TRAINING SESSION

SOIL MOISTURE PRODUCTS VISUALISATION

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Table of Content

I- OBJECTIVE

The objective of this session is to present the SMOS soil moisture product content trough exercises using interactive visualization and analysis.

II – MATERIALS

REFERENCE DOCUMENTS

L2ATBD: SO-TN-ARR-L2PP-0037-Algorithm_Theorertical_Basis_Document_ATBD_v3.6-20111219
L2ProdSpec: SO-TN-IDR-GS-0006-SMOS_Level_2_and_Auxiliary_Data_Products_Specifications-v6.1-2012-02-09
Beam- Visat Help: Beam Visat software help / manual

DATA

- SMUDP2: This is the main product described in this session. It is the swath based soil moisture level2 product processed by ESA. The product is semi-orbit based. The gridding system is the ISEA grid (Icosahedral Snyder Equal Area) 15km. The product is in xml for the header part and Binx format for the data fields.
Description: L2ProdSPec / L2ATBD

Other products
-SMDAP2 : This is the level 2 soil moisture data analysis product.
Description: L2ProdSPec / L2ATBD

-AUX_ECMWF: This is the level 2 ancillary data product
Description: L2ProdSPec / L2ATBD / L2BinningList

-AUX_DFFLAI:
Description: L2ProdSPec / L2ATBD

-**smos_cpd**: folder containing custom color codes palettes located in:
USBStick16GB_Land/Training_Sessions/Day3_From_Brightness_Temperature_To_Geophysical_Products/02_Soil_Moisture_Product_Visualization_content/

The used products are located in SMOS Training USB: **USBStick16GB_Land/Data/SML2/…**

TOOLS AND SOFTWARES

- **VISAT – BEAM - BEAM 4.10.3**: BEAM is an open-source toolbox and development platform for viewing, analyzing and processing of remote sensing raster data developed by Brockmann-Consult for the European Space Agency (ESA).
  Download from: http://www.brockmann-consult.de/cms/web/beam/software
  Installation is user friendly straight forward button clicking
  Note : Beam uses the schemas from SMOS in a compressed jar. When new version of the processor is out Beam can't find the right schemas and doesn't read the file. In this you need to update smos-Box or contact Brockmann . Send us an e-mail we may have a patch !
- **SMOS-BOX 2.2 Add-on for BEAM 4.10.x**
  This is an add-on for VISAT that enables users to open, analyses and extract SMOS products.
  Download from: http://www.brockmann-consult.de/cms/web/beam/software
  Installation is straight forward button clicking
- **Matlab xml_toolbox**: to read header xml file
- **Matlab scripts: (**csv2timeserie.m, udp2timeserie.m)

EXERCISE 1: OVERVIEW OF THE L2 SOIL MOISTURE USER DATA PRODUCT

The SMUDP2 has two parts a HDR file and a DBL file. The product content is described in the **L2ProdSpec** document page 68- 103.

-PRODUCTS NAMING

SM_REPR_MIR_SMUDP2_20110915T010752_20110915T020105_501_001_9

– **SMOS**
—— **OPERATIONAL / REPROCESSING**
——— **MIR : MIRAS /AUX: Auxiliary data**
———— **Soil Moisture**
————— **User Data Product / Data Analysis Product / ECMWF_ …**
—————— **Level 1C**
——————— **Start validity time tag in UTC**
———————— **End validity time tag in UTC**
————————— **Processor version**
—————————— **Configuration file version**
——————————— **Processing center**

-THE HEADER FILE

- Open the HDR file in a text editor: e.g.

gedit SM_REPR_MIR_SMUDP2_20110915T010752_20110915T020105_501_001_9.HDR

Explore the xml file

- Start Beam interface: command line : visat or click icon: (see **Fig. 1**)
- Open the following UDP products : SM_REPR_MIR_SMUDP2_20110915T010752_20110915T020105_501_001_9.DBL
- Double click on the "Metadata" node in the "Product" tab on the left panel , you can now explore the HDR content easily (see **Fig. 1**)
- Open the following node: Metadata > Variable_Header > Specific_Product_Header > Main_Info > Time_Info
- Check the Ascending_Flag tag
- Explore : Metadata > Variable_Header > Specific_Product_Header > List_of_Data_Sets
- Get the name of the input SCFL1C file in Data_set number 1.

The time tag of some Auxiliary and input files and for a given semi-orbit is different than the SMUDP2. So it is useful to use the header to find corresponding files. Also this enables the user to check the version of the files.

