REMOTE SENSING BASICS

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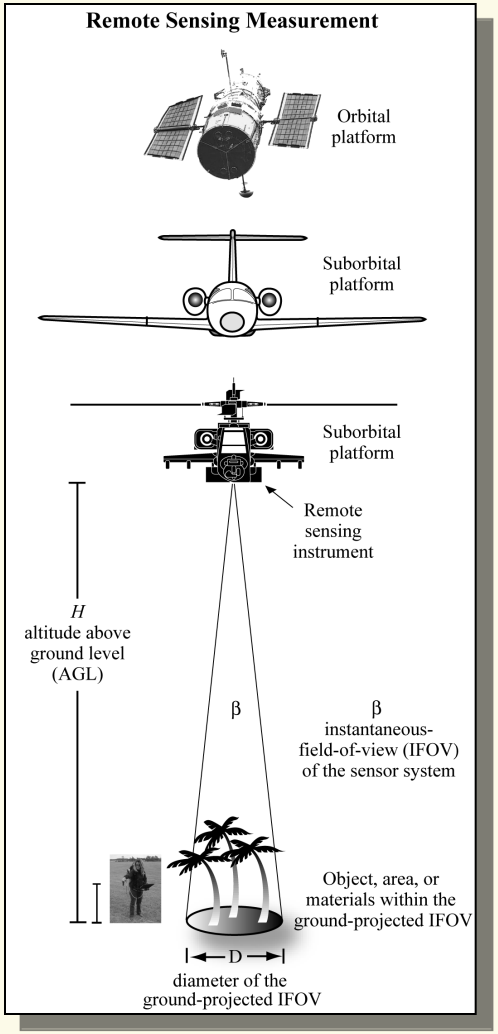
NEW HAMPSHIRE VIEW

What is Remote Sensing?

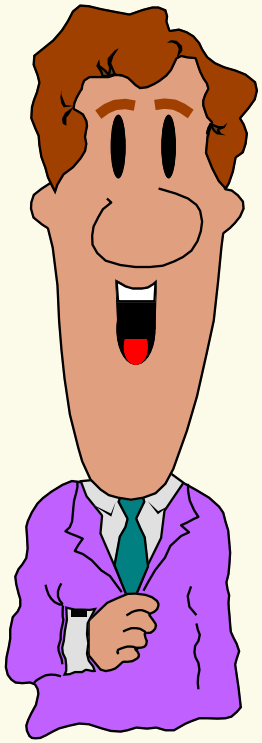
Measurement of some property of an object by a recording device that is *not in physical contact* with the object.

Goal: To obtain the most accurate measurement using the most appropriate sensor on the most practical platform.

Learning something about an object without touching it



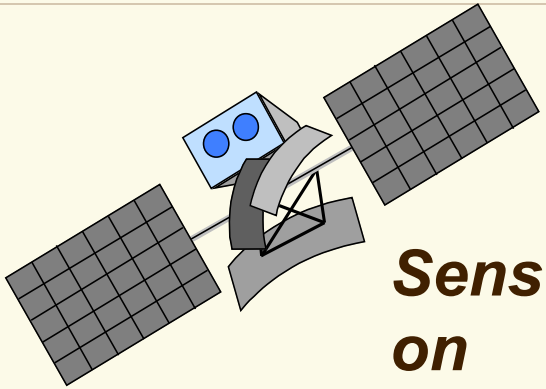
What Are Remote Sensing Systems?



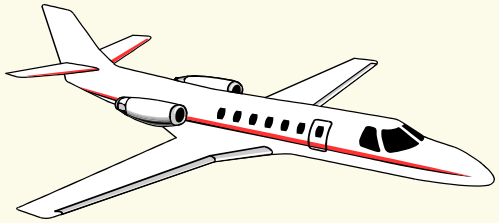
Ears

Eyes

Nose



Sensors on Satellites



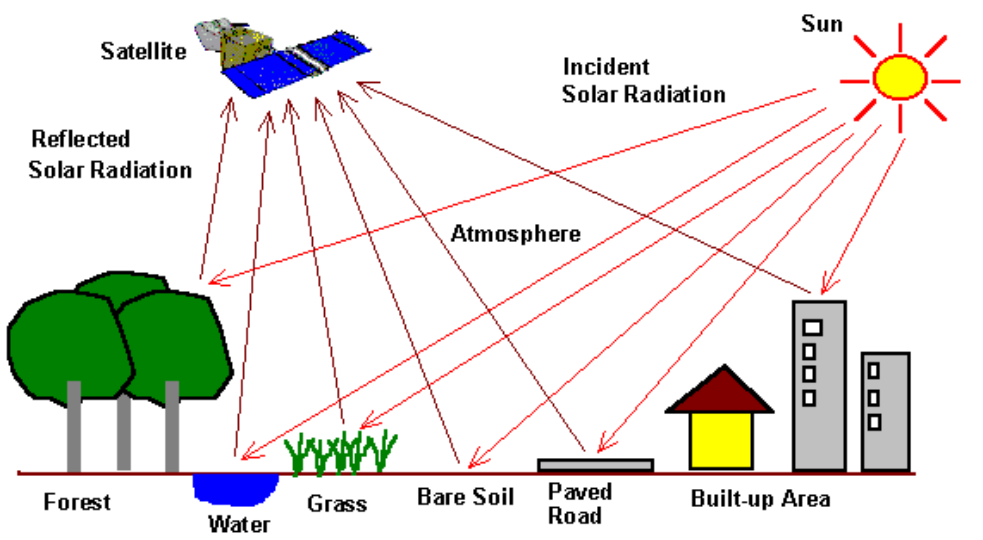
Sensors on Aircraft

Remote Sensing Systems Are Composed of:

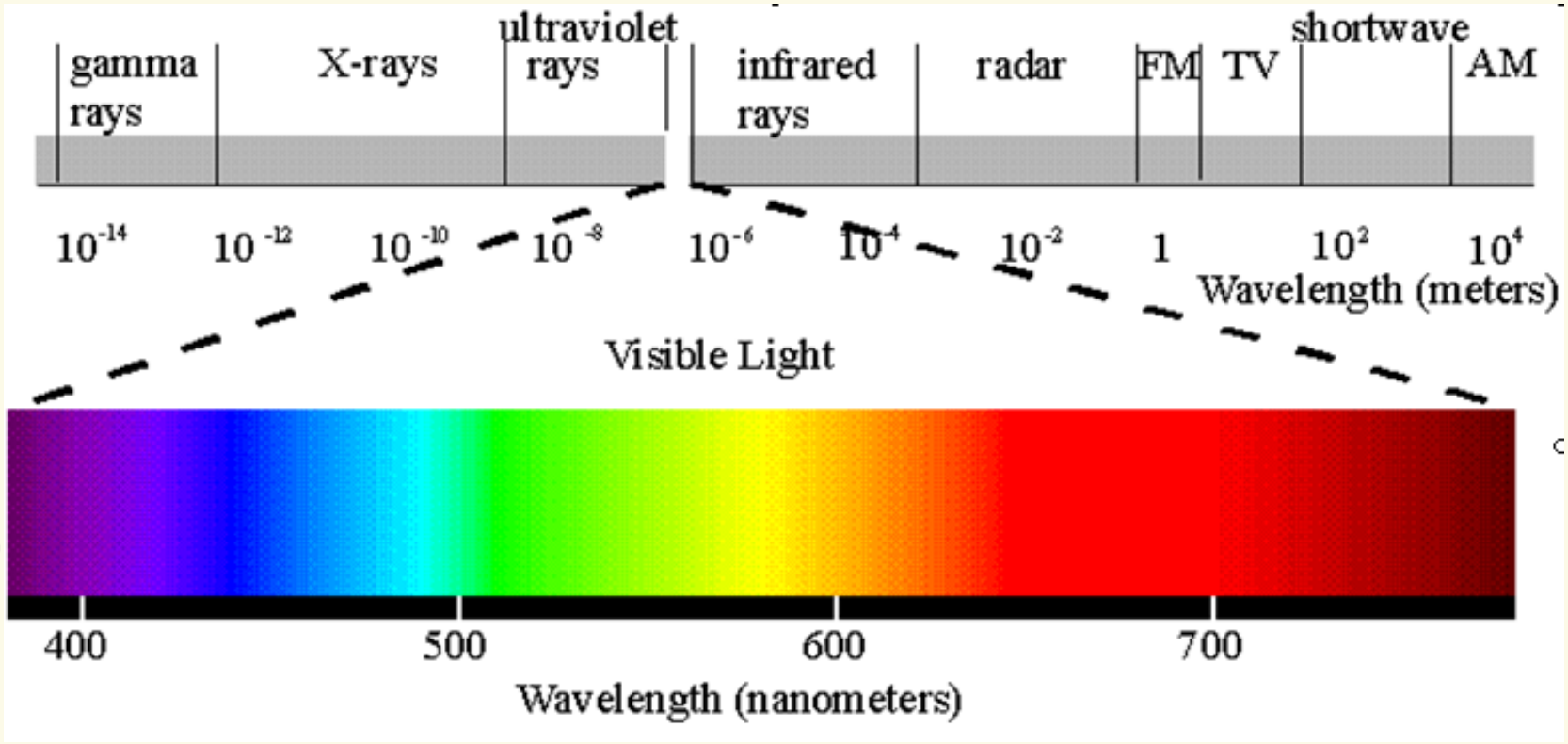
- Two components:
  - Data collection system(s) = Sensor
  - Platform to carry the sensor

Sensor System

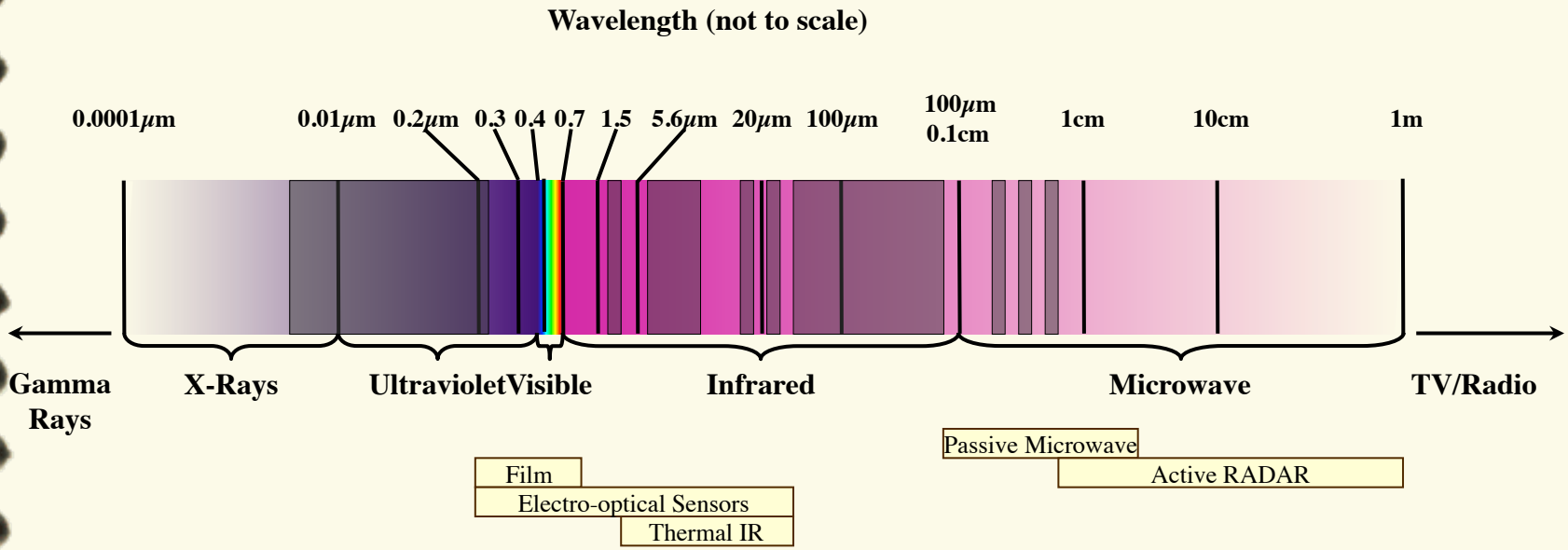
A sensor system records electromagnetic (EM) radiation detected as a combination of reflected solar radiation and emitted radiation by an object



