Georeferencing and Projections

In this Chapter you will learn

- Different Georeferencing methods that can be used to reference a feature to a location on Earth
- What a projection is and you will be given an overview of the most commonly used projections in Idaho
- How to find out what the projection is for a GIS layer
- How to define a projection in ArcGIS
- How to project a GIS dataset from one projection to another in ArcGIS

1. Georeferencing Systems

To show your parcels and other information at the correct location on a map it is important to **georeference** or **geocode** your data. This simply means that you associate your data with a location on Earth. A good way to visualize this is by picturing a pin that pins your data to a specific location on Earth as shown in figure 1.

There are a variety of ways in which data can be georeferenced and we will see that some methods are better than others. The best georeferencing systems are **unique**, have **shared meaning**, are **persistent in time** and are **associated with a spatial resolution**. Those characteristics are explained further below as we list some common georeferencing methods:

Figure 1. Georeferencing can be thought of as using a pin to match your data to a location on Earth.

1. **Addresses**. For example, we can indicate the location of the Idaho State Tax Commission with its address, which is 800 Park Boulevard. At this point our address is not <u>unique</u>, for example there is a residence located at 800 Park Boulevard in Austin Texas. However, if you include "Boise, Idaho" in the address we can be fairly assured that we have referenced a unique location on Earth. The <u>spatial resolution</u> of this georeference is the size of the lot the address refers to, and includes the building that houses the tax commission as well as the parking lots surrounding it. An address typical has <u>shared meaning:</u> most people are familiar with the United States postal system and will be able to locate an address in the real world. Finally we need to make sure that an address is <u>persistent in time</u>. This is always a relative preposition: there is a good chance that this address is no longer valid in 100,000 years – but for the foreseeable future it is a reasonable expectation that this address does not change. Some data is georeferenced based solely on its zip code.

2. **Placenames**. For example "Boise", "USA" and "The Old Tree". Placenames – not surprisingly – are the most ancient georeferencing system. The <u>uniqueness</u> of a placename depends on the

placename itself: "USA" is unique in the world, "The Old Tree" may not be. Similarly, the spatial resolution depends on the placename: "USA" could be anywhere in the USA while "the old tree" could only take up a couple of square feet. While we can assume that the "USA" will be around for a while and be persistent in time, "The Old Tree" may be cut down at any time – after all, it is an OLD tree!

3. **Linear referencing systems**. An example is provided in Figure 2 where the entrance to the Tax Commission is linearly referenced to a nearby intersection. Any project with linear features, such as pipelines, transmission lines, rivers and streams can use linear referencing to identify points, or even stretches along the lines representing those features.

4. **Public Land Survey Systems**. For personnel in assessor's offices this is probably a familiar referencing system. The PLSS in Idaho is referenced to Initial Point which is located in Kuna, Idaho as shown in Figure 3.
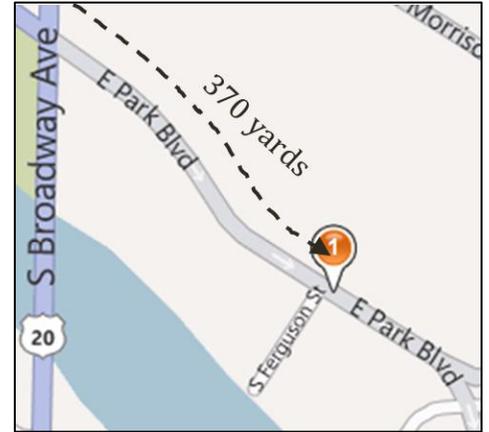
Figure 2. Example of linear referencing where the entrance to the Tax Commission is 370 yards South-East of the intersection of S. Broadway Avenue and E. Park Boulevard.
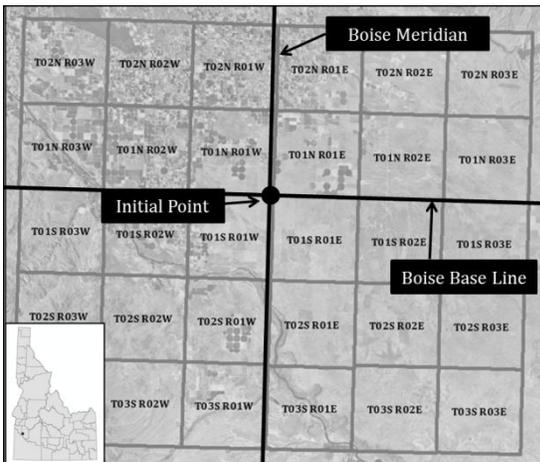
Figure 3. The PLSS is based on a grid of townships that are 6 x 6 miles each. The location of a township is indicated by Township and Range number which is referenced to Initial Point located near Kuna, Idaho.

The Boise Base Line runs east-west through Initial point while the Boise Meridian runs north-south through initial point. The land is divided up into townships which are each 6 by 6 miles. The location of each of those townships can be found by counting how many townships north (or south) a township is from the Boise Base Line while the range number indicates how many townships east (or west) of the Boise Meridian a township can be found. Note that the word "township" refers to a 6 by 6 mile piece of land and a measure of how far north (or) south that piece of land can be found from the Boise

Base Line. Each township is further subdivided into 36 sections, each of them approximately 640 acres. Each section can be further subdivided into aliquot parts such as half sections and quarter quarters.

