How to Create a Landsat Image of Your Park

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Earth to Sky | January 2009

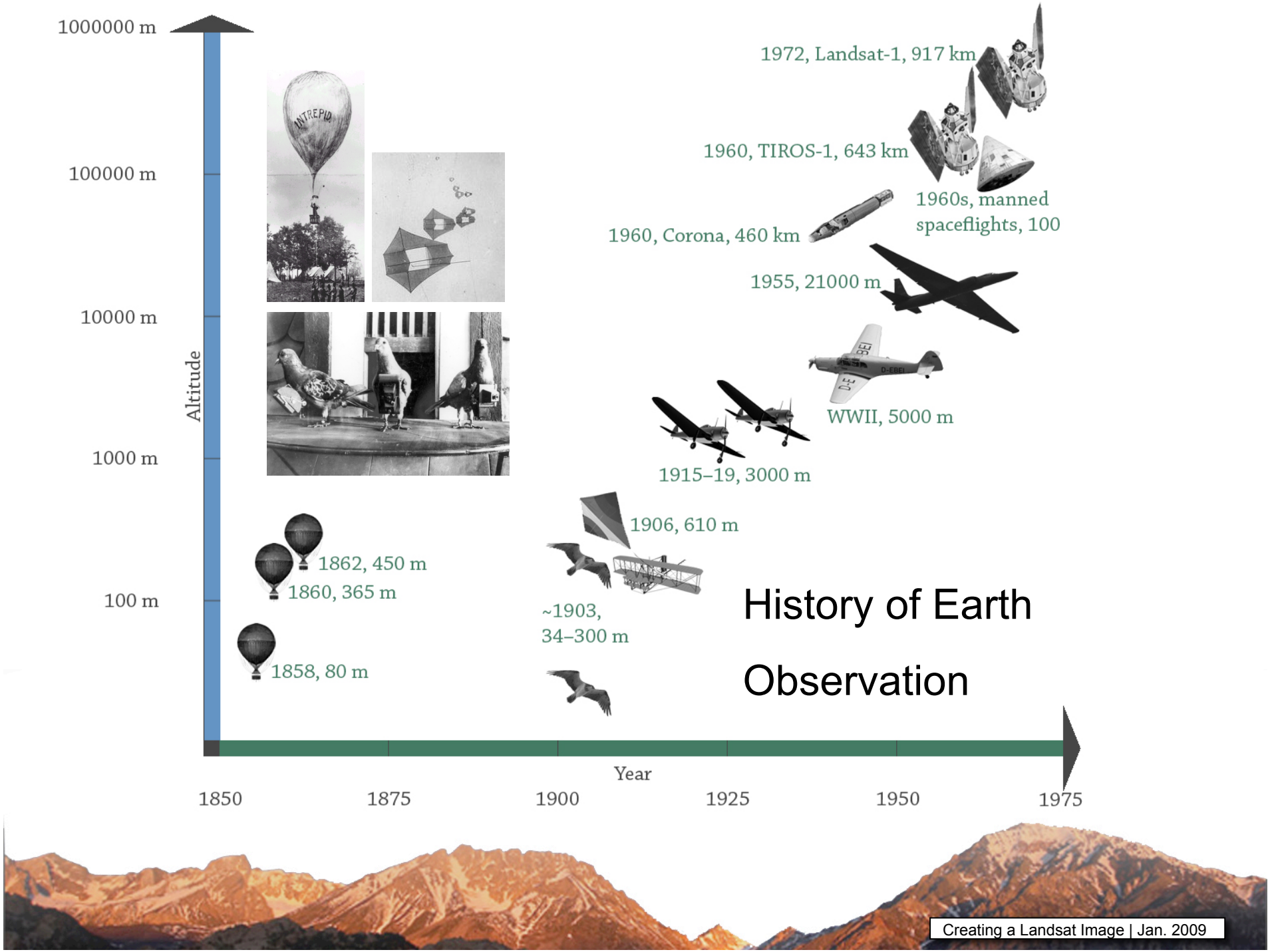
Creating a Landsat Image

- Three (BIG) steps
  1. Know what Landsat data are
  2. Find and download appropriate data
  3. Create a color composite image

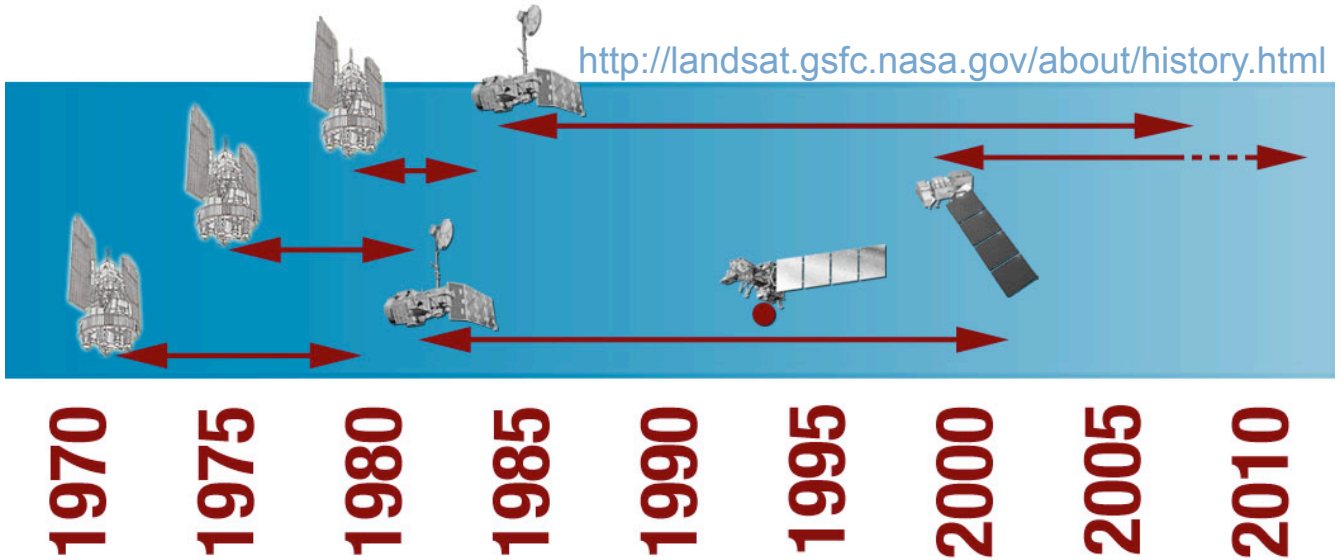
STEP 1: What is Landsat?

- Series of earth-observing satellites
- First launched in 1972
- Medium-resolution
  (backbone of Google Earth)

History of Earth Observation



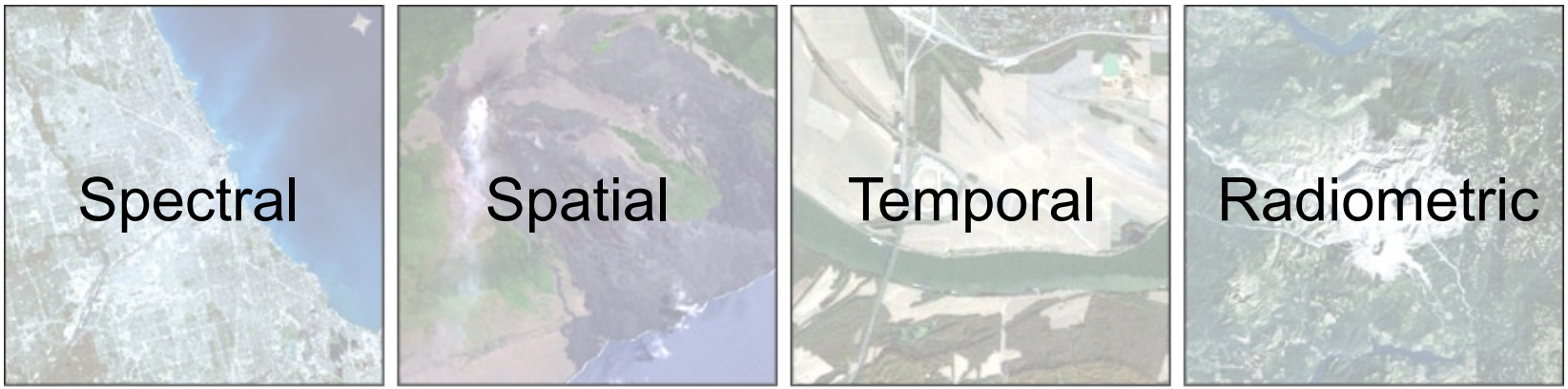
Landsat's History



- L1 launched July 23, 1972
- L7 launched Apr. 15, 1999
- LDCM ~2012

Resolution

Describing remotely sensed imagery



Spectral Resolution

MSS Bands

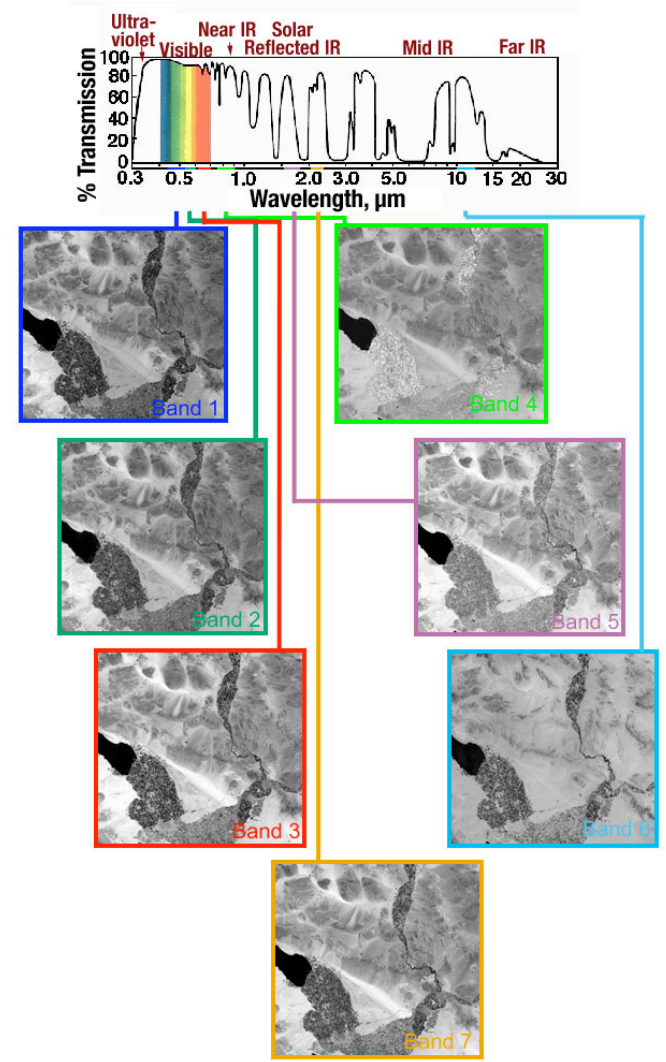
Band Number (L1-L3)	Band Number(L4-L5)	µm	Resolution
4	1	0.5-0.6	80 m
5	2	0.6-0.7	80 m
6	3	0.7-0.8	80 m
7	4	0.8-1.1	80 m
8	n/a	10.41-12.6	237 m

TM Bands

Band Number	µm	Resolution
1	0.45-0.53	30 m
2	0.52-0.60	30 m
3	0.63-0.69	30 m
4	0.76-0.90	30 m
5	1.55-1.75	30 m
6	10.4-12.5	120 m
7	2.08-2.35	30 m

