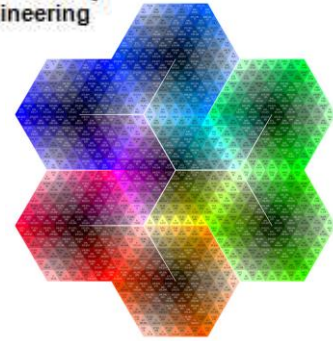


Remote Sensing

Lecture 3: Characteristics of Images



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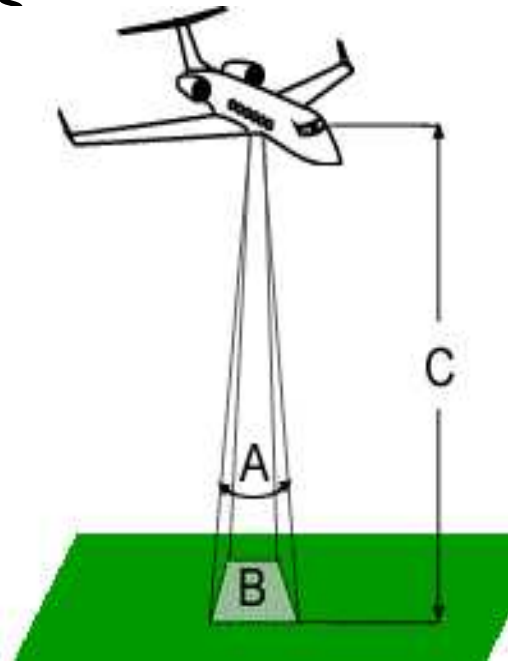
Lecture Contents:

- Spatial Resolution, Pixel Size, and Scale
- Spectral Resolution
- Radiometric Resolution
- Temporal Resolution



Spatial Resolution, Pixel Size, and Scale

- Spatial resolution of passive sensors (we will look at the special case of active microwave sensors later) depends primarily on their Instantaneous Field of View (IFOV).
- The IFOV is the angular cone of visibility of the sensor (A) and determines the area on the Earth's surface which is "seen" from a given altitude at one particular moment in time (B).
- The size of the area viewed is determined by multiplying the IFOV by the distance from the ground to the sensor (C). This area on the ground is called the resolution cell and determines a sensor's maximum spatial resolution.





Spatial Resolution

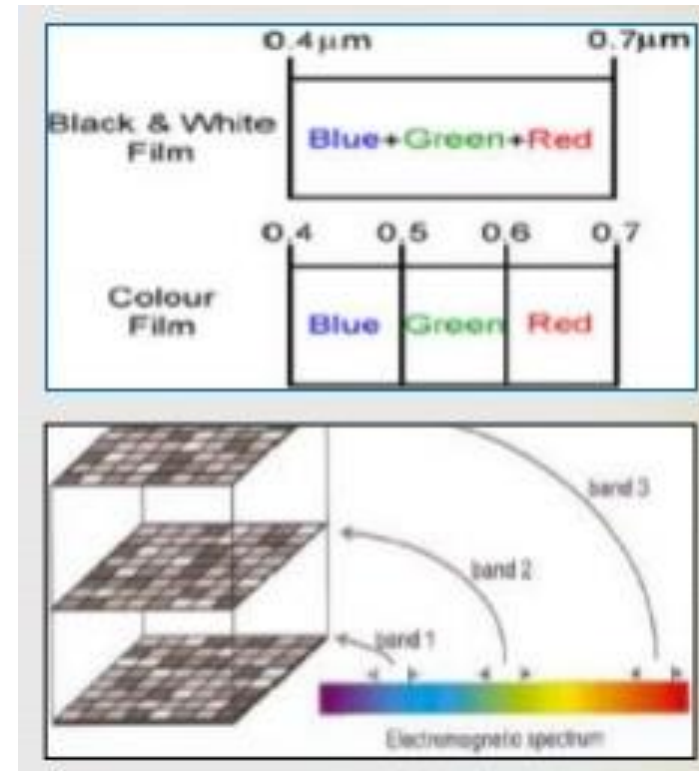
- Images where only large features are visible are said to have **coarse** or **low resolution**. In fine or high-resolution images, small objects can be detected.





Spectral Resolution

- Spectral resolution describes the ability of a sensor to define fine wavelength intervals. The finer the spectral resolution, the narrower the wavelength range for a particular channel or band.
- Many remote sensing systems record energy over several separate wavelength ranges at various spectral resolutions.
- These are referred to as **multi-spectral sensors**