This georeferencing system is unique as long as the description has a reference to the Boise Meridian and Boise Base Line. It has shared meaning since many people are familiar with this system, and for those who are not, there are a number of resources to get the information you need to start using it. The

Figure 4. One township is divided in 36 sections.

system is very persistent in time. While streets, addresses and other land marks may move, this grid system will stay in place. The spatial resolution varies from one township (36 square mile) to quarter quarters (40 acres) or even smaller subdivisions.

5. Geographic Coordinate Systems: Latitude and Longitude.

Starting at the equator this georeferencing systems draws parallels, or lines of **latitude**, north and south of the **equator**. When traveling north from the equator to the **North Pole** you will pass through 30° north, 45° north (which is the latitude that runs east-west through the middle of Idaho) and so on until you arrive at the North Pole which is located at a latitude of 90° North. Similarly, if you were traveling south from the equator to the **South Pole** you would pass 30° south, *etc*. until you reached the South Pole at 90° south. Longitude lines are drawn from the North Pole to the South Pole and

Figure 5. Longitudes and Latitudes can be used to georeference locations on Earth.

are used to indicate how far east, or west, a location is relative to the **Greenwich Meridian**, which is located in England. If you were to travel eastward from the Greenwich Meridian towards France and the Middle East, you would pass through 30° east until you reached a point in the Pacific Ocean. If you move westward from the Greenwich Meridian towards the United States your will pass through a latitude of 30° west, about 116° west in Idaho, until – on the other side of the globe – you end up in the Pacific Ocean again.

This referencing system is <u>unique,</u> for example there is only one place on Earth that corresponds to Longitude 116° 11' 23'' West and Latitude 43° 36' 15'' North. This referencing system is <u>persistent in time</u> (unless the shape of the Earth dramatically changes – but in that case we have bigger troubles), has <u>shared meaning</u> and is associated with an infinitely small <u>spatial resolution</u>. We could pinpoint a location down to the quarter inch, as long as use enough decimal points in our coordinates. For example latitude of 43° 36' 15.97863244'' N is completely acceptable.

It is important to indicate whether a longitude is east or west of the Greenwich Meridian. You can do this either by adding "W" or "E" at the end (for example 116° 11' 23'' **W**) or adding a "-" in front of coordinates that are on the western hemisphere (for example **-** 116° 11' 23''). When adding coordinates to ArcGIS it is good practice to add the "-" in front of all west coordinates. You would

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not be the first person to wonder why your Idaho GIS data ended up in China! Similarly, you should add a "-" in front of latitudes that are south of the equator.

In the previous paragraph we displayed a coordinate in three parts, for example 116° 11' 23''. In this example we have 116 **degrees**, 11 **minutes** and 23 **seconds**. Like a regular clock, there are 60 minutes in a degree, and 60 seconds in a minute. This means that there are (60 x 60 =) 3,600 seconds in a degree, just like there are 3,600 seconds in an hour.

Frequently you will see geographic coordinates displayed as **decimal degrees**, where the minutes and seconds have been collapsed into part of a degree. For example, if you have a longitude of 116° 30' 00" you would be halfway between 116° and 117°. In decimal degrees you would express this as 116.5 degrees. The following formula translates degrees-minutes-seconds into decimal degrees:

$$\text{Decimal Degrees} = \text{Degrees} + (\text{Minutes} / 60) + (\text{Seconds} / 3,600)$$

Example: translate 116° 11' 23'' W into decimal degrees: The table on the right explains how to compute those decimal degrees. Note that your final answer, since this longitude is west of the Greenwich Meridian, is -116.1897222 (note the minus sign in front).

	Computation	Degrees
116 Degrees	none	116.0000
11 Minutes	11 / 60	0.1833
23 Seconds	23 / 3,600	0.0064
Decimal Degrees:		**116.1897**

Exercise 1: Using Latitude and Longitude Coordinates to find a location in ArcGIS

1. Open ArcMap and add the "Imagery with Labels" base map. (Hint: use the drop-down box just to the right of the add data button).
2. Click the "Go To XY" Button on the Tools toolbar XY and follow the instructions below to set the units to "Degrees Minutes Seconds"

1. Click here to set units

Meters
Decimal Degrees
✓ Degrees Minutes Seconds
Degrees Decimal Minutes
MGRS
U.S. National Grid
UTM

2. Pick the unit that corresponds to your input data

Go To XY   (Decimal Degrees)

Long: 2.294444444   Lat: 48.858055556

Go To XY   (Degrees Minute

Long: Lat:
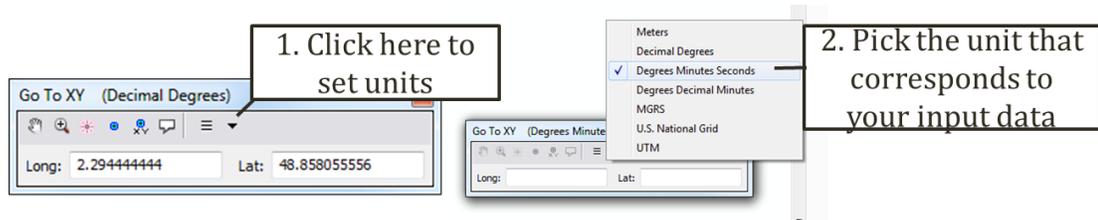
3. Find each of the landmarks that are referenced in the table on the next page. Use the third column of the table to write down which landmark is georeferenced (or, at least write down the City in which this landmark resides). For example, for the first landmark you would type:

Go To XY   (Degrees Minutes Seconds)

Long: 2 17 40   Lat: 48 51 29
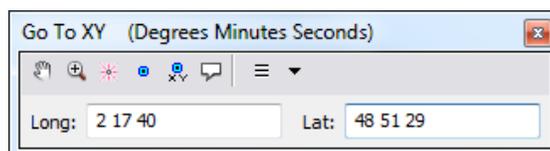
1	48° 51' 29" N	2° 17' 40" E	
2	38° 53' 53.3" N	77° 02' 09.9" W	
3	27° 10' 29" N	78° 2' 32" E	
4	43° 52" 49" N	103° 27' 33" W	

4. Hint: if your XY point falls into an odd location or in an ocean check the following:
    1. Did you add a "-"in front of longitudes that are west of the Greenwich Meridian?
    2. Did you use the right unit? For example did you use "Decimal Degrees" for a pair of coordinates that were given to you in "Degrees minutes Seconds"?

6. **Projected Coordinate Systems**. There are many projected coordinate systems such as "UTM", "Idaho State Plane" and many others. Before delving into each one those, we have step back and discuss one of the greater problems in mapping: the fact that <u>the world is round but a map is flat</u>.

2 Modeling the Earth and the Geographic Coordinate System

We are past the long-held believe that the Earth is flat (which would have been so much easier from a cartographers point of view) and settled on a "round Earth" or a **sphere**. In reality the Earth more resembles a "squashed" ball that bulges out in the middle and is more accurately modeled with a **spheroid**. If we wanted to be even more accurate we would have to describe our planet as a spheroid with irregular bulges and dimples as illustrated in figure 6.

Sphere: a perfect ball

Spheroid: bulging in the middle

Geoid: includes natural "bumps" and "dimples"

Figure 6. The Earth is not a perfect ball, or sphere but closer to a spheroid that bulges out in the middle. A geoid has an irregular shape, but includes the "bumps and dimples" found on the surface of the Earth.

When you draw points and lines based on latitude and longitude coordinates you need both a spheroid – because it forms the mathematical basis for plotting coordinates, and a geoid – because it is more accurate representation of our world.
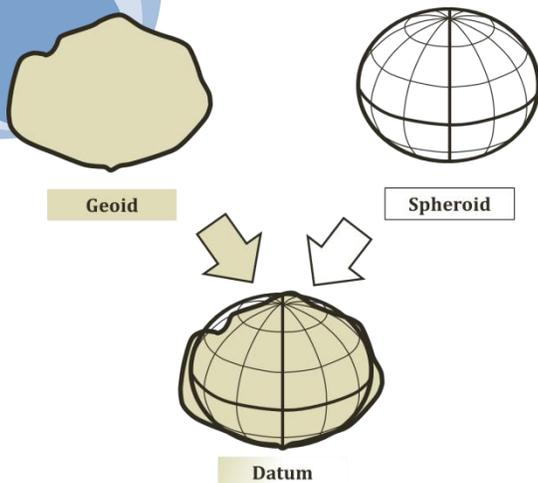
Figure 7. A datum is a relationship between a spheroid and a geoid.

The combination of a geoid and a spheroid is called a **datum**. A datum has three different pieces of information:

(1) The spheroid this is used. There are a couple of different ones, for example "Clarke 1866" and "GRS80" that could have been included in a datum.

(2) The geoid that is used

(3) A relationship between the geoid and the spheroid that explains how they sit on top of each other.

A datum only works well for those areas where a geoid and spheroid are aligned near the surface of the Earth as illustrated in figure 8. This is why, when you are selecting a coordinate system in ArcGIS you would browse to a coordinate system with a datum that works for North America.

Figure.8. A datum only works well for areas where the spheroid and the geoid match closely.

Next, you will experiment with different coordinate systems in Exercise 2. You will use a geographic coordinate system, i.e. one that is based on latitudes and longitudes.

Exercise 2: Displaying a geographic coordinate system

1. Start ArcMap, open a new map document and add the Idaho shapefile from the Topic5_1 folder.

2. Right-click on the data frame called "Layers" (which is the default name for your data frame) in the table of contents as shown on the right. Click on Properties.

3. Click on the "Coordinate System" tab and you will notice that the coordinate system is set to IDTM 83. ArcGIS typically sets the coordinate system of the data frame to match the coordinate system of the first GIS layer that has been added to the map. Notice the curve representing the southern border of Idaho. This is a **projected** coordinate system which we will discuss later. It is interesting to see how IDTM 83, a coordinate system especially designed for Idaho looks on the entire globe.

VIDEO

5.1. Creating a graticule

4. Right-click on "Layers" again to open the Data Frame Properties. Follow the directions below to add a graticules that shows the meridians and parallels. Don't worry if you don't see the graticules yet.

