SMOS Data Viewer

SDV

Software User's Manual

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2.11	26/02/2015	Update the document to include information about the new specific visualizations available for AUX_DTBCUR and AUX_DTBXY products as part of the SDV release 1.7.0. New section (3.1) with the Know Issues of the application Corrected typos along the document.
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1. INTRODUCTION

1.1. Purpose and Scope

This document provides a detailed guide to using the SMOSView tool for viewing data from the Earth observation data products contained in binary files. It explains how this data can be extracted, decoded and displayed using various visual representations, including images where appropriate, and exported in a variety of formats.

1.2. The SMOSView mission

SMOS is an Earth Explorer mission dedicated to analyzing the soil moisture and ocean salinity. These parameters are two key variables used within models developed to study the meteorology and hydrology of the Earth. The European Space Agency launched a program aimed at deriving these parameters from Earth satellite observation data, resulting in the SMOS mission.

The SMOS satellite will carry a specific payload named MIRAS (Microwave Imaging Radiometer with Aperture Synthesis), a two-dimensional L-band interferometer radiometer. This instrument will measure the brightness temperature field from which soil moisture and ocean salinity are derived.

INDRA is responsible for implementing the Data Processing Ground Segment (DPGS). This processing facility will ingest raw data down-linked from the SMOS satellite and produce data containing the ocean salinity and soil moisture parameters.

Developing a data processing ground segment is a complex task and requires a data visualization tool. This tool is used to visualize the content of binary data files generated by the ground segment and verify their content. The SMOS Data Viewer is called SMOSView in the following part of this document.

SMOSView is a tool capable of opening and decoding SMOS data. It then displays the contents as tables, graphs as appropriate.

1.3. Structure of the Document

After this introduction, the document is divided into a number of major sections, which are briefly described below:

- **Chapter 2** presents the SMOSView application and its functionalities.
- **Chapter 3** details the first steps to use SMOSView; installing the software, system set-up and the User Interface.
- **Chapter 4** explains how to view product content and format description
- **Chapter 5** describes plotting capabilities of SMOSView
- **Chapter 6** details visualization features of L1A data
- **Chapter 7** details visualization specific features of L1B data
- **Chapter 8** details visualization features of L1C data
- **Chapter 9** details visualization features of L2 data
- **Appendix A** is about the BinX to Xin converter
- **Appendix B** gives the Prerequisite on the system set-up for printing from SMOSView GUI

- **Appendix C** details Phase calculations in SMOS Data Viewer plots
- **Appendix D** may be useful to scientific users who want to understand how SMOSView performed the transformations to switch from L1B Fourier components of BT to L1B reconstructed BT

1.4. Abbreviations and Acronyms

The following terms have been used in this report with the meanings shown.

Data Set	A collection of data set records in an SMOS product.
Data Set Record	A collection of data fields of certain sizes and data types.
Dialog	A window that displays information or presents options to the user.
Focus	The destination of keyboard input.
Java Runtime Environment	The software required to run a Java application
Product	An SMOS data file
View	A manner of visualizing data. E.g. a Graph View or an Image View.

Table 1: List of Terms Used in this Document

The following acronyms have been used in this document:

ASCII	American Standard Code for Information Interchange
ADS	Annotation Data Set (time stamped processing data)
BT	Brightness Temperature
COTS	Commercial Off The Shelf Software
DSD	Data Set Descriptor
ESA	European Space Agency
GIF	Graphics Interchange Format
GUI	Graphical User Interface
HDF	Hierarchical Data Format
HMI	Human Machine Interface
HTML	Hyper-Text Mark-up Language (web page format)
ID	IDentifier (of snapshot)
IDL	Interactive Data Language

IEEE	Institute of Electronic and Electrical Engineers
JPEG	Joint Photographic Expert Group (image format)
JVM	Java Virtual Machine (also Java VM)
data block	Measurement Data Record
MPH	Main Product Header
OS	Ocean Salinity
PDS	SMOS Payload Data Segment (systems processing and archiving data)
PPM	An image format common on Unix
RGB	Red Green Blue
SDV	SMOS Data Viewer also named as "SMOSView"
SM	Soil Moisture
SMOS	Soil Moisture and Ocean Salinity
SPH	Specific Product Header
TIFF	Tagged Image File Format
UDP	User Data Product
VM	(Java) Virtual Machine (used to run java software. Also JVM)

Table 2: List of acronyms used in this document

2. THE SMOSVIEW APPLICATION

The SMOSView software enables a user to decode and display data from SMOS products, display the contents as images or graphs and export the data to several alternative formats.

SMOSView is a tool providing a *quick and easy look* at SMOS data products. Ease of use is emphasized through its simple graphical user interface for data exploration and visualization. This version is intended in particular for the following purposes:

- Browse through data files and display their content (see section 4),
- Provide plotting capabilities (see section 5)

2.1. Limitations of SMOSView

SMOSView is not intended for a detailed analysis, visualization, and processing of Earth observation data. There are other commercial and proprietary tools providing these facilities and with many specialized options. However, SMOSView allows selected data to be exported to IDL to support more complex analysis.

Widely used commercial packages include:

- IDL & ENVI http://www.ittvis.com/
- Matlab http://www.mathworks.com
- Mathematica http://www.wolfram.com/
- Noesys http://www.ittvis.com/
- PV-WAVE http://www.vni.com

2.2. SMOSView data format

SMOSView can handle multiple versions of any Earth observation data products, as long as the product formats are described in the SMOSView format database.

SMOSView handles all these products thanks to the XIN language, an XML meta-data language used to describe the content and structure of any binary data file. The use of XIN language within SMOSView is fully described in the SMOSView Software Specification document.

2.3. User feedback and bug report

User feedback is essential for improving SMOSView and comments and bug reports can be sent directly to the ESA Earth Observation Missions Helpdesk:
mailto:eohelp@esa.int?subject=SMOSView%20Bug%20Report

When making a bug report, please include the following information:

From the "About" SMOSView option in the Help menu:

- Operating System & Machine Type
- Java version, vendor name and vendor specific
- SMOSView and data format version numbers

- Steps leading to problem
- Any text sent to the terminal

We would like to thank all those who are kind enough to send bug reports and feedback. Every message helps to make the tool better for everyone in the future.

3. GETTING STARTED WITH SMOSVIEW

This chapter presents the first steps to complete before using SMOSView, i.e., installing SMOSView on various platforms and starting the tool.

3.1. Known Issues

The following list presents the known issues of SMOSView that may affect the user interaction with the application:

- The tool has been tested and supported for Windows XP, Vista and 7 (32 and 64 bits installations). For Windows 8 it is only possible to install the 32 bits installation package. For Windows 10 and beyond an executable is provided for the tool.
- The Specific Visualization feature of the OTT data from AUX_DTBXY a AUX_DTBCUR products takes around 30 seconds to load. Please wait while the buttons are disabled on the visualization panel.
- During any Specific Visualization on the World Map the points projected may disappear on some zoom levels. If that happen please center again the map with a click on the center of the navigation arrows.

3.2. Your system setup

SMOSView is a Java application; it can run on any platform. The main requirement for the usage of the tool is RAM memory.

The minimum amount of memory required to launch SMOSView is equal to 512 megabytes, this will allow to use the browse product feature and perform some basic plots (using the chart) of small products.

To use comfortably SMOS View and take advantage of the specific visualization feature up to Level 1C it is recommended to have at least 1 GB of memory. To use the specific visualization of L2 ADFs and L2 products it is recommended to have 2GB dedicated to SMOS View.

SMOSView is fully supported only on Java 1.5, which is included in the installation package. For more information, please refer to www.**java**.com.

NOTE: On 64 Bit operating systems installations, the library glibc-32 bits version is required to be installed.

3.3. How do I install SMOSView?

SMOSView provide installation packages for Microsoft Windows, Mac OS X, AIX, Solaris, Linux and HP-UX operating systems.

Unzip the archive, open the file "install.htm" with your web browser and download the installation file for your architecture. The installation instructions presented below are also available in the page.

Windows XP, Vista, 7:

- After downloading, double-click "install.exe"
- You do not need to install any other software. A Java virtual machine is included with this download.

Windows 8/10 32 bits installation

- After downloading, right-click on "install.exe" and select "Properties"
- On the "Compatibility" tab enable the Compatibility mode and select "Windows 7" and press "Ok"
- Double-click "install.exe"

Windows 8/10 64 bits installation

- After downloading, unzip the file to a chosen directory.
- Navigate to most recent SMOSView directory and double-click "smosview" executable

Mac OS X:

- After downloading, double-click "install".
- Requires Mac OS X 10.4 or later
- Be sure you have Java Virtual machine compliant with version 1.5 installed.
- Make sure that the system allows the installation of software downloaded from everywhere. This can be set in "System Preferences" -> "Security & Privacy".
- The compressed installer should be recognized by Stuffit Expander and should automatically be expanded after downloading. If it is not expanded, you can expand it manually using StuffIt Expander 6.0 or later.

AIX / Linux / HP-UX:

- After downloading open a shell and, "cd" to the directory where you downloaded the installer.
- At the prompt type: "sh ./install.bin"
- A Java virtual machine is included with this download. It will run automatically when you run the shell script.

3.4. Update of New Product Schemas

SMOS View install by default a "jar" file (smos-formats-plugin-SNAPSHOT.jar) containing the latest XIN and XIS SMOS product schemas available on the date of the release, however new schemas releases may happen and this does not mean that a new version of the software shall also be distributed.

SMOS View has the possibility to replace the product schemas jar file with a newer version and the new products can instantly be read. The process is very simple; the user just needs to replace the old "smos-formats-plugin-SNAPSHOT.jar" file with the new one.

The "smos-formats-plugin-SNAPSHOT.jar" is located in the directory where SMOS View was installed.

3.5. How do I start SMOSView?

In order to run SMOSView:

- On Microsoft Windows: In the 'Start' menu, click on the SMOSView shortcut in the SMOSView group menu.
- On an X Windows system (UNIX/Linux) or a BSD based system (Mac OS X): Open a terminal and cd in the SMOSView installation directory. Then type ./SMOSView.

3.6. The SMOSView User Interface

When SMOSView starts, a large window appears containing a *menu bar*, a *tool bar* and an area just below known as a *buffer*, as shown in the Figure 1.

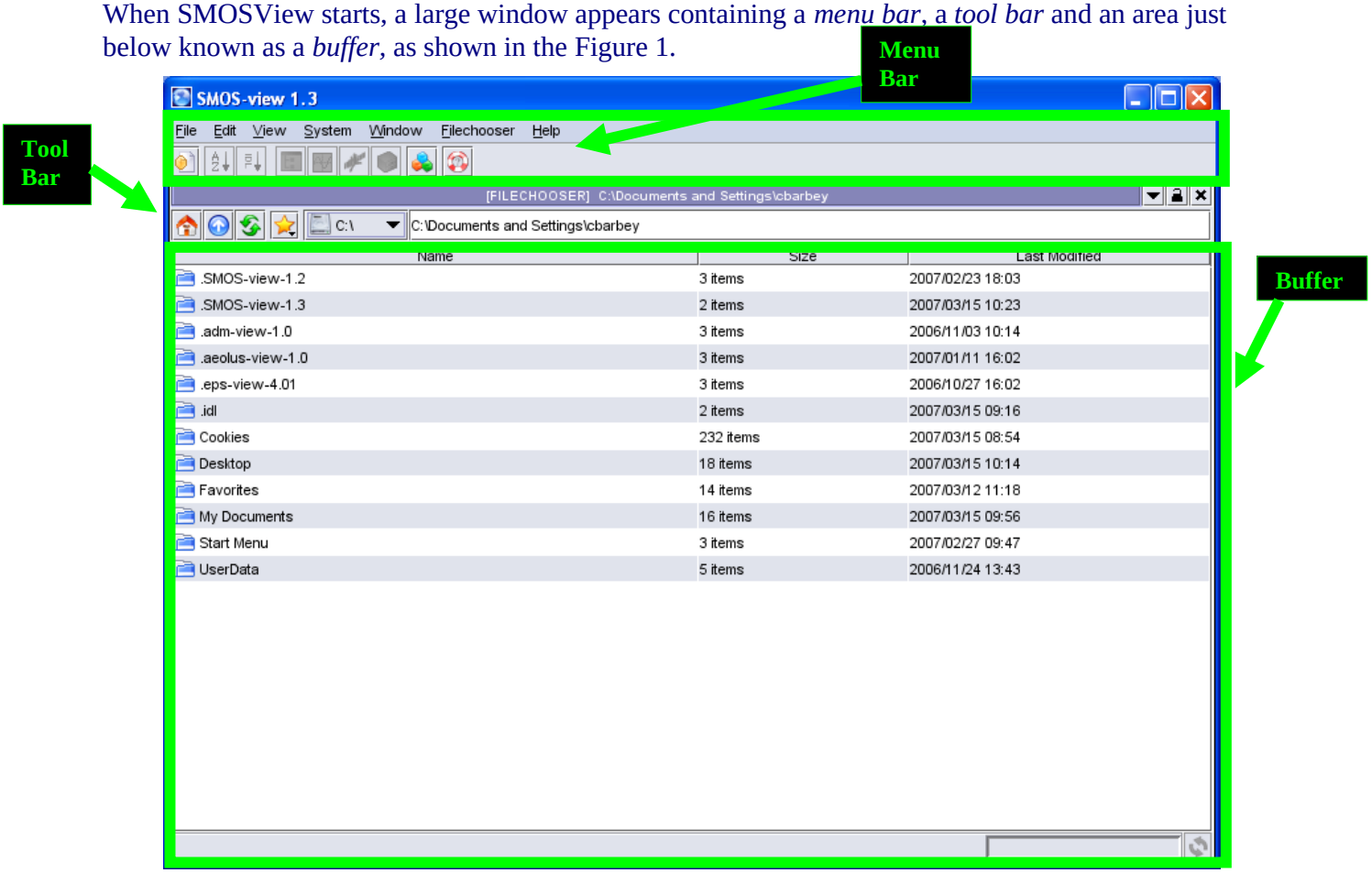


Figure 1: SMOSView start window (From top to bottom: Menu bar, Tool Bar, Buffer)

A window may contain many buffers, and a drop-down list at the top of the buffer area is used to switch between buffers; *the buffer selection box*. To open this selection box as shown in the Figure 2, the user must click on its label. In this example, *the buffer selection box* is labeled: [FILECHOOSER] C:\SMOSView\SMOS TEST PRODUCT\L1A-L1B.

The buffer selection box could also be labeled [BROWSER] followed by the product name if a product is being browsed or [SMOSSVF] followed by the name of the product if the product is being studied with the Specific Visualization Features.

After more than one buffer has been opened, it is possible to come back to a dedicated buffer by clicking the *buffer selection box* located under the main window icons and selecting the buffer of interest.

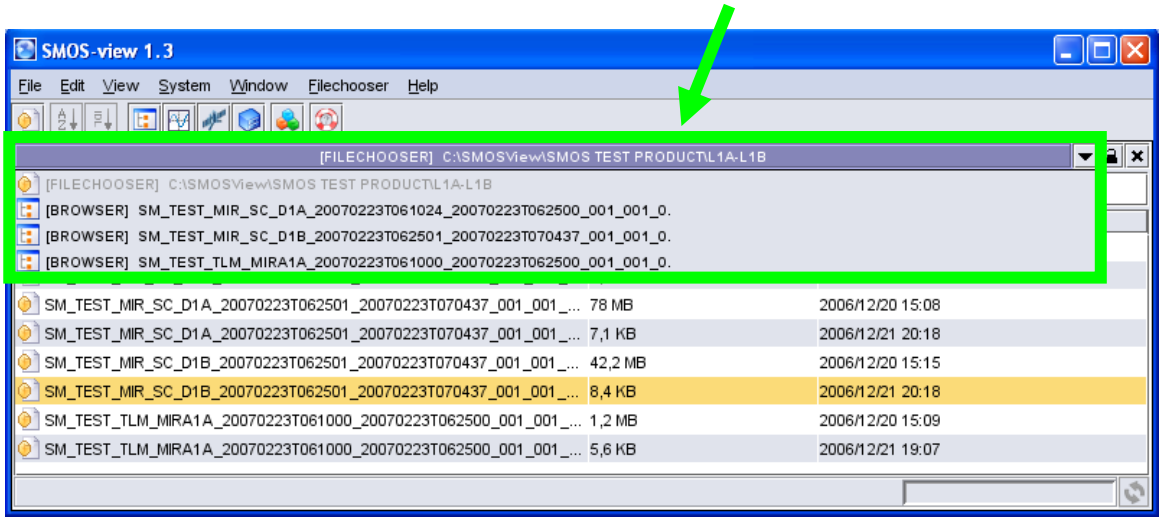


Figure 2: Buffer selection box

Multiple buffers can be displayed in the window at the same time, by *splitting* the window horizontally and or vertically. It can be done by choosing "Split horizontally" or "Split vertically" in the "Window" menu of the menu bar (see Figure 3 and also Section 3.9, Window Menu Figure 8).

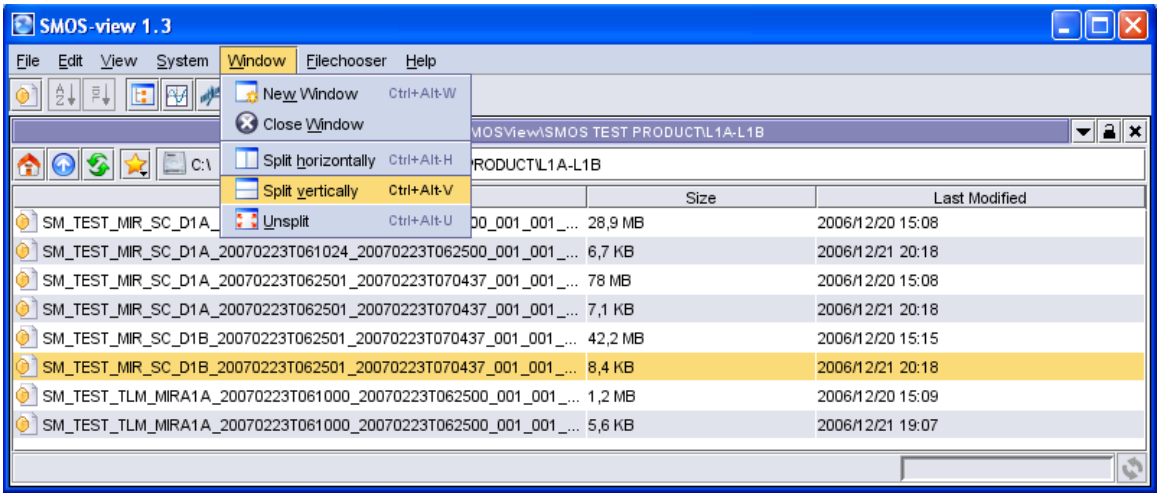


Figure 3: How to split window

Split window sections can be closed by "*Unsplit*" in the "Window" menu of the menu bar.

The same list of buffers is available in each split window section.

Multiple windows may also be opened (see Figure 4, where 4 window-areas have been opened), and within each window, an independent list of buffers may be opened.

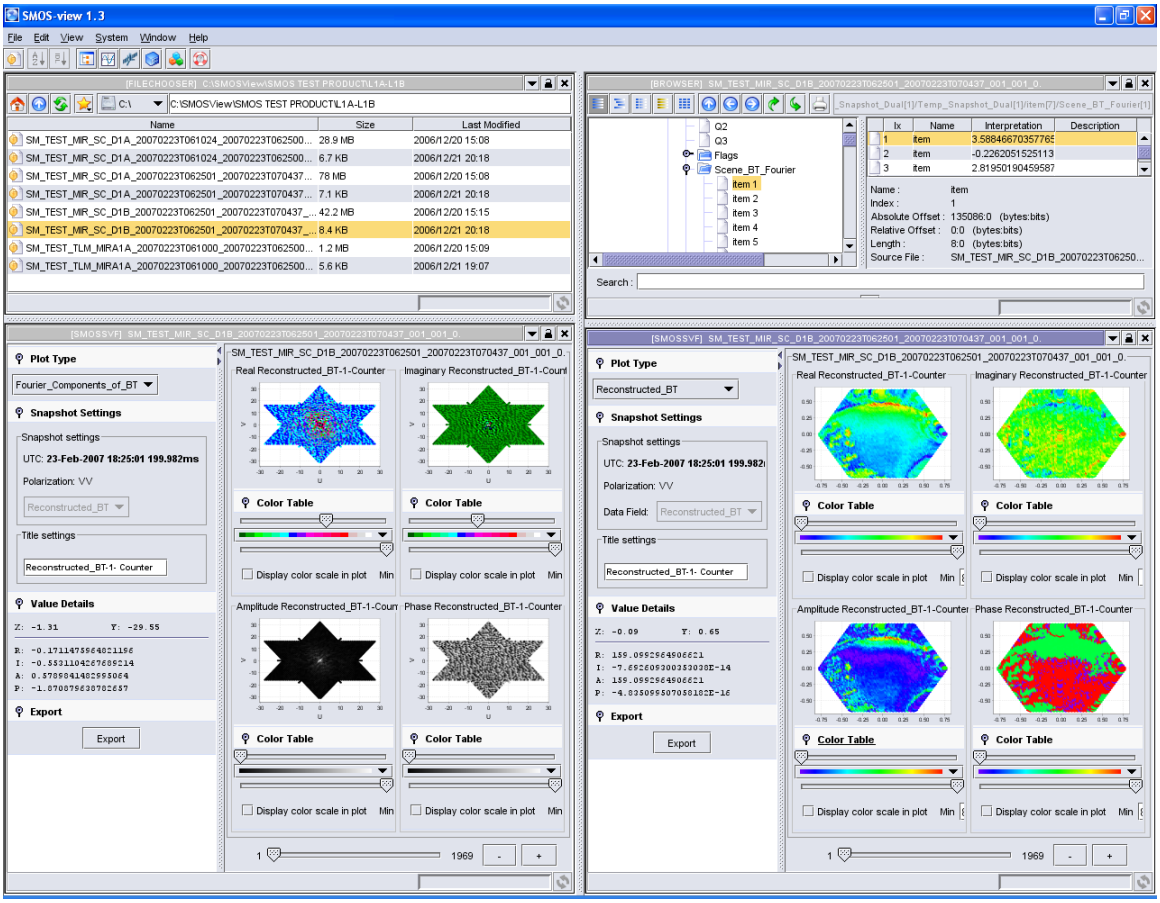


Figure 4: Multiple (x 4) windows opening

A buffer is a SMOSView window containing a set of functionalities/tools associated with a product. Once a product data file is selected with the File Chooser buffer as described in section 4.1 of this document, the user can use the SMOSView functionalities associated with the selected data product by opening a Lat/Long plot, a Plotter or an Image Viewer buffer.

The use of the Format Manager buffer does not require any product to be opened before using it.

3.7. SMOSView buffers

Interaction with data files and the various tools and views provided by the application is through buffers. The current version of SMOSView provides the following buffers:

- *File Chooser* buffer – presents a view of the file system, and identifies compatible files that can be opened with SMOSView
- *Export to ASCII* – allows to export selected data to an ASCII file (.txt extension)
- *Export to IDL* – allows to export selected data to IDL (2 files are created with .pro extension and .dat extension)

  NOTE: There is a limitation on the export IDL feature on variable size arrays. IDL export works correctly if only one pixel is exported. When more than one pixel is exported only the first N-

measurements for each pixel are exported. N is the number of measurements of the first pixel selected.

- *New Browser* buffer – presents a view of the contents of a data file.
- *New Chart* – allows the user to plot data
- *SMOS Specific Visualization features* – allows the user to analyze SMOS L1A, L1B, L1C and L2 products
- *New Format Manager* buffer – presents a description of each of the file formats supported by SMOSView.
- *New Subset Selection* buffer – allows the user to select a data set inside the product
- *Help* – opens the user guide in HTML format

3.8. The first steps

After starting SMOSView, the default window appears which contains a single File Chooser buffer. This allows one to navigate the file system and select a file that can be opened in the application.

At this stage, all the available menus are displayed, but many of the menu items are disabled.

To start viewing data, select a compatible file in the File Chooser, and open a buffer to view the contents (via the toolbar or the buffer menu).

It is also possible to view format descriptions for compatible files via the Format Manager.

The File Chooser buffer is described in section 4.1 and the Format Manager buffer is detailed in section 4.2.

3.9. SMOSView menu tour

This section describes the menus available in SMOSView in version 1.5.2.

The **File menu** enables the user to open a File Chooser buffer or quit the program.

Figure 5: File menu

The **View Menu** enables the user to open a Browser buffer or a Plotter or specific visualisation features buffers. The buffers are only available once a product has been selected (see section 4.1). The Browser, Plotter and specific visualisation features will only be available if a compatible data file has been

selected. After selecting a product, if the user tries to use SMOSView functionality not available with the product, SMOSView will display an empty window.

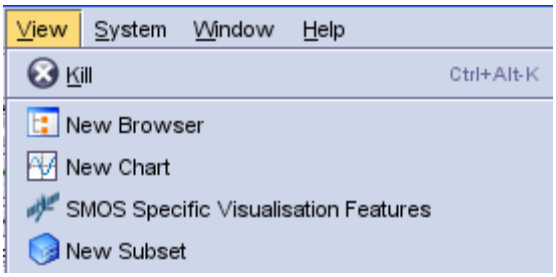


Figure 6: View Menu

The **System menu** enables the user to open the Format Manager buffer, providing a description of the formats contained within SMOSView, as well as a New Logger buffer, giving detailed information on the current SMOSView session as to memory usage, Java version and error reporting.

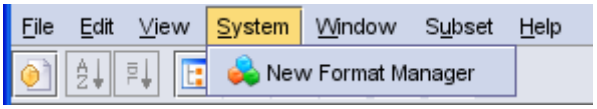


Figure 7: System Menu

The **Window menu** enables the user to open a new window, close a window, or split/unsplit a window.

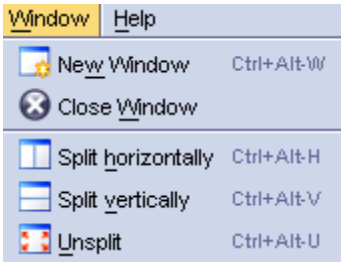


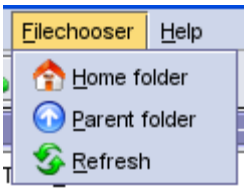
Figure 8: Window Menu

Splitting a window is useful for working with more than one product, or visualizing an image and the related data product file at the same time. (i.e. two or more buffers simultaneously)

For example, a Format browser buffer and an Image Viewer buffer may be viewed side by side by clicking on the Split horizontally menu item, and then selecting the Image Viewer buffer in the second split section.

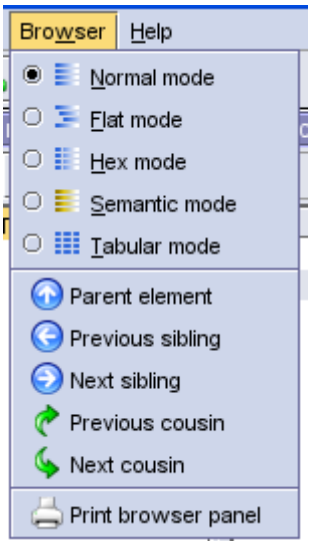
The sixth menu in the menu bar is buffer specific, it means it depends on the content of the current buffer. This 6th menu provides access to options specific to each buffer type:

- When a file chooser is opened, the 6th menu proposes either to go to the home folder, or to the parent folder, or to refresh the current window:

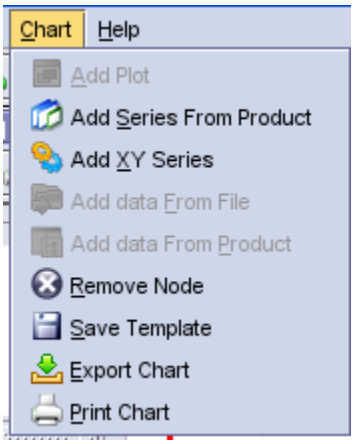


- When a browser is opened, the 6th menu proposes various options to visualize the content of the selected product: visualization mode selection (normal mode, flat mode, Hex mode, Semantic mode,

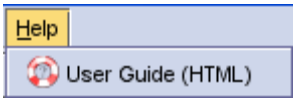
or tabular mode), browsing options (go to the parent element, to the previous or the next brother, to the previous or the next cousin, or printing options:



- When a Plotter buffer is opened, a Plotter menu appears. Depending on the selected field (Plot/Series/Data), the selectable options are different. They could be: Add Plot, Add Series from product, Add XY series, Add data from file, Add data from product, Remove node, save template, export chart, or print chart:



- When the specific visualization feature (SVF) buffer is opened, the 6th menu is not an SVF specific menu but the help menu:



The **Help menu** provides an access to the user guide (based on this document).

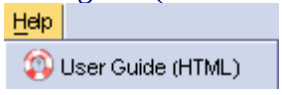


Figure 9: Help Menu

After a buffer is opened, right clicking in a buffer will display additional context sensitive menu options, associated with that buffer as well as a shortcut to some the menus in the menu bar. For example, after opening a Format Browser, right clicking in the buffer will display the following menu:

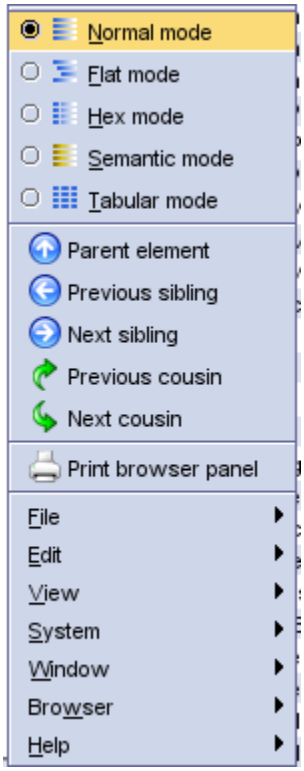


Figure 10: Right-clicking example

3.10. SMOSView toolbar

Below the menu bar, a toolbar is provided as shortcuts for common tasks:

- File chooser
- Export to ASCII
- Export to IDL
- Format Browser
- Plotter
- SMOS Specific visualization features
- New Subset Selection
- HTML format description
- User guide

Figure 11: SMOSView Icons

Toolbar icons are only highlighted when the associated functionality is ready for use. For example, after opening SMOSView, the "Export to ASCII" is greyed, as there is no file open to export data from.

3.11. SMOS View Known Problems and Limitations

Before the user starts to use SMOS View, it shall be clear that the tool have some limitations and some known problems specially on big product files. This section contains some important information related to these issues and will be updated along with the new releases of the tool.

- The chart plugin has memory limitations, when the user tries to plot a variable from a product with a high number of points (more than 2 million) it is very slow and sometimes just freeze. This happens on products such as LAI, AUX_SSS, AUX_DISTAN, and some L2 products.
- In the browser plugin some indications that the data is loading is missing. Sometimes it is still loading data and no information is shown. This usually occurs on big product files.
- The specific visualization panel has refresh problems, sometimes when the user tries to visualize L2 flags they don't appear in the world map, however if the user zooms an area the flags appear.
- When the user tries to use the specific visualization L2 data (especially AUX DGG files) the specific visualization panel is loaded and became completely grey, user must resize the window view the content correctly.

4. VIEWING DATA CONTENT

This chapter details the use of SMOSView for viewing products.

4.1. File Chooser buffer

In order to select a product for analysis in SMOSView, select a File Chooser buffer (one is opened by default at startup), or click on the "New Filechooser" icon.

Figure 12: New file chooser icon

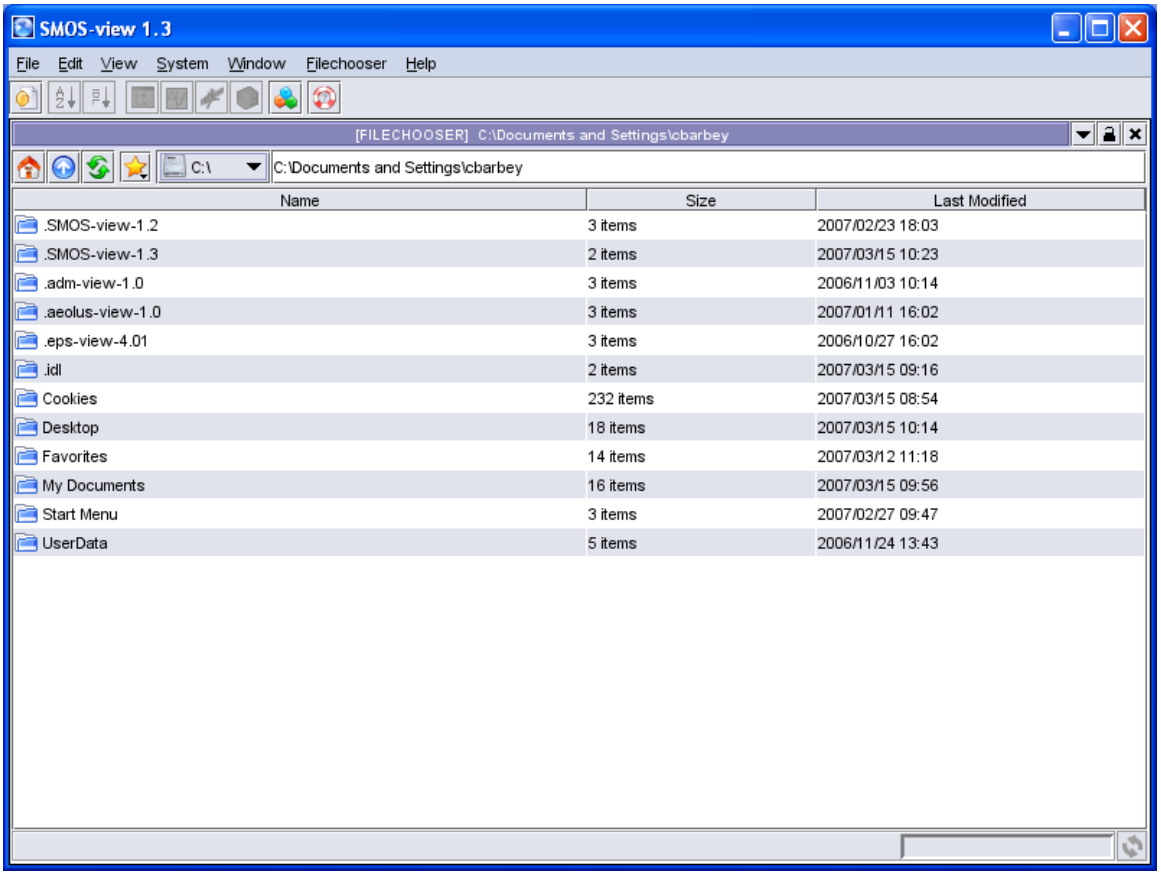


Figure 13: File Chooser buffer

It is possible to navigate through to common directories using the "Home directory", "Parent directory", or "Drive selection" toolbar icons.

- Home directory icon: 
- Parent directory icon: 
- Refresh view icon: 

- Previously accessed directory: 
- Drive selection: 

Figure 14: File chooser icons

The "Refresh view" icon enables the user to update the view of the current folder if a file has been added/deleted from/to the folder since list was first displayed. The location bar provides the location of the selected directory/file. Folders are highlighted with a blue icon.

Figure 15: Folder icon

Double click on a folder to view its contents. Use the Parent directory toolbar icon to go up to the directory level above the current list.

Once the data is located, files compatible with SMOSView are highlighted with the following icon:

Figure 16: Compatible file icon

It is then possible to select the data of interest by simply clicking once on the file of interest. Once the file is selected, it is highlighted in yellow.

To open a compatible data, the user must double click on its name. The data will then be automatically opened in a new Browser buffer, displaying the content of that file (see section 4.3).

After selecting a product, a user can browse through its content using the format browser.

To open a file, the user can either double click on its header name (.HDR) or on its data block name (.DBL).

It is also possible to browse some intermediate products such as CORN1A and UNCN1A in EEF format. In this case SDV automatically generate the corresponding HDR and DBL files allowing the user to browse the content.

4.2. Format Manager Buffer

In order to view format descriptions of compatible data files, click on the "New FormatManager" icon.

Figure 17: Format manager icon

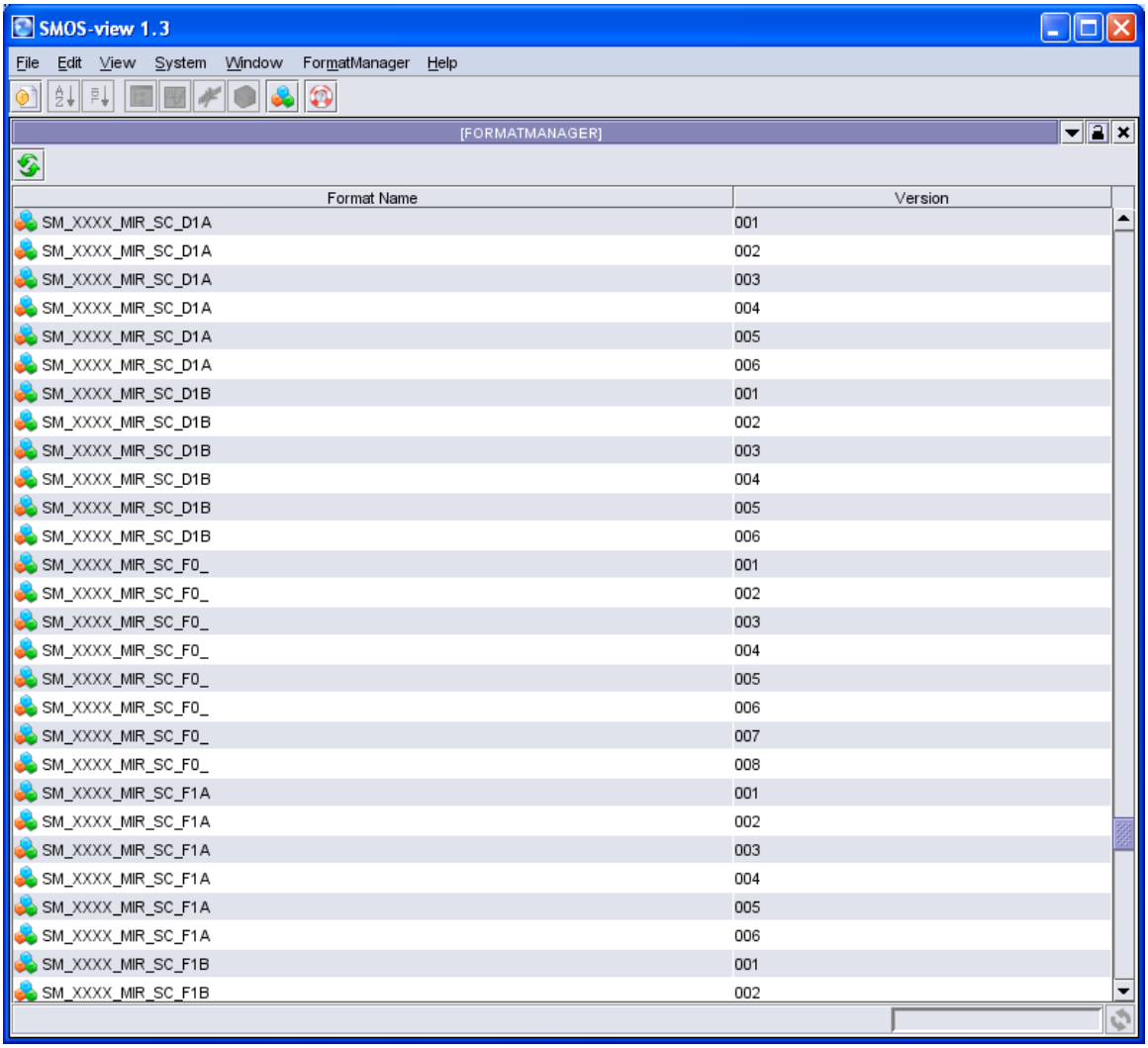


Figure 18: Format manager buffer

The FORMAT MANAGER buffer contains the list of file formats that are recognized by SMOSView and potentially multiple versions of each format.

The version gives the global version of the format, not the header or the datablock version.

The list is obtained by inspecting the formats shipped with SMOSView, therefore the list is always in line with the list of products that can be read using SMOSView.

Double click on any of the formats to visualize the detailed description.

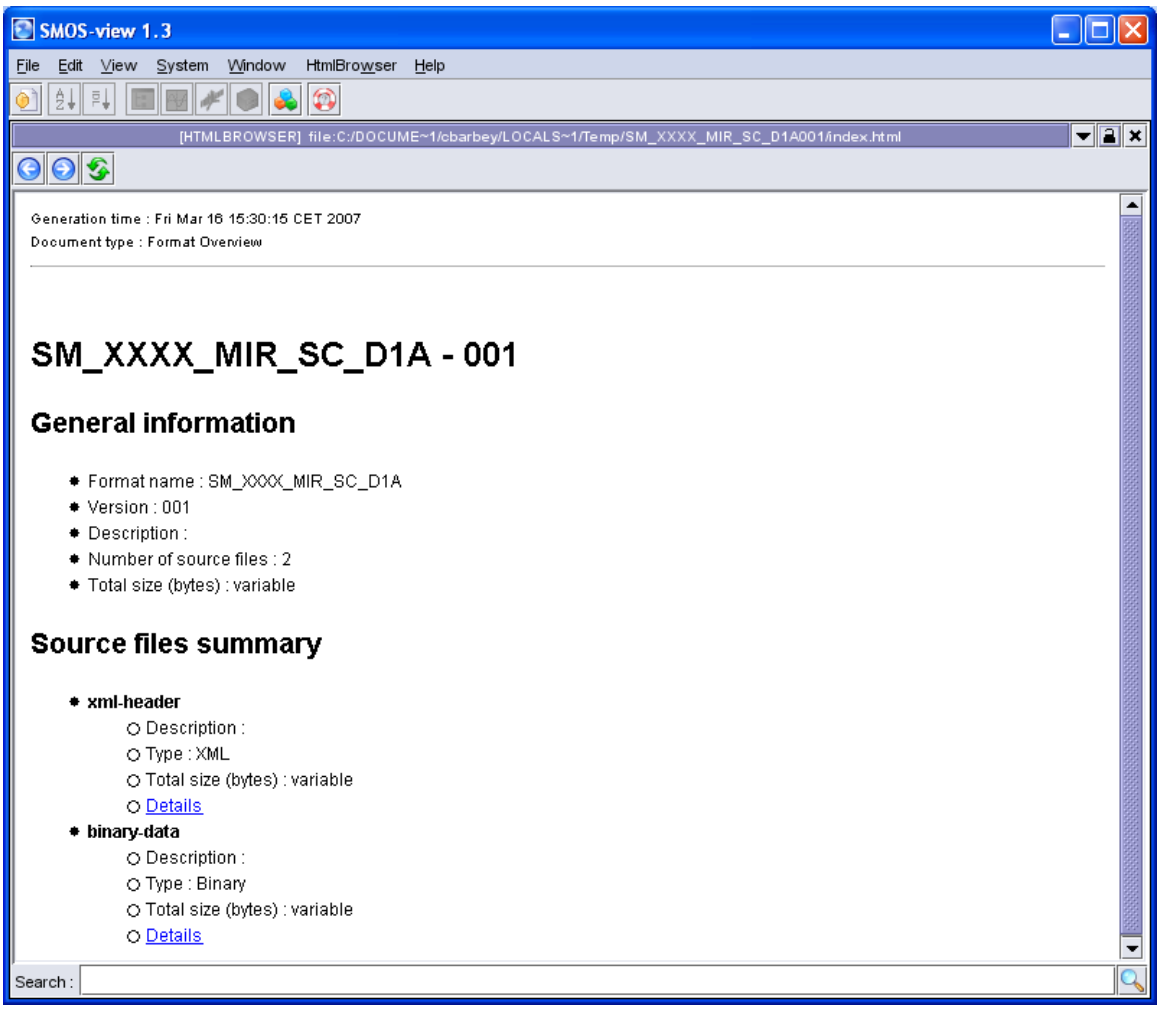


Figure 19: HTML format description example

Format information is available as a hierarchy, through which one navigates by clicking on blue links "Details", similar to a web page.

