NPOESS Phase I Project Report for

Supporting Region References and Quality Flags in HDFView

Peter Cao
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Executive summary

As part of the HDF-NPOESS project, an enhancement was requested to support region reference and quality flags in HDFView. The following is a list of major features added to HDFView for supporting NPOESS specific datasets.

- Aggregated granules: showing the whole dataset pointed by an object reference.
- Granules: showing data pointed by a dataset region reference.
- Quality flags: showing specific bit(s) of quality flags.
- Plugin module: a TreeView plugin for extracting bit(s) from a byte (compact flags).

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1 Introduction

NPOESS data products are delivered in two forms: aggregated granules and granules.

- Aggregated granules are datasets of objects references that point to products of NPOESS data records (RDRs, TDRs, SDRs, EDRs, etc).
- Granules are datasets of region references that point to selection(s) of products of NPOESS data records (RDRs, TDRs, SDRs, EDRs, etc).

Quality flags provide quality information about the delivered data. These multiple bit-level flags are packed into a single byte for storage efficiency. Quality flags appear in the HDF5 files as n number(s) of two or three dimensional, 1-byte arrays.

- Land/Water Background -- 1-bit
- SST Skin Quality -- 2-bits
- SST Bulk Quality -- 2-bits
- Aerosol Correction -- 3-bits

Heretofore, HDFView (version 2.5) did not provide a way to show data pointed to by object references or region references. Also, users were not be able to extract bit-level flags in HDFView. The goal of this project is to provide these features for NPOESS users.

2 Features to support object references and region references

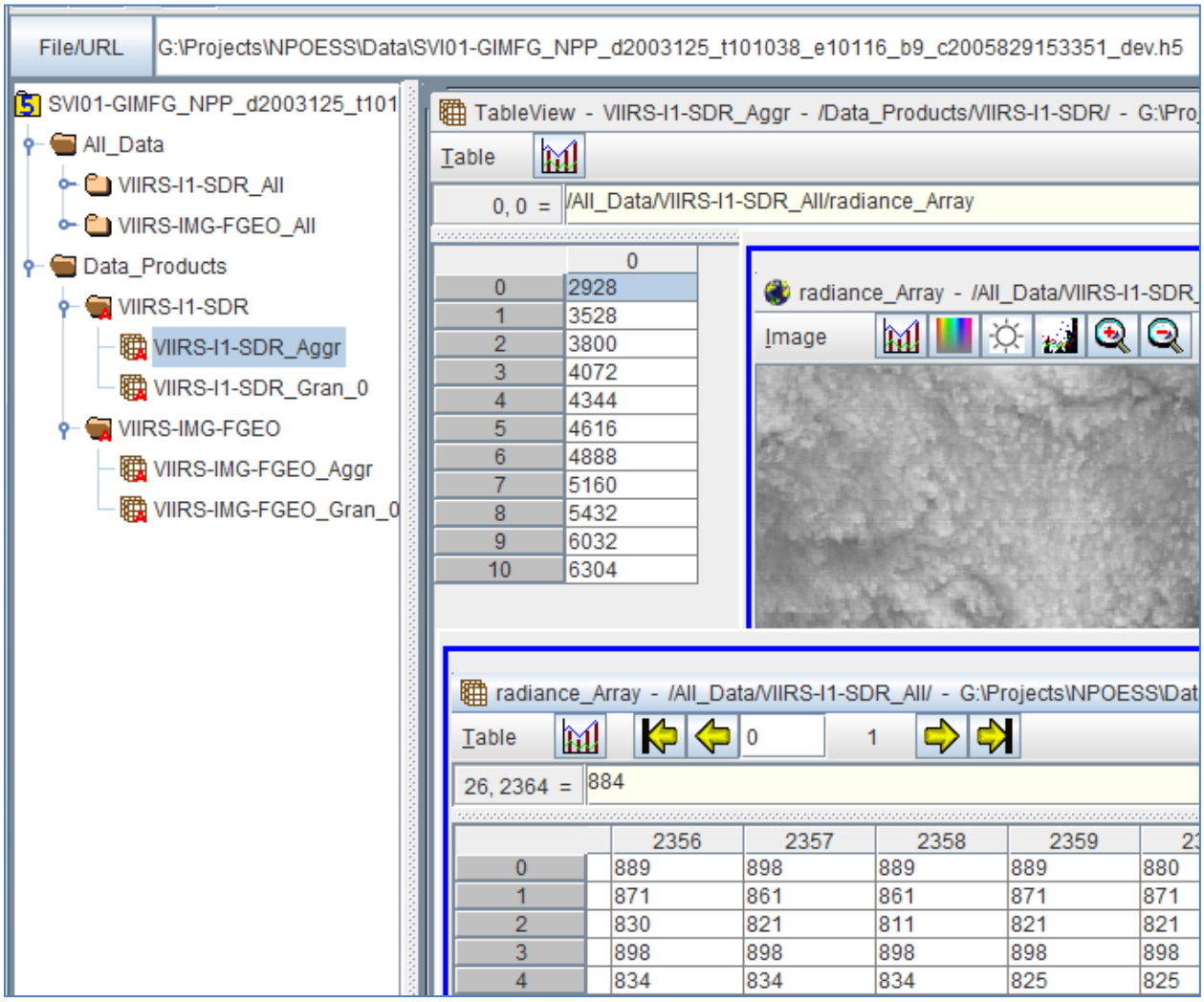
New features are added to show data pointed to by object references or region references in HDFView. The new features have been integrated into HDFView.

