Fundamentals of GIS

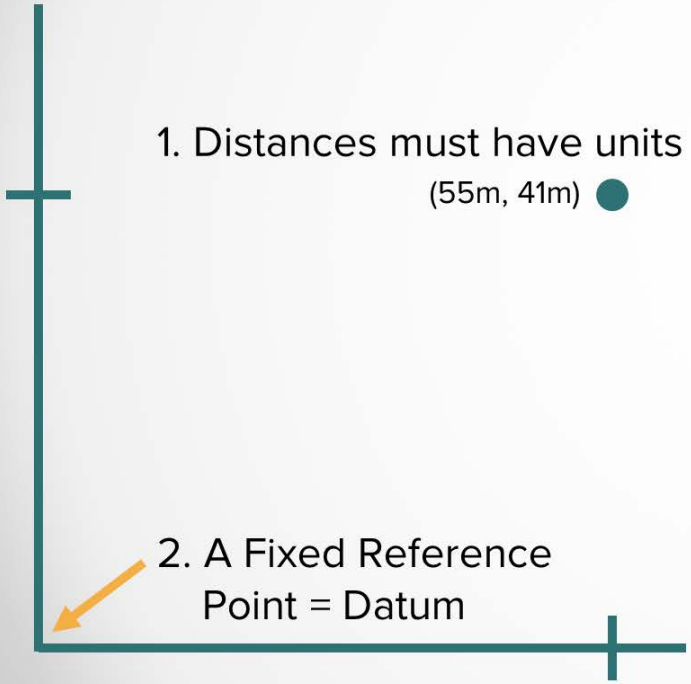
An Introduction to Projections

Learning Objectives

At the end of this lesson, you should be able to:

- Describe what projections and coordinate systems are
- Identify the main types of projection
- Select appropriate projections for GIS data
- Use projections with your GIS data

Coordinate Systems and Map Projections



All projections have a coordinate system

Geographic Coordinate System

- References locations on the earth with spherical coordinates
- Has a datum, angular unit of measure, and a central meridian

Projected Coordinate System

- Cartesian coordinates
- Latitude of origin
- Central meridian

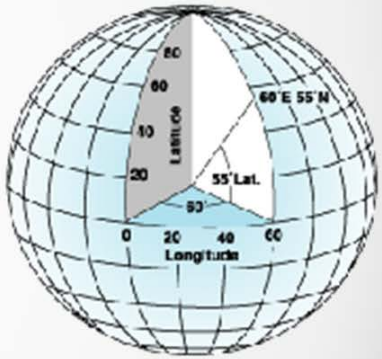
NOT all coordinate systems are projected

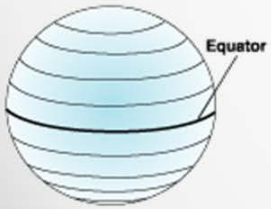
Geographic Coordinate Systems

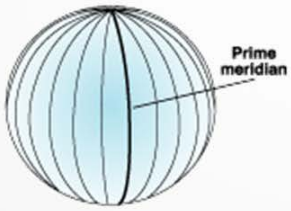
A 3-D spherical surface to define locations on the earth

- Angular unit of measure
- A prime meridian
- Datum (based on a spheroid)

