Project code SO-TN-CB-GS-092

Version 1.0

Date 2020/10/10

Algorithm Theoretical Basis Document

(ATBD)

for the

SMOS Level 4
Root Zone Soil Moisture

	Name	Date and signature
Written by :	Ahmad Al Bitar (corresponding author) *ahmad.albitar@cesbio.cnes.fr* Ali Mahmoodi	

Document status Sheet

ver. / Rév.	Date	Pages	Changes	Visa
0.1	2020/03/15	26	Initial release	
0.2	2020/07/12	26	update of the interface with CATDS	
1.0	2020/09/20	26	Version 1.0, first release	

Initial Distribution list

CESBIO	
Ahmad Al Bitar	AA
Ali Mahmoudi	AM
Yann Kerr	YhK
François Cabot	FC

CNES	
Olivier Vandermarcq	Ov
Philippe Maisongrand	PM
Selma Cherchali	SC
IFREMER	
Stephane Tarot	ST
Jerome Detoc	JD

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Acronyms

CATDS	Centre Aval du Traitement des Données SMOS
CESBIO	Centre D'Etudes Spatial de la Biosphère
CNES	Centre National d'Etudes Spatiales
ESA	European Space Agency
NDVI	Normalized Difference Vegetation Index
ETO	Potential Evapotranspiration
SMAP	Soil Moisture Active Passive
SMOS	Soil Moisture and Ocean Salinity
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
RZSM	Root Zone Soil Moisture
SM	Soil Moisture
SSM	Surface Soil Moisture
CNES	Centre National d'Etudes Spatiales
CDTI	Centre for the Development of Industrial Technology
TB	Brightness Temperatures
FAO	United Nations Food and Agriculture Organisation

Table of content

1 AIM OF THE DOCUMENT

The aim of the document is to present the theoretical basis and the implementation of the SMOS Level 4 Root zone Soil moisture (L4-RZSM) product implemented at CATDS.

The document contains a general introduction containing a description of the SMOS mission, the CATDS processing center and the presentation of the root zone soil moisture variable. This is followed by an overview of the algorithm and a description of the theoretical basis. The last part concerns the operational implementation at CATDS.

2 INTRODUCTION

2.1 THE SMOS MISSION

Soil Moisture and Ocean Salinity (SMOS) satellite is an Earth Explorer mission from the European Space Agency (ESA) in collaboration with the French National Space Agency (CNES) and the Spanish Centre for the Development of Industrial Technology (CDTI).

Fig. 1: SMOS sattelite illustration.

The primary objective of the SMOS mission [Kerr et al. 2010] is to provide global observations of soil moisture over land surfaces and ocean salinity over the oceans. SMOS is also improving the characterisation of ice and snow covered surfaces. The SMOS mission deploys a small satellite (300-500 kg) that uses the generic PROTEUS platform developed by CNES and Thalès Alenia Space. SMOS was successfully launched on the 2nd of November 2009. The mission duration was for three years including six months for the commissioning. Two additional years of operation were foreseen. After 10 years of successful operation SMOS is expected to remain operational for the foreseeable future. The SMOS main instrument is a 2D interferometric radiometer operating in L-Band. It enables acquisition at multiple angles and in full-polarisation. SMOS nominal resolution is about 40 km. Over land the SMOS main products are the 0-5 cm surface soil moisture and vegetation optical depth.

2.2 THE CATDS PROCESSING CENTER

The CATDS (Centre Aval de Traitement des Données SMOS) is the downstream center for the processing of L3 and L4 SMOS mission products. CATDS is constituted of an operational processing center (C-PDC at Ifremer), an Ocean expert center (C-EC-OS) and a soil moisture C-EC at CESBIO, Toulouse. The objective of CATDS is to produce and distribute Level 3 and Level 4 products, to propose enhancement of Level 2 soil moisture algorithms using temporal information (Level 3) and to produce higher end products from the combination of SMOS data with physical models or other remote sensing products (Level 4).

The C-EC centers for soil moisture and for ocean salinity are in charge of the definition of the Level 3 algorithms and will be given enough computation resources and data access for algorithm testing, specific product validation and quality enhancement. The production center C-PDC will generate Level 3 and Level 4 products on a systematic basis. The product will be controlled, verified and distributed by C-PDC, which will collect all SMOS and auxiliary data necessary for the algorithm and for the product validation.

The upstream processing chain (before CATDS) is designed with five product levels:

- Level 0 (L0) products are raw data. They are consolidated half-orbit with Science Data Packets and Ancillary Data Packets.
- Level 1a (L1a) products are: calibration data, ancillary data, calibrated visibilities and fringe washing function data.
- Level 1b (L1b) products provide the Fourier Components of the snapshots.
- Level 1c (L1c) products provide a series of brightness temperatures over a the ISEA grid separated for ocean and land surfaces.
- Level 2 (L2) products, one over land (L2SM), one over sea (L2OS) are geophysical variables mainly soil moisture and sea surface salinity respectively.

