CATDS LEVEL 3

DATA PRODUCT DESCRIPTION

- Soil Moisture and Brightness Temperature -

Project code	SO-TN-CB-CA-0001
Version	3.a
Date	12/09/2014

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MODIFICATION TABLE

Issue	Version	Date	Modifications	Product version
Draft		10/11/2011	First draft	
1	a	16/04/2012	Final report Major update	v2.44
1	b	24/10/2012	Modifications of the path in the ftp website (§ where to find the products)	v2.48
1	c	23/03/13	Replacement of “P11p”, “P1”, etc. by “daily products”, “3-day products”, etc. Update with v2.52: Addition of 2 new fields in the daily product (M_Ava0 and Rfi_Prob)	v2.52
2	a	24/04/13	UDP part removed as no more distributed	v2.52
2	b	11/09/14	Add table 3 science flag	
3	a	12/09/14	Ease Grid 2	V2.7.2

ACRONYMS

Term	Definition
ADF	Auxiliary Data File
ATBD	Algorithm Theoretical Baseline Document
CATDS	Centre Aval de Traitement des Données SMOS
CESBIO	Centre d'Etudes Spatiales de la Biosphère
CCFSMF	Processor Configuration parameters for L2 Soil Moisture, full polarisation
DPM	Data Processing Model
DQX	Data Quality Index
EASE	Equal-Area Scalable Earth Grid
ECMWF	European Centre for Medium-range Weather Forecasting
FL	Flag
LSB / MSB	Lowest / Most Significant Bit*
MD	Cardioid Model
RFI	Radiometric Frequency Interference
SM	Soil Moisture
SMOS	Soil Moisture and Ocean Salinity
Tau	Vegetation Optical thickness
TB/BT	Brightness Temperature
TEC	Total Electron Content

* They are the bit position in a binary number having the lowest and greatest value respectively.

TABLE OF CONTENTS

TABLES

ILLUSTRATIONS

REFERENCES

RD 1 Algorithm Theoretical Baseline Document L3 SM: ATBD CATDS SM L3 SO-TN-CBSA-GS-0029
RD 2 Algorithm Theoretical Baseline Document L2 SM: SM ATBD SO-TN-ESL-SM-GS-0001(3.h)
RD 3 Data Processing Model SM PC2: CAT-DPM-CTSM-00013-CG_13
RD 4 Data Processing Model SM L3TB: CAT-DPM-CTL3TB-00061-CG
RD 5 Spécification Logicielle : CAT-SL-CT-00009-CG_10
RD 6 SMOS Level 1 and Auxiliary Data Products Specifications: SO-TN-IDR-GS-0005

INTRODUCTION

The ESA's (European Space Agency) SMOS (Soil Moisture and Ocean Salinity) mission, operating since November 2009, is the first satellite dedicated to measuring surface soil moisture and ocean salinity. The CNES (Centre National d'Etudes Spatiales) has developed a ground segment for the SMOS data, known as the CATDS (Centre Aval de Traitement des Données SMOS).
Operational since June 2011, it provides data referred to as level 3 products at different temporal resolutions: daily products (see Figure 1), 3 day global products insuring a complete coverage of the Earth surface, 10-day composite products, and monthly averaged products. For each day, there are at most 15 ascending (respectively descending) half-orbits. It always corresponds to the local equator crossing solar time 6:00 am (resp. 6:00 pm).

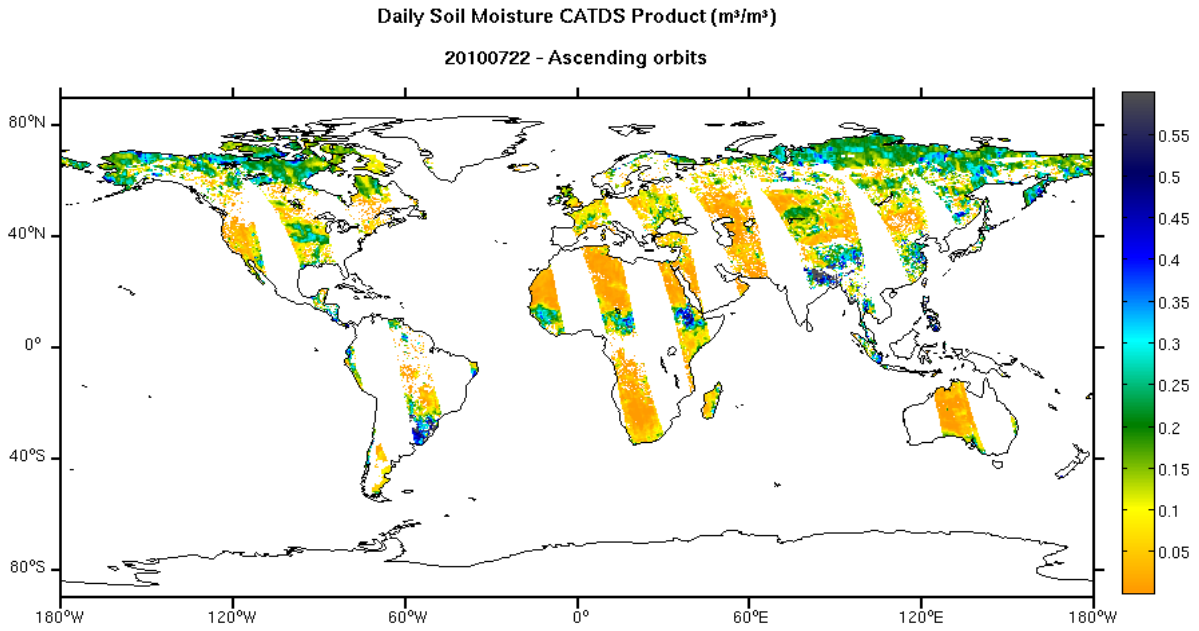

Figure 1: Daily Soil Moisture product: 22nd July 2010 (ascending orbits)

Like the AMSR-E L3 data, these products are presented in the NetCDF format on the EASE (Equal Area Scalable Earth) grid version 2 with a ~25 km cylindrical projection.
On equal-area maps, the grid is changing with latitude: a circle placed anywhere on the map always covers the same area on the globe (here 625 km^2), and the product of the scale h along a meridian and the scale k along a parallel is always equal to one. Its dimension, i.e. the aspect ratio k/h measures the distortion of the shape. The global EASE grid is characterized by h=k at a latitude of +/-30°. It insures a minimum mean angular distortion over continents.
For more information on the EASE grid see the ATBD L3SM [1].

