Chapter 6: Image Viewer

Image Viewer is a graphical window that displays HDF images. HDFView is a simple image viewer for HDF4/5 and has a limited function for processing an image.

An HDF4 image is a raster image of 8-bit pixels with an indexed RGB color table, or a 24-bit true color image. The HDF4 library provides image APIs to access image data and color tables.

An HDF5 image is a dataset that conforms to the HDF5 Image and Palette Specification. HDFView supports two types of images: indexed and true color. Both indexed image and true color image have predefined attributes and data layout according to the HDF5 image specification. For more details about HDF5 image, see the HDF5 Image and Palette Specification.

6.1 Display a 2-D or 3-D Image

HDFView displays HDF4 raster images or HDF5 datasets that follow the HDF5 Image and Palette Specification for indexed images with an 8-bit standard RGB color model palette or three-dimensional true color images. Other image formats supported by the Image and Palette Specification are not supported by this tool.

If an image is larger than the visible area of the image viewer, users can grab and move the image by mouse-drag. Users can also use the side scroller bar to move the image to a desirable view area. Use Shift+Mouse-drag to select a subset of an image in the image viewer.

Fill values are displayed as the color black. Fill values are also excluded from calculating the minimum, maximum and other statistics.

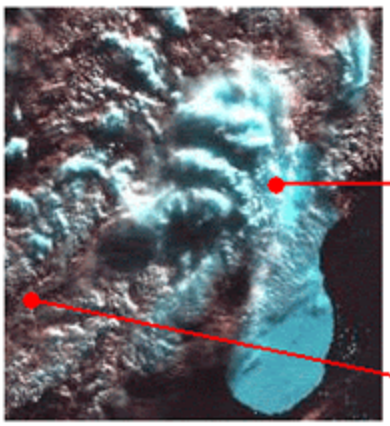
6.1.1 Indexed Image (8-Bit)

An indexed image is one of the following:

- An HDF4 RI8 image
- An HDF5 dataset that conforms to the HDF5 Image specification, and is an “IMAGE_SUBCLASS=IMAGE_INDEXED”
- An SDS or HDF5 dataset with data that can be interpreted as an image

The dataset is displayed as a Java image using IndexColorModel. The dataset is converted to a raster image using the first palette specified by the PALETTE attribute, or the default palette for HDF4. Multiple user-defined palettes (i.e., the PALETTE attribute may be a list) are not supported in version 1.0.

The dataset of an indexed image holds the values of indices of the color look-up table (palette). The dataset is converted into image pixels by looking up the index in the color table. The following figure is an example of mapping dataset values into pixels.



8-bit raster image

	RED	GREEN	BLUE	RGB
0	10	9	15	
1	28	130	124	
2	152	131	131	
3	109	65	69	
4	152	200	203	
5	64	196	203	
6	34	68	77	
7	96	135	141	
8	209	196	199	
9	36	100	118	
10	97	166	168	
11	61	25	30	
12	206	152	155	
13	153	227	233	
14	113	98	101	
15	153	166	168	
16	209	229	227	
17	90	227	236	
18	80	67	71	

Color look-up table (palette)

Mapping of dataset values to image pixels

For a two-dimensional indexed image, HDFView assumes that the width of the image is the size of the second dimension and the height of the image is the size of the first dimension, i.e. dim[0]=height and dim[1]=width.

Although HDFView displays the entire image by the order of (dim[0], dim[1], dim[2])=(depth, height, width) by default, you can always change the order and select a subset for the display as discussed in Chapter 5.

HDFView also displays a three-dimensional array as an array of 2-D images arranged along the third dimension, i.e. dim[0]=depth, dim[1]=height and dim[2]=width. You can flip back and forth to look at images at a different position of the depth dimension. For instance, if the dataset is 20 x 400 x 600 (dim[0]=20, dim[1]=400, and dim[2]=600), HDFView will display it as 20 images each with the size of 600 x 400 (width is 600, height is 400). However, a three-dimension image of [1][height][width] or [height][width][1] is treated as a two-dimension indexed image of [height][width].

A 2-D or 3-D SDS or HDF5 dataset with integer or float data can be displayed as an indexed image using the “Open As” selection from the Context menu. Since the dataset does not have a palette, a default palette is used. The palette is chosen from the “Select Palette” menu in the “Dataset Selection” window. The predefined palettes include:

- gray
- rainbow
- nature
- wave

If no palette is selected, a gray scale will be used.

Converting non-byte data to byte data

Non-byte data will be converted to image byte data in one of the two algorithms: simple linear conversion or auto gain conversion.

Simple linear conversion

y = [(x - min)/(max-min)]*255.

Where,

x is the original value;

y is the byte value.

Auto gain conversion y = (x + bias) * gain.

Where, x is the original value;

y is the byte value;

gain = MAX_VALUE / (max-min);

bias = -min;

MAX_VALUE is the max value of original data type, e.g. USHRT_MAX for unsigned short integers.

