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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assessment of the Level-3 MODIS daily aerosol optical depth in the context of surface solar radiation and numerical weather modeling" *by* J. A. Ruiz-Arias et al.

Anonymous Referee #2

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Background

The authors present evaluation results of Level-3 (L3) MODIS AOD at 550 nm from the Terra satellite over land and ocean for the period Feb. 2000 to Dec. 2011. For ground truth they use the daily AOD observations from the AERONET station network. The objective of the study is to investigate the suitability of the data for surface solar radiation calculations in numerical weather or radiative transfer models.

It was found that the L3 AOD dataset over-estimates the observations by 17%, with a RMSE of 73% and a squared Pearson correlation coefficient of 67%. On a regional basis (using 15 distinct geographical regions), the MBE varies between 2% (eastern

Asia) and 76% (western North America). In parts of northern and southern Africa and Asia, the L3 AOD is too low, whereas too large values are found over central Asia, Middle East and western North America.

The regional RMSE is always larger than 50%, with specially high values for western North America (151%), South America (123%), central Asia (82%) and Australia (88%). The aggregation from L2 AOD to L3 AOD increases the Expected Error (EE) for AODs greater than about 0.3, which approximately correspond to 20% of the highest values. For the remaining 80%, the L2 AOD EE and the L3 AOD EE are very similar. A quadratic function is proposed for the description of the L3 AOD EE, in lieu of the conventional linear function used for the L2 MODIS EE. EE provides an estimate of the MODIS AOD uncertainty in terms of the AOD determined from ground truth.

Using a radiative transfer model he authors quantify the uncertainty in the predicted DNI due to aerosols as available from the L3 product. It was found that the induced uncertainty in DNI is smaller than 15% for AOD values below 0.5 and a solar zenith angle of 30. Under this same condition, the relative uncertainty induced in GHI is always below 5%. They conclude that in spite of the induced uncertainty in the Direct Normal Irradiance (DNI), the daily L3 AOD dataset is valuable because it induces a correct daily variability in DNI, which is important in solar energy applications.

General Comments

Seems, that the problem the authors deal with is not well posed. They use the term “error” not in a conventional way. They point out that “most of the validation efforts so far have focused on Level-2 products (10-km)”. Validation of a product is usually attempted at scales that match in time and space the parameters that are being compared. Such match seems to be better at Level-2. The lack of agreement between the AERONET value and 1 deg box average is not an “error”; they should be different. In order to estimate the error in the larger grid there is a need to sample the AOD at several locations in the 1 deg box to establish to what extent the satellite estimates represents

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the ground observations. As such, what was done is not a “validation” of the Level-3 product but something else. Needs to be clarified.

The “errors” in the aerosol optical depth seem to be quite high (“Overall, the mean error of the dataset is 0.03 (17%, relative to the mean ground-observed AOD), with a root mean square error of 0.14 (73%, relative to the same)”. Yet, the authors claim that the Level 3 product is very useful. Raises questions as to the needed accuracy in estimating the AOD in order for it to be ustll useful for certain objectives. Perhaps, it would be more informative if the authors presented information on error limits that would still produce acceptable values for DNI.

Specific Comments

1. Listed are 4 affiliations:

4 Solar Consulting Services, Colebrook, New Hampshire.

No author seems to be associated with (4).

2. Abstract. The Level-3 MODIS aerosol optical depth (AOD) product offers interesting features for surface solar radiation and numerical weather modeling applications.

Instead of “features” a different word needs to be used.

3. In section “Motivations and objectives” stated:

We will focus here only on AOD because it is the most important aerosol optical property driving solar extinction, and thus the incident surface shortwave irradiance.

This is not always so. Aerosol absorbing properties also play an important role.

4. The Abstract is too long and needs to be of a general nature; no need for detailed results.

5. The opening statement of the Abstract should tell the reader first briefly what the Level-3 MODIS data are.

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6. It is stated: “Consequently, we propose new functions for the expected error of the Level-3 AOD, as well as for both its mean error and its standard deviation”. Again, this is not a measure of error. Possibly, this value represents the area average better than the single AERONET site.

In summary, the issues addressed in this study are relevant. After minor revisions, the manuscript can be published,

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