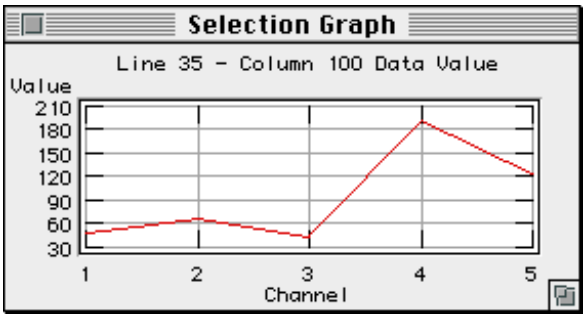
Blue-Band Corrections for GLOBE© Multispectral Landsat Images

A MultiSpec Tutorial

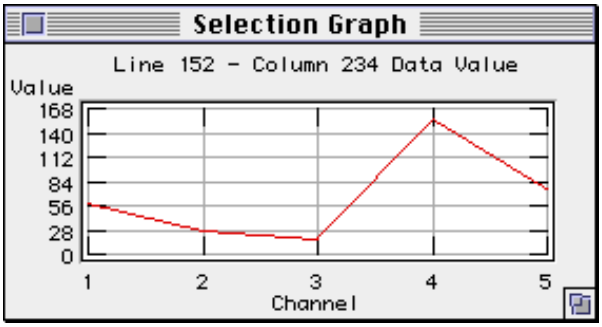
Produced at The University of New Hampshire

Introduction

As part of the GLOBE Program, member schools are provided with 512 pixel x 512 pixel Landsat Thematic Mapper (TM) satellite images for use in Land Cover studies. In the GLOBE training sessions, trainers and teachers are taught to observe and recognize the spectral reflectance patterns of various types of surface materials.[1] When examined, however, the patterns in the images provided to schools do not exactly resemble those used in training materials. This is especially pronounced in the values shown for Channel 1, the values for the satellite "blue band." The blue band values for school images are significantly higher than those used in the Beverly, Massachusetts, training image, as shown below.



Expected spectral pattern for vegetation from Beverly, MA, image, corrected for blue-band.



Spectral pattern from vegetated pixel in an image **not** corrected for blue band.

The problem lies with the degree of processing done to the images provided to schools. The processing center does not correct these images for blue light scattered in all directions by our atmosphere. The sky is blue, of course, because molecules of atmospheric gasses preferentially scatter wavelengths of light corresponding to the color blue. Some of this scattered radiation reaches the satellite sensor. Therefore, the energy seen by the satellite (the At Satellite Radiance) is not the same as what left the ground (the surface Reflectance.) The images used in training have been corrected for this atmospheric effect.

The purpose of this tutorial is to allow the user to make a similar correction to the images provided to schools and training centers in the GLOBE program.

The process of correction is not particularly complex, but it does require that the operator be familiar with the MultiSpec software. Before beginning this tutorial, you should work through the tutorial "Introduction to the MultiSpec© Program," provided in the Toolkit section of the GLOBE Teacher's Guide.

NOTE: MultiSpec is available in both Macintosh and PC formats. Originally developed for the Macintosh platform, the software is being produced by LARS at Purdue for PC's but its development is not complete at this writing. The screen views shown in this tutorial were taken from the Macintosh version of MultiSpec. The process described in this tutorial is not yet available in the PC version.

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1 See the MultiSpec© tutorial materials in the Toolkit of the GLOBE Teacher's Guide. For information on the GLOBE Program, visit the GLOBE WWW site at: http://www.globe.gov

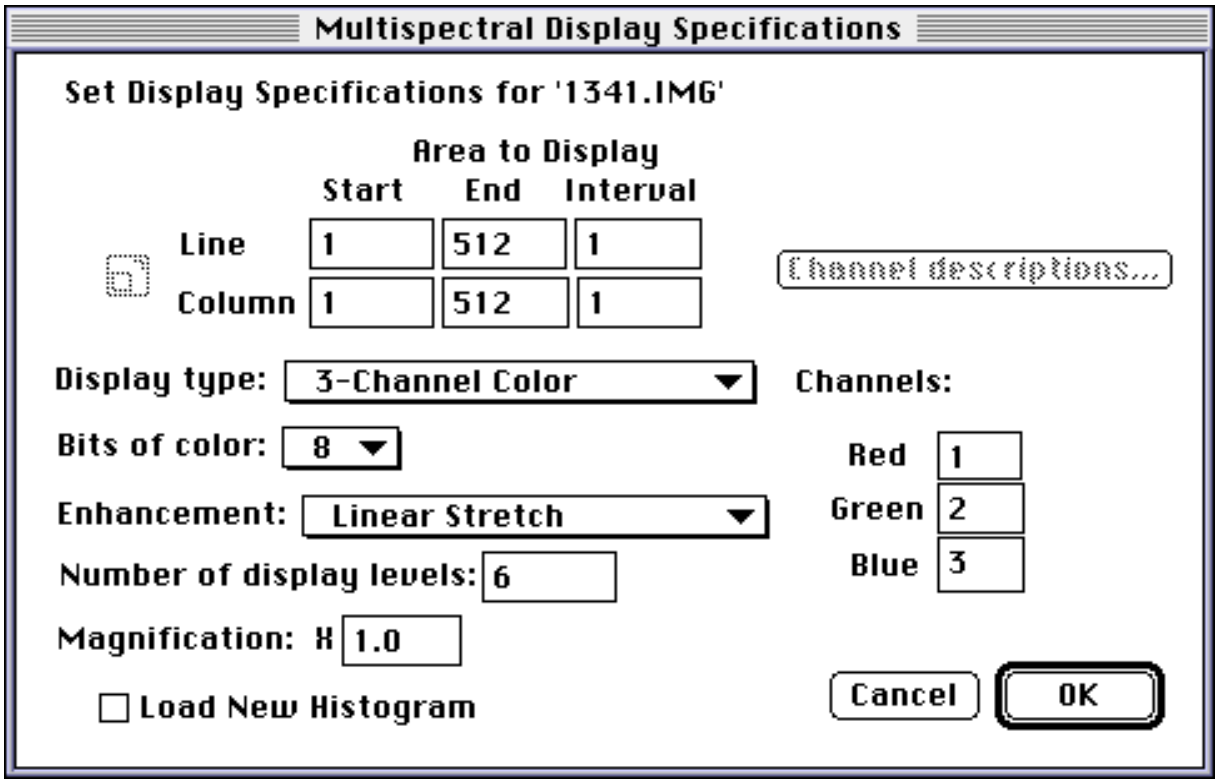
The MultiSpec© software is available on line, at no cost, from the Laboratory for the Applications of Remote Sensing at Purdue University: http://dynamo.ecn.purdue.edu/~biehl/MultiSpec/

An Important Note: If your school image was provided by GLOBE after January 1, 2001, your image may contain georeferencing data (information on latitude and longitude) not present in earlier GLOBE images, the final step in processing this image is slightly different. **Older** images, without georeferencing, are provided with ".lan" and ".ddr" extensions. **Newer** images are provided as ".bil", ".hdr", and ".prt" files. Examine the files on the disk sent to you by GLOBE to determine which formats you have.

