Chapter 5

Displaying Data with SeaDAS

Introduction

A primary functionality of SeaDAS is its image display capabilities. There are various data visualization and manipulation functions available in either the GUI or via the SeaDAS command-line. This chapter will focus on the basic GUI operations involved in displaying data.

Goal

The goal of this chapter is to introduce very basic SeaDAS display functions by way of the following exercises:

- Loading satellite data products
- Displaying a loaded product
- Using the roam and zoom functions
- Using the cursor position display function
- Rescaling the values of the displayed data

The data referred to in this and subsequent chapters can be found in the `example_data` directory

5.1 Starting SeaDAS

- If you have not purchased IDL, start SeaDAS in *runtime* mode:
  `% seadas -em`
- If you have purchased and installed IDL:
  `% seadas`

5.2 Loading Satellite Data Products

From the `SeaDAS Main Menu`, click the *Display* button and then choose `S2006088174413.L2_MLAC` using the file selection window. This will bring up the `Product Selection` window.

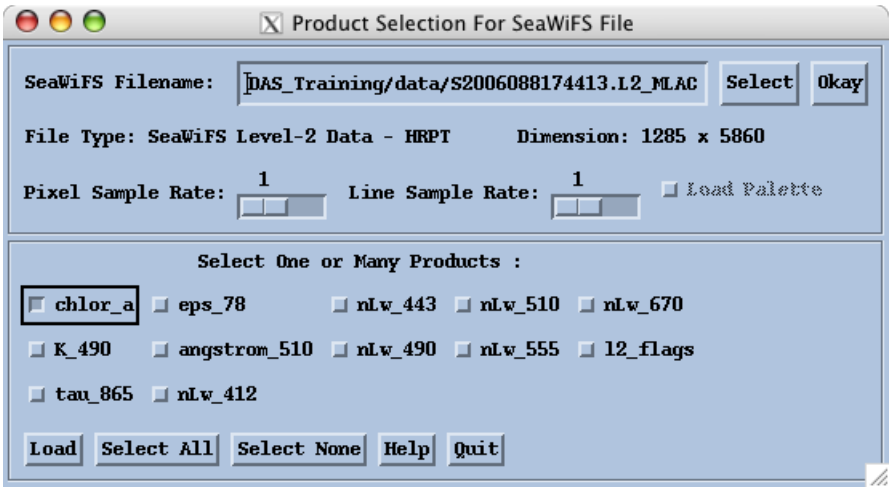

Figure 5.1: `Product Selection` Window

Choose the `chlor_a` product and click *Load*. This will bring up the `Band List Selection` window. Each product loaded into SeaDAS will be listed in this window as a separate "band". To view information about the loaded data product, click `Band List Selection`⇒***Band Info***.

From the `Band List Selection` window, click *Display* to view the data product in a new `Product Display` window.

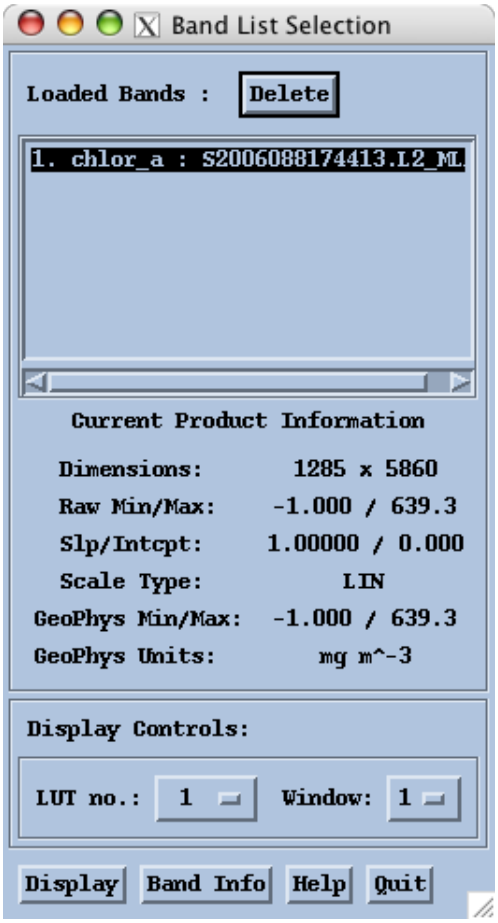

Figure 5.2: `Band List Selection` Window

5.3 The Roam Window

In most cases the displayed image will be larger than the viewable area. The viewable area can be changed by dragging the sides (or corners, this is OS dependent). One may also scroll around the image using the scroll bars on the bottom and left sides of the `Product Display` window, but this will often prove inadequate. To view the entire image at once, the *Roam Window* must be used. From the `Product Display` window, select ***Functions⇒Roam Window On***. This will open a new `Roam` window with the full image scaled so as to be displayed in its entirety. A box outline in this window will show the portion of the loaded image viewable in the `Product Display` window. With the cursor placed over this box, left-clicking and dragging the box will change the viewable contents of the `Product Display` window.

5.4 The Zoom Window

Alternatively, you may wish to zoom in on a feature observed in the `Product Display` window. To do this select ***Functions⇒Zoom Window On*** from the `Product Display` window. This will open a new `Zoom` window with a small portion of the `Product Display` window zoomed (initially) by a factor of 4X. Similar to the `Roam` window, a box outline showing the portion

of the loaded image viewable in the `Zoom` window will be displayed in the `Product Display` window. The magnification of the zoom window can be changed from 1 to 16X by placing the cursor in the `Zoom` window and using the middle or right mouse button to cycle up or down in magnification.

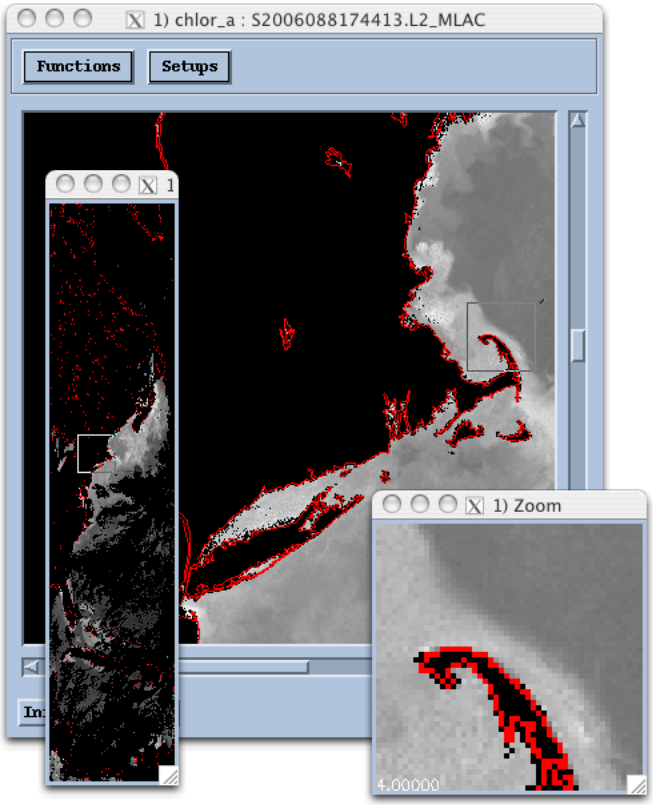

Figure 5.3: `Roam` and `Zoom` Windows

5.5 Cursor Position

It is possible to see the actual data value for the pixel under the mouse cursor by selecting ***Functions⇒Cursor Position*** from the `Product Display` window. This will spawn a new `Cursor Position` window which will display the value for the pixel under the cursor in the `Product Display` window, as well as the `Roam` and `Zoom` windows. By default, the data displayed is interactive, that is, as the cursor is moved over the image the values displayed will correspond to the current cursor position. Alternatively, you may select the *Mouse button* option in the `Cursor Position` window to only display values for pixels when the left mouse button is clicked.

