Egusphere-2025-1727: Instrument uncertainties of network-suitable ground- based microwave radiometers: overview, quantification, and mitigation strategies by Böck et al.

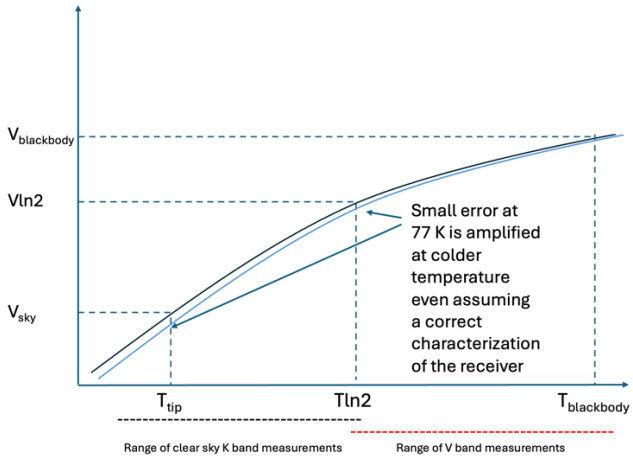
The paper examines sources of uncertainties in ground-based microwave radiometers focusing on liquid nitrogen calibration and detection of long-term drifts as well as rain sensor and degradation of the radome. The paper provides recommendation for the use of microwave radiometers in the field. The discussion focuses on one type of radiometers, namely the HATPRO G5 model. The paper is well written and organized and suitable for publication on AMT.

General comment

My main comment relates to some of the assumptions on the LN2 calibration for channels between 20 and 30 GHz. Specifically, the assumption that if the agreement with the estimated cold target temperature (77 K) is in within a certain range, that is also true when the instrument is looking at the sky.

LN2 calibrates the radiometer in a range of temperatures that is mostly outside the range of what is observed. The "cold" target (~77 K) is actually very warm as the measured brightness temperatures can be as low as 10-15 K (or even lower in high latitudes). Therefore, an accurate calibration is achieved between ~77 K and ~290 K (warm target) forcing an extrapolation to the lower temperature that is prone to larger uncertainties.

Therefore, the assumption is section 4.2.2 line 465 that the *"OmB deviations immediately preceding an absolute calibration would exhibit the maximum drift since the last calibration, aligning perfectly with the observed cold load jumps*" is not realistic. The radiometer may achieve a difference of 0.25 K at 77K but may have a larger (or smaller) bias at colder temperatures because of the non-linear response of the receiver. But this would be true even in the case of a perfectly linear receiver (the well-known lever arm error). On the other hand, the range of sky brightness temperatures in the V-band channels is much more likely to be closer to the LN2 calibration cold-warm target. This should be mentioned in line 470 as the discrepancy shown in Fig. 6 may not be entirely due to the model.



The very good (average) agreement shown in Fig. 8 between 2 units frequently calibrated with LN2 is very encouraging, however having so many calibrations is not typical. Chances are that with one calibration every 6 months or less the K-band may be biased.

A second comment relates to the mention of tip curves. Although not the focus of the paper, in my opinion tip curves should be at least mentioned (if not discussed) as a mitigation strategy for long term drifts in between LN2 calibrations. With tip curves the "cold" target is an independent measurement of the sky and is therefore much lower than the LN2 temperature. Although their practical implementation is not straightforward, continuous tip curves, properly processed and monitored are probably the most accurate calibration for the K-band and can well capture drifts and fluctuations in the receiver hardware. Therefore, for completeness of discussion, especially for users non entirely familiar with the instrument, there should be at least a mention of calibration with tip curves as a mitigation strategy for long term drifts between LN2 calibrations.

Minor comments:

Section 4.2.1, Line 400: "*We know, however, that this particular calibration has to be faulty, as indicated by the large jumps in OmB within the K-band after this event (see Figure 5a and Section 4.2.2 for more details on OmB).*" I may be misinterpreting here, but if I look at Fig. 5 where there is the dashed line on July 22 the OmB actually decreases after the calibration suggesting that it was somewhat successful. What am I missing?

Section 4.2.2, Line 476: *"Our analysis shows that discerning long-term drifts with OmB statistics is challenging*." This is certainly true when using model output. If co-located radiosondes are available, uncertainty due to balloon drifts or spectroscopy are generally much smaller than calibration biases and drifts.