



Creating

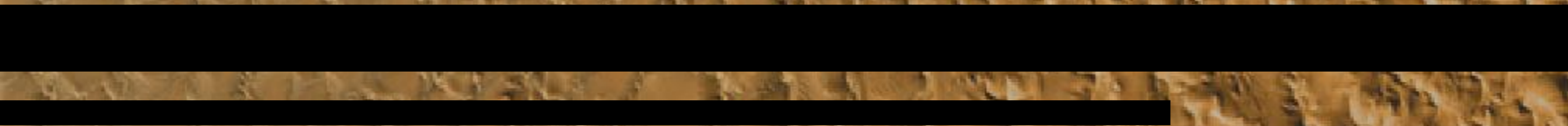
EARTH AS ART



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.

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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"

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

Landsat Missions: Imaging the Earth Since 1972



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 sheer artistic wonder that is our "EARTH!"

Launch readiness date September 2021

N A S A • U S G S



LANDSAT NINE

K S C • G S F C • E R O S

An aerial satellite-style image of a coastline. The image shows a large bay on the left side, with a narrow strip of land extending from the top left towards the center. The land is colored in shades of green and brown, representing vegetation and terrain. The water is a mix of light blue and green, indicating different depths or sediment. The overall image has a slightly grainy, high-resolution appearance typical of satellite imagery.

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

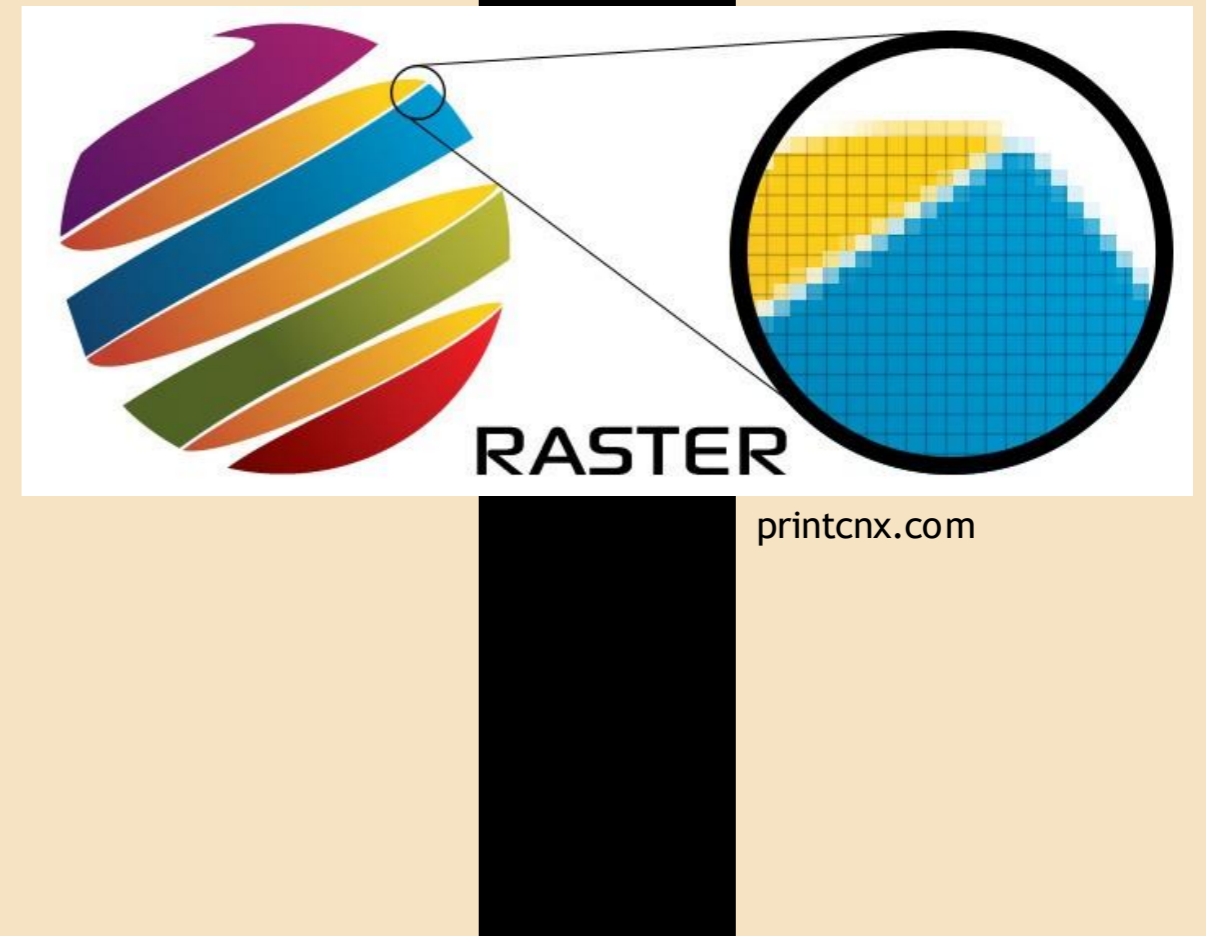
let's move forward to work with the imagery obtained from Landsat. In today's world, computer graphics can be created in either raster or vector format.

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.



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.

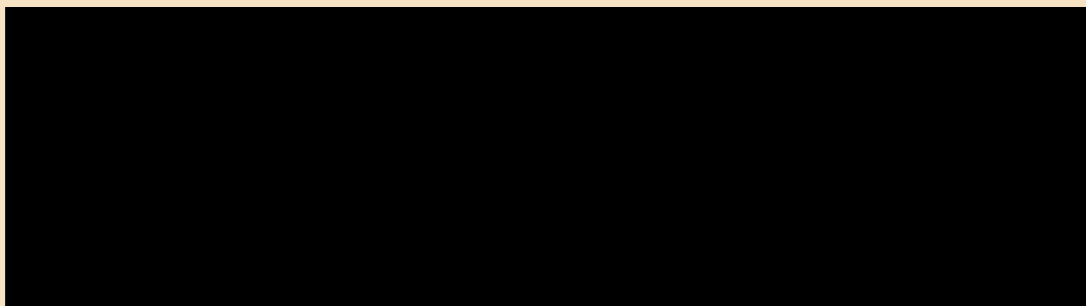
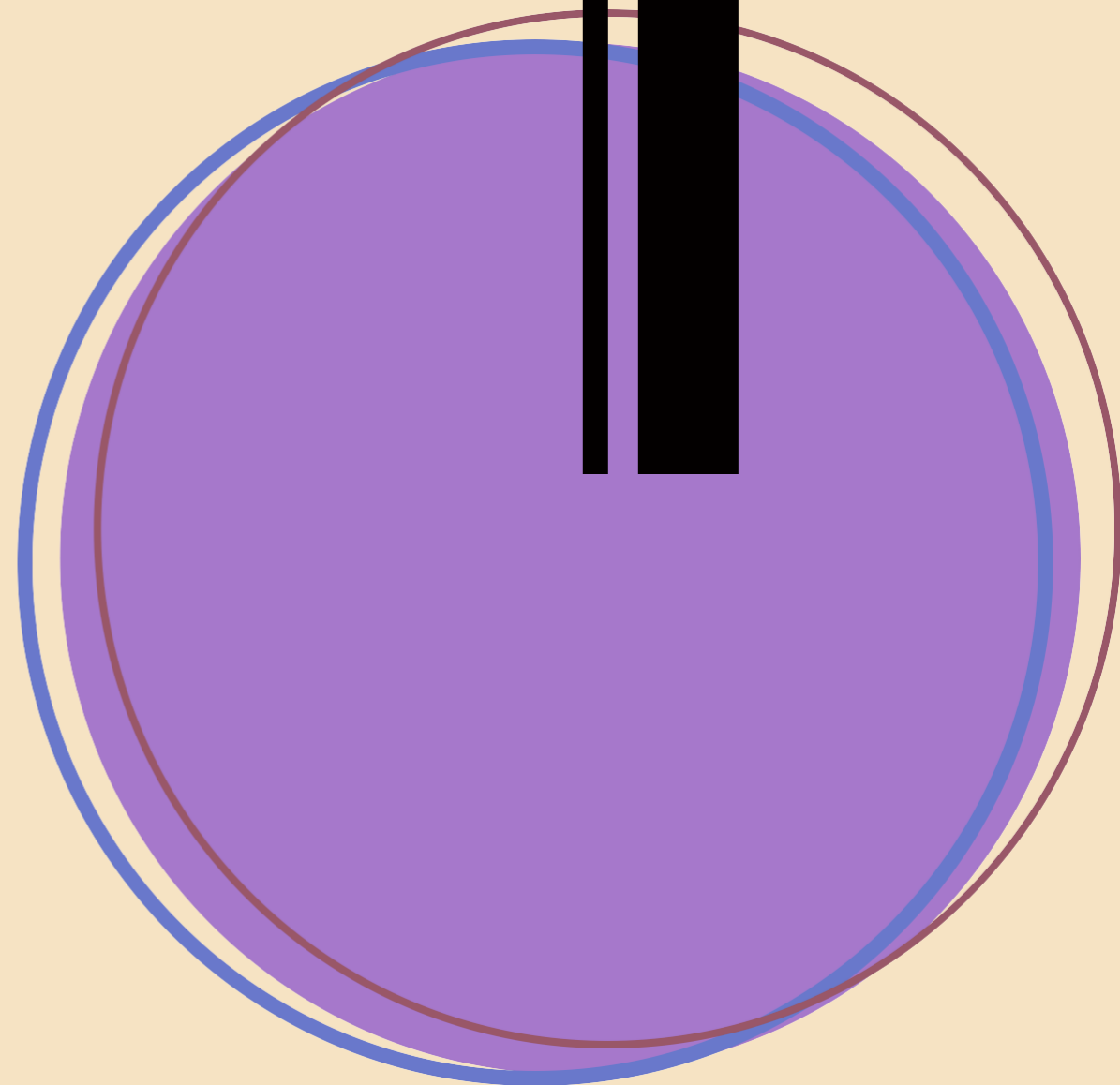




Raster graphics

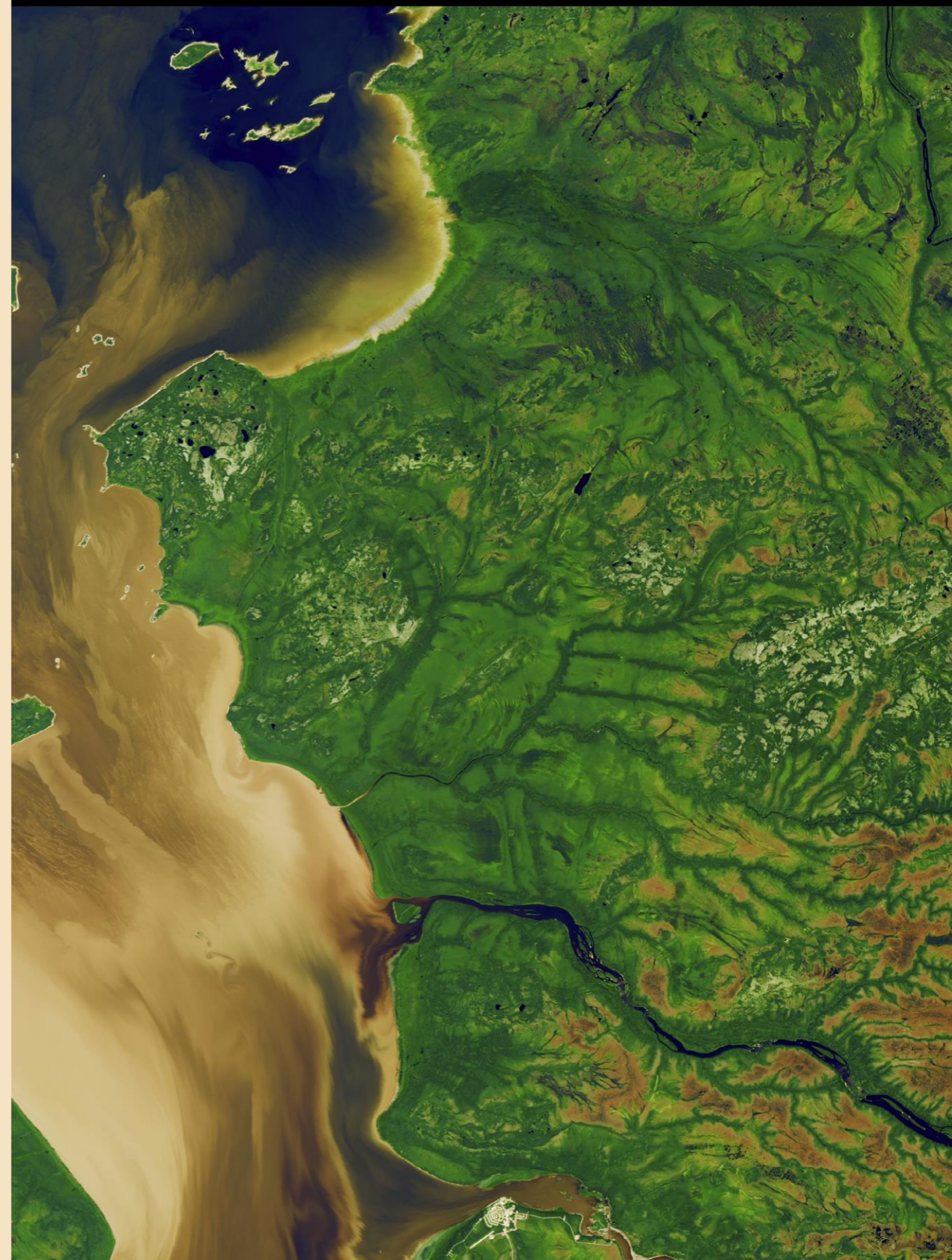
For our raster images that we will be working with, we may choose one of the following formats to display our downloaded image files.

- 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

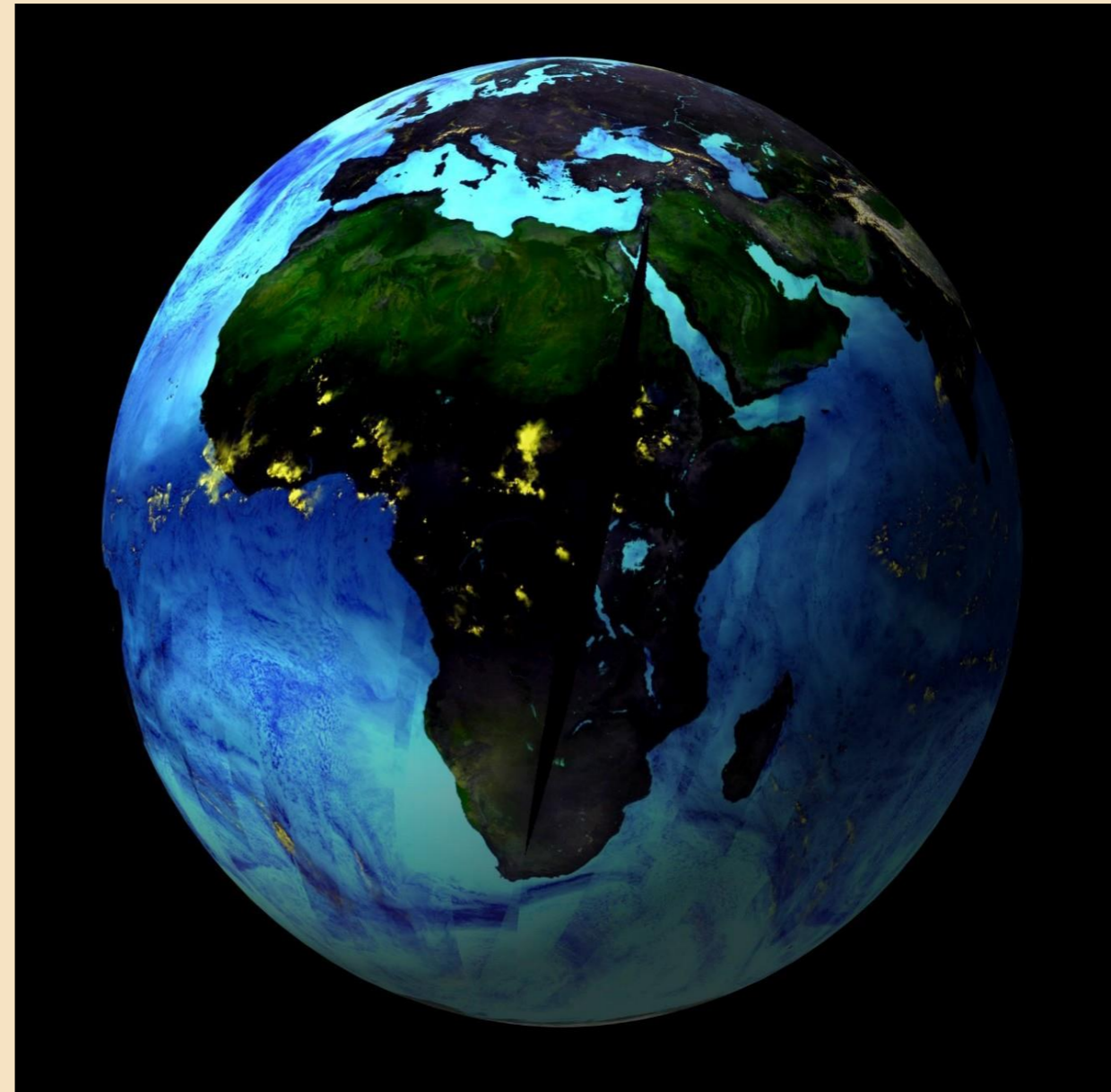
False color images are a representation of a multispectral image produced using any bands other than visible red, green and blue as the red, green and blue components of the display. False color composites allow us to visualize wavelengths that the human eye can not see (i.e., near-infrared and beyond).



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

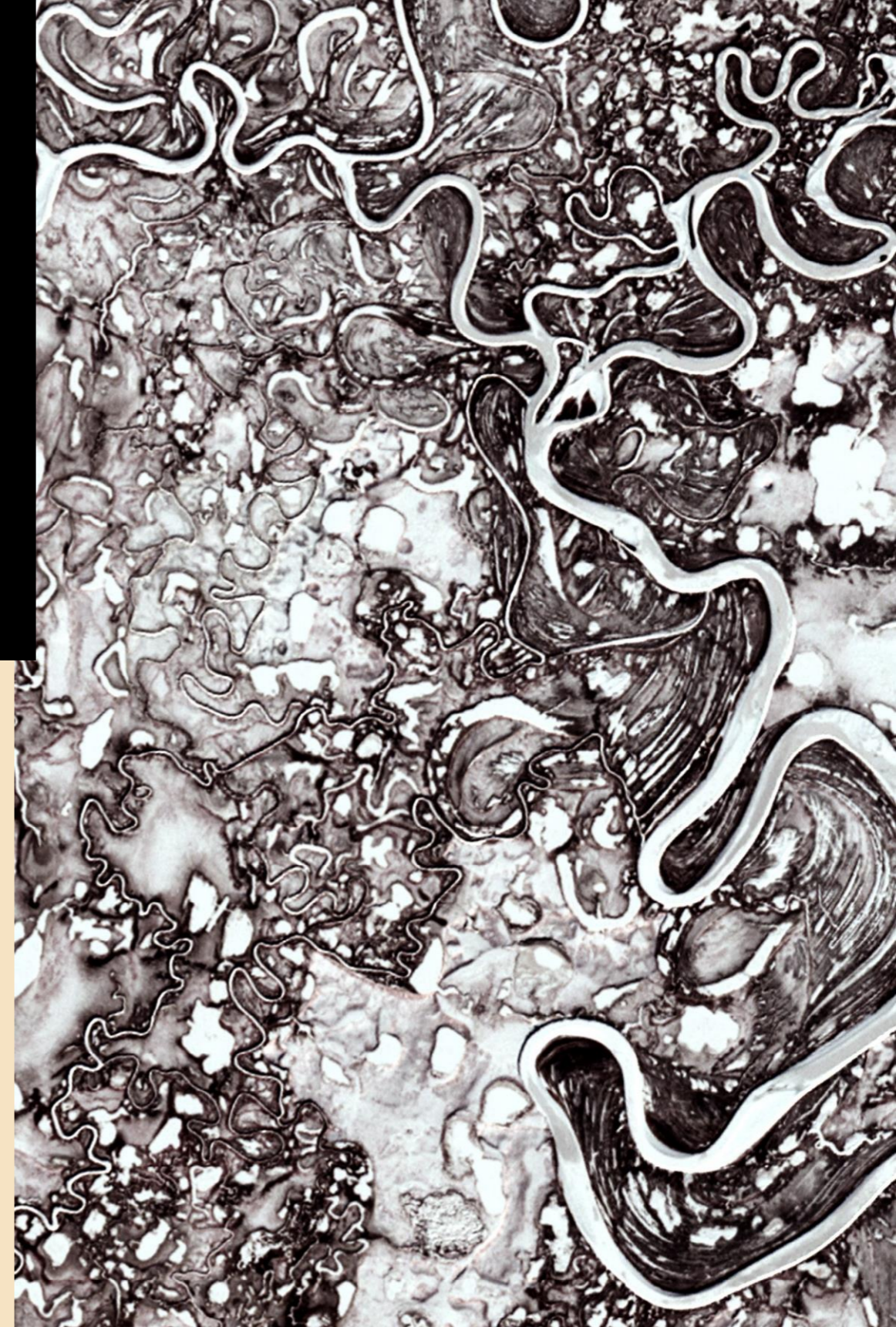
Pseudo color

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. Pseudo 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

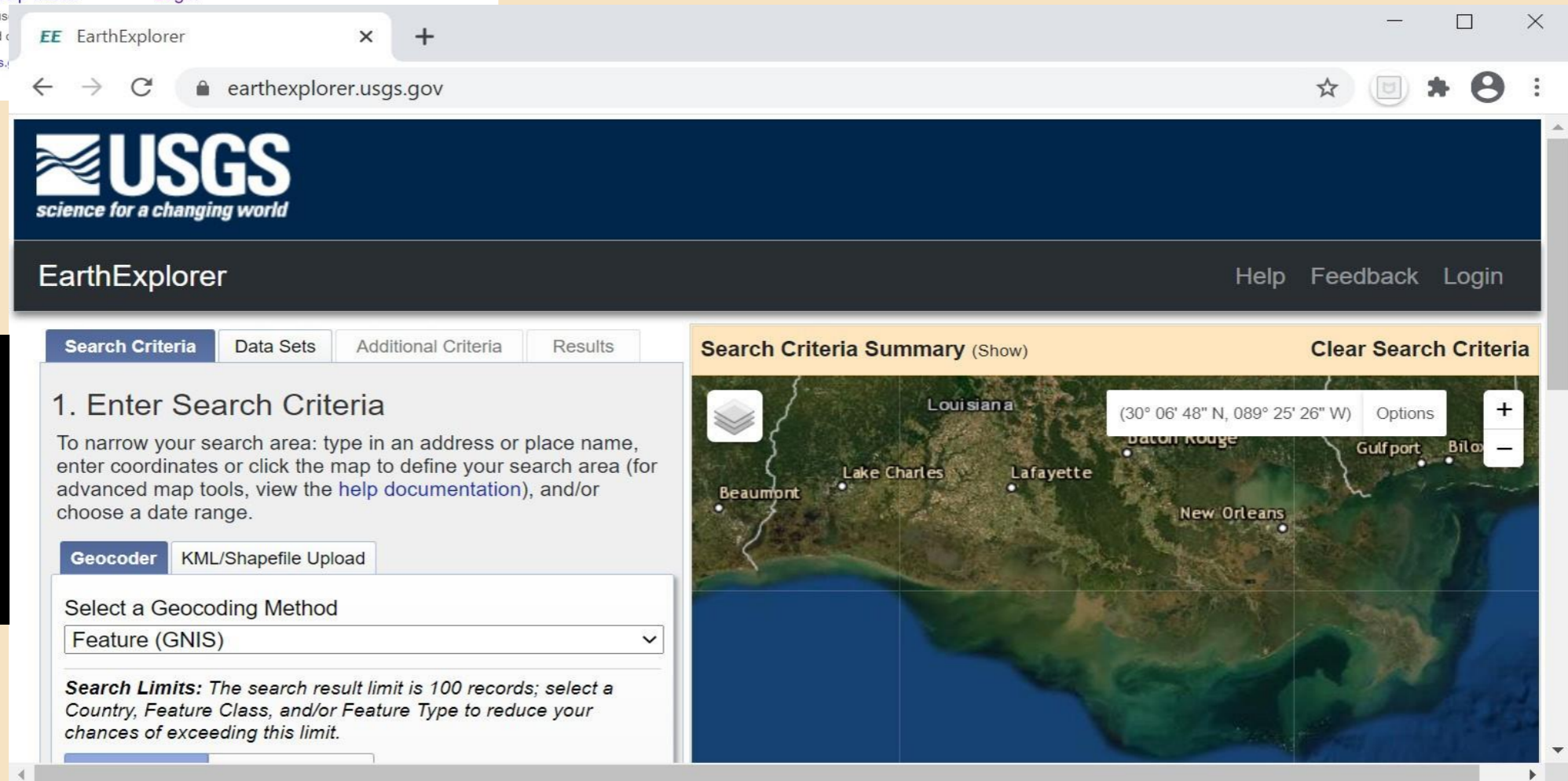
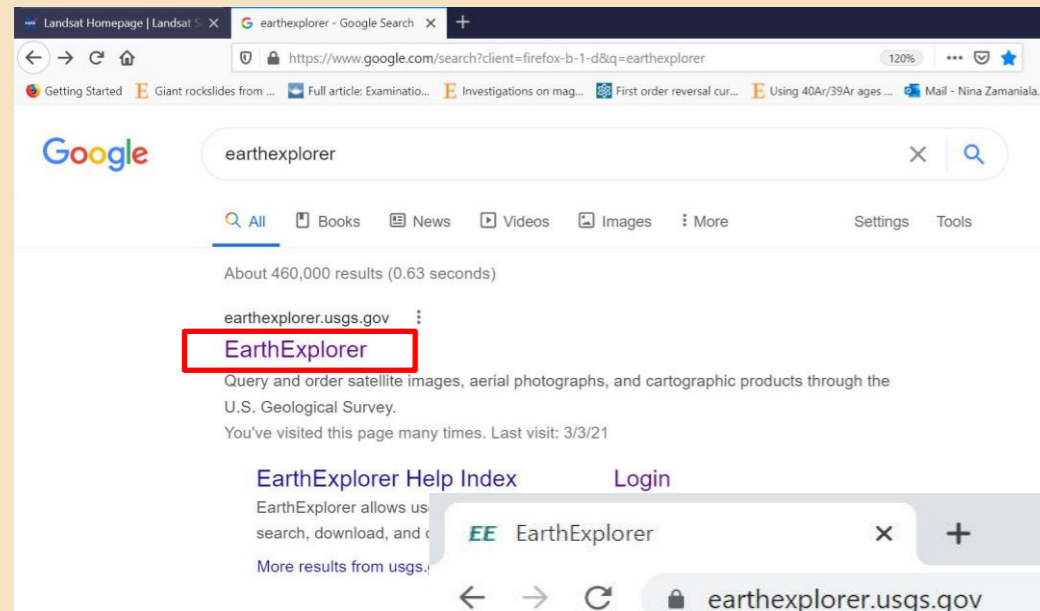
earthexplorer.usgs.gov

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

The screenshot shows a web-based geocoding interface. On the left, the 'Search Criteria' panel is active, with 'Ocean Lake' entered in the 'Feature Name' field. Below this, a table of search results is displayed, with the entry for 'OCEAN LAKE' in Wyoming highlighted in red. A red box also highlights the 'Show' button in the search criteria panel, with an arrow pointing to the table. The main map area shows a satellite view of Wyoming with a blue location pin on a lake in the western part of the state.

