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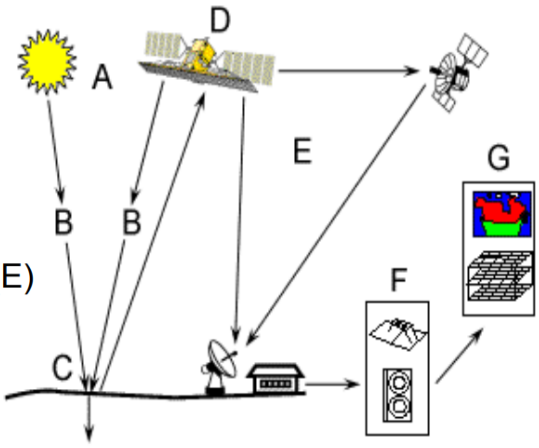
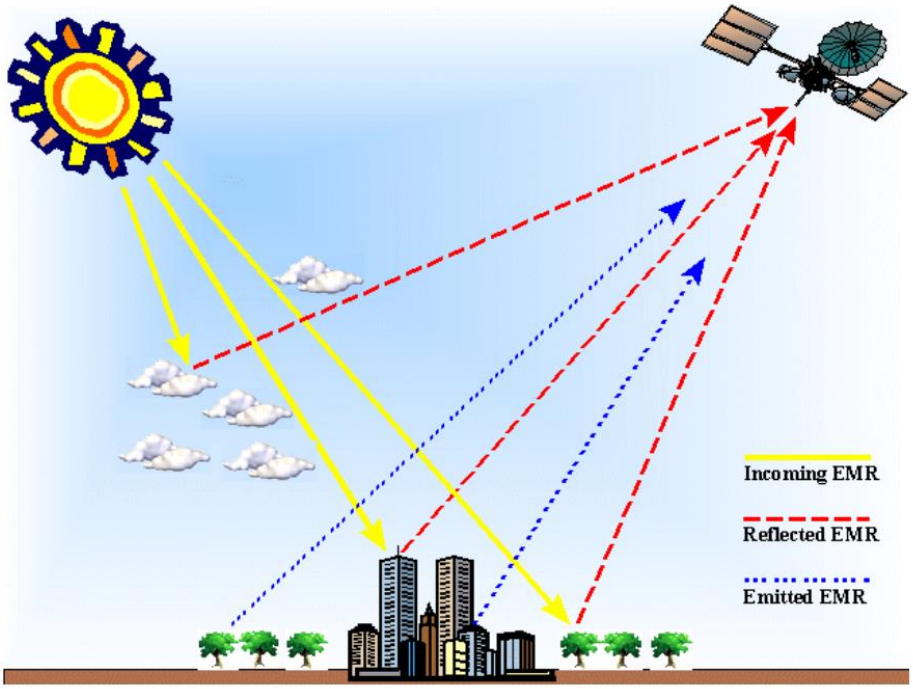
Components of Remote Sensing

1. Energy source or illumination (A)
2. Radiation and the atmosphere (B)
3. Interaction with the Target (C)
4. Recording of energy by the sensor (D)
5. Transmission, Reception and Processing (E)
6. Interpretation and Analysis (F)
7. Application





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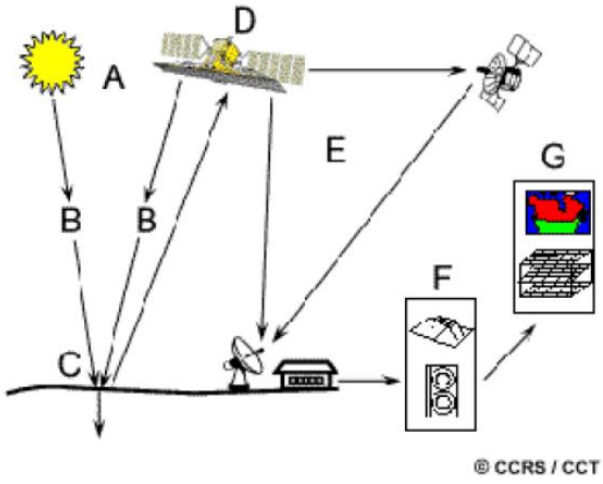
The process of Remote sensing



1. Energy Source or Illumination (A) - the first requirement for remote sensing is to have an energy source which illuminates or provides electromagnetic energy to the target of interest.

2. Radiation and the Atmosphere (B) - as the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through. This interaction may take place a second time as the energy travels from the target to the sensor.

