Earth Observation with Satellite Remote Sensing and ArcGIS Pro

A hands-on workshop sponsored by TexasView

Monday, October 21, 2019

Instructor: Teresa Howard

Brought to you by….

TexasView, a member of AmericaView

AmericaView is a nationwide partnership of remote sensing scientists who support the use of Landsat and other public domain remotely sensed data through applied remote sensing research, K-12 and higher STEM education, workforce development, and technology transfer.

https://americaview.org

Agenda

- Where to find free Earth Observation data
- Lesson 1: Overview of satellite data used in this workshop
- Lesson 2: Introduction to ArcGIS Pro and raster basics
- Lesson 3: Mosaic datasets and time series
- Lesson 4: Working with vegetation indices, surface temperature, burn area, and dynamic surface water and

About me

- MAG from Texas State University
- More than 22 years involved in GIS and remote sensing
- At UT Center for Space Research since 2000
- TexasView/AmericaView collaboration also since 2000
- Taught ArcMap/ERDAS Imagine based workshop 6+ times
- First time teaching Forum workshop using ArcGIS Pro

About you

- Name and affiliation, if applicable
- Local or out-of-town?
- What piqued your interest in this workshop?
  - Earth observation satellites?
  - Image processing in ArcGIS Pro?
  - Something else?

Resources for Data Discovery & Collection

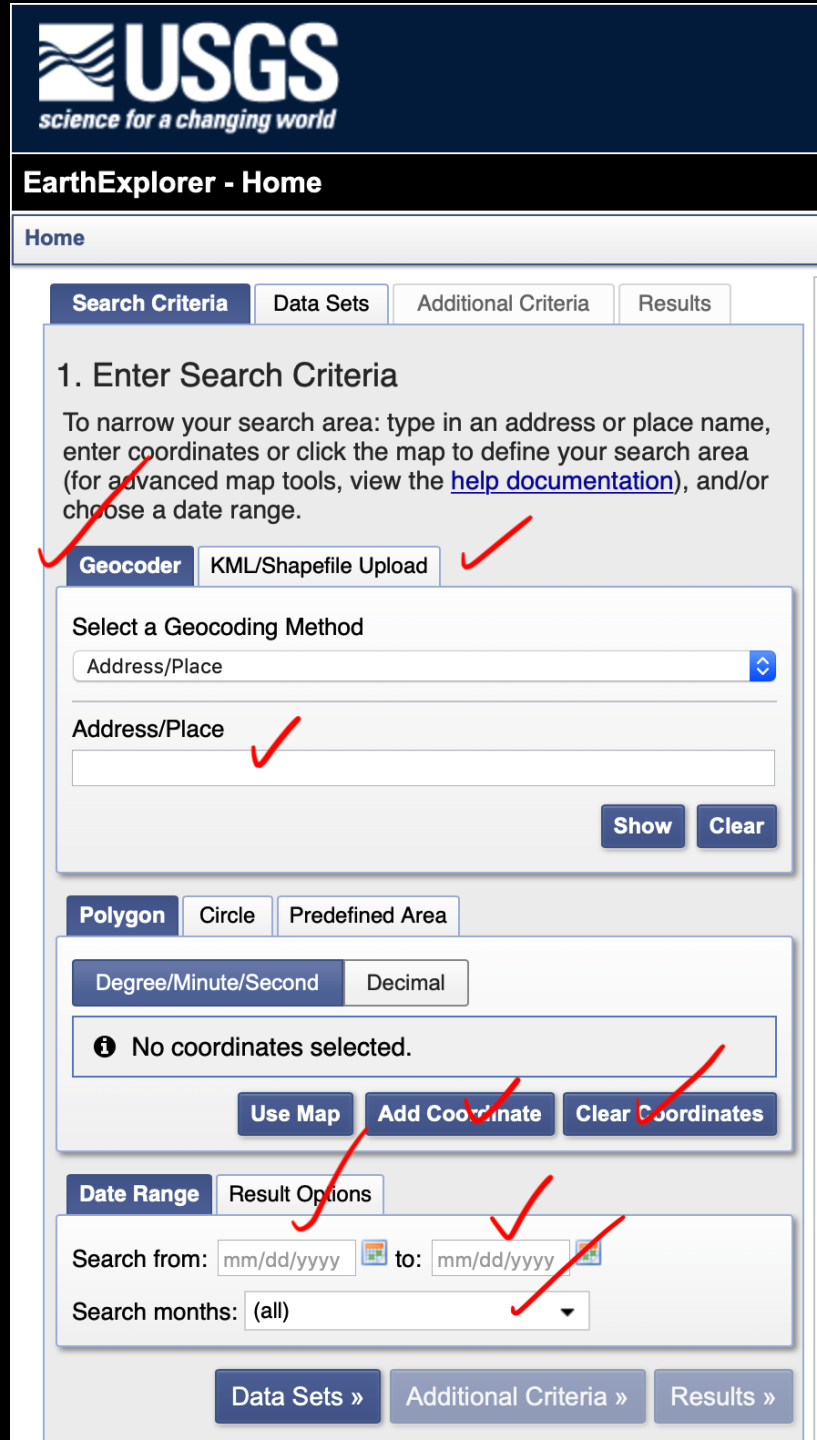
- USGS Earth Explorer (demoed): https://earthexplorer.usgs.gov*
- USGS GloVis (link to video courtesy of VermontView)*
- Landsat Look (how-to guide on workshop USB flash drive)
- NASA's EarthData (access to visualization and data products)^
- NASA's LP DAAC AppEEARS ^

