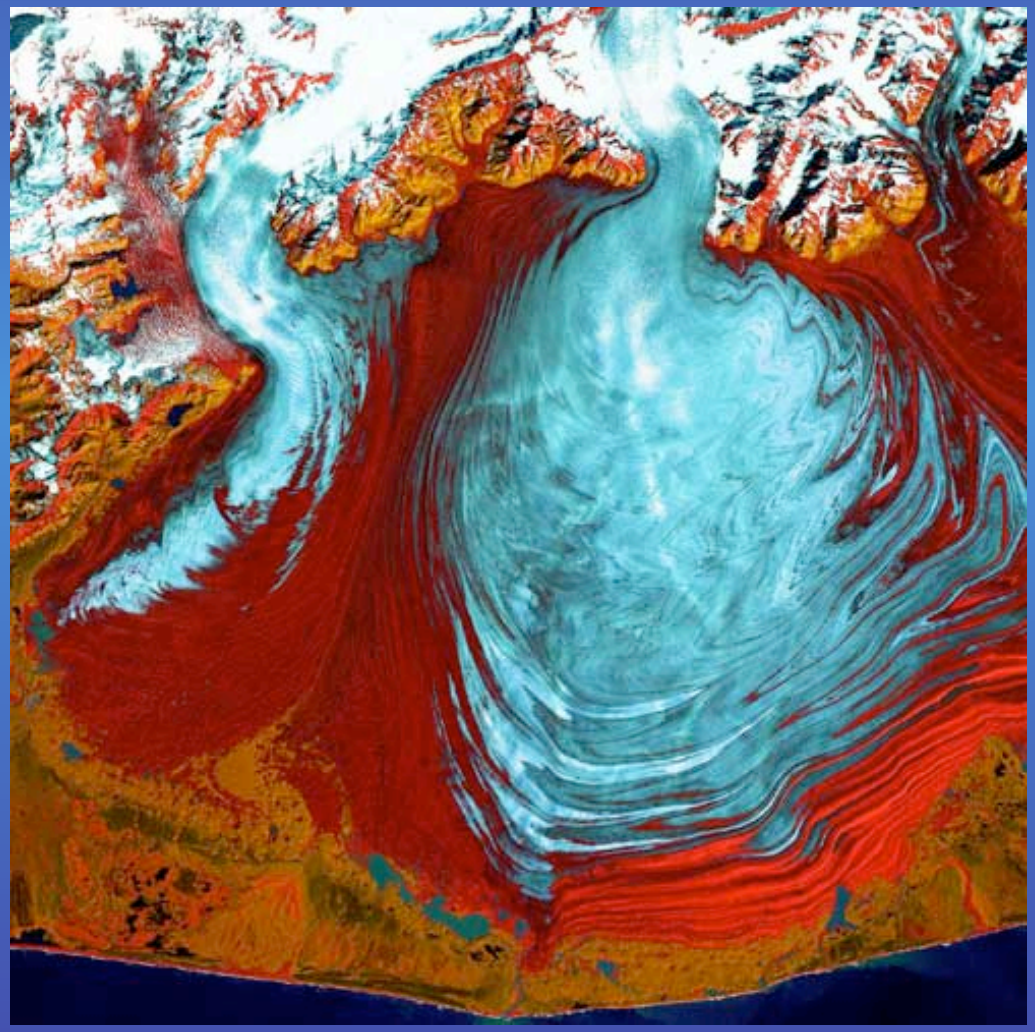
How Landsat Scenes Are Made



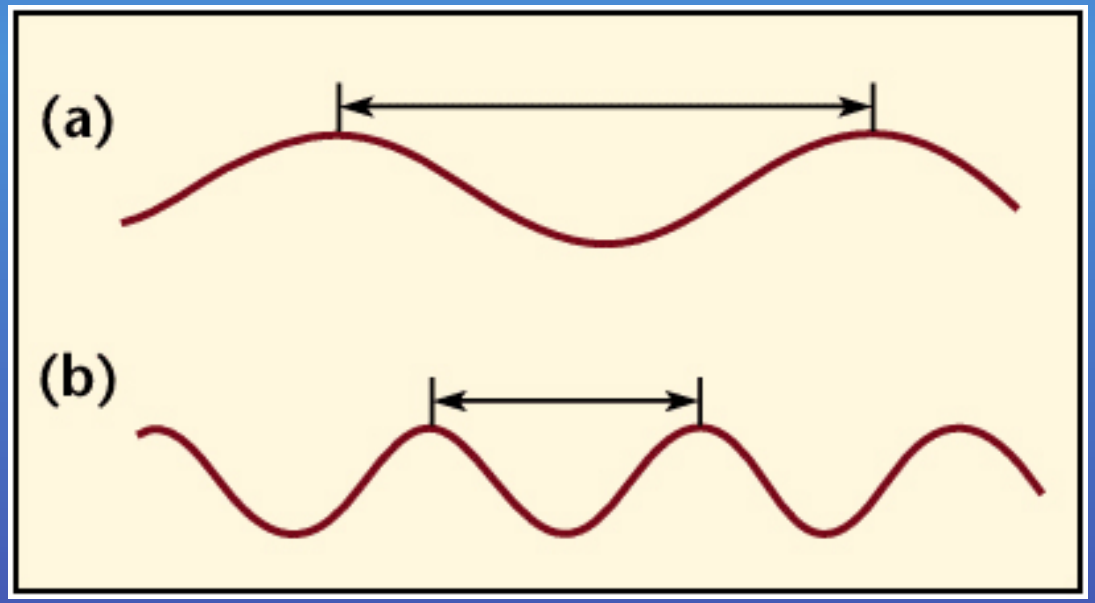
What is remote sensing?

Technology for sampling electromagnetic radiation to acquire and interpret geospatial data from which to extract information about objects and classes on the Earth's land surfaces, oceans, and atmosphere.

Everything emits radiant energy.

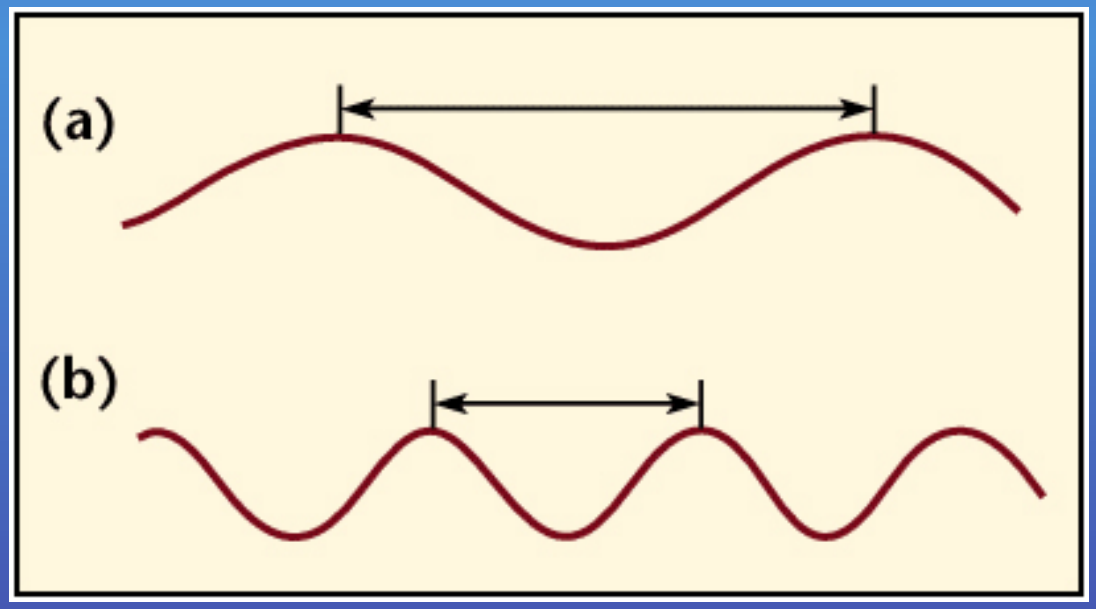
Technically speaking, energy is emitted by all objects above absolute zero

We can measure light in wavelengths.

