

Advances in Modeling Individual-Based Exposures Estimates to VOCs

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by

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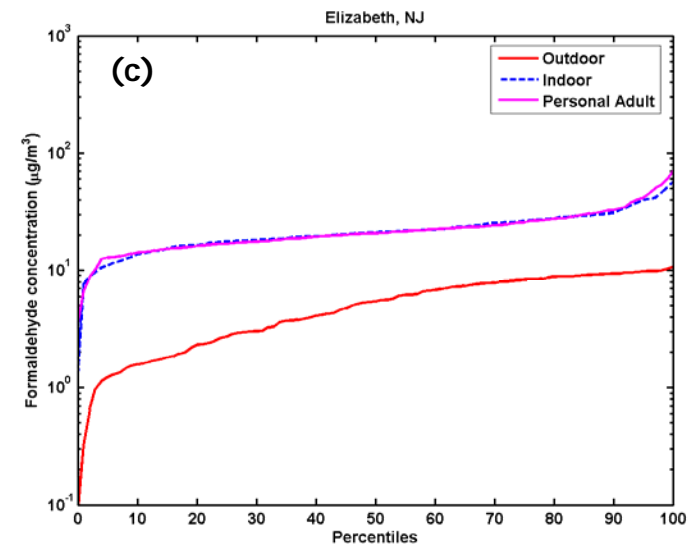
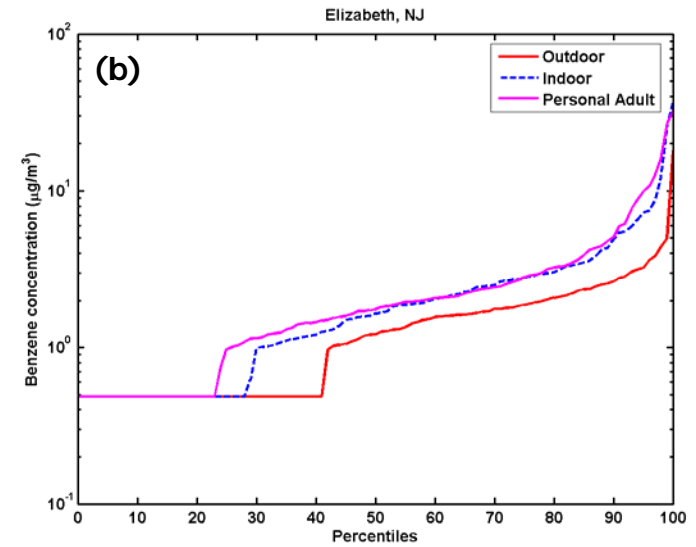
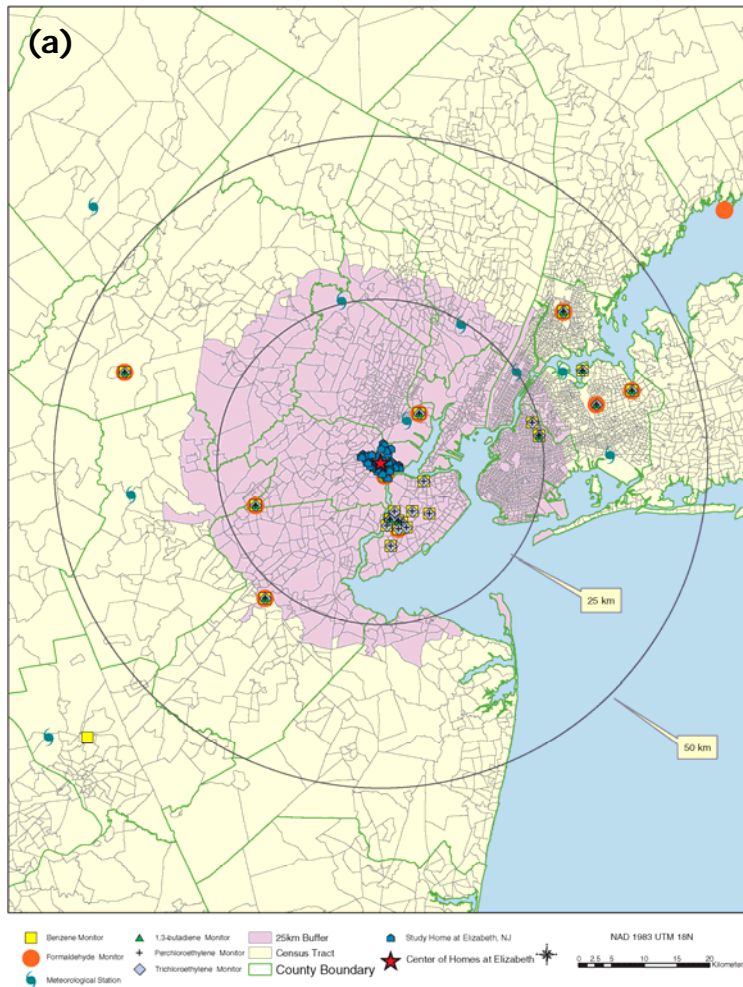
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Presentation Overview

- Modeling subjects: the adult participants of the [Relationships among Indoor, Outdoor and Personal Air \(RIOPA\)](#) study (Weisel et al., 2004)
 - Distributions of the outdoor, indoor, personal samples
 - Distributions of the ratios of indoor/outdoor samples
- Individual-Based Exposure Modeling (IBEM) framework of the MENTOR/SHEDS-1A system
- IBEM applications for the three RIOPA study areas (Elizabeth, NJ; Houston, TX; Los Angeles, CA)
 - Environmental modeling characterization
 - Microenvironmental modeling
 - Activity pattern and exposure modeling

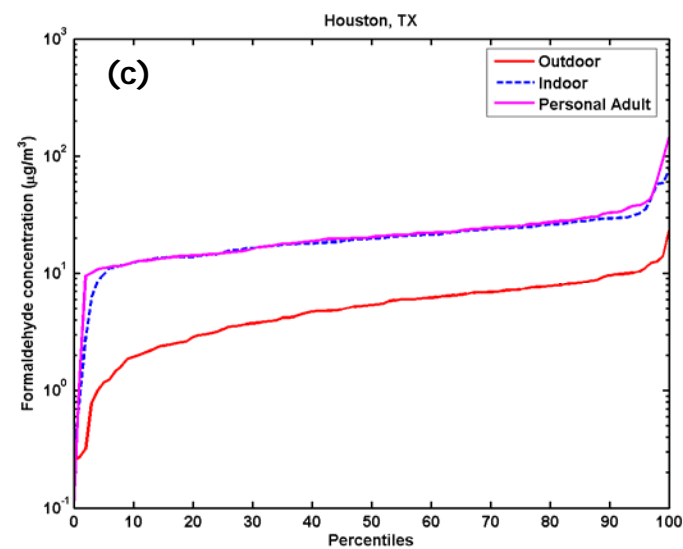
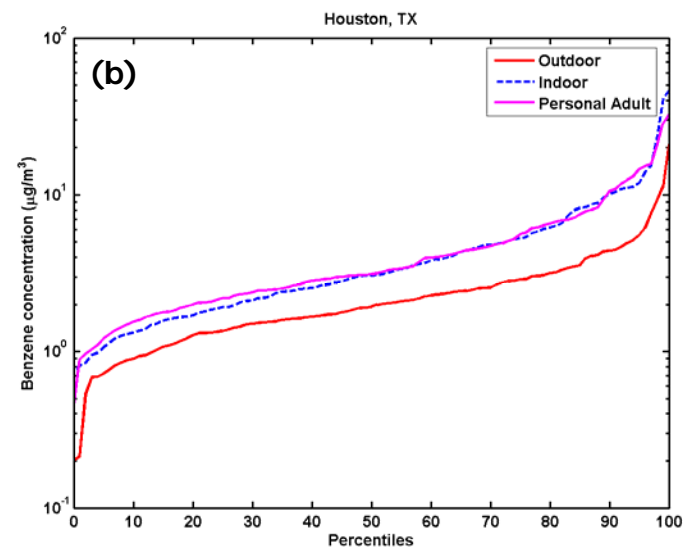
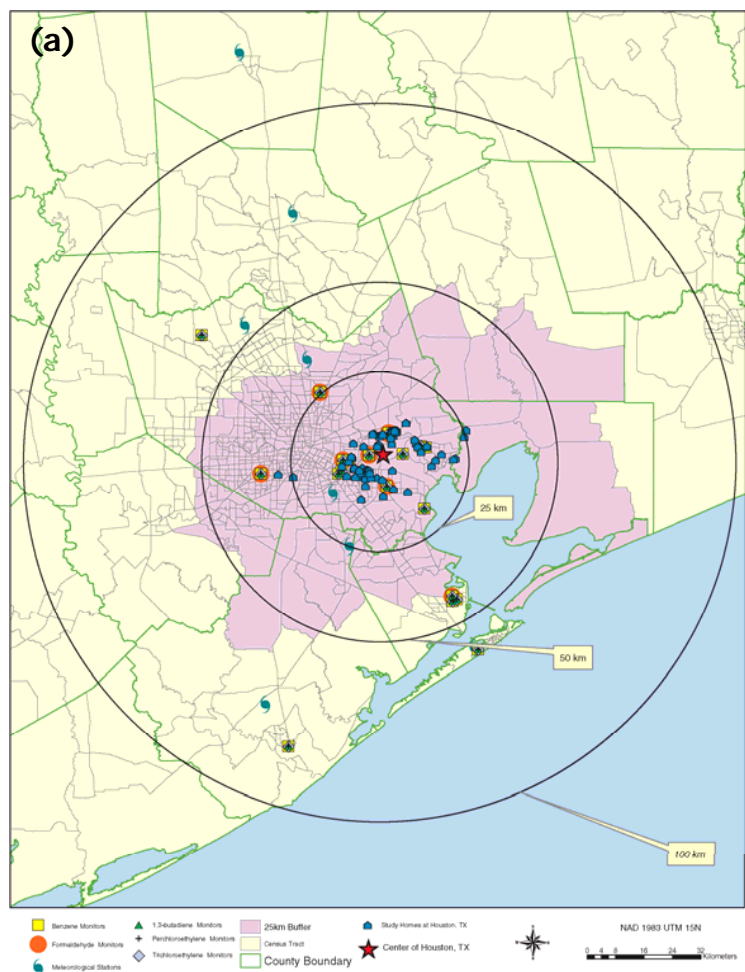
The RIOPA Study Area: Elizabeth, NJ