* Create single account for USGS Earth Explorer & GloVis

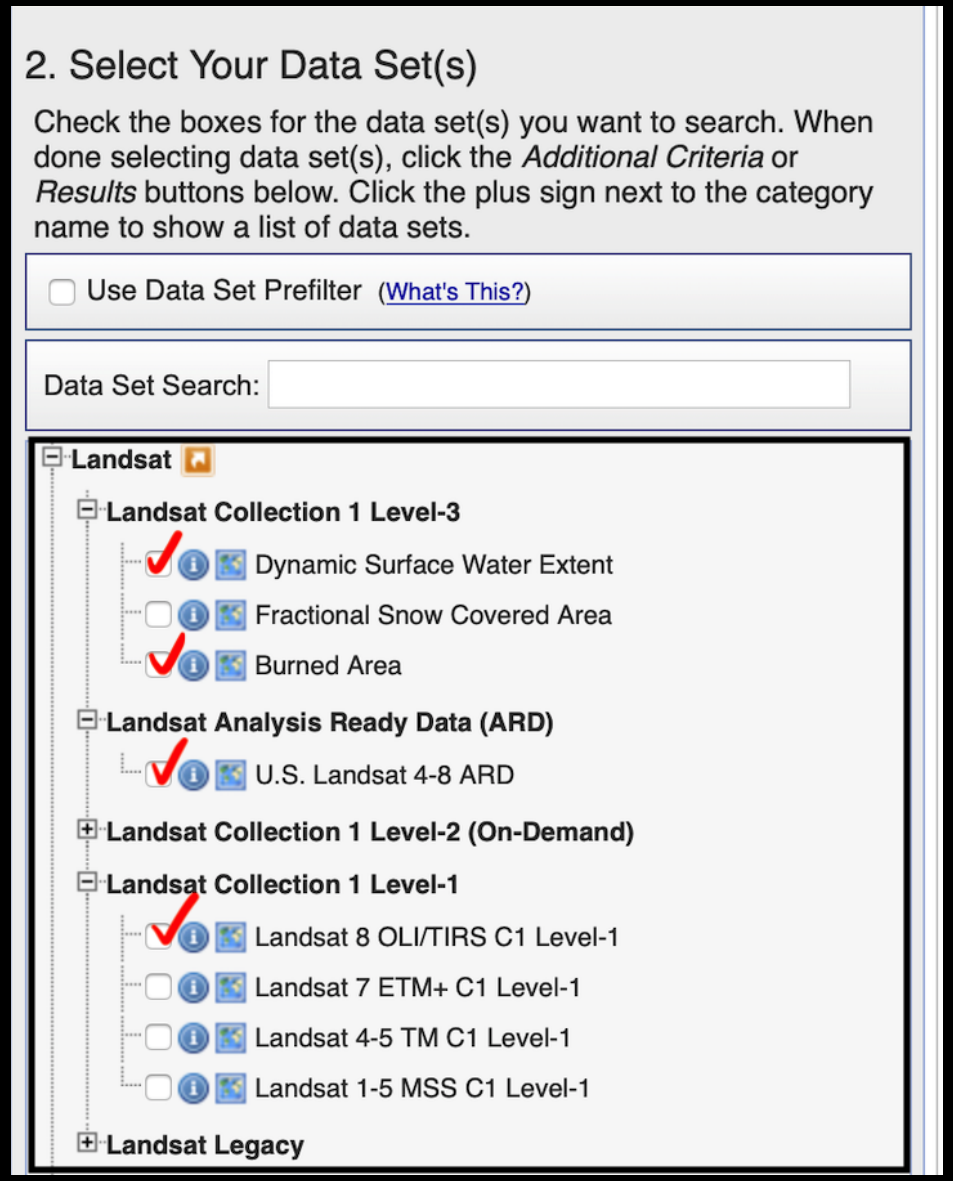
^ Create NASA EarthData account for data download from this site and other NASA data sites, including LP DAAC downloads from Earth Explorer and AppEEARS

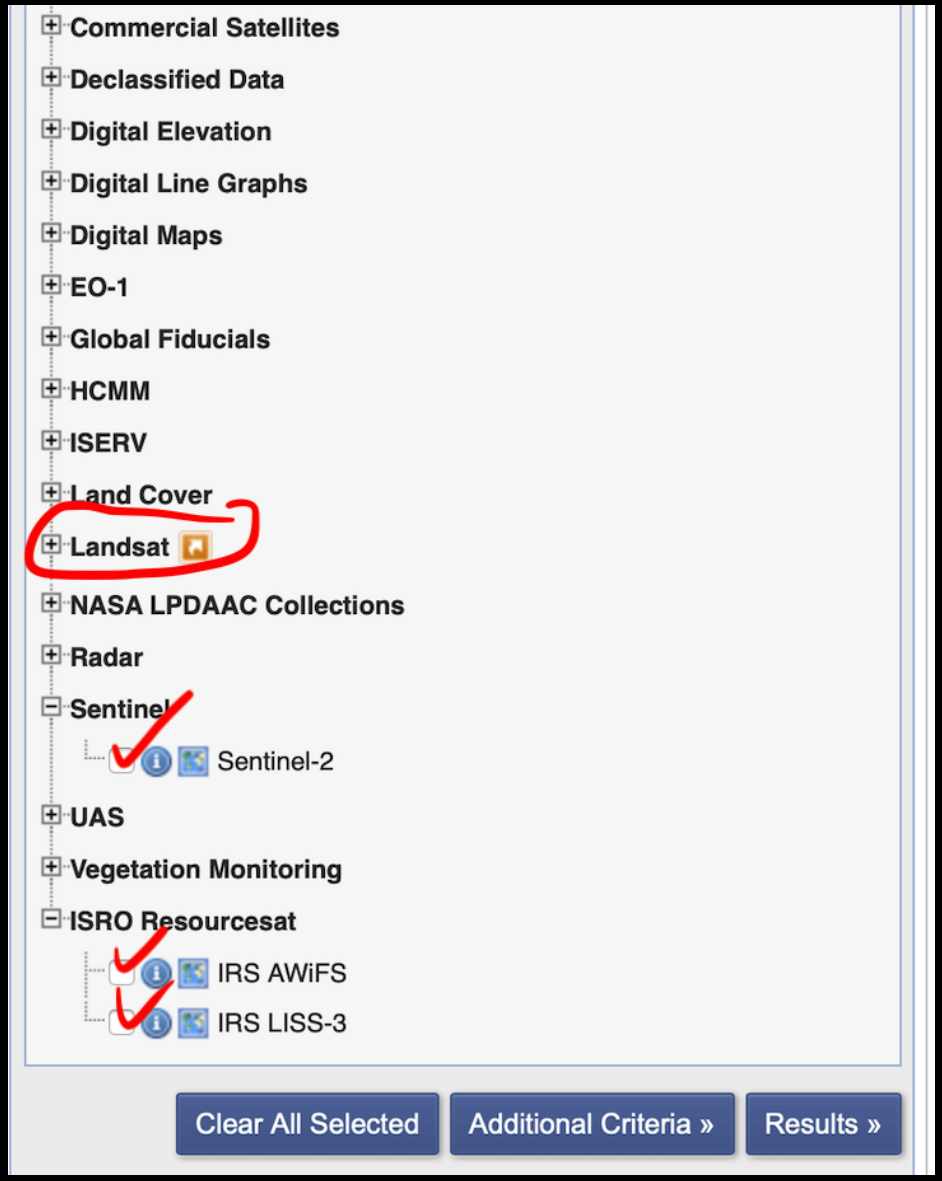
Earth Explorer Search Criteria

- Use Geocoder Address or GNIS search and click Show button OR upload simple shapefile or KML
- As an example, type in El Paso in Address/Place box then click Show button.
- For Date Range, use calendars or type: 09/01/2019 to current date
- Click Data Sets button to proceed



