

## ***Interactive comment on “Effects of global change during the 21st century on the nitrogen cycle” by D. Fowler et al.***

### **Anonymous Referee #1**

Received and published: 4 February 2015

This manuscript is a substantial review of many aspects of the atmospheric N cycle and its coupling to the land surface and biosphere now and through the next century. Overall it is somewhat useful—but in its current form it is trying to be too encyclopedic and as a result fails to present a useful overview and/or to serve as a guide to the primary literature. This is even more of a problem because in the sections I am most familiar with, the review is quite incomplete. There are many authors of this manuscript, but it doesn't appear to have benefitted from sufficient internal review among the authors.

It would be better if the authors divided the review into two or three companion papers where a manageable number of experts could make sure the review is complete and comprehensive enough to represent the current state of affairs in our science and where all the authors would feel sufficiently invested that they would read and comment

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on every aspect of the manuscript.

In addition to this larger structural issue, the manuscript is simply long and could in places be dramatically trimmed without loss. If it stays as one document, it is in many places repetitive—clearly written by committee—and would benefit from a single author/editor coalescing key ideas that frame the discussion once and only once.

Finally, this is a subject that has been at least partially reviewed and had special issues devoted to it quite recently. It would help the reader to have those items pointed out and to have some clarification about the intended utility of this review compared to other recent reviews in the early part of the introduction.

Some examples and specific comments:

pg 1755 line 15: Sentences like this one appear throughout the manuscript. As a topic sentence for a paragraph it is useless and it undermines the utility of whatever follows. I recommend careful review of all references in the text to complexity, uncertainty and a challenging future and that the authors insure they are making a specific statement that a reader can interpret with each one. In most cases it would be better to write instead that current understanding provides upper and lower bounds on values for some property and then to give a central value with some discussion of why that value is more likely than the extremes. (see also pg 1757 lines 2-4 and lines 6-8 and page 1791 lines 4-6)

Section 2.2.3. needs to be edited. There are almost more sentences summarizing or directing the reader to another point in the text than sentences with content.

section 4.1.1 The role of bidirectional exchange in setting the spatial patterns of emission and deposition downwind from large sources should be more clearly discussed.

section 4.3.1. equilibrium and photostationary state are similar but not identical. There are probably some more recent global analyses of the N budget than the references used here. There are certainly many important papers documenting trends of NO emis-

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sions at a continental scale and documenting revised understanding of the processes that were at the heart of the global analyses in the references quoted.

section 4.3.3. the general statements about climate in this section belong earlier in the document,

section 5. My understanding is that the PAN lifetime is set more by dynamical time constants of convective lofting and transport rates from the free troposphere to the PBL than temperature itself.

section 5.1. I think the recent paper by Romps et al. Science 2014 is a more useful basis for estimating climate effects than the references here.

section 6. most of this section focusses on reduced organic nitrogen. If that is the only subject of interest then the section should state that early on and make clear it is not a review of oxidized organic N. On the other hand, if oxidized organic N is important, the section is missing an organizing concept for discussing it and is completely lacking references to recent papers and reviews on gas phase and aerosol oxidized organic nitrogen.

section 7.1 It isn't clear why this topic is in the global change section and not appearing earlier in a section about the state of our understanding of the present day N cycle, Also, this section is missing most of the recent literature on field and lab studies of NO<sub>x</sub> and PAN fluxes.

sections 7.2-10 What would make this review useful would be to somehow link key ideas in the earlier sections to some assessment of what is knowable about the future. Sections 7.2,8,9 and 10 don't do that. They would stand entirely on their own without any of the preceding sections, hence my suggestion to split this document into several papers.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 1747, 2015.

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