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Atmospheric Measurement Techniques
Discussions

AMTD

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Interactive Comment

Interactive comment on "Can AERONET data be used to accurately model the monochromatic beam and circumsolar irradiances under cloud-free conditions in desert environment?" *by* Y. Eissa et al.

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General comments:

The paper presents an interesting work on a relevant question with applications in solar energy and atmospheric research. However, there are some errors in the analysis of the measurement data that lead to partially wrong conclusions.

Previously published information on the measurement data was not considered. This is one explanation for the errors in the presented discussion paper. In particular this concerns information on nearly the same data set and results derived from it in Wilbert, 2014 (see below).

Apparently there is one error that concerns the angles provided in SAM's h files and the angles in the Aeronet almucantar files. In the almucantar files the angles are azimuthal angular deviations from the solar position. In the h files angular distances from the center of the sun are given. I assume from the text that Figure 1 was created under the assumption that both the Almucantar files and the h file contain angular distances from the center of the sun. This would explain why Figure 1 contradicts the calibration results from Wilbert, 2014. Another additional influence could be that you used a different version of the SAM cdf files created with different manufacturer calibration factors (please specify the file version you used). The good news is that this basically concerns Figure 1 and the conclusions, but not the rest of the calculations. Figure 6 corroborates results from Wilbert 2014. Fig. 6 is produced without using the incorrectly interpreted almucantar angles, but using the angles from Aeronet's phase function files. The calibration from Wilbert, 2014 indicates that the deviation between libRadtran results and the SAM CSNI is basically a result of a calibration error of SAM's aureole camera. In Wilbert, 2014 it was found that the Aeronet almucantar radiances are typically only 80% to 90% of the SAM's radiance. This would mean that the Aeronet data can be used to accurately model circumsolar radiation with the selected libRadtran option. In your conclusion and at the end of the result section you rather give the impression that the errors of the Aeronet data are an important contribution to the deviation. The Aeronet data is of course not perfect, but with the discussion of the calibration errors you will find that you were looking in the wrong direction. The specific comments concerning this calibration topic are marked with * below.

Another wrong conclusion concerns the assumed underestimation of AOD from Aeronet. For AOD measurements a calibration error will cause wrong irradiance measurements which then cause AOD errors. The error in irradiance is proportional to the calibration error. The error in vertical column AOD is not proportional to the calibration error. Hence, a linear correction of AOD data does not make sense. The deviation between Aeronet and SAM data is claimed to be caused by circumsolar radiation. This is only one contribution to the error. Also the data suggests that this is not likely, as the highest overestimations of AOD by Aeronet occur for low AOD. Correcting Aeronet data in the proposed way with an instrument that has a higher uncertainty is not acceptable. Furthermore, the SAM is calibrated with Aeronet data by the manufacturer so that the calibration of Aeronet data with the SAM does not make sense. The idea to use the SAM's disk camera calibration to reduce the effects of a wrong aureole camera calibration on the validation of RTM results is also not useful. The SAM's two cameras are calibrated independently. If possible you should repeat the RTM calculations with the original Aeronet data (see marker ** in specific comments).

Another example is that the entrance window of the SAM instrument was exchanged on November 23rd, 2012 because it was apparently damaged (Wilbert, 2014). This should be mentioned when discussing the temporal variation of the deviations between SAM, Aeronet and RTM results.

Other references that must be linked to the work are Reinhardt, 2013 and Reinhardt et al, 2014. There, libRadtran was used to derive sunshapes and circumsolar ratios.

Specific comments:

-7699, 1-3. This statement is misleading. WMO states a range of frequently used opening angles, but only one geometry is recommended. Please change to: The World Meteorological Organization (WMO) recommends slope angles of 1° and aperture (or opening) half-angles of 2.5° for all new instrument designs, equivalent to solid angle

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apertures of 6 msr.

-7699, 15: The term circumsolar contribution is defined as a specific parameter in Blanc et al 2014 and Wilbert, 2014. Please do not use the term for something else.

-7700, 7: Comment to “not further specified”. The modifications of SMARTS are small and described in Wilbert et al., 2013: “The modifications of the SMARTS code allow the usage of user-defined values for the single scattering albedo, the asymmetry factor and Angström’s wavelength exponents aAng,1 and aAng,2 together with the selection of a phase function model.” More information on the processing is also published in Wilbert, 2014.

-7700, 7: Please also mention that the method applies further modelling with the diffraction approximation for sunshapes measured when clouds mask the sun.

-7701, 19: \xi is not the scattering angle, but the angular distance of the given point in the sky to the center of the sun.

-7703, 7: Please mention that more data is available now.

-7706, 16: The data from the aureole camera close to the disk is not useable because of artifacts in the signal that are caused by the roughness of the screen (see Wilbert et al. 2013). This is not noise. Also the angular limit that you use is for the 300 series of the instrument and not for the 400 series. The screen of this 400 series is different from that of the 300 series.

-*7706, 22: The angles in the h files are the distance from the center of the sun. This is quite different from the angles in an almucantar file which are azimuthal deviations (see Tonna et al., 1995).

-7706, 26. Please clarify that the SAM OD file contains the particle optical depth, not the AOD. Explain that you can use this particle OD as AOD for clear sky cases which you filter out as explained in the following.

