Response to Reviewers #1 and #2

We like to thank the reviewers for providing helpful comments to improve the manuscript.

All changes are highlighted in the diff-manuscript below. Added text is wavy-underlined and blue, discarded text is struck out and red. The reviewer comments are listed below in black. The author's response is written in blue.

Anonymous Referee #1

General comments:

The revised manuscript of "Determination of low-level temperature profiles from microwave radiometer observations during rain" incorporated all major comments and concerns from the first review round.

The revised manuscript is now all right content-wise but sometimes suffers from some minor language difficulties.

Some overall comments:

You mention brightness temperatures a lot. You could think about introducing Tb as an abbreviation. Same goes for temperature profile. Consider using T-profile.

We agree. Done as suggested.

You could make it a little more clear (probably in the summary as well) that when a radome gets wet everywhere (not only at the top) due to old age, that none of your proposed retrievals will work properly during (and shortly after) rain events and that monitoring/knowing the state of the radome is very important. Your method relies heavily on a radome in pristine condition. If the radome hasn't been replaced for a long time, is damaged and is not hydrophobic anymore, the accuracy of your T-profile retrievals during rain will suffer.

We agree and added the clarification as suggested in the microwave radiometer HATPRO section 2.1.

Some minor corrections in detail:

line 8-10: We found out,/We show,/ It is shown, that retrievals... provide the best results.

Done as suggested.

line 44: ...with a 1DVAR technique…

Done as suggested.

line 78: multi-variate linear regressions (I would omit the word model here)

Done as suggested.

line 109: ...and was, e.g., also applied in Löhnert and Crewell (2003), Löhnert et al. (2007), and Foth and Pospichal (2017).

Done as suggested.

line 120f: ...retrievals during rain, indicated by unrealistic spikes, is shown…

Done as suggested.

...the rain and sun quality flags (a) denote if... (or is it actually one and the same flag?)

Done as suggested.

line 125: ...During spectral consistency checks. OR ...During a spectral consistency check.

Done as suggested.

line 128: ...for the K-band ...for the V-band.

Done as suggested.

line 130: ...have passed…

Done as suggested.

line 141f: A (temperature) retrieval....multi-variate linear regression method... (I wouldn't talk about a model here, see line 78)

Done as suggested.

line 142f: In this work we use the regression method.

Done as suggested.

line 152: regression method

Done as suggested.

line 159: ...are used at only the zenith angle.

Done as suggested.

line 181: ...was chosen…

Done as suggested.

line 187: Additionally, horizontally homogeneous atmospheric conditions are assumed. /a horizontally homogeneous atmosphere is assumed.

Done as suggested.

I think you don't always need to write the whole term "elevation angle". Usually it's enough to talk about, e.g., 30° elevation. Omitting the word angle often makes long sentences easier to read.

But refrain from just using the word angle alone. Replace angle with elevation (e.g. at end of line 202 and line 227).

We understand the concern but we don’t agree here. We think it is more precise to use the full term.

line 217f: You can delete: "Horizontally homogeneous conditions are assumed for boundary layer scans". You already mentioned that before.

Done as suggested.

line 241: ...retrievals show…

Done as suggested.

line 255: ...the prediction from the regression method…

Done as suggested.

line 309: To summarize, the…

Done as suggested.

line 315: ...up to 3 km during rain (events) with rain rates…

Done as suggested.

lines 323ff: I think mentioning the different retrievals only with their abbreviation in the text sounds a little odd.

We do not believe that it would make sense to stop using the abbreviations in the summary.

line 331ff: Rephrase. Something's wrong here in the sentence structure.

Done as suggested.

line 336: ...to increase the performance of the... (even) further…

Done as suggested.

Anonymous Referee #1

General comments:

The manuscript has much improved during the review process, therefore I suggest that it should be published after some small minor revisions.

Detailed comments:

- In section 3.1/3.2: Please make it clear that the retrievals you created (4v9f, etc.) are not based on PAMTRA simulations, but on the non-scattering RT model. This might be confusing to some readers!

This is already done in Sec. 3.1 with the following sentence “This information is used as input to the non-scattering microwave radiative transfer model (see Sec.2.5). “

- lines 23-24: "Snow and ice clouds do not emit in the considered spectrum, hence they are not taken into account here". This phrase is too early here, as you don't talk about MW observations yet, but only very generally about remote sensing.

We have moved the sentence a little further back in the introduction.

- lines 27-28: "Additionally, radiosondes show a significant sonde-to-sonde variability (Nash et al., 2005) as well as a dry bias (Turner et al., 2003)." This is less relevant for the recent RS41 soundings, these papers refer to older models (e.g. Vaisala RS80). I would omit it therefore.

We omit the sentence.

- lines 34-35: You write: "During rain the atmosphere becomes opaque at high frequencies of the V-band (...)". This is not correct - also during non-rainy conditions, the atmosphere is opaque at these frequencies! Please correct/rephrase!

We omit the sentence and rephrased the next sentence a bit.

- lines 47-49: please check this phrase again, I think there are some words missing.

We rephrased the sentence a bit.

- Section 4.1 and conclusions: Shouldn't it be "7v9f"? You write "7v10f" several times in this section. Please check throughout the whole document!

Yes you are right. Done as suggested.