The downstream processing center CATDS provides two types of products: Scientific products and operational products. The scientific products are produced and validated at research centers (CEC). The operational products are produced at the CPDC operational center.

Level 3 products over land include:

- Level 3 Brightness temperatures (L3TB) which are angle binned and Top of Atmosphere (TOA) brightness temperatures
- Level 3 Soil moisture which are multi-orbit retrieval soil moisture and optical thickness products.
- Level 4 includes high resolution soil moisture products, root zone soil moisture, agricultural drought index.

The current document details the operational L4 root zone soil moisture product from SMOS mission.

2.3 THE ROOT ZONE SOIL MOISTURE

Agricultural drought develops over time as shown in Figure 2. In the early stages it is identified by a precipitation deficit (1). Then the lack of precipitation and irrigation results in a shortage of soil moisture in the root zone (2). The plants are unable to extract the needed water from the RZSM to meet the demands of the evapo-transpiration. To preserve the vegetation water content the vegetation closes its stomates and reduces its photosynthetic activity (3). At this stage the vegetation is in water stress conditions. The reduction of evapotranspiration stops the cooling mechanism of the vegetation and increases the vegetation temperature compared to a non-stressed vegetation cover (4). Stages (3) and (4) can be simultaneous. If dry conditions persist, unable to sustain essential biophysical functions, the vegetation gradually dries the leaves until complete drying (5). The described process can span along a period of several months. Also, even if early stages are only identified (precipitation deficit, reduced RZSM) and no-drying has occurred the final yield of crops can be highly reduced. Figure 2 provides also the most direct remote sensing technique relevant to each agricultural drought stage. For precipitation dedicated microwave missions like the components of the GPM (Global Precipitation Mission) can be used (1). They present two inconveniences. There is a high discrepancy between datasets resulting in high uncertainties [Beck et al. 2017] and they do not integrate the irrigation patterns at large scale. The RZSM can be indirectly obtained from surface soil moisture observations using microwave, active or passive, observations in C-Band or L-Band [Al Bitar et al. 2013, Kerr et al. 2016]. For the next stage, the reduced photosynthetic activity is difficult to monitor and future missions like FLEX [Kraft et al., 2012] are expected to investigate remote sensing of fluorescence (3). Stress conditions can be observed from the spatial anomaly of surface temperatures using sensors like Sentinel-3 and LandSAT [Gao et al. 2011] (4). The drying can be observed using visible sensors like Sentinel-2 and VIRS [Gue et al. 2007] (5). Figure 2 illustrates how a root zone soil moisture is very relevant for a drought early warning system at regional scale.

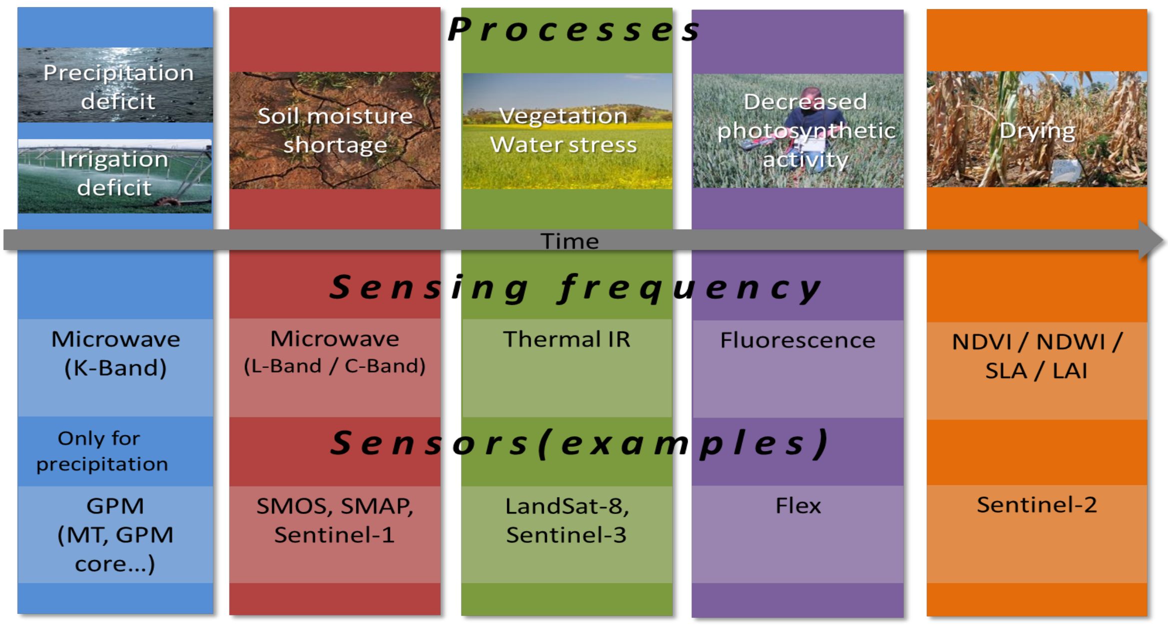

Figure 2: Timeline of an agricultural drought.

