



ACTRIS CCRES

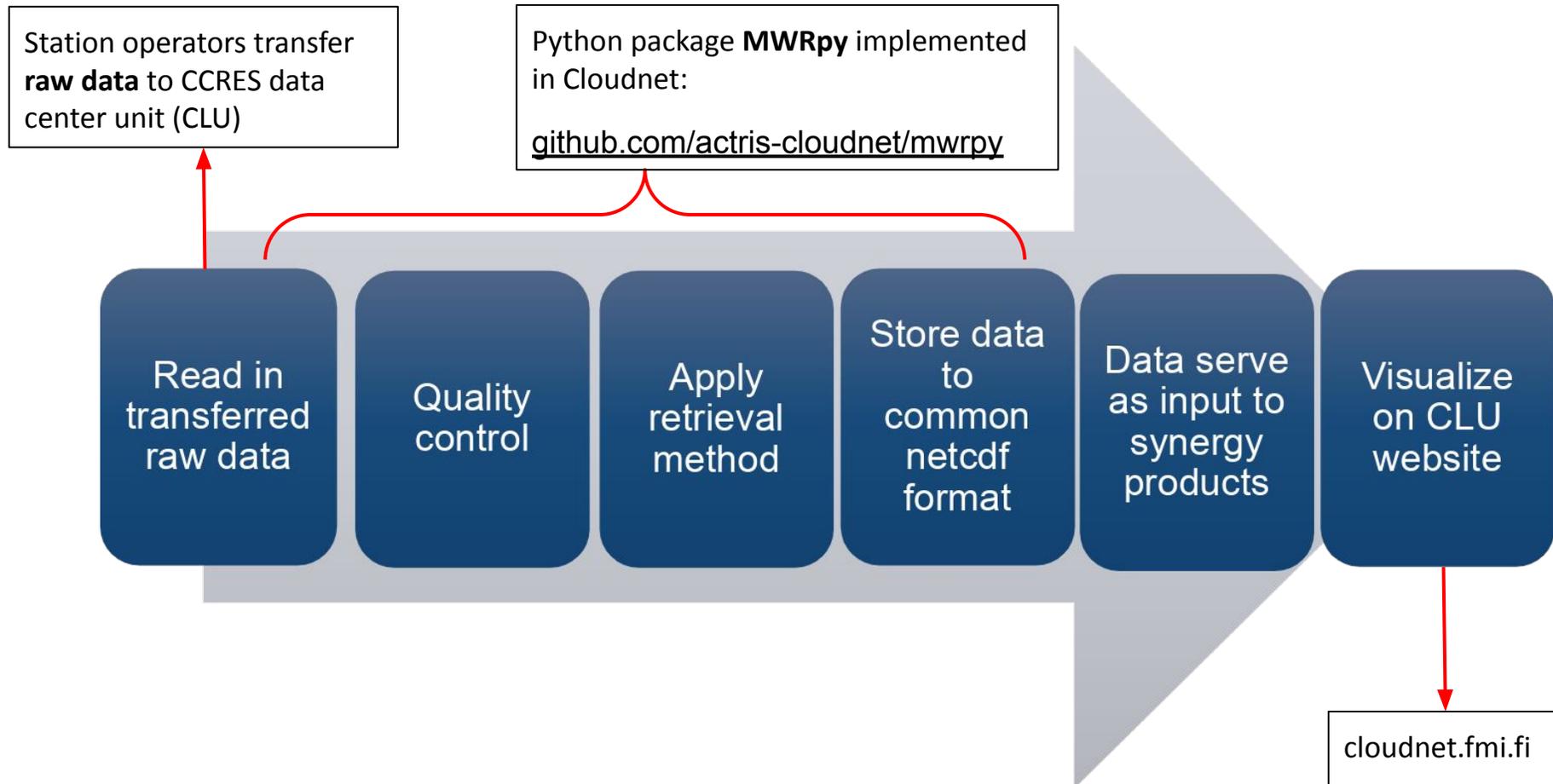
**Update on MWR data processing and
retrieval development**
Tobias Marke

CCRES Workshop, Heraklion – Oct 26th, 2023



This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No 871115

Overview



Data Transfer



Data handling is performed by the Cloud remote sensing data centre unit (CLU)

CLU performs data versioning, data provision and archiving



Station operators are required to transfer the raw data to CLU at least once per hour.

