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Atmospheric Measurement Techniques Discussions

Interactive comment on "Simultaneous and synergistic profiling of cloud and drizzle properties using ground-based observations" *by* Stephanie P. Rusli et al.

Anonymous Referee #1

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The authors present a novel retrieval method with the goal of solving a long-standing problem of separating the cloud and drizzle property profiles within boundary layer clouds. The retrieval distinguishes itself from pre-existing methods through its unique combination of instruments and physically-based constraints (particularly the vertical structure of drizzle). The ideas presented are therefore clearly suitable for publication in AMT. However, after reading through the manuscript, I have two concerns that could have substantial influence on the results and conclusions.

1) The calibration of the MIRA-35 radar

The observed radar reflectivity reported in Figure 6 is significantly less than I would expect for drizzling stratocumulus. As the authors outline on P2 L25, the consensus

in the literature of typical radar reflectivity for the onset of drizzle is between –20 to –15 dBZ. Yet, on P17 L17, the authors report observed radar reflectivity is typically no higher than –28 dBZ. Given that drizzle is clearly present in Figure 6, and almost reaches the ground at around 4 UTC, I anticipate there is a calibration error of at least 10 dB. Extrapolating the 3 dB error investigated on P16 L4, the retrieved LWC and effective radius are likely to be significantly underestimated. It is therefore difficult to trust the conclusions of the evaluations against other retrieval methods in Section 5. Are there any independent observations of radar reflectivity at Cabauw that could be used to validate the MIRA-35 calibration?

2) Test using synthetic data

It is a shame that the LES used to verify the retrieval does not contain drizzle (P14 L22). As the novel aspect of the algorithm is to separate cloud and drizzle signals, the test does nothing but serve as a sanity check to the forward models (in the authors' words on P14 L25) and therefore adds little to the paper. Perhaps testing with idealized profiles of cloud and drizzle would be more informative, or the addition of a synthetic drizzle profile to the LES data? The description of the retrieval technique (Section 2) is somewhat hard to follow, so illustrated examples of the different retrieval scenarios using idealized profiles might be helpful.

Minor comments and style comments:

P1 L18 aerial -> areal

P2 L3 settle -> form

P2 L21 It is not clear whether 'This retrieval' refers to Fielding et al., or the method presented

P3 L12 'respectively' is not needed

P3 L21 define 'Heavy precipitation events'.

P8 L28 minute -> small

P9 L12 If the vertical structure of drizzle within cloud is constrained by Eq. 13, why does the retrieved cloud extinction need to be fixed at 150m? Would it be clearer to include k1 in the state vector (in place of the cloud extinction) and say that any lidar backscatter further than 150m above cloud base is not forward modeled?

P21 L8 (and in other places) when comparing differences in radar reflectivity the unit is dB (relative) rather than dBZ (absolute).

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