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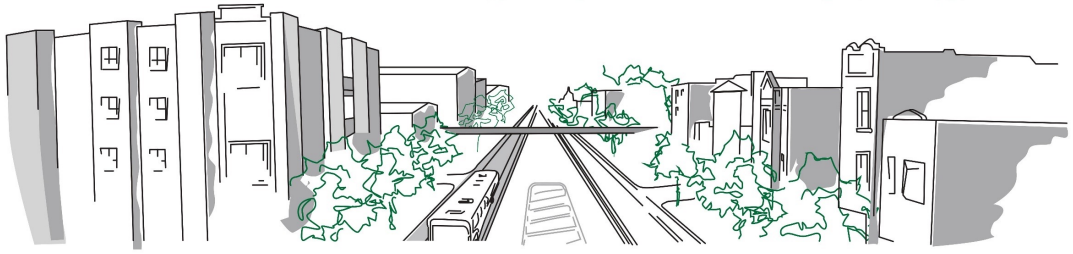

Equity in the distribution of truck emissions in Toronto: Evidence from the past decade

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Outline

1. Background on Air Pollution and Environmental Justice

2. **Study #1**: Spatial and Temporal Trends of Truck and Light-Duty Vehicle Emissions and Environmental Justice

3. **Study #2**: Traffic Emission Scenarios and Impacts on Environmental Justice

Background

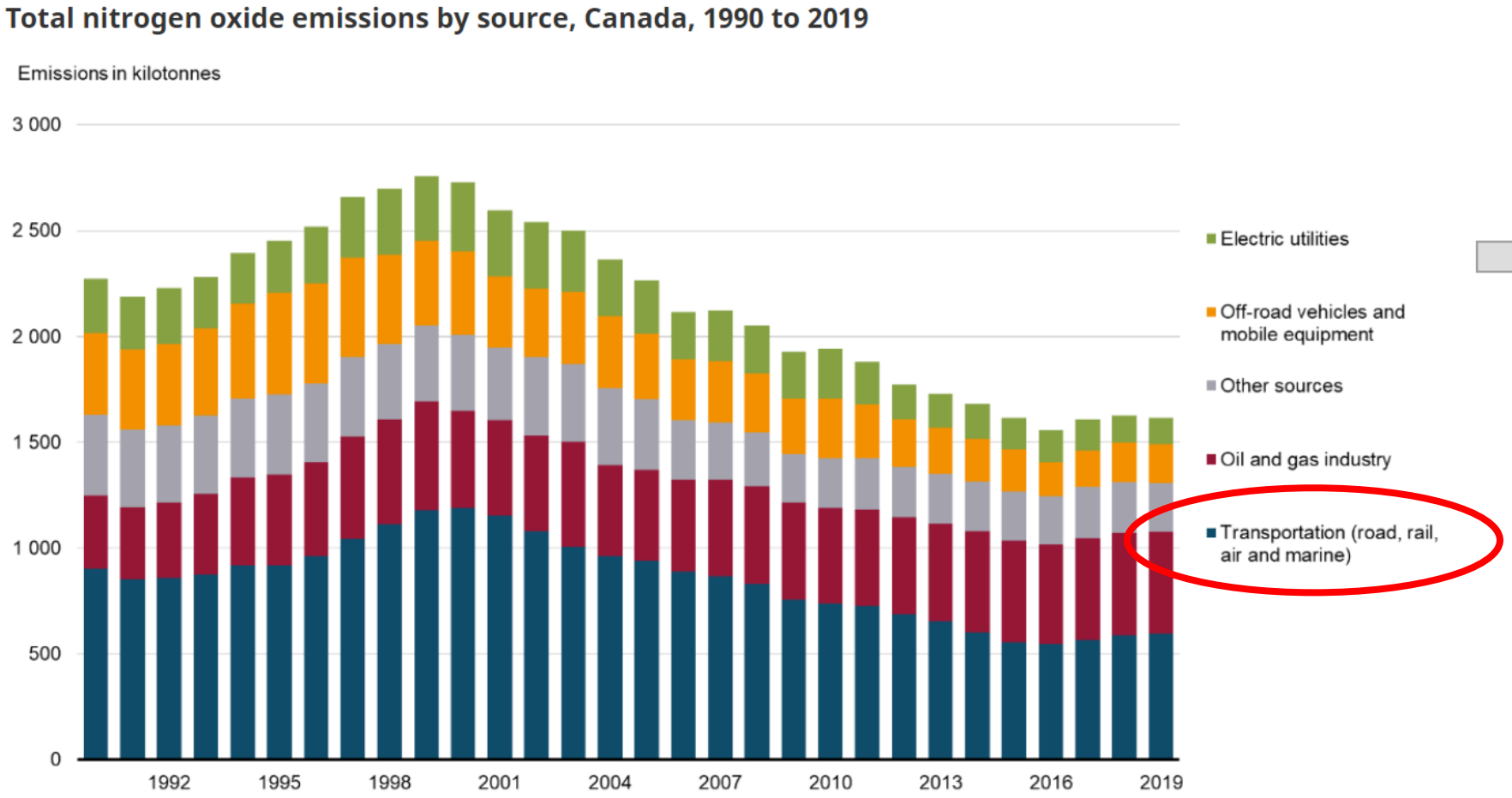
Environmental Justice and Air Pollution

15,300 premature deaths per year attributed to air pollution in Canada and **6,600 in Ontario** (Health Canada, 2021)

