Comments on

**Comparison of CALIPSO aerosol optical depth retrievals to AERONET measurements, and a climatology for the lidar ratio of dust**

by G. L. Schuster et al.

GENERAL

The paper provides an in-depth investigation of CALIPSO AOD retrievals for different aerosol types in comparison to AERONET data. Statistically significant biases are found for marine and dust aerosols. In the case of dust the discrepancies can be explained with the assumption of a too small lidar ratio in the CALIPSO retrieval scheme. Therefore, the authors further investigate the lidar ratio values of dust in different regions based on AERONET inversion results. They also provide an extensive discussion of the possible influences of dust mineralogy on the findings. The paper is well written and based on a very careful statistical analysis. It is a very interesting contribution to the field. However, to my opinion, there are some aspects which have not been adequately tackled in the discussion or have not been mentioned at all. The following issues should be considered in a revised version of the paper.

SPECIFIC COMMENTS

Discussion on the assumption of the dust lidar ratio in the CALIPSO retrieval has been ongoing in the community for several years (see, e.g., Pappalardo et al. 2010, J. Geophys. Res., 115, D00H19; Wandinger et al. 2010, Geophys. Res. Lett., 37, L10801) since a clear discrepancy was found between the CALIPSO a priori value of 40 sr and direct measurements with ground-based lidars giving values mainly in the range of 50-60 sr (e.g., Tesche et al. 2009, Tellus B, 61, 144-164; Pappalardo et al. 2010, J. Geophys. Res., 115, D00H19; Tesche et al. 2011, Tellus B, 63, 677-694). This history of scientific discussion is not adequately reflected. The paper, at least in the beginning, gives the impression that it is the first thought in this direction. In general, the introductory part of the paper is rather short and does not acknowledge the variety of validation efforts for CALIPSO. The structure of the paper could be improved by providing a broader discussion on CALIPSO comparison and validation efforts in the beginning of the paper. At the moment, many arguments, which would be helpful for the reader to know at an early stage, appear only very late in the discussion part.

Section 2, CALIPSO products: Are opaque aerosol layers (no ground return) included or not, and how could this influence the AOD statistics?

Section 2, on spatial/temporal collocation: It should at least be mentioned that there are other approaches which make use of trajectories and wind profiles to get best relation between ground-based and space-borne observations. The “closest approach” seems to be well justified for cross-wind conditions, but might fail when the transport is parallel to the CALIPSO track.

Section 4, pages 11658-11660, depolarization ratio >0.2: It is unclear what the depolarization ratio used in the CALIPSO typing scheme means (particle depolarization, volume

depolarization, or other?), how it is obtained, and how it compares to the depolarization ratio retrieved from AERONET. What are the consequences for possible misclassifications of dust and polluted dust?

Section 4: One of the weakest points of the paper is certainly the "belief" in the AERONET retrieved lidar ratios. This issue should be discussed more critically. Retrieval of the lidar ratio requires exact knowledge of the backscatter phase function at 180°, which sensitively depends on particle shape. The lidar ratio also depends on the absorbing properties of the particles, i.e. the imaginary part of the refractive index. The latter one is not considered in the discussion at all. It has been found that AERONET retrievals could not reproduce measured lidar ratios and depolarization ratios of dust adequately. Also here, there is extensive discussion in the literature available (see, e.g., Müller et al. 2010, J. Geophys. Res., 115, D07202; Müller et al. 2010, J. Geophys. Res., 115, D11207 and citations therein).

Section 4: The authors investigate the presence of the fine mode fraction, which is certainly a good indication for the influence of pollution aerosol. However, although they mention the influence of marine aerosols at coastal and island AERONET stations as well, they do not provide an explanation what it means for the lidar ratio retrievals. Marine aerosol would mainly be present in the coarse mode and thus cannot be distinguished from dust in the size distribution. Because of its low lidar ratio, it can decrease the column lidar ratio drastically even in the presence of strong dust layers above the marine boundary layer.

Section 4.4: The Raman lidar measurements at Cape Verde are summarized by Tesche et al. 2011, Tellus B, 63, 677-694. Wandinger et al. (2010) discussed the discrepancies between the ground-based measurements and the CALIPSO retrievals and the possible influence of multiple scattering on effective lidar ratios obtained by constrained CALIPSO retrievals. Multiple scattering influences the CALIPSO retrievals when the dust particles are large enough and can explain the low effective lidar ratios obtained especially for opaque dust layers/dust storms (see discussion in Sec. 4.4, third paragraph).

TECHNICAL COMMENTS:

Table 4: What is the meaning of INM, TMP, IER, DNM?

Fig. 10: The caption is an interpretation rather than a description of the figure.

Use either Cape Verde or Capo Verde throughout the paper.