Selecting the Best Imagery

Russell G. Congalton, PhD
Professor of Remote Sensing and GIS
Department of Natural Resources & the Environment
University of New Hampshire
[russ.congalton@unh.edu]

NEW HAMPSHIRE VIEW

Choosing the Best Remote Sensing Imagery to Meet Your Needs

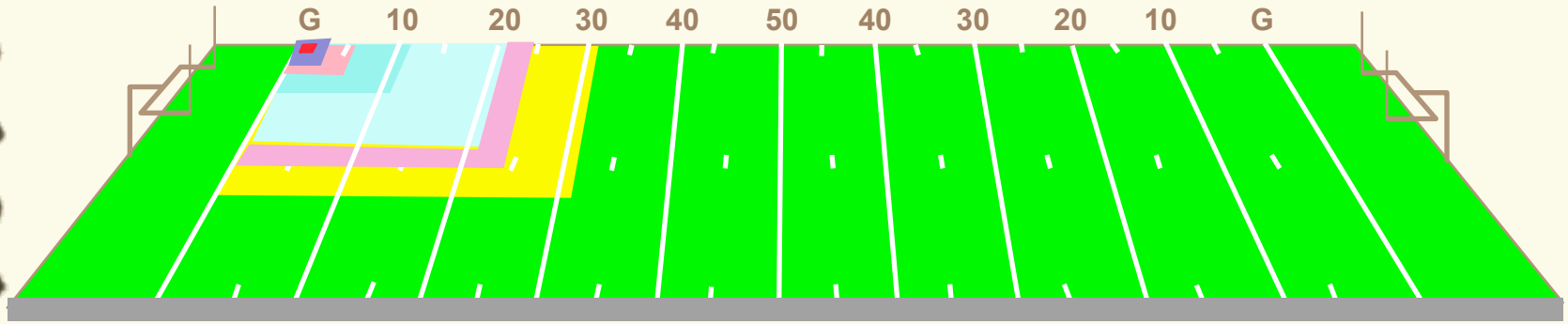
Given a problem to solve and a budget --

There are five characteristics that define each imaging system:

- Spatial Resolution
- Spectral Resolution
- Radiometric Resolution
- Extent
- Temporal Resolution

Spatial Resolution

Spatial resolution is the size of the smallest picture element or “pixel” captured by the sensor

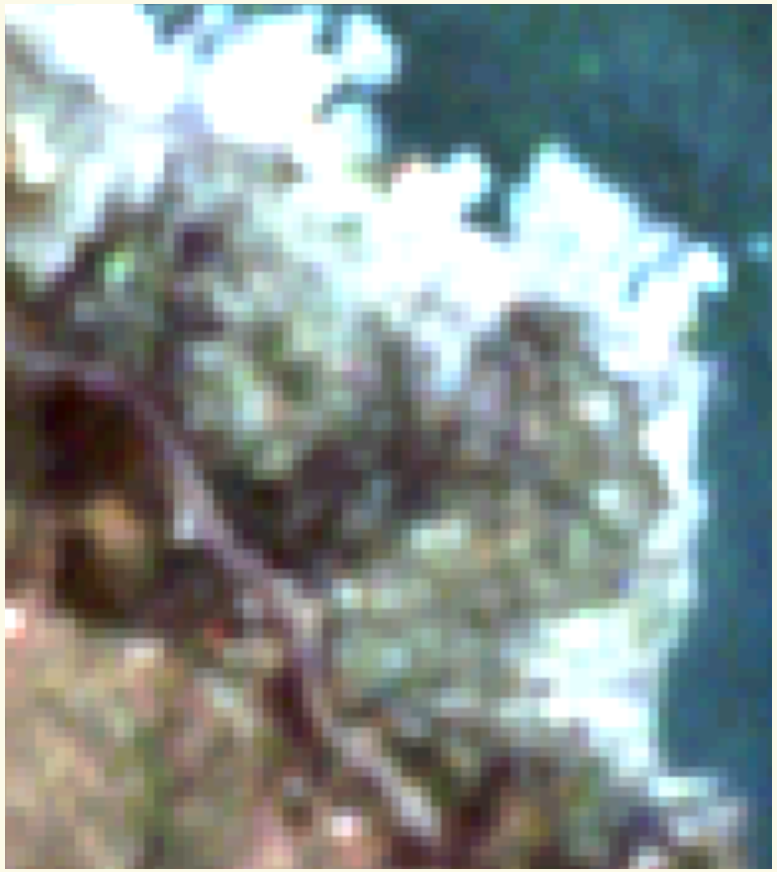


Comparison of Spatial Resolutions

30 m Landsat

1 m Digital Camera

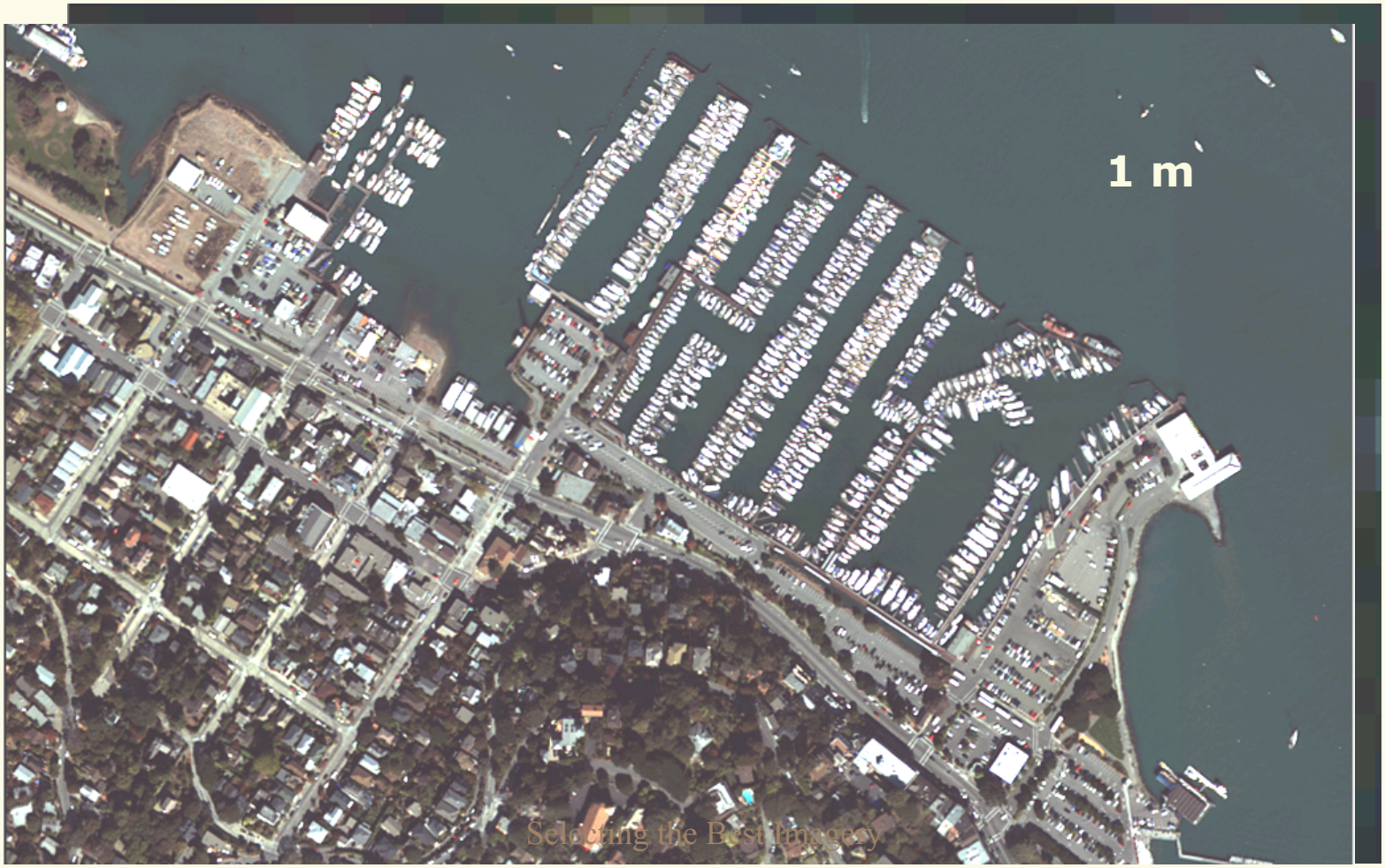
Comparison of Spatial Resolutions – Zoom In



