road dust is a good indicator of overall anthropogenic pollution.

Our **overall goal** is to **inform** students, teachers, and parents of the **best school commute option** that will **not** contribute to local **urban air pollution**

**Gaseous Air
Pollutant
Monitoring**



**Trace
Metals in
Road Dust**

**Thorough Assessment of Air
Pollution from Vehicle
Emissions**

Research Questions and Hypotheses

RQ1: Are ambient concentrations of PM_{2.5}, CO₂, and O₃ higher during school drop-off times compared to non drop-off times?

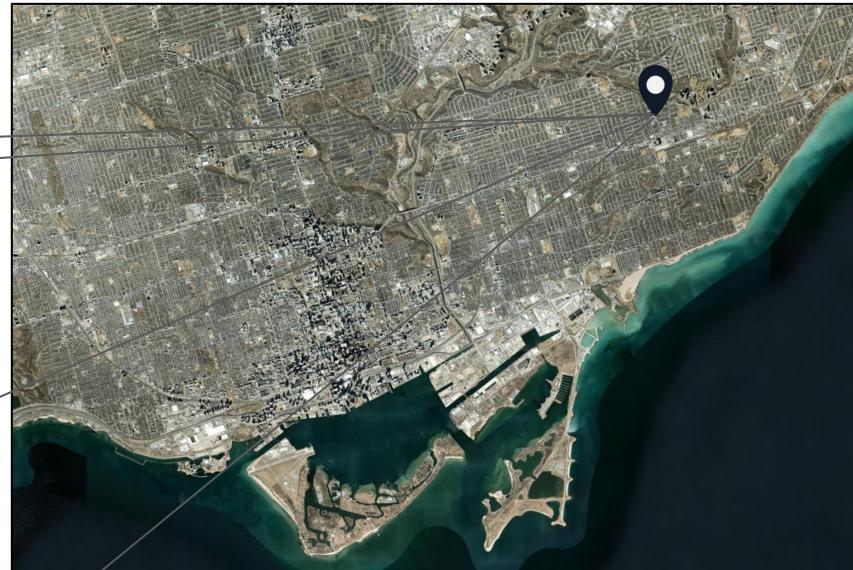
RQ2: Does road dust from high-traffic areas contain a greater abundance of trace metals?

HA1: Concentrations of PM_{2.5}, CO₂ and O₃ will be greater during school drop-off times.

HA2: Road dust collected from high-traffic areas will contain elevated concentrations of trace metals.

Gaseous Air Pollutant Monitoring: Sampling

Sampling Location:
Secord Public School



Sampling Time:
8:30-10:30 a.m.

Gaseous Air Pollutant Monitoring: Sampling



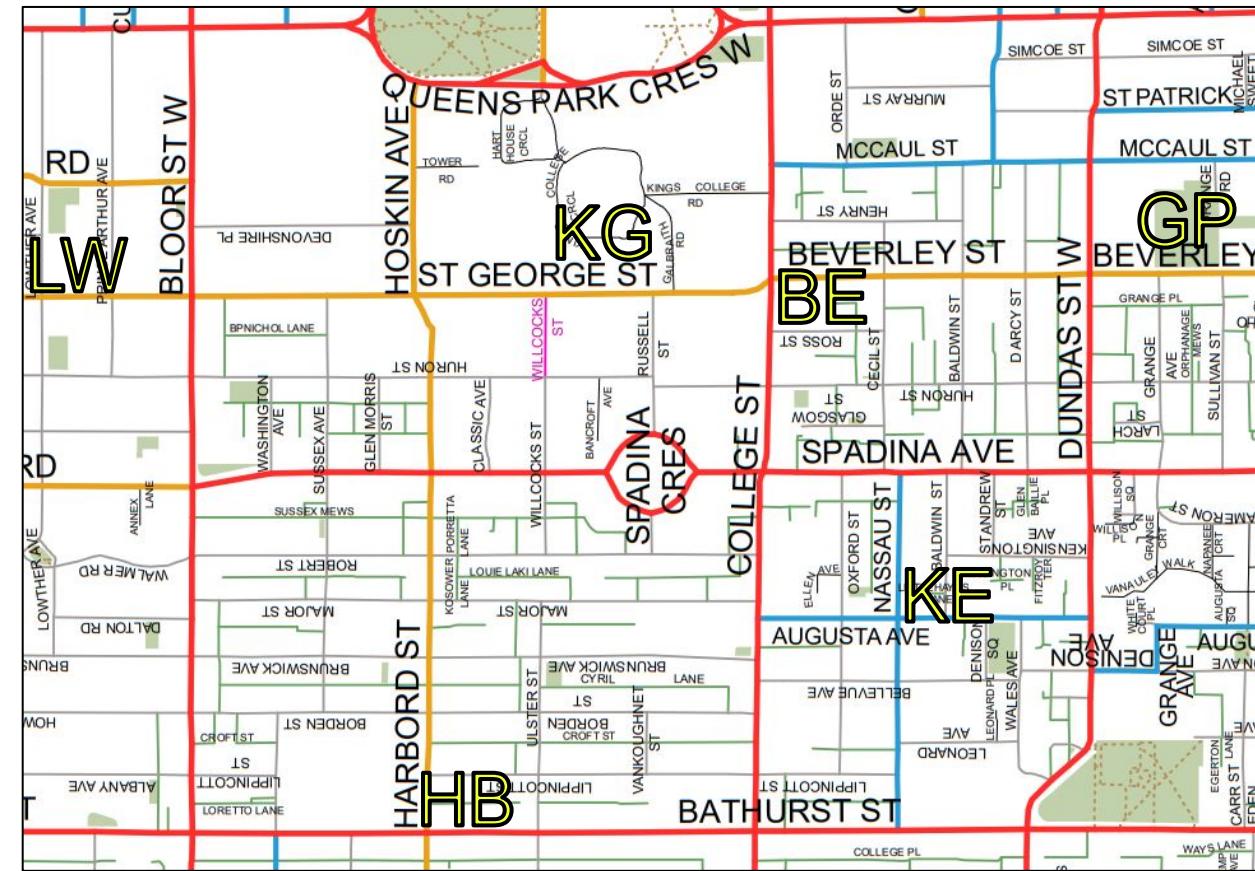
Pollutant monitoring:

CO_2

O_3

PM2.5

Road Dust: Sampling



Road Classification System

Provincial Expressway	Other
City Expressway	Laneway
Major Arterial	Pending
Minor Arterial	Busway
Collector	Access Road
Local	Park Road

6 Sampling Sites

GP - Grange Park

KG - King's College

KE - Kensington

LW - Lowther Ave

BE - Beverly St

HB - Harbord-Bathurst

[Interactive map.html](#)

Dust Pollutant Monitoring: Sampling

Sampling Locations:



Kensington



King's College
Circle



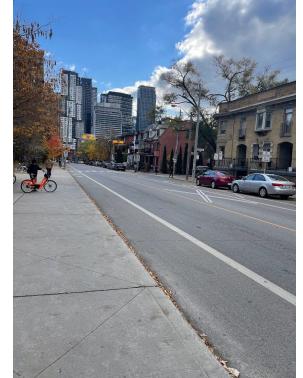
Harbor &
Bathurst



Lowther Avenue

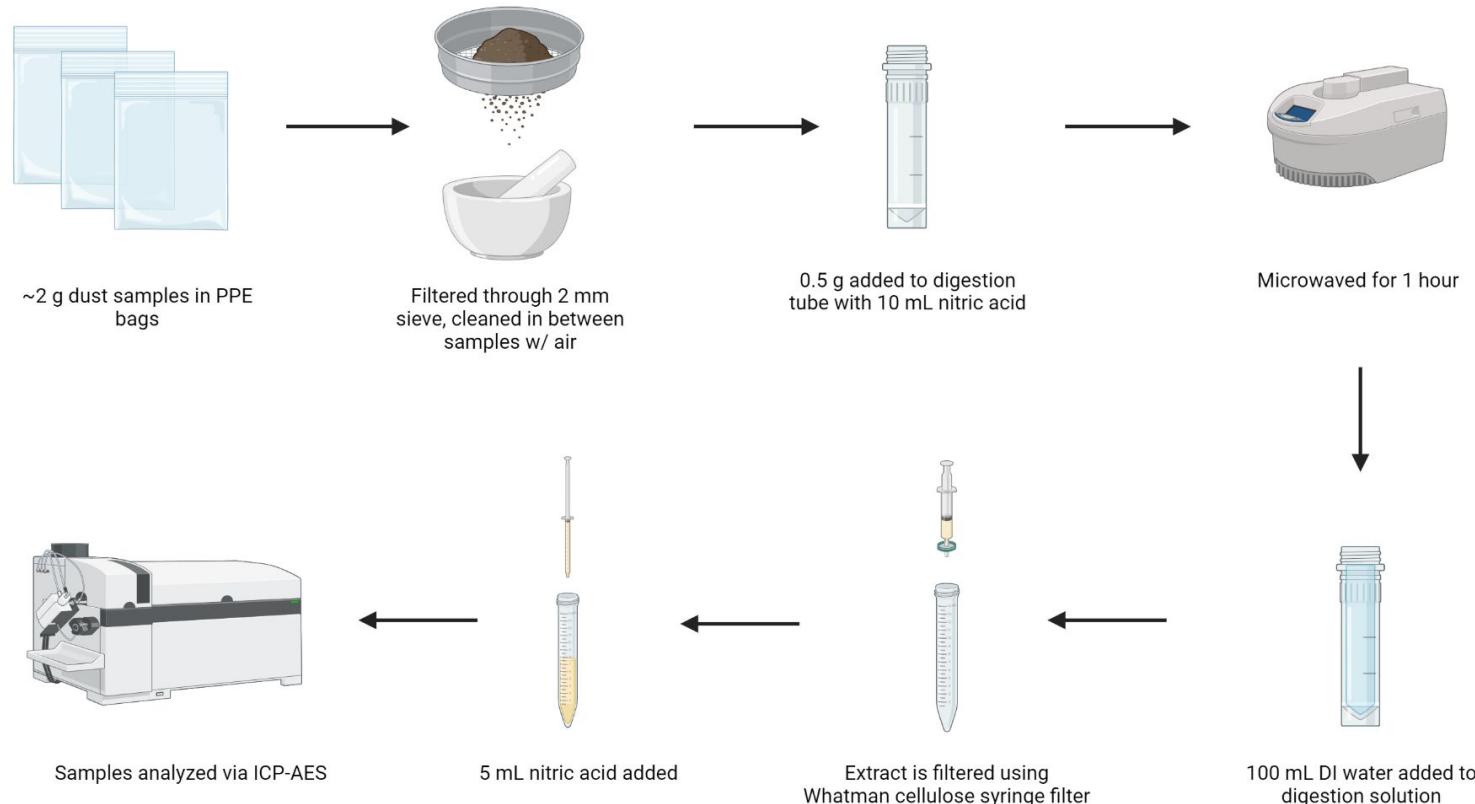


Grange Park



Beverly &
College

Road Dust: Laboratory Methods



Road Dust: Quality Assurance and Quality Control

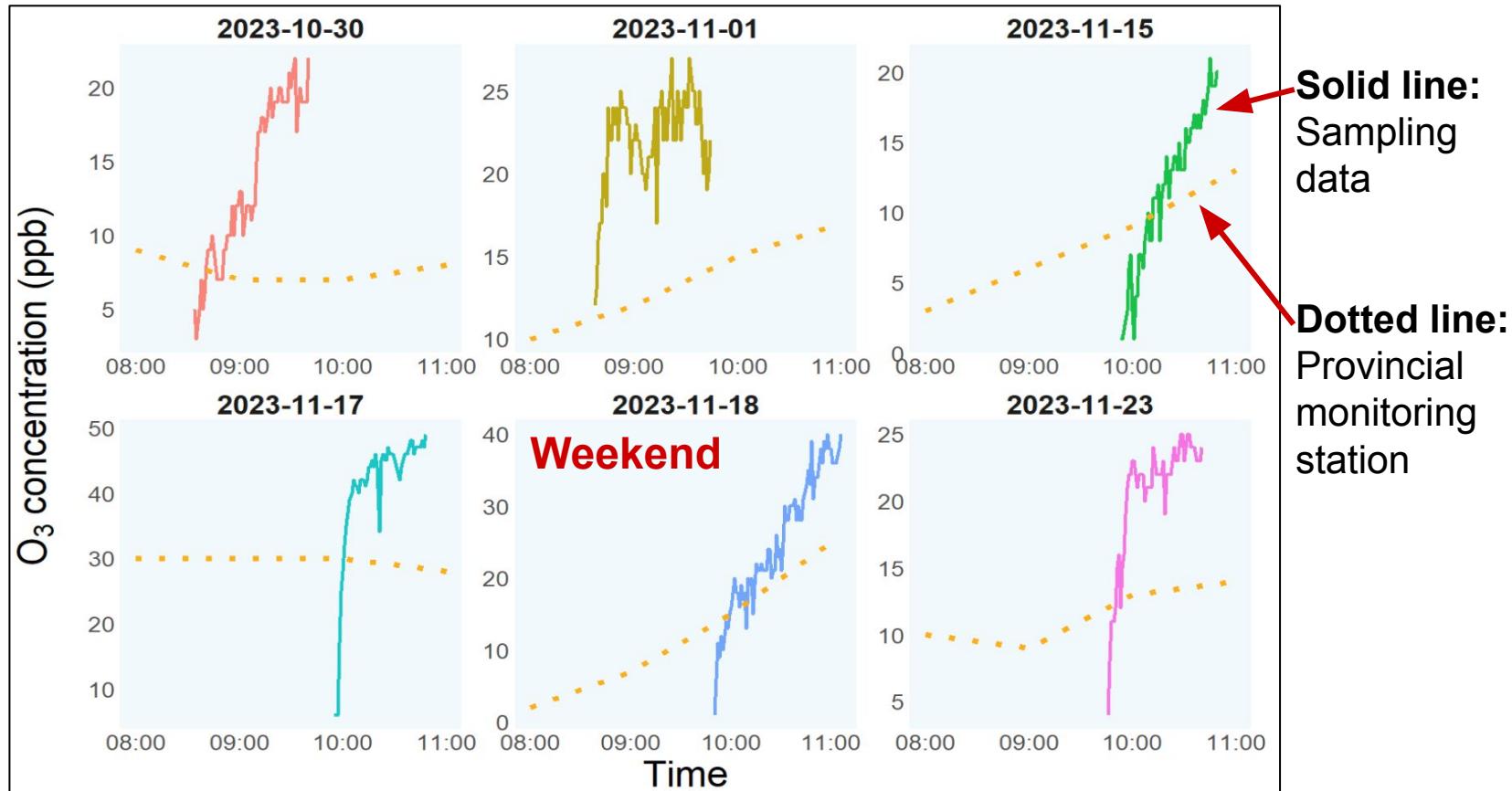
Lab Blanks: To monitor and control potential contamination

