Train yard Neighbourhood Air Quality (TyNAQ)

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TRAQ
The Transportation & Air Quality Research Group

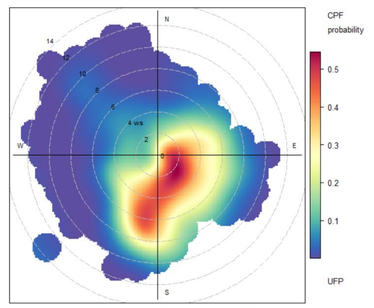
Introduction and Project Overview

- Canadian train yards constitute an air health knowledge gap and relevant emissions and exposure data is needed.
- The Train yard Neighbourhood Air Quality (TyNAQ) research project conducted near-source and neighbourhood scale air quality measurement campaigns near a large Canadian urban train yard in Toronto.
- The TyNAQ project is a partnership with Health Canada's Air Health Science Division, which leads exposure assessment and health research, and Ryerson University.

Figure: Diesel railway locomotives and trains operating in an urban rail yard in Toronto, Ontario (spring, 2021)

Analysis Methods

- Pollutant concentrations measured at the fixed stations can be attributed to potential local sources via a conditional bivariate probability function (CBPF) that relates high-concentration events to meteorological parameters of wind direction and wind speed (Figure below, left).
- Mobile measurements can be plotted on the surrounding road network (Figure below, right) to understand and assess pollutant concentrations as the distance from the rail yard changes.



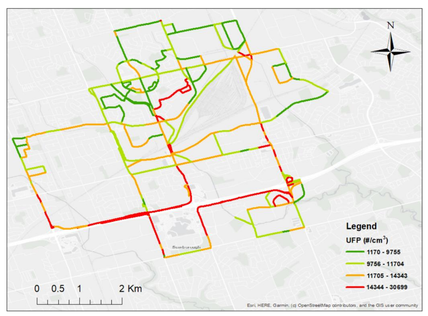
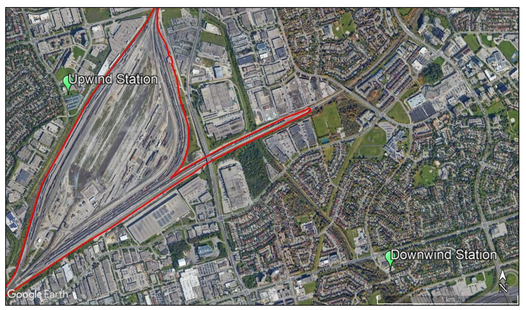


Figure (left): CBPF showing UFP hot spots originating in the direction and proximity of the rail yard.

Figure (right): Median UFP concentration on the road network surrounding rail yard.

Data Collection and Measurement Programs

- A measurement program was designed by Health Canada and the University of Toronto Transportation and Air Quality (TRAQ) research group, which is part of the University of Toronto Transportation Research Institute (UTTRI).
- An upwind/downwind pair of fixed stations (relative to rail yard) were deployed for long-term monitoring from March 2020 to May 2021 to provide comprehensive temporal understanding of air quality in the vicinity of the rail yard.
- Pollutants expected to be associated with rail yard activities and measured as part of the program included:
  - Nitrogen oxides (NO, NO_2, NO_x) and ozone (O_3)
  - Coarse (PM_{10}), fine ($PM_{2.5}$) and ultrafine (UFP) particles
  - Black Carbon (BC)
  - $PM_{2.5}$-elements / heavy metals
  - Polycyclic aromatic hydrocarbons (PAHs)
  - Noise (dBA and frequency)



Figures: Upwind fixed monitoring station (left), aerial map of railyard (red outline) and fixed station locations (green markers), downwind fixed monitoring station (right).

- Mobile monitoring was completed in two campaigns (fall 2020, spring 2021). Mobile monitoring provides a spatial understanding of air quality in the vicinity of the rail yard. The UrbanScanner, developed by Scentroid, was used to measure a suite of pollutants for comparison with the fixed stations.

Figures: UrbanScanner mobile monitoring system. The vehicle is equipped with a computer, pollutant sensors, 360º camera, LiDAR, and meteorological probes.

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