MEGHA-TROPIQUES
PRODUCT DEFINITION DOCUMENT

Top Of the Atmosphere Fluxes & Albedo

Level 2 products

derived from ScaRaB

Version 1

Release 2

N° PDD_SCA_L2-FLUX_V1_R2.doc

Authors	O. Chomette (CNRS/LMD) S. Cloché (CNRS/IPSL) P. Raberanto (CNRS/LMD) R. Roca (CNRS/LEGOS)

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1. Releases

Release n°	Publication date	Authors	Brief description of change
R0	October 2013	O. Chomette (CNRS/LMD) S. Cloché (CNRS/IPSL) P. Raberanto (CNRS/LMD) R. Roca (CNRS/LEGOS)	1st draft
R1	December 2014	P. Raberanto (CNRS/LMD)	- new variable in L2B : Viewing zenith angle at the pixel center (VZA) - an extra dimension (time) in L2B
R2	March 2019	P. Raberanto (CNRS/LMD)	- Correction of the Relative Azimuth bug - new variables in L2B : TOA_IR_Rad, TOA_VIS_Rad - New data set L2B with a 0.5x0.5° spatial resolution : change in naming convention for L2B

Note: Changes in the document are in red

2. Product content

This document specifies the format of Megha-Tropiques level 2 (L2) products derived from ScaRaB (Scanner for Radiation Budget). These L2 products are instantaneous products, on a pixel by pixel basis, over all surfaces.

These products contain one orbit (or dump) of estimated Top Of the Atmosphere (TOA) SW and LW fluxes, albedo, unfiltered radiances obtained using a unfiltering processing, scene identifications and some input data (radiances, angles...) for each pixel. In these products, we have two different TOA fluxes: one derived from SEL (ScaRaB Erbe-Like) algorithm, based on the ERBE ADMs (Suttles et al. 1988, 1989) and corresponding inversion methods (Wielicki and Green 1989) and one derived from SANN (ScaRaB Artificial Neural Network) algorithm. You can find a description of this approach on Viollier et al. (2009).

These products are derived from the level1A2 (L1A2) ScaRaB data. Three different level 1 products are proposed for this instrument: 1A, 1A2, 1A3. The L1A provide a "raw" set of calibrated and navigated filtered radiances. The L1A2 ScaRaB product is obtained after geographical correction of L1A data, while the L1A3 consists in a re-mapping of all the channels to the position of the MADRAS 89 GHz pixel centers.

More details on L1 definition and content can be found in «MEGHA-TROPIQUES, Level 1 Products definition».

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

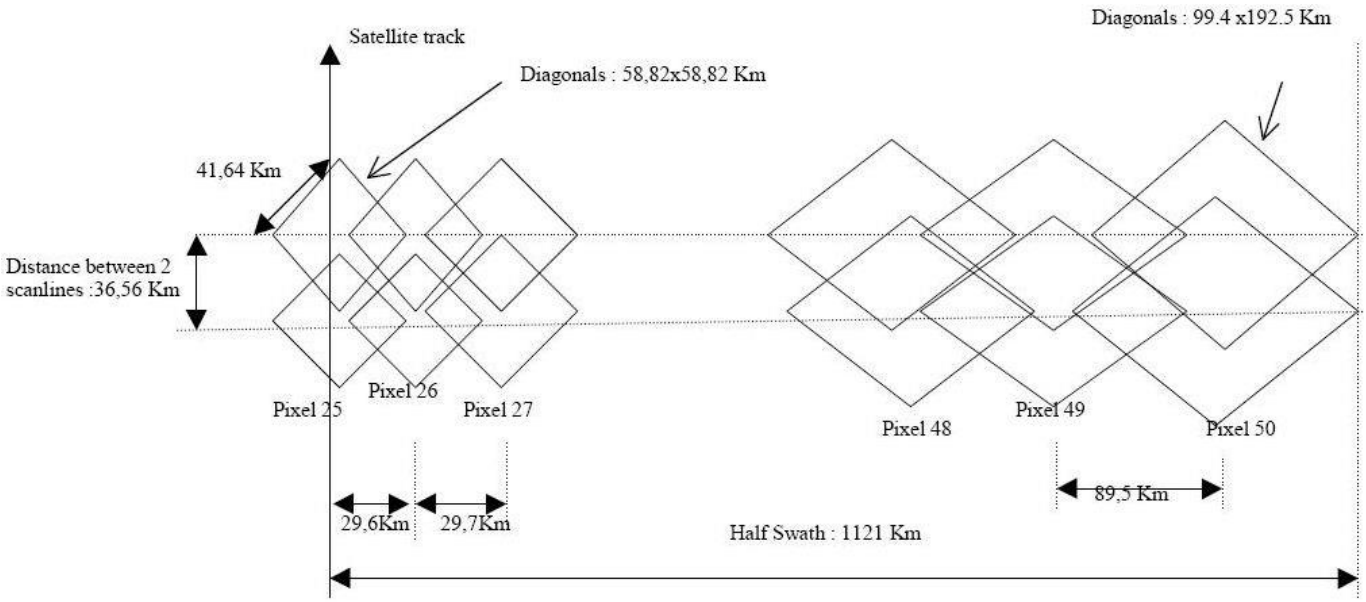

Figure 1: pixel representation on the ground for ScaRaB.

