

Comments from individual members of the Clean Air Scientific Advisory Committee (CASAC)
Secondary NAAQS Review Panel for Oxides of Nitrogen and Sulfur to assist meeting deliberations.
These comments do not represent consensus CASAC advice or EPA policy. DO NOT CITE OR QUOTE

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**Compilation of Comments from Members of the CASAC Secondary NAAQS Review Panel
for Oxides of Nitrogen and Sulfur on the Panel’s Draft (8-4-17) Report**

(As of 8-25-17)

The following comments from Panel members are grouped according to each section of the
Panel’s draft (8-4-17) report. The compilation contains comments received from Panel members
as of 8-25-17.

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General Comments

Edith Allen -- The CASAC NO_x-SO_x Review Draft Report of 8-4-17 is a clear synthesis of many diverse Panel comments and recommendations. I have a few editorial comments related to the Chapter Summaries in the cover letter, and for the Consensus Response to Charge Questions for Chapters 1, 3, 6, 14 and Appendix C.

Praveen Amar - I do not think CASAC panel should recommend a stand-alone NAAQS for ammonia during the REA and PA phase, as we currently do, but should recommend a NAAQS for total reactive nitrogen (page 2 of draft letter, comments on Chapter 3).

Laurie Chestnut – I have reviewed the draft report and it all looks okay to me.

Ivan Fernandez – The panel has made clear by general comments, highlights, and other comments, a priority of issues. However, to further highlight the importance of material included in the sections titled “key findings and recommendations,” it may be useful to move the text in the sections titled “other comments” into an appendix. The appendix could be titled “Other Comments and Technical Corrections.”

Frank Gilliam – This draft report reads quite clearly, and so I would have little to add. Although I have looked over the entire document, I have read most closely the chapters I was directly involved with during the evaluation process. This document appears to represent our collective deliberations in Durham, NC, extremely well. Authors are to be commended for the assembly of the document and the conciseness and clarity of the summary remarks.

Hans Paerl – I have read through the entire document and find it very well prepared, comprehensive and very useful for the preparation of the final document. Only one minor change I'd like to see, on p. 25 line 20 change “limitation” to “co-limitation”.

Introductory Text

p. 1 lines 24-25 (James Galloway) I suggest nitrate be mentioned in lines 24-26, just as sulfate is mentioned on lines 26-27. Note that the charge on sulfate is shown, but throughout most of the document it is not shown

Executive Summary and Chapter 1 (Response to Charge Question 1)

p. 2 line 10 (Ivan Fernandez) After the word “lengthy” insert “(1,412 pages).”

p. 2 line 19 (Ivan Fernandez) Insert “in the scientific literature” after “uncertainties.”

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1 **p. 2 line 20 (Ivan Fernandez)** At the end of the sentence add "...and concepts (e.g., recovery)."
2

3 **p. 2 line 25 (Daven Henze)** I wonder if it would be worthwhile to state more explicitly which
4 aspects of specific models we were thinking of here; I recall modeling source apportionment and
5 treatment of NH₃, in particular; there are likely others.
6

7 **p. 2 line 28 (Praveen Amar)** Revise the sentence as follows: "The CASAC also recommends
8 that the EPA clearly identify science topics that are not thoroughly reviewed in the ISA because
9 they are to be addressed in the **REA and the policy-oriented** phases of the review. The EPA
10 should also explain why these topics are ~~to be~~ **best** addressed in the policy phase of the review."
11

12 **p. 2 line 37 (Ivan Fernandez)** Change the word "rest" to "length."
13

14 **p. 2 line 39 (Praveen Amar)** Change "5" to "five."
15

16 **p. 3 line 11 (Praveen Amar)** Revise the sentence as follows: "A presentation of the NAAQS
17 associated with this review, the requirements/**components** of the NAAQS (**form, indicator,**
18 **level, and averaging time**), and a discussion of how these requirements/**components** may
19 impact the formulation of a standard should be included in the introduction."
20

21 **p. 3 line 25 (Praveen Amar)** In the following text I think the first three terms are described well,
22 but the last term "surprises" is not explained. Maybe, give an example, perhaps? "The following
23 two new sections should be included near the beginning of Chapter 1: (1) a section on
24 uncertainties, and (2) a section on "Concepts, Connections, Changes, and Surprises." This
25 second section should provide readers with a clearer view of: what is to be presented (e.g.,
26 important concepts such as deposition, critical load, and biodiversity); major conceptual changes
27 in the science since the last review (i.e., Changes); how different aspects of the Draft ISA fit
28 together (i.e., Connections); and specific aspects of the review of the science that might be most
29 informative (i.e., Changes, Concepts, and Surprises)."
30

31 **p. 3 line 34. (Edith Allen)** I am not sure what the following sentence means. Should it be
32 explained here? "In this regard, it is important to: (1) differentiate between what may be called a
33 "scientist's critical load" and a "policy-maker's critical load..."
34

