ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ

ανοικτάμαθήματα
opencourses

Thematic Cartography

Session 2: Coordinate systems, map projections and scale

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Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο

ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΕΚΠΑΙΔΕΥΣΗ ΚΑΙ ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗ
επένδυση στην κοινωνία της γνώσης
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ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

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Outline

- Coordinate Systems
- What is a map projection?
- General types of map projections
- Map projections - distortions.
- Types of map projections.
- Scale

Coordinate systems (1)

Coordinate systems are required for locating and indentifying the position of geographic features and locating points relative to one another. Thus they define direction and measure distance.

Common types of coordinate systems used in a geographic information system (GIS):

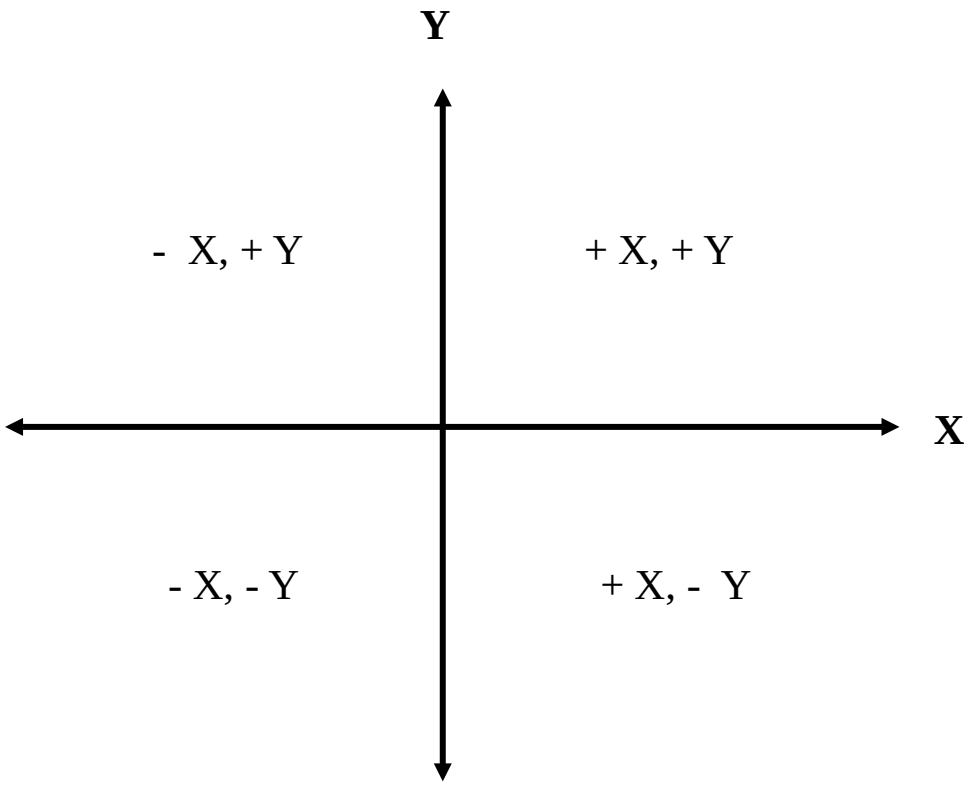
(1) Cartesian coordinates

(2) Geographic coordinates

(3) Projected coordinates

Coordinate systems (2)

Cartesian coordinates (René Descartes 1596-1650)



Cartesian coordinate system

Coordinate systems (3)

Geographic coordinates

Measured in **Latitude** and **Longitude** defined using an ellipsoid, an ellipse rotated about an axis.

Longitude and latitude are **angles** measured from the earth's centre to a point on the earth's surface.

