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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Calibrated sky imager for aerosol optical properties determination" *by* A. Cazorla et al.

Anonymous Referee #3

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Reviewer #3 Comments on the paper "Calibrated sky imager for aerosol optical properties determination" by Cazorla et al.

This paper describes a methodology using neural network analyses for inferring aerosol optical depth (AOD) and Angstrom coefficient estimations from Whole Sky Imager (WSI) data. The justification given is the augmentation of available surface-based aerosol retrievals, which is a reasonable proposal should WSI data be available. The neural network methodology is fairly well described and compared with collocated retrievals from CIMEL sun photometer data at one site.

General Comment:

There are several weaknesses with respect to this paper. One such weakness is that

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despite several other aerosol retrievals using other collocated instruments at the ARM Southern Great Plains (SGP) central facility site, none of these are taken advantage of for comparison. Another weakness is the lack of detail with respect to the WSI radiance and cloud screening uncertainties, as well as an adequate definition of "cloudless" for data used in aerosol property determinations. Altogether, this paper seems more of a preliminary study that is not quite ready for peer reviewed publication, needing significant additional work before it is acceptable. Therefore I recommend that it be rejected at this time. But a good start nonetheless.

Specific comments:

1) Page 19991, line 21: Temporal resolution might indeed be a problem for AERONET; this is by design of the network operational paradigm. However, there are other networks and instruments that are not so restricted. For instance the ARM program, and the NOAA/ESRL Global Monitoring and SURFRAD networks, use MultiFilter Rotating Shadowband Radiometers to infer AOD, sampling every 15 to 20 seconds during daylight hours which is by far greater temporal resolution than the WSI has. So the wording needs to be changed here so that it does not imply that ALL AOD networks suffer temporal resolution problems, just the AERONET data the authors chose for this study.

2) Page 19991, line 22: Not only the CIMEL, but all sun-based AOD retrievals require the sun not be obscured by clouds, including the WSI retrievals. Thus cloud screening is necessary for all types of AOD retrievals. One thing missing in this paper is some description of how well the WSI cloud screening does. This of course also requires some definition of how much condensed water (haze, sub-visual cirrus, etc.) is allowed under the "cloudless" category. But I personally know that WSI cloud detection is not perfect, and that some amount of "whiteness" in the blue parts of the sky is allowed under the "cloudless" classification, as inspection of WSI images and cloud decision images from the ARM Archive easily show. How does the WSI cloud/cloudless detection limit match the cloud-free screening used by AERONET?

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3) Page 19991, line 26: This sentence references 3 papers by Shields et al., none of which are peer reviewed publications. In fact, this paper has a total of 15 references for more detailed information about the WSI none of which are peer reviewed. These references are for 6 papers (2 by Johnson et al. and 4 by Shields et al.) of which 2 appear to be internal Scripps technical reports, and the rest conference abstracts with one of those appearing to be some military conference. These references are generally used in the paper in lieu of more detailed information about the WSI, its design, performance, calibration, and operation all of which are necessary information if one is to better understand the results presented here. How does a reader go about acquiring one of the internal Scripps technical reports? Conference proceedings are not always readily available. There is a problem here. As the paper states: "This (Scripps) group has been researching and developing sky imagers for decades..." In all those decades, has not one single peer-reviewed paper been published on the WSI that could be referenced? If not, why not? Peer review is the science community's means of to some extent ensuring scientifically reasonable publications that include enough detail to substantiate the papers content.

This is the problem. In section 2.3, line 5 is the sentence: "The instrument follows a process to get the radiance and geometric calibration (Shields et al., 1998b)." This sentence is the total content of this paper concerning the calibration of the WSI data used. I have a copy of the Shields et al. AMS conference abstract in which only broad generic statements are made in its "Calibrated Sky Radiance" section on seven different aspects of the WSI system that need to be addressed in order to produce "calibrated radiances" from the system. And in only one of those aspects is any numerical value given, a claim of 0.5% consistency in lamp calibration procedures (note that this is this particular calibration process precision, not accuracy since reference lamps themselves are well known to have accuracies no better than 2%). Additionally, the conference paper is very skimpy on any details regarding the "process" used. So this Shields et al. conference proceedings lists the things that need to be characterized, but does not actually give the methodology employed to characterize the instrument,

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nor results of how well the WSI can be characterized for these characteristics. This is fine for a conference paper, but had this paper been submitted for peer review I have no doubt that the reviewers would have demanded that actual uncertainty estimations and adequate description of the process be included. If that were the case, then referencing the peer-reviewed paper for the information on uncertainties would be justifiable. But in this case not only does the paper referenced not adequately include the information, but the wording of the sentence in this paper is misleading because it implies that adequate information is available in the conference paper thus no further information is needed in this paper, which is false.

