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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.

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It seems like there is a conceptual mistake in the presented analysis. The authors use parameters that are attenuation-corrected but don't actually represent pure particle properties. Such parameters cannot be used to characterize changes in dust properties with transport. Hence, it is hard to judge the results of the presented study.

The volume depolarization ratio cannot be used to investigate changes in the dust bulk properties since it incorporates the contribution of aerosols AND molecules. As can be seen in lidar measurements at short wavelength and/or of weakly backscattering dust layers (strong contribution of molecular backscatter), low volume depolarization ratios can also lead to particle depolarization ratios that are characteristic for mineral dust. Some examples of particle depolarization ratio profiling in mineral dust can be found

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in Freudenthaler et al., Tellus 2009, Gross et al., Tellus 2011, and Tesche et al., Tellus 2011. It is more likely that the effects of the volume depolarization ratio described in the manuscript are due to a decrease in dust concentration (higher molecular contribution to the volume depolarization ratio) rather than actual changes in the dust bulk properties, a mixing with marine aerosol/moist air up to 3 or 4 km height, or a greater drag of non-spherical dust particles (Fig. 6).

The authors speculate that updrafts within the SAL keep the dust at high altitudes. It would be interesting to read more about this or to give some sources. Wind lidar measurements at Cape Verde during SAMUM-2 in May/June 2008 showed waves in the elevated dust layers but no convection above the marine boundary layer.

It is hard to understand how the authors use the cloud-fraction detected by CALIPSO for studying their effect on the aerosols. First of all, CALIPSO only sees clouds along its track which means that a profile with a cloud right next to (but not) in the footprint would be classified as cloud-free. Second, CALIPSO always detects clouds and aerosols in different layers and cloud signals always exceed aerosol signals. If aerosols in the SAL occur above (marine PBL) clouds, there is most likely no connection between the two. If aerosols are found below clouds, signal attenuation and multiple-scattering effects are likely to decrease the quality of the aerosol measurement (lower line in Fig. 4). Note also that CALIPSO level 1 data are probably too noisy to be used in case of neighboring cloudy and cloud-free profiles.

Regarding the 'relationships' in Fig. 5: First of all, the authors investigate a variation of delta' and X' of 10-20%! Note that even well-calibrated ground-based lidars provide particle depolarization ratios and Ångström exponents with uncertainties of at best 10% and 40%, respectively. Especially the errors of the Ångström exponent increase dramatically even for accurate backscatter-coefficient profiles due to the way its calculated. Second, such a comparison would be more reasonable if particle-specific (intensive) parameters were used. Nothing is found if extensive parameters like the volume depolarization ratio and the attenuated backscatter coefficient are used (right

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column)!

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