Response to Anonymous Referee #2

We thank the referee for the constructive comments and address them point-by-point. The comment is copied below in normal font, and the response is in italics.

The paper has been re-organized in order to make the focus on SCIAMACHY L1 evaluation clearer: the part on the Antarctic ozone hole has been removed from the paper, and the Appendix has been incorporated into the main text. A new figure showing profiles of the DFS for all seasons and two representative years has been included.

The textual changes are indicated in colored text in the manuscript version showing differences.

General comments

1. The authors retrieved nadir ozone profiles from SCIAMACHY, validated their results with ozonesondes and applied their data in the study of ozone hole in the Antarctic region during 2003-2011. This paper is ambitious to include retrievals (including slit function), validations and applications of SCIAMACHYs nadir ozone profiles. However, the focus of this paper is too broad, and unfortunately, many aspects were not well described and/or discussed. I think this paper could be separated into two papers at least: one validation paper and one application paper. In addition, the presentation of this paper could be significantly improved. Therefore, this paper needs a major revision to meet AMTs publication requirements.
   Author Response:
   We have followed the suggestion of the reviewer: we have narrowed down the focus of the article to the evaluation of SCIAMACHY L1 data by validation of ozone profiles. We removed the application to the Antarctic ozone hole. We have furthermore drastically improved the text. The title has been changed accordingly. This was a major revision. See also response 1 to Referee #1.

2. This paper simply used 1000-100 hPa and 100-10 hPa to separate the stratosphere and troposphere. Please use the tropopause pressures. Because tropopause pressures have strong temporal and spatial variations, a simple 100 hPa separation could lead many scientific errors.
   Author Response:
   We decided that this improved strat/trop separation was not needed anymore, since we changed the scope of the paper to L1 evaluation. We removed the analysis of the Antarctic ozone hole. In the validation part of the paper we still separate between 1000-100 and 100-10 hPa regions.

3. In Section 3, does OPERA have a slit function in the retrievals? Or did you apply a new slit function rather than the original slit function that improve the retrieval performance?
   Author Response:
   In Section 3: The OPERA retrievals of the paper use the default slit function provided with the SCIAMACHY L1 data. We did not apply the new slit function to the ozone profile retrievals. Please see response 3 to Referee #1.

4. In Section 5, it is a clever idea to show the validation results in different latitude bands, as 90N-30N, 30N-30S and 30S-90S. However, it would be better to separate 90N-30N and 30S-90S latitude bands to 90N- 60N, 60N -30N and 30S-60S and 60S-90S. This is because satellite retrievals have a deficient performance at high latitude regions due to the large solar zenith angles. In the midlatitude, satellite retrievals usually are good.
   Author Response:
   Agreed. We now separate the results for 90N-30N and 30S-90S latitude bands into 90N-60N, 60N -30N and 30S-60S and 60S-90S bands. See Sect. 4 in the revised paper.

5. Figure and table captions are too brief to understand. Appendix A needs more discussions. The validation results are clearly less noisy and smoother for the case where the AK was applied to the ozone sondes. Why?
   Author Response:
   Agreed. We have reworded and improved figure and table captions. We have included the appendix on the AK in the main text. The AK convolved validation results are smoother, because the comparison takes into account the resolution of the satellite retrieval. This is explained at the end of Sect. 4.

Specific comments

Please note that we do not comment on all Antarctic ozone analysis comments, since we removed this whole section and related text elsewhere in the paper from the revised version.