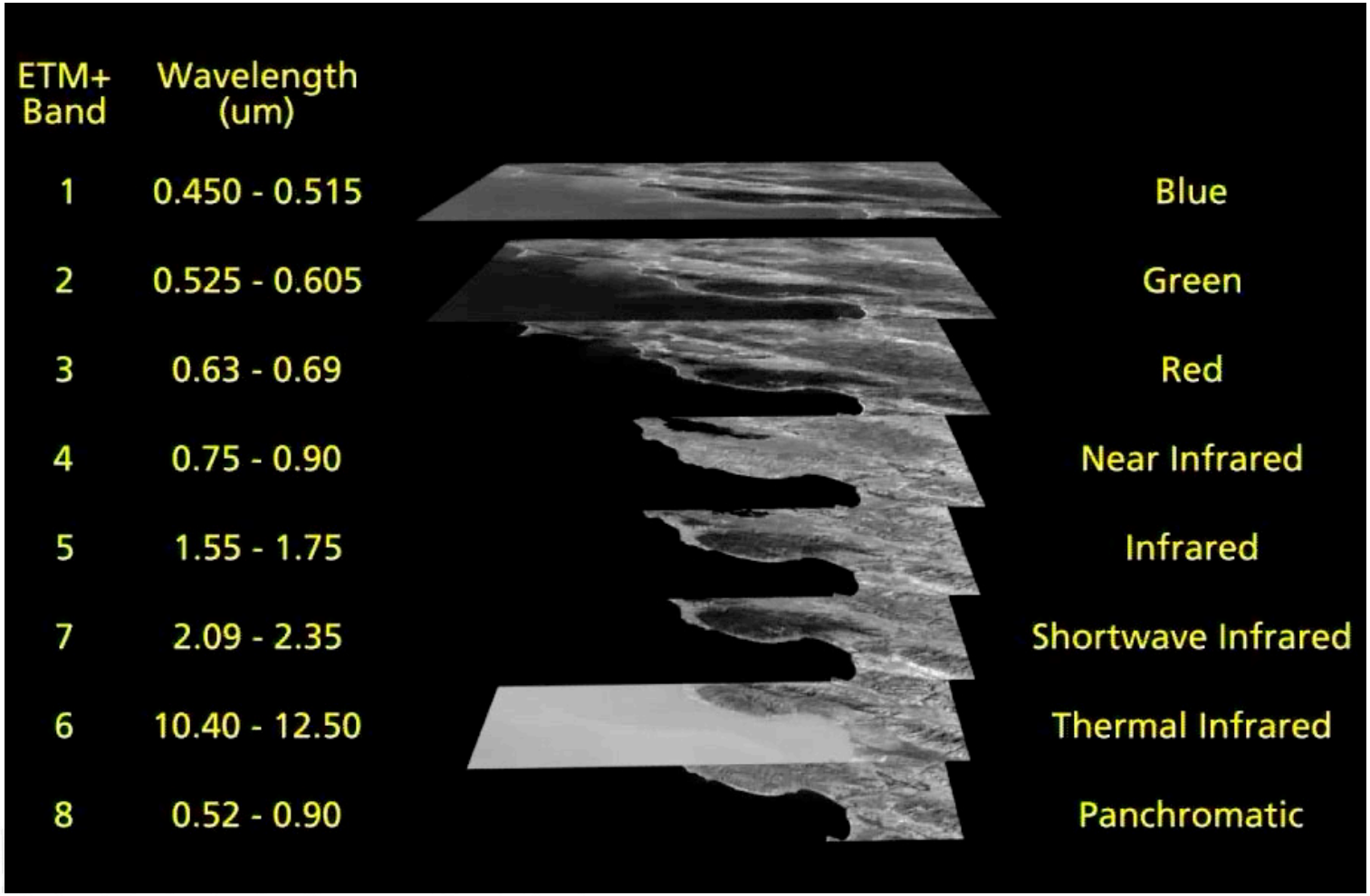
ETM+ Bands

Band Number	µm	Resolution
1	0.45-0.515	30 m
2	0.525-0.605	30 m
3	0.63-0.69	30 m
4	0.75-0.90	30 m
5	1.55-1.75	30 m
6	10.4-12.5	60 m
7	2.09-2.35	30 m
8	0.52-0.9	15 m

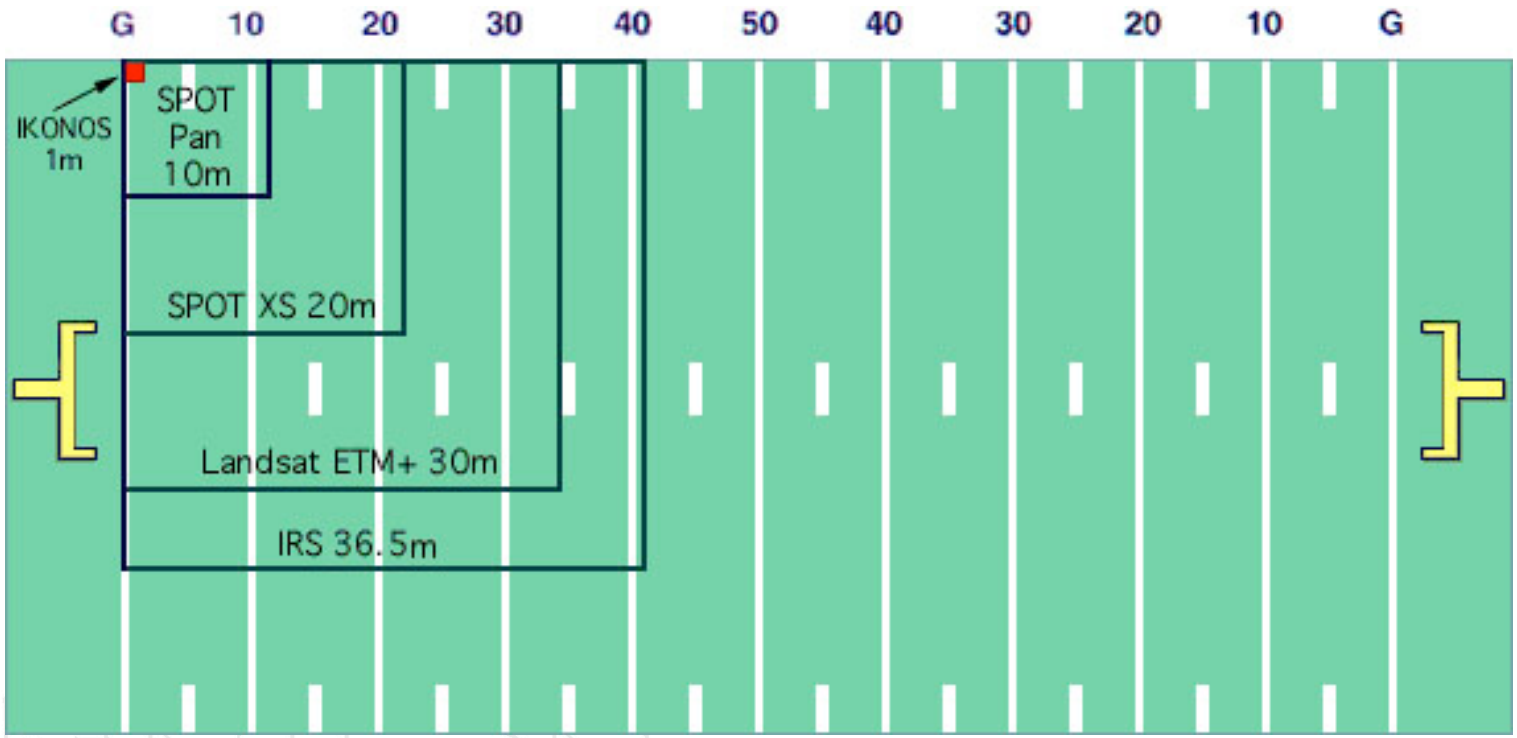


Electromagnetic Spectrum Image from Virtual Hawaii.

Spectral Resolution



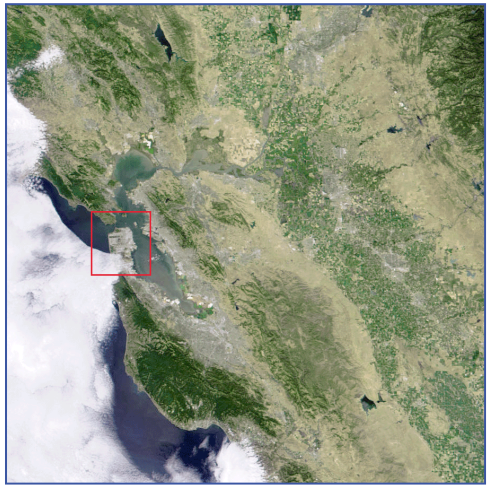
Spatial Resolution



Richard Irish, NASA

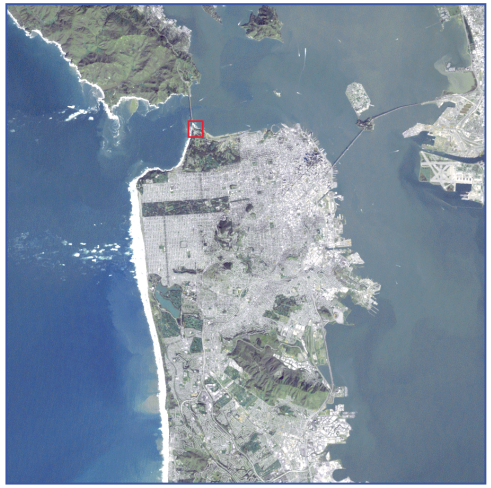
Spatial Resolution

MODIS



250 m

Landsat-7

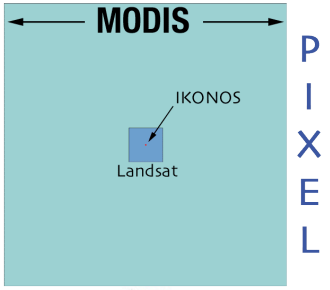


30 m

IKONOS

1 m

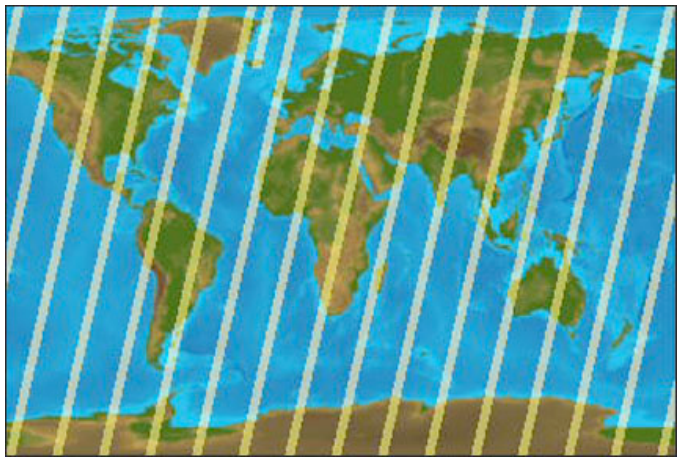
Laura Rocchio, SSAI



Creating a Landsat Image | Jan. 2009

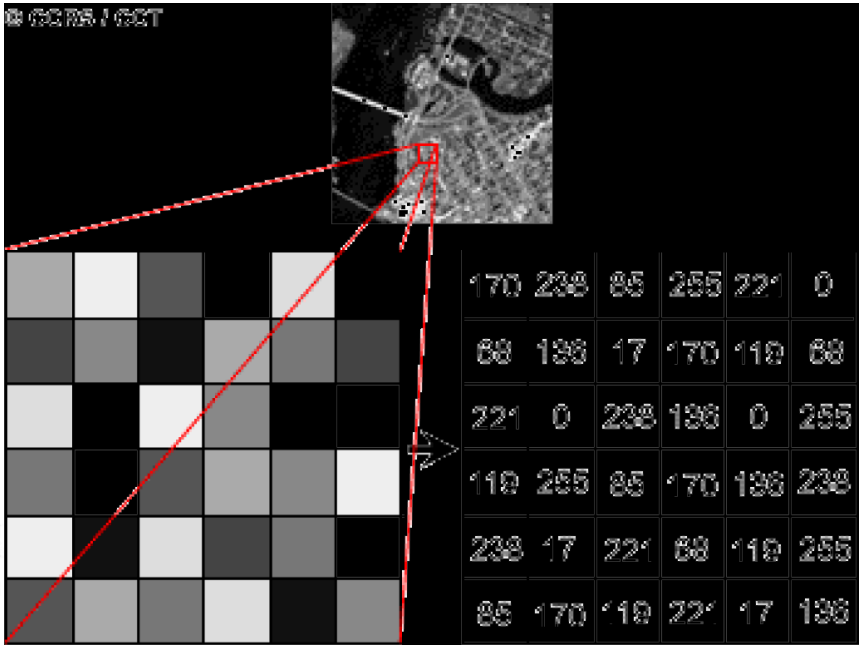
Temporal Resolution

- The revisit time of the satellite over a given point on the ground
- Landsats 4, 5, and 7 all have/had a 16 day repeat cycle
- Landsat 1, 2, and 3 had an 18 day repeat cycle
- Landsat 5 and 7 eight days apart, (see on Glovis)