So one major information related to agricultural droughts assessment is the water availability in the root zone. The definitions of the water availability and root zone depth depend on the observed cropping type, phase of development and irrigation practices, but it is generally agreed that the root zone definition at large scale is related to the first meter of soil and the water availability is defined as percentage of available water between the wilting point and the field capacity associated to the soil texture. The root zone soil moisture currently is not directly accessible by remote sensing technologies. Some studies addressed, through local radiometers, the capacity of future P-Band missions from active or passive remote sensing to measure root zone soil moisture [Garrison et al. 2018], but there is currently no operational satellite in this bandwidth. Still, root zone soil moisture can be indirectly quantified from remote sensing through vegetation stress conditions [Swain et al. 2013], land total water storage, or the link between precipitation and root zone soil moisture. The vegetation stress condition can be monitored using thermal remote sensing [Anderson et al. 2007] and it provides an a-posteriori information about the water availability in the root zone. The link between surface soil moisture and root zone soil moisture is more direct [Qiu et al. 2014].

Root zone estimates can also be obtained from the assimilation of the surface soil moisture into Land Surface models [Lievens et al. 2015, Reichle et al. 2014]. In these experiments the estimates of root zone soil moisture is not only impacted by the information from the surface soil moisture but also by the meteorological forcing and the model errors. Another more direct way to obtain the root zone soil moisture is to use parsimonious hydrological or data driven models. [Wagner et al. 1999] suggested the use of an exponential filter to access root zone soil moisture from surface soil moisture. [Strood et al. 1999] provided a sequential formulation of the model and tested it over local sites in South West of France. At SMOS CATDS Level 4 root zone soil moisture is provided at CATDS by applying modified formulation of the exponential filter linking the time parameter to the soil texture. The FOA 56 based evapotranspiration is deactivated in version 0.1.

3 ALGORITHM OVERVIEW

A schematic diagram of the algorithm for the SMOS Root Zone soil moisture (SMRZ) is presented in Figure 3. It can be divided into four steps: the initialisation followed by a loop over the surface soil moisture products that contain the three remaining steps: first layer SM, second layer soil moisture and root zone soil moisture.