How you save your image after the processing described here differs for the two file types. Be certain to follow the appropriate procedure on page 17.

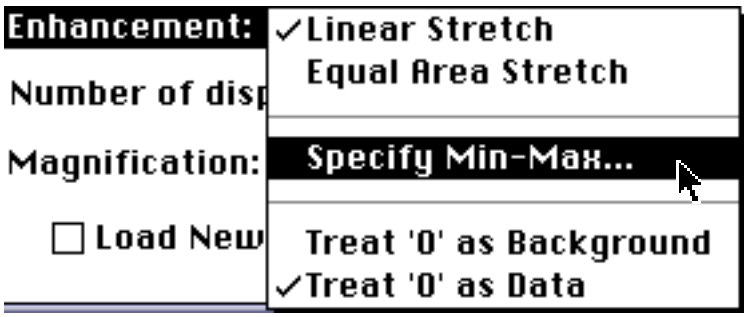
Opening the Image and Gathering Needed Data

- Launch MultiSpec
- From the **File Menu**, select **Open Image**
- The standard "**Display Specifications**" window opens as shown below.

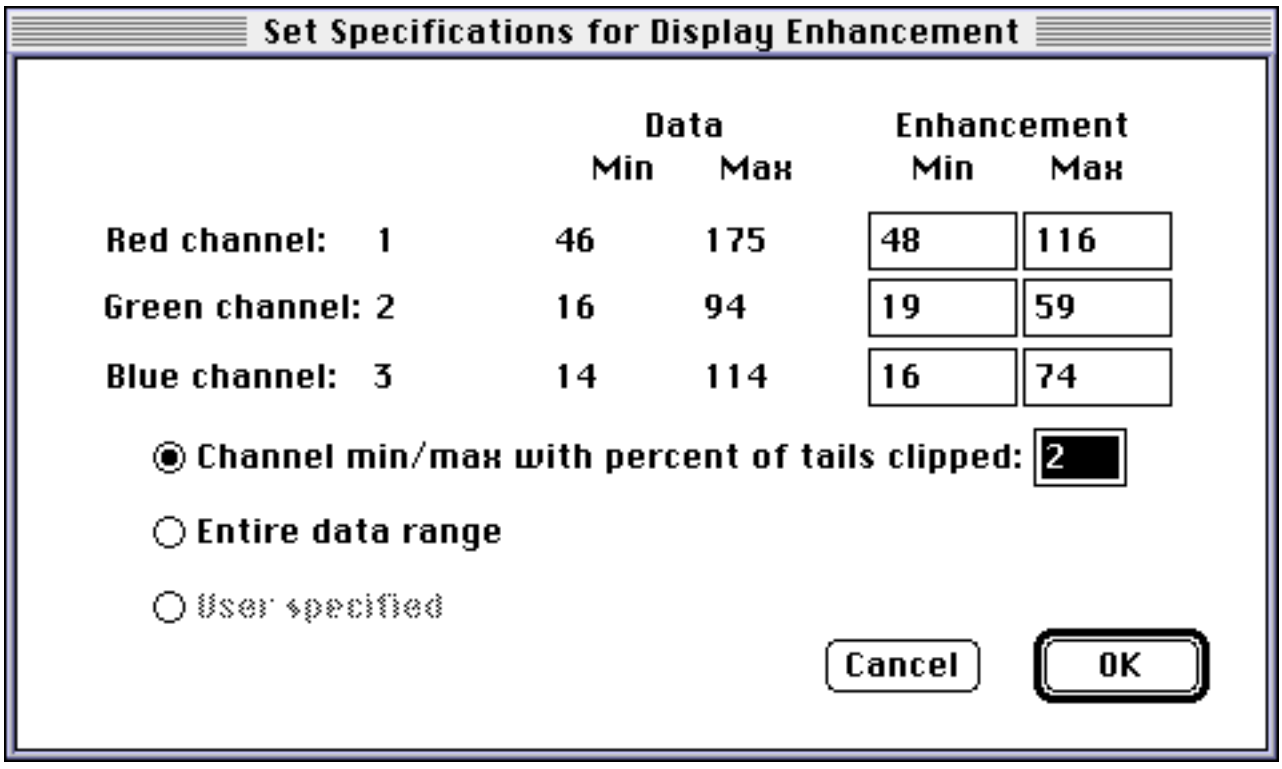


- In the **Channels** selection windows, enter the band combination 1, 2, 3 as shown above. This is different from the normal "**True Color (3, 2, 1)**" or "**False-Color Infrared (4, 3, 2)**" view, but is necessary for this tutorial.
- Click **0K**. The image will open with colors perhaps looking unusual, but this is not a problem.

- From the **Processor** menu in the main menu bar, select **Display Image**. The **Display Specifications** bax opens again.
- From the **Enhancement** pull-down menu, as shown to the right, select "**Specify Min-Max...**"
- The window shown below, the "**Set Sprecifications for Display Enhancement**" opens. Under the heading "**Enhancement**" copy down the **Min** and **Max** values shown for channels **1 through 3**.

