

Compilation of Member Comments on the Draft REM Report

A. LEAD REVIEWERS:

1. Dr. Gregory Biddinger:

Other than the exceptions noted below, the SAB Review of Agency Draft Guidance on the Development, Evaluation and Application of Regulatory Environmental Models and Models Knowledge Base addressed the Agency charge questions in a clear and logical manner and the conclusions and recommendations drawn were supported.

Cover letter

1. The concern raised regarding adequate resources in the 2nd paragraph does not seem to have come from a response to the Agency guidance. As well the draft SAB report does not have a section in the table of contents on this point. Was this based on discussions with the agency during meetings? Personally I can believe it is true but it should be supported somehow.
2. Paragraph 5 recommendations around problem specifications and stakeholders seems out of place. See comments below under charge question 1. This paragraph needs to be modified to create alignment with importance of recommendation provided in section 1.2 of draft report.

Charge question 1.

1. Suggest that the first ten lines of the general comments section 1.2 be moved to the front of the section as an introductory paragraph.
2. The remainder of section 1.2 actually raises the need to expand their model guidance from general models to include site-specific considerations and also to raise the role of stakeholders to a level of central importance. This section should be renamed to be more explicit regarding its content. Something like “ Expanded Guidance Scope or Boundaries” is more appropriate.
3. The alternative Figure 1 discussion does not carry through to the letter to the administrator. The discussion in the 5th paragraph (page 2 of letter , lines 18-23) of the cover letter does not convey the importance that is provided in section 1.2 and 1.3. It is handled a bit better in Paragraph 5 (page two of summary , lines 10 to 16). In essence the report recommends an expanded scope for their guidance from development of general models to include the broader considerations of selecting and adapting

models for site or problem specific applications. This is an important and global recommendation that does not carry through. These are minor changes but expect the messages to be much stronger if made.

4. The recommendation that stakeholders play a central role should be discussed in further detail. There needs to be guidance on how to select appropriate stakeholders dependent on whether the model being developed has general applications versus specific. Suggest a few sentences recognizing the agency will have to include a discussion of what constitute a stakeholder under different conditions of development or application from national policy to local permit decisions.
5. Section 1.2 makes point about importance of peer review (Page 9 lines 10-11) through out the model development/application process. The agency makes the same point in Appendix C of their guidance and graphically presents the point in figure C1.1. Suggest you recognize that in conjunction with this point.

Charge question 2

1. Section 2.2 under Goals and methods raises a number of points related to the agency's need to expand their focus or scope in drafting this guidance (or guiding principles). The SAB Review comments suggest recognizing the following
 - a. Model users may be those that simply use the output and not run the models
 - b. Modelers other than in a regulatory context should be an intended audience
 - c. The guidance needs to cover a broad range of modeling types other than just environmental models

It is not clear to me that there is value in making this guidance be so encompassing that it covers all audiences. This document seems to me to be more in line with previous Framework documents written for Ecological Risk Assessment. That document set the groundwork for a whole series of subsequent documents including separate primer for managers on how to use the output of ERA's and critical issue papers on topics such as uncertainty. I wonder if the panel is asking the agency to do more with this single document than is appropriate. They are charged to focus regulatory environmental models and not the other models listed. Maybe a more appropriate recommendation would be to plan and describe in this document a series of continuing guidance that will follow covering other audiences and model types. It might be better for them to write strong guidance for a narrower audience and then expand in subsequent work once they have a solid basis to work from.

2. Section 2.4 notes the need for documentation during the development of the model not just when it is complete. I would agree with that point and would suggest that you link this point with your recommendation on peer review through out the model development process. It clearly would aid such integrated peer reviews.

Charge question 3.

