Response to comments by Anonymous Referee #1

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

Comment by Referee

Paragraph 7.4: I am referring firstly to this paragraph because the paper is becoming quite confusing at this point. If the authors conclude that the LD parameterization by Waldmeier is too simple, particularly in UV range, why this is being discussed previously in the estimation of total O3? It is recommended to move this paragraph to 7.1 and then discuss the results based on those findings on LD parameterizations. In this concept, paragraph 7.3 should follow the new 7.1. In figure 10, the effect of the eclipse is masked by the dominant effect of changing solar zenith angle. The authors are asked to subtract the solar zenith angle effect by using the AOD and O3 measurements just at the end (or start) of the eclipse (as inputs in model calculations) and, then, discuss the effect of the eclipse and the changes on aerosols and ozone (these paragraph should follow now).

Authors' Response

We have changed the sequence of Sect. 7 as suggest by the referee. The sequence is now:

7.1 Effect of solar limb darkening
7.2 Direct-to-global ratio
7.3 Aerosol optical depth
7.4 Total ozone column
7.5 Measurements near and during totality

We have also changed the sequence of Sect. 8 (Discussion) to be consistent with Sect. 7. The new sequence of Sect. 8 is now:

8.1 Magnitude of solar limb darkening
8.2 Variations of direct-to-global ratio
8.3 Total ozone column variations during an eclipse
8.4 Validation of GUVis-3511 measurements

Following the suggestion by the referee, we have compared the measured direct-to-global ratio with the corresponding modeled ratio and have added a new panel to Figure 10 (now Figure 11) , which shows the ratio of measurement and model. The text was modified to describe the new panel, see below.

Change to manuscript

The following was added to Sect. "Direct-to-global ratio" (now Section 7.2)

"The measured direct-to-global ratio was compared with the modeled direct-to-global ratio using the same method as that employed in Sect. 7.1. In brief, the measured direct-to-global ratio was divided by the modeled direct-to-global ratio. To correct for the difference between measurement and model, linear functions were again constructed to match the ratios of measurement and model at the times of the 1^{st} and 4^{th} contact Finally, the ratios were normalized by dividing with these linear functions. The resulting bias-corrected ratios of the measured and modeled direct-to-global ratio are shown in Fig. 11b and are denoted $R_{DG}(\lambda_i)$.

Before 15:00, the measured direct-to-global ratio is smaller than 0.03 at wavelengths in the UV-B and values of $R_{DG}(\lambda_i)$ are subject to large uncertainties at these wavelengths. Before 15:20, $R_{DG}(\lambda_i)$ varies between 0.55 and 0.87 for wavelengths in the visible range, indicating that the measured direct-to-global ratio is 13 to 45 % below the modeled one. These low values can be attributed to increased aerosol loading prior to the start of the eclipse. After the start of the eclipse (1^{st} contact), values of $R_{DG}(\lambda_i)$ start to drop to reach a local minimum at 16:52, approximately 30 minutes before the eclipse maximum. The decline has a clear wavelength dependence with wavelengths in the UV-B decreasing the most (up to 20 %), followed by wavelengths in the visible (up to 15%) and IR (up to 3.5%). After this local minimum, $R_{DG}(\lambda_i)$ slowly increases during the remainder of the eclipse.

The change of $R_{DG}(\lambda_i)$ over the period of the eclipse could either be caused by processes initiated by the occlusion of the Sun or by variability from aerosols. Aerosols effects are more likely because any eclipse effects should conspicuously peak at the time of totality, not 30 minutes earlier. The wavelength dependence of $R_{DG}(\lambda_i)$ is also characteristic for aerosol effects (Sect. 7.3). In addition, the minimum values of $R_{DG}(\lambda_i)$ during the eclipse are well within the range of values observed prior to the eclipse, which could be unambiguously attributed to aerosols."

