Online Supplement to *GIS and Public Health, 2nd Edition*
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GIS AND PUBLIC HEALTH EXERCISE 2 - MAP PROJECTION AND METADATA (ArcGIS 10)

PREPARATION

Download the **exer2** folder you will need for this exercise from the online supplement.

All of the databases and files used in the exercise will be stored in various subfolders within the folder called **exer2**. The following instructions are written for this folder to be located on the **c:** drive. If the folder is located on another drive, the path names shown below should be modified accordingly. Some of the folders are empty. They have been included because you may need to save the results of an operation to one of these folders.

The map documents created using ArcGIS10 reference the spatial databases and tables in the application based on the directories and paths where the data are stored. Changing the locations of databases in the system can prevent a GIS application from working properly.

Connecting to the Exercise Folder

Go to **Start ⇒ Programs ⇒ ArcGIS ⇒ ArcCatalog 10** to start ArcCatalog.

Find the button labeled **Connect to Folder** and click the button. Navigate to **c:\exer2** then click OK and look at the Catalog Tree in the left window to see that the folder has been added.

Within the data folder, data can be organized in folders identifying the agency that produced the data and then by the format of the data. For these exercises, you will consider yourself to be working for the organization called "agency" that is creating the GIS.

As you work through the exercises, you will be retrieving data from and saving data to specific folders. Please make sure you understand the System Design for the exercises.

Use the **File ⇒ Exit** menu to close ArcCatalog.

MAP PROJECTION

Go to **Start ⇒ Programs ⇒ ArcGIS ⇒ ArcMap 10** to start ArcMap.

In the "ArcMap – Getting Started" window, close the window you would use to open an existing map document or make a new map using a template.

When you open ArcMap, a single Data Frame is created called Layers. A Data Frame simply groups a collection of data layers that you want to display together. So far, we have not added any data to the Layers data frame. To avoid confusion, rename the Layers Data Frame by right clicking the word Layers and selecting the **Properties** item in the menu. Then select the **General** tab and enter the name Geographic. Note that the map units of the display in the Data Frame are unknown. Click on the **Coordinate System** tab and note that the coordinate system is unknown. Then click OK. The name of the Data Frame in the Table of Contents window should now appear as Geographic.

Add a Shapefile of Illinois Counties

To begin, add a shapefile of current county boundaries prepared and distributed by the U.S. Census Bureau. This database and other census geographic data from the TIGER® system can

be downloaded from the Census web site. Find the button labeled **Add Data** and click it. Then, click on **Folder Connections**. You should find the **c:\exer2** folder. If not, please connect to the folder using the **Connect to Folder** button.

Navigate to **c:\exer2\data\census\shapes** and add the **tl_2009_17_county.shp** shapefile.

You have now added a Layer to the Data Frame. A Layer does not actually store geographic data, but it references the geographic database source stored on the computer.

Right click on the Geographic Data Frame (not the file) and select the **Properties** item in the menu. Click the **General** tab and note that the map units are decimal degrees then click the **Coordinate System** tab and note that the Coordinate System is now:

GCS_North_American_1983

Because the Census Bureau completed metadata for this database, the GIS software can recognize the spatial reference properties of the shapefile. Adding the tl_2009_17_county.shp shapefile with its projection information set the spatial reference properties of the Data Frame.

Click OK to close the "Data Frame Properties" window.

Use the **Save** button or go to **File ⇒ Save** to save your map document. Navigate to **c:\exer2\mapdocs** and save the file as **exer2.mxd**.

GCS North American 1983 is a spatial referencing system of geographic coordinates (lon/lat) based on the North American Datum of 1983. Because Illinois is in the mid-latitudes, mapping these data results in a distorted view of the state. It looks like the state is stretched east-west.

To develop a view of Illinois counties which better displays the shape of the state, the map projection tools of the GIS software can be used to create a new shapefile with coordinates based on the Illinois State Plane Coordinate System.

Project a Shapefile of Illinois Counties Using ArcToolbox

Click on the **ArcToolbox window** button in the user interface to open the ArcToolbox window.

Click on the plus sign in the box in front of **Data Management Tools** and then click on the plus sign in front of **Projections and Transformations** to access the tools you will be using. Because the shapefile of Illinois counties is an object or feature database (not a raster database), click on the plus sign in the box in front of **Feature** and then double click the **Project** tool.

In the "Project" window, use the pull-down arrow and select the tl_2009_17_county.shp shapefile as the "Input Dataset or Feature Class." The Input Coordinate System GCS_North_America_1983 should appear in the next section of the window.

The "Output Dataset or Feature Class" shows the name and path to be used for the projected shapefile. Set this to **c:\exer2\data\agency\shapes\tl_2009_17_county_Project.shp** to name the projected shapefile.

