We appreciate Referee #2's insightful feedback and careful evaluation. Our point-by-point responses follow:

General comments

The article (Harmonized Cloud Datasets for OMI and TROPOMI Using the O2-O2 477 nm Absorption Band, by Huan Yu et al.) describes an essential (and timely) step that leads to a closer agreement between the retrieved OMI and TROPOMI cloud properties. However, for the derived cloud pressures, the OMI/TROPOMI consistency relies (in my opinion, in a major way) on the TROPOMI slant-column adjustment. Without it, the OMI/TROPOMI differences could be as large as in the already implemented OMCLDO2 retrievals.

Thank you for your comments. This is partially correct when considering the cloud correction applied in the NO2 retrieval, which primarily focus on the polluted regions. Without this offset correction, the agreement using BIRA-IASB cloud corrections becomes more similar to that obtained with OMCLDO2, although it still remains slightly better.

In the revised manuscript, the following table has been included to summarize the impact of the improvements in the BIRA-IASB cloud pressure retrieval compared to the OMCLDO2 approach. The results show that the most significant difference arises from the use of different settings in DOAS fit.

Table 2: Impact of the key improvements in the BIRA-IASB cloud pressure retrieval compared to the OMCLDO2 approach, and the overall differences between the two retrievals. For each improvement, the BIRA-IASB retrieval is applied, and the cloud pressure difference resulting from the individual change is calculated. The analysis is based on one day of OMI (1 October 2004) and TROPOMI (1 October 2018) measurements, restricted to snow/ice-free pixels within the 50°S to 50°N latitude range.

	Cloud fraction[a]>0.2	0.05<Cloud fraction<0.2, Ocean	0.05<Cloud fraction<0.2, Land
O2-O2 SCD fitting[b]	OMI: 28±35hPa TROPOMI: -17±34hPa	OMI: -5±85hPa TROPOMI: -78±84hPa	OMI: -62±103hPa TROPOMI: -188±119hPa
Correction for OMI across-track variability	0±15hPa	1±28hPa	1±38hPa
TROPOMI O2-O2 SCD Offset correction: -0.08×10^{43} molec^2 cm^{-5}	-17±6hPa	-31±13hPa	-44±19hPa
Updated temperature correction	-17±5hPa	-25±11hPa	-34±16hPa
Updated surface albedo[c]	5±11hPa	22±34hPa	31±74hPa
Overall difference for OMI	20±36hPa	70±105hPa	26±126hPa
Overall difference for TROPOMI	-32±28hPa	-50±68hPa	-147±98hPa

[a] cloud fraction is from the BIRA-IASB retrieval

[b] the wavelength dependence due to the use of different fitting windows between the BIRA-IASB and OMCLDO2 retrievals is not accounted for.

[c] comparison between use of OMI mode LER (Kleipool et al., 2008) and TROPOMI DLER (Tilstra et al., 2024)

The Ozone absorption greatly impacts the wavelength range used in the described O2-O2 retrievals. As a ‘sanity check’, I may advise comparing the O3 SCDs retrieved in the proposed approach to the OMI O3 SCDs

(OMDOAO3). If there are any large, systematic (in essence, VZA and SZA-dependent) differences between the two O3 products, this may imply biases in the retrieved O2-O2 SCDs. E.g., one may note the large high-latitude differences between different approaches (Figure 2). Could these be related to the Ozone interference, besides the implied differences in the surface-albedo characterization?

Thanks for the suggestions. Indeed, there is relatively strong interference from the O3 cross-section in the O2–O2 fitting window.

The figure below shows some differences in the O3 retrieval between the operational products and our DOAS fitting results. However, it should be noted that the O2-O2 fitting window is not optimal for O3 retrieval. Additionally, there is no systematic difference observed between the results from OMI and TROPOMI.

