MEGHA-TROPIQUES

PRODUCT DEFINITION DOCUMENT

Instantaneous non precipitating conditions

Level 2 products

Upper Tropospheric Humidity

derived from SAPHIR

Version 1

Release 4

N° PDD_SAP_L2-UTH_V1_R4.doc

Authors :	H. Brogniez (UVSQ/LATMOS) S. Cloché (CNRS/IPSL) C. Dufour (CNRS/LATMOS)

1. Releases

Release N°	Publication date	Author	Brief description of the change
R0	October 2013	H.Brogniez S.Cloché	1rst version
R1	March 2014	S. Cloché	L2B format description is added.
R2	January 2015	C. Dufour	Adding UTH uncertainty in L2 and an extra dimension for time in L2B
R3	October 2015	C. Dufour	Adding UTH uncertainty in L2B
R4	November 2015	C. Dufour	Syntax correction

2. Products content

This document specifies the format of Megha-Tropiques level 2 (L2) products derived from the SAPHIR sounder. Those L2 products are instantaneous non-precipitating conditions products, on a pixel by pixel basis, over both land and ocean surfaces. For each pixel, the Upper Tropospheric Humidity is estimated separately from the 183.31 ± 0.2 GHz, the ±1.1 GHz and the ±2.7 GHz channels.
The retrieval algorithm used within the Megha-Tropiques framework is similar to the one used in RD1.
Following the budget of errors detailed and discussed in RD5, an estimation of the uncertainty associated to the retrieval method of UTH is provided.
Moreover, two kinds of flags are appended to the UTH product:

- the convective overshooting clouds and of the deep convective clouds, which has been adapted to the SAPHIR specificities (0=false: no detection, 1=true: a deep convective/an overshoot is detected).
- A quality flag, that indicates whether the retrieval of humidity reaches values out of the limits [0%, 100%] in order to detect unphysical restitutions (0=true: pixel OK, 1=false: for unphysical values).

Those products are derived from the level1A2 (L1A2) SAPHIR data. The L1A2 SAPHIR product is obtained after the re-sampling of L1A data (raw set of calibrated and navigated brightness temperatures). The L1A2 is defined as follows:

-The grid is a dynamic grid, which follows actual satellite altitude variations.

-A re-sampling of the L1A data (182 samples) is performed in order to provide 130 non-overlapping pixels for each scan line.

-Each channel and each scan line are processed independently.

-The brightness temperature of each pixel is an average of the brightness temperatures of the neighbor samples of the same scan line.

More details on L1 definition and content can be found in RD3 and RD4.

The Figure 1 below provides a representation of the pixel deformation along the scan line

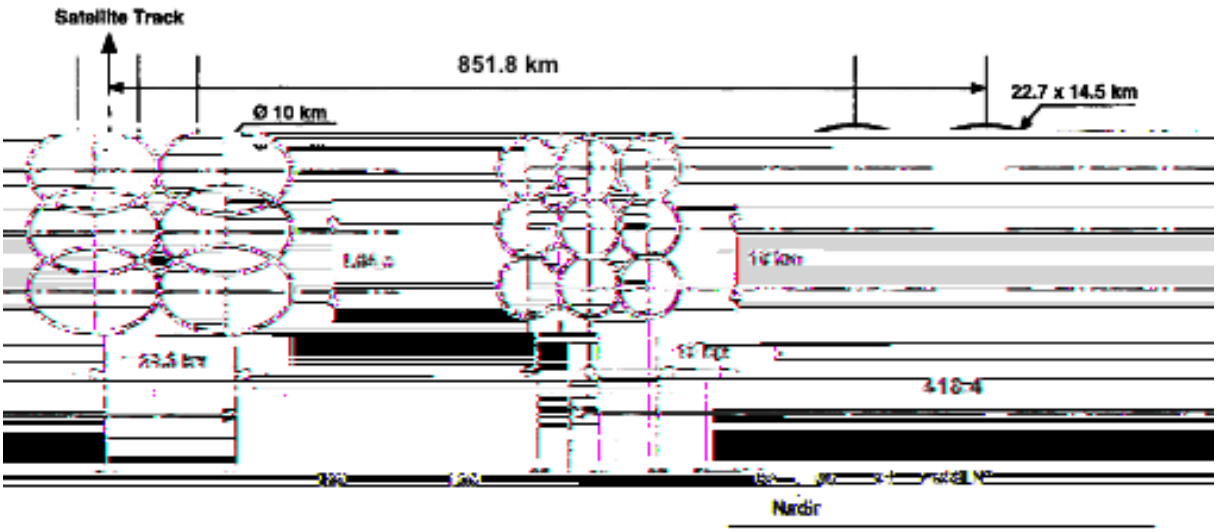

Figure 1: pixel representation on the ground for SAPHIR.