- (a) Locations of sampling homes and surrounding meteorological and air quality monitoring stations
- (b) Cumulative Distribution Functions of Benzene samples
- (c) Cumulative Distribution Functions of Formaldehyde samples



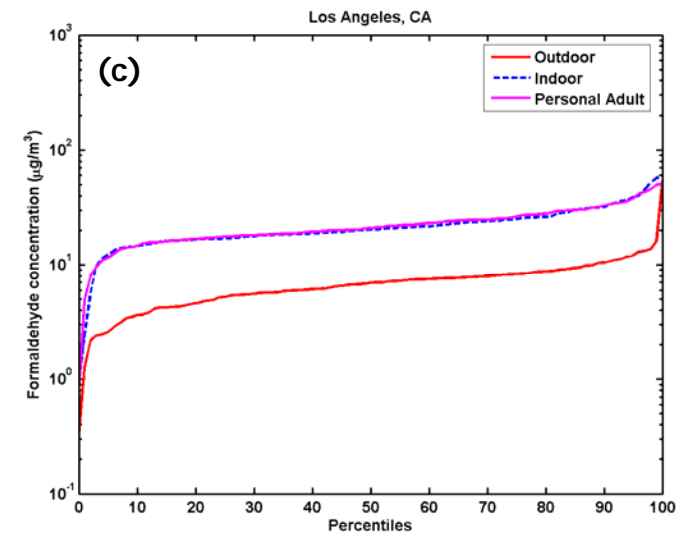
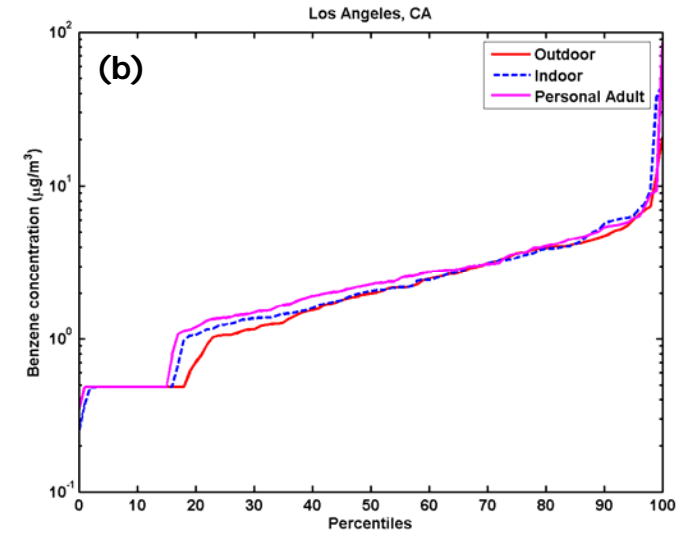
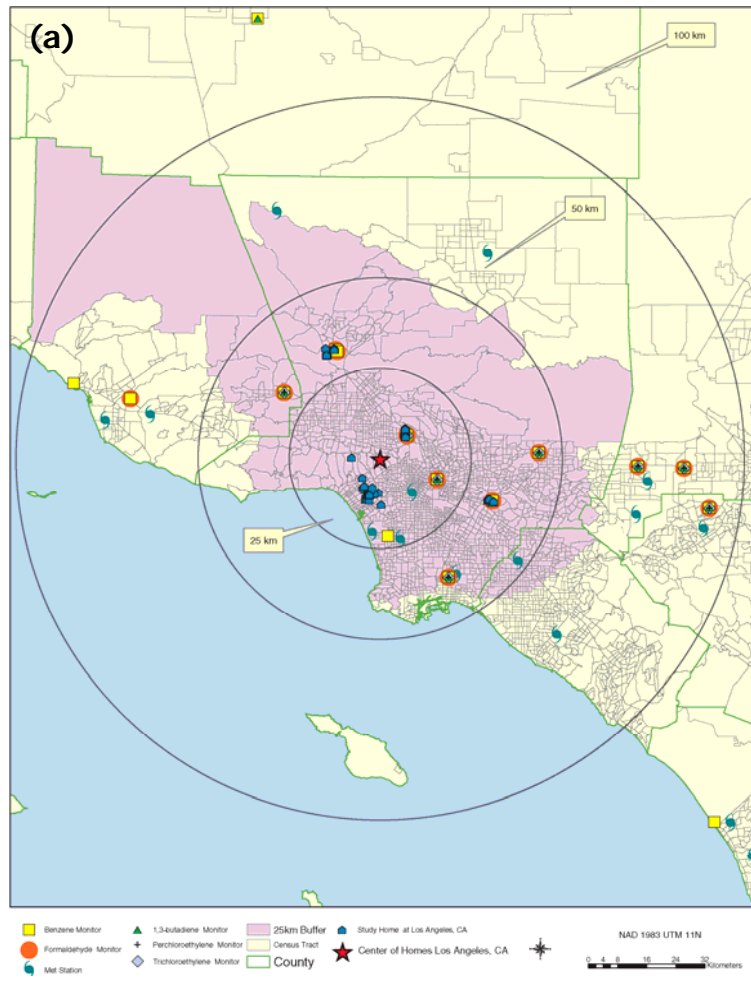
The RIOPA Study Area: Houston, TX

- (a) Locations of sampling homes and surrounding meteorological and air quality monitoring stations
- (b) Cumulative Distribution Functions of Benzene samples
- (c) Cumulative Distribution Functions of Formaldehyde samples



