



## **GEO TUTORIAL**

### TREE CANOPY MAPPING USING NDVI AND AERIAL IMAGE

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*The Geospatial Education and Outreach Project (GEO Project) is a collaborative effort among the Geosystems Research Institute (GRI), the Northern Gulf Institute (a NOAA Cooperative Institute), and the Mississippi State University Extension Service. The purpose of the project is to serve as the primary source for geospatial education and technical information for Mississippi.*

*The GEO Project provides training and technical assistance in the use, application, and implementation of geographic information systems (GIS), remote sensing, and global positioning systems for the geospatial community of Mississippi. The purpose of the GEO Tutorial series is to support educational project activities and enhance geospatial workshops offered by the GEO Project. Each tutorial provides practical solutions and instructions to solve a particular GIS challenge.*

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### REQUIRED RESOURCES

- ArcGIS Pro (v. 3.0 or higher, with Spatial Analyst Extension)
- Internet access to download NAIP image

### FEATURED DATA SOURCES

- USGS Earth Explorer: <https://earthexplorer.usgs.gov/>
  - > 2023 NAIP Image – Biloxi, MS

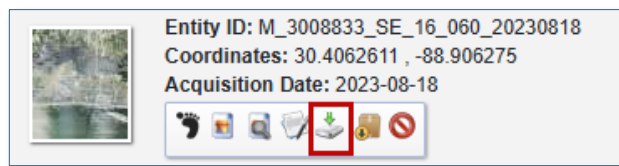
### OVERVIEW

This tutorial provides step-by-step guidance on working with National Agricultural Imagery Program (NAIP) image in ArcGIS Pro to calculate the Normalized Difference Vegetation Index (NDVI) and map tree cover pixels. You'll learn how to download a NAIP image, process it in ArcGIS Pro, and customize symbology to create clear visualization of tree areas. While the image source used here is USGS Earth Explorer, alternative platforms such as [NOAA](#), [USDA](#), and [MARIS](#) also offer valuable datasets for similar analyses.

The focus of this tutorial is on identifying and mapping areas of dense vegetation in Biloxi, Mississippi, specifically tree canopy cover. By analyzing NDVI imagery, you can distinguish between vegetated and non-vegetated areas, assess vegetation health, and analyze its spatial distribution. This information is valuable for environment monitoring, land-use planning, urban forestry management, and enhancing community resilience to environmental changes.

### STEP 1. DOWNLOAD NAIP IMAGE

- A. Visit **USGS Earth Explorer** at <https://earthexplorer.usgs.gov/> and log in. If you don't have an account, create one before proceeding and navigate to the website on a new tab. Image downloads are free.
- B. In the **Search Criteria** tab, under **Select a Geocoding Method**, click **Feature (GNIS)** to view the options. Select **Address/Place**. Ensure you're logged in to enable this option.
- C. In the **Address/Place** blank space, type **Biloxi MS** and click **Show**. Select the location from the suggestions. The map will point to the area.
- D. In the **Date Range** tab, set the dates from **8/1/2023** to **8/31/2023** and click **Data Sets**. From the data set options, click **Aerial Imagery**, then check the **NAIP dataset** checkbox. Click **Results**.
- E. One NAIP image will be displayed. Click on the **Download Options** button and select the **Full Resolution (432.89 MiB)** option. After the download is complete, move it to your preferred folder and *unzip* it. You will work with the *.tif* format file.

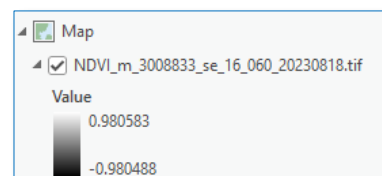
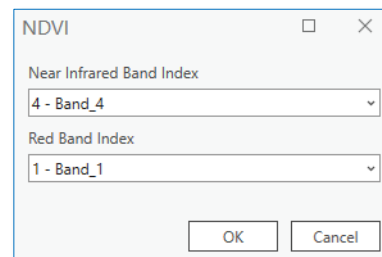


### STEP 2. ADD NAIP IMAGE TO ARCGIS PRO

- A. Start ArcGIS Pro and create a new project by selecting **Map** under **New Project**.
- B. In the **Map** tab, click **Add Data** and navigate to the folder where you extracted your NAIP image. Select the *.tif* file and click **OK**. If prompted to build pyramids or calculate statistics, click **Yes**.
- C. In the **Contents** pane, right-click the image and choose **Properties**. Go to the **Source** tab and expand **Raster Information** to ensure the image has four bands, as NAIP typically contains three visible bands (1-Red, 2-Green, and 3-Blue), and one non-visible band (4-Near-infrared). Click **OK** to close the window.

