Exercise 1: Visualize deforestation in the Amazon

How can I print an exercise to PDF format?

Software requirements

- ArcGIS Online
- ArcGIS Pro 3.1
- ArcGIS Image Analyst extension
- ArcGIS Spatial Analyst extension

Introduction

Climate change is impacted by many factors. One of those factors is greenhouse gas emissions, or GHGs. To mitigate the effects of climate change, GHGs must be reduced globally. In addition to reducing anthropogenic, or human-created, GHG emissions, we must act to protect and restore our forests. Forests not only help create a cooling effect on our planet, but they also act as carbon sinks. Carbon sinks absorb and store carbon dioxide (CO_2), which is one of the leading greenhouse gasses in the atmosphere. As part of efforts to protect forests, GIS can be used to map, visualize, and calculate land cover change over time to determine where deforestation is occurring.

In this exercise, you will use ArcGIS Pro to visualize deforestation. ArcGIS Pro is a desktop GIS application that supports data visualization, analysis, and data sharing across a suite of ArcGIS products, such as ArcGIS Online. Data sharing lets users work across the ArcGIS system through Web GIS. ArcGIS Pro offers scientific analytical tools for 2D, 3D, and 4D data to identify patterns, make predictions, and answer questions.

The data for the exercise is from ArcGIS Living Atlas of the World, which is a collection of authoritative GIS data, including maps, layers, 3D scenes, apps, and tools that can be used for projects.

Scenario

Imagine that you work for a nonprofit organization that is mapping deforestation of the Amazon rainforest in South America. The Amazon is the Earth's largest tropical forest and is an important carbon sink. However, as a result of deforestation, the Amazon could instead become a GHG emitter—when forests are cut down, much of the carbon stored in the trees is released back into the atmosphere as CO_2. The Brazilian state of Rondônia is part of an "arc of deforestation," Amazonian territories where industrial agriculture and deforestation have significantly increased in recent decades. In this exercise, you will visualize where land cover change has occurred in the past two decades, specifically land that changed from forest to cropland and urban areas in Rondônia, Brazil.

Note: The exercises in this course include View Result links. Click these links to confirm that your results match what is expected.

Estimated completion time in minutes: 60

Expand all steps | Collapse all steps

- Step 1: Download the exercise data files

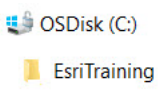
In this step, you will download the exercise data files.

a Open a new web browser tab or window.

b Go to CLIM Section 1: Rondonia Deforestation and download the exercise data ZIP file.

Note: The complete URL for the exercise data file is https://www.arcgis.com/home/item.html?id=86947ebe72614e649a0007fec137e47d.

c On your local computer, create a folder named **EsriTraining**.



*Step 1c***: Download the exercise data files.*

- Hint

Click View Result links, like the one above, to confirm that your results match what is expected.

Throughout this course, you will save all your data to this folder. When you create the folder, do not use spaces or special characters in the folder name.

d Extract the exercise data files to the EsriTraining folder that you just created.

*Step 1d***: Download the exercise data files.*

e Confirm that the extracted data files are stored in the RondoniaDeforestation folder.

f Close File Explorer.

You have downloaded and extracted the exercise data files that you need to complete the first section of the MOOC.

- Step 2: Confirm that your computer can run ArcGIS Pro

Before running your analysis, you must first download and install ArcGIS Pro. For the duration of the course, you will have free access to all the software required to complete the MOOC.

In this step, you will run a test to confirm that your computer can support ArcGIS Pro. Even if you have ArcGIS Pro installed, you should confirm that your computer can support ArcGIS Pro 3.1.

Note: This test uses a third-party executable file. If you prefer not to run this test for security reasons, you can review the Common Questions or go to ArcGIS Pro Help: ArcGIS Pro 3.1 system requirements.

a Go to Can your computer run ArcGIS Pro 3.0 and 3.1?

b Click Run Tech Check.

c Follow the steps to open and run the test.

The site generates a report that lists the minimum requirements and identifies whether your machine meets these requirements.

d Save the report.

The MOOC team may ask you to share the report if you need help in later ArcGIS Pro exercises.

Note: If the report says that you need to update Microsoft .NET, the next exercise step, *Install Microsoft .NET Desktop Runtime*, will guide you through the process.

e If your computer does NOT meet these requirements, check the Common Questions to find links to complete any other recommended updates, and then run the test again.

Note: If your computer does not meet the requirements, you may need to use a different computer or update your graphics card. For more information about graphics card requirements, go to ArcGIS Pro Help: ArcGIS Pro 3.1 system requirements > Hardware requirements.

f If your computer meets the requirements, continue to Step 4, *Locate your course account to install ArcGIS Pro*.

You have run and saved a report that determined whether your computer can support ArcGIS Pro 3.1.

- Step 3: Install Microsoft .NET Desktop Runtime

ArcGIS Pro 3.1 is built on .NET 6.0, Microsoft's latest edition of .NET that has long-term support. Moving to this version of .NET positions Esri and other ArcGIS Pro developers well for future development and enhancements. Because certain third-party components may start to be compatible only with .NET 6.0, it is best to use the most updated software framework.

Before you can install ArcGIS Pro 3.1 to use in the MOOC exercises, you must update your system to .NET 6.0.

Note: If you already have Microsoft .NET Desktop Runtime 6.0 on your computer, continue to the next step to install ArcGIS Pro 3.1. Alternatively, if you already have both ArcGIS Pro and Microsoft .NET 6.0 on your computer, you can update your version of ArcGIS Pro directly from the Settings tab on the Start page of ArcGIS Pro.

a In a web browser, go to ArcGIS Pro Help: ArcGIS Pro 3.1 system requirements > Software requirements.