Auto gain algorithm will be used only if Auto gain is selected from “Tools” ==> “User Options”, and the original dataset does not have any attached palette and you did not select any palette from the “Open As” window. Simple linear conversion will be applied to all other cases. The image values will be different and the image will look different if a different algorithm is used.

6.1.2 True Color Image

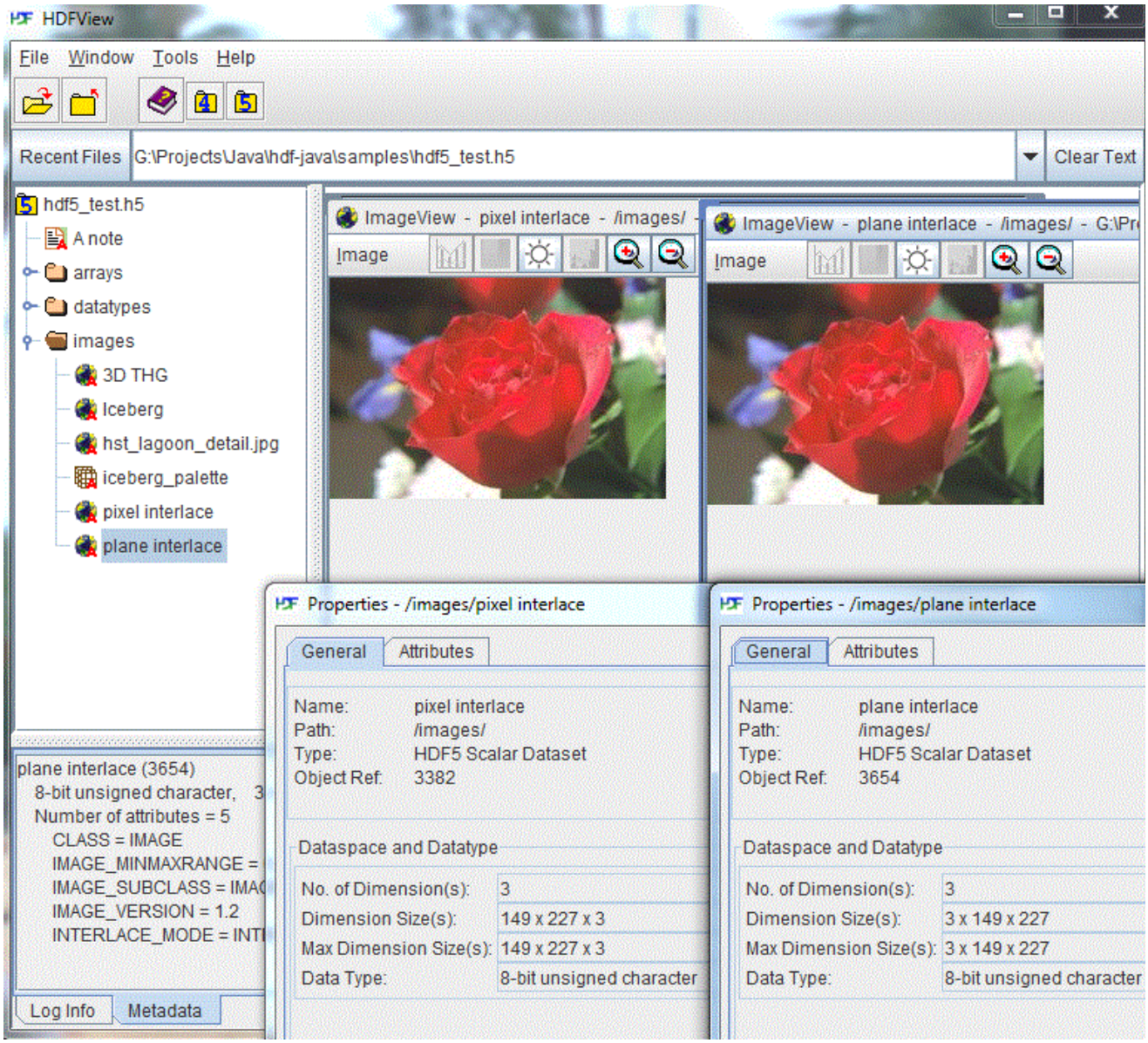
In the case of an image with more than one component per pixel (e.g., red, green, and blue), the data may be arranged in one of two ways. HDFView only supports three color components: red, green and blue.

Following HDF4 terminology, the data may be interlaced by *pixel* or by *plane*. For an HDF5 Image dataset the interlace should be indicated by the INTERLACE_MODE attribute. In both cases, the dataset will have a dataspace with three dimensions, *height*, *width*, and *components*. For *pixel interlace*, the data is arranged in the following order: [height][width][pixel components]. For *plane interlace*, the data is arranged in the following order: [pixel components][height][width].