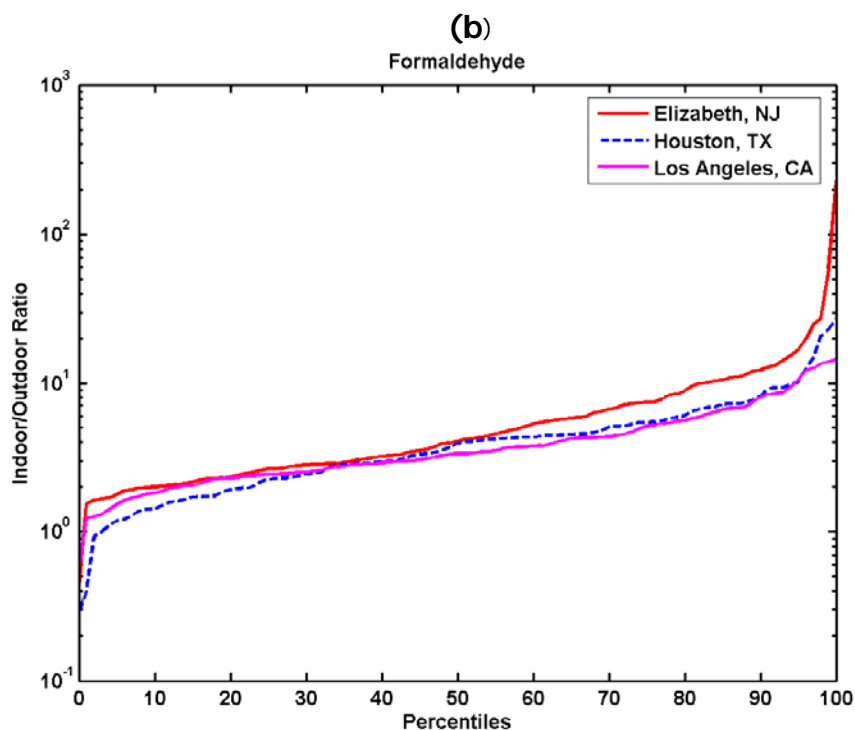
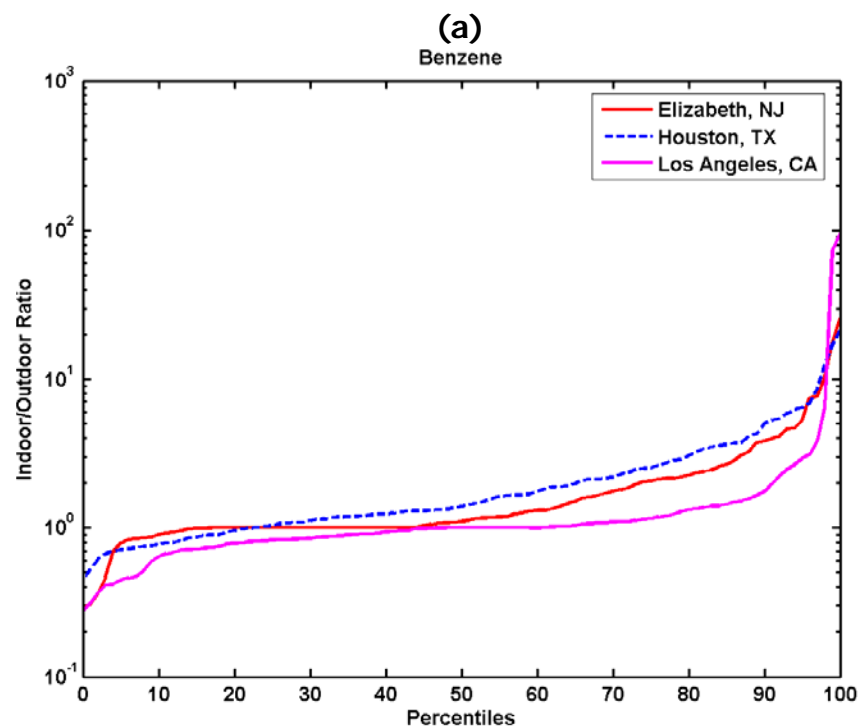
The RIOPA Study Area: Los Angeles, CA

- (a) Locations of sampling homes and surrounding meteorological and air quality monitoring stations
- (b) Cumulative Distribution Functions of Benzene samples
- (c) Cumulative Distribution Functions of Formaldehyde samples

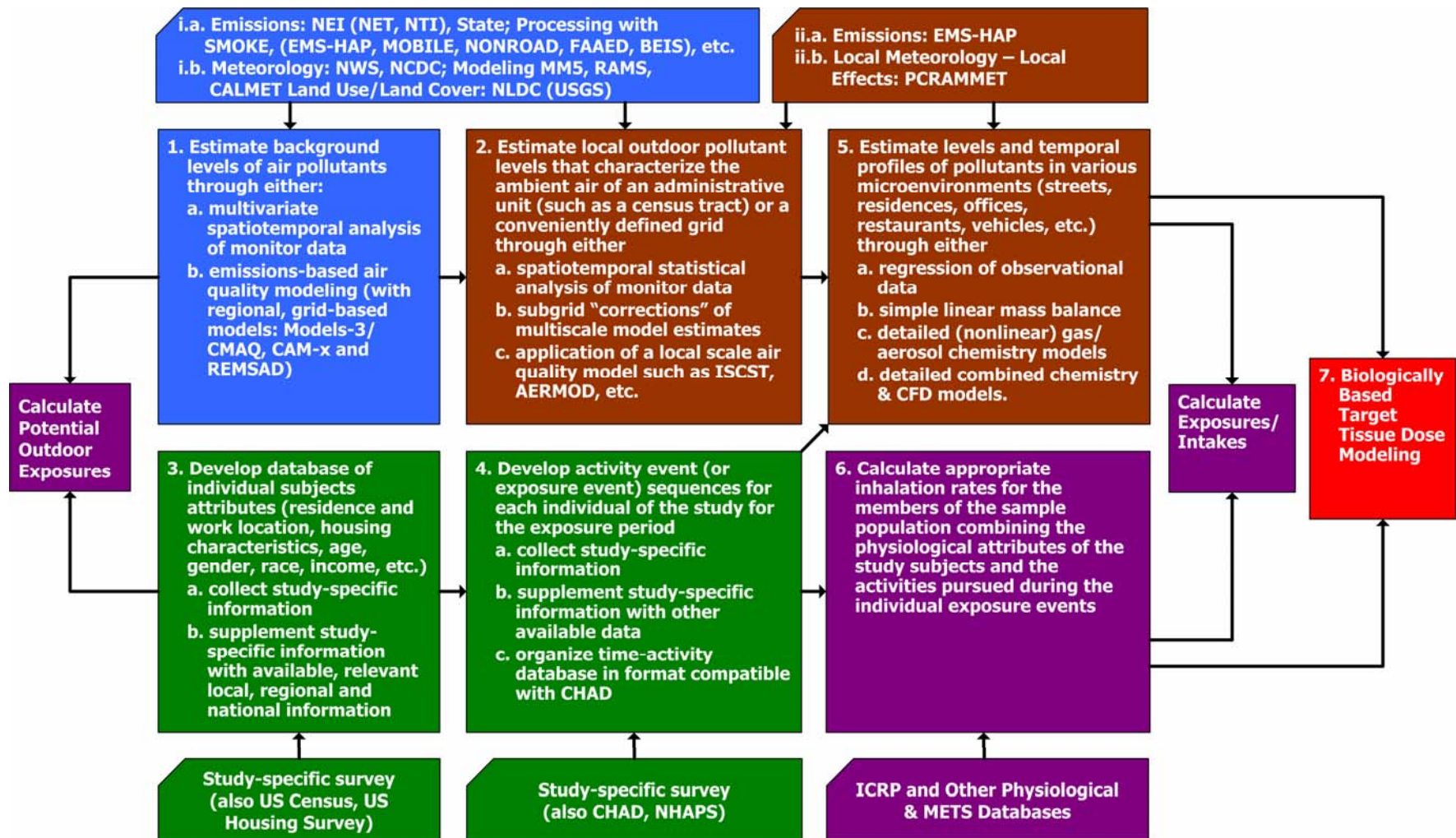


Distributions of Indoor/Outdoor Ratios across Three RIOPA Cities

Cumulative Distribution Functions (CDF) of Indoor/Outdoor ratios for (a) Benzene (b) Formaldehyde across the three RIOPA cities (Elizabeth, NJ: Houston, TX: Los Angeles, CA)

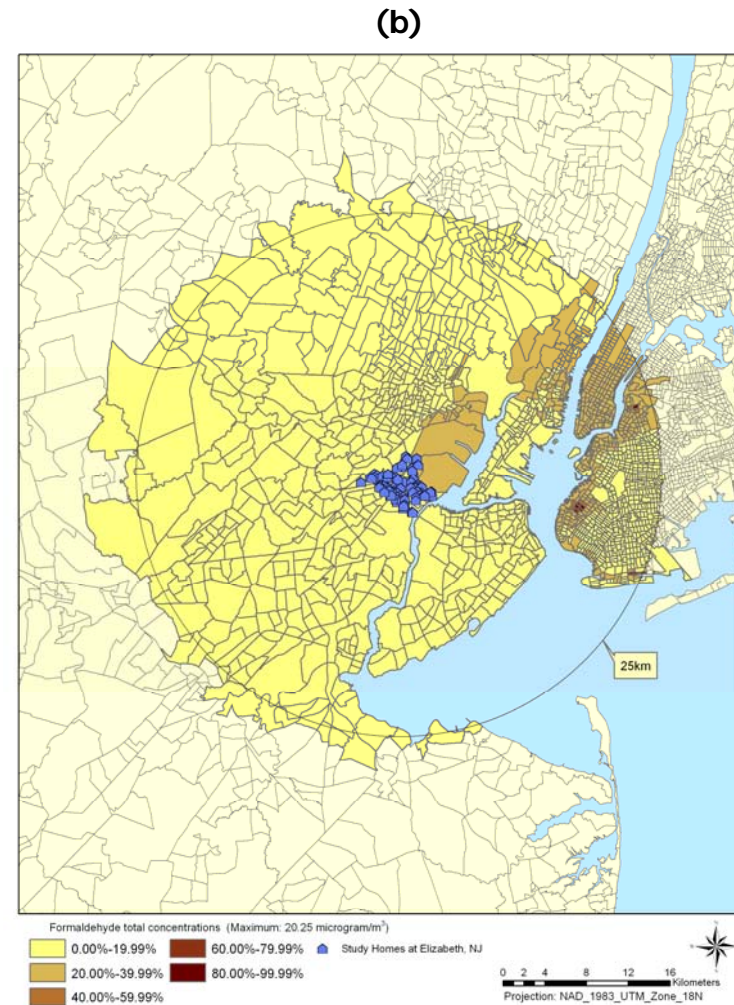
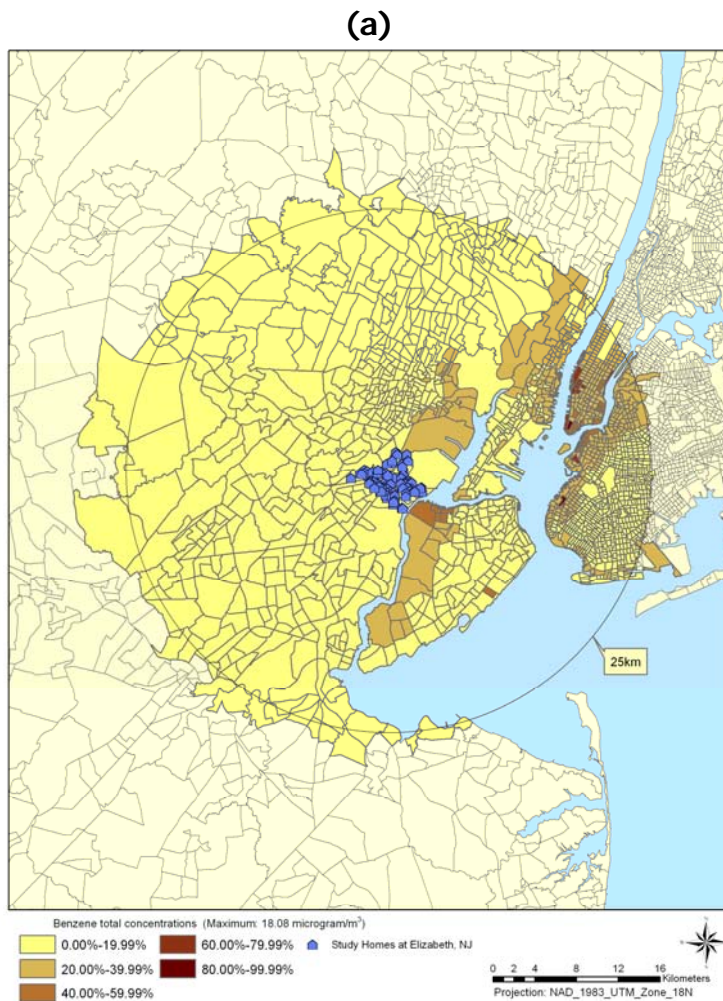