An inversion algorithm is applied to the set of the brightness temperatures from global daily L1C product. This processing is an iterative scheme performed in order to minimize a quadratic cost function. It is exactly derived from the L2 SM algorithm in the principles. The major enhancement at CATDS concerns the use of multi-orbit retrieval: several revisits are taken into account simultaneously, one chosen in the three days before the reference day and another in the three days after.

ABOUT THE PRODUCTS

There are seven different types of Level 3 products distributed:

- the Brightness Temperature product (named L3TB),
- the one day global map of soil moisture values (named daily products),
- the global soil moisture products, 3-day global map (named 3-day products for Surface Soil Moisture),
- the dielectric constant products, 3-day global map (named 3-day products for Dielectric Constant),
- the global soil moisture products, 10-day global map (named 10-day products),
- and the global soil moisture products, monthly global map (named monthly products).

WHERE TO FIND THE PRODUCTS

All the products can be found on the CATDS website (http://catds.fr), in an organisation depending on the type of product. The Level 3 Brightness Temperature, the daily products and all the aggregated products (3-day, 10-day and monthly products) are stored following the organisation shown on figures 2 to 8.

VERSION OF THE PRODUCTS

There are several changes in the products for each update of the version, some have minor impacts, some have more important ones. This document will be updated accordingly.

This document is written for the V2.7.2.
We strongly recommend to use the last set of reprocessed data which are in the folder “RE02” on the CATDS website.

e.g: SM_OPER_MIR_CLF3MD_220130201T000000_20130228T235959_272_001_7 in this product, the version of the processor is V2.7.2.

LEVEL 3 BRIGHTNESS TEMPERATURE PRODUCT (L3TB)

PRODUCT DESCRIPTION

The Level 3 Brightness Temperature product is a **daily global polarised brightness temperature product, arranged by incidence angle values, in full polarisation.** It includes all brightness temperatures acquired that day, transformed to ground polarisation reference frame (H and V polarisation), binned and averaged into fixed angle classes. Ascending and descending orbits are processed separately and only in full polarisation.

NAMING CONVENTION

All the files are named as follows:
"SM_OPER_MIR_CDF3Tx_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n", where the conventions are very close to those of SMOS Level 2.

Table 1: Naming description of the Level 3 Brightness Temperature Product

Naming	Description
SM	in this specific case, it stands for the SMOS mission
OPER REPR	file class: indicates whether the data is produced in a nominal or a reprocessing mode
MIR	file category: MIRAS, as the name of the instrument
CDF3Tx	C = CATDS D = for daily nominal product F = for full polarisation **3T = Level 3 Brightness Temperature Products** x = "A" for ascending orbit and "D" for descending orbit
yyyymmddThhmmss	sensing start time for the data contained in the product. With yyyy, year, mm month, dd day of the month, hh hour, mm minutes and ss seconds, respectively
vvv	version number of the processor generating the product
ccc	file counter, used to make distinction among products having all other filename identifiers identical: the higher the file counter, the more recent the product
n	processing site (C-PDC=7, C-EC SM=8, C-EC OS=9)

WHERE TO FIND THESE PRODUCTS

These products can be found on the CATDS website (http://catds.fr), organised as follows: SM/GRIDDED/L3/OPER/{product type}/{year}/{day of the year}, where {product type} can be MIR_CDF3TA or MIR_CDF3TD depending on orbits type, and {day of the year} is between 001 (1st January) and 365/366 (31st December).

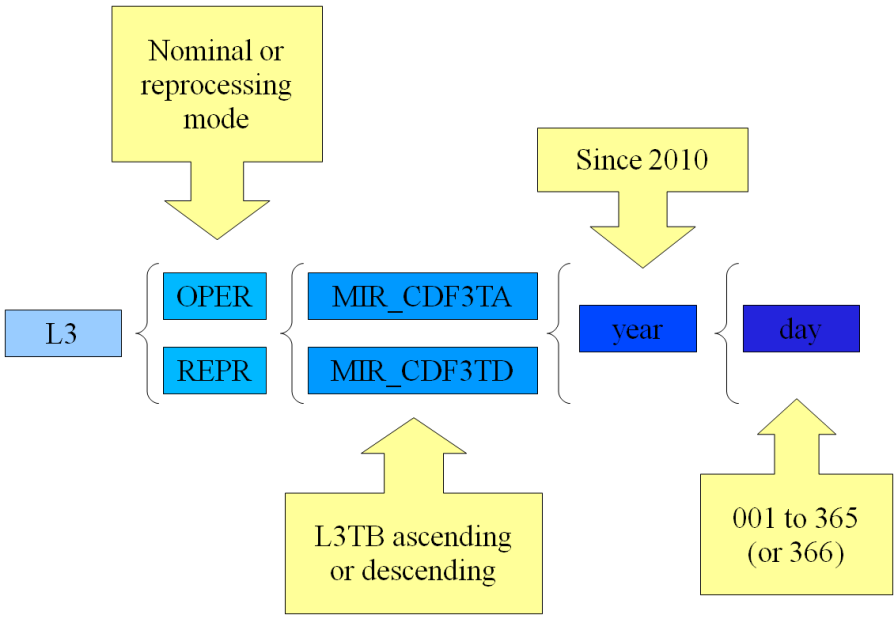

Figure 2: Organisation of the Level 3 Brightness Temperature Products

PRODUCT CONTENT

lat and lon	Geographic coordinates: Vectors of latitudes and longitudes (in degree) of the grid point. The dimensions of « lat » and « lon » are 584×1 and 1388×1 respectively, corresponding to the 584×1388 nodes of the EASE version 2, 25km cylindrical grid.
inc and dinc	Centre (inc) and width (dinc) of each class of angle (in degree), respectively. Their dimensions are 15×1.

The 2 following parameters are presented as a 584×1388 matrix.

X_Swath	Abscissa of the dwell line (in km): The sign of the value is relative to the direction of the satellite. It is positive if it is to the right and negative if it is to the left of the satellite subtrack.
Grid_Point_Mask	Flag indicating land/sea USGS content, coastline distance, and Ice content.

All the following parameters have 3 dimensions: 15×584×1388.