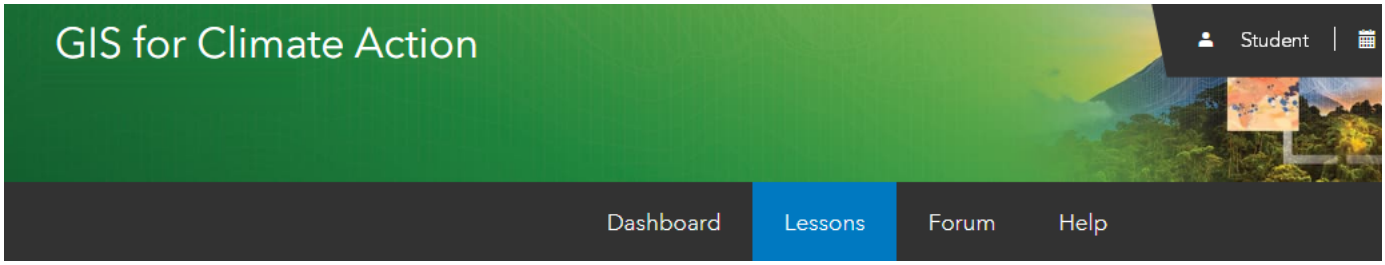
b For Microsoft .NET, click the link in the Minimum Requirement column and follow the instructions to download and install Microsoft .NET Desktop Runtime 6.0.x - Windows x64.

After you successfully download and install Microsoft .NET Desktop Runtime 6.0, you are ready to download and install ArcGIS Pro 3.1.

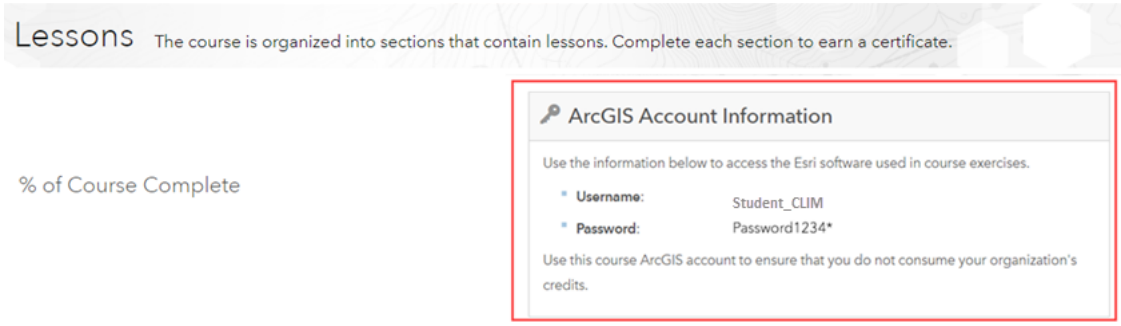
- Step 4: Locate your course account to install ArcGIS Pro

In this step, you will visit the MOOC home page to locate your course account username and password. Then, if necessary, you will install ArcGIS Pro 3.1 from ArcGIS Online.

a On the MOOC home page, click the Lessons tab.



b Under Lessons, locate your ArcGIS account information.



You will use your course ArcGIS account username and password to download ArcGIS Pro and complete all the MOOC exercises. The username for your account ends with **_CLIM** (for example, Student_CLIM). You may want to write down this username and password for quick reference; otherwise, you can return to the Lessons tab at any time to locate your credentials.

Note: If you registered in the last few hours, your account may not be ready. Refresh the page in an about an hour to see whether your account information is available.

If you have already installed ArcGIS Pro 3.1, you can skip the remaining actions in this step and continue to Step 5, *Explore an ArcGIS Pro project*.

c Open a new web browser in private or incognito mode.

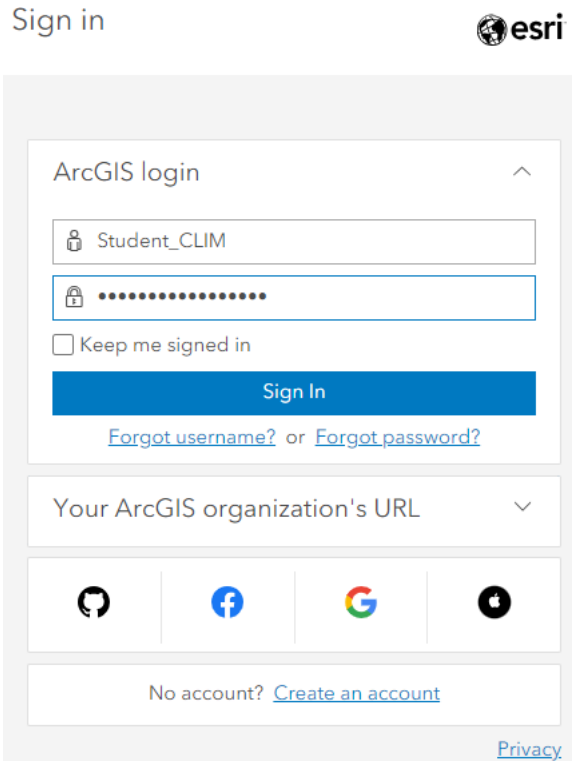
Note: To learn how to enable private browsing, go to How to Enable Private Browsing on Any Web Browser.

d In the address bar, type **www.arcgis.com** and press Enter.

*Step 4d***: Locate your course account to install ArcGIS Pro.*

e Click Sign In.

f Under ArcGIS Login, copy and paste or type your course ArcGIS username and password.