Radiometric Resolution

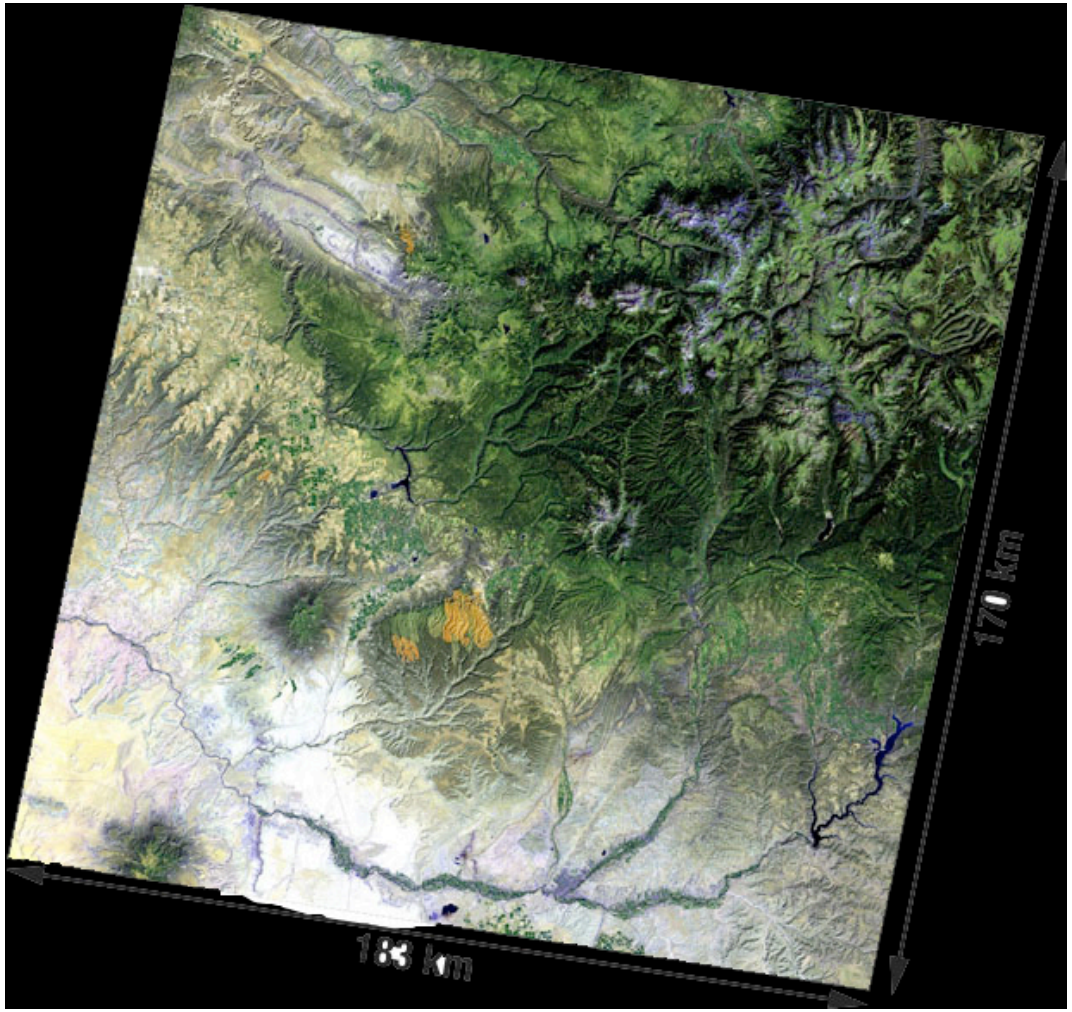
- Data is quantized to 8 bits
  (256 shades of grey)



STEP 2: Find/Download Data

- Scene size
- Scene location / organization
- Archive depth
- Archive interface
- Finding your site
- Downloading data

Scene Size

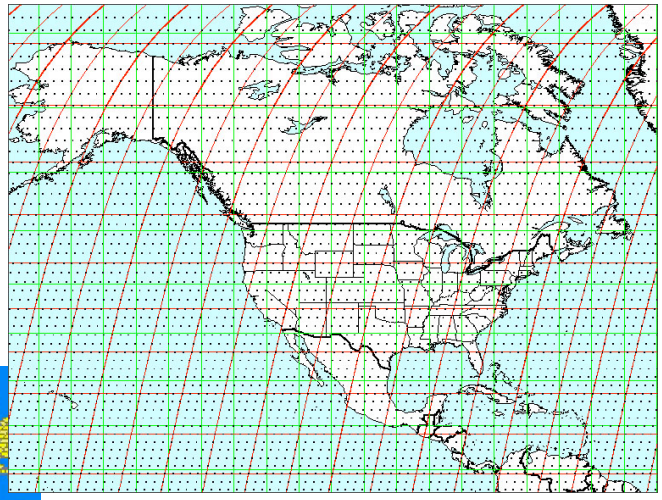


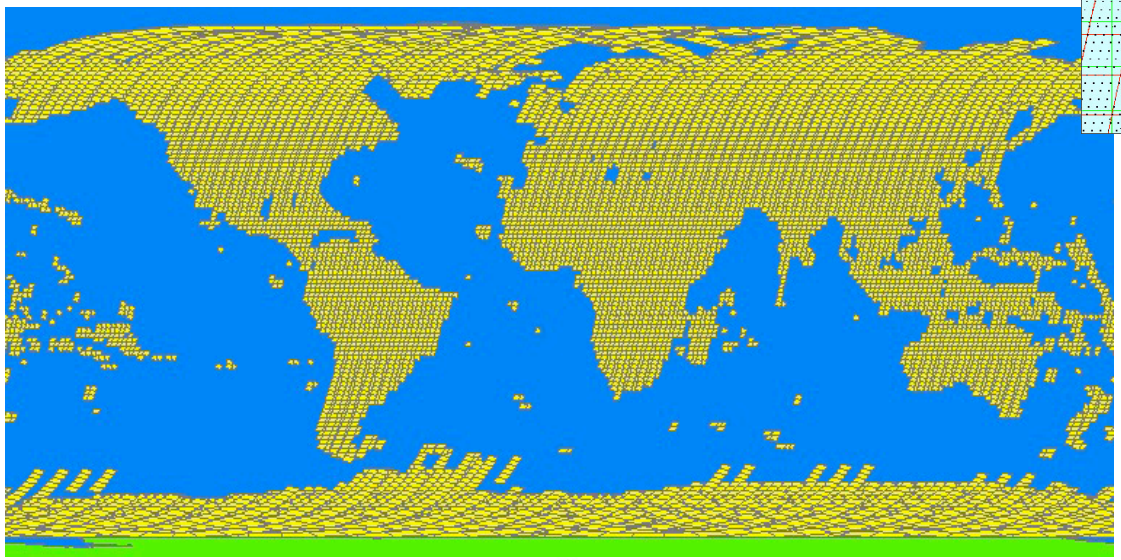
Each scene comes with all spectral bands; data size up to 800 Mb

Scene location / organization

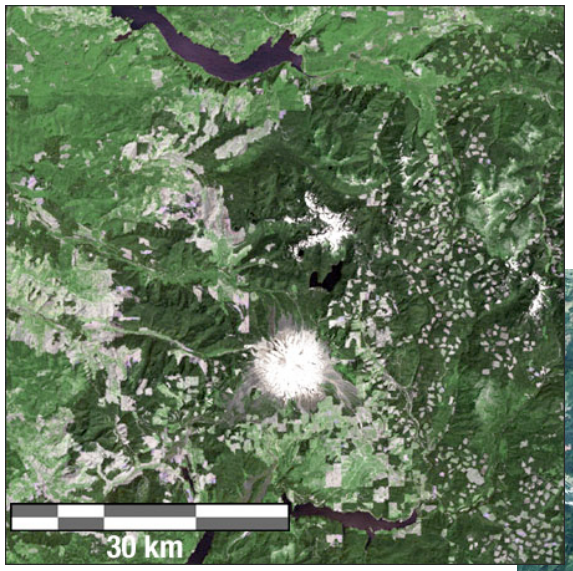
- Each scene has a unique Worldwide Reference System (WRS) Path/Row locator

L1-L3 WRS-1
L4-L7 WRS-2





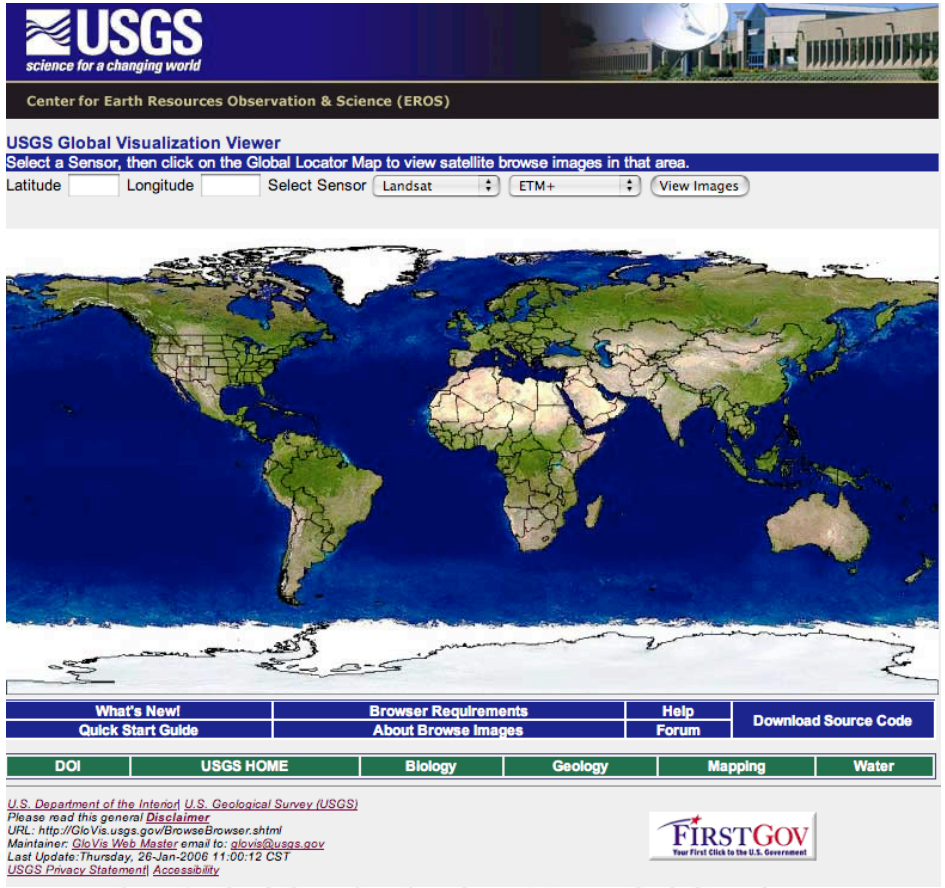
Archive Depth



Landsat has been collecting data for 37 years!

