Comment on amt-2021-203

Anonymous Referee #1

Referee comment on "Optimized Umkehr profile algorithm for ozone trend analyses" by
Irina Petropavlovskikh et al., Atmos. Meas. Tech. Discuss.,
https://doi.org/10.5194/amt-2021-203-RC2, 2021

General comments:

The Authors present reprocessed, homogenized and overall improved datasets containing
long-term Umkehr retrievals of Ozone profiles derived using measurements from Dobson
spectrometers. The dataset is then formally compared against several satellite records
while considering the Averaging Kernels of the Umkehr retrievals. The manuscript is quite
long but comprehensive, and would serve as valuable reference for future works in this
subject.

The implementation of the method is not trivial and probably beyond the current capacity
of other groups operating Dobson spectrometers. Nevertheless, this work demonstrates
the added value of these observations and their usefulness in the future. As improved
instruments, algorithms and spectroscopy arise, long-term historical records such as those
presented here become more important as benchmark in monitoring the history and
evolution of the Ozone layer.

This manuscript fits well within the scope of AMT. Therefore, I recommend its publication
after addressing the comments of Reviewer 1 and some of the comments and corrections
below.

Specific comments:

Most of the figures are well-made, legible and contain the right amount of information. The Red and Green lines/markers can be difficult to distinguish for some readers (e.g. Fig. 1, 2, 4 ,5, etc.), but I think they are still bordering on OK in the plots where they appear. Some of the figure captions need to be checked for typographical errors.

P.9, Line 84: On the step change in the GMI CTM: I would suggest to provide at least one sentence of explanation on what this step change is, and why it happened.

P.10-11, Lines 325-325: The description of the Dobson optical system needs some revision, as already noted by Reviewer 1. Perhaps it is also worth to mention that the Dobson spectrophotometer is a double monochromator. Also important: the optical wedge attenuates the long wavelength signal, the Q-levers indicate the positions of the wavelength pairs (A, B, C or D), which depend on the temperature inside the instrument. The photomultiplier registers the alternating signals from the short wavelength, which is absorbed by Ozone, and the long wavelength attenuated by the optical wedge, resulting in a measureable current.

Also in Section 3.1., The Umkehr N-values need a better explanation for the non-specialist reader.

P.13, Section 3.3, First Paragraph:

This is a long paragraph that could be divided into two or three paragraphs for easier reading.

Also, the Authors mention that the Umkehr N-values are simulated for an idealized Dobson instrument. So, I would like to ask:

- How far or close to ideal are the Dobsons used here?
- Do the stations keep a record of the instrument characteristics mentioned in Sec. 3.1 (slit functions, response, etc.)?
- Would it not be useful to include a Figure of these characteristics, perhaps in the Appendix?

Appendix C: Umkehr Averaging Kernels:

It would be interesting to know the Degrees of Freedom for Signal (DOFs) as defined in Rodgers (2000). I think this should be an easy calculation.

Technical corrections:

In addition to the comments of Reviewer #1, I would like to add these below.

P.7, Line 211: COH acronym not defined

P.11, Line 355: "It is" -> "This is"

P.11, Lines 335-337: The sentences may need some revision, so that the non-specialist readers do not think that the original method used a Laser.

P.11, Line 37: „Komhyr and Evns, 2006" -> Komhyr and Evans, 2006

P.21, Line 76: space missing between the period and "This means that the retrieval is…."

P.23, Line 725: "NRL climatological" -> NRL climatology

P.35, Figure 1: The caption for c) is quite confusing, especially with the usage of multiple ")". Perhaps this can be simplified to:

"c-d) Standard deviations for the mean biases shown in panels a) and b). OPR is operational, and SLC is standard stray light correction."

P.37, Figure 4 Caption: "compare operational" -> "compared with operational"

P.37, Figure 4 Caption: Is it "13-months running smoothing" or "13-month running average"?

P.37, Figure 5 Caption: "(old 6) a" seems misplaced.

References need to be checked, e.g. Rodgers (1990, 2000) are missing.