The diamond-shaped pixels overlap across track and along track at nadir, and due to the instrument field of view, the pixels sizes increase and so the overlapping between pixels. The footprint diagonal size varies from 58.82 x 58.82 km^2 at nadir towards a 99.4 x 192.5 km^2 (across x along track) on the edge of the swath. The L2 ScaRaB 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 housekeeping data are transferred from the L1A2 files to the L2 files (geolocation, time scan, navigation…).

This document also specifies the format of Megha-Tropiques level 2B (L2B) products derived from ScaRaB level 2. These products are, as the L2 product, an instantaneous product but on 1°x1° and on a 0°5x0°5 geographical grids.
To compute the L2B, the ScaRaB pixels are projected onto this grid with the PSF-Weighted method described in Gif et al. (2011).

3. Format of the product ScaRaB-L2-FLUX

Currently, the Level 2 products are in the HDF4.2r4 format.

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

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

With:

- <L1PRODUCT> = SCA**X**L1**NN**-**X.XX** : FLUX level 2 products are derived from ScaRaB 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.
    - L1**NN**: 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 > » = L2 Product version.
- «.hdf » = HDF file suffix.

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

FILE_ATTRIBUTES	File metadata
GELOCATION_FIELDS	Time, latitudes, longitudes...
DATA_FIELDS	Data for each pixel of a scan such as angles, radiances, fluxes, QF, scene identification...

3.1 File Attributes

FILE_ATTRIBUTES		
Parameter & Note	**Data Type**	**Array Size**
File_Name	8-bit character	47
Icare_ID	8-bit character	3
Mission	8-bit character	15
Product_Name	8-bit character	14
Product_Description	8-bit character	503
HDF_Version	8-bit character	43
Beginning_Acquisition_Date	8-bit character	19
End_Acquisition_Date	8-bit character	19
Nadir_Pixel_Size	8-bit character	27
Software_Version	8-bit character	5
Product_Version	8-bit character	5
Production_Center	8-bit character	5
Production_Date	8-bit character	19
North_Bounding_Latitude	32-bit floating-point	1
South_Bounding_Latitude	32-bit floating-point	1
West_Bounding_Longitude	32-bit floating-point	1
East_Bounding_Longitude	32-bit floating-point	1
Sensors	8-bit character	9
Input_Files	8-bit character	99
Ancillary_Files	8-bit character	50
list_of_ECMWF_file	8-bit character	219
Scan_Number	16-bit unsigned integer	1
Sample_Number	16-bit unsigned integer	1
nb_invalid_scan	16-bit unsigned integer	1
Orbit_Start_Number	8-bit character	5
Orbit_End_Number	8-bit character	5
Orbit_Revolution_Number	8-bit character	2
Nskip	8-bit character	4
Skip_Start_Scan_Number	8-bit character	4
Skip_End_Scan_Number	8-bit character	4
SLConf	8-bit character	6
Flip_Start_Scan_Number	8-bit character	4
Flip_End_Scan_Number	8-bit character	4
Man_Start_Scan_Number	8-bit character	4
Man_End_Scan_Number	8-bit character	4
Rad_Cal_File_Version	8-bit character	4
Geom_Cal_File_Version	8-bit character	4
QF_Product	8-bit character	6
Proc_Param_File_Version	8-bit character	98
A_coefficient	8-bit character	8
Level1_Version	8-bit character	98

Table 1 : SCARAB-L2-FLUX file attributes

3.2 File Attributes Notes

FILE_ATTRIBUTES Notes	
File_Name	Name of the file.
Icare_ID	ICARE internal identifier.
Mission	Megha-Tropiques
Product_Name	SCARAB-L2-FLUX
Product_Description	Resumes the principle of the inversion algorithm.
HDF_Version	HDF Version 4.2 Release 3, January 27, 2008.
Beginning_Acquisition_Date	Date of the first pixel in the file. Ex : 2012-12-30T05:17:00
End_Acquisition_Date	Date of the last pixel in the file. Ex : 2012-12-30T07:10:24
Nadir_Pixel_Size	40km
Software_Version	Version of the complete framework algorithm.
Product_Version	Ex : V0-01
Production_Center	Ex : ICARE
Production_Date	Ex : 2013/07/27 21:21:49
North_Bounding_Latitude	Ex : 29.92
South_Bounding_Latitude	Ex : -29.62
West_Bounding_Longitude	Ex : 0.01
East_Bounding_Longitude	Ex : 360.0
Sensors	MT/SCARAB
Input_Files	Name of the L1A2 input file.
Ancillary_Files	Name of the ancillary files used as input in the level-2 process.
list_of_ECMWF_file	Name of the ECMWF files used in the L2 algorithm (referred as SANN-2 hereafter).
Scan_Number	Number of scan processed in the file. [1020 for Orbit-wise]
Sample_Number	Number of pixel in the swath. [51]
nb_invalid_scan	Number of invalid scan in the file.
Orbit_Start_Number	Orbit reference number, for first scan of the file.
Orbit_End_Number	Orbit reference number of the last scan of the file. Start and End number are identical for orbit wise product.
Orbit_Revolution_Number	Orbit revolution number in the 7 days phases orbit – limit range is 1 to 97.
Nskip	Number of missing data skip.
Skip_Start_Scan_Number	
Skip_End_Scan_Number	
SLConf	Bit n°0 = SL, configuration of the first scan backward=0, forward=1 Bit n°1 = Instrument mode change during the orbit or segment wide file Bit n°2 = Satellite mode change during the orbit or segment wise product Bit n°3, 4 and 5 = Satellite mode of first scan

