HIGH RESOLUTION EMISSION ESTIMATION IN A HEAVILY TRAFFICKED URBAN AREA IN MADRID (SPAIN)

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Summary

This work aims to obtain high resolution NO_x and PM_{10} emissions related to traffic activity at a hot-spot in Madrid (Spain). For that, twelve representative scenarios for a heavily trafficked roundabout are simulated with the traffic microsimulation model VISSIM. Measured traffic data (fluxes and fleet composition) are used as input for the model to obtain speed-time profiles for each vehicle. These profiles are used to predict representative emission factors for different vehicle classes in the VERSIT+$_{micro}$ model, through the ENVIVER interface. The emission factors are compared with the ones of COPERT IV, a widely used average-speed model, as a preliminary model assessment. The results are strongly influenced by low average speeds due to saturated traffic situations.

Introduction

Since pollution levels exceed the legal limits in specific traffic-related urban locations it is necessary to develop emission reduction measures on hotspots and highly contaminated micro-environments mainly in urban areas where traffic represents one of the major contribution to emissions (Borge et al., 2012). On these specific points finer-scale tools are needed because of the complexity of the processes that determine emissions from mobile sources (Borge et al., 2014). Therefore, there is a need to test microsimulation models that may reproduce with great detail traffic activity in small areas and may provide reliable emission to find out abatement options and to feed CFD microscale air quality models (Santiago et al., 2013).

Methodology and Results

The selected study area is Fernández Ladreda square, a roundabout with complex geometry, high traffic flow and a freeway crossing through a tunnel in Madrid. An intensive field campaign with cameras was carried out to obtain accurate traffic data. Twelve representative 1-hour length scenarios from a weekly pattern are selected and simulated with the VISSIM model. The data for the speed-time profiles are introduced in the emission model VERSIT+$_{micro}$ and the different vehicle classes are assigned, all through ENVIVER interface. The main results are twelve emission distributions with a resolution of 5m x 5m aggregated to 1-hour and also the total emission in the area for the different traffic scenarios. The emission distribution results of NO_x and PM_{10} are influenced by average speeds of the road section which is affected by traffic intensity and congestion. Scenarios with low traffic intensity (Fig. 1) show fluid traffic conditions presenting emissions in specific zones with low speeds. This methodology is validated comparing the emission factors with the ones of the average-speed emission model COPERT IV.

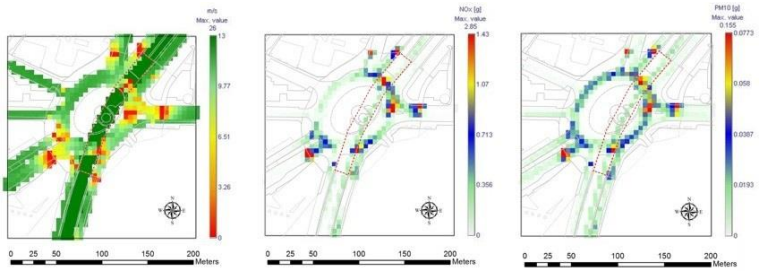

Fig1. *Average speed, NO_x and PM_{10} emission distribution for free flow conditions*

Conclusions

A suitable combination of traffic and emissions micro-simulation models is needed to accurately define the emissions in a specific area. The results obtained from this methodology are in agreement with the ones of COPERT IV and are promising as inputs for CFD models that may be used to design and test microscale air quality abatement measures.

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References

Borge, R., de Miguel, I., de la Paz, D., Lumbreras, J., Perez, J., Rodriguez, E., 2012. Comparison of road traffic emission models in Madrid (Spain). Atmos. Environ. 62, 461-471.

Borge, R., Lumbreras, J., Pérez, J., de la Paz, D., Vedrenne, M., de Andrés, J.M., Rodríguez, M.E., 2014. Emission inventories and modeling requirements for the development of air quality plans. Application to Madrid (Spain). Sci. Total Environ. 466-467, 809-819.

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