***E-PROFILE Programme***

***MWR NetCDF Level 1 data format description***

Prepared by: **E-PROFILE MWR Data Format Task Force**

Summary: **E-PROFILE** **MWR data format description**

Action required: **For information and comment**

Distribution: **EUMETNET Members and Partners**

|  |  |  |  |
| --- | --- | --- | --- |
| Reference | **Date** | **Author(s)** | **Content** |
| Version 1.0 | 31/03/2020 | MWR Data Format Task Force: Simone Bircher-Adrot, Emiliano Orlandi, Bernhard Posphical, Harald Czekala, Christine Knist, Nico Cimini, Rolf Rüfenacht, Myles Turp, Pauline Martinet, Ulrich Loehnert, Claire Merker | Initiation of draft after first meeting of MWR Data Format Task Force on March 18, 2020 |
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| Version 1.4 | 02/06/2021 | MWR Data Format Task Force | Inclusion of decisions taken during task force meeting on January 12, 2021 |

# Level 1: L1 - MWR TB data (1B01)

## Basics

This file provides time series of MWR brightness temperature (TB) data including system parameters and quality flags, i.e. all necessary information so that respective raw files are not needed anymore for retrieval of L2 data products. These data correspond to data level 1B and are denoted 1B01.

The file can be delivered to the E-PROFILE central processing hub in the native data format provided by the instrument manufacturer. The only requirements are to respect the E-PROFILE filename convention and to provide files that preserve the original temporal resolution (with differing integration times between zenith observations and boundary layer scans). There is no constraint on the accepted temporal file length or delivery frequence. Timeliness is the most important criterion.

At the E-PROFILE central processing hub the sent data are harmonized to the E-PROFILE 1B01 data format presented in this section and concatenated into daily files at the central data archive for storage.

The file is written in NetCDF4 format using the NetCDF Climate and Forecast (CF) Metadata Conventions.

## Filename Convention

**MWR\_1B01\_N-NNNNN-N-NNNNN\_IyyyymmddHHMM.nc**

Where:

**MWR** Instruments of type microwave radiometer

**1** for level 1

**B01** is the code specifying the data type (e.g. B01 for MWR TB, B11 for IR, B21 for auxiliary meteorological data, C01 for collocated MWR TB, IR and aux met data)

**N-NNNNN-N-NNNNN** = WIGOS ID (https://wiswiki.wmo.int/tiki-index.php?page=WIGOS-Identifiers).In all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code. If no WIGOS ID is available, a temporary code will be provided by the E-PROFILE network manager. E-PROFILE will help to contact the appropriate representative to get a corresponding WIGOS ID.

**I** = Instrument identifier. Should be A if there is only one instrument on the station. Additional instruments are identified with the letters B, C, D etc.

**yyyymmddHHMM** = The starting date of the observation of instant files (in case of the concatenated daily files only **yyyymmdd** is used)

Please note that there is no distinction in the filename between zenith observations and boundary layer scans (the different integration times of the two observation methods go into the boundary variables).