Once the "Details" page opened, it is also possible to navigate through the format descriptions using the "Previous page", "Next page", or "Reload page" toolbar icons placed in the top left corner of the window.

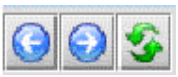


Figure 20: HTML format description navigation icones

4.3. Browser buffer

Select a file in the File Chooser (section 4.1) and create a Browser buffer by either double clicking on the product file, or clicking once on the highlighted "New Browser" icon.

Figure 21: New Browser icon

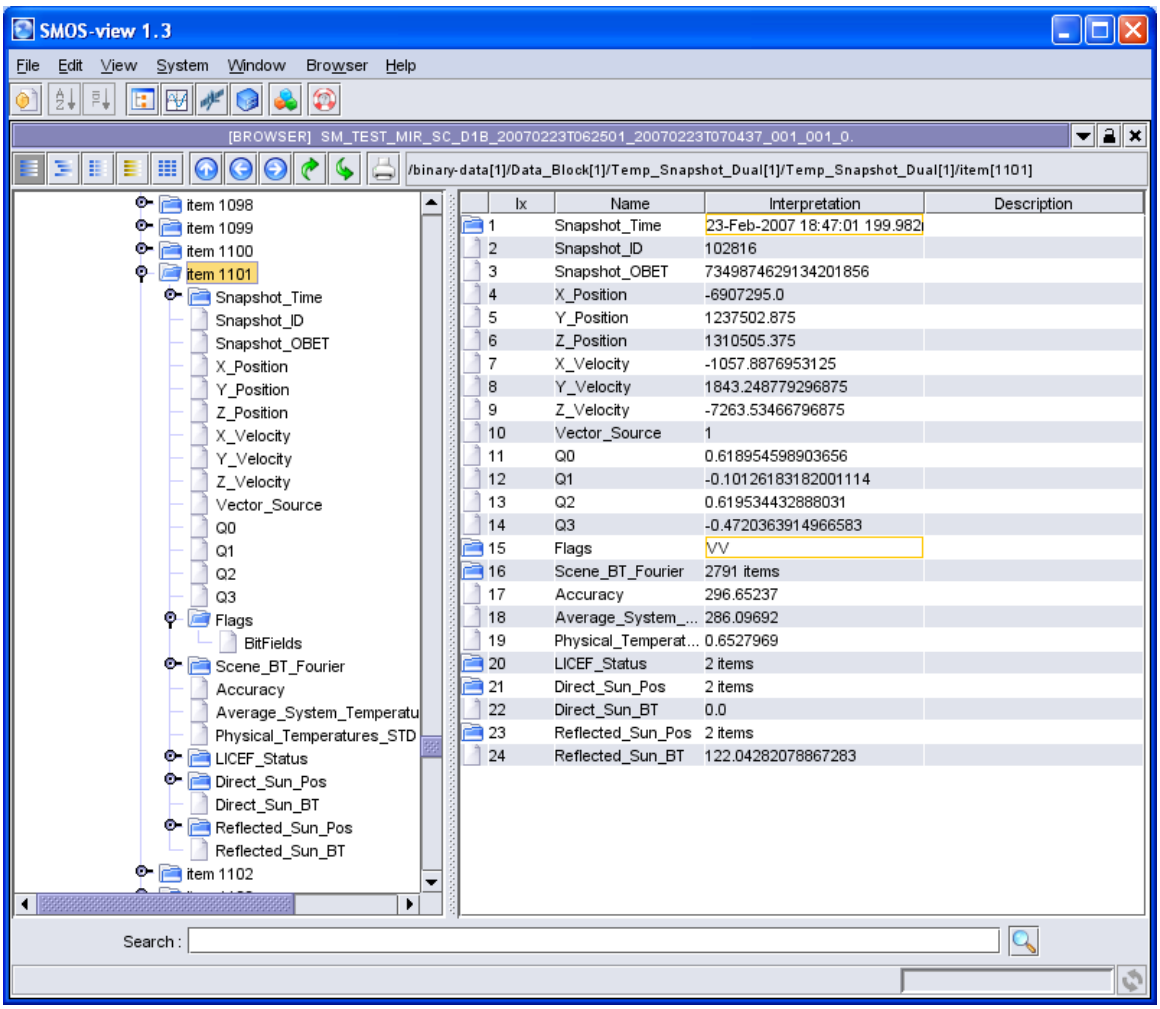


Figure 22: Browser buffer example

The Browser buffer has several display *modes*; Normal mode, Flat mode, Hex mode, Semantic mode and Tabular mode. By default, the Browser buffer opens in Normal mode.

The buffer is divided in two panes: On the left-hand side we find a hierarchical view of the content of the file and on the right-hand side, we find the content of selected parameter or structure, and interpretation of the field values and description.

A tool bar is displayed at the top of the buffer with several toolbar icons to allow switching between the different modes and navigating through the selected file.

- ❑ Normal mode 
- ❑ Flat mode 
- ❑ Hex mode 
- ❑ Semantic mode 
- ❑ Tabular mode 

- Parent element
- Previous element
- Next element
- Previous cousin
- Next cousin
- Print browser panel

Figure 23: Data browsing icons

There are two types of icons within the browser window:

- Representing a data container.

A data container can contain other data containers or leaf nodes.

- Representing a leaf node, containing data.

4.3.1. Search function

The user can search for a field name or a value within the product with the search function at the bottom of the browser window.

4.3.2. Data browsing in Normal mode

One single click on a container (blue-folder icon) in the left-hand pane will display the content of the container in the right-hand pane.

Double clicking on a container in the left-hand pane will provide the content of the container in the right-hand AND left-hand panes.

It is also possible to browse through a product with one single click on the tree opening symbols associated with a data container in the left-hand pane:

- *tree opening symbol*

Clicking on a leaf node in the left-hand pane will provide a view of the parent node in the right-hand pane; the selected leaf node will be highlighted in the right-hand pane.

It is also possible to visualize the content of a container by double clicking on it in the right-hand pane. In this case, the container is highlighted in the left-hand pane.

It is possible to browse through the product using the "Parent element", "Previous element" and "Next element" icon. Using the "Next" and "Previous" icons enables the user to view the next or previous element within a container. Using the "Parent" icon enables the user to view the higher-level data container.

In the context of SMOSView, two cousins are data containers or leaf node belonging to a repeated structure within a data block. It is also possible to browse through the products clicking the Previous cousin and Next cousin Icons. When a leaf node or data container is selected within a data block, clicking on the next/previous cousin will provide same leaf node or data container view of the next/previous data block.

Example: for a SMOS L1B data product, the user selects and clicks on the Snapshot_ID in a container "binary-data/Data_Block/Temp_Snapshot_dual/ Temp_Snapshot_dual/**item 7**".

=> Clicking on the Next cousin icon, SMOSView will show the Snapshot_ID of "binary-data/Data_Block/Temp_Snapshot_dual/ Temp_Snapshot_dual/**item 8**".

When a leaf node is selected, the location bar provides the path to the higher-level container. When a container is selected, the location bar provides the path of the container within the product.

4.3.3. Interpreted data

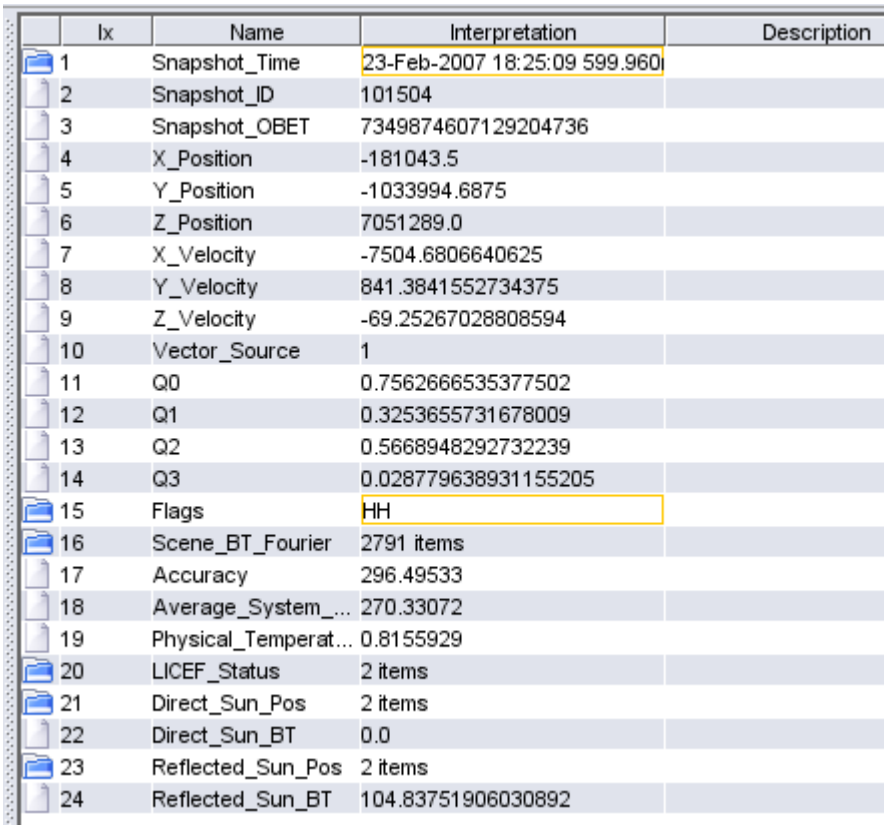
"Interpreted data" are elements of a data file whose numerical value is translated into human readable form.

For example, considering a SMOS L1B product, in the container:

"binary-data/Data_Block/Temp_Snapshot_dual/ Temp_Snapshot_dual/item 7", the field "**Flags**" is interpreted. The field can have several integer values, but SMOSView is capable of decoding the meaning of those values. For instance, the value 0 corresponds to H (horizontal polarization).

The same applies to another field in this container: for example Snapshot_Time (day 2610 has been interpreted as 23-Feb-2007).

In the right-hand side window, interpreted data appear within a yellow box:



Ix	Name	Interpretation	Description
1	Snapshot_Time	23-Feb-2007 18:25:09 599.960	
2	Snapshot_ID	101504	
3	Snapshot_OBET	7349874607129204736	
4	X_Position	-181043.5	
5	Y_Position	-1033994.6875	
6	Z_Position	7051289.0	
7	X_Velocity	-7504.6806640625	
8	Y_Velocity	841.3841552734375	
9	Z_Velocity	-69.25267028808594	
10	Vector_Source	1	
11	Q0	0.7562666535377502	
12	Q1	0.3253655731678009	
13	Q2	0.5668948292732239	
14	Q3	0.028779638931155205	
15	Flags	HH	
16	Scene_BT_Fourier	2791 items	
17	Accuracy	296.49533	
18	Average_System_...	270.33072	
19	Physical_Temperat...	0.8155929	
20	LICEF_Status	2 items	
21	Direct_Sun_Pos	2 items	
22	Direct_Sun_BT	0.0	
23	Reflected_Sun_Pos	2 items	
24	Reflected_Sun_BT	104.83751906030892	

Figure 24: Interpreted data representation

Interpreted data can apply to leaf nodes or containers.

For example, in the SMOS L1B data product, the Snapshot_Time container, consists of 3 fields: Day, Seconds, and Microseconds, but can be interpreted as a human readable time.

It is also possible to read the numerical value associated with an interpreted data when a data container is interpreted. Double-click on the data container, SMOSView will display the numerical value of the interpreted fields. Clicking back on the parent data container changes the field back to the interpreted value.

4.3.4. Ignored data

If SMOSView expects to read an integer, and read an unsigned integer the product, it is flagged in the following way:

Figure 25: Ignored data flag

4.3.5. Other data visualization modes

Data selected in "Normal" mode can be visualized in other modes using the icons placed on the top left-hand side of the BROWSER.

- **"Flat mode":**

If a container is selected, all data within the container are displayed in the right-hand pane down to the lowest leaf level in a hierarchical order. If a leaf node is selected, the parent container is displayed in flat mode in the right-hand pane.

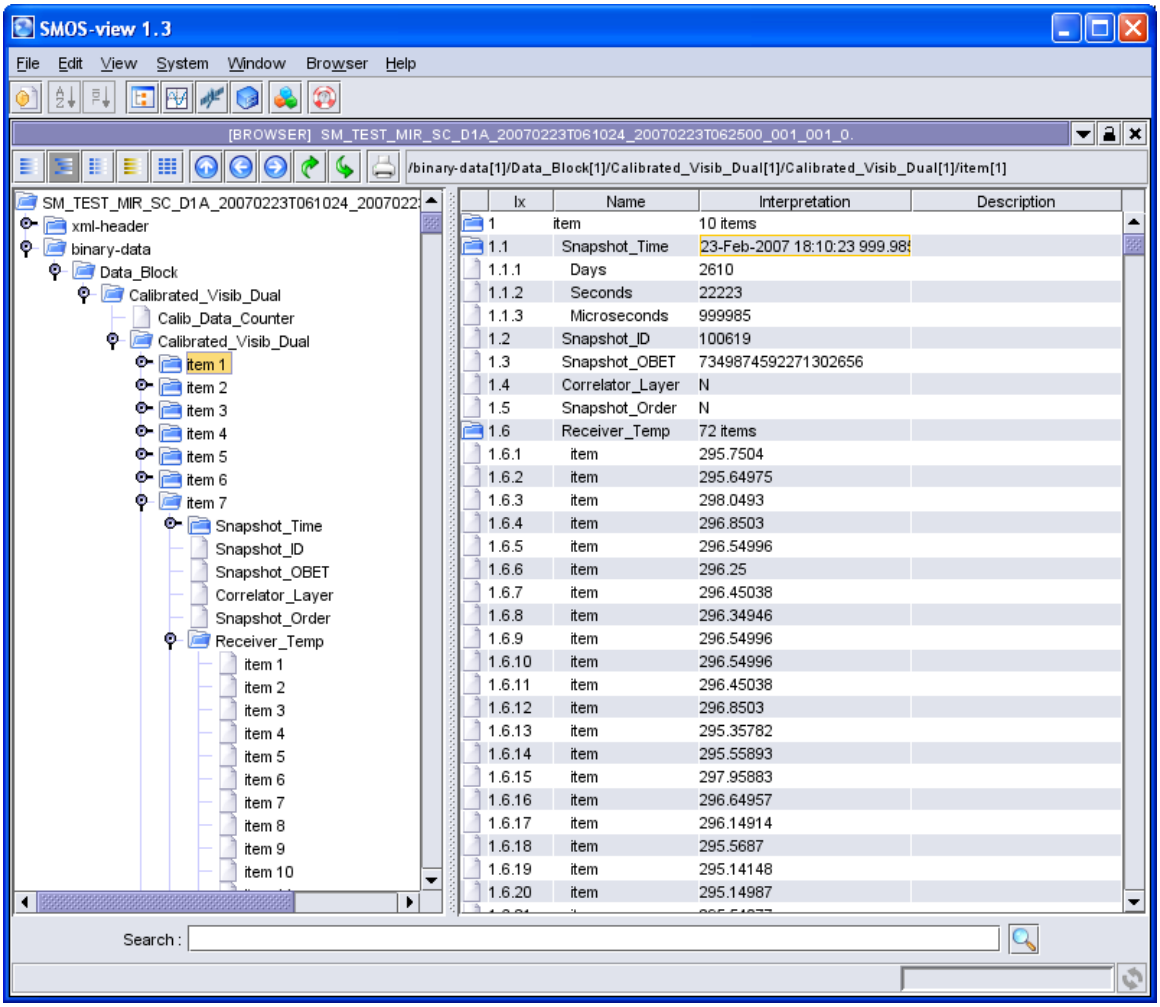


Figure 26: Flat Mode

- **"Hex mode":**

In Hex mode the whole product file is displayed in hexadecimal format in the right-hand pane. The data selected in the browse tree is also highlighted in yellow in the right-hand pane.

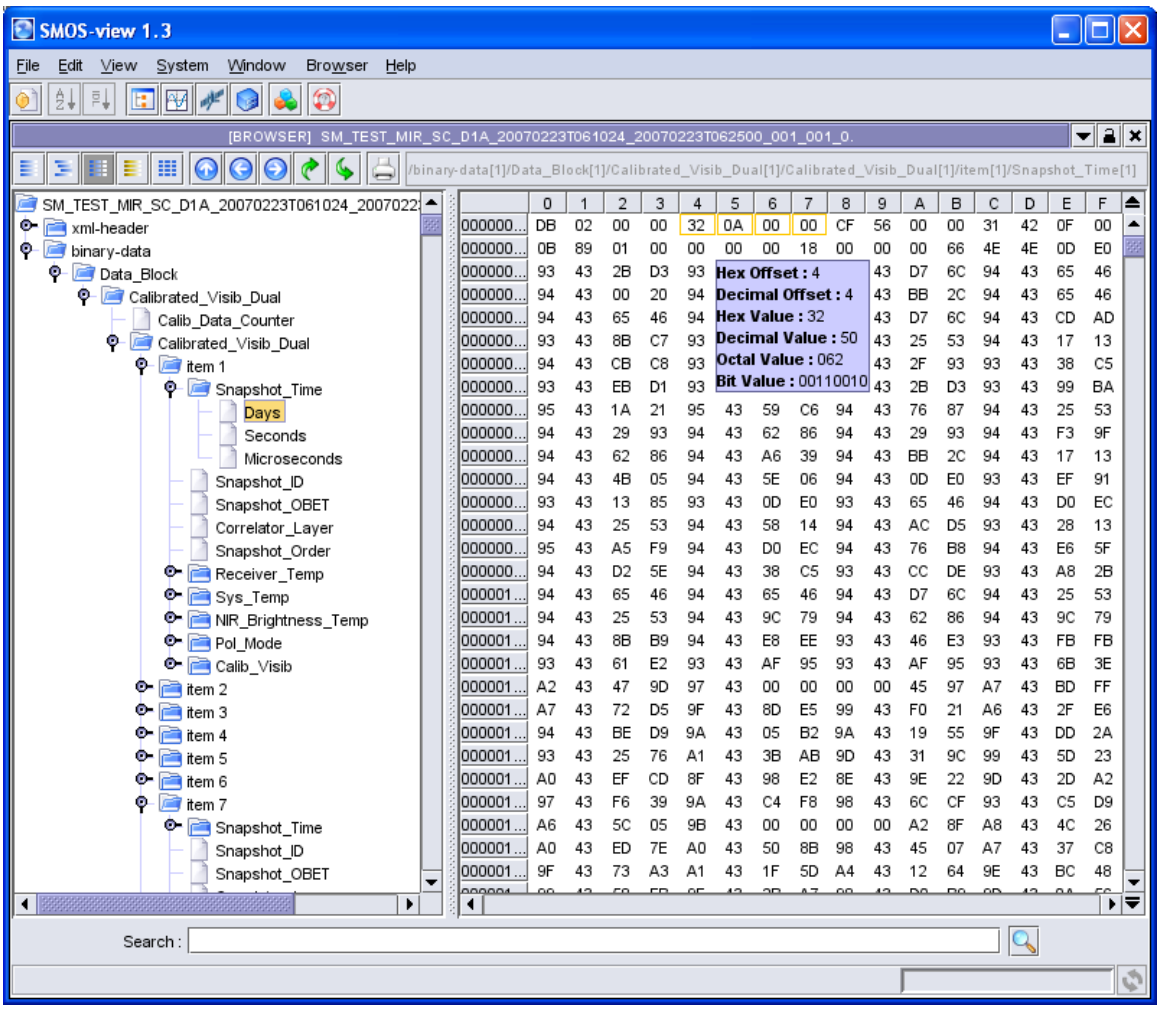


Figure 27: Hex Mode

- **"Semantic mode":**

This mode shows all the semantic data contained within a field of interest. In the case of SMOSView, it should not be useful, except for L3 or L4. The semantic data is limited to images. If a product or a subset of a product contains an image, clicking on the semantic mode icon will display the available images and related channels in the right-hand pane.

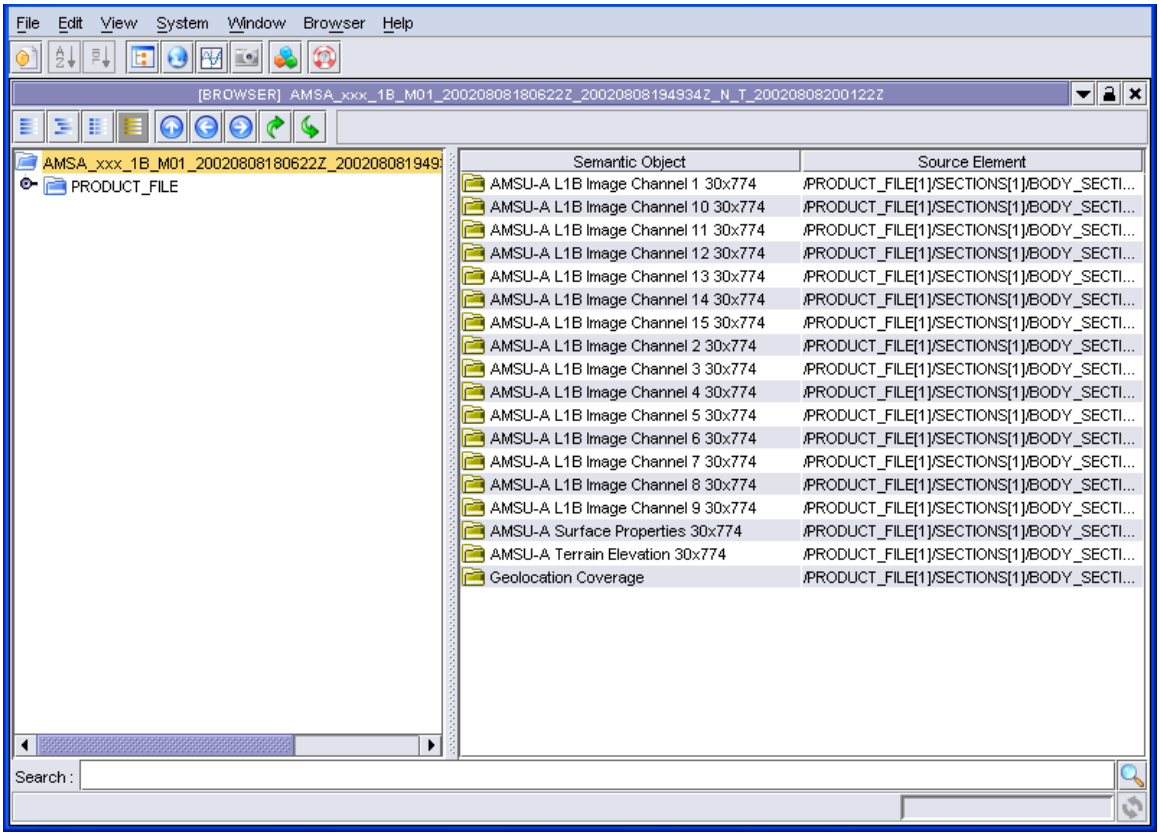


Figure 28: Semantic mode display

Using the semantic mode, it is possible to open an Image Viewer buffer by selecting one or more channels from the right-hand pane. The user can select to visualize a single channel of interest with a simple mouse click. To select multiple channels of interest hold the "Ctrl" key pressed and click on the additional channels until they are highlighted.

- **"Tabular mode":**

To use this mode, the user needs to select a sequence of data or an array (which could be a data container).

The tabular mode allows to visualize all the selected values (or the values contained in the array) in a table that may be transposed (see Figure 29).

To transpose the matrix, click on the upper left cell labeled "tt".

The elements of the transposed table (see Figure 30) can be copied/pasted in another application.

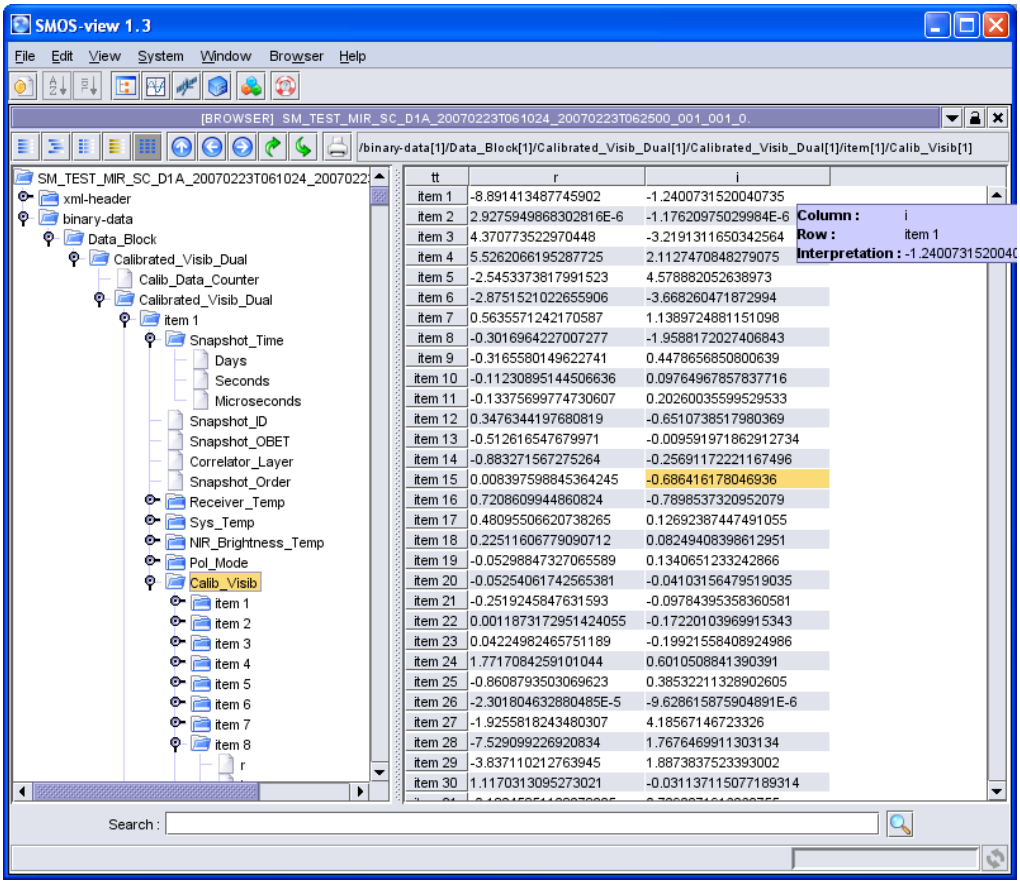


Figure 29: Tabular Mode

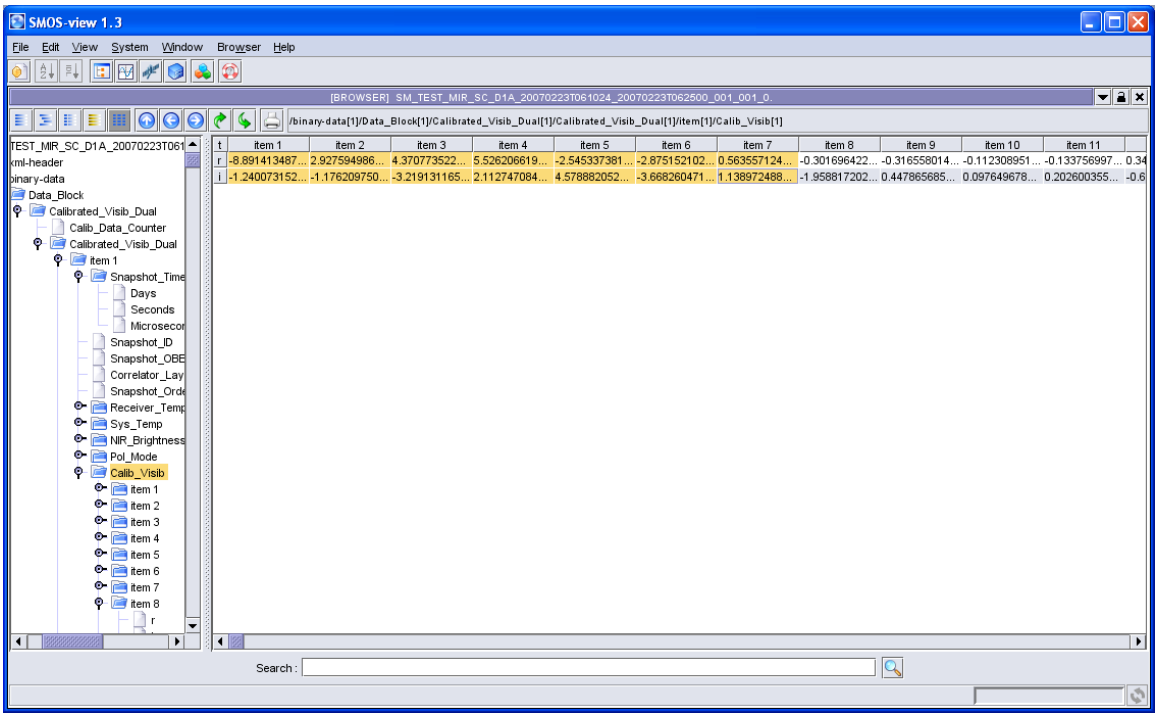


Figure 30: Transposed table from the tabular mode

4.4. Export a product subset to an ASCII file

The Export to ASCII can be performed in two ways:

4.4.1. Export data using the Browser buffer

In order to export a product subset to an ASCII file, it is first necessary to select the data of interest inside a Browser buffer.

When the Browser is in "Normal mode" or "Flat mode", use the right-hand pane to select containers and/or leaf nodes of interest that you would like to export.

To select multiple items, hold the "Ctrl" or "Shift" key while selecting containers and nodes. (CTLR + Click for selecting non-consecutive items, Shift for selecting consecutive items).

Upon pressing the "Export to ASCII" icon in the toolbar  , an "Export to ASCII" dialog box appears allowing you to perform an ASCII export.

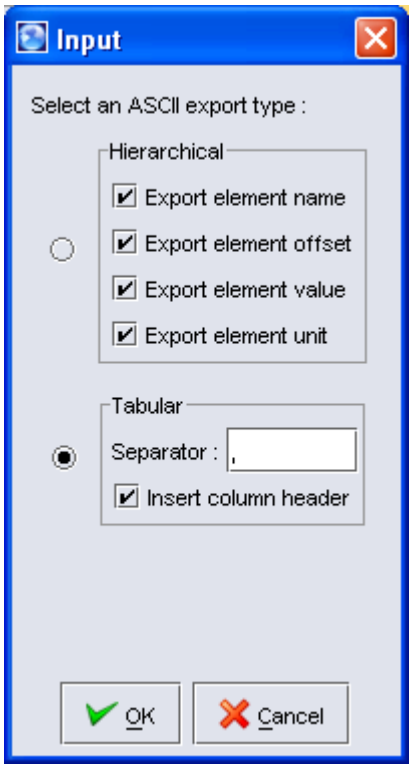


Figure 31: "Export to ASCII" dialog box

You can then choose to perform a Hierarchical export or a Tabular export.

With the Hierarchical export, the user can choose to export:

- the element name
- the element offset
- the element value
- the element unit.

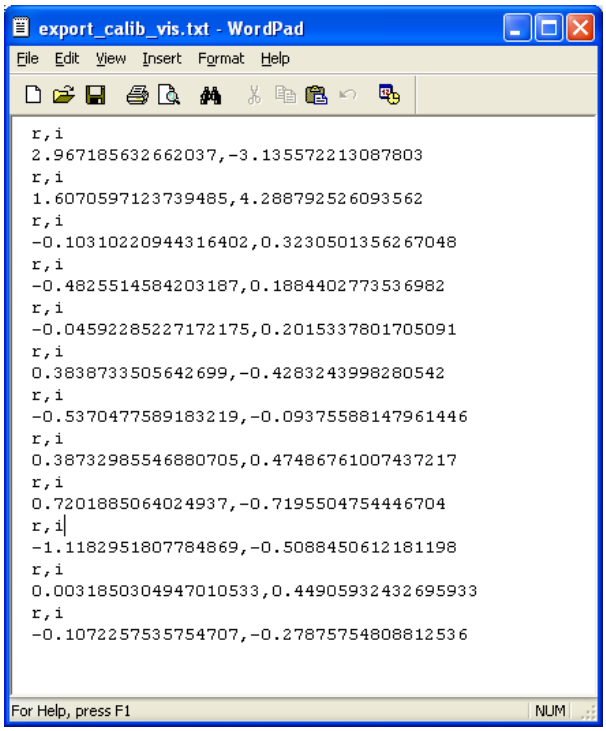


Figure 32: ASCII export example

The example in Figure 32 shows the type of output that is produced by the "Export to ASCII" Hierarchical option. Note that the file has a ".txt" extension.

With the Tabular ASCII, the user has the possibility to select the separator type as well as inserting a column header or not. The Tabular ASCII is very useful if the user wants to export its data in Excel for example. In that case, the user should set as a separator a single comma ",", and then save the file in the csv format. The user can then open the saved file using Excel.

It is important to notice that the Tabular ASCII export function needs to be used with properly selected coherent data. If you try to export a two-dimensional array structure over a repeated number of data blocks along with data contained in the product header for example, there is no guarantee that the export will be satisfactory. On the contrary, if the selected data is coherent, i.e. the selected data is of the same hierarchical level, and containing no dummy data, the Tabular export to ASCII is the perfect tool for allowing further processing with other tools.

4.4.2. Export data using the New Subset selection

It is also possible to select the data to export clicking on the "New Subset" icon. Select a file in the File Chooser (section 4.1) and click on the "New Subset" icon. The following Window appears:

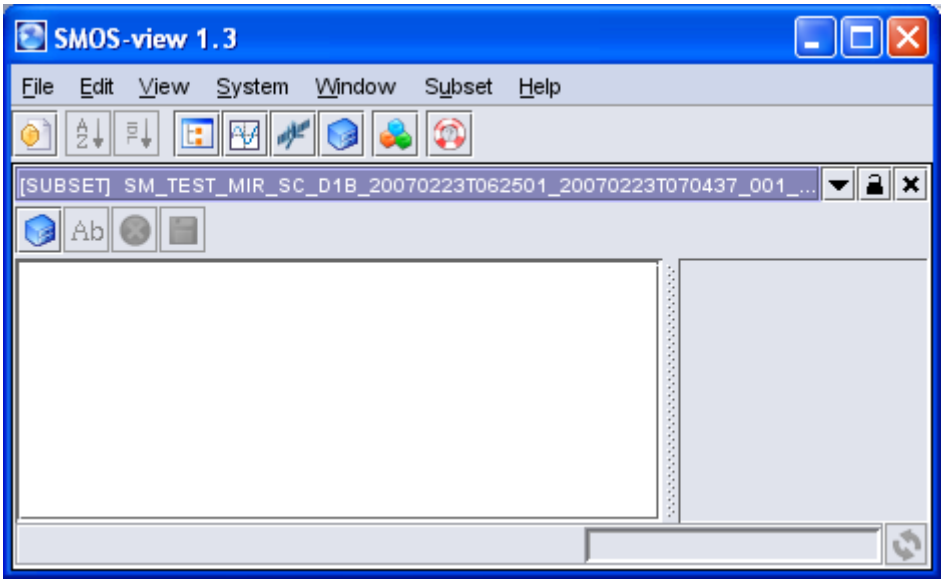


Figure 33: Subset selection Window.

On the top left hand side window area, the user can find the following Icons:

Figure 34: Subset selection icons.

The user can then click on the New Subset blue icon  : he must enter a name for the new subset to be created and click OK:

Figure 35: New subset dialog box

Then the product structure will appear in the right-hand side window. The user can then select and browse through the product structure and select the data to export simply clicking in the selection box attached to the data to be exported (see Figure 36).

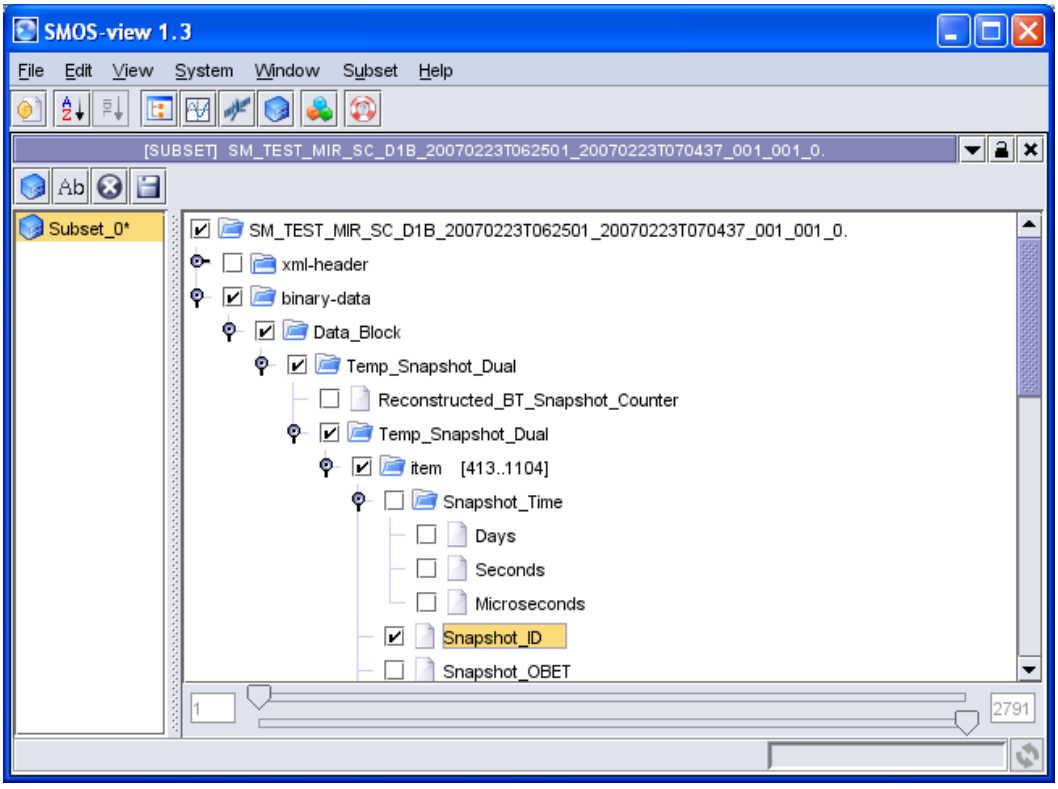


Figure 36: Selected data for export example

The user can then save the created subset, rename it or delete it clicking on the icons presented in Figure 34: Subset selection icons. The saved subset will be available next time the user opens the product.

When a product is made of repeated data structures, you can use scroll bars at the bottom of the selection window to select the subset of data to export, as shown in the example below:

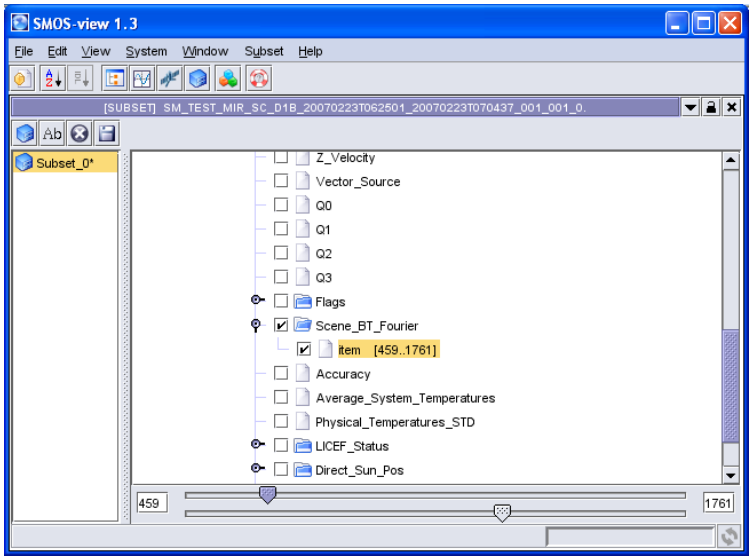


Figure 37: Selection of data with scroll bars

The selected data product contained 2791 Scene_BT_Fourier items. For the scroll bars to be available, the user needs to click on the item array container Scene_BT_Fourier [1.2791] selection box. This

makes the scroll bars appear, the user can then select a subset of items to export by dragging the cursors along the bar by clicking and dragging one of the cursors with the left mouse button pressed.

To complete the export, the user must click on the Export to ASCII Icon in the tool bar and proceed in the same way as described in the previous paragraph.

Once more, the user must select data carefully to perform a valid Export in a Tabular format.

5. PLOTTING DATA

SMOSView allows the user to perform 2D and 3D plots using the 2D plotter buffer and the 3D plotter buffer.

In order to avoid out of memory issues caused by the chart plugin, the maximum number of points that is possible to plot is limited to the first 600.000. If the user tries to plot a variable with a higher number of points a warning message is displayed and the limited plot is produced.

NOTE: It shall be noted that in versions of SDV prior to 1.5.2 the data is loaded in memory and then displayed. Any change on the display preferences will imply a reload of the data into memory.

5.1. 2D plots

In order to use the 2D plot, the user must select first a file using the File Chooser buffer as presented in section 4.1 of this document.

