

***Interactive comment on “Remote sensing the vertical profile of cloud droplet effective radius, thermodynamic phase, and temperature” by J. Vanderlei Martins et al.***

**Anonymous Referee #1**

Received and published: 22 April 2007

The manuscript presents a new method for remote sensing of vertical profiles of convective clouds, from satellite, aircraft, and from the ground. The idea is highly innovative and the applicability is demonstrated by a theoretical study as well as by evaluating first experimental data. The scientific content fits perfectly in the scope of ACP. The manuscript is well-written and good to understand. I strongly suggest publication of the manuscript after addressing the following (mostly minor) points.

Major points:

- In the Introduction, in section 4, and in the Summary and Discussions the importance of aerosols is emphasized, as well as the contribution of the new methodology

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to resolve open issues in aerosol-cloud interactions. On the other hand, no solution is offered how to measure aerosols quantitatively in the vicinity of convective clouds. It is known that clouds strongly affect retrievals of aerosol properties from passive instruments, in particular for such optically thick clouds as addressed here. Please concentrate the paper on clouds, unless you really offer a solution for the aerosol and please don't raise expectations of the reader in the introduction which you cannot satisfy later. In particular, the statements on page 4503, line 5 ("a full set of aerosol and cloud ...") and page 4503, line 22 ("presence, amount, and type of aerosol particles") and page 4504, line 8 ("aerosol amount and type in the neighbourhood of the clouds") are not justified on the basis of this manuscript.

- The question if the effective radius varies horizontally is not really addressed for the scales of interest. On page 4496, bottom, it is outlined that observations show little horizontal variability of droplet size. But is this also true close to cloud edges where droplet sizes could be easily affected by entrainment? At 2.1 micron, the retrieved droplet size is probably representative of an optical depth less than 5 (Platnick et al. calculated something like 2 for the stronger absorbing 3.7 micron channel). This translates to a horizontal distance of less than 100m. Could you elaborate on the penetration depth for your channel combination and the question if droplets really don't vary at distances less than 100m of the cloud edge?

- In Figure 4 you show the reflectance for 2.1 micron. It would be very interesting to see the non-absorbing 0.66 micron reflectance for comparison. It shouldn't be too difficult to produce the plot as you already have the data available, as you mention in the text.

Minor points:

page 4485, line 3: Is the "warm rain paradox" common knowledge? Please explain briefly!

page 4485, line 25: Was 1998 really "recently"?

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page 4486, line 1: "dg" is used as abbreviation of "degree" which seems quite uncommon. You could rather use "deg" or the degree symbol

page 4486, line 5: Out of curiosity: Why was Freud et al (2005) only published in ACPD and not in ACP?

page 4486, line 10: Can one really "learn physics" from an experiment? You probably "gained information"

page 4486, line 18: In addition to the two points mentioned, you probably also want to validate the approach of Freud/Rosenfeld

page 4492, line 6: What have cloud shadows to do with "relatively large scattering angles"?

page 4494, line 29: "rule of thumb" is probably not the correct term; it is simply the most straightforward approach

page 4495, line 26: Some more discussion is needed if the agreement between the retrieval calculations (cylindrical clouds) and the "reality" (stochastic clouds) is actually reasonable. This decision is basically left to the reader. Figure 5 shows that the cylinder curves are usually within the range of dots of the same color, but in particular for effective radius 10 micron the retrieval curves are a bit on the higher end. Please discuss and estimate what that implies for the accuracy of the retrieval!

page 4496, line 6: With this sentence you probably mean that the retrieved profiles are of little value if the cloud properties change close to the cloud edge? See my major point above.

page 4497, line 13: Where did you get the temperature profile from?

page 4497, line 16: Did you use a single look-up-table for these calculations or did you use different ones for water and ice? If the latter, based on which criterion did you switch between both?

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page 4498, line 17: You did not really proof that you can measure profiles inside the cloud, but only close to the cloud edge. In the following (from here to the end of the page) you interpret a lot into a single profile of droplet radii - I would not dare to do that!

page 4500, line 18: How did you separate the water and ice portions of the cloud?

page 4501, line 8: I guess you want to propose a real satellite, not a "hypothetical" one?

page 4501, line 25: The required viewing directions (backward, sideways, ... ) are rather unclear for a reader who is not familiar with satellite orbits.

Figure 6: Please include a color scale for the right image! The colors are highly suggestive, switching from red to blue exactly where the temperature was cold enough but I guess this has nothing to do with the numbers changing from positive to negative as a reader might expect.

Technical corrections:

The manuscript contains quite a few typographical errors. I suggest to check it once more before publishing in ACP. Following are the ones I discovered (probably not exhaustive):

page 4483, line 17: remove "the" before "Twomey's theory"

page 4484, line 4: add "showed" after "Hansen et al. (1997)"

page 4485, line 3: "have been" instead of "are"

page 4485, line 16: replace "Fricsh" by "Frisch"

page 4493, line 25: replace "realist" by "realistic"

page 4493, line 27: replace "profile" by "profiles" and replace the ", " by "and"

page 4495, line 9: replace "Marhsak" by "Marshak", and "presents" by "presented"

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page 4495, line 2: replace "provides" by "provide"

page 4499, line 18: "replace "enough different" by "sufficiently different"

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 4481, 2007.

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