BT_H, BT_V, BT_3 and BT_4	Averaged brightness temperature (in Kelvin) by angle class in H-pol, V-pol, 3rd Stokes parameter and 4th Stokes parameter respectively, over current

	Earth fixed grid point, obtained by rotating the L1c data.
Pixel_Radiometric_Accuracy_H, Pixel_Radiometric_Accuracy_V, Pixel_Radiometric_Accuracy_3 and Pixel_Radiometric_Accuracy_4	Error accuracy measurement (in Kelvin) associated to the averaged brightness temperature by class of angle presented in the previous field, extracted in the direction of the pixel.
Pixel_BT_Standard_Deviation_H, Pixel_BT_Standard_Deviation_V, Pixel_BT_Standard_Deviation_3 and Pixel_BT_Standard_Deviation_4	Brightness temperature standard deviation (in Kelvin) by class of angle.
Incidence_Angle	Incidence angle value (in degree) by class of angle corresponding to the measured brightness temperature value over current Earth fixed grid point.
Azimuth_Angle	Azimuth angle value (in degree) by class of angle corresponding to the measured brightness temperature value over current Earth fixed grid point.
Footprint_Axis1 and Footprint_Axis2	Elliptical averaged footprint major (and minor respectively) semi-axis value by class of angle.
Xi and Eta	Averaged direction cosine for Xi and Eta, respectively, by angle class. Xi and Eta referred to the antenna frame.
Nviews	Number of brightness temperature views used to compute angle class averages.
Days, UTC_Seconds and UTC_Microseconds	Measurement acquisition time: UTC Time at which the averaged brightness temperature was taken, in EE CFI transport time format in days, seconds and microseconds, respectively.

LEVEL 3 SOIL MOISTURE DAILY PRODUCT

PRODUCT DESCRIPTION

This product is the one day product, and contains **filtered data**. The best estimation of soil moisture and dielectric constant are selected (based on the minimisation of the DQX) for each node when several multi-orbit retrievals are available for a given day. A detection of particular events is also performed in order to flag the data aggregation of SMOS orbits. Ascending and descending orbits are still processed separately.
All the aggregated products (3-day, 10-day and monthly products) are based on these daily maps.

NAMING CONVENTION

All the files are named as follows:
"SM_OPER_MIR_CLF31x_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n", where the conventions are very close to those of SMOS Level 2.

Table 2: Naming description of the Level 3 Soil Moisture Daily Product

Naming	Description
SM	in this specific case, it stands for the SMOS mission
OPER REPR	file class: indicates whether the data is produced in a nominal or a reprocessing mode
MIR	file category: MIRAS, as the name of the instrument
CLF31x	C = CATDS L = "land data" F = for full polarisation **31: "3" for L3 product and "1" for 1 day coverage. For the Soil Moisture, it means 1 day global map (L3 daily product)** x = "A" for ascending orbit and "D" for descending orbit
yyyymmddThhmmss	sensing start time for the data contained in the product. With yyyy, year, mm month, dd day of the month, hh hour, mm minutes and ss seconds, respectively
vvv	version number of the processor generating the product
ccc	file counter, used to make distinction among products having all other filename identifiers identical: the higher the file counter, the more recent the product
n	processing site (C-PDC=7, C-EC SM=8, C-EC OS=9)

WHERE TO FIND THESE PRODUCTS

These products can be found on the CATDS website (http://catds.fr), organised as follows: SM/GRIDDED/L3SM/OPER/{product type}/{year}/{day of the year}, where {product type} can be MIR_CLF31A or MIR_CLF31D depending on orbits type, and {day of the year} is between 001 (1st January) and 365/366 (31st December).

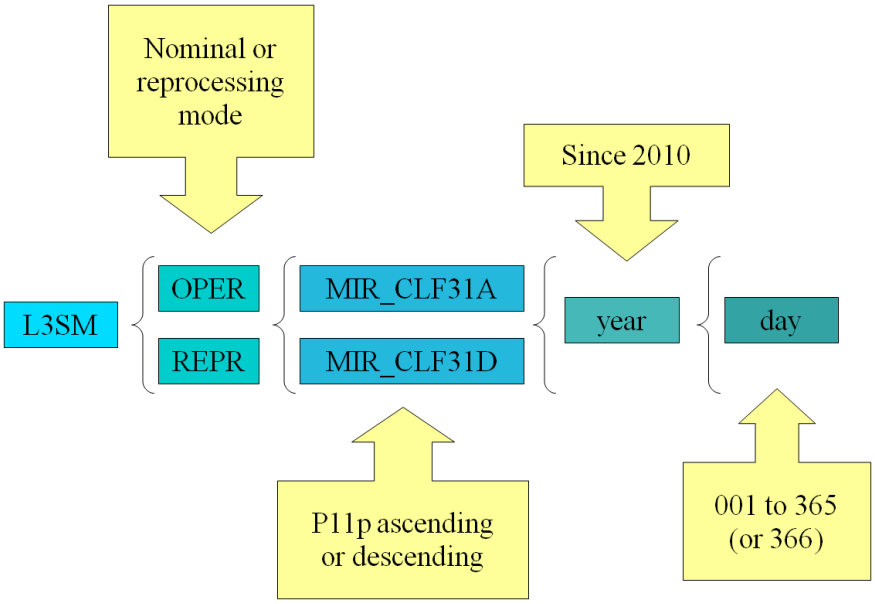

Figure 3: Organisation of the Level 3 Soil Moisture Daily Products

PRODUCT CONTENT

lat and lon	Geographic coordinates: Vectors of latitudes and longitudes (in degree) of the grid point. The dimensions of « lat » and « lon » are 584×1 and 1388×1 respectively, corresponding to the 584×1388 nodes of the EASE version 2, 25km cylindrical grid.

Almost all following parameters are presented as a 584×1388 matrix.