The user can then click on the New Chart Icon  ; the following window appears:

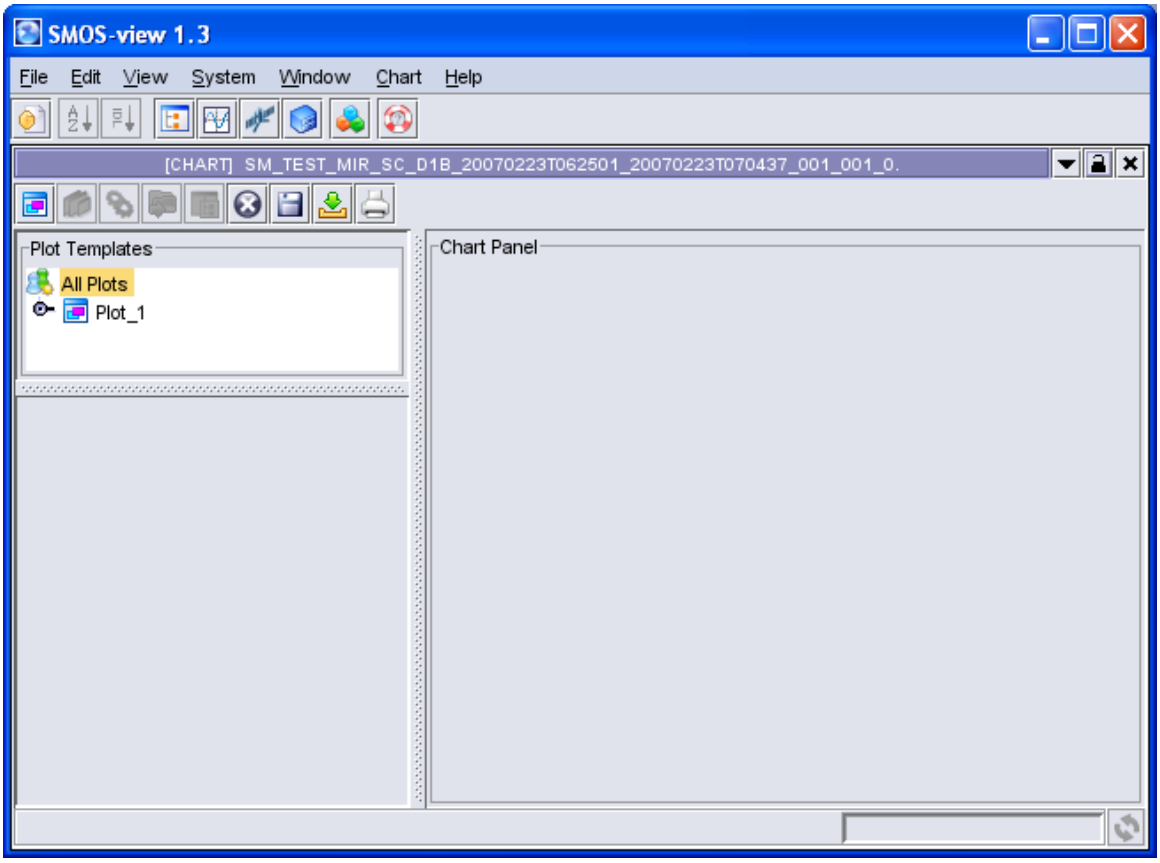


Figure 38: Plot default window

The following icons are available on the top left hand side of the plotter window:

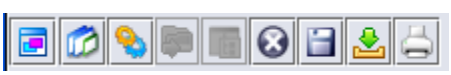


Figure 39: Plotter buffer icons

From left to the right, the following Icons provide the following functions:

- Add plot
- Add Series from Product
- Add XY Series
- Add data from File
- Add data from Product
- Remove Node
- Save template
- Export Chart
- Print Chart

5.1.1. Plotting a data field against an auto-generated index

In the "**Plot Templates**" Box (Figure 40), the user must click on the magnifier icon  of "Plot_1", then "Serie_1", then "Data_1".

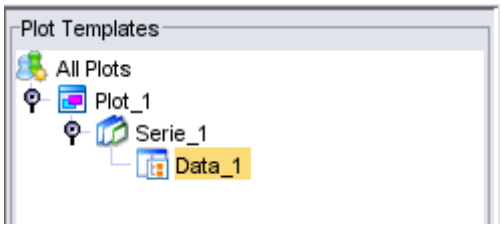


Figure 40: Plot Templates box

A new panel, the "**Data Panel**" box becomes active (Figure 41), below the Plot Templates box.

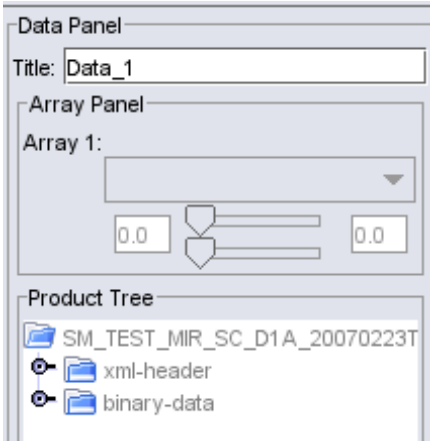


Figure 41: Data Panel

The user must browse inside the data to select data field of interest to be plotted with the Product Tree (See panel on the lower left, Figure 42): The user has then to click on the field of interest to plot it.

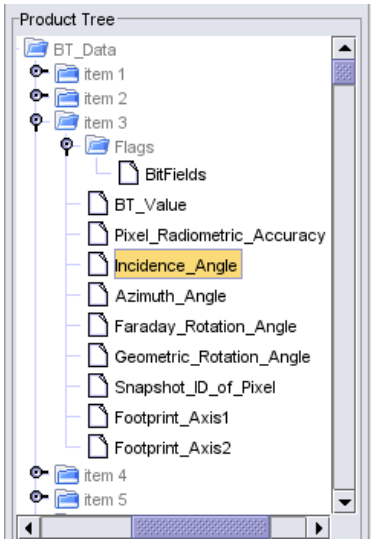


Figure 42: Product Tree

While browsing the data deep inside the "Product Tree" another panel becomes active, which is the "Chart Panel" (big window in the middle). It corresponds to the panel where the plot is displayed, as seen in Figure 43.

The plotter will then try to display the selected data field. If the selected data field is contained within a repeated structure inside the data product file, the plotter will show the selected data field value against the repeated data structure index.

If the data field is contained inside two subsequent repeated data structures, the user has the option to select the index of one data structure or the other.

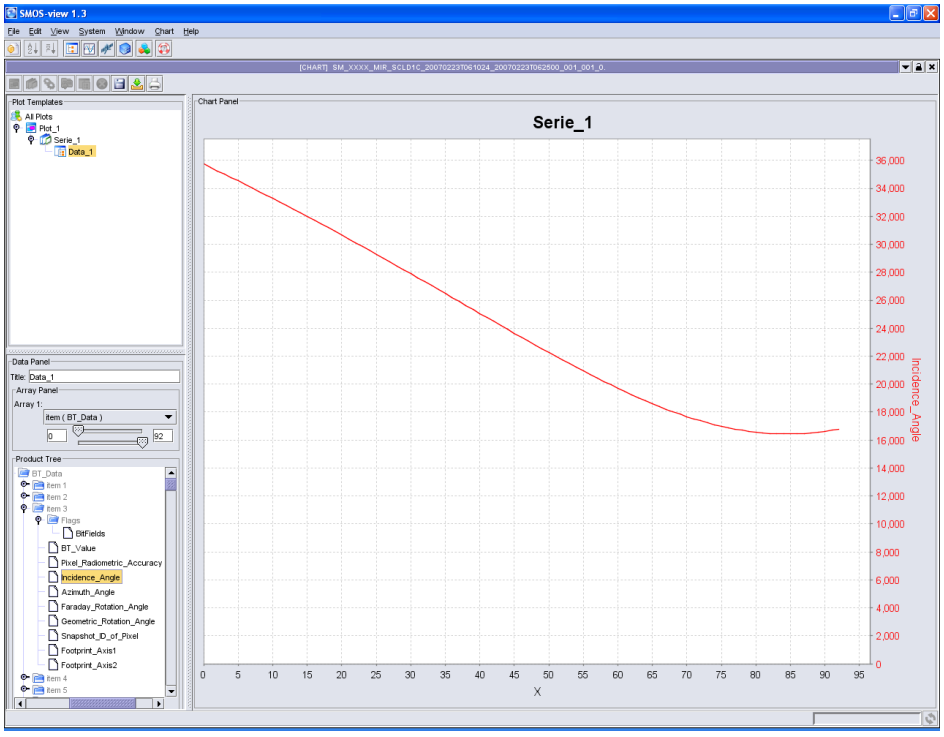


Figure 43: Plot screen - Chart Panel

Let's have a look at the following example:

Let's assume that the field Y_TO_PLOT is contained within an array or structure called CONTAINER_LEVEL_A of size N. Let's assume that CONTAINER_LEVEL_A is contained within an array or structure CONTAINER_LEVEL_B of size M and so on.

CONTAINER_LEVEL_C 1

CONTAINER_LEVEL_B 1

CONTAINER_LEVEL_A 1

Y_TO_PLOT 1

Y_TO_PLOT 2

Y_TO_PLOT 3

…..

Y_TO_PLOT N

CONTAINER_LEVEL_A 2

Y_TO_PLOT 1

Y_TO_PLOT 2

Y_TO_PLOT 3

…..

Y_TO_PLOT N

……..

In such a case, the user may want to plot:

- Y_TO_PLOT data can be plotted against indices of the CONTAINER_LEVEL_A 1 array
- Y_TO_PLOT 1 can be plotted against CONTAINER_LEVEL_A 1, CONTAINER_LEVEL_A 2 and so on.
- Y_TO_PLOT 1 of CONTAINER_LEVEL_A 1 can be plotted against CONTAINER_LEVEL_B 1, CONTAINER_LEVEL_B 2 and so on.
- Y_TO_PLOT of CONTAINER_LEVEL_A 1 in CONTAINER_LEVEL_B 1 can be plotted against CONTAINER_LEVEL_C 1, CONTAINER_LEVEL_C 2 and so on.

In all cases, the "Array" menu will offer the possibility to select different (X, Y) data sets at the following level of the data block: CONTAINER_LEVEL_A, CONTAINER_LEVEL_B or CONTAINER_LEVEL.

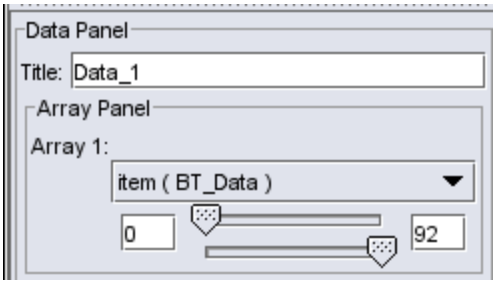


Figure 44: Array Panel

The user can also select the index range using the sliders under the array index selection box to modify the selected data. To change the slider position, set the mouse cursor over the slider icon, click left with the mouse and maintain the button clicked, drag then left or right the mouse.

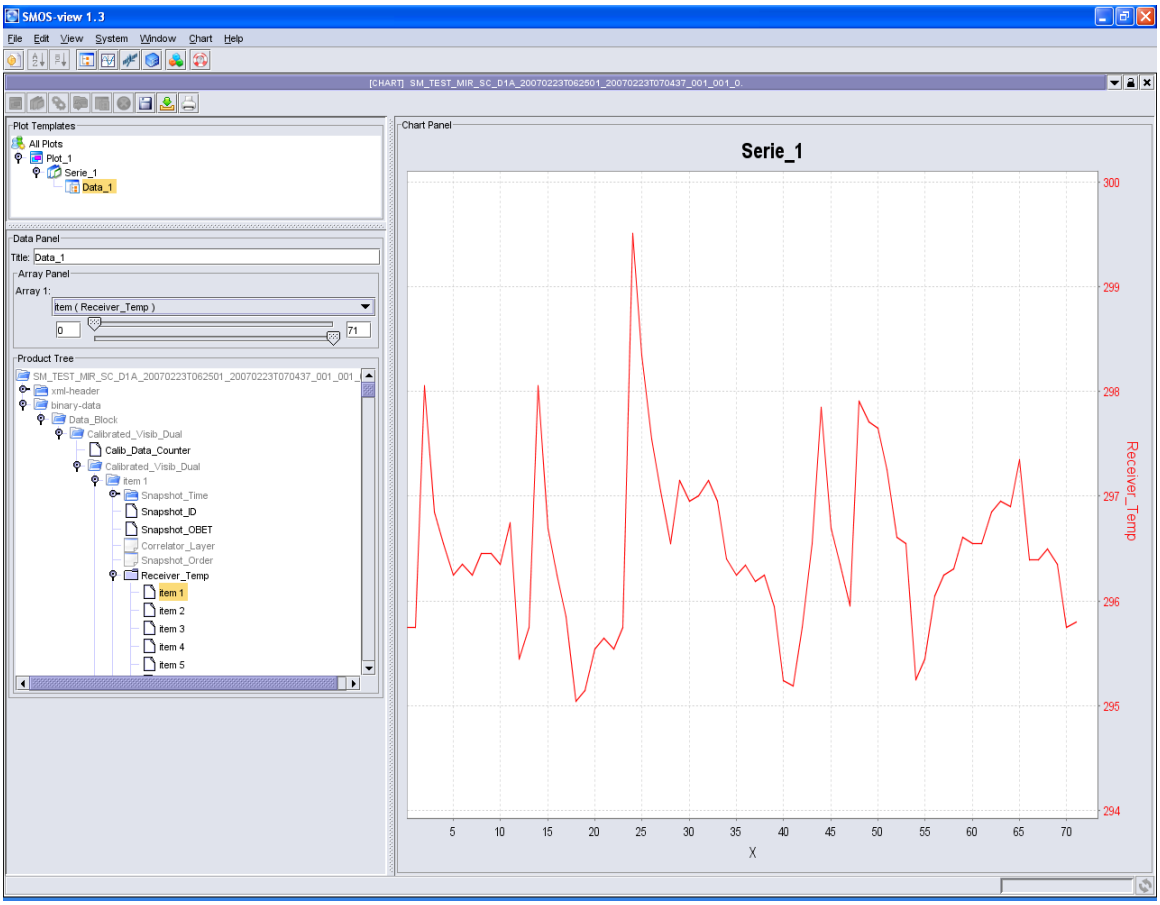


Figure 45: Data value against data container index

5.1.2. Plotting two data fields against each other

The user can create an XY plot with data contained inside the product data file:

First, repeat the previous steps to select data to be set on the X axis.

To select data to be set on the Y axis, click on the Serie_1 Icon 

, click then on the "add data from product" icon  . A Data_2 icon appears in the Plot Templates box, and the Plot_1 icon changes as well to the "add XY series". See Figure 46.

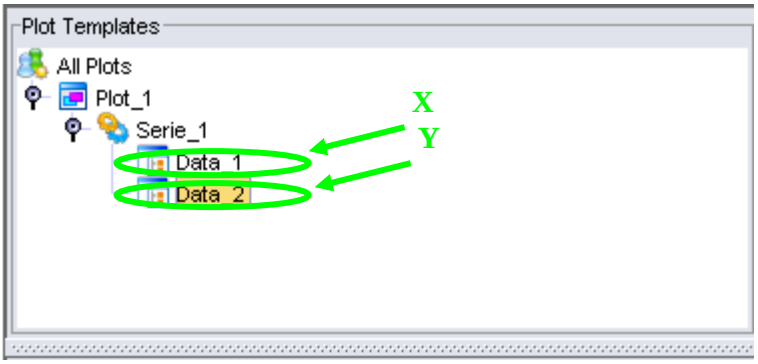


Figure 46: XY series Plot template

The user must then browse through the product tree to set data on the Y axis just as he did for the X axis, opening and browsing through the product tree.

Note that X-axis data always corresponds to the first (upper) icon in the Series list and the Y-axis always corresponds to the lower one.

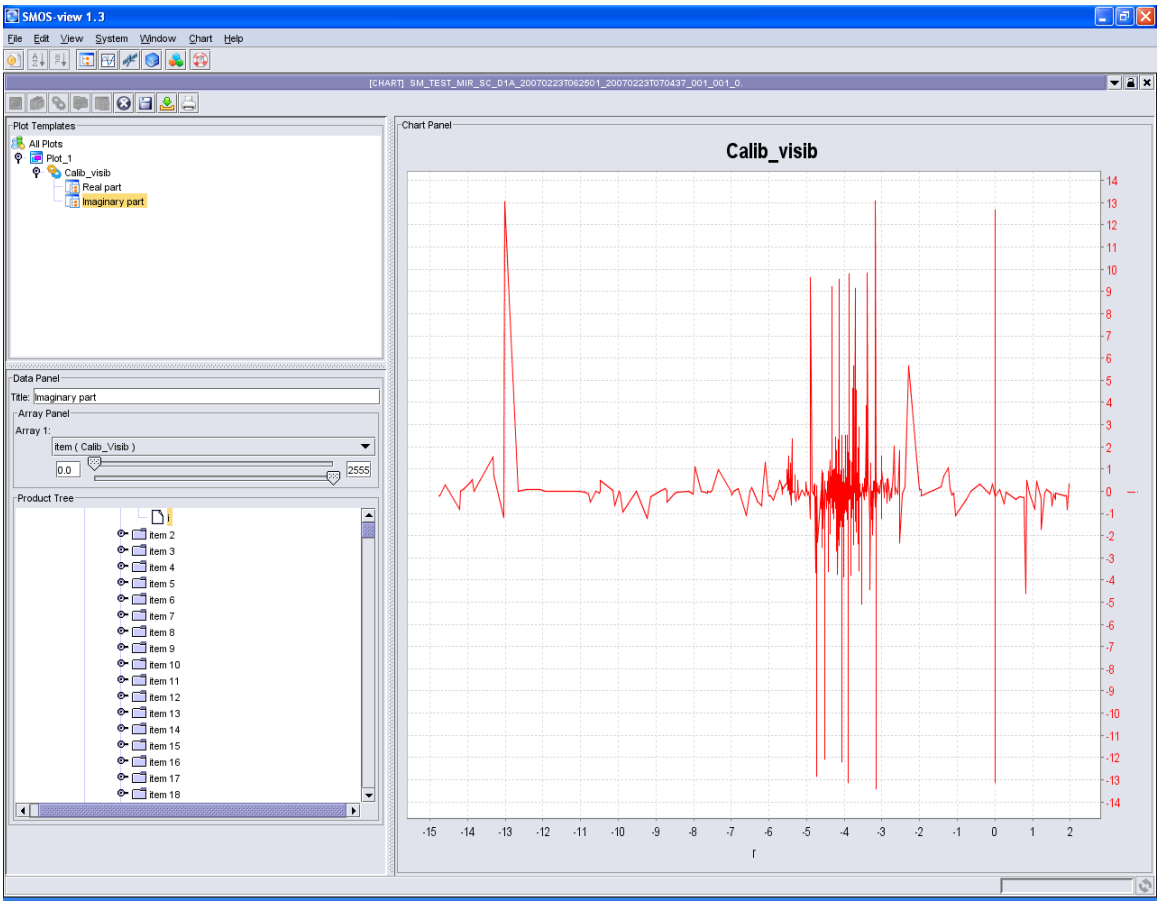


Figure 47: XY series example

5.1.3. Importing external data

With the SMOSView data plotter, it is possible to import numerical data stored in a file on a computer.

If the user clicks on the Plot_1 icon 

, and then clicks on the add XY series  , the following appears:

Figure 48: XY series with external data

The Data_3 icon corresponds to X-axis data that must be imported from an external data file.

In this example, let's click on the Data_3 icon: The following menu appears:

Figure 49: Import file menu

The user can then Click on the "Browse" tab and select a file containing numerical values. Data to be imported must be contained in an ASCII file with one single value per line.

As an example, let's import the following file:

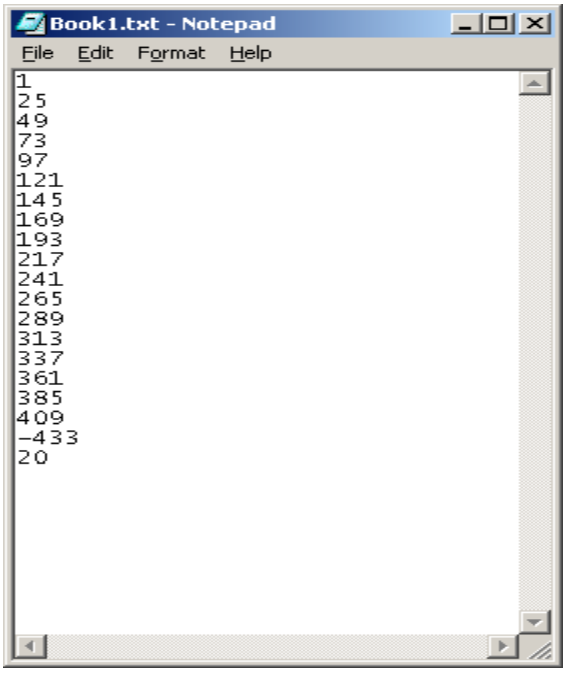


Figure 50: Import file example

The user can then complete the plot by clicking on the Serie_2 icon 

and then on the "Add Data From Product Icon"  to select data to be set on the Y-axis as described in the previous section.

Data can also be imported on the Y-axis. When the plotter is in the configuration described in section 5.1.2, instead of clicking on the "Add Series From Product" icon, the user can click on the "Add Data From File" icon and follow the same steps described here above to import the data file.

5.1.4. Multi plot visualization

The user can visualize several plots in the same chart within the Plot_1.

He must select the first series with the product tree following the steps detailed previously.

He will add another series in the chart by clicking on Plot_1 icon Plot_1, and then clicking on the "Add Series From Product" icon. The user can follow the steps for data selection with the product tree as described in the section here above.

The user can see the resulting plots on the same graph by clicking on the Plot_1 icon Plot_1.

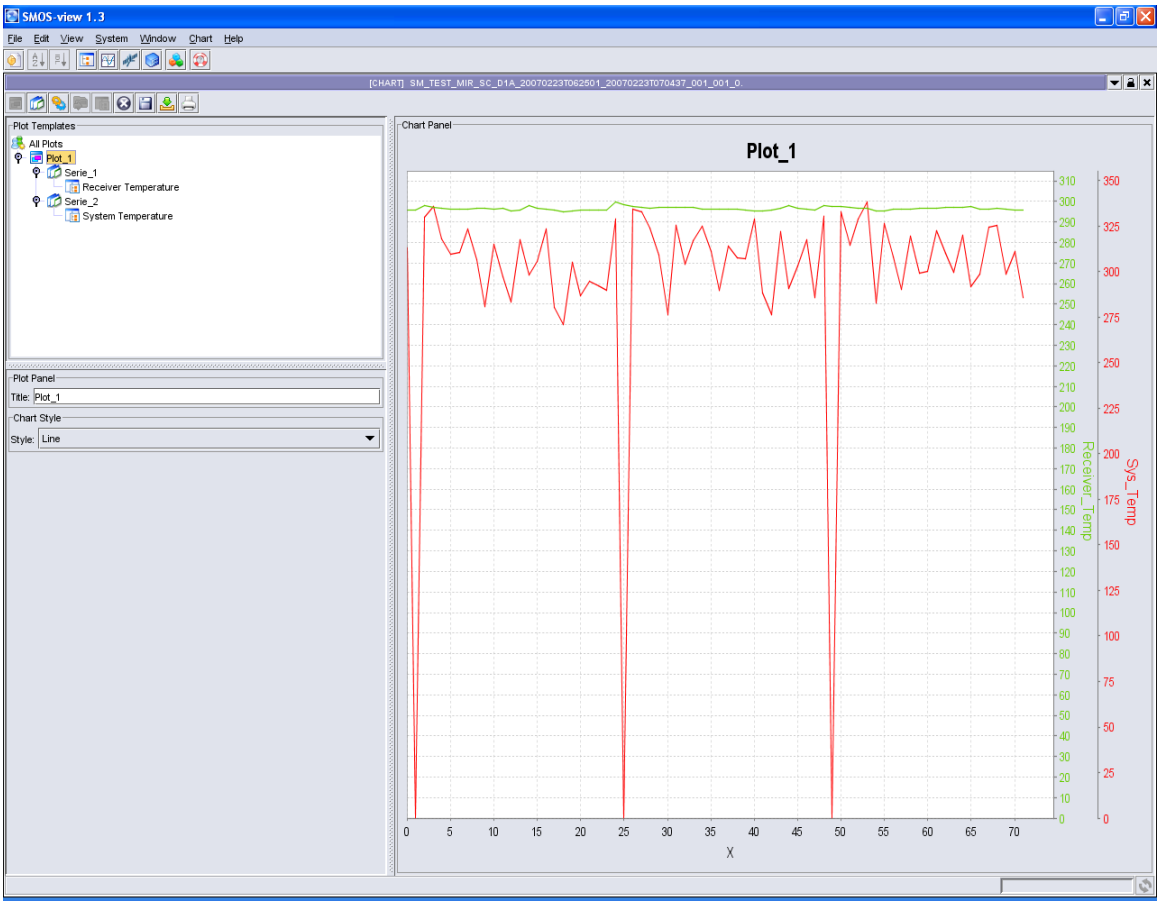


Figure 51: Multi Plot example

For the multi-plot to be available and easy to read, the user shall take care about the data selected on the X-axis and make sure that the ranges and X-axis units are coherent. For example, if the user creates a first curve whose X-axis values range from 1 to 10 (Index), and a second plot whose values range from –100000 to +49000 (mm), there will be a visualization issue on the multi-plot display.

As a rule, the multi-plot will use the unit (or index) of the first plot created within the Plot_N template and only show those curves whose unit (or index) is the same as the first plot.

Data on the Y-axis can be of any unit, the corresponding scale will be shown on the right-hand side of the multi-plot.

The user can create any number of multi-plots by clicking on the "All plots" icon and then clicking on the "Add Plot" icon.

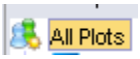


Figure 52: All plots icon

5.1.5. Deleting a plot or data selection

The user can easily remove individual plots, by clicking on the plot icon (typically, Serie_N icon) and then clicking on the "Remove Node" icon.

Figure 53: Remove Node icon

He can also remove entirely a plot (typically, Plot_N icon), and click on the "Remove Node" icon.

5.1.6. Saving a plot Template

The user may want to be able to plot the same data fields using different product files of the same type. SMOSView allows the user to save a plot template and reuse it with other data products of the same type.

To save a plot template, click on the "All plots" or "Plot_N" icon and then on the "Save Template" icon.

Figure 54: Save Template Icon

The next time the user opens the data plotter buffer, the plot templates will be automatically loaded in the "Plot Templates" box and the related plots available for visualization.

5.2. Plot settings

Plot settings are easily configurable.

Plot name:

Although the data container names (Plot_L, Serie_M, Data_N) are auto-generated, the user can change these names by clicking on the related icon the new desired, entering the name in the Title box and pressing enter.

Figure 55: Title renaming example

When the plot is renamed, the new name will appear on top of the plot.

NOTE: The names shall be different between all chart panels otherwise the references to the panels will be lost. This issue will be corrected on future release of SDV.

Plot color:

The user can also change the plot color, clicking on the Serie_N icon, the color menu appears.

Figure 56: color setting menu

Clicking on the Browse tab allows the user to select a color from the color table.

When setting the title color, the following dialog appears:

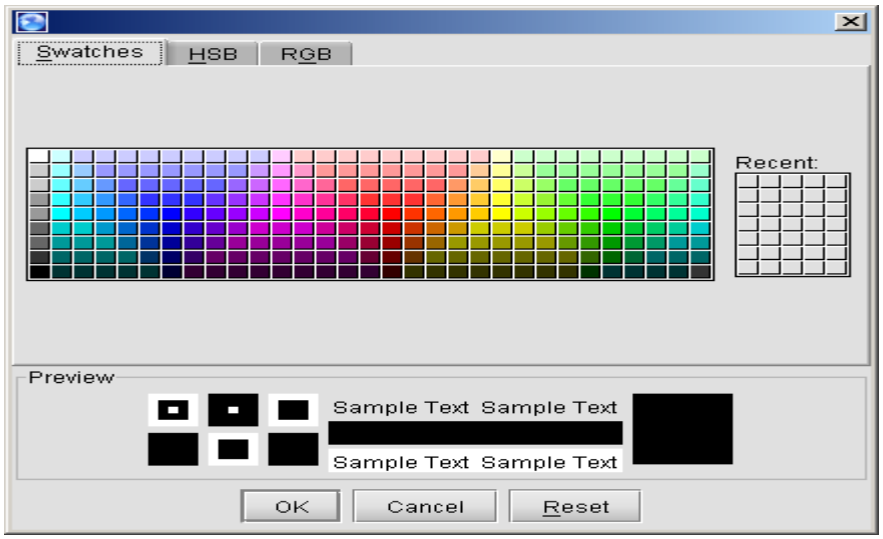


Figure 57: Plotter properties color setting

Select a color by clicking on one of color boxes. Then press OK to set the title to the selected color.

Clicking on the HSB tab, the following dialog appears:

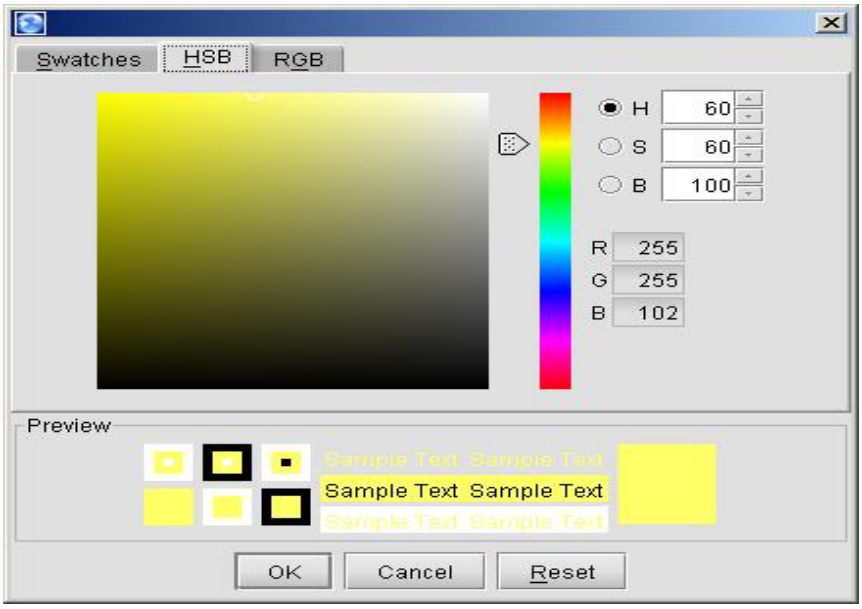


Figure 58: Plotter HSB color setting

The user can then set HSB color components by clicking in the H, S, or B menu box. To select the appropriate value, the user must maintain the left mouse button pressed on the cursor and drag it up or down.

Clicking OK will apply the color settings to the title.

Clicking on the RGB selection box will cause the following menu to appear:

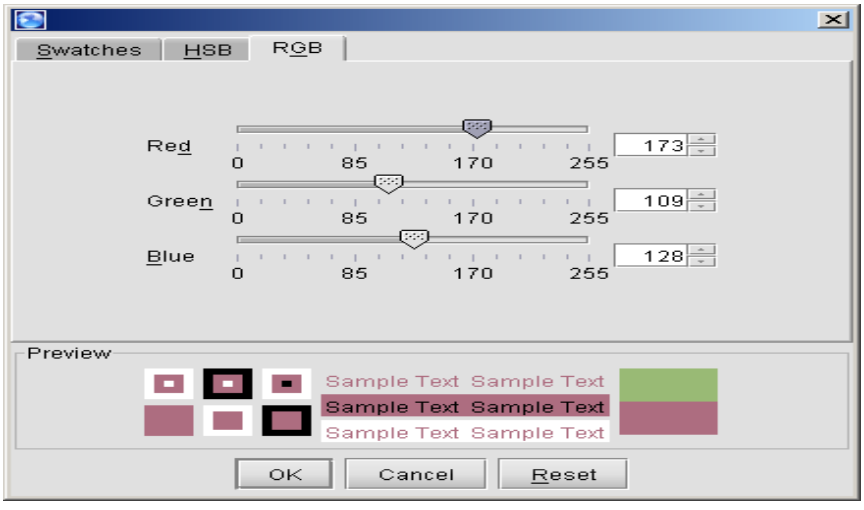


Figure 59: Plotter RGB color setting

The user can then set the RGB components of the color by dragging the RGB cursors using the mouse button.

Clicking Ok will apply the color settings to the title.

Zoom in / Zoom out:

It is possible to "Zoom-In" on a graph by clicking in the graph pane, maintaining the left mouse button clicked and dragging the mouse cursor down and to the right. The zoom-out can be performed dragging the mouse cursor upwards and to the left while maintaining the left mouse button clicked in.

6. L1A SPECIFIC VISUALIZATION FEATURES

This section presents the L1A specific visualization features implemented by SMOSView. There are two L1A visualization features: the L1A visibility matrix and the star domain representation. The L1A specific visualization features apply only to the following L1A products:

L1A products
SM_XXXX_MIR_AFWD1A
SM_XXXX_MIR_AFWU1A
SM_XXXX_MIR_CRSD1A
SM_XXXX_MIR_CRSU1A
SM_XXXX_MIR_FWSD1A
SM_XXXX_MIR_FWSU1A
SM_XXXX_MIR_SC_D1A
SM_XXXX_MIR_SC_F1A
SM_XXXX_MIR_TARD1A
SM_XXXX_MIR_TARF1A
SM_XXXX_MIR_UAVD1A
SM_XXXX_MIR_UAVU1A
SM_XXXX_MIR_UNCD1A
SM_XXXX_MIR_UNCU1A

Table 3: L1A products to which L1A Specific Visualization Features apply

6.1. L1A visibility matrix

In order to use the L1A visibility matrix, the user must select first a L1A product file using the File Chooser buffer as presented in section 4.1 of this document.

The user can then click on the SMOS Specific Visualization Features Icon, the following window appears:

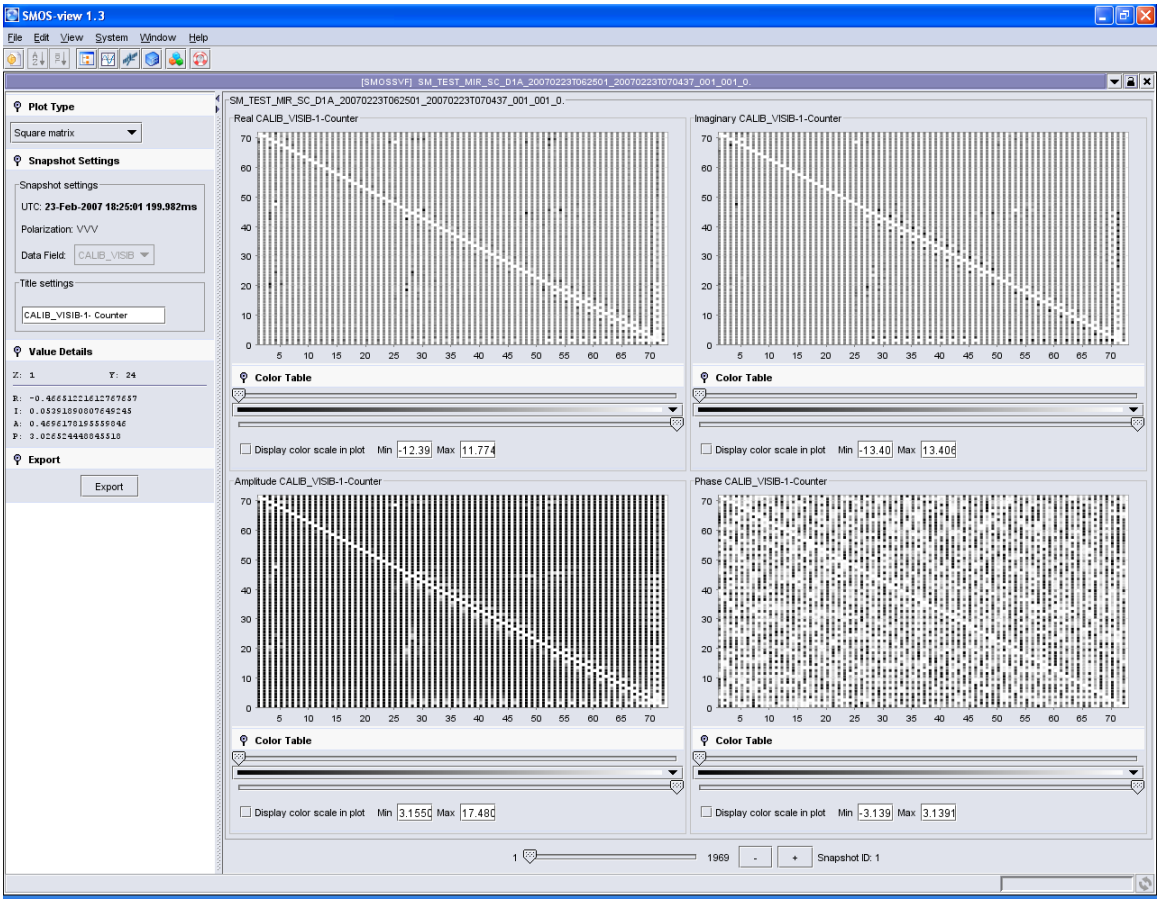


Figure 60: L1A visibility matrix example

6.2. What the plot shows

The plot shows four rectangular matrixes representing the complex data displayed in the Data Field drop down menu, in this case CALIB_VISIB. The plot corresponds to the L1A calibrated visibilities presented in the SMOS Level 1 and Auxiliary Data Products Specifications. The plots show:

- Upper left plot: Real part of the complex L1A data
- Upper right plot: Imaginary part of the complex L1A data
- Lower left plot: Amplitude of the complex L1A data
- Lower right plot: Phase of the complex L1A data

Four rectangular matrixes are displayed, one matrix per real / imaginary / amplitude or phase of the complex number selected by the drop-down menu of the selector field. The lower part of each matrix is filled out with the complex conjugate part of the upper part. Each value extracted from the product is represented using a grey level scale.

NOTE:

In the case of CRSx1A products, the Amplitude matrix shows the consolidated averaged FWF Origin amplitude (**Cons_Ampl_FWF_Origin**), and shall consist of 1 data set record. This structure shall

contain the complete set of calibration parameters for every pair of receivers, expressed as a real value (FWF Origin amplitude only).

The Phase matrix shows the **Cons_Phase_FWF_Origin** structure consisting in a number of data set records with parameters obtained after correlated noise injection in odd and even sources during FWF Origin or Local Oscillator Calibration Sequences. There shall be as many Data Set Records as LO Phase Tracking events plus FWF Origin Sequences.

User will be able to navigate through all the phase measurements, however the Amplitude shall remain constant.

6.2.1. Features available

6.2.1.1. Zoom in / Zoom out:

It is possible to "Zoom-In" on a graph by clicking in the graph pane, maintaining the left mouse button clicked and dragging the mouse cursor down and to the right. The zoom-out can be performed dragging the mouse cursor upwards and to the left while maintaining the left mouse button clicked in.

6.2.1.2. Hide parameters to magnify visualized data:

Each feature has such a magnifying glass sign before:  . The user can hide/unhide the functionality's parameters by clicking on this magnifying glass. It allows the user to save space on the screen to better observe the data. When the functionality's parameters are hidden the icon slightly turns: 

6.2.1.3. Plot Type

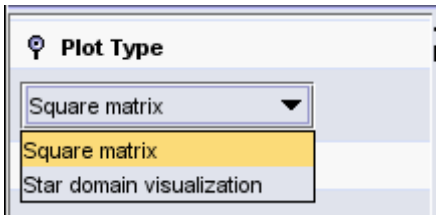


Figure 61: Plot Type drop down menu

The user can select two different plot types using this drop down menu, Square Matrix or Star Domain visualization.

6.2.1.4. Snapshot and title settings

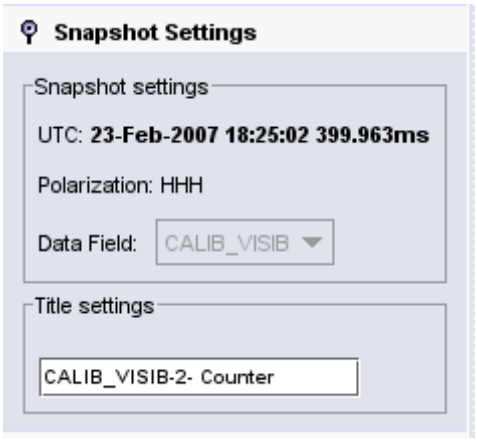


Figure 62: Snapshot setting details

Snapshot settings give information concerning the current snapshot to the user:

- Universal Time Coordinated (UTC) of the snapshot
- Polarization of the snapshot (H: Horizontal, V: Vertical)
- Data field: plotted data fields are predefined. In the case of MIR SC D1A, the L1A specific visualization features, only the data field CALIB_VISIB is available. But the user can select a UNC 1A product. In this case, the Data field drop down menu offers two predefined data fields to be visualized using the L1A specific visualization features: MEAN_OFFSETS and UNC_OFFSET_CORRECTION. The user simply needs to click on the data fields he wants to visualize.

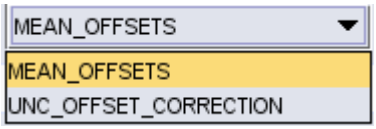


Figure 63: Data field drop down menu example

- Title settings: allow the user to overwrite the title displayed above the real, imaginary, amplitude, and phase matrices. It is useful especially to export these matrices towards various formats (see next paragraph).

In the release 1.6.0 of SDV it has been included in this panel further more information regarding the product.

- **MIR_UAVx1A**

  Start_Time, Stop_Time, Correlator_Layer, Samples, Software_Error_Counter, Instrument_Error_Counter, ADF_Error_Counter, Calibration_Error_Counter

- **MIR_CRSx1A**

  Start_Time, Stop_Time, Correlator_Layer, Samples, Time_From_ANX ,Software_Error_Counter, Instrument_Error_Counter, ADF_Error_Counter, Calibration_Error_Counter

- **MIR_SC_x1A / MIR_TARx1A**

Snapshot_Time, Snapshot_ID Snapshot_OBET , Antenna_Boresight, Max_Mkj_module, X –Band, Software_Error_flag, Instrument_Error_flag, ADF_Error_flag, Calibration_Error_flag

- **MIR_SC_x1B / MIR_TARx1B**

  Snapshot_Time, Snapshot_ID Snapshot_OBET, Antenna_Boresight, X –Band, Software_Error_flag, Instrument_Error_flag, ADF_Error_flag, Calibration_Error_flag

6.2.1.5. Value details

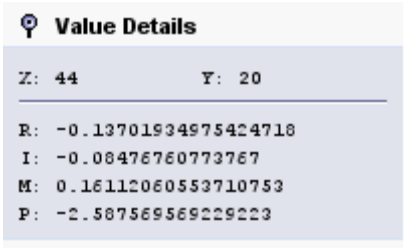


Figure 64: Value Details display

When the user drags the mouse over the plot, the complex values corresponding to the point under the mouse cursor are displayed in the Value Details box.

