



HORIZON 2020



Product Traceability and Uncertainty for the Microwave Radiometer (MWR) total water vapor content product

Version 1.0

*GAIA-CLIM
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Atmospheric ECV Climate Monitoring
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Version history

Version	Principal updates	Owner	Date
0.1 draft	First draft – after Webex meeting on Oct 9 th 2017	CNR	17.11.2017
1.0	First issue – after feedback from NPL and Project Scientific Lead	CNR	21.12.2017

1 Product overview

Product name: MWR total water vapor content product

Product technique: Total water vapor content estimated from humidity profile retrievals from multichannel brightness temperature measurements and a priori knowledge

Product measurand: Total water vapor content [kg/m²]

Product form/range: Total column-integrated water vapor content.

Product dataset: TOPROF data set

Site/Sites/Network location:

SITE	LAT	LON	HEIGHT(m)	MWR	LOCATION	COUNTRY
JOYCE	50.91	6.41	111	HATPRO G2	Juelich	DE
LACROS	51.35	12.43	125	HATPRO G2	Liepzig	DE
Payerne	46.82	6.95	491	HATPRO G1	Payerne	CH
SIRTA	48.80	2.36	156	HATPRO G2	Paris	FR
CESAR	51.97	4.93	-0.7	HATPRO G1	Cabauw	NL
RAO	52.21	14.12	125	MP3000A	Lindenberg	DE

Product time period: Jan 1, 2015 – Feb 27, 2016

Data provider: TOPROF

Instrument provider: Site management

Product assessor: Domenico Cimini, CNR

Assessor contact email: domenico.cimini@imaa.cnr.it

1.1 Guidance notes

This document is meant to be an annex to GAIA-CLIM Product Traceability and Uncertainty (PTU) document for the Microwave Radiometer (MWR) humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf). The reader should refer to that PTU document for the details about the humidity profile uncertainty used here to estimate the total water vapor content (TWVC) uncertainty.

2 Introduction

This document presents the Product Traceability and Uncertainty (PTU) information for the Microwave Radiometer (MWR) total water vapor content (TWVC) product. The TWVC and its uncertainty are derived from the MWR humidity profile product and relative uncertainties. The reader shall refer to the MWR humidity profile PTU document for details on the estimated uncertainty (PTU_MWR_Humidity_profile_V1.0.pdf).

3 Instrument description

The instrument description is given in the GAIA-CLIM PTU document for the MWR humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf).

4 Product Traceability Chain

The product traceability chain is given in the GAIA-CLIM PTU document for the MWR humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf).

5 Element contributions

The element contributions are given in the GAIA-CLIM PTU document for the MWR humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf).

6 Uncertainty Summary

The uncertainty summary is given in the GAIA-CLIM PTU document for the MWR humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf). Here we adopt the same notation (see Section 3), in particular:

- z the vertical coordinate (e.g., the altitude above ground)
- $\hat{\mathbf{x}}$ the estimated atmospheric state vector (i.e. the humidity profile)
- $u_{rnd}(\hat{\mathbf{x}})$ the estimated random uncertainty affecting $\hat{\mathbf{x}}$
- $u_{sys}(\hat{\mathbf{x}})$ the estimated systematic uncertainty affecting $\hat{\mathbf{x}}$

Thus, TWVC and the associated uncertainties are derived from the retrieved humidity profile and the relative uncertainties by:

$$TWVC = \int_0^{TOA} \hat{\mathbf{x}} \cdot d\mathbf{z}$$
$$u_{rnd}(TWVC) = \sqrt{\sum_{l=1}^{N_l} u_{rnd}(\hat{\mathbf{x}}_l)^2 \cdot \Delta z_l^2}$$
$$u_{sys}(TWVC) = \int_0^{TOA} u_{sys}(\hat{\mathbf{x}}) \cdot d\mathbf{z}$$

Note that the smoothing error is removed by the vertical averaging, thus only the observation uncertainty is included in $u_{rnd}(\hat{\mathbf{x}})$, which includes the random noise, a priori, forward model, and representativeness uncertainties. Figure 1 shows a time series of MWR retrieved TWVC products with the associated random and systematic uncertainties.

7 Traceability uncertainty analysis

The traceability uncertainty analysis is given in the GAIA-CLIM PTU document for the MWR humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf).