Search Criteria Summary (Show)

1. Enter Search Criteria
To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Geocoder KML/Shapefile Upload

Select a Geocoding Method
Feature (GNIS)

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
Ocean Lake

State
All

Feature Type
All

Show Clear

Polygon Circle Predefined Area

Degree/Minute/Second Decimal

1. Lat: 43° 11' 05" N, Lon: 108° 36' 07" W

Use Map Add Coordinate Clear Coordinates

Date Range Cloud Cover Result Options

Search from: mm/dd/yyyy to: mm/dd/yyyy

Search months: (all)

Data Sets » Additional Criteria » Results »

Click on a Feature to show the location on the map and add coordinates to the Area of Interest Control.

Placename	Type	Region	Latitude	Longitude
OCEAN LAKE	LAKE	CALIFORNIA	37.9816	-122.7858
OCEAN LAKE	LAKE	TEXAS	32.7809	-95.7897
OCEAN LAKE	LAKE	WYOMING	43.1848	-108.8020

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

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.

Search Criteria | Data Sets | Additional Criteria | Results

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Geocoder | KML/Shapefile Upload

Select a Geocoding Method
Feature (GNIS)

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
Ocean Lake

State
All

Feature Type
All

Show Clear

Polygon | Circle | Predefined Area

Degree/Minute/Second | Decimal

1. Lat: 43° 11' 05" N, Lon: 108° 36' 07" W

Use Map | Add Coordinate | Clear Coordinates

Date Range | **Cloud Cover** | Result Options

Search from: mm/dd/yyyy to: mm/dd/yyyy

Search months: (all)

Data Sets » | Additional Criteria » | Results »

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

Search Criteria | Data Sets | Additional Criteria | Results

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Geocoder | KML/Shapefile Upload

Select a Geocoding Method
Feature (GNIS)

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
(use % as wildcard)

State
All

Feature Type
All

Show Clear

Polygon | Circle | Predefined Area

Degree/Minute/Second | Decimal

1. Lat: 43° 11' 05" N, Lon: 108° 36' 07" W

Use Map | Add Coordinate | Clear Coordinates

Date Range | **Cloud Cover** | Result Options

Cloud Cover Range: 0% - 100%

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 »

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.

Search Criteria **Data Sets** Additional Criteria Results

2. Select Your Data Set(s)

Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets.

Use Data Set Prefilter [\(What's This?\)](#)

Data Set Search:

This data set list is cached for performance. If your user permissions have changed or you are not seeing an expected dataset, click [here](#) to refresh your list.

- Aerial Imagery
- AVHRR
- CEOS Legacy
- Commercial Satellites
- Declassified Data
- Digital Elevation
- Digital Line Graphs
- Digital Maps
- EO-1
- Global Fiducials
- HCMM
- ISERV
- Land Cover
- Landsat**
 - Landsat Collection 2 Level-2
 - Landsat Collection 2 Level-1
 - Landsat 8 OLI/TIRS C2 L1
 - Landsat 7 ETM+ C2 L1
 - Landsat 4-5 TM C2 L1
 - Landsat 1-5 MSS C2 L1

Clear All Selected Additional Criteria » **Results »**

Search Criteria Summary (Show)

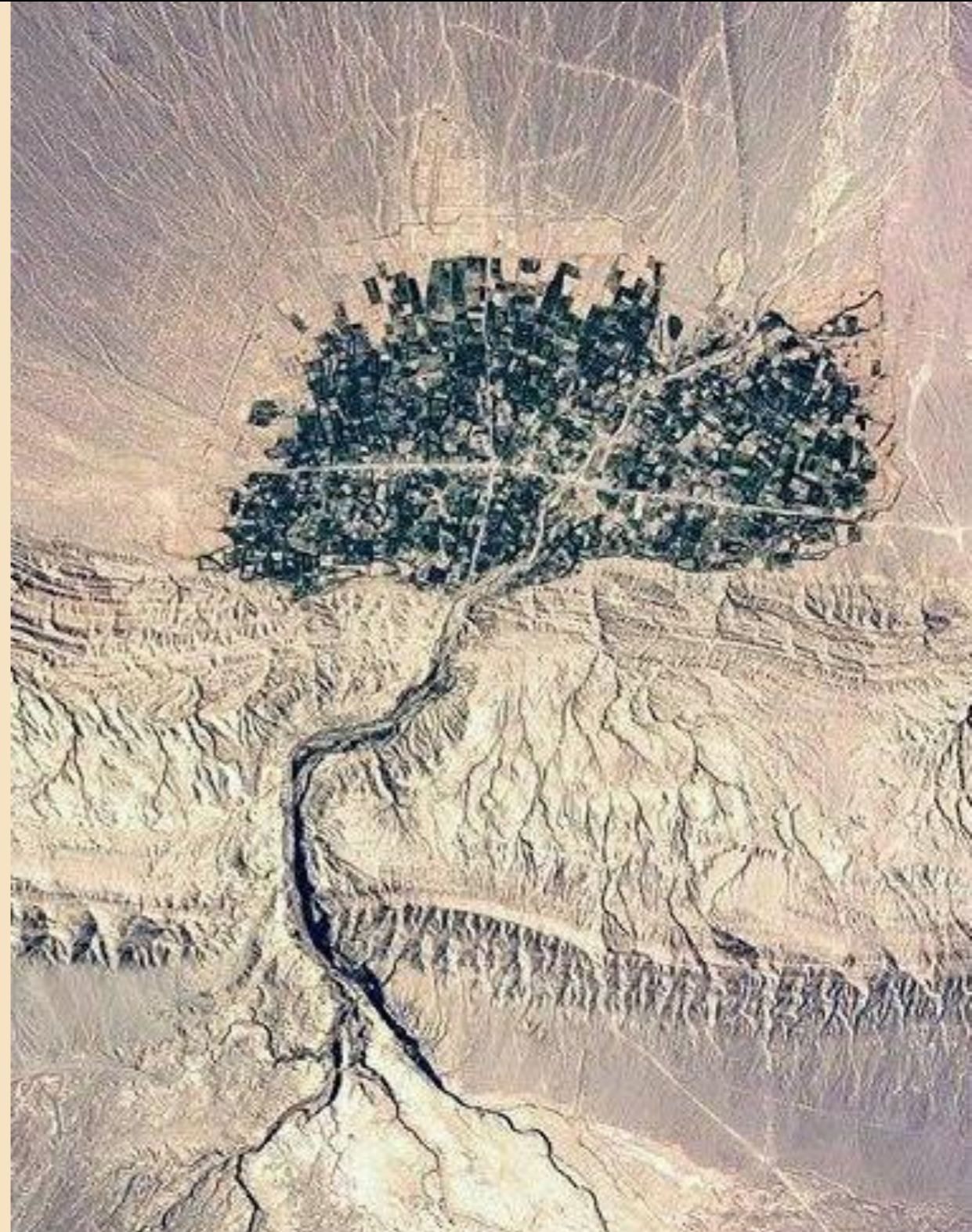
The provided maps are not for purchase or for download; it is to be used as a guide for reference and search purposes only.

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 ...



The background of the slide is a high-resolution aerial satellite image of a river delta, likely the Mississippi River Delta. The image shows a complex network of water channels, wetlands, and land parcels. A semi-transparent white rectangular box is overlaid on the center of the image, containing the text.

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 ...

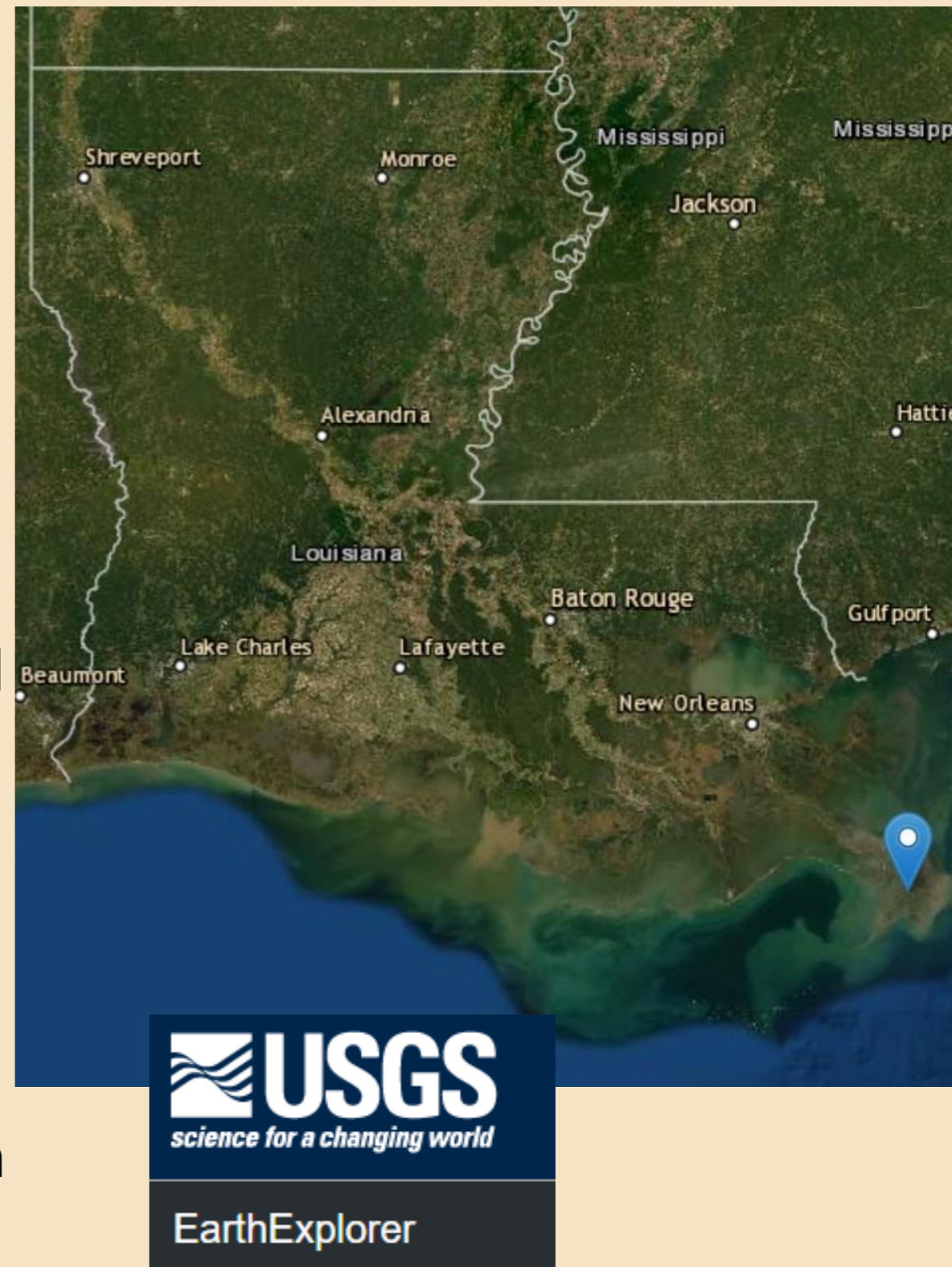
Navigate and Create a Login in EarthExplorer

***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 ...

The screenshot shows the USGS EarthExplorer website interface. The browser address bar displays "earthexplorer.usgs.gov". The USGS logo is in the top left, and navigation links for "Help", "Feedback", and "Login" are in the top right. The "Search Criteria" tab is active, and the "1. Enter Search Criteria" section is highlighted with a red box. Below this, there are instructions on how to narrow the search area. The "Geocoder" section is expanded, showing a dropdown menu for "Select a Geocoding Method" set to "Feature (GNIS)". Below this, there are "Search Limits" instructions and buttons for "US Features" and "World Features". The "Feature Name" field contains "mississippi river delta", the "State" dropdown is set to "LOUISIANA", and the "Feature Type" dropdown is set to "All". "Show" and "Clear" buttons are at the bottom of the form. To the right, a "Search Criteria Summary" section shows a satellite map of the Louisiana Gulf Coast with a blue location pin. The map includes labels for "Lafourche", "Empire", and "Grand Isle". A coordinate box shows "(28° 54' 38\" N, 088° 46' 30\" W)" and "Options" with zoom in/out buttons. A "Clear Search Criteria" link is also visible.

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

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 »

Cloud Cover | Date Range | 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 »

DOI Privacy Policy | Legal | Accessibility | Site Map | Contact USGS

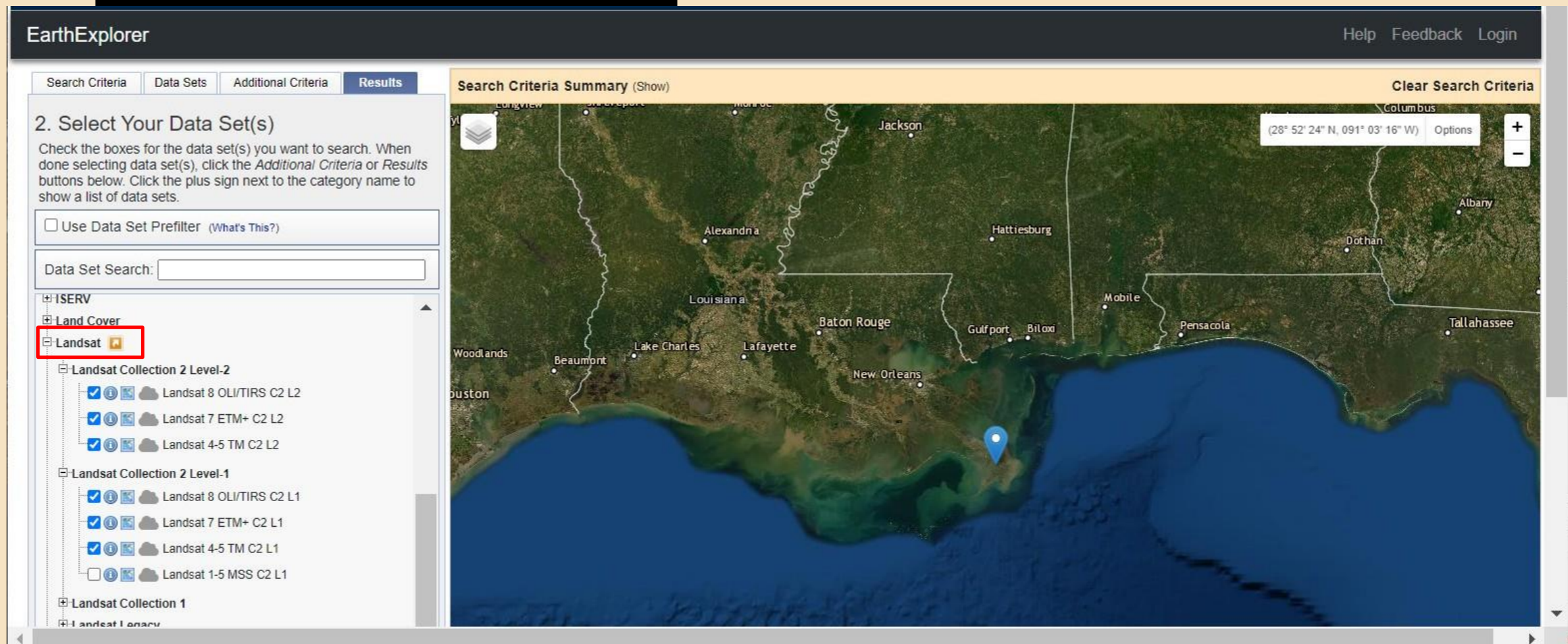
U.S. Department of the Interior | DOI Inspector General | White House | E-gov | No Fear Act | FOIA

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.

The screenshot shows the Earth Explorer USGS website interface. On the left, there is a 'Data Set Search' panel with a search bar and a list of data collections. Under 'Landsat Collection 2 Level-2', three items are checked: 'Landsat 8 OLI/TIRS C2 L2', 'Landsat 7 ETM+ C2 L2', and 'Landsat 4-5 TM C2 L2'. Below this, 'Landsat Collection 2 Level-1' has three items checked: 'Landsat 8 OLI/TIRS C2 L1', 'Landsat 7 ETM+ C2 L1', and 'Landsat 4-5 TM C2 L1'. Other categories like 'Landsat Collection 1', 'Landsat Legacy', 'LCMAP', 'NASA LPDAAC Collections', 'Radar', 'Sentinel', 'UAS', 'Vegetation Monitoring', and 'ISRO Resourcesat' are also listed. At the bottom of the search panel, there are three buttons: 'Clear All Selected', 'Additional Criteria >', and 'Results >'. The 'Results >' button is highlighted with a red rectangular box. The main map area shows a satellite view of a coastal region with labels for 'Port Sulphur', 'Empire', and 'Grand Isle'. A blue location pin is placed on the map. The bottom of the page features a dark blue footer with links for 'DOI Privacy Policy', 'Legal', 'Accessibility', 'Site Map', and 'Contact USGS', and a small text line: 'U.S. Department of the Interior | DOI Inspector General | White House | E.gov | No Fear Act | E.O. 13526'.

3.1

Once the sensor data is selected, scroll down and select the Results tab.

4

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.

Note: You must be logged in to download and order scenes

Show Result Controls

Data Set [Click here to export your results](#)

Landsat 8 OLI/TIRS C2 L2

New download functionality for Collection 2 datasets. See [Landsat Collection 2 Download](#) for assistance.

NOTE: Landsat 8 C2 L2 products become available for download 15 to 17 days after data are acquired. View this [Landsat Collection 2 Generation Timeline](#) to see how this timeframe is determined.

« First » Previous 1 Next » Last »

Displaying 1 - 3 of 3
(Restore Excluded Scenes)

	ID: LC08_L2SP_021040_20201011_20201016_02_T1 Date Acquired: 2020/10/11 Path: 021 Row: 040
	ID: LC08_L2SP_021040_20200925_20201006_02_T1 Date Acquired: 2020/09/25 Path: 021 Row: 040
	ID: LC08_L2SP_021040_20200909_20200919_02_T1 Date Acquired: 2020/09/09 Path: 021 Row: 040

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

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.

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.

Note: You must be logged in to download and order scenes

Show Result Controls

Data Set [Click here to export your results](#)

Landsat 8 OLI/TIRS C2 L2

New download functionality for Collection 2 datasets. See [Landsat Collection 2 Download](#) for assistance.

NOTE: Landsat 8 C2 L2 products become available for download 15 to 17 days after data are acquired. View this [Landsat Collection 2 Generation Timeline](#) to see how this timeframe is determined.

« First < Previous 1 Next > Last »

Displaying 1 - 3 of 3
(Restore Excluded Scenes)

	ID: LC08_L2SP_021040_20201011_20201016_02_T1 Date Acquired: 2020/10/11 Path: 021 Row: 040
	ID: LC08_L2SP_021040_20200925_20201006_02_T1 Date Acquired: 2020/09/25 Path: 021 Row: 040
	ID: LC08_L2SP_021040_20200909_20200919_02_T1 Date Acquired: 2020/09/09 Path: 021 Row: 040

4.2

If you selected multiple data sets, you can click the drop arrow (red box) and select the data set you want to view the results for.

earthexplorer.usgs.gov

Show Result Controls

Data Set [Click here to export your results](#)

Landsat 8 OLI/TIRS C2 L2

NOTE: Landsat 8 C2 L2 products become available for download 15 to 17 days after data are acquired. [View this Landsat Collection 2 Generation Timeline](#) to see how this timeframe is determined.

« First « Previous 1 ▾ Next » Last »

Displaying 1 - 3 of 3
(Restore Excluded Scenes)

ID: LC08_L2SP_021040_20201011_20201016_02_T1
Date Acquired: 2020/10/11
Path: 021
Row: 040

ID: LC08_L2SP_021040_20200925_20201006_02_T1
Date Acquired: 2020/09/25
Path: 021
Row: 040

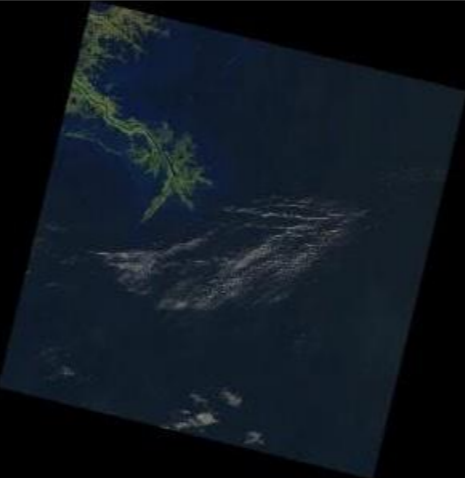
ID: LC08_L2SP_021040_20200909_20200919_02_T1
Date Acquired: 2020/09/09
Path: 021
Row: 040

« First « Previous 1 ▾ Next » Last »

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Full Display of LC08_L2SP_021040_20201011_20201016_02_T1



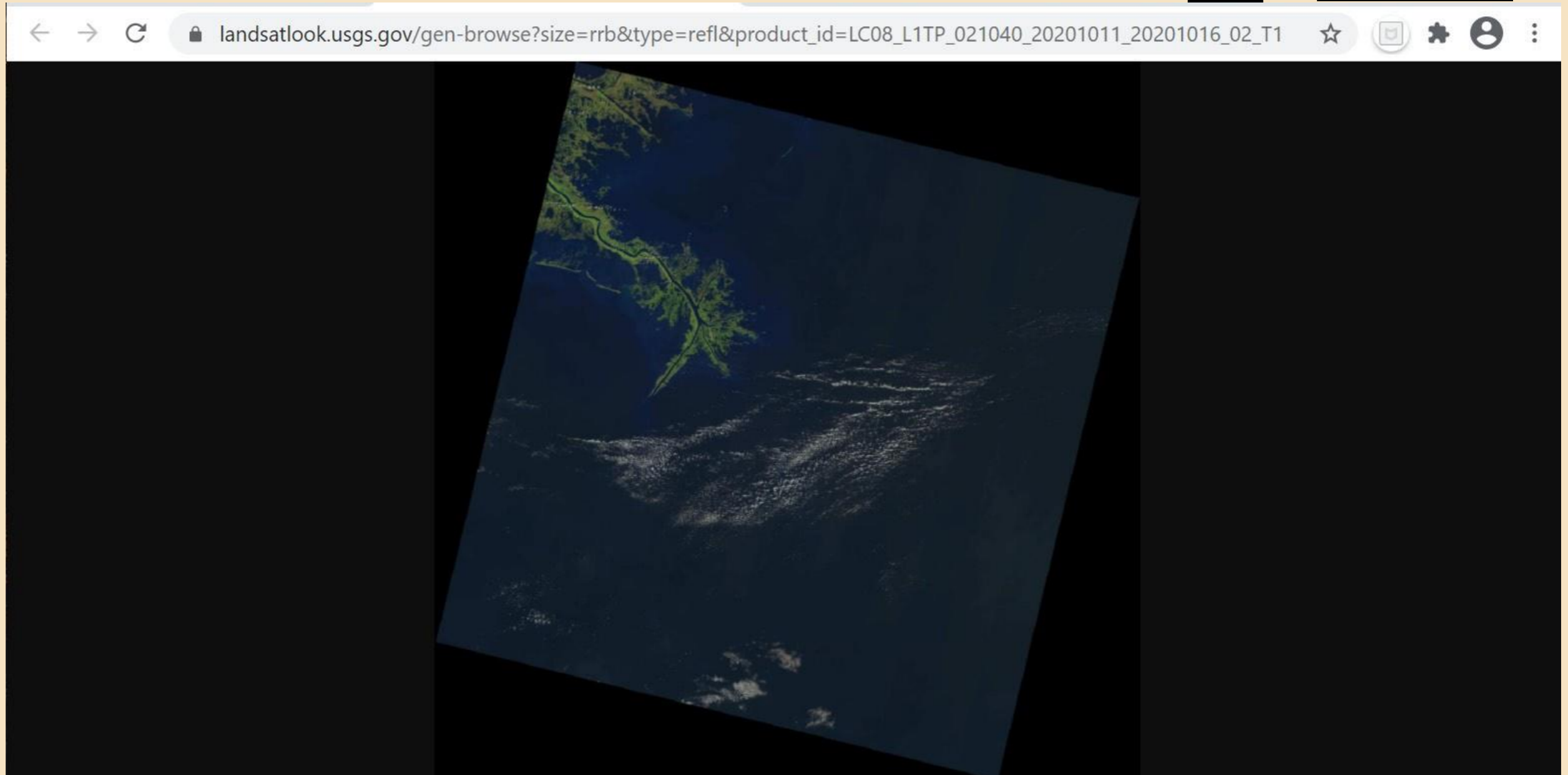
Level-1 Reflective Browse

Data Set Attribute	Attribute Value
Landsat Product Identifier L2	LC08_L2SP_021040_20201011_20201016_02_T1
Landsat Product Identifier L1	LC08_L1TP_021040_20201011_20201016_02_T1
Landsat Scene Identifier	LC80210402020285LGN00

Open New Window Close

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?



