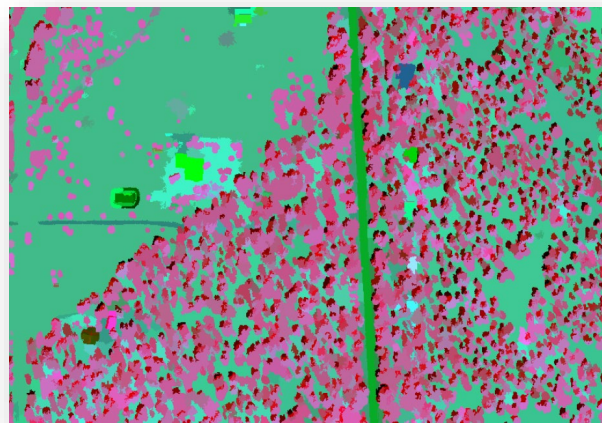# EXERCISE 1
# Segmentation in ArcGIS Pro



## Introduction

ArcGIS Pro is a ribbon-based application. Commands are available from the ribbon at the top of the ArcGIS Pro window and specialized functionality is found in panes (dockable windows) that are opened as needed. Image Segmentation, found in the Imagery tab, is a valuable tool to analyze and classify imagery in meaningful units. To get the most out of segmentation in Pro it is important to understand how to use band combinations and stretch functions to improve your results.

## Objectives

- Improve understanding of band combinations
- Use Stretch Functions to change image display
- Learn how to segment imagery in ArcGIS Pro

## Required Data

- **NAIP.tif** – Four band 1 m imagery
- **NDVI.tif** – NDVI calculated from the NAIP imagery
- **CHM.tif** – Lidar-derived canopy height model

## Prerequisites

- **Install Esri ArcGIS Pro on your computer and have a basic understanding of ArcGIS.**

## Table of Contents

# Part 1: Set up a Project in ArcGIS Pro

Before you begin image segmentation, you'll need to set up a project in ArcGIS Pro. When you create a project in ArcGIS Pro, it creates a project folder with its own geodatabase.

## A. Launch ArcGIS Pro

1. Launch Pro from the start menu by clicking **Start, Programs, ArcGIS, ArcGIS Pro**.
2. Under New Blank Templates click **Map**.
3. In the "Create a New Project" window name the project **Segmentation_Classification.** Save the project to your desired location. Leave **Create a new folder** for this project checked.
4. Click **Ok.**
5. Your new project will open to a world map with no data (see below).
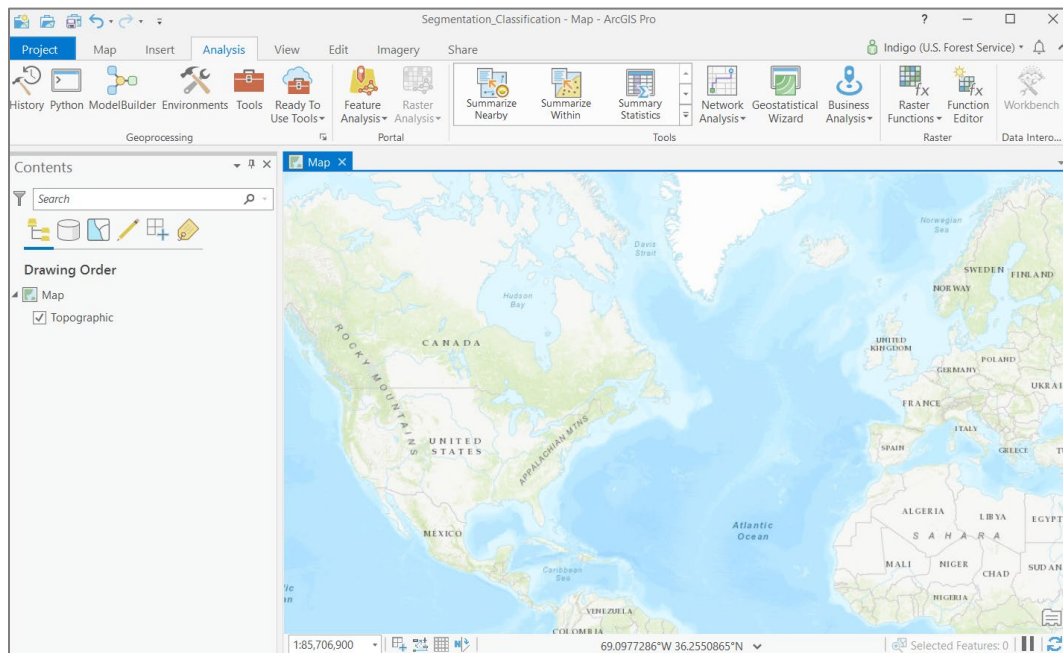