The Electromagnetic Spectrum

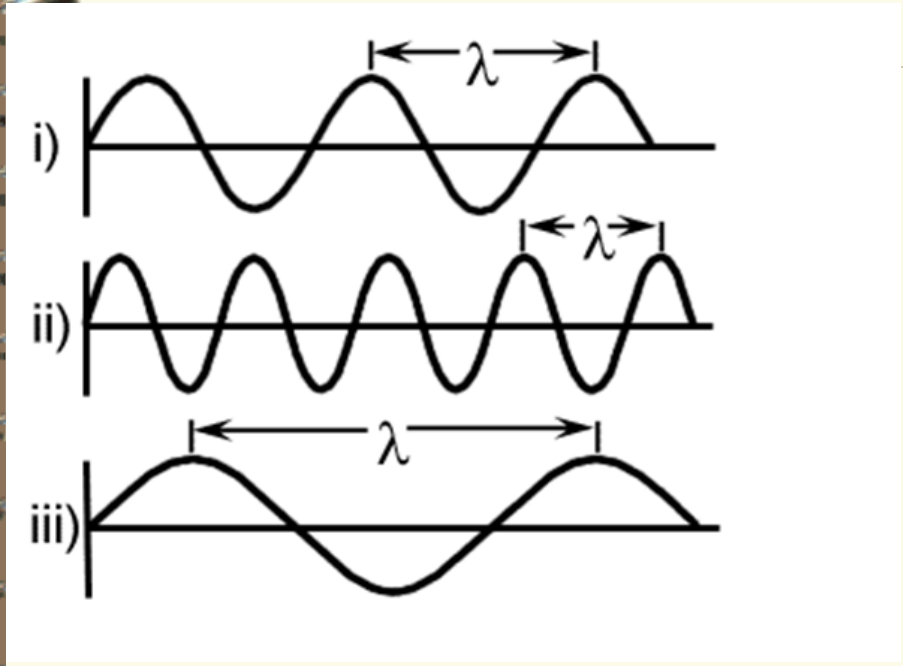


The Electromagnetic Spectrum



Grayed sections indicate significant bands of water or atmospheric absorption

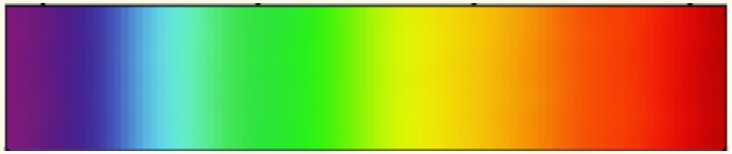
Wavelength and Frequency



Units of wavelength:

Nanometers: 1 nm = 10^{-9} m

Micrometers: 1 μm = 10^{-6} m

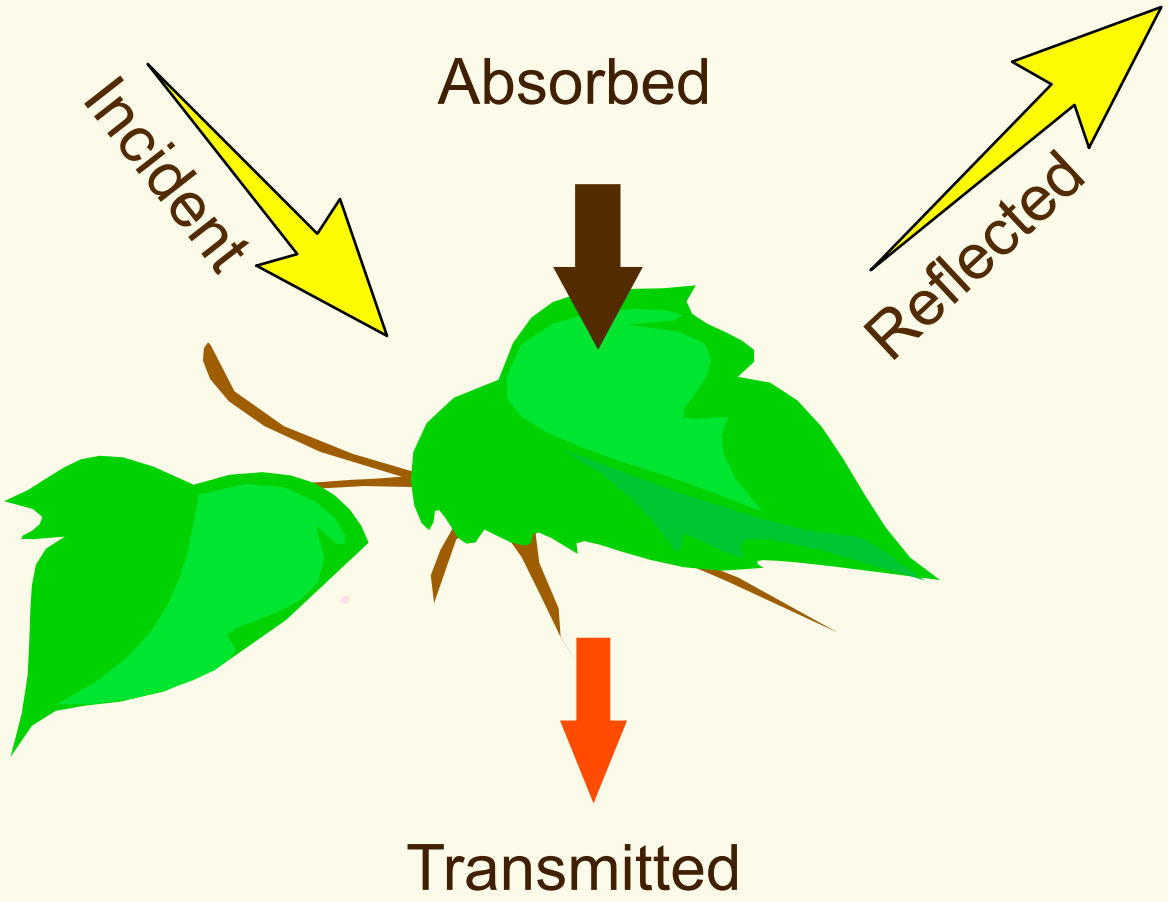


λ = wavelength (m)

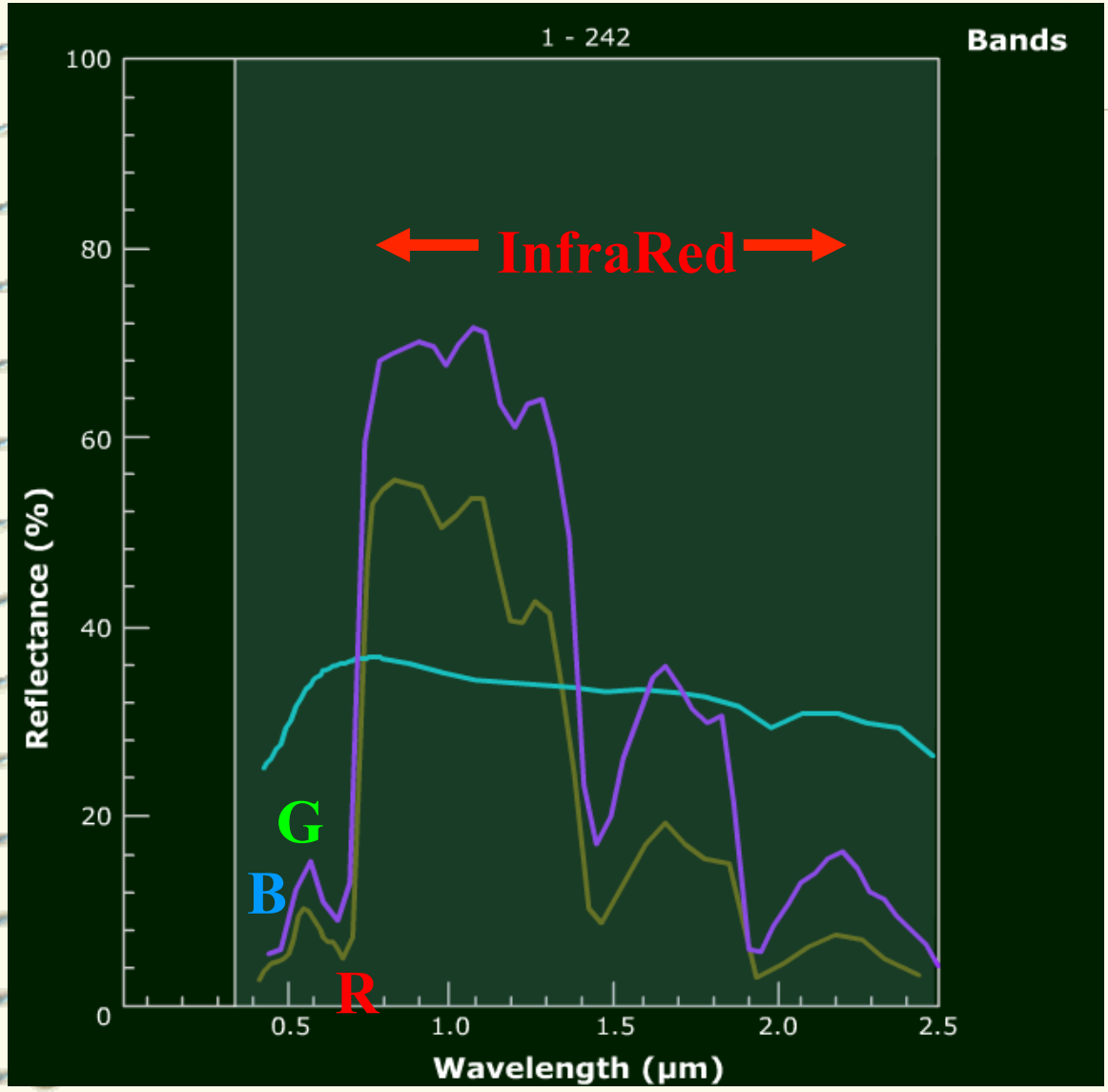
f = frequency (cycles/second, Hz)

