K.T.S.P. Mandal's
Hutatma Rajguru Mahavidyalaya,
Rajgurunagar.

T.Y.B.Sc. Botany
Semester – V (CBCS pattern)

Subject – Plant Ecology
(Paper IV: BO. 354)

Chapter 8
Topic – Remote Sensing

Prof.P.D.Kad
(Assistant Professor, Department of Botany)
Hutatma Rajguru Mahavidyalaya
poojakad92@gmail.com

Remote sensing

Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Special cameras collect remotely sensed images, which help researchers "sense" things about the Earth. Some examples are:

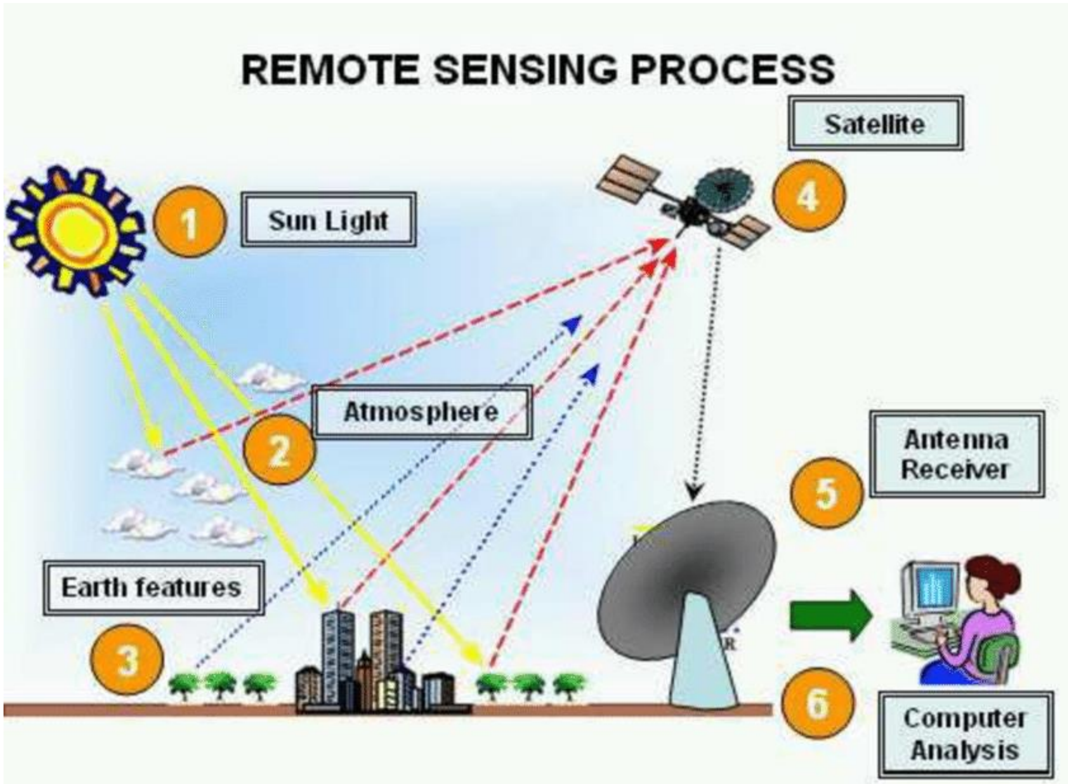
- Cameras on satellites and airplanes take images of large areas on the Earth's surface, allowing us to see much more than we can see when standing on the ground.
- Sonar systems on ships can be used to create images of the ocean floor without needing to travel to the bottom of the ocean.
- Cameras on satellites can be used to make images of temperature changes in the oceans.

Remote Sensing is a technology to gather information and analyzing an object or phenomenon without making any physical contact. This technology is used in numerous fields like geography, hydrology, ecology, oceanography, glaciology, geology.

A geographic information system is a tool that is used for mapping and analyzing feature events on Earth. The remote sensing and GIS technology combine major database operations like statistical analysis and query, with maps. The GIS manages information on locations and provides tools for analysis and display of different statistics that include population, economic development, characteristics, and vegetation. It also allows linking databases to make dynamic displays. These abilities make GIS different from other systems and make it a wide range of private and public remote sensing applications for planning and predicting outcomes from remote sensing satellites.

