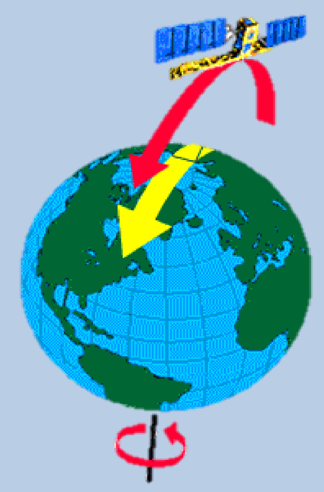
Viewing New Hampshire From Space

A Bird's-eye View of The Granite State!

What is remote sensing?

Remote sensing is learning something about an object without touching it. We can use remote sensing to gather information about a number of things. For example, many people are concerned about the environment and how humans are changing it. Studying these changes is important but it would take a long time to go outside and find them all. We can make this task easier by attaching sensors to satellites that acquire images of the earth from above.

Sensors attached to satellites are orbiting the Earth 24/7 and continuously collecting images of the Earth's surface regardless of the weather. As the satellite orbits around the Earth from north to south, the Earth is rotating from east to west. Eventually the entire planet will be covered and the satellite will begin again. The satellite can operate for weeks, months, even years! Over time, we can collect hundreds of images of the Earth's surface.