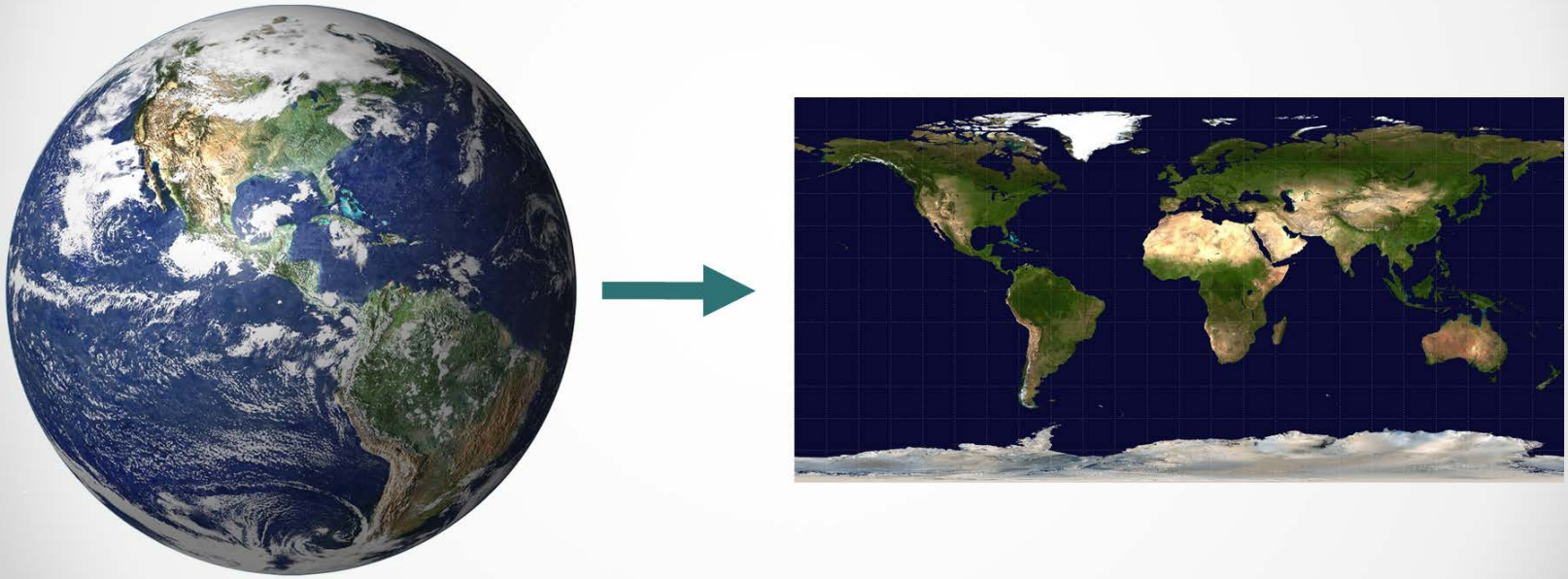
Points referenced by latitude and longitude





