OVERVIEW AND ORGANIZATION

This report provides information on estimating mobile source emissions using MOBILE5a, a model developed by the U.S. Environmental Protection Agency (EPA), and gives special attention to travel-related inputs to this model. The major focus of this research study was the uncertainty or error associated with emissions estimates developed for an emissions inventory, a conformity analysis, or both by local and state agencies using MOBILE5a. This report addresses the following topics:

• Background information on legislation and requirements, key variables and methodologies, and the current state of practice at state and local levels (Chapters 1, 2, and 3);
• Uncertainty or error involved with the use of MOBILE5a (Chapters 4, 5, 6, and 7); and
• Improvements in methodologies and recommendations for further research (Chapters 8 and 9).

BACKGROUND

Chapter 1 presents information on recent legislation and requirements related to air quality analysis for mobile source emissions. Chapter 2 examines the process and procedures used for calculating emissions from mobile sources and focuses on key travel-related variables that must be quantified for this purpose. Methodologies commonly used for estimating each transportation variable are examined in detail. Chapter 3 presents the findings of a survey of the current practices of state departments of transportation (DOTs) and local metropolitan planning organizations (MPOs). Chapter 3 also reviews various sources of error and interrelationships of different components of the travel modeling process commonly used to generate travel-related inputs to MOBILE5a. These three chapters are designed to provide a reader with a sound understanding of the requirements, methodologies, and state of the art related to inputs to MOBILE5a.

UNCERTAINTY AND ERROR ANALYSIS

Chapters 4, 5, 6, and 7 represent the main concern of the research; these chapters examine how emissions estimates produced for an emissions inventory, a conformity analysis, or both are affected by errors from various sources. The sources of error can be grouped into two broad classes—external and internal with respect to MOBILE5a. The external sources of error involve the input variables of MOBILE5a, such as speed, vehicle-miles of travel (VMT), vehicle classification, and operating mode fractions. Chapters 4, 5, and 7 discuss external sources of error while Chapter 6 discusses speed correction factors (SCFs), which constitute an internal source of error. Chapter 4 quantifies how the emission rates for carbon monoxide, hydrocarbons, and oxides of nitrogen vary because of variations in the estimated values of input variables. The analyses presented in Chapter 4 show how errors in input variables alone can cause differences in the results obtained from MOBILE5a. Chapter 5 examines two specific input variables—speed and VMT mix—and quantifies the magnitude of error that can be expected in the estimated values of these input variables when using common methodologies. Chapter 7 focuses on the stepwise travel-modeling process widely used in urban transportation planning and examines different procedural variations with respect to the aggregation of data and their effects on the resulting estimates of VMT and emissions. The analysis in Chapter 7 is based on a case study of an urban area.

Chapter 6 deals with one internal source of error—SCFs. Although the internal calibration of MOBILE5a is outside the reach of transportation engineers and planners working for state DOTs and MPOs, MOBILE5a is an empirically developed model, and the model development process itself has been exposed to various sources of error. This project was able to analyze the data set used to derive SCFs, which the model uses internally to determine responses to externally input speed estimates. Chapter 6 presents the findings of a statistical analysis of this data set and provides valuable information on confidence intervals associated with SCFs.

IMPROVED METHODOLOGIES AND RECOMMENDATIONS

Although the primary focus of this study was on error analysis, effort was made to identify improved methodologies for use by transportation engineers and planners in reducing errors in estimation of four key input variables. The specific variables examined for this purpose were operating mode fractions, VMT on local roads, speed, and types of vehicles (VMT mix). Discussion of these improved methodologies is presented in Chapter 8. Conclusions and recommendations for further research are presented in Chapter 9.