**Atmospheric
Measurement
Techniques
Discussions**

Interactive comment on "An intercomparison of radar-based liquid cloud microphysics retrievals and implication for model evaluation studies" *by* D. Huang et al.

Anonymous Referee #1

Received and published: 12 February 2012

The authors compare 3 standard liquid water cloud retrieval algorithms for liquid water content (LWC) and effective radius (reff) over a time period of 9 years using data from the ARM SGP site. The long-term comparisons are intended to give an uncertainty estimate of current liquid water cloud microphysical products essential for the evaluation and further development of numerical weather prediction models. My main criticism lies in the following points:

1. Introduction: The authors should also mention the following approaches to quantify the accuracy of liquid water cloud retrieval algorithms

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a.) SW and LW radiative closure studies (e.g. McFarlane and Evans 2004 JAS, Ebell et al. 2010 QJRMS)

b.) Model bases approaches, i.e. model output is used to generate remote sensing measurements and then the retrieval is applied and one may quantify the error directly by comparison with original model output (e.g. Löhnert et al., 2007 JGR)

2. Introduction: What is the justification for the assertion that the spread of the three existing retrievals is useful for model evaluation? Can the three retrievals be regarded as independent estimates? Or are they based on similar assumptions? Please make this essential point more clear.

3. Section3: The authors should generally state the expected/documented accuracies of the retrievals algorithms they present. These have been most certainly estimated in the past. Also it would be of high value if the assumptions made in the different algorithms were commented concerning their physical justification/background in a paragraph at the end of each sub-section 3.1, 3.2, 3.3. E.g. the assumption made by Eq. 8 seems non-physical.

4. Section4: The authors should describe their data sets in more detail.

a.) How many cases were evaluated for each retrieval algorithm?

b.) Were exactly the same cases compared with each other – only this would make sense for and direct comparison.

c.) How many cases were clear/cloudy/precipitating?

d.) Could all retrievals algorithms be applied in all cases? Or does the one or the other have difficulties is certain situations?

d.) How many case were excluded due to precipitation?

I would recommend to include this information in a table.

5. Section5: Could generally be shortened significantly. E.g. I do not see any reason for Fig. 1 and Fig. 2. There is no information here from which the reader could benefit. Instead, the authors could analyse the year-to-year variability for the different algorithms or discuss how the different algorithms represent the seasonal cycle. The fact that the mean LWC profiles look similar and the discrepancies for reff are rather large could be described much shorter by means of one figure and details could be summarized in a table. This also holds true for the low-level-stratus comparisons, which could also be summarized in this table. In this sense Fig. 4 is not really necessary – the essential information is shown in Fig. 3; also showing relative difference in LWC is a bit problematic because this can grow very large in case of very small absolute values. Fig. 7 could also be omitted – the statement about auto-correlation could be restricted to one or two sentences.

6. Section5: Before describing the mean properties of the microphysical properties (Fig. 3 and following), the authors should compare the cloud macro-physical properties, i.e. cloud occurrence at each level (yes or no), cloud base, cloud top and cloud depth. This means that Fig. 10 should be positioned at the very beginning of the paper and be extended towards cloud occurrence. Mandatory in this sense is a pdf of cloud occurrence at the different height levels for each of the different retrievals algorithms. In contrast, the pdfs shown in Fig. 5 and Fig. 6 do not contribute to understanding the retrieval algorithm differences because the height dependent information is missing.

7. Only after these properties have been analysed and discussed in detail, is it reasonable to begin discussing differences in LWC and reff. If modellers shall use this paper to find out how good remote sensing observations are for model evaluation, they should first be informed about the accuracies of the macro-physical-properties. Once this has been carried out, I also think the authors should evaluate LWC and reff as a function of normalized height above cloud based (i.e. differentiating by cloud depth classes) instead of plotting mean values throughout the troposphere. Plots like Fig. 3 give no information whether differences are occurring more at cloud base, cloud top

or in the middle of the cloud (see e.g. Löhnert et al. 2003 JGR). This is essential for characterizing the algorithm deficiencies.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 7109, 2011.

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