

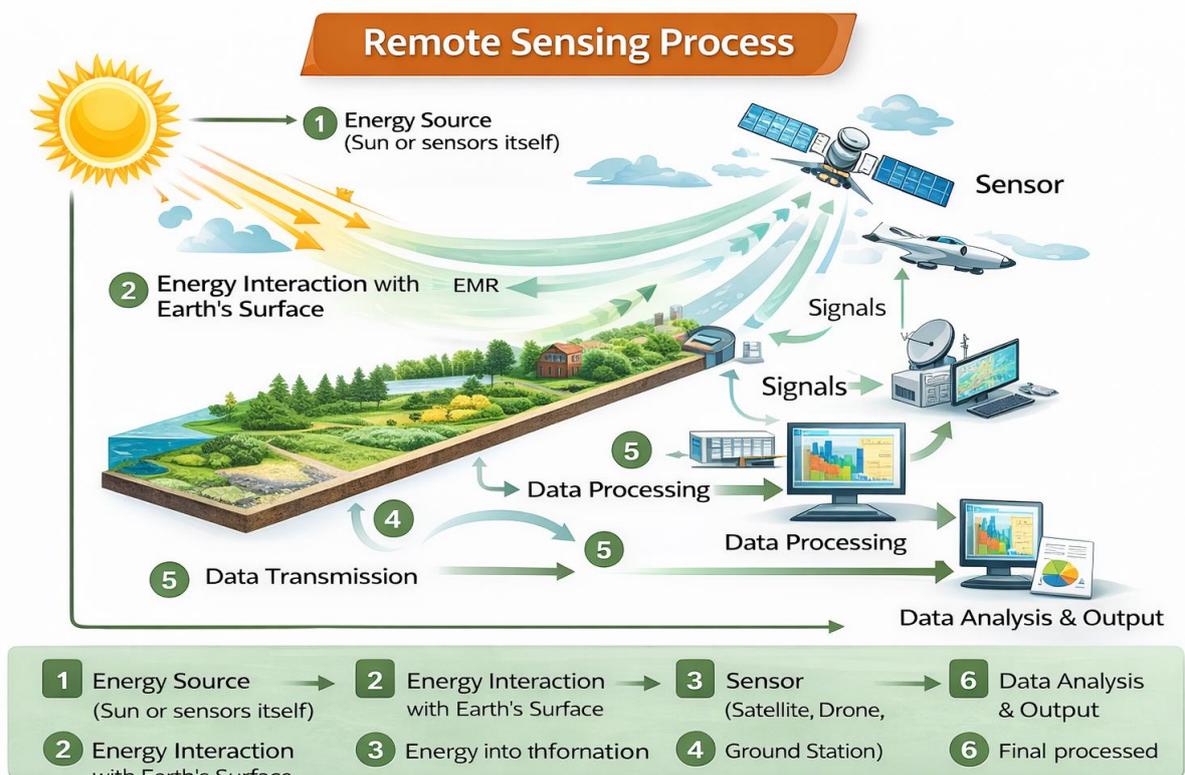


1. Explain about the Concept and Scope of Remote Sensing?

Answer:- Concept of Remote Sensing

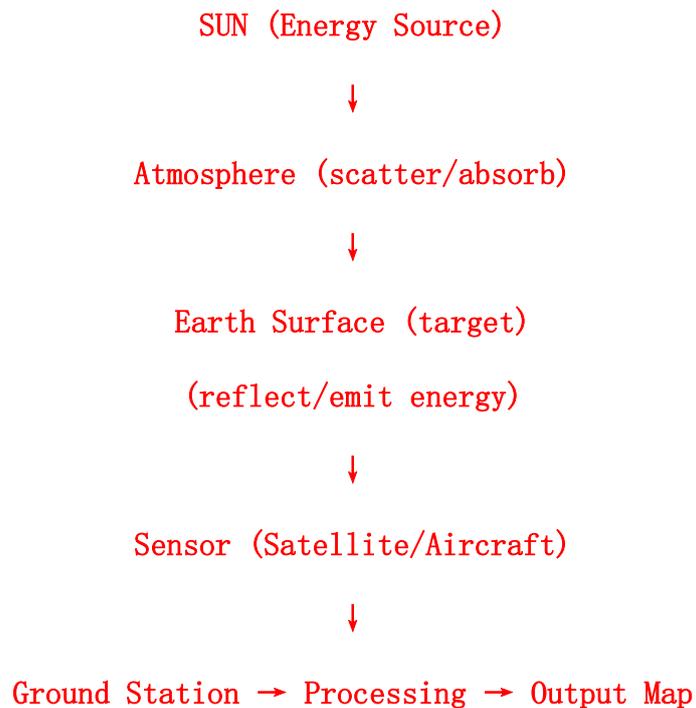
- ✓ **Remote sensing** means **collecting information about an object/area without direct physical contact**.
- ✓ It works by **detecting reflected or emitted electromagnetic radiation (EMR)** from the Earth surface.
- ✓ In simple words: **sensor + EMR + target + data = remote sensing**.
- ✓ The sensor may be on **satellite, aircraft, drone, or ground system**.
- ✓ Objects like **water, soil, vegetation, buildings** reflect/emit energy differently.
- ✓ This difference creates a unique **spectral signature** for each feature.
- ✓ Remote sensing is mainly used for **observation, mapping, monitoring, and analysis**.

✓ Remote Sensing Process (Basic Steps)



- ✓ **Energy source** (Sun / sensor itself) provides EMR.
- ✓ EMR travels through **atmosphere**.
- ✓ It interacts with Earth surface (reflection, absorption, transmission).
- ✓ Sensor collects energy and converts it into signals.
- ✓ Signals are transmitted to the ground station.
- ✓ Image/data processing is done.
- ✓ Interpretation gives final information.

✓ Diagram (Remote Sensing Process)

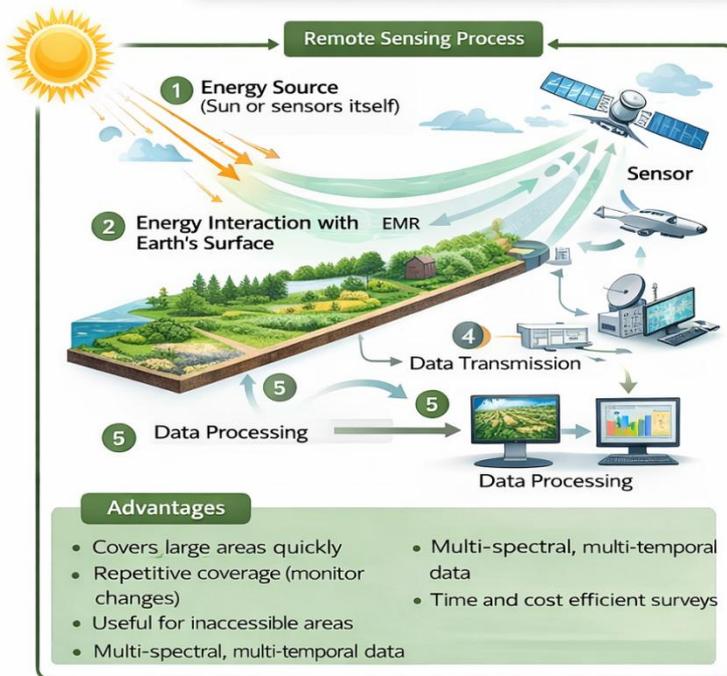


✓ Scope of Remote Sensing (Applications)

- ✓ **Agriculture:** crop health, crop type, yield estimation.
- ✓ **Forestry:** deforestation monitoring, forest fire mapping.
- ✓ **Geology:** mineral exploration, fault detection.
- ✓ **Water resources:** watershed mapping, flood monitoring.
- ✓ **Ocean studies:** sea surface temperature, oil spill detection.
- ✓ **Urban planning:** land use / land cover mapping, city expansion.
- ✓ **Disaster management:** cyclone tracking, drought assessment.
- ✓ **Environment:** pollution monitoring, climate change studies.
- ✓ **Defense:** surveillance, border monitoring.
- ✓ **Transportation:** route planning, infrastructure monitoring.

Advantages

Concept and Scope of Remote Sensing



- ✓ Covers **large area quickly**.
- ✓ Provides **repetitive coverage** (monitor changes).
- ✓ Useful for **inaccessible areas** (mountains/forests).
- ✓ Provides **multi-spectral and multi-temporal information**.
- ✓ Saves time and cost for large surveys.

✓ Limitations

- ✓ Cloud cover affects optical sensors.
- ✓ High resolution data may be costly.
- ✓ Needs skilled interpretation.
- ✓ Atmospheric effects reduce clarity.

✓ Conclusion (Exam line):

34. Remote sensing is a powerful technology used to **collect, analyze, and monitor Earth features** for many engineering and environmental applications.

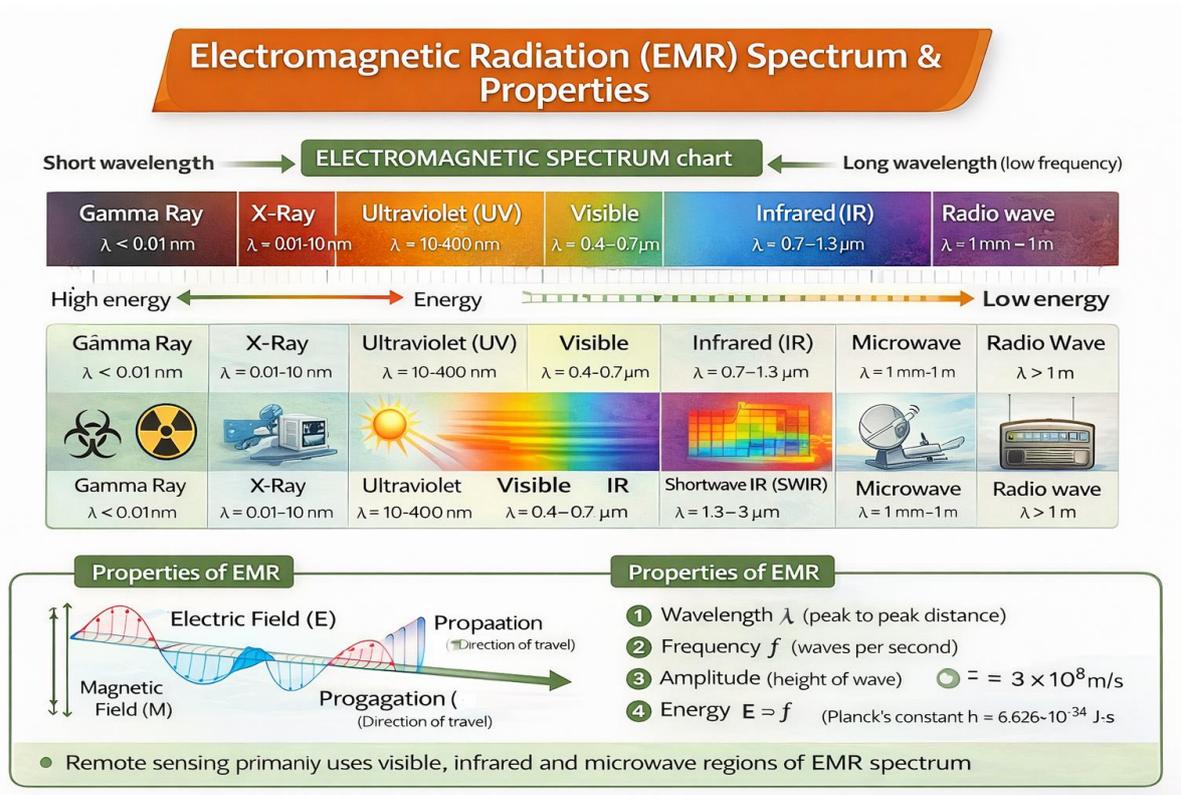
2. Explain about the Electromagnetic Radiation (EMR) Spectrum & its Properties, EMR Wavelengths regions & their applications?

Electromagnetic Radiation (EMR)

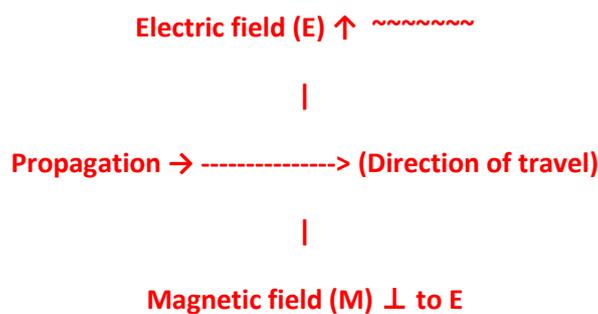
- ✓ EMR is energy that travels in the form of **waves**.
- ✓ EMR includes **radio waves** → **microwaves** → **infrared** → **visible** → **UV** → **X-rays** → **gamma rays**.
- ✓ Remote sensing uses mainly **visible, infrared, and microwave** regions.

✓ EMR Properties

- ✓ EMR travels at the speed of light in vacuum:
 $c = 3 \times 10^8 \text{ m/s}$
- ✓ EMR has two components:
Electric field (E) and **Magnetic field (M)** perpendicular to each other.



✓ EMR Wave Diagram



✓ Key Terms

- ✓ **Wavelength (λ)** = distance between two wave peaks.
- ✓ **Frequency (f)** = number of waves per second (Hz).
- ✓ **Amplitude** = wave height (related to intensity).
- ✓ **Energy (E)** depends on frequency.

✓ EMR Spectrum Ranges & Uses

- ✓ **Visible (0.4 – 0.7 μm)** → human eye, true color images.
- ✓ **Near Infrared (0.7 – 1.3 μm)** → vegetation health analysis.
- ✓ **Shortwave Infrared (1.3 – 3 μm)** → soil moisture, minerals.
- ✓ **Thermal Infrared (3 – 14 μm)** → temperature mapping.

✓ **Microwave (1 mm – 1 m)** → radar, works in clouds/night.

✓ EMR Spectrum Diagram (Easy to remember)

Short λ → HIGH Energy → UV | Visible | IR | Microwave → Long λ

✓ Applications (Wavelength wise)

✓ **Visible band:** land use mapping, water body identification.

✓ **NIR band:** vegetation appears bright → crop monitoring.

✓ **SWIR band:** rock/mineral identification, moisture detection.

✓ **Thermal IR:** heat losses, urban heat island, fires.

✓ **Microwave:** rainfall, floods, ocean waves, SAR imaging.

✓ **Conclusion line:**

20. EMR spectrum helps remote sensing to identify objects because each feature behaves differently in each wavelength.

3) Describe Wavelength - Frequency - Energy Relationship of EMR

Answer:-

Relation between Wavelength and Frequency

✓ EMR wave speed is constant in vacuum:

$$c = \lambda \times f$$

✓ Where:

c = speed of light (3×10^8 m/s)

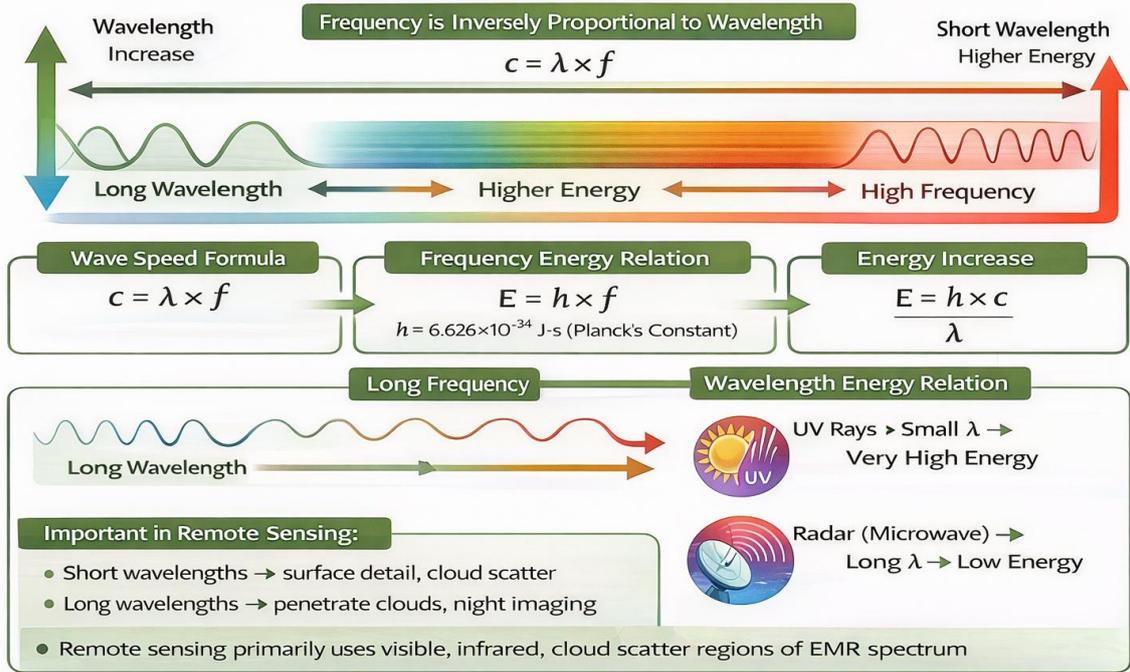
λ = wavelength (m)

f = frequency (Hz)

✓ So wavelength and frequency are **inversely proportional**.

✓ If wavelength increases → frequency decreases.

Wavelength–Frequency–Energy Relationship of EMR



Formula

- ✓ $f = c / \lambda$
- ✓ $\lambda = c / f$

✓ Relation between Energy and Frequency

- ✓ Energy of EMR is:
 $E = h \times f$
- ✓ Where $h = \text{Planck's constant } (6.626 \times 10^{-34} \text{ J}\cdot\text{s})$
- ✓ So energy is **directly proportional to frequency**.
- ✓ If frequency increases \rightarrow energy increases.

✓ Relation between Energy and Wavelength

- ✓ Combine both relations:
 $E = h \times (c/\lambda)$
- ✓ So: **Energy is inversely proportional to wavelength**.
- ✓ Shorter wavelength \rightarrow higher energy.
- ✓ Longer wavelength \rightarrow lower energy.

✓ Quick Diagram

Wavelength $\uparrow \rightarrow$ Frequency $\downarrow \rightarrow$ Energy \downarrow

Wavelength $\downarrow \rightarrow$ Frequency $\uparrow \rightarrow$ Energy \uparrow

✓ Example (Simple)

- ✓ UV rays have small $\lambda \rightarrow$ very high energy.

- ✓ Microwave has long λ → low energy.
- ✓ That is why UV can damage skin more easily than microwave.

