MEGHA-TROPIQUES

PRODUCT DEFINITION DOCUMENT

Level 4 products

Surface accumulated rainfall and uncertainty

L4-TAPEER-BRAIN

Version 1

Release 1

N° PDD_L4-TAPEER-BRAIN_V1_R1

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1. Releases

Release N°	Publication date	Author	Brief description of the change
R1	16 November 2015	E.Lorant R.Roca N.Taburet S.Cloché	First Release

2. Introduction

This document specifies the format of TAPEER-BRAIN Megha-Tropiques level 4 (L4) product. The TAPEER-BRAIN algorithm combines microwave and infrared observations to provide precipitation estimates and their associated error bars at the one-degree/one-day accumulated scale, over land and ocean.

TAPEER stands for Tropical Amount of Precipitation with an Estimate of ERrors. The major improvement in this 1.5 version of the TAPEER algorithm is to separately deal with rain detection and rain rates estimation. As a result different satellite configurations can be used for both aspects, in particular this allows to benefit from the use of microwave sounder (SAPHIR) for rain detection. The current implementation therefore relies on rain detection from LEO microwave imagers and sounder as well as instantaneous precipitation retrievals from LEO microwave imagers using the BRAIN algorithm (Viltard et al, 2006). Those detections and rain rates estimates are then merged with full space/time resolution data from the thermal window channel onboard GEO platforms (MSG, Meteosat 7, GOES-E, GOES-W, MTSAT). The product is further corrected statistically using the TRMM PR v7 near surface rain rates data.

The product looks like the figure below with the daily accumulation and the sampling error both expressed in mm:

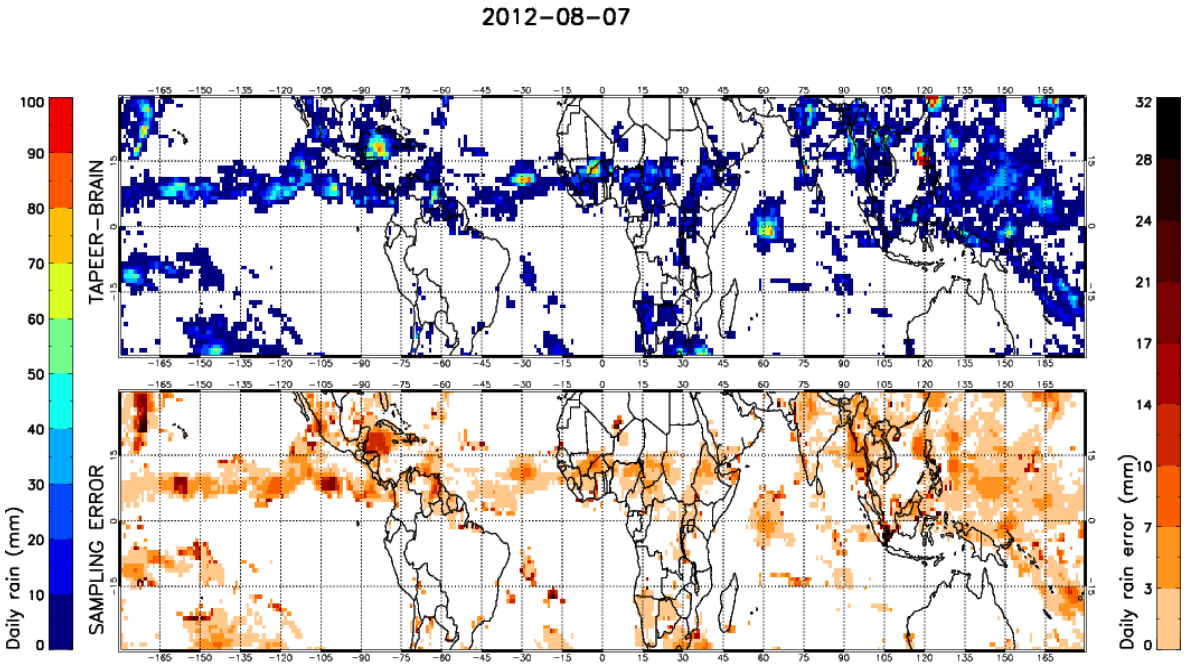

Figure 1 : Illustration of a typical TAPPER-BRAIN product. Top: daily accumulated rainfall (mm). Bottom: sampling error (mm)

The details of the algorithm are available in the ATBD document (Chambon et al.,2012a Roca et al., 2014) while the scientific background on both the algorithm and the error modeling effort are presented in (Roca et al; 2010; Chambon et al., 2012b).

