Anonymous Referee #1
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Reviewer:

This paper compares aerosol optical depth values between AERONET and the MATCH/DLR model on daily and hourly time series. The topic is relevant to the solar industry, as is well discussed and motivated in the text, and also of interest to the aerosol community. I should be published in ACP.

I made a number of remarks regarding the presentation during the initial stage of the review, and am happy to see that most of my concerns have been adressed in the present manuscript.

As it stands, I have only one specific comments to the analysis itself, which is mostly straightforward and interesting.The authors wish to validate the performance of a particular model against a data set. This is fine. They explicitly state that the aim of the paper is not to improve modeling, which is also fair although some steps towards improvements (i.e. sensitivity tests to some of the datasets used in the model, could data, optical parameters etc.?) would have strengthened the paper.

Answer:

Certainly this would be a major step forward. Nevertheless, we see our role as users of such aerosol data and models and not as developers. Therefore, we set up a diagnosis scheme for the final outcome of AOD, but any further analysis would need a much deeper understanding of model internal matters (both scientific and technical) which are at least partly outside of our expertise.

We prefer to collaborate with the model developers originally located at NCAR, US in the case of the MATCH model (now at other universities/institutions) and additionally, also with the European ECMWF GMES MACC aerosol model development team. We continuously assess new model versions developed by these groups with the help of our diagnosis suite set up for the hourly/daily temporal resolution. This is a fruitful cooperation – we assume that it will result in model improvements in the upcoming years. A first step on requirement quantification from the solar sector has been made in ‘Aerosols for concentrating solar electricity production forecasts: requirement quantification and ECMWF/MACC aerosol forecast assessment’ (Bulletin of the American Meteorological Society 2012; doi: http://dx.doi.org/10.1175/BAMS-D-11-00259). Another activity on comparing several experimental ECMWF runs within the European MACC project is currently ongoing.

Reviewer:

But they then introduce a correction for "suspicious" dust events, apply it to the model data, and conclude that they see a slight increase in preformance. This correction - which in a sense is indeed an attempt at a model improvement - needs furter discussion if it is to be kept in the paper.

Answer:

Well, we’d rather not call it model improvement. It is an empirical post-processing in order to reduce outliers acting as a ‘quick help for the solar sector’. Any model improvement should happen in the internals of the model and not as a post-processing.

In order to make the dataset useful for our purpose, we have applied this correction and believe that it is justified. We have shown a positive impact in the dust emission regions and that the correction does not harm in other regions in the clear-sky cases. We certainly do not help in cloud-aerosol interaction cases as we replace those by close-to-background values.

Please have in mind that the dataset is already in use in the solar resource databases and applied especially in areas affected by dust and for the derivation of direct irradiance time series for concentrating solar power. This paper will act as the reference for this and

therefore, it is needed to describe this step. We can't simply wait on the user's side for an update of the model and a better data set. We certainly hope on better models in the future and help in the development through our collaborations. But concentrating solar power plants are currently being built and need the available data in a well described manner and best-of-known-quality already now.

Reviewer:

I agree from the plots and discusson shown that these events need to be treated in the analysis, but I am missing a deeper discussion of what it is the authors are removing. The authors state on p31927, that the physical reasoning is beyond the scope of the paper, but as one of the main conclusions rests on this post processing I think this needs further discussion. As I understand it, the suspicious dust events occur in the model and coincide with times where the AERONET stations mostly have no data. (p 31926, l6-7). Wouldn't this mean that there is also no data for a comparison? If so, how does setting the model AOD down to a background level (which is what the correction does) end up improving the RMSEs and biases? It's likely that this has an obvious answer, but I would wish for further discussion of these points.

Answer:

Yes, mostly these removed events cannot be investigated with the help of AERONET – partly because those events are cloudy, but partly also due to the tendency in AERONET data to flag strong dust cases as clouds. But the remaining data – mainly after the dust event in cloud free conditions – show that there is often too much dust load in the atmosphere after such an event. This supports the hypothesis that the dust peaks are too high.

Now it's the question on how to correct such values. For solar applications it is mainly important to correct the cloud-free values after a dust event. In cloudy cases the solar irradiance is zero anyhow – independent on the accurate dust aerosol load. And as long as we have no further physical understanding we prefer to use the simplest correction possible. This is a linear interpolation between values before and after the event. We are aware that by this the existence of a cloud-aerosol-interaction resulting in a dust event is neglected and replaced by a low aerosol or even background condition. We do not believe that this is the optimum correction for the dust event itself – probably the existence of the dust event is modeled correctly, but with too high values. But for the situation after the clouds and therefore after the dust-creating event this simple scheme is the best we can do at the moment.

Action taken:

We already stated in section 3 that 'there are some cases with existing AERONET observations supporting the hypothesis of the MATCH/DLR overestimation in strong dust events - Fig. 2 and 3 provide examples for the stations Lampedusa and Forth Crete. Also, AERONET measurements in cloud-free conditions after such events indicate that the dust load is too high.' This answers the question of 'no data available for a comparison'.

Overall, we follow the recommendation to discuss the correction (replacement of peaks by background conditions) and its restrictions further:

We add a sentence in the AERONET describing section 2.2 about the clear-sky availability of AERONET data and why this is especially helpful in our case of the solar sector being interested only in the AOD in clear-sky conditions.

We add some rationale on the aim of this correction, its suitability for the solar sector and its restrictions for the aerosol sector in the section describing the correction, the validation and in the final conclusions. This may serve as a warning to the reader that this correction is not justified e.g. for aerosol research.

Reviewer:

So to summarize this comment: I would either remove the dust correction, as I believe the paper is actually interesting without it, or go into further detail about what it removes and what it does to the dataset. I believe anyone aiming to use your results will be concerned about this factor as the manuscript presently stands.

Technical comment:

- Figure 1 is very hard to read, as it has both small numbers for the stations and some weak colors (esp. pink and light blue). I would recommend changing to clearer colors throughut the figures.

Answer:

It is impossible to illustrate all stations in a single map – especially as we have many stations in a small area of the United Arab Emirates or in some locations in France. Therefore, the size of numbers has been chosen as a compromise. Our rationale is, that for the assessment of this work it is needed to differentiate regions, but not all individual stations. Therefore, in most plots the numbers of the individual stations have been omitted anyhow.

We don't fully understand what 'clear colors' mean. We need six different colors – the primary colors (often referred to as being 'clear') red, yellow, and blue are not enough, besides the fact that yellow is rather difficult to read on white backgrounds. Therefore, we have used the secondary colors orange, violet and green together with primary colors red and blue. In order to discriminate e.g. red from orange we have chosen a dark red instead of the typical primary color red. We use different symbols in some figures to mark different datasets – therefore, symbols are not appropriate to add variety in our case. Overall, we think that the colors are suitable to be discriminated.