

GIS Tutorial for Atmospheric Sciences

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Exercise 1

Exploring ArcPro and the Living Atlas

Use case: Tornado Tracks

In this exercise, you will explore the interface of ArcPro. You will learn how to upload different types of data and customize the application to fit the needs of your project. In addition, you will learn how to navigate the Living Atlas of the World within ArcPro, and use the Living Atlas to add data to your project.

Sub-Sections in Exercise 1:

1. Opening and exploring ArcPro
2. Adding Data
3. Attribute Data
4. Navigating and using the Living Atlas

Opening and Exploring ArcPro

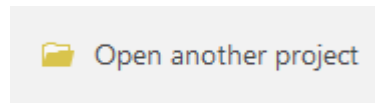
Step 1 Sign in to ArcPro and open a Project file

This step you will open an existing project. Projects are packages of maps, data, layouts, and information.

- Open ArcPro. When prompted, sign in using your ESRI ArcGIS Online account.
- If you do not have an online account, contact your GIS admin to get a login.

From here, you will be able to open up a new or existing project. Notice how there are project templates on the right column under the sign in information. You will open and explore an existing project.

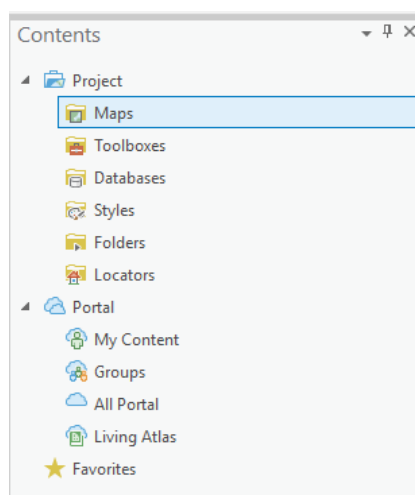
- Click on **Open another project > Computer > Browse**



- Browse to **C:\Exercise1\Maps_Data** and select the **Module1.ppkx** file.

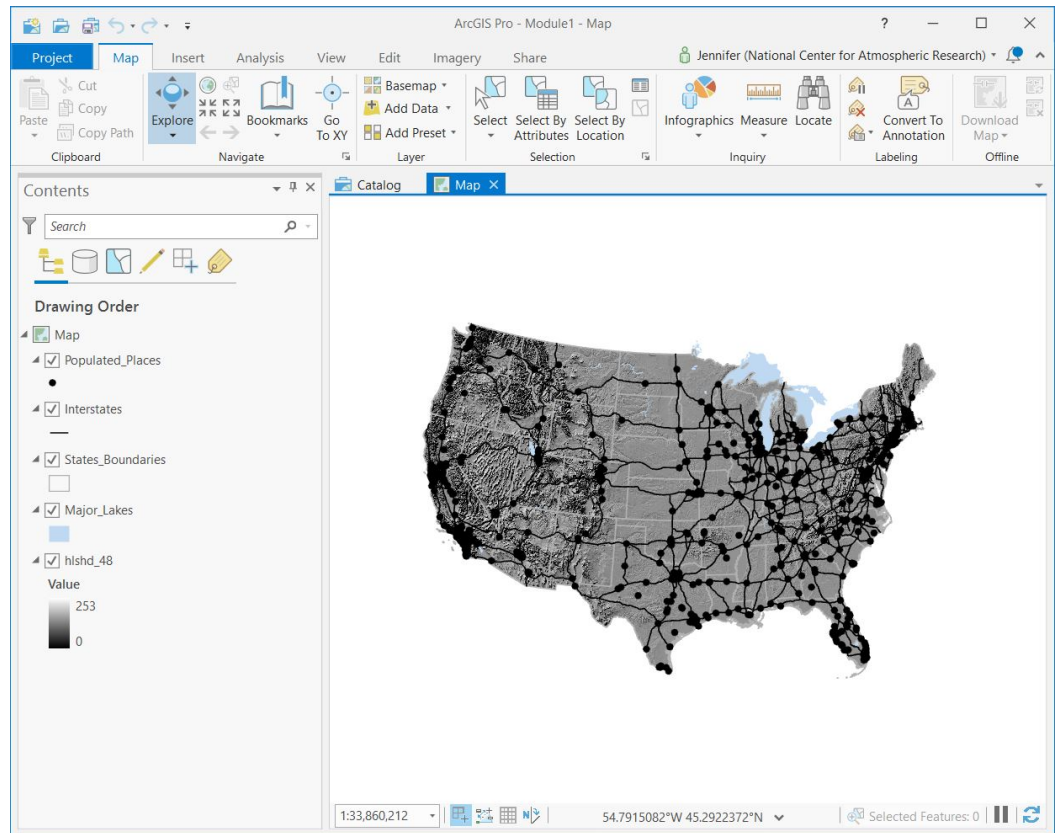
When the project file opens, you will see two tabs, titled Catalog and Map.

