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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observation of absorbing aerosols above clouds over the South-East Atlantic Ocean from the geostationary satellite SEVIRI – Part 1: Method description and sensitivity" *by* Fanny Peers et al.

Anonymous Referee #2

Received and published: 11 February 2019

General Comments:

The paper describes what looks to be a promising method to simultaneously retrieve above cloud aerosol optical depth with cloud optical depth and effective radius from the Spinning Enhanced Visible and InfraRed Imager (SEVIRI). While the technique used is not tremendously novel, the application to geostationary data appears so, and the recognition of the impact of varying water vapour in particular on the measured satellite signal and hence the retrieved quantities shows good insight.

My own feeling is that the paper is a little 'thin' and actually would have benefited from including some of the material that I anticipate will be in the companion manuscript. Moreover, even if some of these comparisons are included here, given the title I think the paper has to encompass or at least discuss the full range of likely sensitivities that could be present in order to either show more generalised utility or to identify when the method will work optimally.

If this is done I see no reason why the work should not be published.

Specific remarks:

Some aspects of the methodology are not clear. I assume that in working out the aerosol model parameters you first fit the size distribution, then iteratively adjust the refractive indices until you fit the EXSCALABAR measurements of SSA, assuming that the biomass aerosols are spherical. Is this correct? If so I think you must: (a) provide some error bars on the size distribution and SSA observations in figure 4. These could then perhaps be used to give a realistic range in the size distribution parameters and the complex refractive index that you have selected. At the moment the reader has no feel whether it is sensible to try to match the EXSCALABAR data as well as you have. (b) justify the assumption of Mie scattering

Does EXSCALABAR extend further than 0.65 microns? This would give more confidence in the final aerosol model both in terms of the size distribution and complex refractive index at the longer SEVIRI channel wavelengths. The assumption of a fixed refractive index with wavelength seems quite large.

You seem to assume a fixed aerosol and cloud layer height. Is this realistic and what impact does it have if the 'real' heights are different (i.e. did you actually investigate the impact of varying these heights – you imply it is negligible)?

It is good that you have investigated the impact of variations in humidity on the retrievals via your correction process but you are limited to the baseline set of atmospheres

contained in the case study you have selected. Are the retrieval errors likely to be of the same order of magnitude if these conditions change? Or how sensitive are you to both the total amount and vertical distribution of water vapour? What about uncertainty in the cloud top height (line 180)? I believe it is quite challenging to (a) detect and (b) accurately locate low cloud over ocean using thermal IR radiances.

Similarly, are you sure that you have considered a wide enough variation in aerosol model parameters? You don't really justify the choices that are made for the perturbations applied. Lines 364 and 365 imply that there should be a variation in the aerosol properties in the study region but you don't tie these to the perturbations you have implemented.

AAOT rather appears from nowhere at line 350. I think it would benefit from at least a small introduction. Before this, all the focus has been on AOT. Line 373 implies that changing the imaginary part of the refractive index results in a very large perturbation to the AOT retrieval (where does the 39 % actually come from – not obvious from the scatter plots which have points that look like there is a higher difference). You imply that the impact is much smaller on the AAOT but do not really clearly explain why. I think I have worked it out but it is not immediately apparent from the text so I suggest a little rewrite here.

Are you sure that your uncertainty terms in equation 4 are independent? I would think not given how (I think) the size distribution and refractive indices have been derived. Moreover, even if they are independent, this is only the uncertainty due to the aerosol model. Uncertainty in the water vapour correction (and cloud top height) will also inflate the uncertainty in the final retrievals. Are these combined anywhere?

In line 382 you state the aerosol model uncertainty as 31 %. It's not immediately obvious how this is consistent with your earlier statement that the uncertainty from the imaginary part of the refractive index can reach 39 % so how do you arrive at this number (could be due to absolute values but it would be nice to be clear)?

I find the evaluation of the retrievals a little lacking. The comparisons to AERONET and MODIS in section 3(a) are very qualitative. It seems obvious to at least include the equivalent MODIS retrievals in figure 12 simply to give some idea of the quantitative consistency between these and the SEVIRI estimates even if it is not clear which, if either, estimate is correct. This should still leave plenty of scope to enlarge on these comparisons in the planned companion paper.

I think the linear trends in Figure 12 add nothing. I'd much prefer to see the individual standard deviations and perhaps even the estimated uncertainty (which are not the same).

Technical Corrections:

At some point early in the manuscript please identify the wavelength(s?) of the COT and AOT retrievals.

Line 48: You've been talking about effect but here you mention forcing. They are not the same. 'of up to'

Line 59: Here I think you are talking about the aerosol indirect effect. It would good to say this explicitly for consistency with the next sentence.

Line 70: Not sure why 'Aerosols Above Clouds' is capitalised.

Line 86: '. . .cloud cover over the SEAO has an. . ..'

Line 124: I appreciate the terms may have been defined elsewhere but I think it would be good to explicitly give the definition here.

Line 129: follows

Line 132: actually from figure 1 there does seem to be some dependence on COT.

Line 143: 'increases the SWIR'. Actually you do not explicitly define NIR and SWIR in terms of wavelength range. This would be helpful. Or lose the terms entirely and just

use the wavelengths.

Line 166: please explain ‘two-way transmittance’ – from where to where? Why is the two-way transmittance important?

Line 228-233: Not really enough detail on ‘weighting’. Someone would struggle to replicate what you have done from this info alone.

Line 255: For the uninitiated it might be useful to say where SAFARI was.

Line 309: ‘typically observed in this region’ – as shown by who exactly?

Line 322: Can you provide a reference for this statement please.

Line 473-474: This isn’t immediately obvious to me. Can you clarify? Obviously you could use a different aerosol model in the LUT but this wouldn’t be ‘easy’.

Figure 5(b): You have lost the latitude labels

Figure 7-11: y-axes labels. Suggest adding 1-1 lines.

Figure 12: Add time basis (e.g. UTC).

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