

Go to earthexplorer.usgs.gov and log in using the info below:

Username: agric

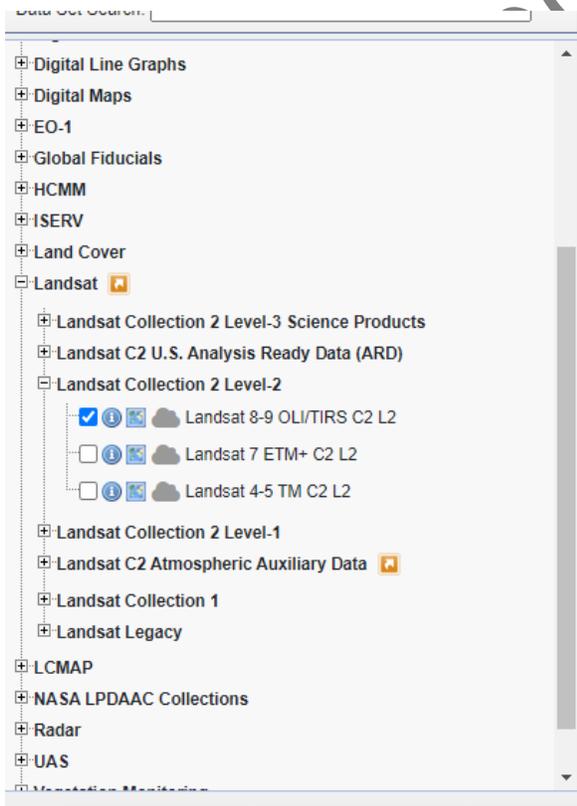
Password: Rho4240desdes



Zoom into the Lima area and select “Use Map” on the left side under the polygon tab.

Click on “Datasets”

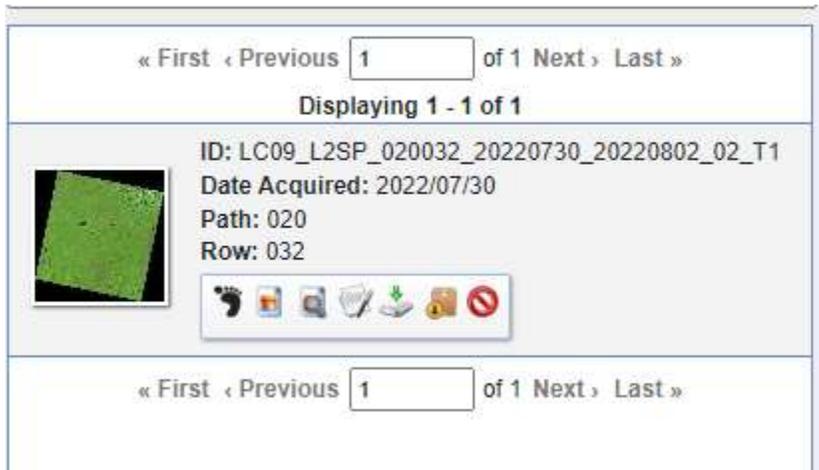
Open Landsat, Landsat Collection 2 Level-2, and select “Landsat 8-9 OLI/TIRS C2L2”



Click on Additional Criteria, and insert dates from July 24-July 30, 2022 in the Data Product Generated L1 box.

Click on Results

You'll find an image like the one below.



Select the button 3<sup>rd</sup> from the right to download the file. If you'd like, you can click on the foot to see the footprint of the image in question. You can also click on the image to the right of the foot to see the image on the web.

When you get to the download page, select product options, and select the Product Bundle at the top of the page. It should be near 953.14 MiB. This download will take a bit.

Go to your downloads folder and find the file you just downloaded. Right click on it, and under 7-zip, select Extract Here. This will extract the files you'll need.

Landsat collects images in various bands, as seen below.

