

1 General Comments

The authors describe a new method to homogenise Dobson Umkehr data recorded on long time periods. These series are based on different instruments with specific optical properties that are regularly calibrated and maintained. These calibration procedures which are necessary to assure good data quality and homogeneity, could introduce breaks in the data sets. The results presented in this paper show that these breaks can be adequately corrected with an advanced data reprocessing. Since the model data underlying this process (M2GMI) is available globally, the procedure could be applied to other Umkehr records even though the implementation of the method is certainly not straight-forward. The numerous tests and comparisons made during the development of the breaks correction process prove the great attention given to the details. The bias correction is important to reconcile the ozone profiles recorded by very different observing instruments and techniques.

The manuscript is well written, fits well within the scope of AMT so I recommend the publication after the technical corrections described below.

2 Specific Comments

The paper being quite long, appendix A could be put as a separate supplementary file.

P.3, L.101: the ozonesondes much finer vertical resolution is mentioned but the resolution of the Umkehr profiles is not explicitly mentioned in the paper. This information could be useful to interpret the results.

P.4, L.123: similarly for the 5% uncertainty quoted for the stratosphere. Is this value changing largely at the various Umkehr levels? Listing the uncertainties and the vertical resolution for example in table D1 is suggested.

P.4, L.126-129: the message of the sentence "The main analysis." is not clear. Are new GB observations type required and/or noise reduction in existing data sets?

P.5, L.153-155: the criterion for valid Umkehr profiles used in this study are not clear here. Are the quality flags referring to the number of iterations, the RMSE or something else? Are the checks toward climatology applied on the raw N-values or on the final ozone values and at each levels separately? The typical number of valid profiles per month or year used in the study would be a valuable information to mention.

P.11, L.341-343: this paragraph should be improved. It is not convincing regarding the optical characterisation of the Dobson instruments. The laser measurements probably refer to ATMOZ project measurements (cited in line 347) but are NOT used in the two mentioned references. The two lamps method is used to define the R to N conversion table that is the wedges response. The

changes of the N tables is done also with the regular standard lamps tests.

P14, L.432: first mention of table 2. It is surprising to see that the calibration listed are until 2012 / 2014 while the data are analysed until 2020. The recommended maintenance/calibrations cycle of 4-6 years is not respected. Have the calibrations of the different instruments been updated recently since biases at the end of a record are especially critical for trend analysis ?

P15, L.473: the procedure adopted for this "iterative modification" is not described. A short description would be helpful.

3 Technical corrections / typing errors, etc

Page 2:

- line 42: "Ball et al.,2019", 2019a or 2019b ?
- line 48: "Krzycin, J. W. and Rajewska-Wich" 2009 or 2007
- line 53: "Damadeo et al." 2018 or 2014
- line 63: "Orbe et al." 2017 or 2020
- line 63: "Dietmüller et al." 2020 or 2021
- line 65: "Morgenstein et al." not in the reference list

Page 3:

- line 70: "Petropavlovskikh et al.", 2005a, b or c
- line 77: "Staehelin, 2017" not in the reference list
- line 81: ... Vigroux *ozone* absorption ...
- line 88: "DeLuisi(1996)" not in the reference list

I stopped the references check here since there are too many mistakes. The authors are invited to go systematically through the list.

Page 4:

- line 119 : remove the extra ")")

Page 5:

- line 164 : the method is not network specific. So "... homogenization methods for *ozonesondes that were applied to* NOAA and SHADOZ networks. ..."

Page 7:

- line 217: change ",," to "."

- line 221: change "https" to "https"
- line 226: what does mean "12 pressure levels per decade" ?

Page 8:

- line 247: change 2.69×1020 to 2.69×10^{20}

Page 12:

- line 367: first mention of a figure of this type. The quality of these figures should be improved for clarity. The grid lines are too faint and should not be behind the shading. The layer numbers on the axis are too small. The averaged profile is almost indistinguishable and extend to layer 1 where not data are present. The common x-axis scale is nice but not large enough (e.g in Fig. A1 and A2). SAGE is not mentioned in the legend.
- line 373: add SAGE
- line 375-376: inconstancy for layer 6.
- line 377: for layer 1, the individual differences are not displayed. Is there a reason or just too large differences ?
- line 381 + 383-384 : the discussion of GMI-CTM and M2GMI differences differs from what is seen in the figures !?
- line 384: on figure 1a), there are also 5 data sets !

Page 14:

- line 432: first mention of the Table 2. The table is not restricted to Boulder data as mentioned in the header. The sentence starting with CAL is not clear, CAL being not defined. "Updated WD" is supposedly a change of WinDobson version. What can be expected from that change ?
- line 446-448: redundant sentences
- line 446: first mention of fig 2 a). Here also the "Mean" profile is indiscernible.
- line 454: On figure 2b), the value at SZA=90 is 1.1 while on fig 1a) it is closer to 1.3. Should these two number match ?

Page 15:

- line 459-460: redundant sentences
- Line 478: first mention of fig 3. No instrument replacement occur on this time period so remove the last words of the table header.

Page 16:

- line 491: the offsets mentioned are for the "OPT - SLC" differences
- line 502: first mention of fig B3. The legend and caption of fig B3 for the black line is SLC-OPT not OPR-OPT which would not have a sign change at the beginning in the 80s.
- line 513: first mention of fig 5. remove "(old 6)" in the caption

Page 17:

- line 524-525: the dark-blue and light-blue curve show the other way around, M2GMI is close to zero

Page 18:

- line 567: ... with a mean *positive* bias ...
- line 578: ... (see Fig 5a.) not 6a

Page 19:

- line 596: first mention of fig A1, A2 and A3. The time period mentioned is "2005-2019" contrarily to table 1 time periods and fig 1
- line 605: MLO and OHP are reversed ?

Page 21:

- line 654: panel b
- line 660: (*purple* line)
- line 661: ... for *four* stations, add OHP in the list
- line 666: the rest of Appendix B is not finished and Figures B2, B3 and B4 not mentioned !!!!! Either complete or remove this part
- line 669: first mention of Table C1. Are the 21 layers column used anywhere in this study ? They are not referred on line 671. Correct the table header for "... top of the ..."

Page 22:

- line 712: Figure *D1*. In the caption, reference to an equation B that is not present !!

Page 23: correct all the figures reference that should be D-something as well as the y-axis label of figure D2b "Temperature difference"