



**SOCAAR**

southern ontario centre for atmospheric aerosol research



# Ultrafine Particle Measurement Characterisation and Monitoring

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Workshop on Ultrafine Particle  
Emissions from Transportation

Sept, 2019



# Overview



- Monitoring ultrafine particles can help characterise vehicle emissions
- UFP concentrations vary over space and time
- Parameters influence emissions and concentrations



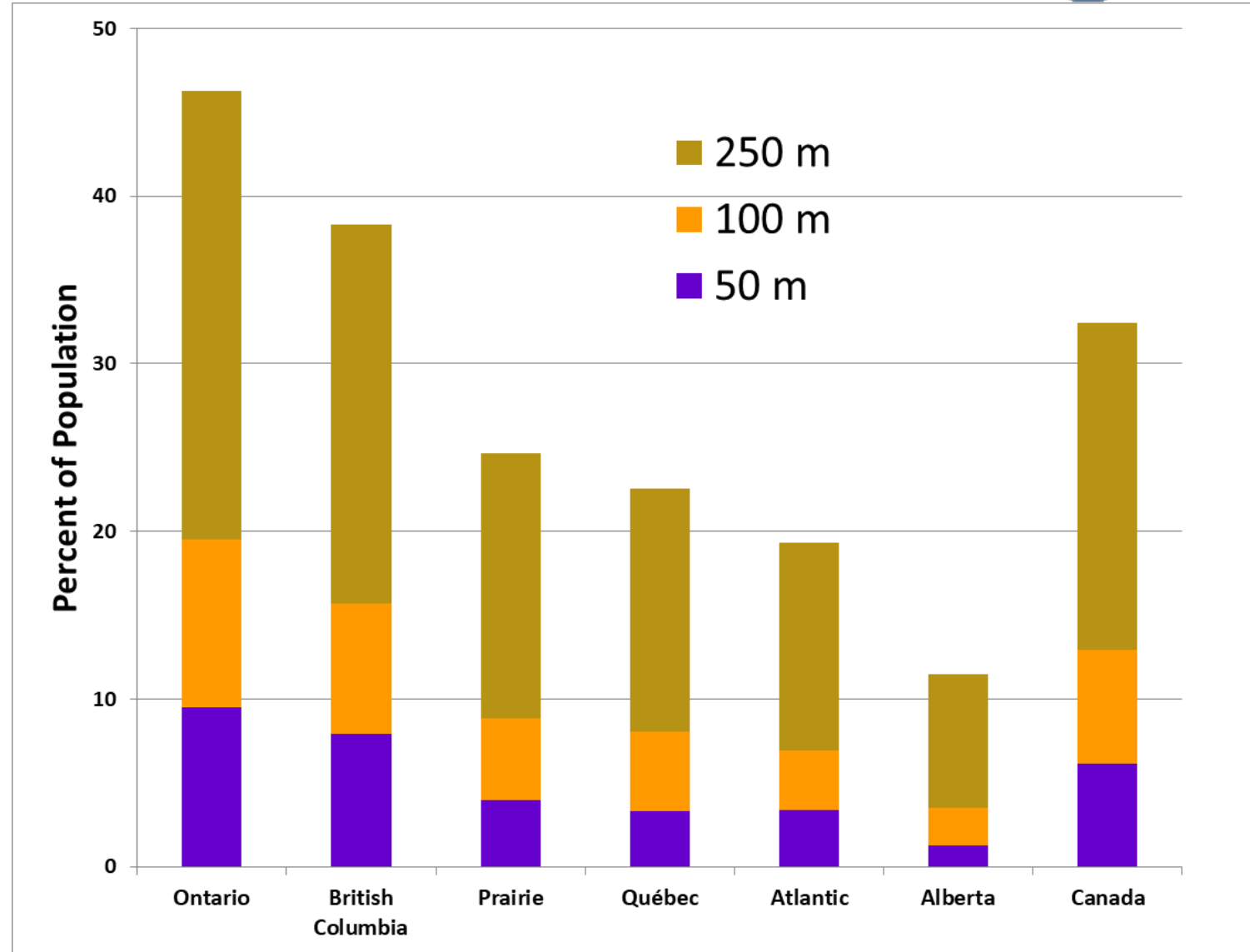
# Canadians Live Near Major Roads



**1/3<sup>rd</sup>** of all  
Canadians

**40%** of Vancouver  
residents

**50%** of Toronto  
residents



# Vancouver: Near Road (NR) and Background (BG) Sites

**Clark Drive Near-Road Site (NR–VAN)**

**Sunny Hill Background Site (BG–VAN)**

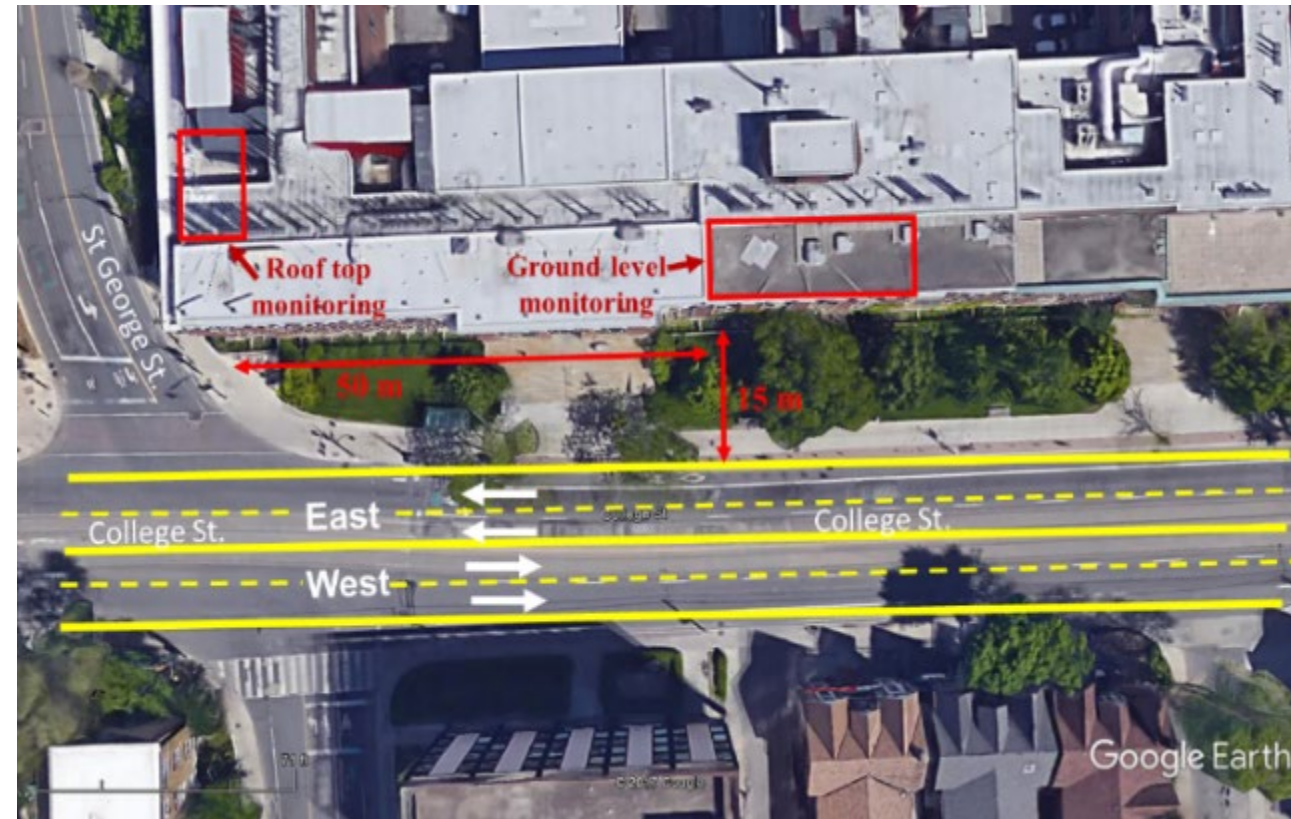