2.1 Aggregated granules -- dataset of object references

HDFView allow users to look at data pointed to by object references. We will use Figure 1 to explain how this is done.

a) Aggregated granules (datasets of object references) are located under the group Data_Products. For example, VIIRS-11-SDR_Aggr (VIIRS sensor data records) is located under the Data_Products group.
b) Double-click on an aggregated granule, e.g. VIIRS-11-SDR_Aggr, to make the values of objects references appear in a table. See example in Figure 1.
c) Click on an object reference (or a cell in the table), e.g. 2928, to display the name of the dataset pointed to by the object reference at the top of the table. E.g. /All_Data/VIIRS-I1-SDR_All/radiance_Array.
d) Right-mouse click on an object reference, e.g. 2928, to show data pointed to by the object reference as image or table.
e) To open multiple cells at one time:

- Select multiple cells by dragging the mouse to select continuous cells or use CTR + mouse click to select non-continuous cells.
- Use right-mouse click to open all of the selected cells at one time.



	0
0	2928
1	3528
2	3800
3	4072
4	4344
5	4616
6	4888
7	5160
8	5432
9	6032
10	6304

	2356	2357	2358	2359
0	889	898	889	889
1	871	861	861	871
2	830	821	811	821
3	898	898	898	898
4	834	834	834	825

Figure 1 -- Show data pointed by object references

2.2 Granules -- dataset of region references

HDFView shows data pointed by region references as image or table. Unlike object reference, only the data pointed by the region section will be displayed not the whole dataset.

a) Double-click on a granule, e.g. VIIRS-11-SDR_Gran_0, the values of selected region are shown in a table. See example in Figure 2.

b) Click on an object reference (table cell), e.g. 2928, the name of the dataset and the selection coordinates are shown at the top of the table. E.g. /All_Data/VIIRS-I1-SDR_All/reflect_Array { (0,0,0)-(511,6399,0) }.

c) Use right-mouse click to show data pointed by the selected region as image or table.

d) Multiple regions pointed by a single reference are displayed in separate tables.