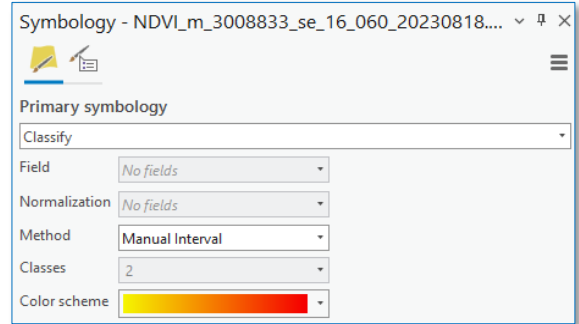
### STEP 3. CALCULATE NDVI FOR TREE CANOPY COVER ANALYSIS

- A. Click on the **NAIP** image in the **Contents** pane to activate it. On the **Imagery** tab, **Tools** group, click **Indices**. Under **Vegetation and Soils**, select **NDVI**.
- B. In the NDVI window, set **Band\_4** as the Near Infrared Band Index and **Band\_1** as the Red Band Index. Click **OK**. This will create a grayscale raster that represents the vegetation index, a proxy for vegetation greenness and density. High NDVI values (closer to 1) are brighter and represent dense vegetation, while low NDVI values (closer to -1) appear dark and represent non-vegetated surfaces (i.e. water, roads, and buildings). *Note: We selected these bands because healthy vegetation strongly absorbs red light and reflects near-infrared light, allowing for a clear distinction between vegetation and other land cover types.*

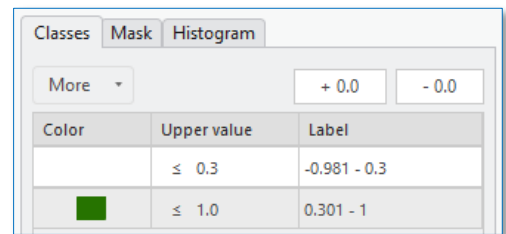


#### STEP 4. SYMBOLIZE THE NDVI LAYER FOR TREE CANOPY COVER

- A. Right-click on the newly created NDVI raster and select **Symbology**. In the **Symbology** pane, under **Primary symbology**, click the drop-down arrow and select **Classify**. Click **Yes** to the warning message that pops up. The warning means that ArcGIS Pro needs a histogram, or a distribution of pixel values, to properly symbolize the raster data. When you click Yes, ArcGIS Pro will calculate it, allowing to render the data more accurately with the correct value ranges. Set **Classes** to **2**, and **Method** to **Manual Interval**.

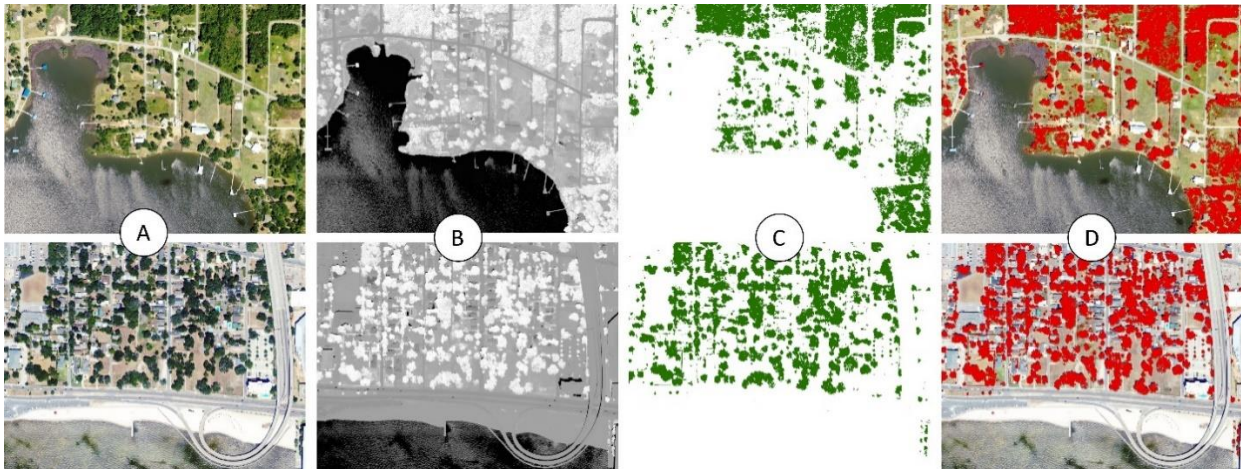


- B. In the **Classes** tab, manually adjust the **Color** that will be displayed on your map. For the low NDVI value (first class), select **No color**; for the high NDVI value, choose your preferred color. Play with the class thresholds under **Upper values** to see how that affects your map. Then, set **1.0** for vegetation (maximum NDVI) and **0.3** for non-vegetation, a typical threshold to distinguish between the two areas. Analyze the area for its extent and distribution. Areas with high NDVI values likely represent tree canopy cover.



#### STEP 5. SAVE AND SHARE YOUR MAP

- A. Click **Save Project** to preserve your work. At this point, you're ready to create a layout and share the results with your team. To share your layout, go to the **Share** tab and, under the **Output** group, select **Export Layout**. Choose your preferred **File Type** and **Name**, then click **Export**.



You have reached the end of our GEO Tutorial. The mapping process you followed is illustrated above: the original NAIP image (A), the grayscale image after NDVI calculation (B), the output canopy layer (C), and the output canopy layer overlaid on the original NAIP image (D) for enhanced visualization. The resulting map highlights the canopy cover and supports critical applications. Continue exploring other areas and applying these techniques to uncover new insights and broaden your geospatial expertise.