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Atmospheric Measurement Techniques Discussions

Interactive comment on "Extinction and Optical Depth Retrievals for CALIPSO's Version 4 Data Release" *by* Stuart A. Young et al.

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This paper is a detailed and well-written discussion of retrieval algorithms used to produce the CALIPSO Version 4 data products. Nevertheless, a few comments:

Page 10, line 28: In Section 2.2.3 there is a mention that for opaque aerosol layers multiple scattering is assumed to be negligible. This is not necessarily true, particularly for dust layers, and so represents a source of error in the retrieval. This point should be made clear.

Page 14, line 27: It is the high optical depth that causes an increase in multiple scattering, not the width of the forward diffraction peak. The width of the forward peak does, however, lead to much more frequent scattering at large angles than in cirrus,

and significant amounts of pulse stretching.

Page 21, line 14 seems to be referring to figures 3d and 3f rather than 4d and 4f.

The "Caveats" section on pages 38-39 is a great addition to the paper. The second paragraph points out that the sensitivity of the extinction retrieval to differences between the lidar ratio used and the true lidar ratio increases with optical depth. This is an important point which will probably not be sufficiently appreciated by many readers and deserves some additional detail. As shown in the CALIPSO ATBDs (written by these same authors), retrieving an optical depth of even 3 to an accuracy of 10% requires knowing the lidar ratio to 0.1%. Most of the integrated signal being used to estimate the lidar ratio comes from the first two optical depths, which thus provides little constraint on small changes in lidar ratio in deeper parts of the cloud. Thus, data users should carefully consider the level of uncertainty in retrievals at high optical depths. These uncertainties are likely larger than the uncertainties reported in the product, which are estimated based on the assumption that lidar ratio is uniform throughout the retrieved layer.

Page 39, line 8: Makes a good point, but "is composed of the same material" is probably better stated as "has uniform optical properties"

Finally, anonymous referee #3 suggests the possibility of "decaying tails" below clouds due to multiple scattering, seen in Monte Carlo simulations of lidar returns from the upcoming ATLID lidar. He suggests these decaying tails might impact constrained retrievals or retrievals of lower layers. Similar Monte Carlo simulations of the CALIOP return signals (having a significantly larger field of view which tends to wholly capture the forward diffraction peak of cirrus particles) shows an impact of multiple scattering which is constant with range rather than decaying. Referee #3 is correct, though, that potential impacts of this on CALIOP retrievals deserves some discussion.

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