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Interactive comment on “Optimizing Saharan dust CALIPSO retrievals” by V. Amiridis et al.

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There are many interesting aspects to this paper, including the application of the method of Tesche et al (2009) to separate the component of extinction in dust mixtures due to dust and the development of a specialized regional Sahara dust data product. I'm concerned, however, about the impression this paper gives that aerosol lidar ratio is the only source of error which needs to be considered in CALIOP dust AODs.

Schuster et al. (2012) also partition the CALIOP data by aerosol type, finding a bias in AOD which can apparently be attributed to dust AOD. Schuster et al. also assumed the differences are due solely to the choice of lidar ratio assigned to the Dust type. A more recent paper (Omar et al., JGR, 2013, doi:10.1002/jgrd.50330) looks at CALIOP-Aeronet comparisons in more detail and finds a number of sources of discrepancies, including the failure to correctly detect aerosol layer base (or failure to detect the aerosol

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at all), and misclassification of aerosol type. These error sources can be dominant. The behavior of the relative bias in Figure 1 at AOD below 0.5 looks more like an artifact due to layer detection than to incorrect lidar ratio, which would tend to produce a constant relative bias. Dense dust layers which are detected on single shots and therefore classified as clouds by the current Level 2 algorithms (frequently seen over the Mediterranean) also lead to an underestimate of AOD. Omar et al. also noticed the possibility of significant cloud contamination in even Level 2 Aeronet AODs.

Nevertheless, adjustment of the lidar ratio as a way of accounting for the net effect of all the error sources has merit in this particular application. The authors should acknowledge, however, that this may be compensating for other sources of error and may improve the agreement in AOD at the expense of biasing the extinction profile.

Applying $S=58$ to the retrieved aerosol backscatter implies a multiple scattering factor of 0.7. This is similar to the multiple scattering factor for cirrus particles – which are much larger than dust particles – and seems unrealistically small. This is a topic requiring further research which would benefit from some direct validation.

Regarding some of the other comparison studies cited:

Version 3 had major changes to aerosol products relative to Version 2, so the results shown in Kittaka et al are not very relevant to the quality of the Version 3 product.

Regarding the discussion of Ma et al. (2012), I hesitate to cite papers in discussion as they are not yet reviewed and subject to change. Ma et al compute average AOD from the 5-km AOD and find larger biases than in Winker et al (2013), where AOD is computed from the averaged extinction profiles. As mentioned by Anonymous Reviewer #2, calculation of AOD by integrating 5 km columns and then averaging tends to be biased low due to data removed by filtering and screening. AOD calculated from the average extinction profile is more representative and tends to agree better with MODIS AOD.

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