Science of the Total Environment 409 (2011) 2626–2634

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

A new method to compare vehicle emissions measured by remote sensing and laboratory testing: High-emitters and potential implications for emission inventories

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ARTICLE INFO

Article history:
Received 29 September 2010
Received in revised form 2 March 2011
Accepted 22 March 2011
Available online 22 April 2011

Keywords:
Vehicle emission inventory
High-emitter
Remote sensing

ABSTRACT

A new method is presented which is designed to investigate whether laboratory test data used in the development of vehicle emission models adequately reflects emission distributions, and in particular the influence of high-emitting vehicles. The method includes the computation of a 'high-emitter' or 'emission distribution' correction factor for use in emission inventories. In order to make a valid comparison we control for a number of factors such as vehicle technology, measurement technique and driving conditions and use a variable called 'Pollution Index' (g/kg). Our investigation into one vehicle class has shown that laboratory and remote sensing data are substantially different for CO, HC and NO_x emissions, both in terms of their distributions as well as in their mean and 99-percentile values. Given that the remote sensing data has larger mean values for these pollutants, the analysis suggests that high-emitting vehicles may not be adequately captured in the laboratory test data.

The paper presents two different methods for the computation of weighted correction factors for use in emission inventories based on laboratory test data: one using mean values for six 'power bins' and one using multivariate regression functions. The computed correction factors are substantial leading to an increase for laboratory-based emission factors with a factor of 1.7–1.9 for CO, 1.3–1.6 for HC and 1.4–1.7 for NO_x (actual value depending on the method). However, it also clear that there are points that require further examination before these correction factors should be applied. One important step will be to include a comparison with other types of validation studies such as tunnel studies and near-road air quality assessments to examine if these correction factors are confirmed. If so, we would recommend using the correction factors in emission inventories for motor vehicles.

1. Introduction

Road traffic is an important global source of air pollution and greenhouse gas emissions and its significance is increasing. The air quality and greenhouse gas emission impacts of road traffic are commonly evaluated using transport and emission models and, in the case of air pollution, dispersion and exposure models. The scale of application of such models ranges from a single point near a road to entire urban or regional road networks, and even national or global scales.

One important application of traffic emission models is in the development of urban emission inventories. Overseas road transport emission inventory models such as COPERT in Europe and MOBILE/MOVES and EMFAC in the United States are well-known and often used in practice (Smit et al., 2009). Urban emission inventories require input that can be extracted from, for instance, strategic transport planning models such as EMME2/3 (Smit & McBroom, 2009). These inventory models use mean emission factors, expressed as grams per vehicle kilometre of travel (g/veh.km). The emission factors are a function of average speed, where average speed is defined as the overall speed on a section of road or for an entire journey. They are typically developed from laboratory emission measurements on a sample of vehicles involving various driving cycles.

As models are simplifications of reality, assessment of prediction accuracy[2] is vital. This is important as poor emission forecasting will cause poor policy decisions if left unchecked. There are various ways to validate motor vehicle emission models and they include tunnel studies

Abbreviations: ADR, Australian Design Rule; PI, Pollution Index; CF, High-Emitter Correction Factor; WCF, Weighted High-Emitter Correction Factor.

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[2] This is the process of validation, i.e. comparison of predictions to independent observations.

0048-9697/$ – see front matter
doi:10.1016/j.scitotenv.2011.03.026