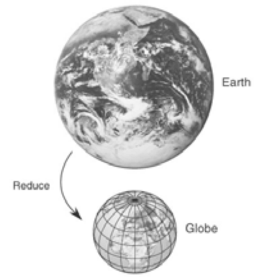
{03} Map Projections

GEOG 201
Map Interpretation & GPS
Spring 2010

Mapping so far…

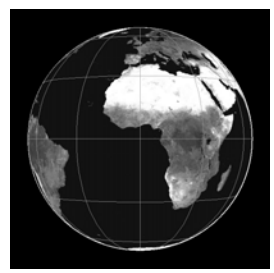


The globe

- *What are the benefits of using a globe?*
- *What are the problems?*

Viewing the World

- We see ***less than half*** of it at any given time.

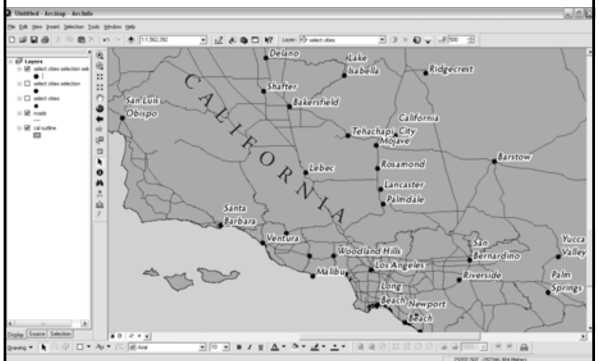


Viewing the World

Looking **orthographically** at the world

Viewing the World

- **Maps**
  - Scaled **representations** of reality
    - Comprised of **points**, **lines**, **polygons**, and **type**

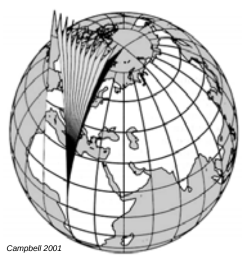


Our Problem

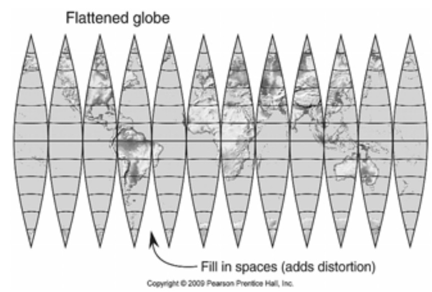
- ‡ How does one take a round surface and place it on a flat piece of paper?

Making a Map

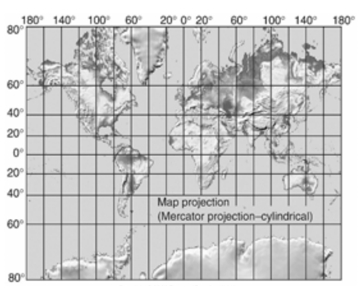
- ‡ Peel it?



A Flattened Globe

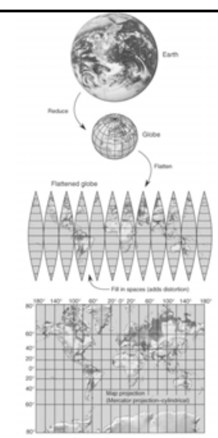


A Projected Globe



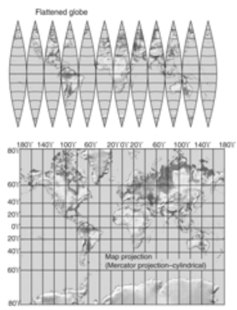
Map Projection

- ‡ A systematic reproduction of a globe and **graticule** onto a flat sheet of paper.

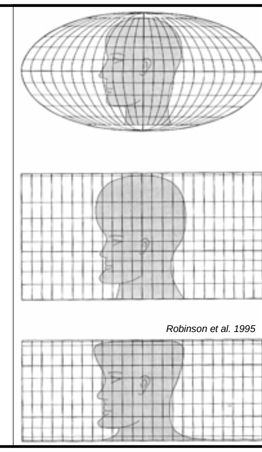


But…

‡ Distortion
  – Stretching
  – Tearing



Distortion



Decisions

‡ We have hundreds of map projections, yet no one projection is perfect!