35 **p. 3 line 36 (Praveen Amar)** Revise the sentence as follows: "In addition, the CASAC
36 recommends that the discussion of critical load indicate that critical loads may vary in time due
37 to past **cumulative** deposition."
38

39 **p. 3 line 42 (Praveen Amar)** Revise the sentence as follows: "In particular, this would apply to
40 the expanded scientific assessment of the approaches used in the prior review and the **section on**
41 "Concepts, Connections, **Changes** and Surprises."
42

1
2 **p. 3 line 44 (Ivan Fernandez)** Should be “Concepts, Connections, Changes, and Surprises.”
3

4 **Chapter 2 (Response to Charge Question 2)**
5

6 **p. 4 line 30 (Praveen Amar)** Revise the sentence as follows: “Structural uncertainty (e.g.,
7 arising from the use of transference ratios) should be distinguished from quantitative uncertainty
8 (e.g., associated with measurement of a concentrations **and deposition** or with estimates of
9 emission rates).”

10
11 **p. 5 line 22 (Praveen Amar)** Revise the sentence as follows: “Further, **wet** deposition is also
12 sparsely measured, and dry deposition is mostly modeled.”
13

14 **p. 5 line 23 (Praveen Amar)** Does the following sentence mean “attainment decision process”
15 for SECONDARY STANDARDS? “These points should be taken into account when
16 considering the potential use of models in the attainment decision process.”
17

18 **p. 5 line 30 (Praveen Amar)** The report states that “It is important to note the increasing role of
19 transportation as a source of NH₃. The role of soil NO_x should also be discussed. It is not clear
20 whether this is included in biogenic emissions or agriculture.” I think it is our understanding of
21 the role of transportation NH₃ emissions is increasing. In any case, we must note that the fraction
22 of ammonia emissions from agriculture sector including animal CAFÉ sources is much larger
23 than transportation sources ammonia.
24

25 **p. 6 line 1 (James Galloway)** ‘rainwater’ should be changed to ‘precipitation’.
26

27 **p. 6 lines 3-4 (James Galloway)** The word ‘notes’ is not very strong. Can there be an additional
28 sentence that recommends a more stable funding base?
29

30 **p. 6 lines 5-7 (Mark Fenn)** In summary here, the report should point out the limitations of the
31 current monitoring networks for effects evaluation---a point that seems to often be overlooked.
32 Notwithstanding the accomplishments of the NADP/NTN, particularly successes in documenting
33 long term directional trends in deposition (but not trends in total deposition), both CASTNET
34 and the wet deposition network (NTN) are quite limited in their ability “to support the current
35 review of ecological effects”. CASTNET has been shown to poorly model actual dry deposition
36 inputs, often with large underestimates of dry deposition when compared to empirical data. And
37 because wet deposition fluxes are often many-fold lower than total deposition, dry deposition is
38 often the largest component of total deposition, especially in more polluted sites. Thus, where
39 dry deposition is elevated, sometimes NADP deposition maps present such sites as moderate or
40 even with very low deposition---which is highly misleading and limits the usefulness of
41 NADP/NTN data for effects evaluations. And of course this is ignoring the need for more
42 spatially intensive monitoring, which is unlikely to improve because of funding limitations.

1
2 **p. 6 line 13 (James Galloway)** the term ‘reactive N’ is used a few times in the document. In the
3 context of this report it does not include nitrous oxide, but in most N-related literature, it does
4 include nitrous oxide. Therefore, I recommend that ‘reactive N’ be defined.

5
6 **p. 6 line 43 (James Galloway)** the citation should be Galloway et al. (1982).

7
8 **Chapter 3 (Response to Charge Question 3)**

9
10 **p. 7 lines 26-27 (Edith Allen)** The report states that “In Chapter 3, the EPA should note that
11 there is a need for research on NH₃ fumigation effects on plants to fill a key knowledge gap.” I
12 agree with this statement. However, there are a few citations (below) from Europe on NH₃
13 fumigation that can be cited in Chapter 3.

14
15 Cape et al. recommend a CL of 1 ug/m³ NH₃ for lichens and 3 ug/m³ NH₃ for higher plants.

16
17 Cape, J. N., L. J. van der Eerden, L. J. Sheppard, I. D. Leith, and M. A. Sutton. (2009). Evidence
18 for changing the critical level for ammonia. *Environmental Pollution* **157**:1033-1037.

19
20 Sheppard et al. observed growth decline of a heathland shrub (*Calluna vulgaris*) and death of a
21 lichen (*Cladonia*) at ammonia critical levels of 8 ug/m³ NH₃:

22
23 Sheppard, L.J., Leith, I.D., Crossley, A., van Dijk, N., Fowler, D., Sutton, M.A., Woods, C.,
24 (2008). Stress responses of *Calluna vulgaris* to reduced and oxidised N applied under ‘real world
25 conditions’. *Environmental Pollution* 154 (3):404–413.

