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Principles of Remote Sensing (RS)

1. Introduction to Remote Sensing: Remote sensing is also called earth observation; geospatial technology refers to obtaining information about objects or areas at the earth's surface without being in direct contact with the object or area.

According to India's National Remote Sensing Agency- "Remote sensing is the technique of acquiring information about objects on the earth's surface without physically coming into contact with them".

The Remote Sensing is generally a multi-disciplinary science, which includes a combination of various disciplines such as optics, spectroscopy, photography, computer, electronics and telecommunication, satellite launching etc. All these technologies are integrated to act as one complete system in itself, known as Remote Sensing System.

2. Stages of Remote Sensing: There are a number of stages in a Remote Sensing process, and each of them is important for successful operation.

I. Energy source or illumination (A).

II. Radiation and atmospheric interaction (B).

III. Interaction with the target (C).

IV. Recording of the energy by sensor (D).

V. Transmission, reception and processing (E).

VI. Image processing and analysis (F).

VII. Application (G).

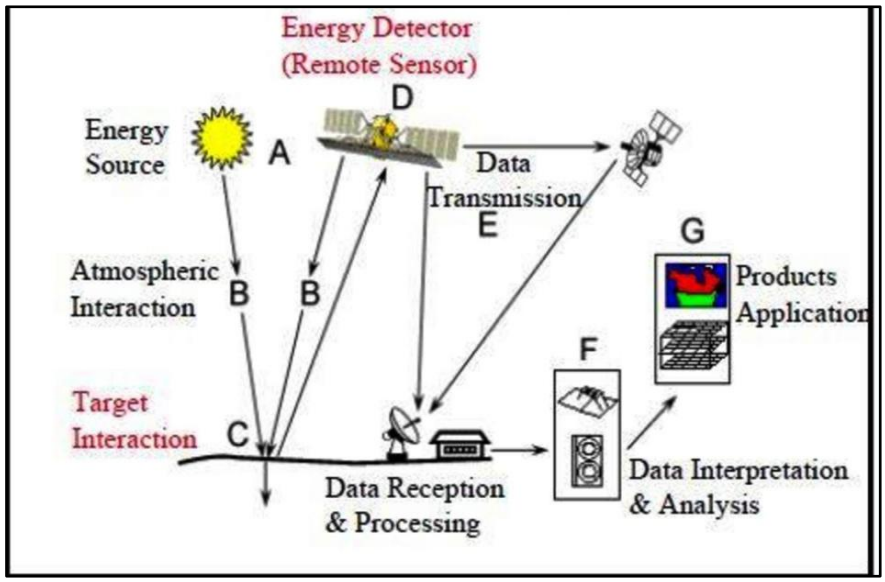

Fig1. Processes of remote sensing

I. **Energy source or illumination (A):** The first necessity of remote sensing is to have an energy source to illuminate the target.

- The energy is the form of electromagnetic radiation.

- Emission of electromagnetic radiation, or EMR (sun/self- emission).

Electro Magnetic radiation (EMR):

EMR is a dynamic form of energy that propagates as wave motion at a velocity of c = 3 x 1010 cm/sec. The parameters that characterize a wave motion are wavelength (λ), frequency (ν) and speed of light (c). The relationship between the above is

$$c = \nu\lambda$$

Electromagnetic wave has two components, Electric field (E) and Magnetic field (M), both perpendiculars to the direction of propagation.

