Atmos. Chem. Phys. Discuss., 4, S2883–S2891, 2004
www.atmos-chem-phys.org/acpd/4/S2883/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Pole-to-pole validation of GOME WFDOAS total ozone with groundbased data" *by* M. Weber et al.

Anonymous Referee #3

Received and published: 9 December 2004

Review for manuscript by M. Weber, L.N. Lamsal, M. Coldewey-Egbers, K. Bramstedt, and J.P. Burrows on "Pole-to-pole validation of GOME WFDOAS total ozone with groundbased data"

Recommendation: publish after revision

Overall assessment: The manuscript presents GOME total ozone data that have been retrieved using the new weighting function differential optical absorption spectroscopy (WFDOAS) algorithm. The GOME data are tested against ground-based Brewer and Dobson observations from the WOUDC archive. In particular, simultaneous Brewer and Dobson measurements have been compared to the GOME results to elucidate

characteristic differences between the data and thus, the total ozone retrievals. Additionally, the WFDOAS results are compared to results from the current standard GOME data version (GOME Data Processor V3). To my mind, the paper addresses an important issue to the reader, namely the validation of a new dataset. The presented comparison of the newly retrieved GOME total ozone against ground-based observations is relevant information for the scientific user of these data. However, I have some reservations with respect to the motivation for the new retrieval algorithm, that I think is not sufficiently given, and also to the chosen time period of the analysis (see main review points) that should be considered before publication. Additionally, the text should be more precise in some parts and the fluency of language should be improved in certain paragraphs (see technical corrections). Altogether, I see the manuscript as a useful contribution to ACP and recommend publication after revision.

Main review points:

- The authors present a new GOME retrieval algorithm. Unfortunately, they do not comment on why this new retrieval is needed or what the advantages of the new WFDOAS algorithm over the standard GDP V 3 version are. Does WFDOAS yield improvements over the standard GDP V3 version and which are they? This should be especially considered in abstract and introduction, and some more emphasis should be given to this in the results sections (see also specific comments).

- GOME data extend from 1995 to 2003/2004. Why is most of the analysis constrained to the years 1996-1999? (all figures except fig. 10). Many of the results, e.g. concerning the seasonal dependence of biases, could gain reliability when still found in a larger sample. As far as I know, ground-based measurements in the WOUDC archive also mostly extend to 2003. Thus, unless there are well-founded arguments against it, it would be desirable that the analyses were extended to the longer period 1995-2003, as is actually already done in section 6 of the manuscript for Lauder and MOHp.

Specific comments:

ACPD

4, S2883–S2891, 2004

1 Introduction and 2 WFDOAS algorithm

- For motivation of the new retrieval, please summarize shortly again the shortcomings of the GOME GDP V3 version (that have already been described in Coldewey-Egbers et al. (2004, their page 4917)). What are the new features of WFDOAS that are not considered in GDPV3 that lead to improvements in the retrieval?

2 WFDOAS algorithm

- p. 6912, line 18: What are ozone and temperature profiles needed for? Again, this is described in more detail in Coldewey-Egbers et al., but it should once be shortly clarified in this manuscript as well.

3 GOME, Brewer, and Dobson triple comparison

- p. 6915, lines 19-26: Since the early eighties, Brewer spectrometers have been installed. Why has this been done? Is there an advantage/are there advantages of using Brewer spectrometers over Dobson instruments? If so, please indicate.

- p. 6916, lines 15/16: See also general comments. Why is the analysis period confined to the years 1996-1999 although both GOME and ground-based data in the WOUDC archive are available from 1995-2003?

- p. 6916, line 23: The text states that the Dobson data have an RMS scatter of 2.9%. Figure 2, however, claims the RMS to be 2.35%. Which number is correct? - p. 69177, lines 5/6: “Note that the percentage scale is larger” It must be “smaller”. Whereas in fig. 3, the scale is +/- 8%, it is +/- 15% in figs. 1 and 2.

4 Pole-to-pole validation

- p. 6918, lines 7/8: Not considering data from stations where biases clearly exceed 5 %, but that otherwise seem reasonable (assuming those stations have no larger gaps and/or unreasonable short-time jumps) possibly results in artificially small differences between GOME and total ozone data from stations. Thus, the sampling of the ground-

ACPD

4, S2883–S2891, 2004

Interactive Comment

based data possibly influences the differences and, as a consequence, statements made on the quality of the satellite data. Please comment.

