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## ***Interactive comment on “Validation of ACE and OSIRIS ozone and NO<sub>2</sub> measurements using ground-based instruments at 80° N” by C. Adams et al.***

**Anonymous Referee #3**

Received and published: 15 March 2012

General comments:

This paper deals with a comprehensive comparison of satellite ozone and NO<sub>2</sub> measurements by OSIRIS/Odin and ACE/FTS, ACE/MAESTRO with several different ground based instruments including DOAS, SAOZ, Brewer spectrometers as well as a Fourier Transform Spectrometer operated at the PEARL station at Eureka in Northern Canada.

I have no really major objections to the publication of this paper, but ask the authors to consider the following comments. I would also like to point out that I find the paper very well written and easy to follow.

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I have three general comments:

1. In terms of the FTIR NO<sub>2</sub> measurements only partial columns were used for the comparison with the satellite instruments. The latter are characterized by a fairly good vertical resolution, which is probably not the case for the FTIR observations. The question is, whether this difference in vertical resolution is dealt with in some way?
2. The abbreviations used for the different data sets are somewhat confusing. In several cases "G1", "G2" appear in the figures, but in the main text "GBS-vis", "GBS-UV" etc. are used to discuss the Figure. This isn't a really big point, but the paper would be easier to follow if only one set of abbreviations would be used. Wouldn't it be possible to use, e.g. "GBS-vis" and "GBS-UV" for the Figures?
3. The quality / resolution of Figures in the ACPD version not very good. Perhaps this is a feature of the ACPD version, and not of the original figures. If this is an issue with the original figures, please increase the resolution of the figures.

Specific comments:

Page 520, line 5: "and/or in the coincidence criteria". What would possible systematic errors in coincidence criteria be?

Page 528, line 21: "the average fitting errors". It's not entirely clear to me what you mean by "fitting errors" here. Are these the random errors in the retrieved partial columns associated with the spectral fit in combination with the random noise on the measured spectra?

Page 535, line 11: "The lower value of this range was determined by GBS partial columns, which range from 17 km to the top of the atmosphere." How are the differences in vertical resolution between the FTS and satellite measurements treated? The vertical resolution of the satellite measurements significantly better than for the GB FTS.

Page 536, 1st paragraph: Have the model results been degraded to the vertical reso-

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lution of the instrument with the worst vertical resolution? Probably not. This may be important for the GB profiles with poorer vertical resolution, and this aspect should be discussed in more detail.

Page 537, line 18: "When applied to the ACE profiles used in this study .." It's not entirely clear (at least to me) what this part of the sentence refers to. What is applied to the ACE profiles?

Page 539, lines 7/8: "The agreement .. IS similar .."

Same sentence: Considering the differences between your results and the other published results discussed in the following sentences, I'm not sure how similar the different results are. Perhaps the sentence should be changed?

Page 540, line 20: "using the new NDACC settings". This phrase may suggest that for the results presented in the previous section the new NDACC settings were not used (which is probably not the case). Perhaps you can add a brief clarifying statement.

Page 542, line 19: "The agreement in Hendrick et al. (2011) is better than the present study for several possible reasons." Another reason can certainly be that the satellite data products compared in the Hendrick paper are all dedicated total ozone column retrievals (from nadir sounders). Here you use limb profilers and integrate the profiles.

Page 542, last line: "(see Fig. 7)". Fig. 7 does not show comparisons with the Bruker instruments. This should probably refer to Fig. 8?

Page 543, line 3: "The comparisons worsen for 14–52 km partial columns, to  $-3.3\%$  for OSIRIS minus Bruker FTIR,  $-12.2\%$  [ $-9.6\%$ ] for ACE-FTS v2.2 [v3.0] minus Bruker FTIR, and  $-11.2\%$  for ACE-MAESTRO minus Bruker FTIR." Here again the issue with the vertical resolution of the FTIR measurements arises. Can one simply compare the FTS profile (having poor vertical resolution) above 14 km with the satellite profiles (having much better vertical resolution). I'm not sure how this should be done properly, but this issue should at least be discussed, and/or its impact on the comparisons

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estimated.

Page 544, line 2: "NO2 17–40 km partial column measurements made by the ground-based". Sorry, I think I'm missing something here. I thought the 17-40 partial column is retrieved by the FTS, but the other ground-based instruments retrieve the total column?

Page 545, line 16: "The GBS measures partial columns from 17km to the top of the atmosphere". OK, that wasn't clear to me. I couldn't find any information on that in the earlier sections.

Page 558, line 16: "Thomasson" -> "Thomason"

Page 558, Burrows reference: Journal title incomplete and spelling incorrect

Page 560, Fraser 2009 reference: Is the journal title complete?

Page 562, line 11: "Proeedings"

Page 563, line 25: "McConnel" -> "McConnell"

Page 564, line 13: "No2" -> "NO2"

Page 564, Piters reference: has already been accepted by AMT.

Page 566, Sung reference: journal title complete?

Page 577, Caption of Fig. 5, and line 3, page 538: "Evening twilight is defined as SZA = 90 deg or the nearest available SZA for the given time of the year." I'm not sure I understand this sentence. During spring and fall, when the sun rises and sets, SZA = 90 deg occurs 2 times per day. In this case you're using SZA = 90 deg for the model simulations, right? During polar summer, when the sun does not set, you use the largest SZA. Is that the correct interpretation? It would be good to mention this explicitly, and the crucial point is that the same SZA values are used at the different latitudes outside of polar summer.

Page 568, Table 2: More detailed information on the meaning of the errors would be

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useful. Are these values comparable?

Fig. 7 and 8: I suggest adding a few minor y-axis marks to all panels of these plots

Fig. 9, panel a): The slope of the linear fit is “m=1”. Is it really “1.000” ? I suggest listing the slopes with the same number of digits in all panels. Perhaps you are only listing the significant digits (which could explain, why 2 or 3 digits after the decimal point are listed).

Fig. 13: The number of digits of the slopes differs from panel to panel. Is this intended?

Fig. B1, caption, line 2: “as a function of altitude” -> “as a function of scattering altitude” ?

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