

# Progress towards a GRUAN MWR product

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# Progress since ICM-10

1. Online calibration monitoring being tested at few sites
2. Absorption model uncertainty extended to 150 GHz
3. Investigation of systematic uncertainty (absorption model)



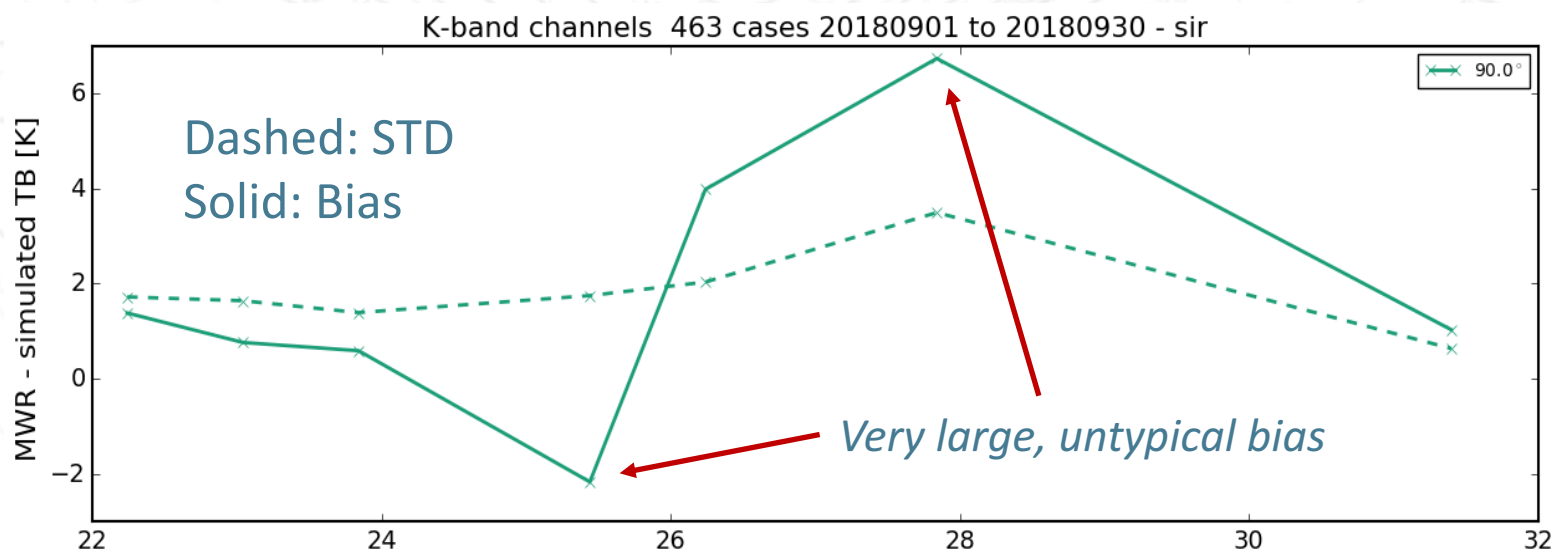
# 1) Online MWR calibration monitoring

- Operated at Meteo France (P. Martinet)
  - Check automatically for clear-sky conditions
  - Simulate observations with RTTOV-gb from AROME output (AROME is a small scale 1.3km numerical prediction model, )
  - Calculate daily differences, monthly means and variances
- Updates display on the web (kindly hosted at Univ. of Köln)
- Applicability limited by AROME domain
  - Now running for 4 sites, including 2 GRUAN
    - Paris (SIRTA, FR)
    - Lindenberg (RAO, DE)
  - plans for Cabauw (NL), Payerne (CH)
- **RAO:** <https://preview.tinyurl.com/MWR-O-B-RAO>

