

McIDAS-V Tutorial

Displaying Suomi NPP Data

updated January 2016 (software version 1.5)

McIDAS-V is a free, open source, visualization and data analysis software package that is the next generation in SSEC's 40-year history of sophisticated McIDAS software packages. McIDAS-V displays weather satellite (including hyperspectral) and other geophysical data in 2- and 3-dimensions. McIDAS-V can also analyze and manipulate the data with its powerful mathematical functions. McIDAS-V is built on SSEC's VisAD and Unidata's IDV libraries. The functionality of SSEC's HYDRA software package is also being integrated into McIDAS-V for viewing and analyzing hyperspectral satellite data.

More training materials are available on the McIDAS-V webpage and in the Getting Started chapter of the McIDAS-V User's Guide, which is available from the Help menu within McIDAS-V. You will be notified at the startup of McIDAS-V when new versions are available on the McIDAS-V webpage -

<http://www.ssec.wisc.edu/mcidas/software/v/> .

If you encounter an error or would like to request an enhancement, please post it to the McIDAS-V Support Forums - <http://www.ssec.wisc.edu/mcidas/forums/>. The forums also provide the opportunity to share information with other users.

This tutorial assumes that you have McIDAS-V installed on your machine, and that you know how to start McIDAS-V. If you cannot start McIDAS-V on your machine, you should follow the instructions in the document entitled *McIDAS-V Tutorial – Installation and Introduction*.

Terminology

There are two windows displayed when McIDAS-V first starts, the **McIDAS-V Main Display** (hereafter **Main Display**) and the **McIDAS-V Data Explorer** (hereafter **Data Explorer**).

The **Data Explorer** contains three tabs that appear in bold italics throughout this document: *Data Sources*, *Field Selector*, and *Layer Controls*. Data is selected in the *Data Sources* tab, loaded into the *Field Selector*, displayed in the **Main Display**, and output is formatted in the *Layer Controls*.

Menu trees will be listed as a series (e.g. *Edit -> Remove -> All Layers and Data Sources*).

Mouse clicks will be listed as combinations (e.g. *Shift+Left Click+Drag*).

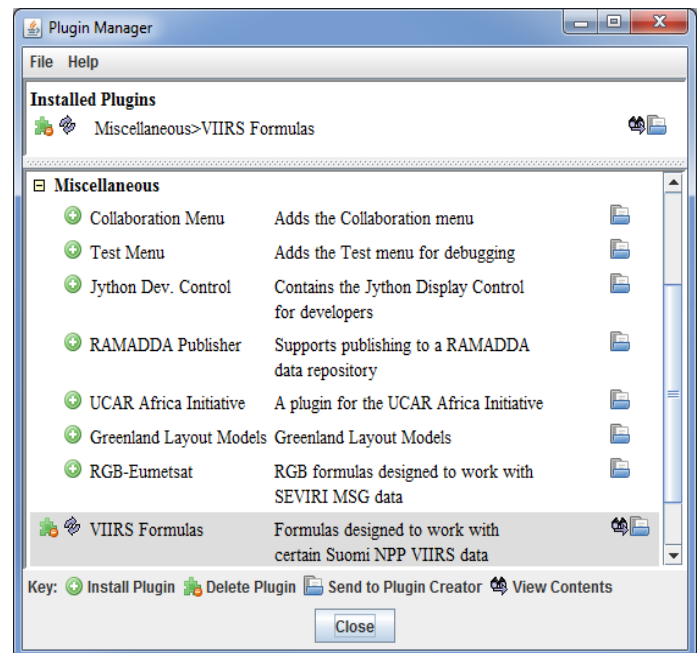
Introduction

McIDAS-V has the ability of displaying Suomi NPP data through the *Under Development -> Imagery -> Suomi NPP* chooser. Among the Suomi NPP products that McIDAS-V can display are different bands of SVM and SVI data, various cloud filter products, and the day/night band. In order for this data to be recognized by McIDAS-V, the data and geolocation files must be contained within the same directory. Some sources of data, including NOAA's CLASS, package the data and geolocation files together, while other sources, including SSEC's PEATE server, do not package the files together. Note that this chooser is still under development and improvements in functionality as well as the ability to utilize different NPP products will be added in the future.