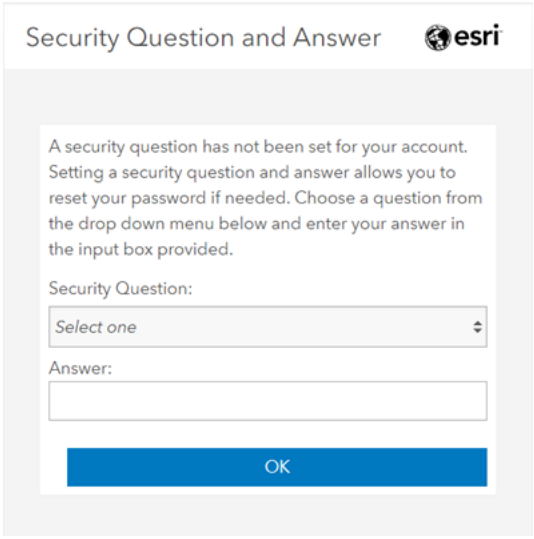


*Step 4f***: Locate your course account to install ArcGIS Pro.*

g Click Sign In.

The first time that you sign in, you may be asked to change your password and set a security question.

h If necessary, follow the on-screen instructions to change your password and set your security question.

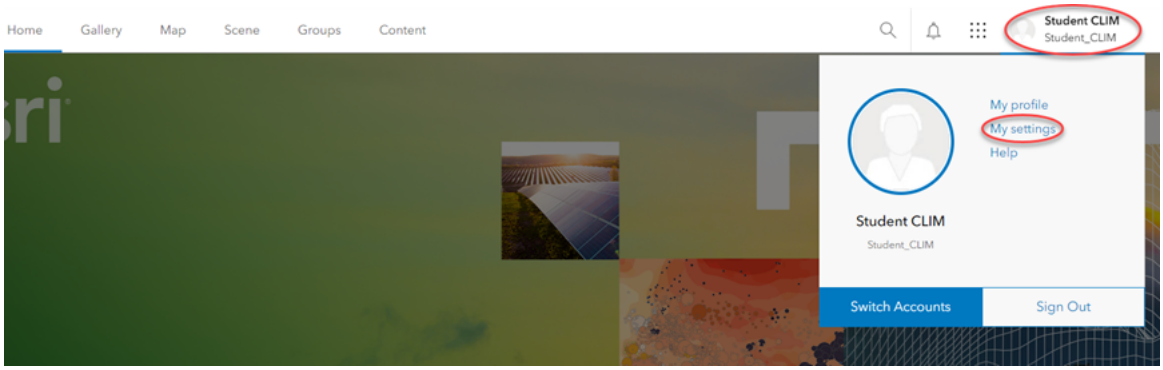


*Step 4h***: Locate your course account to install ArcGIS Pro.*

Note: An automated email will be sent to the email address that is associated with your account, telling you that your account was recently modified. No action is required.

After the sign-in process is complete, you will see the home page of the MOOC organization.

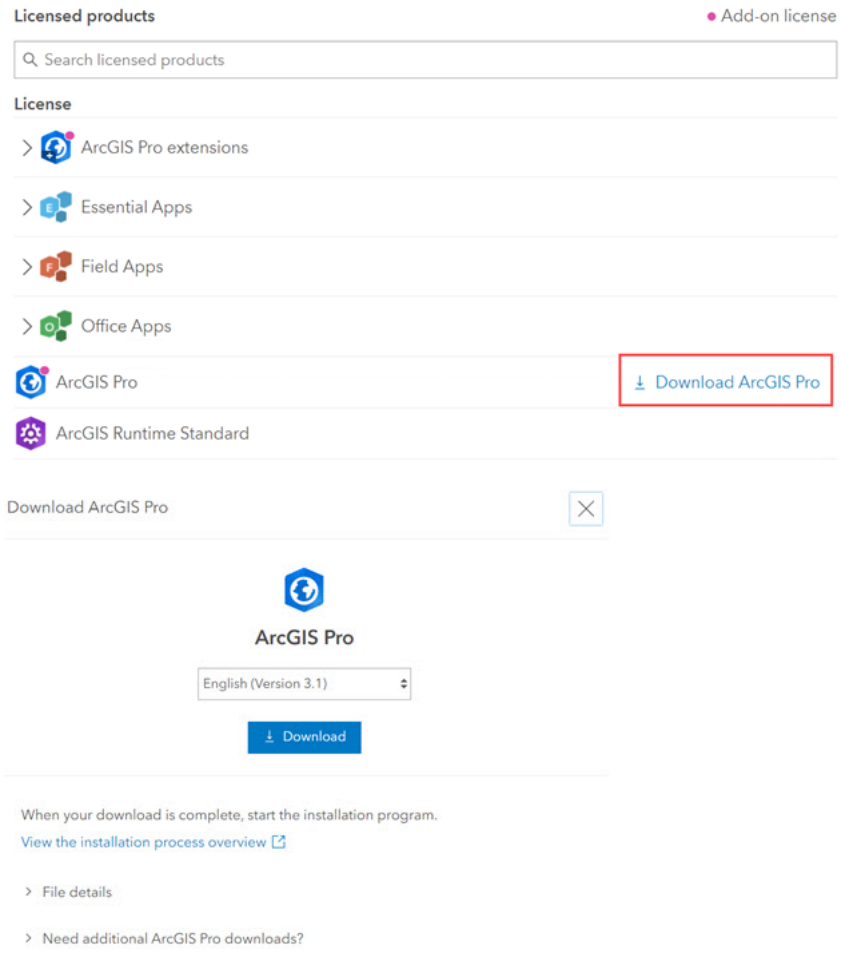
i In the top-right corner, click your account username and choose My Settings, as shown in the following graphic:



j On the left side of the My Settings page, click the Licenses tab.

k Under Licensed Products, locate ArcGIS Pro.

l To the right of the software name, click Download ArcGIS Pro.



