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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Retrieval of cloud liquid water distributions from a single scanning microwave radiometer aboard a moving platform – Part 1: Field trial results from the Wakasa Bay experiment" *by* D. Huang et al.

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We highly appreciate the reviewer for his/her time and patience. We thank the reviewer for his/her comments which did help us to improve and strengthen the manuscript.

Scientific Comments: 1. p. 12027: Author list. Please explain why there are no co-authors from the MIR instrument at NASA/GSFC or the ACR instrument at JPL and CSU. These engineers/ scientists had to be just as involved as the co-author from the Univ. of Colorado for the PSR instrument, in terms of calibrating, quality-checking and

plotting their instruments' data from the Wakasa Bay experiment.

Response: The first author and the team for the PSR instrument have started collaborating on the cloud tomography research since March 2007. Invited by the PSR team, the first author visited University of Colorado at Boulder in following summer and worked intensively with the PSR team to calibrate and process the PSR along-track data. The ACR and MIR data are mainly used for validation purpose in this research.

2. p. 12028, lines 4-6: "A mobile cloud tomography system using only a single scanning microwave radiometer has many advantages over a fixed system using multiple distinctly-located radiometers, e.g. efficient and flexible data collection." These advantages need to be better justified. First, what is meant by "efficient"? This system is certainly not more cost efficient than a set of fixed sensors. Second, the disadvantages of the mobile system need to be listed as well, e.g. limited temporal sampling and duration of observations. Since the most recent data reported were collected in 2003, an obvious limitation is that of available resources required to repeat such an experiment.

Response: The sentence has been rephrased to read "A mobile cloud tomography system using only a single scanning microwave radiometer has many advantages over a fixed system using multiple distinctly-located radiometers, e.g. cloud chasing capability." By saying "efficient data collection" in the original manuscript, we mean that the mobile system can collect more useful data in the same period since it has cloud chasing capability.

The disadvantages of the mobile system has been discussed in Section 1. The following sentences have been added: "The airborne configuration, on the contrary, is much more flexible. But the airborne version has poor temporal coverage and is usually costly to deploy. For field studies that require more flexible data collection like cloud chasing, the airborne version of cloud tomography is superior to the ground-based configuration."

3. p. 12028, line 21: "moving speed" needs to be defined in terms of air speed or ground speed.

Response: The aircraft moving speed is relative to ground. More precise definition has been provided in the revision.

4. p. 12029, lines 10-11: "requires the atmospheric emission at a frequency of 31.6 GHz be measured..." This specific frequency is not "required". Other measurements have shown that he same cloud retrieval could be accomplished from measurements at any window frequency in the range of at least 30-37 GHz.

Response: The sentence has been rephrased to read “The first of the several proposed configurations measures the atmospheric emission at a frequency of 31.6 GHz using multiple ground-based radiometers that are located in distinct locations”.

5. p. 12030, lines 3-4: "Microwave technologies have also advanced considerably and microwave radiometers have become more portable ..." This is certainly true, but PSR and MIR are not examples of such portability since they are large and bulky instruments that require sizable aircraft or UAVs to deploy.

Response: We agree with the reviewer that PSR and MIR are not the best example for portability. But compared with the radiometer of J. Snider in the 1980s, PSR and MIR are much smaller in size.

6. p. 12030, lines 25-26: These lines repeat the exact ideas of p. 12028, lines 4-6 (discussed in #2 above) and do not add any new information.

Response: The sentence has been rephrased and redundant information has been deleted.

7. p. 12032, lines 18-20: Most of these lines repeat the exact ideas of p. 12031, lines 8-9 without providing any new information. One of these two instances should be removed.

Response: The paragraph has been condensed.

8. p. 12033, lines 5-7: This is the *third* time that these exact ideas are stated in the paper, repeating those listed in #7 above. The only new concept is "retreiving the spatial distribution of cloud liquid water," but this is the goal of the entire paper. There is no need to state this three times.

Response: The sentence has been rephrased to avoid repeating the old information.

9. p. 12034, line 1: "precise measurements of the external targets." What are the physical temperatures of the two external targets in PSR? The corresponding temperatures are stated for MIR in the last line of this page and the first line of the next page.

