

Remote Sensing Basic

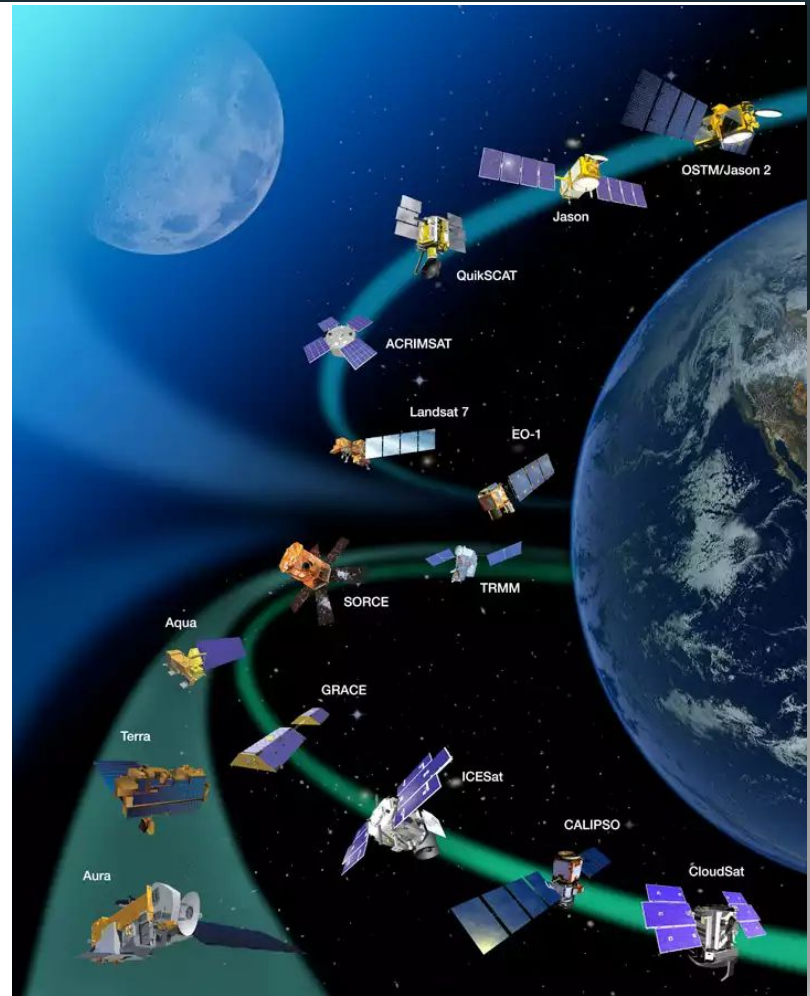
Tek Kshetri

Remote Sensing

- Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object.



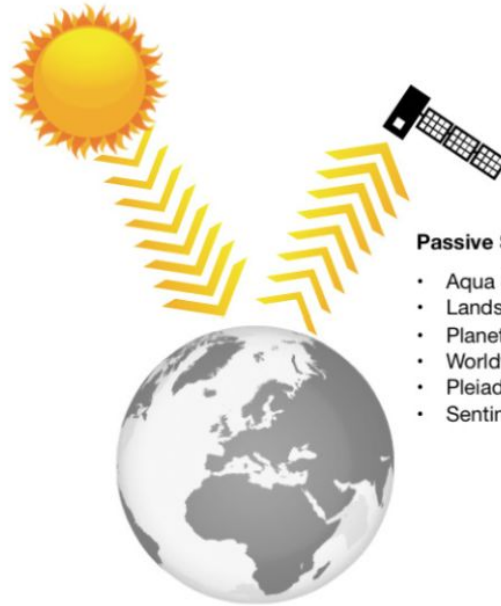
Satellite Remote Sensing



Sensors types

Passive vs. Active Sensors

Most Earth observation satellites are passive, only receiving image data from reflected sunlight, but a few utilize active image capture by transmitting their own signal.



Passive Satellites:

- Aqua (MODIS)
- Landsat-8
- PlanetScope (Dove)
- Worldview-4
- Pleiades
- Sentinel-2

PASSIVE Earth Observation Satellites

Passive satellites detect radiation reflected off the Earth's surface, such as visible light and infrared. In general, passive satellites are not able to work through clouds.

