McIDAS-V Tutorial
Using GOES-16 Data
Created February 2019 (software version 1.8)

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 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*).

ABI Introduction

McIDAS-V currently supports ABI netCDF data through remote servers as well as through the local file chooser on all platforms. Local servers for ABI data are currently available on OS X and Linux platforms. This tutorial will cover how to access this data through remote servers and different ways that the data can be displayed and interrogated in McIDAS-V.

## Accessing GOES-16 ABI Data from a Remote Server – 1 Timestep

1. In the *Data Sources* tab of the **Data Explorer**, navigate to the *Satellite -> Imagery* chooser. Select *atm.ucar.edu* as the **Server** and *RTGOESR* as the **Dataset**. Click **Connect**.

2. Select *FD – GOES-16 FD all bands* as the **Image Type**.

3. In the **Times** panel, select the *Relative* tab. For **Number of times**, enter *1* and click **Add Source** to create a data source of the most recent time.

4. Display band 13 temperature data.

   a. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *10.3 um IR Surface & cloud -> Temperature* field.

   b. From the **Displays** panel, select the *Imagery -> Image Display* display type.

   c. Select the *Region* tab to see a low-resolution preview image of the data. Note that there is a green box drawn around the preview image. Any data inside this bounding box will be displayed.

   d. Select the *Advanced* tab to see information about the band and calibration selected. These values match the domain of the data selected in the **Region** tab, so it covers the entire domain of the data. Notice that the **Image Size** is only *904 x 904* when the raw size of the data is *5424 x 5424*. The magnification of the data is set to *-6, -6*. This reduction in resolution is the default to allow for an efficient display of the data. Modify the *Advanced* tab to display full resolution data over Florida.

      i. **Coordinate Type:** *Latitude/Longitude*
      ii. **Location:** *Center*
      iii. **Lat:** *28*; **Lon:** *-83.5*
      iv. **Image Size:** *400 x 400*
      v. **Magnification:** *1 x 1*

   e. Click **Create Display**.

5. Investigate the display.

   a. In the **Main Display** window, practice navigating around in the display. To do this, use *Control+Right-Click+Drag* to translate the display. This shifts the data left/right and up/down without rotating the display. Zoom in on the display by scrolling down on the mouse wheel. As an alternative, select a region in the **Main Display** by using *Shift+Left-Click+Drag* to zoom in on a specific domain.

   b. Probe individual pixel values by holding down the middle mouse button over the display. This will print out probe values at the bottom of the display. Notice that latitude, longitude, and temperature values are included in the probe output.

c.   Navigate to the *Histogram* tab of the *Layer Controls* to see a histogram of band 13 temperature values.

6.   Add a data transect to the display.

a.   From the *Field Selector* tab of the **Data Explorer**, select the *Data Transect* display type and click **Create Display**.

b.   In the **Main Display** window, there is a red line that is referred to as the data transect. The values along this transect line are output in the *Layer Controls* tab of the **Data Explorer**. The two end points of the transect can be moved around by *Left-Clicking+Dragging* them, or by entering new Lat/Lon values at the bottom of the *Display* tab in the *Layer Controls*. The transect line as a whole can be moved by *Left-Clicking+Dragging* the triangle in the middle of the transect line.

7.   Create a display of the 10.3 micron temperatures so only values of 273K and less are plotted.

a.   Add a new two-paneled map display by selecting *File -> New Display Tab -> Map Display -> Two Panels* menu item.

b.   *Left-Click* in the left panel to make this panel active. The active panel has a blue frame around it, and this is the panel any displays will be added to.

c.   In the *Field Selector* tab of the **Data Explorer**, select the *10.3 um IR Surface & cloud -> Temperature* field. Choose the *Imagery -> Image Display* display type and click **Create Display**.

d.   Create the cloud mask display.

i.   *Left-Click* in the right panel to make this panel active. The active panel has a blue frame around it, and this is the panel any displays will be added to.

ii.   In the *Field Selector* tab of the **Data Explorer**, select **Formulas**.

iii.   Select the *Imagery -> Mask Value* formula, the *Imagery -> Image Display* display type, and click **Create Display**.