# Toronto: Near Road (NR) Sites



## Highway 401 Near-Road Site (NR-TOR-1)

## College Street Near-Road Site (NR-TOR-2)



# Toronto: Background (BG) Site Locations

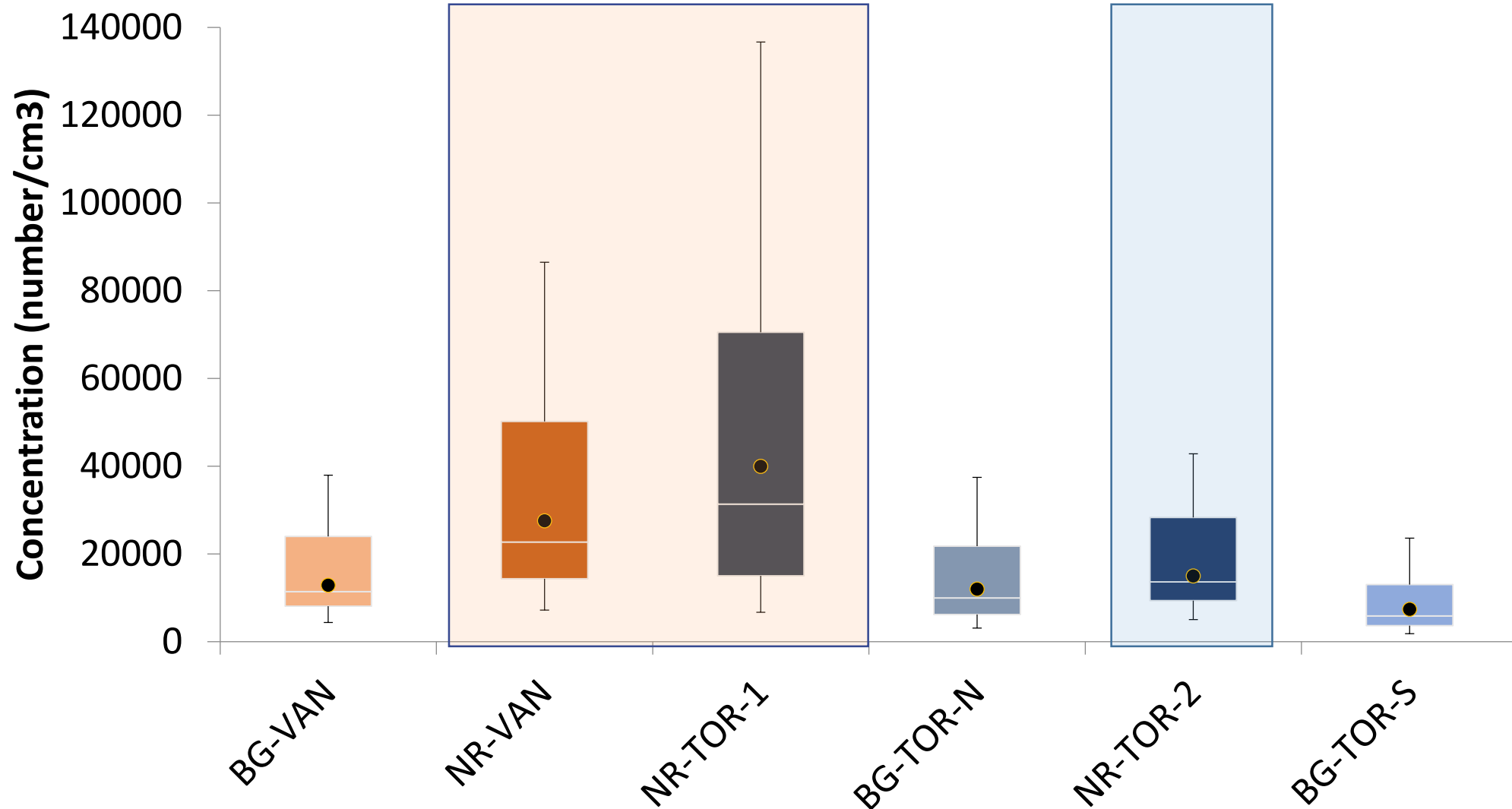


## Toronto North Background Site (BG-TOR-N)

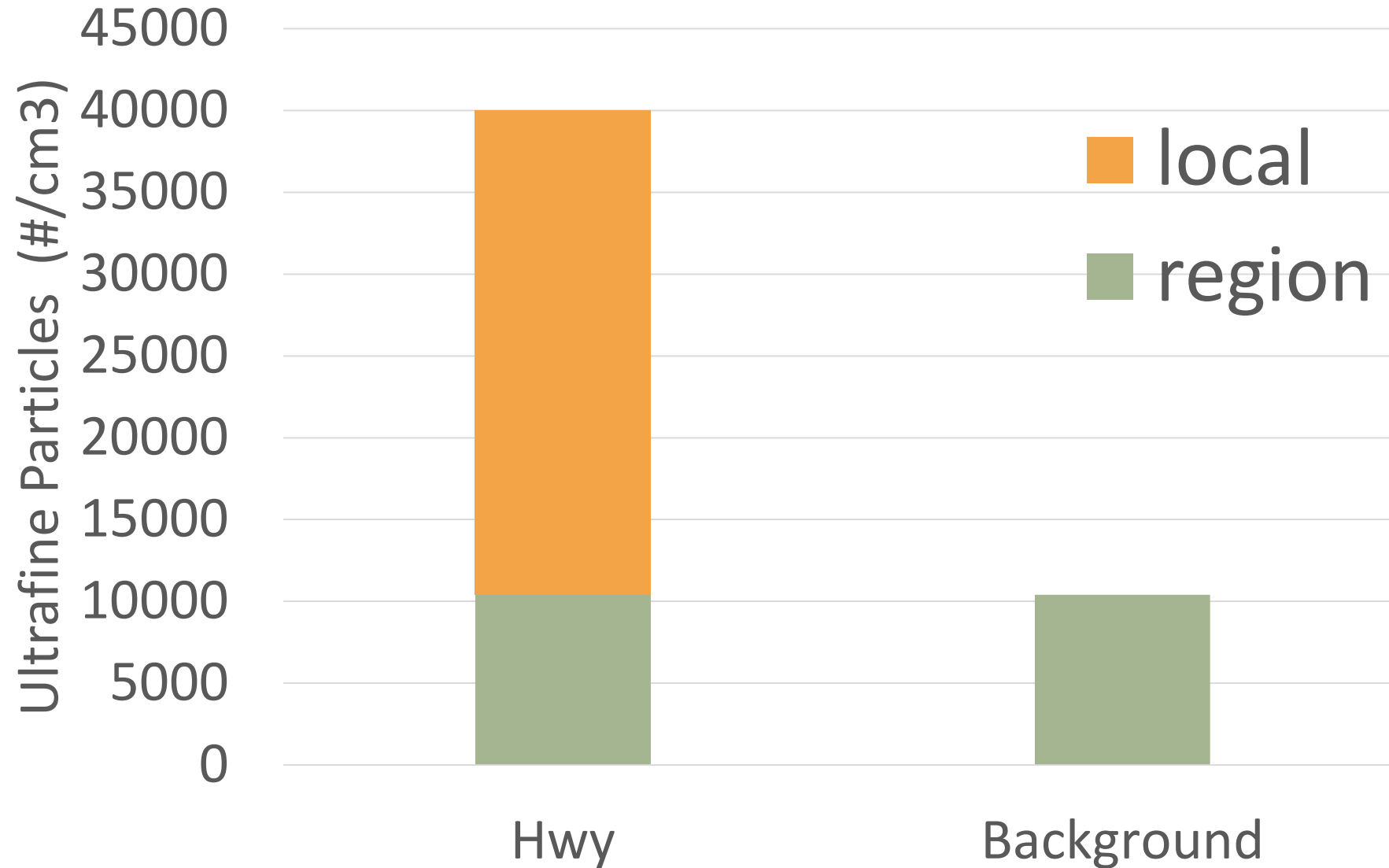
## Toronto South Background Site (BG-TOR-S)



