Creating

EARTH AS ART

Session Two

IT IS MORE THAN COLOR!

IT'S ... SCIENCE

The Earth as Art Tutorial

In Session One, "The Study of Color", we investigated the artistic components of color within images to set our foundation on the elements of art or, as we might say on the science side, photo interpretation. As we begin in Session Two of the Earth as Art series, we want to emphasize the importance of the satellite systems used in acquiring these images and discover the science behind these images, their origin and, most of all, where to obtain the images and develop them into your very own Earth as Art masterpiece. We will examine image acquisition sites, download procedures, and the software used to create your image artwork.

Many images from satellites are simply intriguing to observe and ponder. Satellites capture an incredible variety of views over the Earth that are then archived at the United States Geological Survey for distribution to the public at large.

Contents of *Session Two*

Introduction

An Earth Observation Mission…

AmericaView's continuing mission helps build and foster learning about our Earth, its inhabitants and the use of remote sensing (RS), unmanned aircraft systems (UAS) and geographic information system (GIS) technology to lead systemic reform and support continuous improvements across the nation and abroad, utilizing the "Earth" as art.

Our discussions in this session will begin at the heart of our program, the imagery itself. The images within this session were collected by the Landsat series of Earth-observing satellites. We will learn about the sensors aboard Landsat satellites, how to download the images that they acquire, and how to process the images to create your works of art.

Without further delay, let's launch this session. Onward with Science!

In the beginning ...

Earth-Rise

"We came all this way to explore the Moon, and the most important thing is that we discovered the Earth"

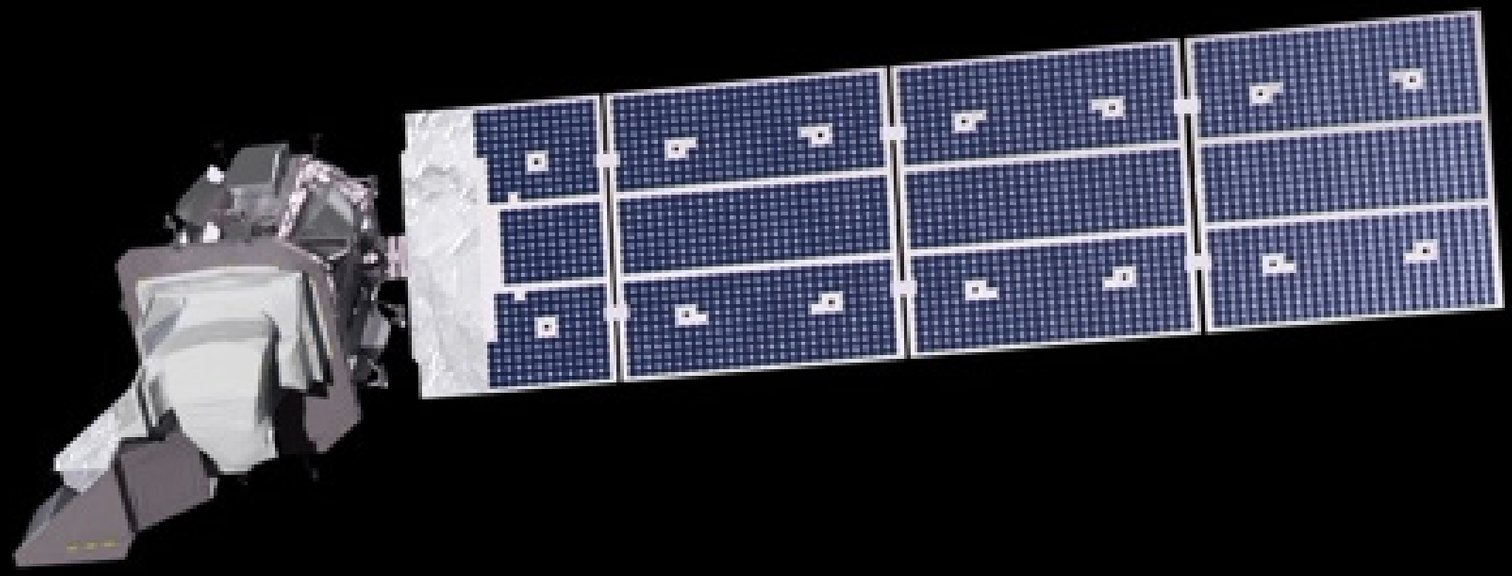
Quote from onboard Apollo 8, December 1968
Astronaut, Maj. Gen. William A. Anders, USAF (ret.) ...

The Science of ...

LANDSAT Spacecraft

Since 1972, the joint NASA/U.S. Geological Survey Landsat series of Earth Observation satellites has continuously acquired space-based images of the Earth's land surface, providing uninterrupted data to help land managers and policymakers make informed decisions about our natural resources and the environment.

The Landsat program is part of the USGS National Land Imaging (NLI) and Core Science programs.



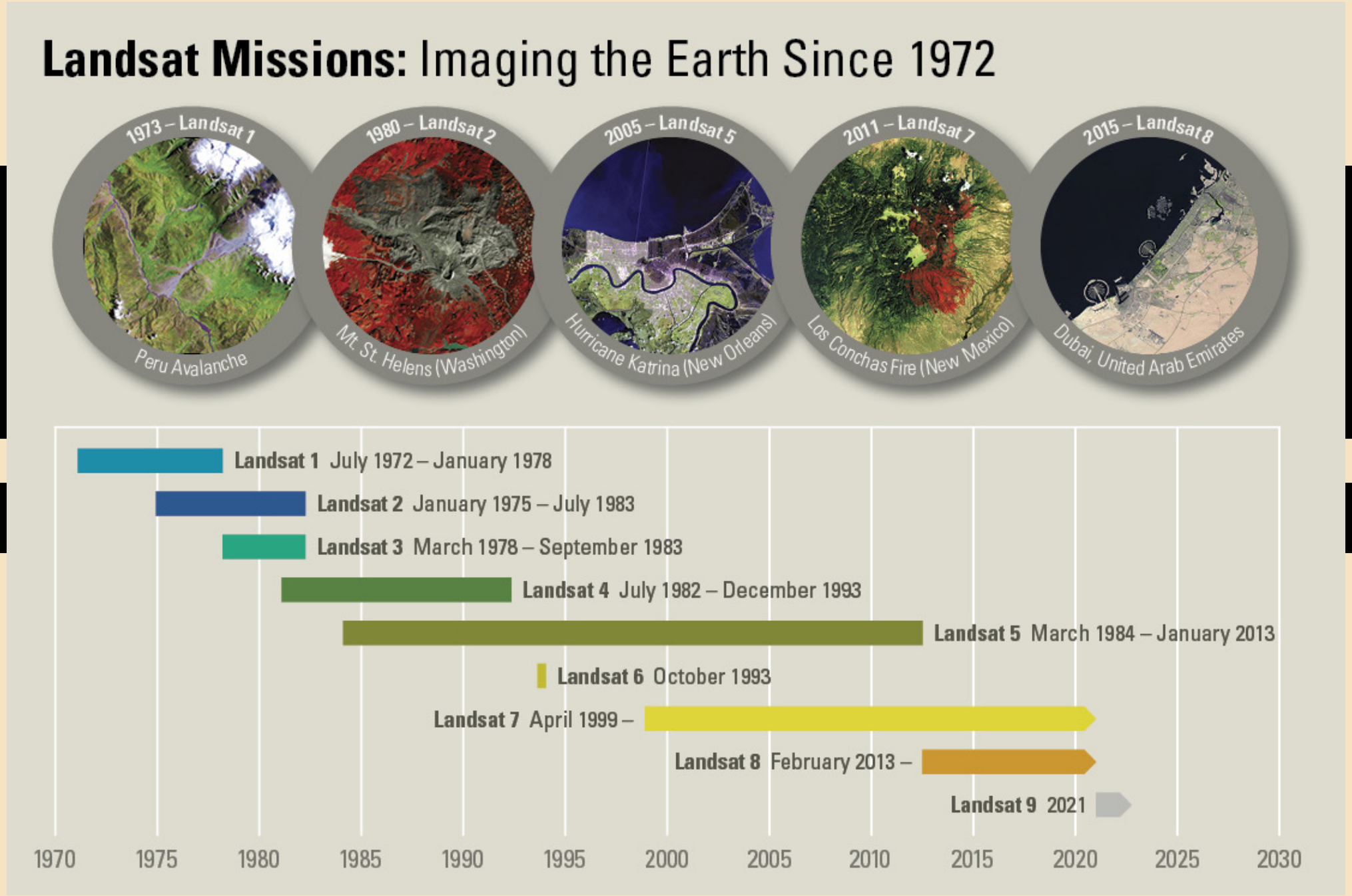
Learn more about Landsat by visiting the EROS Landsat Remote Sensing Classroom https://eros.usgs.gov/remote-sensing-classroom

Lesson Plans

Fun and engaging educational lessons that allow students to look at satellite imagery and perform analysis are located on this site.

"Students of all ages" can learn how remote sensing scientists use Landsat satellite data to track changes to the Earth's surface.

Timeline in the life of Landsat



The Landsat program offers the longest continuous global record of the Earth's surface and continues to deliver visually stunning and scientifically valuable images of our planet. Through the ever-watching eyes of the LANDSAT satellites, we are constantly amazed at the shear artistic wonder that is our "EARTH!"

Launch readiness date September 2021

Now that we have a background knowledge of the Landsat Satellite Program…

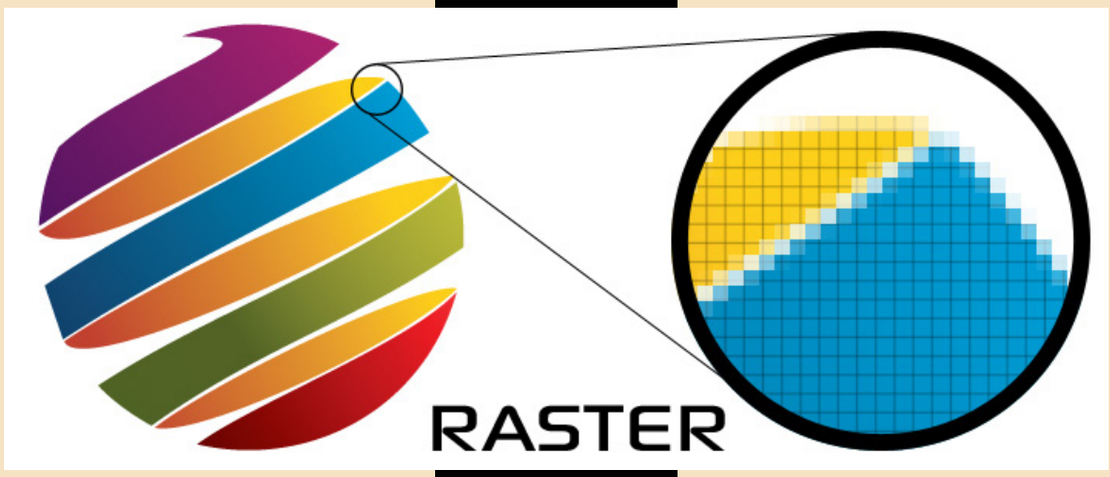
let's move forward to work with the imagery obtained from Landsat. In today's world, computer graphics can be created in either raster or vector format.

It's Raster we want…

Raster graphics

...are bitmaps. A bitmap is a grid of individual pixels that collectively compose an image.

Raster graphics render images as a collection of countless tiny squares. Each square, or pixel, is coded in a specific hue or shade. Individually, these pixels are worthless, yet together, they're worth a thousand words.



printcnx.com

Vector graphics, such as logo files, use intricate paths made up of points and lines to create an image. Raster graphics, such as digital photographs, are created using a grid of tiny pixels.

Raster graphics are best used for non-line art images specifically digitized photographs, scanned artwork or detailed graphics. Non-line art images are best represented in raster form because these typically include subtle chromatic gradations, undefined lines and shapes, and complex composition.

However, because raster images are pixel-based, they suffer a malady called image degradation. Just like photographic images that get blurry and imprecise when blown up, a raster image gets jagged and rough. Why? Ultimately, when you look close enough, you can begin to see the individual pixels that comprise the image. Hence, your raster-based logo, magnified to 1000, becomes bitmapped before you know it. Although raster images can be scaled down more easily, smaller versions often appear less crisp or "softer" than the original.

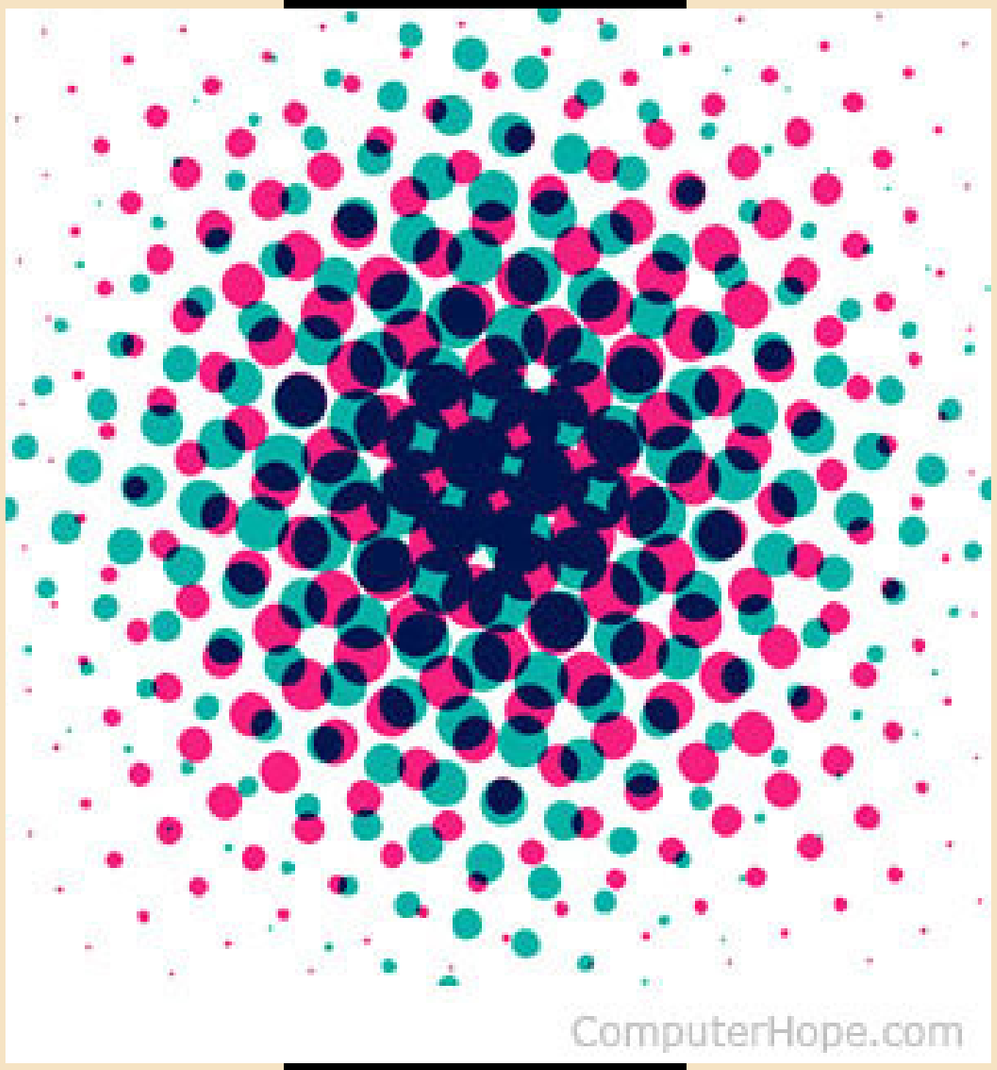
To maximize the quality of a raster image, you must keep in mind that the raster format is resolution-specific, meaning that raster images are defined and displayed at one specific resolution. Resolution in raster graphics is measured in dpi, or dots per inch. The higher the dpi, the better the resolution.

In Summary, a Raster File

...is an image file format defined by a pixel with one or more numbers incorporated with it. The number represents the location, size, or color of the pixels.

Example of raster images: .JPEG, .PNG, and TIFF files.

Today, almost all of the images you see on the Internet and images taken by a digital camera are raster images.



Raster graphics

For our raster images that we will be working with, we may choose one of the following formats to display our downloaded image files.

True Color
False Color
Pseudo Color
Grayscale

True Color

True color images use the blue, green, and red visible color bands to create images that display the Earth in colors similar to what our eyes see.

Rupert Bay, an arm of James Bay, extends into Quebec, Canada

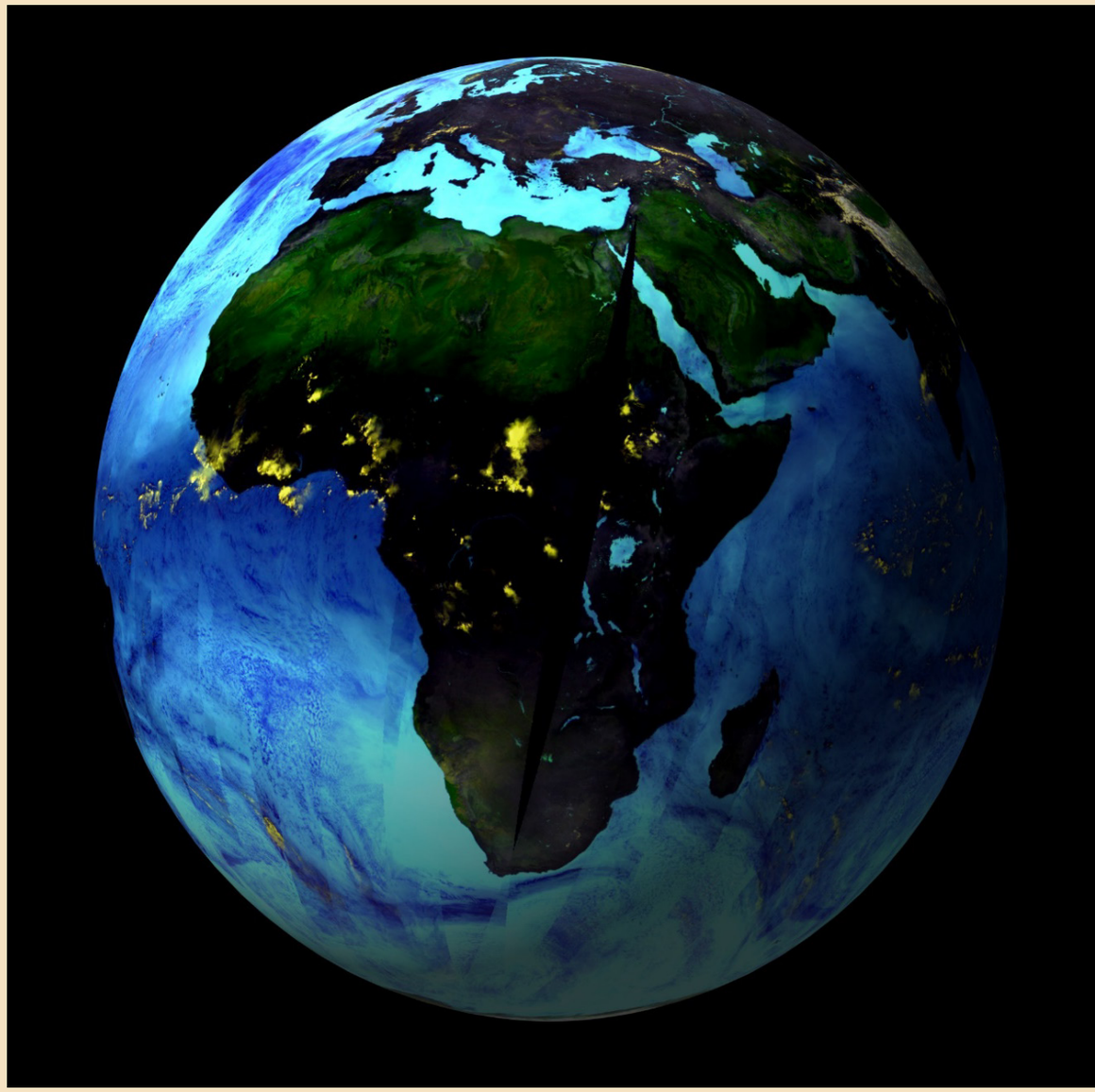
False Color

False color images are a representation of a multispectral image produced using any bands other than visible red, green and blue as the red, green and blue components of the display. False color composites allow us to visualize wavelengths that the human eye can not see (i.e., near-infrared and beyond).

Southwestern Iran. The dark red shape in the center of the image is Shadegan Pond

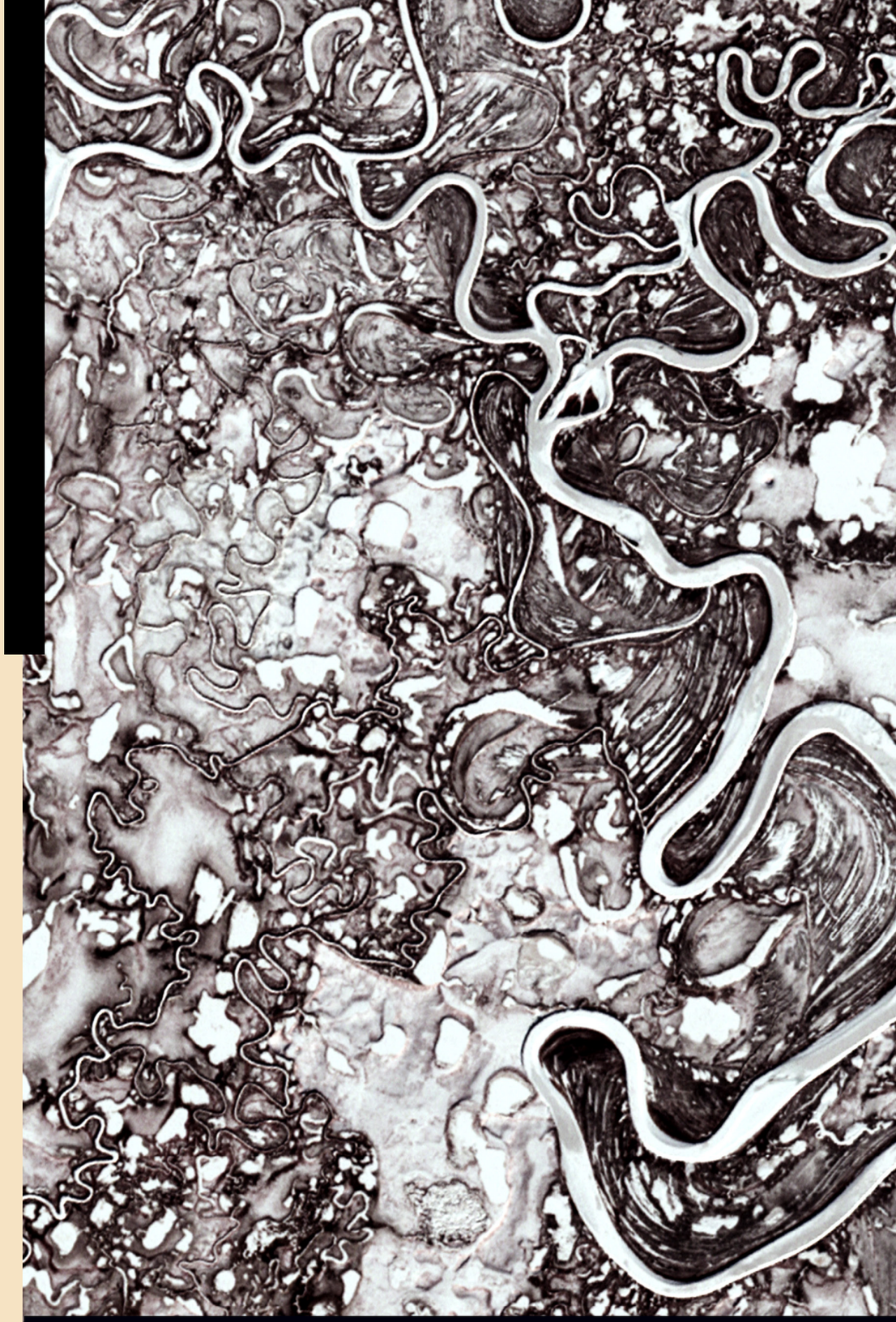
Pseudo color

Pseudo color is a technique to artificially assign colors to a gray scale. Colors are assigned based on the intensity of the values expressed in the gray scale. This technique maps each of the gray levels of a black and white image into an assigned color. Psuedo color is commonly used for thermography which shows infrared radiation instead of light intensity, and in mapping elevation.



Grayscale

Grayscale is a spectrum of shades of gray without apparent color. The darkest shade is black (the total absence of transmitted or reflected light), and the lightest shade is white (the total transmission or reflection of light at all visible wavelengths). Intermediate shades of gray are described by equal brightness levels of the three primary colors (red, green, and blue) for transmitted light or equal amounts of the three primary pigments for reflected light.