1. Go to Grids tab

2. Click "New Grid"

3. Check the box for "Graticule: divides map by meridian and parallel. Click "Next"

4. Create parallels and meridians every 20 degrees. Click "Next", "Next" and then "Finish" to complete the graticule
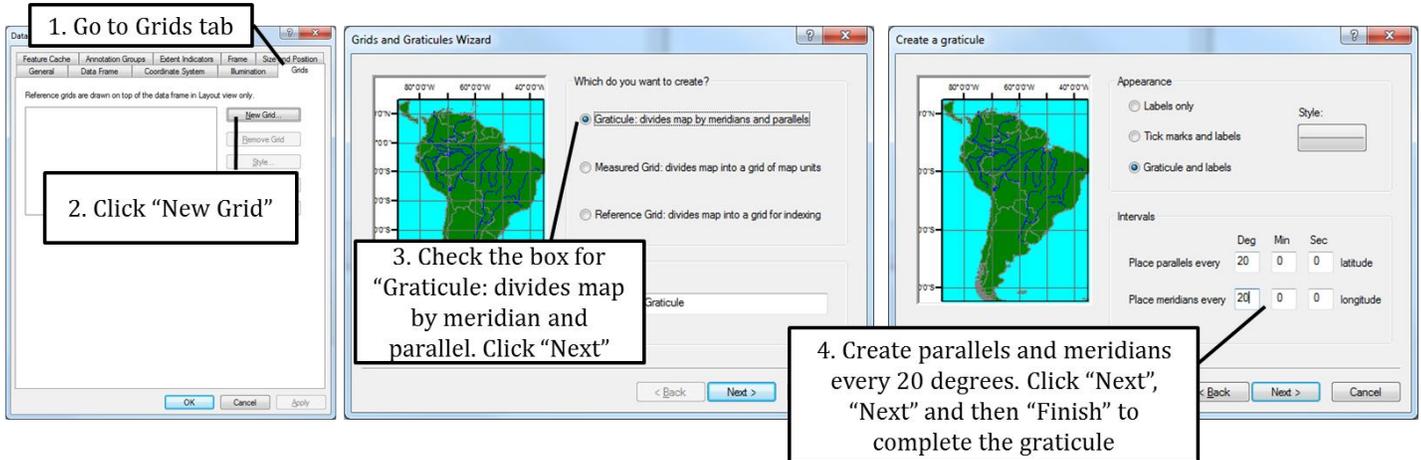
5. Switch to the layout view (Hint: click on "View" near the top of your screen and click on "Layout View". Add the "Imagery" base map and zoom out to the entire world. You should now be able to see your graticules. What do you think? Pretty weird, right?

6. Next you will set your data frame to the Geographic NAD83 coordinate system. Do this by opening the properties for the Layers data frame again (hint: right-click on Layers and choose properties). Click on the Coordinate System Tab and go to Geographic Coordinate Systems > North America > NAD 83 as illustrated below.

1. Double-click on "Geographic"

2. Scroll down and then double-click on "North America""

3. Scroll down and click once on "NAD 1983"
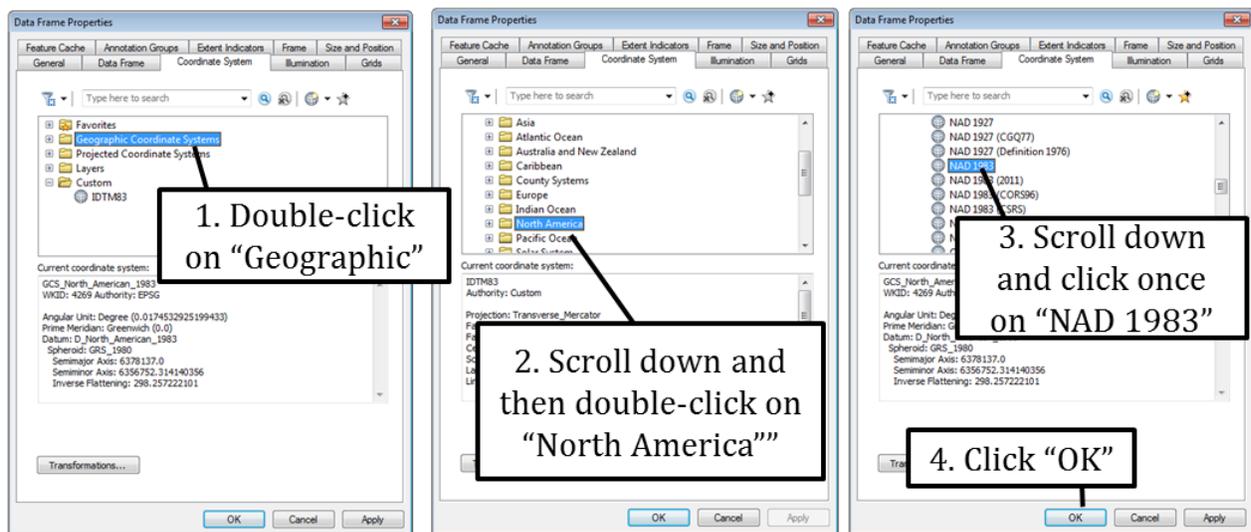
4. Click "OK"

7. Click OK and observe how the shape of Idaho, and the entire world changes. Specifically the southern border is now shown as a straight line. When you plot latitudes and longitudes on a map it will show both of them as straight lines across your map. This is the type of map that makes Antarctica look much bigger than it really is.

8. All geographic coordinate systems, i.e. those displaying latitude and longitude can be found in the "Geographic Coordinate Systems" folder.