- p. 6918, line 11: Why was the maximum collocation radius set to 300 km for the pole-to-pole validation, and not kept at 160 km as was done for the triple comparison at MOHp and Hradec Kralove? Please comment.

- p. 6918, lines 26/27: Five stations have been considered in the comparison of GOME data with representative stations from different climate zones. “Except Boulder and the polar stations” covers three out of five stations. Therefore, “Except” does not seem an appropriate word choice. Please rephrase this sentence.

- p. 6919, line 21 et sqq. : Here, a statistical analysis is presented showing the performance of the new GOME algorithm when different climate zone ozone profile shapes are used in the retrieval. Additionally, the GDP V3 data are included in the analysis. To my mind, the fact that the new WFDOAS retrieval shows smallest differences with ground-based data at tropical and middle latitudes when using the appropriate profile shapes (Figs. 5, 6, and 7) is an important result and should be more emphasized. Please state again what the reasons are for the better performance of the WFDOAS algorithm over the GDP V3 version in these regions.

- p. 6919, line 21: Not clear. Which statistical analysis? Maybe you just have to substitute “the” by “a” in “For a statistical analysis,”

- p. 6916, line 22-24: Not clearly expressed. I assume that both the mid- and the high latitude profile shapes were applied to both mid- and high latitudes. Assuming this is correct, the sentence could read as follows: “For this purpose, the TOMS V7 mid- and high latitude profile shapes (WFD-MI and WFD-HI) were both applied to each region.”

- p. 6920, line 6: “with maximum in winter and minimum in summer”. This should rather be “with minimum deviation in winter and maximum deviation in summer”

- p. 6920, lines 8/9: “lower annual bias” should rather be a “more negative annual bias”

ACPD

4, S2883–S2891, 2004

- p. 6920, line 13: “the seasonal variation” should be “the seasonal variation in differences”

- p. 6920, lines 12-19: Noting that at some stations there is a seasonal cycle in differences and at others, there is none, what were the criteria for selecting the European stations? Do the selected stations (Arosa, Lindenberg, Potsdam, Hohenpeissenberg, Hradec-Kralove, Uccle, Camborne, and Oslo) consistently not show a seasonal cycle as in Uccle?

- p. 6920, lines 19-21: What is the reason for the WFD-MI retrieval to show no seasonal cycle in differences at European stations, whereas there is one for the GDP V3 version. Please clarify.

- p. 6921, discussion figure 8: In the text, the southern hemispheric data are discussed first. However, in fig. 8, the northern hemispheric data are plotted in the top row. It would be more convenient to arrange fig. 8 in accordance with the text, i.e. to swap the upper and lower parts of fig. 8.

- p. 6921, lines 1-6: This paragraph is difficult to read. First, differences at the polar night edge are discussed. In the next sentence, the annual average bias is indicated. In the third sentence, the discussion is back to the polar edge. Please re-sort this paragraph.

- p. 6921, lines 13/14: “high ozone beyond 50 DU” This is probably 500 DU.

- p. 6921, lines 16/17: What could be the reason for the larger differences at low solar elevation and higher total ozone? Please comment.

5 Validation under ozone hole condition

- p. 6922, lines 19-21: From fig. 9, a dependence of Halley Bay differences on total ozone is not evident, not even for total ozone values less than 140 DU.

- p. 6922, lines 21-23: Which “GOME total ozone”? And which effects at low total

ACPD

4, S2883–S2891, 2004

ozone below 140 DU (see above comment)? Sentence not clear.

6 Long-term validation 1996-2003

- p. 6923, lines 2-4: “A long-term comparison” Why has this comparison only been carried out for MOHp and Lauder, and not for the other WOUDC stations? To my knowledge, most ground-based stations used for the 1996-1999 comparison also provide data for the period 2000-2003 in the WOUDC archive. See also general comment.

- p. 6923, 7-10: In section 3, we have learnt that there is a seasonal cycle in differences between total ozone by GOME and measured by Dobson instruments due to the ozone temperature shift that is not accounted for in the Dobson measurements (shown for MOHp in fig. 2). Now looking at the comparison between the Dobson instrument in Lauder and the WFDOAS retrieval, wouldn’t we also expect a seasonal cycle in differences? Additionally, what is the difference between the GDP V3 and the WFDOAS retrievals such that there is a seasonal cycle evident for the former, but not for the latter version? See also comment on introduction and WFDOAS algorithm.

Table 1

It would be desirable to have another column indicating the instrument type, i.e., Brewer, Dobson, M-124 filter, ...

