GIS Level 2: Introduction to Spatial Analysis

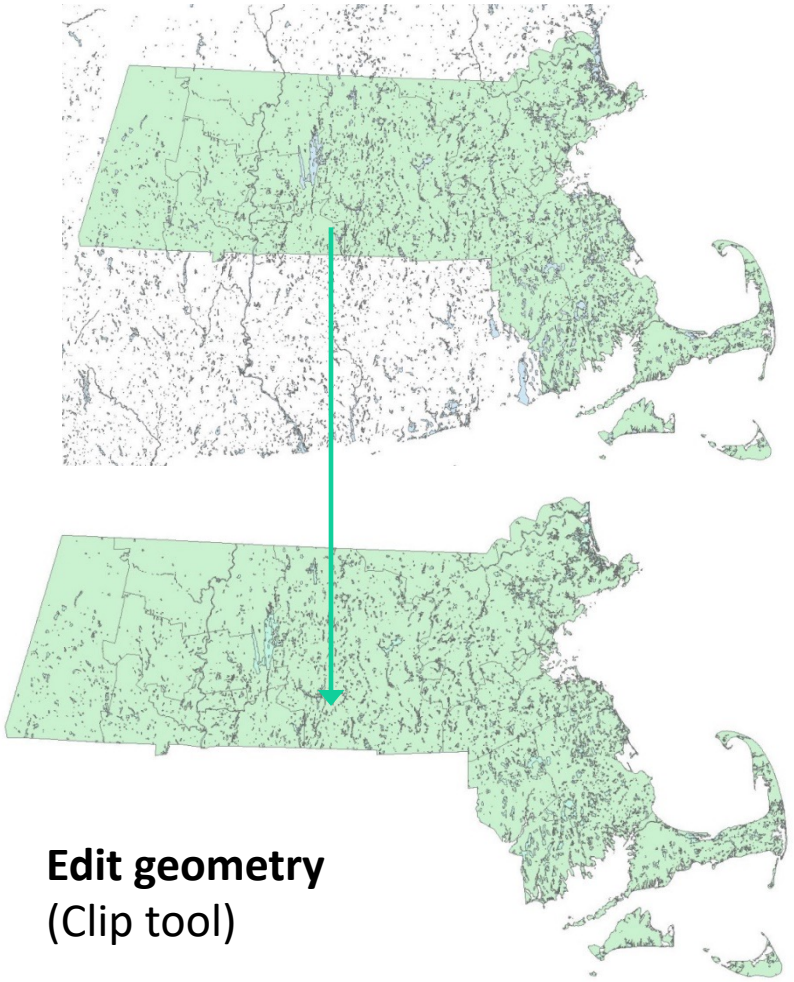
OUTLINE

- Introduction to spatial analyses
- Use map projections & metadata to understand and transform spatial data
- Use different types of processing tools in software(s) to perform a multi-step analysis
- Exercise new knowledge with GIS software(s)

Introduction » Map Projections » Metadata » Processing Tools » Exercise

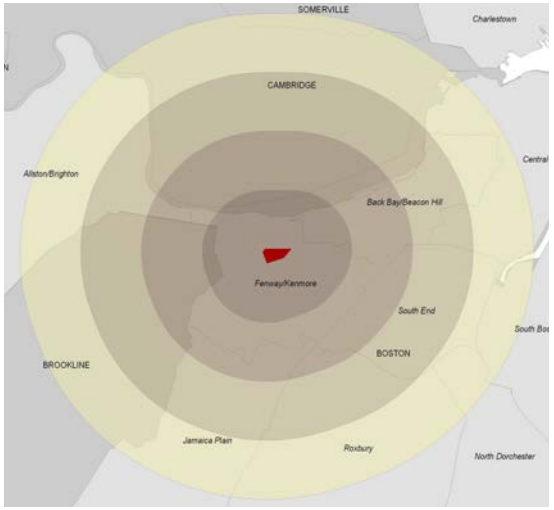
INTRODUCTION TO SPATIAL ANALYSIS

What analyses can you do?



Edit geometry
(Clip tool)

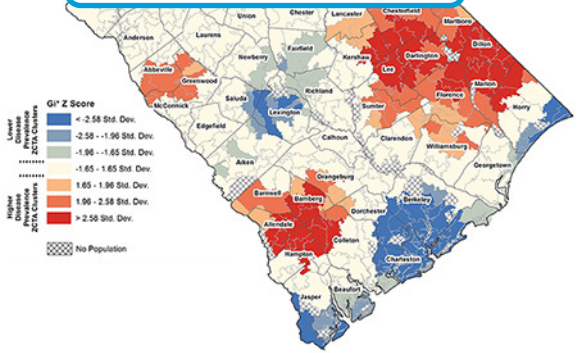
Analyze values
(Vectors)
(Rasters)



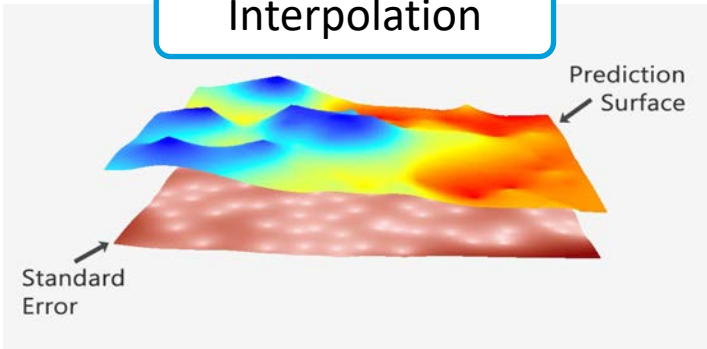
Create data
(Buffer tool)

Specialized tools are used to quantify patterns & relationships in your data.