iv.   In the **Select input** window, enter the following and then click **OK**:

1.   **comparison:** <
2.   **cutoff:** *273*
3.   **useNaN:** *1*
Notes: The comparison is set to < or 'less then' since the goal is to display values less than 273, which was set as the cutoff value. Setting useNaN to 1 makes it so that if the pixels were probed outside of the masked range (where values are greater than 273) they wouldn't show a value. useNaN can be set to 0 as well, and in this case pixel values greater than 273 would probe as 0. Note that if these pixel values are set to 0, then these 0 values will be included in any calculations with the data that may be done later.

    v.   In the new **Field Selector** window, for **inputFieldForMask**, select *10.3 um IR Surface & cloud -> Temperature*. This is the field that is being masked.

    vi.   For **displayFieldToBeMasked**, select *10.3 um IR Surface & cloud -> Temperature*. This is the field that will be displayed where the **inputFieldForMask** is less than 273 degrees. In this case, we are displaying the same field that is being masked.

    vii.   Click **OK**.

  e. Investigate the display. Note that as one of the panels is navigated, the other will be navigated in the same way. This is because by default panels in the same tab are set to share views. This setting can be disabled in a panel by unchecking *Projections -> Share Views* in the display panels.

8. Create a display of a subtraction of two bands.

  a. Add a new one-paneled map display by selecting *File -> New Display Tab -> Map Display -> One Panel* menu item, or by clicking the **Add new tab** () button in the **Main Toolbar**.

  b. In the *Field Selector* tab of the **Data Explorer**, select **Formulas**.

  c. Select the *Miscellaneous -> Simple difference a-b* formula, the *Imagery -> Image Display* display type, and click **Create Display**.

  d. In the new **Field Selector** window, for **a**, select the *8.44 um IR Total WV cloud phase, dust -> Temperature* field. For field **b**, select the *7.34 um IR Lower-level WV, winds & SO2-> Temperature* field.

  e. Click **OK** in the **Field Selector** window to display the band subtracted data.

  f. *Right-Click* on the colorbar of the ABI layer in the **Legend** and select the *System -> Inverse Gray Scale* enhancement.

g. Add latitude and longitude labels to the display.

    i. *Left-Click* on the blue text for the *Default Background Maps* layer in the **Legend** to get to the *Layer Controls* tab of the **Data Explorer** for the layer.

    ii. From the *Lat/Lon* tab of the *Layer Controls*, set the following:

        1. Check the visibility checkboxes for **Lines** and **Labels** to plot them in the display.
        2. **Lines**: **Interval**: *5.0*
        3. **Labels**: **Interval**: *5.0*; **At Longitudes**: *-85.0*, **At Latitudes**: *30.0*, **Color**: *light blue*
        4. **Font**: *Arial*; *Bold*; *20*
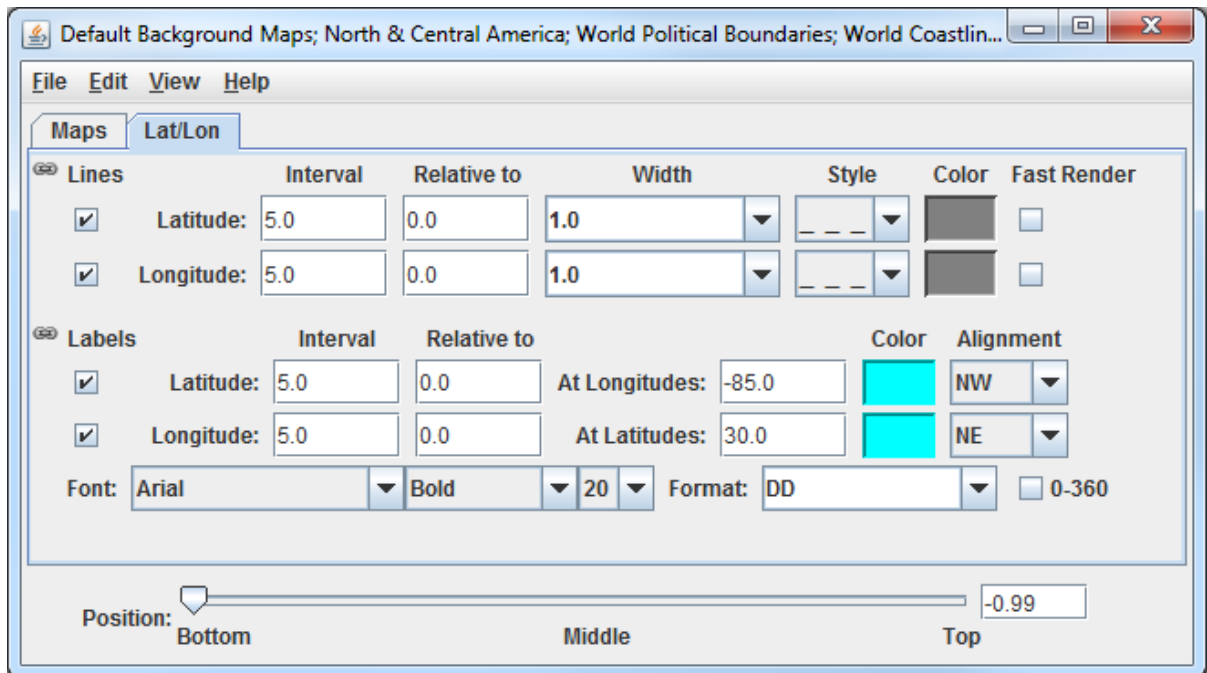
h. Investigate the display to see the latitude and longitude lines and labels. Probe the data to see the temperature difference between the two bands.

