Dear editors and reviewers,

Thank you very much for your constructive comments and advices on our manuscript. Your positive evaluation and comments encourage us and are a great help for us. We have carefully considered every comment, and made the corresponding revisions in the revised manuscript (indicated by the 'tracked changes').

Point to point response is following:

Major comments

1) My main criticism of this study is that it shows literally hundreds of figures without coming to clear conclusions. This is not the first study of its kind, so the main question is: What are new and interesting results of this study not yet published elsewhere, and how can these new results be understood?

From what I understood, the main results are:

- Aerosol parameters SSA and asymmetry factor are not as critical as one may have thought for the aerosol retrieval
- Changing the covariance matrix changes the results of the OE retrieval as it results in different weighting of a priori and measurements in the inversion
- NO2 profiles are not very sensitive to the aerosol profiles used
- AOD is systematically underestimated by MAX-DOAS retrievals
- Low NO2 columns are overestimated, high NO2 columns are underestimated

The first four points have already been discussed in the literature before but maybe not with this level of detail. The last one is new to me and would deserve more discussion as it is unexpected and surprising. What could be the reason for such a behaviour?

Response: Thank you for your suggestion. We reorganized the abstract and conclusion to make the results clearer.

Changes in manuscript:

Abstract: Ground-based Multi-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) is a state of the art remote sensing technique for deriving vertical profiles of trace gases and aerosols. However, MAX-DOAS profile inversions under aerosol pollution scenarios are challenging because of the complex radiative transfer and limited information content of the measurements. In this study, the performances of two inversion algorithms were evaluated for various aerosol pollution scenarios based on synthetic slant column densities (SCDs) derived from radiative transfer simulations. Compared to previous studies, in our study much larger ranges of AOD and NO_2 VCDs are covered. One inversion algorithm is based on optimal estimation, the other uses a parameterized approach. In this analysis, 3 types of profile shapes for aerosols and NO_2 were considered: exponential, Boltzmann, and Gaussian. First, the systematic deviations of the retrieved aerosol profiles from the input profiles were investigated. For most cases, the AODs of the retrieved profiles were found to be systematically lower than the input values, and the deviations increased with increasing AOD. Especially for the optimal estimation algorithm and for high AOD, these findings are consistent to the results in previous studies. The assumed single scattering albedo and asymmetry factor have a systematic influence on the aerosol retrieval. However, for most cases the influence of the assumed SSA and AP on the retrieval results are rather small (compared to other uncertainties). For the optimal estimation algorithm the agreement with the input values can be improved by optimizing the covariance matrix of the *a priori* uncertainties. Second, the aerosol effects on the NO_2 profile retrieval were tested. Here, especially for the optimal estimation algorithm, a systematic dependence on the NO_2 VCD was found with a strong relative overestimation of the retrieved results for low NO_2 VCDs and an underestimation for high NO_2 VCDs. In contrast, the dependence on the aerosol profiles was found to be rather low. Interestingly, the results for both investigated wavelengths (360 nm and 477 nm) were found to be rather similar indicating that the differences in the radiative transfer between both wavelengths have no strong effect. In general, both inversion schemes can well retrieve the near-surface values of aerosol extinction and trace gases concentrations.

Conclusions

Given that severe air pollution often occurs during autumn and winter in China, the effects of different aerosol conditions on the accuracy of MAX-DOAS profile retrieval were studied. The effects of aerosols on MAX-DOAS retrievals of aerosols and NO_2 profiles were examined by assuming a series of aerosol scenarios with 3 aerosol profile shapes (exponential, Boltzmann, and Gaussian) with AODs/VCDs ranging from 0.1 to 5.0 at two wavelengths (360nm and 477nm). In addition, a series of NO_2 scenarios was assumed with the same profile shapes and various VCD values (from 0.1×10^{16} to 10.0×10^{16} molecules cm^{-2}). Compared to previous studies (e.g. Bösch et al., 2018; Frieß et al., 2019) our input profiles cover a much larger range of AODs and NO_2 VCDs and also more profile shapes and more combinations between them.

