

Tutorial 2 – Exploring Map Projections and Grid Systems in ArcGIS 10

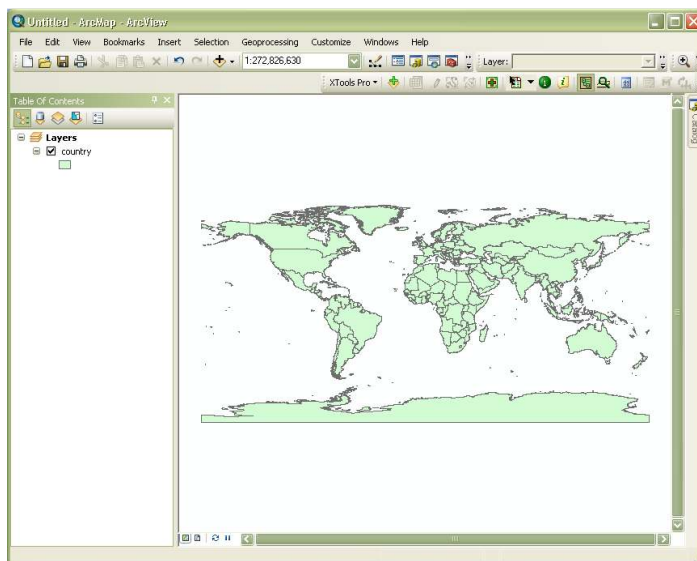
NOTE: Before beginning this tutorial, make sure your GEOGSV01 server folder is mapped on the computer you are using (as we did last week). Refer to the network drive document for instructions. Also, copy and unzip the lab2.zip file from labdata to your network drive (remember to create a new folder for your lab2 work in order to stay organized).

Objectives:

- Examining the coordinate system of a map in ArcMap and in the Catalog window
- Defining or changing the projection of a map in various ways
- Selecting the appropriate projection or grid system for a GIS or mapping project

1. Examining coordinate systems in ArcMap

For the first part of this tutorial, you will be working with the country map of the world. Run ArcMAP and create a new empty map. Add the “country.shp” world map, which can be found in the C:\ESRI\ESRIDATA\WORLD folder. Your computer screen should look something like the one below. Right-click on the name of the map layer within the table of content and select “properties”. When you click on the “Source” tab you will see information for this map layer, including coordinate and projection information. In this case, the coordinates are latitude and longitude (geographic coordinates) based on GCS_WGS_1984 (Geographic Coordinate System using the WGS_1984 datum). You do not see any projected coordinate system information, because this shape file is not “projected.”

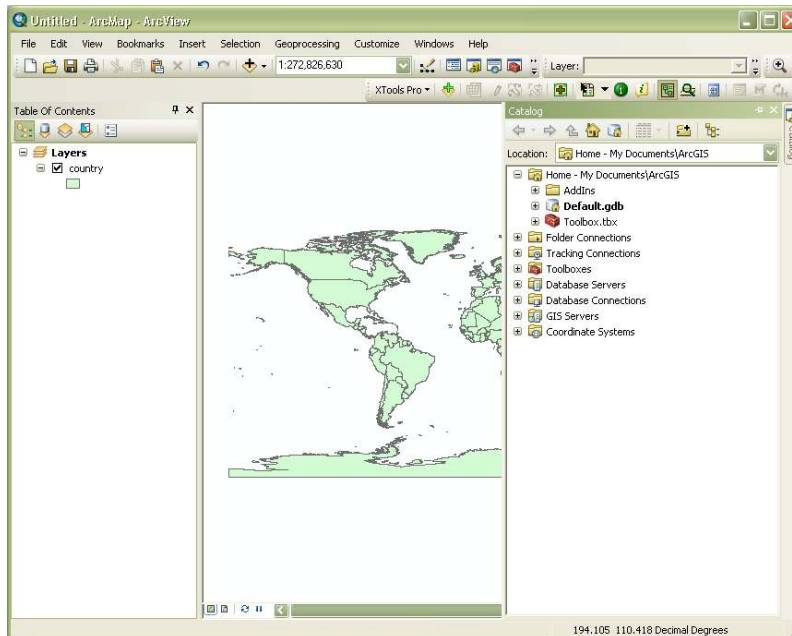


2. Examining coordinate systems using the Catalog Window

The Catalog window allows you quickly explore map characteristics, add maps, or rename maps. The Catalog window can be opened by selecting Catalog, under the 'window' pull down menu (see below).



