M. Tesche
matthias.tesche@itm.su.se
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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 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).

We agree that volume properties don't represent dust as directly as particulate properties do. Still, there are a few reasons to present volume properties in the paper:

1. Volume and particulate properties compliment with each other: volume properties provide information of the direct observation as a whole, while particulate properties provide the information of the particles in the volumes. Volume properties of dust are required for radiative transfer to estimate its particulate components' radiative effect.
2. For CALIPSO, the particulate properties are retrieved properties, thus they may have bigger errors than the direct measured volume properties. For example, for dust properties under cloudy skies, the direct measurement of dust volume properties may already have been degraded by the interference from clouds above, etc. In this circumstance, the retrieved particulate properties can be noisier and inaccurate.
3. Currently, particulate properties are not available in the CALIPSO aerosol product at resolutions higher than 5 km. Understanding the variations in volume properties under different conditions during transport benefits the understanding of the near-cloud behaviors that are observed at 0.333 km resolution.

Even so, the particulate properties provide dust bulk properties without interference by molecular scattering and gas absorption, as correctly pointed out by the reviewer. Therefore we computed the medians of the dust particulate properties, and the results are attached at the end of this response (Figures S2, S4, S5, and S6). The dust particulate properties have been also included into the Appendix of the revised manuscript.

Regarding the specific issue of low volume depolarization ratios observed at low altitudes in all regions and even at higher altitudes in the west region, the results indicate that the basic features observed for volume depolarization ratios remain valid for particulate depolarization ratios (see Figure S2, right panel). Therefore our conclusion about changes of dust bulk property is still valid here. Since mixing with marine aerosols at 3-5 km altitude is rare, shape (and hence depolarization) dependent sedimentation is likely dominates in determining the depolarization ratio features at 3-5km mentioned above.

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.

Thanks for pointing this out. Accordingly, we removed the sentence that speculated about the presence of updrafts in the SAL.

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.

As discussed in the first paragraph of Section 3.2, the cloud fraction here is 1D. Indeed, off-track clouds do exist. For each individual case, the 1D cloud fraction is not expected to have the same values as the 2D cloud fraction (e.g., Astin and Di Girolamo, 1999; Astin, et. al., 2001). But we believe that since this 1D cloud fraction is statistically correlated with cloud fraction obtained from 2D images, it still serves as a rough indicator of cloudiness.

We agree that if aerosols in the SAL occur above the clouds in the marine PBL, there is likely no connection between them (this causes, for example, the different behaviors of low and high dust curves in Figure 7). We also agree that the quality of aerosol data is likely degraded by clouds above. This is a very good point and we have mentioned the possible degradation of aerosol measurement in the revised manuscript. Even so, we can see at least qualitatively that the observed dust properties are affected by cloudiness.

Finally, we agree that the CALIPSO level 1 data is very noisy. Fortunately, using large amount of data can reduce the errors. The comparison between the size of error bars and the magnitude of aerosol property changes near clouds can reveal the statistical significance of aerosols changes near clouds in Figures 4 and 7.

> 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.

Regarding the error bars in Fig5: Indeed, in general color ratio could have larger errors because of larger errors in the infrared channels. Throughout the paper, medians of quantities of the properties are reported. In general, median is more stable than mean because it is not sensitive to outliers. Errors of the medians are estimated by the Bootstrap algorithm. To reduce noise and improve the accuracy of median depolarization and color ratio values, we used large amounts of data.

> 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 column)!

We agree with the reviewer that nothing meaningful can be found directly by comparing the intensive parameters and extensive parameters. Accordingly, the right side column has been deleted from Figure 5.

Appendix:

Figures that are based on dust Particulate properties:

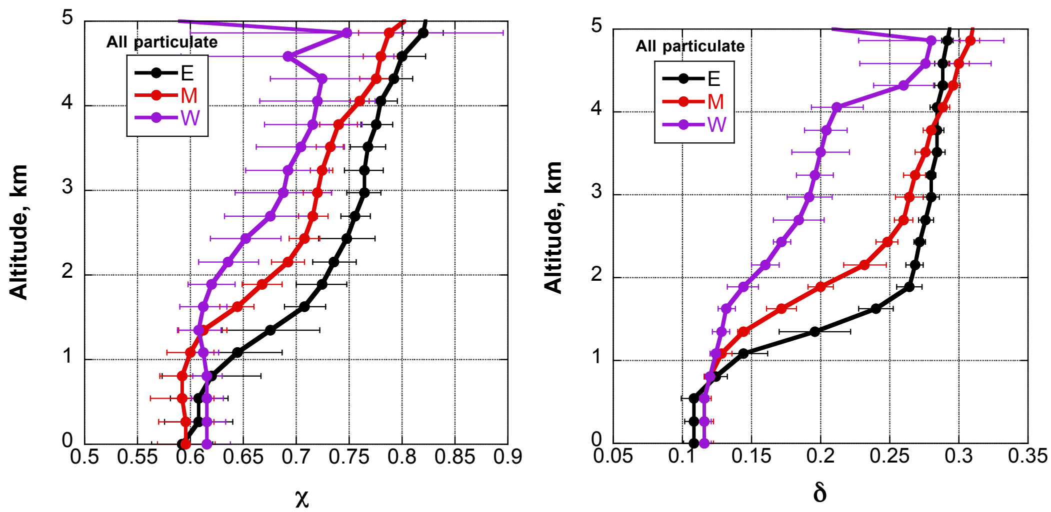

Figure S2. Vertical distribution of retrieved dust particulate color ratio (left) and depolarization ratio (right). These plots correspond to Figures 2b and 2d in the first version of manuscript.

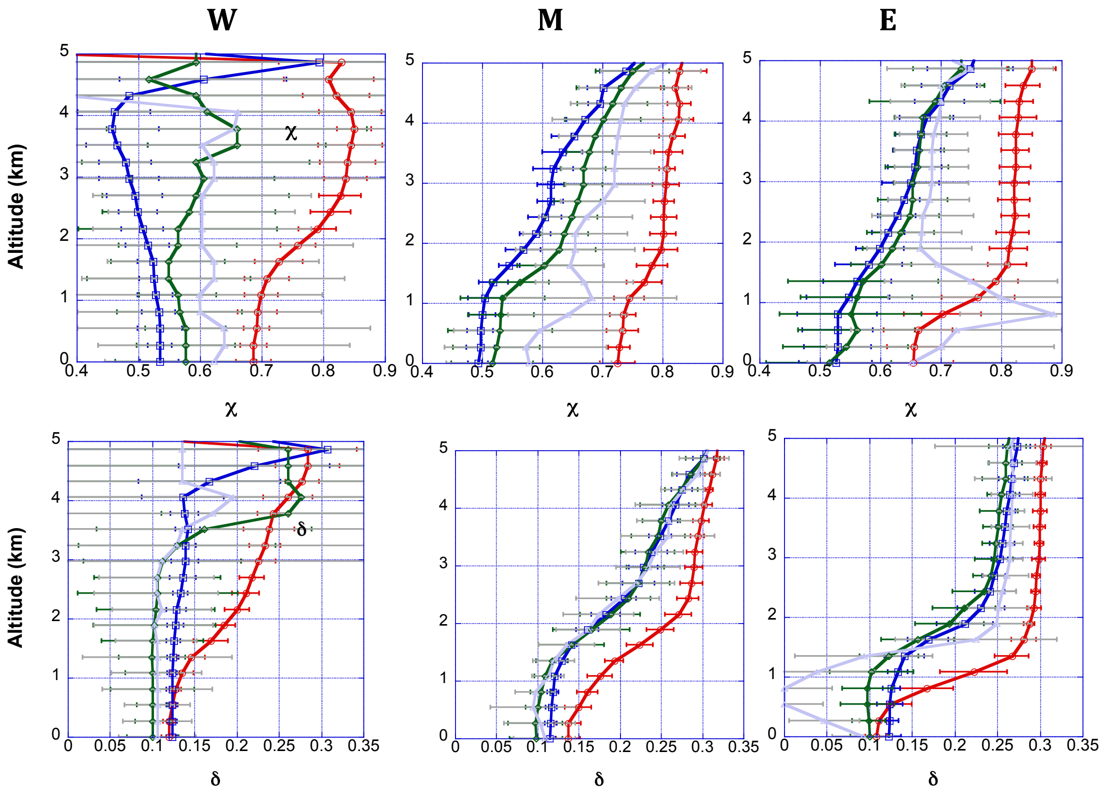

Figure S4. Cloud Fraction effect on the vertical distribution of dust Particulate Color Ratio (first row) and Depolarization Ratio (second row). These two rows correspond to the 3rd and 4th rows of Figure 4 in the first version of manuscript.

