

Author's response

This document provides a point-by-point response to the reviewer including a list of all relevant changes made in the manuscript. All authors sincerely thank the anonymous referee once more for their helpful review.

This document consists of a single section addressing the comments and feedback from Referee 1, beginning on page 2.

Response to Referee 1 Comments

We would like to express our sincere thanks to the referee for their suggested re-wordings and clarifications. Referee comments are written in black and authors answers are in blue.

Specific comments and questions:

Point L24: Why "indeed" here? I suggest deleting this word.

Response L24: This point has been addressed.

Point L82: As noted previously, the study by Wilmouth et al. (2023) pertains to a different time period than those by Evan et al. (2023) and Zhu et al. (2023). Thus, to avoid confusion, add "also" after "highlighted" in this sentence (alternatively, the whole clause about the Wilmouth paper could be deleted).

Response L82: This point has been addressed.

Point L83: The second part of this sentence ("and the slowing down of the NO_x cycle") is also potentially confusing, since of course that effect decreases, not increases, ozone destruction, and the point of this sentence is to describe the mechanisms leading to chemical ozone loss.

Response L83: Additional information on catalytic cycles was added to the manuscript to improve clarity. As noted by Zhang et al. (2024), the slowdown of the NO_x cycle led to enhanced ClO_x levels and subsequent ozone depletion.

Point L101-102: The phrase "relies exclusively on satellite measurements from this area" could be mis-interpreted as contradicting the previous sentence stating that ground-based data are used with satellite data. Some rewording / rearrangement would eliminate the ambiguity: "relies on satellite measurements obtained exclusively within this area".

Response L-101-102: This point has been addressed.

Point L136-137: The added text in this sentence (which I realize I suggested) has led to some repetition. To reduce redundancy and use more precise language, I recommend changing "for the first weeks after the eruption" in L136 to "for the first three weeks after the eruption" and then changing "during the first few weeks after the eruption" in L137 to "immediately after the eruption".

Response L136-137: This point has been addressed.

Point L156-157: This new sentence ("Specifically, ...Hunga-influenced") is largely redundant with the original sentence in L159-160 ("As a result, ... Hunga-influenced"). Only one of these sentences is needed. If the authors choose to retain the first one, then "occurs" should be "occurred". Also, "considered as" → "considered to be".

Response L156-157: This point has been addressed.

Point L164-167: The description of the MLS quality screening is still unclear. For clarity, "for the first three weeks following the eruption" should be added after "with the exception of the v4 and v5 H₂O

profiles". (At least, that is what should have been done-the MLS H₂O data outside of the immediate aftermath of the event should have been quality filtered.) On the other hand, this paragraph is about ozone. Therefore, a better approach would be to add "O₃" after "raw" in L166 for clarity and then simply delete the parenthetical about the H₂O profiles.

Response L164-167: This point has been addressed.

Point L183-184: (Boynard et al., 2018) → Boynard et al. (2018) [i.e., move the parentheses and delete the comma].

Response L183-184: This point has been addressed.

Point L242: determined → calculated

Response L242: This point has been addressed.

Point L285: OMPS LP → OMPS-LP

Response L285: This point has been addressed.

Point L318: I still feel that "MLS appears to be a suitable substitute for lidar data" is too weak (even if the comparisons turned out to be not quite as good as originally thought). I suggest "MLS data are" rather than "MLS appears to be".

Response L318: This point has been addressed.

Point L336: The statement that "the average relative bias decreases" between 40 and 45 km gives the wrong impression. It would be more accurate to say "Between 40 and 45 km, the average relative bias decreases slightly in magnitude but changes sign."

Response L336: This point has been addressed.

Point L336-337: I do not see how the statement "below 20 km, it shows an average of $10.81 \pm 38.08 \%$ " can be correct. For one thing, below 20 km the relative bias values are mostly negative. In addition, given that most of the negative relative bias values visible in Fig. 4a have magnitudes of less than 6 %, I'm not even sure that "-10 %" would be correct, unless the spikes currently cut off at the left-hand edge of the plot are considerably larger than that. If the authors want to quote percentage biases below 20 km, then the x-axis range should be expanded to show these values. However, I would argue that a layer-average bias is not very informative in the face of such large oscillations in the profile. Moreover, I do not believe that this structure is meaningful. Figure 3 shows that the MLS average profile over Reunion is smoothly varying below 20 km. The small wiggles in the DIAL profile are obscured by the thickness of the green and orange lines used for the MLS profiles. The reason for the fairly large relative errors at these altitudes is that the ozone mixing ratios are very small, approaching zero. In this situation—dividing by near-zero values in Eqn. (1)—relative errors become large, exaggerating the discrepancies between the two data sets. The authors state in L342-343 that the increased relative bias below 20 km is attributable to reduced satellite accuracy and precision and a smaller number of available lidar measurements, but, while those factors play a role, I believe that the larger relative biases are mainly due to the very low O₃ mixing ratios at these levels. This point needs to be made in the text. It might be more appropriate to cite raw (absolute) rather than relative biases in this region.

Response L336-337: The bias values below 20 km were incorrect and have been corrected. During

the revision, we also found that the standard error of the mean bias was over-estimated by a factor of two; this has now been fixed. As suggested, the x-axis range was adjusted, and information on low ozone mixing ratios has been added.

Point L: Reminding readers of the selection criteria is helpful. However, to ensure that this does not come across as new information, it would be good to add "As described in Section 2.1.3" at the beginning of this sentence.

Response L: This point has been addressed.

Point L368: All three of these references should be written as "et al., 202x" [i.e., add commas and delete the parentheses]

Response L368: This point has been addressed.

Point L400-401: With the addition of "with excess water vapor" after "aerosol cloud", the last part of this sentence ("and water vapor excess at the same pressure ranges") is not needed. In fact, I'm not convinced that this sentence is necessary at all, as the details are given in the next paragraph.

Response L400-401: This point has been addressed and the sentence has been omitted.

Point L405: This sentence points to Fig. 6e for the MLS Indian Ocean profile and Fig. 3 for the lidar profile. But isn't the January mean lidar profile also shown in Fig. 6e? If so, then it would be easier on readers to simply refer to Fig. 6e for both mean profiles; that is "... Indian Ocean (Fig. 6e, purple line)" and "... lidar profile (Fig. 6, green line)".

Response L405: The MLS Indian Ocean profile and the lidar profile are indeed both present in Fig. 6e. The text has been simplified as suggested.

Point L408: add a comma after "(2023)"

Response L408: This point has been addressed.

Point L421: delete "also" (not needed with "Additionally")

Response L421: This point has been addressed.