

Atmos. Meas. Tech. Discuss., 5, C4074–C4077, 2013

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Interactive comment on “Radar-radiometer retrievals of cloud number concentration and dispersion parameter in marine stratocumulus” by J. Rémillard et al.

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Received and published: 12 March 2013

Reply to Reviewer 3

General Comments:

This paper describes and evaluates a new retrieval of cloud droplet concentration N and dispersion parameter for use in nondrizzling marine stratocumulus clouds that uses chiefly the vertical profile of radar reflectivity and the microwave radiometer-derived LWP. The approach, I think, assumes an adiabatic cloud liquid water content profile. The dispersion parameter, which necessarily is assumed constant with height, together

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with the vertical profile of cloud droplet concentration, are derived independently. From the retrieved parameters (and the input LWP), the cloud optical depth can be derived. This is compared with the observed optical depth from a narrow field of view radiometer (NFOV). As a byproduct, the equilibrium supersaturation in the cloud can be derived.

This is a useful new retrieval and the paper describes the approach well. Initially I had some problem understanding how one can retrieve both the vertical profile of N and the dispersion parameter. But once I realized that the LWC profile is essentially assumed, it becomes clear. The authors should make it a little clearer that the LWC profile is assumed. They also should assess the potential for subadiabatic clouds due to entrainment mixing (see e.g. Nicholls and Leighton 1986, Section 5b). I'm not sure how this might impact the retrieval.

Authors Answer:

The authors understand that parts of the retrieval technique can be confusing at times. The revised version will further clarify the whole process. The LWC profile is not assumed, to account for the possibility of sub- or super-adiabaticity. Using the profiles of reflectivity and of its derivative, together with the LWP and the assumption of growth by condensation, the profiles of N and r_0 are retrieved, as well as a value for the width. However, the LWC profile is first roughly estimated to correct the reflectivity profile for liquid attenuation, which may be substantial. Nevertheless, this estimate is not used directly in the retrievals.

Minor Comments:

Overall, the paper is well-written, concise, and shows that the retrieval has considerable promise for more routine application to radar-radiometer datasets. I have only a few minor suggestions for improvement.

1. The estimated errors in the input parameters used to perform the error breakdown seem a little small. No one thinks that one can achieve 6 g/m^2 error from microwave LWP estimates. And is the radar calibrated to better than 1 dBZ? Perhaps it would be

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worth making the errors a little more realistic.

Authors Answer: The reviewer raises an important point. Realistic errors must be used. Here, the errors for the MWR LWP were taken directly from their files. The 6 g m^{-2} error is obtained only for the case of June 13 by the physical retrieval, which uses other input to better constrain the retrieved values (see Turner et al. 2007 for a description of the methods). For the radar errors, one must be careful: the reflectivity values used are those corrected for bias and water attenuation. Such corrections add an uncertainty to the measured values. Still, it is possible that the values used have an error smaller than 1 dB. The revised version could include the resulting uncertainty when considering a smaller error.

2. P 7512, L8, “of the distribution”

Authors Answer: This will be adjusted in the revised paper.

3. *The authors should clarify exactly how the microwave LWP is used. I am still a little confused. If one knows the base and top, isn't it sufficient to assume adiabatic, or is something else done?*

Authors Answer: It would be sufficient if adiabaticity was assumed. As it is not the case, the microwave LWP is required.

4. Eq 11, center part, numerator: *remove superfluous “(r)”*

Authors Answer: This will be adjusted in the revised paper.

5. P7516, line 3. *By “edges”, do the authors mean “cloud top and base”, or do they mean cloud sides?*

Authors Answer: This will be clarified in the revised version. As everything is done column-wise, it was assumed obvious that “edges” refer to the base and top of the cloud.

6. *An obvious test here would be to take the MWR and the NFOV and derive an effec-*

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tive radius to compare with the retrieved one. How good is the agreement?

Authors Answer: The revised version will clarify that this is actually the effective radius comparison made in panel b of Figs. 3 and 6 (green dots from MWR and NFOV).

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