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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 #2

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This paper evaluates the AOD retrieval from geostationary platform GOES ABI and proposed an empirical bias correction scheme to improve the AOD accuracy. The GOES AOD product is potentially very useful in radiative forcing and air quality studies, in that it offers the diurnal variability of AOD on large scale. However, the existence of s bias in the diurnal cycle is a significant drawback that limits its use. Therefore, the bias correction scheme offered in this paper is both important and useful. However, I hope the authors can give more analysis proving and explaining that surface reflectance is responsible for the bias, and that the bias correction is effective under all AOD loading and surface conditions. These I think are major issues, although they should not be too difficult to address. My detailed comments are listed below.

Major comments:

1. I agree with the authors that surface reflectance parameterization is the most likely cause of the AOD bias. However, in the paper the authors seem very definitive on this point. For example, in the abstract, it says "ABI AOD has diurnally varying biases due to errors in the land surface reflectance relationship between the bands used in the ABI AOD retrieval algorithm". Therefore, I wonder if they can offer more detailed analysis proving this point and explain how the relationship between surface reflectance of different channels vary with geometry? The difference between the test position and the current operational position does not seem large enough to account for such high AOD bias. One possibility is that the NDVI also varies with solar zenith angle. Do the authors use MODIS NDVI? They are calculated from polar orbiting satellites and the NDVI only represent one solar zenith angle. Although NDVI should be a normalized quantity that is not affected by the angle, the large different solar position between polar orbit and geostationary orbits may cause MODIS NDVI not representative of all angles. 2. The bias correction assumes that the difference between 30-day minimum AOD and background AOD is the systematic error, and subtract this error from every AOD retrieval. I wonder if the bias also depends on AOD itself, i.e., aerosol loading, so that the systematic bias derived as above does not represent all AOD conditions? The validation set seems somewhat small (only 6 days of data) and all days have low AOD (<0.1). I thus wonder how the bias and correction algorithm may perform for high AOD cases? Another issue is that the effect of correction is not obvious for top quality data, mostly because the bias data are already removed from top quality (see Figure 1). Is this because these retrievals have high residual error so that they are removed from top quality set? Investigating the reason may offer some clue for the causes of the bias or algorithm improvements.

Minor comments:

1. Section 2.1: What cloud screening scheme is used? And which NDVI data is used, MODIS? 2. Section 2.2: Is there any quality control performed on AERONET Level

1.5 data? What is estimated AOD error? 3. Line 304, the following reference also points out the poor VIIRS aerosol model selection over China: 4. Comparison with PM2.5 seems not very relevant, and removing it does not impair the integrity of the study. There are a lot of factors affecting the AOD-PM2.5 relationship and I think this comparison may complicate the analysis. 5. Figure 6: could the authors also compare with MODIS to demonstrate the effect of bias correction? The peak of the bias happens at 17UTC, which is 1PM US east time and is close to Aqua overpass.

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