SOC 4650/5650: Lab-05 - Major Tornadoes in the St. Louis area

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Directions

Using data from the `MOBoundary` and `MetroWx` directories in `CourseData` geodatabase as well as the `STL_HOUSING_MedianAge` data available on Github (see Slack's `#_news` channel), several maps using both `R` and ArcGIS. Your entire project folder system, including data, notebook output, ArcGIS map document, and map images, should be uploaded to GitHub by Monday, March 5th at 4:15pm.

Part 1: Analysis Development (Review from Lectures 01 and 02)

The goal of this section is to create a self contained project directory with all of the data, code, map documents, results, and documentation a project needs.

1. In your course folder system, find the `Labs/Lab-05` subdirectory and add all necessary subfolders.
2. Open ArcCatalog and add all relevant data to the `data/` folder within your assignment. Remember to remove any unneeded data before making a commit.
3. Open RStudio and add an R project, notebook, and the `README` file to your assignment. Make sure these are stored in the appropriate places in your assignment.
4. Open ArcGIS and then create a new, blank map document. Make sure that it is saved in the `maps` folder you created above.

Part 2: Create a Housing Age Map in R

The goal of this section is to be able to create a thematic map plotting the median age of housing in the St. Louis area to help planners identify neighborhoods must susceptible to damage due to the age of the housing stock.

5. In your `R` notebook, import the `STL_HOUSING_MedianAge.shp` data into a new simple features object.

6. Using `ggplot2` and either `RColorBrewer` or `viridis` , map the estimated median age of residential structures in each census tract. Be sure to add all necessary map layouts including a theme, a title, a subtitle, a caption, and an appropriately titled legend.

7. Export the map as a `png` file at 300 dpi.

Part 3: Map Tornadoes Before 2000

The goal of this section is the produce one of the map elements for your layout that features strong tornadoes in the St. Louis area that have occurred historically in St. Louis.

8. In your blank map document, set the projected coordinate system to `NAD 1983 UTM Zone 15N` for the `Layers` data frame.

9. Add the following layers in this order on your Table of Contents:

   (a) Tornado tracks from the `MetroWx` directory - leave symbol alone for now

   (b) Missouri state boundary from the `MOBoundary` directory - symbolize with no fill, just an outline for now

   (c) Metro county boundaries from the `MetroWx` directory - fill should be white

   (d) Illinois state boundary from the `MOBoundary` directory - symbolize as a ground layer

   (e) Missouri state boundary from the `MOBoundary` directory - symbolize as a ground layer

10. On the Missouri state boundary layer that is directly below the tornado tracks, go to Layer Properties ▷ Symbology tab. Click on the Symbol button and choose Edit Symbol ▷ Outline. Choose "Boundary, National" from the Symbol Selector and use a warm hue for the color.

11. In the Definition Query tab under Layer Properties for the tornado tracks layer, execute the following query to restrict the data view to tornadoes with an Enhanced Fujita scale (EF scale)[1] of 3 or greater and that occurred between 1950 and 2000 - `"mag" >= 3 And "yr" < 2000` .

12. Symbolize the tornado paths using their magnitude categories - the EF-3 and EF-4 paths should have different hues with the hue for EF 4 being warmer and lower value (i.e. darker) than the hue

[1] The enhanced Fujita scale is the standard method of measuring the severity of a tornado. It is on a scale of 0 to 5 with 5 being the most damaging and destructive. An EF-0 tornado has a peak 3 second gust (in miles per hour) of between 65 and 80. An EF-1 has a peak gust between 86 and 110, an EF-2 has a peak gust between 111 and 135, an EF-3 has a peak guest between 136 and 165, and an EF-4 has a peak gust between 166 and 200. The most severe category, EF-5, has a peak 3 second gust greater than 200 miles per hour.

for EF 3. Both lines should be thick with a width of 2.0. When you create the categories under the Layer Properties ▷ Symbology ▷ Categories window, make sure to un-check "all other values".

13. Rename this layer `Severe Tornadoes`.

14. Add another copy of the tornado tracks layer *under* the current tornado tracks layer but above all the other layers on your map. Symbolize it as a ground layer. Restrict this layer to tornadoes that occurred between 1950 and 2000 as well with the following definition query - `"yr" < 2000` .

15. Rename this layer `Less Severe Tornadoes`.

16. Zoom to the metro area counties layer.

17. Rename this data frame as `Tornadoes Before 2000`.

Part 4: Map Tornadoes 2000 and after

The goal of this section is the produce one of the map elements for your layout that features strong tornadoes in the St. Louis area that occurred recently.

18. Copy all of your layers from the `Tornadoes Before 2000` data frame to a new data frame named `Tornadoes 2000 and After`. Ensure that the layers in the Table of Contents are ordered identically to the original data frame.

19. Alter the definition queries for both tornado layers so that they show tornado paths between 2000 and 2015. The query should use this logical operator - `>=` .

20. Zoom to the metro area counties layer.

Part 5: Construct the Inset Map

The goal of this section is to produce a small inset map that helps readers located where St. Louis is relative to Missouri and Illinois.

21. Copy the Illinois and Missouri state boundary layers (the bottom two layers in each data frame) along with the metro area counties layer to a new data frame named `Inset Map`.

22. Change the data frame's coordinate system to `USA Contiguous Albers Equal Area Conic`.

23. Re-symbolize the metro area counties so that they use the "Rose" pre-set symbol.

24. Zoom to the full extent of the map.

Part 6: Construct the Map Layout

At this point you should have three data frames - one with tornado tracks before 2000, one with tornado tracks between 2000 and 2015, and one highlighting the location of the metro area. The goal is to turn these three data frames into a single page map layout.

25. Switch to the Layout View and create a well formatted map layout for an 8.5" by 11" printout in portrait orientation:

    (a) Add guides that create .5" margins around the page to help you construct your layout.

    (b) Re-size your two main data frames so that both of the tornado track data frames are 7.5" wide and 4" tall. The pre-2000 data frame should be on the upper part of the layout and the post-2000 data frame should be below it.

    (c) Add text that serves as a subtitle for each of the two main data frames.

    (d) The inset map should be re-sized as well and should be positioned on the layout to give reference to where these data are located in a broader spatial context.

    (e) Include a legend that identifies what the different tornado tracks mean, a scale bar, a title, and detailed text about authorship, the projection, and what EF-3 and EF-4 mean. These need to be added once and should be used in reference to both main maps. You should use the `Severe Tornadoes` and `Less Severe Tornadoes` layers to generate the legend. Also add detailed data about the primary source of these data. Check the `readme.pdf` file in the `SOC5650/Data` folder for details on data sources.

    (f) Manually add state names to both maps so that you have complete control over where the labels are positioned. Use the halo effect as you normally would for map labels.

26. Export the map layout as a `pdf` file at 300 dpi.