Estimating Traffic Emissions using air quality data – a modeling and monitoring approach

Joana Ferreira, Ana Isabel Miranda, Laura Duque, Alexandra Monteiro
For urban areas and focusing on traffic road emissions, …

… does it make sense to use air quality monitored data from traffic stations to improve emissions?
Previous studies


Methodology

\[ C = F(\text{meteorology}) \cdot Q + C_{\text{background}} \]

\( C \) is the concentration of a particular pollutant (considered as non-reactive) in the street,

\( Q \) is the emission of pollutants from the traffic in the street and is given by a street dispersion model.

\( F(\text{meteorology}) \) is a function describing dispersion processes, and is given by a street pollution model.

\( C_{\text{background}} \) is the contribution to pollution concentrations in the street from all other sources than the traffic in the street.

Palmgren et al., 1999;
How to apply

\[ C = F(\text{meteorology}) \cdot Q + C_{\text{background}} \]

where \( C \) is the observed hourly concentration, \( F(\text{meteorology}) \) is the function of meteorology, \( Q \) is the hourly emission, and \( C_{\text{background}} \) is the background concentration.

- **Observed hourly concentrations** (street and urban background)
- **Simulated hourly concentrations** by a 1-year simulation of a street level dispersion model, but with a unit emission

To calculate the hourly emissions, we use the equation:

\[ Q_h = \frac{C_h - C_{h \text{ background}}}{F(\text{meteorology})} \]

where \( Q_h \) is the hourly emissions, \( C_h \) is the observed hourly concentration, and \( C_{h \text{ background}} \) is the background concentration.

The slope of the best-fit line to the relationship at each hour, for example, can be derived from the observed and simulated concentrations.
Examples

inverse modelling applied to:

- estimate average fleet emission factors typical of urban conditions in Denmark

---

**Emission factors for NOx, CO and ToN (total particle nr)**

---

*Ketzel et al., 2003*
Examples

inverse modelling applied to:

- estimate total emissions and emission factors at street level in St Petersburg

Seasonal variation of averaged calculated emissions ($\mu g \, m^{-1} \, s^{-1}$) for benzene and NOx.

Ziv et al., 2002;
Strengths and Limitations

- Air quality monitoring data at street and urban background levels are needed.

- Accuracy depends on number of observations.

- A (long term) simulation of a street dispersion model is required, but with a unit emission.

- Adequate to estimate traffic emissions for areas where detailed emission data is not available.

- Possibility to estimate emissions by vehicle category if detailed traffic counts are available.

- Only applicable to non-reactive pollutants.
Challenge

- Can we test this approach for a few case studies?