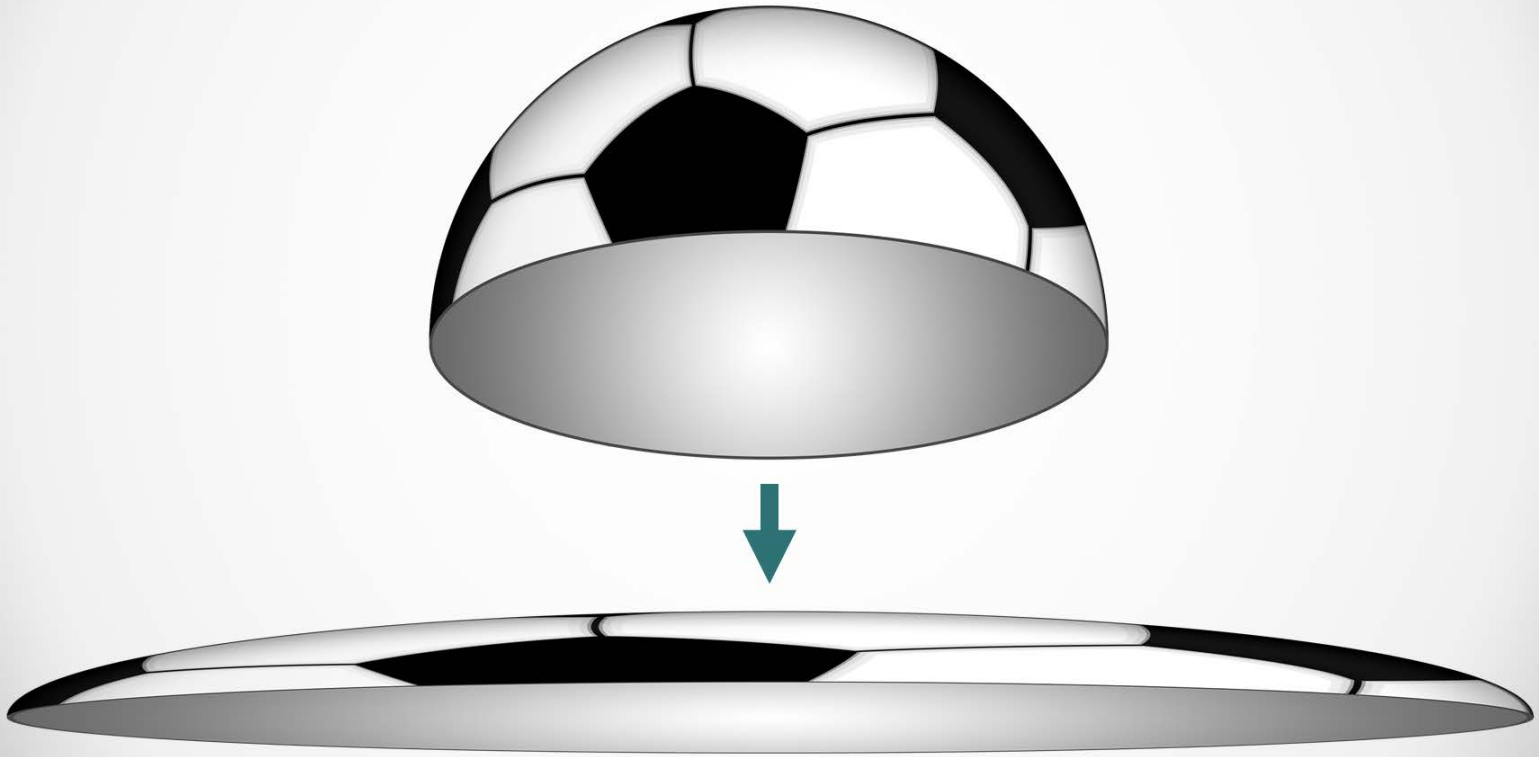


What is a Projection?

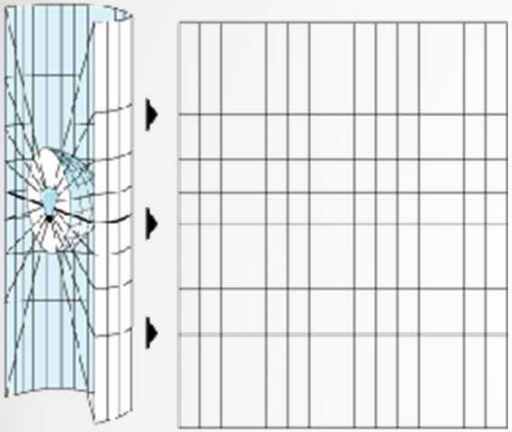


What is a Projection?

What is a Projection?

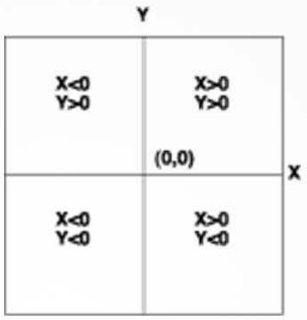


Projected Coordinate System



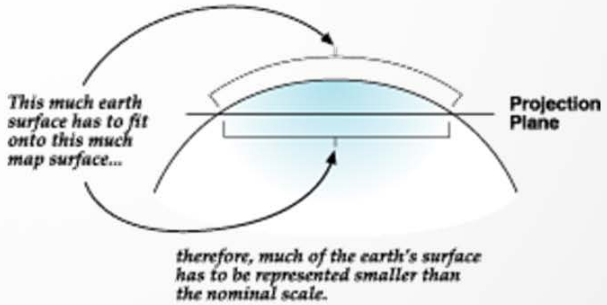
Defined on a flat, 2-D surface

Has constant lengths, angles, and areas across two dimensions



Based on a geographic coordinate system (based on a spheroid)

Locations identified by x,y coordinates on a grid



Distortions

Trade Offs from 3D Sphere to 2D Map

Map Projections distort at least one of the following:

- Shape
- Area
- Distance
- Direction

Different projections are good for different applications

- Conformal – preserve local shape
- Equal Area – preserve area of displayed features
- Equidistant – preserve distances between certain points

