Referee1:

Referee response: L60-61: “no flat” to non-flat. Could just say “and its spectral response is not flat” here and at L56.

Response: Accepted, changed to non-flat, see L55.

Referee response: L139: Rephrase GNSS sensor “was considered” to reflect the fact that this is the solution that was chosen.

Response: Accepted, changed to "was chosen", see L129.

Referee2:

Abstract

1) See: track changes document: L639-684 OK

2) See: track changes document L417 and L594

Referee response: I have some doubts concerning equation 1 (L417)

- How can a calibration factor be unitless? Or is it just a multiplicative gain-type factor?

Response: It is a multiplier stored in non-volatile read only memory inside each sensor. It normalizes the sensor signal response to a standard as defined by the manufacturer. Since the manufacturer calibrates it for reflection measurements, using 3 different LED’s (UV, White and NIR) as an excitation light source (see L267), it is not possible to translate that to a realistic signal response to GHI. We prefer to include the calibration value since it can provide some information about sensor-to-sensor variation, which should be within 15% (according to the manufacturer).

- If Rsensor is the spectral response, it also should have absolute units, otherwise it is just a *relative* spectral response.

Response: It is indeed unitless as it is the normalized peak spectral response. For clarification, we added: “normalized peak” in L395 and we added in L400: “Note that the denominator is the spectrally-weighted source-signal strength.”.

- On the form of the equation: if the wavelength dependence of *Rsensor* is expressed - Rsensor_i, □ – so should be the case for *Tdiffuser* and *Tfilter*.

Response: Agreed, we added this in L396, L397

3) See: track changes document: changed to GHI OK

4) See: track changes document: added in line 554 The remark refers to line 19. There is no mention of dark current nor zero offsets at line 554. Please verify back line 19.

Response: We do refer to and show the zero offsets in Fig. 18 and L409-410. To highlight the zero offsets characteristics we added a note regarding Figs. 13-15 (L485-486). "Note that in Figs. 13-15, the nocturnal offsets are zero."

5) See: track changes document line 23-24 OK

1. Introduction

6) In line 55 we state: "..., and temperature sensitivity". OK

7) See: track changes document: Michalsky et al, (1991) reference was missing and added in L737-738. They only provide rms errors. OK

8) See: track changes document L56. OK

9) We prefer inserting a reference containing such a Figure. See Fig. 1 of Alados-Arboleda et al., 1995. OK

10) This was developed in lines 73-79 OK

2.1 Light Sensor

11) The more specific term for our sensor would be a "filter-based spectrometer", but it still qualifies as a spectrometer. We will clarify this in line 132. The filters are already described in line 136. See: track changes document: L89: added "filter"

Referee response: In order to qualify as spectrometer, an instrument should measure a wavelength dependent quantity (units ~ W.m-2.nm-1). FROST is measuring integrated signal in 18 different wavebands (units ~ W.m-2). Please note that this is in no way diminishing FROST instrument general quality. It is just a matter of correctness of radiometric definitios. I advise to revise several instances of document in the sense of denominating FROST as a multi-channel radiometer rather than a spectrometer.

Response: Every spectrometer has a light filtering method, and even our reference spectrometer (ASD FieldSpec) does not have an absolute nm waveband response (it still is a Gaussian distribution). Our calibration is such that its output is W nm^{-1} m^{-2}, (see also Fig. 10). Of course,

we need to understand the waveband response (see Figs. 6 and 8) as is the case for every spectrometer. Thus, our use of “spectrometer” and its output in W nm^{-1} m^{-2} is valid.

12) No, there are no 3 bands, no RGB bands. The Red, Green and Blue are used to identify each of the 3 light detection chips. Each chip detects 6 light wavebands. The manufacturer (AMS) also identifies the 3 chips using the same color coding. We understand that this may sound confusing. Line 135 should clarify this, but based on the reviewer's comment, more info is needed. See: track changes document: color coding improved, see Figs

Referee response: I don’t understand if this was corrected as there is no information concerning this on line 135.

