Coordinate Systems and Datum Transformations in Action

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Objectives

• Coordinate systems
  - Geographic versus projected
  - Project considerations
  - ‘Gotchas’
• Identifying an unknown coordinate system
• Picking a geographic/datum transformation

Note: Presentation will be available on the Proceedings CD
Coordinate systems
Geographic coordinate system
Geographic coordinate system

(gcs, geogcs)

- Name
- Datum
  - Spheroid
- Prime Meridian
- Angular unit of measure
Geographic coordinate system

(gcs, geogcs)

- **Name**  (European Datum 1950)
- **Datum**  (European Datum 1950)
  - **Spheroid**  (International 1924)
- **Prime Meridian**  (Greenwich)
- **Angular unit of measure**  (Degrees)
Projected coordinate system

- Linear units
- Lengths, angles, and areas are constant
- Shape, area, and distance may be distorted

![Diagram of projected coordinate system]

Data usually here
Projected coordinate system

\[(\text{pcs, projcs})\]

- Name
- GCS
- Map projection
- Projection parameters
- Linear unit of measure
Projected coordinate system

(PCS, PROJCS)

- **Name**  (NAD 1983 UTM Zone 11N)
- **GCS**  (NAD 1983)
- **Map projection** (Transverse Mercator)
- **Projection parameters** (central meridian, latitude of origin, scale factor, false easting, false northing)
- **Linear unit of measure** (Meters)
Demonstration
Geographic versus Projected
Choosing the right coordinate system

- What does your boss think?
- What are other government agencies/partners using?
- For what purposes are the data going to be used?
- Minimize projecting data on the fly
  - Impacts performance
Coordinate system gotchas

• Defining a coord sys updates the metadata ONLY
  - Doesn’t affect the coordinate values
  - Define data in its current coordinate system, then project

• Datum transformations are important!
  - Omit or choose the wrong one—up to 200 m
  - Multiple ones exist—up to you to decide which one is best
  - See Knowledge Base article #21327
What happened to the prj files?

- Coordinate systems were stored as .prj files
  - ArcGIS home\Coordinate Systems
- At 10.1, virtual folder structure
- Search by area, name, WKID/code
- Favorites are usable everywhere
- Use Import to access your own prj files
Demonstration

Improved coordinate system dialogs
Unknown coordinate systems
Unknown coordinate systems

- ALWAYS define the coordinate system
- Good professional practice - help your successor
- Units are unknown
- Map scale is incorrect
- Geodatabase tools can’t use default values
What if I don’t know my data’s coordinate system?

• Check the data provider or source
• Check any existing metadata
• Similar data types
• What coordinate systems are used in the area?
  - http://www.epsg.org
  - http://www.epsg-registry.org
What if I don’t know my data’s coordinate system?

• Try using ArcMap to figure it out
  - See Article ID 24893
    
    HowTo: Identify an unknown coordinate system using ArcMap
  
  - Live Training Seminar (free)
    Working with Map Projections and Coordinate Systems in ArcGIS

Familiarize yourself with common coordinate systems

- Know what ones are used in the area
- Learn what the layer extents should be

<table>
<thead>
<tr>
<th>San Diego, California</th>
<th>NAD 1983</th>
<th>X / longitude</th>
<th>Y / latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic</td>
<td>-116.67°</td>
<td>33°</td>
<td></td>
</tr>
<tr>
<td>UTM zone 11N</td>
<td>530,000 m</td>
<td>3,650,000 m</td>
<td></td>
</tr>
<tr>
<td>State Plane (CA zone 6)</td>
<td>1,960,000 m</td>
<td>593,000 m</td>
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</tbody>
</table>
Real world example

- Longitude: -88.365934
  Latitude: 28.738369

Calculated NAD 27 XY Coords:
- Longitude: 10431702.916855
  Latitude: 1202802.892336
What do you know?

Decimal degrees:
Longitude: -88.365934
Latitude: 28.738369

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What do you know?

In the U.S.

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decimal degrees

NAD27
What do you know?

In the U.S.

Decimal degrees

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Latitude: 28.738369

NAD27

Calculated NAD 27 XY Coords:
Longitude: 10431702.916855
Latitude: 1202802.892336

No units
What do you know?

- In the U.S., decimal degrees are used.
- Calculated NAD 27 XY Coords:
  - Longitude: 10431702.916855
  - Latitude: 1202802.892336
- X or Y?
- No units

Longitude: -88.365934
Latitude: 28.738369

NAD27
Demonstration
Identifying Unknown Data
Geographic (datum) transformations
Geographic transformations

- Convert between two geographic coordinate systems
- Offsets can be significant

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<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAD 1927</td>
<td>-116.6691455</td>
<td>32.9999533</td>
<td></td>
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<tr>
<td>NAD 1983</td>
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<tr>
<td>NAD 1983 HARN</td>
<td>-116.6700004</td>
<td>33.0000000</td>
<td></td>
</tr>
</tbody>
</table>
Datum transformations are important!

- Omit or choose the wrong one—up to 200 m
- Multiple ones exist
  - up to you to decide which one is best
- See Knowledge Base article #21327
Warning: different geographic coordinate system...
Demonstration

Working with Geographic Transformations
Wrap-up
Where to find help

• Geoprocessing Island
• Today until 1:30pm
More information

• Don't forget the Knowledge Base!
  - http://support.esri.com
  - 23025, 29129, 24893, 29035, 17420

• ESRI forums for user-to-user help
  - http://forums.arcgis.com

• Virtual Campus
  - http://campus.esri.com
  - Live Training Seminar and Course

• http://www.epsg.org
  - Database of coordinate systems & datums
  - Guidance Note 7
Books, etc.

- Maher. *Lining Up Data in ArcGIS*
- Meyer. *Introduction to Geometrical and Physical Geodesy*
- Flacke & Kraus. *Coordinate systems in ArcGIS*
- Snyder & Voxland. *An Album of Map Projections*. USGS PP 1453
  - http://infotrek.er.usgs.gov/pubs
- Iliffe and Lott. *Datums and Map Projections*
Thank you!

Please fill out the session evaluation

**ID:** 1386

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Thank you!