The difference in O3 slant columns between the BIRA-IASB and OMCLDO2 retrievals can be partly attributed to discrepancies in the O2–O2 retrieval (see Figure 2 of the manuscript). In general, large differences in O3 SCD corresponds to large discrepancies in O2-O2 SCD retrieval, except at high latitudes where this relationship weakens. Notably, the correlation behaves differently over desert and ocean regions. Additionally, the O3 SCD difference between the two retrieval approaches show generally consistent patterns for both OMI and TROPOMI, while the O2-O2 SCD differences vary significantly between the two instruments, showing a systematically bias (cf. Figure 2b and 2e),

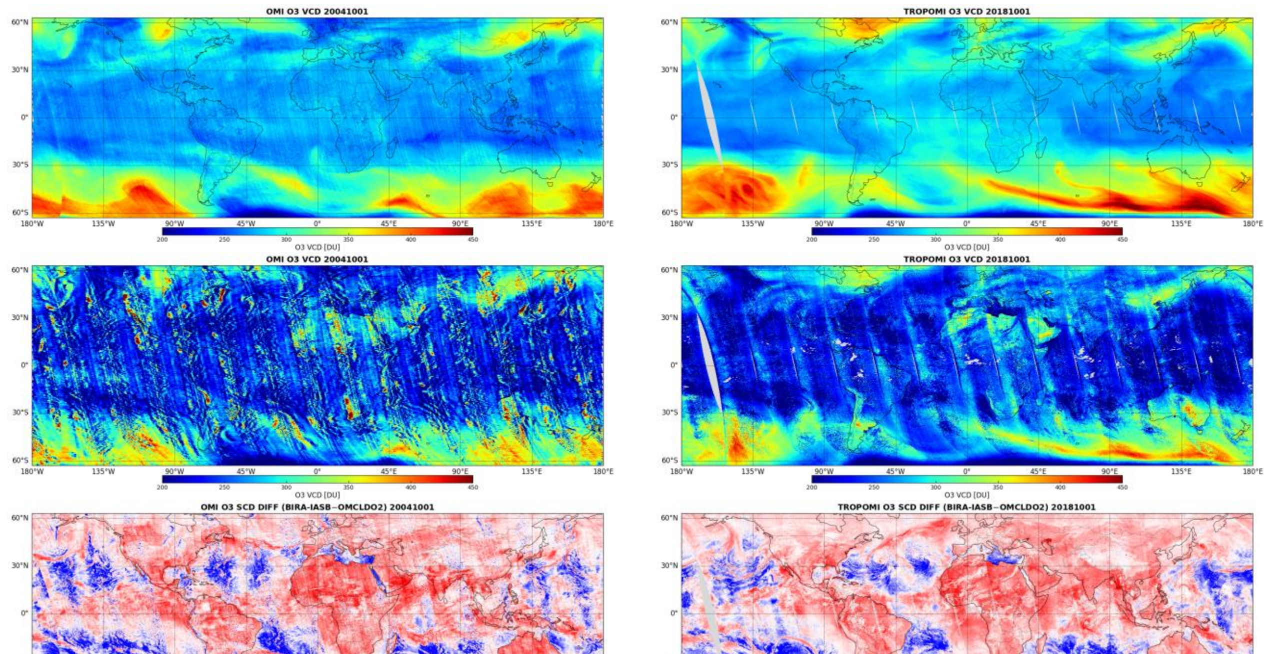

Figure: comparison of O3 retrieval. Top panel: total ozone column from operational products (OMI OMDOAO3 and the operational TROPOMI total ozone product); Middle panel: total ozone column derived from both our DOAS fit and OMCLDO2 for O2–O2 SCD retrieval, obtained by dividing the fitted slant column by the geometric AMF; Bottom panel: differences in O3 SCD retrieved from the O2–O2 fitting window between BIRA-IASB and OMCLDO2. The left column presents results for OMI, while the right column shows results for TROPOMI.

Specific comments

Abstract:

"Due to the suboptimal quality of solar irradiance measurements by OMI…" Consider changing this to: "Due to the inadequate signal-to-noise ratios in the daily solar irradiance measurements by OMI…". 'Suboptimal' may sound like a polite 'inferior'.

Thank you for the suggestion, and corrected.

"Notably, our approach demonstrates improved consistency in cloud parameters, especially cloud pressure, between the two sensors compared to OMCLDO2." This comes in contradiction with the statement from Section 4.1.2 that compares the cross-track trends (thus the offsets) between the BIRA-IASB and OMCLDO2 approaches, where line 503 states "This analysis does not allow us to determine which algorithm achieves better agreement between the two sensors." Indeed, the metrics are many, and many of them show mixed performances. As presented, it mostly relies on the systematic -0.08×10^{43} molec^2 cm^{-5} TROPOMI SCD offset. This should be explicitly mentioned in the Abstract and the main text.