# 1) Online MWR calibration monitoring

Example from SIRTA, September 2018

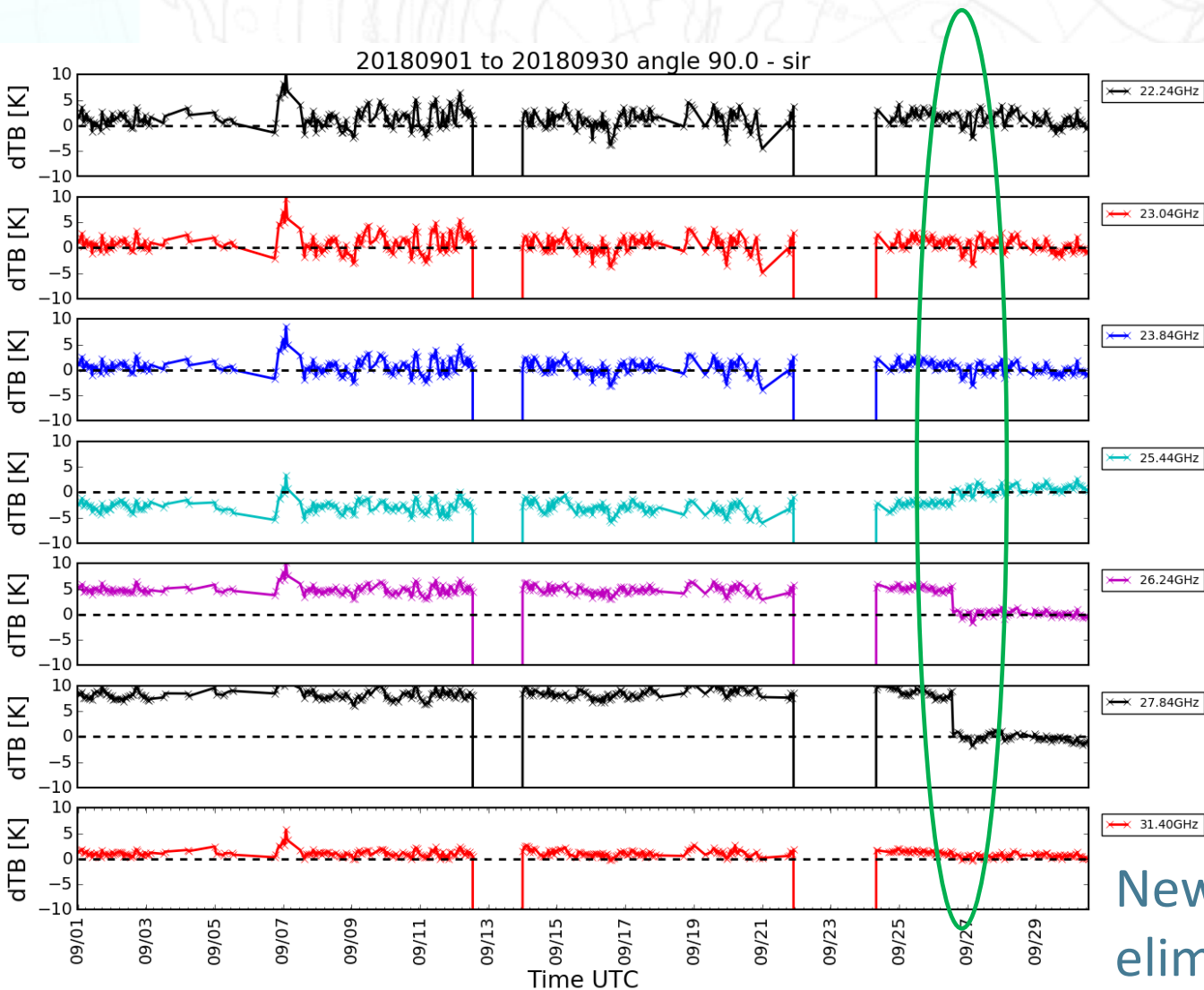
## Water vapor channels, zenith viewing





# 1) Online MWR