Weathers's comments

Overarching comments:
I think this first Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NOx and SOx is an excellent start. The EPA staff should be commended.

Responses to Charge Questions:
CHAPTER 6

15: Developing an AAPI linked to key determinants of aquatic ANC is an interesting and defensible approach to developing an ecologically relevant standard. And, yes, I think the secondary standard options identified by the staff can draw upon existing scientific and technical information. Of course, the devil is in the details (including uncertainties), which is no surprise, but will require significant work (see 16).

16: There are, in fact, considerable uncertainties associated with all steps of developing an APPI, and, of course all of the modeling processes involved in every step of the analysis, from emissions to deposition to effects. It is important to identify where the major uncertainties are and how they affect bottom lines. For example, matching temporal and spatial scales in various components of the AAPI remains an issue. How should uncertainty be characterized with integrity? I note that there is much ongoing research focused on uncertainty, how to characterize it, how to communicate it (witness efforts surrounding the IPCC).

I had actually expected, after suggestions and concerns that arose out of our last CASAC meeting, and because of their importance to the policy process, that the section on uncertainties would have been developed further in this document. It will be crucial.

However, that there are many uncertainties should not make scientists or policy makers reel (or at least reel away from making decisions). It is the state of the science (it is the state of life, in fact), and what is known should not be discounted. For example, what we do know about annual wet+dry deposition of S and N across the US based on monitoring data and models is vastly more than we knew a decade ago, and it is important not to obscure that fact. That there may be 100% uncertainty is better than not having any estimate whatsoever; it is at times important to contrast uncertainty with no knowledge at all!

17: Aggregation has some similarities with using ratios (e.g. stoichiometric ratios). It collapses all kinds of complex variables into a number. It's simpler to understand (at least at first pass), but can obscure important patterns and processes, especially when aggregates change in value, sometimes as a result of component variables changing in different directions. It is therefore important to understand the sensitivity of the various components.

18: CMAQ modeling is a work in progress and highly uncertain, as has been noted before, but perhaps no more uncertain than, say, the MAGIC model. As has also been pointed out before, there is a pressing need to compare CMAQ to other ground-based estimates of deposition, such as NADP + CASTNet sites (e.g., Weathers and Lynch 2008). And, it is critically important to recognize the scale over which deposition estimates can be produced and how they may, or may not, be useful in distinguishing deposition estimates for watersheds, for example, that are geographically close together. CMAQ's spatial resolution for this document is 12-36 km (page 114). That said, I think that the CMAQ model is the best model to use for the AAPI calculation for comparisons on a regional or national scale. One of its strengths is that wet+dry deposition can be estimated, using a common method, across the country, and that urban areas are included (see Pardo et al. 2010). The weaknesses include an inability to scale down to watersheds, or areas where the most intensive ecosystem response variables are measured (e.g., lakes, watersheds that span < 12-36 kms in area). All of these concerns notwithstanding, use of CMAQ <u>and</u> NADP + CASTNeT (including using them to model deposition at finer spatial scales and across heterogeneous terrain, e.g. Weathers et al. 2006) are state-of-the-art, currently.

19: It has parallels with the critical loads approach used for the EU and elsewhere; that approach has been in use for awhile.

20. It depends upon the use/goal, of course. In general, I think that annual (or, in some cases, multi-year) averages are more reasonable than short-term (weeks, months, even quarters) estimates for CMAQ, as well as other modeling results if the goal is to examine annual ecological responses that have seasonal responses or shortish lag times. Experience with P-Net and many other models suggests that "getting it right" for shorter time steps is extremely difficult, and perhaps not a reasonable goal. However, interannual variation can be high, based on weather patterns and emissions, especially for wet:dry ratios; it would be useful to discuss further the rationale for 3-year averages.

21: NHx should be included.

22: Other panelists are better suited to answering (technically) this question. I found the section confusing.

Overarching note: I think it essential to identify and remove from the AAPI analysis "naturally" acidified aquatic ecosystems (as a result of organic acidity vs strong mineral acidity), as was suggested in a few places throughout the document.

CHAPTER 7:

23: I am intrigued by the approach, and appreciated the first-pass comparison. Aquatic and terrestrial systems behave quite differently in the biogoechemical, temporal, and spatial processing of N and S, of course. The standards set for aquatic protection are likely to be more conservative (i.e., stringent) than terrestrial protection because of the ecological responses to deposition, as suggested in this document.

24: I need more clarification on the question here.

References:

Weathers, K.C., S.M. Simkin, G.M. Lovett, and S.E. Lindberg. 2006. Empirical modeling of atmospheric deposition in mountainous landscapes. *Ecological Applications* 16:1590-1607.

Weathers, K.C. and J.A. Lynch. 2008. How Much Atmospheric Deposition Across the US: Comparison of N and S Deposition Estimates. Eos Trans. AGU, 89*(53)*, Fall Meet. Suppl., Abstract: B42A-01.