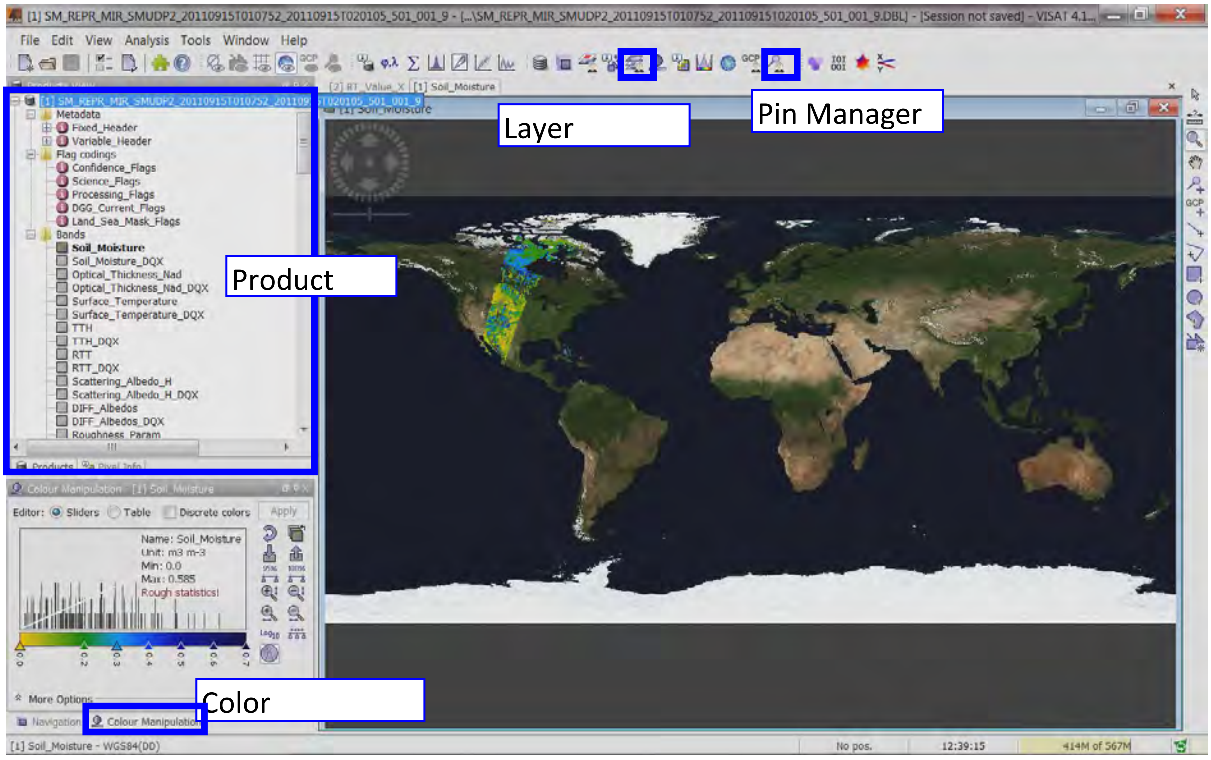


Fig. 1 Screen capture of Beam interface (check Beam Visat manual for a complete description)

- start matlab: matlab
- add xml_toolbox to path:
  addpath(USBStick16GB_Land/Apps/General/matlab_xml_toolbox/")
- open xml file:

L2_hdr=xml_load('SM_REPR_MIR_SMUDP2_20110915T010752_20110915T020105_501_001_9.HDR')

- extract tag:

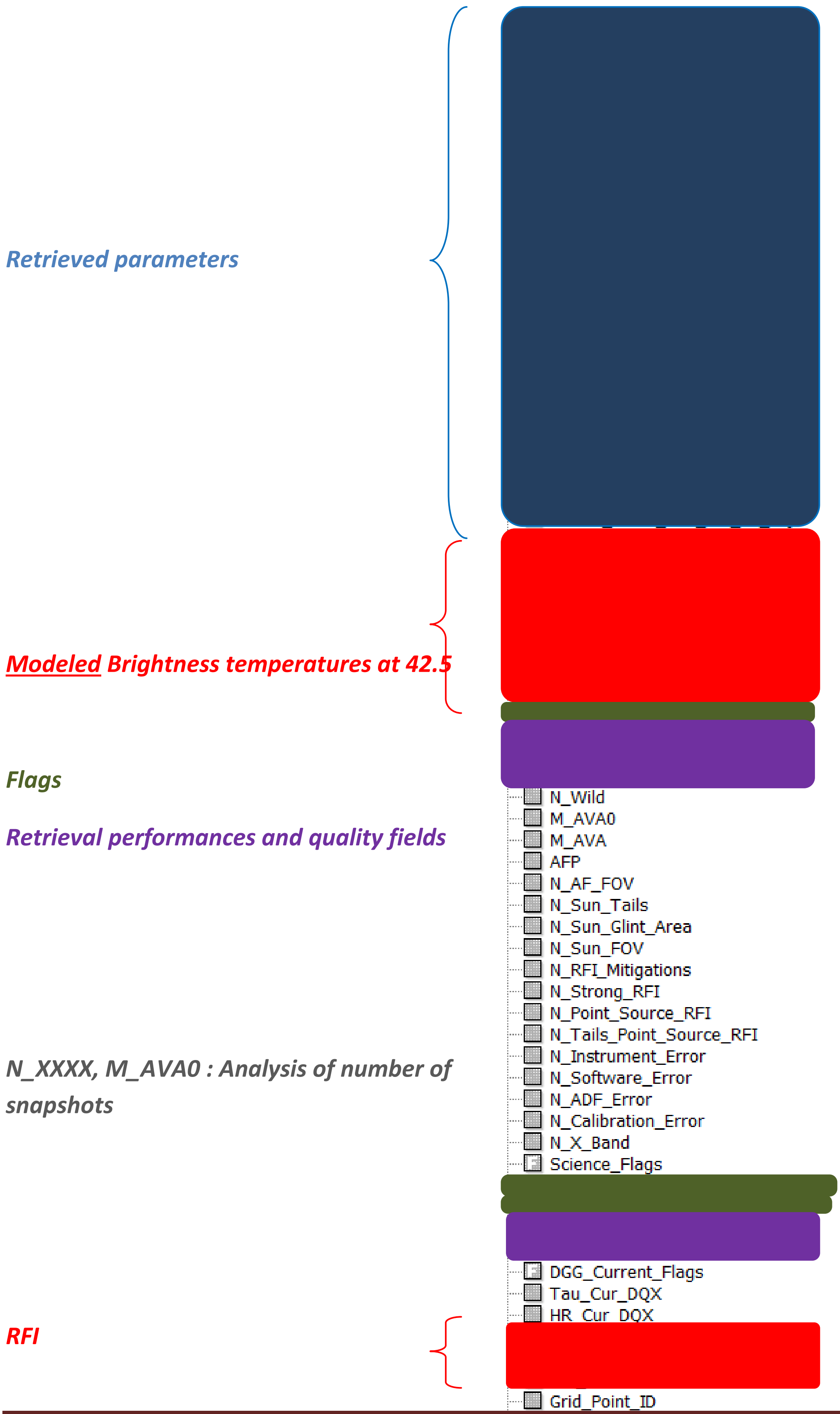
L1C_file=L2_hdr.Variable_Header.Specific_Product_Header.List_of_Data_Sets(1).Data_Set.Ref_Filename

-THE DBL FILE

The DBL file contains the binary data these are presented in VISAT as "Bands". You can double click on any parameter to map it. The flags fields need to be decoded and mapping them before decoding is of no interest.

