

McIDAS-V Tutorial

Displaying Satellite Imagery

updated August 2009 (software version 1.0beta4)

McIDAS-V is a free, open source, visualization and data analysis software package that is the next generation in SSEC's 35-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, and contains "Bridge" software that enables McIDAS-X users to run their commands and tasks in the McIDAS-V environment. The functionality of SSEC's HYDRA software package is also being integrated into McIDAS-V for viewing and analyzing hyperspectral satellite data.



McIDAS-V is currently a beta version of the software, which means that the software may contain bugs and not always work as expected. If you encounter any errors, please send them to the McIDAS Help Desk at mug@ssec.wisc.edu. 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/>. 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.

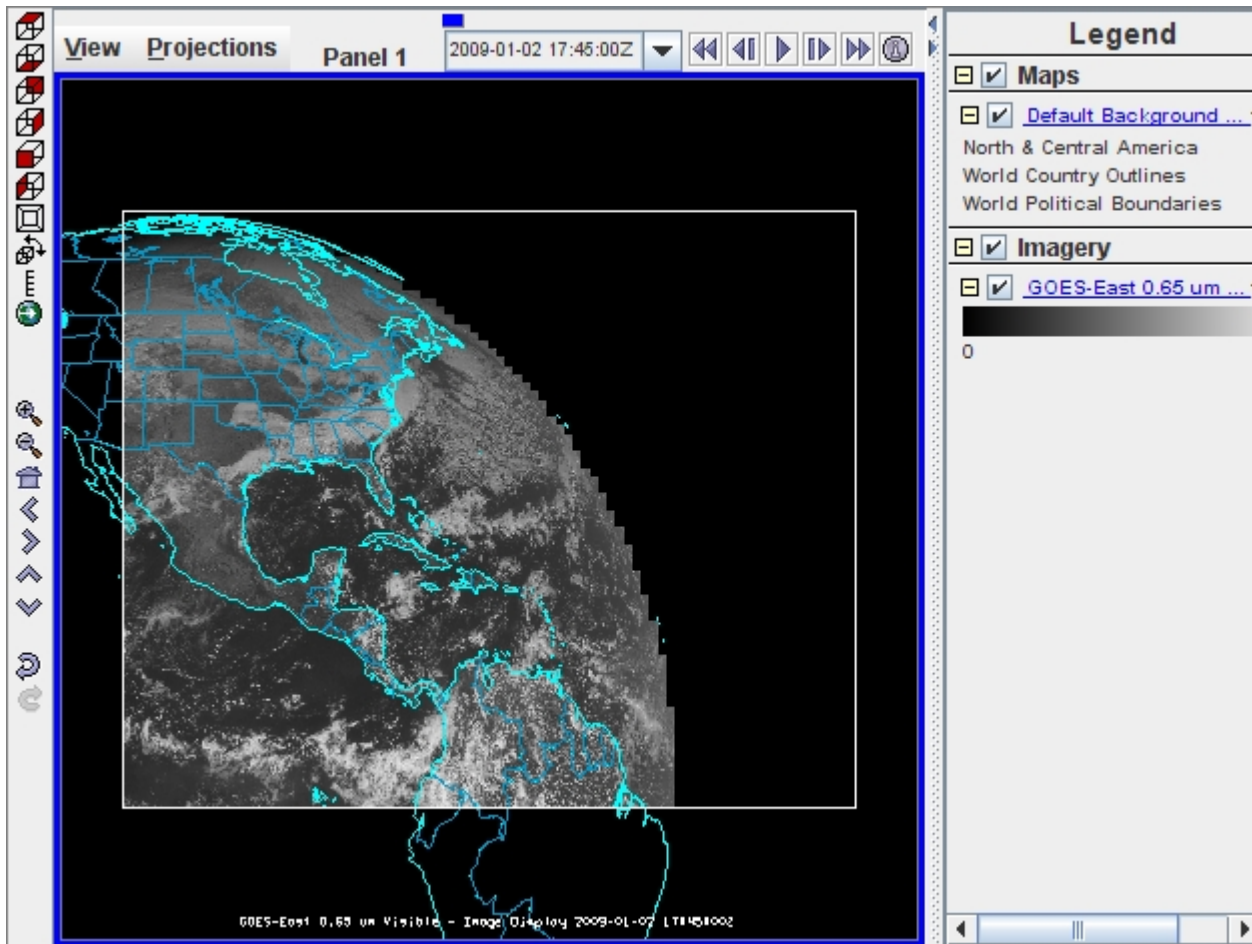
This tutorial assumes that you have McIDAS-V installed on your machine, and that you know how to start McIDAS-V. If you cannot start McIDAS-V on your machine, you should follow the instructions in the document entitled *McIDAS-V Tutorial – Installation and Introduction*.