Residents of low socioeconomic status neighborhoods are more **vulnerable** and **susceptible** to air pollution

Background

Traffic and Air Pollution



ECCC (2020)

48% of Nitrogen Oxide (NOx) transportation emissions are from diesel trucks

Emissions from trucks cause 400 yearly deaths and 8,000 YLL in the GTHA (Minet et al. 2020)

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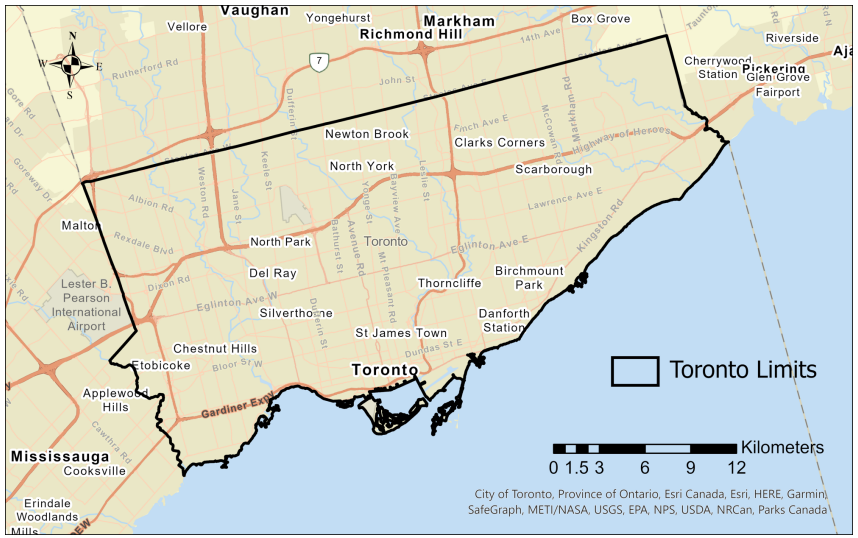
Study #1: Spatial and Temporal Trends of Truck and Light-Duty Vehicle Emissions and Environmental Justice

Overview

Scope of Study

Estimate **light-duty vehicle (LDV) and truck volumes** on all roads in the **city of Toronto** from **2006 to 2020** through a **Machine learning approach**

Calculate **NOx and PM2.5 emissions** from trucks and LDVs for every year between 2006 and 2020



Assess **disparities in exposure** to emissions of trucks and LDVs and how they changed across the years

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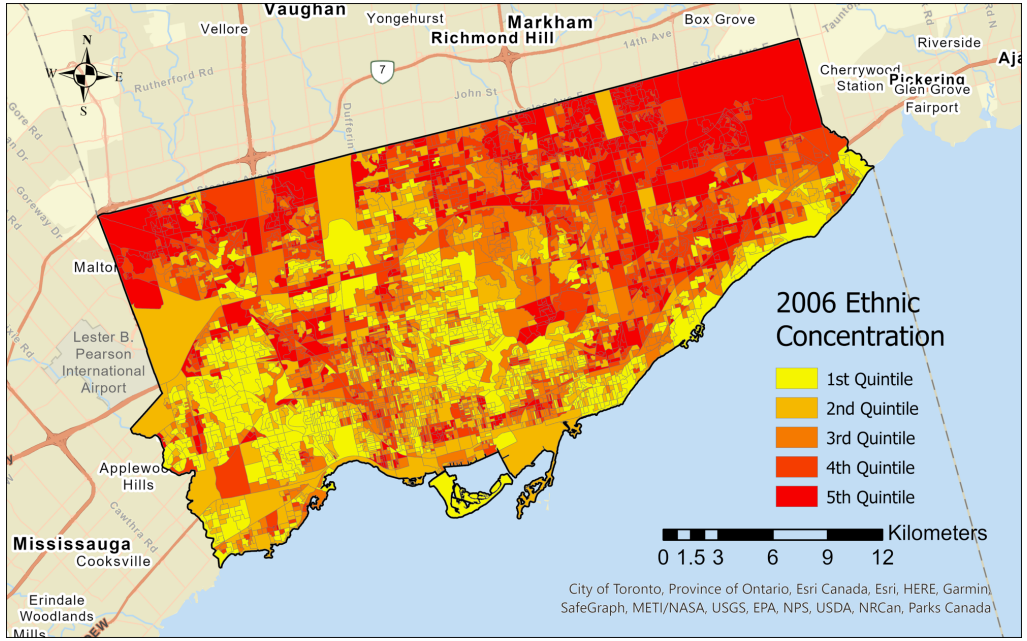
Methods