The Mayn River, northeastern corner of Siberia

Downloading Landsat Imagery

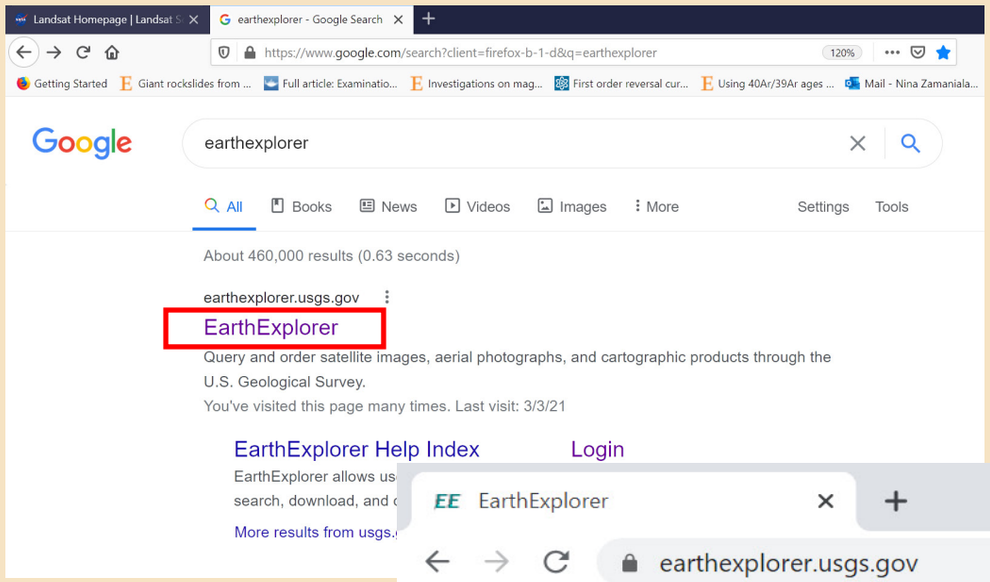
earthexplorer.usgs.gov

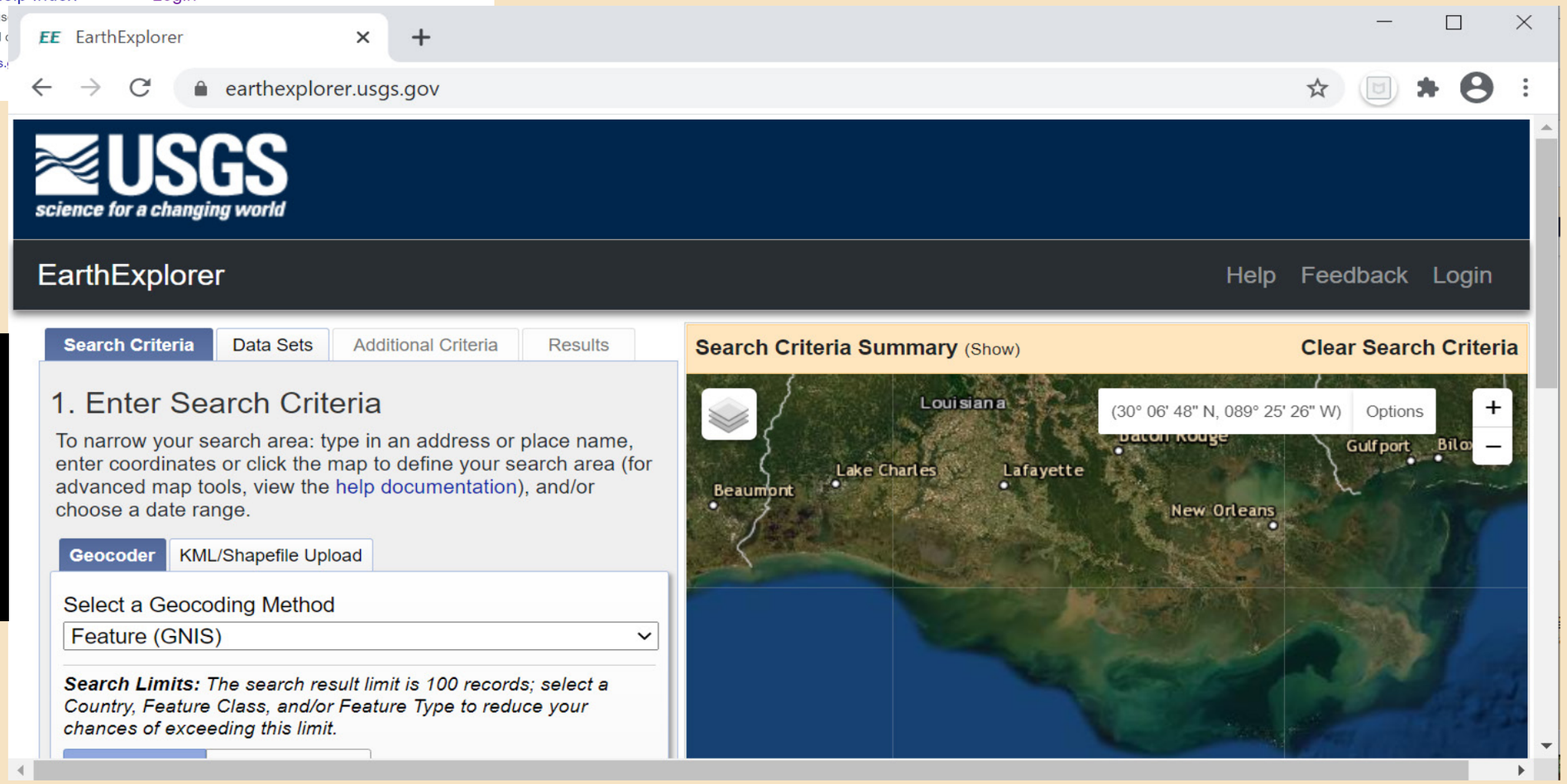
There are different online sources where one can find Landsat satellite imagery to download for the creation of your art masterpieces.

The USGS Earth Explorer website is a reliable source you have access to for FREE download of not only Landsat imagery but imagery from many other satellite systems as well.

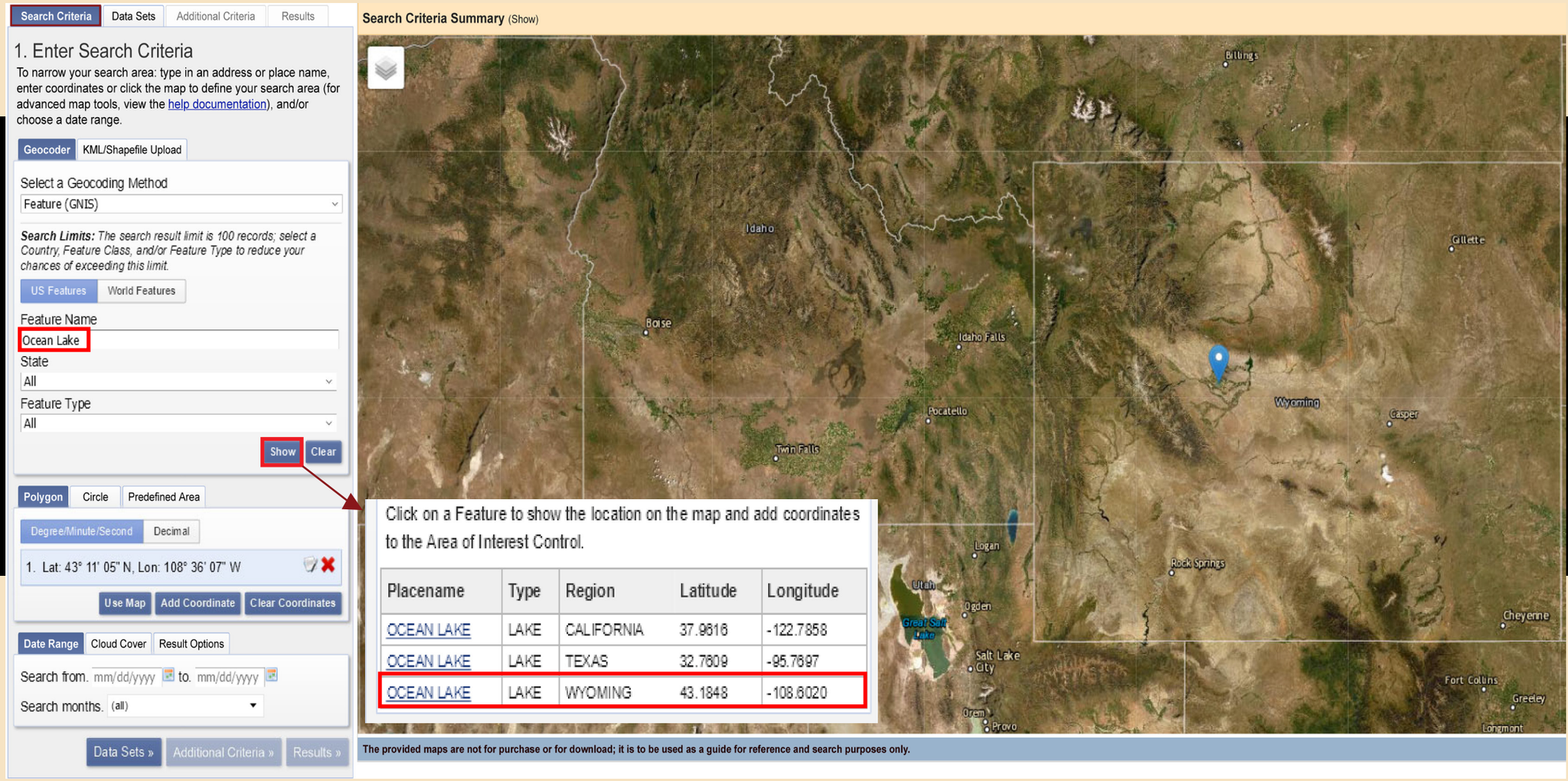
The following exercise will walk you through the steps to acquire your Landsat satellite imagery.

EarthExplorer, a reliable place to find the data

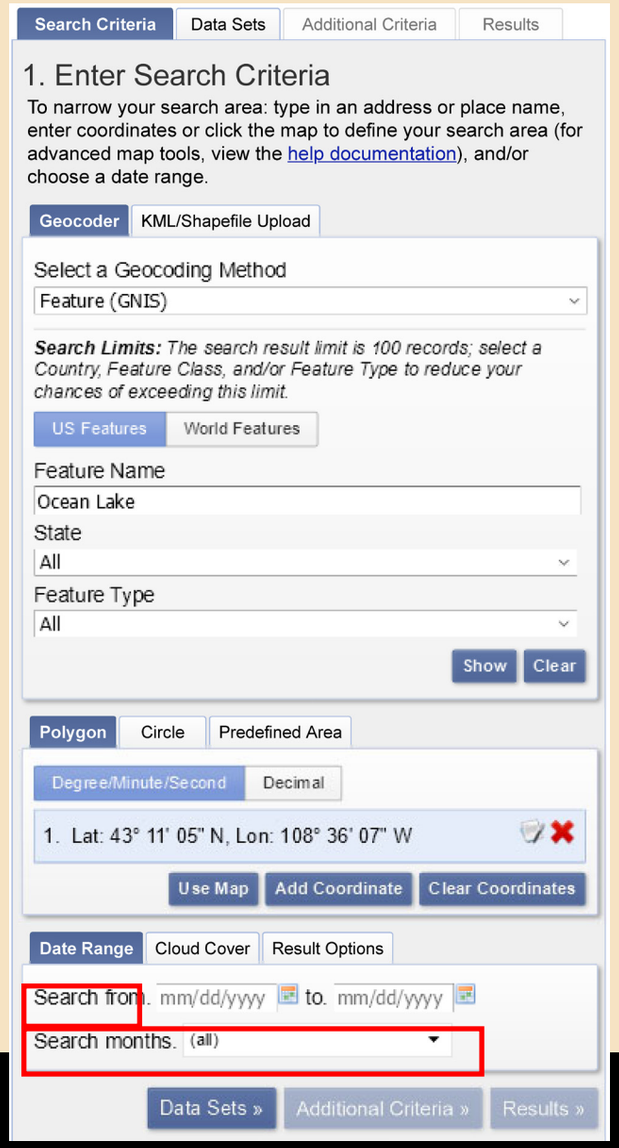




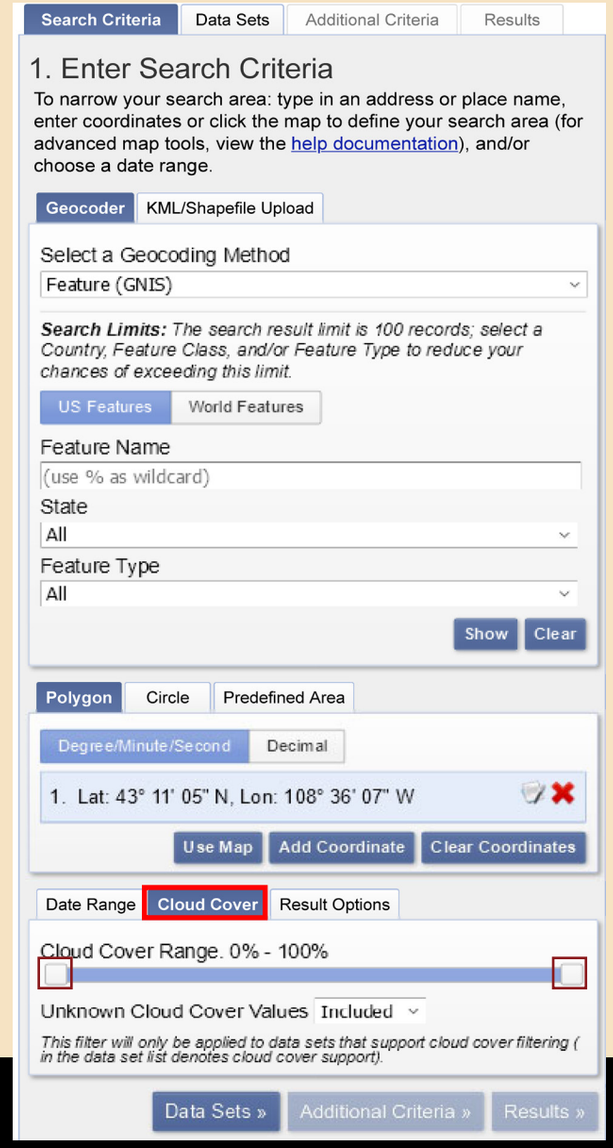
As an example - searching for imagery of Ocean Lake in Wyoming



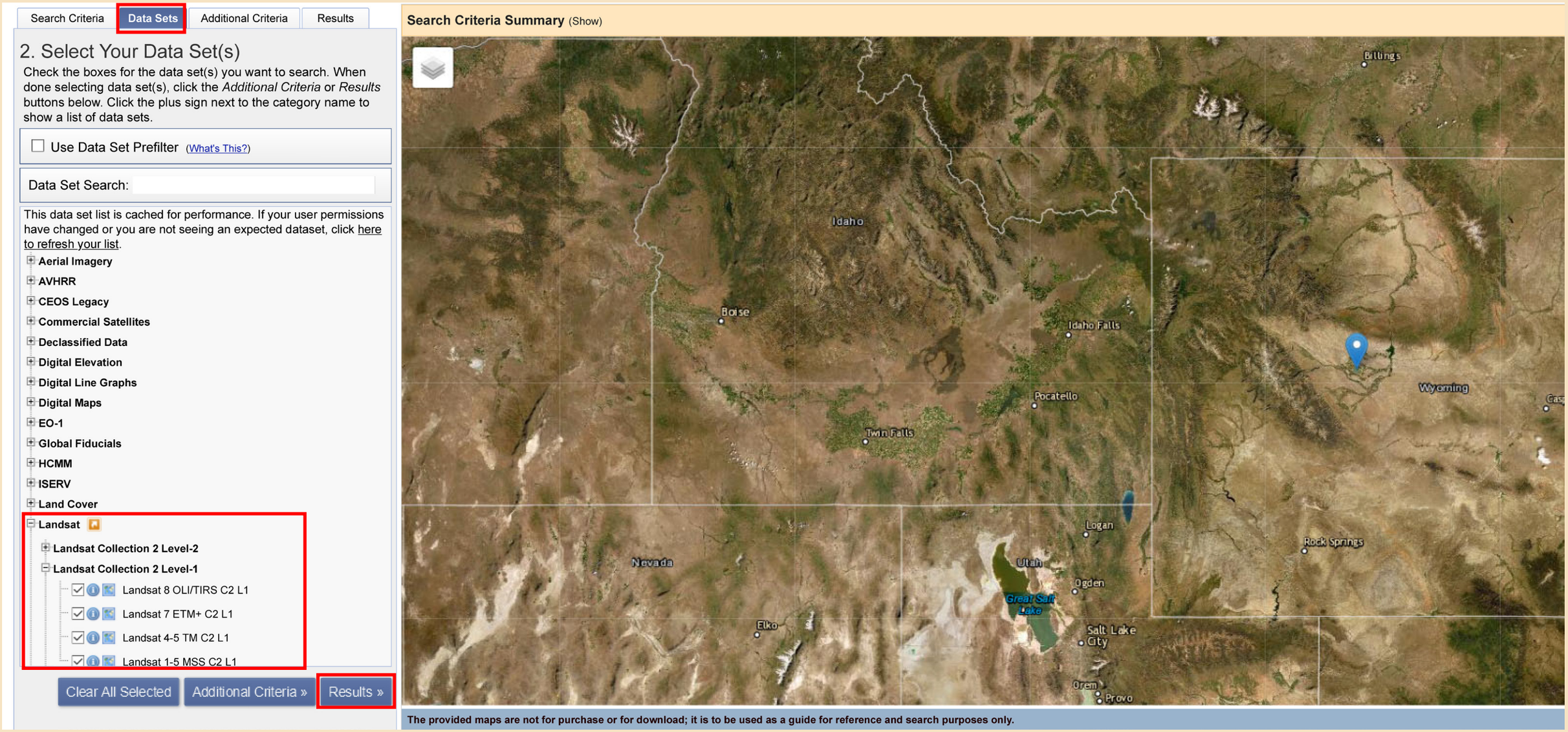
There are several ways you can look for imagery of your area of interest. In this example the Geocoder was used to find features that are named Ocean Lake. Three features with this name were found and the feature in Wyoming was selected from the list of candidates.



Specifying a date range can be useful for several reasons, including finding imagery before and after an event.



Cloud coverage can affect the image quality and practicality of an artwork. You can select the percentage of the cloud coverage for the imagery set.

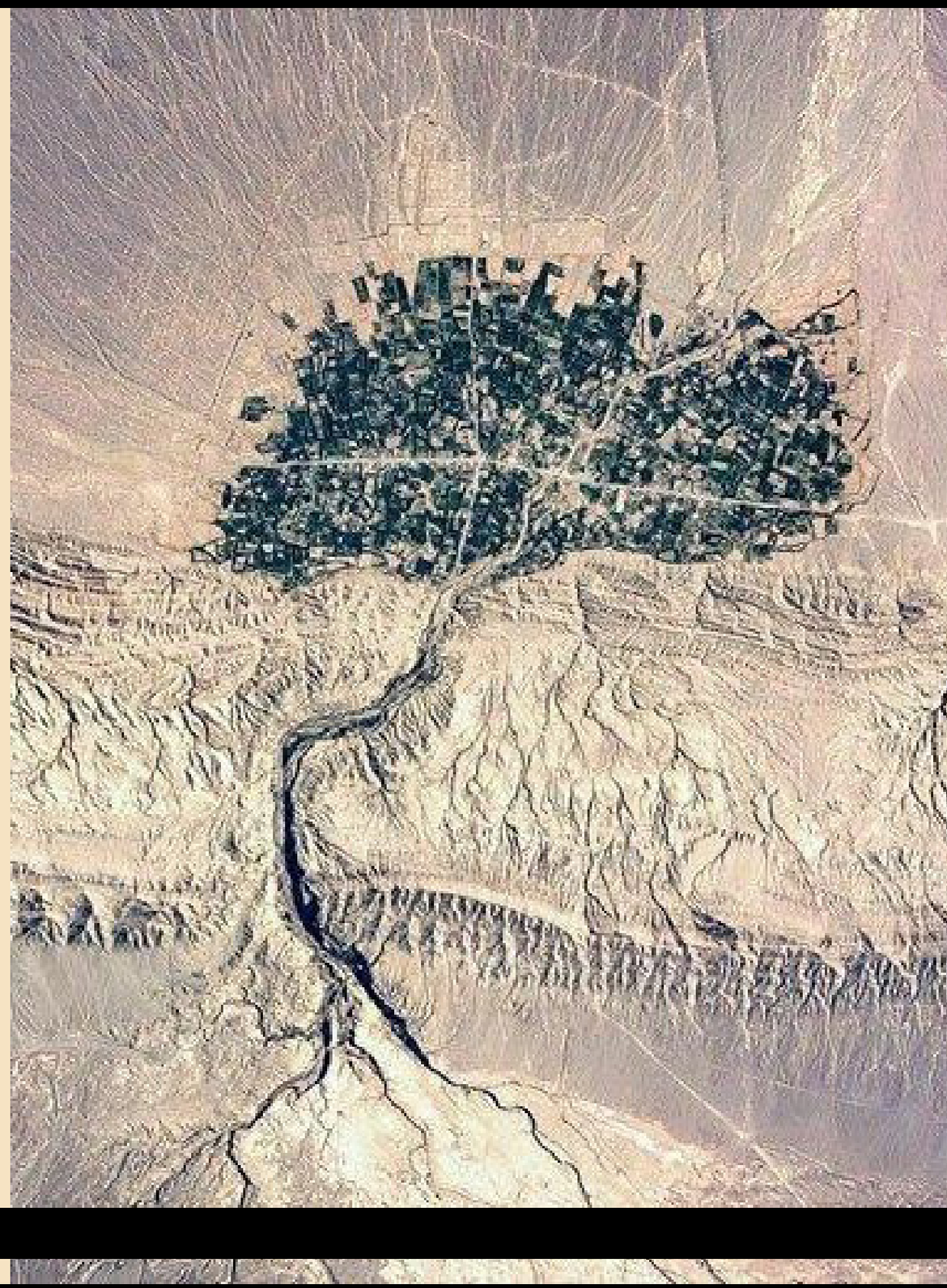


Based on the area of interest and availability, you can select different satellites.

Now that we have learned how to use EarthExplorer to locate our area of interest...

... let's move on to selecting the image we want to use, downloading it as a zipped bundle, and extracting the files from the bundle.

It's the Image we want ...



In the remainder of this tutorial session, we will use imagery from:

- Louisiana's Mississippi River Delta in conjunction with esri's Arc-Map software

- A Texas state park in conjunction with MultiSpec software

- The Caspian Sea in conjunction with Adobe Photoshop software

to create Earth as Art masterpieces...

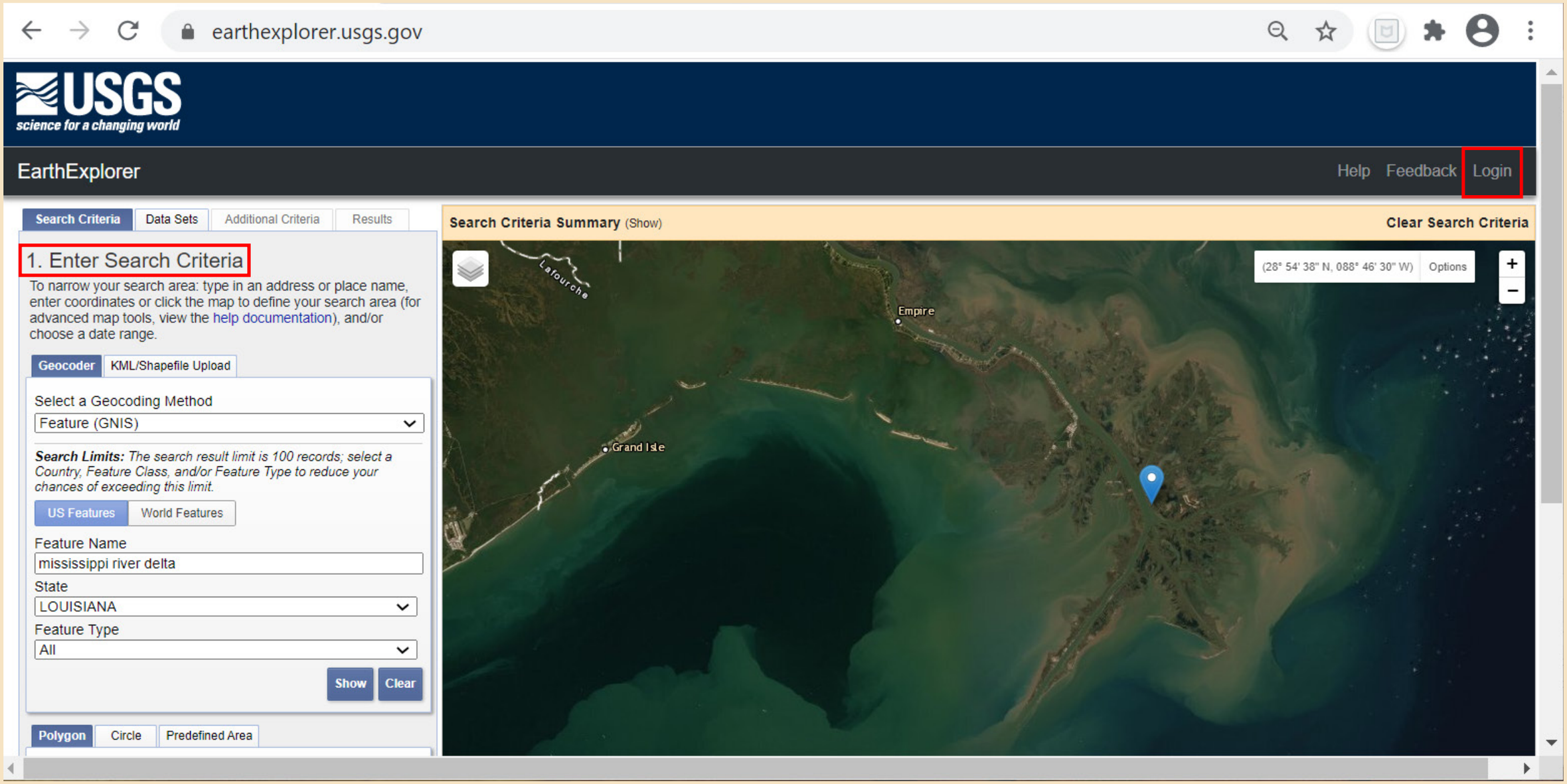
Now it's time to ...
Navigate and Create a Login in EarthExplorer

Create a Login in EarthExplorer and then Navigate to our area of interest (AOI).