Due to the significant differences in spatial resolution between TROPOMI and OMI, relatively more cloud free measurements are available from TROPOMI. Additionally, statistical analysis shows that cloud pressure retrieval for low cloud fraction cases exhibit noticeably different behavior compared to those for cloudy scenes. As a result, even with consistent cloud retrieval algorithm, the averaged cloud pressure values may have slightly differences between OMI and TROPOMI measurements due to the different pixel size.

In the revised manuscript, we have updated this figure and included the average cloud pressures for both cloudy and low cloud fraction cases to address this issue. Accordingly, the statement on line 503 has been removed, as it is no longer relevant.

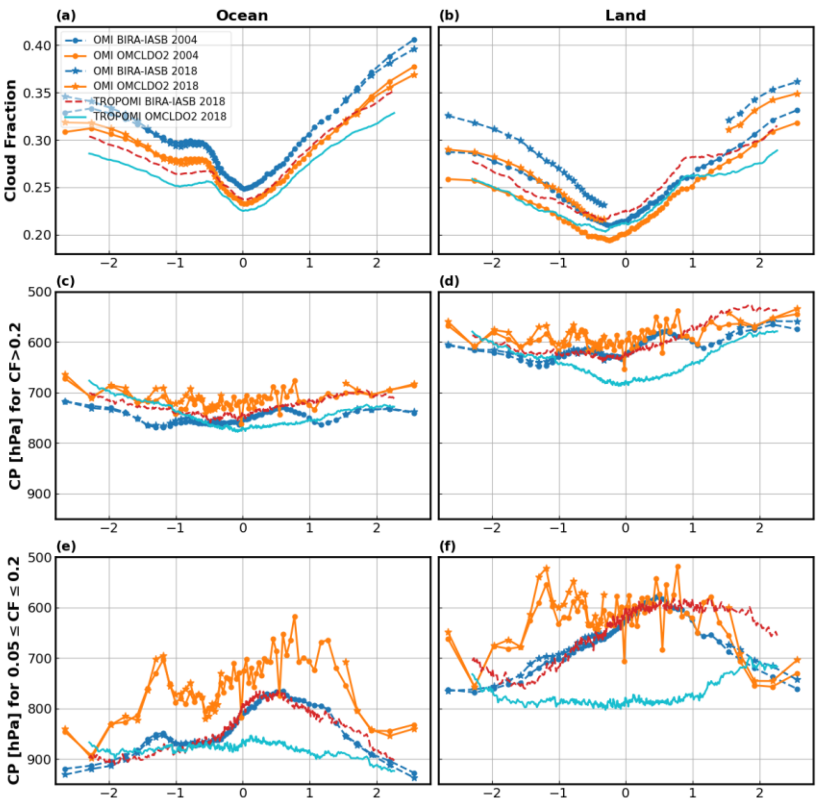

Figure 14: Across-track dependence of monthly mean cloud retrievals from OMI and TROPOMI for October, based on the measurements between 50°S and 50°N latitudes. The left panels present results over ocean,

while the right panels show results over land. The analysis includes cloud fraction (top), cloud pressure in cloudy scenes (middle), and cloud pressure in low cloud fraction scenes (bottom). The legend details the sensors, retrieval methods, and time periods included in the analysis.

In addition, we have included this value in both abstract and conclusion:

"an offset correction of -0.08×10^{43} molec^2 cm^{-5}, motivated by radiative transfer simulations, is applied in the TROPOMI retrieval to improve the consistency with OMI."

"A SCD offset of -0.08×10^{43} molec^2 cm^{-5} is applied in the TROPOMIS retrieval to improve consistency with OMI measurements."

"… primarily attributed to differences in L1b data." Consider expanding this to "…primarily attributed to differences in L1b data that show systematic biases between the OMI and TROPOMI reflectances".

Corrected.

Table 1. Consider expanding/amending the comments

1. " I0 correction is applied with SCD of 5·1015molec./cm2" Does this mean: an offset of 5·10^15molec./cm2 is applied to the cross-sections? Or something else?

Following Eq. A3 in Aliwell et al., 2002, the I_0-corrected absorption cross section is given by:

$$\sigma_{corrected}(\lambda') = \frac{1}{X} ln\{\frac{\int I_0(\lambda)\cdot exp[-\sigma(\lambda)\cdot X]\cdot W(\lambda-\lambda')d\lambda}{\int I_0(\lambda)\cdot W(\lambda-\lambda')d\lambda}\}$$

Here, I_0 represents the solar Frauhofer spectrum, $W(\lambda)$ is the normalized instrument slit function, $\sigma(\lambda)$ denotes the absorption cross section and X is the corresponding column amount of absorber. The correction shows a weak dependence on X, due to nonlinearity in the integral term. In practice, a representative high measured value of X is typically used. In our analysis, modifying the NO2 SCD between $5\cdot10^{15}$ and $2\cdot10^{16}$ has negligible impact on O2-O2 slant column retrieval.

