Okefenokee Water Resources Methodology Tutorial:

Vegetation – Fire Severity – Soil Moisture

NASA DEVELOP Okefenokee Water Resources – Spring 2022

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Contents

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Tutorial 1:
Updated Landcover/Vegetation Map of the Okefenokee National Wildlife Refuge Tutorial

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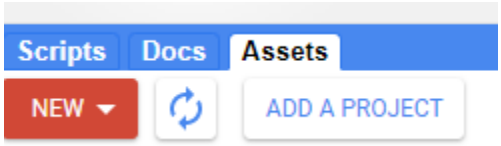
(I) Acquiring & Extracting Data from Google Earth Engine (GEE)

I.I Acquire an Image of the Study Area

1. In GEE create an Image Collection Sentinel-2 MSI: MultiSpectral Instrument, Level-2A. Also, you can use this example script provided by GEE as a template. [1]

2. Load in the study area shapefile as an asset and then import it to the script



3. Filter the date range to the time of your choosing (line 21).

4. Filter the cloud pixel percentage (line 23).

5. Clip the extent of the image to the shapefile using the filterBounds function.

6. Visualize the data in true color (lines 26–30) and false color by copying true color lines and switching B4 with B8. Name this 'false_color'

I.II Export the Image Collection

1. Export the Image Collection to Google Drive using the 'Export image to Drive' function. A brief example of this function can be found here. [2] The portion needed for your purposes should only be ~7 lines.

2. Provide the image (chosen name of the image), description, scale (10), region (name of the shapefile), and maxPixels (1e9).

3. Run the code and start the task.

4. Upon completion, the Image Collection will be mosaiced into a singular image of the study area and will now be located in your Google Drive as a .TIF file.

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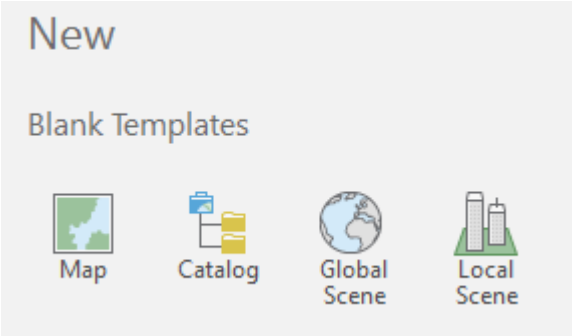
(II) Setting up Initial Classification Parameters

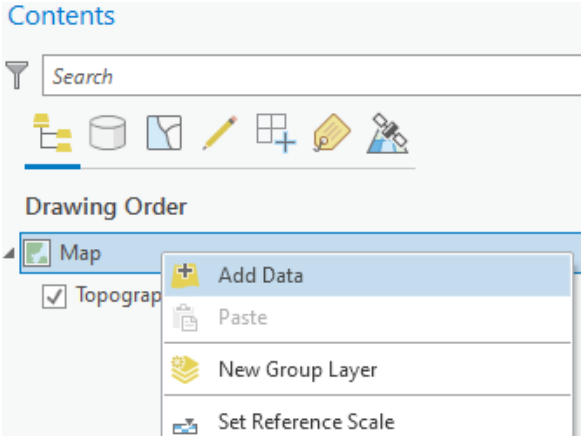
II.I Load the Data into ArcGIS Pro

1. Download the exported data from Google Drive onto the computer.

2. Open ArcGIS Pro and start a new map Project.



3. Under the Contents Pane, right click on 'Map' and select 'Add Data.'



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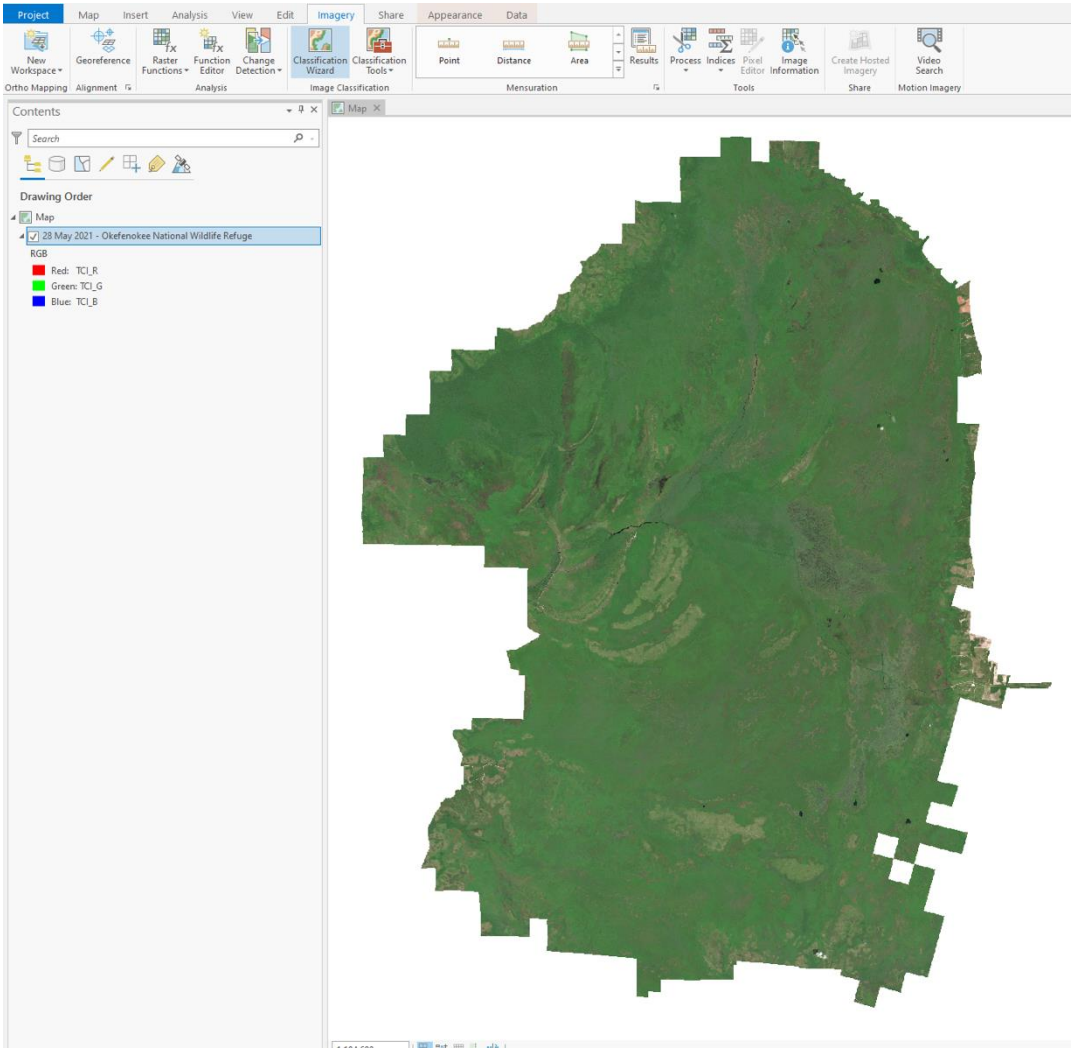
4. While selecting the data, choose 'Classification Wizard' from the 'Imagery' tab.



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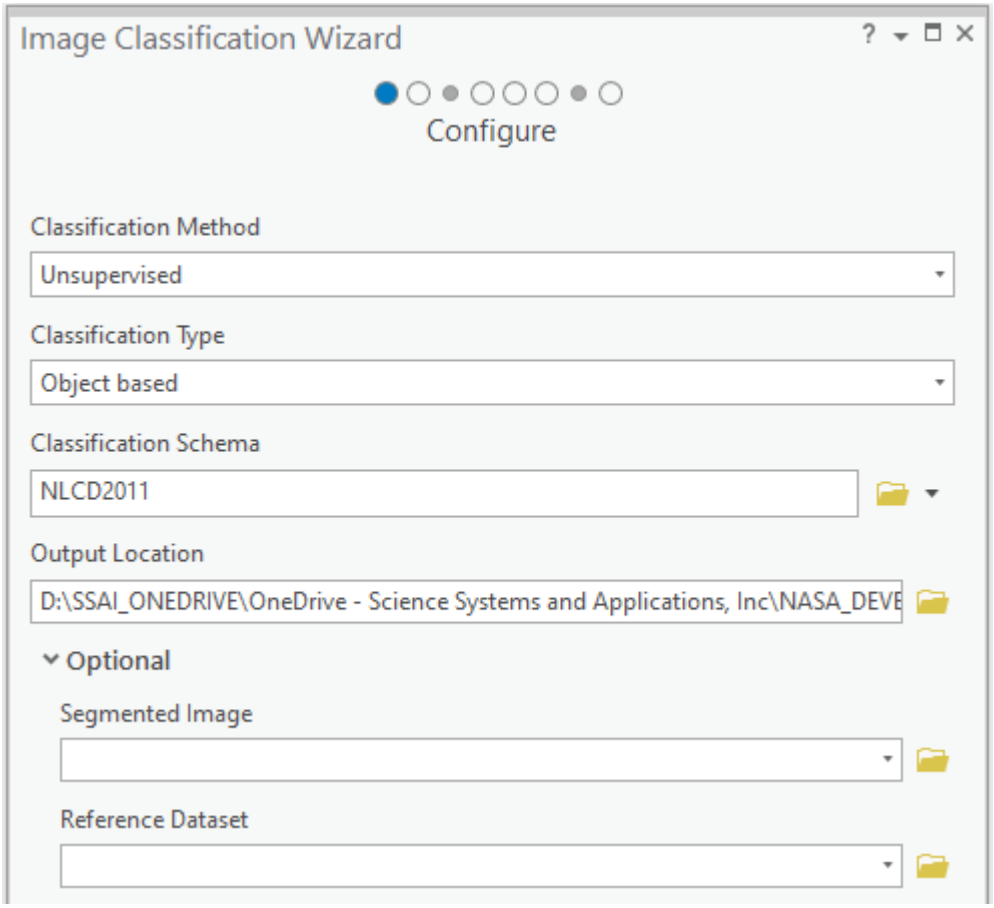
5. Select 'Unsupervised for the Classification Method.'