Some fields (Bands) at the end of the product are computed and added by Beam. They are not present in the original file.

To simplify the readability of the product we present the parameters in different groups.


Retrieved parameters
Modeled Brightness temperatures at 42.5
Flags
Retrieval performances and quality fields
N_XXXX, M_AVA0 : Analysis of number of snapshots
RFI
N_Wild
M_AVA0
M_AVA
AFP
N_AF_FOV
N_Sun_Tails
N_Sun_Glint_Area
N_Sun_FOV
N_RFI_Mitigations
N_Strong_RFI
N_Point_Source_RFI
N_Tails_Point_Source_RFI
N_Instrument_Error
N_Software_Error
N_ADF_Error
N_Calibration_Error
N_X_Band
Science_Flags
DGG_Current_Flags
Tau_Cur_DQX
HR_Cur_DQX
Grid_Point_ID

EXERCISE 2: THE SOIL MOISTURE RETRIEVALS

In this exercise the soil moisture retrievals are mapped and associated quality filters are used.

- SOIL MOISTURE

- Double click on the Soil Moisture Band in the Product Panel  (on the left) to map it
- Associate a custom color palette to the Soil Moisture (see Visat Help - Color Manipulation):

Select the Color Manipulation Tab on the left panel 

Select import settings from text file 

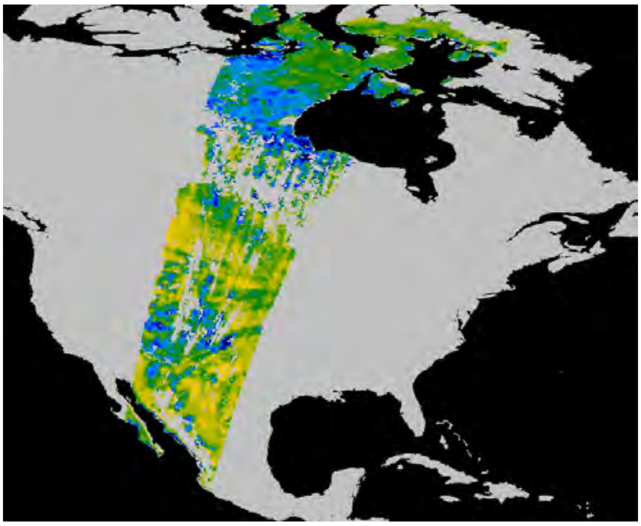
Select "USBStick16GB_Land/Training_Sessions/Day3_From_Brightness_Temperature_To_Geophysical_Products/02_Soil_Moisture_Product_Visualization_content/ smos_cpd/sm.cpd" and open

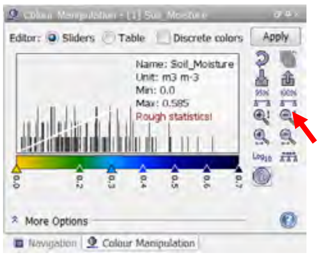
Select "No" for color redistribution/rescaling

click "Apply"

- select  to check the values as you hover over the map

Fig. 2 Soil moisture map using custom color map and color manipulation frame





About Soil Moisture retrievals: The product is presented over the ISEA grid. This is an oversampled grid as the nominal resolution is 40km and the total contribution area is 123 x 123 km, as it will be explained in exercise 3. The retrieved soil moisture range (0.0-1.0) can have unrealistic values >0.6 m^3/m^3. User should not confuse the retrieved soil moisture with a soil moisture index. The retrievals are free to go above 0.7 m^3/m^3 in the sample products delivered. In fact it was found that in case of flooding high Soil moisture values are retrieved and soil moisture can be considered as a good indicator of flooded areas. Also when intense rain occurs pounding effect can give the same response.

- SOIL MOISTURE DATA QUALITY INDEX (DQX)

- Map the Soil_Moisture_DQX
- Use the "smos_cpd/sm_dqx.cpd" as a color palette using Color Manager (see Exercise 1 for details)

About Data Quality Index: Data quality index is in m^3/m^3. It expresses the sensibility of the soil moisture retrieval. SM_DQX ≈ std(TB) d(SM)/d(TB). The very low values of DQX are explained by the low sensibility of the model to soil moisture retrieval values. DQX should not be confused with uncertainty.

- CHI2 RETRIEVAL FIT QUALITY INDEX / GOODNESS OF FIT

The Chi2 parameter is not scaled in Beam. The user needs to get scaling parameters in reference documents and scale it:

- Open L2ProdSpec page 87,get scaling expression for Chi2
- get “Chi_2_Scale” from header :

  Go in terminal to product folder and type: grep –i scale *.HDR

Generate the new band in Beam:

- Scale the Chi2 parameter:

  Select Tools > select Create Band By Band Maths > input in, Name: “Chi2_scaled”, input in Bands maths expression: “Chi_2 * 5 / 255”

- Use the “/smos/chi2.cpd” as a color palette

About Ch2: X^2 is a Goodness of fit test. The higher it is the poorer the fit is. Its value should be analyzed with respect to the number of retrieved free parameters. If we consider two retrieved variables (SM and Tau), then if Chi2 =4.6 the fitting is good with a probability of 0.1. Statistical reference books contain tables for Chi2 values.(search for Chi2 goodness of fit). A perfect Chi2 value is 1, but it is not achieved in the retrievals because of angle dependent biases in Brightness temperature acquisitions.

-FILTERING SOIL MOISTURE RETRIEVALS

Filtering can be done based on several criteria. Here we use the retrieval performances as criteria. In next exercise user will learn about other parameters RFI, surface type, selected model, flags etc. that can be used for filtering

- Make a filtered product:

  Select Tools > select Create Band By Band Maths > input in, Name: “SM_filtered” > select Edit Expression > construct the following expression: (Chi2_scaled < 2.5 or Soil_Moisture_DQX < 0.05) ? Soil_Moisture : NaN

- Use the “smos_cpd/sm.cpd” as a color palette for the SM_filtered band.

About filtering: The values given here for filtering should not be used as reference values. We suggest that the user makes his analysis based on his application and site then filter the data.

