

Dear Editor, dear reviewer,

Many thanks for the valuable comments, which help to improve the quality of this paper. The detailed replies are addressed below point by point.

As below, I would like to clarify some of the points raised by the reviewers. We hope that the reviewers and the editors will be satisfied with our responses to the 'comments' and the revisions for the original manuscript.

Best regards,

Yahui Che on behalf of all authors

2019-5-15

Response to reviewer 3:

Interactive comment on “Investigations into the Development of a Satellite-Based Aerosol Climate Data Record using ATSR-2, AATSR and AVHRR data” by Yahui Che et al.

Anonymous Referee #3

Received and published: 16 March 2019

This manuscript compares aerosol retrievals from 3 different sensors (MODIS, ATSR, and AVHRR) with ground based validation data (including AERONET) over a 10x10 degree box centered on eastern China. The goal is a worthy one, the creation of a continuous climate data record of satellite-retrieved aerosol optical depth from the early 1980's until the present day period. I believe this work can be published if the authors are willing to substantially change the manuscript. Most of my comments are embedded within the PDF attached, but I will summarize a few points.

Re: Thank you for affirmation and the constructive comments. We have addressed these points in the new version of manuscript.

1) As was mentioned by the other two reviewers, where is the SLSTR data? If this data is not available, this manuscript can still add value, but not much (in its current form).

Re: The focus of this paper has been switched to extent ATSR data set back to 1980s. The content about SLSTR data is deleted in the new version of manuscript.

2) MISR shares a lot of similarities to ATSR including: swath size, multi-angle viewing, equatorial crossing time, and algorithm heritage (over-land). Additionally, I expect that the error statistics for MISR (over this region) are quite a bit better than for any other sensor used in this paper. In fact, given MISR's very long data record (2000→2019 and counting), its similarities with ATSR, its overlap with *both* ATSRs *and* SLSTR, I think it makes much more sense to use MISR to stitch together the ATSRs and SLSTR. Once those two datasets are harmonized with MISR (globally, not for one region), I would then look back and compare with AVHRR (globally, or at least using all regions available).

Re: Thanks for this suggestion. MISR data is possibly a better choice to bridge the gap of AATSR and SLSTR data. As mentioned above, the content SLSTR data are deleted, and we have to switch the focus of this paper on period from 1987 to 2012.

3) Please find a way to make this work much more global. A 10x10 degree region is not a very useful climate data record, especially in a region with so much dust and pollution transport. Additionally, the authors could show consistencies and discrepancies with other sensors via a map of gridded correlations and differences (using seasonal AODs, compared with other sensors).

Re: Thank you for your suggestions. We start from the small regions as we only have this region AVHRR long-term AOD till now. Besides, this region with complex aerosol types helps us to analyze the effectiveness of AOD products in complex situations, because it's easy for everyone to be very accurate in simple situations. Correlation maps are not the best choice as the data volume of seasonal maps are with big differences. Hence, we plot seasonal difference maps for three products.

4) As a third party (I work with MISR data) with no stake in any of these instruments (at least data from the ones presented), it seems pretty clear from this small dataset that MODIS provides the best available AOD here (by far). One (or more) of three things is going on here: (1) AATSR's aerosol retrieval algorithm is inferior to MODIS, (2) AATSR's sample size in this region is so small as to border on the irrelevant, or (3) the region selected is so small that regional biases in the algorithm dominate your observed errors. If (1), I have to wonder why bother stitching together AOD from ATSR and AATSR with SLSTR (and AVHRR) at all? Even though ATSR, AATSR, and SLSTR all lack a blue band (which will significantly degrade performance over brighter regions), this should be compensated by the additional view angle. If the current algorithm is insufficient, maybe a new one should be developed. Otherwise, if MODIS truly gives better performance, just create the CDR using MODIS, AVHRR, and VIIRS, which would be easier anyways. If (2) or (3) see point 3) above, you need more data.

