Exercise

Small Multiples

Section 6 Exercise 1

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esri

THE SCIENCE OF WHERE™
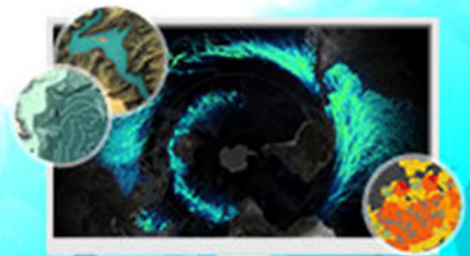
Small Multiples

Instructions

Use this guide and ArcGIS Pro to reproduce the results of the exercise on your own.

Note: The version of ArcGIS Pro that you are using for this course may produce slightly different results from the screenshots you see in the course materials.

Time to complete

Approximately 30-35 minutes.

Software requirements

ArcGIS Pro 2.1

Introduction

Some maps are packed with information that needs to express itself in more than just a single static view. Maybe the mapped phenomenon has a time component that is best explored incrementally in order to show change. Or maybe the phenomenon depicts a range of data that can be shown as growing or shrinking. Depending on the data that you have, and the dynamic phenomenon that it represents, sometimes small multiples are the way to go.

A small multiple layout presents a single phenomenon as a collection of—you guessed it—multiple small graphics, each slightly different, to provide the map reader with a broader, more dimensional understanding.
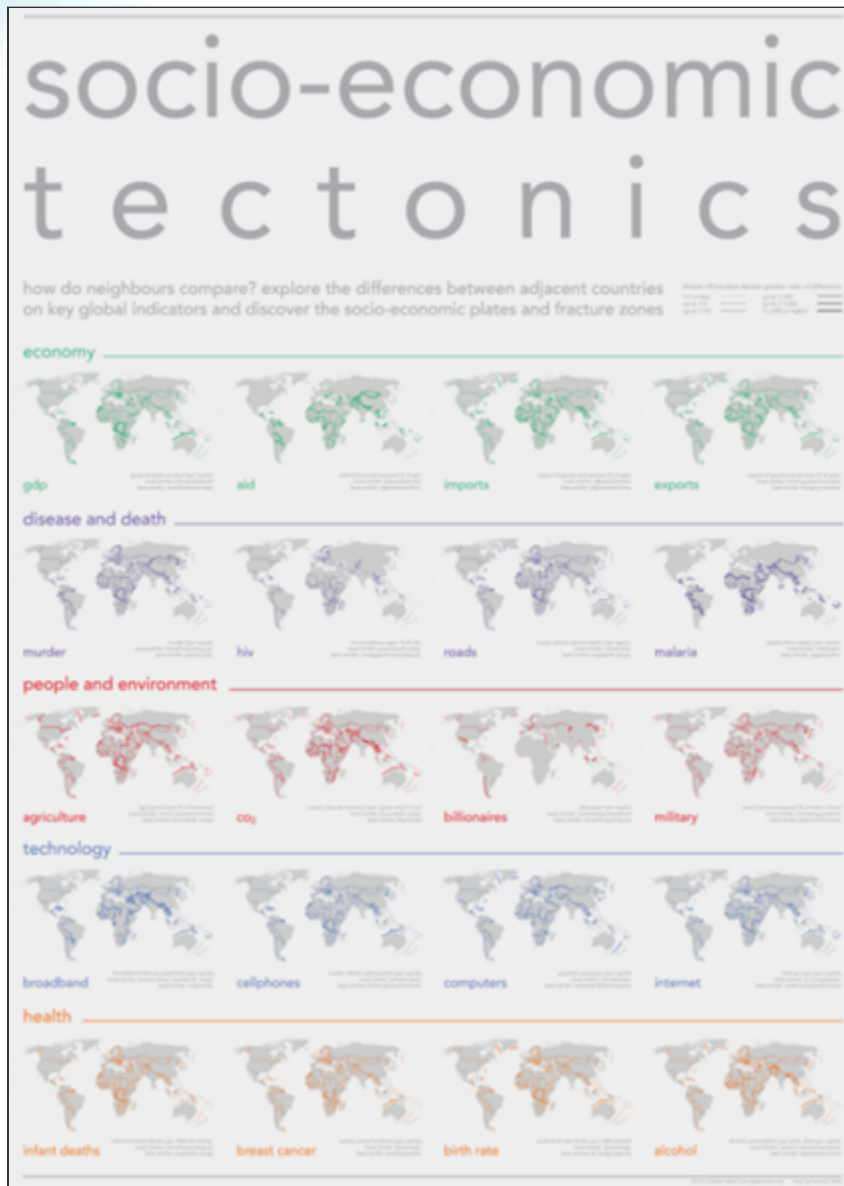
A smalll multiples as an infographic poster (https://bit.ly/2JEQ5vE).