EXERCISE 3: MODEL AND SURFACE DESCRIPTION (S_TREE_1, S_TREE_2)

-GRID AND RESOLUTION

In this part we inspect the product grid and the resolution associated to the retrievals.

- Zoom to a given position and check the grid node shape
- Select import vector data > import ESRI Shapefile > select wa_polygone.shp
- Select 'No' for import geometry question
- An object with 2 circles and 1 square appears
- If this is not visible use the Layer Manager  to disactivate the background layers.

Working area | Average antenna weighting function

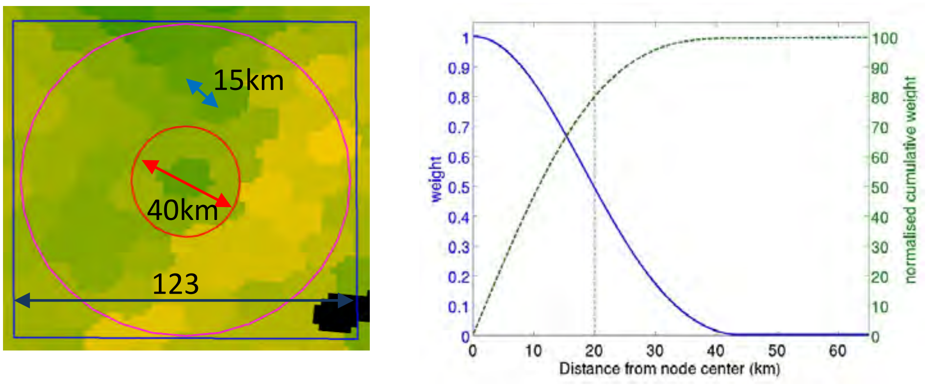


Fig. 3 Working area (left) and Weighting coefficient of the synthetic antenna as a function of distance (right)

About grid and resolution: The product is presented over the ISEA 15km grid that oversamples the 40km nominal resolution. Retrievals are done over each node independently and each time taking a 123 x 123 km area that will include 100% of the contribution. So the retrievals are correlated. Fig. 3 (left) shows the 123x 123 km area (square), the 3dB noise to signal level (red circle). This is equivalent to a 0.5 weight at 21.5 km as we can see in Fig. 3 (right) thus the SMOS nominal resolution of 43 km. In the same figure the cumulative weight, equivalent to cumulative contribution, is about 80% at 20km (inside the 40km circle).

- SURFACE TYPE & RETRIEVAL CASE (DECISION TREE 1- S_TREE_1)

In this part we check the retrieval case selected by the retrieval algorithm depending on surface conditions.

- Double click on s_tree_1 Band to map it
- Use the “smos_cpd/s_tree_1.cpd” as a discrete color palette
- Open L2ATBD page 89 Table 18
- Open Layer Management and change transparency of s_tree_1
- Compare to NASA Blue Marble map (background world map) (see Fig. 4)

About s_tree_1: The s_tree_1 indicates the type of surface that is used for retrieval. The values of s_tree_1 are explained in Table 18 of L2ATBD page 89.

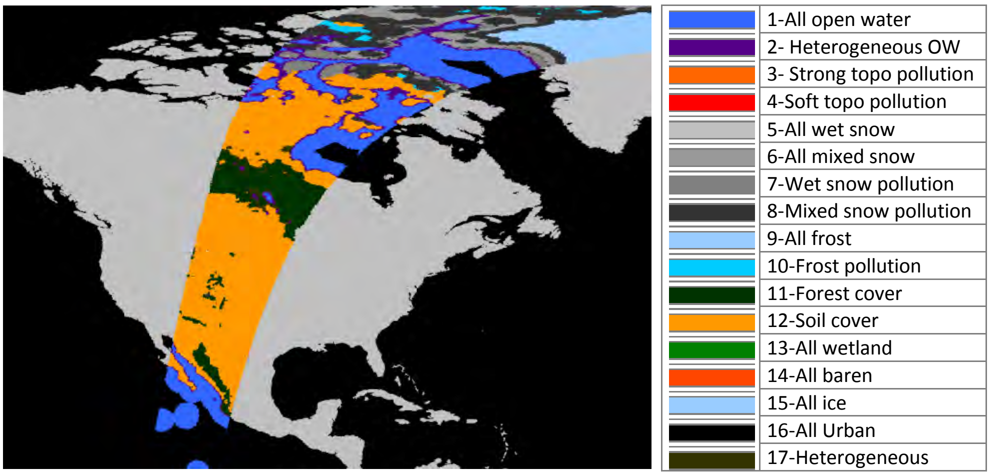


Fig. 4 Retrieved case from decision tree 1 (s_tree_1

-SURFACE FRACTIONS (FROM DATA ANALYSIS PRODUCT)

The s_tree_1 is obtained by applying thresholds to the observed surface fractions. So for a nominal retrieval case the nominal surface can vary from a given threshold value to 1.0. The fractions can be inspected by using the DAP file (Data Analysis Product). For the list of fraction types see L2ATBD page 84 Table 16. Some fractions are dynamic like wet snow. These fractions are considered as complementary and are computed based on climate auxiliary file AUX_ECMWF.

- Open SM_REPR_MIR_SMDAP2_20110915T010752_20110915T020105_501_001_9.DBL
- Compute scaled nominal (bare soil + low vegetation) fraction: Select Tools > select Create Band By Band Maths > input in, Name: "Nominal_Frac" > input in Bands maths expression: "Mean_FM0_FN0 / 65535" (see L2ProdSpec for scale factor)
- Filter **Soil_Moisture** for nominal surface above 90%:
- Select **Tools** > select Create Band By Band Maths > input in, Name: "SM_filtered" > select Edit Expression > construct the following expression: (Nominal_Frac > 0.9 ? $1.Soil_Moisture : NaN)
- Make statistics : select Analysis > Statistics > select the refresh icon

About Fractions: The SMOS retrieval algorithm optimizes the free parameters on the highest representative surface contribution. For example if 30% of the surface is barren/rocks and 70% is nominal (low vegetation and bare soil), the modeled TB is optimized for the 70% nominal surface. So the retrieved soil moisture can be considered as representative to the 70% of nominal surface. This surface fraction can be distributed across the working area.