In this McIDAS-V Tutorial, each exercise will be explained using two different methods of data access: pre-loaded data bundles and real-time access to default remote servers. If you have access to your own real-time ADDE servers, you may also use those, but be aware that different server configurations may make the explanations in this document not quite applicable to all data that you may load.

Note: Users of data from the SSEC Data Center can use the "Import from URL" feature of the ADDE Server Manager and automatically include all of the SSEC Data Center servers in the McIDAS-V server lists. From the main menu, select **Edit -> Preferences -> ADDE Servers -> Import From URL** and enter the URL (<http://www.ssec.wisc.edu/mcidas/software/v/addeservers.xml>), your User ID, and Project #.

Loading Geostationary Satellite Images and Loops

1. Load the single times data bundle for the second tutorial into McIDAS-V. If you want to load real-time data, skip to step 2.
 - a. In the **Main Menu Bar** in the **Main Display** window of McIDAS-V, select **File -> Open File...**
 - b. In the file browser, “Look In” the location where you downloaded the data files for this tutorial, select **Sat-Single-Times.mcvz** and click **Open**.
 - c. In the “Open Bundle” dialog box select the *Replace session* option and click **OK**.
 - d. Under “Confirm Layer/Data Removal” uncheck the *Always Ask* box and click **Remove all layers/data**.
 - e. Select *Write to temporary directory*, check *Don't show this again*, and click **OK**.
2. To load real-time data, follow these steps. If you have already loaded the data in step one, proceed to step 3.
 - a. Click on the  button in the main toolbar to go to the *Data Explorer*.
 - b. Select the **Satellite -> Imagery** chooser from the *Data Sources* tab.
 - c. If you're using the default servers in McIDAS-V, you can connect to the adde.ucar.edu server with the dataset RTIMAGES.
 - d. Choose the *GE-VIS - GOES-East 0.65 μm Visible* **Image Type** and select an **absolute** time of 17:45 UTC from the previous day. (This step may be slow, because when choosing absolute times, McIDAS-V needs to query the ADDE server for all available times.)
 - i. If your real-time server contains data with the original satellite resolution, you may need to change the **Image size** to 2000 X 2000 and the **Magnification** to -2 X -4.
 - e. Click **Add Source** to show the *Field Selector*.
 - f. Click **Create Display**. The 17:45 UTC 0.65 μm image is displayed in the *Map Display* window.
3. Use the zooming and panning controls in the left toolbar to inspect the image.
 - a. Reset the display projection by clicking on the  icon below the zooming buttons on the left toolbar.
 - b. Turn off the **Auto-set Projection** option under the **Projections** menu. When this option is checked, the projection will automatically change to the native projection of the new layer. When this option is unchecked, all new layers will be reprojected into the current projection.
4. Edit the maps in the display by using the options in the *Layer Controls* tab.
 - a. Click on *Default Background Maps* in the Legend to go to the *Layer Controls* tab. The map controls will have two tabs. The first *Maps* tab lists the available maps, and the second *Settings* tab allows the user to control latitude and longitude lines, as well as the Z level of the maps in the 3D display.