Purpose

Wait, this sounds an awful lot like the frames of a flip-book (https://bit.ly/1P7sWOA) animation, or the individual cells of a film strip. Why not just use animation, instead of small multiples? Animation is a lot of fun (and the subject of another exercise), but sometimes you want a map reader to be able to be fully in control of the visual exploration of the maps. A

small multiple layout lets map readers compare and contrast at their own pace, or make connections between maps that might not be neighbors in a conventional animation.

Also, humans have a hard time tracking with long animated transitions, and some of the information in your maps may leak out before an animation completes. Or change blindness (https://bit.ly/2IIKi76) may have obscured some meaningful aspect of the phenomenon altogether. A more practical benefit of small multiples is that they can be shared in a single static image, rather than being subject to digital environments that support animation.

What will you learn?

This exercise uses ArcGIS Pro to create multiple small maps, each showing a different slice of the data. You will create thematic classes, explore symbology, and use the "range" filter to create individual map instances to compile into a small multiple layout. You'll learn how to export that map layout as a sharable image. Additionally, you will see firsthand how an effective small multiple layout affords map understanding at the map reader's pace and allows for an unbounded exploration of differences and similarities.

Step 1: Download the exercise file

In this step, you will download the exercise file.

a   Open a new web browser tab or window.

b   Go to https://bit.ly/2GRnGko, and download the exercise file.

c   Save the file in a location that you will remember.

Step 2: Open an ArcGIS Pro project package

a   If necessary, start ArcGIS Pro and sign in using your course credentials.

b   Open the Sec6Ex1_SmallMultiples.ppkx ArcGIS Pro project.
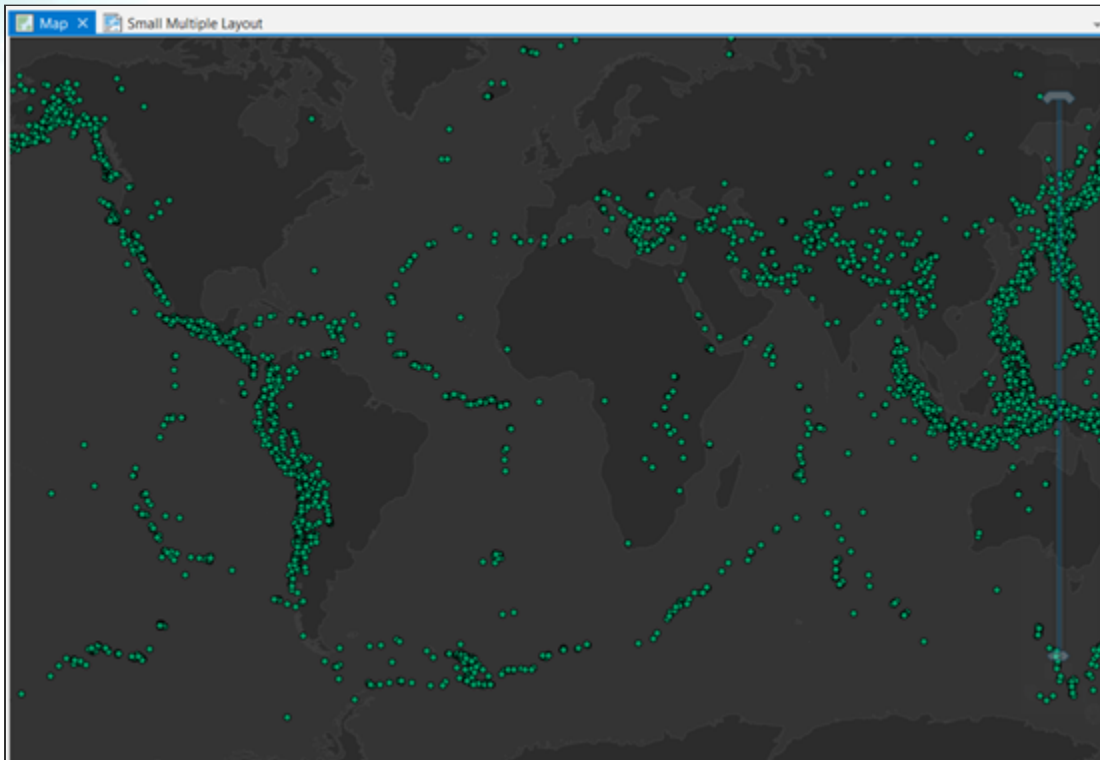
You'll see a map showing the basic outlines of the continents and a layer named Quakes6PlusSince1898. That layer houses thousands of points representing the locations of historical earthquake epicenters that measured at least a magnitude of 6.

To maintain the original project file, you will save your project with a different name.

c From the Project tab, click Save As and type a name for your project, such as **Sec6Ex1_SmallMultiples_<yourfirstandlastname>.aprx**.

To provide more context and meaning, you will use graduated symbols to represent earthquake magnitude.