Spikes: 1 mL of 1000 ppb internal standard, for recovery

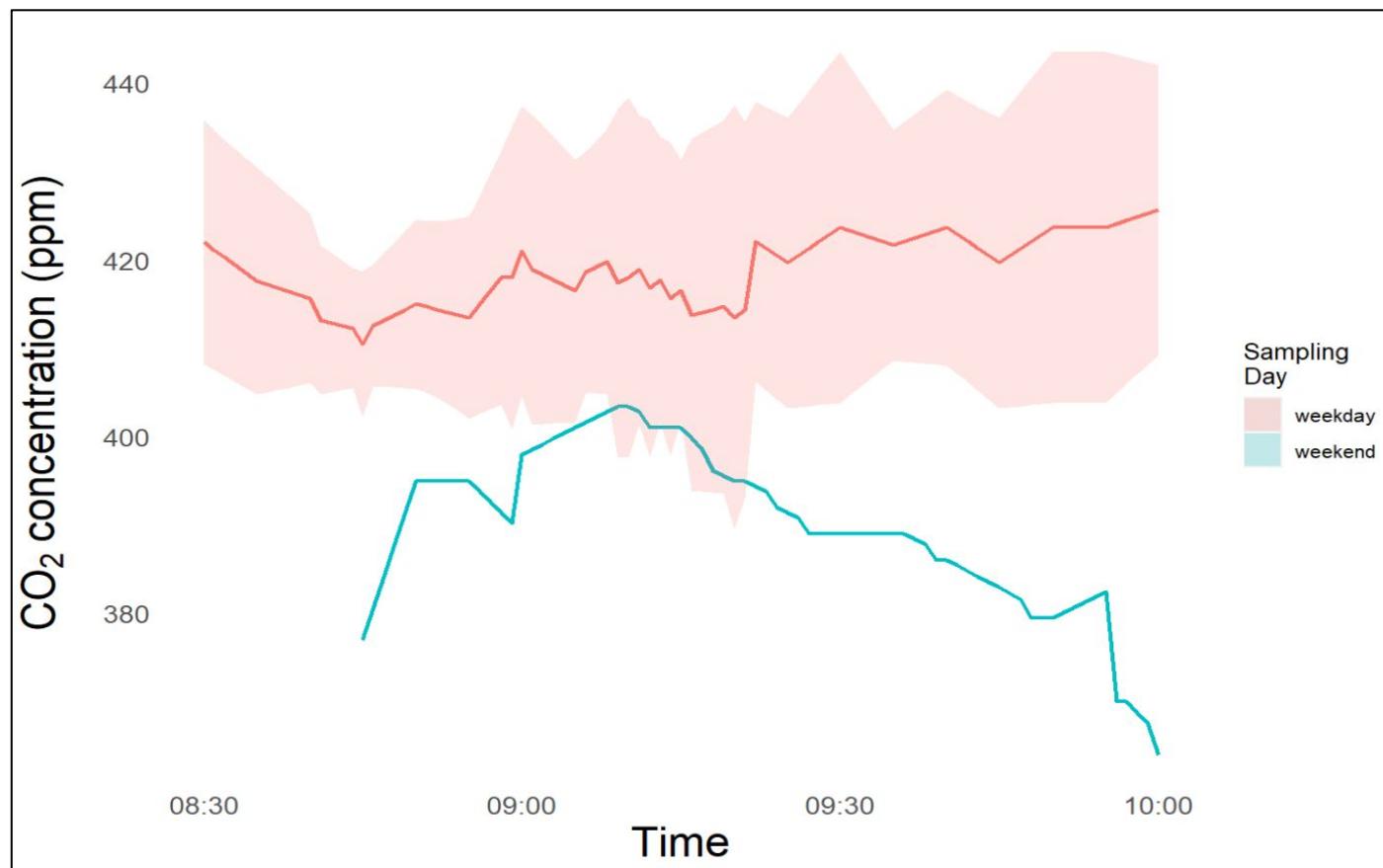
Contamination: Air blowing in between processing samples

