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Comment

## ***Interactive comment on “Improving the solar zenith angle dependence of broadband UV radiometers calibration” by M. L. Cancillo et al.***

**M. L. Cancillo et al.**

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Point by point response to comments of referee #2.

We thank the referee for his comments and suggestions which helped us to improve the paper.

RC– *Referee comment*

RES– *Our response*

Page and line numbers are referred to the previous version of the paper.

Specific remarks

RC–*sed data for the model it adjust and validation. It Would be interesting to know de*

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*distribution generated by the random data selection in the model its adjust (77%) and in its validation (23%) especially about the SZA values, ozone and clear days.*

RES-The histograms show the distribution of ozone values and solar zenith angle (SZA) for the regression data set (left) and for the validation set (right). Mean values for the sets regression and validation are very similar, 284 and 285 DU for total ozone; and 56,2° and 55,8° for SZA values). Since regression and validation cases were randomly chosen, both datasets show similar statistical properties. (these figures are not included in the paper) (We will send you a file including the figures by means of the editor)

RC– 2.- *Ozone frequency (UD) and number of clear days during the campaign. The paragraph number 2 Instrumentation and data; page 17877 shows a valuation of the UD average at El Arenosillo. And it shows that the campaign days represent the annual averages. I think it would be very illustrative to extend that information with the frequency graphic representation as in the ozone values as in clear days for the campaign time.*

RES– In the intercomparison campaign carried out in 2005, no ground instrument to measure cloud amount was available. The campaign lasted for 27 days and different cloud conditions occurred. Considering the reflectivity data given by TOMS instrument as an indicator of atmospheric conditions, 14 days were clear (reflectivity<10%), and 13 were cloudy, of which 6 had reflectivity between 10% and 30%, 2 between 30% and 50% and 5 higher than 50%.

This comment has been included in Section 2: Instrumentation and data, page 17877, line 11.

RC–3.- *One step angular method: Comparison and validation. 3.1 Comparison of one step angular method and two step method behaviour in the solar zenith angle SZA, ozone and cloudiness average, can be very illustrative in the target of this study. That comparison analysis could shows interesting results in both methods analysis.*

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RE– With reference to the analysis of the behaviour of the method proposed with SZA, the new version of figure 2 helps to clarify the comparison between calibration methods (see comments below, in the response to the next referee comment). We consider also very interesting to analyse the behaviour of the method proposed with total ozone variations but we think that it will be necessary to have a wide interval of values and could be subject of a future work. In relation to the cloudiness, it is not possible to make a quantitative analysis, because there were no data available at the moment of the calibration except those provided by TOMS reflectivity (only once a day). It is one of the projects to approach in the near future.

RC– 3.2 *Additionally, the figure number two shows the difference between the irradiance measures by the Brewer spectrophotometer and the one estimated by the broadband radiometer #1 using the four one step methods (ratio, first and second order and angular). It would be interesting to compare in the same graphic the behaviour of the two step method.*

RES–According to the referee suggestion, the values corresponding to the two-step method have been included in the new version of figure 2.

RC– 3.3 *It would be interesting if this job could shows the validation of angular one step method in front of the Brewer spectrophotometer measurements.*

RES–In this new version of the paper we have included the ratio (Broadband/Brewer) values instead the relative differences in figure 2, so we think that it is a way to compare the broadband values with the Brewer ones for the different methods in a unique figure, without including one figure for each method.

RC–4.- *Measurements it's uncertainly. Presentation shows any mention to the measurements uncertainly, its propagation in the calculation and in the final results. Also there is nothing about the results of traceability. It would be advisable that authors tackle this subject in the convenient length.*

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RES– Regarding to the uncertainty in measurements and its propagation, we have included several sentences in the revised paper:

Section 2: Instrumentation and data:

Page 17876, line 23

The average differences between Brewer #150 and QASUME measurements were around a 8% in 2005 campaign (Hülsen and Gröbner, 2007). However, after applying cosine response correction to Brewer data, these differences have been reduced approximately by a factor 2.

Page 17876, line 27

Instrumental errors in the diurnal measurements (raw data) of broadband radiometers are lower than 1.7%.

Page 17881, line 12

From a statistical point of view, the uncertainty in the calibration coefficients for one-step methods is stated as the standard error (SE) multiplied by a coverage factor  $k=2$  which for a normal distribution will give a level of confidence of approximately 95%.

*RC–5.- Explanations. 5.1 In page 17877. paragraphs 2 and 3, it shows in that study its been used an average of 733 minutes from higher to 80° solar zenith angle. It would be convenient to clarify and enlarge this information about higher to 80° angles.*

In this paper were used 733 data (minute average) that correspond to SZA under 80°. The total number of cases possible during the days of campaign was 795 (simultaneous data for Brewer spectroradiometer and broadband instruments), so , the number of cases with SZA over 80° that have not been considered in this work represent only the 7.8% of total.

A sentence has been included in the revised paper (page 17877, line 5)

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Moreover, the data set used in this paper (733) represents the 99.2% of all possible cases during the days of campaign because only the 7.8% of total had values with SZA over 80°.

RC–5.2 *Also they have to clarify the SZA value in the next paragraph: page 17881, line 22;...where the limits of the interval for the differences are reduced to (-55.3 I think it's necessary that similar radiometer 2 and 3 detours that are quoted in page 17881, line 23 be assess for all one step models.*

RES– We have changed the redaction of this page to clarify it and including the comments to the new version of figure 2 in this way:

Figure 2 shows the variation with the solar zenith angle of the ratios between the irradiance measured by Brewer spectrophotometer and the irradiance estimated by broadband radiometer #1. Results using the four one-step calibration methods and the two-step method are depicted. The points represented correspond to the averaged ratios obtained for SZA intervals of 1°. It is observable that, for the one-step methods, the best results are obtained by the angular method, which presents ratios very close to 1.0 (bounded by 0.96 and 1.07 values) in the whole range of solar zenith angles. These results are also very close to those obtained by the two-step method, which ratios are bounded by 0.98 and 1.11 values. Radiometers #2 and #3 (not shown), present very similar behaviour to radiometer #1.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 17873, 2007.

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