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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Improving GOES Advanced Baseline Imager (ABI) Aerosol Optical Depth (AOD) Retrievals using an Empirical Bias Correction Algorithm" *by* Hai Zhang et al.

**Anonymous Referee #3**

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"Improving GOES Advanced Baseline Imager (ABI) Aerosol Optical Depth (AOD) Retrievals using an Empirical Bias Correction Algorithm". Hai Zhang et al.

Submitted to AMT Discussions

Summary

Current operational retrievals of AOD from radiances measured by the ABI sensor on aboard of GOES 16 exhibit a diurnal bias (sun angle dependency) associated to the surface reflectance of the pixel under observation. This study introduces this problem and proposes an ad-hoc correction to the retrieved AOD. A correction is developed by collocating GOES AOD retrievals over selected Aeronet sites (mostly in the East



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of USA). Only days with low and constant (through the day) Aeronet AOD values are used to ensure that the GOES deviations are caused by the solar angle changes and not from aerosol loading variations. The differences are then assessed and a correction based on those differences (which in turn are a function of geometry and NDVI) is created. The correction is assumed to be valid through the full ABI swath and then applied to retrieved AODs. The corrected AODs are validated against Aeronet during a 6-month period. The correction successfully improves the satellite-Aeronet AOD comparison. While the improvement is clear and it may result in a more accurate operational product, this analysis does not address the actual problem the causes the bias (a non-adequate surface reflectance data base) and presents an ad-hoc correction. In addition, I find that this study has important methodological defects and I do not recommend the paper for publication in this form.

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Overall there are two major concerns about this work.

First, this a very empirical approach where the root of the problem is not addressed, namely the angular dependence of the surface reflectance as a function of sun angle. Although the authors do acknowledge that this is the real issue and they are working on it, they are content to use an ad-hoc approach by forcing the retrieved AOD to match the ground truth AOD. While this may be a reasonable practical correction, it does not show any new scientific approach (alternatively the authors do not highlight what is novel in doing this) and it does not attempt a correction on the actual measurement (observed radiances) based on physical principles (such as a modeled BRF) and using radiative transfer. With this regard, the work does not offer anything new.

Second, the validation is carried out by comparing the corrected retrievals against observations from the same instrument used for creating the correcting term. This is not adequate and it puts an asterisk on the goodness of the correction. At least these new corrected AODs need to be validated against an independent set of observations.

Also, note that in comparing figures 4c and 4d, there is a clear improvement in high AODs ($\sim$>0.5) whereas for lower AODs values, the scattering increases in figure 4d. This raises the question on whether the correction should be applied across the board to all aerosol loadings. This is relevant to AQ studies given that the vast majority of aerosol loadings are below AODs $\sim<$ 0.5, it is very desirable to have those levels of loading well characterized.

It should be noted that this critique does not preclude or advise against the application this correction to the operational product. However, the material here presented does not have the depth required for a scientific report.

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