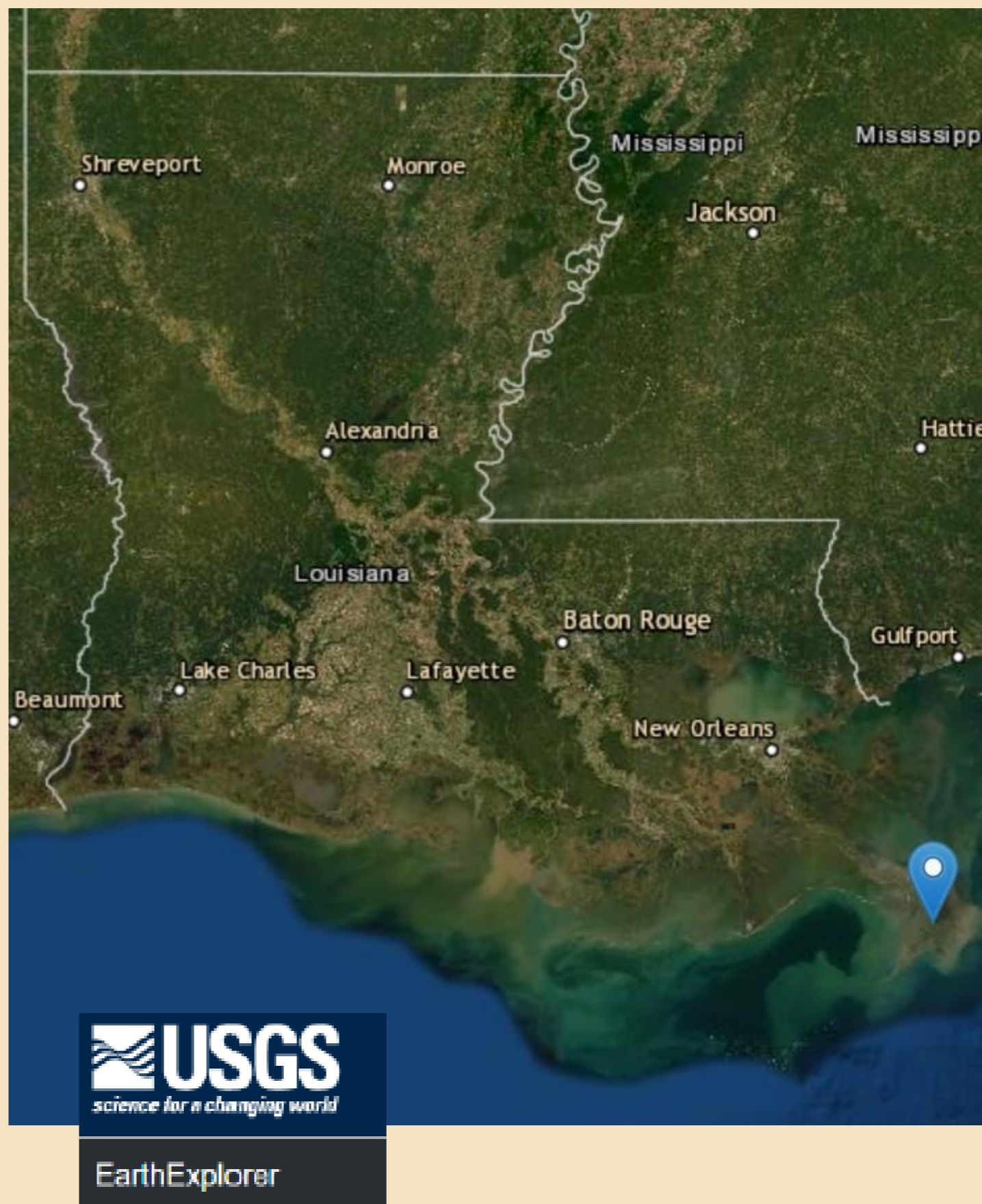
4.3

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** Search Criteria Summary (Show) Clear Search Criteria

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.

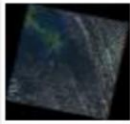

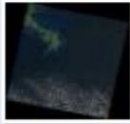

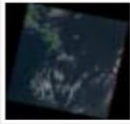

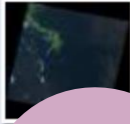

Show Result Controls

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	

Map: Search Criteria Summary (Show) Clear Search Criteria

(29° 18' 54" N, 088° 19' 13" W) Options + -



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

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

Search Criteria Data Sets Additional Criteria Results Search Criteria Summary (Show) Clear Search Criteria

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

Export Requested for Processing
×
We are processing your export request.
Close

Export Submitted for Processing
×
Large exports may take several hours to process during periods of high demand. Once processing has finished,

Download Options

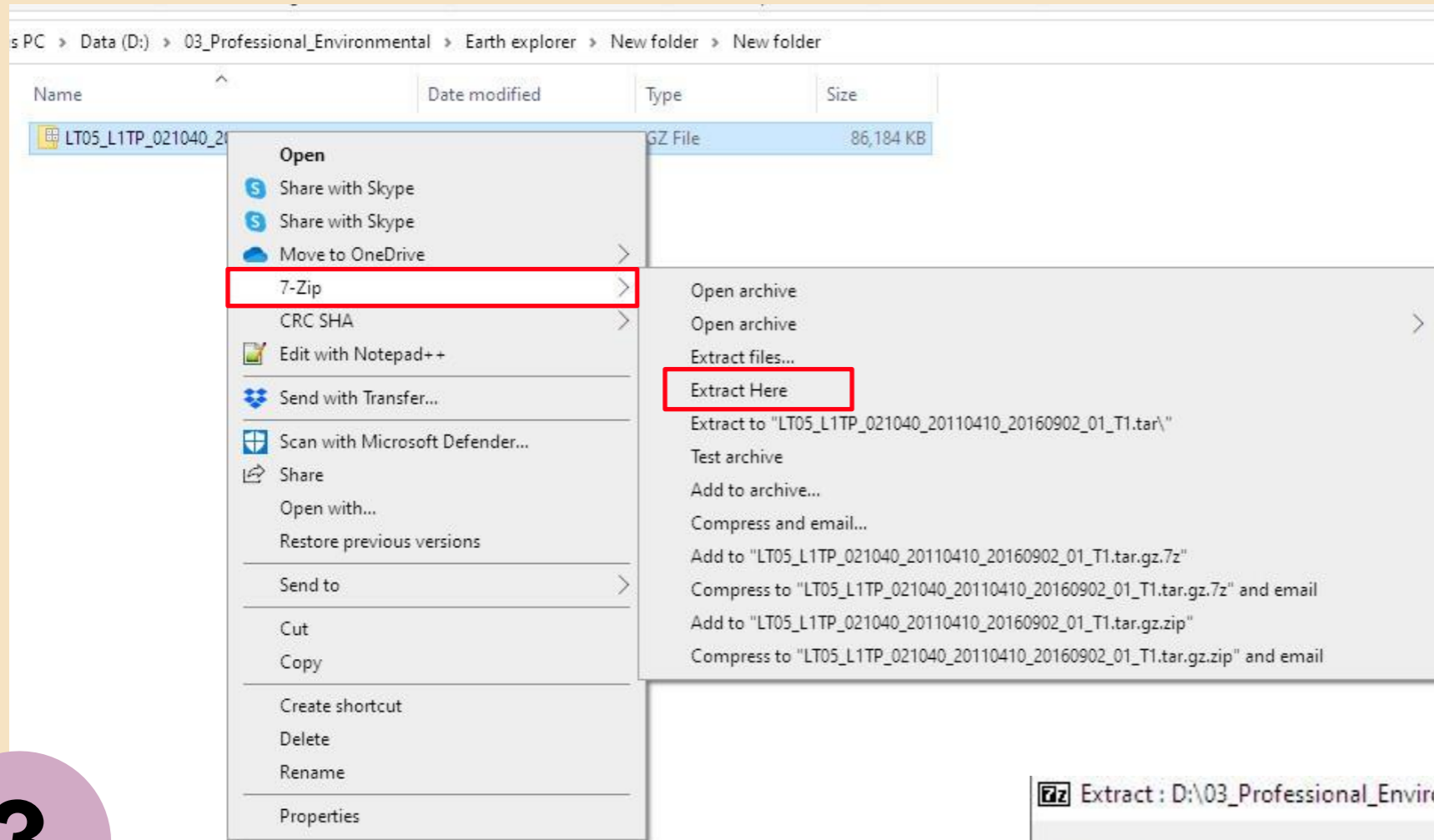
- Download LandsatLook Natural Color Image (3.02 MiB)
- Download LandsatLook Thermal Image (1.74 MiB)
- Download LandsatLook Quality Image (487.27 KiB)
- Download LandsatLook Images with Geographic Reference (5.24 MiB)
- Download Level-1 GeoTIFF Data Product (84.16 MiB)

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

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

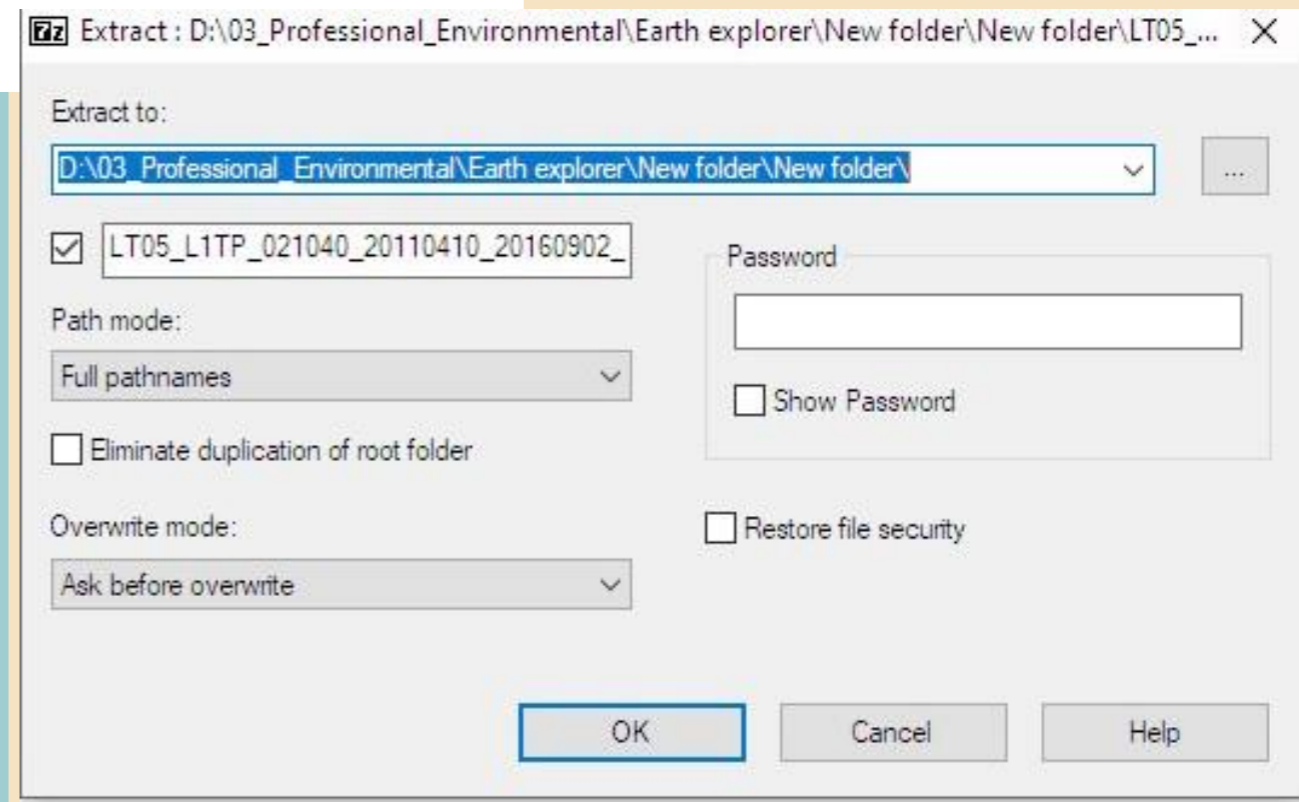
2

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.



LT05_L1TP_021040_20110410_20160902_01...	12/20/2020 1:46 PM	File folder	
LT05_L1TP_021040_20110410_20160902_01...	12/20/2020 1:41 PM	GZ File	86,184 KB

The screenshot shows a Windows file explorer window with a context menu open over a TAR file named 'LT05_L1TP_021040_20110410_20160902_01...' (503,320 KB). The '7-Zip' option is selected, and the 'Extract Here' sub-option is highlighted. The context menu options include: Share with Skype, Move to OneDrive, 7-Zip, CRC SHA, Edit with Notepad++, Send with Transfer..., Scan with Microsoft Defender..., Share, Open with..., Restore previous versions, Send to, Cut, Copy, Create shortcut, Delete, Rename, and Properties. The 'Extract Here' sub-menu is open, showing options: Open archive, Extract files..., Extract Here, Extract to "LT05_L1TP_021040_20110410_20160902_01_T1\", Test archive, Add to archive..., Compress and email..., Add to "LT05_L1TP_021040_20110410_20160902_01_T1_2.7z", Compress to "LT05_L1TP_021040_20110410_20160902_01_T1_2.7z" and email, Add to "LT05_L1TP_021040_20110410_20160902_01_T1_2.zip", and Compress to "LT05_L1TP_021040_20110410_20160902_01_T1_2.zip" and email.

Below the context menu, a grid of unzipped files is visible, including various .TIF and .JSON files. The files are arranged in two rows. The first row contains files such as 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ANG.txt', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_MTL.json', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_MTL.txt', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_MTL.xml', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_QA_P.IXEL.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_QA_R.ADSAT.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_A.TMOS_OPACIT...', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_B.1.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_B.2.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_B.3.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_B.4.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_B.5.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_B.7.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_C.LOUD_QA.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_SR_st.ac.json', and 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_A.TRAN.TIF'. The second row contains files such as 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_B.6.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_C.DIST.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_D.RAD.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_E.MIS.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_E.MSD.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_Q.A.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_st.ac.json', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_T.RAD.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_ST_U.RAD.TIF', 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_thum_b_large.jpeg', and 'LT05_L2SP_02104_0_20110528_2020_0822_02_T1_thum_b_small.jpeg'.

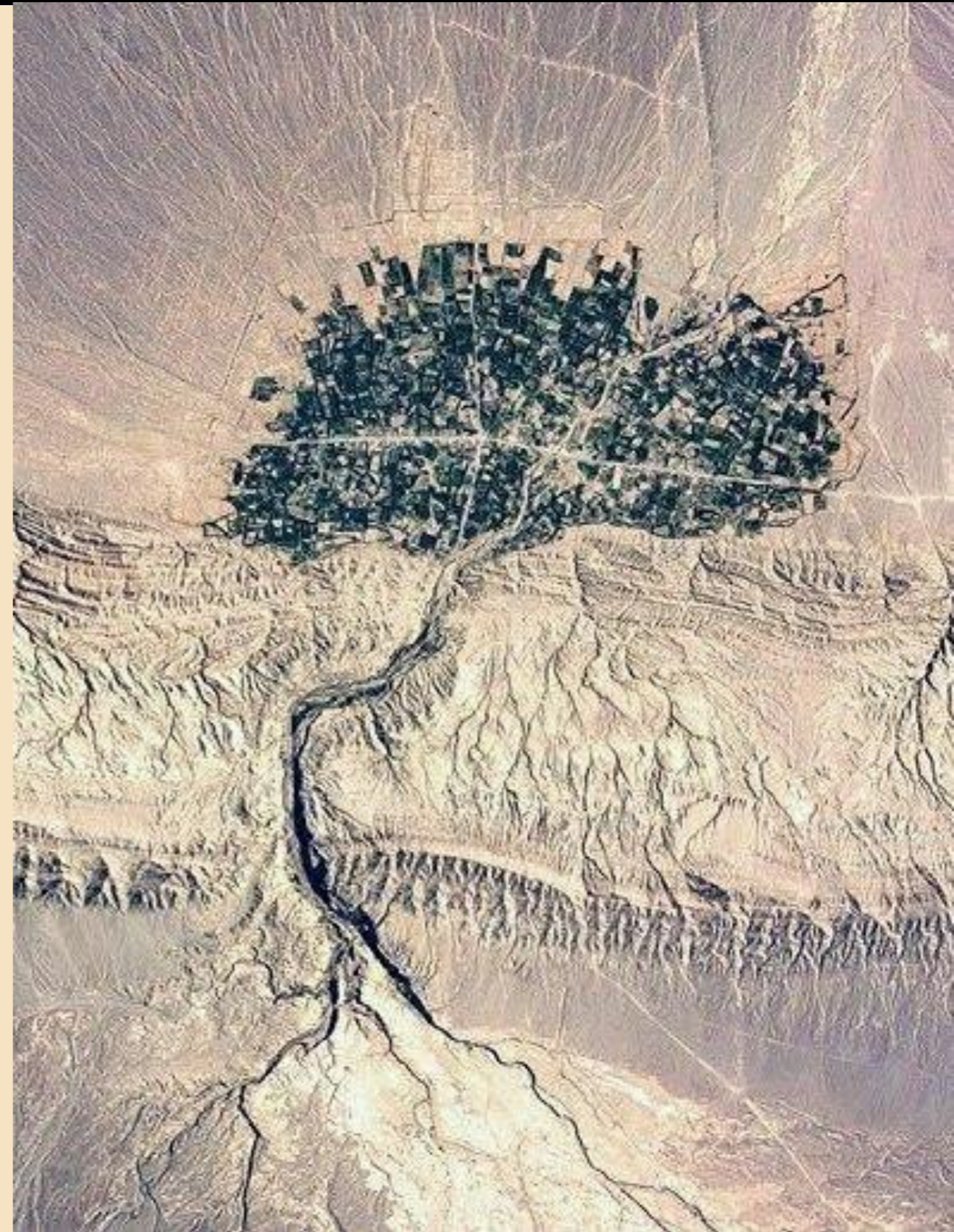
4

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...

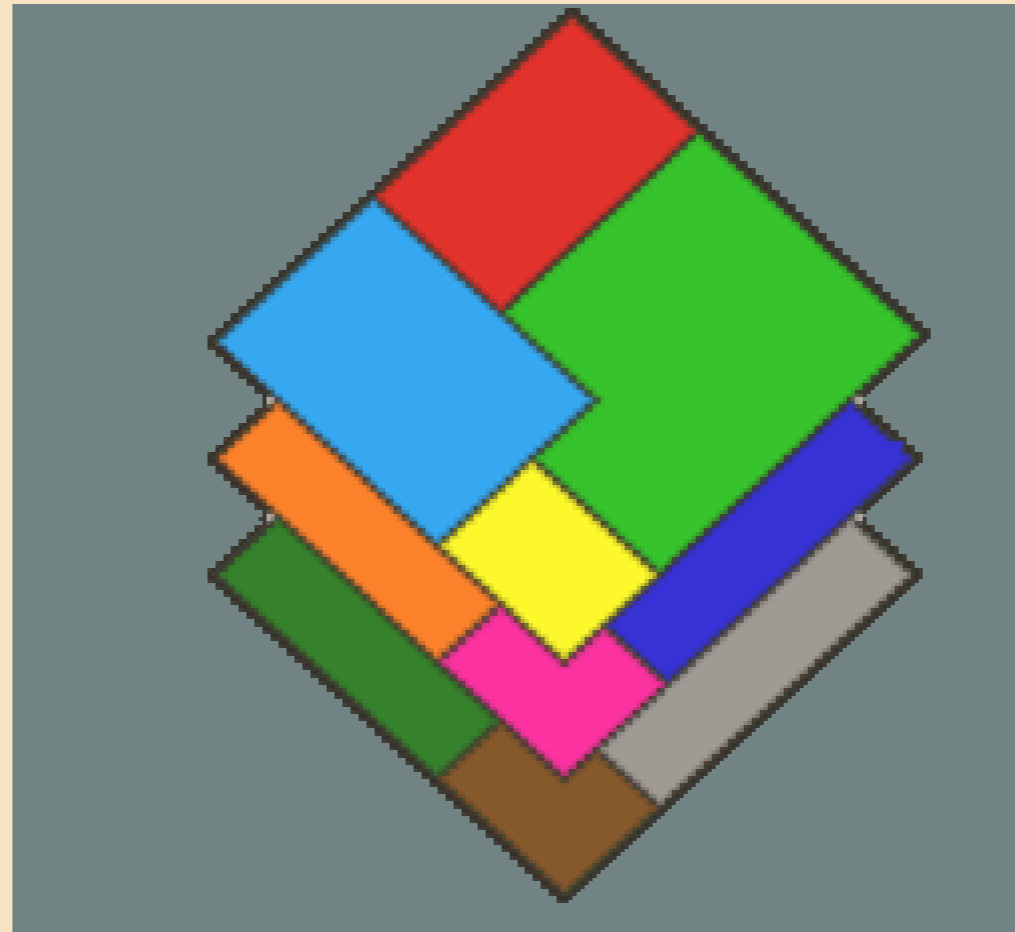


Here are three possibilities

- ArcMap
- Photoshop
- MultiSpec



esri®



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

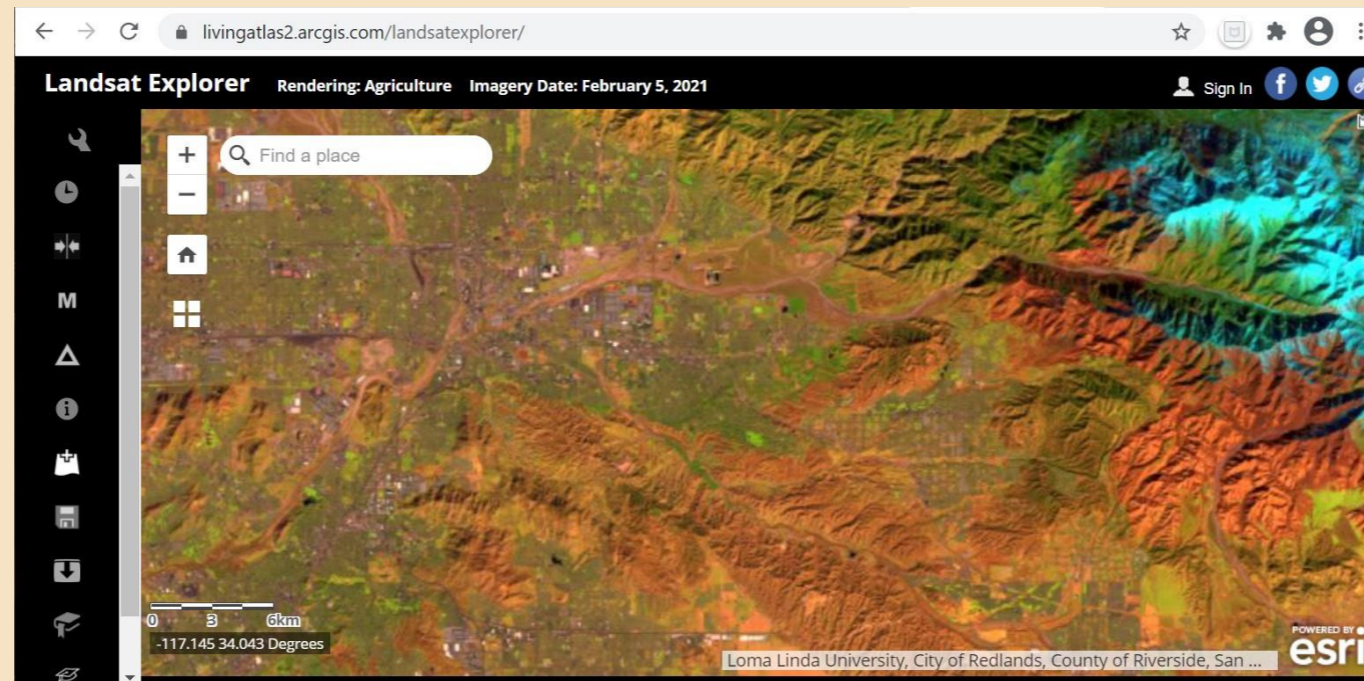
... utilizing the Louisiana Mississippi Delta Image files



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/)

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



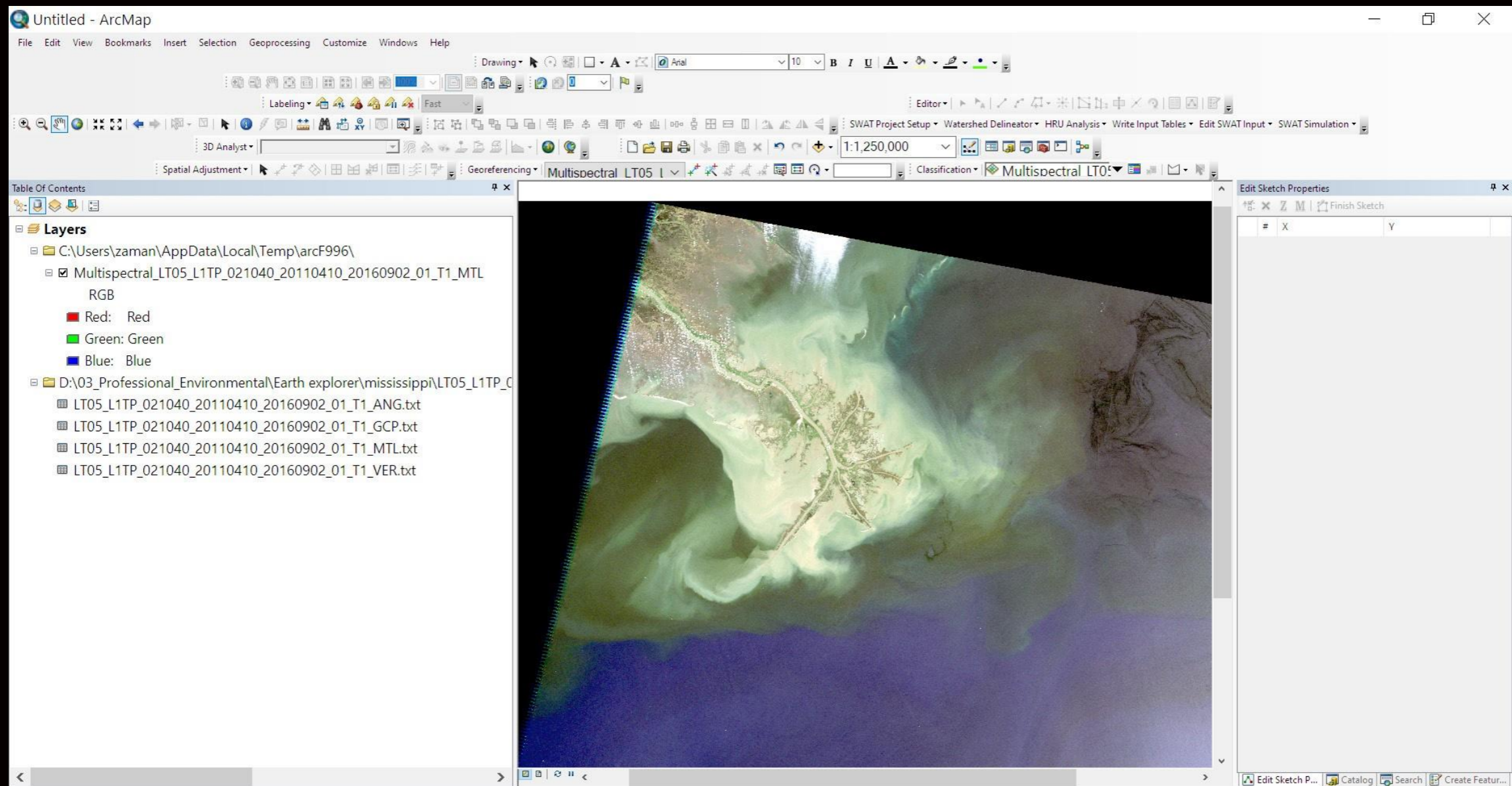
educators & lifelong learners

[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)

