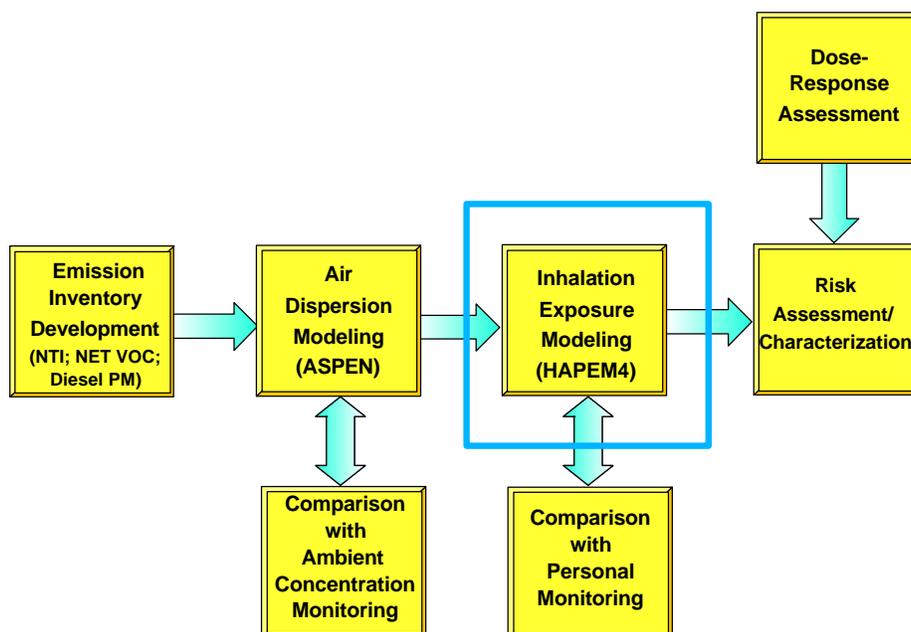


The National Air Toxics Assessment

Exposure Component for the Initial National Scale Assessment

Ted Palma - OAQPS
Science Advisory Board Review
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How Does the Exposure Assessment Fit into the National Scale Assessment?



Exposure Model Selection for the Initial National Scale Assessment

- An exposure model predicts the quantity or amount of a constituent (over a given period of time) that is available for human uptake.
- Primary Exposure Routes: inhalation, ingestion, dermal
- NATA - National Scale Assessment:
 - Primary focus was inhalation
 - Chronic exposure
 - Population based risk/exposure
- Selected the The Hazardous Air Pollutant Exposure Model (HAPEM) which was modified for the initial national scale assessment

HAPEM - Background

- Originally developed by OTAQ/ORD as HAPEM-MS
 - used for mobile sources
- HAPEM3 - Version 3 enhanced by OTAQ and recently used as part of 202(l) rulemaking
 - used for mobile sources - CO as a surrogate to predict toxics

HAPEM - Revisions for the Initial National Scale Assessment

- **HAPEM4 - Version 4 enhanced by OAQPS for use in the Initial National-Scale Assessment**
 - ◆ multiple source category types
 - ◆ census tracts air quality - (61,258 nationwide, PR, VI)
 - ◆ Activity Pattern Data - Combined Human Activity Database (CHAD) from ORD (22,000 records)
 - ◆ Microenvironments (ME) : 37 indoor/outdoor locations
 - ◆ ME Factors - developed for 33 urban HAPs and PM
 - ◆ 40 demographic groups
 - ◆ Commuting between tracts for certain cohorts
 - ◆ Stochastic features: 30 activity-years / cohorts at each tract

The HAPEM4 Modeling Approach

- HAPEM is used to predict your breathing level concentration - follows you around in time and space
- Model tracks cohort (a representative person) movement through time (over a year) and space (through microenvironments located within census tracts).
- Microenvironment concentration are determined as a function of ambient concentration and indoor source term (ME Factors)
 - ◆ $[ME] = [AMBIENT]*F + [INDOOR]$
 - ◆ F = Penetration Factor * Proximity Factor

Detailed report at: <http://www.epa.gov/ttn/uatw/nata/nata2/mereport.pdf>
- Ambient concentrations from ASPEN prediction
- Cohort movements determined from activity diary data (CHAD)

HAPEM Past Peer Reviews

- **HAPEM-MS** - Peer reviewed in October 1994 by Tadeusz E. Kliendienst, Andrew Sivak, Thomas H. Stock, Jaroslav J. Vostal, and Clifford P. Weisel.
- **HAPEM3** - Developed by ORD and recently used by OTAQ as part of 202(I); Peer reviewed by Ted Johnson in August 1999 and NESCAUM in October 1999.
- **HAPEM4** - Technical Expert Peer Review in July 2000 of ME factors (Petros Koutrakis, Brian Leaderer, Will M. Ollison); Reviewed as part of "NATA - Planning and Scoping Document " peer review in July 2000.

