



Introduction to Cartographic Processes

Geography (GEOG 3305)

Lab 5B: Thematic Mapping – Flow

Note: You will complete this lab after Lab5A (about dot density mapping). If you have any questions about how to load ArcGIS Pro or how to create a layout, you need to consult the instructions for Lab5A.

Flow Map

The flow map shows linear movement between places. As such, they are popular maps to represent migrations, commodity flows, and traffic patterns. Flow maps may be used to show both qualitative data (e.g., connections) or quantitative data (e.g., magnitudes). In qualitative flow mapping, the symbols are of uniform width and typically are arrows. In quantitative flow mapping, the cartographer selects a line symbol and alters its width based on the data values.

As with proportional symbol mapping, the cartographer may use either *absolute scaling* or *range grading* in quantitative flow mapping. Absolute scaling involves scaling symbol area proportionately to the data value. For example, a symbol for a line with a data value of 100 should be twice the area of the symbol for a point with the value of 50. With range grading, the cartographer classifies the data and assigns a symbol to represent each class.

When employing this technique, flow lines should be symbolized so they are distinct from the background information/base map. Use arrows if the *direction* of the flow is important. Using lines instead of arrows implies that the direction occurs in both directions. Also, place small lines on top of large lines when they overlap.

Step 1: Getting Started

In this exercise, you will:

- | | |
|---|--------------------------------|
| ✓ Open an ArcGIS Project file | ✓ Convert labels to annotation |
| ✓ Use absolute scaling to symbolize flows | ✓ Create a map layout |
| ✓ Adjust the transparency of a layer | ✓ Insert a neatline |
| ✓ Label features on the map | ✓ Insert a legend |

- Start ArcGIS Pro. You will open an ArcGIS Pro project file: Lab5B_FlowData.ppkx.
- Once the map loads, you will see three layers: Lower 48 states of the U.S., flights, and cities.

The map represents the air connectivity of the medium hub cities of Boise, Idaho, Jackson, Mississippi, and Syracuse, New York in 2007. The data are the number of flights between each of the three cities to all other

cities in the United States (minimum of 100 flights). The circle symbols for the cities represent metropolitan areas, not individual airports. Metropolitan areas with multiple airports are aggregated and the symbol is placed at the central city. Metropolitan areas with multiple airports receiving flights originating in Boise, Jackson, or Syracuse are Chicago (O'Hare, Midway), Dallas-Fort Worth (DFW, Love), Houston (Intercontinental, Hobby), New York (La Guardia, JFK, and Newark), San Francisco (San Francisco, Oakland), and Washington (Dulles, National).

