Response to reviewer 1

We thank reviewer 1 for their detailed reading of the paper. Their numerous suggestions for textual improvements have almost all been applied. Reviewer 1 summarizes the paper as "clear and well written and interesting. "

Line 7 - Abstract - "2) their application to the evaluation of AEROCOM models." Should make a little clearer that no models were used in this paper. The first paragraph of the abstract does that but then this sentence muddies the waters.

Ok, we have rephrased this to read: "This study consist of two papers, the current one that deals with the assessment of satellite observations and a second paper that deals with the evaluation of models."

Line 2 (and line 56) "several satellite products of AAOD have appeared" maybe change 'have appeared' to 'have been developed'?

Ok.

Line 4 (also line 91) "super-observations" are they super because aggregated to 1x1x30min?

Yes, they are not better than the original observations but just aggregates. It's a common term in data assimilation.

Line 33 "The species that absorb most visible sunlight" change to "The species that absorb the most visible sunlight"

Ok.

Line 38-29 "In particular over bright surfaces (ice, deserts, clouds) can the forcing due to absorbing aerosol be significant" change to "In particular over bright surfaces (ice, deserts, clouds) the forcing due to absorbing aerosol can be significant"

Ok.

Line 41 "black carbon may affect the Hadley cell" affect how or what - Hadley cell circulation?

Yes, "circulation" now added.

Line 44 "absorptive aerosol" I prefer 'absorbing aerosol', but I'm not sure if there's official agreement on this!

We don't think there is an official agreement on this. However, we were inconsistent in our choice of words. We changed everything to "absorbing".

Line 47-50 - Could cite Laj et al. AMT, https://amt.copernicus.org/articles/13/4353/2020/, 2020 for these global surface absorption measurements. They present a review of the available data.

Ok.

Line 50 "Moreover, these are surface measurements." This is true, but perhaps should state why this is a problem? Surface insitu measurements do have advantages over AERONET and satellite

retrievals in that they operate continuously (day/night regard- less of clouds) and are less limited by loading requirements. They are definitely sparse though!

Ok. The sparseness was mentioned in the preceding sentence. We have now added "surface measurements that do not measure the full atmospheric column"

Line 64 "error prone" is it that they are more error prone or just more uncertain? (I'm

not a stats person so not sure those are the same or different!)

Uncertain is a better phrase. Replaced.

Line 62-70 perhaps comment on whether anything is known (or not) about bias in AERONET retrievals of AAOD/SSA rather than just on uncertainty in the retrievals?

That is a very good question, and an important one. However, my discussions with the AERONET team gave me the impression this is not clearly understood. As a result, the given uncertainties may be site-specific biases or random errors. In reality, they will probably be a bit of both. Our study suggests that satellite retrievals contain both biases and random errors (the latter amenable through averaging). I have added some explanatory text.

Line 72 "AERONET hardly covers" change to "AERONET only sparsely covers" or something like that.

Ok.

Line 84 "observational model datasets" change to "observational datasets"?

Thanks for spotting that.

Line 90 is 'L2' defined or a well-enough known abbreviation? later, on line 103, it's spelled out as level 2.

Within the satellite community it is well understood. We've added a brief explanation and a reference. L2 data are estimates of geophysical variables on the spatio-temporal sampling pattern of the radiances.

Line 96 therefor –> therefore

Ok.

Line 101 should 'MOC' be defined (and FL-MOC)? Also section header is 'FL-MOC' but the text in this section just uses 'MOC' but later in figures and text it's referred to as FL-MOC.

Ok.

Line 132 'provided' instead of 'provides'?

OMI stills operates.

Line 140 "also the fraction of spheres is included in the" change to: "the fraction of spheres is also included in the"

Ok.

Line 144 define BRDF?

Bi-directional Reflectance Distribution Function (https://en.wikipedia.org/wiki/Bidirectional_reflectance_distribution_function), a more realistic modelling of surface reflectance than the Lambertian assumption. Acronym is now explained in the text.

Line 156 "Aerosol is assumed an" change to "Aerosol is assumed to be an"

Ok.

Line 157 "aerosol components and are retrieved" change to "aerosol components which are retrieved"

Ok.

Line 158 define BPDF?

Bidirectional Polarisation Distribution Function, see als BRDF. Acronym now explained in text.