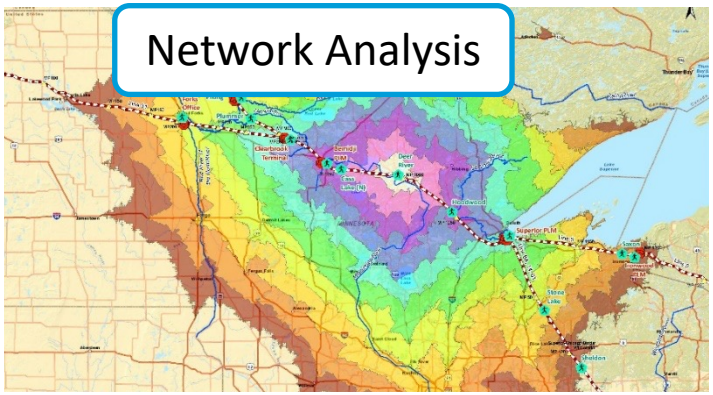
Spatial Statistics



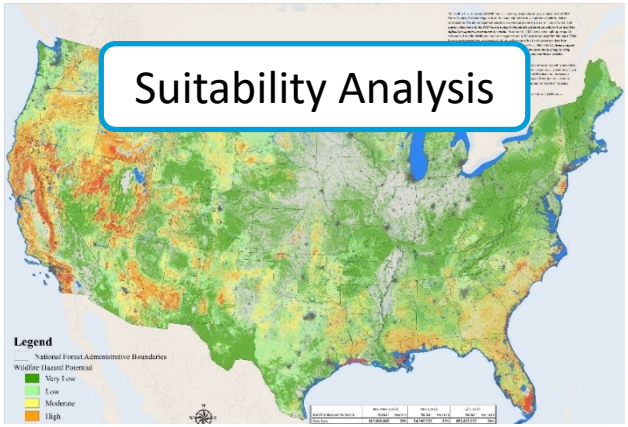
Interpolation



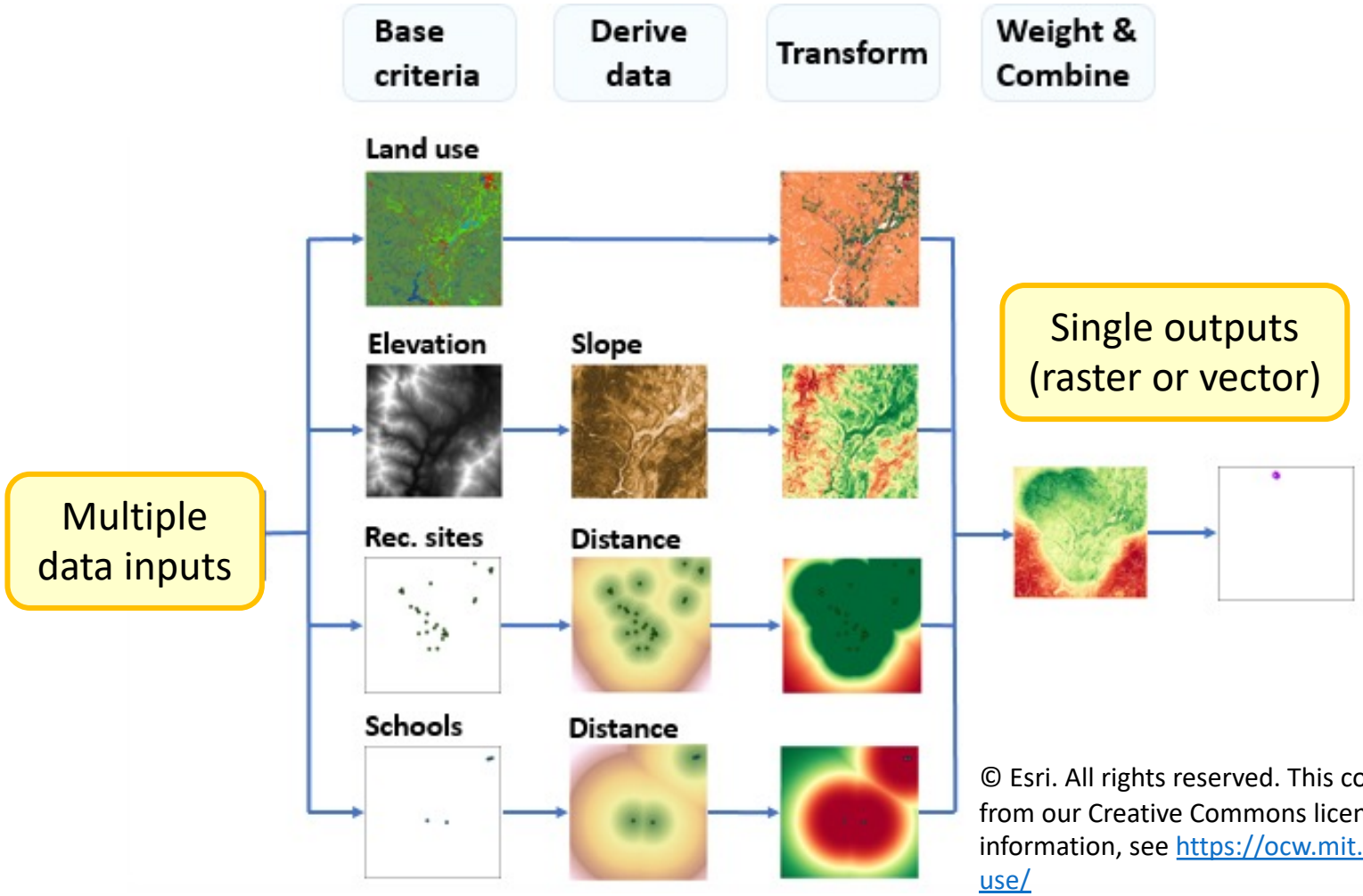
Network Analysis



Suitability Analysis



Multiple tools are often used together.

