Projections – examples and uses

ArcGIS supported projections:

http://resources.arcgis.com/en/help/main/10.1/index.html#//003r00000017000000

Projection Properties

Projections may preserve **shape** or **area,**

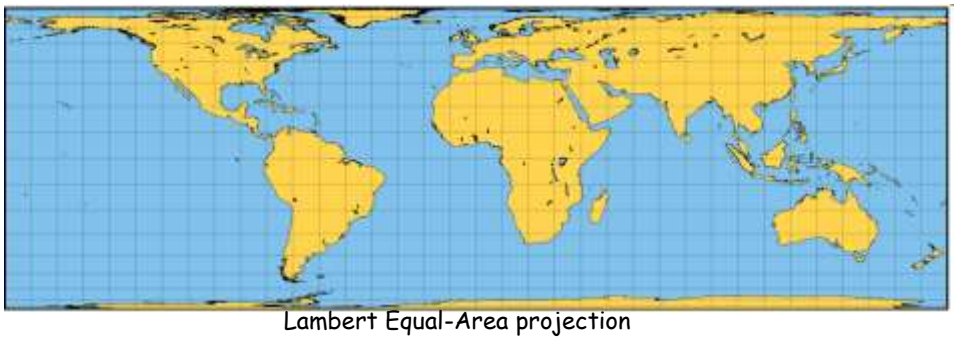
… but NOT **both** area and shape.

a. Area

A projection that maintains 'area' is **equal area** (or **equivalent)**.

This is achieved by sacrificing shape: stretching in one direction to counter for earth curvature must be **compensated** by compaction in the other.

In other words, the product of the two Scale factors at any point in the two directions (N-S and E-W) is 1.0 (e.g 1 x 1, 2 x 0.5 etc..)



Lambert Equal-Area projection

b. Shape

A projection that maintains shape is **conformal** or **orthomorphic**.

For example a 2x2 square becomes a 1x1 or 4x4 square. Stretching in one direction is **matched** by stretching in the other: that is, the scale factors are equal at a point in the two directions (i.e. there is 'equal-stretching').

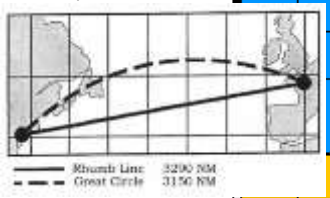
Circles ("Tissot's Indicatrix") ->

These indicate the relative area compared to a standard area at the equator (the standard line)

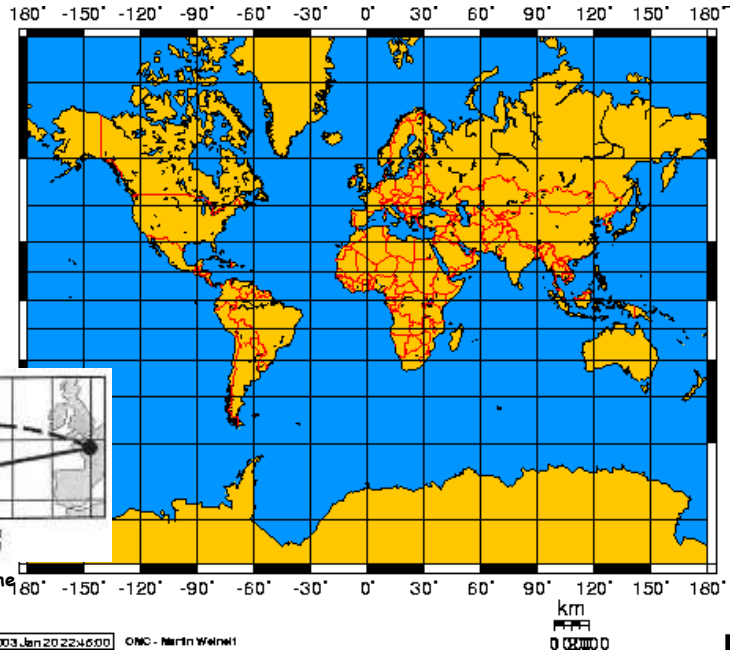
Mercator's Projection 1569 - conformal

All 'straight lines' have constant compass bearings

= Rhumb lines

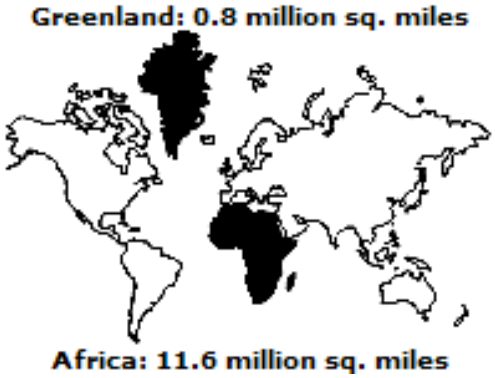


It became known as the "Navigator's friend"