R: real part; I : Imaginary part; M: Magnitude (Amplitude); P: Phase.

X and Y are the line and column number.

6.2.1.6. Export

The user can use the Export box to export the displayed screen in various image, postscript, or PDF formats.

Figure 65: Export Box

Click on "Export". An export format box opens (Figure: 66); then select the path and name of the file to be created, and the format to which you would like to export the matrices. An example of the JPG result is given in Figure 67.

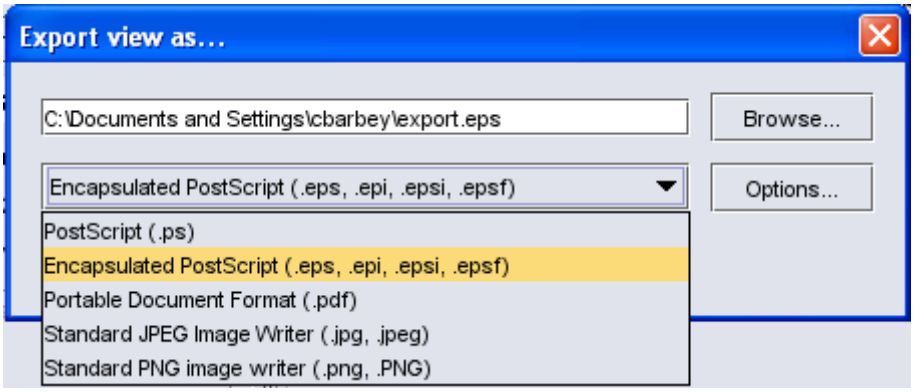


Figure: 66 Export formats

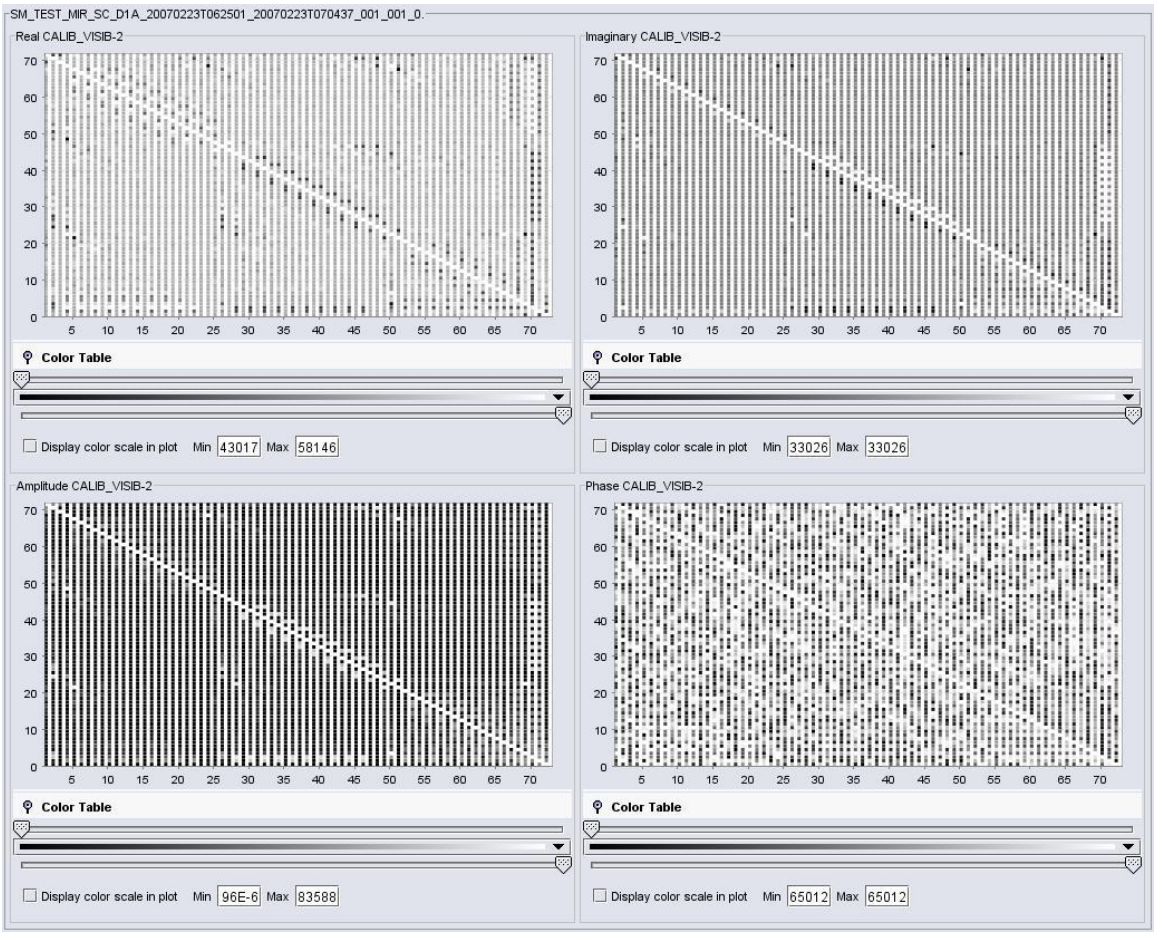


Figure 67: JPG export result

The user can step through the product and visualize consecutive snapshots contained inside the product, as explained at the end of this section. One way of identifying snapshots is the OBET, associated with a snapshot.

6.2.1.7. Colour Table

The matrix values are displayed using a grey level scale, but the user can use color tables to display matrixes using false color. Clicking on the Color Tables tab in each matrix will display a predefined selection of color tables:

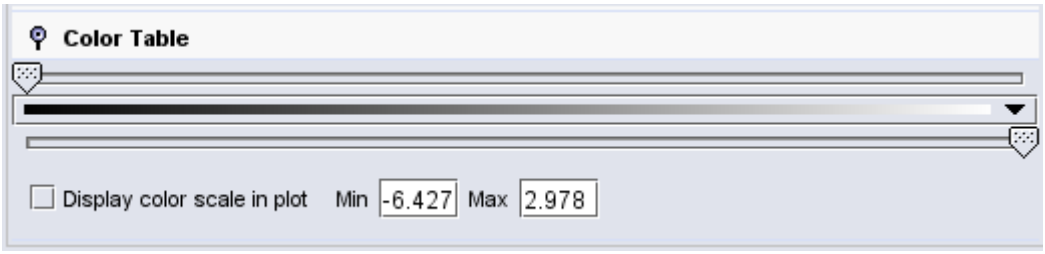


Figure 68: Color Tables menu

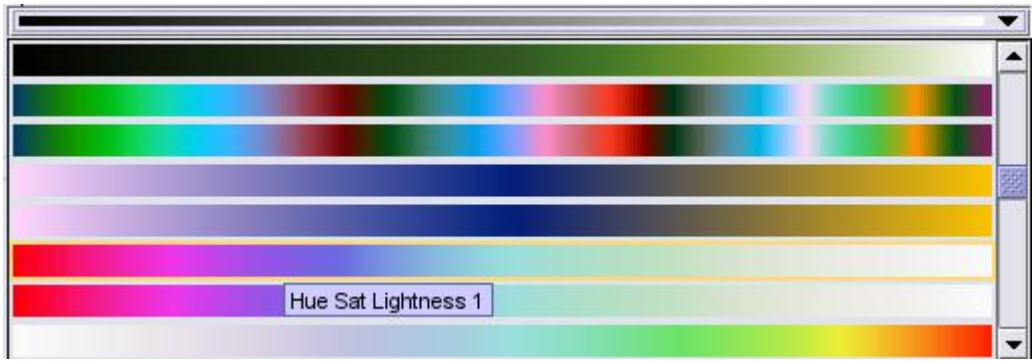


Figure 69: Color table example

Clicking on the selected color table will assign the selected color table to the plot. The matrix plot is then updated.

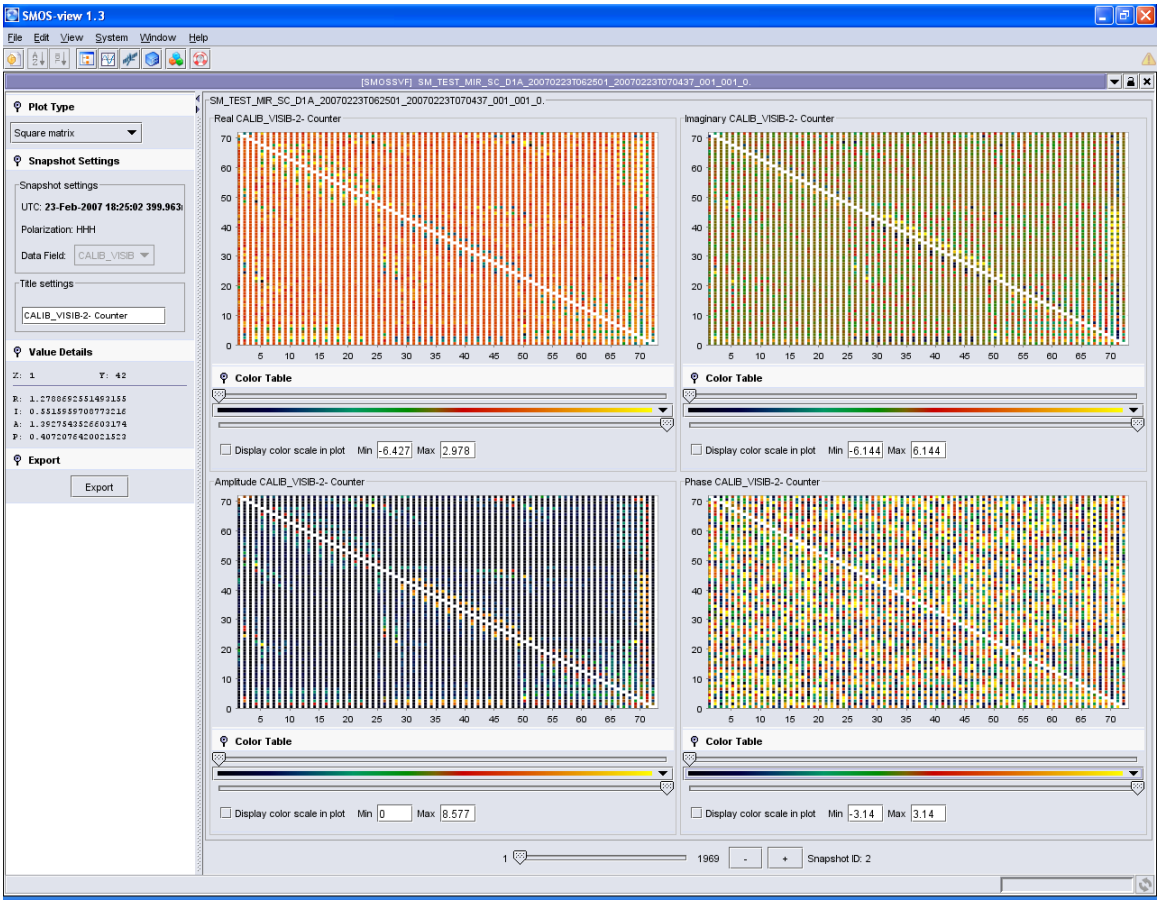


Figure 70: L1A matrix representation using a color table

The user can visualize the color scale just next to the plot, by ticking the box "**Display color scale in plot**". As shown in Figure 71, the color scale appears on the right of the plot with the range of values. The user can display or not this color scale in the plot by ticking / unticking the option. It allows the user to save screen space to visualize the data.

Figure 71: "Display color scale in plot" selected

The user can also select the **minimum and maximum** of the range to be displayed within the color table:

- by moving the sliders located above and below the table color or
- by entering new minimum and maximum values in the box and pressing "Enter"
- by entering new minimum and maximum values and selection "Scale" option. This way the color values will be redefined according to the user defined range instead of the minimum and maximum of the product.

An example of the same matrix than above is given in Figure 72, instead of the whole range [-6.427; 2.978], only the values between 1 and 2 (see color scale in plot) are displayed within the whole dynamic of the color scale.

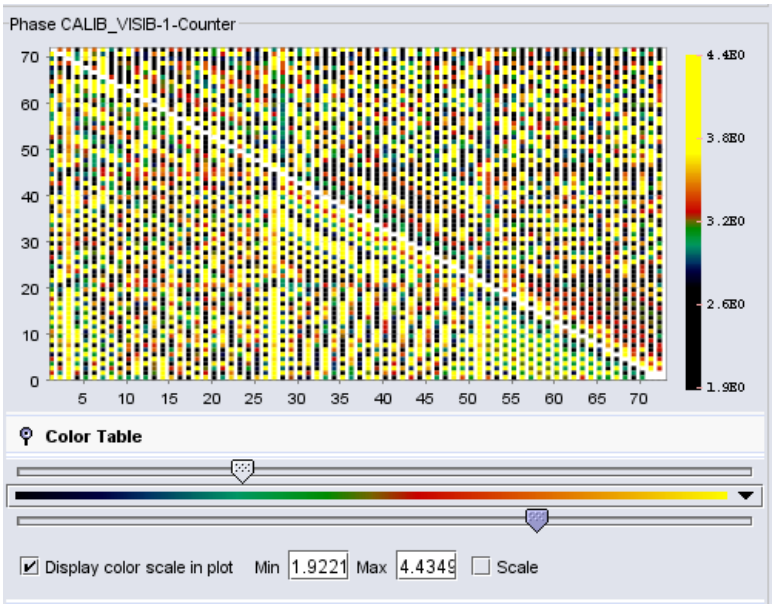


Figure 72: Min and max color scale range selection

6.2.1.8. Stepping through the product

The user can step through the data product and plot the next snapshot using the slider at the bottom of the plot. The user can also use the two buttons "-" / "+" to step through the product and visualize consecutive snapshots.

Figure 73: Snapshot slider

To use the slider, click with the left mouse button on the slider, maintain the button clicked and drag the mouse cursor along the slider bar. To use the - / + buttons to step though the product and see consecutive snapshots, click on the – or + buttons.

6.3. L1A Star Domain

Using the Plot Type tab, select the Star Domain visualization, the following plot appears:

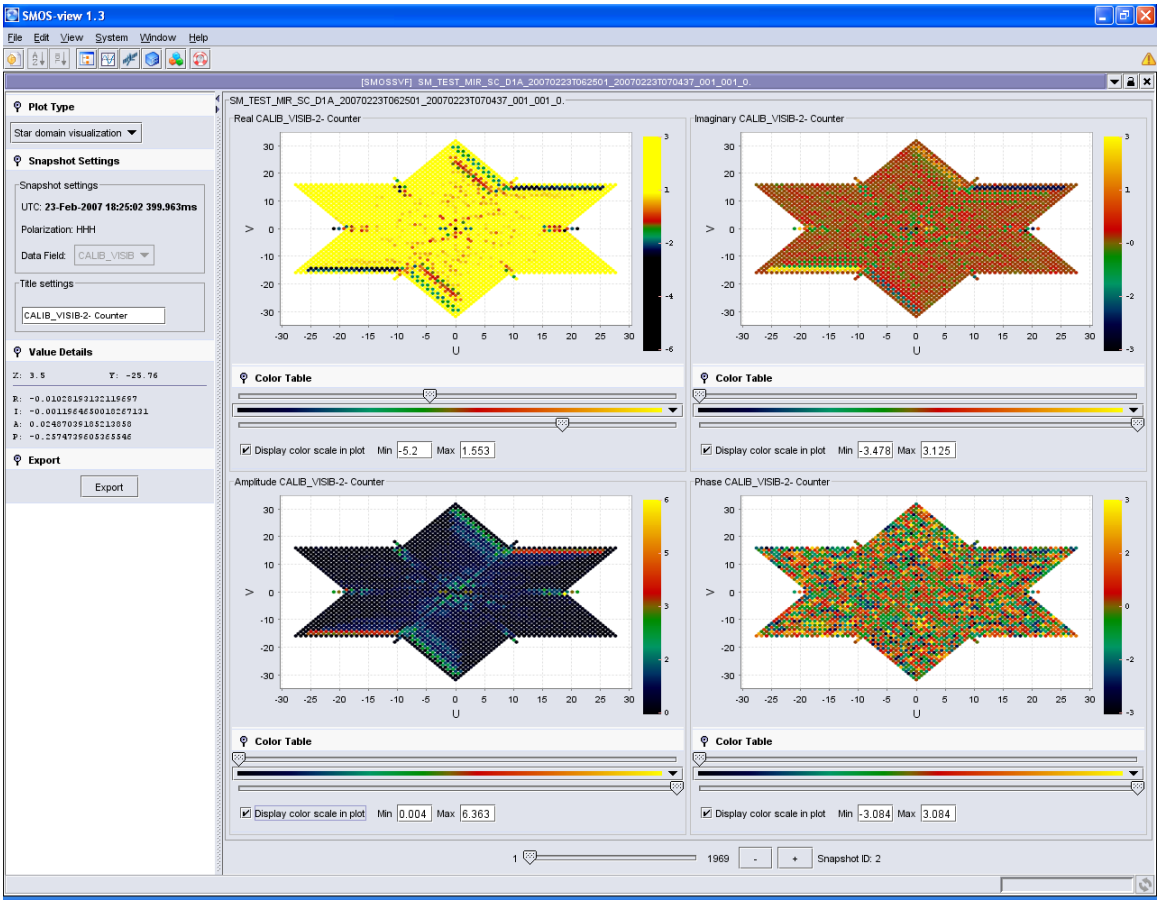


Figure 74: Start Domain visualization example

The plot shows Start Domain representation of the selected Data Field (in this case CALIB_VISIB).

The features available for the "star domain visualization" are the same as the ones available for the "square matrix" representation:

- Zoom in / Zoom out: see page 62
- Hide parameters to magnify visualized data: see page 62

Functions on the left hand side pane are the same:

- Plot Type: see page 62(To Change to Spatial Representation)
- Snapshot and title settings: see page 63
- Value details: see page 64
- Export to image or postscript formats: see page 64

The Colour Table function under each plot is also the same: see page 65.

The Stepping through the product with the **Snapshot slider** is also the same: see page 68.

7. L1B SPECIFIC VISUALIZATION FEATURES

This section presents the L1B specific visualization features implemented by SMOSView. There are two L1B visualization features:

- the Fourier components of Brightness Temperature (BT) representation (or L1B star domain)
- the reconstructed BT (or L1B spatial representation)

The mathematical details associated with these representations are fully detailed in the SMOSView specification document. The L1B specific visualization features apply only to the following L1B products:

L1B products
SM_XXXX_MIR_SC_D1B SM_XXXX_MIR_SC_F1B SM_XXXX_MIR_TARD1B SM_XXXX_MIR_TARF1B

Table 4: L1B products to which L1B Specific Visualization Features apply

7.1. L1B Fourier Components of Brightness Temperature

In order to visualize the Fourier components of BT, the user must select first a L1B product file using the File Chooser buffer as presented in section 4.1 of this document.

The user can then click on the SMOS Specific Visualization Features Icon  , the following window appears:

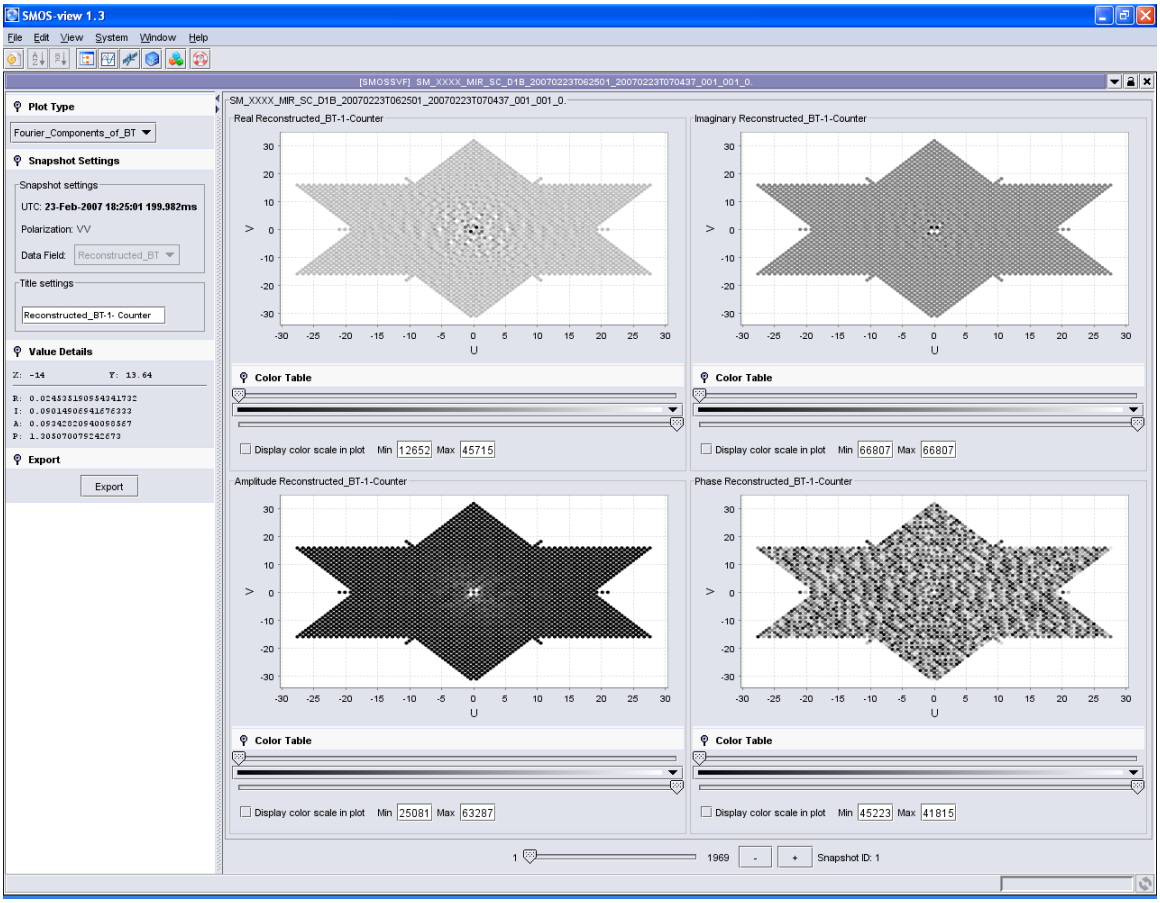


Figure 75: L1B Fourier Components of BT example

This plot is of the same type as the Star Domain plot for L1A.

The controls associated with this plot are the same than the previous ones:

- Zoom in / Zoom out: see page 62
- Hide parameters to magnify visualized data: see page 62

Functions on the left-hand side pane are the same:

- Plot Type:
- For L1B data, the plot type menu allows the user to switch between Fourier Components of BT representation and the spatial reconstructed BT:

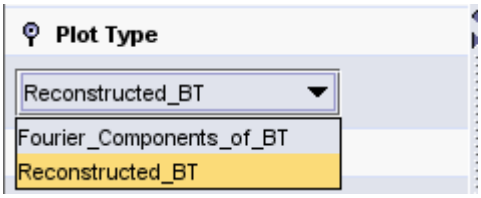


Figure 76: L1B Plot type menu

- Snapshot and title settings: see page 63
- Value details: see page 64
- Export to image or postscript formats: see page 64

The Colour Table function under each plot is also the same: see page 65.

The Stepping through the product with the **Snapshot slider** is also the same: see page 68.

7.2. L1B Reconstructed Brightness Temperature

Using the Plot Type menu, the user can select the Spatial Representation of L1B: "Reconstructed_BT". This plot type is not a simple visualization of L1B data but show features that have been derived from the L1B data by a procedure described in Appendix C.

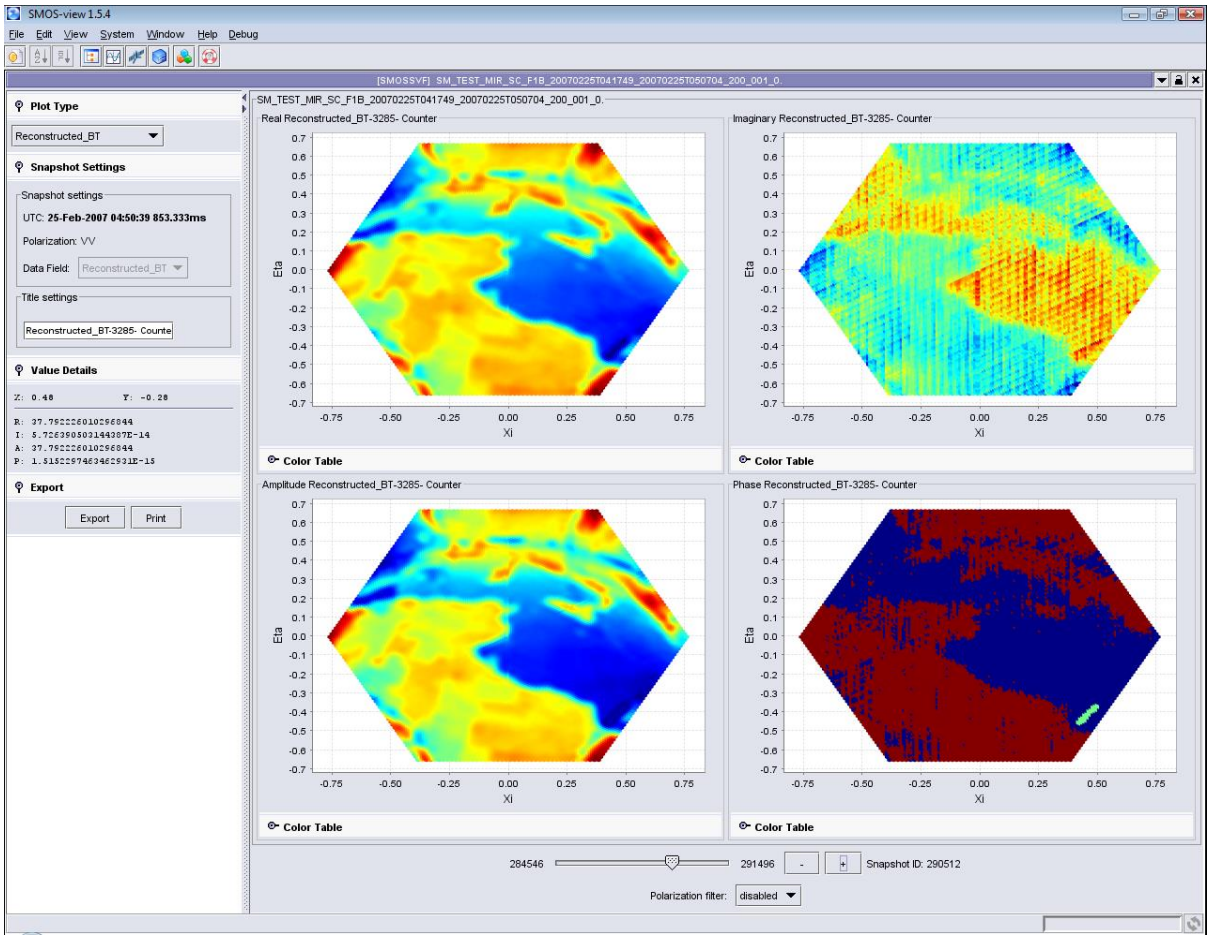


Figure 77: L1B Spatial Representation example

The reconstructed BT plot type shows four hexagonal spatial representations of the L1B complex data field displayed in the Snapshot Settings box.

The controls associated with this plot are the same than the previous ones:

- Zoom in / Zoom out: see page 62

- Hide parameters to magnify visualized data: see page 62

Functions on the left hand side pane are the same:

- Plot Type: see page 71
- Snapshot and title settings: see page 63
- Value details: see page 64
- Export to image or postscript formats: see page 64

The Colour Table function under each plot is also the same as for L1A: see page 65.

The Stepping through the product with the **Snapshot slider** is also the same: see page 68.

8. L1C SPECIFIC VISUALIZATION FEATURES

This section presents the L1C specific visualization features implemented by SMOSView. The L1C specific visualization features apply only to the following L1C products:

L1C products	
SM_XXXX_MIR_SCLD1C SM_XXXX_MIR_SCSD1C	*Dual Polarization reconstructed BT swath*
SM_XXXX_MIR_SCLF1C SM_XXXX_MIR_SCSF1C	*Full Polarization reconstructed BT swath*
SM_XXXX_MIR_BWLD1C SM_XXXX_MIR_BWLF1C SM_XXXX_MIR_BWSD1C SM_XXXX_MIR_BWSF1C	*Browse BT products*

Table 5: L1C products to which L1C Specific Visualization Features apply

Note from the SMOS Level 1 and Auxiliary Data Products Specifications:

- The **dual** polarization reconstructed brightness temperature swaths are L1C products obtained from L1B products in **dual** polarization mode. It is organized in grid points (belonging to the Digital Global Grid DGG).
- The **full** polarization reconstructed brightness temperature swaths are L1C products obtained from L1B products in **full** polarization mode. It is organized in grid points (belonging to the Digital Global Grid DGG).
- The **Browse** Brightness Temperature L1 data products are arranged in pole-to-pole swaths according to ascending and descending passes. Each grid point contains a brightness temperature sample interpolated from MIRAS measurements at an incidence angle of 42.5º.
- The values of the Incidence Angles, Azimuth Angle, Faraday Rotation Angle and Geometric Rotation Angle are now presented in Engineering units in the Browser and also in the Visualization panel.

8.1. L1C Dual polarization visualization

In order to use the L1C Dual polarization specific visualization features, the user must select first a L1C dual polarization product file using the File Chooser buffer as presented in section 4.1 of this document.

The user can then click on the SMOS Specific Visualization Features Icon  , the following window appears:

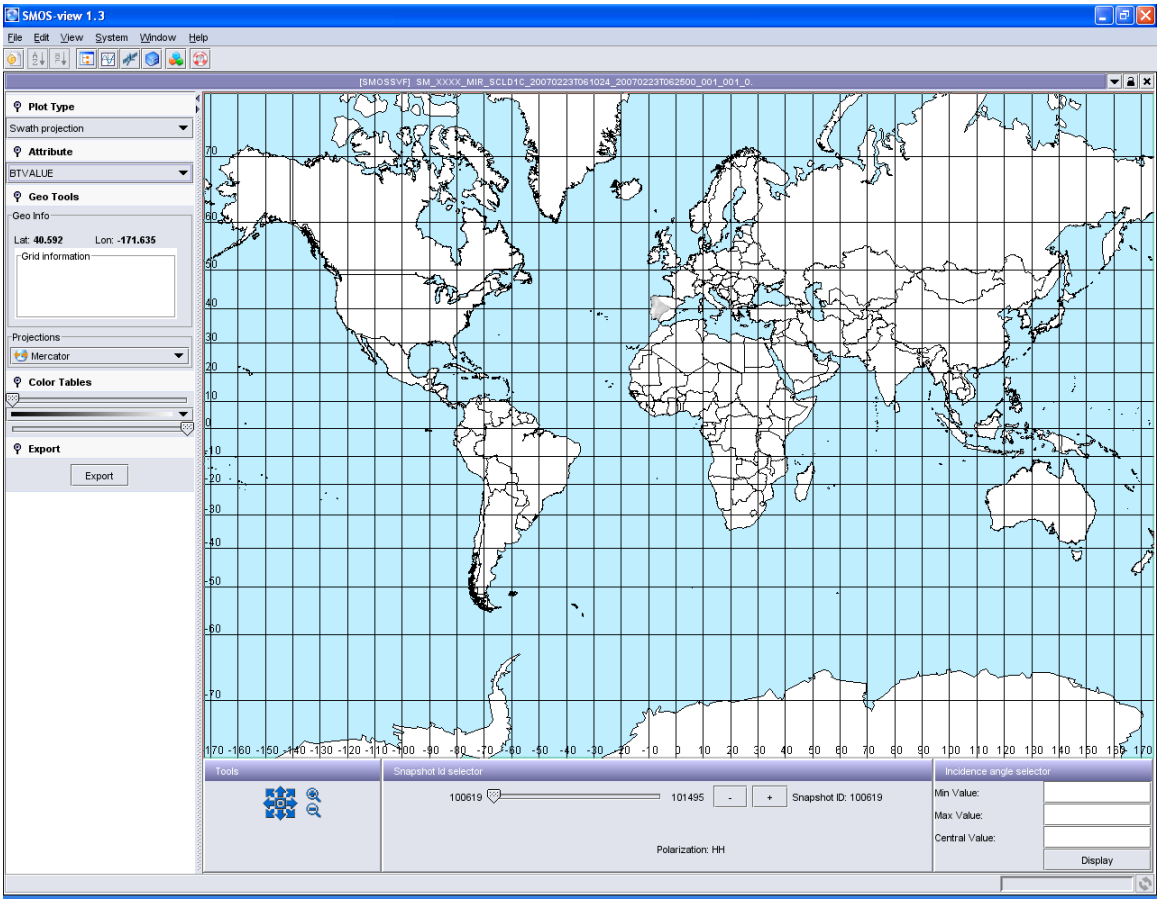


Figure 78: L1C Specific Visualization Feature Window

8.1.1. Plot type

On the left panel, there are several controls. The upper left one is the plot type. For L1C products, there are two options: Pixel Attributes Projection or Measurement Counter Projection, as shown in the Plot type menu below:

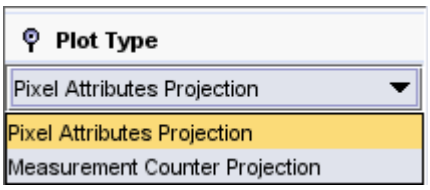


Figure 79: L1C Plot Type Menu

In case of Pixel Attributes Projection, it is possible to select the field to be plotted, and to request its projection for a given snapshot or for a given range of incidence angle. The relevant field to be plotted has to be chosen from the "Attributes" menu (see Figure 80), the snapshot has to be selected from the snapshot ID selector (see Figure 89), the incidence angle range has to be chosen from the incidence angle selector (see Figure 90).

In case of Measurement Counter Projection, there is no selection of incidence angle nor snapshot. The value displayed gives the number of snapshots in the product over each grid point.

8.1.2. Pixel Attributes Projection

WARNING: For big products (around 250 Mb) the time needed to project the data is quite long… Please be patient!

8.1.2.1. Attributes

By default, the selected plot type is pixel attributes projection. It allows the user to visualize all the following L1C fields projected on the Earth map:

- FLAGS: indicate the polarization (H: Horizontal, V: Vertical),
- SNAPSHOT_ID: Unique identifier for the snapshot,
- BTVALUE: Brightness Temperature value over the current Earth fixed grid point (in K),
- RAD_ACC PIX: pixel radiometric accuracy
- Azimuth angle (0º if local North)
- Incidence Angle (0° if vertical)
- FARADY ROT ANGLE: Faraday Rotation Angle
- GEO ROT ANGLE: Geometric Rotation Angle
- Footprint axis 1: Elliptical footprint major semi-axis value.
- Footprint axis 2: Elliptical footprint minor semi-axis value.
- Footprint ratio: Ratio between footprint axis 1 and footprint axis 2.

Even if selected by default, to visualize such parameters projected on the Earth, the **user must select it by the "Attributes"** drop down menu:

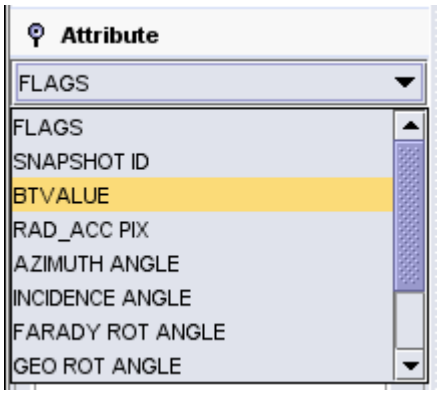


Figure 80: L1C Attributes Drop Down Menu

The value of the selected attribute is given inside the main pane in a little box next to the pixel covered by the mouse and the value is updated (with a less than 1 second refreshing time) when the mouse moves. After some 4 seconds over the same pixel, the value and the little box disappear, they can be visualized again by moving the mouse. See example in Figure 81.

All the pixels displayed in this figure refer to the same snapshot selected from the GUI.

The values of the field plotted correspond to the polarization of the snapshot. The polarization of the product is displayed lower part of the window, below the Snapshot ID.

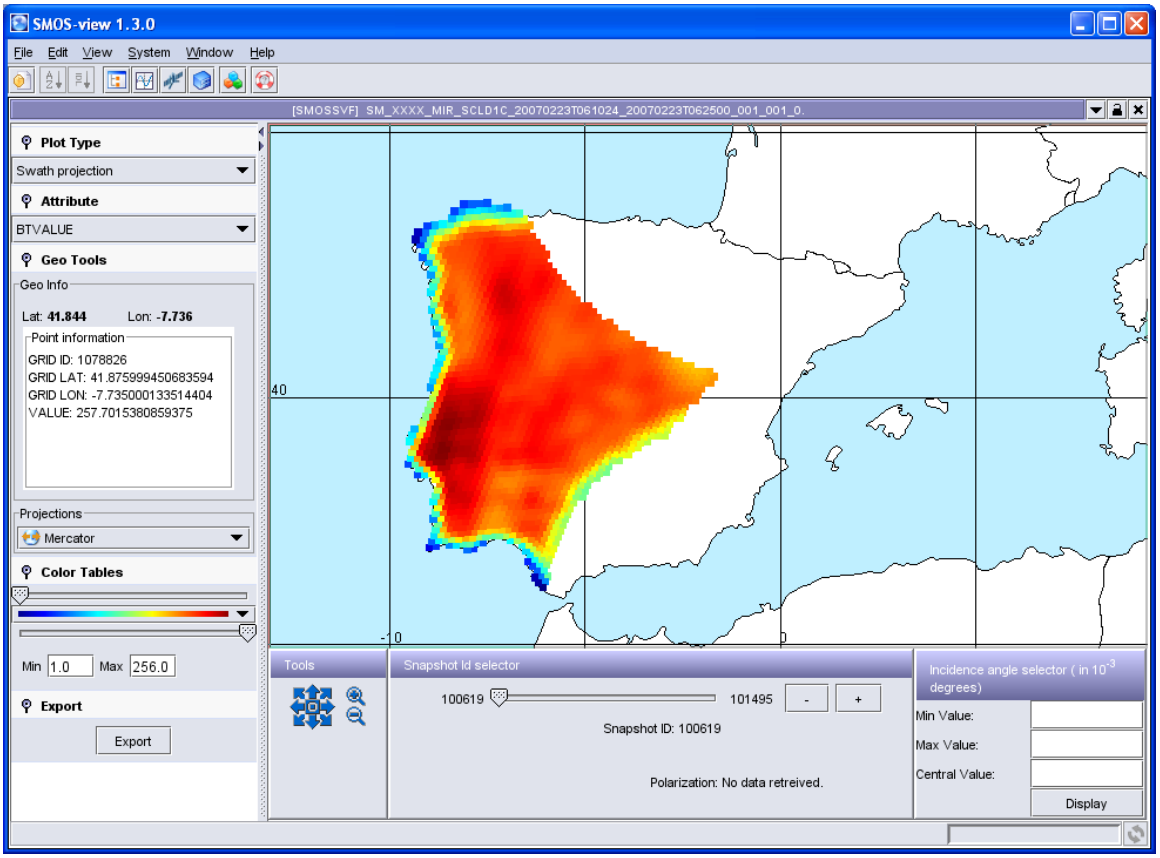


Figure 81: Example of L1C BT value field displayed. All pixels displayed refer to the same snapshot (100619).

8.1.2.2. Geo Tools

When the mouse is moving through the projected data, the "Geo Tools" give the user useful geographical information about the current mouse position: Latitude, longitude, and about the grid information: Grid ID, grid latitude, grid longitude, and grid mask.

Note: the latitude/longitude grid information gives the position of the center of the grid ID, while the "geo info" gives the exact cursor latitude/longitude.

