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Interactive Comment

Interactive comment on "A new method for the absolute radiance calibration for UV/vis measurements of scattered sun light" *by* T. Wagner et al.

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Reply to reviewer #3

First of all we want to thank the reviewer for the positive assessment of our study and for the valuable comments and suggestions. We followed most of them, as decsribed in detail below. Before we respond in detail to the reviewer's comments we briefly summarise the most important changes of the manuscript compared to the original version:

A) We carried out additional sensitivity studies for strongly absorbing aerosols (single scattering albedo of 0.8). These results are added to figures 7 and 8 (old figures 5 and 6). We also carried out additional sensitivity studies for individual changes of temperature or pressure. The results are not shown in the paper (but in our reply to the other reviewer), because the effects are very small. We added this information to the text.

B) As suggested by the other reviewer, we shifted the section on the influence of ozone on our calibration results from the appendix to main text. We also added a discussion on the importance of future studies on the effect of ozone, especially for the UV-B region, at the end of that new section.

C) We corrected two mistakes in the original version: 1) In Fig. 5 (old Fig. 3) and Fig. A3 (old Fig. A4) the simulation results were calculated incorrectly: instead of multiplying the output of the radiative transfer model (the normalised radiance) with the solar irradiance spectrum, the RTM output was divided by the solar irradiance spectrum. Because the values of the solar irradiance spectrum (in units of W/m^2/nm, see Fig. 2) are close to unity, this mistake was not immediately obvious). Fortunately, this mistake did not affect any of the results of our study.

2) The figure caption in Fig. 8 (old Fig. 6) was wrong: The original text: ‘the scaling factors are divided by the scaling factors for the standard scenario’ was corrected to: ‘the scaling factors for the standard scenario are divided by the scaling factors for the different scenarios’

D) A new figure showing the spectral resolution of our instrument (Fig. A1) was added (to the appendix).

General comments

In general the topic of this study is within the scope of AMT. In my opinion, this is an interesting study with useful results. In summary, I believe that it merits publication in AMT provided that authors incorporate into the following:

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Specific comments: In the abstract, lines 17-19: “For wavelengths below about 330nm it is essential. . .”. In my opinion it is important that below 330nm the calibration results, using a constant ozone column density, have to be interpreted with caution, as also mentioned in Section 2.2 and in the “Appendix”. And thus it should be mentioned in the abstract and in the conclusions sections.

Author reply: We agree and added the following statement to the conclusions: ‘For wavelengths below about 330 nm it is essential that the ozone column density during the measurements is constant and known. The accuracy of our method in the UV-B spectral range should be further explored in future studies based on measurements under constant ozone layer thickness during the period of the measurements.’

In page 5333, line 23: Why the authors choose a 10 nm interval and not a smaller interval? A brief explanation should be inserted at this point.

Author reply: We added the following information to the text: ‘Here it should be noted that our choice of wavelengths was arbitrary and also a different (e.g. finer) wavelength grid could be used (e.g. if the detector sensitivity changes rapidly with wavelength).’

Page 5335, lines 7-13: The authors mention “the solar cycle” and then discuss for the 2004 - 2007 period. Sun was declining in activity during this period? They should make it more clear to the reader.

Author reply: We changed the text to: ‘Here it is interesting to note that changes of the solar irradiance during the solar cycle are rather small. Haigh et al. (2010) studied the changes between 2004 and 2007 for the declining phase of the solar cycle (from shortly after the maximum of cycle 23 to close to the subsequent minimum) and found variations <1% for wavelengths > 350 nm. For shorter wavelengths the uncertainties slightly increase (for 315 nm they are about 1.5%). Similar differences are expected for our measurements, which have been taken at the minimum between solar cycle 23 and 24, while the solar spectrum used here was scaled to a measurement taken in 1992, shortly after the maximum of solar cycle 22.’

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Interactive Discussion

Discussion Paper

In page 5336, lines 11-20 and also in the "Appendix" that I believe it should be incorporated in the main text, the authors discuss about the spatial and temporal differences in ozone profile and column in the area under study using measurements from satellite observations (SCIAMACHY) and from the US standard atmosphere. It would be useful for the reader to add a brief discussion with appropriate references on the comparison-differences between the ozone column and profile measurements derived from satellite observations and US standard atmosphere mentioned here with other most reliable instruments and methods (like Dobson spectrophotometer and ozonesondes) in other places e.g. in Europe. Are there any additional uncertainties from these differences?

Author reply: As suggested, we shifted most of the section on the influence of ozone (except old Fig. A3) from the appendix to the main text (new section 2.2.1). We also added the following text at the end of the new section: 'From the measurements used in our study (which represent a rather extreme situation with a relative change of the ozone VCD of about 5% within 3 hours) we can not further explore the potential and accuracy of our calibration method in the UV-B spectral range in a meaningful way. Nevertheless, we expect that in the UV-B spectral range similar accuracies as for the larger wavelengths could in principle be obtained, because usually the thickness of the ozone layer is well known from independent observation. Satellite observations have an accuracy of about 1 to 2 % (e.g. Loyola et al., 2011). Here it should be noted that in principle the ozone VCD can also be derived from the DOAS measurement itself, but usually the ozone VCD is no standard retrieval product. Future studies based on measurements under constant ozone columns should explore the accuracy of our method in the UV-B spectral range.'

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 5329, 2015.