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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Statistics of vertical backscatter profile of cirrus clouds" *by* P. Veglio and T. Maestri

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**Specific Comments:**
*p. 25820, lines 3-5.* It might help their readers and avoid the potential for confusion if the authors were to point out that the symbols used in this present work represent quite different quantities from those they represent in the CALIPSO documentation. (e.g. beta_primed here represents total backscatter while it represents attenuated backscatter in the CALIPSO documents. Similarly, beta_a here represents attenuated backscatter, but aerosol backscatter in the CALIPSO documents.)

**Answer:** A note will be added to the final version of the text. At page 25820 line 6: Note that symbols used in the present work do not correspond with those used in

the CALIPSO documentation (references are given throughout the text) and caution should be taken to avoid possible confusion.

*p. 25823, lines 8 – 15.* The authors should probably add a note of caution here regarding the effects on CALIPSO's layer detection algorithms of the reduced the SNR during daytime. With the higher levels of daytime noise, where backscatter signals near cloud top and base are below the noise level, the cloud boundaries detected by the algorithm will be closer to the center of the cloud than is actually the case. i.e. Detected cloud tops will be lower and bases higher than is actually the case. This effect may account for some, if not all, of the difference reported here. This could also explain some of the reported reduction in detected cloud thickness by day.

**Answer:** At page 25823, lines 16 a note will be added: Distributions with higher and thicker cirrus clouds are then found during the night than at daytime. It is suggested that the nighttime-daytime differences might be related with the higher levels of daytime noise. In fact, if the backscatter signals near cloud top and base were below the noise level, the cloud boundaries detected by the algorithm will be closer to the center of the cloud than is actually the case. As a consequence, the detected cloud top heights will be lower and thicknesses smaller than is actually the case.

*p. 25846, lines18 – 21.* (Possible attenuation correction errors) Did the authors use the CALIPSO extinction retrieval QC flags to filter their selection of data in this work? For example, some researchers only use results with QC $= 0$ or 1 to indicate the highest quality retrievals. Higher values do not necessarily indicate problems, but they may exist.

**Answer:** The extinction retrieval QC was not used for data selection in this paper. The



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suggestion of the Reviewer is however considered and an analysis concerning BSPs with QC flag equal to 0 or 1 is performed. The following steps are performed:

1) The number of profiles contained in the FD having extinction retrieval QC = 0 or 1 is counted and the percentage with respect to the total number of BSPs of the FD is computed. Below, percentages for each region and period of the day are reported:
48% of MLD (meaning that 48% of BSPs considered at Midlatitudes during the day has QC=0 or 1)
59% of MLN
62% of TRD
71% of TRN
Overall BSPs with QC = 0 or 1 represent more than 50% at ML and two thirds at Tropics.

2) The distributions of occurrence as function of geometrical thickness (and total cloud OD) for the 4 cases (MLD, MLN, TRD and TRN) of the FD are compared with the corresponding distributions for profiles flagged QC = 0 or 1 only (MLDQC, MLNQC, TRDQC and TRNQC). Results show that the main differences arise for the largest geometrical depths and optical thicknesses (as expected due to degradation of the backscatter signal for those cases). In Figures 1 and 2 the distributions of occurrence as function of the geometrical thickness are shown.

3) A comparison between mean BSPs, obtained from the FD, before and after the use of the QC condition was then performed. For each region and period of the day it was found that the mean BSPs don't change significantly. The highest value of the difference index is about 7%:
DIFFERENCE INDEX [MLD-MLDQC] = 7%
DIFFERENCE INDEX [MLN-MLNQC] = 2%
DIFFERENCE INDEX [TRD-TRDQC] = 5%
DIFFERENCE INDEX [TRN-TRNQC] = 3%



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In Figures 3 and 4 the results for the midlatitude and tropical cases are presented.