Mean_Acq_Time_Days and Mean_Acq_Time_Seconds	Time of measurement: Day and second of mean acquisition time, per DGG node, corresponding to the selected *soil moisture* value. Day count begins on the 1st of January 2000 AD, seconds and microseconds are relative to the current day in UTC.
Mean_Acq_Time_Days2 and Mean_Acq_Time_Seconds2	Time of measurement: Day and the second of mean acquisition time, per DGG node, corresponding to the selected *dielectric constant* value. The time follows EE CFI time format: Days count begins on the 1st of January 2000 AD, seconds are relative to time for current day in UTC.
Soil_Moisture and Soil_Moisture_Dqx	This is the retrieved soil moisture value (in $m^3.m^{-3}$), and its associated data quality index.
Optical_Thickness_Nad and Optical_Thickness_Nad_Dqx	Vegetation opacity: the nadir optical thickness estimate for vegetation layer (in neper), and its

	associated data quality index, corresponding to the selected *soil moisture* values.
Optical_Thickness_Nad2 and Optical_Thickness_Nad2_Dqx	Vegetation opacity: the nadir optical thickness estimate for vegetation layer (in neper), and its associated quality index, corresponding to the selected *dielectric constant* values.
Dielectric_Const and Dielectric_Const_Dqx	Dielectric constant: Real and imaginary parts of the dielectric constant retrieved from the cardioid model (MD) in Fm^{-1}, and their associated data quality index. *The dimensions of this parameter are 584×1388×2 (for real and imaginary parts).*
Hr and Hr_Dqx	Roughness: the retrieved roughness parameter and its associated data quality index.
Scattering_Albedo_H, Diff_Albedos & Dqx	Spare, not retrieved at the moment.
Surface_Temperature and Surface_Temperature_Dqx	Surface temperature: the retrieved surface temperature (in Kelvin), and its associated quality index corresponding to the selected soil moisture values.
Temp_STL1 and Temp_SKT	ECMWF temperatures for the 0-7 cm soil layer and the soil surface, respectively, corresponding to the selected soil moisture values.
S_Tree_1	Permanent surface category: This represents the considered retrieval cases of the decision tree, i.e. the main surface cover type (see ATBD L2SM)*: 1. all open water 2. heterogeneous open water 3. strong topography pollution 4. soft topography pollution 5. all wet snow 6. all mixed snow 7. wet snow pollution 8. mixed snow pollution 9. all frost 10. frost pollution 11. forest cover 12. soil cover 13. all wetlands 14. all barren 15. all ice

* Only 11 and 12 are of interest for soil moisture retrieval.

16. all urban
17. heterogeneous

Tb_Asl_Theta_B_H, Tb_Asl_Theta_B_H_Dqx, Tb_Asl_Theta_B_V and Tb_Asl_Theta_B_V_Dqx	Brightness temperature At Surface Level: This is the brightness temperature in Kelvin (corrected for sky/atmosphere contribution and provided at the Earth reference frame) computed using the forward model at the specific incidence angle theta_B of 42.5°, for H and V polarisations, respectively, and their associated data quality index. They correspond to the selected soil moisture values.
Tb_Toa_Theta_B_X, Tb_Toa_Theta_B_X_Dqx, Tb_Toa_Theta_B_Y and Tb_Toa_Theta_B_Y_Dqx	Brightness temperature at the Top Of the Atmosphere: This is the brightness temperature in Kelvin (corrected for sky/atmosphere contribution and transferred to antenna reference frame using the Faraday and geometric rotation) computed from the forward models At the Top Of the Atmosphere level at the specific incidence angle theta_B of 42.5°, for X and Y polarisation (at the antenna frame), respectively, and their associated data quality index. They correspond to the selected soil moisture values.*
Science_Flags	Flags: They are the flags associated with the soil moisture value (see table after for more details). This parameter is coded in 32 bits: the reported value has to be converted to a binary number
Fno and Ffo	Fractions: the nominal (i.e. low vegetation and sand) and the forest radiometric fractions, respectively, for each node corresponding to the selected soil moisture values.
M_Ava0	Total number of brightness temperature measurements acquired for each nodes, corresponding to the selected soil moisture values.
M_Ava	Total number of useful measurements: Number of brightness temperature measurements actually considered for retrieval after initial filtering, corresponding to the selected soil moisture values.
N_Rfi_X and N_Rfi_Y	Number of discarded views due to RFI: Number of discarded brightness temperatures due to suspected RFI in the X and Y polarisations

* Note, that in some products (especially products processed with a version lower than vvv=240) the X/Y have been replaced with H/V in the Tb_Toa field name by error. In either case Tb_Toa is always given in the antenna reference frame (X/Y).

	respectively, corresponding to the selected soil moisture values.
Min_Soil_Moisture, Max_Soil_Moisture, Min_Soil_Moisture_Dqx and Max_Soil_Moisture_Dqx	As several soil moisture data (and thus data quality indexes) are available per node and per day, the minimum and the maximum values are reported here.
Soil_Moisture_Init_Val and Soil_Moisture_Init_Std	Initial value and the standard deviation for free parameter soil moisture, corresponding to the selected soil moisture values.
Gqx and Gqx2	Global quality indexes associated with the soil moisture values and the dielectric constant values, respectively.
Event_Flags	Flag about event detection: This parameter is coded in 16 bits, using the following convention: – 00 Not verified – 01 Possible – 10 Sure – 11 Not processed The first two ones (FL_EV_Frost_Soil) are raised to show the possible existence of ground frozen, and the 14 other ones are spare bits padded with 0. e.g.: “0000000000000010” (=2 in a decimal system) means that frost has been clearly detected on the ground.
Rfi_Prob	RFI probability: total number of RFI detected on a large period divided by the total number of brightness temperature measurements acquired on the same period.

Table 3: Science Flag description; is an integer that has to be converted to 32-bit sequence

Bit	***Tag name***	***Type***
1 (LSB)	FL_Non_Nom	This flag is set to 1 if any of the flags in Bits 3 to 10 and 12 to 20 in this table is raised.
2	FL_Scene_T	This flag is set to 1 when either FL_Non_Nom or FL_Nominal is raised.
3	FL_Barren	This flag is set to 1 when the radiometric fraction of Barren surface is above the threshold TH_SCENE_FEB (=5.00%).
4	FL_Topo_S	This flag is set to 1 if the radiometric fraction of Strong Topography surface type is above the threshold TH_SCENE_FTS (=5.00%).
5	FL_Topo_M	This flag is set to 1 if the radiometric fraction of Moderate Topography is above the threshold TH_SCENE_FTM (=10.00%).
6	FL_OW	This flag is set to 1 if the radiometric fraction of Open Water surface type is above the threshold TH_SCENE_FOW (=5.00%).
7	FL_Snow_Mix	This flag is set to 1 if the radiometric fraction of Mixed Snow surface type is above the threshold TH_SCENE_FSN (=5.00%).
8	FL_Snow_Wet	This flag is set to 1 if the radiometric fraction of Wet Snow surface type is above the threshold TH_SCENE_FSW (=5.00%).
9	FL_Snow_Dry	This flag is set to 1 if the radiometric fraction of Dry Snow surface type is above the threshold TH_SCENE_FSD (=5.00%).
10	FL_Forest	This flag is set to 1 if the radiometric fraction of Forest surface type is above the threshold TH_SCENE_FFO (=10.00%).
11	FL_Nominal	This flag is set to 1 if the radiometric fraction of Nominal (vegetated soil + sand) surface type is above the threshold TH_SCENE_FNO (=10.00%).
12	FL_Frost	This flag is set to 1 if the radiometric fraction of Frost surface type is above the threshold TH_SCENE_FRZ (=5.00%).
13	FL_Ice	This flag is set to 1 if the radiometric fraction of Total Ice surface type is above the threshold TH_SCENE_FTI (=5.00%).
14	FL_Wetlands	This flag is set to 1 if the radiometric fraction of Wetlands surface type is above the threshold TH_SCENE_FWL (=5.00%).
15	FL_Flood_Prob	This flag is set to 1 if the sum of the ECMWF value for Large_Scale_Precipitation and Convective_Precipitation (in AUX_ECMWF_) is above the threshold TH_FLOOD (=20mm/h).
16	FL_Urban_Low	This flag is set to 1 if the radiometric fraction of