- b. In the **Maps** tab, you can remove a map, change its visibility, line width, style and color. Use these options to create your own map display.
 - c. If you choose, also add latitude and longitude lines in the **Settings** tab.
 - d. To save a map configuration as the default, in the **Layer Controls** tab select **File -> Default Maps -> Save as the Default Map Set**. The next time you open a new tab, window, or start McIDAS-V, the defaults will reflect what you selected.
5. Add the second image from the single times data bundle to the display. To load real-time data skip to step 6.
 - a. Return to the **Field Selector** and click on the **GE-IR – GOES-East 10.7 μm** under the Data Sources list on the left hand side and click **Create Display**.
 6. If you are using real-time data, follow the steps below.
 - a. Go to the Data Sources tab and select the **GE-IR – GOES-East 10.7 μm IR Image Type** and select an **absolute** time of 17:45 UTC from the previous day.
 - i. If your real-time server contains data with the original satellite resolution, you may need to change the **Image size** to 2000 X 2000 and the **Magnification** to -2 X -4.

- b. Change the **Data Type** to *Temperature* and click **Add Source**. Click **Create Display**.
7. The 10.7 temperature image is overlaid on top of the visible image. To see the visible image, turn off the *GE-IR – GOES-East 10.7 μm* checkbox in the **Legend**. Turn the image back on and click and drag the middle mouse button to activate the **Cursor/Data Readout** option. This option brings up a latitude, longitude, and data value readout in the upper left part of the display on a mouse drag. Since there are two layers in the main display, there are two different readouts with the appropriate values and units (if applicable).
 8. Remove the satellite image layers from the display and load the four panel bundle. To load real-time data skip to step 9.
 - a. Select **Edit -> Remove -> All Layers and Data Sources**.
 - b. Load **Sat-Four-Panel.mcvz** to display the GOES-12 3.9 μm brightness loop.
 - i. In the “Open Bundle” dialog box select the *Add new tab(s) to current window* option and click **OK**.
 9. If you are using real-time data, follow the steps below.
 - a. Select **Edit -> Remove -> All Layers and Data Sources**.
 - b. Open a new 4 panel tab by selecting **File->New Display Tab->Map Display->Four Panels** from the main menu.
 - i. By default, the last panel created will be the active panel. The lower right panel will be highlighted with a default color of blue. Click on the top left panel to activate this panel for the next data load.
 - ii. Double click on the “2 untitled” tab name and enter “GOES 4-panel” in the entry box and click **OK** to change the tab name.
 - c. Go to the **Data Sources** tab and select the GOES-East 0.65 μm Image Type in the satellite image chooser. In the Relative Times tab, select the *5 most recent* images. Change the **Image size** to 900 X 1800 and the **Magnification** to 1 X 1, add the data source, and create the display.
 - i. A warning message may pop up about the amount of data you will be loading; click **OK**.
 - d. Click on the top right panel to make it the active tab. Repeat step 9c using GOES-East 3.9 μm in the top right panel, GOES-East 6.5 μm in the bottom left panel, and GOES-East 10.7 μm in the bottom right panel.
 10. Because the four tabs all have shared views, using the animation controls and zooming and panning in one panel will make the corresponding changes in the other panels.
 - a. In one of the panels, animate the image loop and zoom in on an interesting weather feature. The other panels should also begin looping and zoom in on the same geographical location.
 - b. You may remove one of the panels from updating with the other panels by selecting **Projections -> Share Views** in that panels Projections menu.

11. Another feature for real-time data is data polling which allows the data and display to be updated when a new image exists. To turn this on, go to the *Field Selector* tab and **right click** on the GOES-East 0.65 μm data source and select **Properties**.
 - a. Under *Polling* click on the **Automatically Reload: Active** checkbox.
 - b. Click on the **Reload Displays** checkbox at the bottom of the window.
 - c. Click **Apply** and **OK**. Every 10 minutes (the default polling time) a check will be made for a new image and if one exists, the satellite loop will be automatically updated in your display.
 - d. Repeat this step for the remaining three datasets.