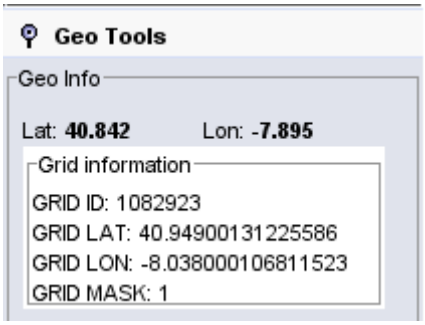


Figure 82: L1C Geo Tools Box Details

8.1.2.3. Projections

The default projection used is the Mercator projection. However, it is possible to visualize the data through other geographical projections such as Orthographic (North/South) or Gnomonic projections. For example, if data are located northern than 50° latitude North or southern than 50° latitude South, it is much more suitable to use a North/South Orthographic projection (see Figure 84). The projection can be selected through the Projections drop down menu:

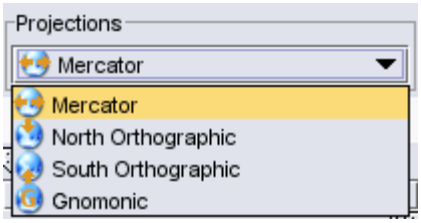


Figure 83: Projections Drop Down Menu

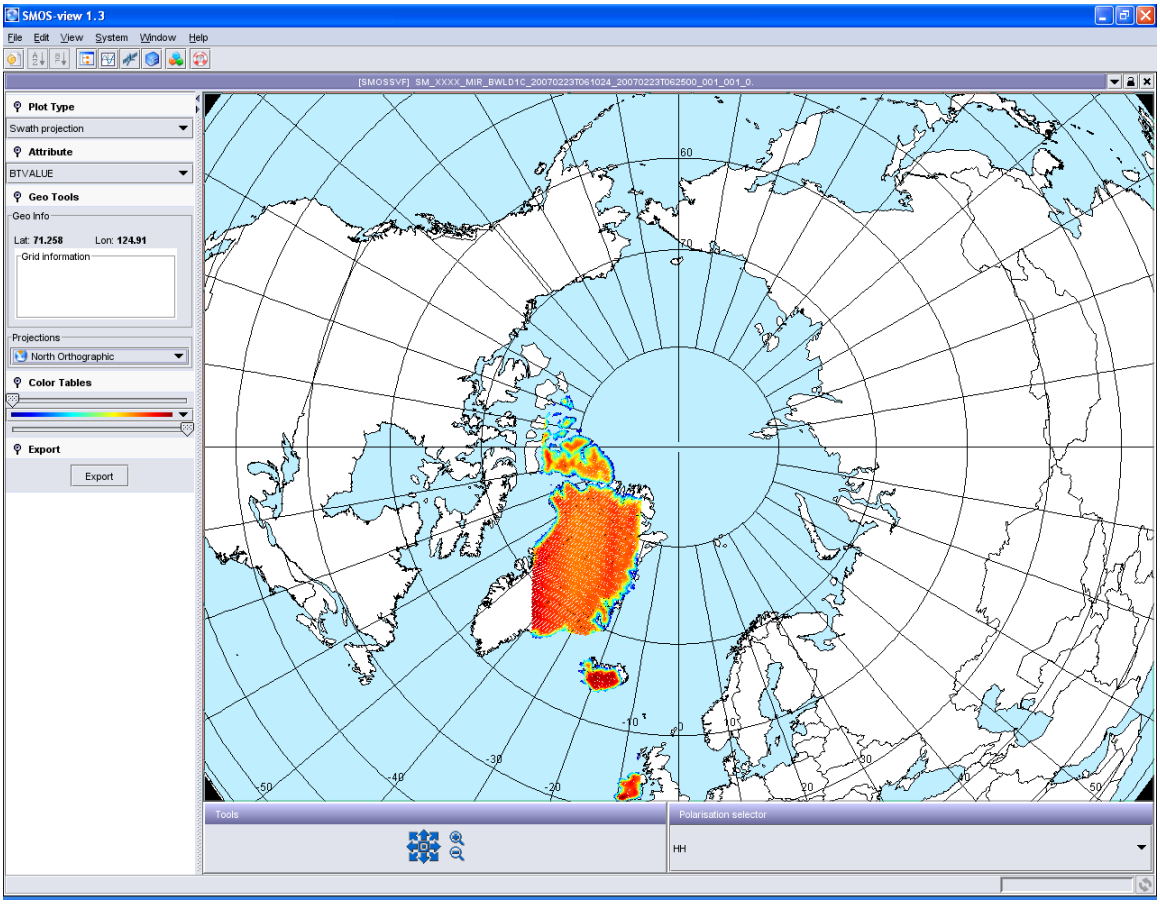


Figure 84: North Orthographic projection example

8.1.2.4. Colour Tables and Range

The L1C products are displayed using a grey level scale, but the user can use colour tables to display L1C product using false colour. Clicking on the Colour Tables tab will display a predefined selection of colour tables:

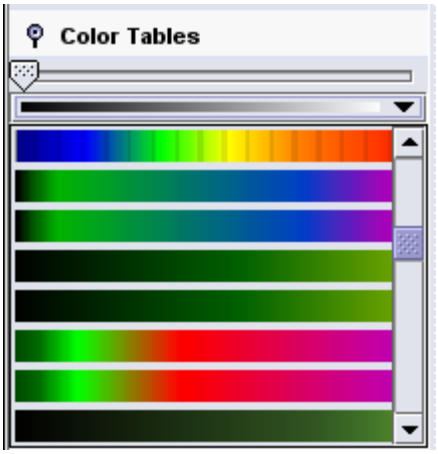


Figure 85: Colour Tables Menu

Clicking on the selected colour table will assign the selected colour table to the plot. The plot is then updated.

The colour range is loaded by default with the Min and Max values calculated directly from the points displayed on the map, however the user can set those values using the Min and Max text fields and then clicking on the "Scale" tick box. Afterwards the points are redisplayed according to the new range.

8.1.2.5. Export

The user can use the Export box to export the displayed screen in various image, postscript, or PDF formats.

Click on "Export". An export format box opens (Figure 86); then select the path and name of the file to be created, and the format to which you would like to export the matrices. An example of the JPG result is given in Figure 87.

Figure 86: Export Box

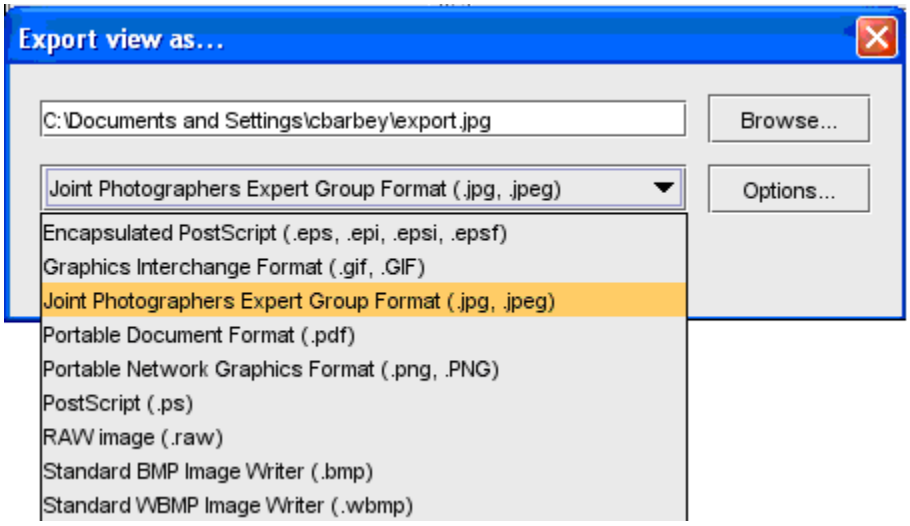


Figure 87: Export formats drop down menu

8.1.2.6. Zoom in / out / around

It is possible to "Zoom In" or "Zoom out" on the product, and to move in each direction by using the zoom in / out/ around tool (Figure 88):

- Zoom in: use the (+) magnifier (upper one) OR without the tool: directly in the graph pane maintain the left mouse button clicked and drag the mouse cursor down and to the right
- Zoom out: use the (-) magnifier (lower one)
- Go to the North / South: use the upper / lower arrow
- Go to the West / East: use the left / right arrow
- Center the plot on 0° latitude; 0° longitude: click on the point in the center of the tool.
- Center the plot on a point within the map: left-click once over the desired center

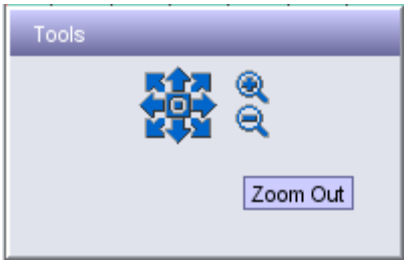


Figure 88: L1C Zoom in / out / around Tool

8.1.2.7. Snapshot ID selector

The user can step through the data product and plot the next snapshot using the snapshot IF slider at the bottom of the plot (Figure 89). The user can also use the two buttons "-" / "+" to step through the product and visualize consecutive snapshots. The user can also visualize only the data corresponding to the polarization of choice. Values for full polarization products are: HH, VV, HV_Real and HV_Img. Values for dual polarization products are HH and VV.

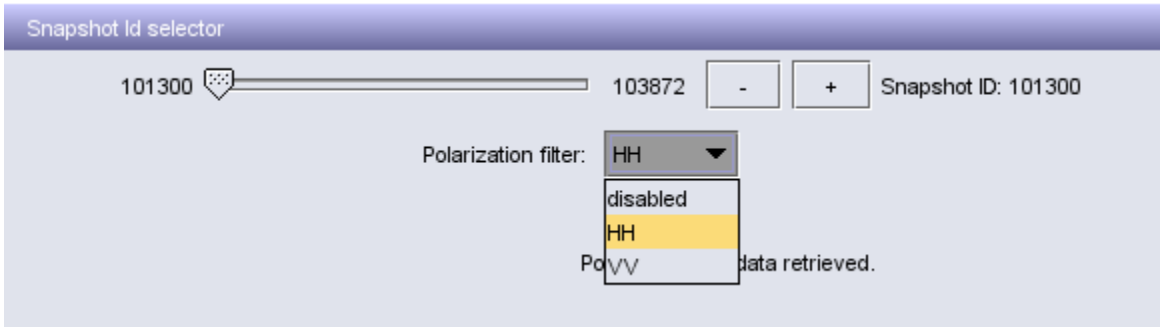


Figure 89: L1C Snapshot ID selector box

8.1.2.8. Polarization

The polarization information is given inside the snapshot ID selector box. For L1C dual product, the polarization can be HH or VV.

8.1.2.9. Incidence angle selector

The user can select a range of incidence angle (0° if vertical incidence) by filling the L1C incidence angle selector (Figure 90). The unit of the angle selector is millidegree (10^{-3} degree), it means the same unit used inside the product. To define the incidence angle range, the user must enter a minimum, a maximum value and the "central value". In case multiple values fit inside the [min, max] range for a single pixel, the application will choose the data that are the nearest to the central value. To display only the data acquired with an incidence angle within the range, the user has then to click on "Display".

Additionally, the user can narrow down the number of points to visualize by selecting the desired polarization. Values for full polarization products are: HH, VV, HV_Real and HV_Img. Values for dual polarization products are HH and VV.

Once the user has selected an incidence angle range, the image will display all the pixels of the file having the incidence angle within the range.

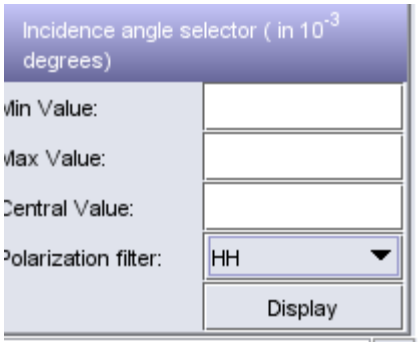


Figure 90: L1C Incidence Angle Selector

8.1.3. Measurement Counter Projection

WARNING: For big products (around 250 Mb) the time needed to project the data is quite long… Please be patient!

If the user selects the "Measurement Counter Projection" plot type, he will then visualize the field "Counter" of the Swath_Snapshot_List data set. The field "Counter" specifies the number of Data Set Record contained in it.

The value displayed in the small box when moving the mouse over the product gives the number of snapshots in the product over each grid point. An example of such a counter is given in Figure 91.

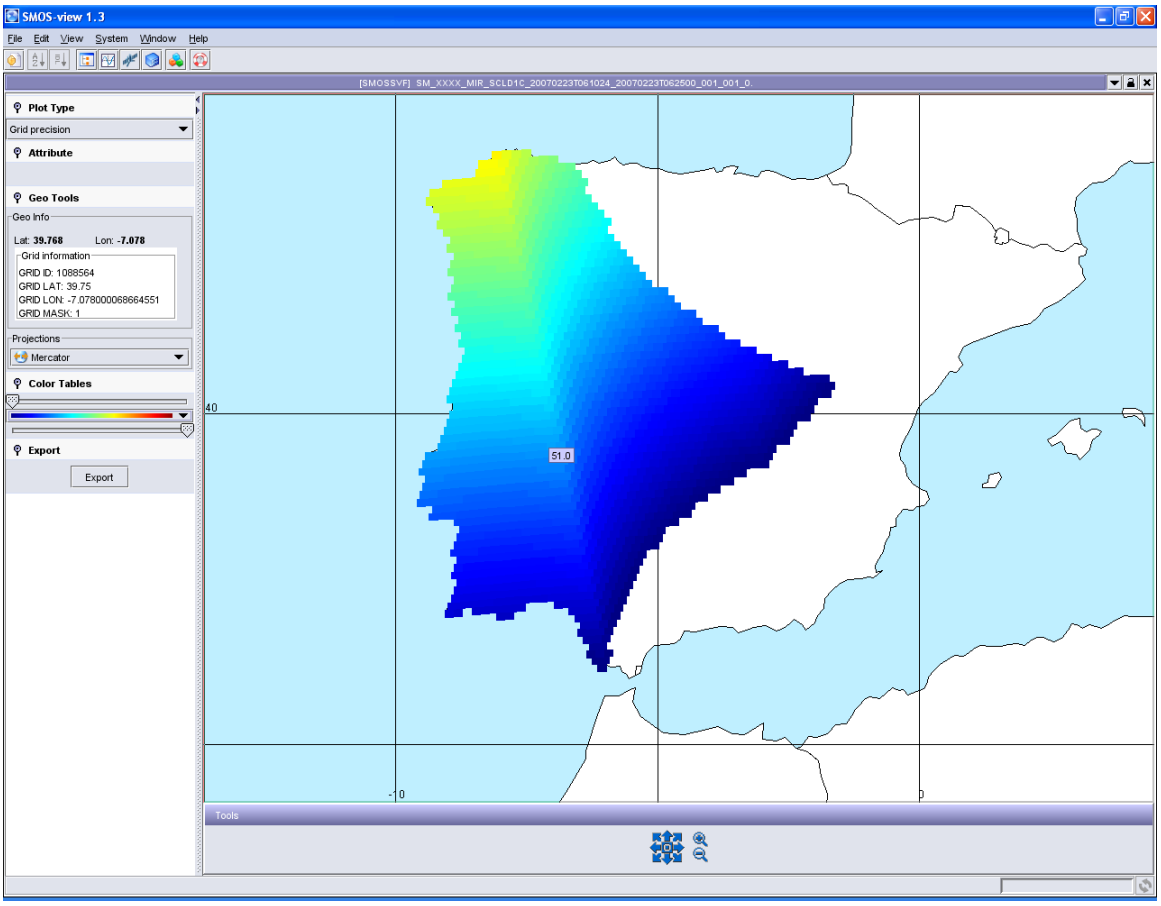


Figure 91: Measurement Counter Projection L1C example

Note: The lower control pane for "Measurement Counter Projection" plot type only has the zoom in / out / around control.

8.2. L1C Full polarization visualization

In order to use the L1C Full polarization specific visualization features, the user must select first a L1C Full polarization product file using the File Chooser buffer as presented in section 4.1 of this document.

The user can then click on the SMOS Specific Visualization Features Icon  , to use these features.

The L1C full polarization visualization features are exactly the same as the ones described in the previous L1C dual polarization specific visualization features section. Please refer to section 8.1.

8.2.1. Polarization

The only parameter that changes compared to L1C dual product is the polarization. This information is also given inside the snapshot ID selector box. For L1C full product, the polarization can be HH, VV, HV_real or HV_imaginary.

8.2.1.1. Brightness Temperatures Specific Plot

Once a brightness temperature map is obtained there is the possibility to display a graph showing the evolution of the BT vs the incidence angle for a selected grid point. This grid point is selected through the left click of the mouse.

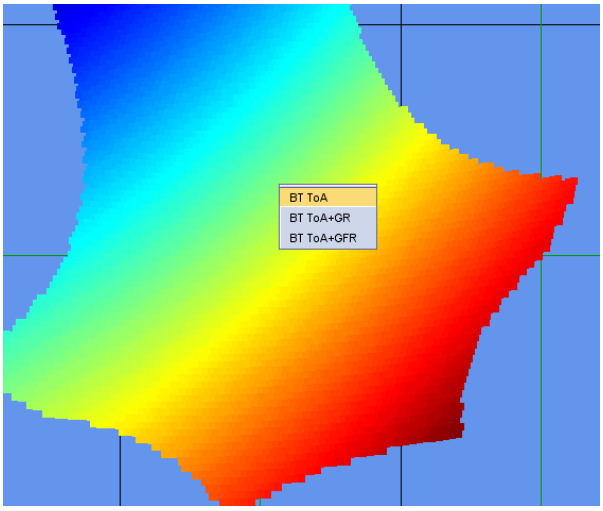


Figure 92: BT vs Incidence Angle Selection Menu

There is the possibility to plot three different types of charts:

1. **BT ToA:** Brightness Temperature on Top of Atmosphere vs Incidence Angle
2. **BT ToA + GR:** Brightness Temperature on Top of Atmosphere with the Geometric Rotation vs Incidence Angle.
3. **BT ToA + GFR:** Brightness Temperature on Top of Atmosphere with the Geometric Rotation and Faraday Rotation vs Incidence Angle

The of the geometric and faraday rotations where performed based on the multiplication presented below. The T3' and T4' is the real and imaginary part of the BT value present in the product. G is the geometric rotation and F the Faraday rotation angles.

- **Full Pol:**

$$\begin{bmatrix} Th \\ T3 \\ T4 \\ Tv \end{bmatrix} = \begin{bmatrix} A^2 & -2AB & 0 & B^2 \\ AB & A^2 - B^2 & 0 & -AB \\ 0 & 0 & 1 & 0 \\ B^2 & 2AB & 0 & A^2 \end{bmatrix} x \begin{bmatrix} Txx \\ T3' \\ T4' \\ Tyy \end{bmatrix}$$

$$A = \cos(G + F) \quad B = \sin(G + F)$$

- **Dual Pol:**

$$\begin{bmatrix} Th \\ Tv \end{bmatrix} = \frac{1}{A^4 - B^4} x \begin{vmatrix} A^2 & -B^2 \\ -B^2 & A^2 \end{vmatrix} x \begin{bmatrix} Txx \\ Tyy \end{bmatrix}$$

$$A^4 - B^4 = 0.01 \Rightarrow Th = Txx \; and \; Tv = Tyy$$

The graphs obtained are composed by two curves, one for the H polarization and another for the V polarization. Each curve has different colours and unique Y-axis scale to allow comparison. In the Full Polarization case two extra curves are plotted. One for the HV_real and another for the HV_imaginary also as function of the incidence angle.

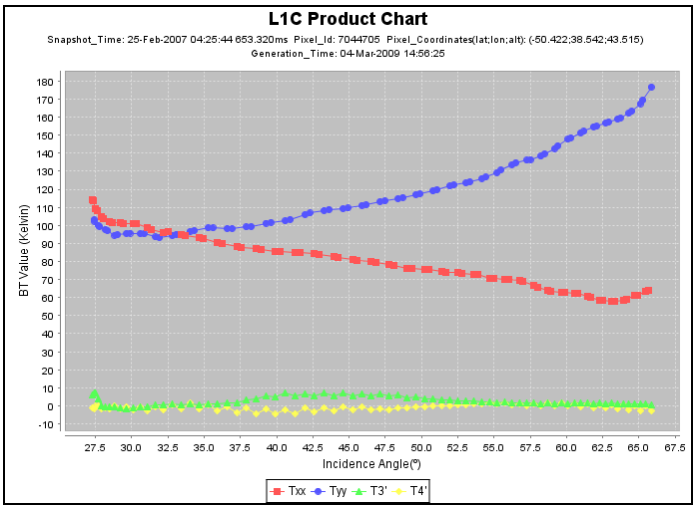


Figure 93: BT vs Incidence Angle Chart

8.3. L1C browse products visualization

In order to use the L1C browse products specific visualization features, the user must select first a L1C browse product file using the File Chooser buffer as presented in section 4.1 of this document. The user can then click on the SMOS Specific Visualization Features Icon  , the L1C browse products visualization window opens. Figure 94 shows a L1C browse product for which the North orthographic projection has been selected and a "blue-red" colour table chosen):

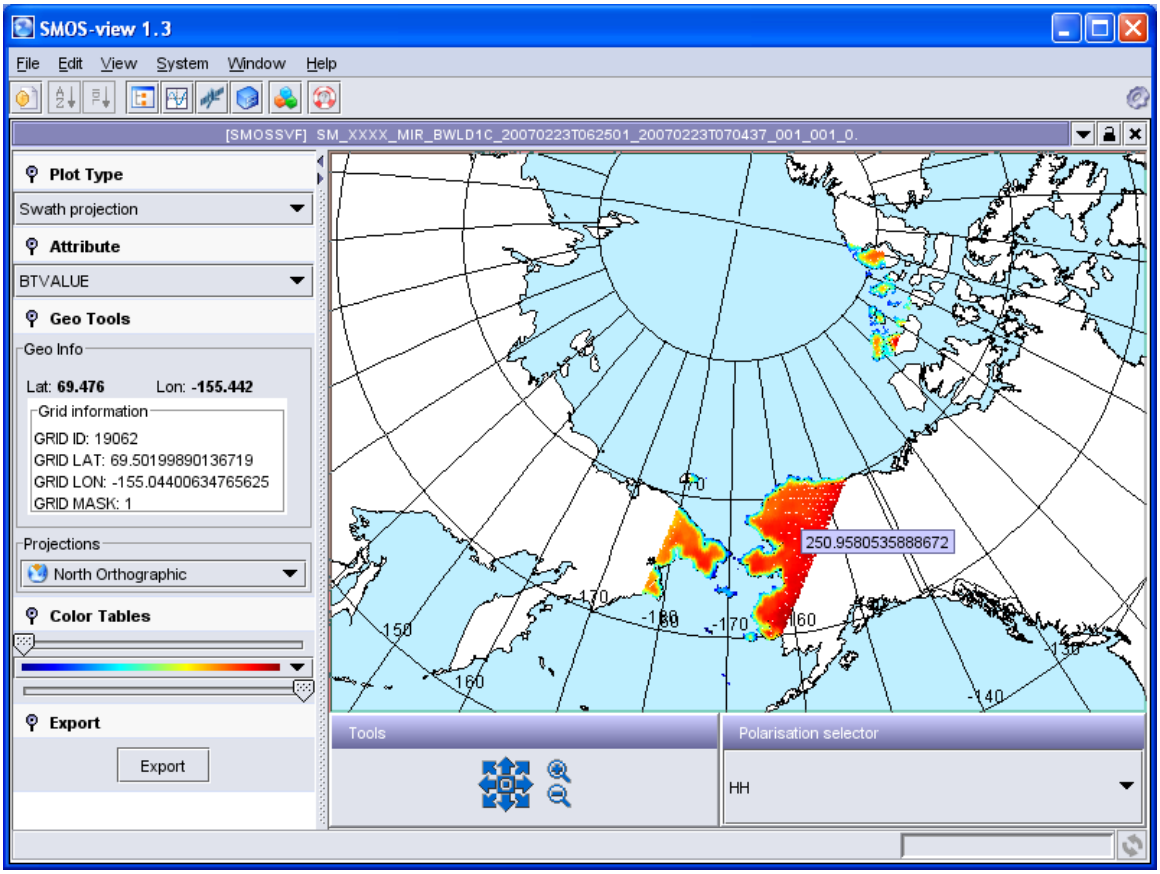


Figure 94: L1C browse product visualization example (North orthographic projection)

Note that for browse products, the controls in the lower pane are slightly different than the dual/full polarization ones. There is no incidence angle selection (all browse products have the same incidence angle) nor snapshot_ID selection.

The controls in the lower panel deal with:

- Zoom in / out / around tool (see page 80).
- Polarisation selector: allow the user to visualize products only from the selected polarization (select the required polarization with the drop down menu).

WARNING: For big products (around 250 Mb) the time needed to project the data is quite long… Please be patient!

9. L2 SPECIFIC VISUALIZATION FEATURES

This section presents the L2 specific visualization features implemented by SMOSView. The L2 specific visualization features apply only to the following L2 products:

L2 products
SM_XXXX_MIR_OSUDP2 SM_XXXX_MIR_SMUDP2

Table 6: L2 products to which L2 Specific Visualization Features apply

Except two functionalities (the selection flags and the error mode) the L2 specific visualization features apply also to auxiliary data files listed in Table 7.

WARNING: However, the user should know that due to the incredible points to project on the map, the auxiliary files could take about 30 minutes to be displayed.

Auxiliary data products
AUX_DGG___ (Geodetic Product) AUX_ECMWF (ECMWF Product) AUX_DFFLAI_ (LAI Product) AUX_DFFLMX (LAI MAX Product) AUX_DGGTLV (Current Tau Nadir LV Product) AUX_DGGTFO (Current Tau Nadir FO Product) AUX_DGGROU (Current Roughness H Product) AUX_DGGRFI_SPH (RFI Product) AUX_DGGFLO_SPH (Current Flood Product) AUX_GAL_SM_SPH (Galaxy Map Product convolved with the AUX_MN_WEF) AUX_SOIL_P_SPH (Soil Properties Product) AUX_BIGBWF_SPH (Big water body flag Product) AUX_RFI_____SPH (L1 RFI Product) AUX_GAL_OS_SPH (Galactic Map Product convolved with the AUX_WEF) AUX_DISTAN_SPH (Land Sea Mask) AUX_SSS____SPH (SSS Climatological LUT) AUX_FARA_ (Faraday Rotation) AUX_GAL_OS (Ocean Salinity Galaxy Map) AUX_GAL_SM (Soil Moisture Galaxy Map) AUX_OTTxD/F (Ocean target transformation) AUX_DTBCUR (Current Delta TB Product) AUX_DTBXY (Delta TBs for the L2OS post-processor)

Table 7: L2 products to which L2 Specific Visualization Features apply

In order to use the L2 specific visualization features, the user must select first a L2 Soil Moisture or Ocean Salinity product file using the File Chooser buffer as presented in section 4.1 of this document.

The user can then click on the SMOS Specific Visualization Features Icon  , the following window appears:

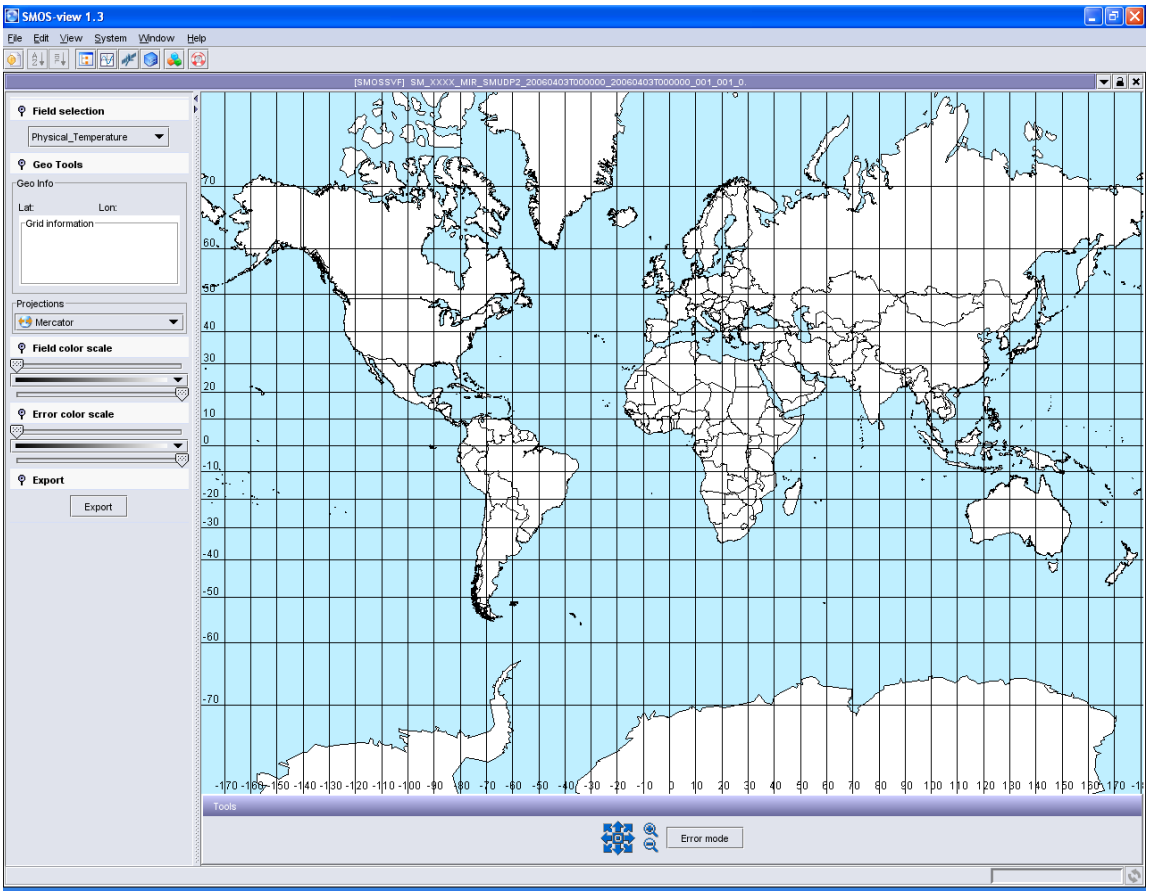


Figure 95: L2 specific visualization feature window

9.1. Controls from left pane

The controls of the control panel on the left are described hereafter:

SMOSView allows projecting all fields and their associated errors from Level 2 Ocean Salinity User Data Product (MIR_OSUDP2) and Level 2 Soil Moisture User Data Product (MIR_SMUDP2). The tables below list all these fields:

OSUDP2 Field	Description
SSS1	Sea surface salinity using roughness model 1
SSS2	Sea surface salinity using roughness model 2
SSS3	Sea surface salinity using roughness model 3
WS	Equivalent neutral wind speed as derived from ECMWF
SST	Sea Surface Temperature as derived from ECMWF
Tb_42.5H	Brightness Temperature at surface level derived with default

	forward model and retrieved geophysical parameters, H polarisation direction.
Tb_42.5V	Brightness Temperature at surface level derived with default forward model and Retrieved geophysical parameters, V polarisation direction.

Table 8: L2 Ocean Salinity fields that can be projected on the geographical map

L2 SM Field	Description
Soil_Moisture	Retrieved soil moisture value
Optical_Thickness_Nad	Nadir optical thickness estimate for vegetation layer
Physical_Temperature	Surface equivalent temperature – may be a retrieved value or from an external source
TTH	Optical thickness coefficient for polarisation H
RTT	Ratio of optical thickness coefficients TTH/TTV
Scattering_Albedo_H	Scattering albedo for horizontal polarisation
DIFF_Albedos	Difference of albedos ωH-ωV
Roughness_Param	Roughness parameter estimate
Dielect_Const_MD_RE	Real part of the dielectric constant from MD retrieval.
Dielect_Const_MD_ IM	Imaginary part of dielectric constant from MD retrieval
Dielect_Const_Non_MD_RE	Real part of dielectric constant from retrieval models other than MD
Dielect_Const_Non_MD_IM	Imaginary part of dielectric constant from retrieval models other than MD
TB_ASL_Theta_B_H	Surface level TB (corrected from sky/atmosphere contribution) computed from forward model with specific incidence angle θ_B (42.5 °), and for H polarisation.
TB_ASL_Theta_B_V	Surface level TB (corrected from sky/atmosphere contribution) computed from forward model a specific incidence angle θ_B (42.5 °), and for V polarisation
TB_TOA_Theta_B_H	Top of the atmosphere TB computed from forward model at specific incidence angle θ_B (42.5º), for H polarisation
TB_TOA_Theta_B_V	Top of the atmosphere TB computed from forward model at specific incidence angle θ_B (42.5º), for V polarisation

Table 9: L2 Soil Moisture fields that can be projected on the geographical map

9.1.1. Field selection

A field selection drop down menu allows the user to select the field to project on the map as shown in Figure 96. Even if selected by default, to visualize such parameters projected on the Earth, the **user must select the field to be projected on the map by the "Field selection"** drop down menu:

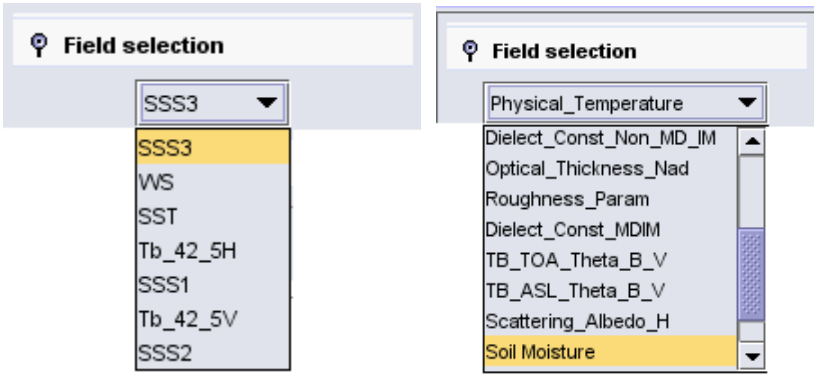


Figure 96: Field selection box (OS product on the left; SM product on the right)

9.1.2. Flags selection

The user can select one or more flags available from the L2 product and overlay them to the displayed product. The available flags for the chosen product can be visualized in the flags selection box, as displayed in Figure 97.

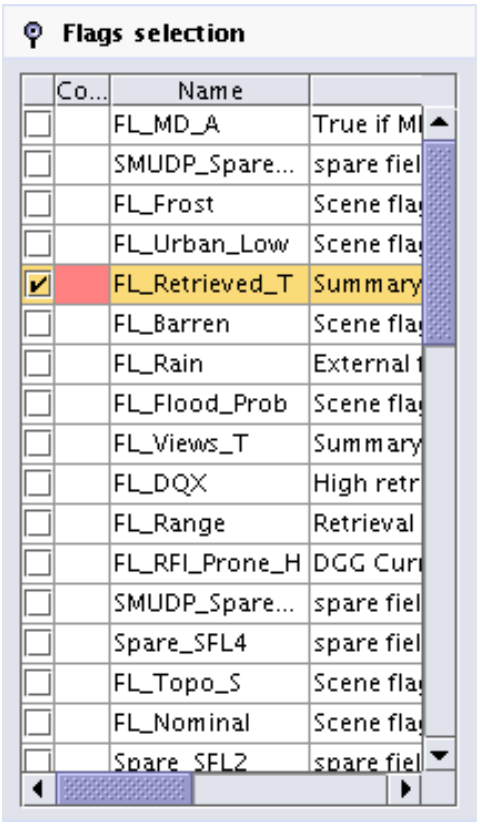


Figure 97: Flags selection box

To select a flag to be overlaid to the image, the user must click in the left column box of the flag. The colour of the fag and the transparency are configurable.

To choose the color and the transparency of the flag to display the user must click in the second column starting left. The following menu is then displayed:

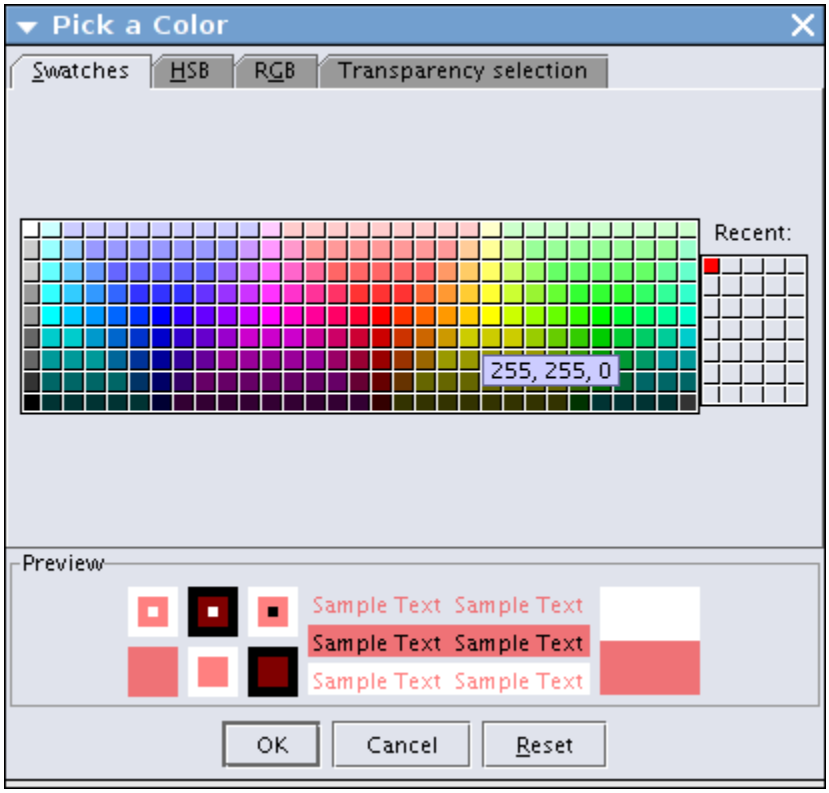


Figure 98: Flags color transparency menu

The user can choose the color of the flag in the "Swatches" tab: by clicking on the desired color (see Figure 98). He can then select the transparency level in the "Transparency selection" tab: by moving the slider to the transparency level desired (see Figure 99).

NOTE: Due to the use of a different point layer to display flags in the world map, sometimes during the zoom operations they may appear outside of the original position. In this case the zoom shall be performed prior to the display of the flags.

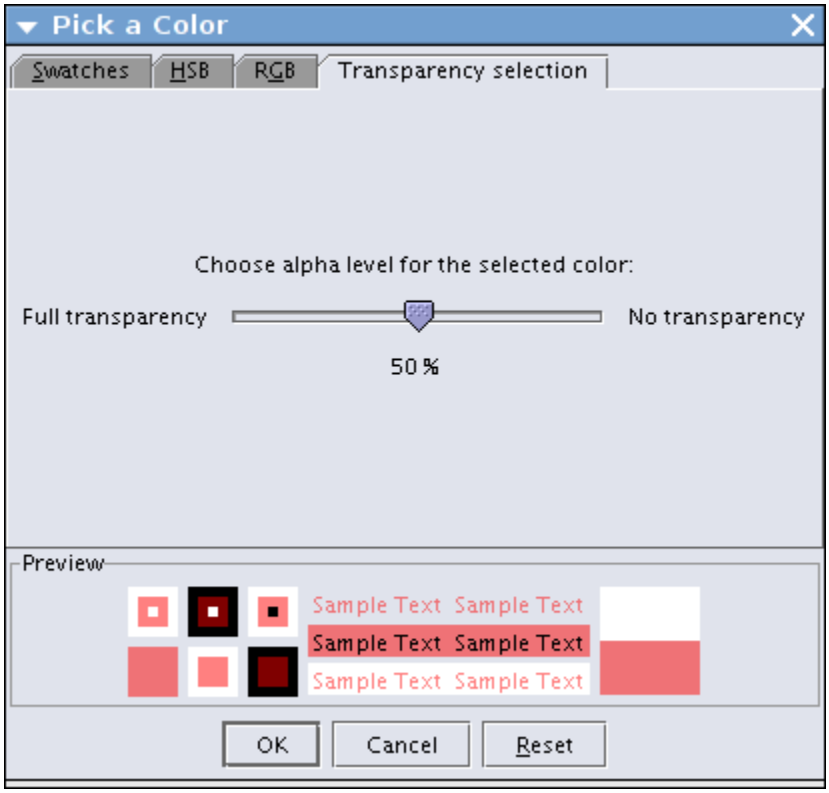


Figure 99: Flags transparency selection menu

9.1.3. Geo Tools

When the mouse is moving through the projected data, the "Geo Tools" give the user useful geographical information about the current mouse position: Latitude, longitude, and about the grid information: Grid ID, grid latitude, grid longitude, and grid mask.

Note: the latitude/longitude grid information gives the position of the center of the grid ID, while the "geo info" gives the exact cursor latitude/longitude.

See Figure 82.

9.1.4. Projections

The default projection used is the Mercator projection. However, it is possible to visualize the data through other geographical projections such as Orthographic (North/South) or Gnomonic projections. See more details in section 8.1.2.3.

9.1.5. Field color Scale

The user can select the color table that will be affected to the field to be projected thanks to the Field color scale. The user has to select a color table within the drop down menu of Figure 100.

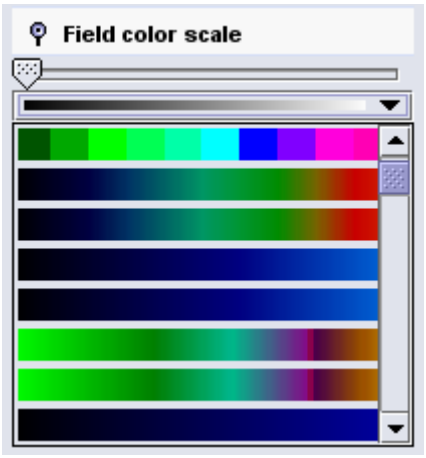


Figure 100: L2 field color scale

The colour range is loaded by default with the Min and Max values calculated directly from the points displayed on the map, however the user can set those values using the Min and Max text fields and then clicking on the "Scale" tick box. Afterwards the points are redisplayed according to the new range.

9.1.6. Example

Once the field, the color tables and the projections selected, the following window displays the L2 data on the geographical map:

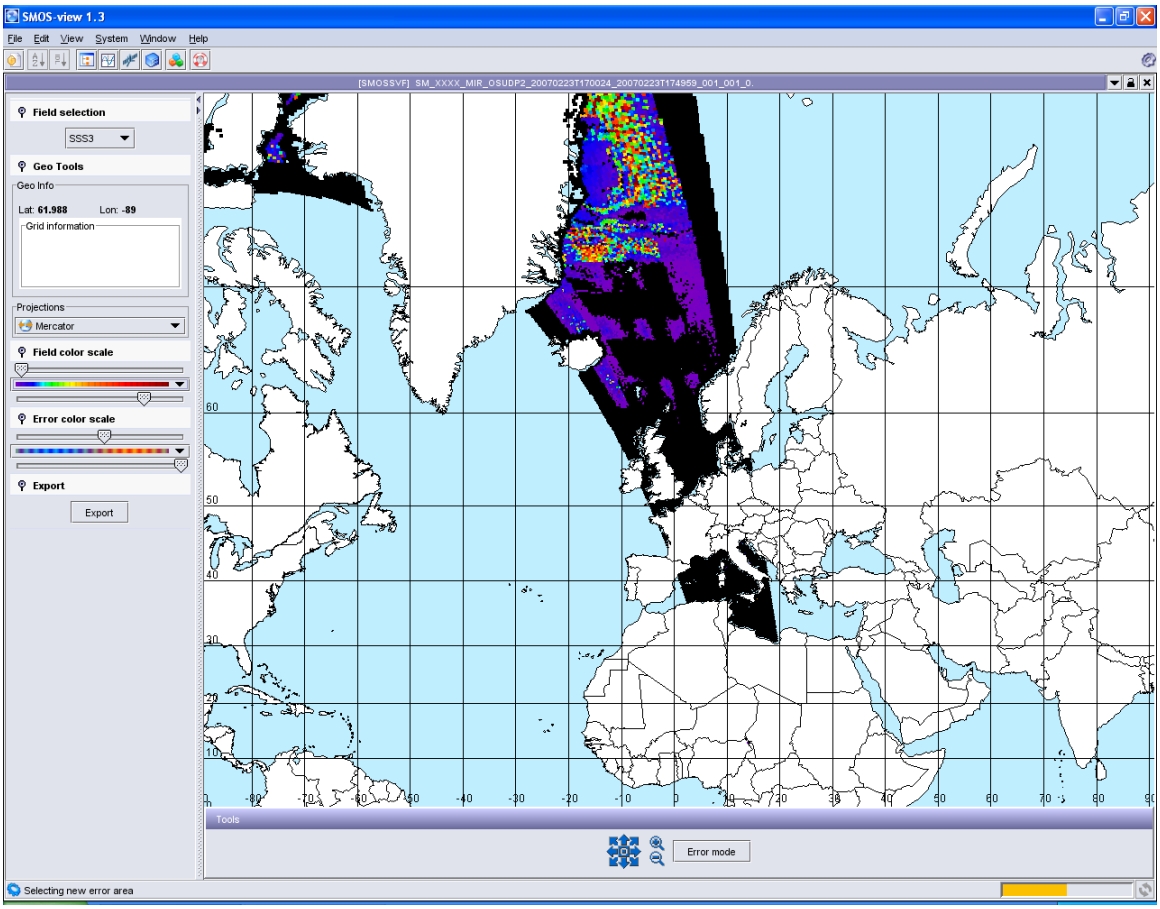


Figure 101: L2 OS product visualization example

9.2. Error mode

L2 specific visualization features include an "error mode" that allows the user to display and project on the map the associated error contained in the L2 product (e.g. DQX) to the field selected (e.g. soil moisture), above the field itself. To use the error mode, the user has to choose the error mode by clicking on the "Error mode" icon below the main panel:

Figure 102: Click on the "Error Mode" icon to start the error mode

Once displayed, the user can as previously navigate through the projected data using the zoom in / out / around tool of Figure 102.