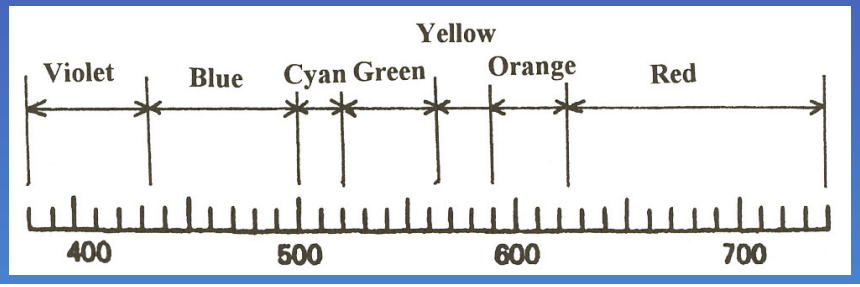


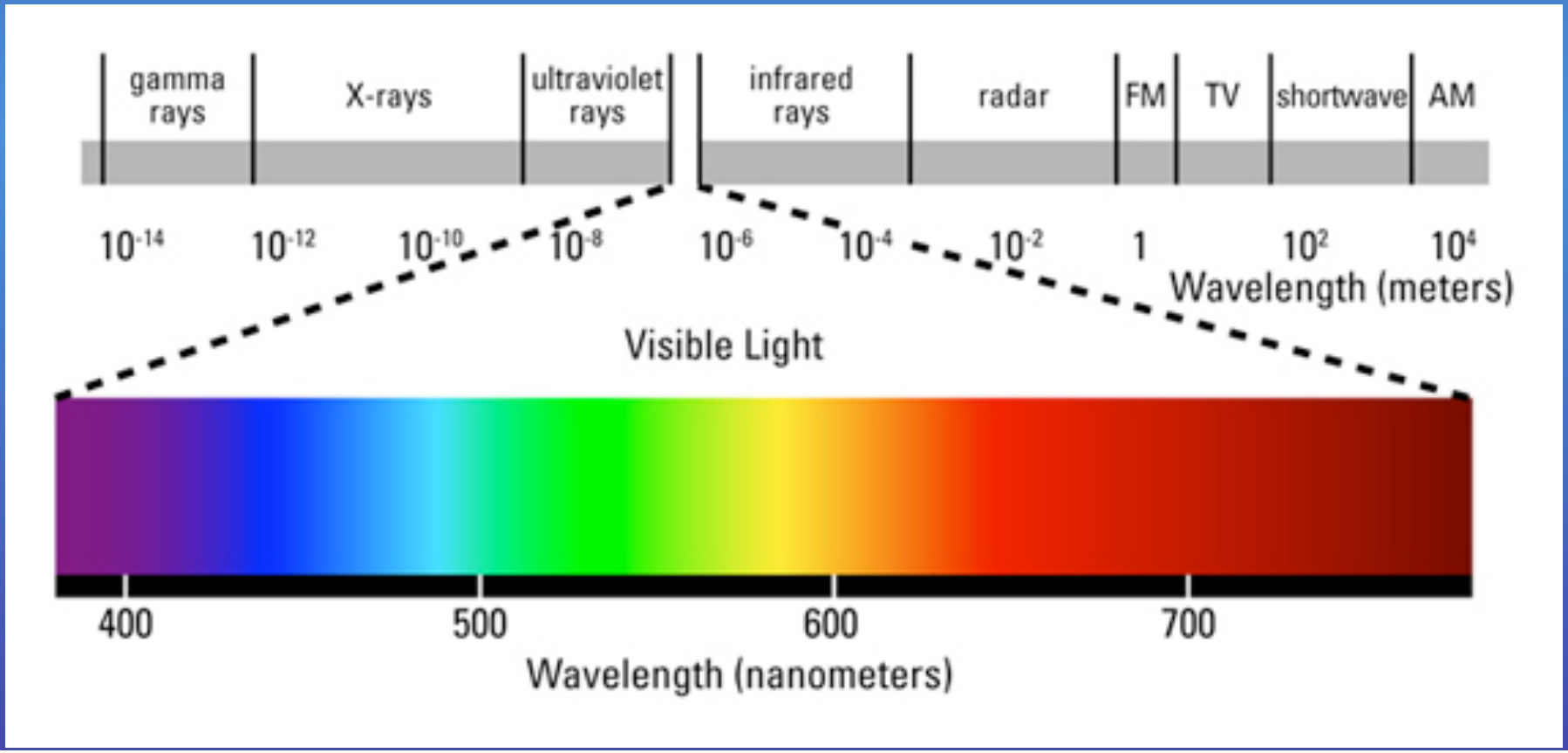
Wavelength

- Wavelength (λ) is defined as the distance between the maximums or minimums of a roughly periodic pattern.
- Normally measured in micrometers (μ) or nanometers (nm).

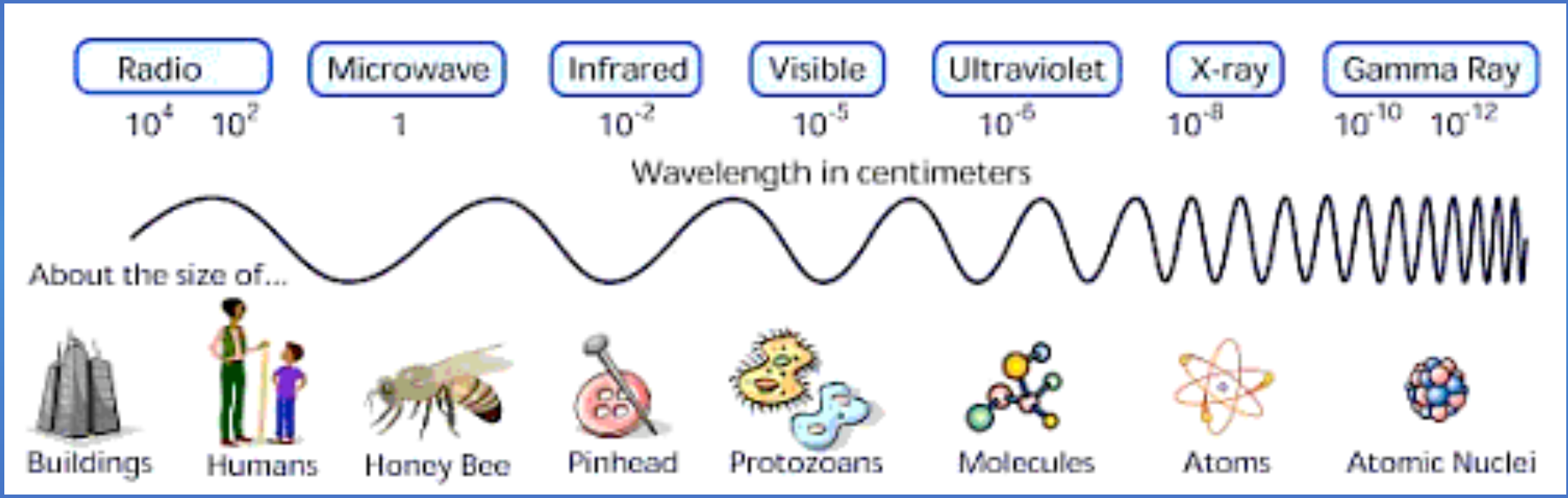


The light we can see is a *small part* of the light on Earth (and in the universe!)