You will be presented with the window below. This window unfolds from the right side of the GUI.

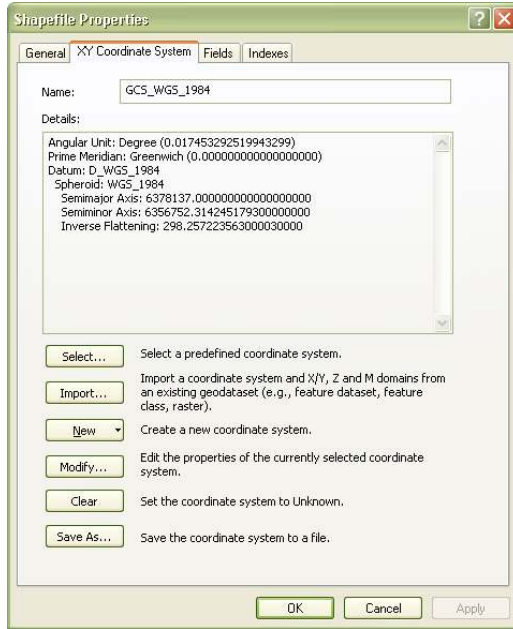


Using the right side of window, navigate into the ESRI data folder, find the world folder, and right click on country.shp and select properties (see below). The XY Coordinate System tab describes the spatial reference information (coordinates) – if that information has been placed in the metadata. You will find that some maps do not have a metadata file. Also note you can see the fieldnames and some properties of the table under the "Fields" tab.

You can also add layers to your map by dragging them from the Catalog and dropping them into the map window. Explore this feature by adding another map layer from the world folder to your map. Choose any layer you want.

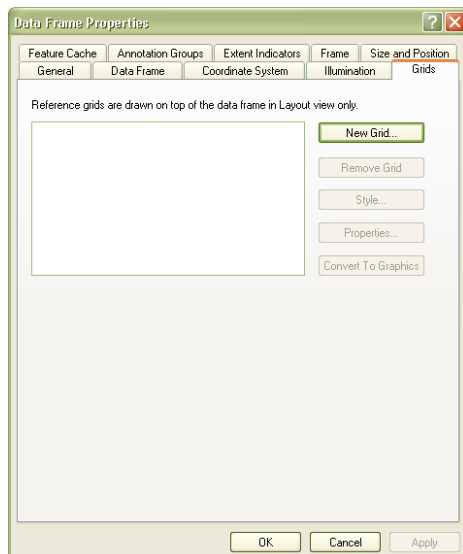
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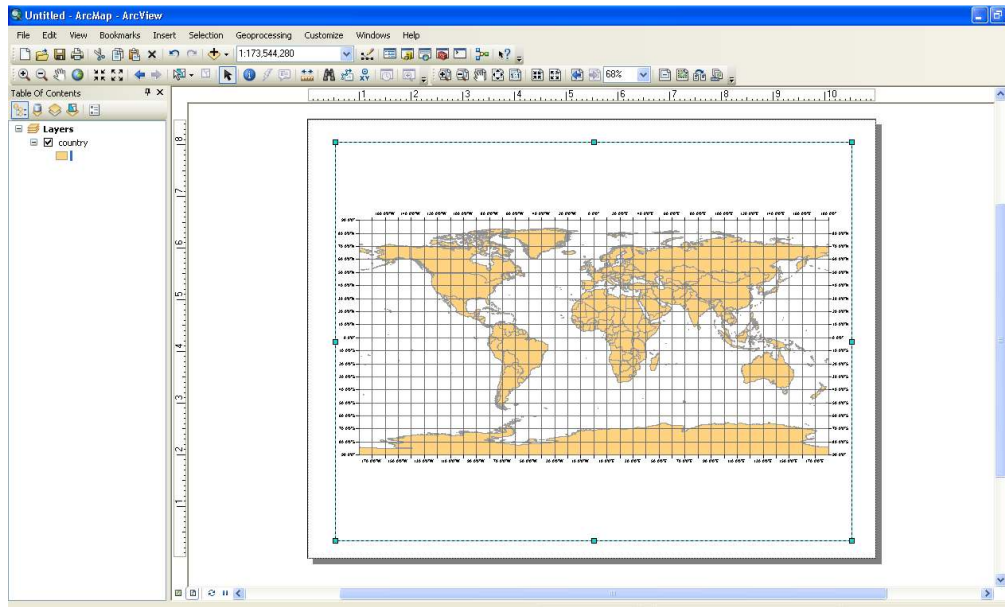