This tutorial utilizes PEATE data with separate data and geolocation files, single-banded data from NOAA CLASS, as well as multi-banded visible data from NOAA CLASS.

Installing the VIIRS Formulas Plugin

1. This tutorial uses two formulas specifically designed to work with Suomi NPP VIIRS data. These formulas are not packaged as part of the core group of formulas in McIDAS-V, and must be added via a plugin. Add this plugin.
 - a. In the **Main Display** window, navigate to the *Tools -> Plugins -> Manage* menu item to open the **Plugin Manager**.
 - b. The top of the **Plugin Manager** lists plugins currently installed, and the bottom panel lists out various plugins available for installation. Expand the *Miscellaneous* tree and click the green **Install Plugin** button next to *VIIRS Formulas*.
 - c. This pops up a message informing that McIDAS-V must be restarted to complete the installation of the plugin. Click **OK** through this message and restart McIDAS-V.



A Nighttime Scene of Hurricane Blanca with VIIRS Longwave IR and Day-Night Band

2. Create a new two-panel map display tab with the *File -> New Display Tab -> Map Display -> Two Panels* menu item.
3. *Left-Click* in the left panel in the **Main Display** to make this panel active. Any displays will appear in the active panel.

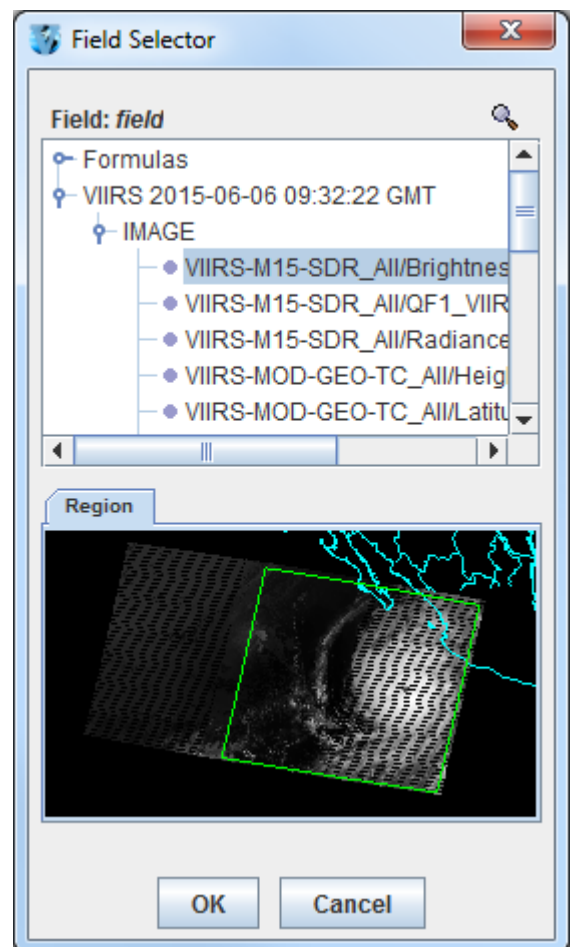
4. Load in the three time-consecutive granules of SVM15 data.
 - a. In the **Data Sources** tab of the **Data Explorer**, select **Under Development -> Imagery - Suomi NPP**
 - b. Under **Files**, use *Shift+Click* to select the following three files:

<local path>/Data/NPP/HurricaneBlanca/SVM15_npp_d20150606_t0932221*
 <local path>/Data/NPP/HurricaneBlanca/SVM15_npp_d20150606_t0933475*
 <local path>/Data/NPP/HurricaneBlanca/SVM15_npp_d20150606_t0935129*

Note that the <local path>/Data/NPP/HurricaneBlanca directory includes three GMTCO* files (one for each SVM15* file). These GMTCO* files contain the geolocation data necessary for McIDAS-V to plot the SVM15 data. These GMTCO* files cannot be selected in the **Data Sources** tab of the **Data Explorer**, only the SVM15 files can be chosen.