*Step 4l***: Locate your course account to install ArcGIS Pro.*

The Download ArcGIS Pro window opens.

Note: To run ArcGIS Pro in a different language, click the English (Version 3.1) down arrow and choose your preferred supported language. Keep in mind that this course is taught in English, which means that all screenshots and exercises use the English version of ArcGIS Pro.

m Click Download.

If the default download location does not have enough space, you can change the location by following the steps in How to Change the File Download Location in Your Browser.

n After the download completes, double-click the .exe file.

o Follow the installation instructions, accepting all defaults.

p After you are finished installing ArcGIS Pro, close the incognito web browser window.

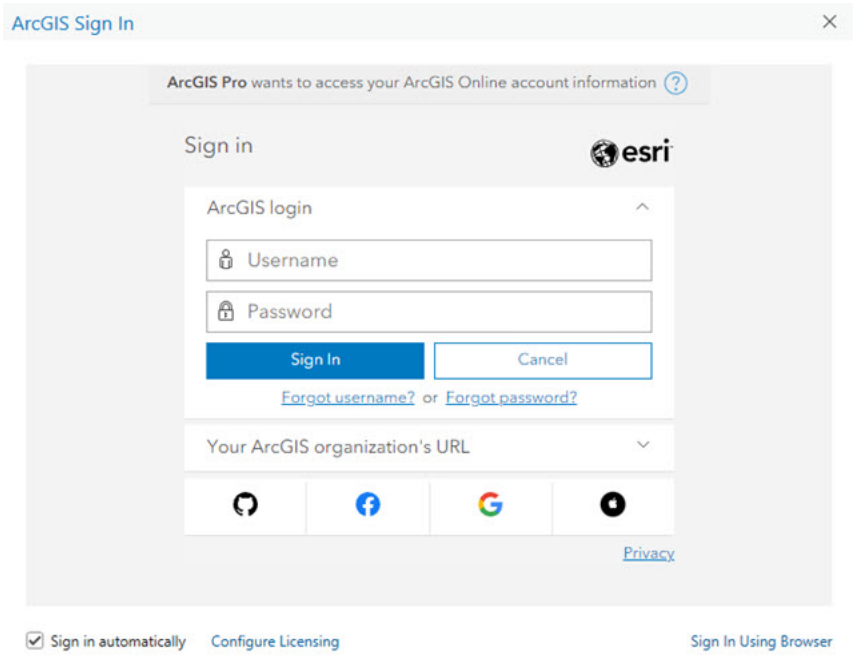
You have located your course ArcGIS account for the MOOC and installed ArcGIS Pro 3.1.

- **Step 5: Explore an ArcGIS Pro project**

In this step, you will open an ArcGIS Pro project for your visualization of deforestation in Rondônia, Brazil. You will first sign in to ArcGIS Pro using your course ArcGIS account username and password. The username for your course account ends with **_CLIM** (for example, Student_CLIM). You will use this course ArcGIS account to complete all the MOOC exercises.

a Click the Windows Start button on your computer.

b Expand the ArcGIS folder and click ArcGIS Pro.



*Step 5b***: Explore an ArcGIS Pro project.*

The ArcGIS Pro sign-in dialog box appears. You will use your course ArcGIS account username (ending in _CLIM) and password to sign in to ArcGIS Pro.

c Type your course ArcGIS account username and password and click Sign In.

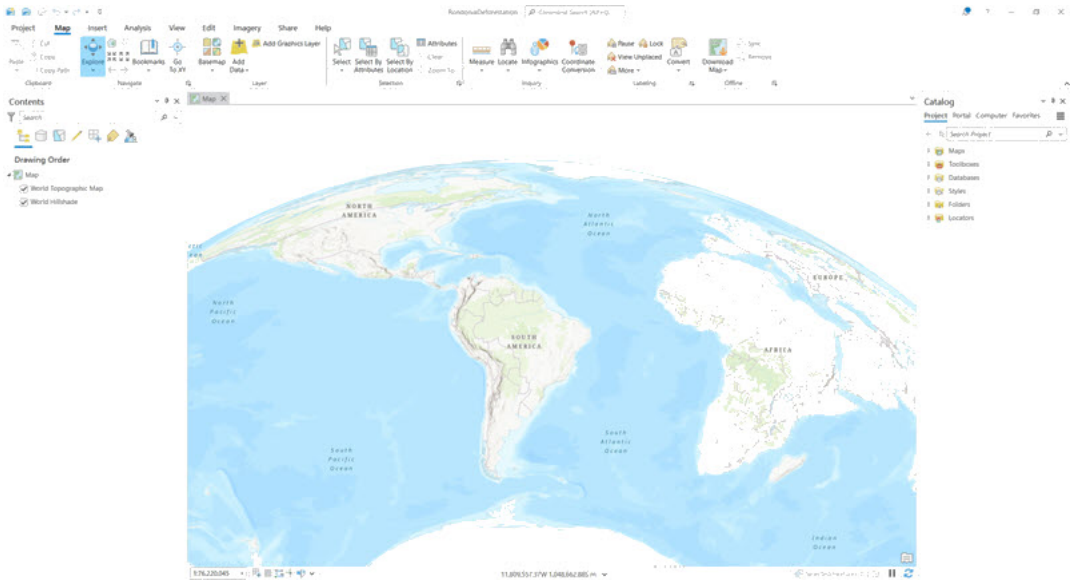
Note: If you are already signed in to ArcGIS Pro with a different organizational account, in the top-right corner, click Sign Out and then sign in again using your course username (ending in _CLIM) and password.

d Near the center of the screen, click Open Another Project.

e In the Open Project dialog box, browse to your EsriTraining folder.

f From the EsriTraining folder, double-click the RondoniaDeforestation folder to open it.

g Double-click the RondoniaDeforestation.aprx file.