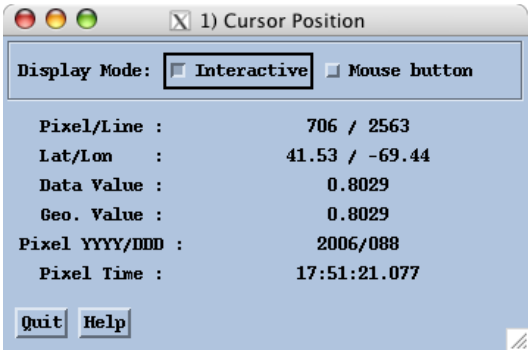

Figure 5.4: `Cursor Position` Window

5.6 Rescaling the Displayed Image

When a data product is initially displayed in SeaDAS, the data is displayed using an indexed color look-up table consisting of only 197 separate colors. The minimum data value is set to the first color in the look-up table and the maximum data value is set to the 197th color. (For more details see the **SeaDAS Color Look-Up Tables** chapter.)

If the product being displayed happens to be a standard OBPG product then SeaDAS will automatically "scale" the data to a pre-defined minimum and maximum value, meaning all data values below the pre-defined minimum will be set to the first color in the look-up table and values above the pre-defined maximum will be set to the 197th color. The look-up table will also be set to either a linear or logarithmic scale-type depending on the product. For example, chlorophyll-a products are scaled to have a min/max of 0.01/64.0 $mg \cdot m^{-3}$ and set to a logarithmic scale-type. If the data product is not recognized by SeaDAS to be a standard OBPG product then the product will not be scaled and a linear scale-type will be used.

TIP The text file $SEADAS/config/seadas_defaults is used to store default scaling information and can be modified by the user.

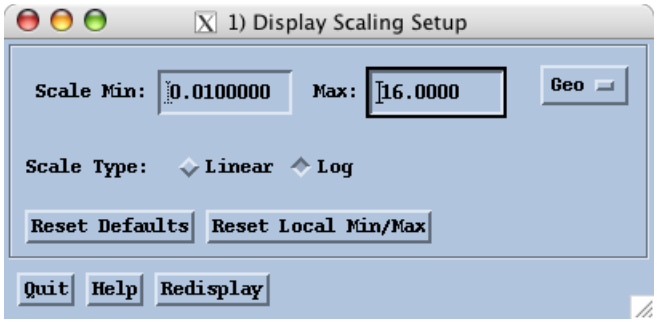

Figure 5.5: Window for Rescaling the Image

The default scaling can be manually changed, as is often done to improve the gradient of features in the displayed data product. To do this, from the `Product Display` window, select ***Functions⇒Rescale***. This will spawn the `Display Scaling Setup` window which provides options for data minimum, data maximum and scale-type (Linear or Log). This window also allows the scaling to be reset to the SeaDAS defaults or to the data range of the loaded data product.

Note that any scaling SeaDAS does while displaying data only affects the appearance of an image's colors and does not affect the data itself.

Chapter 6

SeaDAS Color Look-Up Tables

Introduction

When an image is displayed in SeaDAS, a *color look-up table (LUT)* is used to assign a color to each pixel on the screen. Many pre-defined LUTs come with SeaDAS, including those that correspond to each of the standard OBPG products. It is also easy to create custom LUTs and use them with SeaDAS.

Goal

This chapter introduces color look-up tables and methods to use and maniplulate them within SeaDAS by way of the following sections:

- Understanding Indexed Color and Color Look-up Tables
- Loading a Color Table
- Using Multiple Color Tables
- Modifying a Loaded Color Table
- Viewing and Changing Colors in a Color Table
- Saving and Loading External Color Tables
- Adding Custom Color Tables to SeaDAS

6.1 Understanding Indexed Color and Color Look-up Tables

When displaying images using SeaDAS an *indexed color model* is used to assign colors to each pixel in the image. This means each displayed image is assigned a color look-up table containing a limited number of RGB triplets that will dictate the colors of the pixels on the screen. No color information is contained in a typical indexed image. Instead, its pixel values represent indices into the assigned LUT. Colors are applied by matching these indices to corresponding RGB triplets in the LUT.

Since SeaDAS is currently an 8-bit image application, a SeaDAS session has access to only $2^8 = 256$ colors. Therefore only 256 total colors can be displayed at any given time within all open SeaDAS windows. By default, a SeaDAS session is configured to have two color LUTs. 197 colors are used for the first LUT and 48 for the second, so when an image is displayed using the default primary LUT, the minimum data value will be set to the 1st color in the user-selected LUT and the maximum data value will be set to the 197th

color. The final 11 non-LUT colors are reserved by SeaDAS with 7 used for graphics and 4 for background, foreground, cursor, and one work color.

The pre-defined LUTs used by SeaDAS actually contain 256 colors, but are automatically scaled down to the number of colors available, in the case of the default primary LUT, 197. However, the load color table function can handle loading fixed portions of an input color table without scaling, allowing for the preservation of fixed mask values contained in an input color table.

TIP To avoid certain limitations of the 256 color restriction, users can run multiple concurrent SeaDAS sessions, giving them 256 colors per session.

6.2 Loading a Color Table

Any image displayed in SeaDAS will automatically have a color LUT applied. The default table for a new SeaDAS session is the "B-W Linear" table which is a grey gradient ranging from a black minimum to a white maximum. As mentioned, SeaDAS offers the user a wide variety of pre-defined color tables, including those that correspond to each of the standard OBPG products.

Once a data product is loaded and displayed, a different LUT can be loaded by selecting ***Functions⇒Color LUT⇒Load LUT*** from the `Product Display` window. This will bring up a new `Load Color LUT` window, from which the user may select a new LUT from one of three following color table lists (available via the IDL drop-down menu directly above the color table name list):

- *Standard Product Color Tables* (color tables used for OBPG operational data products)
- *Custom Product Color Tables* (non-standard color tables including those created by the user)
- *IDL Color Tables* (color tables distributed with the IDL application)

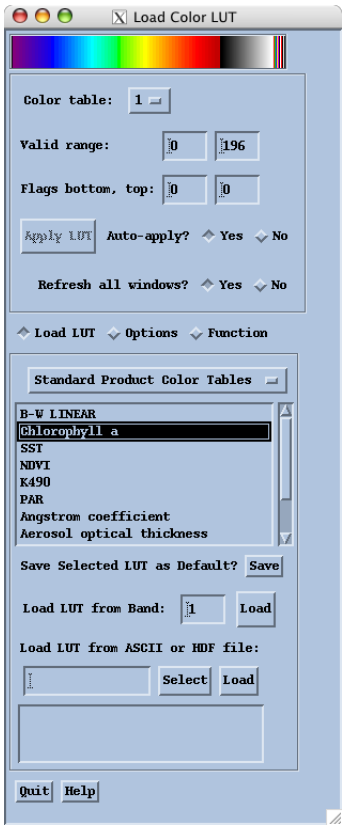

Figure 6.1: `Load Color LUT` Window

It is also possible to select a color table from another loaded band that contains an embedded LUT (such as a Level-3 SMI product) using the 'Load LUT from Band' *Load* button. Additionally, color tables can be loaded from an external ASCII file (RGB triplets), a previously saved SeaDAS HDF LUT file, or RGB specified IDL arrays (see the *Saving and Loading External Color Tables* section in this chapter.

The color bar at the top of the `Load Color LUT` window shows the full color range allotted for the current SeaDAS session. The predefined graphics colors can be seen at the far right of the bar while the rest of the bar shows the multiple concurrent color tables that are currently loaded.

With the *Auto-apply* radio button set to 'Yes' (the default), SeaDAS will immediately apply a color table when it is selected. If auto-apply is set to 'No', selecting a new LUT will update only the Color Bar graphic at the top of the window giving a preview of the LUT. This avoids long waits for a new LUT to load on slow computers and/or large images. Clicking the *Apply LUT* button or setting auto-apply back to 'Yes' will immediately apply the currently selected LUT.

