McIDAS-V Tutorial

Displaying Gridded Data

updated December 2013 (software version 1.4)

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, 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.

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. Notifications at McIDAS-V startup alert users when there is a new version of McIDAS-V is available on the McIDAS-V webpage - **<http://www.ssec.wisc.edu/mcidas/software/v/>**. Please post error reports the McIDAS-V Support Forums - <http://www.ssec.wisc.edu/mcidas/forums/>.

Please post error reports or feature requests to the McIDAS-V Support Forums - <http://www.ssec.wisc.edu/mcidas/forums/><http://dcdbs.ssec.wisc.edu/mcidasv/forums/>. The forums also provide the opportunity to share information with other users.

This tutorial assumes McIDAS-V is installed, and can be run on your machine. For information about installing and running McIDAS-V follow the instructions in the document entitled *McIDAS-V Tutorial – Installation and Introduction*.

In this McIDAS-V Tutorial, each exercise is 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 servers, you may use those, but be aware that different server configurations may make the explanations in this document not applicable to all loaded.

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 are listed as a series (e.g. ***Edit -> Remove -> All Layers and Data Sources***).

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

**Displaying Gridded data: 2D**

1. Remove All Layers and Data Sources from the previous displays. (From the main toolbar  or from the main menu ***Edit🡪Remove🡪All Layers and Data Sources***)
2. For real-time data instructions, skip to step 3. Otherwise, load the data bundle
 *<local path>***/Data/Gridded/Grid-GFS-Intro.mcvz**.

	1. In the Main Display, select the ***File -> Open File…*** menu item.
	2. Navigate to the **Grid-GFS-Intro.mcvz** file and click **Open**.
	3. In the **Open Bundle** dialog box, select the *Replace session* option and click **OK.**
	4. Skip to Step 4
3. Instructions for Real-time data.
	1. Select the ***Gridded Data -> Remote*** chooser from the ***Data Sources*** tab of the **Data Explorer**.
	2. From the **Catalog** pull down menu, select http://www.unidata.ucar.edu/georesources/threddsRtModels.xml.
	3. Add the ***THREDDS Model Data -> NCEP Model Data -> Global Forecast System (GFS) -> GFS-CONUS 80km -> files -> Latest*** source.
4. Display the MSL Pressure.

	1. In the ***Field Selector***, expand the dropdown arrow to the left of ***2D grid.*** Select ***Pressure reduced to MSL @ msl*** field.
	2. Select the ***Plan Views -> Color-Shaded Plan View*** Display.
	3. In the ***Times*** tab, uncheck the **Use Default** checkbox and select the first six times.
	4. Click **Create Display**.
5. In the ***Layer Controls,*** turn on the option to **Shade Colors**.
6. Return to the ***Field Selector***, change the Display type to **Contour Plan View***,* and overlay the same field.
	1. Select the ***2D grid -> Pressure reduced to MSL @ msl*** field.
	2. Select the ***Plan Views -> Contour Plan View*** display type.
	3. Click **Create Display**. The contours now overlay the **Color-Shaded Plan View** display, but are not apparent.
7. In the ***Layer Controls***, click on the **Color Table** name (PressureMSL). Change the color table of the contours to ***System -> Solid Colors -> Black***.
8. In the ***Layer Controls*** tab, click the **Change** button for **Contour**. For **Labels**, change the **Align** item to *Horizontal* and move the **Frequency** slider up to a value of *Hi*.
9. Zoom in over a region to see a display similar to the display shown on the previous page.

**Displaying Gridded data: 3D**

1. Remove All Layers (not the Data). In the ***Field Selector***, expand the dropwdown list to the left of ***3D grid.*** Select ***Temperature @ isobaric*** field.