3. Interaction with the Target (C) - once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation.

4. Recording of Energy by the Sensor (D) - after the energy has been scattered by, or emitted from the target, we require a sensor (remote - not in contact with the target) to collect and record the electromagnetic radiation.

5. Transmission, Reception, and Processing (E) - the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).

6. Interpretation and Analysis (F) - the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated.

7. Application (G) - the final element of the remote sensing process is achieved when we apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.

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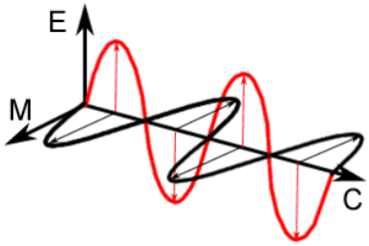
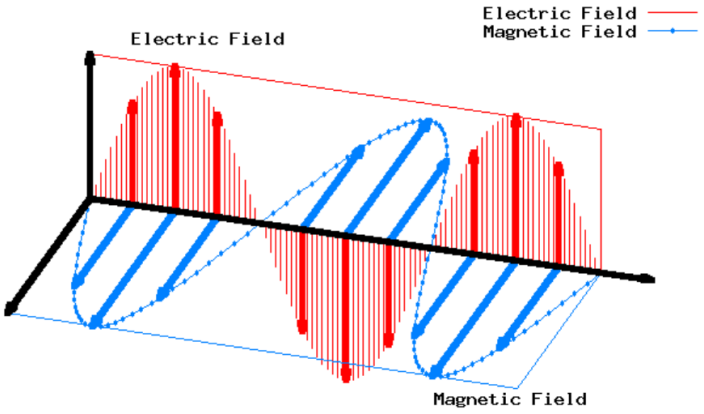
Electromagnetic Radiation (EMR)

- Electromagnetic Radiation (EMR) is the engine that drives remote sensing.
- Electric and magnetic fields fluctuating orthogonally, perpendicular to the direction of travel
- Travels through space at the speed of light ($3x10^8$ m s^{-1})
- Emitted by all objects above –273 degrees C



EMR refers to the waves (or their quanta, photons) of the electromagnetic field, propagating through space, carrying electromagnetic radiant energy.

The EM spectrum is generally divided into seven regions, in order of decreasing wavelength and increasing energy and frequency. The common designations are: radio waves, microwaves, infrared (IR), visible light, ultraviolet (UV), X-rays and gamma rays.



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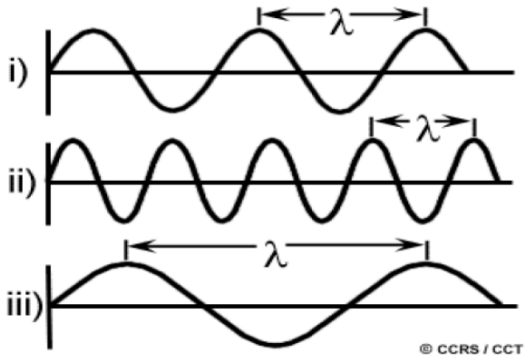
EMR: Wavelength and Frequency

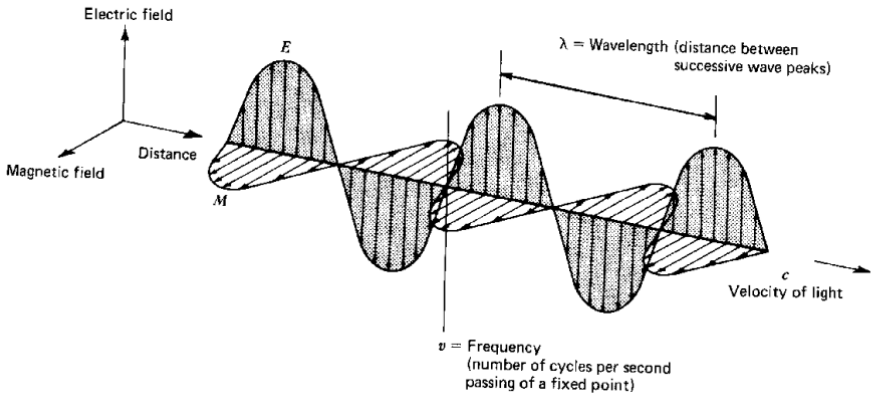
Wavelength

- Distance between successive crests (or troughs) of a wave form
- Usually measured in micrometers (μm) or nanometers (nm)