The *Refresh all windows?* radio buttons determine whether to refresh only the display window that spawned the Load Color window or else to refresh all open display windows. Setting this option to 'No' can avoid long waits for a new LUT to load in multiple windows on slow machines and/or large images.

TIP To change the initial default color LUT for future SeaDAS sessions, select the new default LUT and then click on the 'Save Selected LUT as Default' *Save* button.

6.3 Using Multiple Color Tables

By default SeaDAS is configured with two concurrent color tables. Prior to displaying an image (by clicking the *Display* button in the `BandList Selection` window), the user can choose which color table will be applied. To do this, from the `Band List Selection` window, use the *LUT no.* pull down menu to choose the color table number.

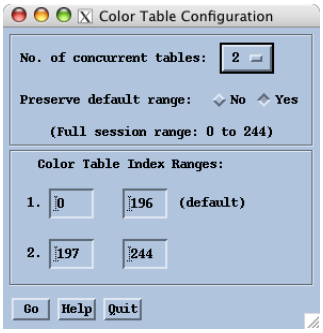

Figure 6.2: LUT Config Window

As mentioned, the two default concurrent color tables contain 197+48 = 245 colors. Though only 245 total colors are available, the number of colors assigned to each table can be redefined by the user. SeaDAS can also be configured to have from 1 to 10 LUTs, each with user-defined index ranges. Since the total number of index values is limited to 245 colors, each additional color table will reduce the number of indexes available for any given color table. To configure the number of color tables and colors per table, select ***Functions⇒Color LUT⇒LUT Control Window*** from the `Product Display` window. This will bring up a new `Color Table Configuration` window that allows the user to change the number of concurrent color tables and to define the index ranges for each.

6.4 Modifying a Loaded Color Table

Two methods exist in the GUI to modify the currently selected color LUT. One method allows functions to be applied to the entire color table at once, and the other allows the user to modify individual colors of the LUT one at a time.

6.4.1 Applying Functions to the Entire Color LUT

The `Load Color LUT` window allows for user modifications to the selected color LUT via the *Options* and *Function* radio buttons that activate two different panes in the window for modifying the entire color table. After any modifications to the table are made, the *Apply LUT* button must be clicked for the change to take effect on the displayed image(s).

- **Options Pane** - select the *Options* radio button to manipulate the loaded color table by:
  - The *Stretch Bottom* and *Stretch Top* sliders: These sliders increases the range of the lowest and highest color index respectively. For example, if black is the color of the lowest index and the *Stretch Bottom* slider is set to 50 percent, the lower half of the color table will become all black and the remaining part of the color table will contain a linearly scaled version of all the previous color ranges. Making 'Stretch Bottom' more than 'Stretch Top' inverts the color table.
  - The *Gamma Correction* slider: This slider can be used to change the contrast within the color table. A value of 1.0 indicates a linear ramp (no gamma correction). Values other than 1.0 indicate a logarithmic ramp with higher values of gamma giving more contrast and values less than 1.0 yielding lower contrast.

- The 'Sliders:' *Independent* and *Gang* radio buttons: When the *Gang* radio button is selected, the *Stretch Bottom* and *Stretch Top* sliders become connected so that moving one slider moves the other. By default the sliders are independent, but with the sliders ganged the width of the wedge can be kept constant.
- The 'Top:' *Clip* and *Chop* radio buttons: When set to *Clip*, values larger than the 'Stretch Top' are set to the largest color index (the 197th color in the case of the default primary LUT). If set to *Chop*, values larger than 'Stretch Top' are set to color index 0.
- The 'Stretch:' *Indices* and *Intensity* radio buttons: These buttons toggle color table manipulations affecting index locations versus affecting the intensity. When set to *Indices*, manipulations affect the mapping between color indices and color table triples. When set to *Intensity*, the mapping controls the intensity of each color table entry. This is a useful when displaying quantized images, where the pixel value is arbitrary and does not represent an intensity. In this mode, the hue and saturation remain relatively constant for a given color index.
- The *Reverse*, *Restore*, and *Replace* buttons: The *Reverse* button completely reverses the indices of the currently selected LUT. *Restore* reverts the color table back to its original state before any changes were made. The *Replace* button resets all sliders to their default positions while preserving any changes that have been made to the color table. This allows the user to incrementally save changes, and gives finer control of slider manipulations and/or the Function Pane's LUT stretching function.

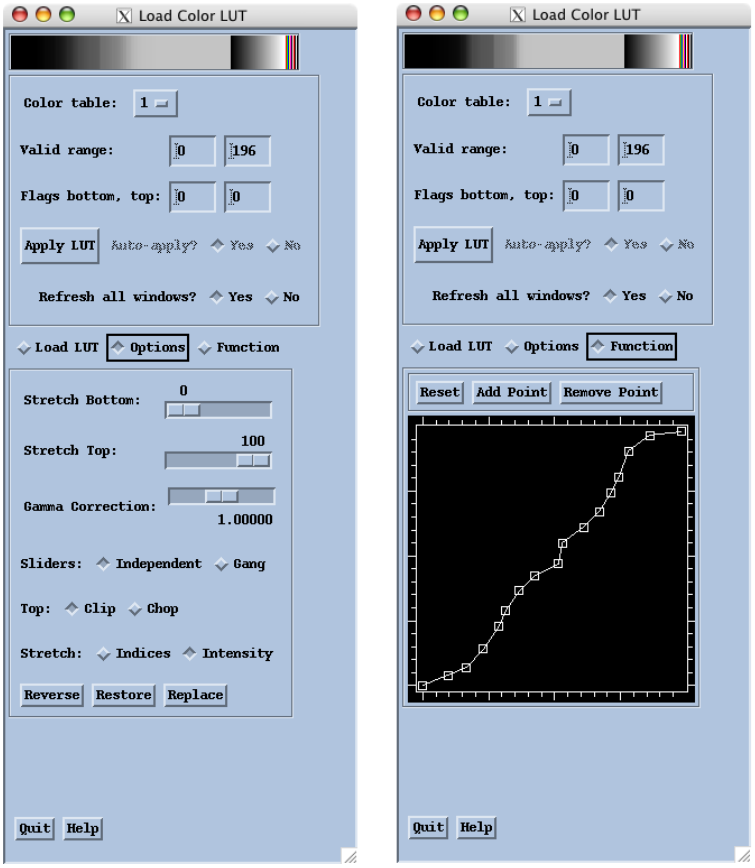

Figure 6.3: The *Options* and *Function* Panes for LUT Modification

- **Function Pane** - select the *Function* radio button to access a tool for finer control over color index manipulation via a LUT stretching function. Clicking the *Add Point* button will add a new control

point to the stretching function line. Clicking and dragging any control point on the line will then move the point along the line and/or change the shape of the line. The first and last control points may only be moved in the vertical direction but other control points may be moved anywhere within the plot as long as they are to the right of their predecessor and to the left of the next control point. The *Reset* button restores a linear one-to-one transfer function. Changes made to the stretching function do not automatically affect the `Product Display` window. To activate changes click the *Apply LUT* button.

6.4.2 Viewing and Changing Individual Colors in a Color LUT

For detailed, index level control over a loaded color LUT, SeaDAS provides the `Modify Color Table` window accessible from the ***Functions⇒Color LUT⇒Modify LUT Colors*** menu in the `Product Display` window. This tool allows for color tables to be interactively created and modified. Changes made to the LUT will not affect display windows until the *Redraw* button is clicked. To alter an individual color, simply click on a color and then adjust the Red, Green, and Blue sliders (CMY, HSV, and HLS color systems can also be used).