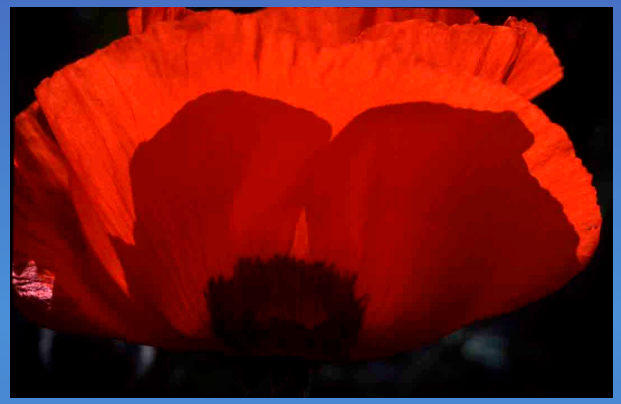


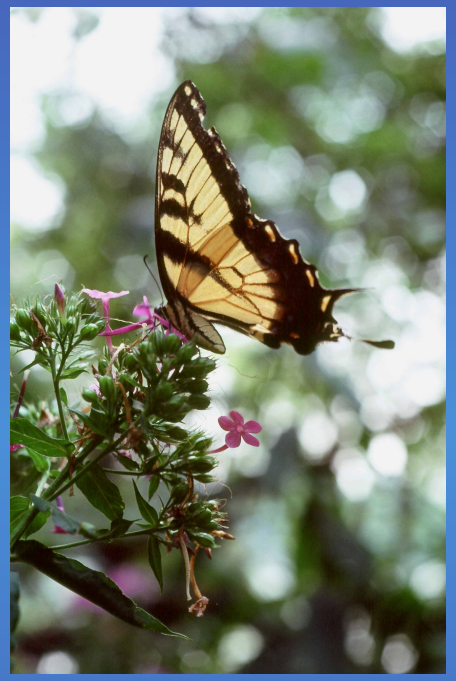


Remote Sensing uses our knowledge of this whole great Electromagnetic Spectrum

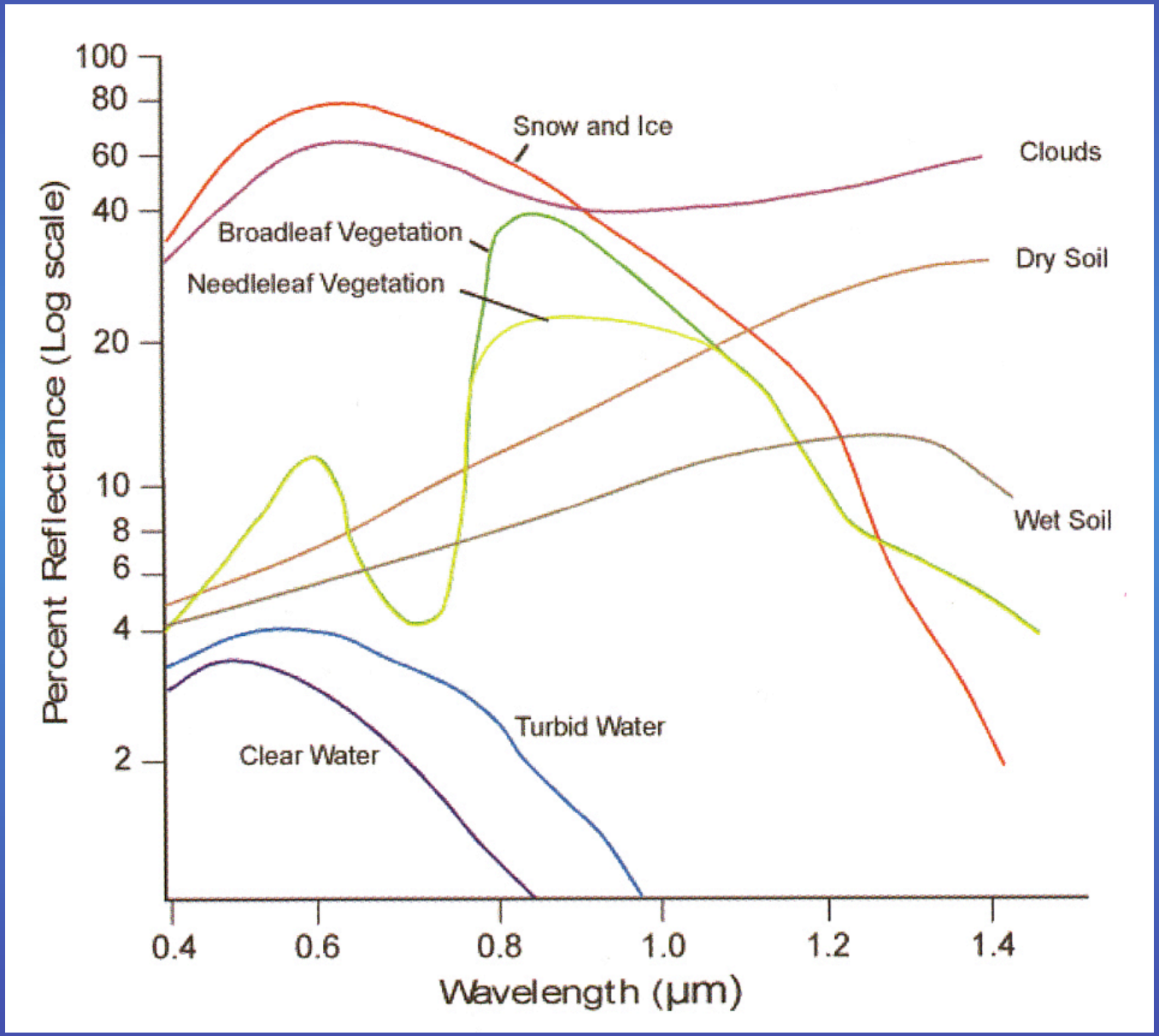


Every kind of surface reflects light differently, absorbing and reflecting it more or less in different wavelengths.

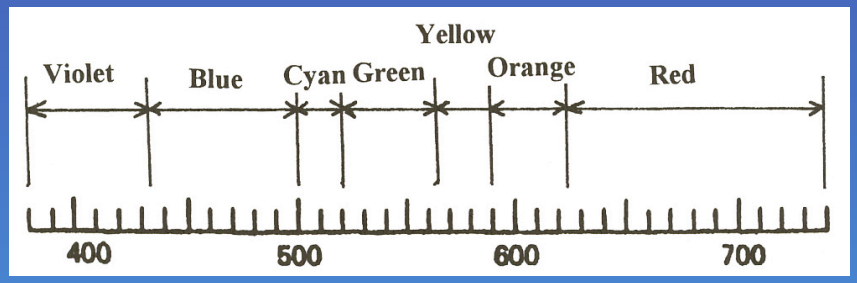


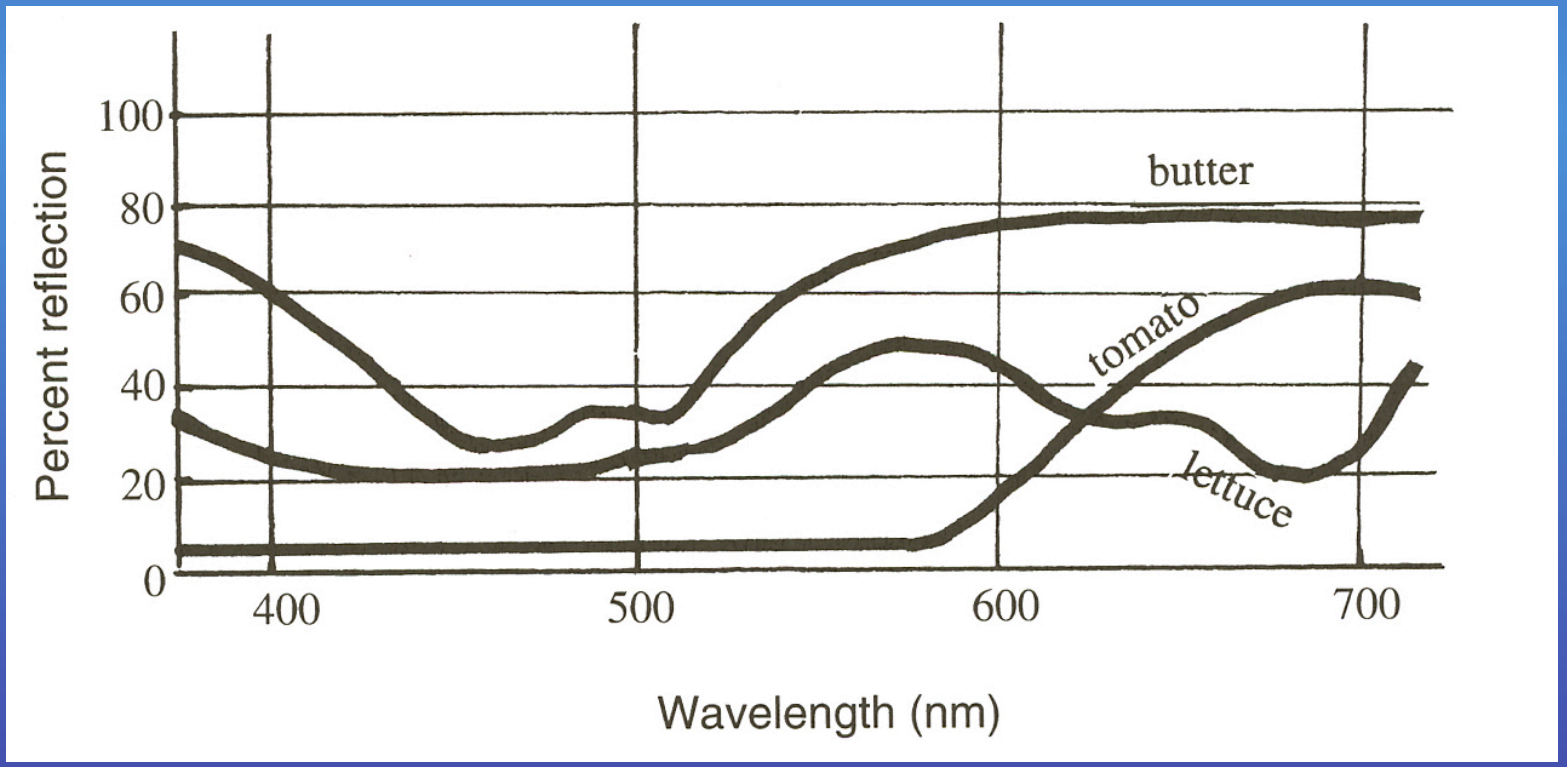


Every kind of surface has its own “spectral signature.”



Spectral Signatures of Some Common Foods



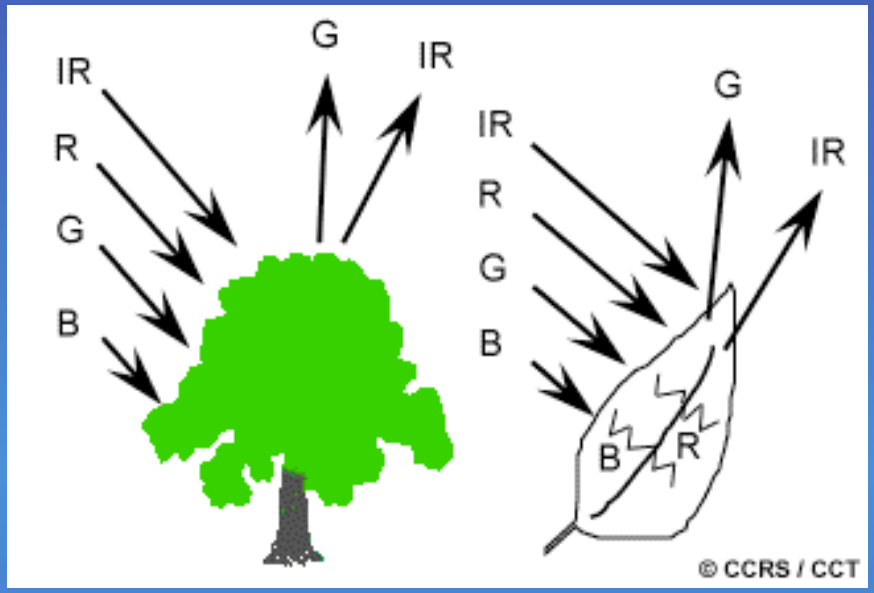


People have learned to relate different kinds of surfaces and their spectral signatures to what they look like in a satellite scene.