Environmental Justice Analysis

Marginalization Dimension	Indicators
Residential Instability	➢ Population that rents their current residence ➢ Population that has moved in the past 5 years
Material Deprivation	➢ Unemployed individuals ➢ Adults without a high-school diploma ➢ Low-income families ➢ Families living in poorly maintained dwellings
Ethnic Concentration	➢ Population who immigrated in the past 5 years ➢ Population that identifies as a visible minority

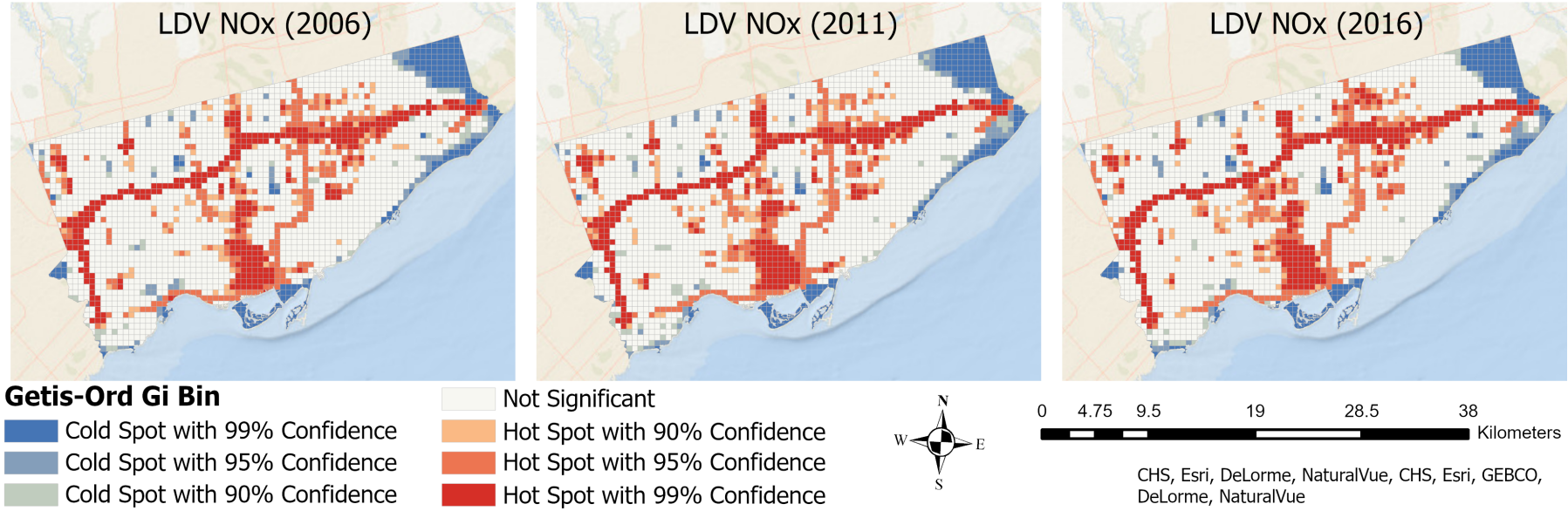


➢ All EJ analysis conducted at the DA level (population of 400 to 700)