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

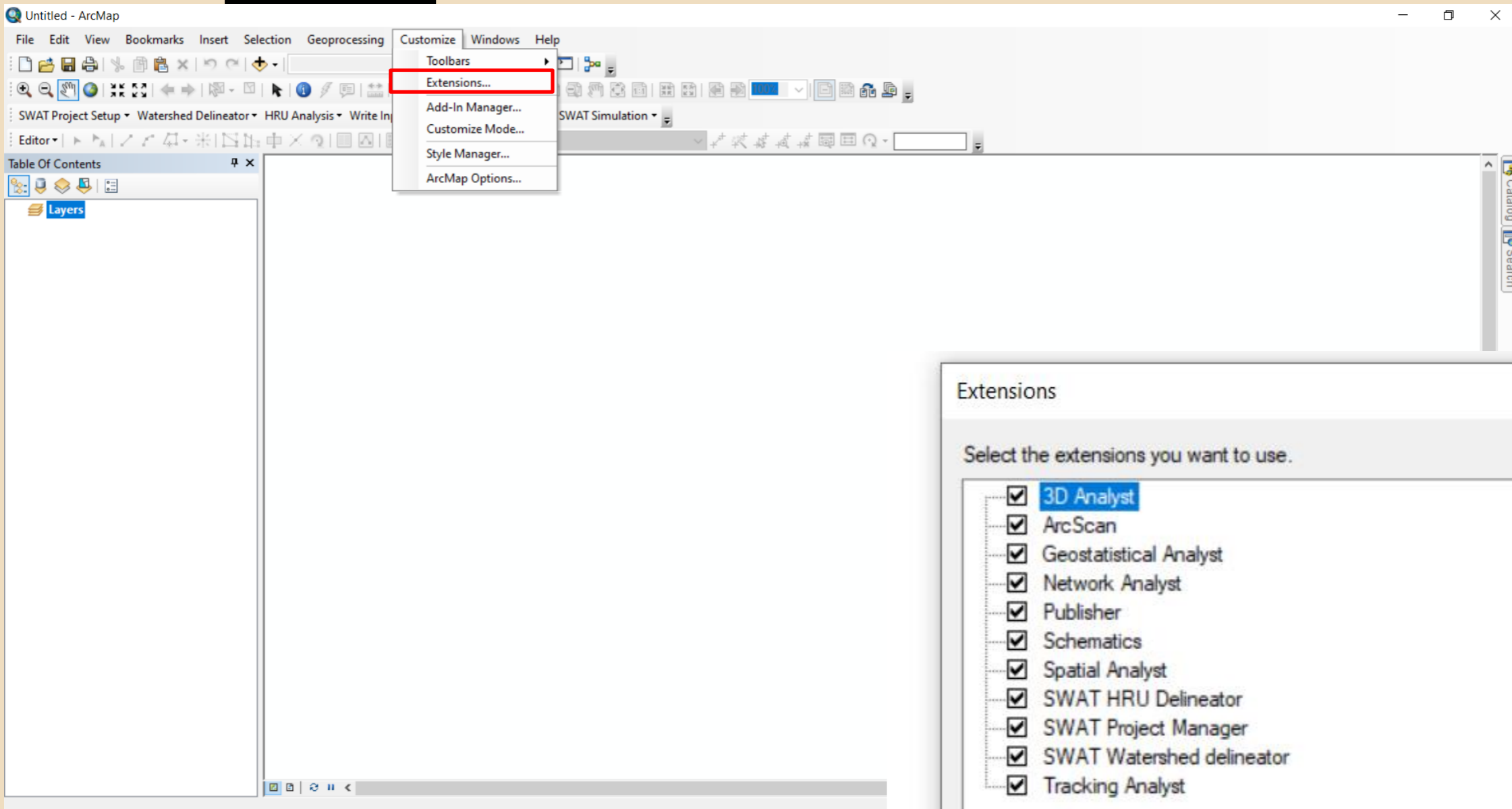
Note: The above information was obtained from the ESRI Learn ArcGIS Program website.

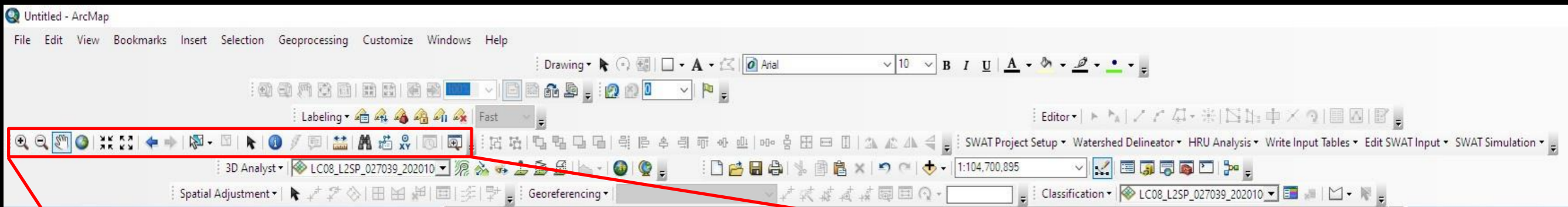
ArcMap



1

Open ArcMap



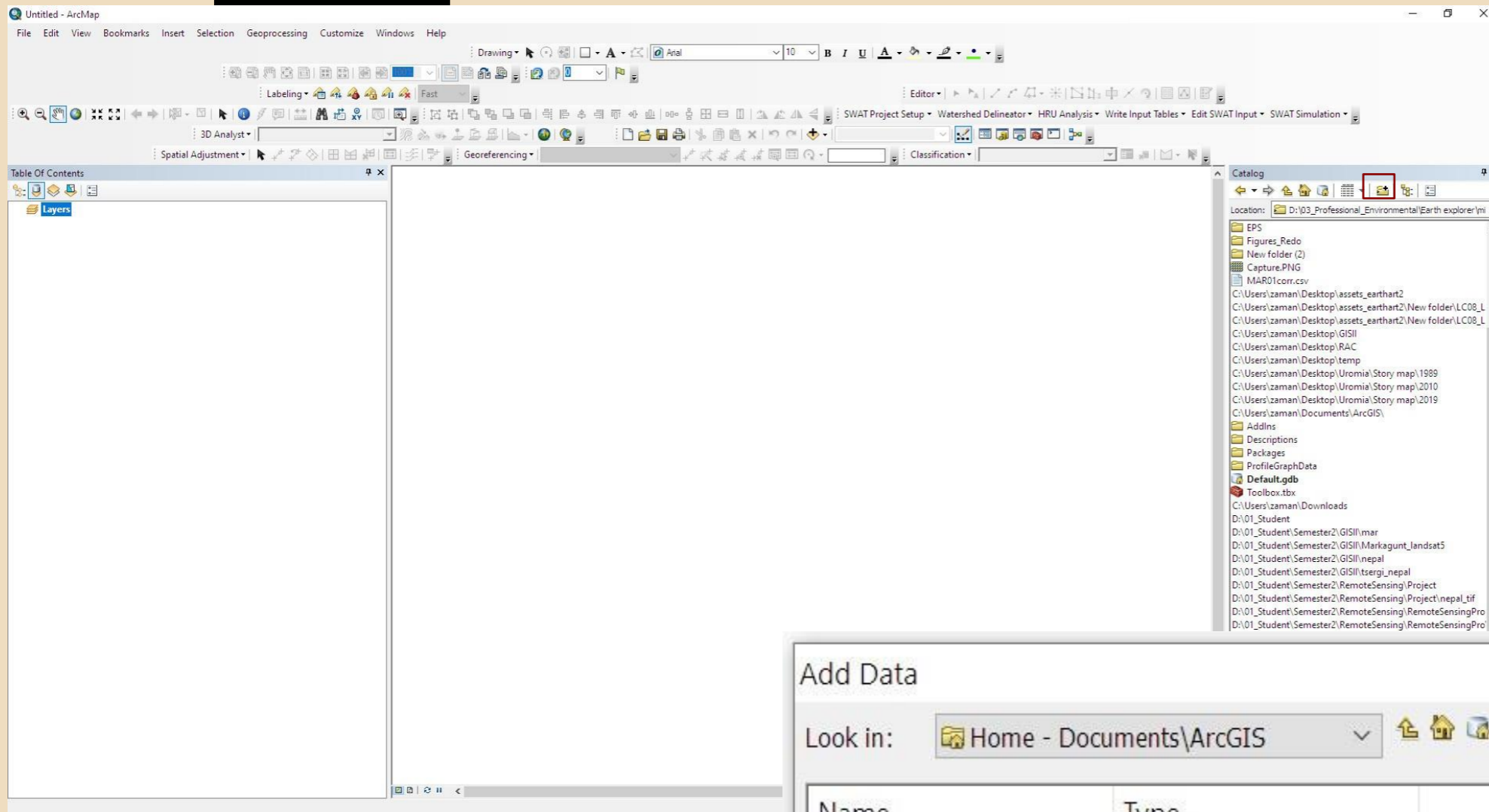


Zoom In Zoom Out

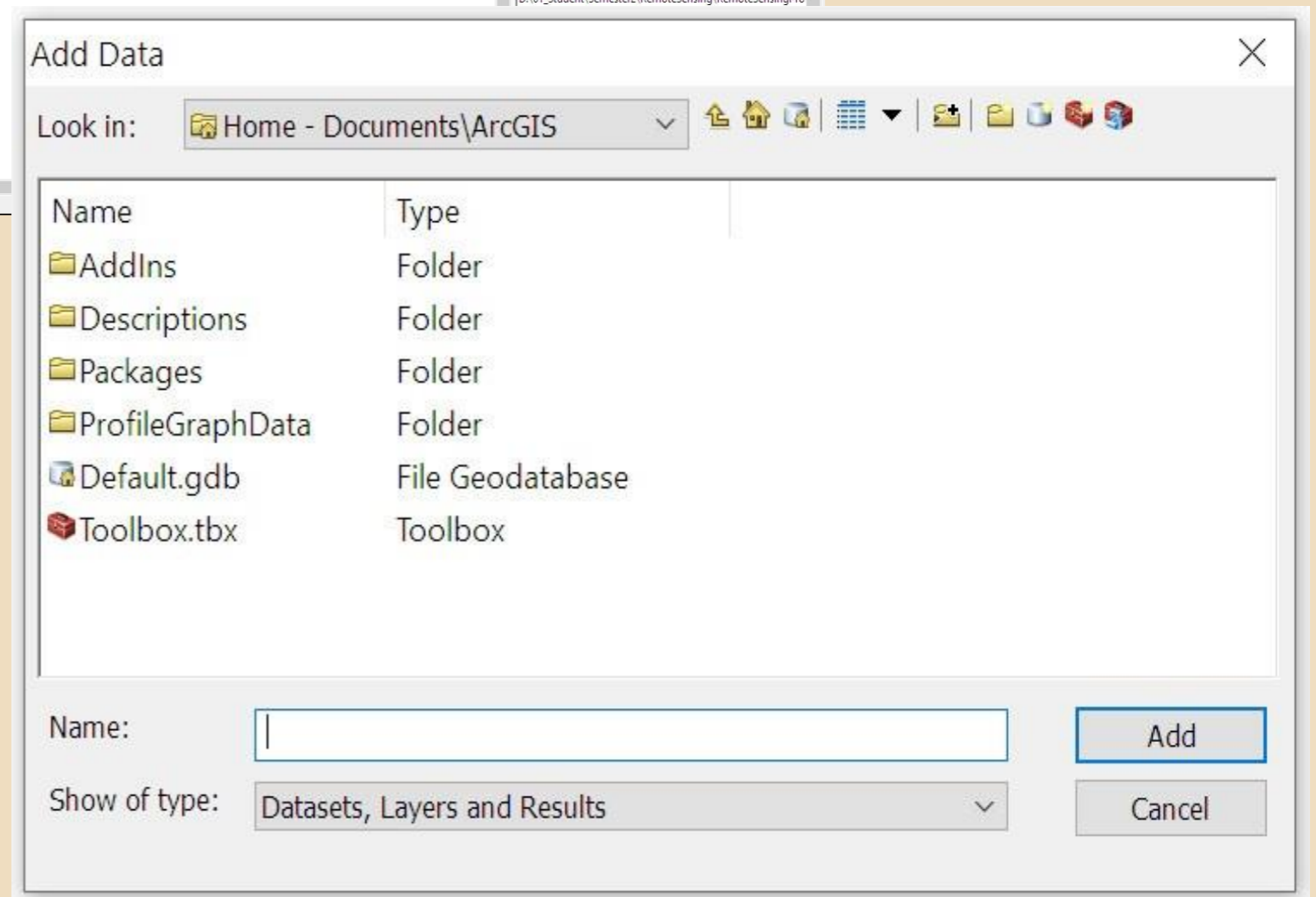
2

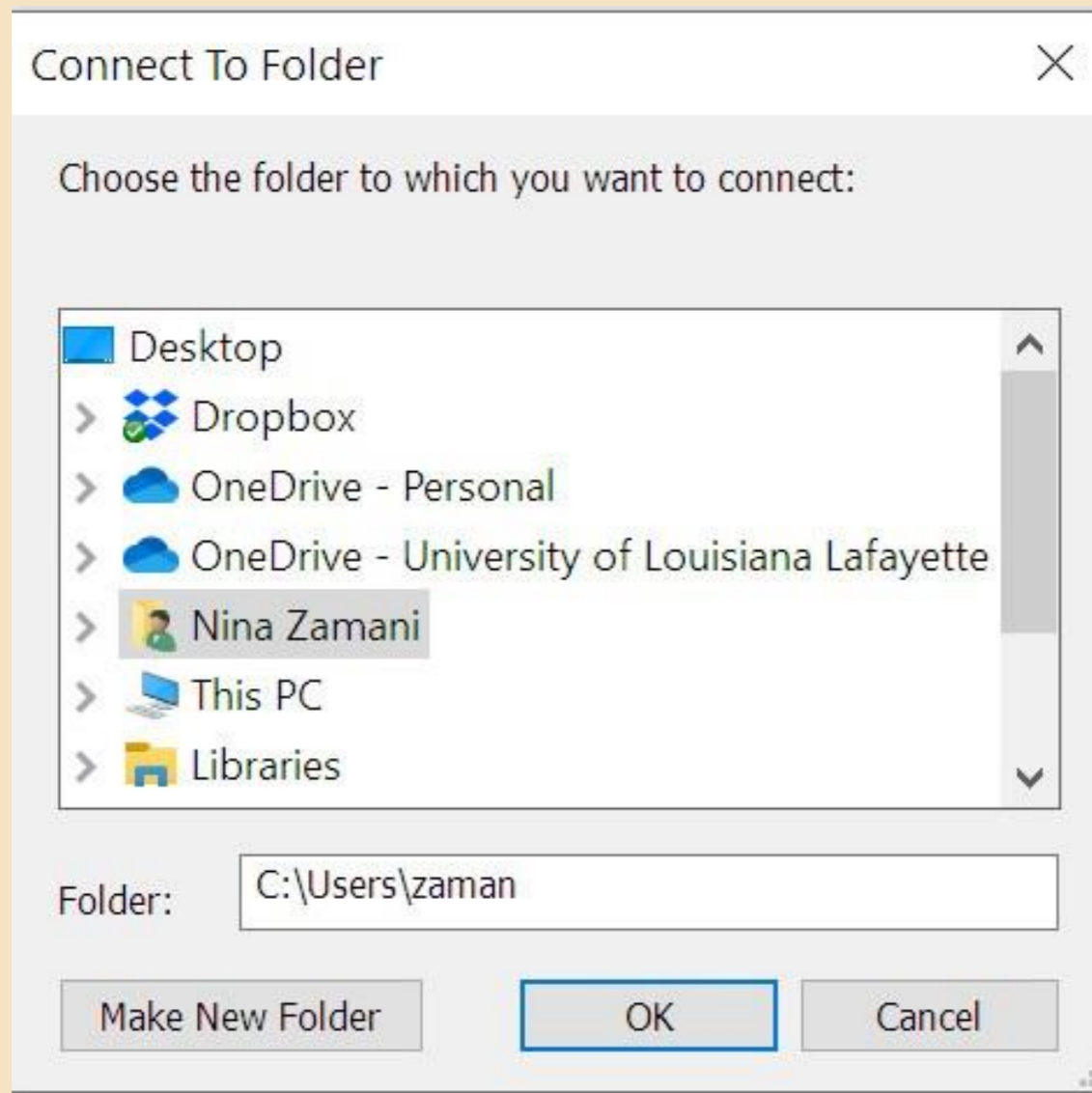
Become familiar with some tools in ArcMap tool box:

- Zoom In
- Zoom Out
- Full Extent
- Pan



Under Catalog we can find the Connect to Folder icon and find the folder that contains the file you saved.

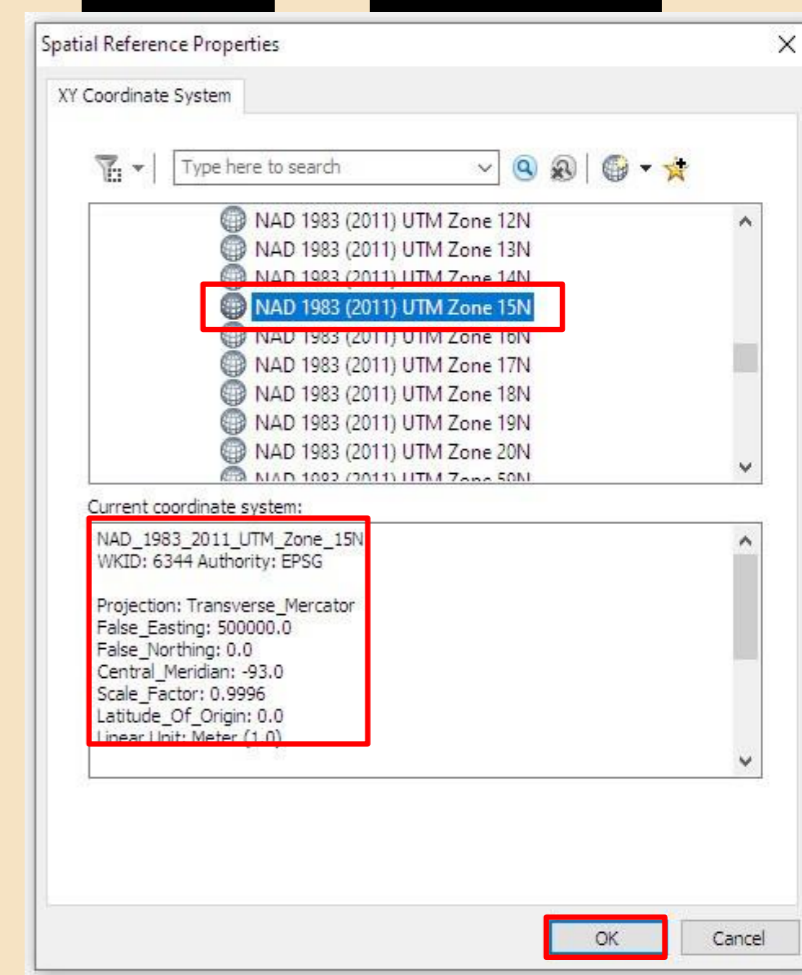
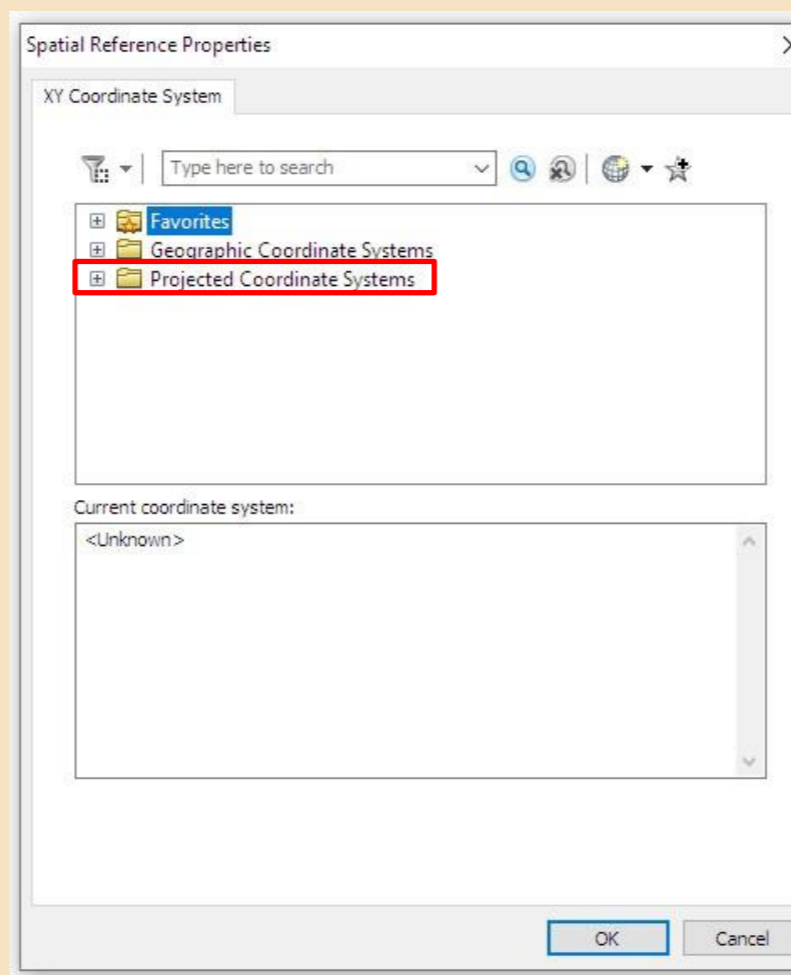
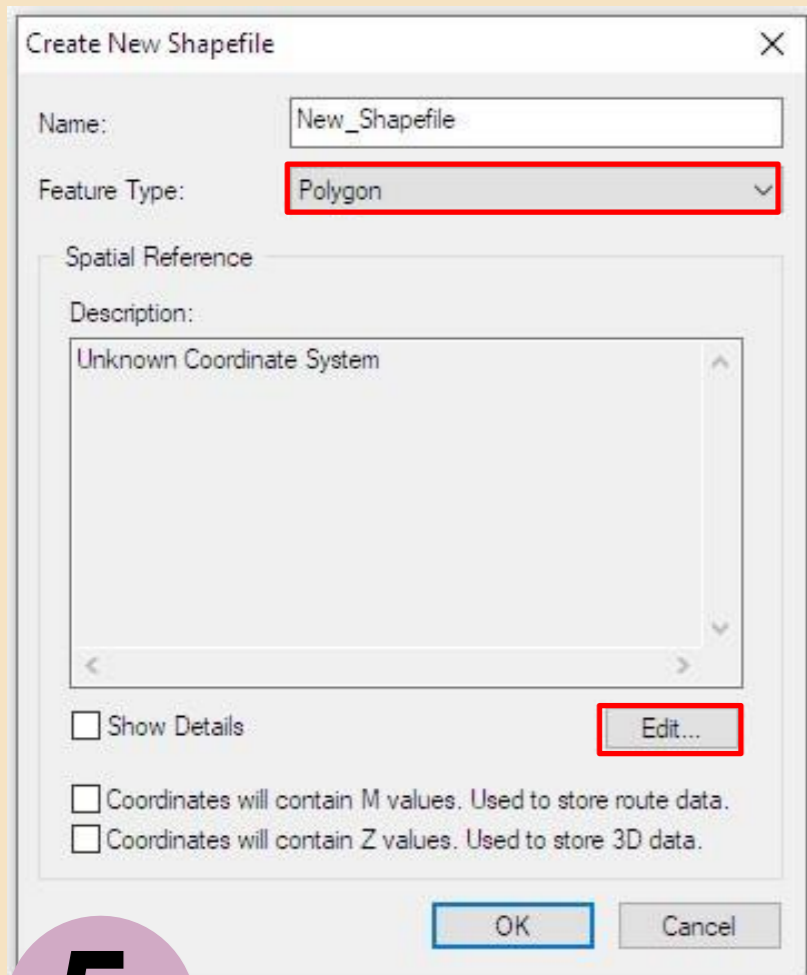




