Atmos. Chem. Phys. Discuss., 8, S1249–S1257, 2008
www.atmos-chem-phys-discuss.net/8/S1249/2008/


Atmospheric Chemistry and Physics Discussions

ACPD

8, S1249–S1257, 2008

Interactive Comment

# *Interactive comment on* "Technical Note: Validation of Odin/SMR limb observations of ozone, comparisons with OSIRIS, POAM III, ground-based and balloon-borne instruments" *by* F. Jégou et al.

**F. Jégou et al.**

Received and published: 3 April 2008

Dear Editor,

The reviewers brought up important things that led to an improvement of the paper. We have attempted to address all of the reviewers'; comments. The minor comments have all been addressed. I also confirm that all of the authors concur with the submission in its revised form.

Sincerely,

Fabrice Jégou

Referee #2

(1) The altitude retrieval appears to be an issue, however it is not clear in the manuscript how such shift has been estimated, if there is sometimes, range corrections prior comparisons and bias estimates. Such altitude shifts seem to be very different from one comparison to the other while it is concluded that no range altitude has been detected. Also this issue is not mentioned in the abstract. Probably the manuscript needs some clarification or rephrasing in some sections.

When the maximum altitude of the intercomparison was sufficiently high we divided the validation study into two altitude ranges 20-35 km and 35-60 km. We applied the same formula (see table 1) to evaluate the difference between SMR and the other instruments measurements. We concluded that no systematic altitude discrepancy was detected in the Chalmers SMR v2.1. On the contrary in the CTSO SMR v222, we detected a systematic positive bias ($<$10%) in the 20-30 km altitude range. Nevertheless we have observed a shift of the maximum ozone in the Odin data compared to POAM III data. This shift is of order to 1-5 km. All this information was already mentioned in the manuscript. We have completed the abstract with this altitude error investigation. We suggest to use the official Chalmers SMR v2.1 to avoid any altitude correction.

For OSIRIS, there is a know underestimation at higher altitudes that does not appear to be associated with a pointing problem, but rather a retrieval problem. There is, however, what seems to be a pointing problem in the May-July period (likely in some way related to satellite eclipse) as well as at other sporadic times during the mission. See the following paper for more information:

McLinden, C.A., V.E. Fioletov, C.S. Haley, N. Lloyd, C. Roth, D. Degenstein, A. Bourassa, C.T. McElroy, and E.J. Llewellyn, An evaluation of Odin/OSIRIS limb pointing and stratospheric ozone through comparisons with ozonesondes, Can. J. Phys., 85, 1125-1141, 2007. This last comment has been added in the 3.2 section.

(2) The comparisons between OSIRIS and POAM give several points with very large



ACPD

8, S1249–S1257, 2008

Interactive Comment

deviations while other comparisons show more normal distributions. Any explanation? A small but systematic bias, in SMR data has been reported, clear conclusions about the significance and the amplitude of this bias need to be provided. The question is whether authors will recommend to apply any systematic corrections on SMR data prior their use.

A first response of the POAM III/OSIRIS difference is explained in page 738 lines 11-14, for more information we advise to read the paper by Petelina et al. (2004) that converts specifically the OSIRIS/POAM III intercomparison. The positive systematic bias in the CTSO SMR v222 data in the 20-30 km range is not detected in the Chalmers SMR v2.1 data. We concluded that this bias has a numerical origin because the two SMR version were not retrieved with the same model. We do not recommend to apply any systematic correction to the CTSO v222 data but to use the Chalmers v2.1 data as they are.

(3) For comparisons with NDACC some warnings have been provided for comparisons close to the vortex. Additional comments will be valuable to know how those cases have been handled. How vortex border is detected and if some cases have been removed for example? The sentence line 23, page 741 is not scientifically speaking very informative. Similar cautions are required for comparisons with POAM data, comments need to be added concerning this issue.

In the Odin/NDACC section a misplaced sentence create a misunderstanding. In our average Odin/NDACC and Odin/POAM III intercomparisons no warning has been provided for comparsions close to vortex edge. In these two cases no selection on the potential vorticity criteria has been applied. We have only provided these warnings in our individual comparisons to investigate the origin of the fine structures observed in the balloons profiles. We have added some sentences or words in order to clarify in the section 3.2 (POAM III) and in section 4.1 (NDACC).

