Atmos. Meas. Tech. Discuss., 8, C2931–C2937, 2015
www.atmos-meas-tech-discuss.net/8/C2931/2015/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Towards a long-term global aerosol optical depth record: applying a consistent aerosol retrieval algorithm to MODIS and VIIRS-observed reflectance" *by* R. C. Levy et al.

R. C. Levy et al.

robert.c.levy@nasa.gov

Received and published: 11 September 2015

Dear Editor, Associate Editor and anonymous Reviewers

Thank you for your careful editing and facilitation of the review process for AMT-2015-157, "Towards a long-term, global satellite aerosol optical depth record: Applying a consistent aerosol retrieval algorithm to MODIS and VIIRS -observed reflectance" by Levy et al. Following are the reviewers comments and our replies to them (bold font). Changes will be reflected in the manuscript.

Reply to Anonymous Referee #1:

General comments: Constructing long-term Climate Data Records from a series of similar satellite instruments is a very important task for their utilization in climate change research. The required accuracy and stability for climate applications are extremely high and therefore usually extra efforts beyond the "normal" mono-sensor processing are needed to meet them. The paper investigates the issues which need to be solved in this challenging task when combining MODIS and VIIRS instruments for producing an AOD (and over ocean Angström coefficient) time series. First the two different algorithms currently in use are analysed and then a common algorithm is applied to both sensors, but due to their (small) differences several sensor-specific adaptations are needed (e.g. deviating central band wavelengths). A thorough evaluation of the results in an overlapping period of about two years is conducted and the arising problems are evaluated and discussed. The evaluation uses different means such as daily imagery, seasonal maps, level2 and level3 validation statistics (including thus the step of data aggregation), frequency histograms, global and regional time series which all together allow a comprehensive assessment of the datasets. The paper also discusses a number of relevant technical and practical aspects, which also need to be tackled to produce a consistent time series. The paper is perfectly in the scope of AMT. It addresses a highly relevant topic (long-term consistent satellite data records), which is key to wider utilization of satellite records in climate science. The paper does present novel concepts (retrievability) and contains a thorough discussion of the requirements to produce a multi-annual climate data record from the two instruments. The discussion is elaborate and sound and all material to support the conclusions is prepared well. The work described is embedded into the existing relevant literature. Title, abstract and conclusion are well prepared and suit the content of the paper well.

Thank you for the positive comments

Specific comments: My major comment is that (for better readability of the printed document) the several images (figures 1, 7, 9, 13, 14) should become larger and for this

purpose re-arranging the sub-images may be appropriate (e.g. fig. 1 (7) two (three) images above each other, fig. 9 two images only in one line.

We understand the issues with font size, figure size and readability. We note that in final form, the figures will look different than when in Discussion phase. Many of the figures will be full page wide (two columns). In addition, they will be zoom-able online. In the end, we considered all figures, and made minor formatting changes to five in total, one of which was Fig 14 from your list.

On page 6891 / l. 15f it is stated that a seasonal mean requires a minimum of 3 days, which is very low. I think this requires a brief explanation / motivation / justification

We agree that this is a low number. The now-standard (MODIS Collection 6) Level 3 protocol for monthly mean is assume each days' mean as an independent sample, and there is a minimum of three days for a monthly mean. For this paper, we assumed the same protocol for creating a seasonal mean. We never considered whether three days (or some other threshold) was a sufficient threshold for a seasonal mean, but rather used the Level 3 protocol as a basis for comparative illustration of MODIS and VIIRS data .

Technical corrections p. 6879 / l. 19: delete "monitoring" p. 6884 / l. 15: correct spelling of "Tanre" p. 6906 / l. 3 (at the end): add after "AOD": " (0.55 μm)" p. 6909 / l. 3: replace "minimums" by "minima" p. 6947 / l. 3 (fig. 15 caption): replace "provisional" by "validated" as in the figure

Thank you for pointing these out. They are corrected in the manuscript.