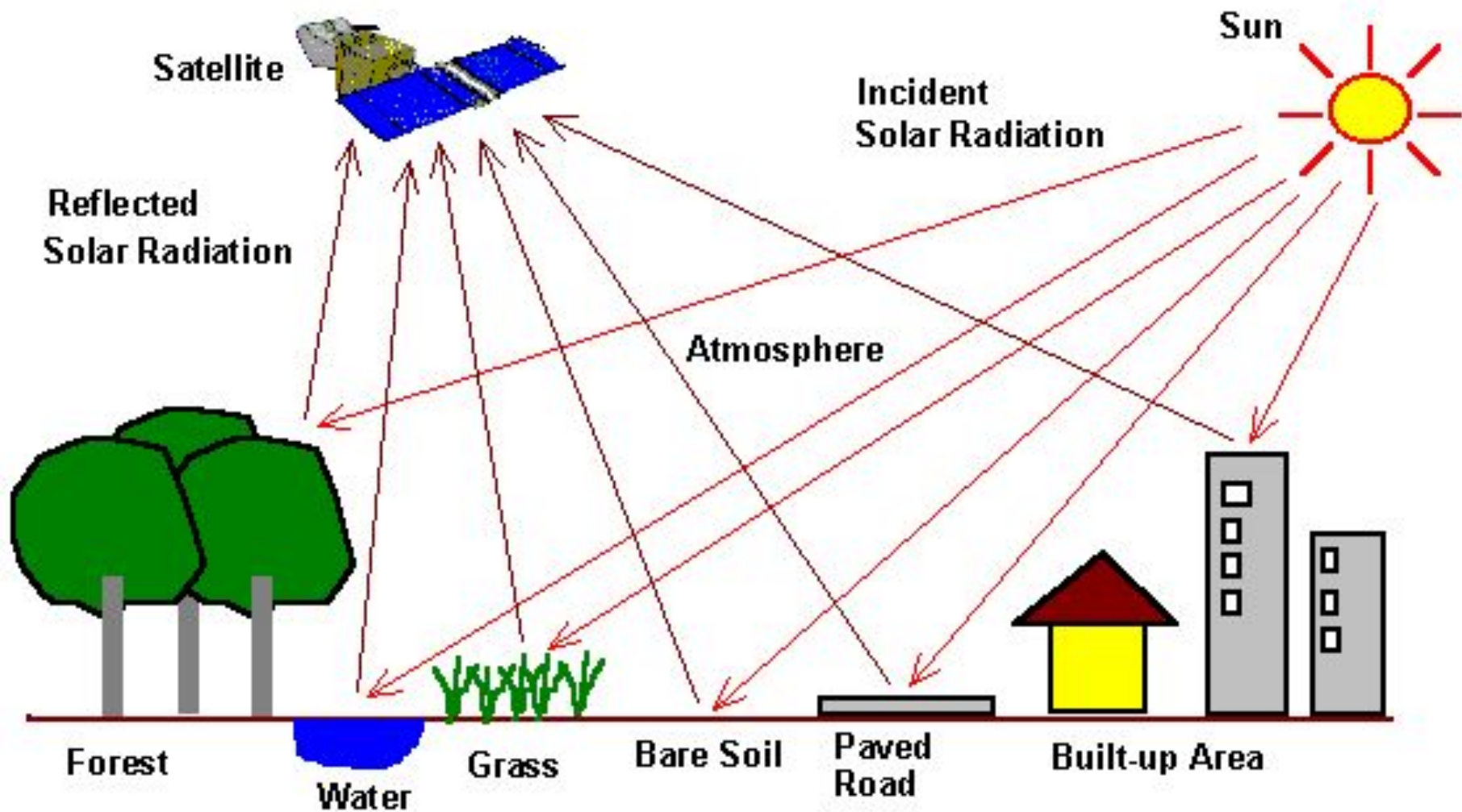


Active Satellites:

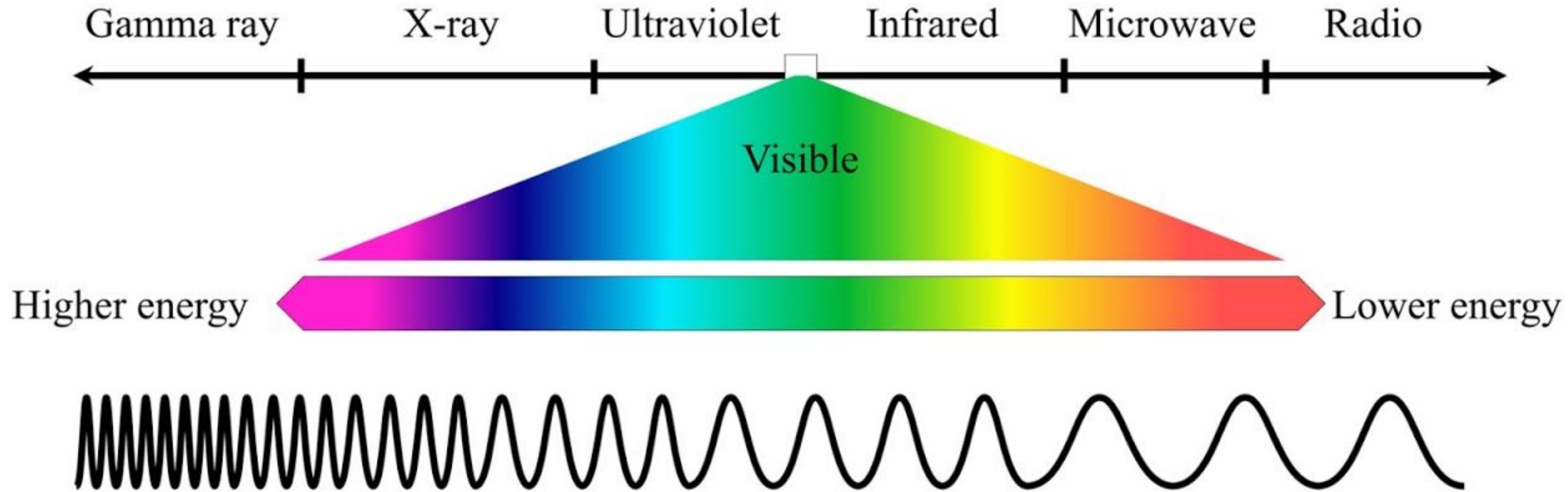
- Sentinel-1
- RADARSAT-2
- ICEYE-X1
- TanDEM-X
- ALOS-2

ACTIVE Earth Observation Satellites

Active satellites transmit energy towards the Earth and measure the returned signal which provides information about the Earth's surface. In general, active satellites can see through clouds.