(4) Page 735, quality flag have been mentioned. The range and the origin of such



ACPD

8, S1249–S1257, 2008

Interactive Comment

proxy need to be given. In this section 0,75 is used as threshold while in the conclusion the 0 value was mentioned and 0,75 was associated with the quantification of a priori information. These flags need to be better explained and clarified.

Additional information has been added in section 3.2 to give a better explanation to the 2 data selections based on the quality flag and the measurement response.

(5) Page 748 Consider providing a pertinent scientific reference for Mimosa description

The reference Hauchecorne (2002) is a really good description of the Mimosa model. We have added this reference in section 4.3 (p 748).

(6) Page 753 Consider including an acknowledgement for NDACC data. You will see the required standard sentence in the NOAA-NDACC web site.

We have changed the acknowledgement for the NDACC data and used the required standard sentence from the NOAA-NDACC website.

Referee #3

(1) Specific comments: One important comparison was left out, namely, the comparison between SMR and OSIRIS profiles. This basic information helps to interpret the comparisons with other profile data, cancels out any spacecraft pointing errors, and will verify if the SMR and OSIRIS error propagation models are adequate. I did not see a reference to this comparison, so perhaps this would be a good place to publish it.

Very pertinent comparisons of the two Odin instruments have been achieved by S. Brohede et al. in 2007. We forgot to mention this important work at the end of section 2. In this section we summarized all the recent studies concerning the validation of the SMR ozone data except the Brohede et al. (2007) article. This mistake has now been corrected.

(2) Assuming that the differences between Odin and other data are significant, you should include a discussion of possible sources for the differences. In the middle and



ACPD

8, S1249–S1257, 2008

Interactive Comment

upper stratosphere a small error in altitude would produce a large error in mixing ratio. What altitude error would explain the bias relative to POAM? Are these altitude biases within the error budget of Odin? If not, how do you explain these errors?

We discussed of altitude biases with POAM III in section 3.2 (p 738). These biases are not within the error budget of Odin and are not really understood. A new version of the OSIRIS data could be the opportunity to verify if such a gap persists compared to POAM III data. Concerning the systematic bias detected in the CTSO SMR v222 data in the 20-30 km altitude range this origin is clearly related to the employed retrieval methodology, because it was not found in the Chalmers SMR v2.1 data.

(3) Can you summarize the performance of SMR and OSIRIS relative to the other instruments? Are we to understand that the differences between Odin and the other instruments are due to differences between those instruments or just due to small sample sizes?

In the conclusion we have summarized all the performances of the SMR relevant to the other instruments. We consider that this summery is sufficiently clear.

(4) The SMR and OSIRIS mixing ratios are biased low compared with the other data. Should the users attempt to remove this bias?

We do not advise to remove the bias detected in the Odin data. The more appropriate attitude is to use the Chalmers SMR v2.1 data as they are, because these data are the Odin product the closest to the other data.

(5) Figures 2, 9, and 13 show a much smaller scatter from comparison data for OSIRIS than from SMR. How do you interpret this difference?

The smaller scatter for OSIRIS is primarily due to the fact that the OSIRIS retrievals are more precise than the SMR ones since the OSIRIS measurements (on an individual basis) are less 'noisy'.

(6) typos.



ACPD

8, S1249–S1257, 2008

22 typos were corrected.

Referee #4

(1) This paper brings together a substantial number of diverse data resources in the validation of the ODIN measurements. It will be a useful addition to the literature. However, it is unfortunate that there are no comparisons to major satellite data sets that have wider latitude coverage than POAM. An example would be SAGE-II, which has provided well-regarded measurements that have been used in numerous ozone trends analyses.

We chose to compare the SMR data to the POAM III data to have a consistent validation process in regard to the Petelina work on the OSIRIS validation (Petelina, 2004).

(2) Figure 9 has a curious feature that looks like the thumb on a mitten. That is, there is a concentration of OSIRIS values at about 4 ppmv while the corresponding microwave values vary up to 7 ppmv. A similar feature is seen in the OSIRIS/ozonesonde scatterplot. If the reason for this feature is known, it would be useful to include it in the discussion of the feature.

This discrepancy is the consequence of the low quality of the maximum altitude values of several NDACC measurements. This feature is not detected in the SMR/NDACC scatterplot because of the large oscillations in the individual SMR profiles. This comment has been added to section 4.2.2 (p 745).

