Atmos. Meas. Tech. Discuss., 6, C3889–C3894, 2014
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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Ozone ProfilE Retrieval Algorithm for nadir-looking satellite instruments in the UV-VIS" *by* J. C. A. van Peet et al.

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Received and published: 6 January 2014

Below are enough suggestions for improvements that I list this as a major revision. Not all of the recommendations are of equal weight or merit. The three topics between _>_>_>_ and _<_<_<_ notations are the key material that should be added to the article at a minimum.

1. Does the paper address relevant scientific questions within the scope of AMT?

The topic of the paper is a new formulation of an optimal estimation ozone profile retrieval algorithm. The results of its application to GOME and GOME-2 measurements are investigated both for short and long term atmospheric ozone monitoring. This is decidedly within the scope of AMT.

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2. Does the paper present novel concepts, ideas, tools, or data?

The paper presents a description of the changes and improvements in the new algorithm version and provides comparisons to validate the combined application across instruments' records.

3. Are substantial conclusions reached?

Yes. The products are shown to meet the 15% accuracy level for stratospheric ozone retrievals.

4. Are the scientific methods and assumptions valid and clearly outlined?

There are some areas where additional details and explanations should be added. See below

5. Are the results sufficient to support the interpretations and conclusions?

The presented validation results support the conclusions. The products will need focused validation studies with long-term time series of comparisons to advance toward climate data record maturity.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

There are some areas that need additional details and explanations. See below.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

The relevant contributions, both their own and those of others, are well represented in their citations and discussion.

8. Does the title clearly reflect the contents of the paper? Yes.

9. Does the abstract provide a concise and complete summary?

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The abstract should provide the specific performance as compared to the limits that are given in the CCI.

10. Is the overall presentation well structured and clear?

The paper is well-organized.

11. Is the language fluent and precise?

The paper is well-written.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

The mathematics follows standard conventions and definitions.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? No.

14. Are the number and quality of references appropriate? Yes.

15. Is the amount and quality of supplementary material appropriate?

The validation would be considered minimal if this were a data product paper. Since it is both an algorithm and a product one, it is acceptable that there are not additional comparisons.

Some specifics comments, questions and requests:

_>_>_>_ A set of averaging kernel figures should be provided for both layer resolution retrievals, preferably in the paper but certainly in supplementary material for some standard retrievals. _<_<_<_

Figure 1 could easily accommodate DFS values for GOME-2.

As shown in Rodgers 2000, one can break the averaging kernel/impulse response matrix, A, into two operators. The first is simply the Jacobian of measurements versus

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variations relative to the a priori, Kij = dYj/dXi, where Y is a vector of measurements and X is a vector of observed/truth ozone layer amounts. It provides a linearized estimate of the measurement changes expected from a profile change. The second is the Measurement Contribution function, Dy = dRi/DYj, where R is a vector of retrieved ozone amounts. It gives the changes in the retrieved profile for changes in the measurements (whether they are produced by truth changes or instrumentation complications). _>_>_>_ It would be useful to have a clear mathematical description of the "additive offset" term (S 3.7) and the temporal and spatial variation in this retrieval quantity. _<_<_<_ How does this term affect the averaging kernels? Additional information on the failure of the RTM to model what is primarily a single scattering phenomenon below 290 nm should be provided. (Are there other studies to cite for this behavior?)

What are the retrieval algorithm behaviors for a theoretical ozone profile variation such as is expected during the last 20 years? That is, how large are the expected measurements changes, what part of these changes would be incorrectly fit with the additive term, and with what fidelity will this algorithm retrieve these profile changes both for GOME-1 and GOME-2.

What are the retrieval algorithm behaviors for measurement errors of the sizes and relations that are expected given the calibration uncertainty of the two instruments? That is, what retrieved profile uncertainties would one expect as computed by positing a measurement uncertainty pattern and multiplying by Dy? Since the GOME-2 makes daily solar measurements, why doesn't the instrument degradation cancel in the radiance/irradiance ratios? Are the instrument characterization deficiencies correlated in wavelength, e.g., imprecision in the etalon corrections?

While there is a discussion of the effects of different FOVs and the measurement noises of the GOME-1 and GOME-2, I did not see specifics on the assumed measurement noise (Table 1 would be a good location), and number of wavelengths (all of them in the window?). How dependent are the DFS on the measurement noise (Se) and number of channels? With regard to the measurement noise, there is a danger in optimal

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estimation in assuming that the measurement errors are uncorrelated. If this is not the case, then the DFS calculations will be biased higher they actually are. This could be explored with the approach in the previous paragraph where a pattern of measurement biases is proscribed (with sizes related to the instrument radiance/irradiance calibration uncertainty) with a persistent relationship across wavelength intervals.

Is the increased coverage at the edges of the SAA worth the difficulties and potential biases of the accepted data? Are the "successful" retrievals identified/flagged as coming from the region where we expect this signal contamination?

While the number of Sondes reaching 10 hPa / 34 km or higher has been increasing, they do not provide a good source of validation above there. Figure 1 shows that only 2.5 DFS are contained in the layers lower in the atmosphere. The top layer in Figure 3 is somewhere around 6 hPa but the values for that level do not have error bars. How many sondes reached this level? _>_>_>_ What portions of the ozone profile variability (relative to the a priori) observed by the sondes (both before and after application of the averaging kernel) is captured by the retrievals? _<_<_<_ The later comparisons to LIDAR data do show performance higher up but for a limited region.

From my preliminary review:

The critical requirements for producing consistent time series include stable algorithms and stable measurements. The degradation correction and additive offset would seem to be key items in this case. What sensitivity experiments have been carried out? For example, one could construct forward model data for an expected trend in the ozone profile (before and after) and see how the retrievals from the algorithm change if it is allowed to include the additive offset term in one or both retrievals.

What information is coming from the A Priori and what is coming from the measurements? Figure 3: Are the results for averaging kernel processed sonde data or simple layer sums? How would they differ? Figures 3, 6, 7, & 8: How do the A Pioris for the retrievals compare to the "Truth" data in the mean differences?

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 9061, 2013.

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