Decisions

‡ Understanding what goes into making a projected map
1. **Surface**
2. **Orientation**
3. **Light source**
4. **Retained Properties**

Decisions

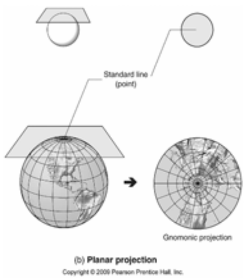
‡ As map users, we need to know the issues involved to use the right map for the right job.

1. Projection Surfaces

‡ 3 different surfaces used for a projection
1. **Planar (Azimuthal**)
2. **Conical**
3. **Cylindrical**

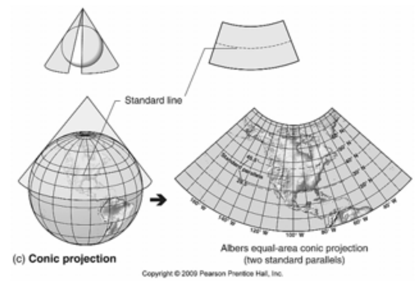
Planar Projections

- A flat plane placed over globe
- Simplest of projections

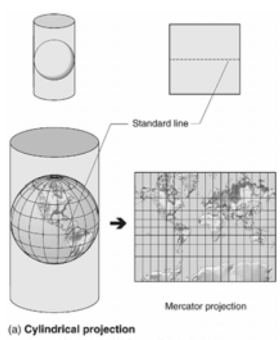


Conical Projections

- The map is **developed** ("cut and unrolled")



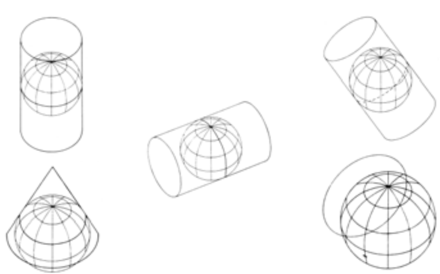
Cylindrical Projections



2. Orientation

- **Orientation**
  - Depends on where the **point of tangency** for the projection surface lies
- **Point (or line) of tangency**
  - Where the projection surface & globe touch

Orientation Examples

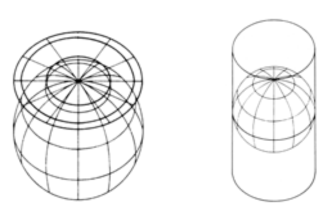


Normal

Transverse (90° from normal)

Oblique **(any angle between normal and transverse)**

Orientation Examples



Polar

Note the lack of polar information on this cylindrical projection.

Orientation

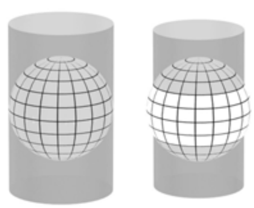
- The line of tangency is also known as the **standard line**.
- Along this line on the map, **there is no distortion.**

Orientation

- A projection that intersects the globe is known as a **secant projection.**
  - This creates two standard lines.

Secant Projections

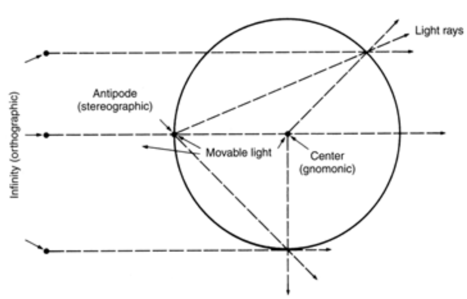
What would be the benefit of using a secant projection?



3. The Light Source

- Shine a light into a globe and record the resulting shadows.
- The light source can be anywhere on the globe.

3. The Light Source



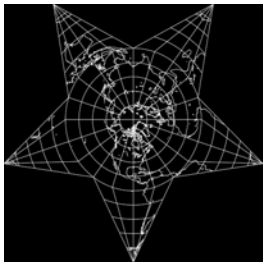
4. Retained Properties

- **Surface**, **Orientation**, & **Lighting** affect patterns of distortion.
- Certain properties can only be favoured over others... You can't have it all.

