

Working with Map Projections

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Some common problems that prevent data from aligning correctly along with other common questions:

Data doesn't have a projection defined.

- How do I identify the projection?

Data has a projection defined, but the data draws in the wrong place.

XY data brought into ArcMap does not show up where it is supposed to.

What projection should I use for my project?

Buffers are the wrong shape

How to apply Vertical Geographic Transformations in ArcGIS Desktop

Here are some techniques to identify projections for data.

Examine the coordinate system for city polygons in Germany

First find the polygons!

Compare the coordinates with the provinces layer

Examine the coordinate system for city points in Germany

First find the points!

Compare with the provinces and countries layers

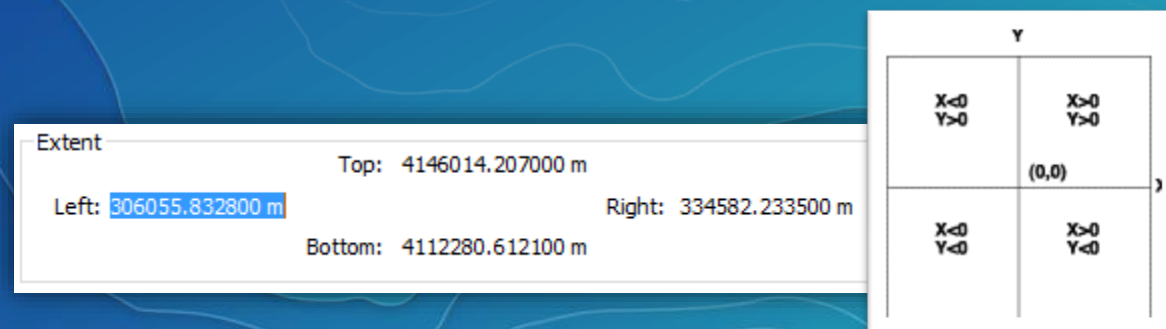
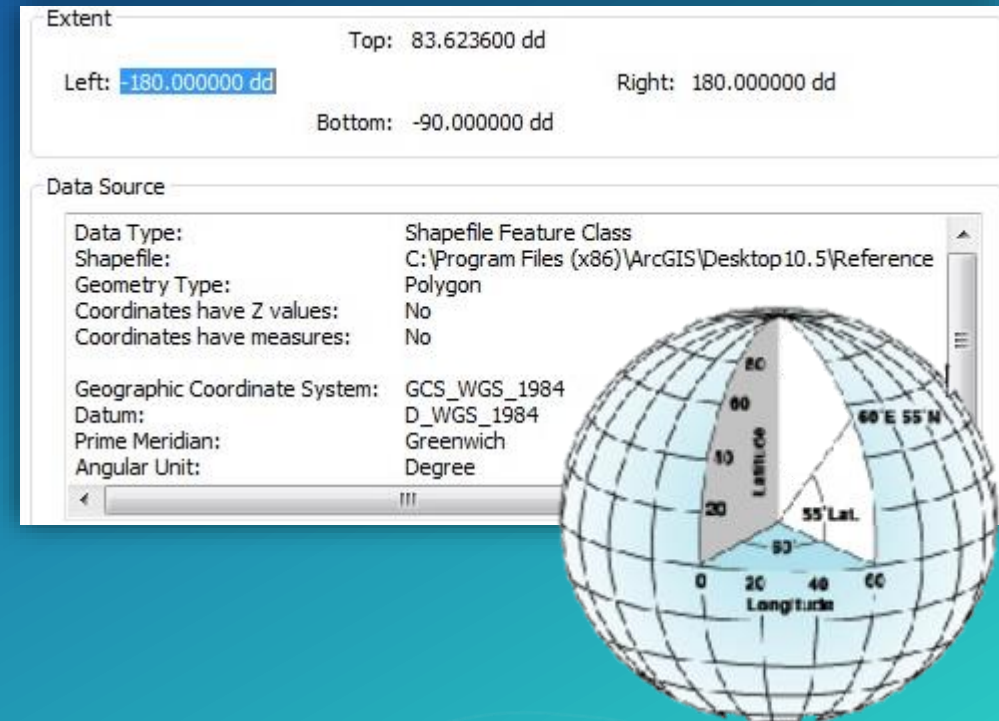
Geographic vs Projected Coordinate Systems

Geographic Coordinate System (GCS)

- Uses a 3D spherical surface to define locations
- Uses degrees as the unit of measure, which are angles
- -180 to 180 for longitude and -90 to 90 for latitude

Projected Coordinate System (PCS)

- Defined on a flat, 2D surface
- Uses linear units, like meters, kilometers, feet or miles



