

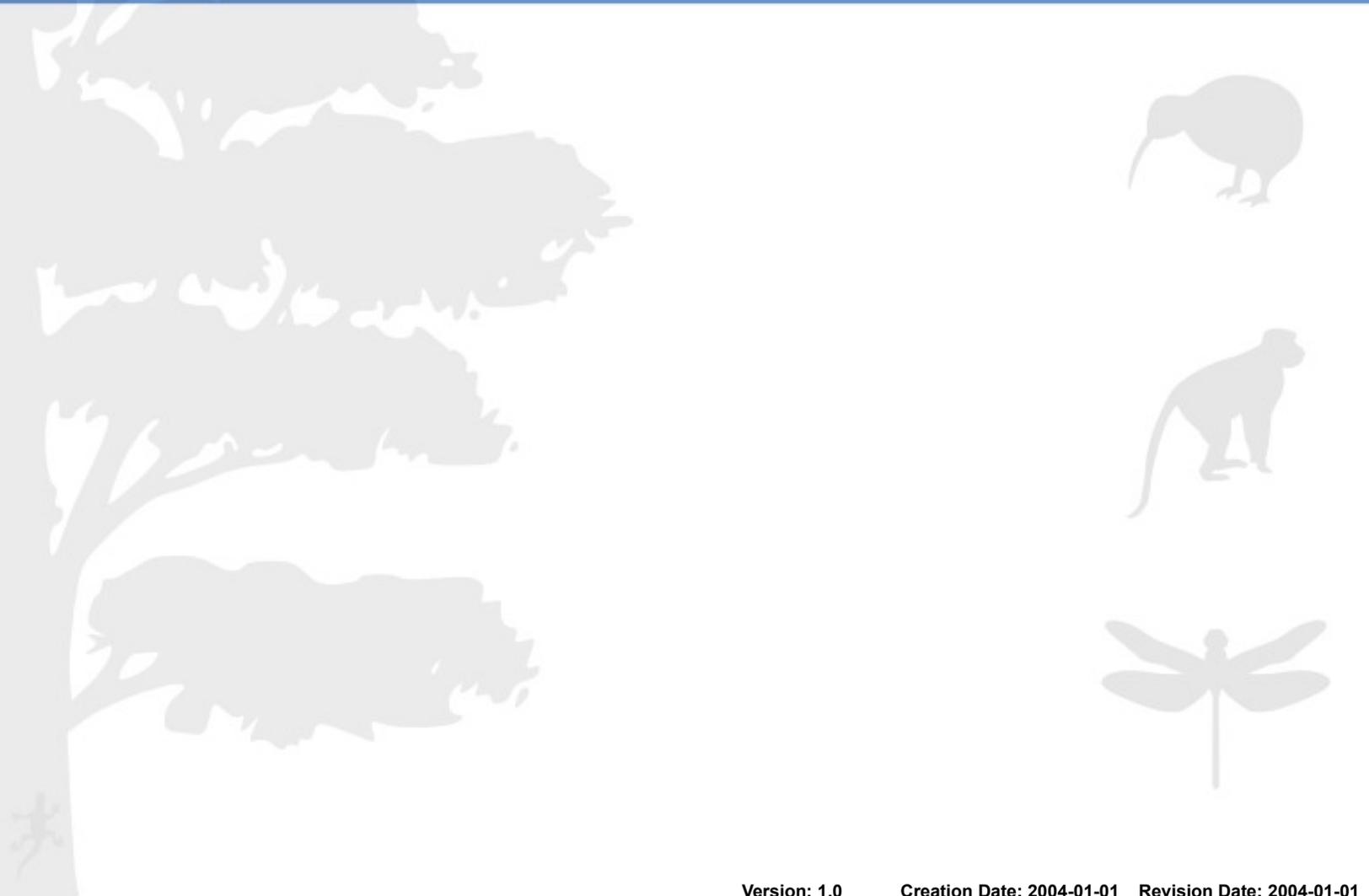


AMERICAN MUSEUM OF NATURAL HISTORY

CENTER FOR BIODIVERSITY AND CONSERVATION

Understanding pixels, bands and channels

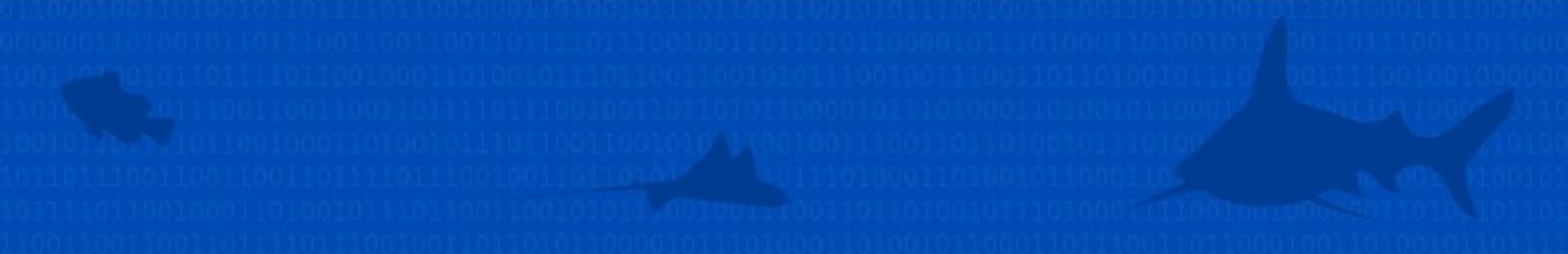
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Understanding pixels, bands and channels

Before we get too involved with remotely sensed imagery we need to understand some of the basic components that make up an image. An image is made up of individual elements that are arranged in a grid of