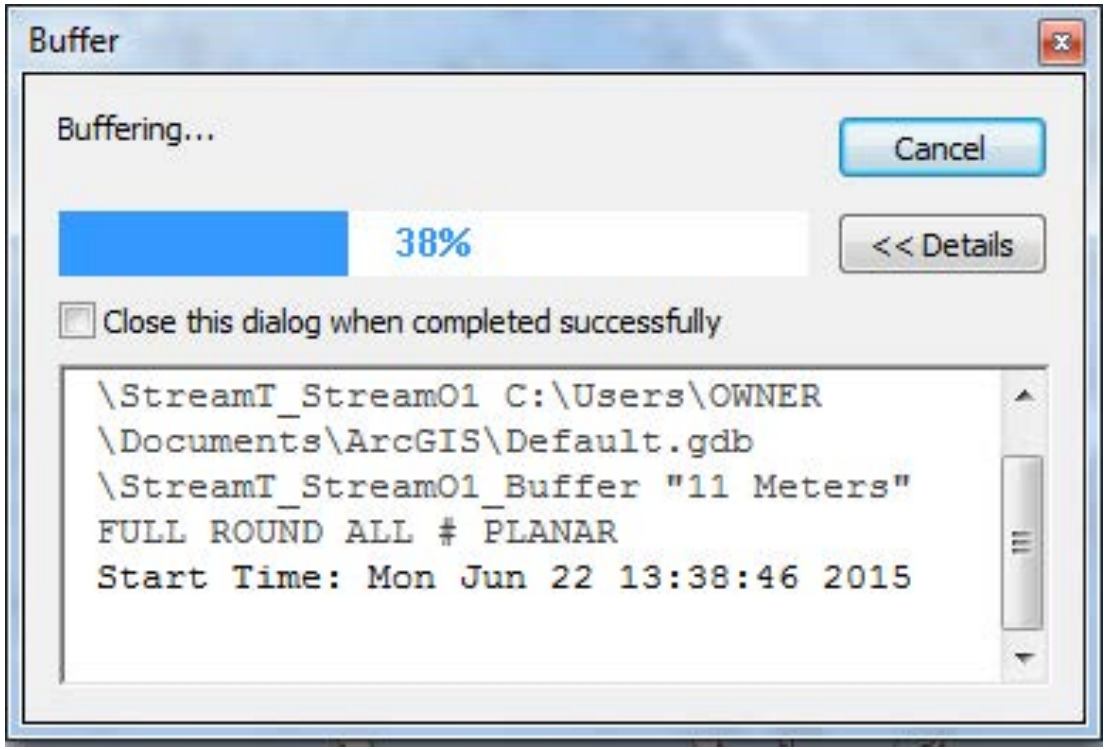


MAP PROJECTIONS:
WHY DO WE CARE ABOUT THEM?

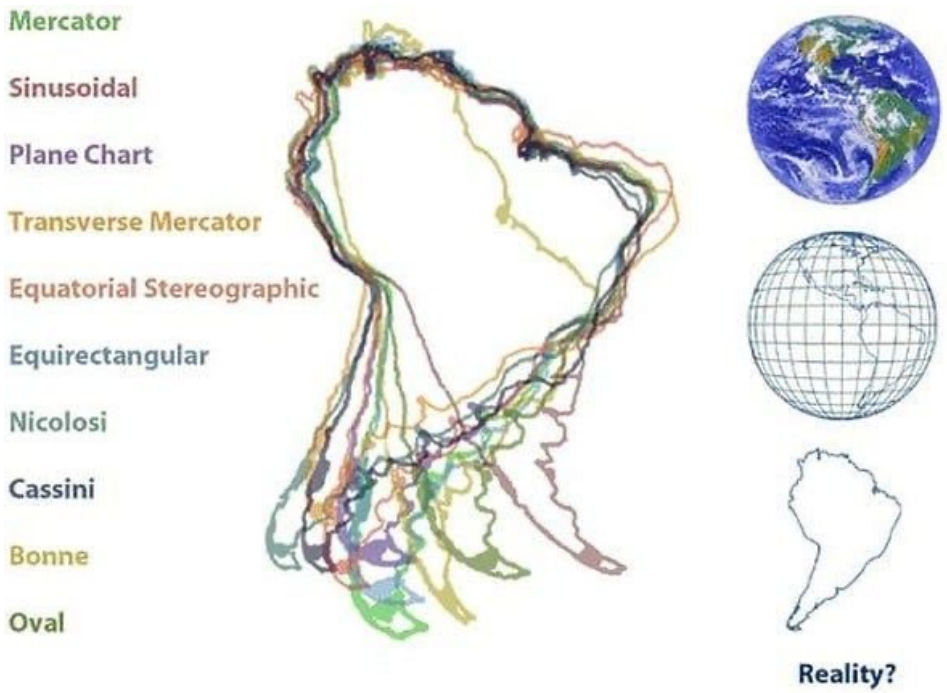
If a coordinate system is wrong or missing, data will not display in the correct location.