USGS Earth Explorer Data Sets

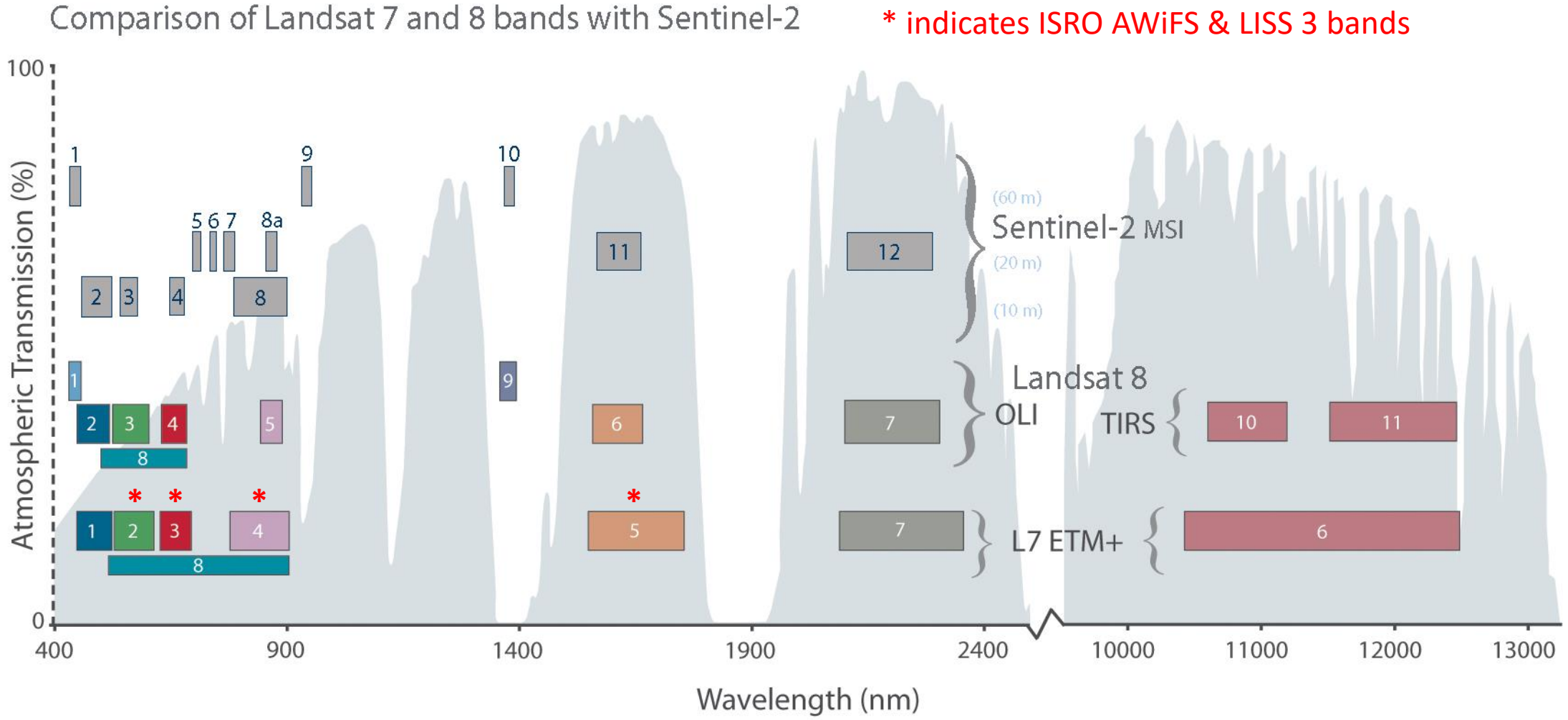




Satellite Sensors & Products used in workshop

- Landsat Analysis Ready Data (ARD)
  - Surface Reflectance
  - Provisional Surface Temperature
- Landsat Collection 1 Level 3
  - Dynamic Surface Water Extent
  - Burned Area
- Landsat 8 OLI/TIRS, Landsat 7 ETM+, Landsat 5 TM
- European Space Agency (ESA) Sentinel 2
- Indian Space Research Organisation (ISRO) ResourceSat 1 & 2
  - Advanced Wide Field Sensor (AWiFS)
  - Linear Imaging Self Scanning (LISS-3)