Pixels are contiguous across track and along track at nadir, and due to the instrument field of view, while the pixels across track are contiguous, pixels along track present some overlap. Footprints are elliptical in shape and the footprint size varies from a circle of diameter 10km at nadir towards a 22.3 x 14.5 km^2 (across x along track) on the edge of the swath. The L2 UTH product is provided at the resolution of the L1A2 product.
The L2 files have the same structure as the input L1A2 files: one file per orbit (or per dump file). All parameters are archived in the same file. Informations on house keeping data are transferred from the L1A2 files to the L2 files (geolo

This document also specifies the format of Megha-Tropiques level 2B (L2B) products derived from SAPHIR level 2. This product is, as the L2 product, an instantaneous product but on a 1°x1° geographical grid.

3. Format of the product L2-UTH

Currently, the Level 2 products are in the HDF4.2r5 format.

The file naming convention for the L2 Megha-Tropiques products is the following:

MT1_L2-UTH-<L1PRODUCT>_< YYYY-MM-DDThh-mm-ss >_V< X-XX >.hdf

With :

- <L1PRODUCT> = SAPXL1NN-X.XX: UTH level 2 products are derived from SAPHIR L1 measurements specified by this item with:
  - X: O/S: Indicates the L1 data is standard (O for Orbit wise) or NRT(S for Segment-wise) product type
  - L1NN: Indicates the product type of level 1 used to derive the L2 product: L1A or L1A2
  - X.XX: Indicates the version of L1 used to derive the L2 product
- < YYYY-MM-DDThh-mm-ss > = Date and time of the first record (Year,Month,Day,hour,minute,second).
- V< X-XX > = Product L2 version.
- .hdf = HDF file suffix.

The Level-2 products structure is as follow and described in detail hereafter:

FILE_ATTRIBUTES	File metadata
SCAN_ATTRIBUTES	Data for a scan
PIXEL_ATTRIBUTES	Data for each pixel of a scan

FILE_ATTRIBUTES		
Parameter & Note	**Data Type**	**Size**
File_Name	String	1
Product_Version	String	1
Mission	String	1
East_Bounding_Longitude	Float 32	1
West_Bounding_Longitude	Float 32	1
South_Bounding_Latitude	Float 32	1
North_Bounding_Latitude	Float 32	1
Beginning_Acquisition_Date	String	1
End_Acquisition_Date	String	1
Input_Files	String	1
Ancillary_Files	String	1
Sensors	String	1
Product_Name	String	1
Product_Description	String	1
Software_Version	String	1
Scientific_Software_Version	String	1
Nadir_Pixel_Size	String	1
HDF_Version	String	1
Production_Date	String	1
ICARE_ID	String	1
Production_Center	String	1
Nb_invalid_scan	Int 16	1

Table 1 : L2-UTH file attributes

FILE_ATTRIBUTES notes	
File_Name	Name of the file
Product_Version	Example : V1-03
Mission	Megha-Tropiques
East_Bounding_Longitude	Ex:345.7
West_Bounding_Longitude	Ex:0.06
South_Bounding_Latitude	Ex:-27.4
North_Bounding_Latitude	Ex:27.8
Beginning_Acquisition_Date	Date UTC of the first pixel in the file (YYYY-MM-DDTHH-MM-SS)
End_Acquisition_Date	Date UTC of the last pixel in the file (YYYY-MM-DDTHH-MM-SS)
Input_Files	Input SAPHIR L1A2 file used for the inversion
Ancillary_Files	Name of the ancillary files used as input in the level-2 process. Here, None for this product.
Sensors	Sensor used for the inversion; here: MT/SAPHIR only
Product_Name	L2-UTH-[L1 VERSION NAME]
Product_Description	Resumes the principle of the inversion algorithm
Software_Version	Version of the complete framework algorithm
Scientific_Software_Version	Version of the scientific algorithm
Nadir_Pixel_Size	Pixel size at nadir
HDF_Version	HDF Version of the product
Production_Center	ICARE
ICARE_ID	ICARE internal identifier
Production_Date	Ex: 2012/11/23 09:38:07
Nb_invalid_scan	Number of invalid scans in the file