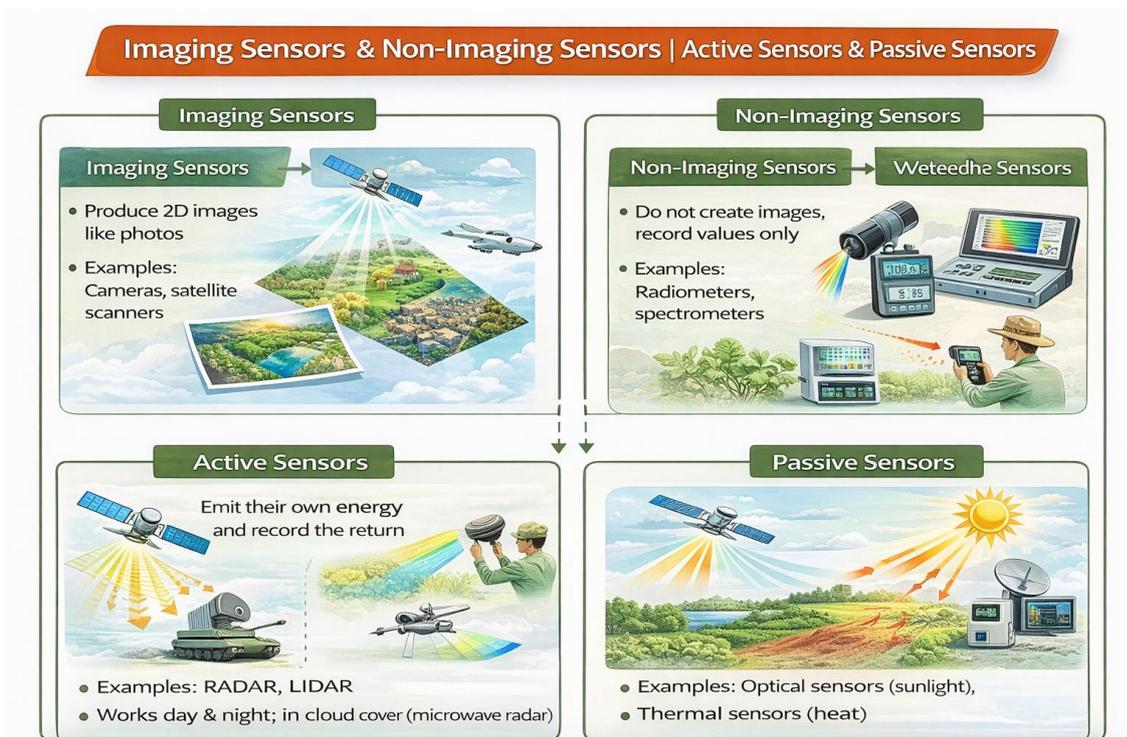
✓ Remote Sensing Importance

- ✓ Short λ (visible) → strong scattering, high detail images.
- ✓ Longer λ (microwave) → penetrates clouds, works at night.
- ✓ Hence different sensors use different wavelength ranges.

✓ Final line:

21. Wavelength controls frequency, frequency controls energy, and energy controls the interaction with Earth features.

4) (a) Imaging & Non-imaging Sensors, Active & Passive Sensors



Answer

Imaging Sensors

- ✓ These sensors produce **2D images** like photos.
- ✓ Example: cameras, satellite scanners (Landsat, Sentinel).
- ✓ They show spatial distribution of objects.

✓ Non-imaging Sensors

- ✓ They do not create images, they record **values only**.
- ✓ Example: radiometers, spectrometers.

✓ Active Sensors

- ✓ Active sensors emit their own energy and record the return.
- ✓ Example: RADAR, LiDAR.
- ✓ Works day/night and in cloud cover (microwave radar).

✓ Passive Sensors

- ✓ Passive sensors detect natural energy.
- ✓ Example: Optical sensors (sunlight), thermal sensors (heat).

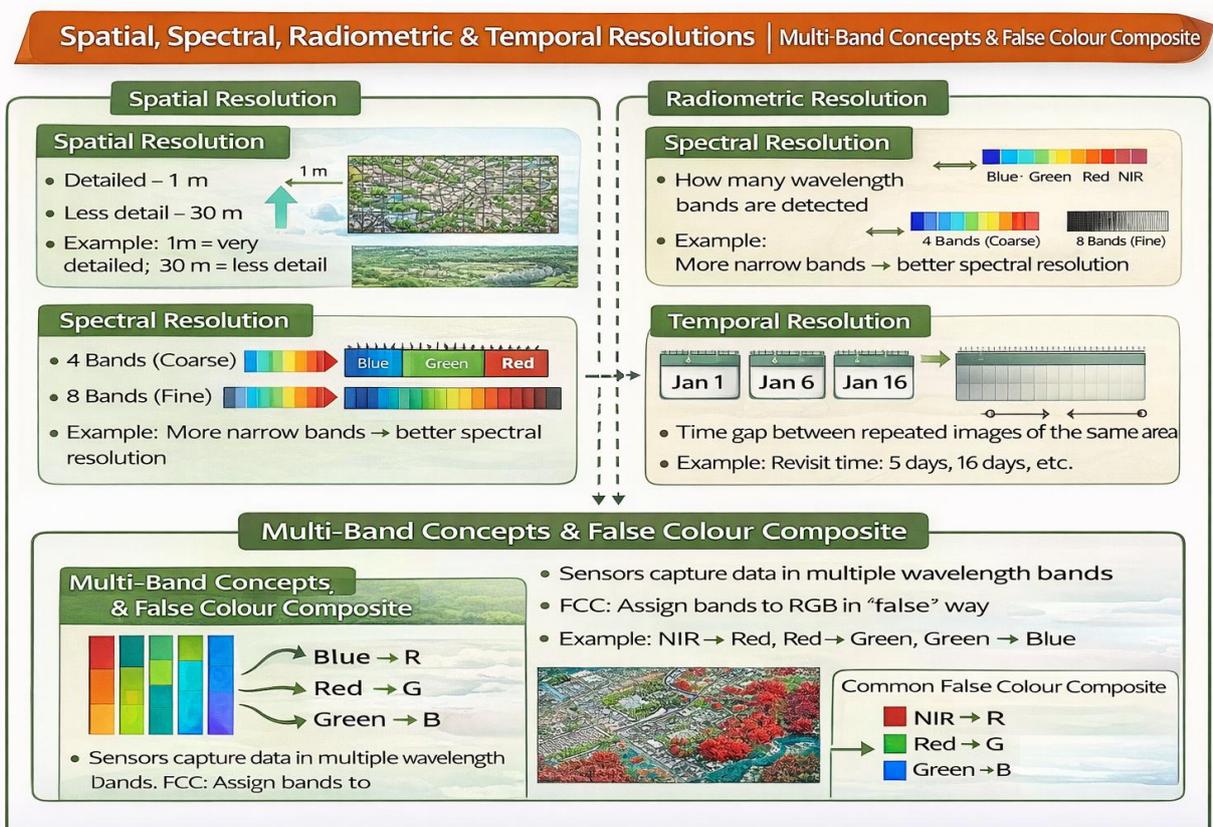
✓ Diagram

Passive: Sun → Target → Sensor Active : Sensor → Target → Sensor (backscatter)

4) (b-i) Explain: Spectral, Spatial, Radiometric, Temporal Resolutions

1) Spatial Resolution

- ✓ It means **smallest object that can be detected**.
- ✓ Example: 1 m = very detailed, 30 m = less detail.



✓ 2) Spectral Resolution

- ✓ Ability to detect **different wavelengths (bands)**.
- ✓ More narrow bands → better spectral resolution.

✓ 3) Radiometric Resolution

- ✓ Ability to detect **small differences in energy**.
- ✓ Expressed as **bit levels** (8-bit, 11-bit, 12-bit).

✓ 4) Temporal Resolution

- ✓ Time gap between repeated images of same area.
- ✓ Example: revisit time 5 days, 16 days etc.

✓ Diagram

Spatial → clarity of objects

Spectral → number of bands

Radiometric → brightness levels

Temporal → repeat time

Q4) (b-ii) Explain: Multi-band & False Colour Composite (5 Marks)

✓ Multi-band Concept

- ✓ Satellite sensors capture data in **multiple bands**.
- ✓ Each band shows different feature information.
- ✓ Example bands: Blue, Green, Red, NIR, SWIR.

✓ False Colour Composite (FCC)

- ✓ FCC means assigning bands to RGB in a false way.
- ✓ Most common FCC:
NIR → Red, Red → Green, Green → Blue
- ✓ In this FCC:
Vegetation appears RED (high NIR reflection).
- ✓ Water appears dark, urban appears cyan/grey.

✓ Diagram (FCC)

FCC:

R = NIR

G = RED

B = GREEN

→ Vegetation = RED color

5) (a) Explain Ground, Airborne & Space borne Platforms (5 Marks)

✓ Ground Platform

- ✓ Sensor placed on Earth surface.
- ✓ Used for field measurements & calibration.
- ✓ Example: hand-held spectrometer.

✓ Airborne Platform

- ✓ Sensors on aircraft or drones.
- ✓ Used for high resolution and local area mapping.
- ✓ Example: drone mapping, aircraft LiDAR.

✓ Spaceborne Platform

- ✓ Sensors mounted on satellites.
- ✓ Covers large area and repetitive monitoring.
- ✓ Example: Landsat, Sentinel, IRS.

✓ Diagram

Ground (low) → Airborne (medium) → Satellite (high)

Coverage small → medium → very large

1) Ground-based Platforms

✓ Explanation

- ✓ Ground platforms have **sensors placed directly on the Earth's surface**.
- ✓ They are mainly used for **field measurements**, calibration, and validation of satellite data.
- ✓ Data collected is **very accurate but covers a small area**.
- ✓ Commonly used in **research, agriculture experiments, and atmospheric studies**.

✓ Examples

- ✓ Hand-held spectrometers
- ✓ Ground radiometers
- ✓ Weather stations

✓ Key Points (for exam)

- ✓ High accuracy
- ✓ Very small spatial coverage
- ✓ Used for **ground truth data**

2) Airborne Platforms

✓ Explanation

- ✓ Sensors are mounted on **aircraft, helicopters, or drones**
- ✓ They fly at **low to medium altitude**.
- ✓ Provide **very high spatial resolution** images.
- ✓ Useful for **local-scale and detailed mapping**.

✓ Examples

- ✓ Aircraft-mounted cameras

- ✓ Drone surveys
- ✓ Airborne LiDAR systems

✓ Applications

- ✓ Urban mapping
- ✓ Corridor mapping (roads, pipelines)
- ✓ Disaster damage assessment

✓ Key Points

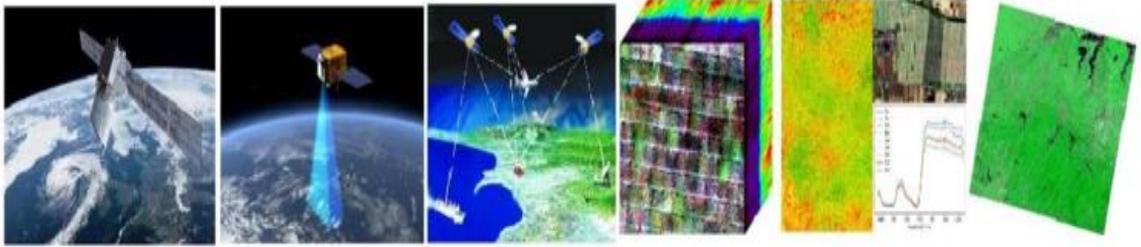
- ✓ Flexible data collection
- ✓ High resolution
- ✓ Costlier than satellite for large areas

3) Space-borne Platforms

✓ Explanation

- ✓ Sensors are mounted on **satellites orbiting the Earth.**
- ✓ They provide **large area coverage** and **repetitive observations.**
- ✓ Used for **regional, national, and global studies.**

Satellite-based Platform



UAV-based Platform

Imaging spectrometer and UAV platforms



Ground-based Platform

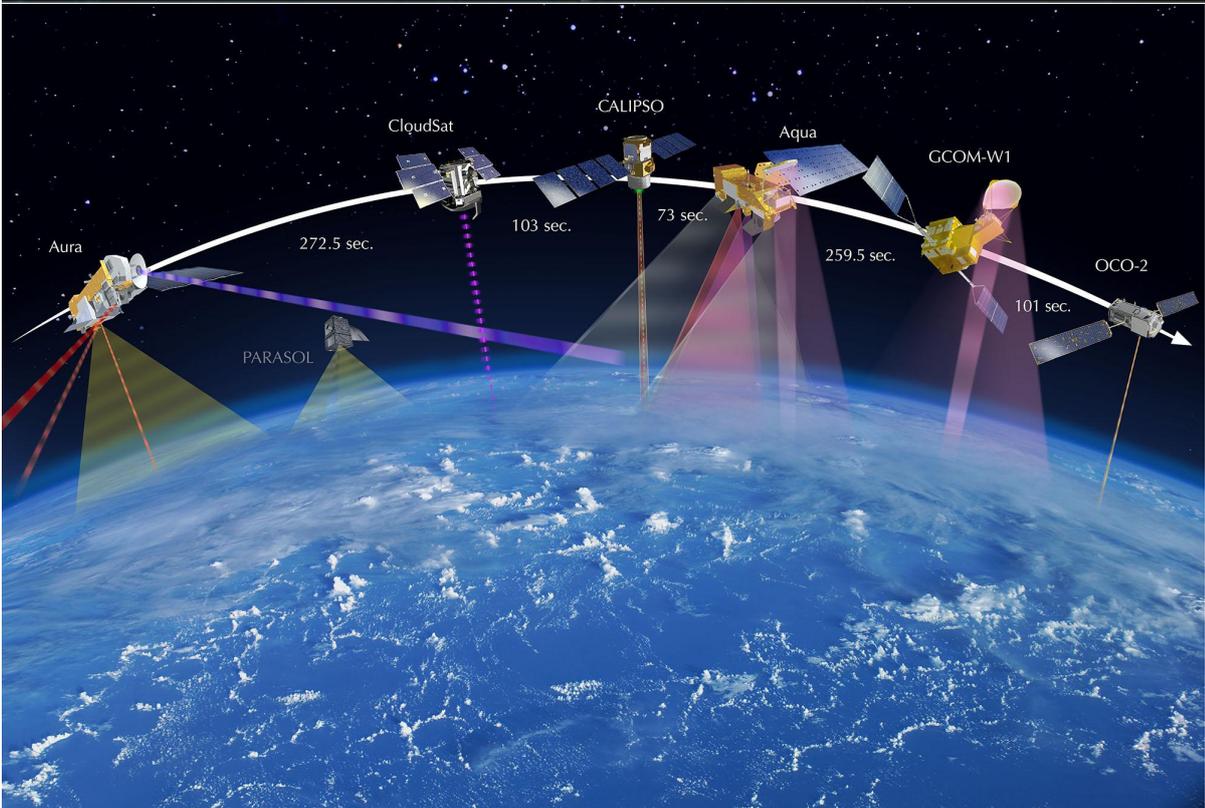
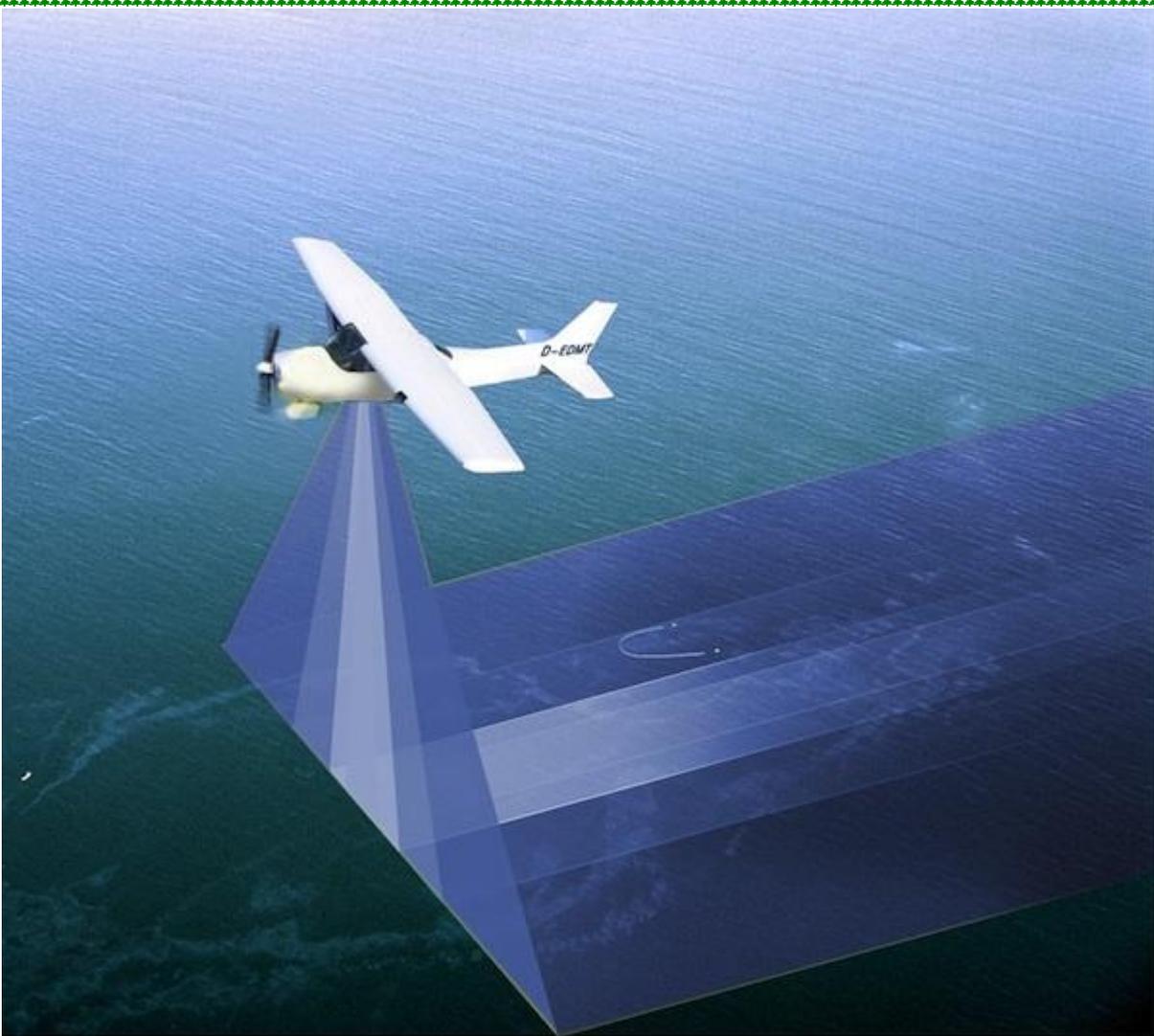
Spectrometers and platforms



Field detecting instruments



✓



✓ Data is consistent and useful for long-term monitoring.

✓ Examples

- ✓ Landsat
- ✓ Sentinel
- ✓ IRS satellites

✓ Applications

- ✓ Weather forecasting
- ✓ Land use / land cover mapping
- ✓ Ocean studies
- ✓ Climate change analysis

✓ Key Points

- ✓ Very large coverage
- ✓ Repetitive data
- ✓ Moderate to high resolution

COMPARISON (Very Important for Exams)

Platform	Height	Coverage	Resolution	Usage
Ground	Earth surface	Very small	Very high	Calibration
Airborne	Low altitude	Medium	Very high	Detailed mapping
Space-borne	Very high altitude	Very large	Moderate - high	Global monitoring

✓ 2-Line Conclusion (Write this in exam)

Ground, airborne, and space-borne platforms differ mainly in **altitude, coverage, and resolution**, and together they support accurate and multi-scale remote sensing applications.

5) (b) Pointing Accuracy, Shuttle Orbit, Geostationary & Sun-synchronous (5 Marks)

1) Pointing Accuracy

✓ Explanation

Pointing accuracy is the ability of a satellite sensor to **precisely aim at a specific target on Earth**.

High pointing accuracy ensures:

- ✓ **Correct location of features**

- ✓ Reduced geometric distortion
- ✓ Better image quality
- ✓ Very important for **high-resolution satellites**.

✓ Exam Keywords

- ✓ Target alignment
- ✓ Image quality
- ✓ Positional accuracy

2) Shuttle Orbit

✓ Explanation

- ✓ Shuttle orbit is a type of **Low Earth Orbit (LEO)**.
- ✓ Altitude: **~200–500 km above Earth**
- ✓ Used by **space shuttles** for experiments and Earth observation.
- ✓ Orbit period is short (about **90 minutes**).

✓ Features

- ✓ Covers limited area
- ✓ High resolution data
- ✓ Short revisit time

3) Geostationary Orbit

✓ Explanation

- ✓ Satellite revolves around Earth at the **same angular speed as Earth's rotation**.
- ✓ Appears **fixed over one point on the equator**.
- ✓ Altitude: **~36,000 km**

✓ Applications

- ✓ Weather monitoring
- ✓ Cyclone tracking
- ✓ Communication satellites

✓ Key Point for Exam

- ✓ Continuous monitoring of the **same area**

4) Sun-Synchronous Orbit

✓ Explanation

- ✓ Satellite crosses the equator at the **same local solar time every day**.
- ✓ Ensures **uniform illumination conditions**.
- ✓ Mostly **near-polar orbit**.