https://ihatecoordinatesystems.com/

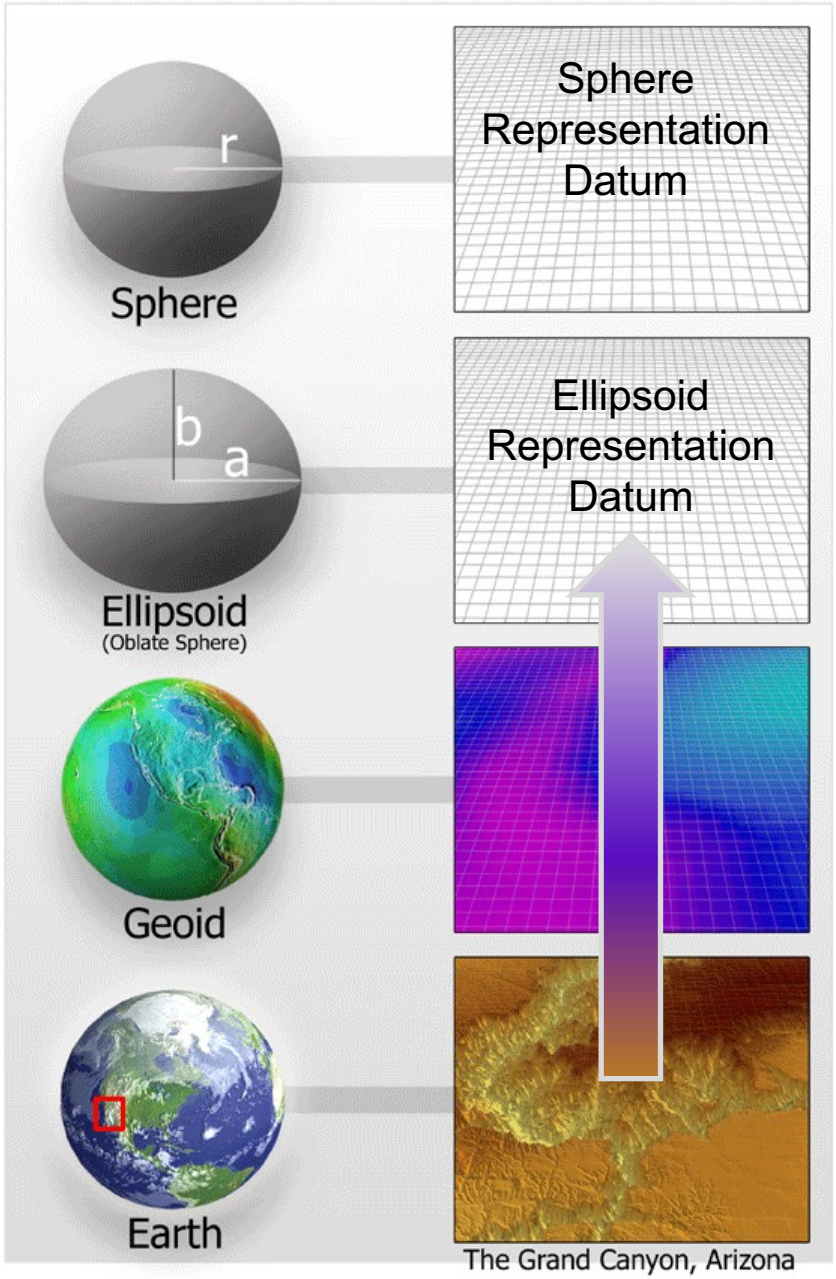
Using the same projection for all the datasets in your project will lead to faster processing time.



Analysis tools that involve shape, area, direction, form, or distance calculations require data to be in a suitable projected coordinate system.



MAP PROJECTIONS:
WHAT ARE THEY?

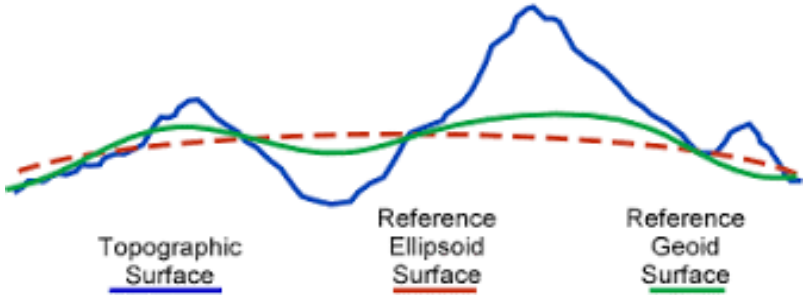


Courtesy of NOAA. Image is in the public domain.

A Geographic Coordinate System (GCS) consists of

- Datum
- Prime Meridian
- Angular Unit

A Datum is an idealized mathematical representation of the Earth.

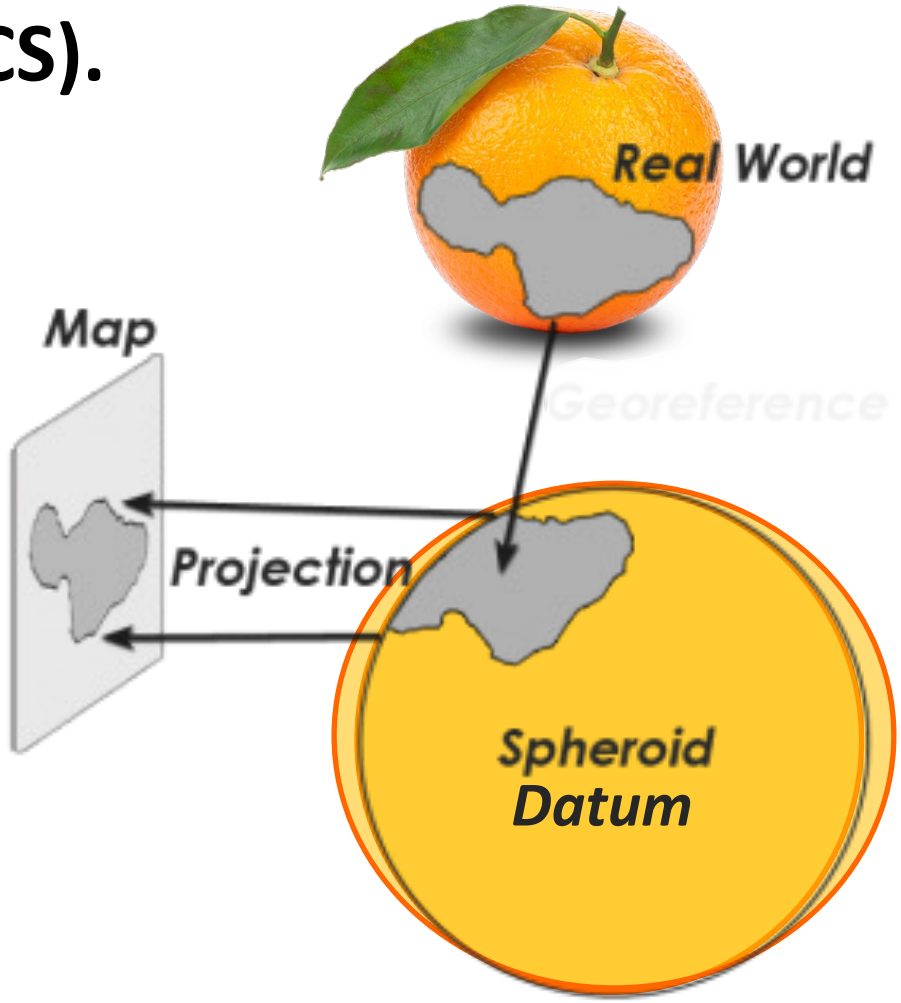


http://desktop.arcgis.com/en/arcmap/latest/map/projections/what-are-map-projections.htm

A projection algorithm is applied to the GCS to create a Projected Coordinate System (PCS).