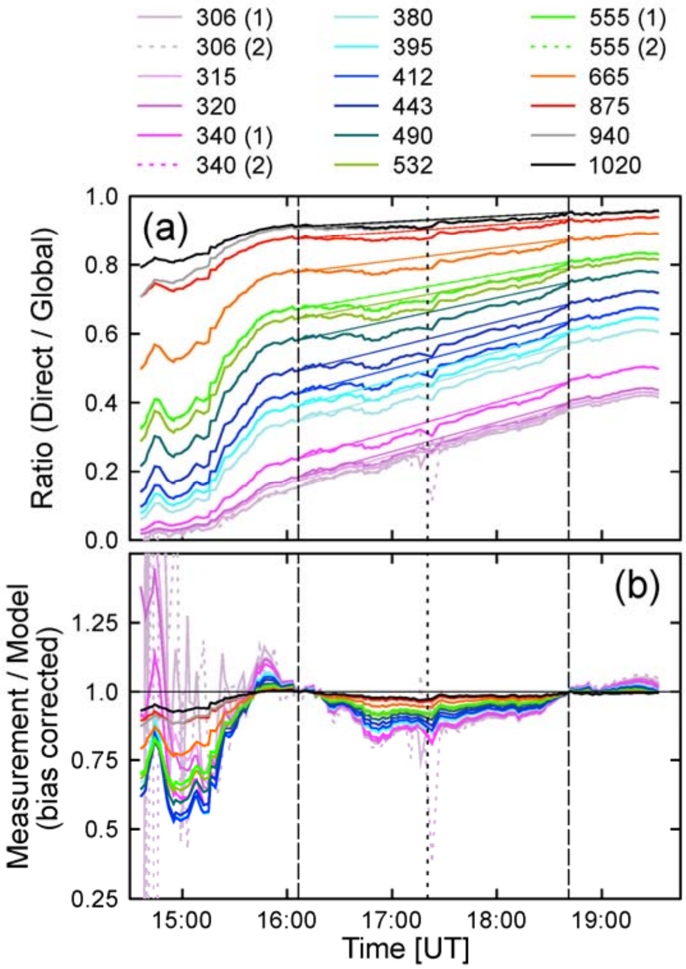

Fig. 1. Panel (a): ratio of direct-to-global spectral irradiance. Measurements are shown as heavy lines. Thin lines connect measurements at the start of end of the eclipse and are drawn to guide the eye. Panel (b): Ratio of the measured and modeled direct-to-global ratios, corrected for the bias between measurement and model. Numbers "(1)" and "(2)" in the legend indicate the channel number for channels equipped with identical wavelengths.

In Section 8.1., the following paragraph:

> "The direct-to-global ratios shown in Fig. 10 increase with time as expected from the decrease in SZA. Deviations from a straight line between the 1st and 4th contact are less than 0.04. It is difficult to determine whether this deviation is caused by processes initiated by the occlusion of the Sun, by variability from aerosols, or artifacts of the algorithm to calculate the direct irradiance from shadowband data. We therefore consider the deviation of 0.04 as an upper limit for the eclipse effect."

was removed and replaced with:

> "Relative to model calculations for the unoccluded Sun, direct-to-global ratios during the eclipse decreased by up to 20 % in the UV-B, 15 % in the visible and 3.5 % in the IR (Fig. 1b). The largest decrease was observed about 30 minutes before totality. The timing of this decrease plus its spectral dependence suggest that changes in aerosol amounts are the main driver for the observed drop in the ratio. However, aerosol effects are difficult to decouple from processes initiated by the occlusion of the Sun or artifacts of the algorithm used to calculate the direct irradiance from shadowband data."

Note that this paragraph is now part of Section 8.2.

Comment by Referee

Page 2, lines 15-20: Kazantzidis et al (2007) were measuring with NILU-UVs and calculated total ozone, too. They reported a slight increase when the visible part of the sun was more than 20% and decreased significantly as the eclipse progressed.

Authors' Response and change to manuscript

The reference to Kazantzidis et al. (2007) has been added to the introduction in support of the following statements:

"study wavelength-dependent changes in spectral irradiance"

"short-term and longer-lasting fluctuations in the total ozone column (TOC)"

Furthermore, we have added the following to Sect. 8.3. of the Discussion:

> "Finally, Kazantzidis et al (2007) discuss TOC measurements performed with NILU-UV filter radiometers at several locations in Greece during the total solar eclipse of 29 March 2006. They did not observe any periodic fluctuations in TOC and only report a small increase in TOC of about 5 DU as the visible fraction of the Sun decreases from ~60% to ~20%. This small change could be caused by incomplete correction of the LD effect."