The catalog tab shows where more information can be found, and contains six standard connections- Maps, Toolboxes, Databases, Styles, Folders, and Locators. Feel free to click around and notice that a many default folders were made when you opened the project file.



- Click the Map tab.

On the “Map” tab, the left contents column will display “drawing order” by default and shows the names as well as the symbology for all the data within this map.



- Save the document by going to **Project > Save as**. Save the Project file in **C:\Exercise1\Maps_Data as Exercise1_<yourname>**.
- In the future to save you can click the symbol in the top left corner that has a purple disk in front of a folder.

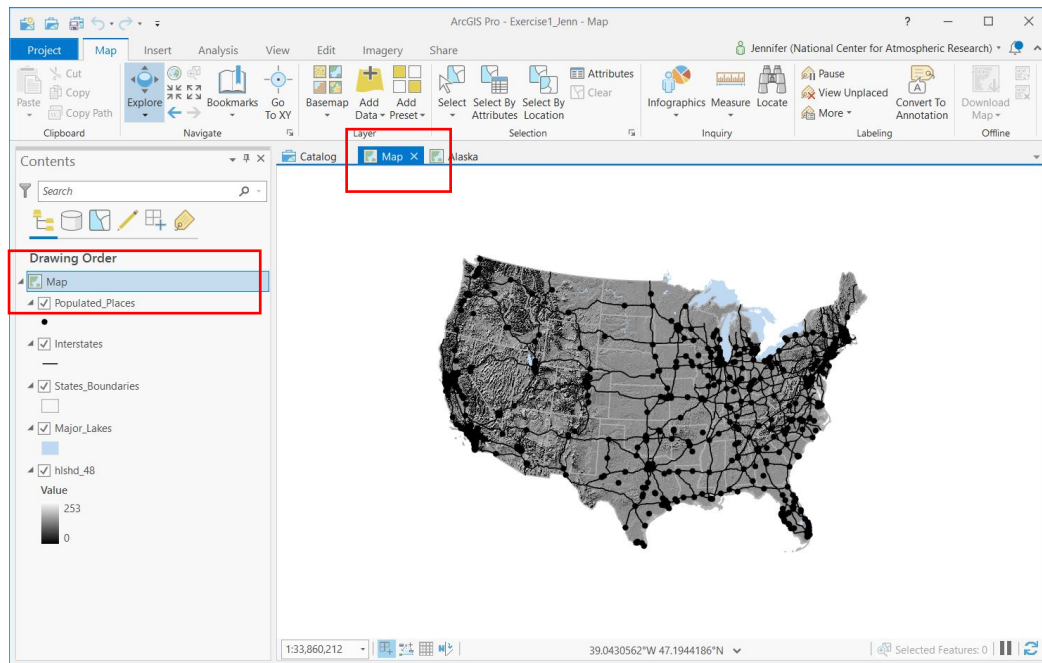


TIP: It is good practice to use only alphanumeric characters or underscores in your file names and to leave no spaces

Step 2 Exploring Ribbons and map views

Ribbons are the manner in which tools and actions are organized within ArcGIS Pro.