By projecting the data you obtained from the Census bureau, you are creating a new database. For this reason, store the new database in the data subfolder named "agency" which is intended to store data created by the "agency" (you). This also leaves the data as originally downloaded from the U.S. Census Bureau for future use in other applications.

Click on the button to the right of the "Output Coordinate System" to open the "Spatial Reference Properties" window.

Click the **X,Y Coordinate System** tab. Then click the Select button.

In the "Browse for Coordinate System" window, double-click the **Projected Coordinate Systems** folder, then double-click the **State Plane** folder, then double-click **NAD 83 (US Feet)**.

Scroll to the right to find the **NAD 1983 StatePlane Illinois West 1202 (US Feet).prj** file. Click the file name so it appears as the "Name" and then click the Add button. The "Name" and "Details" sections of the Spatial Reference Properties should show that you have chosen this projection. Click Apply and OK to close the "Spatial Reference Properties" window. Then click OK to perform the map projection.

When the projection process has completed successfully, click the Close button to close the "Project" window. You should see that the shapefile of projected Illinois counties has been added to the data frame.

Close the "ArcToolbox window" by clicking on the "x" in the upper right corner of the window.

You have probably noticed that the projected database looks exactly the same as the database which uses geographic coordinates as the spatial reference. This is because the data frame properties are set to GCS North American 1983 and all data layers must be displayed using the same spatial referencing system to integrate properly in a GIS application. When the shapefile of projected Illinois Counties was added, the software performed an on-the-fly projection so that the two shapefiles could be displayed together. This did not change the projection of the shapefile in state plane coordinates, only the shapefile's appearance.

You can verify this by right-clicking the **tl_2009_17_county_Project.shp** layer and selecting **Properties**. Click on the **Source** tab and you should see that the source shapefile uses the NAD 83 Illinois State Plane West projection.

Close the "Layer Properties" window.

Save the map document.

The Illinois State Plane coordinate system has two zones—one for the western part of the state and one for the eastern part of the state. To map the entire state, we had to choose which zone to use and selected the Illinois State Plane West projection. The data could have been projected using a number of other coordinate systems.

Display the Projected Shapefile

To display the projected shapefile, use the **Insert ⟹ Data Frame** menu to create a new data frame in the Table of Contents window.

Right click on **New Data Frame** and select **Properties**. Click the **General** tab and change the name of the data frame to Projected. Click the **Coordinate System** tab to see that the current coordinate system for the data frame shows that it has no projection.

Click Apply and OK to change the name of the data frame to Projected.

Use the **Add Data** button and navigate to:

c:\exer2\data\agency\shapes\tl_2009_17_county_Project.shp

then add it to the data frame. You should see that this view of Illinois looks less distorted.

Save the map document.

Compare the Two Views

Use the **View ⟹ Layout View** menu or the button at the bottom of the View Frame where the map is displayed to change from Data View to Layout View. You will see the two views stacked in different frames in the layout.

Click the **Select Elements** tool (the solid black arrow) in the interface to depress it and then click on the small frame containing the view of the projected shapefile of Illinois counties. You can tell that this is the frame selected because selection handles will appear around the perimeter of the layout frame. Holding the left mouse button down, drag the selected layout frame to another position in the layout view so that the two displays of Illinois counties are not overlapping.

You may also click on the larger layout frame containing the shapefile of Illinois counties in geographic coordinates to select it and then resize the frame by clicking on one of the selection handles and making the layout frame smaller. Reposition the resized layout frame so that you can more easily compare the two map displays.

You have probably noticed that the county boundaries in the Census database look unusual for the counties in the northeastern part of the state near Lake Michigan. Political boundaries of coastal units often extend offshore and do not follow the physical coastline. If you want a spatial database of counties which does show the coastline, you will have to find an appropriate counties database and or use the GIS software functions and a spatial database featuring the coastline to clip the Census shapefile of Illinois counties to exclude the offshore areas.

Use the **View ⟹ Layout View** menu or the button at the bottom of the View Frame where the map is displayed to change from Layout View to Data View.

Project a Shapefile Using the Export Data Function

The Illinois Natural Resources Geospatial Data Clearinghouse distributes GIS data for Illinois. The Clearinghouse distributes a number of spatial databases including polygon and line layers of the county boundaries with the Lake Michigan coastline.

Make sure that the Projected data frame is the active data frame. The name of the active data frame is highlighted in bold in the Table of Contents. If the Projected data frame is not the active data frame, right click the Projected data frame and select **Activate** from the menu.

Click the **Add Data** button and navigate to:

c:\exer2\data\isgs\shapes\IL_BNDY_County_Py.shp

and add it to the data frame.