Major & Minor Properties

Major
1. **Conformality**
2. **Equivalence**

Minor
1. **Distance**
2. **Direction**

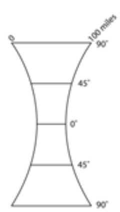


Conformality

The retention of correct angles
- Map features ***look*** like they should (shape)
- Lat/Long cross at right angles

Conformality

Scale is same in all directions at any given point
- *Only possible for small areas on a map*

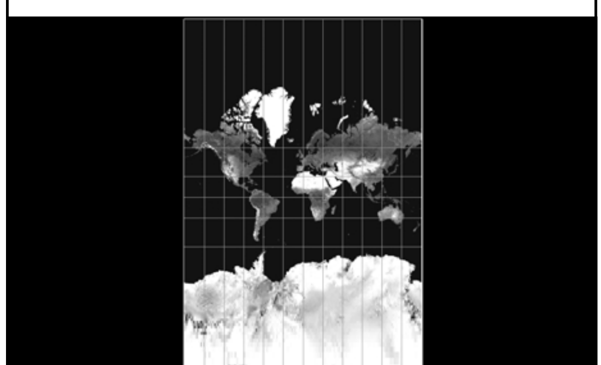


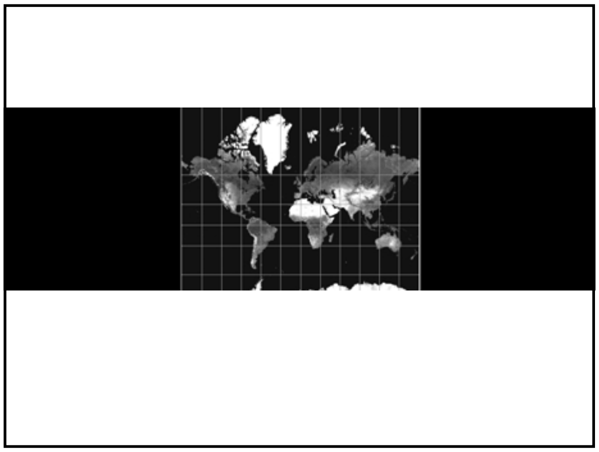
Gerardus Mercator

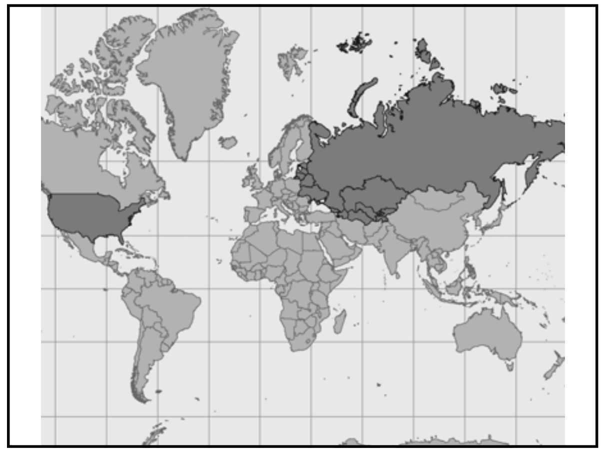
The Mercator projection is a classic
- 1569 – for navigating at sea
- His projection allows one to draw a straight line to get from Point A to Point B.

