INDUSTRIALES RESEARCH MEETING 17

Modelling the effects of local emission abatement measures in hot-spots of Madrid

*C. Quaassdorff, R. Borge

Laboratory of Environmental Modelling. Chemical and Environmental Engineering Department. Technical University of Madrid.

*christina.quaassdorff@etsii.upm.es

Abstract

This work aims at estimating NO_x and PM_{10} emissions from road traffic with high spatial and temporal resolution (seconds and meters). This is useful to understand the effect of local abatement measures and it is an essential input to microscale air quality models. For that, 1-hour representative traffic scenarios are simulated with the traffic microsimulation model VISSIM in selected hot-spots. Measured traffic data (fluxes and fleet composition) are used as inputs for the model to obtain speed-time profiles for each vehicle. These profiles are used to calculate specific emission factors for different vehicle classes according to the VERSIT+$_{micro}$ model through the ENVIVER interface. This modelling system allows assessing possible effects of different local scale interventions such as vehicle volume reduction, fleet composition and vehicle technology changes, etc. both on the total amount of emission amount and their spatial distribution. According to this analysis, some local measures may bring about important emission reductions in both locations, up to 28% and 23% for NO_x and PM_{10} respectively. Such measures may therefore constitute a valuable complement for city-scale policies and measures.

Introduction and Methodology

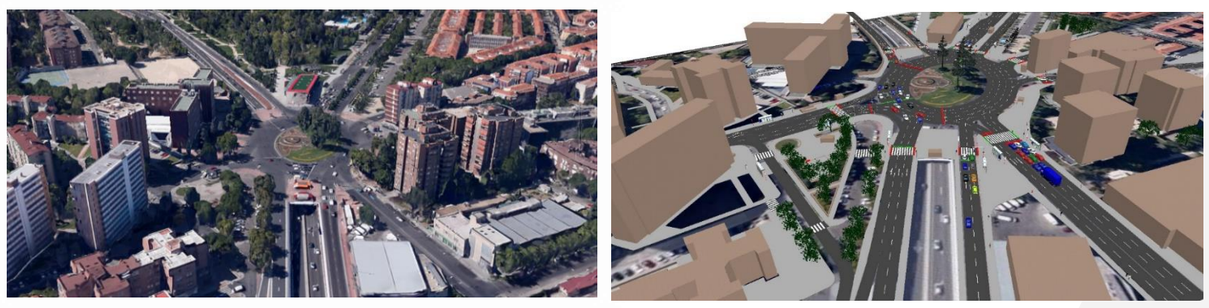
Since pollution levels exceed the legal limits in specific traffic-related urban locations in Madrid it is necessary to develop additional emission reduction measures on hotspots and highly polluted micro-environments (Borge et al., 2014). However, local characteristics (urban typology, traffic conditions, street geometry, etc.) play a very important role to accurately predict the effect of any particular measure at this scale. Therefore, there is a need to test microsimulation models that may reproduce with great detail traffic activity in small areas and may provide reliable emissions (Quaassdorff et al., 2016) able to feed CFD microscale air quality models (Santiago et al., 2013) and support the definition of effective pollution abatement options.

For this study two different highly polluted microenvironments (hot-spots) in the city of Madrid were analysed. The selected areas are a signalized roundabout (Fernández Ladreda area) and a combination of three signalized junctions (Escuelas Aguirre area). In this places the **emission abatement measures** assessed were:

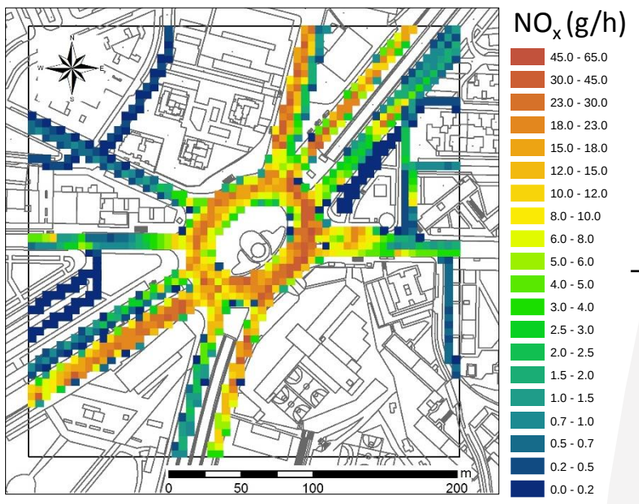
1. Access restriction to heavy vehicles, which consists in the exclusion of Heavy Goods Vehicles (HGV) during peak hours.
2. Change in the technology of Public Transport buses, from diesel to Compressed Natural Gas (CNG).