The footnote is modified by: "I_0 correction is applied based on a NO_2 SCD of $5\cdot10^{15}$molec./cm^2 using Eq. A3 from Aliwell et al., 2002".

2. same as for a)

The footnote is modified by: "I_0 correction is applied based on a O_3 SCD of $2\cdot10^{19}$molec./cm^2 using Eq. A3 from Aliwell et al., 2002".

3. "additional cross-section taken as the inverse of the reference spectrum." It is not clear how this could be applied to the wavelength shifts.

It's an error, this footnote(d) actually refer to the intensity offset correction, and corrected it.

For the offset correction, we use the equation

$$log\,(I(\lambda)) = log\,(I_0(\lambda))\; - \sum \sigma_i \cdot c_i + \frac{offset(\lambda)}{I_0(\lambda)}$$

instead of

$$log\,(I(\lambda)) = \; log\,(I_0(\lambda))\; - \sum \sigma_i \cdot c_i + \frac{offset(\lambda)}{I(\lambda)}$$

Although the difference in results between the two approaches is minimal, using $I_0(\lambda)$ significantly improves performance, especially when nonlinear term such as wavelength shift are included in the fit.

Table 1. Also, mention the intensity offset, if applicable (e.g., line 183).

We have added:

Intensity offset: first-order offset (additional cross-section taken as the inverse of the reference spectrum (see Eq. 5.6 in (Danckaert et al., 2017))

l.167 Please comment on how the broader fitting window helps to improve the low-SCD retrievals.

When we extended the fitting window from 460–490 nm to 435–495 nm while keeping all other settings unchanged, the occurrence of negative SCD retrievals was reduced. On the other hand, increasing the polynomial order within the 460–490 nm window also led to increased retrieved O_2–O_2 SCDs, although this may indicate overfitting. Therefore, we have removed this statement, as we are not confident that it represents a genuine improvement.

The main advantage of the broader fitting window is its improved handling of broadband surface reflectance effects, as the current settings is less sensitivity to the polynomial order compared to the DOAS fit using the 460–490 nm window.

Figure 2. Were the shown BIRA-IASB OMI retrievals de-striped? For better consistency (clarity of the trends), they should not be. Please clarify. Please also comment on the x-track features seen in the BIRA-IASB-OMCLDO2 differences (panel b). Are the shown (panel d) TROPOMI SCDs adjusted by -0.08×10^{43} $molec^2$ cm^{-5} ? If they are not, then in this particular example I would insist on applying such an adjustment prior to comparison.

In this comparison, the BIRA-IASB retrievals from both OMI and TROPOMI are presented without any post-processing or corrections applied; thus, the results directly reflect the differences from the DOAS fitting itself. As shown in Table 2 above, the largest discrepancy between our retrieval and OMCLDO2 comes from the DOAS fitting, whereas the effects of de-striping and offset correction are relatively small. The current structure of the manuscript, which examines each correction separately, effectively emphasizes their individual impacts. Combining all corrections would obscure their distinct contributions, so we recommend retaining the existing approach.

For x-track features, we have included:

“The across-track dependence visible in the OMI difference map is likely caused by calibration issues in the OMI L1b data, which introduce across-track variability in trace gas retrievals (Boersma et al., 2007) and this effect varies depending on the retrieval approach used. A correction methodology for this effect will be detailed in the following section."

How typical are the differences shown in Figure 2? Are these season-dependent? Please comment on.

The differences shown in Figure 2 are highly representative, exhibiting no significant seasonal dependence. Our analysis uses at least one full year of OMI and TROPOMI data, ensuring comprehensive seasonal coverage. Due to space constraints, this seasonal-dependence is mentioned in Section 4.3, which confirms the seasonal stability of our results.

l.221 "Use the median SCDs from rows 2–21 in the desired year, subtracting the mean of the corresponding values…" What are these median SCDs? Are these SCDs adjusted for the linear fits? Are the medians derived row-by-row? What are these corresponding values: the median(s) or something else? The description must be expanded, keeping in mind that at some point it could be implemented by somebody else.