6. Select 'Object based Classification Type.'

7. Select 'Use Default Schema' for the Classification Schema.



8. Choose the output location.

9. Choose '20.00' for the 'Spectral detail'.

10. Choose '19' for the 'Spatial detail'.

11. Choose '20' for the 'Minimum segment size in pixels'.

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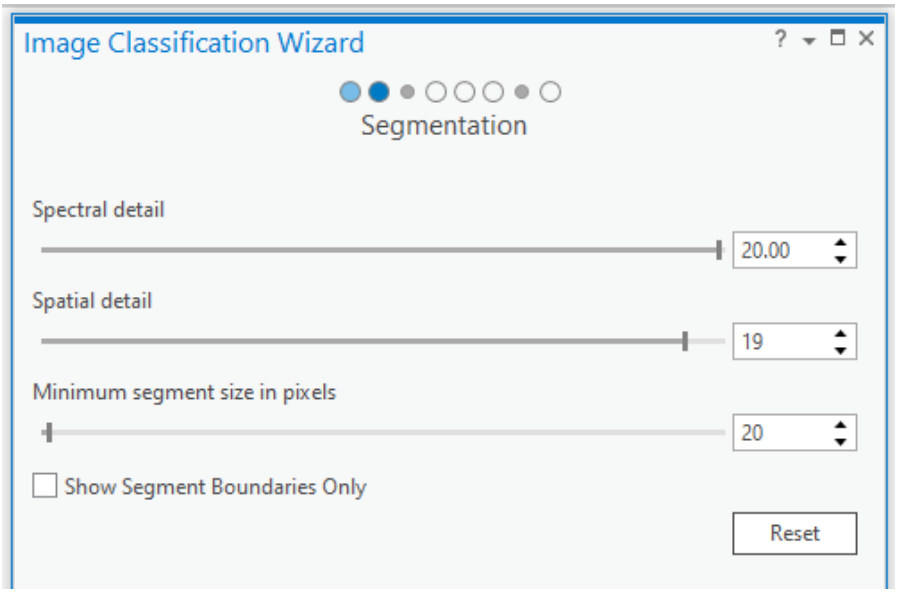

12. Set the 'Maximum Number of Classes' to a suitable number. (This tutorial used 30 classes, but other projects may require more of less depending on the composition of the study area.)

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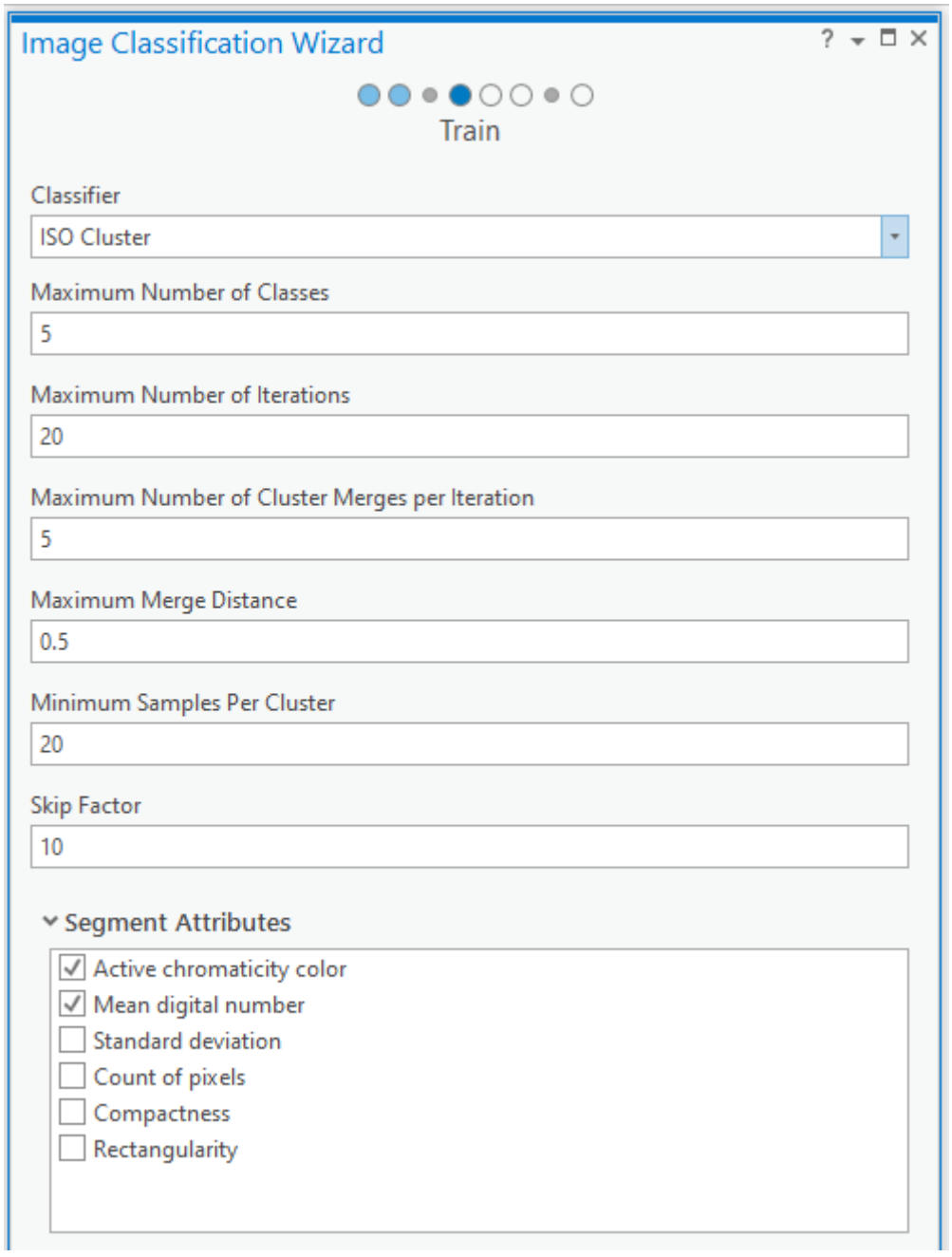
13. Leave the rest of the parameters in the 'Train' section as the default option.



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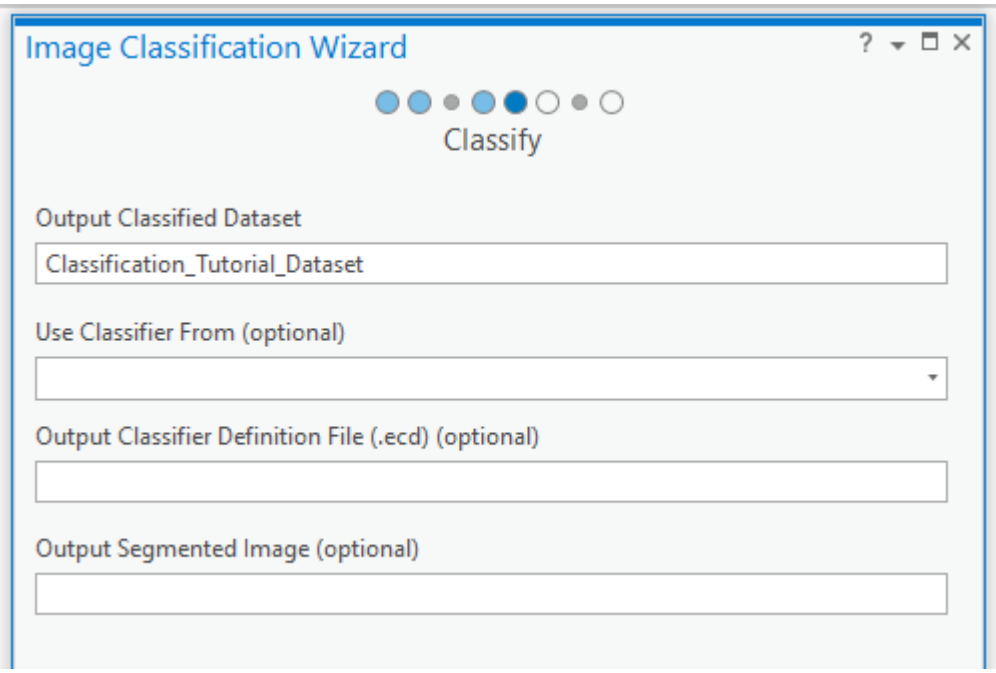
14. Give the Output Classified Dataset a name.