The Illinois Natural Resources Geospatial Data Clearinghouse distributes two other files with the IL_BNDY_County_PY.shp shapefile: a bitmap file (IL_BNDY_County_Py.bmp) containing an image of the shapefile and a textfile (IL_BNDY_County_Py.txt) containing metadata describing the spatial database. These have been placed in separate folders within the isgs folder for your reference.

Right click the IL_BNDY_County_Py shapefile and select **Properties** from the menu. Click the **Source tab** in the "Properties" window and you will see that this shapefile has geographic coordinates, specifically, the GCS_North_American_1983 system coordinates.

Close the "Properties" window.

You can either project the shapefile using ArcToolbox or you can use the **Export Data** function to save a copy of the shapefile in the same coordinate system used in the Projected data frame.

Right click the IL_BNDY_County_Py shapefile and select **Date** ⇒ **Export Data** from the menu.

In the "Export Data" window, select "All features" in the Export section so that you will export all features in the shapefile. Under "Use the same coordinate system as:", select the radio button for "the data frame" so that you will export the data using the Illinois State Plane West coordinates. Click the Browse button next to "Output feature class:" to open the "Saving Data" window. Set the path and name to:

c:\exer2\data\agency\shapes\IL_BNDY_County_Py_Project.shp

then select Shapefile from the pull-down list next to "Save as type:" and click Save to close the "Saving Data" window.

Click OK to export the data. Click the Yes button to add the exported data to the map as a layer. You should see counties of the entire state of Illinois with the Lake Michigan coastline.

Right click the IL_BNDY_County_Py_Project shapefile and select **Properties** from the menu. Click the **Source** tab and you should see that this shapefile has been projected and uses the Illinois State Plane West coordinates.

Right click the IL_BNDY_County_PY shapefile and select **Remove** from the menu.

Save the map document.

Compare the two databases using the display functions of the GIS. First, double click the shaded rectangle in the legend under the IL_BNDY_County_Py_Project shapefile to open the Symbol Selector window. Click the "Hollow" symbol shown in the window on the left and then increase the "Outline Width:" to 2 using the arrows to the right. Click OK. This will enable you to see through the polygons of the IL_BNDY_County_Py_Project shapefile so that you can compare it to the shapefile of counties from the Census.

Use the panning and zooming tools described in Exercise 1 to zoom in and pan along the county boundaries. Zoom to a scale around 1:24000. You should see that the Census geographic database of counties and the Illinois Clearinghouse geographic database of counties are not identical. Open the attribute tables of the two databases and note the differences in the attributes used to describe the counties of Illinois. These databases were created by different agencies using different data sources at different scales from different time periods. It is a useful practice to use the panning and zooming tools to explore the data you are processing using GIS software at various stages in the analysis. Looking at the data in its full extent makes it difficult to see that the boundaries do not coincide.

Once you have created a new spatial database through some type of processing or analysis, it is important to prepare accurate metadata for the spatial database. Metadata can be prepared in ArcCatalog.

METADATA

Go to **Start** ⇒ **Programs** ⇒ **ArcGIS** ⇒ **ArcCatalog 10** to start ArcCatalog.

In the Catalog Tree window to the left, navigate to the

c:\exer2\data\agency\shapes\IL_BNDY_County_Py_Project.shp

shapefile and highlight it.

In the window to the right, click the **Contents** tab. You should see a thumbnail of the database showing what it looks like when displayed. This thumbnail was created by the agency publishing the data and it shows what the database looked like before you projected it. Click on the **Description** tab and scroll through the metadata entry.

To view the full metadata description based on a metadata standard, click the **Customize ⇒ ArcCatalog Options** menu to open the "ArcCatalog Options" window and click the **Metadata** tab.

Under "Metadata Style", select FGDC CSDGM Metadata from the pull-down list. Check the box to update metadata automatically when metadata is viewed. Then click Apply and OK.

To update the thumbnail, click the **Preview** tab in the window making sure that you are seeing the Geography view and that you are seeing the projected counties. Click the **Create Thumbnail** button in the interface. Then click the **Contents** tab to see that the thumbnail view of the data has been updated. Click the **Description** tab to see that the thumbnail has been updated there, too.

In addition, you should update other elements of the metadata for the projected shapefile you created.

Click on the **Edit** button in the toolbar under the **Description** tab. Click through the various sections to identify information that should be updated by you. After you have edited the metadata so that it accurately describes the shapefile, click the Save button to save your edits.

Use the **File ⇒ Print metadata** menu to print a copy of the metadata.

Use the **File ⇒ Exit** menu to close ArcCatalog.

Use the **Save** button to save the map document and then use the **File ⇒ Close** menu to close ArcMap.