30 m Landsat

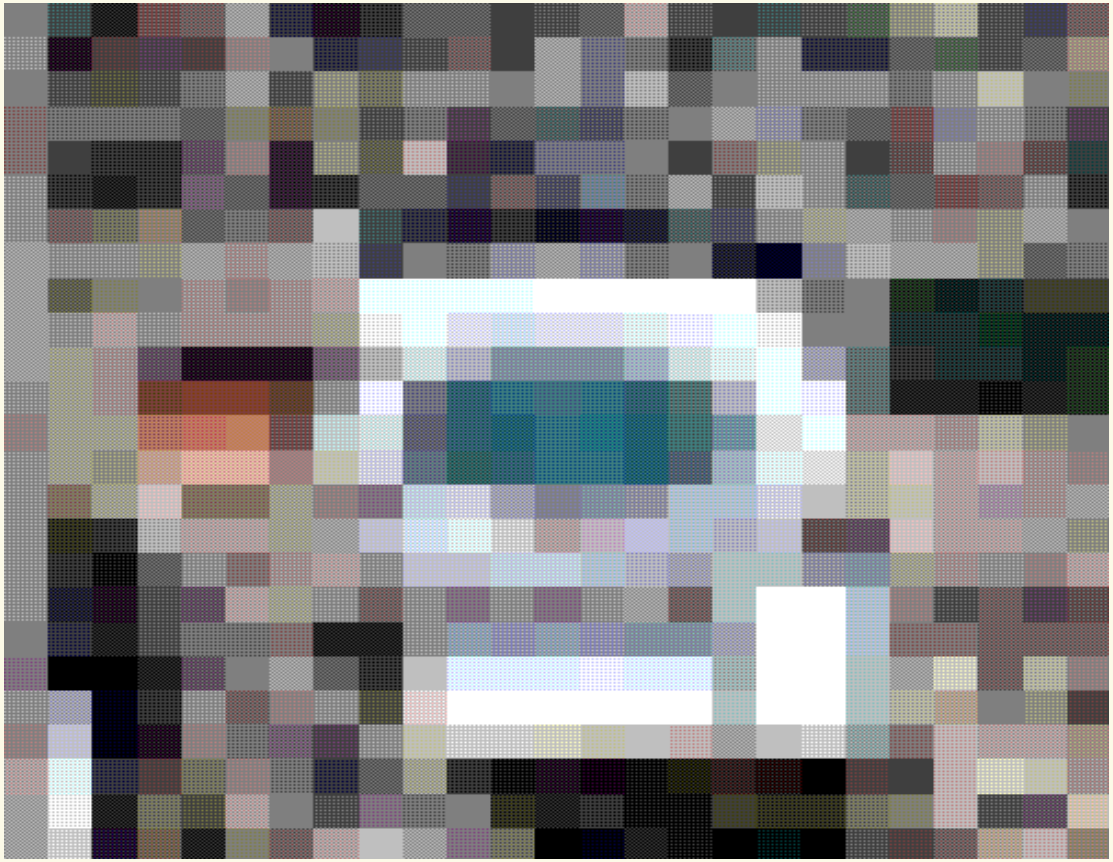
1 m Digital Camera

Comparison of Spatial Resolutions

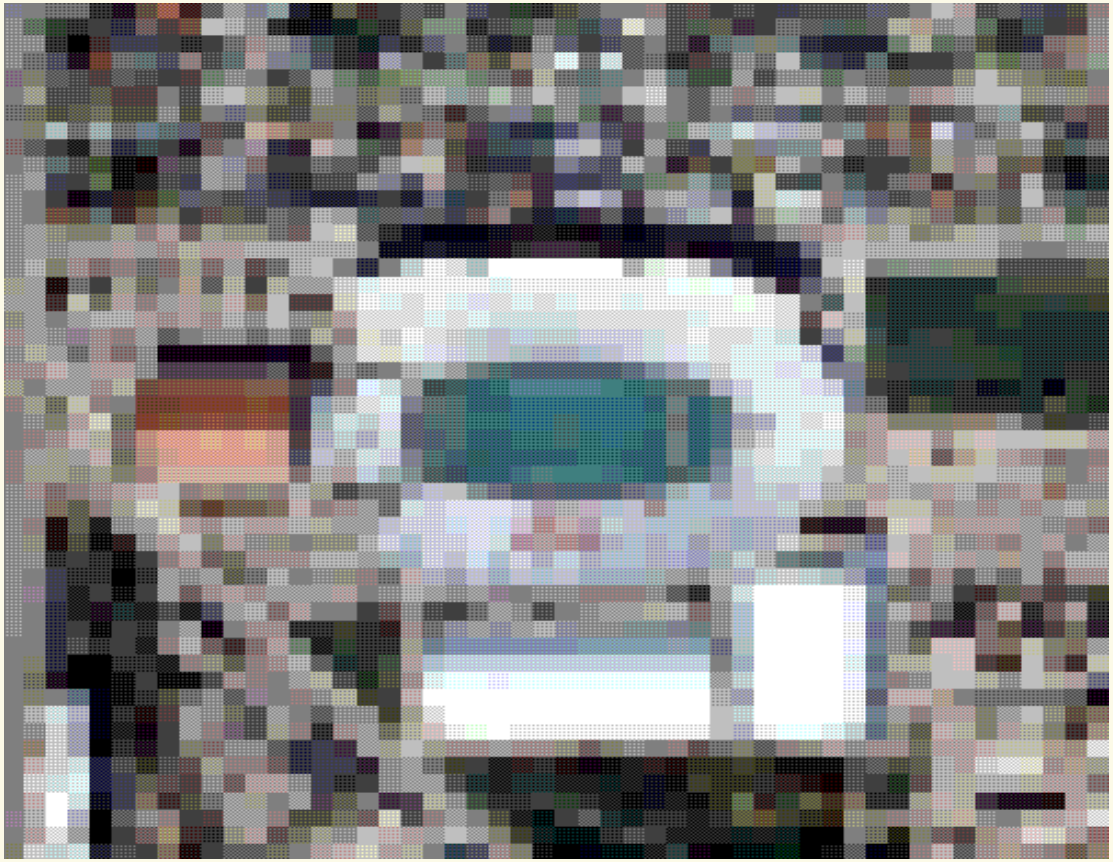


30-meter resolution

20-meter resolution



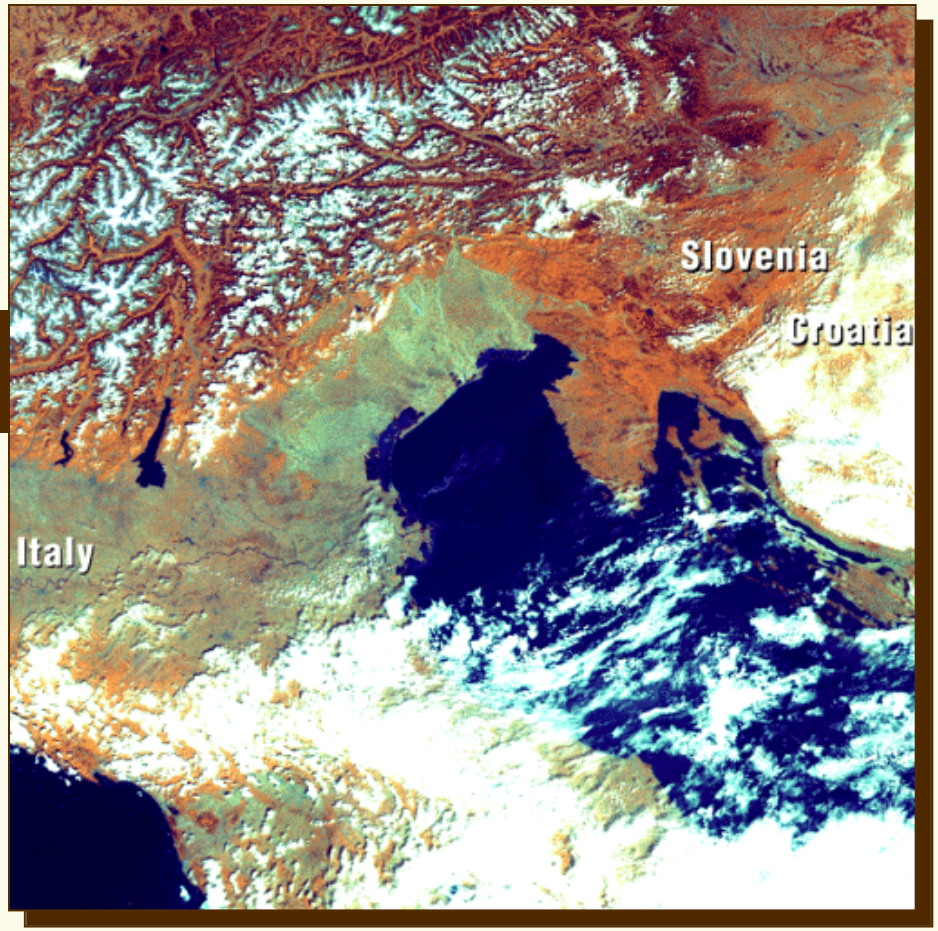
10-meter resolution



1-meter resolution

Example: IRS-1C Imagery

The Alps
