

# VMG 1-page overview: HATPRO MWR Uncertainty Assessment

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## Motivation

Ground-based microwave radiometers (MWRs) like HATPRO (Humidity And Temperature PROfiler) measure brightness temperatures (TBs) and are used to obtain temperature profiles and coarse humidity profiles. It has been shown that the assimilation of MWR observations is beneficial for numerical weather prediction (NWP) models. Also, the COST action PROBE (PROfiling the atmospheric Boundary layer at European scale) Association and the European Research Infrastructure for the observation of Aerosol, Clouds, and Trace gases (ACTRIS) currently focus on establishing Europe-wide quality standards for MWR networks for research and NWP applications. That is why it is important to obtain an overview of HATPRO measurement uncertainties.

## Instrument Errors

The main focus lies on the following 4 instrument uncertainties (expressed in TBs, from Generation 5 HATPROs, see Figure 1): (1) calibration repeatability, (2) radiometric noise, (3) drifts and (4) biases. A summary of the results can be found in Table 1.

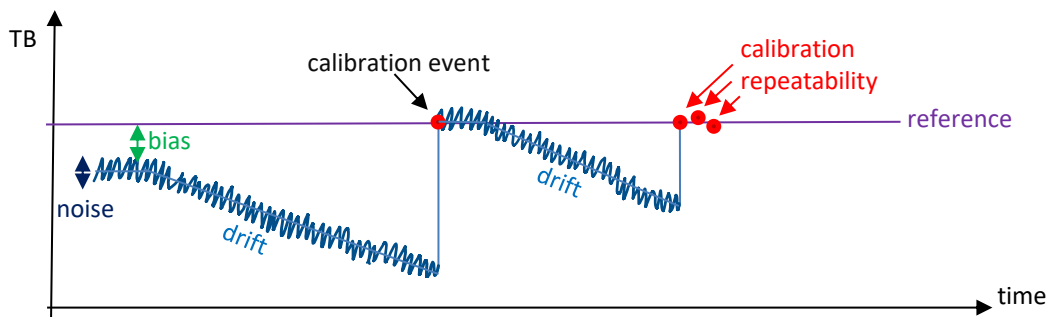


Figure 1: Sketch showing an overview of the HATPRO instrument uncertainties (calibration repeatability, noise, drifts, biases) over time.

Table 1: Summary of instrument uncertainties for Gen5 HATPROs. Uncertainties are described as absolute level 1 TBs.

Type of Error	Typical Error Values K-band	Typical Error Values V-band	Determined via
Calibration Repeatability	$\leq 0.12$ K	$\leq 0.16$ K	Changes to zenith reference measurements after two immediate consecutive calibrations
Noise Levels (3min coldload – 10 min hotload) (1s)	$\leq 0.11$ K – 0.19 K	$\leq 0.11$ K – 0.33 K	Standard deviation (from covariance matrix diagonal)
Drifts (over 6 months)	usually $\leq 0.3$ K (up to 0.78 K)	usually $\leq 0.8$ K (up to 1.3 K)	Differences at coldload before and after a calibration

<b>Biases</b>	mostly $\leq 0.3$ K (up to 0.48 K)	mostly $\leq 0.5$ K (up to 1.15 K)	Zenith measurement differences between two MWRs
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