Response to Anonymous Reviewer #1

Authors' response to Reviewer #1 comments on "Evaluation of the uncertainty of the spectral UV irradiance measured by double- and single-monochromator Brewer spectroradiometers". The authors thank the Reviewer for the additional revision of the manuscript as well as for their suggestions for improving the clarity of the text and reply to all comments below.

The answer is structured as follows: (1) comments from Reviewer #1, (2) authors' response and (3) authors' change in the manuscript.

(1) 153–155: I would rephrase the sentence as follows: It should be noted that some of the uncertainties (such as those related to noise, stray light, or radiometric stability) have not been determined thoroughly, as the data used for their estimation are insufficient to obtain appropriate statistics.

(2, 3) Noted. Lines 153–155 have been rephrased following the reviewer's suggestion.

(1) 359: please rephrase to: methodology for calculating the cosine correction and noise must be adapted accordingly.

(2, 3) Done.

(1) 359: Not clear what is meant here. Maybe: For example, by studying the variability of groups of data measured very close in time.

(2, 3) Following the reviewer's comment, the phrase has been modified to "by studying the variability of groups of data measured very close in time".

(1) 371: Do you plan to include this figure in the revised manuscript? I suggest to do so.

(2, 3) Following the comments made by all reviewers, a section has been added to the manuscript to compare all Brewer spectrophotometers with the QASUME, the European reference unit. As a result, the following information has been added to the text:

"The corrections applied to the irradiance measured (described in section 3.2) are recommended by numerous studies to improve the quality of the measurements (e.g. Fountoulakis et al., 2016b; Garane et al., 2006; Kerr, 2010; Lakkala et al., 2008, 2018). This was also verified during the 18th RBCC-E campaign, as the results show that including the cosine correction improves considerably the comparison to the QASUME (Hülsen, 2023). Although the campaign report shows the ratio of each participating Brewer to the QASUME (see Hülsen (2023)), it is interesting to represent the ratio of all studied Brewers together. In this way, Fig. 4 displays the global irradiance ratio to the QASUME obtained from dividing the irradiances shown in Fig. 1 to the irradiance recorded by the QASUME unit.

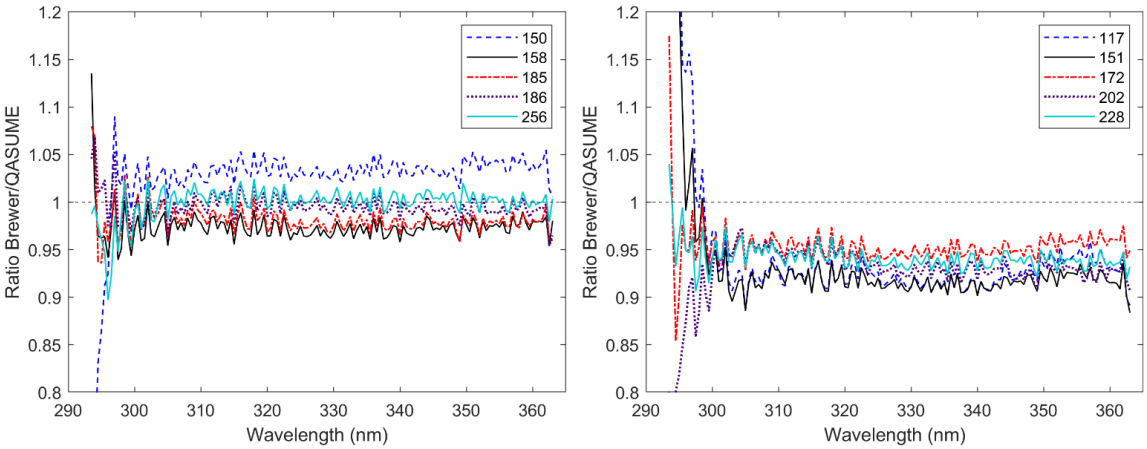

Figure 4. Global irradiance ratio to the QASUME recorded on 13 September at 14:00 UTC. (a) First group (double Brewers with cosine correction). (b) Second group (two single and three double Brewers with no cosine correction implemented).

Figure 4 shows the effectiveness of the cosine correction, since Brewers with such correction implemented (Fig. 4a) report irradiances more similar to the one measured by the QASUME. Nevertheless, the agreement between all Brewer spectrophotometers is within ±10 % from unity for wavelengths above 310 nm.

Furthermore, the irradiance uncertainty found for each Brewer in the previous section can be used to derive the uncertainty of their ratio to the QASUME. Table 3 summarises the combined standard uncertainty of the average Brewer/QASUME ratio measured on 13 September at three different wavelengths. These uncertainties were computed by combining the irradiance uncertainty of each Brewer and the one from the QASUME, calculated by Hülsen et al. (2016).

Table 3. Number of simultaneous scans, mean ratio to the QASUME and its combined standard uncertainty (both absolute and relative) determined between 310 and 360 nm on 13 September.

Brewer ID	N	Ratio to the QASUME (310–360 nm)		
		Mean value	Combined standard uncertainty	Relative standard uncertainty (%)
#117	19	0.927	0.034	3.7
#150	20	1.035	0.035	3.4
#151	24	0.914	0.033	3.6
#158	17	0.972	0.036	3.7
#172	19	0.947	0.033	3.5
#185	18	0.978	0.030	3.1
#186	15	1.003	0.043	4.3
#202	19	0.928	0.033	3.6
#228	19	0.937	0.033	3.5
#256	19	1.003	0.037	3.7

Table 3 shows that only those Brewer spectrophotometers with a cosine correction implemented (#150, #158, #185, #186, and #256) include the ideal value of the ratio (unity) within their uncertainty interval. The remaining Brewers underestimate the UV irradiance and deviate from unity. This is likely caused by the cosine and temperature errors of the instruments, which couldn't be corrected (there was no available information regarding their characterisation). Therefore, to improve the performance of these uncorrected Brewers these two sources must be characterised and corrected".