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Types of Resolutions in Remote Sensing

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What is Resolution

Image resolution is the detail an image holds. The term applies to raster digital images, film images, and other types of images. Higher resolution means more detailed Image.

In remote sensing we refer to four types of resolution:

Spatial, Spectral, Radiometric and Temporal.

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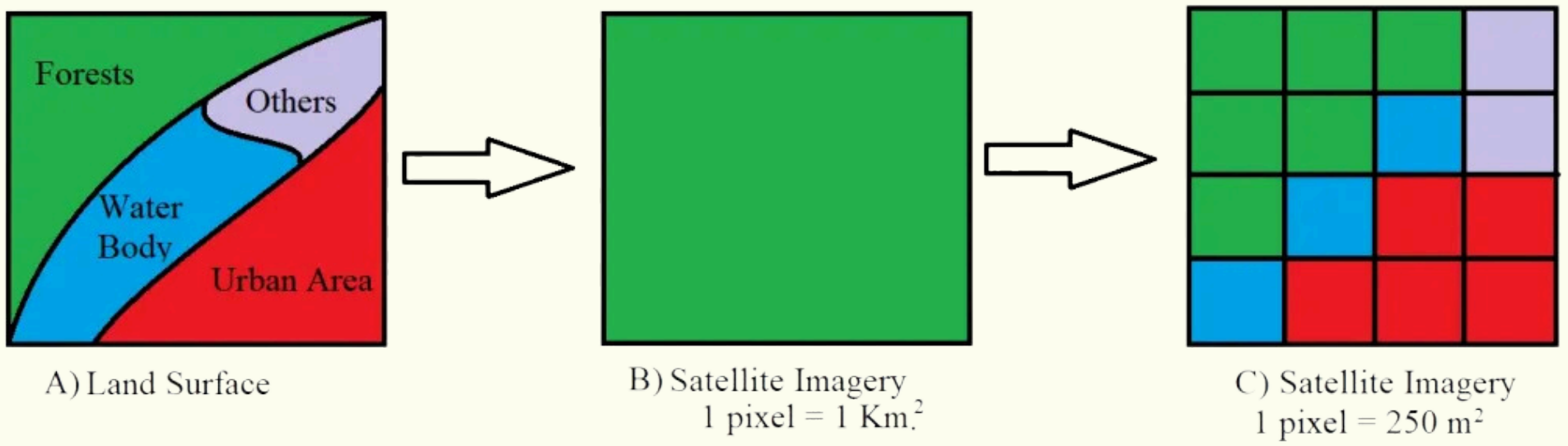
Spatial Resolution

Spatial resolution refers to the clarity of features on the earth surface. Therefore, it is the ability of the sensor to differentiate between various objects and features of the earth surface.

In simple words, spatial resolution refers to the ratio between size of pixel and the area it represents.

For example, a spatial resolution of 250m means that one pixel represents an area 250 by 250 meters on the ground.



