# Demo 02: Raster Data Models

The goal of this first lab is to familiarize you with the raster data model (i.e. digital images). At its completion, you should be comfortable viewing images (of several different types) and navigating around them in the ArcMap software. You will be familiar with techniques designed to enhance images, such as histogram stretching and filtering. There is also a lab assignment at the end. You should work through this during the demo using the sample data and then do the assignment with the data for your study area.

I.   First, download the data for this lab from Sakai.

   a.   Refer to Demo 01 if you need a refresher on this process.

II. First, we will work with manipulating a single-band gray-scale image.

   a.   Make sure you have added the "**SPOT_1987_NotreDame.tif"** file.

   b.   We will first change the stretch on the image. There are two ways to do this in ArcGIS 10.

      1.   The better, but slower, way is to access the **Layer Properties**.

      2.   Do this in the Table of Contents by double clicking on the name of the layer or right clicking and choosing "**Properties**"

      3.   This brings up the Properties window. Each tab has some type of information about the layer.

         i.   The first, "**General**" lets you enter some basic metadata for the later, edit its display name and choose whether it is visible. All of the useful tasks for this tab can be done in the Table of Context as well.

         ii.   "**Source**" is possible the most informative. It contains information like the Extent, Cell Size (spatial resolution), number of bands, projection and extent.

         iii.   "**Extent**" simply allows you to set if the whole image is displayed or small part of it.

         iv.   "**Display**" allows you to adjust the brightness and contrast, transparency and display quality. Most of these can be adjusted in the Image Analysis discussed below, so we will leave it for now.

           a.   Try a simple change in the brightness and contrast.

              1.   Increase the Contrast to 70 and the Brightness to 30.

              2.   This should make the image somewhat more clear.

              3.   Experiment a bit with the Contrast and Brightness. When done set them back to 0%.

         v.   Finally is the "**Symbology**" tab. This is where we will change the stretch of our image

   c.   Here you have a number of different choices for how the image is displayed.

      1.   The high and low values that you can edit are just the labels, they do not change the image

      2.   The Color Ramp: The black to white color map that we use is not obligatory, but it does usually maximize visibility between values.

      3.   You can change whether the background
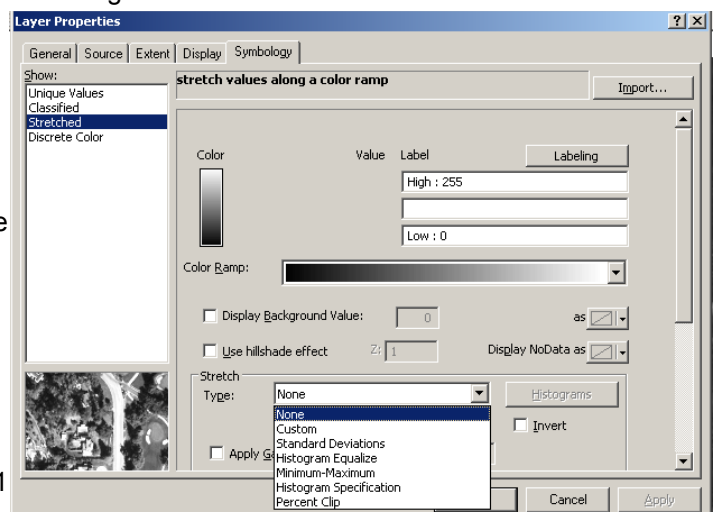
value is displayed. Usually, if the image is rectangular, you will leave this on.

4. Most important for this lab is the section labeled "**Stretch"**

5. Choose different stretches from the dropdown menu and see their results in the viewer by clicking Apply.

d. To perform our own stretch, click on the button labeled "**Histograms**"
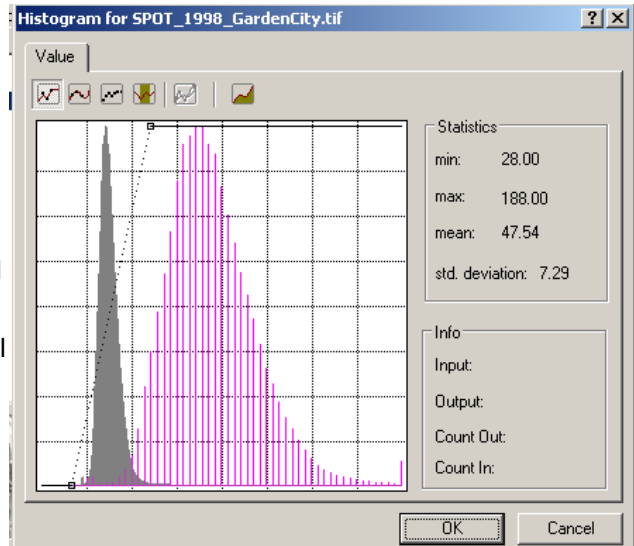
1. These should look familiar from lecture. The window displays basic information on the right and the editable histogram on the left.

