

## ***Interactive comment on “Comparison of south Atlantic aerosol direct radiative effect overclouds from SCIAMACHY, POLDER and OMI/MODIS” by Martin de Graaf et al.***

### **Anonymous Referee #2**

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This short study is a comparison of above-cloud aerosol direct radiative effects estimated by three methods applied to three satellite sensors or combinations of sensors (POLDER, SCIAMACHY, and OMI/MODIS). Looking at two days in August 2006 and at daily averages over 4 months in 2006, the authors find sizeable differences between the three sets of estimates, with POLDER retrievals producing significantly stronger radiative effects. Those differences are reduced when correcting for sampling differences. The remaining differences can be explained by differences in aerosol and cloud optical thickness, with cloud optical thickness being the dominant cause.

The study is of interest to the wider aerosol community because aerosol modellers

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have now begun to use above-cloud aerosol retrievals to compare against their models, and large differences between observation-based estimates weaken observational constraints. This study is hopefully a first stage to eventually reconciling the different estimates. The paper is generally well-written, although language editing will help in places, and Figures and Tables illustrate the discussion well.

My main criticism of the study is that it does not attempt to bring additional information to resolve the disagreement. The discussion can also be improved in places. I recommend major revisions because addressing my main comment will probably require additional analyses.

## 1 Main comment

- The study concludes that differences are mostly caused, once the effect of sampling has been accounted for, by differences in cloud optical thickness (COT) retrievals between the instruments. Differences in aerosol optical thickness (AOT) also play a role, especially at longer wavelengths. But it would be most useful to know which dataset does best. Retrievals of AOT in nearby clear-sky regions, or using CALIOP, or even nearer the sources by AERONET should help determine whether the large AOTs (almost 2) retrieved by POLDER are realistic. Similarly, differences in retrieved COT are large enough to determine whether POLDER is realistic or not by comparing to CALIOP or passive retrievals, e.g. from SEVIRI. Adding such an analysis would make the study a more ambitious, and ultimately more useful, contribution.

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## 2 Other comments

- Page 1, line 15: The statement “The effects of atmospheric aerosols are especially uncertain” repeats the first sentence and can be deleted.
- Page 1, line 21: I acknowledge that the terminology of aerosol direct, indirect, and semi-direct effects is now well known by the wider atmospheric science community, but I recommend defining them anyway for the sake of completeness.
- Page 2, line 2: “which can be characterized relatively well” sounds like an instance of concluding too quickly!
- Page 2, line 5: Caution: the use of “forcing” in the sense of Forster et al. 2007 implies that the unperturbed values correspond to pre-industrial conditions. In the present study however, unperturbed values are for an aerosol-free atmosphere, so to avoid confusion I recommend avoiding the word “forcing”.
- Page 2, line 33: Myhre et al. (2013) is not the correct reference for that statement, as that paper only refers to global averages and does not isolate cloudy-sky radiative effects. I think the authors mean Figure 2 of Zuidema et al. (2016) doi:10.1175/BAMS-D-15-00082.1 . The same comment applies to Page 13, line 28.
- Page 3, line 15: “Finally, the . . . using an RTM.” That has been said already.
- Page 3, line 16: “highest yet”. What do you mean? Over which period are you making that statement?
- Page 5, line 4: “(from models)”. Be more specific.
- Page 6, section 2.4: Isn't it possible to get an error/uncertainty for the POLDER product?

- Page 7, lines 3–4: How were the two cases selected?
- Page 7, section 3.2: That section is confusing. It goes back and forth between case studies and monthly averages. I suggest starting with case studies, then discussing the implications for longer time averages.
- Page 7, lines 30–31: “even of area-averages”: I do not understand that statement.
- Page 9, section 3.2.1: The comparison protocol is unusual. The usual method is to regrid higher resolution datasets on to the coarser grids. The reason for doing like that is that the higher resolution represents variability within the coarser grid-box, so it is safe to make an average. But the authors do the other way around, replicating coarser values to fill the higher-resolution grid. Why that choice?
- Page 11, line 3: “it has been shown” requires a reference.
- Page 11, section 3.2.3: Why not show 12 Aug 2006 on Figure 5? The DRE difference is even larger on that day, which should help identify differences in COT as the main cause.

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