IRS-1C WiFS 180-Meter



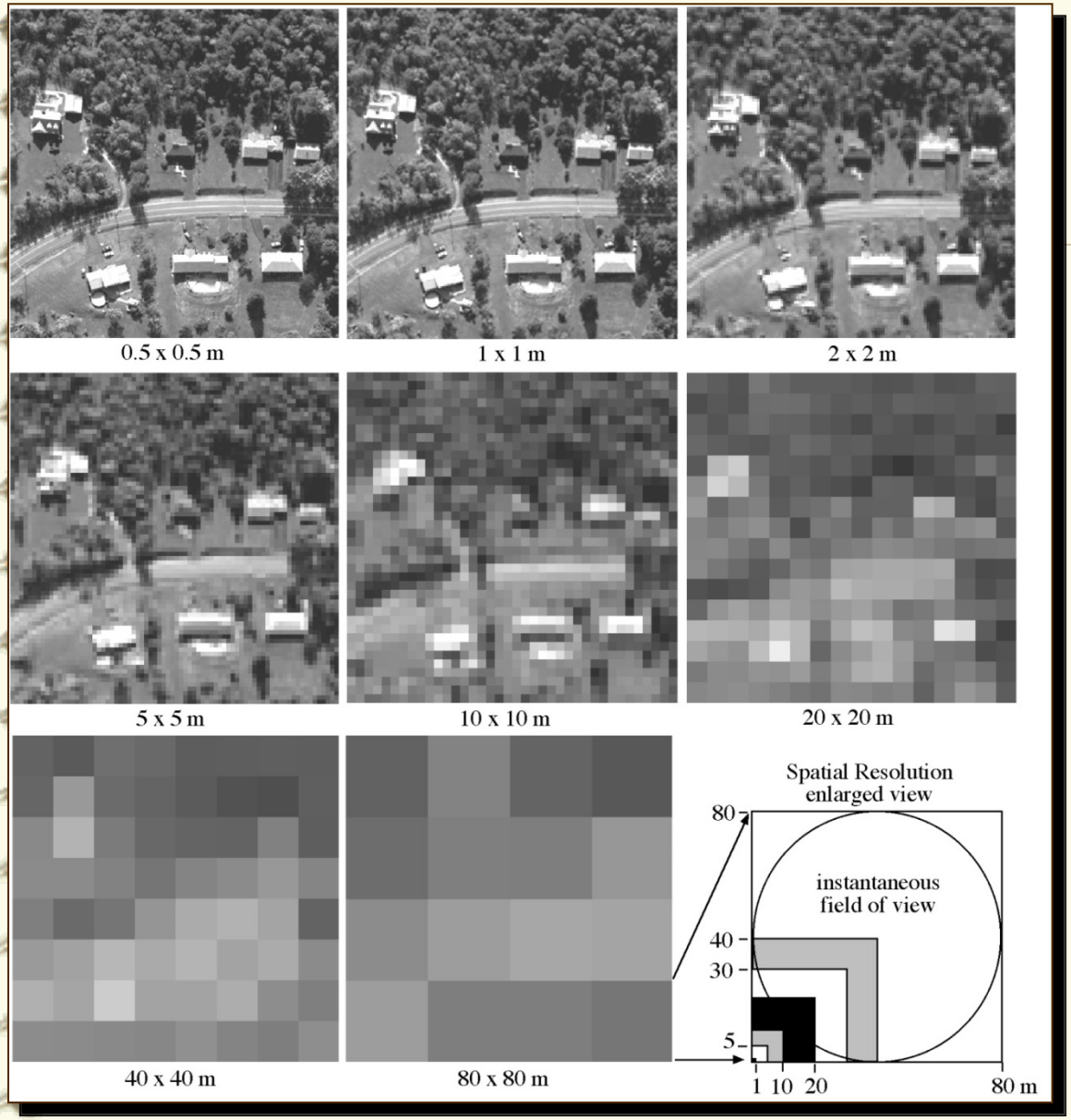
Example: IRS-C Pan

IRS-1C Panchromatic 5-Meter

Example: Ikonos Imagery

IKONOS 1-Meter

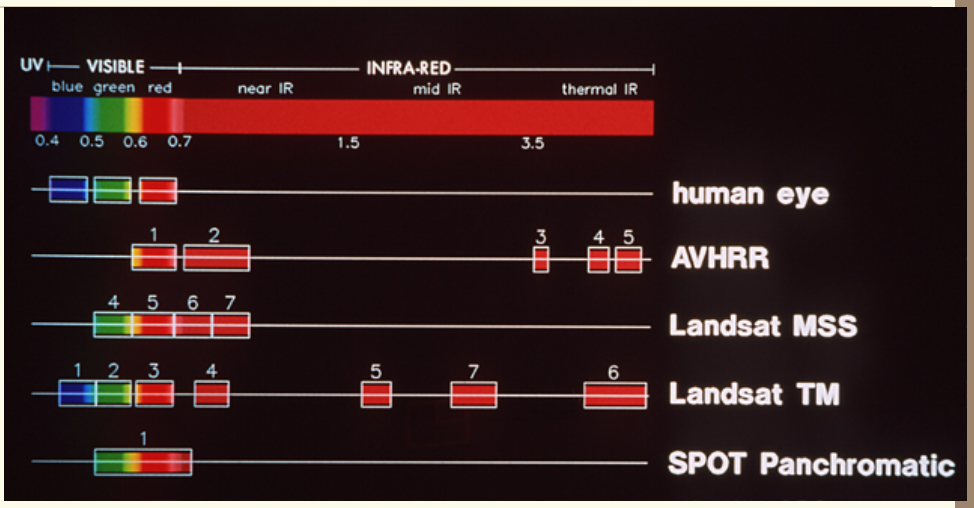
Spatial Resolution



General principle:
To resolve an object of interest (e.g., my 10-inch diameter head), it is necessary to obtain