

Reviewer: 4

The objective of the present study is the intercomparison of various spaceborne retrievals which are widely utilized in aerosol studies. The analysis has been performed at different spatial scales and for a long-term period thus increasing the robustness of the obtained findings. Nevertheless, the major weakness is that the interpretation of the results is poor without providing insight and sufficient answers about the potential reasons which can explain the apparent differences. More specifically, throughout the manuscript the authors are restricted just to a description of the figures which can be easily done by a reader without reading the text. Therefore, I strongly believe that the manuscript needs a major revision before it can be acceptable for publication in ACP. Below are listed my comments/questions which I hope will help the authors to improve their work.

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.

1. Which version of the AERONET data is utilized?

Response: We use the newly released AERONET Version 3 Level 2.0 monthly AOD observations in this study, and we have clarified this information in Section 2.2.

2. You have to provide a better description of the satellite datasets (version, spatial resolution, temporal resolution, temporal availability, where these data are stored, literature etc.).

Response: We have provided more detailed descriptions (including the data version, spatial and temporal resolution, temporal availability, scientific dataset, and literature) of the satellite-derived aerosol products in the revised version according to your suggestion. Meanwhile, the data acquisition addresses are provided in the acknowledgements.

3. Page 6 – Lines 177-179: This sentence is confusing for me. Are you using monthly means or daily retrievals which are used in order to calculate the monthly averages? What do you mean “...with sufficiently high-quality...”? Are you applying any quality assurance flag or are you using the raw data as is?

Response: We apologize for the confusing sentence. In the paper, we did not apply any additional quality assurance and used the original monthly products for all analyses. The mentioned quality assurance flag is only a type of output control in the MODIS aerosol retrieval algorithm (Levy et al., 2013). We have removed this sentence from the revised version.

4. Page 6 – Lines 180-181: Please rephrase this sentence.

Response: We have rephrased the sentence “For multi-satellite aerosol products, the monthly retrievals at 550 nm are collected from the listed scientific dataset (SDS, Table 1) and used for the current analysis in this study” in the revision.

5. Figure 2: I cannot understand why the comparison versus AERONET is made for the periods where each dataset is available and not for the common period (Table 2 and 3). In the scatterplots, the EE dashed lines are common for all satellite data. This is not correct since each satellite sensor has different uncertainty limits (which are not stated in the text).

Response: We have removed the comparison for the period of each dataset and retained the common-period comparisons in the revision according to your suggestion. The problem regarding the EE dashed lines is explained below in the answer to question 7.

6. Page 8 – Lines 228-244: Is there any interpretation for these results? The authors must consider previous evaluation analyses in their discussion.

Response: We have compared our results with the results of previous studies on the four ESA-CCI products in the paper (Section 4.1). However, for the remaining aerosol products, we used the newest versions that have been released recently (e.g., MODIS C6.1 and AVHRR products available in October 2017; MISR V23 in November 2017; VIIRS V1 in February 2018). Meanwhile, most published studies focus on the validation of the instantaneous retrievals of Level 2 products against surface measurements. Comparative studies on Level 3 monthly products are rare, and we did not find similar evaluation papers; thus, we did not make such comparisons in the current study.

7. Section 4.2: You have to repeat the analysis for EE using the corresponding limits for each satellite sensor. Moreover, you have to compare your results with other existing works.

Response: We have removed the EE quantity throughout the analysis due to its limitations for different satellite monthly aerosol products according to the suggestions from two reviewers.

8. Section 5.1: There are several points which must be discussed in Figure 7. For example, the differences among AATSR-ORAC, AATSR-SU, MODIS and SeaWIFS recorded across N. Africa. Likewise, in E. Asia, it seems that there is a strong diversity, in terms of AOD values, among the datasets. In AATSR-ORAC, there is an abrupt change of AODs between maritime and continental areas in the eastern tropical Atlantic Ocean as well as in the Arabian Sea. Finally, it would be useful to reproduce the maps by considering common points in all datasets separately over land (exclude AATSR in order to have available observations over Sahara and in the Middle East) and sea.

Response: We have added a discussion on this issue as “There is also strong diversity in the seasonal mean AODS over North Africa and East Asia among most datasets.

This diversity is mainly due to the different aerosol algorithms applied over bright surfaces (i.e., desert and urban areas). Both high surface reflectance and complex underlying surfaces increase the difficulty of aerosol retrieval (Wei et al., 2018)” in the revision. There was a mistake when processing the AATSR-ORAC product, and we have corrected and fixed the problem you mentioned. Meanwhile, we have reproduced seasonal maps for land and ocean in the Supplement File (Figures S2-3) following your suggestion.

9. Figure 9: For the computation of the regional means based on the satellite observations are used all the grid cells of the domain of interest or only the pixels in which AERONET stations reside? Why there is an increasing trend for MODIS data in EAA as well as in EUR? On the contrary, in SAA the agreement between MODIS and AERONET improves gradually. Why this is happening?

Response: In the original manuscript, we used only the pixels located over each AERONET station. According to the comment from another reviewer, this is not a validation but a comparison because we use the annual averages, not the instantaneous values, which may be the main reason for these uninterpretable trends. The analysis makes little sense; thus, we have deleted this part in the revision.

10. Section 6.4: Are your results in agreement with other similar studies? In the global map, there are clear signals over wide areas of the planet which are not discussed appropriately in the text. Which factors regulate (meteorology, emissions, teleconnections, land use, etc.) the obtained pattern?

Response: Thank you for your suggestion. We have compared our results with the results of other studies and discussed the main factors regulating the present AOD spatial patterns in the revised version (Section 6.3).

11. Figure 1: First of all, there are mistakes on the region names. Please correct the European Coast as well as the South Africa (it is not in Asia!). Which is the domain for the European Coast? Replace Atlantic Ocean with South Atlantic Ocean.

Response: We apologize for these mistakes, and we have corrected them according to your suggestions. The European coast mainly includes the Eastern European Sea and Mediterranean Sea. To make the border clearer, we have replotted Figure 1 in the revision.

12. Figure 11: Replace 2017 with 2010.

Response: This information has been corrected.

13. Page 3 – Lines 64-77: In this part of the manuscript the authors are stating only studies representative for China. Satellite observations have been also used for other regions of the planet such as the Mediterranean, Europe, Atlantic Ocean etc.

Response: Thank you for your suggestion. We have enriched the introduction and added satellite-based AOD research over Europe, the Mediterranean Sea, Northern Africa, Topical Pacific, North and South Atlantic Oceans in the revised version.