

Modeling Exposures to VOCs through the Individual-Based Exposure Modeling Implementation of the MENTOR/SHEDS-1A System

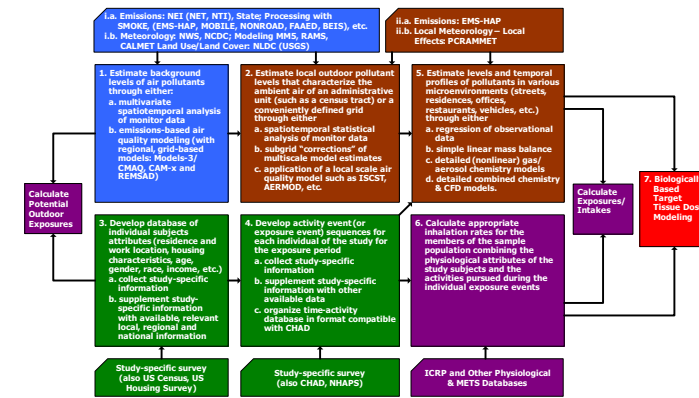
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Introduction

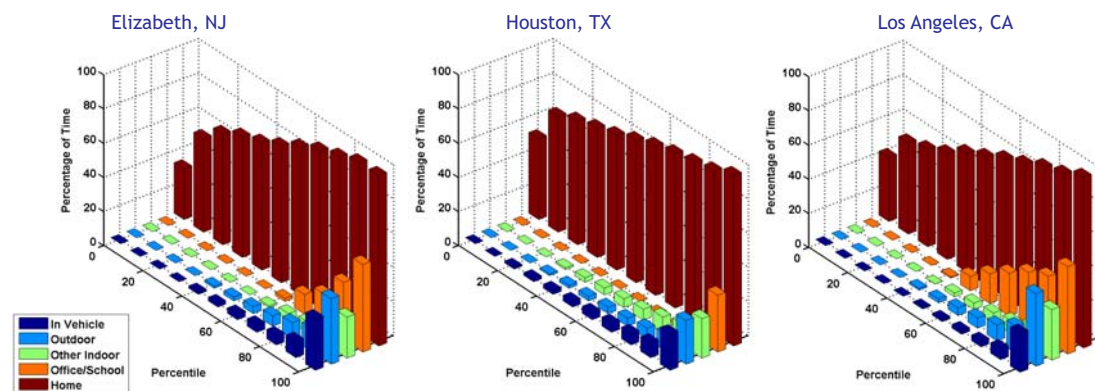
The Individual-Based Exposure Modeling (IBEM) implementation of the MENTOR/SHEDS-1A system was applied on the subjects of three sample populations (Elizabeth, NJ; Houston, TX; Los Angeles, CA) of the Relation among Indoor, Outdoor and Personal Air (RIOPA) study (Weisel et al., 2004) for studying exposures to VOCs. The IBEM approach of MENTOR/SHEDS-1A accounts for the processes determining exposures in a source-to-dose framework. Typical simulations employing the IBEM approach consist of the following steps: (1) Characterization of ambient concentrations through a combination of environmental model predictions and field data; (2) Estimation of local outdoor levels of contaminants, which characterize the ambient air of an administrative unit (e.g. census tract) through subgrid "corrections" of multiscale model estimates or application of a local scale air quality model such as ISCST3, ASPEN, etc.; (3) Estimation of levels and temporal profiles of contaminants in various microenvironments; (4) Characterization of individual subjects attributes (age, gender, race, income, etc.); (5) Development of activity event sequences for each individual of the study for the exposure period; (6) Calculation of appropriate inhalation rates for the study subjects combining the physiological attributes of the subjects and the activities pursued during the exposure events; (7) Estimation of biologically effective doses of target tissues when the structure of the modeling system allows it. Case studies simulating individual exposures to Benzene and Formaldehyde are presented for the adult study subjects in the three RIOPA cities.



A generalized 7-step flowchart describing the processes involved in assessing individual/population exposures/doses in the MENTOR/SHEDS-1A system. The implementation of Individual-Based Exposure Modeling (IBEM) of the MENTOR/SHEDS-1A is utilized in the current study.