Table 2 : SCARAB-L2-FLUX file attributes notes (continued)

FILE_ATTRIBUTES Notes	
Flip_Start_Scan_Number	Scan number at flip start.
Flip_End_Scan_Number	Scan number at flip end.
Man_Start_Scan_Number	Scan number at manoeuver start.
Man_End_Scan_Number	Scan number at maneuver end.
Rad_Cal_File_Version	Radiometric calibration file version.
Geom_Cal_File_Version	Geometric calibration file version.
QF_Product	#bit 0 to bit 7 : percentage of valid scans.
Proc_Param_File_Version	Processing parameter file version.
A_coefficient	This coefficient is used for the subtraction of the SW unfiltered radiance from the Total unfiltered radiance. SW unfiltered radiance is weighted by coefficient A'. A' is related to the equilibrium of both channel responses in the SW domain. Although A' is assumed to be a constant, it might vary slowly in time, reason why its value is given in each record.
Level1_Version	

Table 2 : SCARAB-L2-FLUX file attributes notes

3.3 Geolocation Fields

GEOLOCATION_FIELDS						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
UTC_Date_Scan	8_bit character	UTC Time in seconds	NA	NA	NA	['nscan']
Scan_StartTime	64-bit floating-point	UTC Time in seconds	NA	99999.0	999999.0	['nscan']
POSIX_Date_Scan	64-bit floating-point	UTC Time in seconds	NA	99999.0	999999.0	['nscan']
Colatitude_Nadir	16-bit unsigned integer	Degrees	6000, 12000 (scale factor = 0.01)	65535	65534	['nscan']
Longitude_Nadir	16-bit unsigned integer	Degrees	0, 36000 (scale factor = 0.01)	65535	65534	['nscan']
Colatitude_for_radiance_at_surface	16-bit unsigned integer	Degrees	6000, 12000 (scale factor = 0.01)	65535	65534	['nscan'] x ['npix']
Longitude_for_radiance_at_surface	16-bit unsigned integer	Degrees	0, 36000 (scale factor = 0.01)	65535	65534	['nscan'] x ['npix']
Colatitude_for_radiance_at_TOA	16-bit unsigned integer	Degrees	6000, 12000 (scale factor = 0.01)	65535	65534	['nscan'] x ['npix']
Longitude_for_radiance_at_TOA	16-bit unsigned integer	Degrees	0, 36000 (scale factor = 0.01)	65535	65534	['nscan'] x ['npix']

Table 3 : SCARAB-L2-FLUX GEOLOCATION FIELDS variables

3.4 Geolocation Fields Notes

GEOLOCATION FIELDS Notes	
UTC_Date_Scan	Acquisition time of the first pixel of the scan. format: YYYY-MM-DDThh:mm:ss
Scan_StartTime	Time tagging of the scan start time. Julian day number plus the fraction of the day since that instant.
POSIX_Date_Scan	Date of the scan: number of seconds that have elapsed since midnight Coordinated Universal Time (UTC), 1 January 1970.
Colatitude_Nadir	Colatitude at nadir. The Colatitude is between 0 deg to 180 deg with 0 deg is north, 90 deg is equator and 180 deg is south.
Longitude_Nadir	Longitude at nadir. 0 deg is Greewich meridian.
Colatitude_for_radiance_at_surface	Colatitude of samples projected on ground. The Colatitude is between 0 deg to 180 deg with 0 deg is north, 90 deg is equator and 180 deg is south.
Longitude_for_radiance_at_surface	Longitude of samples projected on ground. 0 deg is Greewich meridian.
Colatitude_for_radiance_at_TOA	Colatitude of samples projected from top of atmosphere i.e the point where the sensor s optical axis intercepts the 20 km altitude earth envelop. The Colatitude is between 0 deg to 180 with 0 deg is north, 90 deg is equator and 180 deg is south.
Longitude_for_radiance_at_TOA	Longitude of samples projected from top of atmosphere i.e the point where the sensor s optical axis intercepts the 20 km altitude earth envelop. 0 deg is Greewich meridian.