In a first step, the effects of the assumed single-scattering albedo (SSA) and asymmetric parameter (AP) on the aerosol profile inversion was investigated. It was found that the retrieved aerosol extinction profiles are very consistent if the same SSA and AP values are used for the simulations of the O_4 DSCDs and the PriAM inversions. If incorrect SSA and AP values were used, the retrieved extinction coefficients were smaller than the input values in the case of too low of AP or too high SSA assumed in the profile inversion and vice versa (with opposite behavior for the surface values). However, for most cases the deviations caused by wrongly assumed AP and SSA were found to be rather small compared to other uncertainties. The maximum relative deviation was generally found around 1.0km with the values of about 25%.

Next, the differences of the PriAM and MAPA profile retrievals from the input profiles for different aerosol conditions were examined. We found that both algorithms have systematic deficiencies in retrieving the 4 profile shapes. Especially at low (above 0.2 km) and high (above 1.5 km) altitudes, often deviations from the true values are found, while for altitudes in between best agreement is found. The algorithms can reasonably retrieve the 4 aerosol profile shapes of AODs < 1.0 for two wavelengths, but for AODs > 1.0 the retrieved values systematically underestimate the true AODs. The smallest magnitude of the relative deviations (typically <20%) were found for exponential profile shapes, with a scale height of 0.5 km. Large magnitude of the relative deviations (up to >50%) are found for the other profile shapes, especially for high AODs. Such a systematic underestimation has also been found in several previous studies (e.g. Irie et al., 2008, Frieß et al., 2016, Bösch et al. 2018, and Tirpitz et al., 2021). The systematic deviation between MAX-DOAS and sun photometers is partly caused by the missing sensitivity of MAX-DOAS observations for higher altitudes and the smoothing effect, especially for optimal estimation algorithms (e.g. Tirpitz ez al., 2021). In general, the relative deviations of the MAPA results depend less on the AOD than the PriAM results. For MAPA, part of the differences between input and retrieved AODs can be explained by the differences in the RTM model. It should also be noted that for the Gaussian profiles, both PriAM and MAPA could retrieve the lifted layer. However, PriAM underestimated the width of the lifted layer and the extinction coefficient at the peak, while MAPA overestimated the width of the lifted layer and significantly underestimated the aerosol extinctions at the peak.

Then, for PriAM, the effect of using different *a priori* profiles and *a priori* profile covariance matrices (Sa) was studied. The results showed that the retrieval results of the aerosol profiles were slightly improved when the same *a priori* profile shape as the input profile shape was used. The main reason is probably that the corresponding *a priori* bias was reduced. In addition, the inversion results were more consistent with the input profiles when the AOD of the *a priori* profile was increased for high AOD scenarios. The effect of the Sa value for the 4 aerosol shapes was investigated for the extreme scenario with an AOD of 5.0. It was found that the correlation coefficient could be improved by increasing the Sa values for all aerosol profile shapes, mainly because of improved values of the retrieved surface extinction and scale height.

Also the modeled O_4 DSCDs corresponding to the aerosol profiles retrieved by PriAM and MAPA were compared to O_4 DSCDs simulated by the RTM for the input aerosol profiles. The averaged correlation coefficients of the modeled and simulated O_4 DSCDs were > 0.99 for both PriAM and MAPA, indicating that a possible non-convergence of the profile retrievals is not a reason for the systematic discrepancies of retrieved profiles from the input profiles.

In the next part, the effects of the aerosol retrieval on the NO_2 profile retrieval were studied for PriAM and MAPA. Two strategies were utilized to retrieve the NO_2 profiles, in which either the retrieved or the input aerosol profiles served as input for the retrievals of the NO_2 profiles in strategy 1 (S1) and strategy 2 (S2), respectively. Strategy S1 was applied both to PriAM and MAPA, while strategy S2 was only applied to PriAM.

From these studies several conclusions could be drawn: The relative deviations of the retrieved NO_2 VCDs do only slightly depend on the AOD or the shape of the aerosol profiles. In contrast, especially for PriAM, a systematic dependence on the NO_2 VCD was found. For low NO_2 VCDs the retrieved NO_2 VCDs largely underestimate the true NO_2 VCDs by up to 60%, while for high NO_2 VCDs a systematic underestimation up to -30% is found. Here it should be noted that in spite of the large relative deviations for low NO_2 VCDs, the absolute deviations are rather small. The underestimation of the true NO_2 VCD for high NO_2 VCDs by the retrieved profiles was not reported before. It is probably caused by non-linearities in the radiative transport for strong NO_2 absorptions. The increase of the Sa values did not improve the inversion results for high AODs, but instead lead to the occurrence of single outliers in some layers.