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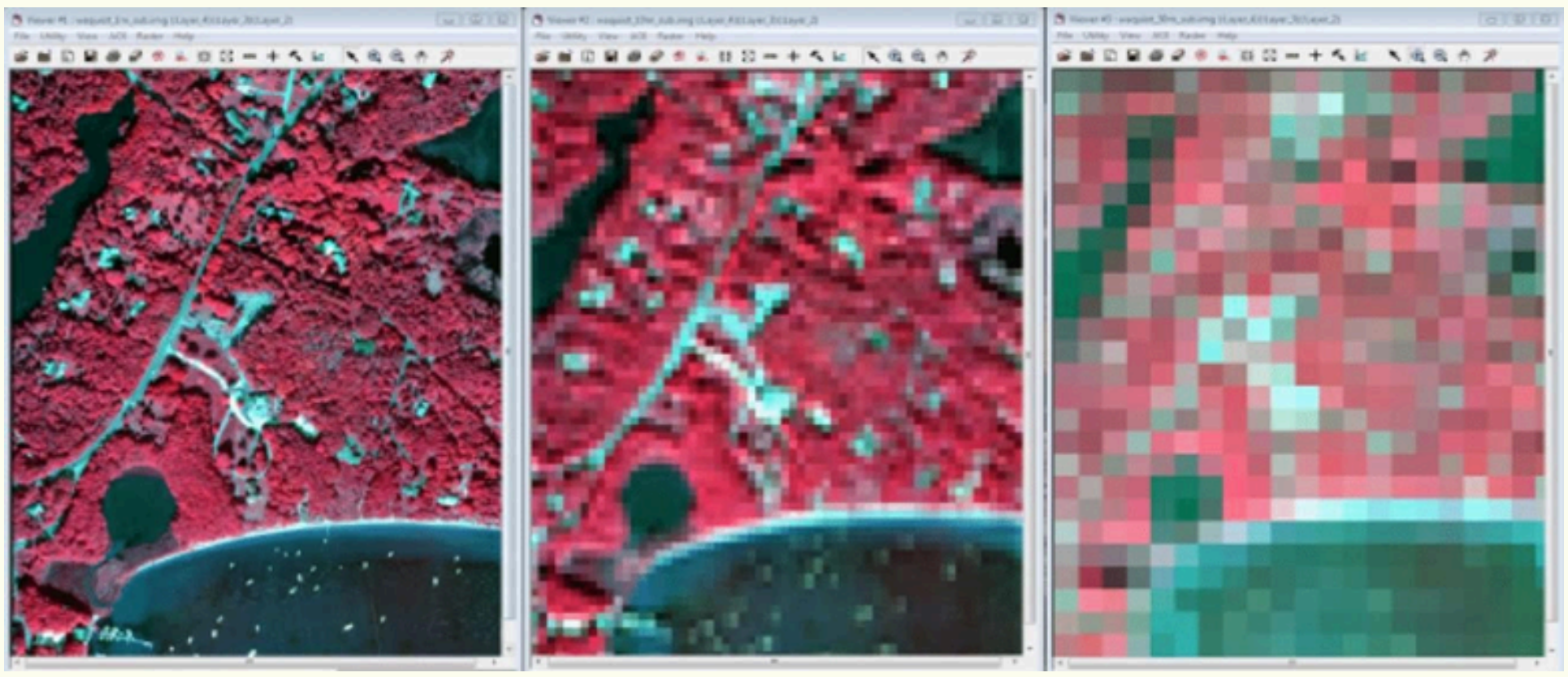
Spatial Resolution

Sensor	Spatial Resolution
DigitalGlobe (and others)	<1 m - 4 m
Landsat	30 m
MODIS	250 m - 1 km
GPM IMERG	~10 km



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Spectral Resolution

Spectral Resolution refers to the ability of a satellite sensor to measure specific wavelengths of the electromagnetic spectrum.

Spectral Resolution describes the ability of a sensor to define fine wavelength intervals. This refers to the number of bands in the spectrum in which the instrument can take measurements.

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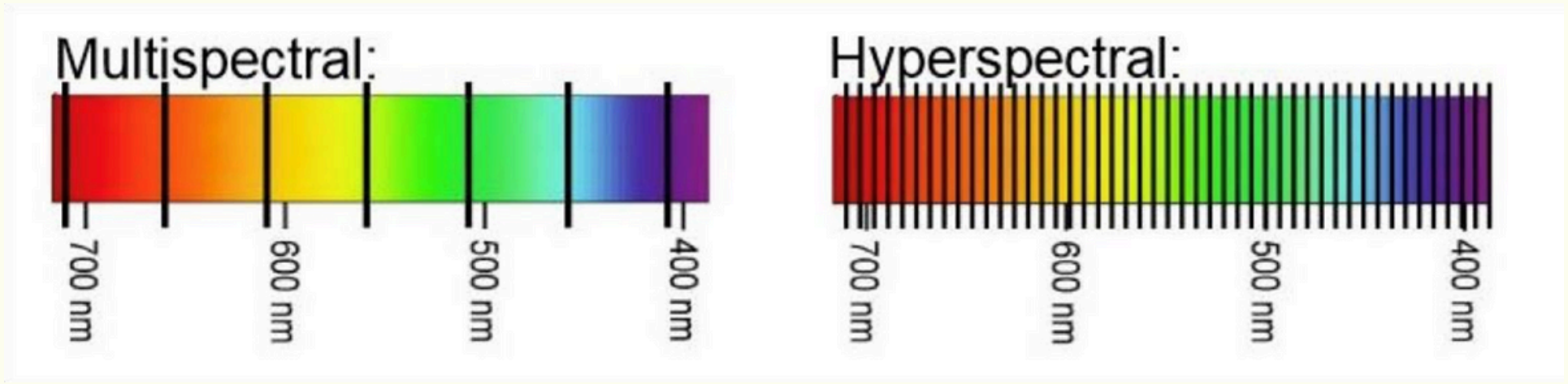
Spectral Resolution

Higher Spectral resolution = better ability to exploit differences in spectral signatures

The finer the spectral resolution, the narrower the wavelength range for a particular channel or band.