Table 4 : SCARAB-L2-FLUX GEOLOCATION FIELDS notes

3.5 Data Fields

DATA_FIELDS						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
Scan_Gain	32-bit floating-point	NA	NA	99999.0	999999.0	['nscan'] x ['ncha']
Scan_Mode_Status	16-bit integer	NA	NA	32767	-32768	['nscan']
Scan_QF	16-bit integer	NA	8196, 24580	32767	-32768	['nscan']
Scan_Number	16-bit integer	NA	0, 1134	65535	65534	['nscan']
Along_Track_diagonal_dimension	16-bit unsigned integer	Meter	0, 20000 (scale factor =10)	65535	65534	['nscan'] x ['npix']
Across_Track_diagonal_dimension	16-bit unsigned integer	Meter	0, 20000 (scale factor =10)	65535	65534	['nscan'] x ['npix']
Pixel_Orientation	16-bit unsigned integer	Degrees	0, 36000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Viewing_Zenith_Angle	16-bit unsigned integer	Degrees	0, 9000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Viewing_Azimuth_Angle	16-bit unsigned integer	Degrees	0, 36000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Solar_Zenith_Angle	16-bit unsigned integer	Degrees	0, 9000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Relative_Azimuth_Angle	16-bit unsigned integer	Degrees	0, 36000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']

Table 5 : SCARAB-L2-FLUX DATA_FIELDS variables (continued)

DATA_FIELDS						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
Filtered_Radiance_for_ Visible_Channel	16-bit unsigned integer	W m-2 sr-1	0, 12000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Filtered_Radiance_for_ Solar_Channel	16-bit unsigned integer	W m-2 sr-1	0, 42500 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Filtered_Radiance_for_ Total_Channel	16-bit unsigned integer	W m-2 sr-1	0, 50000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Filtered_Radiance_for_ Infrared_Channel	16-bit unsigned integer	W m-2 sr-1	0, 3000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Filtered_Radiance_for_ Synthetic_LW_Channel	16-bit unsigned integer	W m-2 sr-1	0, 24000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Unfiltered_SW_radiance	16-bit unsigned integer	W m-2 sr-1	0, 42500 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
Unfiltered_LW_radiance	16-bit unsigned integer	W m-2 sr-1	0, 12000 (scale factor =0.01)	65535	65534	['nscan'] x ['npix']
QF_RD_Vis	16-bit integer	NA	-32760, 12288	32767	-32768	['nscan'] x ['npix']
QF_RD_SW	16-bit integer	NA	0, 12288	32767	-32768	['nscan'] x ['npix']
QF_RD_Total	16-bit integer	NA	-32760, 12288	32767	-32768	['nscan'] x ['npix']
QF_RD_IR	16-bit integer	NA	-32760, 12288	32767	-32768	['nscan'] x ['npix']
QF_RD_LW_Synthetic	16-bit integer	NA	-32760, 12288	32767	-32768	['nscan'] x ['npix']
Geotype	8-bit unsigned integer	NA	0.0, 20.0	255	254	['nscan'] x ['npix']
SEL_TOA_SW_Flux	32-bit floating-point	W m-2	0.0, 1000.0	99999.0	999999.0 Failed value =32767.0	['nscan'] x ['npix']
SEL_TOA_LW_Flux	32-bit floating-point	W m-2	0.0, 500.0	99999.0	999999.0 Failed value =32767.0	['nscan'] x ['npix']
SEL_Scene_Identification	8-bit unsigned integer	NA	0.0, 12.0	255	254	['nscan'] x ['npix']
SEL_Albedo	32-bit floating-point	NA	0.0, 1.0	99999.0	999999.0	['nscan'] x ['npix']

Table 5 : SCARAB-L2-FLUX DATA_FIELDS variables (continued)

DATA_FIELDS						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size**
SANN_TOA_SW_Flux (1)	32-bit floating-point	W m-2	0.0, 1000.0	99999.0	999999.0 Failed value =32767.0	['nscan'] x ['npix']
SANN_TOA_LW_Flux (1)	32-bit floating-point	W m-2	0.0, 500.0	99999.0	999999.0 Failed value =32767.0	['nscan'] x ['npix']
SANN_Albedo (1)	32-bit floating-point	NA	0.0, 1.0	99999.0	999999.0	['nscan'] x ['npix']
SANN_TOA_SW_Flux (2)	32-bit floating-point	W m-2	0.0, 1000.0	99999.0	999999.0 Failed value =32767.0	['nscan'] x ['npix']
SANN_TOA_LW_Flux (2)	32-bit floating-point	W m-2	0.0, 500.0	99999.0	999999.0 Failed value =32767.0	['nscan'] x ['npix']
SANN_Albedo (2)	32-bit floating-point	NA	0.0, 1.0	99999.0	999999.0	['nscan'] x ['npix']
SANN_SW_Scene_Identification	8-bit unsigned integer	NA	0, 5	255	254	['nscan'] x ['npix']
SANN_LW_Scene_Identification	8-bit unsigned integer	NA	0, 4	255	254	['nscan'] x ['npix']
Quality_Index	8-bit unsigned integer	NA	NA	255	254	['nscan'] x ['npix']