- Click on the **Map** tab then in the Contents pane click on “Map” underneath drawing order.

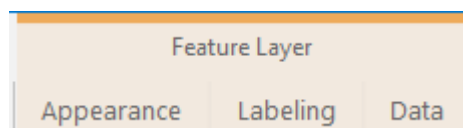


Explore the Ribbon above the Map pane. Notice how almost all actions have an associated symbol. Some of the Symbols are grey, this is because the action cannot be performed with what is selected.

- Select the “**Populated_Places**” feature layer in the Contents pane.

The selected layer is highlighted in blue in the Contents pane. Once it is selected, a **Feature Layer** contextual tab set appears on the Ribbon. Under it are three tabs with tools specific to feature layers.

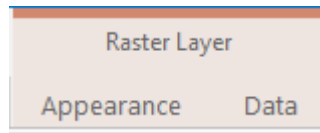
- Explore the tabs specific to Feature Layer; “Appearance”, “Labeling”, and “Data”.



- Select **Terrain** in the Contents pane.

The data titled “terrain” is a raster layer, not a feature layer. When this is selected, the contextual tab set in the Ribbon will change to raster specific actions.

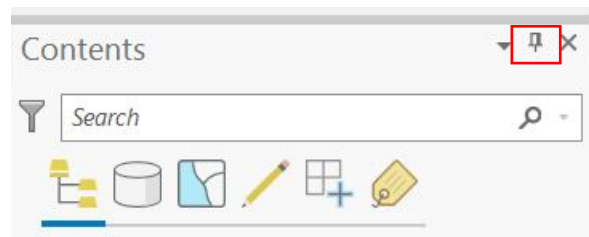
- Explore the dark orange contextual tabs specific to raster layers; “Appearance” and “Data”.



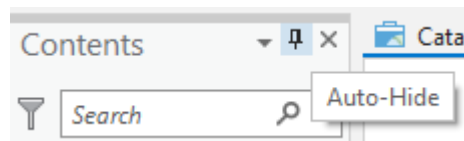
Notice although the names are similar to the feature tabs, the contents and symbols within them are different.

The sidebars displayed on the left and right of the map are called panes. You can set your panes so that they will not display when you are not interacting with them.

- In the upper right corner of the Contents pane, click the **thumbnail** icon (autohide).



- The Contents pane is now hidden and can be displayed by the vertical text on the left side of the map. Click on the text ‘Contents’.
- When the Contents pane re-appear, click on the **thumbnail** again to turn off autohide.



As you work with different maps, views, and panes, you'll open and close panes that you need for specific tasks. You can reposition or minimize them to make room for maps and other views. Grab the title bar of any view or pane to drag it to a target or let it float.

- Click on the **blue bar** (title bar) on top of the Contents pane and drag it to the center of the screen.

Notice the icons that appear on different parts of the screen which allow you to redock while you are dragging the window. For the remainder of the lessons, you will keep the contents pane in the default left position, but feel free to reposition windows as you see fit.



- To dock your Contents pane to the left of the map, click the title bar and drag the pane to the left towards the icon that appears to the left.
- In the Contents pane, click on **Map** and change the name to **United States**.



Step 3 Navigating and Using the Zoom and Pan tools

Typically you will want to explore your data and analysis by looking closely at specific locations.

- Make sure the Explore tool, in the Navigate group on the Map tab is selected.
- Push the **roller up** on your mouse to **zoom in**
- Pull the **roller down** on your mouse to **zoom out**
- Click the **“Map”** tab on the top Ribbon and click on the small globe symbol to show the full extent of the data within the map



TIP: If there is no data within your map the full extent will be the entire earth. To identify outliers in your data sometimes it is helpful to turn off all layers except the one you are trying to understand better. Zoom to full extent to see if any of the points or lines are much further than the space of the general population.



- To return to the previous extent click the **left facing arrow** icon in the Navigation group.

