Satellite Remote Sensing for Conservation

AIA-AHMP GIS Course 3
January 2021

Summary

- Review of hydrology
  - Process and results in SAGA GIS
- Satellite data
  - Electromagnetic (EM) spectrum
- Working with satellite data
  - Downloading
  - Processing
  - Bands
- Analyses
  - Different band combinations
  - Vegetation and farmland

Hydrology

The procedure entails several steps:

- Filling the DEM
- Calculating flow direction
- Calculate flow direction
- Calculate flow accumulation
- Extract a shapefile of high flow areas

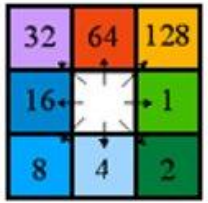
Hydrology: Flow Direction

78	72	69	71	58	49
74	67	56	49	46	50
69	53	44	37	38	48
64	58	55	22	31	24
68	61	47	21	16	19
74	53	34	12	11	12

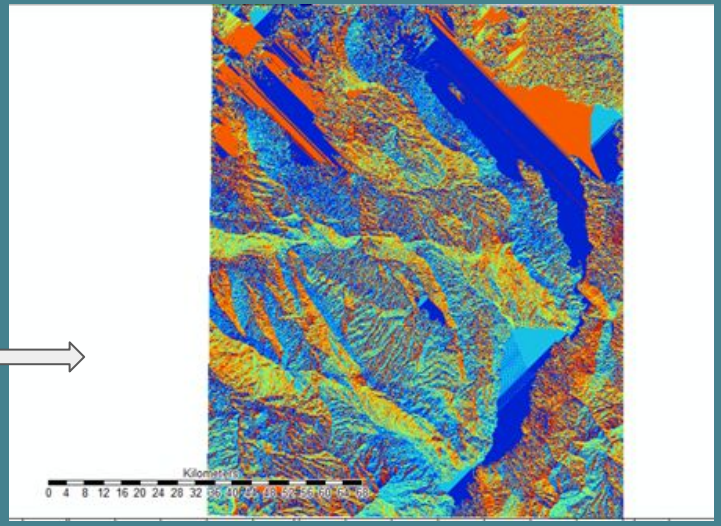
Elevation surface

2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16

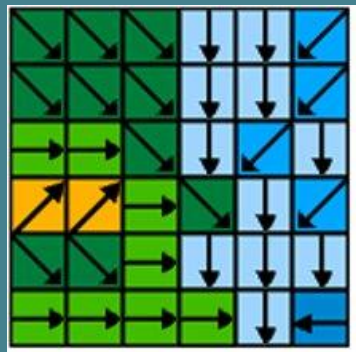
Flow direction



Direction coding



Hydrology: Flow Accumulation

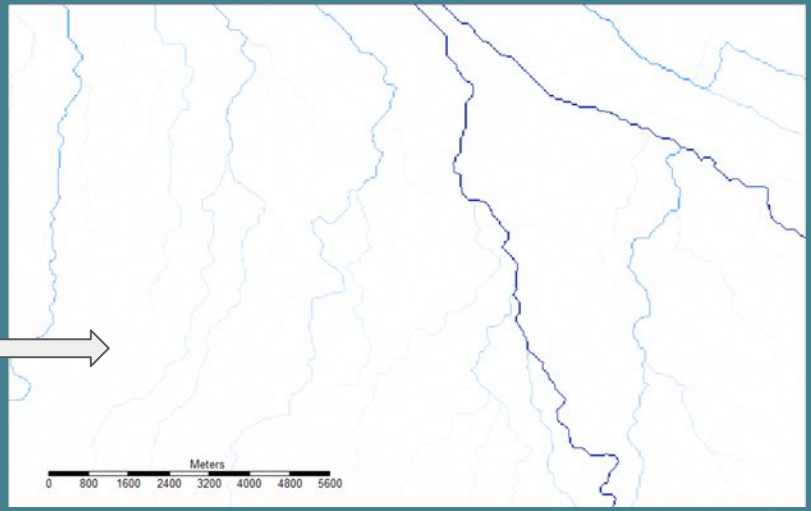


Flow direction

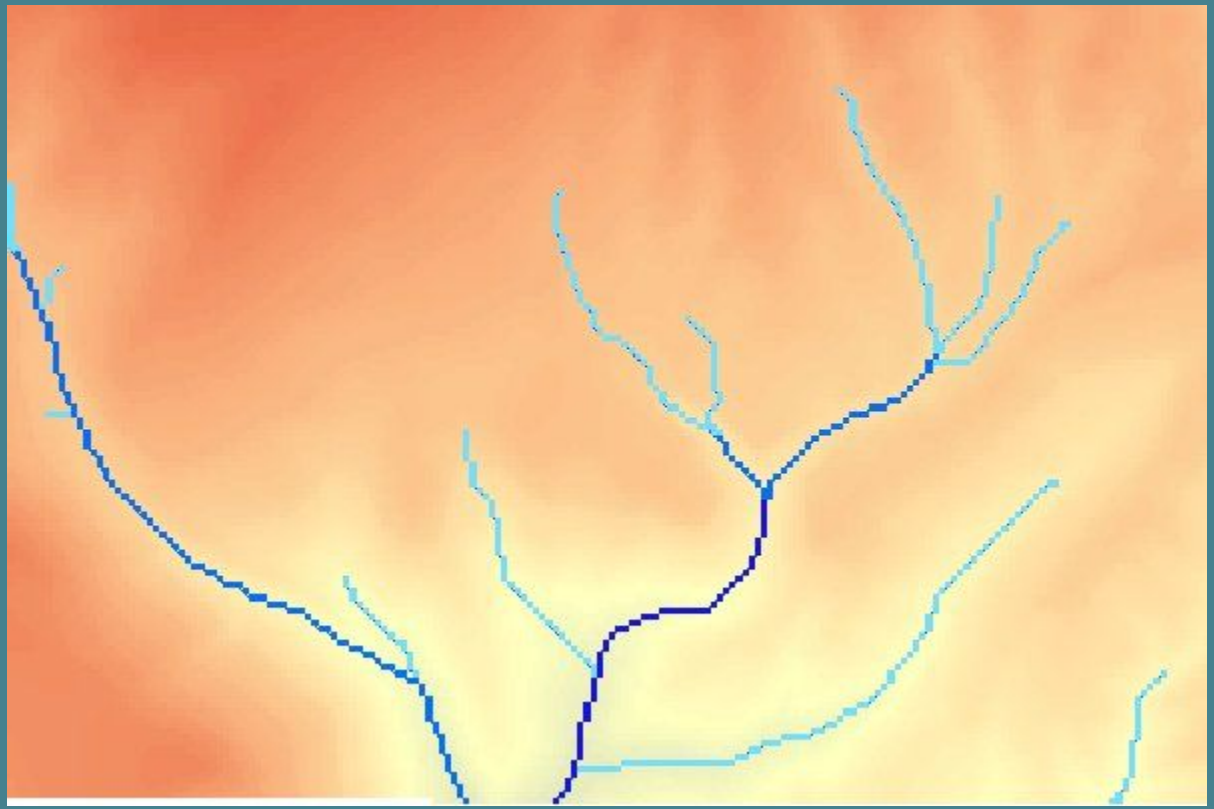
0	0	0	0	0	0
0	1	1	2	2	0
0	3	7	5	4	0
0	0	0	20	0	1
0	0	0	1	24	0
0	2	4	7	35	1