## Global attributes

|  |  |  |
| --- | --- | --- |
| **ATTRIBUTE NAME** | **DESCRIPTION** | **Example, comments** |
| conventions | Name of the conventions followed by the dataset | “CF-1.8” |
| title | A succinct description of what is in the dataset, composed of instrument type and site name | “Lindenberg RPG HATPRO G5 DWD” |
| history | Versioning of the datasets (containing date and software version) | e.g. “20191211 raw2l1 2.1.19” |
| institution | Where the original data was produced |  |
| source | The method of production of the original data | “Ground Based Remote Sensing” |
| comment | Miscellaneous Information about the dataset or methods used to produce it |  |
| references | References that describe the data or methods used to produce it | E-PROFILE data format description document |
| site\_location | Name of measurement station | “Lindenberg, Germany” |
| instrument\_id | E-PROFILE instrument identifier | “A” if there is only one instrument on the station. Additional instruments are identified with the letters B, C, etc. |
| wigos\_station\_id | WIGOS Station identifier acording to WIGOS convention | “0-20000-0-06610”  *Note: in all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code.* |
| principal\_investigator | Department responsible for the instrument | *Note: This should not include the indiviual name due to issues with Data Protection Act* |
| instrument\_manufacturer | Manufacturer of the instrument | e.g. RPG, Radiometrics, ATTEX, home-grown, ... |
| instrument\_model | Instrument model | e.g. RPG-LWP, RPG-HATPRO, RPG-LHATPRO, RPG-HUMPRO, RPG-TEMPRO, Radiometrics MP3000, MP2500, MP1500, ATTEX MTP5. |
| instrument\_generation | Instrument generation | e.g. RPG: G2, G3, G4, G5; ATTEX: 5H, 5HE, 5PE; Radiometrics: MP3000, MP3000-A |
| instrument\_hw\_id | Specific to mainboard |  |
| network\_name | Name of network(s) that instrument may be part of | e.g. DWD, MWRnet, ACTRIS, E-PROFILE  *Note: Possibility to add multiple* |
| campaign\_name | Name of campaign instrument may collect data for | e.g. MOSAIC |
| dependencies | List of files the data set is depending on | *Note: for higher level products: <file name> (without date) of the depending data set or ”external” (for all data sets not archived in the database)* |
| license | Data license | *For non-commercial use only. This data is subject ….* |
| instrument\_calibration\_status | Instrument calibration status | calibrated, needs calibration, diagnosed\_unfit |
| date\_of\_last\_absolute\_calibration | Time of last (automatic or manual) absolute calibration; LN2 or sky tipping |  |
| date\_of\_last\_covariance\_matrix | Time of last covariance update |  |
| type\_of\_automatic\_calibrations\_performed | Description of the type of automatic calibrations performed including information at calibration interval and respective integration time | e.g. gain/hot load calibration, noise diode calibration, sky tipping |
| factory\_history | Logbook repair/replacement work performed | e.g. change of the radome |

## Dimensions

|  |  |
| --- | --- |
| **Dimension name** | **Description** |
| time |  |
| frequency | Number of microwave channels |
| n\_sidebands | Number of sidebands |
| n\_receivers | Number of receivers |

## Variables

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Long\_name** | **Attributes** |
| time | Time (UTC) of the measurement | standard\_name: time  dimension: time  units: seconds since 1970-01-01 00:00:00.000  bounds = “time\_bounds”  comment = "Time indication of samples is at end of integration-time" ; |
| time\_bounds | Start and end time (UTC) of the measurements | dimension: time, 2  units: seconds since 1970-01-01 00:00:00.000 |
| station\_latitude | Latitude of measurement station | standard\_name : latitude  dimension: time  units : degree\_north |
| station\_longitude | Longitude of measurement station | standard\_name : longitude  dimension: time  units : degree\_east |
| station\_altitude | Altitude above mean sea level of measurement station | standard\_name: altitude  dimension: time  units: m  reference: |
| frequency | Frequency of microwave channels | standard\_name : sensor\_band\_central\_radiation\_frequency  dimension: frequency  units:GHz  bounds: time\_bounds |
| bandwidth | Bandwidth of the central frequency | standard\_name: sensor\_band\_spectral\_width  dimension: frequency  Units: GHz  comment: center frequency of single of upper side-band |
| sideband\_count | Single, double, or double-double sideband | comment: 1, 2, 4 are possible values |
| sideband\_IF\_separation | 56.xx +/- X +/- Y | dimension: frequency, n\_sidebands |
| beamwidth | Full width at half maximum | dimension: frequency  units:Degree |
| freq\_shift | frequency shift applied to correct measured brightness temperature for frequency offset of microwave radiometer channel | dimension: frequency  units: GHz |
| tb | Brightness temperatures | standard\_name: brightness\_temperature  dimension:time, frequency  units: K |
| azi | Sensor azimuth angle | standard\_name: sensor\_azimuth\_angle  dimension: time  units: degree  comment: “0=North, 90=East, 180=South, 270=West” |
| ele | Sensor elevation angle | dimension: time  units: degreecomment: “0=horizon, 90=zenith |
| tb\_accuracy | Total absolute calibration uncertainty of brightness temperature, one standard deviation | dimension : frequency  units: K  comment: specify here source of this variable, e.g. literature value, specified by manufacturer, result of validation effort (updated irregularily)  For RDX systems, derived from analysis performed by Tim Hewsion (Tim J. Hewison, 2006: Profiling Temperature and Humidity by Ground-based Microwave Radiometers, PhD Thesis, University of Reading.)  Derived from sensitivity analysis of LN2 calibration plus instrument noise levels (ACTRIS work), currently literature values (Maschwitz et al. for HATPRO, ? for radiometrics) |
| tb\_cov | Error covariance matrix of brightness temperature channels | dimension: time, frequency, frequency  units: K\*K  target\_temp: blackbody target temperature used for the calculation of tb\_cov in Kelvin degrees. (e.g., 77.2 K for liquid nitrogen cooled blackbody, in the range 250-330 K for ambient temperature blackbody)  comment: specify here standardized method used to estimate the covariance matrix |
| quality\_flag | Quality\_flag | standard\_name: quality\_flag  dimension: time, frequency  units: 1 (bit variable)  Bit 1: Missing TB-value  Bit 2: TB threshold (lower range)  Bit 3: TB threshold (upper range)  Bit 4: Spectral consistency threshold  Bit 5: Receiver sanity  Bit 6: Rain flag  Bit 7: Solar flag  Bit 8: TB offset threshold  comment: Bit 4 and 8 are calculated centrally at the E-PROFILE processing hub  *Note: Bit 4 is based on a threshold of the spectral difference of retrieved and observed TB; Bit 8 is based on a threshold of the average of the latest clear-sky observation minus background departures available (difference between measured and simulated TB)* |
| pointing\_flag | Flag indicating observation mode - single vs. multiple pointing | standard\_name:  dimension: time  units: |
| t\_amb | Ambient target temperature | dimension: time  units: K |
| t\_rec | Receiver temperature | dimension: time, n\_receivers  units: K |