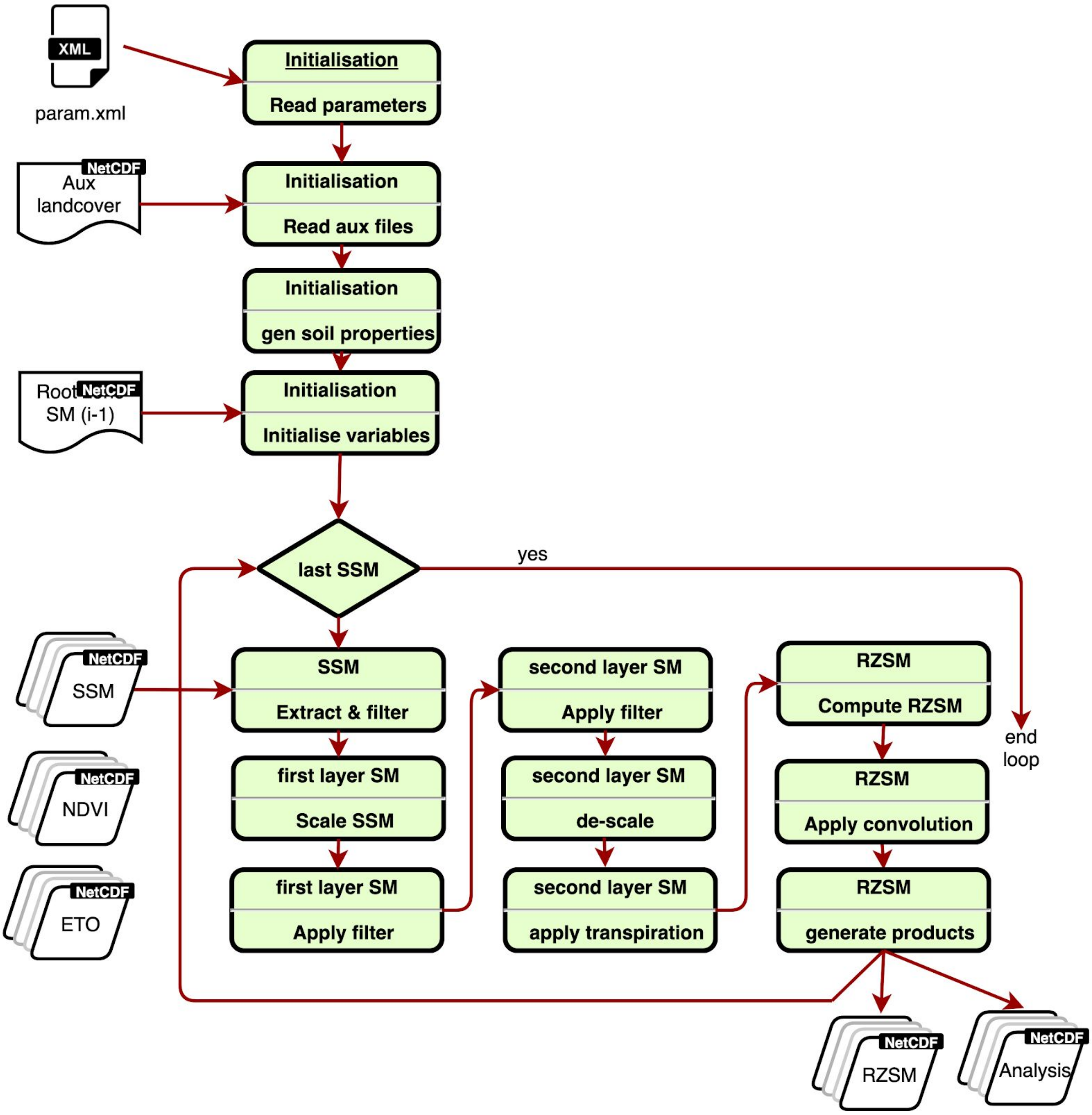

Figure 3: Flowchart of the SMRZ algorithm.

5 THEORETICAL DESCRIPTION

The computation of the root zone soil moisture, in the algorithm presented here, is based on the surface soil moisture product based on a modified formulation of the [Stroud et al. 1999] sequential filter, taking into account the soil properties with an optional implementation of the transpiration. The implementation of the soil texture dependent parameters enables us to take into account the impact of the soil properties on the infiltration rate into the soil.

SOIL PROPERTIES

The soil parameters are computed based on the soil texture (% clay, % sand, % silt) from an updated FAO soil texture map. The FAO map was interpolated to the EASE 25km grid using a bilinear interpolation taking into account the edge effects by displacing the interpolation . The result is stored in an auxiliary file called AUX_LANDCOVER.

The soil hydraulic properties are computed based on the empirical pedotransfer functions in [Mahfouf and Noilhan 1996]. They are used in the meteo france ISBA model.

Three soil retention capacities are computed: the soil moisture at saturation (SMsat) the soil moisture at field capacity (SMfc) and the soil moisture at wilting point (SMwilt).

$$\mathbf{SMsat = 0.001 \times (-10^{8} \times Sand + 494.305)}$$

$$\mathbf{SMwilt = 37.1342E\text{-}3 \times (Clay)^{0.5}}$$

$$\mathbf{SMfc = 89.0467E\text{-}3 \times (Clay)^{0.3496}}$$

where clay and sand are the clay and sand fractions in the soil.

The additional parameter of hydraulic conductivity at saturation (Ksat m/s) is computed as follows:

$$\mathbf{Ksat = 1.0E\text{-}06 \times (10^{0.161874E+01} - 0.581989E+01 \times Clay - 0.907123E\text{-}01 \times Sand + 0.529268E+01 \times Clay^{2} + 0.120332E+01 \times Sand^{2}))}$$

Alternatively the soil resistance (Rsat in s/m) can be computed as (1 / Ksat). The two parameters express the easiness or the resistance to the infiltration of the water in a saturated soil depending on the soil properties. It is worth mentioning that these values are for saturated soils and that in real conditions the partially saturated (or unsaturated soil) will have a lower soil hydraulic conductivity or higher soil resistance.

TIME TRANSFER CONSTANTS

The implementation of the exponential filter requires the determination of the time constant that expresses the time needed for the soil moisture of layer(i) to update the soil moisture in layer (i+1). In our implementation we consider three layers. First the observation layer (layer 0) from the satellite data. This is the surface soil moisture (0-5 cm). The second layer (layer 1) is representative of (5-40 cm) depth and the last layer (layer 2) goes from 40 cm to 1m. The T1 coefficient is the transfer time from layer 0 to layer 1. T2 is the transfer coefficient from layer 1 to layer 2. Based on the application of the Darcy law to conservation of mass in saturated porous media the hydraulic conductivity is related to the time constant via a logarithmic relation. So based on this analytical analysis we implement the following formulation of the T1 and T2 time function :

T1 = (log(Ksat) - log(max(Ksat)) / (log(min(Ksat)) - log(max(Ksat))) x T1int + T1min

T2 = (log(Ksat) - log(max(Ksat)) / (log(min(Ksat)) - log(max(Ksat))) x T2int + T2min

where T1 and T2 are the time constant (days), Ksat is the hydraulic conductivity (m/s), T1int and T2int (days) are parameters representing the interval of the time constant, and T1min and T2min (days) are parameters representing the minimum values of T1 and T2.

