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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multi-Satellite Retrieval of SSA using OMI-MODIS algorithm" *by* Kruthika Eswaran et al.

Anonymous Referee #2

Received and published: 13 August 2018

Comments on acp-2018-564

Dear Editor,

Eswaran et al. paper submitted to AMT presents the new results on the retrieval of aerosol single-scattering albedo (SSA) over the global ocean derived from OMI-MODIS synergy algorithm originally developed by Satheesh et al. [2009]. The synergy algorithm takes advantage of better cloud screening of MODIS AOD retrievals combined with the better sensitivity of the near-UV spectrum to infer the aerosol SSA. The methodology of the retrieval essentially relies on that already published in Satheesh et al. [2009]. The author finds that OMI tends to overestimate SSA when the layer of absorbing aerosol resides closer to surface. The discrepancies in the SSA between the present retrieval dataset and that reported in the operational OMI/OMAERUV aerosol

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product are attributed to the data discontinuity in the aerosol layer height climatology dataset used by the OMAERUV algorithm. The SSA retrieval dataset derived from the present algorithm has been claimed to be in better agreement when compared against the equivalent cruise-based measurements.

The content presented in the paper assumes important in estimating the radiative effects of aerosols for which accurate knowledge of aerosol SSA and layer height is a prime requirement along with the total aerosol loading.

A similar study carried out by Gasso and Torres [2016] presents the results on deriving SSA and ALH from OMI-MODIS synergy and discusses about the role of cloud contamination in OMI aerosol retrievals, which author misses to explain in greater details. A discussion highlighting important findings of Gasso and Torres [2016] and its (in)consistency with the new results presented in the paper is required. The paper requires some significant revisions at several places identified in the specific comments listed below and needs finishing on the language and presentation aspects, where I think both senior-level co-authors can step in and help to improve the manuscript further.

The author fails to mention which version of the OMI aerosol product they are using in the present research. I assume here that the latest OMAERUV version 1.8.9 has been employed here to derive the results. If not, the author needs to redo the entire analysis with the most recent dataset which incorporates a number of changes applied to the previous version of the algorithm.

I would be available to review the revised manuscript once authors provide their detail response to the following concerns with necessary changes included in the revision. Please share this letter with authors; it will be helpful in the improvisation of the submitted the manuscript.

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Specific comments:

A similar study carried out by Gasso and Torres [2016] presents the results on deriving SSA and ALH from OMI-MODIS synergy and discusses the role of cloud contamination in OMI aerosol retrievals, which author misses to explain in greater details. A discussion highlighting important findings of Gasso and Torres [2016] and its (in)consistency with the new results presented in the paper is required.

Citation: Gassó, S. and Torres, O.: The role of cloud contamination, the aerosol layer height and aerosol model in the assessment of the OMI near-UV retrievals over the ocean, Atmos. Meas. Tech., 9, 3031-3052, https://doi.org/10.5194/amt-9-3031-2016, 2016.

Which version of the OMAERUV product does author use in the present study? I assume here that the latest OMAERUV version 1.8.9 has been employed here to derive the results. If not, the author needs to redo the entire analysis with the latest dataset which incorporates a number of changes applied to the previous version of the algorithm.

Introduction: A statement or two citing importance of SSA in estimating radiative forcing with appropriate reference would be needed in the introduction. Figure 5 can be used as a reference. Line 52-55: Author has completely forgotten to mention about the long-term record of aerosol absorption retrievals from AERONET! Line 55: Remove "images". Line 63-65: It is assumed here that the author is referring to the AOD retrievals from satellites. In this case, the statement "they still have a limited success over deserts" is untrue; AOD retrievals over bright surfaces from the near-UV, Deep Blue, and MAIAC algorithms have achieved a great success in retrieving accurate AODs. Line 67-69: What do the "large surface reflectance contrasts" means? Line 72: The sub-pixel cloud contamination is a result of the larger footprint of size 13 x 24 km-square. Line 76: The time difference between the observations from OMI and MODIS is about 7-8 minutes post-2008 period. A brief discussion about the OMI-MODIS com-

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bined retrieval approach is needed here.

Section 2.1 First paragraph: In addition to the higher sensitivity to aerosol loading and its absorption properties, the 354 and 388 nm wavelengths have negligible interference from trace gases. “sulphate-based” aerosol type was a gross terminology used for the boundary layer aerosols; it should be changed to “background and urban-industrial” aerosol type. Line 111: Rephrase the sentence as “the retrievals are performed reported for the five discrete aerosol layer heights, i.e., surface (exponential profile), 1.5, 3.0, 6.0, and 10.0 km with latter four following a Gaussian distribution. The final set of AOD/SSA/AAOD retrievals is reported at the mean ALH provided by the 30-month long averaged climatology developed using OMI-CALIOP combined observations.” Line 120: “have helped distinguish carbonaceous aerosols from dust particles” Line 126: “An effective aerosol layer height was calculated using the CALIOP 1064 nm attenuated backscatter weighted by corresponding altitudes” Line 128: “..in the OMAERUV retrievals which then validated against the AERONET observations”

3. Algorithm MODIS aerosol product reports retrievals at 10 x 10 km spatial resolution at nadir. Line 160: “..prone to sub-pixel cloud contamination which may result in overestimation in AOD and SSA” Line 163: The high accuracy of size-resolved aerosol retrievals with MODIS is because the over-ocean algorithm employs all seven channels (0.47-2.13 micron) in the inversion enabling better characterization of fine and coarse particles. Line 169: “..constraints the retrievals of AOD and SSA” Line 179: Does the algorithm use Angstrom Exponent retrieved by MODIS over the ocean?

Section 5. Results Line 214-215: not a phenomenon, but the instrumental issue. While a brief discussion on row anomaly is provided in Jethva et al. [2014], Torres et al. [2018] discuss it in great details and its effect on the scan dependency on the OMAERUV retrievals. Citation: Torres, O., Bhartia, P. K., Jethva, H., and Ahn, C.: Impact of the ozone monitoring instrument row anomaly on the long-term record of aerosol products, Atmos. Meas. Tech., 11, 2701-2715, https://doi.org/10.5194/amt-11-2701-2018, 2018.

Section 5.1 The differences could also be attributed to the shape of the dust particle. In the latest OMAERUV (V1.8.9) algorithm, dust is assumed to be of spheroidal shape with axis ratio distribution adopted from Dubovik et al [2006] study. Please refer to Torres et al. [2018] AMT paper; the citation is provided earlier in this report.

Section 6. Summary and conclusion In addition to the sub-pixel cloud contamination and ALH, an uncertainty in prescribing surface albedo is another source of error in the retrieval of SSA from space. 3. Is OMI unable to retrieve absorbing aerosols for low ALH or does retrievals but under/over-estimate SSA? 5. Provide the statistics of the cruise vs. satellite comparison.

Figures: Figure 1. Since the dynamical range of SSA variations in these maps is confined to 0.85-1.0, a narrower color scale covering this range would be desirable. Figure 2. For the most part, SSA retrieved from OMI-MODIS synergy is larger than that retrieved from OMI only. Figure 4. From where does the author get ALH difference of 8-10 km? Figure 8. Add the measures of agreement, i.e., N, RMSD, correlation

A plot demonstrating the effect of a change in AOD on the change in SSA either through radiative transfer calculations or from satellite data is needed here. The author may choose a representative region here, say the tropical Atlantic Ocean with dust transport from Sahara for such analysis.

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