3

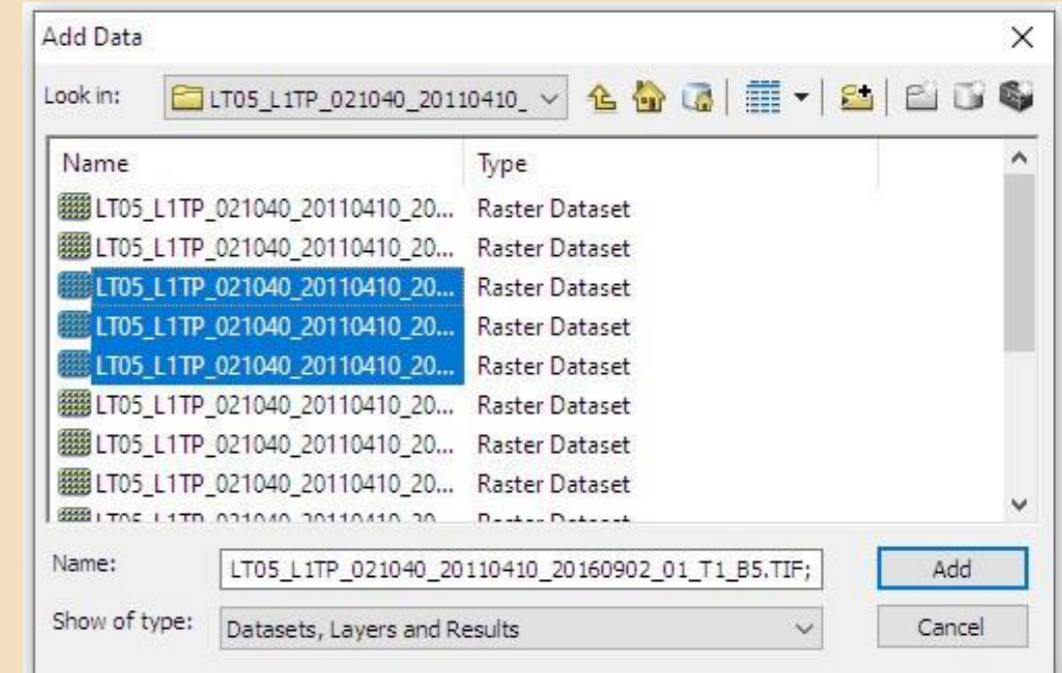
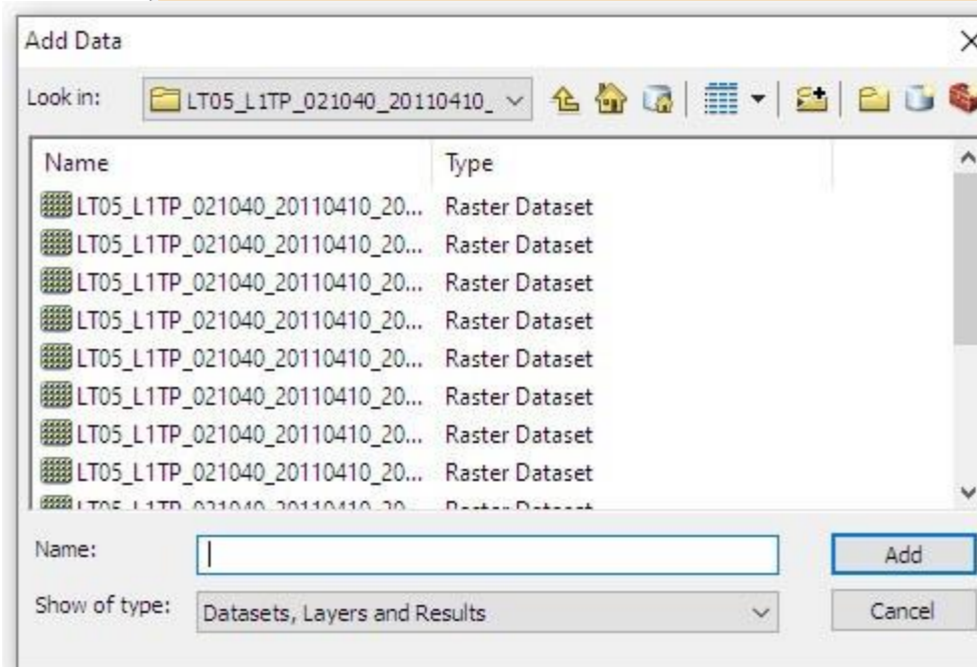
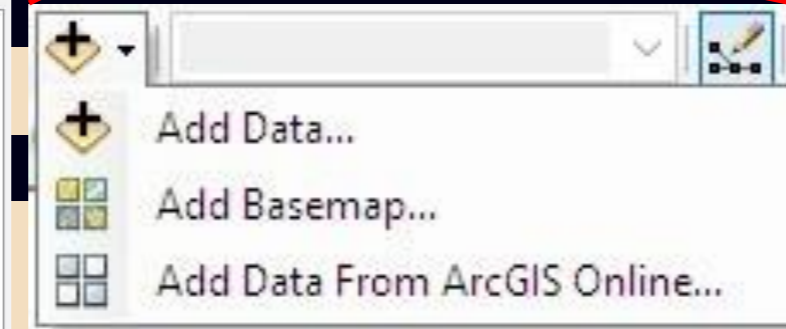
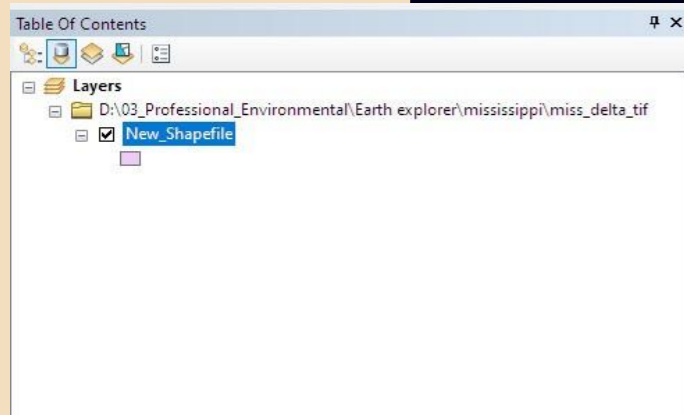
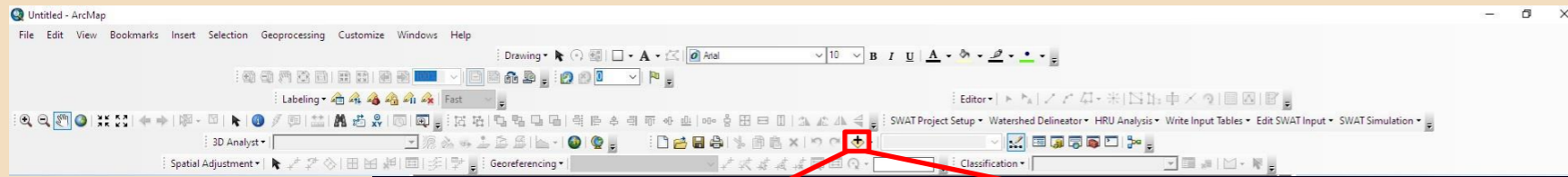
If you are a new user,

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



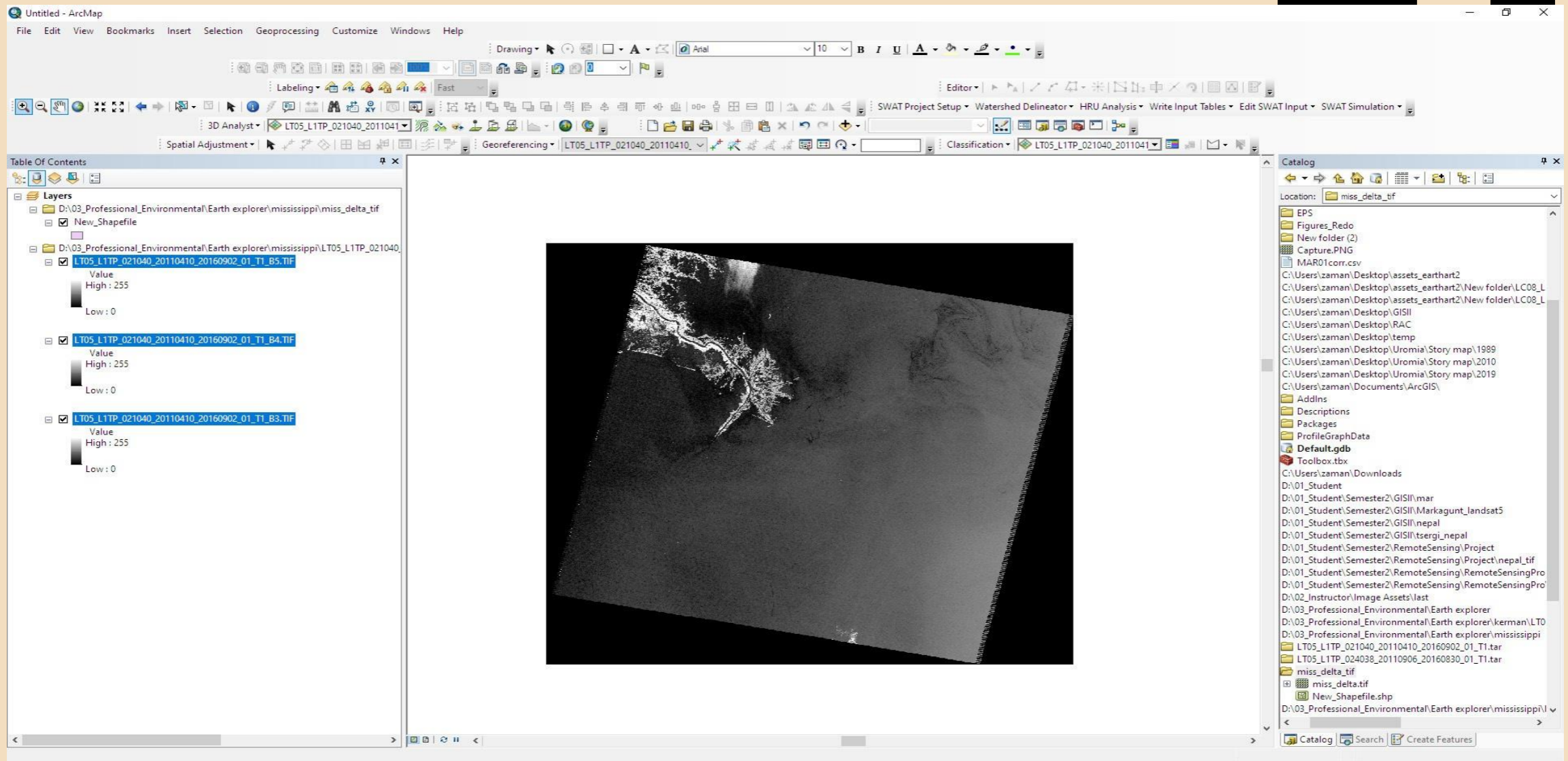
5

- 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



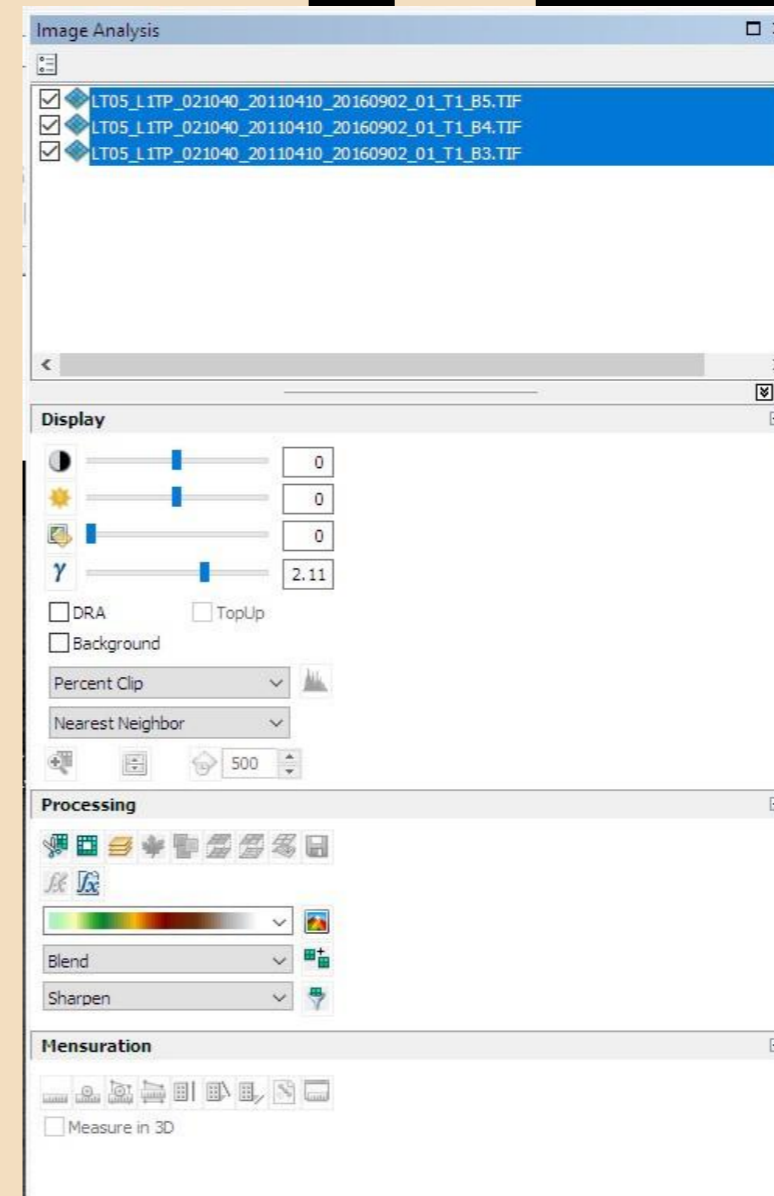
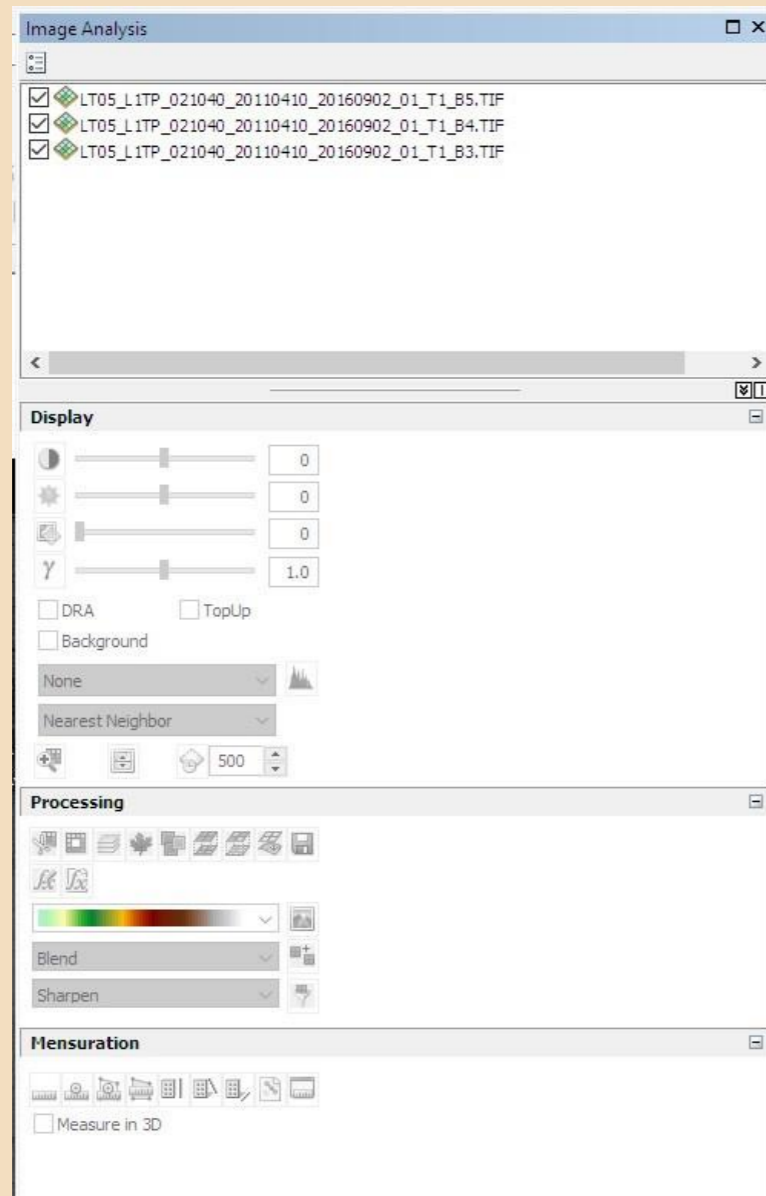
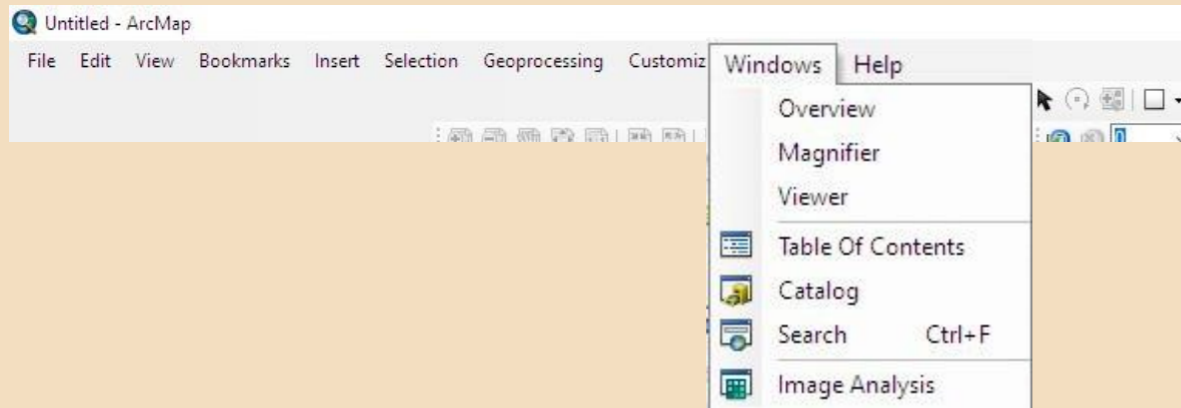
6

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



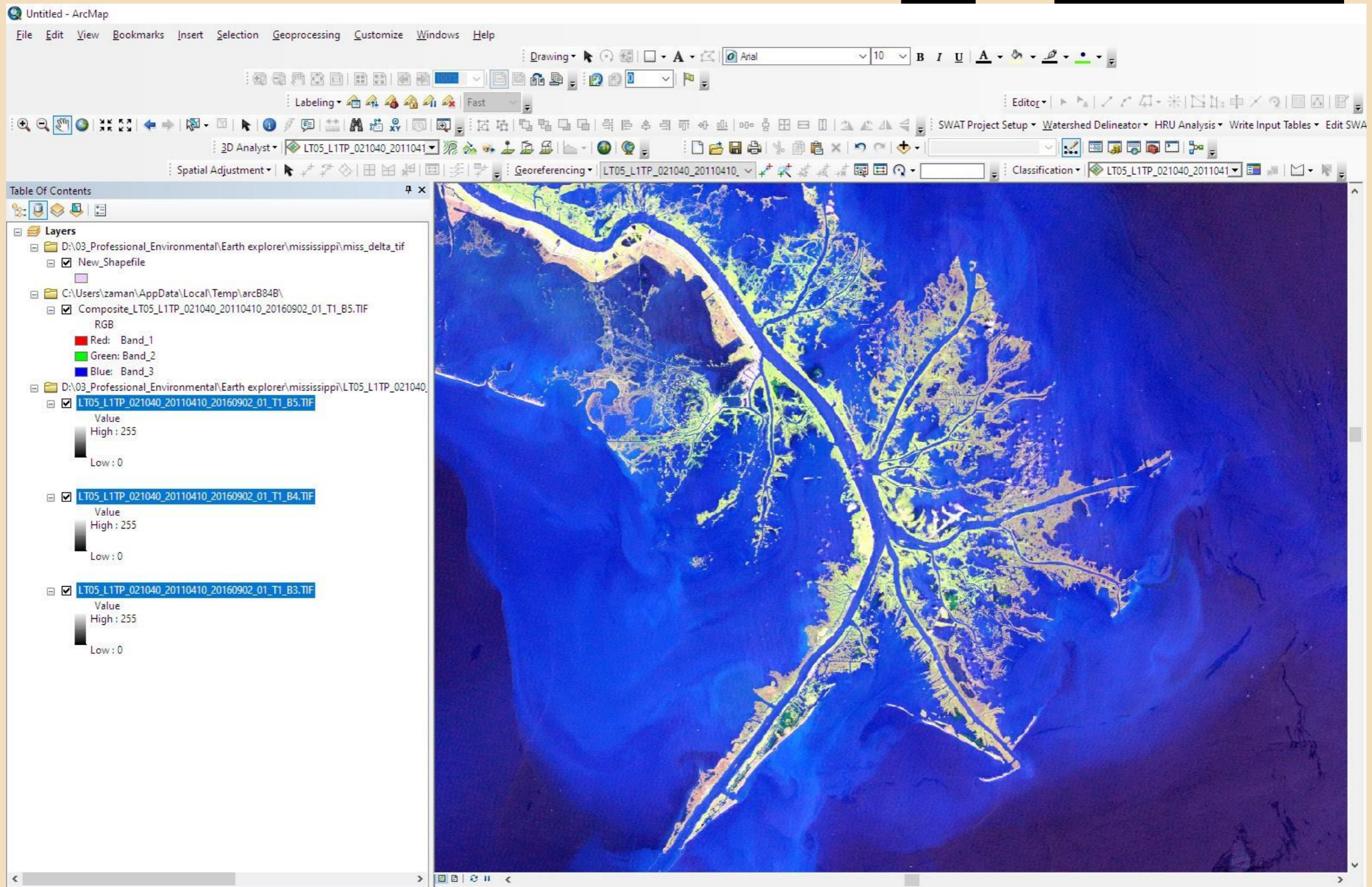
7

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



9

Final Map

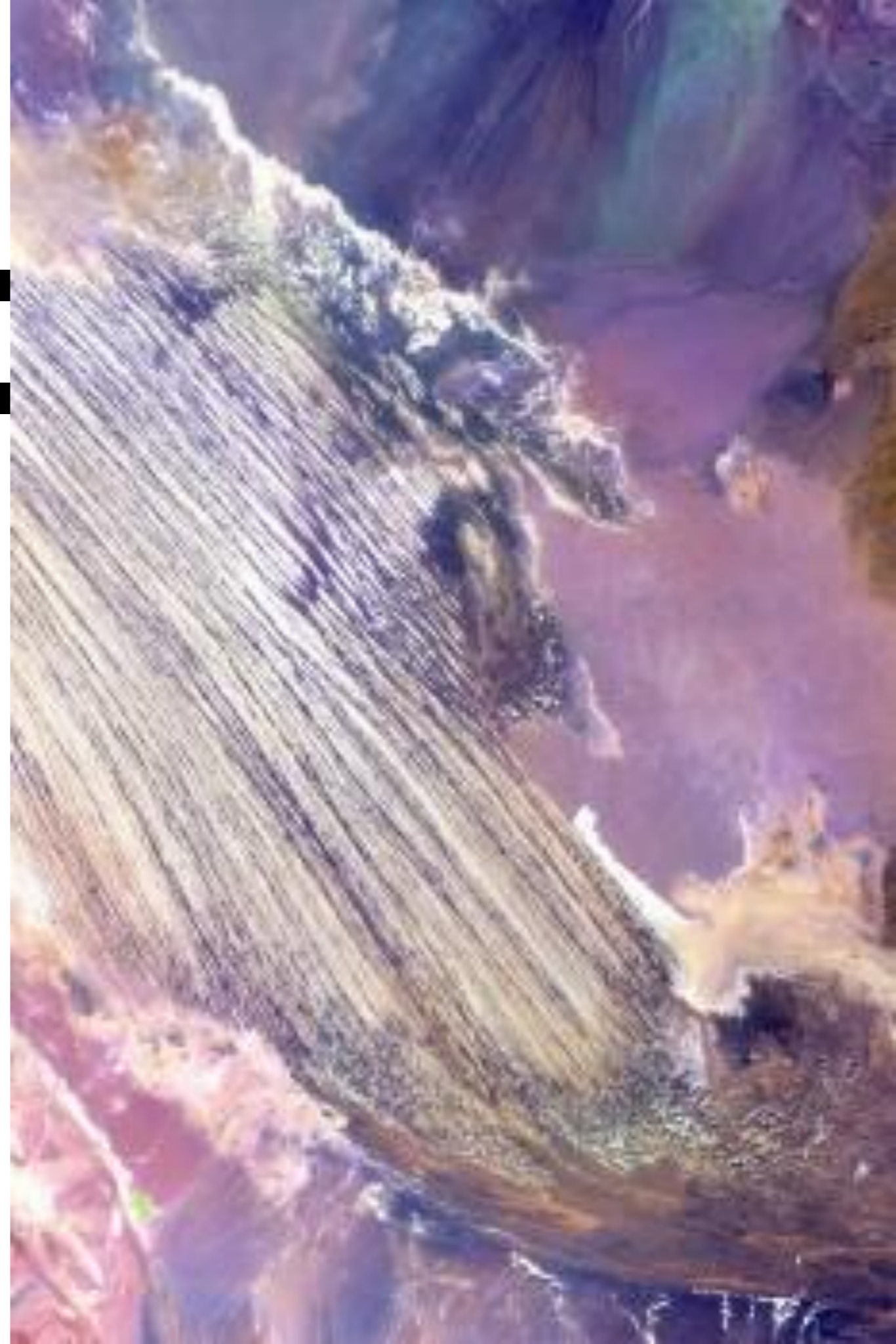
Stepping through ...

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.

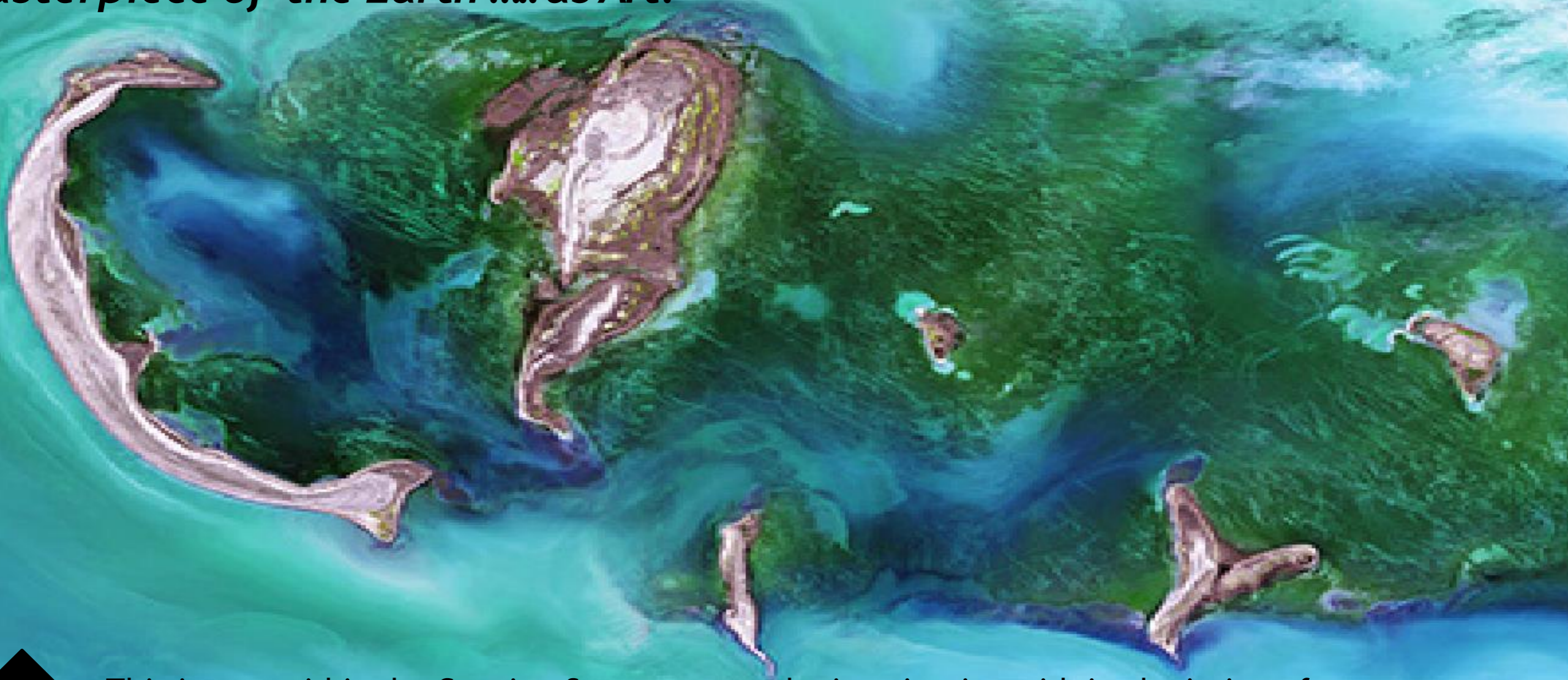
We include this software suite, due to its immense popularity in the graphic arts community, realizing that it is not free; however, its color band enhancement capabilities are quite enticing.

