



EGUsphere, referee comment RC1  
<https://doi.org/10.5194/egusphere-2022-726-RC1>, 2022  
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## **Comment on egusphere-2022-726**

Anonymous Referee #1

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Referee comment on "A new accurate low-cost instrument for fast synchronized spatial measurements of light spectra" by Bert G. Heusinkveld et al., EGU sphere,  
<https://doi.org/10.5194/egusphere-2022-726-RC1>, 2022

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### **General comments**

The article is correctly structured. The scientific rationale is well defined as well as the methodological approach to answer to it.

The Discussion section should be more comprehensive; in particular it should include at least a qualitative assessment of the error budget components affecting the measured PAR with the FROST system.

The interpretation of some results could greatly benefit with the inclusion of mathematical formulae. The radiometrically correct weighting of the wavebands spectral shape should be part of the FROST spectral calibration and digital filter calculations.

### **Specific comments**

#### **Abstract**

- line 12: Doesn't the autor mean "... global horizontal irradiance (GHI)..." ?
- line 19: is "... zero offsets ..." a synonym for dark current? If yes, please replace by it. It is the most used term in the radiometry field.
- line 23: 2% with respect to which reference temperature?

## **1 Introduction**

- line 55: specify that the temperature sensitivity of semiconductors is generally temperature dependent
- line 70: give value of relative (in percentage) rms error as well.
- lines 55 and 59: non-linear/nonlinear or non-flat?
- lines 66 to 69: A figure with both response curves would be more suitable to understand the differences highlighted in this sentence.
- lines 71 and 72: it is not clear why their similar performance is "surprisingly accurate". Please develop.

### **2.1 Light Sensor**

- line 132: Spectrometer is not the good definition for this instrument as it implies the existence of a scanning mechanism. AMS AS7265x would be better referred as a 18-channel filter radiometer or equivalent. Apply same correction throughout the text.
- line 134: It says that there are 3 bands, RGB with 6 Si photodiodes with all the associated optics and electronics but then in line 146, it says that there is a challenge to couple everything to the same sensing area. This seems contradicting as there are 18 sensing areas (from line 134). Clarify this.
- line 143: If it is a specification "+/-" shouldn't appear before 10nm FWHM, instead a tolerance, if existing, could be specified either in percentage or absolute.
- line 143: "AMS states that their filter stability (in time and against temperature) is not detectable but does not provide further specifications." While this is an honest statement from the author, this question might be of non-negligible importance: UV exposition is known to generally degrade materials over time with a possible impact on the measurement performance in this particular case. Mentioning this issue, even from a qualitative perspective with bibliographical support, would be of great value to the article.

### **2.1 Diffuser material**

- line 155: missing %; give more insight on the 1% to 4% transmission changes. Is this between the 3 diffusers, with/without spectral dependence?
- line 157: clarify what the author means by "without jump"

### **3.1 Spectral response and temperature sensitivity**

- general comment: the reader is not necessarily familiar with a Cary spectrophotometer. Please give some detail on the measurement setup (with references when possible) as the spectrophotometer is used for three different types of measurements: wavelength scale, filter transmission and cross-talk.
- general comment: was the FWHM also measured with the Cary spectrophotometer or otherwise?
- lines 247 and 248: Does this wavelength accuracy refer to the position of the bandpass central wavelengths? If yes the measured wavelength could be shown, for instance in table 2, against the nominal wavelength.
- lin 249: Sentence starting by "Comparison" is inconsequent. Rephrase it, putting it in relation with the follow-up sentences.
- line 252 and 253: It would be interesting to have a brief summary of the details on how this non-linearity was obtained.
- line 253: to which quantity does the calibration refer?
- line 272: the paragraph starting here should be rearranged: first mention how the data in Fig.5 were obtained then proceed to compare and then to try to explain the differences observed.
- line 272: if you know the Sun spectrum and the Xe lamp spectrum would not it be possible to correct for this?
- line 306: why would the below crosstalk be increased? Additionally it could be interesting to point the origins of the below crosstalk earlier in the text.
- figure 8: it would be more consistent to maintain the structure of figure 6: spectral responses in left column and crosstalk on right column
- figure 8: from the colors of crosstalk the reader might understand that the bars represent only "above" crosstalk. While this is probably the case, should be indicated in the legend.
- line 318 and 322: Repeated phrase. Keep one instance and develop the sentence.
- line 342: I understand the principle procedure of calibrating the FROST sensors with the solar spectrum, however some details are missing. For instance the weighing of the solar spectrum by the respective channel response function is not mentioned. This particular paragraph should include an equation detailing the calibration procedure.
- Table 2: Counts is usually unitless, but it is indicated has having  $nW^{-1}$  units. Please clarify the quantity.
- Table 2 legend: How is the  $35\% < \text{crosstalk} < 40\%$  category handled?

### 3.3 Cosine response and GHI

- general comment: As this is used often during this paragraph, how to decouple GHI and diffuse radiation?
- Figs. 13, 14 and 15: It is always more tangible if the error is expressed in relative units. Please show the the error in percentage. Additionally mention the content of each panel.
- Figs. 13, 14 and 15: The caption and the legend do not agree. What are each of the 3 curves in the top panel? What error is shown in the bottom panel?
- Fig. 15: Why are there only binary rain values, 0.00 or  $\sim 0.25$  mm/min? The visualization of the bottom panel is confuse, please simplify.
- line 407: Do you refer to figure 15 or 16? Does this information provide an additional insight on the data interpretation? If yes, please state which.
- line 408: The paragraph starting here needs a mathematical expression to better support the text and the interpretation of Fig. 16.

### 3.4 Spatial measurements and synchronization

- Fig. 18: There are only nine data points in this plot. Why not a table or a plot with improved readability? The offset effect of the zeros values worsens the understanding.

### 3.5 Photosynthetic Active Radiation

- 1st paragraph: there seems to be a confusion between solar spectrum ( $\text{W}\cdot\text{m}^2\cdot\text{nm}^{-1}$ ), the number of photons of this spectrum per wavelength and the detector sensitivity. Please clarify the paragraph and taking into account the following remarks:
  - line 480: **measurements** refer to what?
  - lines 481 and 482: the number of photons at a given wavelength is unitless, while  $\text{W}\cdot\text{m}^2\cdot\text{nW}^{-1}$  are the usual units of spectral solar irradiance.
  - lines 482: the wavelength sensitivity or the spectral dependence of the solar spectrum/number of photons?
  - line 486: wavelength ( $\lambda_n$ )
  - second paragraph: the expressions and consequent calculations seem to not take into account the non-finite character of each of the FROST channels spectral response. All these quantities must be properly weighted by each of the wavebands spectral response. This paragraph should be rewritten taking into account the above commentaries and be accompanied by a more rigorous mathematical formalism and notation.
- Fig. 20: Offset term should be shown and, if zero, mentioned.

## 4 Discussion

- An overview of the factors contributing to the PAR measurement uncertainty should be expanded.

### Technical corrections

- line 14: delete "very"
- line 69: their main uncertainty **is** related
- Numbering of subsections: 2.1 is repeated
- line 100: verify autor name. Probably Lopes Pereira.
- line 180: 5 m
- line 252: a t => at
- line 238: missing )

- line 341: spectra is the plural form of spectrum.
- line 352: check English
- figure 10: correct formatting of units: nm-1 => nm<sup>-1</sup> for example. Correct the many instances throughout the text.
- line 595: double check authors surnames: probably Peireira => Pereira, Goncalves => Gonçalves, Vazao => Vazão
- sections 3.1 and 3.2: Temperature sensitivity is repeated