#### Landsat 8-9 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)

Bands	Wavelength (micrometers)	Resolution (meters)
Band 1 - Coastal aerosol	0.43-0.45	30
Band 2 - Blue	0.45-0.51	30
Band 3 - Green	0.53-0.59	30
Band 4 - Red	0.64-0.67	30
Band 5 - Near Infrared (NIR)	0.85-0.88	30
Band 6 - SWIR 1	1.57-1.65	30
Band 7 - SWIR 2	2.11-2.29	30
Band 8 - Panchromatic	0.50-0.68	15
Band 9 - Cirrus	1.36-1.38	30
Band 10 - Thermal Infrared (TIRS) 1	10.6-11.19	100
Band 11 - Thermal Infrared (TIRS) 2	11.50-12.51	100

If you remember from previous classes, NDVI is measured using Red and Near Infrared (NIR).

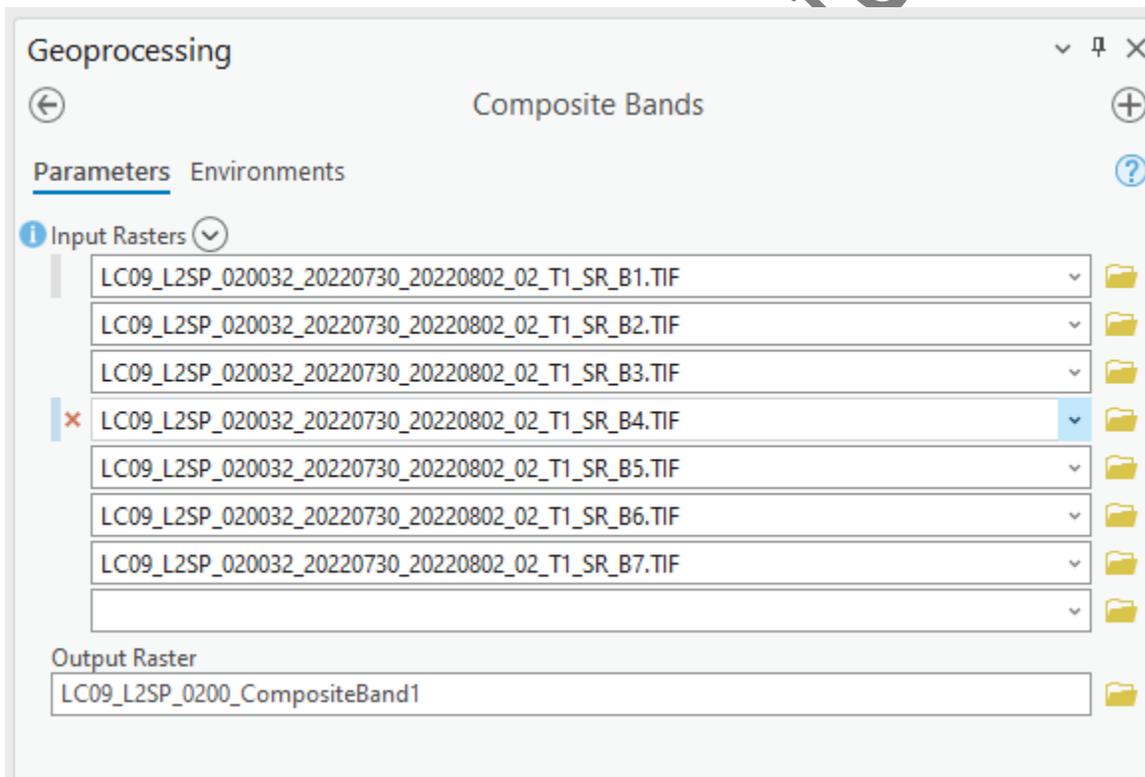
$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$

Next, open ArcGIS and create a new project called 1515NDVI.

Instead of importing each individual band, we want to create a multispectral image using several of the bands.

That being said, we want to go to the tools and search for Composite Bands. This will allow us to compile all of the bands into one image.

It is imperative that we have the correct bands in order.



Looking above, you'll notice that the last digit of the file name is a number. We only need to import Bands 1-7 for now. If one is out of order, you can right click on the left side of the file and move each one up or down until it looks like the picture above.

Click Run. This process may take a moment. It is a large amount of information.

Now, we have a multispectral image that we can do things with.