Table 5 : SCARAB-L2-FLUX DATA_FIELDS variables

3.6 Data Fields Notes

DATA_FIELDS notes	
Scan_Gain	Estimated gain value applied to radiance calculation for each channels in the following sequence: Visible, Solar, Total, Infrared.
Scan_Mode_Status	ScaRaB mode and status (See § Satellite modes on «Megha Tropiques L1 product definition for more details» document).
Scan_QF	Quality flag applicable to the scan line. 16-bits array (=0:good/=1:bad):, #15: scan/row quality flag validity, #14: pass type, #13: Scanning type, #12: Scan/Row error, #11: datation error, #10-8: Blank, #7 CRC Status, #6: Blank, #5-3: Payload Mode, #2-0: Satellite Mode
Scan_Number	Scan number from the first scan of the product derived from telemetry.
Along_Track_diagonal_dimension	Dimension in meters of the along track diagonal of each pixel. Exemple : [99.328, 94.144, 89.699, 85.845, 82.473, 79.503, 76.874, 74.535, 72.450, 70.586, 68.918, 67.425, 66.090, 64.898, 63.837, 62.897, 62.068, 61.344, 60.717, 60.184, 59.740, 59.381, 59.104, 58.908, 58.791, 58.752, 58.791, 58.908, 59.104, 59.381, 59.740, 60.184, 60.717, 61.344, 62.068, 62.897, 63.837, 64.898, 66.090, 67.425, 68.918, 70.586, 72.450, 74.535, 76.874, 79.503, 82.473, 85.845, 89.699, 94.144, 99.328]
Across_Track_diagonal_dimension	Dimension in meters of the across track diagonal of each pixel. Exemple : [192.152, 168.811, 150.542, 135.896, 123.932, 114.014, 105.690, 98.637, 92.612, 87.433, 82.959, 79.080, 75.708, 72.775, 70.223, 68.008, 66.092, 64.444, 63.039, 61.858, 60.884, 60.104, 59.507, 59.086, 58.835, 58.752, 58.835, 59.086, 59.507, 60.104, 60.884, 61.858, 63.039, 64.444, 66.092, 68.008, 70.223, 72.775, 75.708, 79.080, 82.959, 87.433, 92.612, 98.637, 105.690, 114.014, 123.932, 135.896, 150.542, 168.811, 192.152]
Pixel_Orientation	Pixel orientation on earth: angle between north and along track diagonal-Positive convention North to East.
Viewing_Zenith_Angle	Viewing azimuth angle at pixel center.
Solar_Zenith_Angle	Solar zenith angle at pixel center.
Relative_Azimuth_Angle	Relative azimuth angle at pixel center.
Filtered_Radiance_for_ Visible_Channel	Raw measurement of channel 1 after count conversion (calibrated radiances).
Filtered_Radiance_for_ Solar_Channel	Raw measurement of channel 2 after count conversion (calibrated radiances).
Filtered_Radiance_for_ Total_Channel	Raw measurement of channel 3 after count conversion (calibrated radiances).
Filtered_Radiance_for_ Infrared_Channel	Raw measurement of channel 4 after count conversion (calibrated radiances).
Filtered_Radiance_for_ Synthetic_LW_Channel	Raw measurement for LW synthetic channel after count conversion (calibrated radiances).

Table 6 : SCARAB-L2-FLUX DATA_FIELDS variables notes (continued)

DATA_FIELDS notes	
Unfiltered_SW_radiance	Correction for underestimation at the shortest wavelengths, domain where the instrument response diminishes : The real (unfiltered) radiance L is deduced from the filtered radiance Lf and from predetermined filtering factors Fscene, where Fscene is estimated from the spectral radiances Lscene(λ) of different scenes and for the spectral response of the SW channel (see Viollier et Raberanto, 2010 for more details).
Unfiltered_LW_radiance	Subtraction of the SW unfiltered radiance from the Total unfiltered radiance. SW unfiltered radiance is weighted by coefficient A (see Viollier et Raberanto, 2010 for more details).
QF_RD_Vis	Quality flag for samples radiances of channel 1. 16-bits array (=0:good/=1:bad): #15: Radiance validity flag , #14:blank, #13:land/sea contamination, #12:surface type, #11:ChannelON/OFF, #10:Level-0 Count Saturated, #9:Level-0 Count poor value, #8:geolocation estimation, #7:Spacecount error, #6-4:Blank, #3: interpolation quality, #2: Gainflag, #1-0: Blank
QF_RD_SW	Quality flag for samples radiances of channel 2. 16-bits array (0=good, 1=bad). #15: Radiance validity flag , #14:blank, #13:land/sea contamination, #12:surface type, #11:ChannelON/OFF, #10:Level-0 Count Saturated, #9:Level-0 Count poor value, #8:geolocation estimation, #7:Spacecount error, #6-4:Blank, #3: interpolation quality, #2: Gainflag, #1-0: Blank
QF_RD_Total	Quality flag for samples radiances of channel 3. 16-bits array (0=good, 1=bad). #15: Radiance validity flag , #14:blank, #13:land/sea contamination, #12:surface type, #11:ChannelON/OFF, #10:Level-0 Count Saturated, #9:Level-0 Count poor value, #8:geolocation estimation, #7:Spacecount error, #6-4:Blank, #3: interpolation quality, #2: Gainflag, #1-0: Blank
QF_RD_IR	Quality flag for samples radiances of channel 4. 16-bits array (0=good, 1=bad). #15: Radiance validity flag , #14:blank, #13:land/sea contamination, #12:surface type, #11:ChannelON/OFF, #10:Level-0 Count Saturated, #9:Level-0 Count poor value, #8:geolocation estimation, #7:Spacecount error, #6-4:Blank, #3: interpolation quality, #2: Gainflag, #1-0: Blank
QF_RD_LW_Synthetic	Quality flag for samples radiances of LW synthetic channel. 16-bits array (0=good, 1=bad). #15: Radiance validity flag , #14:blank, #13:land/sea contamination, #12:surface type, #11:ChannelON/OFF, #10:Level-0 Count Saturated, #9:Level-0 Count poor value, #8:geolocation estimation, #7:Spacecount error, #6-4:Blank, #3: interpolation quality, #2: Gainflag, #1-0: Blank

