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Assessment and Mitigation of NO_x emission within a street canyon and tunnel portal micro environment

Ulrich Uhrner and Rafael Reifeltshammer
(Uhrner@ivt.tugraz.at) Graz University of Technology, Austria

Substantial breeches of the NO_2 annual mean have been recorded at an air quality station located in a busy road in a German city. The daily traffic volume is about 26 000 vehicles a day and the share of heavy duty vehicles is small due to a heavy traffic driving ban. Critical is that traffic from the 540 m long city tunnel bends into the road and that there are tall buildings located at both sides of the road. 9 additional measurements with passive samplers indicate that the air quality limit value is exceeded from the tunnel portal towards the next major intersection (approximately 500 m).
The objective of this study is to compute emissions from open roads versus tunnel portal emissions and to analyse their effect upon local air quality within this complex urban micro environment. The aim of this project was to evaluate the impact of tunnel ventilation and traffic reductions measures. A base case was computed using sophisticated flow and dispersion modelling, accounting for the impact of buildings and the effect of the sunken road and tunnel jet. NO_x to NO_2 conversion was computed using a Romberg type approach and good results were obtained for NO_2 annual means compared with measurements. The effect of tunnel emissions and emissions from open roads was analysed respectively.
The NO_x/NO_2 concentration pattern revealed that the portal area is affected by the portal emissions about 60 m in driving direction. However, kerbside concentrations are dominated only within 30 m in driving direction. At the air quality station at $\sim$150 m distance from the portal, 75 % of the NO_x concentrations can be attributed to open roads and the rest is mainly attributable to urban background.
A zero portal emission scenario resulted in significant improvement within the immediate vicinity of the portal. Due to the strong impact of open roads a 50 % traffic reduction scenario affecting tunnel and open roads emissions was computed. Although reductions of up to -25 μg/m^3 may result, kerbside NO_2 concentrations remain still over the air quality standard of 40 μg/m^3 at most locations in the area of investigation. The immediate vicinity at the portal remains the most critical area. In order to fulfil future air quality standards extensive traffic reductions or selective traffic bans are necessary together with tunnel portal air management.