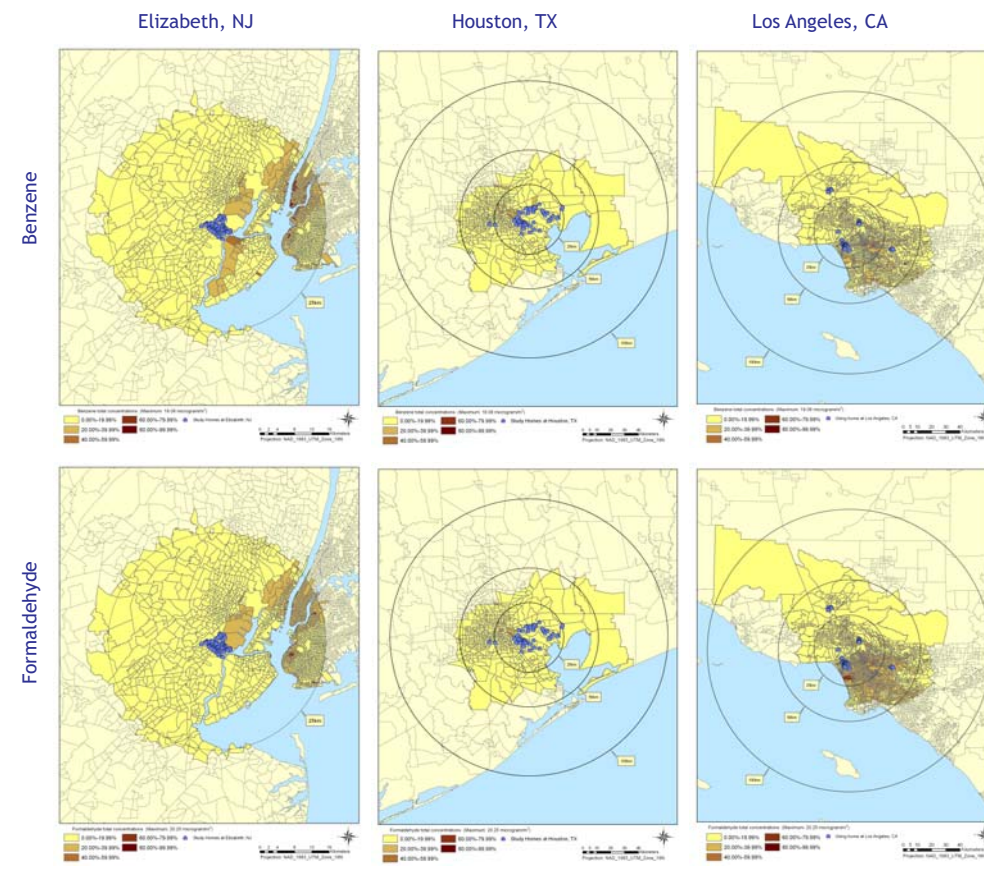
Time-Activity Patterns

Percentages of time spent among five microenvironments (home, office/school, other indoor, outdoor, and in-vehicle) during the 48-hour sampling period for the study subjects in the three RIOPA study areas (Elizabeth, NJ; Houston, TX; Los Angeles, CA).



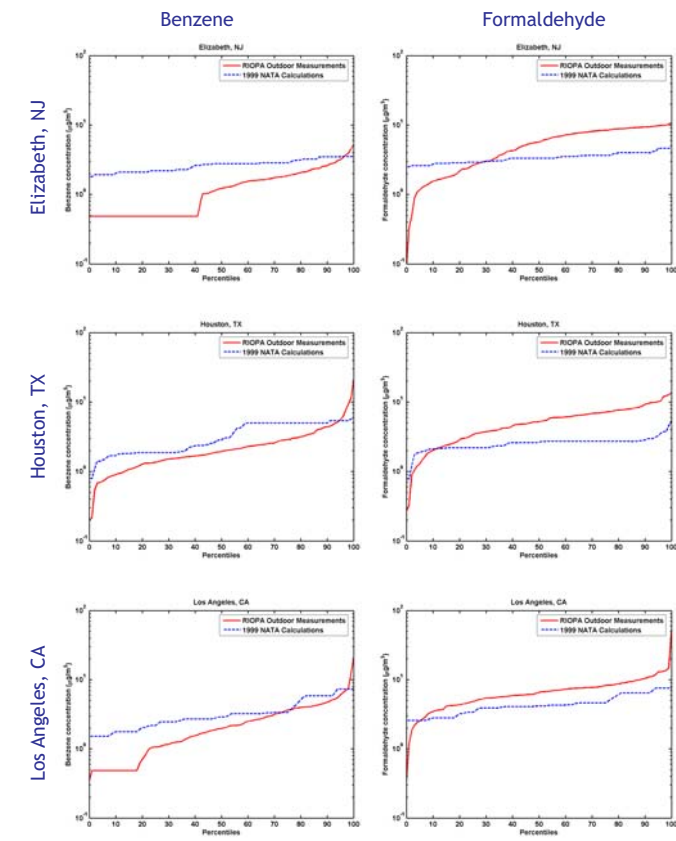
Environmental characterization of air toxics