The translation from pixel values to color components for display or processing purposes is a one-to-one correspondence of data values to components. Data of RGB color components is converted into byte data, which is packed into a single *int* pixel. The Java Image is created with a DirectColorModel, with masks to define packed samples. This color model is similar to an X11 TrueColor visual. The default RGB ColorModel is specified with the following parameters:

```
Number of bits:        32
 Red mask:              0x00ff0000
 Green mask:            0x0000ff00
 Blue mask:             0x000000ff
 Alpha mask:            0xff000000
 Color space:           sRGB
 isAlphaPremultiplied:  False
 Transparency:          Transparency.TRANSLUCENT
 transferType:          DataBuffer.TYPE_INT
```

The following figure shows examples of true color images. The image on the left is pixel interleaving with dimensions of [149][227][3]. The image on the right is plane interleaving with dimensions of [3][149][227].



True color image displayed in the Image View

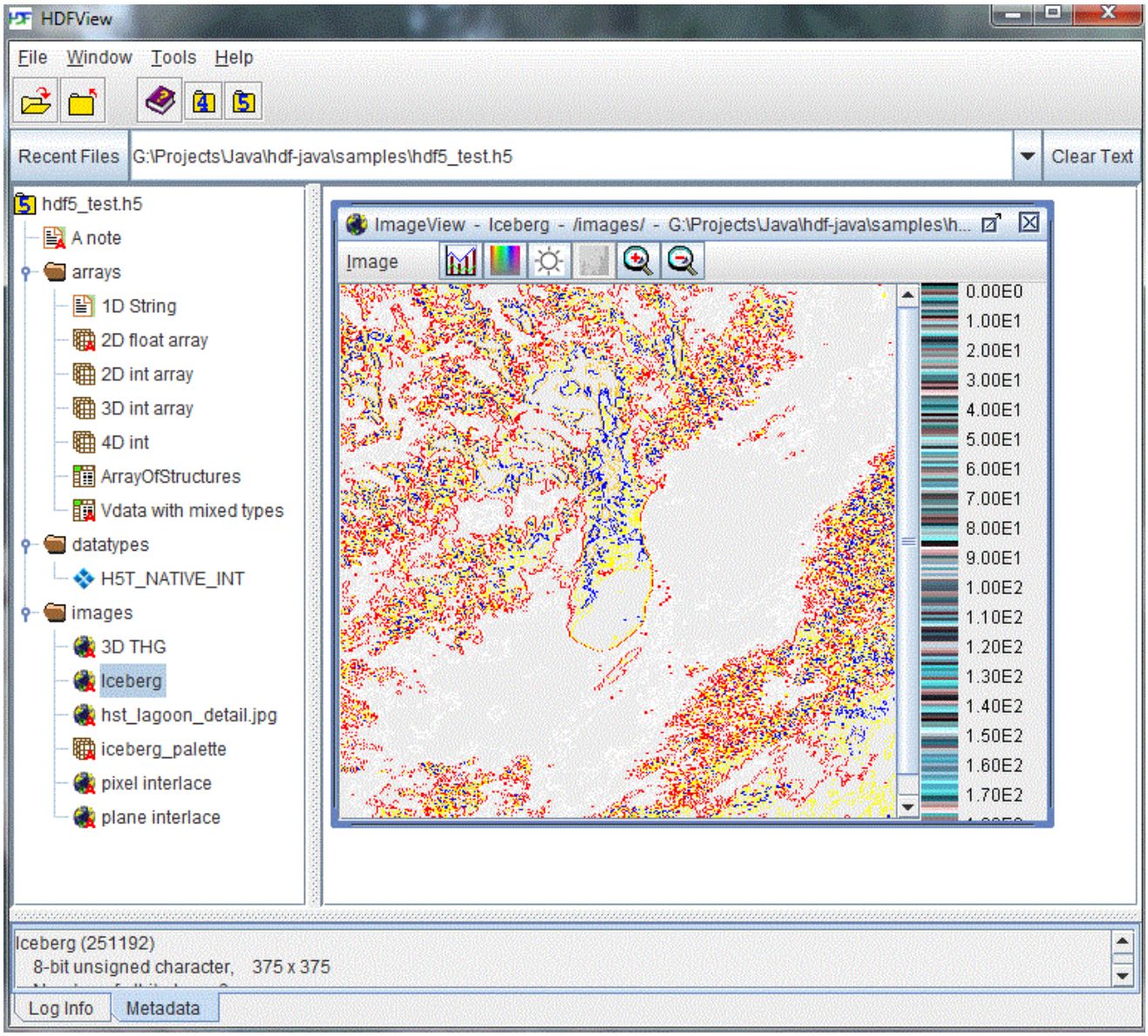
6.2 Zoom/Flip/Contour Image

HDFView supports only limited image manipulation such as zooming, flipping, and contour. You can zoom in and out of an image. The minimum zoom factor is 1/8 (reduced to 1/8 the size) and the maximum is 8 (magnified to 8 times the size). Reduction (zoom out) is done by sampling pixels, for example, a 1/2-size image is created by selecting every second pixel. Magnification (zoom in) is done by replicating pixels.