26
27 Sheppard, L.J., Leith, I.D., Crossley, A., van Dijk, N., Fowler, D., Sutton, M.A., 2009. Long-
28 term cumulative exposure exacerbates the effects of atmospheric ammonia on an ombrotrophic
29 bog: implications for critical levels. In: Sutton, M.A., Reis, S., Baker, S.M.H. (Eds.),
30 *Atmospheric Ammonia – Detecting Emission Changes and Environmental Impacts*. Springer,
31 Berlin, pp. 49–58.

32
33 **Chapter 4 (Response to Charge Question 4)**

34
35 **p. 8 line 16 (Ivan Fernandez)** Change ‘time’ to “time(s)”

36
37 **Chapter 5 (Response to Charge Question 5)**

38
39 **p. 11 lines 7-12 (Mark Fenn)** The comments in this paragraph provide a critique of using soil
40 Ca:Al ratio as an indicator of vegetation effects as described by Cronan and Grigal (1995) and
41 others, but it does so citing a 2007 review paper on Ca:Al ratios in roots, assuming that Ca:Al
42 ratio in soil and fine roots are equivalent indicators. Seems that the jump to criticized soil Ca:Al

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1 ratios based on root studies might be an apples and oranges comparison. Is further information
2 needed here?
3

4 **p. 11 line 9 (James Galloway)** The Vanguelova paper is a decade old. Are there more recent
5 papers that support this conclusion?
6

7 **p. 11 lines 26-28 (Mark Fenn)** Clarify why this study by Whitfield et al (2010) isn't really
8 pertinent to include in the report.
9

10 **p. 11 line 30 (James Galloway)** whenever 'kg/ha/yr' is used, the chemical species should be
11 given (e.g., kgN/ha/yr).
12

13 **Chapter 6 (Response to Charge Question 6)**

14
15 **p. 12 lines 11-15 (Edith Allen)** The report states that "CASAC recommends that the following
16 references be cited to address the possible differential ecological effects of oxidized versus
17 reduced forms of N: Van den Berg et al. 2005; Kleijn et al. 2008; Stevens et al. 2011; Verhoeven
18 et al. 2011; Dias et al. 2014; Huang et al. 2015; Van den Berg et al. 2016; and Mur et al. 2017."
19 Some of these could also be cited in Chapter 3 to emphasize the importance of ammonia
20 deposition.
21

22 **p. 14 lines 11-15 (Edith Allen)** The report states that "The CASAC notes that in the table entry
23 on page 6-162 (Table 6-28) for "Mediterranean California," the old N critical load values are for
24 NO₃ leaching in streams from montane forested watersheds (17 kg/ha/yr) and tree mortality in
25 mixed conifer forests (39 kg/ha/yr), but the new critical load given is for coastal sage scrub
26 vegetation type. The old and new critical loads are for very different vegetation types that occur
27 in different elevations/habitats." Pardo et al. 2011 cite 7.8 to 10 kg/ha/yr as low to high CL for
28 coastal sage scrub diversity loss. These values can be used here as well, and are consistent with
29 the more recently published CL for mycorrhizal diversity loss. The values of 17 to 39 are for
30 different vegetation types and for different ecosystem responses to elevated N. I suggest delete
31 the values 17 and 39, replace with 7.8 and 10 kg/ha/yr.
32

33 **p. 15, line 6 (James Galloway)** The EPA report and the CASAC assessment relies heavily on
34 published literature. Given this, citing 'unpublished' information is not a good idea, in my view.
35

36 **p. 15 lines 36-40 (Edith Allen)** The report states that "In the second entry in Table 6-28 on page
37 6-161 (coastal sage scrub), the correct values for the low and high critical loads for conversion to
38 exotic grasslands are 7.8 and 10 kg N/ha/yr (see Table 13.3 in Pardo et al. 2011). The current low
39 value of 6 kg N/ha/yr is actually for serpentine grasslands (see Table 13.4) and the current high
40 value of 33 kg N/ha/yr given in Table 6-28 is for biodiversity of forest understory in the San
41 Bernardino Mountains (see Table 13.5 in Pardo et al. 2011)." Same as comment above, the
42 values of 6 to 33 reported in Table 6-28 are for different vegetation types and different
43 ecosystem responses. I suggest delete the values 6 and 33, replace with 7.8 and 10 kg/ha/yr.

1
2 **Chapter 10 (Response to Charge Question 10)**

3
4 **p. 22 line 4 (James Galloway)** Has ‘NH_y’ been defined?

5
6 **p. 22 line 29 (James Galloway)** The word ‘the’ is misspelled.

7
8 **p. 25, line 3 (James Galloway)** The charge on nitrate should be a superscript.

9
10 **P. 25 line 20 (Hans Paerl)** change “limitation” to “co-limitation”.