Required files for RPG instruments (binary files) are:

- 
- BRT: Brightness temperatures (single angle)
 - BLB / BLS: Brightness temperatures from multi-angle elevation scans
 - HKD: Housekeeping data
 - IRT: Infrared radiometer brightness temperatures
 - MET: Meteorological sensor data

Calibration LOG files (ABSCAL.HIS, CAL.LOG, CovMatrix.DAT) are planned to be monitored and stored in CLU calibration database.



RPG retrieval coefficients can be applied until ACTRIS retrievals are developed (already stored in database).

Data Processing - MWRpy

release-version Add publishing stuff 3 weeks ago

Used by 1

@actris-cloudnet / cloudnetpy

Contributors 3

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- tobiasmarke
- siiptuo Tuomas Siipola

Languages

- Python 100.0%

README.md

MWRpy

MWRpy tests passing pypi package 0.2.0

MWRpy is a Python software to process RPG Microwave Radiometer data and is developed at the University of Cologne, Germany as part of the [Aerosol, Clouds and Trace Gases Research Infrastructure \(ACTRIS\)](#).

The software features reading raw data, Level 1 quality control, generation of Level 2 data products and visualization.

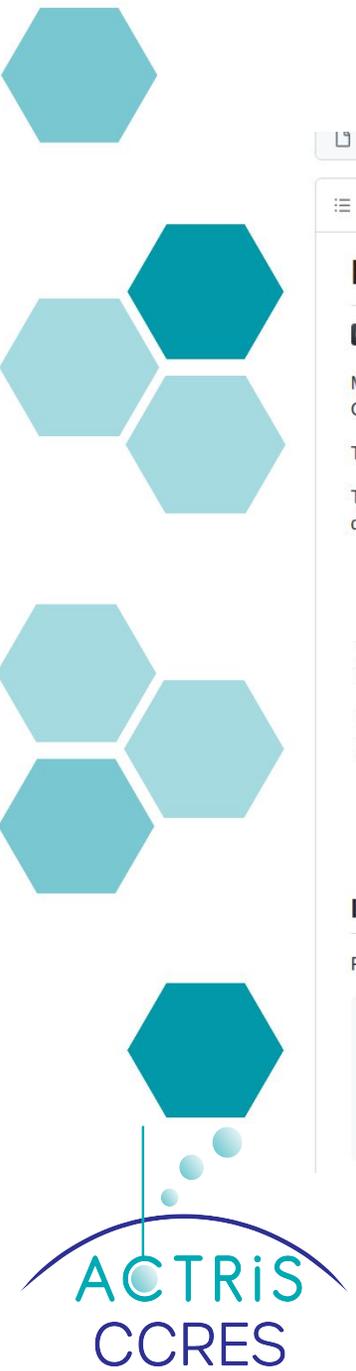
The data format including metadata information, variable names and file naming is designed to be compliant with the data structure and naming convention developed in the [EUMETNET Profiling Programme E-PROFILE](#).

Installation

From GitHub:

```
git clone https://github.com/actris-cloudnet/mwrpy.git
cd mwrpy
python3 -m venv venv
source venv/bin/activate
pip3 install --upgrade pip
pip3 install .
```

- MWRpy implemented in Cloudnet framework and maintained in Cloudnet's github repository
- Can be used as stand-alone software (with E-PROFILE data format)
- Slightly different output in Cloudnet (harmonization with existing products)
- Same output files: Level 1, single/multiple pointing
- First experimental products are derived for 5 stations (4 pilot stations)





Location

Palaiseau x

Show all sites

Date

2023-09-29

Product

MWR single pointing x
MWR multiple pointing x

Show experimental products

Instrument

Select

Variable

Air temperature x
Potential temperature x
Liquid water path x
Integrated water vapour x
Absolute humidity x

