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Comment on amt-2022-290

Anonymous Referee #2

Referee comment on "Assessment of Severe Aerosol Events from NASA MODIS and VIIRS Aerosol Products for Data Assimilation and Climate Continuity" by Amanda Gumber et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-290-RC2>, 2023

Review of "Assessment of Severe Aerosol Events from NASA MODIS and VIIRS Aerosol Products for Data Assimilation and Climate Continuity "

General comments

The objective of this paper is to assess the differences between MODIS-based and VIIRS AOD products. In the context of a likely disruption of the MODIS product, assessing and documenting the consistencies and inconsistencies between MODIS and VIIRS data sets is essential for AOD data assimilation and to ensure the continuity of essential climate variable production. This paper provides a unique and meaningful documentation of the differences between products as well as their performances evaluated against AERONET at both global and regional scales. The analysis of the probability distribution function of each dataset provides a relevant statistical characterization on how the data sets compare each other in terms of capturing major aerosol events. The pairwise comparison informs on product differences for different AOD regimes that can be related to differences in each retrieval algorithm. Finally, the regional analysis allows to identify the product strengths and deficiencies for different regions. While the scientific contribution of this paper is strong and very relevant for its publication in AMT, several aspects of the paper, which are underlined below, should be improved prior to publication.

My main concern is about the description of methodology. There is no dedicated methodological section. The authors have chosen to separate the paper into the 3 types of analysis, namely: probability distribution function, regression and regional analysis, which include a brief method description along with the results and their interpretation. The author can keep that approach but should include a subsection dedicated to methodology in each analysis section or should consider having a separate section on method (similarly to the data one). Several aspects of the methodology should be better presented: what is the role of AERONET ? as far as I read it is involved in the regional analysis and not the global comparison ? Is it used as a reference data set in term of accuracy ? For the pairwise analysis, the method should be clearly explained, the reference to the past paper

is not enough.

Specific comments

- The title is too long
- Abstract: the role of AERONET is not clear, it is presented at same level as the satellite dataset but should be considered as a reference data set because of higher accuracy
- Introduction
 - For the sources of AOD retrieval uncertainty:
 - the measurement information content is a major source of uncertainties and it depends on geometry and the range of scattering angle which is sampled by the instrument
 - Cloud screening is a major source of uncertainty in aerosol retrieval and a large source of departures between products. This interacts in a complex manner with the differences in spatial resolution between products.
 - Regarding the definitions given for data assimilation, observation error and bias: I found it confusing. DA aims at correcting only small amount of random error that can be quantified by the SD of the differences between the observation and its model-simulated equivalent. Observation and model first guess should be unbiased in theory. Bias correction scheme aims at removing any systematic differences between the observation and the model.
 - VIIRS AOD: It should be clearly acknowledged that there are two distinct datasets for VIIRS: one produced by NASA and one produced by NOAA
 - The objective of the paper should be better explained

- The paper does not show/discuss the differences between product from same instrument but from distinct satellites: TERRA vs AQUA; S-NPP vs NOAA20. This is quite important in particular in the context of data assimilation when one product from one satellite can be biased due to radiometric uncertainties, I would suggest to include some results, if possible apply the intercomparison metrics separately to instrument and platforms.
- Satellite AOD (section 2): The description of AOD product is too long. The statements on MODIS instrument characteristics are not essential, the readers can refer to dedicated papers. Any references or statement on the differences between the NASA and NOAA products would be helpful. As well, I suggest to include a Table which summarize the main characteristics of each product and that would help to identify their differences. The YORI method is too detailed, please provide the essential information
- Section 3.2 line 395-397: it is not clear what do the author mean with nonlinearities in AOD
- Line 400-403: the sentence about dynamic range is not clear
- Use mean deviation (MD) instead of bias for product comparison, bias is generally used with respect to reference measurements (such as AERONET)
- Not enough analysis with respect to the impact of differences in cloud screening

between products

- Line 584-587: this statement is not specific to this paragraph