

## ***Interactive comment on “BrO vertical distributions from SCIAMACHY limb measurements: comparison of algorithms and retrieval results” by A. Rozanov et al.***

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Dear Referee,

thank you very much for your comments. Please find our detailed replies below.

*"This paper really struggled with a lack of focus. I found it interesting and somewhat informative but I was never able to capture the main point of the paper. Was it written to compare the algorithms for BrO retrieval from SCIAMACHY, was it written to document the retrievals of BrO from SCIAMACHY, was it written to validate the retrievals of BrO from SCIAMACHY through comparison with balloon based measurements, was*

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*it written to tell the reader of all the systematic errors associated with the retrieval of BrO from SCIAMACHY, was it written to tell the reader about the expected precision associated with the retrieval of BrO from SCIAMACHY, was it . . . I think this paper was written to do all these things and I think it was actually fairly successful. However, I really could have used more guidance as I read the paper and perhaps a little less detail."*

This paper is meant as a documentation of all existing “operational” SCIAMACHY BrO retrievals. Here, “operational” means the retrievals that continuously provide BrO data from the beginning of the SCIAMACHY mission up to now. It has been written to provide an as-full-as-possible description of different retrievals. The structure of the paper is quite common for this type of publications starting from the algorithm description, then going through the sensitivity studies and error analysis, and ending with a comparisons. We think the feeling of a missing focus might be because we do not describe only one algorithm, as usually done by many authors, but try to bring different algorithms together. Unfortunately, this makes the paper long and difficult to read but has an advantage of providing a common picture highlighting similarity and differences in the retrievals.

We have improved the “technical” guidance by rewriting the last paragraph in the introduction. It includes now a short description of the contents for each section allowing the reader to skip some subsections if he/she is not interested in particular details. With respect to the “scientific” guidance please see our replies below. Concerning the details, it is unfortunately quite complicated to skip some details without interrupting the overall paper flow and making the paper more difficult to understand.

*"The paper is very long and contains a lot of detail but other than being thorough it does not provide much guidance with respect to which of the three SCIAMACHY BrO products I should choose if I were interested in BrO science. I am hesitant to ask for the addition of another section but I would find it extremely useful if the retrieved results from each of the three algorithms were directly compared with each other, not just*

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*with results from DOAS, SAOZ or TRIPLE. Perhaps this comparison could be done using zonally and/or monthly averaged climatologies. I leave it up to the authors to decide the exact mechanism for comparison but I would appreciate some guidance when choosing one of the SCIAMACHY BrO products over the others."*

We have added an intercomparison of three SCIAMACHY BrO products for one orbit.

*"If the authors are interested in shortening the paper to make it more concise it is probably only necessary to compare with one of the three balloon based instruments. The TRIPLE comparisons can definitely be excluded as in the author's own words "Comparisons with TRIPLE do not provide any consistent picture"."*

This is true that comparisons with TRIPLE are not very conclusive. However, if we do not show these results, readers will always ask themselves why the comparisons are not presented here. We do not think this is a good idea to skip any results (even not the best results) just for the sake of shortness. In its present form, the paper provides an overview of all available balloon-borne measurements. In any shortened form, it would just cause questions why this and that results were not included.

*"Also, if the authors are interested in shortening the paper to make it more concise a lot more of the detail can be put into the appendices. I found it extremely useful but it took away from what I thought, or perhaps I hoped, was the main goal of the paper. That being an evaluation of the results from the three products."*

The advantage of appendices is that large blocks of information which is not very important can be hidden here. The appendices must be written in the way that a reader understands the main text even if he/she skips them at all. In the present form of the paper, there are no sections which contain large enough blocks of the text which meet these requirements. On the other hand, the revised paper, offers a relatively easy way to skip complete sections if a reader is not interested in much details.

*"There is something about the fact that "The smoothness coefficients are chosen em-*

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*pirically. . ." that I am not comfortable with. Could the authors provide me with more detail on this process? It doesn't necessarily have to go into the paper, as it is already too long. However, I would like to see something that make me believe this is an acceptable idea."*

The smoothness coefficient should be as small as possible (to minimize the smoothness error) but, on the other hand, prevent any oscillations in the retrieved profiles. The optimal coefficients are found by performing retrievals with different settings for a selected set of observations and/or simulations and a set of a priori profiles.