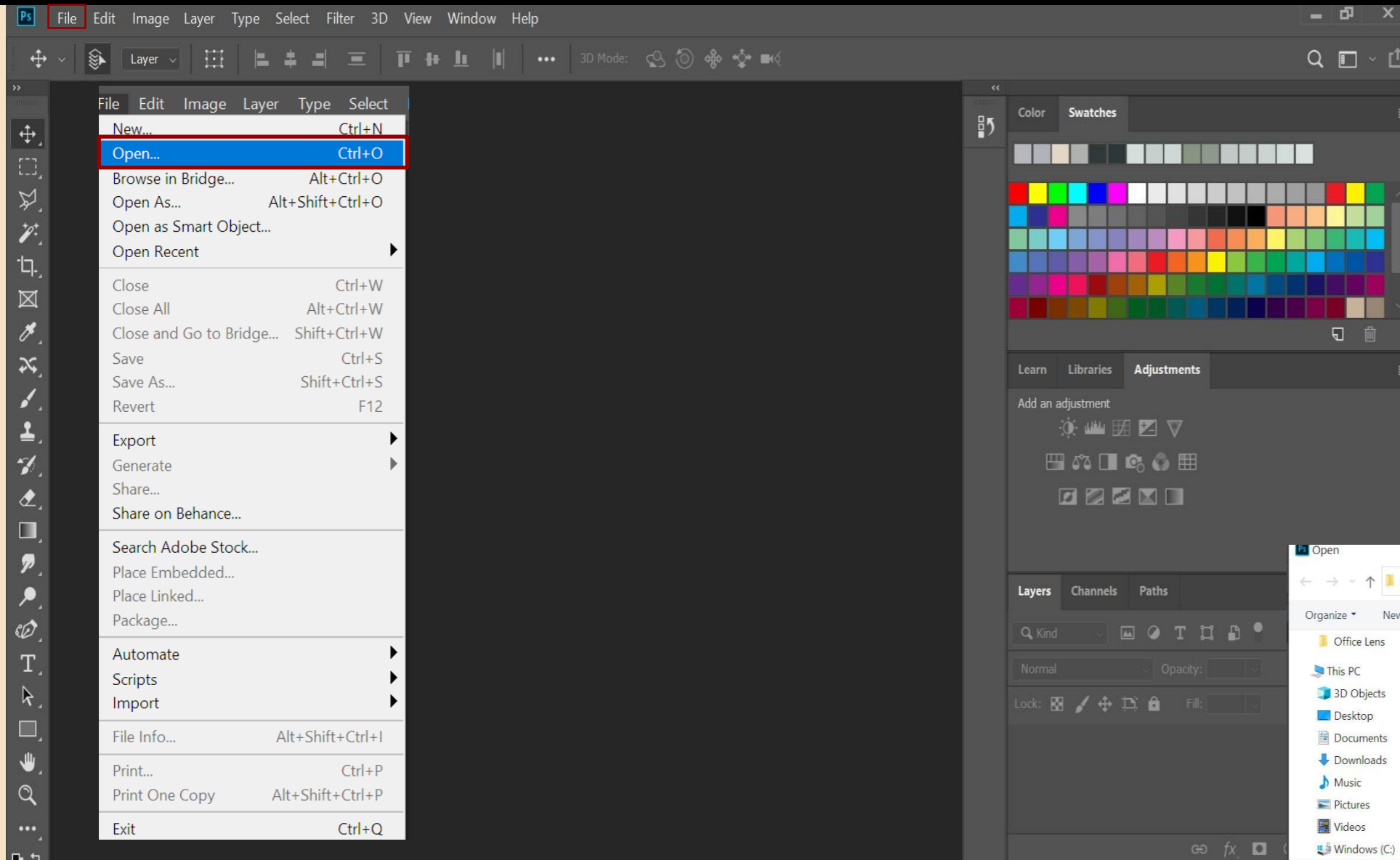


Visiting the Caspean Sea ...

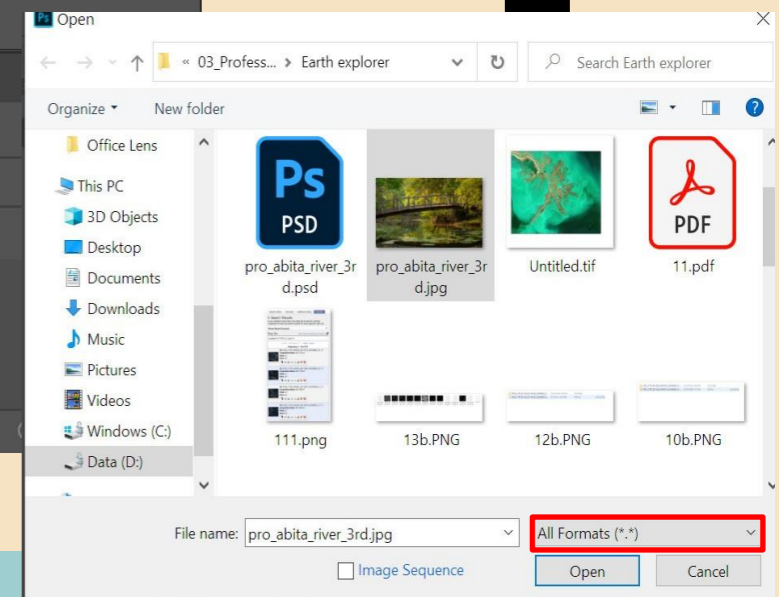
The image we see is a work of art unto itself, yet there is much we can do to enhance the physical features to emphasize its potential as abstract art. The Caspian Sea, located on the northern shoreline of Iran, is the largest inland body of water on Earth.

We will now step through Abode Photoshop as we again*create a new masterpiece of the Earth as Art.*



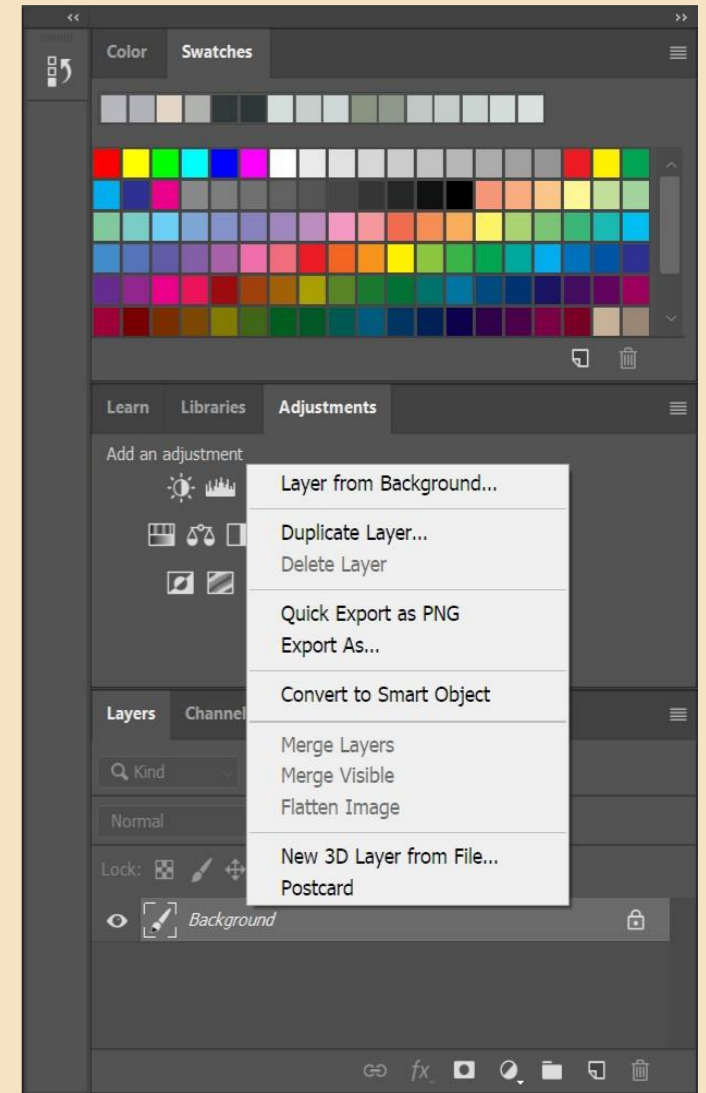
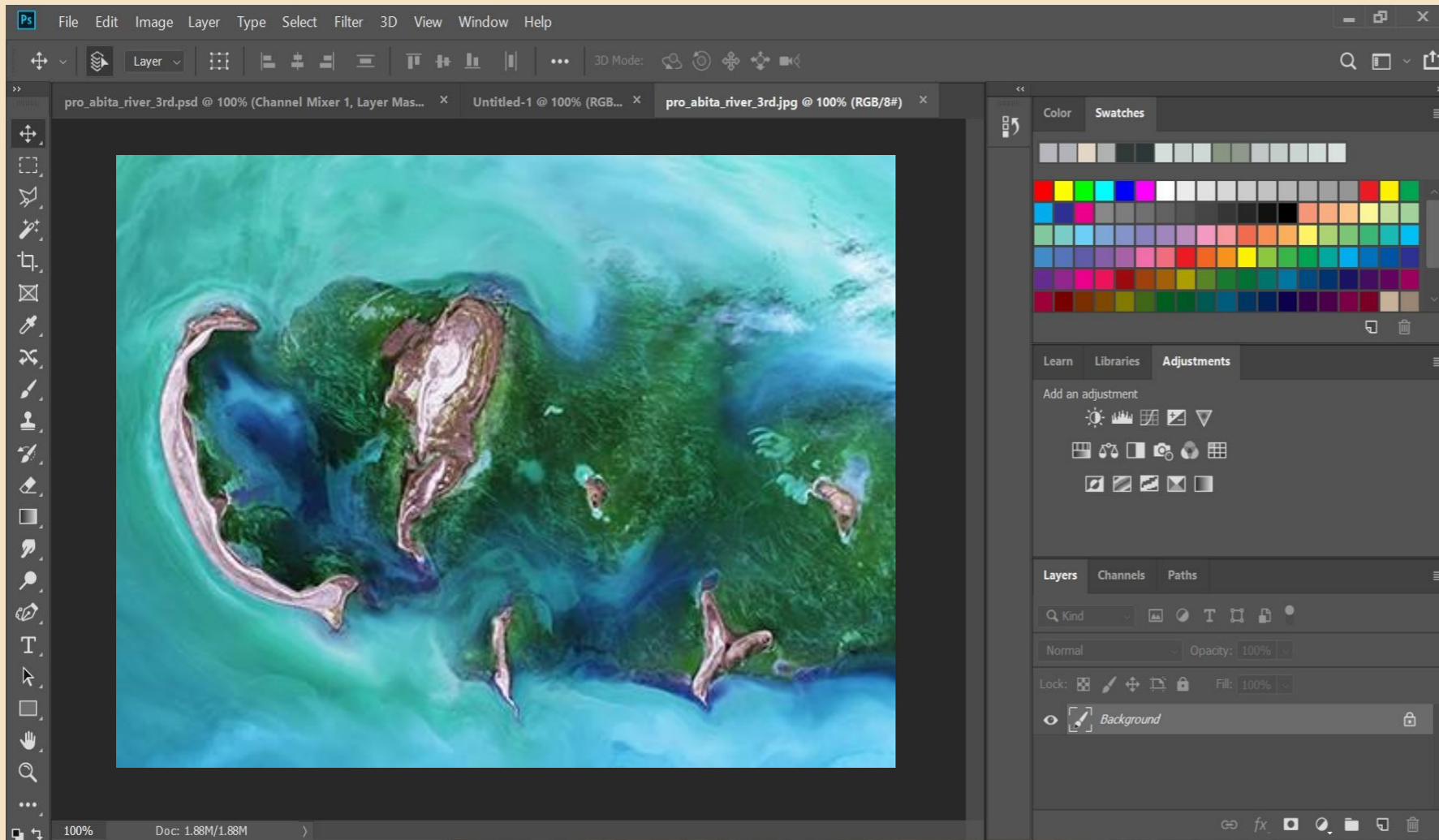


Be sure you are selecting the right format or select "All Formats"



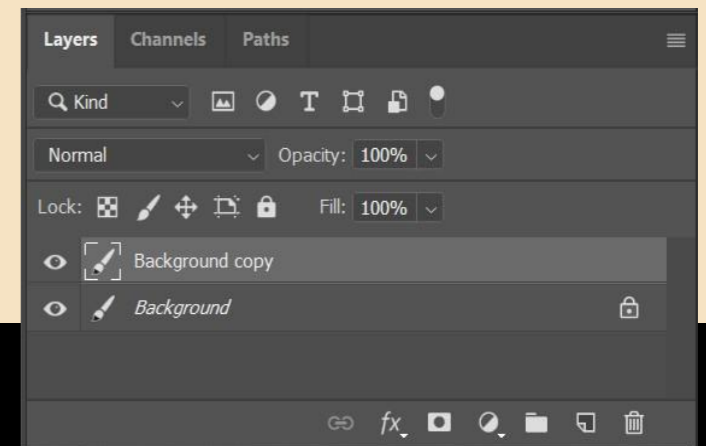
1

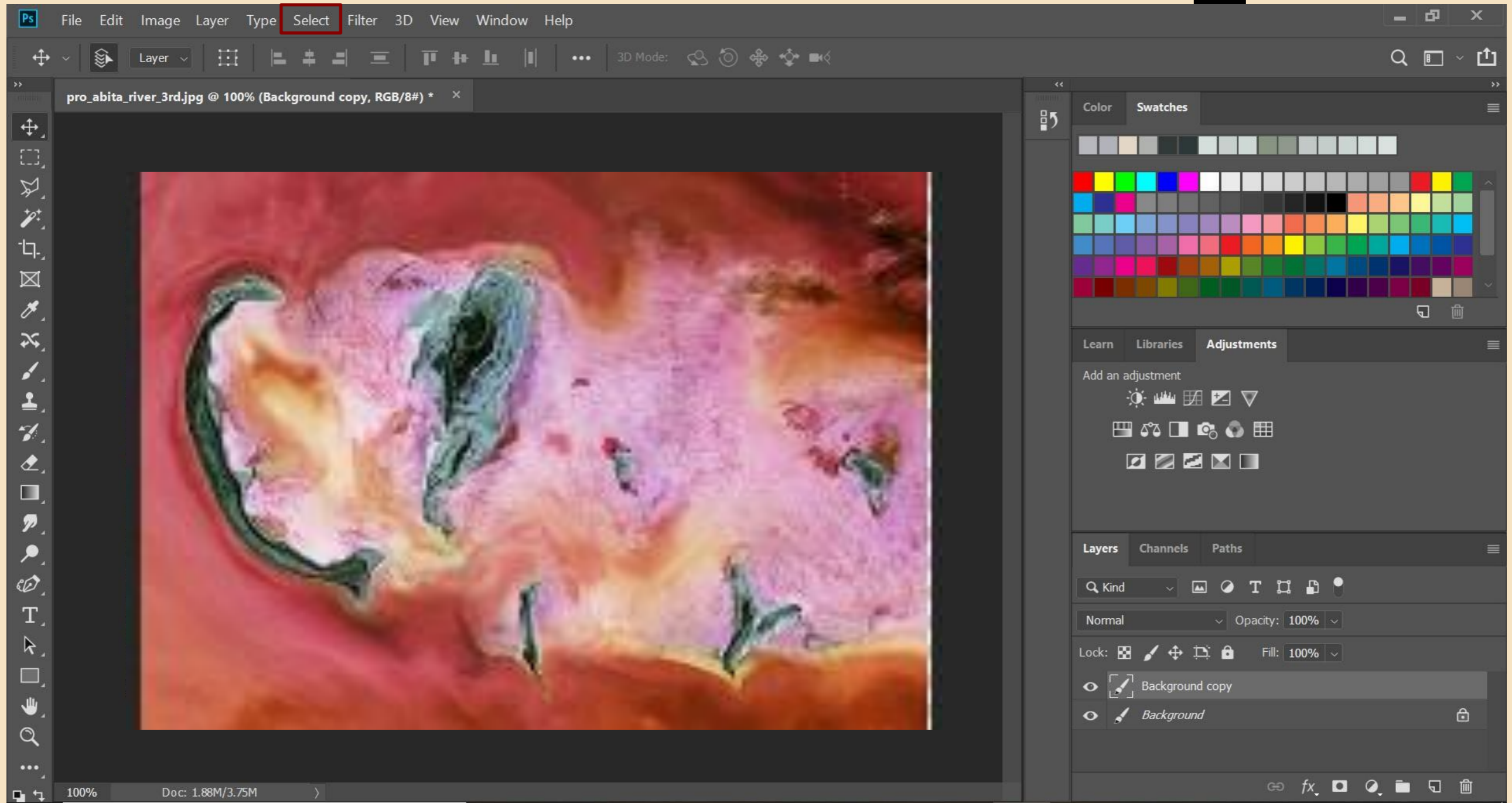
- Open Adobe Photoshop
- Click on the file you want to use and select Open
- Check for the appropriate file format



2

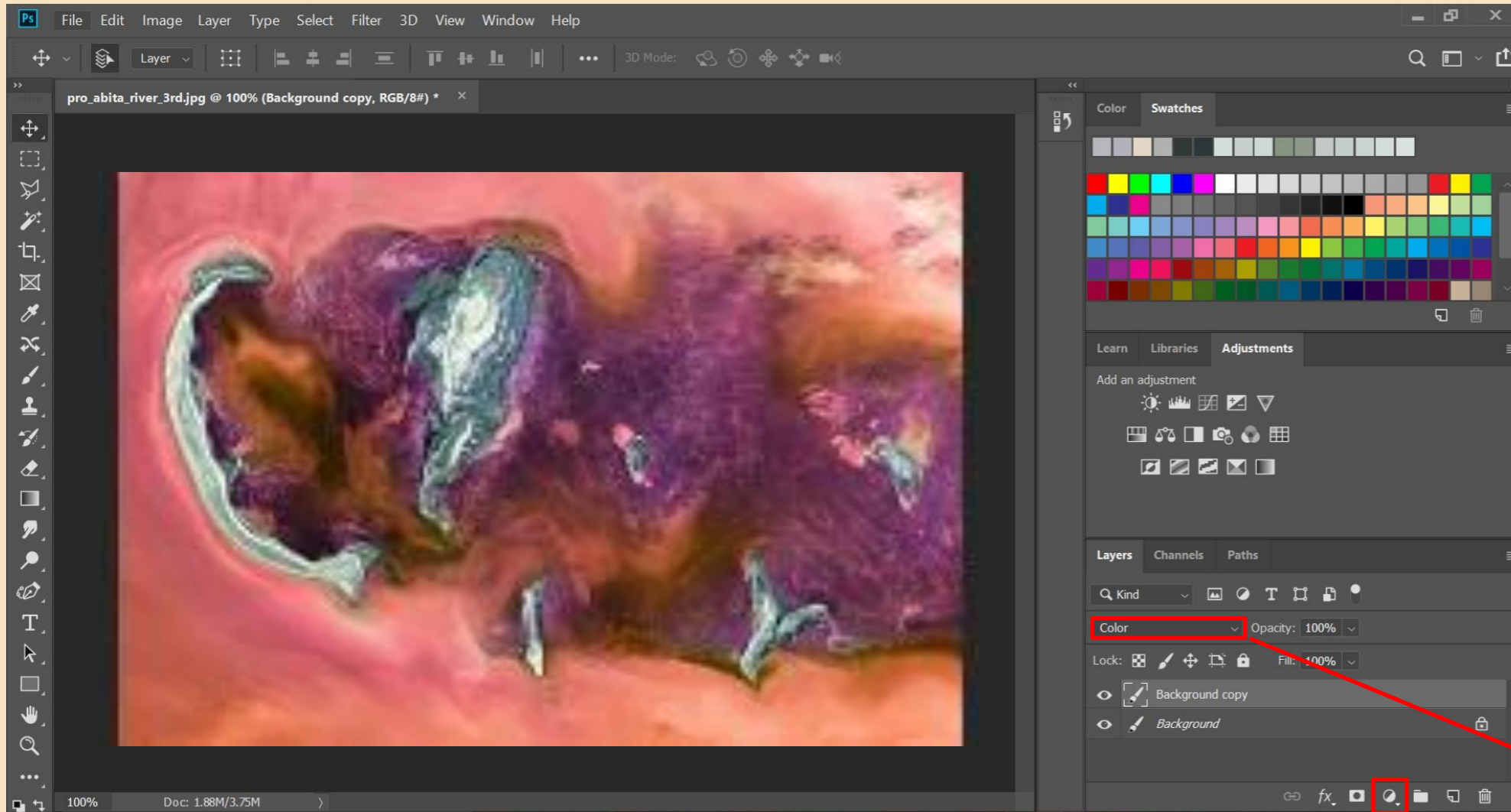
Right click on the file under Layers and select Duplicate Layer





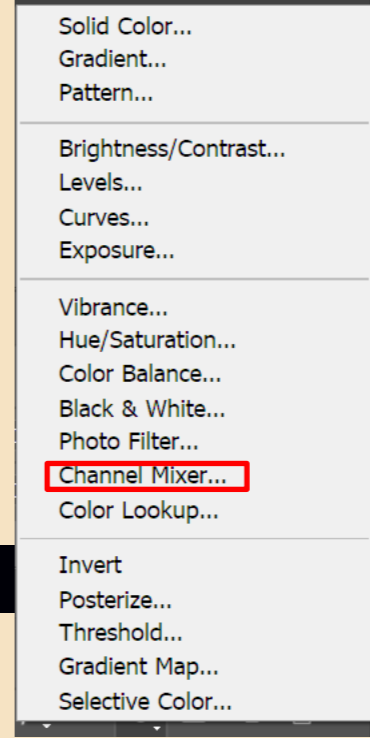
3

- 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)



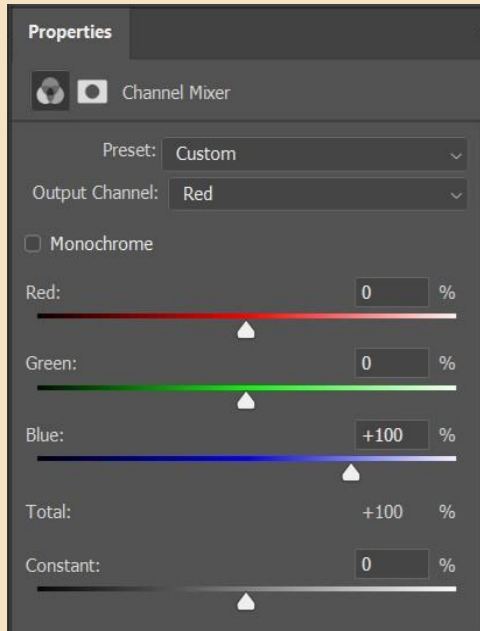
5

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



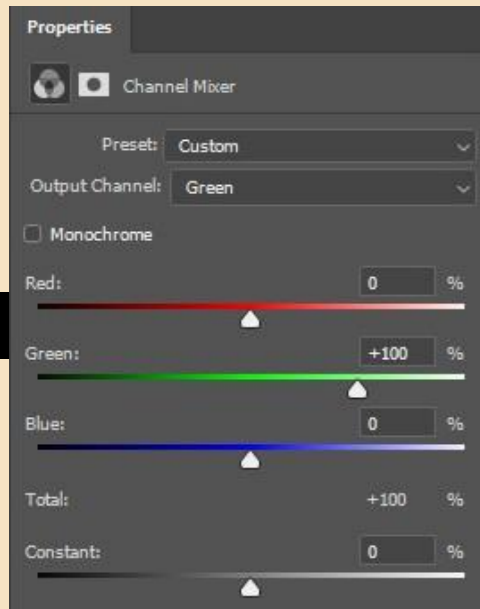
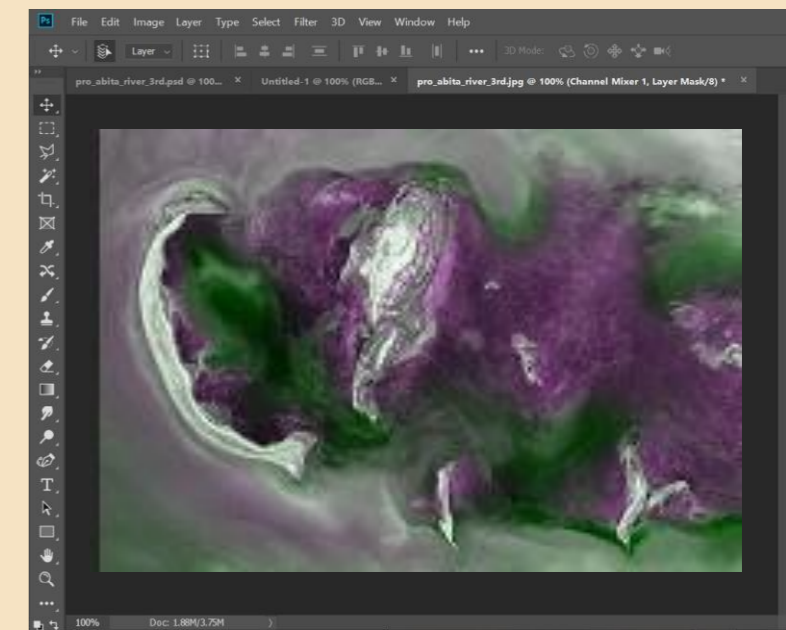
4