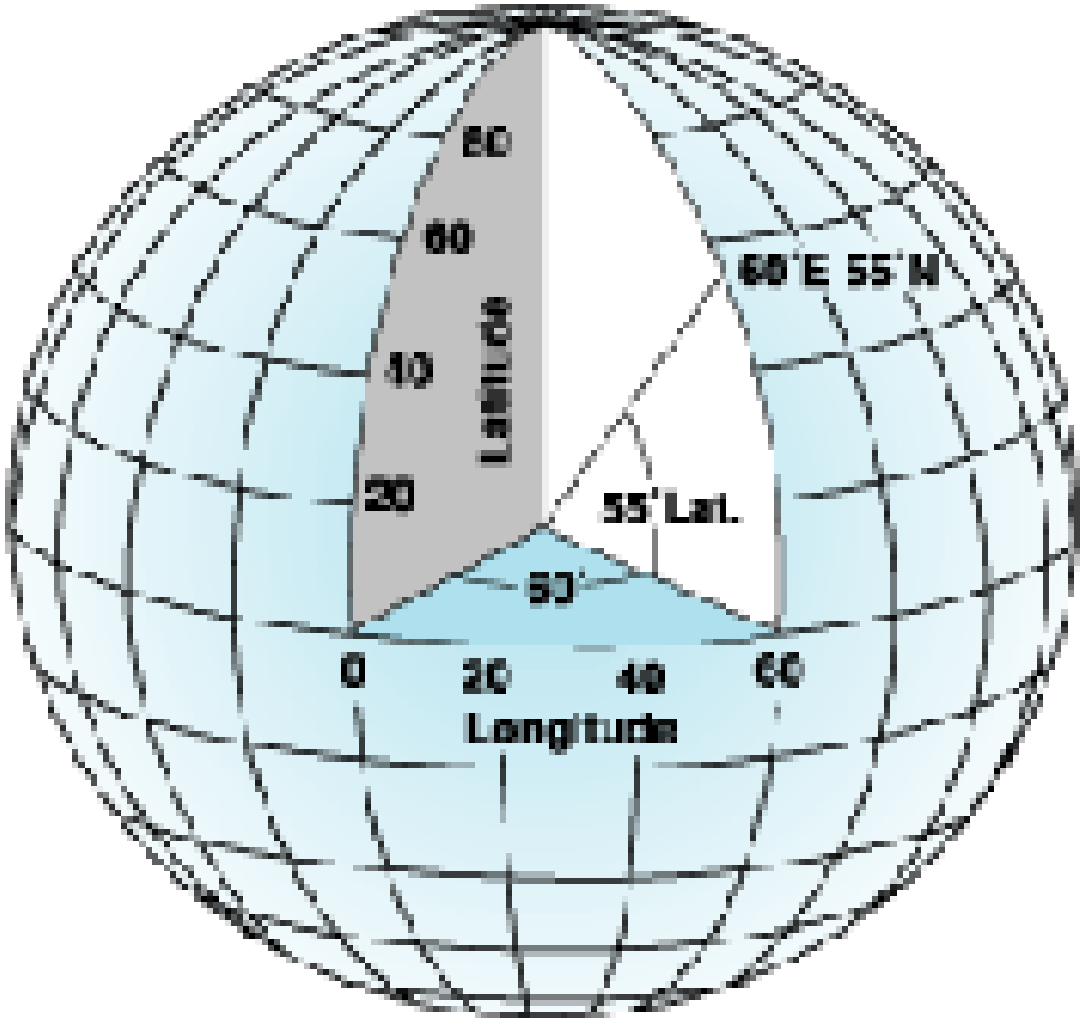
Longitude is measured East and West, while Latitude is measured North and South.

Longitude lines are called **meridians** while latitudes lines are called **parallels**.

Components of a Geographic Coordinate System are:

A datum, an angular Unit of Measure (degrees) and a prime meridian.

Coordinate systems (4)



Source: http://resources.esri.com/help/9.3/arcgisengine/dotnet/89b720a5-7339-44b0-8b58-0f5bf2843393.htm#WhatCoordSys

Map projections (1)

"Map projection is the transformation of the spherical surface to a plane surface; it occurs at the last step in the series of alterations from the earth to the flat map. Any map projection is the systematic arrangement of the earth's (or generating globe's) meridians and parallels onto a plane surface.“.

Borden Dent (1996, p. 36)

Transforming three-dimensional space into a two-dimensional map. Namely, transforming the curved earth’s surface to a flat map.

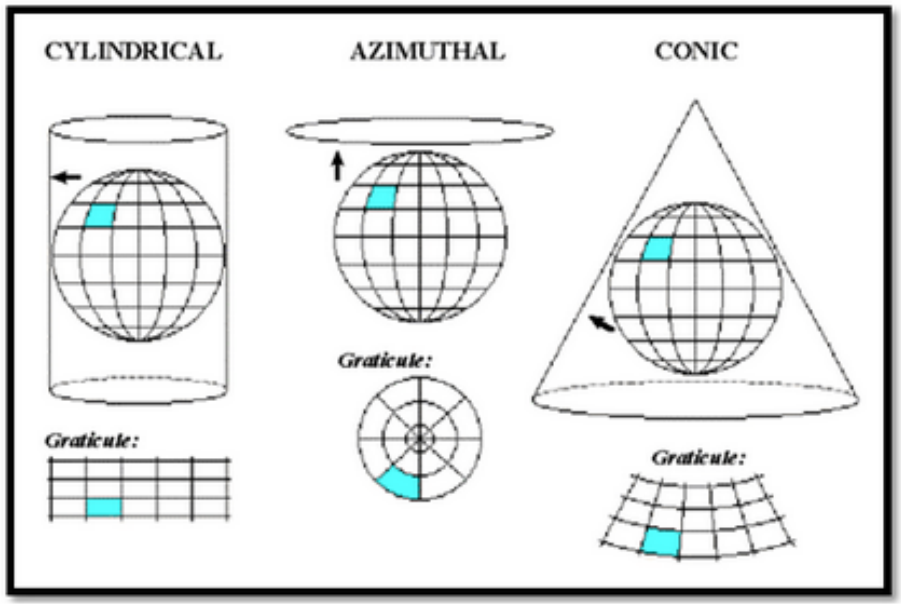
Turning earths globe into a map - projection