Loading Polar Orbiting Satellite Images and Loops

1. Remove the *GOES 4-panel* tab in the McIDAS-V main display by clicking on the “x” in the right corner of the tab.
2. When loading loops of polar orbiting satellite images, it is recommended that either the **Auto-set Projection** option be turned off and a global projection be used in the map display, or the images be displayed on the globe display to ensure all images are able to be viewed.
 - a. Check the *Projections* menu to see that the **Auto-set Projection** option is not checked.
 - b. Change your projection to *Projections -> Predefined -> North America*.
3. Remove all layers and data sources.
4. Display a loop of 10 polar orbiting images by loading the polar orbiting loop bundle. If you are using real-time data, skip to step 5.
 - a. Load **Sat-Polar-Loop.mcvz** and select *Replace Session* to display the loop of all 10 images.
 - b. Use the zooming, rotating, and panning controls to zoom in on the images.
5. If you are using real-time data, follow the steps below.
 - a. Load the 10 most recent *MODIS LIB 1 km 3.97 μm* images by their Line/Element with an **Image size** of 1000 X 1000 and **Magnification** of 1 X 1.


Problem Sets

The previous examples were intended to give you a general knowledge of how to load and display satellite 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. Load the 5 most recent GOES-West 10.7 μm IR Temperature images and change the enhancement to **Basic -> Inverse Grayscale**. Change the range to enhance the colder clouds, create a color enhancement that has values from 190 to 273 interpolated between blue and green, and values greater than 273 transparent, and save the loop as an animated gif. You may use bundle **Sat-Problem-Enhancement.mcvz** or real-time data to load the images.
2. Create a Parameter default for temperature images so all GOES Temperature images use the same enhancement and range as in Problem 1. Then, load several different bands of temperature (10.7 μm , 3.9 μm , etc.) and loop through the different bands. You may use bundles **Sat-Problem-Default.mcvz** and **Sat-Problem-Default-Images.mcvz** or real-time data to load the images.
3. Display a GOES-East 10.7 μm brightness image and overlay a MODIS Level 1b 1km 11.0 μm brightness image. Load a data transect for each image and sync them together. You may use bundles **Sat-Problem-GOES.mcvz** and **Sat-Problem-MODIS.mcvz** or real-time data to load the images.

Problem Set #1 – Solution

Load the 5 most recent GOES-West 10.7 μm IR Temperature images and change the enhancement to **Basic -> Inverse Gray shade**. Change the range to enhance the colder clouds, create a color enhancement that has values from 190 to 273 interpolated between blue and green, and save the loop as an animated gif. You may use bundle **Sat-Problem-Enhancement.mcvz** or real-time data to load the images.

1. The following instructions are the solution to Problem 1 from above. If you are using real-time data, skip to step 2.
 - a. Use the **File -> Open File...** to load bundle **Sat-Problem-Enhancement.mcvz** into McIDAS-V.
 - i. In the “Open Bundle” dialog box select the *Replace session* option and click **OK**.
 - b. Load the loop of 5 images by clicking **Create Display**.
2. If you are using real-time data, follow the steps below.
 - a. Return to the **Data Explorer** by clicking on the  button in the main toolbar.
 - b. Connect to the server adde.ucar.edu with the dataset RTIMAGES.
 - c. Choose the **GW-IR – GOES-West 10.7 μm IR Image Type** and select the 5 most recent times.
 - d. Select a **Channel** of **10.7 μm IR Surface/Cloud-top Temp** and a **Data Type** of **Temperature**.

- e. Click **Add Source** to show the *Field Selector*.
 - f. Click **Create Display**.
3. In the *Legend*, right-click on the GW-IR – GOES-West 10.7 μm IR color table and select **Basic -> Inverse Gray shade**.
 4. Right-click on the color table again and select **Change Range...** Edit the values to focus on the colder clouds. Change the range to 160 to 290 K and click **OK**.
 5. To create a color enhancement, right-click on the color table and select **Edit Color Table**. The inverse gray shade color table will be loaded in with the 160 to 290 K range.