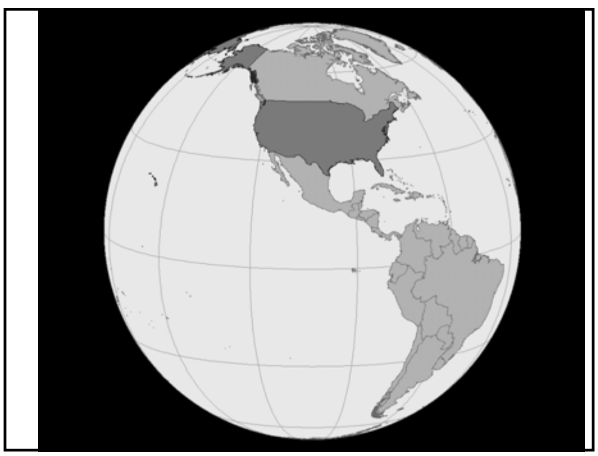
Mercator Projection

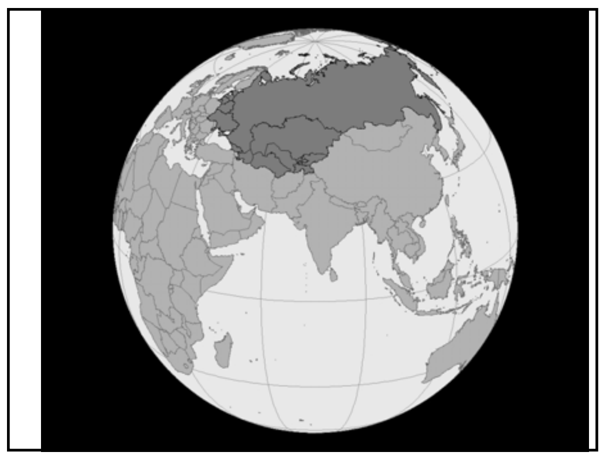
Problems
- The size of land is horribly distorted in the poles
- Does not show the ***shortest*** distance between two points

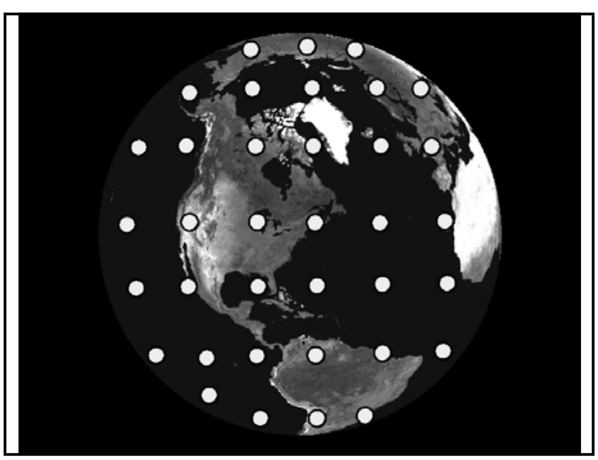


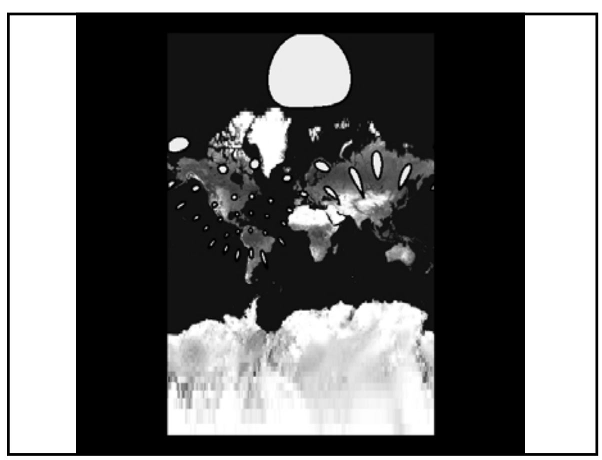






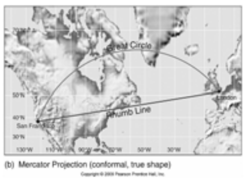


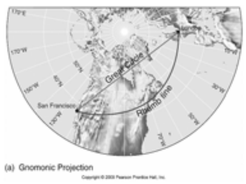




A Straight Line?