Table 2 : L2-UTH File attributes notes

SCAN_ATTRIBUTES						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
Datation Fields						
UTC_Date_Scan	String Hdf-4 vdata	NA	NA	NA	NA	['nscan']
POSIX_Date_Scan	Float 64 Hdf-4 sds	seconds	NA	-999.0	99999.0	

Table 3 : L2-UTH scan attributes

SCAN ATTRIBUTES Notes	
UTC_Date_Scan	Acquisition time of the first pixel of the first scan format: YYYY-MM-DDThh-mm-ss For information, to obtain the pixel datation, follows the L1A2 equation : Date of pixel (n) = UTC_Date_Scan + n * (Pixel acquisition period = 4,576 ms)
POSIX_Date_Scan	Acquisition date and time of the first pixel of the first scan expressed as the number of seconds that have elapsed since midnight Universal Time Coordinated (UTC), 1 january 1970

Table 4 : L2-UTH scan attributes notes

PIXEL_ATTRIBUTES						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
Geolocation Fields						
Latitude	Float 32 Hdf-4 sds	Degrees	-90:90	-999.0	99999.0	['nscan', 'npix']
Longitude	Float 32 Hdf-4 sds	Degrees	0:360	-999.0	99999.0	['nscan', 'npix']
Data Fields						
UTH	Float 32 Hdf-4 sds	%	0:100	-999.0	99999.0	['nscan',
Error_Standard_Deviation	Float 32 Hdf-4 sds	%	0:100	-999.0	99999.0	['nscan',
FLAG_HONG	Byte Hdf-4 sds	none	0:1	255	254	['nscan', 'npix']
QUALITY_FLAG	Byte Hdf-4 sds	none	0:1	255	254	['nscan', 'npix']

Table 5 : L2-UTH pixel attributes

PIXEL ATTRIBUTES notes	
Latitude	Latitude of the SAPHIR pixel
Longitude	Longitude of the SAPHIR pixel
UTH	Upper Tropospheric Humidity determined for nlayers, where each layer corresponds to one of the 3 following channels: nlayer = 1: UTH from the 183.31 ±0.2 GHz channel nlayer = 2: UTH from the 183.31 ±1.1 GHz channel nlayer = 3: UTH from the 183.31 ±2.7 GHz channel
Error_Standard_Deviation	Upper bound of the uncertainty associated to the retrieval of UTH.
FLAG_HONG	True (0) if the retrieval is available for the current pixel
QUALITY_FLAG	True (0) if the retrieval is available for the current pixel

Table 6 : L2-UTH pixel attributes notes

4. Format of the product L2B-UTH

The format of the additional level 2B (L2B) products derived from the previous L2 UTH products is described below. This L2B product is instantaneous but on a 1°x1° geographical grid. To compute the L2B product, all L2 UTH pixels present in one L2B gridpoint are averaged; the averaged UTH calculation for one L2B cell is possible if the L2B grid cell is 75% covered by the L2 pixels.

Currently, the Level 2B products are in the NetCDF-3 format.

The file naming convention for the L2B Megha-Tropiques products is the same as the L2 files:

MT1_L2B-UTH-<L1PRODUCT>_< YYYY-MM-DDThh-mm-ss >_V< X-XX >.nc

The Level-2B products structure is as follow and described in detail hereafter:

GLOBAL_ATTRIBUTES	File metadata
VARIABLES	All the variables

GLOBAL Attributes Notes	
File_Name	Name of the file.
Product_Description	Resumes the principle of the inversion algorithm
North_Bounding_Latitude	30
South_Bounding_Latitude	-30
West_Bounding_Longitude	0
East_Bounding_Longitude	360
Nadir_Pixel_Size	1.0 deg
Software_Version	Version of the complete framework algorithm
Product_Version	Version of the product (ex : VX.XX)
Production_Center	ICARE
Production_Date	Ex : 2013/07/27 20:55:56
Sensors	Sensor used for the inversion; here: MT/SAPHIR
Mission	Megha-Tropiques
Input_Files	Name of the L2 file used to compute the L2B file
Level1_file	Name of the L1 file used to compute the L2 file
NETCDF_Version	Netcdf version used to generate the file
Beginning_Acquisition_Date	Date UTC of the first pixel in the corresponding L2 file (YYYY-MM-DDTHH-MM-SS)
End_Acquisition_Date	Date UTC of the last pixel in corresponding the L2 file (YYYY-MM-DDTHH-MM-SS)
Product_Name	MT1_L2B-UTH-[L1 VERSION NAME]
Icare_ID	ICARE internal identifier

Table 7 : L2B-UTH Global Attributes notes

VARIABLES						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
Time	Double	seconds	NA	NA	NA	[1]
Latitude	Float	Degrees_north	-29.5, 29.5	99999.f	999999.f	[60]
Longitude	Float	Degrees_east	0.5, 359.5	99999.f	999999.f	[360]
Layer	Int	NA	1,3	2147483647	-2147483648	[3]
Pixel_time	Double	seconds	NA	99999.f	999999.f	[1,60,360]*
UTH	Float	%	0,100	99999.f	999999.f	[1,3,60,360]*
UTH_Error_Standard_Deviation	Float	%	0,100	99999.f	999999.f	[1,3,60,360]*
UTH_quality	Float	%	0,100	99999.f	999999.f	[1,3,60,360]*

* : first dimension : time dimension added = [1]

Table 8 : L2B-UTH Variables

VARIABLE notes	
Time	
	Latitude of each gridpoint of the 1°x1°grid. Latitude represents the center of gridpoint. A positive value means North.
Longitude	Longitude of each gridpoint, representing the center of gridpoint.
Layer	UTH is determined for nlayers , where each layer corresponds to one of the 3 following channels: layer = 1: UTH from the 183.31 ±0.2 GHz channel layer = 2: UTH from the 183.31 ±1.1 GHz channel layer = 3: UTH from the 183.31 ±2.7 GHz channel
Pixel_time	The mean time value of each gridpoint is computed by averaging the time value of all the instantaneous L2 pixels included in a gridpoint (Only first pass is considered). A L2 pixel (lat,long) is included in a gridpoint centered at (Latitude, Longitude) if its lat/long values are included in the range (Latitude/Longitude +/- 0.5°). The pixel time format is "seconds since 2011-10-12 00:00:00.000".
UTH	The mean UTH value of each gridpoint is computed by averaging all instantaneous L2 UTH pixels included in a gridpoint weighted by their uncertainty.
UTH_Error_Standard_Deviation	The error standard deviation of UTH values included in each gridpoint weighted by their uncertainty.
UTH_quality	Percentage of valid UTH (QUALITY_FLAG) values within each 1°x1°gridpoint.

Table 9 : L2B-UTH Variables notes

5. References

Index	Title of document	Reference
RD1	Article	Brogniez H. and R.T. Pierrehumbert, 2006: Using microwave observations to assess large-scale control of the free tropospheric water vapor in the mid-latitudes. *Geophys. Res. Lett., 33, L14801, doi:10.1029/2006GL026240*
RD2	Article	Hong G., G. Heygster, J. Miao and K. Kunzi, 2005: Detection of tropical deep convective clouds from AMSU-B water vapor channels measurements. *J. Geophys. Res., 110, D05205, doi:10.1029/2004JD004949*
RD3	Megha Tropiques L1 product definition	2013_01_17_Level-1productdef_ED3rev4.pdf
RD4	SAPHIR L1 format	ProductDefinition_SAPHIR_L1A-1-1-2-3-B_HDFMGTStructure_13rev1.xls
RD5	Article	Brogniez H., G. Clain and R. Roca , 2015 :Validation of Upper Tropospheric Humidity from SAPHIR onboard Megha-Tropiques using tropical soundings. *Journal of Applied Meteorology and Climatology*.