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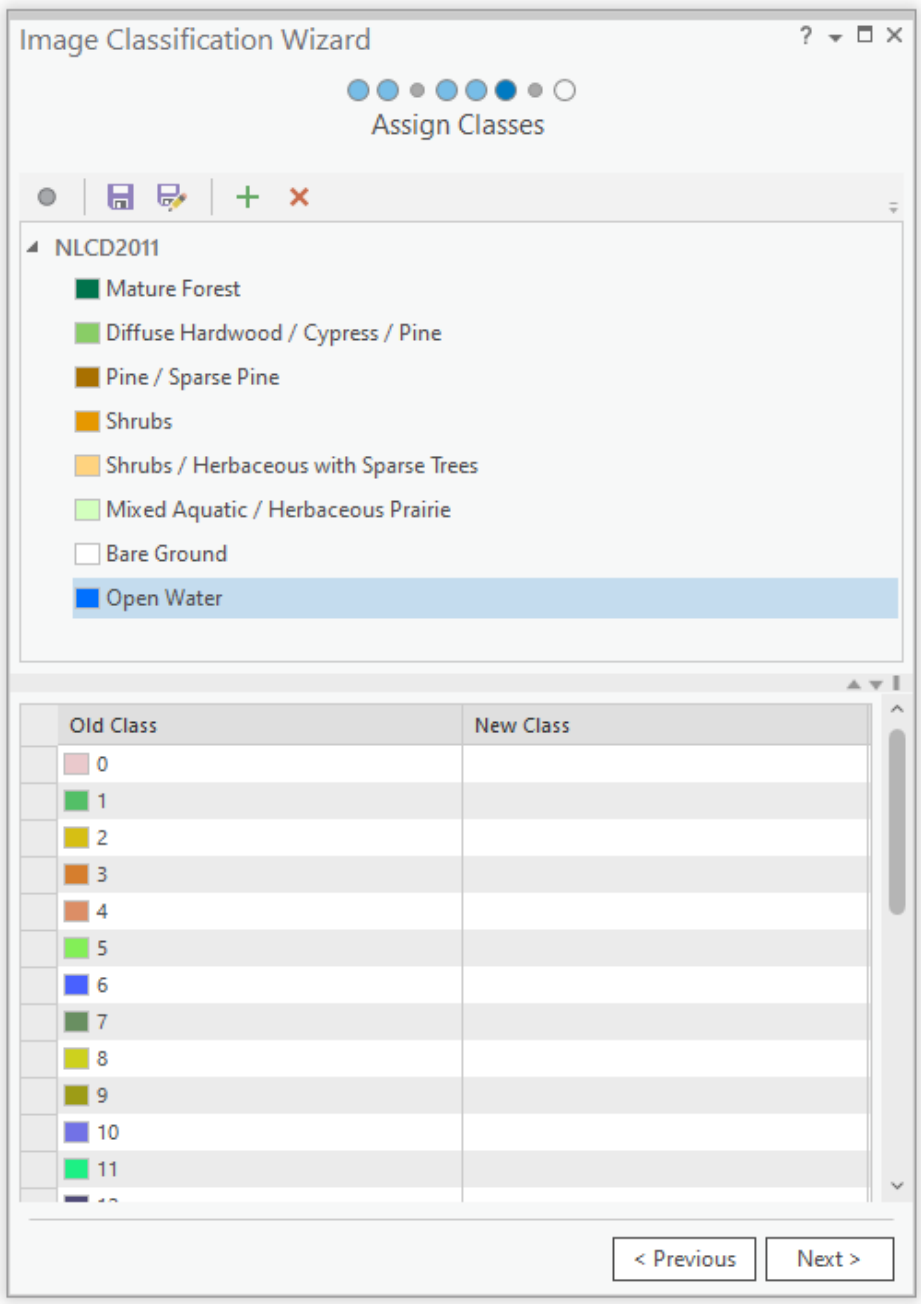
15. Create the Classification Scheme with each class having a unique name, value, and color



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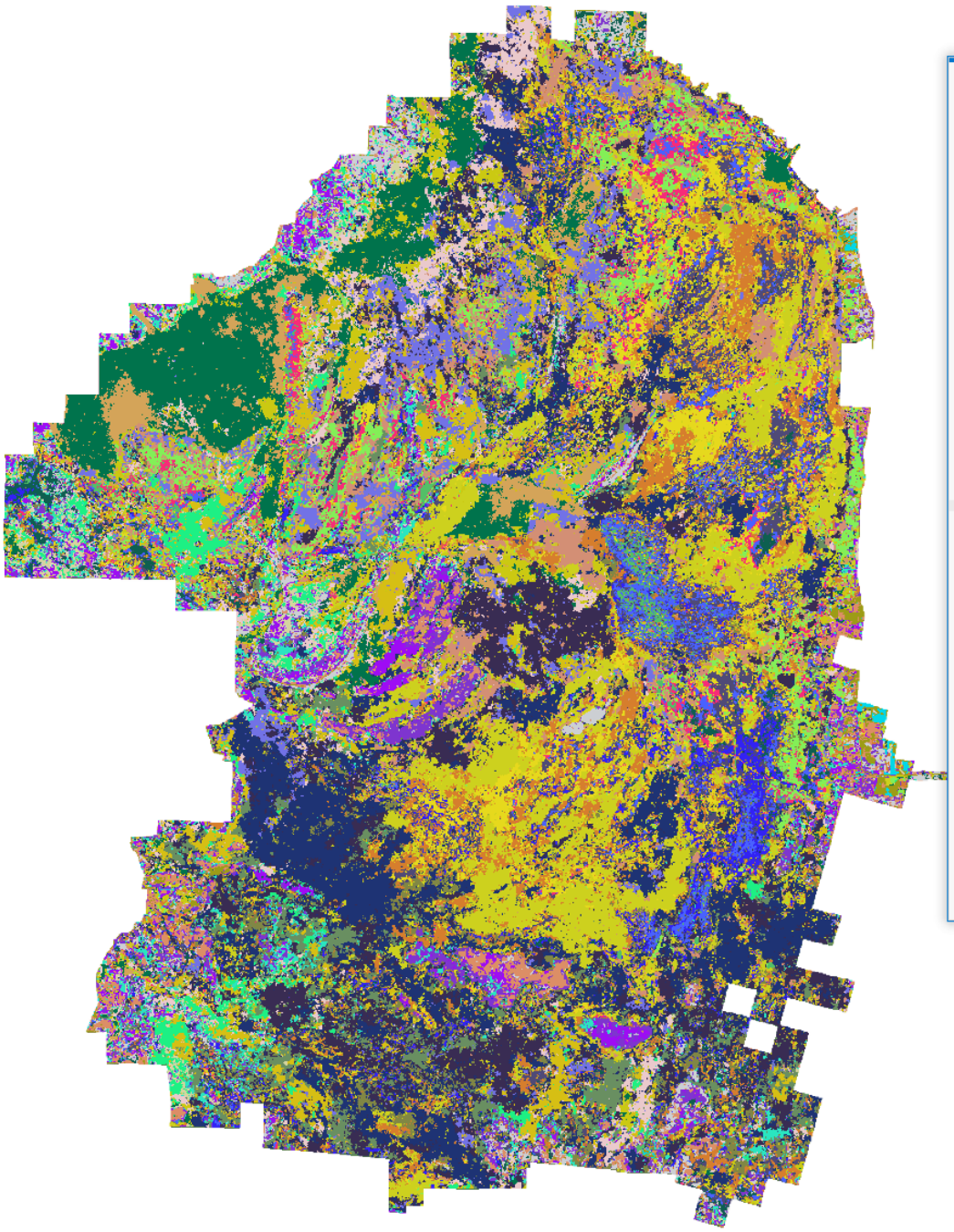
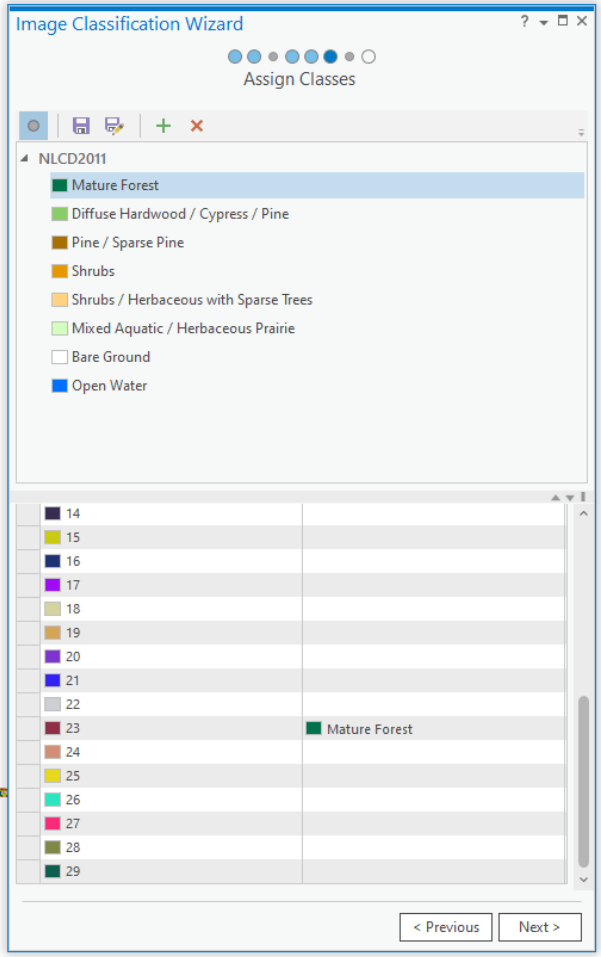
16. Manually classify and aggregate the classes into the custom classification scheme.