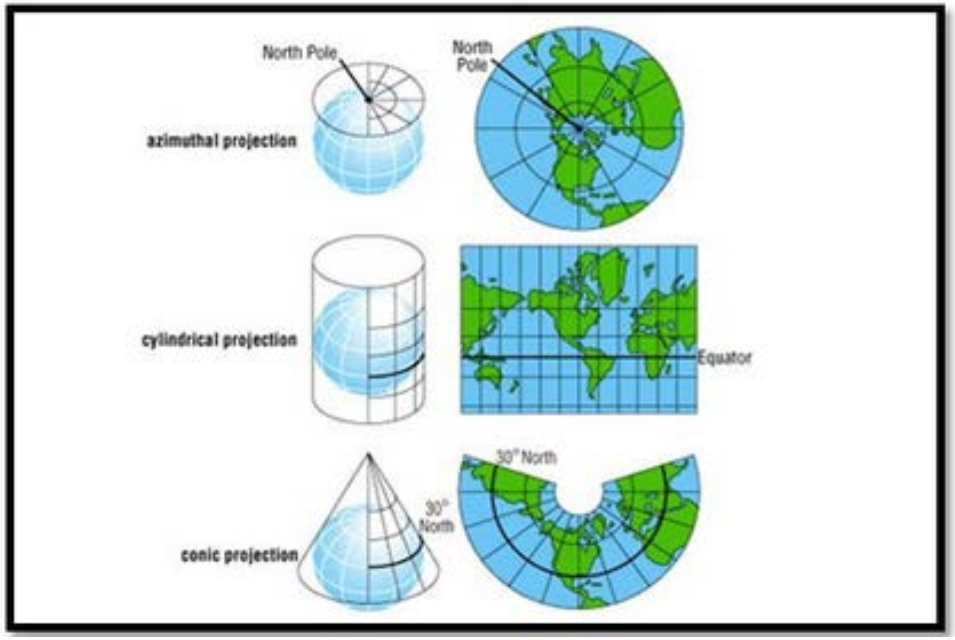
General types of map projections (1)

The general types of map projections would include: cylindrical,

conical, and

azimuthal projections.





Source: http://gisedu.colostate.edu/WebContent/nr505/2012_Projects/Team6/GISConcepts.html

Map projections - distortions (1)

Map projections *always* introduce a certain degree of error and distortion.

So the problem is that map projections distorts surface's properties such as:

- area,
- shape,
- distance,
- direction.

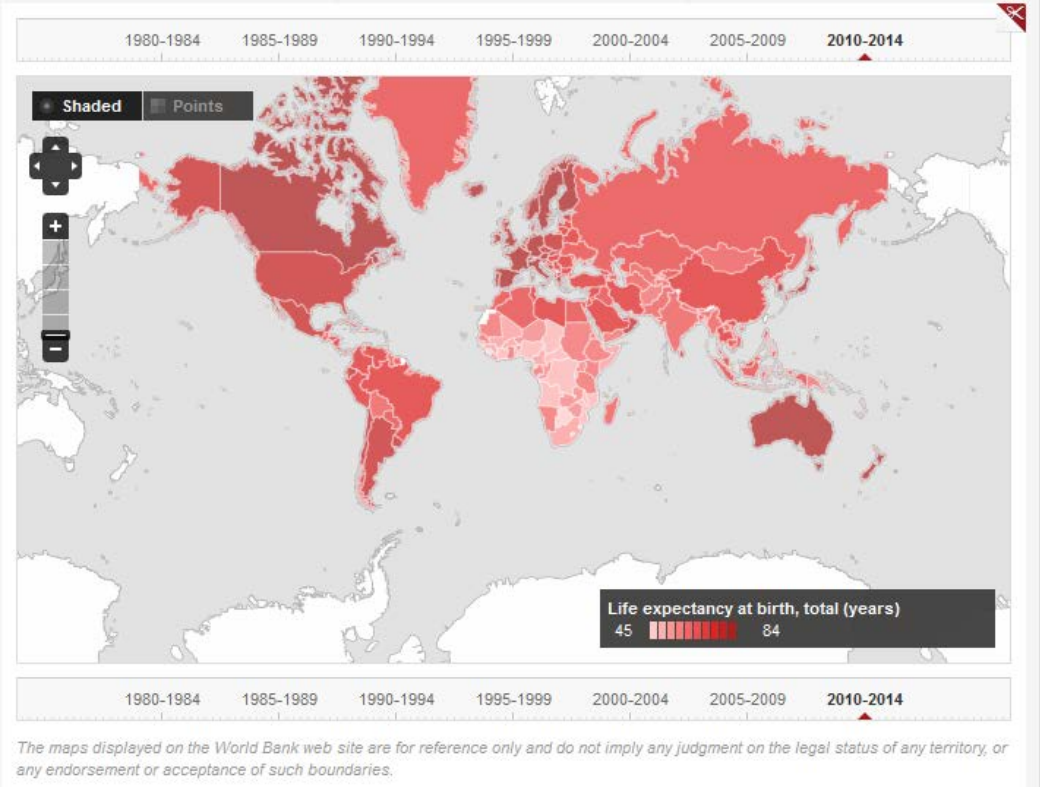
Map projections – distortions (2)