-RETRIEVAL LEVEL AND FREE PARAMETERS (DECISION TREE 2 - S_TREE_2)

The s_tree_2 contains three flags: retrieval level flag, optical thickness level flag and selected model flag that are needed to determine the free parameters that will be used in retrieval. The three flags are the three entries to L2ATBD Table 23 page 93. S_tree_2 is considered as advanced analysis parameter and is often inspected in last to check retrieval performances.

It is not in binary form in Beam (not decoded) it is plotted as integer value. Bitwise comparison is needed to decode it:

- **Generate the three flags: s_tree_2_ret, s_tree_2_tau, s_tree_2_mod:**
- Select Tools > select Create Band By Band Maths > input in, Name: "s_tree_2_ret", input in Bands maths expression: "S_Tree_2 & 3" (to compare to the last 2 bits: 00000011)
- Select Tools > select Create Band By Band Maths > input in, Name: "s_tree_2_tau", input in Bands maths expression: "S_Tree_2 & 12" (to compare to bits 3 & 4: 00001100)
- Select Tools > select Create Band By Band Maths > input in, Name: "s_tree_2_mod", input in Bands maths expression: "S_Tree_2 & 48" (to compare to bits 5 & 6: 00110000)
- Associate the color palette "s_tree_2_ret.cpd", "s_tree_2_tau.cpd" & "s_tree_2_mod.cpd" to s_tree_2_ret, s_tree_2_tau, & s_tree_2_mod respectively
- Select Pixels Info & nagivate in the product
- Use the values over several nodes in for L2ATBD Table 23 to determine retrieved parameters.

About the s_tree_2 flags: The values associated with the s_tree_2 flags are:

S_tree_2_ret	S_tree_2_Tau	S_tree_2_Mod
0 ➔ No retrieval	0 ➔ min Tau	0 ➔ MW
1 ➔ R2	4 ➔ med Tau	16 ➔ MD
2 ➔ R3	8 ➔ High Tau	32 ➔ MC
3 ➔ R4 (not active)	12 ➔ -	48 ➔ -

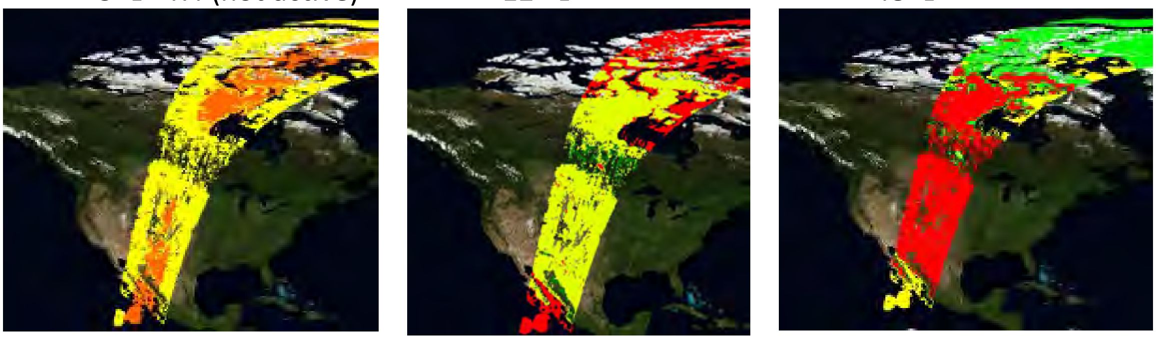


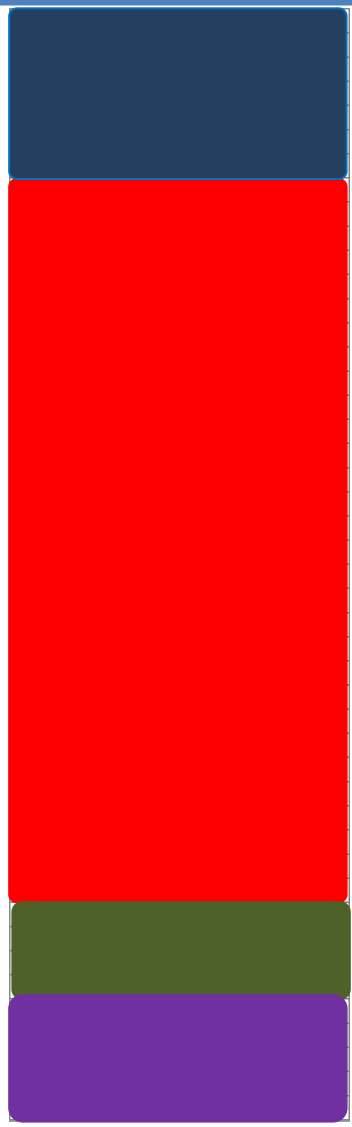
Fig. 5 The three flags retrieval, tau and optical thickness obtained from s_tree_2

EXERCISE 4: THE FLAGS

The flag list is can be presented as follows:

Confidence Flags: filtering flags

(see RFI exercise and soil moisture filtering)



Science Flags: scene flags and surface description
(see s_tree_1 exercise)

Processing flags: level of processing (see s_tree_2 exercise)

Current flags : initialization of parameters

-EXPLORE FLAGS BY NAVIGATION OVER PIXELS

- open a UDP product and map s_tree_1, and soil_moisture
- Pixel info > press show/hide Flags
- explore pixels and check flag values by hovering mouse over map