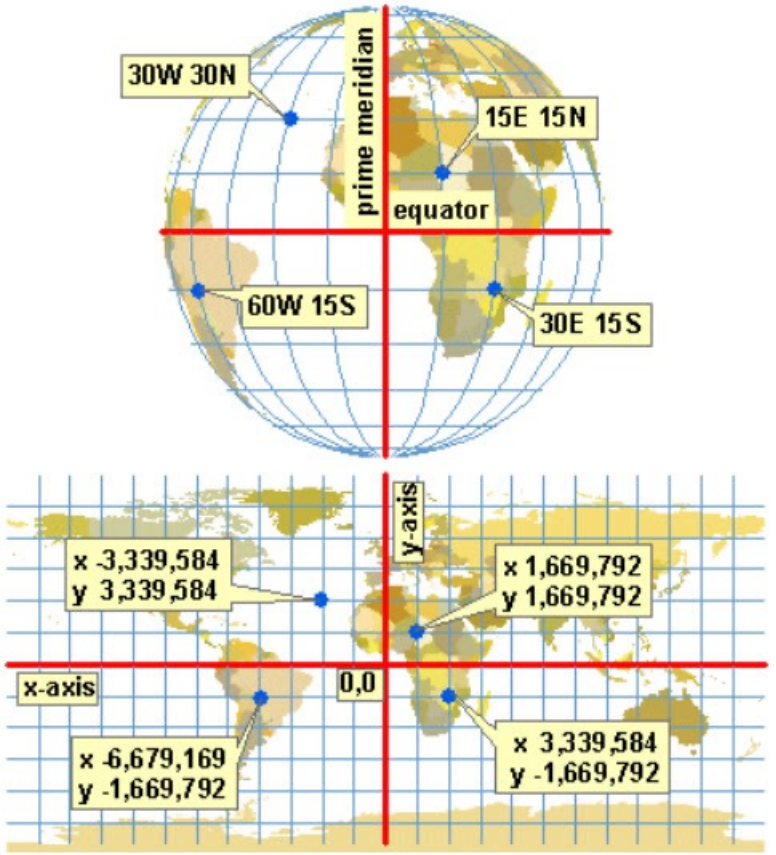
Imagine an orange as the Earth, and you want to be able to peel it in such a way as to lay the peel flat.

Similarly,
projection is a method by which cartographers translate a 3D globe (spheroid or ellipsoid) to a 2D map surface.

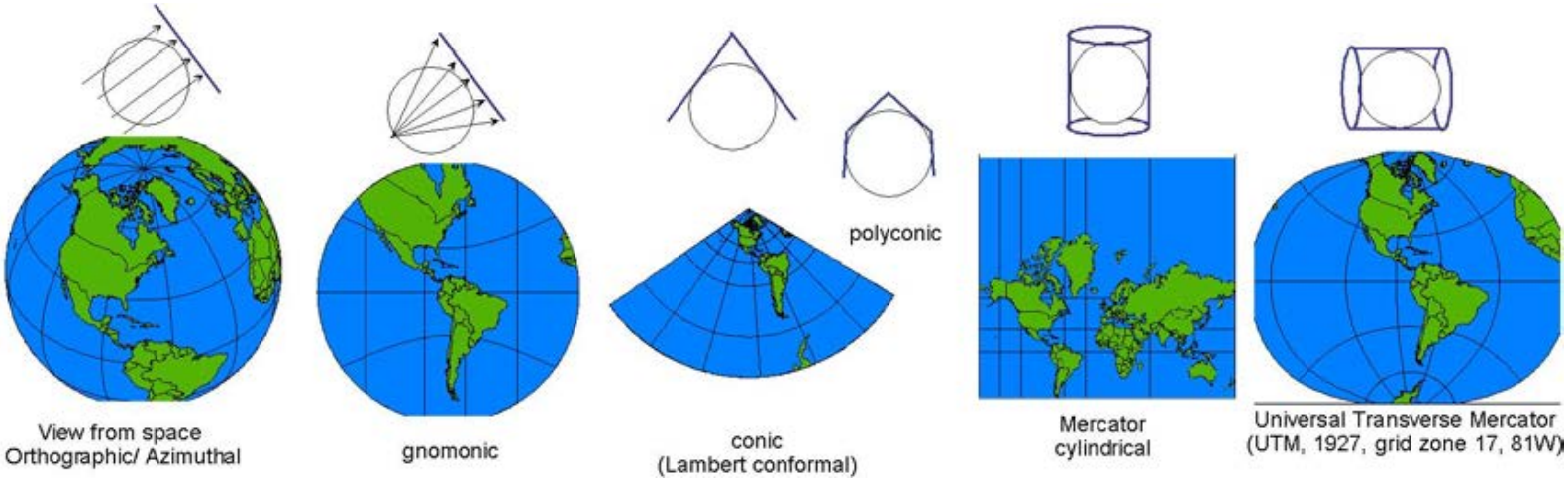


A Projected Coordinate System consists of

- Geographic Coordinate System
- Projection Algorithm
- Linear Unit
- Parameters that center the system on a certain location



There are many different types of projections. Each have certain strengths and limitations in the following types of distortions: shape, area, distance, direction