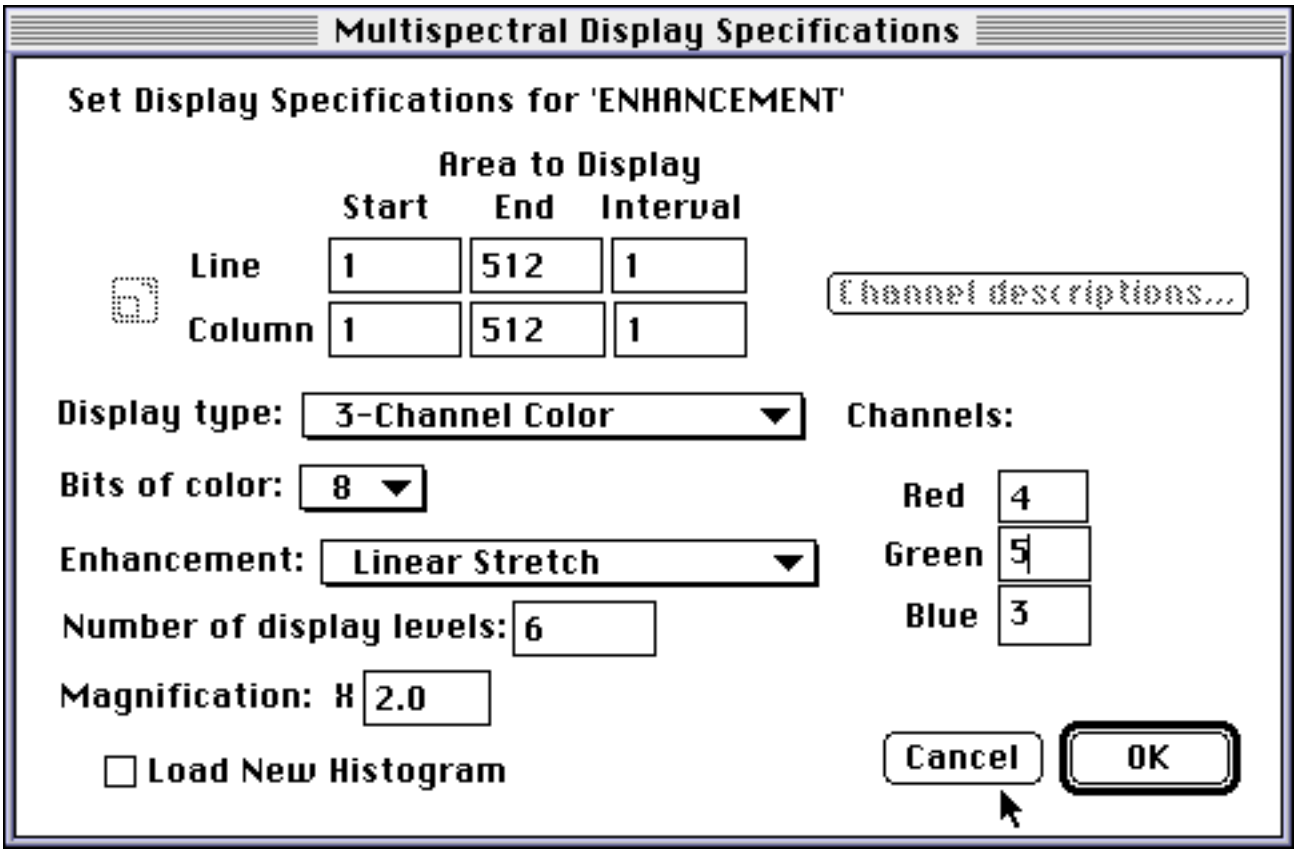


NOTE: The values shown in screens for this tutorial will be different than those you encounter with your own image. They were taken from an image of Utah used to develop this tutorial.



- Click **Cancel.**
- You return to the **DisplaySpsecifications** screen.

- In the **Channels** windows, enter “4” and “5” for the Red and Green channels, in that order, as shown below.



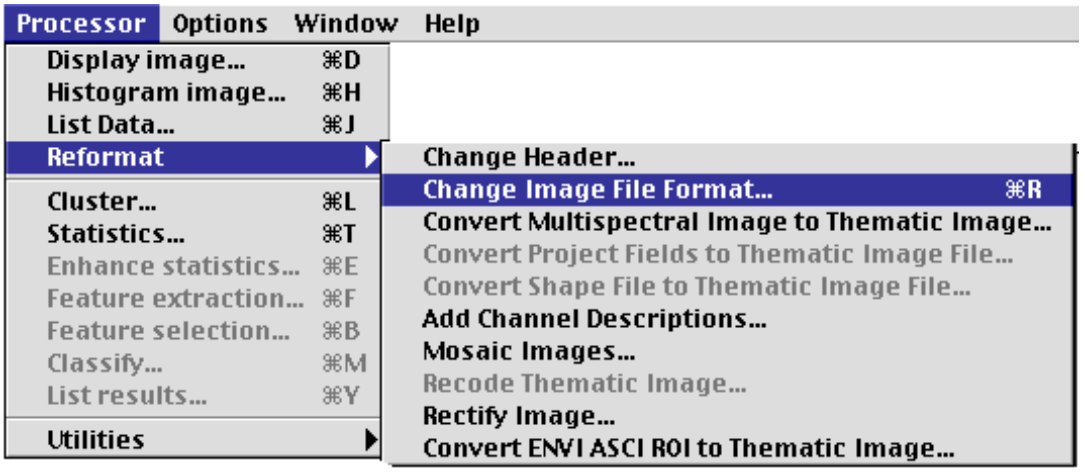
- Again, select “**Specify Min-Max...**” from the Enhancement window.
- Copy down the **Min** and **Max** values for Channels 4 and 5, just as you did for Channels 1 - 3.
- When you have copied these data, press “**Cancel**.”

NOTE: This tutorial assumes that your image contains 5 channells, which is standard for images supplied by the GLOBE program to its participating schools. If your image has a different number of channels, modify the instructions to fit your number of channels.

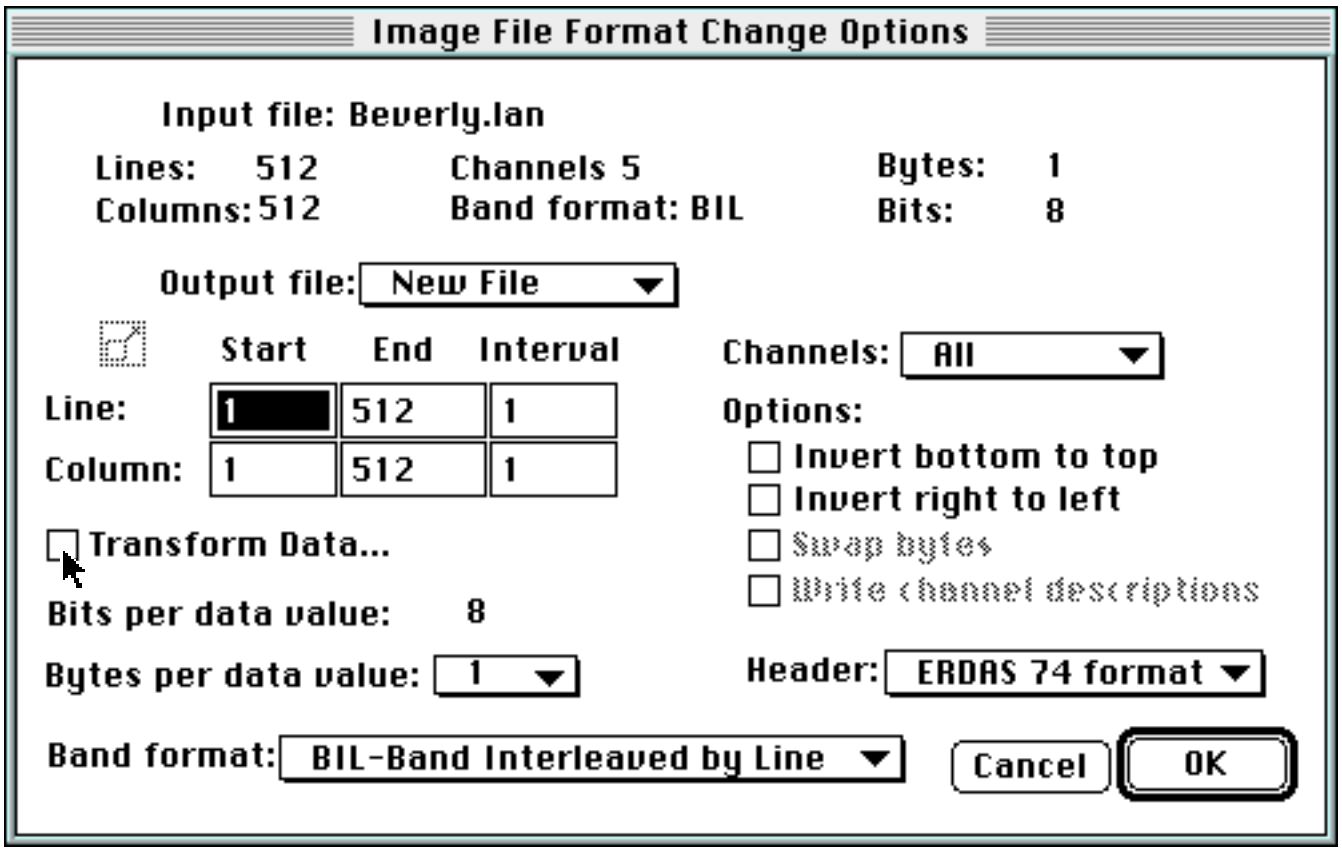
Processing the Data: "Stretching"