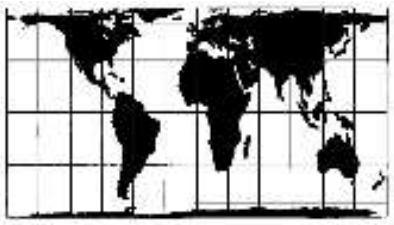
Misuse of Mercator projection: (area distortion)

[Area of Australia: 7.7 million km^2 Ellesmere Island: 200,000 km^2 Alaska: 1.5 million km^2]



Conformal projection - Mercator

Equal-Area projection
Gall - Peters



c. Distance

Distances can be correct in <u>one direction</u> from a line, usually a standard line … (or distances can be correct in all directions from a point in an azimuthal).

In these cases, the projection is termed **equidistant**

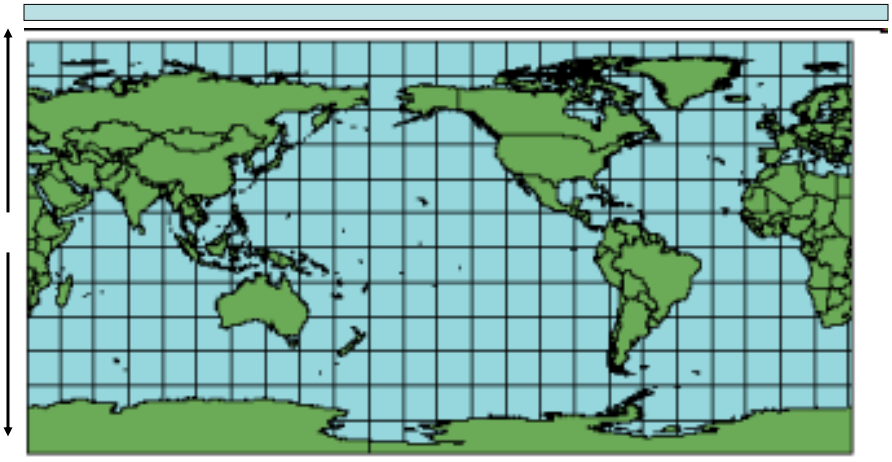
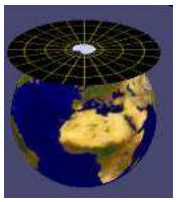


Plate Carrée projection

Map projections – 3 major groups



Conic **Cylindrical** **Planar (azimuthal)**

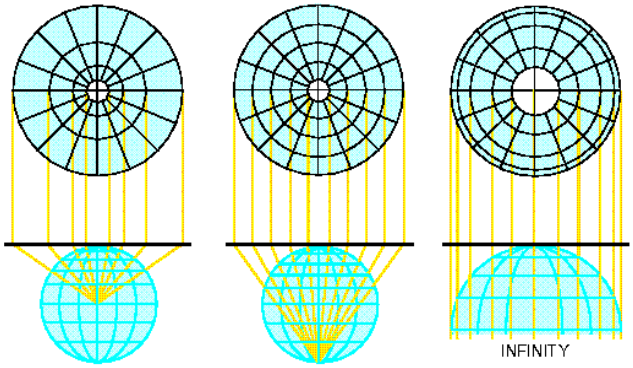
Sub-groups based on projection orientation (**normal**, transverse, oblique)

Possible Properties : **area, shape**, distance

1. **Azimuthal projections** (since 500BC) : used for polar areas

Can also be projected to centre on any point (oblique)

http://www.progonos.com/furuti/MapProj/Normal/ProjAz/projAz.html



GNOMONIC	STEREOGRAPHIC	ORTHOGRAPHIC
Great circles = straight lines	Conformal (shape)	'View from space'
Thales	Hipparchus	Ptolemy