3. Projections

In order to create maps that correctly display different parts of the world in an undistorted, true to scale manner it is necessary to use **projections**. For example, the map displayed in figure 9, clearly shows some of the shortcomings of a geographic coordinate system: Antarctica is huge and stretched funny as are other areas close to the North and South Poles.
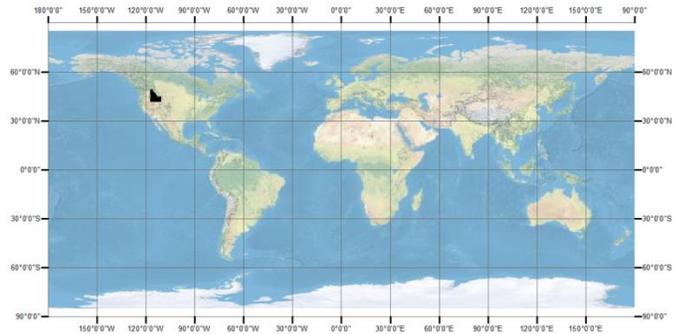
Figure 9. A map displayed in a geographic coordinate system map not model Earth accurately in some areas.

Figure 10 shows the concept of a projection: light is projected from the inside of our globe, through the surface and onto a screen. There are three main types of projections that differ on how a screen is placed around the globe to intercept, and then display the projected light. Screens can be folded around and positioned next to the globe in different ways:

Figure 10. To understand projections visualize a globe with a light shining out from its center and projecting your map on a surface outside the globe.

Cylindrical projection: a screen is folded into a cylinder and placed over the lighted globe as illustrated in figure 11. As you can see the representation is quite good where the cylinder touches the globe – which is along the equator – but much distorted in both size and shape as

Figure 11. Cylindrical projection.

you more towards the North and South Poles. This is always true: the representation is the best where the screen touches the surface of the globe.

A common projection in Idaho is a **Transverse Mercator** where the cylinder is wrapped horizontally, with the open ends at the east and west side as shown in figure 12, instead of north and south as shown in figure 11. The key is to make the cylinder touch the globe in your area of interest. So, for Idaho projection the "touching line" should run through the middle of Idaho – which is the case for the **Idaho Transverse Mercator** (or **IDTM** for short), a common projection used when displaying data for the entire State of Idaho.
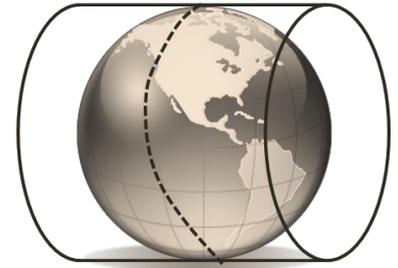
Figure 12 Transverse Mercator

Figure 13. Conic Projection

Figure 14. Planar Projection

Conic projections have their screen wrapped around the globe like a cone as illustrated in figure 14.13. The projection works best at the areas where the cone touches the globe. Given that you can wrap this cone around any part of the globe you wish you can make this projection work anywhere.

Planar projections, as illustrated in figure 14, have a flat screen touching the globe at one point. This method only works at (or very near) the point where the screen touches the globe. This projection is good at displaying accurate directions from that one center point.

4. Universal Transverse Mercator (UTM)

The world is divided into 60 UTM zones, each of them 6 degrees wide and stretching from the North to the South Pole as shown in figure 15. Idaho is covered by UTM zones 11 and 12.
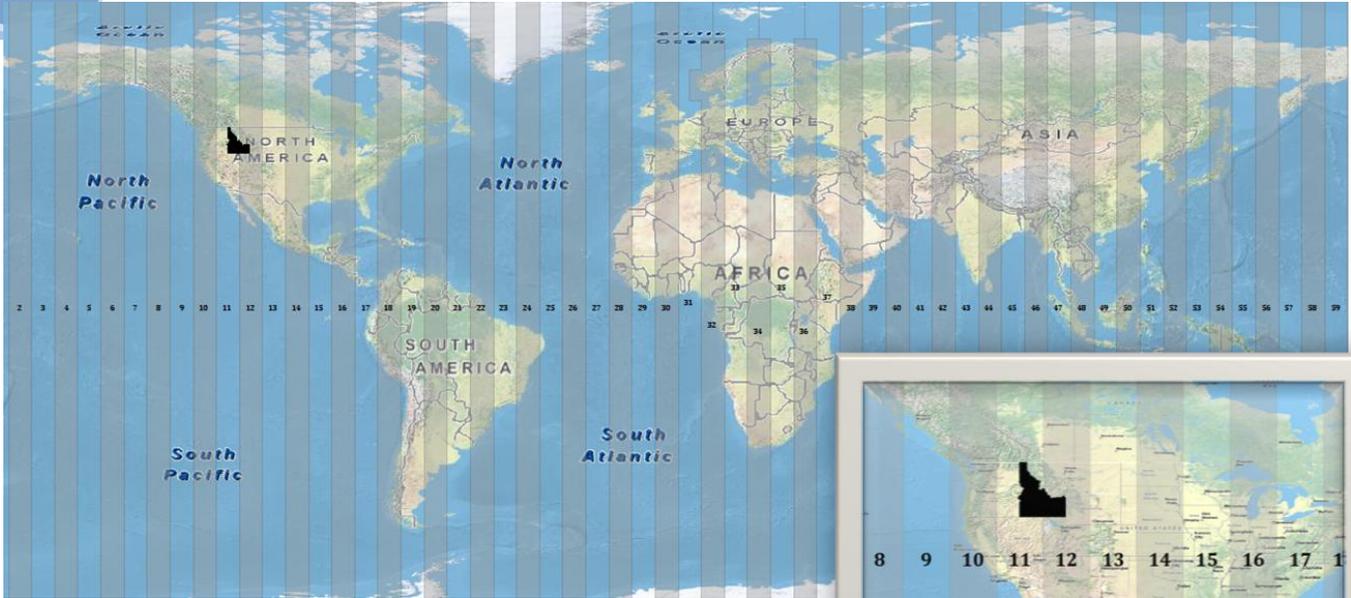
Figure 15. UTM Zones in the world and in the United States (inset)
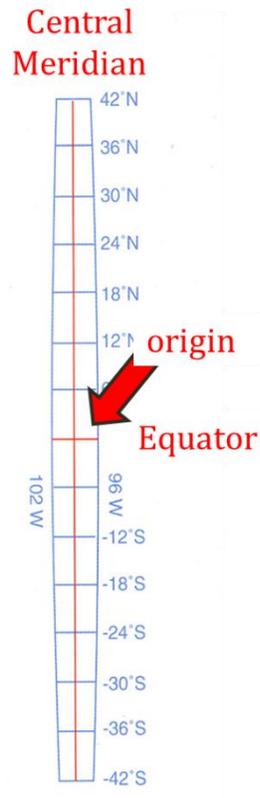
Figure 16. One UTM Zone