Line 158 "The aerosol is assumed a mixture" change to "The aerosol is assumed to be a mixture"

Ok.

Line 192 "Andrews et al. (2017) only had observations over two sites" Andrews 2017 did include comparisons of insitu flight profiles from other sites in addition to the two main sites they studied.

That is true. We've changed the text.

Line 231 change '&' –> 'and'

Ok.

Line 242 add comma after 'i.e.' also after 'e.g.' on various lines (question for editor?)

Apparently this differs in American (comma) and British usage (no comma). We'll stick with no comma for now.

Line 275 "Rocky mountains" change to "Rocky Mountains"

Ok.

Line 280 "The impact of AOD will later be discussed." change to "The impact of AOD will be discussed later."

Ok.

Line 284 extra space before the word 'which' in parentheses

Removed.

Line 316 "observations and was" change to "observations and so it was"

Ok.

Line 324 "underestimate AOD and AAOD" change to "underestimate AERONET AOD and AAOD"

Ok.

Line 324 "amount in case" change to "amount in the case"

Ok.

Line 326 product –> products

Ok.

Line 347 "have hard cut-off" change to "have a hard SSA cut-off"

Ok.

Line 350 put '2019a' in parentheses

Ok.

Line 360 "corrollary" check spelling - only 1 r? i.e., corollary

Ok.

Line 370 "satellite SSA still" change to "satellite SSA values still"

Ok.

Line 386 put 'in general' in commas: ', in general, '

Ok.

Line 402 "and use them to evaluate AEROCOM models" This line in the conclusions suggests that AEROCOM models are used in this paper. Perhaps rephrase and say "in preparation for evaluation of AEROCOM models" instead?

Ok.

Line 409 "could suggests" change to "could suggest"

Ok.

Line 410 "to obtain best" change to "to obtain the best"

Ok.

Line 416 In conclusions refer to 'AQUA dark target', but in text refer to AQUA-DT. Per- haps be consistent?

Ok. We now use Aqua-DT.

The appendix is weirdly interspersed with the figures.

I suppose this will improve with the final version but I'll keep it in mind.

Line 722 "observations of AOD" but then in next sentence require AOD and AAOD. Should it be "observations of AOD and AAOD"?

Yes, corrected.

Line 727 (and 733) "(here 30min x 1 x 1) exceeds" in the main text use format "1 x 1 x 30 min" make consistent, i.e., length x length x time or time x length x length

Ok, changed to 1 x 1 x 30 in appendix.

Line 735 "MAN data" It makes me laugh to ask, but what is MAN data? do you mean SAT data?

Maritime Aerosol Network, basically AERONET on ships, see
https://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html . Acronym now explained.

Throughout the text, the words 'criterion' and 'criterium' are used. I'm not 100% sure if they have exactly the same meaning or not, but they seem to be used same way. Maybe just choose one?

Criterion seems to be the correct one, unless one speaks of cycling in which case criterium is a valid possibility https://en.wikipedia.org/wiki/Criterium .

Figure 5 - indicate what the slashes on the Taylor diagram points represent.

These indicate biases (normalized to the standard deviation in the reference dataset), see also Sect 3.1. Explanation and reference to Sect. 3.1 now included.

Figure 7 - what are the 'remainder' sites if they are not land or ocean? Remainder sites not mentioned in text. Also explain what 'OLSB s' is in figure legend (the rest of the abbreviations in the legend list were obvious)

These sites cannot be identified as ocean or land according to our criterion, e.g. cases where 50% land and 50% ocean. "OLSB s" stands for Ordinary Least Squares Bisector slope. It appears a small section on error metrics was dropped from the text and has now been included again.

Figure 8 - "products used Schutgens" change to "products used in Schutgens"

Ok.

Figure 9 - "except right-most column" change to "except the right-most column"

Ok.

Figure 11 - work on arrangement of plots and make sure x-axis label shows on all of them

In the final version, these figures should appear in a single column and only the bottom figure will have a visible x-axis label and values.

Figure 12 - larger font at top? changing text so not angled might provide more space

This is difficult to do without making the bottom labels spread all over the page. The figure is meant for a single column or it would take up a lot of white space.

Figure A2 - caption says "both observations and model data in this paper" but there was no model data in this paper.

Corrected.