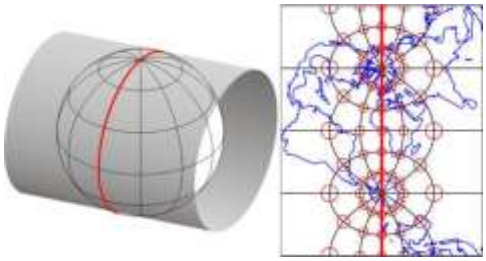
2. Cylindrical Projections

16th century ->

Best for **equatorial** areas and for early world maps
-They fill a rectangular shape

Mercator (16th century)

Transverse Mercator



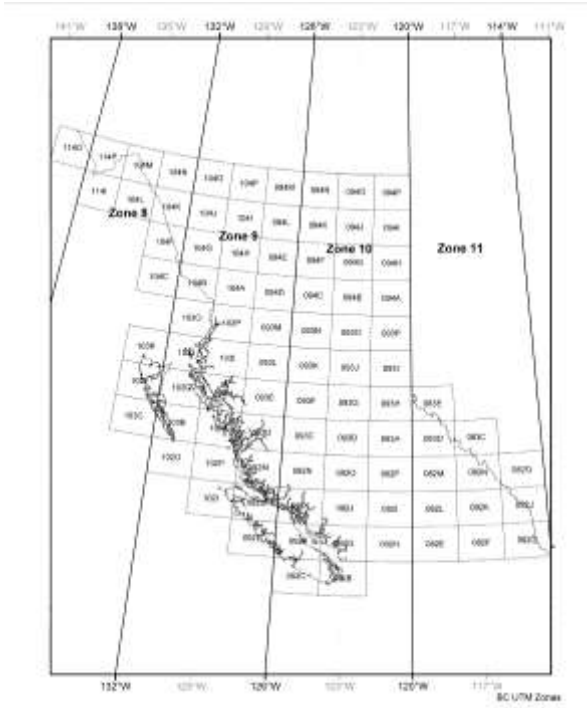
http://www.progonos.com/furuti/MapProj/Normal/ProjCyl/ProjCEA/projCEA.html

The TM projection is the basis for the (Universal) UTM system

Each UTM zone is 6° longitude wide, each Central Meridian is a standard line.