imagery with a spatial resolution that is one-half the size of the object's greatest dimension (e.g., 5-inches).

Spectral Resolution

Spectral resolution is the width and number of specific wavelength bands that a sensor can capture



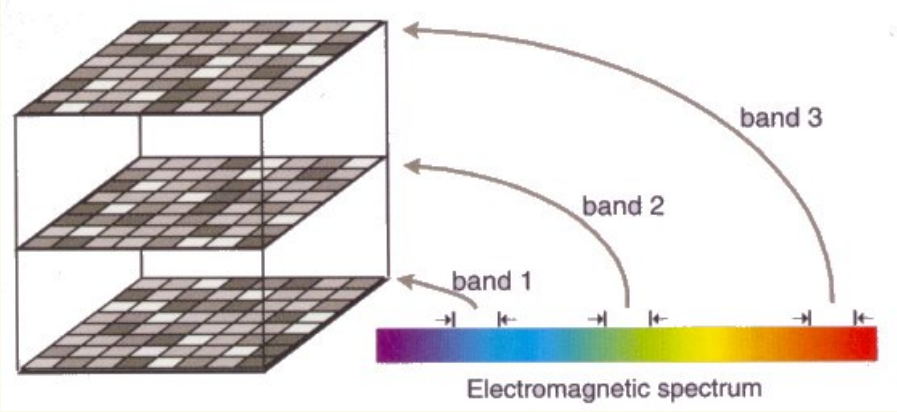
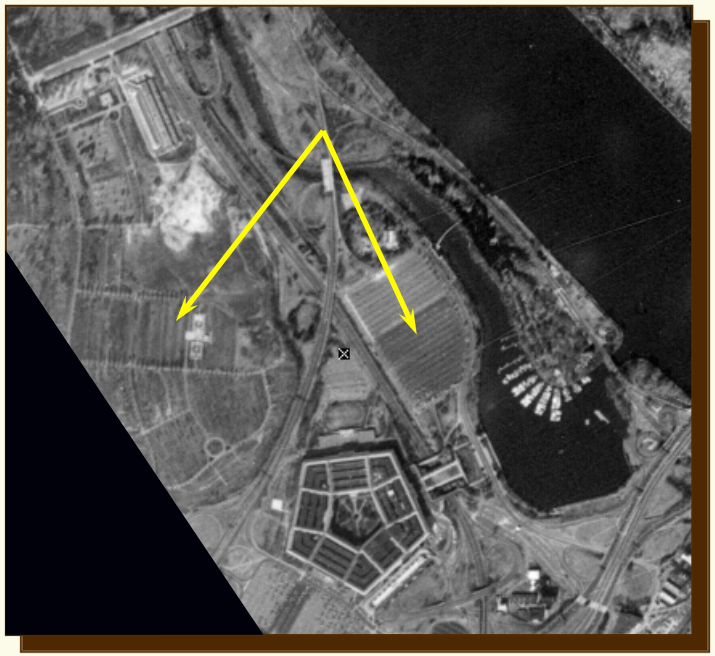