On this slide the blue pointer indicates the Mississippi River Delta AOI.
(We illustrated this so you would have an idea of where you will be working, if you are unfamiliar with the Gulf Coast).

The next slide highlights the Login button on the tool bar located at the top right-hand side of the EarthExplorer window. Click on the Login button to create your very own EarthExplorer account. This will make working in the program and downloading your imagery much easier. Once you have completed your login, specify the search criteria for your AOI within Step 1, as shown in the following slides.

Visiting Louisiana's Gulf Coast Landscape …



1

Enter search criteria information to more precisely locate your area of interest

earthexplorer.usgs.gov

Search Limits: *The search result limit is 100 records; select a Country, Feature Class, and/or Feature Type to reduce your chances of exceeding this limit.*

US Features | World Features

Feature Name
mississippi river delta

State
LOUISIANA

Feature Type
All

Show | Clear

Polygon | Circle | Predefined Area

Degree/Minute/Second | Decimal

1. Lat: 29° 10' 00" N, Lon: 089° 15' 01" W

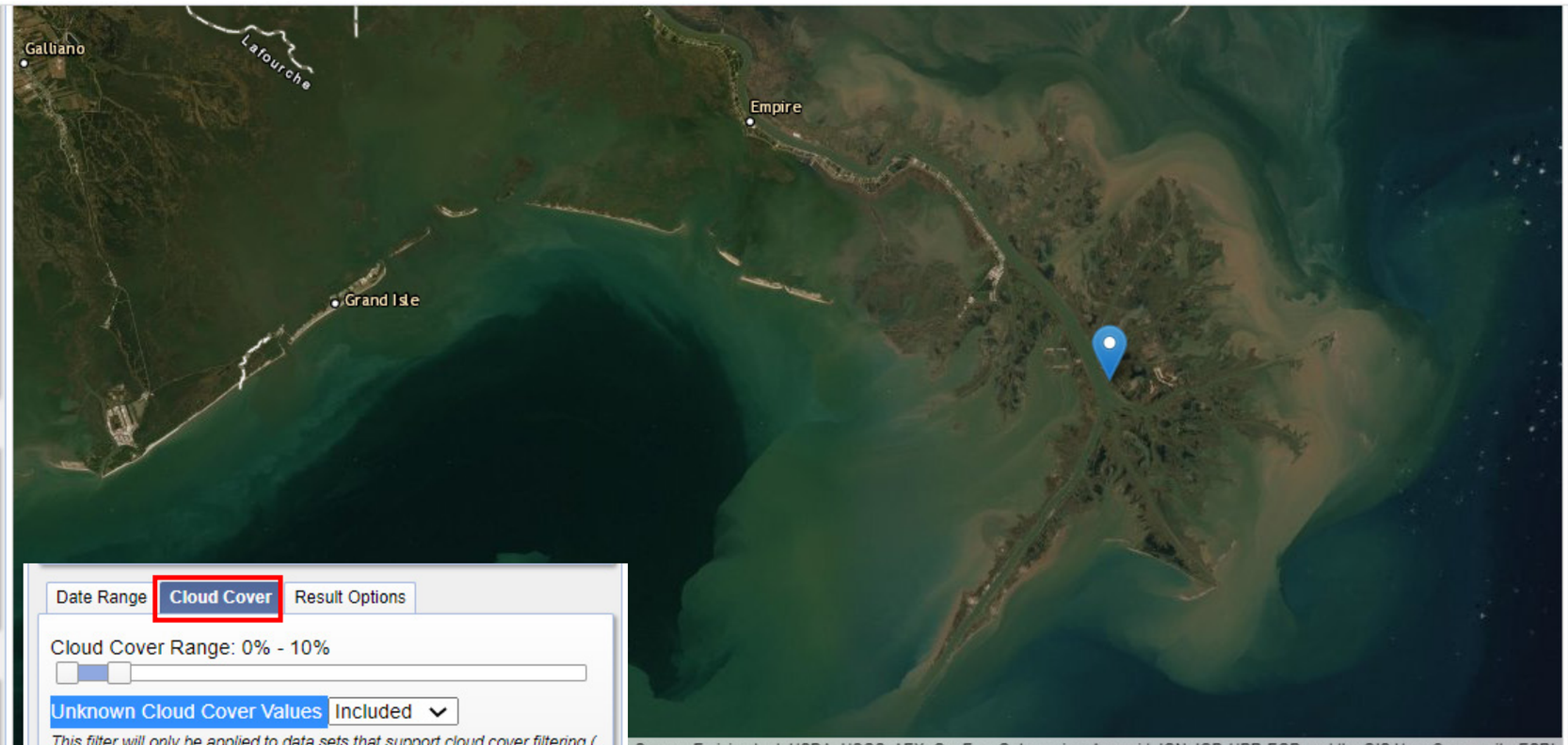
Use Map | Add Coordinate | Clear Coordinates

Date Range | Cloud Cover | Result Options

Search from: 08/31/2020 to: 09/18/2020

Search months: (all)

Data Sets » | Additional Criteria » | Results »



Date Range | Cloud Cover | Result Options

Cloud Cover Range: 0% - 10%

Unknown Cloud Cover Values Included

This filter will only be applied to data sets that support cloud cover filtering (in the data set list denotes cloud cover support).

Data Sets » | Additional Criteria » | Results »

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community, ESRI

ide for reference and search purposes only.

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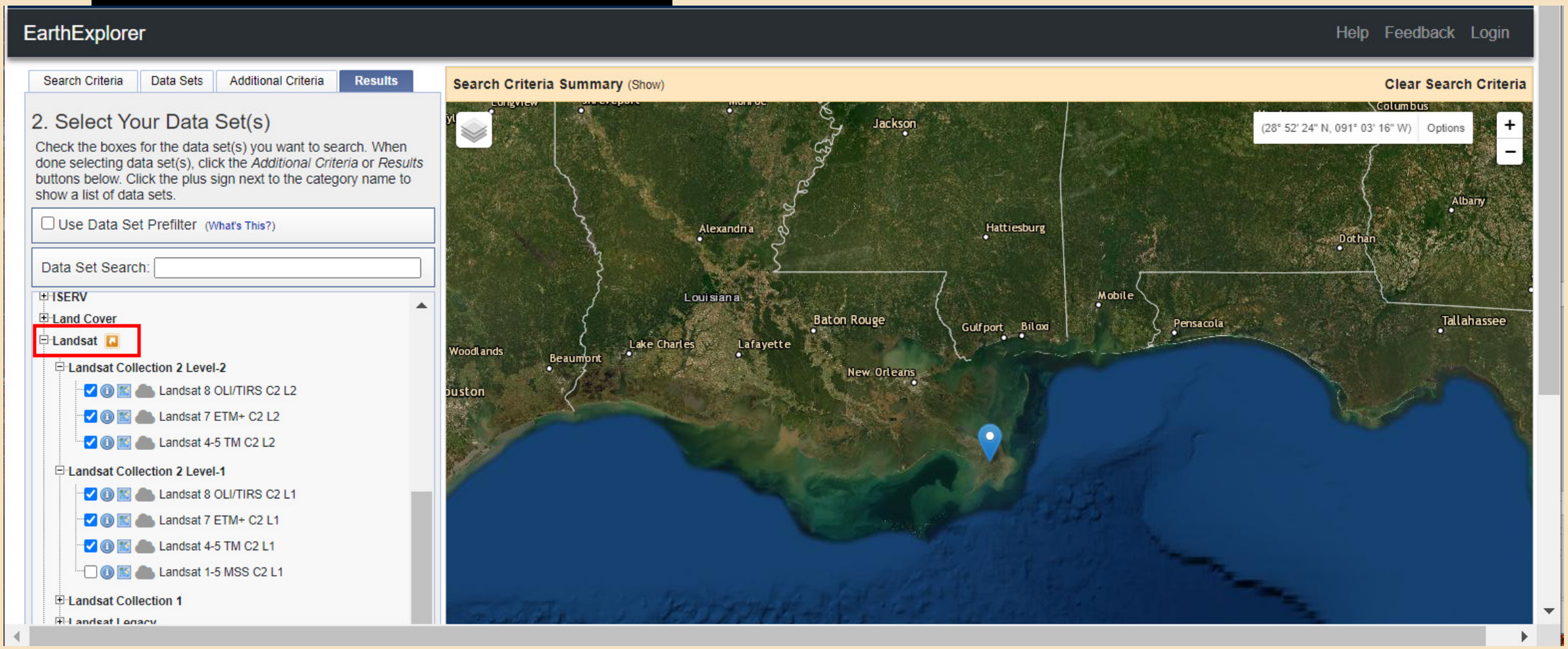
U.S. Department of the Interior | DOI Inspector General | White House | E-gov | No Fear Act | FOIA

2

Specify the date range and cloud cover range

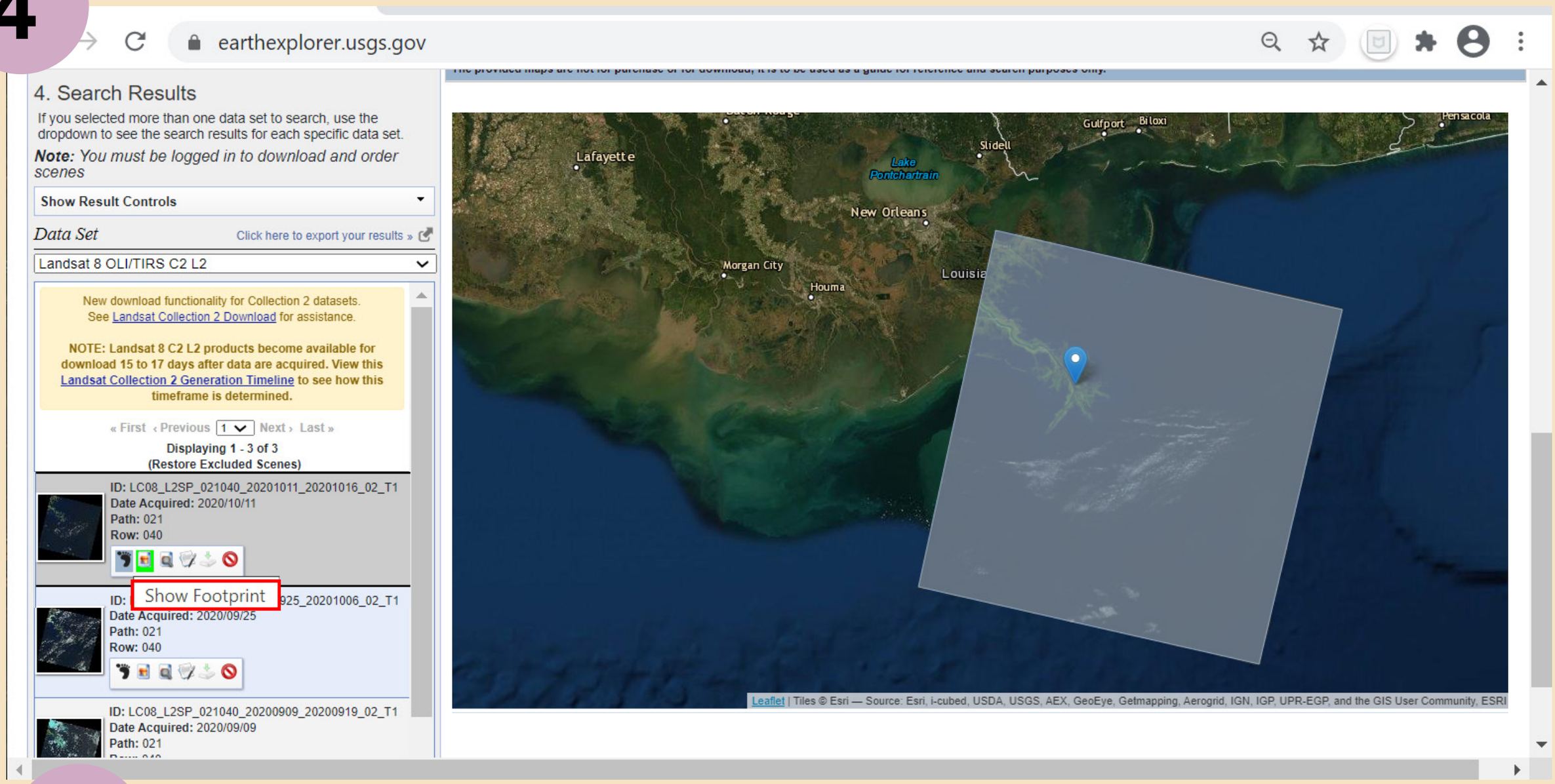
3

Select Your Satellite/Sensor



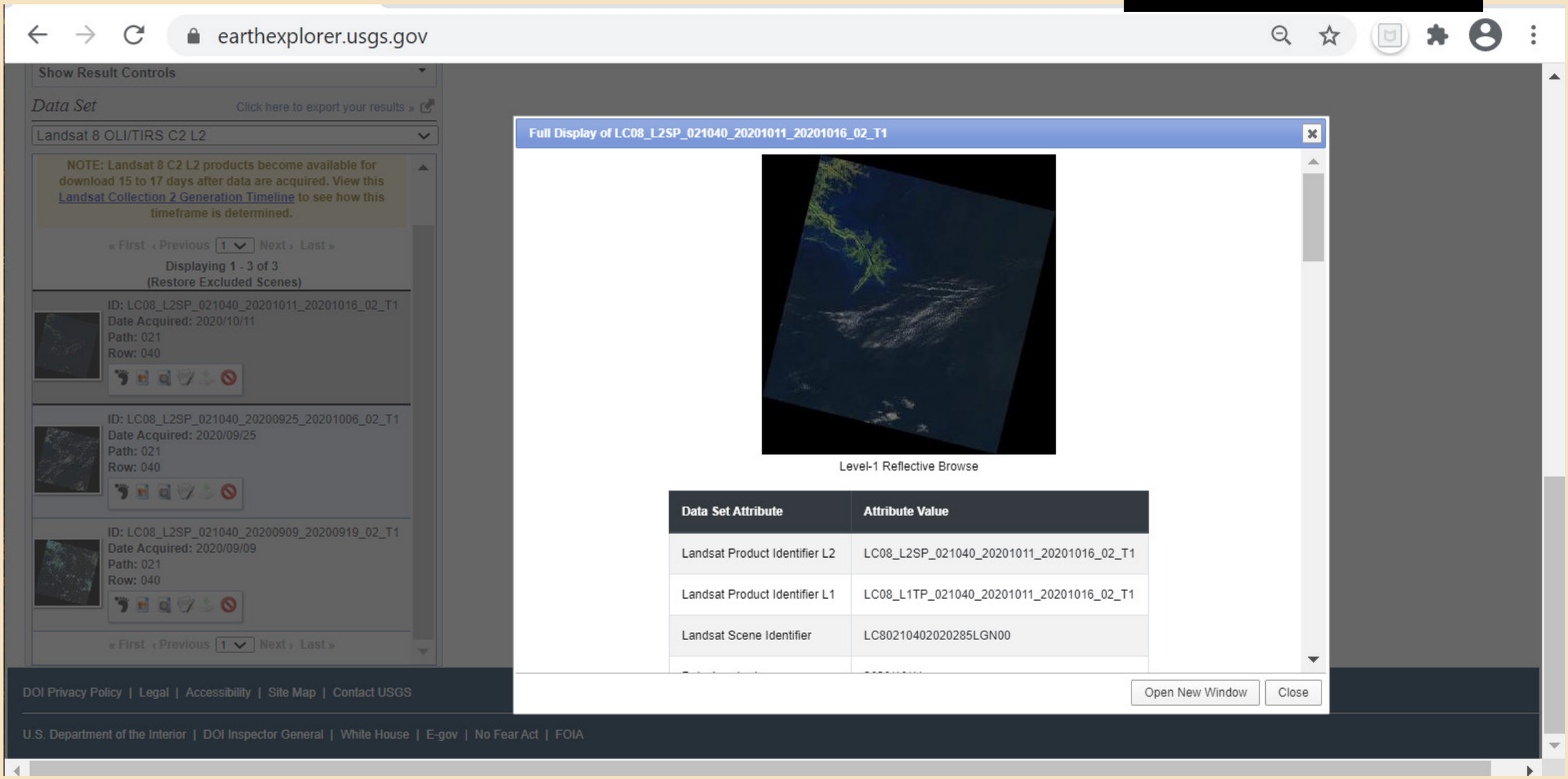
Select the data set(s) that will be searched for imagery that matches the criteria you specified. In this example several collections of Landsat imagery are selected. This increases the chances of finding the imagery you desire. Although this step gives the user the ability to further refine their search results, it is not required in selecting your image for creating an Earth as Art Masterpiece.

4



4.1

EarthExplorer will use the criteria you entered to display a list of images that match the specified criteria. If no imagery is listed, go back and change your search criteria. Feel free to adjust these multiple times to see the results. Click on the "Show Footprint" icon within an image listing to see the area of coverage for that image.

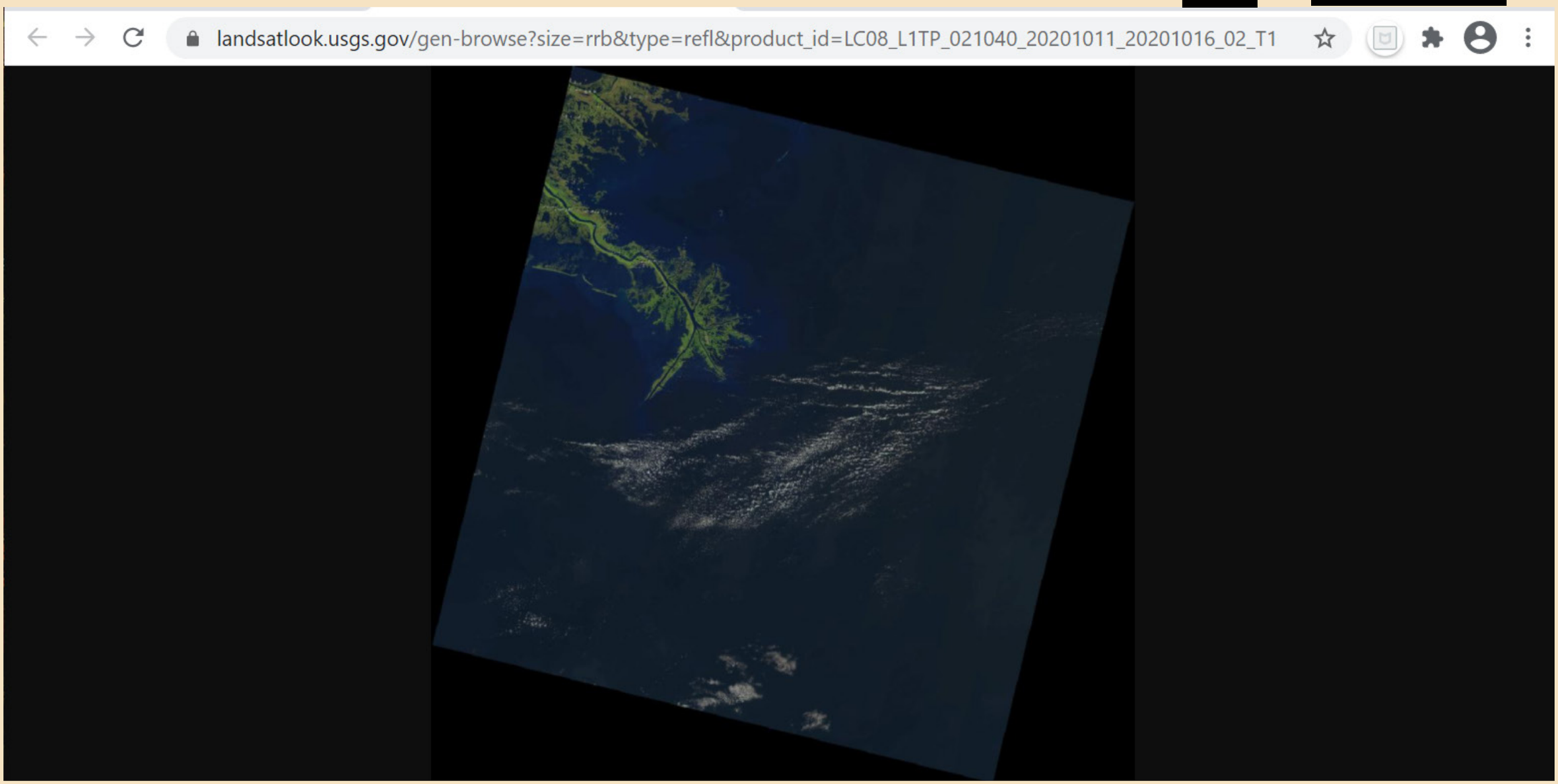


[redacted]

4.2

Clicking on the “Show Metadata and Browse” icon will display a thumbnail image and metadata that will aid you in evaluating the image for your use. Is your area covered in clouds? Did you capture your area of interest?

[redacted]



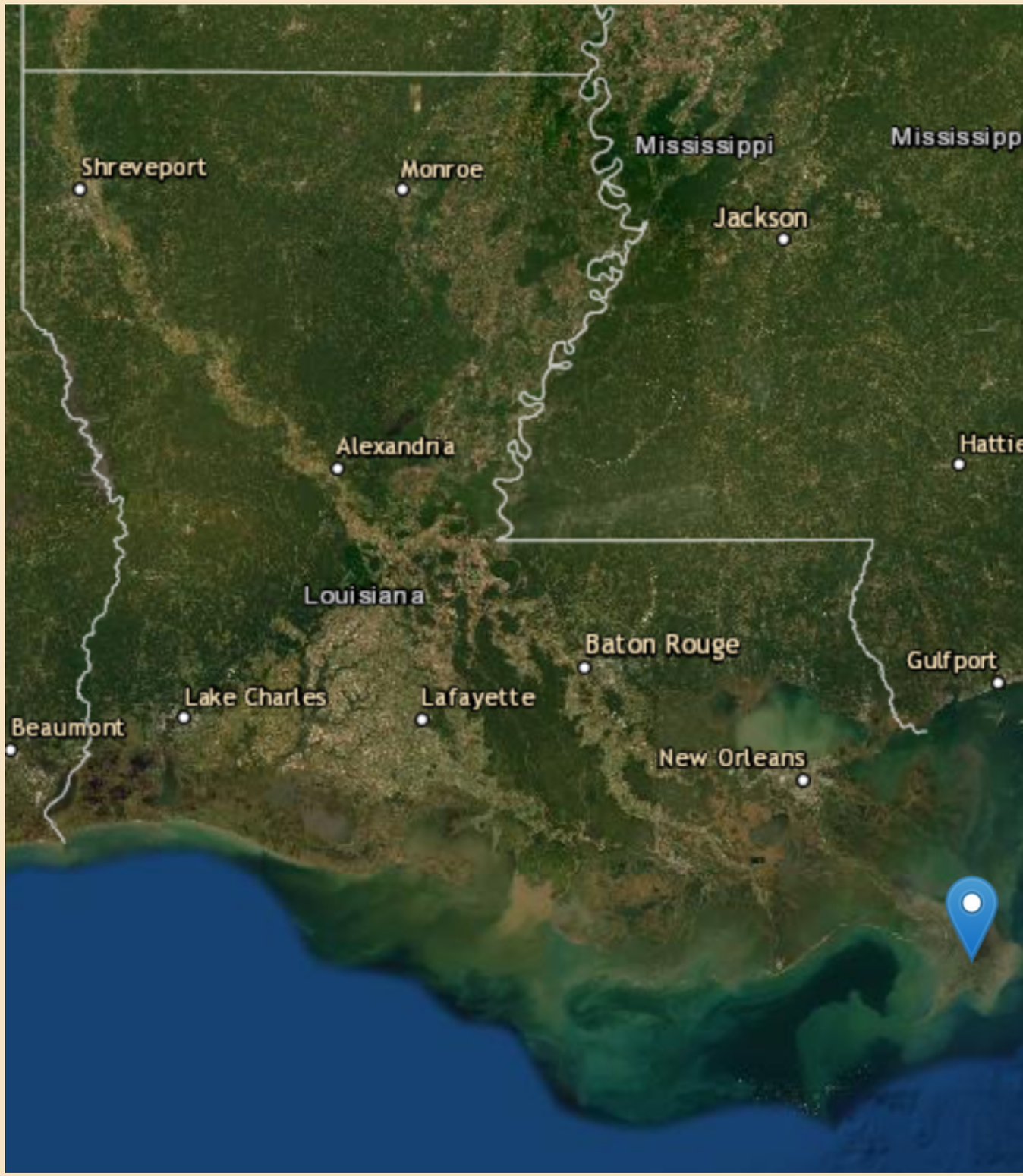
4.3 [redacted]

Clicking on the image within the metadata window results in a larger display of the image. Once evaluated, close these windows.

Begin the Download process

The following slides will step you through the download process.

Click on the download icon associated with each image you would like to acquire. Landsat products on Earth Explorer are available as a .tar.gz bundle download that includes all files associated with a scene. Users can also select individual bands and files to download if they know the specific bands desired. A step-by-step guide is available at: https://lta.cr.usgs.gov/sites/default/files/LS_C2_Help_122020.pdf



Where in the "Delta" are we?