# A Key Marker For Traffic Emissions



# Traffic Dominates Near Roads

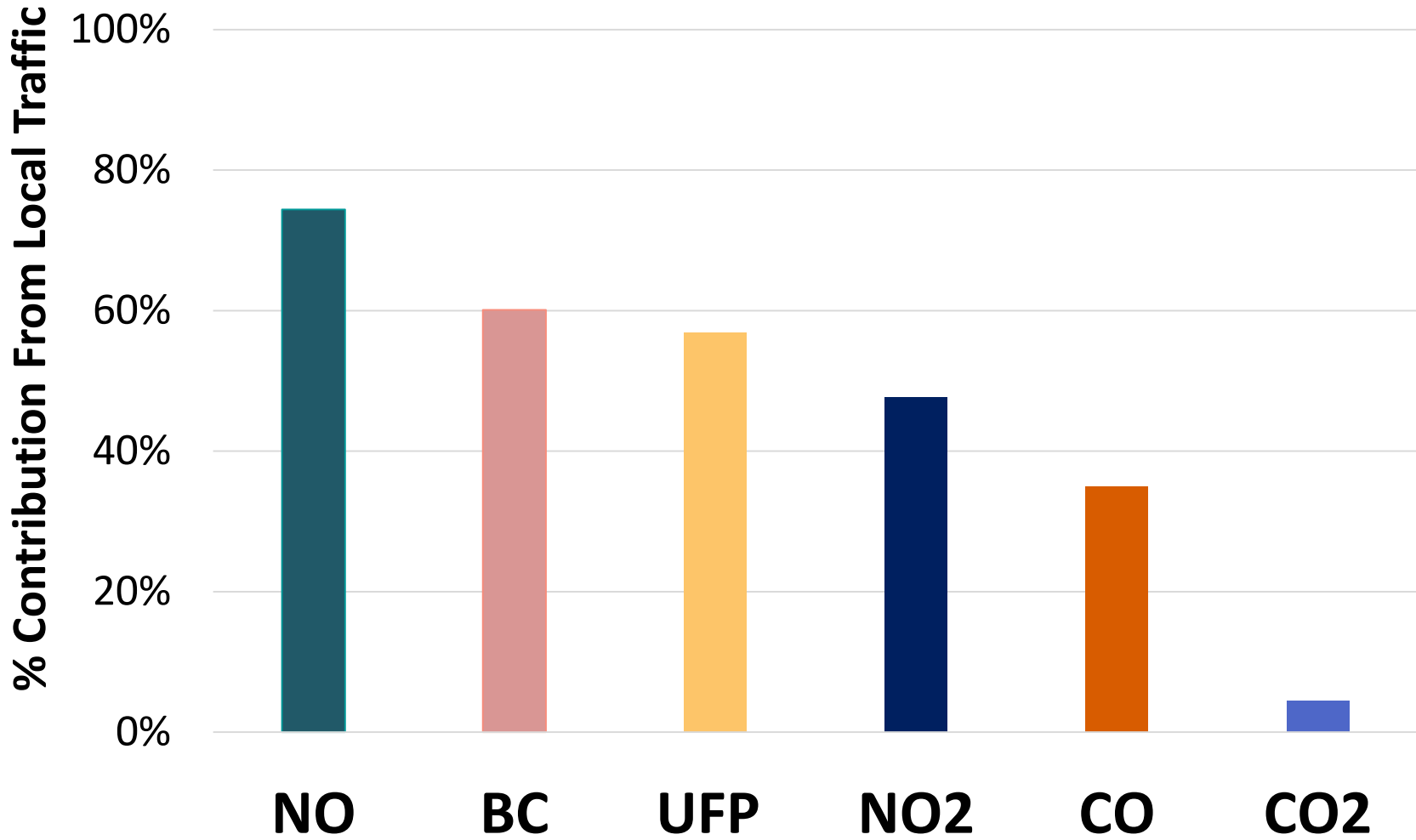




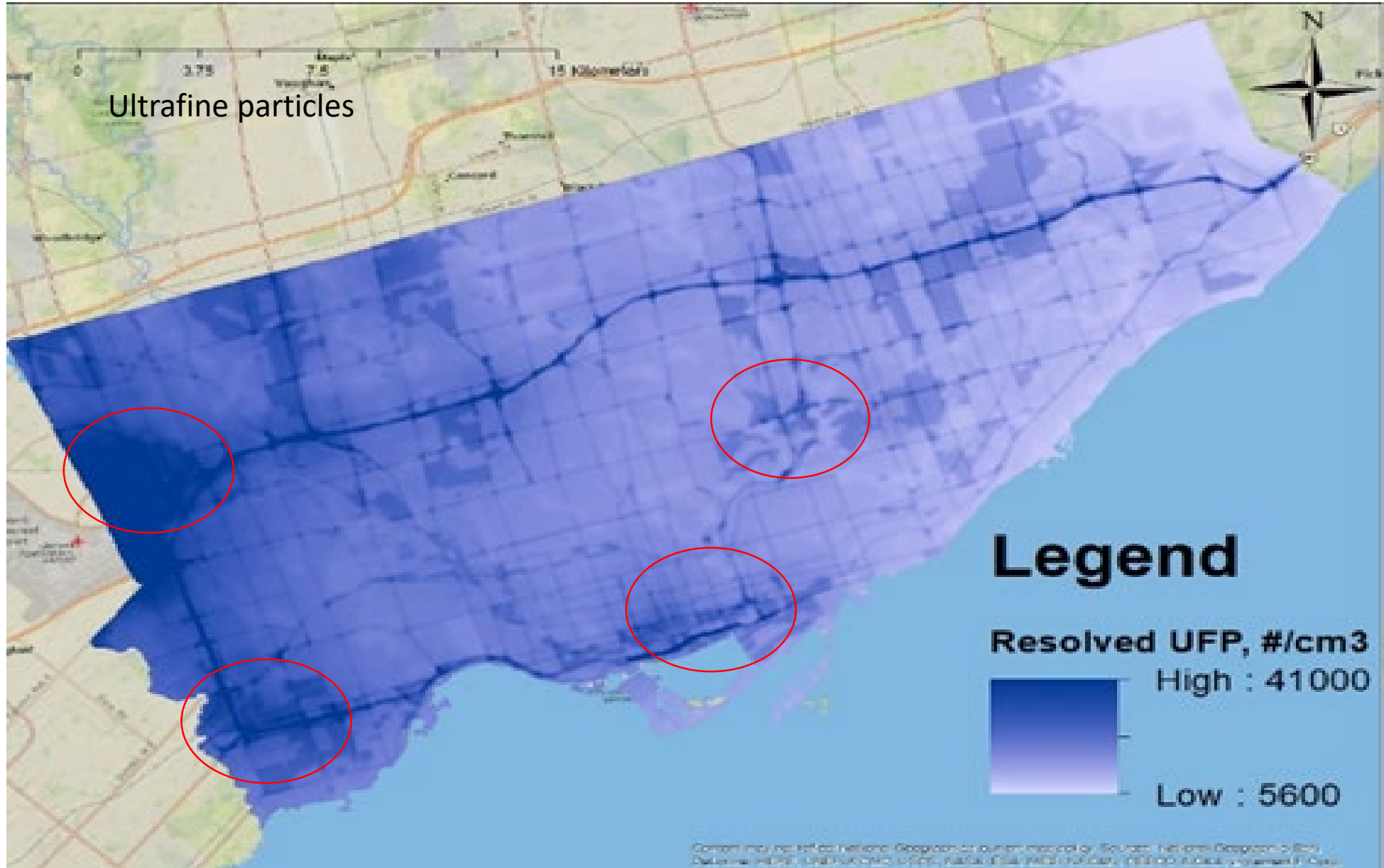


# Traffic Dominates Near Roads

## Highway 401 (NR-TOR-1)