✓ Applications

- ✓ Land use / land cover mapping
- ✓ Change detection
- ✓ Environmental monitoring

✓ Key Exam Line

Same lighting conditions → easy comparison of image

✓ 2-Line Conclusion (Exam Ready)

Geostationary orbit provides continuous coverage, while sun-synchronous orbit ensures consistent illumination, and pointing accuracy controls precise target observation.

✓ Pointing Accuracy

- ✓ Ability of satellite sensor to point exactly to the target area.
- ✓ Higher pointing accuracy → better image quality and correct location.

✓ Shuttle Orbit

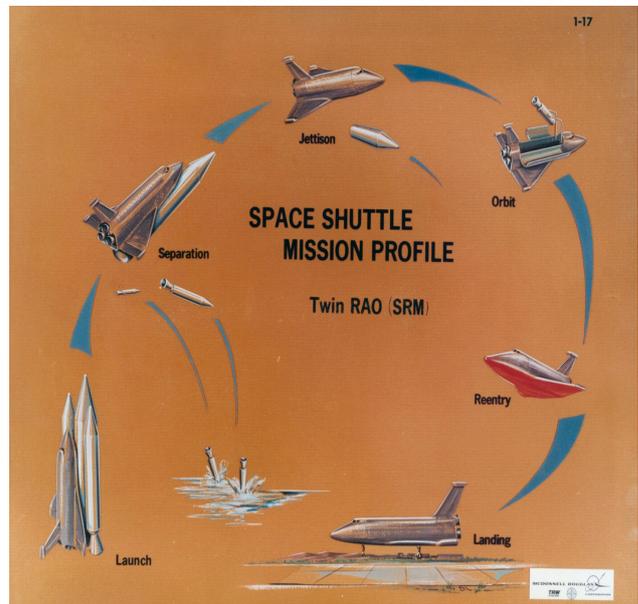
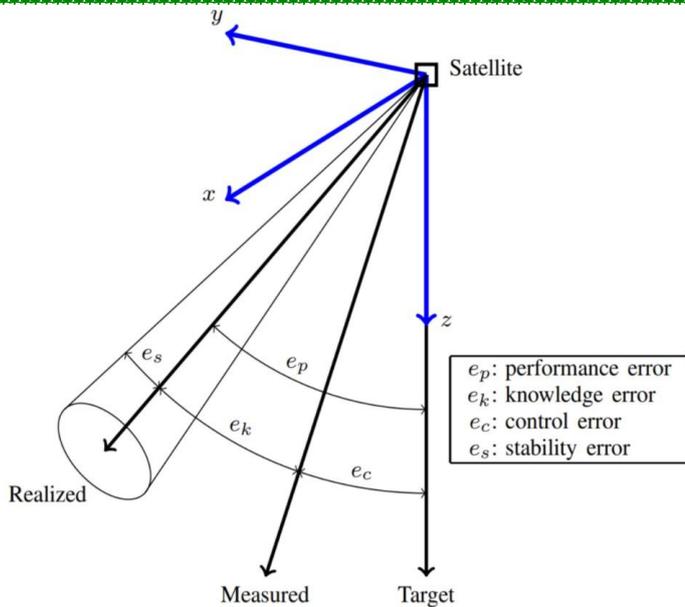
- ✓ Space shuttle orbit is **low earth orbit (LEO)**.
- ✓ Used for experiments and Earth observation.

✓ Geostationary Orbit

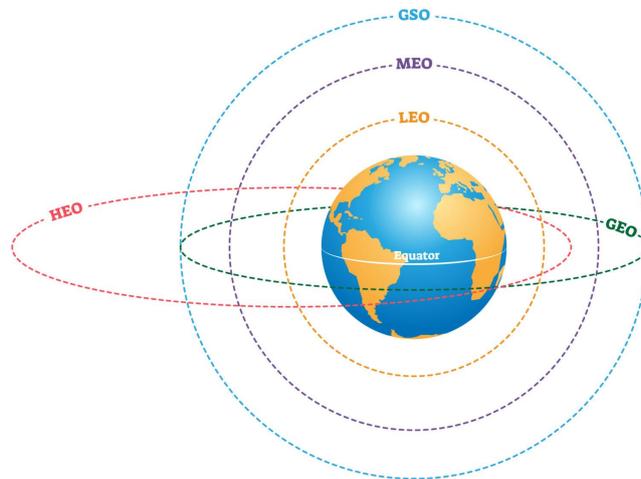
- ✓ Satellite appears fixed over one point on Earth.
- ✓ Height \approx **36,000 km** above equator.
- ✓ Used in weather monitoring (continuous coverage).

✓ Sun-synchronous Orbit

- ✓ Satellite passes same place at same local solar time.
- ✓ Used in mapping and remote sensing satellites.
- ✓ Gives constant illumination conditions for comparison.



ORBIT TYPES



LEO	MEO	Over the Equator GEO	GSO	HEO
Low Earth Orbit	Medium Earth Orbit	Geostationary Orbit	Geosynchronous Orbit	Highly Elliptical Orbit
↑ Altitude: 160-2,000 km	↑ Altitude: 2,000-35,786 km	↑ Altitude: 35,786 km	↑ Altitude: 35,786 km	↑ Apogee altitude: 40,000 km Perigee altitude: 1,000 km
→ Speed: ~8 km/sec	→ Speed: ~3-8 km/sec	→ Speed: ~3 km/sec	→ Speed: ~3 km/sec	→ Speed: ~1.5-10.0 km/sec
🕒 Orbital period: ~90 min	🕒 Orbital period: ~2-24 hours	🕒 Orbital period: 24 hours	🕒 Orbital period: 24 hours	🕒 Orbital period: ~12 hours
Example: Globalstar - 48 satellites Voice and Data Services	Example: GPS - 24 satellites Global Positioning System	Example: Communications satellites, Broadcast satellites	Example: SBAS Weather satellites	Example: Communications, Remote sensing

6) Energy interaction in atmosphere & with Earth surface features (10 Marks)

- ✓ Atmospheric Interaction
- ✓ EMR travels through atmosphere and faces: scattering, absorption, transmission.

✓ Scattering Types

- ✓ **Rayleigh scattering:** small particles, affects blue light.
- ✓ **Mie scattering:** dust/smoke, medium particles.
- ✓ **Non-selective scattering:** large droplets → clouds appear white.

✓ Absorption

- ✓ Some gases absorb energy (like CO₂, H₂O, O₃).
- ✓ Absorption reduces energy reaching the sensor.

✓ Transmission

- ✓ Some wavelengths pass easily = atmospheric windows.

✓ Interaction with Earth Surface

- ✓ Main processes:
 - ✓ reflection, absorption, transmission, emission.

✓ Spectral Reflectance Curve

- ✓ Graph showing reflectance vs wavelength.
- ✓ Used to identify objects by signatures.

✓ Example: Vegetation

- ✓ Low reflectance in blue & red (chlorophyll absorption).
- ✓ High reflectance in NIR (leaf structure).

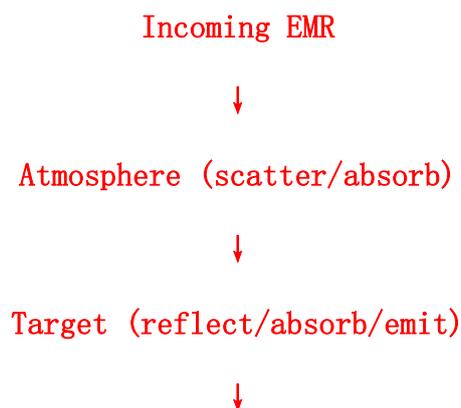
✓ Example: Water

- ✓ Water absorbs IR strongly → appears dark in NIR/SWIR.

✓ Example: Soil

- ✓ Soil reflectance increases gradually with wavelength.

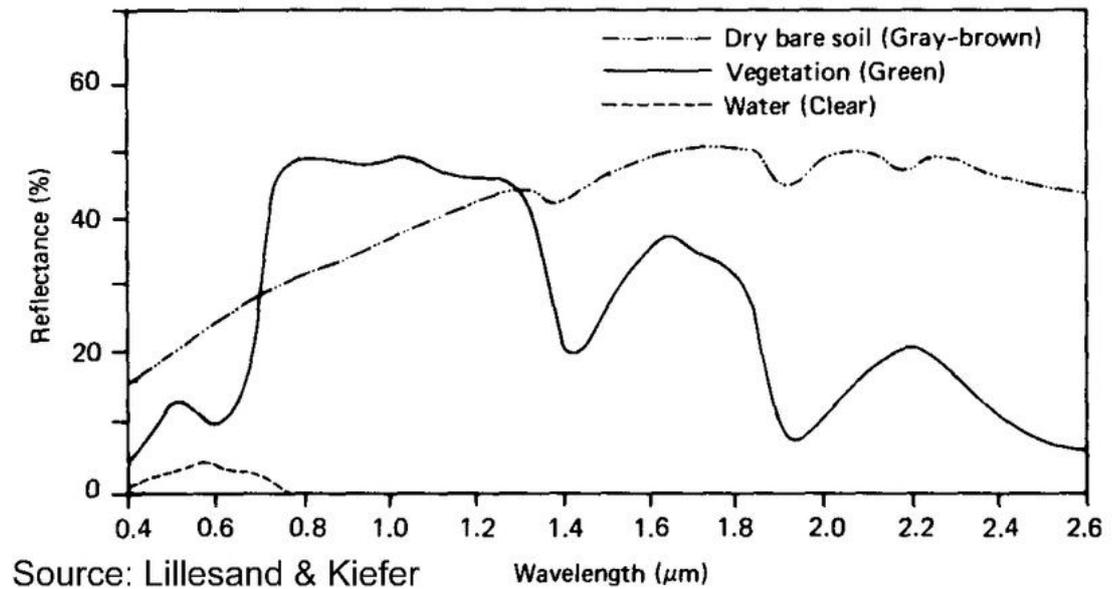
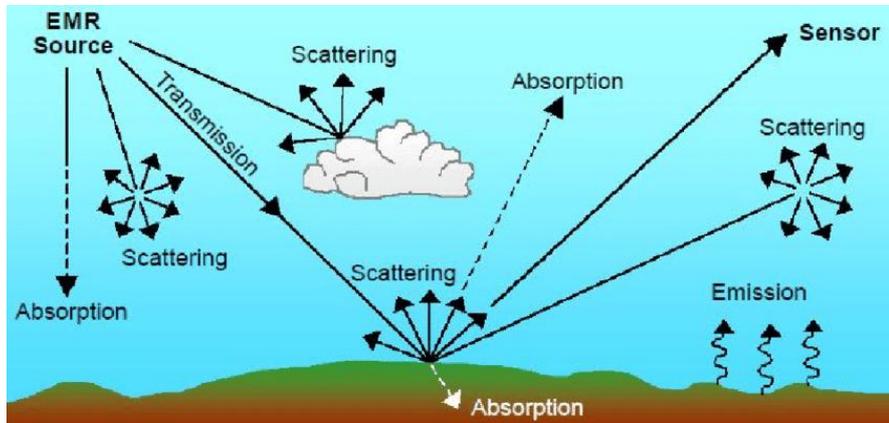
Diagram (Energy Interaction)

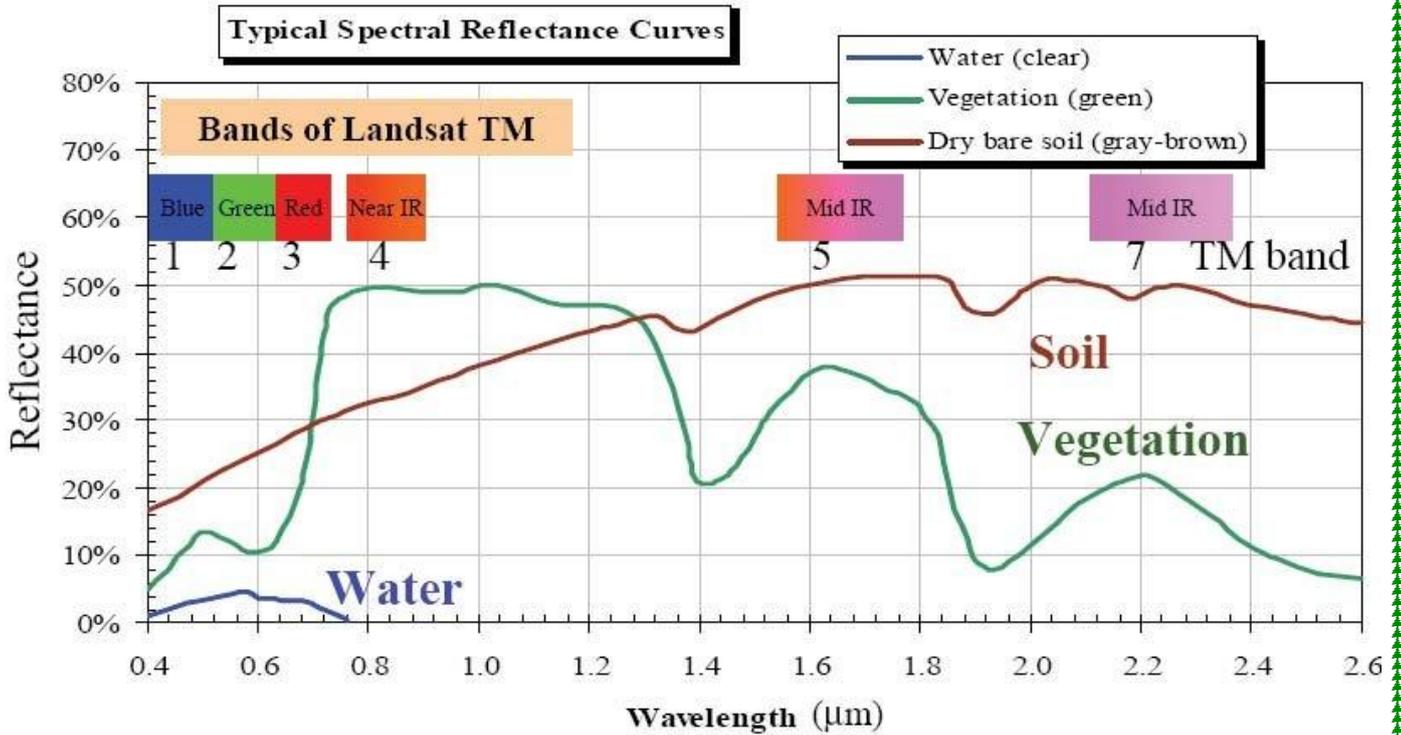


Sensor receives recorded signal

✓ Conclusion:

15. Energy interaction helps us identify Earth features and select best bands for remote sensing studies.





A) Energy Interaction in the Atmosphere

✓ When EMR travels through atmosphere, it undergoes:

1 Scattering

- ✓ **Rayleigh scattering** → very small particles (blue sky)
- ✓ **Mie scattering** → dust, smoke
- ✓ **Non-selective scattering** → clouds (white appearance)

2 Absorption

- ✓ Certain gases (CO_2 , H_2O , O_3) **absorb EMR**
- ✓ Reduces energy reaching the sensor

3 Transmission

- ✓ Some wavelengths pass freely → **Atmospheric windows**
- ✓ Used for remote sensing observations

B) Energy Interaction with Earth Surface

✓ After reaching Earth, EMR undergoes:

- 1 **Reflection** – energy bounces back to sensor
- 2 **Absorption** – energy absorbed by material
- 3 **Transmission** – energy passes through
- 4 **Emission** – objects emit thermal energy

C) Spectral Reflectance Curves

Vegetation

- ✓ Low reflectance in **blue & red**
- ✓ High reflectance in **NIR**

Water

- ✓ Strong absorption in IR → appears **dark**

Soil

- ✓ Gradual increase in reflectance with wavelength

These curves help identify Earth features.

D) Importance in Remote Sensing

- ✓ Helps in **band selection**
 - ✓ Enables **feature identification**
 - ✓ Basis for **false colour composites**
 - ✓ Essential for **image interpretation**
- ✓ Final Exam Conclusion (Write This)

Energy interaction through scattering, absorption, and reflection creates unique spectral signatures, which form the foundation of remote sensing analysis.



SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES
(AUTONOMOUS)

QUESTION BANK

Year / Semester: **III B.Tech VI Semester**

Regulation: **R23**

Subject and Code: Remote Sensing and GIS (20CIV473C)

SYLLABUS

UNIT III: REMOTE SENSING APPLICATIONS Scope of Remote Sensing Applications - Potentials and Limitations. Applications in land use and land cover analysis. Resource evaluation - Soils, forest and agriculture. Water Resource Applications - Mapping, monitoring of surface water bodies, tanks, lakes/reservoirs. Environmental applications.

UNIT IV: GEOGRAPHIC INFORMATION SYSTEM Basic Concepts: Definition of GIS, Components of GIS, Variables - points, lines, polygon, Functionality of GIS, Areas of GIS application, Advantage and Limitation of GIS.

UNIT V: GIS DATA Spatial and Attribute Data, Information Organization and Data Structures - Raster and Vector data structures, Data File and database Creating GIS Data: Creating GIS Software's, File organization and formats, Geo-database, Database model, Rectification, Digitization and Map Composition



Year / Semester: **III B.Tech VI Semester**

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Max Marks: 10

Questions

UNIT III: REMOTE SENSING APPLICATIONS

Introduction

Remote sensing is the science of acquiring information about the Earth's surface without direct contact, using sensors mounted on satellites, aircraft, or drones. It records reflected or emitted electromagnetic radiation (EMR) from Earth features.

Remote sensing plays a major role in resource management, environmental monitoring, disaster management, and sustainable planning.

