Exercise 3: Data Preprocessing and Visualization

70 Points scaled to 20 Points

Introduction

In this exercise, you will preprocess Landsat 8 Operational Land Imager (OLI) data to create a dataset covering the extent of the Monongahela National Forest. This will include stacking bands, mosaicking scenes, and clipping/masking to a polygon extent. You will then symbolize the data using different band combinations and false color composites.

Objectives

- *Describe and explain common multispectral imagery preprocessing tasks*
- *Perform preprocessing tasks (band stacking, mosaic, and masking)*
- *Create and interpret false color composites*

Prerequisite Materials

- Modules: Spectral Signatures, RS Satellites, Contrast Enhancements, and Georeferencing/Preprocessing
- Videos
    - Lab 3 Intro: https://youtu.be/2lxPYLx2eI0
    - Band Combinations: https://youtu.be/_RFsszA1HLY
    - Band Stack and Combinations: https://youtu.be/sf_MAi5pmw8
    - Image Contrast Stretch: https://youtu.be/krJqBctZqxY
    - Clip Raster: https://youtu.be/MaUKazySYq8
    - Mosaic to New Raster: https://youtu.be/J3LCVmIJ_Hs

Data

- **LC08_L2SP_017033_20210308_20210317_02_T1:** Landsat 8 OLI/TIRS data collected on March 8, 2021 for Path 17/Row 33, which covers a portion of West Virginia. Data are from Landsat Collection 2 Level-2. See the following table for band designations. OLI bands have been converted to surface reflectance.
- **LC08_L2SP_017034_20210308_20210317_02_T1:** Landsat 8 OLI/TIRS data collected on March 8, 2021 for Path 17/Row 34, which covers a portion of West Virginia. Data are from Landsat Collection 2 Level-2. See the following table for band designations. OLI bands have been converted to surface reflectance.

- **mon_forest_boundary.shp:** vector polygon boundary of Monongahela National Forest.

Band	Native Spatial Resolution
Band 1 (Coastal Aerosol)	30 m
Band 2 (Blue)	30 m
Band 3 (Green)	30 m
Band 4 (Red)	30 m
Band 5 (NIR)	30 m
Band 6 (SWIR 1)	30 m
Band 7 (SWIR 2)	30 m
Band 8 (Panchromatic)	15 m
Band 9 (Cirrus Cloud)	30 m
Band 10 (Thermal 1)	100 m
Band 11 (Thermal 2))	100 m

Background Questions

Question 1. Explain the difference between digital numbers (DNs), radiance, and surface reflectance. (4 Points)

Question 2. Explain the concept of dynamic range adjustment (DRA). (4 Points)

Question 3. Explain the difference between a linear and percent clip stretch for contrast enhancement. (4 Points)

Question 4. Explain the difference between a linear and standard deviation stretch for contrast enhancement. (4 Points)

Question 5. Why are bilinear interpolation and cubic convolution inappropriate techniques for resampling categorical raster data? (4 Points)

Question 6. Explain the difference between the bilinear interpolation and cubic convolution resampling methods. (4 Points)

Question 7. Explain the difference between a raster file and a mosaic dataset. (4 Points)

Question 8. Explain two methods for determining the location of seam lines when creating an image mosaic. (4 Points)

Question 9. Explain two methods that can be used to perform color correction when an image mosaic is created. (4 Points)

Question 10. Explain the concept of pansharpening. What is the purpose and what inputs are required? (4 Points)

Required Steps

- ❖ Download and uncompress the data.
- ❖ Create a new ArcGIS Pro project.
- ❖ Add the **mon_forest_boundary** layer to the project.
- ❖ Stack the bands for the Path 17/Row 33 and Path 17/Row 34 data separately using the Composite Bands Tool. You only need to include the blue, green, red, NIR, SWIR1, and SWIR2 bands, and they should be in this order. Use the file names to select the correct bands. For example, Band 2 will end in _B2.TIF.
- ❖ Use the Mosaic To New Raster Tool to mosaic the two scenes to a single dataset.
- ❖ Use the Clip Raster Tool to clip the mosaic to the extent of the Monongahela National Forest. Pixels outside of the extent should be masked.

