

## ***Interactive comment 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.***

**Anonymous Referee #2**

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The paper presents an extensive investigation of CALIPSO AOD biases derived from comparison with AERONET direct AOD measurements. The biggest biases are found for the CALIPSO “dust” particle type, and therefore authors perform in-depth analysis on how possible “mistyping” of dust properties can contribute to CALIPSO AOD biases. The authors assemble a climatology of dust refractive indices determined by “Dubovik et al.” AERONET inversions, and then survey in detail regional dust particle properties reported in the literature to justify the AERONET climatology. This climatology is used to derive the CALIPSO lidar ratio in dusty regions. The paper demonstrates that the pre-selected CALIPSO lidar ratio is too low in many regions, and new lidar ratio climatology is suggested as a result of this study. A new approach to CALIPSO retrievals

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(e.g., including multiple dust models) is also suggested as a conclusion.

The paper is very well written; there are many interesting, in depth discussions. The authors demonstrate very good understanding of CALIPSO retrievals, AERONET inversions, and dust mineralogy. The paper was a pleasure to read. I certainly recommend the paper for publication in ACP. I have only couple of general comments that might be outside the scope of this paper.

General comments:

- The paper has a discussion on the AERONET spheroidal model assumption, however it concludes that particle irregularity is not a concern. Currently there are some discussions in the literature on how well a spheroidal particle can represent properties of realistic dust. There is a possibility that the shape assumption might alter the AERONET-retrieved refractive index. For example, the MISR irregular dust models with a real part of the refractive index of 1.51 fit well over the Sahara and western Atlantic, but not over the Asia. Merikallio, S., Lindqvist, H., Nousiainen, T., and Kahnert, M.: Modelling light scattering by mineral dust using spheroids: assessment of applicability, Atmos. Chem. Phys., 11, 5347–5363, doi:10.5194/acp-11-5347-2011, 2011

- It could be very interesting to see, at least for a few cases, if altering the CALIPSO lidar ratio in the way suggested by the authors actually produces the better agreement between CALIPSO retrieved and AERONET measured AOD in the Saharan region.

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