Results

Traffic Hotspots

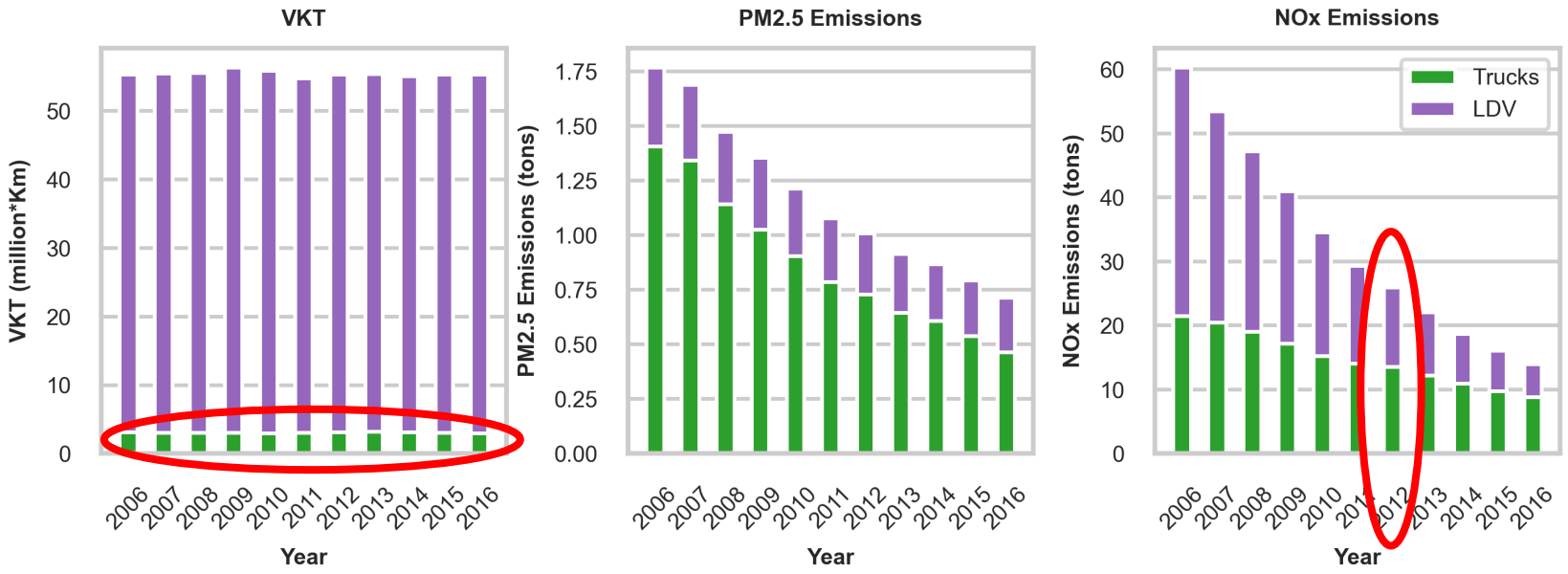
- LDV and truck spatial patterns were consistent across the years
- Different spatial patterns for trucks and LDVs



Results

Emission trends

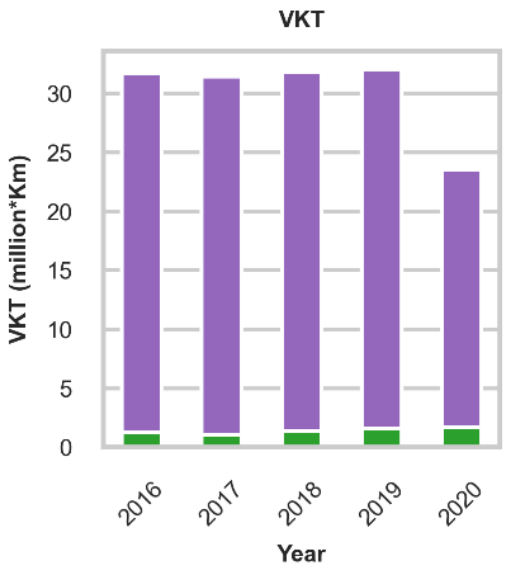
- Overall emissions decreased by 60% and 77% for PM2.5 and NOx
- Trucks account for 5% of total VKT
- Trucks account for >60% of traffic NOx and PM2.5 emissions
- Trucks became largest source of NOx as of 2012

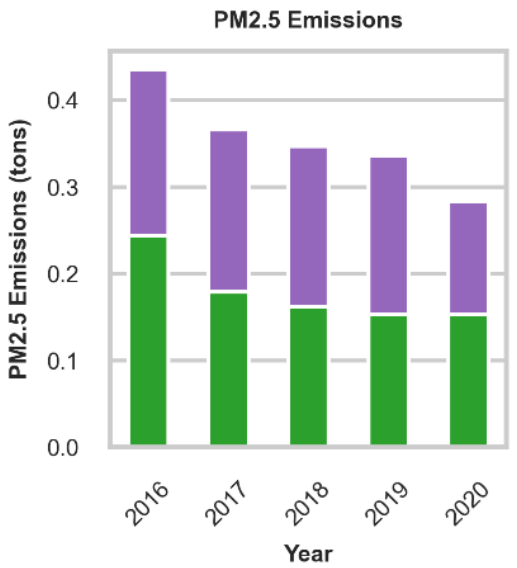


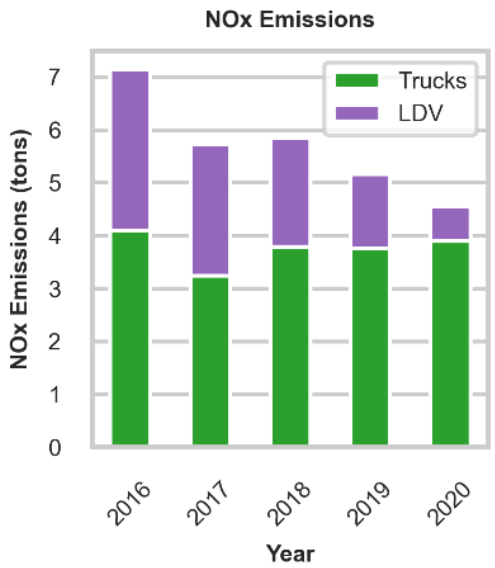
Results

Emission trends – Pre-vs Post COVID19

- 11% increase in truck VKT
- 28% decrease in light-duty vehicle VKT
- Emissions decreased by 12% and 16% for NOx and PM2.5