SURFACE SOIL MOISTURE FILTERING

The surface soil moisture from SMOS L3SM is extracted from the netcdf products and filtered for the probability of the Chi2 test and the Radio Frequency Interference (RFI) probability. For every acquisition and every node each retrieval that doesn't meet the predetermined thresholds for Chi2 probability and RFI probability is excluded for the computation of the root zone soil moisture.

SURFACE SOIL MOISTURE SCALING

The surface soil moisture from SMOS is scaled to retrieve a soil moisture index using a logarithmic relation.

$$SWI = \log(c \times SSM + a) + b$$

where SSM (m^3/m^3) is the surface soil moisture, a, b and c are scaling parameters given as follows:

$$a = \exp(SMmin-1) / (1-\exp(SMmin -1)) \times SMmax$$

$$b = 1 -\log(SMmax+a)$$

where SMmin (m^3/m^3) and SMmax (m^3/m^3) are the wilting point and field capacity values respectively.

EXPONENTIAL FILTER IMPLEMENTATION

As mentioned above the sequential formulation of the filter is applied.

$$SWI (i+1,k)=SWI (i,k) + Kn(i+1) \times (SWI (i,k-1) - SWI(i,k))$$

where i is the time index and k is the layer index. SWI is the soil moisture index (unitless), Kn is the update kernel from layer (k-1 to layer k) computed as follows:

$$Kn(i+1)=Kn(i) / (K(i) + \exp (-DT/T))$$

where T is the time constant (days), with T1 for the transition from layer(k-1) to layer (k), and T2 for the transition from layer 1 to layer 2. DT (days) is the time interval since the last update (time(i+1)-time(i)).

ABSOLUTE SOIL MOISTURE COMPUTATION

The absolute soil moisture is computed from the SWI based on simple linear scaling between minimum and maximum soil retention capacity (e.g. field capacity and wilting point).

$$SM(k) = (SMmax(k)-SMmin(K)) \times SWI(k) + SMmin(K)$$

where SMmin and SMmax are respectively the SM at wilting point and field capacity

TRANSPIRATION

Transpiration computation can be activated or deactivated in the parameter file. The transpiration is applied for the second layer of the soil and thus the evaporation is not considered as the frequent forcing of the SSM into the first layer takes it into account.

The FAO formulation is used for the computation of the transpiration.

$$\textbf{Trans (mm/day)} = \textbf{ETO (mm)} \times \textbf{Kcb}$$

where Kcb is the Basal Crop coefficient. It can be computed based on [Er-Raki et al. 2007] from optical remote sensing:

$$Kcb = a \times \exp(b \times NDVI)$$

where NDVI is the Normalised Difference Vegetation Index that is forced from optical remote sensing (MODIS); a and b are vegetation dependent parameters that can be found in the literature. Typical values are a=1.2 and b=-0.8

The second layer soil moisture is updated while ensuring based on the computed transpiration if activated, as follows :

$$SM2^* = \max(SM2 - Trans\ ,\ SM2min)$$

Finally a linear rescaling is done:

$$SWI\ 2 = (SM2 - SM2min) / (SM2max - SM2min)$$
$$SM2 = (SM2max - SM2min) \times SWI\ 2 + SM2min$$

ROOT ZONE SOIL MOISTURE

The root zone soil moisture is computed based on a depth weighted average of the two layers soil moisture.

$$SMRZ = (SM1 \times d1 + SM2 \times d2) / (d1 + d2)$$

where SMRZ is the root zone soil moisture (m3/m3), d1 and d2 (m) are the depth of layer 1 and layer 2, and SM1 and SM2 (m3/m3) are the soil moisture of layer 1 and layer 2.

QUALITY INDEX

Currently a simple quality flag is implemented in the algorithm based on the SSM acquisitions.

A quality index of 1.0 indicates that the data is not impacted by any artifact.

If any of the following artifacts is detected the quality index is reduced by 0.2.

- Presence of RFI
- Poor SSM retrievals (Chi2)
- High percentage of forest surface in the scene (FFOmean)

- A long period (number of days) since the last update of the root zone soil moisture status.

