

ArcGIS Spatial Analyst Procedure: How to Stretch Image Pixel Values

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This document will introduce a procedure within ArcMap for "stretching" (or color enhancing) pixel values within a satellite image so that features within the scene are more readily recognizable.

1) Download satellite data onto your hard disk. For this exercise a satellite image will be acquired from:

<http://gis.ca.gov/DRG.epl>

- ⇒ Click on "CalView Landsat Data". (this goes to:
<http://gis.ca.gov/casil/gis.ca.gov/landsat7>)
- ⇒ Click on the "UC Davis, CA" link. (this goes to:
<http://casil.ucdavis.edu/casil/gis.ca.gov/landsat7/>)
- ⇒ Scroll to the bottom of that page and click "by_path_row/". (this goes to:
http://casil.ucdavis.edu/casil/gis.ca.gov/landsat7/by_path_row/)
- ⇒ Scroll down to the image of California which shows the Landsat scene boundaries and click the scene in southern California labeled as 40037. (this goes to:
http://casil.ucdavis.edu/casil/gis.ca.gov/landsat7/by_path_row/40037/)
- ⇒ Scroll to the bottom of the page and you will see directory listings of satellite imagery by year. Click the most recent directory which, as of this writing, is 20020601/. (this goes to:
http://casil.ucdavis.edu/casil/gis.ca.gov/landsat7/by_path_row/40037/20020601/)
- ⇒ Scroll to the bottom of the page. Notice there files with long prefixes. The ".tif" files are the satellite tiff image files. The ".twf" files are the "world files" (which contain coordinate correction information) for the tiff images. The ".jpg" files are jpeg files which are viewable images of the satellite data. We will download the world file first (simply because it's quicker to download) then the tiff file.
- ⇒ Right click on ***17_04003720020601b321.tfw*** then download the world file to your computer.
- ⇒ Right click on ***17_04003720020601b321.tif*** then download the tiff file to your computer in the same directory where you stored the world file. (If not in the same directory then ArcMap will not be able to use the world file coordinates to register the image.)

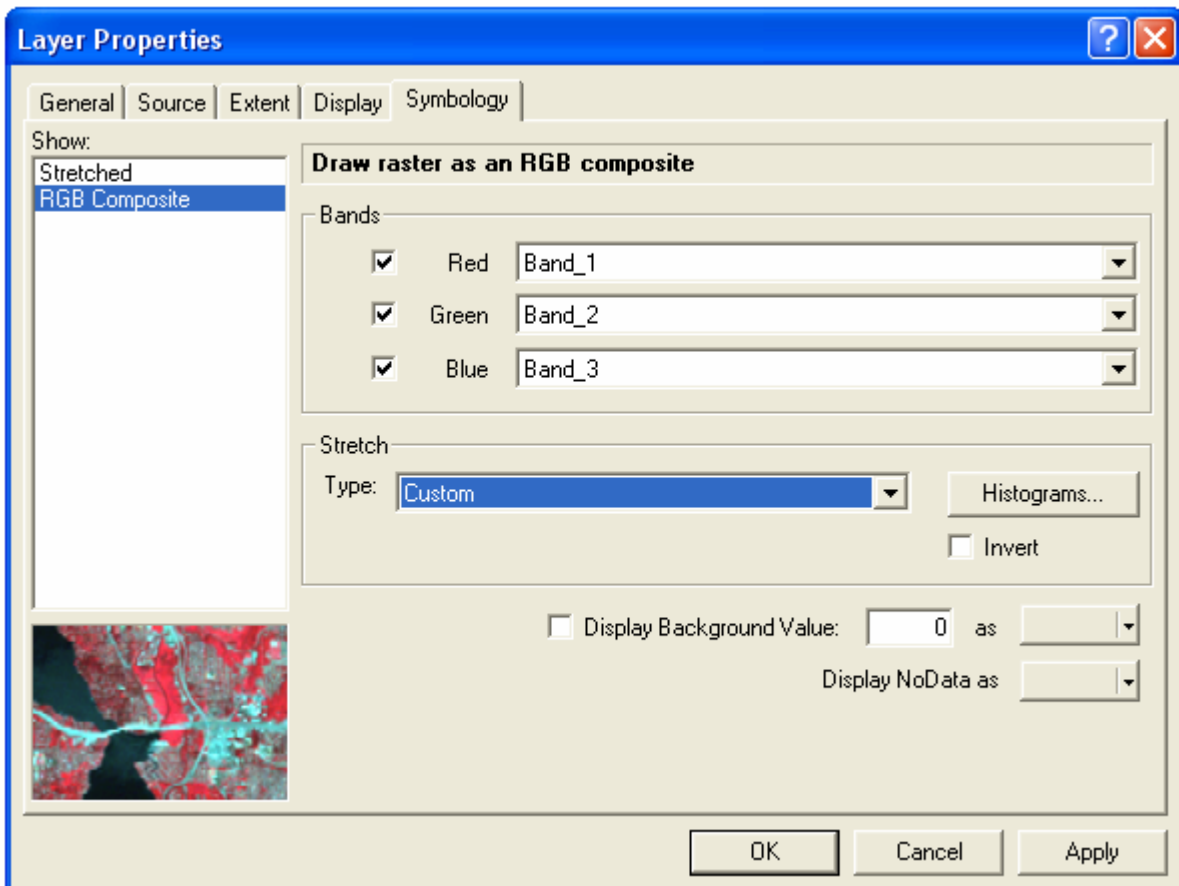
2) Open ArcMap.