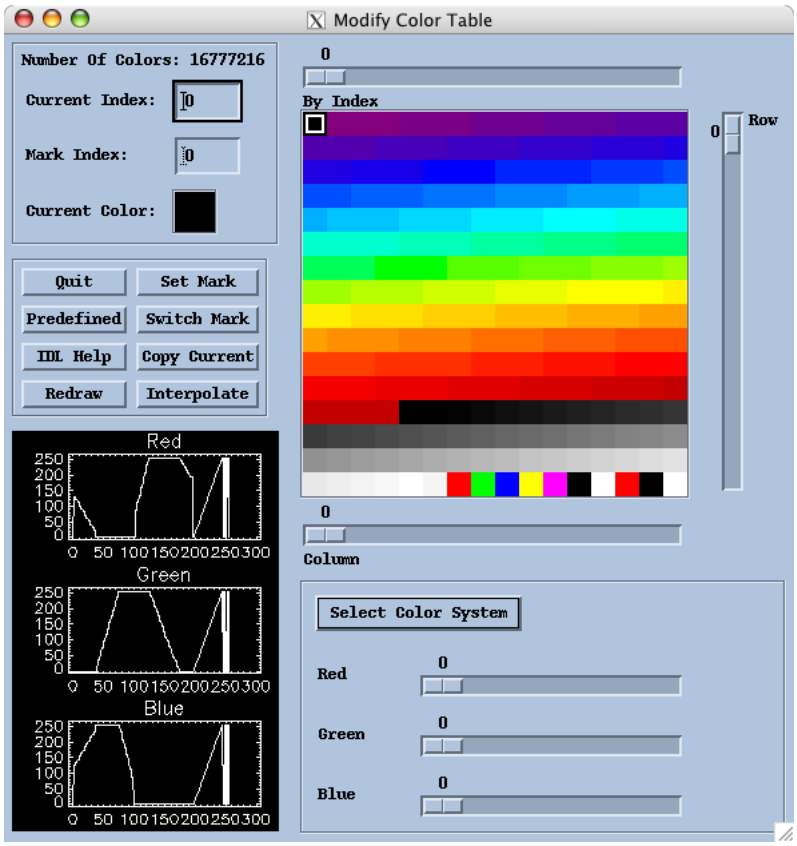

Figure 6.4: `Modify Color Table` Window

It is also possible to interpolate the range between two color indices to create smooth color transitions. To do this select a first index, optionally modify its color, and then click the *Set Mark* button. Next select a second index, optionally modify its color, and then click the *Interpolate* button to smoothly interpolate colors between the mark index and the current index. Alternatively the *Copy Current* button can be used to make every color lying between the current index and the mark index (inclusive) the same color as the current color. The *Switch Mark* button exchanges the mark and the currently selected index.

6.5 Saving and Loading External Color Tables

It is possible to save the currently loaded (and potentially modified) SeaDAS color look-up table to an external file for future use. This is done by selecting ***Functions⇒Color LUT⇒Save LUT*** from the `Product Display` window. The color LUT can be saved to a new ASCII file or as a palette in an new HDF file. It can also be saved by replacing or appending a palette in a pre-existing HDF file.

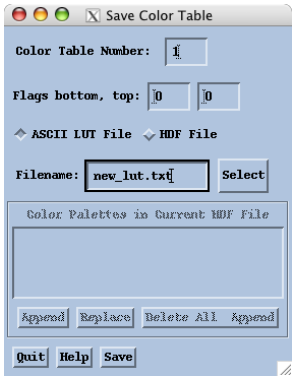

Figure 6.5: `Save Color Table` Window

Betaware that only the **data portion** of the displayed image's LUT will be saved (colors 0-196 if it is the default first LUT), and this portion will be interpolated to 256 output RGB values. Flag text boxes in the `Save Color Table` window allow the user to specify a range of color indices from both the top and bottom of the color table to be output directly, without any interpolation. This is useful if flags or masks are assigned to specific indices.

It is also possible to load a color look-up table from an external file using the `Load Color LUT` window (accessed by selecting ***Functions⇒Color LUT⇒Load LUT*** from a `Product Display` window). The filename containing the LUT can be entered in the 'Load LUT from ASCII or HDF file' text box, or a file can be chosen using the 'Select' button. Clicking the 'Load' button will then load the LUT from the file.

When loading a color table from a file, SeaDAS linearly scales the 256 RGB values contained in the file into the **data portion** of the current SeaDAS color table (197 or 48 colors for the first and second default LUTs respectively). As with saving color tables, numbers can be entered in the flag text boxes to specify a range of color indices from both the top and bottom of the color table to be loaded directly from the file, without any scaling applied.

6.6 Adding Custom Color Tables

Custom color tables can be easily created and then added to SeaDAS so that they are accessible from the SeaDAS GUI. To add a custom color LUT to SeaDAS:

1. Create an ASCII file containing 256 8-bit RGB space-separated triplets, one per line (e.g. 255 0 255). This can be done within SeaDAS by saving a modified color table as an ASCII file. It can also be done by manually creating the ASCII file using a Unix text editor.
2. Insert one line at the top of the ASCII file specifying a name for this new LUT. (The file will now have 257 lines.)
3. Move this text file into the directory for custom tables: $SEADAS/data/common/luts/custom/

This new LUT will now be available in the LUT list when the *Custom Product Color Tables* menu option is selected in the `Load Color LUT` window (see Figure 6.6).

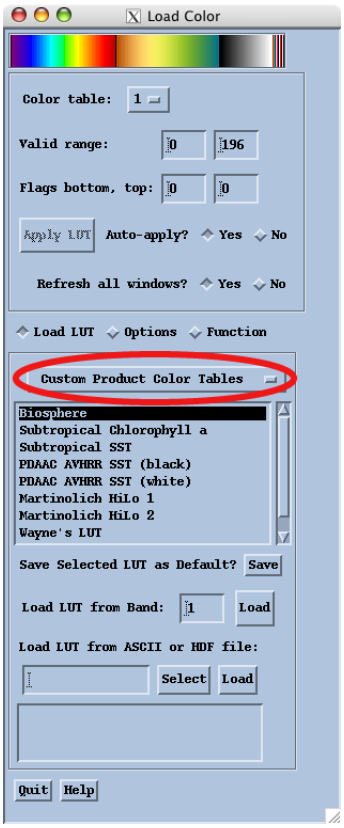

Figure 6.6: Custom Color Tables

Chapter 7

SeaDAS Graphic Overlays

Introduction

SeaDAS has the capability to overlay various types of vector graphics on displayed images. Graphics can be useful for data visualization, annotations, and also for isolating specific data pixels of interest for further analysis. SeaDAS offers graphics functions for overlaying coastlines, lat/lon grids, contours, vectors, text annotations, and user created drawings. Other functions can be used to 'mask' certain data pixels based on user-defined criteria (e.g. data value ranges, processing flags, etc.). Seven independent, color-configurable graphics planes are available for use.

Goal

This chapter introduces the basic functions for configuring/controlling graphics, and outlines the methods for creating, loading, and saving the following types of graphic overlays:

- Latitude/longitude gridlines, coastlines, and landmasks
- Contour lines
- Masks based on ranges of data values
- u,v vectors
- Text annotations and drawings

7.1 Configuring and Controlling SeaDAS Graphics

Creating a graphic in SeaDAS is as simple as displaying a data file that contains geolocation information and selecting ***Functions⇒Coastline*** from the display window. SeaDAS graphics are not initially permanently embedded into the displayed data, but are instead overlayed on the image in a separate 'plane'. After overlaying graphics it is then possible to access, or even modify data lying under (or alternatvely, not covered by) the graphics. It is also possible to 'flatten' the image by saving both the displayed graphics and data together in a raster-type image such as a PNG file.

SeaDAS graphics can be configured and controlled using the display window's ***Functions⇒Graphics*** menu (see Figure 7.1). From this menu graphics can be erased, temporarily turned on and off, loaded, saved, copied to another window, or assigned user selected colors.