4) The same comparison was performed for a subset containing only clouds of the FD with OD $>$ 0.6 and DZ $>$ 2 km. The number of profiles having OD $>$ 0.6, DZ $>$ 2 km and QC $=$ 0 or 1 is about the 36% of total BSPs of the FD with similar physical and optical features (i.e. OD $>$ 0.6, DZ $>$ 2 km but all possible values of QC). Below the percentages for each region and period of the day are reported:
25% of MLD
38% of MLN
35% of TRD
46% of TRN

In this case the results are:
DIFFERENCE INDEX [MLD-MLDQC] = 4%
DIFFERENCE INDEX [MLN-MLNQC] = 7%
DIFFERENCE INDEX [TRD-TRDQC] = 4%
DIFFERENCE INDEX [TRN-TRNQC] = 8%
Since these differences are very small we may conclude that for the studied dataset the QC flag is of minor importance. Moreover, the same results also suggest that the differences found at point 3) (again very small) are mostly due to a change in the frequency distributions of the new subsets (MLDQC, MLNQC, TRDQC and TRNQC) rather than to a different quality of the BSPs of the MLDQC, MLNQC, TRDQC and TRNQC subsets.

5) Note that, reducing the FD to BSPs with QC $=$ 0 or 1 only, would strongly reduce the number of optically and geometrically thickest clouds and thus would make very difficult to perform a statistically relevant analysis of the BSPs for multiple geometrical depth and optical depth classes.



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In conclusion we have decided to maintain the FD as it is. Nevertheless, a note concerning the above discussion will be inserted in the final version of the paper so that the reader will have full knowledge of our choice.

**Minor technical points:** All the suggestions listed as minor technical points in your comment are accepted and will be corrected in the final version of the text.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25813, 2011.





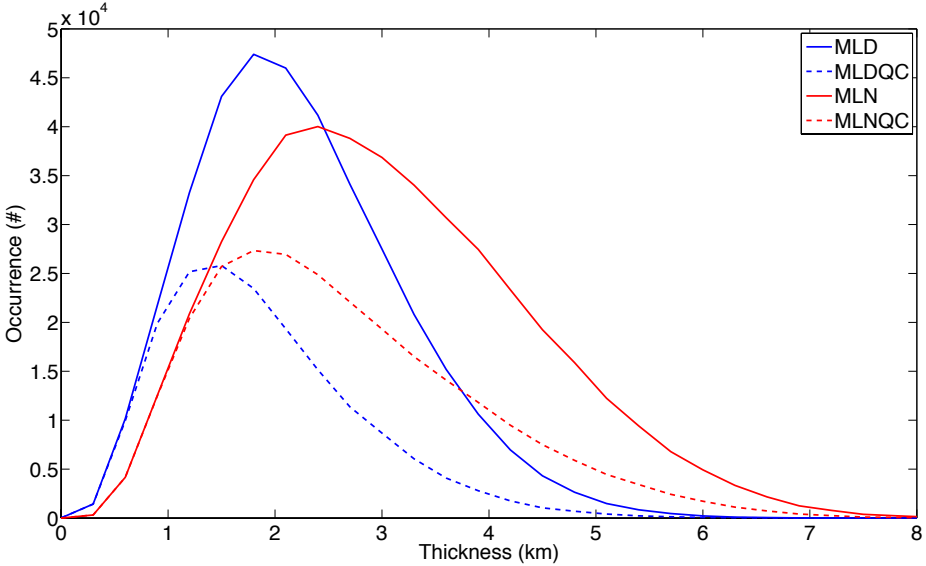


**Fig. 1.** Distributions of occurrence as function of geometrical thickness at ML for the FD with and without the condition on QC = 0 or 1.



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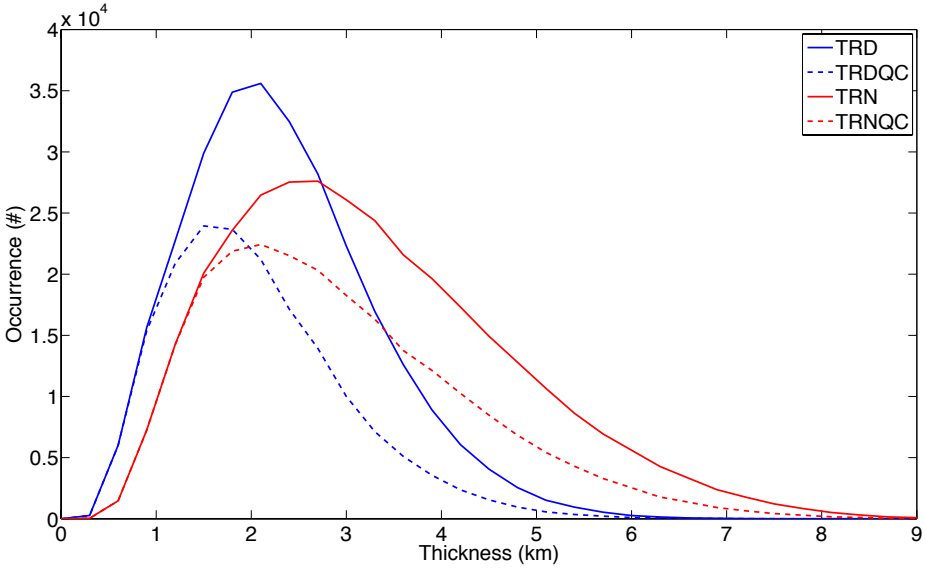