3) Open the *17_04003720020601b321.tif* file. Once you open the image you can see that there is a blue tinge across the scene. The stretching procedure will correct for that condition.

4) Open the **Symbology** tab

⇒ Right-click on *17_04003720020601b321.tif* then click

Properties... > Symbology



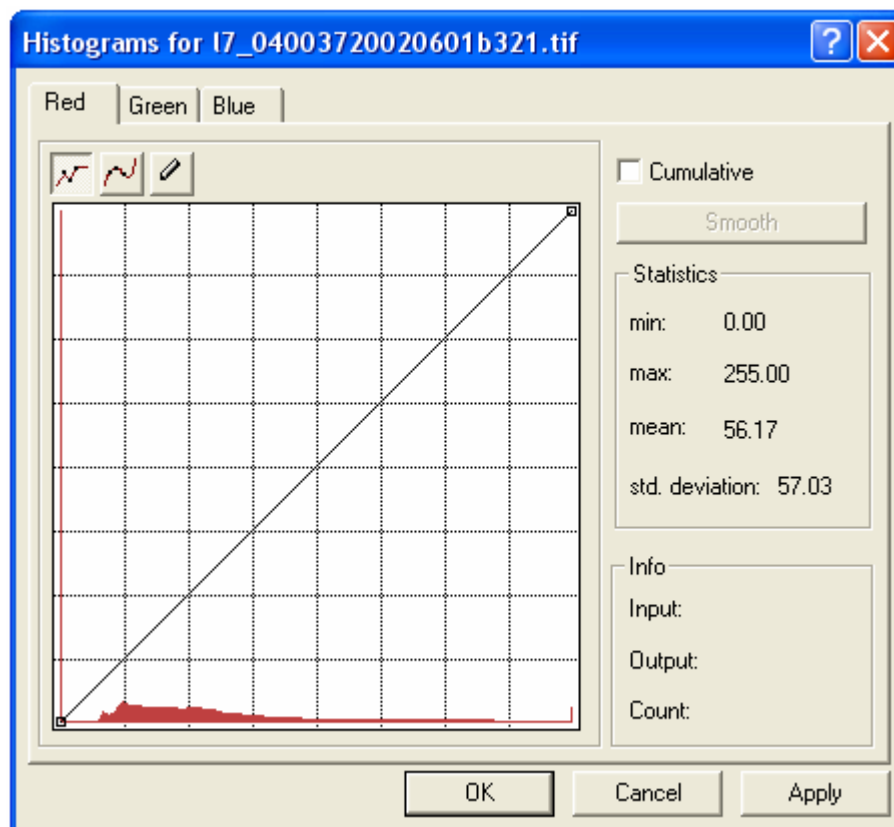
⇒ Under the **Show:** window click **RGB Composite**