	1. Select the ***Plan Views -> Color-Filled Contour Plan View*** display type.
	2. In the ***Times*** tab select the first 6 images.
	3. In the ***Level*** tab, select 500 hPa.
	4. Click **Create Display**.
2. Use the rotating and zooming controls to rotate the **Main Display** window. Verify that the 500hPa surface is displayed above the map layer.
3. Keep the **Main Display** rotated so the difference in height between the map and the display is discernable.
4. Change the level of the display. Note that when the level is changed, both the plotted values and the z-level of the display change in the **Main Display**.

	1. Click on *Latest NCEP GFS CONUS…* in the **Legend** to access the ***Layer Controls*** for this item.
	2. Change the level to 850 hPa by using the **Levels** menu.
	3. Change the contour interval to 2 Celsius by clicking on the **Change** button in the Contour section of the ***Layer Controls***.
5. Reset the projection using the  button on the left side of the **Main Display** window
6. Change the level to 250 hPa in the ***Layer Controls*** using the method in 13b. Notice that the map is not visible above the contours.
7. Move the map above the 250 hPa contours and change the map colors to white.
	1. In the ***Layer Controls***, select “Default Background Maps” from the list of layers on the side of the tab.
	2. At the bottom of the ***Maps*** tab, move the **Position** slider to the z-level of 0.30 to move higher into the 3D display. The map lines should now be visible on the data displayed in the **Main Display**. However, the map lines are indistinct since the lines are drawn in the same color as the data.
	3. In the ***Maps*** tab of the ***Layer Controls*** for Default Background Maps, change the map colors of “North & Central America”, “World Political Boundaries”, and “World Coastlines” to white: For each map click on the colored square next to each of the map lines, select white, click **OK**. The map lines are now clearly visible in the **Main Display** window.

**Problem Sets**

The previous examples provide the general knowledge necessary to load and display gridded data.  The problem sets below introduce new topics related to the data, as well as challenge your knowledge of McIDAS-V.  It is recommend that you attempt to complete each problem set before reading the solutions, which are provided below the problem set.

1. Using data from the *<local path>***/Data/Gridded/Grid-GFS-Intro.mcvz** bundle
	* Using the most recent time, create a display of 2D Pressure with the 3D Color Shaded Image Over Topography.
	* Overlay an Absolute Vorticity isosurface using the most recent time.
	* Remove the Absolute Vorticity layer and add a Relative Humidity Color-Filled Contour Cross Section using the oldest time.
2. Use the bundle *<local path>***/Data/Gridded/Grid-Problem-Globe.mcvz** to load the grids.
	* Create a movie of the animation, which includes display rotation. Note: This bundle is large, so it may take a minute to open the file.
3. Use the grids in the bundle *<local path>***/Data/Gridded/Grid-Problem-Difference.mcvz** or load real-time data grids. When using
	* Create a display showing the difference between the 0Z and 6Z *2D Pressure Reduced to MSL @ msl* field for 2009-05-29 00:00:00Z.
	* Change the units to millibars and change the range to match the new units.
	* Save a JPG image of the difference.
4. grids in the
	* Use the first 10 time steps of the data, to create a display of 2D trajectories colored by Relative Humidity overlaid on precipitable water.
	* Use the rectangle Trajectory Initial Area over the United States with an Initial Area Skip Factor of 2 to limit the number of trajectories drawn.
	* Shorten the number of time steps for the trajectories to two.
	* Set the trajectory thickness to 2.
	* Add a color scale for the relative humidity field to the **Main Display**.
	* Add a Color-Shaded Plan View of *Precipitable water @ Entire atmosphere*
	* Shade the colors
	* Change the colorbar to *System > Gray Scale* and set the transparency of the layer to 20%.