# Level 1: L1 - IR TB data (1B11)

## Basics

This file provides time series of infrared brightness temperature (IRT) data including system parameters, i.e. all necessary information so that respective raw files are not needed anymore for retrieval of L2 data products. These data correspond to data level 1B and are denoted 1B11.

The file can be delivered to the E-PROFILE central processing hub in the native data format provided by the instrument manufacturer. The only requirements are to respect the E-PROFILE filename convention and to provide files that preserve the original temporal resolution. There is no constraint on the accepted temporal file length or delivery frequence. Timeliness is the most important criterion.

At the E-PROFILE central processing hub the sent data are harmonized to the E-PROFILE 1B11 data format presented in this section and concatenated into daily files at the central data archive for storage.

The file is written in NetCDF4 format using the NetCDF Climate and Forecast (CF) Metadata Conventions.

## Filename Convention

**MWR\_1B11\_N-NNNNN-N-NNNNN\_IyyyymmddHHMM.nc**

Where:

**MWR** Instruments of type microwave radiometer

**1** for level 1

**B11** is the code specifying the data type (e.g. B01 for MWR TB, B11 for IR, B21 for auxiliary meteorological data, C01 for collocated MWR TB, IR and aux met data)

**N-NNNNN-N-NNNNN** = WIGOS ID (https://wiswiki.wmo.int/tiki-index.php?page=WIGOS-Identifiers).In all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code. If no WIGOS ID is available, a temporary code will be provided by the E-PROFILE network manager. E-PROFILE will help to contact the appropriate representative to get a corresponding WIGOS ID.

**I** = Instrument identifier. Should be A if there is only one instrument on the station. Additional instruments are identified with the letters B, C, D etc.

**yyyymmddHHMM** = The starting date of the observation of instant files (in case of the concatenated daily files only **yyyymmdd** is used)

