Answer to RC1:

Reviewer comments are given in black and author answers are in blue. Changes in the revised manuscript are marked in red.

This manuscript presents a validation exercise for the GOME2-A and GOME2-B OClO data product using OClO SCDs measured at 9 high latitude NDACC stations. Given the range of parameters used in the different data analysis approaches undertaken by the individual research groups for each of the stations, the sensitivity tests performed as part of this study are essential for a meaningful outcome. The authors found that the total uncertainty for the OClO data sets investigated in this study ranges from about 26% to 33% for the different stations. They furthermore found that satellite and ground-based data sets show a good agreement for the inter-annual variability and the overall seasonal behaviour at the different sites. But they also found a median bias of about -2.2x10^{13} molec/cm2 over all stations for both GOME-2 instruments with individual biases up to 8x10^{13} molec/cm2.
The validation study is comprehensible and clearly presented in the manuscript, and the authors also provide a more in-depth description of the three sensitivity tests in Appendix A2. The paper is definitely recommended for publication in AMT after the specific comments below have been addressed.

Answer: *We thank the reviewer for his useful comments and suggestions. We answer to each point below.*

Specific comments:
Page 1, line 1: '… produced within the …' *-->done*
Page 1, line 3: Only measurements up to 2016 are discussed in this paper. Why was this study not extended to include at least some data from the most recent 5 years (2017 – 2021)?
Unfortunately, these GOME-2 data are from a data record that has only been produced until 2016 (see https://acsaf.org/datarecords/oclo_vcd.php) and therefore the corresponding data for the 2017-2021 period do not exist. The following modification has been included in the text:
"using the GOME2-A and -B instrument~~s~~ measurements covering ~~over~~ the 2007-2016 and 2013-2016 periods, respectively."

Page 1, lines 6-13: The uncertainty for the ground-based data sets is provided in the abstract as a percentage (lines 6/7) while the bias between ground-based and satellite data is given as an absolute number (lines 11/13). It would certainly be helpful if one of the two quantities could be provided as both, percentage and absolute value. That would make it easier to understand and interpret the information provided in the abstract, and it would put the retrieved bias and the uncertainty into context.
We thank the reviewer for this comment. The absolute uncertainty values are now also added in the abstract. As discussed in Sect 3.1.1 and Table 3, the random uncertainties are estimated for an SCD of around 15e13 molec/cm², so this SCD value is used also for the conversion from relative to absolute values of the other uncertainty sources. Therefore 25% maximum systematic uncertainty corresponds to 3.75 e13 molec/cm², and 26% to 33% total uncertainties correspond to about 4-5e13 molec/cm². The 4% to 16% expected systematic bias against GOME-2 correspond to about 0.6 to 2.4e13 molec/cm². These values have also been added in Sect 3.1.1.

Page 1, line 7: '… data analyses …' *-->done*
Page 2, line 19: '…associated with strong …' ' *-->done*
Page 2, line 35: '…its Amendments.' ' *-->done*
Page 3, line 51: delete 'study' ' *-->done*

Page 3, line57: '… mostly for a few … ' *-->done*
Page 3, line 59: 'In this paper, …' *-->done*
Page 3, line 60: Add space between 'AC' and 'SAF' *-->done*
Page 3, line 63: '… comparison method.' *-->done*
Page 4, line 92: Replace comma with space after 'orbit' *-->done*
Page 4, lines 90-93: Would be great, if you could give the reader an idea here regarding how big the amount in this bias correction is compared to actual OClO amount? E.g. how does this amount compare with the median bias quoted in the abstract.
This can be a rather important normalization/offset correction, which is needed because there can be (large) biases between the OClO SCDs from orbit to orbit (e.g. when the solar reference spectrum changes).
Typically, the offset can be can be a few (~1-4) e13 molec/cm2, but it seems to be corrected very well since it a systematic bias in the SCD on top of the OClO signal. Since there is no OClO at the lower latitudes, the large systematic bias can be accurately removed by this offset correction.
The following sentence has been added in the manuscript:
Typically, the offset can be can be a few (~1-4) e13 molec/cm2.

Page 5, Figure 1: It would really help with the readability of the plot if the text and legend would be bigger. Also add 'SCD' after 'OClO' in the caption.
The figure has been modified as suggested.

Page 5, line 96: Add comma after 'circumstances' *-->done*
Page 5, lines 103 & 105 & 107: Capitalize 'Hemisphere' when its used in combination with 'Southern' or 'Northern'. *-->done*
Page 5, lines 106 – 108: Not sure if I quite follow this interpretation here. For me, it looks more like GOME-2A for the NH starts with a baseline close to 0 for the first 3 years, then has a jump up in 2010 before it slowly drifts down again to a 0 baseline in 2016. GOME2-A for the SH starts negative, drifts up until in it is in the positive in 2010/2011, but then jumps straight down again in 2011/12 and stays in the negative.
Based on this comment, the discussion is now extended as follows:
"This is partly the case in the first years of measurements of each instrument, especially in the Northern Hemisphere, although some negative or positive offsets (of up to 4 to 5 x10^{13} molec/cm^2) and drifts appear for some of the years (e.g. 2010 in the Northern Hemisphere for GOME-2A). In particular, GOME-2A for the Northern Hemisphere starts with a baseline close to 0 for the first 3 years, then has a jump up in 2010 before it slowly drifts down again to a 0 baseline in 2016. For the Southern Hemisphere GOME-2A starts negative, drifts up until it is in the positive in 2010/2011, and then jumps straight down again in 2011/12 and stays in the negative."