- c. Click **Add Source**. Adding these three files at once will aggregate the data together, combining the three individual granules into a single image.
5. Use the swathToGrid formula to display SVM15 Brightness Temperature data in the left panel.

- a. In the **Field Selector** tab, under **Data Sources** select **Formulas**.
- b. Under **Fields**, select the **swathToGrid** formula. Click **Create Display**.
- c. In the **Select input** window, enter values of *750* for **res** and *1.0* for **mode** and click **OK**.
- d. At the top of the **Field Selector** window, choose the **VIIRS* -> IMAGE -> VIIRS-M15-SDR_All/BrightnessTemperature** field.
- c. The **Region** panel gives a preview image of the display. The region of interest is contained within the bowtie deletion lines. Use *Shift+Left-Click+Drag* to subset an area around the hurricane. Anything contained within the green bounding box will be displayed at full-resolution with the bowtie removed by the formula. Note that the entire region must be contained within the granule's data.
- d. Click **OK**.



6. The default enhancement applied to the display is gray scale. Change this to inverse gray scale by going to the **Layer Controls** tab of the **Data Explorer** and clicking on the **Gray scale** button. Use the dropdown menu to select **System -> Inverse Gray Scale**.
7. **Left-Click** in the right panel in the **Main Display** to make this panel active. Any displays will appear in the active panel.
8. Load in the Suomi NPP Day/Night band granule.
 - a. In the **Data Sources** tab of the **Data Explorer**, navigate to the **Under Development -> Imagery - Suomi NPP** chooser.
 - b. Load in the three time-consecutive granules of SVDNB day-night band data using the same method from step 4b earlier.

<local path>/Data/NPP/HurricaneBlanca/SVDNB_npp_d20150606_t0932221*

<local path>/Data/NPP/HurricaneBlanca/SVDNB_npp_d20150606_t0933475*

<local path>/Data/NPP/HurricaneBlanca/SVDNB_npp_d20150606_t0935129*

Note that the <local path>/ **Data/NPP/HurricaneBlanca** directory includes three GDNBO* files (one for each SVDNB* file). These GDNBO* files contain the geolocation data necessary for McIDAS-V to plot the SVDNB data. These GDNBO* files cannot be selected in the **Data Sources** tab of the **Data Explorer**, only the SVDNB files can be chosen.

- c. Click the **Add Source** button.
9. Select the field to display, the display type, and display the data at full-resolution.
 - a. In the **Fields** panel of the **Field Selector**, expand the **IMAGE** dropdown to view the fields included with the data. Select the **VIIRS-DNB-SDR_ALL/Radiance** field.
 - b. In the **Displays** panel, select **Imagery -> Image Display**.
 - c. The **Region** panel gives a preview image of the display. By default, McIDAS-V will display the data at a reduced resolution to save on memory usage. To display the data at full resolution, use **Shift+Left Click+Drag** to subset a region around the hurricane. Anything contained within the green bounding box will be displayed at full-resolution. Note that the entire region must be contained within the granule's data.
 - d. Click **Create Display**.

10. Adjust the display to make the hurricane more visible.
 - a. Zoom in on the region of interest in the **Main Display** by using *Shift+Left-Click+Drag*. The display region can be further customized by zooming in/out with the scroll wheel on the mouse and the display can be translated using *Control+Right-Click+Drag*.
 - b. Adjust the colorbar range to make the data visible by going to the **Layer Controls** tab of the **Data Explorer** and clicking on the **Gray scale** button. Use the dropdown menu to select **Change Range**. In the **Change Range** window, set **From** to *1.5E-10* and set **To** to *1.5E-8*. Click **OK**.
11. Investigate the display to determine different features that can be seen in the day-night band and longwave infrared band.