## B. Add Data

1. In the **Map** tab, **Click** Add Data
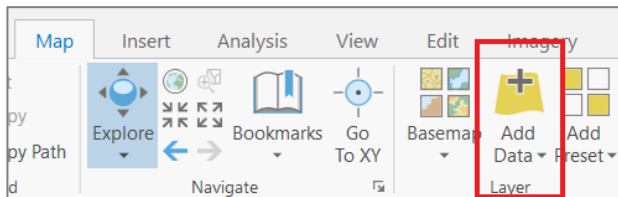


2. Navigate to your course downloads folder, open **CourseData, Exercise1_2.**
3. Select **NDVI.tif**, **NAIP.tif**, and **CHM.tif.**
4. Click **Ok** to add the data to the map.

# Part 2: Create and Display a Multiband Raster

In ArcGIS Pro's segmentation tool you are limited to three bands from one 8-bit image. To use layers sourced from multiple datasets in segmentation, you need to create a multiband raster with the desired layers. In this part of the exercise you will create a multiband raster, explore band combinations, and use stretch functions to highlight features of interest.

## A. Create Multiband Raster

1. In the **Analysis** Tab in the upper left corner. Click the **Tools** button to open the Geoprocessing Search window.
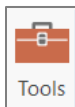
2. In the **Geoprocessing Search** window enter **Composite Bands**.

3. Click **Composite Bands** in Data Management Tools to open.
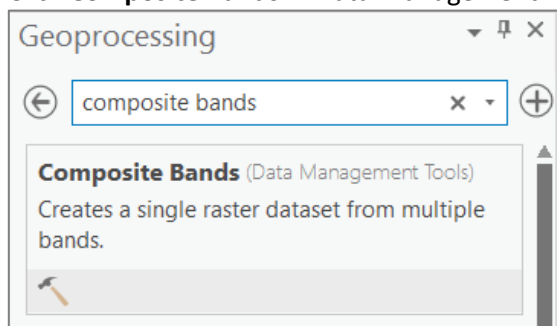
4. For **Input Rasters** select **NAIP.tif**, **NDVI.tif** and **CHM.tif** in that order from the drop-down menu. The input order determines the band numbers in the output.
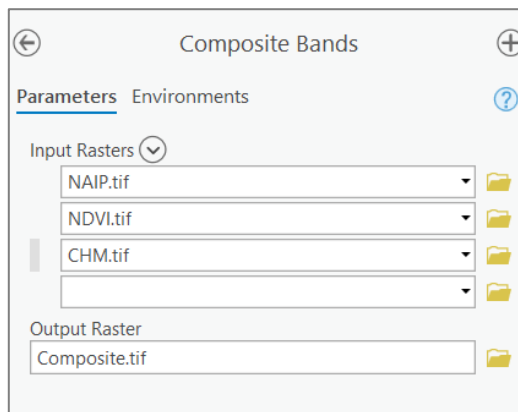
5. Name the output **Composite.tif**. Save the output in your desired location.

6. Click **Run.**

## B. Change the Band Combination

1. In the Table of Contents, Right click on **Composite.tif**, then click **Symbology**. This will open the Symbology pane. The composite has six bands, but you can only use three in segmentation.