Step 3: Use graduated symbols

As you've seen, graduated symbols are used to show a quantitative difference between mapped features by varying the size of the symbols. Symbol size is an effective way to represent differences in magnitude of earthquakes because larger symbols are naturally associated with meaning a greater amount of something.

a In the Contents pane, right-click the Quakes6PlusSince1898 earthquakes layer and choose Symbology.

b In the Symbology pane, for Symbology, choose Graduated Symbols from the drop-down list.
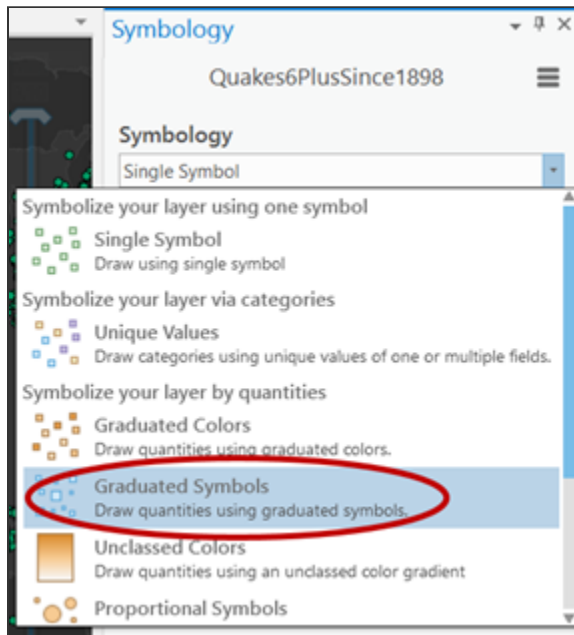
Graduated symbols can be based on a numeric attribute field in the dataset. In this case, you will use the Magnitude (Mag) field, which contains values from 6 through 9.1.

c For Field, choose Mag.

You will start with the Natural Breaks data classification method and then manually add class breaks and set class ranges that are appropriate for this data.
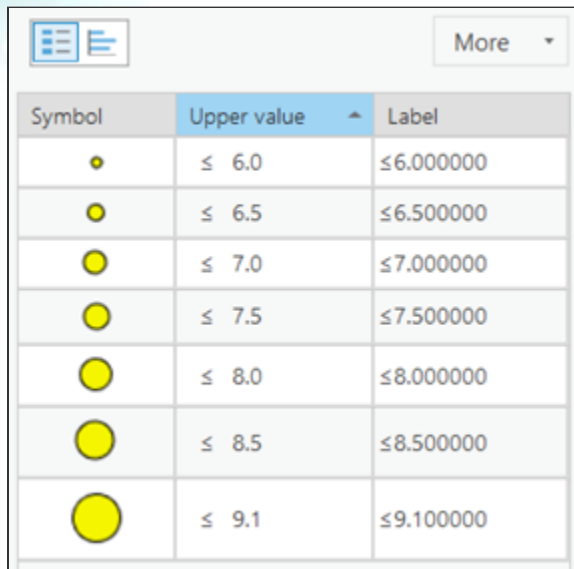
d For Classes, type 7.

e In the table at the bottom of the Symbology pane, starting at the bottom of the table, click in the Upper Value field for the largest symbol, replace the existing value with 9.1 and press Enter.

f Continuing up the rows in the table, replace the existing values and manually assign the range break numbers in the Upper Value column of the table to the following numbers: 8.5, 8.0, 7.5, 7.0, 6.5, and 6.0, pressing Enter after changing each value.

Note: Start at the bottom of the table with the largest value and replace all the values in the Upper Value field, working your way up the table.

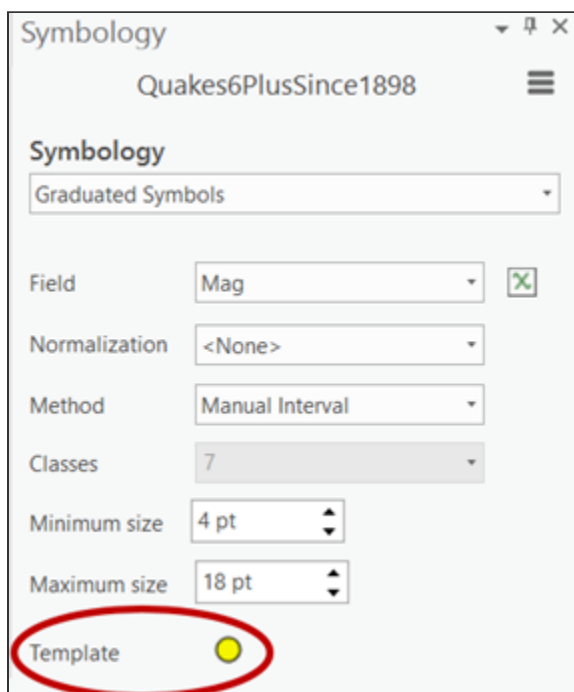Your table should look like the following graphic:

Symbol	Upper value ▲	Label
●	≤ 6.0	≤6.000000
●	≤ 6.5	≤6.500000
●	≤ 7.0	≤7.000000
●	≤ 7.5	≤7.500000
●	≤ 8.0	≤8.000000
●	≤ 8.5	≤8.500000
●	≤ 9.1	≤9.100000

You will see that the data classification method in the Method field changed to Manual Interval after you began manually entering values in the Upper Value field.