Today, we want to first focus on NDVI. Thankfully, ArcGIS has an NDVI calculation built in.

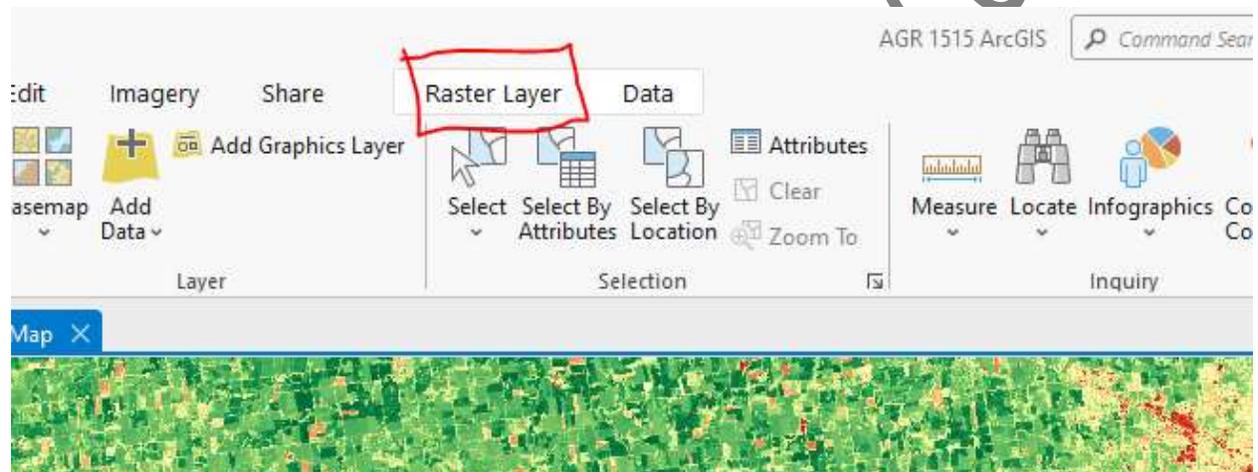
Go to the Imagery tab at the top of the screen. Find the button for Raster Functions. Select it and a variety of tools will show up on the right side. Click on NDVI (**NOT** NDVI Colorized).

Make sure to select the correct composite file we just created as the input raster.

Next, you need to select the visible band and infrared band. Use the table provided above to determine which band is which.

When you've decided the correct bands, select create new layer.

This will result in a black and white image. However, we want a green and red image that we're used to. Go to the top of your screen and select "Raster Layer."

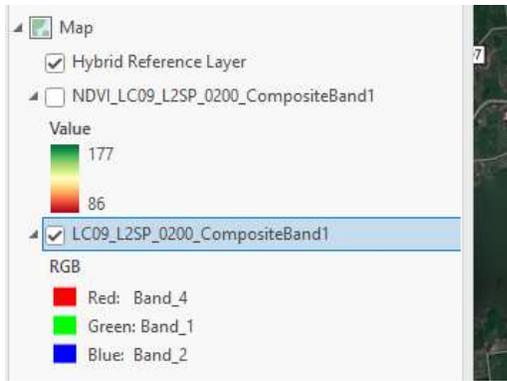


Next, click on symbology, and change the color scheme to be red on the left, and green on the right.

Now that you've used Landsat imagery to create an NDVI map, let's look at other unique ways we can display the imagery.

Go back to your composite image you created earlier, so we can display different bands.

Make sure the NDVI image is unchecked in the contents panel, and the composite image *is* checked.



Now go back to the Raster Layer and select Band Combination. Under the drop down, select custom.

Create these custom combinations and see how they appear. The numbers on the right are associated with the 3 bands you can select in the custom application.

Natural Color	4 3 2
False Color (urban)	7 6 4
Color Infrared (vegetation)	5 4 3
Agriculture	6 5 2
Atmospheric Penetration	7 6 5
Healthy Vegetation	5 6 2
Land/Water	5 6 4
Natural With Atmospheric Removal	7 5 3
Shortwave Infrared	7 5 4
Vegetation Analysis	6 5 4