- EXPLORE FLAGS BY SPATIAL EXTENT

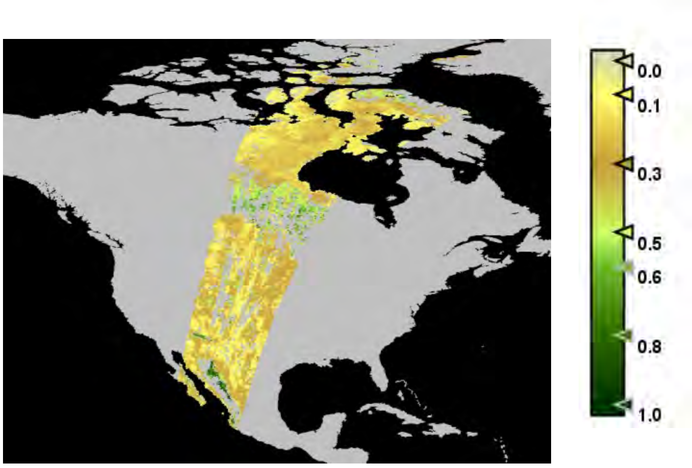
- open UDP products and map s_tree_1, and soil_moisture
- open "Manage Binary Mask and Roi" 
- Activate flags Science_Flags_TOPO_S & Science_Flags_TOPO_M
- Select other flags and check spatial extent

EXERCISE 5: THE OPTICAL THICKNESS

- THE OPTICAL THICKNESS

- Map the vegetation layer Optical_Thickness_Nad and associate to it 'smos_cpd/tau.cpd'
- Map the vegetation layer Optical_Thickness_Nad_DQX and associate to it 'smos_cpd /tau_dqx.cpd'
- Compare the optical thickness over nominal and forest fractions: select Analysis > select Statistics > select use ROI masks > select Science_Flag_Forest and Science_Flag_Nominal > select refresh icon to compute statistics (see Fig. 6)

About optical thickness: optical thickness (neper) represents the vegetation layer opacity in observation spectral band (L-Band) . It is dependent on vegetation water content. Depending on type of surface the retrieved optical thickness represents forest or low vegetation. SMOS makes advantage of angle dependent acquisitions to



retrieve optical thickness using the LMEB model.

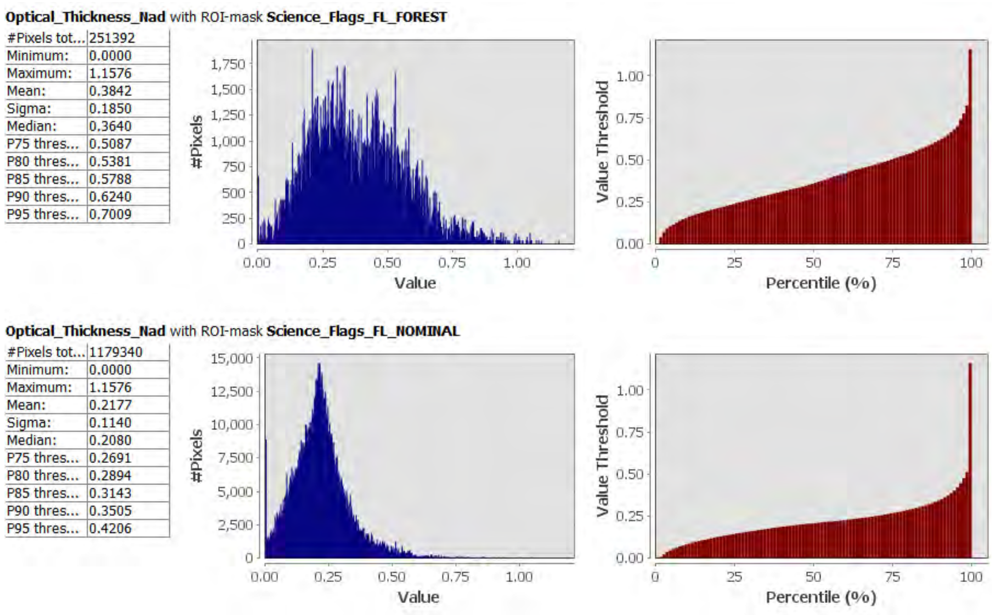


Fig. 6 Optical Thickness statistics over Forest and Nominal (low vegetation and bare soil) surfaces.

- THE OPTICAL THICKNESS VS LAI

- Open SM_OPER_AUX_DFFLAI_20110909T000000_20110919T014000_307_101_3.DBL
- Map the LAI layer
- Add ESA Glob Cover : open Layer Manager > select + > select ESA Glob Cover
- Add Optical Thickness : in Layer Manager > select + > select Image of Band / Tie Band > select Next > select Optical_thickness_Nad from UDP product >select Finish
- Compare the three datasets by using the transparency slider in the layer manager

About optical thickness: As mentioned above optical thickness (neper) represents the vegetation layer opacity in observation spectral band (L-Band) . It is dependent on vegetation water content. The LAI (Leaf Area Index) is based on observations in the visible range and is representative of the top of canopy emissions. So optical thickness in microwave and LAI or NDVI is related but don't represent the same processes and dynamics.

EXERCISE 6: INITIAL SOIL MOISTURE

The level 2 processor SML2OP uses as initial value of soil moisture the European Center for Medium Weather Forecast operational product. This value is also used in areas where the soil moisture contribution is computed by default. It is important in this context to know if the retrieved Soil Moisture from SMOS is different to see the contribution of SMOS acquisitions.

-INITIAL SOIL MOISTURE AND WORKING AREA

- Get AUX_ECMWF file used in UDP processing : grep –i AUX_ECMWF ./*.HDR
- Open AUX_ECMWF file
- Map SMVL1 and associate 'smos/sm.cpd'
- Open SM_REPR_MIR_SMDAP2_20110915T010752_20110915T020105_501_001_9.DBL file
- Map SM_Init val and associate 'smos/sm.cpd'
- Select Navigation > select synchronize comp. view > Compare the two datasets

The DAP initial value is the initial value used in the processor. It is smoother because it is computed based on a 123 x 123 km area (the total contribution area) for each node.