↗ Guy with hand-held spectrometer

Seeing leaves with remote sensing

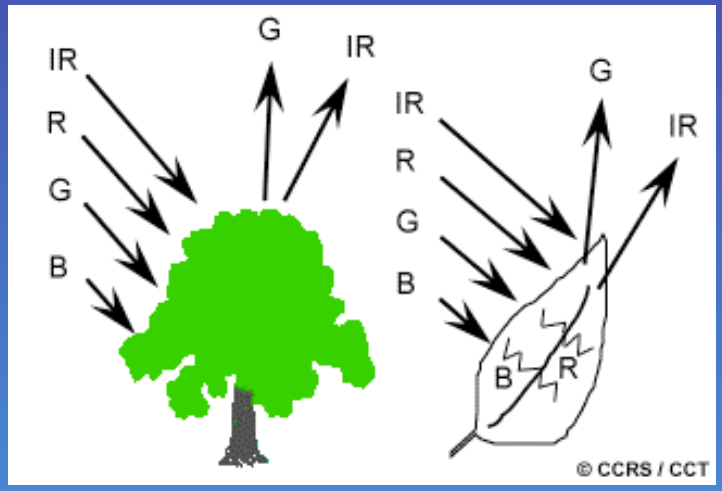
IR = Infrared
R = Red light
G = Green light
B = Blue light



Infrared, red, green, and blue light from the sun hit the leaves.

Green and Infrared light are reflected from the leaves, so that's what we see.

Put another way…

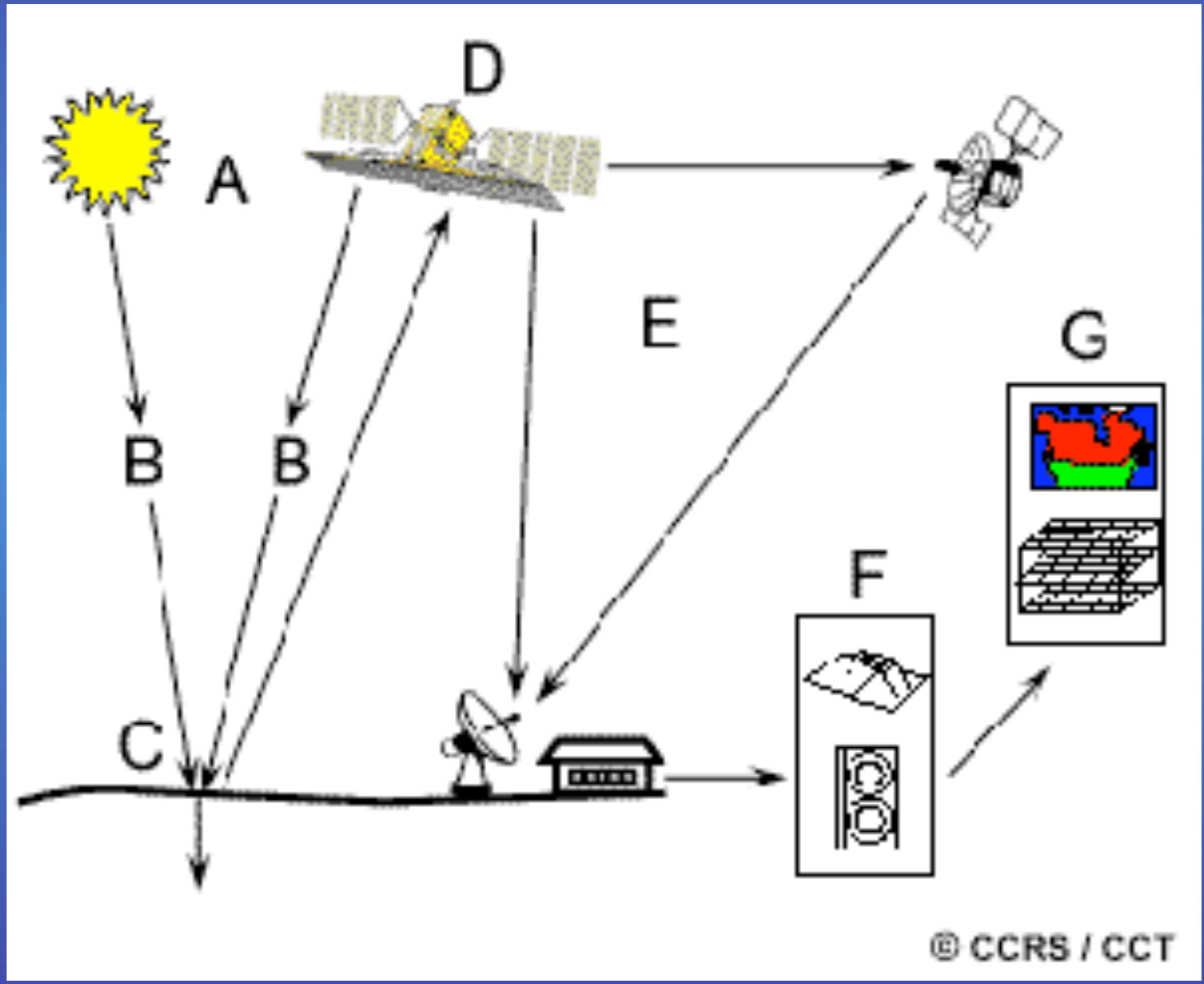


Chlorophyll strongly absorbs radiation in the red and blue wavelengths and reflects green wavelengths. This is why healthy vegetation appears green.

Healthy leaves are excellent reflectors of near-infrared wavelengths.

So we can use near-infrared reflectance to determine how healthy (or unhealthy) vegetation may be.