Comment by Referee

Figure 3 and relevant text: please provide a figure only with the UV wavelengths, no logarithmic axes. From the literature it seems that the bandwidth of 305nm channel is quite wide: it is more than 10nm even at full width at half maximum. In this case, please discuss the possible implications when measuring with this high bandwidth.

Authors' Response and change to manuscript

Figure 3 was plotted separately for the UV, visible and IR wavelength range on a non-logarithmic x-axes. The new figure plus raw data in text format will be made available as Supplements.

The following was added to Section 3:

> "The spectral bandwidth of all channels is approximately 10 nm full width at half maximum (FWHM) with the exception of the two channels at 305 nm, which have a bandwidth of 18.5 nm."

The following was added to the Caption of Fig. 3:

> "A version of the figure, plotted separately for UV, visible, and IR wavelengths, is part of the Supplement."

The following was added to Sect. 5.1:

> "Aerosol optical depth was not calculated for the two 305 nm channels because of the large bandwidth of these channels and the strong interference with ozone absorption at this wavelength. Both factors lead to large uncertainties."

As described in Section 5.2., TOCs are calculated using look-up tables that are based on response-weighted global irradiance, i.e., the spectral irradiance weighted with the spectral response functions shown in Fig. 3. TOC calculations therefore take the large bandwidth of the 305 nm channels into account.

The impact of the relatively large bandwidth of the 305 nm channels on spectral irradiance calibrations is implicitly addressed by the vicarious calibration method described in Sect. S1.2 of the Supplement. Uncertainties to derive spectral irradiance at 1 nm resolution from response-weighted irradiance are discussed in Section S1.3 of the Supplement.

Comment by Referee

Page 5, lines 15-24: please provide/add some sentences about the performance of this method on estimating the direct and the shadowband corrected spectral irradiances.

Authors' response and change to manuscript

The following was added to the paragraph in question:

> "The uncertainty of our method was estimated by Witthuhn et al. (2017). AOD can be retrieved with an uncertainty of 0.02 for all channels within a 95 % confidence interval."

Comment by Referee

Figure 4 and relevant text: What is the expected cosine error in UV wavelengths? Are there any measurements? Are the measurements in UV channels (used for this study) cosine corrected? How significant this effect is expected to be during the solar eclipse (when the direct component of solar irradiance is minimized)?

Authors' Response

The cosine error in the UV has also been measured but results were omitted from Fig. 4 because these measurements are very noisy due to the low output of the FEL used for the characterization in the UV. In general, the cosine error of wavelengths between 305 and 380 nm is similar to that at 395 nm because scattering properties of PTFE (Teflon) deteriorate only towards longer wavelengths but not towards shorter wavelengths. We have now generated a composite figure showing cosine errors in the UV in the upper panel and those for the visible and IR ranges in the lower panel:

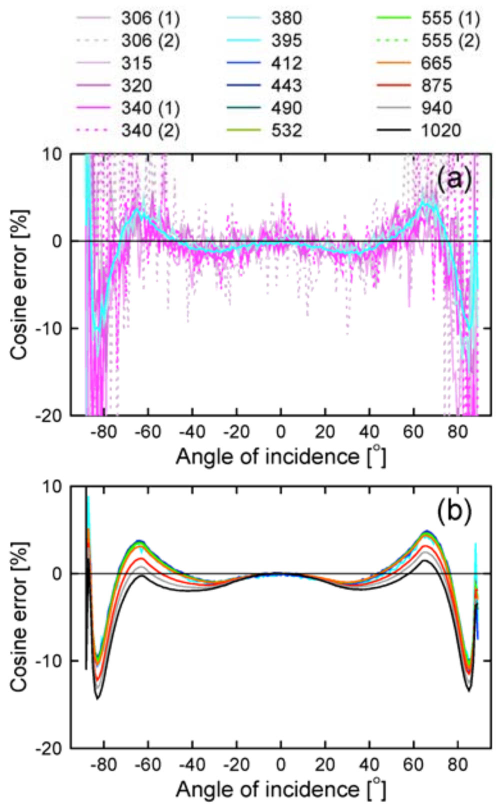

Fig. 2: Cosine error of the GUVis-3511 radiometer in one azimuthal plane at wavelengths between 305 and 395 nm (Panel a) and 395 and 1020 nm (Panel b). Measurements performed at the orthogonal plane are similar. Measurements at wavelengths below 395 nm are affected by noise due the low UV output of the incandescent lamp used for the characterization.