You can also flip an image horizontally or vertically. Flipping an image will change the coordinates of the image. This technique can be used to adjust images that may have been created with different origins from the defaults.

Manipulating the “contour” creates a contour plot of the pixel values. The contour can have from three to nine contour levels. Level three provides less details of contour and level nine provides more. **Repeated contour operations show a *cumulative* effect of contouring. For example, if you contour an image with level 3 and then contour that resulting image with level 4, the final image shows the cumulative effect of applying a level 4 to the level 3–contoured image**.

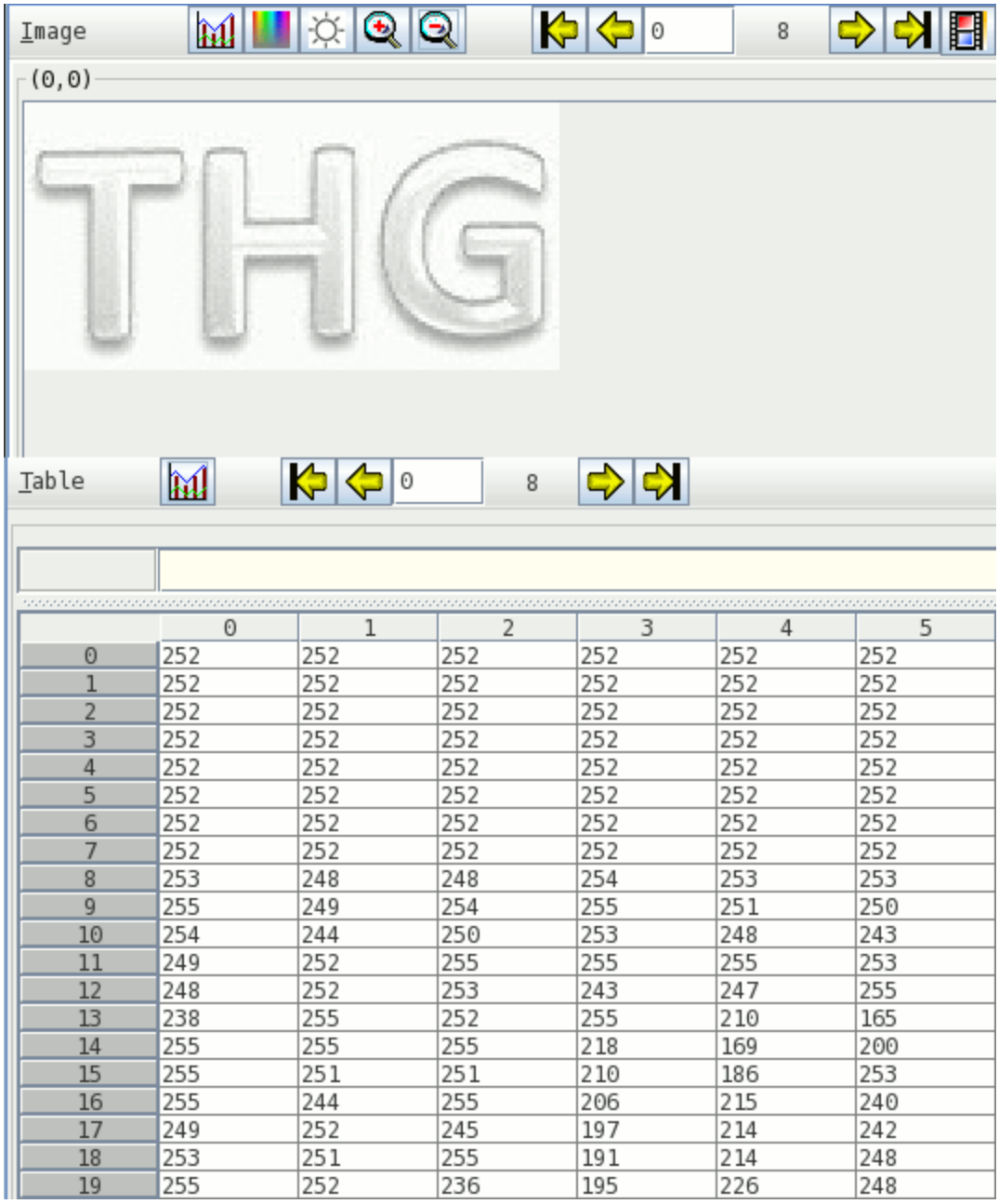
The following figure shows a contour image of level 9.