IBEM Framework of the MENTOR/SHEDS-1A System



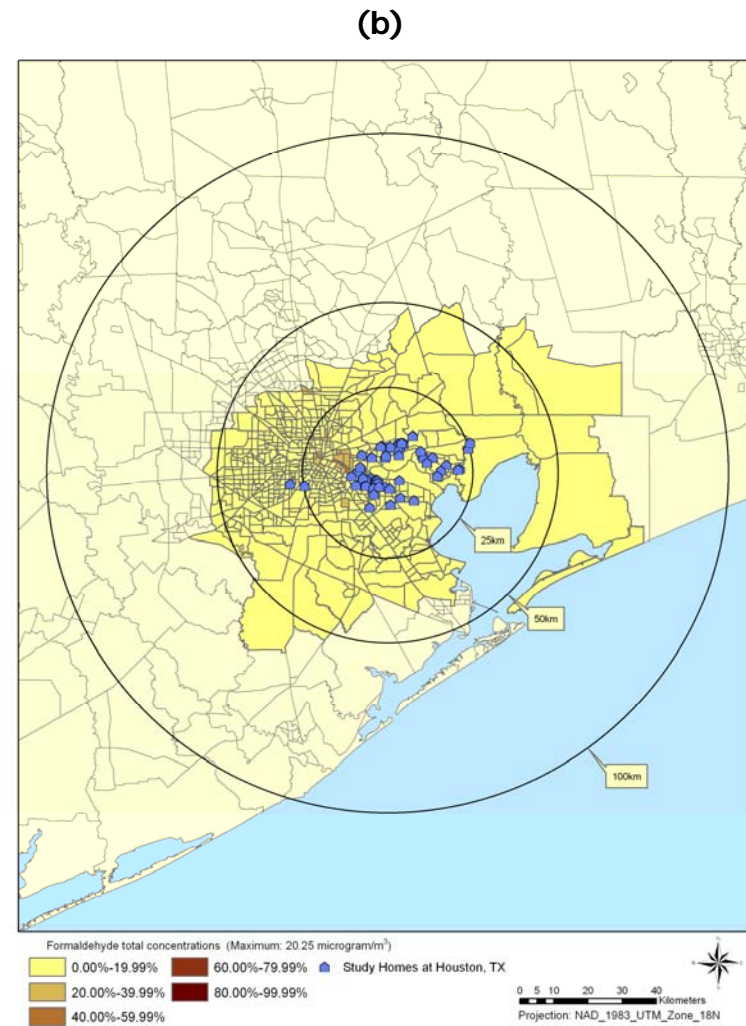
Environmental Modeling Characterization: Elizabeth, NJ

1999 Annual average ambient concentrations of (a) Benzene (b) Formaldehyde calculated by the ASPEN model
Data source: 1999 NATA study (USEPA, 2005)



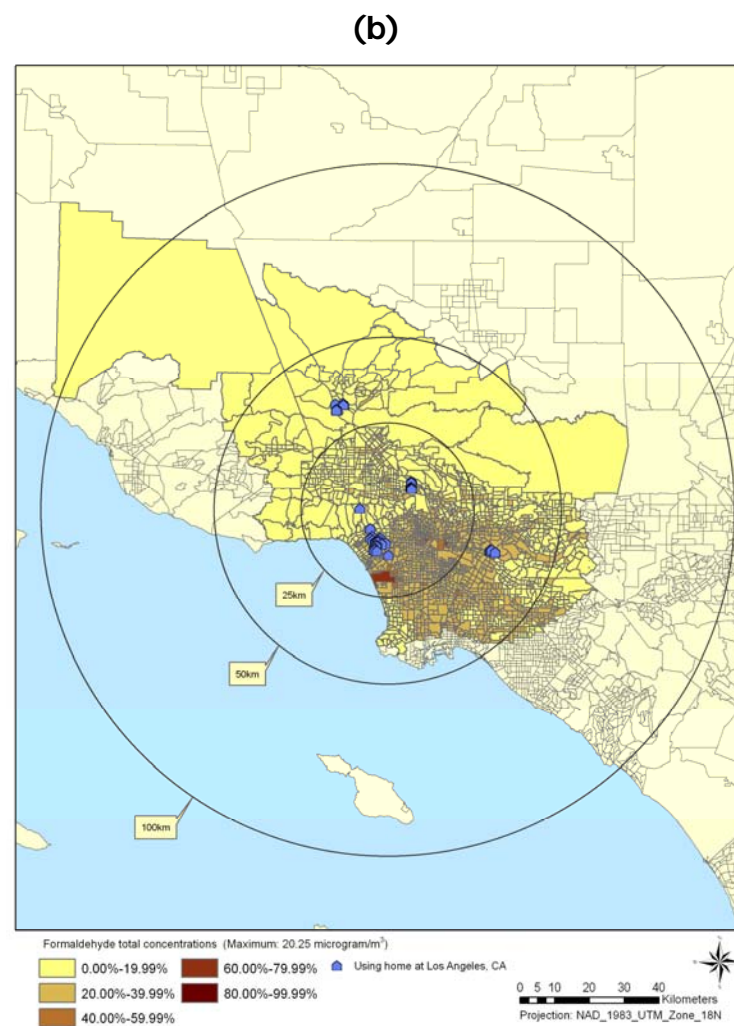
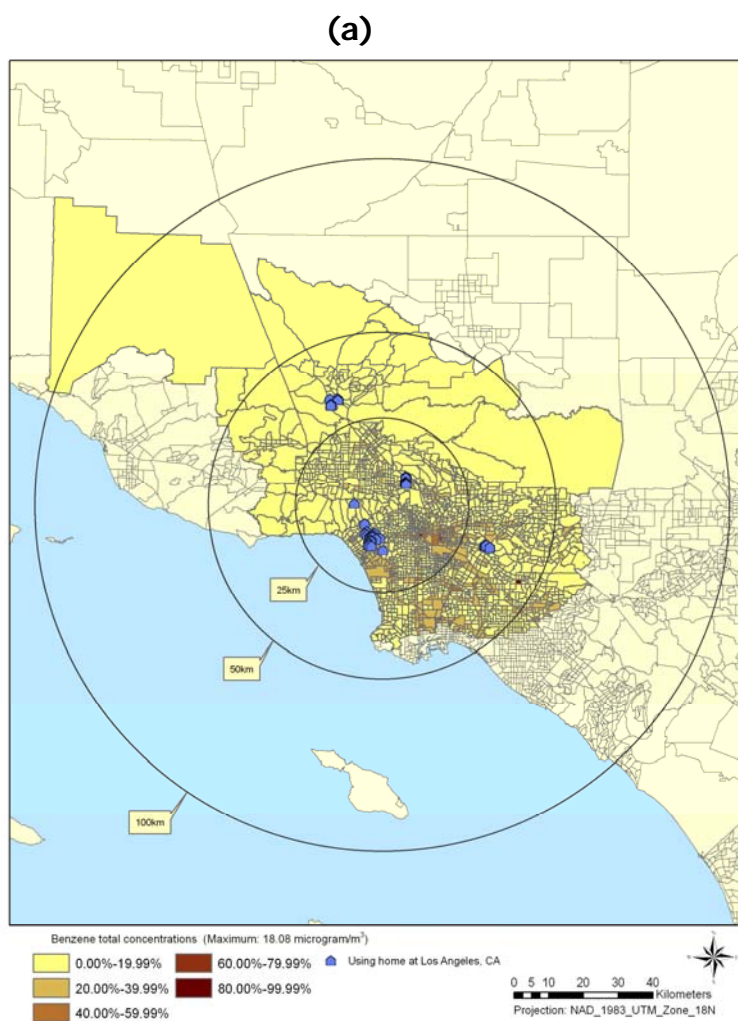
Environmental Modeling Characterization: Houston, TX