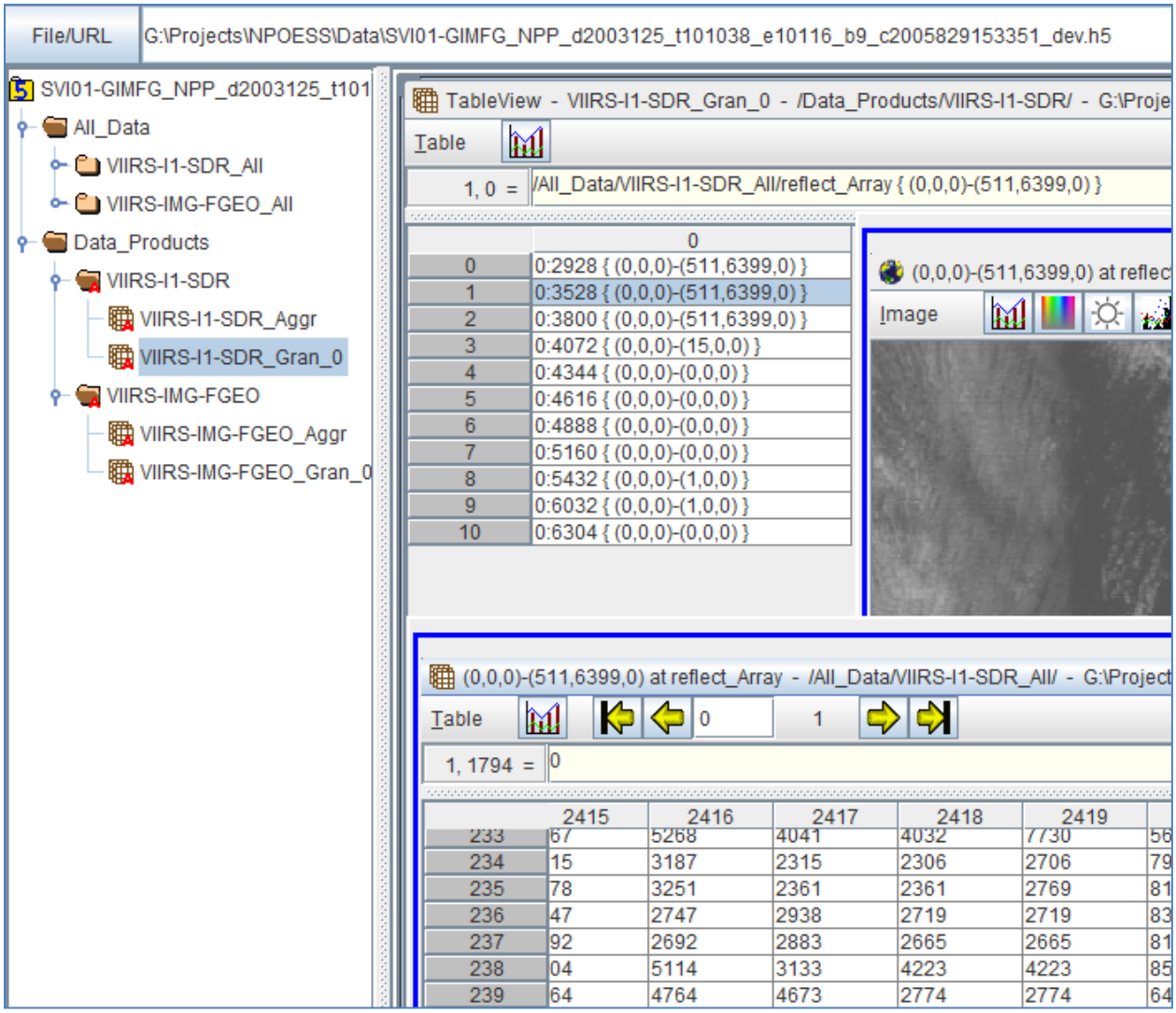


Figure 2 -- Show data pointed region references

3 Features to support quality flags

Because datasets with quality flags are specific to NPOESS data, HDFView features to display quality flags are implemented in a plugin, rather than as a standard feature in HDFView.

3.1 The NPOESS TreeView plugin (or module)

The HDFView package consists of several interfaces that enable users to write and use alternative implementations of GUI components to replace default modules. The current replaceable modules include Image view, Table view, Text view, Metadata view, Tree view, and Palette view. For details, see the module guide at http://www.hdfgroup.org/hdf-java-html/hdfview/ModularGuide/index.html.

Selecting a way of showing data in HDFView is a function of the TreeView. To support quality flags, we implemented a TreeView plugin, ext.npoess.TreeViewNPOESS, which allows users to select specific bit(s) to be displayed. The plugin for Phase I is a modification of the default implementation of the TreeView, DefaultTreeView. A more extendable plugin will be implemented in Phase II.

The plugin was built and released with hdf-java 2.5 patch 03. The source and prebuilt binaries can be downloaded from ftp://ftp.hdfgroup.org/HDF5/hdf-java/v25p3/.

Steps to use the plugin:

a) Download and install HDFView version 2.5p3.
b) Open HDFView and select the NPOESS plugin from Tools ➔ User Options ➔ Default Module ➔ TreeView ➔ ext.npoess.TreeViewNPOESS.
c) Restart HDFView.