9.2.1. Error color scale

The color scale of the error displayed above the field projected can be chosen among various color tables thanks to the "Error color scale" drop down menu:

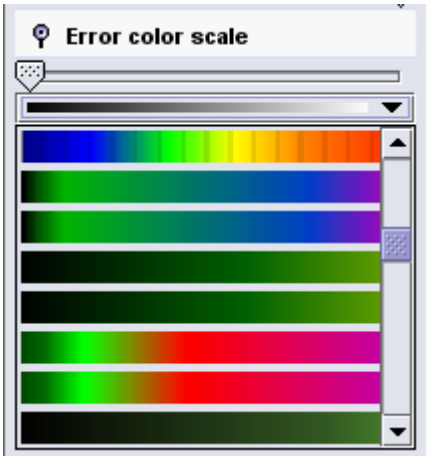


Figure 103: Error color scale

9.2.2. Error mode example

To use the error mode, the user has first to project one field using the features of the previous section "Field selection", page 89.

Once the error mode selected and the colour table selected, the user can simply left-click on the area where he would like the error to be displayed above the projected data. The error is then displayed above the data, all around the clicked position as seen in Figure 104 hereafter.

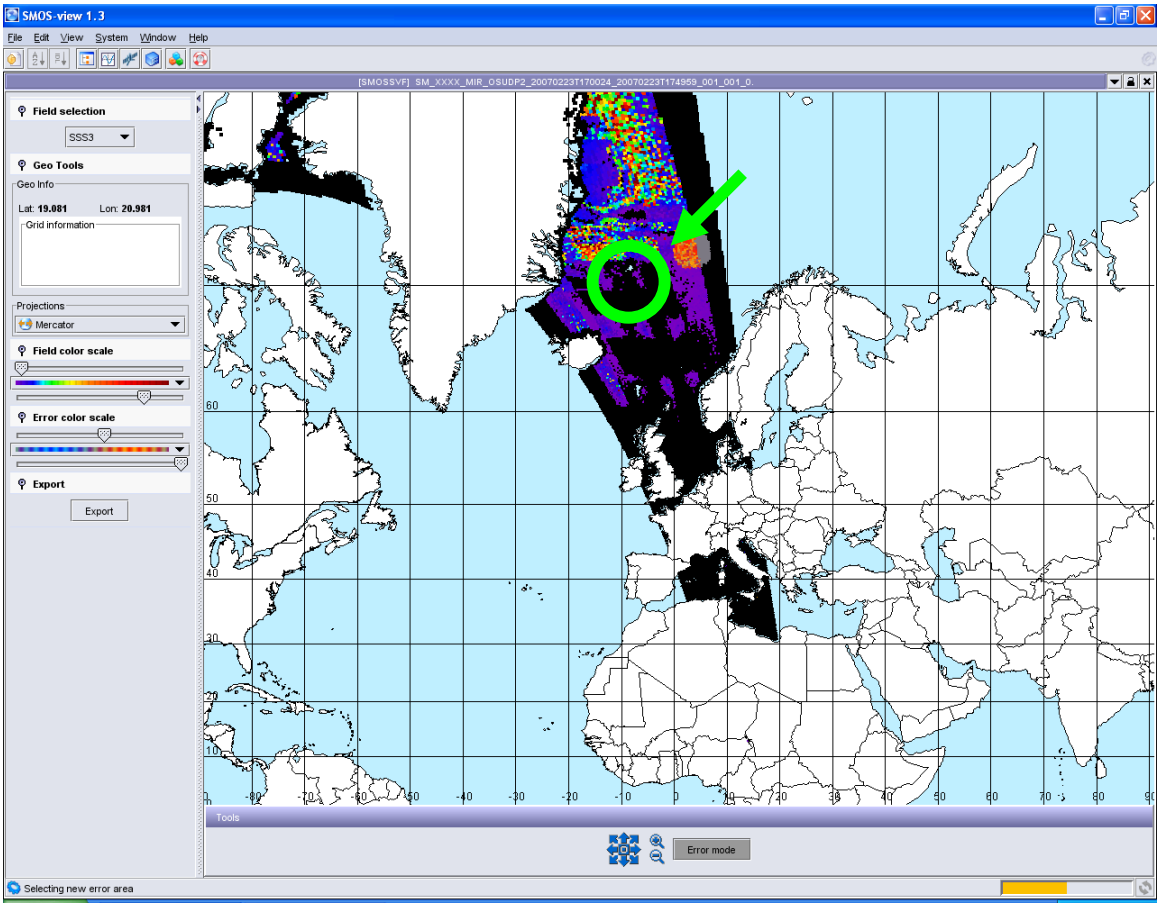


Figure 104: Error mode display above SSS field

9.2.3. Visualization Approach on AUX_SSS and AUX_DISTAN

Due to the fact that this AUX_SSS and AUX_DISTAN files have a huge number of points (cover the whole DGG grid) and SMOS View visualization plugin memory limitations don't allow the simultaneous display of a so large number of points, the display of data is performed zone by zone. In total there are 6 zones available

A new panel was created below the world map containing the available zones.

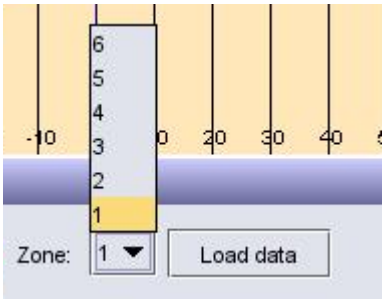


Figure 105: AUX_SSS Zone PanelDummy Data Filtering

Some SMOS products like L2 and AUX are filled with dummy data, which is initialization values that are kept in the final product. In most of the cases those values don't have an important meaning, therefore it was found the need of don't display them in the world map.

The values considered as dummy are the following:

- -999
- -99999
- -99998

By default, the specific visualization feature doesn't consider these values on the world map, however the user is able to display them.

To display the dummy values on the world map the user must select the option "Display DUMMY Values" present on the "Tools" panel, located below the world map.

Figure 106: Display DUMMY Values Option

The values are then displayed in the world map with colour "Black", in order to clearly identify them, the colour scale shall be different than the "Black and White", if for some reason the "Black and White" scale its set it should be changed to another that doesn't contains the black colour. The dummy values are then added and shown within the values layer. If the user unselects the option, then world map will be repainted without the dummy values.

9.2.3.1. Visualization Approach for the AUX_SSS for schema version 400

For the new schema version 400 a new visualization panel was implemented for the AUX_SSS product.

With this new panel the user can plot the monthly values, divided into 6 zones, for the following parameters: SSa, SSa-quality, SSb and SSB_quality for each LUT A and D.

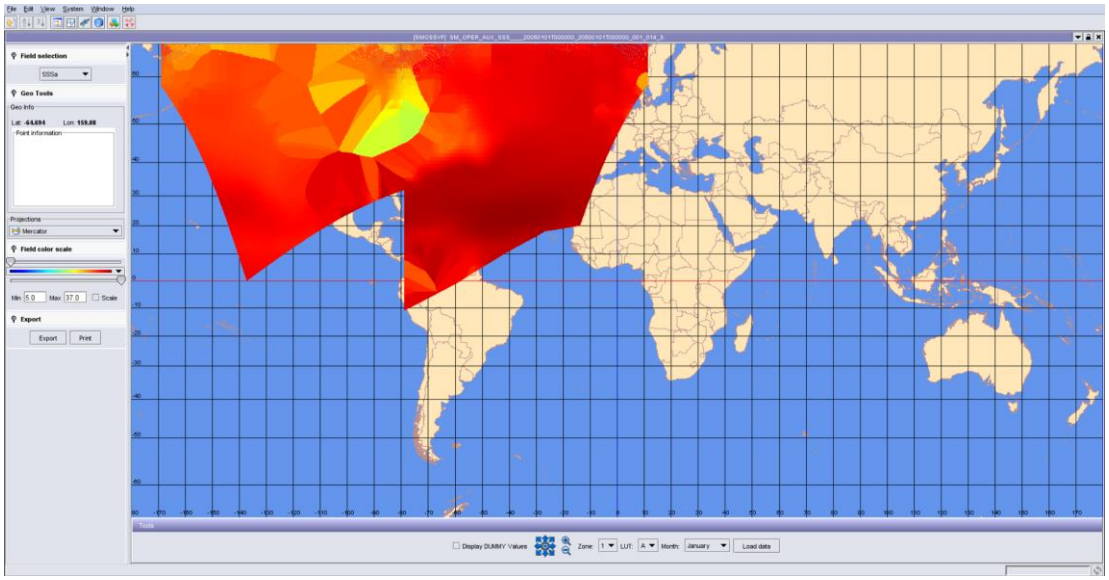


Figure 107: AUX_SSS product visualization for a product schema version 400

9.2.4. Visualization of AUX_FARA Products

The main purpose of this ADF is to provide the L2OP with a more precise computation of the Faraday angle based on algorithm improvements and refined VTEC background field (i.e. the combined VTEC). In addition, the Faraday rotation auxiliary file can be used in any of the DPGS sub/system, and allows de-coupling L1 reprocessing activity for algorithm upgrades and availability of a more precise Faraday rotation (i.e., VTEC combined, usage of refined geomagnetic model). This ADF has the following types:

- AUX_FARA_C (Consolidated Faraday Rotation)
- AUX_FARA_P (Predicted Faraday Rotation)
- AUX_FARA_R (Rapid Faraday Rotation)

SMOS Data Viewer provides the possibility for the user to perform a specific visualization in a panel similar to L1C (snapshot by snapshot basis) but without the polarization filter. The following figure presents a screenshot of a visualization showing on the left side the variables available for the user.

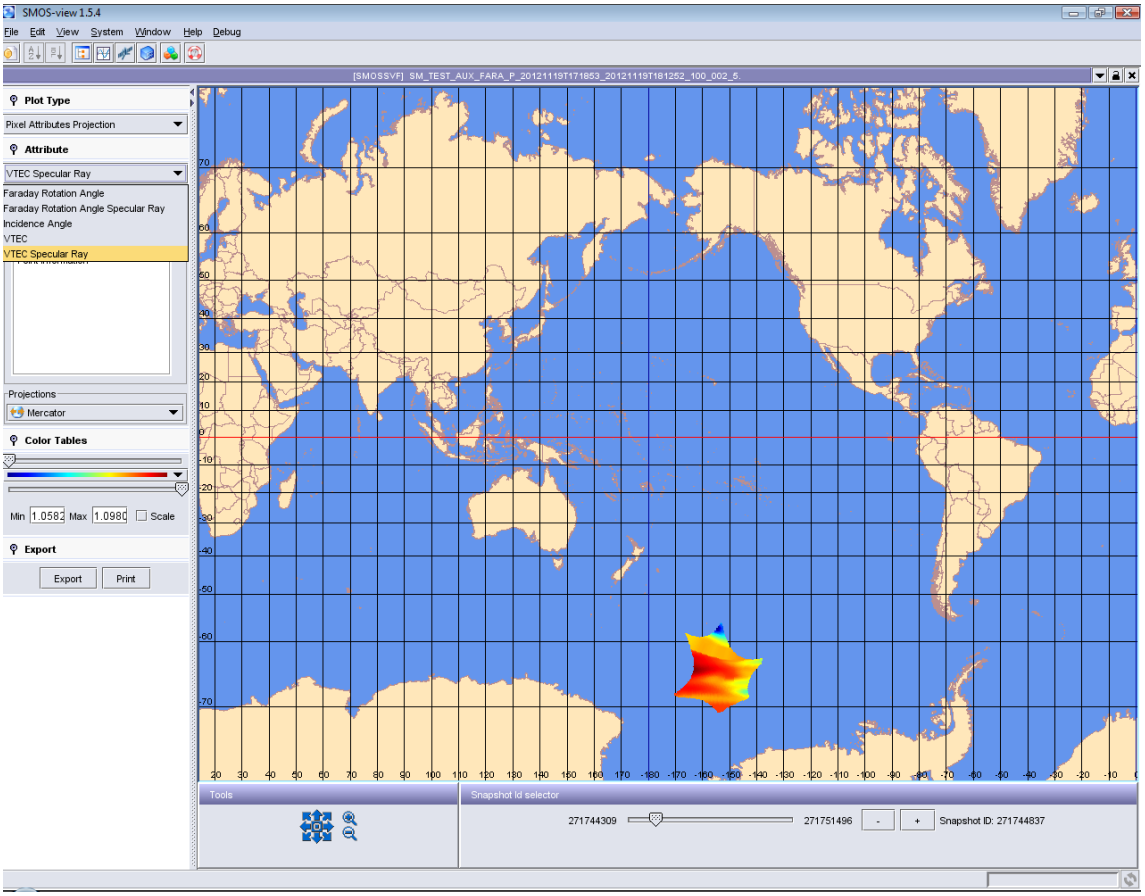


Figure 108: AUX_FARA Specific Visualization

9.2.5. Visualization of AUX_GAL_OS and AUX_GAL_SM

The specific visualization of AUX_GAL_OS and AUX_GAL_SM is performed on a (Ra, De) chart with 721x1441 elements. On the AUX_GAL_OS the chart will display the corresponding TB_Sky_H (Sky TB for Horizontal Polarization) and TB_Sky_V (Sky_TB for Vertical Polarization) values for each Right Ascension (Ra), Declination (De) pair of coordinates.

For the AUX_GAL_SM the visualization panel is divided in four charts:

- I_CSWeF (First Stokes Parameter)
- Q_CSWeF (Second Stokes Parameter)
- U_CSWeF (Third Stokes Parameter)
- Delta_I (Potential Error Due to Strong Noise Sources)

Due to jFreeChart limitations the Ra and De coordinates have a step of 0,5. The Ra ranges are from 0.0 to 360.0 while the De are from -90.0 to 90.0.

It must be noted that due to performance issues, the zoom and colour scale operations are performed slowly.

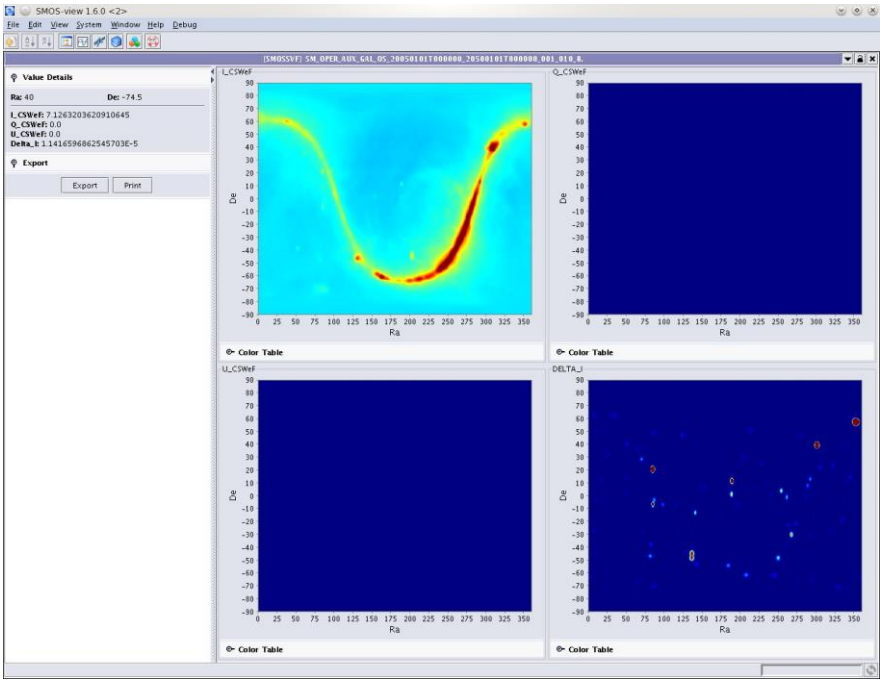


Figure 109: AUX_GAL_OS Specific Visualization

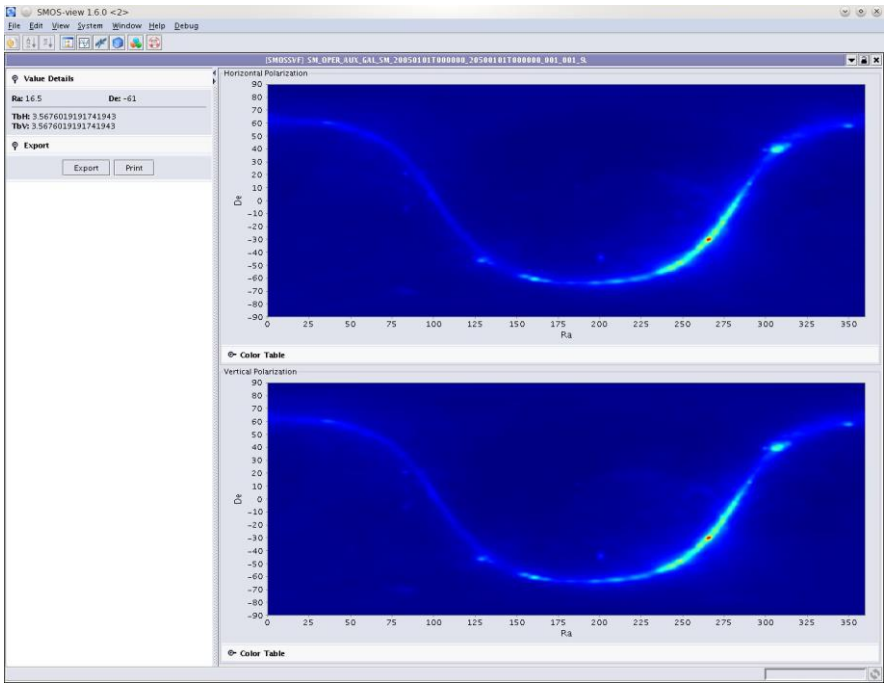


Figure 110: AUX_GAL_SM Specific Visualization

9.2.6. Visualization of AUX_OTTxD/F

The specific visualization of AUX_OTT data is performed on (Xi, Eta) charts divided by ascending and descending orbit. The visualization panel is divided in four plots, the two on the left have the Ascending orbit and the two on the right the Descending orbit.

The values shown on the "**Value Details**" panel are according to the organization of the visualization panel.

By default, the colour scale range is set to [-10.0, 10.0], if the user uncheck the "Scale" option the scale range will be set to the minimum and maximum values of the plots.

For dual polarization products the only four plots displayed are:

- LUT_offset_HH_A on the top left panel.
- LUT_offset_HH_D on the top right panel.
- LUT_offset_VV_A on the bottom left panel.
- LUT_offset_VV_D on the bottom right panel.

The following picture shows the visualization panel for the dual polarization product.

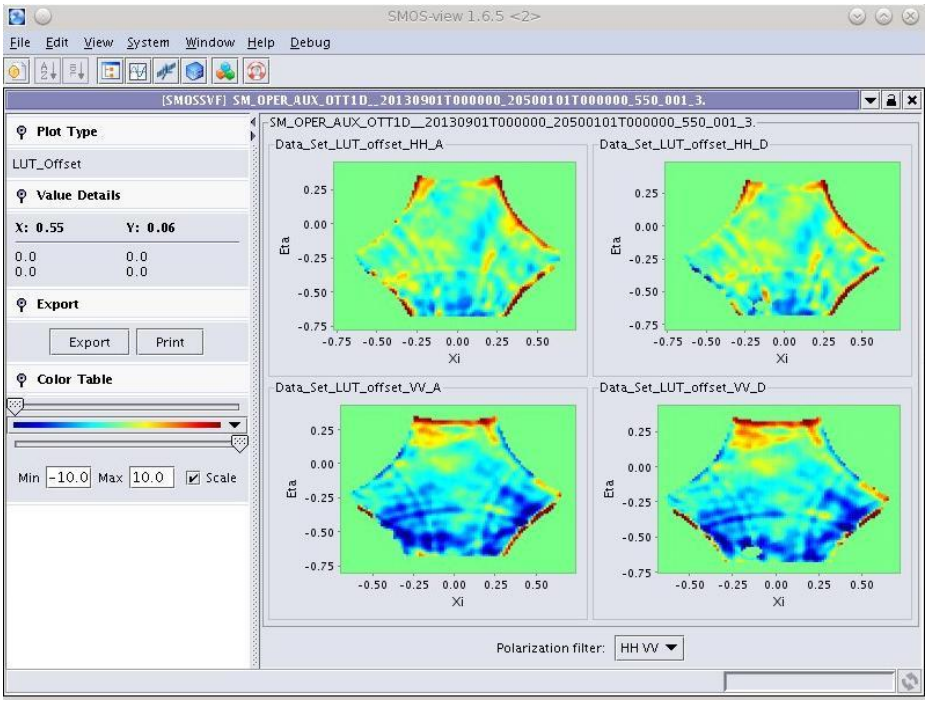


Figure 111: AUX_OTT Dual Pol Specific Visualization

For the Dual Polarization case the user can select the following polarization filters:

- **HH VV**
  - Same plots as the dual polarization case
- **HH_short VV_short**
  - LUT_offset_HH_short_A on the top left panel.

- LUT_offset_HH_short_D on the top right panel.
- LUT_offset_VV_short_A on the bottom left panel.
- LUT_offset_VV_short_D on the bottom right panel.

❑ **HH HH_short**

- LUT_offset_HH_A on the top left panel.
- LUT_offset_HH_D on the top right panel.
- LUT_offset_HH_short_A on the bottom left panel.
- LUT_offset_HH_short_D on the bottom right panel.

❑ **VV VV_short**

- LUT_offset_VV_A on the top left panel.
- LUT_offset_VV_D on the top right panel.
- LUT_offset_VV_short_A on the bottom left panel.
- LUT_offset_VV_short_D on the bottom right panel.

❑ **T3_HHV T4_HHV**

- LUT_offset_T3_HHV_A on the top left panel.
- LUT_offset_T3_HHV_D on the top right panel.
- LUT_offset_T4_HHV_A on the bottom left panel.
- LUT_offset_T4_HHV_D on the bottom right panel.

❑ **T3_VVH T4_VVH**

- LUT_offset_T3_VVH_A on the top left panel.
- LUT_offset_T3_VVH_D on the top right panel.
- LUT_offset_T4_VVH_A on the bottom left panel.
- LUT_offset_T4_VVH_D on the bottom right panel.

9.2.7. Visualization of AUX_DTBCUR

The specific visualization of AUX_DTBCUR data is performed on (Xi, Eta) charts divided in four plots, XX, YY (top) and XX Short, YY Short (bottom). The user can select other polarization filter (XY) where the four plots will be XXY Stokes 3 and XXY Stokes 4 (top), YYX Stokes 3 and YYX Stokes 4 (bottom).

Apart from the polarization, the user can select as well the orbit, model and variable (count_deltaTB, deltaTB, std_deltaTB or flags) to plot.

The values shown on the "**Value Details**" panel are according to the organization of the visualization panel.

By default the colour scale is range is "Blue-White-Red" and the range is set to [-10.0, 10.0], if the user uncheck the "Scale" option the scale range will be set to the minimum and maximum values of the plots.

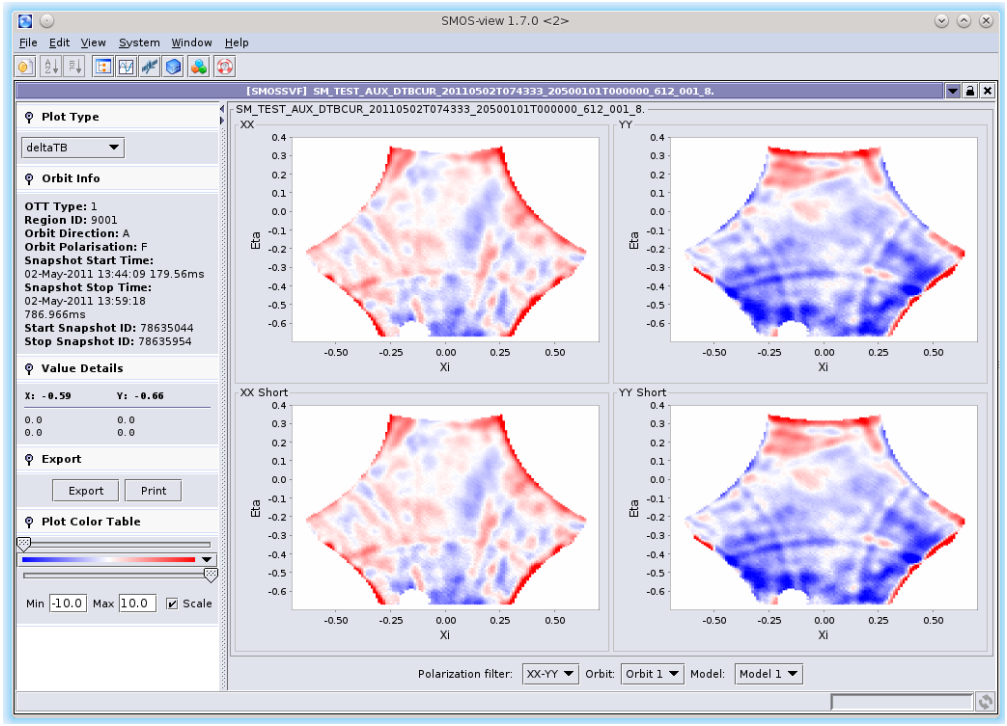


Figure 112: AUX_DTBCUR Specific Visualization

9.2.8. Visualization of AUX_DTBXY

The specific visualization of AUX_DTBXY can be performed through three different panels selected by the user on the Graphics Type box:

- **Plot Panel** (Default): Showing the OTTs as it is done for the AUX_DTBCUR.
- **World Map Panel:** Showing the Snapshot through a ground track representation.
- **Charts Panel:** Show the A3TEC variables through four X-Y plots.

Introduced in version 1.8.5 of the SMOS Data viewer the user has new options to visualize the data for AUX_DTBXY products with a schema version 401. The specific visualization of AUX_DTBXY can be performed through three different panels selected by the user on the Graphics Type box:

- **World map TB bias Panel:** Showing the TB Snapshots through a ground track representation.
- **World map GeoPhy Panel:** Showing the Geo-physical through a ground track representation.

9.2.8.1. Plot Panel

Please refer section 9.2.7. Only available for AUX_DTBXY products up to with a schema version equal or below 300.

9.2.8.2. World Map Panel

On this panel the user is able to see several snapshot variables over the world map. The user can select the Region ID, FOV Zone, Polarization and Model. The supported variables are meas_count, delta_TB, model_TB and flags. Only available for AUX_DTBXY products up to with a schema version equal or below 300.

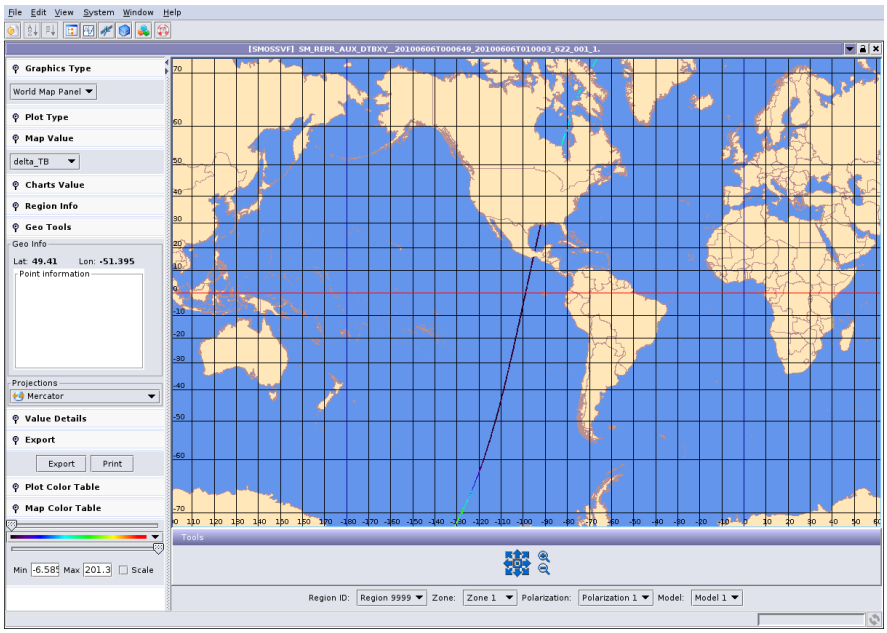


Figure 113: AUX_DTBXY World Map

9.2.8.3. Charts Panel

In this specific visualization the user is able to select the A3TEC variables (latTEC, l1cTEC, tecres, signpost) to be plotted against fovlatitude (top-left), fovLongitude (top-right), geoLatitude (bottom-left), geoLongitude (bottom-right). Only available for AUX_DTBXY products up to with a schema version equal or below 300.

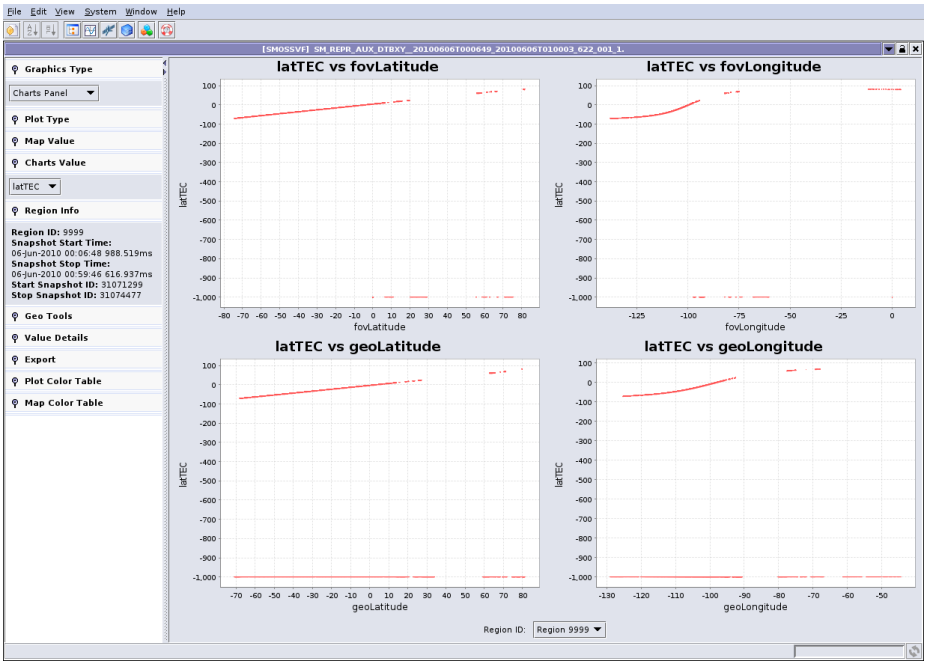


Figure 114: AUX_DTBXY Charts Panel

9.2.8.4. World map TB bias Panel

On this panel the user can see several snapshot variables over the world map. The supported variables are:

- Measurement_Count
- L1cTEC
- TB_biasL1TEC
- TB_biasA3TEC

Where the TB_biasL1TEC is determined with this computation:

TB_biasL1TEC = L1c_Stokes_Stats. L1c_Stats.L1cTB - TOA_L1cTEC_Model_Stokes.sumTB

and the TB_biasA3TEC like so:

TB_biasA3TEC = L1c_Stokes_Stats. L1c_Stats.L1cTB - TOA_A3TEC_Model_Stokes.sumTB

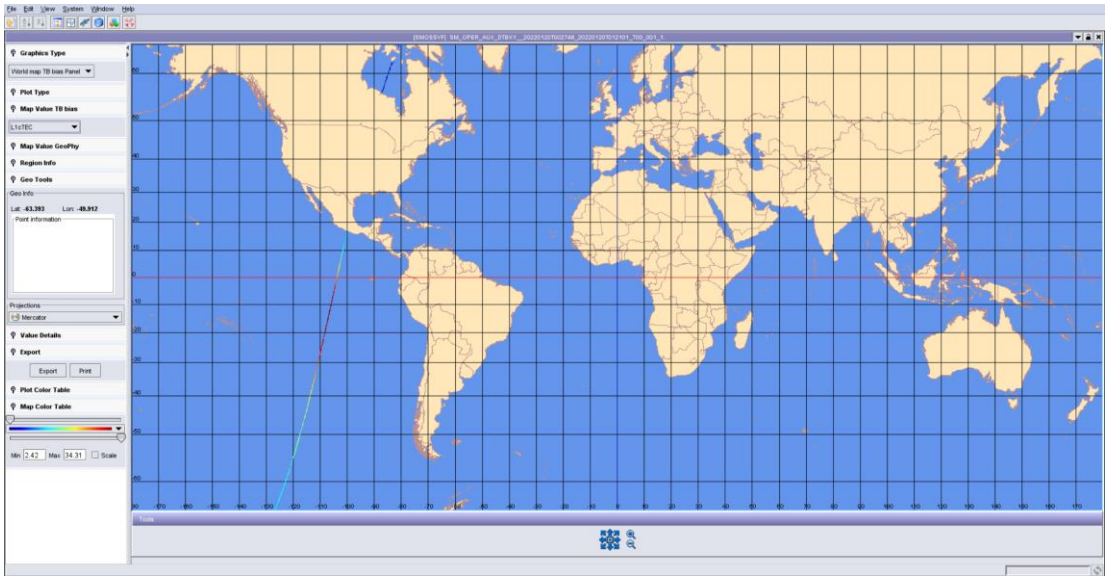


Figure 115: AUX_DTBXY World map TB bias Panel

9.2.8.5. World map GeoPhy Panel

On this panel the user can see several Geo Physical snapshot variables over the world map. The supported variables are:

- SSS
- std_SSS
- SST
- std_SST
- WS
- std_WS
- A3TEC
- std_A3TEC
- Tair
- std_Tair
- SP
- std_SP
- TCWV
- std_TCWV
- HS
- std_HS

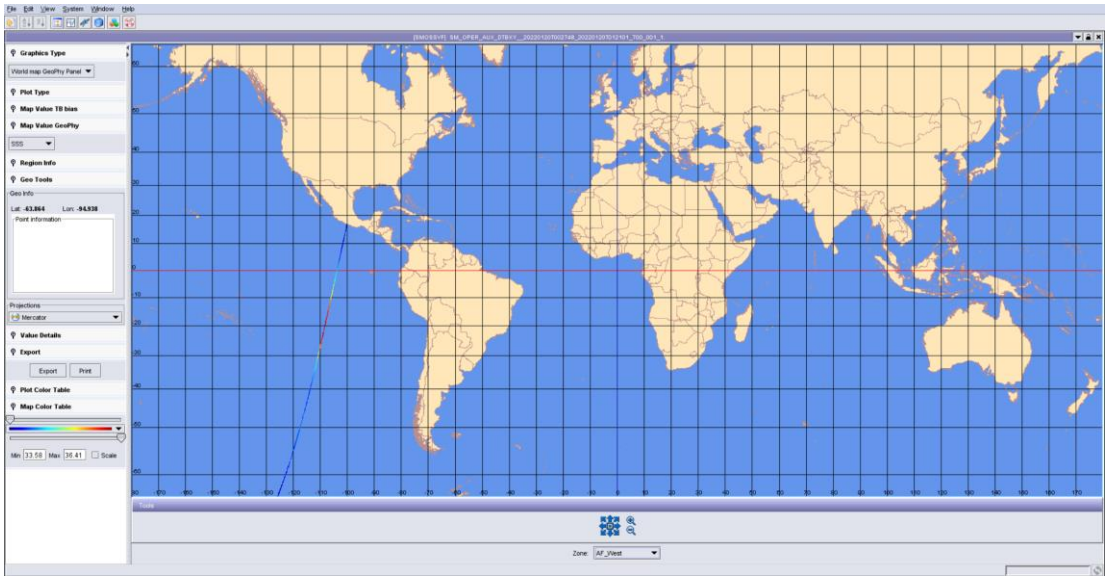


Figure 116: AUX_DTBXY World map GeoPhy Panel

The list of zones available for the user to choose from are listed below:

- Border
- Angle_45
- Angle_40
- Angle_38
- Angle_29
- Angle_0
- Antenna_02
- Antenna_04
- Antenna_06
- EAF_W
- EAF_SW
- EAF_SE
- EAF_E
- Central_NW
- Central_NC
- Central_NE
- Central_CW
- Central_CC
- Central_CE

- Central_SW
- Central_SC
- Central_SE
- Suspenders_West
- Suspenders_East
- Circle_04
- Filtered
- AFFOV
- EAFFOV
- FOV

APPENDIX A PREREQUISITE FOR PRINTING

- **Windows, MacOS X**

No particular requirements should be needed.

- **Linux, UNIX**

It is necessary to have the CUPS package installed.

This package is by default installed on most UNIXes and it is freely downloadable from the following website: http://www.cups.org/

APPENDIX B PHASE CALCULATIONS IN SMOS DATA VIEWER PLOTS

Phase is calculated using the atan2 function provided by the standard Java library.

The code that executes this operation is the following:

```
if (_realPart != 0.0 || _imaginaryPart != 0.0)
        _phase = Math.atan2(_imaginaryPart, _realPart);
else
   _phase = 0.0f;
```

To comply with Enhancement 8 (ref. SO-MN-VEG-GS-0050 page 5), the value of the phase is set to 0 when real and imaginary values are 0.

The documentation of the atan2 routine is the following:

The routine converts rectangular coordinates (x, y) to polar (r, *theta*). This method computes the phase *theta* by computing an arc tangent of y/x in the range of *-pi* to *pi*. Special cases:

- If either argument is NaN, then the result is NaN.
- If the first argument is positive zero and the second argument is positive, or the first argument is positive and finite and the second argument is positive infinity, then the result is positive zero.
- If the first argument is negative zero and the second argument is positive, or the first argument is negative and finite and the second argument is positive infinity, then the result is negative zero.
- If the first argument is positive zero and the second argument is negative, or the first argument is positive and finite and the second argument is negative infinity, then the result is the `double` value closest to *pi*.
- If the first argument is negative zero and the second argument is negative, or the first argument is negative and finite and the second argument is negative infinity, then the result is the `double` value closest to *-pi*.
- If the first argument is positive and the second argument is positive zero or negative zero, or the first argument is positive infinity and the second argument is finite, then the result is the `double` value closest to *pi*/2.

- If the first argument is negative and the second argument is positive zero or negative zero, or the first argument is negative infinity and the second argument is finite, then the result is the `double` value closest to -*pi*/2.

- If both arguments are positive infinity, then the result is the `double` value closest to pi/4.

- If the first argument is positive infinity and the second argument is negative infinity, then the result is the `double` value closest to 3**pi*/4.

- If the first argument is negative infinity and the second argument is positive infinity, then the result is the `double` value closest to -*pi*/4.

- If both arguments are negative infinity, then the result is the `double` value closest to -3**pi*/4.

Parameters:

y - the ordinate coordinate

x - the abscissa coordinate

Returns:

the *theta* component of the point (*r*, *theta*) in polar coordinates that corresponds to the point (*x*, *y*) in Cartesian coordinates.

APPENDIX C TRANSFORMATIONS PERFORMED TO SWITCH FROM L1B FOURIER COMPONENTS OF BT TO L1B RECONSTRUCTED BT

Technical note provided by Indra:

The visualization of the L1B product in (chi,eta) domain requires some transformations. The steps to be followed are these:

1. The starting point are the L1B product's fields:
   - **Scene_BT_Fourier** (field number 17), which contains the information to be plotted,
   - and **Flags** (field number 16) which contains information on the polarization of **Scene_BT_Fourier**.
2. **Scene_BT_Fourier** has several elements that varies depending on the product and polarization mode:
   1. Dual polarization product (SM_XXXX_MIR_SC_D1B or SM_XXXX_MIR_TARD1B):
      - the Scene_BT_Fourier field in this product has only pure polarizations, HH or VV. It has 1395 complex values and one real in the centre of the star. These are contained in the product as 2791 double elements.
   2. Full polarization product (SM_XXXX_MIR_SC_F1B or SM_XXXX_MIR_TARF1B): the Scene_BT_Fourier field in this product has 4 possibilities
      - HH or VV: it has 1395 complex values and one real in the centre of the star (2791 doubles totally).
      - HV_real or HV_imag: it has 2791 real values (doubles) covering all the star, either the real part of HV polarization or the imaginary part.
3. In dual polarization products it must be performed the complex conjugate of the **Scene_BT_Fourier** fields in pure polarizations to complete the star in the hexagonal domain. In case of a full polarization product instead of the complex conjugate, the real part is obtained through the 2791 real values of HV_real and the imaginary part is obtained through the 2791 real values of HV_imag.

   I call this **Scene_BT_Fourier***. This follows the same order as **Scene_BT_Fourier**.
4. The resulting variable, which I call **CompleteStar_Scene_BT_Fourier**, is a list of values to be visualized in the hexagonal star domain plot (this is the variable to be visualized by feature specified in SOW's Req. SDV-T-6.1.6-120). The order and coordinates for the complete list of points in the star is specified in LUT *L1B_STARVIS_LUT.txt*.
5. The variable **CompleteStar_Scene_BT_Fourier** is the origin for the Brightness Temperature image in the (chi,eta) domain in whatever resolution (specified by **Xi_Eta_Resolution** field #64 in Table 4-28 of L1OP Specs), although obviously some transformations are needed in

between. The **CompleteStar_Scene_BT_Fourier** variable is related to the BT image by an Inverse FFT procedure.

6. In order to use standard FFT techniques, the **CompleteStar_Scene_BT_Fourier** variable must be fitted into a square matrix of the specified **Xi_Eta_Resolution**, I call this matrix **Rectangular_Scene_BT_Fourier**. To do this, the following procedure must be performed:

   - Create the variable **Rectangular_Scene_BT_Fourier** whose size is **Xi_Eta_Resolution** rows by **Xi_Eta_Resolution** columns, filled with all zeroes. There are 3 possible resolutions, 64x64, 128x128, and 256x256.

   - Use the look up table (*L1B_UV_STAR2RECT_LUT_***.txt*) to find the positions in **Rectangular_Scene_BT_Fourier** rectangular matrix on which the elements of **CompleteStar_Scene_BT_Fourier** have to be placed. First 2 columns contain the row and column indexes in the rectangular grid, the 3rd and 4th columns contain the corresponding (u,v) coordinates values, and the 5th column contains the position of the corresponding element of **CompleteStar_Scene_BT_Fourier** variable. In fact, you don't need columns 3rd and 4th, they are only included for clarification purposes.