Reply to Anonymous Referee #2:

General Comments: The authors describe results of their findings from an experiment designed to evaluate the feasibility to generate a consistent, long-term aerosol record by stitching together aerosol optical depth (AOD) data from MODIS and VIIRS. In the experiment, they apply the MODIS dark-target algorithm appropriately modified to run

on VIIRS data. Given the maturity and extensive evaluation of the MODIS aerosol algorithm, as well as the long record of AOD data already available from it, the choice of applying the MODIS-like algorithm to the VIIRS data are both logical and economical. Generation of a consistent, long-term record of AOD is far from trivial. The sources of major difficulties in this endeavor are clearly indentified and a number of them (sensor, algorithm, sampling, and pixel selection) discussed in detail. The presentation is clear and very readable. The techniques applied are scientifically sound, and the results presented are informative and are useful to characterize the current state of MODIS-to-VIIRS AOD data. The authors acknowledge that a reliable climate data record (CDR) from MODIS and VIIRS "will take much more work". I fully agree with this statement, but I also agree with the authors' decision to publish their current results now. Presumably, not all applications need the kind of CDR that satisfies the rigorous definition of an aerosol CDR by the NRC. Applications can tolerate different level of inconsistencies, and providing them with the characterization of this level, as the authors do in this article, enables them to make a decision whether or not to use the AOD record.

Thank you for the positive comments

Specific Comments: The NRC (2004) definition of a CDR is stated in the Introduction (P6880, L1-5) saying that for an AOD dataset to be considered as CDR, AOD should be measured globally, every four hours, etc. Considering the limitations for AOD retrieval from MODIS (only two daytime overpasses, no retrieval over bright surface by the DT algorithm) it seems the CDR definition cannot be satisfied. This may be construed as a contradiction by some readers, and may need to be resolved.

We should have made it clear that there are many requirements for a CDR. We cannot address all aspects using a MODIS-VIIRS product, but we can study the joint accuracies (compared to AERONET) and repeatability (compared to each other). We revise the text.

P6887, L1-5: The Jackson et al. (2013) paper already discusses the VIIRS algorithm with the updated blue/red to SWIR surface reflectance ratios. As they read now, lines 1-5 on page 6887 suggest that the paper has the “at-launch” values.

Clarified

A reference is made to the VIIRS Intermediate Product (IP) on page 6889 (Line 22). The name may imply that they are not available to the user as the “official” product is the EDR. It would not hurt to point out that the IP are also distributed to users.

Done

P6891, L8-9: It may also be that the VIIRS did retrieve AOD, but it resulted in a negative value, and was discarded as an out-of-range AOD by the QC process.

Done

P6891, L14-17: While it is a legitimate comparison, the seasonal maps shown in Figure 3 may hide substantial sampling differences. Different number of days and/or different number of retrievals within the grid from MODIS and VIIRS could have contributed to the average. In what sense the grids are collocated in Figure 4?

Agreed. However the scatterplots show points only for grids that contain values in both datasets.

P6898, L9-11: It is stated that ML_V is biased high relative to ML_M over ocean and reference is made to Figure 6. It is hard to see if indeed more ML_V pixels are redder in color that their ML_M counterparts, although staring at the figure for a long time some pixels appear redder.

We agree that the colorscale shown here does not show the higher values (redder pixels). Rather than take our words for it, we have removed this statement from the text.

P6898, L21: What constitutes to the number of possible retrievals? Daytime, cloud-

free, dark pixels?

Number of possible retrievals is retrieval boxes that are in daylight, over a particular surface. Valid AOD are made for cloud-free, dark-pixels, free of glint, ice/snow, etc. This concept is now better-explained in the text .

Technical Corrections: P6879,L19: I think you mean “local air quality”, not “local air quality monitoring”.

Yes, corrected

P6880,L9-10: Recommend writing : “. . . by their lack of consistent sampling (due to changes in orbit) and calibration.”

Agreed

P6881, L14: “MODIS Characterization Support Team (MCST)”?

Yes!

P6882, L9: Change “cannot not help” to “cannot help”.

Done

P6883, L8: “. . . significantly different than the . . .” to “. . .significantly different from the ...”

Done

P6883, L23: Sentence “In order to retrieve aerosol. . .” may need to be revised. Perhaps “The retrieval of aerosol . . .”.

Done

P6894, L11: NOAA’s Center for Satellite Applications and Research

Okay

P6883, L23: Sentence “In order to retrieve aerosol. . .” may need to be revised. Perhaps “The retrieval of aerosol . . .”.

Done

P6894, L11: NOAA’s Center for Satellite Applications and Research

Okay

Figure 4: Labels a and b are missing. Data are plotted on top of the axis and hide the tick marks on the plot on the right.

Done

Figure 10: Labels a, b, c and d are missing from the plots.<U+2028>Figure 12: top figure colorbar: change “Retreivability” to “Retrievability” in the title.

Done

Figure 15: Legend: Change “provisional” to “validated”.

Done