Search Criteria | Data Sets | Additional Criteria | **Results**

4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

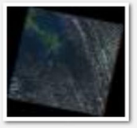
Show Result Controls

Data Set — Click here to export your results »

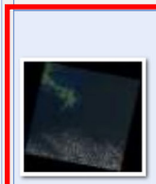
Landsat 4-5 TM C1 Level-1

« First ‹ Previous 1 Next › Last »

Displaying 1 - 10 of 273



ID: LT05_L1TP_021040_20111019_20160830_01_T1
Acquisition Date: 2011-10-19
Path: 21
Row: 40



ID: LT05_L1TP_021040_20111003_20160830_01_T1
Acquisition Date: 2011-10-03
Path: 21
Row: 40

ID: LT05_L1TP_021040_20110917_20160830_01_T1
Acquisition Date: 2011-09-17
Path: 21
Row: 40

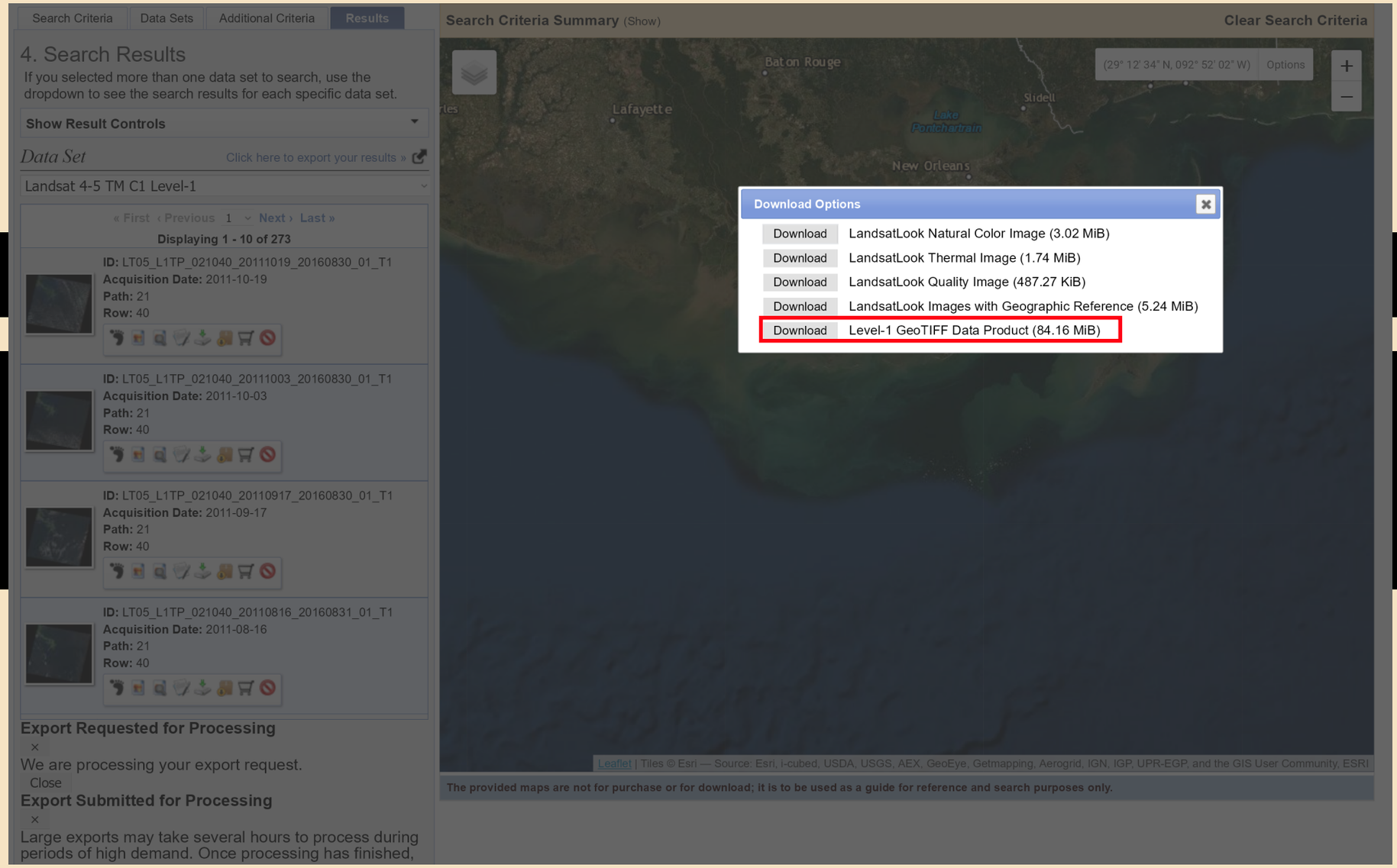
ID: LT05_L1TP_021040_20110816_20160831_01_T1
Acquisition Date: 2011-08-16
Path: 21
Row: 40

Search Criteria Summary (Show) — **Clear Search Criteria**

The provided maps are not for purchase or for download; it is to be used as a guide for reference and search purposes only.

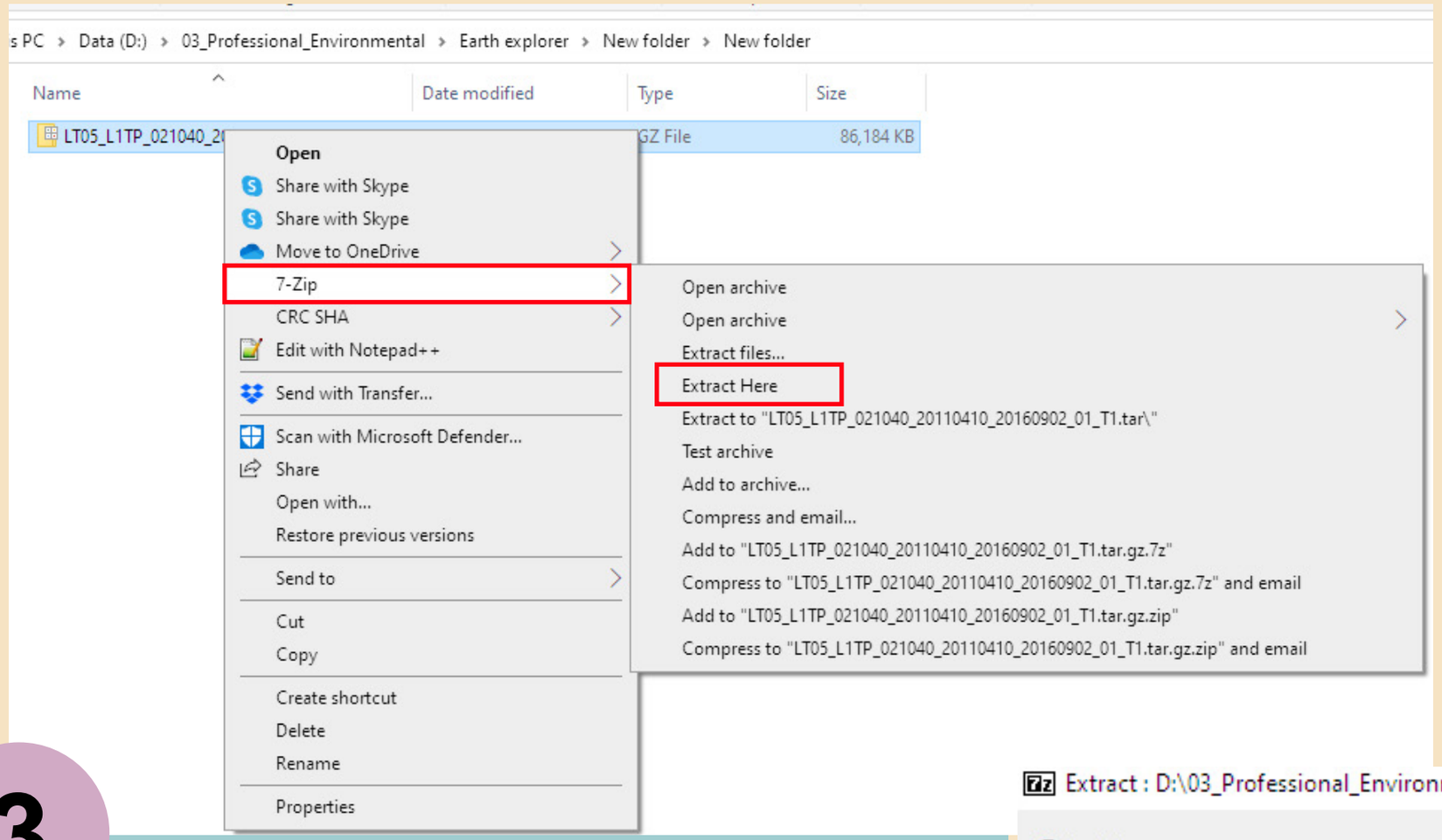
1

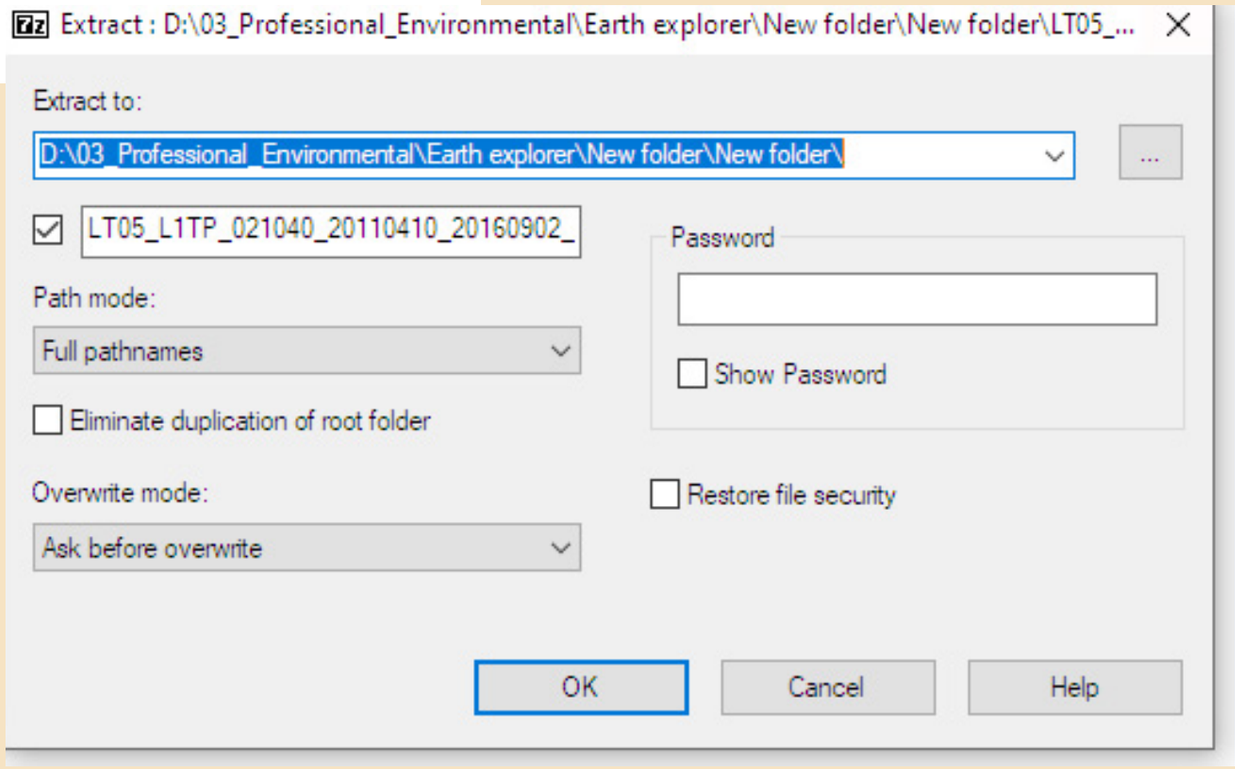
Highlight the scene you want



2

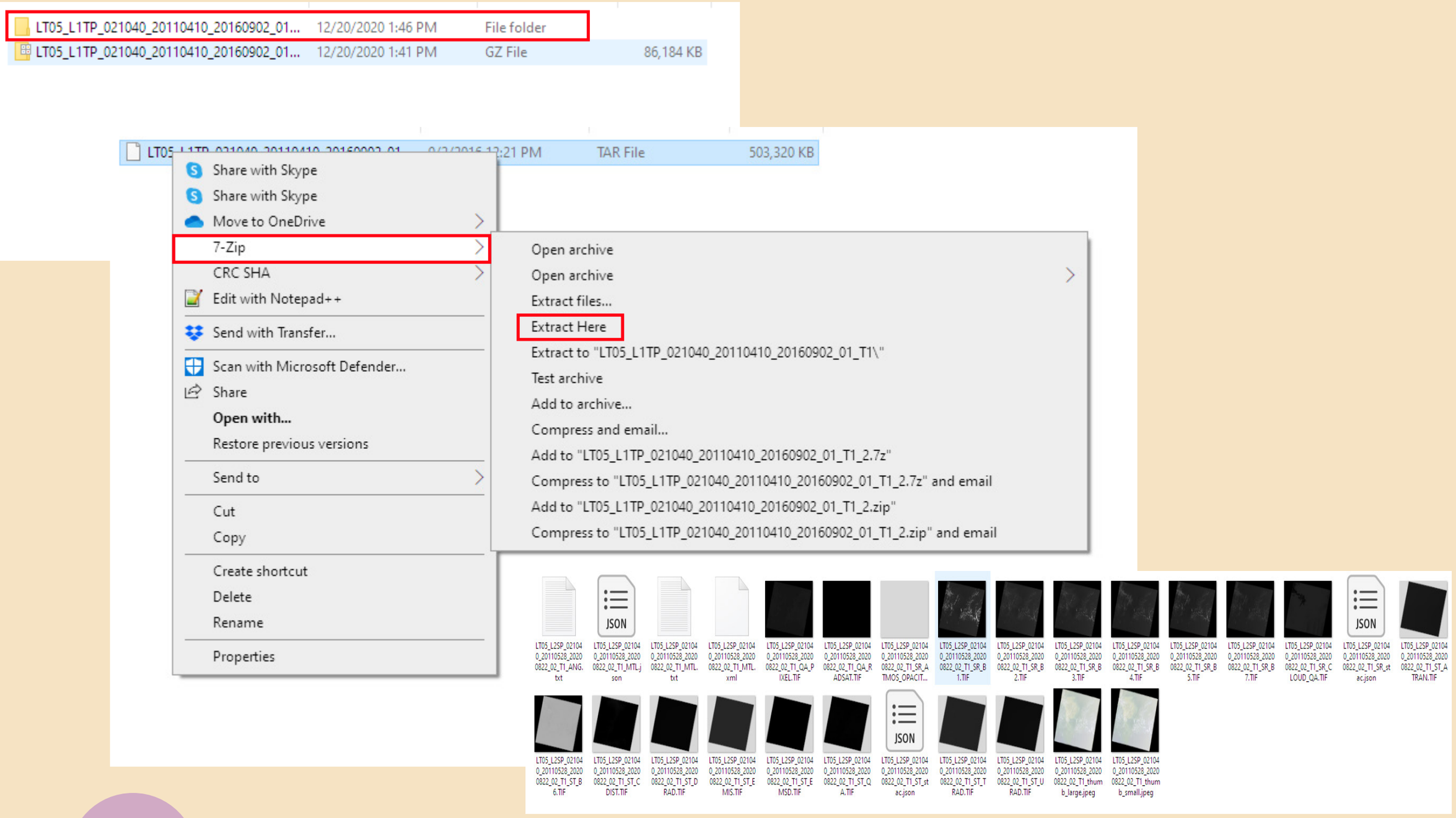
Select the download data product you wish to use. For the Earth as Art project selecting the GeoTIFF Data Product is recommended. Notice that the file size is not small.





3

Once you have downloaded the file bundle, navigate to where you placed the data and begin the steps to unzip your data and extract your image files. File organization is critical, so plan where you will place your zipped and extracted files during this process.



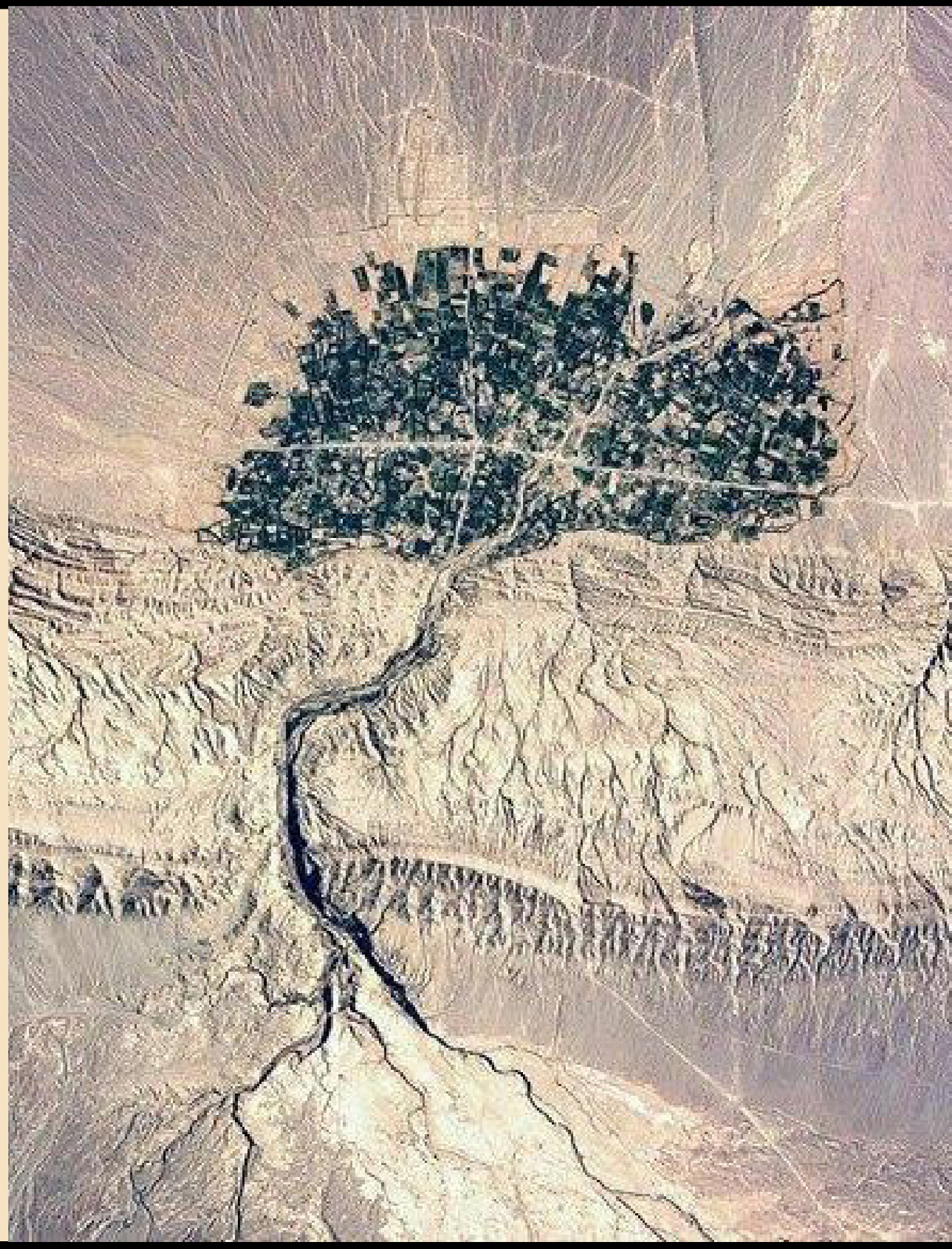
4

Next, choose the unzipped file folder that contains your layers (bands) of image data. You will need to unzip again to extract the individual band files.

Now that we have downloaded the image files for our area of interest from Earth Explorer...

...let's explore various software platforms we can use to process our image files.

It's the ArtWork we want to create now...

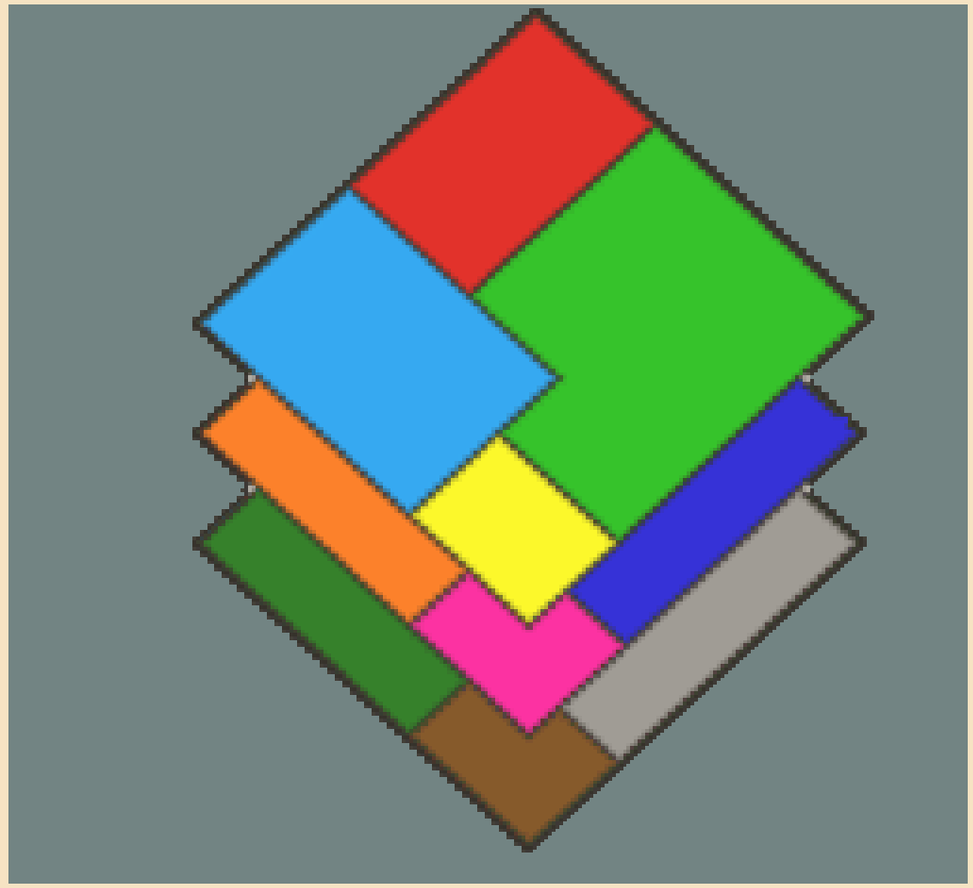


Here are three possibilities

- ArcMap

- Photoshop

- MultiSpec



Creating our Artwork …

Three Software Platforms

A Road Map of what's to follow

-Louisiana's Mississippi Delta in ArcGIS

-The Caspian Sea in Adobe Photoshop

-Davis Mountains State Park , Texas
in MultiSpec

Creating within …

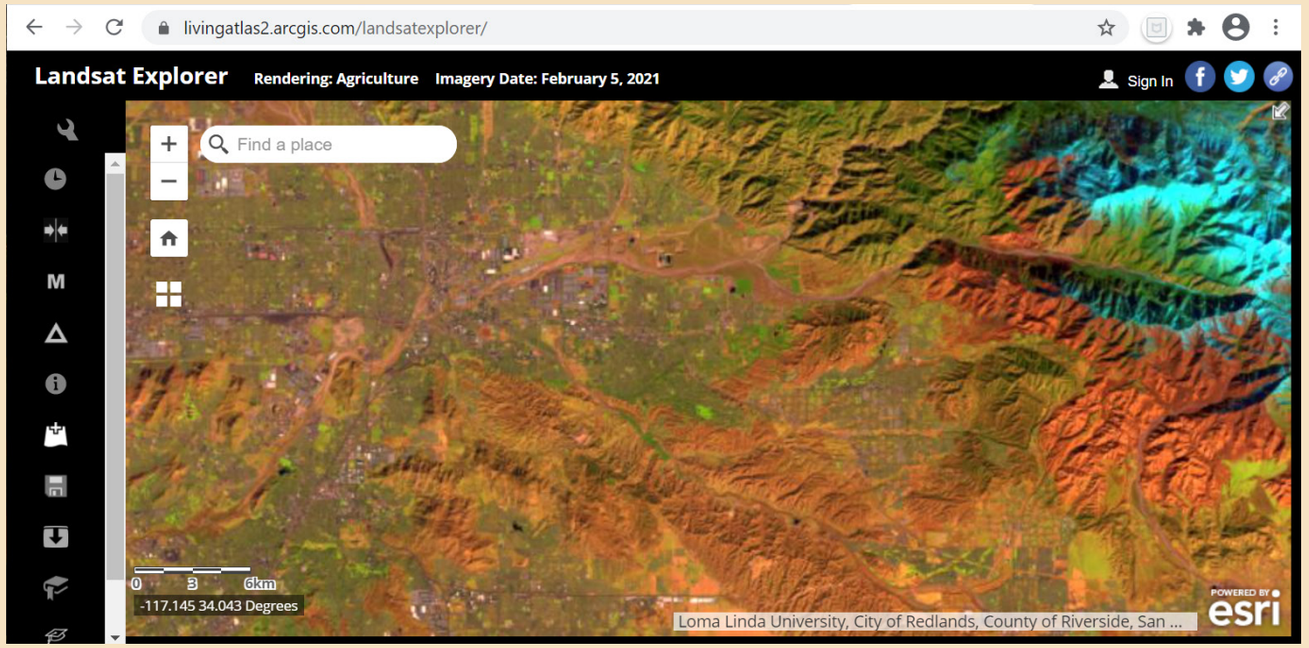
The ArcGIS Platform

… utilizing the Louisiana Mississippi Delta Image files

student program

[The Learn ArcGIS Student Program provides one year of free software for students learning ArcGIS who don't have access via their institution. To sign up, you'll need to verify that you're enrolled in a degree program.]