calibration monitoring

Example from SIRTA, September 2018



22 GHz

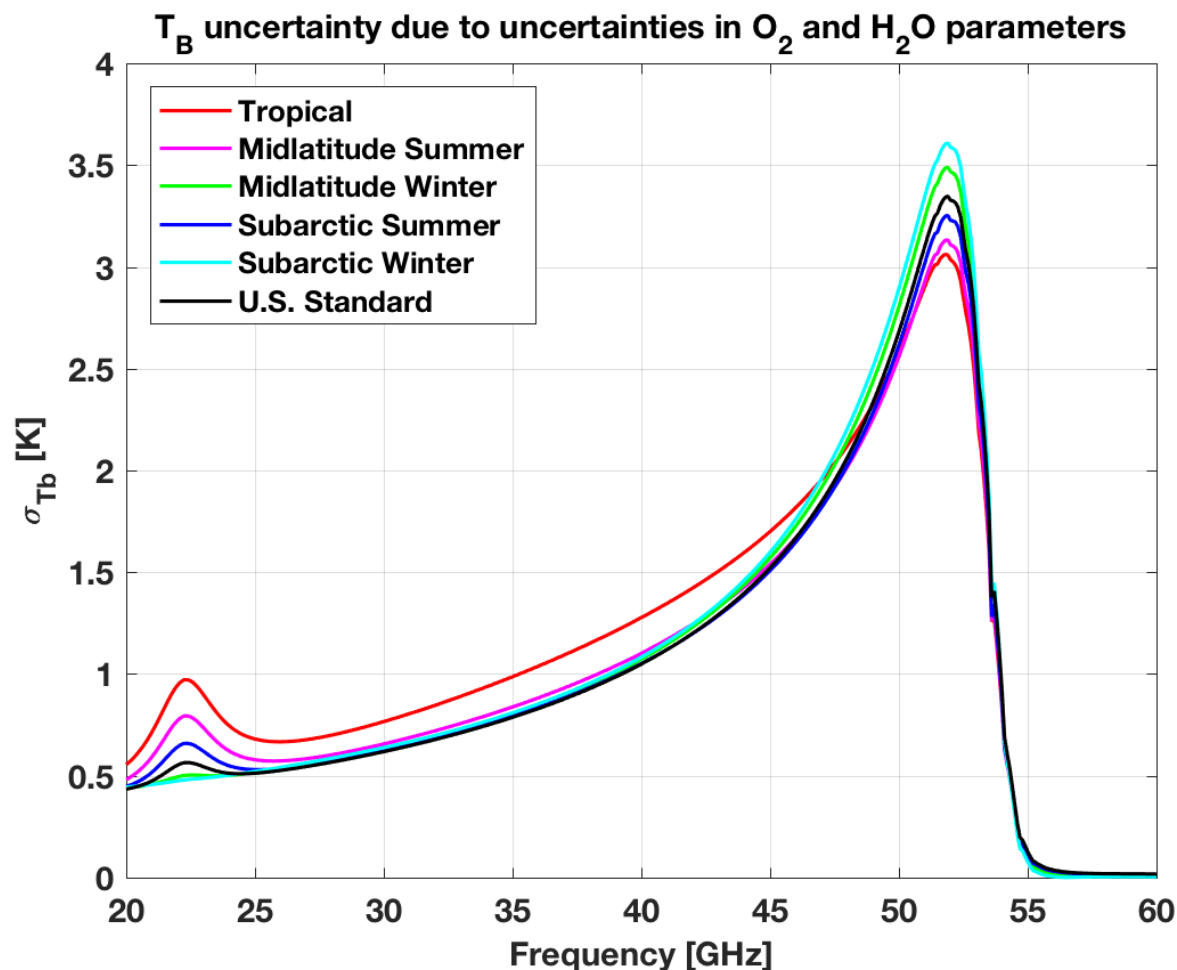
25.4 GHz

27.8 GHz

New calibration on 09/26  
eliminates biases!