Archive Interface

USGS Global Visualization Viewer



- All data FREE!
- Data format: GeoTIFF, UTM
- http://glovis.usgs.gov/

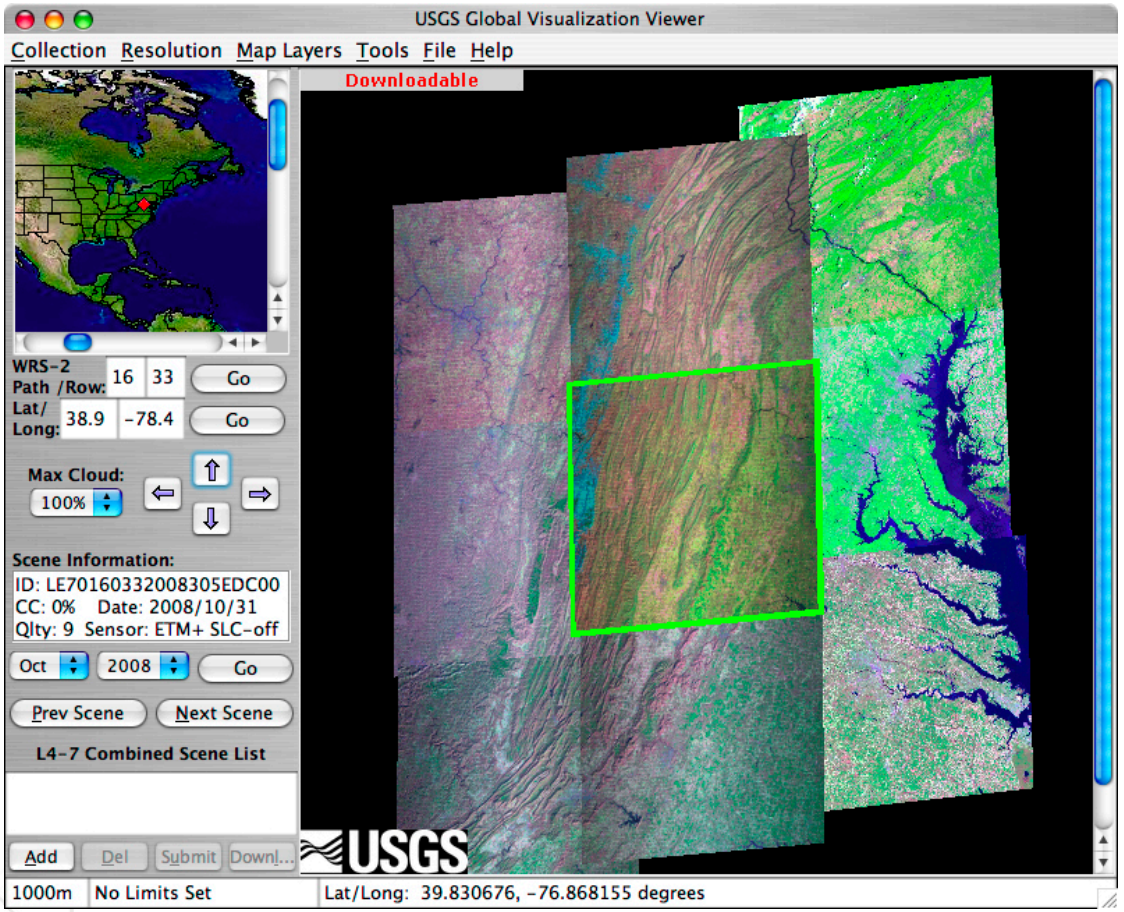
USGS
science for a changing world

Finding your site

- Map-based selection
- Coordinate location
- Path Row selection
- *Suggestion: make note of your Path/Row*

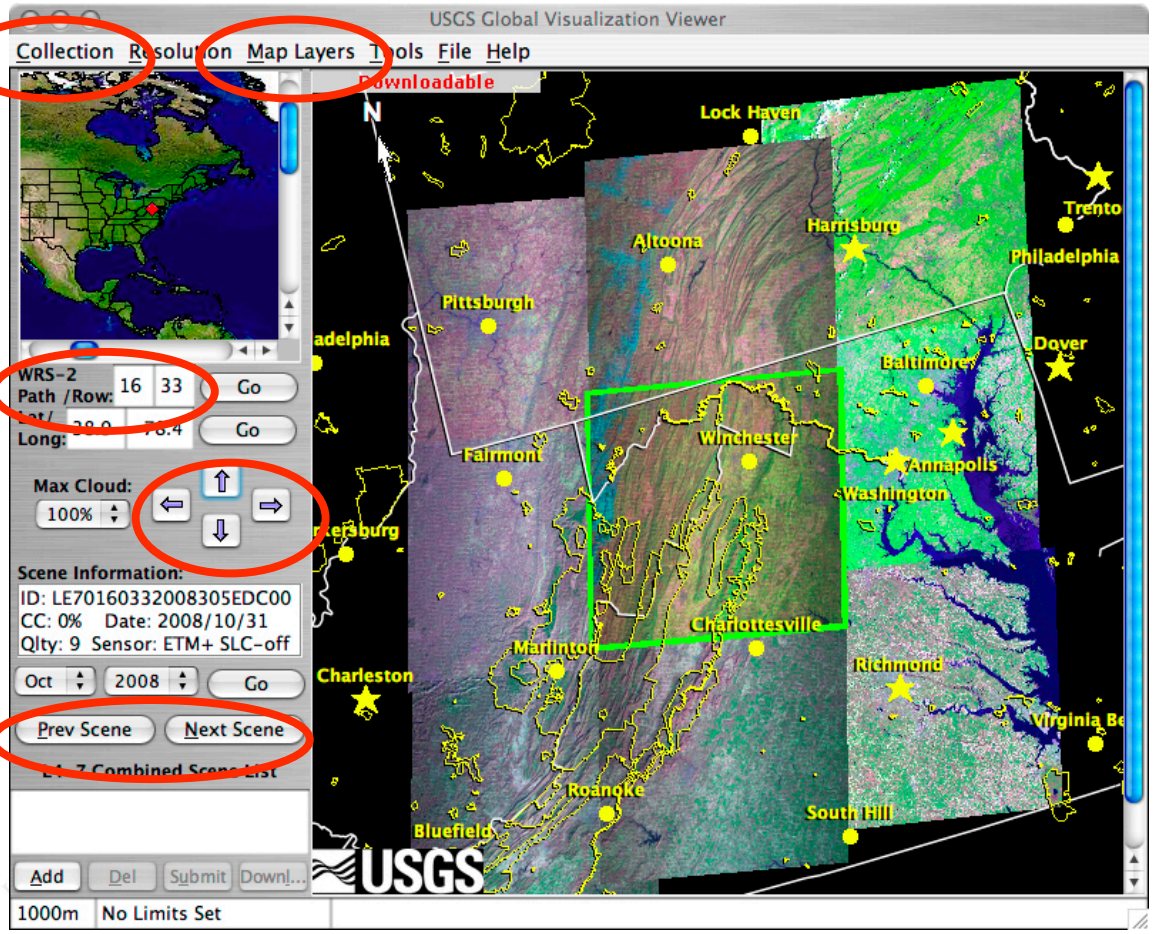
Navigating Glovis

- Click on map (or enter coordinates)
- Make sure your pop-up blocker is off

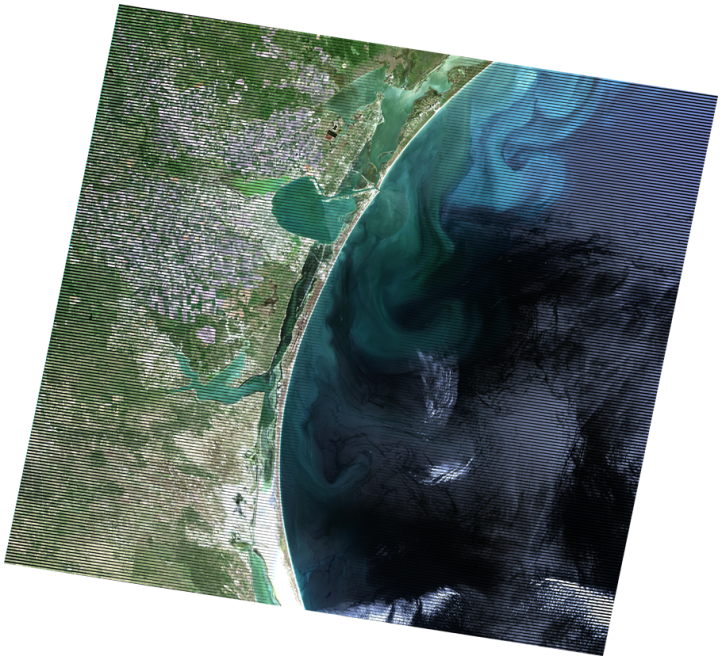


Navigating Glovis

- Under Collection, select Landsat Archive > L4-7 combined
- Turn on Map Layers (if you wish)
- To find your site, either enter coordinates or use arrows to navigate to it by hand
- Once you find your site, make note of the Path / Row
- You can increase the image resolution under “Resolution”
- Use “Prev Scene” and “Next Scene” buttons to toggle date



Note about SLC-off Landsat 7 Data



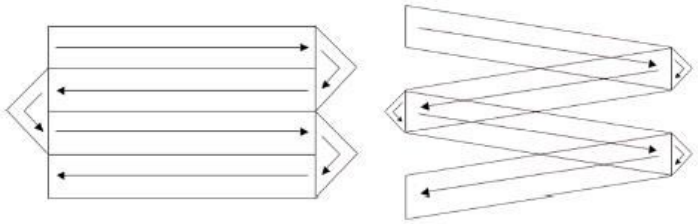
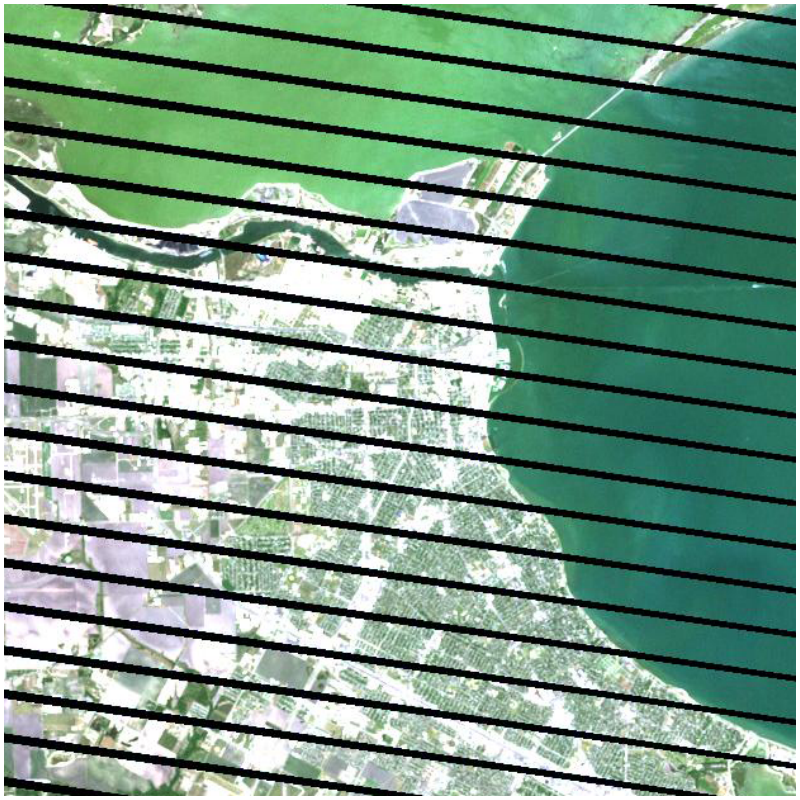