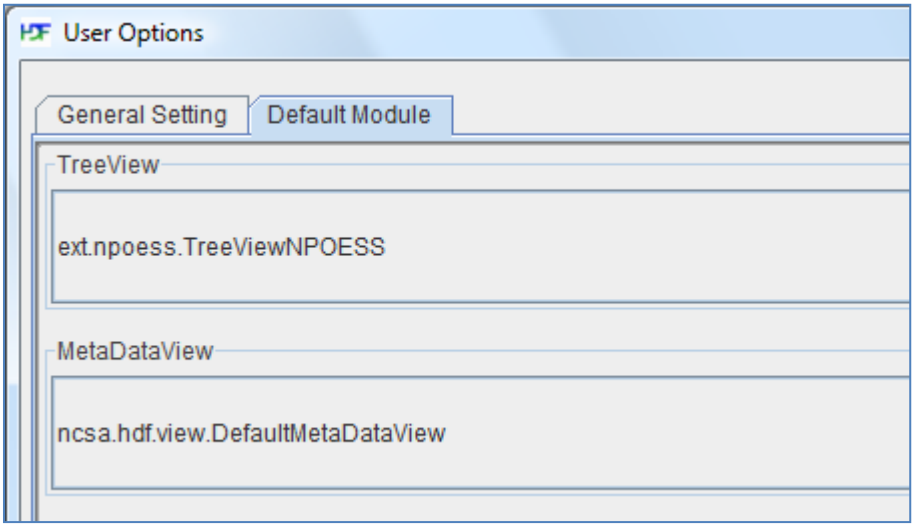


Figure 3 -- Select NPOESS plugin

You only need to do this once. The settings will be stored in the HDFView property file located in your home directory. You can also directly set up the plugin from the property file. Below is an example of the property file, .hdfview2.5.

```
#User properties modified on
#Thu Sep 17 12:42:25 GMT-06:00 2009
data.delimiter=Tab
enum.conversion=false
file.extension=hdf, h4, hdf4, h5, hdf5, he4, he5
font.size=12
font.type=Dialog
h4toh5.converter=
image.contrast=auto
max.members=10000
module.fileformat.HDF=ncsa.hdf.object.h4.H4File
module.fileformat.HDF5=ncsa.hdf.object.h5.H5File
module.imageview=ncsa.hdf.view.DefaultImageView
module.metadataview=ncsa.hdf.view.DefaultMetaDataView
module.paletteview=ncsa.hdf.view.DefaultPaletteView
module.tableview=ncsa.hdf.view.DefaultTableView
module.textview=ncsa.hdf.view.DefaultTextView
module.treeview=ext.npoess.TreeViewNPOESS
recent.file0=G\:\\Projects\\NPOESS\\Data\\SVI01-
GIMFG_NPP_d2003125_t101038_e10116_b9_c2005829153351_dev.h5
recent.file1=g\:\\temp\\t1.h5
recent.file2=C\:\\Program Files\\The HDF Group\\hdfview 2.5\\Data\\concept_map_demo.h5
users.guide=file\:C\:\\Program Files\\The HDF Group\\hdfview 2.5\\UsersGuide\\index.html
work.dir=C\:\\Program Files\\The HDF Group\\hdfview 2.5
```

3.2 Select quality flags in HDFView

After you select the TreeViewNPOESS as the default TreeView, you will be able to select specific bit(s) to show in a table.

Steps to select quality flag bit(s):

a) Right-mouse click on the quality flag array, e.g. QF_VIIRSI1SDR_Array and select “Open As”. An option window appears to allow you select bit(s) for displaying.
b) Check “Apply Bitmask” and check the bit(s). For example, bit[1] and bit[2] for SST Skin Quality. Click on the “Help” button for more help. See example in Figure 5.
c) The flag values will be displayed in a table. The flag values can be displayed in binary format or decimal format. See example in Figure 5.