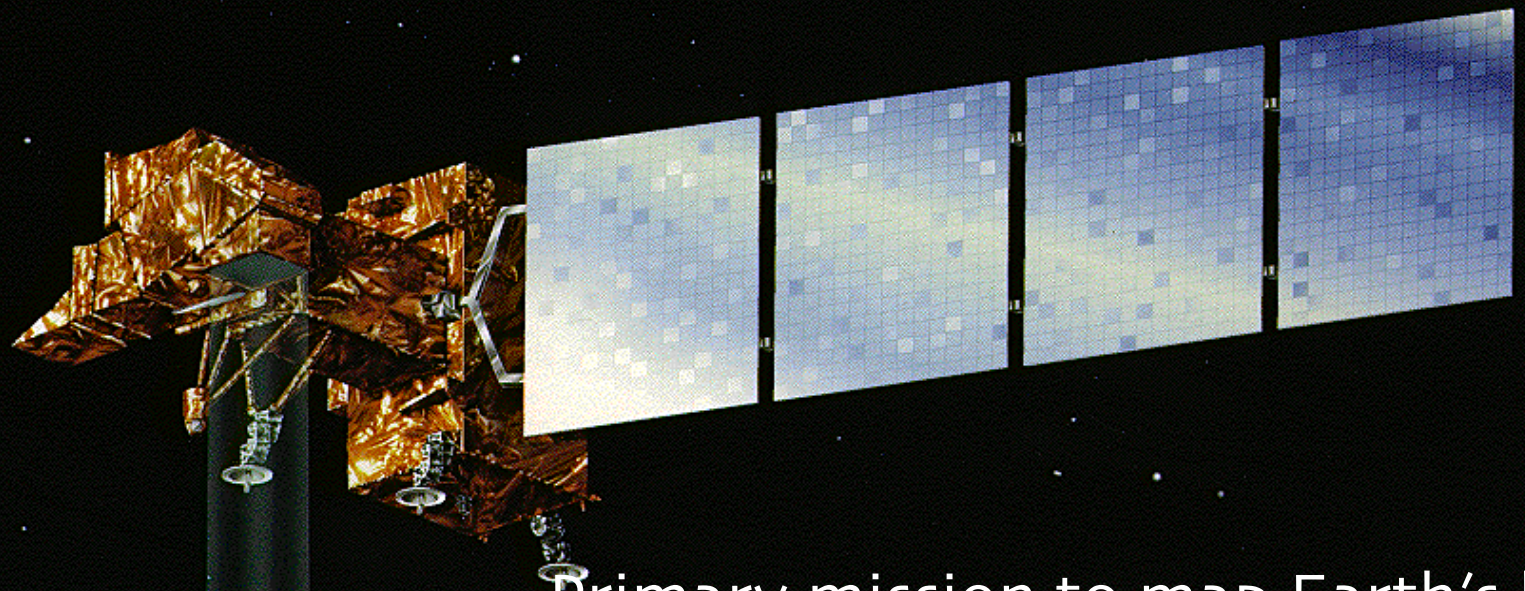
Remote Sensing Pathway of Light



Sensor senses some segment of the Electromagnetic Spectrum

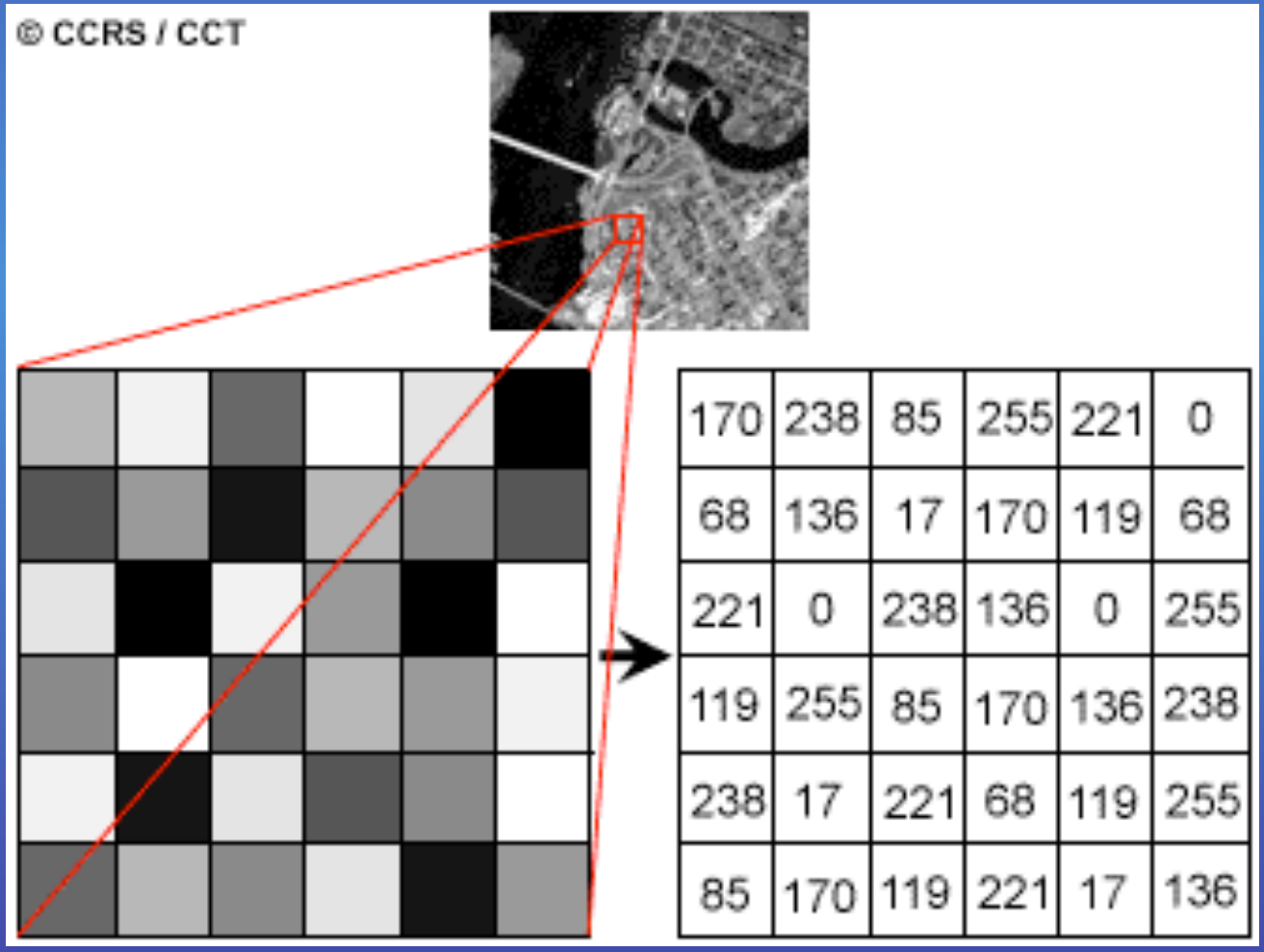
Reads the "spectral signature" of the surface that is reflecting/emitting light

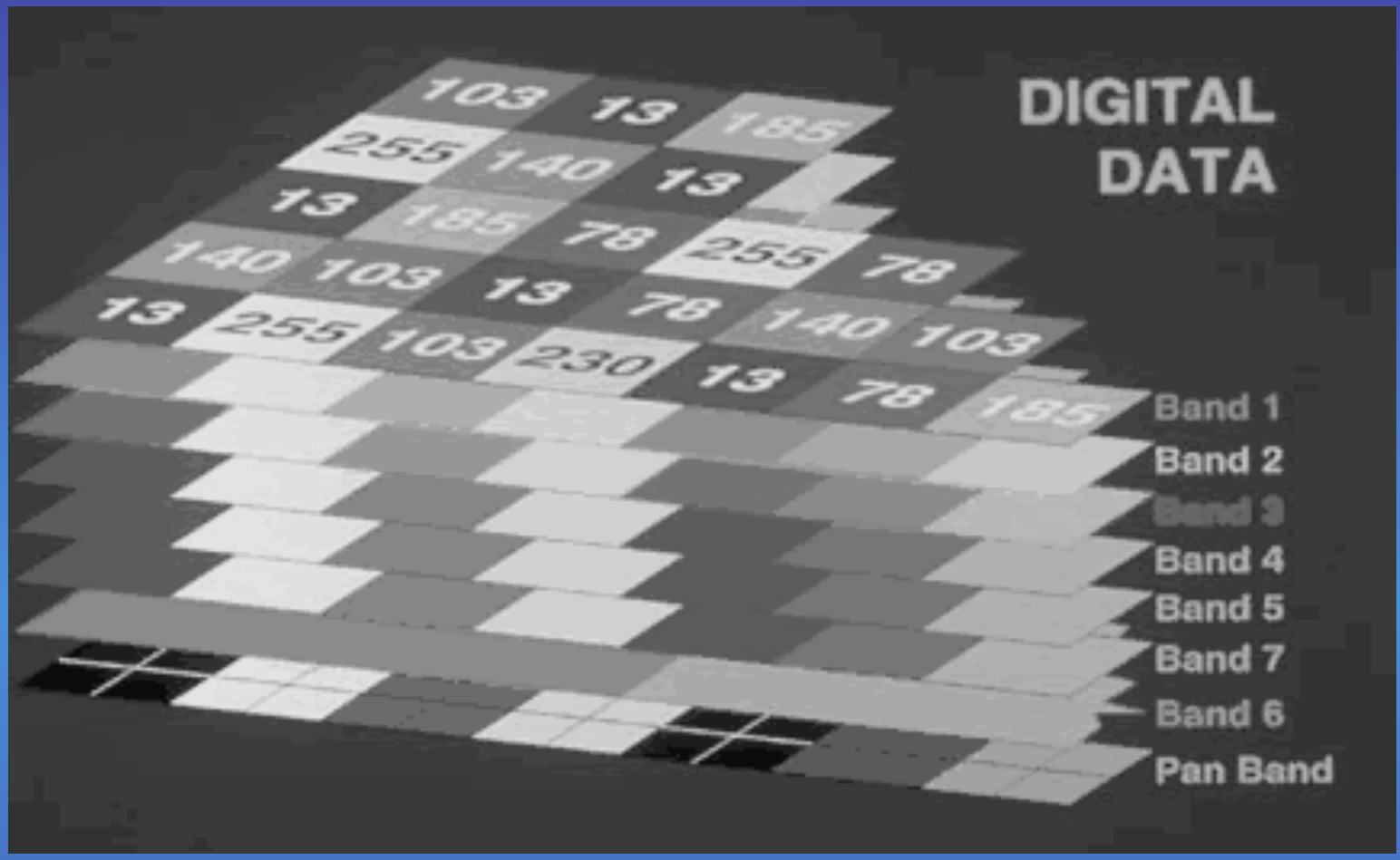
What's Special About Landsat



- Primary mission to map Earth's land surface
- Over 30 years of consistent data
- 16 day repeat
- 30-meter resolution
- A lot of free and low-cost data

