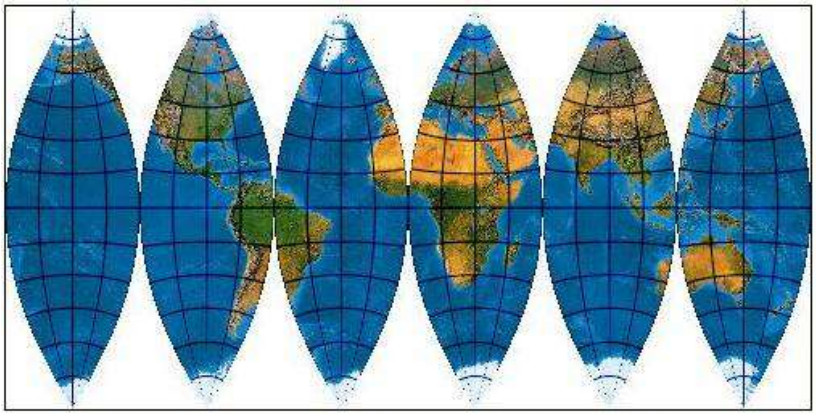
Map projections

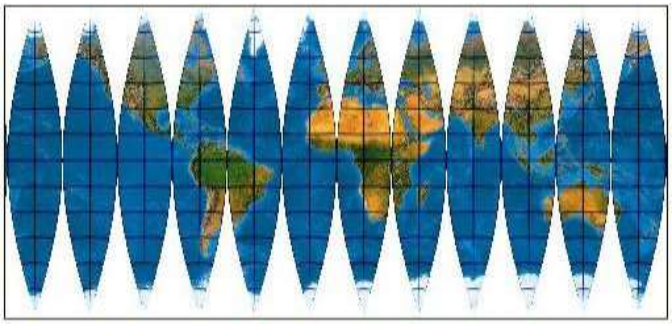
How can we 'project' a 3D globe onto a 2D display?

The world could be like orange peel …
the strips would still have some curvature
- not a problem locally, but it is for large areas



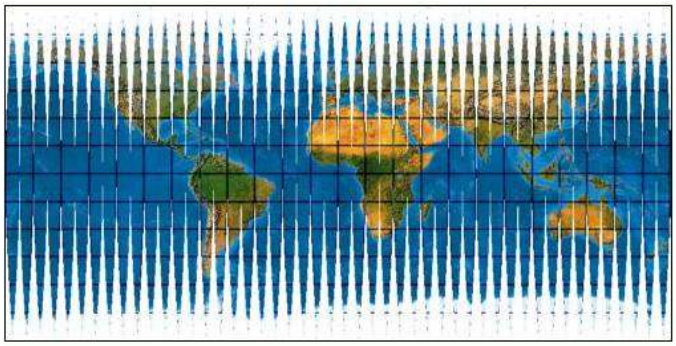
http://boehmwanderkarten.de/kartographie/is_netze_globussegmente.html

12 pieces



48 pieces

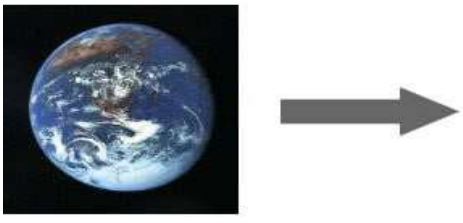
(becoming like UTM zones)



What is a Map Projection?

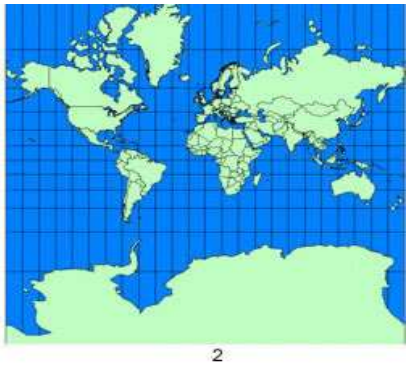
http://earth.google.com/userguide/v4/ug_importdata.html#mapprojection

….a mathematical expression representing the 3D surface of the earth on a 2D map.



1.