https://learn.arcgis.com/en/become-a-student-member/



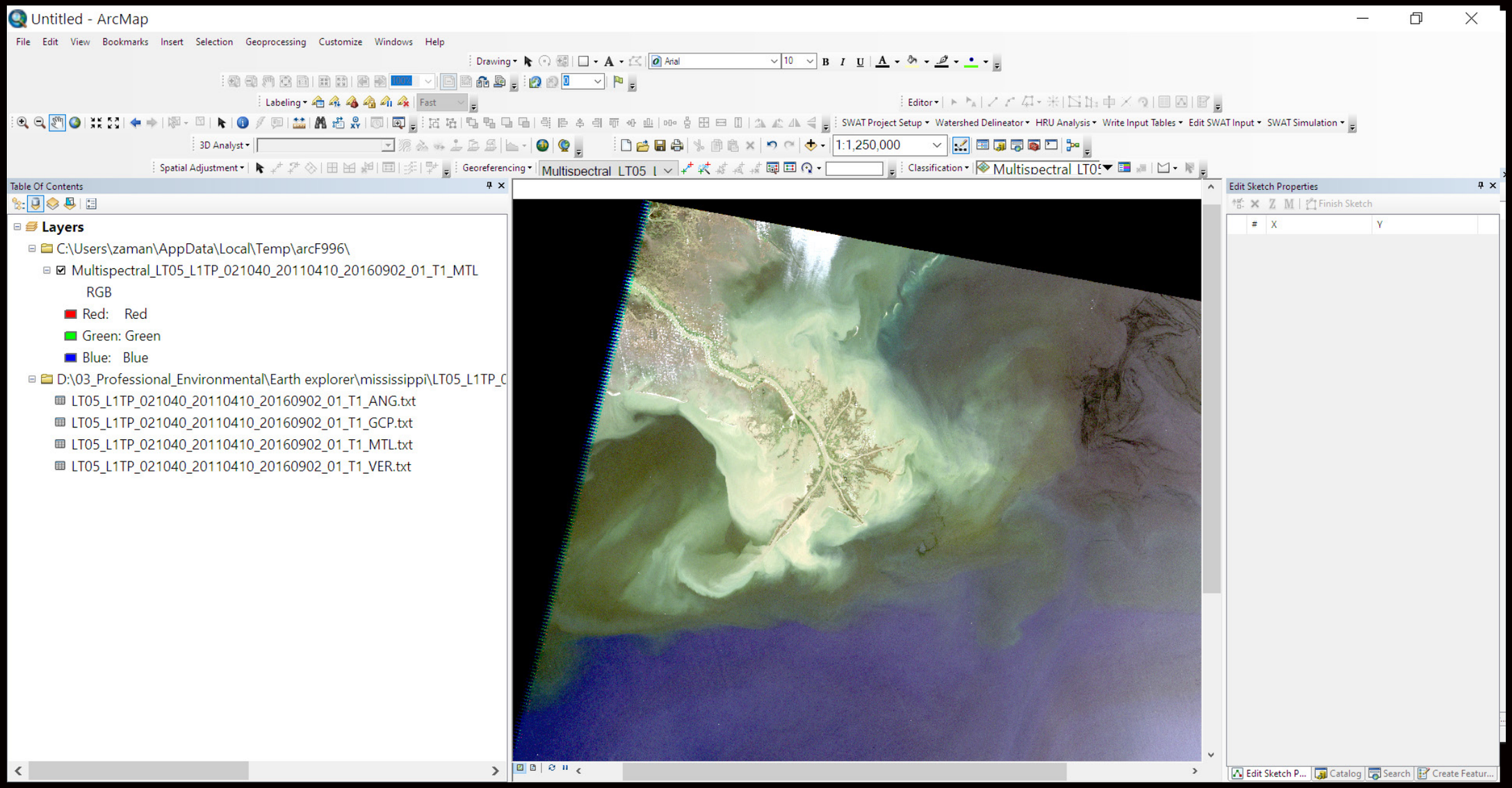
educators & lifelong learners

[Learn ArcGIS provides 60 days of free software, including licenses to ArcGIS Online, ArcGIS Pro, ArcGIS Business Analyst, and many other applications.]

https://www.esri.com/en-us/lg/training-and-services/learn-arcgis-education-trial

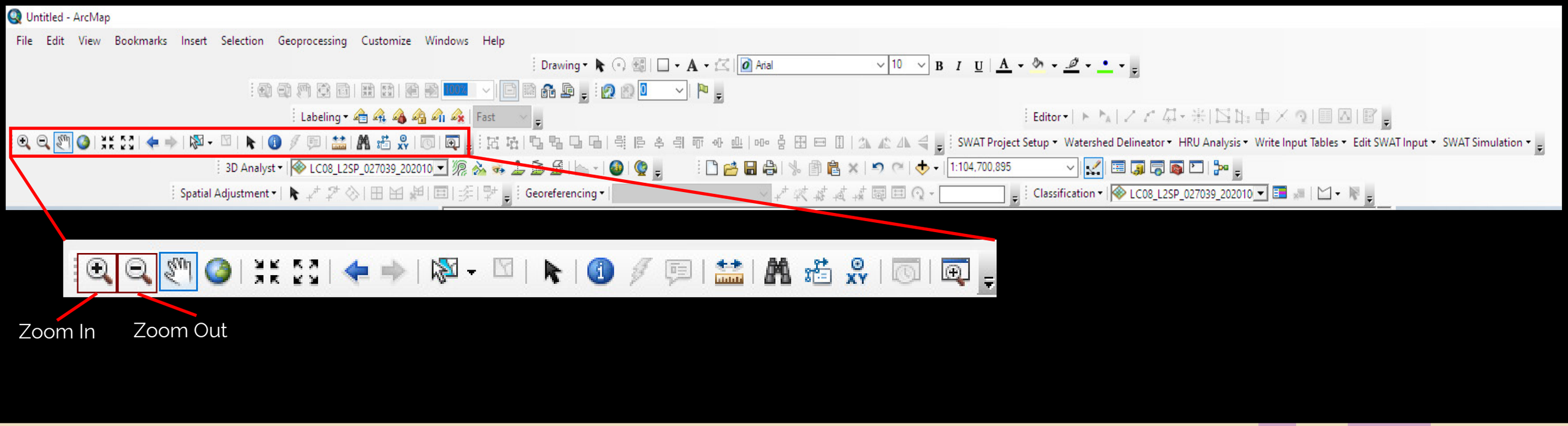
Note: The above information was obtained from the ESRI Learn ArcGIS Program website.

ArcMap



1

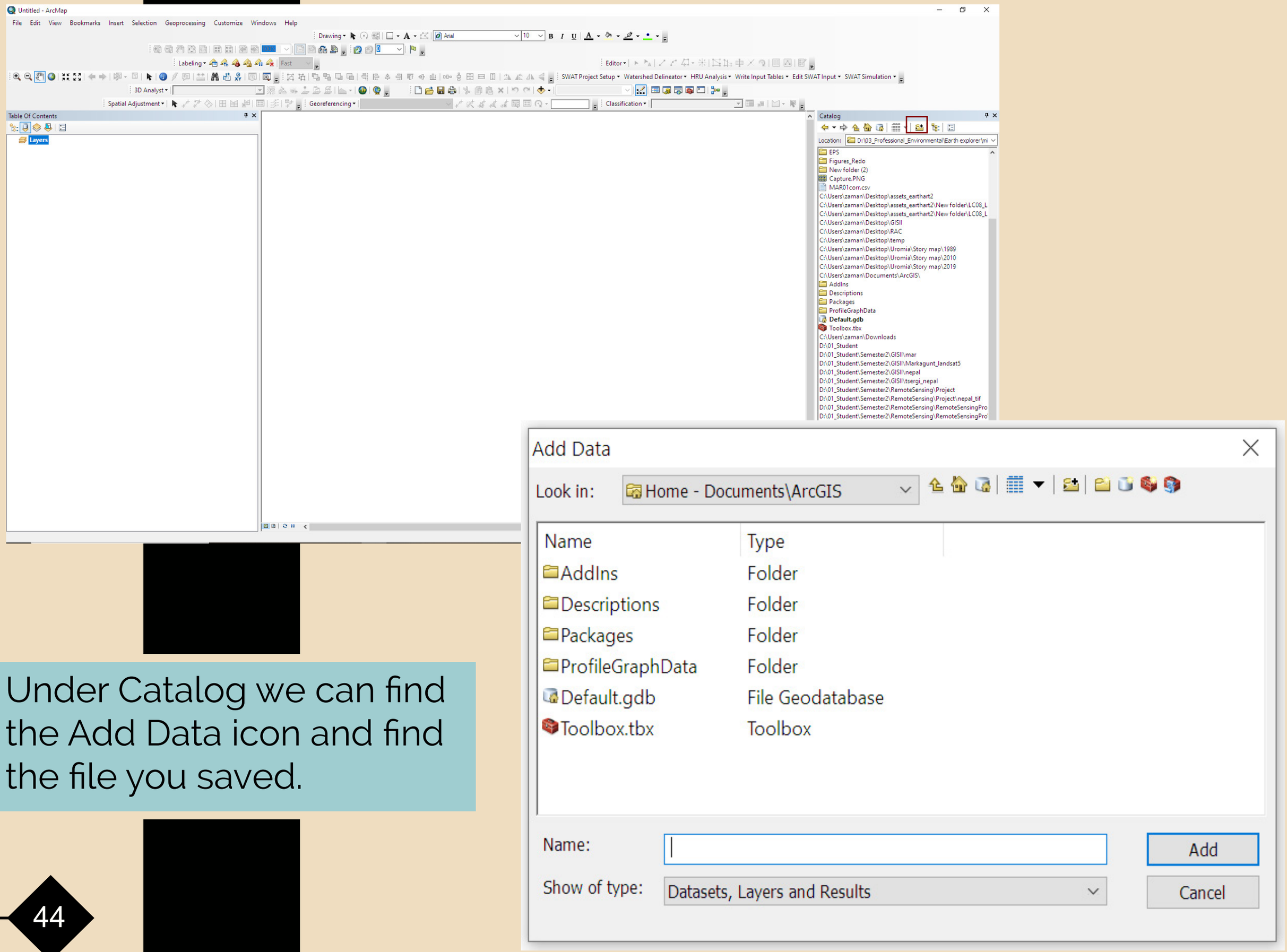
Open ArcMap



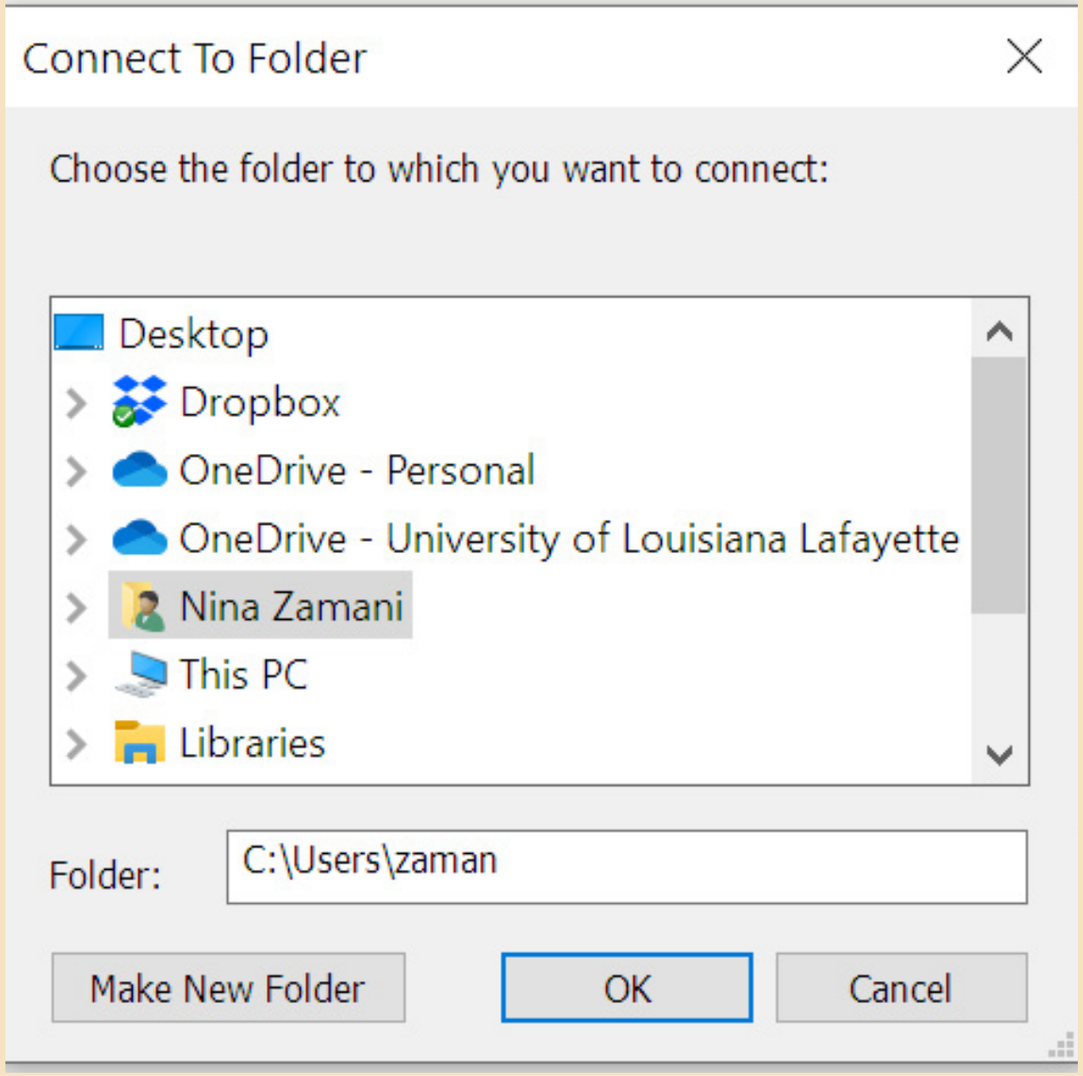
2

Become familiar with some tools in ArcMap tool box:

Zoom In
Zoom Out
Full Extent
Pan



Under Catalog we can find the Add Data icon and find the file you saved.



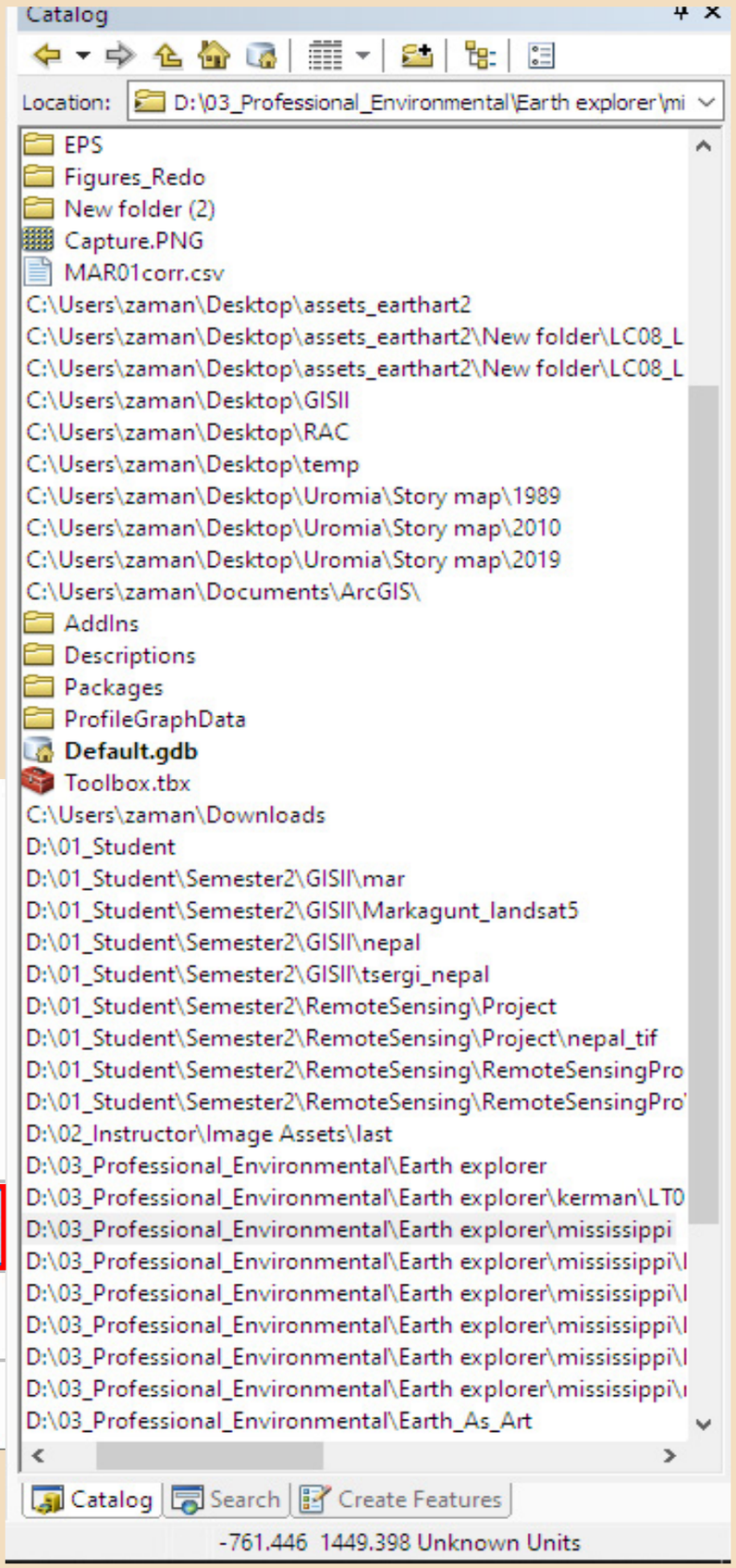
3

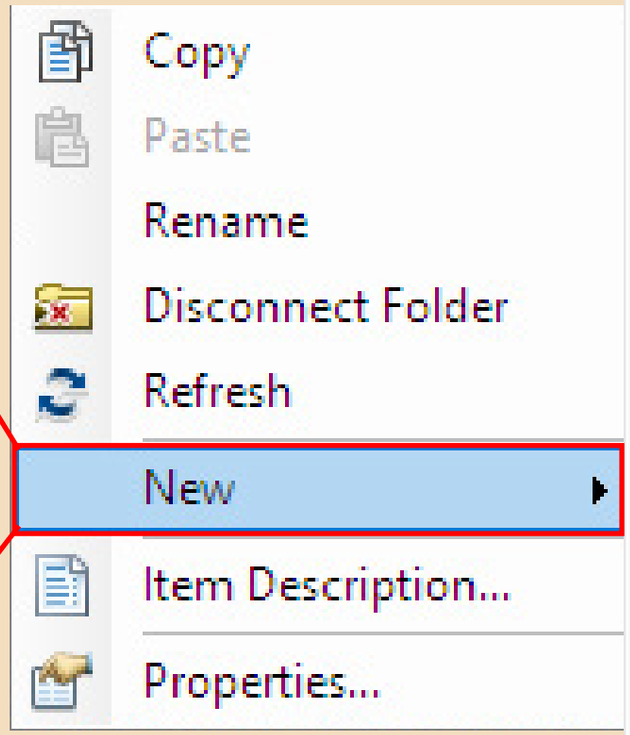
If you are a new user,

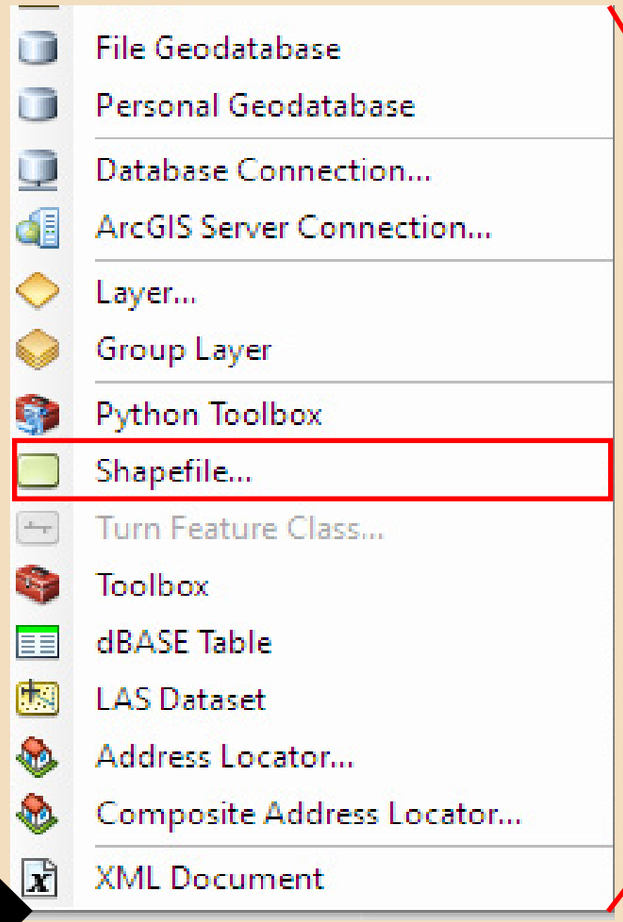
- Click on Add Data
- Click on Connect to Folder
- Find the folder that contains the image files
- Click on Add

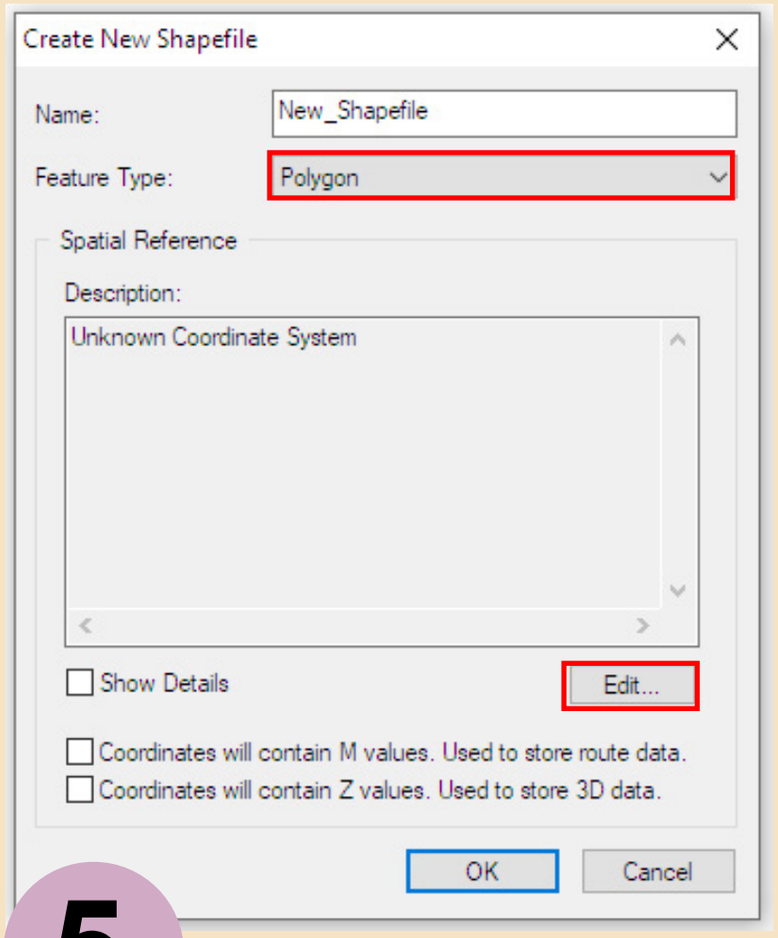
4

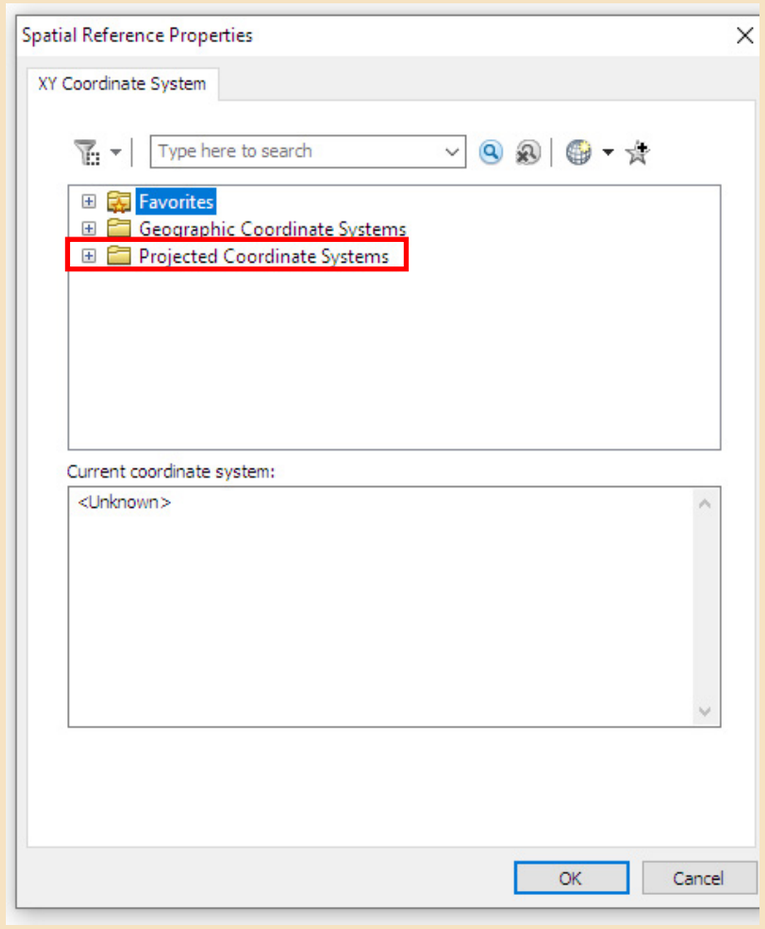
- Open Catalog
- Find your file
- Right click on the file
- Select New
- Select Shapefile