The new figure will be included in the Supplement. Measurements of UV channels used in our study are cosine error corrected. Corrections of channels between 305 and 380 nm are based on the cosine error of the 395 nm channel to avoid spurious corrections caused by the noisy cosine response data. The cosine error correction takes the measured direct-to-global ratio into account. The accuracy of the cosine error correction method is therefore not affected by the solar eclipse.

Change to manuscript

The following was added to Sect. 3:

> “Measurements of the cosine error at wavelengths below 395 nm are affected by noise due the low UV output of the incandescent lamp used for the characterization.

> Corrections for the cosine error of UV channels described further below are based on the measured cosine error at 395 nm.”

The following was added to the caption of Fig. 4:

> “(A figure with cosine errors in the UV is provided in the Supplement.)”

The following was added to Sect. 4:

> “Both direct and global irradiance measurements were corrected for the cosine error of the instrument’s collector as described by Morrow et al. (2010), based on the measured cosine error (Fig. 4) and the ratio of direct and global irradiance extracted from the shadowband measurements.”

Comment by Referee

Figure 8: Aerosol Optical Depth (AOD) around 305nm is not depicted in figures 8a and 8b. Why? Do you think that the LD correction (8b) by Pierce is valid also for the lower UV wavelengths? If yes, how this decrease of AOD in these wavelengths can be explained? There is an assumption that this is not a measurement artifact but an unknown absorber. Which type of absorber could change the expected AOD values only at 314.2, 319.4nm (and 442.4nm!)? Moreover, what would be the AOD estimations if you apply the Neckel LD parameterization?

Authors’ Response and change to manuscript:

The uncertainty in calculating AOD at 305 nm is far too high to be useful. As already mentioned earlier, we have added the following to Sect. 5.1 to make this clear:

> “Aerosol optical depth was not calculated for the two 305 nm channels because of the large bandwidth of these channels and the strong interference with ozone absorption at this wavelength. Both factors lead to large uncertainties.”

Yes, we believe that the LD correction by Pierce is valid also for the lower UV wavelengths because the difference in global irradiance between measurement and theory is also reasonable at

305 nm (Fig. 11d of original manuscript). Furthermore, the LD corrections by Pierce and Neckel (which were derived from independent datasets) agree to within 1.8% at 305 nm.

We do not know with certainty why the AODs at 314.3, 319.4, and 442.4 nm are below the AODs expected from the Ångström parameterization, which was derived using channels between 340 and 1020 nm, excluding the channel at 940 nm, as stated in the manuscript. These low values could be caused by absorbing aerosols released by the near-by fires or measurement errors, but this is speculation. If the low values were due to measurement errors, one would expect that the discrepancies for the three wavelengths observed at 16:02:58 and 19:00:30 are of similar magnitude because measurements at both times were processed in the same way. The fact that these discrepancies are larger at 19:00:30 suggests that they are caused by real changes in aerosol properties. While these drops could be caused by an unknown absorber, we removed this suggestion from the text because we don't have evidence that such an absorbing aerosol or gas was indeed present.

Considering the uncertainty with respect to the cause of the low AODs at the three wavelengths, we changed the last sentence of the paragraph to:

> "As measurements at the two time were processed in the same way it seems unlikely that the discrepancies are caused by a measurement artifact."

With respect to the question "Moreover, what would be the AOD estimations if you apply the Neckel LD parameterization?" we note that AODs shown in the figure were calculated for times before the start (16:02:58) and after the end (19:00:30) of the eclipse. Hence, no LD parameterization was applied or is necessary.