Scope of Remote Sensing Applications

Remote sensing has wide scope in:

- ✓ Land use and land cover mapping
- ✓ Agricultural monitoring
- ✓ Forest resource management
- ✓ Water resource assessment
- ✓ Urban planning
- ✓ Disaster monitoring
- ✓ Environmental protection
- ✓ Climate change analysis

It provides:

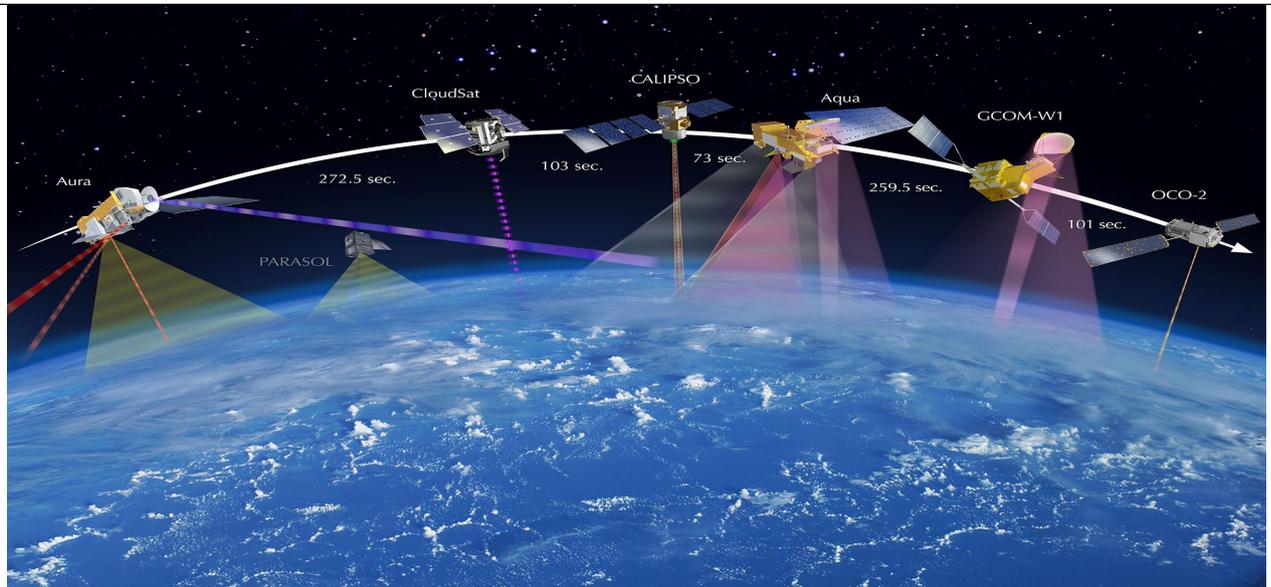
- ✓ Large area coverage
- ✓ Repetitive data acquisition
- ✓ Multi-spectral analysis
- ✓ Digital data integration with GIS



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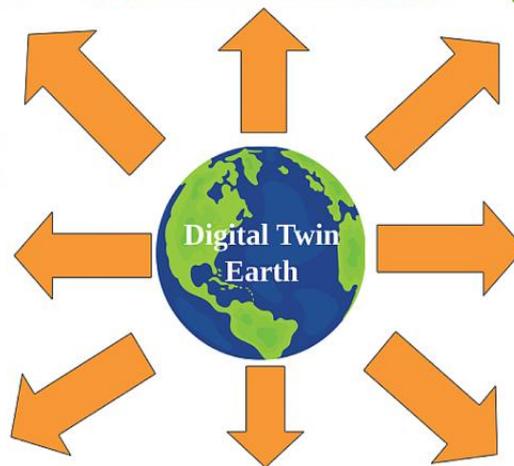
AI&Agriculture

AI&Marine Life

AI& Urban Hospital



AI&Mountains



AI&Urban Ecosystem



AI&Semi Land



AI&Forest



AI&Deserts



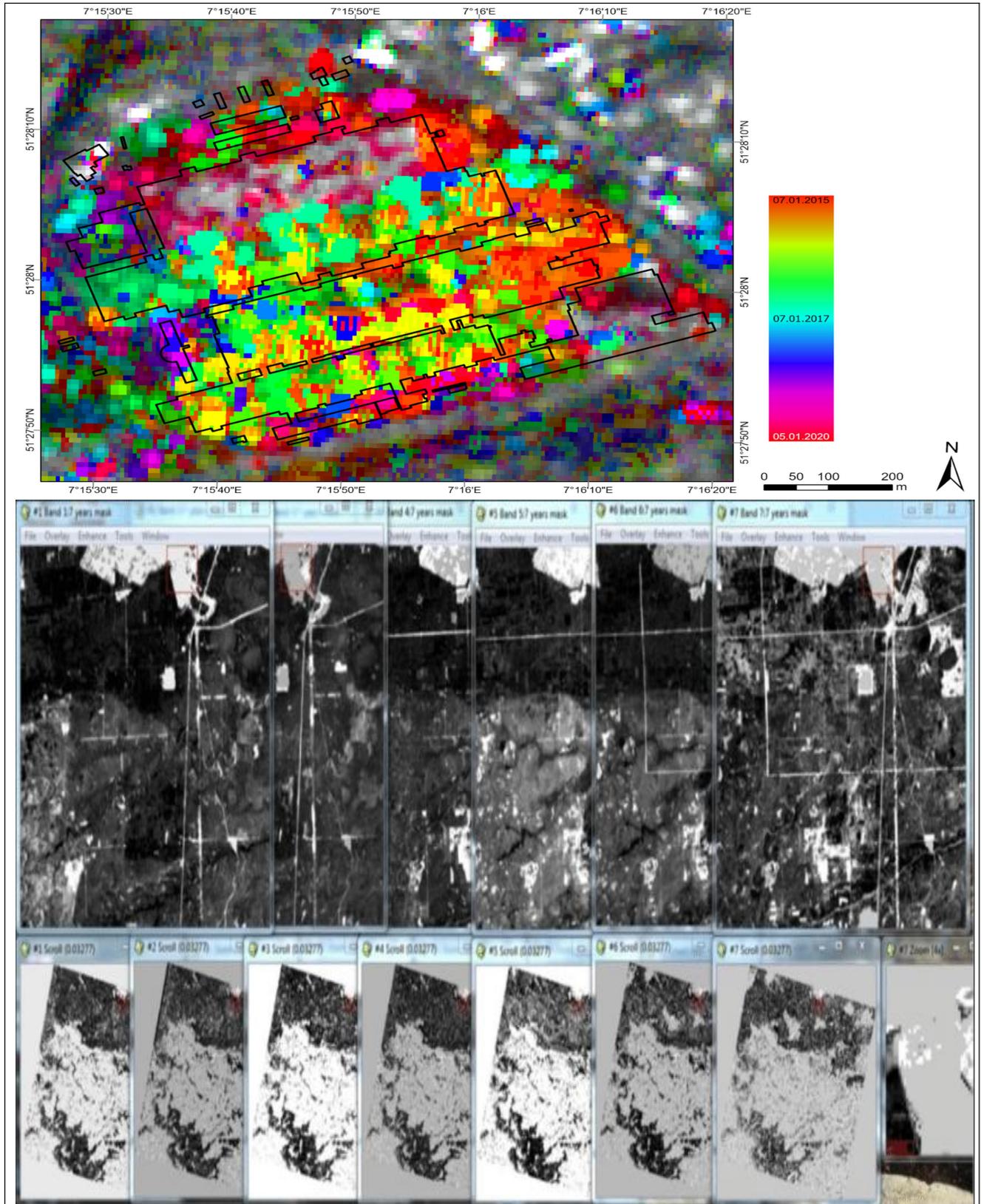
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Potentials of Remote Sensing

- ✓ Rapid mapping of large geographical areas
- ✓ Monitoring inaccessible areas (mountains, forests)
- ✓ Multi-temporal analysis for change detection
- ✓ Early warning systems for floods and cyclones
- ✓ Accurate classification using spectral signatures
- ✓ Cost-effective for national level surveys
- ✓ Supports decision making in planning

Real-Time Example:

During **Cyclone Fani (India, 2019)**, satellite imagery was used to monitor cyclone path and damage assessment.

Limitations of Remote Sensing

- ✓ Optical sensors affected by cloud cover
- ✓ High-resolution data can be expensive
- ✓ Requires skilled interpretation
- ✓ Atmospheric scattering reduces clarity
- ✓ Cannot directly detect underground features

Example:

During monsoon season, cloud cover prevents optical satellites from capturing land features clearly.

Land Use and Land Cover (LULC)

Applications

Land Use → Human utilization (residential, industrial, agricultural)

Land Cover → Physical material (water, vegetation, soil)

Applications:

- ✓ Urban expansion mapping
- ✓ Deforestation monitoring
- ✓ Wasteland identification



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- ✓ Infrastructure planning
- ✓ Environmental impact assessment

Real Example:

- ✓ Satellite analysis shows rapid urban growth in Bengaluru between 2000–2020.
- ✓ Vegetation appears red in FCC due to high NIR reflectance.





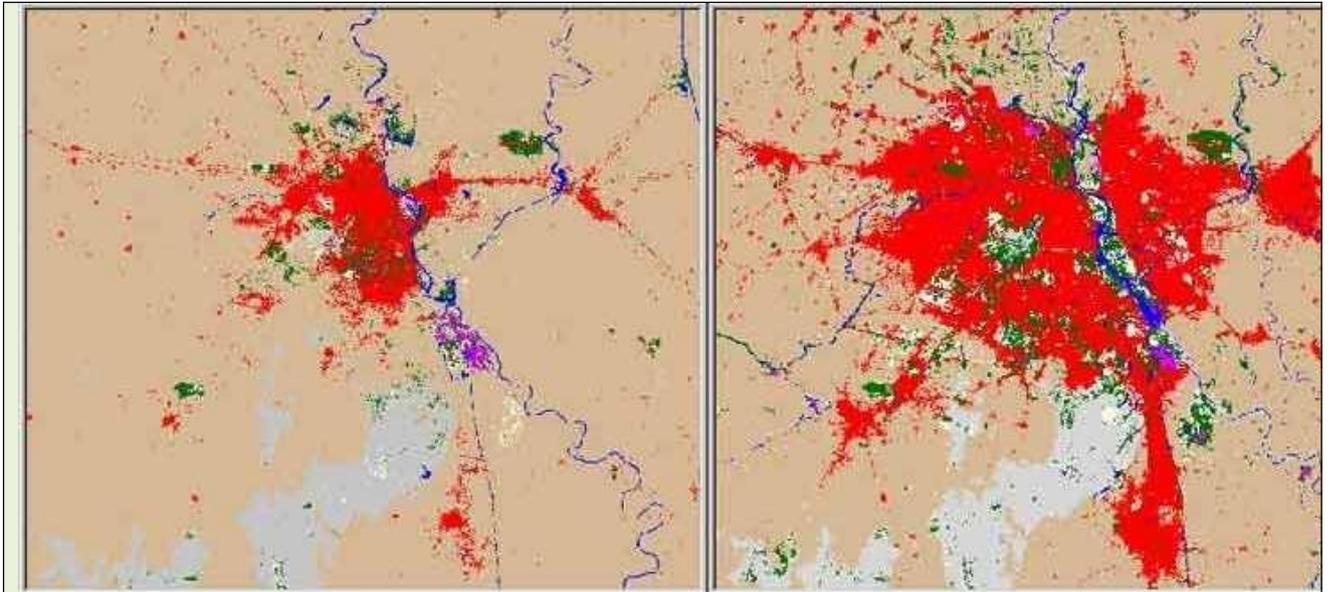
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The Economist



Year / Semester: **III B.Tech VI Semester**

Regulation: **R23**

Subject and Code: Remote Sensing and GIS (20CIV473C)

Resource Evaluation

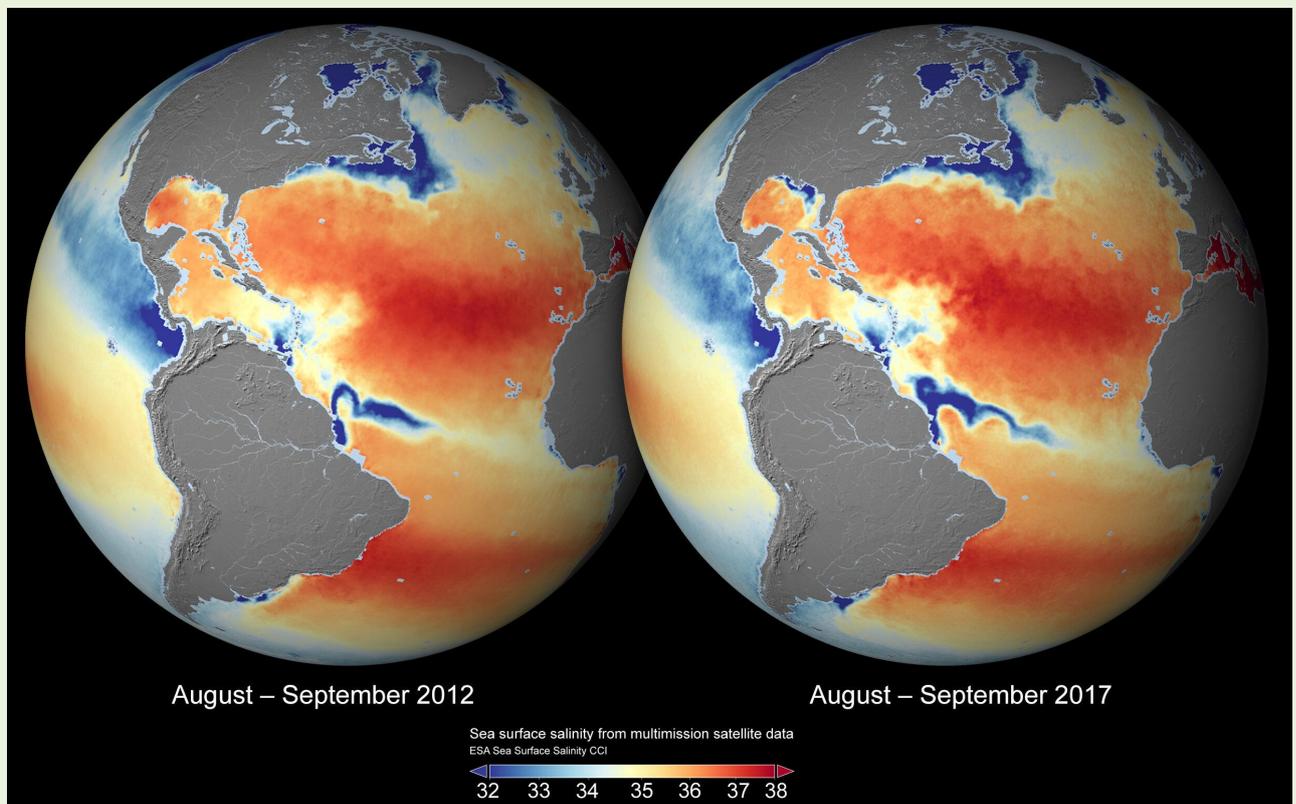
A) Soil Resources

Applications:

- ✓ Soil type classification
- ✓ Soil moisture estimation
- ✓ Salinity detection
- ✓ Erosion mapping
- ✓ Land capability assessment

Example:

Remote sensing helps identify saline soils in Gujarat for reclamation programs.

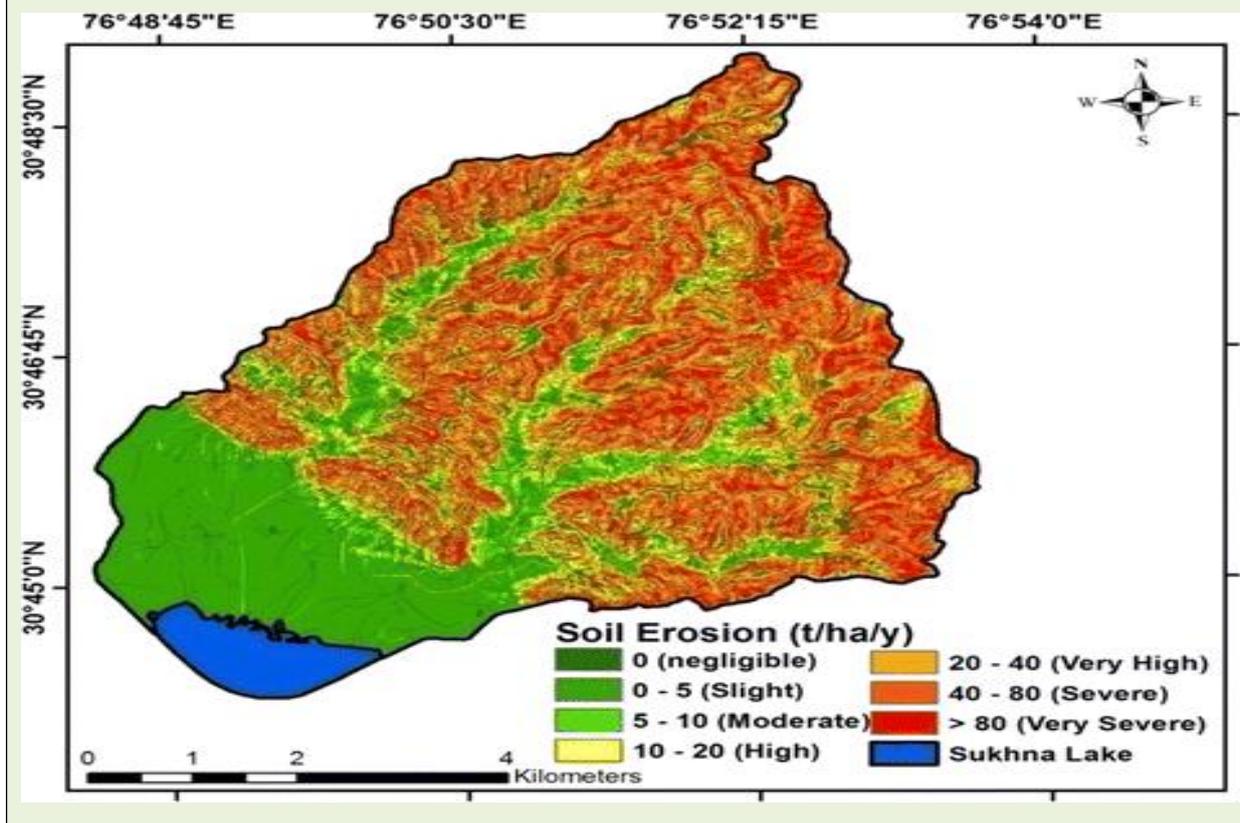
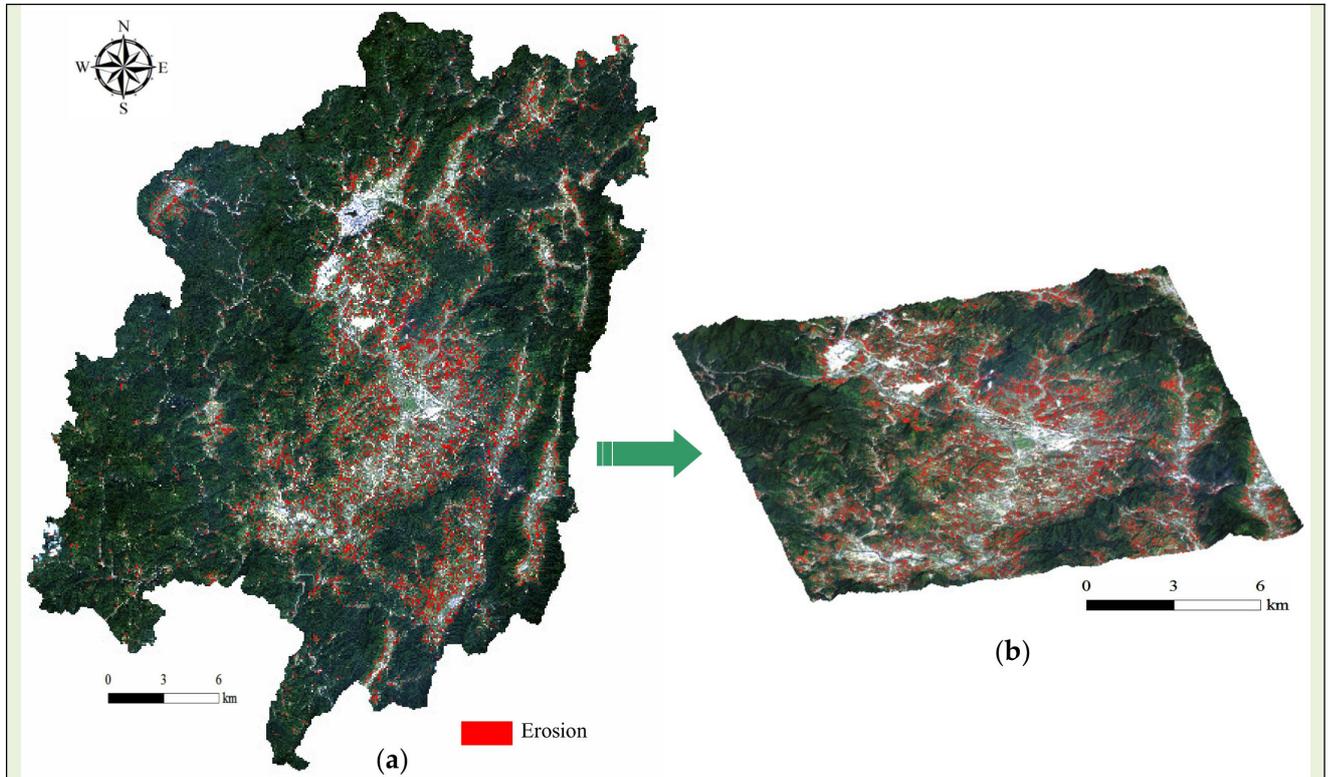