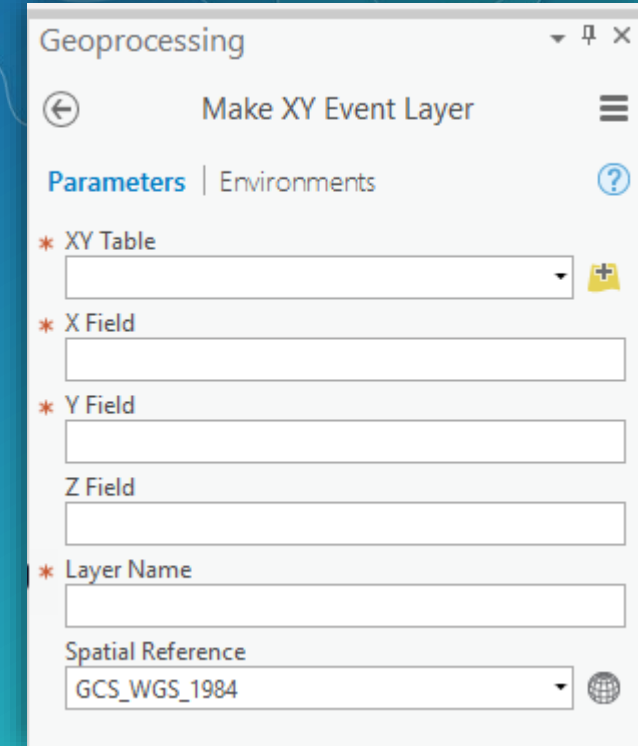
When adding XY data from a table to ArcMap

Here are things to watch out for:

- The data must be in a format ArcMap can read:
 - XLS, XLSX, PRN, CSV, DBF, TXT formats can all be used .
- The *field names* must not be over 10 characters long, cannot contain spaces, cannot contain special characters, and cannot begin with a number.
- Fields containing X and Y coordinates must be formatted as Number. Fields formatted as General in Excel will drop decimals when brought into ArcMap.
- For coordinates in decimal degrees, set the field properties to a minimum of 6 decimal places in Excel.

How to add the XY data table to ArcMap:

- Click on the Add Data button, navigate to the file, and add to the map.
- Right click on the name of the table, and Open.
- Examine the coordinates, and note the names of the fields that contain the X (Longitude) and Y (Latitude) values.
- Right click on the name of the table, and select Display XY Data.
- **WARNING:** *If the ArcMap Data Frame already has a projection assigned which does not match the coordinate system of the table, that will need to be corrected in the Display XY Data dialog!*



Make XY Event Layer is the ArcGIS Pro equivalent of Display XY Data

What projection should I use for my project?

There are four major considerations:

1] Objective – what do you need to preserve?

- Distance Area Shape Direction

2] How much area does the data cover?

A city, a province, a small country, a continent, the whole earth?

3] Where is the data located on the earth's surface?

Is it polar, at the Equator, at the midlatitudes?

4] What is the shape of the data?

Is it larger north to south, or is the larger extent east to west?

Knowledge article 000006113 is linked to a list of supported map projections that includes properties of each map projection, and normal applications for each projection. Note that the article link is:

How To: Select a suitable map projection or coordinate system - <http://arcg.is/2tNYAzb>

Problems with Buffers

Buffers on the map appear oval, not round.

These are the sources of confusion:

- 1] A geometrically correct buffer, which measures the same distance in every direction from the center, can look oval or some other shape, depending on the projection of the ArcMap Data Frame
- 2] A buffer can appear nice and round, but have a great difference in north-south vs. east-west measurements.

It is extremely important to consider this issue:

- > Do you NEED geometrically correct buffers for analysis?**
- > Do you NEED circular buffers for an illustration?**

Consider this issue carefully when creating your map so that you create the appropriate buffer style to satisfy the objective for the project.

Applying Vertical Geographic Transformations in the Project Tool

Vertical geographic transformations are available in ArcGIS Desktop beginning with version 10.4. Here are the requirements to apply vertical transformations:

- 1] Download and install ArcGIS_Coordinate_Systems_Data_10x.
- 2] The Project Tool will not project data from one horizontal coordinate system to another, or apply a horizontal geographic transformation, and apply a vertical datum transformation in the same process. These operations have to be performed separately.

Applying Vertical Geographic Transformations in the Project Tool

- 3] It is easier to project the data to the new horizontal coordinate system while applying the appropriate geographic transformation. When the output data from that projection is created, run the Project tool again and apply the vertical datum transformation in a separate process.
- 4] The input Vertical Coordinate System (VCS) for the 3D data must be defined for the input data before running the Project tool.

Applying Vertical Geographic Transformations in the Project Tool

- 5] The name of the vertical datum transformation that is to be applied must be typed in, exactly as it is specified in the list of transformations linked to the Knowledge article at the link below. At this time there is no dropdown pick list for vertical datum transformations:

How To: Select the correct geographic (datum) transformation when projecting between datums (000004829) - <http://arcg.is/2tO0C27>

- 6] If only applying a vertical transformation, the output horizontal coordinate system must still be specified in the Project Tool dialog to match the input.

Additional Resources:

Esri Support Center Knowledge Articles:

"Identify the spatial reference, projection, or coordinate system of data"

<http://arcg.is/2sWmMLN>

"Identify an unknown projected coordinate system using ArcMap"

<http://arcg.is/2uTQ13c>

"Create a custom projection file in ArcMap to align CAD data"

<http://arcg.is/2u1BYwa>

"Select a suitable map projection or coordinate system"

<http://arcg.is/2sWv1Hq>

"Select the correct geographic (datum) transformation method"

<http://arcg.is/2sWFhQb>

"Lining Up Data in ArcGIS: a guide to map projections, second edition" from Esri Press

<http://arcg.is/2tW5UIY>

QUESTIONS

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