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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Extinction coefficients retrieved in deep tropical ice clouds from lidar observations using a CALIPSO-like algorithm compared to in-situ measurements from the Cloud Integrated Nephelometer during CRYSTAL-FACE" *by* V. Noel et al.

V. Noel et al.

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Answer to Anonymous Referee #1 - Specific comments

1) p.10650, l.9: the Reviewer correctly notes that the CALIPSO mission has been successfully launched at the present time. The paper has been corrected to reflect this fact.

2) p. 10655, l. 10: the Reviewer notes a reference is lacking for the quadratic function used for the retrieval of the extinction-to-backscatter ratio S (this function is actually

present on p. 10653). The quadratic function and the relevant parameters were provided by D. L. Hlavka (Goddard Space Flight Center) in a private communication. This was not clear in the reviewed version of the paper, and the text has been modified to make this clearer. This parameterization and factors are used routinely in the process of CPL observations, and are based on a polynomial regression on retrievals of backscatter-to-extinction coefficients and observed temperatures, in transmissive cloud cases where the use of transmission-loss algorithm was possible.

3) p. 10657, l. 17: The Reviewer notes that in the current paper, multiple scattering is neglected due to the small field of view and nearness of the clouds (leading to a ˜1m footprint)ă; while the footprint of actual CALIPSO observations on clouds will be closer to ˜100m, meaning multiple scattering will have significant effects on the observations and thus on the retrieval of the extinction-to-backscatter coefficient. Indeed, in the present paper the limited multiple scattering allows for the use of a simplified equation for the retrieval of the extinction-to-backscatter coefficient. In the analysis of actual CALIPSO observations, multiple scattering cannot be neglected and the full equation must be used in the Deep Convection algorithm, with the multiple scattering correction factor. As this comment correctly highlights, in its reviewed state the current study silently assumed that a correct multiple scattering factor would be available when analyzing actual CALIPSO observations. This parameter is retrieved operationally through the analysis of different observations that those used in the present paper, and as such is outside the scope of a review of the Deep Convection algorithm itself. However, the Reviewer is right to state this is a limitation of the current study when seen as a validation of the CALIPSO algorithm. The fact that the paper's conclusions (i.e. the fact that the CALIPSO Deep Convection algorithm produces consistent extinction coefficients) depends on the availability of a valid multiple scattering correction factor is now acknowledged up front in the paper (Sect. 3.2), and also clearly stated in the discussion (Sect. 5). This remark is similar to the main comment from the Anonymous Referee #2.

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4) p. 10657, l. 8: The Reviewer suggest that the 6 min delay between aircraft may explain the differences on retrieved parameters. This is indeed a potential explanation. However, trying to relate the time difference and horizontal distance between aircraft with differences in observations (such as seen below 13.9 km on July 28) does not reveal any specific correlation. This is now mentioned in the text (Sect. 4). This remark is similar to the specific comment #7 from Anonymous Reviewer #3.

5) p. 10658, l. 19: The Reviewer suggests that the impact of a 11% difference in optical depth on the estimation of clouds radiation budget should be discussed. In the paper, this 11% difference is attributed to the total extinction of lidar signal inside deep convective clouds, which show huge optical depths (generally $>$ 10, up to 80). Since the difference is due to instrumental limitations, it has limited physical significance when considering clouds radiative impact. Moreover, the lidar is only able to probe a very limited fraction of the cloud optical depth. Since the 11% difference applies to a small portion of the entire cloud column, its importance can be safely neglected when considering the radiative impact of the entire cloud. This is now mentioned in the text (Sect. 4).

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 10649, 2006.