Image Interpretation

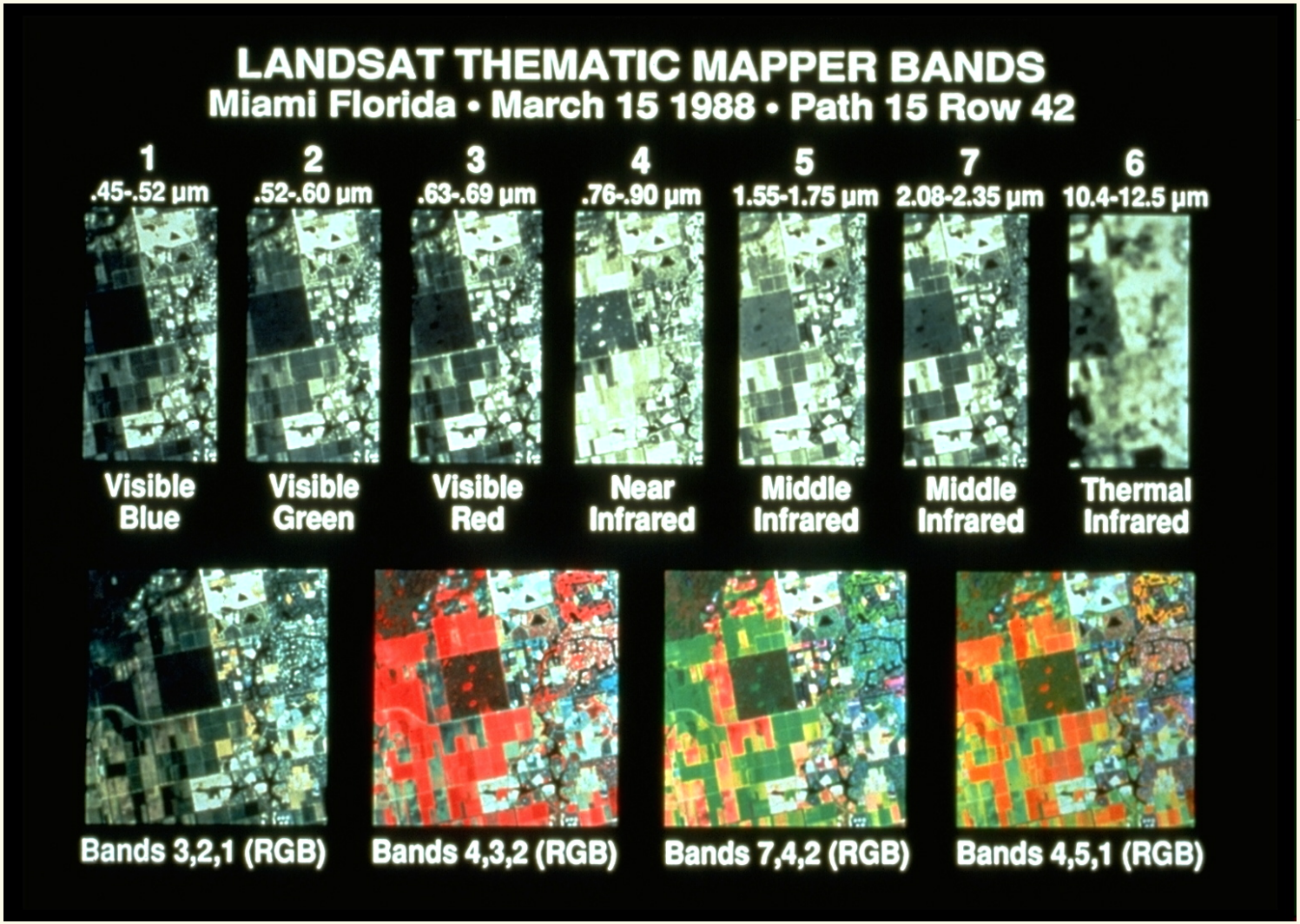
- The human eye can see many more colors (200,000) than shades of gray (200)
- The human brain is capable of using all these colors to derive more accurate and faster feature identification