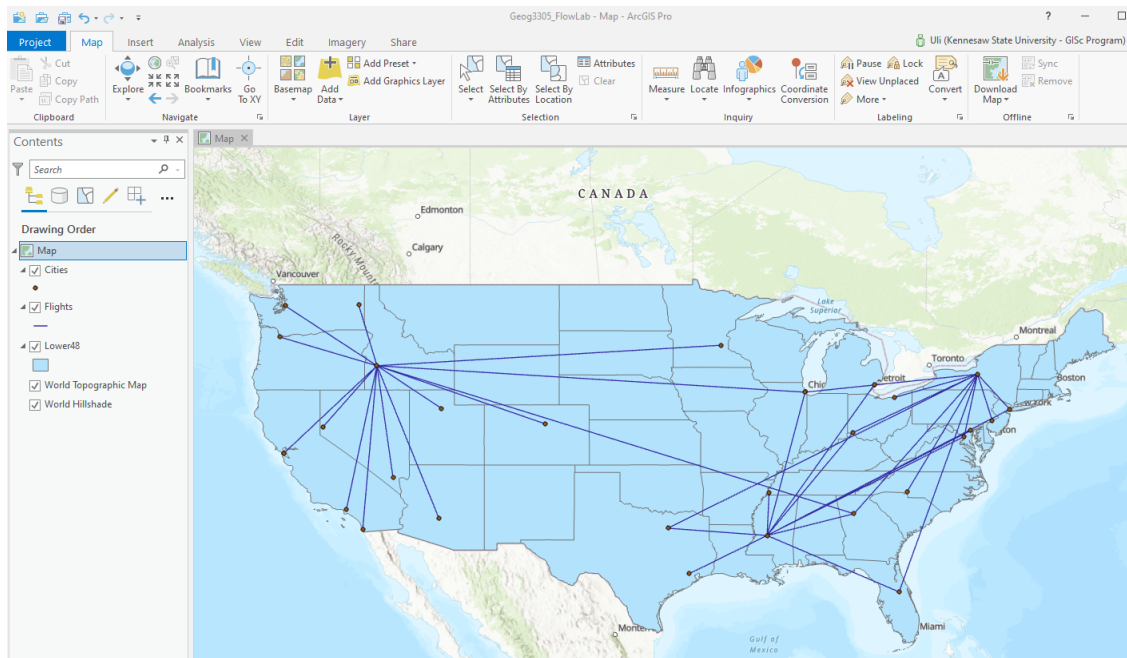


Figure 1. Airline connections from Boise, Jackson and Syracuse.

Step 2: Setting Symbolology for Flight Lines

Many flow maps are *directed flow maps*, where the direction of movement is shown using arrows. The data used here is the *total number* of flights between the origin-destination pairs, *not* the flights *originating* from Boise, Jackson, or Syracuse. Because the values are for movements aggregated for both directions, you will make an *undirected flow map*.

i It is rare to find an existing shapefile of origin-destination pairs for non-highway route connectivity. If you wish to make a similar map, you will likely need to create a new shapefile and digitize the lines that will symbolize connections.

- Change the basemap to Light Gray Canvas. Turn off the “Light Gray Reference” layer in the Table of Contents. This will remove the basemap labels. You will also label the cities later.
- Add a bookmark zoomed to the Lower48 layer. Right-click on that layer in the Table of Contents – click on Zoom to Layer. Then on the Map tab, go to Bookmarks – New Bookmark – and name it Lower48.
- Change the fill color of the Lower48 layer to No Color.
- Open the **Flights** layer **Symbolology** window by **right-clicking Flights** in the Table of Contents and selecting **Symbolology**.
- Change the primary symbology to **Proportional symbols**.

- Select **Flights** from the Field drop-down menu.

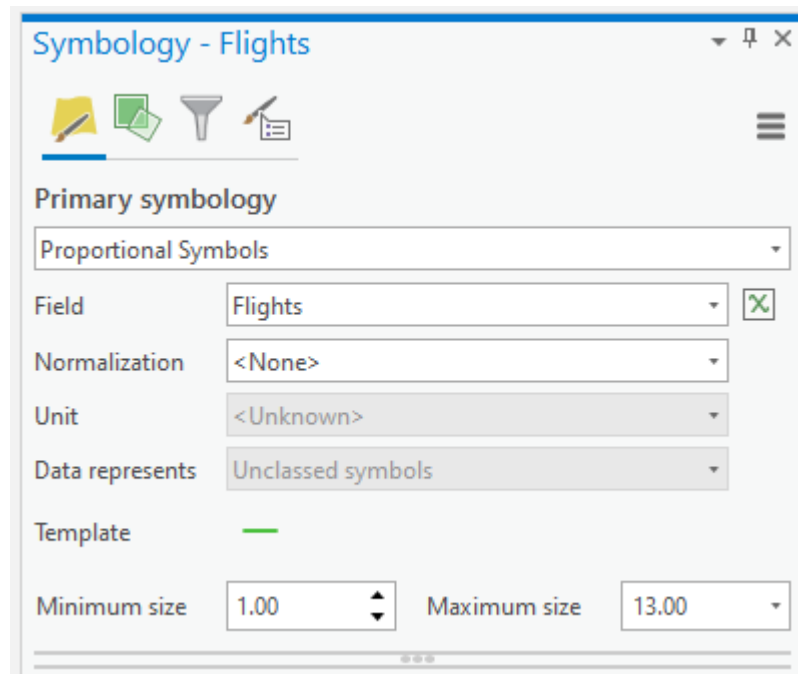


Figure 2. Select Proportional Symbols and change your field value to Flights.

- Click **Apply** (do not click OK yet) and move the Properties window out of the way to see the flow map.