Frequency

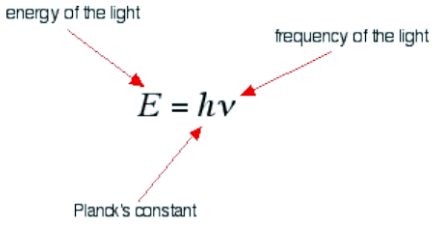
- The number of crests that pass a point per unit time (one second)
- Usually measured in megahertz (MHz) or gigahertz (GHz)



Wavelength and frequency are related by the following formula:

c = λ v , λ = c/v, and v = c/ λ

c is the speed of light
λ is wavelength
v is frequency



Higher frequency- Smaller wavelength

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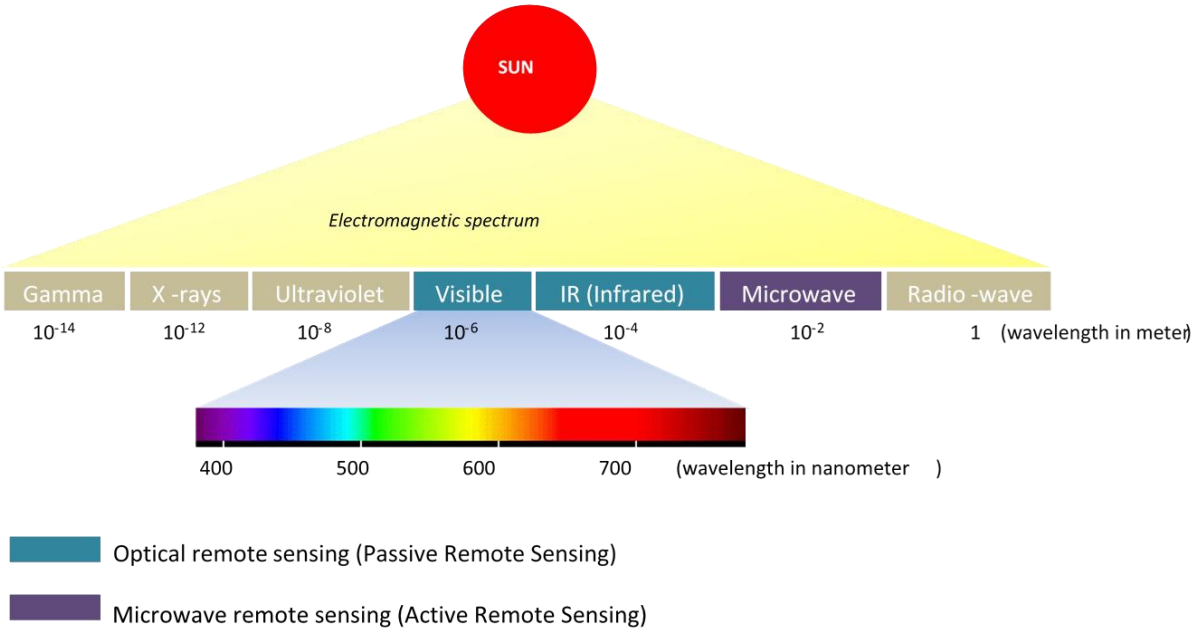
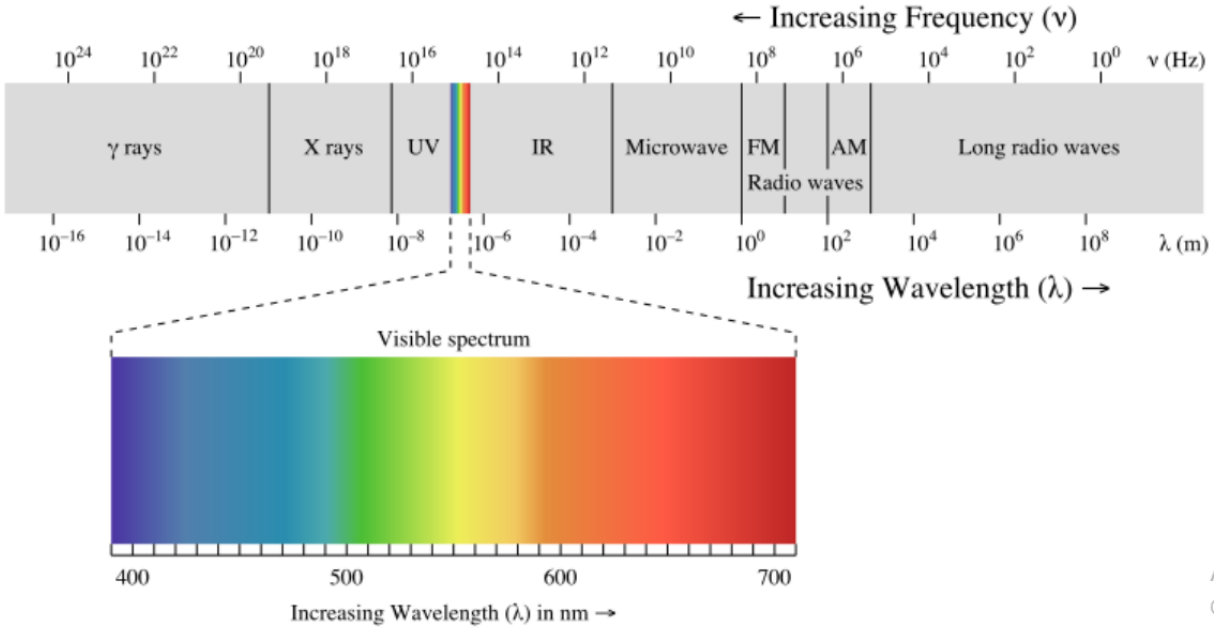
Remote Sensing Data Acquisition