**Problem Set #1 – Solution**

Using data from the *<local path>***/Data/Gridded/Grid-GFS-Intro.mcvz** bundle

* Using the most recent time, create a display of 2D Pressure with the 3D Color Shaded Image Over Topography.
* Overlay an Absolute Vorticity isosurface using the most recent time.
* Remove the Absolute Vorticity layer and add a Relative Humidity Color-Filled Contour Cross Section using the oldest time.
1. Remove All Layers.
2. Create a new tab.
3. Display the most recent 2D Pressure field over topography.
	1. In the **Fields** panel of the ***Field Selector***, select the ***2D grid -> Pressure reduced to MSL @ msl*** field.
	2. Under **Displays**, select the ***3D Surface -> Color-Shaded Image Over Topography*** display.
	3. In the ***Times*** tab of the ***Field Selector***, choose the first listed time only.
	4. Click **Create Display**. A secondary field selector appears for topography field selection.
	5. In the new **Field Selector** window, select the ***Latest NCEP GFS CONUS 80km -> Geopotential\_height @ surface*** field under **Field: Topography**, select the earliest time under ***Times***, and click **OK**. The 2D field is displayed as topography.
4. In the Pressure field ***Layer Controls*** tab, check the **Shade Colors** option.
5. View the display in 3D using the zooming and rotating controls..
6. Reset the display projection using the  icon on the left side of the **Main Display** window.
7. Display the most recent ***3D grid -> Absolute Vorticity @ isobaric*** with the ***3D Surface -> Isosurface*** display type. Click **Create Display**.
8. Zoom in over the US and rotate the display to see the absolute vorticity isosurface over the continental US.
9. The **Isosurface Value** in the ***Layer Controls*** can be used to change the value of absolute vorticity displayed. Change the value to 5 (x 1.0e-5 s-1).



1. Remove the absolute vorticity isosurface layer from the display.
2. Select the earliest ***3D grid -> Relative Humidity @ Isobaric*** field as a **Color-Filled Contour Cross Section**. Click **Create Display**. The cross section will be displayed in 3D in the **Main Display** window and in 2D in the ***Layer Controls***.
3. To reposition the cross section in the **Main Display** window, *Left Click* on the plus or square to move the ends of the cross section, and the triangle to move the entire line.



#### Problem Set #2 – Solution

1. Use the bundle *<local path>***/Data/Gridded/Grid-Problem-Globe.mcvz** to load the grids.
* Create a 3D globe display of jet stream winds and 2D surface temperature from grids for the first three times.
* Create a movie of the animation, which includes display rotation. Note: This bundle is large, so it may take a minute to open the file.
1. Add a one panel globe display tab by selecting ***File -> New Display Tab -> Globe Display -> One Panel*** from the **Main Display**.
2. Load bundle *<local path>***/Data/Gridded/Grid-Problem-Globe.mcvz** via the ***File -> Open File…*** menu item in the **Main Display**. In the **Open Bundle** dialog box select the *Replace session* option and click **OK.** This is a large dataset, so it may take a minute to open the file.
3. Display the first three ***2D grid -> Temperature -> Temperature at Surface*** grids as a **Color-Filled Contour Plan View**. Overlay as contours.
4. Next, display the ***3D -> Momentum -> Derived -> Speed*** grid as a **3D Isosurface** for the same times.
5. In the ***Layer Controls***, change the following:
	1. Change **Isosurface Value** to 60 m/s.
	2. Change the default World Coastlines map color to RGB 0-153-204 and the default World Political Boundaries map color to RGB 0-255-25: Use the **Default Background Maps Layer Controls**. Double-click the color square to the right of the desired map. The **Set Map Linee Color** chooser appears. Select the ***RGB*** tab. Enter the values Red: 0, Green: 255, Blue: 25.
6. Start the loop and turn on the **Auto-Rotate View** option (***View -> Viewpoint -> Auto-Rotate View*** from the **Main Display**). Use the Zooming and Panning controls to observe the data from different views. (Depending on preference, it might help to turn the **Auto-Rotate View** option off.)
7. Click the play button on the animation toolbar and verify that the **Auto-Rotate View** option is on.
8. Capture a movie of the rotating globe by selecting ***View -> Capture -> Movie…*** in the **Main Display**.