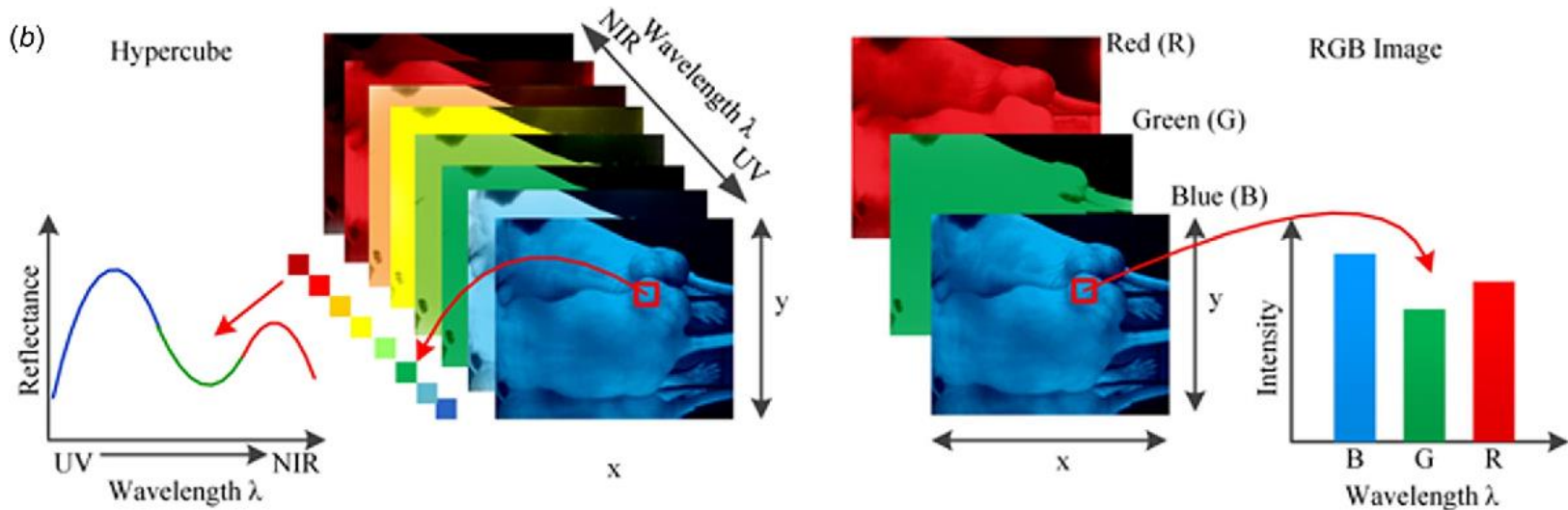
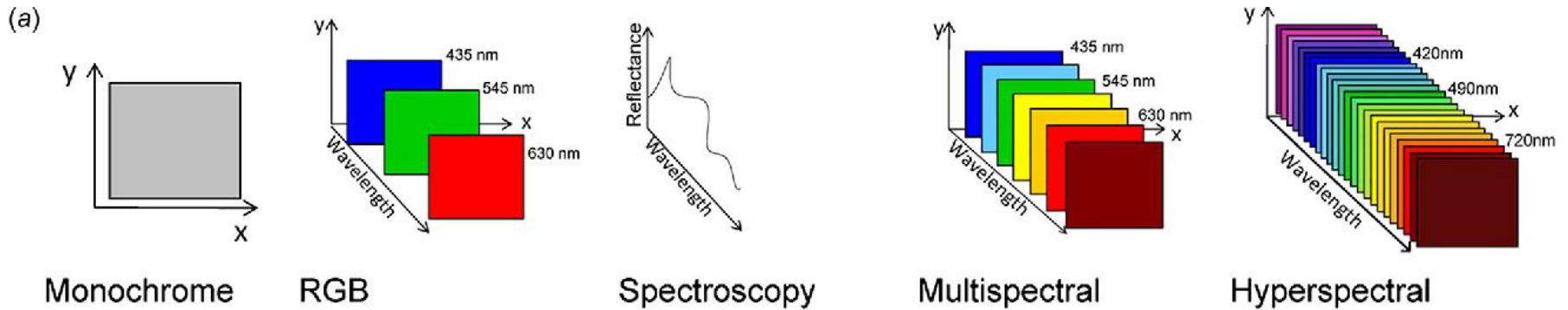




Spectral Resolution

- Advanced multi-spectral sensors called **hyperspectral sensors**, detect hundreds of very narrow spectral bands throughout the visible, near-infrared, and mid-infrared portions of the electromagnetic spectrum.
- Their very high spectral resolution facilitates fine discrimination between different targets based on their spectral response in each of the narrow bands.

Spectral Resolution





Radiometric Resolution

- The **radiometric resolution** of an imaging system describes its ability to discriminate very slight differences in energy. The finer the radiometric resolution of a sensor, the more sensitive it is to detecting small differences in reflected or emitted energy.





Radiometric Resolution

1. Imagery data are represented by positive digital numbers which vary from 0 to (one less than) a selected power of 2.
2. Thus, if a sensor used 8 bits to record the data, there would be $2^8=256$ digital values available, ranging from 0 to 255.
3. By comparing a 2-bit image with an 8-bit image, we can see that there is a large difference in the level of detail discernible depending on their radiometric resolutions.

