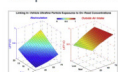


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Abstract

Graphical abstract



Highlights

Keywords

1. Introduction

2. Methods

2.1. Vehicle selection and ventilation conditions tested

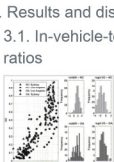
2.2. Speed and routes driven

2.3. AER, particle concentration, and I/O ratio measurement

2.4. Predictive models

3. Results and discussion

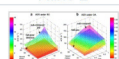
3.1. In-vehicle-to-roadway concentration ratios



3.2. Predictive model for In(AER) at RC and OA setting

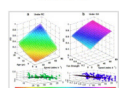
Table 1

Table 2

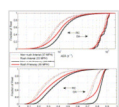


3.3. Predictive model for logit(I/O) under RC and OA setting

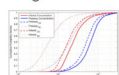
Table 3



3.4. Fleet-wide distributions of AER and I/O ratio



3.5. Expected in-cabin concentrations for given roadway concentrations



4. Conclusions

Acknowledgments

Appendix A. Supporting information

ec1

References



Atmospheric Environment

Volume 59, November 2012, Pages 578–586



Linking in-vehicle ultrafine particle exposures to on-road concentrations

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Referred to by Neelakshi Hudda, Sandrah P. Eckel, Luke D. Knibbs, Constantinos Sioutas, Ralph J. Delfino, Scott A. Fruin

Corrigendum to "Linking in-vehicle ultrafine particle exposures to on-road concentrations" [Atmos. Environ. 59C (2012) 578–586]

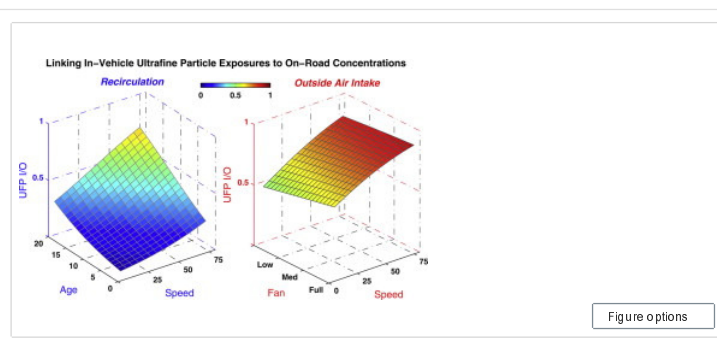
Atmospheric Environment, Volume 64, January 2013, Page 124

PDF (81 K)

Abstract

For traffic-related pollutants like ultrafine particles (UFP), a significant fraction of overall exposure occurs within or close to the transit microenvironment. Therefore, understanding exposure to these pollutants in such microenvironments is crucial to accurately assessing overall UFP exposure. The aim of this study was to develop models for predicting in-cabin UFP concentrations if roadway concentrations are known, quantifying the effect of vehicle characteristics, ventilation settings, driving conditions and air exchange rates (AER). Particle concentrations and AER were measured in 43 and 73 vehicles, respectively, under various ventilation settings and driving speeds. Multiple linear regression (MLR) and generalized estimating equation (GEE) regression models were used to identify and quantify the factors that determine inside-to-outside (I/O) UFP ratios and AERs across a full range of vehicle types and ages. AER was the most significant determinant of UFP I/O ratios, and was most strongly influenced by ventilation setting (recirculation or outside air intake). Further inclusion of ventilation fan speed, vehicle age or mileage, and driving speed explained greater than 79% of the variability in measured UFP I/O ratios.

Graphical abstract



Highlights

► Significant overall ultrafine particle (UFP) exposure occurs in vehicles. ► In-vehicle exposures depend on inside-to-outside UFP ratios (I/O). ► At outside air setting, I/O is determined mostly by fan strength. ► Under recirculation, I/O is determined by vehicle age and speed. ► Fleet-wide UFP exposure varies 10-fold.

Keywords

Ultrafine particles; In-vehicle; Exposure; Microenvironment; Air exchange rate; Model

1. Introduction

Exposure to traffic-related pollutants has been associated with detrimental health outcomes like asthma, exacerbation of adverse respiratory (Brauer et al., 2002; Gauderman et al., 2005; McConnell et al., 2006; Gan et al., 2011) and cardiovascular outcomes (Delfino et al., 2005), coronary artery atherosclerosis (Araujo et al., 2008; Künzli et al., 2011), and an increase in mortality (Hoek et al., 2002; Stölzel et al., 2007).

Bibliographic information

Citing and related articles

Applications and tools

Workspace

Table 1. AER under RC model values.

GEE model	Estimate	Std. Error
Intercept	2.79	0.36
speed >0 (miles h ⁻¹)	0.019	0.00
speed= 0	−0.51	0.12
age (yr)	0.015	0.03
age ² (yr ²)	0.0033	0.00
vol (ft ³)	−0.023	0.00
vol ² (ft ⁶)	0.000066	0.00
Manuf: Japan	−0.39	0.12
Manuf: Germany	−0.71	0.25