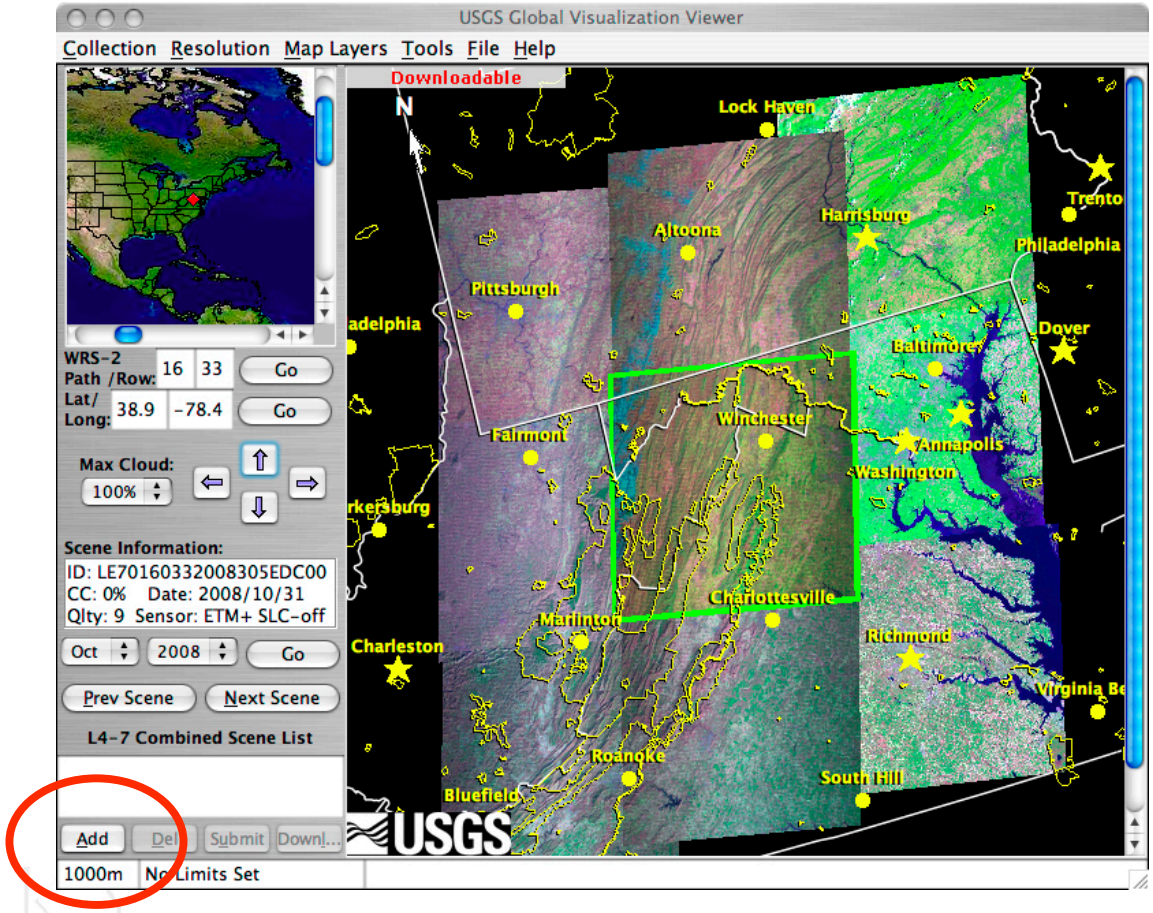
Fig. 1

L7 data collected after 5/30/03 has missing data

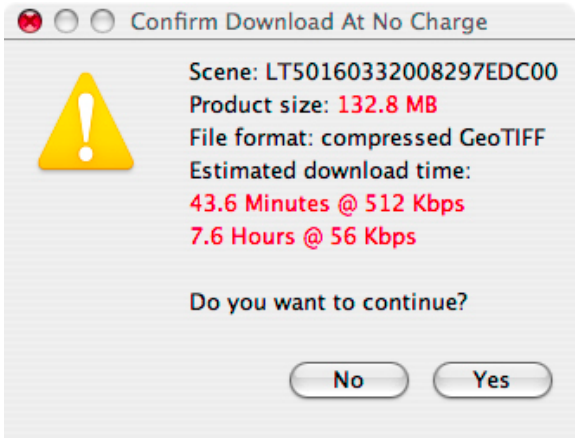


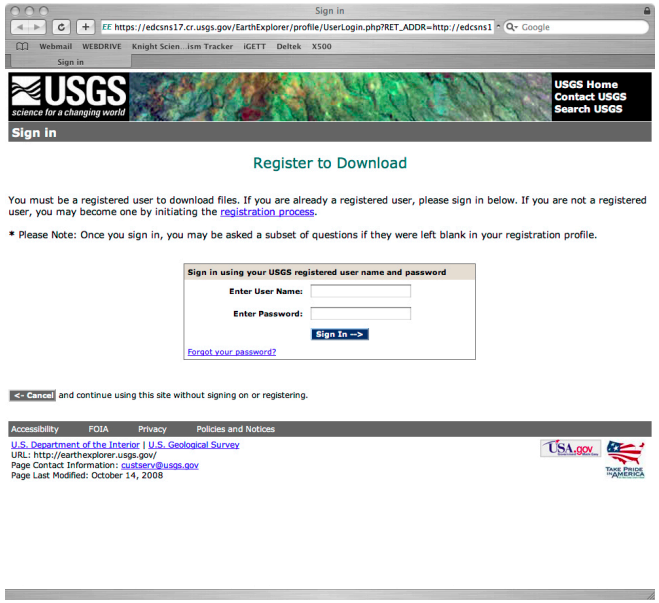
Navigating Glovis

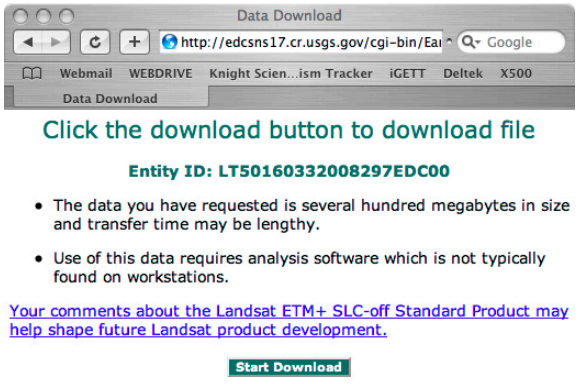
- Once you find your site and the scene that you want, use the “Add” button to select it
- Then either “Order” or “Download” the data
- Note: you’ll need to create a user account for yourself
- The data will come in a compressed format (gunzipped and tarred)
- Use an extraction program such as WinZIP to uncompress the data



Download Data







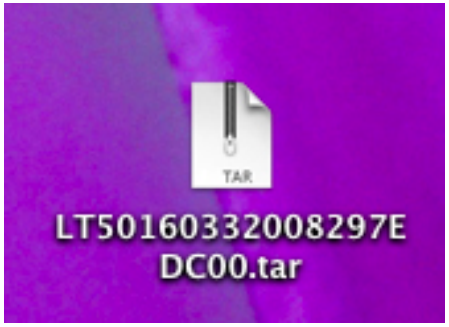
STEP 3: Create an Image

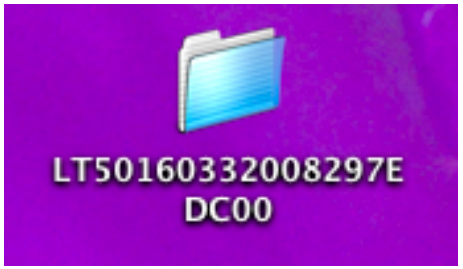
- Decompress data (WinZip, StuffIt, 7-Zip)
- Create a composite using Photoshop

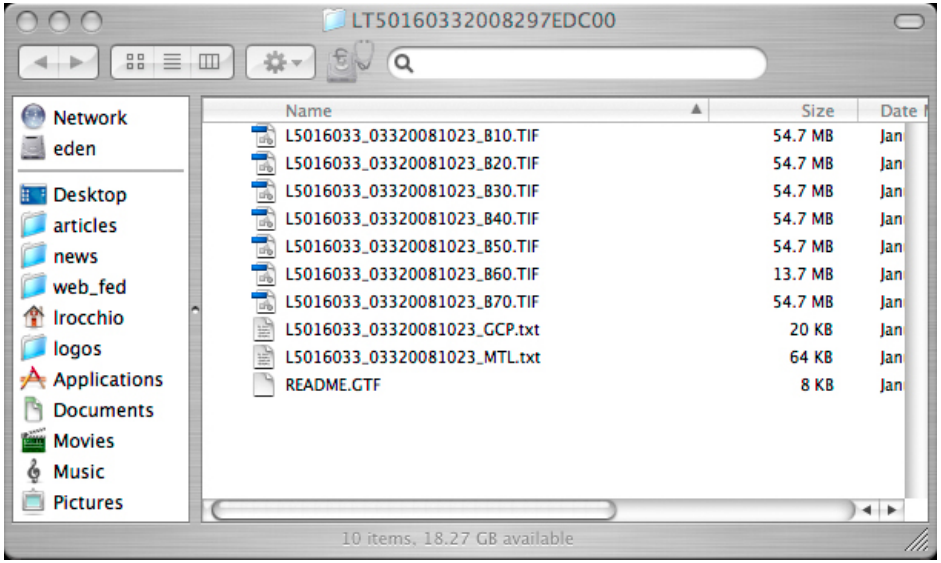
(Alternatively you can use free image processing software such as MultiSpec)

Decompress File

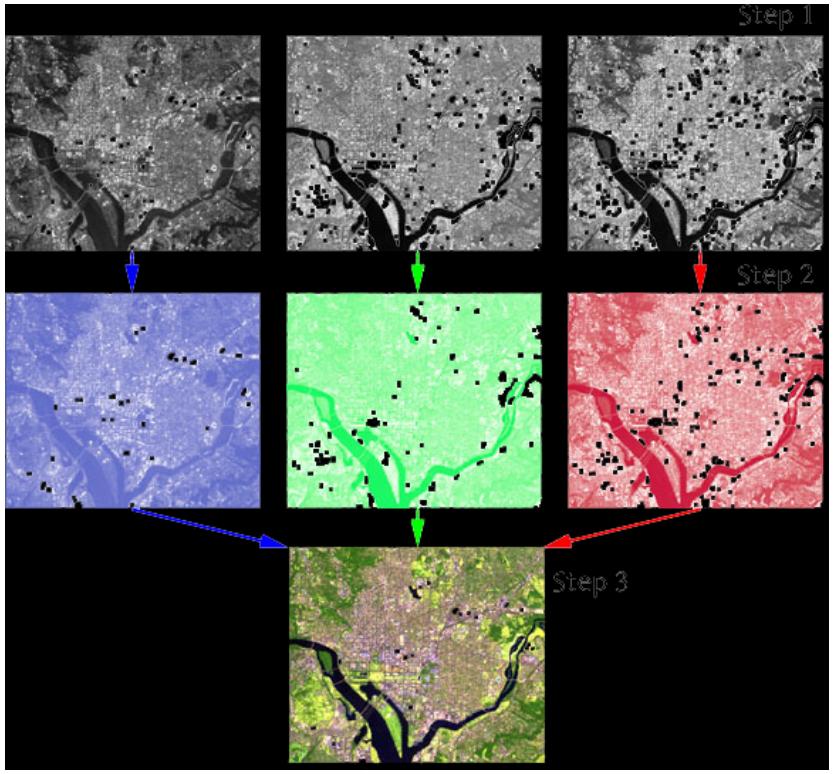
- Don’t panic!
- Decompress data
  (WinZip, StuffIt, 7-Zip)



