Lab #2
Map Projections, Working with XY Coordinates: Google Earth

For ArcGIS Desktop

Last update: September 2020
Lab #2: Map Projections, Working with XY Coordinates

This lab will examine the importance of map projections and coordinate systems. We will explore how different global map projections change the size and distance of the continents, and then apply a projection to a map of the Democratic Republic of the Congo. The lab will also show how to add a tabular dataset with XY coordinates to ArcMap, and then how to export the layer to Google Earth for interactive viewing.

EXERCISE OBJECTIVES:

1. Understanding projections
2. Adding XY data
3. Exporting to Google Earth
Part 1: Experimenting with Coordinate Systems

1. Open ArcMap and begin with a new, blank document.

2. Click the ‘Add Data’ button and navigate to the Lab 2 Data folder. Add the World_Boundaries and World30 shapefiles to your map.

   First, we are going to check on the spatial reference for the data frame. The data frame automatically adopts the coordinate system of the first layer added. In this case, the data frame will show the coordinate system of the World_Boundaries shapefile. The data frame will remain with this coordinate system even if the layer is later removed.

3. Right-click on ‘Layers’ at the top of the Table of Contents and Select ‘Properties.’ (You can also access the data frame properties by right-clicking anywhere in the map display and scrolling to ‘properties.’)

4. In the dialogue box, click on the Coordinate System tab. In the lower display box, you should see the current system is set to GCS_WGS_1984 (which stands for Geographic Coordinate System, World Geodetic Survey, 1984). This is the standard geographic coordinate system for the world.

   **Note:** GCS_WGS_1984 is not a projection. It is a coordinate system that uses latitude and longitude to define the location of points on the surface of a sphere. It is the bare minimum that the software needs in order to identify where on the earth we are working. A projected coordinate system, on the other hand, is a coordinate system used to project the 3D spherical earth onto a 2D surface. A projected coordinate system is necessary if you wish to do any type of analysis or measurement- while a geographic coordinate system uses decimal degrees, a projected coordinate system converts to standard measurements such as miles or kilometers.
5. Now, we are going to project the world layer into various coordinate systems that have already been defined by ArcMap. In the top display box, expand the folder ‘Projected Coordinate Systems.’

6. Scroll all the way to the bottom and expand the folder ‘World.’ This will take you to the projections that ArcMap has defined at the global level.

7. Select the projection ‘Cylindrical Equal Area’ and click Apply. If you see a warning message, click OK. The look of your map should drastically change.
8. Repeat the process (Data Frame Properties > Coordinate System > Predefined > Projected Coordinate Systems > World), but this time select Sinusoidal. Click apply to see how this projection changes the map.

9. Repeat these steps again looking at Mercator, The World From Space (good for locator/inset maps), Fuller, and Robinson projections. Observe how each one changes the look and shape of the map, and think about how different projections might be appropriate in different circumstances.

10. If you wish, change the projection of the map to any others that you would like to see, and then close out of ArcMap once you are done exploring. Do not save.
4 FULLER

5 ROBINSON
Part 2: Adding Tabular Data with Spatial Coordinates (XY data)

Now, we will look at a more specific area in Africa and add a tabular dataset for waterfalls in the Democratic Republic of the Congo. The dataset has spatial coordinates, so we are able to use a tool in Arc toolbox that allows us to display XY data.

1. Open a new, blank ArcMap window and add the Democratic_Republic_of_the_Congo shapefile from the Lab 2 Data folder.

2. Add the .dbf file (database file in tabular format) called WaterfallsDRC.dbf from the Lab 2 Data folder. Notice that you can only see the WaterfallsDRC table icon in your table of contents when you are in the ‘List by Source’ view (see red box below), and not in the ‘List by Drawing Order’ view (green box).

3. Before moving on, save your file as Waterfalls in the DRC.mxd to your Lab 2 folder. Remember to save your work periodically throughout the lab.
4. Right click on the **WaterfallsDRC** table and select ‘Open.’

   *The tabular data looks just like an attribute table for a shapefile. The last two columns, POINT_X and POINT_Y are the spatial coordinates that will allow us to display the data on a map. Also notice that the dataset is in French. On the next page is a translation of this dataset to help you understand what you’ll be mapping.*

5. Close the table.

6. Right click on the **WaterfallsDRC** table and select ‘Display XY Data.’
7. For the X Field, select POINT_X. In the Y Field, select POINT_Y. Leave <None> for the Z Field.