7.1.1 Modifying Graphics Colors

Seven independent graphics planes are available in SeaDAS and each of these can be assigned any color using the `Modify Graphics Colors` window. This window can be accessed via the ***Functions⇒Graphics⇒Modify Graphics Colors*** or ***Setups⇒Graphics*** menus. Any changes to the graphics palette will affect all currently displayed images.

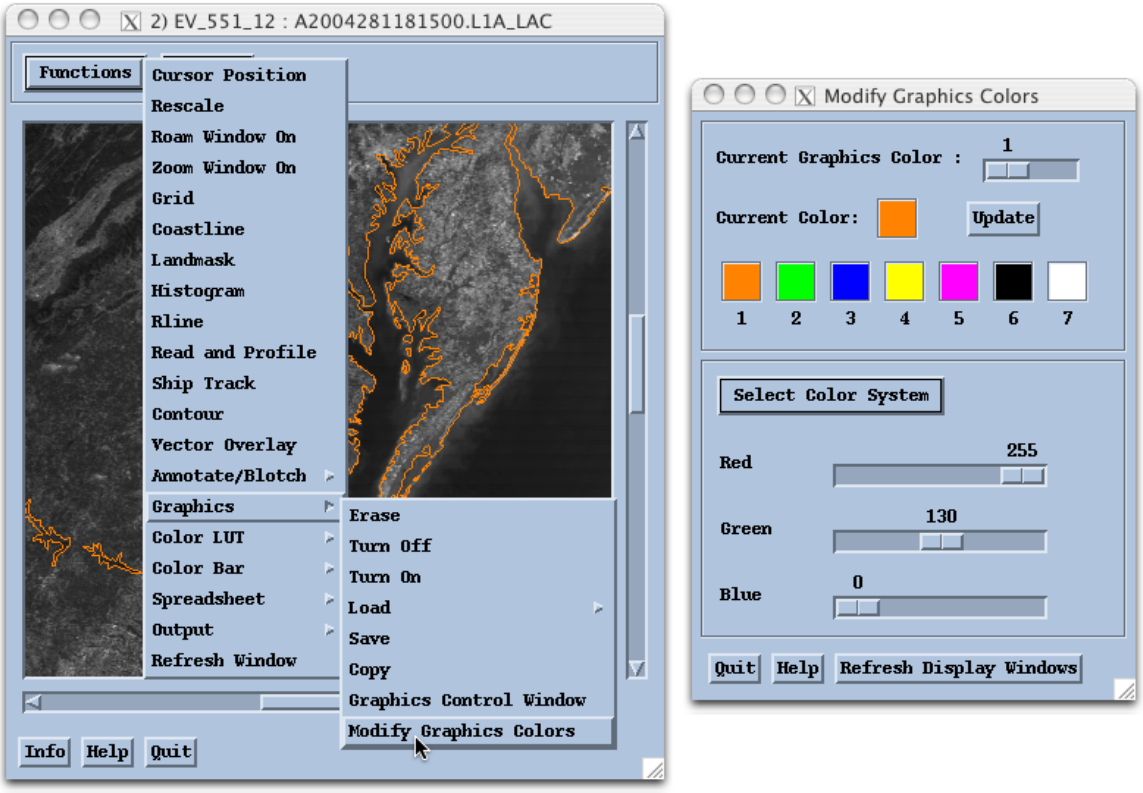

Figure 7.1: The `Graphics` Menu and the `Modify Graphics Colors` Window

To modify the color of a graphic, select the graphics color to be modified using the *Current Graphics Color* slider or by clicking the desired graphics color box. After choosing the color to be modified, manipulate the color sliders to create a new color. The *Current Color* box will dynamically display the new working color as it is being mixed. This color will not be overwritten in the graphics palette until the *Update* button is clicked. The default sliders control RGP triplets, and the *Select Color System* menu allows for the following color systems to be utilized:

- RGB: Red, Green, Blue
- CMY: Cyan, Magenta, Yellow
- HSV: Hue, Saturation, Value
- HLS: Hue, Lightness, Saturation

After completing modifications to the graphics colors, clicking the *Refresh Display Windows* button will apply these changes to the graphics in all currently open display windows.

TIP Use the *loadgp* procedure to modify SeaDAS graphics colors via the SeaDAS command-line. Also, the '*loadgp, /reinit*' command will reload the default seven graphics colors.

7.1.2 Controlling Graphics

Selecting ***Functions⇒Graphics⇒Graphics Control Window*** allows the user to interactively:

- Turn specified graphics colors on and off
- Erase specified graphics colors permanently
- Define a new graphics area as being the complement of existing graphics areas.

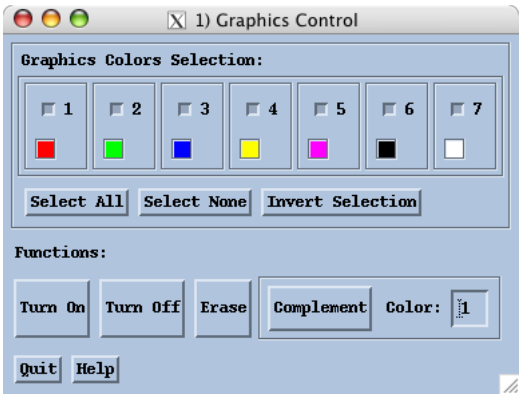

Figure 7.2: `Graphics Control` Window

Within the *Graphics Colors Selection* section the user can select which graphics colors to operate on in the *Functions* section. Clicking *Turn On* or *Turn Off* will then temporarily turn graphics on or off for the selected colors. Clicking the *Erase* button will permanently erase all selected graphics colors. To create a brand new graphic that covers the complement (inverse) area of those graphics colors specified, first enter the number of the new graphic to be created in the *Color* text field and then click the *Complement* button. Note that graphics can also be turned on/off or erased directly from the ***Functions⇒Graphics*** menu.

7.1.3 Copying Graphics

The `Copy Graphics` window enables graphics to be copied from one display window to another. All graphics in the source window or only those graphics colors specified may be copied to the destination window.

To perform the copy, enter the source (*From Window*) and destination (*To Window*) windows in the text boxes and select the graphics numbers/colors to be copied. Next, choose one of the three graphics copy modes:

- Overlay: Overlay copied graphics on top of existing graphics in the destination window.
- Underlay: Underlay copied graphics underneath existing graphics in the destination window.
- Replace: Replace all graphics in the destination window with the selected graphics in the source window.

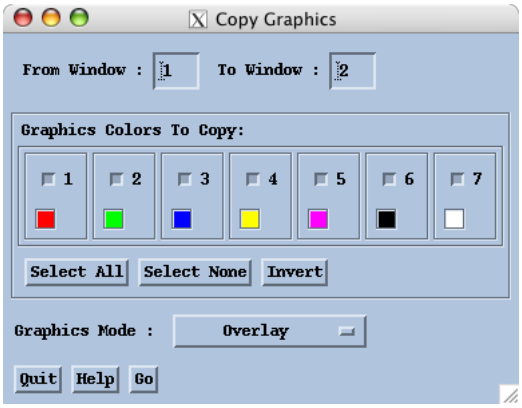

Figure 7.3: `Copy Graphics` Window

Finally, click the *Go* button to carry out the window-to-window graphics copy operation. Note that if the source and destination windows have different dimensions, the copied graphics will be aligned at the top left-hand corner of the window and the graphics will also be truncated if necessary.

7.2 Types of Graphics

This section briefly outlines the various types of graphics that can be created using SeaDAS. For a few in-depth examples of more advanced graphics operations see the **Advanced Graphics Overlays** chapter. Also note that clicking the *Help* button in any of the functions' windows will display local help webpages included with SeaDAS.