Contour image (level 9)

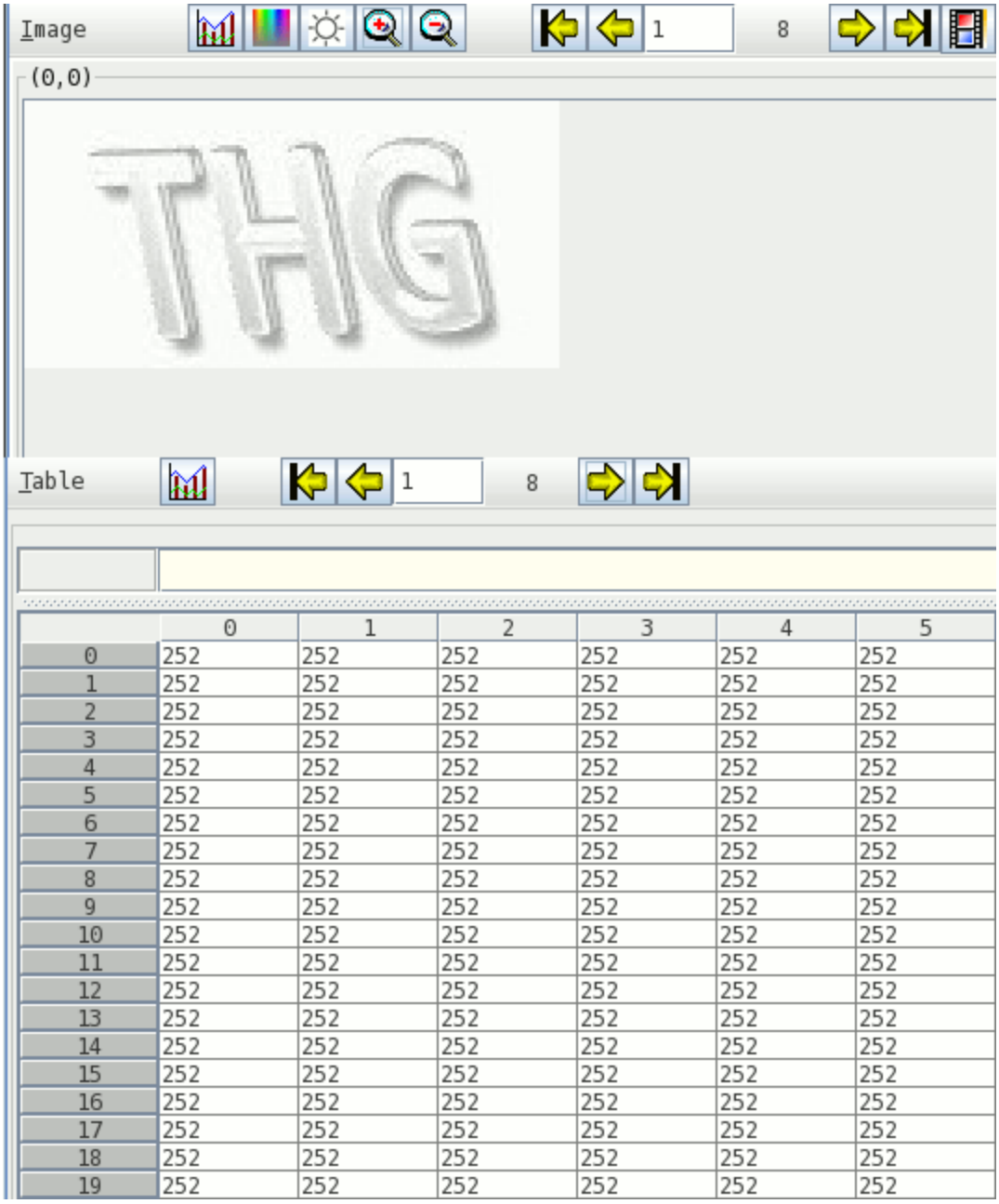
6.3 Animation

24-bit True color images of three dimensions have the option of being displayed as an animation. These "animated" images are represented the same way as a three-dimensional dataset is, with each "frame" of the total animation representing another "flip" along the third dimension of the associated dataset (see figure below). After opening such an image in the ImageViewer, you can step backwards and forwards through the individual "frames" of the image by using the first, previous, next and last buttons located at the top of the ImageViewer panel.



	0	1	2	3	4	5
0	252	252	252	252	252	252
1	252	252	252	252	252	252
2	252	252	252	252	252	252
3	252	252	252	252	252	252
4	252	252	252	252	252	252
5	252	252	252	252	252	252
6	252	252	252	252	252	252
7	252	252	252	252	252	252
8	253	248	248	254	253	253
9	255	249	254	255	251	250
10	254	244	250	253	248	243
11	249	252	255	255	255	253
12	248	252	253	243	247	255
13	238	255	252	255	210	165
14	255	255	255	218	169	200
15	255	251	251	210	186	253
16	255	244	255	206	215	240
17	249	252	245	197	214	242
18	253	251	255	191	214	248
19	255	252	236	195	226	248