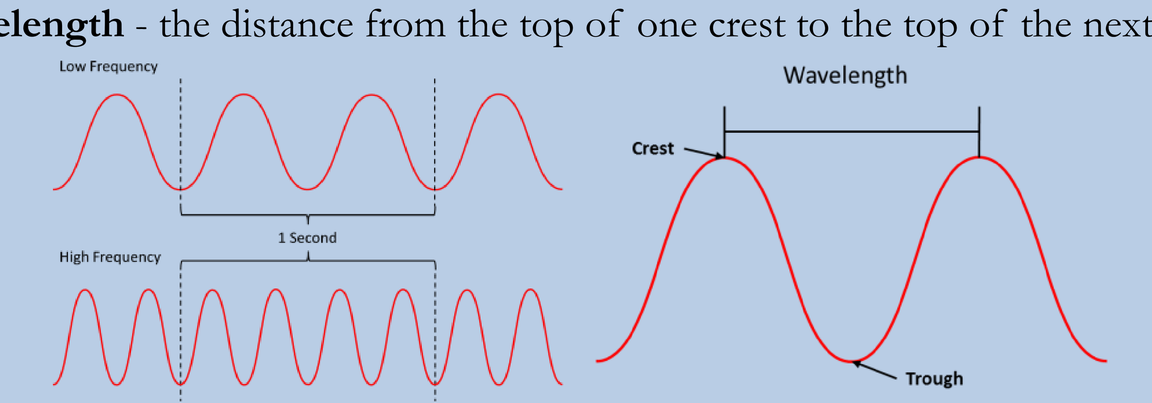


Source: Canada Center for Remote Sensing

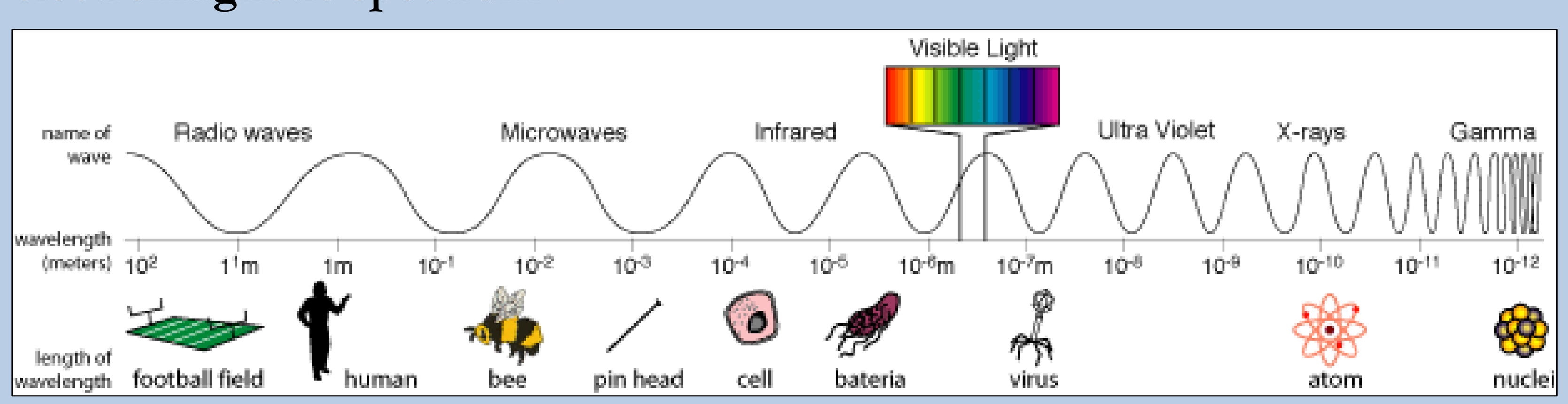
Properties of light

Satellite sensors detect reflected light. Light is energy that radiates from a source, for example a light bulb or the sun. This energy is called electromagnetic (EM) energy. EM energy is made up of charged particles that move like a wave with high points called crests and low points called troughs. We can describe these waves using two important properties, **frequency and wavelength.**

Frequency - the number of crests that pass by a given point in a given time
Wavelength - the distance from the top of one crest to the top of the next crest

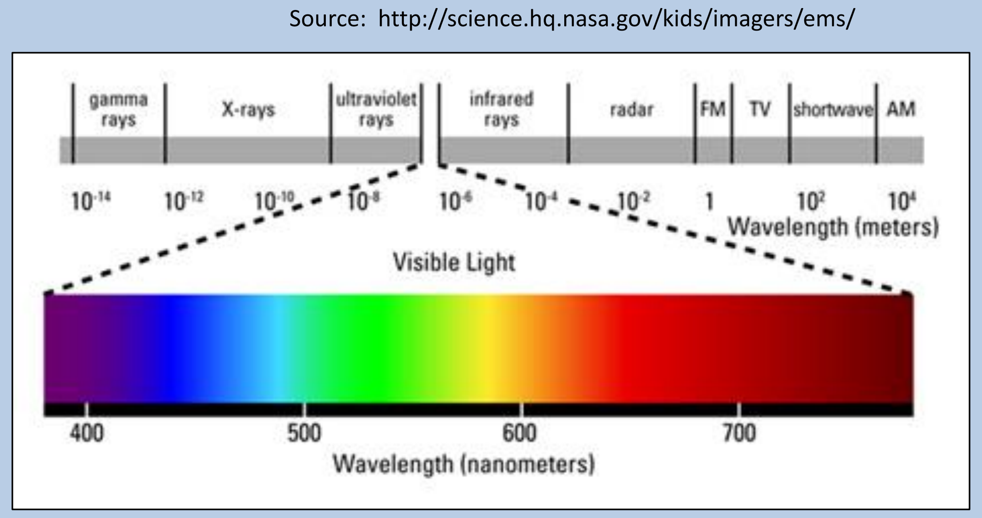


EM energy can have different frequencies and wavelengths. The diagram below shows these different frequencies and wavelengths and is called the **electromagnetic spectrum .**



Source: http://science.hq.nasa.gov/kids/imagers/ems/

Our eyes can only see the light or EM energy from a very small portion of the EM spectrum known as **visible light**. Everything else falls outside of that range so we don't see it, but is can be detected by other remote sensing devices.



