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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Validation of brightness and physical temperature from two scanning microwave radiometers in the 60 GHz O_2-band using radiosonde measurements" *by* Francisco Navas-Guzmán et al.

Anonymous Referee #1

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General comments

The paper presents the results of the assessment of the capability of the new 12 channel microwave radiometer TEMPERA to measure tropospheric temperature profiles. The analysis is performed based on the measurements with this radiometer at the eteorological station Payerne for the year 2014. TEMPERA is developed at university of Bern. It has the unique capability to measure simultaneously the temperature in the tropopshere and stratosphere. The retrieval of the temperature profile from the observed brightness temperatures is based on an Optimal Estimation Method, while more

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Discussion paper

common the retrieval is based on a neural network or a linear regression method. Two retrievals for the TEMPERA are discussed, one which uses all the 12 channels, and one which uses only the 8 more opaque channels.

In the paper the authors assess the TEMPERA measurements by comparison to collocated measurements by radiosonde and a HATPRO scanning microwave radiometer. Statistical analysis (bias and standard deviation) is presented both for the measured brightness temperature and for retrieved tropospheric air temperature. To calculate brightness temperature from the radiosonde measurements they use a forward model (ARTS) and make an assumption on the liquid water content. These methods are commonly applied and similar assessments have been published in literature. Furthermore they assess by forward modeling the effect of the antenna beam width and the system bandwidth on the brightness temperature compared to a pencil beam assumption and a monochromatic receiver resp. Analysis is presented for both all weather situation and for clear-sky cases only.

The results show that the TEMPERA brightness temperatures show similar behavior as the HATPRO measurements when compared to modelled radiosonde brightness temperatures. For the more opaque channels (above 54 GHz) the results show little dependence on the elevation angle, while for the more transparent channels there is a strong dependence of the bias on the elevation angle. To avoid possible effects of atmospheric inhomogeneity in cloudy conditions on the comparison results the analysis is also performed for clear sky conditions. Although the biases do change there is still a strong dependence on the elevation angle for both radiometers for the more transparent channels.

For the tropospheric temperature profiles the results for both radiometers seem comparable. With the HATPRO standard deviation a little lower than the TEMPERA below 6 km, but the TEMPERA 8 channel retrieval shows a smaller bias than the HATPRO retrieval. Separating between day and nighttime clear sky conditions shows similar results for HATPRO but has some effect on the TEMPERA bias especially for the 12

channel retrieval.

The authors mention some of the possible causes for the differences found between the radiometers and the RS observations, like atmospheric inhomogeneity, temperature inversions (at night), unknown exact center frequency of the channels (HATPRO), forward model accuracy. Analyzing all-weather and clear sky conditions separate they address the problem of atmospheric inhomogeneity.

Since both microwave radiometer systems differ in design, measurement set-up and retrieval method, it is assuring that the results are comparable and that microwave radiometers are capable of the measuring the tropospheric temperature profile for several meteorological applications.

If the authors address some of the remaining questions (see Specific comments) the article should be considered for publication.

Specific comments

1) Introduction:

The authors mention the use of AMDAR and MODE-S as in-situ techniques for measuring temperature. The main disadvantage is according to the authors the high cost and very low temporal resolution. They do so without providing any reference or numbers. Since the mention of these techniques isn't relevant for the paper, either skip this remark or present some references and/or numbers on which the statement is based.

2) Experimental site and instrumentation:

2a) local set-up: was the pointing direction of both radiometers the same?

2b) time resolution of TEMPERA retrievals is 15 minutes (pg 4.), what is the time resolution of the HATPRO retrievals?

2c) not any numbers are presented on the estimated accuracy of the measured Tb's (specification?), are these unknown?

3) Brightness temperature comparison:

3a) what is the effect of the fixed LWC assumption of 0.28 g/mˆ2 on the forward model results, e.g. compared to a quasi-adiabatic assumption?

3b) the radiosonde takes about half an hour to reach 10 km height. Are the data of the radiometers averaged over this period? Or is any other processing applied?

4) HATPRO radiometer versus RS:

4a) Loehnert and Maier (2012) did find that LN calibrations might not always be properly executed. Did the authors check that for the analysis period 2014 the relevant LN calibrations were of sufficient quality?

4b) the bias dependence of the HATPRO 52.25 GHz channel on the elevation in clear-sky is quite different for this study than in Loehnert and Maier (2012) (both table 3). Since it concerns the same radiometer, have the authors an explanation for this difference?

5) Intercomparison of retrieved temperature profiles:

5a) a-priori profile for OEM. The authors claim one of the advantages of the OEM is that it doesn't need radiosondes profiles to train either the neural network or to retrieve the linear regression coefficients. But the authors use radiosonde profiles to calculate mean monthly a-priori temperature profiles. How does that relate to their statement that OEM doesn't need radiosonde profiles?

Technical corrections.

pg 1 line 15 "neuronal networks": the common used name is "neural networks"

pg 1 line 23 "spatial resolution": for radiosonde "vertical resolution" is a more appropriate term

pg 2 line 8 "atmospheric dynamics", since the radiometer provides temperature profiles,

"atmospheric thermodynamics" is characterized

pg 5 fig. 2 in caption: "for HATPRO" change to "for TEMPERA"

pg 5 line 6 "radiometric resolution": should this be "radiometric accuracy" instead?

pg 5 line 15 "first seconds of the flight" change to "first part of the flight"

pg 9 line 20 "temporal variations of" change to "standard deviations of"

pg 11 line 3 "the mean and the standard Tb deviation" although what is meant is clear, but more proper would be "the mean and the standard deviation of the Tb differences"

pg 13 line 15 "first kilometer there" change to "first kilometer, there"

pg 14 line 13 "any temporal dependence" is "any diurnal dependence" meant here?

pg 16 line 3 "patter"change to "pattern"

pg 21 add DOI's to the references where applicable

Note: only the first occurence of a suggestion/correction of a certain term/word is mentioned.

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