rows and columns. These elements are called pixels. In fact, the word "pixel" is derived from "picture element". When we zoom into an image we begin to see these individual pixels (Figure 1). Usually when we look at an image these pixels are so small that we do not see the individual pixels (Figure 2).

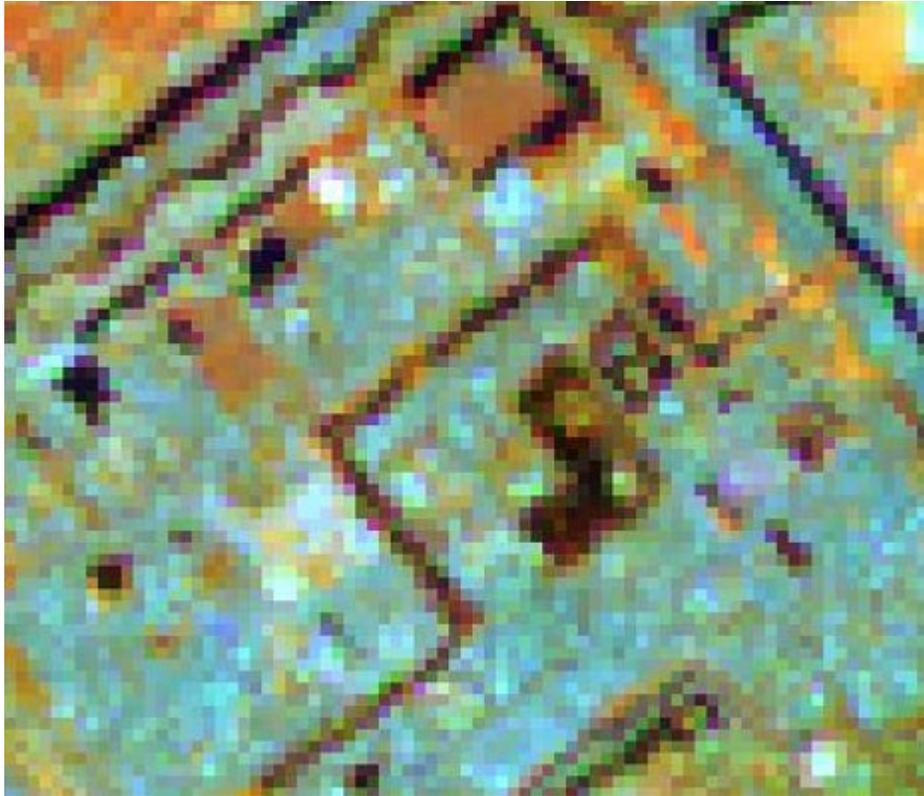


Figure 1: A Landsat Thematic Mapper image that has been magnified by a factor of 6. When zoomed in we can see the individual pixels that make up the image.