1999 Annual average ambient concentrations of (a) Benzene (b) Formaldehyde calculated by the ASPEN model
Data source: 1999 NATA study (USEPA, 2005)

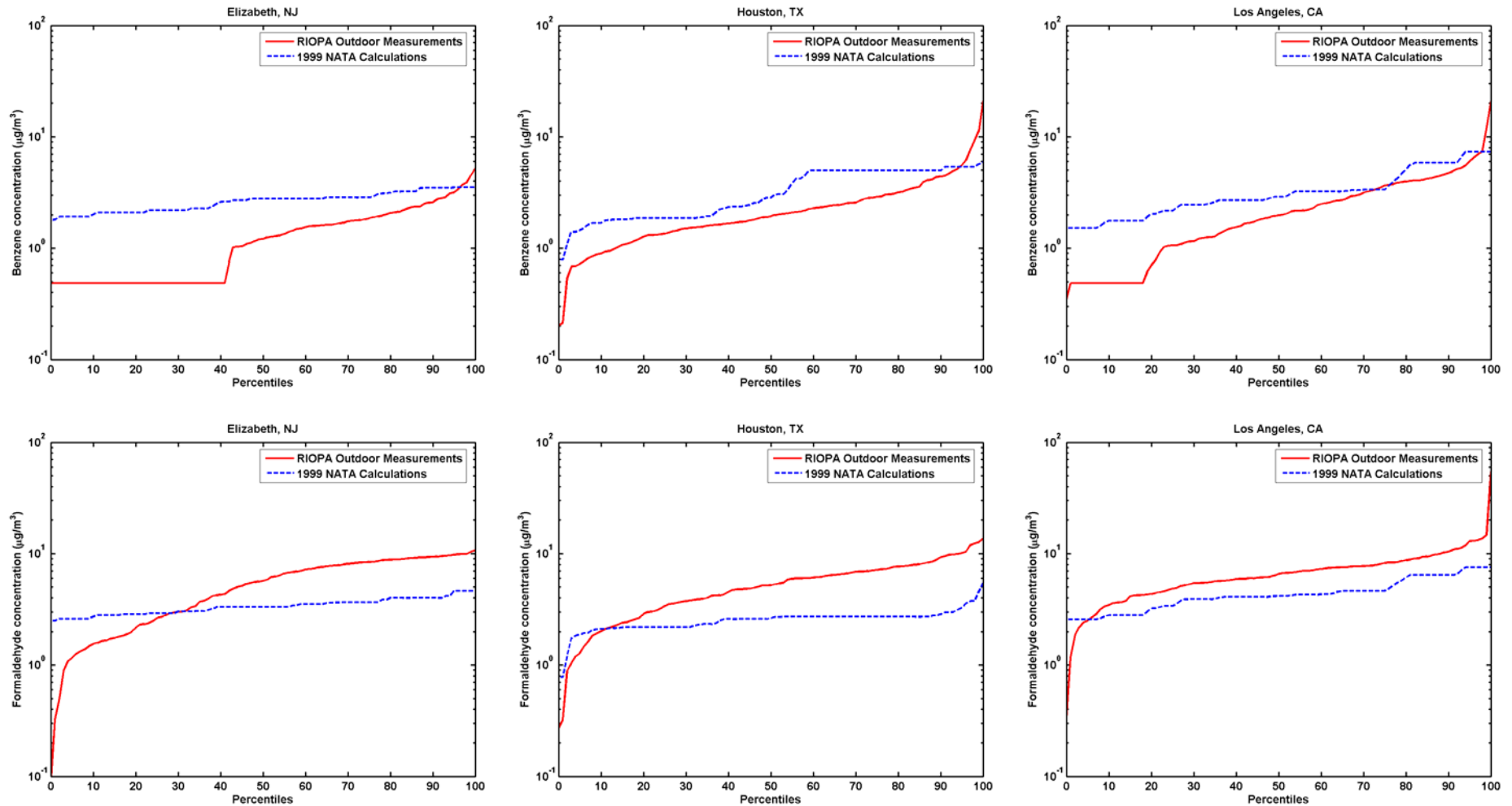


Environmental Modeling Characterization: Los Angeles, CA

1999 Annual average ambient concentrations of (a) Benzene (b) Formaldehyde calculated by the ASPEN model
Data source: 1999 NATA study (USEPA, 2005)



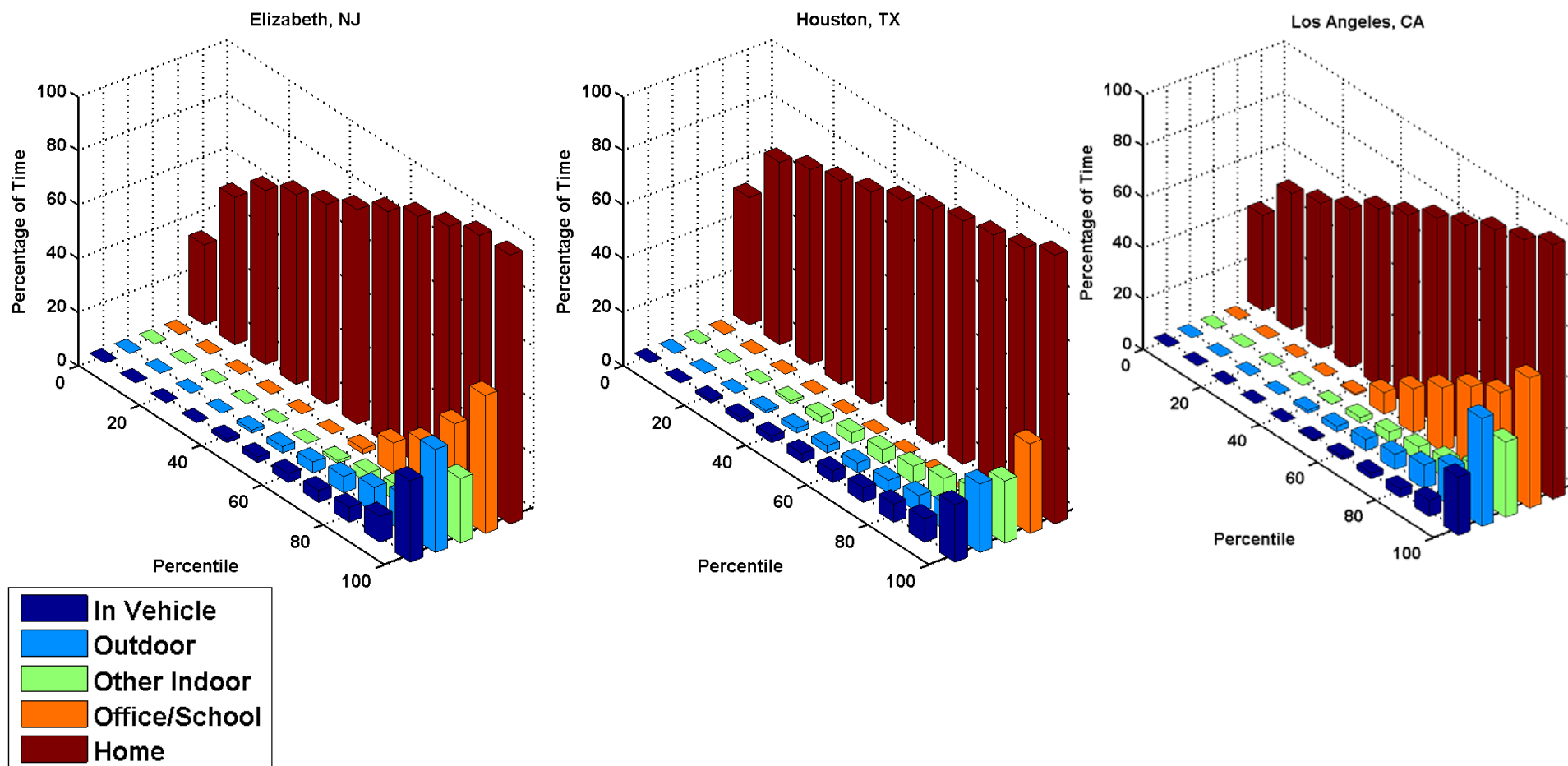
Comparison of 1999 NATA Estimates with RIOPA Outdoor Samples