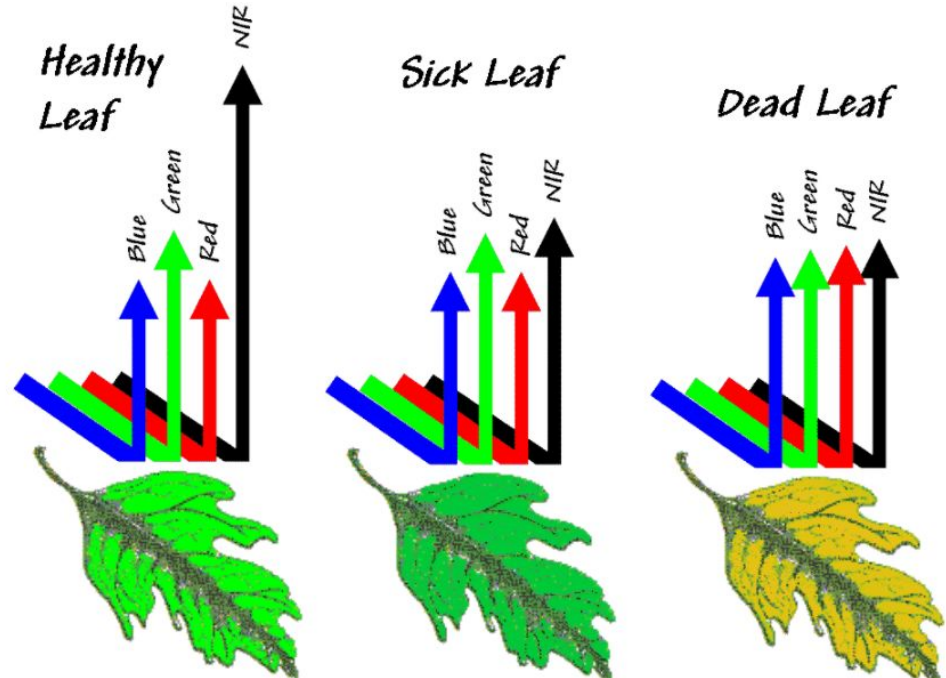


Electromagnetic Spectrum



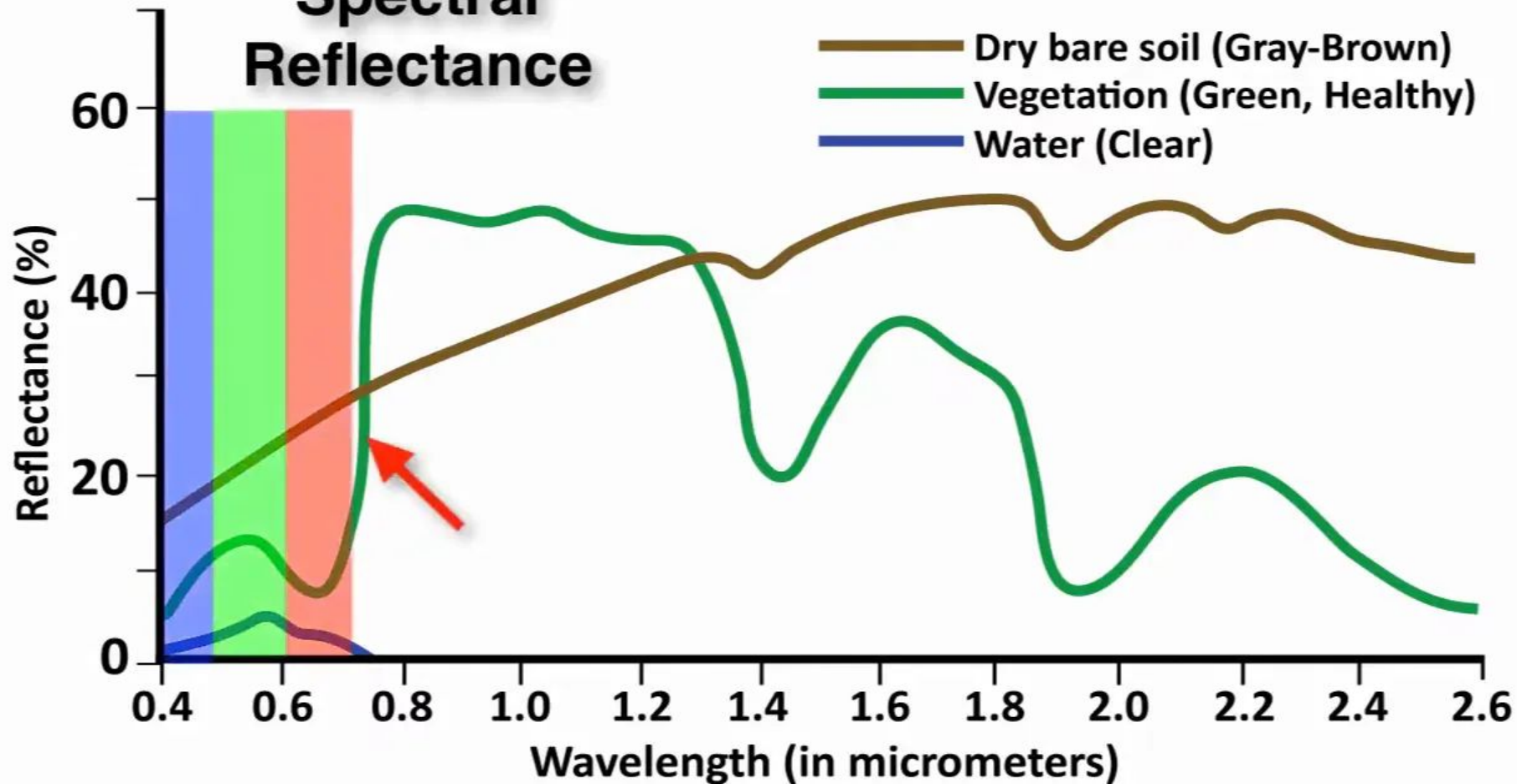
Interaction with vegetation

The healthy vegetation absorbs blue and red wavelengths and reflects green and (near) Infrared (NIR).



