

## Response to Reviewer (minor revision)

Many thanks for your additional work on our manuscript. We appreciate your efforts. Below you can find our answer to the comments in blue. We have also revised the manuscript to clarify this open point. The changes are marked with track changes based on the first revised word document.

### General Comments

I would like to thank the authors for their genuine engagement with the comments from both referees, and for the acknowledgement on lines 513-514.

Apart from some minor corrections listed below, there is only one response which I think has been misunderstood and where I would request some additional revision.

Regarding the ozone and aerosol air mass factor (originally lines 185-197 in the submitted manuscript, responded to in lines 218-221 in the revised manuscript), the authors state they have followed the US Standard Atmosphere from 1976. However, after many years of careful observation at Davos, I am sure better information than this must exist for the true vertical distribution of both ozone and aerosol at this location. Many previous works have considered the appropriate aerosol vertical distribution for measuring AOD in the UV, including some written by PMOD authors. I think the authors should state explicitly what height and distribution they are assuming for both aerosol and ozone, and comment on whether this would represent a significant source of uncertainty or not, particularly at higher zenith angles. The Payerne ozonesonde record would provide a climatology of effective ozone height.

*We agree that more information about the vertical distribution profile could improve the retrieval of TCO. We have addressed the impact of the difference between the standard atmosphere and the ozone sondes from Payerne on TCO retrieval for a) double ratio technique in Gröbner et al. (2021) and for the LSF retrieval in Egli et al. (2022). In summary, the averaged effective ozone height over Payerne is 22.3 km with a minimum of 20.2 km (winter) and a maximum of 23.8 km (summer). The difference of 3.6 km results in a maximum of 0.3% difference in TCO at air mass of 3.9 (SZA 76), which is the maximum that can be reached due to the mountainous horizon of Davos. For comparability with Brewer 156 we have chosen a constant ozone layer of 22 km and the effective molecular scattering height relevant for Rayleigh scattering of 5 km as discussed in Gröbner et al. (2021).*

*The effect of the variation of the effective ozone height is implicitly considered in this publication in the uncertainty budget for both the LSF retrieval and the CDR retrieval (lines 425 – 439). For the LSF retrieval, the air mass uncertainty is included in the statement that the contribution of the other uncertainties remains the same as in Egli et al. (2022). Regarding the CDR retrieval, the uncertainty from air mass of 0.085% ( $k=1$ ) is explicitly stated in line 432. Since 0.3% are maximum values we have derived the  $k=1$  (1 sigma) uncertainty by  $0.086\% = 0.3\% / 2 / \sqrt{3}$  as discussed in Egli et al. (2022).*

*We agree with the reviewer that we should explicitly state the vertical height for ozone (22 km) and aerosol (5 km) layer we have used. We have clarified this in the description of the CDR retrieval lines 258-263 and included in 439 (uncertainty budget of CDR). For further operational long-term measurements and to further reduce the uncertainty we consider including the individual soundings from Payerne and local ground pressure. We thank the reviewer for this suggestion.*

## Minor Comments

Line 18 Has it really been 'optimized'?

*Done. We have removed "optimized"*

Line 26 "as good" -> "as well"

*Done.*

Line 30 "similar as" -> "similar to"

*Done.*

Line 32 "allows to determine" -> "allows the determination of"

*Done.*

Line 33 Insert space between "to" and "monitor"

*Done.*

Lines 33-34 "The presented TCO retrieval" -> "The TCO retrieval presented" or "The TCO retrieval presented here"

*Done.*

Line 37 "is" -> "was"

*Done.*

Line 38 "and since then" -> "and since then has been"

*Done.*

Line 54 Insert space between "network" and "still"

*Done.*

Line 61 I would prefer to say the ETC defines the inferred response of the instrument to the irradiance at the top of the atmosphere

*Done.*

Line 104 "is attributed to" -> either "should be attributed to" or "is caused by"

*Done.*

Line 123 "allows to retrieve TCO" -> "allows TCO to be retrieved" or "allows retrieval of TCO"

*Done.*

Lines 123-124 "the measured spectra of Koherent are used to apply" doesn't make sense, I suggest something like "the measured spectra of Koherent are used as an input" or "a custom double ratio technique can be applied to the measured spectra".

*Done.*

Line 237 Insert space between "than" and "other"

*Done.*

Line 286 Again, I think "customized" is misleading, given this doesn't seem to have been a particular aim of your work

*Done. We use "chosen" instead of customized.*

Line 437 "to about" -> "to be about"

*Done.*

Line 487 "method" -> "methods"

*Done.*

Line 487 "such as" -> "namely" or another similar word

*Done.*

*We have further removed other typos in the revised manuscript.*