Table 6 : SCARAB-L2-FLUX DATA_FIELDS variables notes (continued)

<table>
<tr><th colspan="2">DATA_FIELDS notes</th></tr>
<tr><td>Geotype</td><td>Surface GeoType from IGBP.
Each ScaRaB pixels (in their specific geometry) have geotype data. These data, derived from the IGBP land cover map, have been projected in the Level 2 processing using the PSF-Weigthed method (See Gif et al. 2011). Only the most represented geotype in each ScaRaB pixel is kept in this variable.
IGBP Land Cover Legend :
1=Evergreen Needleleaf Forest ; 2=Evergreen Broadleaf Forest ; 3=Deciduous Needleleaf Forest ; 4=Deciduous Broadleaf Forest ; 5=Mixed Forest ; 6=Closed Shrublands ; 7=Open Shrublands ; 8=Woody Savannas ; 9=Savannas ; 10=Grasslands ; 11=Permanent Wetlands ; 12=Croplands ; 13=Urban and Built-Up ; 14=Cropland/Natural Vegetation Mosaic ; 15=Snow and Ice ; 16=Barren or Sparsely Vegetated ; 17=Water Bodies ; 18=Tundra ; 19=Fresh Snow ; 20= Sea Ice.</td></tr>
<tr><td>SEL_TOA_SW_Flux</td><td>The SW unfiltered radiance is converted into flux, using the view and sun angles, the scene identification and the SW Erbe bi-directional function (Suttles et al, 1988). A linear interpolation of BRDF between angles is used in order to remove the discrete nature of the angular model TOA : top of atmosphere (30km altitude as in Erbe).</td></tr>
<tr><td>SEL_TOA_LW_Flux</td><td>The LW unfiltered radiance is converted into flux, using the view angle and colatitude, the scene identification and the LW Erbe anisotropic function (Suttles et al, 1988). A linear interpolation of the anisotropic function between view angle and colatitude is also used.</td></tr>
<tr><td>SEL_Scene_Identification</td><td>Scene Id: There are 12 possible values for the whole part (1 .. 12) plus 0 as unknown scene.
<table>
<tr><th>NGEO/NCC</th><th>OCEAN</th><th>LAND</th><th>SNOW-ICE</th><th>DESERT</th><th>COAST</th></tr>
<tr><td>Clear Sky (0-5%)</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Partly Cloudy (5-50%)</td><td>6</td><td>7</td><td>0</td><td>7</td><td>8</td></tr>
<tr><td>Mostly Cloudy (50-95%)</td><td>9</td><td>10</td><td>0</td><td>10</td><td>11</td></tr>
<tr><td>Overcast (95-100%)</td><td>12</td><td>12</td><td>12</td><td>12</td><td>12</td></tr>
</table>
Scene Index (1 to 12) according to the Cloud Cover Category (NCC) and the geotype (NGEO)</td></tr>
<tr><td>SEL_Albedo</td><td>Albedo using the SEL SW flux.</td></tr>
</table>

Table 6 : SCARAB-L2-FLUX DATA_FIELDS variables notes (continued)