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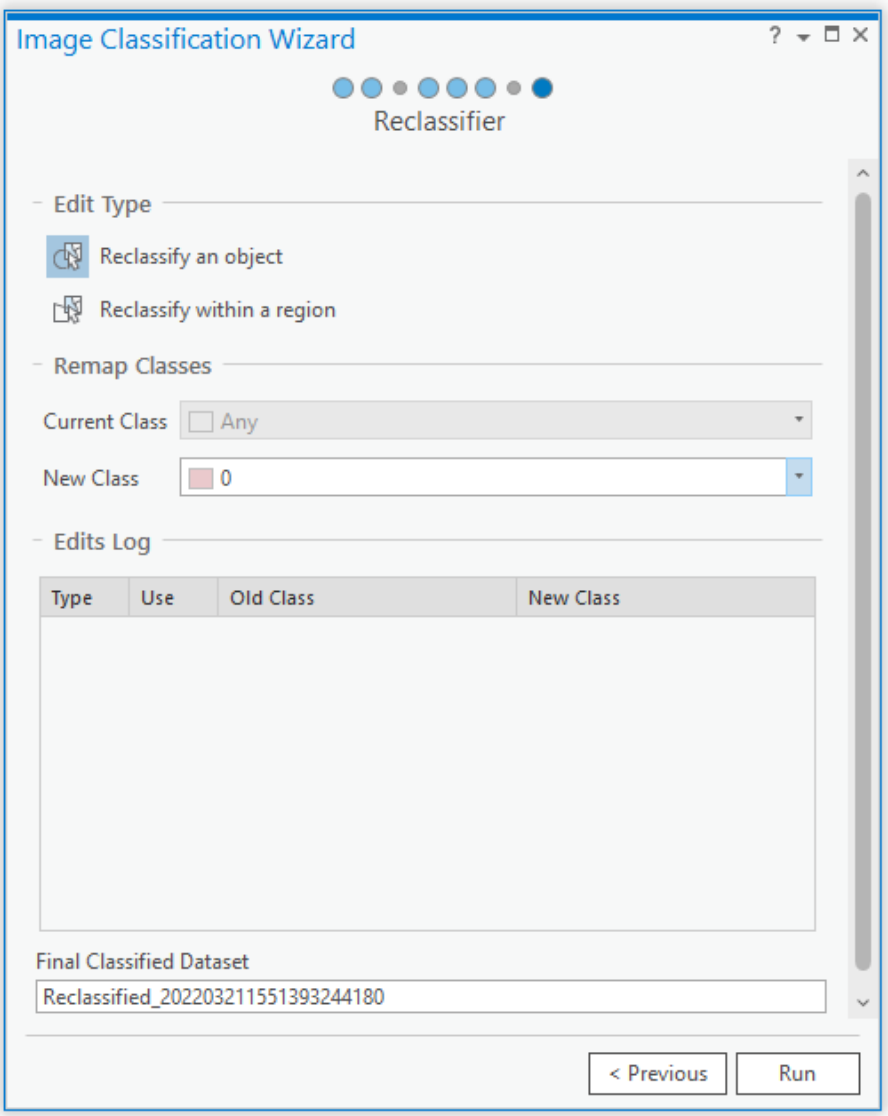
17. If necessary, reclassify an object or region if the classification failed to distinguish segments with subtle differences spatial or spectral properties.



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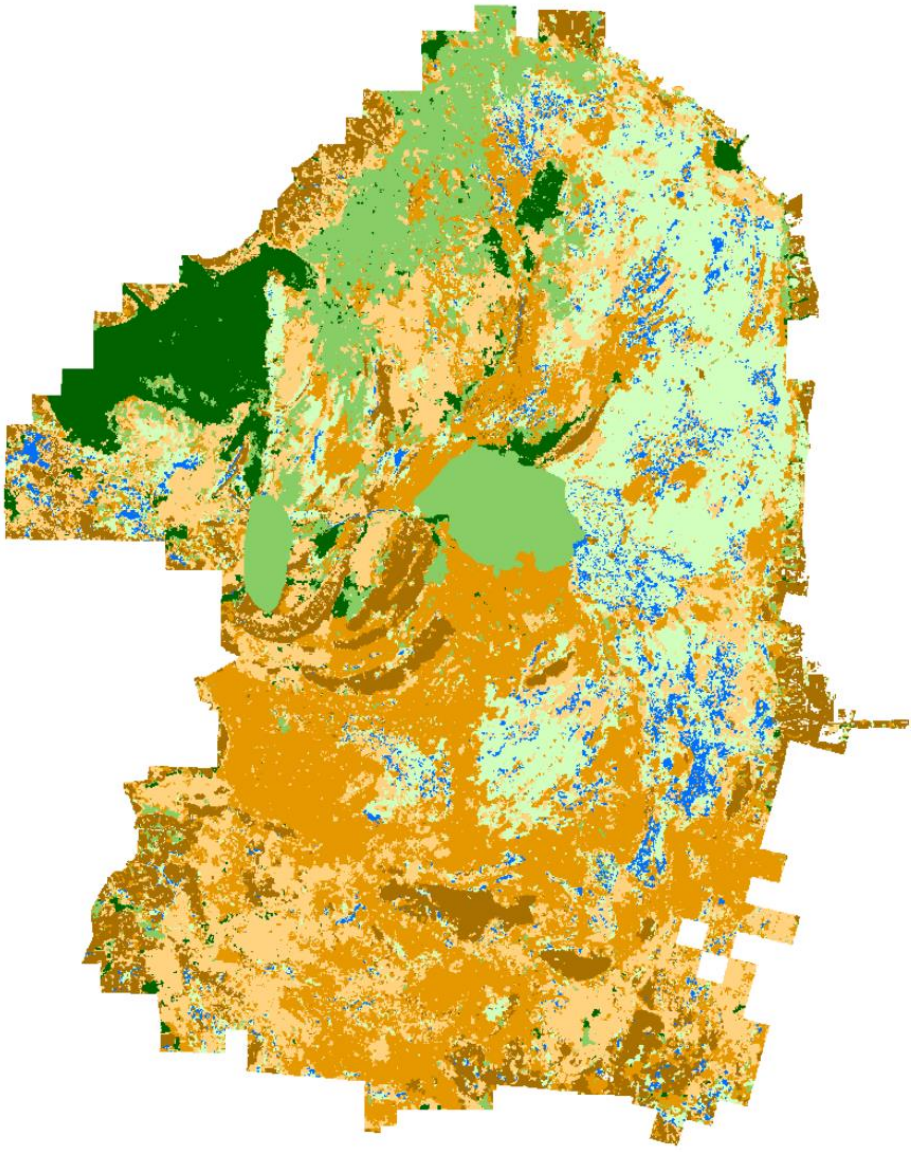
18. After running the reclassification, the dataset is complete.



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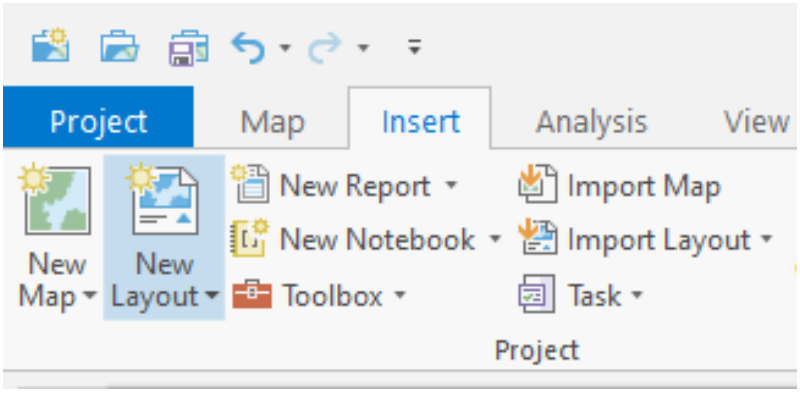
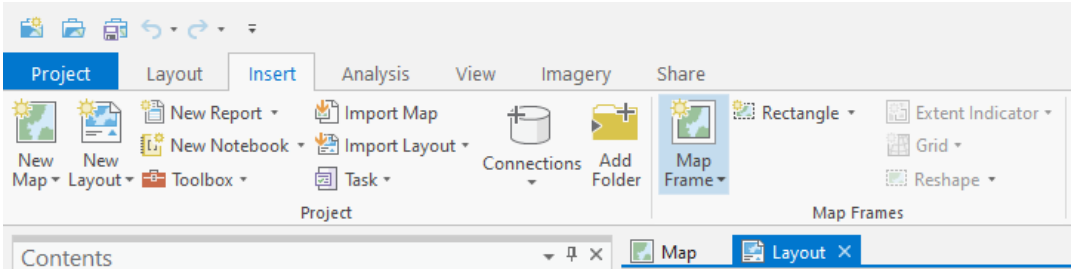
19. To export the data, click on the 'Insert' tab then 'New Layout'. Select an appropriate layout.