7.2.1 Latitude/Longitude Gridlines, Coastlines and Landmasks

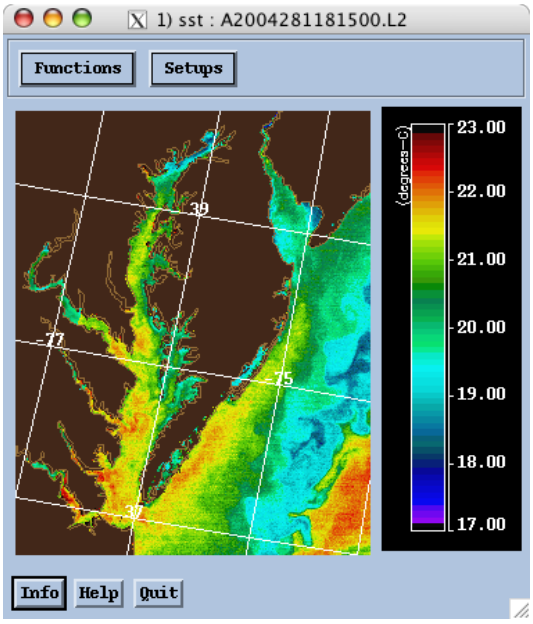

Figure 7.4: Gridline, Coastline, and Landmask

For displayed data that is georeferenced (includes geolocation data), SeaDAS has functions to overlay latitude/longitude gridlines, and high-resolution (~1km) coastlines and landmasks. To overlay these graphics simply select ***Functions⇒Grid***, ***Functions⇒Coastline***, or ***Functions⇒Landmask*** from the display window.

By default, these three graphics are assigned to graphics color '1' (red), but they can be reassigned to separate graphics planes with customized colors as shown in Figure 7.4. This can be done using a separate configuration windows for each graphic available by way of the ***Setups⇒Grid***, ***Setups⇒Coastline***, and ***Setups⇒Landmask*** menu selections.

Using the coastline configuration window, various line-styles can be selected, and if the displayed product is mapped then rivers, continents, countries, and US states can be overlaid. The grid configuration window allows adjustment of lat/lon intervals, line-style and thickness, as well as font selection for labelling.

TIP To access these three graphics functions on the SeaDAS command-line, use the *grid*, *coast*, and *landmask* procedures.

7.2.2 Contour Lines

Selecting ***Functions⇒Contour*** from the display window will spawn the `Contour Main Window`. This function can be used to generate a contour plot either on the displayed source image, or in a new separate plot window (in which the source image can also be included).

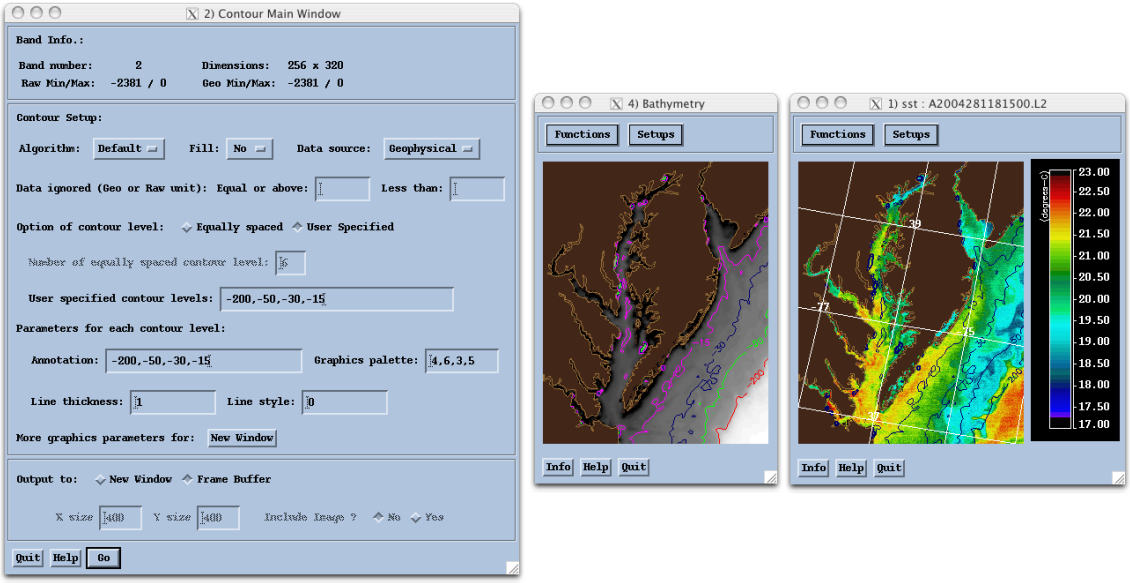

Figure 7.5: Using the Contour Function to Overlay Bathymetry Contours on an SST Product

Figure 7.5 shows the main contour window and a contouring example that makes use of the 2-minute resolution bathymetry database included with SeaDAS. (See the **Advanced Graphics Overlays** chapter for a step-by-step example of how to do this.) There are various options available for the contour function including:

- automatic or user-defined contour levels and annotations
- contour line color, thickness, and style control
- ability to color-fill contour levels, each with a different color
- use of either raw or geophysical data values as the source for contouring
- a variety of plotting options if a separate new plot window is chosen

TIP As with all SeaDAS GUI windows, clicking the *Help* button in the `Load Color LUT` window will spawn that window's local help webpage. All SeaDAS-specific help documents are also available online: http://oceancolor.gsfc.nasa.gov/seadas/help.html

7.2.3 Graphic Masks Based on Ranges of Data Values

It can be very useful to isolate specific data values in an image for the purpose of data processing or analysis. This process is referred to as 'masking' the data. There are a variety of ways to perform masking in SeaDAS, and the *Paint Color (Density Slice)* GUI function is one simple method.

This function performs 'density slicing', dividing the range of values in the displayed image into intervals and assigning a graphics color to each interval. This may aid in the analysis of the image, and the graphics created may be used as masks for further operations. The function is accessed from the `SeaDAS Main Menu` window via the ***Utilities⇒Data Visualization⇒Paint Color (Density Slice)*** menu selection.

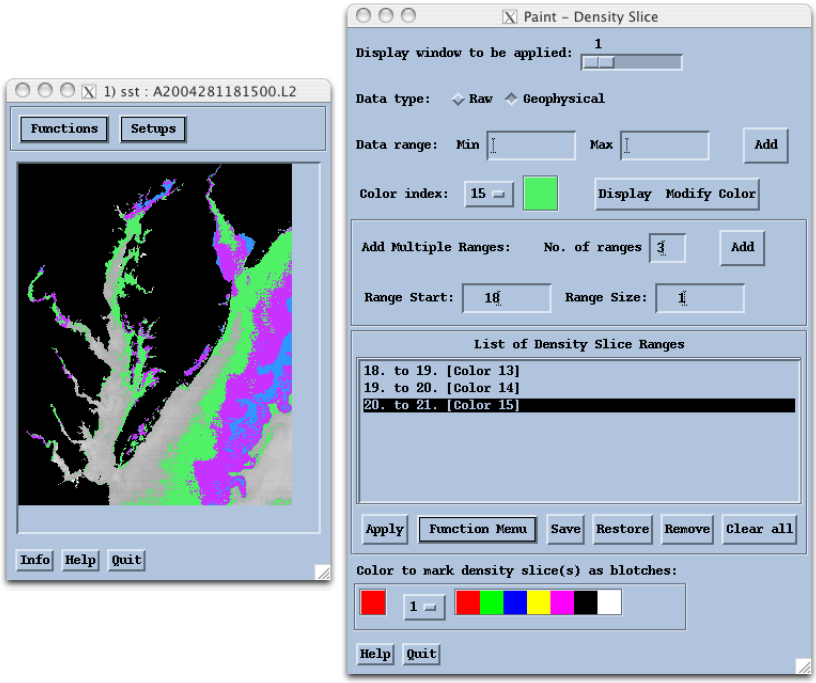

Figure 7.6: The *Paint Color (Density Slice)* Function

To begin creating density slices, the `Paint - Density Slice` window (see Figure 7.6) can be used to create a list of individual raw or geophysical data ranges each with an associated color. Entries can be added one at a time, or if the range sizes are equal, multiple range entries can be added at once. As range entries are added they appear in the list pane. Clicking the *Apply* button will then generate graphic slices on the indicated display window. Once the desired density slices have been applied, they can be turned into one or more permanent graphics (called blotches or masks) using the *Function Menu*. This menu also offers a variety of other interactive operations. The *Save* and *Restore* buttons allow for saving and loading of lists (data types, density slice ranges, and their corresponding colors in red, green, and blue attributes) via ASCII files.

