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Interactive comment on "Evaluation of satellite-based aerosol datasets and the CAMS reanalysis over ocean utilizing shipborne reference observations" *by* Jonas Witthuhn et al.

Anonymous Referee #4

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The paper discusses aerosol optical depth observations from ships. The calibration and retrieval techniques for a shadowband radiometer are revised to improve agreement with simultaneous sun-photometer measurements, removing a fractional bias. The new dataset is used to evaluate products from the MODIS and SEVIRI sensors. The former is, unsurprisingly, found to be more precise, but both overestimate the Angstrom exponent, with SEVIRI being out by up to an order of magnitude. The CAMS aerosol reanalysis is similarly evaluated, finding it eliminates much of the bias in the underlying MODIS data.

The paper is suitable for publication in this journal. Current satellite retrievals show

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signficant disagreement as to the average AOD over remote ocean and the data provided by this study should be invaliable in resolving that discrepancy. I hope the authors can place their data in a publicy available repository — I am eager to use it in the evaluation of my own satellite products!

I have a few minor few comments that warrant the authors' attention:

- Though I am fond of your analysis in Fig. 9, I disagree with the scope of your conclusions with respect to the information provided by SEVIRI.

  – By using the name of the sensor to refer to a specific dataset, you imply that your conclusions apply to *all* SEVIRI aerosol products. If one could produce a more accurate aerosol product from SEVIRI, that would provide useful information. You don't present sufficient evidence that all possible SEVIRI products provide minimal additional information.

  – Your wording is fairly definitive: 'only offer minor benefits compared to the use of polar-orbiting satellite platforms'. The circumstances where aerosol changes rapidly, such as plumes or the passing of a frontal system, are scientifically very interesting and exactly the sort of circumstances that geostationary imagery are absolutely vital in understanding. Geostationary observations might not add much to our understanding of the climatology of AOD, but this doesn't mean that they only provide minor benefits; they provide targetted benefits.

  – You only evaluate the representivity of observations between the two MODIS overpasses. This omits the periods of boundary layer growth and collapse in the morning and evening, which current polar orbiting satellites do not observe.

  There is no need to perform additional analysis, but your conclusions should be reworded to be clearer about their breadth.

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- I am surprised by the repeated implications that laboratory lamp calibration is inadequate. Calibration in a controlled environment is usually held up as the gold standard of observational atmospheric science. Did the authors mean to imply that such calibrations are insufficient to produce a scientifically valid product (e.g. 'limited accuracy')? I would find that difficult to believe.

  I suspect what was meant is that there is an intrinsic difference between what a sun-photometer and shadowband radiometer measure. That limits the extent to which they could ever agree without additional correction methods, such as those outlined in this paper.

- I'm not convinced by the explanation in §4.2 of the narrow, highly biased observations of AOD $\simeq 0.3$ in Fig. 4 as I can't see why the choice of aerosol type would only affect one range of AODs. Are there an anomalously small number of collocations in those conditions or are they clustered in a small area? If you loosen your quality control conditions, does the distribution more closely resemble the typical behaviour?

- Are the outliers identified at page 11 (line 344) excluded from further analysis? That seems satistically suspect, as we expect large deviations to occur occassionally by random chance.

- I found it strange that Fig. 1 implies that only maritime and dust aerosols were observed while Fig. 2 shows that mixed and continental were ocassionally encountered as well.

- Fig. 7 is a compelling way to present the limitations in the retrieval of Angstrom exponent. In a future paper, it would be interesting to see a study of the implications of your results on the Aerosol Index, which is widely used as a proxy for cloud condensation nuclei in studies of aerosol-cloud interactions.

- At L540, is an increase from 0.90 to 0.92 really evidence of a 'clearly superior' product? That doesn't seem a particularly significant shift.

- On page 21, the EarthCARE lidar isn't itself that 'unique'. It's unique that said lidar is being flown collocated with an imager and radar.

- Your discussion about CAMS in §4.3 would be improved if you mention that the inputs to a renalysis system must be bias corrected before input to ensure a stable assimilation of the data. Hence, the reduction in bias is to be expected (but remains evidence of the utility of the CAMS product).

- In Fig. 3, is the sharp transition from maritime to dust aerosols at 0.18 a true feature of your data (which would be concerning) or a feature of plotting the orange points over the blue ones? If the latter, perhaps add some transparency, so the transition is easier to see?

- In point (ii) of the appendix, you change the method for filtering perturbed observations. What motivated this choice? In undergraduate labs, I teach my students to throw out any observation for which the method was suspect as making a correction involves a number of assumptions. Why do you feel the need to keep some corrupted observations here?

I also include some technical comments and corrections. P1L2 means line 2 of page 1.

P1L16 similar performances for both datasets

P2L39 e.g. from ships are available

P2L57 Does 'earth' need to be capitalized?

P3L79 complex, non-spherical shape

C4

P4L109 These findings are understood in the context of the results found for the SEVIRI aerosol product to observe

P4L119 Add a space after the comma.

P4L124 are publicly available

P5L133 reference: the sunphotometer

P8L251 of ± 30 min have been used

P9L257 distance angle less than $0.2°$

P9L272 the analyses are

P10L303 Perhaps add 'to ensure the' after 'compensated for'? It means something slightly different but is what I think you meant to say here.

P12L373 Add a space after 'Table'.

P16L513 The wrong style of reference is used.

P16L518 I don't know what you meant to say by 'follow up'.

P20L627 has channels only at

P20L640 products can provide a

P21L672 with the next few years collocated with an imager and radar.

Tab.5 collocated data points. Listed

Fig.1 The aerosol classification method

Fig.8 requirement for simultaneous . . . figure also shows CAMS RA