Response to Anonymous Referee #2

Authors' response to Referee #2 comments on "Comparison of global UV irradiance measurements between a BTS CCD-array and a Brewer spectroradiometers".

The authors thank the Referee for the careful and constructive examination of the manuscript and reply to all comments below. The answer is structured as follows: the comments from Referee #2 are marked in red and the authors' response and changes in manuscript are written in black.

The paper assesses the performance of a CCD-based spectrometer (BTS) in measuring the spectral solar irradiance in the UV range using data from 3 campaigns that took place in a period of 1.5 years. The comparison was done against data of a double monochromator Brewer spectroradiometer operating regularly at the campaign site. The BTS spectrometer is a rather new instrument and such studies to assess its long term performance are useful contributions for solar UV monitoring. The paper is well structured and addresses most of the usual aspects of intercomparisons of radiation instruments. To my opinion it is in a good stage to be accepted for publication, but I believe with some extra work as suggested in my specific comments below, the results could be further improved and possibly better substantiated. The language of the paper in good, despite some small flaws; some of them are mentioned in the "technical comments" section below.

Specific comments

1, 1: In the title, I suggest adding the word "spectral" before measurements.

The word "spectral" has been added to the title.

3, 66: You actually mean range of intensity, therefore I suggest to avoid using the term UV Index in this context.

The term "UV index" has been replaced by "intensity".

4, 98: What is "high-end light measurements"?

The text "high-end light" has been replaced by "high quality", for greater clarity.

4, 101: The "measurement time ranging from 0.1 to 6000 ms" applies only to the photodiode or also to the CCD?

According to the BTS' manual this measurement time only applies to the photodiode. The CCD has an integration time that ranges from 2 µs to 60s. This information has been added to the manuscript.

5, 138: I suggest to draw a darker horizontal line at 1.0, to guide the eye of the reader and make the comparison amongst the three panels easier. This applies also to figures 3 and 4.

Figures 1, 2, 3 and 4 have been modified to include a horizontal line at 1.0.

5, 143: Concerning the increasing ratio towards shorter wavelengths below 300 nm, this could be partly produced by the cosine response of the BTS diffuser, if the cosine error is larger than the Brewer's. Please include this information in section 2.2, and if the error is larger than the Brewer's I suggest including a brief discussion. Moreover, from figure 1, I don't think that the 5% agreement is valid down to 300 nm. I would be more conservative to the lower limit (e.g. closer to 305 nm). This is also evident from table 1, where only the last column shows variabilities below 5%, contradicting the statement of line 148.

Following the reviewer's comment, information about the cosine response of the Brewer and the BTS spectrometers has been included in sections 2.1 and 2.2, respectively. Since both instruments are equipped with improved diffusers, the difference in the cosine response does not completely explain the increasing ratio towards shorter wavelengths below 300 nm. An additional source of discrepancy could be the stray-light, which becomes more significant as the wavelength decreases. Although both instruments are equipped with means to reduce the stray-light, its contribution cannot be totally neglected. Thus, this information has been included in the manuscript as follows:

"This increase in the ratio could be partly due to stray light and cosine response. Although both instruments are equipped with improved diffusers and stray-light reduction, their contribution cannot be totally neglected."

Moreover, we agree that the more conservative 305 nm is a more suitable threshold and the text has been modified accordingly.

6, 157-159: The discussion around the noise level and its reset to 0 is not clear for inexperienced readers.

For greater clarity, the discussion has been rewritten as follows:

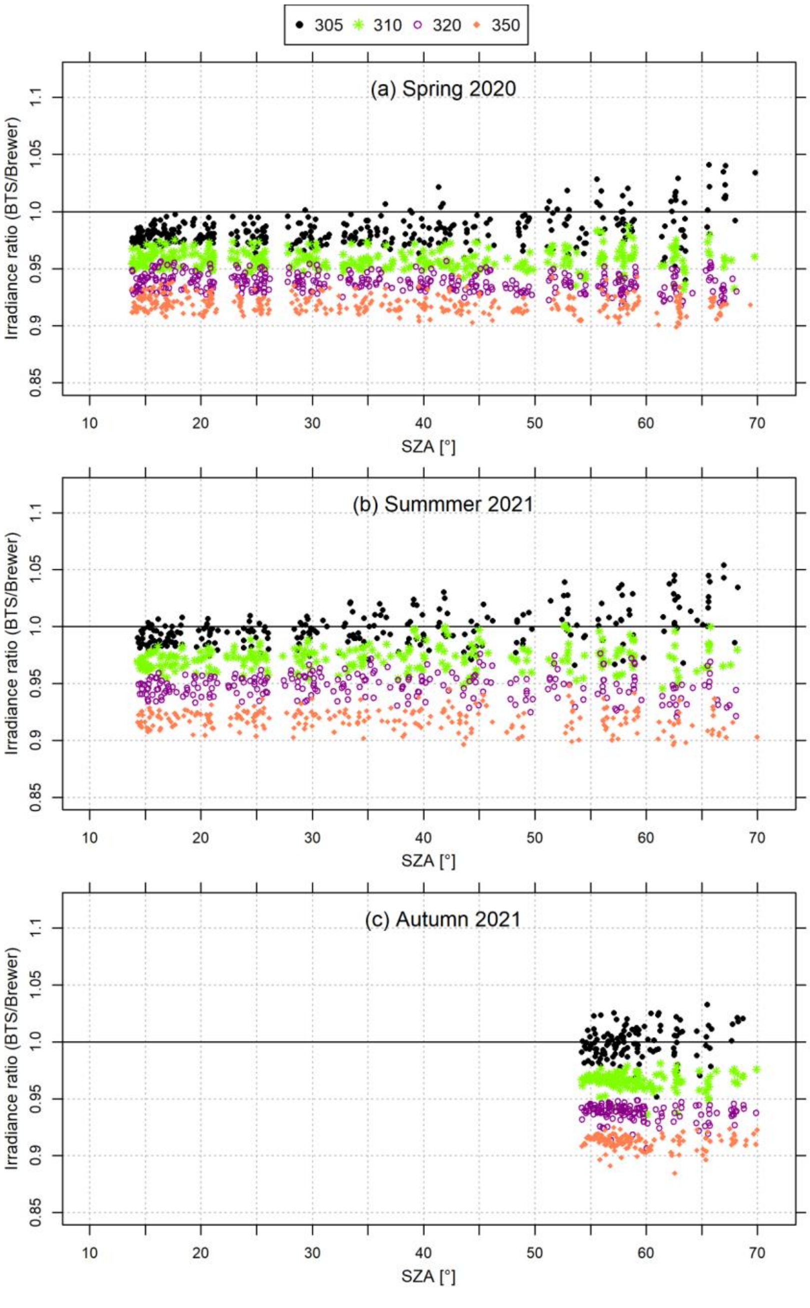
"Figure 1 shows that the average ratio is significantly lower for the autumn 2021 campaign exclusively in the 290–300 nm region. This behavior could be likely related to several factors, such as stray light, differences in the detection threshold between Brewer and BTS, and the BTS's noise reduction filter. These factors have a larger effect for low signals, which are more frequent during autumn due to the lower range of solar elevation as compared with the other two campaigns."

7, 173: For the plots of Figure 3, a more stringent time synchronization could be achieved for each wavelength band (of ±2.5 nm) as opposed to the general synchronization based on the time at 326.5 nm. To be clearer, I mean to compare the data based on the difference between the time the central wavelength of each band is measured and the time of the BTS spectrum. This might further improve the results, especially at larger SZAs when small time differences increase notably the irradiance level. Actually, this might explain a small part the deviations at the shorter wavelengths, in addition to stray-light and (possibly) to cosine response.

The comment of the reviewer has been followed and, after synchronizing with respect to each band's central wavelength, better agreement between measurements has been achieved. The number of outliers has decreased and the increase observed at short wavelengths for large

SZAs has been reduced. As the reviewer said, the synchronization was partly responsible for this increase.