Flow accumulation

Direction coding



Hydrology: Flow Accumulation

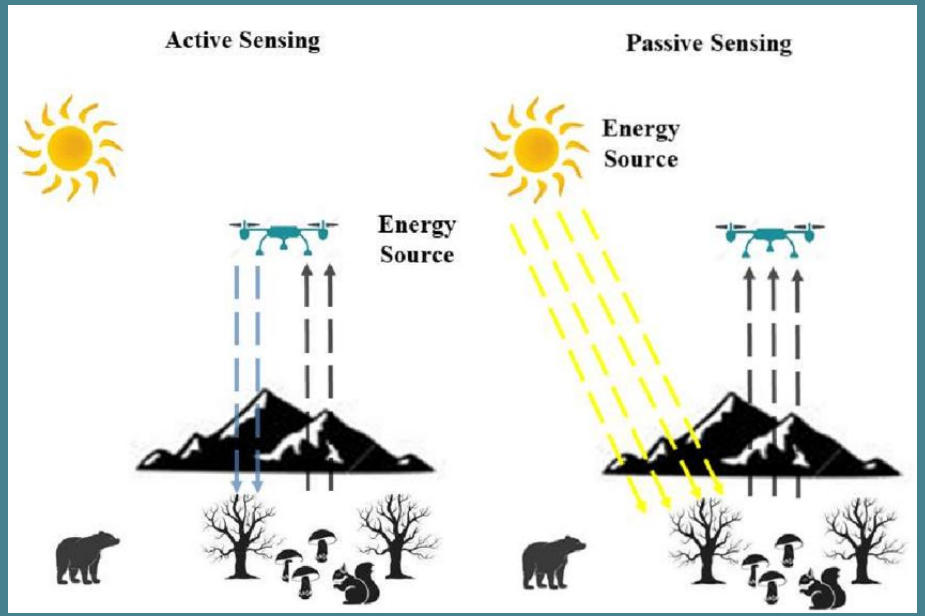


Remote sensing from space

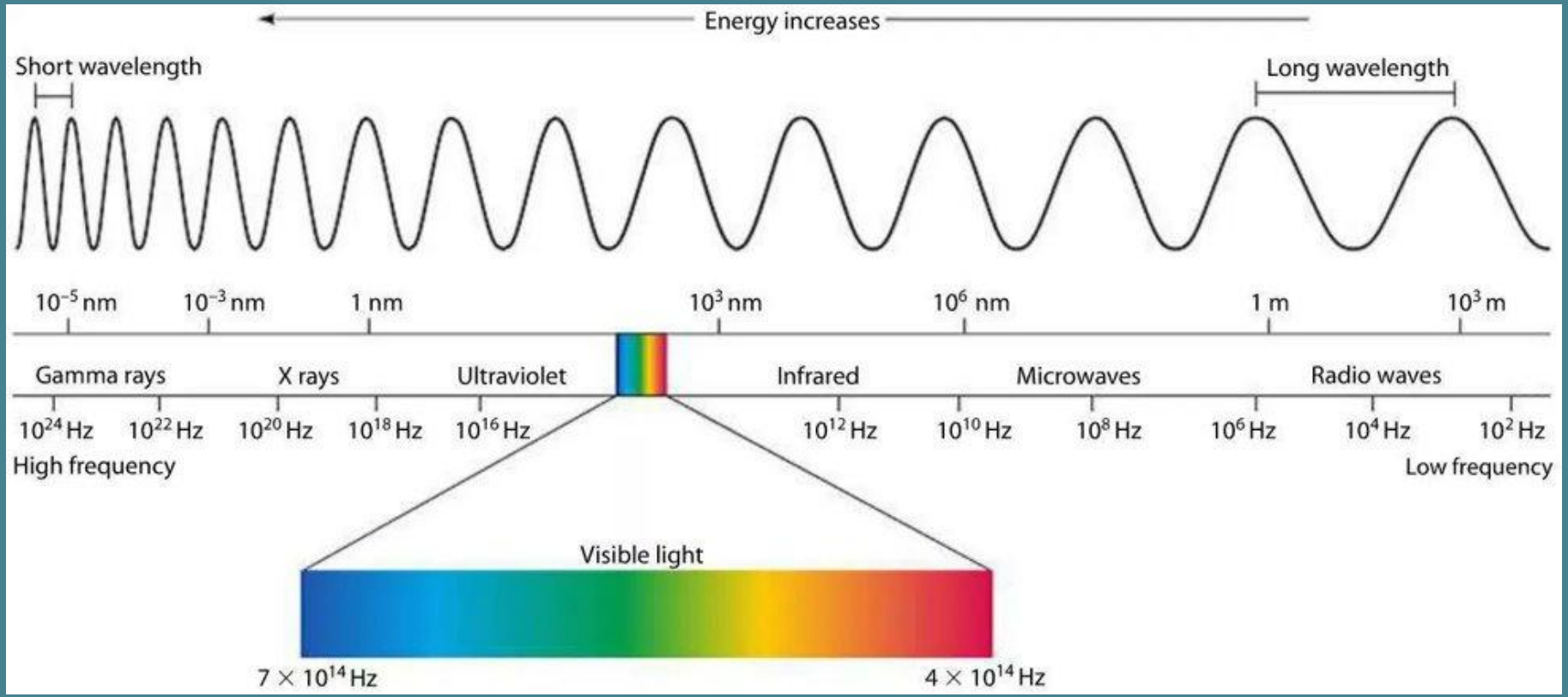
While the RADAR that's used to generate a DEM works with a radio signal sent out from a satellite in space (active), most satellite imagery is just like a camera that receives light

Satellite cameras that take pictures of different kinds of light wavelengths are called multispectral:

Red, Green, Blue, infrared, etc.