Answer the following questions. You will need to change the band composites to visualize the data and answer the questions.

Question 11. Some of the high elevation areas have snow cover, which appears white in a simulated true color composite. Explain why it appears white based on visible spectrum reflectance of snow. (4 Points)

Figure 1. Snow in simulated true color composite.

Question 12. Snow also appears white when using a standard false color composite (Red = NIR, Green = Red, Blue = Green). Explain why it appears white based on visible spectrum and NIR spectral reflectance of snow. (4 Points)

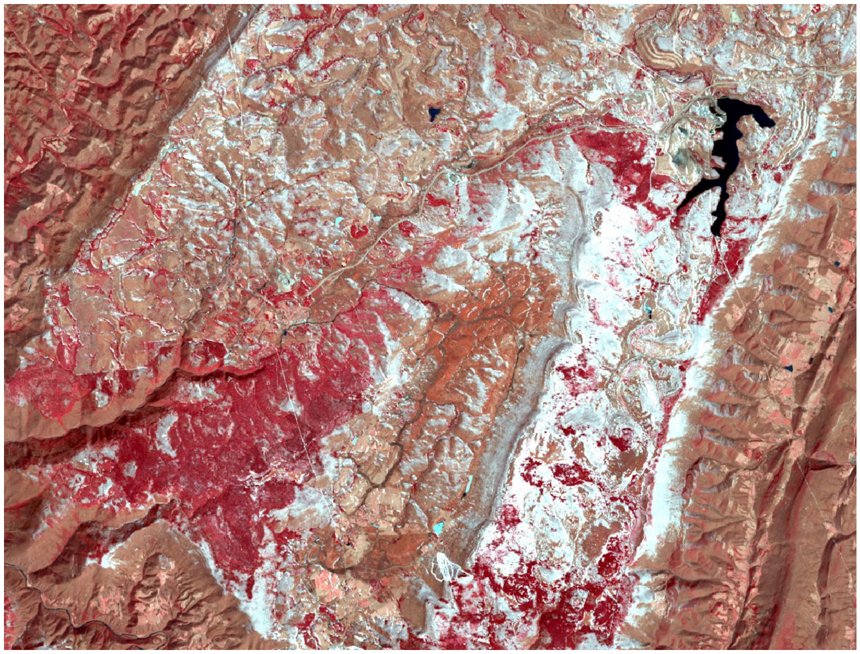

Figure 2. Snow in false color composite (Red = NIR, Green = Red, Blue = Green).

Question 13. When using this following false color composite, snow appears blue/green (Red = SWIR2, Green = NIR, Blue = Green). Explain this based on visible, NIR, and SWIR spectrum spectral reflectance of snow. (4 Points)