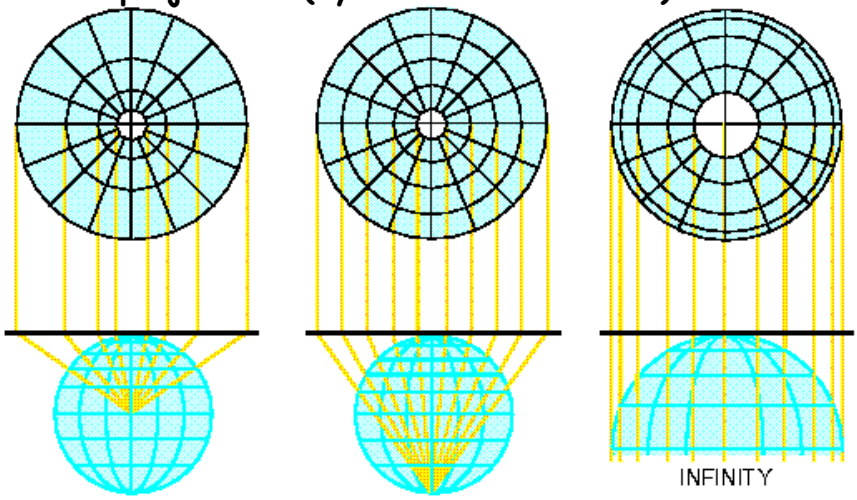
1



2

This process *always results in distortion* to map properties:
….hundreds of projections have been developed to best suit a particular type of map and data layers. The distortion, flattening or stretching needs to be done systematically

Literally projecting the globe onto a map … 3 of the earliest projections (by the ancient Greeks)



GNOMONIC **STEREOGRAPHIC** **ORTHOGRAPHIC**

[Gnomon = pagan sundial]

Projection Terms

a. Scale Factor (SF)

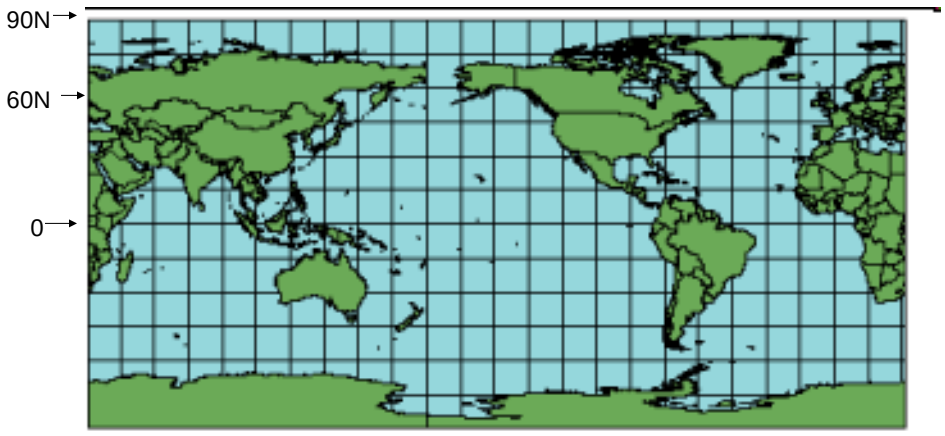
SF = scale at any location / divided by the 'principal scale'

e.g. if scale = 1:2 million and principal scale = 1:1 million

then SF at that point = 1/2million divided by 1/1million
= 1/2 (0.5)

For example, in any projection, **where every line of latitude is equal in length**
(whereas the relative lengths on the globe are 1 at the equator, 0.5 at 60 latitude and 0 at the Poles),