2. The gray histogram is the real data and pink histogram is what will be displayed.

3. You can drag the white boxes along the dotted line to edit the histogram.

4. Be careful, clicking anywhere on the image will create a new editable point. These are no easy to get rid of, but dragging them to one corner or another seems to work.

5. You have a series of buttons across the top

    i. The first 3 allow you to work in straight lines, curves, or by dragging the mouse to a custom shape. You should leave it on the first usually, but feel free to experiment with the others.

    ii. The 4th button gives you information about how selected area will be displayed.

    iii. The 5th is usually grayed out, but it smooths a custom curve a bit

    iv. And the last button switches the histogram to a cumulative display.

    v. To see the results of your custom histogram, you must click "**OK'** to return to the previous window and then click "**Apply**"

   vi. After you experiment a bit with these, choose and apply a Standard Deviation stretch

III. We will now experiment a but with the other way of applying stretches and filters, the **Image Analysis** module.

a. To access it, go to **Windows → Image Analysis**

1. At first, the window will be free-floating (and in the way), but you can dock it where you like. Personally, I usually put it to the far right with the Catalog.

2. If you dock it to one side or another you can use the pin button to hide it without closing it.

b. The Image Analysis window is broken up into 3 main sections

1. The topmost section lists the images present in your viewer and lets you select if they are visible or not with the check box. To enable any of the other tasks you must select one layer in this window.

2. The middle section is where you can adjust the display of the selected image without changing it.

    i. The sliders control (in descending order) the brightness, contrast, transparency and gamma. Clicking on the icons will reset the values.
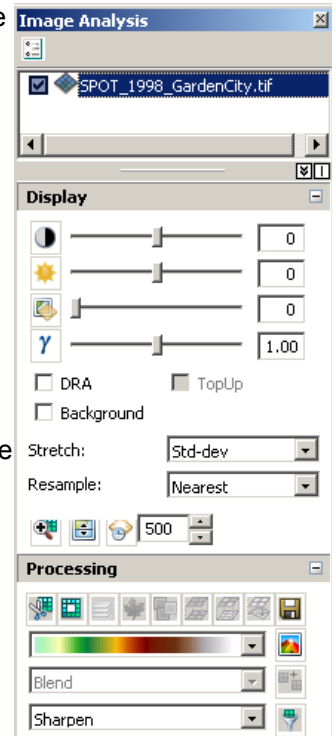
      ii.   You also have the option to change the stretch a bit, though there is no option for custom stretches here.

      iii.   Resample refers to how the program chooses values if the image is warped at all. For now it is fine to leave on Nearest.

      iv.   Along the bottom of the Display section are tools for viewing multiple layers at once. We will make use of these in a future lab.

3. The bottom-most section is where we can do real image processing, that is changing the image significantly by applying a kernel or statistical filter and then saving the results to a different file.

      i.   The buttons across the top are shortcuts to perform a series of specific tasks. Each will create a new temporary layer than can later be made permanent.

          a.   These include Clipping (cropping), masking, combining layers, computing differences and creating vegetation and other standard indices.

          b.   Rather than explaining each of these tasks at once, we will discuss them as we need them in later labs. But if you are interested, full details on each can be found in the ESRI help by searching for "Image Analysis window: Processing section."

      ii.   More important here are the three drop-down menus under these tools.

          a.   The top one (🖼) is for shading elevation datasets. We will use this later

          b.   The middle (▦) mosaics several selected layers into one

          c.   The bottom (▼) is the one we will be using the most. It lets us filter the image like we discussed in lecture.
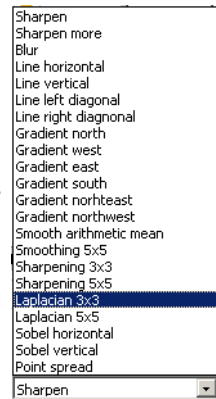
             1.   As you can see there are a number of different filters that we can run.