Coordinate Systems Characteristics

Geographic

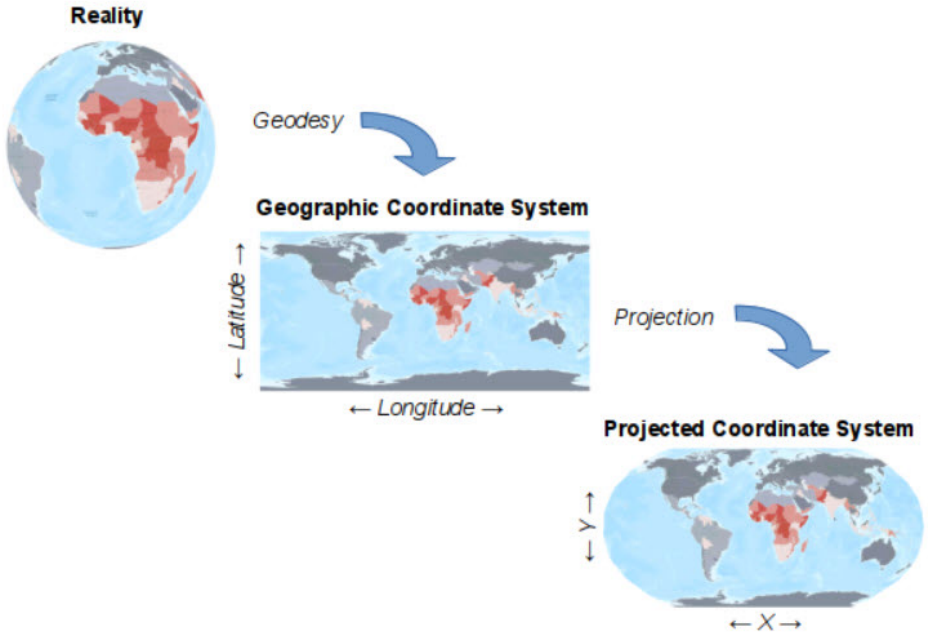
- 3D spherical/spheroidal surface defines locations
- Units: degrees (angular)
- Lengths, angles, and areas change with distance away from equator

Projected

- 2D flat/planar surface defines locations
- Units: ft, m, miles, etc. (linear)
- Lengths, angles, and areas constant across the two dimensions

Coordinate Systems Summary

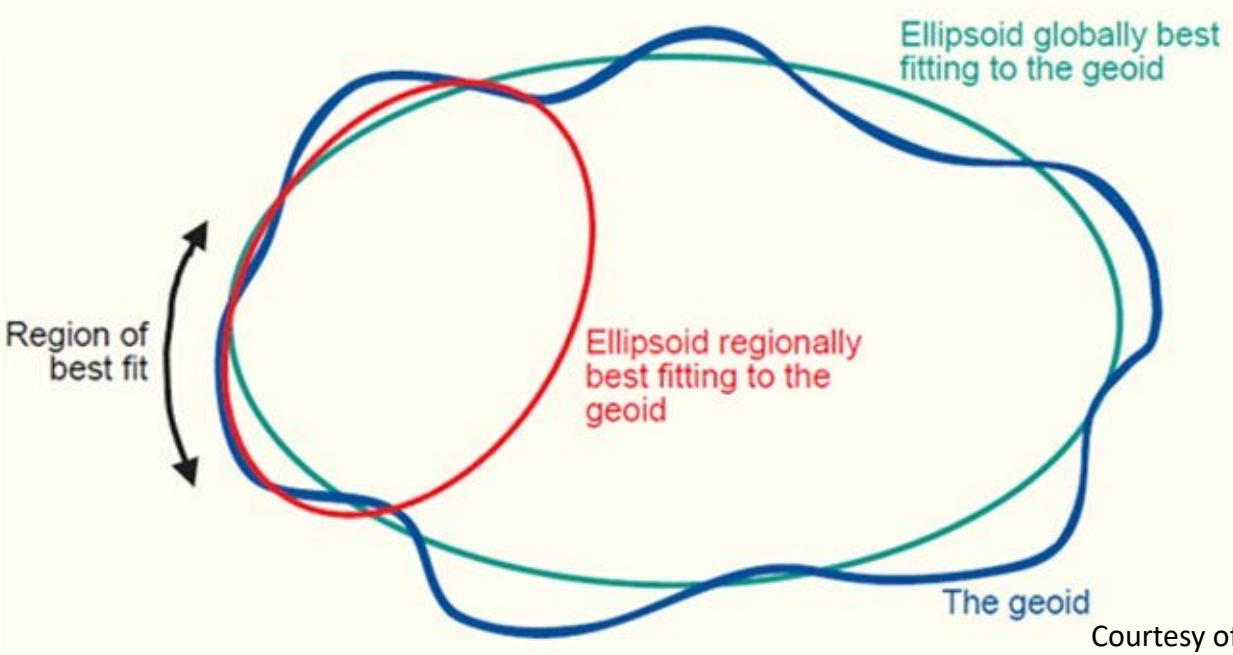
1. Data often start in a geographic coordinate system.
2. They are projected into a projected coordinate system.
3. The projection depends on the data location and analyses

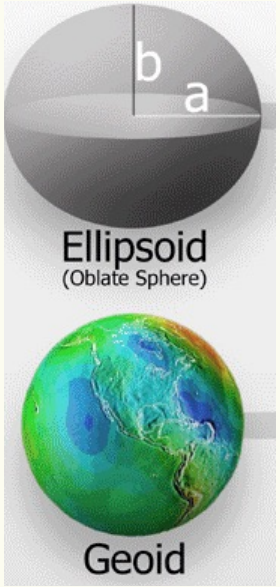


Commonly Encountered Systems

Geographic Coordinate System

- NAD83 (North American Datum) – best fitting ellipsoid for North America
- WGS1984 (World Geodetic System) – best fitting ellipsoid for the globe/world