3. Placing a geographic grid (graticule) on the map layout

Move back over to ArcMap (you may close Catalog if you want by clicking the pushpin or the x) where you should still have the country map layer in the view. Right-click in the map window (which is also called the data frame) and select Data Frame Properties. Select the Grids tab (see below), click the New Grid button, and work through the default options to put a graticule in the layout window. You will not see the grid in the data view. Switch to the layout view to see the latitude and longitude lines. **Remember – the graticule will only appear in the layout window.**



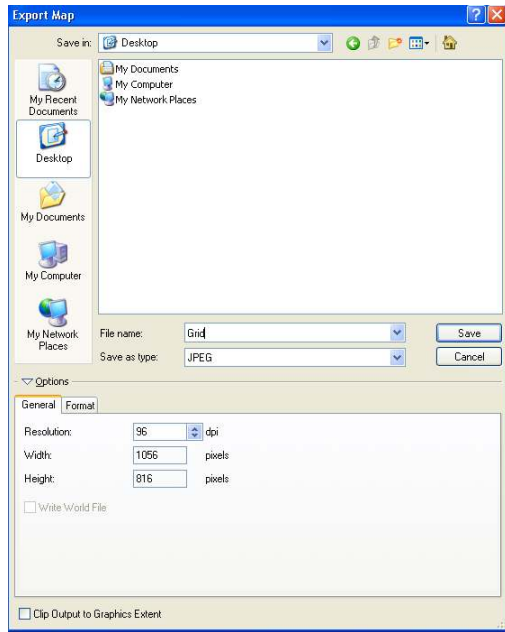
Once you have added a graticule to your map, switch over to layout view. You should now see a graticule like the one below.



Next, we're going to make a quick and dirty world map, but rather than actually printing it we will create an image of the map. Under file on the main GUI select page and print setup and change your layout from portrait to landscape. Next, adjust your dataframe (shown above in dashed line, with side "handles") to fit the new shape of your page. The handles can be used to change the actual shape of the dataframe. Once it approximately matches the one above then select the full extent button to zoom in and center on the county map layer.

Assuming your map now looks something like the one above, select 'export map' under the file menu on the main GUI. This feature enables you to make an image of your map (similar to taking a picture of it). Change the file type to "jpeg" and make sure you save the file into your workspace. When you select OK the image will be rendered. You should be able to open it up and view it like you would any picture, or image, file. Do this to make sure everything worked.

Note: this is the best way to move graphics from ArcMap into the office suite of products (Word or Powerpoint).



4. Three main (re)projection operations (VERY IMPORTANT)

How does one (re)project a map layer? There are three possibilities:

- To simply change the way a map layer is displayed in the data frame **without permanently** changing its original projection (i.e modifying the data). Such a map layer has a defined projection and we are simply reprojecting it temporarily.
- To define a projection for a map layer that has **no original projection** information.
- To create a new map layer with its projection **permanently** altered.

Knowing how each operation works and when to use which operation becomes critical during the rest of the semester. Let's try each one.