Mercator **Gnomonic**



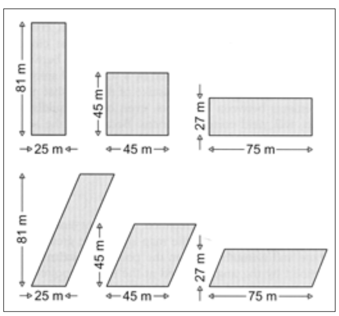


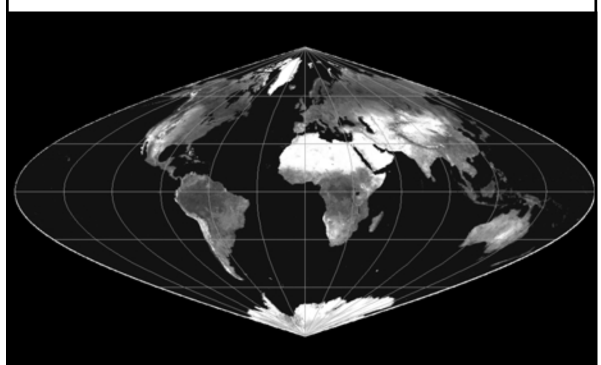
Equivalence

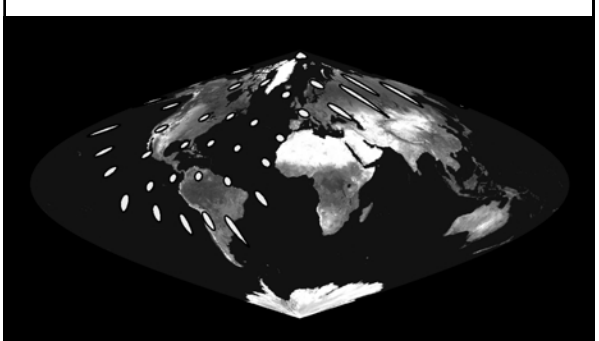
"In which a unit area drawn anywhere on the map always represents the same number of square units on a globe" (Campbell 2001).

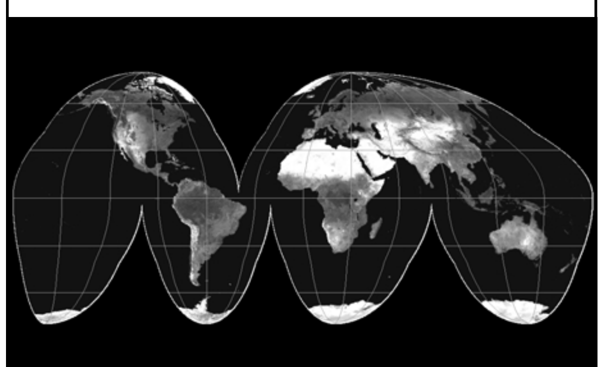
- '**Equal-area**' projections
- Parallels & meridians ***do not*** cross at right angles

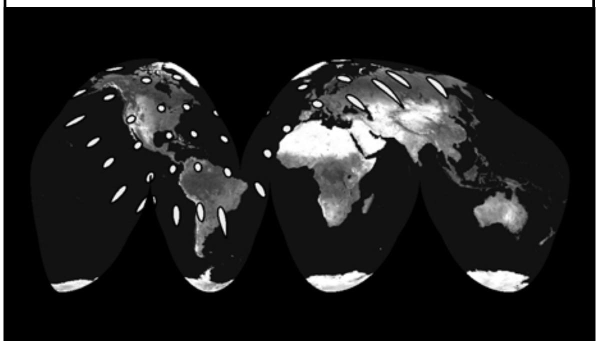
Equivalence





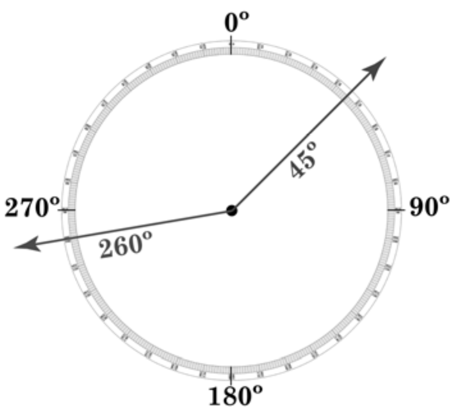




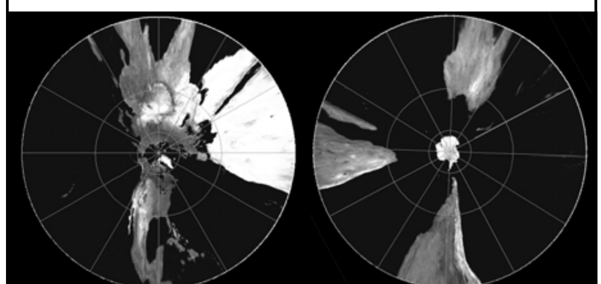


Direction

- ‡ Allow for proper azimuth & great circle routes to be drawn between two points
- ‡ This means a straight line **is** the shortest distance between two points
- ‡ **Azimuthal**