Re: The focus of this paper has been switched to make an extension of ATSR back to 1980s, and the study area is still limited to north China before newly AVHRR data are produced. The performance of ATSR is inferior to MODIS over small region but they are very close when study area is extended to whole China region as described in Sogacheva et al (2018). Besides, ATSR could provide data set before 2000. Our following work is to produce AVHRR data set over whole China.

Reply to comments in supplement:

1. Page 1, line 6, AOD>0.6 is not uncommon for the Beijing region in winter either.

Re: We revised this in the new version of manuscript.

2. Page 3, line 11, delete "and thus restore nature"

Re: We rewrote introduction in new version of manuscript in which this line was deleted.

3. Page4, line 22, Why choose only China if Europe is also available with this dataset? I would expect that Europe may have had some validation data going further back than the validation data available over China.

Re: Our following work is to produce AVHRR AOD data set over whole China region and we have BEM AOD (boardband extinction method) from at least ten sites. Hence, in this paper we focus on north China, but we will consider Europe in next paper.

4. Figure1, This figure needs to have land cover included on the colormap. We should not have to scroll up and down.

Re: Color codes have been replaced by the name of land covers.

5. Page 5, line 22, Any reason MISR is not included here? Of the sensors listed here, it probably compares most favorably with validation in the region. The latest version (23) of the product also has an improved spatial resolution (17.6-->4.4 km), and performs noticeably better at high AOD.

Re: MISR is really a good instrument for producing aerosol data set. The current purpose of this paper is to extent AOD back to 1987. When SLSTR data are available, MISR is possibly the best choice to bridge the gap of AVHRR and SLSTR. But this will be considered in another study.

6. Page 6, line 19, Sea spray extinction probably never exceeds 0.01 at 3.75 microns (and is probably

much smaller).

Re: We only consider the land surface, and sea is not included in this study of AVHRR AOD.

7. Page 7, line 6, I am curious, is this 55 degrees from the surface normal, or is boresight angle 55 degrees?

Re: 55 degrees are from nadir to forward. We have added an explanation of this in the new version of manuscript.

8. Page 7, line 9, Similar swath to MISR (400 km), similar crossing time to MISR as well.

Re: Thanks for this remind and we will use MISR data to bridge the gap between AATSR and SLSTR when SLSTR data is ready.

9. Page 7, line 11, MISR's shape-similarity algorithm (part of the land algorithm) is probably based on this heritage.

Re: Thanks again.

10. Page 11, line 6, It would be relatively simple to perform a correlation between the different sensors. Additionally, a correlation (and RMSD) map based on seasonal mean AODs could be generated as well. This could give a very good indication on spatial agreement.

Re: We have plotted seasonal AOD difference maps instead of correlation maps as the data volume in averaging seasonal AOD for ATSR is much less than the other two.

11. Page 11, line 12, delete "overall somewhat"

Re: It has been deleted.

12. Page 12, line 11, For MODIS or ATSR?

Re: It is the difference between MODIS and ATSR.

13. Page 13, line 12, Hence the importance of using data from all available regions (including Europe). This will also greatly increase the amount of data available from AATSR.

Re: The presented paper focuses on data sets over north China, but our following research will be extended to whole China regions so that the data volume of ATSR will not be a problem. We will consider Europe as well.

14. Page 13, line 13-15, replaced by "an adequate retrieval over bright surfaces".

Re: This line has been replaced by "an adequate retrieval over bright surfaces".

15. Figure 3, as a third party with no stake in any of these instruments, it seems pretty clear (from this small dataset) that MODIS provides the best available AOD here (by far). One (or more) of three things is going on here: AATSR's aerosol retrieval algorithm is inferior to MODIS, AATSR's sample size in this region is so small as to border on the irrelevant, or the region selected is so small that regional biases in the algorithm dominate your observed errors.

Re: The same as (4).

16. About qualities of figures.

Re: We will upload figures with high quality with a resolution of at 300dpi separately.