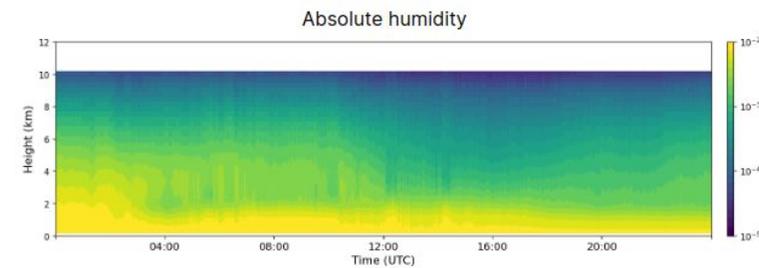
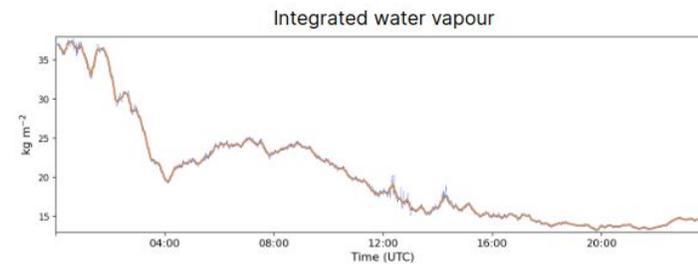
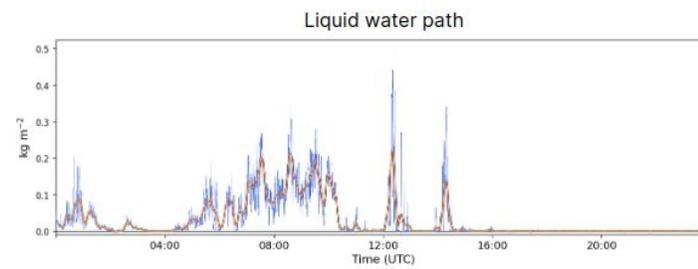
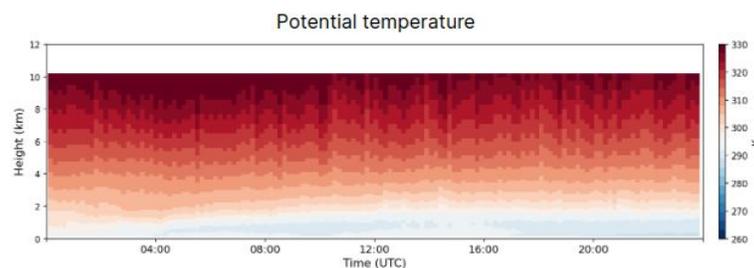
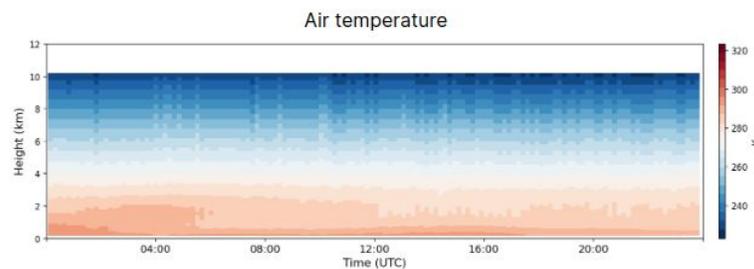
[View in data search →](#)