Note: RIOPA data were sampled during the period of June 1999 – January 2001

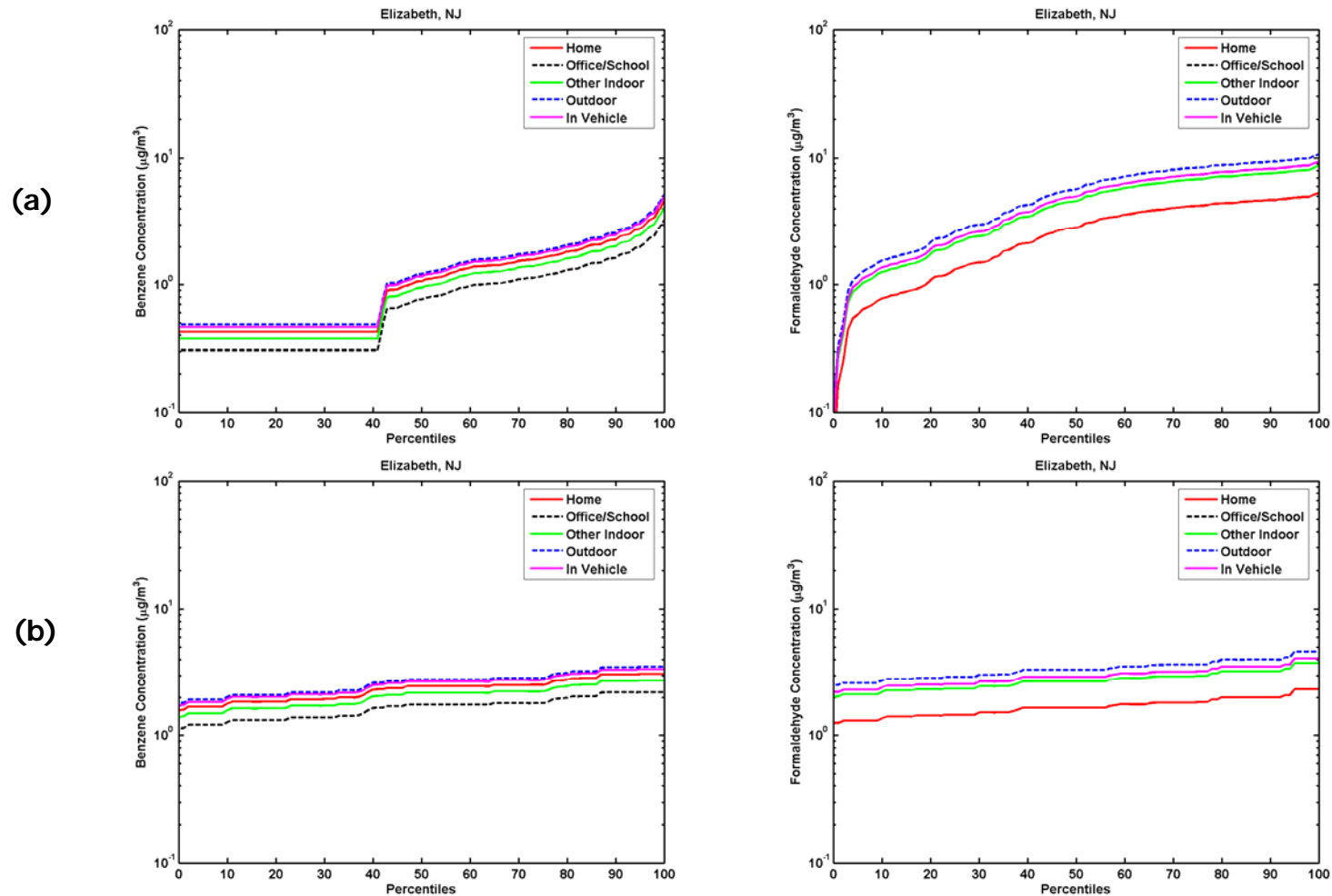
Time-Activity Patterns of the RIOPA Study Subjects

Percentages of time spent in five microenvironments (home, office/school, other indoor, outdoor, in vehicle) of the RIOPA subjects during the 48-hour sampling period



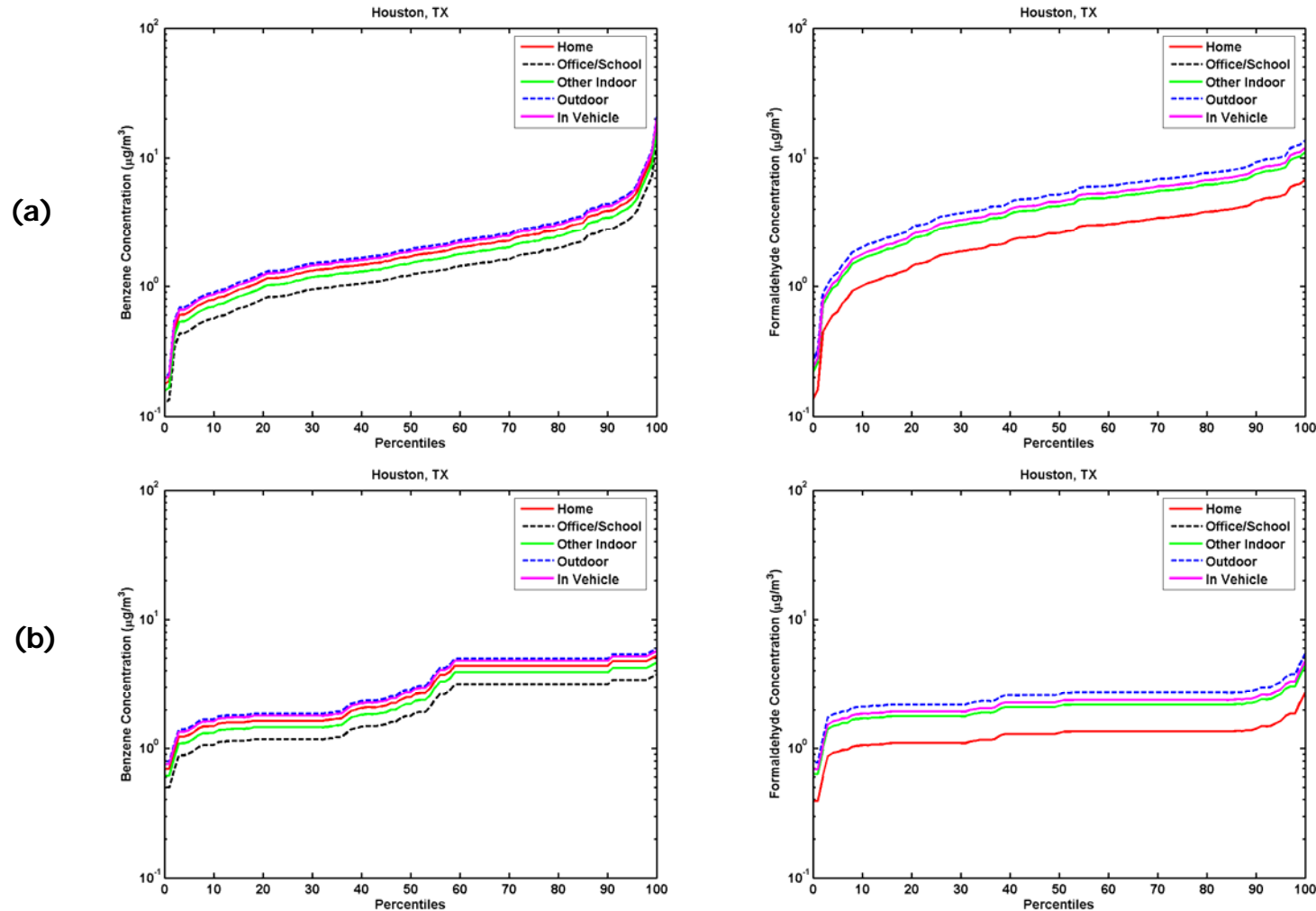
Microenvironmental Modeling: Elizabeth, NJ

Cumulative Distribution Functions (CDF) of Benzene (1st column) and Formaldehyde (2nd column) in five microenvironments calculated by MENTOR/SHEDS-1A with the inputs of ambient concentrations from (a) RIOPA outdoor samples, (b) 1999 NATA estimates