20. Within the Layout Pane, select 'Map Frame' under the 'Insert Tab'



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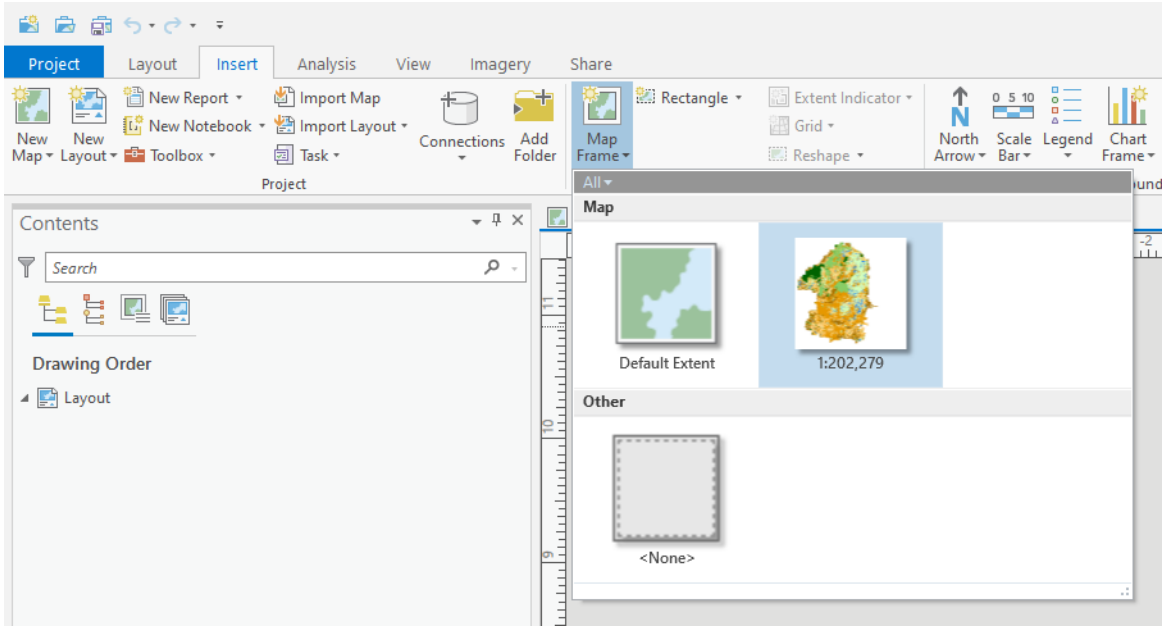
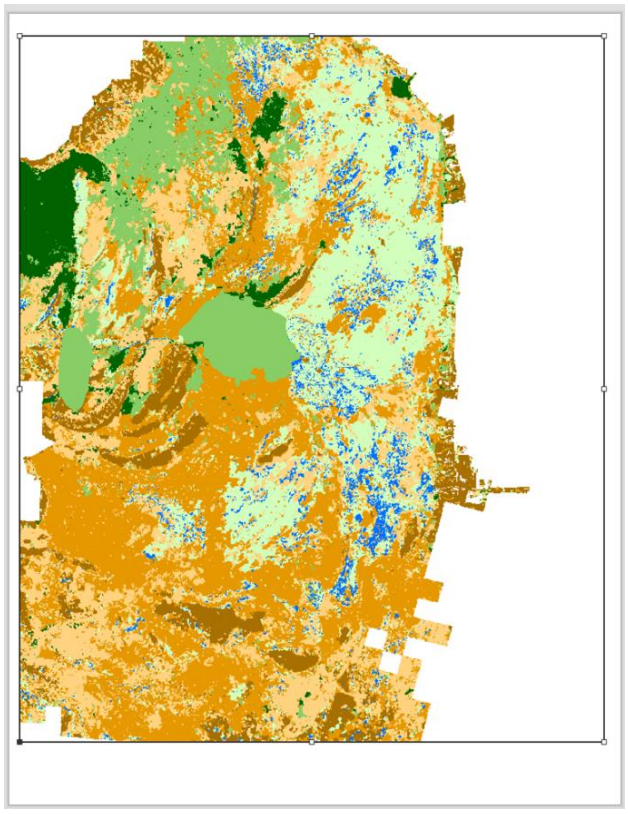
21. Choose the map frame with the appropriate data.



22. Draw the map frame onto the layout.



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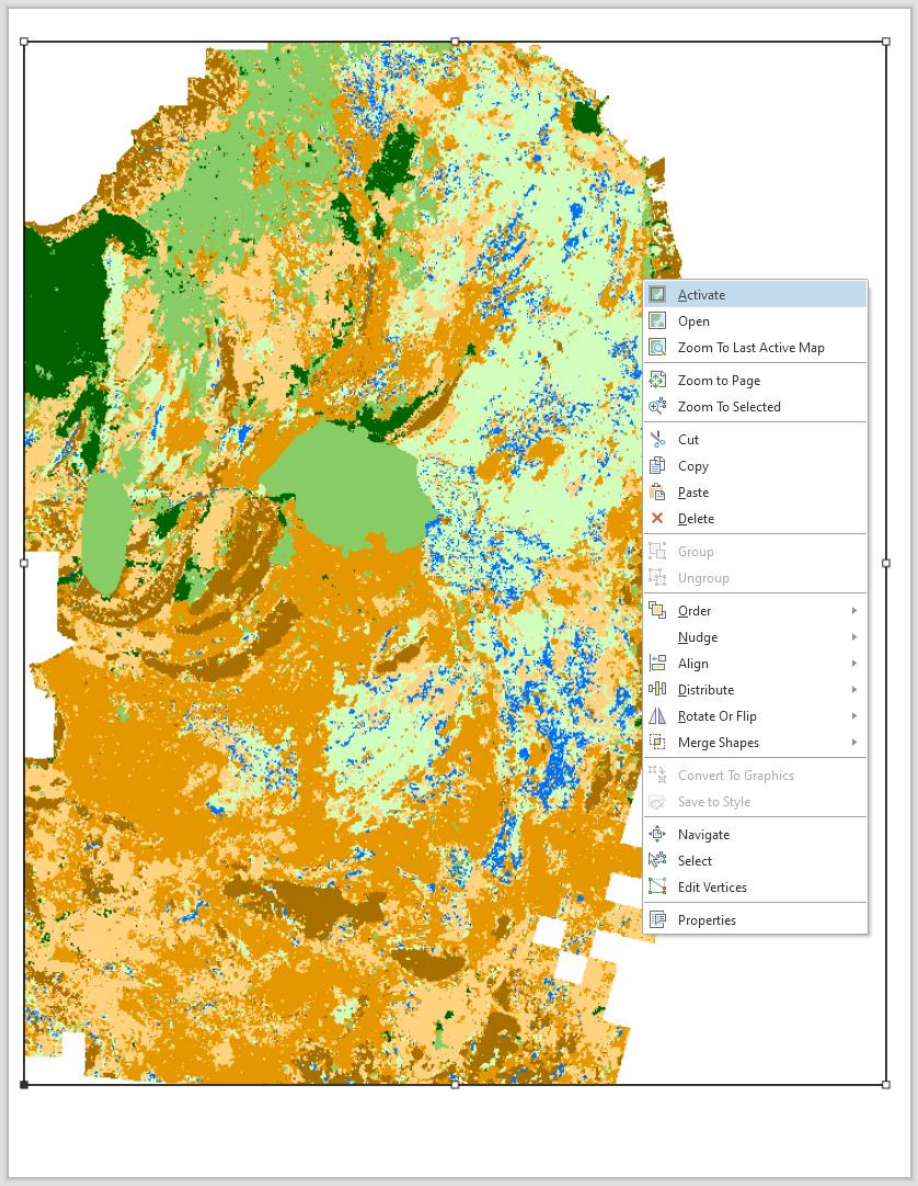
23. Right click on the map frame then select 'Activate'.



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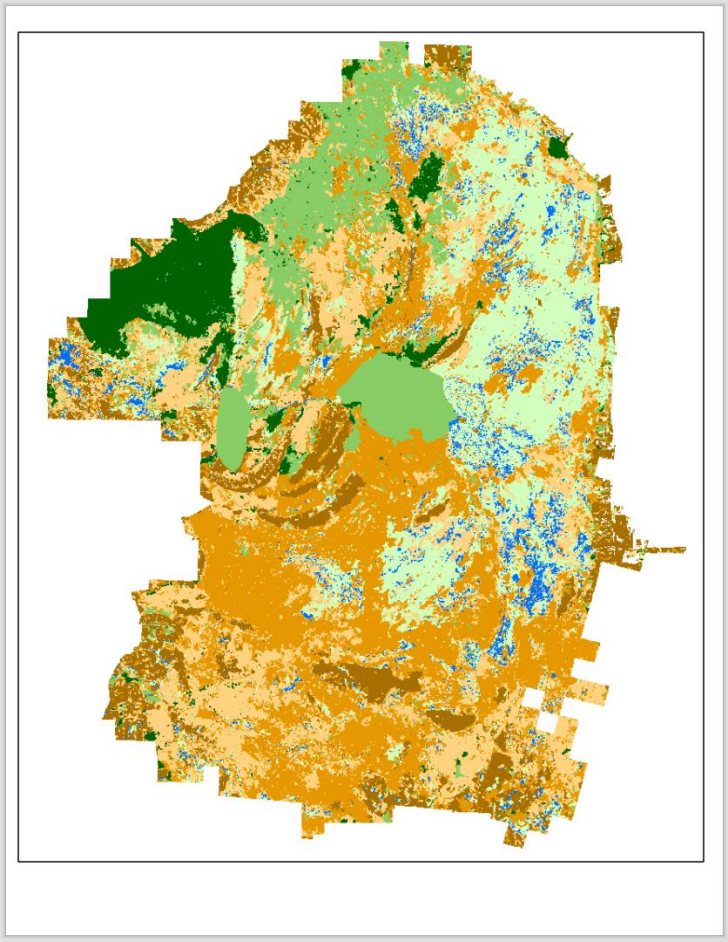
24. Rescale the image to fit within the map frame borders