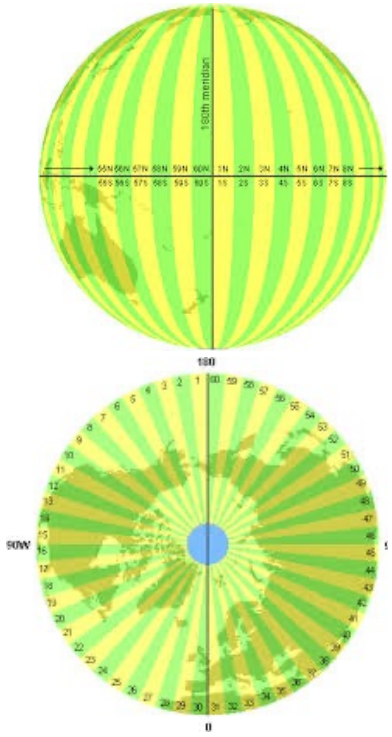


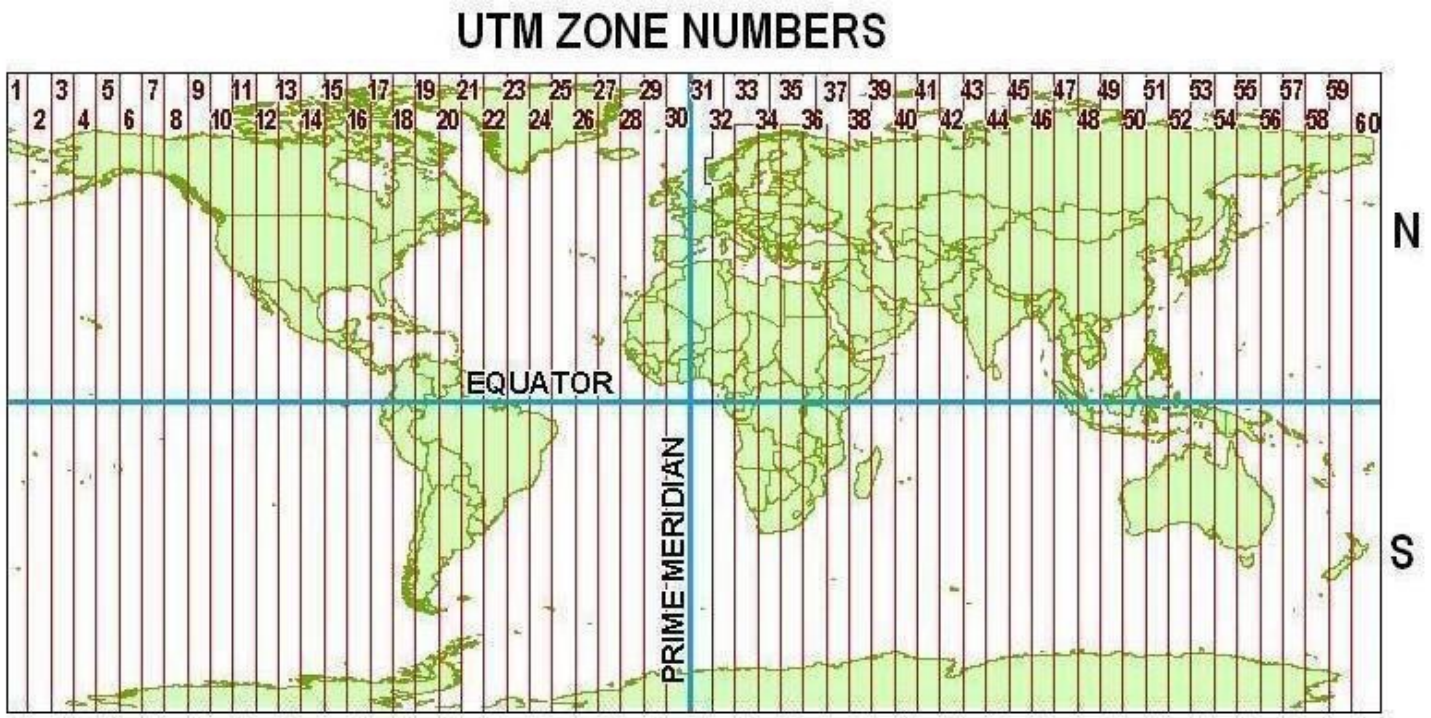


Commonly Encountered Systems

Projected Coordinate System

- UTM (Universal Transverse Mercator) – often best for large regions



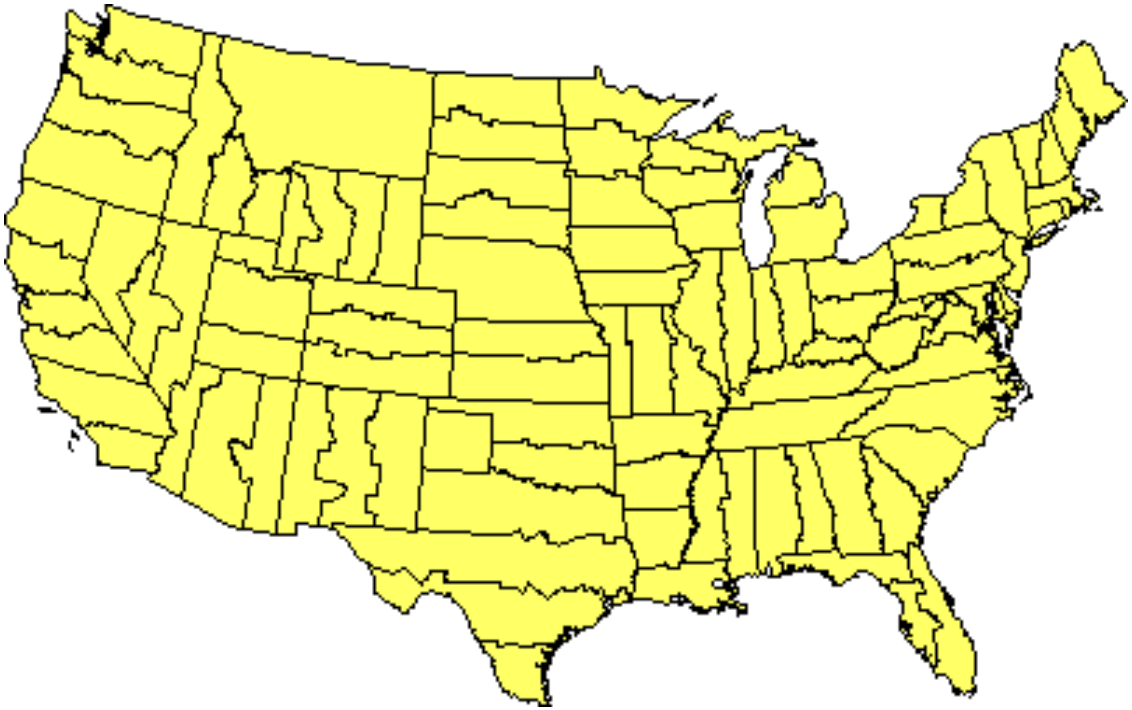


Courtesy of the National Geospatial-Intelligence Agency. Image is in the public domain.

Commonly Encountered Systems

Projected Coordinate System

- USA State Plane Systems – have been optimized per state, see updates here.