1. In the **Movie Capture** window, change **Rate:** to 0.25 seconds.
2. Move the **Main Window** and the **Movie Capture** window around so they do not overlap. (During the movie capture, if the view in the **Main Window** is obscured, the obstruction will appear in the movie).
3. Start the movie capture by clicking **Automatically**.
4. Once the globe has rotated 360°, click **Stop**. Click **Save Movie** to save it as a QuickTime movie.

**Problem Set #3 – Solution**

Use the data in the bundle *<local path>***/Data/Gridded/Grid-Problem-Difference.mcvz** or load real-time data grids. When using real-time data, do not use the 2009 time, but choose one time or both model runs.

* + Create a display showing the difference between the 0Z and 6Z *2D Pressure Reduced to MSL @ msl* field for 2009-05-29 00:00:00Z.
	+ Change the units to millibars and change the range to match the new units.
	+ Save a JPG image of the difference.
1. Open a new tab and close the globe display tab.
2. For real-time data instructions, skip to step 3. Otherwise, load the data bundle **Grid-Problem-Difference.mcvz**. In the **Open Bundle** dialog box select the *Replace session* option and click **OK.**
3. Real-time data instructions. Skip to step 4 if the data has been loaded via a bundle.
4. Remove All Layers and Data Sources.
5. Return to the ***Data Sources*** tab, and load the 0Z and 6Z GFS *Global 1°* grids (***NCEP Model Data -> Global Forecast System (GFS) -> GFS-Global onedeg -> GFS\_Global\_onedeg\_YYYYMMDD\_0000.grib2 (0600.grib2)***) for today into the ***Field Selector***.
6. Choose **Formulas** in the ***Field Selector***, and select ***Miscellaneous -> Simple difference a-b***.
7. In the **Displays** panel select ***Plan Views -> Color-Shaded Plan View*** and click **Create Display**. A **Field Selector** window will pop up prompting you for the two fields to subtract. You may need to expand the window to see the full descriptions.
8. For **Field: a**, select the 0Z run *Pressure Reduced to MSL @ msl* field and 2009-05-29 00:00:00Z.
9. For **Field: b**, select the 6Z run *Pressure Reduced to MSL @ msl* field and 2009-05-29 00:00:00Z. Click **OK**.
10. The resulting plot will show the difference between the two grids in Pascals. Change this to millibars.
11. In the ***Layer Controls***, select ***Edit -> Change Display Unit…***
12. Select *millibar* from the dropdown list and click **OK**. To change the range of data values with the new units, *Right Click* on the color bar in the **Legend** and select **Change Range**. Click on ***Use Predefined -> From All Data*** and click **OK**. Positive values indicate the 0Z forecast predicted a higher pressure than the 6Z, and negative values indicate the opposite.
13. Save the **Main Display** window as an image. Select the ***View -> Capture -> Image…*** menu item from the **Main Display**.
14. Under **Capture What**, change the radio button to *Full Window*.
15. Enter in a name, followed by the “.jpg” extension and click **Save**.

 **Problem Set #4 – Solution**

Use the grids in the bundle *<local path>***/Data/Gridded/Grid-Problem-Trajectories.mcvz** or real-time data grids.

* Use the first 10 time steps of the data, to create a display of 2D trajectories colored by Relative Humidity overlaid on precipitable water.
* Use the rectangle Trajectory Initial Area over the United States with an Initial Area Skip Factor of 2 to limit the number of trajectories drawn.
* Shorten the number of time steps for the trajectories to two.
* Set the trajectory thickness to 2.
* Add a color scale for the relative humidity field to the **Main Display**.
* Add a Color-Shaded Plan View of *Precipitable water @ Entire atmosphere*
* Shade the colors
* Change the colorbar to *System > Gray Scale* and set the transparency of the layer to 20%.
	+ - 1. For real-time data, skip to step 2. Otherwise, load the data bundle **Grid-Problem-Trajectories.mcvz**. In the **Open Bundle** dialog box select the *Replace session* option and click **OK.** Skip to step 3
			2. Real-time data instructions. If the data was loaded via a bundle, skip to step 3 .