Projection Types

Equirectangular

Equal, constant distances between parallels and meridians

Usually how data stored in a GCS is displayed by default

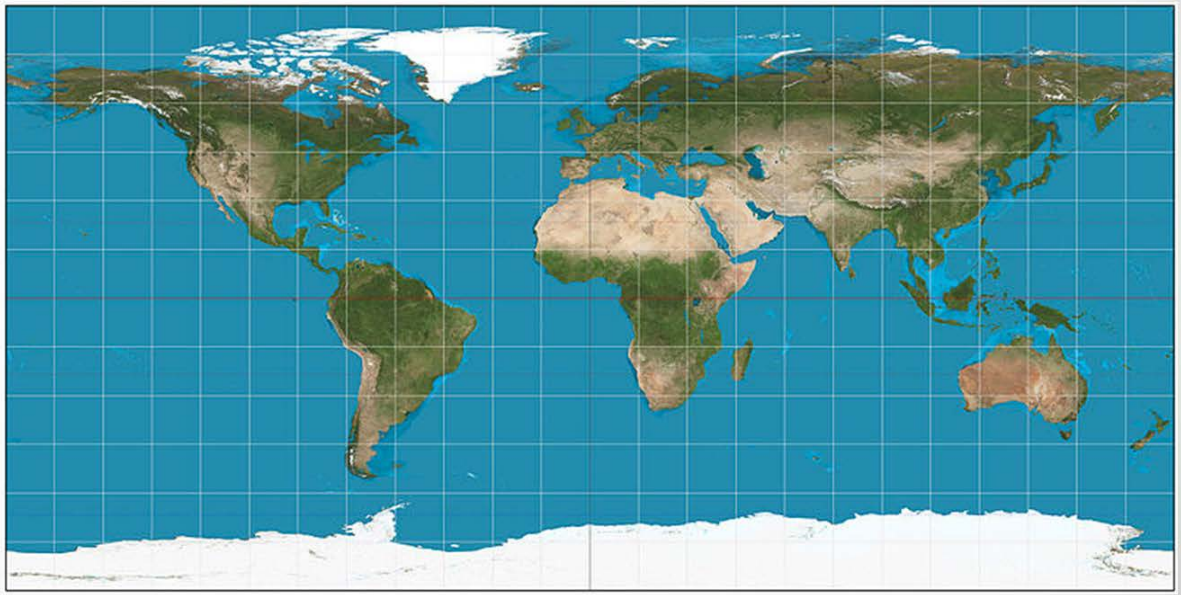


Image from Wikimedia Commons. CC-BY-SA 3.0 Strebe.
https://commons.wikimedia.org/wiki/File:Equirectnagular_projection_SW.jpg

Projection Types

Mercator

Angles preserved

Good for navigation

Optimized for calculation speed

Standard for Web Mapping

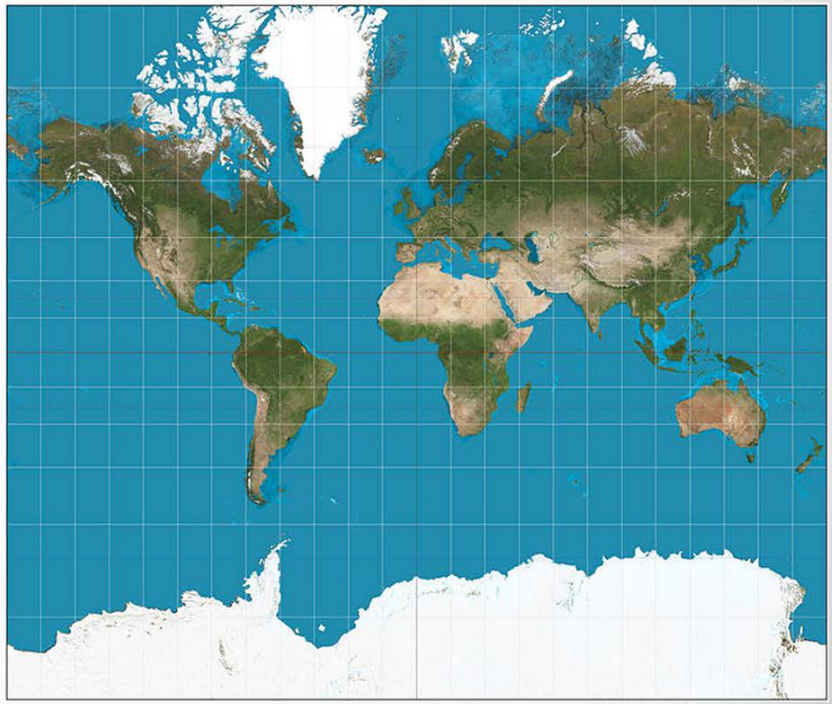


Image from Wikimedia Commons. CC-BY-SA 3.0 Strebe.
https://commons.wikimedia.org/wiki/File:Mercator_projection_SW.jpg

