The thoughtful comments by Reviewer 2 are greatly appreciated.

Comments are repeated in *italic*.

Comment 1: The author should extend the analysis and differentiate between clear, cloudy and possibly precipitating cases. In order to be network-suitable, a MWRP retrieval must deliver reliable results in nearly "all-weather" cases. If this can be shown, this would enhance the relevance of the manuscript.

Reply to comment 1:
I agree with the reviewer and add an analysis regarding the cloud dependence of the retrievals. The following text will be included (Secion 4, page 2946, line 8):

An addtional analysis was carried out to demonstrate the "all-weather" capabilities of microwave radiometers. For the training of the REGmod operators pairs of radiometer and NWP model data were used excluding observations disturbed by rain. Therefore precipitating cases can't be retrieved reliably by the model-based regression method. For the remaining part, retrievals with comparable accuracies are required to make them suitable for network applications and assimilation. In order to examine potential differences the validation dataset is divided into two groups, one contains cloudless and the other clear cases. The observations of the infrared pyrometer integrated in the radiometer are used to distinguish between cloudy and clear.The retrievals are assigned to the group of clear cases if the infrared temperatures are less than 230 K and are fairly constant during the 10 minute period which was used for the intercomparison. From the total of 104 cases of the validation data set, 38 have been recognized as clear in this way. The results are shown in Figure A7. Although the cloud coverage isn't considered for the REGmod calculation, the temperature bias for clear cases is lower than the systematic deviation of the cloudy cases above 2 km height. A small advantage becomes apparent for the STD of the clear cases as well. In contrast to that, cloudy retrievals show a smaller bias for lower levels up to 1.5 km. However, we should take into consideration that water vapor is highly variable in space and time and data from from different sites are compared located about 10 km from each other. Furthermore, a relatively small number of comparisons are evaluated including 104/ 38/ 66 cases for all/ clear/ cloudy conditions. On an overall basis, the REGmod method provides reasonable results in the expected range indicating that ground-based radiometry has "all-weather" capabilities required for operational applications.

Comment 2: Also, I would find it important to analyse the bias behaviour as a function of time of day. The radiosondes from Oberschleißheim could be used to evaluate 0 vs 12 UTC retrieval performance, also REGmod could be cross-checked against the hourly COSMO model output to see if the MWRP is principally able to capture the diurnal cycle adequately.

Reply to comment 2:
From my point of view, the time of the day has no influence on the bias behaviour of the regression retrievals. In the training dataset the time isn't taken into account and information in temporal proximity are not used. I fully agree, that the temporal resolution of microwave observations offers good prospects to describe atmospheric processes. To make that more clear, the following text is added now in the manuscript (page 2939, line 17):

a) The approach enables the observation of the diurnal cycle and their important underlying physical processes. The temperature diurnal variation induced by solar heating as well as the water vapor cycle influenced by precipitation, moist convection and evapotranspiration can be recognized by microwave observation as shown by Güldner and Leps (2005).

Additionally is stated (page 2946, line 8) after the reply to comment 1:

b) Concerning the campaign at Munich Airport, the REGmod algorithm was applied and weak-biased profiles are calculated consistently. Additionally, images of the daily course of temperature and humidity profiles compared with NWP model data are provided as shown in Figure A8.

Comment 3: From my point of view, Fig. 6 should provide the most important and essential information of the manuscript: that REGmod and REGobs do or do not compare in accuracy. However, I cannot draw this information from the figure in a conclusive way, because the training data sets the Lindenberg and Munich retrievals were derived from differ statistically - probably both due to station characteristics (climatology) as well as to different sub-sample size (using different months?). This can be explicitly seen from the STD curves (black) shown in Fig. 6, bottom. Now, since the variability of temperature and humidity in the training data set determines the derived retrieval uncertainties to a certain extent, the results from REGmod (Munich) and REGobs (Lindenberg) cannot be compared 1:1 as carried out by the author in Fig. 6 and the discussion in Section 4. So my question here is very simple: why does the author not apply the REGmod retrieval to Lindenberg data? He could then use training data from the same location and time period for creating both REGmod and REGobs – this would then allow a much more conclusive assessment of the REGmod method. Of course, the application to Munich data could additionally underline the applicability of the method.