Return to the ***Data Sources*** tab, and load the most recent GFS 80km CONUS data (***NCEP Model Data > Global Forecast System (GFS) > GFS-CONUS 80km > files > Latest NCEP GFS CONUS 80km)***) in the ***Field Selector***.

Click **Add Source**.

* + - 1. Display the first 10 times of 2D trajectories colored by Relative Humidity.
	1. Under **Fields** in the ***Field Selector***, select the ***2D grid > Derived > Grid 2D Trajectory\**** field.
	2. Under **Displays**, select *Trajectory Colored By Parameter*.
	3. In the ***Times*** tab, *Right-Click* and choose ***Select Range > First 10***.
	4. Click **Create Display**.
	5. In the secondary **Field Selector** window, select ***Latest NCEP GFS CONUS 80km > 2D grid > Relative humidity\****.
	6. Click **OK**.
1. Display trajectories over the United States.

	1. In the ***Layer Controls*** tab, select the *Rectangle* **Trajectory Initial Area**.
	2. In the **Main Display** window, use *Left-Click+Drag* to draw a rectangle over the United States. This will be the trajectories origin.
	3. In the ***Layer Controls***, set **Initial Area Skip Factor** to *2*.
	4. Click **Create Trajectory**.
2. By default, the entire length of the trajectories is shown, which can lead to a cluttered display. Change this so the trajectories are only 2 time steps long at any given time in the loop. Set the trajectory width to 2.

	1. In the ***Times*** tab of the ***Layer Controls***, select the **Time Mode** button.
	2. For **Start Time**, change the dropdown menu to *Relative to End Time*. **End Time** is denoted as the current time step of the loop. Change the **Start Time** offset to *(-12 hours)* to make the trajectories only show the last 12 hours of data (or two 6-hour time steps).
	3. Click **OK** in the **Time Settings** window.
	4. In the ***Layout*** tab of the ***Layer Controls***, change **Line Width** to *2*.
	5. Play the loop in the **Main Display** to animate the trajectories paths. When done, pause the loop.
3. Add a relative humidity color scale to the **Main Display**.

	1. In the ***Layer Controls*** tab for relative humidity, select the *Edit > Properties* menu item.
	2. In the ***Color Scale*** tab of the **Properties** window, turn on the **Visible** checkbox, turn on both the **Visible** and **Show Unit** checkboxes for **Labels**, and change the font size to *24*.
	3. Click **OK**.
4. Overlay a Color-Shaded Plan View of precipitable water in the **Main Display**.

	1. Under **Fields** in the ***Field Selector***, select the ***2D grid > Precipitable water\**** field.
	2. Under **Displays**, select ***Plan Views > Color-Shaded Plan View***.
	3. In the ***Times*** tab, *Right-Click* and choose ***Select Range > First 10***.
	4. Click **Create Display**.
5. Change the precipitable water display to use the ***System > Gray Scale*** colorbar, shade the colors, and set the transparency at 20%.

	1. *Right-Click* on the colorbar in the **Legend** and select *System > Gray Scale*.
	2. In the ***Layer Controls*** tab, select the **Shade Colors** item.
	3. *Right-Click* on the colorbar in the **Legend** and select *Transparency > 20%*.
6. Play the loop in the **Main Display** to compare the trajectories of relative humidity to precipitable water .

**Challenge**

The bundle *<local path>***/Data/Gridded/Grid-Problem-Challenge.mcvz** contains 3D u and v data. Use the available data and display options to find a jet entrance or exit region. To view the problem worked solution, load the <*local path*>/**Data/Gridded/Grid-Problem-Challenge-Result.mcvz** bundle.

The graphic below is a model of jet entrance and exit regions:

<http://www4.ncsu.edu/~nwsfo/storage/training/jets/JETS.gifs/JET.4Cell.A.gif>

**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. |