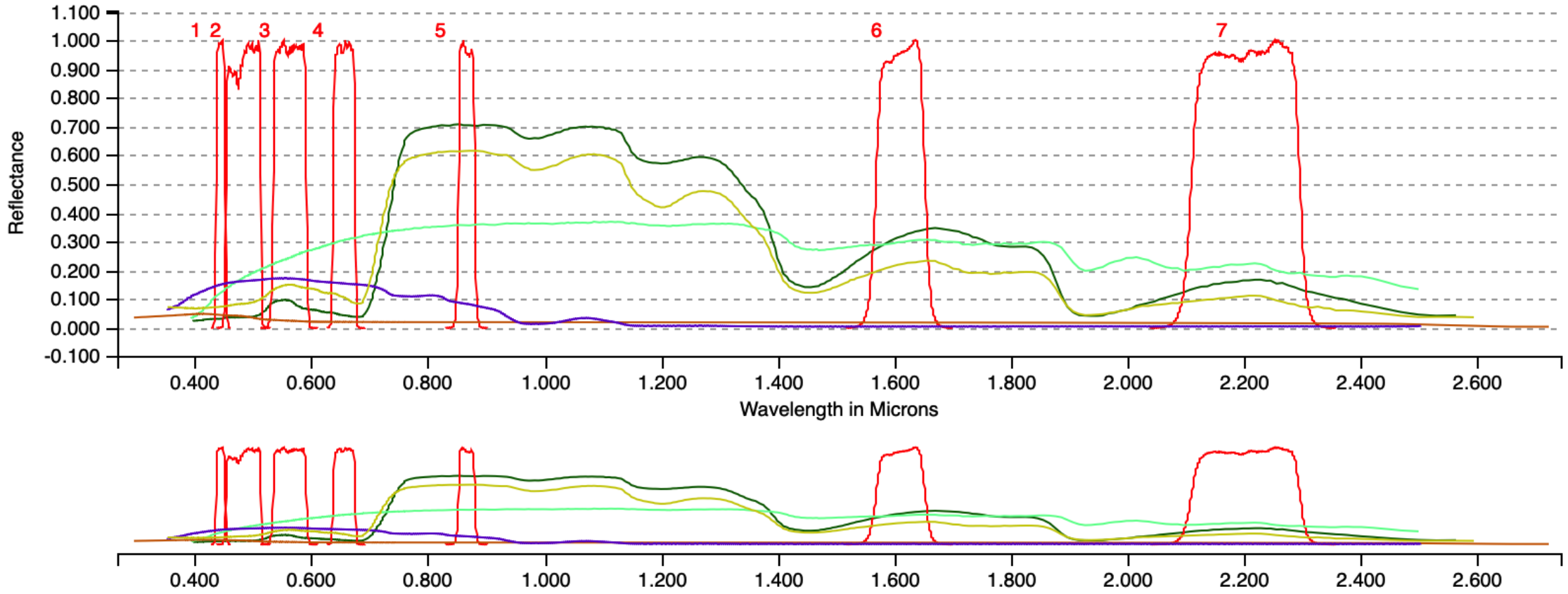
Electromagnetic spectrum for remote sensing



Bands/Spectra/Convolve

Reset

USGS Spectral Characteristics Viewer



Bands

Landsat 8 OLI

Spectra

Lawn Grass Dry Grass Clear Water Turbid Water Juniper Bush

NASA Resources

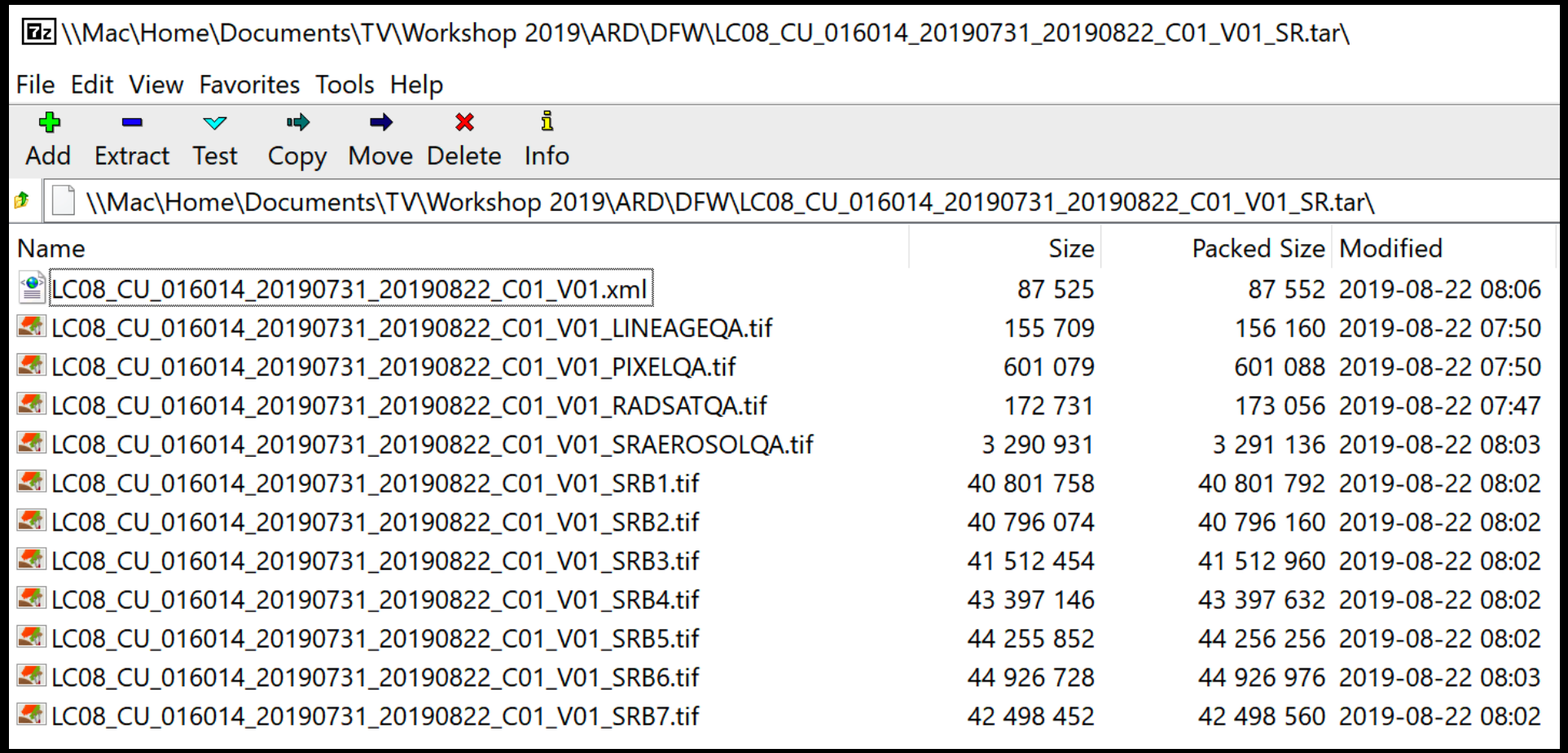
Landsat 8 OLI Spectral Bands by Charlie Loyd of MapBox

- https://landsat.gsfc.nasa.gov/landsat-8/landsat-8-bands/

Images of Change

- **Mendecino Fire** **OLI July 26, 2018 - Aug. 11, 2018**
- **Mississippi Flooding** **OLI Feb. 27, 2014 - Feb. 25, 2019**

