Driver Exposure to Particulate Matter: 
Field Study, Data Analysis and 
Modelling

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Driver Exposure to Particulate Matter: 
Field Study, Data Analysis and Modelling 

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Institute of Energy and Sustainable Development 
De Montfort University Leicester
I dedicate this thesis to the memory of my father who encouraged me to seek new challenges and always believed that I would achieve my goals.

Gesell dich einem Bessern zu,
dass mit ihm deine besser' n Kräfte ringen.
Wer selbst nicht weiter ist als du,
der kann dich auch nicht weiterbringen.

FRIEDRICH RÜCKERT (1788 - 1866)
Abstract

An empirical study investigating human exposure to particulate matter in a transport microenvironment is described in this thesis. The focus of the investigation is the exposure of car drivers to ultrafine particles on urban roads. In-vehicle exposure to larger particles (PM\textsubscript{10}, PM\textsubscript{2.5}) is also explored.

The field study methodology, developed particularly for this project and applied during a twelve month field campaign, is outlined in some detail. The data processing methods and the structure of the field study database are described.

Findings from the analysis of high-frequency time series data are presented. Results indicate there are significant differences between ultrafine particles and particles of the larger size ranges (PM\textsubscript{10}, PM\textsubscript{2.5}) in terms of their short-term variability and sensitivity to external parameters (i.e. meteorological conditions and traffic events). Further analysis reveals significant differences in seasonal and diurnal variability of average exposure values for the investigated particle size ranges. Novel visualisation techniques are described which aid the detection of significant patterns in large volumes of time series data.

The methods and findings regarding the analysis of the main determinants of driver exposure by multiple linear regression analysis are described. Exposure levels are shown to be strongly affected by particular road layouts and meteorological conditions. Different determinants are identified for ultrafine particles than for the other two size ranges.

Three scenarios are presented which aim to utilize field data in conjunction with the findings regarding the main determinants to estimate exposure on future journeys. Results show that strong over- or underestimation of exposure levels occurs in some cases, indicating that alternative modelling methods may be more suitable.

Finally, a method for modelling average annual driver exposure is proposed. Methods and implications are discussed. The results indicate that the method may produce useful results but validation with additional data is required.
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Finally, I thank Brian for always being there for me and for providing excellent advice and software support.

I declare that the content of the submission represents solely my own work.

Birgit Krausse, July 2004.
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