

# Canada



# Traffic-Related Air Pollution: *A Moving Target*

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#### A Target that moves in time and space



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#### Black carbon trend – last half century



#### Long-Term Trend in Black Carbon in Canadian Cities



COH = coefficient of haze

# Mobile labs can bring much detail

- Resolve the spatial pattern in the urban background concentrations
- Within and between neighborhood/grid variations
- Isolate local hotspots, survey unmonitored areas







#### **Recent Mixtures (Montréal 2009)**



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#### Mixtures today (Toronto, 2015-16)

On-road plume-based emission factors of 'unmeasured species'



Wren et al, Atmos Chem & Physics, submitted





#### **Benzene at Intermodal Freight Hubs**



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Met Soc., 2018

#### **California Goods Movement Policy**



Figure 2. Boxplots of the measured  $NO_2$  and  $NO_X$  concentrations for the pre-policy (left side of a panel) and post-policy (right side of a panel) periods for the Los Angeles (first two panels) and Bay Area (the third panel), summarized by location category.  $NO_X$  for the pre-policy period was not sampled for the Bay Area and the comparison was thus not listed.

Su et al. ES&T 2017



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#### **Effect of DPF on Vascular Function**



Lucking et al., Circulation, 2011



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DPF = diesel particulate filter



#### **Toronto and Vancouver Near Road Network**











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#### Vancouver – Toronto NO and NO<sub>2</sub> Near Road Site Comparisons



Data courtesy of NAPs (D. Herod et al.)

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### Vancouver – Toronto Black Carbon Near Road Site Comparisons



Data courtesy of NAPs (D. Herod et al.)

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#### **Toronto and Vancouver Near Rd Network**









Page 14 – 9 mai 2018



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#### **U.S. Near-road network observations**



2014-15

AADT Range of traffic counts 75-320 (x10<sup>3</sup>)

Range of monitoring site distances to road 2-50 m

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AADT = annual average daily traffic

#### **Exposure vs. fleet characteristics**



Jon Wang, U Toronto PhD Thesis 2018

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# Comparison of ozone is one example of how the mixtures can be different



#### Data courtesy of NAPs (D. Herod et al.)



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NR = near-road NAPS = National Air Pollution Surveillance

#### **Near-road changes PM<sub>2.5</sub> composition**



Temp (°C)

#### Zhang et al., Atmos. Env. 2016

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# Nature of traffic particles changing



# **Tailpipe PM<sub>2.5</sub> and NO<sub>2</sub>**



Distance from highway center (m)

Levy et al. ACP 2014

NO2 = nitrogen dioxide

CO = carbon monoxide

HOA = hydrocarbon-like organic aerosol

 $PM25 = PM_{2.5}$  = particulate matter <2.5 micrometers in diameter BC = black carbon

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## Changing Gasoline Engine (GDI) Technology – near term





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Environment and Climate Change Canada Zhang et al. (in prep.)

Hyundai Sonata

GDI = Gasoline direct injection GPF = Gasoline particulate filter

#### **Very Near Road Evolution in Particles**

GDI – Ford Focus



GDI = Gasoline direct injection



Zimmerman et al. ES&T 2016

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# Changing nature of the mixture with Gasoline Direct Injection (GDI)



EI C

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#### Longer term changes in the mixture





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# **Closing Remarks**

- Although considerable similarity in the major pollutants in TRAP there is potential for large diversity in the details in the exposures attributed to simple indicators
- Given the inherent limitations in epidemiological studies, especially variations in precision in determining individual exposures, are there novel study designs remaining to be attempted to capitalize on TRAP mixture variability to gain new insight?
- What types of insight are most-needed to inform policy and other measures to reduce risk?
  - In light of the fleet on/off roads today

TRAP = traffic-related air pollution





Page 25 – 9 mai 2018

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