9. Capture an image of the display.

a. From the **Main Display**, select the *View -> Capture -> Image* menu item.

b. In the **Save As** text field, enter the name to give your image, for example: *band_subtraction.gif*.

c. Use the dropdown below **Save As** to select the directory to save your image to.

d. Under **Capture What**, select *Current View*. This will capture an image of the display without including any other components of the **Main Display** such as menu items and the **Legend**.

e. Click **Save**.

f. View your saved image to verify the image was captured correctly.

Accessing GOES-16 ABI Data from a Remote Server – 5 Timesteps

10. Remove all layers and data sources from any previous displays via the *Edit -> Remove -> All Layers and Data Sources* menu item from the **Main Display**.

11. Add a new one-paneled map display by selecting *File -> New Display Tab -> Map Display -> One Panel* menu item. Close any previously-existing tabs.

12. In the *Data Sources* tab of the **Data Explorer**, navigate to the *Satellite -> Imagery* chooser. In the *Relative* tab of the **Times** panel, for **Number of times**, enter *5* and click **Add Source**.

13. Display a loop of 10.4um Temperature data over Wisconsin and Illinois.

    a. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *10.3 um IR Surface & cloud -> Temperature* field.

    b. From the **Displays** panel, select the *Imagery -> Image Display* display type.

    c. Navigate to the *Advanced* tab, and enter the following information:
        i. **Coordinate Type:** *Latitude/Longitude*
        ii. **Location:** *Center*
        iii. **Lat:** *42*; **Lon:** *-89.6*
        iv. **Image Size:** *450 x 450*
        v. **Magnification:** *1 x 1*

    d. Click **Create Display**.

14. Investigate the display.

    a. The **Main Display** now has a loop of the 5 most recent times of data in the FD dataset. As done in step 5 earlier, navigate around and zoom in/out of the display. Probe the display by holding down the middle mouse button over the data.

    b. Use the Time Animation Widget at the top of the display panel to play through a loop of the data.

    c. Click the **Properties** button () in the Time Animation Widget to modify settings of the animation including the dwell rate (the time spent on each frame in the animation). As an example, set the **Forward**, **First**, and **Last** dwell rates to *0.2* and click **OK**. This reduced dwell rate allows the display to

loop faster.

15. Change the enhancement used in the display.

    a.   Stop the animation by clicking the **Stop Animation** button in the Time Animation Widget (⏸).

    b.   *Right-Click* on the colorbar of the ABI layer in the **Legend** and select the *Satellite -> GOES-R -> ABI IR Temperature* enhancement.