The UTM system consists of 60 TM projections

UTM zones : BC ->

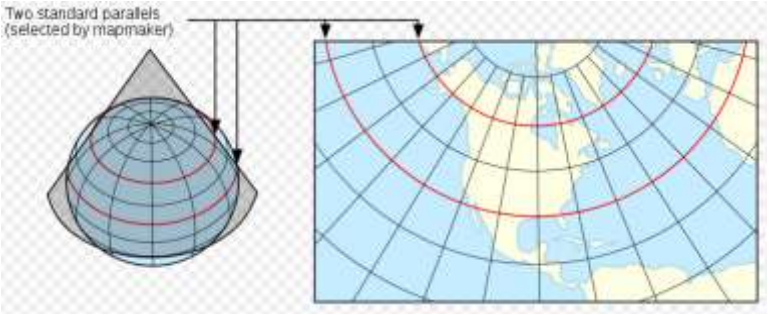


3. Conic projections – 18th century

The cone opens at a line of longitude

the cone intersects the sphere at one or two parallels – standard lines

Conic projection with 2 standard parallels: mid latitudes

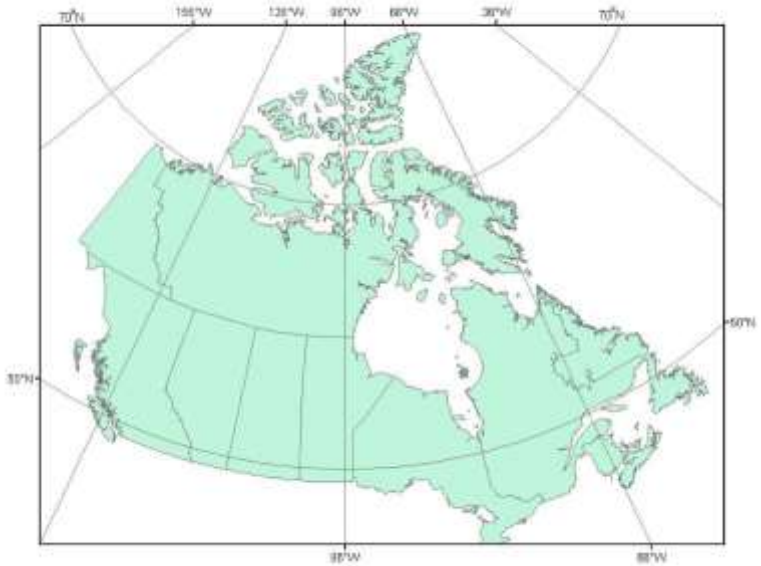


Albers projections (1805) – with 2 standard parallels –coordinate systems

- BC: 50 and 58.5 N (central meridian 126 W = 1,000,000)
- Yukon: 61.67 and 68 N
- Alaska: 55 and 65 N
- Hawaii: 8 and 18 N

Canada Albers Equal Area Conic:

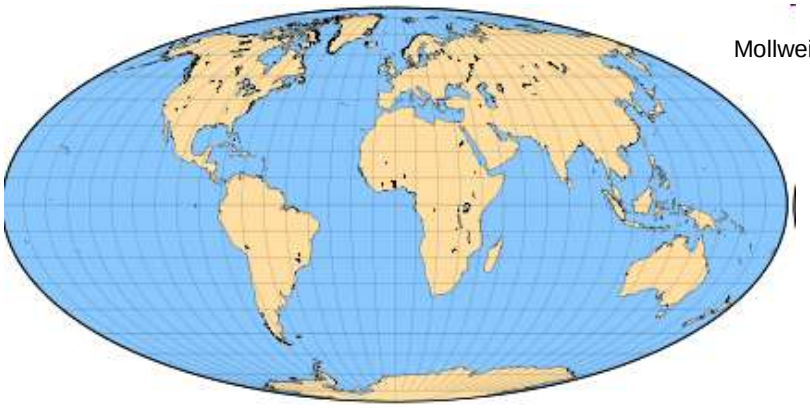
Central Meridian: -96 Latitude Of Origin: 40
First Standard Parallel: 50 Second Standard Parallel: 70



4. Conventional (pseudo-cylindrical) Projections

-**19th century (and 20th)**

These are geometrically constructed. The parallels are generally equally spaced but are made more proportional to their real length to minimize distortion.



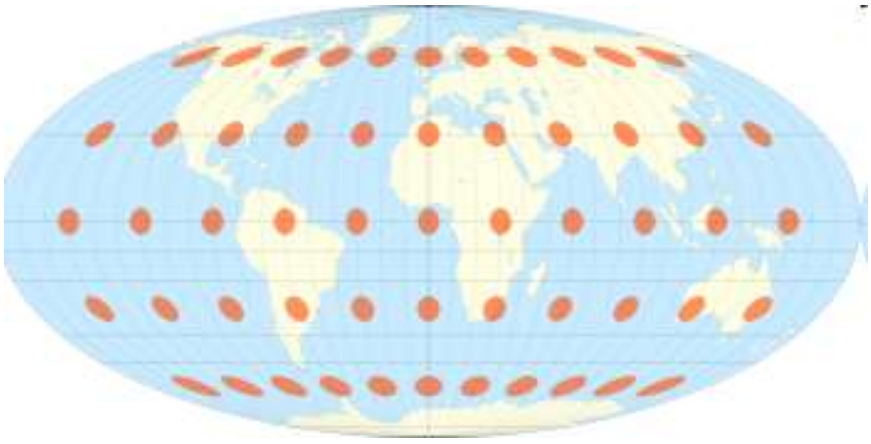
Mollweide

http://www.progonos.com/furuti/MapProj/Normal/ProjPCyl/projPCyl.html

Conventional projections

-show the whole world with least overall distortion (and is equal-area)