1999 Annual average ambient concentrations of Benzene and Formaldehyde calculated by the ASPEN model in the three RIOPA study areas (Elizabeth, NJ; Houston, TX; Los Angeles, CA). Data source: 1999 NATA study (USEPA, 2005)



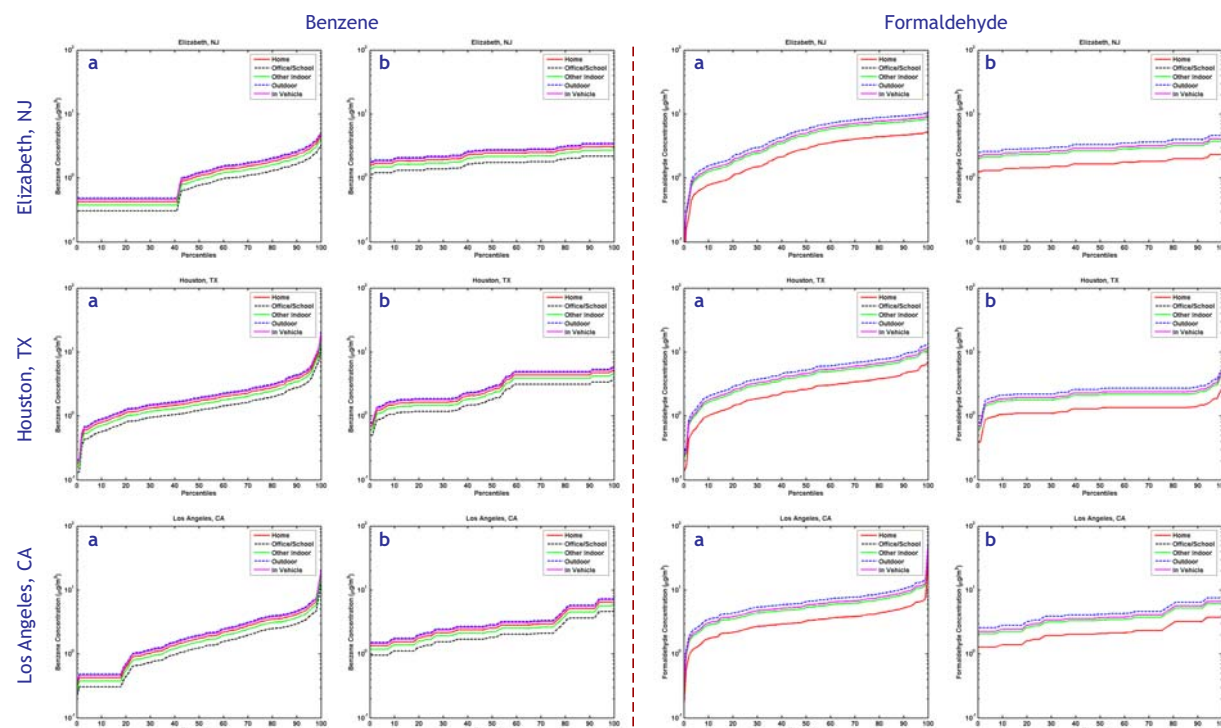
Comparison with RIOPA outdoor sampling

Comparison of Cumulative Distribution Functions (CDF) of Benzene and Formaldehyde concentrations from RIOPA outdoor measurements and corresponding 1999 NATA calculations at those census tracts where the RIOPA subjects homes are located.