16. Add a color scale to the display.

    a.   *Right-Click* on the ABI layer in the **Legend** and select *Edit -> Properties*.

    b.   In the **Properties** window, navigate to the *Color Scale* tab and set the following:
        i.   **Visible**: Check this option to add the color scale to the display.
        ii.   **Position**: *Top*. This will position the color scale at the top of the display.
        iii.   **Labels -> Visible**: Check this option to add numerical labels to the color scale.
        iv.   **Labels -> Show Unit**: Check this to add the display unit to the color scale labels.
        v.   **Labels -> Font**: Set the size to *32*.
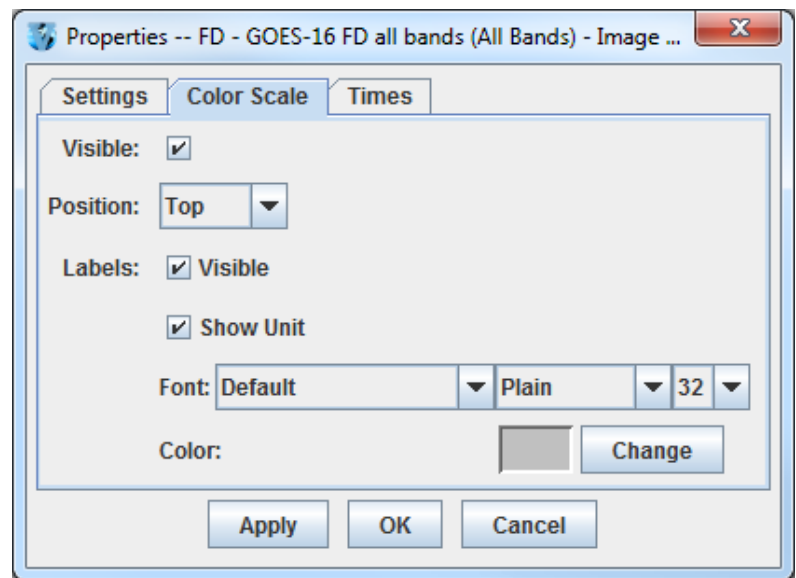
    c.   Click **OK**.

17. Create a Data Probe/Time Series display of band 13 temperature data. This display type allows for plotting how temperature values at a specific location change through time throughout the loop.

    a.   In the *Field Selector* tab of the **Data Explorer**, select the *Data Probe/Time Series* display type and click **Create Display**.

    b.   The *Layer Controls* tab of the **Data Explorer** now shows a time series display of temperature values at the location of the probe in the **Main Display**. Change the range of the y-axis (temperature values) to match the range of the data.

        i.   At the bottom of the *Layer Controls* tab, *Double-Click* on the *186-Band13_TEMP* parameter to open the **Properties** window.

ii. In the **Properties** window, change the **Range** text boxes to a **Min** of *180* and a **Max** of *320* to match the range of the enhancement in the **Main Display**.

iii. Click **OK** to apply the new range in the *Layer Controls* and close the **Properties** window.

c. Move the data probe in the **Main Display** around with *Left-Click+Drag*. The time series display in the *Layer Controls* automatically updates itself as the probe's location changes.

d. The data probe in the **Main Display** can also be set to a specific latitude/longitude value by using the **Lat** and **Lon** text boxes at the bottom of the *Layer Controls*. For example, enter values of *38.6* for **Lat** and *-88.1* for **Lon**. Note that you must press *Enter* in each text field for latitude/longitude to update the location of the data probe.

## Accessing ABI Data from a Remote Server through Scripting

Both of the previous sections of this tutorial can be replicated through scripting. This section covers creating a loop of ABI data and applying an enhancement to the display.

18. Remove all layers and data sources from any previous displays via the *Edit -> Remove -> All Layers and Data Sources* menu item from the **Main Display**.

19. From the **Main Display**, select *Tools -> Formulas -> Jython Shell* to open the **Jython Shell**.

20. The **Jython Shell** defaults to single-line input mode, where only one line of code can be executed at a time. This script is more than one line long, so it requires multi-line input. To switch to multi-line input, click the double-down blue arrow button (⌄) to the right of the text entry box.

