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Interactive comment on "Merging regional and global AOD records from 15 available satellite products" *by* Larisa Sogacheva et al.

Anonymous Referee #2

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Review report of the ACP manuscript Merging regional and global AOD records from 15 available satellite products (https://doi.org/10.5194/acp-2019-446), by Sogacheva et al.

This manuscript discusses approaches to merge satellite AOD data sets from a large number of datasets derived from various instruments. The analyses start at the monthly AOD L3 products at a low spatial resolution (1x1° lat-lon). An extensive intercomparison of the various datasets is performed and different merging techniques are discussed.

The strongest part of this manuscript is the section 4, where the different datasets are compared. This could be a publication on its own. The weaker parts are the sections 5 and 6, which should be significantly improved in structure and readability.

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Discussion paper

Main comments One of the goals of the manuscript is to present a merged dataset. However, different merging methods are described, and no clear recommendation is made for a merged dataset. Also, a description of the final dataset is lacking. Therefore, the claim made in the abstract that a merged dataset is introduced is not fulfilled. If a dataset is presented its contents should be described, including on the technical level (in an appendix). Also, the dataset should be made available, preferably on one of the large datacentres, and with a doi.

The intended audience for the manuscript is not clear to me. If the intention is to describe a merged dataset, the intended reader is a potential user of that dataset. This user group is probably not an expert in the aerosol field and is probably not (so) interested in the performance of the individual underlying datasets (section 4, which is the largest part of the manuscript), but rather in a description of the performance and caveats of the merged one. This needs to be taken into account in the sections 5 and 6, which should be written at the right level, and more or less separate from section 4.

To summarize my main comments: - Make the merged datasets available and include a technical description. - Rewrite the sections 5 and 6 with the intended user of the dataset in mind as the audience. More comments on section 5 and 6 are found below. - Make clear what the final advertised merged data set is.

Section 5

This section should be rewritten, to clarify what was done and limited to methods that are used in the further analyses.

Section 5.1. This section is too brief and starts with a statement why the mean is not a good statistical indicator, whereas the it is one of the parameters that is calculated. What is missing is information on which data it is applied (to the monthly mean L3, or also to the seasonal and/or annual L3?).

Section 5.2. This section is too brief and unclear. With the information contained in

this section I would not be able to reproduce the results. The ATSR_ensemble is not available for the entire dataset. How do you deal with this? Clarify all the steps of the method.

Section 5.3. This section describes to methods: RM1 and RM2. However, RM1 is -as far as I can tell- not used in the rest of the paper. Therefore, it should be removed from this section, so approach 3 is limited to RM2 (in the remainder of the manuscript reference to RM2 should be changed to Approach 3). Furthermore, I propose to add one or more equations to clarify the procedure. Also, it should be clarified on which datasets it is applied, because if I understand section 6 correctly, there are also some sub-methods here (e.g. regional weights, monthly weights versus time-series weights, aerosol type weights).

Section 5.3 In approach 1 and 2 the mean, median and standard deviations are calculated. Why is this not done for approach 3 (see for example https://en.wikipedia.org/wiki/Weighted_median)?

Section 6 Section 6 should in my opinion describe the quality and caveats of the merged data using method 1, 2 and 3. It should not describe the performance of individual datasets. I think that part of my confusion seems to come from what is called the "merged product". As a reader, I think that methods 1,2 and 3 all yield a merged product but using different merging methods.

Section 6.1.1 I think this section doesn't belong in section 6. It describes the rationale for merging approach 2 and therefore should be moved to section 5.2.

Section 6.1.2: The title of this section is not covering the contents: in the current manuscript it is comparing the Merging Methods 1 and 2. However, I don't understand why Method 3 is left out in this section. Instead, I propose to describe the comparison of all three minutes, using figure 13 and to drop figures 9 and 12.

Section 6.2.1: This section described the weights; it doesn't assess the merged data

quality. I strongly suggest moving this section to section 5.3, which also increases the readability of that section.

Section 6.2.2: first paragraph. This describes sub-methods of approach 3 and should be described in section 5.3.

Figure 11, I like this figure, but why include it only for method 3? I think it should also be generated for methods 2 and 3 and the differences discussed.

Section 6.2.3. In the first 2 sentence 2 sub-methods are introduced of approach 3. This is not the right place, this should be done in section 5.3. The remainder of section 6.2.3 should be moved to 6.1.2, and also differences with the other methods should be described.

Section 7. I don't really see the need for this section. Line 1-22 would fit with the comparison of the time series of the three methods (e.g. 6.1.2). The last paragraph should be moved to the conclusion.

Specific comments

I strongly suggest adding a figure with timelines of the availability of all the products as part of the section 2. This information is also in Table 1, but a graphical overview would be a great help.

Table 1 presents the datasets, but the doi's and url's in Table 2. For each dataset the reference of doi (or url if doi is not available), should be included in Table 1, and the reference doi's and urls should be included in the list of references. Table 2 can be removed.

Page 14, lines 1-11. In the discussion of the comparison of AERONET with AOD L3 data, instead on the more common comparison with L2 data, one argument is missed. When L2 data is compared with AERONET with strict temporal and spatial criteria, the L2 data is implicitly cloud-cleared, because the AERONET data is only available under these conditions. This does not hold when comparing the L3 data. If the cloud clearing

is not optimal, this would lead to difference in the comparison results of L2-AERONET versus L3-AERONET.

Page 15, line 5 "manuscript" -> "work"

Page 16, line 16-17. It is not clear what is meant here. What does "different surface treatment" mean (compared to what?).

Page 19, section 4.3. Define how the ATSR_ensemble is computed.

Caption Figure 5, In light of my comments on section 5-6, I don't understand which merged product is shown as "M" in this figure.

Page 22, section 5.1. I would suggest to not only compute the standard deviation, but also percentiles, for example the 10th, 25th, 75th and 90th, because the standard deviation is very sensitive to outliers.

Page 22, line 5: "AOD weighted" is not clear. I suggest "Weighted mean, where the weights are derived from the comparisons with AERONET.

Page 23 line 26: "ATRS" should be "ATSR".

Page 29, line 1: "aerosol particles" should be "aerosol types"

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