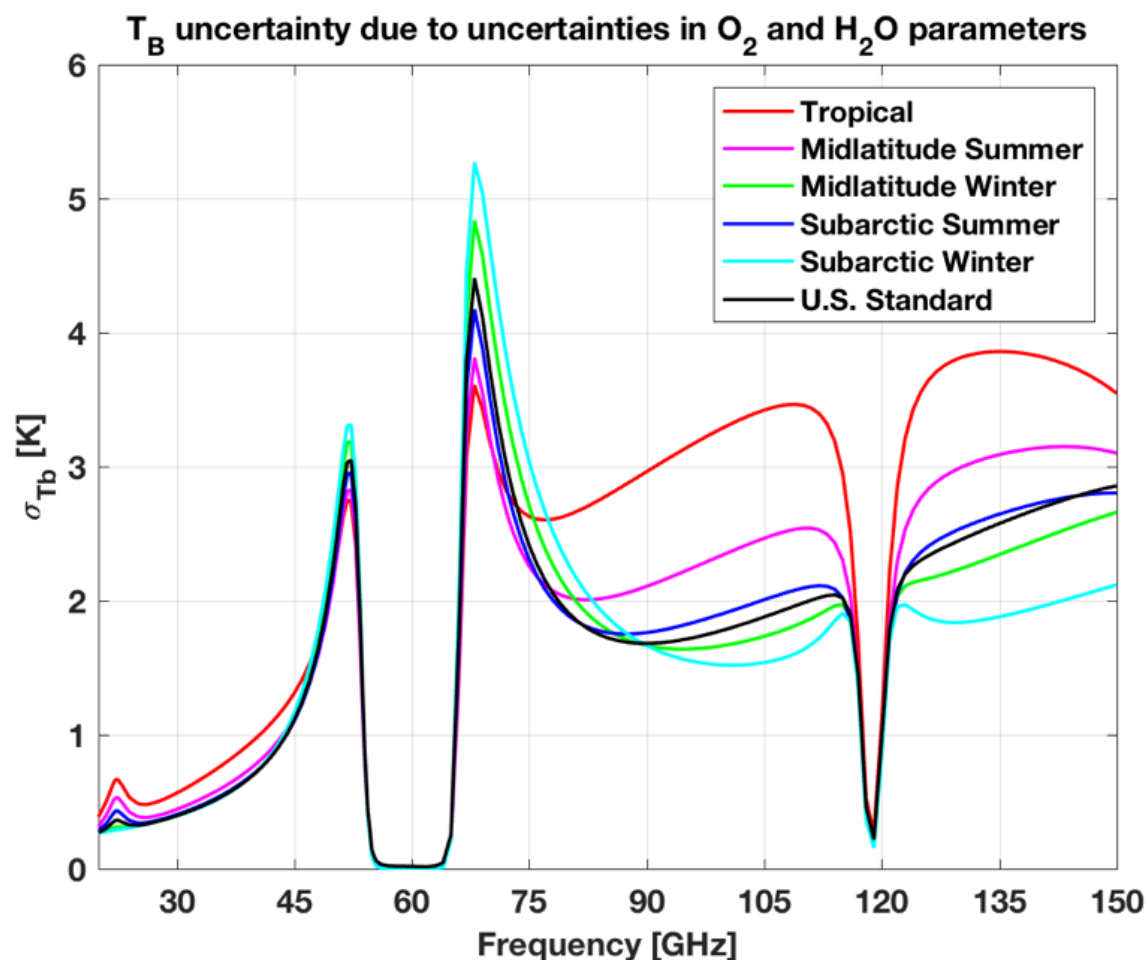
## 2) Absorption model uncertainty

- Efforts started within GAIA-CLIM
- Completed for 20-60 GHz range within GAIA-CLIM