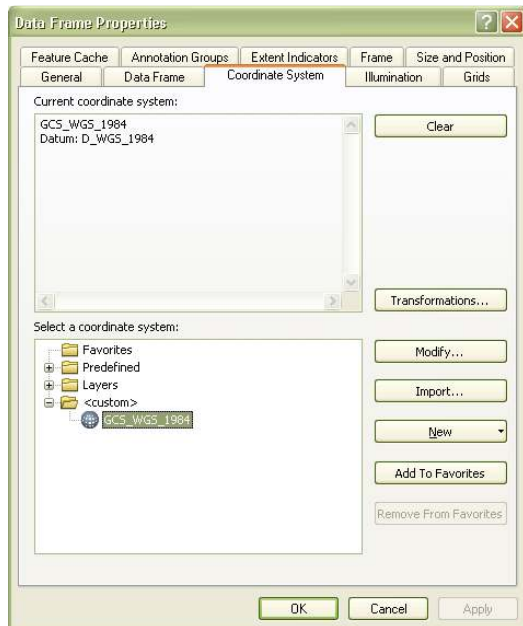
4.1 Changing the map projection in the data frame (temporarily)

Reminder – the first approach only changes the way the map is viewed. Its native coordinates are not changed. The second and third techniques create a new map with new native coordinates.

Go back to the ArcMap data frame, right-click in the map window, and select Data Frame Properties. This time, select the Coordinate System tab. You will see a window similar to the one below. Notice that the "Coordinate system" tab shows only "GCS_WGS_1984" which is a geographic coordinate system, without any projected coordinate system. This is because the current map on the screen is actually not projected based on any conventional projected coordinate system.

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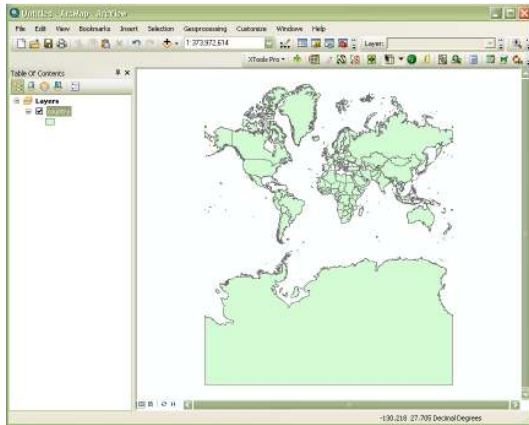


Click the Predefined folder -> Projected Coordinate Systems folder. Continue working your way through to the World folder (plain world, not 'Sphere-based'). A list of common projections for the world will be given. The term "Predefined" refers to various coordinate systems that have been pre-programmed into ArcMap.



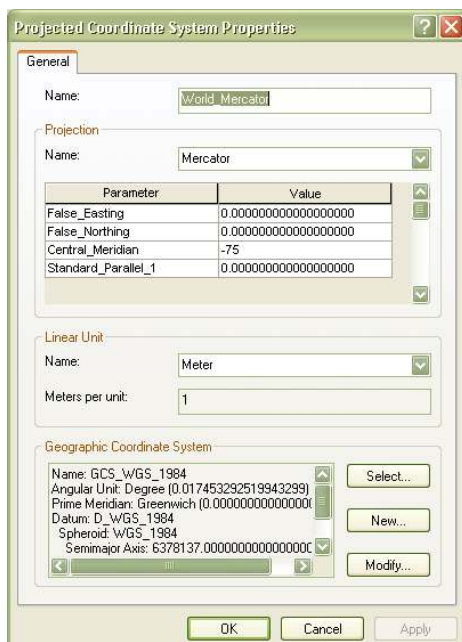
Select the Mercator (world) projection (see above) and examine the pattern of latitude and longitude lines in the layout. Note the increasing area distortion in the polar regions. If you map does not look like the one below, click the full extent button (the one that looks like a globe on the main toolbar).