		Urban surface type is above the threshold TH_SCENE_FUL (=10.00%).
17	FL_Urban_High	This flag is set to 1 when the radiometric fraction of Urban surface type is above the threshold TH_SCENE_FUH (=30.00%).
18	FL_Sand	This flag is set to 1 if the mean sand fraction is above the threshold TH_Sand (=95.00%). The mean sand fraction is computed as the non-weighted average of the sand percentage from the Soil Properties product.
19	FL_Sea_Ice	This flag is set to 1 if the radiometric fraction of Sea Ice surface type, which is determined by the sea ice cover of the ECMWF database, is above the threshold TH_Sea_Ice (=20.00%).
20	FL_Coast	This flag is set to 1 when the Wetlands fraction in at least one DFFG cell in the working area is above zero and the Land Cover Class reports an intertidal area.
21	FL_Occur_T	This flag is set to 1 if any of the FL_Litter, FL_PR, or FL_Intercep is raised, indicating the occurrence of a special event during the retrieval.
22	FL_Litter	This flag is set to 1 if the mean litter opacity is above the threshold TH_TAU_Litter (=0.10 neper).
23	FL_PR	This flag is set to 1 if the interception index is below the threshold TH_PR (=0.026).
24	FL_Intercep	This flag is set to 1 if the ECMWF parameter Skin_Reservoir_Content (SCR) is above the threshold TH_Intercep (=0.02m).
25	FL_External	This flag is set to 1 if one of the flags FL_Rain, FL_TEC is raised or N_Sky > 0.
26	FL_Rain	This flag is set to 1 if the sum of the ECMWF parameters Large_Scale_Precipitation and Convective_Precipitation (LSP and CP) is above the threshold TH_RAIN (=10.00mm/h).
27	FL_TEC	This flag is raised if the TEC (Total Electric Constant) content of the first snapshot contributing to the brightness temperature measurements to the last retrieval is above the the threshold TH_TEC (=95.00*10^16 electrons/m²). If no retrieval has been attempted, then the brightness temperatures are those used to compute MVAL0.
28	FL_TAU_FO	This flag is set to 1 if the mean forest opacity is above the threshold TH_SCENE_TAU_FO (=1,0 neper).
29	FL_WINTER_FOREST	Flag indicating that the forest case has been selected by the decision tree despite the fact that the mean fraction is mainly in the FNO case.
30	FL_DUAL_RETR_FNO_FFO	Flag indicating the dual retrieval is performed on the FNO and FFO fractions.

31	Spare bit	
32	Spare bit	

3-DAY PRODUCT FOR SURFACE SOIL MOISTURE

PRODUCT DESCRIPTION

The 3-day global product of soil moisture is an aggregation of daily global maps of soil moisture and its associated parameters over a 3 day moving window. The whole Earth's surface is covered in this 3-day product. This product is based on the best soil moisture retrievals (minimisation of the DQX). The distinction between ascending and descending orbits is kept.

NAMING CONVENTION

All the files are named as follows:
"SM_OPER_MIR_CLF33x_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n", where the conventions are very close to those of SMOS Level 2.

Table 4: Naming description of the 3-day product for Surface Soil Moisture

Naming	Description
SM	in this specific case, it stands for the SMOS mission
OPER REPR	file class: indicates whether the data is produced in a nominal or a reprocessing mode
MIR	file category: MIRAS, as the name of the instrument
CLF33x	C = CATDS L = "land data" F = for full polarisation **33: for SM, it means 3 days global map (3-day product for Surface Soil Moisture)** x = "A" for ascending orbit and "D" for descending orbit
yyyymmddThhmmss	sensing start time for the data contained in the product. With yyyy, year, mm month, dd day of the month, hh hour, mm minutes and ss seconds, respectively
vvv	version number of the processor generating the product
ccc	file counter, used to make distinction among products having all other filename identifiers identical: the higher the file counter, the more recent the product
n	processing site (C-PDC=7, C-EC SM=8, C-EC OS=9)

WHERE TO FIND THESE PRODUCTS

These products can be found on the CATDS website (http://catds.fr), organised as follows: SM/GRIDDED/L3SM/OPER/{product type}/{year}/{month}, where {product type} can be MIR_CLF33A or MIR_CLF33D depending on orbits type.

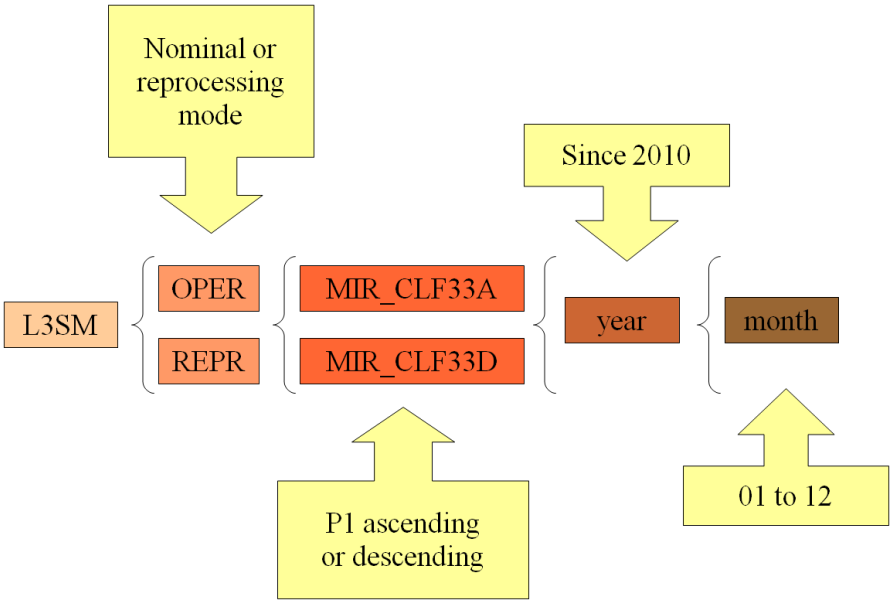

Figure 4: Organisation of the 3-day products for Surface Soil Moisture

PRODUCT CONTENT

lat and lon	Geographic coordinates: Vectors of latitudes and longitudes (in degree) of the grid point. The dimensions of « lat » and « lon » are 584×1 and 1388×1 respectively, corresponding to the 584×1388 nodes of the EASE version 2, 25km cylindrical grid.