## Global Attributes

|  |  |  |
| --- | --- | --- |
| **ATTRIBUTE NAME** | **DESCRIPTION** | **Example, comments** |
| conventions | Name of the conventions followed by the dataset | “CF-1.8” |
| title | A succinct description of what is in the dataset, composed of instrument type and site name | “Lindenberg RPG HATPRO G5 DWD” |
| history | Versioning of the datasets (containing date and software version) | e.g. “20191211 raw2l1 2.1.19” |
| institution | Where the original data was produced |  |
| source | The method of production of the original data | “Ground Based Remote Sensing” |
| comment | Miscellaneous Information about the dataset or methods used to produce it |  |
| references | References that describe the data or methods used to produce it | E-PROFILE data format description document |
| site\_location | Name of measurement station | “Lindenberg, Germany” |
| instrument\_id | E-PROFILE instrument identifier | “A” if there is only one instrument on the station. Additional instruments are identified with the letters B, C, etc. |
| wigos\_station\_id | WIGOS Station identifier acording to WIGOS convention | “0-20000-0-06610”  *Note: in all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code.* |
| principal\_investigator | Department responsible for the instrument | *Note: This should not include the indiviual name due to issues with Data Protection Act* |
| ir\_instrument\_manufacturer | Manufacturer of the infrared radiometer | e.g. Heitronics, Heimann |
| ir\_instrument\_model | Infrared radiometer model | e.g. KT19.85 |
| network\_name | Name of network(s) that instrument may be part of | e.g. DWD, MWRnet, ACTRIS, E-PROFILE  *Note: Possibility to add multiple* |
| campaign\_name | Name of campaign instrument may collect data for | e.g. MOSAIC |
| license | Data license | For non-commercial use only. This data is subject …. |
| factory\_history | Logbook repair/replacement work performed | e.g. replacement of gold mirror, |
| ir\_instrument\_fabrication\_year | Fabrication year of the infrared radiometer |  |

## Dimensions

|  |  |
| --- | --- |
| **Dimension name** | **Description** |
| time |  |
| ir\_wavelength | Number of infrared channels |

## Variables

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Long\_name** | **Attributes** |
| time | Time (UTC) of the measurement | standard\_name: time  dimension: time  units: seconds since 1970-01-01 00:00:00.000  bounds = “time\_bounds” ;  comment = "Time indication of samples is at end of integration-time" ; |
| time\_bounds | Start and end time (UTC) of the measurements | dimension: time, 2  units: seconds since 1970-01-01 00:00:00.000 |
| station\_latitude | Latitude of measurement station | standard\_name : latitude  dimension: time  units : degree\_north |
| station\_longitude | Longitude of measurement station | standard\_name : longitude  dimension: time  units : degree\_east |
| station\_altitude | Altitude above mean sea level of measurement station | standard\_name: altitude  dimension: time  units: m  reference: |
| ir\_wavelength | Wavelength of infrared channels | standard\_name : sensor\_band\_central\_radiation\_wavelength  dimension: ir\_wavelength  units: um  bounds: time\_bounds |
| ir\_bandwidth | Bandwidth of the infrared channels central frequency | dimension: it\_wavelength  Units: um  comment: channel centre frequency |
| ir\_beamwidth | Full width at half maximum of the infrared channels | dimension: ir\_wavelength  units: Degree |
| irt | Infrared brightness temperatures | dimension:time, ir\_wavelength  units: K |
| azi | Sensor azimuth angle | standard\_name: sensor\_azimuth\_angle  dimension: time  units: degree  comment: “0=North, 90=East, 180=South, 270=West” |
| ele | Sensor elevation angle | dimension: time  units: degree  comment: “0=horizon, 90=zenith |
| irt\_accuracy | Total absolute calibration uncertainty of infrared brightness temperature, one standard deviation | dimension : ir\_wavelength  units: K  comment: specify here source of this variable, e.g. literature value, specified by manufacturer, result of validation effort (updated irregularly). |

# Level 1: L1 – Auxiliary meteorological data (1B21)

## Basics

This file provides time series of auxiliary meteorological data including system parameters, i.e. all necessary information so that respective raw files are not needed anymore for retrieval of L2 data products. These data correspond to data level 1B and are denoted 1B21.

The file can be delivered to the E-PROFILE central processing hub in the native data format provided by the instrument manufacturer. The only requirements are to respect the E-PROFILE filename convention and to provide files that preserve the original temporal resolution. There is no constraint on the accepted temporal file length or delivery frequence. Timeliness is the most important criterion.

At the E-PROFILE central processing hub the sent data are harmonized to the E-PROFILE 1B21 data format presented in this section and concatenated into daily files at the central data archive for storage.

The file is written in NetCDF4 format using the NetCDF Climate and Forecast (CF) Metadata Conventions.