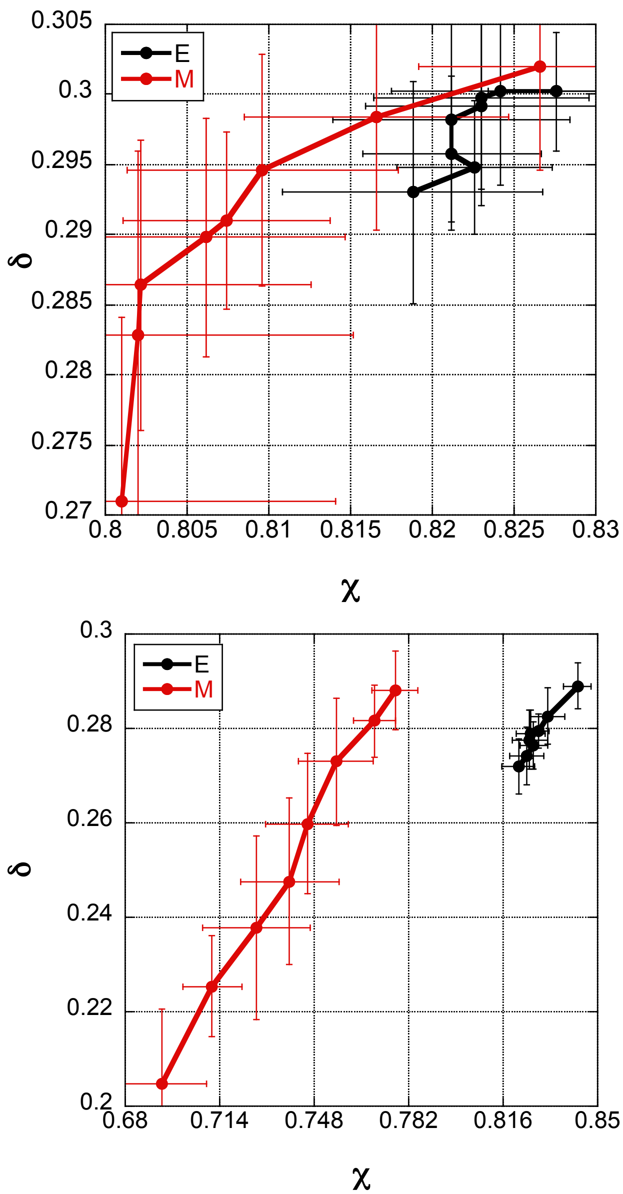

Figure S5. Depolarization ratio as a function of color ratio, based on dust particulate properties. These panels correspond to Figures 5a and 5c in the first version of manuscript.

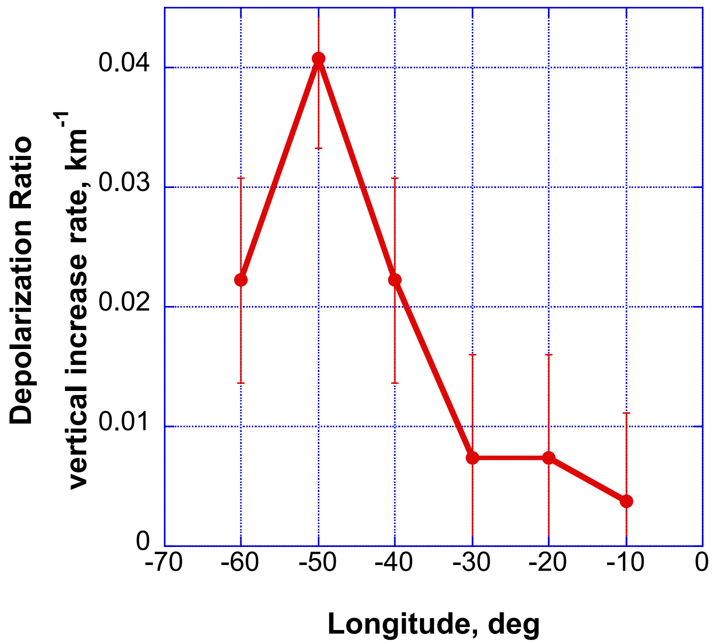

Figure S6. Rate of vertical increase in dust particulate depolarization ratio between 3 km and 4 km altitudes, vs. distance from the African coast. This corresponds to the Figure 6 in the first version of manuscript.

References:

Astin, I., and L. Di Girolamo, 1999: A general formalism for the distribution of the total length of a geophysical parameter along a finite transect. *IEEE Trans. Geosci. Remote Sens.*, **37**, 508-512.

Astin, I., L. Di Girolamo, and H. M. Van de Poll, 2001: Bayesian confidence intervals for true fractional coverage from finite transect measurements: implications for cloud studies from space. J*. Geophys. Res*. **106**, 17303-17310.