Reply to comment 3:
I fully agree that REGmod (Munich) and REGobs (Lindenberg) cannot be compared 1:1. REGobs and REGmod are similar (identical) algorithms basing on different training datasets. However, given the fact that one operator is calculated from observations and the other from forecast model data, the observation-based method should show lower STD, even if comparisons are performed at the same site. Additionally to the observation errors, the model-based method has to compensate forecast and assimilation errors.
It is beyond the scope of this paper to analyse microwave data from Lindenberg which has been available for more than 10 years. The intercomparison given in Figure 6 primarily demonstrates that REGmod retrievals can be provided with accuracies which are approximately equivalent to the approved REGobs method, although no a priori information have been used. I regret that this point led to misunderstandings and will attempt to make the main aims of the paper clearer.

Therefore on page 2937, line 20 is now stated:

a) The challenge here was to retrieve temperature and humidity profiles within the expected error range, although no a priori information are used in advance. That's important, first of all to provide best possible data for subsequent applications in the frame of the project and secondly to simulate any potential stand-alone radiometer site.

Further is added on page 2945, line23:

b) This figure is not intended to compare REGmod with REGobs methods. Both methods are the solution of Eq. (1) basing on different training data sets. Furthermore, different surface heights and the large distance between the sites are out of question. Nevertheless, the REGobs results of Lindenberg can be used as reference for the potentials and limits of microwave sounding within a profiler network.

Minor comments:

1 A native speaker should check the English used in this manuscript, i.e. Page 2944, line 23: "redraw" – does the author mean "withdraw" here? There are several of such improper formulations, which could lead to misunderstandings.

R1: "redraw" is replaced by "reduce"

2 Sections 3 and 4: The authors should note which frequencies and elevation angles are used to derive the temperature and humidity profiles. Also it is important to note on which temporal resolution the MWRP measurements are available. And in addition, the author needs to state how large the training and testing data sets used for the different REGmod versions are.

R2: Page 2943, line 7 is added:
" ... measurements y, which here correspond to TB zenith observations at 22 frequencies, 8 in the K-band ranging from 22.23 to 30 GHz and 14 in the V-band from 51.25 to 58.8 GHz. x0 and y0 denote the associated mean values."

Further is specified (page 2942, line 3-4):
"However, since only zenith measurements are used in this study, seven to eight measurements are available for each ten minute interval."

The numbers are added.

3 Page 2936, line 17: The bias can also be caused the retrieval uncertainties, i.e. a non-representative training data set.

R3:
Indeed, I agree. Changed

4 Page 2941, line 13: I would not speak of "inaccuracies" in general, but more of systematic uncertainties.

R4:
Changed.

5 Equation (1): x0 and y0 are not described in the text.

R5: Done now (see R2)

6 Page 2945, lines 2-3: "Note, . . ." What does the author mean to say with this sentence?

R6:
It is stated now: “The STD of the humidity profiles is about one half of the radiosonde STD from the surface up to 10 km.”

7 Page 2945, line 9: What “nonlinear relationship” is the author talking about? Could he show an example?

R7:
This author impression is omitted now.

8 Page 2945, line 24: With “a.s.l.” does the author refer to “above sea level”? Isn’t “above ground level” the correct term here?

R8:
Done.

9 Page 2946, line 20: What does the author mean with “good correlation” – please specify quantitatively.

R9:
Additionally is stated now: “Especially for water vapor the absolute deviation of the mean values and the STD are less than 0.1 g m^{-3}.

10 Page 2946, line 21: MWRP are capable of deriving highly accurate temperature (< 0.5K uncertainty) profiles in the lowest 500 m if elevation scans are used (see e.g. Crewell and Löhnert 2007, TGARS). The author should comment on this.

R10:
The reference is added as suggested and the following statement is inserted (Page2943, line 9):
REGmod operators can be calculated as well by including angular information to the zenith observations if horizontal homogeneity is assumed. Crewell and Löhnert (2007) have shown that for temperature a higher accuracy can be achieved by combining angular and spectral information. In this study only zenith observations are used. In order to generate robust operators for "all-weather conditions the fine-tuning by using angular observations seems to be not appropriate, in particular as they are trained with forecast model data.

11 Page 2946, line 27: What does the author mean with “permanent interferences”. Generally “interference” in the microwave region tend to be “spiked” and thus temporally highly variable in they are in connection to active, transmitting sources

R11:
Changed.