- INITIAL SOIL MOISTURE AND RETRIEVED SOIL MOISTURE

- Open SM_REPR_MIR_SMUDP2_20110915T010752_20110915T020105_501_001_9.DBL
- Compute difference between SM_init_val and Soil_Moisture: Select Tools > select Create Band By Band Maths > input in, Name: "SM_diff" > select Edit Expression > make difference between UDP/Soil_Moisture and DAP/SM_Init_Val
- Associate 'smos/smdiff.cpd' color palette
- select Analysis > select Statistics > select refresh icon

About initial vs retrieved soil moisture: ECMWF is wetter that SMOS. Some rain events are detected by SMOS and not by ECMWF. **Related link:** http://www.cesbio.ups-tlse.fr/SMOS_blog/?p=988

EXERCISE 7: DIELECTRIC CONSTANT

Two types of dielectric constant fields are present in the product Non_MD and MD. The MD is relative to dielectric model retrievals and is recommended for analysis.

- Compute dielectric constant module: select Tools > select Create Band and Band Maths > input in Name: dielec_mod > enter in Band Math expression: ampl(Dielect_Const_MD_RE ,Dielect_Const_MD_IM)
- Associate smos/diel.cpd color palette (Fig. 7)
- Compare Dielectric constant to selected Science Flags (snow, ice ,...) and s_tree_1

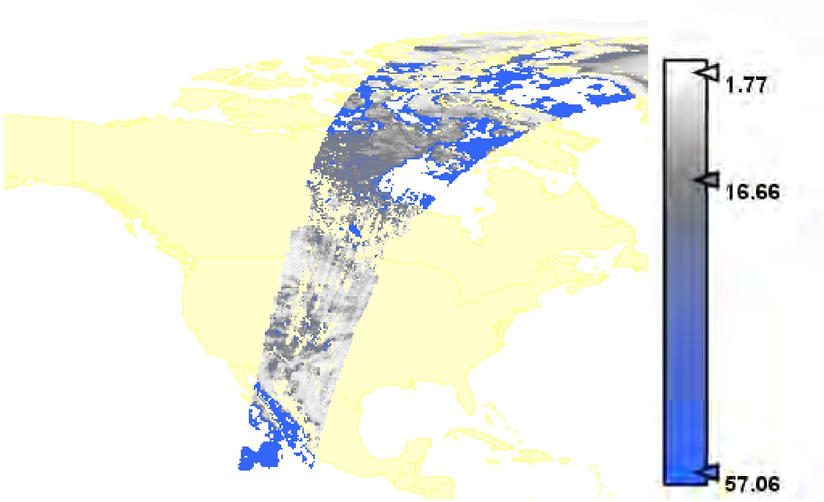


Fig. 7 Dielectric constant module map (15/09/2011)

About Dielectric constant: The dielectric constant is a good indicator of Dry soils, freezing and thawing.

Related link: http://www.cesbio.ups-tlse.fr/SMOS_blog/?tag=dielectric-constant

http://www.esa.int/esaCP/SEM4C38XZVG_index_0.html

EXERCISE 8: RADIO FREQUENCY INTERFERENCE

The radio Frequency interferences are unauthorized emissions polluting the spectral band of SMOS observation. Many fields in the L2UDP enable the user to inspect them.

- RFI PROBABILITY (RFI_PROB)

- Map the RFI_Prob
- Associate "smos/rfi_prob.cpd" as color palette
- use probability to determine RFI sources position

About RFI_Prob: The RFI_Prob are obtained from a moving window average over several months of fraction of infected brightness temperature records over total brightness temperature records. So if the RFI source is switched off, the RFI_Prob remains high for some time.

- RFI FRACTION

- Compute the RFI_Fraction: Select Tools > select Create Band By Band Maths > input in, Name: "RFI_FRAC", input in Bands maths expression: (N_RFI_X+ N_RFI_Y)/ M_AVA0
- Associate "smos/rfi_prob.cpd" as color palette
- Make a scatter plot of Soil_Moisture and RFI_Frac: select Analysis > select Scatter plot > input RFI_Frac for x-axis and Soil_Moisture for y-axis

About RFI_Frac: The user can compute the RFI Fraction or the fraction of infected Tb records for a given product RFI_Frac= (N_RFI_X + N_RFI_Y) / M_AVA0. This is computed the same way as the RFI_Prob but is representative of one over pass so has no memory effect.

RFI_Prob is useful to determine RFI sources positions and to determine RFI environment in a specific location. The RFI Frac is used in the soil moisture retrieval preprocessing to filter infected nodes. This is why in the scatter plot no soil moisture is retrieved for high values of RFI_Frac.

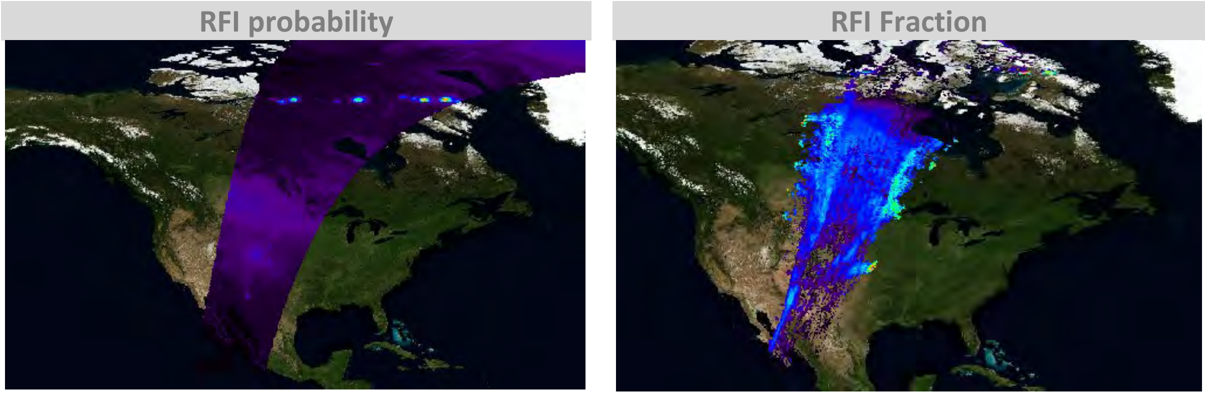


Fig. 6 RFI probability and RFI Fraction maps

Related links: http://www.cesbio.ups-tlse.fr/SMOS_blog/?p=632

http://www.cesbio.ups-tlse.fr/SMOS_blog/?p=2963

EXERCISE 9: EXTRACTING DATA

The objective of this exercise is to present several methods for data extraction from L2 UDP products to time series. Beam provides a detailed help on how to export with Beam: see Beam Help - SMOS Grid Point Export. This exercise explains how to make time series of grid nodes (DGG) through the use of Beam-ViSAT and simple complementary scripts.