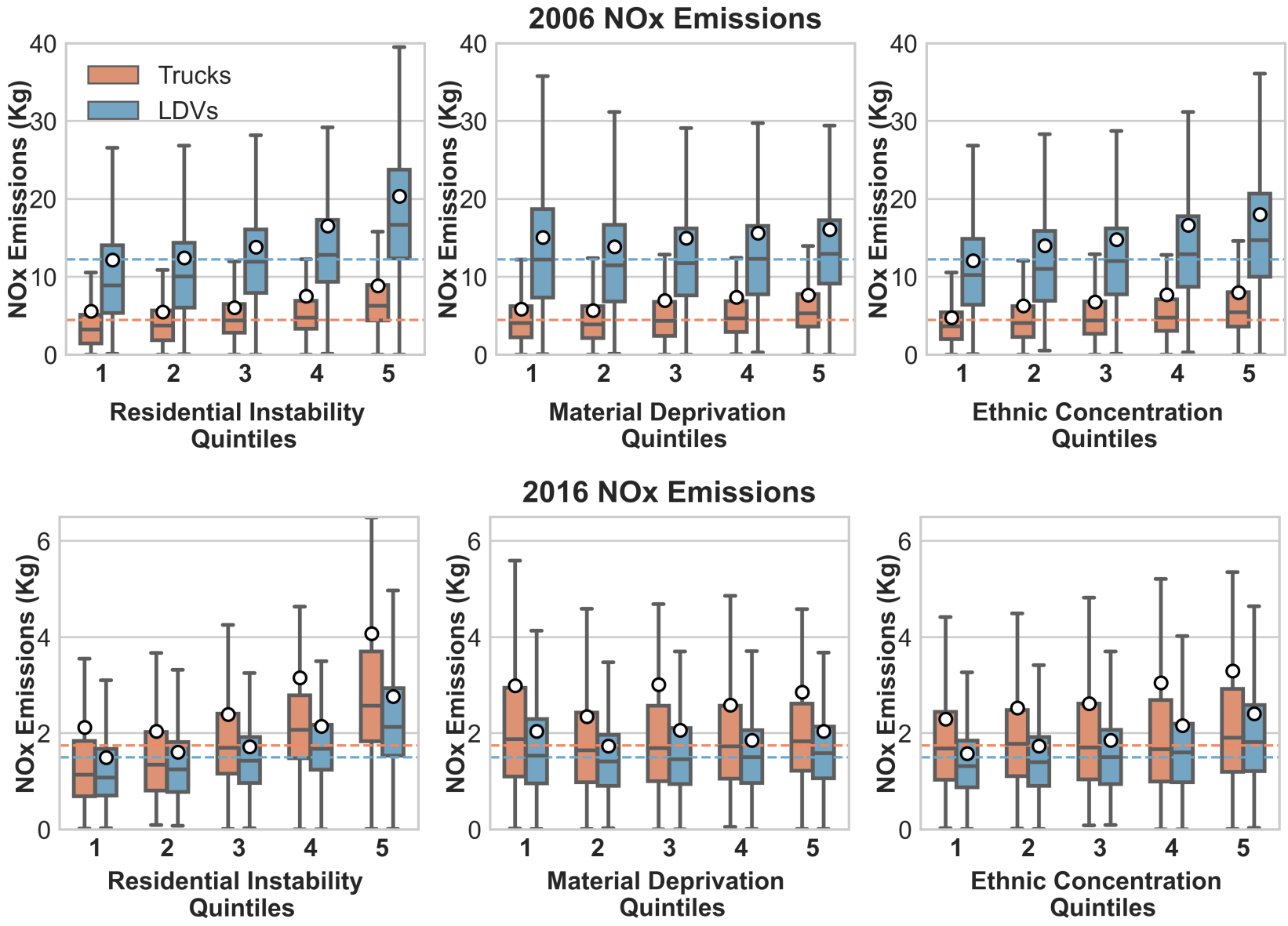




Results

EJ Analysis – Boxplots of NOx emissions

- Higher residential instability and ethnic concentration has higher NOx emissions in 2006
- Disparities only from trucks in the case of material deprivation in 2006
- Same trends for 2016 except for material deprivation
- Trucks became larger contributor to disparities compared to LDVs in 2016