Source: <https://news.mongabay.com/2018/01/data-fusion-opens-new-horizons-for-remote-imaging/>

Spectral Reflectance



Spectral Indices

Normalized Indices $[-1, 1]$

- Normalized Difference Vegetation Index (NDVI)

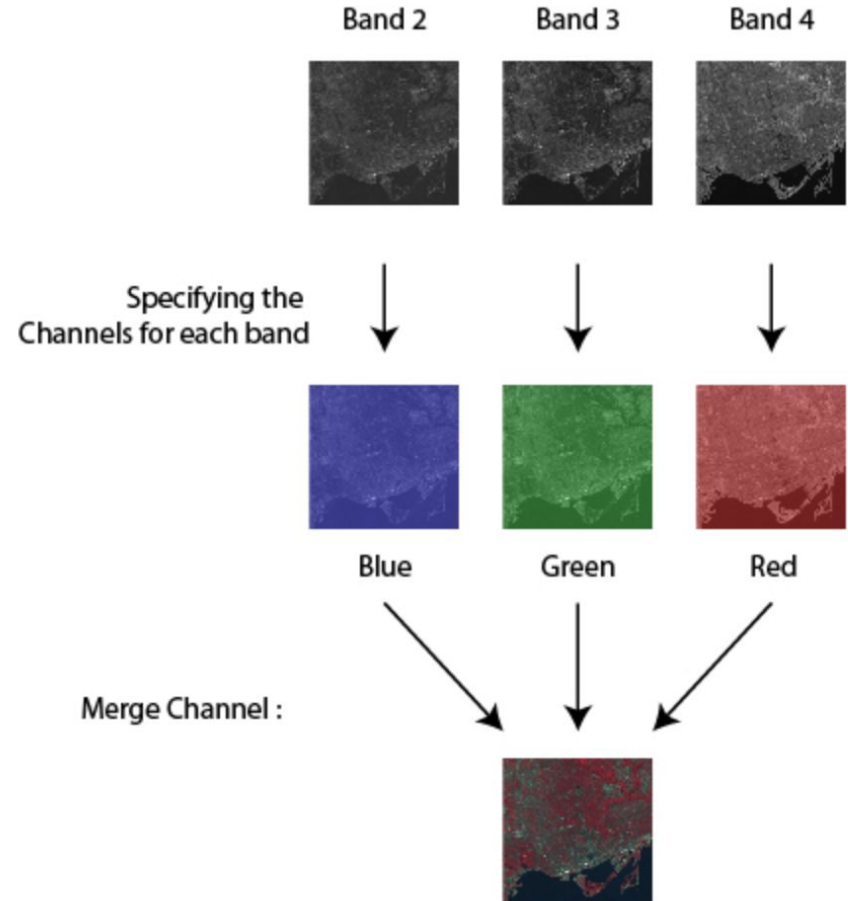
$$\text{NDVI} = \frac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}$$

- Normalized Difference Water Index (NDWI)

$$\text{NDWI} = \frac{\text{Green} - \text{NIR}}{\text{Green} + \text{NIR}}$$

What are Bands?

- Bands in imagery are layers of an image that are made up of specific wavelengths of light.
- Bands are also known as **channels**.



True Color
(RGB)



False Color
(NIR, G, B)



NDVI



Satellite Platforms

Seeing the Changing Planet

A Selection of Earth Observation Satellites

DigitalGlobe



WorldView-4

Launch Mass 2,485kg

AIRBUS



Pleiades

Launch Mass 970kg

planet.