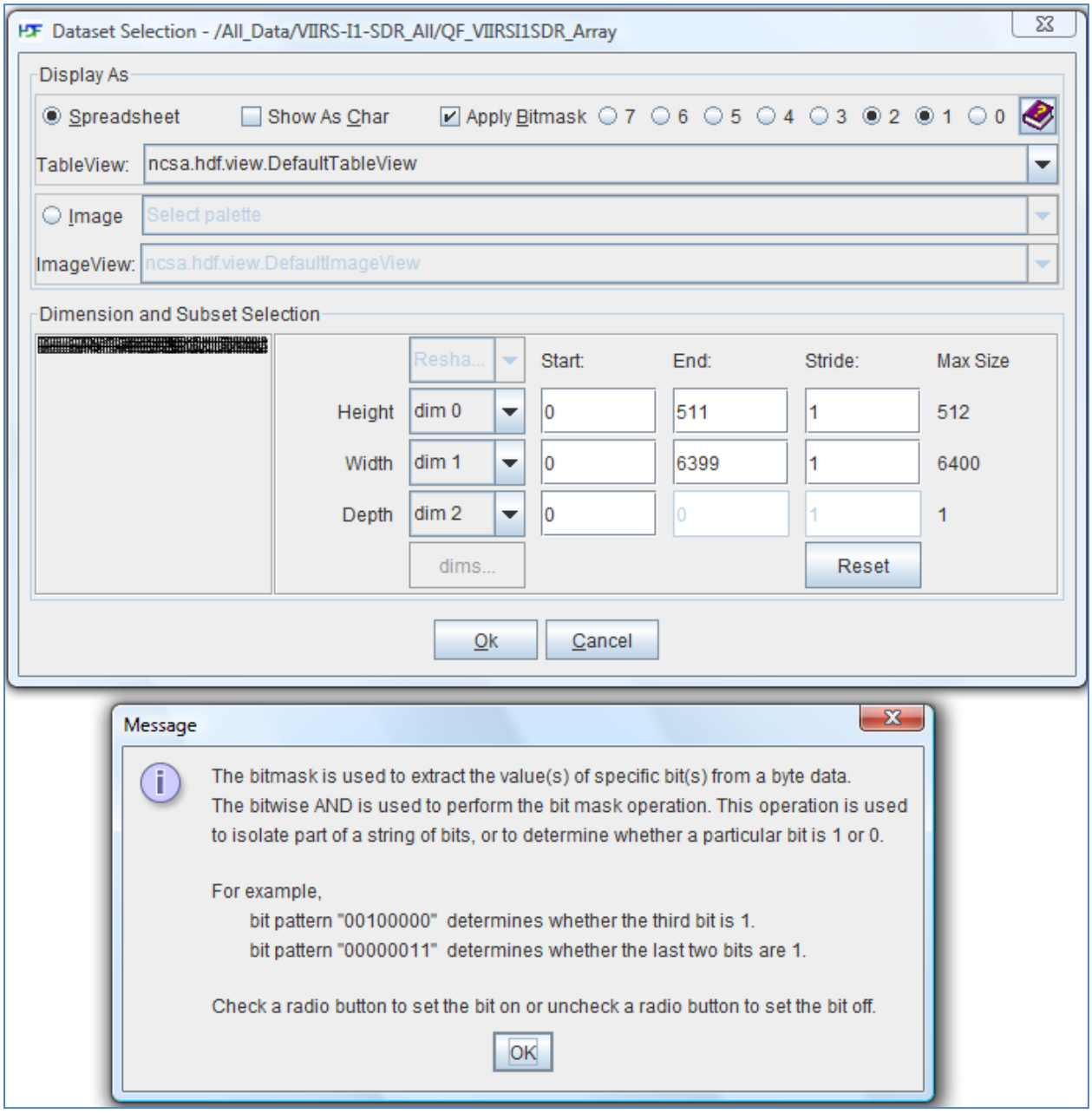
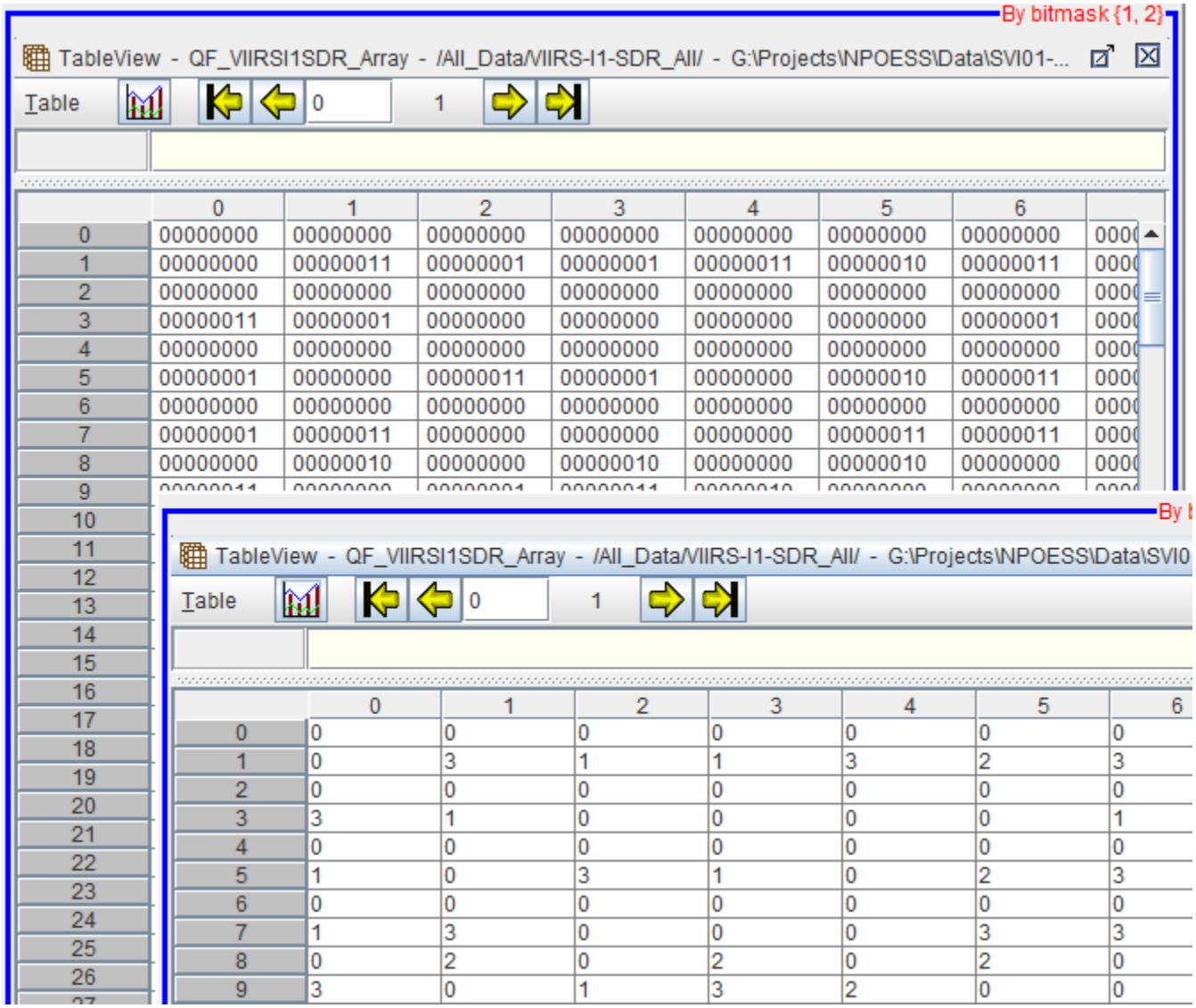


