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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 are thankful for the reviewer's valuable comments.

TECHNICAL COMMENTS 1. Abstract. P12028, L20-25. In addition to a flawed data collection geometry, possible reasons for the incorrect indication of high altitude clouds could be radiometric calibration, incorrect absorption model (either water vapor or cloud liquid), or both. In addition, I could not find in the manuscript, any mention of the absorption models used.

Response: We agree with the review that radiometer calibration, uncertainty in absorption model, and geometry all together could be responsible for the artificial high altitude clouds in the retrievals. The flawed data geometry is believed to be the main reason because the artificial high altitude clouds appear to be vertically homogeneous which indicates the lack of vertically-resolved information at high altitudes in the data . We have provided a short discussion on this in the revision.

A description of the absorption model (the model used to calculate the absorption efficiencies of liquid water,water vapor and oxygen) has been added in Section 4. Relevant references have been provided.

2. P12031-Data. I think that it would be helpful if a table containing all of the radiometric frequencies and other relevant parameters were inserted in this section.

Response: Taken. A table has been added to better illustrate the specification of each instrument.

3. P12030 and P12033. Fig. 1b depicts an upward viewing aircraft radiometer while Fig. 3 shows how the radiometers were deployed in a downward-viewing mode. Since the experiment was conducted following the outline of Fig. 3, I suggest modifying Fig. 1b.

Response: The reviewer is right that Fig. 1b depicts an upward configuration, but the experiment used a downward configuration Fig. 1 was adopted from Warner et al. (1985). The upward viewing configuration was first proposed and tested by Warner et al. It uses a dual-antenna radiometer (no scanning) instead of a scanning radiometer. This is a very different configuration with that used in the Wakasa Bay experiment.

4. P12034, L1. ": : :temperature to precise measurements of the external targets." Please quantify.

Response: The following sentence has been added: "The calibration method consists of periodically switching the receivers' input to a noise diode and infrequently view-

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ing two external reference targets that have up to 100-120 K centigrade of hot-cold temperature spread. ”

5. P12037, (1). Since x is a vector of absorption coefficients, both A and b must also be related to absorption. How was the transformation from Tb to absorption done? Furthermore, (4) contains the parameter ?, which must have the dimensions of absorption, not Tb. Does epsilon have an implicit dependence on Tb?

Response: We have provided a detailed description of each term in the matrix equation in the revision, and more technical details on the radiative transfer model are provided in Section 2 of Part II of this paper. The kernel matrix A is the radiative transfer operator that relates cloud liquid absorption coefficient x to measured brightness temperature b. Epsilon is chosen to represent the overall uncertainty in the brightness temperature data and it has the same dimensions as brightness temperature.

6. P12046. Retrieval using combined MIR and PSR data. The PSR retrievals were based on 37 GHz data while MIR used its 89 GHz channel. Since the PSR had a 89 GHz channel, why wasn't a direct comparison using common channels done?

Response: The Ka-band is considered to be more appropriate for the cloud liquid water retrieval purpose for the following two reasons: (1) the contrast between background water vapor and cloud liquid is maximum at this frequency; (2) less scattering by large particles like rain and ice. So we choose the 37 GHz data to perform the tomographic retrieval. The 89 GHz MIR data (the lowest frequency of MRI) is mainly used to evaluate creditability of the PSR retrieved horizontal structures.

7. P12048. Section 5.5. Again, when comparing measured vs. calculated Tb, the underlying models should be stated.

Response: The detailed description on how to simulate microwave radiometer measurements using a radiative transfer model based on given cloud and atmospheric fields is provided in Section 2 of Part II of this paper. A reference to the companion

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paper has been provided in this revision.

8. P12063. Fig. 10a. The MIR retrievals overestimate LWP (relative to the PSR) above about 450 gm-2, and underestimate below this value. Is due to scattering at 89 GHz at the higher LWPs? Do both the MIR and PSR retrievals use the same absorption models? It might be useful to produce a line of best fit with its associated statistics (slope, offset, and rms differences),

Response: "The MIR retrievals overestimate LWP (relative to the PSR) above about 450 gm-2, and underestimate below this value". The major reason for this is that the PSR retrievals rely on slant beams to estimate the vertically-integrated quantity, LWP, at each location. Thus, the fine horizontal structures are smoothed out in the PSR retrievals. More scattering at 89 GHz means the observed brightness temperature at 89 GHz will be lower. This depression in brightness temperature actually will result in a lower LWP in the retrieval.

Both the MIR and PSR retrievals use the same absorption model. A description of the absorption model (the model used to calculate the absorption efficiency of water vapor and oxygen) has been added in Section 4. Relevant references have been provided.

A regression line based on robust fitting techniques has been added to Fig. 10a with associated statistics.

9. P12064. What do the various colors show?

Response: The color in Fig. 11 shows the value of the mean difference between the observed and calculated brightness temperatures. We have changed this figure to a grey-scale one because the value of the mean difference can also be obtained from the Y-axis (so the color scheme is not necessary).

GRAMMATICAL COMMENTS

Response: We have worked through the manuscript for several more iterations. We have corrected typos/grammatical erros as suggested.

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