Comments on manuscript: "Measurement uncertainties of scanning microwave radiometers and their influence on temperature profiling" by Böck et al.
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**Summary:**
The paper discusses the topic of ground-based scanning radiometers and associated uncertainty related to the measurements and temperature retrievals. Uncertainties discussed include horizontal inhomogeneity, radiometer tilt, obstacles in the scanning path, and RFI. The paper addresses these aspects with simulations and data from a field campaign.

**General comments:**
In my opinion the manuscript is a little bit confused in several aspects and would benefit from rethinking of some sections. I offer here some detailed comments on the parts that could use improvement and clarifications.

The main shortcoming of the paper as it stands is the assumption explicitly stated in line 315 that "*K-band channels do not play a role*" in temperature retrieval. This assumption leads to several inaccuracies in the approach and great confusion for the reader in the understanding of how clouds and vapor are treated in the retrievals. The main problem is due to the fact that channels 8 (51.26), 9 (52.28), and in less amount 10 (53.86) are indeed sensitive to both vapor and liquid water for which the K-band channels are needed. The authors should therefore address in better detail how they are accounting for vapor and clouds effects in channels 8-10 even if they only use the zenith measurements.

**Section 3.2 Retrieval method**: It is not clear how the forward model simulations are conducted and how the coefficients are derived. Are clouds included in the forward model simulations? If yes, how are they included? Same questions for the retrieval coefficients.

**Figure 1**: If I well understand Fig. 1 shows the TBs simulated and then inverted to derive temperature profiles. Are all channels (8-14) used in the scanning configuration? Of course, these simulations predict an improvement of the scanning configuration over the zenith because in the simulations all the shortcomings of real-world scanning are absent. Although it is true that in a perfect clear sky scenario of a perfectly homogeneous atmosphere in a perfectly flat and free horizon, scanning would improve the sensitivity of the temperature retrieval, the interpretation of measurements from scanning instruments is not always simple. Additionally, it is my impression that the excessive standard deviation of the zenith view retrievals in the first 200 m is due to the fact that the retrieval doesn't include surface temperature, pressure, and humidity. These quantities (available from the hatpro) are essential in the zenith configuration to constrain the first retrieval level where the channels have no sensitivity. It would be important to include those measurements when developing the retrieval coefficients.

**Figure 1:** Is the standard deviation of the differences a measure of accuracy? I don't think this is true. It is rather a measure of precision. Perhaps the RMS error between radiosondes and

retrievals can give us a better understanding of the two retrievals? In any case I think the label "*accuracy*" shouldn't apply here.

**Section 4.1**: it is stated in **line 196** that only clear sky cases are used to analyze the impact of horizontal inhomogeneity. However, in lines 220-230 and following the discussion of cloudy scenes is mentioned therefore it is not clear to the reader what is really being discussed here.

Same **in section 4.1.2.** Are the profiles of section 4.1.2 clear sky or all cases? If cloudy scenes are included in the retrievals but PWV and LWP are not retrieved there will be a mismatch between what channels 8-10 detect and what the other channels detect, potentially leading to incorrect results even using channels 8-10 in zenith mode. This because the signal from vapor and clouds is interpreted in the retrieval as a signal from temperature.

**Section 4.1.2**. I think this section requires more discussion because the intended meaning is not clear. If I scan the instrument both sides, I am going to retrieve temperature using both scans. In this case, even if the instrument is tilted, the average of the two brightness temperatures at the corresponding angles should take care of the bias introduced by the tilt. Therefore, the effect of the radiometer tilt will be introduced only if the radiometer is scanned on one side. For this and many other reasons *scanning on one side is never recommended*. This section should perhaps clarify this concept.

**Section 4.1.2.** Why not show the actual retrievals from the scanning configuration and the zenith configuration compared to the radiosondes during the JOYCE campaign? I think it will provide good information on how much improvement we can gain from scanning the radiometer from real world measurements rather than simulations.

**Section 4.2** Again the importance of scanning both sides should be stated.

**Figure 5:** Do retrievals in this figure use scanning data at all channels or only channels 11-14?

**Figure 5:** x-axis label should be RS-RET (K) – without *"elevation"*

**Line 343:** *"Nevertheless … pointing errors of up to ±1°".* Again if I well understand, these results in Figure 5 are simulations. If these simulations are conducted scanning all channels (8-14) they are very difficult to implement in the real world because of the highly varying vapor and cloud fields that will require scanning the K-band channels as well.

**Section 4.3:** If this section is meant to be a guide for users on field installation in my opinion is not very practical. When in the field, it is hard to know the temperature of an obstacle located 1 km away and in table 2 there is not a direct connection with the height of the object. For example, an object located 3.5 km away needs to be at least 600 m tall to be detected at an elevation of 10.2 degrees ($1^{st}$ row, $3^{rd}$ column in Table 2). Therefore, anything short of a small mountain or a very tall skyscraper won't be detected by the instrument at that elevation angle. In my opinion, the most direct question people face in the field is: *How far (minimum distance) from a XX m tall obstacle do I need to install the radiometer if I want to scan down to YY* *degrees elevation?* The answer could be given as a table of which I draw a simplified example below. The paper could also come up with an approximate way to calculate that distance in the field for each channel without the need to run a radiative transfer code.

| | | **Minimum Distance (m)** | | |
|---|---|---|---|---|
| Height of object (m) | Elevation | CH1 | CH2 | CH3 |
| **10** Nearby antennas, power lines, small trees, 3-story buildings | 5.4 | 100 | … | … |
| | 10.2 | 55 | … | … |
| | 19.2 | 2 | … | … |
| | 30.0 | … | … | … |
| **30** Power lines, medium trees, tall apartment buildings | 5.4 | 300 | … | … |
| | 10.2 | 16 | … | … |
| | 19.2 | 86 | … | … |
| | 30.0 | … | … | … |
| **100** Cell tower, building towers, skyscrapers, surrounding hills | 5.4 | 11,000 | … | … |
| | 10.2 | 600 | … | … |
| | 19.2 | 300 | … | … |
| | 30.0 | … | … | … |
| **300** Tall skyscrapers, surrounding mountains, cell towers, | 5.4 | … | … | … |
| | 10.2 | … | … | … |
| | 19.2 | … | … | … |
| | 30.0 | … | … | … |