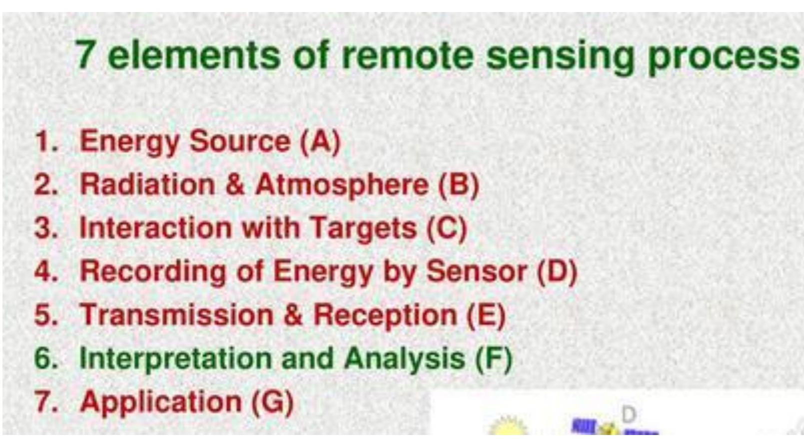
There are three essential elements for Remote Sensing :

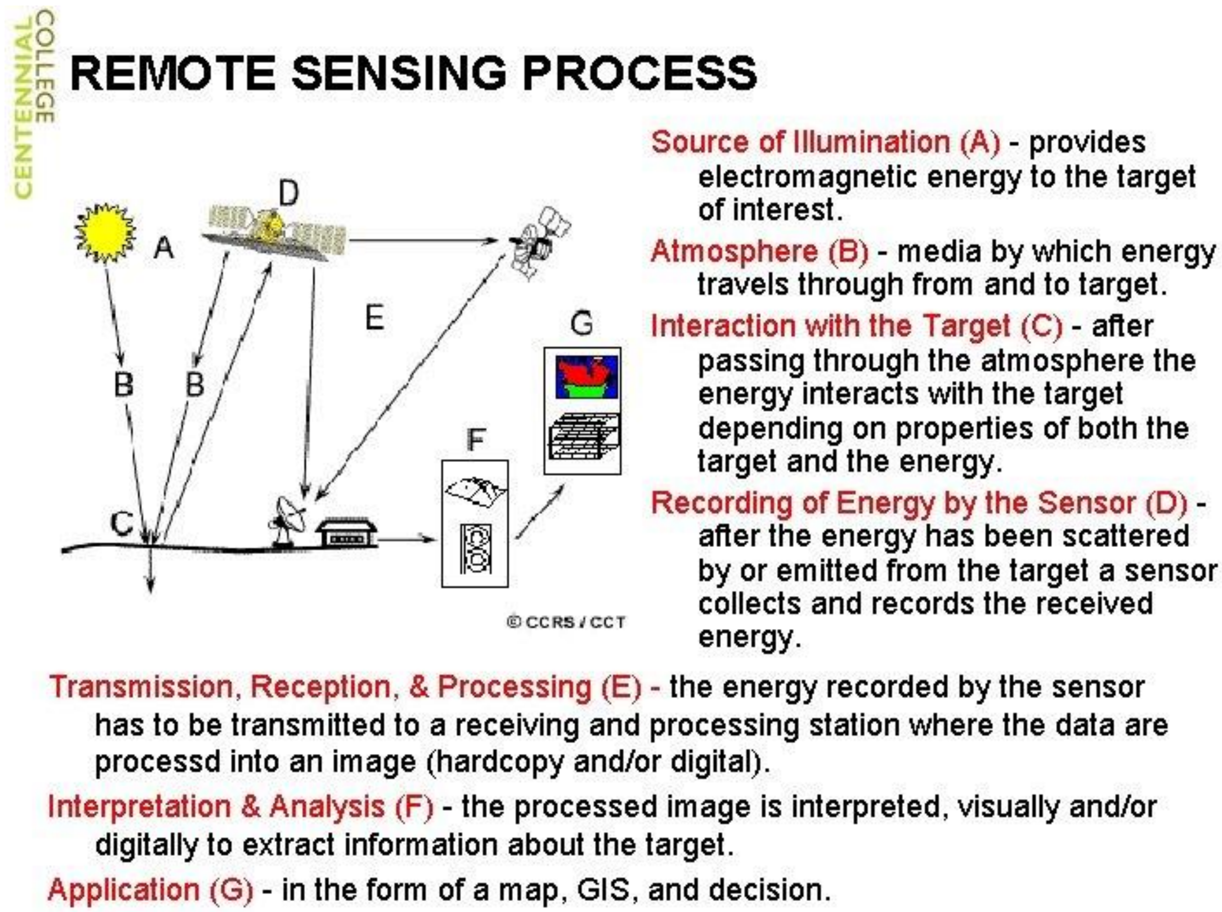
- A platform to hold the instrument
- A target or object
- An instrument or sensor (to observe the target)



Principles of Remote Sensing:

Remote sensing involves the detection and measurement of the radiations of different wavelengths reflected or emitted from distant objects or materials, which helps in their identification and categorization.