11
12 **Chapter 13 (Response to Charge Question 13)**

13
14 **General comment (Praveen Amar)** – My major comment is on CASAC recommendation on
15 Chapter 13 that addresses climate modification of ecosystem responses to nitrogen and sulfur
16 deposition. As currently formulated (page 3, lines 44-45), it states, “However, the CASAC
17 suggests that EPA consider whether the discussion of climate change effects should be integrated
18 into other chapters of the Draft ISA OR organized at the end of the document as a separate
19 chapter.” CASAC draft letter goes on to say that “by including a separate chapter on climate
20 change at the end of the document, the EPA may convey the incorrect message that this is a
21 minor issue to be considered in the NAAQS process.”

22
23 My sense (as a non-expert) is that the emerging literature on the effect of climate change on
24 certain ecosystem effects (Chapters 3 to 12) is important enough and robust enough that we
25 should recommend that EPA discuss such climate effects in the body of *each* of the effects
26 chapters itself. We should also recommend that the current chapter 13 be retained with focus on
27 integrating/synthesizing the climate effects included in all of the previous chapters.

28
29 **p. 28 lines 9-10 (James Galloway)** Of course, both could be done (that is including a separate
30 chapter on climate change as well as and integrating the issue into chapters of the ISA.

31
32 **p. 28 lines 17 - 18 (Erik Nelson)** Do we want to specifically refer to the Climate Science Special
33 Report ([https://assets.documentcloud.org/documents/3914777/Third-draft-of-the-Climate-
34 Science-Special-Report.pdf](https://assets.documentcloud.org/documents/3914777/Third-draft-of-the-Climate-Science-Special-Report.pdf))? I know that a draft copy has been published.

35
36 **Chapter 14 (Response to Charge Question 14)**

37
38 **p. 29 line 34 - 40 (James Boyd)** The report reproduces a sentence the review team included in
39 its Chapter 14 report. I would like to revisit and change/amend the sentence. The sentence is:

40
41 “For the purposes of the Draft ISA the authors could declare that they consider any ecological
42 process that humans value or utilize, and is affected by NO_x, SO_x, or PM emissions and/or
43 related deposition, as an ecosystem service of relevance.”

1
2 Upon reflection, I find this statement to be a source of potential confusion. The problem is that
3 “any ecological process that humans value or utilize” could be misinterpreted, since in principle
4 *any/all* ecological processes can be viewed as undergirding human welfare. The reviewers want
5 the authors to move away from broad, vague definitions and toward more specific definitions
6 and quantification – as we make clear in the rest of the comments.

7
8 Proposed solution. Change the sentences (starting with the sentence quoted above) to read:

9
10 “For the purposes of the Draft ISA the authors could declare that they consider any ecological
11 process that humans value or utilize, and is affected by NO_x, SO_x, or PM emissions and/or
12 related deposition, as an ecosystem service of relevance. However, that is not our
13 recommendation. We recommend that the report’s approach to ecosystem services focus on the
14 *outcomes* of ecological processes (biophysical or social) – and, specifically, focus on outcomes
15 that facilitate social and economic interpretation. A reference that makes that terminological
16 point is Boyd and Banzhaf (2007).”

17
18 **p. 30 lines 2- 4 (Erik Nelson)** Revise the sentence as follows: “Analysis that translates ambient
19 and deposition outcomes into biological, ~~and~~ physical, **or monetary metrics that give people**
20 **insight into the public welfare impacts of ambient and deposition** outcomes. ~~that facilitate~~
21 ~~social evaluation and public understanding of loads’ effects on public welfare.”~~

22
23 **p. 31 lines 5-6 (Edith Allen)** add the following citations from Ecosphere publications on societal
24 ecosystem services:

25
26 Irvine, I. C., T. Greaver, J. Phelan, R. D. Sabo, *and* G. Van Houtven. 2017. Terrestrial
27 acidification and ecosystem services: effects of acid rain on bunnies, baseball, and Christmas
28 trees. *Ecosphere* 8(6):e01857. 10.1002/ecs2.1857

29
30 Clark, C. M., M. D. Bell, J. W. Boyd, J. E. Compton, E. A. Davidson, C. Davis, M. E. Fenn, L.
31 Geiser, L. Jones, and T. F. Blett. 2017. Nitrogen-induced terrestrial eutrophication: cascading
32 effects and impacts on ecosystem services. *Ecosphere* 8(7):e01877. 10.1002/ecs2.1877

33
34 Rhodes, C., A. Bingham, A. M. Heard, J. Hewitt, J. Lynch, R. Waite, and M. D. Bell. 2017.
35 Diatoms to human uses: linking nitrogen deposition, aquatic eutrophication, and ecosystem
36 services. *Ecosphere* 8(7):e01858. 10.1002/ecs2.1858

37
38 **p. 32 lines 17-23 (Erik Nelson)** Is this recommendation redundant? Wouldn’t the table
39 recommended here be part of the table recommended in lines 10 – 25 of page 31?