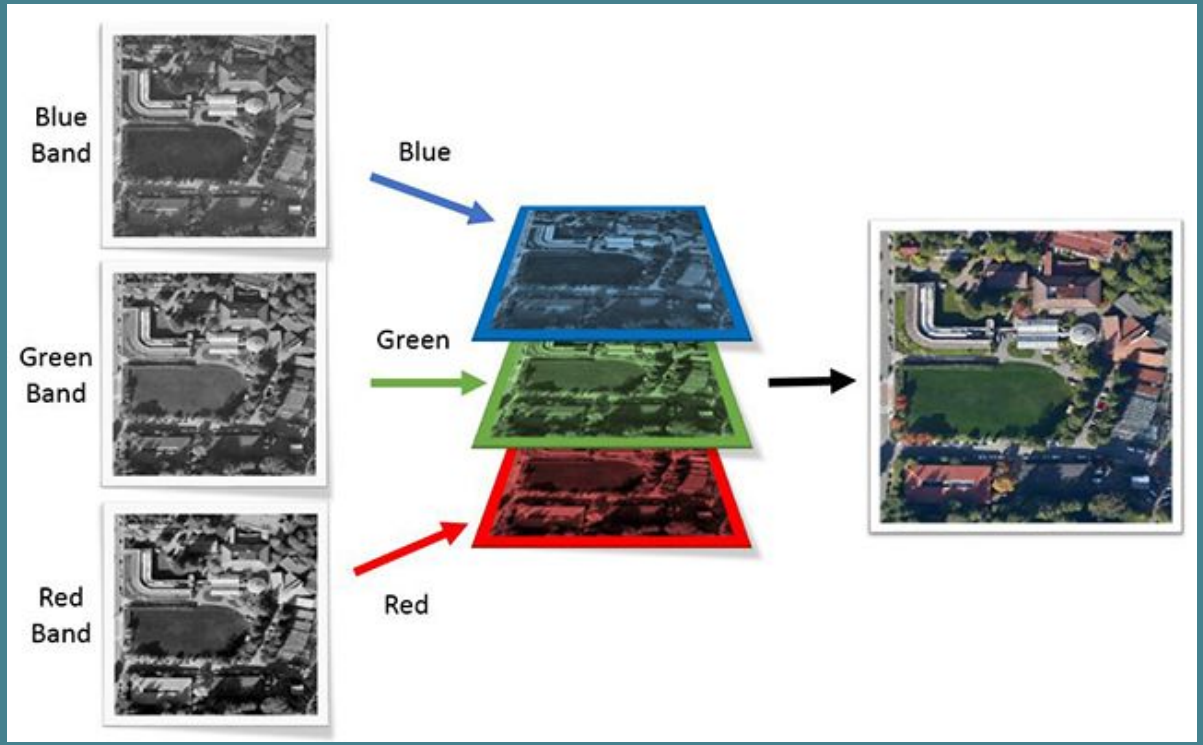
The Electromagnetic Spectrum



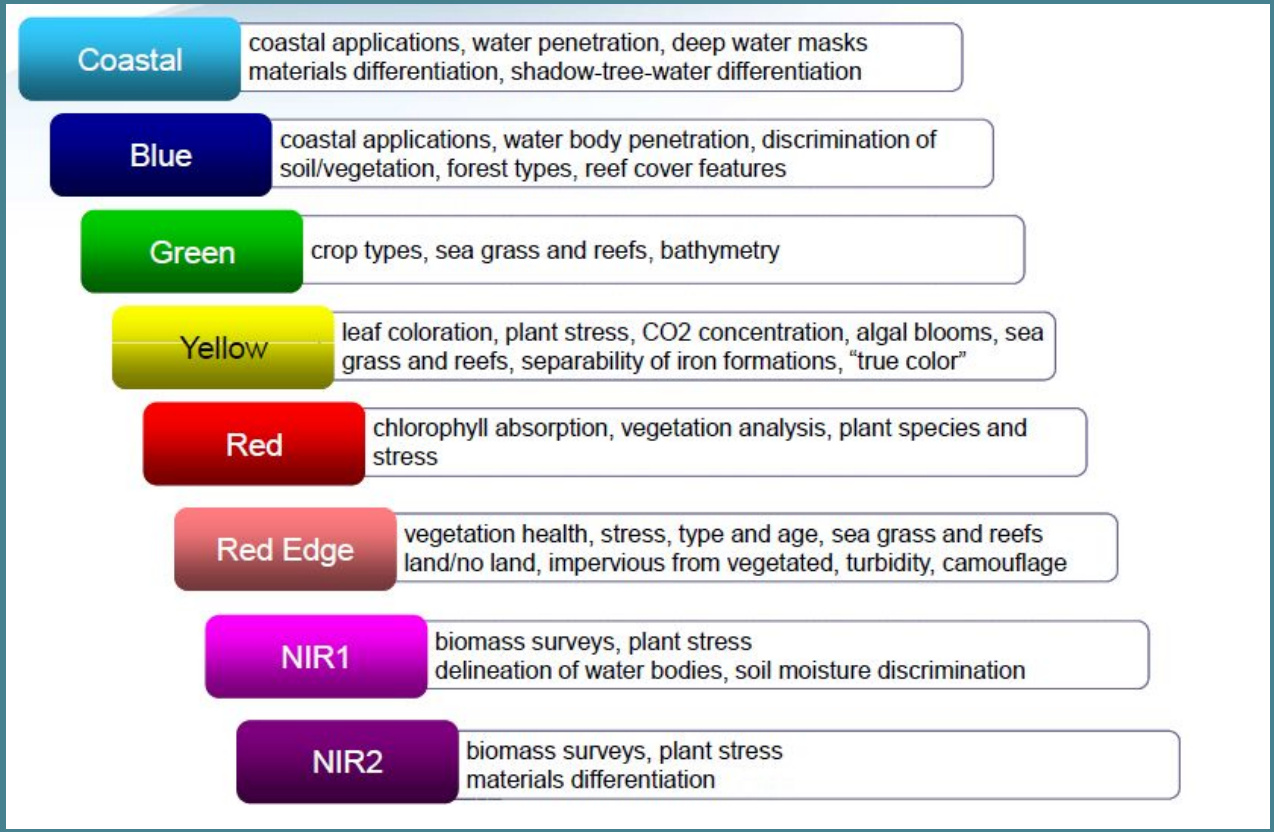
The Electromagnetic Spectrum

Satellites record light from different parts of the spectrum in **bands**:

- Each individual band appears as black and white, but when combined the Red, Green, and Blue bands show us a color image



Different Bands



