ARCMAP WARNINGS/ERRORS

Unknown Spatial Reference

The following data sources you added are missing spatial reference information. This data can be drawn in ArcMap, but cannot be projected:

onlyUTM83
ARCMAP WARNINGS/ERRORS

The following data sources use a geographic coordinate system that is different from the one used by the data frame you are adding the data into:

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Geographic Coordinate System</th>
</tr>
</thead>
<tbody>
<tr>
<td>lakes_lam</td>
<td>GCS_Sphere_ARC_INFO</td>
</tr>
</tbody>
</table>

Alignment and accuracy problems may arise unless there is a correct transformation between geographic coordinate systems.

You can use this button to specify or modify the transformation(s) used by this data frame:

Transformations...  

The Transformations dialog can also be accessed from the Data Frame Properties dialog's Coordinate Systems tab after you have added the data.

Don't warn me again in this session
Don't warn me again ever

Close
ARCMAP WARNINGS/ERRORS

Warning:
This coordinate system has a geographic coordinate system that differs from one or more data sources in the map. Alignment and accuracy problems may arise unless there is a correct transformation between geographic coordinate systems. Use the Transformations button to specify or modify the transformation(s) used by this data frame.

Do you wish to use this coordinate system anyway?

[ ] Yes

[ ] No

[ ] Don't warn me again in this session

[ ] Don't warn me again ever
HOW TO FIND COORDINATE SYSTEM?

Coordinate system of data

Data frame coordinate system
ARCGIS TOOLS

· ArcToolbox > Data Management Tools > Projections and Transformations
Without a coordinate system a map is just a drawing.

There are many different coordinate systems – each one is better for certain purposes.

Unfortunately, there is no single best system.

The “best” systems depends on what you want to do.

Data from different sources may have different coordinate systems.

Always make sure you know the system you are working with.
WHAT IS A COORDINATE SYSTEM?

- A system that uses coordinates to represent features in a space from a point of origin.
SHAPE OF THE EARTH

We think of the earth as a sphere

Earth bulges at the Equator and it’s more like an ellipsoid
DATUM

- A datum is a set of constants specifying the coordinate system used for calculating coordinates of points on earth.
  
  – National Geodetic Survey

- Datum = ellipsoid + point of origin

- Different areas of the world use different datums that fit their local area.
COMMON DATUMS IN THE U.S.

- North American datum of 1927 (NAD 27)
- Clarke 1866 ellipsoid.
- Holds a fixed latitude and longitude in Meade’s Ranch, Kansas
COMMON DATUMS IN THE U.S.

- North American datum of 1983 (NAD 83)
  - Uses earth centered reference ellipsoid
  - 250,000 points were measured to adjust latitude and longitude locations

- World Geodetic System of 1984 (WGS 84)
  - Based on satellite measurements
  - Worldwide Coverage
  - GPS receivers use this datum

- HARN or HPGN – 2000
  - High Accuracy Reference Network or High Precision Geodetic Network

- North American Vertical Datum of 1988 (NAVD 88)
HORIZONTAL DATUM

- Geoids, ellipsoids, and coordinate systems are abstractions.
- Control points are collected to create a datum.
- Coordinates of the control points varies for different ellipsoids as they have different coordinate grids.
VERTICAL DATUM

- Mean Sea Level is used as the reference point to calculate elevation data
- NAVD 88 established in 1991
- Different datums use different reference points to calculate MSL

**Datum Information**

<table>
<thead>
<tr>
<th>Tide Station</th>
<th>Pointe-au-Pere, Rimouski</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tide Station Location</td>
<td>Quebec, Canada</td>
</tr>
<tr>
<td>PID</td>
<td>TY5255</td>
</tr>
<tr>
<td>Geodetic Survey of Canada Designation</td>
<td>54L071</td>
</tr>
<tr>
<td>Bench Mark</td>
<td>1250 G</td>
</tr>
<tr>
<td>Ht above LMSL (meters)</td>
<td>6.271</td>
</tr>
</tbody>
</table>

COORDINATE SYSTEMS

- 3D Coordinate Systems – Geographic CS (GCS)
  - Latitude and Longitude

- 2D Coordinate Systems – Projected CS (PCS)
  - State Plane
  - Universal Transverse Mercator (UTM)
STATE PLANE COORDINATE SYSTEM

- 124 geographic zones
- High accuracy within each zone
- Not useful for regional or national mapping (small scale)
- SPCS 1983 is used currently and SPCS 2022 is coming soon
STATE PLANE COORDINATE SYSTEM

Source: GPS for Land Surveyors
STATE PLANE COORDINATE SYSTEM

Existing SPCS 83 design:
New Mexico Central Zone

Transverse Mercator projection
North American Datum of 1983
Central meridian: 106° 15' W
Cen merid scale: 0.999 9 (exact)

Areas within ±100 ppm distortion
(±0.53 ft per mile):
0% of entire zone
0% of all cities and towns
0% of population

Distortion values (ppm)
Entire zone: Cities and towns:
Min = -670 Min, Max = -484, -151
Max = -94 Range = 333
Range = 576 Median = -364
Mean = -346 Mean = -323
(weighted by population)