**Fig. 2.** Same as Fig. 1 but for tropics



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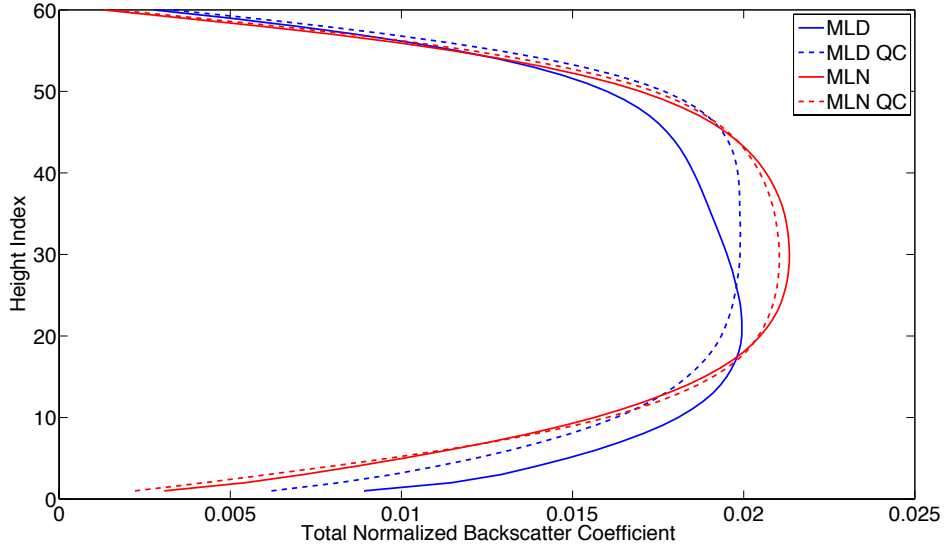


**Fig. 3.** Mean backscatter profiles for midlatitudes derived from FD with and without the condition on QC = 0 or 1



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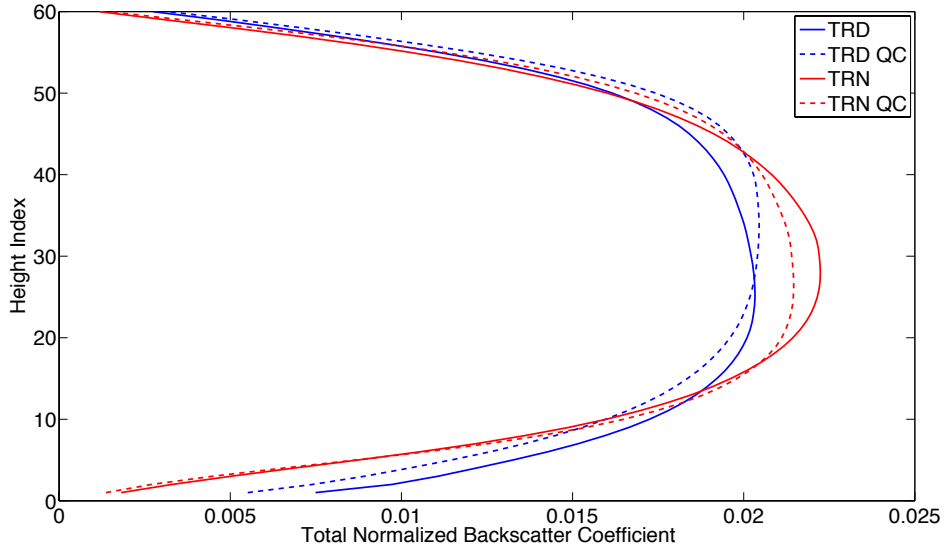


**Fig. 4.** Same as Fig. 3 but for tropics



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