Replicate Tests: Three from each sampling site

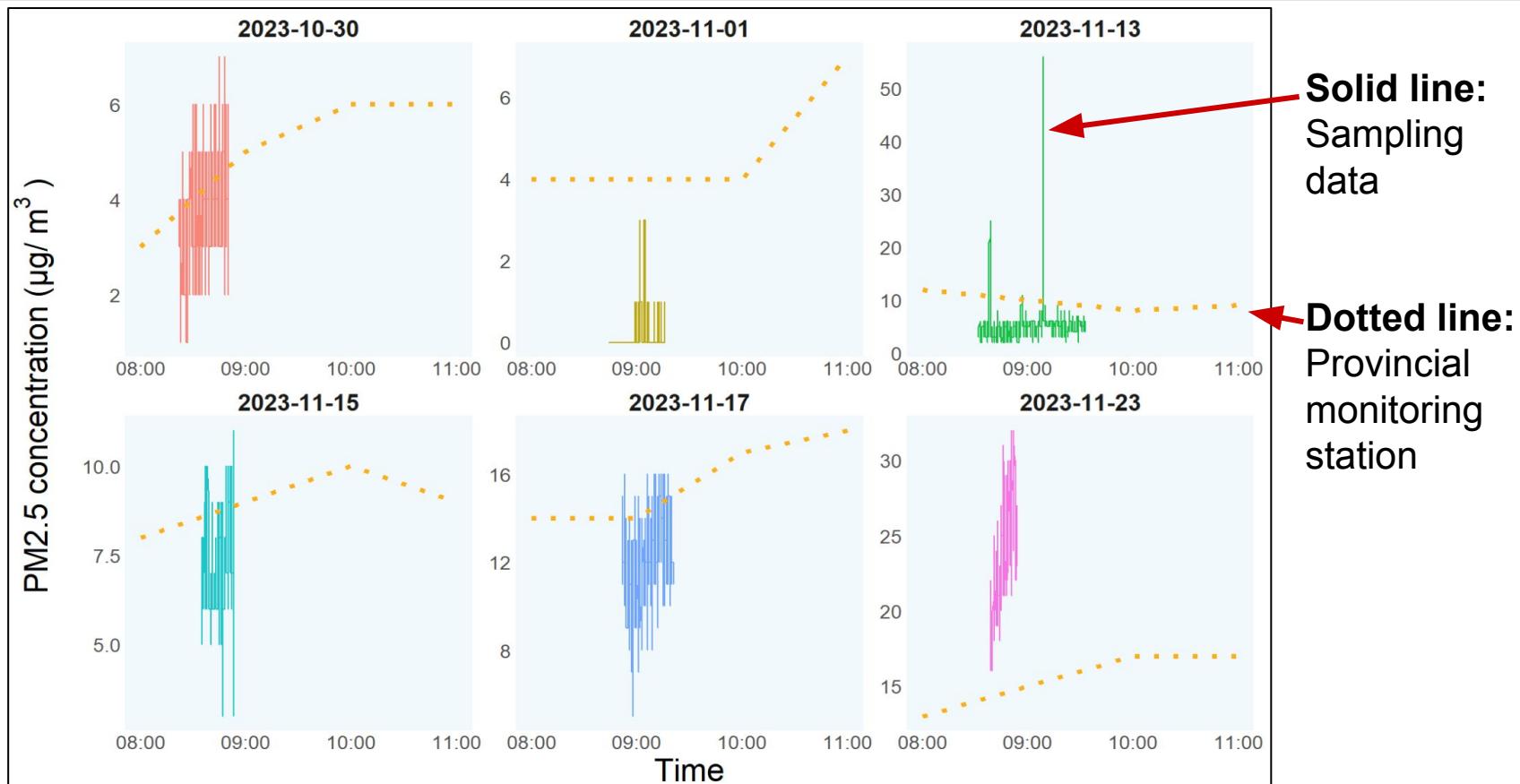
Results: Ozone



Results: Carbon Dioxide



Results: Particulate Matter (2.5)