We also performed a consistency check of the optimal estimation algorithm by using exactly the a priori profiles as input profiles. For the aerosol retrieval, almost the exact input profiles were retrieved (differences < 0.05%) indicating that there are no inconsistencies in the algorithm. However, for the trace gas profiles no such perfect agreement was found, especially towards scenarios with high AODs and NO_2 VCDs indicating the more complex dependencies of trace gas retrievals compared to aerosol retrievals. Here it is important to note that the relative deviations for the retrieved NO_2 profile by using both the aerosol and NO_2 *a priori* profiles as input profiles are smaller than those for scenarios for which only the aerosol a priori profile is used as input profile.

Finally it should be mentioned that the results of this study are very similar for both selected wavelengths (360 and 477 nm) indicating that the differences in the radiative transfer between both wavelengths have no strong effect on the MAX-DOAS profile retrievals.

2) As this study is on synthetic data which are necessarily idealized in many ways, the question is: Which of these results are of relevance for real MAX-DOAS measurements? Are there any take-home messages for people working on MAX-DOAS profiles? What is specific to the two inversion codes used, what is fundamental to MAX-DOAS retrievals?

Response: Thank you for this comment.

In our opinion, all findings of our study are relevant for real measurements. We summarized them now in a clearer way in the conclusions of the updated manuscript. We also added a new section (3.3) with the comparison of our results to previous studies (see next point).

3) In general, I think a section on comparison of the results found here with what was reported in earlier studies should be added.

Response: Thank you for your suggestion. The comparison to the findings of previous studies was added.

Changes in manuscript:

3.3 **Comparison with the earlier studies**

In this section we discuss the most important findings of our investigations and compare them to the results from earlier studies. Especially Bösch et al. (2018) and Frieß et al. (2019) investigated the sensitivity of the MAX-DOAS inversion results using synthetic data. But compared to this study, they used less profile shapes (Bösch et al. 2018) or they restricted their investigations to a set of profiles with fixed combinations of shapes and vertically integrated quantities (VCDs and AOD). Most importantly, in this study, we cover a larger range of VCDs and AODs, including especially high values (AODs up to 5, and NO_2 VCDs up to 10^{16} molecules cm^{-2}), while previous studies used maximum NO_2 VCDs of 2×10^{16} molecules cm^{-2} and 3.5×10^{16} molecules cm^{-2}, respectively and maximum AODs of 1. Also our study investigates the trace gas retrievals for a minimum NO_2 VCD of 0.1×10^{16} molecules cm^{-2}. Using these wide ranges of VCDs and AODs revealed new effects and/or confirmed earlier findings in more detail. The most important findings are:

With increasing AOD the retrieved AODs systematically underestimate the true AODs. The underestimation reaches values of >40% and >50% for AODs of 3 and 5, respectively. The largest underestimation is found for Gaussian profiles, while for exponential profiles with scale height of 0.5 km the smallest underestimation is found. These results confirm results from previous studies with similar findings (e.g. Irie et al., 2008; Bösch et al., 2018; Frieß et al., 2019; Tirpitz et al., 2021). However, in this study, the range of AODs and the variety of profile shapes is much larger, which allows a more detailed interpretation of the results. Interestingly, the underestimation is systematically smaller for MAPA compared to PriAM, which indicates that only a part of the underestimation can be attributed to the missing sensitivity of MAX-DOAS measurements towards higher altitudes. In most cases, the larger effect for OE algorithms is probably due to the smoothing effect.

Another important finding of this study is that the NO_2 profiles are not very sensitive to the aerosol profiles confirming similar findings by Frieß et al. (2019).

Further, it was found that the influence of the assumed asymmetry parameter and single scattering albedo have typically a minor effect on the retrieval results. This is an important result, because usually the optical properties of aerosols are not well known. However, for aerosol inversions, the errors can still be up to 25%. Thus it is still important to use reasonable values for both parameters to minimize the remaining uncertainties. For the NO_2 inversion the influence of the asymmetry parameter and single