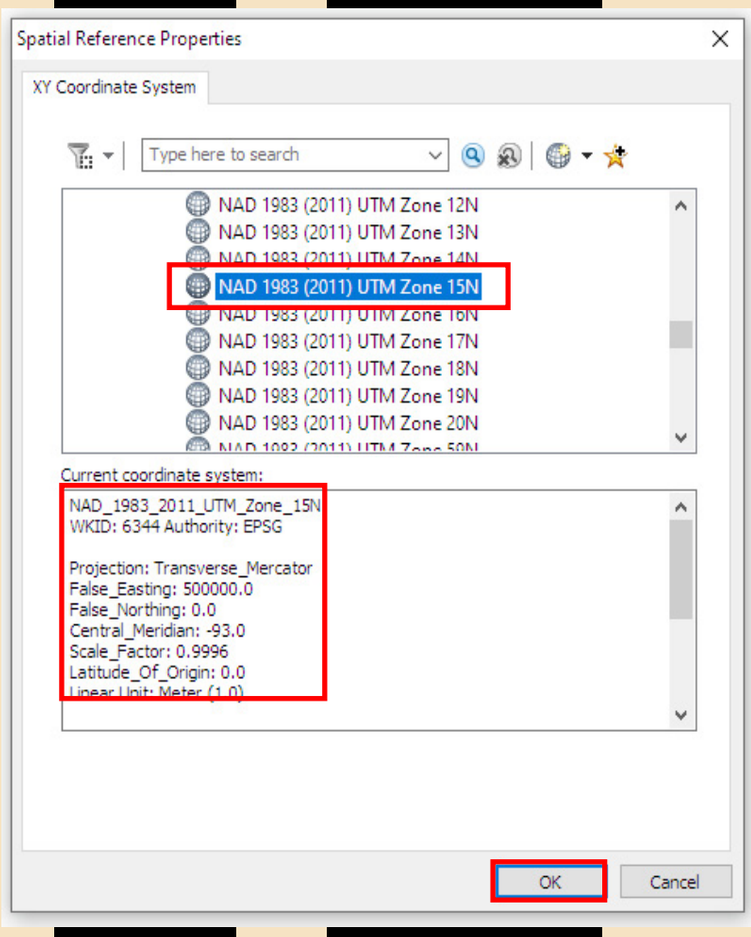






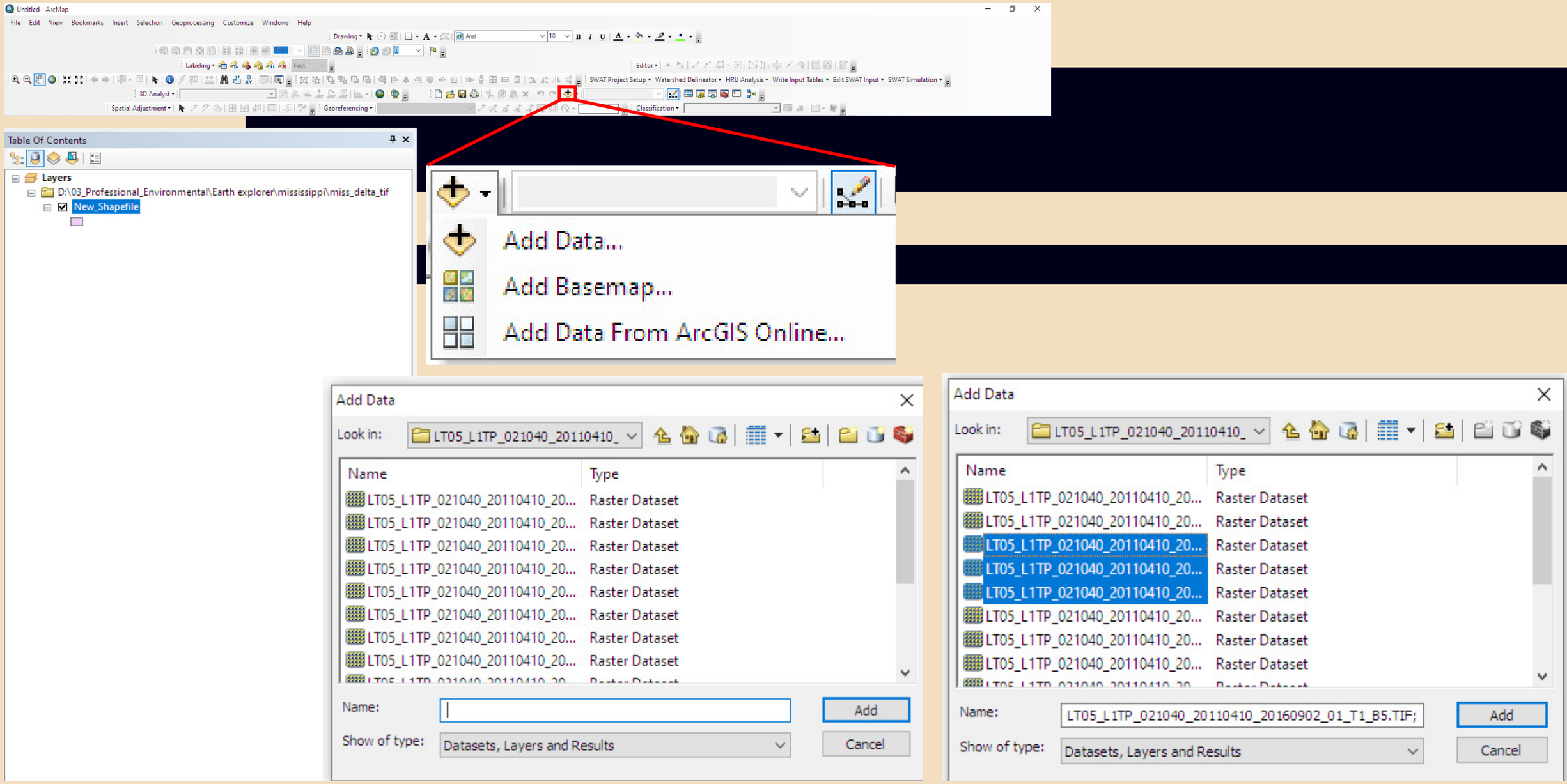






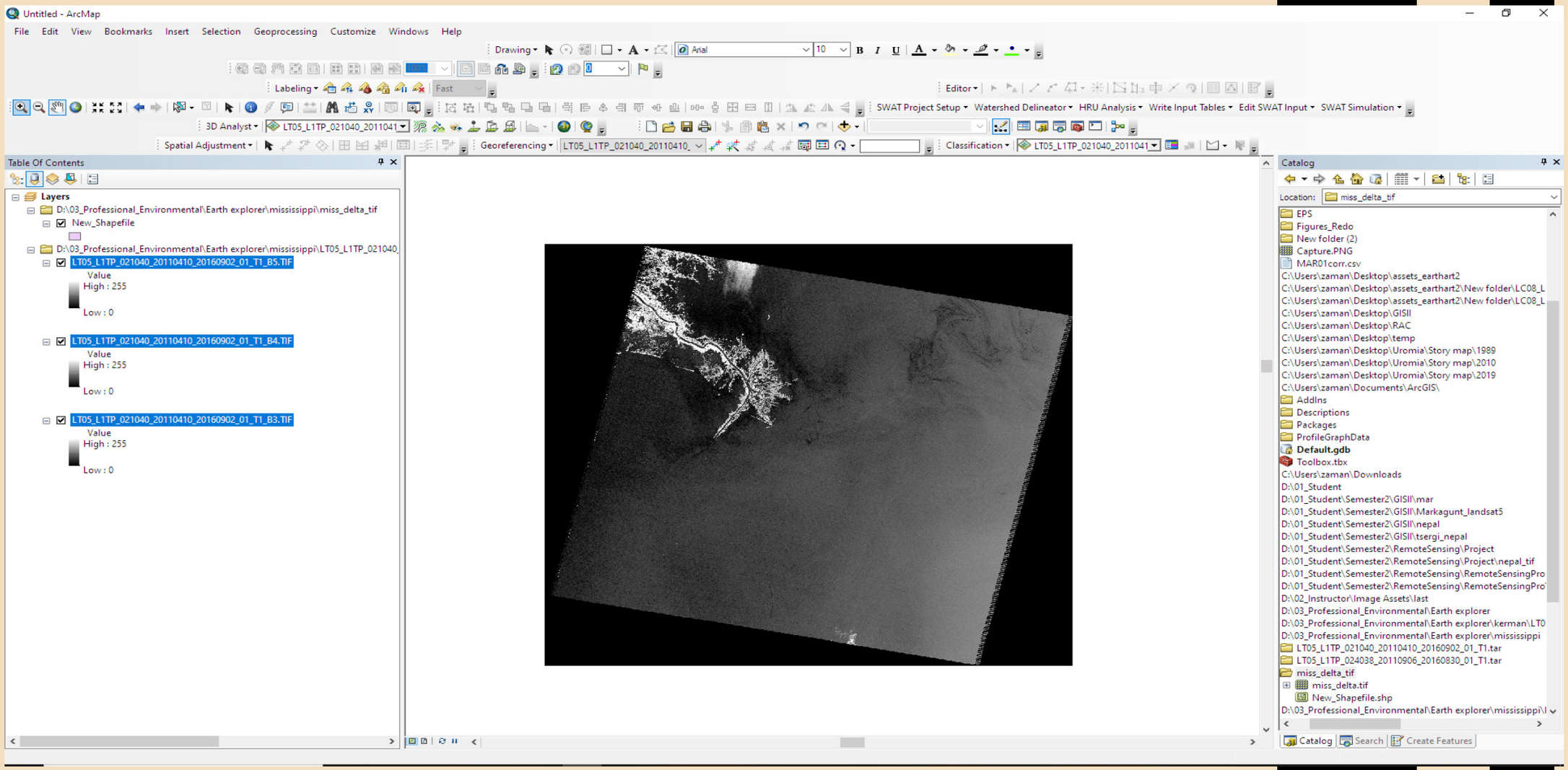
5

- In Feature Type, select Polygon
- Select Edit
- Select Spatial Reference Properties
- Select projected Coordinate System
- Find your proper coordinate system (in our example we use NAD 1983(2011)UTM Zone 15N)
- Press Ok



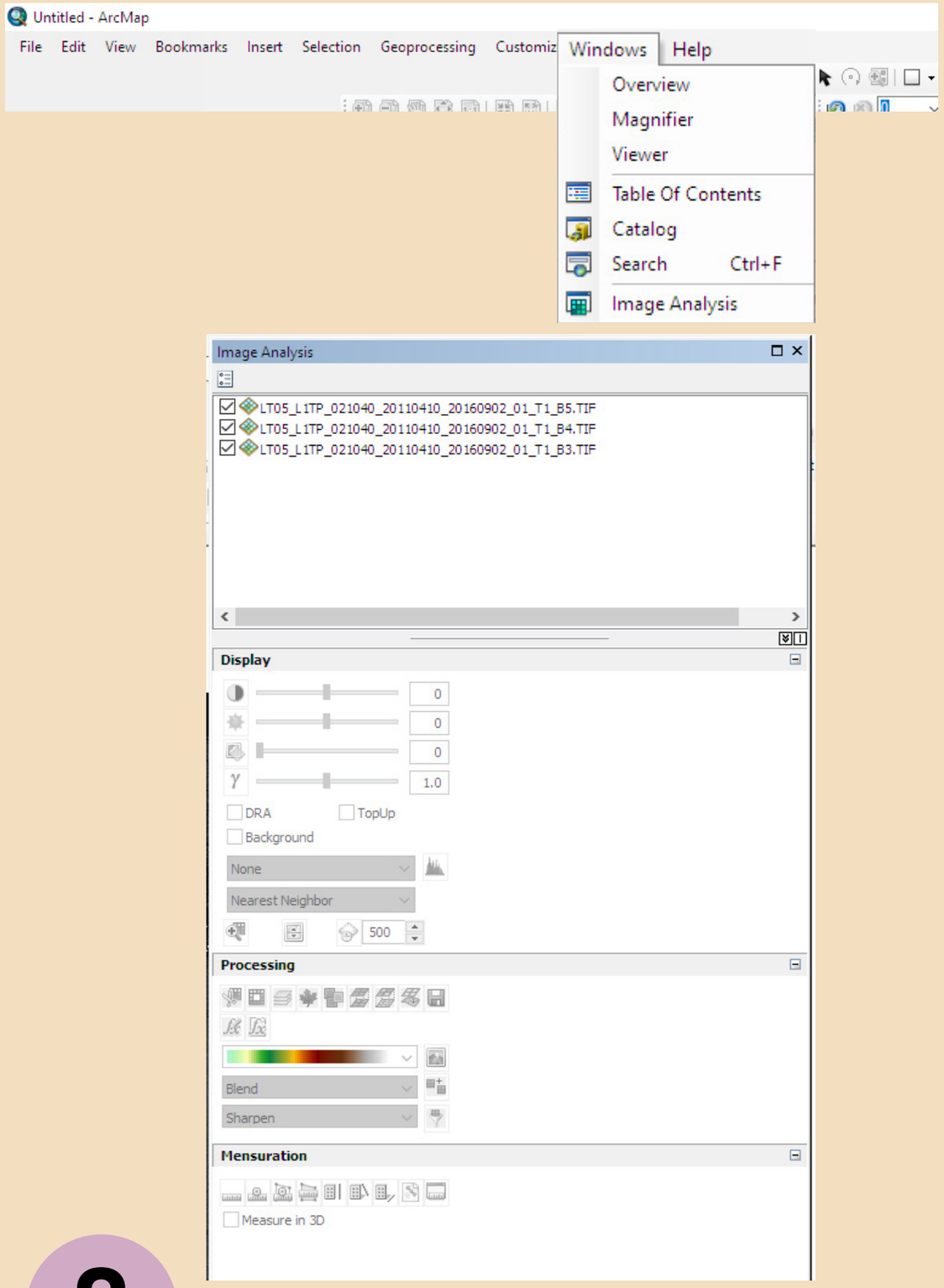
6

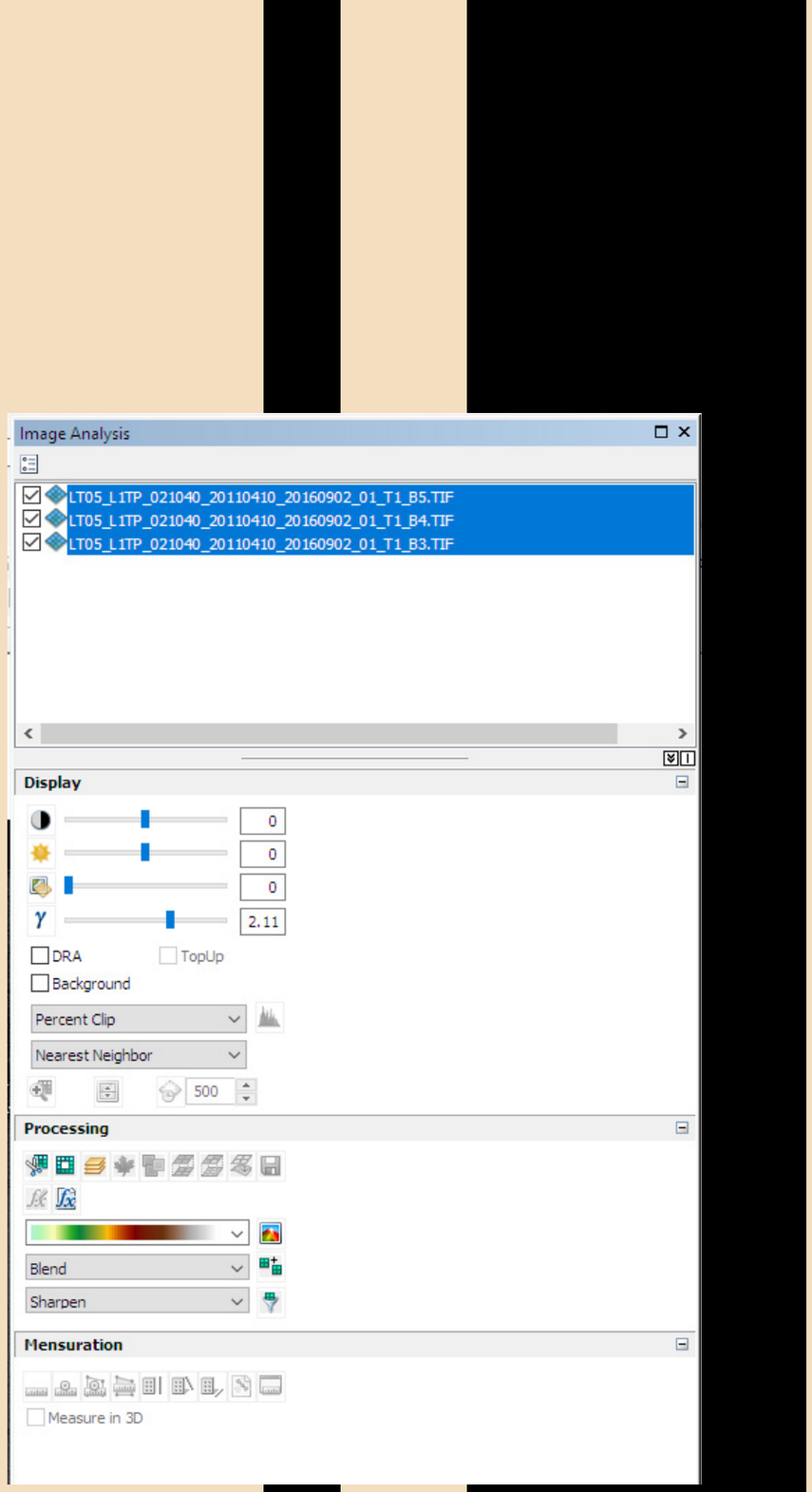
- Select Add Data
- Select your Band 3, 4, 5
- Press Add



7

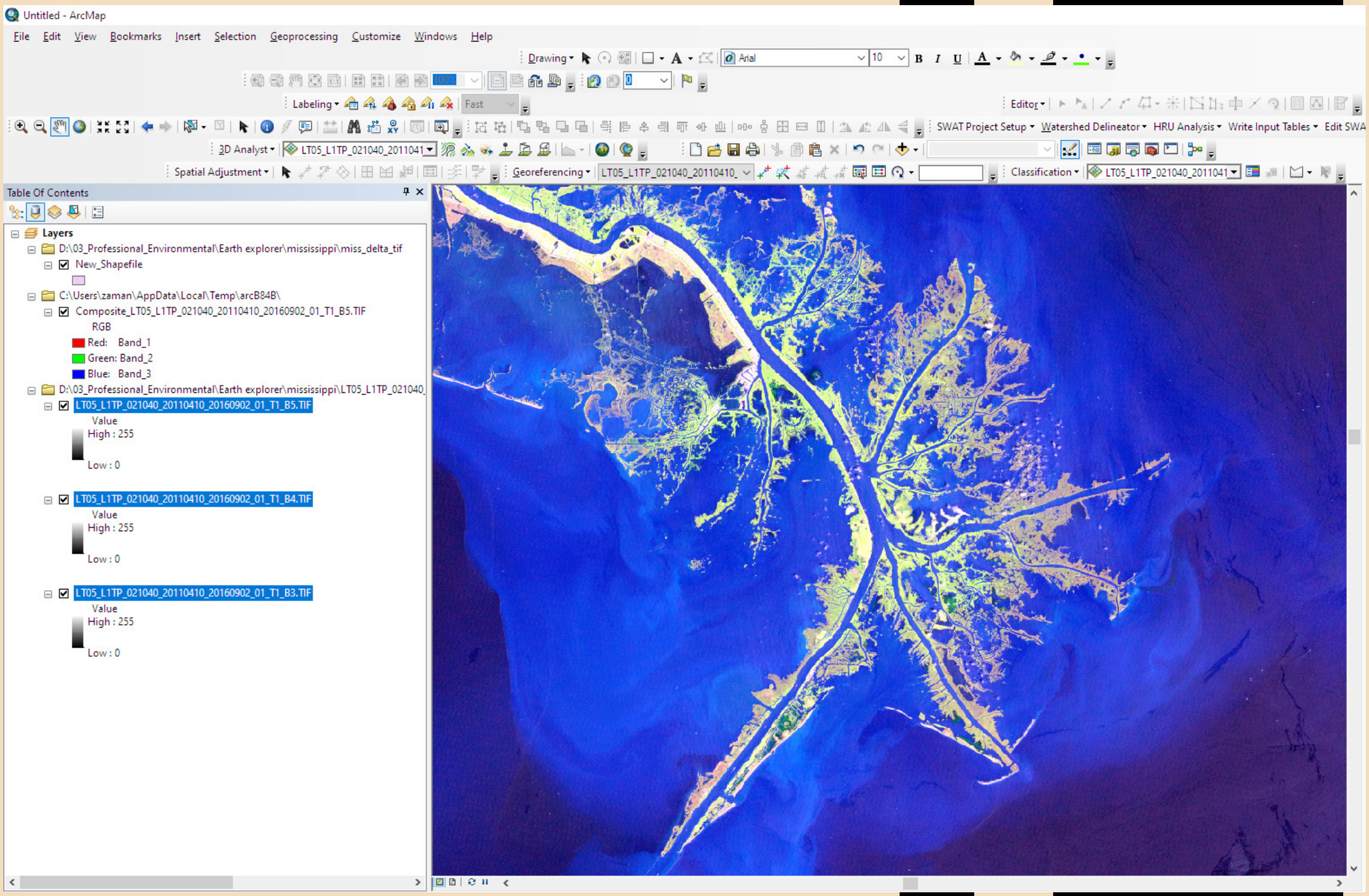
The individual bands display as grey scale images





8

- Under Windows select Image Analysis
- Select all three bands
- You can use the values in the above example


Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
D:\03_Professional_Environmental\Earth explorer\mississippi\miss_delta_tif
New_Shapefile
C:\Users\zaman\AppData\Local\Temp\arcB84B\
Composite_LT05_L1TP_021040_20110410_20160902_01_T1_B5.TIF
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
D:\03_Professional_Environmental\Earth explorer\mississippi\LT05_L1TP_021040_
LT05_L1TP_021040_20110410_20160902_01_T1_B5.TIF
Value
High : 255
Low : 0
LT05_L1TP_021040_20110410_20160902_01_T1_B4.TIF
Value
High : 255
Low : 0
LT05_L1TP_021040_20110410_20160902_01_T1_B3.TIF
Value
High : 255
Low : 0

9

Final Map

Stepping through ...

Photoshop

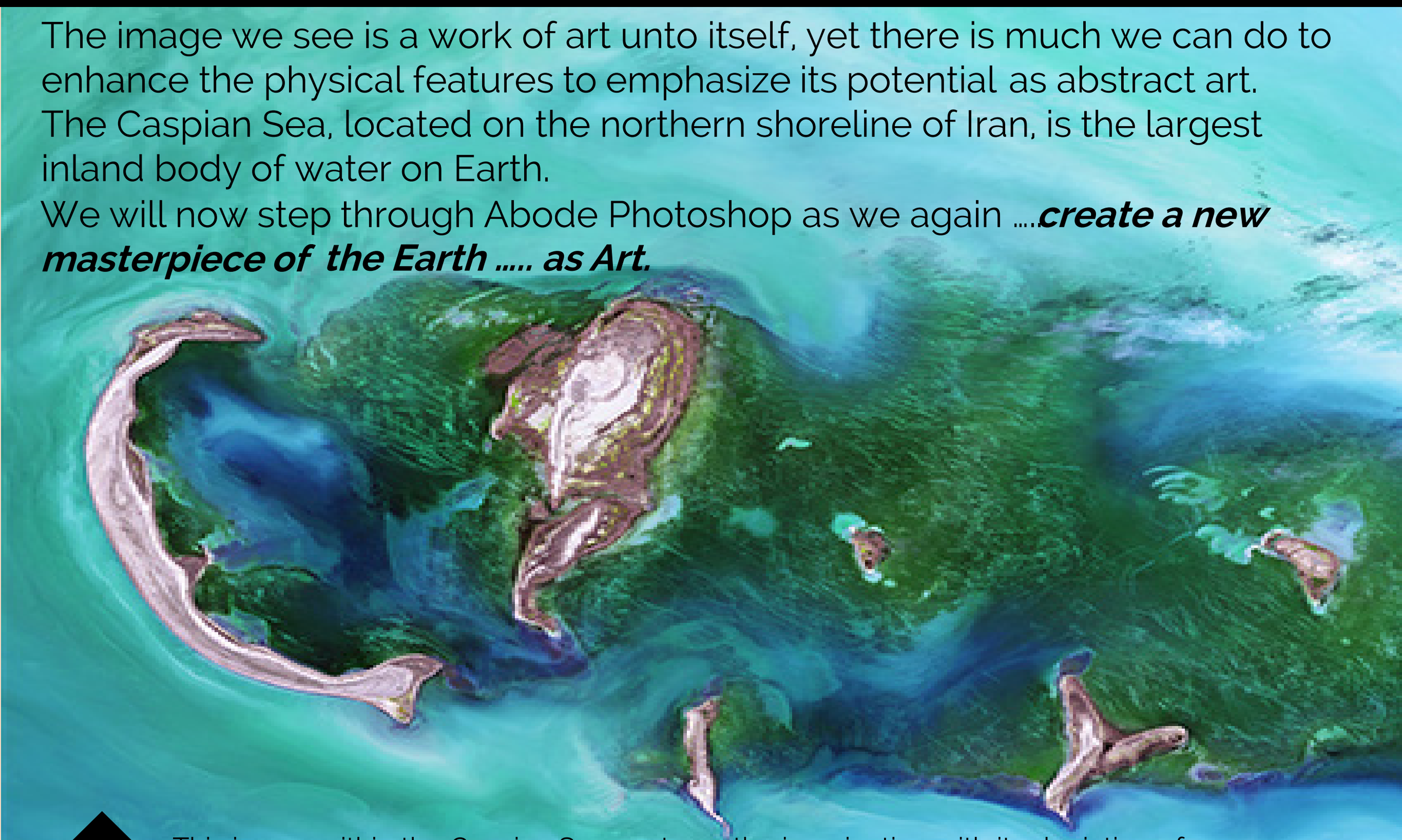
utilizing the Caspian Sea Image files

Adobe Photoshop is another software option for displaying and enhancing various band combinations to create artwork from the data you have downloaded.