Step 4 Using the measure tool to measure distances

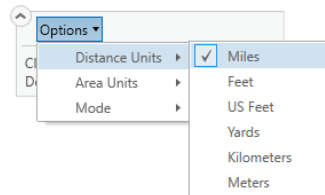


- Still on the “map” Ribbon, find the icon of a ruler. This is the measure tool.
- Click on the small downward **arrow** underneath the ruler to reveal the different functionalities of measuring.

This tool is default set to measure a straight line unless otherwise specified. Now you will test some of these functionalities.

- **Zoom out** to the full extent of the United States.
- Click on the measure **ruler**. Click on the **southernmost point of Texas**. Drag the mouse over to the **southernmost point of Florida** and **double click** to end the measuring.

In the top left corner it will display the distance between the drawn points. You can modify the units by selecting **options**. You should have a distance of roughly 1,000 miles between the southernmost tips of Texas to Florida.



TIP: The icon next to the eraser copies the results of your measurements

- Close the measure tool window

Step 5 Accessing and creating Bookmarks

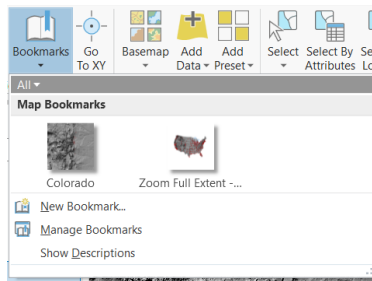
Bookmarks are convenient for saving specific spatial extents of your map. Once created, you can add a description to describe why that bookmark is important. The project has two bookmarks set up already- Zoom full extent- US, Colorado, and the Southeast.

- Click on **Bookmarks** from the Map Ribbon and select **Colorado**.
- Click on **Bookmarks** again and select **Zoom full extent – US**.

Now you will learn how to create our own bookmarks.

- Using your cursor, zoom to **Texas**.

- From the bookmarks menu, click on **New Bookmark...**



- Type **Texas** for the title and in the description type “Texas is popularly known as The Lone Star State.”
- Click **OK**.

You now have a bookmark for Texas.

Step 6 Layer Properties

Similar to the Map Properties, each Layer has an associated set of properties which can be modified. To modify Layer Properties, right click on the layer in the left column.

- Right click on the **Populated Places** layer.
- Select **Properties**.

Here you will see a number of options similar to the Map Properties.

- Click on the **General** tab
- Change the layer name to **Cities**.

Similar to the Map Properties, changing the name in the General tab only changes how it is displayed in the Contents pane and does not change the name of the actual data. The map document is just accessing the layers, not storing them.

- Click on the **Source** tab. Explore the information provided.
- Click **OK** to close the **Layer Properties**.

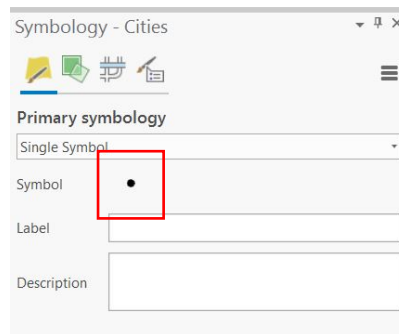
Step 7 Symbolizing data

In this step you will change the way the data is visualized or symbolized.

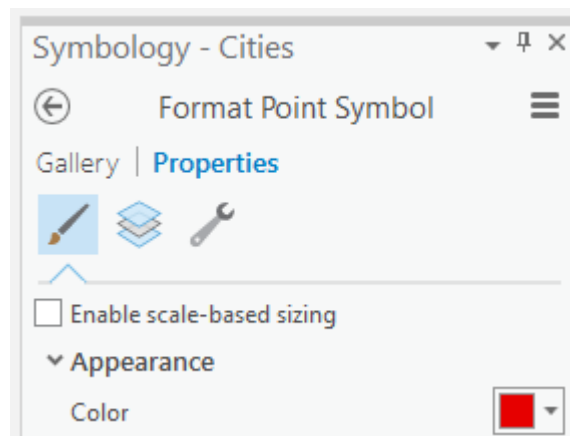
- Right click on **Cities** in the Contents pane and select **Symbology**.