Landsat 8 OLI ARD Surface Reflectance Files



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LC08_CU_016014_20190731_20190822_C01_V01_SRAEROSOLQA.tif	3 290 931	3 291 136	2019-08-22 08:03
LC08_CU_016014_20190731_20190822_C01_V01_SRB1.tif	40 801 758	40 801 792	2019-08-22 08:02
LC08_CU_016014_20190731_20190822_C01_V01_SRB2.tif	40 796 074	40 796 160	2019-08-22 08:02
LC08_CU_016014_20190731_20190822_C01_V01_SRB3.tif	41 512 454	41 512 960	2019-08-22 08:02
LC08_CU_016014_20190731_20190822_C01_V01_SRB4.tif	43 397 146	43 397 632	2019-08-22 08:02
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LC08_CU_016014_20190731_20190822_C01_V01_SRB6.tif	44 926 728	44 926 976	2019-08-22 08:03
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Landsat 8 OLI XML Metadata

An Introduction to working with multispectral satellite data in ArcGIS Pro

Lesson 1

Lesson 1 – in which you learn…

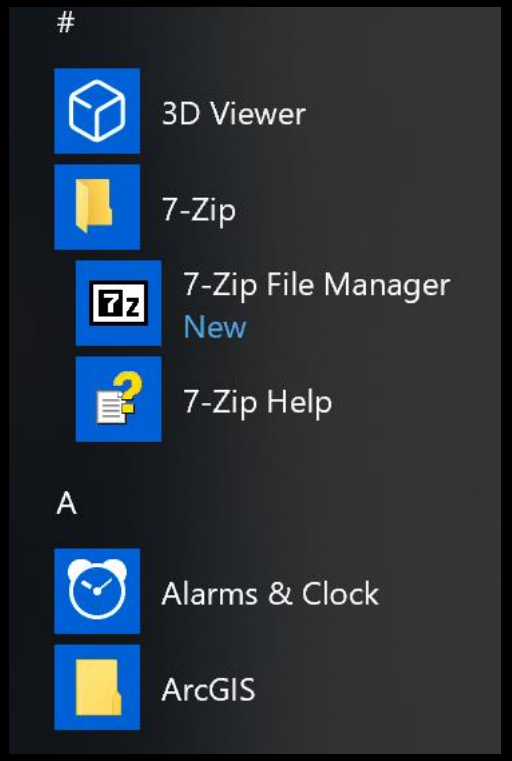
- How to unpack tar and gz files from USGS EROS
- The basic map interface in ArcGIS
- How to add image files
- What each individual band of Landsat spectral data looks like
- The difference between:
  - Analysis-ready data: surface reflectance and surface temperature
  - Landsat Collection 1 Level 3 data: burned area and dynamic surface water
  - Sentinel 2 data
  - ISRO AWiFS and LISS-3 data

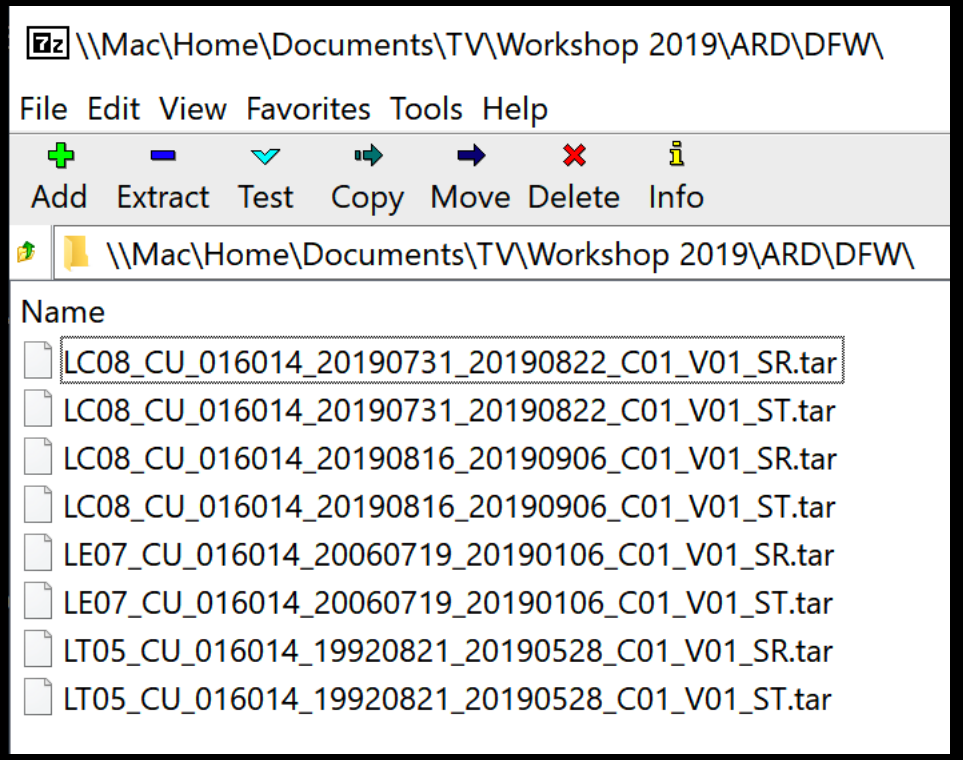
Unpacking ARD & Landsat Level 3 tar files

