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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simultaneous measurements of OClO, NO_2 and O_3 in the Arctic polar vortex by the GOMOS instrument" *by* C. Tétard et al.

C. Tétard et al.

cedric.tetard@aeronomie.be

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Reply to anonymous referee #2:

General comments: This is a review of the paper "Simultaneous measurements of OClO, NO2 and O3 in the Arctic polar vortex by the GOMOS instrument" by Tétard et al. The paper presents the retrieval of stratospheric minor species in the Arctic vortex stellar occultation measurements by the GOMOS instrument on Envisat. O3 and NO2 are already standard GOMOS products, and the focus in this paper is on the retrieval of OClO, which requires coadding of measured transmittances to improve the detection. The paper is wellwritten, and I recommend that it be published in ACP after

the following comments are addressed.

Reply: We are grateful to the referee's comments and suggestions.

Specific comments:

1. Page 12709, Line 9: Could you expand on the use of OClO to constrain chemical models, or at least supply a reference?

Reply: We have removed the end of the sentence line 9. Thanks to the referee's comment, we realized that, according to us, OClO is not used to constrain chemical models.

2. Page 12709, Line 19: You list a number of measurements of OClO that have been made in the past, but you should highlight the shortcomings of these measurements in terms of global coverage and/or vertical information, i.e. the motivation for this work.

Reply: According to the referee suggestion, the shortcomings of these measurements have been added in the manuscript.

3. Page 12710, Line 20: I suggest that you remove the last sentence of this paragraph and replace it with a comment on the importance of these OClO measurements even if they are not validated (e.g. the limited amount of OClO data available).

Reply: The last sentence of this paragraph has been removed and replaced by a comment on the importance of the OClO measurements ("Even if these OClO measurements are not validated, this article highlights the capabilities of GOMOS to ensure a global monitoring of OClO and NO2 during nighttime.").

4. Page 12711, Line 23: I am not clear about whether the OClO retrieval presented here is the same method used by Fussen et al. If it is indeed the method used by Fussen et al., this should be specifically stated. If not, some discussion about the differences in the approach should be added. Also, somewhere you should mention what the predicted accuracy of your measurement are.

Reply: This is the same method as those used by Fussen et al. . The only difference is the use of normality tests to check the homogeneity of each bin. This has been added at the beginning of section 3 (“The method used here to retrieve OClO is the same as those used by Fussen et al.”).

5. Page 12711, Line 24: When averaging data over the period of one month, is interpolated onto an altitude grid sufficient to not introduce any artifacts in the data? You should consider interpolating in potential temperature, which should give a more consistent grid.

Reply: Indeed, the interpolation onto a common altitude grid could induce some errors but the use of normality tests at each altitude of this common grid (and at each wavelength) and the use of median transmittances (instead of mean transmittances) allow to avoid artifacts. Furthermore, the consistency between the NO2 slant column densities obtained from our DOAS method and those obtained from the operational algorithm indicates that there are no artifacts in the data (cf Fig. 1). It is true that the use of potential temperatures should give a more consistent grid but the use of a common altitude grid gives also (for this study) consistent results.

6. Page 12713, Line 3: Please specify the absorption cross sections that you used.

Reply: The corresponding references (Orphal et al., Merienne et al. and Wahner et al.) have been added in the text and in the bibliography.

7. Page 12713, Line 7: Is there a reference for the GOMOS operational algorithm?

Reply: This has been added in the text and in the bibliography.

8. Page 12713, Line 4: Although you show that there is good consistency between your results and the GOMOS operational algorithm, I am not sure that this really says anything about the accuracy of the OClO results since the error sensitivities, etc. could be very much different.

Reply: We agree that the good consistency between our NO2 results and those from

the operational algorithm does not induce that our OClO product is quite accurate. Nonetheless, we think that this consistency shows that our algorithm works well. We have modified the sentence line 13/14 to explain this in a better way (“We can therefore conclude that the NO2 SCDs retrieved from both algorithms are consistent and that our DOAS algorithm works well.”).

9. Page 12713, Line 14: Again, did Fussen et al. use the same retrieval method as is presented here?

Reply: The retrieval method is the same. (cf. the answer to the comments number 4). 10. Page 12713, Line 21: Rather than referring to a web site, please add some references to the literature about the 2007/2007 winter.

Reply: According to the reviewer suggestion, we have changed the web site reference by a literature reference (Kuttippurath et al., 2009).

11. Page 12714, Line 8: I understand that the white circle in Fig 2 represents the GOMOS measurements, but why not plot the actual locations?

Reply: The latitude of the GOMOS occultations used are between 71.5 and 72.9° north over all the longitude range. We think that this white circle around 72° north is sufficient to show where the GOMOS occultations (from Sirius) occurred in January 2008.

12. Page 12715, Line 9: You do not mention the role that dynamics might be playing in your interpretations of the retrievals. For example, to what extent is the decrease in ozone in Figure 5 due to dynamics rather than halogen activation?

Reply: We agree. Our study can not allow to distinguish the part of dynamics and the part of chemistry in the slow decreasing of ozone in the polar vortex. This has been added in the text (“Nonetheless, the role of dynamics in this observing ozone decreasing can not be highlighted by our study.”).

13. Page 12716, Line 4: You mention errors bars here, but where do they come from and what is included?

Reply: The error bars represent the estimated retrieval error in the DOAS process (they are extracted from the jacobian). It is specified in the section 3.

14. Page 12717, Line 5: Again, please refer to papers in the literature about the 2004/2005 arctic winter.

Reply: A reference has been added (Kleinböhl et al., 2005)

15. Page 12717, Line 23: I am not sure that the behavior of OClO that you are seeing in 2005/2006 is that different from what you have seen in other years, where OClO is fairly constant in mid to late January.

Reply: We agree that OClO is fairly constant in mid to late January 2006. Nonetheless, we wanted to highlight in this section that the increase in NO2 observed during January 2006 is not simultaneous with a decrease of OClO as it is observed for the previous years.

16. Page 12718, Line 1: Given the poor quality of the 2007/2008 data (very large error bars), I am not sure that you can conclude anything from this data. Is there any reason why you did not carry out any longitudinal discrimination here, perhaps by looking at the potential vorticity?

Reply: We agree. The 2 last sentences of this section have been removed. We have not performed longitudinal discrimination for the study of the temporal evolutions because there is not enough measurements in a spatio-temporal bin with a 2 days resolution to increase sufficiently the signal-to-noise ratio to retrieve OClO. This is explained at the beginning of section 5 ("no longitudinal separation (like in the previous section) has been done because the number of measurements available is not sufficient to perform spatio-temporal binning with a two days resolution.")

17. Page 12718, Line 24: I am not sure that you have shown that you can measure the degree of halogen activation with your measurements since you do not quantitatively relate this to what you measure.

Reply: We agree that we can not measure the degree of halogen activation with our measurements. The word "degree" has been removed.

18. Page 12719, Line 3: Perhaps you can elaborate a bit on how you will go about validating your OClO product. I assume that it will be complicated by the strong diurnal variation?

Reply: We have added in the text a few words about how to validate the measurements ("Nevertheless, these instruments perform daytime measurements so it will be necessary to model the diurnal variations of OClO. Direct comparisons will be possible only with the profiles retrieved from the SALOMON (Spectroscopie d'Absorption Lunaire pour l'Observation des Minoritaires et NOx, Renard et al., 2000) balloonborne instrument (lunar occultation method).")

Typographical Errors, Etc. All the typographical errors have been accounted for and changed in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 12707, 2009.