The National Air Toxics Assessment

Exposure Component for the Initial National Scale Assessment

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Science Advisory Board Review

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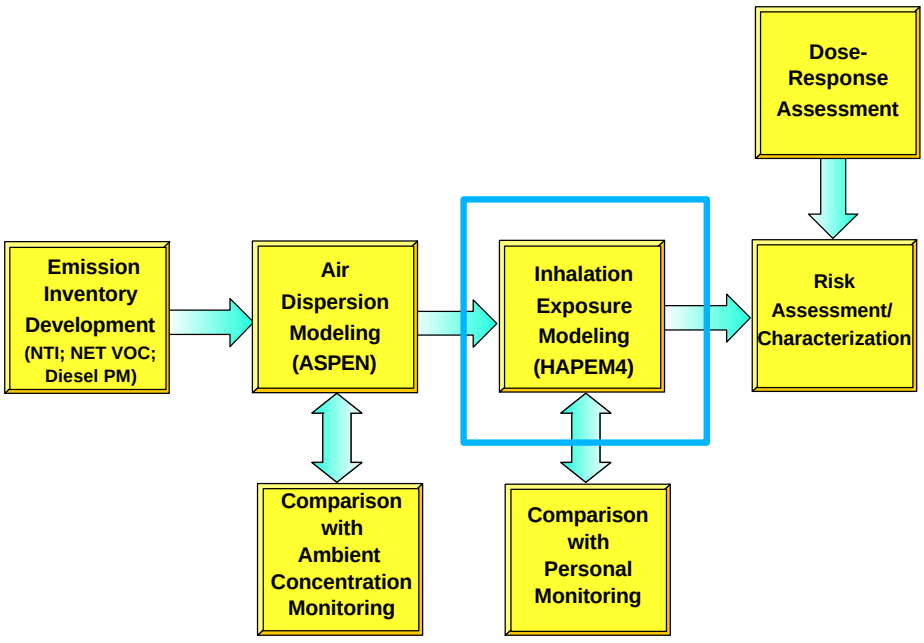
How Does the Exposure Assessment Fit into the National Scale Assessment?



Exposure Model Selectionfor 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(l); 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

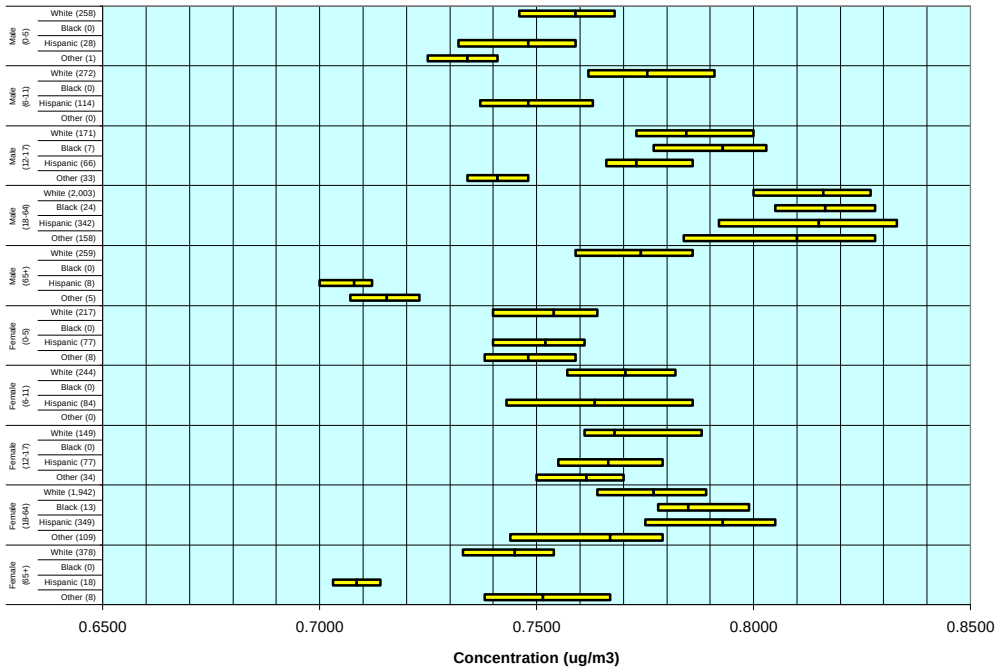
- **Approach**
  - Not suited for prediction of "extremes" in distribution of exposures
- **Air Quality Data**
  - Model does not allow for a concentration gradient within a tract
  - As applied in NATA it does not include seasonal variations
- **Microenvironment (ME) Factors**
  - Limited studies to 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



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