## Filename Convention

**MWR\_1B21\_N-NNNNN-N-NNNNN\_IyyyymmddHHMM.nc**

Where:

**MWR** Instruments of type microwave radiometer

**1** for level 1

**B21** is the code specifying the data type (e.g. B01 for MWR TB, B11 for IR, B21 for auxiliary meteorological data, C01 for collocated MWR TB, IR and aux met data)

**N-NNNNN-N-NNNNN** = WIGOS ID (https://wiswiki.wmo.int/tiki-index.php?page=WIGOS-Identifiers).In all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code. If no WIGOS ID is available, a temporary code will be provided by the E-PROFILE network manager. E-PROFILE will help to contact the appropriate representative to get a corresponding WIGOS ID.

**I** = Instrument identifier. Should be A if there is only one instrument on the station. Additional instruments are identified with the letters B, C, D etc.

**yyyymmddHHMM** = The starting date of the observation of instant files (in case of the concatenated daily files only **yyyymmdd** is used)

## Global Attributes

|  |  |  |
| --- | --- | --- |
| **ATTRIBUTE NAME** | **DESCRIPTION** | **Example, comments** |
| conventions | Name of the conventions followed by the dataset | “CF-1.8” |
| title | A succinct description of what is in the dataset, composed of instrument type and site name | “Lindenberg RPG HATPRO G5 DWD” |
| history | Versioning of the datasets (containing date and software version) | e.g. “20191211 raw2l1 2.1.19” |
| institution | Where the original data was produced |  |
| source | The method of production of the original data | “Ground Based Remote Sensing” |
| comment | Miscellaneous Information about the dataset or methods used to produce it |  |
| references | References that describe the data or methods used to produce it | E-PROFILE data format description document |
| site\_location | Name of measurement station | “Lindenberg, Germany” |
| instrument\_id | E-PROFILE instrument identifier | “A” if there is only one instrument on the station. Additional instruments are identified with the letters B, C, etc. |
| wigos\_station\_id | WIGOS Station identifier acording to WIGOS convention | “0-20000-0-06610”  *Note: in all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code.* |
| principal\_investigator | Department responsible for the instrument | *Note: This should not include the individual name due to issues with Data Protection Act* |
| met\_instrument\_manufacturer | Manufacturer of the weather station | e.g. Vaisala, Lufft, Reinhardt |
| met\_instrument\_model | Weather station model | e.g. WXT536, WS600, MWS3 |
| network\_name | Name of network(s) that instrument may be part of | e.g. DWD, MWRnet, ACTRIS, E-PROFILE  *Note: Possibility to add multiple* |
| campaign\_name | Name of campaign instrument may collect data for | e.g. MOSAIC |
| license | Data license | For non-commercial use only. This data is subject …. |
| factory\_history | Logbook repair/replacement work performed | e.g. replacement of the temperature and humidity sensor unit, |
| air\_temperature\_accuracy | Air temperature accuracy. Unit: K. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| relative\_humidity\_accuracy | Relative humidity accuracy. Unit: 1. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| air\_pressure\_accuracy | Air pressure accuracy. Unit: Pa. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| rain\_rate\_accuracy | Rain rate accuracy. Unit: mm/h. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| wind\_direction\_accuracy | Wind direction accuracy. Unit: degrees. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| wind\_speed\_accuracy | Wind speed accuracy. Unit: m/s. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| met\_instrument\_fabrication\_year | Fabrication year of the weather station |  |

