

Comments from Anonymous Referee #3

Review for manuscript titled “Has the 2022 Hunga eruption impacted the noctilucent cloud season in 2023/24 and 2024?” by S. Wallis, M. DeLand, and C. von Savigny
The manuscript tries to answer the question whether the water vapour injected by the Hunga Tonga-Hunga Ha’apai eruption in 2022 had an impact on the noctilucent cloud (NLC) occurrence in 2023-2024. To answer this question, authors show observations from MLS and OMPS-LP instruments for both hemispheres. Authors also compare observations for 2024 to several previous years to highlight the difference. Despite an increased water vapour mixing ratio in both hemispheres were shown, it was not possible to find a significant change in NLC occurrence frequency. Based on the results shown, authors conclude that it took roughly 2 years for the water vapour injected by the Hunga Tonga-Hunga Ha’apai eruption to reach the polar summer mesopause.

The article is well written and presents results relevant to the journal of Atmospheric Chemistry and Physics. However, there are some minor issues that authors could fix to strengthen the article. I therefore recommend a minor revision that should not be difficult for the authors to perform. Comments are summarized below.

We would like to thank the reviewer for taking the time to revise our manuscript and agree that her/his comments resulted in its improvement. We will address all of the reviewer’s comments below.

General comments:

Throughout the text, authors use “SH NLC season 2023/2024” but “NH NLC 2024 season”. It would look better if authors could homogenize it. For example, the year always follows the word season or the opposite.

We agree and changed the relevant parts of the text to make the phrasing consistent.

Figures 2-8 state years 2013/2014 to 2020/2021 in the legend, but the average is shown for 2016/2017 – 2020/2021 referred to as reference period in Section 2.1. It is unclear why one would show more years than needed to calculate the average.

As suggested, we revised Figure 2 -8 and now only show data starting from 2016/17 for the SH and 2017 for the NH.

Minor comments:

Abstract

Line 9: abbreviation NLC is used without being described.

The abbreviation NLC is replaced by “noctilucent cloud”.

Line 11: authors could consider replacing “seem to” with something more solid like “based on analysis performed in the study, we show/believe/demonstrate/assume”

We agree and replaced “seem to” with “based on analysis performed in the study, we show that” as suggested.

Section 3

Figure 2: please consider adding years to the panel b. This is because many different years are shown in panel a, and it would be easier for the reader to understand which of those years you show in panel b.

A date was added to Figure 2b to improve the clarity of the plot.

Line 107: does occurrence frequency exceed 3 std at the end of February or January?

We would like to thank the reviewer for pointing out this mistake. We corrected “February” to “January.”

Line 130: this is the first time seasons 2013/2014 to 2022/23 are mentioned. Please see my general comment on how this is related to the reference period mentioned in Section 2.1.

We changed all of the Figures to only show data starting in 2016/17 for the SH and 2017 for the NH and corrected their description in the text accordingly.

Line 136-138: based on Figure 6, it does not look like the NLC occurrence frequency in 2023/24 is always higher than in previous years.

We agree and added “on average”.

Line 139: “Similar scatter plots for latitudes 60°S - 65°S and 65°S - 70°S are shown in Figure S7...”, but latitude band 65 – 70 S is already shown in Figure 6, right?

We thank the reviewer for drawing our attention to that and removed Figure S7a.

Line 143: consider adding “in the NH” after “is also detected”

We agree and added “in the NH” to make the sentence clearer.

Line 151: consider adding “that could explain the decline in NLC occurrence in Figure 7a” after “compared to the mean average”. Otherwise, this assumption is only mentioned in the conclusion.

We agree and added the phrase as suggested.

Line 152: please add that the limited vertical resolution of MLS was already mentioned in Section 2.

The phrase “as discussed in Section 2” was added.

Section 4

Line 206/209: could high H₂O amount be explained by the time of the year when maximum climatological values take place and not be a result of volcanic contribution?

In order to account for the seasonal variation in mesospheric H₂O mixing ratios, we calculated the anomaly compared to a five year reference period, i.e. the 5-year multi-annual monthly means were subtracted from the respective current monthly mean (Figure 1 and Figures S1 – S3). Only Figures 2b and 7d show anomalies based on daily means. Nevertheless, we agree that a variation in the seasonal H₂O content could result in positive or negative H₂O anomalies. Figure S1-S3 show the monthly H₂O mixing ratio anomalies from January 2022 to August 2024 and highlight the areas, that exceed more than 3 times the standard deviation of the 2017 – 2021 reference period. These areas seemed to be well connected and appear to be due to the volcanic H₂O emission. Therefore, we focus on the contribution of the Hunga volcano to the H₂O budget in the mesosphere as we think that this will be the dominant cause for the anomalies.

We would like to thank Anonymous Referee #3 for their time and for providing comments on our manuscript.