Electromagnetic Waves Used in Remote Sensing



The Electromagnetic Spectrum



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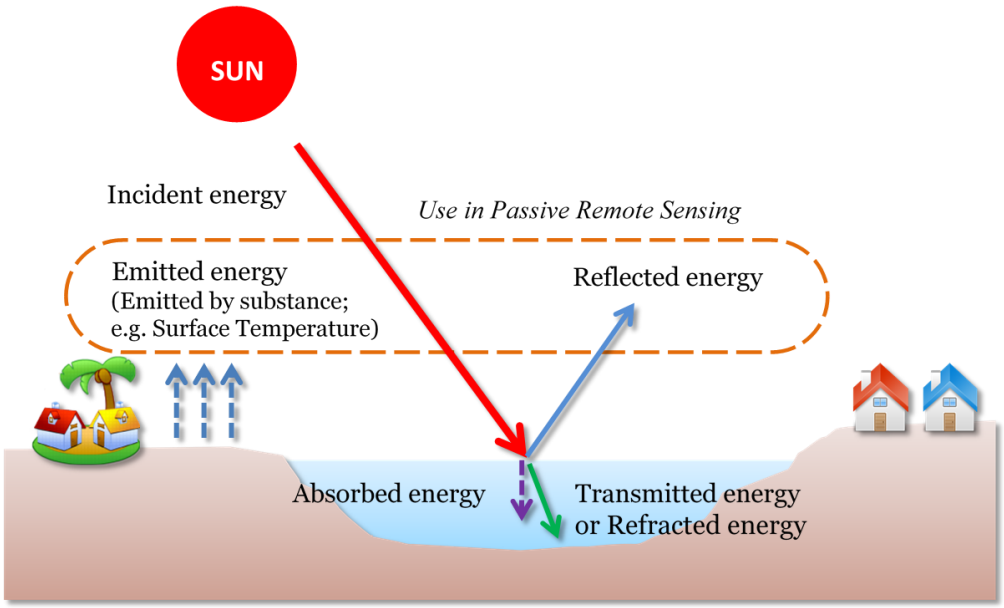
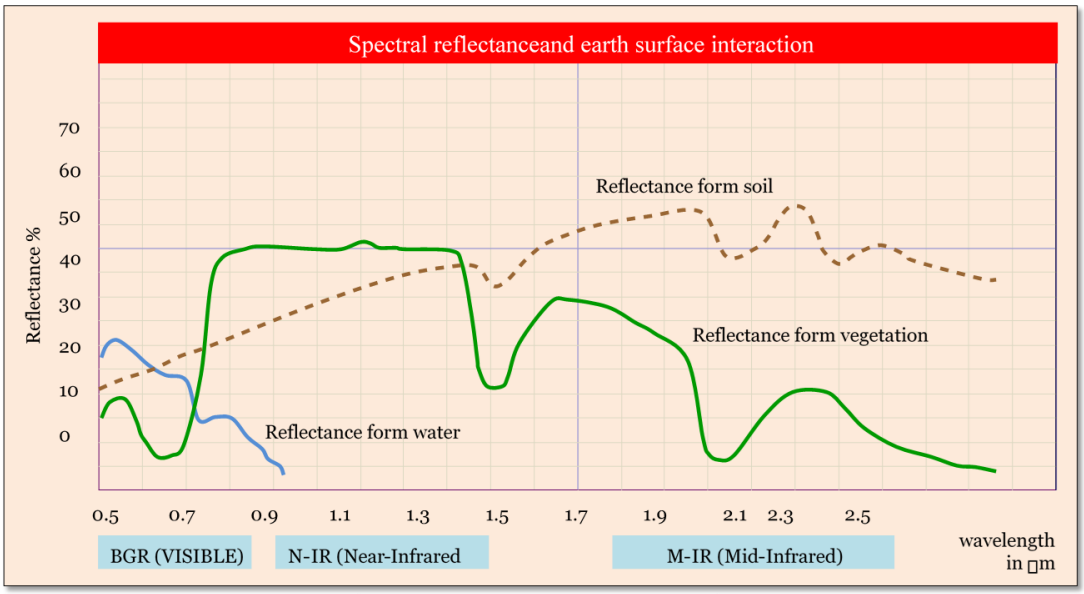
Properties of Electromagnetic Waves