## Dimensions

|  |  |
| --- | --- |
| **Dimension name** | **Description** |
| time |  |

## Variables

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Long\_name** | **Attributes** |
| time | Time (UTC) of the measurement | standard\_name: time  dimension: time  units: seconds since 1970-01-01 00:00:00.000  bounds = “time\_bounds” ;  comment = "Time indication of samples is at end of integration-time" ; |
| time\_bounds | Start and end time (UTC) of the measurements | dimension: time, 2  units: seconds since 1970-01-01 00:00:00.000 |
| station\_latitude | Latitude of measurement station | standard\_name : latitude  dimension: time  units : degree\_north |
| station\_longitude | Longitude of measurement station | standard\_name : longitude  dimension: time  units : degree\_east |
| station\_altitude | Altitude above mean sea level of measurement station | standard\_name: altitude  dimension: time  units: m  reference: |
| air\_temperature | Air temperature | standard\_name: air\_temperature  dimension: time  units: K |
| relative\_humidity | Relative humidity | standard\_name: relative\_humidity  dimension: time  units: 1 |
| air\_pressure | Air pressure | standard\_name: air\_pressure  dimension: time  units: Pa |
| rain\_rate | Precipitation amount | standard\_name: rainfall\_rate  dimension: time  units: mm/h |
| wind\_direction | Wind direction | standard\_name: wind\_from\_direction  dimension: time  units: degree |
| wind\_speed | Wind speed | standard\_name: wind\_speed  dimension: time  units: m/s |
| met\_valid\_flag | Meterological data validity flag | standard\_name: met\_valid\_flag  dimension: time  units: 1 (bit variable: 0=invalid, 1=valid data)  Bit 1: quality of air temperature data  Bit 2: quality of relative humidity data  Bit 3: quality of air pressure data  Bit 4: quality of rain rate data  Bit 5: quality of wind direction data  Bit 6: quality of wind speed data  Bits 7, 8: not used |

# Level 1: L1 – Collocated MWR TB, IR TB and auxiliary meteorological data (1C01)

## Basics

This file is generated at the E-PROFILE central processing hub from the associated level 1B data files 1B01, 1B11, and 1B21. It provides time series of MWR brightness temperatures (TB), infrared brightness temperatures (IRT), and auxiliary meteorological data (MET) including system parameters and quality flags, i.e. all necessary information so that respective raw files are not needed anymore for retrieval of L2 data products.

The time series of IRT and MET data are collocated in time with the TB data using the TB data time grid. These data correspond to data level 1C and are denoted 1C01.

Data are delivered in files that preserve the original temporal resolution of the TB data (with differing integration times between zenith observations and boundary layer scans). There is no constraint on the accepted temporal file length or delivery frequence. Timeliness is the most important criterion. At the central data archive the files are concatenated into daily files for storage.

The file is written in NetCDF4 format using the NetCDF Climate and Forecast (CF) Metadata Conventions.

## Filename Convention

**MWR\_1C01\_N-NNNNN-N-NNNNN\_IyyyymmddHHMM.nc**

Where:

**MWR** Instruments of type microwave radiometer

**1** for level 1

**C01** is the code specifying the data type (e.g. B01 for MWR TB, B11 for IR, B21 for auxiliary meteorological data, C01 for collocated MWR TB, IR and aux met data)

**N-NNNNN-N-NNNNN** = WIGOS ID (https://wiswiki.wmo.int/tiki-index.php?page=WIGOS-Identifiers).In all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code. If no WIGOS ID is available, a temporary code will be provided by the E-PROFILE network manager. E-PROFILE will help to contact the appropriate representative to get a corresponding WIGOS ID.

**I** = Instrument identifier. Should be A if there is only one instrument on the station. Additional instruments are identified with the letters B, C, D etc.

**yyyymmddHHMM** = The starting date of the observation of instant files (in case of the concatenated daily files only **yyyymmdd** is used)