*Step 5g***: Explore an ArcGIS Pro project.*

Your project opens in ArcGIS Pro to a map showing only the Topographic basemap. You only see the basemap because you have not added any data to the project yet. Basemaps are the foundation for your maps and provide context for your work. They serve as reference maps for overlaying data from layers and visualizing geographic information.

Above the map is the ArcGIS Pro ribbon. ArcGIS Pro uses this horizontal ribbon to display and organize functionality into a series of tabs.

h On the ribbon, click the View tab.

i In the Windows group, click Reset Panes and choose Reset Panes For Mapping (Default).

j On the ribbon, click the Map tab.

You reset the panes to show the default mapping panes. To the left of the map is the Contents pane, which will list the layers that you add to the map. To the right of the map is the Catalog pane, which lists the items that are associated with the ArcGIS Pro project: Maps, Toolboxes, Notebooks, Databases, Styles, Folders, and Locations.

The Map tab includes a Navigate group, which provides the tools that you need to navigate the map. The default tool is the Explore tool , which you can use to pan and zoom in and out of maps. To explore different areas of the world on this basemap, you can pan the map by clicking your mouse and holding down the button while you move the map. When you pan a map with the mouse, the pointer becomes a hand. To zoom in or out of the map, you can either use the mouse wheel or click the Fixed Zoom In button and Fixed Zoom Out button , respectively, in the Navigate group.

To learn more about the ArcGIS Pro interface, go to ArcGIS Pro Help: ArcGIS Pro user interface. To learn more about ArcGIS Pro projects, go to ArcGIS Pro Help: Projects in ArcGIS Pro.

You have signed in to ArcGIS Pro with your course ArcGIS account credentials and opened an ArcGIS Pro project. Next, you will add data to your project.

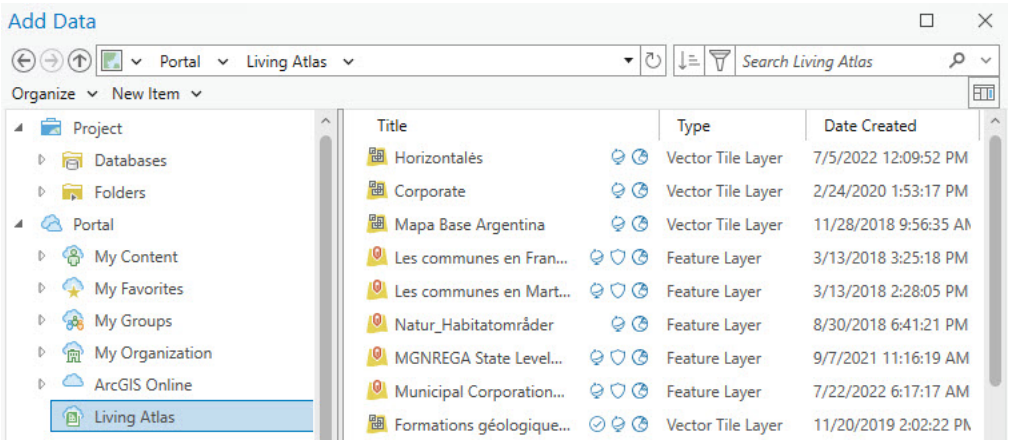
- Step 6: Add data from ArcGIS Living Atlas of the World

ArcGIS Pro allows you to add data from your computer, a local network, or a portal such as ArcGIS Online or ArcGIS Living Atlas of the World.

In this step, you will add to your map global land cover imagery data for the years 1992–2020 from Living Atlas. You will use this data to visualize forest changes between those dates.

a On the ribbon, in the Layer group, click the Add Data down arrow and choose Data.

b In the Add Data dialog box, from the menu on the left, click Living Atlas.



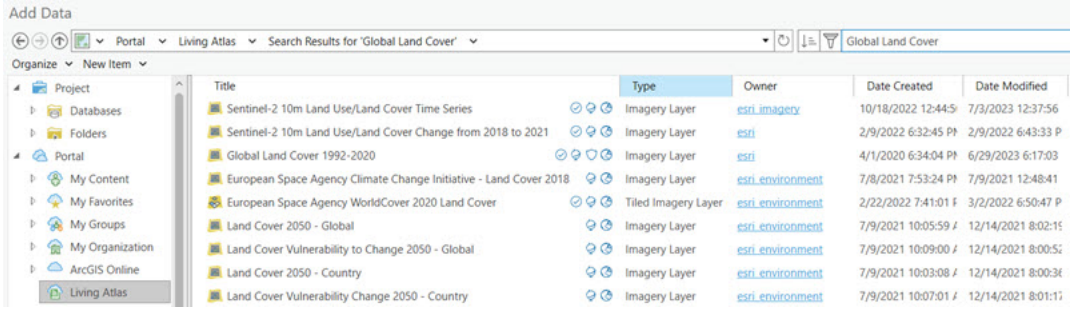
*Step 6b***: Add data from ArcGIS Living Atlas of the World.*

The Living Atlas layers you see listed may differ from the graphic.

A list of layers in Living Atlas appears. You will search Living Atlas for a global land cover imagery layer that is owned by Esri. Imagery layers are images stored as data; typically the images are acquired by a satellite or aircraft using different types of sensors. The imagery layer that you will use was acquired by a satellite over a series of years.

c At the top right of the dialog box, in the Search Living Atlas field, type **Global Land Cover**, and then press Enter.

d If necessary, expand the Add Data dialog box until you can see the Owner column.