The median values are from step 1, and derived row-by-row, without any adjustment.

We have rephrased this paragraph:

"Collect the median SCDs obtained from step 1 for rows 2 to 21, calculate their average, and then compare this value with the mean of similarly calculated values from the same period during the reference years (2004–2007) to determine an offset, which reflects the interannual variation of O_2–O_2 SCD"

I may suggest normalizing (beforehand) all SCDs by tan(VZA) and, possibly (?), by cos(SZA); or, alternatively, by the geometric air mass factor. This could further simplify the approach.

Thank you for the suggestion. However, none of these approaches are effective. Please note that box-AMF at low atmospheric layer shows very weak dependence on solar/viewing geometry, whereas the box-AMF values are close to geometric air mass factor at higher altitudes. The O2-O2 SCDs depend on the combination of these two effects. Although we observe a clear correlation between O2-O2 SCD and tan(VZA), this relationship cannot be quantified by simple geometric parameterizations.

l.227 "The data selection method used in Figure 3(a) avoids regions with significant variations in surface albedo and surface pressure." The described destriping approach uses SCDs, and SCDs only. If SCDs are additionally filtered for these two factors, please add a comment. Otherwise, I'm not able to follow the statement – please explain.

We have rephrased the sentence:

"The data selection method used in Figure 3(a) excludes land regions due to the significant variations in surface albedo and surface pressure, as these factors strongly affect the O2-O2 SCD."

l.237 Even with the minimal inter-annual variability of the striping patterns, there is no guarantee that these patterns remain stable intra-annually. Please either comment on or provide additional (Appendix) evidence of the short-term (seasonal) stability.

The striping patterns are generally stable, with small seasonal variation as well. However, we consider inter-annual variability to be more critical here, especially since smoothed reference is not available after 2007. If strong inter-annual variability is present, this approach would not be feasible. In contrast, substantial seasonal variation would have no impact on the methodology.

Figure 4. It is impossible to assess the impact of de-striping from 2D plots. Please add 1 panel that shows the average (say, for scanlines 1150-1200) cloud pressures for the three products (b-d).

Thank you for the suggestion. It is challenging to illustrate the impact of the de-striping correction using averages from such a limited dataset. Moreover, the correction is highly dependent on the cloud fraction, an effect that is not apparent in the average data. Instead, we have revised Figure 4(d) to directly show the differences in cloud pressure with and without the de-striping correction. This revised panel clearly highlights the row-dependent of the correction. The resulting differences in cloud pressure are generally within ±30 hPa, with significantly larger deviations observed when the cloud fraction approaches zero. The OMCLDO2 cloud pressure map has been removed, as its across-track dependence is already addressed in Section 4.1.2.

We have rephrased the sentence in the revised manuscript:

"As shown in Figure4(d), the differences in cloud pressure due to this correction are generally within ±30hPa, with significantly larger deviations observed when the cloud fraction approaches zero."

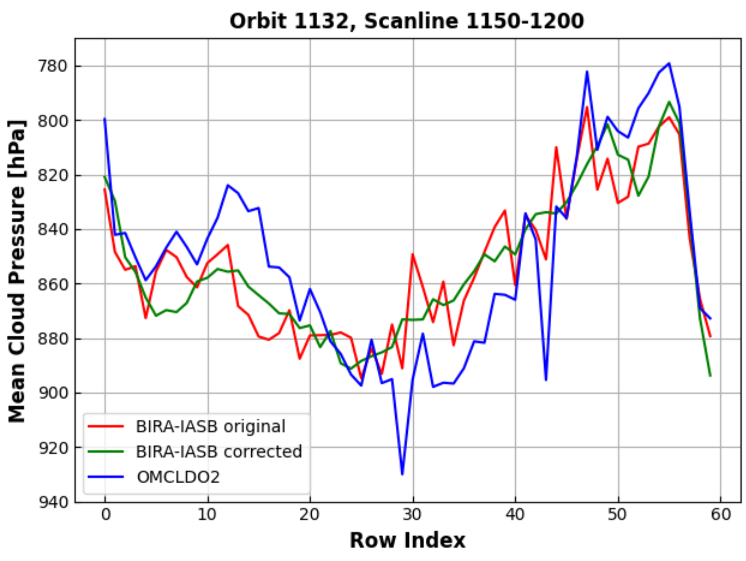

Figure: Row dependence of averaged cloud pressures from the OMI swath (scanlines 1150–1200) for orbit 1132 on 1 October 2004.