Figure 16 shows one of the sixty UTM zones. Through the middle of the UTM zone runs the **central meridian**. Think of one UTM zone as a Cartesian coordinate system – one that you may be familiar with from elementary or high school math classes.

Along the horizontal X-axis you plot the **easting**, i.e. how far east or west your point of interest is, while the Y-axis functions as the **northing**. The point of origin is where the X-axis and Y-axis meet, where the (x, y) coordinate it typically set to (0, 0).

Figure 17. Think of one UTM zone as a Cartesian coordinate system.

The origin in the UTM zone is the point where the equator and the central meridian meet. To avoid negative numbers on the X-axis as you move west, the origin is (artificially) set to (500000, 0). The UTM measures distance in meters. Thus a point with location (500001, 10) is one meter east of the central meridian, and 10 meters north of the equator.

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Exercise 3: Understanding UTM Coordinates

1. The center of the blue turf at the Boise Bronco's football stadium in located in UTM Zone 11 at the coordinates indicated in the figure on the right.
   a. How many meters north is this field from the equator? _____
   b. Is this football field located east or west of the central meridian? _____
   c. If you were to walk 20 meters (about 20 yards) north to the edge of the field, what would your new coordinates be? _____
   _____

(564,983 , 4,827,877)

5. State Plane Coordinate Systems

17. Tennessee's shape does not lend itself to a transverse Mercator projection.

We have seen that a projection based on a transverse Mercator works well for areas that "tall and skinny". So it is not surprising that the most common coordinates systems used in Idaho, the "Idaho Transverse Mercator (IDTM)" for maps showing the entire state, or the Idaho State Plane projections for smaller parts of Idaho. For states that are "wide and short" such as Tennessee are better mapped using a conic projection.

14.18. Idaho has three State Plane Coordinate Systems.

The **State Plane Coordinate Systems** list the best projection for each State. Idaho has three State Plane Coordinate Systems, one for Idaho West, Idaho Central and Idaho East.

The State Plane Coordinates for Idaho can be found in Predefined > Projected Coordinate Systems > State Plane > NAD83 (feet or meters)

The Idaho Transverse Mercator is location in Predefined > Projected Coordinate Systems > State Systems.

6. Defining a projection

Assume that during a recent BSU Bronco football game you
brought your GPS unit and managed to get a reading from
the center of the field: (564,983 , 4,827,877). Being home
again you decide you want to show this waypoint on a map
using ArcGIS. If you just provide ArcGIS with those two
numbers the software will not know where to place your
point. Did you collect your data in UTM coordinates? If so,
which zone? State Plane? Figure 19 shows those same
coordinates and where they would fall in four different
coordinate systems. Obviously, besides the coordinates
themselves you also need to tell ArcGIS which coordinate
system to use. In other words: you need to **define a
projection**. The easiest way to know which projection to define is by checking the system setting of
your GPS unit to see what coordinate system it uses. Alternatively, you can try to define your data in
different projections and see which one puts your data in the right location. In figure 19 you can see
that the data was collected in UTM Zone 11 since that point landed in Boise, Idaho on the map.
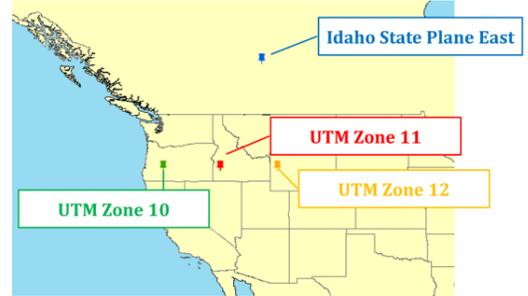
19. The coordinate (564,983, 4,827,877)
projected in four different projections.

Exercise 4: Defining a projection in ArcGIS

5.1. Defining a
Projection

1. Open ArcMap, open a new blank map and add the Idaho shapefile from the
    Topic5_1 folder. For this exercise assume you downloaded a shapefile called
    "Cities" showing three cities in Idaho that you would like to display those on a
    map. Unfortunately, the shapefile does not have a projection associated with it.