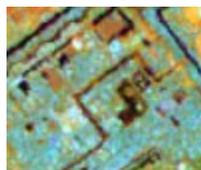


Figure 2: The image used in figure 1 without magnification. Individual pixels are no longer visible.

When we look at an image on the computer screen it appears to be 2-dimensional but in addition to the rows and columns of pixels, images also have layers. These layers are commonly referred to as bands or channels. The terms "band" and "channel" are used by electrical engineers to describe a range of wavelengths (colors). Since these image layers are created using specific wavelengths of light the terms "band" and "channel" are used in place

of layer. Throughout the CBC guides we use the term "band" to refer to the layers in an image, such as a satellite image or an image from a digital photograph. We use the term "channel" to represent the different colors or light that are used to display an image on a computer screen.

Now we know that images have three-dimensions (rows, columns, and bands), but how do these pixels and layers work together to produce a nice looking image on a computer screen? Computer monitors use the three primary colors of light; red, green, and blue, to create the images we see. We call these red, green, and blue channels. The RGB interactive tool illustrates how the primary colors can be mixed to create any color.

By selecting three bands from a multi-band image and illuminating each of them with either red, green, or blue light we can create a color image. This is illustrated in Figure 3. Another way to visualize this process is to see how an individual pixel is composited. Figure 4 illustrates this same process for an individual pixel. On the left side of the figure we see that a pixel has three layers; one each for the red, green, and blue light emitted from the computer screen. Each of these layers is represented by a number, the pixel value, which typically ranges from 0 - 255 where "0" represents black (no light) and "255" represents very bright light. When each of these layers is illuminated by one of the primary colors of light, the color filter, and the layers are superimposed on top of one another, the appropriate color is produced for that pixel. If the pixel we want to view is from a black and white image we still use the three primary colors to create the image on the computer monitor. This is done by using the same pixel value for each of the pixel layers as illustrated in Figure 5.

