Manuscript title: "Can AERONET data be used to accurately model the monochromatic beam and circumsolar irradiances under cloud-free conditions in desert environment?"
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OVERALL COMMENTS

This manuscript presents a detailed analysis comparing simulated direct beam irradiances and circumsolar irradiances with corresponding measurements using the SAM instrument. AERONET data are also used, both for comparing with SAM and as a source of radiative properties of aerosols used as input to radiative transfer models. This is an interesting topic and the manuscript is mostly clearly written. However, it seems to me that the authors do not discuss in proper detail the various sources of uncertainties that influence their analysis. In particular, the conclusion that AERONET underestimates the AOD because of its field-of-view is too strong, in my opinion. Thus, I find that the manuscript could be suitable for publication in AMT after important improvements.

Areas that need to be improved

1. The manuscript would need to consider and discuss all sources of uncertainty in SAM, AERONET, and radiative transfer model results. This is an overarching item that connects to many parts of the manuscript. I try to give some examples below.
    a. Eq. 1 is true from a radiative transfer theory point of view, but does not agree with the definitions of DNI and DNI_S given in the Introduction. In RT theory, the direct radiation is usually defined as radiation originating from the Sun that has neither been scattered nor absorbed. In DNI measurements (as defined in the Introduction), the DNI will always contain a component of forward scattered radiation even for an instrument with sufficiently narrow field-of-view.
    b. The effect of forward scattered radiation on AERONET AOD has been discussed in a paper by Sinyuk et al. (GRL, L23806, 2012; perhaps also elsewhere).
    c. From eq. 1, it is clear that even a small systematic difference (error) in E_0 will have an effect on the analysis presented. This is not discussed in the manuscript. How well is E_0 known? Is the same E_0 used in radiative transfer models and in AERONET and SAM aerosol retrievals?
    d. P7706, L10-12: SAM circumsolar radiances are accurate to ~5 to 15%. This uncertainty is mentioned here, but thereafter it is given little emphasis. What exactly does it mean that the relative error is, e.g., 15%? If SAM circumsolar radiances have a systematic bias of 15%, then that would more or less explain the difference seen in Fig. 6. This brings to my mind a major challenge of this manuscript: when comparing data from various sources, which all have their uncertainty, how can one know what

the truth is? For example, why do the authors choose to correct AERONET data using SAM as a reference, what are the scientific evidence saying that SAM is truly better?

e. Modeling circumsolar irradiances using libradtran may require extra efforts. The paper by Reinhardt et al. (AMT, doi:10.5194/amt-7-823-2014), including authors from the libradtran team, chooses to use Monte Carlo simulations for simulating the circumsolar radiances. This could be a better approach than the one chosen in the present manuscript. The reason for this is: If I understand correctly, it becomes difficult to realistically calculate the circumsolar irradiance (i.e., integrate over the chosen solid angle) when choosing the disort solver with 16 streams. With 16 streams, there are 8 discrete streams (directions) in the downwelling hemisphere. How can one get a realistic value for the integrated circumsolar irradiance (narrow solid angle) from only 8 streams? (note that the same problem exists still for 32 streams)
f. Modeling circumsolar irradiances: the actual surface pressure is not taken into account. How big influence could that have on your calculations?
g. P7719, L19-23: The fact that AERONET measurements are only made for angles larger than 3 degrees, although the phase function is reported also for the very forward directions is interesting. It means, in practice, that AERONET somehow (how?) determines the phase function also for the angles that are not measured. Considering how closely this manuscript is looking into the small differences between SAM and RTM/AERONET, I think this fact could be given some more emphasis (or be said more clearly) in the manuscript.

2. Minor comments/suggestions
    a. P7700, L22-25: Would be interesting to have a number (order of magnitude) on how significant/important it is to have both CSNI and DNI_S
    b. P7703, L6: How close by are the two instruments?
    c. P7704, L17-18: aerosols contribute most when no clouds are present
    d. P7709, L24-: I agree with the other reviewer. It seems unclear why data pairs having a difference larger than 0.03 should be removed.