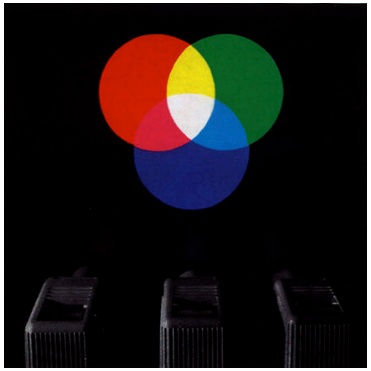




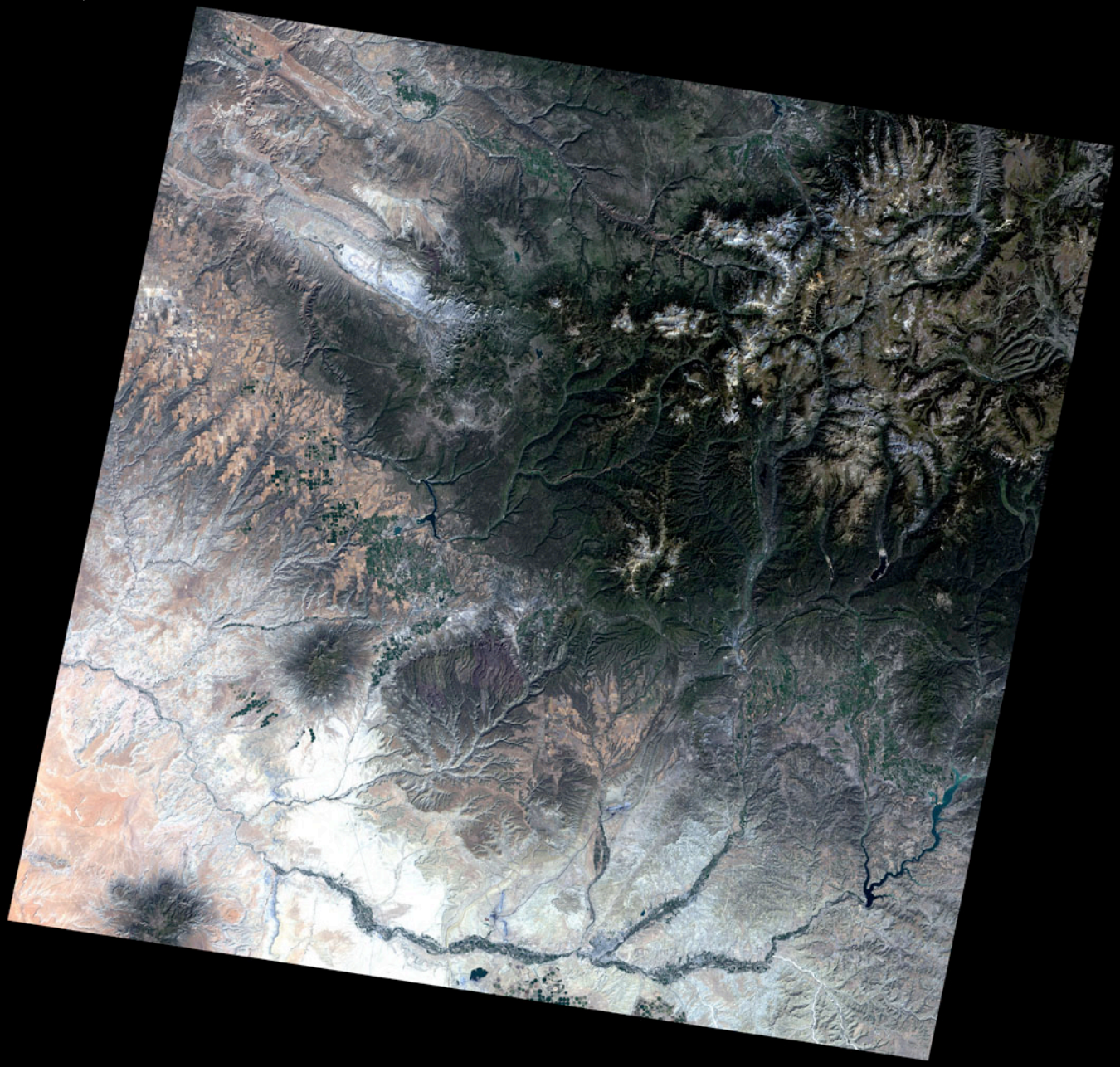
Create a Composite



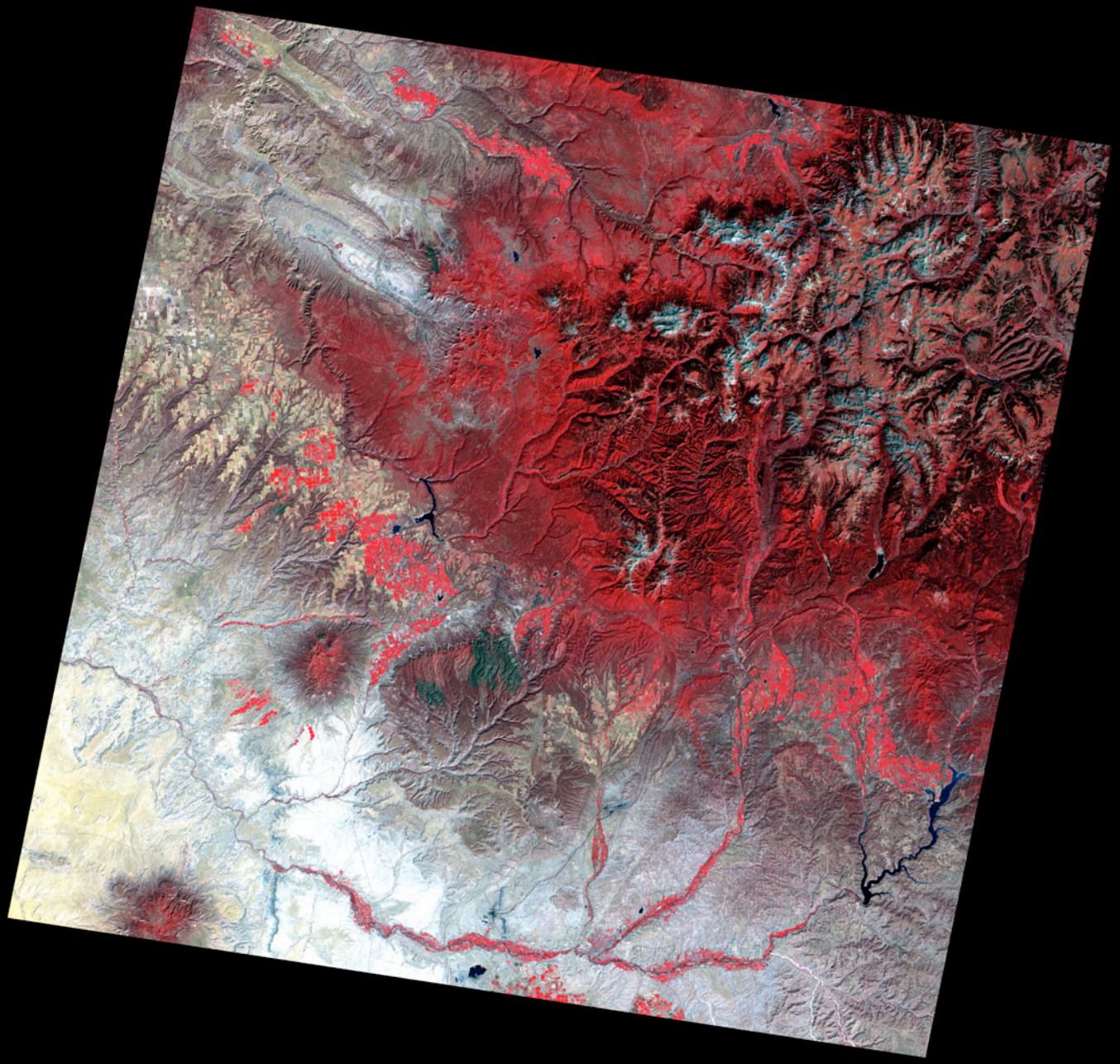
- The bands or channels can be composited into RGB images