Page 6, line 127: comma after 'From Table 2' *-->done*
Page 7, Figure 4 & Fig 4 caption: I like Figure 4, it's a nice visualisation of the different wavelength intervals used. To figure out which interval is used by which group, this can be identified via Table 2. Just to make it a bit easier, would it be possible to add the group names into Fig 4 straight behind the wavelength interval? Or alternatively, the group names could also be added in the caption e.g. in the order of appearance from top to bottom.
We thank the reviewer and we followed his suggestion of adding the group names in the caption of Fig. 4.

Page 7, Fig 4 caption: add 'analysis' after 'DOAS', just to clarify that this is not the wavelength interval each instrument covers but the interval each group uses for their data analysis. *-->done*

Page 7, line 138: 'Also, …' *-->done*
Page 8, line 139: Add comma after 'needed' *-->done*
Page 8, line 141: Just to be clear, water vapour should have been included but it was not, correct? Could clarify that in the text.
The NIWA analysis has considered water wapor for the OClO retrieval. We changed the "'should be" to "is" to clarify.

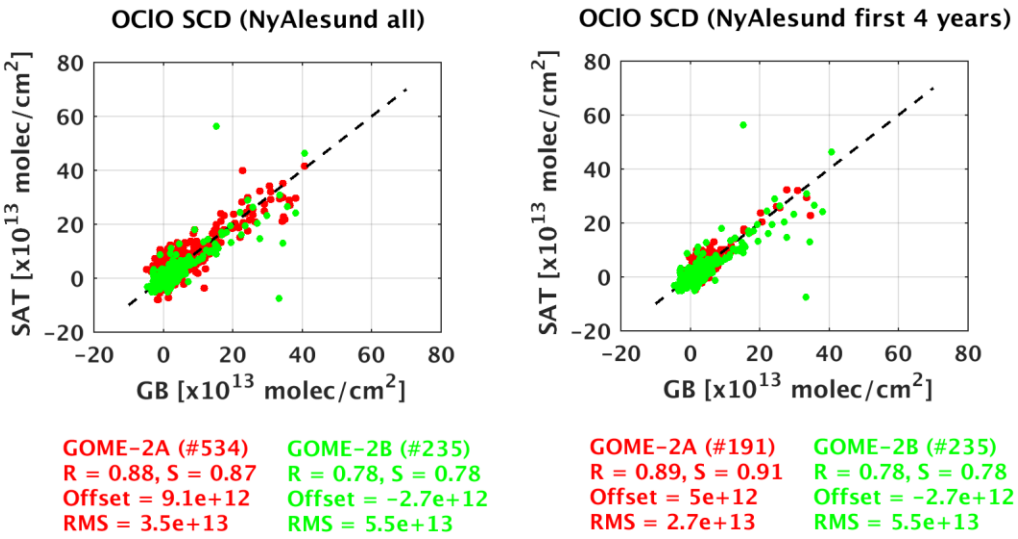
Page 8, line 146: 'In this section, …' *-->done*
Page 9, line 160-161: Is there any particular reason why Ny- Ålesund was chosen to be the test site?
Ny-Ålesund was used as a test case because (1) there was a close collaboration with the IUPB group for this OClO work and (2) the spectra are known as being of good quality. Spectra from the BIRA Harestua instrument could not be used as the spectral coverage was smaller (only up to 379nm, see table A1).

Page 9, lines 168: How were the median OClO SCD values determined, e.g. were any selection criteria applied?
The median OClO SCD values are, for each spectra, the median values of the OClO SCD retrieved with the different group's choices/cases. There were no specific selection criteria applied.

Page 10, line 192: '… lead to a systematic …' *-->done*
Page 10, line 205: '… used as input for…' *-->done*
Page 11, line 218: '… measurements at Arrival Heights. At this site, the …' *-->done*
Page 12, Figure 7 caption: '… the offset …' and delete 'of' before 'Neumayer' *-->done*
Page 13, line 238: delete the 2nd 'et al.' *-->done*
Page 13, line 242 – 244: The authors state: 'On average, over the 85° to 92° SZA range, the AMF difference is close to zero.' However, looking at Figure 8, this is still between 5% and -8% … is that accounted for?
The 5 to -8% difference on the AMF dependence on SZA is not taken into account in the present work, and could therefore explain part of the remaining differences between GOME-2 and ground-based SCDs. Fig. 17 shows that generally SCD_Sat< SCD_gb, for valid flags (ie >85°SZA), but this could be compensated in the VCD by the AMF. We should thus also have AMF_sat < AMF_gb, but Fig. 8 shows that this is only the case for SZA>88°. We added a comment in this sense also in Sect. 4.3 when also discussing potential explanations of the remaining differences, following reviewer 2 request.
"..). The impact of the AMF differences highlighted in Fig. 8 is also a multiplicative effect. The smaller satellite SCDs for valid flags (ie >85°SZA) found here compared to the ground-based ones, could be potentially compensated in the VCD by the AMF. Fig. 8 shows that AMF_sat is smaller than AMF_gb, only for SZA>88°. "