   - Note that some of this column 5's positions values are set to -001: this must be understood as that the **Rectangular_Scene_BT_Fourier** must be kept with zero values. In fact, **Rectangular_Scene_BT_Fourier** is zero-padded rectangular version of **CompleteStar_Scene_BT_Fourier**. The hexagonal-grid variable is always the same size, the change in resolution in the rectangular-grid variable is achieved by zero-padding.

7. Once you have the rectangular-grid variable, you must perform an Inverse FFT. The L1PP project has used the FFTW library methods:

   p = fftw_plan_dft_2d(nx, ny, bt_freq_matrix, bt_temp_snapshot, FFTW_BACKWARD,FFTW_ESTIMATE);

   Where **nx** and **ny** are the number of rows and columns in the rectangular grid, **bt_freq_matrix** is the **Rectangular_Scene_BT_Fourier** and **bt_temp_snapshot** the resulting variable in the (chi,eta) domain, which I call from now on **Rectangular_Scene_XiEta**.

8. The variable **Rectangular_Scene_XiEta** has the same size of **Rectangular_Scene_BT_Fourier**. **Rectangular_Scene_XiEta** must be plotted against the coordinates specified in look-up tables *L1B_FFT_XIETA_LUT_***.txt*. The first 2 columns give the indexes in the rectangular matrix, and columns 3rd and 4th give the corresponding Xi and Eta positions.

9. You must plot all values in the **Rectangular_Scene_XiEta** variable, as scientists are interested in everything that is retrieved by the SMOS instrument, even if it is hardly usable with current algorithms.

10. The reconstruction in the xi,eta domain is implemented using the Blackman apodisation window, therefore the brightness temperature is calculated by the following approach:

$$T(\xi,\eta) = \frac{\sqrt{3}}{2} d^2 \sum_m \sum_n \hat{T}(u_{mn}, v_{mn}) \cdot W(u_{mn}, v_{mn}) \cdot e^{j2\pi(u_{mn}\xi + v_{mn}\eta)}$$

APPENDIX D: STAR DOMAIN VISUALIZATION

The Star Domain representation is performed based on the Square Matrix. The ordering is based on reporting only the baselines with positive v coordinate and u positive for v=0:

- The v coordinate for the upper half of the baselines goes continuously from 0 to sqrt(3)*NEL*d, where NEL=21 and d=0.875, in incremental steps of sqrt(3)*d/2
- The u coordinate of the upper half of the baselines shall follow the mathematical rules defined as:
  - If v=0, then u goes from d to 24*d in incremental steps of d
  - If v>0 and v<=sqrt(3)*NEL*d/2, then u goes from –(NEL*d +v/sqrt(3)) to +(NEL*d +v/sqrt(3)) in incremental steps of d
  - If v=sqrt(3)*(NEL+1)*d/2, then u goes from –11*d to +11*d in incremental steps of d
  - If v=sqrt(3)*(NEL+2)*d/2, then u has the values –23*d/2, –19*d/2 to +19*d/2 in incremental steps of d and +23*d/2. Notice that the elements ±21*d/2 are not present.
  - If v=sqrt(3)*(NEL+3)*d/2, then u has the values –12*d, –9*d to +9*d in incremental steps of d and +12*d. Notice that the elements ±11*d and ±10*d are not present.
  - Finally, if v>sqrt(3)*(NEL+3)*d/2 and v<=sqrt(3)*NEL*d, then u goes from –(NEL*d –v/sqrt(3)) to +(NEL*d –v/sqrt(3)) in incremental steps of d

The order followed is shown in the next picture. For the 1395 element vector, the baselines shall be taken first from left to right, then from bottom to top. I.e. the first 24 elements are the ones with v=0 and ordered by increasing u; the next 42 elements are the ones with v=sqrt(3)*d/2 and ordered by increasing u (from negative to positive), and so on until the 1395 elements are covered.

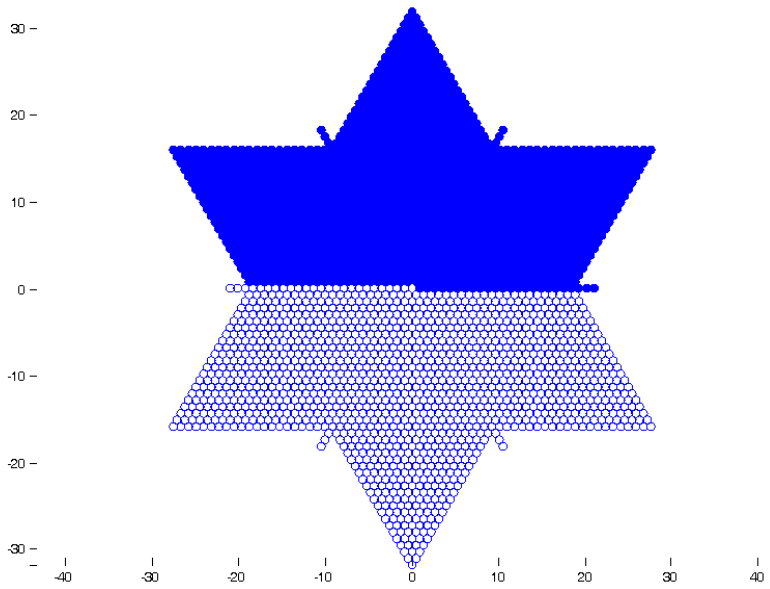


Figure 117: Star Domain Representation

For the case of HV polarisation, where the vector is 2791 elements long, the complete star must be covered. In this case, the ordering shall be similar to the one adopted above. The first element shall be the zero baseline (u=0, v=0); the next 1395 elements shall be ordered like it has been described (left to right, then bottom to top); and the remaining 1395 element shall be ordered in the same way as well, but inverting the sign of the resulting u and v coordinates (i.e., it changes to ordering from right to left, then top to bottom).

APPENDIX E: BROWSE STRUCTURE OF LEVEL 0 PRODUCT ARRAYS

In order to be possible to correctly browse and plot variables for level 0 products, some changes have been made to the XIN schema to split the I Q correlations in smaller arrays. The following table presents the array index number and the corresponding correlation.

Array Index	Correlation
Correlator_Counts_1	
1	1_1-0
2	1_0-0
3	I24_1
4	I24_Q24
5	I24_I23
6	I24_I22
7	I24_I21
8	I24_I20
9	I24_I19
10	I24_I18
11	I24_I17
12	I24_I16
13	I24_I15
14	I24_I14
15	I24_I13
16	I24_I12
17	I24_I11
18	I24_I10
19	I24_I9
20	I24_I8
21	I24_I7
22	I24_I6
23	I24_I5
24	I24_I4
25	I24_I3
26	I24_I2
27	I24_I1
28	I24_0
29	I23_1
30	I23_Q24
31	I23_Q23
32	I23_I22
33	I23_I21
34	I23_I20
35	I23_I19
36	I23_I18
37	I23_I17
38	I23_I16
39	I23_I15
40	I23_I14
41	I23_I13
42	I23_I12
43	I23_I11
44	I23_I10
45	I23_I9
46	I23_I8
47	I23_I7
48	I23_I6
49	I23_I5
50	I23_I4
51	I23_I3
52	I23_I2
53	I23_I1
54	I23_0
55	I22_1
56	I22_Q24
57	I22_Q23
58	I22_Q22
59	I22_I21
60	I22_I20
61	I22_I19
62	I22_I18
63	I22_I17
64	I22_I16
65	I22_I15
66	I22_I14
67	I22_I13
68	I22_I12
69	I22_I11
70	I22_I10
71	I22_I9
72	I22_I8
73	I22_I7
74	I22_I6
75	I22_I5
76	I22_I4

77	I22_I3
78	I22_I2
79	I22_I1
80	I22_0
81	I21_1
82	I21_Q24
83	I21_Q23
84	I21_Q22
85	I21_Q21
86	I21_I20
87	I21_I19
88	I21_I18
89	I21_I17
90	I21_I16
91	I21_I15
92	I21_I14
93	I21_I13
94	I21_I12
95	I21_I11
96	I21_I10
97	I21_I9
98	I21_I8
99	I21_I7
100	I21_I6
101	I21_I5
102	I21_I4
103	I21_I3
104	I21_I2
105	I21_I1
106	I21_0
107	I20_1
108	I20_Q24

109	I20_Q23
110	I20_Q22
111	I20_Q21
112	I20_Q20
113	I20_I19
114	I20_I18
115	I20_I17
116	I20_I16
117	I20_I15
118	I20_I14
119	I20_I13
120	I20_I12
121	I20_I11
122	I20_I10
123	I20_I9
124	I20_I8
125	I20_I7
126	I20_I6
127	I20_I5
128	I20_I4
129	I20_I3
130	I20_I2
131	I20_I1
132	I20_0
133	I19_1
134	I19_Q24
135	I19_Q23
136	I19_Q22
137	I19_Q21
138	I19_Q20
139	I19_Q19
140	I19_I18

141	I19_I17
142	I19_I16
143	I19_I15
144	I19_I14
145	I19_I13
146	I19_I12
147	I19_I11
148	I19_I10
149	I19_I9
150	I19_I8
151	I19_I7
152	I19_I6
153	I19_I5
154	I19_I4
155	I19_I3
156	I19_I2
157	I19_I1
158	I19_0
159	I18_1
160	I18_Q24
161	I18_Q23
162	I18_Q22
163	I18_Q21
164	I18_Q20
165	I18_Q19
166	I18_Q18
167	I18_I17
168	I18_I16
169	I18_I15
170	I18_I14
171	I18_I13
172	I18_I12

173	I18_I11
174	I18_I10
175	I18_I9
176	I18_I8
177	I18_I7
178	I18_I6
179	I18_I5
180	I18_I4
181	I18_I3
182	I18_I2
183	I18_I1
184	I18_0
185	I17_1
186	I17_Q24
187	I17_Q23
188	I17_Q22
189	I17_Q21
190	I17_Q20
191	I17_Q19

192	I17_Q18
193	I17_Q17
194	I17_I16
195	I17_I15
196	I17_I14
197	I17_I13
198	I17_I12
199	I17_I11
200	I17_I10
201	I17_I9
202	I17_I8
203	I17_I7
204	I17_I6
205	I17_I5
206	I17_I4
207	I17_I3
208	I17_I2
209	I17_I1
210	I17_0

211	I16_1
212	I16_Q24
213	I16_Q23
214	I16_Q22
215	I16_Q21
216	I16_Q20
217	I16_Q19
218	I16_Q18
219	I16_Q17
220	I16_Q16
221	I16_I15
222	I16_I14
223	I16_I13
224	I16_I12
225	I16_I11
226	I16_I10
227	I16_I9
228	I16_I8

Array Index	**Correlation**
Correlator_Counts_2	
1	I16_I7
2	I16_I6
3	I16_I5
4	I16_I4
5	I16_I3
6	I16_I2
7	I16_I1
8	I16_0
9	I15_1
10	I15_Q24

11	I15_Q23
12	I15_Q22
13	I15_Q21
14	I15_Q20
15	I15_Q19
16	I15_Q18
17	I15_Q17
18	I15_Q16
19	I15_Q15
20	I15_I14
21	I15_I13
22	I15_I12

23	I15_I11
24	I15_I10
25	I15_I9
26	I15_I8
27	I15_I7
28	I15_I6
29	I15_I5
30	I15_I4
31	I15_I3
32	I15_I2
33	I15_I1
34	I15_0

35	I14_1
36	I14_Q24
37	I14_Q23
38	I14_Q22
39	I14_Q21
40	I14_Q20
41	I14_Q19
42	I14_Q18
43	I14_Q17
44	I14_Q16
45	I14_Q15
46	I14_Q14
47	I14_I13
48	I14_I12
49	I14_I11
50	I14_I10
51	I14_I9
52	I14_I8
53	I14_I7
54	I14_I6
55	I14_I5
56	I14_I4
57	I14_I3
58	I14_I2
59	I14_I1
60	I14_0
61	I13_1
62	I13_Q24
63	I13_Q23
64	I13_Q22
65	I13_Q21
66	I13_Q20

67	I13_Q19
68	I13_Q18
69	I13_Q17
70	I13_Q16
71	I13_Q15
72	I13_Q14
73	I13_Q13
74	I13_I12
75	I13_I11
76	I13_I10
77	I13_I9
78	I13_I8
79	I13_I7
80	I13_I6
81	I13_I5
82	I13_I4
83	I13_I3
84	I13_I2
85	I13_I1
86	I13_0
87	I12_1
88	I12_Q24
89	I12_Q23
90	I12_Q22
91	I12_Q21
92	I12_Q20
93	I12_Q19
94	I12_Q18
95	I12_Q17
96	I12_Q16
97	I12_Q15
98	I12_Q14

99	I12_Q13
100	I12_Q12
101	I12_I11
102	I12_I10
103	I12_I9
104	I12_I8
105	I12_I7
106	I12_I6
107	I12_I5
108	I12_I4
109	I12_I3
110	I12_I2
111	I12_I1
112	I12_0
113	I11_1
114	I11_Q24
115	I11_Q23
116	I11_Q22
117	I11_Q21
118	I11_Q20
119	I11_Q19
120	I11_Q18
121	I11_Q17
122	I11_Q16
123	I11_Q15
124	I11_Q14
125	I11_Q13
126	I11_Q12
127	I11_Q11
128	I11_I10
129	I11_I9
130	I11_I8

131	I11_I7
132	I11_I6
133	I11_I5
134	I11_I4
135	I11_I3
136	I11_I2
137	I11_I1
138	I11_0
139	I10_1
140	I10_Q24
141	I10_Q23
142	I10_Q22
143	I10_Q21
144	I10_Q20
145	I10_Q19
146	I10_Q18
147	I10_Q17
148	I10_Q16
149	I10_Q15
150	I10_Q14
151	I10_Q13
152	I10_Q12
153	I10_Q11
154	I10_Q10
155	I10_I9
156	I10_I8
157	I10_I7
158	I10_I6
159	I10_I5
160	I10_I4
161	I10_I3
162	I10_I2

163	I10_I1
164	I10_0
165	I9_1
166	I9_Q24
167	I9_Q23
168	I9_Q22
169	I9_Q21
170	I9_Q20
171	I9_Q19
172	I9_Q18
173	I9_Q17
174	I9_Q16
175	I9_Q15
176	I9_Q14
177	I9_Q13
178	I9_Q12
179	I9_Q11
180	I9_Q10
181	I9_Q9
182	I9_I8
183	I9_I7
184	I9_I6
185	I9_I5
186	I9_I4
187	I9_I3
188	I9_I2
189	I9_I1
190	I9_0
191	I8_1
192	I8_Q24
193	I8_Q23
194	I8_Q22

195	I8_Q21
196	I8_Q20
197	I8_Q19
198	I8_Q18
199	I8_Q17
200	I8_Q16
201	I8_Q15
202	I8_Q14
203	I8_Q13
204	I8_Q12
205	I8_Q11
206	I8_Q10
207	I8_Q9
208	I8_Q8
209	I8_I7
210	I8_I6
211	I8_I5
212	I8_I4
213	I8_I3
214	I8_I2
215	I8_I1
216	I8_0
217	I7_1
218	I7_Q24
219	I7_Q23
220	I7_Q22
221	I7_Q21
222	I7_Q20
223	I7_Q19
224	I7_Q18
225	I7_Q17
226	I7_Q16

227	I7_Q15
228	I7_Q14

229	I7_Q13
230	I7_Q12

231	I7_Q11

Array Index	Correlation
Correlator_Counts_3	
1	I7_Q10
2	I7_Q9
3	I7_Q8
4	I7_Q7
5	I7_I6
6	I7_I5
7	I7_I4
8	I7_I3
9	I7_I2
10	I7_I1
11	I7_0
12	I6_1
13	I6_Q24
14	I6_Q23
15	I6_Q22
16	I6_Q21
17	I6_Q20
18	I6_Q19
19	I6_Q18
20	I6_Q17
21	I6_Q16
22	I6_Q15
23	I6_Q14
24	I6_Q13
25	I6_Q12
26	I6_Q11
27	I6_Q10
28	I6_Q9
29	I6_Q8
30	I6_Q7
31	I6_Q6
32	I6_I5
33	I6_I4
34	I6_I3
35	I6_I2
36	I6_I1
37	I6_0
38	I5_1
39	I5_Q24
40	I5_Q23
41	I5_Q22
42	I5_Q21
43	I5_Q20
44	I5_Q19
45	I5_Q18
46	I5_Q17
47	I5_Q16
48	I5_Q15
49	I5_Q14
50	I5_Q13
51	I5_Q12
52	I5_Q11
53	I5_Q10
54	I5_Q9
55	I5_Q8
56	I5_Q7
57	I5_Q6
58	I5_Q5
59	I5_I4
60	I5_I3
61	I5_I2
62	I5_I1
63	I5_0
64	I4_1
65	I4_Q24
66	I4_Q23
67	I4_Q22
68	I4_Q21
69	I4_Q20
70	I4_Q19
71	I4_Q18
72	I4_Q17
73	I4_Q16
74	I4_Q15
75	I4_Q14
76	I4_Q13
77	I4_Q12
78	I4_Q11
79	I4_Q10
80	I4_Q9
81	I4_Q8
82	I4_Q7
83	I4_Q6
84	I4_Q5
85	I4_Q4

86	I4_I3
87	I4_I2
88	I4_I1
89	I4_0
90	I3_1
91	I3_Q24
92	I3_Q23
93	I3_Q22
94	I3_Q21
95	I3_Q20
96	I3_Q19
97	I3_Q18
98	I3_Q17
99	I3_Q16
100	I3_Q15
101	I3_Q14
102	I3_Q13
103	I3_Q12
104	I3_Q11
105	I3_Q10
106	I3_Q9
107	I3_Q8
108	I3_Q7
109	I3_Q6
110	I3_Q5
111	I3_Q4
112	I3_Q3
113	I3_I2
114	I3_I1
115	I3_0
116	I2_1
117	I2_Q24

118	I2_Q23
119	I2_Q22
120	I2_Q21
121	I2_Q20
122	I2_Q19
123	I2_Q18
124	I2_Q17
125	I2_Q16
126	I2_Q15
127	I2_Q14
128	I2_Q13
129	I2_Q12
130	I2_Q11
131	I2_Q10
132	I2_Q9
133	I2_Q8
134	I2_Q7
135	I2_Q6
136	I2_Q5
137	I2_Q4
138	I2_Q3
139	I2_Q2
140	I2_I1
141	I2_0
142	I1_1
143	I1_Q24
144	I1_Q23
145	I1_Q22
146	I1_Q21
147	I1_Q20
148	I1_Q19
149	I1_Q18

150	I1_Q17
151	I1_Q16
152	I1_Q15
153	I1_Q14
154	I1_Q13
155	I1_Q12
156	I1_Q11
157	I1_Q10
158	I1_Q9
159	I1_Q8
160	I1_Q7
161	I1_Q6
162	I1_Q5
163	I1_Q4
164	I1_Q3
165	I1_Q2
166	I1_Q1
167	I1_0
168	0_1-0
169	0_Q24
170	0_Q23
171	0_Q22
172	0_Q21
173	0_Q20
174	0_Q19
175	0_Q18
176	0_Q17
177	0_Q16
178	0_Q15
179	0_Q14
180	0_Q13
181	0_Q12

182	0_Q11
183	0_Q10
184	0_Q9
185	0_Q8
186	0_Q7
187	0_Q6
188	0_Q5
189	0_Q4
190	0_Q3
191	0_Q2
192	0_Q1
193	0_0-0

Array Index	Correlation
Correlator_Counts_4	
1	1_1-1
2	1_Q48
3	1_Q47
4	1_Q46
5	1_Q45
6	1_Q44
7	1_Q43
8	1_Q42
9	1_Q41
10	1_Q40
11	1_Q39
12	1_Q38
13	1_Q37
14	1_Q36
15	1_Q35
16	1_Q34
17	1_Q33
18	1_Q32
19	1_Q31
20	1_Q30
21	1_Q29
22	1_Q28
23	1_Q27
24	1_Q26
25	1_Q25
26	1_0-1
27	I24_Q48
28	I24_Q47
29	I24_Q46
30	I24_Q45
31	I24_Q44
32	I24_Q43
33	I24_Q42
34	I24_Q41
35	I24_Q40

Array Index	Correlation
Correlator_Counts_5	
1	I24_Q39
2	I24_Q38
3	I24_Q37
4	I24_Q36
5	I24_Q35
6	I24_Q34
7	I24_Q33
8	I24_Q32
9	I24_Q31
10	I24_Q30
11	I24_Q29
12	I24_Q28
13	I24_Q27
14	I24_Q26
15	I24_Q25
16	I23_Q48
17	I23_Q47
18	I23_Q46
19	I23_Q45
20	I23_Q44
21	I23_Q43
22	I23_Q42
23	I23_Q41
24	I23_Q40
25	I23_Q39
26	I23_Q38
27	I23_Q37
28	I23_Q36
29	I23_Q35
30	I23_Q34
31	I23_Q33
32	I23_Q32
33	I23_Q31
34	I23_Q30
35	I23_Q29
36	I23_Q28
37	I23_Q27

38	I23_Q26
39	I23_Q25
40	I22_Q48
41	I22_Q47
42	I22_Q46
43	I22_Q45
44	I22_Q44
45	I22_Q43
46	I22_Q42
47	I22_Q41
48	I22_Q40
49	I22_Q39
50	I22_Q38
51	I22_Q37
52	I22_Q36
53	I22_Q35
54	I22_Q34
55	I22_Q33
56	I22_Q32
57	I22_Q31
58	I22_Q30
59	I22_Q29
60	I22_Q28
61	I22_Q27
62	I22_Q26
63	I22_Q25
64	I21_Q48
65	I21_Q47
66	I21_Q46
67	I21_Q45
68	I21_Q44
69	I21_Q43

70	I21_Q42
71	I21_Q41
72	I21_Q40
73	I21_Q39
74	I21_Q38
75	I21_Q37
76	I21_Q36
77	I21_Q35
78	I21_Q34
79	I21_Q33
80	I21_Q32
81	I21_Q31
82	I21_Q30
83	I21_Q29
84	I21_Q28
85	I21_Q27
86	I21_Q26
87	I21_Q25
88	I20_Q48
89	I20_Q47
90	I20_Q46
91	I20_Q45
92	I20_Q44
93	I20_Q43
94	I20_Q42
95	I20_Q41
96	I20_Q40
97	I20_Q39
98	I20_Q38
99	I20_Q37
100	I20_Q36
101	I20_Q35

102	I20_Q34
103	I20_Q33
104	I20_Q32
105	I20_Q31
106	I20_Q30
107	I20_Q29
108	I20_Q28
109	I20_Q27
110	I20_Q26
111	I20_Q25
112	I19_Q48
113	I19_Q47
114	I19_Q46
115	I19_Q45
116	I19_Q44
117	I19_Q43
118	I19_Q42
119	I19_Q41
120	I19_Q40
121	I19_Q39
122	I19_Q38
123	I19_Q37
124	I19_Q36
125	I19_Q35
126	I19_Q34
127	I19_Q33
128	I19_Q32
129	I19_Q31
130	I19_Q30
131	I19_Q29
132	I19_Q28
133	I19_Q27

134	I19_Q26
135	I19_Q25
136	I18_Q48
137	I18_Q47
138	I18_Q46
139	I18_Q45
140	I18_Q44
141	I18_Q43
142	I18_Q42
143	I18_Q41
144	I18_Q40
145	I18_Q39
146	I18_Q38
147	I18_Q37
148	I18_Q36
149	I18_Q35
150	I18_Q34
151	I18_Q33
152	I18_Q32
153	I18_Q31
154	I18_Q30
155	I18_Q29
156	I18_Q28
157	I18_Q27
158	I18_Q26
159	I18_Q25
160	I17_Q48
161	I17_Q47
162	I17_Q46
163	I17_Q45
164	I17_Q44
165	I17_Q43

166	I17_Q42
167	I17_Q41
168	I17_Q40
169	I17_Q39
170	I17_Q38
171	I17_Q37
172	I17_Q36
173	I17_Q35
174	I17_Q34
175	I17_Q33
176	I17_Q32
177	I17_Q31
178	I17_Q30
179	I17_Q29
180	I17_Q28
181	I17_Q27
182	I17_Q26
183	I17_Q25
184	I16_Q48
185	I16_Q47
186	I16_Q46
187	I16_Q45
188	I16_Q44
189	I16_Q43
190	I16_Q42
191	I16_Q41
192	I16_Q40
193	I16_Q39
194	I16_Q38
195	I16_Q37
196	I16_Q36
197	I16_Q35

198	I16_Q34
199	I16_Q33
200	I16_Q32
201	I16_Q31
202	I16_Q30
203	I16_Q29
204	I16_Q28
205	I16_Q27
206	I16_Q26
207	I16_Q25
208	I15_Q48
209	I15_Q47
210	I15_Q46
211	I15_Q45
212	I15_Q44
213	I15_Q43
214	I15_Q42
215	I15_Q41
216	I15_Q40
217	I15_Q39
218	I15_Q38
219	I15_Q37
220	I15_Q36
221	I15_Q35
222	I15_Q34
223	I15_Q33
224	I15_Q32
225	I15_Q31
226	I15_Q30
227	I15_Q29
228	I15_Q28
229	I15_Q27

230	I15_Q26
231	I15_Q25

Array Index	Correlation
Correlator_Counts_6	
1	I14_Q48
2	I14_Q47
3	I14_Q46
4	I14_Q45
5	I14_Q44
6	I14_Q43
7	I14_Q42
8	I14_Q41
9	I14_Q40
10	I14_Q39
11	I14_Q38
12	I14_Q37
13	I14_Q36
14	I14_Q35
15	I14_Q34
16	I14_Q33
17	I14_Q32
18	I14_Q31
19	I14_Q30
20	I14_Q29
21	I14_Q28
22	I14_Q27
23	I14_Q26
24	I14_Q25
25	I13_Q48
26	I13_Q47
27	I13_Q46
28	I13_Q45
29	I13_Q44
30	I13_Q43
31	I13_Q42
32	I13_Q41
33	I13_Q40
34	I13_Q39
35	I13_Q38
36	I13_Q37
37	I13_Q36
38	I13_Q35
39	I13_Q34
40	I13_Q33
41	I13_Q32
42	I13_Q31
43	I13_Q30
44	I13_Q29
45	I13_Q28
46	I13_Q27
47	I13_Q26
48	I13_Q25
49	I12_Q48
50	I12_Q47
51	I12_Q46
52	I12_Q45
53	I12_Q44
54	I12_Q43
55	I12_Q42
56	I12_Q41
57	I12_Q40
58	I12_Q39
59	I12_Q38
60	I12_Q37
61	I12_Q36
62	I12_Q35
63	I12_Q34
64	I12_Q33
65	I12_Q32
66	I12_Q31
67	I12_Q30
68	I12_Q29
69	I12_Q28
70	I12_Q27
71	I12_Q26
72	I12_Q25
73	I11_Q48
74	I11_Q47
75	I11_Q46
76	I11_Q45
77	I11_Q44
78	I11_Q43
79	I11_Q42
80	I11_Q41
81	I11_Q40
82	I11_Q39
83	I11_Q38
84	I11_Q37
85	I11_Q36

86	I11_Q35
87	I11_Q34
88	I11_Q33
89	I11_Q32
90	I11_Q31
91	I11_Q30
92	I11_Q29
93	I11_Q28
94	I11_Q27
95	I11_Q26
96	I11_Q25
97	I10_Q48
98	I10_Q47
99	I10_Q46
100	I10_Q45
101	I10_Q44
102	I10_Q43
103	I10_Q42
104	I10_Q41
105	I10_Q40
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110	I10_Q35
111	I10_Q34
112	I10_Q33
113	I10_Q32
114	I10_Q31
115	I10_Q30
116	I10_Q29
117	I10_Q28

118	I10_Q27
119	I10_Q26
120	I10_Q25
121	I9_Q48
122	I9_Q47
123	I9_Q46
124	I9_Q45
125	I9_Q44
126	I9_Q43
127	I9_Q42
128	I9_Q41
129	I9_Q40
130	I9_Q39
131	I9_Q38
132	I9_Q37
133	I9_Q36
134	I9_Q35
135	I9_Q34
136	I9_Q33
137	I9_Q32
138	I9_Q31
139	I9_Q30
140	I9_Q29
141	I9_Q28
142	I9_Q27
143	I9_Q26
144	I9_Q25
145	I8_Q48
146	I8_Q47
147	I8_Q46
148	I8_Q45
149	I8_Q44

150	I8_Q43
151	I8_Q42
152	I8_Q41
153	I8_Q40
154	I8_Q39
155	I8_Q38
156	I8_Q37
157	I8_Q36
158	I8_Q35
159	I8_Q34
160	I8_Q33
161	I8_Q32
162	I8_Q31
163	I8_Q30
164	I8_Q29
165	I8_Q28
166	I8_Q27
167	I8_Q26
168	I8_Q25
169	I7_Q48
170	I7_Q47
171	I7_Q46
172	I7_Q45
173	I7_Q44
174	I7_Q43
175	I7_Q42
176	I7_Q41
177	I7_Q40
178	I7_Q39
179	I7_Q38
180	I7_Q37
181	I7_Q36

182	I7_Q35
183	I7_Q34
184	I7_Q33
185	I7_Q32
186	I7_Q31
187	I7_Q30
188	I7_Q29
189	I7_Q28
190	I7_Q27
191	I7_Q26
192	I7_Q25
193	I6_Q48
194	I6_Q47
195	I6_Q46
196	I6_Q45
197	I6_Q44
198	I6_Q43

199	I6_Q42
200	I6_Q41
201	I6_Q40
202	I6_Q39
203	I6_Q38
204	I6_Q37
205	I6_Q36
206	I6_Q35
207	I6_Q34
208	I6_Q33
209	I6_Q32
210	I6_Q31
211	I6_Q30
212	I6_Q29
213	I6_Q28
214	I6_Q27
215	I6_Q26

216	I6_Q25
217	I5_Q48
218	I5_Q47
219	I5_Q46
220	I5_Q45
221	I5_Q44
222	I5_Q43
223	I5_Q42
224	I5_Q41
225	I5_Q40
226	I5_Q39
227	I5_Q38
228	I5_Q37
229	I5_Q36
230	I5_Q35
231	I5_Q34

Array Index	**Correlation**
Correlator_Counts_7	
1	I5_Q33
2	I5_Q32
3	I5_Q31
4	I5_Q30
5	I5_Q29
6	I5_Q28
7	I5_Q27
8	I5_Q26
9	I5_Q25
10	I4_Q48
11	I4_Q47
12	I4_Q46

13	I4_Q45
14	I4_Q44
15	I4_Q43
16	I4_Q42
17	I4_Q41
18	I4_Q40
19	I4_Q39
20	I4_Q38
21	I4_Q37
22	I4_Q36
23	I4_Q35
24	I4_Q34
25	I4_Q33
26	I4_Q32

27	I4_Q31
28	I4_Q30
29	I4_Q29
30	I4_Q28
31	I4_Q27
32	I4_Q26
33	I4_Q25
34	I3_Q48
35	I3_Q47
36	I3_Q46
37	I3_Q45
38	I3_Q44
39	I3_Q43
40	I3_Q42

41	I3_Q41
42	I3_Q40
43	I3_Q39
44	I3_Q38
45	I3_Q37
46	I3_Q36
47	I3_Q35
48	I3_Q34
49	I3_Q33
50	I3_Q32
51	I3_Q31
52	I3_Q30
53	I3_Q29
54	I3_Q28
55	I3_Q27
56	I3_Q26
57	I3_Q25
58	I2_Q48
59	I2_Q47
60	I2_Q46
61	I2_Q45
62	I2_Q44
63	I2_Q43
64	I2_Q42
65	I2_Q41
66	I2_Q40
67	I2_Q39
68	I2_Q38
69	I2_Q37
70	I2_Q36
71	I2_Q35

72	I2_Q34
73	I2_Q33
74	I2_Q32
75	I2_Q31
76	I2_Q30
77	I2_Q29
78	I2_Q28
79	I2_Q27
80	I2_Q26
81	I2_Q25
82	I1_Q48
83	I1_Q47
84	I1_Q46
85	I1_Q45
86	I1_Q44
87	I1_Q43
88	I1_Q42
89	I1_Q41
90	I1_Q40
91	I1_Q39
92	I1_Q38
93	I1_Q37
94	I1_Q36
95	I1_Q35
96	I1_Q34
97	I1_Q33
98	I1_Q32
99	I1_Q31
100	I1_Q30
101	I1_Q29
102	I1_Q28

103	I1_Q27
104	I1_Q26
105	I1_Q25
106	0_1-1
107	0_Q48
108	0_Q47
109	0_Q46
110	0_Q45
111	0_Q44
112	0_Q43
113	0_Q42
114	0_Q41
115	0_Q40
116	0_Q39
117	0_Q38
118	0_Q37
119	0_Q36
120	0_Q35
121	0_Q34
122	0_Q33
123	0_Q32
124	0_Q31
125	0_Q30
126	0_Q29
127	0_Q28
128	0_Q27
129	0_Q26
130	0_Q25
131	0_0-1

Array Index	Correlation
Correlator_Counts_8	
1	1_1-2
2	1_Q72
3	1_Q71
4	1_Q70
5	1_Q69
6	1_Q68
7	1_Q67
8	1_Q66
9	1_Q65
10	1_Q64
11	1_Q63
12	1_Q62
13	1_Q61
14	1_Q60
15	1_Q59
16	1_Q58
17	1_Q57
18	1_Q56
19	1_Q55
20	1_Q54
21	1_Q53
22	1_Q52
23	1_Q51
24	1_Q50
25	1_Q49
26	1_0-2
27	I24_Q72
28	I24_Q71
29	I24_Q70
30	I24_Q69
31	I24_Q68
32	I24_Q67
33	I24_Q66
34	I24_Q65
35	I24_Q64
36	I24_Q63
37	I24_Q62
38	I24_Q61
39	I24_Q60
40	I24_Q59
41	I24_Q58
42	I24_Q57
43	I24_Q56
44	I24_Q55
45	I24_Q54
46	I24_Q53
47	I24_Q52
48	I24_Q51
49	I24_Q50
50	I24_Q49
51	I23_Q72
52	I23_Q71
53	I23_Q70
54	I23_Q69
55	I23_Q68
56	I23_Q67
57	I23_Q66
58	I23_Q65
59	I23_Q64
60	I23_Q63
61	I23_Q62
62	I23_Q61
63	I23_Q60
64	I23_Q59
65	I23_Q58
66	I23_Q57
67	I23_Q56
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69	I23_Q54
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71	I23_Q52
72	I23_Q51
73	I23_Q50
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75	I22_Q72
76	I22_Q71
77	I22_Q70
78	I22_Q69
79	I22_Q68
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84	I22_Q63
85	I22_Q62
86	I22_Q61
87	I22_Q60
88	I22_Q59
89	I22_Q58
90	I22_Q57
91	I22_Q56
92	I22_Q55
93	I22_Q54
94	I22_Q53

95	I22_Q52
96	I22_Q51

97	I22_Q50

Array Index	Correlation
Correlator_Counts_9	
1	I22_Q49
2	I21_Q72
3	I21_Q71
4	I21_Q70
5	I21_Q69
6	I21_Q68
7	I21_Q67
8	I21_Q66
9	I21_Q65
10	I21_Q64
11	I21_Q63
12	I21_Q62
13	I21_Q61
14	I21_Q60
15	I21_Q59
16	I21_Q58
17	I21_Q57
18	I21_Q56
19	I21_Q55
20	I21_Q54
21	I21_Q53
22	I21_Q52
23	I21_Q51
24	I21_Q50
25	I21_Q49
26	I20_Q72
27	I20_Q71
28	I20_Q70
29	I20_Q69
30	I20_Q68
31	I20_Q67
32	I20_Q66
33	I20_Q65
34	I20_Q64
35	I20_Q63
36	I20_Q62
37	I20_Q61
38	I20_Q60
39	I20_Q59
40	I20_Q58
41	I20_Q57
42	I20_Q56
43	I20_Q55
44	I20_Q54
45	I20_Q53
46	I20_Q52
47	I20_Q51
48	I20_Q50
49	I20_Q49
50	I19_Q72
51	I19_Q71
52	I19_Q70
53	I19_Q69
54	I19_Q68
55	I19_Q67
56	I19_Q66
57	I19_Q65
58	I19_Q64
59	I19_Q63
60	I19_Q62
61	I19_Q61
62	I19_Q60
63	I19_Q59
64	I19_Q58
65	I19_Q57
66	I19_Q56
67	I19_Q55
68	I19_Q54
69	I19_Q53
70	I19_Q52
71	I19_Q51
72	I19_Q50
73	I19_Q49
74	I18_Q72
75	I18_Q71
76	I18_Q70
77	I18_Q69
78	I18_Q68
79	I18_Q67
80	I18_Q66
81	I18_Q65
82	I18_Q64
83	I18_Q63
84	I18_Q62
85	I18_Q61

86	I18_Q60
87	I18_Q59
88	I18_Q58
89	I18_Q57
90	I18_Q56
91	I18_Q55
92	I18_Q54
93	I18_Q53
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96	I18_Q50
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106	I17_Q64
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110	I17_Q60
111	I17_Q59
112	I17_Q58
113	I17_Q57
114	I17_Q56
115	I17_Q55
116	I17_Q54
117	I17_Q53

118	I17_Q52
119	I17_Q51
120	I17_Q50
121	I17_Q49
122	I16_Q72
123	I16_Q71
124	I16_Q70
125	I16_Q69
126	I16_Q68
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138	I16_Q56
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141	I16_Q53
142	I16_Q52
143	I16_Q51
144	I16_Q50
145	I16_Q49
146	I15_Q72
147	I15_Q71
148	I15_Q70
149	I15_Q69

150	I15_Q68
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152	I15_Q66
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154	I15_Q64
155	I15_Q63
156	I15_Q62
157	I15_Q61
158	I15_Q60
159	I15_Q59
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161	I15_Q57
162	I15_Q56
163	I15_Q55
164	I15_Q54
165	I15_Q53
166	I15_Q52
167	I15_Q51
168	I15_Q50
169	I15_Q49
170	I14_Q72
171	I14_Q71
172	I14_Q70
173	I14_Q69
174	I14_Q68
175	I14_Q67
176	I14_Q66
177	I14_Q65
178	I14_Q64
179	I14_Q63
180	I14_Q62
181	I14_Q61

182	I14_Q60
183	I14_Q59
184	I14_Q58
185	I14_Q57
186	I14_Q56
187	I14_Q55
188	I14_Q54
189	I14_Q53
190	I14_Q52
191	I14_Q51
192	I14_Q50
193	I14_Q49
194	I13_Q72
195	I13_Q71
196	I13_Q70
197	I13_Q69
198	I13_Q68

199	I13_Q67
200	I13_Q66
201	I13_Q65
202	I13_Q64
203	I13_Q63
204	I13_Q62
205	I13_Q61
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208	I13_Q58
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210	I13_Q56
211	I13_Q55
212	I13_Q54
213	I13_Q53
214	I13_Q52
215	I13_Q51

216	I13_Q50
217	I13_Q49
218	I12_Q72
219	I12_Q71
220	I12_Q70
221	I12_Q69
222	I12_Q68
223	I12_Q67
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226	I12_Q64
227	I12_Q63
228	I12_Q62
229	I12_Q61
230	I12_Q60
231	I12_Q59

Array Index	**Correlation**
Correlator_Counts_10	
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2	I12_Q57
3	I12_Q56
4	I12_Q55
5	I12_Q54
6	I12_Q53
7	I12_Q52
8	I12_Q51
9	I12_Q50
10	I12_Q49
11	I11_Q72
12	I11_Q71

13	I11_Q70
14	I11_Q69
15	I11_Q68
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19	I11_Q64
20	I11_Q63
21	I11_Q62
22	I11_Q61
23	I11_Q60
24	I11_Q59
25	I11_Q58
26	I11_Q57

27	I11_Q56
28	I11_Q55
29	I11_Q54
30	I11_Q53
31	I11_Q52
32	I11_Q51
33	I11_Q50
34	I11_Q49
35	I10_Q72
36	I10_Q71
37	I10_Q70
38	I10_Q69
39	I10_Q68
40	I10_Q67

41	I10_Q66
42	I10_Q65
43	I10_Q64
44	I10_Q63
45	I10_Q62
46	I10_Q61
47	I10_Q60
48	I10_Q59
49	I10_Q58
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53	I10_Q54
54	I10_Q53
55	I10_Q52
56	I10_Q51
57	I10_Q50
58	I10_Q49
59	I9_Q72
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61	I9_Q70
62	I9_Q69
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67	I9_Q64
68	I9_Q63
69	I9_Q62
70	I9_Q61
71	I9_Q60
72	I9_Q59

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75	I9_Q56
76	I9_Q55
77	I9_Q54
78	I9_Q53
79	I9_Q52
80	I9_Q51
81	I9_Q50
82	I9_Q49
83	I8_Q72
84	I8_Q71
85	I8_Q70
86	I8_Q69
87	I8_Q68
88	I8_Q67
89	I8_Q66
90	I8_Q65
91	I8_Q64
92	I8_Q63
93	I8_Q62
94	I8_Q61
95	I8_Q60
96	I8_Q59
97	I8_Q58
98	I8_Q57
99	I8_Q56
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101	I8_Q54
102	I8_Q53
103	I8_Q52
104	I8_Q51

105	I8_Q50
106	I8_Q49
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108	I7_Q71
109	I7_Q70
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111	I7_Q68
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129	I7_Q50
130	I7_Q49
131	I6_Q72
132	I6_Q71
133	I6_Q70
134	I6_Q69
135	I6_Q68
136	I6_Q67

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138	I6_Q65
139	I6_Q64
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141	I6_Q62
142	I6_Q61
143	I6_Q60
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145	I6_Q58
146	I6_Q57
147	I6_Q56
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149	I6_Q54
150	I6_Q53
151	I6_Q52
152	I6_Q51
153	I6_Q50
154	I6_Q49
155	I5_Q72
156	I5_Q71
157	I5_Q70
158	I5_Q69
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163	I5_Q64
164	I5_Q63
165	I5_Q62
166	I5_Q61
167	I5_Q60
168	I5_Q59

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171	I5_Q56
172	I5_Q55
173	I5_Q54
174	I5_Q53
175	I5_Q52
176	I5_Q51
177	I5_Q50
178	I5_Q49
179	I4_Q72
180	I4_Q71
181	I4_Q70
182	I4_Q69
183	I4_Q68
184	I4_Q67
185	I4_Q66
186	I4_Q65
187	I4_Q64
188	I4_Q63
189	I4_Q62
190	I4_Q61
191	I4_Q60
192	I4_Q59
193	I4_Q58
194	I4_Q57
195	I4_Q56
196	I4_Q55
197	I4_Q54
198	I4_Q53
199	I4_Q52
200	I4_Q51

