

Response to the comments from referee 2 (Italicized)

Referee Report to “Solar occultation measurement of mesospheric ozone by SAGE III/ISS: Impact of variations along the line of sight caused by photo-chemistry” by Murali Natarajan et al.

The manuscript investigates the influence of the diurnal variation of the mesospheric ozone on the retrievals from SAGE III/ISS measurements and suggests a correction algorithm to account for the diurnal variation in the retrieval of the vertical profiles of the mesospheric ozone. The topic of the manuscript is certainly interesting and has a scientific importance. In general the manuscript is written clearly and concise. A great disappointment for me, however, is the fact that the authors did not make any attempt to compare their results to any independent measurements. A significant difference between the standard retrievals and those corrected for the diurnal variation of ozone is found but the reader is forced to believe that the new results are better and the implementation of the correction scheme is correct. In my opinion, some comparisons with independent measurements need to be added before the manuscript can be published.

We thank the reviewer for the comments. We have revised the manuscript to consider these comments and we hope this version will satisfy the reviewer.

We have included a section discussing intercomparison with other data. Mesospheric O₃ measurements under similar conditions regarding the time of the day are available only from other solar occultation experiments like HALOE and ACE-FTS. Irrespective of whether these experiments include the corrections for the twilight variations of O₃ in their retrieval schemes or not, they cannot independently validate the need for or the magnitude of such a correction. Other experiments such as MLS and ground-based microwave radiometry provide mesospheric O₃ data. We have shown a comparison MLS data with SAGE III/ISS for a selected latitude band and period in June 2021. We have chosen to compare mean profiles taken over a 3-day period. Diurnal variation in O₃ makes it necessary to convert the MLS day or night measurements to SZA of 90° during sunrise or sunset. For this, we used the diurnal photochemical model results. We have shown the results from this comparison and discussed the implications. We feel that the use of the diurnal model for both the modified SAGE III/ISS O₃ retrieval and the conversion of MLS O₃ makes this comparison strictly not an independent validation of the need for twilight correction of the solar occultation retrieval. In the absence of any other independent data taken at SZA of 90°, we realize that this is probably the best we can do. The main emphasis of this paper is not the validation of SAGE III/ISS mesospheric O₃ measurements but to highlight the cause for a bias in the retrieval and suggest a correction scheme.

Minor comments

- Line 39: “longer path length” - longer in comparison to what?

Reference to the path length is removed.

- Line 99: “in this altitude” - please specify the altitude more precise

Revised the sentence to indicate the altitude range where O_x has a diurnal variation.

- Lines 99–102: It is not quite clear how the discussion about the odd oxygen is related to ozone, please clarify.

The odd oxygen variation and its relation to O_3 diurnal changes have been added.

- Lines 103–105: “At higher altitudes...” - this sentence provides no useful information. Please either delete this sentence or be more specific with respect to altitudes and diurnal behavior.

This sentence has been removed since we have decided to focus our discussion on the region below 70 km.

- Line 129: Please spell out “LaRC”

Done

- Line 133: “positive direction ...” - please provide this information also in figure caption

Revised the figure caption to include more information about the axis.

- Line 134: here and below it is more appropriate to use the term “solar zenith angle” instead of “zenith angle”, although I agree it is the same for the occultation geometry.

Done

- Lines 346–350: The discussion about dynamical issues is out of place here. It was not mentioned in the paper and thus should not occur in the summary.

We have deleted the sentence about dynamical issues from the Summary.

- Figure 1: In the light of the discussion in the manuscript, the figure needs a second x-axis showing the solar zenith angle.

A second X-axis showing the solar zenith angle is added to the Figure 1.

Technical corrections

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- Lines 25-26: “...the impact of the twilight variations is to increase the optical depth...” - maybe you meant “corrections” rather than “variations”.

The sentence has been modified to make it clearer.

- Line 138: “is readily seen” → “are readily seen

Corrected.