Different Bands

These different bands record kinds of light that the human eye cannot see, including infrared wavelengths that can tell us a lot about heat and moisture

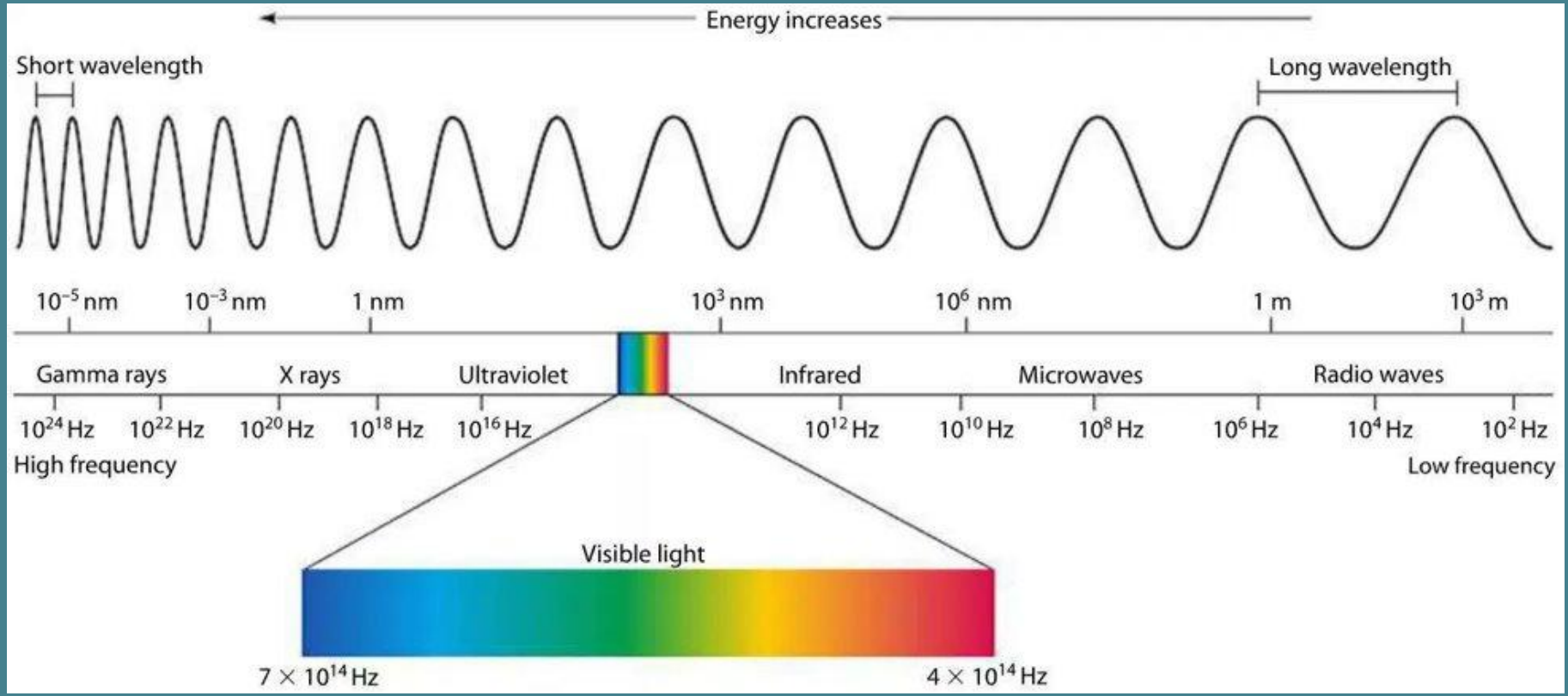
Each band is a separate file with a different resolution. Since each band is separate it needs to be made into a composite to be view effectively.