Visualisations for 29 September 2023

Palaiseau MWR multiple pointing

Palaiseau MWR single pointing

comparison view



Model Comparison - Temperature

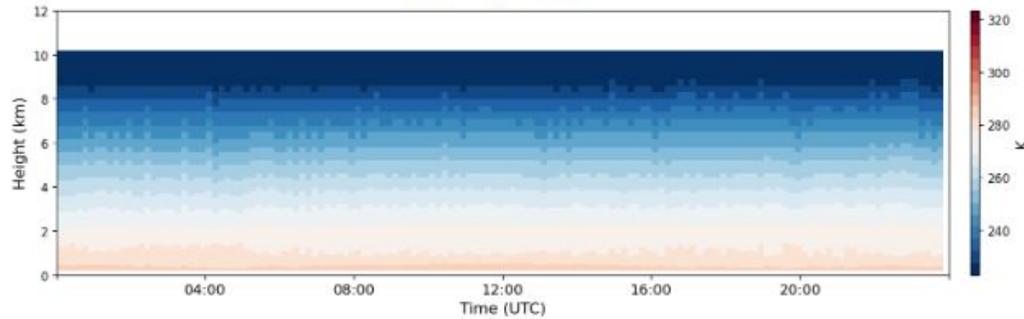
Visualisations for 1 October 2023

comparison view

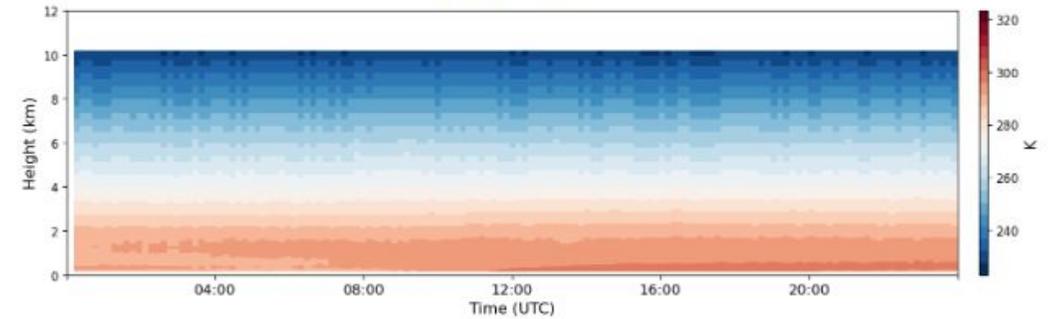
Hyytiälä MWR multiple pointing [↗](#) Volatile Experimental

Palaiseau MWR multiple pointing [↗](#) Volatile Experimental

Air temperature



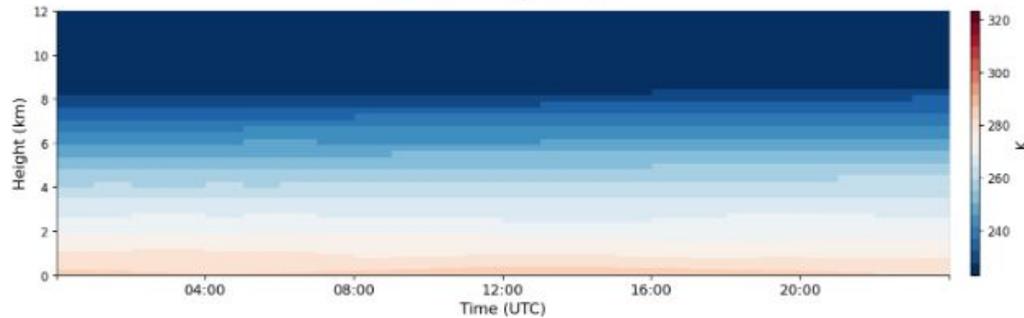
Air temperature



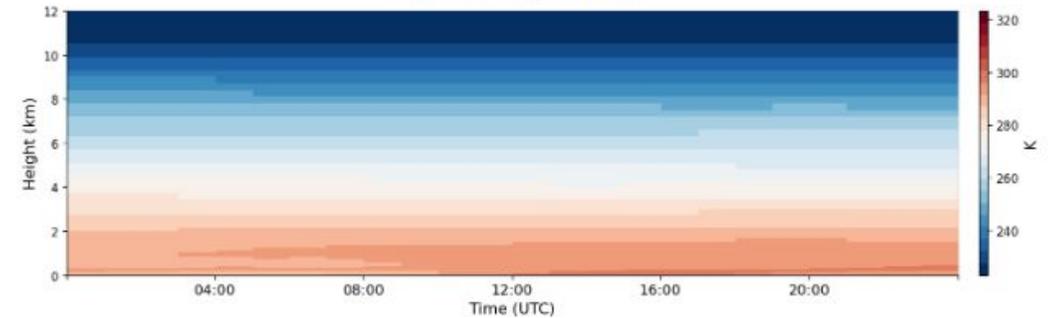
Hyytiälä ECMWF IFS forecast [↗](#)

Palaiseau ECMWF IFS forecast [↗](#)