1. Section 3.2 in the last paragraph on page 24 makes the point of need to discuss the use of qualitative assessments tools such as expert judgement to test model appropriateness before moving to more quantitative tools. The agency does make a note of qualitative approaches under section 3.1.3.2 of their report covering the topic of model corroboration. Seems appropriate to recognize that and build from there on what more you would like to see in the guidance.
2. The point in section 3.4 on need to provide some discussion in this guidance about linking models to create a larger modeling tool is well taken. I would also suggest that this might be a good example of where a more detailed guidance document on this specific topic might be worth recommending. This would give them the option of providing high level guidance here and more rigorous guidance in a following document.

Charge Question 4 – Still reviewing

1. Section 4.0 included many good recommendations and lots of interesting and useful suggestions for approaches and references. Many of these good points may deserve more explicit definitions as “recommendations” and bolding in the text. The following are a few, but suggest that the authors revisit this text and make sure some key points are not left with less emphasis than is warranted.
 - a. In the 3rd and 4th paragraphs (page 29) of section 4.1 the point is made that the guidance needs to direct focus on other sources of uncertainty in the decision-making process than just the modeling. The discussion provided suggests that the guidance should direct the modeler should consider the needs of the decision-maker and relevant stakeholders in determining how much uncertainty is acceptable in model design and execution. This seems to beg a specific recommendation
 - b. Later in section 4.1 (page 31 lines 19-22) the review suggests the guidance should include a discussion about propagations of uncertainties when working with multiple models. This is a very important issues and in regulatory analysis very often the real situation. This discussion is worth expanding, but if not at a minimum I suggest it needs more emphasis as a recommendation.
 - c. There is a general recommendation at the end of section 4.1 but it seems to me that many of the good points earlier in the section are lost

- in the generality. The review panel may want to revisit and redraft to capture some of the above recommendations more explicitly
- d. In section 4.2 the point about confusion and lack of clarity between sensitivity analysis and uncertainty analysis is both important and well described. Unfortunately no explicit recommendation is made. This could be as simple as bolding lines 23-25 on page 32.
 - e. Section 4.3 suggests that uncertainty analysis needs more complete treatment in section C.6 and specifically there is little guidance on how to evaluate uncertainty in model parameters. But no recommendation is give. A more explicit recommendation seems warranted
2. The use of case study examples seems like a worthwhile addition both for the guidance and for the MKB. As noted above (see charge question 2 #1) it seems to me that the development of guidance for Regulatory Environmental Models could follow a similar pattern as that for Ecological Risk Assessment. In the case of the ERA guidance documents there were 2 volumes developed that included a number of complete and detailed case studies of the application of ERA's. The REM Guidance could also follow such a series approach and you might want to consider not only that they include a few illustrative examples but also they develop guidance in future using detailed applications of modeling to support regulatory decisions and use them to highlight how to do the problem formulation, model design, execution, and quality analysis plus the communication of modeling results.
 - a. As well it might be worth considering that the MKB has a series of white papers on the various tools to assess model sensitivity and analysis, and also include white papers on critical technical issues around modeling such as communication of results.

Charge Question 5 –

See comment above about the value of considering white papers on types of models, tools for analysis of modeling sensitivity and uncertainty and also white papers on critical issues.

Charge Question 6 – No comments

Charge Question 7 – No comments

2. Dr. James Galloway:

Thank you for the opportunity to serve as a Lead Reviewer of the *Draft Guidance on the Development, Evaluation, and Application of Regulatory Environmental Models* and *Models Knowledge Base* prepared by the Regulatory Environmental Modeling Guidance Review Panel of the EPA Science Advisory Board. My overall impression is that the panel has done an excellent job in thoroughly reviewing the report and in the process has of great service to the agency. My

comments therefore are more focused on how the information is presented rather than its quality.

Following are my response to my three charges as a lead reviewer.

1. Have the original charge questions to the SAB Panel been adequately addressed in the draft report? It is my assessment that the original charge questions to the SAB Panel are adequately addressed in the draft report. The responses to each of the seven charge questions are clear and extensive. The panel has been thorough in not only reviewing what was written but in also suggesting alterations or additions to the text and the supporting figures.