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1 **Appendices (Response to Charge Question 15)**
2

3 **p. 35 line 21 (Praveen Amar)** Revise the sentence as follows: “There is a large amount of
4 information included in the case studies.”
5

6 **p. 35 (Edith Allen)** In Draft ISA p. C-126, l. 30 add citation Cox et al. (2014) (already in lit.
7 cited). Talluto and Suding (2008) is cited here, but Cox et al. 2014 reports CL.
8

9 **Letter to the Administrator**
10

11 **p. 1 line 31 (Daven Henze)** Perhaps this is a bit obvious, but it might be worthwhile to state here
12 that the content in these pages is just the main highlights, and that the detailed comments include
13 topics that are not represented here in the highlights.
14

15 **p. 1 line 35 (James Galloway)** The word “also” is not needed.
16

17 **p. 1 line 35 (Praveen Amar)** The report states that “The CASAC also recommends that the
18 following topics be discussed in Chapter 1: (1) key scientific uncertainties; (2) requirements for
19 National Ambient Air Quality Standards (NAAQS)...” I think we mean Components of NAAQS
20 (form, level, indicator, averaging time)
21

22 **p. 1 line 39 (Praveen Amar)** Revise sentence as follows: “...(5) the concept of critical loads
23 (including the strengths and limitations of approaches to developing **and implementing** critical
24 loads);...”
25

26 **p. 2 line 1 (Praveen Amar)** Revise the sentence as follows: “In addition, the CASAC
27 recommends that: (1) the Chapter 2 summary (Section 2.11) be moved to the front of the chapter;
28 (2) a comprehensive discussion of the major atmospheric transport and flux modeling platforms
29 be included in Chapter 2; (3) the process used to obtain emissions estimates (**including**
30 **estimates of ammonia emissions**) in Chapter 2 be better documented; (3) text be added to
31 Chapter 2 to discuss the usefulness of data from various monitoring networks **to estimate**
32 deposition; and (4) more definitive conclusions be presented about the usefulness of transference
33 ratios for linking ambient air quality to **total** deposition.”
34

35 **p. 2 line 10 (Praveen Amar)** Revise the sentence as follows: “The CASAC notes that the
36 ecological effects of reduced nitrogen compounds are important for understanding the effects of
37 atmospheric **total reactive** nitrogen deposition and should be emphasized **included** in Chapter 3
38 and other chapters of the Draft ISA.”
39

40 **p. 2 line 12 (Praveen Amar)** The report states that “Ammonia emissions are increasing in many
41 regions of the U.S. and the CASAC recommends that EPA consider the need for developing
42 National Ambient Air Quality Standards for reduced forms of nitrogen during the Risk and

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1 Exposure Assessment and Policy Analysis phases of this NAAQS review.” Not sure if we want
2 to say that NAAQS for reduced forms of nitrogen need to be developed on stand-alone basis. I
3 think the focus should be the development of NAAQS or critical loads for total reactive nitrogen
4 and total sulfur deposition.
5

6 **p. 2 lines 12-15 (Edith Allen)** The draft letter states that “Ammonia emissions are increasing in
7 many regions of the U.S. and the CASAC recommends that EPA consider the need for
8 developing National Ambient Air Quality Standards for reduced forms of nitrogen during the
9 Risk and Exposure Assessment and Policy Analysis phases of this NAAQS review.” Can we
10 state this more strongly? For instance, wording such as: CLs are developed based on total N
11 deposition, but only half or less of the total N deposition in the U.S. is regulated based on the
12 NO₂ standard. I realize the rationale for regulating ammonium is stated in the more detailed
13 Panel responses below, but it would be helpful to give a rationale here in the cover letter.
14

15 **p. 2 line 17 (Praveen Amar)** the report states that “Chapter 4 of the Draft ISA summarizes *soil*
16 *biogeochemical responses to atmospheric sulfur and nitrogen deposition*. The chapter is
17 generally complete with respect to the discussion of indicators, processes, models, monitoring,
18 and national sensitivity.” The reference to national sensitivity is not clear.
19

20 **p. 2 line 20 (Edith Allen)** The language in the report “(and other effects chapters in the Draft
21 ISA)” is not clear. Is there a word missing or incomplete phrase?
22

23 **p. 2 line 23 (Praveen Amar)** The report states that “It would also be useful to present maps in
24 Chapter 4 to show the relative contribution of sulfate, nitrate, and reduced nitrogen driving
25 acidification and eutrophication effects, particularly for areas of the U.S. where acidification and
26 nitrogen critical loads are exceeded.” Should we say nitrate or oxidized nitrogen?
27

28 **p. 2 line 29 (Praveen Amar)** The report states that “In addition, the CASAC finds that much of
29 the literature reviewed in Chapter 5 concerns natural variability in soil pH, calcium
30 concentration, and base saturation impacts on plant health and microbial composition (rather
31 than effects of nitrogen or sulfur deposition on acidification). These studies are useful for
32 understanding basic physiological principles of acidification effects on biota, but the Draft ISA
33 should clearly identify studies that are not based on elevated levels of nitrogen or sulfur
34 deposition.” Not clear what we are emphasizing.
35