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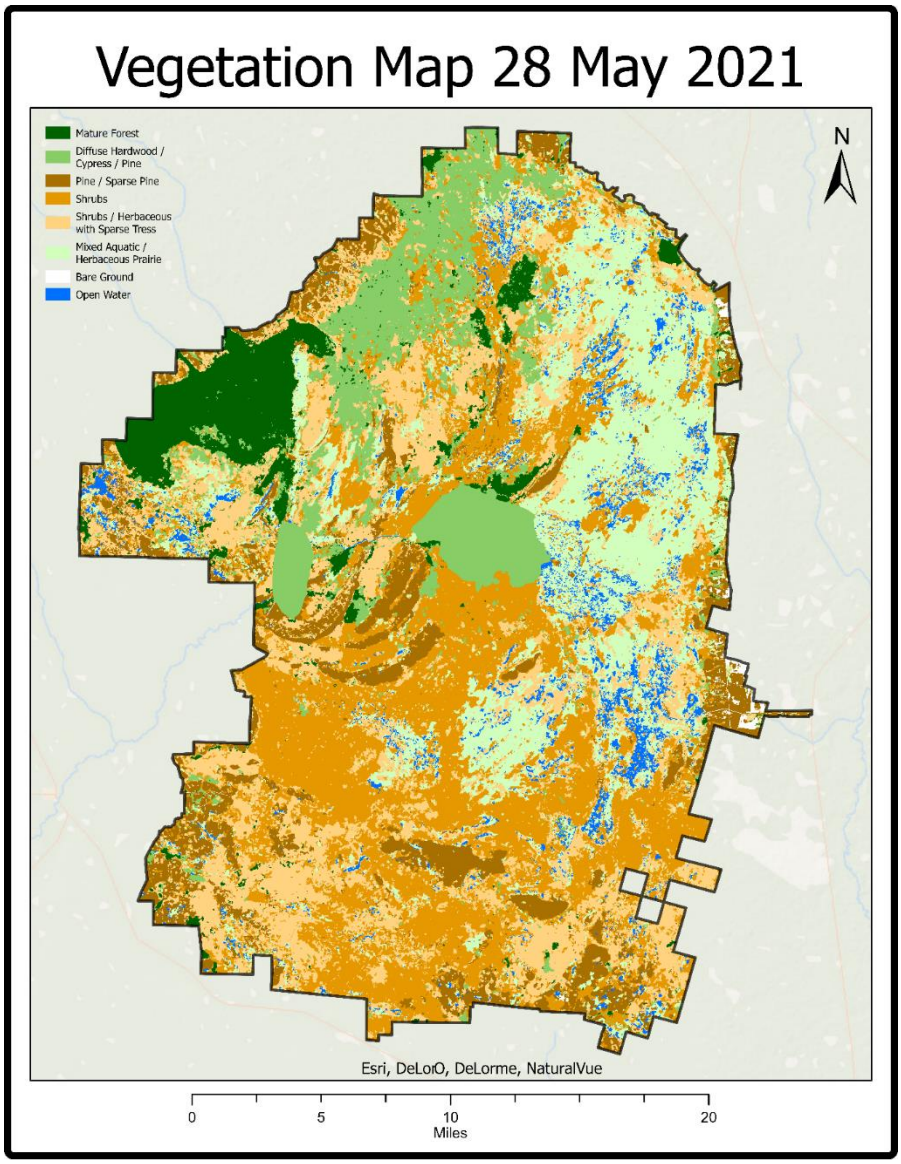
25. If desired, add a base map, border, title, legend, scale bar, and north arrow.



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Tutorial 2:

Fire Severity Tutorial

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(I) Acquiring & Extracting Data from Google Earth Engine

In order to acquire the data to map burn severity, you can follow a pre-made tutorial from the United Nations [3] and switch out the dates and locations for the area and time of interest; however, that tutorial only supports satellite images from Landsat 8 OLI and Sentinel-2 MSI, which means you cannot look at any fires before 2013. If you want to look at fires prior to 2013, follow the steps below to create your own script in Google Earth Engine. These instructions only work if you know the dates a fire occurred. They cannot identify historic fires.

I.I Acquire an Image of the Study Area

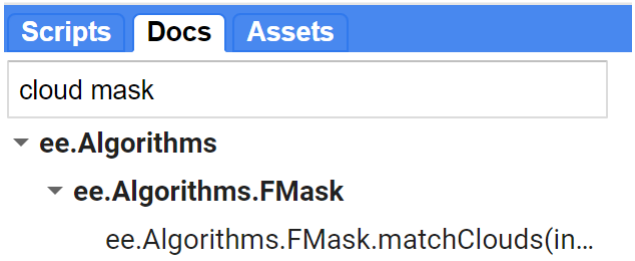
1. Create an Image Collection with either Landsat 7 Enhanced Thematic Mapper Plus or Landsat 8 Operational Land Imager.

    a. Landsat 7 ETM+ has been collecting data since 1999

    b. Landsat 8 OLI has been collecting data since 2013

2. Use separate variables to set the time frame for a few months before the fire and a few months after the fire occurred. Use "prefire" to denote months before the fire occurred and "postfire" for months after the fire occurred. Use "start" to indicate the first month and "end" to indicate the last month in the series.

3. Mask out clouds by using the cloudShadowBitMask and cloudsBitMask functions. Cloud Masking functions can be found by searching "Cloud Mask" under the Docs tab on the left of the Google Earth Engine user interface.



4. For both prefire and postfire, visualize the data in true color and create an Image Collection that mosaics all of these images together and clips them to the Okefenokee shapefile.

5. Calculate Normalized Burn Ratio (NBR) indices for both pre-and post-fire months using the .normalizedDifference function and selecting the Near Infrared (NIR) band first and the Shortwave 2 Infrared (SWIR2) band second.

    a. You will need to create two separate NBR variables. One will be "preNBR" to show zNBR before the fire and the other "postNBR" to show NBR after the fire.

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b. For Landsat 7 ETM+, NIR is band B4 and SWIR2 is band B7.

c. For Landsat 8 OLI, NIR is band B5 and SWIR2 is band B7.

d. It is helpful to note that the equation for NBR is: $NBR = \frac{NIR-SWIR2}{NIR+SWIR2}$.

e. Please note that the feature collection name is unique to whatever variable name you chose for the months preceding and following the fire.

6. Calculate a Difference Normalized Burn Ratio (dNBR) index for the wildfire by subtracting "preNBR - postNBR." Multiple this dataset by 1,000.

7. Create a grayscale visualization and apply it to the dNBR data using the Map.addLayer function. Set the minimum and maximum to -1000 and 1000 respectively.

   a. The resulting image will be black and white – white indicates burnt areas.

   b. Note, -/+ 1,000 are arbitrary numbers. Changing these numbers will affect the end visualization. We encourage you change the numbers until the image has a desired effect.

8. Create a color classification scheme to identify the different severity levels within the dNBR data.

   a. Let yellow indicate low severity at pixel values 100–269.

   b. Let orange indicate moderate-low severity at pixel values 280–439.

   c. Let red indicate moderate-high severity at pixel values 440–659.

   d. Let purple indicate high severity at pixel values 660–1300.

   e. Classification schemes can be found using the United Nations wildfire tutorial. [3]

9. Add a legend that will appear on the Google Earth Engine map display.

I.II Export the Image Collection

1. Follow steps I.II on the vegetation tutorial.

(II) Finalizing the map in GIS

II.I Load the Data into ArcGIS Pro

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1. Download the exported data from Google Drive onto the computer. In GIS, click "Add Data" and choose the file that you downloaded

II.I Adjust the color scheme

1. Unfortunately, color schemes do not translate from GEE into GIS, so you have to reclassify the colors.

    a. Right click on the layer that you uploaded and choose "Symbology."

    b. In the Symbology panel, change Pixel Type to "Manual Interval." This will open a panel to manually input and change your color scheme.

    c. Change Column number to 4.

2. Now change the colors to correspond with the legend in Google Earth Engine

3. Make Column 1 Yellow and let the upper value be 269. Change the display text to "Low Severity."

    a. Make Column 2 Orange and let the upper value be 439. Change the display text to "Moderate-Low Severity."

    b. Make Column 3 Red and let the upper value be 659. Change the display text to "Moderate-High Severity."

    c. Make Column 4 Purple and let the upper value be 1300. Change the display text to "High Severity."

