Measuring Particulate Matter Concentrations in the GTA using Low-cost Sensors
Stephanie Gu, Amy Mann, Mishaal Kandapath, Dr. Debra Wunch
Wunch Group, Department of Physics, University of Toronto

Introduction
• Particulate matter (PM) is a mixture of solid particles and liquid droplets
• PM is classified based on the diameter of the particle or droplet
  • PM2.5: particles or droplets with diameter < 2.5 microns
• Exposure to PM can lead to adverse health effects
  • In cities such as the GTA, traffic is a major source of particulate matter. Other sources include industrial activities and domestic fuel burning.

Instrument
• Low-cost particulate matter sensor developed by PurpleAir
• Consists of two Plantower PM 5003 laser counters
• Measures PM2.5, PM10, temperature, humidity, and pressure
• Live measurements can be found on the PurpleAir real-time map

Objectives
• Deploy twenty-seven PurpleAir sensors evenly across the GTA
• Collect data on the air quality of different neighborhoods
• Investigate the existence of relationships between air quality and neighborhood demographic.

Correction Model
• PurpleAir sensors are optical sensors that can be affected by environmental factors such as temperature and ambient humidity
• To account for these factors, we apply a correction model

Step one:
• Collocate all twenty-seven sensors on the Mclellan Physical Laboratories rooftop
• Set one sensor, MP2, to be the "benchmark" sensor
• Perform simple linear regressions on each sensor against the benchmark sensor, and obtain calibration coefficients and intercepts

Correction equation:
\[ PM2.5_{\text{corrected}} = \beta_0 + \beta_1 (PM2.5) + \beta_2 T + \beta_3 RH + \beta_4 DP \]

Step two:
• Collocate MP2 with a regulatory-grade instrument, the Thermo 5030 Synchronized Hybrid Ambient Real-time Particulate Monitor (SHARP)
• Apply multivariate linear regression model with temperature (T), relative humidity (RH), and dew point (DP)

Step three:
• Using the calibration coefficient and intercept obtained from step one, put the twenty-six sensors on the standard of the benchmark sensor
• Using the correction coefficients and intercept obtained from step two, put the twenty-six sensors on the standard of the regulatory-grade SHARP instrument

Deployment of sensors
As of August 5th, 2022, we have deployed eight sensors at various businesses and churches in the GTA.

Data from Existing and Deployed Sensors

References

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