36 **p. 2 line 34 (Praveen Amar)** The report states that “The CASAC also recommends that the
37 chapter discuss uncertainty in the base cations to aluminum ratio considered to be protective for
38 various species.” The last sentence needs to be written more clearly. The uncertainty of the B/Al
39 ratio is NOT considered to be protective, but the ratio is.
40

41 **p. 2 line 42 (Praveen Amar)** Should be “conclusions”
42

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1 **p. 3 line 4 (Praveen Amar)** The report states that “The CASAC also recommends that: (1) the
2 section on dissolved organic carbon be rewritten to address specific concerns identified in the
3 enclosed report, and (2) a framework be provided in Chapters 4, 5, 7, and 8 to define recovery.”
4 Should we say “recovery of ecosystems” or “chemical and biological recovery of ecosystems”?
5

6 **p. 3 line 9 (Praveen Amar)** The report states that “The CASAC recommends that Section 8.4.6
7 of the chapter discuss the different mitigation responses of direct application of lime on water
8 and whole watershed liming.” Not sure if this recommendation about studying the effects of
9 adding lime on mitigation responses is important enough to be included here.
10

11 **p. 3 line 23 (Praveen Amar)** The report states that “The CASAC notes that reduced forms of
12 atmospheric nitrogen are playing an increasingly important role in estuarine and coastal
13 eutrophication, and in harmful algal bloom dynamics.” Do we mean to say that “reduced forms
14 of atmospheric nitrogen are PLAYING...” Or should we say “that reduced forms of atmospheric
15 nitrogen PLAY” an important role. The way it is written implies that reduced nitrogen forms are
16 PLAYING an important role now, but they did not in the past.
17

18 **p. 3 line 41 (Praveen Amar)** Revise the sentence as follows: “The chapter should indicate that
19 the changing character of atmospheric temperatures, precipitation and increasing carbon dioxide
20 can modify processes discussed in the other chapters (**Chapters 3 to 12**) of the ISA.”
21

22 **p. 3 line 44 (Praveen Amar)** The report states “However, the CASAC suggests that the EPA
23 consider whether the discussion of climate change effects should be integrated into the other
24 chapters of the Draft ISA or organized at the end of the document as a separate chapter.” My
25 suggestion is that EPA do both. Each effects chapter (Chapters 3 to 12) should have a section on
26 how climate modification is expected to impact the effect discussed in that chapter, and then
27 Chapter 13 brings together all the effects of climate change in an integrated/combined manner.
28

29 **p. 4 line 5 (Praveen Amar)** The report states that “Recommendations to improve Chapter 14
30 include: (1) incorporating a better definition of ecosystem services ...” Do we need to use the
31 term “ecosystem services VALUATION” as in “ecosystem services analysis and
32 VALUATION”?
33

34 **p. 4 line 19 (Praveen Amar)** Revise the sentence as follows: “...2) a section be added to
35 Appendix C to compare various aspects of the **five** case studies...”
36

37 **Panel Roster**

38
39 **p. ii (Daven Henze)** Dr. Henze’s affiliation should be Associate Professor and Johnson faculty
40 fellow.
41
42

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Individual Comments from Panel Members

p. A-49 lines 5 - 45 (James Galloway) There is some text duplication on this page.

p. A-53 line 41 through A-57, line 24 (Daven Henze) Replace Dr. Henze's individual comments on Chapter 2 with the following edited version that was previously submitted.

2. Atmospheric Chemistry

Major comments for discussion:

Table 2-1: This table strikes me as overly precise; as mentioned in the supporting discussion, there are considerable uncertainties associated with many of these values. At the very least, it should specifically state the year and version of the NEI being used. At best, some estimates or uncertainties, ranges, or notes on levels of certainty (high, medium, low) could be included. Another question about Table 2-1 is the apportionment of soil NO_x – about 10 % of soil NO_x emissions are owing to fertilizer applications (e.g., Hudman et al., 2012). Why are these then not classified as agricultural emissions, as is the emissions of NH₃ owing to fertilizer?

2-6, 15-24: NH₃ emissions are quite uncertain. This should be discussed, including references to the relevant literature. NH₃ emissions from transportation may also be underestimated in the NEI by x2 (e.g., Sun et al., ES&T, 2017).

2-17, 27 through 2-21, 14: This very generic section on atmospheric transport feels a bit dated, and somewhat out of place. While some review of basic terminology relevant to transport discussions seems warranted, the content here seems a step or two removed from the aspects of transport critical for discussion of N and S. It seems like boilerplate description of transport associated with the Bermuda high copied from another report. This is but one mode of transport of interested to S and N deposition. Boundary layer dynamics and mixing, mountain up-slope effects (e.g., transport into Rocky Mt National Park from ag and urban areas to the east), continental-scale (e.g., transport to Rocky Mt. NP from CA) and transcontinental-scale long-range transport all come to mind.