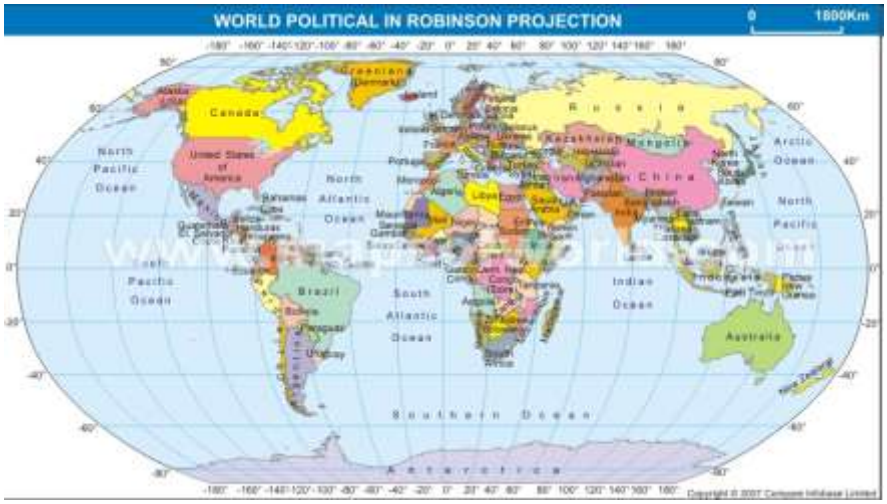
-19th century (and 20th) e.g. Mollweide



Tissot's Indicatrix of distortion

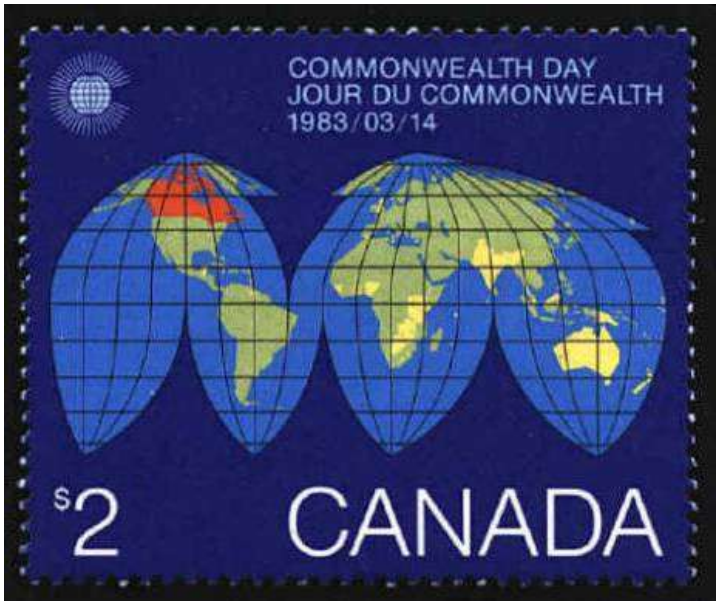
Robinson projection - adopted by National Geographic in 1988

Poles drawn as lines to create better shapes



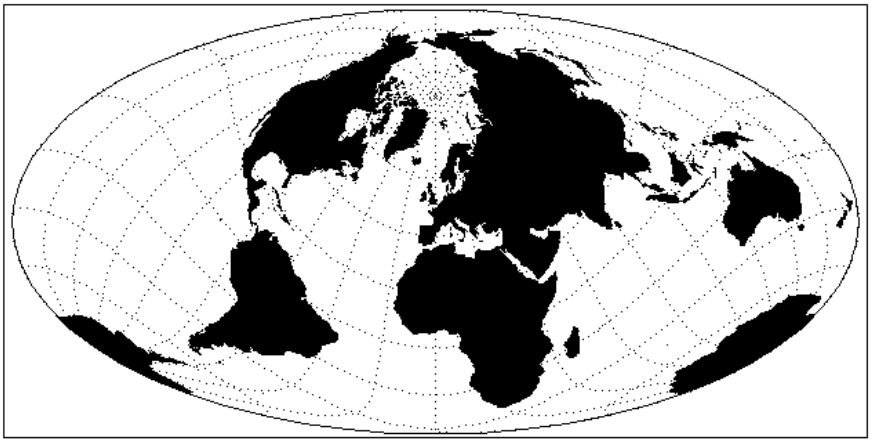
http://www.mapsofworld.com/projection-maps/robinson/world-political-light.html

Interrupted version (Goode's)