Precipitation in Hurricane Blanca with ATMS Microwave Data

12. *Left-Click* on the left panel in the **Main Display** window to make this panel active.
13. Load in the ATMS data.
 - a. In the **Data Sources** tab of the **Data Explorer**, select **Under Development -> Imagery - Suomi NPP**
 - b. Under **Files**, select the following file:

*<local path>/Data/NPP/HurricaneBlanca/SATMS_npp**

Note that the *<local path>/Data/NPP/HurricaneBlanca* directory includes a GATMO* file. The GATMO * file contain the geolocation data necessary for McIDAS-V to plot the SATMS data. The GATMO * file cannot be selected in the **Data Sources** tab of the **Data Explorer**, only the SATMS file can be chosen.
 - c. Click **Add Source**.

14. Create a multi-spectral display of the ATMS data.
 - a. In the **Fields** panel of the **Field Selector**, select the **MultiSpectral -> ATMS-SDR_All/BrightnessTemperature** field.
 - b. In the **Displays** panel, select the **Imagery -> MultiSpectral Display** display type.
 - c. In the **Region** tab, use *Shift+Left-Click+Drag* to subset an area around the hurricane.
 - d. Click **Create Display**.

15. The display of the ATMS data now overlaps the SVM15 data displayed earlier. Open the **Legend** for this tab and toggle between layer visibilities.
 - a. The **Main Display** shows a display of the data and includes two data probes that are overlaid on top of each other. Use *Left-Click+Drag* to position the probes in two different locations. For example, place one over the hurricane, and one over open water.
 - b. In the left panel of the **Main Display**, select the *View -> Displays -> Float Legend* menu item. This opens a **Legend** window similar to that used in a one panel display.
 - c. The top layer listed under the *Imagery* tree, *MultiSpectral*, is the ATMS layer. Turn the visibility of this layer on and off by toggling the checkbox next to the layer. This allows for easily comparison of the VIIRS SVM15 and ATMS brightness temperature data.

16. In the *Layer Controls* tab of the **Data Explorer**, change the frequency using either *Left-Click+Drag* on the green selector line, or by using the **Band** dropdown at the bottom of the tab. Notice how the display changes with different frequencies. Investigate how the display appears at different frequencies.
 - a. Higher frequency values are useful for detecting ice because of the scattering.
 - b. Lower frequency values are useful for detecting liquid water because of the emission. One good band for detecting precipitation within Hurricane Blanca is band 4. Within the hurricane, the lighter colored areas (colder) are representative of areas of precipitation.

Problem Sets

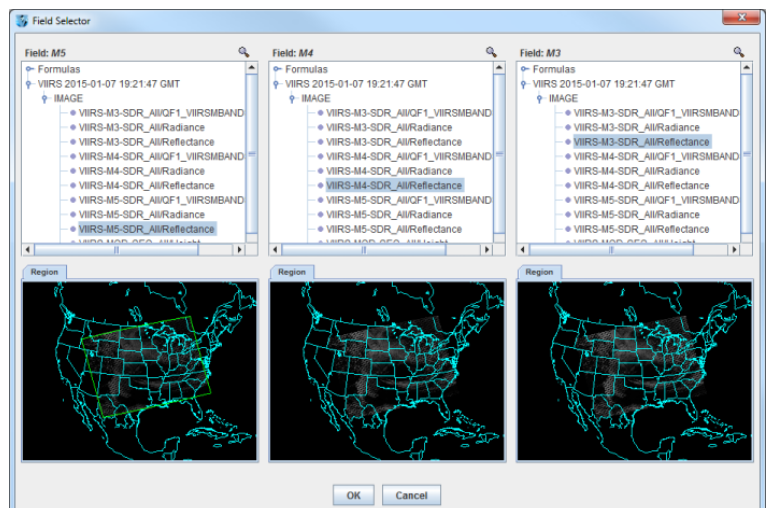
The previous examples were intended to give you a general knowledge of how to load and display Suomi NPP data. The problem sets below are intended to introduce you to new topics related to the data, as well as challenge your knowledge of McIDAS-V. We recommend that you attempt to complete each problem set before looking at the solutions, which are provided below the problem set.