DATA_FIELDS notes	
SANN_TOA_SW_Flux (1)	The SW unfiltered radiance is converted into flux, using the ScaRaB Artificial Neural Network Algorithm (SANN). Method 1. This method uses the ScaRaB auxiliary narrowband channels as inputs: visible (VIS : 0.5–0.7 mm) and infrared window (IR : 10.5–12.5 mm). Because the anisotropy of the radiance field is strongly dependent on the scene content, it is expected that auxiliary (narrowband) measurements are better predictors for the radiance anisotropy. In the SW domain, the input variables are the SZA (Solar Zenith Angle), VZA (Viewing Zenith Angle), RAZ (Relative Azimuth Angle) observation angles, the VIS, IR, SW and LW radiances. For more details, see Viollier et al. (2009).
SANN_TOA_LW_Flux (1)	The LW unfiltered radiance is converted into flux, using the ScaRaB Artificial Neural Network Algorithm (SANN). Method 1. This method uses the ScaRaB auxiliary narrowband channels as inputs: visible (VIS : 0.5–0.7 mm) and infrared window (IR : 10.5–12.5 mm). In the LW domain, the input variables are VZA, and the IR, SW, and LW radiances. For more details, see Viollier et al. (2009).
SANN_Albedo (1)	Albedo using the SANN SW flux. Method 1.
SANN_TOA_SW_Flux (2)	The SW unfiltered radiance is converted into flux, using the ScaRaB Artificial Neural Network Algorithm (SANN). Method 2. This method uses the ScaRaB broadband channels as inputs. In the SW domain, the input variables are the SZA (Solar Zenith Angle), VZA (Viewing Zenith Angle), and RAZ (Relative Azimuth Angle) observation angles and the SW and LW radiances. For more details, see Viollier et al. (2009).
SANN_TOA_LW_Flux (2)	The LW unfiltered radiance is converted into flux, using the ScaRaB Artificial Neural Network Algorithm (SANN). Method 2. This method uses the ScaRaB broadband channels as inputs. In the LW domain, the input variables are the VZA (Viewing Zenith Angle), PW (Precipitable Water from ECMWF), and the SW and LW unfiltered radiances. For more details, see Viollier et al. (2009).
SANN_Albedo (2)	Albedo using the SANN SW flux. Method 2.
SANN_SW_Scene_Identification	SANNN SW Scene type [0 to 5] : ocean glint, ocean no glint, land LMTS (low to medium amount of tree/shrubs), land MHTS (medium to high amount of tree/shrubs), bright desert, dark desert.
SANN_LW_Scene_Identification	SANN LW Scene type [0 to 4]Surface type are night time scenes (all types), ocean no glint, ocean glint, land & desert.
Quality_Index	TBD

Table 6 : SCARAB-L2-FLUX DATA_FIELDS variables notes

4. Format of the product ScaRaB-L2B-FLUX

Currently, the Level 2B products (0.5 deg and 1 deg) are in the NetCDF-3 format.

The file naming convention for the L2B Megha-Tropiques products is the following:

MT1_L2B-FLUX-<L1PRODUCT>_< YYYY-MM-DDThh-mm-ss >_Z.Zdeg_V< X-XX >.nc

With :

- <L1PRODUCT> = SCA**X**L1**NN**-**X.XX** : FLUX level 2 products are derived from ScaRaB 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.
    - L1**NN** : 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).
- " Z.Zdeg " = Spatial resolution : 1.0deg or 0.5deg
- « V< X-XX > » = L2B Product version.
- «.nc » = NetCDF file suffix.

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

GLOBAL_ATTRIBUTES	File metadata
VARIABLES	All the variables

4.1 Global Attributes

GLOBAL Attributes Notes	
File_Name	Name of the file.
Product_Description	Level-2B 1deg grid-wise: The product contains one orbit of estimated top of the atmosphere (TOA) SW and LW fluxes as well as scene identifications and some input data (radiances, angles...).
North_Bounding_Latitude	30
South_Bounding_Latitude	-30
West_Bounding_Longitude	0
East_Bounding_Longitude	360
Nadir_Pixel_Size	1.0 deg
Software_Version	3.1.1
Product_Version	V0-01
Production_Center	ICARE
Production_Date	2013/07/27 20:55:56
Sensors	MT/SCARAB
Mission	Megha-Tropiques
Input_Files	Name of the L1 input file(s).
Ancillary_Files	Name of the ancillary file(s) used in L2 processing.
list_of_ECMWF_file	Name of the ECMWF file(s) used in L2 processing.
NETCDF_Version	3
Orbit_Start_Number	
Orbit_End_Number	
Orbit_Revolution_Number	
Nskip	
Skip_Start_Scan_Number	
Skip_End_Scan_Number	
SLConf	
Flip_Start_Scan_Number	
Flip_End_Scan_Number	
Man_Start_Scan_Number	
Man_End_Scan_Number	
Rad_Cal_File_Version	
Geom_Cal_File_Version	
QF_Product	
Proc_Param_File_Version	
A_coefficient	Value of the A coefficient used in the L2 processing (to compute the LW unfiltered radiances with the SW & Total unfiltered radiances).
Level1_Version	
Beginning_Acquisition_Date	2012-12-29T18:15:42
End_Acquisition_Date	2012-12-29T19:31:42
Product_Name	L2-FLUX-SCASL1A2-1.05
Icare_ID	

