

## Review of

Data assimilation in atmospheric chemistry models: current status and future prospects  
for coupled chemistry meteorology models

by

M. Bocquet et al.

### **Summary**

This manuscript presents a review of data assimilation in atmospheric chemistry models and contains a wealth of information.

I appreciate that the authors addressed some of my comments from my “short review” before this manuscript was published in ACPD. Nonetheless, my overall opinion is nearly unchanged—I still think the manuscript is too long and unfocused and that the writing and presentation are the main shortcomings of this manuscript. However, I have little concern regarding the scientific content, as I believe the authors appropriately encapsulated most of the work to date on data assimilation in atmospheric chemistry models.

I have identified several places where I think the authors can shorten their paper. However, ultimately, I will defer to the authors’ choices. If the authors do not wish to make any substantial omissions, that is fine, but I expect that many readers will be turned-off from this article because of its size and often unfocused writing.

### **Bigger comments and suggestions**

**1.** I feel you should strongly consider removing section 5 and all the figures because they add little to the paper. Section 5.2 is essentially just Pagowski and Grell (2012) restated, and section 5.3 is already-published work from P. Saide. I found section 5.4 to be the most interesting of the case studies, but even that can be safely removed, in my opinion. While it’s nice to have figures in an article, I feel that in this case, they don’t contribute to further understanding of the topics already described in the text.

I feel that section 2.4 can be omitted. A few lines about nonlinearity and non-Gaussianity can easily be slipped into other earlier material in section 2.

Is section 2.5 really necessary? The point of this paper is data assimilation, not verification approaches. If you’re going to keep section 2.5, then, within it, I suggest removing the “leave-one-out-approach” because, as you mention, this approach is very expensive, and quite frankly, I believe a bit silly and unpractical.

Can section 3.3 be omitted? I felt it added little to the text.

The first paragraph of section 4.2 can be safely omitted. Further, I feel that the text in section 4.2 beginning “Most retrieval products” through the end of the section can be

removed.

I feel that section 4.3 can be safely omitted too—of course observations are used in chemical data assimilation. Most of this content has been said somehow earlier.

2. Section 3.1 should be broken into subsections to make it easier to read. Perhaps one subsection could contain studies looking at inverse modeling and another those that examined modifying initial conditions.

Similarly, section 3.2 should also be broken into subsections. I'd suggest one subsection for gaseous chemistry data assimilation and another for aerosol data assimilation.

3. In general, I strongly urge you to remove all unnecessary text, primarily in section 3. The details of the various studies do not have to be mentioned here. For example, in the paragraph about Schutgens et al. (2010), beginning on page 32253, the sentences starting with “To obtain” and “In addition” can probably be safely removed without detracting from the main point of this study. If readers want more information, they can consult the reference.

#### **Smaller comments and suggestions**

1. P 32236, L 24: Clarify how this paper differs from Zhang et al. (2012b)
2. I feel the paragraph beginning on line 17 on page 32237 can be shortened.
3. Suggest rewriting the first sentence of section 2.1
4. P 32238, L 14: 90's should be “1990s”
5. P 32238, L 18-20: What errors? Please be precise.
6. P 32239, L 27: “of” not “in”, specify it's the *background* error covariances
7. P 32240, L 20: This sentence can probably be omitted.
8. P 32241, L 5-10: How are the “hybrid ensemble/variational” and “ensemble variational schemes” different? I believe you're referring to the same thing.
9. In section 2.3, it might be appropriate to mention the NMC method as a way of obtaining background errors.
10. P 32250: Suggest omitting the paragraph beginning in line 14.
11. P 32252, L 12: “led” not “lead”
12. P 32255: Please rewrite the sentence beginning in line 11. I suggest omitting lines 13-17.
13. I suggest omitting the text beginning in line 18 on page 32255 through the end of

- the section. Seems out of place to me.
14. I believe lines 4-15 on page 32265 could be removed, since IMPROVE and STN network observations are not suitable for data assimilation purposes.
  15. Suggest omitting the paragraph beginning “MPLNET is a global lidar” on page 32266.
  16. P 32271, L 18, “past” not “passed”
  17. P 32284, L 18: Please rewrite this sentence.
  18. P 32287, Lines 1-9: This material was just said nearly verbatim in section 6. Please consider removing.