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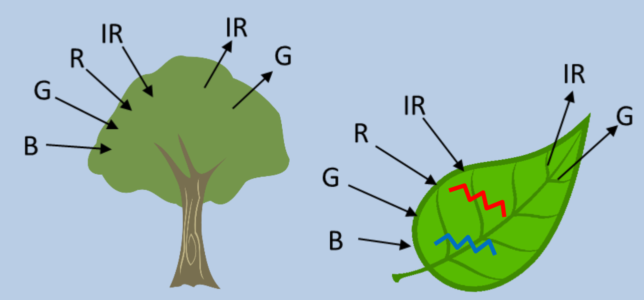
Electromagnetic Energy Interactions

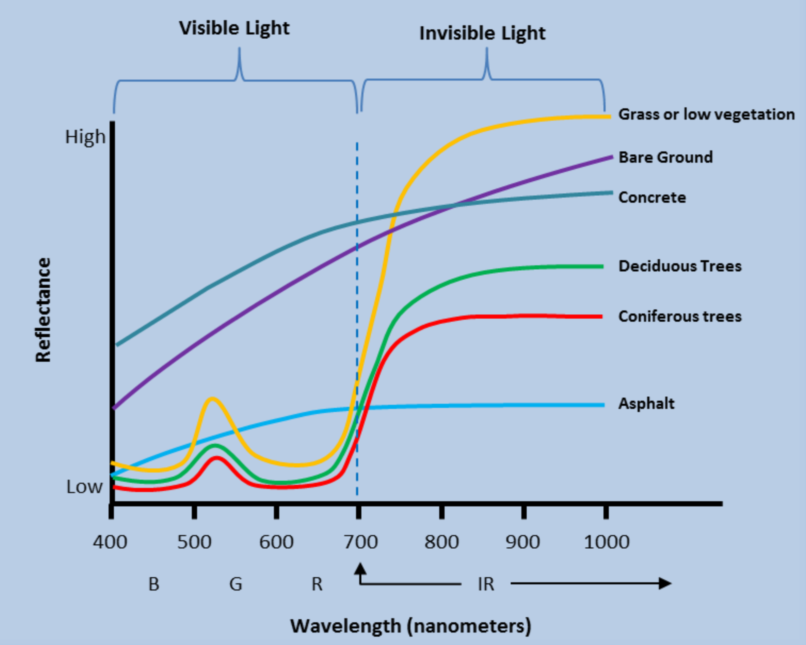
When any light, or EM energy, travels through space and strikes an object, energy can be either absorbed by the object or reflected off the surface of the object.



For example, the blue light and the red light are absorbed by leaves because leaves contain chlorophyll that absorbs red and blue light for photosynthesis. The plant does not need the green or infrared light so they are not absorbed; instead they are reflected back.

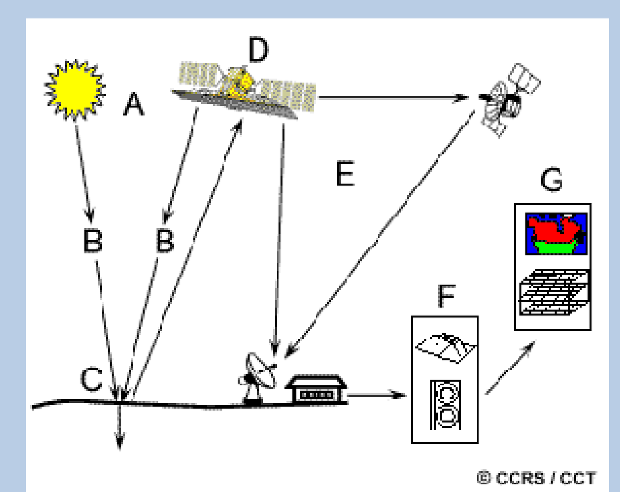
Every surface interacts with EM energy differently, absorbing and/or reflecting energy weakly or strongly in different wavelengths. If we measure the amount of energy reflected off a surface at different wavelengths, we can create a spectral reflectance curve and use that information to figure out what an object is.

Different types of objects or surfaces tend to have a characteristic spectral reflectance curves that we can use to distinguish one object from another. Vegetation is very different from bare ground or concrete. Deciduous and coniferous trees look very similar because there is not a big difference in the amount of reflected energy in the visible wavelengths, but there is a bigger difference in the infrared wavelengths.