Sources of HAPEM4 Model Uncertainty/Limitations

- **Approach**
 - ◆ Not suited for prediction of "extremes" in distribution of exposures
- **Air Quality Data**
 - ◆ Model does not allow for a concentration gradient within a tract
 - ◆ As applied in NATA it does not include seasonal variations
- **Microenvironment (ME) Factors**
 - ◆ Limited studies to develop ME factors for most HAPs
 - ◆ ME factors are in model as "best" estimate not ranges
 - ◆ No spatial or temporal variability in ME factors
 - ◆ ME relationship not always linear

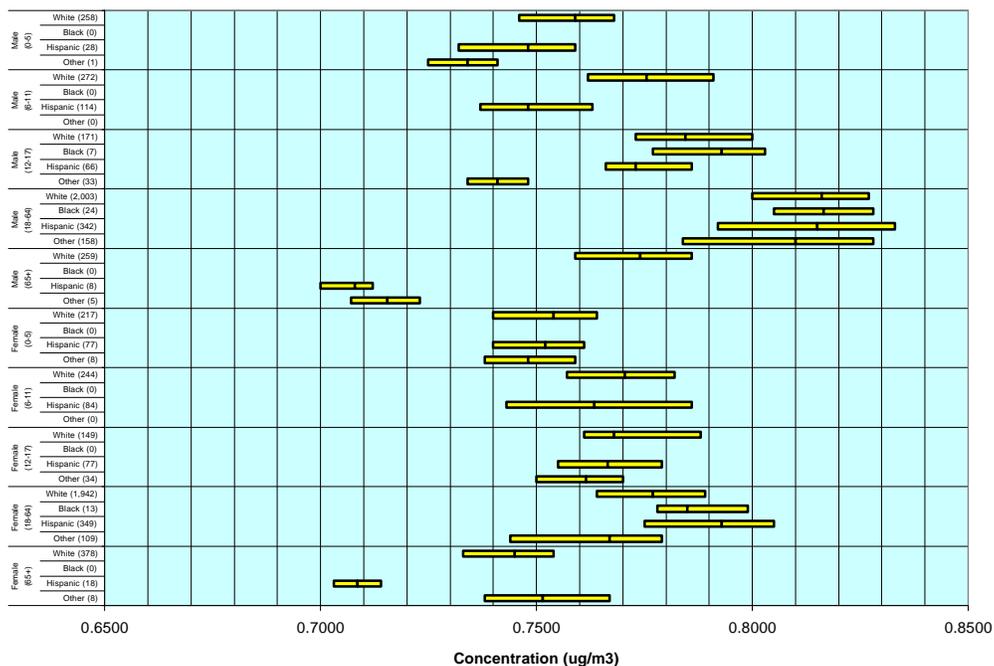
Sources of HAPEM4 Model Uncertainty/Limitations (*continued*)

- **Activity Data**
 - ◆ Annual patterns built from single day diary entries (diary entries from up to 365 people to represent a single cohort).
 - ◆ Daily temporal sequence of activities not retained
 - ◆ Activity patterns data for certain demographic groups is limited (non-English speaking)
- **Commuting Data**
 - ◆ No provisions for "in route" time (uses AQ from home or work tracts only)
 - ◆ No children commuting

HAPEM4 Model Findings from the Initial National Scale Assessment

- **HAPEM4 predicted exposure concentrations generally lower than ASPEN ambient predictions**
 - ◆ Overall Average - 79% of ambient
 - ◆ Particulate HAPs - 75% of ambient
 - ◆ Gaseous HAPs - 81% of ambient
 - ◆ Onroad Mobile Gaseous HAPs - 101% of ambient
- **Best Suited for predicting "population" exposures**
 - ◆ Does not predict MEI; misses tails of distributions
 - ◆ Intra-census tract variation in exposure generally less than 15%
 - ◆ Intra-cohort variation in exposure generally less than 10%
- **Exposures highly dependent on "indoor - residence" ME factor**
 - ◆ Most cohorts spend average of 15+ hours indoors

Benzene Exposure Concentration Distribution Among Cohorts in an Urban CA Census Tract



Reason for Including the Exposure Assessment in the Initial National Scale Assessment

- Incorporates inhalation exposure route
- Uses indoor exposures that are believed to be lower than outdoor, avoids overestimating risk
 - People don't live outside at census tract centroids
- Apply demographic distributions to exposures
- Allows for commuting between tracts - important when local tracts to tract variations are large
- Framework is in place for future improvements to exposure assessment

Expected Future Studies

- Improve ME factors
- Incorporate ME factor ranges where possible
- Allow range in air quality within a tract
- Longer time period diary studies
- Children commuting
- Comparison with personal monitoring data