Sensors Record Intensity of Reflected Energy Numerically



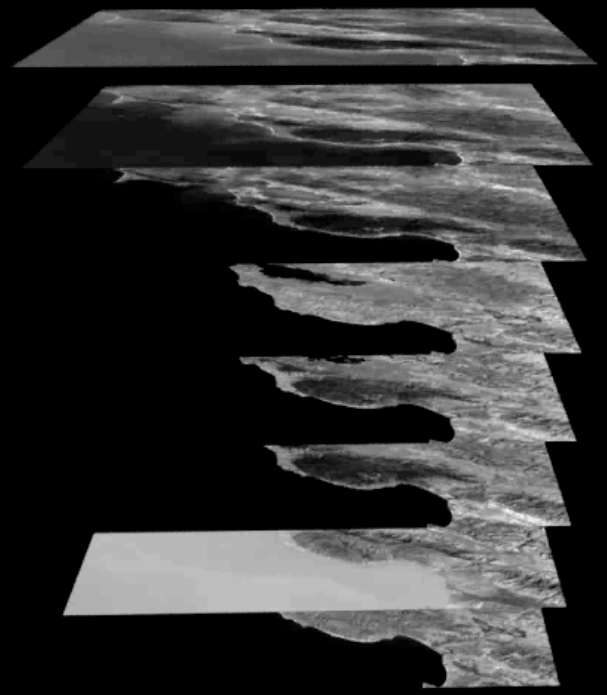


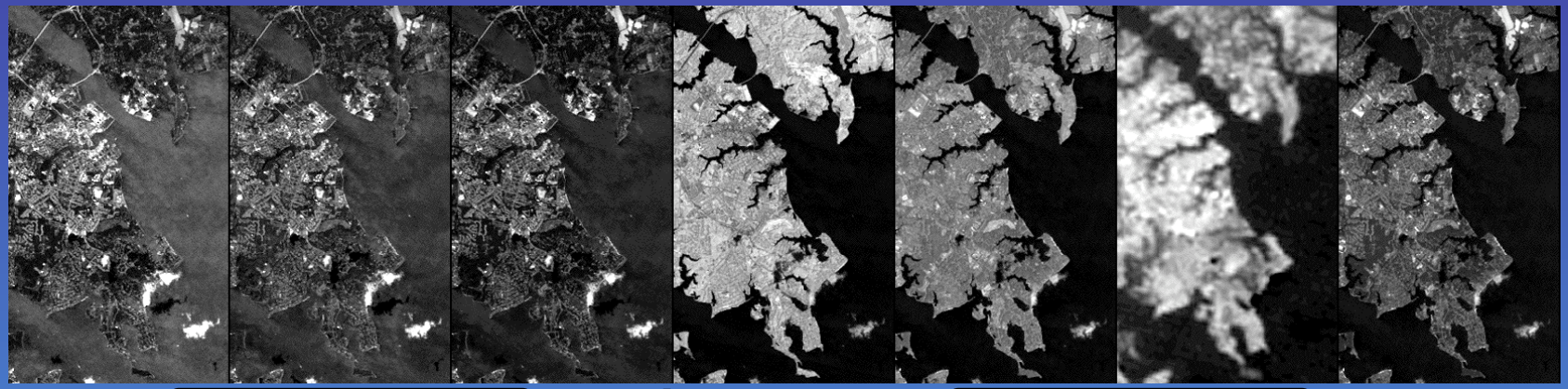
The amount of the reflected energy (intensity) is recorded for each pixel, in each band, on a scale of 0-255.

Assigning Colors to Bands


TM Band
Wavelength (um)
6
10.4 - 12.5
Thermal Infrared
7
2.08 - 2.35
Shortwave Infrared
5
1.55 - 1.75
Shortwave Infrared
4
0.76 - 0.90
Near Infrared
3
0.63 - 0.69
Red
2
0.52 - 0.60
Green
1
0.45 - 0.52
Blue

ETM+ Band	Wavelength (um)	
1	0.450 - 0.515	Blue
2	0.525 - 0.605	Green
3	0.63 - 0.69	Red
4	0.75 - 0.90	Near Infrared
5	1.55 - 1.75	Infrared
7	2.09 - 2.35	Shortwave Infrared
6	10.40 - 12.50	Thermal Infrared
8	0.52 - 0.90	Panchromatic





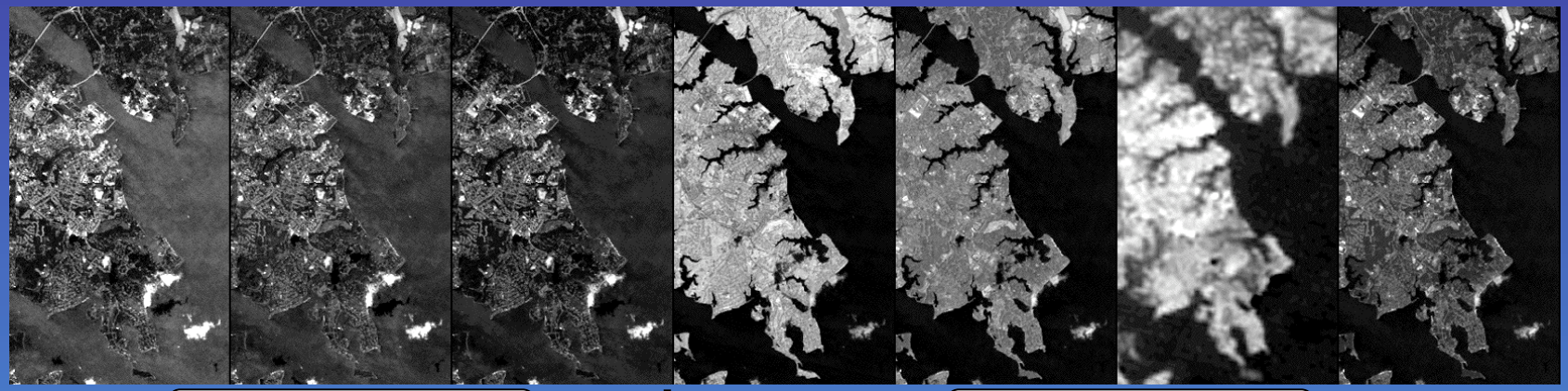
Visible

Infrared

1 2 3 4 5 6 7

3,2,1

Red Data is shown as Red

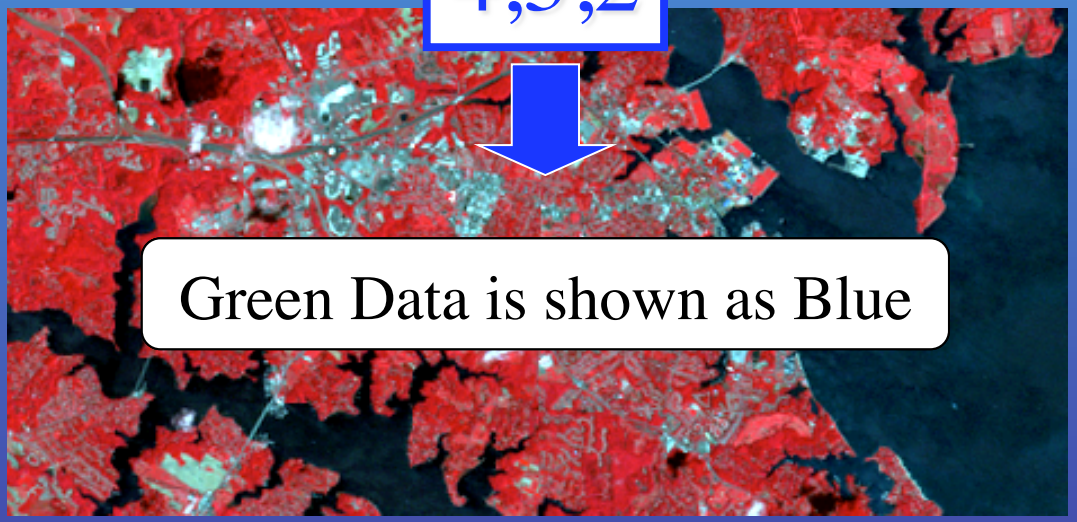


Visible

Infrared

1 2 3 4 5 6 7

4,3,2

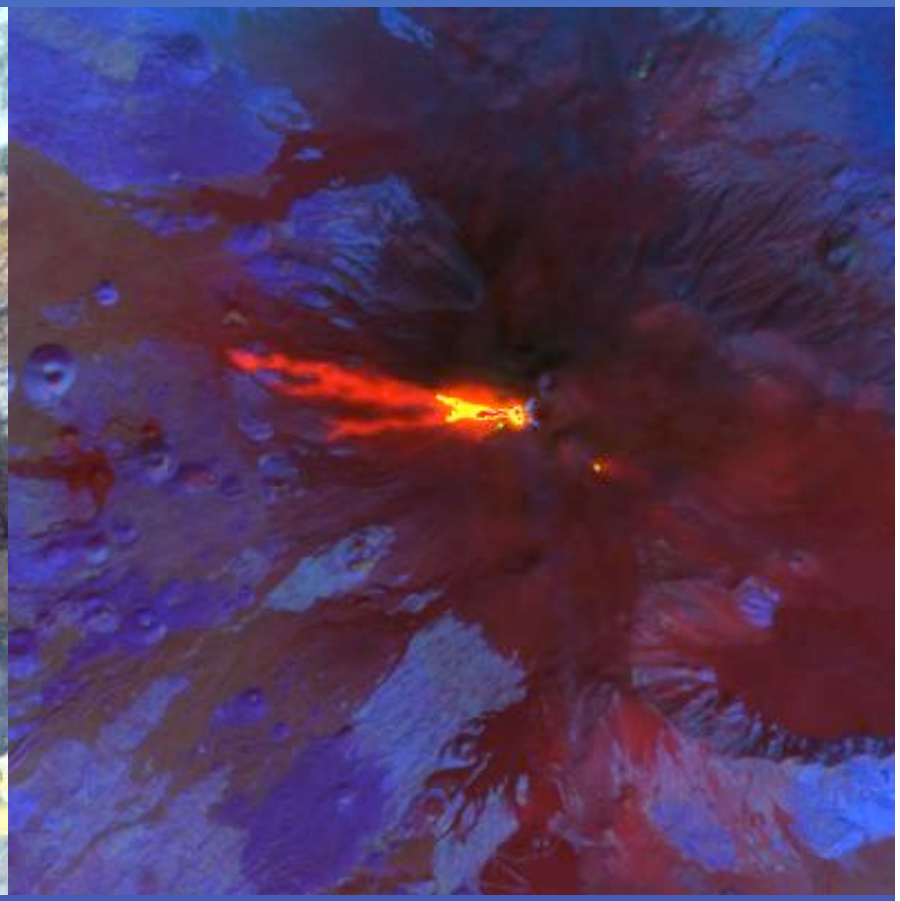


Green Data is shown as Blue

So we see more than we could otherwise.

