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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A long term study of polar ozone loss derived from data assimilation of Odin/SMR observations" *by* Kazutoshi Sagi and Donal Murtagh

Anonymous Referee #1

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Sagi et al. apply 12-years of Odin/SMR ozone measurements for deriving ozone loss and ozone loss trends in the Northern and Southern Hemisphere. They apply the data assimilation technique described in Rösevall et al. (2007). Internal comparisons as well as comparisons to other data sets have been performed. Overall, the paper presents valuable results, but lacks in writing up of the results. There are a lot of small issues which could have already been resolved before submission. Major revisions are necessary before the paper can be published in ACP.

General comments:

1. It is not common to cite other studies in the abstract and it is also absolutely not

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Discussion paper

necessary. The sentences should be rephrased accordingly (suggestions will be given below). Further, the abstract reads like an introduction and should be thoroughly revised. Especially, the sentences discussing the comparison to other studies should be revised (L12-L19). From the text it does not become clear that these are results of the presented study. Why have these comparisons performed? What do we learn from these comparisons?

2. On several pages throughout the document the line numbering is messed up! Line numbers on one page are increasing and then decreasing again (“10” “15” “5” on page 16) or stuck to one value (e.g. “5” “5” “5” “10” on page 8). The manuscript should be more carefully checked before resubmission. It would probably help to just put the Figures at the end of the manuscript (behind the reference list) as it is the common style for manuscripts.

3. The Sections should be restructured. Section 4 should consist solely of Subsections 4.1-4.3 and renamed to e.g. “Vortex mean estimation and data quality assessment”. Section 5 would be consist then of three subsections: 5.1 Arctic ozone loss, 5.2 Antarctic ozone loss (would suggest to call it here loss as well rather than hole), and Section 5.3 should be called Arctic and Antarctic Partial Columns. Further, the result should be discussed referring more clearly to the three classes cold, warm and intermediate.

4. A conclusion section should added. What have we learned from this study? How can your results be utilized in future studies?

Specific comments:

P1, L5: This is the only reference that may be used in the abstract, but nevertheless the sentence could also e.g. be written as follows without necessarily needing to cite the Rösevall study: “We apply an improved version of the previously used data

assimilation technique, therefore allowing us to study the inter-annual variability during the entire Odin period".

P1, L5: What improvements have been made?

P1, L12: rephrase sentence as follows: ". . ..in the Southern Hemisphere differences larger than 50
P1, L12: rephrase sentence as follows: "In our study we find that 544 GHz ozone is . . .."

P1, L14-16: References should not be used in the abstract and the text would be more concise and better readable when shortened a bit. Therefore, I would suggest to rephrase the sentence as follows: "Comparisons with other studies were performed using consistent estimates of ozone depletion from SCIAMACHY (Scanning Imaging Absorption SpectroMeter for Atmospheric CHartografY)." Nevertheless discussing the results of comparisons shown in previous studies are obsolete in the abstract.

P1, L16: It is not clear to what the time period refers to. Is it meant that the comparison was performed for the time period 2002-2009 or that the data was available from 2002-2009?

P1, L18: MLS has not been introduced yet. Further, referencing the Kuttipurath study should be removed from the abstract and the sentence should be rephrased e.g. as follows: The comparison of Antarctic ozone depletion with MLS (Microwave Limb Sounder) shows an agreement in the derived ozone loss within 0.1 ppmv. As mentioned above discussing the results of previous studies in the abstract is obsolete. Thus, it would be better to move these sentences to the introduction.

P1, L21: Why not just name the classes cold, warm and intermediate winters.

Using the expression “Intermediate winters between cold and warm” is quite confusing.

P1, L22: As in the SH? Do you really mean as in the SH or should it just read in the SH?

P1, L20-P2, L2: The results should be presented in a better (more structured) manner. What are the results for each of the three classes and the Northern and Southern Hemisphere, respectively? How large is the column loss for the NH?

P3, L1: The abbreviation PT for potential temperature should be skipped throughout the manuscript.

P3, l2: This holds for both hemispheres and thus the sentence should read “. . ...Arctic and Antarctic ozone depletion.”

P4, L10: To the DIAMOND description a few sentences should be added stating what improvements have been made to the DIAMOND model and that these had been already applied to the 2009/2010 winter in the study by Sagi et al. (2014).

P4, L17ff: The text does not fit to the Figures. Why is for the Arctic only 501 GHz shown and for the Antarctic 544 GHz? There are now assimilated results shown in the Figure. How can you than state (L25) that the assimilated results show the same differences?