scattering albedo is smaller, similar as found by Hong et al. (2017).
Another important finding of this study is that the NO_2 VCDs either systematically overestimate (for low NO_2 VCDs) or underestimate (for high NO_2 VCDs) the true NO_2 VCDs. Interestingly, these results are rather insensitive to the shape or the AOD of the respective aerosol profiles. The underestimation for high NO_2 VCDs is a new finding which was not reported so far. It is probably caused by non-linearities in the radiative transport for strong NO_2 absorptions. It can reach deviations of more than –30% for a NO_2 VCD of 10^{16} molecules cm^{-2}. A tendency of an overestimation for small NO_2 VCDs was already observed (for OE algorithms) by Frieß et al. (2019), but not discussed in detail. Our results clearly indicate that the overestimation systematically increases towards small NO_2 VCDs (with deviations >50% for an NO_2 VCD of 0.1×10^{16} molecules cm^{-2}). Here it is interesting to note that similar results are found for different profile shapes. This finding is probably caused by the fact that the trace gas VCD is mostly constrained by measurements at high elevation angles and the fact that the trace gas SCDs for these elevation angles only weakly depend on the profile shape.
Overall, the reason for the underestimation of the retrieved NO_2 VCD for low NO_2 VCDs is not yet fully understood. However, for the OE algorithm it might be caused by the influence of the a priori profile on the retrieval result. Interestingly, in this study a similar underestimation was also found for the parameterised algorithm (which was not observed by Frieß et al., 2019). This finding is currently unexplained, but might be caused by the different radiative transfer models used for the generation of the synthetic data (SCIATRAN) and in the MAPA inversion algorithm (MCARTIM). This aspect should be further investigated in future studies.
Interestingly, an overestimation of the true NO_2 VCDs (derived from direct sun observations) by the retrieved NO_2 VCDs from MAX-DOAS observations was also reported by Tirpitz et al. (2021) for low NO_2 VCDs (but not for HCHO VCDs).
Another important finding of our investigations confirms the results from earlier studies (e.g. Wang et al., 2017; Bösch et al., 2018). Changing the covariance matrix changes also the retrieval results from OE retrieval as it results in different weighting of a priori and measurements in the inversion.

4) Something I could not find in this manuscript is information on the uncertainties assumed for the slant columns. I assume that no noise was added to the results from the RTM but still the retrievals must have made an assumption on the uncertainties. This is an important point which needs to be added to the manuscript as it can have a large impact on the results.

Response: Thank you very much for your remark. It clarified our assumptions in P11L22-P12L1 to make it clear.

Changes in manuscript: The fitting error for all O_4 DSCDs is set as 0.03×10^{43} molecules^2 cm^{-5}, and that for NO_2 DSCDs to 1% of the NO_2 DSCDs in the PriAM and MAPA retrievals.

5) Another information I'm missing is what the atmosphere in the forward simulations looked like above 4 km. Was there any NO2 or aerosol present at higher altitudes as well?

Response: Thank you very much for your questions. The value above 4.0 km is set to 0. And it is added in the P9L4 to make it clear. In the real atmosphere, aerosols and gases are typically concentrated below 3 kilometers (or even lower).

Changes in manuscript: P9L4. The value above 4 km altitude is set to 0.

6) Throughout the manuscript, results are shown for two wavelengths, but there is no discussion whatsoever of similarities and differences between these results. If there is no discussion then I do not see the reason for adding all these figures.

Response: Thank you very much for your suggestions. We have added a discussion of the similarities and differences between the two wavelengths to the abstract and conclusions.

Changes in manuscript:

Abstract:

Interestingly, the results for both investigated wavelengths (360 nm and 477 nm) were found to be rather similar indicating that the differences in the radiative transfer between both wavelengths have no strong effect.

P18. The highest correlation coefficient was found when the diagonal elements of Sa were set to the square of 20% of the *a priori* profile for the Boltzmann profiles and exponential profiles with a scale height of 1.0 km at AOD of 5.0, with the smallest root-mean-square deviation (RMSD) of 0.54 and 0.50 (averaged of 360nm and 477nm for each shape), respectively. For the Gaussian profile, the correlation coefficient was highest with the diagonal elements of Sa in 50% of the *a priori* profile. The smallest averaged RMSD of 0.55 was also found for this scenario with values of 0.58 at 360nm and 0.52 at 477nm, respectively.

P33 Finally it should be mentioned that the results of this study are very similar for both selected wavelengths (360 and 477 nm) indicating that the differences in the radiative transfer between both wavelengths have no strong effect on the MAX-DOAS profile retrievals.

