

Introduction to Remote Sensing

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Key concepts, components, and applications

1. What Is Remote Sensing?

- Definition:** The acquisition of information about an object or area from a distance, typically using aircraft or satellites equipped with sensors.
- Core Idea:** Detect and record electromagnetic energy (or other types of energy) reflected, emitted, or scattered by the Earth’s surface and atmosphere without physical contact.

2. Basic Principles

Principle	Description
Energy Source (Illumination)	Sunlight (most common) or artificial sources (radar, lidar).
Interaction with the Target	Energy is reflected , absorbed , transmitted , or scattered depending on surface properties (e.g., moisture, texture, material).
Recording the Signal	Sensors convert the incoming energy into electronic signals (digital numbers).
Data Transmission & Storage	Signals are transmitted to ground stations, then archived for processing.
Interpretation	Processed data are analyzed to extract physical, chemical, or biological information.

3. Types of Remote Sensing Systems

Category	Sub?type	Typical Platform	Main Characteristics
Passive	Optical (visible, near?infrared, short?wave infrared)	Satellites (Landsat, Sentinel?2), aircraft	Requires external illumination (sunlight).
	Thermal Infrared	Satellites (MODIS, ASTER)	Detects emitted heat; useful for temperature and moisture studies.

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Category	Sub?type	Typical Platform	Main Characteristics
Active	Radar (microwave)	Satellites (Sentinel?1, RADARSAT)	Emits its own microwave pulse; works day/night & through clouds.
	Lidar (laser)	Aircraft, UAVs, spaceborne (ICESat?2)	Measures distance by timing laser returns; high?resolution elevation data.

4. Sensor Characteristics

Attribute	Explanation
Spatial Resolution	Size of the smallest object that can be resolved (e.g., 10?m, 30?m, 1?km).
Spectral Resolution	Number and width of wavelength bands captured (multispectral vs. hyperspectral).
Radiometric Resolution	Number of digital values per pixel (e.g., 8?bit = 256 levels, 12?bit = 4096 levels).
Temporal Resolution (Revisit Time)	Frequency with which a sensor observes the same location (daily, weekly, monthly).
Swath Width	Width of the ground area captured in a single pass.

5. Data Acquisition Process

1. **Mission Planning** – Define objectives, select sensor, schedule observations.
 2. **Sensor Calibration** – Convert raw digital numbers to physical units (radiance, reflectance).
 3. **Image Capture** – Sensor records energy as digital images or point clouds.
 4. **Georeferencing & Orthorectification** – Align data to a map coordinate system, correct terrain distortions.
 5. **Pre?processing** – Radiometric correction, atmospheric correction, noise removal.
 6. **Data Storage** – Formats: GeoTIFF, HDF, NetCDF, ENVI, etc.
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6. Data Processing Levels

Level	Description
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Level 0 Raw, unprocessed sensor output (binary).

Level 1 Radiometrically corrected; still sensor-specific geometry.