Page 14, line 247: '… OClO SCD measurements…' *-->done*
Page 14, line 252: '… mid-May…' *-->done*
Page 14, line 254: '… is larger in …' *-->done*
Page 14, line 255: '…OClO SCDs…' *-->done*
Page 14, line 260: 'At Arrival Heights, …' *-->done*
Page 14, line 262: '… mid-April…' *-->done*
Page 14, line 264: '…overpasses are …' *-->done*
Page 14, line 266: 'Each year, …' *-->done*
Page 15, Fig 9 & page 16, Fig 10 captions: '…there are no …' Same also for Figures 13 & 14 *-->done*
Page 18, line 288: '… can only be made during April/May …' *-->done*
Page 18, line 291: '… SCDs …' *-->done*

Page 18, line 299: '… prevent detection of the other …' *-->done*
Page 19, line 300: 'The large OClO peak at Ny- Ålesund and Kiruna in early 2008 …' (just to be clear) *-->done*
Page 20, line 304: Should it be 'over Ny- Ålesund and Kiruna' rather ? *-->yes, thanks!*
Page 20, line 309: Shouldn't that be 'GOME2-A SZA'? *-->actually, this is the case for both GOME-2A and –B sensors. This has been specified in the text.*
Page 20, line 315: Add 'respectively' in the bracket *-->done*
Page 20, Figure 15: Would be interesting to have the same plot for one more station, in particular e.g. for Ny- Ålesund (NH station).
The figure for Ny-Ålesund is included below. We however think it does not bring so much to the discussion, as the number of points for Ny-Ålesund during the first years of operation is quite small (from 534 to 191 points). However, the improvements in the comparison are clear: reduction in RMS (from 3.5e13 to 2.7e13), almost half the value of the offset and increase of the slope (from 0.87 to 0.91).



Page 22, Fig 16 caption: '… defined as follows:…' *-->done*
Page 23, Fig 17 caption: '… during the active months.' *-->done*
Page 24, line 359: 'For the ground-based …' *-->done*
Page 25, line 377: Replace 'points' with something like 'measurements' or 'data' *-->done*
Page 25, line 380: 'OClO GOME2 products …' *-->done*
Page 25, line 379-381: On what study or analysis is the conclusion based that the GOME2 OClO data product discussed within this manuscript meets the AC SAF mission requirements? Either this needs to be explained in more detail in the text or the relevant reference together with a short summary needs to be provided.
A sentence making the link between the different hemispheric biases found in this study and the AC SAF mission requirements has been added at the end of Sect. 4.3 and the reference to the AC SAF mission requirement document (Hovila and Hassinen, 2021) is also added here.
"These numbers are within the EUMETSAT AC SAF GDP OClO product target accuracy of 50% and close to the optimal accuracy of 30% (Hovila and Hassinen, 2021)."

Page 25, line 390: comma after 'retrievals' *-->done*
Page 24, line 401: 'At the end of 2012, a new instrument was installed …' *-->done*

Page 24, line 405: '… since 1999 ….' (delete 'the') *-->done*
Page 26, line 406: 'Generally, …' *-->done*
Page 26, lines 412 & 418: '… a Vis zenith-sky DOAS at …' (more consistent with the rest of the text) *-->done*
Page 26, line 414: '… during the winter/spring season …' *-->done*
Page 26, lines 415 & 419: '… UV/Vis MAX-DOAS was…' *-->done*
Page 26, lines 415 – 417: The last 2 sentences in this paragraph should be switched around. *-->done*
Page 26, lines 415 & 421: 'OClO SCDs' *-->done*
Page 26, line 416: 'Ground-based SCD measurements…' (delete s in SCDs) *-->done*
Page 27, line 424: '… OClO SCD analyses …' and looks like a bracket is missing after 'window' *-->done*
Page 27, line 429: '… what is used for …' *-->done*
Page 27, line 433: '… each group's OClO cross-section …' *-->done*
Page 27, line 440: '… each group's choice …' *-->done*
Page 27, line 443: '… the Ny-Ålesund …' ' *-->done*
Page 27, line 452: '… each group's analysis …' ' *-->done*
Page 28, Figure A1, caption: '… Ny-Ålesund … result on the cross-sections … DOAS analyses …. what is described in …' *-->done*
Page 29, Figure A2 & Figure A3, caption: '… OClO SCDs …' and '… Ny-Ålesund …'
Page 29, Figure A3, caption: '… DOAS analyses used ….' *-->done*