             2.   From here you can not enter your own kernel, but there is another tool where it is possible.

             3.   Also, there does not appear to be a "Smoothing 3x3" in the drop-down menu.

             4.   For now, choose "Sharpening 3x3" and click on (▼) to run the filter.

             5.   A new layer called "**Filter_SPOT_ 1987_NotreDame.tif**" should appear in the Table on Contents. To save this filtered image you can either :

                i.   Select it in the Image Analysis window and click on the (💾) button in the Image Analysis Window, not at the top of the screen

                    a.
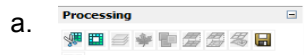
                ii.   Right-click on it in the Table of Contents and choose **Data** → **Export Data**

             6.   Experiment with some of the other filtering techniques

             7.   Some of these should highlight particular types of landcover, including gradients and linear features.

IV. Working with multi-band (multi-spectral) imagery

   a.   Thus far we have been working with a single band black-and-white image. Some of these tools are more complicated when used on multi-spectral or color imagery.

      1.   Add the layer **Landsat_MSS_1973_NotreDame.tif**

      2.   Choose Yes if it asks you about building pyramids or calculating statistics.

3. Make sure your new layer is on top of **SPOT_ 1987_NotreDame.tif**

4. When you add the image, it should be with the bands in the order 1, 2, 3.

5. This is a Landsat MSS image from 1973. The colors are obviously a little off.

   i. This is because of several factors

      a. First, the ArcGIS default is to apply a stretch to images with more than one band. This makes it clearer, but can cause some distortion.

      b. Second, the satellites do no sample the entirety of the visible spectrum, so the image will not represent all of what our eyes could pick up without processing.

6. First, we should turn off the stretch.

   i. Enter the Image Properties by double-clicking on the layer name and go to the **Symbology** tab.

   ii. Turn off any stretch by choosing None in the drop-down menu.

   iii. If you want to modify the stretch, you can do it the same way as we did before with gray-scale image. Just note that now, we have tabs representing the Red, Green and Blue guns.

7. Now, we should set up the band combinations to show the infrared layer.

   i. The Image Properties window should be a little different

   ii. On the left you can choose either "Stretched" or "RGB Composite." If you change to Stretched the image will be displayed as a gray-scale for the band you choose.

   iii. To change the bands being displayed in the RGB composite you use the center section. Change the band being displayed by clicking on the name and choosing a new one from the drop-down.

   iv. If you set all three to the same band it will be displayed as a gray-scale.

   v. Also, any of the guns can be turned off. This excludes that color from the display.

   vi. This old Landsat image has 4 bands. 1, 2, and 3 are the visible spectrum and 4 is the infrared. Change the band displayed in the

      a. Red Gun to band 4

      b. Green Gun to band 2

      c. Blue Gun to band 1

   vii. This is the standard display for multi-spectral imagery.
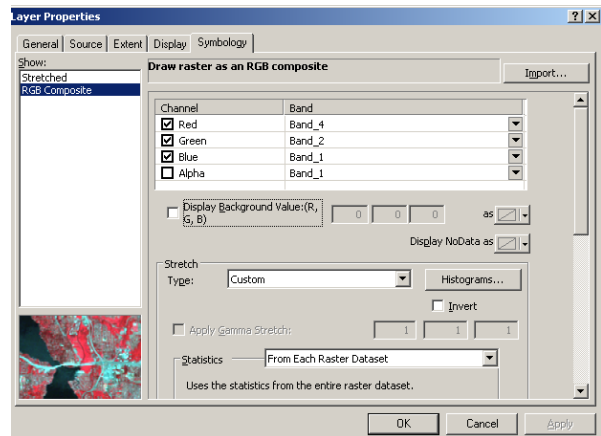
V. Working with multiple image files simultaneously

   a. There are a few things in ArcMap that make dealing with multiple raster layers a little easier

      1. In the Table of Contents you can drag and drop which layer is on top and turn them off and on.

      2. In the Display section **Image Analysis** window there are two buttons that let you do a bit more

         i. : Swipe the top layer back and forth to see whats underneath.

         ii. : Flickers the top layer at the defined interval.