7) The authors decided to put the figures showing relative differences in the manuscript and the other figures in the supplement. I'd suggest to do the opposite and to show the retrieved profiles in the main text, adding the true and the a priori profiles. In my opinion, these figures give a more rapid access to the performance of the retrievals while the relative differences are additional information, which can be moved to the supplement.

Response: Thank you very much for your suggestion. We have considered your advice to change the figures in the main text. The actually retrieved profiles were moved to the main text, and the relative deviation was moved to the supplementary material. And we also changed the corresponding content in the article.

8) I found it a bit unfortunate that the authors decided not to include a perfect scenario, where the profile shape and AOD of the a priori agree with the true profile. It would be very interesting to see, if in this case PRIAM also underestimates the AOD / NO_2.

Response: Thank you very much for your suggestions. We have considered your advice and added the correlative sensitivity analysis. The corresponding result for aerosol and gas profile were added in Sec.3.1.3 P16 and Sec. 3.2.1 P25, respectively.

Changes in manuscript:

3.1.3

P16 We also investigated the retrieval results if exactly the a priori profiles were used as input. The results are presented in **Fig. 5**. The results show that the retrieved aerosol profiles are basically the same as the input profiles, and the relative deviation is less than 0.05% (**Fig. S14** of the supplement). This sensitivity study shows that a) PriAM is implemented in a proper way and b) improved retrieval results can be obtained with improved *a priori* profiles. This provides a possibility for real measurements to obtain more accurate aerosol profiles if independent information on the *a priori* profiles is available, e.g. from Lidar observations and sun photometers.

3.2.1

P25 We also investigated the retrieval results if exactly the a priori profiles were used as input profiles. The results are presented in **Fig. 16**. In contrast to the aerosol inversion, here for some scenarios substantial differences are found, which in general increase with increasing NO_2 VCD and AOD. The smallest deviations are found for exponential and Boltzmann profiles, whereas for Gaussian profiles larger differences are found. The magnitude of the relative deviation increases from 20% to 50% with the NO_2 VCD increasing from 1×10^{14} to 10×10^{16} molecules cm^{-2} (**Fig. S28**). It is important to note that the relative deviations for the retrieved NO_2 profile by using both the aerosol and NO_2 *a priori* profiles as input profiles are less than those if only the aerosol a priori profile is used as input profile (PriAM by S2). This finding also provides guidance for gas inversions in the real atmosphere, if the aerosol and gas profiles can be provided as the *a priori* profile by other monitoring techniques, the inversion results of MAX-DOAS will be more accurate.

Detailed comments

1. Abstract: It is claimed that the finding of the AOD underestimation in the sensitivity study explains the underestimation seen in real data. I think this is neither new, nor an explanation – the explanation as far as I see it is the insensitivity to the upper part of the extinction profile in combination with the forcing of the profile shape from a priori or parametrisation.

Response: Thank you very much for your suggestions. We reorganized the abstract, see above.

2. Page 11: The selection of profiles to be used later appears completely random – at least from the text, it is not clear how the "representative" profiles have been selected.

Response: Thank you for your remark. On page 12, we introduced the reasons for choosing these "representative" profiles in detail.

Changes in manuscript:

In order to limit the number of investigated profiles, first a sensitivity study with PriAM was carried for the selected profile shapes in Table 1 (these best represent the variety of realistic profile shapes). Based on the result shown in **Figs. S2 to S4** it turned out that one height parameter is mostly representative for the parameterization with Gaussian and Boltzmann profiles. For the exponential profiles, two height parameters were chosen, because for both height parameters systematically different results were obtained: when the scale heights of the exponential profiles are low, the retrieved profiles are close to the input profiles. But for high scale height, the retrieval underestimates the scale heights of the exponential profiles.

3. Page 11: The selection of the scenario used for evaluation of the sensitivity to aerosol parameters

could be critical. Have other relative azimuth angles be evaluated as well? I would have expected the effect of the asymmetry factor to be different for different scattering and relative azimuth angles.

Response: Thank you for your questions. In this study, we studied the effects of the relative azimuth and solar zenith angles. We found that the results for different SZA (20°, 40°, 60°, 80°) and RAA (30°, 60°, 120°, 180°) are basically the same. But here it is important to note that in the real atmosphere, very different phase functions might occur, and especially for small RAA stronger systematic deviations might occur.

Changes in manuscript: P13.

