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Atmospheric Measurement Techniques Discussions

Interactive comment on "An over-land aerosol optical depth data set for data assimilation by filtering, correction, and aggregation of MODIS Collection 5 optical depth retrievals" *by* E. J. Hyer et al.

Anonymous Referee #1

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1. This is a very ambitious paper that develops corrections to the MODIS AOD product relative to AERONET over land, with the aim of providing better correlation with the sun photometer observations. This approach offers a good, practical way to produce an "assimilation quality" global satellite AOD product. This study is very carefully done, and demonstrates good understanding of the products used. It represents an important contribution to the literature.

2. You might comment on how this approach compares with "neural net" methods

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(e.g., Radosavljevic et al., IEEE Geosci. Remt. Sens. Lett., 2010), which match the MODIS radiances directly to AERONET, completely avoiding any physical basis for the retrieval, but achieving very high correlation with the "ground truth" data.

3. The title might be: "... assimilation by filtering, correcting, and aggregating MODIS Collection 5..."

4. Introduction, paragraph 5, lines 2-3. I think you could make a case that MODIS represents the state-of-the-art for global aerosol optical depth, but I don't think that would be true for aerosol properties (which usually mean intensive properties). Same comment for Section 2.1, line 2. Over land, MODIS assumes aerosol properties, based on an AERONET-derived seasonal/regional climatology.

5. Figure A1. I think I know what it is, but you might mention what the blue lines represent. Also, what actual quantity is plotted on the Compliance scale. For Figure A1(c), you might mention that when AOD_A is very high, there is likely a plume over the AERONET site, in which case the larger MODIS sampling region would typically yield a lower spatial-average value.

6. Section 2.4, equation 1. Actually, Abdou et al. use an envelope of *the larger of* 0.05 or 0.2 * AOD. The MODIS team uses the sum of an absolute and a relative criterion for their envelopes.

7. Figure 1b. I'm not sure if you allow for the negative AOD values the MODIS Collection 5 data contain over land. I can understand why you might truncate the data at zero, but you might mention explicitly how you handle this. (Same question for Table 1c.) Also, if the black dashed lines represent the 25^{th} and 75^{th} percentile values of the actual data within each AERONET AOD bin, I'm not clear why they go to zero near the origin.

AMTD

3, C2012–C2016, 2010

8. Section 3.0, last paragraph. Levy et al., ACP 2010 updates some of the references given here, specifically for the over-land AOD retrievals. Also, next-to-last sentence, might add: "... should be used for scientific analysis, and the results here corroborate that these data provide systematically better agreement with AERONET."

9. Section 3.1, paragraph 3, line 1. "through" not "though" Very nice work here.

10. Section 3.1, last paragraph, sentence 3. There are also correlations between scattering angle, latitude, and view angle in the MODIS observations that might be of relevance here.

11. Section 4.1, first paragraph end. Just for interest, can you tell if the higher-slope values for Aqua at high-AOD sites are due to more intense wildfires in the afternoon vs. the morning?

12. Section 5.1, equation 7. This is clearly a good approach. I'm a little surprised you use the same three fitting parameters for the global range of surface types. Perhaps this is be more detail than is needed for good assimilations, and I do realize that your thresholds remove the extremes. FYI, I found it difficult to keep track of all the dimensions of information encoded in Figure 5a.

13. Section 5.1, equation 7. Also, I guess there is no need to include view-angle dependence – I can see that Figure 4 suggests minimal view-angle bias in tau_M, but I'm wondering if the application of equation 7 for all cases could introduce one?

14. Section 5.2, first paragraph. You might mention here that over land, the MODIS algorithm essentially assumes particle properties based on an AERONET climatology. As such, there might also be some interesting aspects of the way this climatology is derived that produce the larger differences in the Sahel and S. America.

AMTD

3, C2012–C2016, 2010

15. Figures 9, 10, and 12. The scale bars are difficult to discern. For Figure 10, I'm wondering whether it might be more useful to show in the right column the number of days, on the same scale as is used for the left column, rather than showing differences. In the current version, I don't see any structure in the right-column plots, and it is difficult to make comparisons between the left-column and corresponding right-column plots. For Figure 11, again it is difficult to see more in the multiple plots than just the seasonal variation in MODIS coverage, e.g., at high northern latitudes. Perhaps showing just a few plots, for selected regions and/or seasons, but at higher resolution, would convey more of the key differences.

16. Section 6.2, "Quality assurance filtering" paragraph, last sentence. For clarity: "... and positive errors dominate for the excluded data."

17. Section 6.2, "Exclusion of partially cloud retrievals" subsection, last sentence. This is interesting. I'm not surprised that it preferentially removes high-biased cases, but if the filter does not change the overall compliant fraction, does this mean that it removes proportionately equal fractions of initially compliant and non-compliant cases? If so, and if the identification of partly cloudy cases is working well, is the AERONET data cloud-contaminated to roughly the same degree as the MODIS data for these events?

18. Section 6.2 overall. You might mention the rationale for performing the filters in the particular sequence chosen. I can see that the order might not matter for some tests, but it might make a difference for others, such as the "buddy check'.

19. Section 7(a), line 4. Perhaps: "... a prognostic RMS error model with a noise floor is more appropriate."

20. Section 7(g). See Point 14 above. Perhaps there is a bit more worth saying here.

21. Section 7(h). If Basic QA reduces the data volume by 50% to achieve a 50% improvement in compliance, whereas the additional 10% filtering produces an

AMTD

3, C2012–C2016, 2010

additional 30% improvement, I'm wondering what would happen if you imposed the filtering step producing the greatest proportional compliance improvement first.

22. Section 7(i). Would it be appropriate to reference here Zhang and Reid (ACPD 2010) about MODIS calibration?

23. Section 7, very last paragraph. Whether the QA procedures reduce biases and random error in themselves seems less important than that the final product meet specific compliance criteria for assimilation, i.e., for this application, it seems that the question is not whether the data are "better," but whether they are "good enough."

Very nice work!

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