

Introduction to Remote Sensing

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Key concepts, components, and applications

1. What Is Remote Sensing?

- Definition** – Acquisition of information about an object or area from a distance, typically using sensors mounted on aircraft or satellites.
- Core Idea** – Detect and record electromagnetic energy (or other signals) reflected, emitted, or scattered by the Earth's surface and atmosphere.

2. Electromagnetic Spectrum (EMS) Basics

Region	Wavelength (nm)	Typical Uses in Remote Sensing
Ultraviolet (UV)	10–400	Atmospheric ozone monitoring, water quality
Visible (VIS)	400–700	True-color imagery, vegetation health
Near-Infrared (NIR)	700–1300	Plant vigor, water content
Short-Wave Infrared (SWIR)	1300–3000	Soil mineralogy, fire detection
Thermal Infrared (TIR)	3–14 μm	Surface temperature, heat flux
Microwave (Microwaves & Radar)	1 mm–1 m	Soil moisture, cloud-penetrating imaging

- Energy interaction types** – Reflection, absorption, emission, and scattering.

3. Types of Remote Sensing Systems

Category	Platform	Sensor	Data Characteristics
Passive	Satellites (e.g., Landsat, Sentinel-2), aircraft	Optical radiometers, spectrometers	Record natural energy (sunlight, thermal emission).

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Active	Satellites (e.g., Sentinel-1), aircraft, drones	Radar (SAR), LiDAR, sonar	Emit own signal; work day/night & through clouds.
Spaceborne	Orbiting satellites	Wide swath, repeat coverage	Global monitoring, long-term datasets.
Airborne	Planes, balloons, UAVs	High spatial resolution, flexible timing	Targeted studies, validation of satellite data.

4. Sensor Characteristics

Parameter	What It Describes	Why It Matters
Spatial Resolution	Size of ground pixel (e.g., 10m, 30m)	Determines detail that can be discerned.
Spectral Resolution	Number & width of wavelength bands	Influences ability to differentiate materials.
Radiometric Resolution	Number of digital levels (e.g., 8-bit = 256 levels)	Affects detection of subtle differences in energy.
Temporal Resolution (Revisit Time)	Frequency of observations over same area	Critical for monitoring change (e.g., crop growth).
Swath Width	Width of ground area captured in a single pass	Impacts coverage speed and data volume.

5. Data Acquisition Process

1. **Planning** – Select platform, sensor, acquisition date, and area of interest.
 2. **Sensor Capture** – Energy is sensed and converted to digital numbers (DN).
 3. **Transmission** – Data downlinked to ground stations.
 4. **Preprocessing** – Radiometric correction, geometric correction, and (if needed) atmospheric correction.
 5. **Archiving & Distribution** – Data stored in repositories (e.g., USGS EarthExplorer, Copernicus Open Access Hub).
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6. Image Processing Workflow

1. Radiometric Calibration – Convert DN ?