1. Using the *<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM03-SVM04-SVM05** file, create an RGB image using the Reflectance field of all three bands. Create the display by using the **VIIRS_M_RGB(M5,M4,M3)** formula. Display the data at full-resolution and make sure to include a large portion of the granule in your subsetted region. Adjust the **Common Gamma** field in the *Layer Controls* to make the individual colors stand out more in the display.
2. Looking at the display over the Great Lakes, it is difficult to discern between clouds and snow over the land. Using the *<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM14** data, display brightness temperature data with the **swathToGrid** formula over the Great Lakes region. Adjust the enhancement to make the clouds display as white instead of black. Overlay this display on the RGB image created in problem 1. This longwave infrared band is useful to distinguish between clouds and snow.
3. Looking at the RGB display over Louisiana, smoke can be observed. Using the *<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM13** data, display brightness temperature data with the **swathToGrid** formula over Louisiana. Overlay this display on the RGB image created in problem 1. This medium-wave infrared band is useful to detect fire activity.
4. Determine the smoke concentration from the Louisiana fire using the *<local path>/Data/NPP/LakeEffectRGB/GMTCO-VSUMO** VIIRS suspended matter EDR data. Overlay this display on the RGB image created in problem 1.

Problem Set #1 – Solution

Using the *<local path>/Data/NPP/LakeEffectRGB/GMOD0-SVM03-SVM04-SVM05** file, create an RGB image using the Reflectance field of all three bands. Create the display by using the **VIIRS_M_RGB(M5,M4,M3)** formula. Display the data at full-resolution and make sure to include a large portion of the granule in your subsetted region. Adjust the **Common Gamma** field in the *Layer Controls* to make the individual colors stand out more in the display.

1. Remove all layers and data sources from the previous displays.
2. Select **File -> New Display Tab -> Map Display -> One Panel** to create a new one-panel map display tab.
3. Load in a granule containing three bands of VIIRS SVM visible data (SVM03, SVM04 and SVM05).
 - a. In the *Data Sources* tab of the **Data Explorer**, select **Under Development > Imagery – Suomi NPP**
 - b. Select *<local path>/Data/NPP/LakeEffectRGB/GMOD0-SVM03-SVM04-SVM05_npp** (Note: this file packages the geolocation (GMODO) and the data (SVM*) together into the same file.)
 - c. Click the **Add Source** button.
4. Use the VIIRS formula to create a true-color RGB image with the bowtie effect removed.
 - a. In the *Field Selector* tab, under **Data Sources** select **Formulas**.
 - b. Under **Fields**, select the **VIIRS_M_RGB(M5,M4,M3)** formula. Click **Create Display**.
 - c. In the new **Field Selector** window, select:
 - For **Field: M5**, select **VIIRS -> IMAGE -> VIIRS-M5-SDR_All/Reflectance**
 - For **Field: M4**, select **VIIRS -> IMAGE -> VIIRS-M4-SDR_All/Reflectance**
 - For **Field: M3**, select **VIIRS -> IMAGE -> VIIRS-M3-SDR_All/Reflectance**
 - d. In the **Region** tab of **Field: M5**, use **Shift+Left-Click+Drag** to select a region to display at full-resolution. Select a region that contains most of the granule, as shown in the image below. It is not necessary to subset a region in for **M4** and **M3**, as the region selected for **M5** will be used for all fields.
 - e. Click **OK** to display the results of the **VIIRS_M_RGB(M5,M4,M3)** formula.