*"On page 5115 the impact of the a priori is discussed where terms like "negligible" and "significantly different" are used. I would really like to see this discussion expanded as I believe this topic to be extremely important. This is where systematic biases are introduced within the retrieval process and I would like to know their impact on the study of atmospheric BrO. In many applications or uses of the data the random noise may average out but a systematic bias introduced by a dependence on the a priori may be misinterpreted with undesirable result. Could the authors put these systematic biases in context with the accuracy required for BrO science? Also, could the authors recommend the data product they feel has the least amount of bias for all possible measurement conditions?"*

The word "significantly" has been removed to avoid its misinterpretation in the statistical sense. Some discussion with respect to possible biases and different data products is added at the end of the section.

*"On page 5116 it is not clear to me how the BrO optical depth is calculated. Could the authors please clarify this?"*

The optical depth is calculated according to Eq. (51). This is explained by the sentence just before the equation.

*"The discussion about aerosol loading in section 7.3 needs to be expanded to discuss*

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*the impact of the systematic bias that may be imposed upon the data products by an improper treatment of aerosol. Which retrieval process better treats the aerosols and are the biases that are introduced too large to allow for useful science with the BrO data sets?"*

The discussion in Sect. 7.3 has been extended as requested by adding a paragraph at the end of the section.

*"The words "a" or "the" are either misused or missing on many pages. Here is the list I found. The format is (page numbers; followed by all line numbers on that page)."*

*(5082; 25 and 26), (5086; 12, 13, 15 and 21), (5090; 17), (5092; 17), (5094; 11), (5095; 7), (5110; 27), (5111; 11), (5112; 11, 12, 27), (5114; 5), (5115; 3, 4, 5), (5117; 27), (5118; 13, 25), (5119; 2, 11, 23), (5120; 21) and (5121; 2, 7)*

Most of the occurrences have been corrected.

*"Sentences that contain bad English that require rewriting (overall not that many): "Being . . ." starting on page 5084, line 2. "Thus . . ." starting on page 5092, line 11. "The obtained . . ." starting on page 5095, line 16. "The effect . . ." starting on page 5095, line 2. "In the tropical . . ." starting on page 5113 line 7. "The SCIATRAN . . ." starting on page 5116, line 4. "This yields . . ." starting on page 5117, line 23. "To do this, . . ." starting on page 5121, line 7."*

All mentioned sentences have been rewritten.

*"The first sentence in Section 3.2 indicates there are only two ways that are commonly used to retrieve constituent proñAles from limb scattered sunlight. This is not true. Ozone and aerosol are commonly retrieved with SCIAMACHY and OSIRIS data and I believe that none of these retrieval processes use either a global fit or DOAS."*

The first sentence in Sect. 3.2 has been removed. At the end of the section a new paragraph is added mentioning other methods.

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*"Are there commas missing in equation 6 that should be there to separate the elements of the vector?"*

*"In the first sentence of Section 3.2.2 I don't believe you mean "their dependence upon the retrieval".*

*Line 21 on page 5089 the worn "of" should be "in".*

*Line 6 on page 590 should contain "by rewriting all of the terms".*

*On page 5092 and elsewhere the term "fitted out" is used. This isn't a good choice of words.*

*On line 19 page 5092 the phrase "results in only incomplete cancelling" needs to be reconstructed.*

*On page 5092 line 25 is the choice of the word "convoluted" correct or should it be "convolved"?"*

*In line 20 on page 5093 it is the "shape of the tilt spectrum..." that is considered to be independent."*

Corrected

*"In line 19 on page 5094 "fitted then" should go to "then fit".*

"Fitted" seems to be a bit outdated but still valid form. As this form is used throughout the text we have changed "fitted then" to "then fitted".

*On page 5095 and elsewhere the words "can not" must be replaced by the word "cannot".*

*Line 7 on page 5098 should start with "It".*

*The sentence that starts in line 9 on page 5098 should start with "These".*

*In line 11 on page 5112 the phrase should read "the bulk of the information originates"*

*In line 22 on page 5117 I'm pretty certain the authors don't mean an SNR of  $1.5 \times 10^{-3}$ ."*

Corrected

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5079, 2010.

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