On Windows use freeware 7-Zip

Find latest version at https://www.7-zip.org/download.html

Executable file available in Software folder on USB flash drive





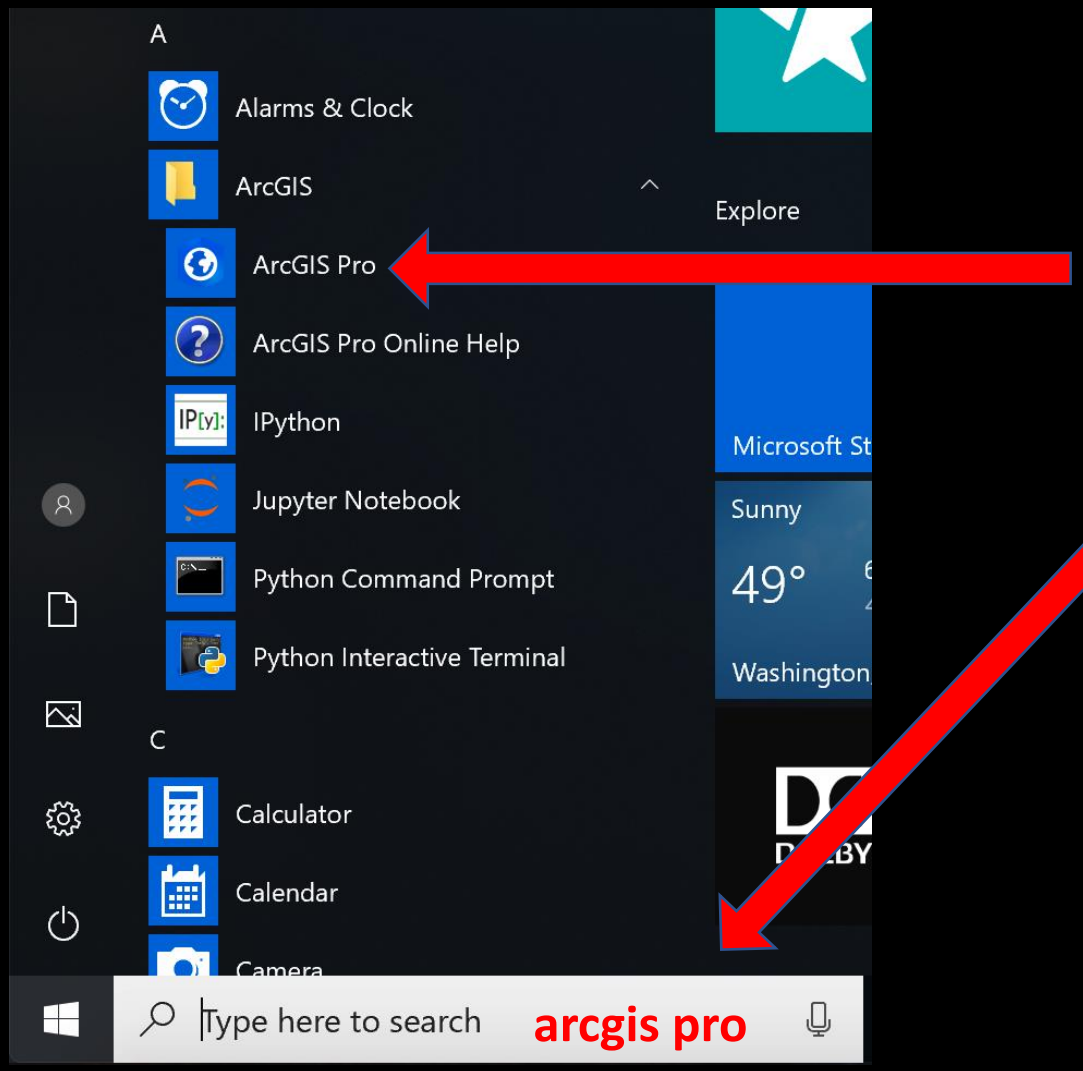
Understanding ARD file naming conventions

LC08_CU_012017_20190125_20190613_C01_V01_SRB1.tif

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CCC_vvv_product_band

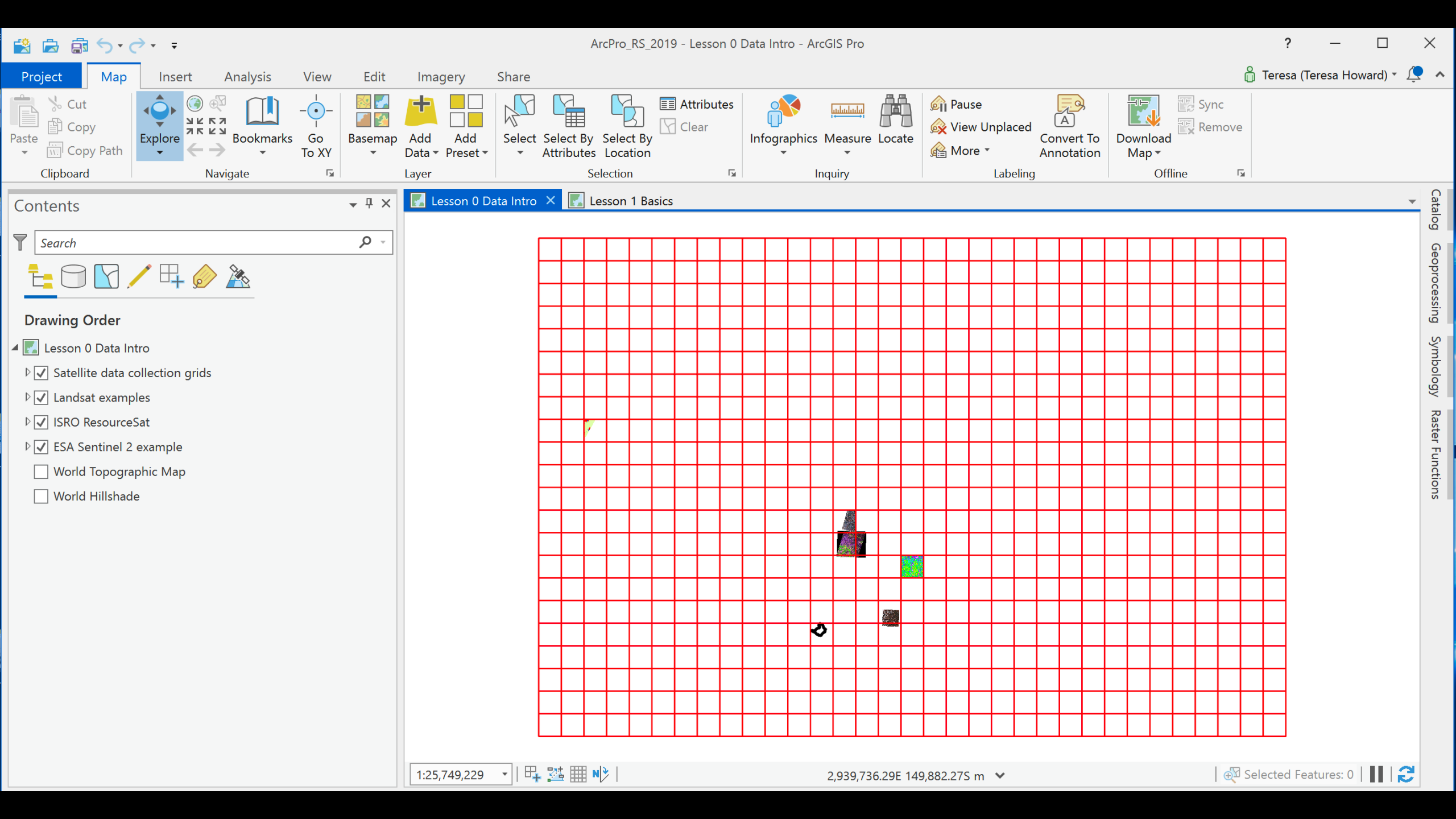
- L = Landsat
- X = Sensor (C, O, E, T)
- SS = Satellite (08, 07, 05, 04)
- US = grid region (“CU” = CONUS)
- HHH = horizontal tile number, VVV = vertical tile number
- YYYYMMDD = collection date
- Yyyymmdd = processing date
- CCC = ARD collection number
- Vvv = ARD version number
- Product = 2 character product reference
- Band is only in surface reflectance products

