INDUSTRIALES RESEARCH MEETING 16

HIGH RESOLUTION EMISSION ESTIMATION IN HOT-SPOTS OF MADRID (SPAIN)

*C. Quaassdorff, R. Borge, D. de la Paz, J. Pérez, J.M. de Andrés, J. Lumbreras

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

*christina.quaassdorff@etsii.upm.es

Abstract

This work aims at obtaining high resolution NO_x and PM_{10} emissions from road traffic at hot-spots in Madrid (Spain). For that, 12 1-hour representative scenarios 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. Emission factors are compared with the ones of COPERT 4, 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 additional emission reduction measures on hotspots and highly polluted 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 define 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 able to feed CFD microscale air quality models (Santiago et al., 2013) and support the definition of effective abatement options.

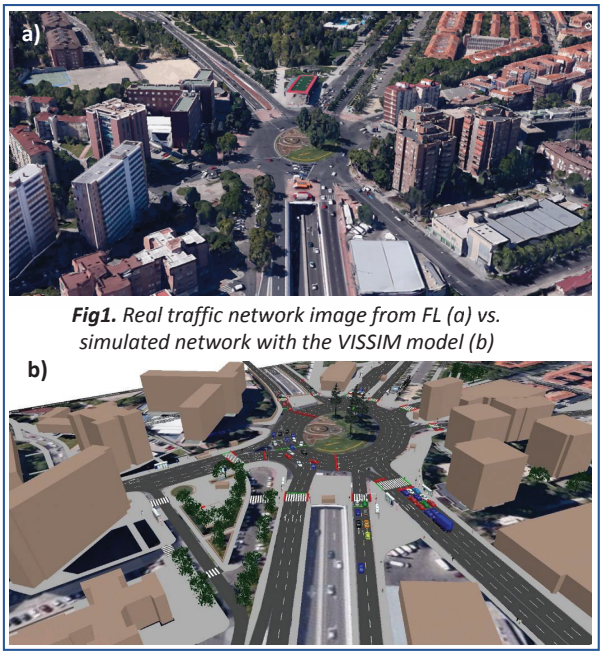

Fig1. *Real traffic network image from FL (a) vs. simulated network with the VISSIM model (b)*

Fig2. *Video cameras deployed to characterize traffic fluxes composition and detailed routes*

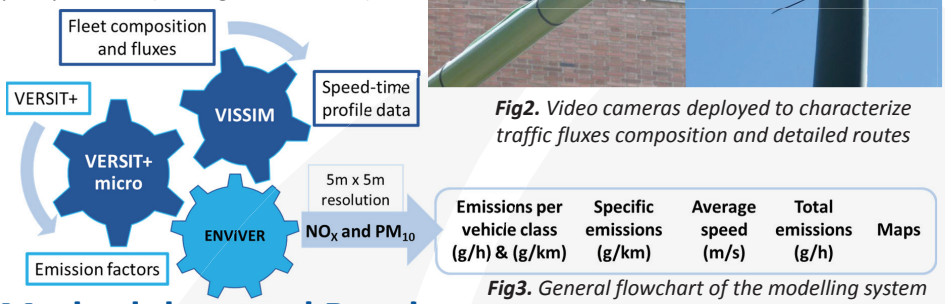

Fig3. *General flowchart of the modelling system*

Methodology and Results

The first selected hot-spot is Fernández Ladreda (FL), a roundabout with complex geometry, high traffic flow and a freeway crossing through a tunnel in Madrid (Fig1 a). An intensive field campaign with cameras was carried out to obtain accurate traffic data (Fig2). 12 representative 1-hour length scenarios from a weekly pattern are simulated with the VISSIM model (Fig1 b). Resulting speed-time profiles are fed to the emission model VERSIT+$_{micro}$ and the different vehicle classes are assigned through the ENVIVER interface. This methodology allows to compute emission distributions with a resolution of 5m x 5m aggregated to 1-hour and also the total emission in the area for the different scenarios. The results are strongly influenced by average speeds in the road network which are affected by traffic intensity and congestion (Fig4). Scenarios with low traffic intensity show fluid traffic conditions presenting high emissions only in the vicinity of traffic lights. This methodology is validated comparing the emission factors with the ones of the average-speed emission model COPERT 4.

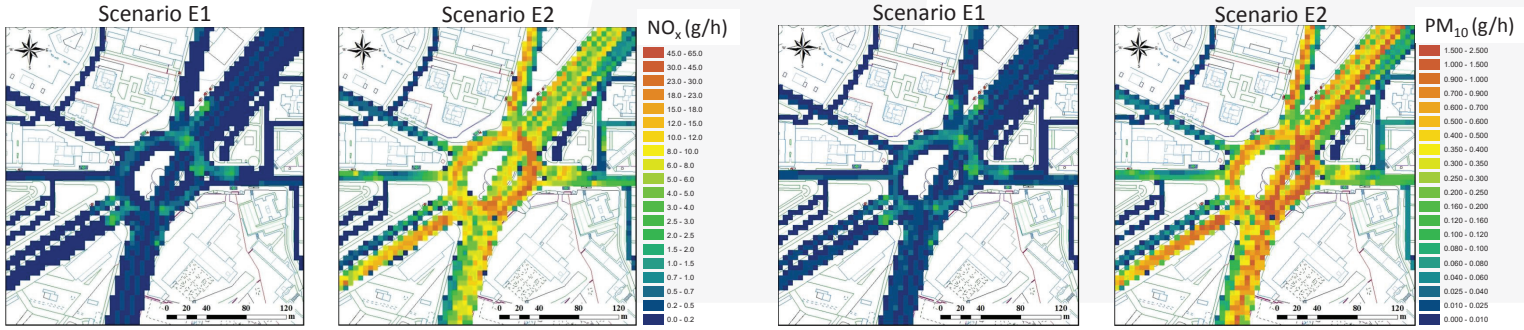

Fig4. *NO_x and PM_{10} emission distribution aggregated to 1h for free flow conditions (Scenario E1) and saturated traffic conditions (Scenario E2) with 5 x 5 m resolution*

Conclusions

A suitable combination of traffic and emissions micro-simulation models is needed to accurately define the emissions in hot-spots. NO_x and PM_{10} emissions are up to 27 and 23 times larger respectively during peak hours than those of free-flow conditions, non-rush hours. Differences in both total emissions and specific emission factors (by travelled distance) highlight the potential of local measures in traffic hot-spots. The results are in agreement with the ones of COPERT 4 and are promising as inputs for CFD models that may be used to design and test microscale air quality abatement measures.

Acknowledgements

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

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