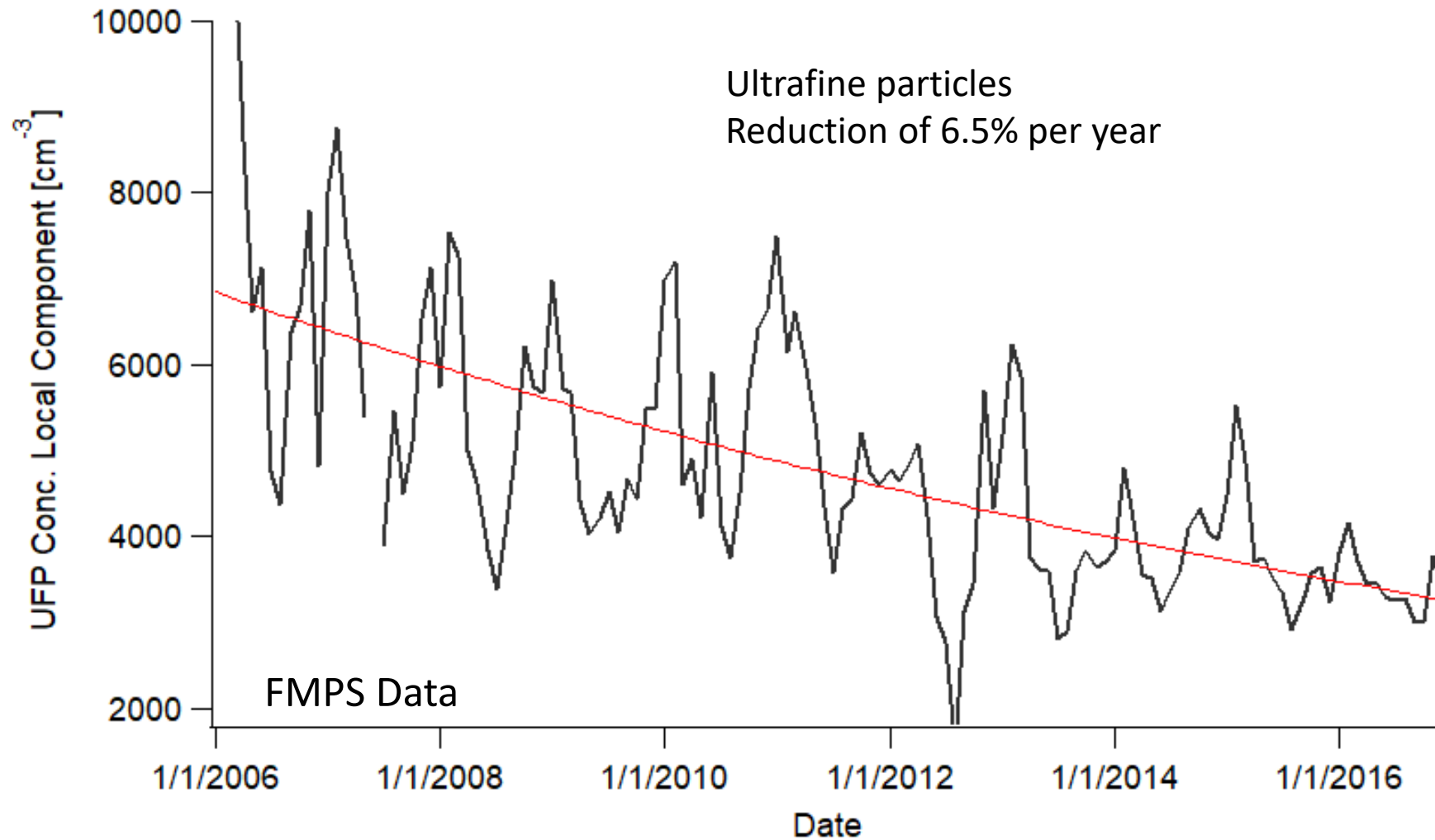
# Concentrations Vary Across the City



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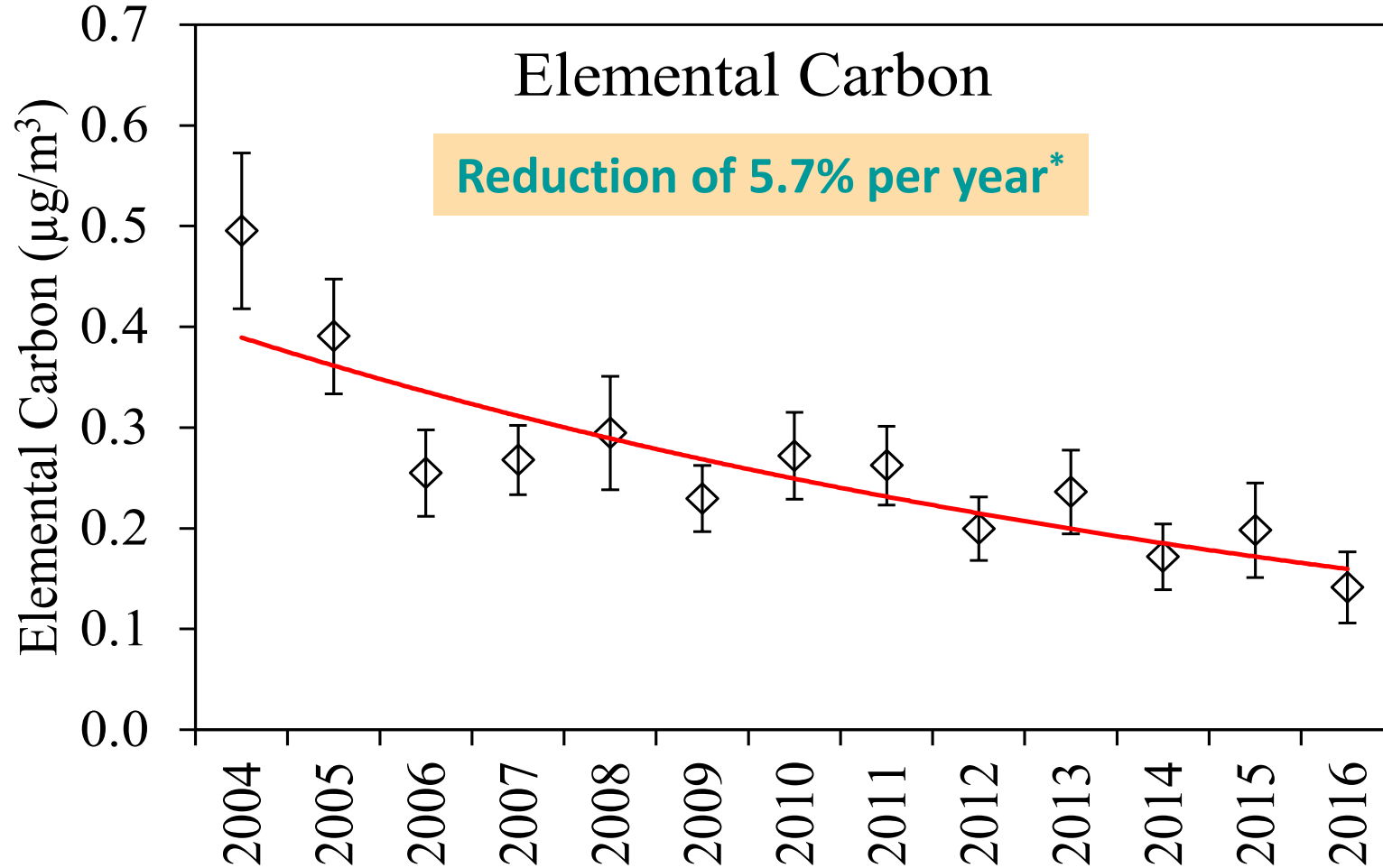
# Concentrations Change Over Time