You will now modify the symbol being used.

g For Template, click the yellow circular point symbol to open the Format Point Symbol pane.

Symbology ▾ 🕮 ✕

Quakes6PlusSince1898 ≡

Symbology

Graduated Symbols ▾

Field	Mag ▾	🅧
Normalization	<None> ▾	
Method	Manual Interval ▾	
Classes	7 ▾	
Minimum size	4 pt ⏶⏷	
Maximum size	18 pt ⏶⏷	
Template	●	

At the top of the Format Point Symbol pane, the Gallery tab displays symbol shapes and colors.

(h) From the gallery of icons, choose Circle 1 (a solid black circle).

(i) At the top of the pane, click the Properties tab.

Here, you can modify the selected symbol.

(j) Click Color to open the color palette.

You can select one of the standard ArcGIS Colors from the color palette, but you will create your own color for this exercise.

(k) At the bottom of the color palette, choose Color Properties.

(l) In the Color Editor dialog box, use the Red, Green, and Blue sliders to create a color that appeals to you and apply a transparency value of 75%.
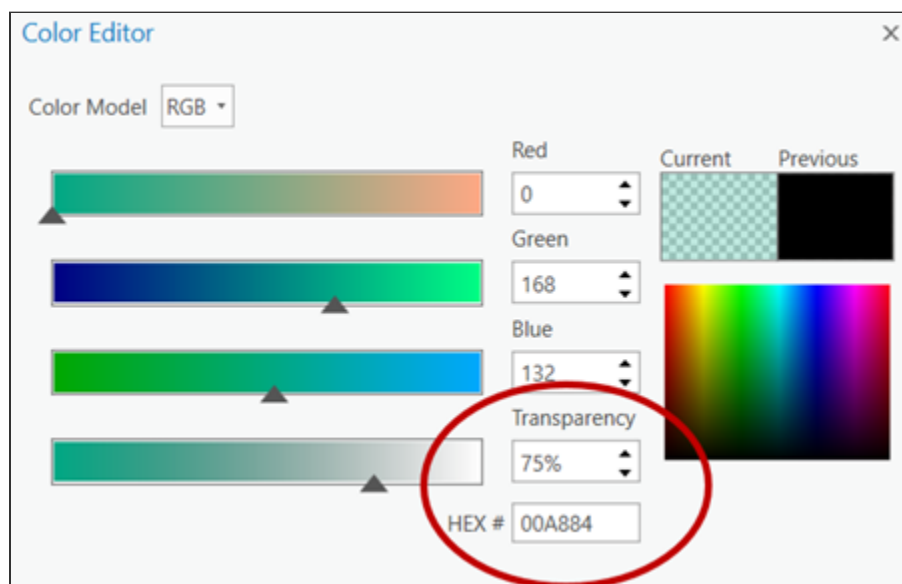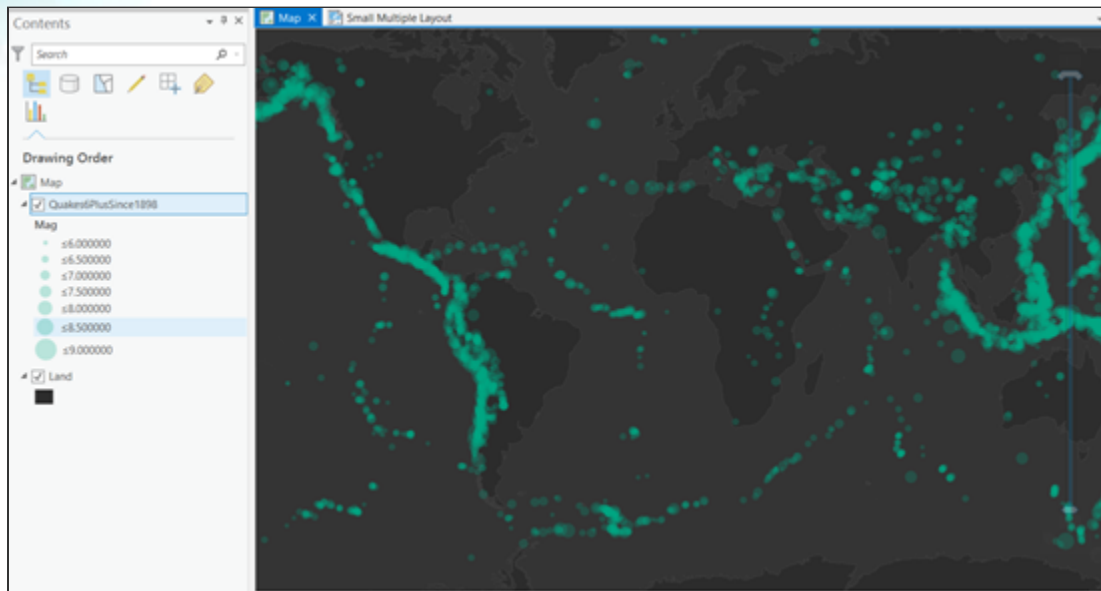

The example shown uses Malachite Green, which is HEX color #00A884.