The suggested synchronization has been applied, resulting in the following figures:



Furthermore, the Methodology section has been modified to describe the different synchronization methods that have been essayed (UV index and spectral ratio), as follows:

"However, to further improve the results, different synchronization criteria were applied to study the UV index and angular dependence of the BTS. In this way, to obtain the UV index, only the BTS spectra within ±1 minute of the Brewer's 307 nm timestamp have been considered. This wavelength was selected since the erythemally weighted irradiance peaks between 306 and 308 nm, depending on SZA and total ozone. To analyze the angular dependence, the spectral ratio BTS/Brewer has been calculated in four different wavelength bands. For each band, the ratio was obtained using BTS spectra within ±1 minute of the Brewer central wavelength (305, 310, 320 and 350 nm) of each band."

The Results section has also been modified to reflect that the angular dependence is slight at short wavelengths.

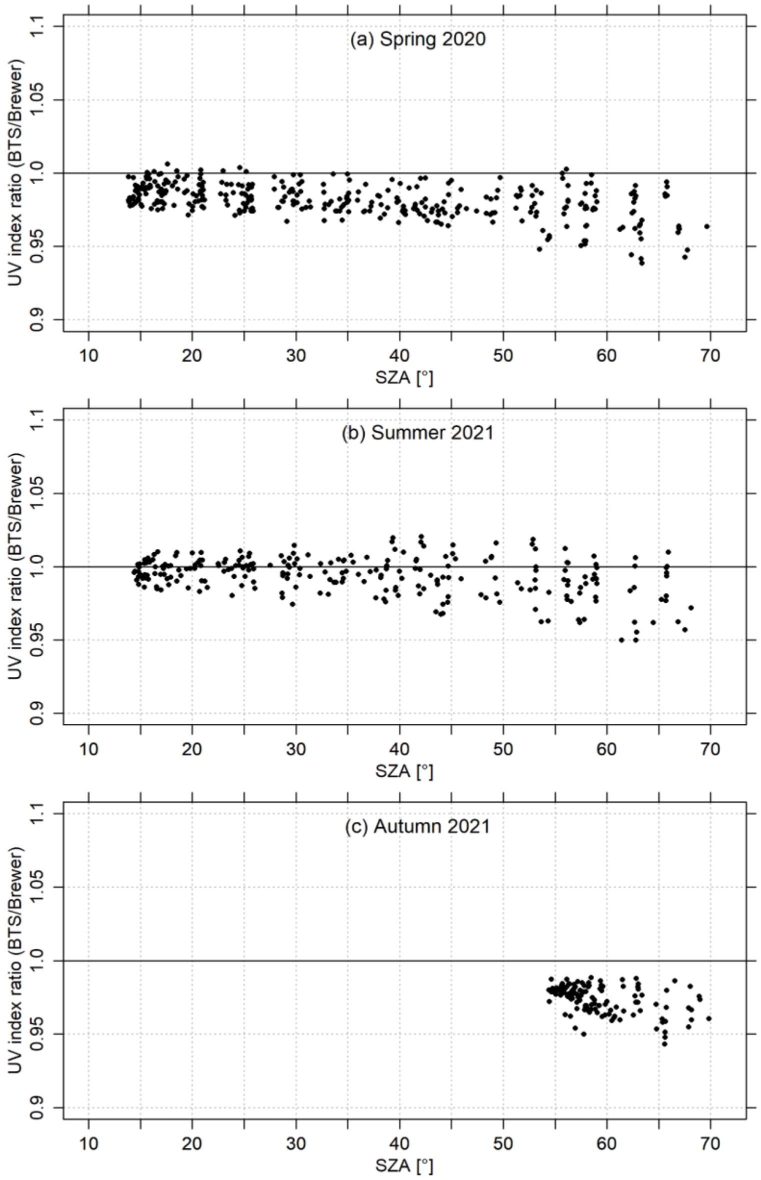
8, 183: At the caption of Figure 3 please add a note to alert the reader for the x-axis scale change in the bottom panel. The same holds for Figure 4.