## College Street



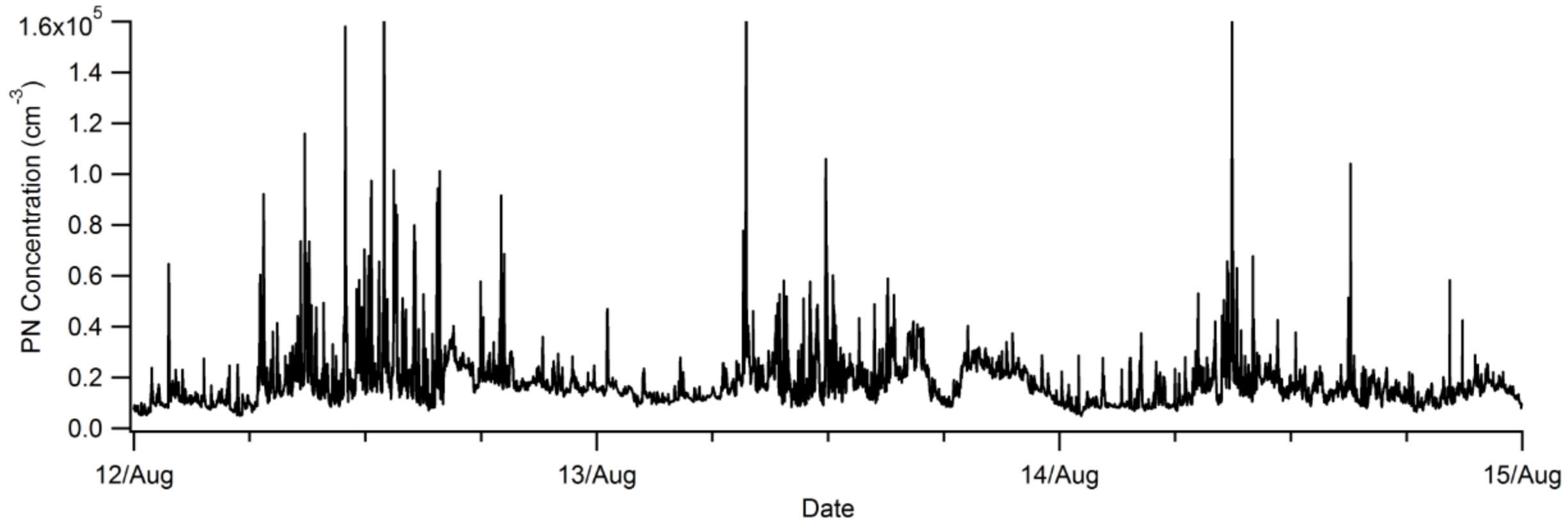
# Similar Pattern for Elemental Carbon

## College Street



# Emitted as Many Individual Vehicle Plumes

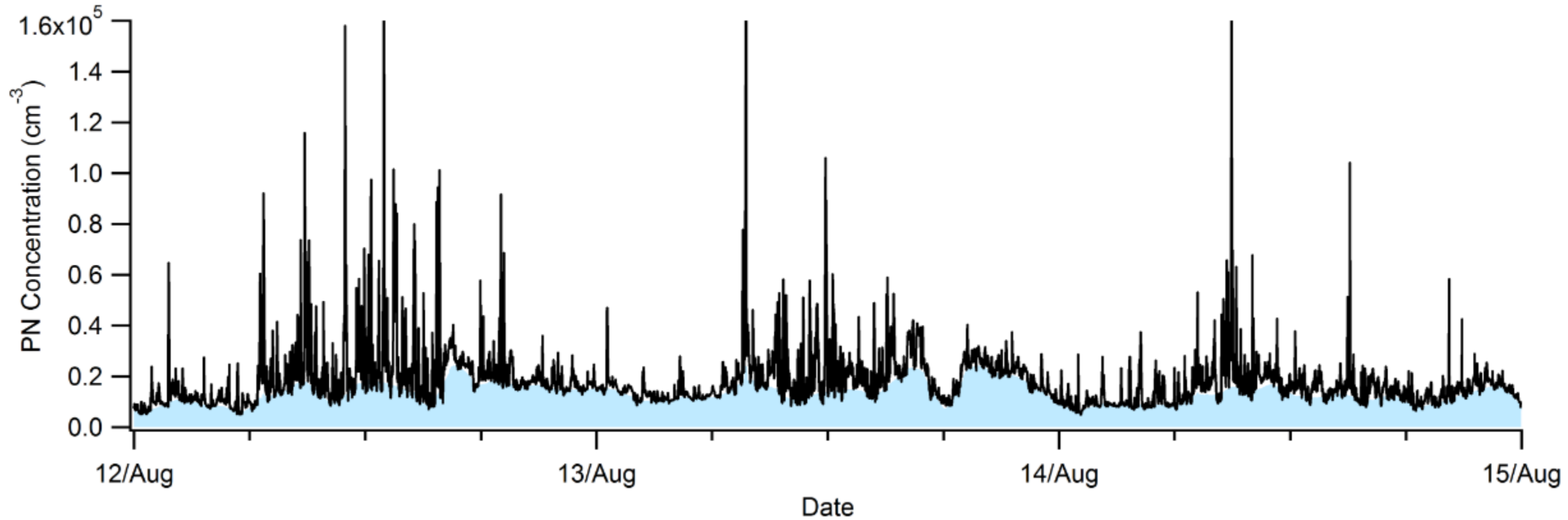
## College Street



Time related pattern: **rapid vs slow variations**

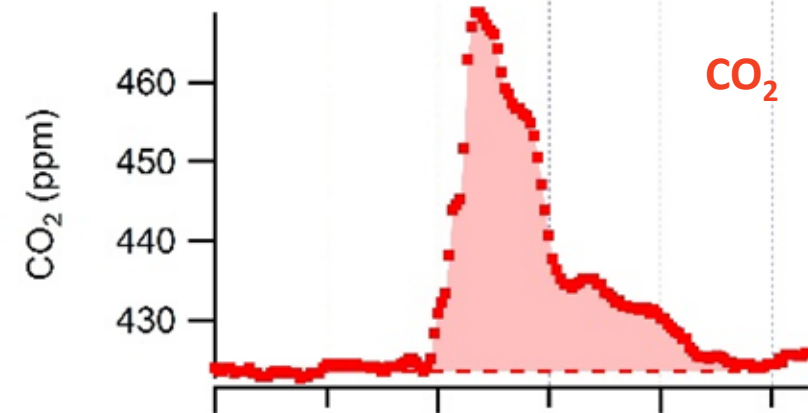
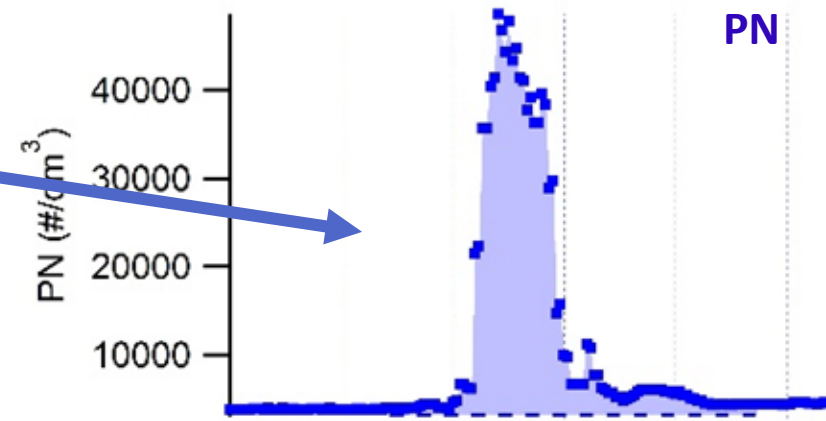
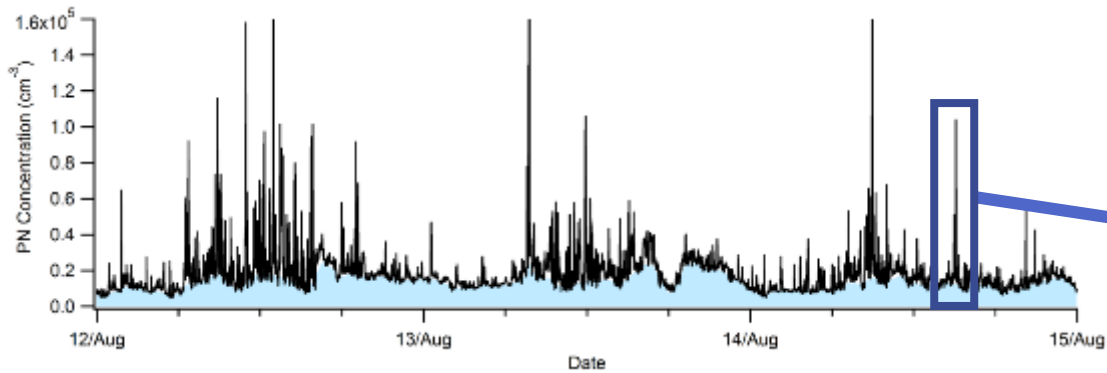
# Emitted as Many Individual Vehicle Plumes

