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Atmospheric Measurement Techniques Discussions

Interactive comment on "A hybrid method for reconstructing the historical evolution of aerosol optical depth from sunshine duration measurements" *by* W. Wandji Nyamsi et al.

Anonymous Referee #1

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Review of "A hybrid method for reconstructing the historical evolution of aerosol optical depth from sunshine duration measurements"

Information of long term series of atmospheric data is an essential task in order to understand various processes going back to more than 20-30 years. Aerosol optical depth investigated here, is a parameter that for surface based measurements is not available before the early 1990's. So the motivation of the paper to use SD mainly and other data in order to retrieve AOD in the past is solid and the results valuable for the atmospheric community.

As the authors quote, this is not the first paper approaching this issue (AOD retrieval)

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Discussion paper

using SD data, however a new and other methods are compared here.

My point of view is that there are two major aspects that are not mentioned in this work and without addressing them the work limits its credibility.

The first one is the uncertainty estimation. This is a difficult task but in order for the AOD data that will be calculated from past SD data to be useful, authors have to provide an uncertainty estimation. There are a lot of aspects linked with this uncertainty that have to do with:

- The input data.

There are various technical aspects mentioned and referring the Sanchez – Lorenzo work but the effect is not quantified. In addition to them, the use of daily information increases the uncertainty related with the presence of clouds. Datasets that were used for cloud cover assessment include various uncertainties, the simplest one being that their temporal resolution within one day can not ensure for the 100%-non presence of clouds.

- With the method itself

This is addressed but not quantified through the aeronet based comparison. Temporal issues from the use of daily data too.

The second one already mentioned partly, is the role of clouds.

a. Cirrus clouds. Cirrus clouds optical thickness (or depth) is in the same magnitude as the one of aerosols. In a number of cases they can be practically invisible and their effect on the SD measurements can not be distinguished with the one of the aerosols. In the case that instruments like sky cameras or human observations are used, the problem can be partly solved. However, data series going back to the past include mostly or only observations, commonly with a temporal resolution of the order of hours. Moreover, for meteorological station observers it is evident that SD measurements are not affected by partly visible or invisible cirrus clouds.

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b. Clouds. During the course of the day the presence of clouds will have an effect on the SD duration data. Daily mean cloud cover used here from ECA & D is defined "Daily mean cloud cover: Whenever synoptical cloud cover data is available at 00, 06, 12 and/or 18 UT, mean daily cloud cover is calculated as the average of the available values." So CCT $\sim$0 is only an average of 4 measurements during the day. In addition, WMO has defined the SDF>0.7 for a cloudless condition threashold but of course for Aerosols where in most of the cases, the solar attenuation is well within those limits, the threashold serves eliminating only part of the number of cases that can introduce a cloud related uncertainty to the method application.

Moreover, AERONET related comparisons does not include most of cirrus related and all of thicker clouds cases as these are algorithmically eliminated from aeronet retrievals.

Summarizing, the presence of clouds in some part of the day (with SDF>0.7) can be comparable to the aerosol effect. This causes a small but systematic overestimation of the effect of aerosols in DNI measurements when applying any method based on radiative transfer modeling (where clouds are set to zero) to past series. In addition, periods in the past with changes in cirrus clouds (or increased partly cloudiness) could be wrongfully characterized based in this method, as high aerosol periods.

Minor comments

Page 2 L15 AERONET has the denser network but looking at the site I can see only four stations with data series more than 15 years. Probably WMO-GAW network or Skynet network can be mentioned too.

15 line 15 Ångström

Why is the effective wavelength in BAOD close to AOD at 750 nm ?

How can anyone trust Merra data for small to moderate aerosol changes in the past when Pinatubo and El Chichon are not visible in the dataset ?

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