The editor uses “breakpoints” which are used for a number of things: showing the data value at a point along the color table and changing the colors (fill, interpolation or transparency) directly below the breakpoint by dragging the breakpoint and changing colors through a popup menu. Breakpoints are indicated along the top of the color legend bar with little triangles and a number.

- a. Create a new breakpoint at 273 K by right-clicking on or near the color table and selecting **Add Breakpoint->At Data Point**. Enter in 273 and click **OK**. By default, this breakpoint will be active.
- b. The Color Chooser in the lower half of the editor window allows you to select any possible color. Use the slider bar to choose a green hue. Once you have chosen a hue, click and drag the mouse on the square color display to choose a specific color, which should also update the color of the breakpoint.
- c. Click on the 160 breakpoint to make it active and use the same method to select a dark blue color.
- d. Interpolate the colors from 160 to 273 by right-clicking on the 160 breakpoint and selecting **Edit Colors -> Interpolate->Right**. The enhancement on the images will automatically update.
- e. Click on the 290 breakpoint, select a yellow color, and interpolate left to interpolate between 273 and 290.
- f. Another option is transparency. Click on the Transparency paint mode radio button below the color table and change the pull down menu to 100%.
 - i. Move the mouse over the color table to see the cursor change to a paintbrush. A gray line representing the position of the cursor is also drawn.
 - ii. Left click on 273 and drag the paint brush to the right to the 290 value. All values between 273 and 290 will now be transparent.
- g. Save the color table as *IR Temps* in the Satellite category.
 - i. At the top right of the editor, select *Satellite* from the **Category** pull down list.
 - ii. Select **File->Save As...**, enter in *IR Temps* and click **OK**. This color table will now show up in the list of color tables as **Satellite->IR Temps**.

6. Select **View -> Capture -> Movie** to bring up the Movie Capture window.
 - a. Make sure that the main display window is not obscured by any other window, including the **Data Explorer** and the Movie Capture window.
 - b. Click the **Time Animation** button. Each time in the loop will be automatically captured.
 - c. When the capture is complete, a Save window will pop up. Select “Animated GIF” from the **Files of Type** pull down menu, enter in a file name, and click **Save**.
7. Click **Close** to close the Movie Capture window.

Problem Set #2 – Solution

Create a Parameter default for temperature images so all GOES Temperature images use the same enhancement and range as in Problem 1. Then, load several different bands of temperature (10.7 μm , 3.9 μm , etc.) and loop through the different bands. You may use bundles **Sat-Problem-Default.mcvz** and **Sat-Problem-Default-Images.mcvz** or real-time data to load the images.

1. Select **Tools -> Parameters -> Defaults** from the main menu to bring up the Parameter Defaults Editor.
 - a. Select **File -> New Row** from the editor menu.
 - b. Click the double down arrows to the right of the Parameter entry box and select “Current Fields -> GW-IR – GOES-West 10.7 um IR -> 76_Band4_TEMP”.
 - c. Modify the Parameter name and replace “76” and “4” with an asterick followed by a period “*.”.
 - i. The final result should be: ***._Band*._TEMP**
 - d. Check the Color Table option and select “Basic -> Inverse Gray shade”
 - e. Check the Range option and enter in a range of 160 to 290.
 - f. Click **OK**.
 - g. Click **Close** in the Parameter Defaults editor.
2. If you are using real-time data, skip to step 3.
 - a. Use the **File -> Open File...** to load bundle **Sat-Problem-Default.mcvz** into McIDAS-V.
 - i. In the “Open Bundle” dialog box select the *Replace session* option and click **OK**.
 - b. Load the single image by clicking **Create Display**. The GOES-East image should have the same range and enhancement as the GOES-West loop did in the previous problem.