Almost all following parameters are presented as a 584×1388 matrix.

Nb_Sm	Number of available soil moisture estimates obtained over the 3 day period: It could vary from 0 to 3 if the point is successfully retrieved over the 3 days.
Soil_Moisture and Soil_Moisture_Dqx	Selected soil moisture value for the period: The selected soil moisture value (in $m^3.m^{-3}$) with the smallest Dqx is kept between all the values (maximum 3) available during the period for one DGG, and its associated data quality index.
Nominal_Fraction	It is the nominal fraction associated with the selected soil moisture values.
Optical_Thickness_Nad and Optical_Thickness_Nad_Dqx	Vegetation opacity: Once the soil moisture value has been chosen between the available retrievals, the associated nadir optical thickness estimated for the vegetation layer (in neper), and its associated quality index are used to fill up these fields.
Science_Flags	Flags: They are the flags associated with the selected soil

	moisture values (see 0for more details).
Event_Flags	Flag about event detection: This parameter is coded in 16 bits, using the following convention: – 00 Not verified – 01 Possible – 10 Sure – 11 Not processed The first two ones (FL_EV_Frost_Soil) are raised to show the possible existence of ground frozen, and the 14 other ones are spare bits padded with 0. e.g.: "0000000000000010" (=2 in a decimal system) means that frost has been clearly detected on the ground.
Gqx	Global quality index associated with the selected soil moisture value.
Mean_Acq_Time_Days and Mean_Acq_Time_Seconds	Time of measurement: Day and second of mean acquisition time, per DGG node, corresponding to the selected soil moisture value. Day count begins on the 1st of January 2000 AD, seconds and microseconds are relative to the current day in UTC.
Dielectric_Const and Dielectric_Const_Dqx	Dielectric constant: Real and imaginary parts of the dielectric constant retrieved from the cardioid model (MD) in Fm^{-1}, and their associated data quality index. *The dimensions of this parameter are 584×1388×2 (for real and imaginary parts).*
list_of_data_set	This is the list of the daily products used in the processing.

3-DAY PRODUCT FOR DIELECTRIC CONSTANT

PRODUCT DESCRIPTION

The 3-day global product of the dielectric constant is an aggregation of daily maps of dielectric constant and its associated parameters over 3 days moving window. The whole Earth's surface is covered in this 3-day product. This product is based on the best dielectric constant retrievals (minimisation of the DQX). The distinction between ascending and descending orbits is kept.

NAMING CONVENTION

All the files are named as follows:
"SM_OPER_MIR_CLF3Ex_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n", where the conventions are very close to those of SMOS Level 2.

Table 5: Naming description of the 3-day product for Dielectric Constant

Naming	Description
SM	in this specific case, it stands for the SMOS mission
OPER REPR	file class: indicates whether the data is produced in a nominal or a reprocessing mode
MIR	file category: MIRAS, as the name of the instrument
CLF3Ex	C = CATDS L = "land data" F = for full polarisation **3E: it means dielectric constant map (3-day product for Dielectric Constant)** x = "A" for ascending orbit and "D" for descending orbit
yyyymmddThhmmss	sensing start time for the data contained in the product. With yyyy, year, mm month, dd day of the month, hh hour, mm minutes and ss seconds, respectively
vvv	version number of the processor generating the product
ccc	file counter, used to make distinction among products having all other filename identifiers identical: the higher the file counter, the more recent the product
n	processing site (C-PDC=7, C-EC SM=8, C-EC OS=9)

WHERE TO FIND THESE PRODUCTS

These products can be found on the CATDS website (http://catds.fr), organised as follows: SM/GRIDDED/L3SM/OPER/{product type}/{year}/{month}, where {product type} can be MIR_CLF3EA or MIR_CLF3ED depending on orbits type.

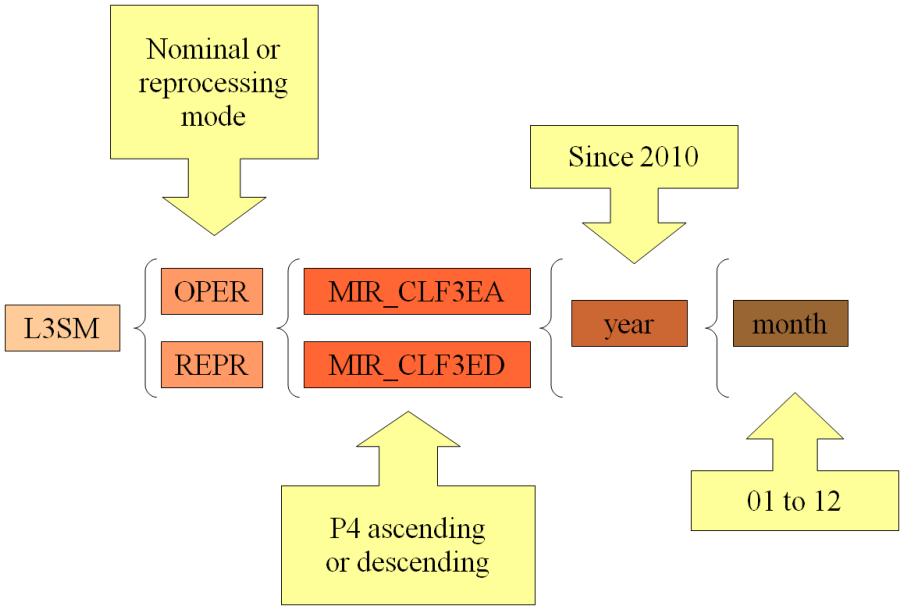

Figure 5: Organisation of the 3-day products for Dielectric Constant

PRODUCT CONTENT

lat and lon	Geographic coordinates: Vectors of latitudes and longitudes (in degree) of the grid point. The dimensions of « lat » and « lon » are 584×1 and 1388×1 respectively, corresponding to the 584×1388 nodes of the EASE version 2, 25km cylindrical grid.