201	I4_Q50
202	I4_Q49
203	I3_Q72
204	I3_Q71
205	I3_Q70
206	I3_Q69
207	I3_Q68
208	I3_Q67
209	I3_Q66
210	I3_Q65
211	I3_Q64
212	I3_Q63
213	I3_Q62
214	I3_Q61
215	I3_Q60
216	I3_Q59
217	I3_Q58
218	I3_Q57
219	I3_Q56
220	I3_Q55
221	I3_Q54
222	I3_Q53
223	I3_Q52
224	I3_Q51
225	I3_Q50
226	I3_Q49
227	I2_Q72
228	I2_Q71
229	I2_Q70
230	I2_Q69
231	I2_Q68

Array Index	Correlation
Correlator_Counts_11	
1	I2_Q67
2	I2_Q66
3	I2_Q65
4	I2_Q64
5	I2_Q63
6	I2_Q62
7	I2_Q61
8	I2_Q60
9	I2_Q59
10	I2_Q58
11	I2_Q57
12	I2_Q56
13	I2_Q55
14	I2_Q54
15	I2_Q53
16	I2_Q52
17	I2_Q51
18	I2_Q50
19	I2_Q49
20	I1_Q72
21	I1_Q71
22	I1_Q70
23	I1_Q69
24	I1_Q68
25	I1_Q67
26	I1_Q66
27	I1_Q65
28	I1_Q64
29	I1_Q63
30	I1_Q62
31	I1_Q61
32	I1_Q60
33	I1_Q59
34	I1_Q58
35	I1_Q57
36	I1_Q56
37	I1_Q55
38	I1_Q54
39	I1_Q53
40	I1_Q52
41	I1_Q51
42	I1_Q50
43	I1_Q49
44	0_1-2
45	0_Q72
46	0_Q71
47	0_Q70
48	0_Q69
49	0_Q68
50	0_Q67
51	0_Q66
52	0_Q65
53	0_Q64
54	0_Q63
55	0_Q62
56	0_Q61
57	0_Q60
58	0_Q59
59	0_Q58
60	0_Q57
61	0_Q56
62	0_Q55
63	0_Q54
64	0_Q53
65	0_Q52
66	0_Q51
67	0_Q50
68	0_Q49
69	0_0-2

Array Index	Correlation
Correlator_Counts_12	
1	1_1-3
2	1_0-3
3	I48_1
4	I48_I24
5	I48_I23
6	I48_I22
7	I48_I21
8	I48_I20
9	I48_I19
10	I48_I18
11	I48_I17
12	I48_I16
13	I48_I15
14	I48_I14
15	I48_I13
16	I48_I12
17	I48_I11
18	I48_I10
19	I48_I9

20	I48_I8
21	I48_I7
22	I48_I6
23	I48_I5
24	I48_I4
25	I48_I3
26	I48_I2
27	I48_I1
28	I48_0
29	I47_1
30	I47_I24
31	I47_I23
32	I47_I22
33	I47_I21
34	I47_I20
35	I47_I19
36	I47_I18
37	I47_I17
38	I47_I16
39	I47_I15
40	I47_I14
41	I47_I13
42	I47_I12
43	I47_I11
44	I47_I10
45	I47_I9
46	I47_I8
47	I47_I7
48	I47_I6
49	I47_I5
50	I47_I4
51	I47_I3

52	I47_I2
53	I47_I1
54	I47_0
55	I46_1
56	I46_I24
57	I46_I23
58	I46_I22
59	I46_I21
60	I46_I20
61	I46_I19
62	I46_I18
63	I46_I17
64	I46_I16
65	I46_I15
66	I46_I14
67	I46_I13
68	I46_I12
69	I46_I11
70	I46_I10
71	I46_I9
72	I46_I8
73	I46_I7
74	I46_I6
75	I46_I5
76	I46_I4
77	I46_I3
78	I46_I2
79	I46_I1
80	I46_0
81	I45_1
82	I45_I24
83	I45_I23

84	I45_I22
85	I45_I21
86	I45_I20
87	I45_I19
88	I45_I18
89	I45_I17
90	I45_I16
91	I45_I15
92	I45_I14
93	I45_I13
94	I45_I12
95	I45_I11
96	I45_I10
97	I45_I9
98	I45_I8
99	I45_I7
100	I45_I6
101	I45_I5
102	I45_I4
103	I45_I3
104	I45_I2
105	I45_I1
106	I45_0
107	I44_1
108	I44_I24
109	I44_I23
110	I44_I22
111	I44_I21
112	I44_I20
113	I44_I19
114	I44_I18
115	I44_I17

116	I44_I16
117	I44_I15
118	I44_I14
119	I44_I13
120	I44_I12
121	I44_I11
122	I44_I10
123	I44_I9
124	I44_I8
125	I44_I7
126	I44_I6
127	I44_I5
128	I44_I4
129	I44_I3
130	I44_I2

131	I44_I1
132	I44_0
133	I43_1
134	I43_I24
135	I43_I23
136	I43_I22
137	I43_I21
138	I43_I20
139	I43_I19
140	I43_I18
141	I43_I17
142	I43_I16
143	I43_I15
144	I43_I14
145	I43_I13

146	I43_I12
147	I43_I11
148	I43_I10
149	I43_I9
150	I43_I8
151	I43_I7
152	I43_I6
153	I43_I5
154	I43_I4
155	I43_I3
156	I43_I2
157	I43_I1
158	I43_0
159	I42_1

Array Index	Correlation
Correlator_Counts_13	
1	I42_I24
2	I42_I23
3	I42_I22
4	I42_I21
5	I42_I20
6	I42_I19
7	I42_I18
8	I42_I17
9	I42_I16
10	I42_I15
11	I42_I14
12	I42_I13
13	I42_I12
14	I42_I11

15	I42_I10
16	I42_I9
17	I42_I8
18	I42_I7
19	I42_I6
20	I42_I5
21	I42_I4
22	I42_I3
23	I42_I2
24	I42_I1
25	I42_0
26	I41_1
27	I41_I24
28	I41_I23
29	I41_I22
30	I41_I21

31	I41_I20
32	I41_I19
33	I41_I18
34	I41_I17
35	I41_I16
36	I41_I15
37	I41_I14
38	I41_I13
39	I41_I12
40	I41_I11
41	I41_I10
42	I41_I9
43	I41_I8
44	I41_I7
45	I41_I6
46	I41_I5

47	I41_I4
48	I41_I3
49	I41_I2
50	I41_I1
51	I41_0
52	I40_1
53	I40_I24
54	I40_I23
55	I40_I22
56	I40_I21
57	I40_I20
58	I40_I19
59	I40_I18
60	I40_I17
61	I40_I16
62	I40_I15
63	I40_I14
64	I40_I13
65	I40_I12
66	I40_I11
67	I40_I10
68	I40_I9
69	I40_I8
70	I40_I7
71	I40_I6
72	I40_I5
73	I40_I4
74	I40_I3
75	I40_I2
76	I40_I1
77	I40_0
78	I39_1
79	I39_I24
80	I39_I23
81	I39_I22
82	I39_I21
83	I39_I20
84	I39_I19
85	I39_I18
86	I39_I17
87	I39_I16
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91	I39_I12
92	I39_I11
93	I39_I10
94	I39_I9
95	I39_I8
96	I39_I7
97	I39_I6
98	I39_I5
99	I39_I4
100	I39_I3
101	I39_I2
102	I39_I1
103	I39_0
104	I38_1
105	I38_I24
106	I38_I23
107	I38_I22
108	I38_I21
109	I38_I20
110	I38_I19
111	I38_I18
112	I38_I17
113	I38_I16
114	I38_I15
115	I38_I14
116	I38_I13
117	I38_I12
118	I38_I11
119	I38_I10
120	I38_I9
121	I38_I8
122	I38_I7
123	I38_I6
124	I38_I5
125	I38_I4
126	I38_I3
127	I38_I2
128	I38_I1
129	I38_0
130	I37_1
131	I37_I24
132	I37_I23
133	I37_I22
134	I37_I21
135	I37_I20
136	I37_I19
137	I37_I18
138	I37_I17
139	I37_I16
140	I37_I15
141	I37_I14
142	I37_I13

143	I37_I12
144	I37_I11
145	I37_I10
146	I37_I9
147	I37_I8
148	I37_I7
149	I37_I6
150	I37_I5
151	I37_I4
152	I37_I3
153	I37_I2
154	I37_I1
155	I37_0
156	I36_1
157	I36_I24
158	I36_I23
159	I36_I22
160	I36_I21
161	I36_I20
162	I36_I19
163	I36_I18
164	I36_I17
165	I36_I16
166	I36_I15
167	I36_I14
168	I36_I13
169	I36_I12
170	I36_I11
171	I36_I10
172	I36_I9

173	I36_I8
174	I36_I7
175	I36_I6
176	I36_I5
177	I36_I4
178	I36_I3
179	I36_I2
180	I36_I1
181	I36_0
182	I35_1
183	I35_I24
184	I35_I23
185	I35_I22
186	I35_I21
187	I35_I20
188	I35_I19
189	I35_I18
190	I35_I17
191	I35_I16
192	I35_I15
193	I35_I14
194	I35_I13
195	I35_I12
196	I35_I11
197	I35_I10
198	I35_I9
199	I35_I8
200	I35_I7
201	I35_I6
202	I35_I5

203	I35_I4
204	I35_I3
205	I35_I2
206	I35_I1
207	I35_0
208	I34_1
209	I34_I24
210	I34_I23
211	I34_I22
212	I34_I21
213	I34_I20
214	I34_I19
215	I34_I18
216	I34_I17
217	I34_I16
218	I34_I15
219	I34_I14
220	I34_I13
221	I34_I12
222	I34_I11
223	I34_I10
224	I34_I9
225	I34_I8
226	I34_I7
227	I34_I6
228	I34_I5
229	I34_I4
230	I34_I3
231	I34_I2

Array Index	Correlation
Correlator_Counts_14	
1	I34_I1
2	I34_0
3	I33_1
4	I33_I24
5	I33_I23
6	I33_I22
7	I33_I21
8	I33_I20
9	I33_I19
10	I33_I18
11	I33_I17
12	I33_I16
13	I33_I15
14	I33_I14
15	I33_I13
16	I33_I12
17	I33_I11
18	I33_I10
19	I33_I9
20	I33_I8
21	I33_I7
22	I33_I6
23	I33_I5
24	I33_I4
25	I33_I3
26	I33_I2
27	I33_I1
28	I33_0
29	I32_1
30	I32_I24
31	I32_I23
32	I32_I22
33	I32_I21
34	I32_I20
35	I32_I19
36	I32_I18
37	I32_I17
38	I32_I16
39	I32_I15
40	I32_I14
41	I32_I13
42	I32_I12
43	I32_I11
44	I32_I10
45	I32_I9
46	I32_I8
47	I32_I7
48	I32_I6
49	I32_I5
50	I32_I4
51	I32_I3
52	I32_I2
53	I32_I1
54	I32_0
55	I31_1
56	I31_I24
57	I31_I23
58	I31_I22
59	I31_I21
60	I31_I20
61	I31_I19
62	I31_I18
63	I31_I17
64	I31_I16
65	I31_I15
66	I31_I14
67	I31_I13
68	I31_I12
69	I31_I11
70	I31_I10
71	I31_I9
72	I31_I8
73	I31_I7
74	I31_I6
75	I31_I5
76	I31_I4
77	I31_I3
78	I31_I2
79	I31_I1
80	I31_0
81	I30_1
82	I30_I24
83	I30_I23
84	I30_I22
85	I30_I21
86	I30_I20
87	I30_I19
88	I30_I18
89	I30_I17
90	I30_I16
91	I30_I15
92	I30_I14
93	I30_I13
94	I30_I12

95	I30_I11
96	I30_I10
97	I30_I9
98	I30_I8
99	I30_I7
100	I30_I6
101	I30_I5
102	I30_I4
103	I30_I3
104	I30_I2
105	I30_I1
106	I30_0
107	I29_1
108	I29_I24
109	I29_I23
110	I29_I22
111	I29_I21
112	I29_I20
113	I29_I19
114	I29_I18
115	I29_I17
116	I29_I16
117	I29_I15
118	I29_I14
119	I29_I13
120	I29_I12
121	I29_I11
122	I29_I10
123	I29_I9
124	I29_I8
125	I29_I7
126	I29_I6

127	I29_I5
128	I29_I4
129	I29_I3
130	I29_I2
131	I29_I1
132	I29_0
133	I28_1
134	I28_I24
135	I28_I23
136	I28_I22
137	I28_I21
138	I28_I20
139	I28_I19
140	I28_I18
141	I28_I17
142	I28_I16
143	I28_I15
144	I28_I14
145	I28_I13
146	I28_I12
147	I28_I11
148	I28_I10
149	I28_I9
150	I28_I8
151	I28_I7
152	I28_I6
153	I28_I5
154	I28_I4
155	I28_I3
156	I28_I2
157	I28_I1
158	I28_0

159	I27_1
160	I27_I24
161	I27_I23
162	I27_I22
163	I27_I21
164	I27_I20
165	I27_I19
166	I27_I18
167	I27_I17
168	I27_I16
169	I27_I15
170	I27_I14
171	I27_I13
172	I27_I12
173	I27_I11
174	I27_I10
175	I27_I9
176	I27_I8
177	I27_I7
178	I27_I6
179	I27_I5
180	I27_I4
181	I27_I3
182	I27_I2
183	I27_I1
184	I27_0
185	I26_1
186	I26_I24
187	I26_I23
188	I26_I22
189	I26_I21
190	I26_I20

191	I26_I19
192	I26_I18
193	I26_I17
194	I26_I16
195	I26_I15
196	I26_I14
197	I26_I13
198	I26_I12
199	I26_I11
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201	I26_I9
202	I26_I8
203	I26_I7
204	I26_I6
205	I26_I5

206	I26_I4
207	I26_I3
208	I26_I2
209	I26_I1
210	I26_0
211	I25_1
212	I25_I24
213	I25_I23
214	I25_I22
215	I25_I21
216	I25_I20
217	I25_I19
218	I25_I18
219	I25_I17
220	I25_I16

221	I25_I15
222	I25_I14
223	I25_I13
224	I25_I12
225	I25_I11
226	I25_I10
227	I25_I9
228	I25_I8
229	I25_I7
230	I25_I6
231	I25_I5

Array Index	**Correlation**
Correlator_Counts_15	
1	I25_I4
2	I25_I3
3	I25_I2
4	I25_I1
5	I25_0
6	0_1-3
7	0_0-3

Array Index	**Correlation**
Correlator_Counts_16	
1	1_1-4
2	1_0-4
3	I48_Q48
4	I48_I47

5	I48_I46
6	I48_I45
7	I48_I44
8	I48_I43
9	I48_I42
10	I48_I41

11	I48_I40
12	I48_I39
13	I48_I38
14	I48_I37
15	I48_I36
16	I48_I35

17	I48_I34
18	I48_I33
19	I48_I32
20	I48_I31
21	I48_I30
22	I48_I29
23	I48_I28
24	I48_I27
25	I48_I26
26	I48_I25
27	I47_Q48
28	I47_Q47
29	I47_I46
30	I47_I45
31	I47_I44
32	I47_I43
33	I47_I42
34	I47_I41
35	I47_I40
36	I47_I39
37	I47_I38
38	I47_I37
39	I47_I36
40	I47_I35
41	I47_I34
42	I47_I33
43	I47_I32
44	I47_I31
45	I47_I30
46	I47_I29
47	I47_I28
48	I47_I27

49	I47_I26
50	I47_I25
51	I46_Q48
52	I46_Q47
53	I46_Q46
54	I46_I45
55	I46_I44
56	I46_I43
57	I46_I42
58	I46_I41
59	I46_I40
60	I46_I39
61	I46_I38
62	I46_I37
63	I46_I36
64	I46_I35
65	I46_I34
66	I46_I33
67	I46_I32
68	I46_I31
69	I46_I30
70	I46_I29
71	I46_I28
72	I46_I27
73	I46_I26
74	I46_I25
75	I45_Q48
76	I45_Q47
77	I45_Q46
78	I45_Q45
79	I45_I44
80	I45_I43

81	I45_I42
82	I45_I41
83	I45_I40
84	I45_I39
85	I45_I38
86	I45_I37
87	I45_I36
88	I45_I35
89	I45_I34
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91	I45_I32
92	I45_I31
93	I45_I30
94	I45_I29
95	I45_I28
96	I45_I27
97	I45_I26
98	I45_I25
99	I44_Q48
100	I44_Q47
101	I44_Q46
102	I44_Q45
103	I44_Q44
104	I44_I43
105	I44_I42
106	I44_I41
107	I44_I40
108	I44_I39
109	I44_I38
110	I44_I37
111	I44_I36
112	I44_I35

113	I44_I34
114	I44_I33
115	I44_I32
116	I44_I31
117	I44_I30
118	I44_I29
119	I44_I28
120	I44_I27
121	I44_I26
122	I44_I25
123	I43_Q48
124	I43_Q47
125	I43_Q46
126	I43_Q45
127	I43_Q44
128	I43_Q43
129	I43_I42
130	I43_I41
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133	I43_I38
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137	I43_I34
138	I43_I33
139	I43_I32
140	I43_I31
141	I43_I30
142	I43_I29
143	I43_I28
144	I43_I27

145	I43_I26
146	I43_I25
147	I42_Q48
148	I42_Q47
149	I42_Q46
150	I42_Q45
151	I42_Q44
152	I42_Q43
153	I42_Q42
154	I42_I41
155	I42_I40
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163	I42_I32
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166	I42_I29
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168	I42_I27
169	I42_I26
170	I42_I25
171	I41_Q48
172	I41_Q47
173	I41_Q46
174	I41_Q45
175	I41_Q44
176	I41_Q43

177	I41_Q42
178	I41_Q41
179	I41_I40
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181	I41_I38
182	I41_I37
183	I41_I36
184	I41_I35
185	I41_I34
186	I41_I33
187	I41_I32
188	I41_I31
189	I41_I30
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191	I41_I28
192	I41_I27
193	I41_I26
194	I41_I25
195	I40_Q48
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197	I40_Q46
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201	I40_Q42
202	I40_Q41
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207	I40_I36
208	I40_I35

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211	I40_I32
212	I40_I31
213	I40_I30
214	I40_I29
215	I40_I28
216	I40_I27
217	I40_I26
218	I40_I25
219	I39_Q48
220	I39_Q47
221	I39_Q46

Array Index	Correlation
Correlator_Counts_17	
1	I39_Q45
2	I39_Q44
3	I39_Q43
4	I39_Q42
5	I39_Q41
6	I39_Q40
7	I39_Q39
8	I39_I38
9	I39_I37
10	I39_I36
11	I39_I35
12	I39_I34
13	I39_I33
14	I39_I32
15	I39_I31
16	I39_I30
17	I39_I29
18	I39_I28
19	I39_I27
20	I39_I26
21	I39_I25
22	I38_Q48
23	I38_Q47
24	I38_Q46
25	I38_Q45
26	I38_Q44
27	I38_Q43
28	I38_Q42
29	I38_Q41
30	I38_Q40
31	I38_Q39
32	I38_Q38
33	I38_I37
34	I38_I36
35	I38_I35
36	I38_I34
37	I38_I33
38	I38_I32
39	I38_I31
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41	I38_I29
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43	I38_I27
44	I38_I26
45	I38_I25
46	I37_Q48
47	I37_Q47
48	I37_Q46
49	I37_Q45
50	I37_Q44
51	I37_Q43
52	I37_Q42
53	I37_Q41
54	I37_Q40
55	I37_Q39
56	I37_Q38
57	I37_Q37
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62	I37_I32
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64	I37_I30
65	I37_I29
66	I37_I28
67	I37_I27
68	I37_I26
69	I37_I25
70	I36_Q48
71	I36_Q47
72	I36_Q46
73	I36_Q45
74	I36_Q44
75	I36_Q43
76	I36_Q42

77	I36_Q41
78	I36_Q40
79	I36_Q39
80	I36_Q38
81	I36_Q37
82	I36_Q36
83	I36_I35
84	I36_I34
85	I36_I33
86	I36_I32
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90	I36_I28
91	I36_I27
92	I36_I26
93	I36_I25
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95	I35_Q47
96	I35_Q46
97	I35_Q45
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103	I35_Q39
104	I35_Q38
105	I35_Q37
106	I35_Q36
107	I35_Q35
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116	I35_I26
117	I35_I25
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131	I34_Q35
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136	I34_I30
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138	I34_I28
139	I34_I27
140	I34_I26

141	I34_I25
142	I33_Q48
143	I33_Q47
144	I33_Q46
145	I33_Q45
146	I33_Q44
147	I33_Q43
148	I33_Q42
149	I33_Q41
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153	I33_Q37
154	I33_Q36
155	I33_Q35
156	I33_Q34
157	I33_Q33
158	I33_I32
159	I33_I31
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161	I33_I29
162	I33_I28
163	I33_I27
164	I33_I26
165	I33_I25
166	I32_Q48
167	I32_Q47
168	I32_Q46
169	I32_Q45
170	I32_Q44
171	I32_Q43
172	I32_Q42

173	I32_Q41
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175	I32_Q39
176	I32_Q38
177	I32_Q37
178	I32_Q36
179	I32_Q35
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181	I32_Q33
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186	I32_I28
187	I32_I27
188	I32_I26
189	I32_I25
190	I31_Q48
191	I31_Q47
192	I31_Q46

193	I31_Q45
194	I31_Q44
195	I31_Q43
196	I31_Q42
197	I31_Q41
198	I31_Q40
199	I31_Q39
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201	I31_Q37
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207	I31_Q31
208	I31_I30
209	I31_I29
210	I31_I28
211	I31_I27
212	I31_I26

213	I31_I25
214	I30_Q48
215	I30_Q47
216	I30_Q46
217	I30_Q45
218	I30_Q44
219	I30_Q43
220	I30_Q42
221	I30_Q41
222	I30_Q40
223	I30_Q39
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226	I30_Q36
227	I30_Q35
228	I30_Q34
229	I30_Q33
230	I30_Q32
231	I30_Q31

Array Index	**Correlation**
Correlator_Counts_18	
1	I30_Q30
2	I30_I29
3	I30_I28
4	I30_I27
5	I30_I26
6	I30_I25
7	I29_Q48
8	I29_Q47
9	I29_Q46

10	I29_Q45
11	I29_Q44
12	I29_Q43
13	I29_Q42
14	I29_Q41
15	I29_Q40
16	I29_Q39
17	I29_Q38
18	I29_Q37
19	I29_Q36
20	I29_Q35

21	I29_Q34
22	I29_Q33
23	I29_Q32
24	I29_Q31
25	I29_Q30
26	I29_Q29
27	I29_I28
28	I29_I27
29	I29_I26
30	I29_I25
31	I28_Q48

32	I28_Q47
33	I28_Q46
34	I28_Q45
35	I28_Q44
36	I28_Q43
37	I28_Q42
38	I28_Q41
39	I28_Q40
40	I28_Q39
41	I28_Q38
42	I28_Q37
43	I28_Q36
44	I28_Q35
45	I28_Q34
46	I28_Q33
47	I28_Q32
48	I28_Q31
49	I28_Q30
50	I28_Q29
51	I28_Q28
52	I28_I27
53	I28_I26
54	I28_I25
55	I27_Q48
56	I27_Q47
57	I27_Q46
58	I27_Q45
59	I27_Q44
60	I27_Q43
61	I27_Q42
62	I27_Q41
63	I27_Q40

64	I27_Q39
65	I27_Q38
66	I27_Q37
67	I27_Q36
68	I27_Q35
69	I27_Q34
70	I27_Q33
71	I27_Q32
72	I27_Q31
73	I27_Q30
74	I27_Q29
75	I27_Q28
76	I27_Q27
77	I27_I26
78	I27_I25
79	I26_Q48
80	I26_Q47
81	I26_Q46
82	I26_Q45
83	I26_Q44
84	I26_Q43
85	I26_Q42
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89	I26_Q38
90	I26_Q37
91	I26_Q36
92	I26_Q35
93	I26_Q34
94	I26_Q33
95	I26_Q32

96	I26_Q31
97	I26_Q30
98	I26_Q29
99	I26_Q28
100	I26_Q27
101	I26_Q26
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104	I25_Q47
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119	I25_Q32
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121	I25_Q30
122	I25_Q29
123	I25_Q28
124	I25_Q27
125	I25_Q26
126	I25_Q25
127	0_1-4

128	0_0-4

Array Index	Correlation
Correlator_Counts_19	
1	1_1-5
2	1_0-5
3	I48_Q72
4	I48_Q71
5	I48_Q70
6	I48_Q69
7	I48_Q68
8	I48_Q67
9	I48_Q66
10	I48_Q65
11	I48_Q64
12	I48_Q63
13	I48_Q62
14	I48_Q61
15	I48_Q60
16	I48_Q59
17	I48_Q58
18	I48_Q57
19	I48_Q56
20	I48_Q55
21	I48_Q54
22	I48_Q53
23	I48_Q52
24	I48_Q51
25	I48_Q50
26	I48_Q49
27	I47_Q72
28	I47_Q71
29	I47_Q70
30	I47_Q69
31	I47_Q68
32	I47_Q67
33	I47_Q66
34	I47_Q65
35	I47_Q64
36	I47_Q63
37	I47_Q62
38	I47_Q61
39	I47_Q60
40	I47_Q59
41	I47_Q58
42	I47_Q57
43	I47_Q56
44	I47_Q55
45	I47_Q54
46	I47_Q53
47	I47_Q52
48	I47_Q51
49	I47_Q50
50	I47_Q49
51	I46_Q72
52	I46_Q71
53	I46_Q70
54	I46_Q69
55	I46_Q68
56	I46_Q67
57	I46_Q66
58	I46_Q65
59	I46_Q64
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61	I46_Q62
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63	I46_Q60
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66	I46_Q57
67	I46_Q56
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69	I46_Q54
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76	I45_Q71
77	I45_Q70
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79	I45_Q68
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83	I45_Q64
84	I45_Q63
85	I45_Q62
86	I45_Q61
87	I45_Q60
88	I45_Q59

89	I45_Q58
90	I45_Q57
91	I45_Q56
92	I45_Q55
93	I45_Q54
94	I45_Q53
95	I45_Q52
96	I45_Q51
97	I45_Q50
98	I45_Q49
99	I44_Q72
100	I44_Q71

Array Index	Correlation
Correlator_Counts_20	
1	I44_Q70
2	I44_Q69
3	I44_Q68
4	I44_Q67
5	I44_Q66
6	I44_Q65
7	I44_Q64
8	I44_Q63
9	I44_Q62
10	I44_Q61
11	I44_Q60
12	I44_Q59
13	I44_Q58
14	I44_Q57
15	I44_Q56
16	I44_Q55
17	I44_Q54
18	I44_Q53
19	I44_Q52
20	I44_Q51
21	I44_Q50
22	I44_Q49
23	I43_Q72
24	I43_Q71
25	I43_Q70
26	I43_Q69
27	I43_Q68
28	I43_Q67
29	I43_Q66
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31	I43_Q64
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33	I43_Q62
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36	I43_Q59
37	I43_Q58
38	I43_Q57
39	I43_Q56
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41	I43_Q54
42	I43_Q53
43	I43_Q52
44	I43_Q51
45	I43_Q50
46	I43_Q49
47	I42_Q72
48	I42_Q71
49	I42_Q70
50	I42_Q69
51	I42_Q68
52	I42_Q67
53	I42_Q66
54	I42_Q65
55	I42_Q64
56	I42_Q63
57	I42_Q62
58	I42_Q61
59	I42_Q60
60	I42_Q59
61	I42_Q58
62	I42_Q57
63	I42_Q56
64	I42_Q55
65	I42_Q54
66	I42_Q53
67	I42_Q52
68	I42_Q51
69	I42_Q50
70	I42_Q49
71	I41_Q72
72	I41_Q71
73	I41_Q70
74	I41_Q69
75	I41_Q68
76	I41_Q67
77	I41_Q66
78	I41_Q65
79	I41_Q64

80	I41_Q63
81	I41_Q62
82	I41_Q61
83	I41_Q60
84	I41_Q59
85	I41_Q58
86	I41_Q57
87	I41_Q56
88	I41_Q55
89	I41_Q54
90	I41_Q53
91	I41_Q52
92	I41_Q51
93	I41_Q50
94	I41_Q49
95	I40_Q72
96	I40_Q71
97	I40_Q70
98	I40_Q69
99	I40_Q68
100	I40_Q67
101	I40_Q66
102	I40_Q65
103	I40_Q64
104	I40_Q63
105	I40_Q62
106	I40_Q61
107	I40_Q60
108	I40_Q59
109	I40_Q58
110	I40_Q57
111	I40_Q56

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115	I40_Q52
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117	I40_Q50
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120	I39_Q71
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138	I39_Q53
139	I39_Q52
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141	I39_Q50
142	I39_Q49
143	I38_Q72

144	I38_Q71
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152	I38_Q63
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158	I38_Q57
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161	I38_Q54
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163	I38_Q52
164	I38_Q51
165	I38_Q50
166	I38_Q49
167	I37_Q72
168	I37_Q71
169	I37_Q70
170	I37_Q69
171	I37_Q68
172	I37_Q67
173	I37_Q66
174	I37_Q65
175	I37_Q64

176	I37_Q63
177	I37_Q62
178	I37_Q61
179	I37_Q60
180	I37_Q59
181	I37_Q58
182	I37_Q57
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187	I37_Q52
188	I37_Q51
189	I37_Q50
190	I37_Q49
191	I36_Q72
192	I36_Q71
193	I36_Q70
194	I36_Q69

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203	I36_Q60
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211	I36_Q52
212	I36_Q51
213	I36_Q50

214	I36_Q49
215	I35_Q72
216	I35_Q71
217	I35_Q70
218	I35_Q69
219	I35_Q68
220	I35_Q67
221	I35_Q66
222	I35_Q65
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224	I35_Q63
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226	I35_Q61
227	I35_Q60
228	I35_Q59
229	I35_Q58
230	I35_Q57
231	I35_Q56

Array Index	**Correlation**
Correlator_Counts_21	
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2	I35_Q54
3	I35_Q53
4	I35_Q52
5	I35_Q51
6	I35_Q50
7	I35_Q49
8	I34_Q72
9	I34_Q71
10	I34_Q70

11	I34_Q69
12	I34_Q68
13	I34_Q67
14	I34_Q66
15	I34_Q65
16	I34_Q64
17	I34_Q63
18	I34_Q62
19	I34_Q61
20	I34_Q60
21	I34_Q59
22	I34_Q58

23	I34_Q57
24	I34_Q56
25	I34_Q55
26	I34_Q54
27	I34_Q53
28	I34_Q52
29	I34_Q51
30	I34_Q50
31	I34_Q49
32	I33_Q72
33	I33_Q71
34	I33_Q70

35	I33_Q69
36	I33_Q68
37	I33_Q67
38	I33_Q66
39	I33_Q65
40	I33_Q64
41	I33_Q63
42	I33_Q62
43	I33_Q61
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45	I33_Q59
46	I33_Q58
47	I33_Q57
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49	I33_Q55
50	I33_Q54
51	I33_Q53
52	I33_Q52
53	I33_Q51
54	I33_Q50
55	I33_Q49
56	I32_Q72
57	I32_Q71
58	I32_Q70
59	I32_Q69
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61	I32_Q67
62	I32_Q66
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65	I32_Q63
66	I32_Q62

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69	I32_Q59
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71	I32_Q57
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73	I32_Q55
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75	I32_Q53
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78	I32_Q50
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93	I31_Q59
94	I31_Q58
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96	I31_Q56
97	I31_Q55
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101	I31_Q51
102	I31_Q50
103	I31_Q49
104	I30_Q72
105	I30_Q71
106	I30_Q70
107	I30_Q69
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126	I30_Q50
127	I30_Q49
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129	I29_Q71
130	I29_Q70

131	I29_Q69
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133	I29_Q67
134	I29_Q66
135	I29_Q65
136	I29_Q64
137	I29_Q63
138	I29_Q62
139	I29_Q61
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148	I29_Q52
149	I29_Q51
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151	I29_Q49
152	I28_Q72
153	I28_Q71
154	I28_Q70
155	I28_Q69
156	I28_Q68
157	I28_Q67
158	I28_Q66
159	I28_Q65
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161	I28_Q63
162	I28_Q62
163	I28_Q61
164	I28_Q60
165	I28_Q59
166	I28_Q58
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168	I28_Q56
169	I28_Q55
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173	I28_Q51
174	I28_Q50
175	I28_Q49
176	I27_Q72
177	I27_Q71
178	I27_Q70
179	I27_Q69
180	I27_Q68
181	I27_Q67
182	I27_Q66
183	I27_Q65
184	I27_Q64
185	I27_Q63
186	I27_Q62
187	I27_Q61
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198	I27_Q50
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203	I26_Q69
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217	I26_Q55
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219	I26_Q53
220	I26_Q52
221	I26_Q51
222	I26_Q50
223	I26_Q49
224	I25_Q72
225	I25_Q71
226	I25_Q70

227	I25_Q69	229	I25_Q67	231	I25_Q65
228	I25_Q68	230	I25_Q66		

Array Index	Correlation
Correlator_Counts_22	
1	I25_Q64
2	I25_Q63
3	I25_Q62
4	I25_Q61
5	I25_Q60
6	I25_Q59
7	I25_Q58
8	I25_Q57
9	I25_Q56
10	I25_Q55
11	I25_Q54
12	I25_Q53
13	I25_Q52
14	I25_Q51
15	I25_Q50
16	I25_Q49
17	0_1-5
18	0_0-5

Array Index	Correlation				
Correlator_Counts_23					
1	1_1-6	7	I72_I21	15	I72_I13
2	1_0-6	8	I72_I20	16	I72_I12
3	I72_1	9	I72_I19	17	I72_I11
4	I72_I24	10	I72_I18	18	I72_I10
5	I72_I23	11	I72_I17	19	I72_I9
6	I72_I22	12	I72_I16	20	I72_I8
		13	I72_I15	21	I72_I7
		14	I72_I14	22	I72_I6

23	I72_I5
24	I72_I4
25	I72_I3
26	I72_I2
27	I72_I1
28	I72_0
29	I71_1
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32	I71_I22
33	I71_I21
34	I71_I20
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36	I71_I18
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42	I71_I12
43	I71_I11
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45	I71_I9
46	I71_I8
47	I71_I7
48	I71_I6
49	I71_I5
50	I71_I4
51	I71_I3
52	I71_I2
53	I71_I1
54	I71_0

55	I70_1
56	I70_I24
57	I70_I23
58	I70_I22
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65	I70_I15
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76	I70_I4
77	I70_I3
78	I70_I2
79	I70_I1
80	I70_0
81	I69_1
82	I69_I24
83	I69_I23
84	I69_I22
85	I69_I21
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87	I69_I19
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89	I69_I17
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91	I69_I15
92	I69_I14
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95	I69_I11
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98	I69_I8
99	I69_I7
100	I69_I6
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102	I69_I4
103	I69_I3
104	I69_I2
105	I69_I1
106	I69_0
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110	I68_I22
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112	I68_I20
113	I68_I19
114	I68_I18
115	I68_I17
116	I68_I16
117	I68_I15
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121	I68_I11
122	I68_I10
123	I68_I9
124	I68_I8
125	I68_I7
126	I68_I6
127	I68_I5
128	I68_I4
129	I68_I3
130	I68_I2
131	I68_I1
132	I68_0
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136	I67_I22
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143	I67_I15
144	I67_I14
145	I67_I13
146	I67_I12
147	I67_I11
148	I67_I10
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152	I67_I6
153	I67_I5
154	I67_I4
155	I67_I3
156	I67_I2
157	I67_I1
158	I67_0
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174	I66_I10
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176	I66_I8
177	I66_I7
178	I66_I6
179	I66_I5
180	I66_I4

181	I66_I3
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183	I66_I1
184	I66_0
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203	I65_I7
204	I65_I6
205	I65_I5
206	I65_I4
207	I65_I3
208	I65_I2
209	I65_I1
210	I65_0

Array Index	Correlation
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4	I64_I22
5	I64_I21
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10	I64_I16
11	I64_I15
12	I64_I14
13	I64_I13
14	I64_I12
15	I64_I11
16	I64_I10
17	I64_I9
18	I64_I8
19	I64_I7
20	I64_I6
21	I64_I5
22	I64_I4
23	I64_I3
24	I64_I2
25	I64_I1
26	I64_0
27	I63_1
28	I63_I24
29	I63_I23
30	I63_I22
31	I63_I21
32	I63_I20
33	I63_I19
34	I63_I18
35	I63_I17
36	I63_I16
37	I63_I15
38	I63_I14
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42	I63_I10
43	I63_I9
44	I63_I8
45	I63_I7
46	I63_I6
47	I63_I5
48	I63_I4
49	I63_I3
50	I63_I2
51	I63_I1
52	I63_0
53	I62_1
54	I62_I24
55	I62_I23
56	I62_I22
57	I62_I21
58	I62_I20
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71	I62_I7
72	I62_I6
73	I62_I5
74	I62_I4
75	I62_I3
76	I62_I2
77	I62_I1
78	I62_0
79	I61_1
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81	I61_I23
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97	I61_I7
98	I61_I6
99	I61_I5
100	I61_I4
101	I61_I3
102	I61_I2
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112	I60_I18
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119	I60_I11
120	I60_I10
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122	I60_I8
123	I60_I7
124	I60_I6
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126	I60_I4

127	I60_I3
128	I60_I2
129	I60_I1
130	I60_0
131	I59_1
132	I59_I24
133	I59_I23
134	I59_I22
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141	I59_I15
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152	I59_I4
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178	I58_I4
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204	I57_I4
205	I57_I3

206	I57_I2
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222	I56_I12
223	I56_I11
224	I56_I10
225	I56_I9
226	I56_I8
227	I56_I7
228	I56_I6
229	I56_I5
230	I56_I4
231	I56_I3

Array Index	Correlation
Correlator_Counts_25	
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2	I56_I1
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4	I55_1
5	I55_I24
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10	I55_I19
11	I55_I18
12	I55_I17
13	I55_I16
14	I55_I15

15	I55_I14
16	I55_I13
17	I55_I12
18	I55_I11
19	I55_I10
20	I55_I9
21	I55_I8
22	I55_I7
23	I55_I6
24	I55_I5
25	I55_I4
26	I55_I3
27	I55_I2
28	I55_I1
29	I55_0
30	I54_1

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32	I54_I23
33	I54_I22
34	I54_I21
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36	I54_I19
37	I54_I18
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43	I54_I12
44	I54_I11
45	I54_I10
46	I54_I9

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48	I54_I7
49	I54_I6
50	I54_I5
51	I54_I4
52	I54_I3
53	I54_I2
54	I54_I1
55	I54_0
56	I53_1
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76	I53_I5
77	I53_I4
78	I53_I3
79	I53_I2
80	I53_I1
81	I53_0
82	I52_1
83	I52_I24
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85	I52_I22
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155	I50_I4
156	I50_I3
157	I50_I2

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159	I50_0
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178	I49_I7
179	I49_I6
180	I49_I5
181	I49_I4
182	I49_I3
183	I49_I2
184	I49_I1
185	I49_0
186	0_1-6
187	0_0-6

Array Index	Correlation
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9	I72_I42
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13	I72_I38

14	I72_I37
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23	I72_I28
24	I72_I27
25	I72_I26
26	I72_I25
27	I71_I48
28	I71_I47

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32	I71_I43
33	I71_I42
34	I71_I41
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36	I71_I39
37	I71_I38
38	I71_I37
39	I71_I36
40	I71_I35
41	I71_I34

Array Index	Correlation
Correlator_Counts_27	
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9	I71_I25
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11	I70_I47
12	I70_I46
13	I70_I45
14	I70_I44
15	I70_I43
16	I70_I42
17	I70_I41
18	I70_I40
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225	I62_I25
226	I61_I48
227	I61_I47
228	I61_I46
229	I61_I45
230	I61_I44
231	I61_I43

Array Index	**Correlation**
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46	I59_I45

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231	I52_I28

Array Index	Correlation
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6	I51_I46
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65	I49_I35
66	I49_I34
67	I49_I33
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69	I49_I31
70	I49_I30
71	I49_I29
72	I49_I28
73	I49_I27
74	I49_I26
75	I49_I25
76	0_1-7
77	0_0-7

Array Index	Correlation
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2	1_0-8
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4	I72_I71
5	I72_I70
6	I72_I69
7	I72_I68
8	I72_I67
9	I72_I66
10	I72_I65

11	I72_I64
12	I72_I63
13	I72_I62
14	I72_I61
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16	I72_I59
17	I72_I58
18	I72_I57
19	I72_I56
20	I72_I55
21	I72_I54
22	I72_I53
23	I72_I52
24	I72_I51
25	I72_I50
26	I72_I49
27	I71_Q72
28	I71_Q71
29	I71_I70
30	I71_I69
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46	I71_I53
47	I71_I52
48	I71_I51
49	I71_I50
50	I71_I49
51	I70_Q72
52	I70_Q71
53	I70_Q70
54	I70_I69
55	I70_I68
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61	I70_I62
62	I70_I61
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98	I69_I49
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101	I68_Q70
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103	I68_Q68
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142	I67_I53
143	I67_I52
144	I67_I51
145	I67_I50
146	I67_I49
147	I66_Q72
148	I66_Q71
149	I66_Q70
150	I66_Q69
151	I66_Q68

Array Index	Correlation
Correlator_Counts_31	
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5	I66_I63
6	I66_I62
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9	I66_I59
10	I66_I58
11	I66_I57
12	I66_I56
13	I66_I55
14	I66_I54

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16	I66_I52
17	I66_I51
18	I66_I50
19	I66_I49
20	I65_Q72
21	I65_Q71
22	I65_Q70
23	I65_Q69
24	I65_Q68
25	I65_Q67
26	I65_Q66
27	I65_Q65
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29	I65_I63
30	I65_I62

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39	I65_I53
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42	I65_I50
43	I65_I49
44	I64_Q72
45	I64_Q71
46	I64_Q70

47	I64_Q69
48	I64_Q68
49	I64_Q67
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51	I64_Q65
52	I64_Q64
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54	I64_I62
55	I64_I61
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66	I64_I50
67	I64_I49
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70	I63_Q70
71	I63_Q69
72	I63_Q68
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74	I63_Q66
75	I63_Q65
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77	I63_Q63
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91	I63_I49
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229	I57_I55
230	I57_I54
231	I57_I53

Array Index	Correlation
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