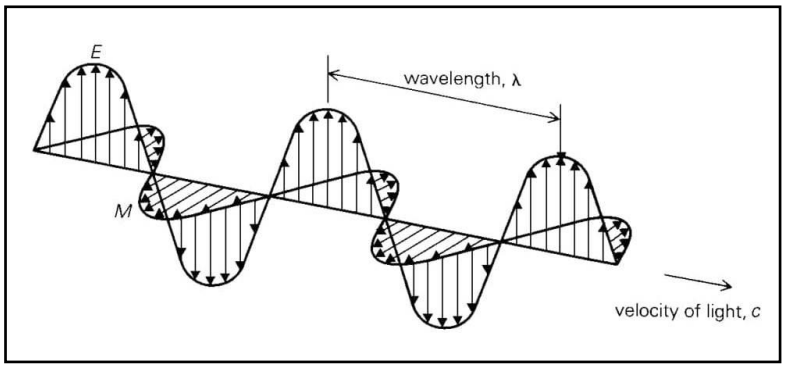

Fig2. Electromagnetic wave

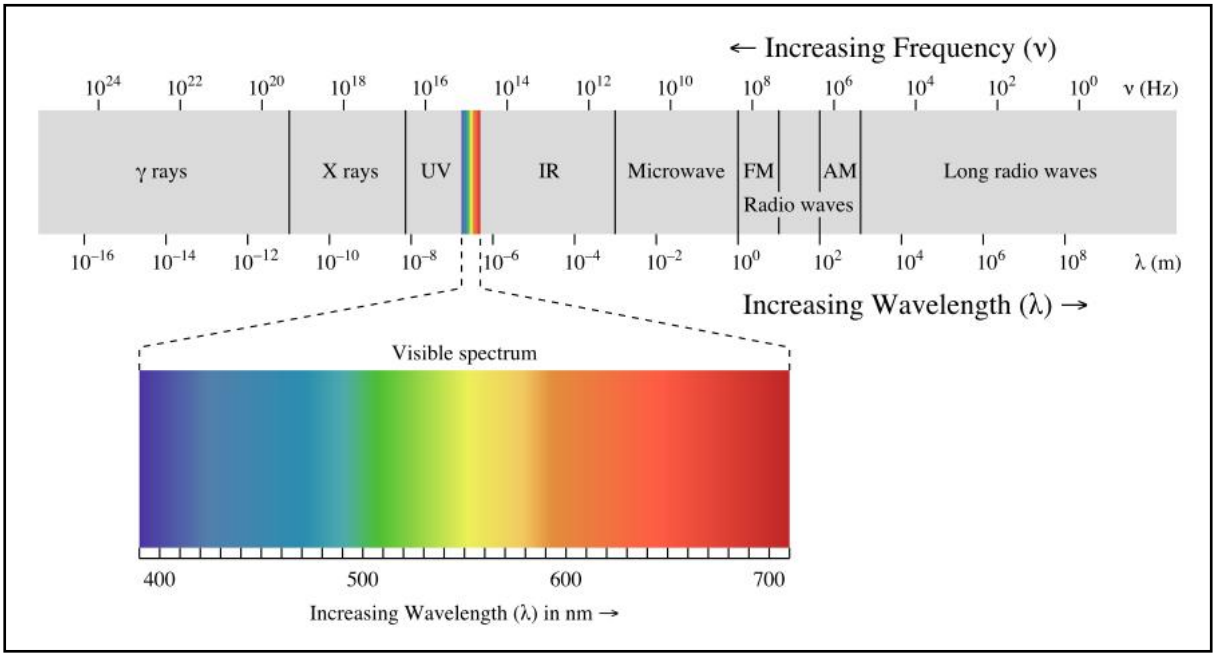

Fig3. Electromagnetic spectrum

II. **Radiation and atmospheric interaction (B):** The EMR interacts with the atmosphere while travelling from the source to earth features and from earth features to the sensor. During this whole path the EMR changes its properties due to loss of energy and alteration in wavelength, which ultimately affects the sensing of the EMR by the sensor.

- This effect is caused by the mechanisms of scattering and absorptions.
- Scattering is a generally physical process, occur when particles or large gas molecules present in the atmosphere interact with and cause the electromagnetic radiation to be redirected from its original path.
- Absorptions is a process in which electromagnetic energy is converted in an object or medium into other forms of energy. This phenomenon causes molecules in the atmosphere to absorb energy at various wavelengths. The strongest absorbers of solar radiation in the atmosphere are ozone (O3), water vapour (H2O), and carbon dioxide (CO2).

III. **Interaction with the target (C):** Radiation from the sun, when incident upon the Earth's surface, is reflected by the surface, transmitted into the surface or absorbed and emitted by the surface.

There are three forms of interaction that can take place when energy strikes upon the surface. These are absorption, transmission and reflection. Absorption occurs when radiation (energy) is absorbed into the target. Transmission occurs when radiation passes through a target. Reflection occurs when radiation "bounces'' of the target and is redirected.

The EMR, on interaction, experiences a number of changes in magnitude, direction, wavelength, polarization and phase. These changes are detected by the remote sensor and enable the interpreter to obtain useful information about the object of interest. The remotely sensed data contain both spatial information (size, shape and orientation) and spectral information (tone, colour and spectral signature).

IV. **Recording of the energy by sensor (D):** After the energy has been scattered by or, emitted from the target, we require a remote sensing device called sensor. The kind of EMR which can be sensed by the device depends upon the amount of EMR and sensor's capabilities.

V. **Transmission, reception and processing (E):** The EMR recorded by the remote sensing device (sensor) is transmitted to earth receiving and data processing

stations. Here the EMR are transformed into interpretable output- digital or analogue images.

VI. **Image processing and analysis (F):** The digital satellite images are processed using specialized software meant for satellite image processing, e.g. Arc Gis, Envi, Edras imagine software, etc.

The image processing and further analysis of satellite data leads to information extraction, which is required by the users. For examples- extraction of water body, vegetation, built-up land, etc.

VII. **Application (G):** The extracted information is utilized to make decisions for solving particular problems.

- Geology: geological mapping.
- Hydrology: monitoring wetlands and snow cover;
- Agriculture: crop type identification, crop condition monitoring, soil moisture measurement, etc.
- Forestry: Forest type mapping, biomass estimation, etc.
- Ground water: ground water prospects mapping, ground water quality mapping, ground water potential zones, etc.
- Soils and Land degradation: soil mapping, land degradation status analysis, land degradation hotspots, land degradation prediction, etc.