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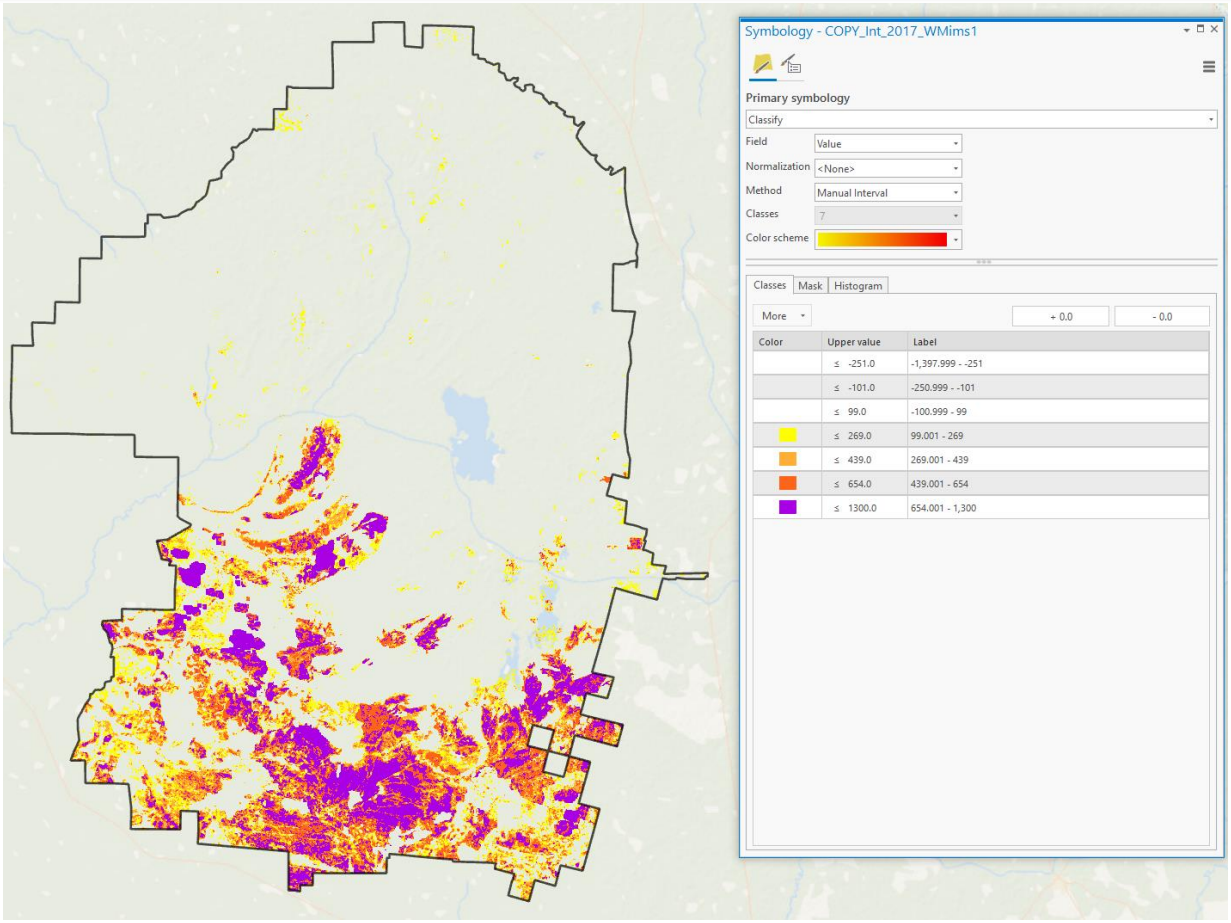

II.I Overlay other layers

1. At this point, the map displays fire severity from a specific wildfire, and you can overlay this map with other layers like the Okefenokee shapefile or the peat deposits shapefiles.

2. Export your final map using the export steps from the Vegetation Map Tutorial.

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Tutorial 3:

Checking SMAP SSMA Values in Google Earth Engine

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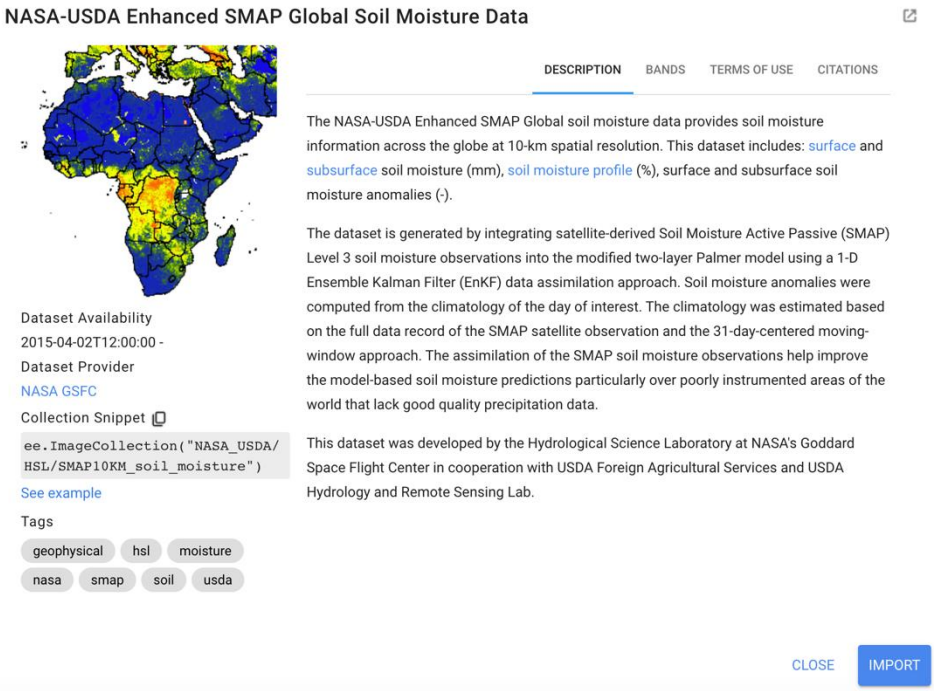
(I) Setup Visual Image in GEE

1. In GEE search for and Import 'NASA-USDA Enhanced SMAP Global Soil Moisture Data'



2. Use the example provided by Google Earth Engine as a script template. [4] Click 'See Example'.

3. Change the dates in line 2 to show the desired time period of soil moisture.

4. Upload Shapefile or Draw a polygon around the study region. Name this shape 'Boundaries'

5. In order to clip the data to the new shape, use a .filterBounds() function with your specified 'Boundaries' in the parentheses at the end of line 2 just before the semicolon.

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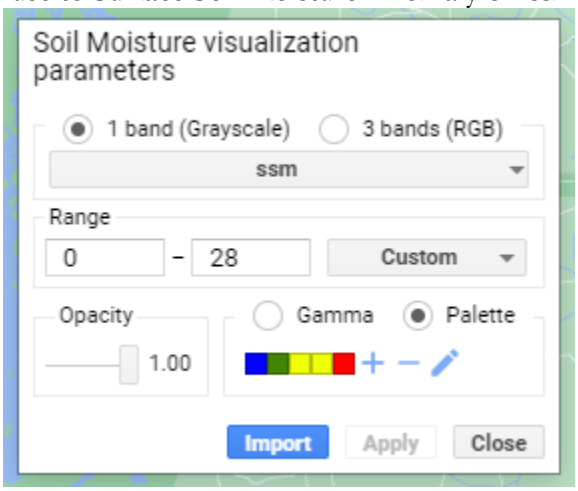
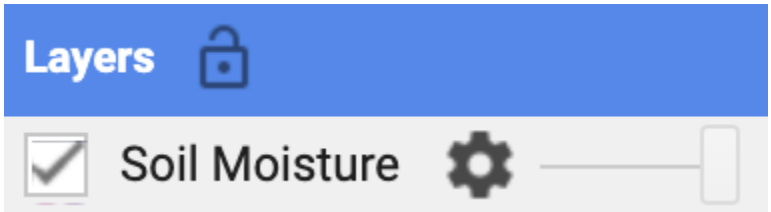
6. Change the band in use to Surface Soil Moisture Anomaly or 'ssma'



7. Select the dates you want to observe (SMAP gives images every 3 days, so putting in dates for the previous month is a good start)

8. Set the Center of your map in the middle of the Okefenokee. In line 9, change the numbers in parentheses to '-82.2715, 30.8153, 10'

9. Click the gear icon under 'Layers' to access visual parameters



10. Select 1-Band Grayscale

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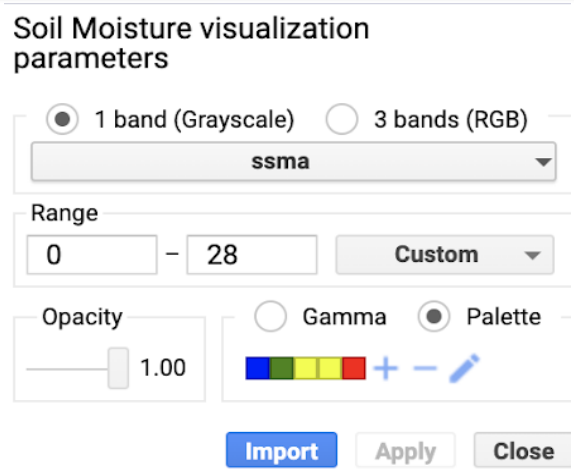
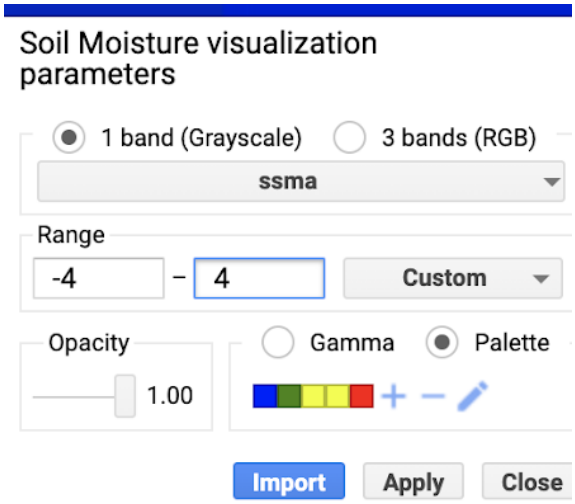