Model temperature



Model temperature



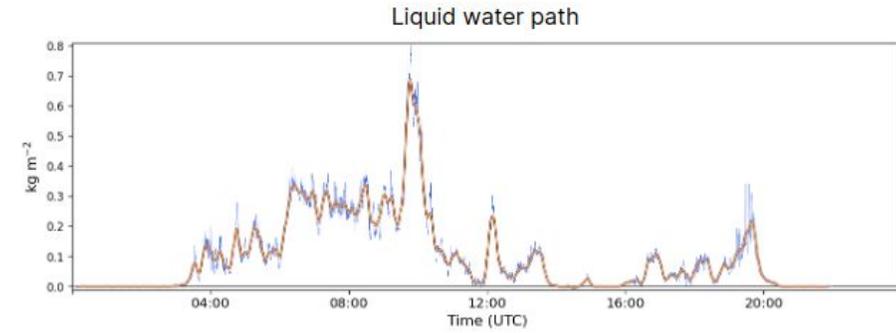
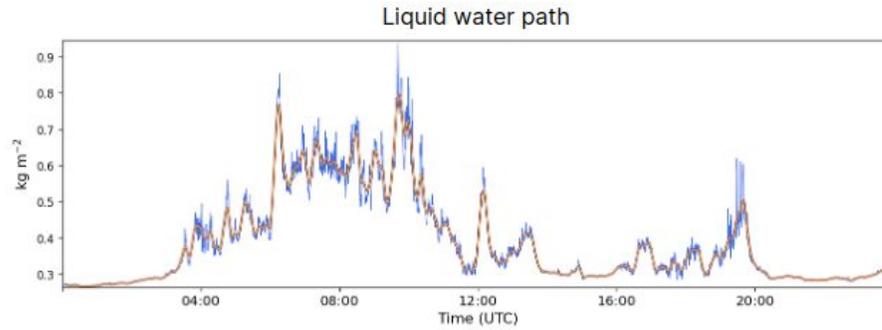
Instrument Comparison - LWP

Visualisations for 10 October 2023

comparison view

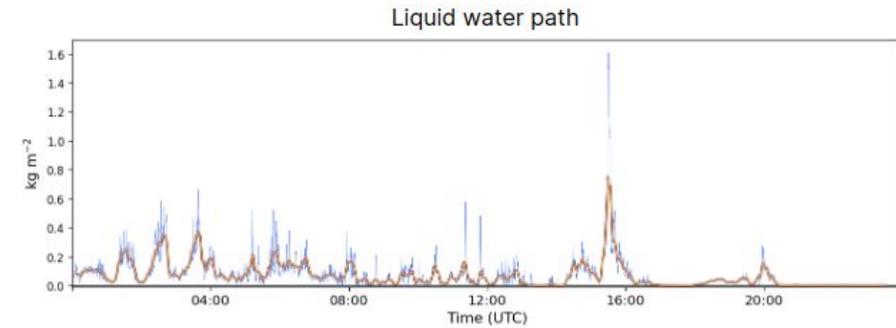
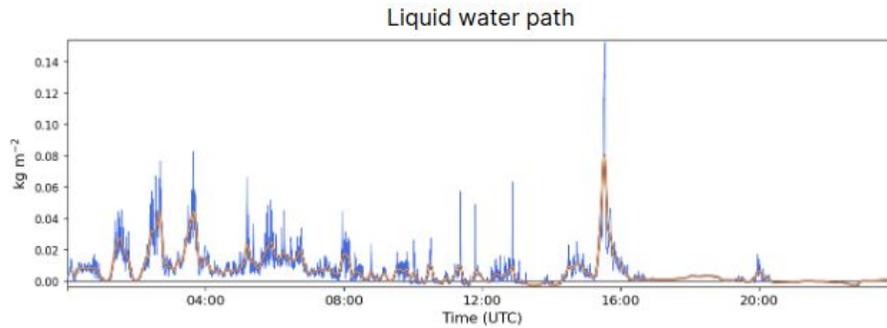
Hyytiälä RPG-FMCW-94 cloud radar [↗](#) Volatile

Hyytiälä MWR single pointing [↗](#) Volatile Experimental



Leipzig LIM RPG-FMCW-94 cloud radar [↗](#) Volatile

Leipzig LIM MWR single pointing [↗](#) Volatile Experimental



Quality Control

Quality flags derived and applied for Level 1 data (also provided in product files)