A new pane appears on the right side of the map. You can choose from an existing symbol in the gallery or customize it yourself. You will manually change the color of the preexisting symbol to red.

- Click on the black dot which is the existing symbol.



- Click on **Properties**
- Change the color to **RED**.



- Click **Apply** to save the new symbol formatting

- Close the **symbolology** pane.

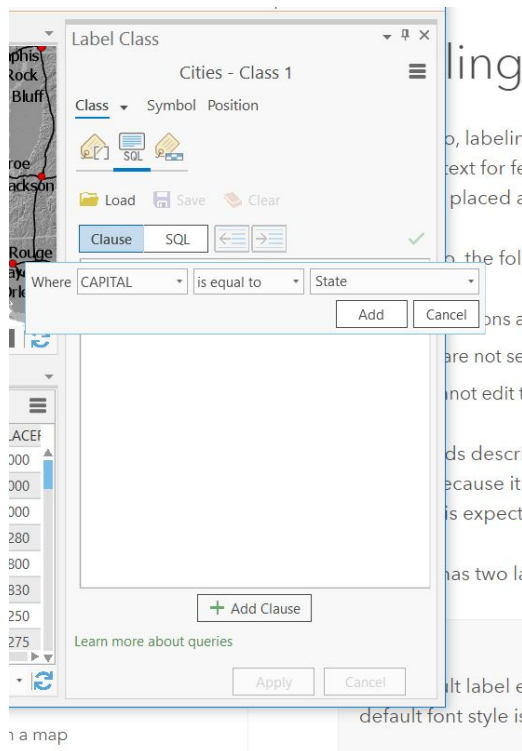
You can also label features on your map. Labeling adds descriptive text to your features on the map.



- Right click on **Cities** and click on **Label**.

Labeling all the cities in the map is too confusing. You will now just label the capital cities for each state.

- With **Cities** still selected, click on the **Labeling** tab in the Ribbon.
- Click the **SQL** tool in the **Label Class** group.
- In the new pane that appears to the right of the map click **Add Clause**.
- Add the following query “Where CAPITAL is equal to State”.



- Click **Add** and click **Apply**.
- **Save** your project



Now only the state capitals will be labeled in your map.

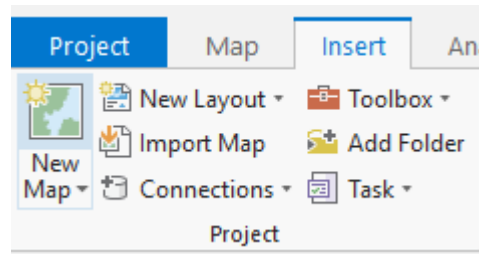
Adding Data to ArcGIS Pro

In the next few steps you are going to add tornado tracks and the National Weather Service County Warning Areas to our maps.

Step 8 Start a new Map

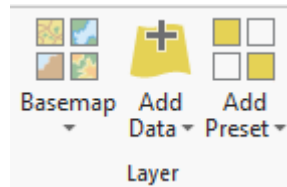
You will now start a new map.

- On the top Ribbons, click on **Insert**.
- Click on **New Map**.

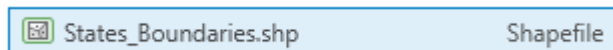


A new tab will pop up with a basemap and no data within the map.

- Click the Catalog tab.
- Right click on the **Folders** and navigate to **C:\Exercise1\Maps_Data\data** click **OK**.
- Click on the Map tab to open the new map.
- Click **Add Data** from the Layer group on the Map tab in the Ribbon.



- In the left-hand panel click **Folders** then in the right-hand panel click **data**.
- Click **States_Boundaries.shp** and click **OK**.