To choose which bands to include you will explore different band combinations. The table below shows the source band for each band number. The composite is displayed in natural color, where vegetation appears green.

| Band Number | Source Band |
|---|---|
| Band_1 | Red |
| Band_2 | Green |
| Band_3 | Blue |
| Band_4 | NIR |
| Band_5 | NDVI |
| Band_6 | CHM |

2. First, display the image in color infrared. Under **Primary Symbology** use the drop-down menus to **Set Red = Band_4, Green = Band_1, Blue = Band_2.**



3. Pan around the image and notice what features are on the landscape. This band combination is useful for distinguishing healthy vegetation.

4. Next display the composite using NDVI and CHM. Set **Red= Band_2, Green= Band_5, and Blue=Band_6.**



5. Pan around the image to see how features appear in this band combination. This band combination utilizes a canopy height model which makes it easy to distinguish tall trees, which appear bluer.

6. Play around with different band combinations to see which features stand out. When you are finished exploring band combinations set **Red= Band_4, Green= Band_1, and Blue=Band_2**.
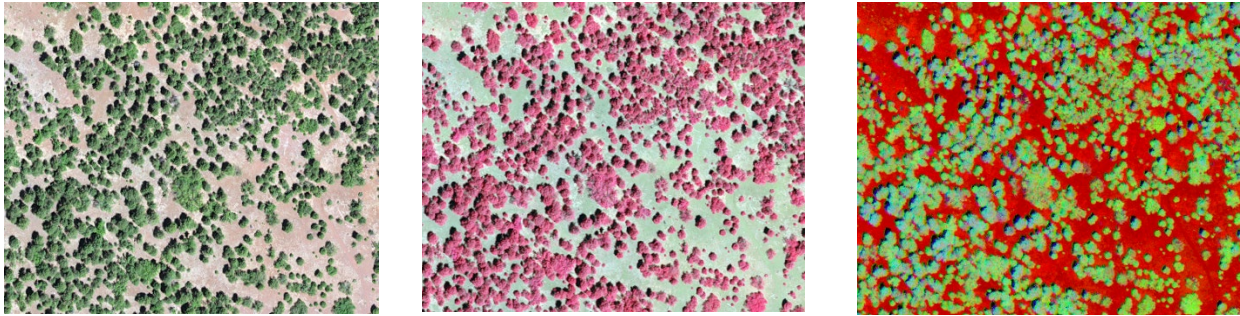
## C. Use Stretch Functions to Change Image Display

Stretch functions can be used to make features of interest stand out. Stretch spreads pixel values across a defined histogram, which alters brightness and contrast. First, you will preview different stretch options in appearance then apply a stretch function. The segmentation tool uses these stretched raster values to segment imagery.

1. Make sure **Composite** is selected in the Table of Contents.

2. In the **Raster Layer** toolbar click **Appearance**

3. Click the **Stretch Type** button to open the stretch symbology tab.



4. **Click** the dropdown menu for **Stretch Type** and change it to **Minimum Maximum.** Notice how the brightness changes. This stretches the values in your raster to the min and max range for the given bit depth to distribute values across a given entire range.

5. **Click** the dropdown menu and change the **Stretch Type** to **Standard Deviation**. This will stretch values across a defined number of standard deviations to show how far from values are from the mean.

6. **Click** the dropdown menu and change the **Stretch Type** to **Percent Clip**. This excludes a percent of upper and lower values.
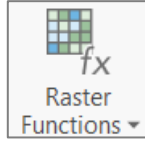
| **Minimum Maximum** | **Standard Deviation** | **Percent Clip** |
|---|---|---|





7. Now you will apply the stretch function so stretched values will be used in segmentation. In the **Imagery** tab, Click on the **Raster Functions** button to open the raster function search window.

8. Enter **Stretch** in the search window and click the **Stretch** button to open.

9. Set **Type** to **StdDev.**

10. Click the **General** tab and set **Output Pixel Type** to **8 bit unsigned.**

11. Click **Create new layer** to run the function. The new layer **Stretch_composite** will appear in the table of contents.