Section 2.5: This section focuses on (some) ground network measurement techniques and remote sensing techniques. What about measurements from aircraft (e.g., work from John Nowak on NH₃), mobile platforms (Mark Zondlo, also NH₃), or other research-grade techniques? Or does the title of the section just need to be renamed?

2-29, Section 2.5.4.1: This section unfortunately does not include the best remote sensing measurements available for NH₃ – those from CrIS. These measurements essentially combine the accuracy of TES with the spatial coverage of IASI. See details in Shephard and Cady-Pereira, AMT, 2015, and Dammers et al., AMTD, 2017.

- 1 2-30, 1-4: This is a strangely incomplete and out of place overview of the use of remote sensing
2 to constrain NH₃ emissions. It doesn't even mention the most relevant works targeting US
3 emissions. Regardless, discussion of top-down emissions estimates should be the subject of
4 another sections (e.g., end of Section 2.2) and should be kept separate from a description of the
5 observations here.
6
- 7 2-39, Fig 2-11: Later, in Section 3 (3-12, 37; 3-13, 8-10), it is noted that exposure to HNO₃ may
8 have been a driver of declines in lichen in the LA basin, and may be continuing to have an
9 impact. I believe this is the only direct gas-phase impact of S or N species referenced to believed
10 to be occurring in ambient conditions in recent times in all of section 3. The cited studies of
11 HNO₃ impacts on lichen were referenced to daily peak exposure. Would it be useful then to
12 present estimates of daily peak HNO₃ values, rather than / in addition to annual averages?
13 Section 2, figures: Scanning across the figures of species distributions in this section leads to a
14 misleading first impression as to the spatial variability of different compounds owing to some
15 seemingly arbitrary choices of color-bar scales. For example, the distribution of SO₂
16 concentrations looks quite flat, as the max value plotted is ~6 ug/m³ on a scale up to 20. In
17 contrast, nitrogen oxide concentrations are plotted on a much better scale (Fig 2-9), such that
18 gradients associated with particular sources (cities, power plants, and roads) are visible. Can all
19 of the figures in this section be adjusted so that the max color-bar scale matches the max value
20 on the map?
21
- 22 2-43, Section 2.6.6: Would it be worth providing information on current levels of 3hr max SO₂
23 concentrations, as that is what the NAAQS are based on, instead of / in addition to the 3 year
24 annual mean?
25
- 26 2-66, 3: The statement that N dep is overall in reduced form – is that based on the total budget of
27 reduced N dep to oxidized N dep? Or does that mean there is a greater area where the former
28 dominates? Is organic N accounted for in this statement? I thought (e.g., Zhang et al., ACP,
29 2012) that oxidized N dep was larger than reduced N dep in the US under current conditions,
30 although that is expected to change in the near future as NO_x emissions decrease and NH₃
31 remain the same or increase (e.g., Ellis et al., ACP, 2013; Paulot et al., ES&T, 2013).
32
- 33 2-74: Fig 2-29, 2-30 and 2-31 -- any comment on the changes at the tip of Florida?
34
- 35 Section 2.9, 2-80...: This section delves into the details of a study by Koo et al. (2012)
36 documenting variability across two models for transference ratios. Transference ratios are the
37 inverse of atmospheric lifetimes, weighted by the ratio of the volume over which the
38 concentration is calculated to the area over which the flux is calculated, ie the height of the
39 system. Presumably since the latter isn't a variable quantity across studies, variability in
40 transference ratios is just variability in the lifetime of NO_y, SO_x, or NH_x. And then I tend to
41 think that variability in lifetime has been more widely studied across models.

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1 Section 2.10: I think there should be an additional paragraph or two in Section 2.10 (or an entire
2 section) devoted to source-receptor estimates for N dep within the US. Lee et al. (ACP, 2016)
3 evaluated the sources driving deposition of reactive N in several Federal Class I areas in the US.
4 This study quantified the natural contribution, as well as provided maps of the footprints for each
5 location. Locations such as Big Bend had substantial contributions from soil NO_x (~20%) as
6 well as foreign emissions. Another important point of this work was the domestic, yet long-
7 range influence of some anthropogenic emissions on N deposition in remote parks such as Rocky
8 Mountain, which was impacted by NO_x and NH₃ emissions from CA. This type of long-range
9 influence (on deposition in RMNP in particular) was also previously identified in works such as
10 Paulot et al. (ES&T, 2013), Benedict et al. (JGR, 2013) Malm et al. (JAWM, 2013), and
11 Thompson et al. (JGR, 2015).

12
13 2-42, Section 2.6.4: Increasing trends in NH₃ are mentioned in several other locations
14 throughout the report (e.g., 2-87, 1) – have these trends been detected with measurements from
15 AMoN or SEARCH? There are papers examining trends in NH₃ from remote sensing
16 instruments.

