



Remote Sensing of the Environment

Main text book:

Jensen, J.R., 2007, Remote Sensing of the Environment: an Earth resource perspective, 2nd ed., Prentice Hall, 592p

*Most citations come from the main text book except the ones with specific references



Remote Sensing of the Environment

Remote Sensing Data Collection

- Information collection about an object or geographic area from a distant vantage point.
- This remote data collection was originally performed using aerial cameras.
- Photogrammetry
 - “the art or science of obtaining reliable measurement by means of photography” (American Society of Photogrammetry, 1944; 1952; 1966)
- Photogrammetric interpretation
 - “the act of examining photographic images for the purpose of identifying objects and judging their significance” (Colwell, 1960)



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Remote Sensing Data Collection

- Remote Sensing was defined by American Society for Photogrammetry and Remote Sensing (ASPRS)
 - ASPRS Definition: “the measurement or acquisition of information of some property of an object or phenomenon, by a recording device that is not in physical or intimate contact with the object or phenomenon under study” (Colwell, 1983)
 - ASPRS Combined Definition of photogrammetry and remote sensing (1988): “photogrammetry and remote sensing are the art, science, and technology of obtaining reliable information about physical objects and the environment, through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from noncontact sensor systems” (Colwell, 1997)
- Remote Sensing
 - Maximal Definition: “remote sensing is the acquiring of data about an object without touching it”
 - Minimal Definition: “remote sensing is the noncontact recording of information from the ultraviolet, visible, infrared, and microwave regions of the electromagnetic spectrum by means of instruments such as cameras, scanners, lasers, linear arrays, and/or area arrays located on platforms such as aircraft or spacecraft, and the analysis of acquired information by means of visual and digital image processing.”



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Remote Sensing Data Collection

- Remote Sensing: Art and/or Science?
- Science
 - Remote sensing is a tool or technique similar to mathematics.
 - Using sophisticated sensors to measure the amount of electromagnetic energy exiting an object or geographic area from a distance and then extracting valuable information from the data using mathematically and statistically based algorithms is a scientific activity.
- Art
 - The process of visual photo or image interpretation brings to bear not only scientific knowledge but all of the background that a person has obtained through a lifetime.



Remote Sensing of the Environment

Remote Sensing Data Collection

- Remote Sensing Advantages and Limitations
- Advantages
 - Passive remote sensing does not disturb the object or area of interest.
 - Systematic data collection can remove the sampling bias introduced in some in situ investigations.
 - The remotely sensed data may be obtained systematically over very large geographic areas rather than just single point observations.
- Limitations
 - Remote Sensing simply provides some spatial, spectral, and temporal information of value.
 - Human method-produced error may be introduced as the various remote sensing instrument and mission parameters are specified.
 - Powerful active remote sensor systems, such as lasers or radars that emit their own electromagnetic radiation, can be intrusive and affect the phenomenon being investigated.
 - Remote sensing instruments like in situ instruments often become uncalibrated, resulting in uncalibrated remote sensor data.
 - expensive to collect and interpret or analyze



Remote Sensing of the Environment

The Remote Sensing Process

- The Remote Sensing Process



Remote Sensing of the Environment

The Remote Sensing Process

- Remote Sensing Data Collection
 - Passive sensors record naturally occurring electromagnetic radiation that is reflected or emitted from the terrain.
 - Active sensors such as microwave (radar) or sonar bathe the terrain in man-made electromagnetic energy and then record the amount of radiant flux scattered back toward the sensor system.
- Sensor Resolution
 - Resolution: a measure of the ability of an optical system to distinguish between signals that are spatially near or spectrally similar
- Spectral Resolution
 - the number and dimension of specific wavelength intervals in the electromagnetic spectrum to which a remote sensing instrument is sensitive
- Spatial Resolution
 - a measure of the smallest angular or linear separation between two objects that can be resolved by the sensor
- Temporal Resolution
 - how often records imagery of a particular area



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The Remote Sensing Process

- **Sensor Resolution**
 - Resolution: a measure of the ability of an optical system to distinguish between signals that are spatially near or spectrally similar



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The Remote Sensing Process

- Spectral Resolution
 - the number and dimension of specific wavelength intervals in the electromagnetic spectrum to which a remote sensing instrument is sensitive



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- Spatial Resolution
 - a measure of the smallest angular or linear separation between two objects that can be resolved by the sensor



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The Remote Sensing Process

- Temporal Resolution
 - how often records imagery of a particular area
- Radiometric Resolution
 - the sensitivity of a remote sensing detector to differences in signal strength as it records the radiant flux reflected or emitted from the terrain
- Polarization Information
- Angular Information



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The Remote Sensing Process

- Suborbital (Airborne) Remote Sensing Systems
 - These sensors can collect data on demand when disaster strikes (e.g., oil spills or floods) if cloud-cover conditions permit.
 - Suborbital remote sensor data are usually expensive to acquire per km².
 - Atmospheric turbulence can cause the data to have severe geometric distortions that can be quite difficult to correct.



Remote Sensing of the Environment

Earth Resource Analysis Perspective

- Earth resource information
 - information concerning terrestrial vegetation, soils, minerals, rocks, water, and urban infrastructures as well as certain atmospheric characteristics