2. Is the draft report clear and logical? In general, the draft report is well-written and clearly sets out the panel's recommendations. I do recommend that following improvements. First, at the end of each of the sections dealing with a specific charge question, there should be a summary of the panel's recommendations. Second, the Executive Summary should state each charge question along with the summary from the body of the report. Third, the letter to the Administrator is about 3 pages, which in my mind is too long. It would be more effective if it were reduced in length by about a page. Lastly, as noted in the report, Appendix C has not been highly edited given the individual nature of the responses. Given the diffuse nature of the information provided, the panel might wish to consider condensing the key points from the Appendix and merging them into the body of the report. It would make the overall report shorter, and make the information in the report more centrally located.

3. Are the conclusions drawn and/or recommendations made by the panel supported by information in the body of the draft report? It is my assessment that the panel's recommendations are supported by the information in the report.

In summary, I commend the panel for doing an excellent job on the review. It is thorough, well-written and should be of great value to the agency.

3. Dr. Michael McFarland:

General Comments: In general, the SAB draft report is well written, logical and appropriately referenced. The SAB draft report provides a clear and comprehensive response to each of the seven charge questions posed by the Agency. In all of its responses, the SAB Panel furnishes the Agency with a number of useful and pragmatic recommendations that, if implemented, would result in considerable improvement in the scientific defensibility of the Agency's use of model derived information in regulatory decision-making.

The SAB Panel is to be commended in its highlighting of the Agency's scientific accomplishments in preparing the "Draft Guidance on the Development, Evaluation and Application of Regulatory Environmental Models and Models

Knowledge Base”, which included acknowledging the Agency’s responsiveness to earlier SAB advice on model formulation, development and implementation. Moreover, in recognizing the range of deficiencies in the draft guidance, the Panel has eschewed the common practice of merely accentuating the document’s technical limitations and has, in all instances, provided the Agency with practical steps that would substantively improve the Agency’s modeling activities and those decisions that are supported by model output.

The following are my specific responses to the quality review charge questions. It should be noted that, as a non-modeler, my technical comments should be seen in the light of a generalist whose knowledge of the models and modeling terminology referenced in the draft document is somewhat limited.

Response to Charge Questions

1. Are the original charge questions adequately addressed in the draft report? The SAB Panel’s responses to the original charge questions are adequately addressed in the draft report. In formulating its responses, the Panel has demonstrated a broad and practical understanding of a range of technical issues germane to the Agency’s generation and use of model-derived information in support of regulatory program decisions. Moreover, the Panel has furnished a number of detailed and pragmatic recommendations in its response to each of the charge questions. Finally, an overarching and valuable recommendation offered by the SAB Panel is the reformulation of Figure 1. In my opinion, the improvements highlighted in alternative Figure 1 represent substantive opportunities for the Agency to establish a scientifically defensible framework for future model formulation, development and implementation.
2. Is the draft report clear and logical? The SAB draft report provides a clear and logical basis in identifying and describing those scientific, technical and programmatic issues that have the potential to undermine the validity of using models and model-derived information to support Agency decisions. The SAB draft report cover letter and executive summary are well written and highlight those salient issues that Agency senior management should consider in ensuring the scientific and regulatory defensibility of decisions that are supported by modeling data and associated information. The main body of the report provides clear, comprehensive and logical responses to each of the charge questions. Where appropriate, the SAB Panel has supported its charge question responses with practical examples, peer-reviewed references and Panel member modeling experience.
3. Are the conclusions drawn and/or recommendations made supported by information found in the body of the report? The SAB Panel’s draft document has identified and described a number of important conclusions focused on enhancing the value and reliability of the Agency’s model-derived

information as well as a range of practical recommendations formulated to address its current use and limitations. The SAB Panel is to be commended for clearly supporting each of its conclusions and recommendations within the main body of the report. The SAB Panel has provided detailed descriptions of the broad range of scientific, technical and programmatic challenges facing the Agency with regard to its current modeling programs. Finally, the Panel's recommendations describe practical approaches for addressing a number of critically important cross-Agency modeling issues and concerns including: 1) uncertainty quantification and communication, 2) integration of appropriate levels of peer review, 3) systematic model formulation and development, 4) model transparency and 5) ensuring model output is based on the best available science.