Comment by Referee

Paragraph 7.2: It is quite surprising that although AOD can be estimated by direct GUV measurements, this is not happening for the total O3 amount as well, despite that direct measurements (divided by global ones) are presented in figure 10. Moreover, the 305/340 wavelength ratio methodology to derive total O3 is based on model calculations as a function of O3 and solar zenith angles but under cloud-free skies e.g. specifically defined direct and diffuse components of solar irradiance. This is not the solar eclipse case. And this is accounted by the authors. However, how valid are the LD parameterizations on CHANNEL irradiances when it is known that the direct/diffuse ratio has significant spectral sensitivity? And how repeatable will be their results if the they use: a) direct irradiances, b) different channel ratios, e.g. 305/320, 312/340? The authors here should acknowledge a couple of very crucial facts: 1) the 305/340 wavelength ratio of channel irradiances is a well-known method that can be used for total O3 estimations but it is accompanied by significant uncertainties (aerosol optical depth and scattering properties, cloudiness, ozone profile, direct/diffuse irradiance etc), 2) the comparison with ozone values or previous studies derived from instruments measuring the direct irradiance should be done under the acknowledgement that these measurements are correct not only because they are the standard ones but also because they are correct in terms of physics and the best in terms of overall uncertainty.

Authors' Response

First, we like to emphasize that this paper is not about the most accurate or appropriate method to calculate TOC. TOC measurements were mainly included in the manuscript (i) to illustrate that TOC measurements during an eclipse are affected by the solar limb darkening (LD) effect and that errors arising from this effect can be greatly reduced with appropriate LD corrections, and (ii) to determine whether gravity waves generated by the Moon's shadow can cause oscillations in TOC as suggest by several authors in the past. In our opinion, both questions were sufficiently addressed with the results presented in the original manuscript. Please see also our response to the comments by Forrest M. Mims.

Motivated by the referee's comments, we have calculated total ozone now also from global irradiance of the wavelength pairs 305 / 313 and 313 / 340. Results are presented in Fig. 3. Fig. 3a shows results without LD correction. TOCs for the 305 / 340 pair (blue) are identical with the "uncorrected" data shown in Fig. 9 of the original manuscript. Ozone values for the 313 / 340 are *lower* than those of the 305 / 340 pair and exhibit a *negative* slope as a function of time. In contrast, ozone values for the 305 / 313 pair are *larger* than those of the 305 / 340 pair and exhibit a *positive* slope. These biases are likely caused by a small systematic error in measurements of the 313 nm channel. When measurements of this channels are scaled with a factor of 0.95 and ozone retrievals repeated, TOCs derived from the three wavelengths pairs are consistent to within ±2.5 DU outside the period of the eclipse (Fig. 3b). A systematic error of 5% is well within the expanded uncertainty of 7.3% of the 313 nm channel (see table S1 of Supplement.). Using this adjustment, measurements of all pairs agree with OMI data to within 5 DU (1.7%) (red line in Fig. 3).

