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Atmospheric Measurement Techniques Discussions

Interactive comment on "MODIS Collection 6 MAIAC Algorithm" *by* Alexei Lyapustin et al.

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Overview: This is a very well written theoretical basis document sort of paper on the MAIAC algorithm. Often papers are criticized for being too long or involved, but typically I disagree-wanting to know how to reproduce the work and try and get a feel of what the authors are really thinking. This current paper is an outstanding example of how such ATBD papers should be written and published in the peer reviewed literature. I have been familiar with the basic nature of MAIAC, and yet after reading the paper I have an even more thorough understanding and know how to apply the data. The authors discuss the algorithm thoroughly, what works, and what the limitations are. In the "pre review" gave Lyapustin et al., some small corrections that need not be repeated here. I did have a few major comments that I said did not to be address immediately for public review but did need attention before final publication. They are neither hard nor time consuming, but it does I think need to get done. Thus, I would like the following

three things to be addressed in the final revised paper. 1) Prognostic error modeling: As is typical for satellite aerosol products, MAIAC is compared in bulk to all available AERONET in a regression (Figure 7). Bias and RMSE are calculated. I consider this a "diagnostic error model." Now I understand that this paper is more of an ATBD style, and expect that a thorough verification paper will be forthcoming. But one minor addition to Figure 7 (say a Figure 7 b) is a plot of RMSE and or RMSD (if there is a consistent bias) as a function of retrieved (e.g., MAIAC) AOD. That will give you the actual error bar for any retrieval. Consider- if we knew AERONET AOD, we would have no need of MAIAC. You need to know what the error is at any given place and time, and you only have the MAIAC algorithm, to go on. What the authors will undoubtedly find is that their error is parabolic, with a well-defined flat noise floor at low AODs, then growing nonlinearly. I would like to know based on the bulk analysis what that noise floor is, and how nonlinear the error is. The authors can devise more complicated error model, including the addition of other non-MAIAC data at hand, but that for certain is not necessary here.

2) Use for data assimilation: Currently there are nine centers doing operational or near real time global aerosol modeling, four of which with operational data assimilation. Without a doubt, the field is moving towards data assimilation as one of if not the biggest "power users" of retrievals such as MAIAC. In DA, we are often in the situation of violating the fundamental assumption that errors between adjacent retrievals are uncorrelated. I think it should be emphasized in the paper that the way the retrieval has regional optical models outlined in blocks leads to very sharp inconsistencies in AOD across arbitrary lines. Similarly, you can see very strong deviations at the coastlines from time to time.This can be a problem for data assimilation or anyone trying to invert sources and sinks out of the data. This issue is noted in the paper (and I commend the authors for stating what does not work so well), but I think an example figure as to how big a deviation there can actually be.

3) Overlap uncertainty: One thing we noticed when looking at the MAIAC data online,

which I discussed in person with Alexei Lyapustin a few weeks ago was that it appears that under some circumstances the overlap regions between successive orbits can have led to significantly different values in AOD in the overlap. This behavior was inconsistent, being difficult to notice in retrievals of the environment 5 year ago, but being very prominent in data being collected right now. I think this issue should be listed in the paper, and the potential users should be explained what the current best idea of what this is, and any advice as to how we can control for it. Also note the timeline for correction.

For example regarding 2& 3, today as I write this review you can see the sharp change along the meridian in western Africa https://landweb.modaps.eosdis.nasa.gov/browse/images/006/Both/MCD19A2-AOT/2018/A2018191/MCD19A2-AOT.A2018191.006.full.png. You can also see optical model change from land to water and scan lines as well. These spatially correlated errors might need a paragraph of discussion or two. But they are pretty common-just pick any day in the past few years and you will see them popping up. https://landweb.modaps.eosdis.nasa.gov/cgi-bin/browse/browseMODIS.cgi

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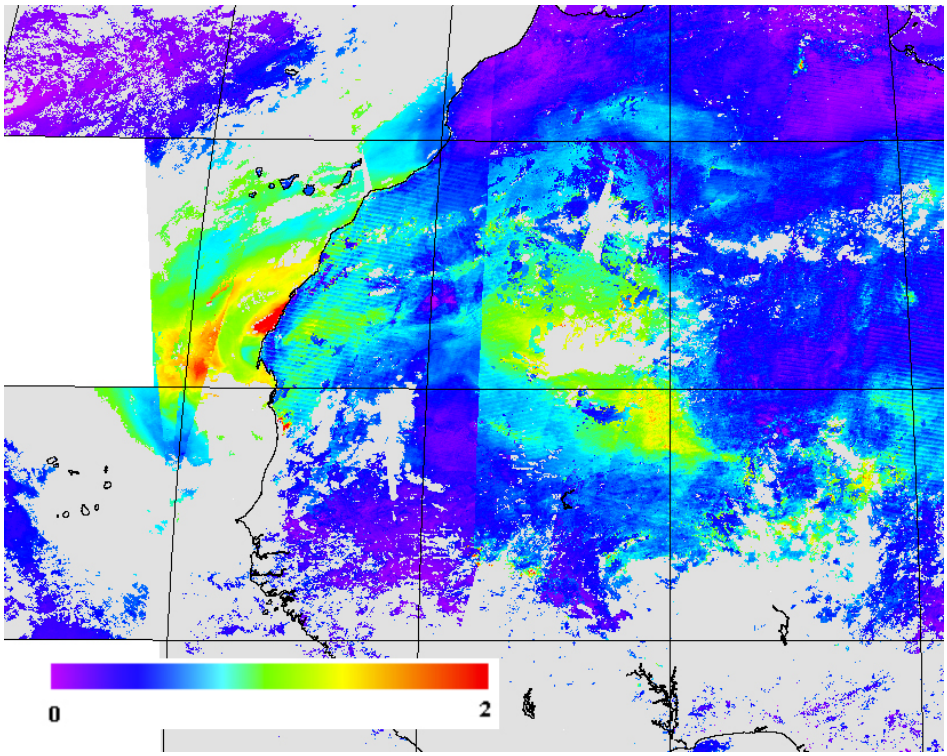

Fig. 1.