First page (frame) of image



	0	1	2	3	4	5
0	252	252	252	252	252	252
1	252	252	252	252	252	252
2	252	252	252	252	252	252
3	252	252	252	252	252	252
4	252	252	252	252	252	252
5	252	252	252	252	252	252
6	252	252	252	252	252	252
7	252	252	252	252	252	252
8	252	252	252	252	252	252
9	252	252	252	252	252	252
10	252	252	252	252	252	252
11	252	252	252	252	252	252
12	252	252	252	252	252	252
13	252	252	252	252	252	252
14	252	252	252	252	252	252
15	252	252	252	252	252	252
16	252	252	252	252	252	252
17	252	252	252	252	252	252
18	252	252	252	252	252	252
19	252	252	252	252	252	252

Second page (frame) of image

To view an image as a smooth animation, first select the "Animation (frames/second)" option from the "Image" menu and select the rate at which you wish to view the animation (higher values provide a smoother animation). Then, either select the "Show Animation" option from the "Image" menu or press the animation button located next to the "last" button at the top of the ImageViewer.

6.4 View and Modify Image Palette/Values

A palette (or color lookup table) is the means by which color is applied to an image. It is a table in which every row contains the numerical representation of a particular color. In the example of an 8-bit standard RGB color model palette, this numerical representation of a color is presented as a triplet specifying the intensity of the red, green, and blue components that make up each color.

Although the HDF5 palette specification allows for variable color length, different look-up methods, and color models beyond RGB, HDFView only supports the indexed RGB color model of 256 colors. To view the image palette, click the palette icon on the tool bar or select the palette command from the image menu. The red, green, and blue components of the color table are plotted in a line plot.