Because these earthquakes overlap so heavily, semitransparent point symbols still convey a visual sense of density in highly clustered areas.

(m) Click OK to accept the color and close the Color Editor dialog box.

(n) At the bottom of the Symbology pane, click Apply, and then close the pane.

○ Zoom and pan the map to see the historical earthquake points presented as graduated symbols.

The legend in the Contents pane shows the class range values that you previously provided. The smallest symbols represent quakes with a magnitude of 6.0 or less, while the largest symbols represent quakes with a magnitude of over 9.0.

p To return to the full extent of the layout, from the Map tab, in the Navigate group, click the Full Extent button 🌐.

Now you will take a look at layout options.

Step 4: Explore the layout view

At the top of the map window, you will see two tabs.
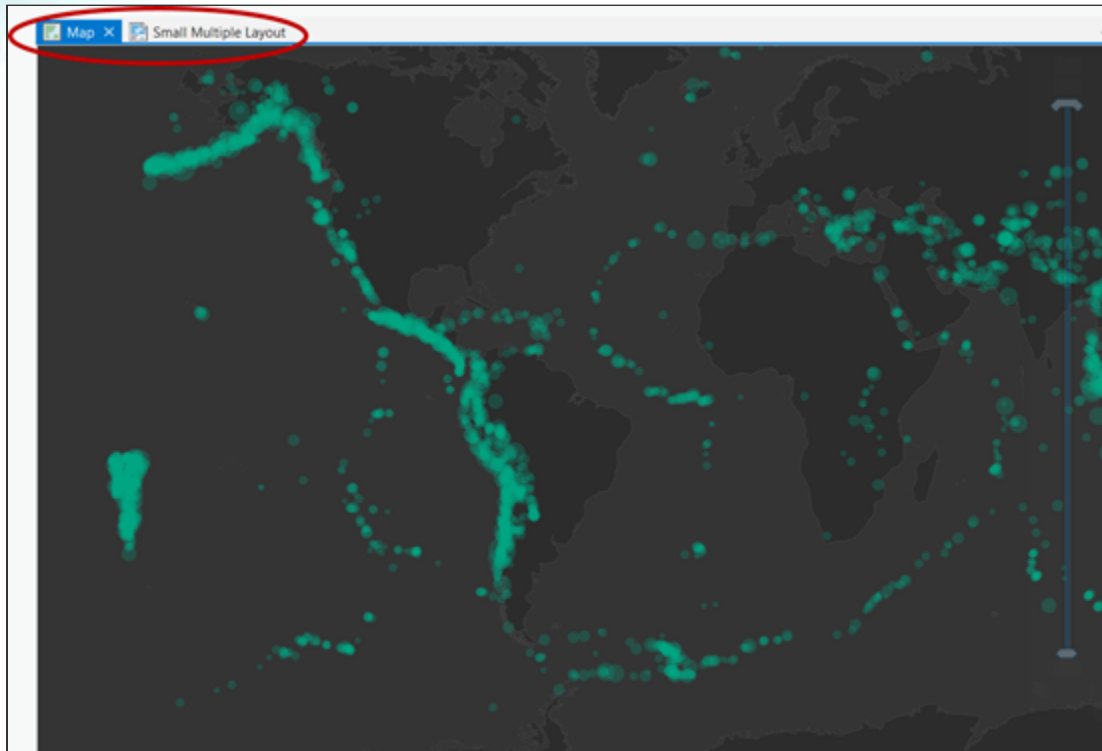
The Map tab on the left is currently selected. This is the map window where you work with map layers and perform analysis and symbology. Next to it is a ==Small Multiple Layout== tab. This is a layout window where you manage the graphical layout of a produced map.

(a) Click the Small Multiple Layout tab to activate the layout.

Note: It may take a moment or two to draw.