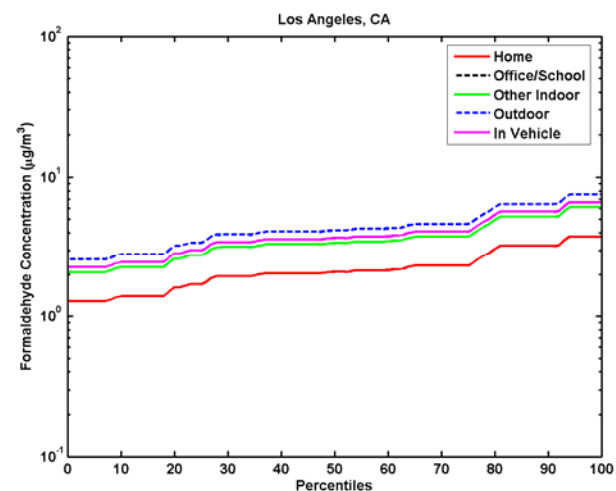
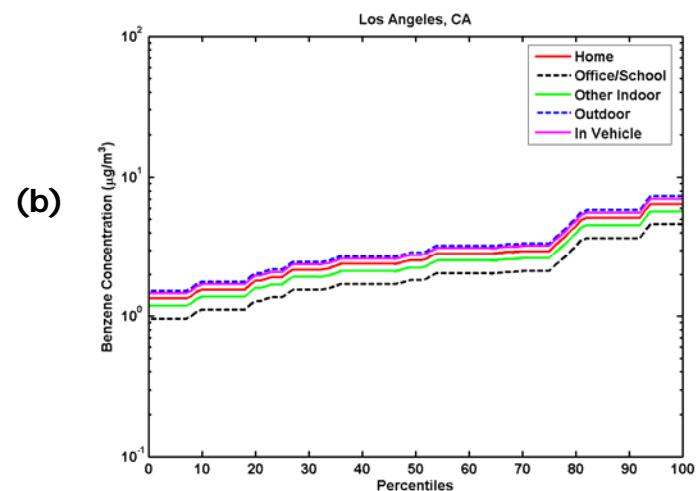
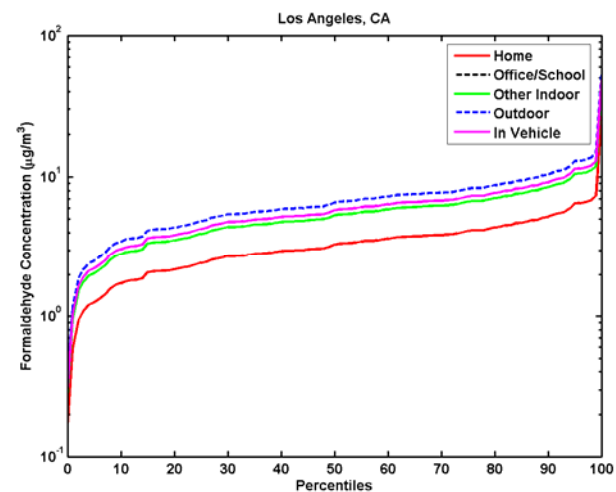
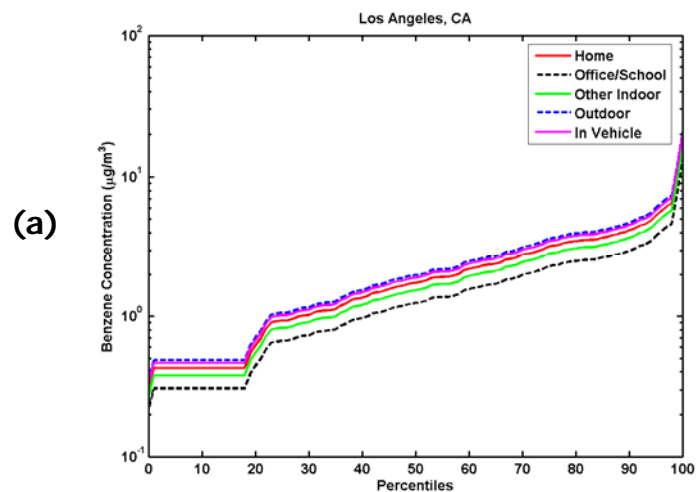
Microenvironmental Modeling: Houston, TX

Cumulative Distribution Functions (CDF) of Benzene (1st column) and Formaldehyde (2nd column) in five microenvironments calculated by MENTOR/SHEDS-1A with the inputs of ambient concentrations from (a) RIOPA outdoor samples, (b) 1999 NATA estimates



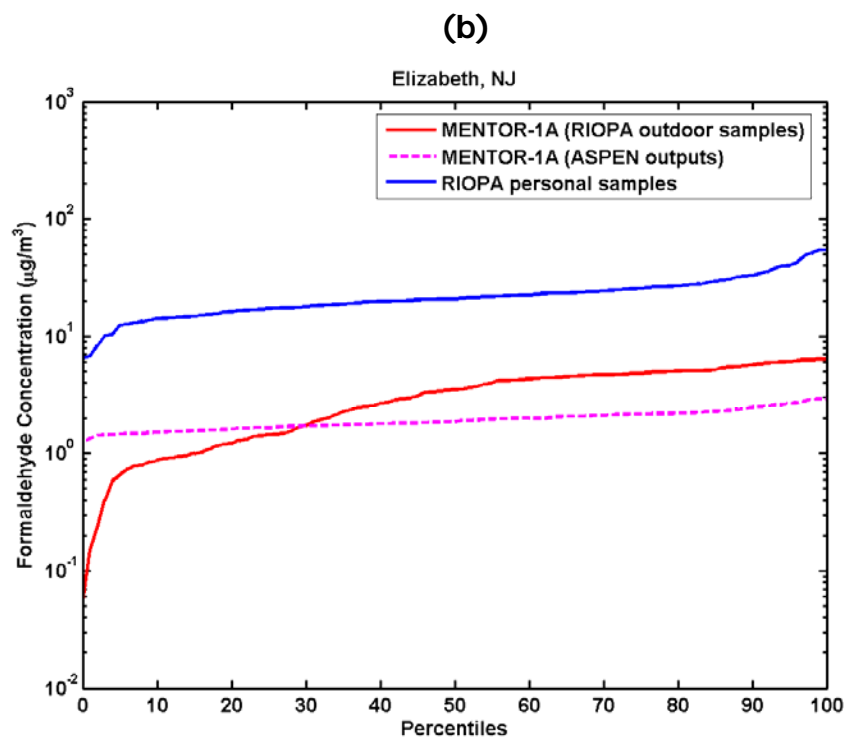
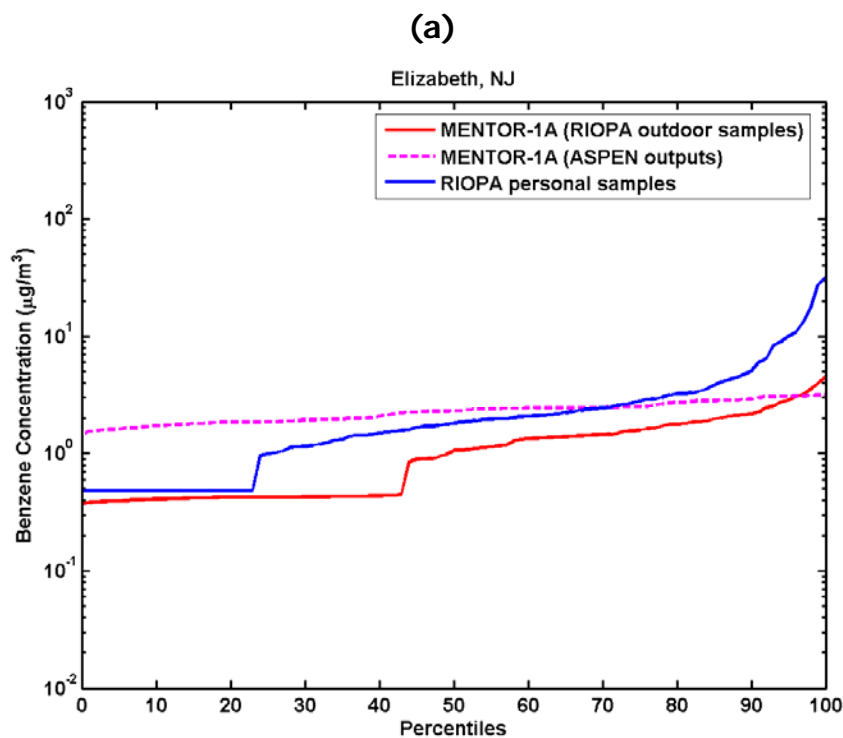
Microenvironmental Modeling: Los Angeles, CA

Cumulative Distribution Functions (CDF) of Benzene (1st column) and Formaldehyde (2nd column) in five microenvironments calculated by MENTOR/SHEDS-1A with inputs of ambient concentrations from (a) RIOPA outdoor samples, (b) 1999 NATA estimates