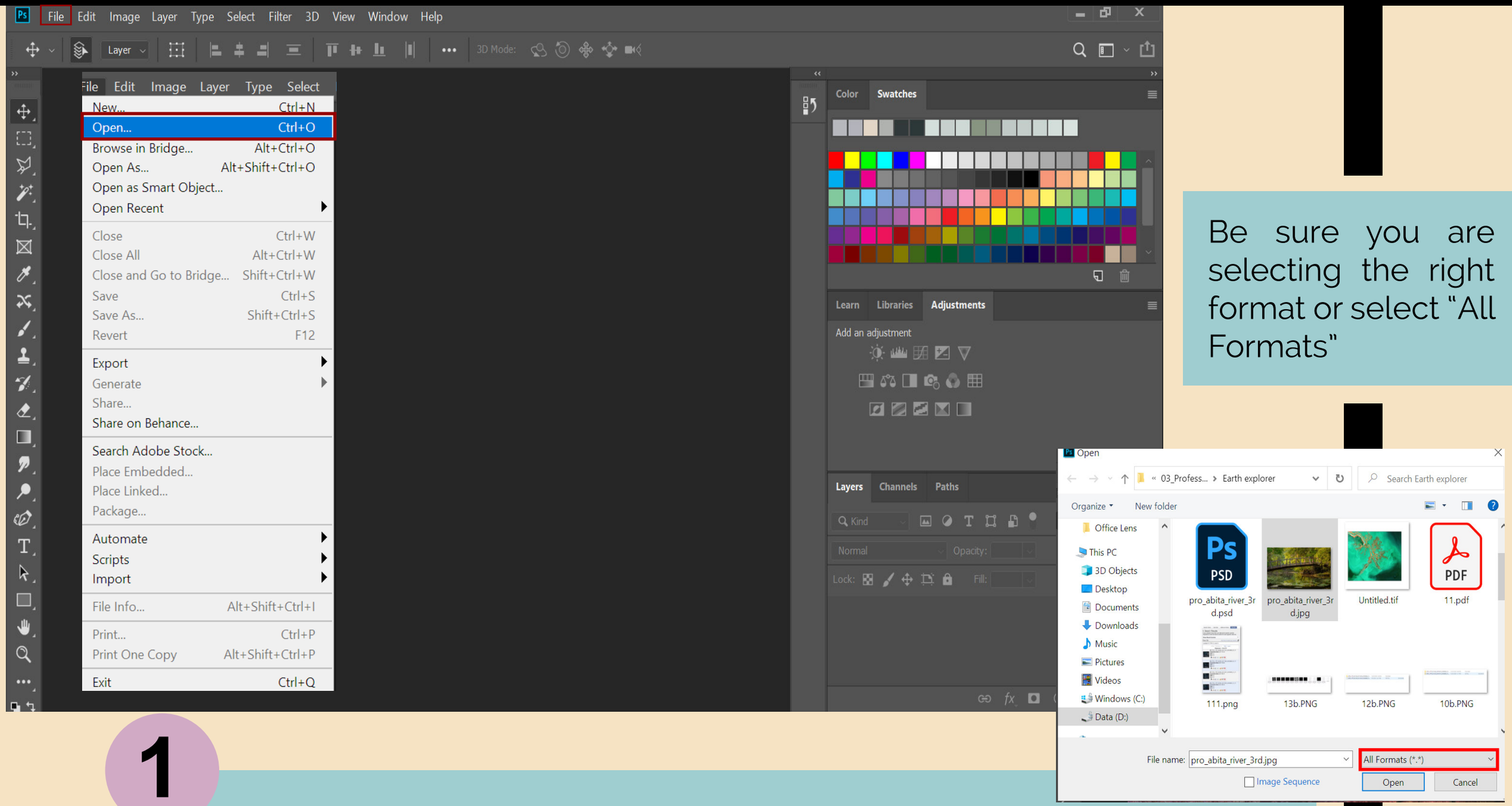
We include this software suite, due to its immense popularity in the graphic arts community, realizing that it is not free; however, its color band enhancement capabilities are quite enticing.

Visiting the Caspean Sea ...

The image we see is a work of art unto itself, yet there is much we can do to enhance the physical features to emphasize its potential as abstract art.
The Caspian Sea, located on the northern shoreline of Iran, is the largest inland body of water on Earth.
We will now step through Abode Photoshop as we again ....***create a new masterpiece of the Earth ..... as Art.***



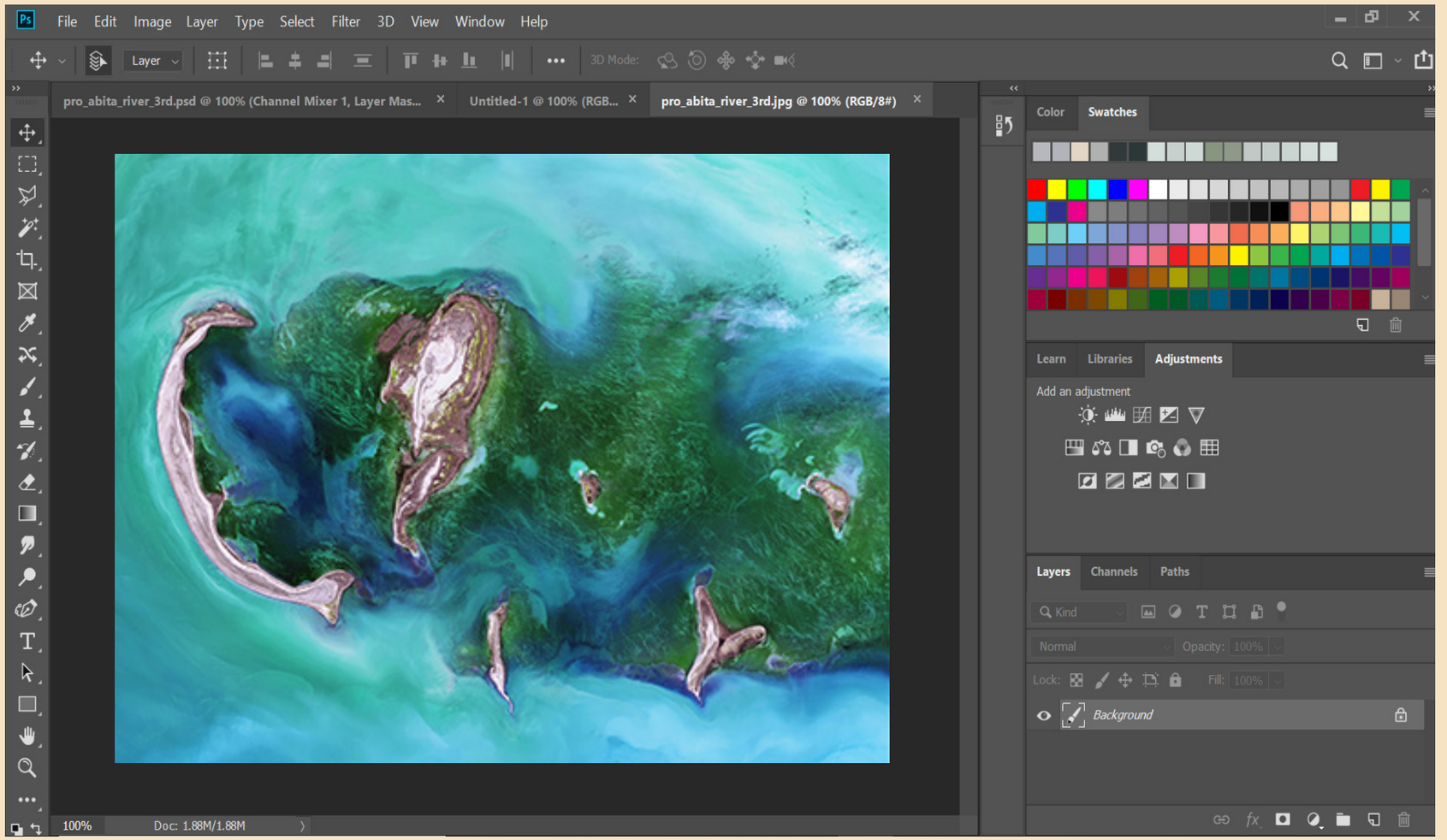
This image within the Caspian Sea captures the imagination with its depiction of seagrass beds that are scoured by water currents and ice.

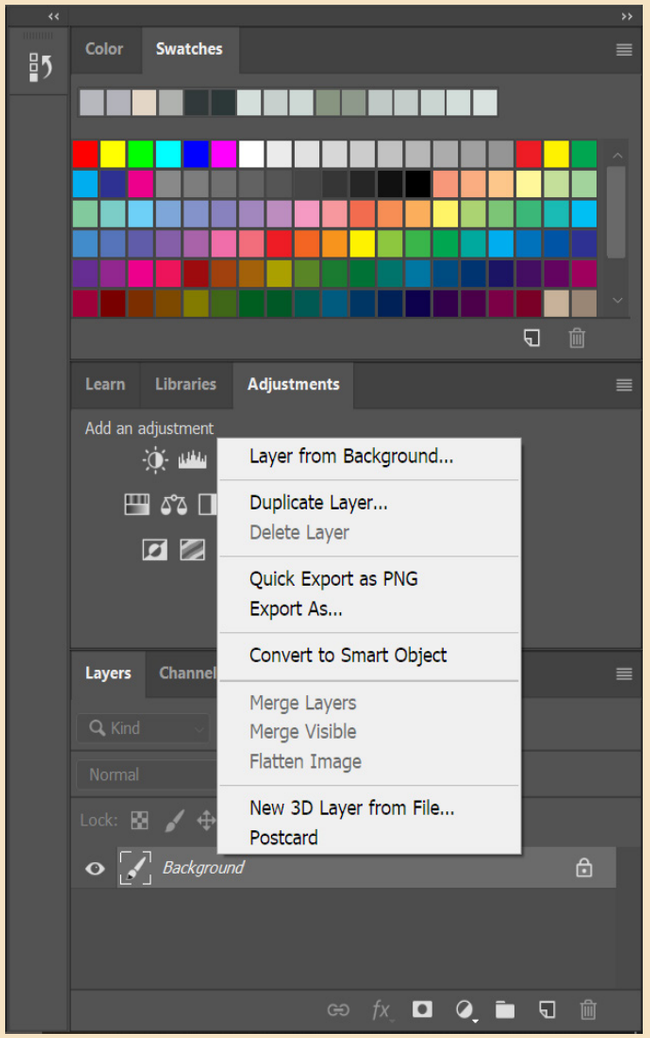


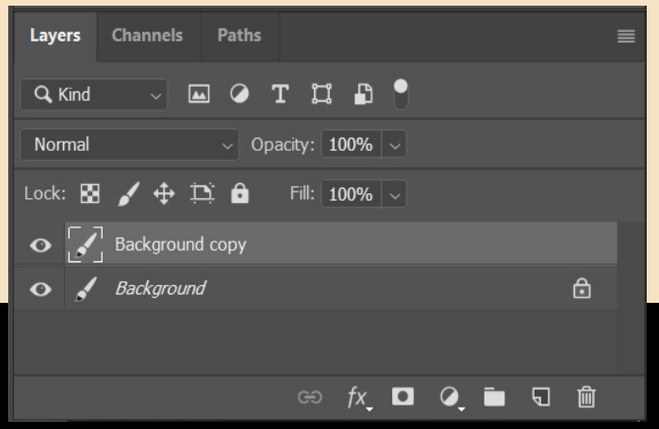
Be sure you are selecting the right format or select "All Formats"

1

- Open Adobe Photoshop
- Click on the file you want to use and select Open
- Check for the appropriate file format

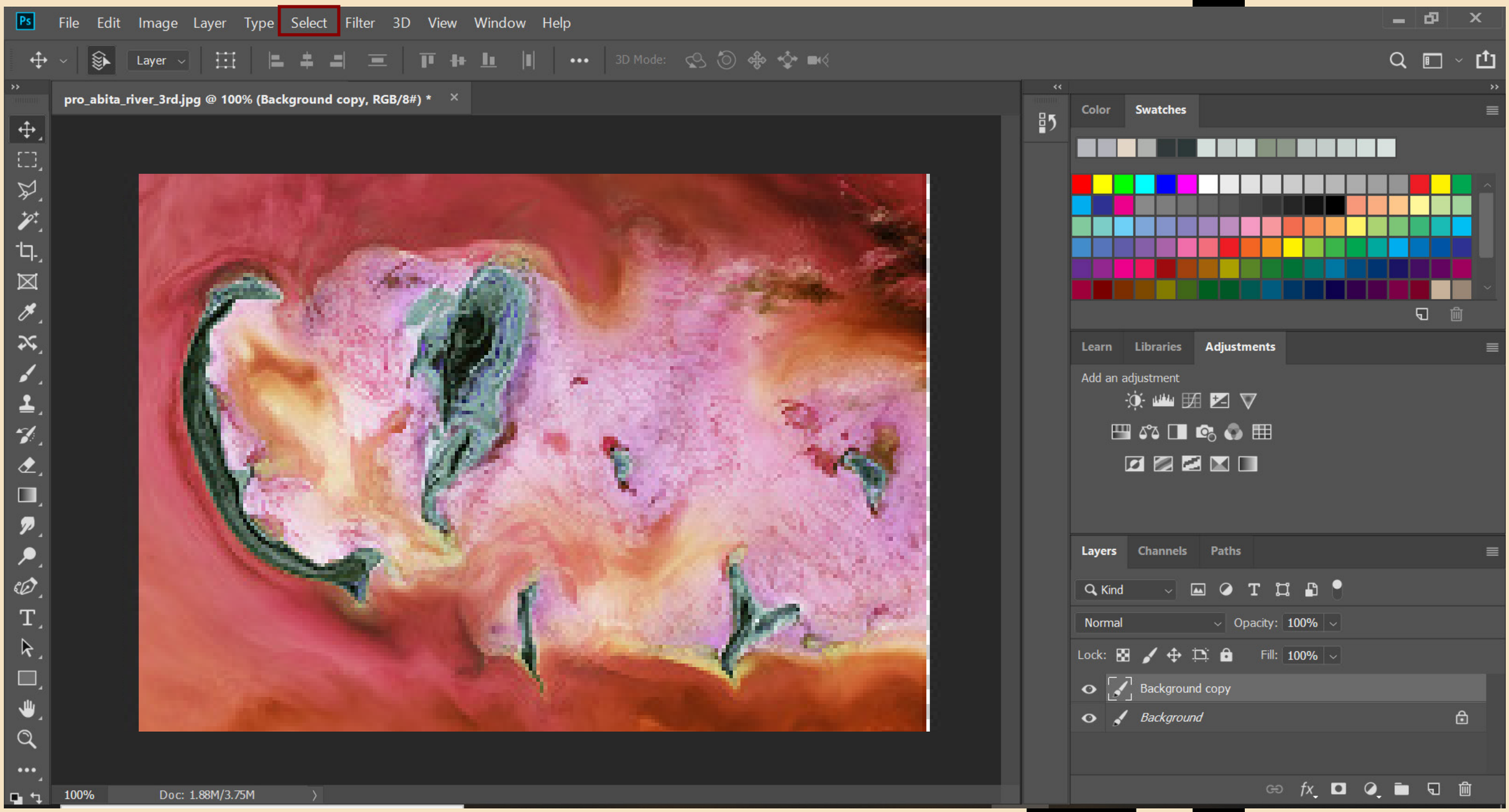






2

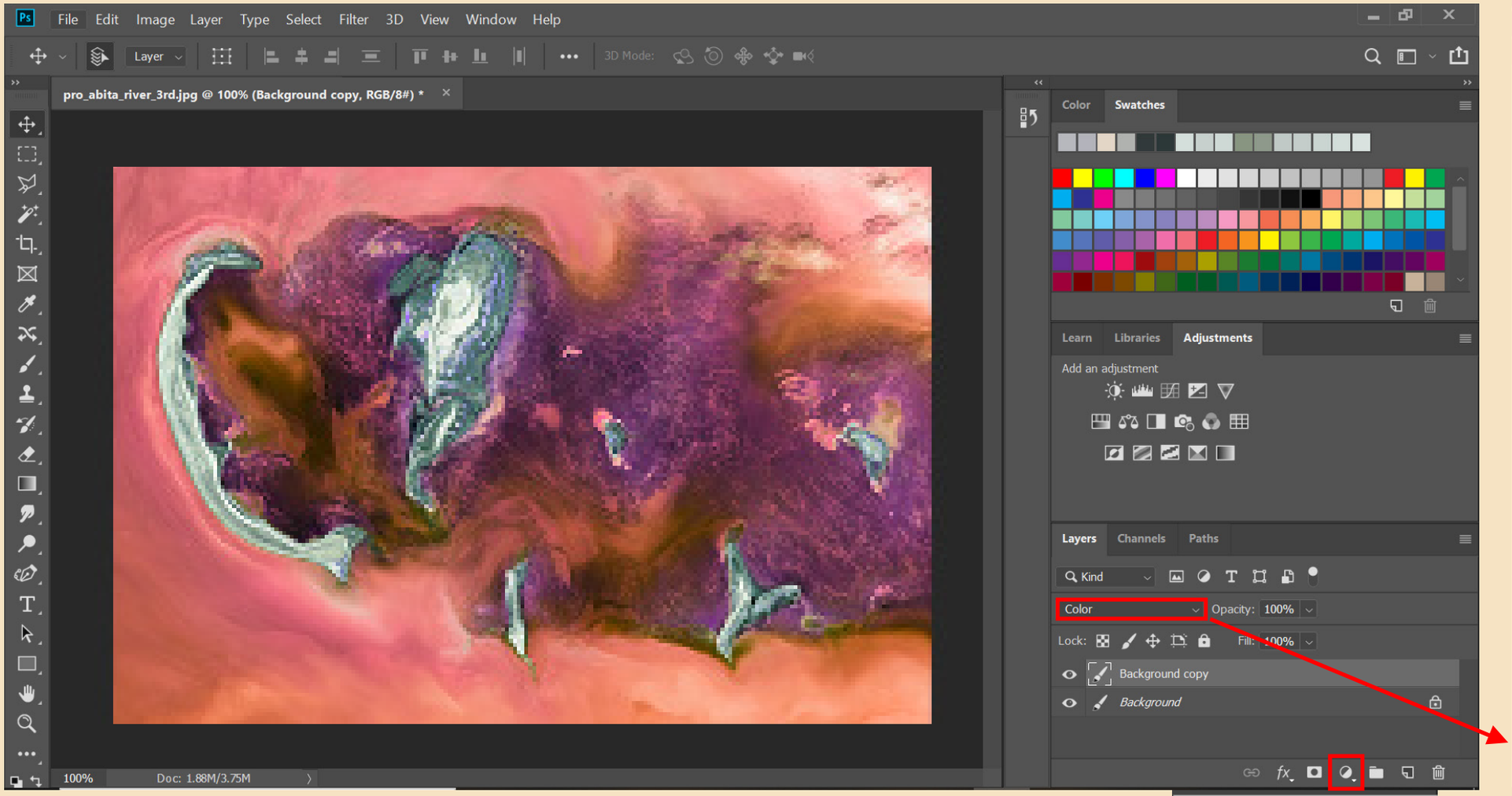
Right click on the file under Layers and select Duplicate Layer



3

- Select the duplicated layer
- Click on Select on the top toolbar
- Click on Inverse or press Ctrl+I

(the color of the layer will change)

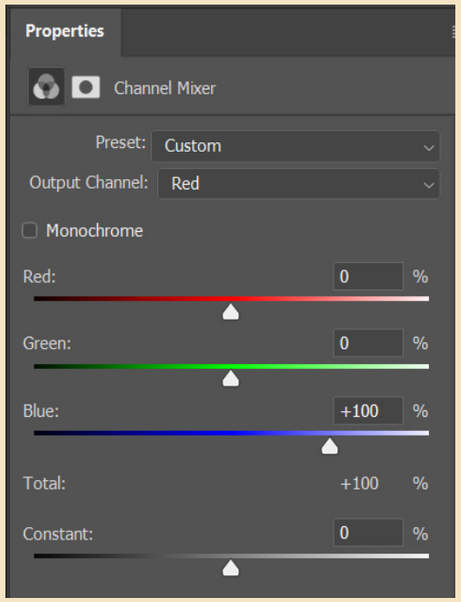


5

Click on the Create New Fill or Adjustment Layer icon and then select the Channel Mixer

4

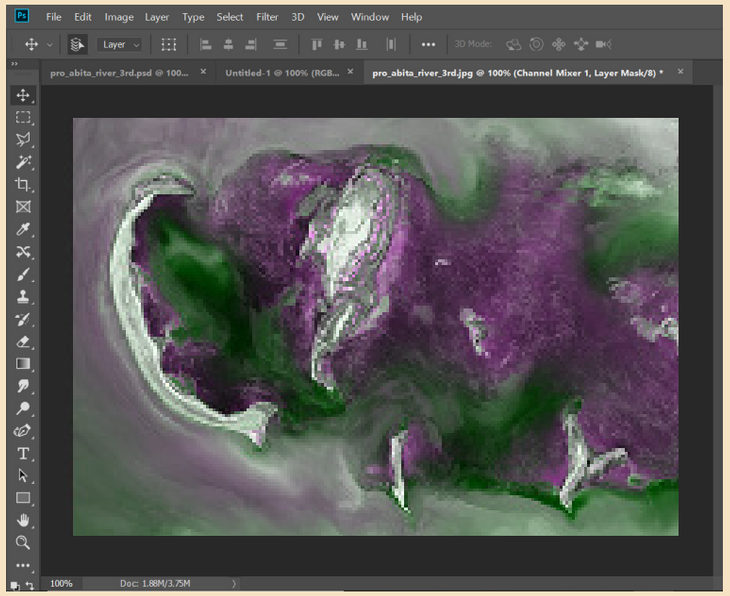
Under Normal select **Color**

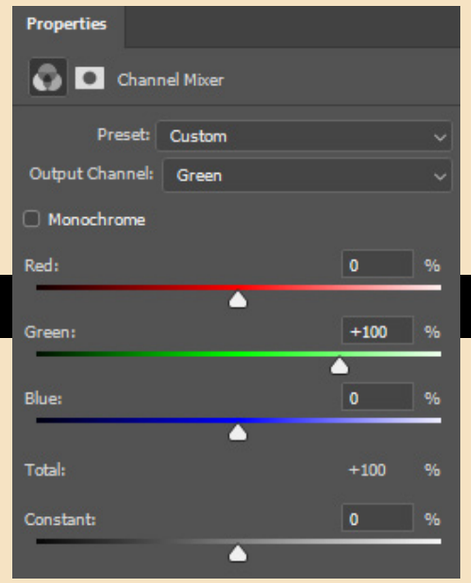


6-1

In Output channel dropdown select red

For the red ramp select 0%
For the Green ramp select 0%
For the Blue ramp select 100%

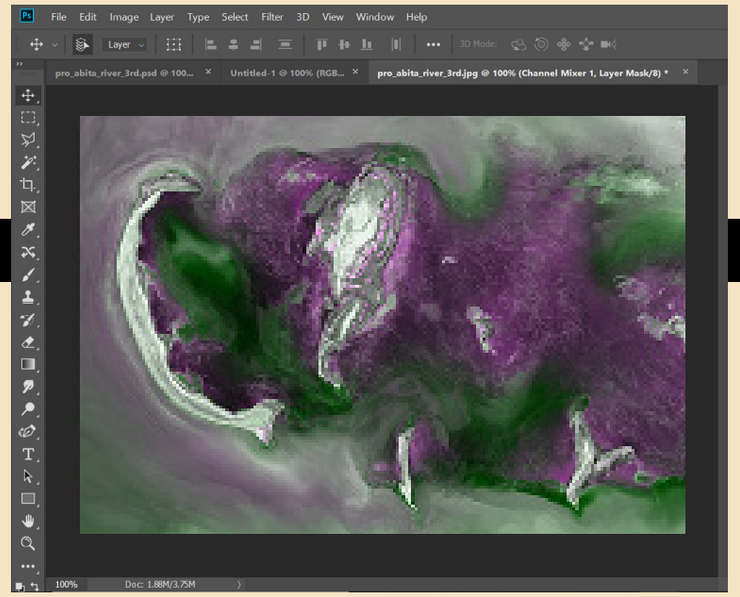


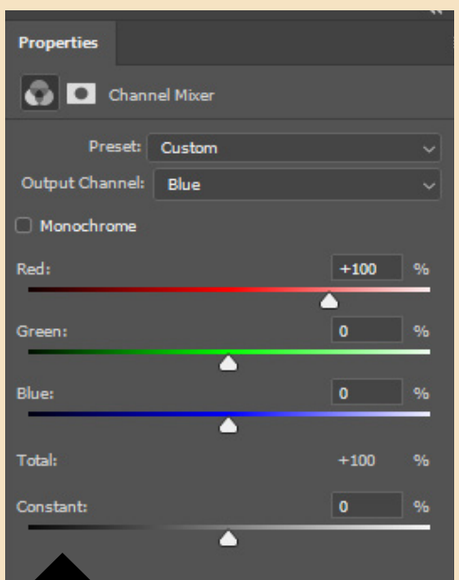


6-2

In Output channel dropdown select Green

For the red ramp select 0%
For the Green ramp select 100%
For the Blue ramp select 0%