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-7707 –7708 points 1 and 3 to 5: These criteria are not quality criteria. Hence, the list should first of all have a different name, e.g. sort out criteria. Points 3-5 help to remove measurements during cloud passages. However, when clouds are present such measurement might be perfectly correct. Point 5 furthermore restricts your dataset to specific aerosol conditions. It is difficult to quantify how strict your criterion is. However, it is possible that two very different slopes occur in a sunshape if a particle mixture with particles of different sizes is present. Please discuss the effect of these sort out criteria.

-*7708, 19: Please describe in more detail how you derived the SAM radiances for the Aeronet radiances. This could clarify the deviation of the results from Fig. 1 on the one hand and and Fig. 6 and Wilbert, 2014 on the other hand.

-7709, 4: Please add the distance between the two instruments for both positions of the SAM.

-7709, 5: Here you should also discuss the calibration results from Wilbert, 2014.

-*7709, 5: Please explain which data set you used in more detail.

-**7710, 2. Why should one perform a correction of the AOD as a linear fit in AOD? Calibration errors affect the irradiance and are hence not linear in vertical column AOD.

-**7710, 9: Change "is due to the field of view" to "is partially due to the field of view". You do not at all investigate other effects that might cause errors of both AOD data. Calibration errors are typically the most important ones and hence a comparison should be based on irradiance. Another interesting aspect is that errors due to circumsolar radiation would be higher for high slant AODs. It is not completely straight forward to see in your graph, but I see the highest overestimation for low AOD <0.2. This indicates that your conclusion is wrong. Please add a discussion of other errors or remove the section on the AOD comparison as this is irrelevant for your RTM validations. The SAM OD is not relevant for the SAM's aureole measurements.

-7711, 16. Clarify if DS1 is the dataset with the AOD "correction".

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-7712, 10. Here would be a place to discuss the differences between your version of libradtran and the one used by Reinhardt, 2013. Also, Reinhardt, 2013 and Reinhardt et al 2014 should be discussed in more detail in the introduction and/or the theoretical back ground.

-7715, 17 – 21: Clarify that you only describe other options that are available in libRadtran.

-7716, 18. Do you derive the AOD from the Angström coefficients and AOD at 670nm? If you apply the “correction” from Eq. 10 to the AOD for 500nm this is not ok. Or did you apply your correction to the AOD at 670nm and then applied the Angström coefficients? In the latter case the AOD you specify in SMARTS and libradtran at 670nm is the same and your discussion (7717, 23) doesn’t make sense to me.

-7717, 18: Here, in table 1 and in figures 4 and 5 you should specify the bias with one digit after the comma. Otherwise it is hard to follow your discussion between the two biases of 1%.

-7718, 5: The SAM’s window was exchanged in November 2012 (see Wilbert, 2014).

-7718, 21. No. You can also specify AOD at 1000nm, meteorological range and prevailing visibility.

-*7719, 22. No. The angles in the almucantar files are azimuthal deviations from the solar position. Hence, 3° at solar zenith angle of 40° results in an angular distance of 1.9° from the center of the sun. (see Tonna et al., 1995).

-7719, 25. Discuss the change of SAM’s entrance window

-*7719, 20 The accuracy of the manufacturer’s aureole calibration must appear much earlier in the discussion.

-7721, 21. It seems to be exaggerated to call your sort out a quality check as only one of the tests is a quality check.

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-**7721, 24-26: The conclusion concerning the sun photometers field of view is wrong.

-7722, 8: Discuss that your next step would be to apply the model to broadband clear sky data. Then the work must be extended to all sky conditions e.g. following the approach by Reinhardt, 2013, and Reinhardt et al. 2014.

-7722, 8: Furthermore, it should be noted that you did not investigate at all what happens in the region from the solar disk angle to 0.62°. So your conclusions must always be given stating the angular restriction. Here, your argument about extrapolation of the Aeronet data for the derivation of the phase functions to small scattering angles has to be included in the discussion.

-7729: Figure 1: The part of the dataset from Figure 6 that overlaps with Almucantars should be shown in the same way as Figure 1.

-7733: Did you use Desert_Max or the User option for the graph?

Technical corrections

-7700, 3: (state the date of last visit)

-7700, 17: New line after CSNI.

-7703, 9: Change AOD -> vertical column AOD to avoid confusion.

-7704, 12: changes: between 8% and -> from 8% to; 491 from -> 491 of

-7704, 14: Add full stop after 2012.

-7704, 16: add “a” between offer and statistically

-7704, 17 - 19: Change: If an atmosphere containing aerosols only is assumed, Eq. (4) becomes “EQ 6” since the aerosol optical properties contributes the most to the radiance for clear sky conditions (Dubovik and King, 2000)

-7709, 25 & 27: Replace accuracy with uncertainty

-7713, 6: change final CSNI to "finally investigated CSNI"

-7735: Use different plot method to increase readability.

References

R. Reinhardt. 2013. On the retrieval of circumsolar radiation from satellite observations and weather model output. PhD thesis, LMU München.

Reinhardt, B., R. Buras, L. Bugliaro, S. Wilbert, and B. Mayer. 2014. "Determination of circumsolar radiation from Meteosat Second Generation." Atmos. Meas. Tech. no. 7 (3):823-838. doi: 10.5194/amt-7-823-2014.

G. Tonna, T. Nakajima, and R. Rao. Aerosol features retrieved from solar aureole data: a simulation study concerning a turbid atmosphere. Applied Optics, 34(21):4486{4499, 1995.

S. Wilbert. 2014. Determination of Circumsolar Radiation and its Effect on Concentrating Solar Power. PhD thesis, Fakultät für Maschinenwesen, Rheinisch-Westfälische Technische Hochschule Aachen, DLR.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 7697, 2015.