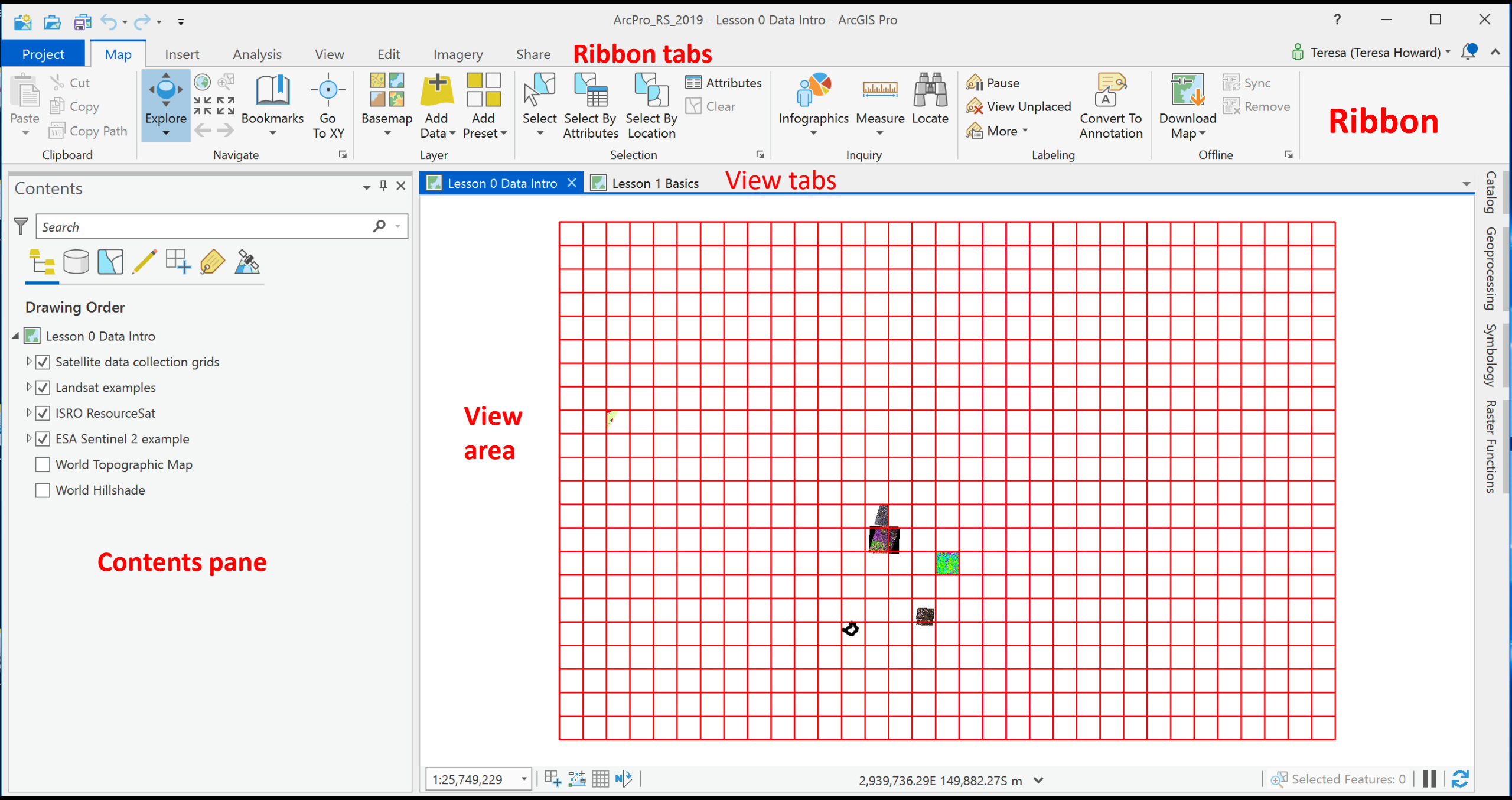
Let’s crank up ArcGIS Pro



- Click on Windows Start menu
- Option 1 – Open ArcGIS folder in A section and choose ArcGIS Pro
- Type *ArcGIS Pro* in the Search box

We will open an existing project (aprx)


ArcPro_RS_2019 - Lesson 0 Data Intro - ArcGIS Pro
Project
Map
Insert
Analysis
View
Edit
Imagery
Share
Teresa (Teresa Howard)
Paste
Cut
Copy
Copy Path
Clipboard
Explore
Bookmarks
Go To XY
Navigate
Basemap
Add Data
Add Preset
Layer
Select
Select By Attributes
Select By Location
Attributes
Clear
Selection
Infographics
Measure
Locate
Inquiry
Pause
View Unplaced
More
Convert To Annotation
Labeling
Download Map
Sync
Remove
Offline
Contents
Search
Drawing Order
Lesson 0 Data Intro
Satellite data collection grids
Landsat examples
ISRO ResourceSat
ESA Sentinel 2 example
World Topographic Map
World Hillshade
Lesson 0 Data Intro
Lesson 1 Basics
Catalog
Geoprocessing
Symbology
Raster Functions
1:25,749,229
2,939,736.29E 149,882.27S m
Selected Features: 0