The effects of the different SZA (20°, 40°, 60°, 80°) and RAA (30°, 60°, 120°, 180°) are basically the same. But here it is important to note that in the real atmosphere, very different phase functions might occur, and especially for small RAA stronger systematic deviations might occur. Here only the result for SZA = 60° and RAA = 120° was shown.

4. Page 11: Which aerosol model has been used?

Response: We are not sure if we correctly understand this question. Probably you refer to the aerosol phase function. Here we used a HG parameterization. This information was made more clear in the manuscript.

5. Page 15: Which 4 diagonal elements of Sa are you talking about? I assume there are 20 or 21 diagonal elements in Sa? Do the relative values of the diagonal elements in Sa not depend on altitude?

Response: Thank you for your remark. The values of the diagonal elements in Sa depend on the *a priori* profile. In other words, they depend on altitude. The description in the article was probably a little unclear. In order to make it more clear, a new symbol (Sa_ratio) is introduced.

Changes in manuscript:

P17. The Sa is the covariance matrix of the *a priori* profile (N×N), and its diagonal elements are the square of the *a priori* state uncertainties with the off-diagonal elements calculated from the Gaussian function with the correlation length of 0.5 km (Frieß et al., 2006).

The diagonal elements of Sa for the aerosol profile were set as the square of the *a priori* profile uncertainty. The standard settings for the *a priori* profile uncertainty were 10% of the *a priori* profile. To describe this ratio, a new symbol (Sa_ratio) is introduced (see Table 4). The 4 Sa_ratio were set to 6%, 10%, 20%, and 50%.

6. Page 16, Line 6: “the higher the Sa values, the lower the upper limits are for the inversion” – this is not clear to me.

Response: Thank you for your remark. We added the missing information.

Changes in manuscript: P17. This is due to the fact that the biases towards the *a priori* profiles are reduced with increasing Sa values.

7. Page 16, line 22: must be related to systematic performances … or RTM differences

Response: Thank you for your suggestion. We changed the text accordingly.

Changes in manuscript: P18. Therefore, it can be concluded that the discrepancies of the retrieved aerosol profiles from the input profiles were not caused by failed convergences of the retrievals but must be related to systematic performances of the inversion algorithms in solving the ill-conditioned problem or RTM differences.

8. Page 20, Line 8: "The artificial smoothing effect of the profile inversion algorithm mistakenly overestimates" => "The smoothing effect of the profile inversion algorithm overestimates"

Response: Thank you for your suggestion. We changed the text accordingly.

Changes in manuscript: P22. The smoothing effect of PriAM overestimates the NO_2 concentrations around 500 m to compensate for the underestimation of the NO_2 concentrations above 1.0 km.

9. Summary: "We found that both algorithms can reasonably retrieve the 4 aerosol profile shapes" – I'm not sure that readers will agree to this point after having studied the figures with the results. It is clear that the retrievals cannot retrieve the extinction profiles above 1.5 km, and at low and high AOD, they also fail in the lower altitudes for many scenarios.

Response: Thank you for your suggestion. We changed the text accordingly.

Changes in manuscript: P30. We found that both algorithms have systematic deficiencies in retrieving the 4 profile shapes. Especially at low (above 0.2 km) and high (above 1.5 km) altitudes, often deviations from the true values are found, while for altitudes in between best agreement is found. The algorithms can reasonably retrieve the 4 aerosol profile shapes of AODs < 1.0 for two wavelengths, but for AODs > 1.0 the retrieved values systematically underestimate the true AODs.

10. Table 1: Why are there stars for both 0.5 and 1.5 km exponentials?

Response: Thank you for your remark. For the exponential profile inversions, two exponential profiles are used by default with scale heights of 0.5km and 10km, respectively. So both 0.5 and 1.0 km exponential profiles were marked with stars.

11. Table 2: not needed

Response: Thank you for your suggestion. We have considered your suggestion, but we think that the Table 2 should be retained. It allows the reader to quickly see the differences between the two algorithms.