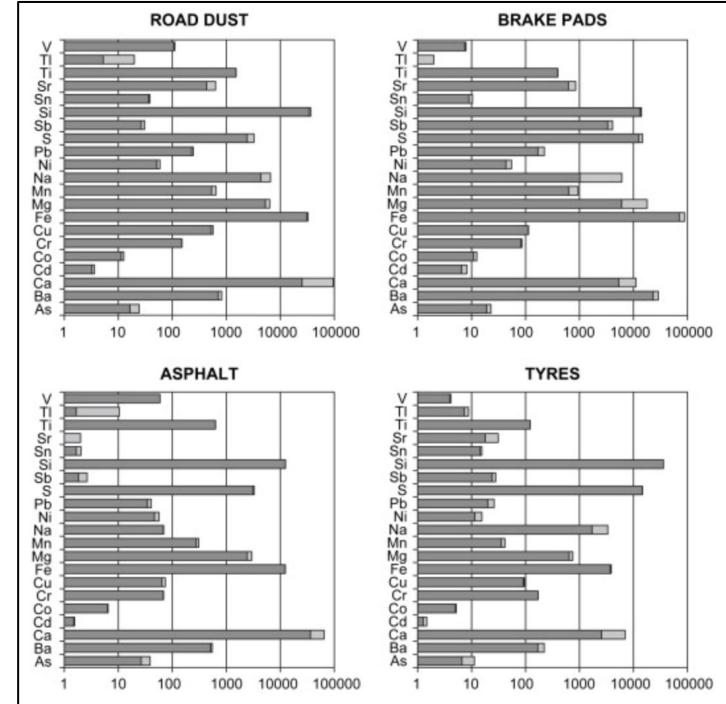
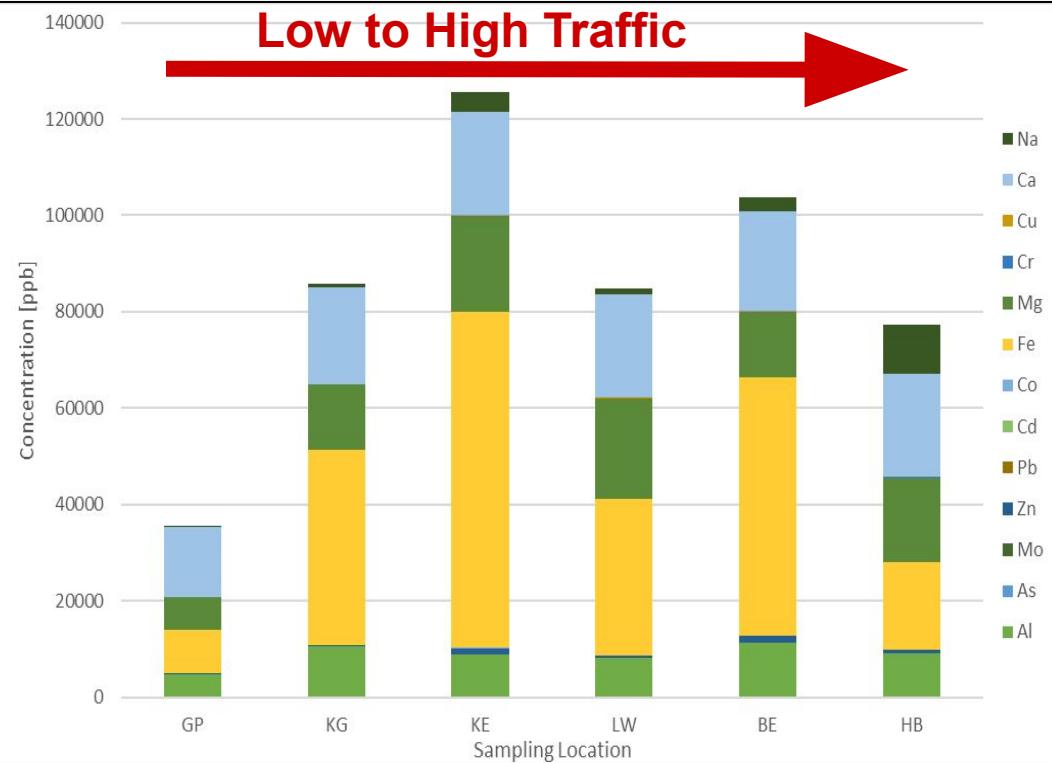
Discussion: Air Pollutant Monitoring

O_3 : Concentration at the school greater than Provincial Monitoring site; **Weekend** had highest levels; General **increase** over time; Photochemistry

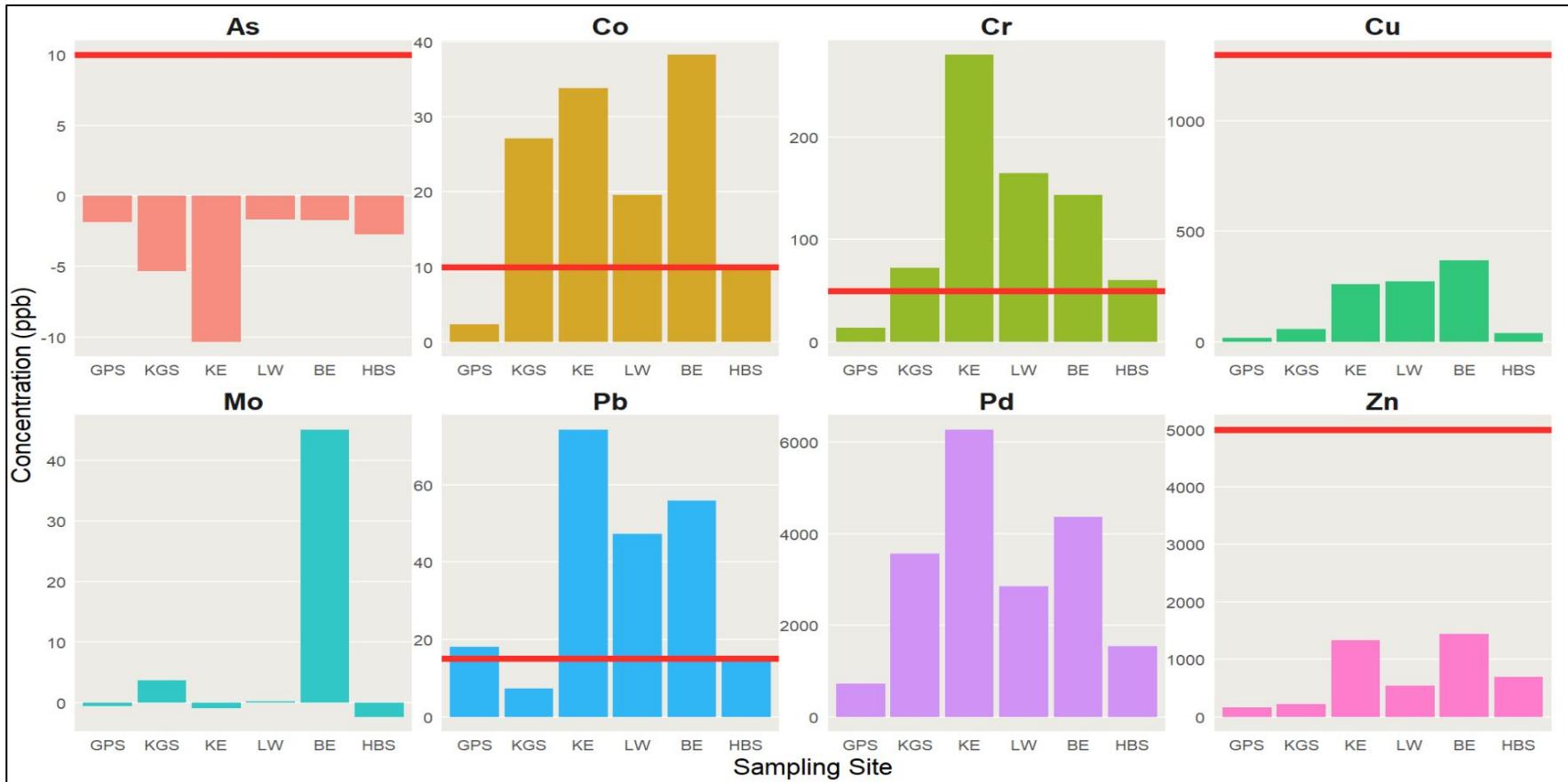
CO_2 : Higher concentrations observed on **weekdays**; Greater vehicle traffic