Table 1: Configuration parameters of L4 Root Zone Soil Moisture processor					
	Name	Description	Type	Units	Value
General	Id	Id of simulation used only for offline	string	-	"sample"
	Orb	Choice of orbit (A:ascending, D: descending)	String	-	"D"
	EASE2_lon_dim	number of nodes in longitude of the EASEv2 25km	Int16	-	1388
	ESASE_lat_dim	number of nodes in latitude of the EASEv2 25km	Int16	-	584
	dt_A	Delay in local time of overpass for acs orb	Float32	Days	0.75
	dt_D	Delay in local time of overpass for dec orb	Float32	Days	0.25
	date_gap_th	Threshold of time gap for reduced quality	Float32	Days	1-10
	Save_mat_files	Save matlab outputs for offline use	Int16	-	1/0
	save_MIRCLF4RX_files	Make netcdf user data product (catds:1)	Int6	-	1
	save_MIRCLD4RX_files	Make netcdf data analysis product (catds:1)	Int6	-	1
Layer 0	TH_Chi_2_P	Threshold of Chi2 probabilities for rejection	Float32	-	0.95
	Th_Rfi_Prob	Threshold of Rfi_Prob for rejection	Float32	-	0.95
	Th_qual_Chi_2_P	Threshold of Chi2 probabilities for quality	Float32	-	0-1
	Th_qual_Rfi_Prob	Threshold of Rfi probabilities for quality	Float32	-	0-1
	Th_qual_FF0mean	Threshold for mean forest cover for quality	Float32	%	0-70
	Th_Delta_Days	Threshold for number of days for quality	Float32	days	1-10
	flag_SMmin	SMmin flag (0: constant value, 1: from aux file)	Int16	-	1
	SMmin	Constant value for SMmin (if flag_SMmin=0)	Float32	M3/M3	-
	flag_SMmax	SMmax flag (0: constant value, 1: from aux file)	Int16	-	1
	SMmax	Constant value for SMmin (if flag_SMmax=0)	Float32	M3/M3	-
Layer 1	d1	Depth of Layer 1	Float32	M	0.1-0.4
	flag_init_file	Flag for initialization from data analysiss (catds:1)	Int16	-	1
	SWI1_0	Initial value of SWI1 (if flag_init_file=0)	Float32	-	0.3-0.5
	Kn_1_0	Initial value of Kn_1 (if flag_init_file=0)	Float32	-	1
	flag_T1	Flag for T1 function (0: constant, 1: func of soil)	Int16	-	1
	T1	Time function for layer 1 (if Flag_T1=0)	Float32	days	1-5
	T1min	Minimum value of T1 func (if flag_T1=1)	Float32	days	1-4
	T1int	Interval for T1 func (if flag_T1=1)	Float32	days	1-4
	flag_SM1min	Flag for SM1min (0: constant, 1: depends on soil)	Int16	-	1
	SM1min	Minimum SM layer1 (if flag_SM1min=0)	Float32	M3/M3	-
	flag_SM1max	Flag for SM1max (0: constant, 1: depends on soil)	Int16	-	1
	SM1max	Maximum SM layer1(if flag_SM1max=0)	Float32	M3/M3	-
Layer 2	d2	Depth of Layer 2	Float32	M	0.5-1.5

	flag_init_file	Flag for initialization from data analysiss (catds:1)	Int16	-	1
	SWI2_0	Initial value of SWI2 (if flag_init_file=0)	Float32	-	-
	Kn_2_0	Initial value of Kn_2 (if flag_init_file=0)	Float32	-	1
	flag_T2	Flag for T2 function (0: constant, 1: func of soil)	Int16	-	1
	T2	Time function for layer 2 (if Flag_T2=0)	Float32	days	10-20
	T2min	Minimum value of T2 func (if flag_T2=1)	Float32	days	5-15
	T2int	Interval for T2 func (if flag_T2=1)	Float32	days	2-15
	flag_SM2min	Flag for SM2min (0: constant, 1: depends on soil)	Int16	-	1
	SM2min	Minimum SM layer2 (if flag_SM2min=0)	Float32	M3/M3	-
	flag_SM2max	Flag for SM2max (0: constant, 1: depends on soil)	Int16	-	1
	SM2max	Maximum SM layer2 (if flag_SM2max=0)	Float32	M3/M3	-
Trans	flag_trans	Activate/disactivate Transpiration computation	Int16	-	0
	Prod_ndvi_dir	Path to ndvi product	string	-	-
	Prod_et0_dir	Path to the potential evapotranspiration file	sting	-	-
	Kcb_file	Path to the Kcb prameters file	string	-	-
Spa	Flab_spa_filter	Flag to activate average spatial filter	Int16	-	0
	size	Size of spatial filter (odd int, >= 3)	Int16	-	3

6 DESCRIPTION OF THE C4SMRZ_V0.1 PROCESSOR

C4SMRZ PACKAGE

The description above gives the algorithmic details of the root zone soil moisture processor. The integration of the processor into the CPDC processing center at CATDS requires a specific packaging and interfacing taking into account the formatting at CATDS.

The ***Exe*** folder contains the **run_C4SMRZ_XX_XX.sh** is the main script to launch the all processor. The **C4SMRZ_XX_XX** is a bin file generated from the SMRZ algorithm source codes using the makefile.

The ***Config*** folder contains the main configuration file of the processor which encapsulates the processor parameters. It also contains the **CGESPD** configuration file for the CATDS cluster configuration for the runs. The **CGEST** is a generic file containing the list of all available CATDS products.

The ***Constant*** folder is not used.