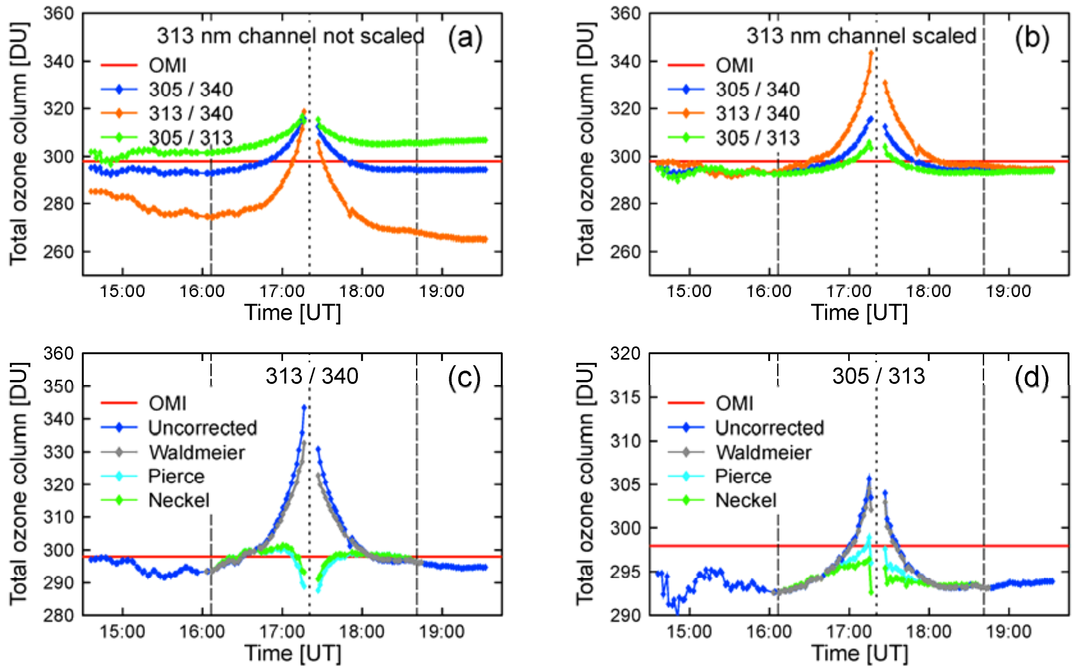

Fig. 3. Total ozone column derived from global irradiance measurements of the GUVis-3511 radiometer using different wavelength pairs. Panel (a): comparison of ozone retrievals with the 305 / 340 pair (blue), the 313 / 340 pair (orange), and the 305 / 313 pair (green). Panel (b): same as Panel (a) but measurements of the 313 nm channel were scaled with a factor of 0.95 before calculating ozone. Panel (c): TOC retrievals for the 313 / 340 pair using either no correction (blue), or the LD-corrections by Waldmeier (grey), Pierce (cyan), and Neckel (green). Panel (d): same as Panel (c) but for the 305 / 313 pair. Measurements of the 313 nm channel were scaled by 0.95 for all retrievals shown in Panels (c) and (d). Long-dashed lines indicate the start and end times of the eclipse and the short-dashed line indicates the time at totality. Note that y-scales of the various panels differ.

TOC data shown in Fig. 3c and 3d were corrected for the LD-effect similar to the TOC data derived from the 305 / 340 pair shown in Fig. 9 of the original manuscript. As in that figure, TOCs calculated for the 313 / 340 and 305 / 313 pairs (Fig. 1c and 1d, respectively) spike at the time of totality when no LD correction is applied. The LD correction by Waldmeier has only a marginal effect on this result. In contrast, LD corrections using the parameterizations by Pierce and Neckel greatly decrease this spurious spike.

Calculations of TOCs from global irradiance using the pairs 305 / 313 and 313 / 340 therefore confirm the conclusions reached from results of the 305 / 340 nm pair that were presented in the original manuscript:

- There are no periodic oscillations in the TOC, either before or after totality, that could be attributed to the effects of bow waves from the Moon's shadow.
- The LD corrections by Pierce and Neckel greatly reduce the spurious spike in TOCs during totality resulting from the LD effect. In contrast, the correction that is based on the parameterization by Waldmeier is too small.
- The spurious TOC spike is larger for the 313 / 340 pair than for the 305 / 340 pair even though the relative difference in the LD effect is smaller for the two wavelengths used in the former pair. This observation is due to the fact that small errors in measurements at 313 nm have a larger effect on TOC than at 305 nm because the absorption coefficient of ozone is much smaller at 313 than 305 nm. The effect of ozone absorption on the 305 / 340 ratio therefore outweighs the LD effect.
- There is no evidence that aerosol effects have an important effect on our TOC measurements. While we agree with the referee's assessment that the method of calculating TOCs from ratios of global irradiance at 305 and 340 nm "is accompanied by significant uncertainties (aerosol optical depth and scattering properties, cloudiness, ozone profile, direct/diffuse irradiance etc)," we believe that these uncertainties are of little relevance for the conclusions reached in our paper. Specifically:
    - AODs were characterized and used for the lookup tables for ozone retrievals. The good consistency of TOC retrievals for different wavelength pairs (after adjusting for the bias of measurements at 313 nm) confirms that aerosol effects were addressed adequately.
    - There were no clouds during the period of the measurements that could have skewed our TOC retrievals.
    - The ozone profile (through the Umkehr effect) becomes only important for SZAs > 75° (i.e., outside the range of SZAs occurring during the eclipse).
    - Changes in the direct-to-global irradiance agree to within 2.5% for the wavelength range 305 - 340 nm, except for a short period centered about totality (Fig. 1 above). So our look-up tables, which were calculated for no-eclipse conditions, are also suitable for calculating TOCs during the eclipse.