11. Change the visual range to –4 to 4



12. Select 'Palette' and chose any 5 sperate colors, select apply

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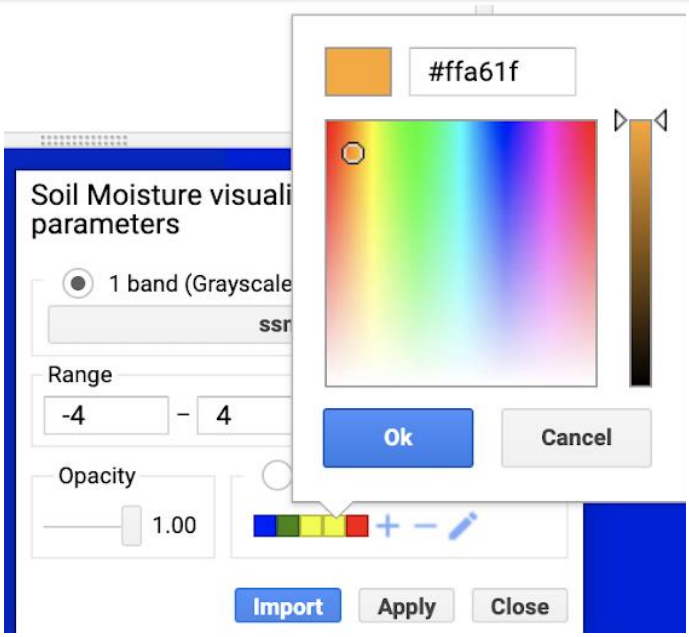
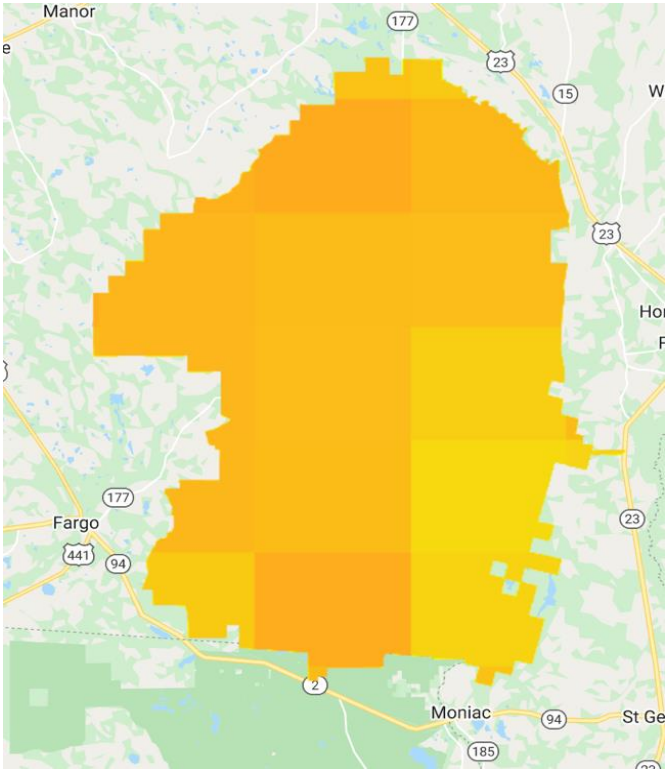


13. You can now see the visual differences of the Okefenokee. If there is no change in color, change the range to –2 to 2.



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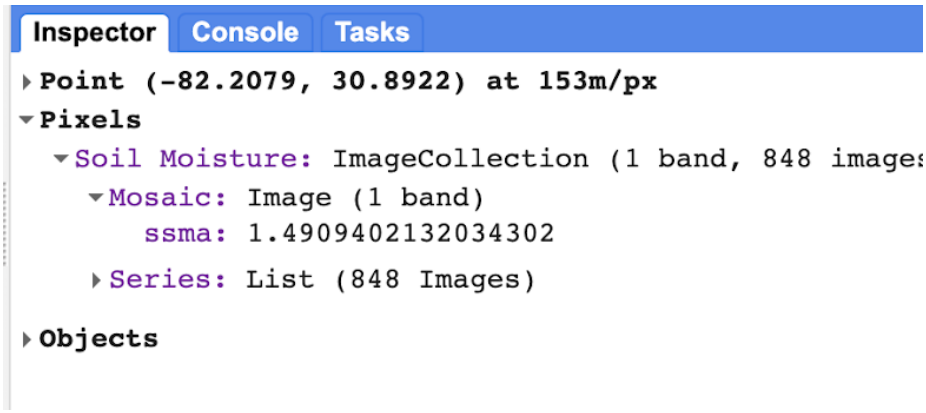
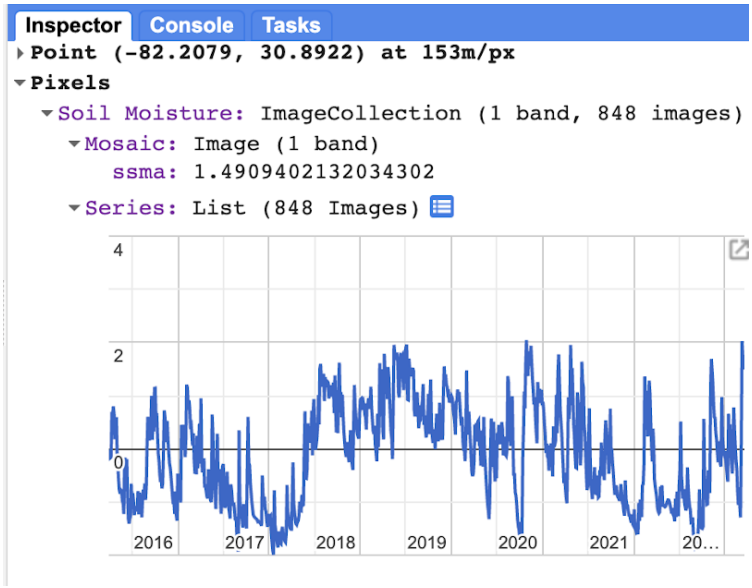
(II) Analyze SSMA Values in GEE

1. In the top right pane, click the 'Inspector' tab
2. On the map, click on the corresponding pixel to the area you want to see.
3. Under 'Mosaic' the average SSMA value for the date range will be seen.



4. Under Pixels click on 'Series' and a line graph for the date range will appear.



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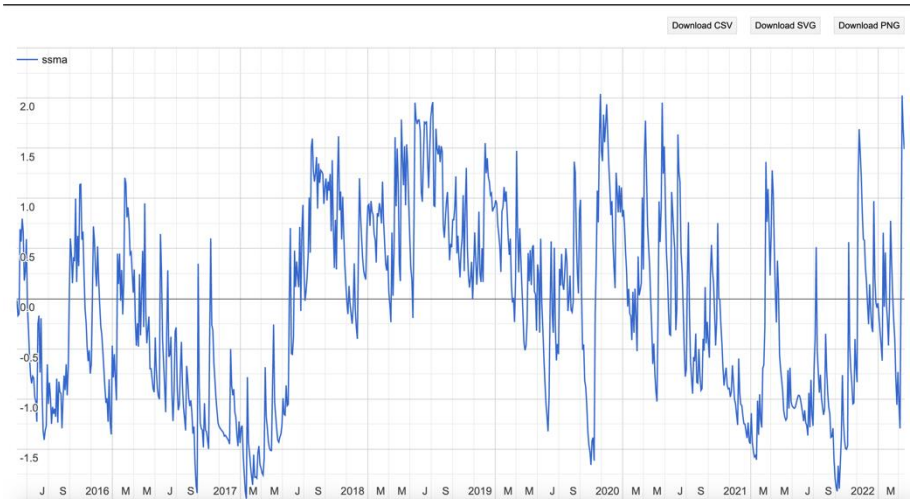
5. To download the graph, select the box with the arrow at the top right of the graph, and on the next page select 'download...' to the format of your choosing.



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Citations

[1] Google Earth Engine. (n.d.) Harmonized Sentinel-2 MSI: MultiSpectral Instrument, Level-2A. [Collection Snippet]. https://code.earthengine.google.com/?scriptPath=Examples%3ADatasets%2FCOPERNICUS_S2_SR_HARMONIZED

[2] Google Earth Engine. (n.d.). Export.image.to.drive. [Code Example]. https://developers.google.com/earth-engine/apidocs/export-image-todrive#code-editor-javascript

[3] Google Earth Engine. (n.d.). NASA-USDA Enhanced SMAP Global Soil Moisture Data. [Collection Snippet]. https://code.earthengine.google.com/?scriptPath=Examples%3ADatasets%2FNASA_USDA_HSL_SMAP10KM_soil_moisture

[4] United Nations. (n.d.). Step by Step: Burn Severity mapping in Google Earth Engine. https://un-spider.org/advisory-support/recommended-practices/recommended-practice-burn-severity/burn-severity-earth-engine

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