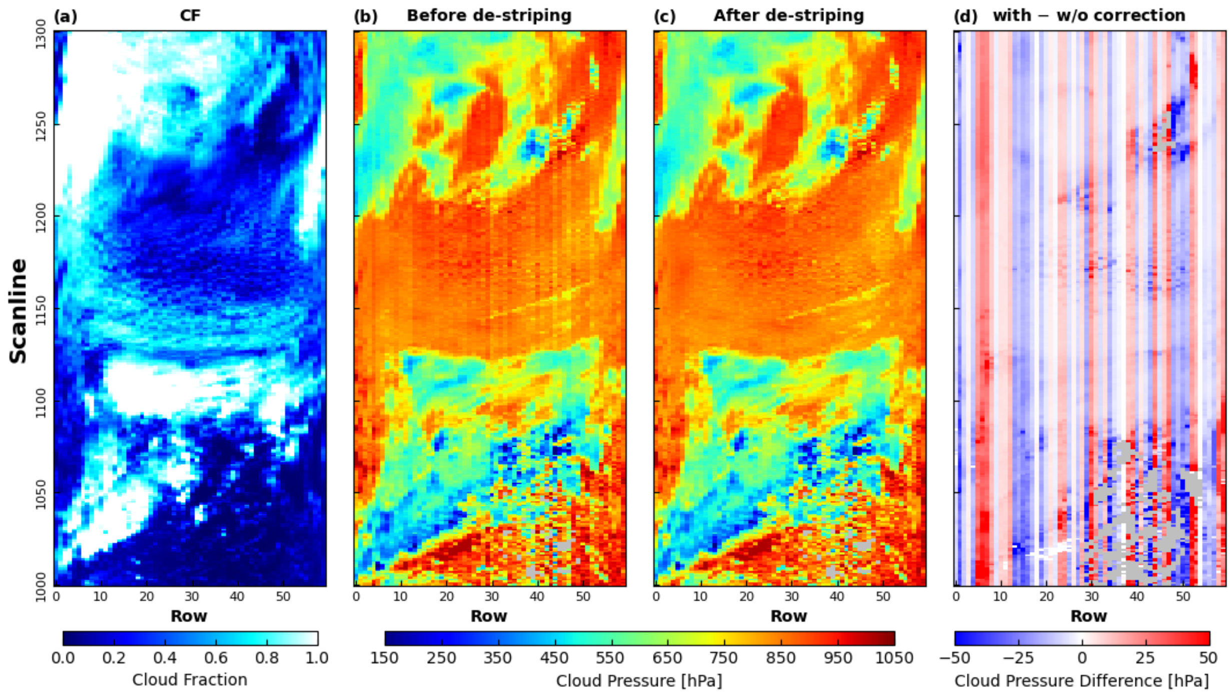

Figure 4: OMI O2-O2 cloud retrievals for BIRA-IASB cloud fraction (a), BIRA-IASB cloud pressure before (b) and after (c) de-striping correction, and (d) difference between with and without correction. The data shown represent a segment of an OMI swath (scanlines 1000-1300) from orbit 1132 on 1 October 2004. Pixels with cloud fractions below 0.05 have been removed from the cloud pressure maps.

l.280 Is/are there any reason(s) why OMI is considered the 'truth', thus prompting the TROPOMI adjustment? Considering that TROPOMI retrievals use more advanced surface characterization, one may side with TROPOMI as a 'truth'. Please comment on.

The purpose of this simulation study is to verify that the O2-O2 SCD ratio approaches 1 as the cloud fraction approaches 0. Accordingly, a correction is applied to the TROPOMI data in this case—though this may be coincidental. Any changes in the DOAS retrieval or the simulation settings could lead to different correction results. Given the current configuration, we apply this correction to the TROPOMI data.

l.300 "…this study uses the TOA reflectance, which accounts for both Rayleigh scattering and atmospheric absorption…" Ozone is an important contributing factor, especially at high VZA and SZA angles. Is it accounted for? Please mention what atmospheric absorptions are taken into account.

Yes, both NO2 and O3 absorptions are included. We have added it:

"...which accounts for both Rayleigh scattering and absorptions by O3 and NO2…"

l.319 "…where the cloud fraction lies within [0, 1.5]…" What necessitates the range extension to (completely unphysical) 1.5 – please explain.