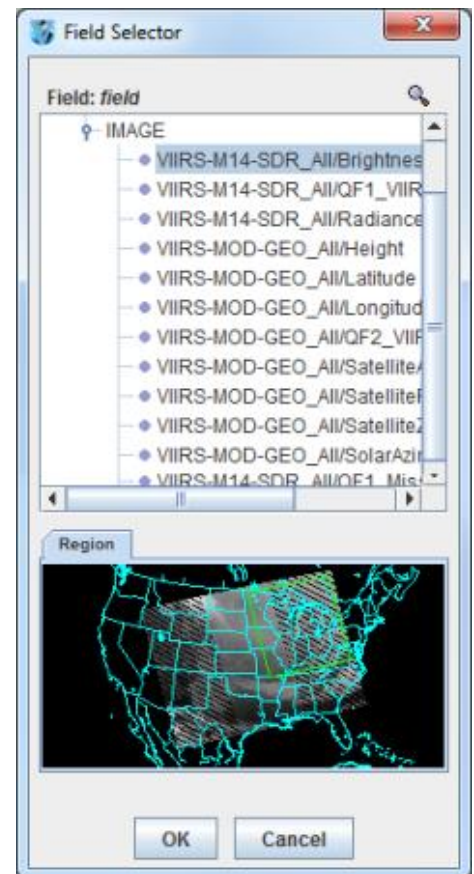


5. Adjust the display to enhance the Red, Green, and Blue components of the display.
 - a. Navigate to the **Layer Controls** tab of the **Data Explorer**. By default, all **Gamma** values for all colors are set to 1.0. Change this value to 0.4 by entering in *0.4* in the **Common Gamma** field and clicking the **Apply to All Gamma Fields** button.
 - b. Return to the **Main Display** window to observe the RGB display and also notice that the bowtie effect has been removed by the formula.

Problem Set #2 – Solution

Looking at the display over the Great Lakes, it is difficult to discern between clouds and snow over the land. Using the `<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM14*` data, display brightness temperature data with the **swathToGrid** formula. Adjust the enhancement to make the clouds display as white instead of black. Overlay this display on the RGB image created in problem 1. This longwave infrared band is useful to distinguish between clouds and snow. Remove all layers and data sources from the previous displays.

1. In the **Data Sources** tab of the **Data Explorer**, select **Under Development -> Imagery -> Suomi NPP**
 - a. Under **Files**, select the following file: `<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM14*`
 - b. Click the **Add Source** button.
2. Use the **swathToGrid** formula to create a full-resolution display of the data without the bowtie effect.
 - a. In the **Field Selector** tab, under **Data Sources** select **Formulas**.
 - b. Under **Fields**, select the **swathToGrid** formula. Under **Displays**, select **Imagery > Image Display**. Click **Create Display**.
 - c. In the new **Select input** window, enter *750* for **res** and *1.0* for **mode**. Click **OK**.
 - d. In the **Field Selector**, select **VIIRS* -> IMAGE -> VIIRS-M14-SDR_All/BrightnessTemperature**.
 - e. In the **Region** tab, use **Shift+Left-Click+Drag** to select a region over the Great Lakes (as seen in the image on the right) to display at full-resolution.
 - f. Click **OK** to display the result of the **swathToGrid** formula.



3. Adjust the display to make the clouds over the Great Lakes appear as white instead of black and investigate the display.
 - a. Change the colorbar to Inverse Gray Scale. To do this, *Right-Click* on the colorbar in the **Legend** and select **System -> Inverse Gray Scale**. This is done to make the lower data values (colder temperatures, such as clouds) display as white, while warmer temperatures are black.
 - b. Use the visibility checkbox in the **Legend** to toggle the SVM14 layer on and off to compare with the RGB display underneath. The temperature difference between clouds and snow in this infrared band allows the clouds to stand out more than they do in the visible bands used in the RGB display.