(3) Some experimenters include in their data products altitudes at which their instruments do not provide easily interpreted data, i.e. altitudes outside the range where the averaging kernels peak at or close to their nominal altitudes. If such data are included in the figures, the plots should be cut off at the altitudes at which the averaging kernels "pile up" to avoid confusion.

Only good quality measurements have been retained with measurement response larger than 0.75 to ensure a minor contribution of the climatological a priori profile



ACPD

8, S1249–S1257, 2008

Interactive Comment

in the retrieved value. In general SMR profiles show measurement responses larger than 0.75 above 20 km but in some cases down to 10 km. We show comparisons in the 10-60 km range keeping in mind that profiles below 20 km are averaged over a smaller number of profiles. Numbers of profiles indicated on the different figures concern the 20-60 km range.

(4) It would be easier to follow the discussion if altitudes were given in consistent units throughout the paper. The figures all show geometric altitude, but the text sometimes gives altitudes as pressure levels. If pressures are the preferred units, perhaps the approximate geometric altitudes could be shown after the pressure levels in parentheses, or typical pressures shown on the right hand ordinates of the profile plots.

The approximate geometric altitudes are now shown after the pressure levels in parentheses.

(5) The phrase "below 10 hPa" in the conclusions can be misinterpreted - it could mean "at pressures below 10 hPa" or "at altitudes below that at which the pressure is 10 hPa".

This sentence has been changed in the conclusion.

(6) Because the mixing ratios in an ozone profile vary by more than an order of magnitude, I think it is preferable to quote profile differences in relative rather than absolute terms. An absolute difference of less than, e.g. 0.5 hPa, might be considered good agreement near the ozone peak but poor agreement in the mesosphere or lower stratosphere. In the conclusions, around line 14, page 752, the statements "SMR V222 profiles are found to be lower..." and "This positive bias..." appear to be conflicting.

It is a personal choice to use absolute values in the comparisons. The values shown in the different tables are averaging over two altitude ranges 20-35 and 35-60 km. I think it is easier to compare average difference in absolute rather than in relative terms. But I agree with the referee's comment and it is the reason why I plotted systematically for each comparison the difference profiles in absolute and relative terms (figures 3, 4, 5,



ACPD

8, S1249–S1257, 2008

Interactive Comment

7, 8, 10, 11 and 12).

In the conclusion a real conflict has been revealed by the referee. We have corrected the adequate sentence.

(7) The discussion in the first few lines of page 753 should be clarified, particularly in terms of which comparisons it refers to.

The first few lines of page 753 have been rewritten to clarify the discussion about the quality SMR v2.1 data.

Author

1) 3 articles have been added to the reference list.

Barret, B., Ricaud, P., Santee, M.L., Attié, J.L., Urban, J., Le Flochmoën, E., Berthet, G., Murtagh, D., Eriksson, P., Jones, A., de La Noë, J., Dupuy, E., Froidevaux, L., Livesey, N.J., Waters, J. W. and Filipiak, M. J.: Intercomparisons of trace gases profiles from the Odin/SMR and Aura/MLS limb sounders, J. Geophys. Res., 111, D21302, doi:10.1029/2006JD007305, 2006.

Pommereau, J. P. and J. Piquard, Ozone, Nitrogen dioxide and Aerosol vertical distributions by UV-visible solar occultation from balloons, Geophys. Res. Lett, 21, 1227-1230, 1994.

McLinden, C.A., V.E. Fioletov, C.S. Haley, N. Lloyd, C. Roth, D. Degenstein, A. Bourassa, C.T. McElroy, and E.J. Llewellyn, An evaluation of Odin/OSIRIS limb pointing and stratospheric ozone through comparisons with ozonesondes, Can. J. Phys., 85, 1125-1141, 2007.

2) A new acknowledgment has been added : "...(Tekes) and is since 2007 supported by the European Space Agency (ESA)."

3)



ACPD

8, S1249–S1257, 2008

We corrected the date of the second SAOZ flight on the section 4.3 (Large-balloon-borne experiments): "The first flight was performed at sunrise (20 km tangent height at 9:00) 4 h ahead SMR, whilst the second was at sunset (20 km tangent height at 22:00), 9h20 after SMR".

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 727, 2008.