Small multiples are a great way to juxtapose different aspects of a related dataset, as you can see in this layout.
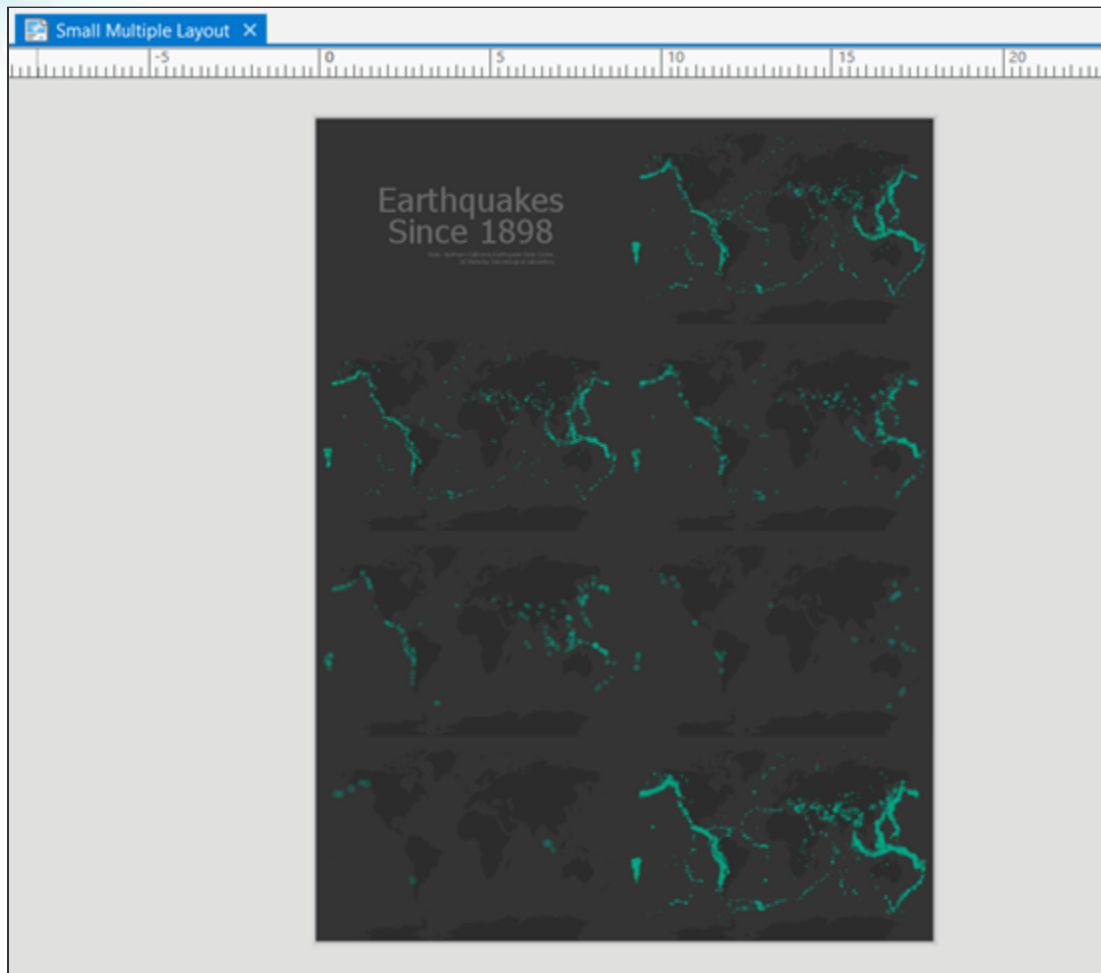
The layout contains seven instances of the map you just made, one for each class range. Each map is contained in a map frame, a page layout element that is used to display the contents of a map on a layout. These map frames have been added in for you to save time. This small multiple layout shows the locations of these historical quakes in ranked order of magnitude range. All but the last map on the bottom right have been filtered to show just the quakes in the identified range.

   b   In the Contents pane, click any of the items to see them highlighted in the layout.

You will now apply a range filter to the last map.

Step 5: Apply a range filter

A small multiple layout could be made up of many individual maps, but it is much simpler to apply a range filter to each map frame so that only one source map has to be maintained.

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a In the Contents pane, right-click the 9+ map frame and choose Activate.
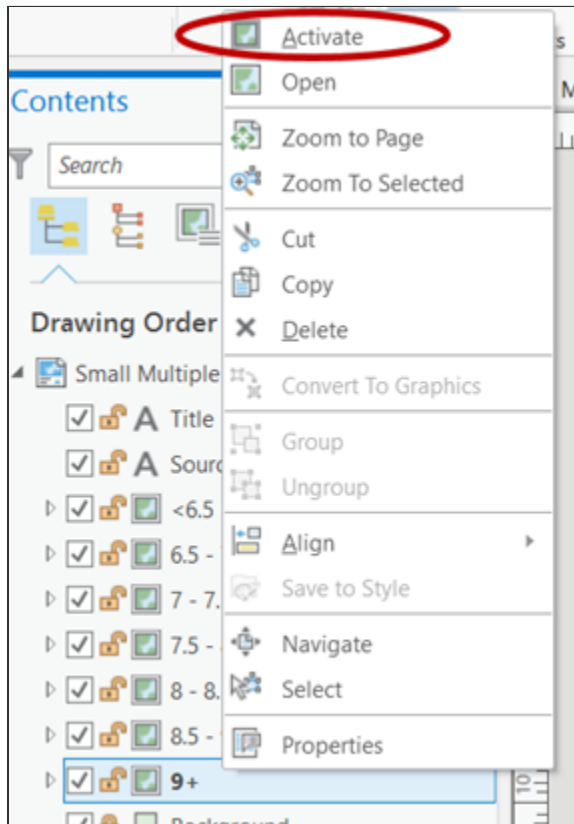
Activating the map frame highlights it in the layout area. In the ribbon at the top of the ArcGIS Pro interface, a contextual tab named Range is now available.

b Click the Range tab to see the filter options.

