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CALIBRATING GROUND-BASED MICROWAVE RADIOMETERS: ACCURACY AND REPETITION FREQUENCY

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Data of multi-frequency, ground-based microwave radiometers (MWR) has manifold applications in atmospheric research and has the potential
to be assimilated into numerical weather prediction models.
To provide reliable measurements, accurate calibrations are necessary. The calibration accuracy of MWRs has been discussed for several decades; however, the uncertainty estimates
that have been given were based on comparisons to relative standards and therefore the absolute accuracy of MWR calibrations has not yet been assessed.

The Microwave Radiometer Calibration Experiment (MiRaCalE) was conducted to determine the accuracies and repetition frequencies
two ``hot''-``cold'' calibration techniques for a fourth generation
Humidity and Temperature Profiler (HATPRO) measuring between 20 and 60 GHz: (i) ``Liquid Nitrogen Calibrations''
(LN2cal) and (ii) ``Tipping Curve Calibrations'' (TCC). New quality thresholds for both calibration types were introduced and tested. It was shown that spectral inconsistent calibrations
on the one hand affect multi-frequency retrievals of integrated water vapor and on the other hand can be used to determine biased calibrations.
The calibration frequency depends on which system parameter is updated and on the receiver technology.

For the first time, the accuracy
of TCCs was determined using a third absolute reference with a temperature of 77 K. It was found that TCCs are accurate within 0.5 K. After assessing the
accuracy of TCC, the quality of LN2cals could be obtained by comparing both techniques. TCCs and LN2cals were found to agree within 0.5 K. Furthermore, these results indicate
that the radiometric scene temperature of liquid nitrogen cooled blackbodies is accurate within the found uncertainties of 0.5 K, which is a significant reduction of the
uncertainty estimates that have been assumed for the HATPRO.