1. Page 1 Line 24: Tropospheric ozone could also come from the stratosphere.
   Author Response:
   Agreed. Text has been corrected.
2. Page 2 Line 7:. . . the ozone trend layer. . .. Did you mean ozone layer trend?
   Author Response:
   Yes. Text corrected.
3. Page 2 Line 9 12: Please add references to the descriptions and discussions of ozonesondes.
   Author Response:
   We added the suggested references on ozonesondes.
4. Page 2 Line 16: Please add references for IASI and TES.
   Author Response:
   We added references on IASI and TES.
5. Missing version numbers of L1 data on Page 3 Line 34 and on Page 3 Line 2.
   Author Response:
   The version numbers are now given.
6. Page 3 Line 7: It is the first time you use OPERA in your text, except the abstract. Please specify the full name here.
   Author Response:
   Full name of OPERA is now specified in Sec. 2.2.
7. Page 5 Line 9: The link to describe goes to V8mfac, please revise the link.
   Author Response:
   We corrected the link.
8. Page 5 Line 17: difference between this version with the ones above: : :. Please change with to and.
   Author Response:
   Text corrected.
9. Page 5 Line 24: It would be a good idea to have a paragraph to describe briefly the retrieval theory in Rogers (2000), like van Peet et al. (2014) did. van Peet, J. C. A., van der A, R. J., Tuinder, O. N. E., Wolfram, E., Salvador, J., Levelt, P. F., and Kelder, H. M.: Ozone ProfilE Retrieval Algorithm (OPERA) for nadir-looking satellite instruments in the UVVIS, Atmos. Meas. Tech., 7, 859-876, doi: 10.5194/amt-7-859-2014, 2014.
   Author Response:
   Agreed. Description has been added to Sect. 2.2.
10. Page 5 Line 25: : : : using UV and Visible wavelengths. Did you mean UV wavelengths here?
    Author Response:
    Yes, this is now corrected.

11. Page 10 Section 4.1:

1. I think it is a good idea to also include satellite retrieved ozone profiles (for) 2002 and 2012 in your validation, although you have (not) the entire year data.

2. Why did you only present mean profiles in 2003 and 2009? Could you list annually mean retrieved ozone profiles from 2002-2012 (or 2003-2011)? It would indicate the temporal variation of ozone profiles based on different level 1 data, and the instrument degradation.

Author Response:

(1) We do not include 2002 and 2012, because there are only a few months of data for those years which is not sufficient for validation.

(2) The two years 2003 and 2009 were chosen to show the effect of degradation. We did not make figures or tables for all the years, to not increase the size of the paper unnecessarily. The year-to-year variation of retrieved ozone profile quality is shown in Fig. 7.

12. *Page 11 Line 4*: The ozonesonde ozone profiles have different top pressures because of some early burst balloons. Did you apply correction factors to ozonesonde profiles? Some ozone data processes should be described here.

Author Response:

Correction factors to ozonesonde profiles are indeed applied. Ozone data processes are described a bit more, but the details are already described in van Peet et. al. 2015 to which we refer.

13. Page 11 Line 10: Please specify the equation of average kernel convolution. And why did you need to convolve ozonesonde profiles with SCIAMACHY average kernels.

Author Response:

We now better explain the role of averaging kernels. See also response 6 to Referee #1.

14. Page 10 Line 29: ... the lower- middle stratosphere (100 10 hPa): : :. The lowermid stratosphere is roughly 100-10 hPa. But it is key to point calculate the tropopause pressures. I suggest including yearly mean tropopause pressure here.

Author Response:

See our response to General Comment #2 above.

15. Page 11 line 10: An ideal agreement between sonde and satellite would give a difference of zero at all layer heights. This is not necessarily true. Sometimes, small biases are because of retrieval information coming from the a priori due to the low satellite sensitivity in the lower troposphere.

Author Response:

Agreed. We removed the sentence.

16. Figure 3. Please convert x-axis ticks from year 0-8 to year 2002-2010 or 02-10.

Author Response:

We converted x-axis ticks from year 0-8 to 02-10.

17. Figure 4: In the right columns, please indicate that they are mean ozone profiles based on different level 1 data within the 10N and 10S region. And what do these dashed lines mean?

Author Response:

We have now clarified this.

18. Figure 5: Please add latitude and longitude ticks in the figures.

Author Response:

Added.

19. Figure 6: What kind of uncertainty did you plot here? Standard deviations?

Author Response:

The uncertainties plotted here are the 25-75 percentile differences.