Pan

Multispectral Data

Spectral Resolution



Natural Color Composite

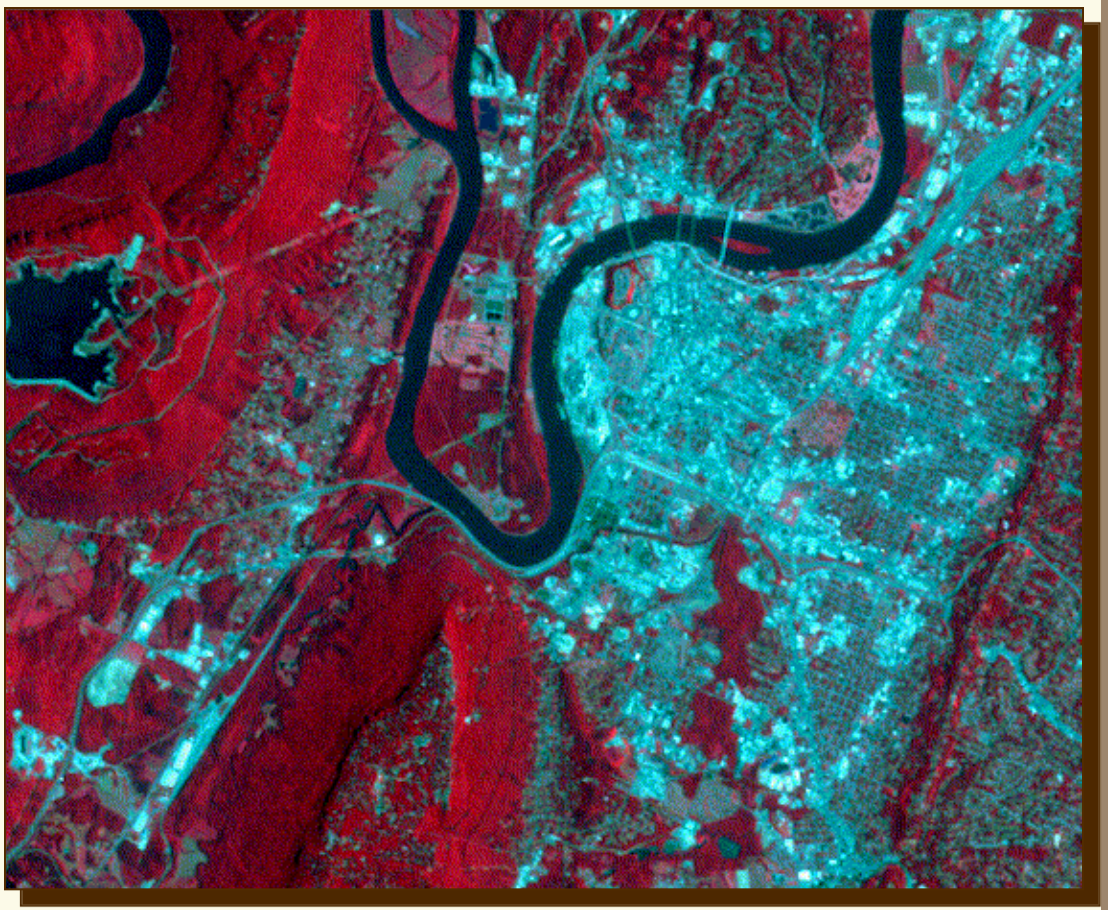
True Color

Chattanooga, TN
Landsat TM 25-meter
Bands 3,2,1 = RGB

False Color Composite

Standard False Color
(NIR Composite)

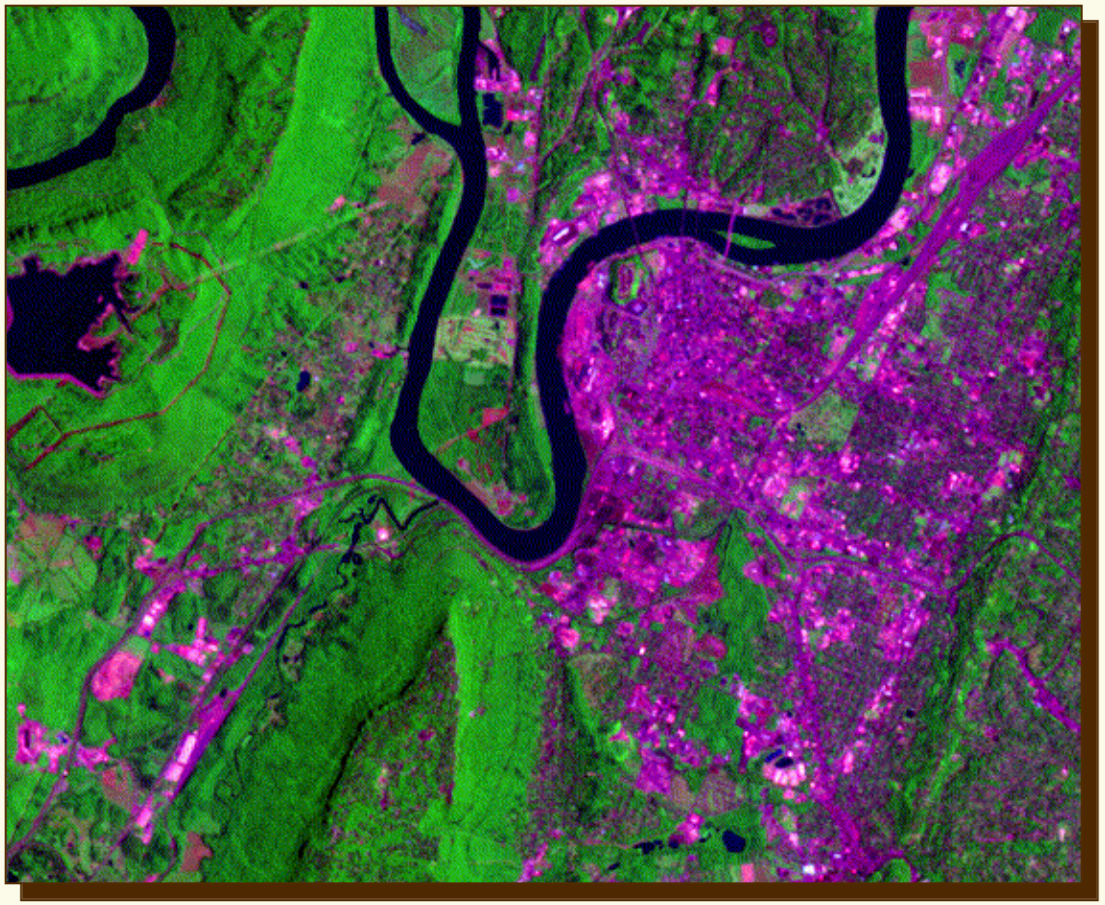
Chattanooga, TN
Landsat TM 25-meter
Bands 4,3,2 = RGB



Other Composites: 7,4,2

SWIR Composite

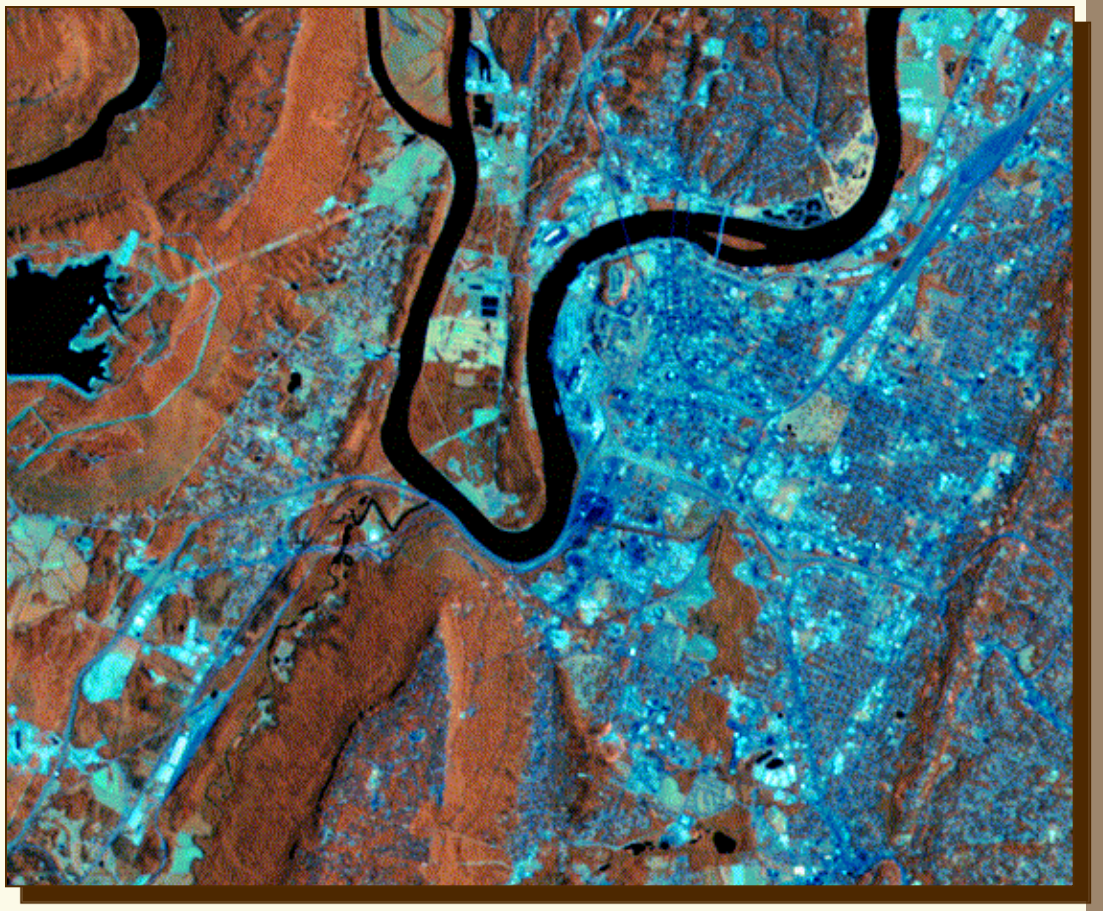
Chattanooga, TN
Landsat TM 25-meter
Bands 7,4,2 = RGB



