Reviewer: 3

The authors provide a comparison of nine satellite-derived global AOD data sets, with ground-based AERONET (land) and MAN (ocean) AOD data as reference. They apply different statistical metrics and look at the data sets on different spatial scales: global, regional and per reference site. They also look at trends. Differences and agreements between data sets are described. The manuscript provides an interesting overview of AOD data sets available in the public domain, although some recent data sets like those from VIIRS are missing. Also, I wonder why for AVHRR only the over-ocean AOD is included and the recent over-land data sets described by Sayer and Hsu in JGR, 2017, were not included. It would be interesting to see how these data sets, retrieved from a sensor not designed for aerosol retrieval, compares to those from dedicated sensors like MISR and MODIS. Likewise, a comparison with PARASOL (POLDER) would have been interesting. As regards the title, I would recommend changing "inconsistency" to "Intercomparison", because not all and not always are the data sets inconsistent, they are often also consistent.
Response: We appreciate the time and effort the reviewer spent on this manuscript and the insightful comments and constructive suggestions. In light of your opinion, we have carefully revised our manuscript. The responses to the questions raised in your report are as follows.
Regarding the AOD product selection, we actually collected the VIIRS aerosol product. However, VIIRS was launched in 2012, and its common matching period with most other satellite products was short. In this revision, we have added the VIIRS monthly product for a simple comparison of the spatial coverage and distributions in Figure 1. Because of the similar sensor parameters and algorithms of VIIRS and Aqua MODIS, both data products have close monthly spatial coverages and mean AODs values throughout the time series. Therefore, we did not include the VIIRS products in the inter-comparison in the following analysis. In addition, we have added the AVHRR and POLDER products over both land and ocean in the revision according to your suggestions. Meanwhile, we have modified the title to "Inter-comparison in spatial distributions and temporal trends derived from multi-source satellite aerosol products".

Specific comments (line numbers refer to the pdf published online)

1. 46: suggest "composition and short life time of atmospheric aerosol particles"
Response: This phrase was modified per your suggestion.

2. 57: remove "observable"
Response: This term was removed per your suggestion.

3. 79: remove "seemingly"
Response: This term was removed per your suggestion.

4. 80: This sentence suggests that some studies have indeed focused on exploring : : : ; hence references to these studies are needed here
Response: Thank you. We have cited the main references in the revision according to your suggestion.

5. 85: suggest “evaluation and comparison”
Response: This phrase was changed per your suggestion.

6. 91: validation
Response: This term was corrected.

7. 103: ADV was first published by Veefkind et al., 1998a, for retrieval over land; Over Ocean ASV was first developed by Veefkind et al., 1998b
Response: We have modified and cited these references in the paper.

8. 112: A more recent reference for the Swansea algorithm is Bevan et al., 2012
Response: The relevant reference has now been cited in the paper.

9. 117: Holzer-Popp
Response: This name has been corrected.

10. 122: “AVHRR aerosol product is only available”: this is NOT true, see my general comment and references to Sayer and Hsu Sect.
Response: Yes, according to the suggestions by two reviewers, we have replaced the ocean-only AVHRR data with the NASA AVHRR aerosol product as you mentioned (Sayer and Hsu), which is available over both land and ocean. We have also rephrased this paragraph in the paper.

11. 2.2: not only AERONET is used, AOD over ocean is provided by the Marine Aerosol Network (Smirnov et al., 2009)
Response: We have cited this reference and revised the statement in the paper.

12. 196: could you reword the text to make clearer how the lsq fit is applied
Response: We have rephrased this sentence and cited the main reference on the LSQ method in the paper.

13. 199: trend symbols: same direction of the trend Para starting at
Response: This has been corrected.

14. 230: An important indicator is also the EE, and the above and under EE which clearly indicate overestimation (e.g. for MODIS) and underestimation (e.g. for MISR). Here and in the next paragraphs, I do not understand how MISR can have a similar number of collocations as MODIS in spite of its much smaller swath; MISR should have an N similar to AATSR

Response: We apologize for the incorrect statistics, and we have corrected the sentence to "The Terra MISR product provides a sample size of 8418, which is smaller than the Terra MODIS sample size (N = 9196) and is possibly due to the narrower swath width" in the revised version.

15. 235: I am not sure that your judgement of ADV is completely fair, since indeed MAE and RMSE are worse, but not EE; looking at the statistics in Table 2, it seems that none of the sensors has the best statistics for all numbers, so it is hard to make such statements.
Response: We apologize for the improper description here, and we have removed the statement from the revision.

16. 236: smaller number of retrievals collected: I think this should be a smaller number of collocation pairs since less references data are available; again, how can MISR provide a similar number of data collections as MODIS?
Response: Yes, the small number of data is due to the limited availability of reference data. We have corrected the description in the revision.

17. 244: SeaWiFS is not improved, but its performance is better
Response: This information was revised per your suggestion.

