**MicroFac - A New Microscale Motor Vehicle Emission Model: Determination of Neighbourhood Air Pollution for Human Exposure Assessment**

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**Project Focus and Purpose**

- **MicroFac** – the most accurate tool to date for determining emissions from traffic on busy transportation corridors for quantifying exposure in a human health context.
- Target audience: provincial policy makers, municipal/transportation planners, public health units – tool for Environmental Impact Assessment, Growth Management Strategies, and Transportation Demand Management.
- Emphasize local action and policy advocacy addressing air pollution

**Research Considerations**

- Increases in vehicular traffic offset emission control improvements
- Ambient concentrations of pollutants do not reflect personal exposures accurately
- Greater exposure of pedestrians, urban cyclists/joggers, etc. to vehicular pollutants
- Greater danger to occupations and age groups spending significant periods outdoors
- Sub-populations need to be identified geospatially in proximity to points of exposure
- Maps can be generated for any municipality with such variables as:
  - Demographics (e.g. <18 yrs, >65 yrs. Old)
  - Aggregated cardio-respiratory disease morbidity data plotted by postal code
  - Locations of parks, school fields, retirement homes, hospitals, community centres and sports fields
- All show proximity to major transportation corridors

**Emissions from Transport Sector**

- Road vehicle emissions in Ontario account for:
  - 45% of Carbon Monoxide (CO), 35% of Nitrogen Oxides (NOx), 22% of Volatile Organic Compounds (VOCs), 12% of Particulate Matter
  - more than half of transportation related GHG emissions
- Densely populated downtown cores, such as Toronto, have much higher proportion of air pollution from local transportation sources at street level
  - 90% CO, 80% NOx, 60% SOx

**MOBILE Emission Model**

- **MOBILE modeling approach**
  - Time averaged emission estimates over a large area based on Vehicle Kilometre Traveled (VKMT)
- **MOBILE is designed for**
  - Designed for county-scale (minimum), not street-scale, emission estimates
  - Not designed for application for air quality and human exposure modelling

**MicroFac Microscale Emission and Exposure Model**

- **MicroFac** is a site-specific vehicle emission model based on real-time vehicle fleet to provide pollutant concentration in roadway environments
- **MicroFac** gives emissions in significant microenvironments such as roadside, in-vehicle, street canyons, etc.
- United States Environmental Protection Agency’s Consolidated Human Activity Database (CHAD) provides input data for exposure modeling and risk assessments
- CHAD must be integrated with local data such as time spent outdoors
- Local transportation data and traffic counts are also needed

**Application in Air Quality Modeling**

- **MicroFac Process Flow Diagram**
  - Site-specific meteorology
  - MicroFac
  - Dispersion Model
- **MicroFac** provides emissions in terms of the specific vehicle fleet being considered
- **MicroFac** gives emissions from a specified fleet built up from the contributions of the individual vehicles
- Provides lane-by-lane emissions at very high temporal (starting from 5 minutes) and spatial resolution (starting from 10 metres)
- Input requirements are simple
  - Date and time
  - Ambient temperature and relative humidity
  - Average vehicle speed
  - Road gradient
  - Fuel composition
  - Vehicle fleet characterization
- Designed for application in:
  - Street level air quality modelling
  - Identifying hot spots
  - Human exposure assessment
  - Project level analysis

**Conclusions**

- Site-specific real-time emissions are needed for modeling air transport/dispersion and human exposure in various roadway microenvironments
- MicroFac models will provide emissions at fine resolution critical for the prediction of traffic related impacts on local air quality and assessment of exposure conditions in micro-environments