$PM_{2.5}$: A slight increase in concentration over the sampling period; **Not significant**

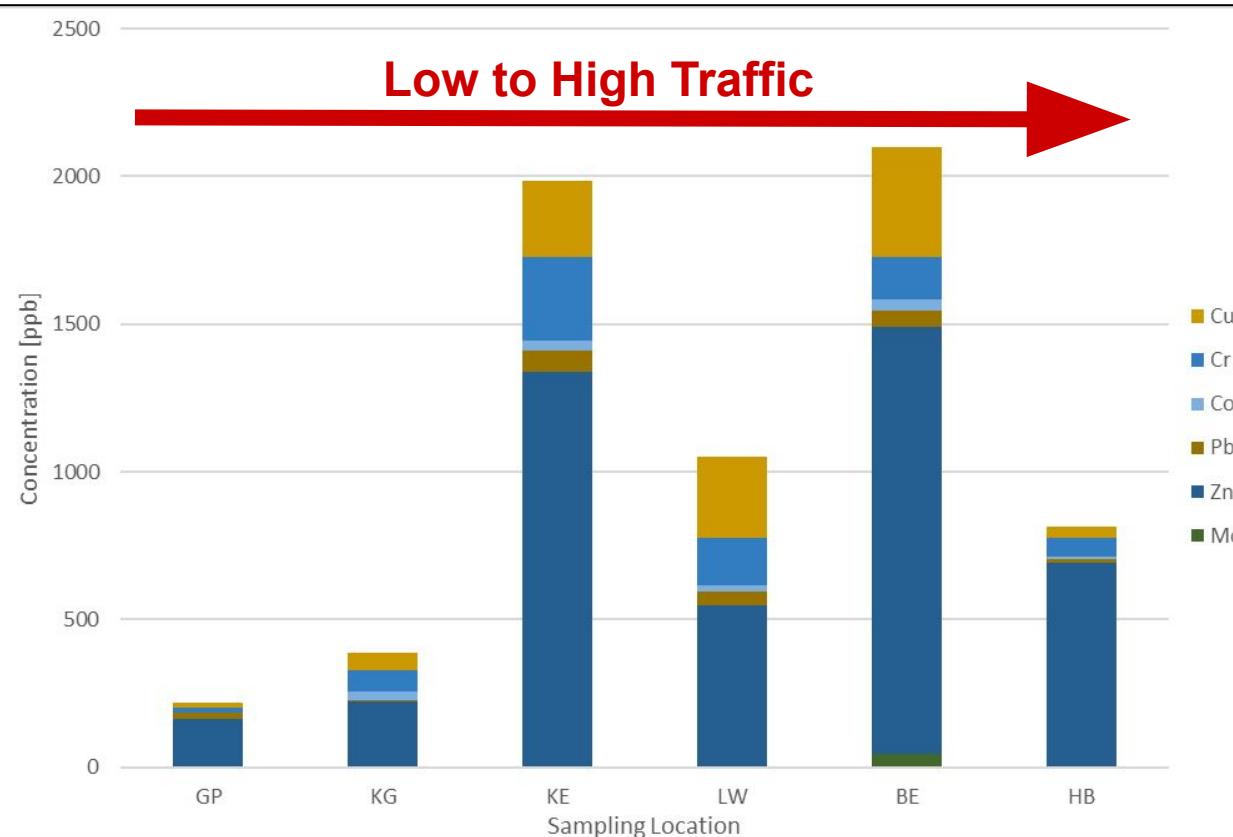
Results & Discussion: Road Dust - Raw Visualized



Results & Discussion: Road Dust - Specific Elements



Results: Road Dust - Overall Total Quantifiable Metals



Weak positive correlation between metal concentration & traffic.