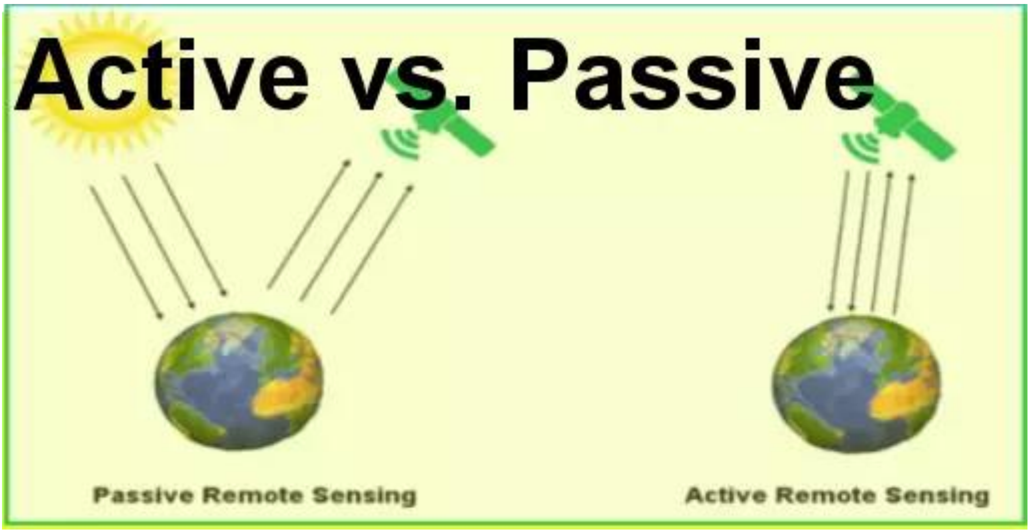
Types of Remote Sensing:

Satellite remote sensing involves gathering information about features on the Earth's surface from orbiting satellites, which may carry either of the following two types of sensor systems:

(i) Passive System:

It generally consists of an array of small sensors or detectors, which records the amount of electro-magnetic radiation reflected and/or emitted from the Earth's surface. Thus, passive remote sensing relies on naturally reflected or emitted energy of the imaged surface.

Most remote sensing instruments fail into this category, obtaining pictures of visible, near-infrared and thermal infrared energy. A multi-spectral scanner is an example of a passive system. Passive visible and near-infrared data are used in a variety of GIS applications, for example in the classification of vegetation and land-use, and may be performed at a variety of temporal and spatial scales.



(ii) Active System:

This type of a system propagates its own electro-magnetic radiation and measures the intensity of the return signal. Thus, active remote sensing means that the sensor provides its own illumination and measures what comes back. Remote sensing technologies that use this type of system include lidar (laser) and radar.

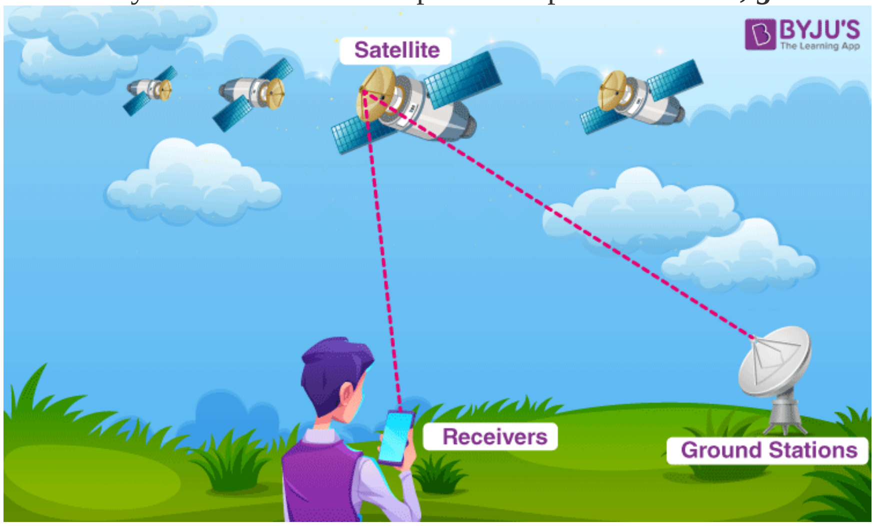
Synthetic Aperture Radar (SAR) is an example of an active system. Active remote sensing (radar and lidar) systems are rapidly increasing in use since the launch of the ERS-1 Synthetic Aperture Radar (SAR) satellite in 1991. In comparison to visible/near-infrared imagery, radars are sensitive to very different surface properties.