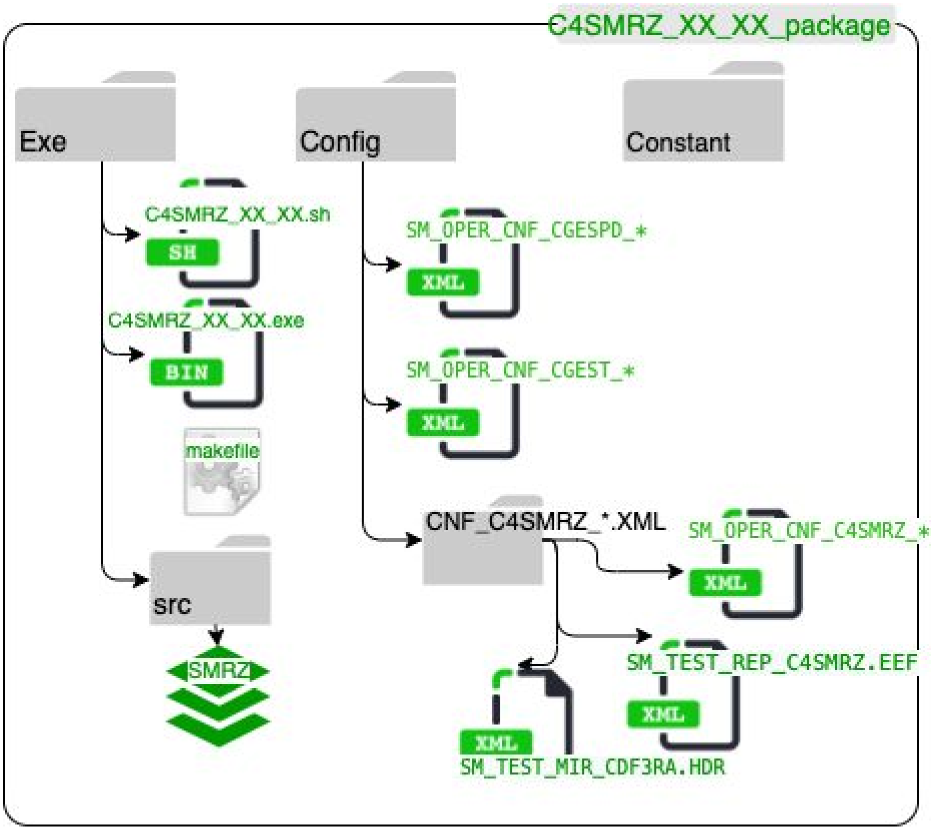

Figure 4: Description of the C4SMRZ processor package

C4SMRZ EXECUTION CONTEXT

The execution context with all inputs and outputs of the C4RZSM are shown in figure 5.

