Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-288

Anonymous Referee #1

Referee comment on "Optical receiver characterizations and corrections for ground-based and airborne measurements of spectral actinic flux densities" by Birger Bohn and Insa Lohse, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-288-RC1, 2022

This study examines actinic flux density optical collectors and develops a new technique to quantify correction functions for angular imperfections. The detailed responses of a pair of 2 pi optics used for a Zeppelin and a second pair used on the HALO aircraft. They are examined individually as downwelling ground based detectors and in 4 pi pairs as they perform on the aircraft. These optics show significant differences in the azimuthal and zenith responses and thus differ in the corresponding correction functions.

I commend the authors for the rigorous and exhaustive examination of the optical collectors and the deep analysis to correct imperfections on their specific measurements. The tools developed provide a resource to the community to improve actinic flux measurements. Importantly, these corrections do not rely on knowledge of the atmospheric environment (e.g. clouds, aerosols, etc) but rather on the relative changes in the measurements themselves.

This work provides a call to all groups with measurements of actinic flux to consider optical accuracy and the impacts of the non-ideal response. While this may not be practical for all groups, I suggest experts in the community may support more detailed optical analyses.

That said, the corrections are not always large and depend on measurement requirements. The authors note that the magnitude of corrections depends on the optical quality and measurement geometries. Downwelling optics for ground-based UV measurements (e.g. spectrometers or filter radiometers) may have relatively minor corrections (e.g. Figure S28), particularly with lower surface albedo. Total actinic flux from optical pairs with a sufficiently accurate 4 pi response also have relatively small corrections (e.g. Figure 11 and the discussion Section 7). The authors note that mechanical adjustment can improve hemispherical measurements, though corrections may still be necessary.

In addition, the primary purpose for such measurements is the subsequent calculation of photolysis frequencies. The impacts of the corrections on photochemistry are reduced and the authors note this is beyond the scope of this work. Nevertheless, it is an important consideration in the larger picture. Most photolysis frequencies are driven by UV wavelengths and the UV corrections in this study were relatively minor. In addition, photolysis frequency calculations include large molecular parameter uncertainties that typically exceed the measurement uncertainties. Nevertheless, better measurements are in fact, better, and molecular uncertainties may be reduced in future studies. At longer wavelengths, the uncertainties were more significant affecting the photochemistry of NO3 and other molecules.

The paper is well written, relevant and fits well within the scope of AMT.

Minor comments and revisions:

Line 1 and/or line 28: UV/VIS to "ultraviolet and visible (UV/VIS)"

Lines 114-5: I do not see a description of FLT, FLV and FLN. Nor do I understand the acronyms. Figure S7 does give some information but does not distinguish between FLT and FLN.

Line 228: Typo. Change 'was' to 'were'

Figures 7, 8: The paper jumps between Zeppelin and HALO configurations. Be sure to distinguish the platform in each figure caption for clarity. In these two plots they are the Zeppelin optics.

Line 358-60: Should this refer to Figures S4 and S5. Figure S11 does not show the azimuthal variability. Also, the variability of the nadir sensitivity looks to be about 5% based on the error bars in Figure S5. That does not seem to qualify as "small". Perhaps note it is an exception here.

Figure S5: Just a comment: The bottom optic for the Zeppelin seems to be a significantly inferior optic. Perhaps that is why it was placed in the less consequential upwelling position. Could this be improved through mechanical adjustments? If so, the corrections would be more in line with the other optics. In addition, both Zeppelin optics seem to encourage crosstalk as they show 80% sensitivities at 90 degrees. Optimizing the angular response is a balancing act but perhaps these could be adjusted to be closer to 50%.

Lines 370-380: I think this is an important place to note explicitly that the impact of the large upwelling correction near the surface has only a small impact on the total. Thus, the impact on total photolysis frequencies would be small.

Figures 11 and S27: The grey bars for the Cs cloud in these figures are deceiving. The cloud ranges from 10-12 km but is shown as a thin line at 11 km. I also suggest adding a point at 12 km to show the correction from the bottom to the the top of the cloud.

Line 374: "Because of insufficient,…". This line is vague. If I am interpreting the meaning correctly, you could modify the end to, "Because of insufficient field-of-view limitations of the bottom receiver, significant cross talk to the upper hemisphere occurs and the Z(NH) are generally greater than unity".

Line 410: Typo. I think you mean "contain the uncertainties"

Line 420: Typo. "final"

Line 504-5: The main source of the increase in upwelling flux from 300 to 600 nm is the orders of magnitude increase in the solar spectral shape. The albedo effect is secondary.

Figure 17: The error bars show the uncertainties from the corrections and calibrations. I was disappointed not to see the impact of the corrections alone as that is the point of the entire paper. It should be shown in this figure (or another) and well explained in the text. The fact that they may be relatively small (especially on this HALO flight) is important.

Section S3.4: Note that the relative contributions apply at 400 nm. That is stated in the figure captions but not the text.