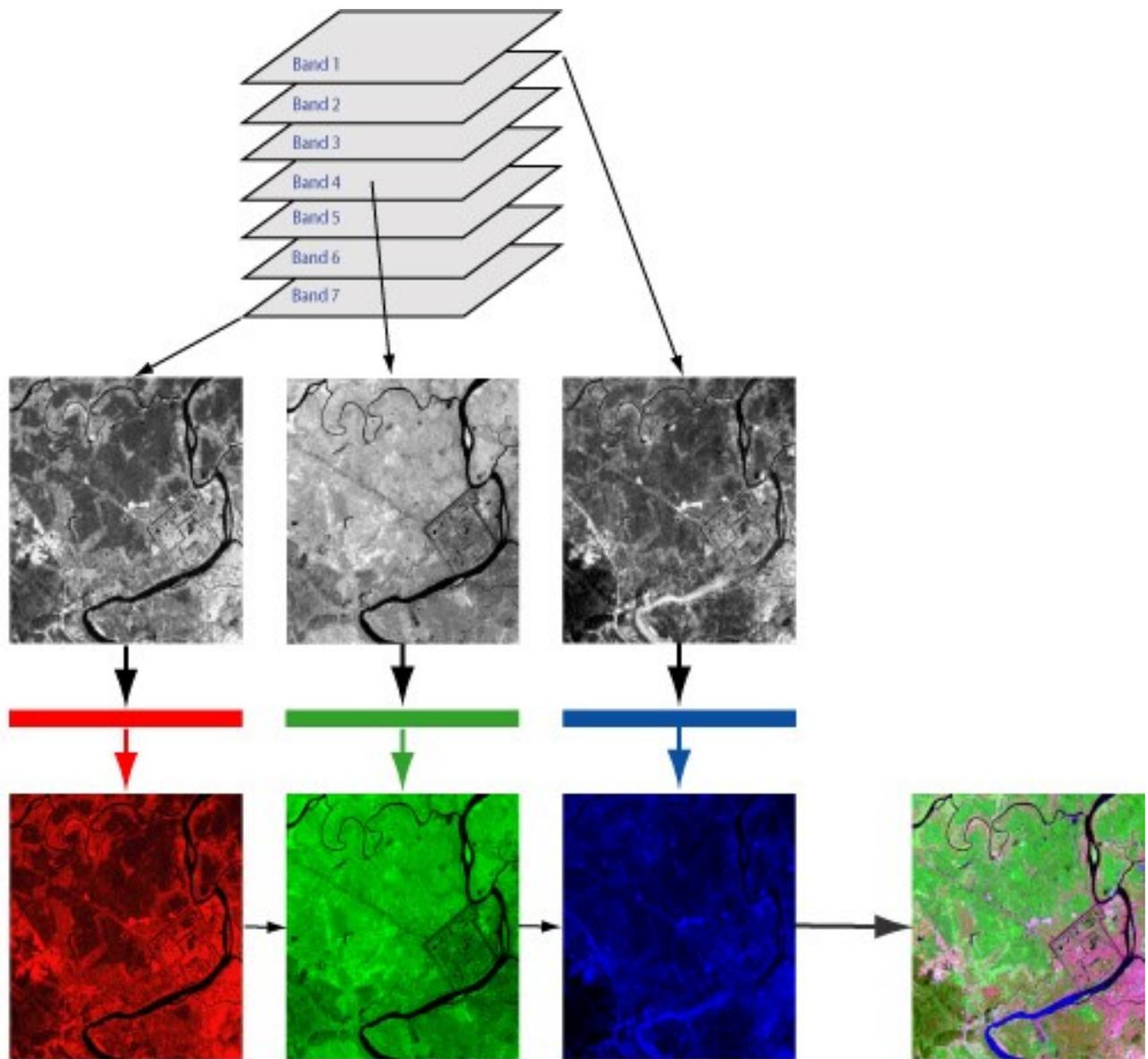


Figure 3: Creating a color image using three bands from a satellite image.

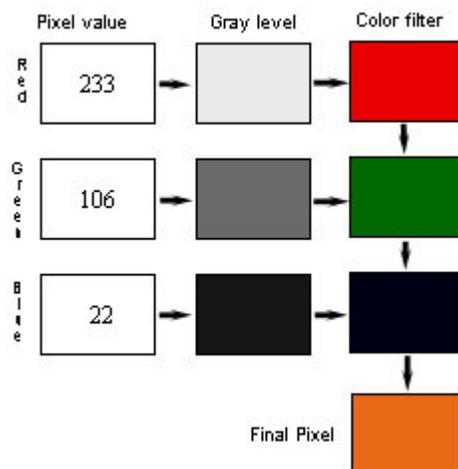


Figure 4: The process of creating a single pixel from a color image on a computer monitor.

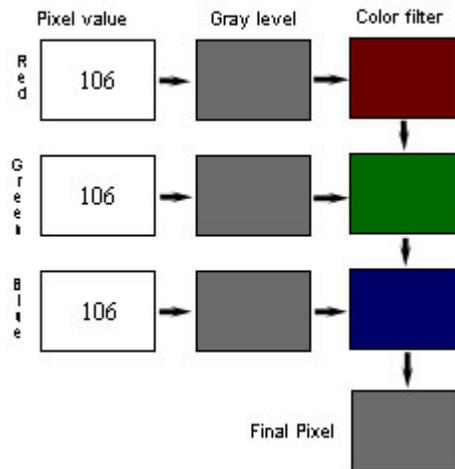


Figure 5: The process of creating a single pixel from a black and white image on a computer monitor.

Even though black and white images only have one band Figure 5 demonstrates that the three primary colors of light are used to create the image on a computer monitor. Color images acquired using a digital camera have three bands that are illuminated as is illustrated in Figure 4. Many images that are acquired using remote sensing instruments can have dozens or even hundreds of bands. To make a color image from images that have several bands we need to select three bands that can be assigned to the 3 color channels in a computer monitor. Use the band combination tool to experiment with different band combination for a Landsat Enhanced Thematic Mapper Plus (ETM+) image, an ASTER image, and a MODIS image. To see what the individual bands look like select the same band number in each of the three drop down menus.

Selecting appropriate bands to be used to create a useful and attractive image takes some experience. Experimenting with different combinations is often a good way to find a combination that best highlights the features of interest. For more information about how to do this look at the guide [Selecting the appropriate band combination for an RGB image using Landsat imagery](#).