Polar Gnomonic

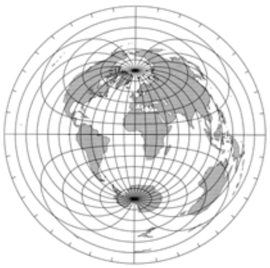


Distance

"Correct distance relationships require that the length of a straight line between two points on a map represents the correct great circle distance between the same points on the earth" (Campbell 2001).

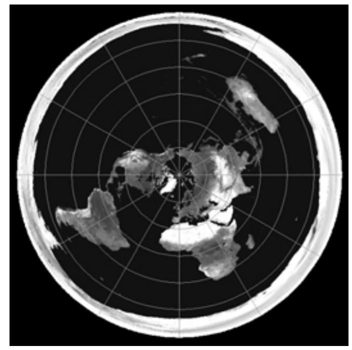
Equidistant

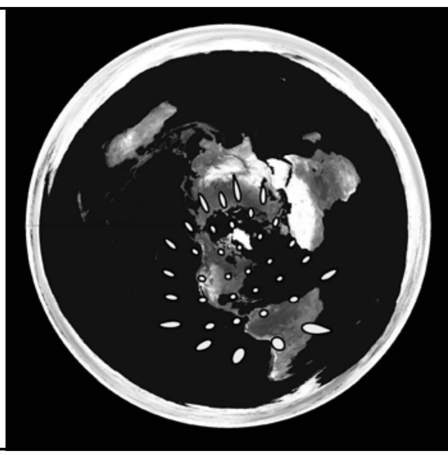
Azimuthal Equidistant



- ‡ Every point retains its proper distance & azimuth from the center of the map
- ‡ Size & shape are **distorted** the farther one moves from the center

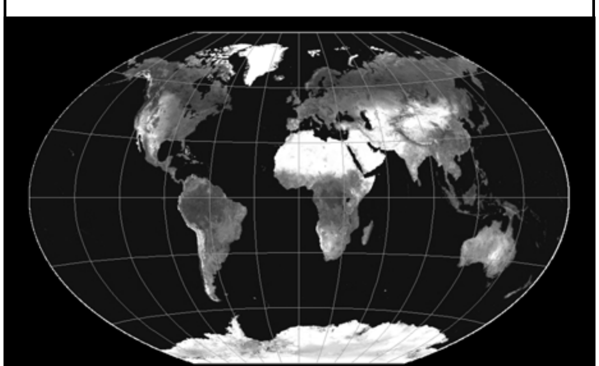
Azimuthal Equidistant

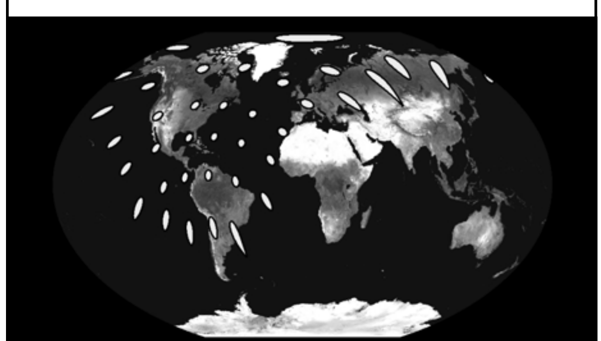




Compromise Projections

- ‡ *Sometimes a map does not need to stress any one property.*





Projections Summary

1. Only a globe can maintain true size, shape, distance, & direction.
2. That said, the right projection can give the map reader the benefits of the globe with the convenience of a map.