Almost all following parameters are presented as a 584×1388 matrix.

Dielectric_Const and Dielectric_Const_Dqx	Dielectric constant: Real and imaginary parts of the dielectric constant retrieved from the cardioid model (MD) and respectively a non cardioid model (Non MD) in Fm^{-1}, and their associated data quality index. *The dimensions of this parameter are 584×1388×2 (for real and imaginary parts).* Between all the values (maximum 3) available for one DGG, the value with the smallest Dqx is kept in the 3-day product for Dielectric Constant with its associated Dqx.
Dielect_Const_Module and Dielect_Const_Module_Dqx	This is the module of dielectric constant and the module of Dqx of dielectric constant.
Optical_Thickness_Nad and Optical_Thickness_Nad_Dqx	Vegetation opacity: Once the dielectric constant value has been selected between the available retrievals, the associated optical thickness estimated for vegetation layer (in neper), and its associated quality index are reported (namely Optical_Thickness_Nad2 and

	Optical_Thickness_Nad_Dqx2 from the daily product).
Mean_Acq_Time_Days and Mean_Acq_Time_Seconds	Time of measurement: Day and second of mean acquisition time, per DGG node, corresponding to the selected dielectric constant values. Day count begins on the 1st of January 2000 AD, seconds and microseconds are relative to the current day in UTC. (Mean_Acq_Time_Days2 and Mean_Acq_Time_Seconds2 in the daily product).
Event_Flags	Flag about event detection: This parameter is coded in 16 bits, using the following convention: – 00 Not verified – 01 Possible – 10 Sure – 11 Not processed The first two ones (FL_EV_Frost_Soil) are raised to show the possible existence of ground frozen, and the 14 other ones are spare bits padded with 0. e.g.: "0000000000000010" (=2 in a decimal system) means that frost has been clearly detected on the ground.
Gqx	This is the global quality index associated with the selected dielectric constant value (Gqx2 in the daily product).
list_of_data_set	This is the list of the daily products used in the processing.

10-DAY PRODUCT

PRODUCT DESCRIPTION

The 10-day global product is a 10-days aggregation of daily global maps. Three products are obtained per month whereof the last one has a duration of 8 to 11 days. Each product contains the median, minimum and maximum values of soil moisture and its associated parameters over the 10 days. The distinction between ascending and descending orbits is kept.

NAMING CONVENTION

All the files are named as follows:
"SM_OPER_MIR_CLF3Dx_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n", where the conventions are very close to those of SMOS Level 2.

Table 6: Naming description of the 10-day product

Naming	Description
SM	in this specific case, it stands for the SMOS mission
OPER REPR	file class: indicates whether the data is produced in a nominal or a reprocessing mode
MIR	file category: MIRAS, as the name of the instrument
CLF3Dx	C = CATDS L = "land data" F = for full polarisation **3D: for SM, it means 10-days global map (10-day product)** x = "A" for ascending orbit and "D" for descending orbit
yyyymmddThhmmss	sensing start time for the data contained in the product. With yyyy, year, mm month, dd day of the month, hh hour, mm minutes and ss seconds, respectively
vvv	version number of the processor generating the product
ccc	file counter, used to make distinction among products having all other filename identifiers identical: the higher the file counter, the more recent the product
n	processing site (C-PDC=7, C-EC SM=8, C-EC OS=9)

WHERE TO FIND THESE PRODUCTS

These products can be found on the CATDS website (http://catds.fr), organised as follows: SM/GRIDDED/L3SM/OPER/{product type}/{year}/{month}, where {product type} can be MIR_CLF3DA or MIR_CLF3DD depending on orbits type.

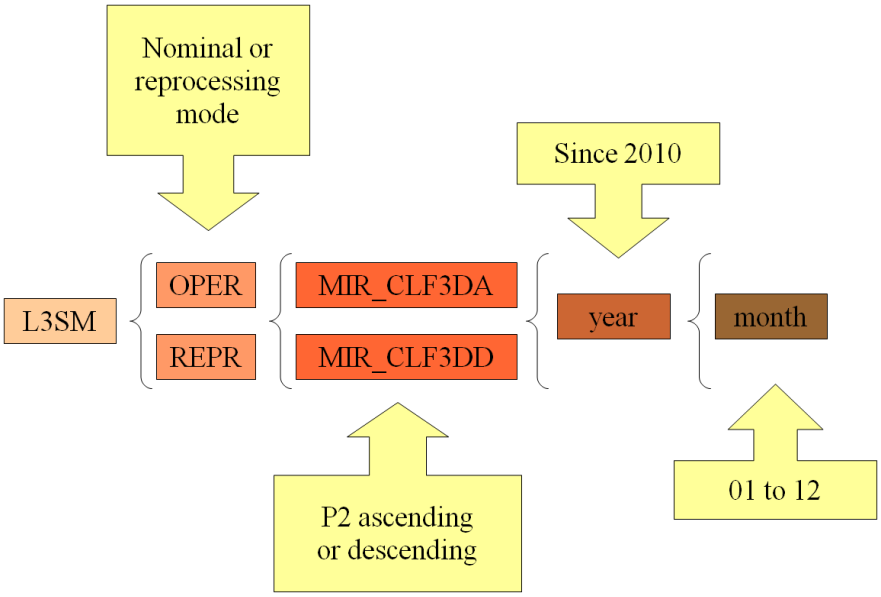

Figure 6: Organisation of the 10-day products

PRODUCT CONTENT

lat and lon	Geographic coordinates: Vectors of latitudes and longitudes (in degree) of the grid point. The dimensions of « lat » and « lon » are 584×1 and 1388×1 respectively, corresponding to the 584×1388 nodes of the EASE version 2, 25km cylindrical grid.

The following parameters are presented as a 584×1388 matrix.

Nb_Sm	Number of available soil moisture estimates obtained over the 10-day period: It could vary from 0 to 11 (last 10 days can be 8 to 11 days) if the point is successfully retrieved for the 10 days.
Gqx	This is the global quality index.

For this product, in addition of the two dimensions (lat×lon), there is a third one (med_min_max = 3) corresponding to the median, the minimum, and the maximum soil moisture values obtained over the 10-day period.

