

1 **Response to comments by Anonymous Referee #2**

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3 We thank the referee for his or her comments, which we have addressed as follows:
4

5 **Comment by Referee**

6 A further examination on the effect of the above (mainly the FOV) issues have to be
7 considered when comparing results of this and older papers using different principles of
8 measurements. For example the definition of the diffuse (or direct) irradiance calculated
9 using a shadow (band) that has spectral, solar zenith angle, (and in this case) also sun-
10 dimensions dependent, apparent shadow dimensions compared with the instrument
11 diffuser, could impact the presented results.
12

13 **Authors' Response**

14 First we like to point out that total ozone column (TOC) was calculated from
15 measurements of global spectral irradiance, not direct solar irradiance as indicated by the
16 referee's introductory statements. The FOV of the shadowband is therefore irrelevant for
17 TOC retrievals. Please see our response to the comments by Forrest M. Mims III
18 regarding TOC calculations.
19

20 Shadowband measurements were only used to determined aerosol optical depth and the
21 direct-to-diffuse ratio. The shadowband obstructs a wedge of the sky with a width of 15°
22 when the band is vertical and 13° when it is horizontal. These relative large angles may
23 suggest that the instrument is not able to adequately remove the contribution of
24 circumsolar radiation when calculating the direct irradiance, which would also lead to
25 systematic errors in aerosol optical depth (AOD) retrievals. However, this notion is not
26 correct due to the unique way of shadowband operation and data analysis. Other
27 shadowband radiometer typically use two measurements on either side of the Sun to
28 correct for the signal lost from the portion of the sky that is obscured by the shadowband.
29 For example, side-band measurements of Multifilter Rotating Shadowband Radiometer
30 (MFRSR) are typically performed at 9° from the center of the Sun (Krotkov et al., 2005).
31 Hence, the increase of diffuse radiation towards the Sun is often not corrected adequately.

1 In contrast, direct measurements and AOD retrievals of GUVis-3511 measurements are
2 based on measurements at high sampling rate (15 Hz) whereby the band moves slowly
3 and continuously over the instrument. The processing algorithm determines the irradiance
4 from direct Sun plus the unshaded portion of the sky by analyzing several seconds of
5 measurements when the shade from the band is close to the diffuser but not in contact
6 with it. The algorithm is described in detail by Hooker et al. (2012) and Witthuhn et al.
7 (2017). The algorithm compensates for the effect of the relatively large FOV, resulting in
8 AOD data that have similar accuracy than that of traditional shadowband radiometers.

9
10 **Proposed change to manuscript**

11 The following text will be added to Sect. 3 of the manuscript:

12 “The band obstructs a wedge of the sky with a width of 15° when the band is
13 vertical and 13° when it is horizontal. [...] The algorithm compensates for the
14 effect of the relatively large width of the shadowband, resulting in AOD data that
15 have similar accuracy than those of traditional shadowband radiometers, which
16 use measurements on either side of the Sun to correct for the portion of the sky
17 that is obscured by the band. For example, side-band measurements of Multifilter
18 Rotating Shadowband Radiometer (MFRSR) are typically performed at 9° from
19 the center of the Sun (Krotkov et al., 2005) and therefore may not adequately
20 measure circumsolar radiation. Our algorithm alleviates this problem.”

21
22
23 **Comment by Comment by Referee**

24 What do you mean by: P6, L10 The calibration was further optimized for the conditions
25 (solar zenith angle, TOC, AOD, etc.) at the measurement site.

26
27 **Authors' Response**

28 As described in the Supplement of the manuscript, the instrument measures “response-
29 weighted irradiance”. The conversion to spectral irradiance requires knowledge of the
30 solar zenith angle, TOC, AOD, etc., and uncertainties in these parameters results in

1 uncertainty in the conversion factor. These issues are discussed at length in the
2 Supplement.

3

4 **Proposed change to manuscript**

5 The following will be added after the sentence in question:

6 “Details of this optimization are provided in the Supplement.”

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8 **References**

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- 13 Krotkov, Nickolay A., Pawan K. Bhartia, Jay R. Herman, James R. Slusser, Gordon J.
14 Labow, Gwendolyn R. Scott, George T. Janson, Tom Eck, and Brent N. Holben.
15 "Aerosol ultraviolet absorption experiment (2002 to 2004), part 1: ultraviolet
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