12 Fig. 2 (and Fig. 3): Please use frequency in GHz on x-axis instead of channel number (Fig. 2). It is also not clear how many measurements are used to create the plot. If the author would like to underline the problem of general systematic TB differences between MWRs and/or radiosondes, he should either point to suited references or show statistically significant comparisons showing systematic and random differences. From my point of view, no conclusions can be drawn from regarding just one day.

R12:
The frequencies are added in the figure caption.

In respect to the number of measurements is completed that 144 10-min mean values were used.

The figure is part of an enumeration. Listed are possible error sources which have to be taken into account within a network if a multitude of radiometers are operating at various sites. From my point of view, it is very likely that such differences appear. Pictures as Figure 2 are generated operationally in Lindenberg and they are similar.

I state this (Page 2940, line 27) as follows:
“TB differences on different days are quite similar for comparable atmospheric conditions if they are close in time to each other and no calibrations are performed. That can be concluded from the operational output of plots as given in Figure 2 (not shown).

References:

Crewell, S. and Löhnert, U.: Accuracy of boundary layer temperature profiles retrieved with multifrequency multiangle microwave radiometry, IEEE T. Geosci. Remote, 45, 2195–2201, doi:10.1109/TGRS.2006.888434, 2007.

Güldner, J. and Leps, J.-P.: Analysis of CLIWA-NET intensive operation period data as part of the monitoring activities at the German Meteorological Service site Lindenberg, Atmos. Res., 75, 151-166, 2005.

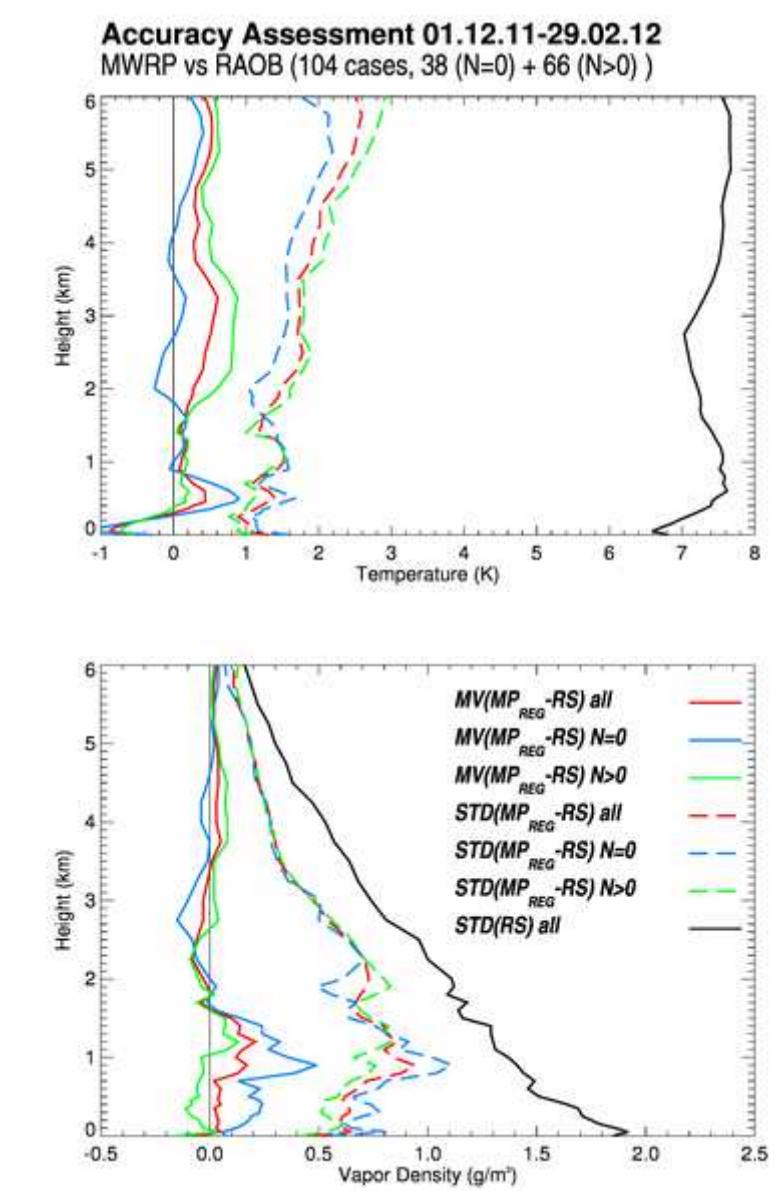

Figure A7: Retrieval errors of temperature (top panel) and humidity (bottom panel) calculated for Munich (REGmod was applied). Bias (solid lines) and STD (dashed lines) are plotted for all cases (red), and for cases identified as clear (blue) or cloudy (green). The black lines denote the STD of radiosondes at Munich/Oberschleißheim.