Area: Features' relative area to each other is not represented correctly (see example below). Map projections in which areas are identical to the areas on the curved reference surface, namely areas are represented correctly on the map are called equal-area (equivalent) projections.

Area of:

- Greenland: 2,166,086 km^2

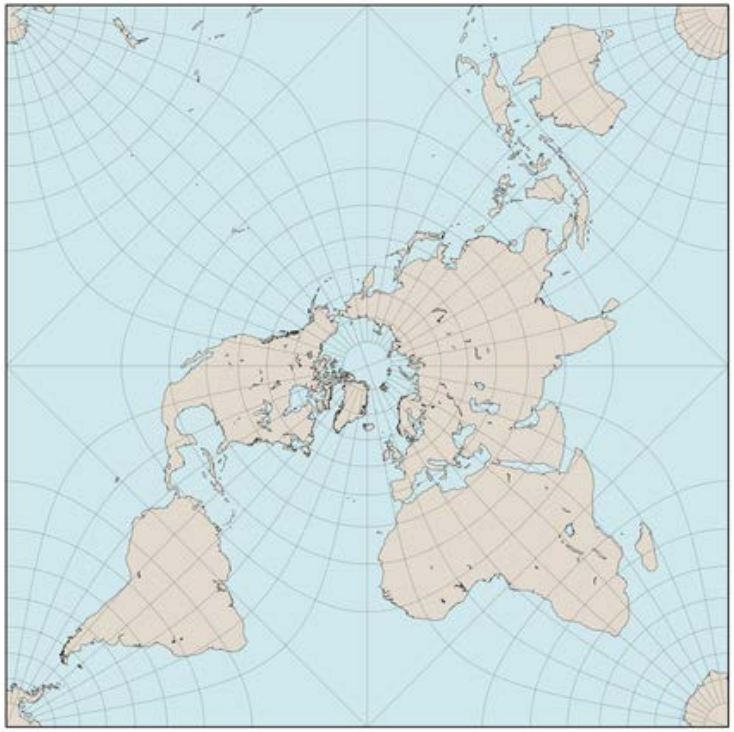
- Latin America:
19,197,000 km^2



Source: http://data.worldbank.org/indicator/SP.DYN.LE00.IN?display=map

Map projections – distortions (2)

Shape: the shape of a feature can be distorted. Conformality or fidelity of shape, when adopted to a map projection, produces conformal maps that preserve the size of local angles in the representation. Smaller areas retain their correct shapes, while the general shapes of larger areas are distorted.