c = speed of light (3×10^8 m/s)

Diagram of Light Interactions

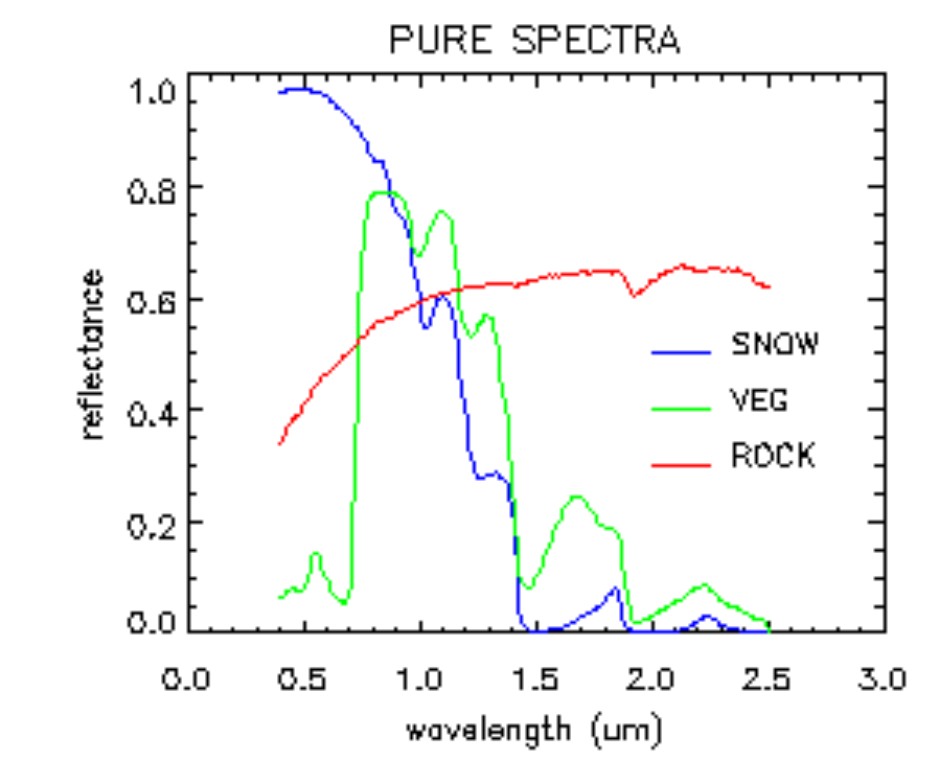


Spectral Pattern Analysis



- Oak
- Pine
- Concrete

Spectral Pattern Analysis



Spectral Pattern Analysis

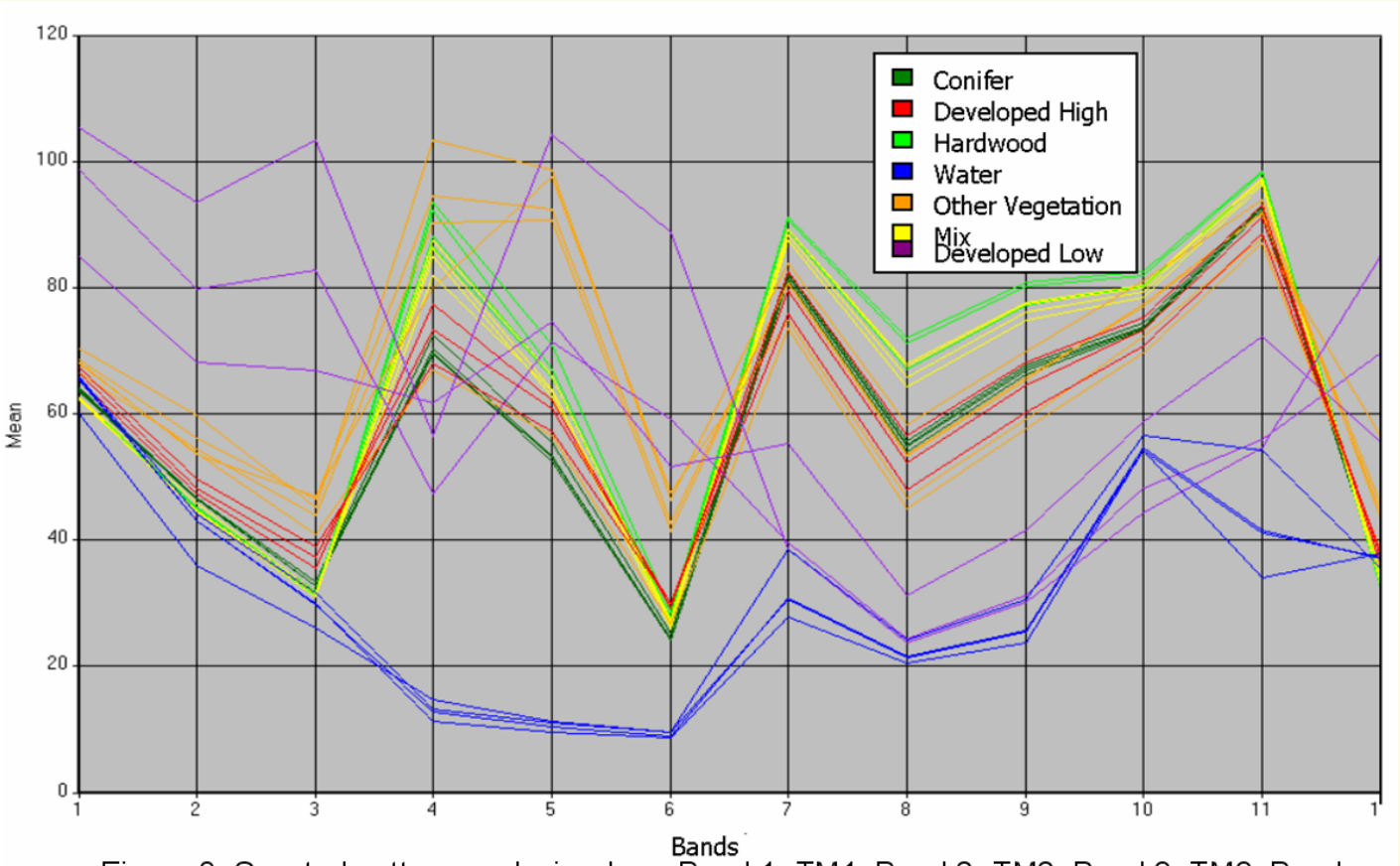
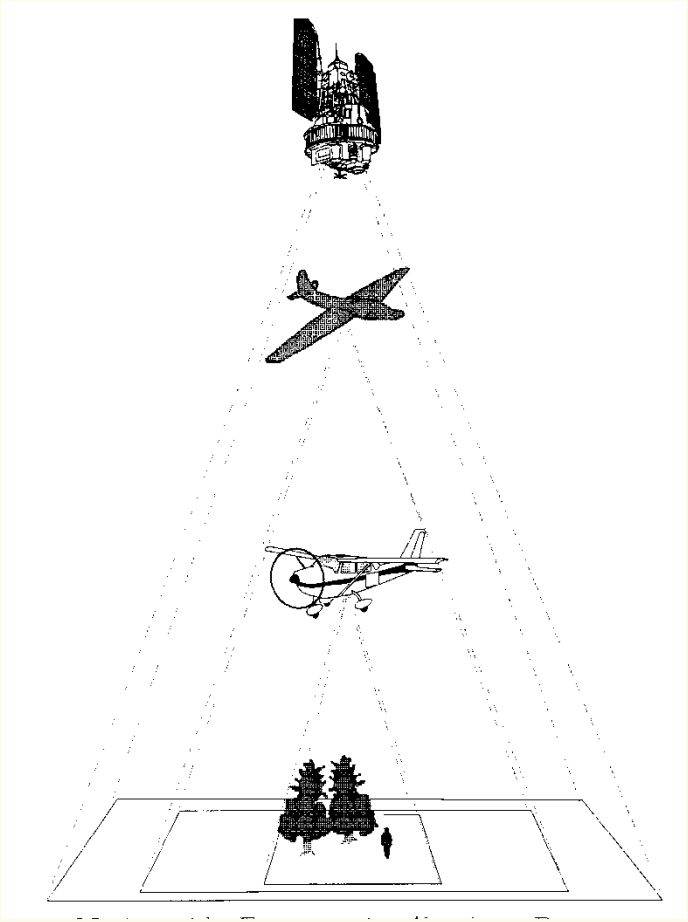


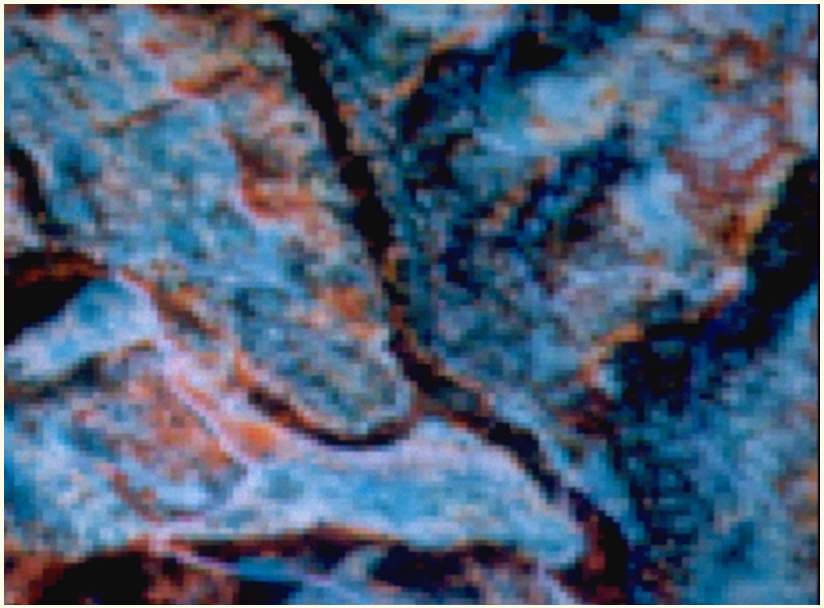
Figure 8. Spectral pattern analysis where Band 1=TM1. Band 2=TM2, Band 3=TM3, Band 4=TM4, Band 5=TM5, Band 6=TM7, Band 7=NDVI, Band 8=Ratio 4/3, Band 9=SqRt(IR/R), Band 10=Veg Index, Band 11= TNDVI, and Band 12=Ratio 5/4

Types of Platforms

- ✓ Satellites
- ✓ Aircraft
- ✓ Ground systems



Analog versus Digital



Why Use Remotely Sensed Data?

- Is usually is less expensive than ground data
- Provides a “bird’s eye” (synoptic) view
- Can sense data that humans are incapable of measuring (e.g., infrared)
- Allows for various spatial and temporal scales