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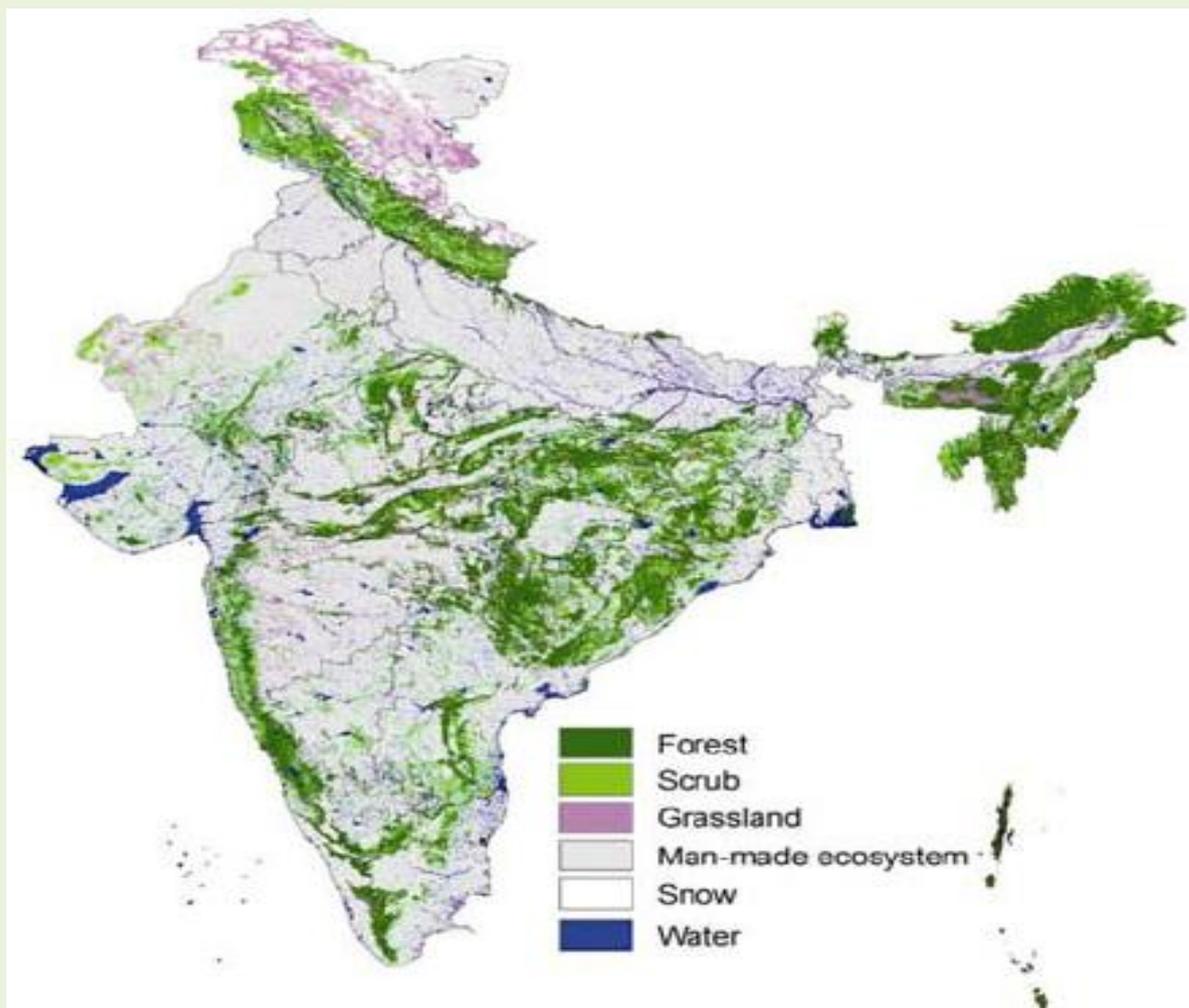
B) Forest Resources

Applications:

- ✓ Forest cover mapping
- ✓ Biomass estimation
- ✓ Forest fire monitoring
- ✓ Wildlife habitat assessment
- ✓ Deforestation detection

Example:

ISRO conducts biennial forest cover assessment using satellite data.





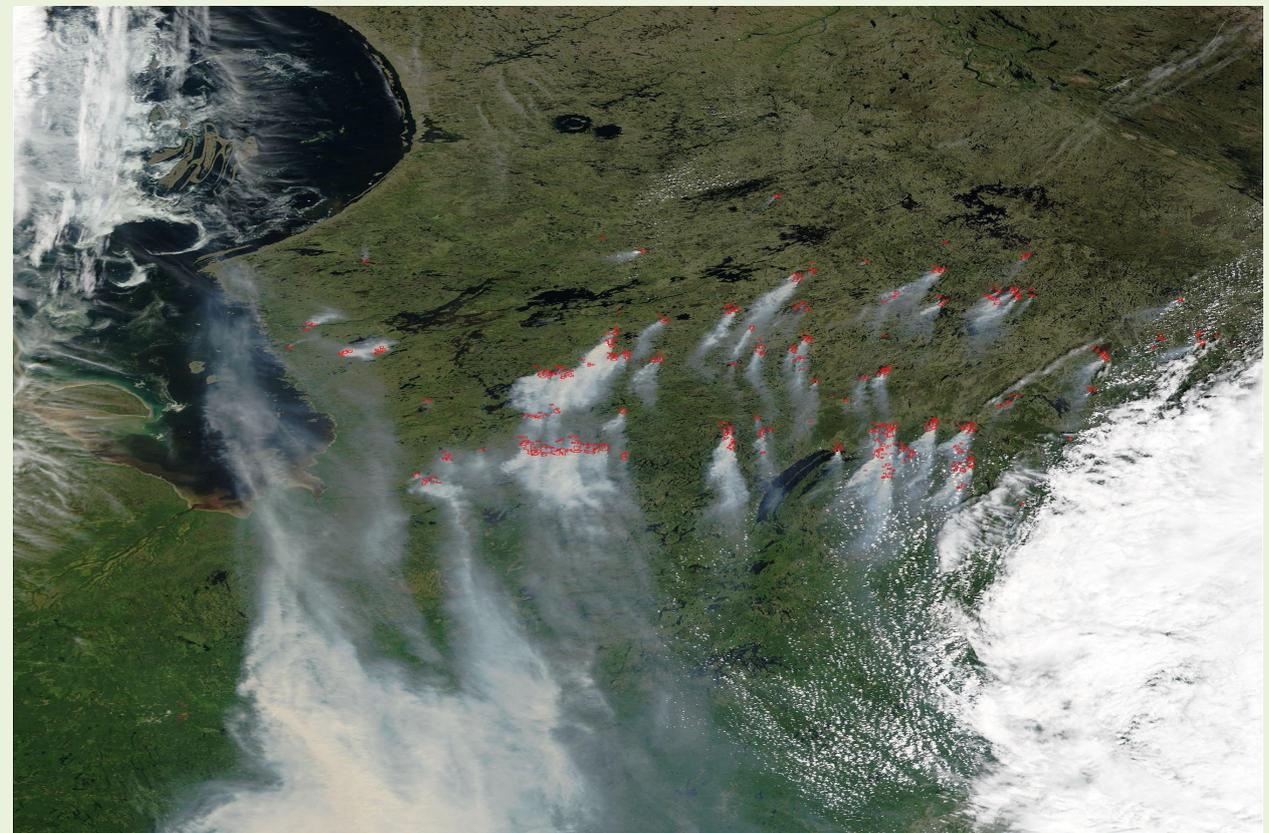
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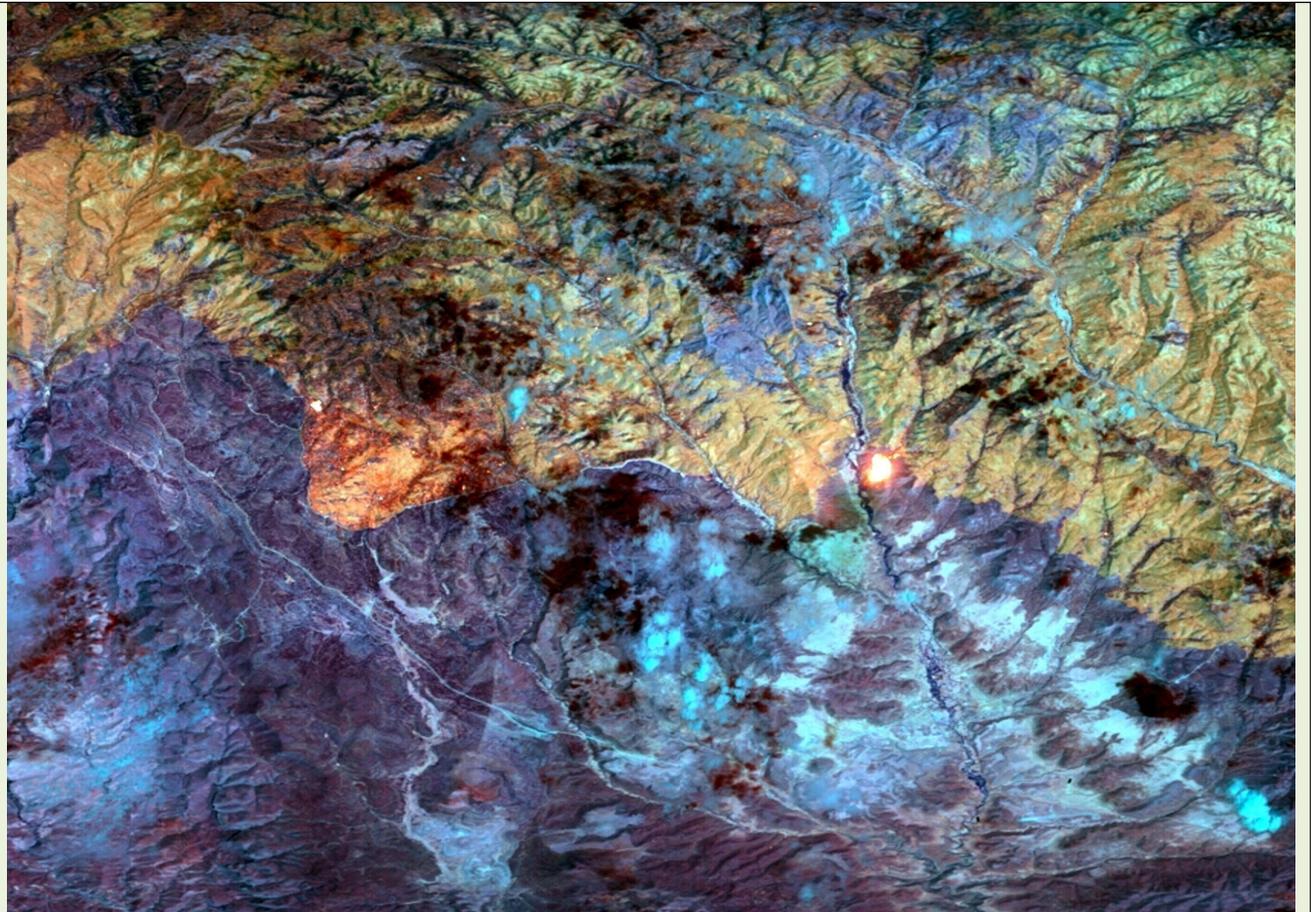
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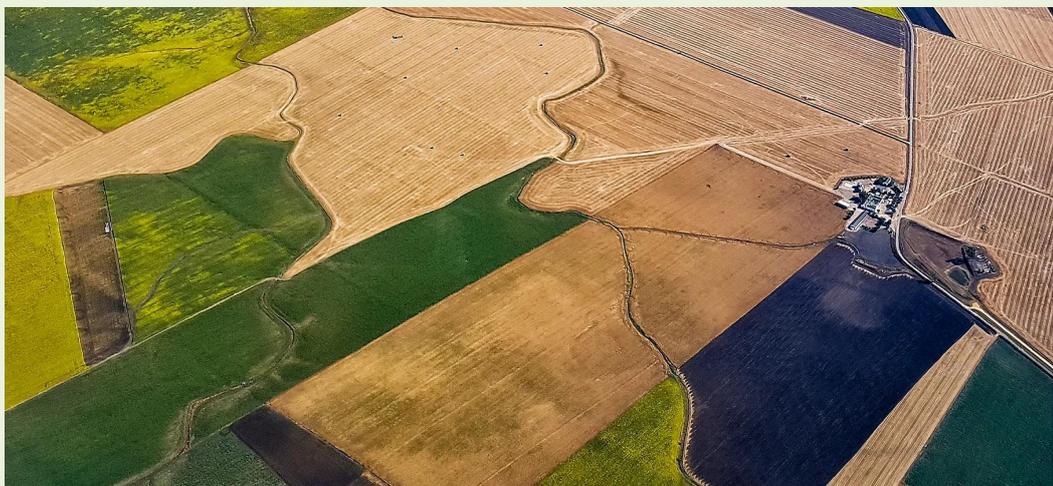
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C) Agriculture Applications





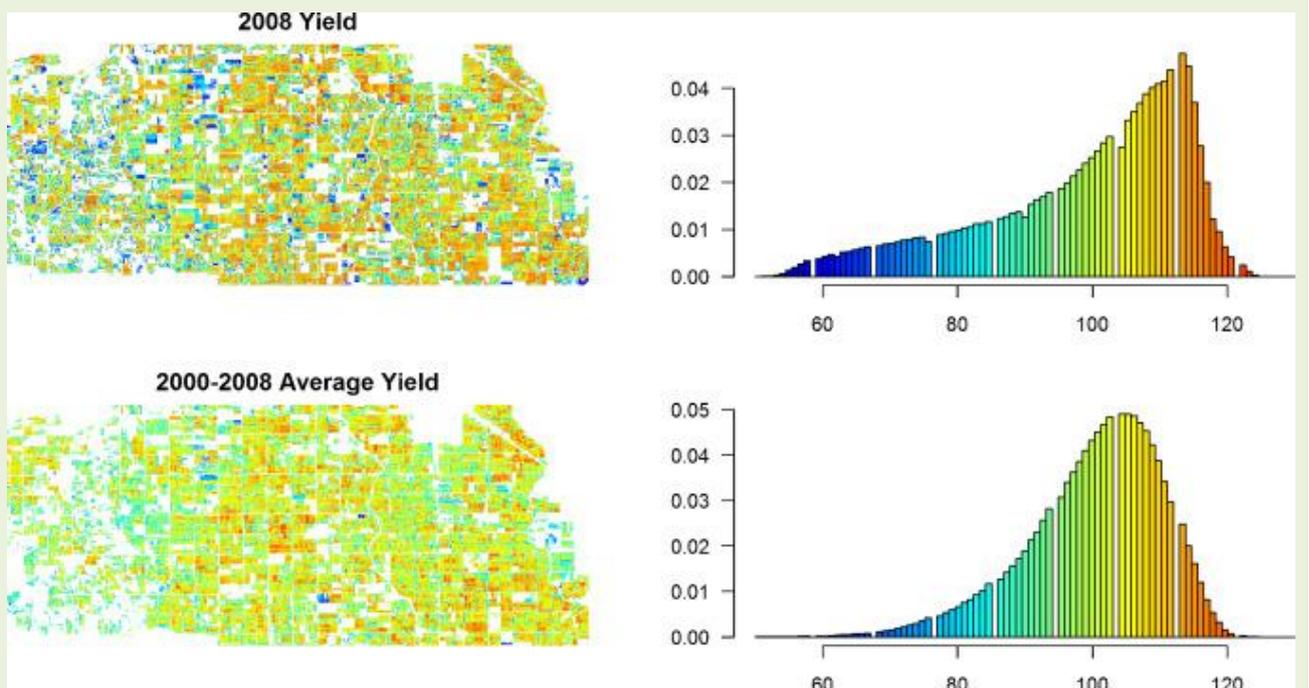
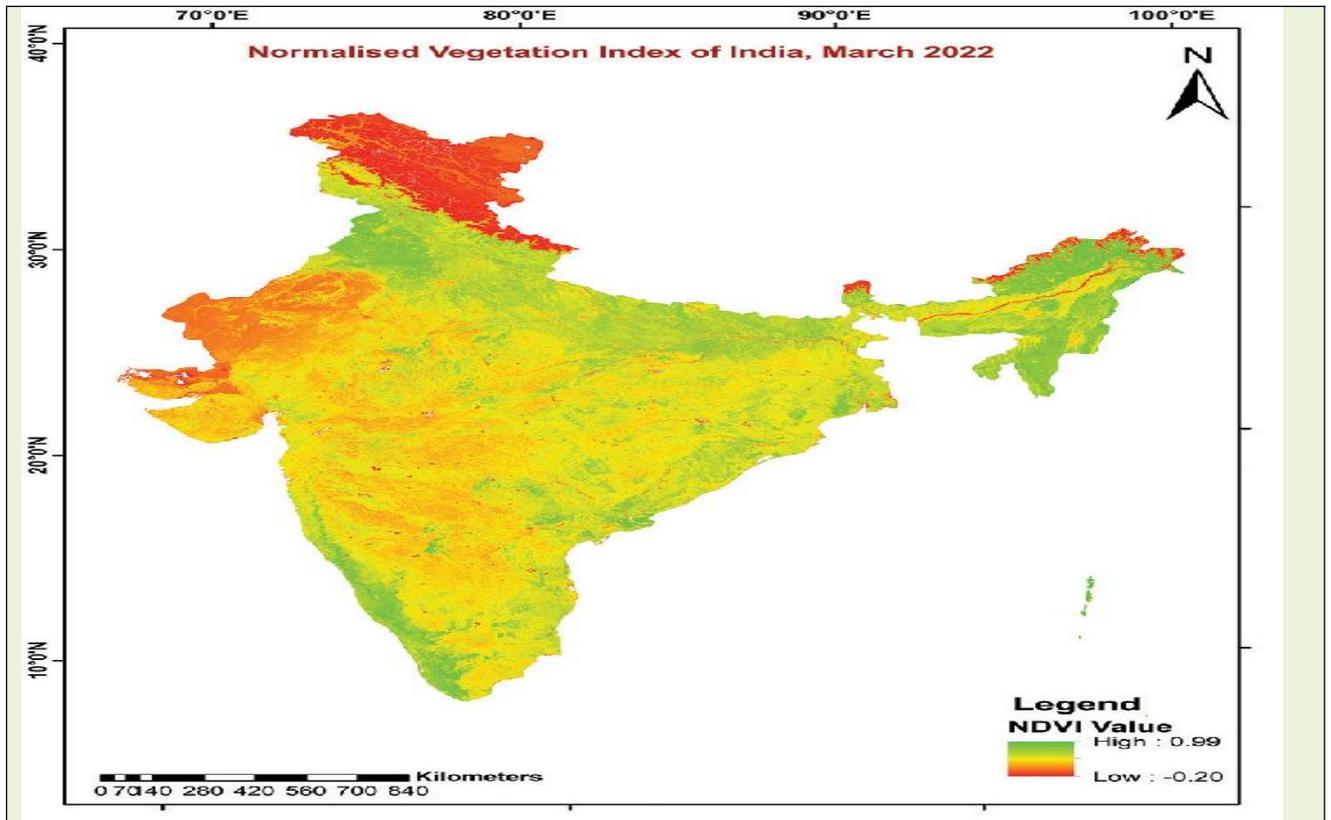
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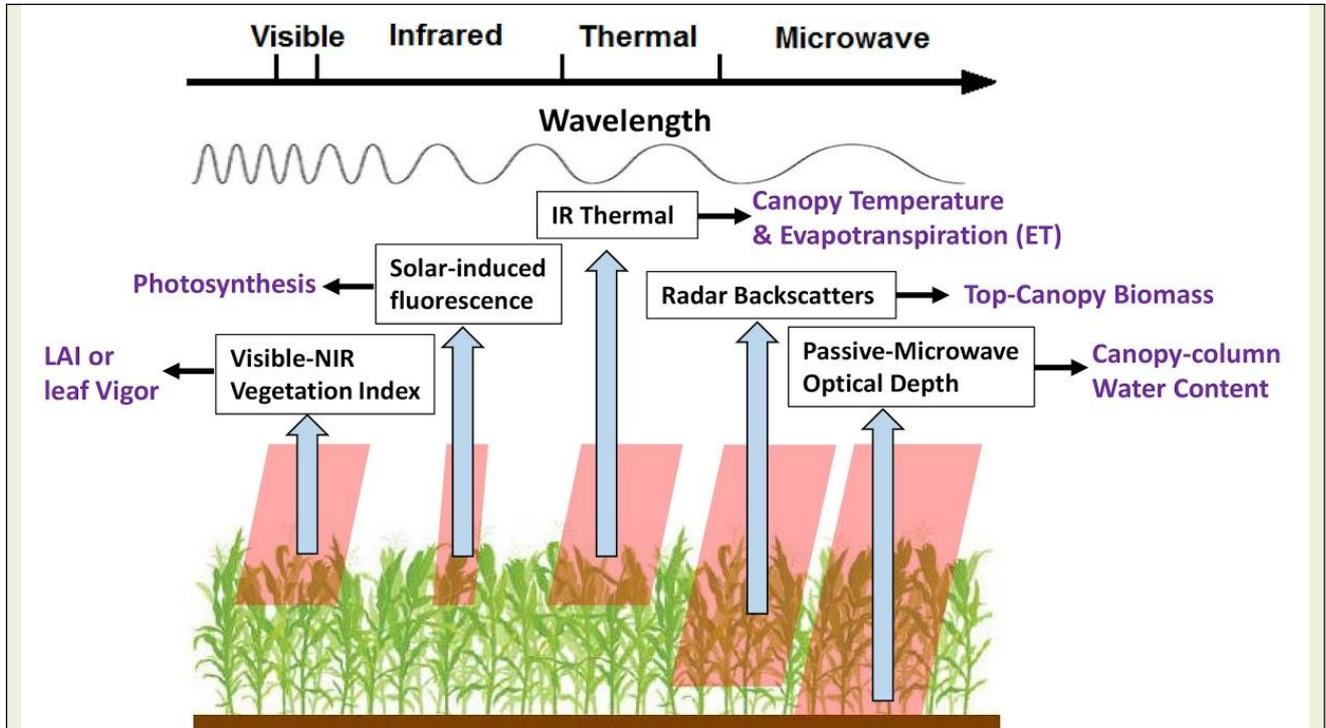
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Applications:

- ✓ Crop type identification
- ✓ Crop health monitoring
- ✓ Yield estimation
- ✓ Pest and disease detection
- ✓ Drought monitoring

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

Healthy crops → High NDVI
Unhealthy crops → Low NDVI

Example:

Punjab wheat yield prediction uses NDVI-based satellite analysis.

D Water Resource Applications

Applications:

- ✓ Surface water mapping
- ✓ Reservoir storage monitoring



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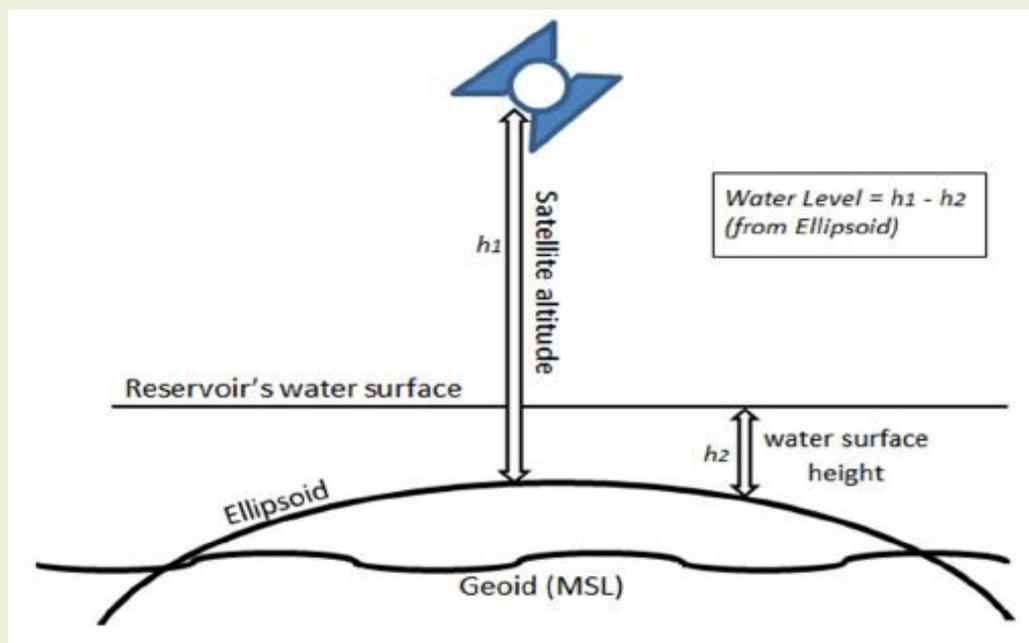
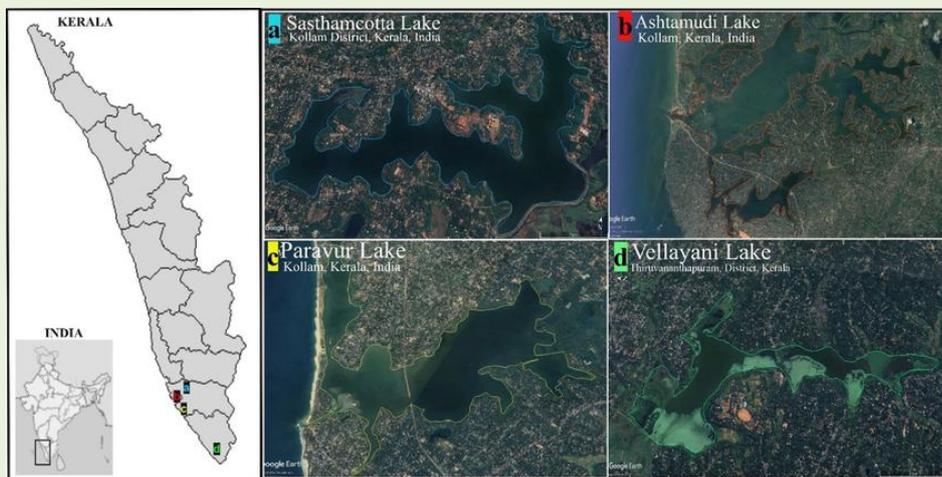
Subject and Code: Remote Sensing and GIS (20CIV473C)

- ✓ Flood mapping
- ✓ Watershed delineation
- ✓ Sedimentation studies
- ✓ Tank and lake monitoring

Example:

During **Kerala floods (2018)**, satellite images were used to map flood-affected areas.

Microwave sensors can monitor water even during cloudy conditions.

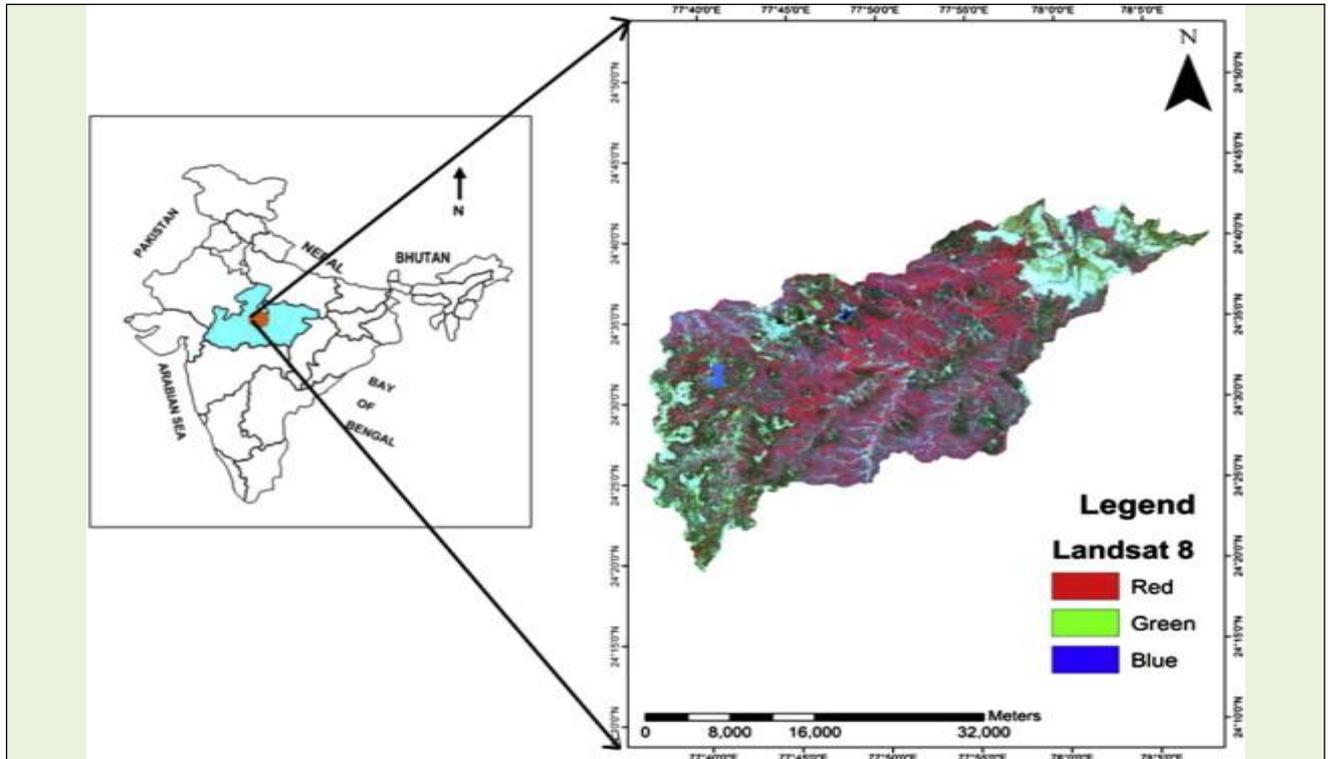




Year / Semester: **III B.Tech VI Semester**

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Environmental Applications

Applications:

- ✓ Air pollution monitoring
- ✓ Urban heat island detection
- ✓ Coastal erosion monitoring
- ✓ Glacier retreat study
- ✓ Wetland mapping
- ✓ Climate change analysis

Example:

Thermal imagery shows higher surface temperature in Delhi urban areas compared to rural areas.



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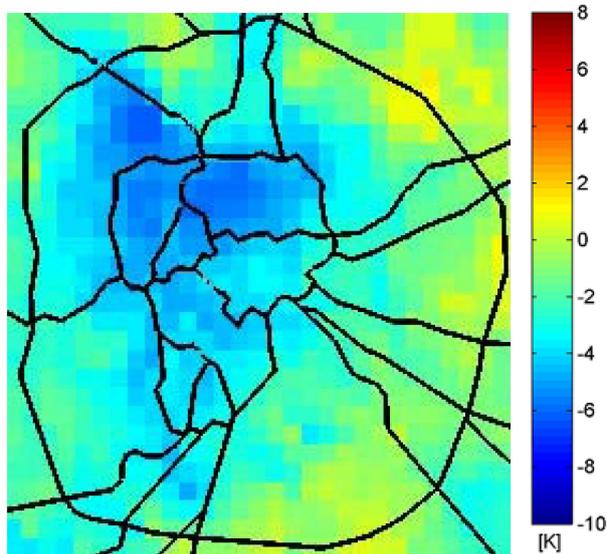
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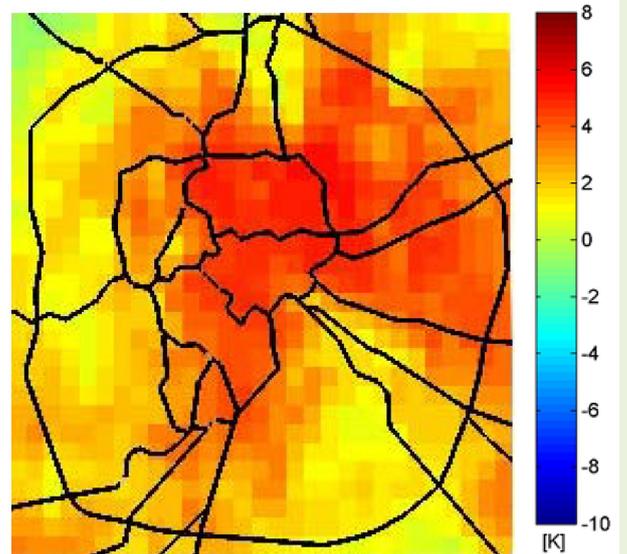
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Urban Heat Island – 20/08/2003 – Time: 09UTC



Urban Heat Island – 20/08/2003 – Time: 21UTC





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Conclusion

Remote sensing has become an essential technology for sustainable development. It provides accurate, repetitive, and large-scale information for land, water, agriculture, forestry, and environmental management. Despite limitations such as cloud interference and cost, its advantages in monitoring, planning, and decision-making make it indispensable in modern civil engineering and environmental studies.

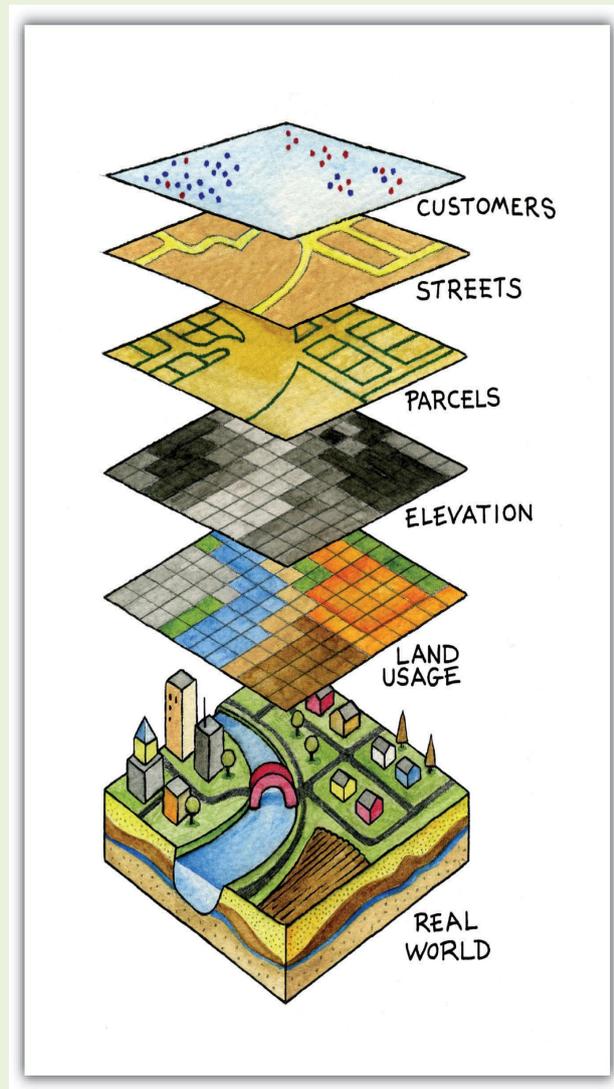
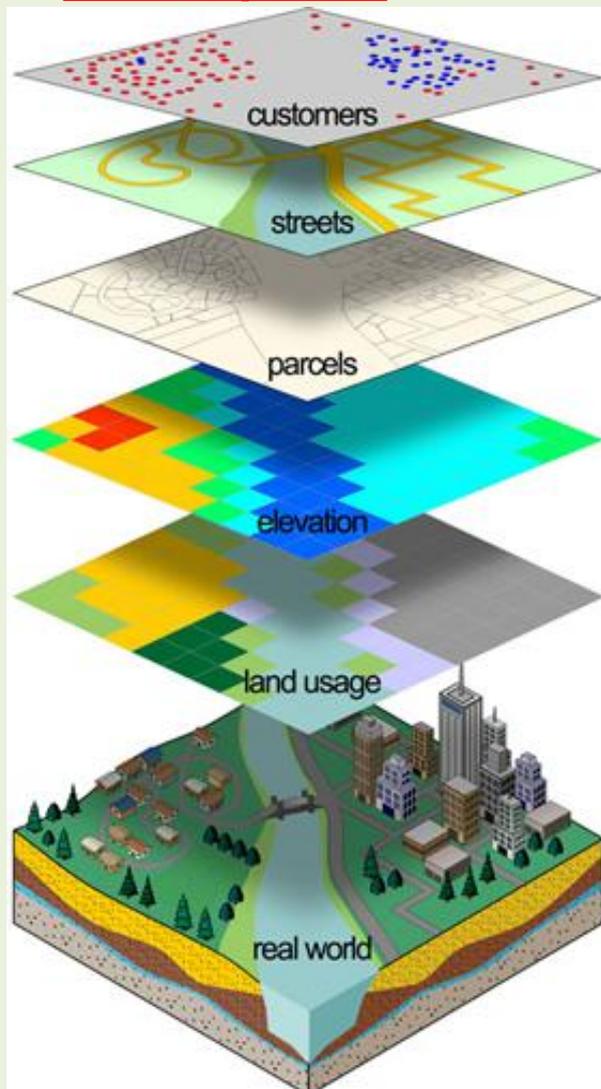


UNIT – IV: GEOGRAPHIC INFORMATION SYSTEM (GIS)

1. Introduction & Definition of GIS

A **Geographic Information System (GIS)** is a computer-based system designed to **capture, store, manage, analyze, and display geographically referenced data**. In simple words: **GIS = Spatial Data + Attribute Data + Computer System**. It helps in understanding patterns, relationships, and trends based on location.

✧ **Basic Concept of GIS**

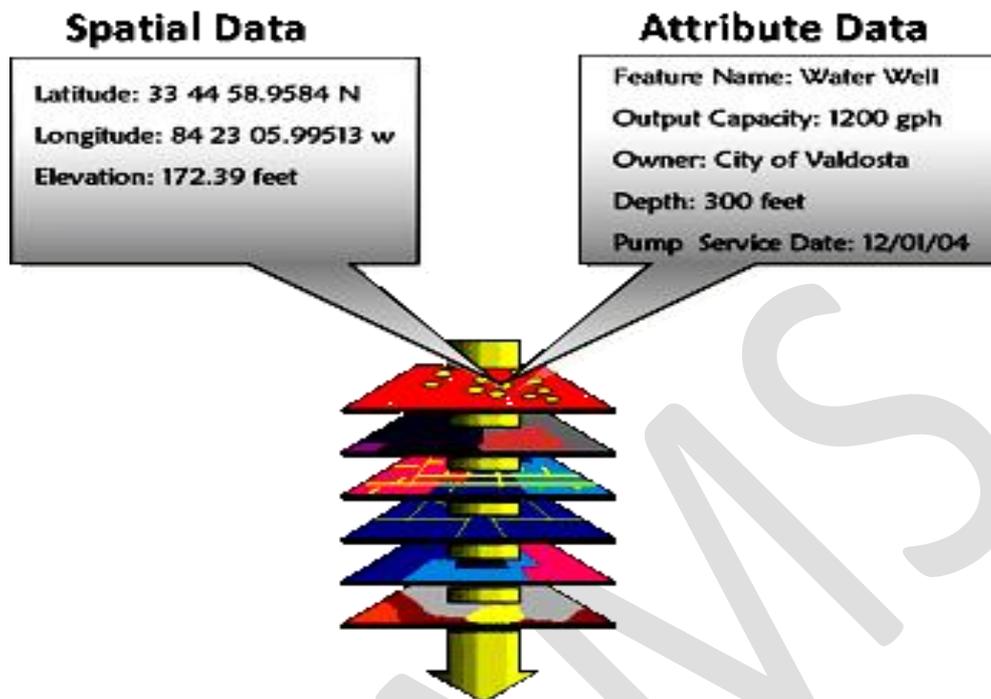




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GIS works on the concept of **layers**:

- ✓ Roads layer
- ✓ Rivers layer
- ✓ Land use layer
- ✓ Soil layer
- ✓ Population layer

Each layer contains spatial and attribute information. When layers are overlaid, powerful analysis can be performed.

