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Atmospheric Measurement Techniques Discussions

Interactive comment on "Improvement of Airborne Retrievals of Cloud Droplet Number Concentration of Trade Wind Cumulus Using a Synergetic Approach" *by* Kevin Wolf et al.

Anonymous Referee #2

Received and published: 21 January 2019

Wolf et al. provide an interesting mutli-sensor approach towards better constraining CDNC estimates in trade wind cumuli. These clouds present a challenge to remote sensing of their microphysical parameters, especially in the Vis/NIR portion of the spectrum. Using a combined V/NIR and active/passive microwave measurements, while in and of itself is not novel, the use of MW LWP measurements to help quantify the degree of adiabaticity in the cloud retrieval is. It definitely contributes to the existing body of literature. I recommend that the manuscript be published subject to a few relatively minor revisions.

Specific comments:

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P2 L32 : Perhaps mention that Q_ext is around 2 and thus the coefficient in equation 1 is 2/3. It would be helpful for those not as familiar with VNIR cloud retrievals.

P2 L18: Bennartz and Rausch (2017) doesn't assume a constant LWC vertically, but a sub-adiabatically stratified, linearly increasing LWC of roughly 80% of the purely adiabatic value

P5L25: The k-parameter shows up in equation 3, but there is no mention of what k represents until page 12. It may be helpful to provide the reader a little more information on k rather than leaving them hanging for 7 pages.

P11L19: With regard to the effective radius retrievals, SMART's absorption channel around 1.6 microns, which has a significant amount of vertical penetration into the cloud relative to 3.7 or 2.1 micron absorption channels. For an adiabatically stratified cloud, the re represents the cloud-top value. So, 1.6 microns would underestimate the true re,LWP and thus N. I understand that it is a limitation of the instrument, but it may be worth mentioning this and how it may impact your retrievals especially when comparing to microwave LWP. It is mentioned in the conclusions on P31 of the manuscript, but would be worth mentioning again in this section.

P19L7: The study used radar measurements to identify potentially precipitating observations. Since Z is more sensitive to larger droplets, it can't easily identify drizzle cases, as you mention. For the cases in section 6, I think it may be helpful to augment the radar with a VNIR ratio of cloud geometrical thickness and CDNC to identify potentially drizzling cases that radar can't identify. Van Zanten and Stevens (2005) for example establishes ratios of Hˆ3/N for identification of drizzle in stratocumuli. For the transition to trade cumuli, this may not be clear-cut, but nevertheless is may help reduce the misclassification of drizzling clouds, which would affect the statistics on retrieved optical parameters.

P25: Figure 6. I don't see any mention of it in the body of the manuscript.

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P32: Of the three methods A,B, & C, which is best? and when? I didn't feel like I got a clear and concise message on that in the conclusions. I feel like the conclusion section broadly covered this, but not concisely.

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