Bit 1: **missing_tb**

Bit 2: **tb_below_threshold**

Bit 3: **tb_above_threshold**

} TB values are being checked

Bit 4: **spectral_consistency_above_threshold** ➡ Comparison: retrieved & observed TB

Bit 5: **receiver_sanity_failed** ➡ Receiver & ambient target stability + noise diode status

Bit 6: **rain_detected** ➡ Rain sensor

Bit 7: **sun_in_beam** ➡ Calculate sun position for site location (relevant for scans)

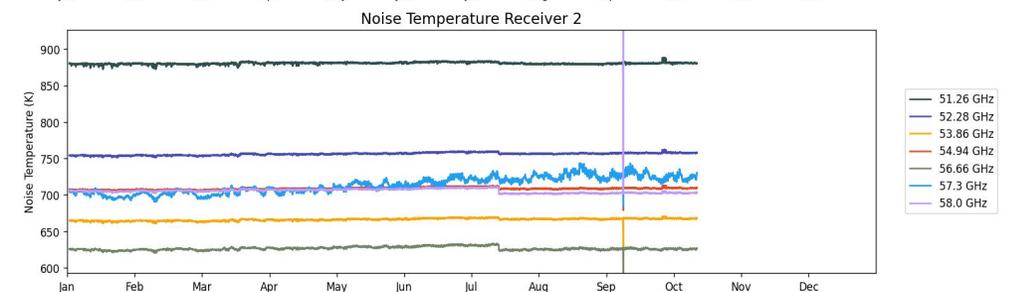
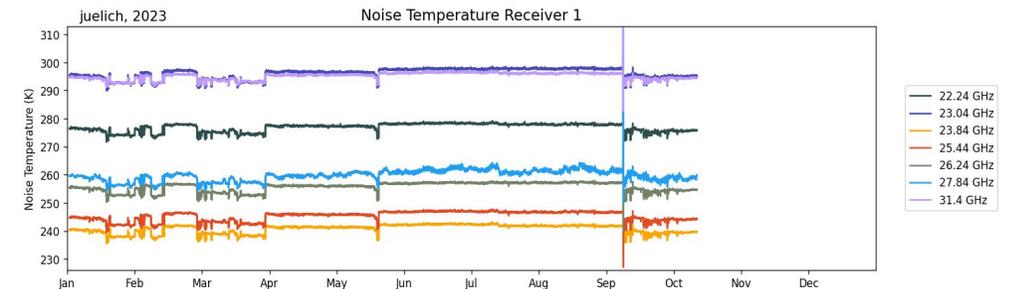
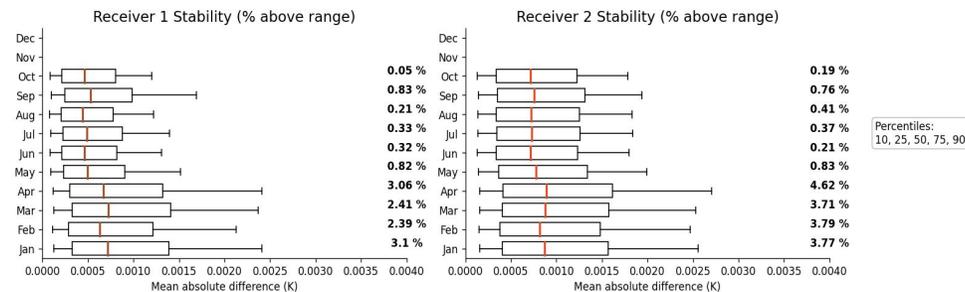
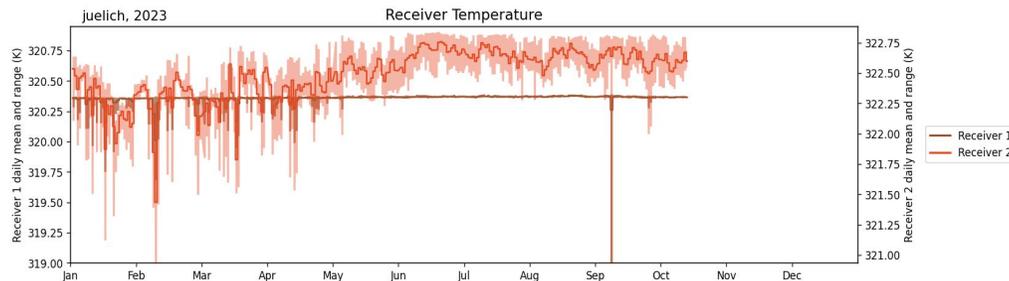
Bit 8: **tb_offset_above_threshold** ➡ Not implemented yet