We did not calculate TOCs from measurements of direct irradiance because such retrievals have a comparatively large uncertain when direct irradiance in the UV-B (in particular 305 nm) is calculated from shadowband data. In contrast to wavelengths in the UV-A and visible, where direct irradiance under clear skies with moderate aerosol loading makes up a large fraction of the global irradiance, this is not true for wavelengths in the UV-B, in particular at large SZAs (see Fig. 1a). When using a shadowband, direct irradiance in the UV-B is calculated as the difference of two large numbers (global and diffuse irradiance), and the uncertainty of the result is therefore higher than those of TOCs derived from global irradiance.

Regarding the referee's comment:

> "the comparison with ozone values or previous studies derived from instruments measuring the direct irradiance should be done under the acknowledgement that these measurements are correct not only because they are the standard ones but also because they are correct in terms of physics and the best in terms of overall uncertainty."

While we agree that measuring TOC from direct irradiance is the more straightforward method (as only Beer-Lambert's law is involved), the referee's assertion that "these measurements are correct" is not appropriate. There are many error sources that can affect these measurements such as pointing errors, calibration errors, non-linear sensor response, stray light from diffuse radiation that is detected with the direct beam (a problem affecting Brewer measurements as mentioned by several papers cited in our manuscript), uncertainty of the filter functions and their center wavelengths, etc. Considering that we do not have the raw data that other authors have collected to calculate TOCs during historical ellipses we do not want to speculate on the uncertainty of those measurements and their magnitude relative to our results.

As explained above, adding TOC data derived from different wavelength pairs would not change our conclusions about the effect of the solar eclipse on short-term TOC fluctuations. However, results obtained with the 305 / 313 and 313 / 340 pairs are valuable because they confirm the results from the 305 / 340 pair discussed in the manuscript. In order to keep the length of the manuscript within reasonable limits while also respecting the referee's suggestion, we added these new results to the Supplement with references provided in the manuscript.

Change to manuscript

The following was added to Sect. 5.2:

> "The following three wavelength pairs were used: (1) λ_L = 340 nm, λ_S = 305 nm; (2) λ_L = 340 nm, λ_S = 313 nm; (3) λ_L = 313 nm, λ_S = 305 nm.
>
> […]

"While TOCs could also be derived from direct irradiances, these measurements are not discussed here due to the relatively large uncertainty to calculate direct irradiance from shadowband data at wavelengths in the UV-B (280–315 nm), in particular at large SZAs."

The following was added to Sect: 7.4:

"Results obtained from the 305 / 340 wavelength pair are discussed below. Similar results calculated with the 305 / 313 and 313 / 340 wavelength pairs are presented in Sect. S2 of the Supplement."

[…]

Results obtained with the 305 / 313 and 313 / 340 wavelength pairs (Sect. S2 of the Supplement) corroborate these findings."

Change to Supplement:

Calculations of TOC from the 305 / 313 and 313 / 340 wavelength pairs have been added to the Supplement. Please see Section S2 of the new version of the Supplement for details.

Comment by Referee

Figure 9 and relevant text: Kazantzidis et al (2007), when using the 305/320 wavelength ratio (in order to reduce the effect of spectral effect of the eclipse on direct and diffuse irradiances) reported very similar results to those derived from yours when using the 305/340 wavelength ratio AND applying the Neckel or Pierce parameterization. Surprisingly, this paper is referenced only for the comparison of measured and model irradiances. However, the results of this paper for ozone, irradiances and irradiance ratios vs eclipse percentage are not referenced, although it is based on results from 8 narrowband multi-channel NILU-UV6 radiometers.

Authors' response and change to manuscript

As mentioned already earlier, we have now added the following to the manuscript to compare our ozone measurements with those reported by Kazantzidis et al (2007):

"Finally, Kazantzidis et al (2007) discuss TOC measurements performed with NILU-UV filter radiometers at several locations in Greece during the total solar eclipse of 29 March 2006. They did not observe any periodic fluctuations in TOC and only report a small increase in TOC of about 5 DU as the visible fraction of the Sun decreases from ~60% to ~20%. This small change could be caused by incomplete correction of the LD effect."