4. Dr. Jana Milford:

General Comments: Due to time constraints, I focused my review on the panel's review of the Draft Guidance. I did not closely review the panel's comments on the Models Knowledge Base. With a few exceptions, I found the draft report to adequately address the charge questions and to be generally clear and logical, and found the recommendations to be supported by information in the body of the report. Overall, I feel the report could be improved by redrafting, to make the recommendations and conclusions more direct. This is most important in the letter to the administrator and the executive summary. I did not try to suggest editorial changes, but tried to point out in my comments the places where I felt improvement was especially needed. Two significant substantive concerns I have about both the Draft Guidance and the panel's review are that (1) more attention needs to be paid to the question of whether the Guidance adequately addresses (or should address) models other than pollutant fate and transport models, and (2) more attention needs to be paid to how to address uncertainties, such as scenario uncertainties in forecast model applications, which are relatively difficult to quantify.

Letter to the Administrator: p. 1, line 32. I did not see the back-up for the "concern" that "the REM vision is not matched by a commensurate, and steady, allocation of resources." This seems like a very important concern, which warrants clear and open discussion of the signs or consequences of this lack of sufficient resources, and the reasons for it. The fact that the panel discusses in the introduction to its report the recommendations it made in the 1980's on regulatory modeling underscores the concern, but only in a very indirect way. If there is a problem here, couldn't it be discussed more directly?

p. 2, lines 10-16. The point that the Draft Guidelines are not accessible to many in its potential audience is important. This paragraph should be rewritten to state this more clearly and directly, and to recommend that the Draft Guidelines be rewritten to be made more widely accessible, not to recommend that the Agency "clarify" how the document should be used.

p. 2, lines 25-31 and p. 3, lines 1-9. The recommendations made in this paragraph are important, but not clearly or directly phrased. Could the letter state more directly that the Guidelines need to provide more context, examples, and recommendations on appropriate uncertainty analysis and communication of uncertainties?

Executive Summary

p. 1, lines 19-22. Same comment as above on Letter, p. 1, line 32.

p. 1, lines 24-27 and p. 2, lines 1-8. Same comment as above on Letter, p. 2, lines 10-16.

p. 2, lines 29-31 and p. 3, lines 1-9. Same comment as above on Letter, p. 2, lines 25-31 and p. 3, lines 1-9.

p. 3, lines 3 and 10. It's not clear what the panel means by "practicable". Is the term used to mean accessible, or useful, or ...?

p. 3, line 21. The ES needs to explain why "framework" needs to be redefined.

p. 3, line 27. What is meant by "purveyors"?

The question of how well the Draft Guidance extends to models other than pollutant fate and transport models, which is discussed on p. 18, is important, and warrants mention in the ES.

Report

p. 7, lines 1-2. The panel leaves us hanging. What was the outcome of the SAB's 1989 model resolution? If it's worth mentioning the resolution, isn't it worth summarizing the Agency's response (or lack thereof) over the ensuing 17 years?

Charge Question 1. Best Practices. I found this section of the report to adequately address the charge question, to be clear and logical, and to provide adequate support for the recommendations and conclusions made.

