Review: Development of Microenvironmental Factors for the HAPEM4 in Support of the National Air Toxic Assessment (NATA).

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1. Is HAPEM4's application proposed for the initial NSA consistent with recommended uses of this model? Given the national goals of the NSA, is this model the appropriate model to use?

The proposed HAPEM4 model seems to be a "work in progress" rather than a complete scientific effort which could be used to assess exposure and risk to HAPs. Overall, this effort falls short of meeting the ambitious objectives of the NSA program.

It is very difficult to assess the accuracy of the proposed ratios for the following two reasons: first, the existing data are not sufficient to establish accurate indoor/outdoor ratios; and second, the approach of grouping the different compounds based on their reactivity is too simplistic. I think it is imperative that a number of studies be conducted that will measure the 33 HAPs in a variety of microenvironments. Without real indoor and outdoor concentration data it will be very difficult to develop accurate exposure and risk models.

Considering the lack of data, the authors made appropriate assumptions to estimate indoor/outdoor ratios for classifying the different HAPs according to their reactivity. However, in the absence of real data it may be more realistic to set all indoor/outdoor ratios to unity.

2. Is the proper scientific approach to developing a ME concentration employed by the HAPEM4 model? If not, what other approach would you recommend.

The microenvironmental approach is scientifically sound. Existing exposure models for ozone and carbon monoxide can be adapted to assess human exposures to other hazardous air pollutants. However, the way the microenvironmental concentrations were determined is very rudimentary.

3. Has a complete and approach scientific literature review been performed in the development of the HAPEM4 ME factors?

The authors conducted a comprehensive literature search. I think they captured most of the relevant publications. I am very impressed with the fact that they were able to identify so many studies. Their work is commendable. However, these data are not sufficient to establish indoor/outdoor ratios and microenvironmental concentrations. Also the authors did not provide a synthesis of their literature search. I understand this may be a difficult task mainly because these studies used different field protocols. Obviously these studies were not designed to support the development of the HAPEM4 model.

4. Are there significant scientific improvements in the exposure assessment field that should be incorporated in this model for future national-scale assessments?

Because the proposed model will underestimate population exposures for HAPs with important microenvironmental sources, it is necessary to measure the contributions of these sources. A cost-effective approach to determine microenvironmental concentrations is the use of scripted activities. This method should be used to establish distributions of microenvironmental concentrations for different

geographic locations and seasons. I understand that the EPA is not interested in indoor sources for reasons that we all know, but from the public health point of view this information is essential.

Also the data on the spatial variation of HAP concentrations are very sparse, which makes the calculation of the proximity factors very difficult. Therefore, the development of comprehensive models that can predict HAP outdoor concentrations will make it possible to reduce uncertainty. For example, models currently exist which can use information such as geographic position and vicinity to point and line sources in order to provide accurate estimates of outdoor exposures.

5. Can the uncertainties associated with the use of the HAPEM4 model be defined? If so, how can a quantitative assessment of this uncertainty be defined and implemented?

It is very difficult to assess the accuracy of the HAPEM4 model because it is very qualitative in its present status. Once exposure data become available it will be possible to assess uncertainties. With this given status, it is surprising that there was no discussion about model validation.

6. Does the HAPEM4 modeling system deal with uncertainty in an adequate and transparent way? Does HAPEM4 adequately integrate the uncertainty, qualitative or quantitative, into the presentation of the analyses such that eventual consumer of the NATA will understand the nature and magnitude of uncertainties associated with the exposure estimates? If not, how can we improve the treatment of uncertainty in this modeling system?

The report does not deal with uncertainty. This is especially important because a large fraction of the input data of the HAPEM4 model are inferred. Concerning the question of how to treat uncertainty please see below (response to question 7).

7. Can a more quantitative estimate of uncertainty be attempted? If so, can you make specific suggestions about quantifying individual as well as composite uncertainties associated with the HAPEM4 model.

Of course uncertainty can be quantified. This can be accomplished by assessing uncertainty for each of the model input parameters such as microenvironmental concentration, indoor/outdoor ratios, proximity factors, etc. However, it will be necessary to collect some real data in order to adequately assess these uncertainties.

Another approach would be to conduct population based exposure studies in order to determine exposure distributions. These distributions can be subsequently compared to those estimated from the HAPEM4 model. A special emphasis should be to determine the exposure distributions of sensitive sub-populations such as children.

The model performance should be evaluated as a function of geographic location, season, sub-populations and pollutant type.

Risk assessors and policy makers like models because they can crank numbers. In some cases they are not aware of the inherent uncertainties of these models. As a result, some of the decisions made can lack scientific rigor. I am afraid that HAPEM4 is not yet suitable for use. As mentioned above, this is not because we lack basic scientific understanding, but because we do not have adequate and sufficient information. Therefore, I urge EPA to make available the resources to conduct the appropriate field studies. These studies should be specifically designed to support the development of HAPEM4.