Note: To perform this function, SeaDAS must be configured with at least 2 color tables, the last of which will be used to display the colors of the density slice ranges. Color conflicts may arise if this function is activated while other display windows are using the last color table, or if other display functions are being utilized at the same time.

TIP After creating a mask on a *mapped* image, the graphic can be saved and then reloaded/applied to other mapped images created with the same projection and dimensions.

7.2.4 *u,v* Vector Graphics

u,v vectors (often used to denote wind or current velocity) can be overlaid as graphics on images whose pixels are geographically equidistantly spaced, i.e. regularly gridded data (e.g. equi-distant rectangular projection, equi-distant cylindrical projection). Using ***Functions⇒Vector Overlay***, *u,v* data can be loaded from an ASCII file, from a loaded band, or directly from IDL variables. As with the image the *u,v* data also must be stored on regular grids.

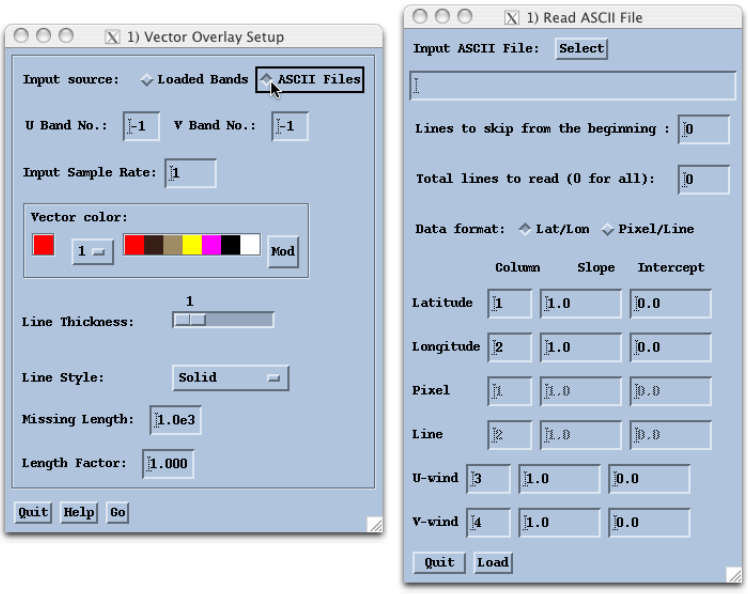

Figure 7.7: `Vector Overlay Setup` and `Read ASCII File` Windows

The user can configure the plotted vectors' graphics properties such as color, thickness, length, etc. A subsampling rate for the *u,v* input data can be used to display fewer vectors, and a maximum vector length can also be specified, to exclude vectors greater than a certain magnitude ($\sqrt{u^2+v^2}$). The maximum vector length is also printed to the terminal when the vectors are plotted.

TIP Use the command-line *vector* procedure to access all features of the *Vector Overlay* GUI function.

As mentioned SeaDAS can use data from loaded bands to construct the u,v vectors. One example of this method would be to load a standard NCEP ancillary HDF file's z_wind and m_wind products and use them as the u and v vector components respectively. Figure 7.8 shows just such a case where wind vectors have been overlaid on a Level-3 Standard Mapped Image chlorophyll product.

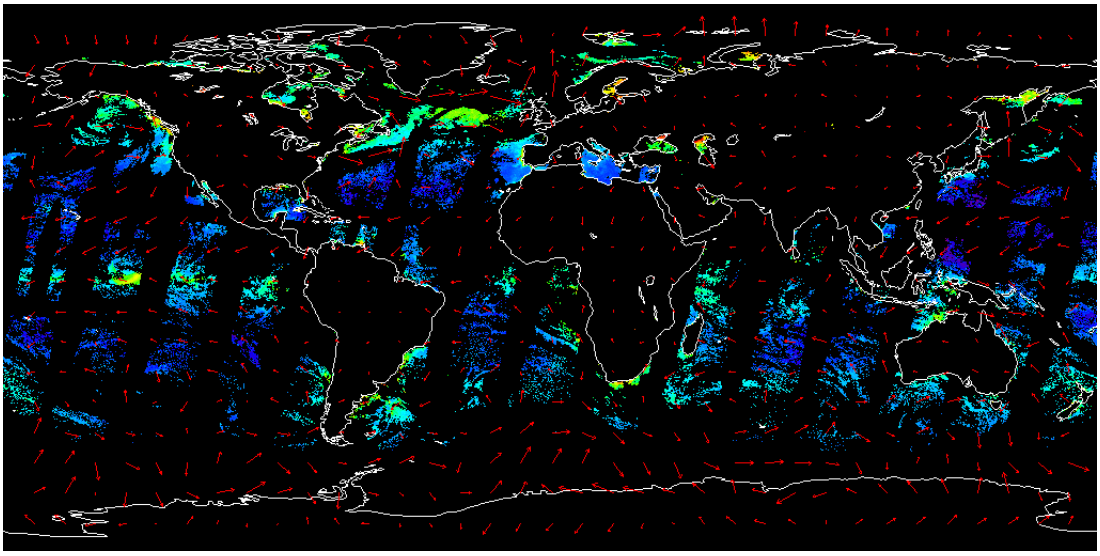

Figure 7.8: Wind vectors from an NCEP meteorological ancillary HDF file overlaid on an SMI image

TIP To achieve the highest vector resolution, use the SeaDAS postscript output option to save images containing vector and/or graphics data. Vector data in a postscript file are stored as annotation objects and will be redrawn at postscript resolution.

7.2.5 The Annotate/Blotch Function

The ***Functions⇒Annotate/Blotch*** function allows the user to interactively annotate any displayed SeaDAS image (including zoom and roam windows) with text and/or drawings. Five types of annotation objects are available: text, lines and arrows, polygons and polylines, ellipses, and rectangles. Annotation object files can be saved and restored, and annotated displays can be written to the output image formats supported by SeaDAS.

Annotation items are stored internally as objects (not bitmaps) and can be modified, deleted or added at any time. Annotation objects will be recognized as objects between multiple invocations of the `Annotate` window within a single SeaDAS session. To retain these dynamic objects between SeaDAS sessions, it is necessary to use the ***File⇒Save As*** and ***File⇒Load*** options in the `Annotate` window, since SeaDAS graphics (including any displayed annotated objects) are saved as bitmaps.

The main display window, roam window, and zoom window can each be individually annotated.

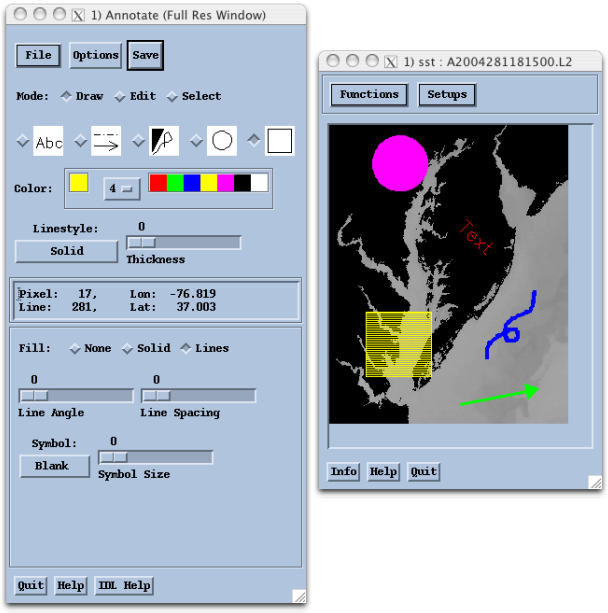

Figure 7.9: `Annotate` Window and Examples

For example, spawning the `Annotate` window via the ***Functions⇒Annotate/Blotch⇒Roam Window*** function allows for direct annotation to the roam window. The annotation objects will reside concurrently in both the main display window and roam windows in two different scales. Scaling is necessary in the roam window since in many cases the subsampled annotation vector objects would be otherwise unrecognizable. Users can choose to work in either scale or both scales, whichever makes sense for the application.