Same scene, different wavelengths

Visible wavelengths



Infrared wavelengths

True-Color Composite (3,2,1)

True-color composite images approximate the range of vision for the human eye, and hence these images appear to be close to what we would expect to see in a normal photograph. True-color images tend to be low in contrast and somewhat hazy in appearance. This is because blue light is more susceptible than other bandwidths to scattering by the atmosphere. Broad-based analysis of underwater features and landcover are representative applications for true-color composites.

Near Infrared Composite (4,3,2)

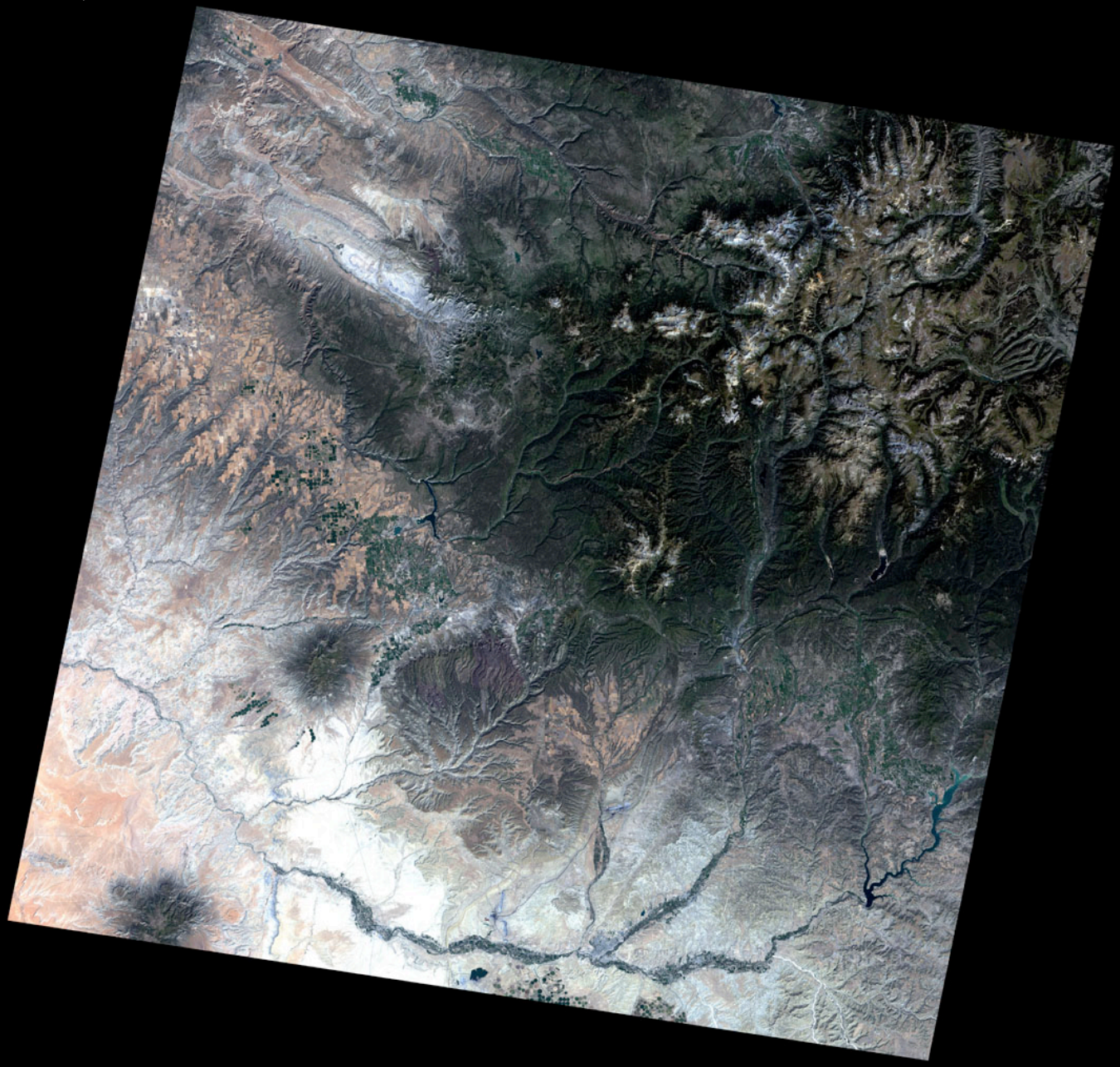
Adding a near infrared (NIR) band and dropping the visible blue band creates a near infrared composite image. Vegetation in the NIR band is highly reflective due to chlorophyll, and an NIR composite vividly shows vegetation in various shades of red. Water appears dark, almost black, due to the absorption of energy in the visible red and NIR bands.

Shortwave Infrared Composite (7,4,3 or 7,4,2)

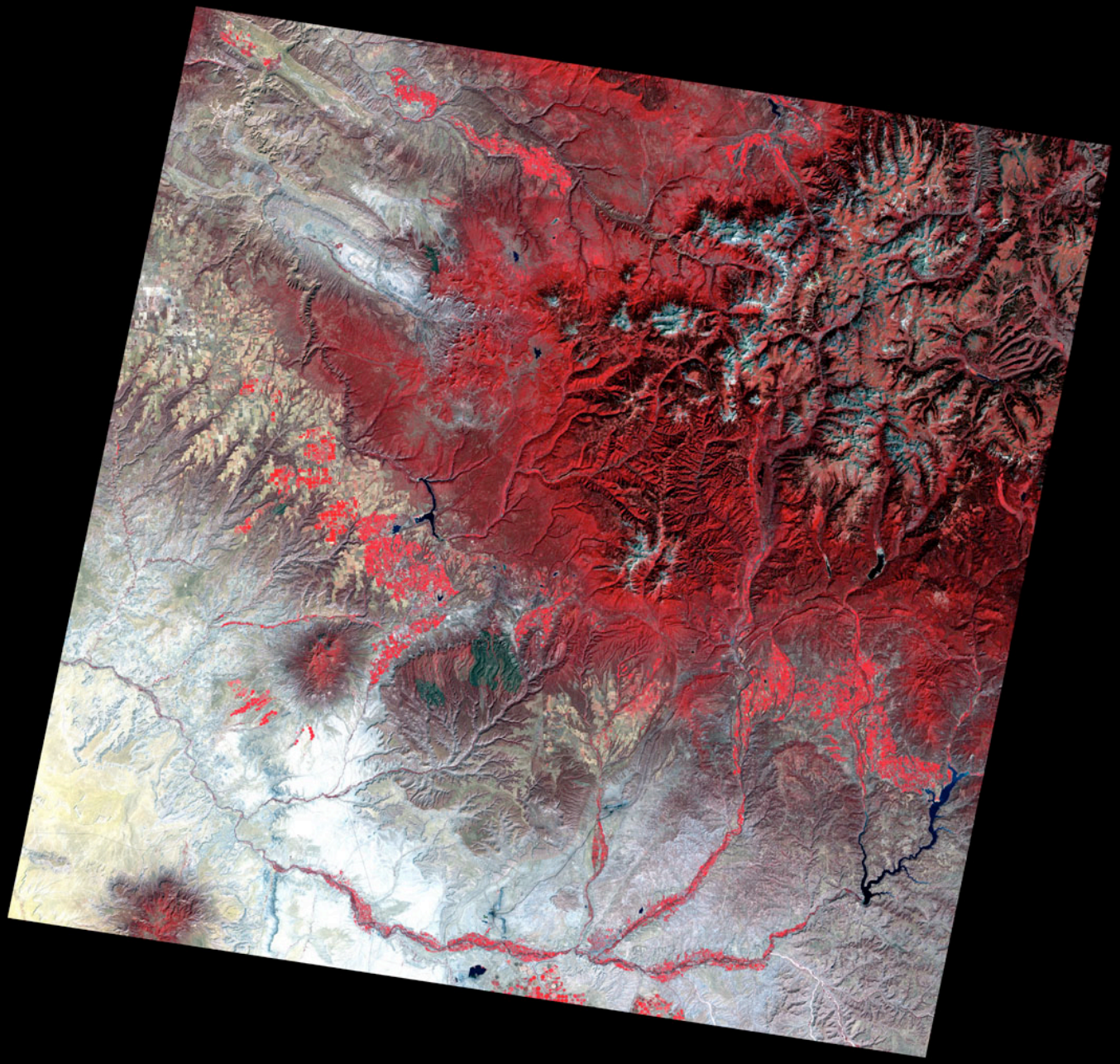
A shortwave infrared composite image is one that contains at least one shortwave infrared (SWIR) band. Reflectance in the SWIR region is due primarily to moisture content. SWIR bands are especially suited for camouflage detection, change detection, disturbed soils, soil type, and vegetation stress.