Under Normal select **Color**



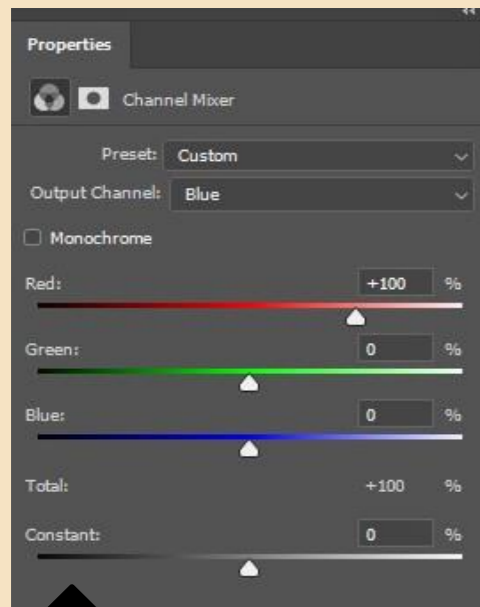
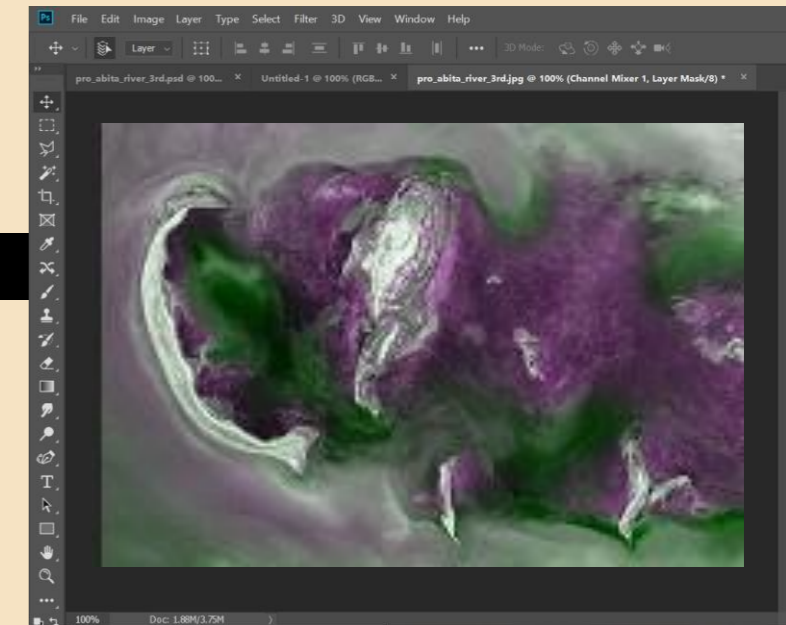
6-1

**In Output channel dropdown
select red**
For the red ramp select 0%
For the Green ramp select 0%
For the Blue ramp select 100%



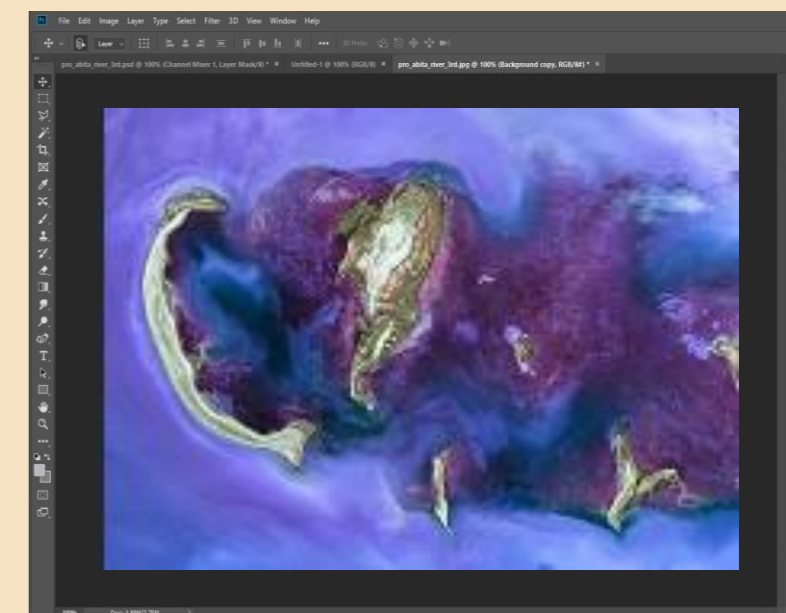
6-2

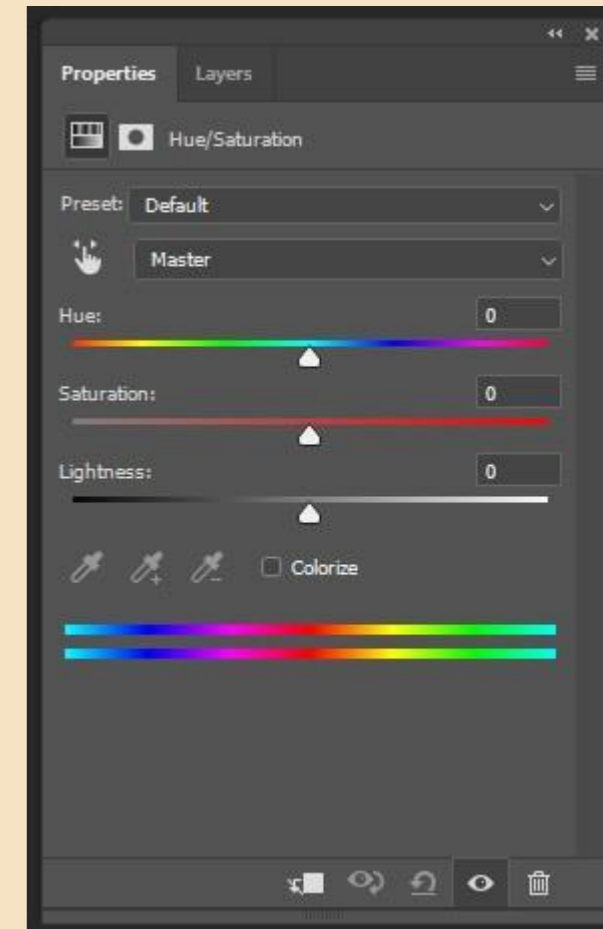
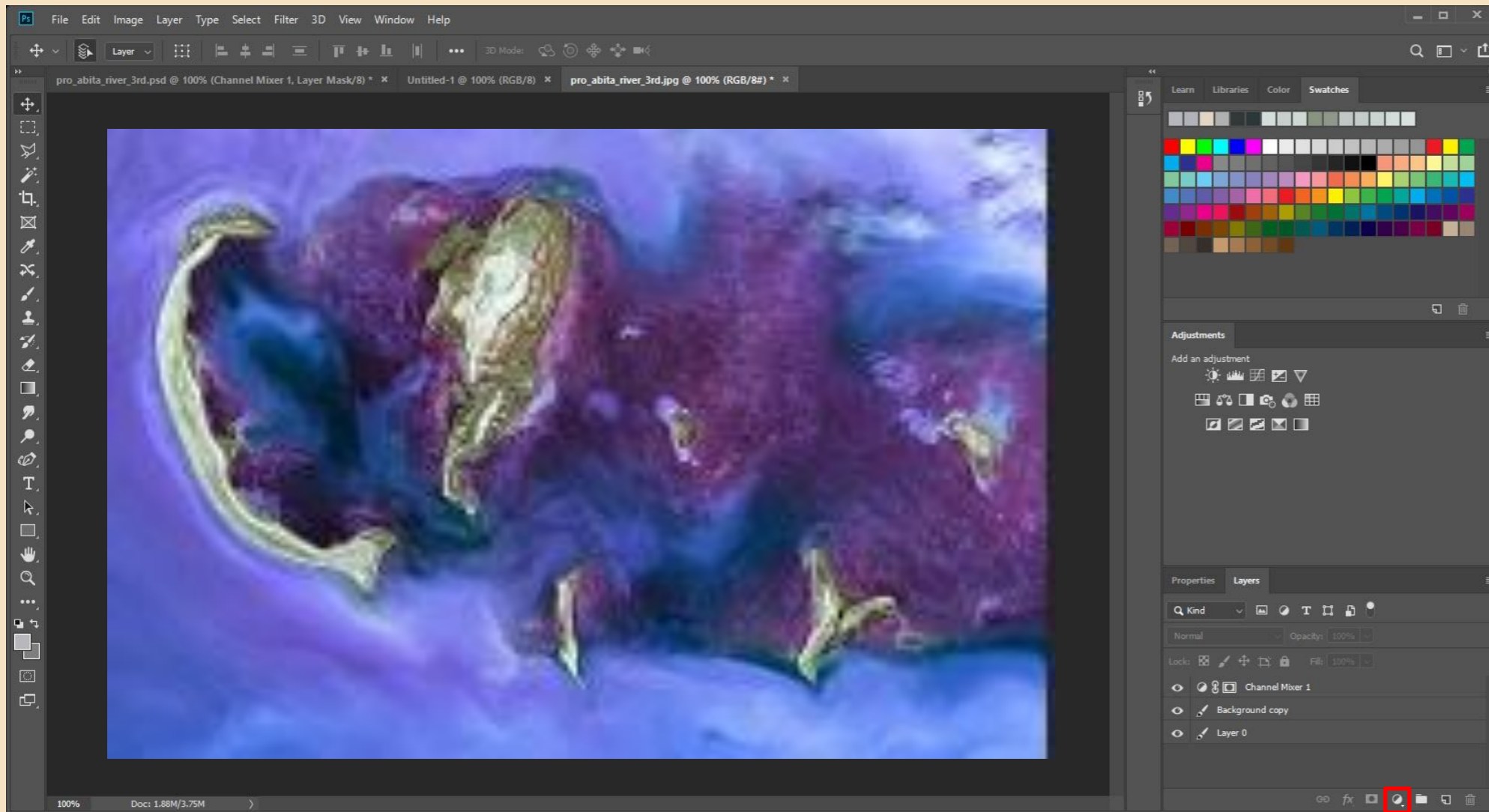
**In Output channel dropdown
select Green**
For the red ramp select 0%
For the Green ramp select 100%
For the Blue ramp select 0%



6-3

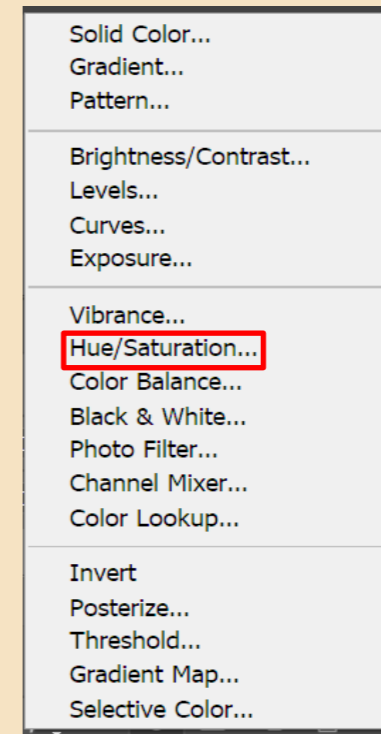
**In Output channel dropdown
select Blue**
For the red ramp select 100%
For the Green ramp select 0%
For the Blue ramp select 0%

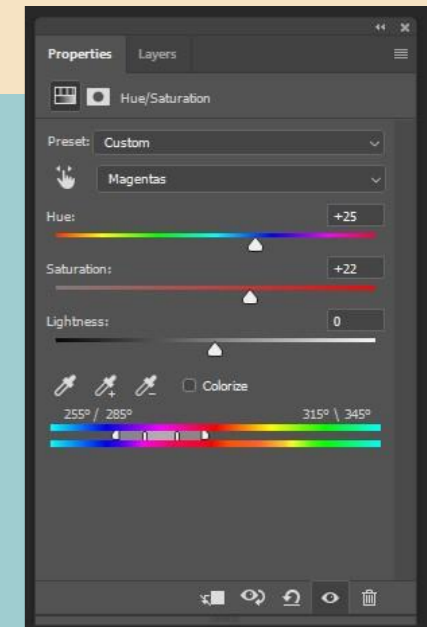
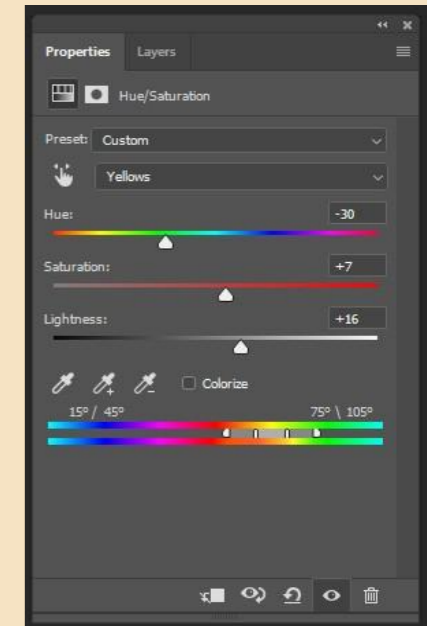
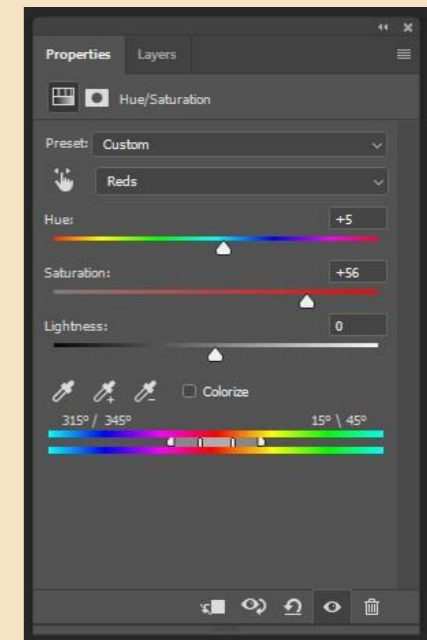
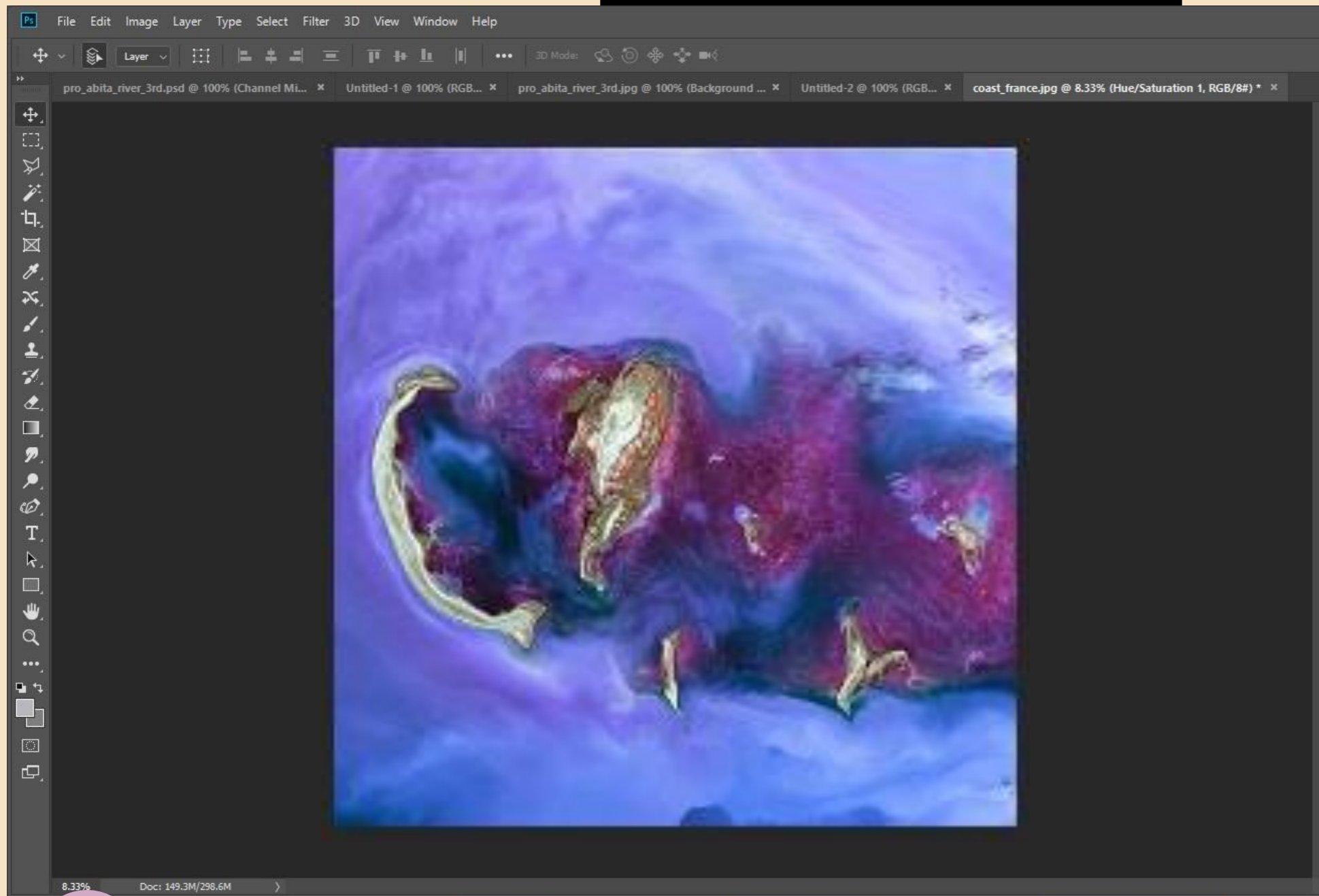




7

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

The MultiSpec Platform

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

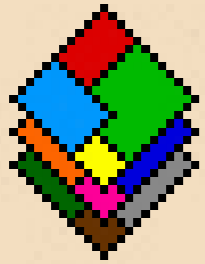
It results from an on-going multiyear research effort which intended to define robust and fundamentally based technology for analyzing multispectral and hyperspectral image data, and to transfer this technology to the user community in as rapid a manner as possible.

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 (<https://americaview.org/>)



MultiSpec©

A Freeware
Multispectral Image
Data Analysis
System

Accessing MultiSpec

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



 **MultiSpec**©

A Freeware Multispectral Image Data Analysis System

Home Description What's New **Download** Resources Other Links

MultiSpec is being developed at [Purdue University, West Lafayette, IN](#), by [David Landgrebe*](#) and [Larry Biehl](#) from the [School of Electrical and Computer Engineering, ITaP and LARS](#). It results from an on-going multiyear research effort which is 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.

The source code for MultiSpec was released as open source on [github.com](#) on February 28, 2020. ([github.com/larrybiehl/MultiSpec](#))

Please send questions, comments or problems to [Larry Biehl](#). (Web page designer: Katie Biehl)

*[David Landgrebe](#) passed away on November 21, 2020.

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Work leading to MultiSpec was funded in part by NASA Grants NAGW-925, NAGW-3924 and NAGW5-3975.

Supported by AmericaView ([www.americaview.org](#))

You can either download the software package for your operating system or utilize the online version.



MultiSpec

By Larry Biehl¹, [Abdur Rahman Maud¹](#), [Wei-Kang Hsu¹](#), [Tsung Tai Yeh¹](#)
¹. [Purdue University](#)

Image processing application to display and analyze geospatial images

[Launch Tool](#)

Version 3.51 - published on 10 Sep 2020

Open source: [license](#) | [download](#)

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Abstract

MultiSpec is an image processing tool to display and analyze geospatial images. It can be found at the [MultiSpec site](#).

Note that you need to create an account (register) on mygeohub. You can set it up...



Choose your sign in method:

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When using the online version,
you must first create a free
login in order to launch
MultiSpec.

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Your account is currently pending approval from a site administrator. If you feel you are receiving this message in error, please [contact the site administrator](#).

Get Help <ul style="list-style-type: none">Report problemsForgot username?Lost password?Accessibility IssuesContact us	Participate <ul style="list-style-type: none">Submit a resourceCreate a groupAnswer questionsMake a wishJoin the discussion	Discover <ul style="list-style-type: none">What's NewResourcesWikiTagsKnowledge Base	Learn <ul style="list-style-type: none">About usTerms of usePrivacy PolicyAbuse PolicyCopyright Infringement
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When you finish creating your account, you click the activation link in the email that you created your account with. Then, you wait for authorization from the site to confirm and accept your account (~24 hours).

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

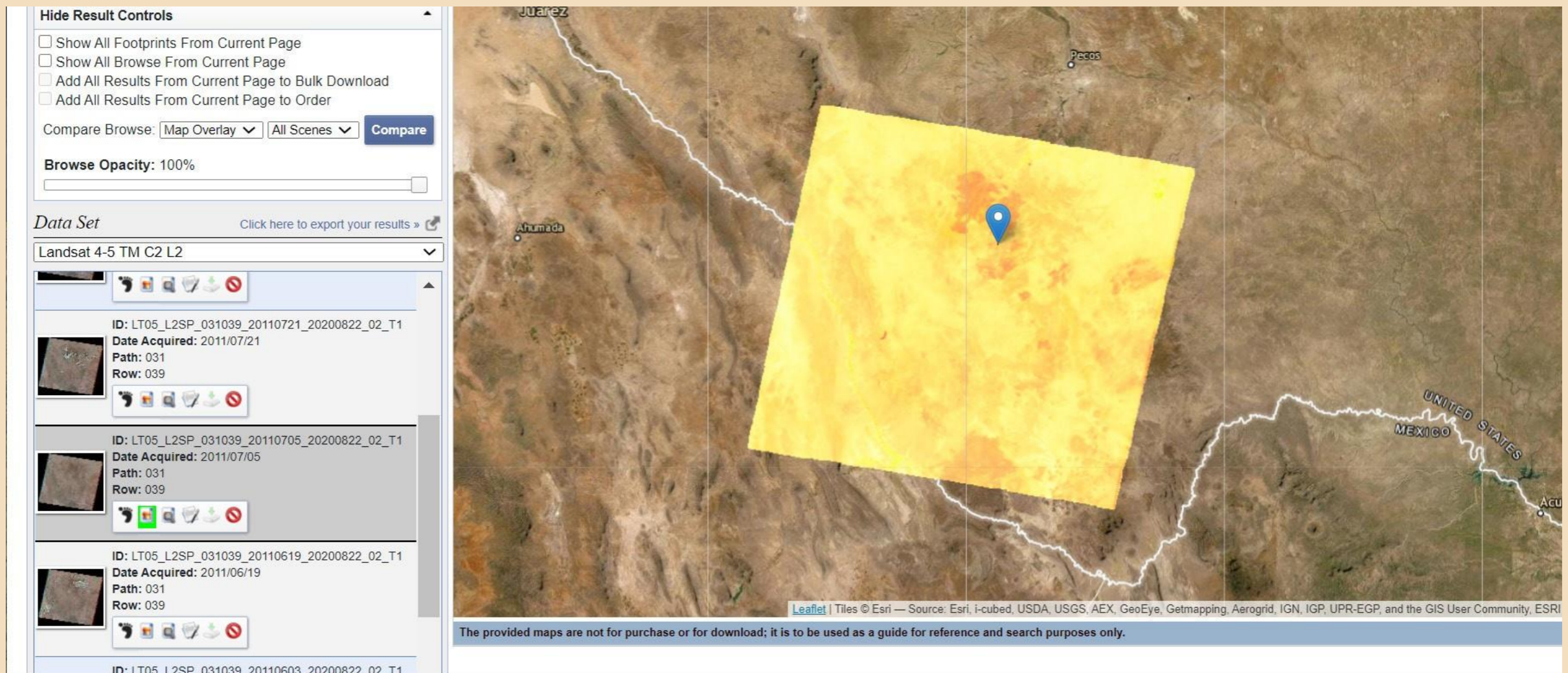
Imagery of Davis Mountain State Park in southwestern Texas is used in the next section. After downloading the imagery from Earth Explorer, it will be processed using MultiSpec software to create a work of art. The area of interest was selected from the Texas as Art exhibition collection, which is currently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

Downloading in Earthexplorer

The screenshot shows the Earth Explorer interface with the following elements:

- Browser:** earthexplorer.usgs.gov
- USGS Logo:** science for a changing world
- Navigation:** EarthExplorer, Help, Feedback, Login
- Search Criteria Summary (Show):** Clear Search Criteria
- Search Criteria Summary (Map):** (30.6224, -103.8844) Options + -
- Search Criteria Panel:**
 - 1. Enter Search Criteria:** To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the help documentation), and/or choose a date range.
 - Geocoder:** KML/Shapefile Upload
 - Select a Geocoding Method:** Feature (GNIS)
 - 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:** US Features (selected)
 - Feature Name:** Fort Davis
 - State:** TEXAS
 - Feature Type:** All
 - Buttons:** Show, Clear
 - Polygon:** Circle, Predefined Area
 - Coordinate Format:** Degree/Minute/Second, Decimal

Identifying the scene for download



The screenshot displays the Earth Explorer interface. On the left, the 'Data Set' panel shows a list of Landsat 4-5 TM C2 L2 scenes. The selected scene is highlighted in green. The main map area shows a satellite image of a desert region with a yellow rectangular scene overlay. A blue location pin is placed on the scene. The interface includes controls for 'Hide Result Controls', 'Compare Browse', and 'Browse Opacity'. A disclaimer at the bottom states: 'The provided maps are not for purchase or for download; it is to be used as a guide for reference and search purposes only.'