Signalized roundabout

Fernández Ladreda hot-spot



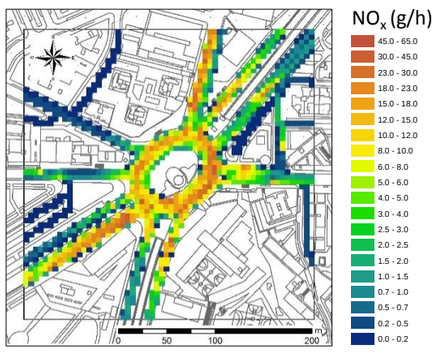
Weekday 8:00-9:00h - morning rush hour



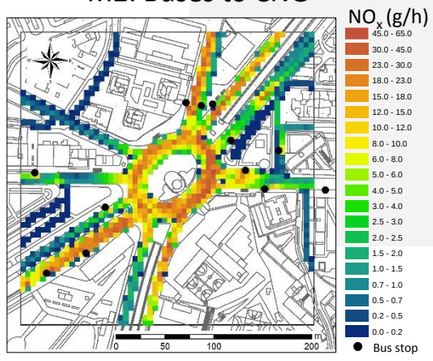
-27%

-2%

M1: HGV restriction



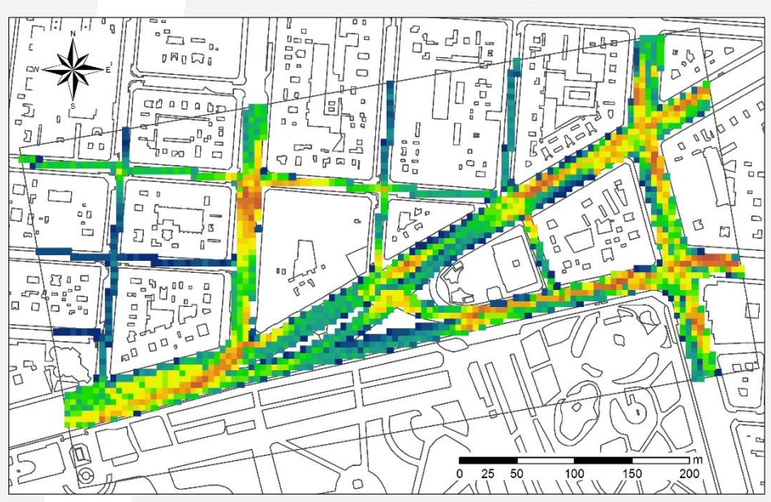
M2: Buses to CNG



Signalized junctions

Escuelas Aguirre hot-spot

Weekday 8:00-9:00h - morning rush hour



-22%

-2%

M1: HGV restriction

M2: Buses to CNG

Conclusions

A suitable combination of traffic and emissions micro-simulation models is needed to accurately define emissions and abatement options in hot-spots. NO_x emissions reduction is up to 27% in the case of HGV restrictions which is more effective than a change in the technology of Public Transport buses (2% emission reduction). These results are promising as inputs for CFD models that may be used to design and test microscale air quality abatement measures.

Acknowledgements

Funded by the Madrid City Council and the project TECNAIRE-CM (S2013/MAE-2972).

Traffic modelling system VISSIM available by PTV AG and emission modelling system VERSIT+$_{micro}$/ENVIVER available by TNO.

To the TARIndustrial group (ETSII, UPM) for the useful advice on emission abatement measures and ArcGis maps representation.

References

Borge, R., et al. 2014. Emission inventories and modeling requirements for the development of air quality plans. Application to Madrid (Spain). Sci. Total Environ. 466-467, 809-819.

Quaassdorff, C., et al. 2016. Microscale traffic simulation and emission estimation in a heavily trafficked roundabout in Madrid (Spain). Sci. Total Environ. 566-567:416-427.

Santiago, J.L., et al. 2013. A computational fluid dynamic modelling approach to assess the representativeness of urban monitoring stations. Sci. Total Environ. 454-455, 61-72.