Some different band combinations…

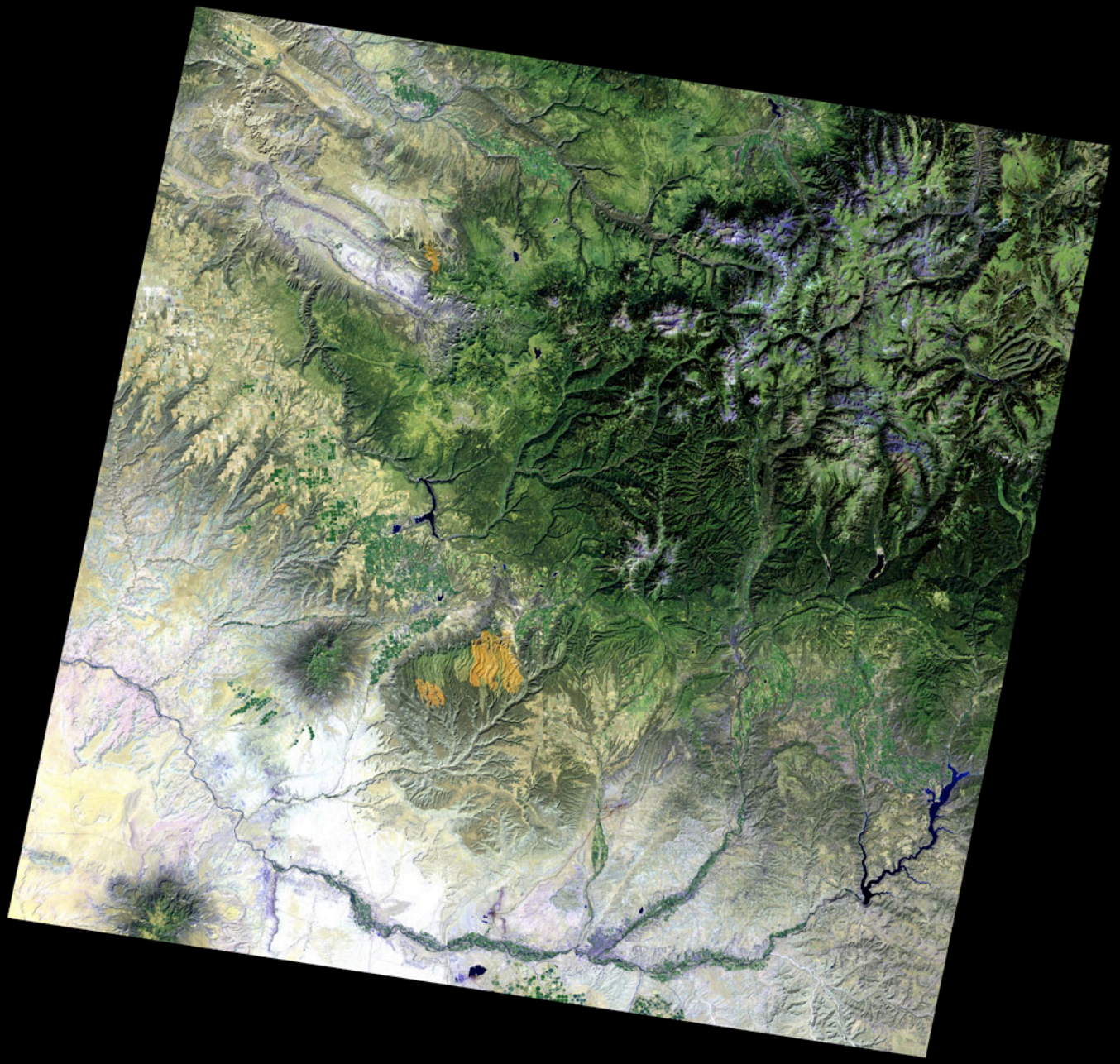
Landsat 7, Path 35 Row 34, 09.12.00



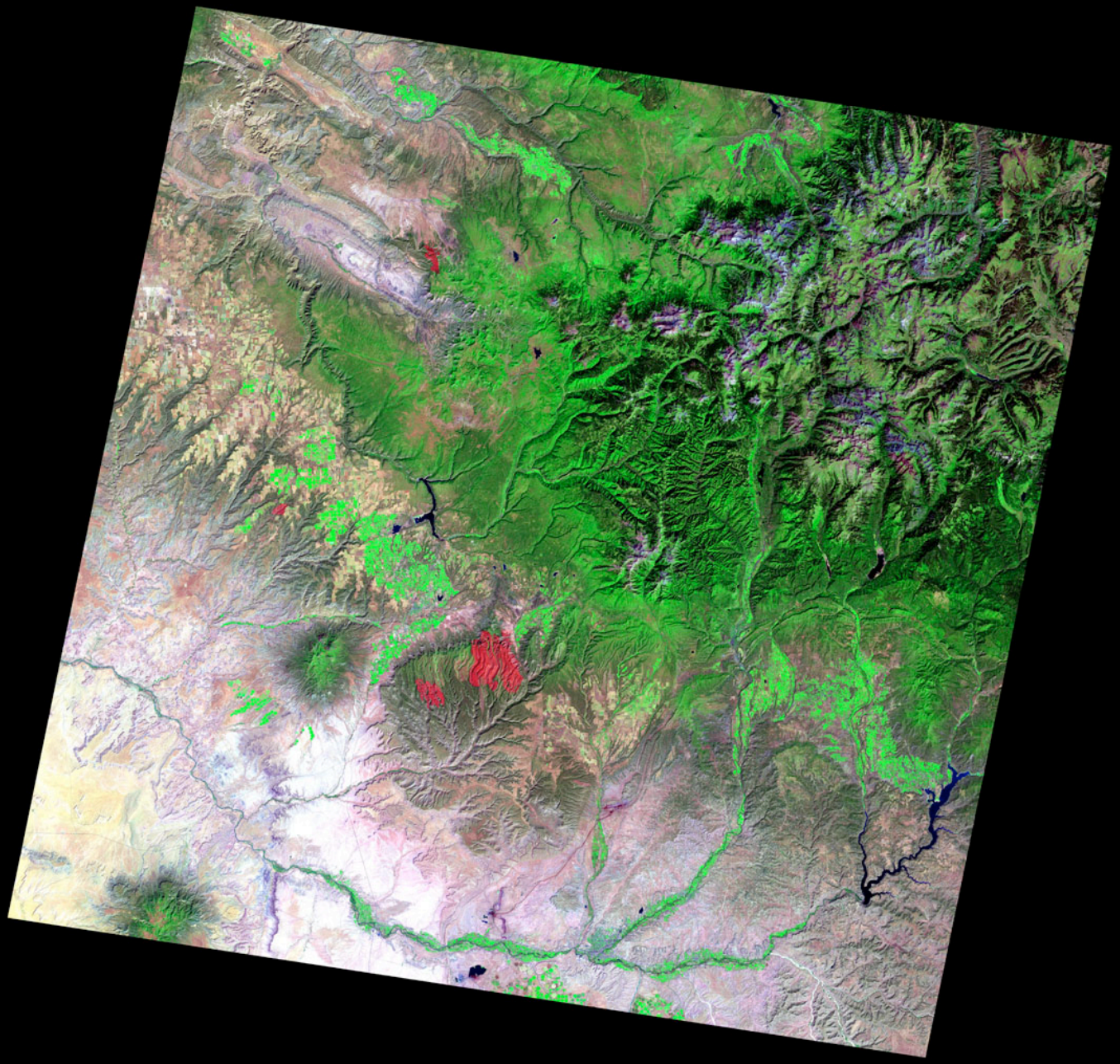
3,2,1



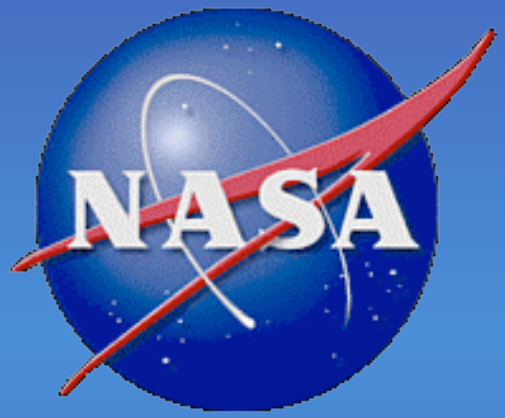
4,3,2



7,5,2



7,4,2



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http:www.nasa.gov