Quality Control

Quality flags derived and applied for Level 1 data (also provided in product files)

Long term quality assessment

- Required for ACTRIS labeling step 1b
- Checks quality of data and whether SOPs are being followed
- Detection of malfunction possible in operational use



Quality Control



Quality flags derived and applied for Level 1 data (also provided in product files)



Long term quality assessment

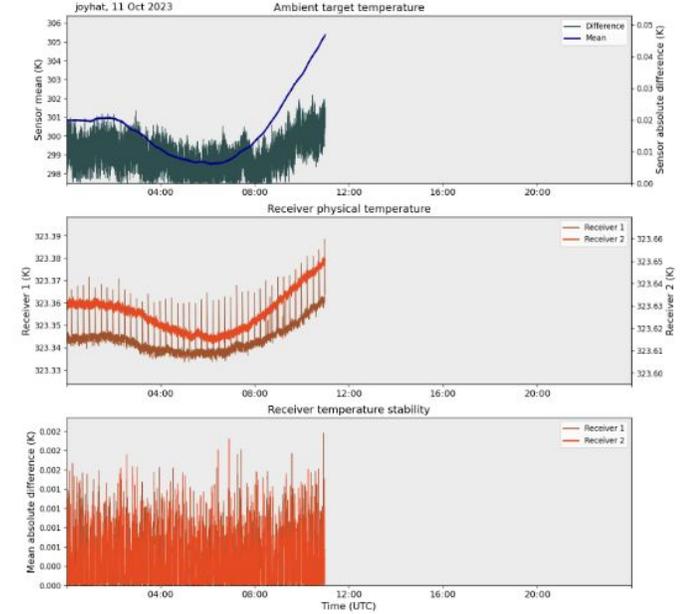
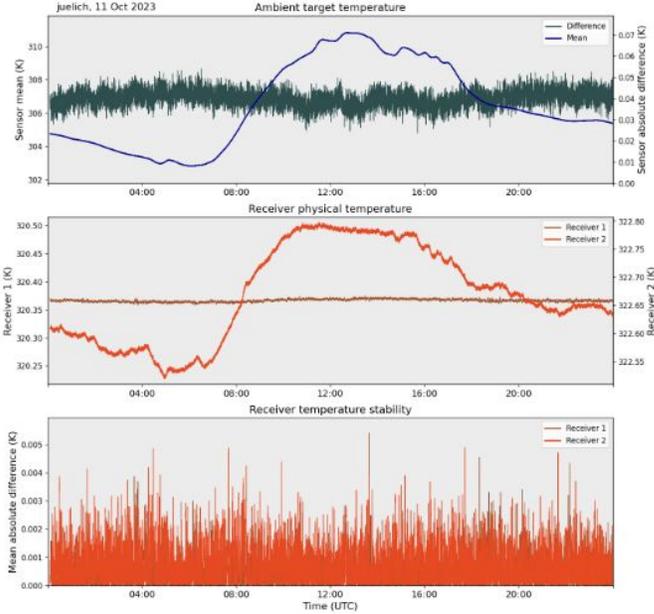
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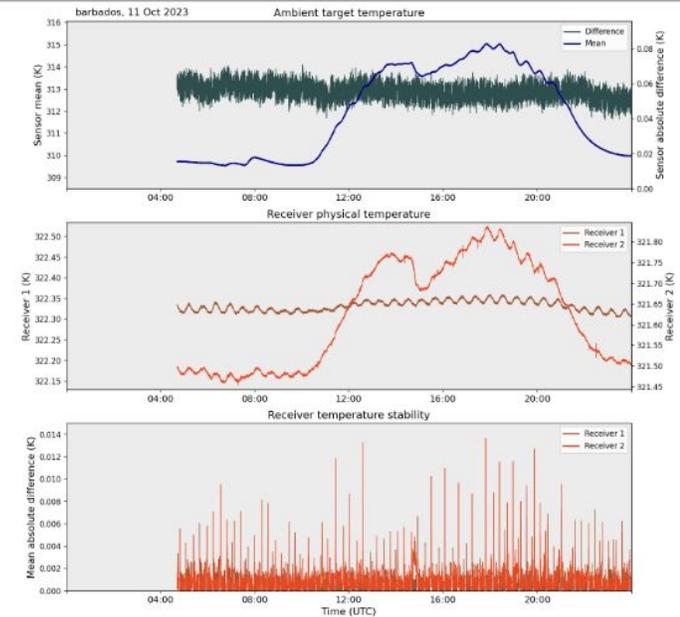
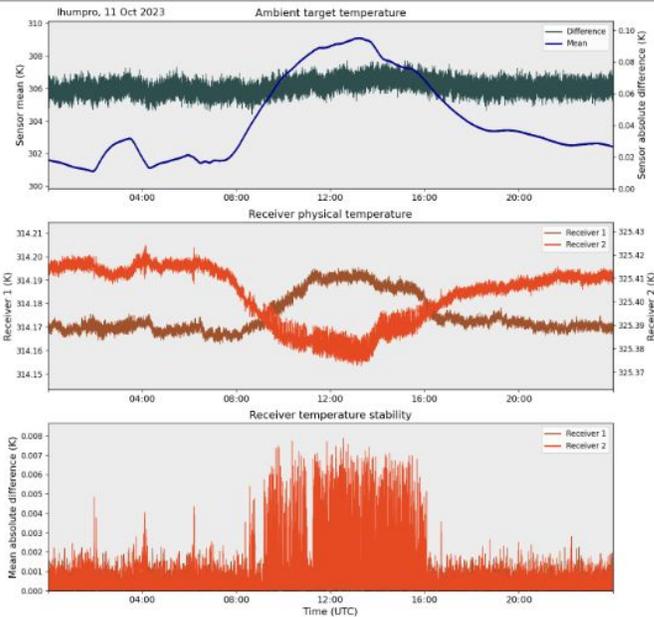
Centralized housekeeping data (HKD) monitoring in development