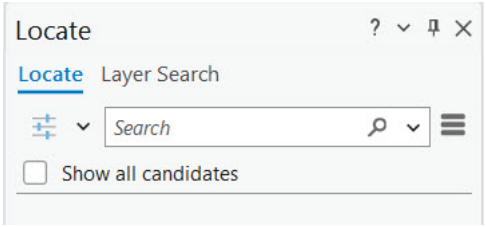
*Step 6d***: Add data from ArcGIS Living Atlas of the World.*

e Click the Global Land Cover 1992-2020 layer that is owned by Esri, and then click OK.

The Global Land Cover 1992-2020 imagery layer is added to the map and the Contents pane. By adding this imagery layer, you now have a time-series map of the surface of the Earth from the European Space Agency Climate Change Initiative. Time-series maps, or maps that contain temporal data, provide additional functionality in ArcGIS Pro that allows you to explore the data over time.

The map is classified into 36 land cover types. You will search for Rondônia, a state in Brazil that is located in the Brazilian Amazon.

f On the ribbon, in the Inquiry group, click Locate.

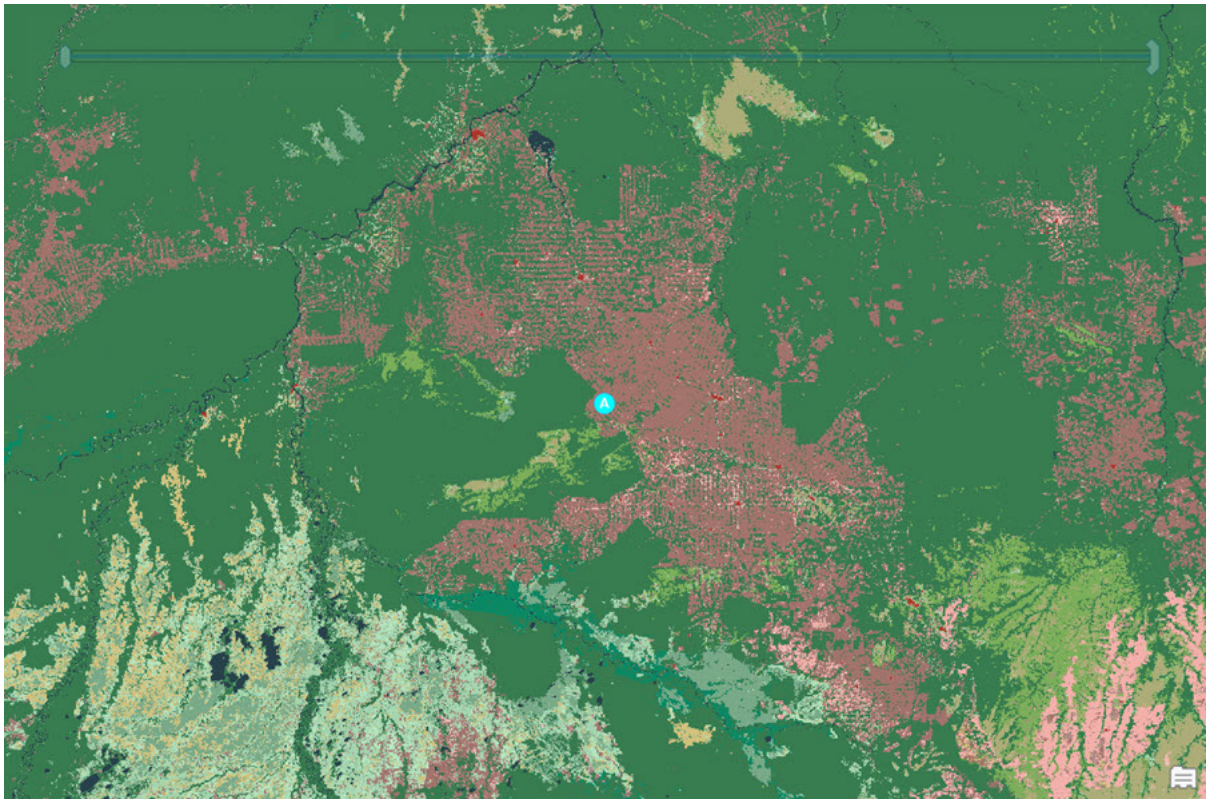


*Step 6f***: Add data from ArcGIS Living Atlas of the World.*

The Locate tool opens on the right. You can use this tool to search for locations on the map by address, place-name, or coordinate values. You will search for Rondônia, Brazil.

g In the Locate tool, in the Search field, type **Rondonia**.

h From the list of results that appears as you type, select Rondonia, BRA.



*Step 6h***: Add data from ArcGIS Living Atlas of the World.*

The map, which shows various land cover classifications, zooms to the state of Rondônia, Brazil. You will create a bookmark for this location. A bookmark identifies and saves a geographic location for you to reference later.

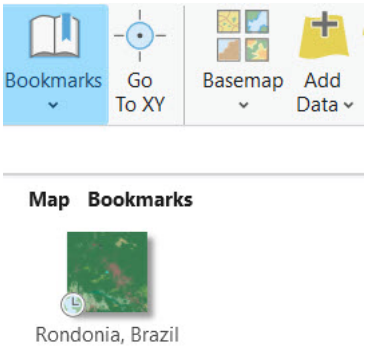
i On the ribbon, in the Navigate group, click Bookmarks.

j Click New Bookmark.

k In the Create Bookmark dialog box, for Name, type **Rondonia, Brazil**.

l Click OK.

m On the ribbon, click Bookmarks to view your new bookmark.



*Step 6m***: Add data from ArcGIS Living Atlas of the World.*

n Above the ribbon, click the Save Project button .