12. Figure 2: There is confusion about MAPA excluding scenarios with AOD 2 – please check

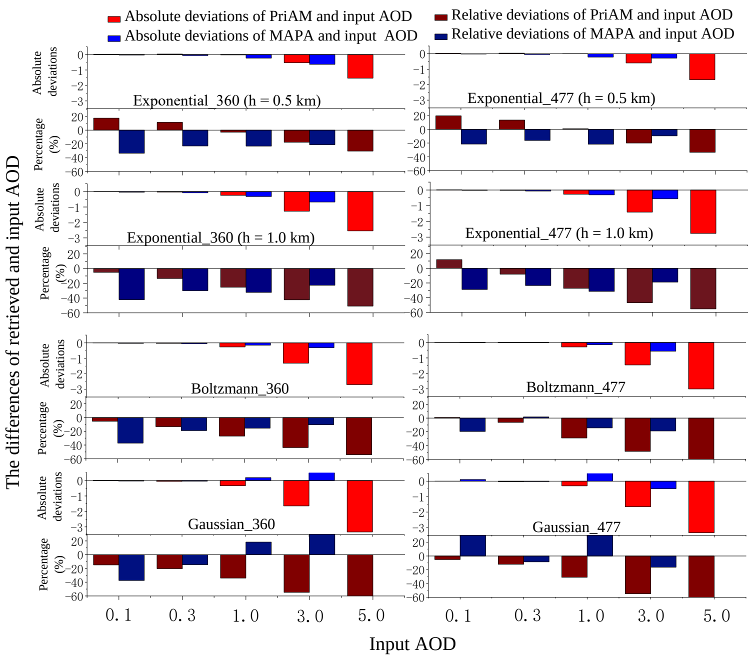
Response: Thank you for your remark. The AOD is 3. The text was corrected accordingly

Changes in manuscript: Note that MAPA by default flags cases where the retrieved AOD exceeds 3, thus the high aerosol scenarios are missing for MAPA.

13. Figure 7: Typo "deviatiobs"

Response: Thank you for your hint. It was corrected

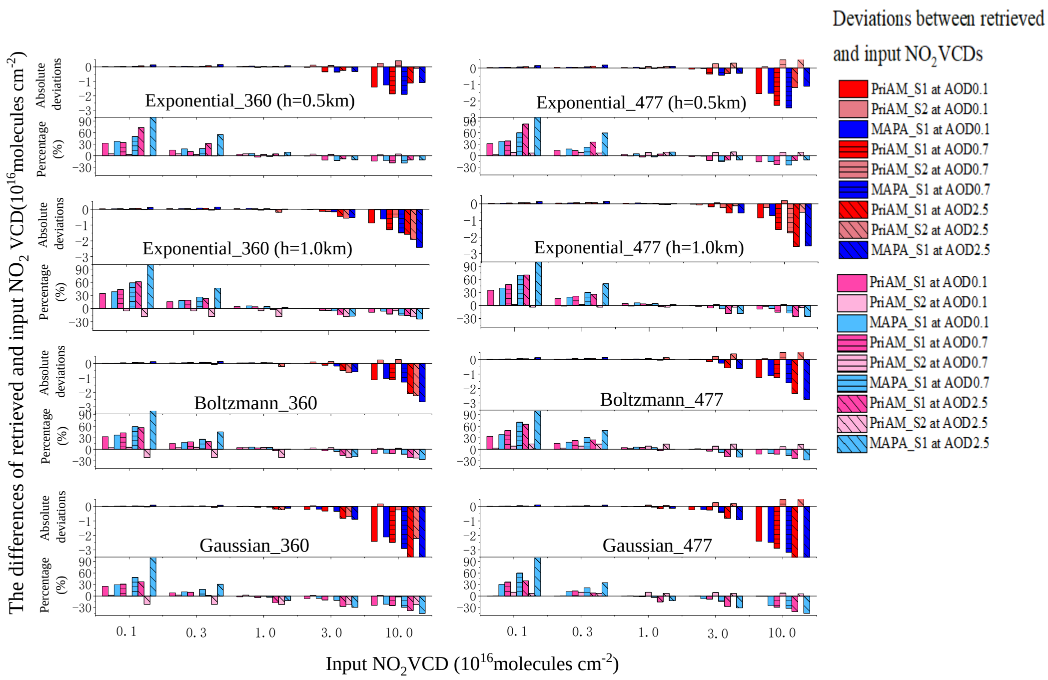
Changes in manuscript:



14. Figure 16: It looks as if the bars of the lower 2 lines are partially clipped – please check and change scale if needed

Response: Thank you for your suggestion. The changed the scale as suggested.

Changes in manuscript:



Thank you for taking care of our manuscript.

Kind regards,

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