P5, Figure 1 caption: “2010/03/05 (YY/MM/DD)”. Why so complicated. Why don’t you write the date as “25 March 2010” in the caption?

P6, Figure 2 caption: Same here. Why not just writing the date as 20 September 2002?

P8, L9: On this page something went wrong with the line numbering. There is three times line number 5 marked. In “line 9” it should read: . . . . . with differences of approximately 0.5 ppmv.

P8, L12-14: This is not clear. Why does than get more information in higher altitudes when the vertical resolution is higher?

P9, L5: What do you mean with active ozone? Do you mean assimilated ozone?

P8, section 4.3: SMILES has not been introduced yet.

P9, L6: I guess you mean “in” Section 4,.4?

P10, Figure 6 caption: It should rather read “We excluded the results of the 2002 Antarctic winter. . . . .”

P10, L15-L16: Add years for the time periods the Rösevall and Sonkaew study were performed.

P11, Figure 7 caption: Same as above. Add the years.

P12, L28-30: This is not clear. I thought you used a vortex mean. In that case air from outside the vortex should have no influence.

P12, L15: This sentence should be rephrased so that it becomes clear what the authors want to say.

P14, L33: This sentence is a general explanation why ozone is destroyed, but does not explain why the largest ozone loss occurred in 2010/2011.

P15, L1: This sentence is misleading and should be rephrased.

P15, L2: What do you mean with NOx increase inducing ozone loss? Do you mean NOx driven ozone loss?

P15, L11: The reference to the study in preparation should be given.

P15, section 4.4.2., line 9: For which time period? Over the last years? Please clarify.

P16, L13: What is the Ap Index? What does it describe? How is this index derived?

P23, L25: The third class should be just called “intermediate” and all three classes should be put into quotation marks.

Technical corrections:
P1, L7: line break not correct
P1, L12: space between “Hemisphere” and “more” is missing.
P3, L11: Space between “Section” and “4.3” is missing.
P3, L16: It should rather read “ . . ..affected not only by chemical processes but also by transport.
P4, L6: Space between number and unit is missing.
P4, L23: “of” is obsolete.
P4, L24: space between measurements and full stop obsolete.
P6, Figure 2 title: It should read -83.1 S (not North!)
P7, Figure 3 caption: include “its” so that it reads “. . .. . .gradient of potential vorticity

has its maximum. . .. . .”
P7, L4: It should read Hemisphere instead of Hemispheres and a comma after respectively should be added.
P9, last line: remove space between closing bracket and full stop.
P10, L16: remove space between closing bracket and full stop.
P11, L18 and 20: Add model after DIAMOND, so that it reads in both cases DIAMOND model.
P11, L20: remove space between closing bracket and full stop.
P11, L21: Please correct the sentence as follows: This discrepancy in ozone depletion is not only found for the 2004/2005 winter but also for the other Arctic winters.
P12, L34: Please correct the sentence as follows: This value is lower than in other studies not using. . .. .
P12, L12: Please correct the sentence as follows: We have also compared ozone loss estimates for the Southern Hemisphere with the results from Kuttipurath et al. (2015). . ...
P15, L4: It should read: . . ..Arctic ozone loss using POAM (. . ...) and MIPAS (. . .. . .) measurements in 2002/2003. P15, Section 4.4.2, L8: Space between studies and citations is missing.
P15, Section 4.4.2, L18: either an “:” should be put between instruments and Environment satellite or the sentences should be connected by namely, the. . .. .
P16, last line: rephrase as follows: . . ..presented by Fytterer et al. (2015) but supports their hypothesis.
P17, first line after Fig. 11: “the partial column of ozone and depletion” should rather read “the partial column of ozone and the column ozone loss”.
Table 1 caption: Add “N” so that it reads 70 N.
P19, L3: Space between number and unit is missing.
P19, first line of the last paragraph: It should rather read: “In the Southern Hemisphere, the change in stratospheric ozone from year to year. .. . . .”
P21, last line: “altitudes” instead of height”.

P22, Table 2 caption: It should read “ozone loss” rather than “ozone hole”.
P22, Table 2 caption: Add “S” so that it reads 70 S.
P22, L22: It should read “. . .. . .., while being 0.3 ppmv lower than. . .. . ..”
P23, L26: Add “ozone” so that it reads: “The maximum ozone depletion. . .. .”

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