You have added global land cover data from Living Atlas to your map and created a bookmark that you can use to quickly return to your geographic location of interest on the map.

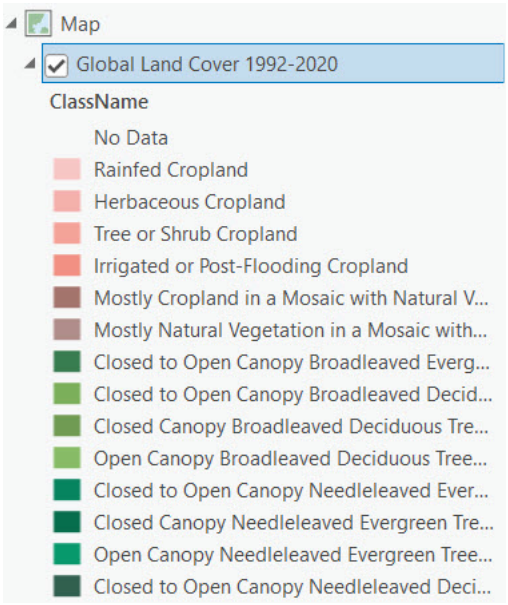
Next, you will explore the data.

- Step 7: Explore the data

Data found in Living Atlas comes from trusted sources. Each item is carefully reviewed by Esri subject matter experts to ensure that it meets Living Atlas quality standards. Because of this review process, the data that you added to your map is already symbolized, includes the necessary metadata, and is time-enabled. Although you could have found the source data for this layer on the European Space Agency Climate Change Initiative website, using Living Atlas saved you time because you did not have to symbolize or configure the data.

In this step, you will explore the data in the layer to prepare to visualize how much land has changed from forest to cropland and urban areas.

a In the Contents pane, to the left of the Global Land Cover 1992-2020 layer name, click the arrow to expand the layer's legend.



*Step 7a***: Explore the data.*

By expanding the layer, you can see what each symbology color represents in the map. Cropland is displayed in shades of pink, urban areas in red, and forested areas in shades of green.

Because the layer contains temporal data, a time slider appears at the top of the map and a Time tab appears on the ribbon. You can use temporal data to visualize your data over time.

b At the top of the map, place your mouse over the time slider and click the Play button ▶.

> Using the time-enabled visualization, what do you see happening in Rondônia, Brazil?
>
> - Answer
> Between 1992 and 2020, areas of pink and red expanded across the map, representing land that was converted from forest to cropland or urban areas in this region of the world. This phenomenon is known as deforestation.

c Place you mouse over the time slider and click the Time Enabled button to disable the time slider.

In this step, you explored time-enabled data in ArcGIS Pro.

d On the right, close the Locate pane.

e On the Map tab, in the Navigate group, click Explore.

f Save your project.

- Step 8: Create definition queries

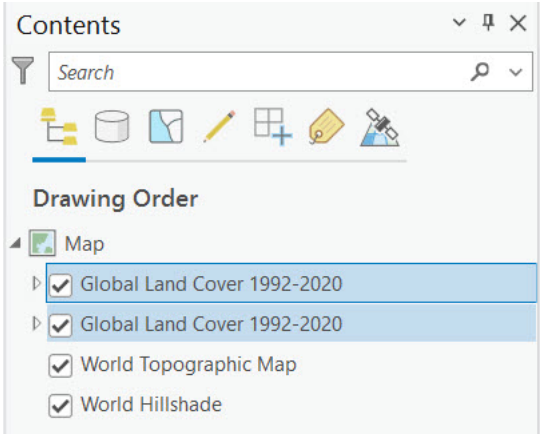
Definition queries allow you to filter data so that only a subset of the features appear in the layer. Definition queries affect not only what is visualized on the map but also which features appear in the layer's attribute table and can be selected, labeled, identified, and processed by geoprocessing tools.

In this step, you will create two layers using definition queries to help you visualize forest that was converted to croplands and urban areas between 1992 and 2020.

a In the Contents pane, to the left of Global Land Cover 1992-2020, click the arrow to hide the legend.

b Right-click Global Land Cover 1992-2020 and choose Copy.

c Still in the Contents pane, right-click Map and choose Paste.

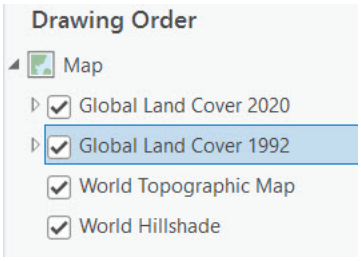


*Step 8c***: Create definition queries.*

You now have two identical layers listed in the Contents pane, both called Global Land Cover 1992-2020. Before creating the definition queries, you will rename the layers to differentiate between land cover in 1992 and land cover in 2020.

d Click the name of the top Global Land Cover layer and rename it **Global Land Cover 2020**.

e Click the name of the bottom Global Land Cover layer and rename it **Global Land Cover 1992**.



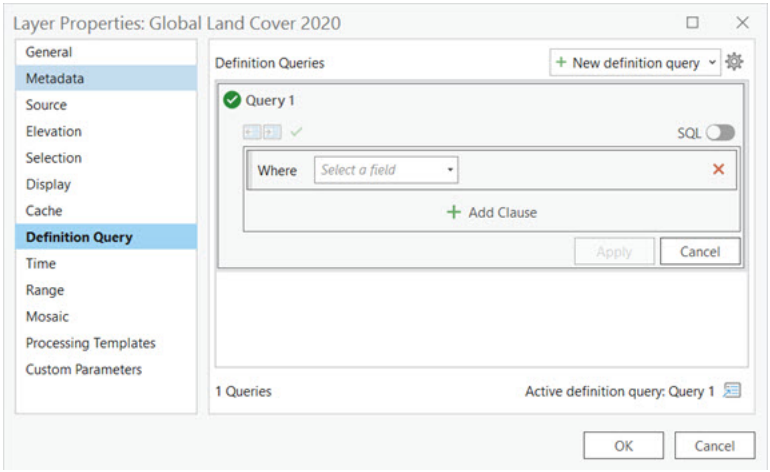
*Step 8e***: Create definition queries.*

Now that you have renamed the layers, you will add a definition query to each layer.

f Right-click the Global Land Cover 2020 layer and choose Properties.

g In the Layer Properties dialog box, click Definition Query.

h Click New Definition Query.