## Global Attributes

|  |  |  |
| --- | --- | --- |
| **ATTRIBUTE NAME** | **DESCRIPTION** | **Example, comments** |
| conventions | Name of the conventions followed by the dataset | “CF-1.8” |
| title | A succinct description of what is in the dataset, composed of instrument type and site name | “Lindenberg RPG HATPRO G5 DWD” |
| history | Versioning of the datasets (containing date and software version) | e.g. “20191211 raw2l1 2.1.19” |
| institution | Where the original data was produced |  |
| source | The method of production of the original data | “Ground Based Remote Sensing” |
| comment | Miscellaneous Information about the dataset or methods used to produce it |  |
| references | References that describe the data or methods used to produce it | E-PROFILE data format description document |
| site\_location | Name of measurement station | “Lindenberg, Germany” |
| instrument\_id | E-PROFILE instrument identifier | “A” if there is only one instrument on the station. Additional instruments are identified with the letters B, C, etc. |
| wigos\_station\_id | WIGOS Station identifier acording to WIGOS convention | “0-20000-0-06610”  *Note: in all WIGOS ID’s allocated after June 2016 the Issuer of the Identifier - second block from the left “NNNNN” – should correspond to the numeric ISO country code.* |
| principal\_investigator | Department responsible for the instrument | *Note: This should not include the indiviual name due to issues with Data Protection Act* |
| instrument\_manufacturer | Manufacturer of the instrument | e.g. RPG, Radiometrics, ATTEX, home-grown |
| instrument\_model | Instrument model | e.g. RPG-LWP, RPG-HATPRO, MP3000, MTP5 |
| instrument\_generation | Instrument generation | e.g. G2, G3, …, G5 (or: MP3000, MP3000-A, …) |
| instrument\_hw\_id | Specific to mainboard |  |
| network\_name | Name of network(s) that instrument may be part of | e.g. DWD, MWRnet, ACTRIS, E-PROFILE  *Note: Possibility to add multiple* |
| campaign\_name | Name of campaign instrument may collect data for | e.g. MOSAIC |
| dependencies | List of files the data set is depending on | for higher level products: <file name> (without date) of the depending data set or ”external” (for all data sets not archived in the database) |
| license | Data license | For non-commercial use only. This data is subject …. |
| instrument\_calibration\_status | Instrument calibration status | calibrated, needs calibration, diagnosed\_unfit |
| date\_of\_last\_absolute\_calibration | Time of last (automatic or manual) absolute calibration; LN2 or sky tipping |  |
| date\_of\_last\_covariance\_matrix | Time of last covariance update |  |
| type\_of\_automatic\_calibrations\_performed | Description of the type of automatic calibrations performed including information at calibration interval and respective integration time | e.g. gain/hot load calibration, noise diode calibration, sky tipping |
| factory\_history | Logbook repair/replacement work performed | e.g. change of the radome, replacement of the infrared radiometer gold mirror, replacement of the temperature and humidity sensor unit. |
| ir\_instrument\_manufacturer | Manufacturer of the infrared radiometer | e.g. Heitronics |
| ir\_instrument\_model | Infrared radiometer model | e.g. KT19.85 |
| ir\_instrument\_fabrication\_year | Fabrication year of the infrared radiometer |  |
| met\_instrument\_manufacturer | Manufacturer of the weather station | e.g. Vaisala, Lufft, Reinhardt |
| met\_instrument\_model | Weather station model | e.g. WXT536, WS600, MWS3 |
| met\_instrument\_fabrication\_year | Fabrication year of the weather station |  |
| air\_temperature\_accuracy | Air temperature accuracy. Unit: K. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| relative\_humidity\_accuracy | Relative humidity accuracy. Unit: 1. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| air\_pressure\_accuracy | Air pressure accuracy. Unit: Pa. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| rain\_rate\_accuracy | Rain rate accuracy. Unit: mm/h. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| wind\_direction\_accuracy | Wind direction accuracy. Unit: degrees. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |
| wind\_speed\_accuracy | Wind speed accuracy. Unit: m/s. | *Note: source of this variable will be specified, e.g. literature value, specified by manufacturer, result of validation effort* |

## Dimensions

|  |  |
| --- | --- |
| **Dimension name** | **Description** |
| time |  |
| frequency | Number of microwave channels |
| n\_sidebands | Number of sidebands |
| ir\_wavelength | Number of infrared channels |