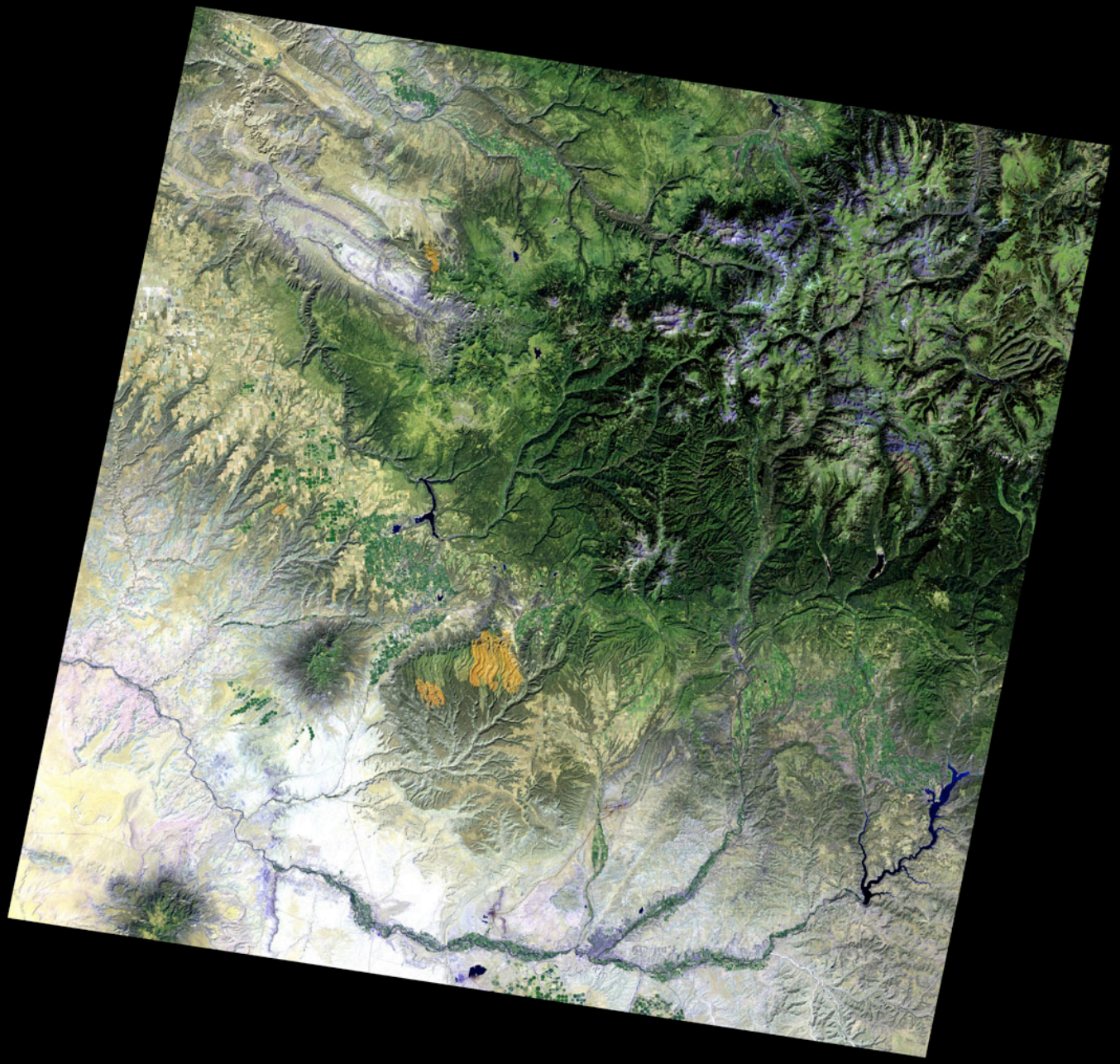
Landsat 7, Path 35 Row 34, 09.12.00



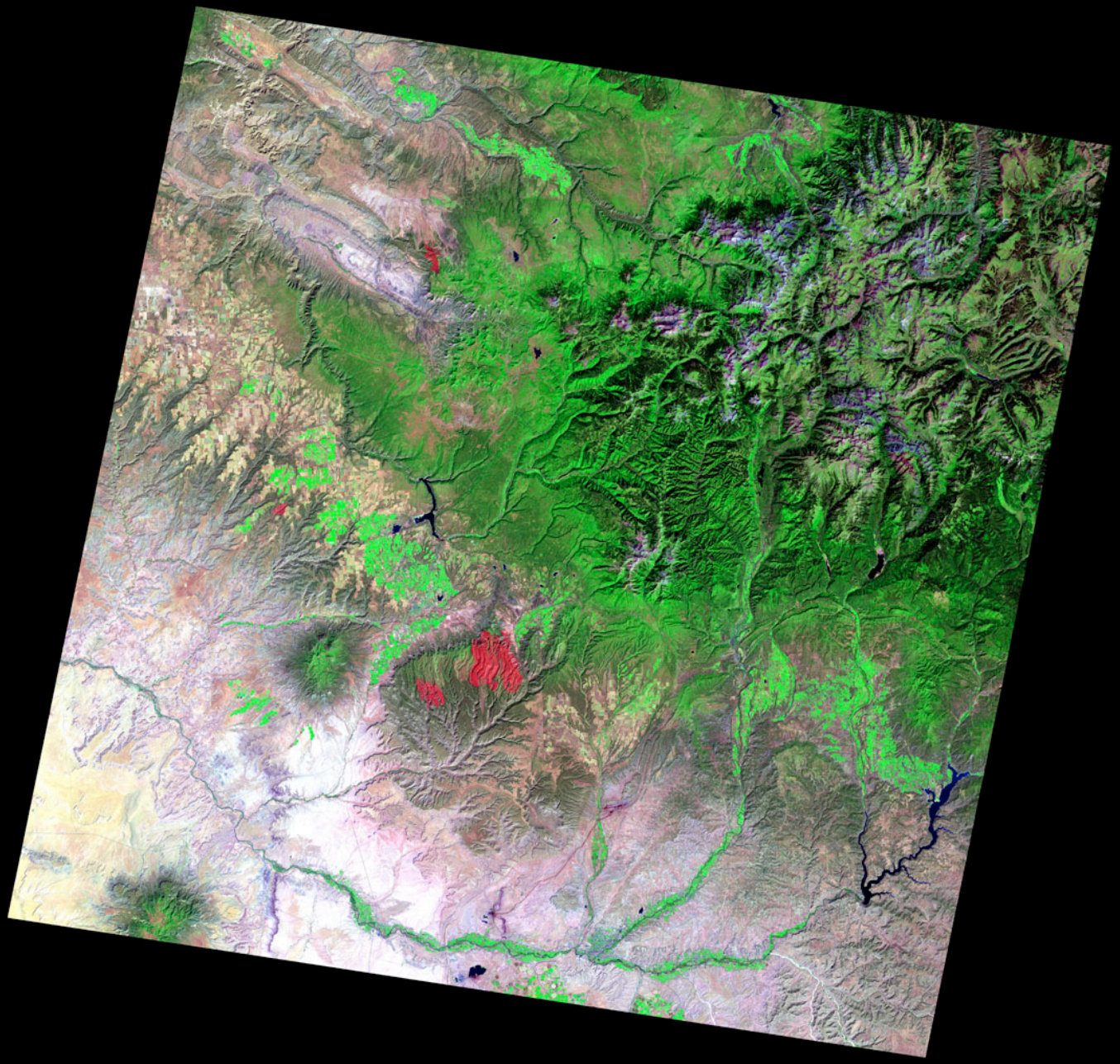
3,2,1



4,3,2



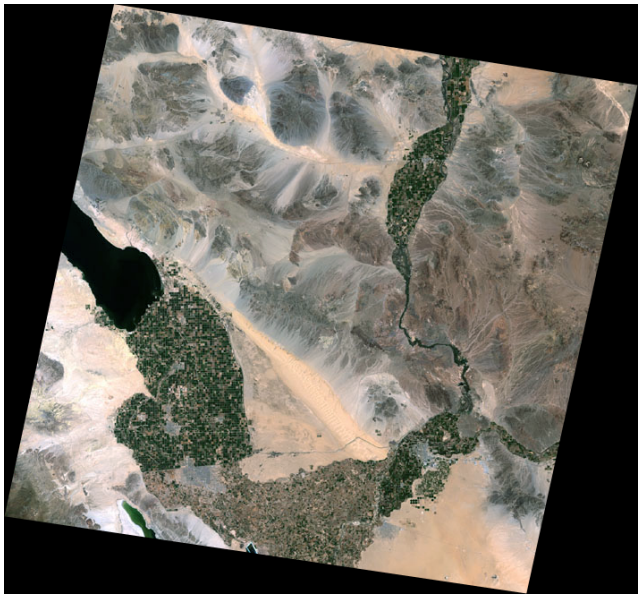
7,5,2



7,4,2

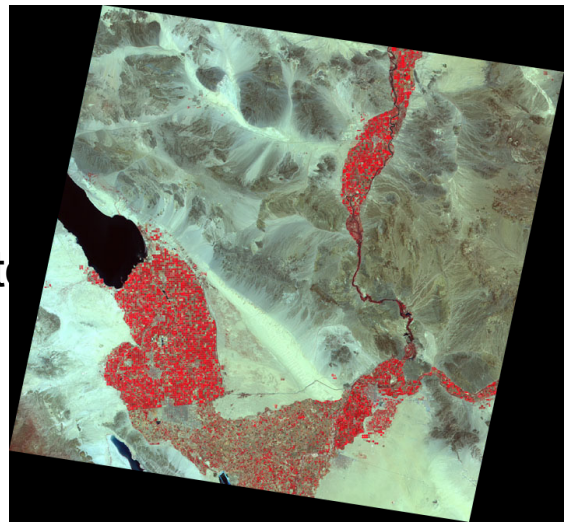
Band Combinations: True Color

- Red (red), green (green), blue (blue) – the Landsat TM and ETM+ 3-2-1 composite
- The "natural color" band combination.
- In this combination, ground features appear in colors similar to their “true” appearance:
    - Healthy vegetation is green, recently cleared fields are very light, unhealthy vegetation is brown and yellow, roads are gray, and shorelines are white.
    - This band combination provides the most water penetration and superior sediment and bathymetric information.



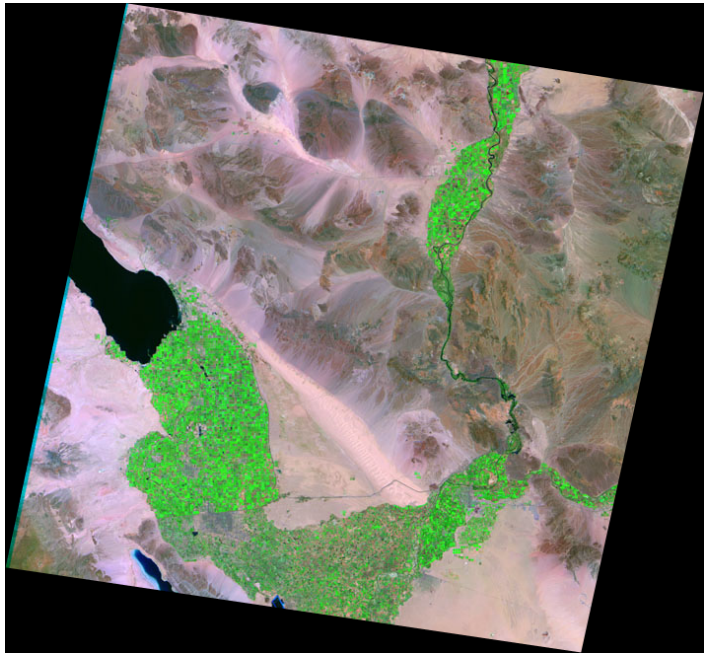
Band Combinations – False Color Composite

- Near IR (red), red (green), green (blue) – the Landsat TM and ETM+ 4-3-2 composite
- The standard "false color" composite. This band combination gives results similar to traditional color infrared aerial photography.
    - Vegetation appears in shades of red, urban areas are cyan blue, and soils vary from dark t light browns.
    - Ice, snow and clouds are white or light cyan.
    - Coniferous trees will appear darker red than hardwoods. Densely populated urban areas are shown in light blue.
    - Generally, deep red hues indicate broad leaf and/or healthier vegetation while lighter reds signify grasslands or sparsely vegetated areas.



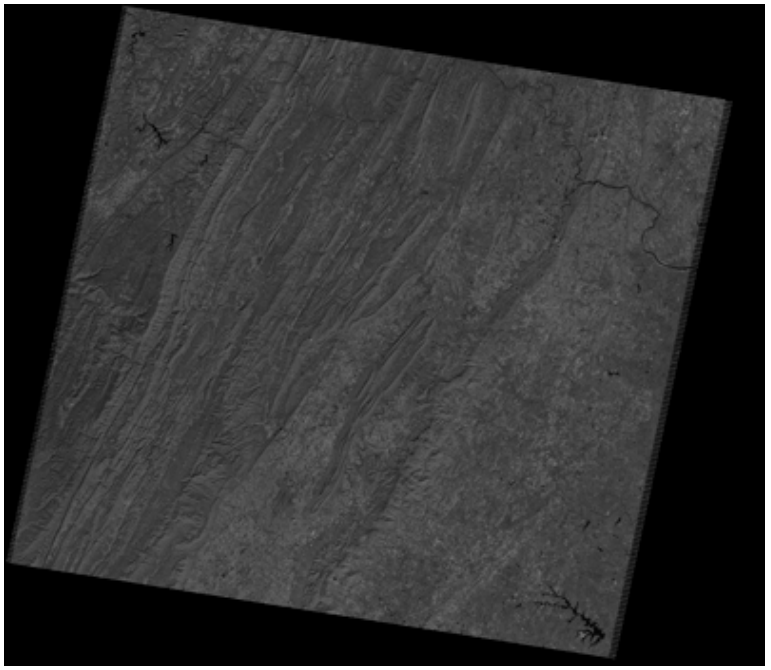
Band Combinations: 7-4-2 Composite

- Middle IR (red), Near-IR (green), green (blue) – the Landsat TM and ETM+ 7-4-2 composite
- This combination provides a "natural-like" rendition, while also penetrating atmospheric particles and smoke.
    - Healthy vegetation will be a bright green, pink areas represent barren soil, oranges and browns represent sparsely vegetated areas.
    - Dry vegetation will be orange and water will be blue.
    - Sands, soils and minerals are highlighted in a multitude of colors.
    - Urban areas appear in varying shades of magenta.
- This band combination is useful for geological, agricultural and wetland studies.
- If there were any fire scars in this image they would appear red. This combination is used in the fire management applications for post-fire analysis of burned and non burned forested areas.



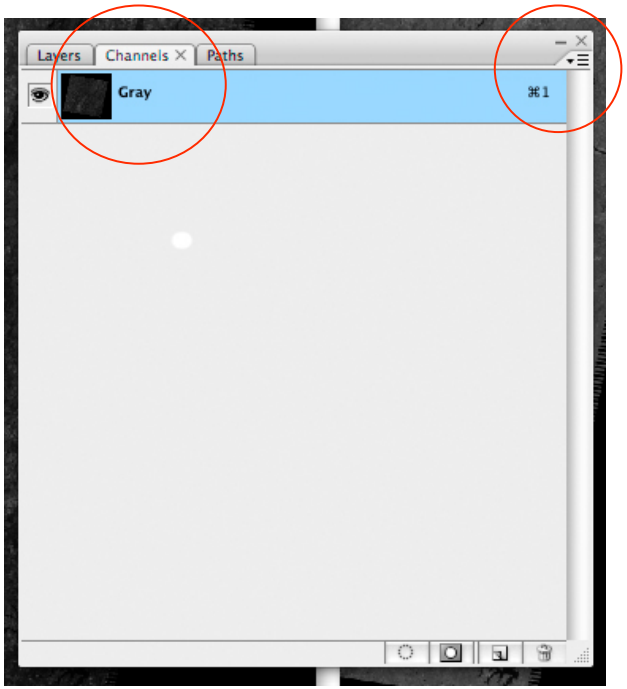
Create Image Composite in Photoshop

- Open Photoshop
- File > Open; select three TIFF bands you want to use
- Note: Band is shown in the file name as “_B#0” so Band 1 is “_B10”
- Each of the three bands will open up; they are greyscale images