*Step 8h***: Create definition queries.*

You will build a definition query that only shows the land cover data for the year 2020.

i For Select A Field, click the down arrow and choose `Start Date`.

j For Is Equal To, click the down arrow and choose `Is On Or After`.

k For the empty field, click the down arrow and choose `1/1/2020 12:00:00 AM`.

*Step 8k***: Create definition queries.*

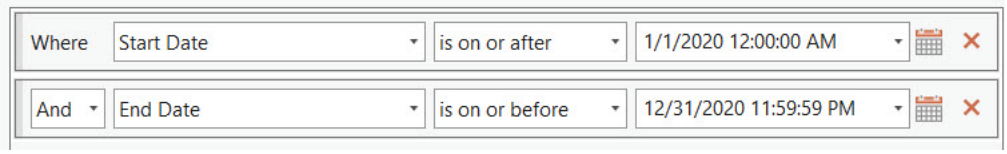
You will now add an end date to the query.

l Click Add Clause.

m For Select A Field, click the down arrow and choose `End Date`.

n For Is Equal To, click the down arrow and choose `Is On Or Before`.

o For the empty field, click the down arrow and choose `12/31/2020 11:59:59 PM`.



*Step 8o***: Create definition queries.*

You have created a definition query for the Global Land Cover 2020 layer to show data only for the year 2020.

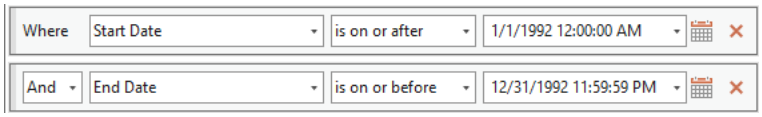
p Click Apply, and then click OK.

q Follow the same steps to create a definition query for the Global Land Cover 1992 layer to show data only for the year 1992.

- Hint

  Your final definition query should read:

  `Where Start Date Is On Or After 1/1/1992 12:00:00 AM And End Date Is On Or Before 12/31/1992 11:59:59 PM.`



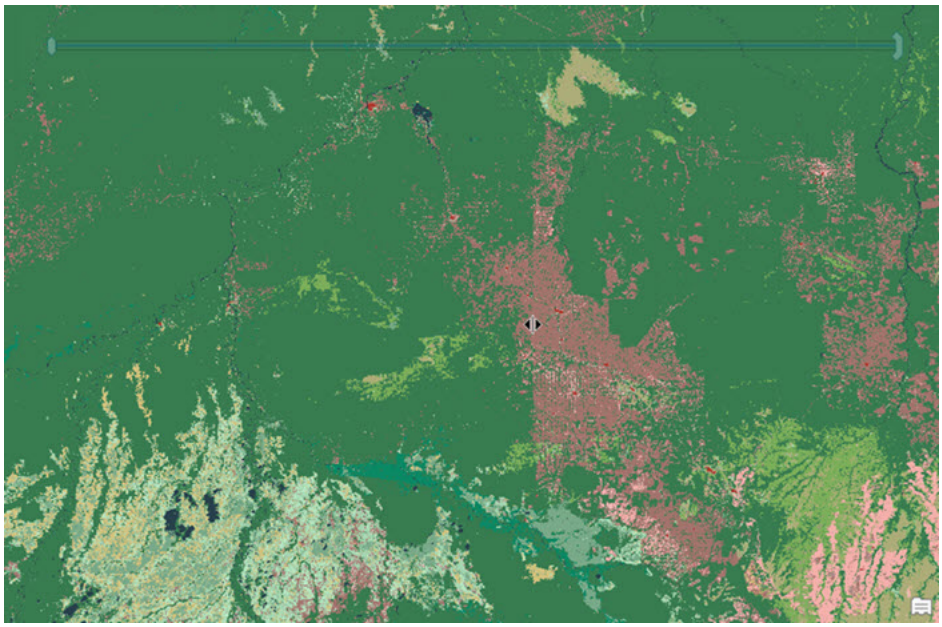
You have created definition queries for 2020 and 1992 to prepare your data for analysis. To visually compare the two years, you will use the Swipe tool.

r In the Contents pane, click the Global Land Cover 2020 layer.

s On the ribbon, click the Image Service Layer tab.

t In the Compare group, click Swipe.

u Click the map, and then hold and move your mouse from left to right.



*Step 8u***: Create definition queries.*

Using the Swipe tool, you can visually compare the amount of land cover change, or deforestation, that occurred in Rondônia, Brazil, between 1992 and 2020.

v Save your project.

w If you are continuing to the next exercise, leave ArcGIS Pro open; otherwise, exit ArcGIS Pro.

In this exercise, you visualized deforestation in Rondônia. Because massive deforestation has occurred in this part of the Amazon, it was easy to visually identify the areas on the map that changed from forest to croplands and urban areas.

After visualizing the changes, you might have wondered whether your data could answer other questions, such as how much land was converted from forest to croplands and urban areas. In the next exercise, you will use geoprocessing tools in ArcGIS Pro to calculate the amount of deforestation between 1992 and 2020.