ArcPro_RS_2019 - Lesson 0 Data Intro - ArcGIS Pro
Project
Map
Insert
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View
Edit
Imagery
Share
Ribbon tabs
Teresa (Teresa Howard)
Paste
Cut
Copy
Copy Path
Clipboard
Explore
Bookmarks
Go To XY
Navigate
Basemap
Add Data
Add Preset
Layer
Select
Select By Attributes
Select By Location
Attributes
Clear
Selection
Infographics
Measure
Locate
Inquiry
Pause
View Unplaced
More
Convert To Annotation
Labeling
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Offline
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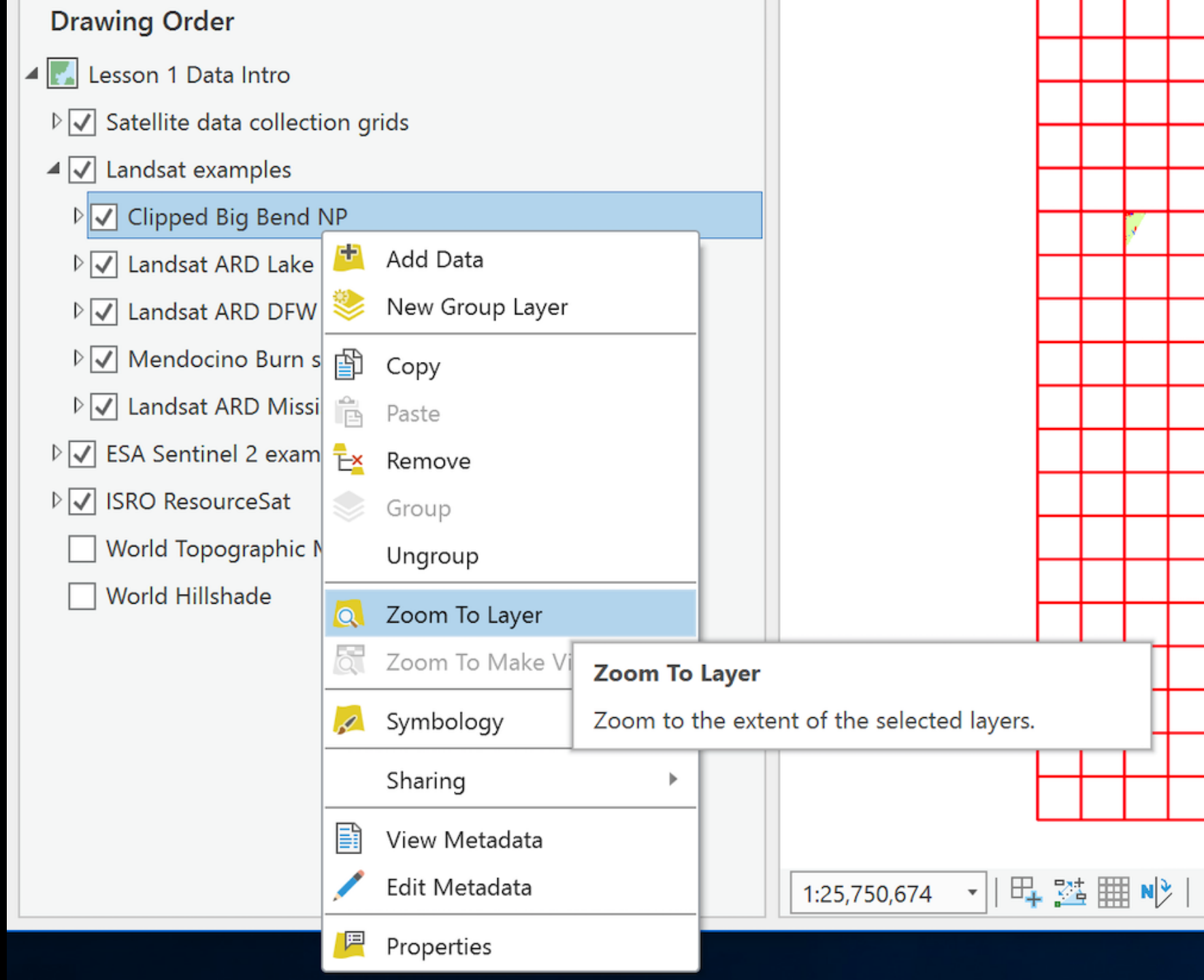
Contents
Search
Drawing Order
Lesson 0 Data Intro
Satellite data collection grids
Landsat examples
ISRO ResourceSat
ESA Sentinel 2 example
World Topographic Map
World Hillshade
Contents pane
Lesson 0 Data Intro
Lesson 1 Basics
View tabs
View area
Catalog
Geoprocessing
Symbology
Raster Functions
1:25,749,229
2,939,736.29E 149,882.27S m
Selected Features: 0

For our tour, we will zoom to each layer group from top to bottom.

We will turn layers off and on.

We will investigate spatial resolution, coordinate systems, and data product characteristics.



Basic image preprocessing

Lesson 2

Lesson 2 – in which you learn…

- How to composite using the composite band tool
- How to represent composite images
- All about band combinations
- How to composite using raster functions
- How to subset data into a rectangle
- How to clip to a polygon

Working with mosaic datasets

Lesson 3

Lesson 3 – in which you learn…

- How to prepare an empty mosaic dataset
- How to add images to a mosaic dataset
- How to change symbology in a mosaic dataset
- How to add a time attribute
- How to add a time dimension to the mosaic dataset
- How to view time series data in a mosaic dataset

Working with and creating derived datasets

Lesson 4

Lesson 4 – in which you learn…

- How to visualize Landsat ARD surface temperature
- How to calculate F° from K° using ARD surface temperature
- How to generate and apply .lyrx files
- How to calculate an NDVI raster using ISRO LISS-3 data
- How to visualize burned areas using Landsat Level 3 data
- How to visualize dynamic surface water extent using Landsat Level 3 data

Closing thoughts

We didn’t cover raster reprojection and coordinate systems in this workshop, but fortunately…

Jarlath O'Neil-Dunne of the University of Vermont and VermontView/AmericaView has created an excellent Penn State University video series related to Projecting Raster Data using ArcGIS Pro.

https://www.e-education.psu.edu/geog883/node/582

Questions? Comments?

Reach me at teresahoward@utexas.edu

Thank you for you interest!