To create high resolution annotations directly in the zoom window select the ***Annotate/Blotch⇒Zoom Window*** function. The high resolution zoom window and annotations can be output via the ***Functions⇒Output⇒Display*** option by specifying to output the zoom window **and selecting the 'PNG 24 Bit TrueColor' or 'Postscript' output format**. However, this must be done prior to exiting the `Annotate` window as after the window is closed, annotated objects aren't saved at a higher scale than the full resolution window.

MODES

The Annotation widget has three modes of operation: Draw, Edit, and Select.

- Draw Mode Allows you to design and create new annotation objects.

- Edit Mode Allows you to move, resize, or otherwise change existing annotation objects. In Edit Mode, "handles" appear on the annotation object.

- Select Mode Allows you to choose an existing annotation object for editing. Select an object by clicking the left mouse button in the center of the object. When you release the mouse button, the object's handles will appear and the Annotation widget will switch to Edit Mode.

Select a mode by clicking on the appropriate Mode Button. You can also switch between Draw Mode and Edit Mode by clicking the middle mouse button.

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SAVING OBJECTS

Once you have created an annotation object, you must save it before going on to create another. Save objects either by clicking on the "Save" button or by clicking the right mouse button when the annotation object to be saved is selected. If the object is not saved and you switch from one type of object to another, the unsaved object will be removed from the annotation. When the object has been saved, the mode switches automatically from "Edit" to "Draw".

To change a saved object, choose Select Mode, select the object and edit it. Note that once an object is selected, it is removed from the "saved" list and thus must be saved again after modification.

ANNOTATION OBJECTS

The Annotation widget supports five types of annotation objects: Text, Lines and Arrows, Polygons and Polylines, Ellipses, and Rectangles. The different objects are represented by a row of bitmap buttons in the Annotation widget. To select a type of annotation, click on the appropriate button. The lower portion of the Annotation widget changes to present the controls available for that type of object.

NOTE: If you switch from one type of object to another before saving an object, the unsaved object will be deleted.

- Text To create a text annotation, enter the text in the field labelled "Text", then click with the left mouse button in the image. Your annotation text appears and the mode switches immediately to "Edit." Resize or rotate the annotation text using the mouse by clicking on one of the handles and dragging, or adjust the "Size" and "Orientation" sliders. Adjust the thickness of the text line strokes using the "Thickness" slider.

Use the "Font" selection widget to select a font. Text can be aligned to the left, right, or center by selecting the appropriate button.

- Lines and Arrows To create a line or arrow, click with the left mouse button and drag the mouse until you have created the desired line. Click on the "Arrow" button to create an arrow or on "Solid Arrow" to

create an arrow with a filled triangle as its head. Adjust the size of the arrowhead by moving the "Head Size" slider.

- Polygons and Polylines The Polygon/Polyline tool has three sub-modes:

- Draw: (the initial mode). Drag or click the left mouse button to add points to the object, connecting the most recent point to the mouse position. - Edit: Select and move a vertex or point by clicking and dragging with the left mouse button. - Delete: Remove the vertex or point closest to the cursor position when the left mouse button is pressed.

Polygons can be unfilled, filled with a solid color, or filled with parallel lines by selecting the appropriate button next to the "Fill" label. If an object is filled with lines, the angle of the lines and the spacing between them can be adjusted using the "Line Angle" and "Line Spacing" sliders.

Choosing "Spline" next to the "Interpolation" label will produce objects constructed of smooth curves rather than polygons.

- Ellipses To create an ellipse, click with the left mouse button at the point you wish to be the center of the ellipse and drag until the ellipse is the desired size. Adjust the eccentricity of the ellipse using the "Eccentricity" slider.

Ellipses can be unfilled, filled with a solid color, or filled with parallel lines by selecting the appropriate button next to the "Fill" label. If an object is filled with lines, the angle of the lines and the spacing between them can be adjusted using the "Line Angle" and "Line Spacing" sliders.

- Rectangles To create a rectangle, click with the left mouse button at the point you wish to be the upper left corner of the rectangle and drag until the rectangle is the desired size.

Rectangles can be unfilled, filled with a solid color, or filled with parallel lines by selecting the appropriate button next to the "Fill" label. If an object is filled with lines, the angle of the lines and the spacing between them can be adjusted using the "Line Angle" and "Line Spacing" sliders.

COLOR

The color of any annotation object can be changed by selecting the object and picking a new color from the Annotation widget color bar.

LINESTYLE

You can adjust the thickness of lines and text using the "Thickness" slider. You can change the style of lines and shapes using the "Linestyle" selection widget. Note that fill lines are not affected by the choice of line style.

CURSOR POSITION

The current cursor position with the graphics window is shown (in pixel coordinates) in the window in the center of the Annotation widget.

THE FILE MENU

The File menu (at the upper left-hand corner of the Annotation widget) contains the following items:

- Load Load a saved annotation file into the current graphics window. A file-selection dialog allows you to select a previously-saved annotation file. When restoring objects, be sure that the window you are loading into has the same geometry as did the window from which the objects were saved.

- Save Save the current annotations in a file. If an annotation file has not yet been opened or specified using the "Save As" menu option, the file will be named "annotate.dat" and placed in the current directory. Note that only the annotations, and not the underlying image or plot, are saved.

- Save As Save the current annotations in a file. A file-selection dialog allows you to name the resulting file. Annotation files have the suffix ".dat" by default. Note that only the annotations, and not the underlying image or plot, are saved.

- Write PostScript Create a PostScript file of your annotations. This menu choice reveals a submenu allowing you to choose "Everything" or "Objects only".

Choose "Everything" to output the contents of the graphics window (your original plot or image) as a bitmap, and the annotation objects as PostScript drawing commands. This creates a single file and provides the best resolution.

Choose "Objects only" to save only the annotation objects. Use this mode to combine the annotations with PostScript commands that have already been output to obtain the highest resolution. To use this procedure, take the following steps:

1) Open the PostScript device and create the plot over which you wish your annotations to appear. Be sure that it has the same aspect ratio as does you drawing window. For example, if you have a 640 x 512 drawing window, and you wish to make your PostScript drawing 4 inches wide, the PostScript height or YSIZE must be set to 4.0 * 512 / 640 = 3.2 inches, e.g. DEVICE, XSIZE=4, YSIZE=3.2, /INCHES.

2) Select the window system as your plot device, and re-execute the commands that produced the background you wish to annotate.

3) Call ANNOTATE, make your annotations, and then use this option to output the PostScript. The PostScript device is not closed upon completion, as it is with the other two PostScript output options.

- Export Bitmap Convert the entire contents of the graphics window (image and annotations) to a bitmap and output in the format you choose. The options available are PNG, PostScript, and TIFF.

- Clear Clear the graphics window of all annotations.

- Exit Exit the Annotation widget.

OPTIONS BUTTON

Click on the "Options" button to select various types of PostScript output:

- Standalone or Encapsulated (to be inserted into another document).

- Monochrome or Color, always use Monochrome unless you have a color PostScript printer.

- Portrait or Landscape.

The width parameter scales the output size. The height of the output drawing is scaled from the width to retain the same aspect ratio as the original drawing window.

TIP blah

7.2.6 Loading Graphics from Windows, Loaded Bands, and Files

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TIP blah

7.3 Output/Save

blah

TIP blah

Note: This is a modified version of IDL's Annotate procedure.