On the Range tab, in the Current Range group, there are empty Max and Min text fields.

c For this final map of the largest historical earthquakes, in the Current Range group, assign a Min value of 9 and press Enter.
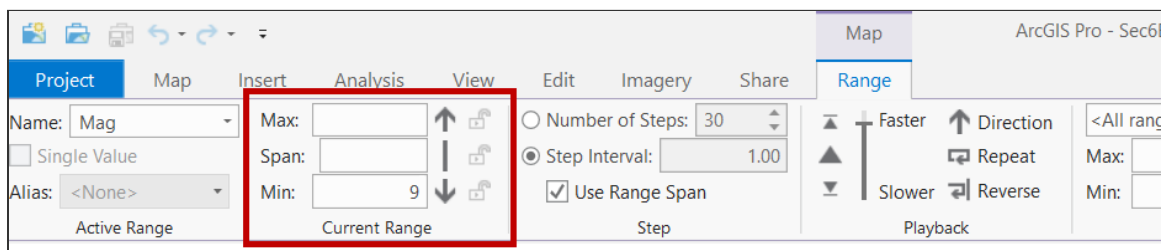
This setting will restrict the earthquake data to only earthquakes of magnitude 9 or higher.

d. In the layout panel for the last map, click the X button at the top right of the window to close the activated map frame view and return to the layout.
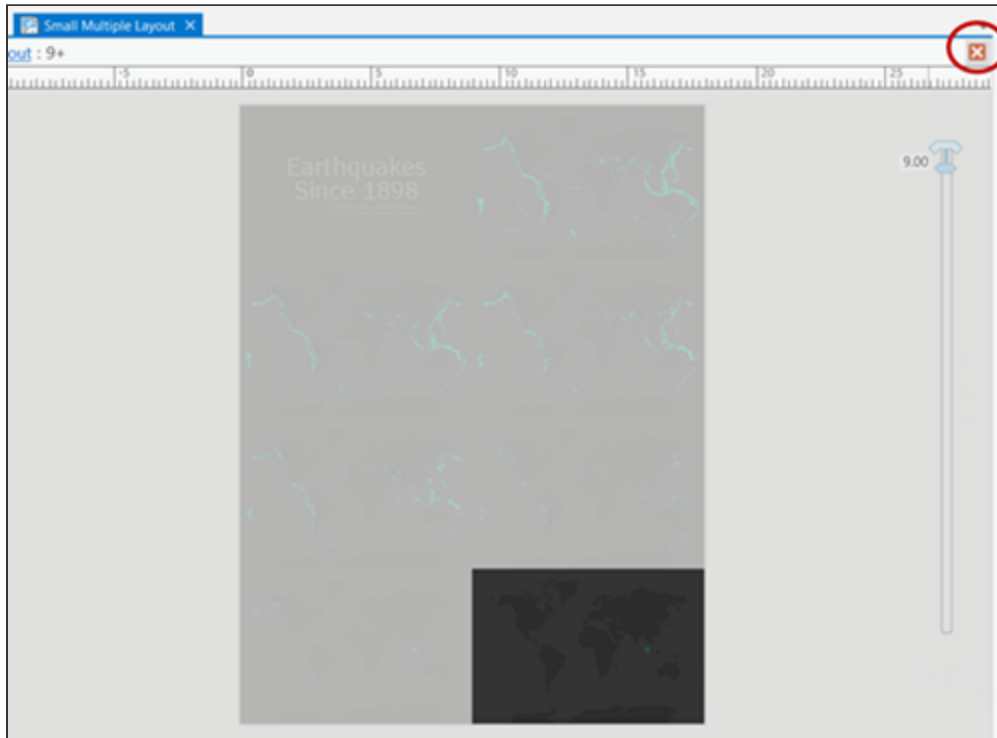
You should now see a small multiple layout showing seven maps, ranging from small but frequent earthquakes to large but rare earthquakes.

Step 6: Add labels to your map layout

You will now add some labels to the layout to more clearly identify what each of the maps shows.

(a) From the Insert tab, in the Text group, click Text.
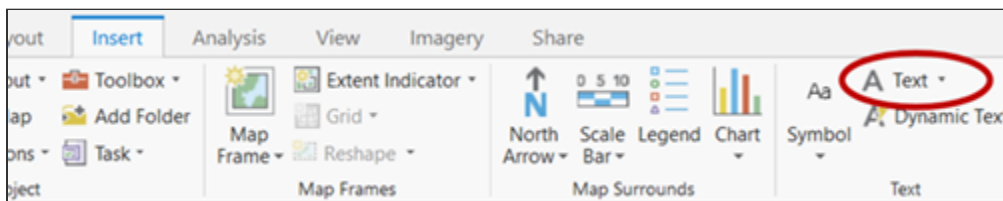
This will activate the option to insert text into the layout. Your pointer will change to a small crosshair with the letter A, indicating text mode.

b Zoom in to the first map and click the map to insert a text block.

c Type in the magnitude range that map represents (for example, **Magnitude 6.0-6.5**).

d With this text block active, click the Format tab and play with type design to create an attractive label for your map.

e Repeat this process for the six remaining map views.