Table 7 : SCARAB-L2B-FLUX Global Attributes notes

4.2 Variables

VARIABLES						
Parameter & Note	**Data Type**	**Units**	**Range**	**Fill Value**	**Missing Output**	**Size*** **
Time	Double	s	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]
Pixel_time	Double	s	NA	99999.f	999999.f	[1,60,360]*
Albedo	Float	NA	0,1	99999.f	999999.f	[1,160,360]*
TOA_SW_Flux	Float	W m-2	0. , 1400.	99999.f	999999.f	[1,60,360]*
TOA_LW_Flux	Float	W m-2	0., 500.	99999.f	999999.f	[1,60,360]*
TOA_IR_Rad	Float	W m-2 sr-1	0., 40.	99999.f	999999.f	[1,60,360]*
TOA_VIS_Rad	Float	W m-2 sr-1	0.,120.	99999.f	999999.f	[1,60,360]*
Quality Index	Int	NA	TBD	2147483647	-2147483648	[1,60,360]*
Box_percent_coverage	Float	%	TBD	99999.f	999999.f	[1,60,360]*
Solar_Zenith_Angle	Float	Degrees	0., 180.	99999.f	999999.f	[1,60,360]*
Viewing_Zenith_Angle	Float	Degrees	0., 70.	99999.f	999999.f	[1,60,360]*
Relative_Azimuth_Angle	Float	Degrees	0.,360.	99999.f	999999.f	[1,60,360]*
Geotype	Byte	NA	1, 20	127b	-128b	[1,6,60,360]**
Geotype_percent_coverage	Float	%	0., 100.	99999.f	999999.f	[1,6,60,360]**
SW_Scene_Identification	Byte	NA	0,5	127b	-128b	[1,6,60,360]**
SW_Scene_Identification_ percent_coverage	Float	%	0., 100.	99999.f	999999.f	[1,6,60,360]**
LW_Scene_Identification	Byte	NA	0,4	127b	-128b	[1,6,60,360]**
LW_Scene_Identification_ percent_coverage	Float	%	0., 100.	99999.f	999999.f	[1,6,60,360]**

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

****: 2nd dimension : the 6 most represented values in the 1° x 1° or 0.5°x0.5° grid = [6]**

*****: For the 0.5deg spatial resolution files, the size of the variables should be multiplied by 2 : [120,720]**

Table 8 : SCARAB-L2B-FLUX Variables

4.3 Variables Notes

GLOBAL Attributes Notes	
Time	Unlimited dimension. The time value is the first scan time expressed in "seconds since 2011-10-12 00:00:00.00".
Latitude	Latitude of the grid center. A positive value means North.
Longitude	Longitude of the grid center.
Pixel_time	The pixel time is computed by averaging the time of all the instantaneous pixel included in the grid. The pixel time format is the same as the level 2 product but "seconds since 2011-10-12 00:00:00.000".
Albedo	Averaged Albedo from instantaneous ScaRaB pixels. Albedo were derived from SW Fluxes computed using SANN-Method-1 (ScaRaB Artificial Neural Network Algorithm) algorithm.
TOA_SW_Flux	Averaged SW Fluxes from instantaneous ScaRaB pixels. Fluxes were computed using SANN-Method-1 (ScaRaB Artificial Neural Network Algorithm) algorithm.
TOA_LW_Flux	Averaged LW Fluxes from instantaneous ScaRaB pixels. Fluxes were computed using SANN-Method-1 (ScaRaB Artificial Neural Network Algorithm) algorithm.
TOA_IR_Rad	Averaged Filtered_Radiance_for Infrared_Channel
TOA_VIS_Rad	Averaged Filtered_Radiance_for Visible_Channel
Quality Index	TBD
Box_percent_coverage	This parameter represents the coverage for each 1 deg per 1 deg grid. This percentage value can be 0 (when we don't have any ScaRaB measurements over a grid) and up over 100% (because the original ScaRaB pixels overlap).
Solar_Zenith_Angle	Solar zenith angle at pixel center.
Viewing_Zenith_Angle	Viewing zenith angle at pixel center
Relative_Azimuth_Angle	Relative azimuth angle at pixel center
Geotype	Each ScaRaB pixels (in their specific geometry) have geotype data. These data, derived from the IGBP, have been projected in the Level 2 processing. In this level-2B, they have been again reprojected on a 1 deg per 1 deg grid. Here all the information has been kept (i.e. not averaged). This parameter shows the 6 most represented geotype number found in each 1°per 1°pixel. IGBP Land Cover Legend:1=Evergreen Needleleaf Forest ; 2=Evergreen Broadleaf Forest ; 3=Deciduous Needleleaf Forest ; 4=Deciduous Broadleaf Forest ; 5=Mixed Forest ; 6=Closed Shrublands ; 7=Open Shrublands ; 8=Woody Savannas ; 9=Savannas ; 10=Grasslands ; 11=Permanent Wetlands ; 12=Croplands ; 13=Urban and Built-Up ; 14=Cropland/Natural Vegetation Mosaic ; 15=Snow and Ice ; 16=Barren or Sparsely Vegetated ; 17=Water Bodies ; 18=Tundra ; 19=Fresh Snow ; 20= Sea Ice.
Geotype_percent_coverage	For each of the 6 most represented geotype, we have the percentage coverage for one 1 deg per 1 deg grid.
SW_Scene_Identification	We have 6 different SW scenes identification (i.e. ocean no glint, ocean glint, dark desert, bright desert, low-to-moderate tree/shrub and moderate-to-high tree/shrub).
SW_Scene_Identification_percent_coverage	For each of the 6 scenes identification, we have the percentage coverage for one 1 deg per 1 deg grid.
LW_Scene_Identification	We have 5 different LW scenes identification (i.e. night, ocean no glint, ocean glint, land, desert).

LW_Scene_Identification_percent_coverage	For each of the 5 scenes identification, we have the percentage coverage for one 1 deg per 1 deg grid.

Table 9 : SCARAB-L2B-FLUX Variables notes

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