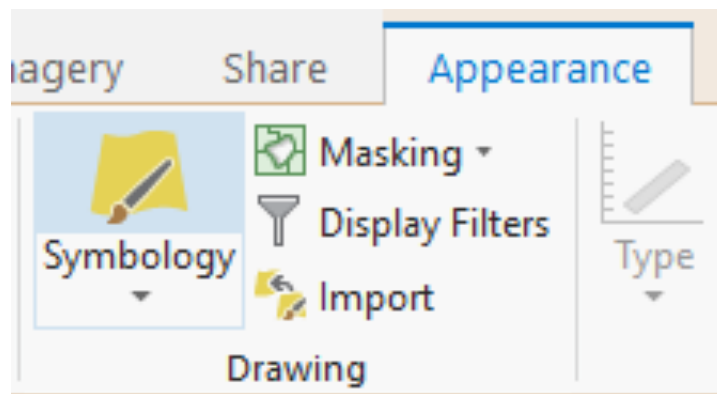


TIP: Be careful of the type of file you are adding to the map. The extension will tell you what you are adding, an mxd, a later, or a raster.

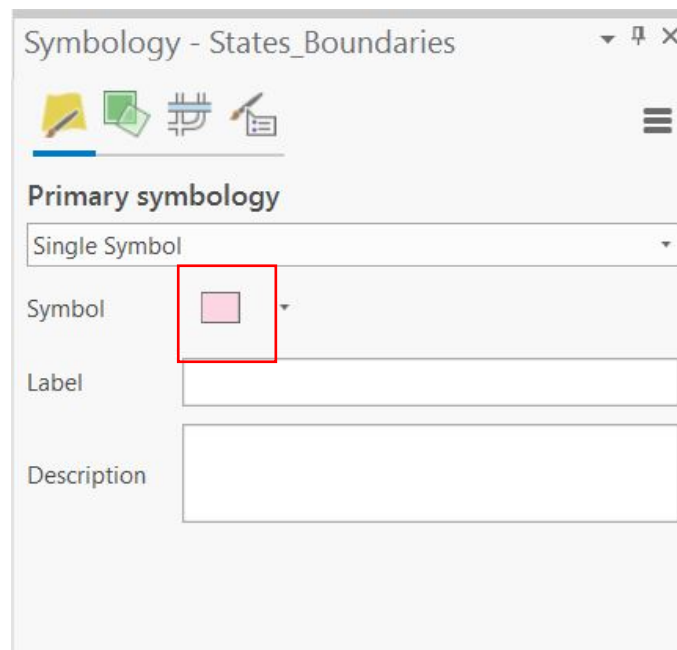
- Now you will add data from the Catalog pane. Click the **View** tab and select **Catalog Pane**.

This will open a new pane on the right side of your map.

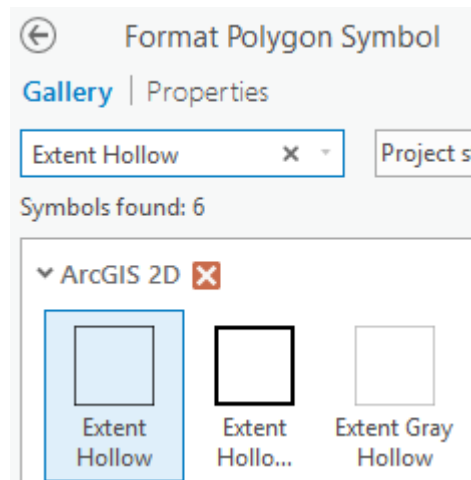
- Navigate to **Folders > data** and drag **NWS_CWA_Boundaries.shp**, and **Tornado_tracks.shp** into your map.
- Reorder the layers so that **NWS_CWA_Boundaries** is below the **States_Boundaries** layer.
- Click on the **States_Boundaries** layer in the Contents pane.
- In the Ribbon click on the **Appearance** tab.
- Click the **Symbology** tool. (this will open the Symbology pane)



- In the Symbology pane to the right of the map, click on the symbol.