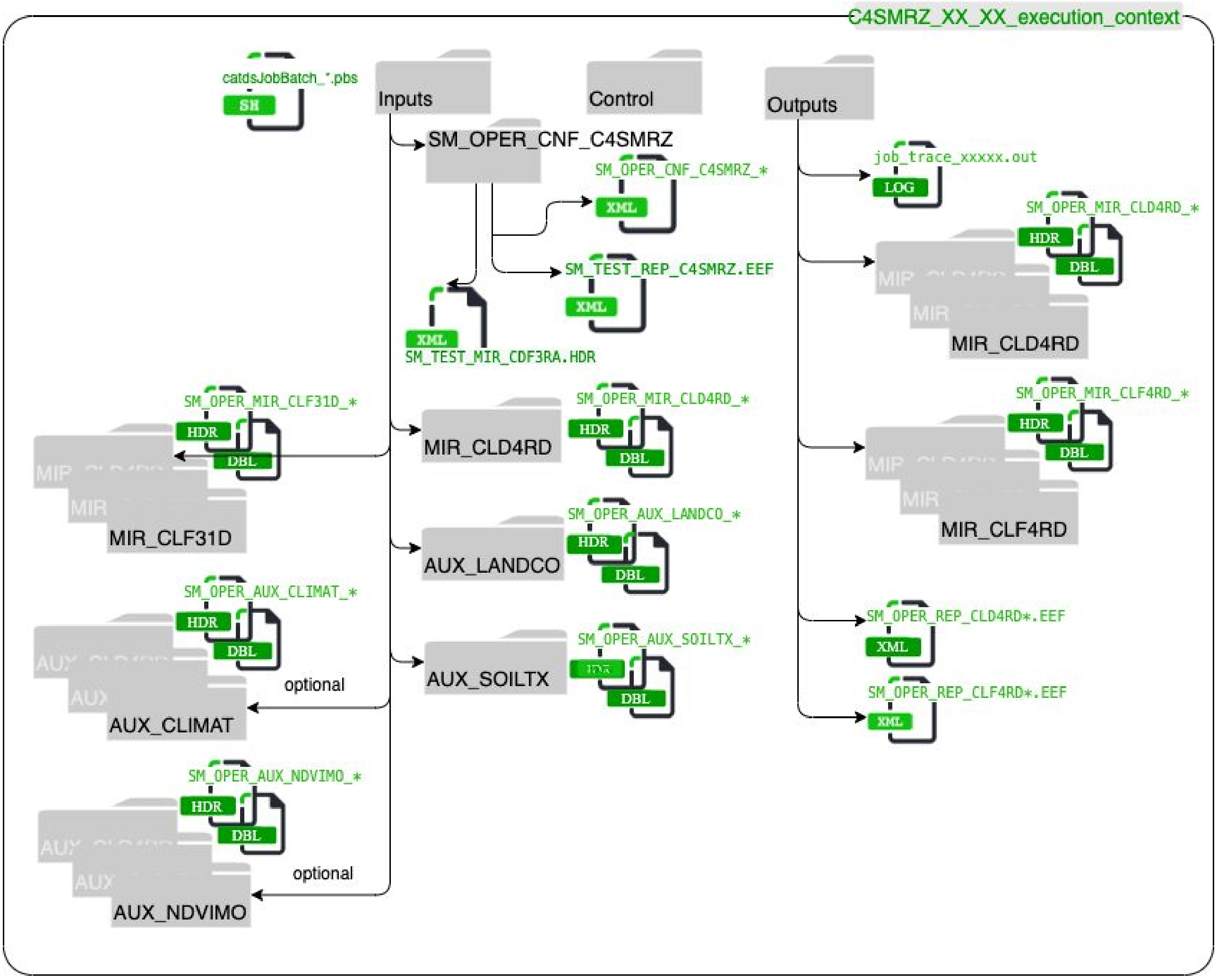

Figure 5 : Execution context of the C4SMRZ processor

DESCRIPTION OF OUTPUTS PRODUCTS

LEVEL 4 ROOT ZONE SOIL MOISTURE USER DATA PRODUCT - MIR_CLF

File Type: MIR_CLF4RD

Description: L4 Root Zone Soil Moisture User Data Product

Name Format: (see Naming Conventions at the end of this section)

SM_PPPP_MIR_CLF4Rx_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n

Format : NetCDF using EASE-Grid 2.0 for gridded data

Frequency: Daily for ascending or descending orbits

Content :

- **lat:** latitudes of EASE-Grid 2.0
- **lon:** longitudes of EASE-Grid 2.0
- **RZSM:** Root zone soil moisture (0-1m) in M3/M3
- **Quality:** Quality of the product, with 1 being the highest and 0 the lowest

Notes: Product consists of two file: a NetCDF file with ".DBL" extension and a text file in XML format with ".HDR" extension.

LEVEL 4 ROOT ZONE SOIL MOISTURE DATA ANALYSIS PRODUCT -

File Type: **MIR_CLD4RD**

Description: Root zone Soil moisture processor (C4RZSM) data analysis product from day-1

Name Format: (see Naming Conventions at the end of this section)

SM_PPPP_MIR_CLD4Rx_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n

Format : NetCDF using EASE-Grid 2.0 for gridded data

Frequency: Daily for Ascending or Descending

Content :

- **lat:** latitudes of EASE-Grid 2.0
- **lon:** longitudes of EASE-Grid 2.0
- **SW1:** Soil moisture index for layer 1
- **SW2:** Soil moisture index for layer 2
- **Time1:** date tag since the last update of layer 1
- **Time2:** date tag since the last update of layer 1
- **Kn1:** update kernel for layer 1

- **Kn2:** update kernel for layer 2
- **Quality:** Quality of the product, with 1 being the highest and 0 the lowest
- **Science_Flags:** copied from MIR_CLF31D for information purposes at this stage.

Notes: Product consists of two file: a NetCDF file with ".DBL.nc" extension and a text file in XML format with ".HDR" extension.

Naming Convention

All files follow naming conventions follow the CATDS naming convention. Table below presents the possible values in the naming:

SM_PPPP_MIR_DDDDDD_yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_n

Table 2: Naming convention of the C4RZSM outputs CATDS convention

Naming	Description
SM	in this specific case, it stands for the SMOS mission
PPPP	File class: indicates whether data is nominal operational mode (**OPER**), reprocessing mode (**REXX**)
SSS	File category: Indicates the source of the data with :**MIR** for MIRAS (as the name of the SMOS instrument)
DDDDDD	Use CLX4RY for L4 Root Zone SM products where **C** : CATDS **L** : products over "Land" **X**= **F** or **D** : can be "F" for user data product in Full pol mode or "D" for analysis product **4** : Stands for Level 4 data **R**: "R" for Root-Zone product **Y**= **A** or **D** : "A" for ascending orbit and "D" for descending orbit. Currently only Descending orbits are distributed.
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

YYYYMMDDTHHMMSS	sensing stop 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)

Full description of the processor inputs and outputs are described in : [SO-TN-CB-GS-090-CATDS_L4RZSM_ISD_20200716]