# Part 3: Segment Imagery

You will now learn how to use the segmentation tool paramaters to segment imagery into meaningful units to represent on the ground features. First you will segment to individual trees then segment to clusters of trees.
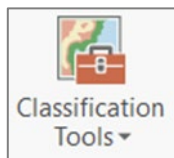
## A. Segment Image to Individual Trees

1. In the Table of Contents select **Stretch_composite**.

2. In the lower left corner of the Map, type in 1:2,000 and press Enter.



Note: The segmentation preview in ArcGIS Pro is scale dependent. Segment previews appear differently at different scales, but it will not impact the final output. To preview segments closest to the final output, zoom to the source resolution of the input raster.

3. Click the **Imagery** tab

4. **Click** the dropdown menu for **Classification Tools,** then click **Segmentation** to open the image segmentation tool.



5. First, you will segment the image to highlight individual trees. Set **Spectral detail** to **10**. Increasing this value will further distinguish features with similar spectral values.

6. Set **Spatial detail** to **13**. Spatial detail sets the importance of feature proximity. A high value will help distinguish small clustered features.

7. Set **Minimum segment size in pixels** to **30**.

8. Click **Preview**. A new layer called **Preview_Segmented** will appear in the Table of Contents. It may take a minute or two for your preview to load.

Note: The preview layer will refresh on the fly for the display area. This allows you to preview the segmentation before running the tool. You can alter the segmentation parameters and the layer Preview_Segmented will automatically update to reflect the changes. If you are working on your own

*data it may be helpful to take screen shots as you determine the correct parameters so you can compare results.*

9. Check the box for **Show Segment Boundaries Only**. This will display the segment outlines so you can see the imagery below the segments.

10. Inspect the segments. Do they capture whole trees? Is the image over-segmented (features of interest are broken up into more segments than desired) or under-segmented (too many features of interest are included in a single segment)?

11. Name the output dataset **tree_segment.tif**

12. Click **Run** to segment the imagery.

## B. Segment to Clusters of Trees

1. Next you will segment the imagery to capture larger clusters of trees. In the Table of Contents select **Stretch_composite**.

2. Click the **Imagery** tab.

3. **Click** the dropdown menu for **Classification Tools,** click **Segmentation** to open the image segmentation tool.
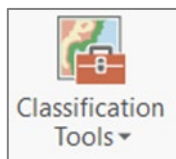


4. Set **Spectral detail** to **6.0**. A lower value will group features with similar spectral values.

5. Set **Spatial detail** to **11**. Spatial detail sets the importance of feature proximity. A lower value will group spatially close features.

6. Set **Minimum segment size in pixels** to **80**.

7. Check **Show Segment Boundaries Only.**
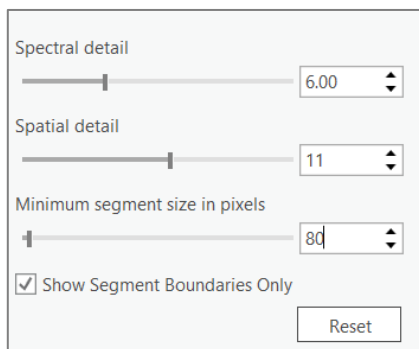


8. Click **Preview**. The new layer called **Preview_Segmented** will appear in the Table of Contents. It may take a minute or two for your preview to load.

9. Name the output dataset **cluster_segment.tif**

10. Click **Run** to segment the imagery.

11. Compare the tree segments and cluster segment outputs by using the Swipe tool. Select **cluster_segment.tif** in the Table of Contents. In the **Raster Layer** tab, under **Appearance** click the **Swipe** tool. Click and drag in the map pane to swipe between layers.

Swipe

**Congratulations!** You have successfully completed this exercise. You now know how to control segmentation parameters and segment imagery at multiple scales in ArcGIS Pro. In the next exercise you will learn how to classify these segments!