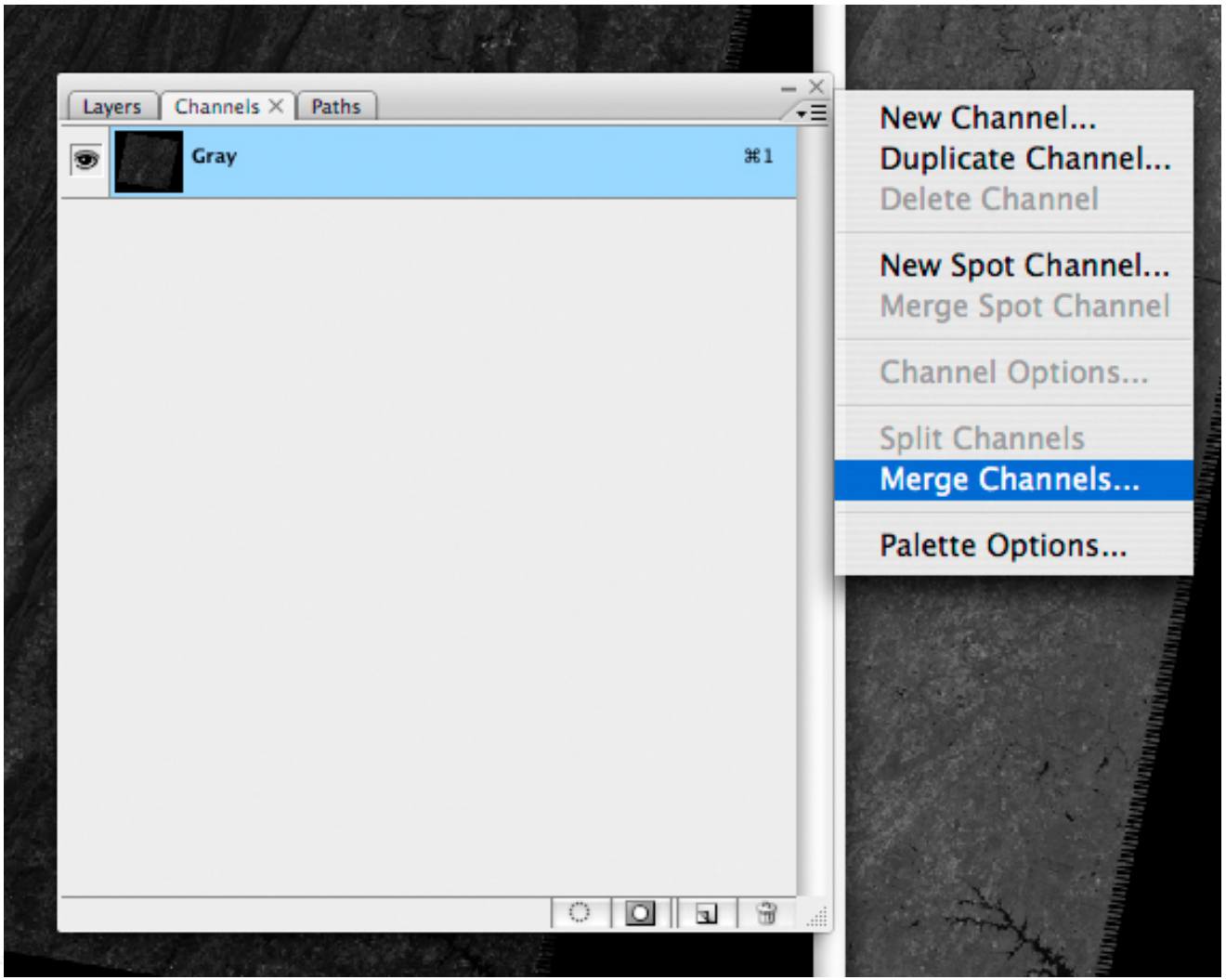


Composite Image in Photoshop

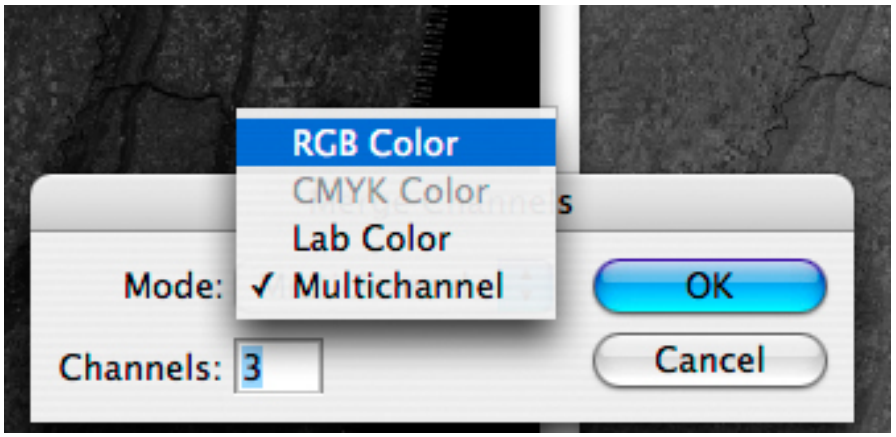
- Go to Windows > Channels and make sure a check mark is by Channels
- Find the Channel Palette window
- Click on the downward arrow in the upper right corner of the Palette to open the menu



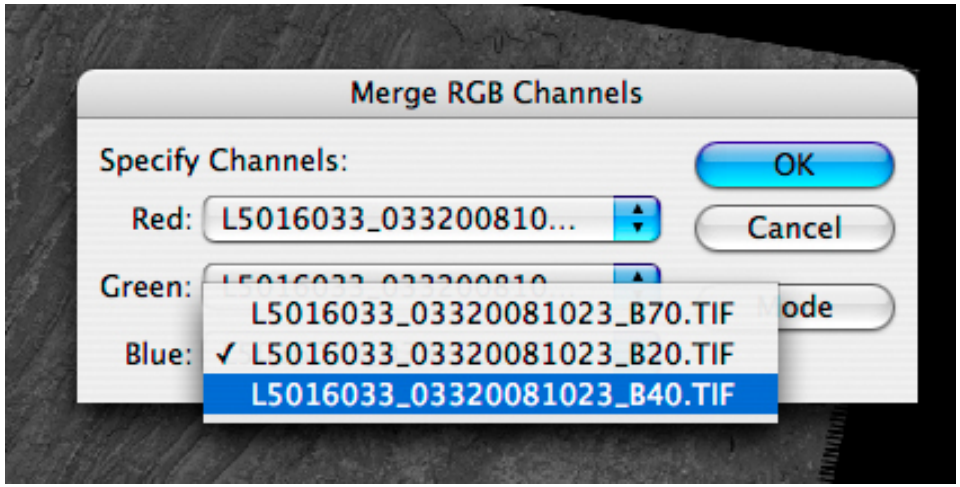
- From the Channel Palette menu, select “Merge Channels”



- In the Merge Channel window, change the Mode: to “RGB Color”; OK

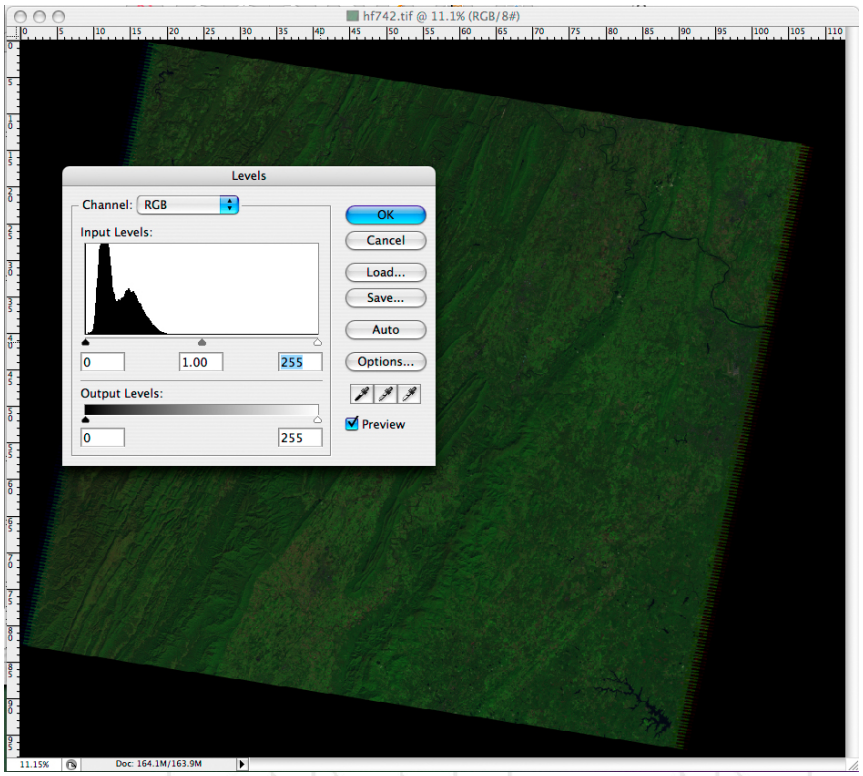


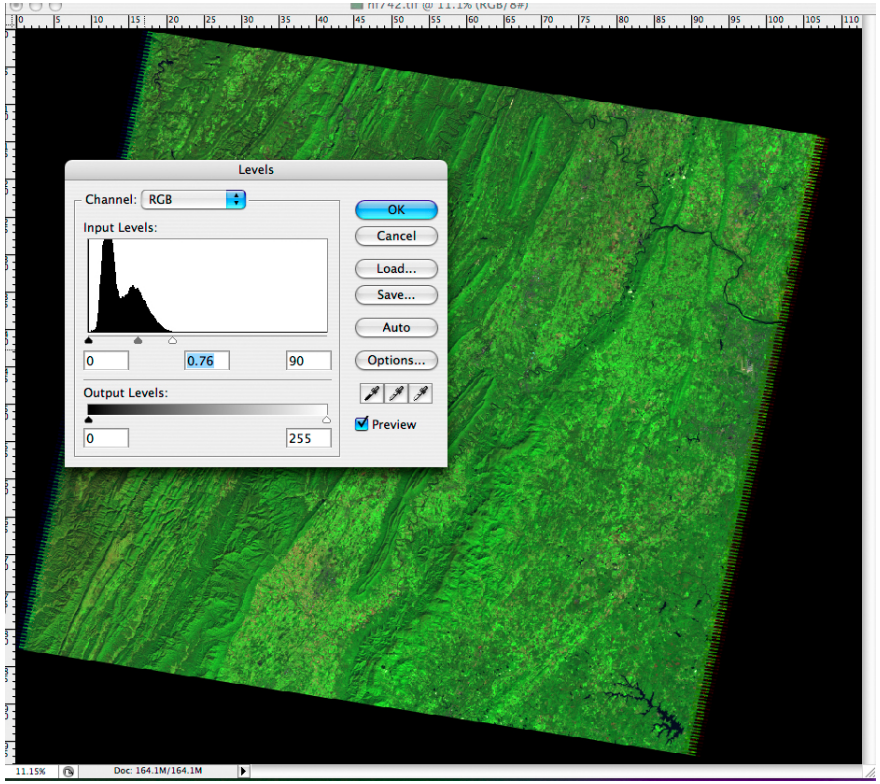
- Order your files in the desired order; click OK



Your RGB Composite Appears

- Use Image > Adjustments > Levels to adjust the colors





Crop Image as Needed

Landsat TM Band Applications

- Band 1 (0.45 - 0.52 blue): soil/vegetation discrimination; bathymetry/ coastal mapping; cultural/urban feature identification
- Band 2 (0.52 - 0.60 green): green vegetation mapping (measures reflectance peak); cultural/urban feature identification
- Band 3 (0.63 - 0.69 red): vegetated vs. non-vegetated and plant species discrimination (plant chlorophyll absorption); cultural/urban feature identification
- Band 4 (0.76 - 0.90 NIR): identification of plant/vegetation types, health, and biomass content; water body delineation; soil moisture
- Band 5 (1.55 - 1.75 Mid-IR): sensitive to moisture in soil and vegetation; discriminating snow from clouds
- Band 6 (10.4 - 12.5 TIR): vegetation stress and soil moisture discrimination; thermal mapping (urban, water)
- Band 7 (2.08 - 2.35 Mid-IR): discrimination of mineral and rock types; sensitive to vegetation moisture content