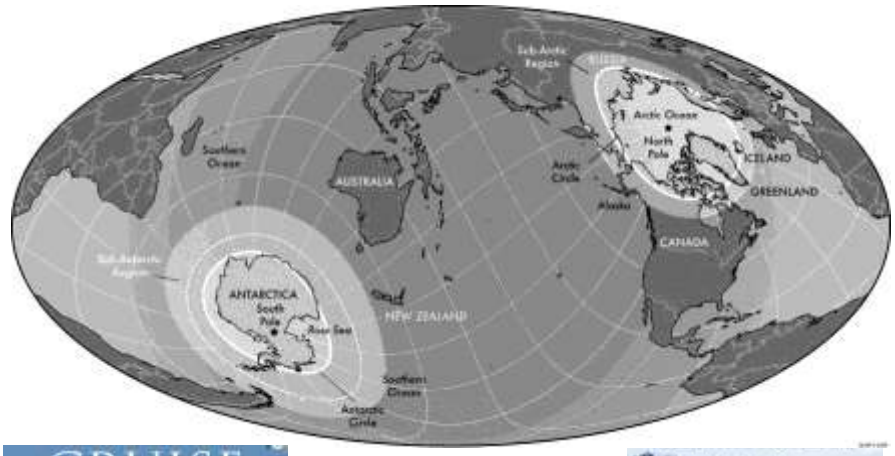


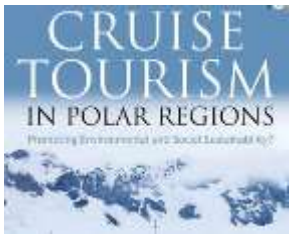
Designed to 'take advantage of ocean areas

Oblique Mollweide (obliques are used sparingly)



http://idlastro.gsfc.nasa.gov/idl_html_help/Pseudocylindrical_Projections.html





Excellent use of oblique Mollweide

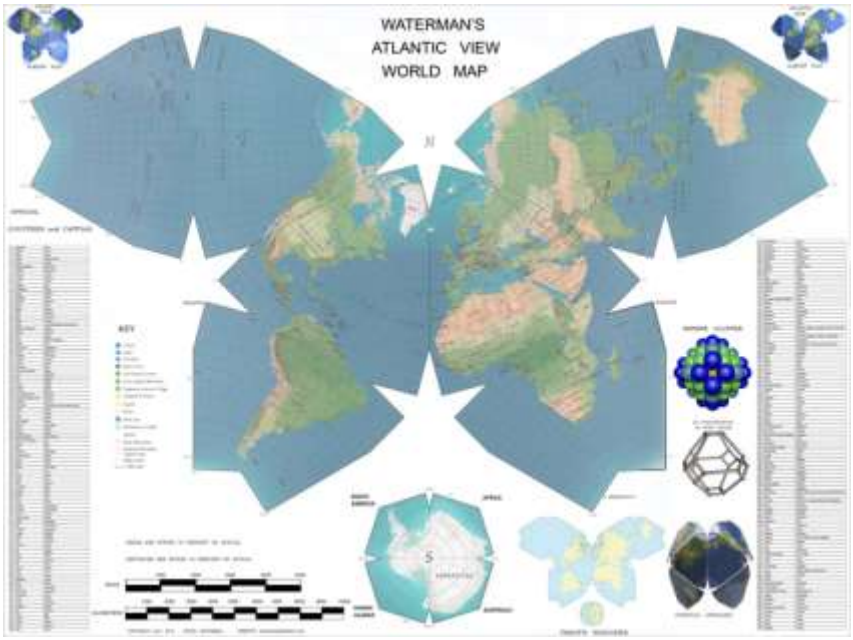
http://www.progonos.com/furuti/MapProj/Normal/ProjAppl/projAppl.html

Present and fossil teeth suggest several migration waves in the past, when reduced sea levels created bridges between now isolated Japanese and Aleutian islands.

Cassini's projection is a transverse *plate carrée*, here with central meridians 70°E and 110°W.

World religions

One more projection …. The butterfly map



Summary – use of projections

(based on distortion patterns)

Azimuthal: polar areas

Cylindrical: equatorial areas

Conic: mid-latitudes

Conventional: whole globe

Special purpose: oblique

http://www.progonos.com/furuti/MapProj/Normal/TOC/cartTOC.html