Soil_Moisture and Soil_Moisture_Dqx	This is the medain, minimum and maximum value of soil moisture (in $m^3.m^{-3}$) retrieved over the 10 days, and its associated data quality index.
Mean_Acq_Time_Days and Mean_Acq_Time_Seconds	Time of measurement: Day and second of mean acquisition time, per DGG node. Day count begins on the 1st of January 2000 AD, seconds and microseconds are relative to the

	current day in UTC.
Optical_Thickness_Nad and Optical_Thickness_Nad_Dqx	Vegetation opacity: It is the nadir optical thickness estimate for vegetation layer (in neper), and its associated data quality index.
Hr and Hr_Dqx	Roughness: It is the retrieved roughness and its associated quality index.
Scattering_Albedo_H, Diff_Albedos & Dqx	Spare, not retrieved at the moment.
Nominal_Fraction	Nominal fraction.
Science_Flags	They are the flags associated with the median, the minimum and the maximum values of soil moisture (Table 3, see § 0 for more details).
list_of_data_set	This is the list of the daily products used in the processing.

MONTHLY PRODUCT

PRODUCT DESCRIPTION

The monthly global product of soil moisture is a monthly average of daily global maps. It provides a mean retrieved soil moisture weighted by their accuracy (DQX), vegetation optical thickness (separated for lower vegetation and forest), RFI statistics over a month, without taking into account estimations affected by detected event (only frost for the moment) in the daily product. It can be useful for climate monitoring. The distinction between ascending and descending orbits is kept.

NAMING CONVENTION

All the files are named as follows:
"SM_OPER_MIR_CLF3Mx_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n", where the conventions are very close to those of SMOS Level 2.

Table 7: Naming description of the monthly product

Naming	Description
SM	in this specific case, it stands for the SMOS mission
OPER REPR	file class: indicates whether the data is produced in a nominal or a reprocessing mode
MIR	file category: MIRAS, as the name of the instrument
CLF3Mx	C = CATDS L = "land data" F = for full polarisation **3M: for SM, it means monthly global map (L3 monthly product)** x = "A" for ascending orbit and "D" for descending orbit
yyyymmddThhmmss	sensing start time for the data contained in the product. With yyyy, year, mm month, dd day of the month, hh hour, mm minutes and ss seconds, respectively
vvv	version number of the processor generating the product
ccc	file counter, used to make distinction among products having all other filename identifiers identical: the higher the file counter, the more recent the product
n	processing site (C-PDC=7, C-EC SM=8, C-EC OS=9)

WHERE TO FIND THESE PRODUCTS

These products can be found on the CATDS website (http://catds.fr), organised as follows: SM/GRIDDED/L3SM/OPER/{product type}/{year}/{month}, where {product type} can be MIR_CLF3MA or MIR_CLF3MD depending on orbits type.

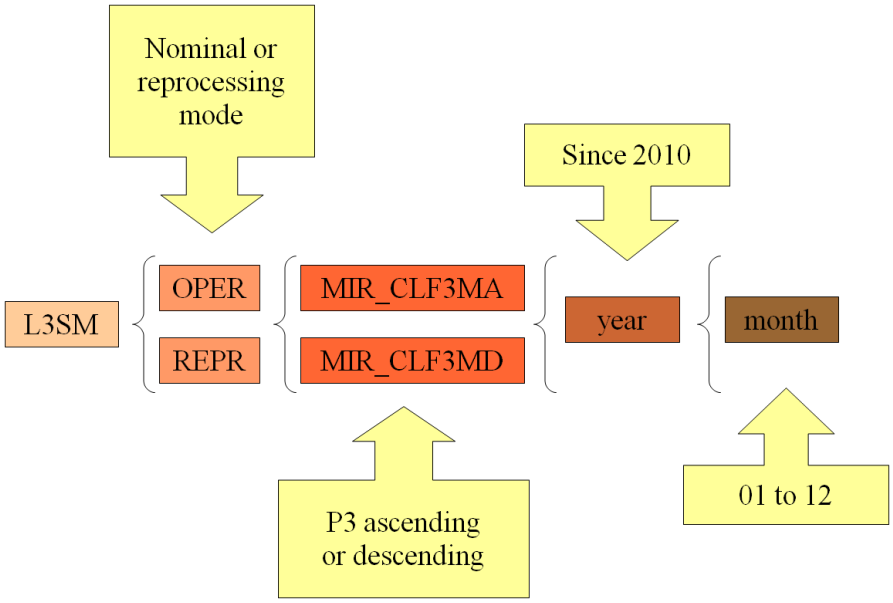

Figure 7: Organisation of the monthly products

PRODUCT CONTENT

lat and lon	Geographic coordinates: Vectors of latitudes and longitudes (in degree) of the grid point. The dimensions of « lat » and « lon » are 584×1 and 1388×1 respectively, corresponding to the 584×1388 nodes of the EASE version 2, 25km cylindrical grid.

Almost all following parameters are presented as a 584×1388 matrix.

Nb_Sm	Number of available soil moisture estimates obtained over the month: It could vary from 0 to the number of days in the considered month if the point is successfully retrieved over the month.
Soil_Moisture, Soil_Moisture_Dqx, and Var_Soil_Moisture	This is a mean monthly soil moisture value (in $m^3.m^{-3}$) weighted by DQX, which does not take into account the estimations affected by an event in the daily product (it corresponds only to data whose Event_Flags is equal to zero), and its associated quadratic mean quality index and variance.
Optical_Thickness_Lv, Optical_Thickness_Lv_Dqx, and Var_Optical_Thickness_Lv	This is a mean monthly nadir optical thickness value weighted by DQX, for lower vegetation (in neper) which does not take into account the estimations affected by an event in the daily product, and its associated quadratic mean quality index and variance.
Optical_Thickness_Fo,	This is a mean monthly nadir optical thickness value

Optical_Thickness_Fo_Dqx, and Var_Optical_Thickness_Fo	weighted by DQX, for forest (in neper) which does not take into account the estimations affected by an event in the daily product, and its associated quadratic mean quality index and variance.
Nominal_Fraction and Forest_Fraction	The mean nominal and forest fractions when the model is nominal or forest, respectively. The mean is weighted by the soil moisture dqx value.
Gqx	This is the mean global quality index where soil moisture is available.
Rfi_X_Frac and Rfi_Y_Frac	They are the fractions of SMOS TB measurements contaminated by RFI in X and Y polarisations.
list_of_data_set	This is the list of the daily products used in the processing.