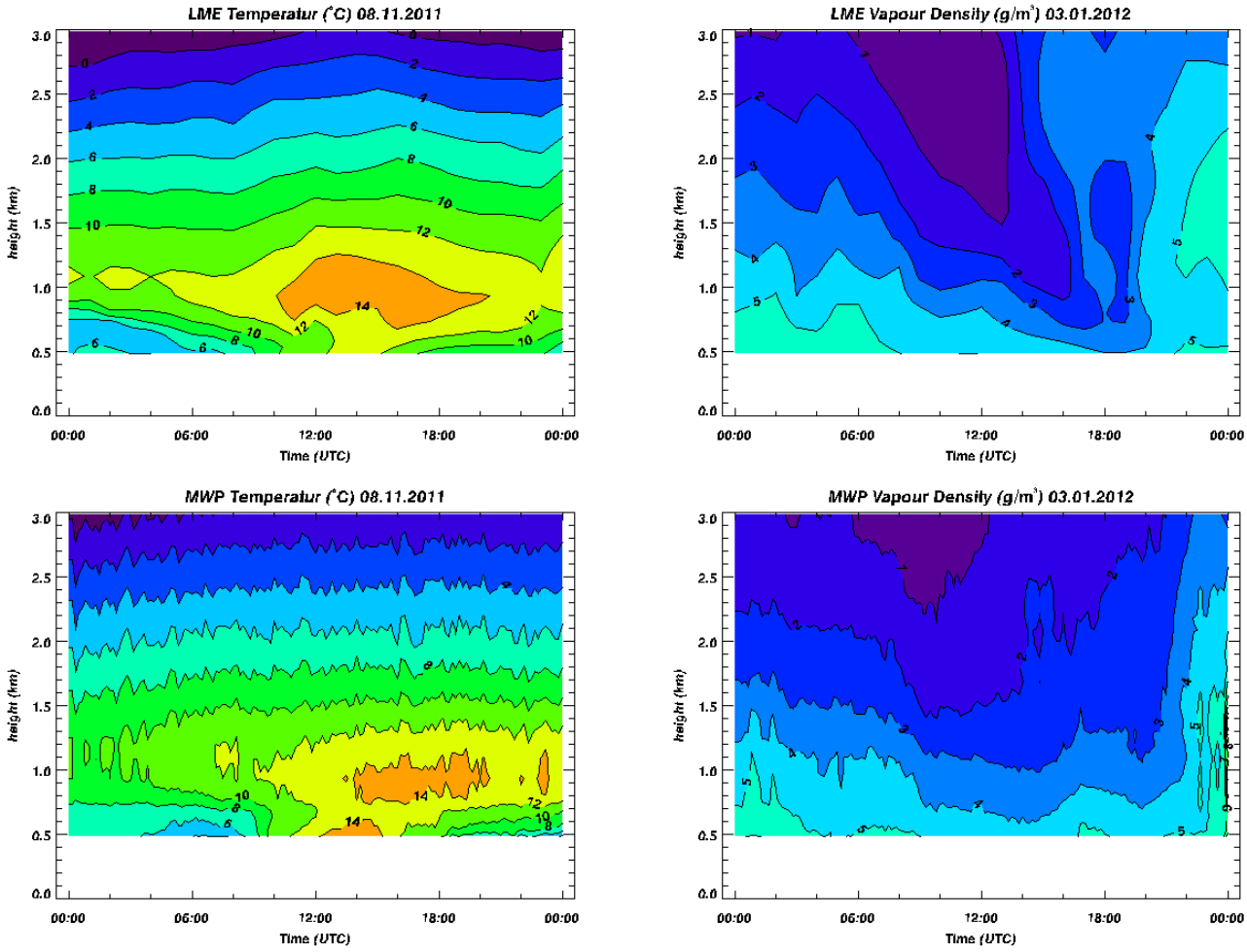

Figure A8: Comparison of forecast model data (top panels) versus microwave radiometer retrievals (bottom panels) for temperature (left) and water vapor (right).