Planetscope (Dove)

Launch Mass 4kg

esa



Sentinel-2

Launch Mass 1,130kg

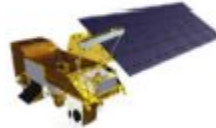
NASA USGS



Landsat-8

Launch Mass 2,780kg

NASA



Aqua (MODIS)

Launch Mass 2,934kg

Satellite Resolutions

1. Spatial resolution
2. Spectral resolution
3. Temporal Resolution
4. Radiometric Resolution

Spatial Resolution



Aqua (MODIS)
250m Resolution



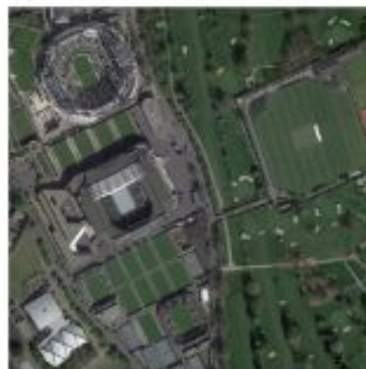
Landsat-8
30m Resolution



Sentinel-2
10m Resolution



PlanetScope (Dove)
3m Resolution



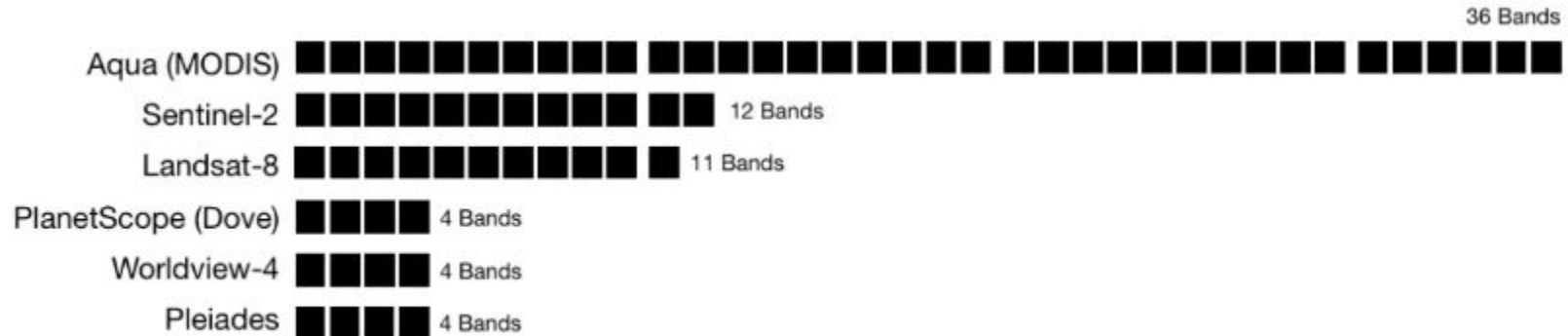
Pleiades
0.5m Resolution



Worldview-4
0.3m Resolution

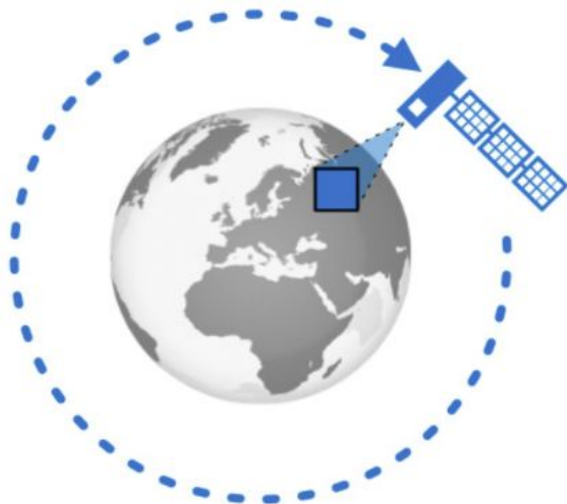
Spectral Resolution

- Number of bands of radiation in electromagnetic spectrum that a satellite can sample (eg. RGB, Infrared, microwave, etc)



Temporal Resolution

Temporal resolution varies by satellite and describes the time it takes for an individual satellite to orbit and revisit a specific area. Some satellites operate as a constellation with multiple satellites working together to increase their global coverage daily.



	(#)	Days between images
Aqua (MODIS)	(1)	■
PlanetScope (Dove)	(172)	■
Worldview-4	(1)	■ (When requested)
Pleiades	(2)	■ (When requested)
Sentinel-2	(2)	■ ■ ■ ■ ■ 5 Days
Landsat-8	(1)	■ 16 Days

Radiometric Resolution

- Radiometric resolution is the amount of information in each pixel, that is, the number of bits representing the energy recorded.



Thank you!