WHITE PAPER

DigitalGlobe™

RADIOMETRIC RESOLUTION AND INFORMATION EXTRACTION

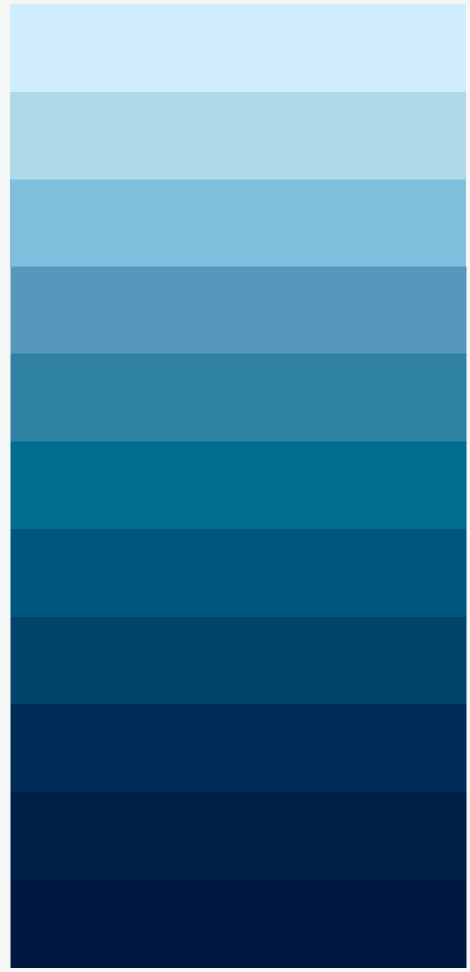
Corporate (U.S.) +1.303.684.4561 or +1.800.496.1225 | London +44.20.3695.0920 | Singapore +65.6389.4851

Table of Contents

What is Radiometric Resolution?

Radiometric resolution refers to how much information is in a pixel and is expressed in units of bits. A single bit of information represents a binary decision of yes or no, with a mathematical value of 1 or 0. Typical Black &White images from a source such as a digital camera are 8 bits, meaning the information is represented with a value of 0-255 or 256 in total. In contrast, a color image is represented using 3 channels, Red-Green-Blue, and each channel is 8 bits, equaling 24 bits of information. Humans visualize colors as a combination of the three primary colors, red, green, and blue. Every color and corresponding shade is represented using a combination of these 3 primary colors and the intensity of each color. A value of 0 in the blue channel means that pixel is black. If the value of a pixel in blue channel is 255, it means that the pixel is bright blue. So if a blue channel pixel has a radiometric resolution of 8 bits, there will 256 shades of blue. A radiometric resolution of 11 means the pixel has 2048 possible intensities of blue, 12 bit resolution represents 4,096 shades of blue, and 14 bits represents 16,384 shades of blue.

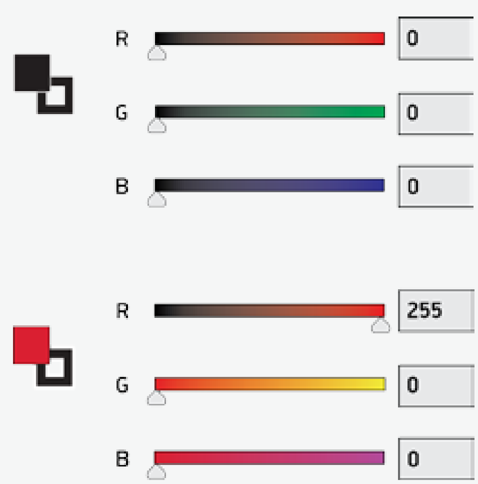
While increasing radiometric resolution means that there is more variability in the pixel, it does not necessarily mean that more is better. Digital camera companies weigh the tradeoff between quality of the image and how many pictures can be stored on a camera to reach to the best radiometric resolution that meets customer quality expectations. Similarly, satellite remote sensing companies determine on desired radiometric resolution based on variety of factors including perceived image quality and information that needs to be extracted, etc. It is also important to note that the human eye cannot differentiate more than 7 to 11 shades of a given color, which becomes an important consideration in determining the "right" radiometric resolution for an intended use.



Seeing Colors

Colors are created by combining all three primary colors, while shades of a given color are dictated by the intensity of the individual channels. This method is referred to additive color mixing. Another way of combining colors is called subtractive mixing where primary colors are Cyan, Magenta, and Yellow. In this paper we focus on the additive mixing technique which is the primary technique used in remote sensing industry.

If all three channels — red, green and blue — have a value of 0, the corresponding pixel shows up overall as black; for a pixel to be white, all three primary channels need to have a value of 255. As we learned growing up, when using color paints to paint a picture red, one need only use red paint. In the digital technology world, this translates to the primary channel red needing to have a higher intensity, while blue and green channels require a lower intensity of 0 or black. To achieve different shades of red, we add black "paint" to make



it darker, which moves the digital intensities towards the 0 value. Similarly, to achieve bright red, the digital intensity needs to be close to the value 255. And as we learned as children, to make yellow, you can mix red and green colors.

Remotely Sensed Data and Information

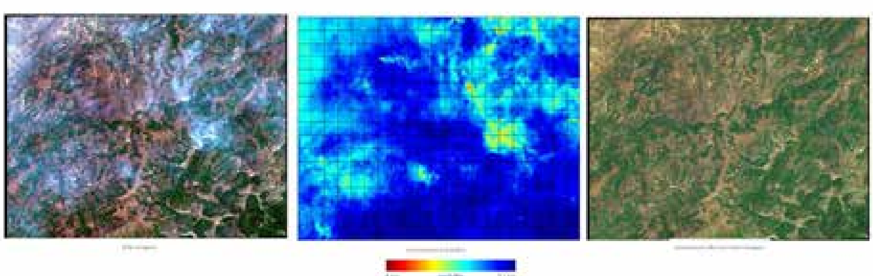
DigitalGlobe's panchromatic and visible near-infrared (VNIR) spectral bands are currently provided in 11 bit radiometric resolution. This ensures a good dynamic range that captures the information of interest to our customers. For visual products, all imagery products are scaled to 8 bit information in each of the red, green, and blue bands. This will be the same for other satellite data and aerial data providers.

The picture on the right demonstrates comparable visual representation in 8 bits from different collected radiometric resolution.

For information extraction from our imagery, DigitalGlobe compensates for varying atmospheric conditions to create consistent imagery over multiple collects and over large regions using state-of-the-art calibration technology. This information, also known as Surface Reflectance, is created as 32 bit information per each channel (4 or 8 bands). Additionally, customers are provided with an option to receive this product in 16 bits, with values ranging from 0-10,000.

The pictures below reflect the example of the power of atmospheric calibration.

DigitalGlobe's WorldView-3 satellite will provide short-wave infrared (SWIR) imagery in 14 bit resolution to ensure users have the ability to leverage the power of SWIR bands for more robust information extraction. Upon customer request, this data will also be adjusted for atmospheric changes and be provided in surface reflectance units. Today, DigitalGlobe is beta testing our Surface Reflectance products for GeoEye-1 and WorldView-2 satellite imagery.



14 BIT AERIAL IMAGERY FROM ADS40 SENSOR

QUICKBIRD 11 BIT IMAGERY