Traffic is a likely source of metals, **Cu and Zn** concentrations were likely due to **tire wear & brakes**

Limitations

- Location inconsistency - UofT Campus vs. School
- Difficult to estimate the amount of traffic
- Location is not representative: Most students may walk, and too young to bike
- Unable to measure other important air pollutants, such as SO_2 and NO_x

Conclusions

We have **weak support for HA1** since CO₂ (highest weekdays, lowest weekend) and PM_{2.5} (similar to provincial) and O₃ (highest weekend) were elevated over time.

We have **weak support for HA2** since road dust collected from high traffic areas did not contain a significantly greater concentration of trace metals compared to low traffic areas.

Cannot fully accept either hypothesis due to **limitations**

Future Work

Explore correlation between **pollutants** and **meteorological conditions**, considering temperature, wind speed and humidity.

Conduct a **prolonged study** to observe trends over an extended period, capturing seasonal variations.

Organize **community workshops** to raise awareness about air quality and discuss **potential health implications**.

Acknowledgements

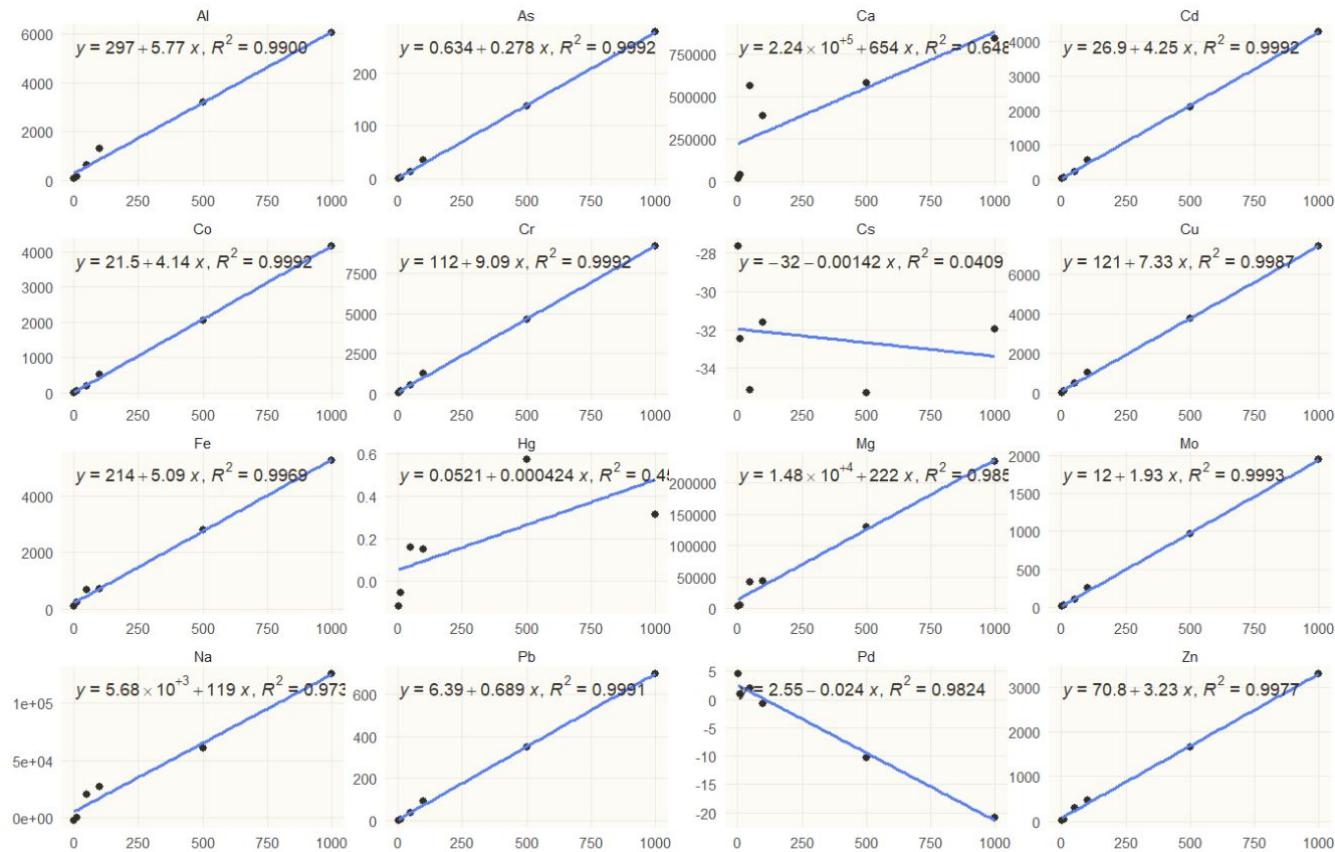
Maggie Wang
Prof Jessica D'eon
Group C
CHM1410



Thank you!

Questions?

Appendix



Appendix