7.1 Recommendations

The recommendations are given in the GAIA-CLIM PTU document for the MWR humidity profile product (PTU_MWR_Humidity_profile_V1.0.pdf).

8 Conclusion

The MWR total water vapor content (TWVC) product has been assessed against the GAIA CLIM traceability and uncertainty criteria.

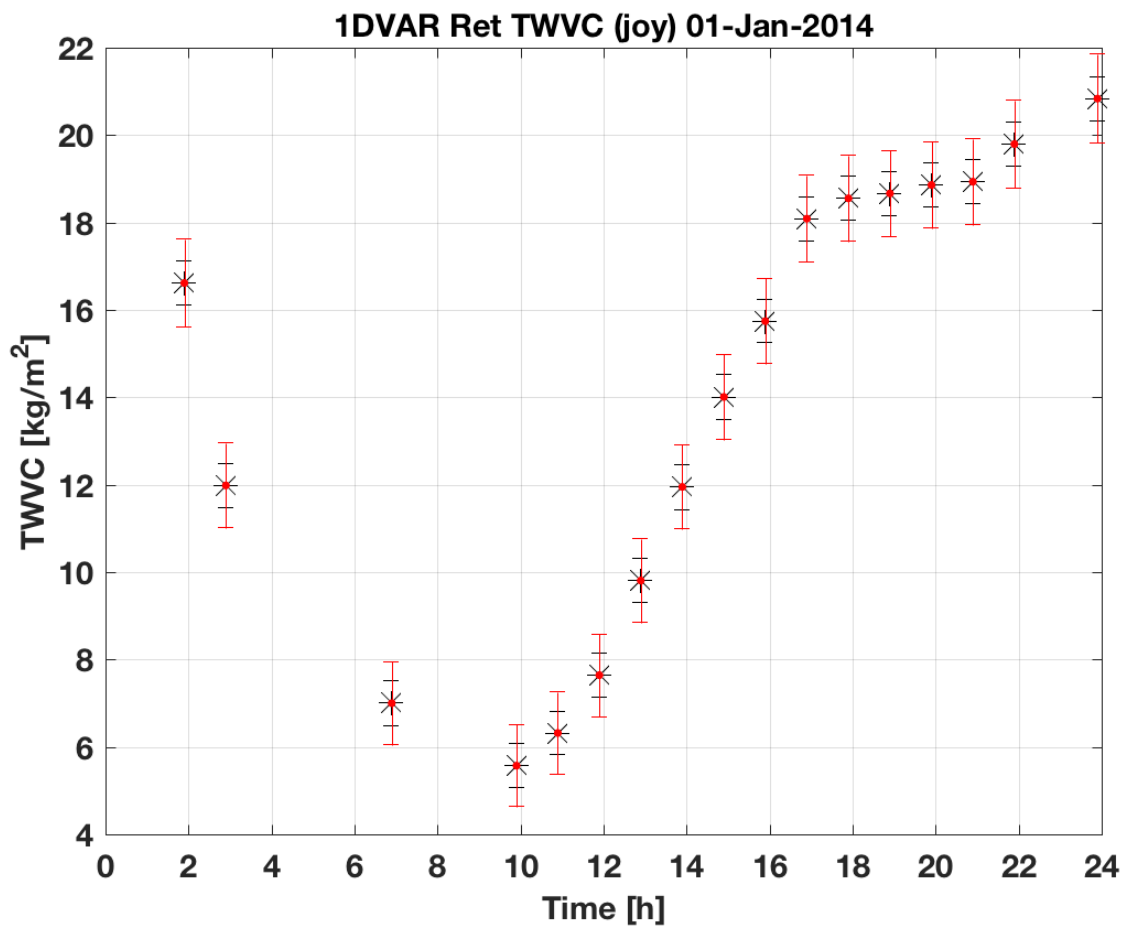


Figure 1. An example of TWVC time series retrieval at the Joyce site (Juelich, Germany) on January 1st 2014. The associated random and systematic uncertainties are shown in black and red errorbars, respectively.

References

GAIA-CLIM Product Traceability and Uncertainty (PTU) document for the Microwave Radiometer (MWR) humidity profile product (2017), PTU_MWR_Humidity_profile_V1.0.pdf