Since our retrieval assumes a fixed cloud albedo of 0.8, a higher actual cloud albedo can result in retrieved cloud fractions exceeding 1. In real measurements, the retrieved cloud fraction values can exceed 1.5 in cases with high surface albedo and large SZAs. For cases with cloud fraction larger than 1, the current retrieval approach becomes unreliable.

l.345 "Here, T represents the atmospheric temperature representative of satellite observations…" The key word is 'representative'. Considering the multitude of contributing factors, please provide more details on choice of the representative temperature. Is this c(T) related to C(T(p)) from eq. 7? If true, then change eq. 6 to c(T(p)=…(T(p)-T_0)… Otherwise, explain how c(T(p) and c(T) are brought together.

Yes, corrected it.

l.355 "…the temperature correction for the O2-O2 cross-section must be accounted for when creating the inverted LUT." Please provide more details on how this is done. Via an additional LUT dimension?

We have rephrased the sentence:

"the temperature correction for the O2-O2 cross-section must be accounted for in the calculation of O2–O2 VCD (see Eq. 4 and 5) when creating the inverted LUT"

Figure 7 "…compares temperature correction factors calculated using the BIRA-IASB and OMCLDO2 algorithms…" Note that the only unbiased way to assess the changes caused by the different temperature corrections is to use these two corrections within the framework of the same retrieval algorithm. Otherwise, other contributing factors (LUTs and the adopted interpolation approach, surface characterization, general DOAS setup, etc., etc.) may not be cleanly disentangled from the temperature impact. Consider either performing such a test or removing Figure 7(b) and the related discussion.

Yes, this study is based on the BIRA-IASB retrieval approach, but it employs the temperature correction factors derived using different ways. We have added the text in Figure 7 (b):

"Both cloud retrievals implement the BIRA-IASB approach, with temperature correction factor being the only parameter calculated separately using both the BIRA-IASB and OMCLDO2 methods."

l.422 "Additionally, cloud pressure retrievals are shown only for pixels with cloud fractions above 0.01." Later, in the caption of Figure 15, the authors say: "To ensure reliable cloud pressure comparisons, pixels with a cloud fraction below 0.05 are excluded, as very low cloud fractions lead to high uncertainties in cloud pressure retrievals." Agreed! Please make sure that this 0.05 threshold is consistently implemented in the revised text (e.g., in Figures 10, 13, 14 and elsewhere).

Corrected, and corresponding figures are updated.

Section 4.1.1 If the adjustment (-0.08×10^{43} molec^2 cm^{-5}) was applied to the TROPOMI data, mention this early in the Section.

This adjustment has been mentioned in Table 2.

Sect. 4.1.1, Figures 11-14. It would be very helpful to provide a table with the relevant characteristics (offset, slope, correlation) for all the performed comparisons, cloud fractions first, followed by the cloud pressures. The discussion could be shortened and streamlined hereafter.

We have added Table 2 shown above, summarizing the impact of the main improvements in the BIRA-IASB cloud pressure retrieval compared to the OMCLDO2 approach, and included the following paragraph in section 4.1.1:

"Table 2 summarizes the impact of each improvement in our cloud pressure retrieval relative to OMCLDO2, as well as the overall differences between the two retrieval approaches, based on one day of OMI and TROPOMI data. Effects on cloud fraction are not included, as the implemented changes have minimal influence in this regard. The impact is generally much greater in scenes with low cloud fraction than in cloudy conditions, and it tends to be more pronounced over land than over ocean. The results suggest that the most significant discrepancies primarily arise from differences in the DOAS fitting settings. While the wavelength dependence introduced by using different fitting windows in the O2-O2 SCD retrievals is not accounted for in this analysis, its impact is expected to be minor." (mostly 1-2% between the AMF calculated at 465 and 475nm)

Figure 13. There are extremely large (300-400 hPa) offsets in the shown TROPOMI low-cloud-fraction retrievals, both over land and oceans. The introduced SCD offset may account for a very small fraction (~50 hPa) of these differences. Where does this (very concerning!) BIRA-IASB and OMCLDO2 difference come from?

As shown in Table 2 and Figure 2, the most significant difference in cloud pressure retrieval is due to the O2–O2 SCD difference between BIRA-IASB and OMCLDO2, especially for low cloud fraction cases, with an average discrepancy of approximately 0.5×10^{43} molec^2 cm^{-5}, corresponding to 15–20% of the total O2–O2 SCD. This difference is much larger than the applied offset correction values.