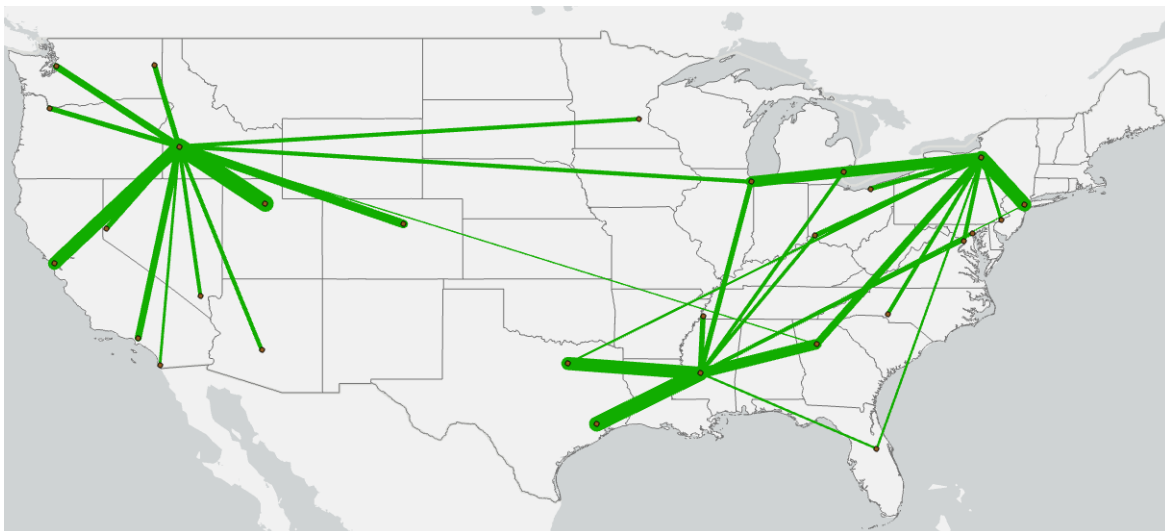


Figure 3. Origin-Destination pairs scaled by number of flights.

The map should now have with the lines scaled according to the number of flights.

Typically, in flow mapping the cartographer selects the size of the widest line that will be placed on the map and scaling downwards. In proportional symbol mapping, whether it proportional point symbol mapping or flow mapping, you control only the size of the *smallest symbol on the map*. All other symbols are scaled upward from this size.

i When making a flow map where there is an exceptionally large range of data values, it may be more appropriate to create classes and symbolize each class with a distinct symbol. In such situations, select *Graduated symbols* from the Quantities menu.

- Click the **Min Value** button to change the width of the narrowest line.
- **Experiment with the width** until you find one that provides a pattern where the largest symbols do not overwhelm the map. By clicking the **Apply** button in the Properties window, you can adjust your symbol sizes incrementally while keeping the window open. Clicking the OK button will close the Properties window. If you wish to make a change, you must reopen the window.

i When making changes in symbol size, you may do so in increments of tenths or hundredths. To do so, you will need to *type* the number. Using the up or down arrow will make changes only in whole number increments.

When you are satisfied with your symbol sizes, change the **color** of the symbol to a **dark red**. Before closing the Properties window, you will adjust the transparency of the Flights layer. Doing so is not required of flow mapping but is can be helpful to view background information such as political boundaries.

- When you choose the dark red color, click on Color Properties (at the bottom of the color window), then specify Transparency to be 25%.

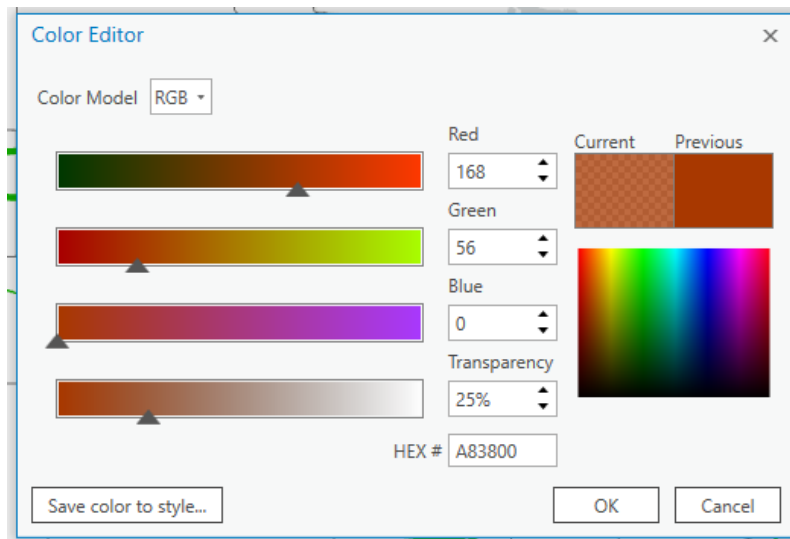


Figure 4. Transparency setting for Flights layer.

