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Atmospheric Measurement Techniques
Discussions

Interactive comment on "Multi-modal analysis of aerosol robotic network size distributions for remote sensing applications: dominant aerosol type cases" *by* M. Taylor et al.

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The topic of this paper caught my eye as interesting and so I took a brief read through and passed the link to colleagues for their interest. While reading, I noticed similarities between the introductory text and a recent paper of which I was lead author (Sayer, A. M., A. Smirnov, N. C. Hsu, and B. N. Holben, 2012, A pure marine aerosol model, for use in remote sensing applications, *J. Geophys. Res.*, 117, D05213, doi:10.1029/2011JD016689).

Specifically, the Introduction on page 10753 of the submitted manuscript by Taylor *et al.* begins:

"Satellite retrievals of aerosol optical depth (AOD) and related parameters typically require the use of prescribed models of aerosol size and composition. In particular, the aerosol volume size distribution (AVSD) and the spectral complex refractive index are needed to compute properties such as the scattering phase function, the single scattering albedo and the extinction coefficient, which are in turn used to calculate quantities such as the total AOD from the columnar abundance. In general, the information content of measurements from current satellite radiometers is insufficient to unambiguously retrieve all these parameters particularly when the (spectral and directional) behavior of the surface reflectance is unknown (Hasekamp and Landgraf, 2007). For this reason, aerosol retrieval algorithms employed by most of these sensors are required to make assumptions about microphysical properties. The consequence is that these assumptions then contribute to differences in retrieved AOD – even in the idealized case of a black (non-reflecting) surface (Kokhanovsky et al., 2010)."

For comparison, the first part of the first sentence of the abstract of Sayer *et al.*, (2012) begins:

"Retrievals of aerosol optical depth (AOD) and related parameters from satellite measurements typically involve prescribed models of aerosol size and composition,"

The introductory paragraph of Sayer *et al.*, (2012) reads:

"The size distribution and spectral complex refractive index of aerosols are needed to compute properties such as their scattering phase function, single scatter albedo,

and extinction coefficient, which are in turn used to calculate quantities such as total aerosol optical depth (AOD) from column abundance. In general, the information content of measurements from current satellite radiometers is insufficient to unambiguously retrieve all these parameters, particularly when the (spectral and directional) behavior of surface reflectance is unknown [Hasekamp and Landgraf, 2007]. For this reason, aerosol retrieval algorithms employed by most of these sensors are required to make assumptions about aerosol microphysical properties, and rely on a set of predefined aerosol models or components. The assumptions in these aerosol retrieval algorithms contribute to differences in retrieved AOD, even in the idealized case of a black (non-reflecting) surface [Kokhanovsky et al., 2010]."

The authors do cite Sayer *et al.* (2012) several times in their study, and we are pleased that the authors found our study useful for their research. Better ways to parametrise aerosol microphysical/optical properties for various scientific applications are useful and, following a second thorough read through, I may offer some more specific comments and suggestions on Taylor *et al.*'s study in the future. However, in the meantime we first suggest that the authors revise the opening of their Introduction, as it appears that much was copied verbatim from our prior study, which we do not feel is good practice.

I also had a few questions/comments at this stage about the analysis, mostly relating to the marine data. If my reading is correct, the authors have taken the AERONET/GOCART time series and extracted one AERONET inversion for each type corresponding to the case where GOCART suggests a single aerosol type for that site is most dominant (as given in their Table 1), rather than looking in a more climatological sense. I ask as several references are made in the submitted manuscript to the double-humped coarse mode at the marine site (Lanai). In our multi-site analysis of AERONET-derived climatological aerosol properties at marine

stations we did not observe this double-hump (Figure 3 of Sayer *et al*., 2012), merely the 'long tail' which Taylor *et al.* also comment on. However, in our study we were looking at climatological properties in 'clean marine' conditions rather than single cases, which may explain this difference. So I am curious as to how common this double-humped coarse mode feature might be, and whether it is linked in GOCART with any particular aerosol species-dominance (for this case it looks like GOCART is saying the fine mode is mostly sulphate and the coarse mostly sea salt?

As the submitted manuscript seems mostly a description of this technique applied to four different aerosol 'type' cases it is perhaps less important here, but as GOCART is not perfect (as indeed no dataset or model is), by picking a single case study which GOCART estimates to be the most 'pure' (in the sense of dominated by a single component in the model) there is a danger that the authors or readers may overgeneralise the results. In that sense it would be interesting to look at the results for, say, the top 10 or 50 'pure' cases for each site and see whether you draw the same conclusions from the ensemble as from the individual 'top case'. This may also help mitigate the effects of the uncertainties on individual AERONET retrievals on the analysis (maybe you could see how variability on the retrievals in these cases compares with the expected level of error on the AERONET inversion). I am not an expert on the GOCART model and so cannot comment on the reliability/utility of its aerosol composition results for these specific sites investigated, but as natural sea spray aerosol is more than just sea salt (for example O'Dowd, C. D., and G. de Leeuw, 2007, Marine aerosol production: A review of the current knowledge, *Philos. Trans. R. Soc. A*, 365, 1753–1774, doi:10.1098/rsta.2007.2043, and de Leeuw, G., E. L Andreas, M. D. Anguelova, C. W. Fairall, E. R. Lewis, C. O'Dowd, M. Schulz, and S. E. Schwartz, 2011, Production flux of sea spray aerosol, *Rev. Geophys.*, 49, RG2001, doi:10.1029/2010RG000349 for recent reviews) it could be that some other method of selecting case(s) for analysis could be considered for marine aerosol.

Related to the above, it is likely that in general coastal/island AERONET sites in the northern hemisphere may have a greater background 'non-marine' component from transported continental aerosols than those in the southern (although doubtless there are 'pristine' days in the northern hemisphere and so picking an appropriate day for a case study would mitigate this). We found Tahiti (17.6° S) to be a useful southern-hemisphere island AERONET site with reasonably good data record in our previous analysis on climatological properties of marine aerosol from AERONET. The authors may wish to consider this as an additional or alternate to Lanai for this or future analyses.

My other scientific comment/suggestion is that the present analysis focusses on reconstruction of the aerosol volume size distribution. I was wondering whether the authors have considered investigating the effects of these parametrisations on reproducing other quantities such as extinction efficiency and phase function (or asymmetry parameter)? For some applications, such as remote sensing of AOD from passive spaceborne imagers, reproduction of scattering/absorption behaviour may be more important than reproduction of size distribution.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10571, 2013.