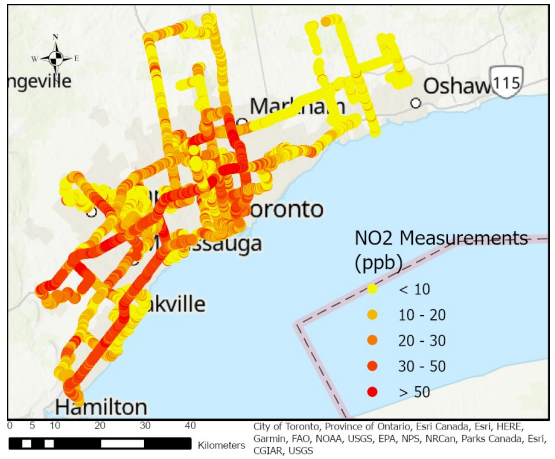


Study #2: Traffic Emission Scenarios and Impact on Environmental Justice

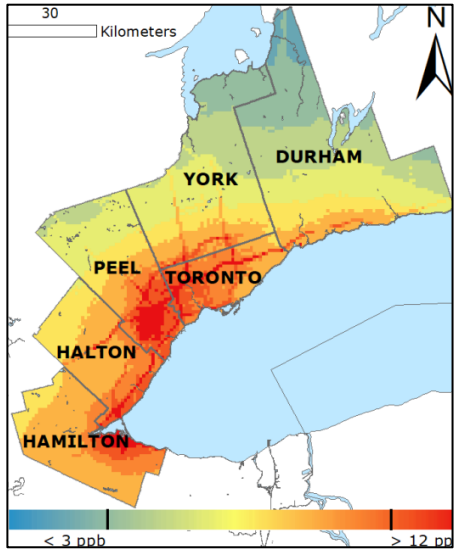
Overview

Scope of Study

Mobile monitoring campaigns

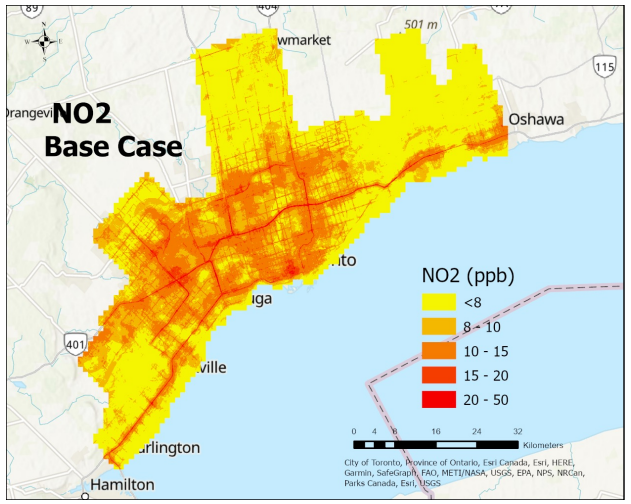


CTM outputs at 1kmx1km (Minet et al. 2020)