## College Street



Time related pattern: **local vs regional** signal

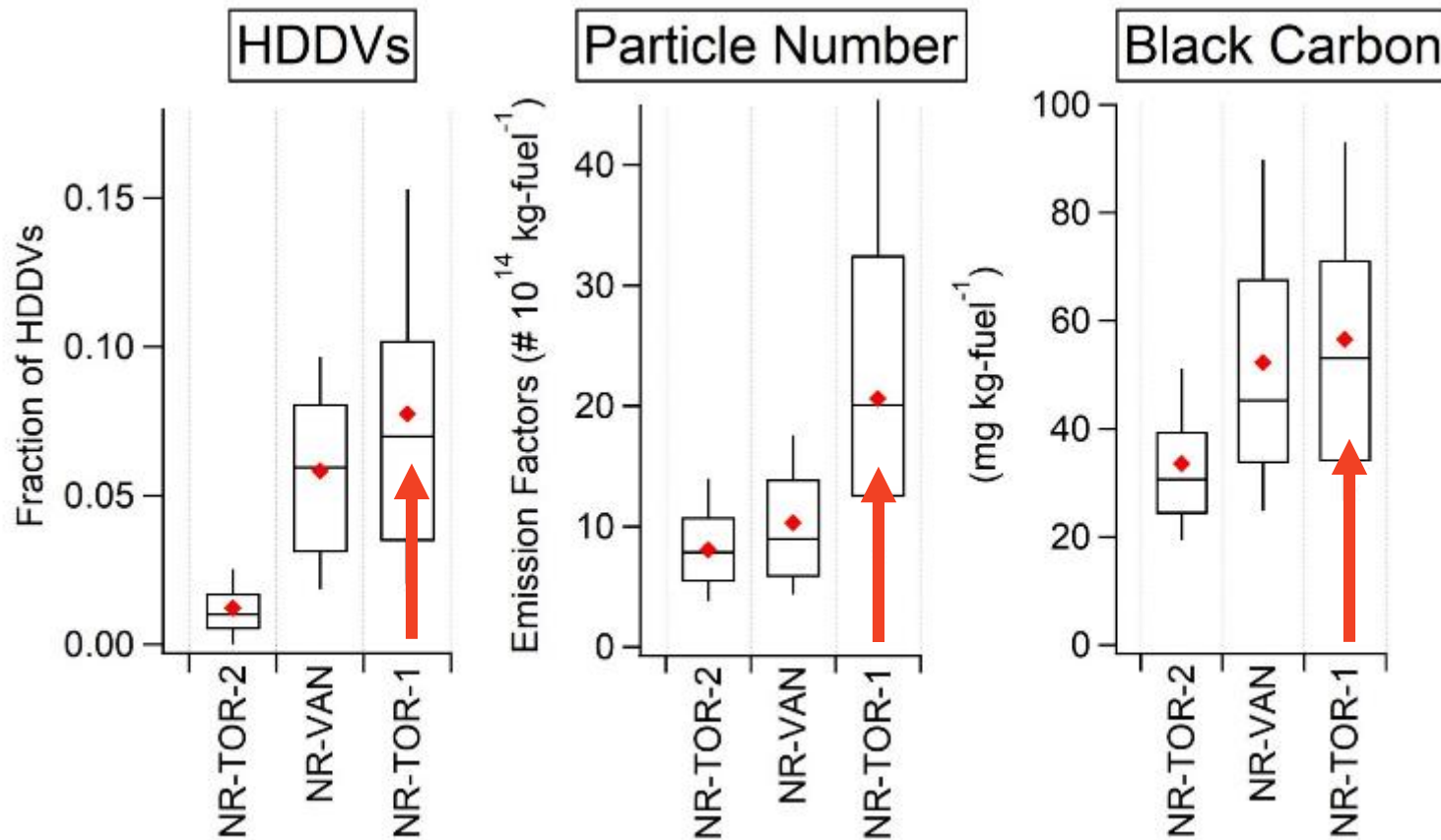
# Quantifying Vehicle Emissions with Emission Factors



$$EF_P = \left( \frac{\overset{\text{Pollutant emitted}}{\Delta[P]}}{\underbrace{\Delta[CO_2] + \Delta[CO]}_{\text{carbon content of fuel}}} \right) w$$