Figure 4 -- Select bit(s) for quality flags



	0	1	2	3	4	5	6
0	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1	00000000	00000011	00000001	00000001	00000011	00000010	00000011
2	00000000	00000000	00000000	00000000	00000000	00000000	00000000
3	00000011	00000001	00000000	00000000	00000000	00000000	00000001
4	00000000	00000000	00000000	00000000	00000000	00000000	00000000
5	00000001	00000000	00000011	00000001	00000000	00000010	00000011
6	00000000	00000000	00000000	00000000	00000000	00000000	00000000
7	00000001	00000011	00000000	00000000	00000000	00000011	00000011
8	00000000	00000010	00000000	00000010	00000000	00000010	00000000

	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	3	1	1	3	2	3
2	0	0	0	0	0	0	0
3	3	1	0	0	0	0	1
4	0	0	0	0	0	0	0
5	1	0	3	1	0	2	3
6	0	0	0	0	0	0	0
7	1	3	0	0	0	3	3
8	0	2	0	2	0	2	0
9	3	0	1	3	2	0	0

Figure 5 – Example of SST Skin Quality Flags of VIIRSI Sensor Data Records

4 Phase II work

NPOESS/NPP users have requested a number of additional features. These features will be implemented based on the priorities and available resources. Requests include

- Support variable-length datasets.
- Add more menu items such as "Open", "Open as“, and "Show Properties" on the object ID popup window other than "Show as Table" and "Show as Image".

- Use the definitions of quality flags, which are in two separate locations: 1) The Common Data Format Control Book – External (CDFCB-X), Volumes II, III and IV. 2) XML files provided as part of the CDFCB-X delivery.
- Apply the structure of the XML to determine whether a field is a packed quality flag byte.
- Extend the NPOESS plugin from the default implementation so that changes (new features and bug fixes) in the general HDFView will be automatically applied to the plugins.
- Implement production quality testing, documentation, and distribution.