Linear distortion at topographic surface (parts per million)
< -400 to -400 to -200 to +200 to +150
to -400 to -350 to -300 to +300
to -350 to -300 to +50
to -300 to +100
to -250
> +300
STATE PLANE COORDINATE SYSTEM

- Projected Coordinate Systems > State Plane > NAD 1983 (US Feet)
UNIVERSAL TRANSVERSE MERCATOR COORDINATE SYSTEM

- Divides earth into 60 zones, each of 6° of longitude
- Uses transverse Mercator projection
- Distortion is minimal within each zone and near central meridian of each zone
UNIVERSAL TRANSVERSE MERCATOR COORDINATE SYSTEM

Source: GPS for Land Surveyors
UNIVERSAL TRANSVERSE MERCATOR COORDINATE SYSTEM

Existing
UTM Zone 13 North
used as statewide zone:
New Mexico

Transverse Mercator projection
North American Datum of 1983
Central meridian: 105° 00’ W
Cen merid scale: 0.999 6 (exact)

Areas within ±400 ppm distortion
(±2.11 ft per mile):
37% of entire zone
37% of all cities and towns
71% of population

Distortion values (ppm)
Entire zone: Cities and towns:
Min = -1000 Min, Max = -796, +1203
Max = +1223 Range = 1999
Range = 2223 Median = -426
Mean = -226 Mean = -294
(weighted by population)

Linear distortion at topographic
surface (parts per million)

-700 to -300 to -200 to -100 to 0 to 100 to 200 to 300 to 400 to 500 to 600 to 700
-500 to -400 to -300 to -200 to -100 to 0 to 100 to 200 to 300 to 400 to 500 to 600 to 700

0 50 100 150 200 250 km
UNIVERSAL TRANSVERSE MERCATOR COORDINATE SYSTEM

- Projected Coordinate Systems > UTM > NAD 1983
MAP PROJECTIONS

3D to 2D Representation
CHALLENGE

Curved Earth
Geographic coordinates:
(Latitude & Longitude)

Flat Map
Cartesian coordinates:
(Easting & Northing)
MAP DISTORTIONS
MAP PROJECTION FAMILIES

- Azimuthal (Planar)
- Cylindrical
- Conic
- Mathematical
PLANAR PROJECTIONS

Lambert Azimuthal Equal Area

maintains direction and area
CYLINDRICAL PROJECTIONS

Standard Mercator

Transverse Mercator
CONIC PROJECTIONS

Lambert Conformal Conic
- maintains shape

Albers Equal Area Conic
- maintains area
MAP PROJECTION PROPERTIES

- Area, Shape (Major Properties and are mutually exclusive)
- Distance and Direction (Minor and can coexist but cannot be true everywhere)

What does the below projections preserve?
- Equal Area Map Projections: preserves _____, distorts ____
- Conformal Map Projections: preserves _____, distorts ____
- Equidistant Map Projections: _____
- Azimuthal Map Projection: _____
- Aphylactic Map Projection: _______
Lambert cylindrical equal-area projection

By Eric Gaba (Sting - fr:Sting) - Own work
Data: U.S. NGDC World Coast Line (public domain), CC BY-SA 4.0,
https://commons.wikimedia.org/w/index.php?curid=4256495
SHAPE

https://www.axismaps.com/guide/general/map-projections/
DISTANCE

Distance — Most projections distort distances (e.g., Equirectangular projection)

https://www.axismaps.com/guide/general/map-projections/
Directions – sometimes a straight line isn’t the shortest path!

https://www.axismaps.com/guide/general/map-projections/
TISSOT’S INDICATRIX

- A common method used to determine deformation on a map projection by quantifying the distortion
- Composed of infinitely small circles centered at points on the earth
- Shape of circles determine the deformation and distribution of error
TISSOT’S INDICATRIX

Equal Area

Equidistant

Conformal

Aphylactic

TRUE SIZE

https://en.wikipedia.org/wiki/Mercator_projection#/media/File:Worlds_animate.gif
WHICH PROJECTION TO USE?

Things to consider

- Projection Properties
- Deformational Patterns
- Projection Center
- Familiarity
- Software Support
EPSG GEODETIC PARAMETER DATASET

What is new?

Online Registry
The current version of the Online Registry which includes all recent updates (version 9.8.6, 2020-01-16)

Download Dataset
Download Dataset (version 9.8.6, 2020-01-16)

Read about planned Upgrade of EPSG Dataset data model

About the EPSG Dataset
The IOGP's EPSG Geodetic Parameter Dataset is a collection of definitions of coordinate reference systems and coordinate transformations which may be global, regional, national or local in application. The primary EPSG Dataset is maintained in the online registry, from which data may be accessed through a graphic user interface or through a service interface. The online registry contains the most current data. Registry users may query and view the data, generate printable maps and use a Web-based Tool (WiTD).

About registration
To gain access to the EPSG data through these web pages, you must agree to the Terms of Use by registering on this site. Once logged in, you may also subscribe to updates and make change requests.

To register, you must enter your email address (visible to IOGP) and password (not visible). This information is not used outside this site, nor is it passed on to any third party.
READINGS

- http://www.flexprojector.com/