Historical Perspective

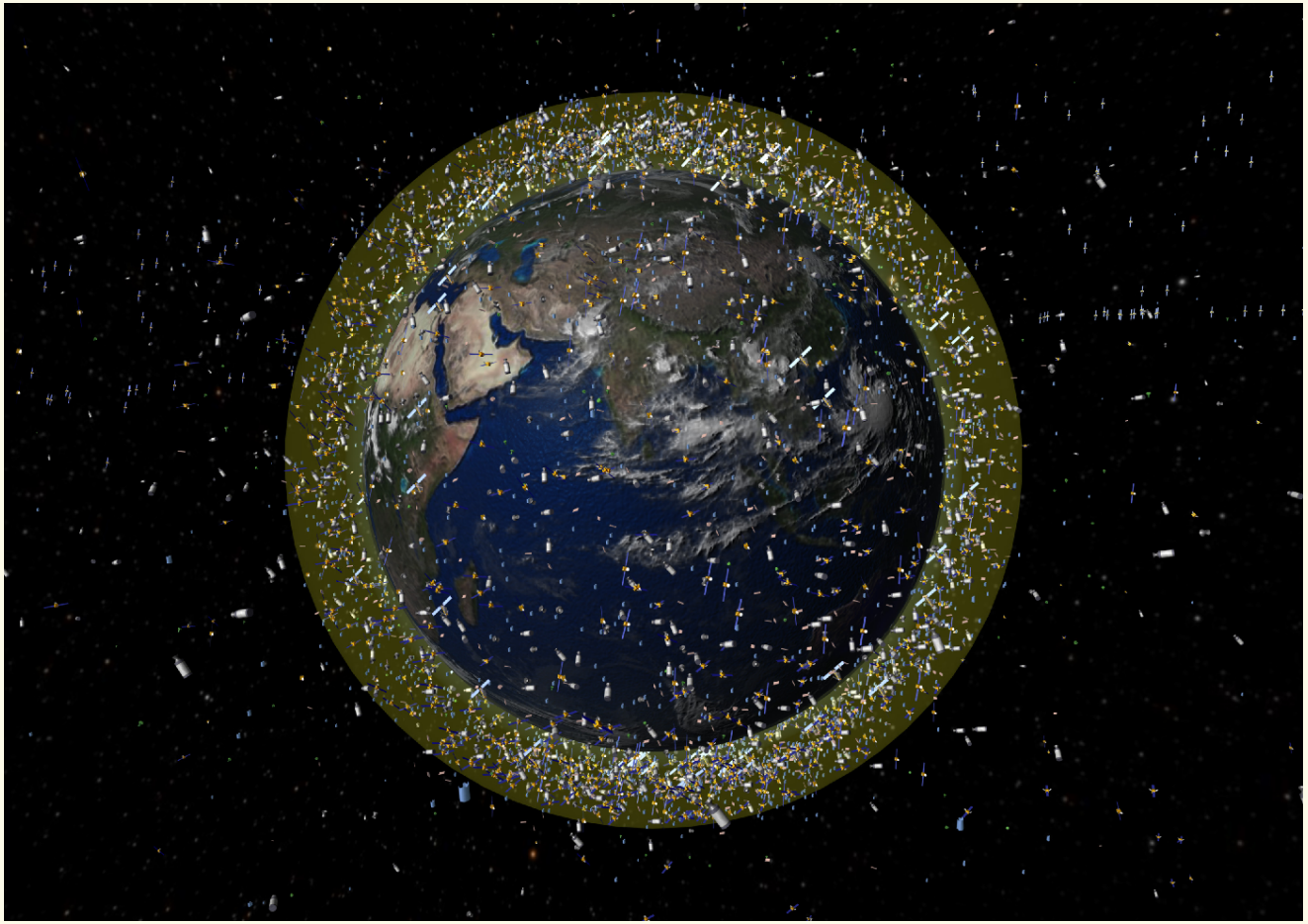
- 1860's - First aerial photos from balloons
- 1940-50's - Widespread us of aerial photos (WWII)
- 1960's - First satellite images
- 1970's - Landsat MSS, airborne scanners
- 1980's - Landsat TM, SPOT, AVHRR
- 1990's - Airborne digital cameras, RADAR, IRSc&d, release of classified data, failed launches
- 2000's - New satellites, improvements in airborne digital cameras, LIDAR
- 2010's – Higher spatial & spectral resolution, extensive use of LIDAR, Hyperspectral, UAS

Sensor Types

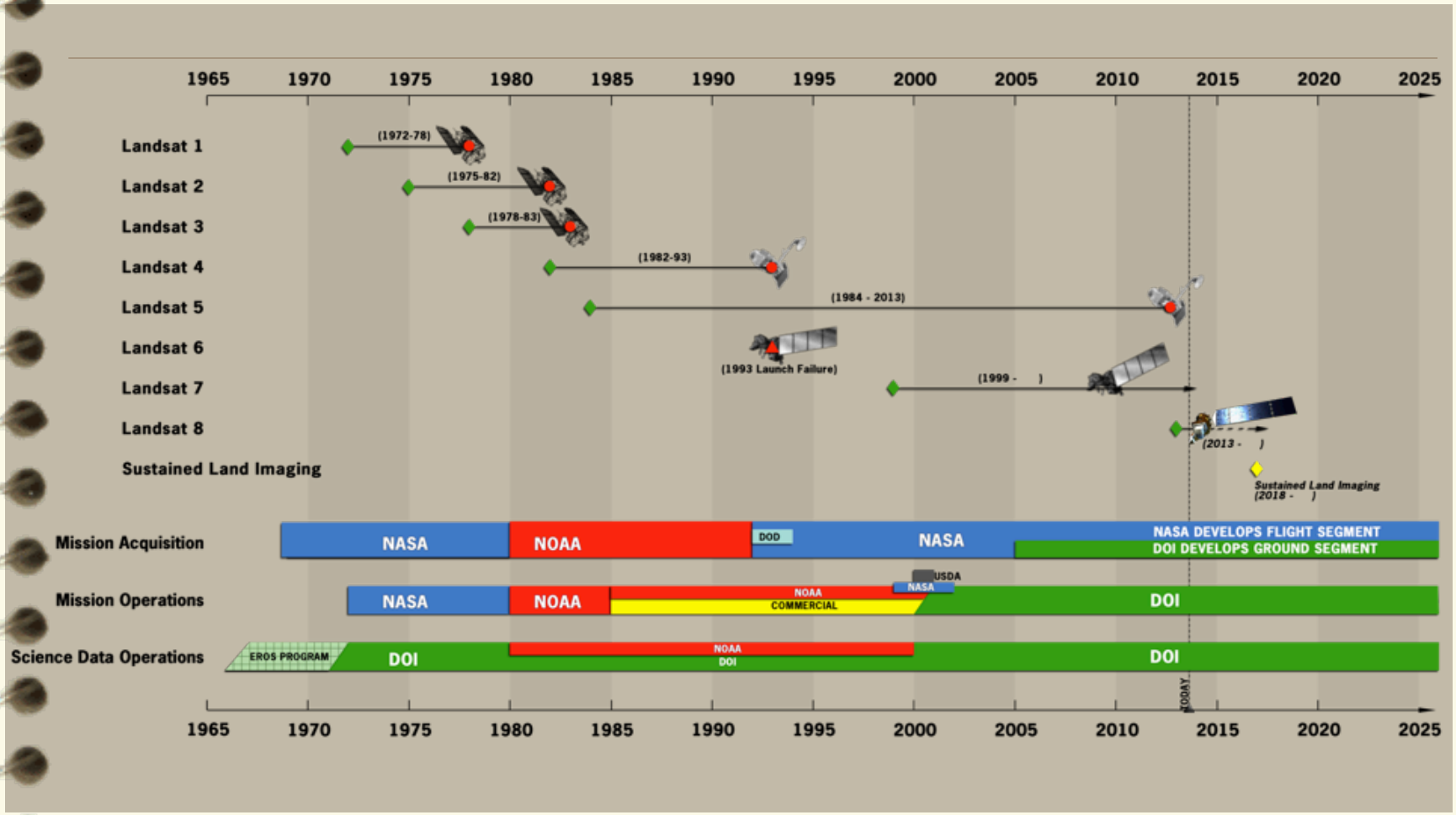
Land Observing Sensors and their Features