- Work is being done at IPSL together with data center CLU
- Synchronizes HKD data with CLU
- Based on InfluxDB as database and Grafana for visualization
- Includes instrument type specific thresholds and alert settings
- Planned to generate statistics





4 Panels | Site: ACTRIS | TOPHAT-HKD | LHUMPRO-HKD | 2023-10-11 | JOYHAT-HKD | BCOHAT-HKD | permalink | Press 'a/s' for +/- 1 day

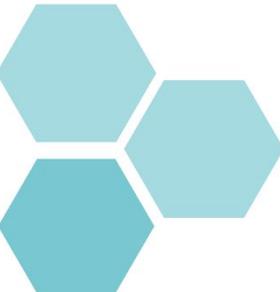


Links with E-PROFILE



Common data format and standard operating procedure for a better cross network compatibility

- 
- Enables stations to participate in both networks
 - Similar file types and data format (including metadata, quality flags)
 - Discussion needed on:
 - Common SOP (with minimum requirements of both networks)
 - Calibration procedures (and transfer of LOG files)
 - Scanning strategy (setup of observation mode and file transfer)



Differences in generation of Level 2 products (retrieval method)

Retrieval Development - Radiative Transfer

- Recent version of the **Rosenkranz absorption code** (2022) for oxygen, nitrogen, water vapor, and liquid water
- Effects of **beam-width and bandwidth** (instrument characteristics) can be included
- **Open questions:**
 - Benefit vs computation time (magnitude of errors compared to other uncertainties)
 - Bandpass filter for bandwidth effect
 - Implementation at RPG



Retrieval Method & Training Data

- **Statistical retrieval** method (Neural Network including auxiliary information)
 - similar to RPG
 - comparison to E-PROFILE retrieval approach (TROPoe)
- Retrieval training with **ERA5 climatology** as input
 - allows homogeneous data streams
 - comparison with radiosondes (as input / product evaluation)
- Include **89 GHz channel** of cloud radar / MWR (LHUMPRO) for improvements in LWP retrieval
- Develop retrievals for LHUMPRO + tests in **low humidity** conditions
- MWR + IRT **synergy retrieval** for LWP



Thank you