SF along lines of latitude are: equator SF = 1;
at 60N/S, SF =2; at 90, SF = ∞

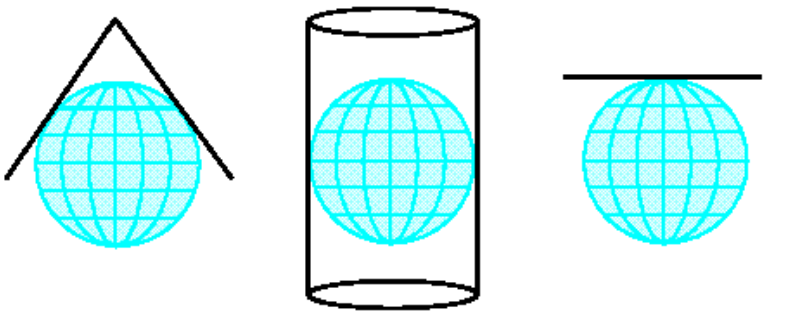


The SF in the other direction (along meridians) however is 1

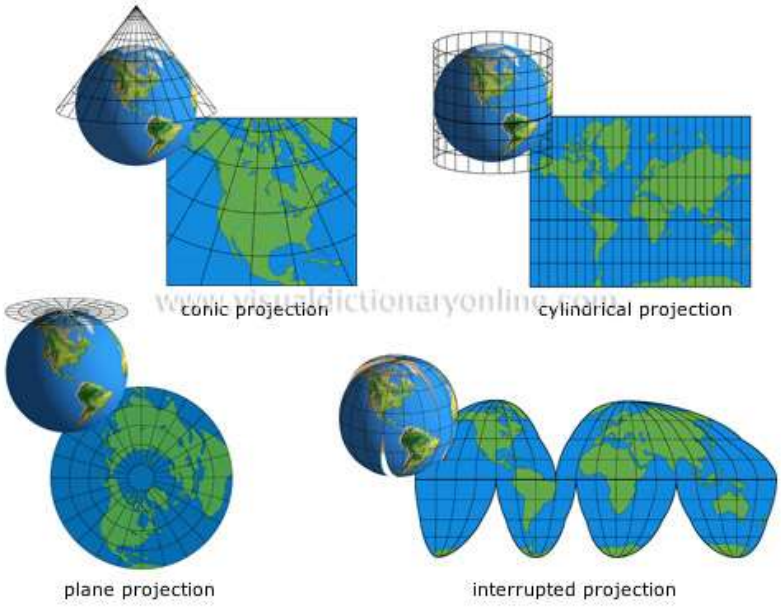
b. Developable surface:

A two dimensional surface onto which the globe is projected

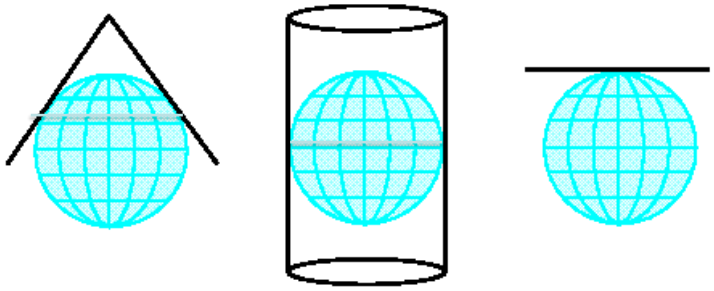
Conic **Cylindrical** **Azimuthal (planar)**



Distortion increases with distance between the 'globe' and the surface



c. Standard Line

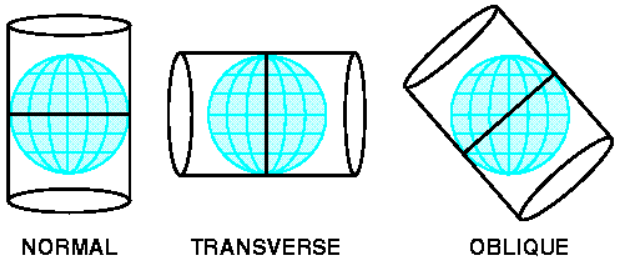


Distortion increases with distance between the 'globe' and the surface

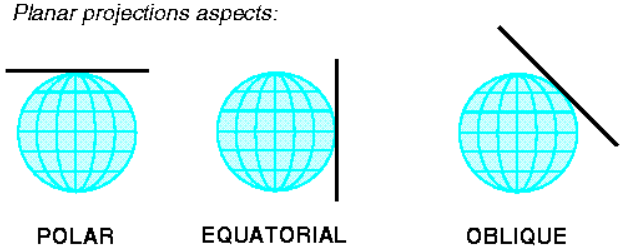
The standard line is a line along which the scale factor equals 1
(it is often the line of contact)

d. **Projection Orientation**

Cylindrical projections:



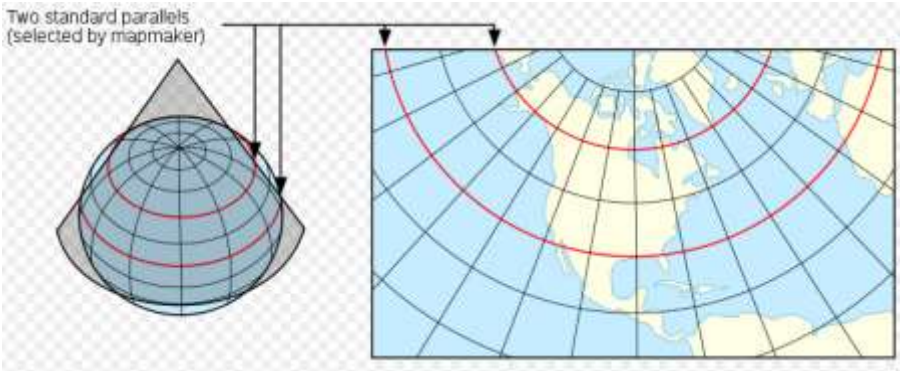
Planar projections aspects:



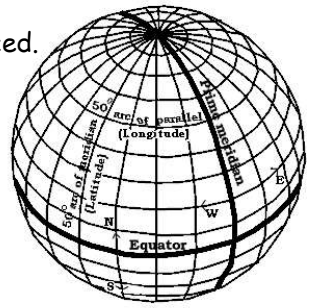
CONIC projections … are all 'normal orientation'
(e.g. Albers)

They can be varied by :

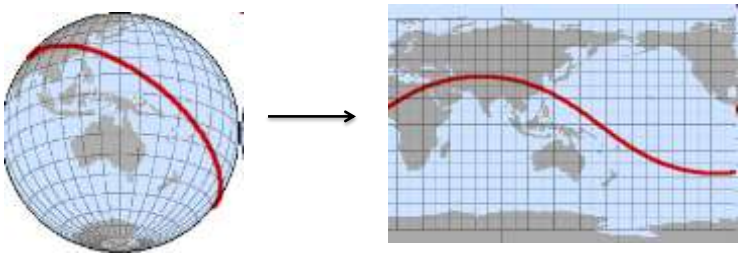
A: angle of the cone B: 1 or 2 standard parallels



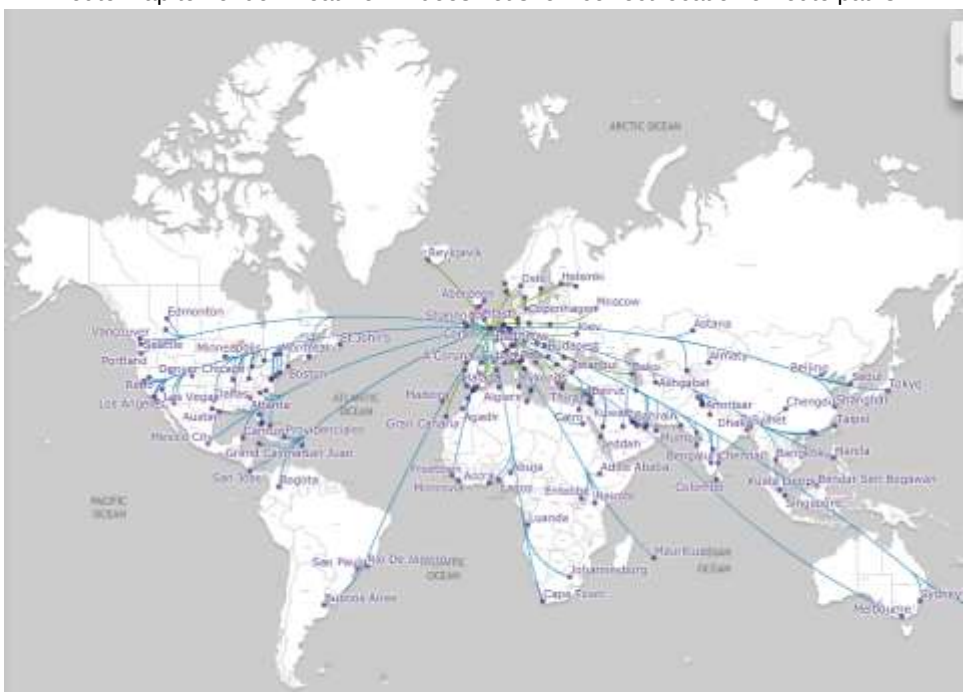
e. Distortion: compared to the graticule:



- Lines of latitude are 'parallel' and evenly spaced.
- Meridians converge at the poles, (half the distance at 60° N/S).
- Scale factor is 1 in all directions.
- 'Great circles' are straight lines e.g. meridians, equator, flight lines