2. Components of GIS

GIS has five main components:

1. Hardware:- Computers, GPS devices, Servers, Plotters & scanners
2. Software:- ArcGIS, QGIS, ERDAS, GRASS GIS
3. Data:- Spatial data (location), Attribute data (information about location)
4. People:- GIS analysts, Engineers, Planners, Decision makers

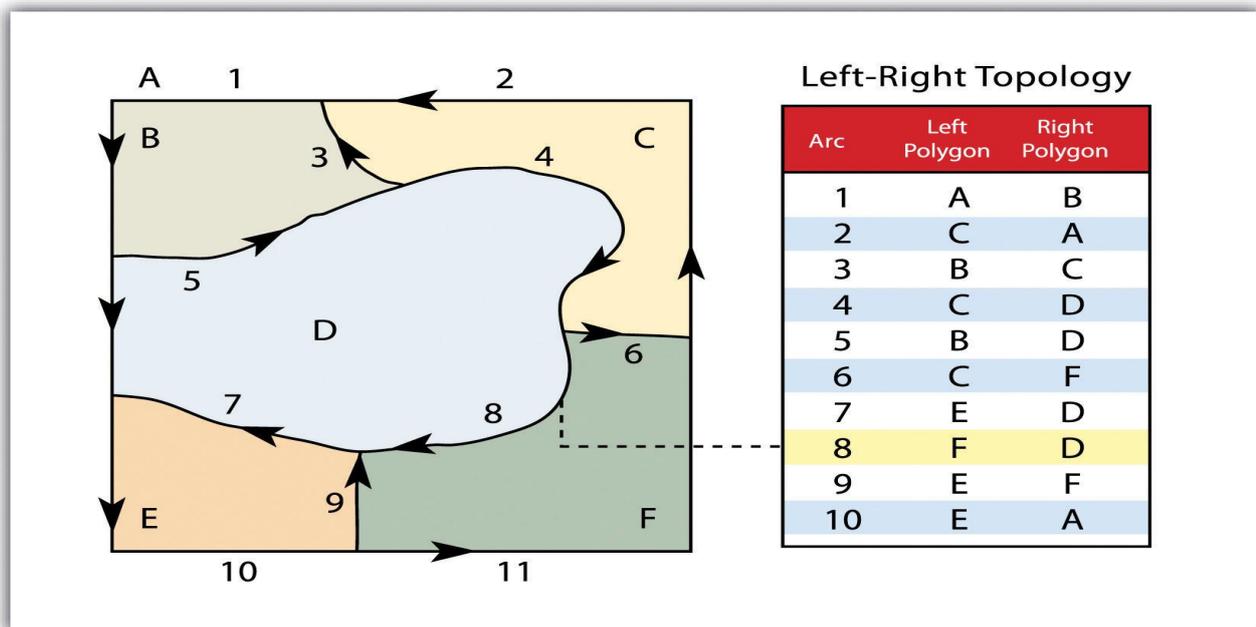
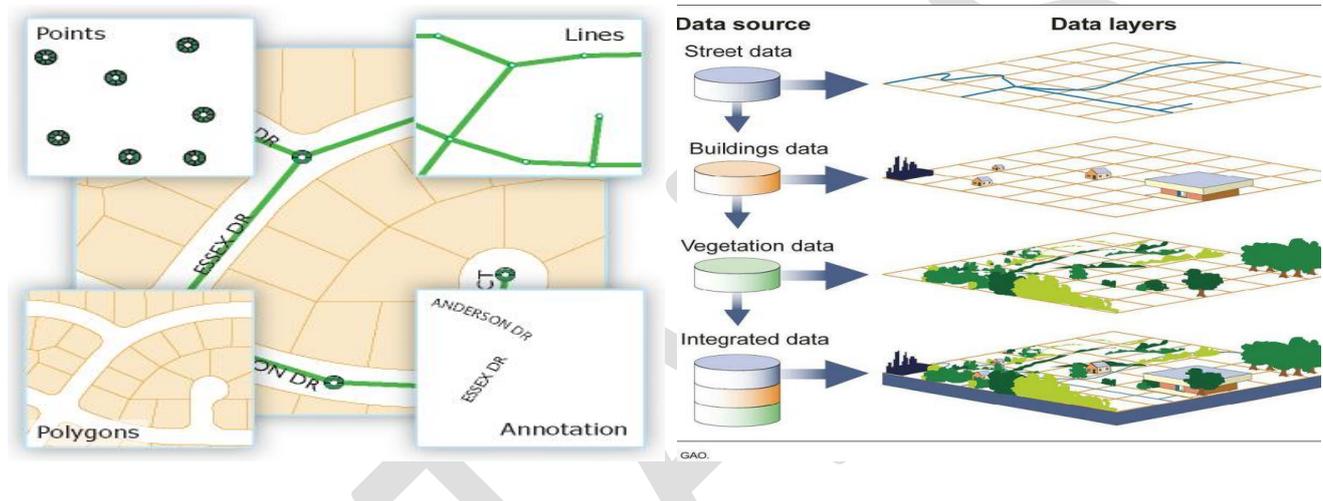


5. Methods:- Procedures, Workflows, Standard

Real Example:

In smart city projects, GIS software is used on servers to manage urban planning data.

3. Variables in GIS - Points, Lines, Polygons

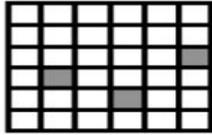
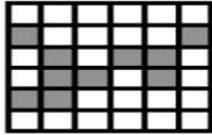
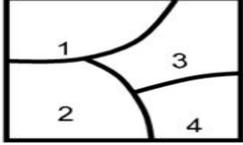
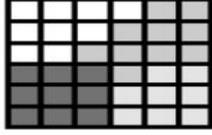




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<i>Feature Type</i>	<i>Vector Model</i>	<i>Raster Model</i>
<i>Point Feature</i>	 Building	
<i>Line Feature</i>	 Road	
<i>Area Feature</i>	 Land-use	

GIS mainly represents spatial data in **vector format**:

Point:- Represents single location

Examples: Wells, Trees, Schools, Boreholes

Line:- Represents linear features

Examples: Roads, Rivers, Pipelines, Transmission lines

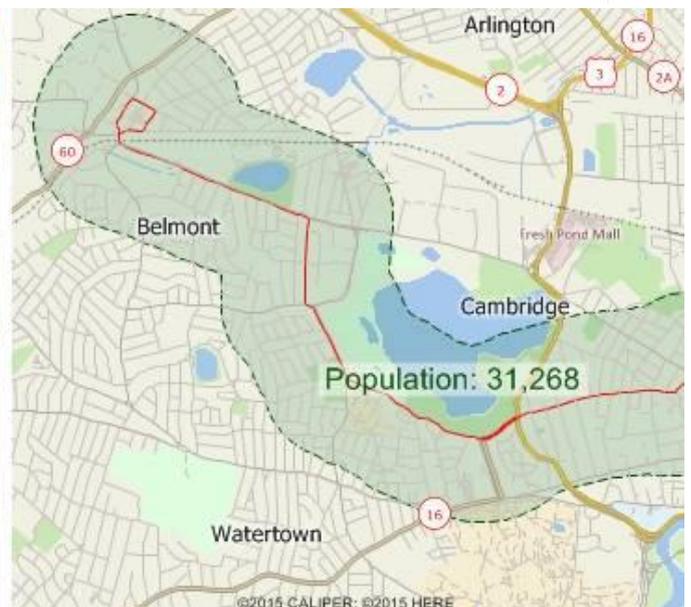
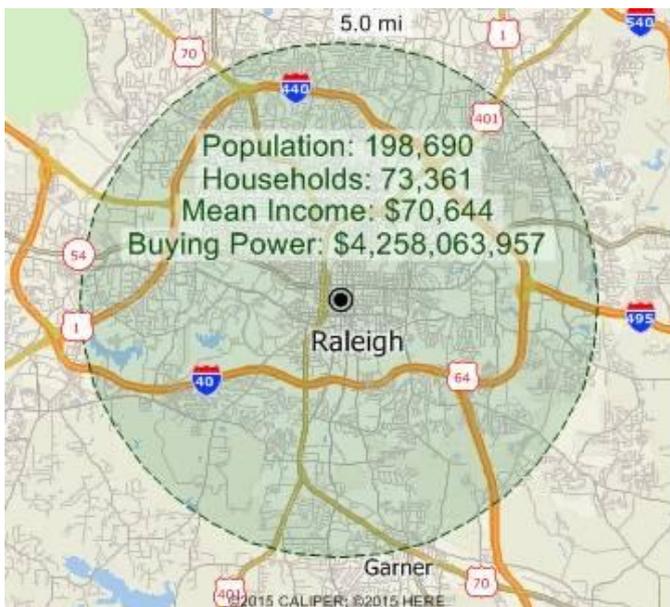
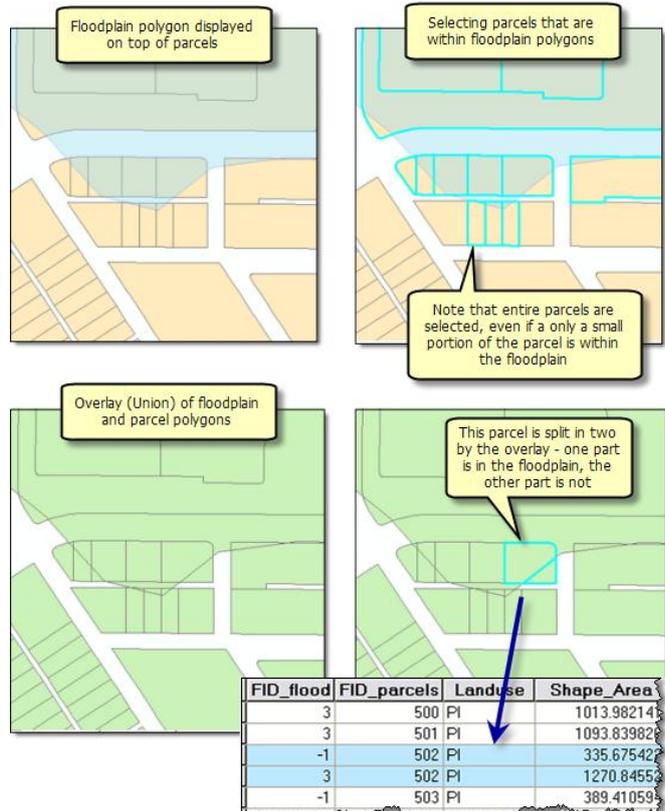
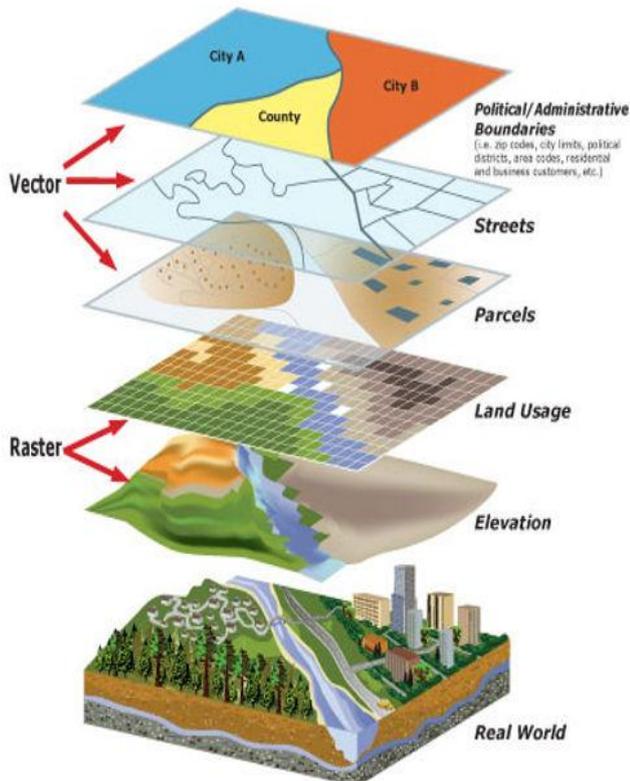
Polygon:- Represents area features

Examples: Lakes, Forest areas, Land parcels, Agricultural fields

Important Concept:- These geometries are used to build spatial databases.



4. Functionality of GIS





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GIS performs several important functions:

- 1. Data Input:- Digitizing maps,Satellite data import,GPS data collection**
- 2. Data Storage & Management:- Database creation,Spatial indexing**
- 3. Data Analysis:- Overlay analysis,Buffer analysis,Network analysis,Spatial interpolation**
- 4. Visualization:- Thematic maps,3D maps,Charts and reports**

Real-Time Example:

Google Maps uses network analysis to calculate shortest routes.

5. Areas of GIS Application

GIS is used in multiple fields:

- 1. Urban Planning:- Road design,Smart city planning,Land zoning**
- 2. Water Resource Management:- Watershed analysis,Flood mapping**
- 3. Agriculture:- Crop monitoring,Soil mapping**
- 4. Disaster Management:- Earthquake mapping,Flood risk zones**
- 5. Environmental Monitoring:- Pollution tracking,Deforestation analysis**

Real Example: Chennai flood-prone zones are identified using GIS-based flood modeling.

6. Advantages of GIS

- ✓ Handles large spatial datasets
- ✓ Quick spatial analysis
- ✓ Accurate mapping
- ✓ Better decision making
- ✓ Time-saving
- ✓ Cost-effective planning
- ✓ Integration with remote sensing



7. Limitations of GIS

- ✓ High initial cost
- ✓ Requires trained personnel
- ✓ Data accuracy dependency
- ✓ Complex data handling
- ✓ Software compatibility issues

8. Integration of GIS and Remote Sensing

Remote sensing provides satellite imagery.
GIS analyzes and manages that imagery.

Together they support:- Land use mapping, Resource evaluation, Urban growth monitoring, Disaster management

9. Conclusion

GIS is a powerful spatial decision-support system that integrates hardware, software, data, people, and methods to analyze geographically referenced information.

It plays a critical role in civil engineering, environmental management, urban planning, agriculture, and disaster mitigation.

Despite some limitations, GIS has become an essential tool in modern geospatial technology.



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Unit V: (GIS DATA)

SITAMS



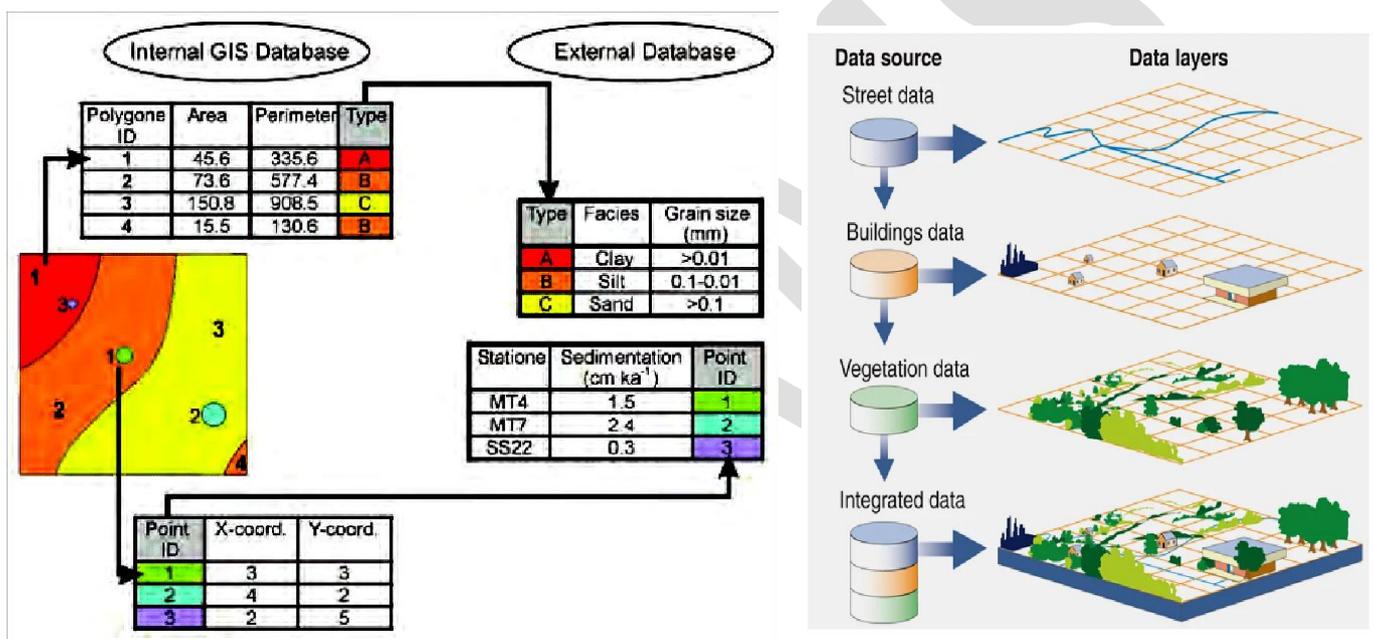
1. Introduction to GIS Data

GIS data forms the foundation of any Geographic Information System. Without proper data organization, storage, and management, GIS analysis cannot be performed effectively.

GIS data mainly consists of:- **Spatial Data (Location), Attribute Data (Description of location)**

Both types together form meaningful geographic information.

2. Spatial and Attribute Data



Spatial Data

- ✓ Spatial data represents the geographic location and shape of features.
- ✓ Examples:- Location of schools, River boundaries, Road networks, Lake areas
- ✓ Spatial data includes:- Coordinates (Latitude, Longitude), Geometry (Point, Line, Polygon)

Attribute Data

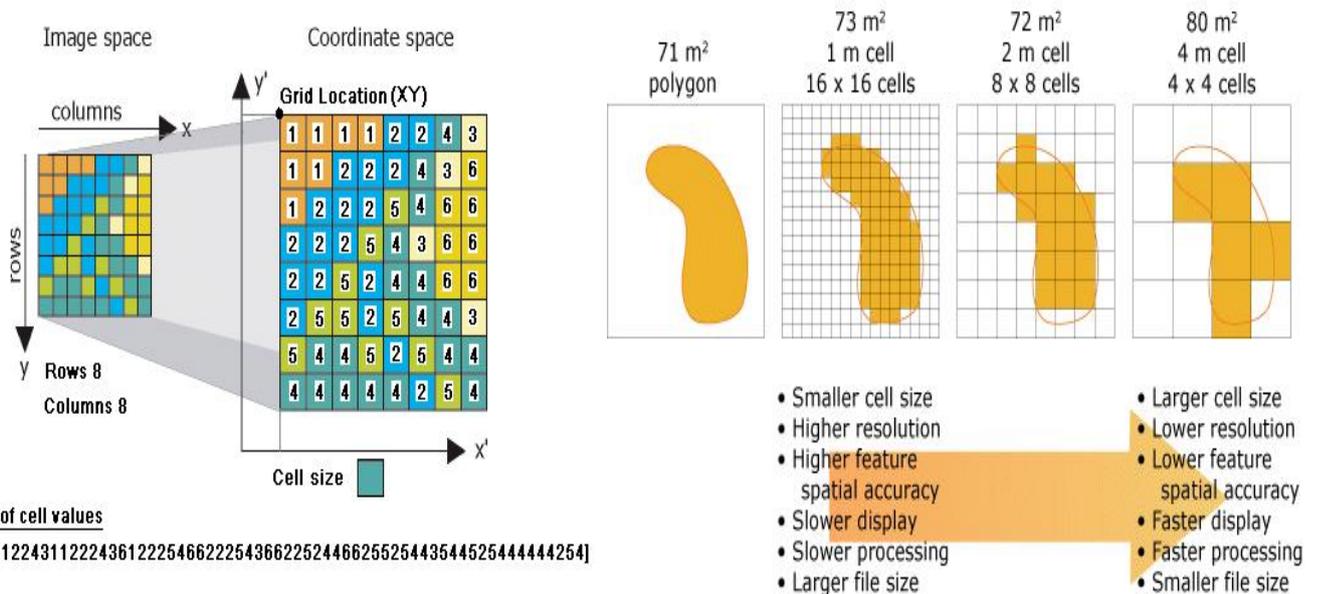
- ✓ Attribute data describes the characteristics of spatial features.