21. In a text editor, open the *Data/GOES16/abiLoop.py* file. Copy this text and paste it into the **Jython Shell**.

22. To evaluate this code, click the **Evaluate** button, or use *Shift+Enter*. In-line documentation of what the script is doing can be found in the script (lines that begin with '#' are comments). More information about McIDAS-V scripting can be found in the User's Guide as well as the *Scripting* and *User Functions* tutorials.

23. After you are done analyzing the display created with the script, close the new display window.

Using GOES-16 GLM and Satellite Derived Winds

24. This section of the tutorial uses a new Data Type through the *General -> Files/Directories* chooser as well as a new layout model which is must be added via a plugin. Add this plugin.

    a. From 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 the various plugins available for installation. Expand the *Data Sources* tree and click the green **Install Plugin** button next to *GLM NetCDF Files*.

    c. This pops up a message notifying the user that McIDAS-V must be restarted to complete the installation of the plugin. Click **OK** through this message and restart McIDAS-V.
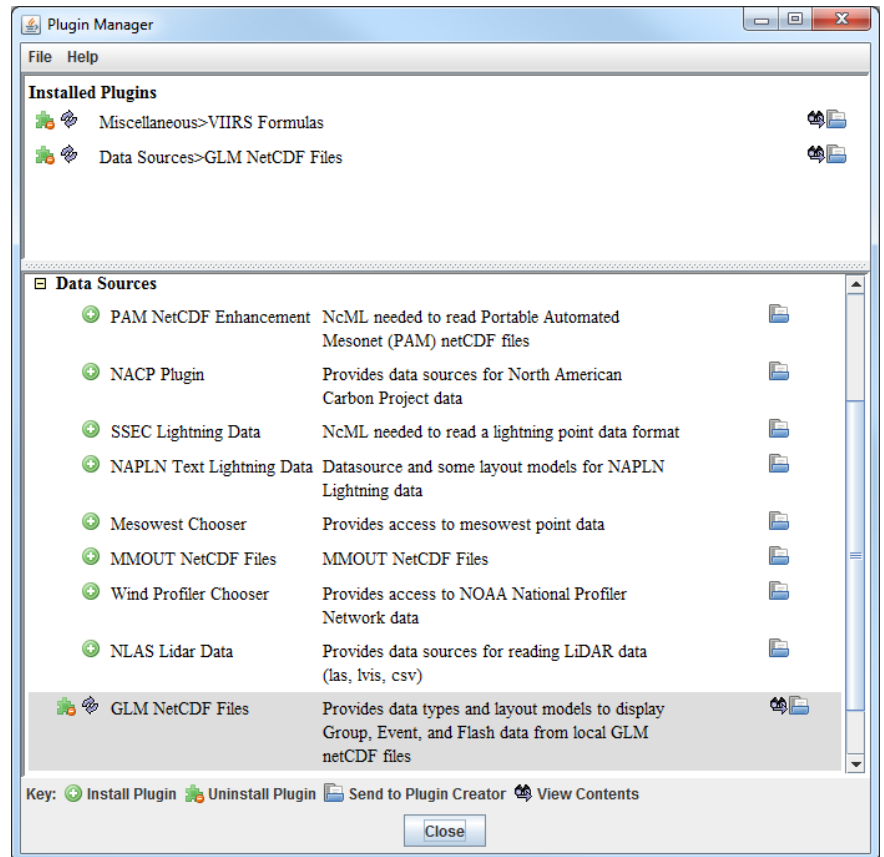
25. Display GOES-16 band 14 data.

    a. From the *General -> Files/Directories* chooser, navigate to the *<local data>*/**Data/GOES16/ABI** directory.

    b. Select the GOES16_CONUS* file.

    c. From the **Data Type** dropdown, select *Grid files (netCDF/GRIB/OPeNDAP/GEMPAK)*.

    d. Click **Add Source**.

    e. In the **Fields** panel of the *Field Selector*, verify that *brightness_temperature* is selected.

    f. In the **Displays** panel of the *Field Selector*, select *Imagery -> Image Display*.

    g. Click **Create Display**.