Weather, Global Coverage Satellites					
Sensor Name	Pixel Resolution	Swath Width, km	No. Spectral Bands	Spectral Coverage	Temporal Repeat, days
AVHRR	1.1km	2700	5	VNIR, TIR	4*day
SPOT Vegetation	1.15km	2250	4	VNIR, SWIR	26
MODIS	0.25,0.5,1km	2330	36	VNIR, SWIR, TIR	2* day
Regional Satellites					
Sensor	m	km	bands	Spectral	Repeat
ASTER	15, 30, 90	60	16	VNIR, SWIR, TIR	16
Landsat TM	30, 120	185	7	VNIR, SWIR, TIR	16
Landsat ETM+	30, 60, 15	185	8	Pan + TM	16
SPOT HRV	10, 20	60	4	Pan, VNIR	26
SPOT HRVIR	10, 20	60	5	SWIR + HRV	26
Local Coverage Satellites					
Sensor	m	km	bands	Spectral	Repeat
Quickbird	0.61 Pan, 2.44	16.5	5	Pan, VNIR	2 to 11
IKONOS	1.0 Pan, 4	11.3	5	Pan, VNIR	3
AIRBORNE Instruments					
Sensor	m	km	bands	Spectral	Repeat
AVIRIS, Hymap	4, 20	2 km, 10 km	168 - 224	VNIR, SWIR	on demand
CASI-2	5-Jan	1 km - 2.5 km	48-288	VNIR	on demand
ADAR-5500	0.5 - 3	1 km - 2.5 km	4	VNIR	on demand

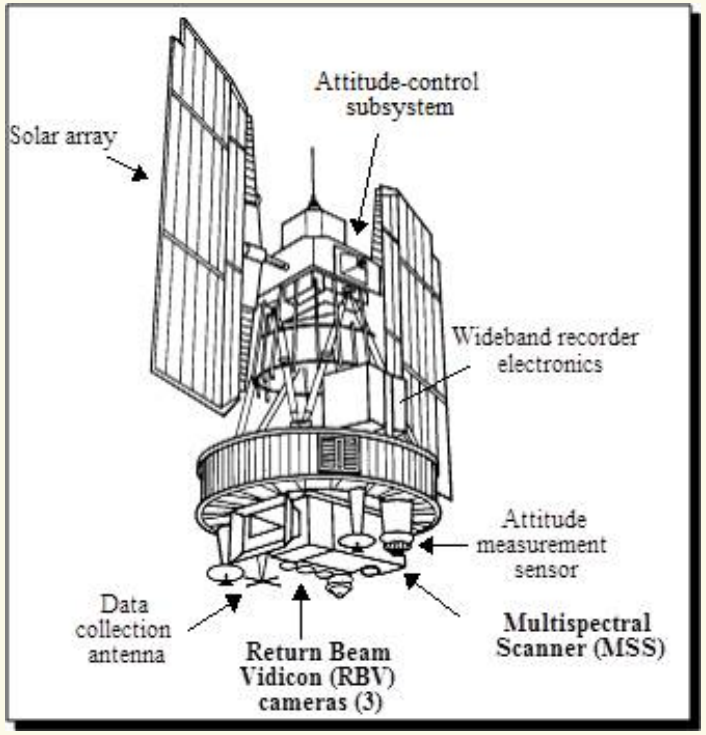
It has gotten a little crowded



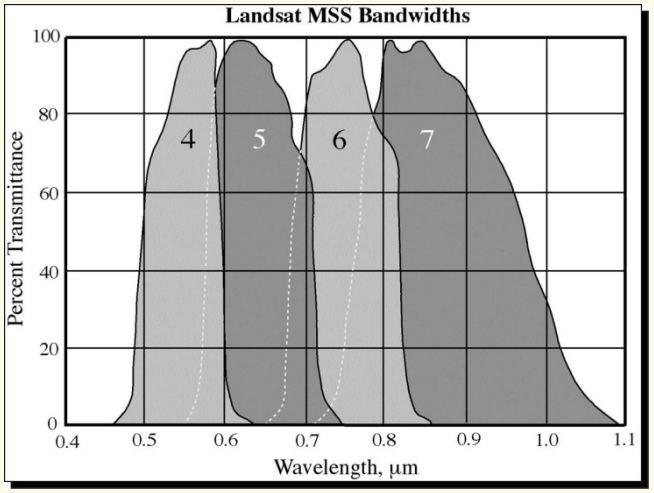
History of Landsat



Landsat MSS



- Launched 1972
- Spatial resolution = 80m
- Spectral resolution = G, R, and 2 NIR (bands 4, 5, 6, & 7)



Landsat TM

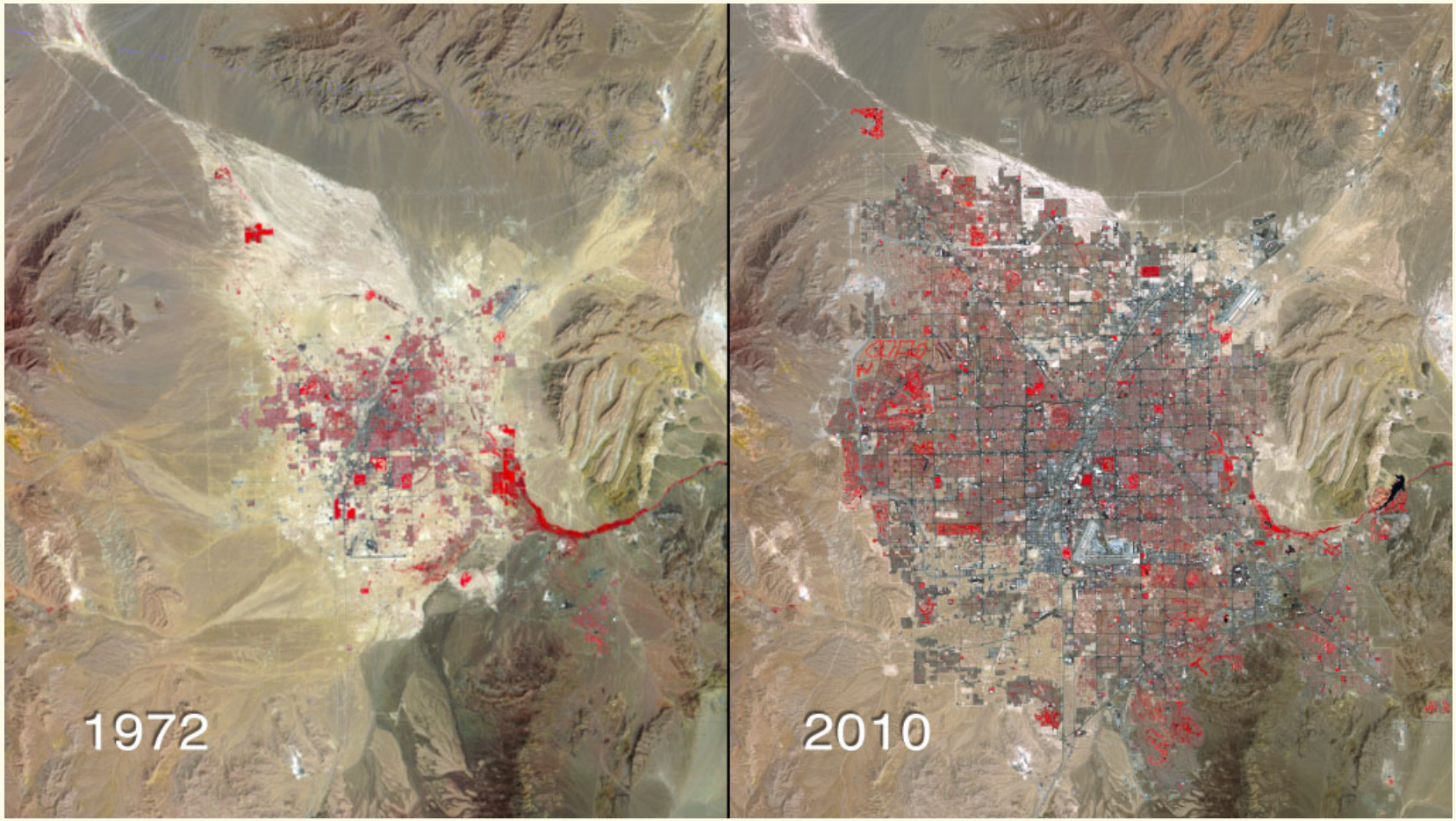
- Landsat 4 launched 1982
- Spatial resolution = 30 m
- Spectral resolution = 7 bands