Charge Question 2. Goals and Methods.

p. 16, lines 26-27 and p. 17, lines 1-15. The discussion in this paragraph seems to relate to the concern expressed in the Letter and Executive Summary that the Draft Guidance is not likely to be very accessible to many "users" of model results who are not modelers. I think this is a serious concern and warrants fixing, e.g., to expand the use of illustrative examples in the Guidance, rather than merely clarifying how different audience members might use the Guidance.

p. 18, lines 6-20. The panel notes (and I agree) that while the Guidance could have been meant to apply to a wide variety of models, it seems to have been developed based primarily on literature, experience, and prior recommendations for pollutant fate and transport models, as opposed to economic models or engineering process models. I think this point warrants further consideration and elaboration in the panel's review. Are the Best Practices identified in the Guidance appropriate or even applicable for models other than pollutant fate and transport models? Or put another way, would the Guidance be very different if other types of models had been more fully considered? The panel recommends that the Guidance "articulate the broad range of model types to which it is to apply" and "ensure that the guiding principles ... reflect this diversity of model types." However, I think it may be difficult to develop concise, comprehensive, and understandable guidance that covers the full breadth of models EPA employs. Would it make more sense to recommend that the Draft Guidance the panel reviewed be represented as applicable to a more limited range of models (e.g., pollutant fate and transport models and their close relatives), with separate guidance developed for other types of models, if necessary?

Charge Question 3. Graded Approach. I found this section of the report to adequately address the charge question, to be clear and logical, and to provide adequate support for the recommendations and conclusions made.

Charge Question 4. Advice for Decision-Makers.

p. 31, lines 16-17. I'm glad the panel identified "scenario uncertainty" as an important source of uncertainty in modeling that should be clearly identified in the Draft Guidance. But doesn't this particular source of uncertainty warrant further discussion by the panel and in the Draft Guidance? EPA's applications of models (including pollutant fate and transport models) are often made in forecast mode (e.g., using REMSAD to examine whether the Clean Air Interstate Rule will suffice to bring Pittsburgh into attainment with the PM NAAQS), where huge uncertainties are associated with future economic, regulatory, and physical conditions. Quantitative uncertainty analysis techniques that are tractable for model parameters and inputs developed for historical conditions, may not work well for "scenario uncertainties." Yet if these scenario uncertainties are significant, a complex and expensive QUA that focuses only on model input uncertainty would have little meaning for decision-makers. The panel suggests something along these lines on p. 39, lines 16-17, when it recommends that "the REM Guidance be clear on the types of model uncertainty that most QUA tools address." However, I think the point needs more explicit articulation and emphasis. Additionally, the panel might be able to significantly assist EPA by pointing the Agency to best practices for dealing with scenario uncertainty. My colleague, Roger Pielke, Jr., argues that a large part of the reason we academic modelers have had such a difficult time getting practitioners who have real decisions to make to utilize formal uncertainty analysis techniques is that often

fail to address the most critical uncertainties in real-world decisions – those having to do with uncertainty in forecasts of socio-economic and technological trajectories.

p. 32, lines 2-7. I'm not sure what the panel means by the recommendation that the Guidance “advise modelers to begin model development or use only after they have obtained an awareness of how a decision maker plans to use the information on uncertainty that they will be providing.” Is the point that modelers need to understand how uncertainty in model results factors into decisions about a particular issue, and take that into account in selecting or developing and applying a model? In any case, could the recommendation be phrased more directly?

Charge Question 5. Identification and Structure of Optimal Information. This section of the report is clear and adequately responds to the charge question.

5. Dr. Lauren Zeise:

This report is well done. The original charge questions to the SAB Panel were adequately addressed in the draft report. Overall, the draft report is well constructed, clear, logical, at just the right level of detail for the type of document reviewed, and the quality of the commentary is excellent. The conclusions drawn and recommendations made are supported in the draft report text.

Specific, mostly editorial comments

The letter makes the important point that the use of increasingly complex quantitative uncertainty analysis without a sophisticated framework for decision-making and communication may only make decision making more challenging. It then emphasizes the report's practical advice for guidance to the modeler, which is fitting for the SAB panel report. However, I wonder whether the letter would be the place to point out to the Administrator the need to develop risk management frameworks that might be better able to cope with the results of uncertainty analyses. The report takes the existing decision-making as a given, but perhaps the letter need not. In this transmission letter from the SAB chair and REM Panel chair the observation could be made that this appears to be an area where efforts are sorely needed.