- Click on **Gallery**.
- In the Search box, type in **Extent Hollow** and hit Enter.
- Click on the symbol **Extent Hollow**.



- Click the layer **NWS_CWA_Boundaries** in the Contents pane.
- In the Symbology pane, click the Symbol.
- Select Black Outline (1pt) for the symbol.
- Click the Properties option.
- Change the Outline color to purple and click Apply.
- Save your project.

Working with attribute data in ArcGIS Pro

Step 9 Viewing the Attribute Table

The manual selection allows us to look at the attributes of individual selected layers and features. By viewing the attribute table you can look at all the information for everything within a specific layer.



- Right click on the **States_Boundaries** layer and click on **Attribute Table**.

An attribute table is displayed as a series of rows and columns. Sometimes these are also referred to as records and fields.

At the bottom of the table (if your selection is cleared) it will say 0 of 49 selected. If it is not cleared, click on clear selection at the top of the table.

- In the attribute table, right click on the **Name** field and choose **Sort Ascending**.

The table has updated and is now showing the state records in alphabetical order.

Step 10 Selecting features through query

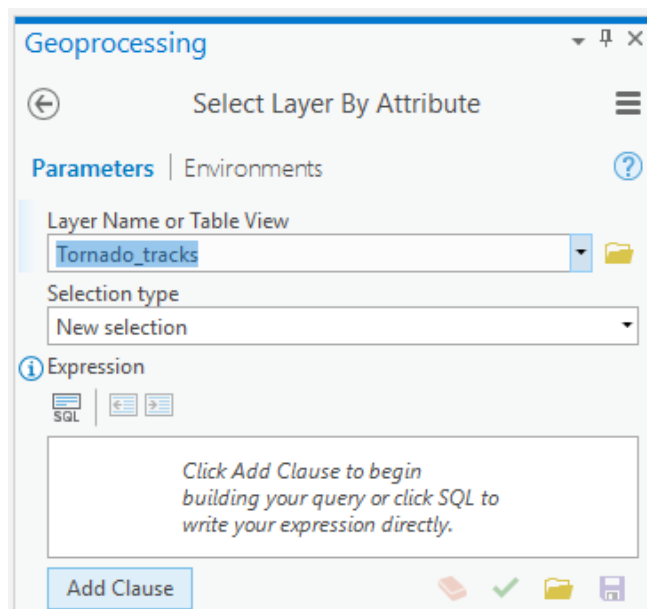
In many instances you want to select information based off of a field characteristic and not necessarily location.

Tornadoes in the United States are often characterized by the maximum speed of their winds. The Fujita Scale, or “F scale” is a scale of 0 to 5, F0 being winds 73 mph or less, and incrementally increasing till F5 which is winds of 218-318 mph. You are asked to create a map of all the tornadoes in the US which were ranked as F4 or higher.

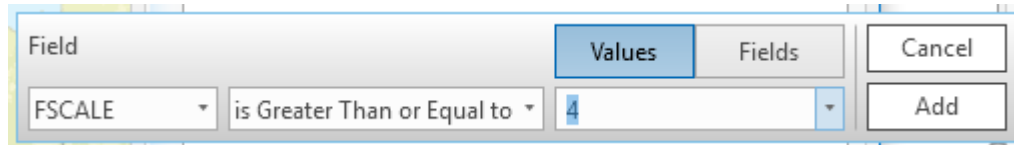
In the tornadoe_tracks attribute table, you will see one of the fields is FSCALE. This is where you will filter our records.

- In the Map tab, in the Selection group, click on the **Select By Attributes** tool.
- In the Layer name or table view, select **Tornado_tracks**. For selection type, leave it as **New selection**.

Below this information you will see a black box which is titled “expression” ArcGIS Pro has the function “Add Clause” which walks you through the steps of generating a SQL statement with a friendly user interface.