Click **Apply** to register the changes. You should now see the state boundaries through the flow symbols.

i A strategy for providing symbol differentiation in complex flow maps is to employ *redundant coding*, whereby a color ramp is used in addition to the scaled lines. Redundant coding is not available in proportional symbol mapping. To use redundant coding, you must use the graduated symbol method.

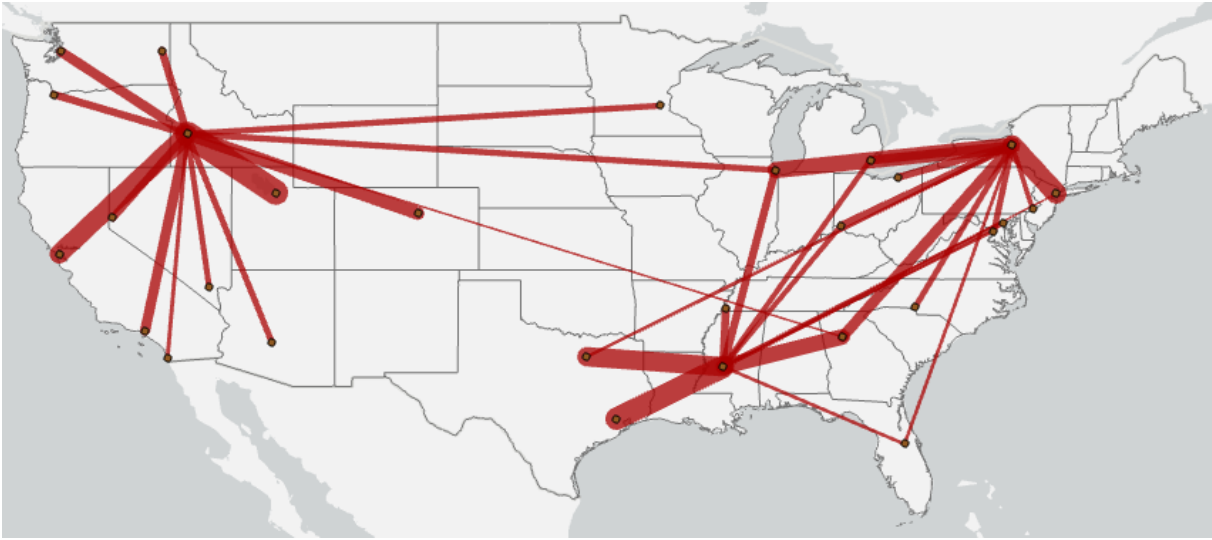


Figure 4. The updated flow map with red lines and transparency set.

Step 3: Setting Symbology for Cities

Next, you will change the city symbols to emphasize the three origin airports.

- **Open** the **Symbology** window for the **cities** layer (right-click cities and select **Symbology**).
- With the **Symbology** tab selected, select **Primary Symbology** > **Unique values**.
- Change the **Value Field** to **Category**. The values **Destination** and **Origin** appear.
- Double-click the **Origin** symbol to open the Symbol properties window.
- Make the color **White** and the Size **18.00**. Change the outline width to 1 pt.
- Click **OK** to register the changes and close the Symbol Selector window.
- Repeat the procedure for the Destination cities, this time making the circles **white** with a size of **10.00** and an outline width of 1 pt.
- Click **Apply** to register the changes and close the Symbol Selector window.
- You want to remove the “All other values” category. On the primary symbology tab, click on More, then uncheck “Show all other values.”
- Click **OK** to register the changes and close the Properties window.

Next, you will label the cities on the map.

- **Right-click** the **cities layer** in the Table of Contents and select **Label Features**.