3. Format of the TAPEER-BRAIN product

The TAPEER-BRAIN algorithm derives 2 geophysical products, rain accumulation and the associated error bars (or uncertainty), for a 24 hours time range, starting at 4 different times: 0, 6, 12, 18h UTC. The 2 geophysical variables are regrouped in one NetCDF file for one time start: four files per day are available. The NetCDF version currently used is the NetCDF-3, using the CF convention (convention for climate and forecast (CF) metadata). The file naming convention for the TAPEER-BRAIN file is the following:

MT1_L4-TAPEER-BRAIN-ZZ_<YYYY-MM-DD>T<hh-mm-ss>-P1D_V<X-XX>.nc

«ZZ » = Product status, ZZ = **BC** for **B**ias **C**orrected with bias correction scheme

« < YYYY-MM-DD>**T**<hh-mm-ss > » = Start date and time of the 24 hours period of the rain accumulation (Year, Month, Day, hour, minute, second).Start time has the following values: hh-mm-ss =00-00-00, 06-00-00, 12-00-00, 18-00-00

« **V**< X-XX > » = Product version.

The NetCDF file is stored as a single file containing two parts :

- A header, including all the informations about dimensions, attributes and variables. An exemple of header is given in Annexe.
- A data part, including the data of the variables

The structure of the variables (data) and the global attributes (general informations about the file) stored in the NetCDF file are described hereafter.

GLOBAL_ATTRIBUTES	File metadata
VARIABLES	Data structure

GLOBAL_ATTRIBUTES		
Parameter & Note	**Data Type**	**Size**
Mission	String	50
Title	String	50
Description	String	50
File_Name	String	50
Date	String	50
Product_Name	String	50
Product_Status	String	50
Product_Version	String	50
Production_Center	String	50
Production_Date	String	50
Contact	String	50
Grid	String	50
Geo_Sensors	String	50
GeoL1b_Version	String	50
LEO_Sensors_1	String	50
LEO_Sensors_2	String	50
Brain_Product_Version	String	50
UTH_Product_Version	String	50
GeoBrain_Version	String	50
GeoUth_Version	String	50
Software_Version	String	50
Scientific_Software_Version	String	50
NetCDF_Library_Version	String	50
NetCDF_Version	String	50
Conventions	String	50
Icare_ID	String	50
Ancillary_File	String	50

Table 1 : TAPEER-BRAIN global attributes

GLOBAL_ATTRIBUTES Notes	
Mission	“ **MT1** “
Title	“ **Megha-Tropiques TAPEER-BRAIN product** “
Description	“ **1-degree daily accumulated surface rainfall estimated from geostationnary IR data and MW data by using the TAPEER algorithm with double constellation**”
File_Name	File Name
Date	Start date and time of the 24 hours period of the rain accumulation (Year, Month, Day, hour, minute, second)
Product_Name	“ **L4-TAPEER-BRAIN** “
Product_Status	**B**ias **C**orrected with bias correction scheme
Product_Version	TAPEER-BRAIN product version
Production_Center	“**ICARE Data and Services Center**“
Production_Date	Production date
Contact	Person/service to contact
Grid	“ **1 x 1 deg regular lon/lat grid** “
Geo_Sensors	Name of the geostationary sensors
GeoL1b_Version	Geo2HDF product version
LEO_Sensors_1	Name of the microwave imagers and sounder in the first constellation used for rain detection
LEO_Sensors_2	Name of the microwave imagers in the second constellation used for rain rates estimation
Brain_Product_Version	BRAIN product version
UTH_Product_Version	UTH product version
GeoBrain_Version	GeoBrain colocalisation product version
GeoUth_Version	GeoUth colocalisation product version
Software_Version	Framework version
Scientific_Software_Version	Scientific algorithm version of TAPEER
NetCDF_Library_Version	NetCDF library version
NetCDF_Version	NetCDF version
Conventions	Name of the convention used for the NetCDF file
Icare_ID	“ **RFU** “
Ancillary_File	Name of bias correction coefficient file