Other Composites: 4,5,7

Infrared Composite

Chattanooga, TN
Landsat TM 25-meter
Bands 4,5,7 = RGB



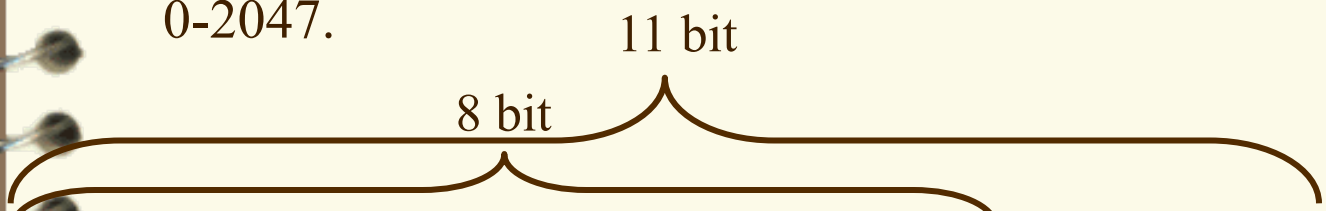
Other Composites: Thermal

Thermal Band

Chattanooga, TN
Landsat TM 120-m
Band 6

Radiometric Resolution

- Digital data use binary machine code. Each bit location is a one or zero (on or off).
- The higher the radiometric resolution, the more range available for each pixel.
- Thus each pixel in 8 bit data (Landsat) will have a potential value from 0 -255; while11 bit data (Orbital, Ikonos, Quickbird, many airborne systems) will have a potential value in each pixel from 0-2047.



								2X	3X	4X	… as much info
1	2	3	4	5	6	7	8	9	10	11	Number of Bits
2	4	8	16	32	64	128	256	512	1024	2048	Max Value

Radiometric Resolution

Computer Storage
8 bits = 1 byte
2 bytes = 1 integer (word)
4 bytes = 1 real number (single precision)
8 bytes = 1 real number (double precision)

0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 = 255

Intensity Levels

1 bit = 2 levels of intensity – B&W
2 bits = 4 levels
4 bits = 16 levels
6 bits = 64 levels
7 bits = 128 levels
8 bits = 256 levels
11 bits = 2048 levels

16 colors 256 colors

Intensity Levels - Data Bits

11 bit image

8 bit image

AREA 1: Bright Areas

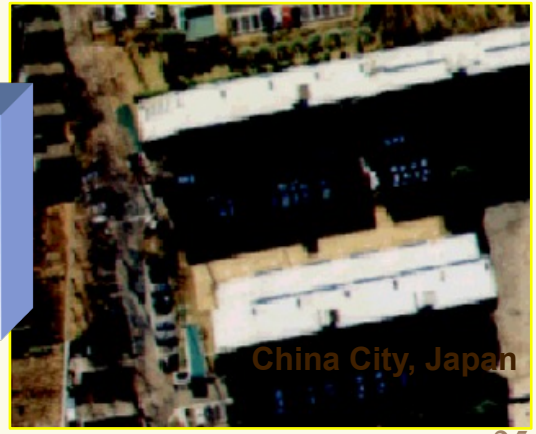
11 bit data makes structures distinguishable