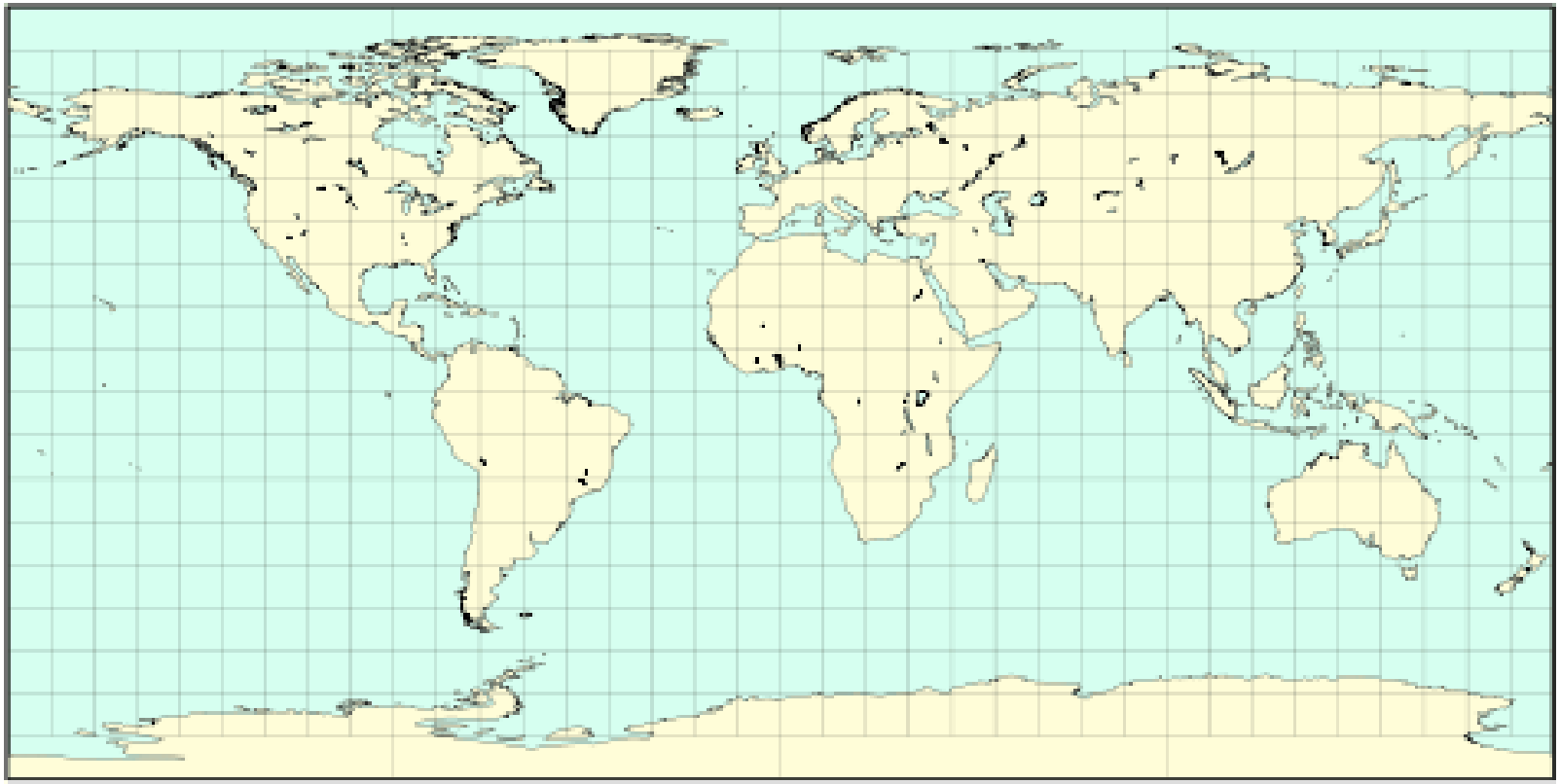


Peirce's Quincuncial conformal map in a square

Source: http://www.progonos.com/furuti/MapProj/Normal/ProjConf/projConf.html

Map projections – distortions (3)