Hide Result Controls

- Show All Footprints From Current Page
- Show All Browse From Current Page
- Add All Results From Current Page to Bulk Download
- Add All Results From Current Page to Order

Compare Browse:

Browse Opacity: 100%

Data Set [Click here to export your results »](#)

Landsat 4-5 TM C2 L2

ID	Date Acquired	Path	Row
LT05_L2SP_031039_20110721_20200822_02_T1	2011/07/21	031	039
LT05_L2SP_031039_20110705_20200822_02_T1	2011/07/05	031	039
LT05_L2SP_031039_20110619_20200822_02_T1	2011/06/19	031	039
LT05_L2SP_031039_20110603_20200822_02_T1			

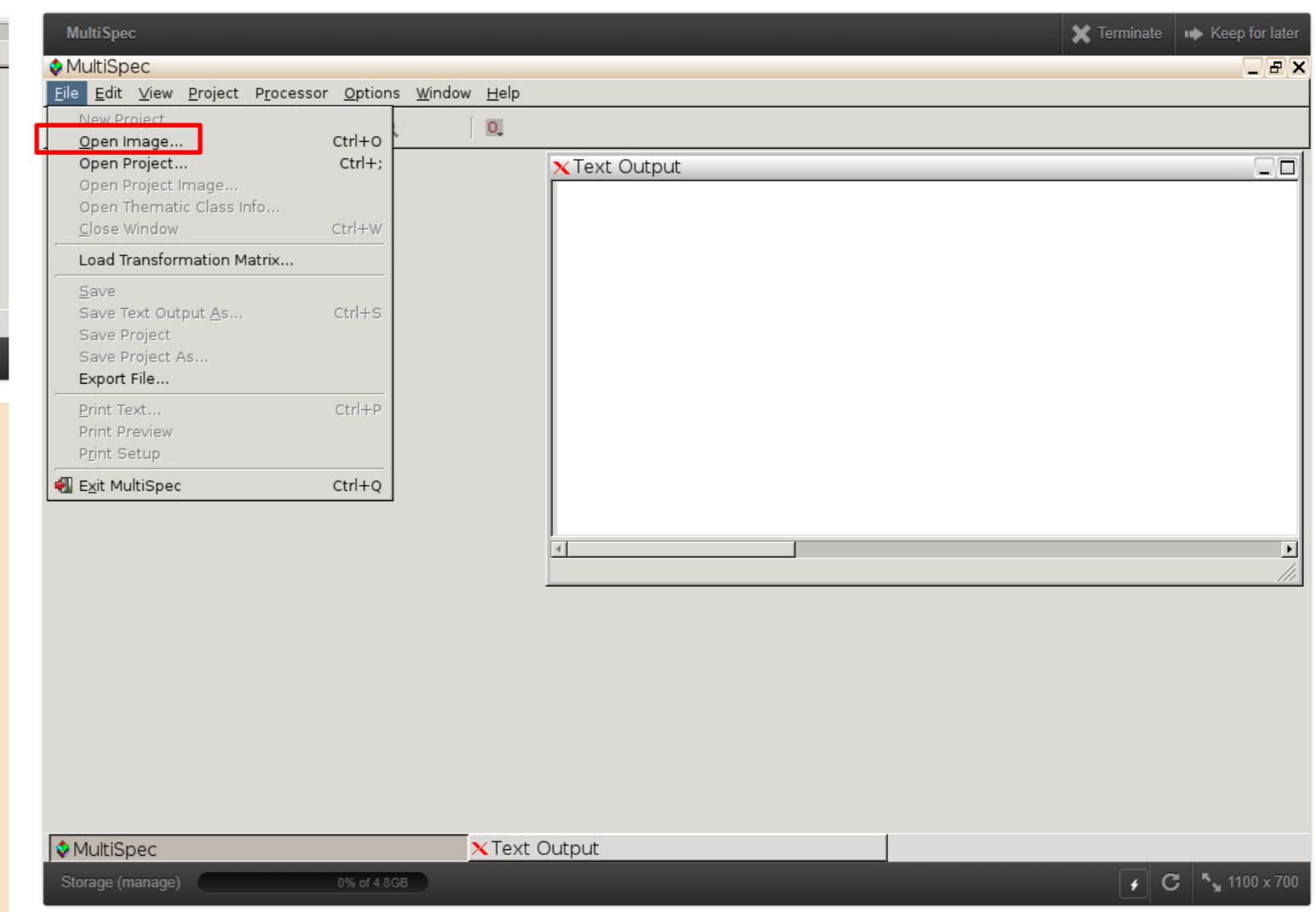
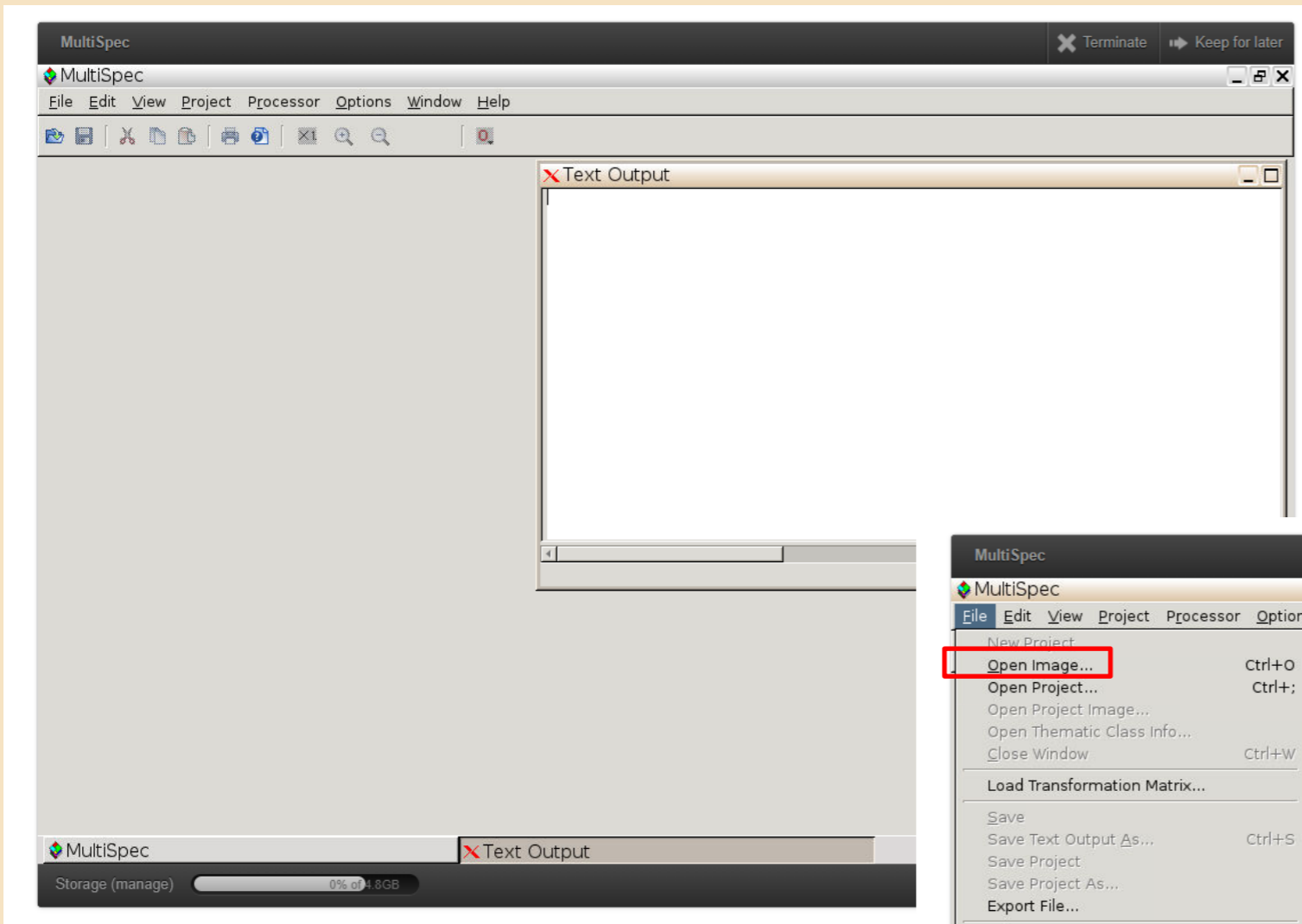
Leaflet | Tiles © Esri — Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community, ESRI

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

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

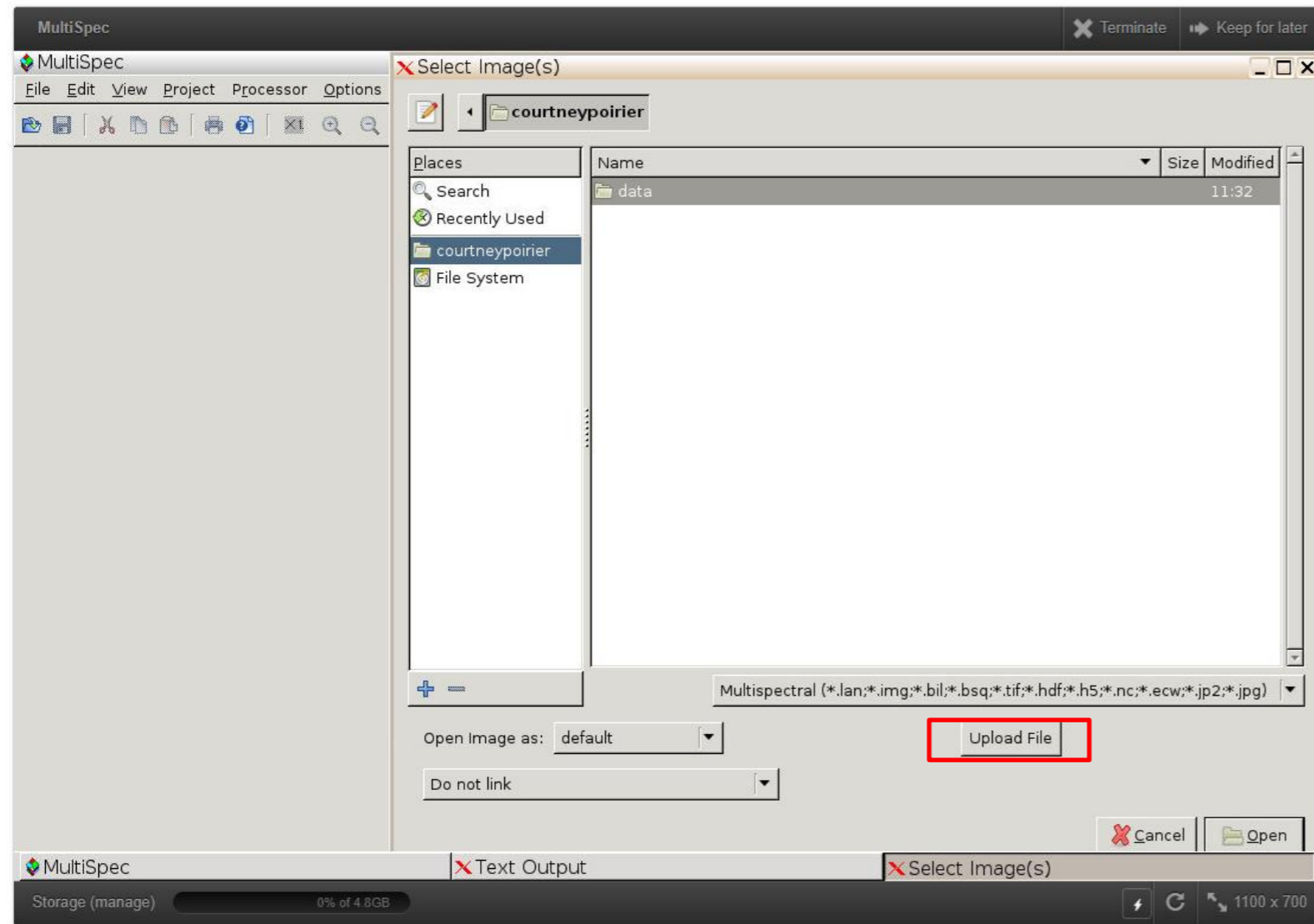
Opening MultiSpec and adding an image

When you have your image, launch MultiSpec.

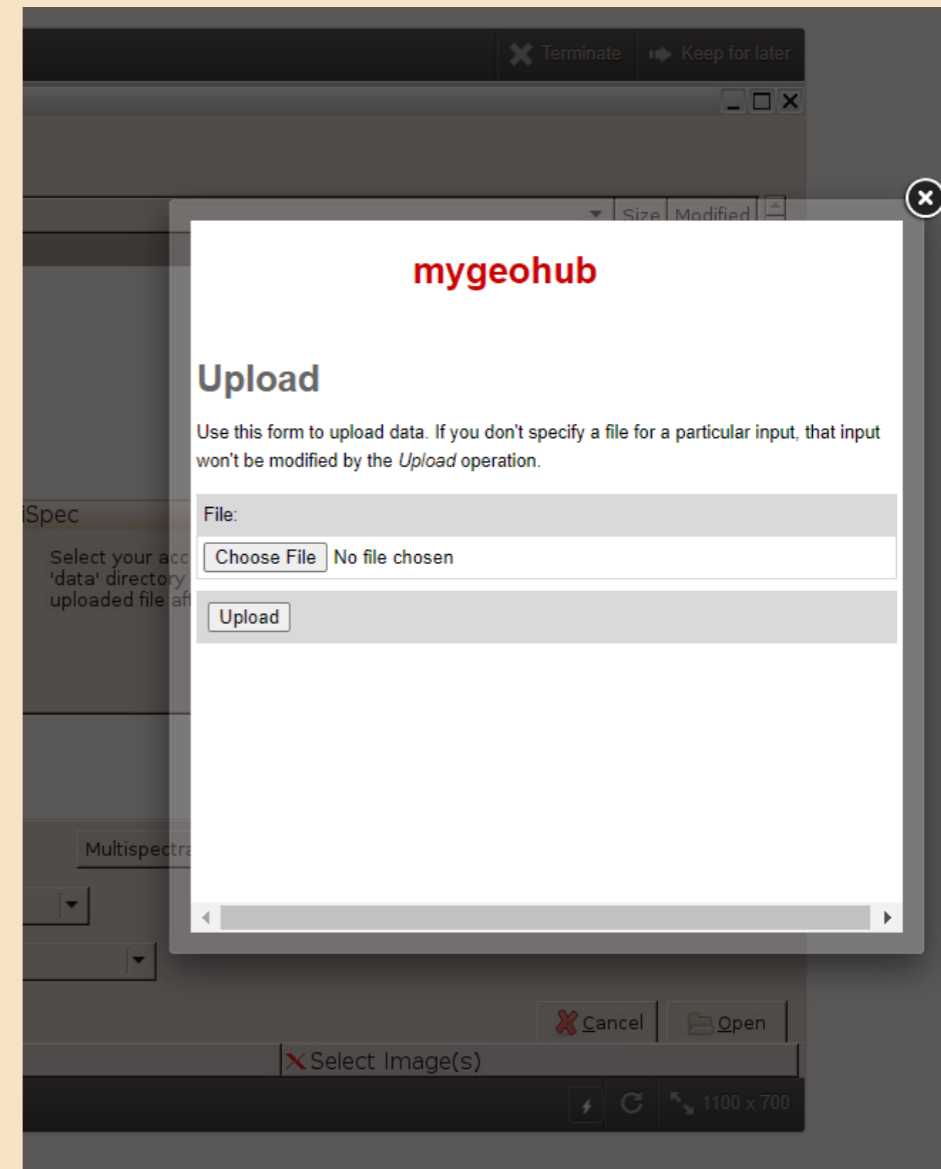


Click File and then Open Image (red box)

Uploading image file



Click your account name and click upload file (red box)

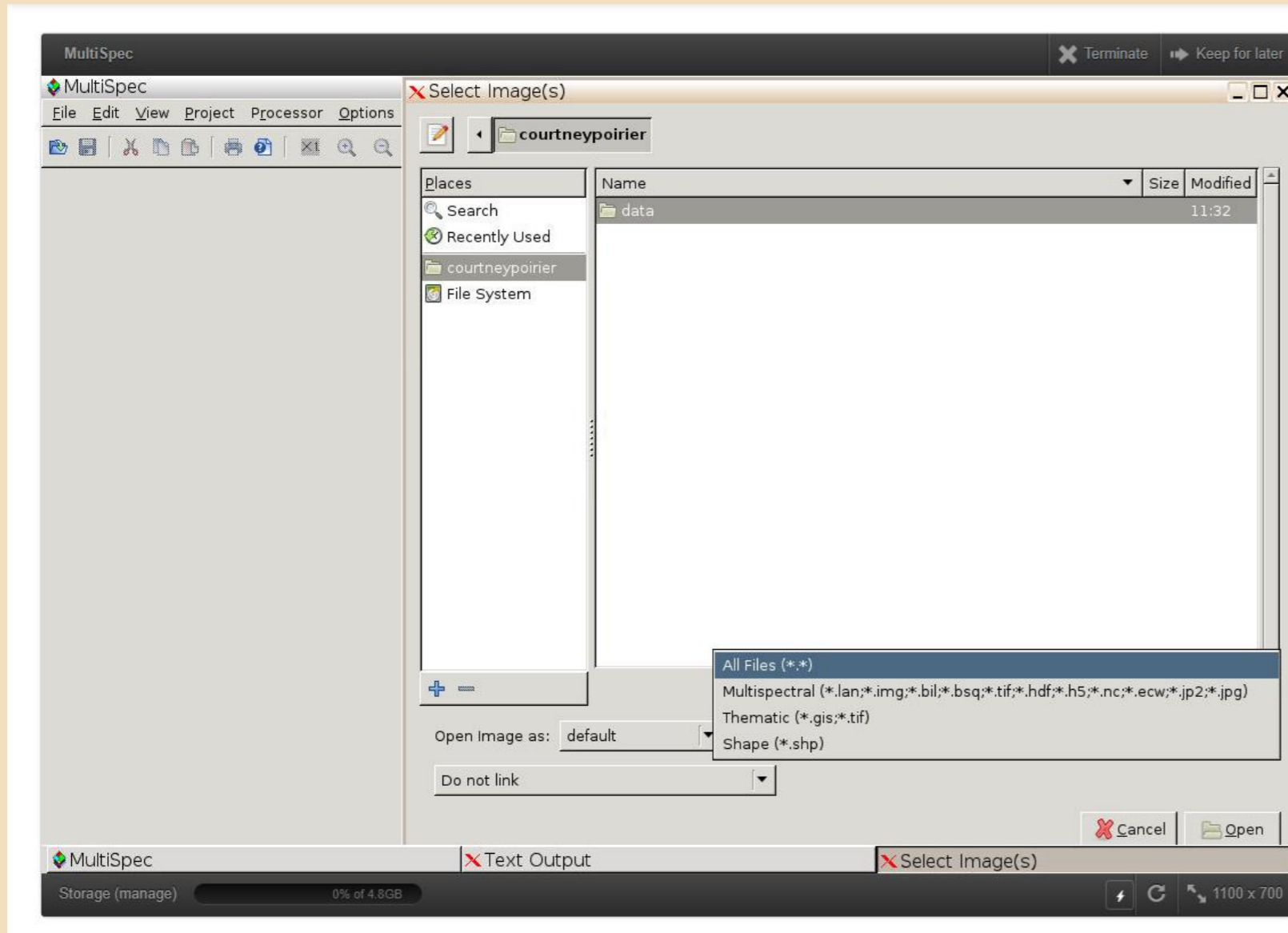


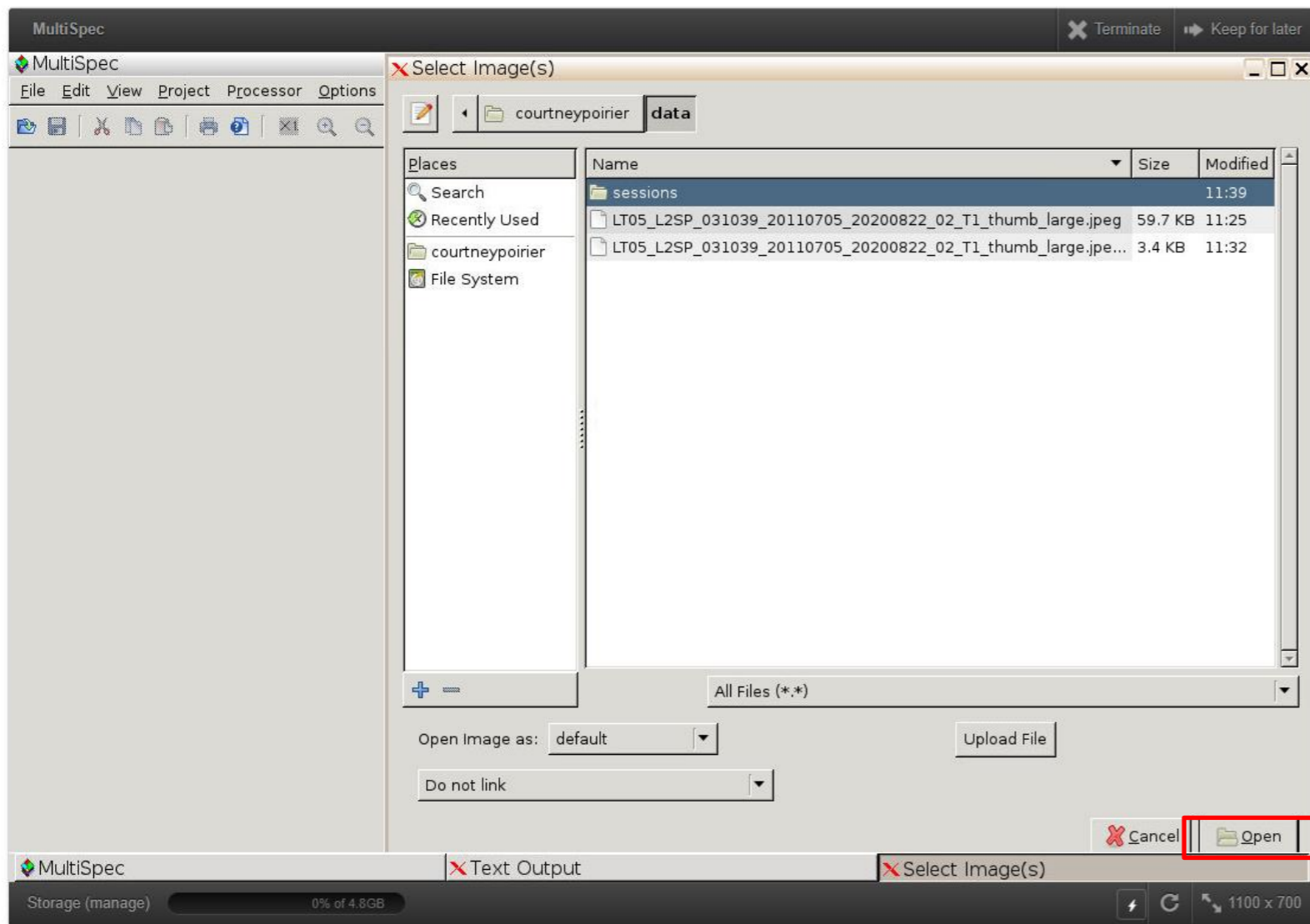
An upload pop up will appear for you to choose your image file from your computer to upload.

Opening your uploaded image

Your uploaded image will appear in the data folder under your account name.

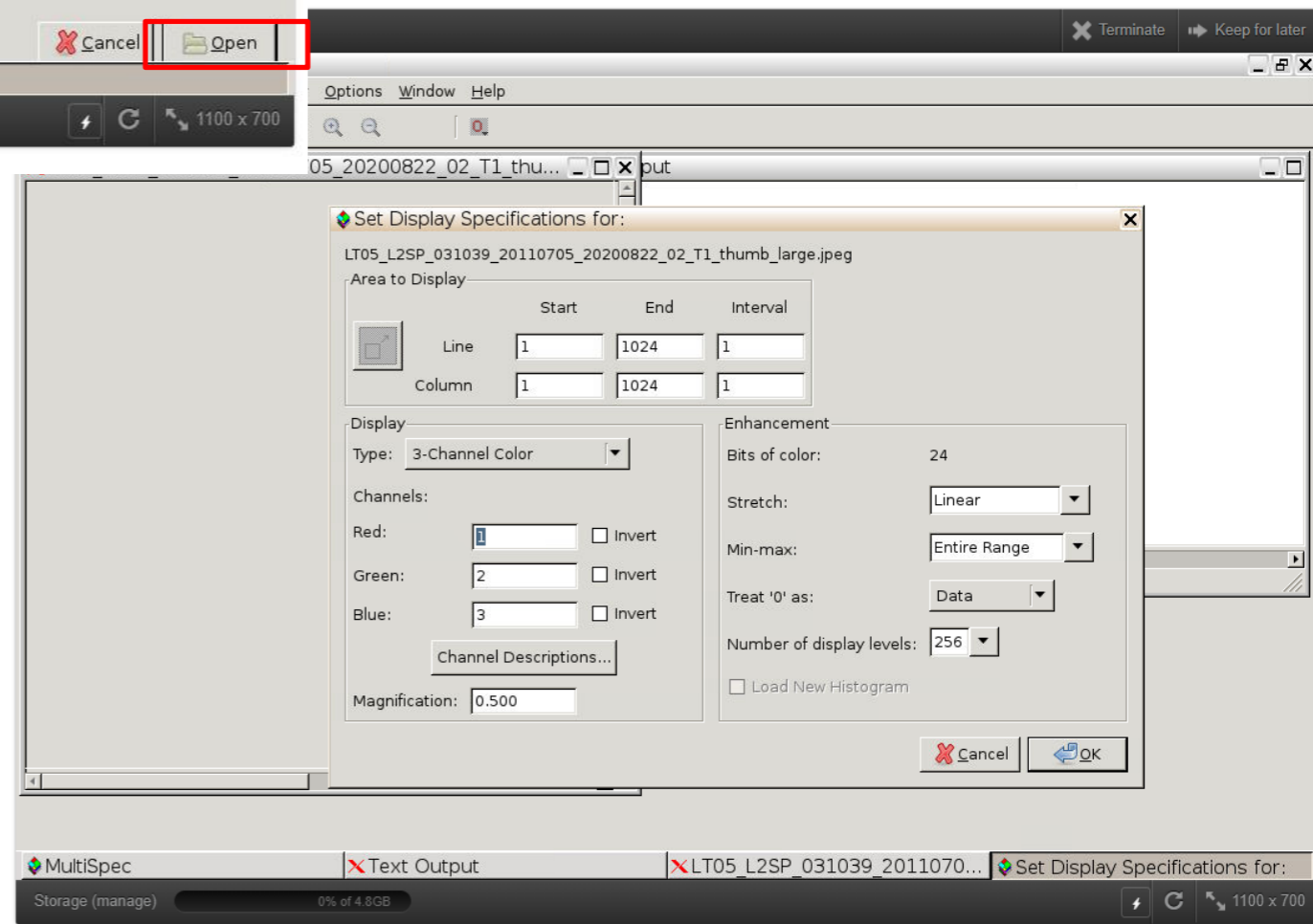
Depending on your image file type, click all files to view all files at once.





In your data folder, select the image you would like to add. Then click open (red box).

After clicking open, a display box will appear for you to select your image display specifications. Step by step instructions is provided in Tutorial 1 pdf (link on next slide)





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:

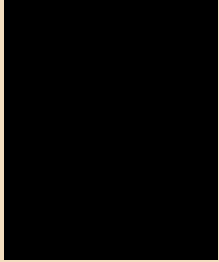
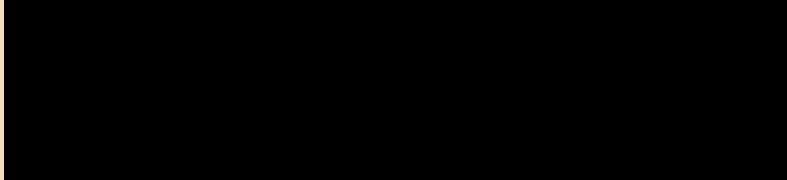
https://engineering.purdue.edu/~biehl/MultiSpec/MultiSpec_Intro_9_11.pdf

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 Zamanielavijeh

Courtney Poirier

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.