Furthermore, we have added the following to Sect. 8.2 (now Sect. 8.1) where we compare the magnitude of solar LD used in our paper with that used by other authors:

"Kazantzidis et al.(2007) have analyzed ratios of global spectral irradiance (305 nm / 380 nm, 312 nm / 380 nm, 340 nm / 380 nm, and PAR / 380 nm) that were measured with NILU-UV filter radiometers at three locations in Greece during the total solar eclipse of 29 March 2006. These measured ratios were compared with theoretical predictions based on the algorithm by Koepke et al. (2001) and the LD parameterization by Waldmeier. As the eclipse progressed, the model underestimated the measured spectral effect, capturing only half of the observed change. For example, measured ratios of spectral irradiances at 340 and 380 nm were 10 % lower close to totality compared to similar ratios calculated for the 1st and 4th contact. The theoretical calculation only predicted a decrease of 5%. Our results suggests that discrepancies between the measured and modeled ratios reported by Kazantzidis et al. (2007) can partly be attributed to limitations of the LD parameterization by Waldmeier used in their model."

Comment by Referee

Paragraph 8.1: the authors seem to have a point here. In order to better understand the similarities/differences with previous studies, a more detailed information is needed apart from direct/diffuse ratios: the measured wavelengths and the eclipse percentages should be provided. Moreover, the theoretical calculations from Emde and Mayer are quite capable to estimate the global irradiance (when normalized 5 minutes before totality) at 380 nm but maybe irradiance is significantly underestimated at 312 nm (Kazantzidis et al., 2007, figure 7 and relevant text). This affects directly the diffuse component. Of course, also this result is sensitive to factors like surface albedo, ozone profile and the dynamic range of the measuring system. All these factors should be mentioned.

Authors' response

We added the following sentence to Section 8.1. (now Sect. 8.2), which now specifies the measured wavelengths (i.e. erythemal irradiance), eclipse percentage (88%), location (Thessaloniki), and time (11 August 1999):

> “However, these results disagree with the results by Zerefos et al. (2000; 2001), who suggest that the erythemal (sunburning) diffuse irradiance was declining at a slower rate than the erythemal direct irradiance during the solar eclipse observed in Thessaloniki, Greece, on 11 August 1999. The largest difference was observed at the time of the eclipse maximum when 88% of the solar disk was obscured and the diffuse irradiance was reduced 30 % less than the direct irradiance.”

With regards to factors such as “surface albedo, ozone profile and the dynamic range of the measuring system” that affect irradiance close to totality, we note that we concluded our original manuscript with the sentence:

> “During totality, the irradiance at the surface will become also more sensitive to the topography (e.g., the mountains surrounding the measurement sites), surface albedo (and its spectral dependence), and the distribution of ozone in the atmosphere (the ozone profile). These aspects will be discussed in a follow-on publication.“

The “follow-on publication” mentioned here is close to completion and will be submitted soon. The factors enumerated by the referee will be discussed in detail therein.

Comment by Referee

Page 22-23: This comment refers to the ozone issue, described in detail by the authors. From my point of view, some (or much?) of these differences could be attributed on the measuring methods and the selected pairs of wavelengths. As mentioned before, a decrease of (uncorrected for LD effect) ozone retrievals has been reported by Kazantzidis et al (2007) for the same eclipse when using 8 NILU-UVs. As it was stated earlier in this review, the authors could strongly defend their findings if they will come up with the same results when using other wavelength pairs and the direct GUV irradiances. Unfortunately, this measuring campaign is not accompanied by more instruments.

Authors’ response

One important “take-home message” from our paper is that accurate LD corrections are necessary for accurate TOC retrievals. Basically all papers that have discussed TOC measurements for previous eclipses use a LD correction that is based on a parameterization that is too simple for wavelengths in the UV. In addition to TOC retrievals using the 305 / 340 wavelength pair, we have now also calculated TOCs from the 305 / 313 and 313 / 340 wavelength pairs (Fig. 3

above). These new calculation corroborate our initial findings that the spurious peak in TOC measurements caused by LD effect can be greatly reduced by using either the LD parameterization by Neckel or Pierce. We agree with the referee's assessment that the presence of additional instrument during "our" eclipse could have strengthened our conclusions further. We hope that a multi-instrument campaign can be organized during an upcoming eclipse to get closure on some of the remaining questions raised in our paper.

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