![Image of Display XY Data window]

8. Now, we need to choose a projection. Click on ‘Edit’ near the bottom of the window.

10. Select ‘WGS 1984 World Mercator’ (at the end of the list). This is one of the most common projections; it is the default captured by most GPS devices.

11. Click OK twice to close out of the ‘Displaying XY Data’ wizard.

12. Switch to the ‘List by Drawing Order’ view in the table of contents (red box below). Notice that the XY data was added as a new layer called WaterfallsDRC Events. This is not yet a real shapefile until it is exported as a permanent file, with its projection.
13. Right-click on the **WaterfallsDRC Events** layer and select Data > Export Data. Save the file to your Lab 2 folder as **Waterfall_Locations_DRC**.

NOTE: Make sure the ‘Save As Type’ drop-down menu is set to Shapefile - otherwise you will get an error.
14. Say yes when prompted if you want to add the exported data to the map as a layer.

15. Delete the **WaterfallsDRC Events** layer from the table of contents by right clicking and selecting ‘Remove.’ This was only a semi-permanent layer, which is explained on the following page.
Event layers are semi-permanent layers in ArcMap that only exist within the confines of a particular mapping session, or .mxd. We usually get event layers when XY data has been plotted. Event layers are not permanent shapefiles in the same way as the Democratic_Republic_of_the_Congo shapefile. Although the waterfall data has spatial information in terms of the x, y coordinates found in the original .dbf table, this information is not yet saved as permanent shapefile geometry, so you would be unable to send/share this layer with others, or even use it again once you’ve closed out of the mapping session. The process of exporting the waterfall event layer as a shapefile creates projected vector geometry for the new layer Waterfall_Locations_DRC.shp.
PART 3: Exporting to Google Earth

In the final part of Lab 2, we will learn how to export shapefiles to a format that can be used in Google Earth. Viewing shapefiles in Google Earth allows you to examine the data with high resolution imagery as the base layer, and interactively zoom and pan around the area of interest.

1. Right-click on Democratic_Republic_of_the_Congo and select ‘Zoom to Layer.’

   If you wish, before we export the Waterfall_Locations_DRC layer to a Google Earth format, take a minute to symbolize the waterfall features however you like. The exported layer will hold the symbology you choose in ArcMap once you open it in Google Earth. You also have the option of symbolizing the layer in Google Earth directly, which will be covered in this section.

2. Open Arc Toolbox from the top menu by clicking Geoprocessing > Arc Toolbox.

   Arc Toolbox opens a selection of numerous geoprocessing tools that allow you to manipulate datasets. We will learn more about Arc Toolbox and how to use some of the specific tools in a later lab.

3. Expand Conversion Tools > To KML (see blue box below). Double click on ‘Layer to KML.’
4. For the ‘Layer’ field, select Waterfall_Locations_DRC.

5. For the ‘Output File,’ click the folder to the right of the field. Navigate to your Lab 2 Data folder and title the file Waterfalls_GoogleEarth.
6. Leave the layer output scale set to 0 (the default), and make sure the ‘clamped features to ground’ box is checked.

7. Click OK to create the KMZ file, and save your map.

8. Minimize ArcMap and open Google Earth.

9. Click File > Open, and select the Waterfalls_GoogleEarth.kmz from your Lab 2 Data folder.

   Google Earth will automatically take you to the Democratic Republic of the Congo and display the waterfall data. The layer will also appear in the table of contents on the left side of the window.

10. Right-click on the Waterfall_Locations_DRC layer (the name of the original shapefile from ArcMap), and select ‘Properties.’

11. Click on the feature icon in the top right. This is where you can symbolize your features if you haven’t already done so in ArcMap. Click OK twice to return to the image.
12. Zoom to an individual waterfall feature (using the zoom tool found in the red box below) and click on the symbol to access the attribute information; the same information from the data’s attribute table in ArcMap.

Congratulations!

You now know how to display the XY data in ArcMap, apply a projection to a dataset, and export a layer to Google Earth for interactive viewing. These are important skills especially when working with data collected from the field with a GPS, and fixing very common issues with map projections. Your Google Earth file is saved so you can open it at any time.