Beam is very efficient in cpu time and memory consumption in extracting the data over regions of interest. Never the less it is highly recommended to put (or link) in the product directory only the products where the region of interest is visited. In fact SMOS swath based data files are numerous: about ~10440 product per year and product type. If the number of files is high (complete SMOS dataset over more than one year), then you need to divide the extraction into smaller (monthly) parts. The best is to use command line extraction in this case.

The extraction will take into consideration all readable SMOS products. So make sure only desired type of product is in the sub-directories.

-Why use Beam to extract SMOS data: it is fast and convenient (faster than Matlab_rwapi and udp2ascii) but not faster as a custom binary reader.

-When not to use Beam: Beam doesn't read the all data types AUXILIARY data files

Related link: http://www.cesbio.ups-tlse.fr/SMOS_blog/?p=514 (first verification of SMOS retrievals using Beam extraction)

- EXTRACTING DATA USING BEAM INTERFACE

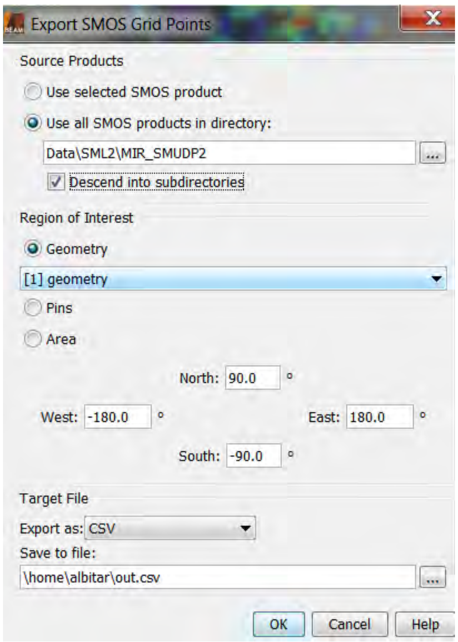
- EXTRACTING DATA FROM REGION OF INTEREST

This extraction is useful for users that need to extract over a custom ROI (non rectangular shaped) with multiple nodes or a ROIs.

- use the geometry tools to construct the regions of interest
- (In the current version of ViSAT SMOS extraction using shapefile is not available but the user can import a shapefile and make a region of interest around it.)
- select Tools > select export SMOS Grid Points

in export dialog fill :

- select use all products in directory
- fill the root directory of the products
- select Descend into subdirectories
- select Geometry
- input output filename (save to "extract" dir as 'out.csv')



The output of this is a text file with name of products, header and extracted data per DGG.

# path_to_SMOS_product	*#SML2\MIR_SMUDP2\2011\15\SM_REPR_MIR_SMUDP2_20110915T010752_…*
Header_containing_parameters	*Grid_Point_ID;Latitude;Longitude;Altitude;Days;Seconds;Microseconds;Soil_…*
Extracted_data	*207194.0;38.96500015258789;-99.4280014038086;634.5130004882812 …*
Extracted_data	*207195.0;39.020999908447266;-99.26300048828125;613.645019…*
Empty_line	*207196.0;39.077999114990234;-99.09700012207031;…*
.	.
.	.
.	.

- use matlab script to transform extract to point time series :
- Open matlab:
- Change directory to the [session folder]/extract
- Type: beam2timeseries('out.csv','./out')
- Type: run plot_timeseries.m %open the function to check

Note: usefull functions in matlab:

Time computation: datenum: transforms a date to number of days since (01,01,0000) ,gives the date of a given date number datestr, datetick('x') use it if you use time number in plots.

Bitand: fast comparision for flags

dec2bin: easy extraction of flags

-EXTRACTING DATA FROM LIST OF LAT / LON

This extraction is useful for users that have a big list of points distributed across the globe. It is more efficient than command line because the product is accessed once for each extraction.

- A pin list text file is provided

```
# Pin list file
Name   X     Y     Lon          Lat          Label   Desc
pin_1  0.0   0.0   -94.954834   40.968018    Point1  P1
pin_2  0.0   0.0   -93.954834   42.968018    Point2  P2
```

- Import the file with the Pin manager > import pin
- Select the pins in the map view or pin manager
- select Tools > select Export SMOS Grid Points
- Fill the export dialog (see section above)
- use matlab script to transform extract to make point time series files as in previous part

-EXTRACTING DATA USING COMMAND LINE OVER A POINT OR BOX

This extraction is based on the Beam ViSAT script/binary. This extraction mode is useful for users that want to have minimal user interaction. But it becomes less efficient for large number of points or boxes as the extraction is done for each element separately.

- Open maltab
- Change directory to the [session folder]/extract
- Type:

```
extract_DGG_from_UDP(-98,-97,38,39,'../../../../Data/SML2/MIR_SMUDP2/','./out2/')
```

As stated before, prior to extraction it is recommended to put (or link) in the product directory only the products where the ROI is visited. This will greatly reduce extraction time. Command line extraction is available for box area and one point of interest (lat lon) at a time (in Beam interface see Help > Grid Point Export)

EXERCISE 10: TIME SERIES ANALYSIS

In this exercise the XXX is used to inspect a time series of several products. Products that cover the region of interest have been prepared in a separate folder.

- display the timeseries toolbar: select View > select Tool Bars > select Time series Tool
- select Time series manager > select New > select + > select add directory recursively > select Next > select soil moisture > select Next > select Finish
- open the timeseries soil moisture map > add the NASA Blue Marble in layer manager
- activate the timeseries player and timeseries graph
- inspect soil moisture over the time period

Related link: a time series analysis of flooding event on smos blog

http://www.cesbio.ups-tlse.fr/SMOS_blog/?p=2015