Tips on selecting a Projected Coordinate System

- **Based on your project's analyses:**
  - Preserve **area** with equal-area projections
  - Preserve **shape** with conformal projections
  - Preserve **direction** with azimuthal projections
  - Preserve **distance** with equidistant projections
  - Other projections compromise on the distortions
  - (Usually you stick with one, but can re-project)

Tips on selecting a Projected Coordinate System

- **Based on your project's location:**

  Size

  – Locally, the US has 'state plane systems'

  – Regionally, UTM is often a good option

  – World, World Mercator (EPSG: 3857)

  Region

  – To map tropical regions, use a cylindrical projection 

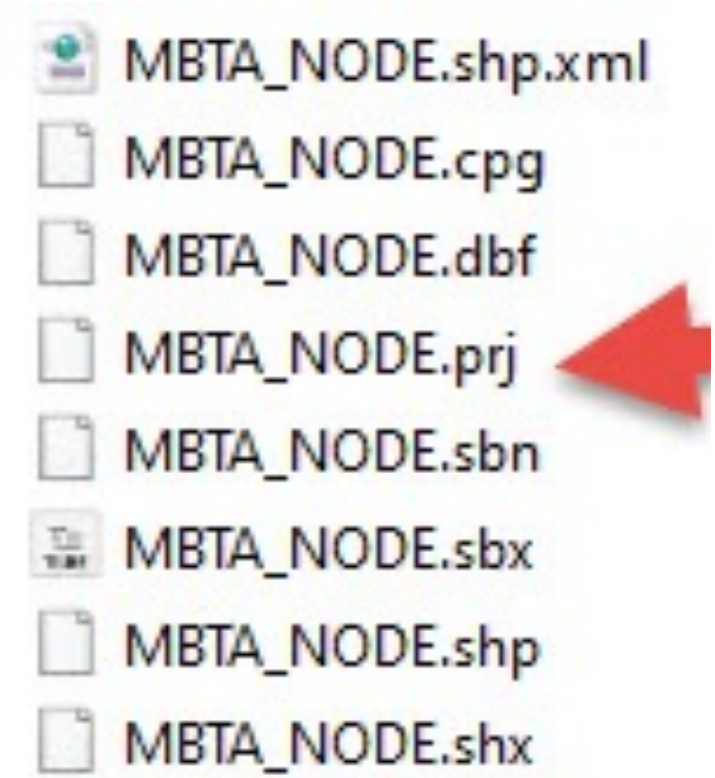
  – To map middle latitudes, use a conic projection 

  – To map a polar region, use an azimuthal projection 

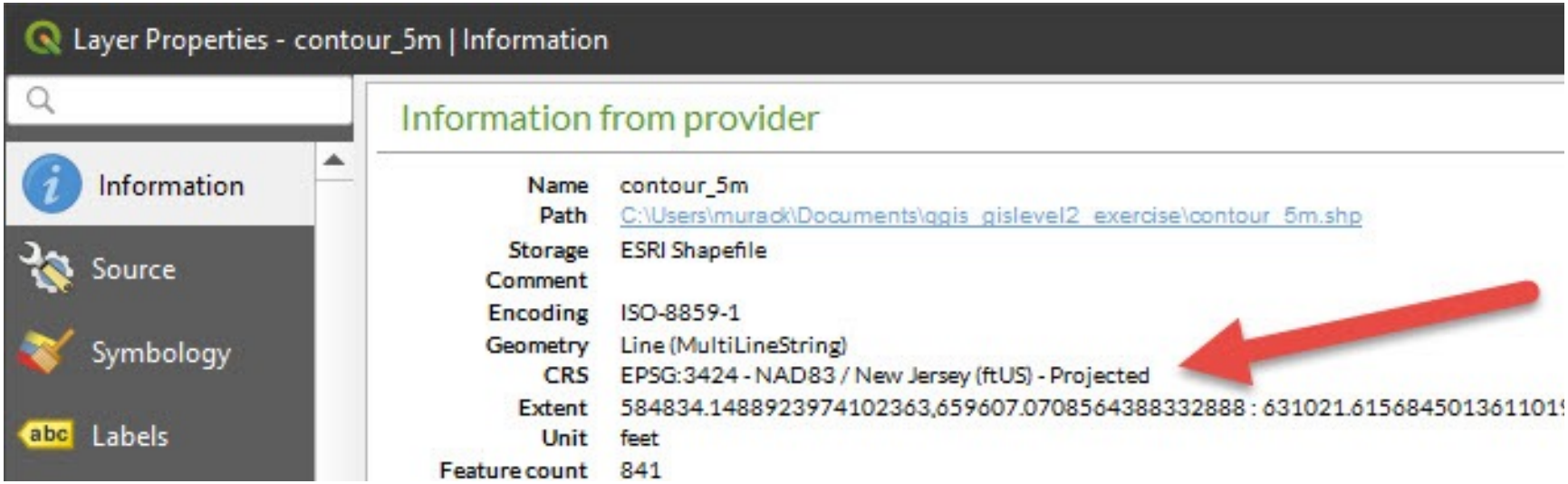
MAP PROJECTIONS:

HOW DO YOU KNOW THE COORDINATE SYSTEM OF YOUR DATA?

Option 1: Look for a .prj (projection) file within the files that make up the “shapefile” and then…



Option 1 continued: Open the file in QGIS or ArcGIS and examine the data layer information.



Note: ESRI products (ArcGIS Desktop and ArcGIS Pro) refer to geographic & projected coordinate systems with names while QGIS uses EPSG codes:
NAD 1983 StatePlane New Jersey FIPS 2900 (US Feet) versus EPSG: 3424

Option 2: Consult the metadata

Spatial Reference Information

Horizontal Coordinate System Definition

Geographic Coordinate Units	Decimal degrees
Latitude Resolution	0.000000
Longitude Resolution	0.000000
Horizontal Datum Name	D_WGS_1984
Ellipsoid Name	WGS_1984
Semi-major Axis	6378137.000000
Denominator of Flattening Ratio	298.257224

Geographic Coordinate System in WGS84

Entity and Attribute Information

Distribution Information