Note : In bold, the permanent informations of the global attributes

Variables						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
Datation Fields						
Time	date	hours since 1960-01-01 00:00:00 UTC	N/A	N/A	N/A	[1]
Time_bnds	date	hours since 1960-01-01 00:00:00 UTC	N/A	N/A	N/A	[2]
Geolocation Fields						
Latitude	Float 32	degrees_north	[-29,5:29,5]	N/A	N/A	['lat']
Longitude	Float 32	degrees_east	[-179,5:179,5]	N/A	N/A	['lon']
Data Fields						
Rain	Float 32	mm/day	[0:1000]	-999	-999	['time','lat','lon']
Uncertainty	Float 32	mm/day	[0:1000]	-999	-999	['time','lat','lon']

Table 3 : TAPEER-BRAIN variables

Variables notes	
Time	The midpoint of the 24 hours time range for which the accumulated rain is computed, expressed in hours since 1960-01-01 00:00:00 UTC; one time value per file
Time_bnds	Time range of the accumulated rain computation period, expressed in hours since 1960-01-01 00:00:00 UTC
Latitude	Latitude of grid point center
Longitude	Longitude of grid point center
Rain	Daily accumulated surface rainfall
Uncertainty	Uncertainty on daily accumulated surface rainfall, missing value if non convergence of the algorithm or convergence to a non-physical value

4. References

Chambon P., Roca, R., Jobard, I., Aublanc, J. (2012a). TAPEER-BRAIN product: Algorithm Theoritical Basis Document, Level-4, Megha-Tropiques Technical Memorandum #4, 13 pp. Available from http://megha-tropiques.ipsl.polytechnique.fr

Roca, R., Chambon, P., Jobard, I., Kirstetter, P.-E., Gosset, M., and Bergès, J.-C. (2010)**.** Comparing satellite and surface rainfall products over west africa at meteorologically relevant scales during the amma campaign using error estimates. J. Appl. Meteorol. and Climatol.

Chambon P, Jobard I, Roca R, Viltard N. (2012b). An investigation of the error budget of tropical rainfall accumulation derived from merged passive microwave and infrared satellite measurements. Q. J. R. Meteorol. Soc. 138: 000.000. DOI:10.1002/qj.1907

Viltard, N., Burlaud, C., and Kummerow, C. (2006). Rain retrieval from tmi brightness temperature measurements using a trmm pr–based database. J. Appl. Meteorol. and Climatol.

Roca R., J. Aublanc, P.Chambon, T. Fiolleau, and N. Viltard, (2014) Robust observational quantification of the contribution of mesoscale convective systems to rainfall in the tropics, J Climate, 27, 4952–4958. doi: http://dx.doi.org/10.1175/JCLI-D-13-00628.1

Annexe

Exemple of a TAPEER-BRAIN product header (without the global attributes) :

dimensions:
time = UNLIMITED ; // (1 currently)
latitude = 60 ;
longitude = 360 ;
nv = 2 ;

variables:
double time(time) ;
time:units = "hours since 1960-01-01 00:00:00 UTC" ;
time:long_name = "The midpoint of the 24 hours time range for which the accumulated rain is computed; one time value per file" ;
time:delta_t = "000-00-01 00:00:00" ;
time:calendar = "standard" ;
time:bounds = "Time_bnds" ;

float latitude(latitude) ;
latitude:units = "degrees_north" ;
latitude:long_name = "Latitude of grid point center" ;
latitude:actual_range = -29.5f, 29.5f ;
latitude:delta_lat = 1.f ;

float longitude(longitude) ;
longitude:units = "degrees_east" ;
longitude:long_name = "Longitude of grid point center" ;
longitude:actual_range = -179.5f, 179.5f ;
longitude:delta_lon = 1.f ;

double time_bnds(time, nv) ;
time_bnds:long_name = "Time range of the accumulated rain computation period" ;
time_bnds:units = "hours since 1960-01-01 00:00:00 UTC" ;

float rain(time, latitude, longitude) ;
rain:_FillValue = -999.f ;
rain:units = "mm/day" ;
rain:long_name = "Daily Accumulated Surface Rainfall" ;
rain:comment = "Accumulated from 20120801-00h to 20120802-00h" ;
rain:missing_value = -999.f ;
rain:valid_range = 0.f, 1000.f ;

float uncertainty(time, latitude, longitude) ;
uncertainty:_FillValue = -999.f ;
uncertainty:units = "mm/day" ;
uncertainty:long_name = "Uncertainty on daily Accumulated Surface Rainfall" ;
uncertainty:comment = "Missing value if non convergence of the algorithm or convergence to a non-physical value" ;
uncertainty:missing_value = -999.f ;
uncertainty:valid_range = 0.f, 1000.f ;