Notice the projection parameters for the Mercator projection. How do they differ from the WGS_1984 GCS specifications you previously viewed? Remember, all projections have both projection parameters (such as standard lines) as well as GCS specifications (such as spheroid and datum). In other words, projected coordinates are produced from the GCS following the conventions of the projection. If you do not understand this point ask your lab instructor.



Modifying projection characteristics

The default settings for the Mercator projection uses 0° longitude as the central meridian (center of the map). I would like you to change this value to -75 (75°W), which is closer to NY. Remember that western longitudes and southern latitudes are identified by negative numbers in ArcGIS. To change the value of the central meridian you must first make sure you are in the data frame view (not layout) and again right-click on the map. Select the Data Frame Properties and click on the Coordinate System tab. The map should be still set on a default World-Mercator. Click the Modify button to make the appropriate projection adjustment for changing the central meridian (see below). Note how changing this value changes how the data is displayed.



4.2 Defining (adding) projection information to an existing map that has no information

ArcGIS provides a tool that allows us to permanently define projection information for an undefined map. This task is performed using the ArcToolbox.

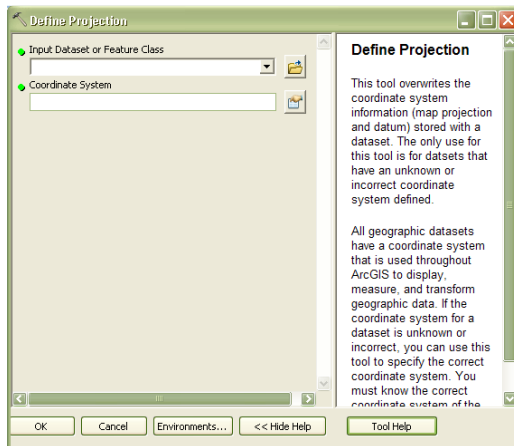
ArcToolbox

- 3D Analyst Tools
- Analysis Tools
- Cartography Tools
- Conversion Tools
- Data Interoperability Tools
- Data Management Tools
 - Data Comparison
 - Database
 - Distributed Geodatabase
 - Domains
 - Feature Class
 - Features
 - Fields
 - File Geodatabase
 - General
 - Generalization
 - Graph
 - Indexes
 - Joins
 - Layers and Table Views
 - Package
 - Projections and Transformations
 - Feature
 - Convert Coordinate Notation
 - Create Custom Geographic Transform
 - Create Spatial Reference
 - Define Projection**
 - Raster
 - Subtypes
 - Table
 - Workspace
- Editing Tools
- Geodatabase Tools

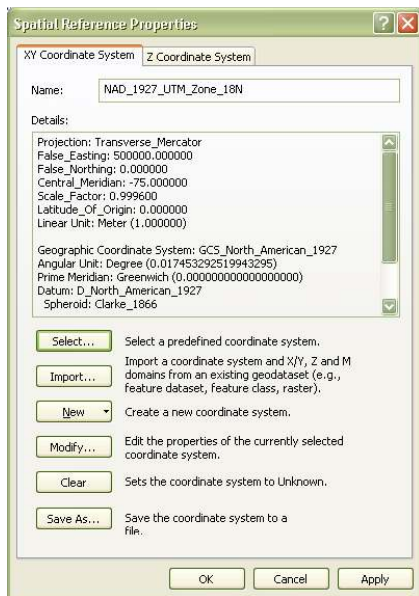
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You must identify the input map (Madroads_no_coord) and the coordinate system that you are defining. To do this, click the buttons to the right of each input field and work through the options. Note that you could use this tool for a map layer in your present table of contents, or you could navigate to a map layer in a folder and define its projection as well. When you click the button next to the coordinate system field, you must hit the Select button and navigate to your desired projection. Note: UTM projections are found in the Projected Coordinate Systems folder. After you select the correct system the window below will appear.