- Click **Add Clause**.
- In the first pull down menu, select the field you wish to search in, in our case **FSCALE**.
- The second pull down menu allows you to choose the operation. In our case you want to select **is greater than or equal to**.
- The third pull down menu is where you input the values. In our case you want **4**. Click **Add** when you have finished putting the expression together.



TIP: Underneath the expression box there is a small green check mark. This will verify to see if your expression is valid without running the actual query. It is always a good idea to check with this before running your expression.

- Click **Run**.
- Close the Selection box.

You will see that all the tornados with a F score of 4 or 5 were highlighted in blue

- Open the Attribute Table for Tornado_tracks and click on the icon in the lower left corner that has three blue rows. This shows only the selected records. You will have 650 of 27608 records selected.



- **Clear** the selection

Step 11 Applying multiple definition queries

In the previous step you learned how to select only the tornados with an f score of 4 or higher. Now let's see if any of those occurred in the year that you were born. (These records only extended to 2010, so if you were born past then, pick the year your parents were born)

- In the Map tab, in the Selection group, click on the **Select By Attributes** tool.
- Click Add Clause.
- Make your first query Where FSCALE is greater than or equal to 4.
- Click Add.
- Click Add Clause a second time.

You will notice this interface is identical with a new dropdown menu on the left that allows you to make it an AND, or OR statement. You want **4 or higher tornadoes** that were **in your birth year**, so this is an **AND** statement.

- Select And.
- choose **YEAR_** for the field, then **is Equal to**, then select your birth year.

TIP: If you want to learn what SQL looks like and get more familiar with the format, you can click the SQL button to display the query you created in SQL. For this selection, it should look like “FSCALE >= 4 And YEAR_ = 1996” (if you were born in 1996)

- Click Add.
- **Run** the selection
- Open the **attribute table** for **tornado_tracks** and examine the results. Like in the previous selection, all the selected results appear highlighted in light blue on the map.

How many tornados of an F score of 4 were in the year you were born? F score of 5?

Queries are one method of exploring your data in ArcGIS Pro, and are a key to spatial analysis. You will dive further into this functionality in later exercises.

- Close the Select box.
- Clear your **selection**.
- Save your project.

The Living Atlas

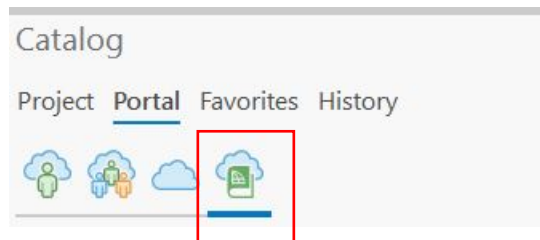
Step 12 Exploring the Living Atlas

The Catalog pane is the easiest way to explore all the data associated with the project you are working on, including toolboxes, geodatabases, connections to folders on your computer, etc.

New to ArcGIS Pro is a built in link to the Living Atlas of the works. The Living Atlas is a curated online dataset of layers, basemaps, and feature services. Each layer has to go through a quality check before it is uploaded and must be from a credible source. This is a great resource for students and professionals alike, just be cautious of the credits and use limitations if you intend on publishing maps with these layers.

- In the in the Contents pane click **Portal**.
- Click the **Living Atlas icon**.

You will need an internet connection to use this service.



TIP: Use the living Atlas in your browser by going to livingatlas.arcgis.com This interface allows for more constraints to be applied and may be easier to use when locating specific information. When you know the name of the layer you want, directly search for it in ArcGIS Pro.

- In the search bar, type "**USA Storm Reports**".
- **Right** on the search result and select **Add to Current Map**.

This layer is hosted by NWS and has locations of current hail, tornado, and wind storms.

- In the **Map** tab, in the **Navigate** group, click on the **Explore** tool.
- Click on one of the icons from the Storm Report in your map.

The pop-up window gives you information about this storm.

- **Save your Project and close ArcGIS Pro.**

Hopefully you are beginning to understand that GIS is an incredibly powerful tool for so many different applications. As you dive into examples in the context of atmospheric science, challenge yourself to think of other ways GIS could be used.