In your remote sensing work in GLOBE, you have seen that pixel values for a Landsat image may range from 0 to 255. The data for the channels in your image do not cover that range, nor is it necessary that they do. In this section, you are going to take the data for each channel separately, "stretch" it proportionately over that range of 0 to 255, and then save it as a new channel. Once you have made five new channels, one for each band in your original image, you will put these new channels back together to make a new, corrected image.

- From the **Processor** menu, select **Reformat --> Change Image File Format, as shown below.**



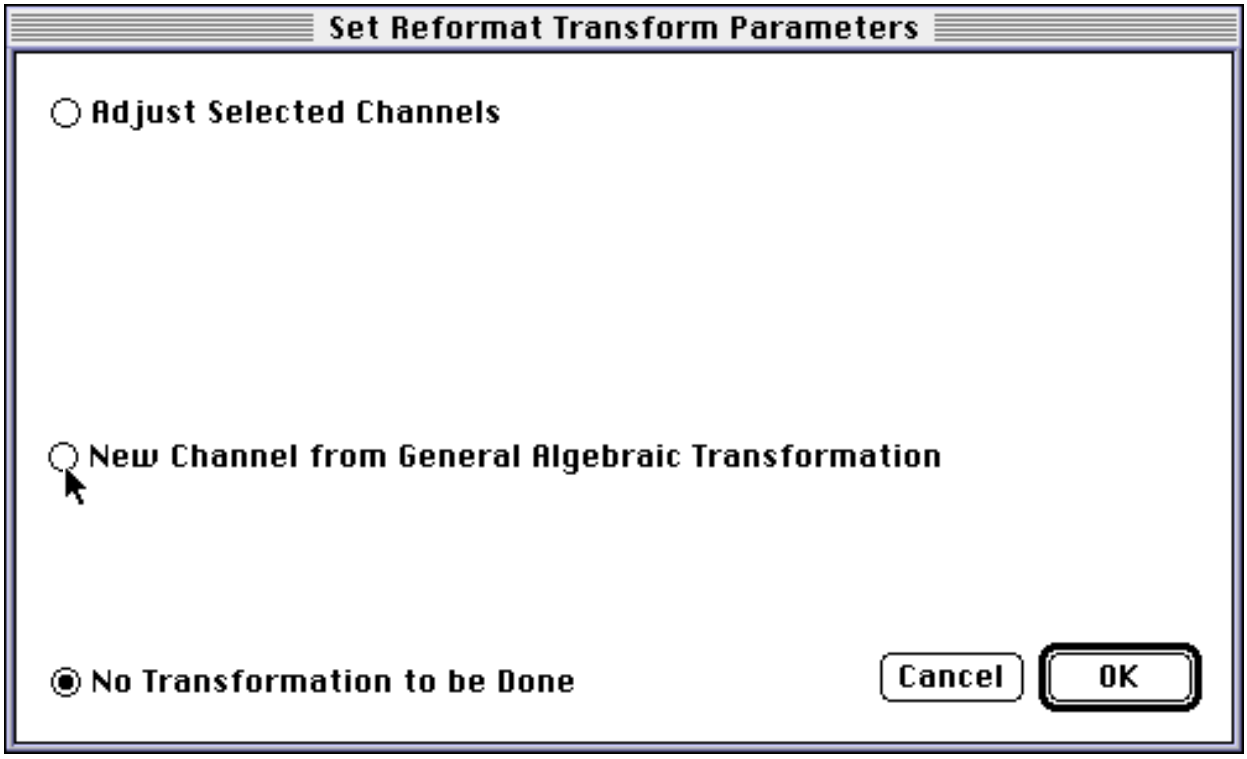
As shown below, the **Image File format Change Options** window opens.



- Click once in the **Transform Data...** box, as indicated by the cursor in the diagram above.

You will immediately proceed to the next screen, without needing to press **0K**.

- The "**Set Reformat Transform Parameter**s" window opens, as shown below.



- Click the button marked "**New Channel from General Algebraic Transformation**."

In the screen that follows, you will be entering an equation to "stretch" the values of channel 1 proportionately over the range of 0 to 255. The illustration uses values from the author's image, but you must use the values you obtained earlier for the channels in **your** image.

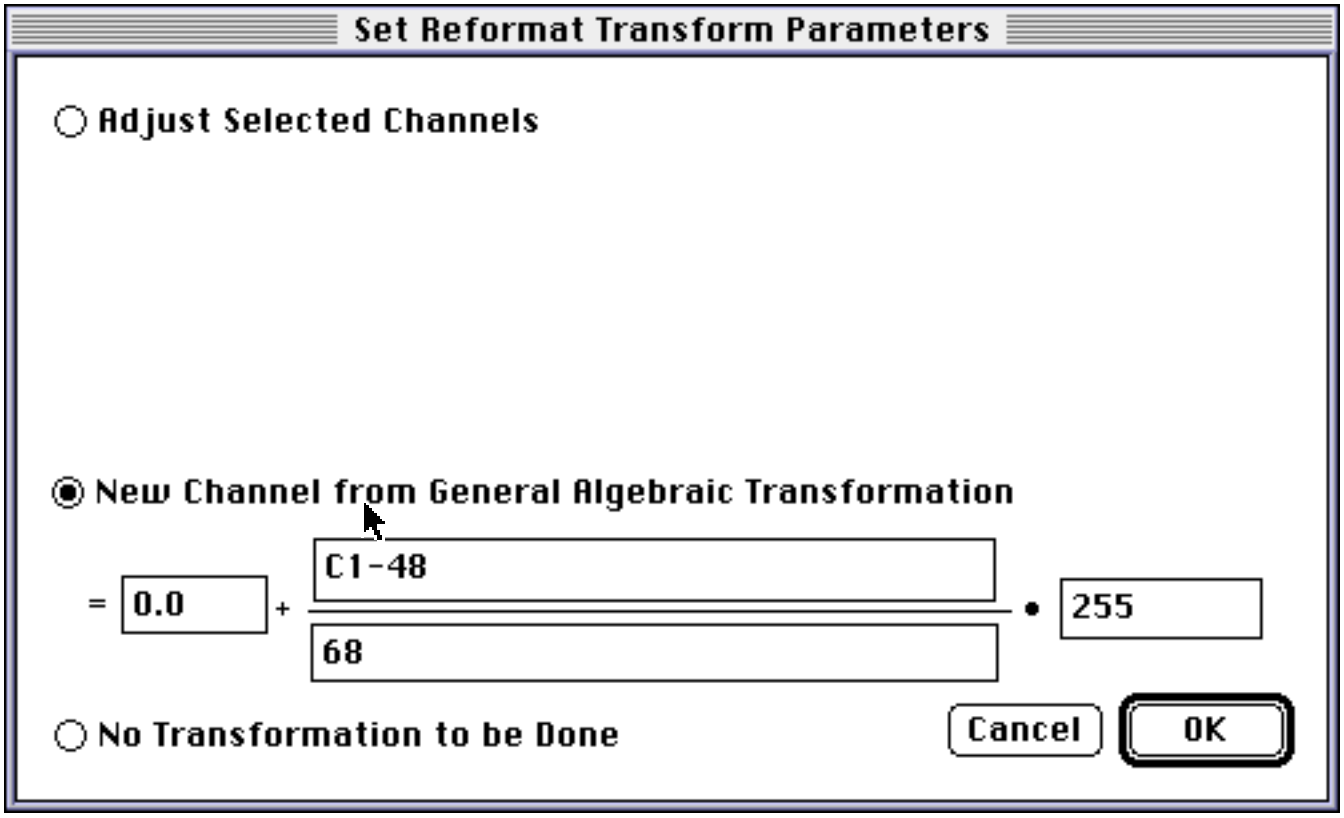
The equation we will be using is:

$$\text{New Channel \#1} = \frac{\text{Old Channel 1 - Minimum Value}}{\text{(Maximum - Minimum) for Old Channel}} \times 255$$

In the screen from the author's computer, on page 4, the minimum value for channel 1 was 48 and the maximum value was 116. Therefore, the equation for the author's stretch would be:

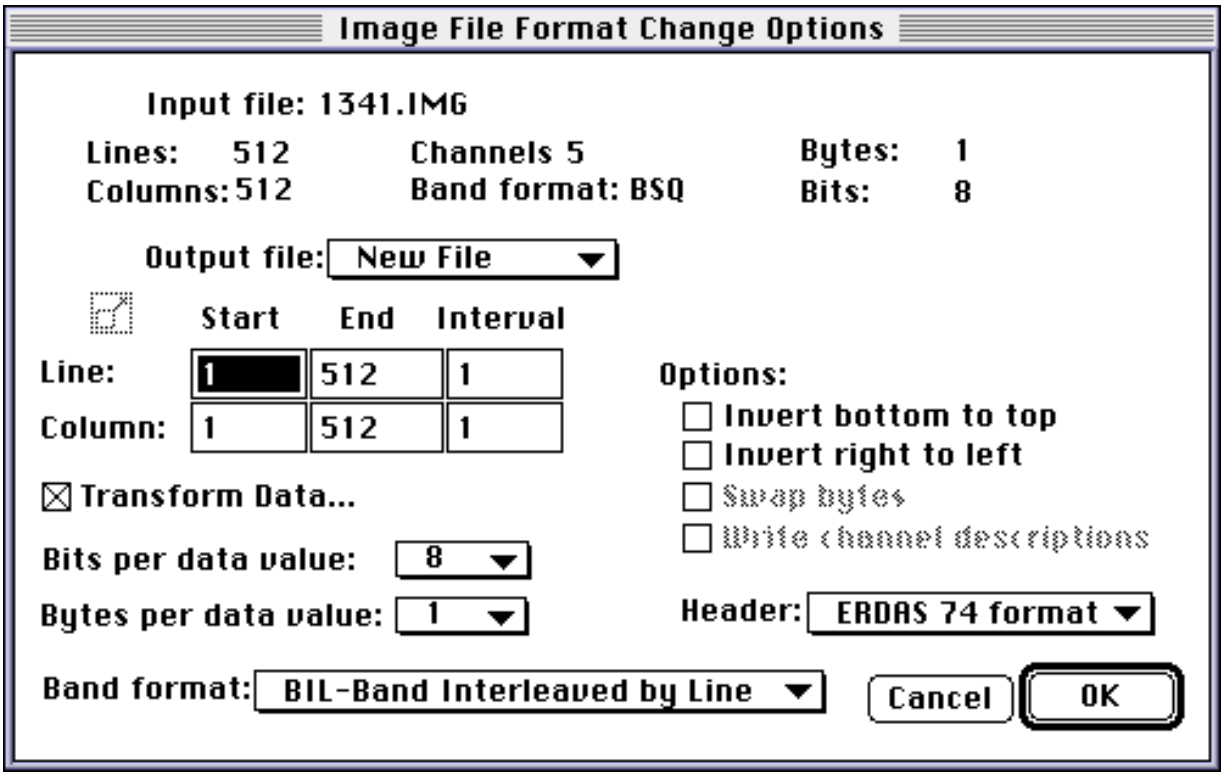
$$\text{New channel \#1} = \frac{\text{C1 - 48}}{68} \times 255$$

- The "**Set Reformat Transform Parameters"** screen opens. It is here we enter the equation that will stretch the channel values.
- The values shown in the screen are from the author's example.
- Using the "**Tab**" key, move from entry point to entry point in the equation and **enter the values appropriate to channel 1 in your image**. Notice that the equation begins with "C1." This tells the system to take the value for channel 1, for each pixel, subtract the Minimum value from, divide by the difference, and multiply by 255.

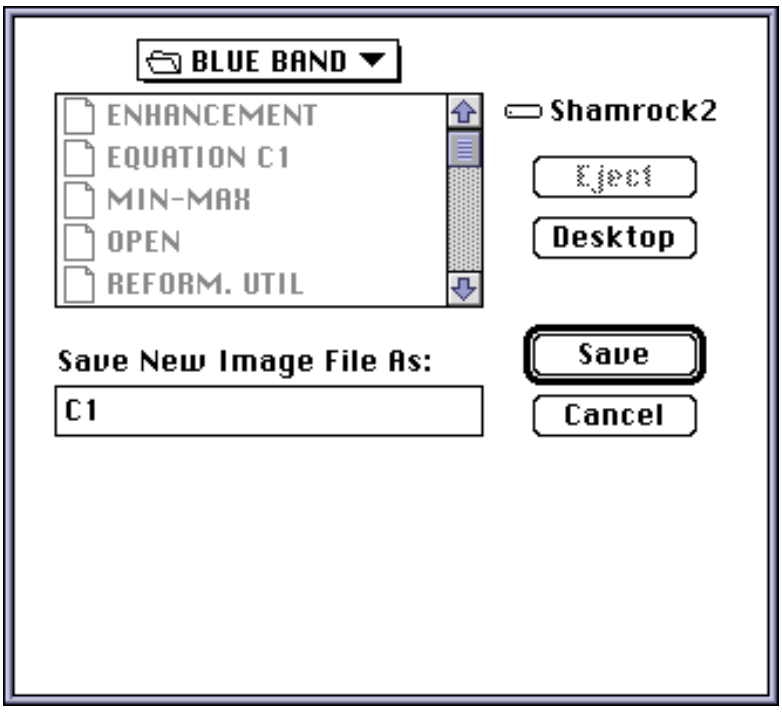


- Click **0K**

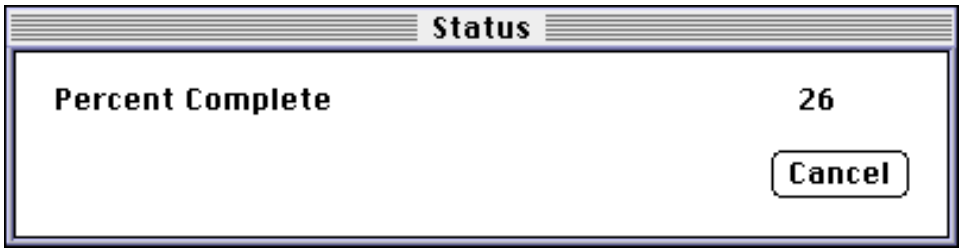
- The **Image File Format Change Options** screen, shown below, opens.



