Review of the manuscript “A physically-based correction for stray light in Brewer spectrophotometer data analysis” by V. Savastiouk et al.

The paper describes an easy to use new procedure to take into account spectral stray light in the derivation of total column ozone and total sulphur dioxide from measurements of solar irradiance by single Brewer spectrophotometers.

The method uses a single parameter to quantify the impact of stray light on total column ozone (and a second parameter for the SO2 retrieval), which is specific to a Brewer spectrophotometer. These parameters are usually retrieved by comparison to a reference instrument, that is not sensitive to stray light (e.g. a double Brewer for example, or an already corrected single Brewer), even though a method is explained how these parameters can be retrieved without external reference instrument. A detailed uncertainty budget is also provided.

The method is validated by applying it to several single Brewer instruments, that are collocated with a double Brewer used as the reference. Furthermore, a theoretical justification of the stray light correction methodology is provided by modelling the stray-light impact from laboratory based slit function measurements for one Brewer instrument (Brewer #009).

The authors are well-known scientists, and experts of the Brewer spectrophotometers. The paper is very well written and understandable to a broad audience (in my opinion). Prior work is mentioned as needed, and the references are comprehensive and complete. Figures, tables are all of excellent quality.

I commend the authors for this paper that will definitely have an impact on the data quality of the Brewer network.

In my opinion, the paper can be accepted as is, even though I list a number of points below which the authors might want to take into account, or at least answer in their response to this review:

1) The authors claim a “physically-based correction for stray light”. I assume that they base this claim on the fact that they introduce a stray-light correction concept based on slit functions, and validated through a physical model of the Brewer. However the validation is really only qualitative, since the retrieved stray-light factor alpha is off by a factor of 2 when comparing the value obtained from the simulation with the actual factor obtained from the outdoor comparison using real measurements. The authors claim that the discrepancy comes from using outdated slit function measurements of this particular Brewer (#009), and that in the meantime this Brewer has changed. The comparison between simulation and measurements would have been more convincing if the authors would have been able to use a Brewer where the slit functions are known and could be trusted. In the current version of the manuscript, the discrepancy leaves the argument hanging. Without a better validation, this method is also only sort of empirical, where the physical justification is well argued, but not substantiated.

2) line 304: “orthogonality between alpha and ETC”: Without clear definition of this term, it sounds a bit colloquial, and I suggest to replace it by a more precise statement. For example the term “correlated” or “uncorrelated” could be used here.

3) Line 318 : “the results show that Langley plots with measurements affected by stray light make little sense” is a worrying statement, considering that historically, the Brewer network traceability was based on a triad of single Brewers. Could the authors comment on the potential impact to the historical datasets of the Brewer network, and if it would be necessary and possible to apply this stray light correction procedure retrospectively to the whole network?

4) table 3 . it would be helpful to briefly describe the terms of the first column in the table caption. For example I do not understand what DeltaETCO3 stands for.

5) In the uncertainty budget, Table 5, the contribution labelled “Mathematical model”, is probably more correctly named “residuals”, as the residuals between retrieving the model parameters by fitting the model to the measurements?

6) the discussion S1 in the Supplement, and referred to at lines 705-708 on the correctness of using measured slit functions as a basis for a stray-light correction is not very convincing. The authors are correct in stating that the stray light measured through the various slits of the Brewer spectrophotometer can differ between themselves, and that the common orientation of the grating could produce a common feature in the slit functions. However this does not mean that there is some additional mysterious effect that could produce additional stray light that would not be captured by an accurate slit function measurement. To avoid any misunderstanding, I would recommend to rewrite this part of the manuscript (or to skip as it has no impact on the paper itself).