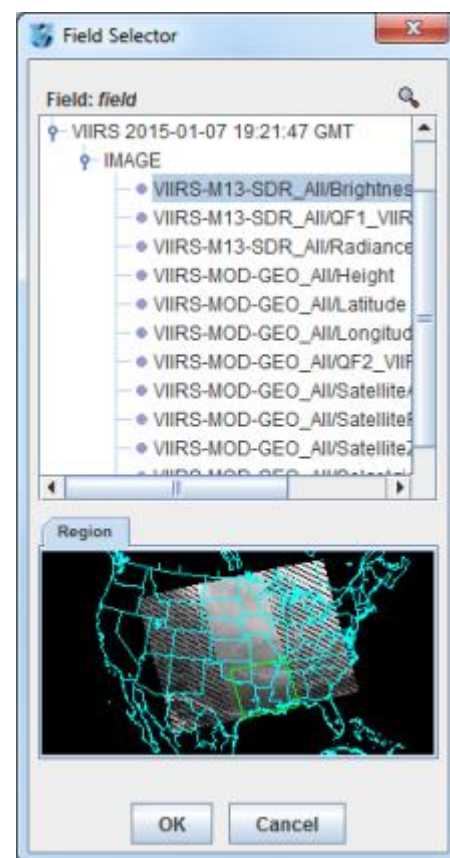
Problem Set #3 – Solution

Looking at the RGB display over Louisiana, smoke can be observed. Using the `<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM13*` data, display brightness temperature data with the **swathToGrid** formula over Louisiana. Overlay this display on the RGB image created in problem 1. This medium-wave infrared band is useful to detect fire activity.

1. In the **Data Sources** tab of the **Data Explorer**, select **Under Development -> Imagery -> Suomi NPP**
 - a. Under **Files**, select the following file: `<local path>/Data/NPP/LakeEffectRGB/GMODO-SVM13*`
 - b. Click the **Add Source** button.
2. Use the **swathToGrid** formula to create a full-resolution display of the data without the bowtie deletion.
 - a. In the **Field Selector** tab, select **Formulas** under **Data Sources**.
 - b. Under **Fields**, select the **swathToGrid** formula. Under **Displays**, select **Imagery -> Image Display**. Click **Create Display**.
 - c. In the new **Select input** window, enter **750** for **res** and **1.0** for **mode**. Click **OK**.
 - d. In the **Field Selector** window, select **VIIRS* -> IMAGE -> VIIRS-M13-SDR_All/BrightnessTemperature**.

In the **Region** tab, use *Shift+Left-Click+Drag* to select a region over Louisiana to display at full-resolution. Click **OK** to display the result of the **swathToGrid** formula.

3. Use the visibility checkbox in the **Legend** to toggle the SVM13 layer on and off to compare with the RGB display underneath.



Problem Set #4 – Solution

Determine the smoke concentration from the Louisiana fire using the *<local path>/Data/NPP/LakeEffectRGB/GMTCO-VSUMO** VIIRS suspended matter EDR data. Overlay this display on the RGB image created in problem 1.

1. In the **Data Sources** tab of the **Data Explorer**, navigate to the **Under Development -> Imagery -> Suomi NPP** chooser.
 - a. Under **Files**, select the following file:
*<local path>/Data/NPP/LakeEffectRGB/GMTCO-VSUMO**
 - b. Click the **Add Source** button.
2. Display the smoke concentration from the EDR data.
 - a. In the **Fields** panel of the **Field Selector**, select:
Image -> VIIRS-SusMat-EDR_/All/SmokeConcentration field.
 - b. Select **Imagery -> Image Display** in the **Displays** panel of the **Field Selector**.
 - c. In the **Region** tab of the **Field Selector**, use *Shift+Left Click+Drag* to subset a region over Louisiana. Anything within this subsetted region will display at the full resolution of the data.
 - d. Click **Create Display**.
3. Investigate the smoke concentration from the Louisiana fire.
 - a. In the **Legend** of the **Main Display**, toggle off the visibilities of the SVM13 and SVM14 data so only the RGB and the VIIRS EDR data is displayed.
 - b. Navigate over the fire in Louisiana and toggle the VIIRS EDR layer on and off with the visibility checkbox in the **Legend**.
 - c. With the EDR data displayed, hold down the middle mouse button over the smoke region to see probe output of smoke concentration at the bottom of the display.