Technical corrections:

General:

The authors should be consistent with the use of British or American English (BE or AE). For example, in line 15 of the introduction, “summarise” is used in the British form. On the other hand, American English expressions are used, for instance, in the conclusions in line 19: “fall/winter” and “spring/fall”.

Abstract

- Lines 8/9: “From the global validation, excellent agreement between WFDOAS and

ACPD

4, S2883–S2891, 2004

ground data was found with differences lying in the range of ś 1 % on average."

- Lines 9/10: Replace "are observed." By "are found."

- Line 10: Unclear, are both hemispheres meant? Replace "In the polar region" by "In the polar regions"

1 Introduction

- p. 6911, line 11: Replace "and properly accounts" by "and proper accounting"

- p. 6911, line 18: Not clear. Are stations now changing from regular Dobson to Brewer observations, or have they recently changed? If the former applies, replace "are changing" by "are now changing". If the latter is true, use "have recently changed." or "have changed from Dobson to Brewer observations in the last years" or something similar.

- p. 6911, line24: replace "relied" by "rely"

2 WFDOAS algorithm

- p. 6912, line 27: Insert comma "For ozone retrieval with WFDOAS,"

- p. 6913, line 15: Insert comma "As described in Coldewey-Egbers et al. (2004),"

- p. 6913, line 18: replace "weighting functions and are stored" by "weighting functions, they are stored"

3 GOME, Brewer, and Dobson triple comparison

- p. 6915, lines 7/8: Insert comma "Global Atmospheric Watch (WMO-GAW),"

- p. 6915, line 8: Insert comma "At low solar elevation,"

- p. 6916, line 5: Insert comma "in all three instruments, GOME,"

- p. 6916, line 9: note "center", AE used here

ACPD

4, S2883–S2891, 2004

- p. 6917, line 15: “(Staehelin et al., 2003, see Fig. 5)” is misleading. Use “(Staehelin et al., 2003, their Fig. 5) instead.

- p. 6917, line 17: Several minima exist. Therefore, “in winter and minima”

- p. 6917, line 26: it should be “at mid-latitude stations”

4 Pole-to-pole validation

- p. 6918, line 7: “should not suffer from unreasonable short-time jumps”

- p. 6918, line 14: “at a given day.”

- p. 6918, line 19, p. 6919, line 10: “three monthly mean time series”

- p. 6919, line 12: “The two stations in the south and north polar regions,"

- p. 6919, line 21: Delete “the”: For a statistical analysis, GOME total ozone”

- p. 6919, line 25: Insert comma “In order to evaluate the spread of the various station data,”

- p. 6920, lines 7/8: Insert comma “If the high-latitude profiles are used,”

- p. 6920, lines 10/11: “However, the maximum and minimum in the GDP difference are shifted towards spring and fall, respectively.”

- p. 6920, lines 25/26: Word order: “Like in the NH mid latitudes, the default WFD-MI differences show no significant annual cycle.”

- p. 6921, line 4: Replace “winters” by “years”

- p. 6921, lines 5/6: “and large ozone gradients near the polar vortex edge lead to”

- p. 6921, line10: Replace “differences has” by “differences have”

- p. 6921, lines 20/21: “At the same time, the intensity of the scattered light decreases and the signal-to-noise” The last part of this sentence “and error also gets larger” is

ACPD

4, S2883–S2891, 2004

incomprehensible in context with the whole sentence.

- p. 6921, lines 23-26: Suggestion to rephrase sentence: “To reach a better understanding of differences between satellite and ground-based instruments at high-latitudes, a comparison between TOMS satellite data and two Dobson and Brewer instruments was carried out in a measurement campaign in Fairbanks, Alaska, in March/April 2001.”

- p. 6921, line 28: Delete “with respect to the world standard”. This has already been mentioned in the beginning of the sentence.

- p. 6922, line 3: Is the dot correct after “TOMS3-F campaign”?

5 Validation under ozone hole condition

- p. 6922, line12: Insert comma “However,”

- p. 6922, line13: Delete “be” such that the sentence reads: “may also to a large extend depend on”

- p. 6922, line 18: Replace “are” by “is” such that “is clearly observed.”

6 Long-term validation 1996-2003

- p. 6923, line 7: Insert comma “bias observed in Hohenpeissenberg),”

7 Conclusions

- p. 6924, line 17: Word order: “generally makes the comparison”

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6909, 2004.