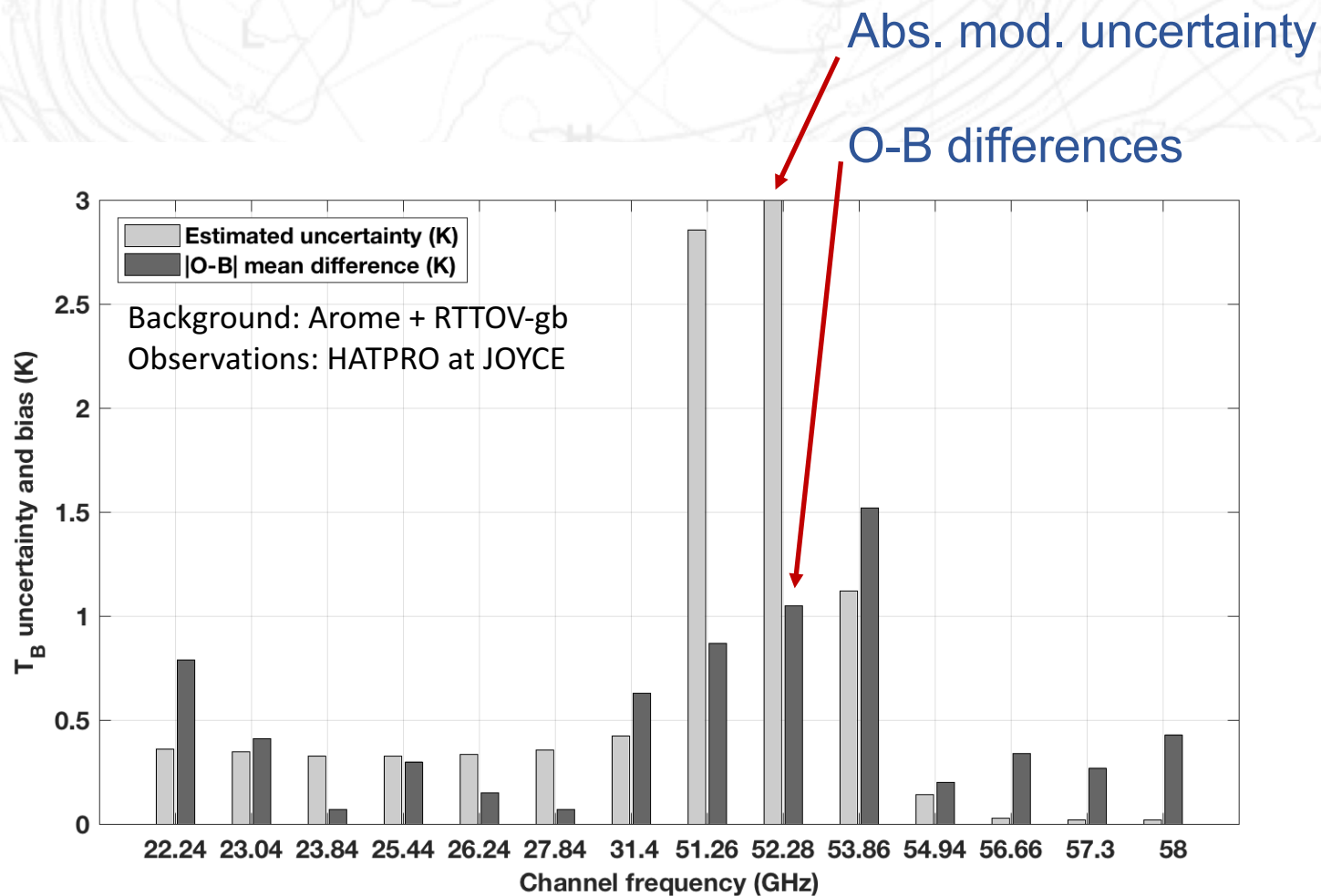
## 2) Absorption model uncertainty

- Extended to higher frequency (up to 150 GHz)
  - To include 70-150 GHz MWR used for CLW retrievals



## 2) Absorption model uncertainty

- For a well maintained MWR, absorption model uncertainty explains most of O-B differences



### 3) Investigation of systematic uncertainty

- Current MW absorption models may be affected by systematic uncertainty
  - e.g. speed-dependence of line shapes is currently not considered
- Theory for speed-dependent line shapes (for 22 and 118 GHz lines) has been developed and tested\*