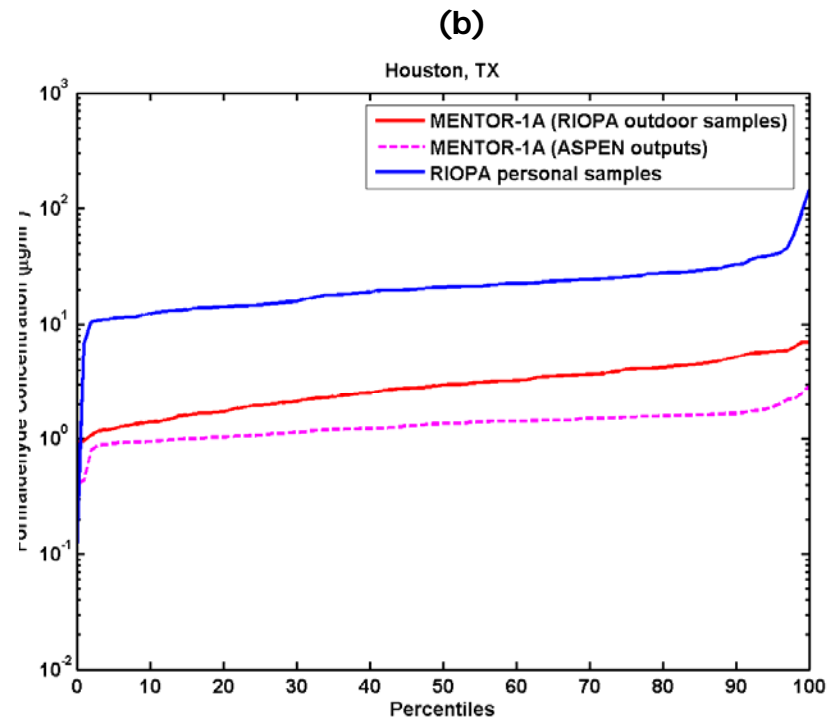
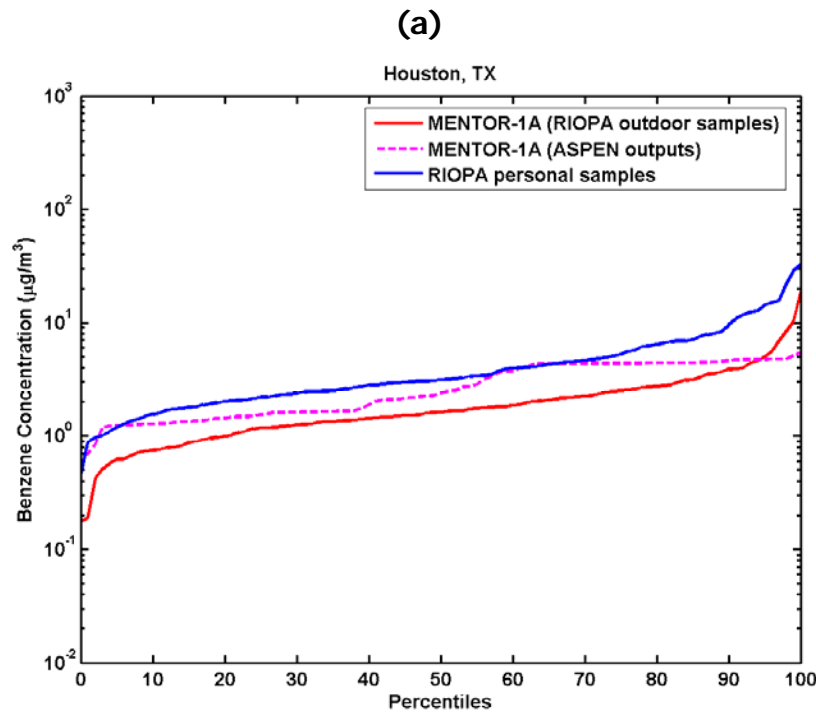
Exposure Modeling: Elizabeth, NJ

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



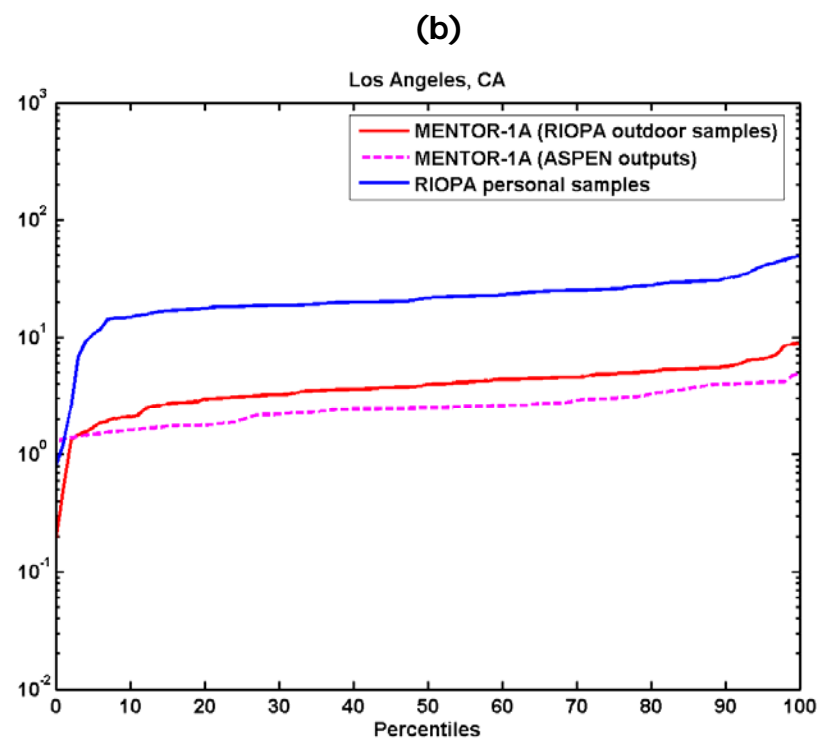
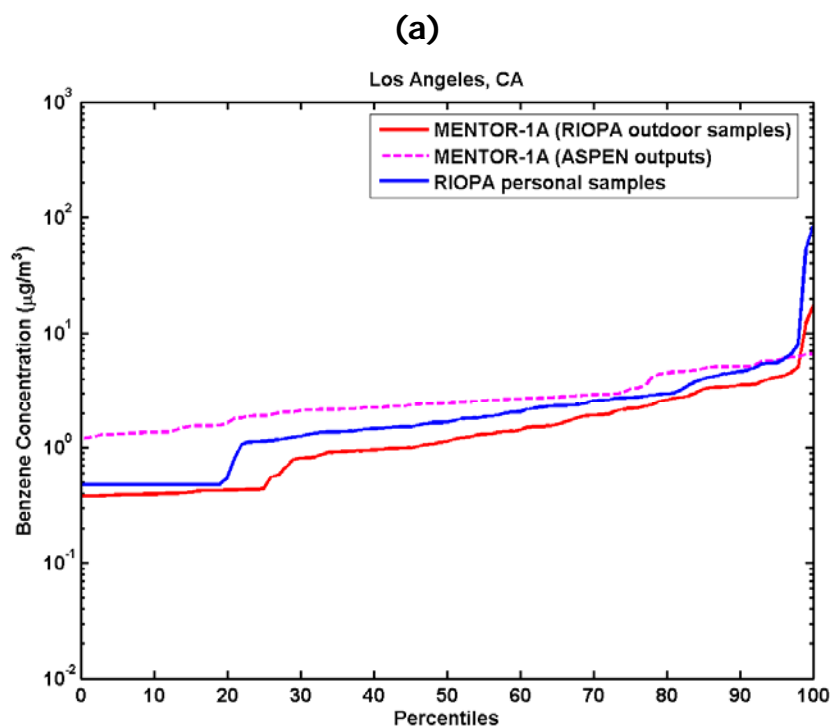
Exposure Modeling: Houston, TX

Cumulative Distribution Functions (CDF) of 48-hour average exposure concentrations of (a) Benzene (b) Formaldehyde 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



Exposure Modeling: Los Angeles, CA

Cumulative Distribution Functions (CDF) of 48-hour average exposure concentrations of (a) Benzene (b) Formaldehyde 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



Preliminary Conclusions and Discussion

- The IBEM approach of the MENTOR/SHEDS-1A was applied to assess personal exposures to benzene and formaldehyde for the RIOPA study subjects
- Different inputs of ambient concentrations (RIOPA outdoor measurements vs. 1999 NATA estimates) were used to simulate personal exposures
 - Calculated personal exposures based on RIOPA outdoor measurements showed reasonable agreement with measured personal samples
 - The above simulation results underestimate personal exposures, most probably due to the lack of modeling exposure contribution from indoor sources
 - The degree of underestimation is higher for modeling exposures to formaldehyde than benzene
- On-going effort and future work:
 - Local-scale air quality modeling using USEPA's EMS-HAP/ISCST3 models for the actual days of RIOPA sampling
 - Development of modules to account for contributions of indoor sources of air toxics

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