While in more recent years more publications are allowing conference proceedings and technical reports to be used as references, there are still some "rules" effectively employed. For instance if a conference abstract is referenced that included some more recent results with respect to something that has already used a peer-reviewed reference in the paper. Or a technical report that includes more detailed related information than a referenced peer-reviewed paper does. But in both instances the non-peer-reviewed reference is in SUPPORT of a peer-reviewed reference used in the paper. And the number of non-reviewed references should certainly be much fewer in number than the number of peer-reviewed references on the subject. But to have 15 references with not one relevant peer reviewed reference is unacceptable, especially when investigation reveals that the conference proceeding referenced does not actually contain the information implied in the context of the referring paper as is the case here.

Thus in my opinion the authors of this paper need to either include adequate description of the WSI design, operation, and measurement uncertainties of the various characteristics relevant to the retrievals described, or reference at least one peer-reviewed paper in which all of this needed information is adequately presented. And in the process, remove these 15 references to non-peer-reviewed papers.

4) Page 19993: I am puzzled. The ARM SGP CF has at least four instrument systems that I know of that can retrieve column aerosol information: the CIMEL used here, two

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MFRSRs, a high spectral resolution Rotating Shadowband Radiometer (RSS), and a Raman Lidar. Yet the authors have chosen to restrict themselves to using only CIMEL data, which they themselves note has more temporal resolution limitations than any of the other instruments. Including these other sources of aerosol information would presumably significantly increase the number of collocated data available for use in these analyses. Additionally, comparison would help verify and constrain the CIMEL operational uncertainties instead of having to rely only on the AERONET published uncertainty estimates. Why not use them?

5) Page 19995, line 6: Here ends the (inadequate) description of the WSI instrument and data characteristics, as noted above. In the introduction a comment is included that for the AERONET data "temporal resolution remains a problem." Besides there being several other sources of AOD and Angstrom coefficient retrievals with much better temporal resolution than the AERONET data, I can find no mention of what the WSI data resolution is. I seem to recall that a set of sky images is recorded every 10 minutes? But the various filters are mounted on a rotating wheel that takes some time to step through the various filters, so that as a set the several spectral wavelength images are not "acquired simultaneously" as stated here, but rather over several minutes.

6) Page 19995, line 26: The authors state that they screened out (eliminated) all WSI data for cases that included clouds. Again, it needs to be shown what atmospheric conditions remained in the used data set with respect to condensed water loading. How well do these cloud-free occurrences agree with the AERONET cloud screening?

7) Page 19998, line 25: Why not test this using the ARM SGP RSS data? That way there would be no need for wavelength interpolation since the RSS spectral range and resolution provides measurements for all these spectral channels.

8) Page 20001, line 3: define how "RMSD" and "MBD" are calculated.

9) Page 20005, line 2: There is no need to speculate that this technique is location independent. The ARM Program had WSIs and MFRSR at all their central facility sites

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including Nauru, Manus, and Darwin in the tropics, at the North Slope of Alaska site. The Nauru site also has a Cimel sun photometer. Thus the data are readily available for the authors to test this hypothesis rather than relying on speculation.

10) Page 20005: The authors note the temporal resolution limitations of AERONET, and then describe using only WSI-determined times of hemispherically cloudless skies. Certainly the occurrence of hemispherically cloud-free conditions is far less than the AERONET temporal limitations. Yet it is unclear whether the WSI retrievals are possible under partly cloudy skies, or whether if so what additional uncertainty might arise. If these WSI retrievals are possible under partly cloudy skies, as certainly other sun photometer and MFRSR retrievals are, then a separate comparison of WSI retrievals versus others under partly cloudy skies is needed. In order for the reader to make a decision on whether to invest in the work associated with training a WSI for AOD retrievals, this paper must include some estimation by the authors of how often they reckon these WSI retrievals might be possible compared to the AERONET and other instrument retrievals.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 19989, 2008.