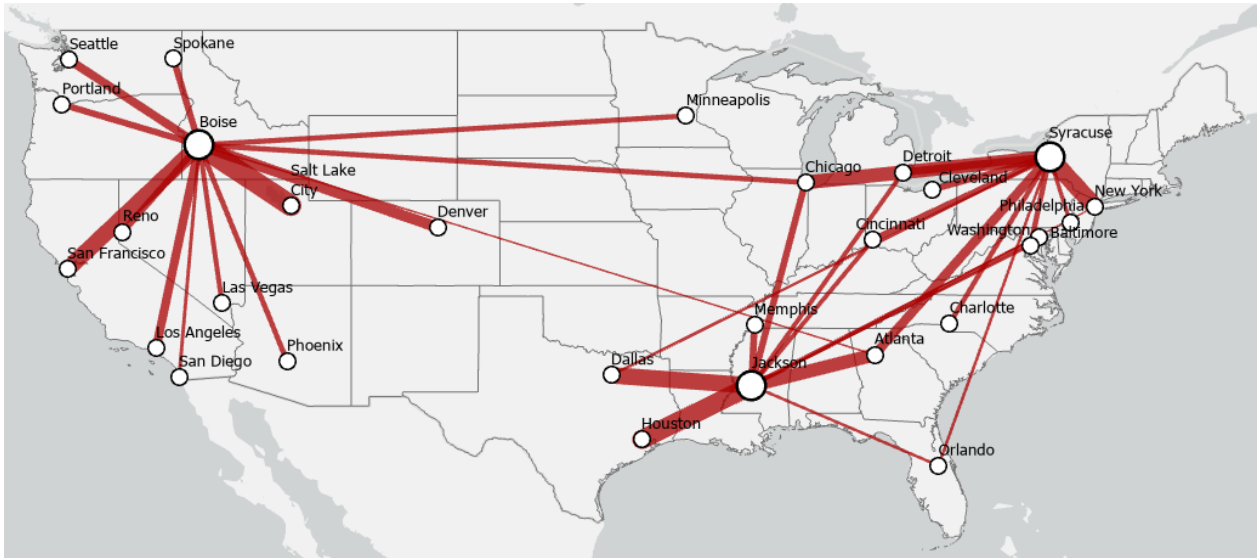


Figure 6. The updated flow map with the cities symbolized and labeled.

Note that several of the labels overlap the map symbols. You will reposition labels where this occurs to minimize the clutter of symbol overlap.



Figure 7. Label-symbol clutter.

To reposition the labels, you must first **convert them to annotation**. When you use automatic labeling, you do not have the ability to reposition individual labels.

- **Right-click the cities layer** in the Table of Contents and select **Convert Labels** – then **Convert Labels to Annotation**. See the screenshot below for further settings.

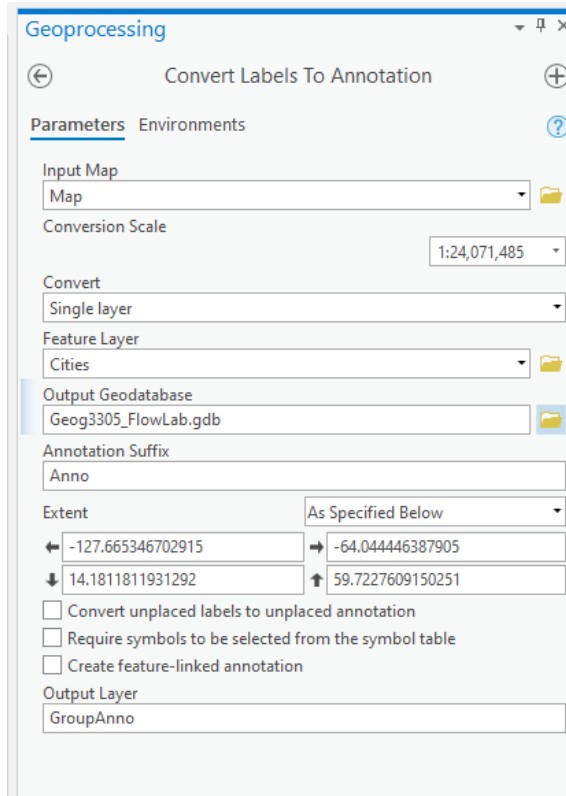


Figure 8. Label-symbol clutter.

Step 4: Creating the Layout

- Insert a new layout – Letter Sized Landscape. From here on, you will follow the instructions to create the layout from the instructions for Lab5A.
- Come up with an appropriate title for the map (remember that you are mapping airline connectivity for Boise, Jackson and Syracuse in 2007).
- In the lower left-hand corner of the layout, inside the neatline, add the following:
Data source: Federal Aviation Administration

In the end, you will export the layout and save it as YourLastName_Lab5B.pdf. Again, if you have any questions, the layout creation process is explained in detail in Lab5A.docx.