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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Synergetic use of millimeter and centimeter wavelength radars for retrievals of cloud and rainfall parameters" *by* S. Y. Matrosov

Anonymous Referee #1

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General comments:

A novel method is presented how to retrieve separately cloud- and rain-liquid water in raining clouds from radar measurements. This method tries to cope with the basic difficulty of such measurements, which is related to the fact that cloud droplets in raining clouds are not "visible" for the radar because the radar echo is dominated by the rain drops. The general underlying principle is the differential attenuation, which is well established in various remote sensing applications, but which is augmented here by a further element, namely the relation between radar reflectivity and rain-attenuation (Z-K-relation). Here the radar reflectivity profiles obtained at K- and C-band are compared,

and it was shown that the difference of the observed reflectivity gradient can be attributed to the K-band attenuation (C-band attenuation is negligible). The rain-induced fraction of the total attenuation is inferred from the un-attenuated C-band reflectivity using a K-Z-relation. Then the cloud water attenuation is estimated as the residual between the total and the rain-induced attenuation. Using the tight relation between LWC and attenuation the cloud water content is derived from the residual attenuation. The method is very appealing as it converts the ostensible problem of "invisible cloud droplets" into an essential element of the retrieval chain.

The field study has been conducted carefully including auxiliary in-situ measurements, and the paper is written clearly with technically sound inferences.

Specific comments:

1. The assumption of 1 dB uncertainty of the reflectivity difference is not obvious to me in view of the substantial differences of the sampling volumes of both radars. Are there arguments for this estimate which escaped my attention? Would it be possible to corroborate this figure by correlating the C- and K-Band reflectivities at some lower range where attenuation is not important for both wave lengths?

2. delta R_m in equation (8) needs to be defined. (I assume it is the uncertainty of R_m = 0.2?)

3. What is exactly the meaning of the standard deviation "SD" in figure 3? It cannot be the SD of single samples, because the SD of single samples of stochastic beam filling targets is equal to the mean value (or about 5.6 dB).

4. The combination of a scanning C-band radar and a vertically pointing K-band profiler would not be my first choice for such an experiment. A combination of two radar profilers at attenuating and non-attenuating wavelengths, located side by side, would appear more appropriate to me. Was it just the existing set up for demonstrating the principle or are there reasons (which then should be mentioned) in favor of just this

measuring geometry?

5. Using equation (5) the C-POL radar reflectivities were constrained on the basis of JWD rain rates using a mean Z-R-relation. Is there a reason for this indirect way? The uncertainty of the Z-R-relation could be avoided by calculating the reference radar reflectivity directly from the actual JWD DSD.

Technical comments:

Figure 4: Delete the left y-axis-labels ("rainfall rate ...."). Only accumulation is shown.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 947, 2010.