3. If you are using real-time data, follow the steps below.
 - a. Return to the *Data Sources* tab.
 - b. Connect to the server adde.ucar.edu with the dataset RTIMAGES.
 - c. Choose the *GE-IR – GOES-East 10.7 μm IR Image Type* and select the most recent time.
 - d. Select a **Data Type** of *Temperature*.
 - e. Click **Add Source** to show the *Field Selector*.
 - f. Click **Create Display**. The GOES-East image should have the same range and enhancement as the GOES-West loop did in the previous problem.
4. Load bundle **Sat-Problem-Default-Images.mcvz** into McIDAS-V and repeat using other GOES-East Infrared bands with Temperature Data Types with the saved parameter default.
 - a. In the “Open Bundle” dialog box select the *Merge with active tab(s)* option and click **OK**.
 - b. In the list of Data Sources in the *Field Selector*, there should now be two additional data sources – GOES-East 3.9 μm and 13.3 μm temperature images. Load both of these images.
 - c. Use the *View -> Bring to Front* menu option in the layer controls for each band to bring the display to the front.
5. To loop through the different bands, use the **View -> Displays -> Visibility Animation -> On** option.

Problem Set #3 – Solution

Display a GOES-East 10.7 μm brightness image and overlay a MODIS Level 1b 1km 11.0 μm brightness image. Load a data transect for each image and sync them together. You may use bundles **Sat-Problem-GOES.mcvz** and **Sat-Problem-MODIS.mcvz** or real-time data to load the images

1. Load bundle **Sat-Problem-GOES.mcvz** to load the GOES-East 10.7 μm image. If you are using real-time data, skip to step 2.
 - a. In the “Open Bundle” dialog box select the *Replace Session* option and click **OK**.
2. If you are using real-time data, follow the instructions below.
 - a. Remove all layers and data sources.
 - b. From the *Data Sources* tab, connect to the server adde.ucar.edu with the dataset RTIMAGES.
 - c. Choose the *GE-IR – GOES-East 10.7 μm IR Image Type* and select the 17:45 UTC image from the previous day.

- d. Click **Add Source** to show the *Field Selector*.
3. Click **Create Display**.
4. Select **Projections->Auto-set Projection** from the Projection menu to turn this option off.
5. Load bundle **Sat-Problem-MODIS.mcvz** to load the MODIS L1b 1km 10.7 μm image from 17:45 UTC the previous day. If you are loading real-time data, skip to step 6.
 - a. In the “Open Bundle” dialog box select the *Merge with active tab(s)* option and click **OK**.
6. If you are using real-time data, follow the instructions below.
 - a. From the *Data Sources* tab, connect to a server and dataset that has MODIS or other polar orbiting imagery.
 - b. Select a $\sim 10.7 \mu\text{m}$ channel and select an image as close to 17:45 UTC from the previous day, add the source, and create the display.
7. Return to the *Field Selector* and click on the *1KM – MODIS L1b 1km* data source and create the display.
8. Go back to the *Field Selector* and select the “Data Transect” Display type and click **Create Display**.
9. Repeat the data transect for the *GE-IR – GOES-East* dataset.
10. In the Legend, right click on both transects (under “Cross sections”) and select **Edit -> Sharing -> Sharing On**.
11. In the *Layer Controls*, click on each transect layer and select **View -> Undock from Data Explorer** to remove the transects from the **Explorer**.
 - a. Turn off the GOES image by clicking off the checkbox in the Legend.
 - b. Move the MODIS transect line, keeping it within the bounds of the MODIS image. Once you move one of the transects in the main display window, both transects will align and move to the same points.