The end of the Introduction to the Panel report needs a punch line to tie the REM report to the series of recommendations and bring the reader back to the issue at hand, the review of the REM report.

The Panel stresses the importance of post application audits and recommends the addition of a section of its own to model application. Alternative Figure 1 on page 14 shows the audit on the public policy process side, as part of a policy observation box, with an arrow leading into the problem identification and stakeholder boxes. While this is a bit of a contradiction with the text, it is a

logical spot to refer to it. But it could have its own box on the Model Development and Application side of the figure, perhaps with a dashed arrow leading into it, with arrows going from it to model identification and development boxes, since there would be also be a significant science effort to the audit.

Regarding the discussion at the end of page 29, the panel takes as a given the current decision making framework and does not take on the issue that work on decision-making frameworks would enable better use of uncertainty information in decision-making. The panel report calls for communication between modelers and risk managers and stakeholders regarding how they view scientific uncertainty and would like to see expressed and that should help produce more effective uncertainty assessments. However, a general coordinated and formalized approach toward use of uncertainty information by decision makers seems needed, beyond the problem specific approach suggested by the Panel. This may be a bit beyond the scope of the Panel review though.

Letter, Page 2, line 3. would add “advocacy groups” and “general public” to the list, or use the groups named in the asterisk to Alternative Figure 1.

The Panel makes the important observation that the complexity of the optimal modeling framework depends on the problem specification and resource constraints and goes beyond Figure 2 in the REM report. The sentence on page 8 at lines 18-20 is a bit hard to take in. I think it may be better to italicize “for the problem and available resources” than “the best available, practicable science,” to emphasize the point being made.

Page 9, line 10. “encourages the document to urge” - wording a bit awkward

Page 11, lines 1-2. Suggest adding another sentence indicating the nature of the clarification is that the Panel is seeking.

Page 18, line 12. Suggest adding in “ecological” and perhaps “fate and transport” and take out “scientific” which is overly broad.

The report gives a fairly comprehensive treatment to model uncertainty. The advice on the other three sources of uncertainty listed on page 31 is more limited. Structural model uncertainty is addressed at different places in the Panel report. The Panel’s message/advice on treatment of structural model uncertainty in the REM report may be more effective if placed in a separate section.

In the Panel report, it probably would be better to define model (structure) uncertainty as something like “structural model uncertainty.” The term model uncertainty is being used to mean this but also the overall uncertainty, and perhaps in one place model input uncertainty.

Page 39, line 20, the word “necessarily” seems to be missing. Mismatches of observations and model simulation can signal problems in the modeling effort.

p. 25, lines 16-17. unclear if square bracket US EPA is a placeholder to remind writer to spell out a title.

B. OTHER BOARD MEMBER COMMENTS:

Dr. Myrick Freeman:

I have read the Draft SAB Panel Report on on the agency's Draft Guidance. In my judgment, the answers to the three charge questions for reviewers are "Yes, Yes, and Yes."

I did note three minor editorial changes:

p. 5, line 23-4: the reference to 2 1/2 decades, apparently since 1989. By my count this would be 1 1/2 decades.

p. 34, line 8: I think "distribution" should be singular.

p. 37, line 24: "is to use of the ..." should be either "is the use of ..." or "is to use the ..."

Dr. James Johnson:

My biggest concern of the report is that the introduction section leaves the reader hanging. At a minimum it should include the footnote on page 1.

The second concern is the use of calibration in the text and corroboration in alternate figure 2.

Dr. Cathy Kling:

I've read the review panels report on the “Draft Guidance on the Development, Evaluation, and application for Regulatory Environmental Models and MKB.” This is a very well done review. It is clear and comprehensive.

I have a single comment that the committee is welcome to take or leave:

I found the commentary in the introduction section entitled "Background Material" to be odd and somewhat out of place. It read to me as complementing the agency on taking the advice of the SAB, and of being self-congratulatory about the importance and impact of the SAB's previous work (the material about the EEC's Modeling Resolution). I'm not sure what connection there is between this section and the remainder of the report.

