

Atmos. Meas. Tech. Discuss., referee comment RC1
<https://doi.org/10.5194/amt-2022-266-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on amt-2022-266

Anonymous Referee #1

Referee comment on "Solar occultation measurement of mesospheric ozone by SAGE III/ISS: impact of variations along the line of sight caused by photochemistry" by Murali Natarajan et al., Atmos. Meas. Tech. Discuss.,
<https://doi.org/10.5194/amt-2022-266-RC1>, 2022

In this paper, a correction is discussed for the strong changes of ozone in the (lower) mesosphere along the line-of-sight of a solar occultation measurement due to changing solar zenith angle around the terminator. The method is developed using a 1D chemical box model and applied to as a correction factor to the retrieval of ozone from SAGE III/ISS. Corrected and uncorrected profiles ozone profiles are compared, and differences of up to 50% are found for sunrise observations above 64 km, around 10% for sunset observations around 62 km. Similar corrections are used for the retrieval of stratospheric NO and NO₂, but are apparently not widely used for mesospheric ozone. Considering the large differences particularly for the sunrise data, it is certainly good to address this issue. The paper is generally very well written, but I have a few points which should be addressed listed below.

Line 22/23, also lines 46-48, line 200: (1) while you allow for variation of ozone with the solar zenith angle along the line of sight, you still have to make the assumption that $O_x = O + O_3$ is constant along the LOS, is that correct? Can you state this a bit more clearly? (2) Were the model experiments carried out for different latitudes / seasons, or just for the one example shown (tropics)?

Line 30: see my comment below (line 311-312) about the sunrise to sunset ratio as shown in Figure 11

Line 88-89: considering the model results are really an essential part of the paper, a more concise description would be appropriate. At the very least you should mention which species are considered, and how the model is initialized, which certainly has some impact on the model results (i.e., how much H₂O or HO_x will have a big impact on daytime ozone). A list of the photochemical reactions considered would be good as well, maybe in an Appendix.

Line 92: please state the altitude range here, and explain why it is restricted to 58-74 km. This information is provided further down, but really belongs here.

Lines 92-93 and lines 102-103: these lines appear to be in contradiction. The figure shows constant ozone (presumably constant O_3) during night, in agreement with lines 92-93. Or do you mean "around sunset" in line 103?

Line 103-104: as results for higher altitudes are shown later, you should also show model results from these altitudes.

Line 105-106: however you do show results from 70-100 km for the O_3 day/night ratio, so you maybe should show results and discuss this region here as well.

Line 268, discussion of the impact of the twilight correction as shown in Figure 8: you stated before that data above 70 km are very noisy, and this is presumably the reason for the very patchy structure with occasionally high values (100%). First of all – are you certain there are no NaNs or negative / unrealistically low values in this sample? Considering the high noise, it would make sense not to show the data above 70 km as you did for other properties. However, if you want to show them, you should average over larger samples, either by increasing the latitude bins above 70 km, or by calculating a running average above 70 km.

Line 305-308: can you provide error bars, i.e., the standard error of the mean, for the corrected and uncorrected values?

Line 311-312: considering the large quantitative differences between the theoretical values and the corrected and uncorrected values you could argue with as much justification that the uncorrected values are in better agreement with the theoretical values as they seem to agree better quantitatively in the lower altitudes. A clear statement which fits better seems difficult here. However, it might be possible to provide a more robust statement if error bars were provided.

Line 345-346: see my comment above to lines 311-312.