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Interactive comment on "Research on Retrieval of Atmospheric Temperature and Humidity Profiles from combined Ground-based Microwave Radiometer and Cloud Radar Observations" *by* Yunfei Che et al.

Anonymous Referee #2

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General comments:

This study quantifies how utilizing cloud base and cloud thickness estimates from MWCR and radiosonde data is beneficial for improving temperature and humidity retrievals derived from MWR measurements. In general, the methodology is unclear. There is decent discussion of the retrievals and the various measurements but it is unclear how the BT and cloud information derived from the radiosonde data is used in the retrieval process. A reader should be able to read a clear, consolidated description of the methodology stating how the retrievals were developed.

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Discussion paper

One of the key findings is that adding cloud macrophysical measurements improves the retrieved temperature and humidity profile accuracy. While it is useful to quantify this truth, the paper needs to put the current study in context with previous findings. How this approach is different or better than previous retrievals (more references are needed to put this paper in context) will help make clear the purpose of the paper.

In addition, adding the location of the study will clarify in what environment these measurements were taken and suggest how applicable they are to other locations.

These changes require major revisions.

Specific Comments:

Section 2 should include more detail regarding the measurements. Was the MWR calibrated via a tip-curve technique, LN2 calibrations, or a combination of both? What is the threshold of the MWCR reflectivity (in dBz) to detect cloud base height and cloud thickness? How does changing this threshold affect the comparison in Fig 2?

Section 2.2 discusses the "pre-treatment of sounding data". Why is the simulated BT not included in this section? It would make sense to discuss all the measurements and radiosonde-derived parameters together before introducing the retrieval methodology.

In table 1 what is the average bias of the 60 samples of each MWR channel compared to the radiosonde-derived BT value? Bias of the MWR BT will affect the accuracy of the temperature retrievals.

Section 3 is titled "Retrieval methodology" and is where I expect to find clear explanation of the retrieval processes. Yet, prior to this section (pg 3, line 14-19) a training dataset is introduced, which is based on the sounding data. It seems that the description of the training data set should be included in the methodology section and the description of the data sources should be introduced prior to this section. I do not know what is meant by: "Initially, the pre-treatment of the radiosonde data focused on the removal of rainy or uncertain weather conditions" (pg 3, 15-16). There needs to be

a clear, consolidated explanation of the retrieval and the training dataset used in the retrieval.

Page 5 line 16: "The linear regression method and neural networks are probably the most popular in current research." The most popular what? Provide references. What about optimal estimation techniques?

Section 3.2.2 is where the input elements are defined for "no-cloud" and "cloud", yet the retrieval nomenclature is introduced on page 8 lines 14-15. Section 3.2.2, called "Methodology on the comparison of the addition of cloud", actually introduces both the "no-cloud" and "cloud" retrievals but fails to label them leaving the reader to decipher that these two methods are what will be later and be dubbed BBPN(cloud) and BPNN(no-cloud).

Generally, the methodology should explicitly describe the training data set, the two BPNN retrievals, and the HATPRO retrieval so it is clear what is being compared in figures 5-9.

Why aren't the same soundings to train the RPG-HATPRO retrieval (page7 lines 6-7) and were used to train the BBPN retrievals? The differences in the results section could be due to differences in the training set and not the retrieval methods.

What is meant by "In the whole 75 group samples, the number of correlation coefficients generated increased to 49 after the addition of cloud information."? (page9, lines 29-30)

Section 4.1 "Theory" This section seems out of place as well. The information on page 7 could be condensed and used to motivate why you did the retrievals. By the time the reader gets to page 8, lines 2-4, you have already described the retrievals, thus you are motivating why you are doing the new retrieval after you have already described it in a fragmented way.

Page 7 lines 24-25. Cite the research that has shown this statement.

Page 10 line 28: reword the last paragraph of section 5 (page 10 lines 22-31). The use of "can" makes it difficult to discern what was actually done and what will be done in future. On line 28 "judged" should be reworded because the sounding data is not used to judge the cloud-base height and thickness. Perhaps use "performed"?

Stay consistent in referring to the MWR retrieval. The Figures are labeled "RPG" and the text talks of MWR retrievals, but it is unclear if the MWR retrievals are RPG derived or the BPNN technique. For example: page 11, line 12 says "3. The precision of the retrieval without cloud and the MWR product reduced significantly in the cloud layers, but the precision significantly improved after addition of accurate information from the cloud radar." This sentence seems to be the main message of the paper yet it is still unclear which retrievals are being referred to.

Overall the language needs to be more precise. Avoid statements such as those used in the conclusion: "basically showed", ". . . tackle the problem of increased bias . . .", or " . . . a more complete vertical profile. "

Technical corrections:

Page1, line 4: Should be "Key Laboratory for Cloud Physics,"

Reword: pg 4 line 16-17." . . . the cloud information must be more accurate and richer than before." This is unclear.

"Clean-sky" should be "clear-sky" throughout the manuscript.

Fig 10: The axis labels are too small. Perhaps make it a 4 panel figure (a-d) with infrared radiometer components overlaid the cloud radar reflectivities.

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