Again, I think the overall report is very well done. I especially like the material concerning the treatment of uncertainty and the role of models in decision making.

Dr. Granger Morgan:

Overall the review looks to me to be in very good shape.

I am concerned that the current discussion in the review suggests that whether and to what extent a model should incorporate an analysis and treatment of uncertainty should be entirely driven by the analytical sophistication of the decision makers and the extent to which the current regulatory decision framework allows for a consideration of uncertainty. While I certainly agree that these factors should be a consideration in the choice of the level and nature of the treatment of uncertainty that is undertaken, I do not believe that they should completely dominate.

If a problem involves considerable uncertainty it should not be completely ignored or suppressed simply because decision makers are not sophisticated in thinking about uncertainty, or will be bothered to learn that there is uncertainty. Such suppression is a recipe to keep naive decision makers naive, and inadequate regulatory decision frameworks, inadequate. Followed strictly, such advice would slow, or perhaps even begin to reverse, the dramatic progress the Agency has made over the past three decades in thinking about and dealing with uncertainty.

Rather, I would like to see the discussion on pages 29 and 30 (and in the executive summary) reworked to indicate that while the level and sophistication of the treatment of uncertainty should be appropriately matched to the problem at hand, and to the way the results will be used, whenever uncertainty is an important element in a problem, it should at a minimum be acknowledged and receive some basic quantitative analytical treatment. I do very much agree that analytical sophistication for its own sake should be avoided.

I like the distinction that is drawn between different kinds of uncertainty on page 31 of the SAB draft review. To my quick reading of the EPA document itself, I did not see any serious discussion of what to do about "model (structure) uncertainty." I urge the review panel to suggest that some discussion of this topic

be included in the EPA document. In many cases, this source of uncertainty swamps all others, and yet is not considered or discussed, even in qualitative terms.

Finally, I ask the review committee to take another look at Figure C.5.1. The pie diagram does not make sense to me given the shape of the response surface shown. Also, it looks to me like the orientation of the plane in Figure C.5.2 should be rotated to correspond to the slope of the response surface. At the moment it is not properly aligned, making it very hard for a reader who does not already understand, to figure out what is intended.

Dr. Kathleen Segerson:

I have only very small comments on the draft SAB Panel Report: (1) The Introduction provides background information on the Modeling Resolution, but doesn't explicitly link that effort to the current efforts under review. I suspect that the current effort grew out of the recommendations on p. 6, but that is not stated explicitly. Providing some context linking the two efforts would be helpful.

(2) I particularly applaud the report's discussion of uncertainty, including the need to identify how the information about uncertainty will be used and the distinction between sensitivity analysis and uncertainty analysis. A small comment on this latter issue: on p. 32, lines 25-26, the report states that "the discussion in Section C.5.5 relating to Monte Carlo analysis currently reads more like a discussion of uncertainty analysis, rather than sensitivity analysis." Perhaps this statement needs more explanation, since many economists (myself included) view Monte Carlo analysis as a form of uncertainty analysis.

(3) The report notes in several places that the criteria and discussion included in the EPA draft documents seem to focus on models for pollution fate and transport and exposure. It notes the need to consider other models, such as economic models designed to predict behavior and the resulting emissions or other environmental impacts. I would agree that the modeling guidance and knowledge base need to include these other types of models, which can be important in regulatory as well as other settings. I would add another category of models that might also be considered for inclusion, namely, ecological models. There is increasing interest in the ecological impacts of EPA actions (see the CVPESS work) and a need for ecological models (e.g., ecological production functions) that can predict, for example, how a given water quality change will affect a fish or insect population.

(4) I think the question of the selection criteria to be used in deciding what to include (or not include) in the MKB is key. The SAB Panel report notes the need to identify criteria (p. 63) but doesn't suggest what those criteria should be. Can the panel give EPA any advice on this?

