

Interactive comment on “The Effect of Instrumental Stray Light on Brewer and Dobson Total Ozone Measurements” by Omid Moeini et al.

Anonymous Referee #1

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General Comments

This manuscript calculates the effect of stray light on the ozone absorption cross-sections, and hence the derived values of total ozone, from Dobson and Brewer spectrophotometers. These two instruments have formed the basis of global ground-based measurements of total ozone for many decades and thus this is a very useful issue to address and well within the scope of AMT.

In its current form, however I feel the manuscript suffers from two major defects.

Firstly, I found the logic hard to follow, meaning I was often quite confused about how the different sections related to each other and what the purpose of each really was. Results from different sections didn't seem to even be used in the following sections.

C1

(More details are given in the specific comments). The analysis of measurements at South Pole is only very partially linked back to the model calculations and not at all linked to the lab measurements. The connections and argument need to be made much more explicit.

Secondly, the study seems to have been carried out largely in isolation from work that has been undertaken in the Brewer community over the last five years or so. Some recent references are missing, and others are cited but not sufficiently engaged with.

In particular, I would insist the analysis be re-computed using Serdyuchenko cross-sections. This makes the work relevant to the current day concerns of the community and removes factors that are known to be caused by the use of Bass-Paur (Redondas et al. 2014).

Specific comments Page 1

Line 20 – This needs to be done using Sedyuchenko cross-sections to be relevant and comparable to modern work.

Line 22 – I dispute that you have "evaluated" the error. The discrepancy between Dobson and Brewers as a result of their different assumptions is calculated but nothing here says what the deviation from the true value is.

Line 24 Between 2008 and 2012 – this is quite misleading because you actually only use two distinct periods in 2008 and 2012 (Unless the description on page 11 is wrong?)

Line 25 I can't see that you have shown this at all. You have shown the difference between the Dobson values and the double-Brewer values, but how have you actually attributed this difference to stray light? This is a serious defect that needs to be addressed.

Line 30 I wouldn't say a "similar network" was introduced because of the more limited geographical coverage of Brewers even to today.

C2

Page 2

Line 15 Refer to Staehlin et al. GAW report

Line 16 I think you need to be specific here – what fraction of the difference can be accounted for?

Line 21 "properly" is not the right word, a lot of work has been done, eg at the RBCCE

Page 3

Line 4 "large SZA and large TOC" – this is only true in the Northern Hemisphere. It is not true at all in Antarctica, which you use for your comparison. Was South Pole even a good choice for your study?

Page 5

Line 24 It's fine to do the calculations using Bass-Paur so you can compare them to older work but you also have to do them using Serdyuchenko to be relevant to modern work, eg Redondas et al. 2014, Köhler et al. 2018)

Line 29 the "relevant temperature" – you need to be explicit here – are you using the same temperature for both Dobsons and Brewers? Which is it? Otherwise won't this introduce a difference separate to what you're looking at?

Page 6

Line 25-27 To be clear, you are not going to use this approximation? (equation 18). You should be explicit.

Page 7

Line 4 Why do you use θ_0 not just θ ?

Line 9 You say "it is important" but don't give any evidence as to why it's important. Evidently the Brewer algorithm doesn't think it's important.

C3

Line 9 You say the "correct" value of the height of the ozone layer but don't show that the Dobson parameterisation is correct. I think you just mean that the Brewer and Dobson methods are different to each other and this will cause a slight difference in derived total ozone.

Line 19 How do you know the stray light in a Dobson is similar to Mk IV and Mk II Brewers? Are you taking this from previous studies? This is one of my major confusions. I don't think you measured it?

Line 24 You should mention that He-Cd laser has been used before and give the references (see Pulli et al. 2018)

Line 24-25 You should give at least a very brief description of the experimental set-up. For example, you should explain how you derive a slit-function from a single wavelength laser? What is the sensitivity of your detector? (This is important since you are measuring over such a wide dynamic range).

Page 8

Line 15 You need to refer to Köhler et al. 2018.

Lines 29-32 I am very confused here about what is what. In Figure 3 the slit functions are curved, not trapezoids. Where did this shape come from?

Page 9

Line 3 It seems you are not using the approximation in equation 18. Did you use a radiative transfer model?

Page 10

Lines 8-9 I find this statement completely baffling. What do you mean by "measured slit functions"? What value of stray light are you suggesting WMO use?

Line 15 I would like to see a plot showing what the Langely looked like without and

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without the stray light being added to the model

Page 11

Line 3 It seems to me your results would imply the AD-CD correction should use an expression linear in μ rather than an average across the μ range?

Line 15 You can't say "error" because you don't make any attempt to look at the what the true value is (for example by using South Pole ozonesonde data). You could call it a "discrepancy" between the Dobson and Brewer.

Line 30 Do you mean "February 2008 and December 2014" or is it actually meant to be "February 2008 to December 2014" ?

Line 31 I don't think you can say "corrected" because you don't know that the Dobson value is any more correct than the Brewer value.

Page 12

Line 9-14 It looks like a linear relation. Couldn't you then calculate the gradient and compare the value with your model? This is what I was expecting you to do to better finish off the study.

Line 24-26 It seems a bit curved. You need to calculate how close the measured values are to what you expect from your model.

Line 28 "Physical model" but four lines later you say "mathematical model".

Line 30 Again, I don't think you have found anything about the "error" – only the difference between the Dobson and Brewer.

Line 32 But does this 25% relate to a realistic value of Dobson stray light?

Page 13 Line 2 "like polar stations" would be better worded as "such as polar stations"

Line 2 This is misleading because the study has considered South Pole data where ozone is very low in spring.

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Line 6 You say "stray light also can affect" but isn't this just a different way of expressing the same thing? (ie stray light will affect total ozone, which alternatively you could express as the effect on the absorption coefficients).

Line 10-16 You need to discuss Köhler et al. 2018 here

Line 34 This calculation needs to be with Serdyuchenko cross-sections.

Page 14

Line 6 "high" should be "higher"

Line 7 "low" should be "lower"

Page 20 Table 3 Are the values for the single or double Brewer?

Page 23 Figure 2 Would this be better on a log scale as in Figure 1?

Page 24 Figure 3 I am very confused about this figure. The shapes are curved not straight lines. Did you measure these in the lab with the laser?

Page 29 Figure 8 How did you identify the outliers? (If they represent bad data, perhaps you shouldn't plot them?)

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Köhler, U., Nevas, S., McConville, G., Evans, R., Smid, M., Stanek, M., Redondas, A., and Schönenborn, F.: Optical characterisation of three reference Dobsons in the ATMOZ Project – verification of G. M. B. Dobson's original specifications, *Atmos. Meas. Tech.*, 11, 1989-1999, <https://doi.org/10.5194/amt-11-1989-2018>, 2018.

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