As for example, radar images are sensitive to the shape, orientation and size of leaves and their moisture content, rather than the vegetation color. Similarly, airborne lidars have been largely used for mapping surface topography in three dimensions. Existing and planned radar and lidar altimeters will also help in monitoring closely the elevation of the world's ice caps and sea level with centimeter precision.

GPS stands for Global Positioning System. It is a radio navigation system used in land, sea, and air to determine the exact location, time and velocity irrespective of weather conditions. The US military first used it in the year 1960.

Components of a GPS system

GPS is a system and it is made up of three parts: ***satellites, ground stations,*** and ***receivers***.



Following are the functionalities of each of these parts:

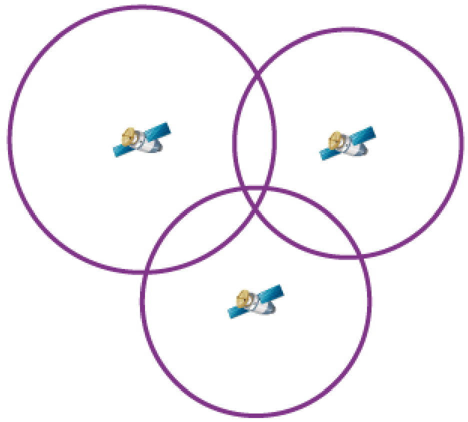
- *Satellites* act like the stars in constellations, and we know where they are because they invariably send out signals.
- The *ground stations* make use of the radar to make sure the satellites are actually where we think they are.
- A *receiver* is a device that you might find in your phone or in your car and it constantly seeks for the signals from the satellites. The receiver figures out how far away they are from some of them. Once the receiver calculates its distance from four or more satellites, it knows exactly where you are.

How GPS Works?

There are at least 4 GPS satellites in the line of sight of a receiver on the earth. The transmitter GPS sends information about the position and time to the receiver GPS at fixed intervals. The signals that are sent to the receiver devices are radio waves. By finding the difference in time between the signal sent from the GPS satellite to the time the GPS receives, the distance between the GPS receiver and the satellite can be calculated. Using the trilateration process, the receiver locates its position as the signals are obtained from at least three satellites.

For a GPS to calculate a 2-D position, which includes the latitude and longitude, a minimum of 3 satellites are required. For a 3-D position that provides latitude, longitude, and altitude, a minimum of 4 satellites are needed.

What Is Trilateration?



Trilateration is defined as the process of determining the location based on the intersections of the spheres. The distance between the satellite and the receiver is calculated by considering a 3-D sphere such that the satellite is located at the centre of the sphere. Using the same method, the distance for all the 3 GPS satellites from the receiver is calculated.

Following are the parameters that are calculated after trilateration:

- **Time of sunrise and the sunset**
- **Speed**
- **Distance between the GPS receiver to the destination**

GPS systems are remarkably versatile and can be found in almost any industry sector. They can be used to map forests, help farmers harvest their fields and navigate aeroplanes on the ground or in the air.

---

6. Applications of Remote Sensing:

Satellite data allows the proper management of our renewable and non-renewable resources as it provides timely and detailed information about the Earth's surface.

Following are a few examples of some of the important uses of satellite data:

(i) Assessment and monitoring of vegetation types and their status.

(ii) Agricultural property management planning and crop yield assessment.

(iii) Soil surveys including mineral and petroleum exploration.

(iv) Litho logic mapping.

(v) Monitoring and planning of water resources and groundwater exploration.

(vi) Geographic information

(vii) Map making and revision and production of thematic maps.

(viii) Weather and agricultural forecasts and assessment of environment and natural disasters.

(ix) Urban planning.

(x) Image processing.

(xi) Precision geo-referencing.

(xii) Laser film writing and printing.

Applications of Remote Sensing in Forest Resource Management:

(i) Satellite imagery can provide the visible boundaries of soil types, while remote sensing provide for a shallow penetration of soils. Additional physical data can be obtained from spectral signatures for the soil surfaces.

(ii) Remote sensing allows for classification of soils, which can be interpreted from the remote sensing images and the spectral signatures.

(iii) Remote sensing can provide information on the productivity of forests, meadows, wildlife habitat conditions, land-use and recreational suitability, which allows for future protection of the environment.

(iv) Multi temporal techniques can be used to map dynamical features, erosion and soil moisture.

(v) Remote sensing can also be used in combination with ground radar, to detect changes of diagnostic soil horizons such as albic, spodic and argillic horizons or soil/rock boundaries.

References:

- T.Y.B. Sc Textbook Nirali Prakashan.
- www.biologydiscussion .com
- Website data