Response: Information about the physical temperature of the PSR external targets has been added in Section 2.

10. p. 12034, lines 9-10: "brightness temperatures at the 37 GHz frequency averaged over horizontal and vertical polarizations" Please explain the justification for averaging horizontally- and vertically-polarized brightness temperatures when they are so different over the ocean. Such averaging would seem to obscure the value of measuring oceanic brightness temperatures.

Response: We add the following argument in the manuscript:“Horizontally-polarized microwave emission from the sea surface has a maximum at the zenith direction and decreases with incidence angle (bell-shaped), while vertically-polarized emission increases with incidence angle (bowl-shaped). Thus, averaging the measured brightness temperatures over the two polarizations will suppress the range of angular variation in the brightness temperatures due to the background sea surface emission (thus will reduce the uncertainty associated with the sea surface emission model).” Our goal is to retrieve cloud information from the radiometer measurements.

11. p. 12034, lines 12-13: "view angles range from 200 degrees (70 degrees off nadir in the forward direction) to 340 degrees (70 degrees off nadir in the backward

direction)." The reason for this odd definition of angles (as used in Fig. 4(b)) is unclear and hard to interpret.

Response: We has used a more standard way to describe radiometer view geometry, so the zenith direction will be zero degree.

12. p. 12043, lines 14-15: Since altitudes are referred to in the text in km, one needs a conversion from hPa = mbar to km above sea level (ASL). It could be plotted on the right axis of Fig. 6.

Response: Taken. The right axis has been labeled with km above sea level.

13. p. 12045, line 22: "The maximum LWC in the retrieval ... occurs in the 2.0 to 2.8 km altitude range." What is the large amplitude signal at 75 km distance and about 3.5 km altitude?

Response: It could be a retrieval artifact. The radar image shows no significant return at this location.

14. p. 12047, line 9: "point-by-point comparison between the MIR LWP and the PSR LWP." Since this comparison shows a very large correlation coefficient of 0.96, it needs to be stated whether the PSR and MIR brightness temperatures were used in calibration the other's brightness temperatures (and if so, how), and whether or not their LWP retrieval algorithms use the other's brightness temperature data in any way.

Response: The PSR and MIR brightness temperatures are calibrated independently. As described in the manuscript, the three LWP retrieval runs uses three different datasets: (1) MIR data only; (2) PSR data only; (3) MIR and PSR data.

15. p. 12050, lines 3-4: "It is unfortunate that there were no in-situ measurements of cloud water content during the field campaign that can be used to validate the tomographic retrievals." This repeats the exact ideas of p. 12044, lines 12-14. Again, there is no need for such redundancy in the paper.

Response: The sentence has been deleted.

16. p. 12050, lines 29-ff: "The wind speed was about 20 m/s during the cloud tomography test, causing a 2 to 3 K uncertainty in the background (sea surface brightness temperatures" (1) The average wind speed is specific information that was not mentioned, and is only being introduced in the conclusions. Furthermore, a reference height is needed for the wind speeds. Are they at a standard 10 m height?

Response: We have rephrased the relevant sentences to read: "The wind was strong during the cloud tomography test, causing at least a 2-3 K modeling error of background (sea surface) brightness temperatures. This modeling error will inevitably propagate to the tomographic retrievals. " And the quantitative information of the wind speed has been moved to Section 4 now.

References: The authors have omitted a reference to related work in water vapor tomography published before Huang et al. (2008a,b) [p. 12030, line 10] and that is appropriate to add as an application of algebraic reconstruction tomography on p. 12040, line 12. The reference is: S. Padmanabhan, S. C. Reising, F. Iturbide-Sanchez and J. Vivekanandan, "Retrieval of 3-D Water Vapor Field Using a Network of Scanning Compact Microwave Radiometers," in Proc. IEEE Geosci. Remote Sens. Symp., Barcelona, Spain, 2007, pp. 251- 254.

Response: The reference has been added and cited at Section 2.

English Grammar and Detailed Comments:

Response: We thank the reviewer again for his/her time and patience for providing the valuable comments. We have iterated the manuscript for several times and corrected the grammar errors/misused words/typos as suggested by the reviewer.

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