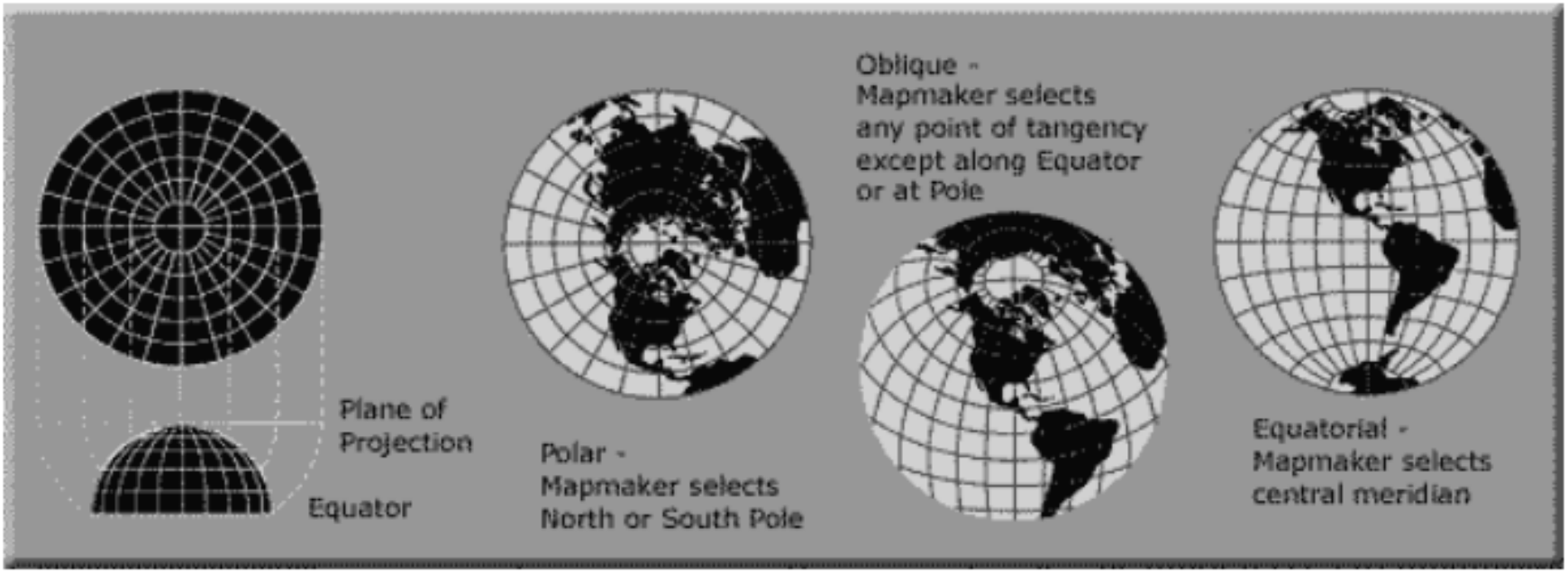
Distance: Can be distorted, namely measures of distance do not reflect reality (extreme lack of accuracy). Equidistant maps represent accurate distance from some standard point/line to all other points/lines of the map.



Source: http://www.progonos.com/furuti/MapProj/Normal/ProjCyl/projCyl.html#Rectangular

Map projections – distortions (4)

Direction: In order to avoid incorrect representations of directions, certain map projections ensure that all directions from a central point/line are accurate.

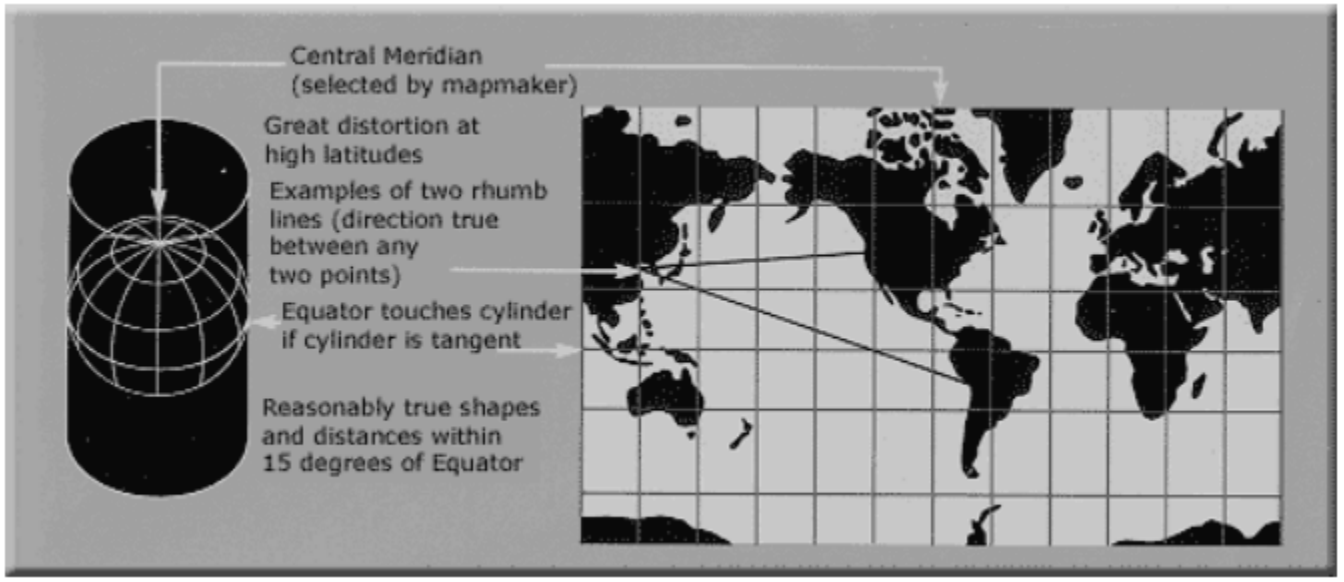


Source: http://egsc.usgs.gov/isb//pubs/MapProjections/projections.html , **© USGS**