Response: There is numerous information regarding the color coding:

-Figure 1 and L105-106.

-Color coding is explained in L141: “We will identify the AS72651, -52, -53 as the blue, red and green sensor, as indicated in Fig. 1.”

-Figure 6a, 6b (Blue sensor, Green sensor, Red sensor), L317

-Figure 8, L344-347

-L360-361

-L368-369

-L376

-Table 2

-L441

13) See: track changes document L157 and added +/-10 nm center-wavelength specification OK

14) See: track changes document L669-671 OK

2.1 Diffuser material

15) See: track changes document: L169-170 OK

16) See: track changes document L171-172 OK

3.1 Spectral response and temperature sensitivity

17) See: track changes document: technical specs updated, Fig. 5 caption expanded, added L262-266 OK

18) See: track changes document: Fig. 6a added OK

19) See: track changes document: L273-276 OK

20) We will provide an xy Figure to show the quality of the comparison (supplementary materials)? Unfortunately the experimental data could not be retrieved.

Referee response: OK, but the method should be briefly explained nonetheless

Response: The method was described in L259-261. For further clarification we added "…in a dark room".

21) See: track changes document: L279-280 OK

22) See: track changes document: L279-280 OK

23) See: track changes document: some rearrangements and additions: L284-307 OK

24) See: track changes document: improved Figs. 5, 6b, changed: L348-352 OK

25) See: track changes document improved Fig. 8 OK

26) See: track changes document: Line removed and L385 Figure references added OK

27) See: track changes document: L418-436 and new S1. OK

28) See: track changes document: improved Table 2 OK

3.3 Cosine response and GHI

29) The FROST cannot decouple diffuse radiation from GHI. OK

30) Agreed, we will add relative units also and improve Figure 13, 14 and 15 captions

Referee response: The error is still shown in absolute units [W.m-2].

Referee response: I think it would be more readable if it is given in percentage.

Response: Accepted. We included the percentage error above a certain GHI threshold (otherwise we think it makes no sense, i.e. >100% around sunset/sunrise. See L463-464: "Relative errors at GHI >200 W m-2 are <2% and mainly related to horizontal misalignment causing an asymmetric error before/after noon.", L471-472: "Relative errors at GHI >100 W m-2 are <7% and mainly related to spatial separation between FROST and reference." and L479-480:" Relative errors at

GHI >100 W m-2 are <7% and mainly related to spatial separation between FROST and reference."

31) See: track changes document: All Figs. 13-15 and Fig. captions improved OK

32) See: track changes document: improved Fig. 15 OK

33) See: track changes document: L505-506 OK

34) See: track changes document: L507 added and Figure caption improved

Referee response: OK for changes in Figure 16. But I would still strongly recommend including a mathematical expression.

Response: Accepted, see Eq. 2.

3.4 Spatial measurements and synchronization

35) We think it is nice to show this as a Figure since it directly visualizes the perfect synchronization, the fast response speed and no zero offset (or dark current) OK

3.5 Photosynthetic Active Radiation

36) Measurements of PPFD intensity OK

37) Removing (per W m-2 nm-1) solves this confusion OK

38) • line 486: wavelength (λn)

Referee: Can't trace this in the text

Response: Yes, we remember the typo and it was corrected but we can't trace the exact location.

39) See: track changes document: New Eq. 1 OK

40) See: track changes document: Improved Table 2 OK

4 Discussion

41) Agree, the major factor would be the limited coverage of the PAR band due to narrow band response of the 11 bands.

Referee: Where is this overview given?

Response: We have extensively clarified the wavebands, sensitivity, crosstalk, etc. so one can properly judge the quality for their application. It would be beyond the scope of our manuscript to discuss all limitations for every application.

Technical corrections

42) • line 100: verify autor name. Probably Lopes Pereira. Not fully done Peirera => Pereira

Response: Corrected in L132 and L704.