It should also be noted that variations in O2-O2 slant column density (SCD) have a more significant impact on high cloud retrieval than on low cloud retrieval.

Figure 14. The sharp increase of cloud fractions toward the edges of the swaths is puzzling, especially considering the absence of such prominent trends in the OMI retrievals based on an alternative approach (Vasilkov et al. 2018). This also applies to the west-east cloud-pressure differences seen in the discussed retrievals. I hope these subjects will be followed upon by the authors.

Our results are very similar to other TROPOMI cloud retrieval results (see Figure 16 and 17 in Latsch et al., 2022). The average cloud fraction ranges from 0.2 to 0.4, with the lowest values typically near nadir and slightly increasing with VZA, which is consistent with the patterns reported by Latsch's findings. In contrast, Vasilkov et al., 2018 present across-track cloud fraction patterns based on scenes with low cloud fractions (between 0.05 and 0.25), which may account for the differences observed.

l.603 Please remind the reader that the OMCLDO2 OMI/TROPOMI retrievals use [very!] different surface albedo datasets. The differences could be mostly related to this aspect.

As shown in Figure A1, the difference in surface albedo between the OMI and TROPOMI albedo climatology datasets is generally small, typically around 0.01–0.02, with slightly large difference over desert and snow/ice-covered regions. The OMI albedo values tend to be biased higher. This result has only a minor impact on cloud fraction retrievals (see Table 2 and Figure 12). We believe that the effect of L1b differences between OMI and TROPOMI is likely much larger than the impact of using different surface albedo datasets in the cloud retrieval. (See Figure 19a/19c and Figure 20).

Technical comments

l.122 Mention that Band 4 is used for the O2-O2 retrievals. Also mention how the saturation flags are accounted for in the retrievals.c

We have added:

"This saturation can affect the O$_2$–O$_2$ cloud retrieval, which rely on measurements from Band 4. To mitigate this, spectral pixels flagged as saturated are excluded from data analysis."

l.193 "In contrast, for OMI, the limited quality of the daily solar measurements…" – consider adding 'daily'.

Corrected.

Figure 5, the caption: "Data are binned by cloud fraction intervals of 0.1…" – use 0.1 instead of 0.01

This should be 0.01, as the comparison focuses exclusively on nearly cloud-free scenes (The x-axis in Figure 5 ranges from 0 to 0.1).

Figure 6(a) – Please check the match between the color legend and the plotted curves.

Corrected.

l.478 "The retrieved cloud fraction is constrained between 0.05 and 1…"

Cloud fraction retrievals are clipped to the [0, 1] range; however, for the cloud pressure analysis, only pixels with cloud fraction greater than 0.05 are used.

Reference:

Boersma, K. F., Eskes, H. J., Veefkind, J. P., Brinksma, E. J., Van Der A, R. J., Sneep, M., Van Den Oord, G. H. J., Levelt, P. F., Stammes, P., Gleason, J. F., and Bucsela, E. J.: Near-real time retrieval of tropospheric NO2 from OMI, Atmos. Chem. Phys., 7, https://doi.org/10.5194/acp-7-2103-2007, 2007.

Danckaert, T., Fayt, C., Van Roozendael, M., De Smedt, I., Letocart, V., Merlaud, A., and Pinardi, G.: QDOAS Software User Manual, Version 3.2, 2017.

Latsch, M., Richter, A., Eskes, H., Sneep, M., Wang, P., Veefkind, P., Lutz, R., Loyola, D., Argyrouli, A., Valks, P., Wagner, T., Sihler, H., Van Roozendael, M., Theys, N., Yu, H., Siddans, R., and Burrows, J. P.: Intercomparison of Sentinel-5P TROPOMI cloud products for tropospheric trace gas retrievals, Atmos. Meas. Tech., 15, https://doi.org/10.5194/amt-15-6257-2022, 2022.

Vasilkov, A., Yang, E. S., Marchenko, S., Qin, W., Lamsal, L., Joiner, J., Krotkov, N., Haffner, D., Bhartia, P. K., and Spurr, R.: A cloud algorithm based on the O2-O2 477 nm absorption band featuring an advanced spectral fitting method and the use of surface geometry-dependent Lambertian-equivalent reflectivity, Atmos. Meas. Tech., 11, https://doi.org/10.5194/amt-11-4093-2018, 2018.