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Projections

Learning Objectives

1. Project unprojected data using ArcPro
2. Transform a projected data file using ArcPro.
3. Compare different projections.
4. Create a choropleth map.

Use the form link to submit your responses for this lab.

Reproject a Shapefile

One of the most common practices you will partake in as a GIS analyst is creating data from non-projected data. It may be a series of GPS points collected in the field, or addresses that you pulled from a directory. In the case of the GPS points, projecting data from a World Geodetic System 1984 (WGS84) reference system to a new projection is rather straightforward. The WGS84 is a geographic coordinate reference system. In the case of addresses, another step called georeferencing must be completed first. We will not talk about georeferencing here, but you should learn more about it in your GIS class.

There are two types of coordinate systems. The first, Geographic Coordinate Systems, are used to locate points on a spheroidal surface, for example WGS that is mentioned above. The second type, and the type that you will be converting to is the Projected Coordinate System, also called a projection, which defines the location of points in a 2D surface. We have discussed various projections in class and if you would like to read more about them check out the ESRI blog post by Heather Smith that can be found here.

1. Download the WGS84 world country boundary shapefile from the ArcGIS Hub here. Display the file in ArcPro and create a screen capture of the file.
2. To confirm that this data set is in WGS84, right click on the shapefile and open the Layer Properties. From there, you can find the Spatial Reference information under the Sources menu. What is the location of the prime meridian for WGS84?
3. Locate the Project tool. You can find this simply by searching the toolbox under the Analysis tab. Use this tool to reproject the shapefile as NAD 1983 Contiguous USA projection which is found under the Projected Coordinate Systems. Make sure to save your new dataset with the name World_NAD83.shp.
4. Insert a new map and add your NAD file. What visual difference strikes you immediately? What is the projection surface used for this projection?

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Converting Projections

Just as one might want to change from an unprojected coordinate system to a projected one, you may also find yourself wanting to change between projected coordinate systems. This is a common problem when bringing together data from different sources as many organizations have different standards about what projections they use to store their data. The process is the same as the conversion from a geographic coordinate reference system to a projected one and you should use the steps provided above to accomplish each of the reprojection tasks below.

1. Create a new map within the Arc project.
2. Download the Michigan Counties shapefile from the State of Michigan website found here. Open the file and determine if it is already projected by opening file properties.

Next, you will transform the file into three different projections and then compare and contrast them. To do this create new projected files for the following projections.

1. State - NAD 1983 (2011) State Plane Michigan Central (meters)
2. State - NAD 1983 UTM Zone 16N
3. Continental - USA Contiguous Albers Equal Area Conic
4. Next, compare and contrast them. To do this, set up a separate map document for each of the three files and then add the maps to a layout. Create a screen capture of your layout and write 2-3 sentences about what you see is different between the three projections.
    a. *Try using the measure tool's distance and net bearing metrics as one method of comparison beyond visual inspection.*

Final Question: In class we have discussed the importance of projections when creating thematic maps. As part of these discussions we have identified the correct projections for different data representations. Discuss why the transverse mercator projection and the conic conformal projection are not useful for the display of choropleth maps. Finally, what type of map projection would you use for a choropleth map?

Create a Choropleth Map

You should now be able to convert between various projections using ArcPro. For the second half of your lab you will create a choropleth map using a correct projection. You will use the Census's American Community Survey data for 2019 accessible at data.census.gov. The ACS is

a vital program for government officials to make timely decisions about a variety of services. If you'd like to learn more about the program you can find a synopsis here.

1. Go to the Data.Census.Gov portal and search for the 2019 ACS DEMOGRAPHIC AND HOUSING ESTIMATES. Under Product select 2019: ACS 5-year Estimate Data Profile.
2. Select the table and then use the GEO filter to select all of the counties of Michigan. *Note that this could take some time to load, and if you try to download the excel file too early it will come out incomplete. You should have data for all 83 counties!*
3. In order to link the Census data to our counties shapefiles we need to find a common id. There are actually two different ways to do this in the ACS data. The first is obviously the county name which is listed in the csv file you downloaded. The second is using the FIPS code, which is called the GEO_ID in the ACS csv file. (MAKE SURE YOU DOWNLOAD THE CSV FILE AND NOT THE EXCEL FILE).
    a. Open the ACS excel file and locate the GEO_ID. You should see 0500000US26001 for Alcona County. If you find Alcona County in your shapefile you can see that the FIPSCODE is 001 and FIPSNUM is 1. This slight mismatch can easily be corrected in excel by adding leading 00 to the FIPSUM or deleting 00 from the FIPSCODE using find and replace.
    b. Use Find and replace to remove the first 11 digits of the GEO_ID. You should be left with a number that matches the FIPSNUM value for each county.
    c. While you have excel open delete row 1 and row 85 as these are summary rows and not rows corresponding to individual counties. You should have a clean data set that you can join to the shapefile. You can use the metadata file that downloaded with your data to find out specifics about the various metrics.
4. Create a new map and add the Michigan Counties file and the new data file (CSV).
5. Next, reproject your shapefile with the correct choropleth-friendly projection. Make sure once you are done that you change the projection for the map under its Properties-Spatial Reference tab.
6. Use Add Join to create a join of these two files based on that FIPS number. You can validate the join if you like, and also use the attribute table of the county shapefile to make sure that the data is correctly joined. You are now ready to create your choropleth map.
7. Select one of the attributes that is provided as a percentage that interests you (use the metadata file). If you remember from the lecture, a choropleth is only correct if the data is normalized in some fashion, such as the percentage. For example DP05_0002E is the percentage of the population that is male for each county.
8. Under Symbology select graduate colors, an appropriate color scale, and the equal interval classification method. *Also, make sure you use the appropriate legend labels. You can change these under Advanced Symbology.*
9. Add a legend, title, and the projection information to your map in a Layout. Then export the final map as a PDF to submit.

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