18. 251: what is the statistical parameter indicating estimation uncertainty and accuracy?
Response: In this paper, the accuracy is represented by MAE, and the uncertainty is represented by RMSE and RMB, where RMB > 1.0 or RMB < 1.0 indicate the over- or under-estimation uncertainty. We have clarified this information in Section 3.3 in the revision.

19. 257 and 263 and 275-277: a high R does not imply that the performance is better: MODIS has high R, but figure 2 shows that MODIS overestimates, so actually it's performance in estimating AOD is not so good. This should be re-worded in the text.
Response: We agree with your opinion and revised this information in the results analysis. We mainly use the following indicators (i.e., MAE, RMSE and RMB) to describe the product performance and no longer use the correlation (R) according to the suggestions from two reviewers.

20. 266: RSA, typo and you mean ESA?
Response: This term has been corrected.

21. Sect. 5.2: there are very large differences in the mean AOD values; yet they all compare well with AERONET (Fig. 2 and 3): why are these differences not visible in the scatterplots?
Response: These figures have been corrected.

22. 304: suggest plotting the eight-year mean value in the figures
Response: This change has been implemented per your suggestion.

23. Sect. 5.3 title not clear: suggest changing the Section title to " Comparison of satellite- and AERONET- derived annual mean AOD at each site
Response: The title has been modified per your suggestion.

24. 340: this sentence is not accurate: you compare annual mean AOD for each satellite over an AERONET sites with the AERONET annual mean value
Response: We have revised the sentence as follows: "Furthermore, we also compare the annual mean AODs calculated from each satellite product and AERONET throughout the world from 2003 to 2010 (Figure 9)."

25. 375-376: I do not understand the sentence "Four : : : areas." Why are the first 4 similar and the other 2 consistent? What do you mean with that? MYD08 and SeaWiFs show quite some differences. Could you re-word so it is clearer?
Response: We apologize for the unclear description, and we have rephrased the descriptions to "On the other hand, the four ESA-CCI and MISR aerosol products are not significant in most ocean areas, even for the open seas. MODIS and SeaWiFS products have similar spatial patterns in most ocean areas, such as the significantly increasing trends observed over the Pacific and Indian Oceans" in the revised version.

26. 379: what do you mean with "treatment in neighboring pixels": did you describe that in the text?
Response: We apologize for the incorrect description, and we have removed this information from the revised version.

27. Sect. 6.4: Linear trends were fitted, so it may be that upward and downward trends are compensated over this long period of 18 years and thus the trends in Fig 14 are not representative. Could you please add a comment in the text?
Response: We have added this comment in the revised version according to your suggestion.

28. Figure Captions: 2 and 3: Density scatterplot of the monthly averages of satellite-derived AOD (operational products) versus AERONET AOD
Response: These captions have been corrected.

8: replace aerosols with AOD
Response: This term has been corrected.

10: ".. with annual mean AERONET AOD data for all sites : : :"
Response: This phrase has been corrected.

11: trends of AOD at 550 nm

Response: This phrase has been corrected.

12: replace “aerosol trends” with “trends of AOD at 550 nm”
Response: This phrase has been corrected.

13: I think you show trends of AOD at 550 nm, not annual mean aerosols?
Response: This phrase has been corrected.

15: remove “variations”
Response: This term has been removed.

References:

Bevan, S. L., North, P. R. J., Los, S. O., & Grey, W. M. F. (2012). A global dataset of atmospheric aerosol optical depth and surface reflectance from AATSR. Remote Sensing of Environment, 116, 119–210.

Hsu, N. C., Lee, J., Sayer, A. M., Carletta, N., Chen, S. H., Tucker, C. J., : : : Tsay, S. C. : Retrieving near-global aerosol loading over land and ocean from AVHRR. Journal of Geophysical Research: Atmospheres, 122. doi:10.1002/2017JD026932, 2017

Sayer, A. M., N. C. Hsu, J. Lee, N. Carletta, S.âA˘ RH. Chen, and A. Smirnov: Evaluation of NASA Deep Blue/SOAR aerosol retrieval algorithms applied to AVHRR measurements, J. Geophys. Res. Atmos., 122, doi:10.1002/2017JD026934, 2017.

Smirnov, A., et al. (2009), Maritime Aerosol Network as a component of Aerosol Robotic Network, J. Geophys. Res., 114, D06204, doi:10.1029/2008JD011257.

Veefkind, J.P., G. de Leeuw and P.A. Durkee (1998a). Retrieval of aerosol optical depth over land using two-angle view satellite radiometry during TARFOX. Geophys. Res. Letters. 25(16), 3135-3138.

Veefkind, J.P. and de Leeuw, G., 1998b, A new algorithm to determine the spectral aerosol optical depth from satellite radiometer measurements. Journal of Aerosol Sciences, 29, 1237-1248.