- Click **0K**
- You then get the standard Macintosh "**Save**" window. Name this file **C1** (for channel 1) and save this to the directory of your choice.

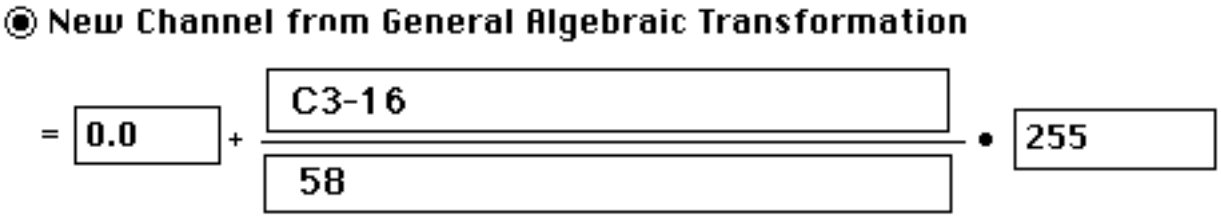


- The **Status** box, shown below, shows the progress of this operation.



- You are now returned to your image. The task now is to **repeat the exact same process for channels 2 - 5** (assuming your image has only 5 channels, as in the standard GLOBE school image.) For each channel, the equation should be changed. For example, the channel **3** equation (using the author's data from page 4.)

For channel 3:



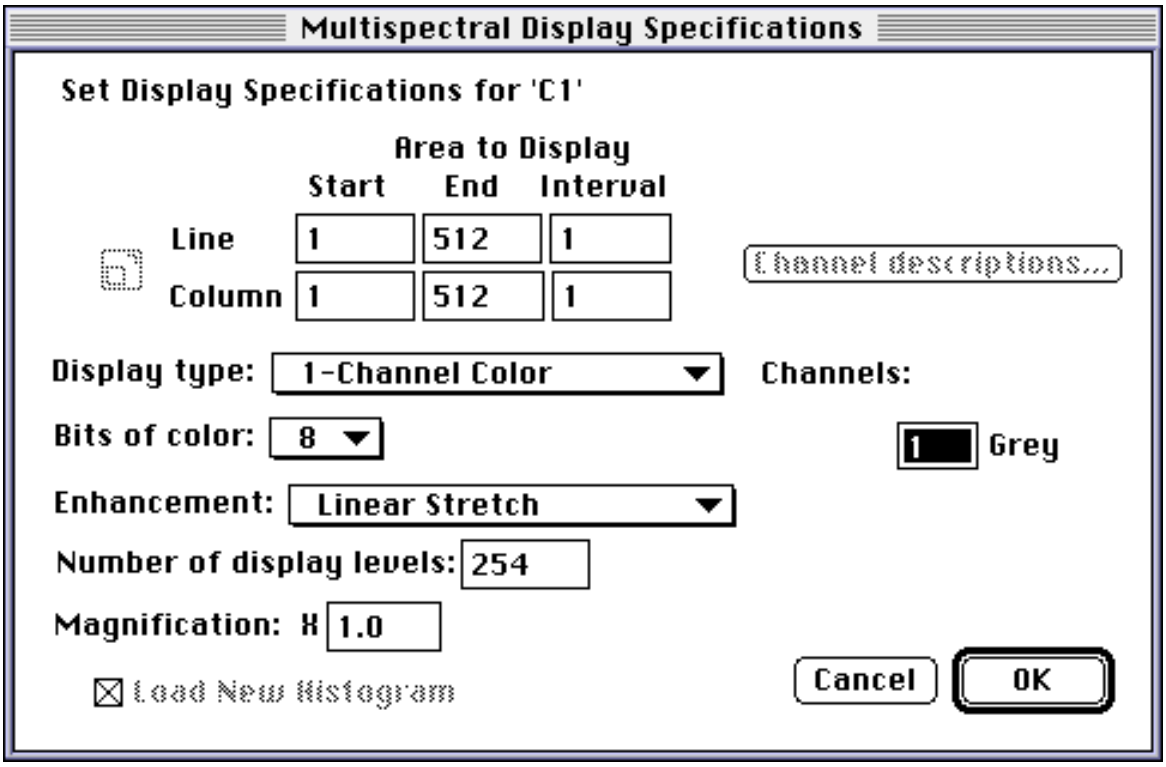
- **Save** subsequent channels as C2, C3, C4 and C5, all in the same directory (folder) as you saved C1.
- When you have saved all the new channels, **Close** the open image window.

The next step is to put these new channels together to make a multispectral image.

Assembling the New Channels (Compositing)

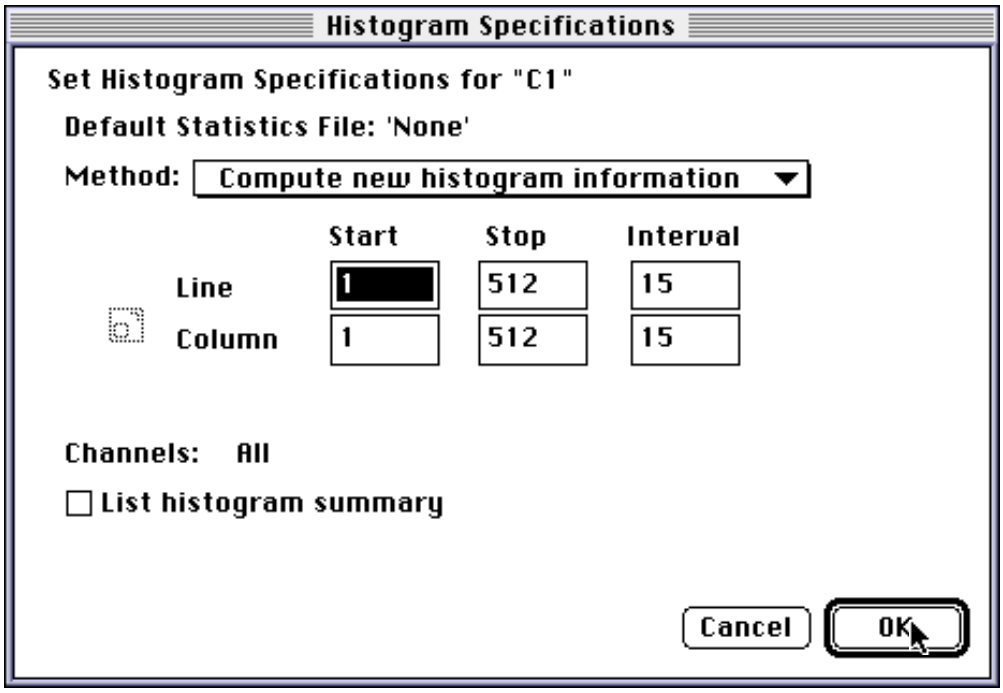
You should now have 5 separate files, labeled C1 - C5. Each represents a separate "layer" of your image, each in a different part of the electromagnetic spectrum. These must now be assembled to make a new, "whole" image.