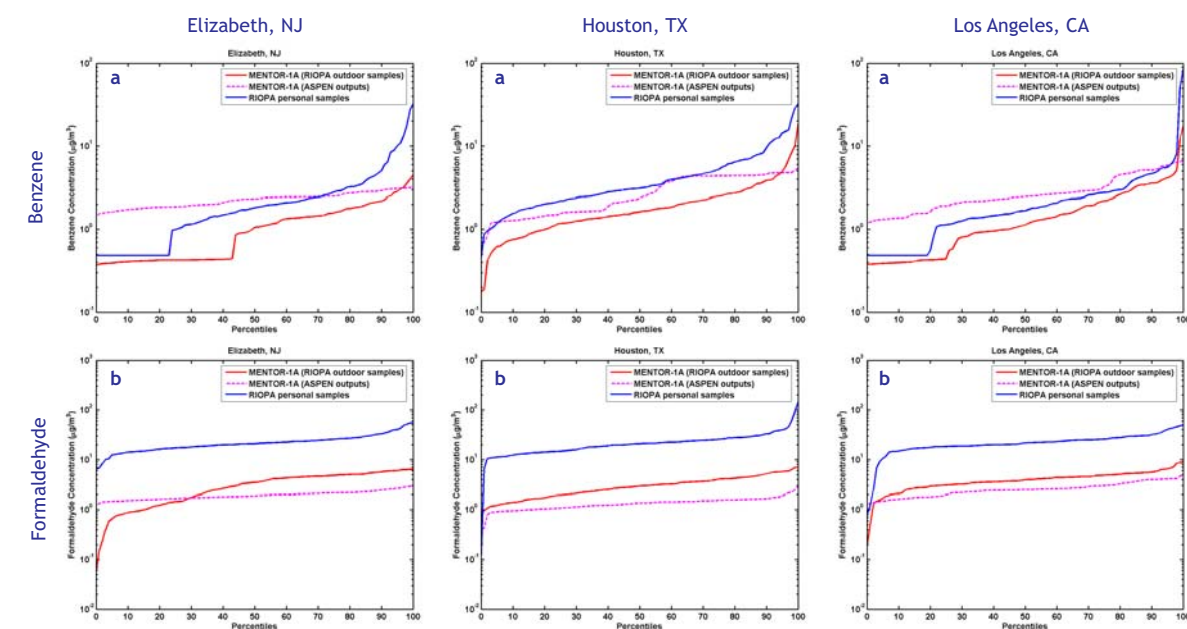
Microenvironmental Modeling

Cumulative Distribution Functions (CDF) of Benzene and Formaldehyde concentrations in five microenvironments (home, office/school, other indoor, outdoor, and in-vehicle) calculated by MENTOR/SHEDS-1A with inputs of ambient concentration from (a) RIOPA outdoor samples and (b) 1999 NATA estimates in the three RIOPA study areas (Elizabeth, NJ; Houston, TX; Los Angeles, CA). Microenvironmental concentrations were calculated using the microenvironmental module of MENTOR/SHEDS-1A with the linear factor approach, which only uses ambient concentrations as the inputs. Characterization of contributions of indoor sources to residential microenvironmental concentrations is currently on-going.



Exposure Modeling

Cumulative Distribution Functions (CDF) of 48-hour average exposure concentrations of (a) Benzene (b) Formaldehyde in the three RIOPA cities (Elizabeth, NJ, Houston, TX, Los Angeles, CA) generated from the RIOPA personal samples and corresponding MENTOR/SHEDS-1A calculations with inputs of ambient concentrations from RIOPA outdoor samples and from 1999 NATA estimates, respectively



Acknowledgements

Base Funding for the Ozone Research Center is Provided by the State of New Jersey Department of Environmental Protection (NJDEP - Contract AQ05-011). The present work has been funded by the American Chemistry Council (ACC - Research Agreement 2488) and the U.S. Environmental Protection Agency (USEPA - Cooperative Agreement CR-83162501). The viewpoints expressed in this work are solely the responsibility of the authors and do not necessarily reflect the views of NJDEP, USEPA, ACC, or their contractors.

References

Weisel, C.P., Zhang, J., Turpin, B.J., Morandi, M.T., Colome, S., Stock, T.H., and Spektor, D.M. 2004. Investigators' Report: Relationships of Indoor, Outdoor and Personal Air (RIOPA). Health Effects Institute.

USEPA, 2005, personal communication