Available online at www.sciencedirect.com
ScienceDirect
Atmospheric Environment 42 (2008) 916–926
ATMOSPHERIC ENVIRONMENT
www.elsevier.com/locate/atmosenv

Improved road traffic emission inventories by adding mean speed distributions

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Received 23 May 2007; received in revised form 10 October 2007; accepted 11 October 2007

Abstract

Does consideration of average speed distributions on roads—as compared to single mean speed—lead to different results in emission modelling of large road networks? To address this question, a post-processing method is developed to predict mean speed distributions using available traffic data from a dynamic macroscopic traffic model (Indy) that was run for an actual test network (Amsterdam). Two emission models are compared: a continuous (COPERT IV) and a discrete model (VERSIT+[macro]). Computations show that total network emissions of CO, HC, NO_x, PM_{10} and CO_2 are generally (but not always) increased after application of the mean speed distribution method up to +9%, and even up to +24% at sub-network level (urban, rural, motorway). Conventional computation methods thus appear to produce biased results (underestimation). The magnitude and direction of the effect is a function of emission model (type), shape of the composite emission factor curve and change in the joint distribution of (sub)-network VKT (vehicle kilometres travelled) and speed. Differences between the two emission models in predicted total network emissions are generally larger, which indicates that other issues (e.g., emission model validation, model choice) are more relevant.

Keywords: Emission inventory; Speed variability; Road traffic; Emission model; Road network; Accuracy

1. Introduction

Prediction of road traffic emissions and fuel consumption is becoming increasingly important for evaluation of environmental policies and (proposed) infrastructural developments. The scale of interest varies from local road projects to entire (urban) transport networks and even national or global emission inventories. Around the world, road traffic is the dominant anthropogenic source of air pollution in urban areas (e.g., Fenger, 1999).

Different types of traffic input data are required in the emission modelling process, and the following types may be distinguished: traffic (e.g., traffic volume, traffic composition, average speed) and infrastructure characteristics (e.g., type of road, road length, speed limit, number of traffic lanes). Traffic models are commonly used to generate the required traffic data input to emission models (Smit, 2006). However, the demand for resources (costs, labour, computer runtime) to generate and process traffic data increases with road network size. The extent and the level of detail of traffic data are

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1352-2310/$ - see front matter
doi:10.1016/j.atmosenv.2007.10.026