- Launch MultiSpec, if it is not open, and from the **File** menu, select **Open Image**.
- Select the file **C1** and click **0K**. The screen shown below appears.

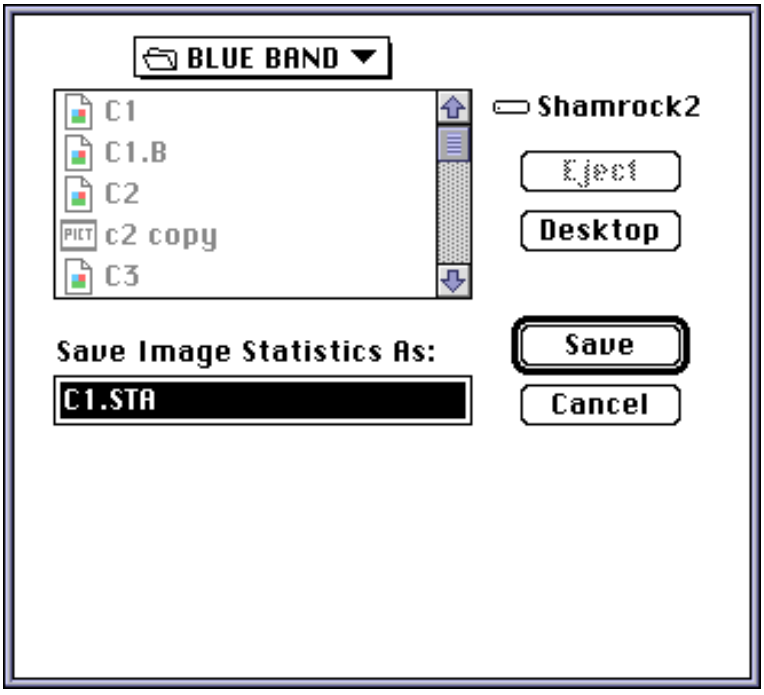


- Notice that the image will open automatically as a "**1-Channel Color**" image, in "**Grey**." This image has only one channel, and single channel images are displayed as grey.
- Click **0K**.

- When you click **0K**, the "**Histogram Specifications**" window opens. The historgram is a file containing pixel distribution information for your image.
- Click **0K**.

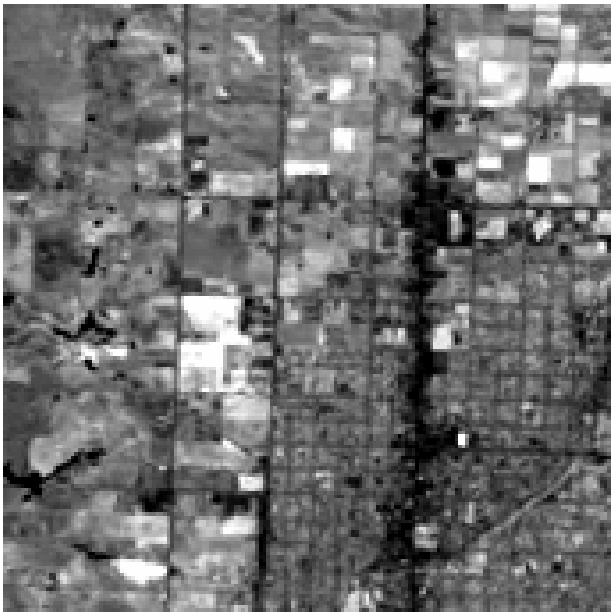


- The "**Save Image Statistics As**:" window opens, as shown below. The newly created file is saved as the "**.sta**" file you see accompanying MulTiSpec's images.
- Click **Save**.



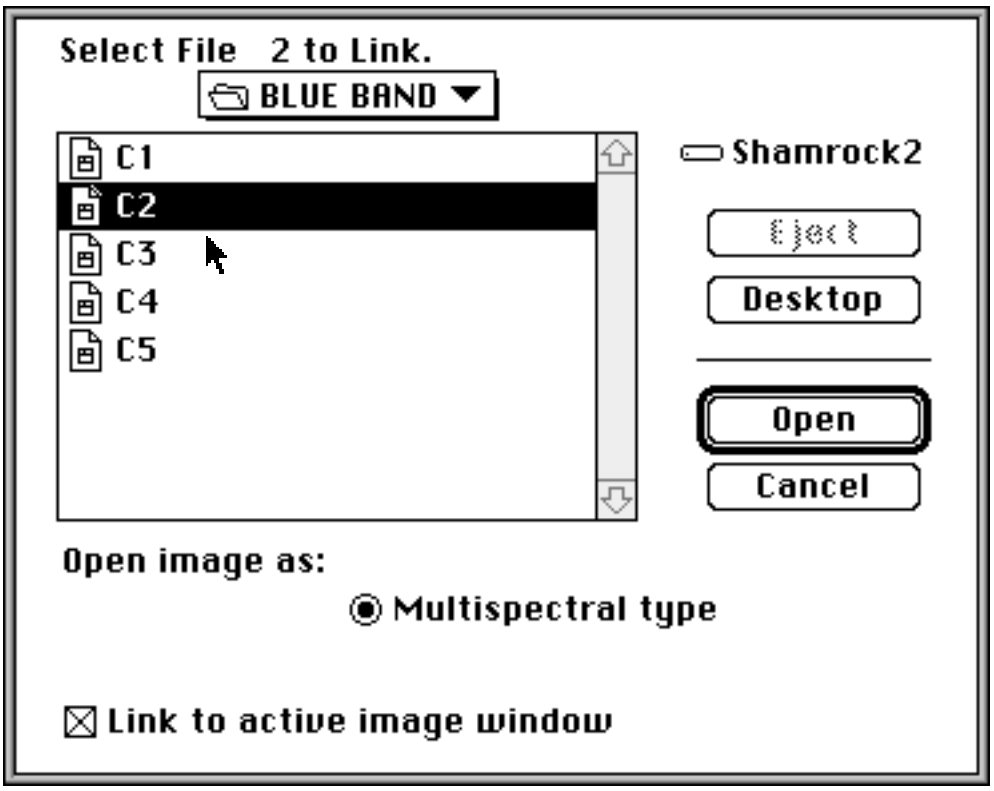
- Your image appears in grey. This is the image as seen only in the Blue part of the spectrum. A portion of a Channel 1 image is shown below. Those areas that are the brightest are those that are most strongly reflecting in this channel.

