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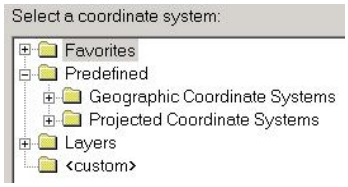
Projections in ArcGIS – demonstration on 9-8-09



1. Predefined Coordinate System – one stored in ArcGIS

Geographic Coordinate System (GCS) – decimal-degree based; has a datum for determining shape of the earth but contain no projection equations. Graticule remains evenly spaced, Cartesian.

- Example showing how resetting GCS has no visible affect on unprojected global data.
    - Location of Austin with NAD27 is -97.74^{o}W, 30.27^{o}N
    - Location of Austin with NAD83 is -97.74^{o}W, 30.27^{o}N

Projected Coordinate System (PCS) – converts decimal degrees to meters or feet according to definitions contained within projection equations. Must contain a GCS to begin with (determine axes lengths), then applies transformation equations to determine spacing of graticule.

- Example (Mollweide, Mercator, South Polar Stereographic) of dramatic differences achieved by different projections for global data
    - Look at ArcGIS Help files for projections
    - Note change of units to meter after projection; makes little sense on global maps
    - Examine projection parameters to determine origin; mouse over to do same
    - Change projection parameters to look at different view of the World from Space to World from above Austin

2. Projections of Continental Areas – U.S.
Demo. going from GCS to Albers Equal Area Conic PCS

- Show how display can be changed to show other units, though projection is metric
- Show how to detect difference in coordinate system of Data Frame and of data themselves

3. Projections of Texas
Demo. showing little difference in appearance for UTM zone 14 projection and Albers

- Cut/Paste the two into Word document for comparison

Explain on-the-fly projection

- **Data Frame assumes projection of first layer loaded** – all other layers are projected to that coordinate system
- ArcMap attempts to rectify differences in datums (GCS) and differences in projected coordinate systems (PCS)
- User has a choice of the transformation equations to go from one datum to another

Demonstrate by loading data that have a different GCS into new Data Frame

- e.g. compare Texas with GCS of Clark 1866 and NAD83 – note noticeable mismatch near El Paso at scales of > 1:15,000 when improper transformation used

4. How does on-the-fly projection work?

Every set of data needs a stored GCS and PCS. These comprise the files **Spatial Reference**. ArcMap read the spatial reference to do on-the-fly projection. Lack of a spatial reference is a common problem for data from the web.

5.Where are spatial reference data stored?

Soft storage: metadata files
Hard storage: within the data themselves or within separate files associated with the data.

- Demonstrate how to use ArcCatalog to view spatial metadata and file properties, including Spatial Properties.

6. What happens when a spatial reference is lacking?

Demonstrate with UTM air photo added to decimal degree Data Frame
Demostrate with UTM Shapefile added to decimal degree Data Frame

7. How can a spatial reference be defined?

- Demonstrate how to define Spatial Properties in ArcCatalog
- Demonstrate how to define Spatial Properties in ArcToolbox
- Show .prj file that is created
- Raster data use an .aux file

Questions to ask of any data set:

1) What is the native coordinate system i.e. what coordinates are the data stored in? Geographic? (Lat. Long.) Projected? (UTM or SPCS meters?, something else?)
2) What is the Horizontal (and vertical, if relevant) Datum? E.g. WGS84, NAD83, NAD27?
3) Is the Spatial Reference (Datum+projection+coordinate system) explicitly defined, i.e. does a separate file exist that the software can read that contains this information? E.g. with an .aux or .prj extension?