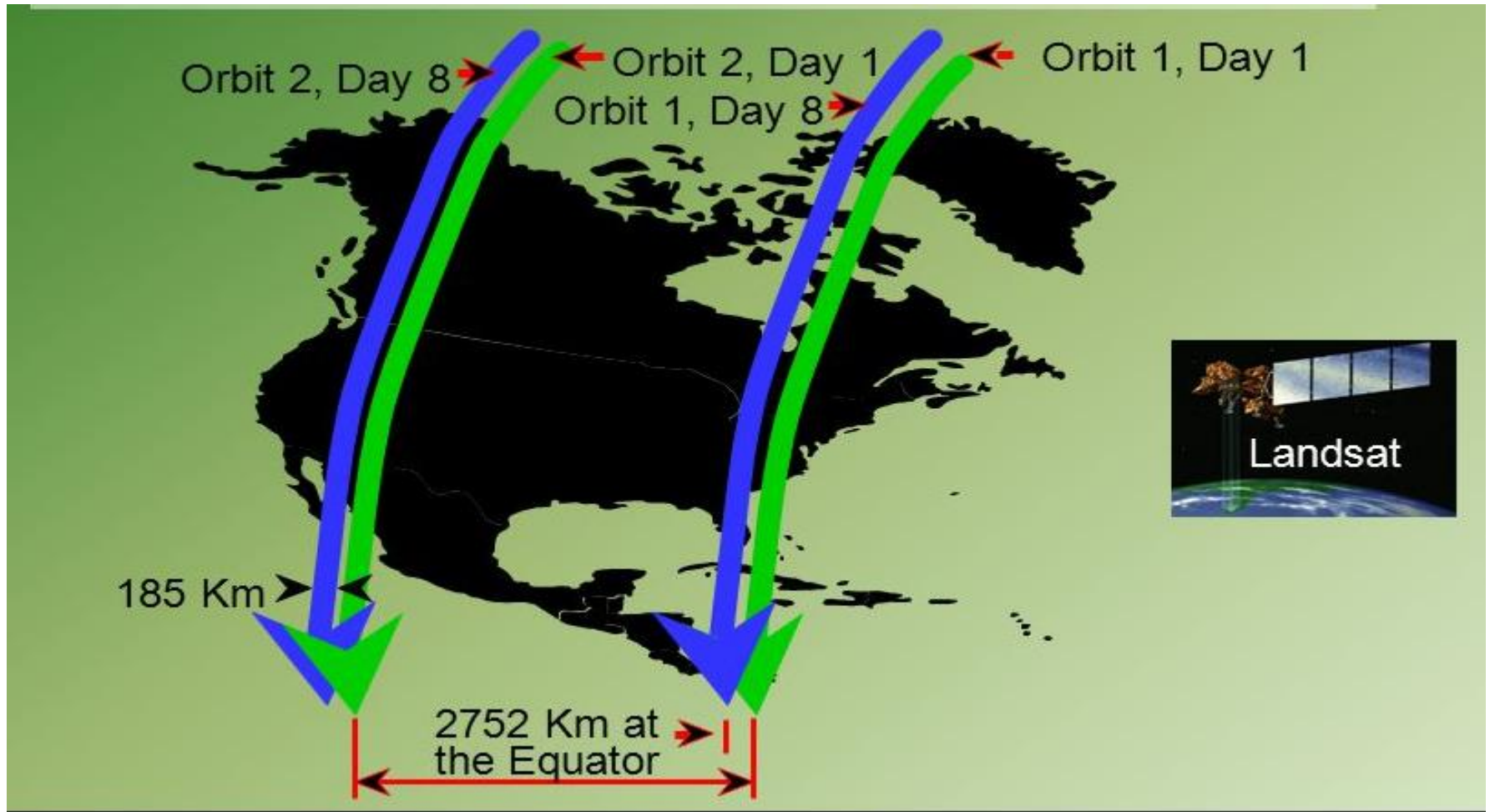




Temporal Resolution

- The concept of revisit period, which refers to the length of time it takes for a satellite to complete one entire orbit cycle.
- The revisit period of a satellite sensor is usually several days.
- Therefore the absolute temporal resolution of a remote sensing system to image the exact same area at the same viewing angle a second time is equal to this period.

Temporal Resolution





Temporal Resolution

- Persistent clouds offer limited clear views of the Earth's surface (often in the tropics)
- Short-lived phenomena (floods, oil slicks, etc.) need to be imaged
- Multi-temporal comparisons are required (e.g. the spread of a forest disease from one year to the next)
- The changing appearance of a feature over time can be used to distinguish it from near similar features (wheat / maize)



Summary

- **Spatial:**
 - X and Y resolution
- **Spectral:**
 - Number of bands
- **Temporal:**
 - Number of samples per time unit
- **Radiometric:**
 - Number of bits or bytes per sample





Supplementary files:

- https://www.youtube.com/watch?v=6KuSGSNX9_Q&t=219s
- https://www.youtube.com/watch?v=Hu1T_rEb7D0
- <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spatial-resolution>

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Thanks

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