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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An AeroCom/AeroSat study: Intercomparison of Satellite AOD Datasets for Aerosol Model Evaluation" *by* Nick Schutgens et al.

Anonymous Referee #2

Received and published: 19 June 2020

This manuscript provides an evaluation and intercomparison of 14 different satellite AOD products, based on 9 different retrieval algorithm families using observations from 5 different sensors on 6 different platforms. The 14 satellite products include retrievals from MODIS (Terra/Aqua), AATSR (ENVISATE), AVHRR (NOAA18), SeaWiFS (SeaStar) and OMI (Aura). The validation is made with AERONET and MAN data for 2006, 2008 and 2010 three years on daily and multi-year time scales. With the increased numbers of available satellite AOD products in the past two decades, there is a need for users to know uncertainties of these products and how they intercompare using a same evaluation method. This research provides such very needed information. Besides basic verification statistics (bias, correlation, RMSE), the authors also

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discuss spatial and temporal sampling impacts on verification results. One of their findings is that the diversity among these products may be used as an indication of AOD uncertainty for the better performing satellite products. This would be potentially useful for satellite AOD applications, e.g, AeroCOM model verifications over areas without AERONET measurement. Overall the manuscript is well organized and statistical analysis is nicely carried out.

I had a chance to read the other review comment, and I am in general agreement with the comments there. I strongly agree that there could be brief descriptions for each individual AOD algorithms, and how each one of them treats clouds and surface. This information could be put in an appendix. As "Up to 50% of the difference between satellite AOD is attributed to cloud contamination", knowing how each individual algorithm treats clouds is very important to help understand the AOD differences. On page 9 line 8-9 "In contrast, it is hard to use other factors determine spatial coverage (sun-glint, surface albedo, failed retrievals) to explain this."("this" here means impact of spatial coverage upon evaluation result) The authors look only at global scale. However it is expected that the importance of surface albedo may show up in some regions, e.g., mountainous regions. So it may be worth some regional analysis on the impact of spatial coverage upon evaluation result. In addition, the detailed analysis is acknowledged, however a total number of 30 for figures is relatively high. Authors could consider moving some figures into supplement, and making the most important results stand out in the manuscript.

Some minor points are listed below:

It is noted that the author has his own writing style, which is fluent, however, not necessarily formal. For example, the second sentence on Page 13 line 15, starts with "E.g." which should be "For example. . .." And there are many more places which are not listed in this review. I would leave to the editor if minor English editing is required.

P1 Line 10: It is confusing what "spatial coverage" means here. Please be specific.

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P2 Line 25: “AOD (Aerosol Optical Depth)” should be “Aerosol Optical Depth (AOD)”, ie., full expression first, and abbreviation next. Same thing for Line 28, MODIS, MISR abbreviations, and AERONET.

P3 Line 8, please define “super-observation”.

P4 line 27-28 this sentence reads awkward.

P6 Line 18-19, I don’t think this averaging over all sites of their bias and correlation is a novel error metric.

P23 Table 1, Under “Spatial” resolution column , there is a “?” for Kinne (2009), which needs to be fulfilled.

Table 2, It would be nice to provide information about time span of each product.

Figure 5. There seem to be missing panels based on the figure caption. The figure only shows evaluation result with collocated AERONET observation within 3hours, but result with AERONET observation within 1hour is also expected.

Figure 8. Colors representing different satellite products overlap each other. For about half of the satellite products, it is impossible to see their presence. Please think of different plotting method (e.g., making hatching less dense, with different patterns„ smaller area on top of larger area) so that large area does not totally cover smaller areas, etc,) to make all the products visually identifiable.

P10 Line 10 To be consistent with the rest of the manuscript, remove “FMI” in “AATSR-FMI-ADV”.

Figure 24. This figure gives the ratio of difference between satellite AOD products for spatial coverage at 90-100% to 0-10%, which corresponds to approximately 0-10% to 90-100% cloud coverage if cloud is considered the largest impactor for the AOD spatial coverage. It would be nice to break up into a few similar panels, e.g, similar subplots with relatively low, median and high spatial coverages, e.g. around 10%, 30% , 50%,

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70%, 90%. This information would be useful for AOD data assimilation users, as cloud fraction is one of the used information (as threshold) of AOD data to generate DA-quality product for aerosol DA. This would give some guidance on what could fraction is reasonable to obtain AOD consistency among multiple satellite products in AOD DA efforts.

Figure 27. What do the contours over north Africa, Arabian Peninsula and Siberia represent? This is explained in the text, but it would be nice to describe in the figure caption also.

Page 13 Line 8, “de average. . .” typo?

Figure 30 caption, typo “diveisity”

Page 14, Line 19. Summary section, “. . .. . ..MISR because the product was in the middle of an update cycle, and VIRRS because it was only launched in 2011.” I understand the meaning of this sentence, but formal English is preferred as this is for publication. Also I believe there is a typo for VIIRS.

Page 14, line 20. “For MODIS and AATSR, four resp. three different retrieval algorithms were used”. See comment above.

Page15, Line 31, “patters”, typo.

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