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Interactive comment on "Intercomparison of satellite retrieved aerosol optical depth over ocean during the period September 1997 to December 2000" *by* G. Myhre et al.

G. Myhre et al.

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Response to Reviewer 2. We thank the reviewer for many constructive suggestions for improvement of our paper

General comments

Some (but by no means all) satellite specific limitations are introduced (e.g. threshold cutoffs for SeaWifs, large pixel size for TOMS or GOME, or poor statistics of MISR). These limitations should be an additional item in Table1 and also should appear in figure captions comparing uncorrected aot retrievals. Clearly preferred is a harmonization (e.g. like to a common wavelength), that takes account of these deficien-

cies (surely Seawifs aot has to be low in many regions, if the aot maximum is set to 0.3). Even the minimum requirement for global ocean coverage is not always fulfilled (GOME/ATSR) and differences between MISR and MODIS and especially between MODIS and AERONET are belittled.

Response: There are many limitations in the retrievals used in this study. We have strengthened the focus on these by including an additional item in Table 1 on limitations. To investigate the uncorrected AOD retrievals, as suggested, is a good idea, but we regard this to be beyond the scope of this paper.

The entire comparison, as it includes some strongly biased retrievals, leaves the wrong impression that there is large uncertainty among satellite retrievals for aerosol optical depths over oceans, while in fact these differences are largely driven by deficiencies of retrievals method and a-priori assumptions. I strongly recommend to clearly identify deficiencies and even better to correct for comparability (if possible) any biased data-set. Along those lines I like to see a recommendation, what data-set to use (pre-2000 and past-2000) and what uncertainty to expect by region and season. There should not be a fear that some co-authors take offense, as long as with (even with their help, such as for MISR) weaknesses and strengths are explained and demonstrated.

Response: To make this point clearer in our paper we have added a sentence in the abstract to describe that some of the differences found in the retrievals are due to deficiencies specifically mentioned by the reviewer. The reviewer is of course right that 'Part of the differences can be explained by limitations and deficiencies in some of the aerosol retrievals'. We also agree with the reviewer that an assessment of the various methods would be of great interest. However, the emphasis of this work is more limited, namely to point out similarities and differences between satellite aerosol retrievals. However, clearly such an assessment would have been very useful.

Finally, I regret that the authors only tackled the easiest retrieved aerosol property (aot over oceans) and left out comparisons of the spectral dependence (Angstrom

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parameter, thus size) and especially any efforts to compare retrievals of aerosol optical depths over land.

Response: Again we agree with the reviewer that additional comparisons would have been valuable. However, in this study we have chosen to focus on AOD over ocean, since AOD over land is only available for MODIS, MISR and for some limited regions GOME/ATSR. As suggested by the reviewer, clearly a comparison of AOD over land is needed, but we will leave that to future investigations.

Minor comments

- The last sentence of the introduction promises to explore differences of aot for certain satellites ˇ E.but somewhat such a summary is missing. A table summarizing findings in a more general sense (remote, dust-, biomass-, urban- outflow) satellite by satellite would be great, maybe in reference to MODIS or to AERONET.

Response: In our opinion most of the 'Summary and Discussion' already summarize the issues mentioned here, so that a separate table should not be necessary. Perhaps we have promised too much in the last sentence of the introduction. We have removed this sentence.

-Table1 needs an aditional item on limitation and how this limitation is likely to impact the aot retrieval - also based on comparisons of this paper.

Response: Such an item is included in Table 1 to strengthen the focus on the limitations of the retrievals.

- info on page 8206 is very important, but can be condensed with an appropriate addition to Table1. The TOMS wavelength conversion is not quite clear. Remember it is not only the size that changes but also the absorption-especially for dust (O.Torres has a 550nm product based on his assumed aerosol model, which may be a better choice to use). Also isn't there also an Angstrom limit for Seawifs?

Response: P8206: We have added some information on the conversion of the TOMS

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data. To some extent the Angstrom coefficient is of importance as the limit of 0.3 is for 865nm and we use 550nm in all comparisons

- Comparing strong local statistics to poor statistics for large regions (mainly here with the center >100km off in one direction) will at best allow very general conclusion - not to speak of the case when the local site is characterized by local pollution.