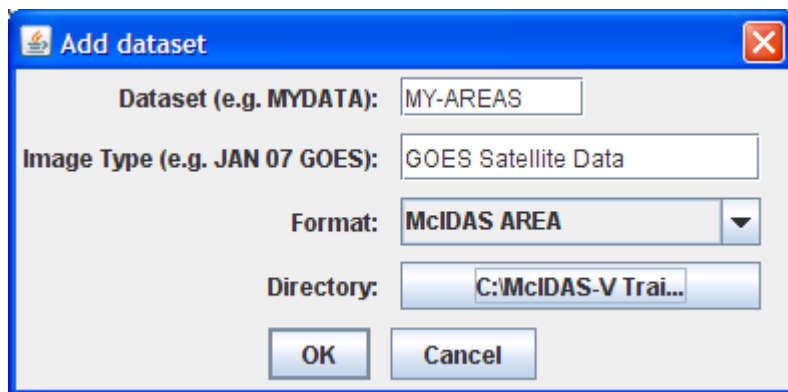
Creating RGB images using formulas

1. Load **Sat-RGB-MODIS.mcvz** to load *MODIS LIB 1/2 km* data sources. If you are using real-time data, skip to step 2.
 - a. In the “Open Bundle” dialog box select the *Replace Session* option and click **OK**.
2. If you are using real-time data, follow the instructions below.
 - a. Remove all layers and data sources.
 - b. From the *Data Sources* tab, connect to the server *nanuk.eosdis.nasa.gov* with the dataset *NANUK*.
 - c. Choose the *AQUA_HKM Aqua 500 meter resolution Calibrated Radiances* **Image Type** and select the most recent image.
 - d. Select **Channel:** All Bands.
 - e. Change the location to Line/Element.
 - f. Make sure the chain links to the right of the **Magnification** are linked together and change the **Magnification:** to -5 X -2.
 - g. Click **Add Source**.
3. To define the Red, Green, and Blue channels of your image display, begin by clicking on **Formulas** under the Data Sources listed in the *Field Selector*.
 - a. Select *Imagery -> Three Color (RGB) Image*, and click **Create Display**.
 - b. In the pop up box, select **Aqua_HKM... -> 0.6465 um -> Brightness** as Red, **Aqua_HKM... -> 0.5537 um -> Brightness** as Green, and **Aqua_HKM... -> 0.4656 um -> Brightness** as Blue and click **OK**.
4. Load **Sat-RGB-BBM.mcvz** to load the *Big Blue Marble channels*. If you are using real-time data, skip to step 5.
5. If you are using real-time data, follow the instructions below.
 - a. Remove all layers and data sources.
 - b. From the *Data Sources* tab, connect to the server *pepe.ssec.wisc.edu* and the dataset *BBM*.
 - c. Load the three image types: *Big Blue Marble blue/green/red* with a magnification of -10 X -20.
6. Follow the same procedure as above to select the red, green, and blue images from left to right and click **OK**.

7. Save this as a favorite bundle in the toolbar.
 - a. Select **File -> Save Bundle...**
 - b. Under *Category* select **Toolbar** and under *Name* enter in **BBM**.
 - c. Make sure the view, display, and data sources options are checked and click **OK**.
 - d. To the right of the toolbar buttons, there should be a **BBM** button.
8. Remove all layers and data sources and click on the **BBM** button to see the bundle load.

Accessing Local Data Files from the Image Chooser

1. Remove all layers and data sources.
2. Open the **Local Data Manager** by selecting **Tools -> Local ADDE Data**.
 - a. To add local data entries, select **File->Add New Dataset** from the menu. Enter in the following parameters to set up a dataset with the AREA files provided with this tutorial:



- b. The data formats available for use with the local ADDE servers are listed under *Format*.
 - c. Under *Directory*:, select the directory where the AREA files provided with this tutorial are located.
3. In the **Data Sources** tab in the **Data Explorer**, select **Satellite -> Imagery**. The first server listed will be <LOCAL-DATA>, and if you only have one local dataset created, the dataset listed will be MY-AREAS.
 - a. Click **Connect**.
 - b. Select an **Image Type**: of *GOES Satellite Data*.
 - c. Under **Relative**, select the number of images to view, and under **Channel**, select the band to view.
 - d. Click **Add Source** to bring up the **Field Selector**, and then **Create Display**. The image loop will load in the **Main Display** window.

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>