Route map to London Heathrow – does not show correct location of route paths

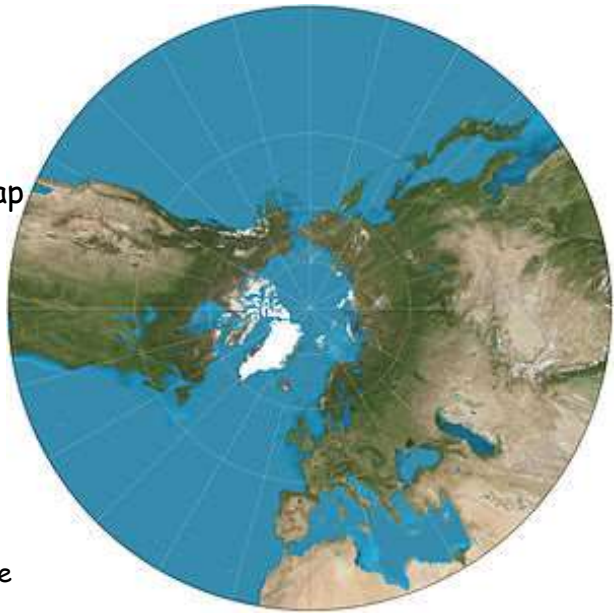


Gnomonic projection

Probably the world's oldest map projection – 6th century BC

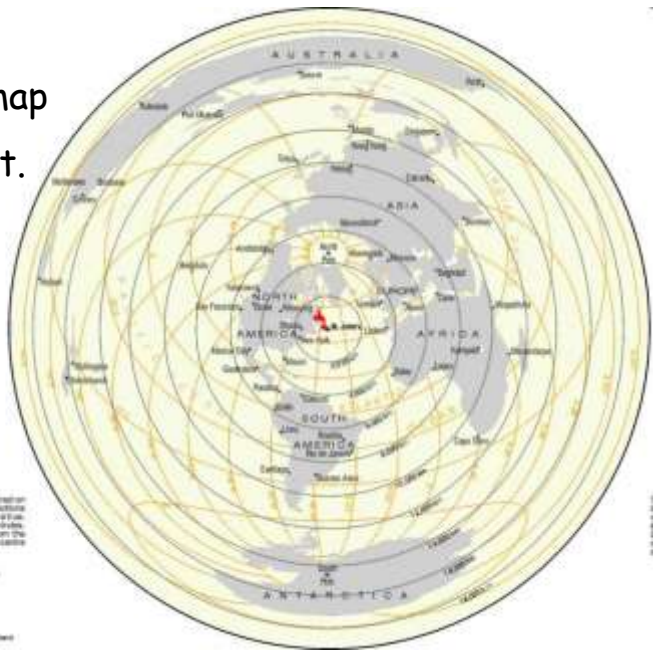
– the only one that shows all great circles as straight lines

(but cannot show one entire hemisphere)

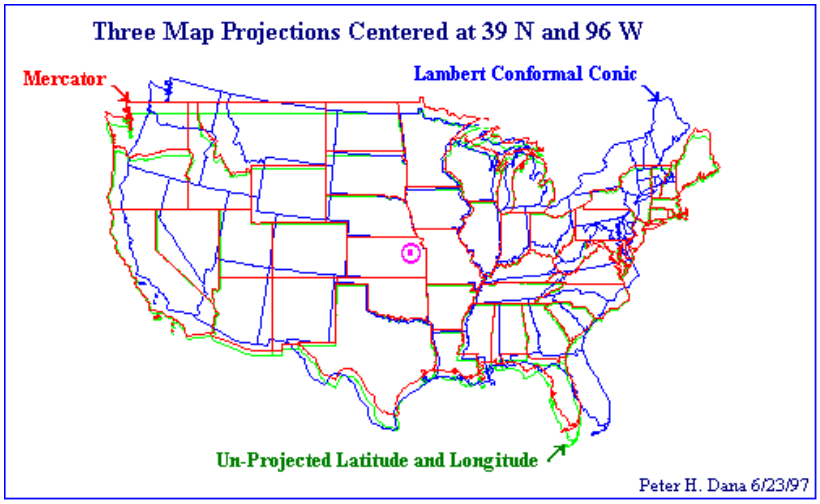


Azimuthal equidistant map

centred on St. John's, NL



In digital mapping, data layers should be in the same projection:



GIS software can overlay / project map layers 'on the fly' but only if they are properly defined

You can also project data from one projection to another

List of map projections supported in ArcGIS:
http://resources.arcgis.com/en/help/main/10.1/index.html#//003r00000017000000