Response to comments from Referee 1. (Italicized)

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.

We thank the reviewer for the comments and suggestions. Our responses to the comments are shown below in italics. We hope the revised manuscript addresses the comments to the satisfaction of the reviewer.

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 Ox = O + O3 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)?

(1) *In this analysis we don't assume that O_x is constant along the LOS. We do use the fact that the integrated column of O_3 along the LOS is the same for the standard and modified retrievals (Equation 2 in the text). The mesospheric O_3 column along the LOS in the solar occultation experiment comprises O_3 concentrations corresponding to different SZA from every level above the tangent altitude. The O_x in each of these levels is different and the partitioning into O and O_3 is also different based on the local SZA. The one-dimensional time dependent model doesn't assume constant O_x. Both O and O_3 are independent variables in the model. In the lower mesosphere, the chemical lifetime of O_x is shorter than a day. The production of O_x from the photolysis of O_2 during the day is balanced by the loss of O_x from O_x and HO_x reactions integrated over the diurnal cycle. We have added an appendix showing the photochemical scheme used in the model.*
(2) *The diurnal model calculations were done for each month at 11 latitude bands 11.25° wide from 56.25°N to 56.25 °S. The diurnal factors were interpolated over latitudes and calendar days.*

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

Please see the response below (line 311-312)

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 HOx will have a big impact on daytime ozone). A list of the photochemical reactions considered would be good as well, maybe in an Appendix.

We appreciate this suggestion from the reviewer. We have expanded the description of the model and added the mesospheric photochemical reaction scheme used in the model as an appendix. We recognize that the absolute O_3 concentrations are dependent on factors such as the abundance of H_2O used in the model. We point out that the variation in O_3 near the terminator normalized to its value at SZA of 90° is very robust and the twilight ratio can be used to make the correction required in the retrieval. We have also added a figure illustrating the sensitivity of the O_3 twilight ratios to a 25% increase in H_2O.

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.

We state the altitude range in this section of the revised version.

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

Around sunset, there is a net loss of Ox which continues until all the O is transformed to O_3. Within a few hours after sunset O_x and O_3 reach a steady value. We have revised the line 103 to make this clear.

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

We have decided to remove the results for higher altitudes because of the noisy data. The large twilight ratios above 73 km combined with noisy data add to the uncertainty of the results for higher altitudes. We have also revised the text in line 104 (New line 122)

Line 105-106: however, you do show results from 70-100 km for the O3 day/night ratio, so you maybe should show results and discuss this region here as well.

We now limit our attention to the region below 70 km and do not show the results from the upper regions.

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.

We have decided not to show the data and the results above 70 km because of the noisy structure. O_3 *profile reaches a minimum in the 75 to 80 km region and the uncertainty in the data is high. We have retained the negative values, but we removed the data points with large filled-in values representing low confidence in the retrieval.*

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

We have revised the plot to show the mean and the standard deviation for both the standard and modified retrievals.

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.

We emphasize that this figure only shows a qualitative improvement achieved by the modification to the retrieval scheme. The sunrise to sunset ratio should exhibit a decreasing value with altitude in this region based on the known photochemistry. The modified retrieval yields such a profile though the standard deviations are large enough to overlap.

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

See response above.

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