17
18 General: It struck me as a bit odd that there is a lot of discussion of CLs, but for the section on
19 the distributions and trends in actual deposition values, the latter were presented with little
20 reference to their magnitudes in relationship to CLs. Works such as Ellis et al. (ACP, 2013) and
21 Lee et al. (ACP, 2016) broadly examine drivers of deposition above CLs, as well as others.
22 Should this be discussed?

23
24 General: There were some pretty strong statements about the importance of bidirectional
25 exchange, in a few locations. However, no results were shown for how bidirectional exchange
26 impacts model estimates of concentrations or deposition. Could/should these be included?

27
28 Minor comments:

29
30 2-5, line 4-18: Evidence of NO_x emissions overestimates also in Texas during the GoMACCS
31 campaign (Yu, S. C., et al. (2012), Comparative evaluation of the impact of WRF-NMM and
32 WRF-ARW meteorology on CMAQ simulations for O₃ and related species during the 2006
33 TexAQS/GoMACCS campaign, *Atmospheric Pollution Research*, 3(2), 149-162.) And note the
34 paper by Travis is now published.

35
36 2-6, 35: Some top-down studies don't use CTMs, such as the constraints on NO_x and SO_x
37 emissions derived from OMI (e.g., Fioletov et al., GRL, 2011).

38
39 2-14: What about uptake of HNO₃ by coarse-mode dust?

40

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1 2-17, 15: The lifetime of NO_x is typically a few hrs, owing to rapid dry deposition. It seems odd
2 to pit this against the lifetime of HNO₃, which is also short, but I'm not sure that the latter is
3 significantly shorter.

4
5 2-23, 33: sometimes models are used here as well

6
7 2-33, 3: Shouldn't discussion of NO₂ have been in the earlier section on OMI NO₂?

8
9 Section 2.5.4: What about the techniques used in the SEARCH network?

10
11 Section 2.5.5.1: Should probably also include discussion of SO₂ work from Fioletov et al.,
12 GRL, 2013, and others from NASA Goddard. There should also be a distinction between
13 generating and using retrievals of SO₂ columns, which aren't intrinsically tied to GEOS-Chem,
14 and extrapolating these column concentrations to estimates of surface concentrations, as done in
15 Lee et al. (2011) and Nowlan et al. (2014).

16
17 2-40, 7-12: I believe that paper only identifies a 5% /yr trend in December. Another possible
18 reason discussed was increasing domestic NH₃.

19
20 2-54, 35: I wasn't sure about the claim that aerosol nitrate is found "mainly" in the coarse mode
21 in the Eastern US. Could this be clarified, and referenced? Are they referring to nitrate uptake
22 on dust, or sea salt?

23
24 2-55, Fig 2-18: The axis labels are nearly illegible – could these be remade?

25
26 2-57, 4-6: Well, yes, that is bound to happen since the unidirectional model doesn't include the
27 upward flux.

28
29 2-59, 31: Is there any large-scale evidence of this type of NO₂ emission from e.g.
30 SOAS/SEACRS? As found in the BEARPEX study mentioned on the next page, much of this
31 may be converted to other species before it exists the canopy.

32
33 2-70, 9: This result from Krotkov 2016 was just over the Eastern US (see their Fig. 1). But the
34 decreases in NO₂ are generally supported by evidence from remote sensing, reported in Krotkov
35 as well as several other studies cited therein (Duncan et al., 2013; Lamsal et al., 2015; Lu et al.,
36 2015; Russell et al., 2012; Tong et al., 2015).

37
38 2-70, 16: This is also owing to reduced levels of sulfate, and hence less NH_x present as
39 ammonium sulfate.

40
41 2-72, 27-32: Didn't they also suggest increasing NH₃ may play a role?

42

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- 1 2-75, 1-2: A little redundant with the text at the end of page 2-72.
- 2
- 3 2-90, 5-17: It may be good to also reiterate the results of Kim (2015) here as well, in terms of
- 4 interactions between organics and inorganics impacting aerosol neutralization.
- 5
- 6 2-87, 18-26: As with the main body, the summary should be updated to reflect uncertainties in
- 7 NH₃ emissions.
- 8
- 9 Editorial:
- 10 2-17, 19-26: Perhaps this is just a writing style issue, but the text seems to make a point about
- 11 NO_x lifetime vs that of HNO₃, and then backs this up (for example) by reference to the lifetime
- 12 of NH₃ and SO₂, which doesn't flow (logically). Perhaps all of these are just examples of the
- 13 broader topic of this paragraph (different species have different lifetimes), which should be
- 14 clarified.
- 15 2-20 16: Strangely worded, as emissions cannot be transported (emitted species can be though).
- 16 2-24, 26: which has shown → have shown
- 17 2-52, 19: remove comma: models, typically
- 18