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Rediometric Resolution

Radiometric resolution refers to the ability of a sensor to capture the minute differences in the radiated energy from the earth surface.

In other words, it is the number of shades of a grayscale in the pixels of a given satellite imagery (measured in bits)

A 1 bit imagery means that the number of colors in the imagery may be 2^1 = 2 i.e. black and white. Similarly, a 4 bit data means that the number of shades in a pixel of the imagery may be 2^4 = 16. Similarly, 8 bits means 256 digital values or shades.

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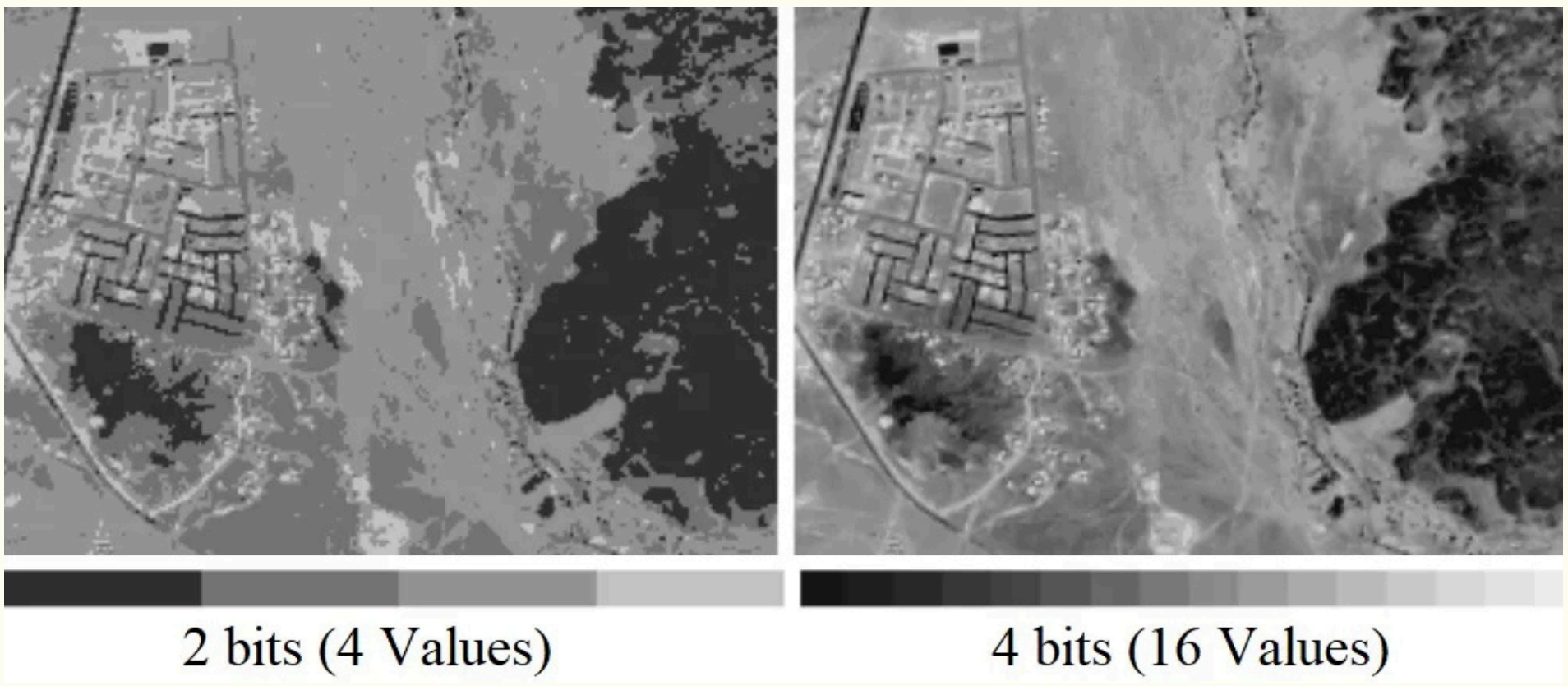
Bits	Range of values	Levels of grey
1Bit	$2^1 = 2$ (0-1)	0 … 1
4Bit	$2^4 = 16$ (0-15)	0 … 15
8Bit	$2^8 = 256$ (0-255)	0 … 255

You can differentiate between a 2 bit and 4 bit imagery. The four bit imagery shows the tree cover, pathways and settlements clearer than the two bit imagery.



2 bits (4 Values) 4 bits (16 Values)

If we see image of 8 bits one would be able to see all featrures in finer detail.