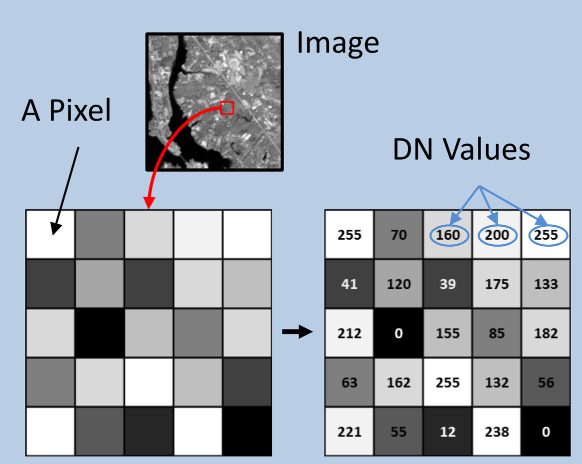


How Do Satellites Work?

- The sun emits EM energy
- The energy travels through the atmosphere
- The energy is absorbed and/or reflected
- The satellite collects the type and amount of reflectance from an object on the surface
- Data are transmitted to a processing center
- We extract information from the data
- We apply the information to solve a problem



Source: Canada Center for Remote Sensing



A digital image is a grid of equal-sized squares called pixels. Each pixel covers a certain area on the ground and has a digital number (DN) that represents the amount of EM energy being reflected in that area. Higher values mean more reflectance.

Satellites record the amount of reflected energy in different portions of the EM spectrum. Each portion is called a spectral band. A digital image is generated for each spectral band collected by the sensor.

Bands	Wavelength (nanometers)	Color
Band 1	430 - 450	Coastal Blue
Band 2	450 - 510	Blue
Band 3	530 - 590	Green
Band 4	640 - 670	Red
Band 5	850 - 880	Near Infrared
Band 6	1570 - 1650	Shortwave Infrared 1
Band 7	2110 - 2290	Shortwave Infrared 2

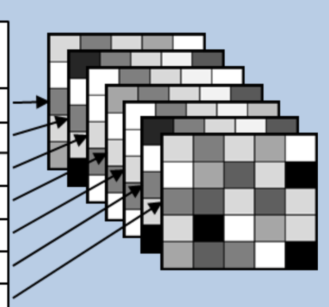
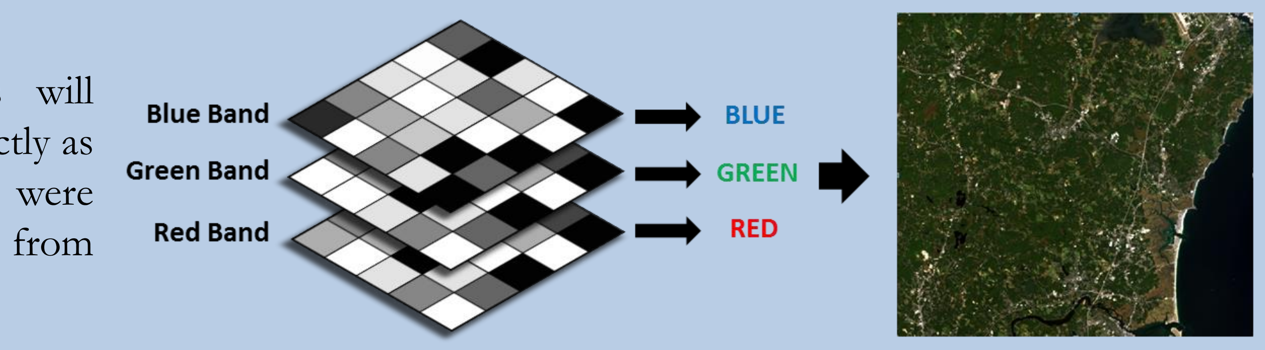


Image Composites

Computer monitors use the primary colors (red, green, and blue) to generate all the colors we see on the screen. Using special software, we can assign one of the primary colors to a particular band that was collected by the sensor to create an image. The two most common types are natural color and false color composites.