⇒ Under **Bands** click the drop-down arrow to the right side of the **Red** window. Initially the window says **Band_1** but you can use this drop-down window for the **Red** band to choose which of the three satellite bands (**Band_1**, **Band_2** or

Band_3) could be displayed in red. If you change the satellite band to be used for red then logically you would then have to choose to change either or both of the green and blue displays as well. Leave **Red** set to **Band_1**, **Green** to **Band_2** and **Blue** to **Band_3**.

The checkboxes under **Bands** indicate which band colors (Red, Green and Blue) will be displayed. We will be modifying each of the three colors. Initially this is best done with only one color displayed at a time. Later, to refine the color enhancement all three colors can be turned on at the same time.

- ⇒ Click off the green and blue color check boxes then click the **Apply** button. Notice that the image is now just shades of red.
- ⇒ Under **Stretch** in the **Type:** window click **Custom**.
- ⇒ Click **Histograms...** (the histograms for each satellite band will be constructed over the next few minutes) then you will see the histogram for the red band.



The diagonal line running across the graph represents the current parameters that are being used to stretch the image. The orientation of the line (coupled with the image input values) dictates what will be the image output values and therefore how the output image will appear.

The bottom of the graph represents the input image values (from 0 to 255), that is, what individual pixel values are stored on disk. The left side of the graph represents what are the output (or display) pixel values. To demonstrate this, find an input value on the bottom of the graph, move up to the curve, then where you intersect the curve move over to the left side of the graph. The number on the left side indicates the value that the pixel will display.

Since the diagonal line runs from the lower-left corner of the graph to the upper-right corner of the graph, no stretch is currently being applied. At the corners, and attached to the diagonal line, notice there are tiny boxes. These are the control handles that you will use to change the image stretch values.

- ⇒ Use the mouse control (it is a cross symbol) to grab the lower-left box. Drag the box along the left y-axis. Notice under **Info** the **Input** stays at **0** whereas the **Output** value increases. Make subtle changes to the lower-left box then click the **Apply** button to see the effect that the change has on the image display.
- ⇒ Now move the lower-left control to the lower-left corner of the graph then drag the control to the right along the bottom of the graph. Notice, under **Info**, that the **Input** value increases but the **Output** value remains at **0**. Moving the control in this manner defines what will be the maximum input value to receive the lowest output value (i.e., 0 or no contribution from the red band). In other words, this procedure is used to define what will be the lowest input value to receive a display value of 0.
- ⇒ Now move the upper-right control by moving it to the left along the top of the graph. Notice, under **Info**, that the **Input** value decreases while the **Output** value remains at **255**. Moving the control in this manner defines what will be the minimum input value to receive the highest output value (i.e., 255 or pure red).
- ⇒ Bringing the two controls closer together increases the *scene contrast*. Moving them to the right (essentially in concert, though this must be done one control at a time) decreases the *scene brightness*, whereas moving them to the left increases the *scene brightness*.
- ⇒ Find the best setting for the red band then repeat the procedure for the green band (turning off the red and blue bands and manipulating the image controls to change the color stretch values), then do the same for the blue band (turning off red and green and changing the stretch values). Then turn on all three bands (all check boxes are checked on) to view the final product. Make adjustments to individual bands with all three colors turned on to perform the final color enhancements.

This concludes this image enhancement procedure. With some experimentation you will define a combination of band color values that produce an image which is visually pleasing yet which reveals important ground features.