2. Open ArcCatalog within ArcMap (Hint: windows > ArcCatalog) and
    browse to the Topic5_1 folder. You will see three copies of the Cities
    shapefile: Cities_1, Cities_2 and Cities_3. In this exercise you will
    project Cities_1 into UTM Zone 11N, Cities_2 into IDTM and Cities_3
    into Idaho State Plane Central and, through trial and error, find out
    which of the three coordinate systems is the correct one.

3. Click on the search tab on the right-hand side of ArcMap (or click
    Windows > Search). Type "define projection" in the search box, and
    then click on "Tools". You should now see the Define Projection tool.
    Click on the link to start the tool.

4. Follow the steps below to project the Cities_1 shapefile in UTM Zone 11N

Define Projection

1. Add "Cities_1" as your Input Dataset

Input Dataset or Feature Class
napter_14_Georeferencing_and_Projections\Topic5_1\Cities_1.shp

Coordinate System
Unknown

2. Click here

OK   Cancel   Environments.

Spatial Reference Properties

XY Coordinate System   Z Coordinate System

Type here to search

- Favorites
- Geographic Coordinate Systems
- Projected Coordinate Systems

3. Double click on "Projected Coordinate System". Then double-click on "UTM" and double-click on "NAD 1983"

OK   Cancel

Spatial Reference Properties

XY Coordinate System   Z Coordinate System

Type here to search

- NAD 1983
  - NAD 1983 UTM Zone 10N
  - NAD 1983 UTM Zone 11N
  - NAD 1983 UTM Zone 12N
  - NAD 1983 UTM Zone 13N
  - NAD 1983 UTM Zone 14N
  - NAD 1983 UTM
  - NAD 1983 UTM
  - NAD 1983 UTM
  - NAD 1983

4. Click once on "NAD 1983 UTM Zone 11N"

Current coordinate system:

NAD_1983_UTM_Zone_11N
WKID: 26911 Authority: EPSG

Projection: Transverse_Mercator
False_Easting: 500000.0
False_Northing: 0.0
Central_Meridian: -117.0
Scale_Factor: 0.9996
Latitude_Of_Origin: 0.0
Linear Unit: Meter (1.0)

5. Click OK

OK   Cancel

Define Projection

Input Dataset or Feature Class
napter_14_Georeferencing_and_Projections\Topic5_1\Cities_1.shp

Coordinate System
NAD_1983_UTM_Zone_11N

OK   6. Click OK   ts...   Show Help >>

5. Start the define projection tool again. This time add the Cities_2 shapefile. Set the Coordinate System to Projected Coordinate Systems > State Systems > NAD 1983 Idaho TM (Meters).

6. Use the define projection tool one more time and define Cities_3 as Projected Coordinate Systems > State Plane > NAD 1983 (Meters) > NAD 1983 StatePlane Idaho West FIPS 1103 (Feet).

7. Start a new map document and add Cities_1, Cities_2 and Cities_3 to your map and zoom to the full extent of all layers. Note that each of those three layers is in a different area. To know which of the three Cities shapefiles is projected correctly add the Idaho shapefile (which we know is in the correct projection). Which Cities layer is in the correct projection?

8. Click on the "Full Extent" button (that is the one that looks like a globe and is located right next to your pan tool).

7. Projecting data

You **project** a dataset if you move it from one known coordinate system into another. For example, someone gives you a roads dataset in UTM Zone 11N coordinates, but you would prefer to store it in Idaho State Plane West so it is in the same projection as all your other GIS data (which is not absolutely necessary because ArcMap **projects on the fly**, but still a good idea nevertheless). In that case you would project your roads layer. Notice how this is different than defining a projection were we started with a dataset that did not have a projection associated with it at all.

VIDEO

5.1. Projecting a GIS Dataset

Exercise 5: Projecting a dataset in ArcGIS

1. Start a new map in ArcMap and add the Idaho shapefile from the Topic5_1 folder.
2. Right-click on the Idaho shapefile and open its properties. Go to the Source tab. Notice that Idaho is currently projected in IDTM83. In this exercise you will project the Idaho shapefile to Idaho State Plane Central (Meters).
3. Open ArcToolbox

Open ArcToolbox
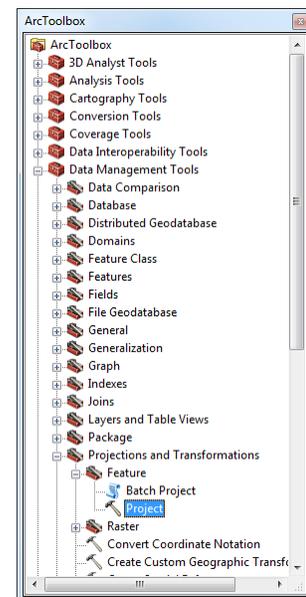
4. Open the Data Management Tools followed by the Projections and Transformation Tools. Open the Feature Tools and double click on Project to get this projection tool started.

1. Choose "Idaho.shp" as the Input Dataset

2. Click here. Then name your output dataset "Idaho_State_Plane"

3. Click here to choose a coordinate system

4. Click Select. Then go to Projected Coordinate Systems > State Plane > NAD 1983 (Meters) > NAD 1983 StatePlane Idaho Central FIPS 1102 (meters)

6. Verify all your settings

7. Click OK

5. Click OK

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5. Use the figure below to populate and run the Project tool.