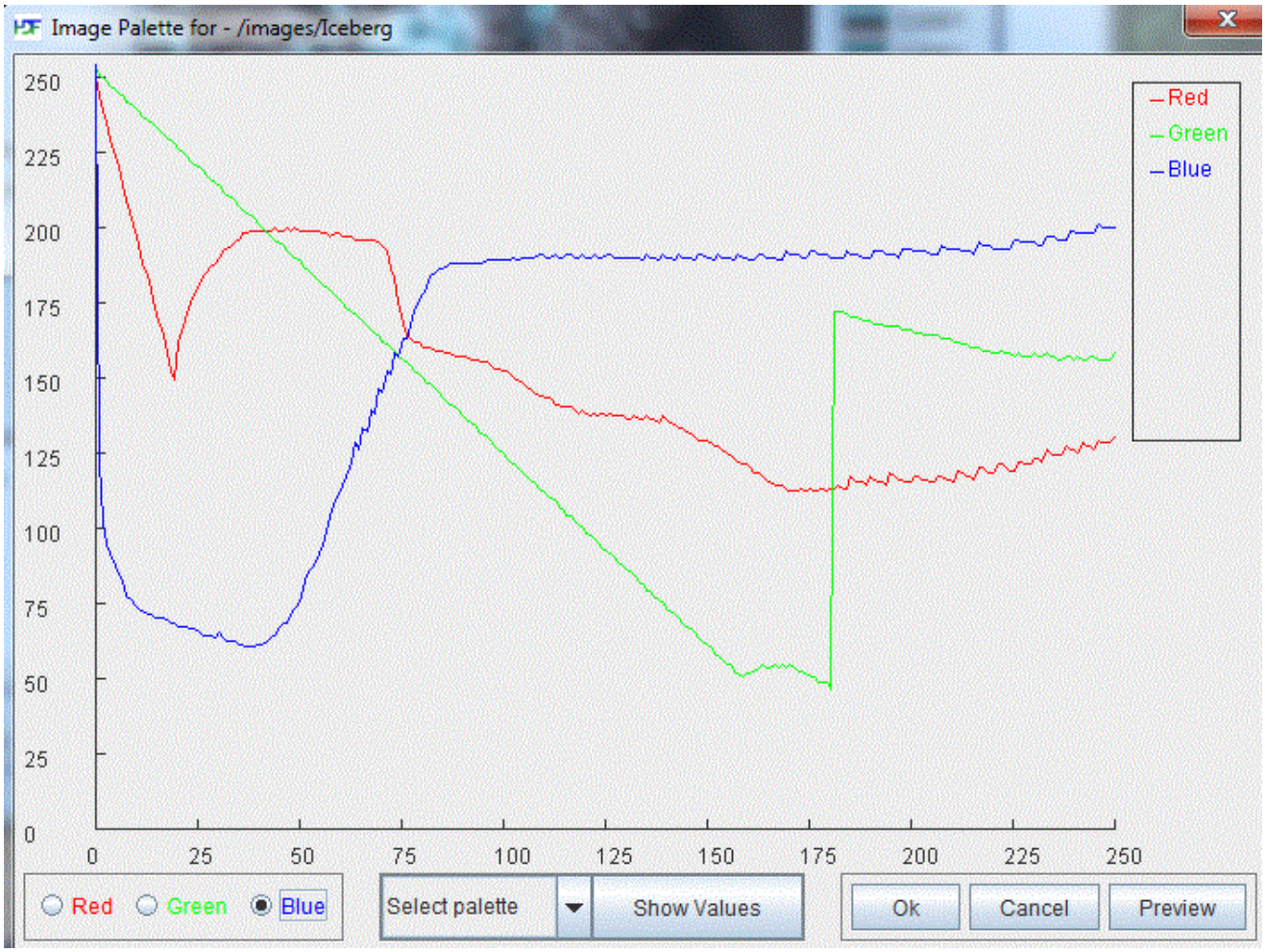
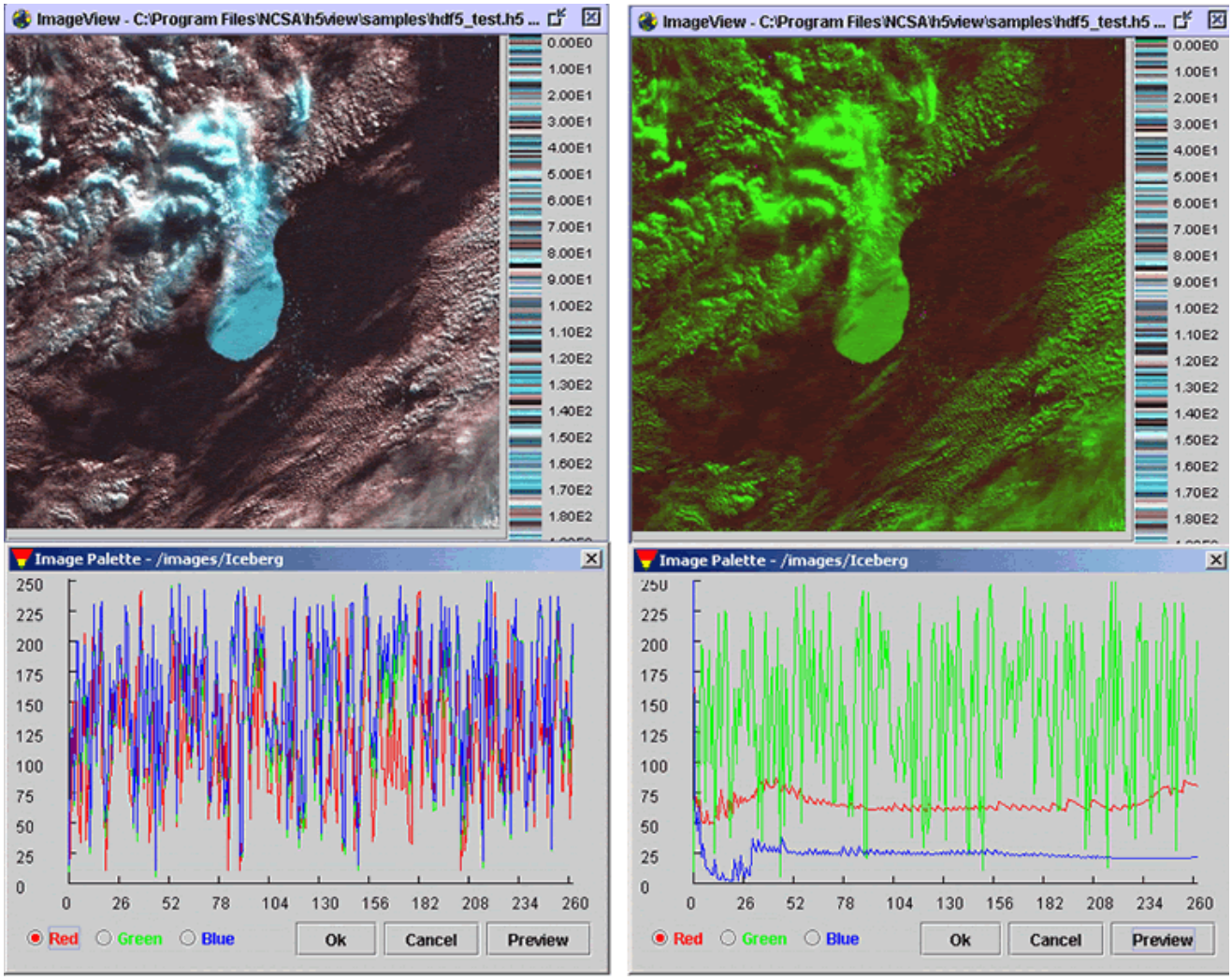


Image palette (256 colors)

To view the pixel values of each individual point, check the “Show value” item in the “Image” menu. When you move the mouse over the image, the pixel values of the mouse point are shown at the bottom of the image.

