

Improved spectral fitting of nitrogen dioxide from OMI in the 405—465 nm window

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Summary

Geffen *et al.* present results of OMI NO₂ columns derived with an improved version of their NO₂ slant column retrieval algorithm. They show column values from the old and new algorithm, and present comparisons with NO₂ from independent satellite observations. The improved OMI NO₂ data remove the known high-bias in the stratospheric columns that the OMI NO₂ product has been suffering from.

In principle, the results presented in the paper are well worth publishing, particularly since OMI NO₂ is a high-impact data product frequently used in air quality studies. Making the user- and general science-community aware of improvements in this product is important. However, the manuscript is unpublishable in its current form. As I already pointed out in my initial “quick review”, the manuscript is way too lengthy and unfocused. It resembles an ATBD (Algorithm Theoretical Basis Document) much more than a science publication. The latter is supposed to highlight important aspects of scientific development and not, like the former, present an unfiltered log book of all the gruesome details of algorithm development and retrieval elements. In fact, I wouldn't be surprised if a good portion of the writing here was taken from van Geffen (2014), the TROPOMI ATBD.

To compound the problem, the authors have thought it a good idea to add a “Supplement” with even more details. Sure, electronic real estate is cheap these days, and why not cram all there is ever to know about an algorithm development into a PDF and data-dump it on-line, unabridged. But neither a reader's nor a reviewer's time is that cheap, and authors should be mindful of conveying essential information in a journal publication, so that key elements are available for easy grasp and reference. By all means, have a 50 page Supplement, if you must, that can also serve as ATBD. But do not waste readers'/reviewers' time with a manuscript that is unable to concisely make its point.

In its current form, I recommend rejection of the paper. If the manuscript is SEVERELY shortened, it may be resubmitted for a new review process. The results are important, so I strongly encourage the authors to revise the paper for eventual publications. The comments below include some suggestions for revision.

Suggestions for Revision

What I expected from this manuscript was a clear description of the (1) problem (OMI NO₂ high bias), (2) the steps that were taken to remedy that problem (concise summary of old and new algorithm approach), and (3) selected results (comparison of old and new OMI NO₂; comparison with independent measurements) that highlight the improvements. All of these elements are in the current manuscript, but buried in between lengthy descriptions of algorithm elements that, while being essential for the retrievals, do not need to be spelled out in detail. A prime example is the descriptive list of cross-sections: In a paper like this, it is completely pointless to show images of convolved cross-sections, old and new, and describe at length what they are.

In essence, everything before Section 5 is non-essential. In the Intro to Section 5, the authors repeat the lists of changes (4 bullet points). Start from there and fill in the blanks with concise descriptions what has gone into them. Don't use 17 pages to do that! Some ways to shorten:

Section 2.1.1 has three paragraphs, each an almost verbatim copy of the other, differing only in the name and characteristics of the satellite instruments (OMI, GOME-2, SCIAMACHY). Include only that information which is actually relevant to the work, and/or put the values side-by-side in a table, if you must. If spectral sampling is not specifically used/mentioned in the comparisons, then there is no point in listing it.

Sections 2.1.2/2.2 can be combined and shortened. DOAS is a pretty well known technique by now. First describing model function elements over two paragraphs, and then showing the same again in an equation is repetitively useless.

Section 3 wastes two pages, two figures, and one table to establish the fact of the OMI NO₂ stratospheric bias, when it has already been published in literature (Belmonte-Rivas, 2014). It also does so without mentioning that this is entirely about the old version of the retrievals. This section should be deleted altogether, including figures 1 and 2. Elements of figure 1 can be used for a graph that shows old and new OMI with GOME and SCIAMACHY.

Section 4.1 can be condensed to a few sentences that list the changes in cross-sections for the new NO₂ retrieval. Figures 3, 4, and 5 should be deleted or. Alternatively, wavelength-dependent fitting residuals could be shown that demonstrate the effect of changing from the old to the new cross-sections. That would actually provide some information for the retrieval expert. A mere side-by-side display of old and new cross-sections, at least in the context of this manuscript, is silly.

Section 5 makes two references to the Supplement – for the “spectral residual of the NO₂ retrieval” and for a “OMNO₂A – QDOAS” comparison. Both of these may actually be better served if included in the main text. After all, the authors want to convince us that their new retrievals are an improvement over the old ones. A concise description should fit well within the flow of the manuscript.

In general, a Supplement distracts the reader and detracts from the main text. A Supplement should be used to provide relevant information in support of claims that can't be elaborated on in the framework of the main text (GRL page limits come to mind). Given that this work does not, in fact, describe new science in as much as it describes an improvement of a data set, I seriously challenge the necessity of having any Supplement at all.