Projection Types

Mollweide

Relative areas preserved

Shape distorted

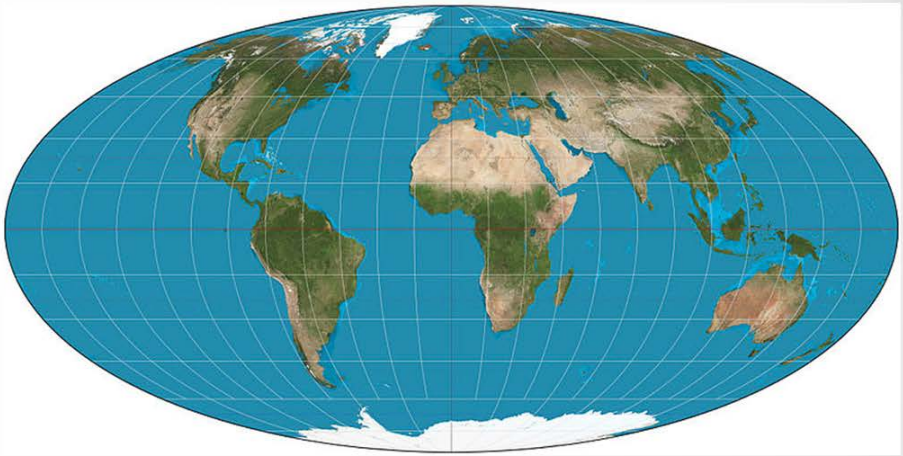


Image from Wikimedia Commons. By user Strebe.
https://commons.wikimedia.org/wiki/File:Mollweide_projection_SW.jpg

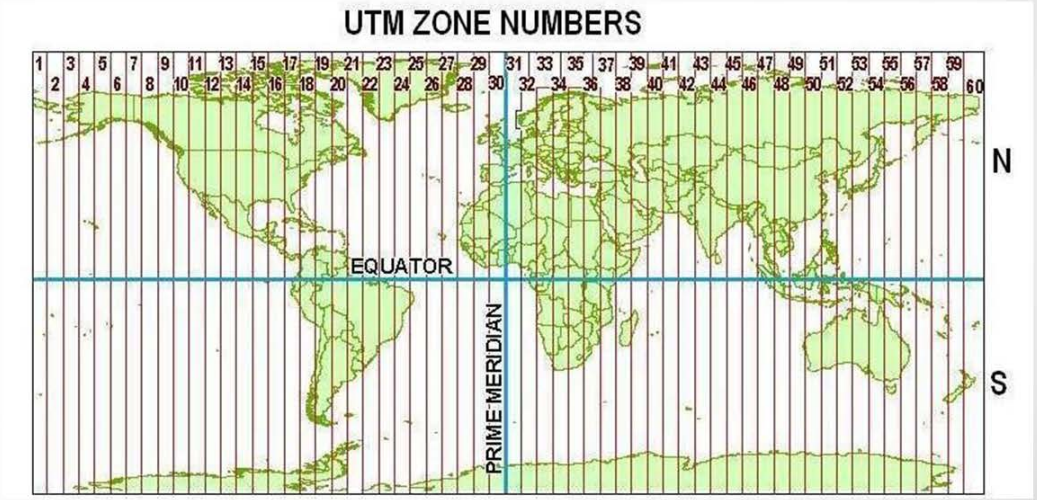
Projection Types

Universal Transverse Mercator

Developed by US ACE, 1940

60 North and South Zones

- Each zone spans 6°of longitude
- Origin of each zone is central meridian and equator
- False Eastings and Northings to eliminate negative coordinates



Projection Types

Universal Transverse Mercator

Conformal Shape

- Accurate representation of small shapes
- Minimal distortion of larger shapes within zone

Area

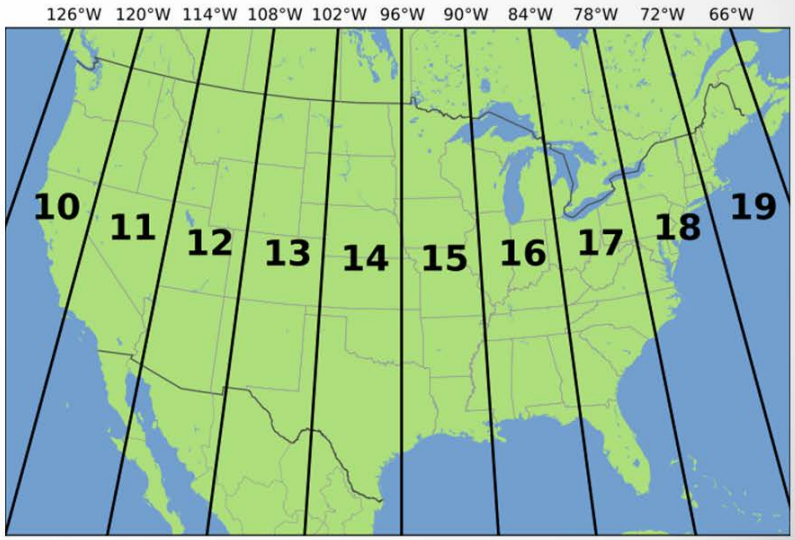
- Minimal distortion within each zone

Direction

- Local angles are true

Distance

- Scale is consistent along central meridian



Review

Projections and Coordinate Systems

Differentiating Between Projections and Coordinate Systems

Common Projections

Viewing Different Projections in ArcGIS