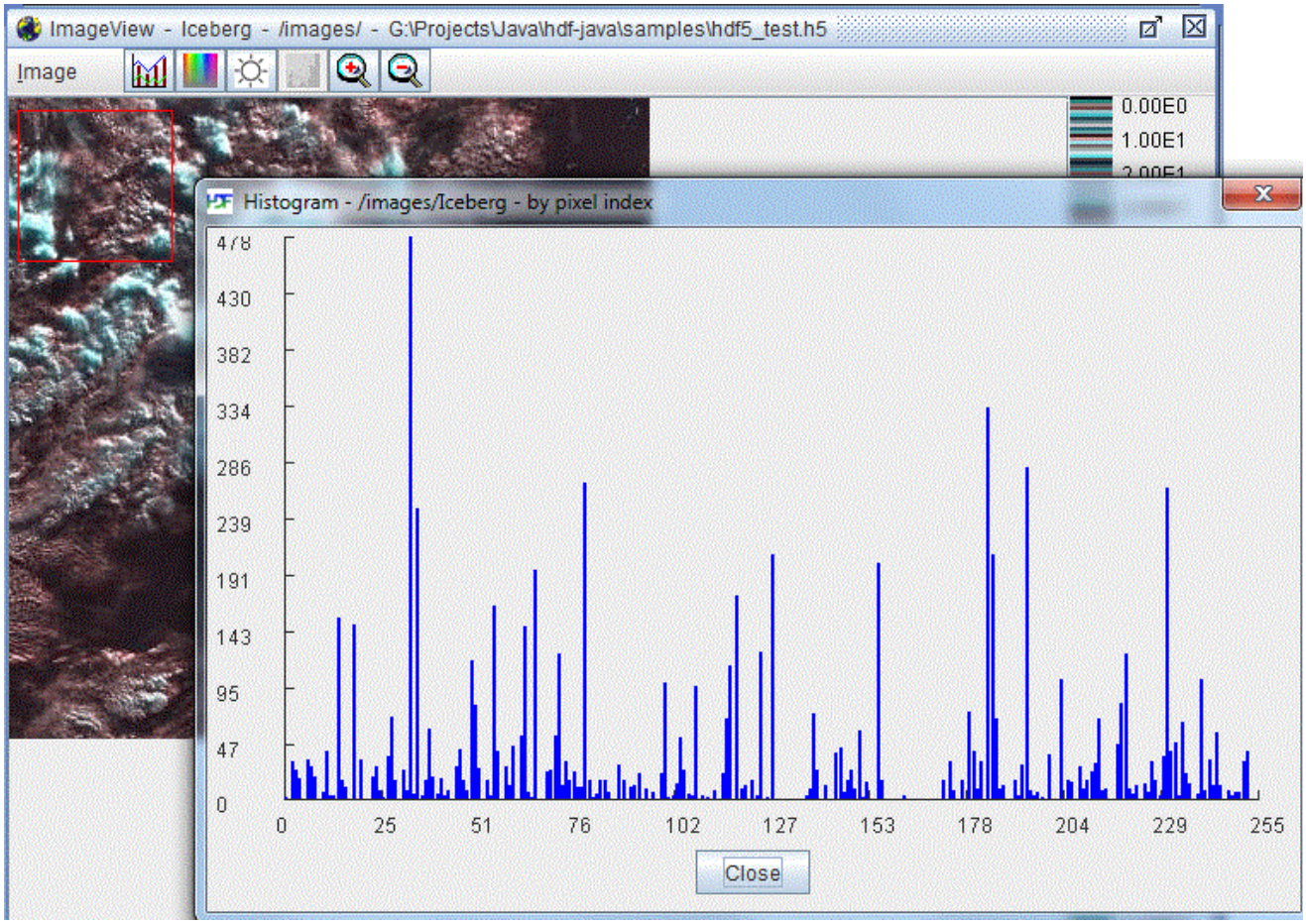
You can modify the values of the color table. Select the color (red, green, or blue) in the palette view and drag the line of the selected color. The value of the selected color changes as you move the color line. In the following figure, the image on the left is the orginal image, and the image on the right is the image with a modified color table.



Modified image palette (256 colors)

6.5 Show Histogram of Pixel Values

The frequency of pixel values of a selected area, or the whole image, can be displayed in a histogram chart. The horizontal axis of the histogram chart depicts the 256 pixel values. The vertical axis shows the frequency of the pixel values.



Histogram of pixel values

6.6 Import JPEG, GIF, PNG, or BMP Image to HDF4/5

Using HDFView, you can convert a JPEG, GIF, PNG, or BMP image into an HDF4 or HDF5 image. Select the “Convert Image To” command in the Tools menu, a popup window prompts you to choose the image file that you want to convert. The image is converted into a 24-bit HDF4 or HDF5 image. The current conversion does not support an image with indexed color model or an image with less than two color components. The image data is saved as an 8-bit unsigned integer regardless of the data type of the original image.

6.7 Save HDF Image to JPEG, GIF, PNG, or BMP File

Using the “Save Image As” command in the “Image” menu, you can save the current HDF image as a JPEG, GIF, PNG, or BMP file.