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Atmospheric Chemistry and Physics Discussions

Interactive comment on "CALIPSO observations of transatlantic dust: vertical stratification and effect of clouds" *by* W. Yang et al.

Anonymous Referee #2

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Review of manuscript by Yang et al.: CALIPSO observations of transatlantic dust: vertical stratification and effect of clouds

In this article the authors describe changes of Sahara dust microphysical properties during westward transport through three adjacent North Atlantic regions and in the vicinity of clouds, based on one month (two orbital cycles) nighttime CALIOP data. Observations also indicate shape-induced vertical segregation of dust. Quantities used are attenuated backscatter at 532 and 1064 nm (from which a colour ratio is deferred) and the volume depolarisation ratio at 532 nm, both at 5/0.27 km horizontal/vertical resolution. For the near-cloud impact study 0.333 km resolution lev 1 CALIOP data are used, cloud/aerosol discrimination algorithms use CALIOP lev2.

The change of particle characteristics in the vicinity of clouds is an important topic

which is of interest to users of CALIOP products, but the depolarization part needs revision in order to draw robust conclusions.

General comments: The main results critically depend on the performance of the operational CALIOP cloud/aerosol discrimination algorithm. Thus this would merit a more detailed discussion. E.g., whether different PDF are used for water and ice clouds since the latter could easily be confused with depolarizing aerosols. As far as I understand, the PDF discrimination uses no information on the vertical distribution of the scatterers. How does the misinterpretation rate depend on the distance from clouds? How large is, statistically, the influence of nearby off-track clouds?

The authors should more clearly demonstrate the novelty of their approach/results which to me seems only given for the investigations of particle modification in the vicinity of clouds. The latter is an important topic which is of interest to all users of CALIOP products. The changes of dust characteristics in the course of long-range transport, as discussed here, in most aspects have already been demonstrated in the literature to ACE-ASIA, SAMUM, AMMA,. . .

The data base of about 2 x 60 latitudinal tracks seems rather small to derive general statements about changing Saharan dust characteristics during transport – therefore this is more like a case study since SD may exhibit quite variable properties depending on its origin and mixing with other aerosols and quite different cases have been reported in the literature (and this should be mentioned here).

An error of up to 30% in cloud/aerosol discrimination sounds high. Moreover, I wonder why the PDF classes' separation should be better (the overlap smaller) with coarser (5 km instead of 0.33 km) resolution – is this due to limitations by SNR?

Specific comments:

If the CAD (12055, 13-16) applies for discrimination of clouds from aerosols in general, i.e not specific for dust, the 'CALIOP aerosol product' should be explained more in

detail. Otherwise, it is not self evident how the assignment of the number of samples to dust (and not any other type of particles) is justified.

12058, 15-22: why does chi' increase to the west when there are more sea salt particles instead of SD particles? According to your definition on p. 12054, l23-25 larger chi' means larger particles, i.e. chi' =beta'1064/beta'532. They are not necessarily larger.

12058, 25 to 12059, 5 and section 3.3.2.: This is a plausible, hypothesis. Can you confirm it by estimating the segregation based on typical sizes, shape factors?

12064, 3-17: The increase of delta' towards clouds is odd and may either indicate important effects, artefacts or detection limitations. Is it significant with respect to accuracy? How large is your minimum detectable delta' and how large is it in terms of aerosol depolarization delta_aerosol= R/(R-1)*(delta'-delta_molecular/R) with R=(beta_part+beta_mol)/beta_mol. How do you calculate the error bars? Although I do not expect large difference using aerosol-depol instead of volume-depol it (as was previously commented) in this specific case, indeed it would be the better one to use.

Section 3.1.1.: The profound different shape of the western sample profile may be a result of air-mass change rather than changing dust characteristics. Is there experimental or model evidence for there being the same air-mass (e.g. trajectories)?

Fig 7: The colours/symbols used for dust alt < 2km and dust alt > 2km are hardly distinguishable on a printout -> choose different

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