Machine Learning Models

Concentration surfaces at 100mx100m resolution



Scenarios: No Buses, No LDVs, No Trucks

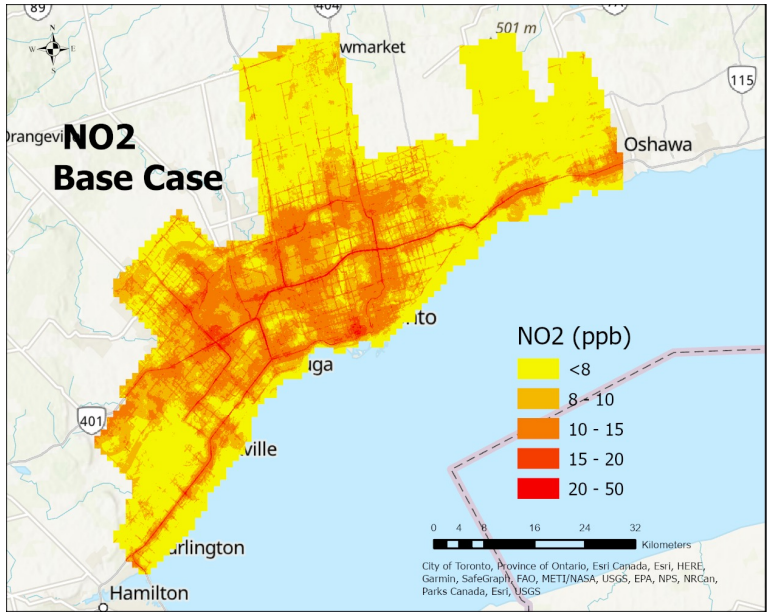
Environmental Justice Analysis

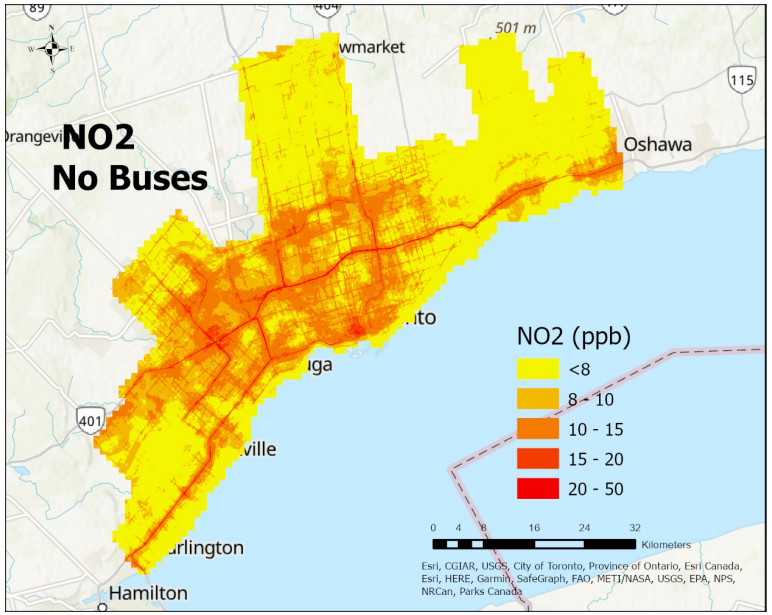
Results

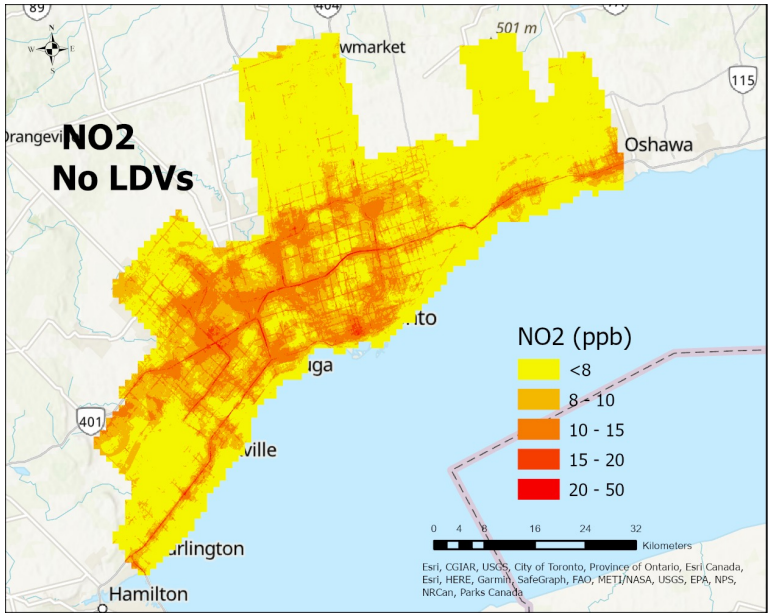
Scenario Surfaces

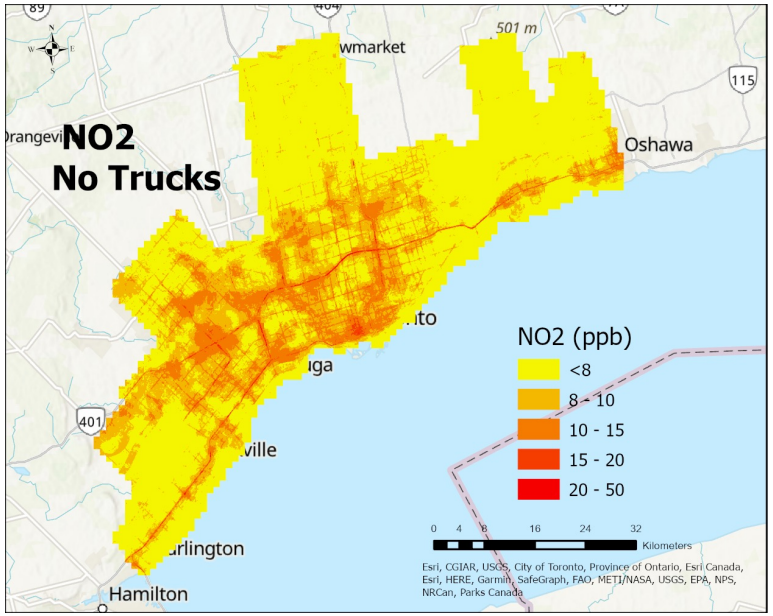
WHO NO2 Standards:

Daily = 13ppb
Yearly = 5ppb









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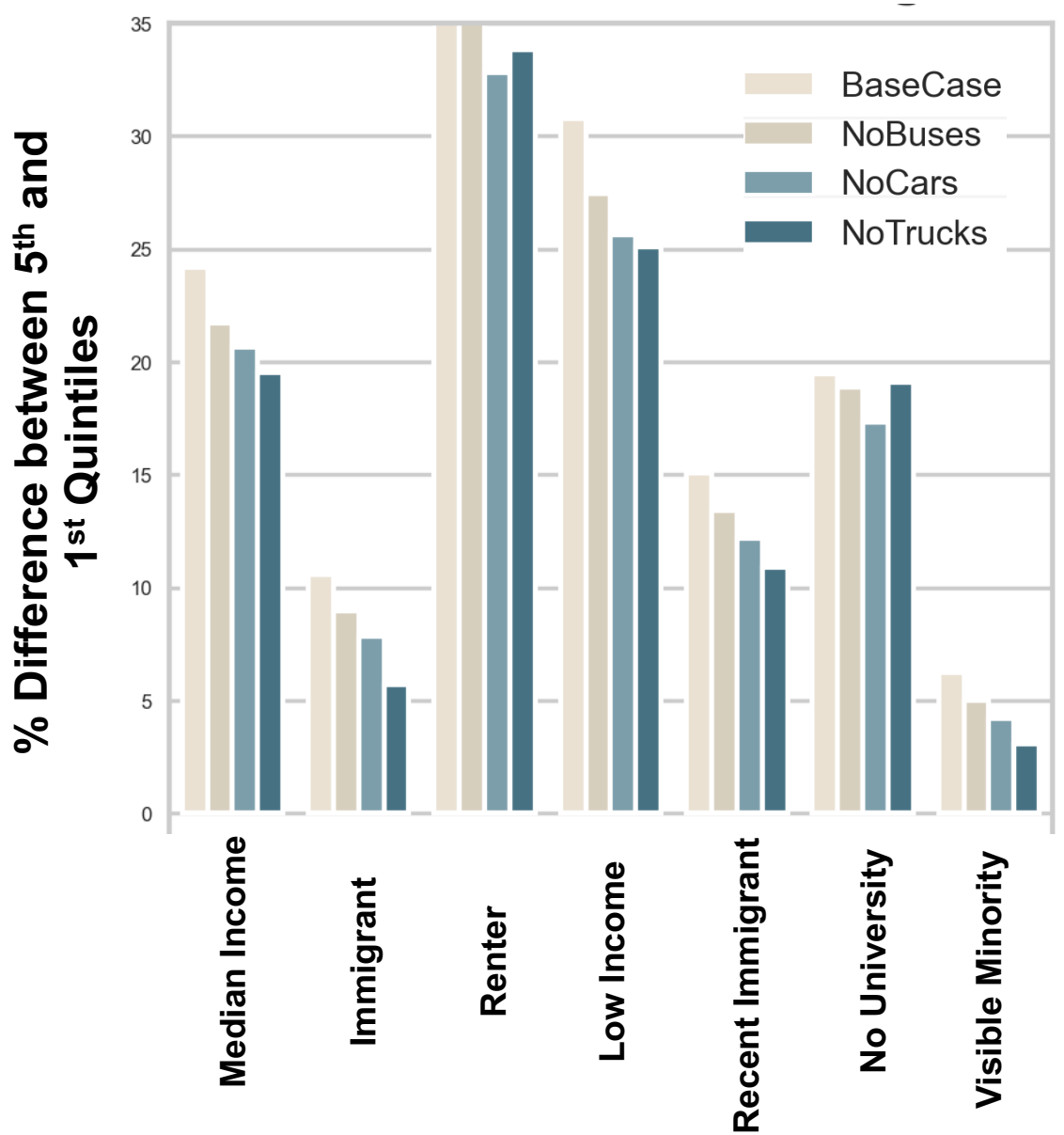
Results

Environmental Justice

- Large disparities were observed across all socioeconomic variables
- All scenarios resulted in a reduction in disparities
- **No Truck scenario** resulted in the largest improvements across variables



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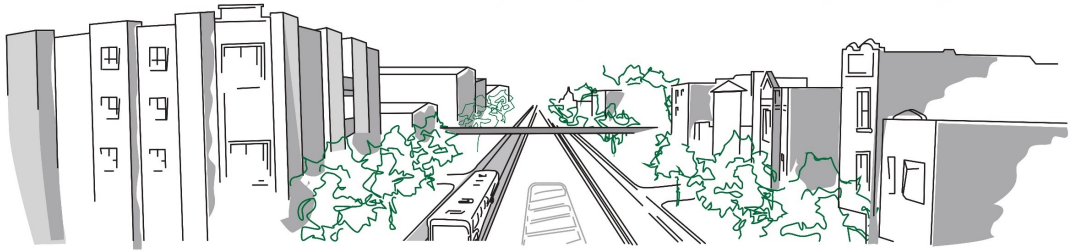

Thank you!

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