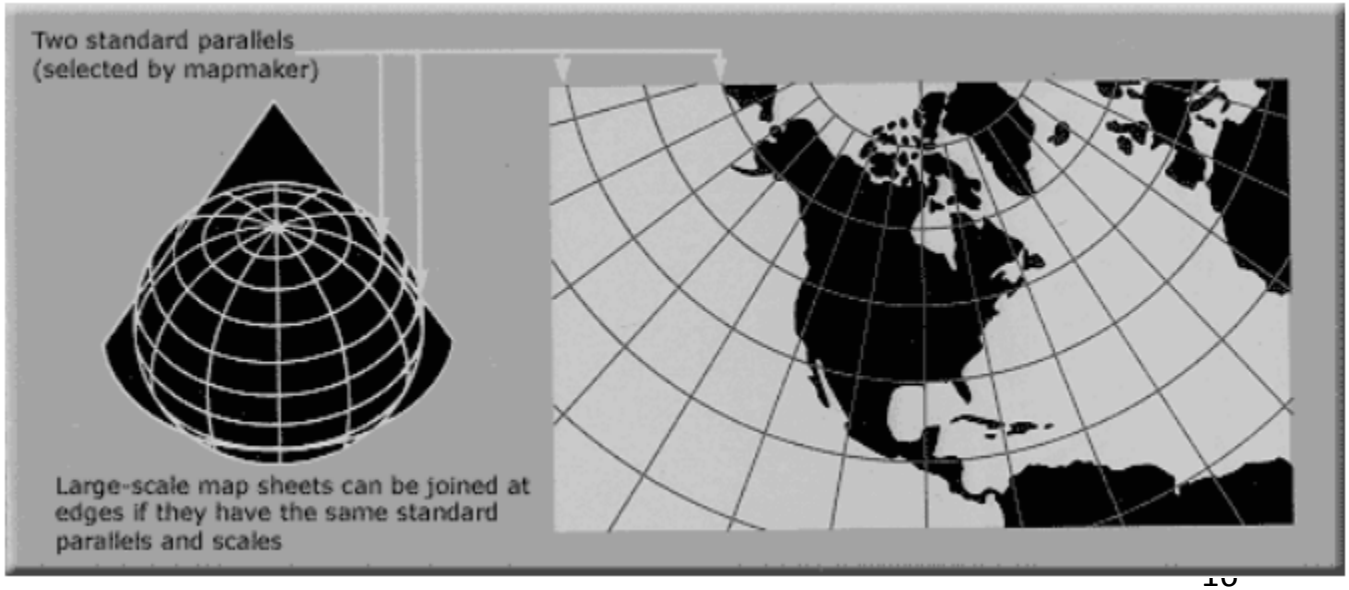
Map projections – distortions (5)

Examples:

Mercator



Lambert Conformal Conic

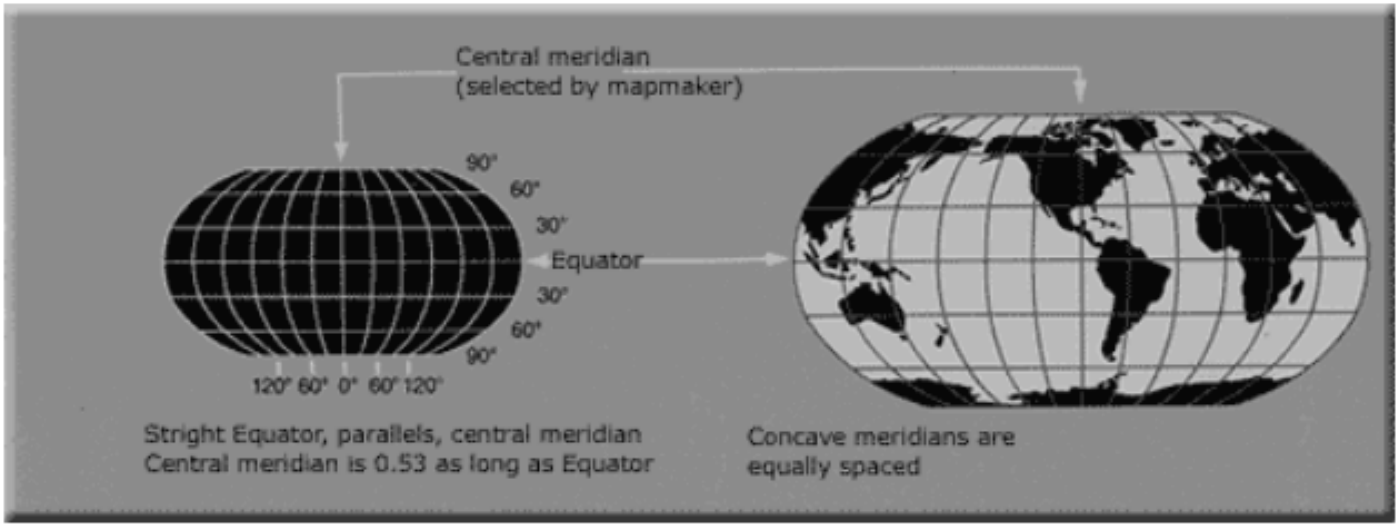


Source: http://egsc.usgs.gov/isb//pubs/MapProjections/projections.html , © USGS

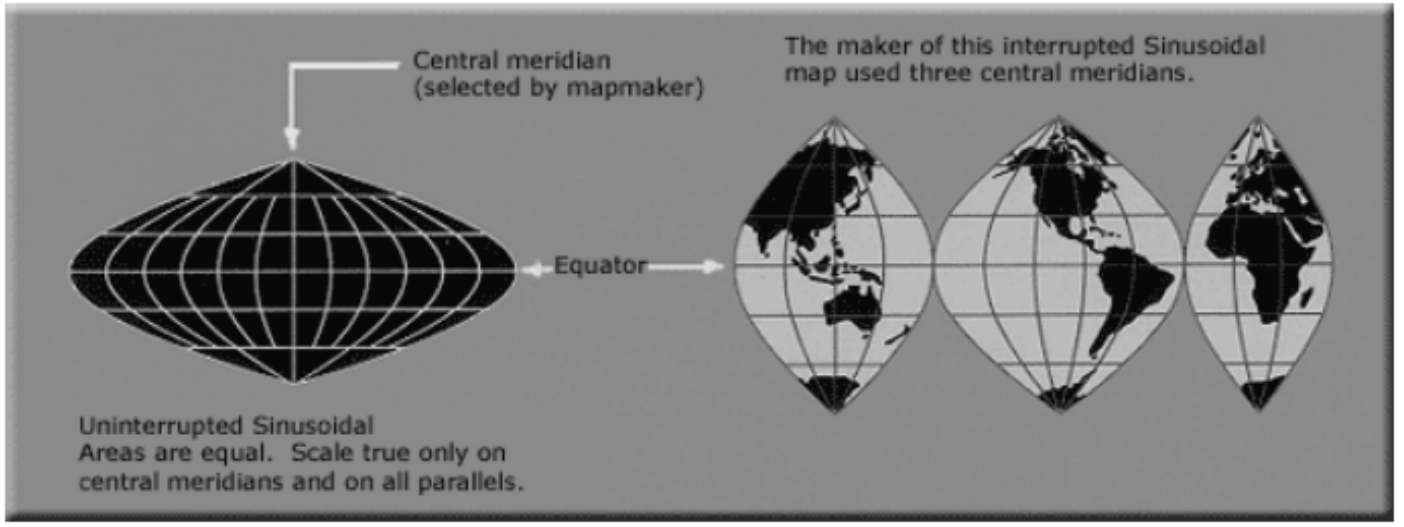
Map projections – distortions (6)

Examples:

Robinson



Sinusoidal Equal Area



Source: http://egsc.usgs.gov/isb//pubs/MapProjections/projections.html , © USGS

Types of map projections (1)

So far we have identified the following types of map projections depending on what spatial attributes are to preserved:

Conformal - local shapes are preserved.

Equal Area - preserves area. Many thematic maps use an equal area projection.

Equidistant - preserves distance from one or more selected point(s).

Azimuthal – directions from a single location to all other locations are preserved.

Compromise - preserves a balance between aforementioned distortions.

Scale (1)

Scale determines the size and shape of features represented to a map.

Scale represents the ratio of distance and area on Earth to the distance and area on a map.

Example: one cm on map equals 10 km

Representations:

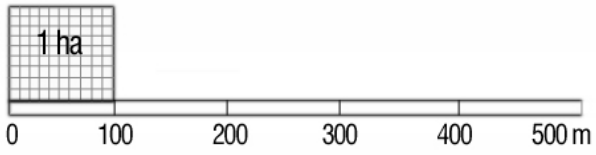
proportional fraction (1/100.000)

ratio (1:100.000)

bar scale

verbal statement (see above)

Graphic (mix)



Scale – Opposite concepts (2)

A **large-scale** map shows a **small** area

A **small-scale** map shows a **larger** area

example

1:20.000 is a LARGER scale than 1:100.000

Large-scale maps show a **small** area with a **large** amount of details and **less** generalization

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End of Session