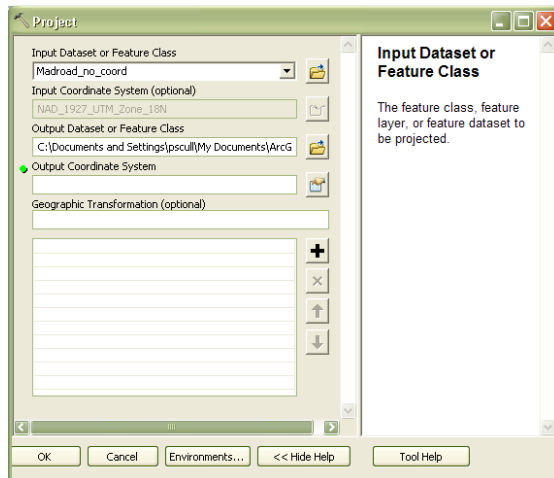


Click OK to select the projection and another OK to finish the process. You will not see the effects immediately. You must open a new data frame and re-add the road map. You will see that it now has the correct projection information. This is most easily identified by looking at the units of the cursor's location in the lower right. How else could you

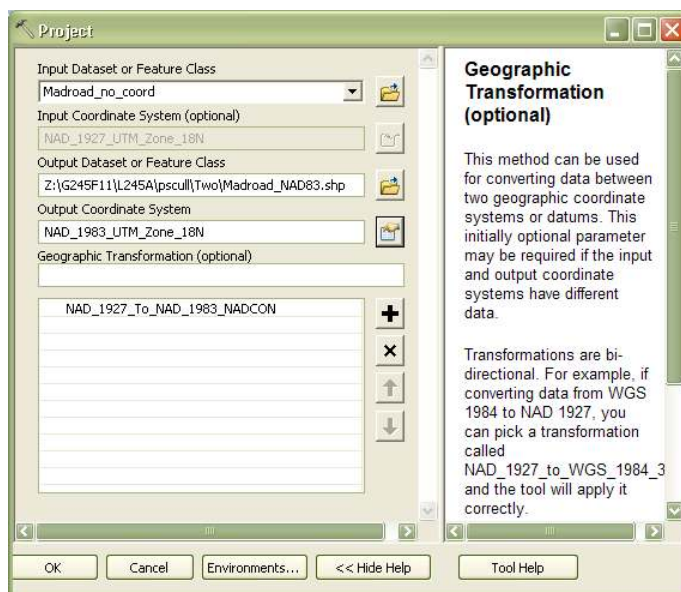
confirm that it worked? Ideally, you would now rename the layer to indicate that it has a defined coordinate system. This is most easily done using the Catalog.

4.3 Permanently changing projection systems

There may come a time when you want to take an existing map and create an **entirely new map** with different coordinates. For example, we could take the Madison road map that we just defined to be UTM zone 18N NAD27 and create a new map in UTM zone 18 NAD83. To do this, use the ArcToolbox and select Data Management -> Projections and Transformations -> Feature -> **Project**. A window like the one below will appear.



Work through the various options, which will eventually take you to something like the one below. Please note that you will need to pay attention to the output map name (output dataset). You will also need to select NAD_1927_to_NAD_1983_NADCON option under geographic transformation.



Once you click 'ok' a new UTM NAD83 version of the Madison road map will be created and added to your workspace, assuming you have provided the correct path in the 'Output Dataset or Feature Class' field. By default ArcMAP will also add this new map to the map view.

5. Projecting on the fly

In the "old days" of GIS, if you attempted to overlay maps with different coordinate systems or datums (such as NAD27 and NAD83), they would not line up. However, if the coordinate systems of your maps are properly defined, ArcMap will make the necessary adjustments. For example, open a new map document, and add the NAD27 Madison Roads first and then your new NAD83 road map in the data view. Check the Data Frame Properties. What is the coordinate system used? Next, open another new map document, but this time add the NAD83 road map first, then the NAD 27 road map. What is the coordinate system used now?

ArcMap set the display coordinates based on the first map you open and then reprojects the second to match the first. This is called "projecting on the fly" and is a convenient feature of ArcMAP. **However, be warned that you should understand the coordinate system and units of every map you work with and not assume that ArcMap will take care of projection issues.**