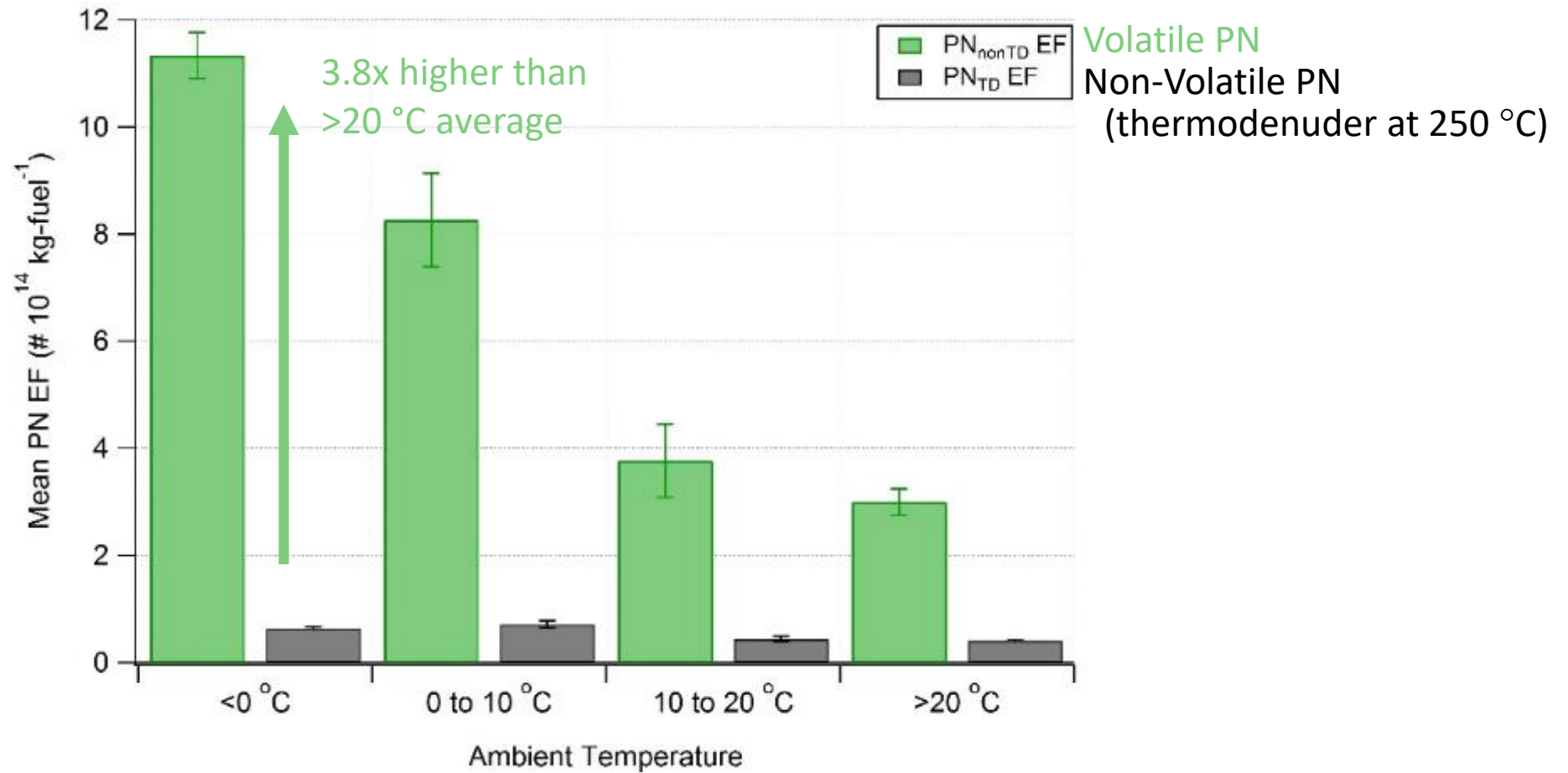
“Work done by vehicle”, carbon combustion products

# Fleet Make-Up Define Particle Emissions

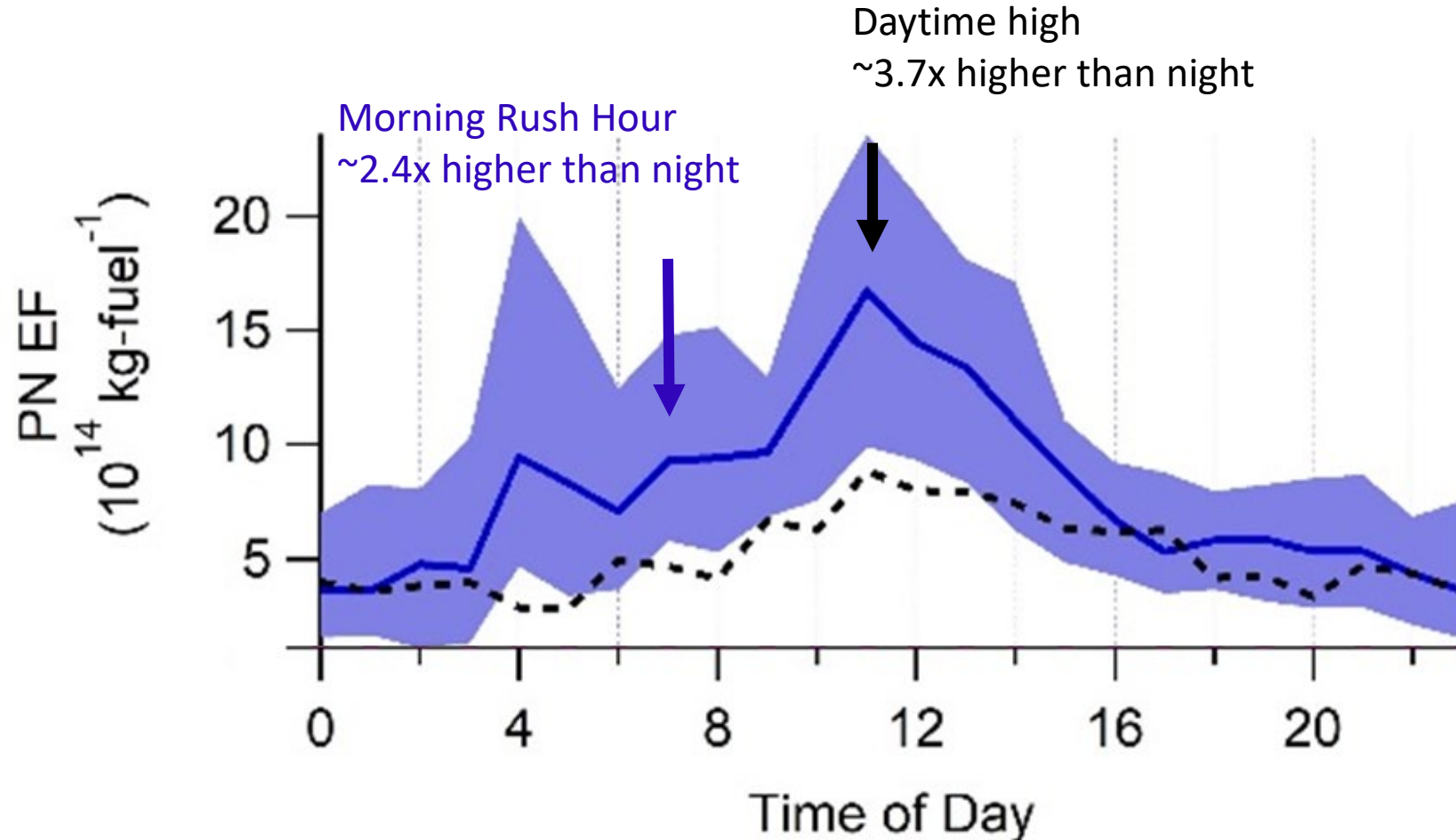




# Volatility Increases Particle Emissions College Street



# Particle Emissions Increase Midday College Street



# Summary



- Canadians Live Near Major Roads
- Vehicles are the major source of UFP near roads
- UFP concentrations vary over space and time
- Fleet makeup influences emissions
- Seasonal difference arise due to particle volatility
- Emissions are higher in winter and midday