Spectral Reflectance and Earth Surface Interaction



Surface category	Low reflectance	High reflectance
Water	N-IR (Near -Infrared)	Blue (Visible)
Vegetation	M-IR (Mid-Infrared)	N-IR (Near-Infrared)
Soil	Blue (Visible)	M-IR (Mid-Infrared)

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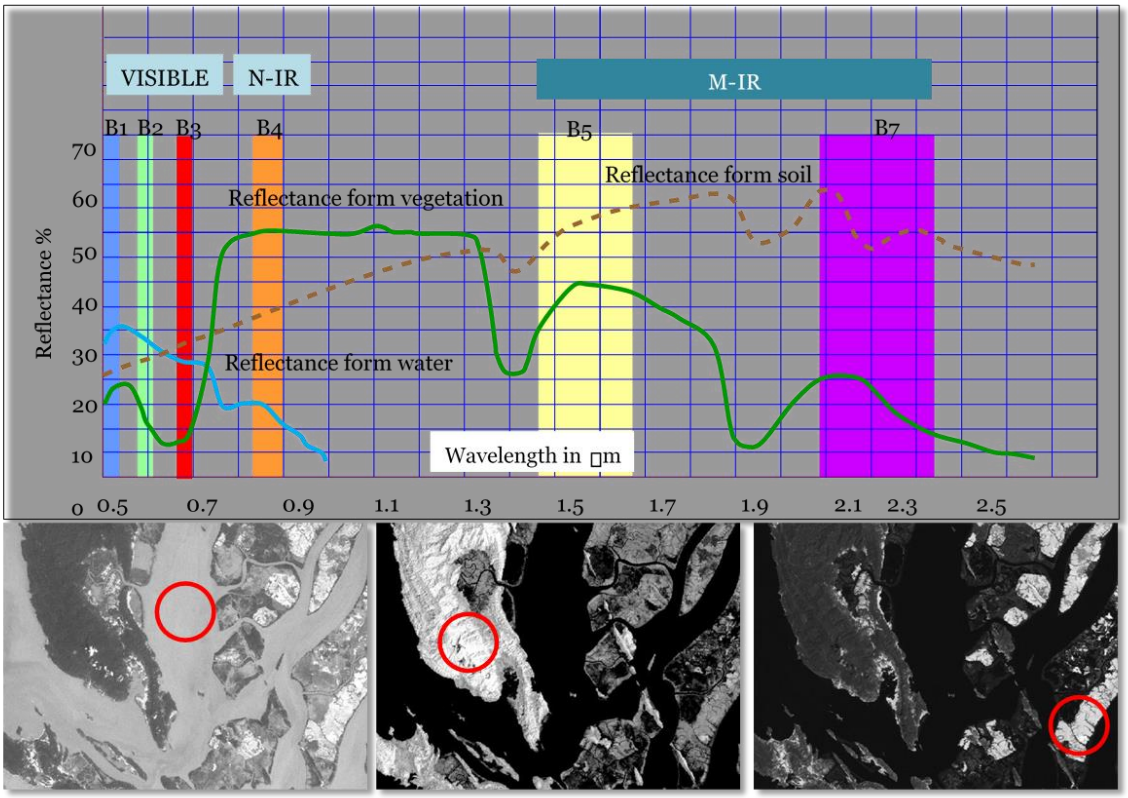
Multi-spectral Remote Sensing Data (Image)

- Composed with more than one spectral band and each band represents specific wavelength
- Example in Landsat TM (Total 7 bands, Band 6 Thermal band omitted in here)



TM Band 1: High reflectance in water **TM Band 4**: High reflectance in vegetation **TM Band 7**: High reflectance in bare land (soil)