Natural Color- This will display the imagery exactly as we would see it if we were looking at the Earth from above with our eyes.



False Color- Allows us to visualize the amount of infrared reflectance that we cannot see with our eyes.

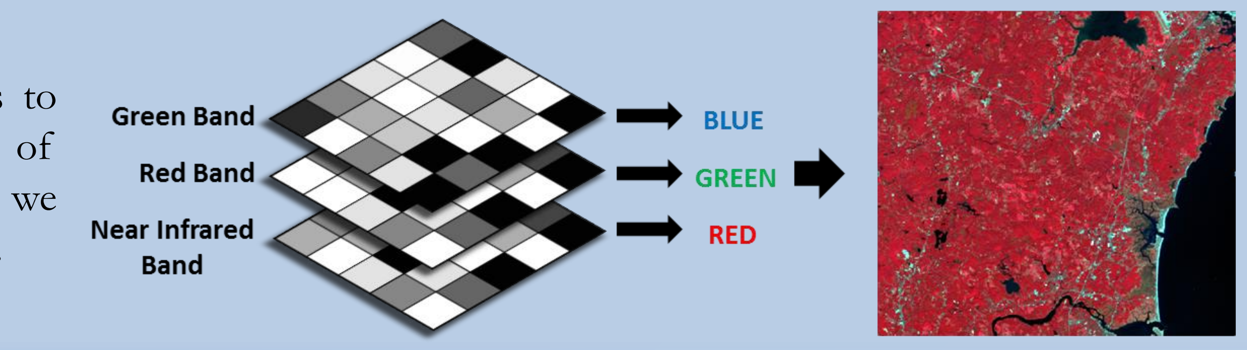
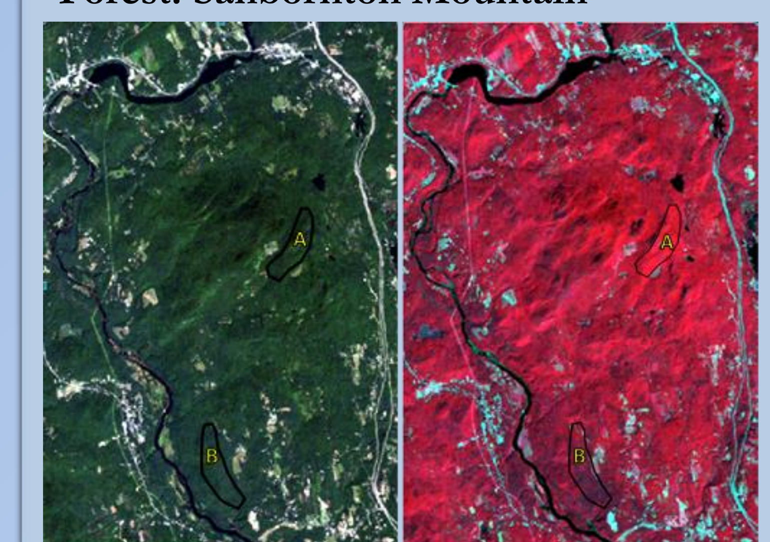