Example: For a school point:- Name, Number of students, Address, Type (Government/Private)
Real-Time Example:- In municipal GIS systems, road maps (spatial data) are linked with road width, surface type, and traffic data (attribute data).

3. Information Organization & Data Structures

✓ GIS organizes data mainly in two structures:- Raster Data Structure, Vector Data Structure



Raster data consists of a grid of cells (pixels).

Each pixel has:- Row and column location, A value (elevation, temperature, NDVI)

Characteristics:- Good for continuous data, Used in satellite imagery, Suitable for elevation, rainfall, temperature maps

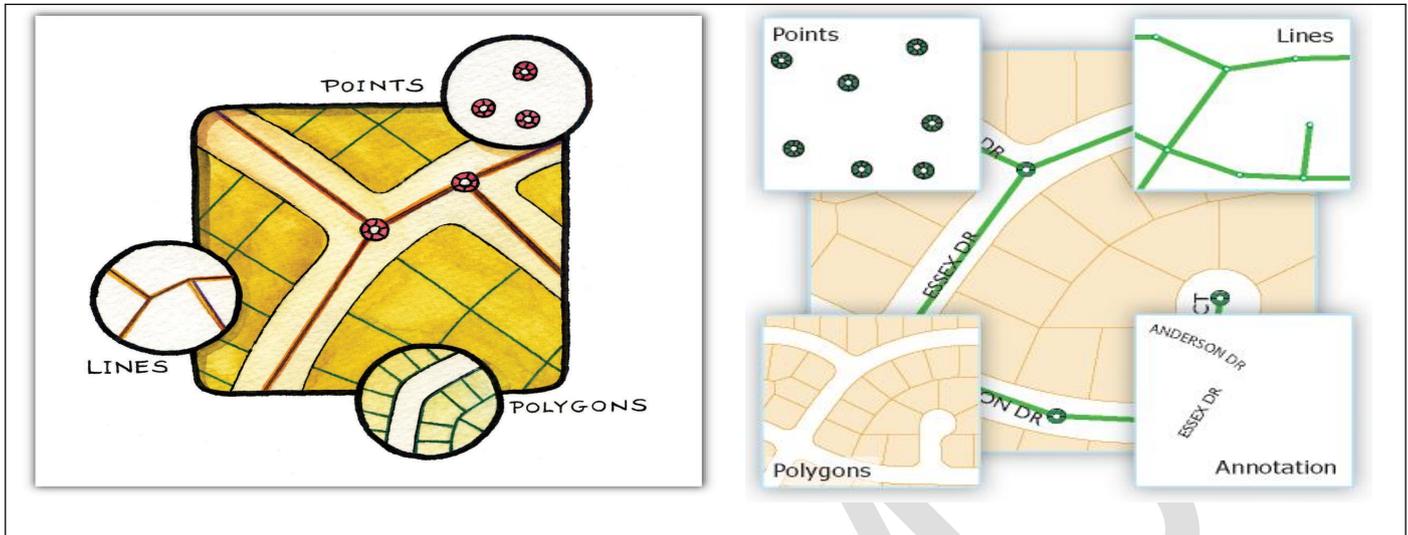
Example:- Digital Elevation Model (DEM) used for watershed analysis.

Vector Data Structure

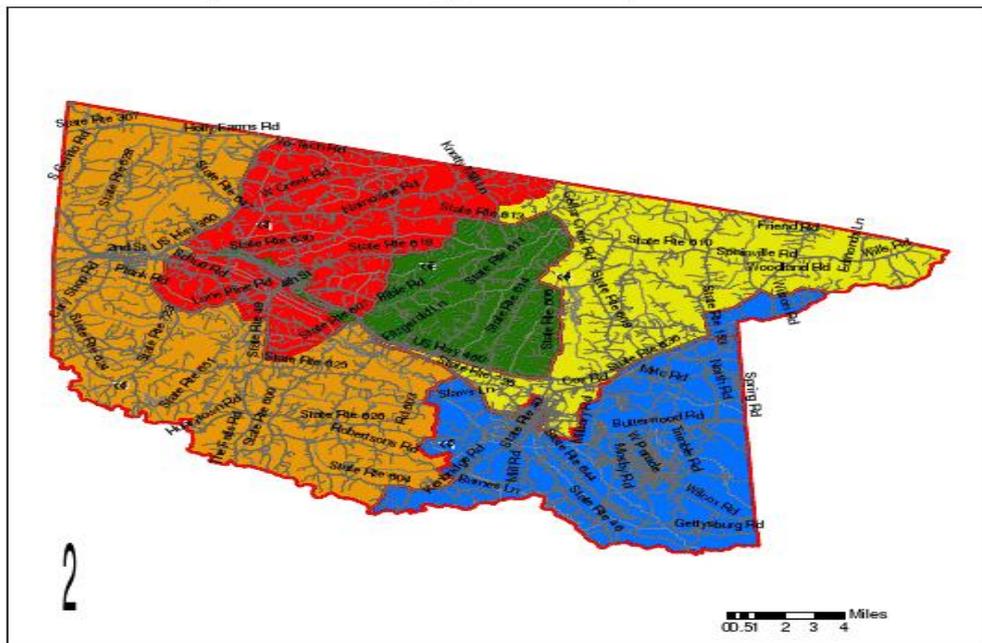
Vector data represents features as:- Points, Lines, Polygons

Characteristics:- High precision, Efficient storage, Suitable for discrete features

Example:- City road network stored as line features.



Nottoway Redistricting Plan - Option 4



Legend

- District 1
- District 2
- District 3
- District 4
- District 5

Created By: Redistricting Committee

Date: March 4, 2011

4. Data File and Database

GIS stores data in files and databases.

Common file formats:- Shapefile (.shp), GeoJSON, KML, TIFF (raster), Geodatabase (.gdb)

Database systems used:- SQL databases, PostgreSQL/PostGIS, Oracle Spatial

Real-Time Example:- Smart city GIS databases store property records in geodatabases linked with parcel polygons.



5. Creating GIS Data

Creating GIS data involves several steps:

GIS Software Used

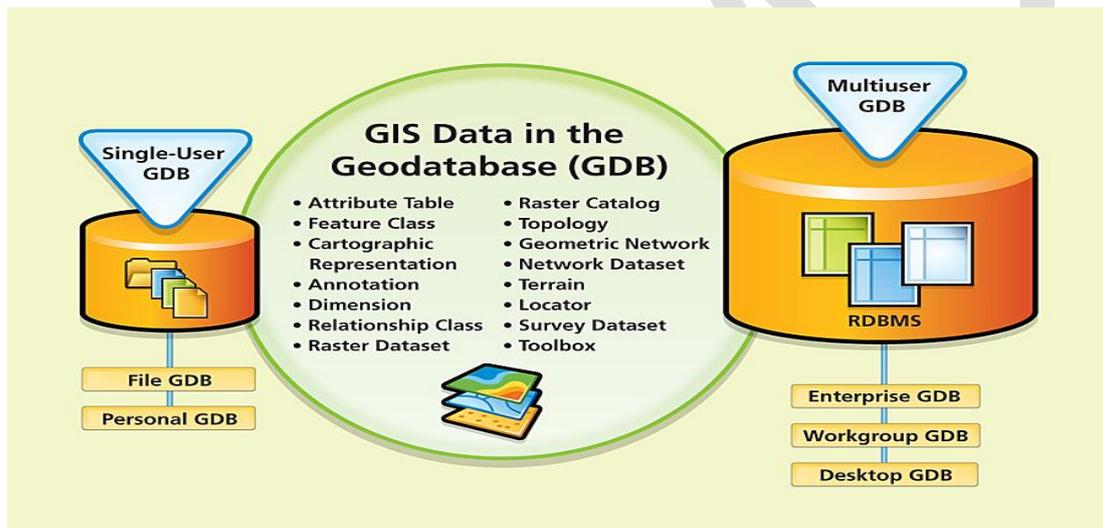
Popular GIS software:- ArcGIS, QGIS, GRASS GIS, ERDAS Imagine

These tools allow:- Map creation, Digitization, Analysis, Database management

File Organization and Formats

GIS data must be properly organized into:- Feature datasets, Feature classes, Raster datasets, Tables
Proper folder structure ensures easy data management.

Geo-database



A Geodatabase is a collection of geographic datasets stored in a database system.

Types:- Personal geodatabase, File geodatabase, Enterprise geodatabase

Benefits:- Data integrity, Efficient storage, Relationship management

Database Models:- GIS uses:- Hierarchical model, Network model, Relational model (most common),
Relational model links tables using keys.Example:Parcel ID links land map with owner information table.

6.Rectification:- Rectification is the process of correcting distorted images.It involves:- Assigning real-world coordinates, Using Ground Control Points (GCPs), Removing geometric distortion

Example:-Scanned topographic map aligned to WGS84 coordinate system.

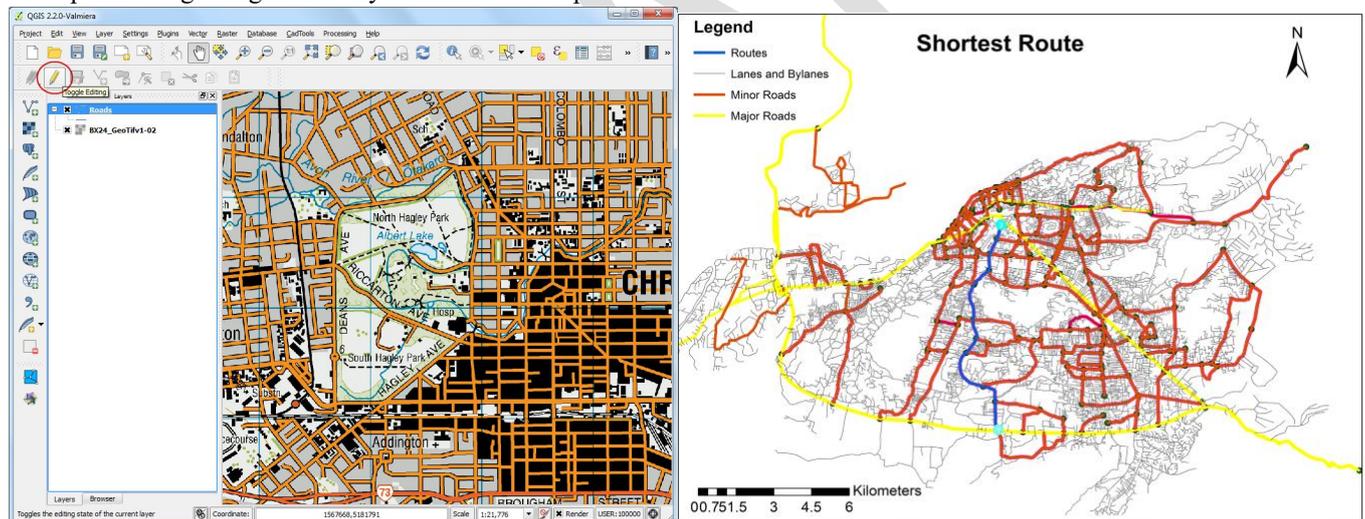


7. Digitization

Digitization converts paper maps or raster images into vector data.

Types:- Manual digitization, On-screen digitization, Automatic vectorization

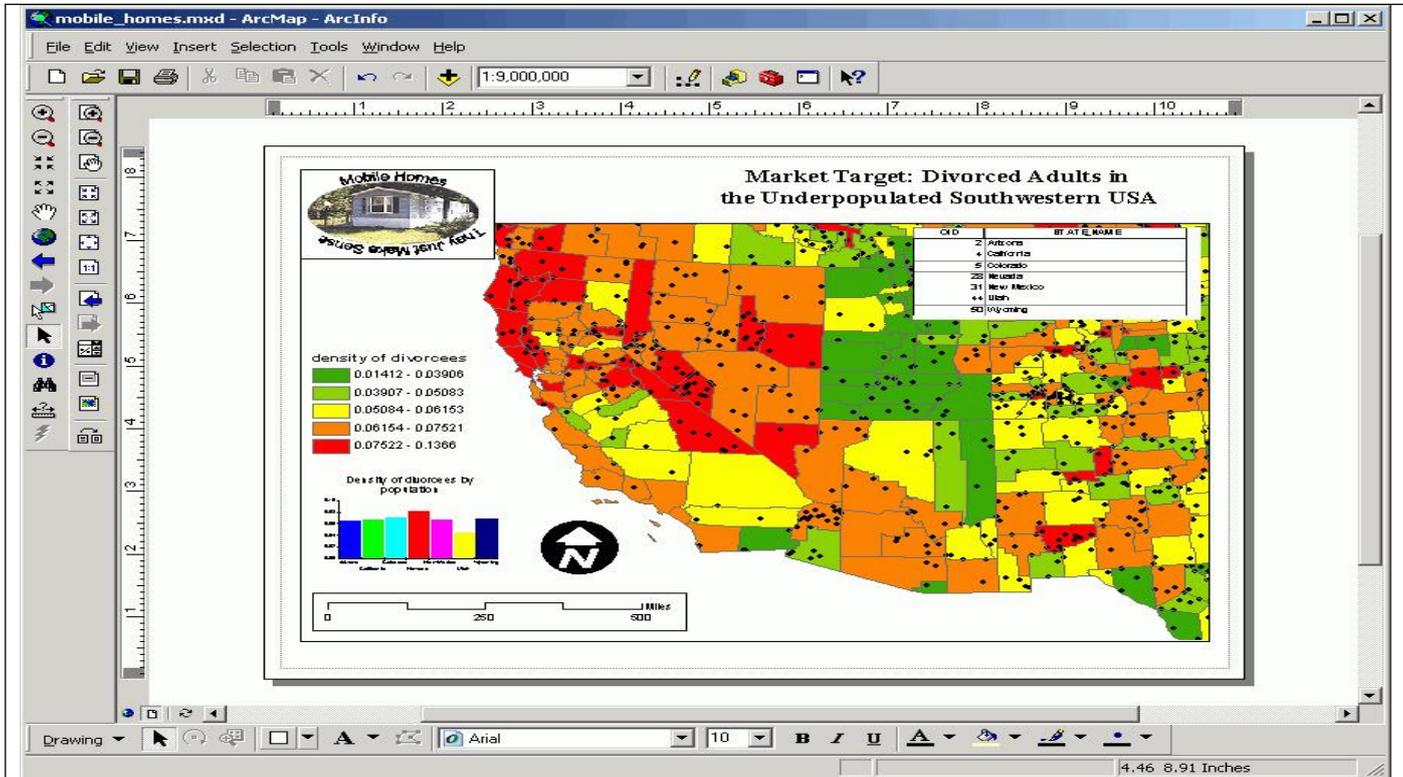
Example: Tracing village boundary from scanned map.



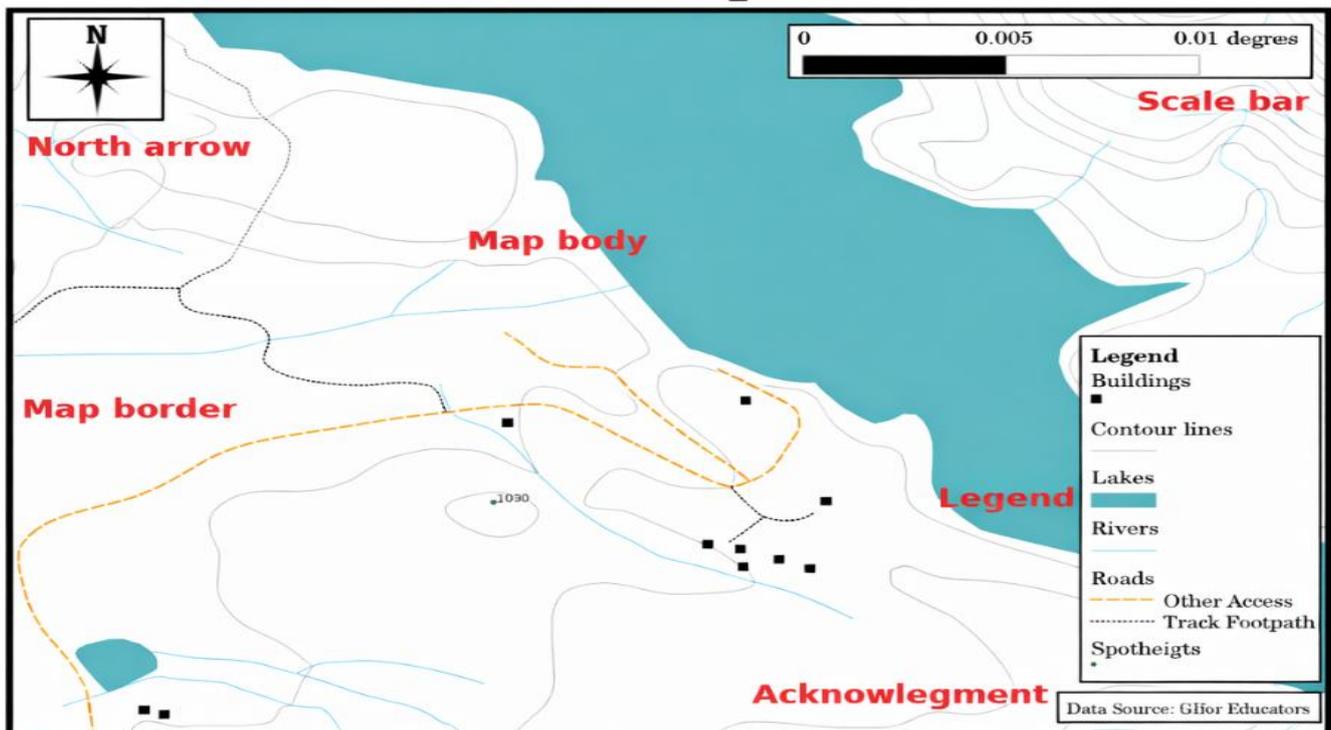
8. Map Composition

Map composition involves designing final output maps. Essential elements: Title, Legend, Scale, North arrow, Coordinate grid

Example: Flood hazard map prepared with legend and scale for district planning.



Title Common map elements





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9. Real-Time Integrated Example

Consider Chennai Flood Mapping:

- ✓ Satellite raster data collected
- ✓ Roads digitized as vector layers
- ✓ Attribute data added (road width, traffic)
- ✓ Flood zones mapped using DEM
- ✓ Final layout prepared for disaster management

This shows full GIS data workflow.

Conclusion

GIS data includes spatial and attribute information organized in raster and vector structures. Through geodatabases, digitization, rectification, and proper file management, GIS enables accurate spatial analysis and decision-making.

Modern urban planning, agriculture monitoring, flood mapping, and smart city systems depend heavily on well-organized GIS data.