## Variables

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Long\_name** | **Attributes** |
| time | Time (UTC) of the measurement | standard\_name: time  dimension: time  units: seconds since 1970-01-01 00:00:00.000  bounds = “time\_bounds” ;  comment = "Time indication of samples is at end of integration-time" ; |
| time\_bounds | Start and end time (UTC) of the measurements | dimension: time, 2  units: seconds since 1970-01-01 00:00:00.000 |
| station\_latitude | Latitude of measurement station | standard\_name : latitude  dimension: time  units : degree\_north |
| station\_longitude | Longitude of measurement station | standard\_name : longitude  dimension: time  units : degree\_east |
| station\_altitude | Altitude above mean sea level of measurement station | standard\_name: altitude  dimension: time  units: m  reference: |
| frequency | Frequency of microwave channels | standard\_name : sensor\_band\_central\_radiation\_frequency  dimension: frequency  units:GHz  bounds: time\_bounds |
| bandwidth | Bandwidth of the central frequency | standard\_name: sensor\_band\_spectral\_width  dimension: frequency  Units: GHz  comment: center frequency of single of upper side-band |
| sideband\_count | Single, double, or double-double sideband | comment: 1, 2, 4 are possible values |
| sideband\_IF\_separation | 56.xx +/- X +/- Y | dimension: frequency, n\_sidebands |
| beamwidth | Full width at half maximum | dimension: frequency  units:Degree |
| freq\_shift | frequency shift applied to correct measured brightness temperature for frequency offset of microwave radiometer channel | dimension: frequency  units: GHz |
| tb | Brightness temperatures | standard\_name: brightness\_temperature  dimension:time, frequency  units: K |
| azi | Sensor azimuth angle | standard\_name: sensor\_azimuth\_angle  dimension: time  units: degree  comment: “0=North, 90=East, 180=South, 270=West” |
| ele | Sensor elevation angle | dimension: time  units: degree  comment: “0=horizon, 90=zenith |
| tb\_accuracy | Total absolute calibration uncertainty of brightness temperature, one standard deviation | dimension : frequency  units: K  comment: specify here source of this variable, e.g. literature value, specified by manufacturer, result of validation effort (updated irregularily)  For RDX systems, derived from analysis performed by Tim Hewsion (Tim J. Hewison, 2006: Profiling Temperature and Humidity by Ground-based Microwave Radiometers, PhD Thesis, University of Reading.)  Derived from sensitivity analysis of LN2 calibration plus instrument noise levels (ACTRIS work), currently literature values (Maschwitz et al. for HATPRO, ? for radiometrics) |
| tb\_cov | Error covariance matrix of brightness temperature channels | dimension: frequency, frequency)  units: K\*K  target\_temp: blackbody target temperature used for the calculation of tb\_cov in Kelvin degrees. (e.g., 77.2 K for liquid nitrogen cooled blackbody, in the range 250-330 K for ambient temperature blackbody)  comment: specify here standardized method used to estimate the covariance matrix |
| quality\_flag | Quality\_flag | standard\_name: quality\_flag  dimension: time, frequency  units: 1 (bit variable)  Bit 1: Missing TB-value  Bit 2: TB threshold (lower range)  Bit 3: TB threshold (upper range)  Bit 4: Spectral consistency threshold  Bit 5: Receiver sanity  Bit 6: Rain flag  Bit 7: Solar flag  Bit 8: TB offset threshold  comment: Bit 4 and 8 are calculated centrally at the E-PROFILE processing hub  *Note: Bit 4 is based on a threshold of the spectral difference of retrieved and observed TB; Bit 8 is based on a threshold of the average of the latest clear-sky observation minus background departures available (difference between measured and simulated TB)* |
| t\_amb | Ambient\_target\_temperature | dimension: time  units: K |
| t\_rec | Receiver temperature | dimension: time  units: K |
| ir\_wavelength | Wavelength of infrared channels | standard\_name : sensor\_band\_central\_radiation\_wavelength  dimension: ir\_wavelength  units: um  bounds: time\_bounds |
| ir\_bandwidth | Bandwidth of the infrared channels central frequency | dimension: ir\_wavelength  Units: um  comment: channel centre frequency |
| ir\_beamwidth | Full width at half maximum of the infrared channels | dimension: ir\_wavelength  units: Degree |
| irt | Infrared brightness temperatures | dimension:time, ir\_wavelength  units: K |
| air\_temperature | Air temperature | standard\_name: air\_temperature  dimension: time  units: K |
| relative\_humidity | Relative humidity | standard\_name: relative\_humidity  dimension: time  units: 1 |
| air\_pressure | Air pressure | standard\_name: air\_pressure  dimension: time  units: Pa |
| rain\_rate | Precipitation amount | standard\_name: rainfall\_rate  dimension: time  units: mm/h |
| wind\_direction | Wind direction | standard\_name: wind\_from\_direction  dimension: time  units: degree |
| wind\_speed | Wind speed | standard\_name: wind\_speed  dimension: time  units: m/s |
| met\_valid\_flag | Meterological data validity flag | standard\_name: met\_valid\_flag  dimension: time  units: 1 (bit variable: 0=invalid, 1=valid data)  Bit 1: quality of air temperature data  Bit 2: quality of relative humidity data  Bit 3: quality of air pressure data  Bit 4: quality of rain rate data  Bit 5: quality of wind direction data  Bit 6: quality of wind speed data  Bits 7, 8: not used |