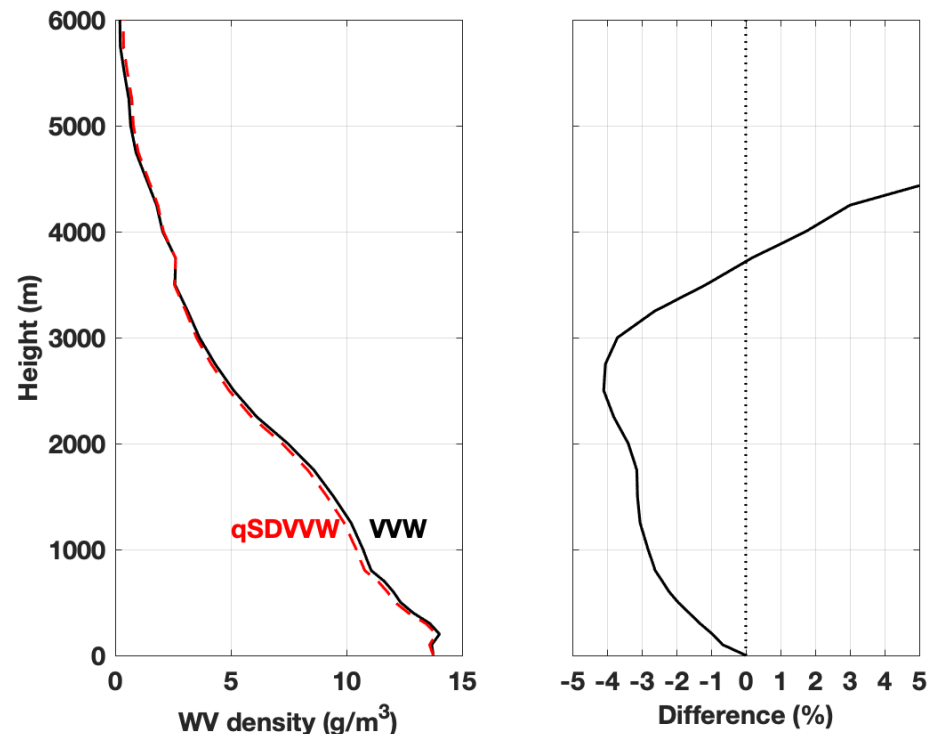
\*Rosenkranz & Cimini, submitted to TGRS, in review, 2019





### 3) Investigation of systematic uncertainty

- The impact of speed-dependent line shape on WV profile retrievals changes sign with height
- The impact is of similar magnitude as the measurement- and spectroscopic-uncertainty contributions, but it is systematic.
- The impact on ARM IWV 2-channel retrieval is a negative bias ( $-1.1\%$ )\*



\*Rosenkranz & Cimini, submitted to TGRS, in review, 2019

- Next slides are from ICM-10, including open issues

# Why a GRUAN MWR?

Microwave Radiometer (MWR) provides:

- Brightness temperatures at several frequencies
- Low-resolution Temperature and Humidity profiles
- Total water vapor + liquid water column (TWVC, TLWC)
- ~1 min temporal resolution
- ~all weather

With respect to radiosondes

- Highly redundant (but much lower resolution)
- Independent (e.g. RS80 dry bias)
- Complement diurnal cycle
- Complement TLWC (no other GRUAN instrument)

# GRUAN MWR Program Guide

## STATUS:

- Following the GRUAN Guide (GCOS-171)
- First draft delivered (15 April 2016)
- **GRUAN MWR Program Guide TD-N.1.0**
  1. Introduction
  2. Instrumentation
  3. Reference Measurements
  4. Measurement Uncertainty
  5. Measurement Scheduling
  6. Data Management
  7. Post-processing Analysis and Feedback
  8. Quality Management
  9. Site Assessment and Certification
    - Appendix 1 - Acronyms
    - Appendix 2 - Examples of MWR lv1 and lv2 data files
    - References

# GRUAN MWR Program Guide

- **V1.0 touches all sections**
  - but it's only a first draft (by no means complete)
- **V1.0 is a living document**
  - continuous updates following TOPROF/GAIA-CLIM activities
- **Drafting stopped when**
  - MWR TD-N.1.0 ↔ MWR Product 1.0



# GRUAN product requirements

- Data and metadata available
- Open and transparent processing
- Treaceble to SI
- Uncertainty estimate



# What's missing for a GRUAN MWR product?

- Implementation of automatic MWR data product
  - Who shall/could develop this?
  - Centralized data processing facility?
- Current observation accuracy corresponds to >10-year old technology
  - much better characterization of new generation instruments
  - not currently available at all GRUAN sites (more in the short-term)

# What's missing for full SI-traceability?

1. MW transfer standard calibration targets
  - NIST is working on this development
2. Certified internal temperature sensors
  - Manufacturers should provide certifications
3. Uncertainties on *a priori* model background and radiative transfer model are not SI-traceable

# Summary and conclusions

- First draft of MWR Program Guide is on hold
  - GRUAN MWR Program Guide TD-N.1.0
- Prototype uniform procedure is available
  - Parts are being tested operationally
- MWR SI-traceability needs a breakthrough
  - Partially being addressed at NIST

**Thank you very much for your attention!**