The “normal” part of the light spectrum is called the panchromatic band, and has the highest resolution

Different Bands

Landsat 8-9 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)

Bands	Wavelength (micrometers)	Resolution (meters)
Band 1 - Coastal aerosol	0.43-0.45	30
Band 2 - Blue	0.45-0.51	30
Band 3 - Green	0.53-0.59	30
Band 4 - Red	0.64-0.67	30
Band 5 - Near Infrared (NIR)	0.85-0.88	30
Band 6 - SWIR 1	1.57-1.65	30
Band 7 - SWIR 2	2.11-2.29	30
Band 8 - Panchromatic	0.50-0.68	15
Band 9 - Cirrus	1.36-1.38	30
Band 10 - Thermal Infrared (TIRS) 1	10.6-11.19	100
Band 11 - Thermal Infrared (TIRS) 2	11.50-12.51	100


Energy increases
Short wavelength
Long wavelength
10^{-5} nm
10^{-3} nm
1 nm
10^{3} nm
10^{6} nm
1 m
10^{3} m
Gamma rays
X rays
Ultraviolet
Infrared
Microwaves
Radio waves
10^{24} Hz
10^{22} Hz
10^{20} Hz
10^{18} Hz
10^{16} Hz
10^{12} Hz
10^{10} Hz
10^{8} Hz
10^{6} Hz
10^{4} Hz
10^{2} Hz
High frequency
Low frequency
Visible light
7×10^{14} Hz
4×10^{14} Hz

