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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Site representativity of AERONET and GAW remotely sensed AOT and AAOT observations" *by* Nick A. J. Schutgens

Anonymous Referee #2

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This paper presents results assessing the representation errors for observations of AERONET AOT and AAOT, and GAW AOT (and surface absorption aerosol), using a modeled GEOS5 Nature Run and an OSSE, for hourly, daily, monthly, and yearly protocols. A particularly interesting result is the comparison to results from Wang et al., 2018, with the finding that model downscaling is responsible for the larger biases in the former paper compared with the current one. I would recommend publication provided the following comments are addressed.

Major comments:

There are two places in the paper where it appears representativity/bias-based conclusions are drawn based on information that could be mostly influenced by aerosol type:

1) P. 7, line ∼15: "As the minimum number of observations per site increases, so do the correlations, probably due to a reduction in statistical noise (partly due to different simulated and actual meteorologies). But the overall bias also increases." The author then goes on to state that the sites with very high minima of observations are dust-dominated, and dust AOT is overestimated.

2) P. 11, line ∼8: "for yearly collocation protocol which allows significant biases for sites in South America and Africa. This is related to the AOT criteri[on] for valid observations and the dominant influence of episodic biomass burning for these two continents"

These seem to be potentially interesting results which are not discussed in this paper: representation errors also vary based on the aerosol type itself (specifically for the dust case). What happens if the dust sites are explicitly excluded? Does the correlation/noise/bias trend remain? Can you disentangle those two effects? What's the non-dust site with the highest number of observations? Since South America/Africa are such outliers, is there some lesson to be had from how seasonal sampling variability affects these errors?

This paper has a lot of figures which show generally similar results (trends from yearly to daily collocation protocols for different subsets are fairly similar) but have somewhat limited discussion of each. I wonder if it would be possible to consolidate a few of them to more clearly distill the main story of the paper, but it's probably fine if everything stays in. I would recommend more detailed figure captions, though; as-is the individual figures are a bit hard to follow. Also, does Fig 17 have a different collocation protocol for the brown bars than the others?

p. 12, Line 11: I might clarify that this ranking at the DOI under Schutgens (2019) is the same as that which was mentioned p. 9, Line 33. It would be interesting to have a comment as to how this has changed since the Kinne et al., 2013 rankings, since if I understand correctly this new ranking has up to a full decade of additional data?

Minor comments:

-p. 3 , Lines 28-29: I believe CERES “cloud fractions” are derived from their collocated MODIS instruments.

-p. 7 Line 5: “correlation ($\sim$0.45)”. To what does this $\sim$ refer?

-p. 7 Line 20: as the other reviewers said, this is not strictly true; the L2.0 data have a minimum AOT of 0.4 at 440nm, which here has been interpolated to $\sim$0.25 at 550nm. I’d clarify this point.

-Figure 1: which is the solid and which is the dashed line? This should have a caption.

-Figure 21: the color bar from Fig 7 should be reproduced here; also there should be units added to the BC emissions shading.

-throughout the paper, I believe the singular form of “criteria” should be “criterion,” not “criterium.”

-Figures 6 and 7: captions say top/bottom, but should say left/right. Also “yearly”

-Figure 23: this figure could benefit from a 1:1 line to guide the eye.

-I also found many typos, misspellings, and minor grammatical errors throughout, some of which were mentioned by the other reviewers. I’d recommend a careful readthrough for such minor errors before publication. Some of them are below.

p. 1 Line 12: “is advocated instead”

p. 2 Line 14: “S16b In this paper” ?

p. 4 Line 7 “sun photometers”; Line 17 “sub-sampling”

Table 5: “southern”

p. 7 Line 14: “observations”

p. 8 Line 3: comma after Again; Line 4: “its”; Line 20 “Sahara and Saudi Arabia”

p. 9 Line 29: extra)

p. 10 Line 1: “cannot observe”.

p. 10 Line 20: “significant”

p. 11 Line 6: broken reference to Fig [I assume 18].

p. 11 Line 9: “many fewer observations are made”

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