6. Add the Idaho_State_Plane shapefile you just created to your map. Open its properties and go to the source tab to verify it is projected into Idaho State Plane Central.

7. Close ArcMap.

Exercise 6: Defining a projection and projecting by hand.

1. You have collected the following GPS coordinates: (1,4). (3,4), (6,2) and (6,5). <u>If possible</u>, draw those coordinates in the Cartesian coordinate system shown on the right.

    a. Do you have enough information to draw the points? _____

    b. If not, what information do you need? _____ _____ _____
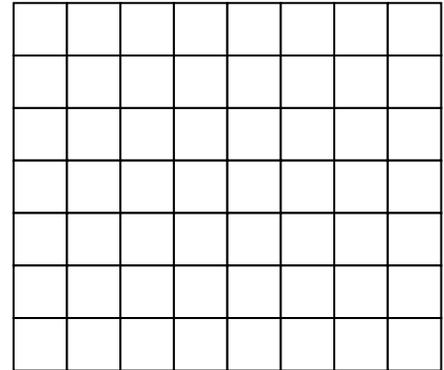
2. Drawing coordinates is difficult when a coordinate system is not **defined**. With a little research you find out that those coordinates were projected in "Projection A" which is depicted below.
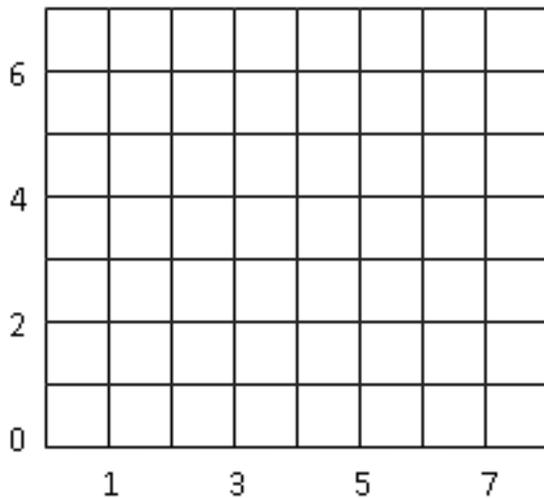
Can you draw the coordinates now? If so, please draw them.

3. You decide you rather store your points in projection B. Now you need to **project** from Projection A into Projection B. Start by plotting your points below in projection A.

Projection B

Projection A in **bold lines**
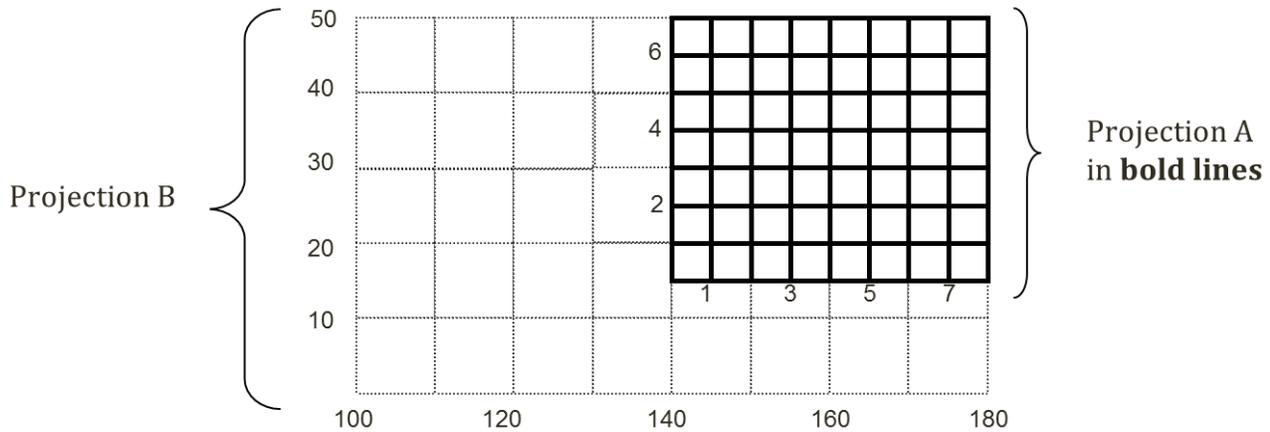
4. List the coordinates for your four points in projection B: (____ , ____) (____ , ____) (____ , ____) (____ , ____).

Exercise 7 (Challenge): Help! My data does not line up.

1. Open Help_MyDataDoesNotLineUp.mxd map document. This map contains two layers: roads and parcels. Go to Bookmarks > Roads to look at the roads and Bookmarks > Parcels to view the parcel. Zoom to the full extent to see both layers. It is obvious that the two layers do not line up, and usually this is because the projection for one of the two layers has been defined incorrectly. In this challenge you need to:

VIDEO

5.13: Help! My data does not line up…

   a. Figure out which one of the two layers has a projection that has been defined incorrectly. (*Hint: add a base layer and see which of the two datasets does not line up with the base layer*).

   b. Use the "define projection" tool to override the incorrect projection with the correct one (the "define projection" tool will give a warning that you are overriding an existing projection – but that is OK if the existing one if wrong to begin with).

   c. Figure out what the correct projection is through trial and error. To narrow it down the correct projection is either "UTM Zone 11", "IDTM83" or "Geographic NAD83".

2. This solution to this challenge is demonstrated in a video 5.13: Help! My data does not line up…