Note: To save time, you might consider copying an already formatted text block and pasting it.

f Save your layout.

When finished, your layout should look similar to the following graphic:

Earthquakes Since 1898

g You've now got a map with a default font. As a cartographer, you should cast a critical eye on any default and apply your thoughtful design sense to it. So <mark>consider choosing a font that fits with the theme or reinforces your aesthetic</mark>. It's more important than it sounds!

You've made a small multiple! Now you can export it as an image to share with others.

Step 7: Share your layout

You can share a layout as a vector format (such as PDF) or an image format (such as JPEG or PNG) file in ArcGIS Pro.

Note: Refer to ArcGIS Pro help for more information about available export file formats (https://bit.ly/2v6eyXl).

a From the Share tab, in the Export group, click Layout.
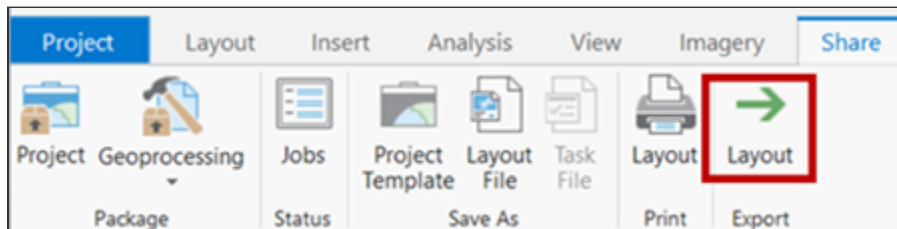
b Browse to a location on your computer (such as My Documents), choose a file format that you prefer, and click Export to save the small multiple to your computer.

You can share the exported layout file with a colleague or stakeholder, or you can put it on your social media channels.

c Leave ArcGIS Pro open for the next exercise.

Conclusion

In this exercise, you were introduced to the concept of small multiples as a map layout method that <mark>shows nuance and detail for a dynamic set of data</mark>. You used your thematic mapping skills to define earthquake symbol ranges. You used the range filter to slice up your map into distinct views into the data, and you labeled all the component maps. You became empowered to crank out small multiples, appropriate for all sorts of phenomena, ready to be unleased to the eager masses!

Stretch Goals

- Remember when you chose a symbol to represent earthquakes? You know you aren't stuck with the set of symbols provided in the menu. You can upload an image to use as a point symbol. Try using the Firefly Glowing Point Image Symbols (https://bit.ly/2H6suWD) as the point symbols in your map.
- If you are feeling ambitious, you could get a jumpstart on the next exercise on animated maps. Small multiples are great, but if your mapped phenomenon has an inherent ordering to it (less to more, time, and so on), then you've got all the ingredients for a flip-book style animation! Explore the animation capabilities of ArcGIS Pro (https://bit.ly/2qlODXn), and see if you can turn your earthquake small multiple map into a simple animation. Why make one map when you can have two?

Use the Lesson Forum to post your questions, observations, and map examples.

Learn More

- Feast your eyes on Andy Woodruff's Beyond the Sea small multiple collection:
  http://andywoodruff.com/blog/beyond-the-sea/ (https://bit.ly/1RA0rIJ)

- Check out Ken Field's small multiple visualization of the socioeconomic tectonics of political boundaries:
  http://www.arcgis.com/home/item.html?id=047ac4944fd84bfab00af0e5ed1084fa
  (https://bit.ly/2IHo2um)

- John Nelson created small multiples of piracy in the Gulf of Aden. Then, he stacked them into a simple animation—because why not?
  http://uxblog.idvsolutions.com/2012/09/somali-pirate-years.html (https://bit.ly/2v6qLvD)

- Be amazed and inspired by Fred Bruenjes' use of small multiple images positioned to build a map:
  http://www.moonglow.net/eclipse/2002dec04/index.html (https://bit.ly/ 2HoTfD5)

- If the maps are designed simply enough, a great many can be packed into a small multiple, with beautiful and effective results like this excellent example from the *New York Times*:
  http://www.nytimes.com/interactive/2012/07/20/us/drought-footprint.html
  (https:// nyti.ms/2HonHgJ)

- The term "small multiple" was popularized by Edward Tufte (https://bit.ly/2s0WGc9), but these maps have been around for a long time:
  https://www.nypl.org/blog/2016/12/14/digging-nineteenth-century-roots-thematic-map-techniques (https://on.nypl.org/2IJZBfI)

- Learn from the Wikipedia community about small multiples:
  https://en.wikipedia.org/wiki/Small_multiple (https://bit.ly/2v5GydW)

- A small multiple of animated maps? Behold the awesomeness of Mike Bostock's looping visualization of seasonal drought:
  https://bost.ocks.org/mike/drought/ (https://bit.ly/ 2GTMp7S)