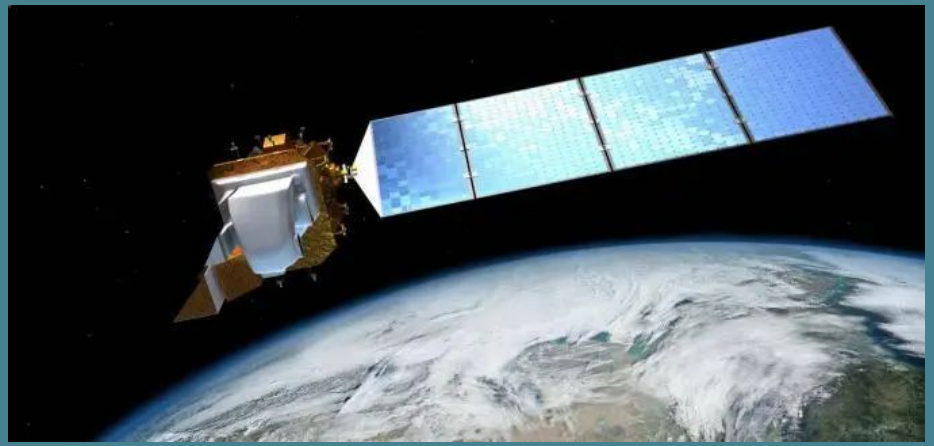
Satellite Missions

Landsat 1-9: 1976-2021, 15-100m/pixel resolution

ASTER: 15-90m/pixel

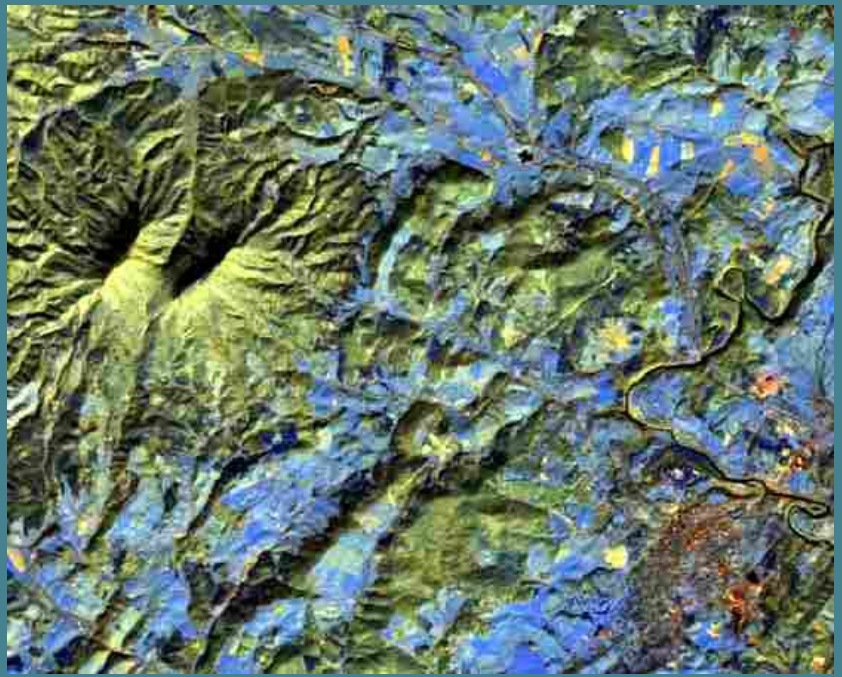
Sentinel 1-2: 10-60m/pixel

AVHRR: 1km/pixel



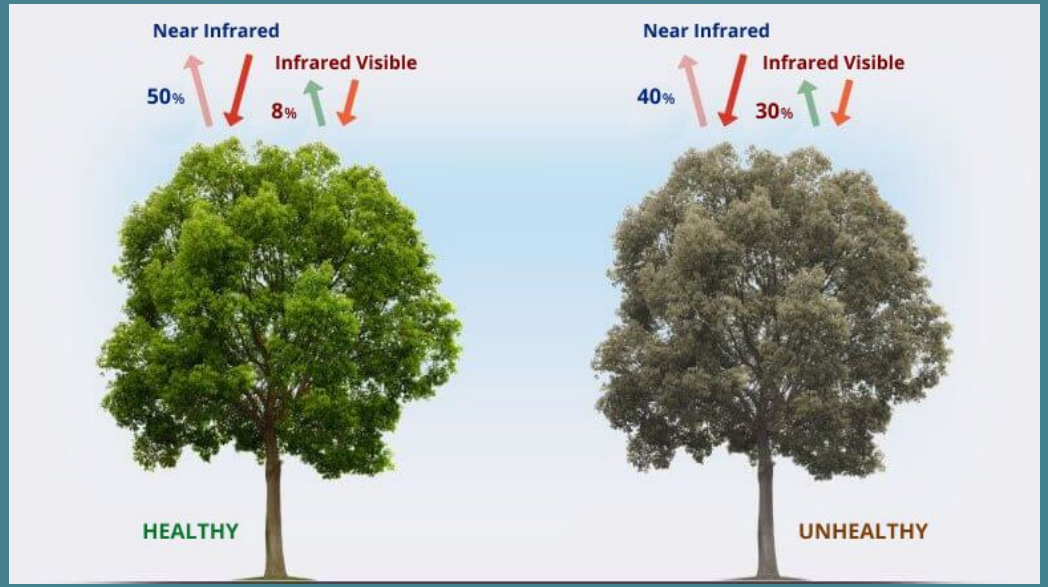
Analyses with Satellite Imagery

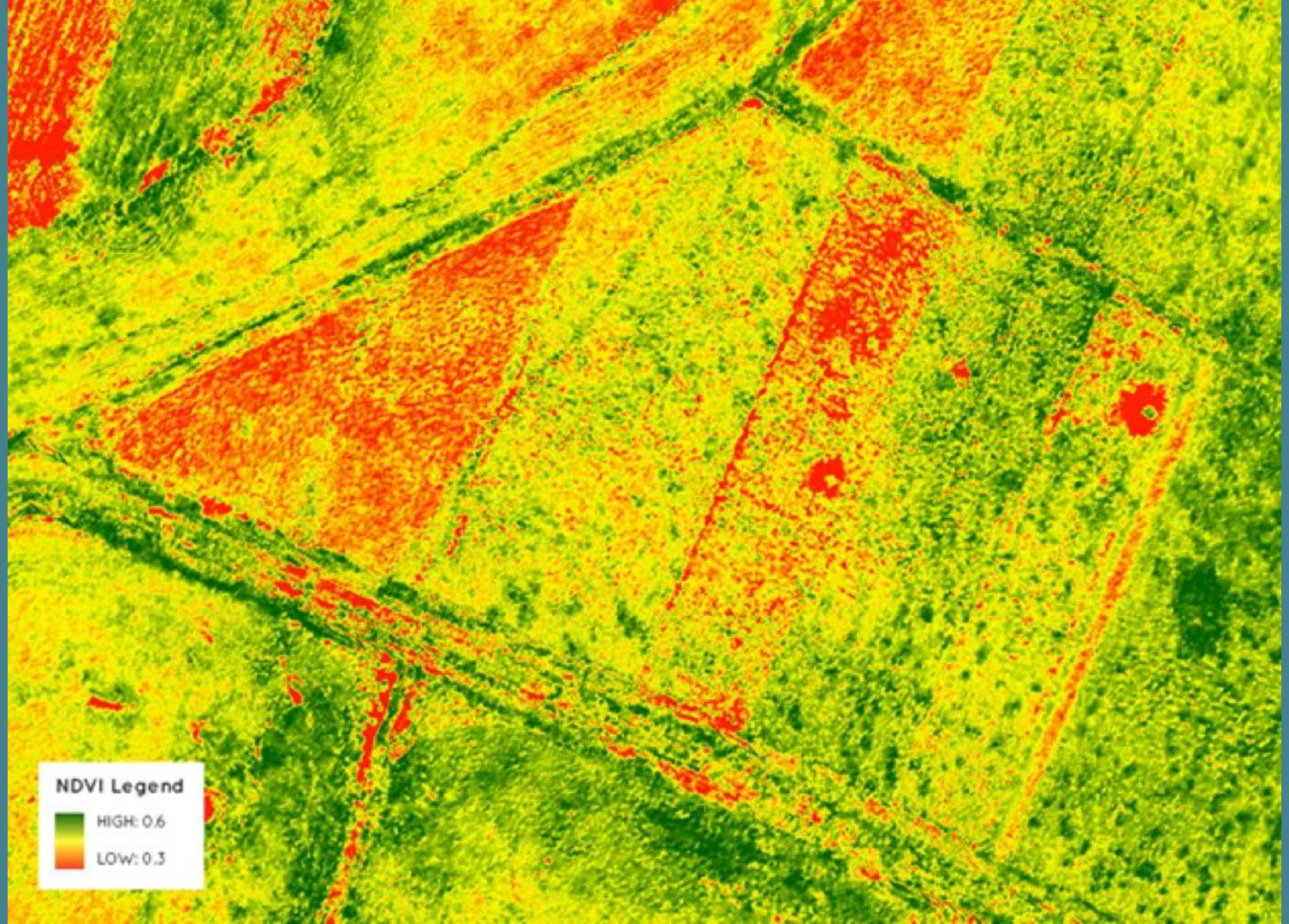
- Surface temperature
- Soil moisture readings
- Land cover mapping
- Some geological features can be detected



Vegetation Index

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$




NDVI Legend
HIGH: 0.6
LOW: 0.3

Band Combinations

False Colour 6,5,2
Vegetation

False Colour 7,6,4
Urban

Colour IR 5,4,3
Vegetation

False Colour 5,6,4
Land/Water