(5) The Panel notes the need to provide incentives to encourage the voluntary effort by modelers to put their models in the MKB (p. 61). Does the Panel want to recommend that this be a requirement for models developed under EPA funding (e.g., STAR grants)?

(6) A minor editorial comment: In several places, the word "however" is used as a conjunction (synonymous with "but" in the middle of a sentence) rather than as an adverb (e.g., p. 2 line 21-22). I've always thought that this is not grammatically correct.

Dr. Deborah Swackhamer

1. Have the original charge questions to the SAB Panel been adequately addressed in the draft report? The Charge Questions have been addressed very well by the committee's report, and in fact in many cases they have gone beyond the Charge Questions (this isn't necessarily bad, just an observation).

Is the draft report clear and logical? The report is generally clear and logically organized. I found the Letter to the Administrator to be too long – it is the same length as the Exec Summary, and has the same tone, where in fact they should be oriented to different audiences. The Exec Summary would benefit from having a sentence or two that says that the Committee was asked to address 7 charge questions. The introduction would greatly benefit by telling the reader that there are 7 charge questions and that the report is organized to address each of them in subsequent chapters. The chapters themselves (esp 1-7) would benefit from having the recommendations summarized up front; there is a tendency for the report to meander.

4. Are the conclusions drawn and/or recommendations made by the panel supported by information in the body of the draft report? Absolutely. This is a very well done and thorough report. The recommendations and discussion are supportive of the overall effort, yet highly constructive. Each recommendation is fully discussed in the body of the report.

Dr. Valerie Thomas:

1. Where charge questions adequately addressed? Yes.

2. Is the draft report clear and logical? The Introduction of the Draft Report presents the 1989 SAB Modeling Resolution recommendations. However, there is no clear discussion of the extent to which the EPA has achieved these resolutions. Nor is there discussion of whether the current draft report is a reprise of that Resolution or is focusing on different issues. This makes the draft report unclear; it is difficult to find the logical connection between the Introduction and the rest of the report.

The connection needs to be made between the 1989 SAB Modeling Resolution, the resulting developments at EPA, and the current SAB review. The one small connecting link is on p. 9 lines 2-3: "the Panel finds that the Agency has been responsive to previous SAB advice on modeling practices." What does "the Agency has been responsive" mean? That the Agency followed all the recommendations? Some of them? Which ones? Or simply that the Agency responded to the Modeling Resolution with a letter or comments?

In at least some cases, the draft report goes farther than the 1989 Modeling Resolution. For example, recommendation 3 of the Modeling Resolution, on model validation (p. 6 line 6), does relate to the discussion of Model Post-Audit (p. 12) although the Post-Audit discussion addresses models of system change, which seems to be beyond what was considered in the 1989 Resolution.

It would be helpful to have a clearer statement of whether the EPA and the SAB have now moved beyond the recommendations of the 1989 Modeling Resolution, or whether EPA and SAB are still working to address those issues, or whether this draft report addresses a largely distinct set of modeling issues.

pp. 54-55. The discussion of "inclusion of additional information on model performance" (p. 54 line 20 - p. 55 line 5) is not clear. The meaning of p. 54 lines 2-4 is not at all clear; perhaps these paragraphs should be cut.

3. Are the conclusions and recommendations supported by information in the body of the draft report? The draft report states (p. 1, lines 19-22) that "the panel is concerned that the REM vision is not matched by a commensurate, and steady, allocation of resources on the part of the Agency. It is therefore recommended that the Agency provide a meaningful commitment of resources to the REM initiative." No information in the body of the draft report addresses the allocation of resources to the REM initiative. In Appendix C, there is the suggestion of the need for oversight and for a Scientific Editor, on p. 89, there is the suggestion that EPA might be better off turning the MKB over to the private sector. If this Appendix C discussion is the basis for the recommendation for more resources, it should be moved up into the main body of the draft report.

Dr. Robert Twiss:

I concur in the REM report (with deference to conclusions that might be raised in the call).