26. Modify the display of the GOES-16 band 14 data.

a. To make the cold clouds white and the relatively warmer land darker, change the enhancement used by the displayed layer by *Right-Clicking* on the colorbar in the **Legend** and selecting *System -> Inverse Gray Scale*.

b. Disable the wireframe box around the display by selecting *View -> Show -> Wireframe Box* in the display panel.

c. Other layers will be added to the display in the next several steps. To maintain the current projection, from the display panel, disable *Projections -> Auto-Set Projection*.

27. Add a data source of six consecutive (2 minutes total) GLM files as group data.

a. From the *General -> Files/Directories* chooser, navigate to the *<local data>*/**Data/GOES16/GLM** directory.

b. Use *Shift+Left-Click* to select all six OR_GLM-L2-LFCA* files.

c. From the **Data Type** dropdown, select *GLM Groups Data files*. This data type was added from the plugin that was installed in step 24 above.

d. Click **Add Source**.

28. By default, each data point in each GLM file has its own timestep, which would create a loop of potentially thousands of frames. Bin all of the times together so each data point plots at the same timestep.

a. From the *Field Selector*, *Right-Click* on the **6 Files** Data Source and choose *Properties*.

b. At the bottom of the *Properties* tab of this window, find the **Time Binning** section. Set the following using the dropdown menus:

Bin Size: *5 minutes*
Round To: *1 hour*

A bin size of 5 minutes is large enough to contain all of the data. The round to value of 1 hour sets this timestep to be right on the hour, 13Z, thus matching the time of the band 14 data displayed earlier.

c. Click **OK** at the bottom of the **Properties** window.

29. Display the GLM data.

a. In the **Fields** panel of the *Field Selector*, select *Point Data*.

b. In the **Displays** panel of the *Field Selector*, choose the *Point Data -> Point Data Plot* display type.

c. In the *Layout Model* subset tab, click the double-down blue arrows next to *None* and choose *GLM -> Group*. This layout model was added from the plugin that was installed in step 24 above.

d. Click **Create Display**.

30. Investigate and modify the display of GLM data. Note that the points of GLM data are parallax-corrected (from the data itself), so they may not perfectly match up with the location of the band 14 imagery, which is not parallax-corrected.

a. The pink plus signs in the display represent the GLM group data points. As you zoom in and out of the display, you'll see the number of points change. This is because of decluttering that McIDAS-V does to the display. To modify the decluttering, *Left-Click* on the *6 files* data source in the **Legend** to get to the *Layer Controls* of the layer. Disable the **Declutter** checkbox to show every point. Another option would be leaving **Declutter** enabled (checked) and adjusting the **Density** slider. As the slider moves to the right, more points will be shown.

b. If you wish to change the size of the plus signs in the display, adjust the **Scale** value in the *Layer Controls*. Decreasing the value from 1 (for example, 0.5) will make the points smaller. Increasing the value from 1 (for example, 2) will make the points larger.

31. Add a data source of satellite derived winds.

a. From the *General -> Files/Directories* chooser, navigate to the *<local data>*/**Data/GOES16/Derived Winds** directory.

b. Select the OR_ABI-L2-DMWC* file.

c. From the **Data Type** dropdown, select *netCDF/GEMPAK Point Data files*.

d. Click **Add Source**.

32. Display the satellite derived winds.

a. In the **Fields** panel of the *Field Selector*, choose the *Point Data* field.

b. In the **Displays** panel of the *Field Selector*, choose the *Point Data -> Point Data Plot* display type.

c. A new layout model will be imported to plot the satellite derived winds colored by speed. To do this, go to the *Layout Model* subset tab of the *Field Selector* and choose *Edit*.

d. From the **Layout Model Editor** window, select *File -> Import*.

e. From the **Layout Model import** window, select the *<local data>*/**Data/GOES16/G16_Winds.ism** file and click **Open**.

f. From the **Layout Model Editor** window, select *File -> Save* and close the **Layout Model Editor**.

g. From the *Layout Model* subset tab of the *Field Selector*, click the double-down blue arrows next to *None* and choose *G16_Winds <local>*.

h. Click **Create Display**.

33. Investigate and modify the display of GOES-16 satellite derived winds using the same methods used in step 30 above with GLM data.

Zooming, Panning, and Rotating Controls

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