- The same area is shown below in Channel 4, the Near-Infrared channel. Areas that are bright in this image are those that strongly reflect near-infrared radiation. Such areas are generally vegetated. You will not that the bright areas below generally correspond to dark areas in the image above.



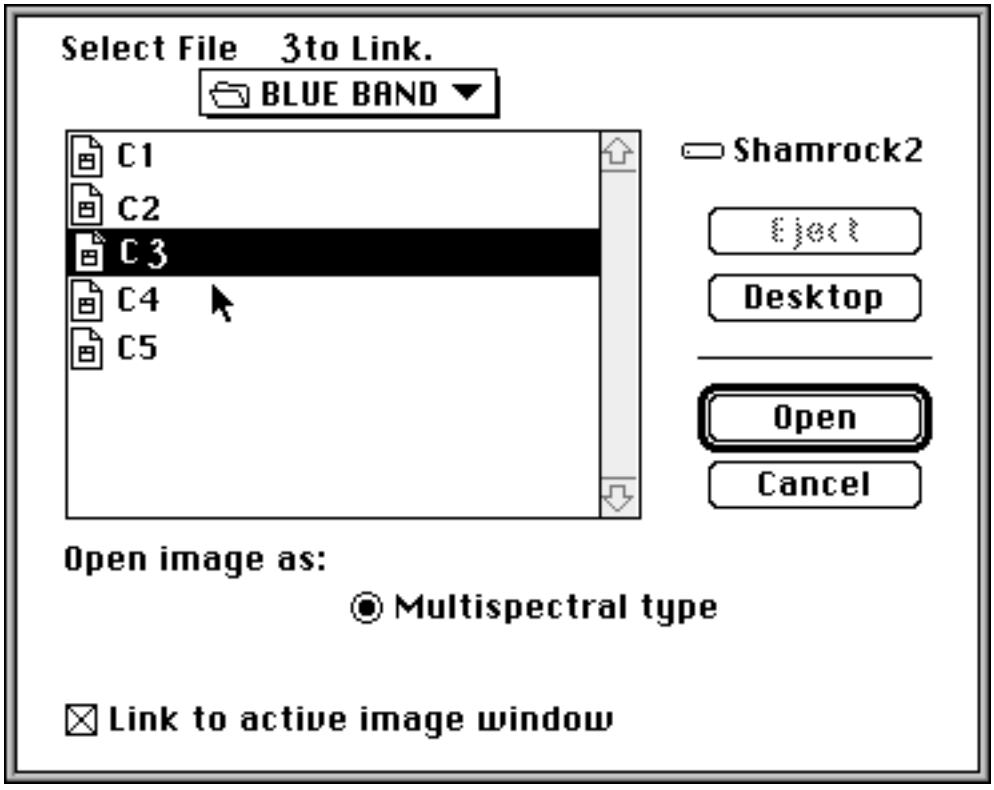
Adding the Other Channels

- From the File menu, select Open Image. The dialog box shown below opens.



- Click in the box before the text "**Link to active image window.**" This tells the system that the next file will become part of the file that is already open.
- Note that the top line says "**Select File 2 to Link**."
- Select file **C2** and click **Open**.

- What appears to be the **same window** appears. However, as shown below, the system is now asking for "**File 3 to Link**."
- Select channel **C3** and click **Open**.



- The window now appears asking for "**File 4 to Link**." Select **C4** and click **Open**.
- Again the window appears, asking for "**File 5 to Link**." Select **C5** and click **Open**.
- The window now asks for "**File 6 to Link**." Press **Cancel**, since there are no more channels to add.

The new image, for that is what you have created, must now be saved under a new name.

Saving Your Image: ".bil" format: See page 18

Saving Your Image: ".lan" format

- From the **Processor** menu, select **Reformat**.
- In the window that opens, Click **0K**.
- Click **0K** in the next window.

This should bring you to the standard "**Save File**" dialog box. The default file name is "**Image File**." It is important that you give your image a name that tells you what it is. Do not use the same name as your original image, but you may use variations. It is also helpful to add an "extension" to this image. This extension identifies the type of image you have. If, for example, you wish to call your image "Old Hill," give it the file name:

Old Hill.lan

The extension "**.lan**" tells you that this file is a Landsat image file.

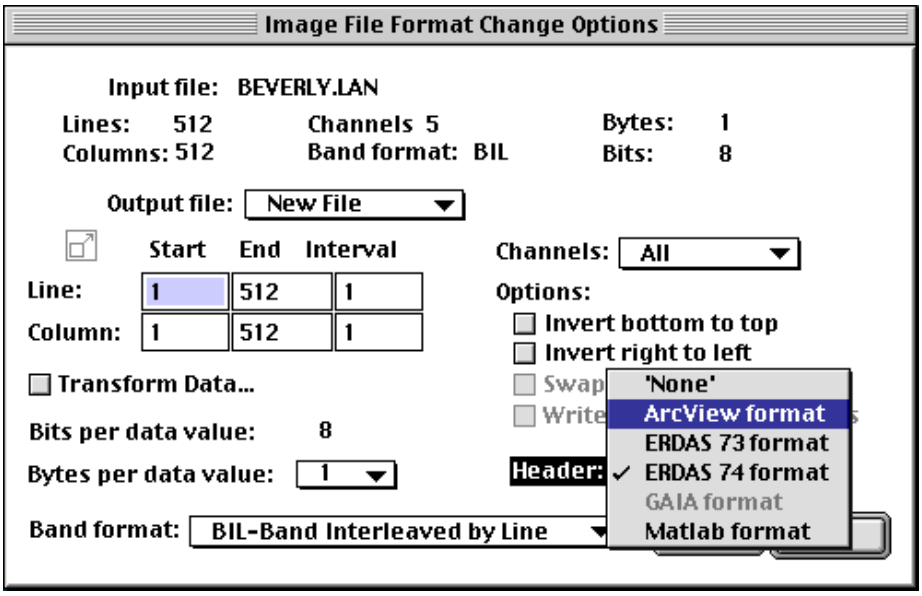
- **Close** the current image window.

Opening Your New Image

- From the **File** menu, select **Open Image**.
- Select your newly named image and click **Open**.
- In the "**Display Specifications**" screen, set the band combination you desire.
- Since this is a new image, you will next see the "**Histogram Specifications**" window, just as you did when you opened the C1 image. Click **0K**, telling the system to build a histogram file for the image.
- At the "**Save Image Statistics As:**" window, click **0K**.

Saving Your Image: ".bil" format

- From the **Processor** menu, select **Reformat**.
- In the **Image Format Change Options** window, select **ArcView** format from the **Header** pull-down menu as shown below.



- Click OK

This brings you to the standard "**Save File**" dialog box. The default file name is "Image File.bil"

- Give your new file the same name and extension as the original, but save it in a different location.
- You will note that, in addition to the ".bil" file, MultiSpec has created a header file, ".hdr." Discard this ".hdr."