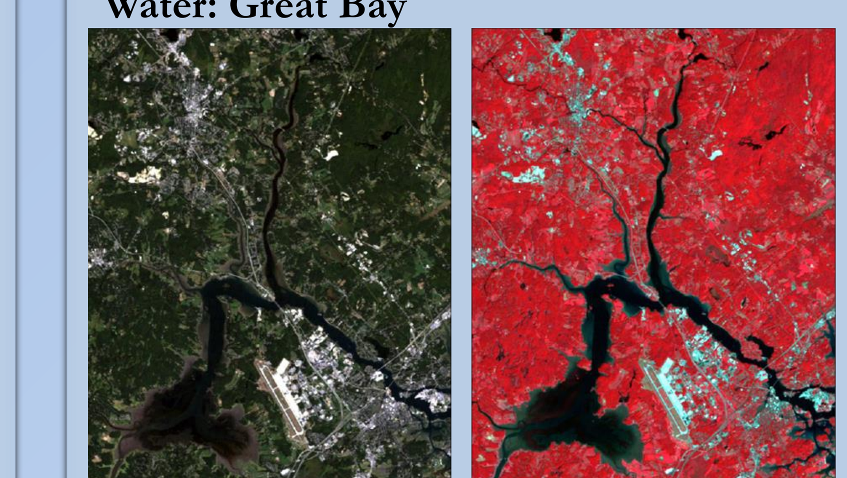
Image Interpretation Examples

Forest: Sanbornton Mountain



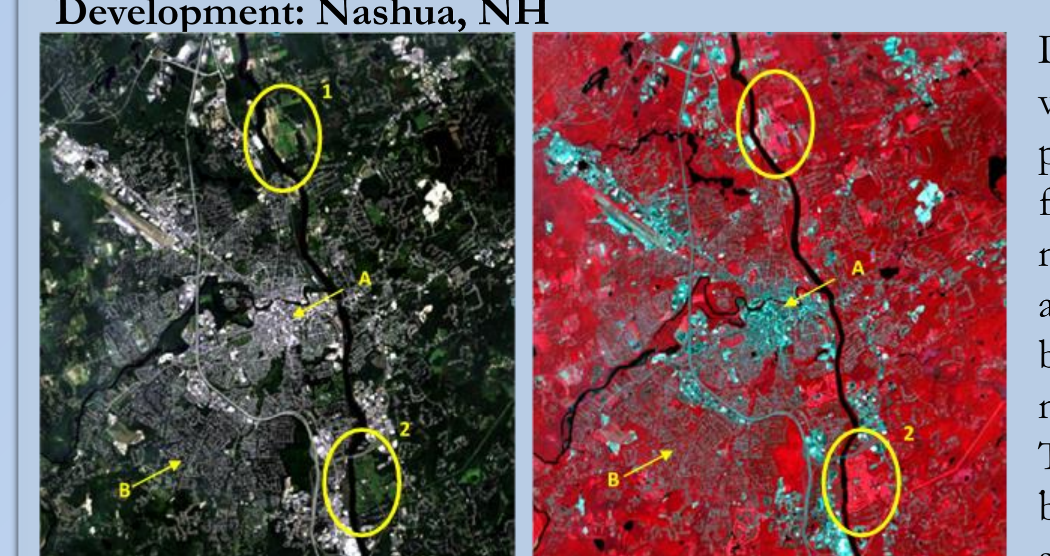
This forest is a mix of deciduous trees and conifer trees. On the natural color composite it is difficult to see the difference between different tones of green, but if you look at the same area on a false color composite you'll see far more shades of red. Deciduous trees reflect more infrared energy than the conifers. So, if we are looking at a false color composite that lets us see infrared reflectance, the deciduous forests are much brighter shades of red while coniferous forests more red-purple.

Water: Great Bay



Water absorbs a lot of the EM energy that hits it and reflects very little. It appears very dark (dark blue to black) in both the natural and false color composites. If there is a lot of sediment or algae in the water, the reflectance characteristics of water, especially in the visible range, will change significantly. The materials floating in the water or at the bottom (if the water is shallow enough) will reflect some energy creating a higher reflectance. (See the edges of the bay.)

Development: Nashua, NH



Development is interesting because it has a variety of land cover types like bare pavement, grassy fields/lawns, water, and forested areas. The circles are centered on non-woody vegetation like grass or agricultural field. They tend to be pale or bright pink in color because of the high near infrared reflectance of the vegetation. The blue areas (yellow arrows) are roads, buildings, or non-vegetated areas. They stand out significantly more from vegetation in the image. There are also areas of bare ground (no vegetation or pavement) that look blue-grey.

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