The following table lists out band, wavelength and resolution information for VIIRS SVM, DNB (Day/Night Band) and SVI data. Source: <http://rammb.cira.colostate.edu/projects/npp/>

VIIRS bands and bandwidths

VIIRS Band	Central Wavelength (µm)	Wavelength Range (µm)	Band Explanation	Spatial Resolution (m) @ nadir
M1	0.412	0.402 - 0.422	Visible/ Reflective	750 m
M2	0.445	0.436 - 0.454		
M3	0.488	0.478 - 0.488		
M4	0.555	0.545 - 0.565		
M5 (B)	0.672	0.662 - 0.682	Near IR	
M6	0.746	0.739 - 0.754		
M7 (G)	0.865	0.846 - 0.885	Shortwave IR	
M8	1.240	1.23 - 1.25		
M9	1.378	1.371 - 1.386		
M10 (R)	1.61	1.58 - 1.64	Medium-wave IR	
M11	2.25	2.23 - 2.28		
M12	3.7	3.61 - 3.79		
M13	4.05	3.97 - 4.13		
M14	8.55	8.4 - 8.7	Longwave IR	
M15	10.763	10.26 - 11.26		
M16	12.013	11.54 - 12.49		
DNB	0.7	0.5 - 0.9	Visible/ Reflective	750 m across full scan
I1 (B)	0.64	0.6 - 0.68	Visible/Reflective	375 m
I2 (G)	0.865	0.85 - 0.88	Near IR	
I3 (R)	1.61	1.58 - 1.64	Shortwave IR	
I4	3.74	3.55 - 3.93	Medium-wave IR	
I5	11.45	10.5 - 12.4	Longwave IR	

M = Moderate (750 m) resolution bands

I = Imagery (375 m) resolution bands

DNB = Day-Night Band (or Near Constant Contrast (NCC) band)

M-bands highlighted in **pale yellow** are available as EDRs, in addition to SDRs.

Red, Green, and Blue components of true-color visible imagery are also highlighted.

True-color component bands are highlighted in red, green, and blue.

Natural-color component bands are noted with R, G, and B.

M6 on Suomi NPP has a high radiance fold-over issue with many saturated pixels.

Zooming, Panning, and Rotating Controls

Zooming	Panning	Rotating
	Mouse	
<p>Shift-Left Drag: Select a region by pressing the <i>Shift</i> key and dragging the left mouse button.</p> <p>Shift-Right Drag: Hold <i>Shift</i> key and drag the right mouse button. Moving up zooms in, moving down zooms out.</p>	<p>Control-Right Mouse Drag: Hold <i>Control</i> key and drag right mouse to pan.</p>	<p>Right Mouse Drag: Drag right mouse to rotate.</p>
	Scroll Wheel	
<p>Scroll Wheel-Up: Zoom Out.</p> <p>Scroll Wheel-Down: Zoom In.</p>		<p>Control-Scroll Wheel-Up/Down: Rotate clockwise/counter clockwise.</p> <p>Shift-Scroll Wheel-Up/Down: Rotate forward/backward clockwise.</p>
	Arrow Keys	
<p>Shift-Up: Zoom In.</p> <p>Shift-Down: Zoom Out.</p>	<p>Control-Up arrow: Pan Down.</p> <p>Control-Down arrow: Pan Up.</p> <p>Control-Right arrow: Pan Left.</p> <p>Control-Left arrow: Pan Right.</p>	<p>Left/Right arrow: Rotate around vertical axis.</p> <p>Up/Down arrow: Rotate around horizontal axis.</p> <p>Shift-Left/Right arrow: Rotate Clockwise/Counterclockwise.</p>