8 bit data leaves bright areas overexposed

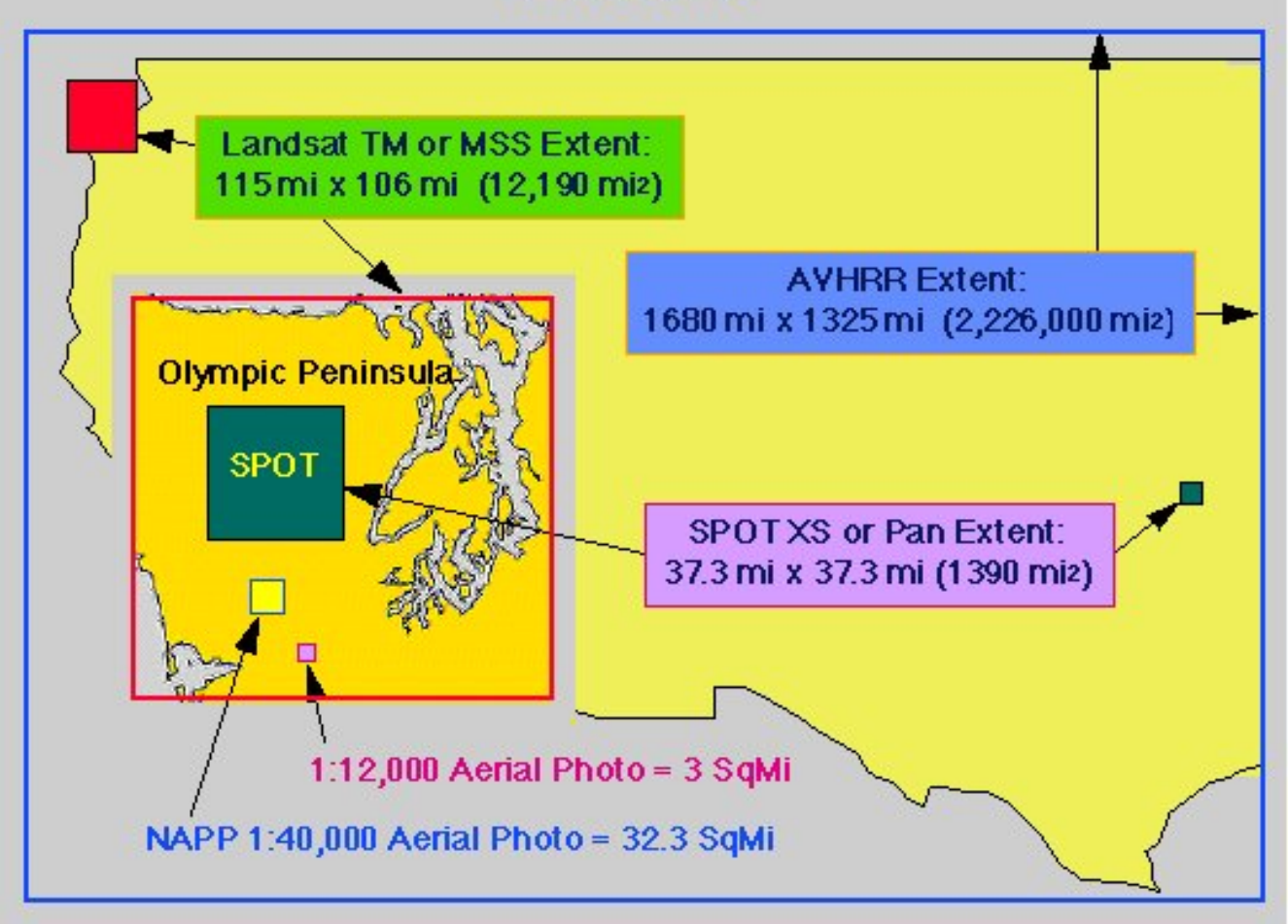
AREA 2: Dark Areas

11 bit data makes shadowed features distinguishable

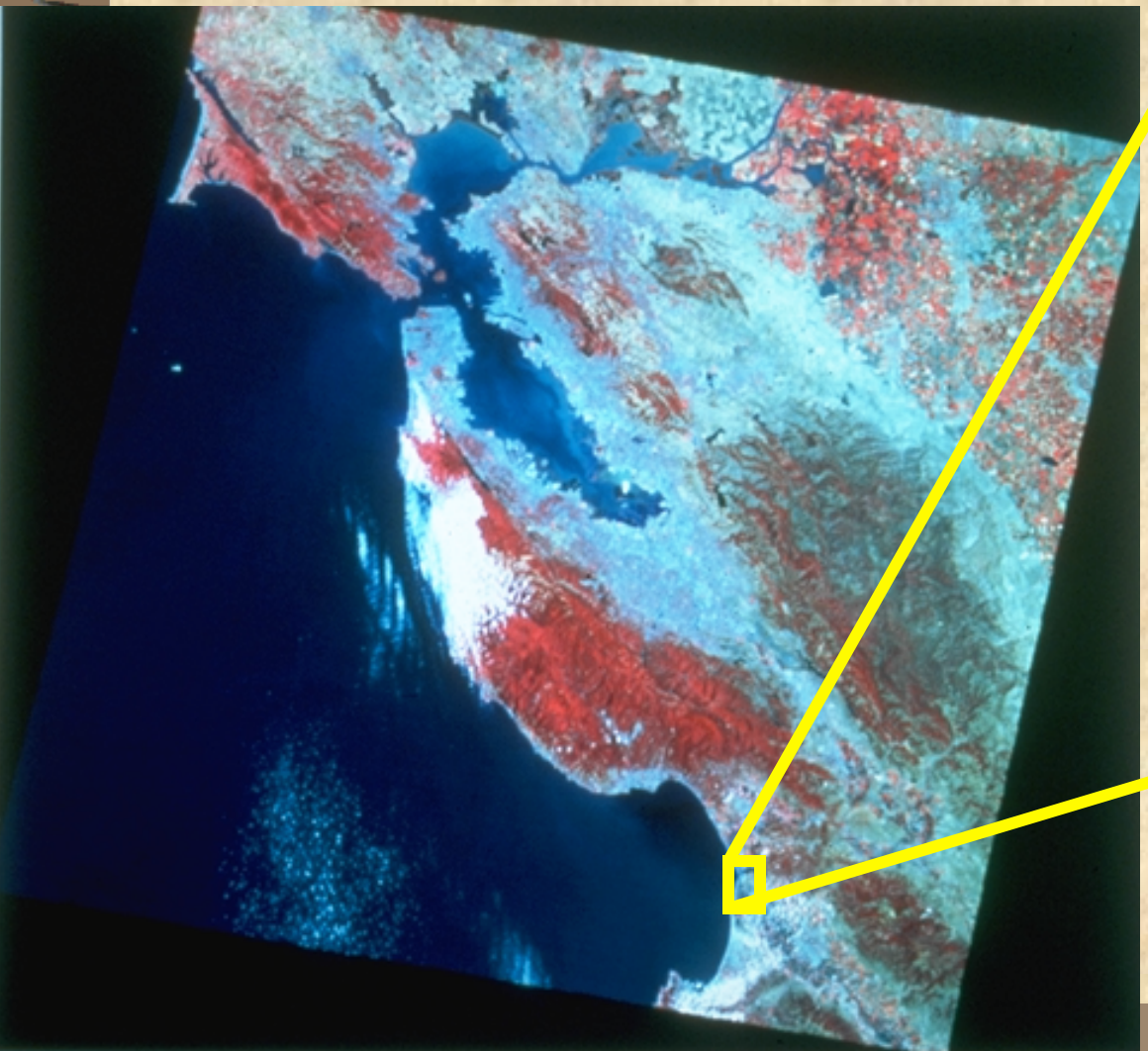
8 bit data loses features to shadows



Extent


Landsat TM or MSS Extent:
115 mi x 106 mi (12,190 mi2)
AVHRR Extent:
1680 mi x 1325 mi (2,226,000 mi2)
Olympic Peninsula
SPOT
SPOT XS or Pan Extent:
37.3 mi x 37.3 mi (1390 mi2)
1:12,000 Aerial Photo = 3 SqMi
NAPP 1:40,000 Aerial Photo = 32.3 SqMi

Comparison of Extent



Temporal Resolution

a measure of how often the same area is revisited by the sensor


Thanks