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Temporal Resolution

Temporal resolution refers to how often a satellite captures images of the same area. It’s the time between revisits.

For example, if a satellite passes over same area every 12 hours, its temporal resolution is 12 hours.

This is crucial for tracking changes: slow processes like land-use shifts may need monthly or yearly data, while fast events like disasters require frequent updates, such as hourly.

Temporal resolution helps monitor changes over time accurately.

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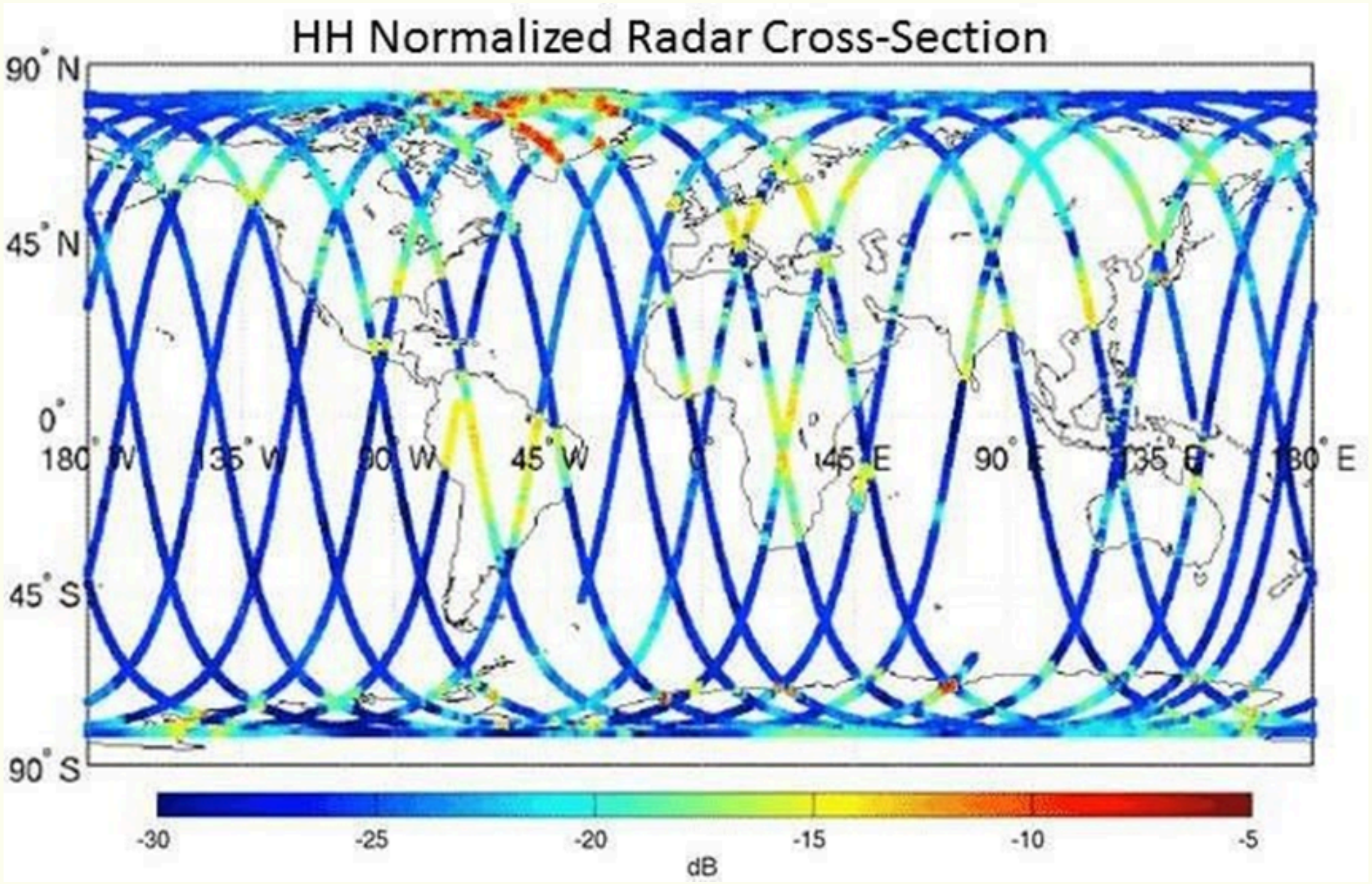
Sensor	Revisit time
Landsat	16-days
MODIS	2-days
Commercial (OrbView)	1-2 days



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