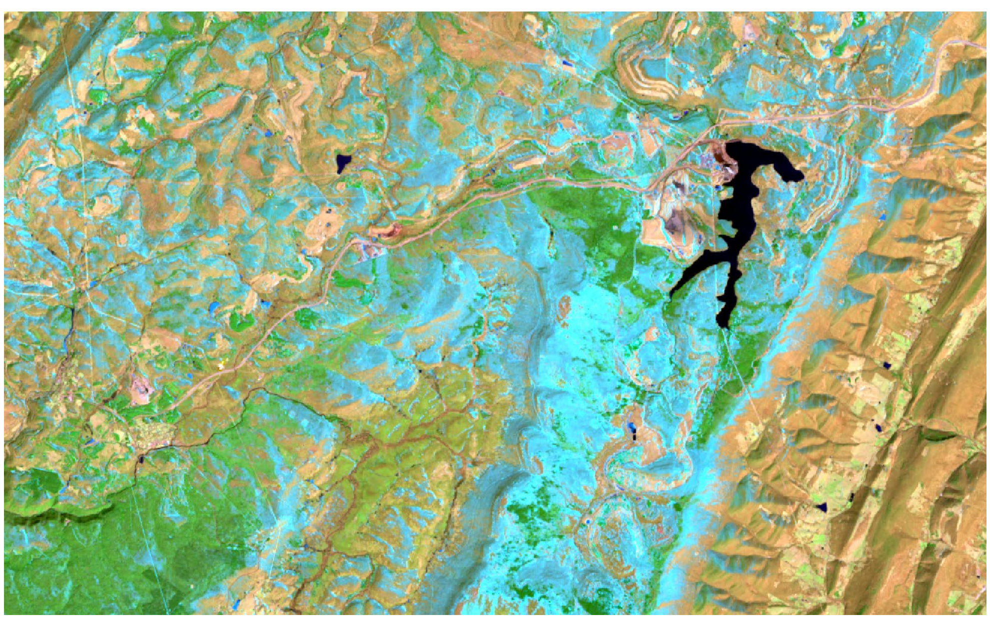

Figure 3. Snow in false color composite (Red = SWIR2, Green = NIR, Blue = Green).

Question 14. Barren areas take on a pink hue using the following false color composite (Red = SWIR2, Green = NIR, Blue = Green). Explain this based on visible, NIR, and SWIR spectrum spectral reflectance of bare rock or soil. (4 Points)

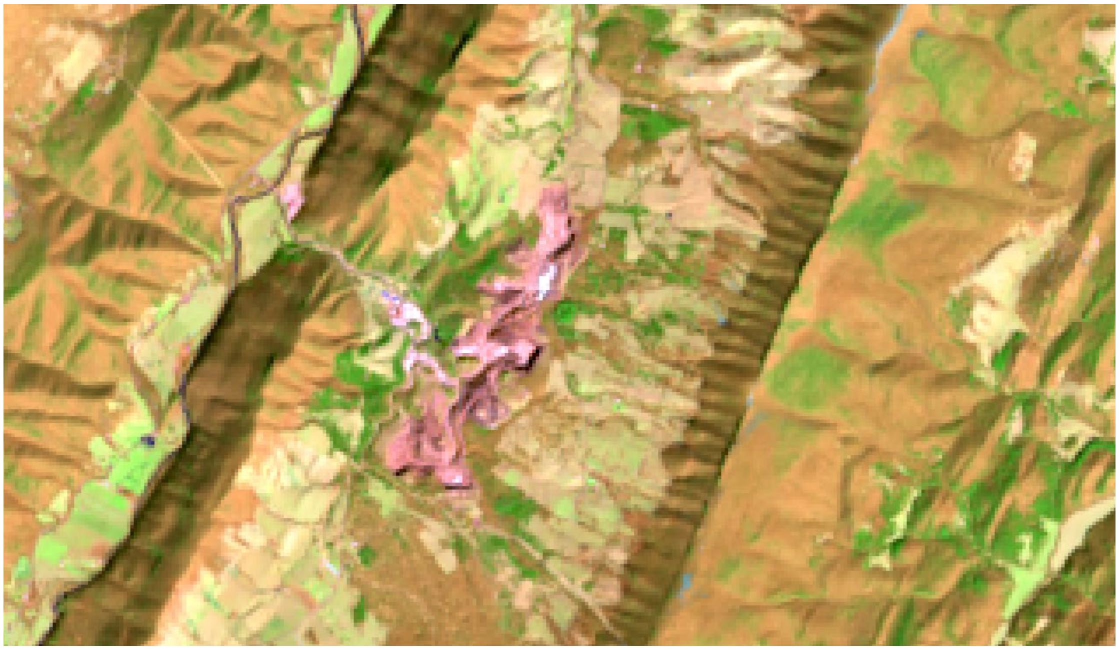

Figure 4. Barren area in query (Red = SWIR2, Green = NIR, Blue = Green).

Question 15. Explain the strong differentiation of deciduous and conifer trees in the early March imagery. (4 Points)

Deliverable 1. Create a map layout that includes 3 separate map frames that show the Landsat 8 OLI data using different composites: (1) Red = Red, Green = Green, and Blue = Blue; (2) Red = NIR, Green = Red, Blue = Green; and (3) Red = SWIR2, Green = NIR, Blue = Green). Label each frame with the band combination used. Make sure to provide a title, scale bars, north arrows, and cite the Landsat Program. The layout will be judged based on neatness, presentation, and use of space. (10 Points)