The x-axis scale of Figures 3 and 4 has been modified to be the same, so as to facilitate the comparison between figures.

8, 185: A different time synchronization could also be applied for the UV Index comparisons, instead of the time at 326.5 nm. As the erythemally weighted irradiance peaks at between 306-308 nm (depending on SZA and total ozone) the time in this wavelength range would be more appropriate for the comparison and I believe would also improve the results.

The comment of the reviewer has been followed and the UV index has been recalculated using spectra synchronized with respect to 307 nm. The new values of UV index ratio show a less marked dependence with SZA but larger scatter. When comparing the UV index measured by both instruments the linear regression is practically the same as the one obtained with the previous synchronization (326.5 nm).

Thus, the suggested synchronization has been applied and the methodology and figures have been changed accordingly. The results obtained are very similar and the conclusions drawn remain valid, confirming the robustness of the study. The new figures follow:



As for the methodology modification, it has already been shown in the comment regarding the spectral ratio dependence with SZA (Line 7, 173).

Technical Comments

2, 45: “on arrays of CCD sensors”. Do you mean “on arrays or CCD sensors”? Otherwise, just say “on CCD sensors”.

The phrase has been corrected and changed to “on CCD sensors”.

2, 54: Replace “a considerable effort” with “considerable efforts”

The term “a considerable effort” has been replaced with “considerable efforts”.

3, 70: Replace “calibration” by “sensitivity”

The term “calibration” has been replaced by “sensitivity”

3, 84: Omit the unnecessary term (double Brewer).

The term “double Brewer” has been omitted.

4, 99: “The spectral detector is a spectrometer”. This doesn’t make sense. Maybe you can omit “a spectrometer”?

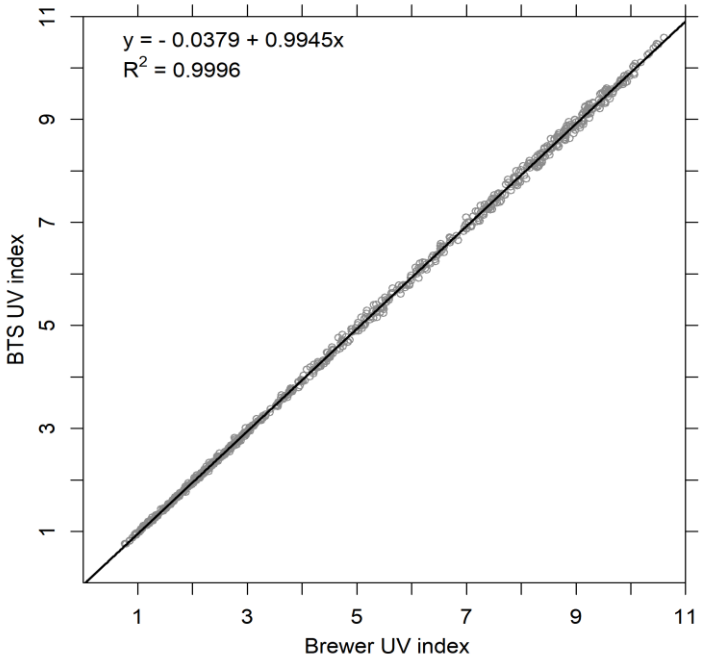
The term “spectrometer” has been omitted.

5, 149: Replace “is similar to the one other stray-light-corrected CCD-array spectroradiometers have” with “is similar to other stray-light-corrected CCD-array spectroradiometers”

The phrase has been corrected and changed to “is similar to other stray-light corrected CCD-array spectroradiometers”.

10, 200: I would prefer to see Figure 5 with axes of equal length.

Figure 5 has been changed to reflect the new synchronization and to have axes of the same length. The new figure follows:



10, 208: I assume you mean agreement within ±5%.

Exactly. The phrase has been corrected and changed to “the spectral ratio is constant, at around 0.94, and agrees within 5 %.”

11, 221: Replace “specific” with “regular”

The term “specific” has been replaced by “regular