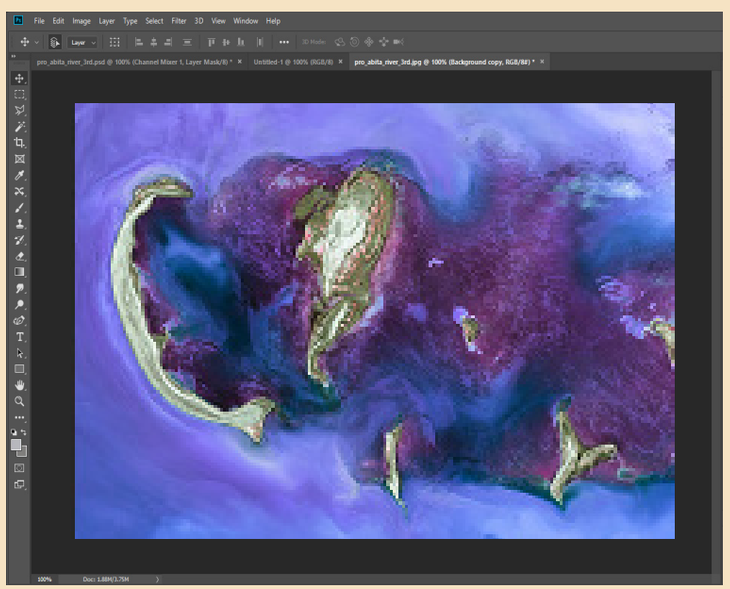


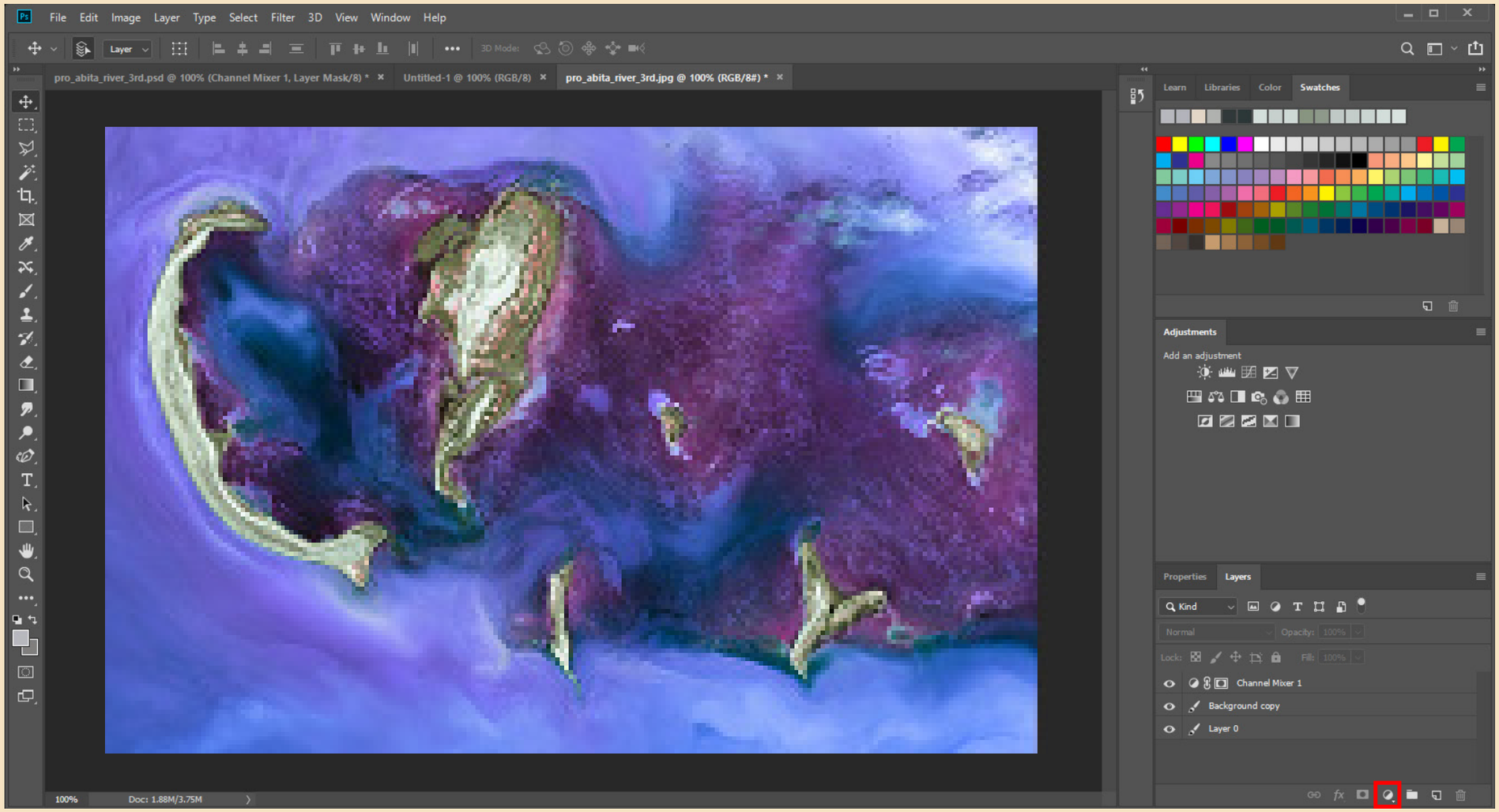


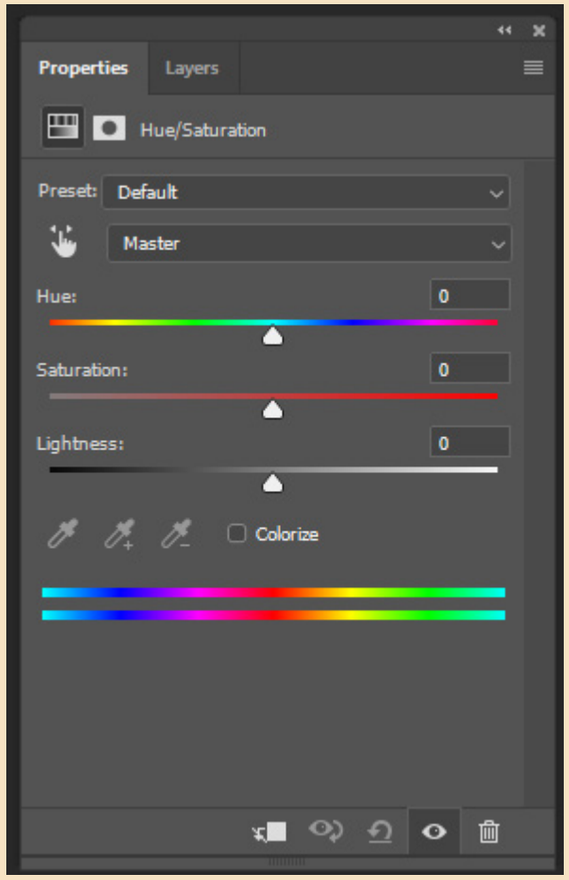
6-3

In Output channel dropdown select Blue

For the red ramp select 100%
For the Green ramp select 0%
For the Blue ramp select 0%

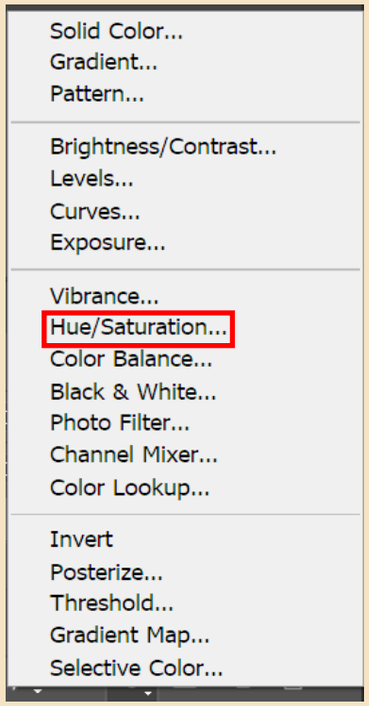


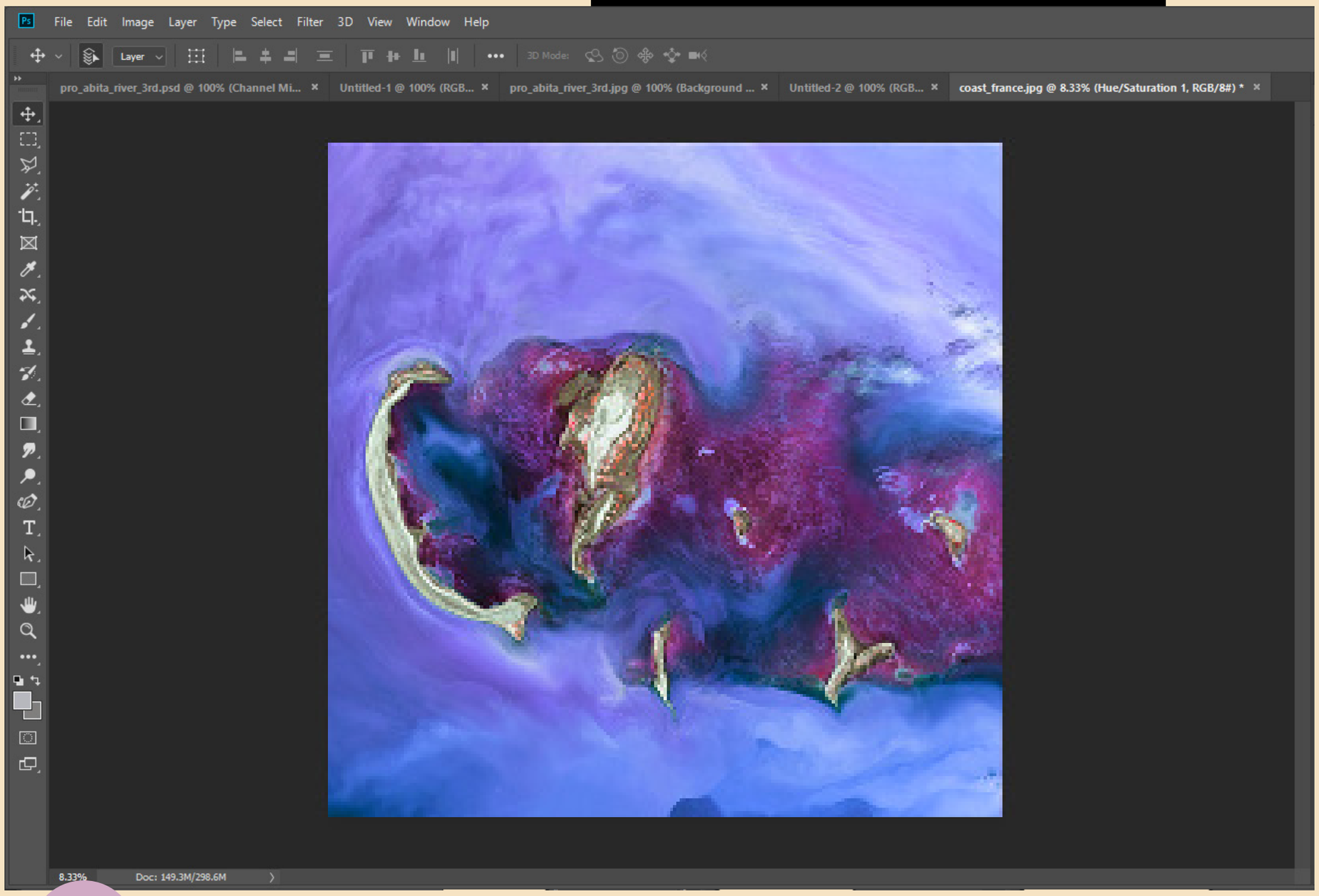


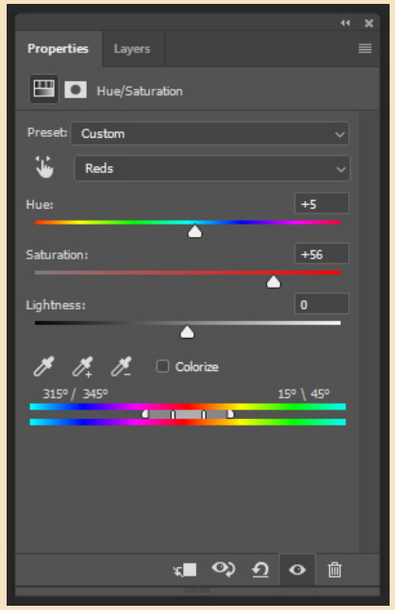


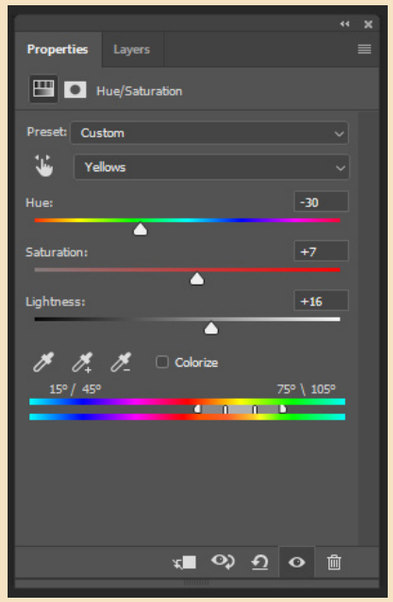
7

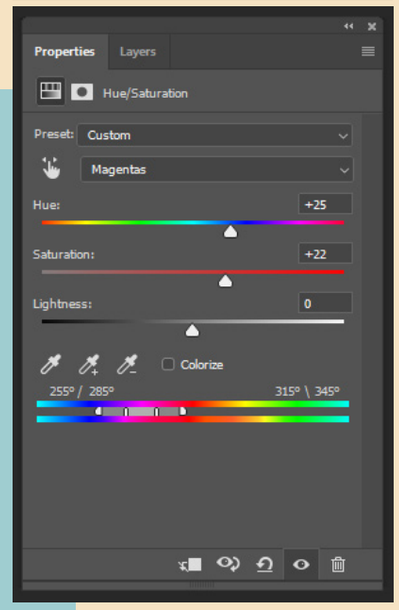
Click on the **Create New Fill or Adjustment Layer icon** Select **Hue/Saturation**











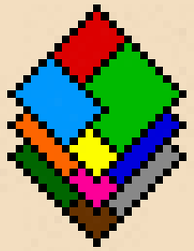
8

In the **Hue/Saturation** panel
-Open the dropdown under **Master**
-Select **Reds** and find the best combination of settings for **Hue**, **Saturation**, and **Lightness**.
Repeat the process for **Yellows** and **Magentas**
(the percentages in the example are a good place to start)

Compare the True and False Color Images

True Color

False Color



MultiSpec©

A Freeware Multispectral Image Data Analysis System

The MultiSpec Platform

MultiSpec has been developed at Purdue University, West Lafayette, IN.

It results from an on-going multiyear research effort which intended to define robust and fundamentally based technology for analyzing multispectral and hyperspectral image data, and to transfer this technology to the user community in as rapid a manner as possible.

The results of the research are implemented into MultiSpec and made available to the user community via the download pages.

MultiSpec© with its documentation© is distributed without charge. Note that an online version is available.

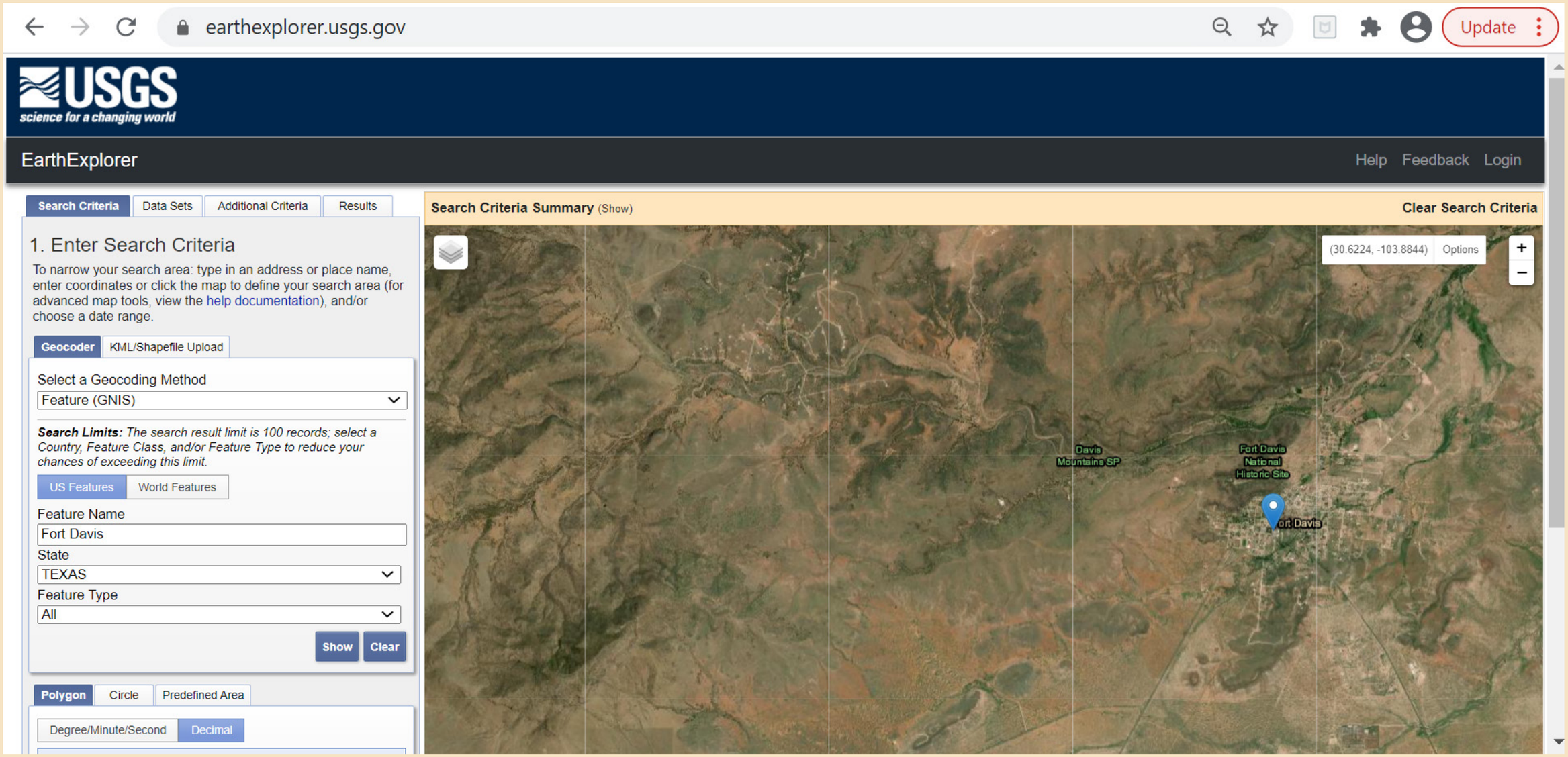
https://engineering.purdue.edu/~biehl/MultiSpec/

Work leading to MultiSpec was funded in part by NASA Grants NAGW-925, NAGW-3924 and NAGW5-3975.Support for MultiSpec has also been provided by AmericaView (www.americaview.org)

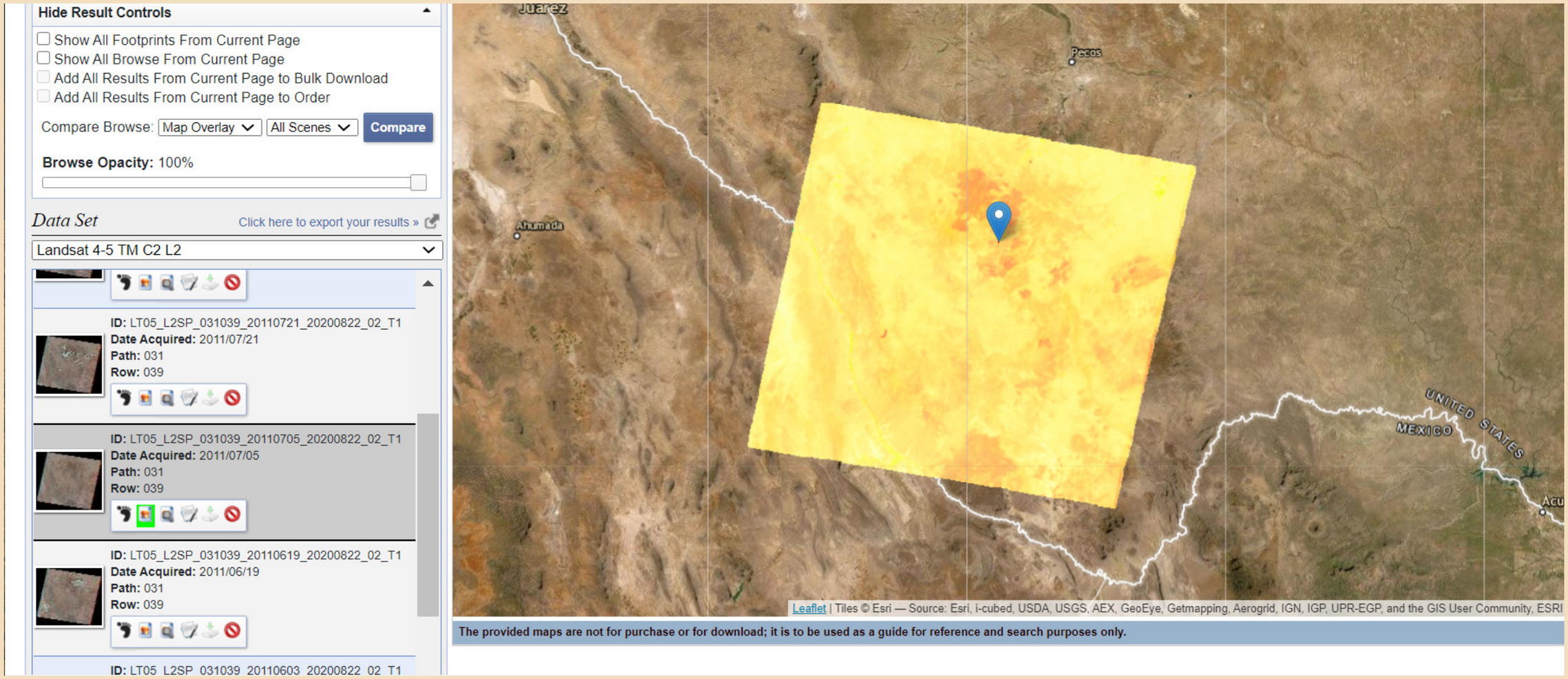
A Round-Up of Imagery over a Southwest Texas Landscape ...

Imagery of Davis Mountain State Park in southwestern Texas is used in the next section. After downloading the imagery from Earth Explorer, it will be processed using MultiSpec software to create a work of art. The area of interest was selected from the Texas as Art exhibition collection, which is currently touring the state of Texas.

Downloading in Earthexplorer



Identifying the scene for download



In EarthExplorer, select the image you wish to use and begin the download of the zipped files for that image.

Use the MultiSpec tutorials to process your image

Follow the instructions in the MultiSpec tutorials to create your final images. The MultiSpec tutorials and reference information are available at: *https://engineering.purdue.edu/~biehl/MultiSpec/MultiSpec_Intro_9_11.pdf*

Step through tutorial one for displaying image data
https://engineering.purdue.edu/~biehl/MultiSpec/tutorials/MultiSpec_Tutorial_1.pdf

Then move to tutorial two for image enhancement
https://engineering.purdue.edu/~biehl/MultiSpec/tutorials/MultiSpec_Tutorial_2.pdf

Unsupervised classification and cluster analysis are the topics in tutorial three
https://engineering.purdue.edu/~biehl/MultiSpec/tutorials/MultiSpec_Tutorial_3.pdf

Supervised classification, which allows the user to select the number of feature sets to display, is the topic in tutorial four
https://engineering.purdue.edu/~biehl/MultiSpec/tutorials/MultiSpec_Tutorial_4.pdf

Images that result from supervised or unsupervised classification can be further enhanced by using Adobe Photoshop software.

Artwork produced utilizing ...

MultiSpec

with Adobe Photoshop Enhancement

This image was created by downloading the image files from EarthExplorer over the Davis Mountain State Park area (Fort Davis, Texas).

The files were uploaded into the MultiSpec freeware for classification and then input into Adobe Photoshop for image enhancement. This image utilized Landsat bands 7, 4, and 3 to enhance the burn scar area of the Davis Mountain fires in April 2011.

Image courtesy of the Texas as Art collection

Session Two Wrap-Up

Upon completion of Session Two in the Earth as Art tutorial, you have learned how to use EarthExplorer to select and download imagery which can then be processed using software packages such as ArcGIS, Multi-Spec and Adobe Photoshop. These software programs have allowed you to take a real image of the Earth and develop it into a work of art. By working with various bands of data and processing techniques, you learned to highlight, enhance and develop the natural colors found within our landscape. From this point forward you will learn the options, procedures and possibilities of printing, showcasing and creating your own Earth as Art gallery exhibit, no matter what size, as an educational outreach program. Session Three will provide guidance to assist you on furthering your journey as an artist working from science to engage and enlighten others about this endless and ever-changing canvas we call home… "Earth"

Brent Yantis
Nina Zamanialavijeh

This material is based upon work supported by the U.S. Geological Survey under Grant/Cooperative Agreement No. G18AP00077. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Geological Survey. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Geological Survey.