

3 Data characteristics

GIS data that is created using tables and spatial objects also has specific characteristics that allow for it to be manipulated spatially. These interconnected characteristics are scale, resolution, and map projection. All GIS layers should be created with this information attached (generally located in other associated files such as metadata or the prj or projection file).

3.1 Scale

Scale is commonly defined as ‘the amount of reduction found on maps’ (DeMers, 2000). Scale may be represented on a map by a graphic or bar scale, a verbal scale, or a representative fraction. If there is no scale on a map, it is NOT a map. A scale must be located on the map. For GIS maps, the bar scale is the most commonly used. ArcGIS provides easy options for adding and editing bar scales to maps.

3.2 Resolution

Map resolution is most often associated with raster data, although there are some applications in vector (polygon) data. The resolution of a data layer refers to the smallest unit of measurement used. For raster data, this should be the cell size.

There are benefits to greater resolutions: (1) more detailed data and (2) often data has greater accuracy (since some ‘rounding’ takes place for each cell). However, there are also some drawbacks to increased resolution. These include (1) greater computer processing times and (2) greater expense in data collection and GIS transformation.

The resolution of a dataset is very important and can have implications for GIS analysis. For example, if you are evaluating two different land use layers collected for two different years, they may not have the same resolution. The lower resolution layer will contain less accurate data, therefore land use change evaluations should be evaluated with consideration of the type of error the resolution difference may have on results.

3.3 Map projection

Datum

Positions on the Earth’s surface are measured using the latitude and longitude (Φ, λ). Latitude and longitude or geographic coordinate systems are based on the curved surface of the Earth. A geographic coordinate system is defined by the particular spheroid or ellipsoid used to calculate a position. The ability to measure and model the shape of the Earth has improved over time. Depending on when and by whom geographic coordinate data was collected, datum will differ. Common datum types are: the North American Datum of 1927 (NAD27), the North American Datum of 1983 (NAD83), and World Geodetic System of 1984 (WGS84).

It is important that the GIS data that you use is in the same datum or they will not appear correctly on a map. If you have data with different datum types, you can convert datum from one type to another. However, this process is not perfect so it is best to collect data in the same datum if possible.

Projection

The most challenging aspect of creating maps is projection, or taking a rounded surface (Earth) and making it flat. This is accomplished through a Cartesian coordinate system. This system uses two coordinates (x,y) to indicate a position on a flat surface. All positions are in reference to a known origin (0,0) located so that the x and y axis are perpendicular to each other.

Since data is often collected in terms of latitude and longitude or a curved surface, this data must be transformed so that it can be viewed on a flat map in a coordinate system. In mathematical terms:

$$\begin{aligned}x &= f(\Phi, \lambda) \\y &= g(\Phi, \lambda)\end{aligned}\tag{1}$$

The functions used to transform the data vary depending on the specific projection chosen. There are many projections available. It is very important that the correct projection is selected when transforming data. By selecting the correct project, the distortion errors are minimized.

There are many different projects. Two will be discussed here: the Universal Transverse Mercator projection and the State Plane Coordinate System.

Universal Transverse Mercator

The UTM projection creates a flat map of the Earth using a cylindrical projection surface with the cylinder wrapped around the Poles. There are 60 zones in the UTM projection and each zone corresponds to a half cylinder wrapped along a particular line of longitude. Each zone is 6 degrees wide and coordinate units are in meters (Longley et. al, 2001).

If you project data into UTM, you must identify which zone. For South Florida, Zone 17 is commonly used. To identify the zone you would need in other locations, please visit a UTM map. UTM maps can be found at: <http://www.dmap.co.uk/utmworld.htm>, <http://www.wa6otp.com/UTM.htm>, or simply search on the web.

UTM projection is often used for larger areas (entire states or regions).

State Plane Coordinate System

Each US State has adopted its own coordinate system for use in applications that require high accuracy, such as property surveys. The systems selected by each state differ and maybe divided into regions. Florida is divided into 3 zones: Florida East, Florida West, and Florida North.

The most common problem/mistake with using a GIS is projection. Always be aware of the projection of your GIS data. In order to view multiple layers in a GIS correctly, all layers must be in the same projection. Some software applications will transform projections on the fly. This should be used with caution, especially if you have different datum.

Generally, each institution or agency that provides GIS data to the public use a common projection and datum for all their layers.