Response: A new sentence is added to address this point: 'Local pollution may also cause differences between AERONET and satellite retrievals.'

- on page 8209: wouldn't we expect background contamination with the large pixels of TOMS, that is, if we want any data at all? On line 25 the 20-30deg low aot feature looks like a humidity effect. How does the dust outflow off Africa fit into this picture?

Response: To address this issue the following sentence is added: 'Aerosol outflow from Africa, relatively high AOD in the Indian Ocean, and high AOD at higher latitudes fit into this picture.'

- on page 8210: explain the statement in the last sentence, as the assumptions on absorption (and often on size) in retrievals are usually pre-defined. Different sampling IS a problem, so some info on regional or monthly sample number statistics would help put results into their place.

Response: This is an important point. We have added the following: 'For a high temporal variation in AOD sampling issues are especially important. Further, variation in aerosol type and mixture may be problematic since most of the retrievals have predefined assumptions on absorption, and in many cases also on size.'

- AERONET aot data (direct measurements) are certainly more accurate than retrievals (this can be stated!)

Response: The paragraph referred to could be somewhat misleading and it is deleted

- What do you want to say in the last sentence of chapter 2? How does it relate to aot

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retrievals?

Response: This sentence has also been changed, see comment above

- on page 8213 line 17: the sentence is difficult to understand.

Response: P8213, L17: The sentence is changed also to make it easier to understand

-Figure 1b illustrates why the GOME/ATSR2 retrieval really is not global in the sense of other retrievals with very poor spatial coverage (Did you ever consider to plot global difference plots (sat minus sat) with respect to MODIS -which I consider the best choice. This will nicely illustrate problem areas.)

Response: Both reviewers indicate that there are too many figures and thus we hesitate to including additional ones. Note also that some comparisons asked for have been included in Figure 2 and 3.

- in the captions of Figures 2,3,4 I would mention the expected biases for comparisons to AERONET, which are shown later (expected to convey that aot differences are much smaller than these figures indicate)

Response: We are sorry that we do not see the need to refer to AERONET in these figures. In our opinion this issue raised by the reviewer is clearly and strongly enough dealt with elsewhere in the manuscript.

- Figure 6 correlations refer to monthly averages with different time-sample. As sampling is generally low (large pixel [you may want to indicate, how many pixels contribute for each region], few overpasses) and overpass times usually disagree, these data can be best taken in a relative sense, indicating that TOMS, MISR and AVHRR2 are outliers (if the MODIS data are the 'trusted' reference over oceans). Thus, as the general information is contained in Figure 5, I would leave out Figure 6.

Response: We find the information in Figure 6 to be very important in identifying regions with similarities and differences, as it presents a quantification of correlations

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which is not included elsewhere.

- Figure 8 can and should be utilized to somewhat quantify regional and seasonal retrieval biases, which eventually can be the basis for a recommendation on data-sets to be used. The statistical summary in Figure 9 somewhat contributes, but I would leave out satellite data with poor statistics and taking the global average diffuse some of the biases seen in Figure 8.

Response: This is a very good suggestion for work to be done, but again recommendations on which satellite retrieval to be used are considered to be beyond the scope of this work.

- Appendix A: Based on the scatter plot A1b there appears to be a high aot MODIS bias, especially if optical depths are low - while the text talks about general agreement. In Figure A1c it also may be of value to show the y-axis intercept, if correlations are high to demonstrate biases.

Response: The issue in Figure A1c is to show that MODIS grid cell average data behave similarly to MODIS data in the grid cell centre in our analysis. The weak overestimation for small AOD which the reviewer points to here is already shown in the AERONET comparison in the main text in the discussion of Figure 10.

- To compare local AERONET statistics not only to 3*3deg data but also to 1*1deg data is a big stretch. Problems are expected for polluted sites (e.g. Arica) and the fact that ocean retrievals are linked generally only in one direction to the 'near-coastal' land data.

Response: We find this as an important point and a new sentence is added: 'Local pollution may also cause differences between AERONET and satellite retrievals.'

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 8201, 2004.