Table 5.9.1 Landsat MSS and TM observation function

Sensor	Band	Spectral range (micro m)			IFOV
MSS	4	0.50	~ 0.60	green	80m
	5	0.60	~ 0.70	red	80m
	6	0.70	~ 0.80	near - IR	80m
	7	0.80	~ 1.10	near - IR	80m
TM	1	0.45	~ 0.52	blue	30m
	2	0.52	~ 0.60	green	30m
	3	0.63	~ 0.69	red	30m
	4	0.76	~ 0.90	near - IR	30m
	5	1.55	~ 1.75	interm - IR	30m
	6	10.40	~ 12.50	thermal - IR	120m
	7	2.08	~ 2.35	mid. - IR	30m

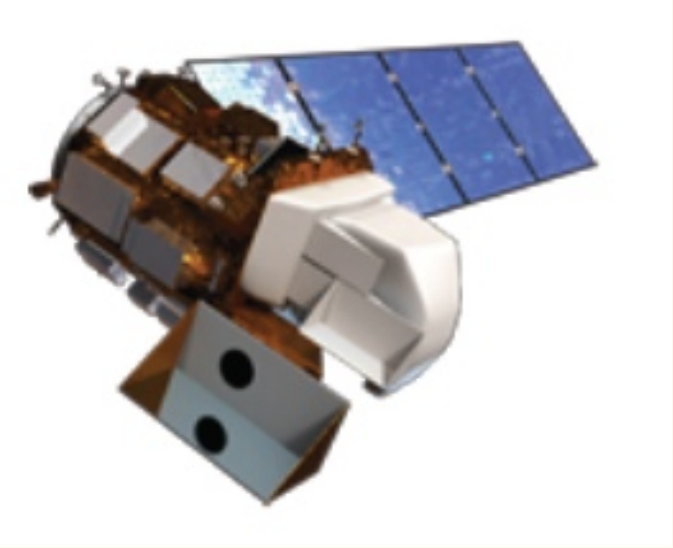
Growth in Las Vegas

Las Vegas Time Lapse 1972-2010

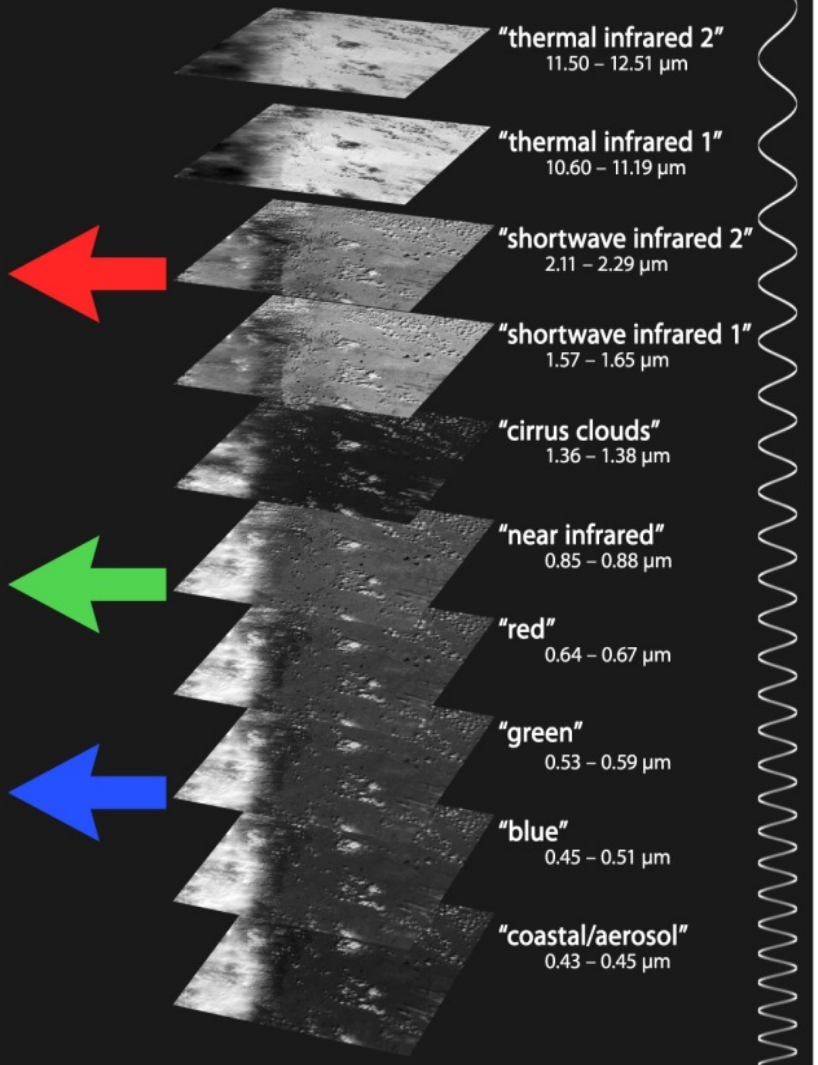


Landsat 8

- Launched Feb. 11, 2013
- 10 bands – 8 on OLI & 2 on TIRS
- 30 m pixels
- 12 bits



The Landsat Data Continuity Mission collects data from several regions of the electromagnetic spectrum. This is the first data from the mission.



Three wavelengths are colored red, green, and blue, and then combined to make a single image.

Different features of the landscape can be highlighted by combining different wavelengths. The burned area after a wildfire reflects strongly in the shortwave infrared, therefore the fire scar in the image is a strong red color.


Thanks