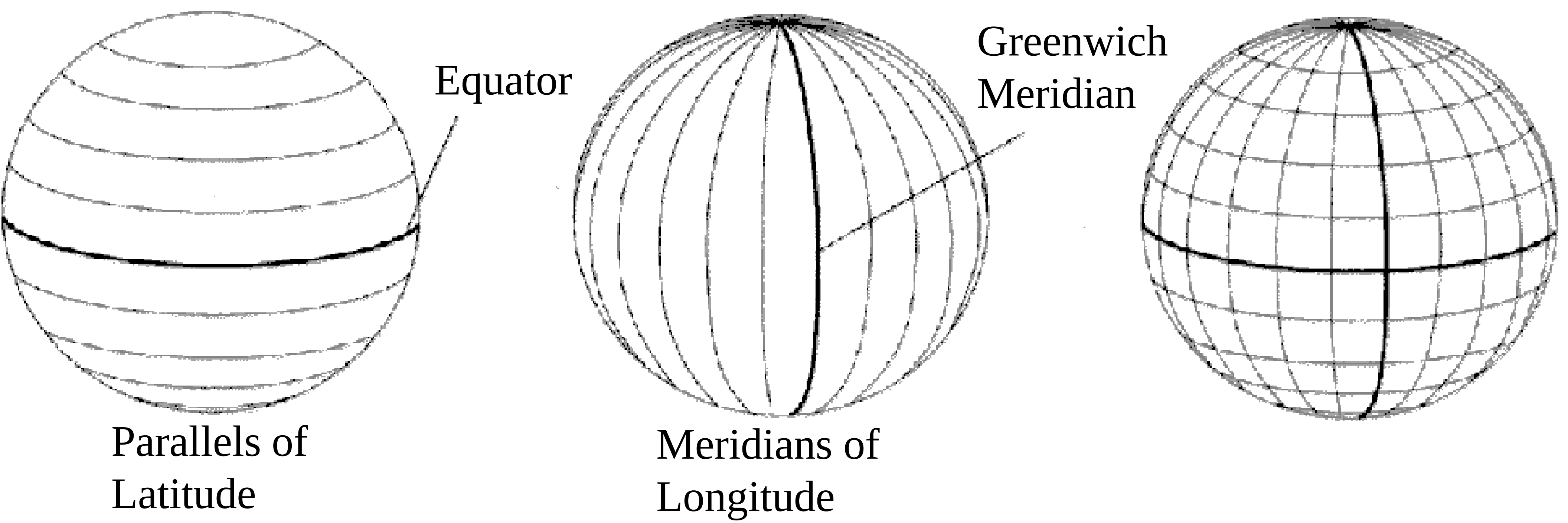
Referencing map features:

Coordinate systems and map projections

Coordinate systems and map projections

- if we want to integrate geographic data from many different sources, we need to use a consistent spatial referencing system for all data sets

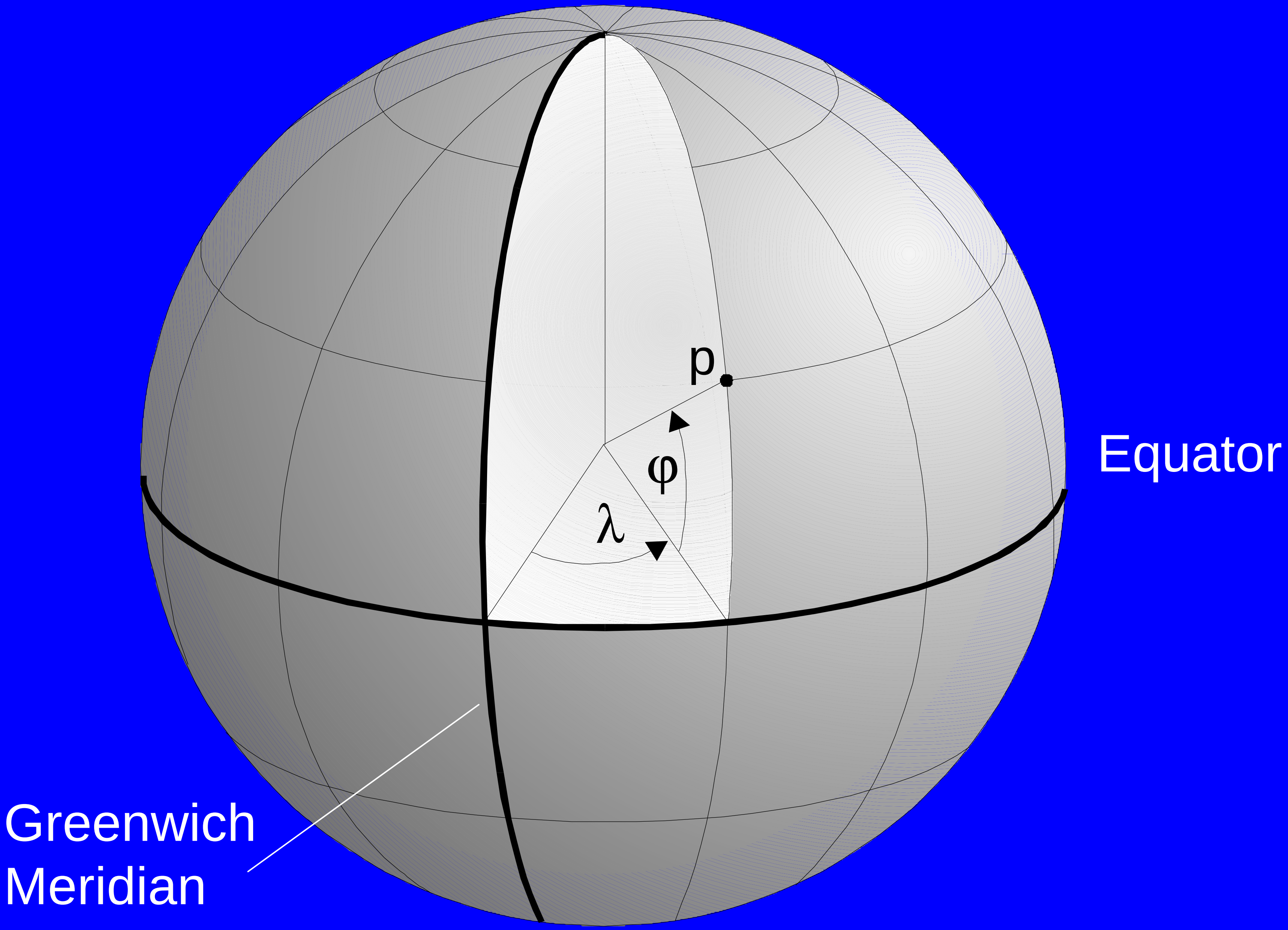
Referencing location on the earth's surface



Referencing location on the earth’s surface

- latitude φ : angle from the equator to the parallel
- longitude λ : angle from Greenwich meridian

Referencing location on the earth's surface



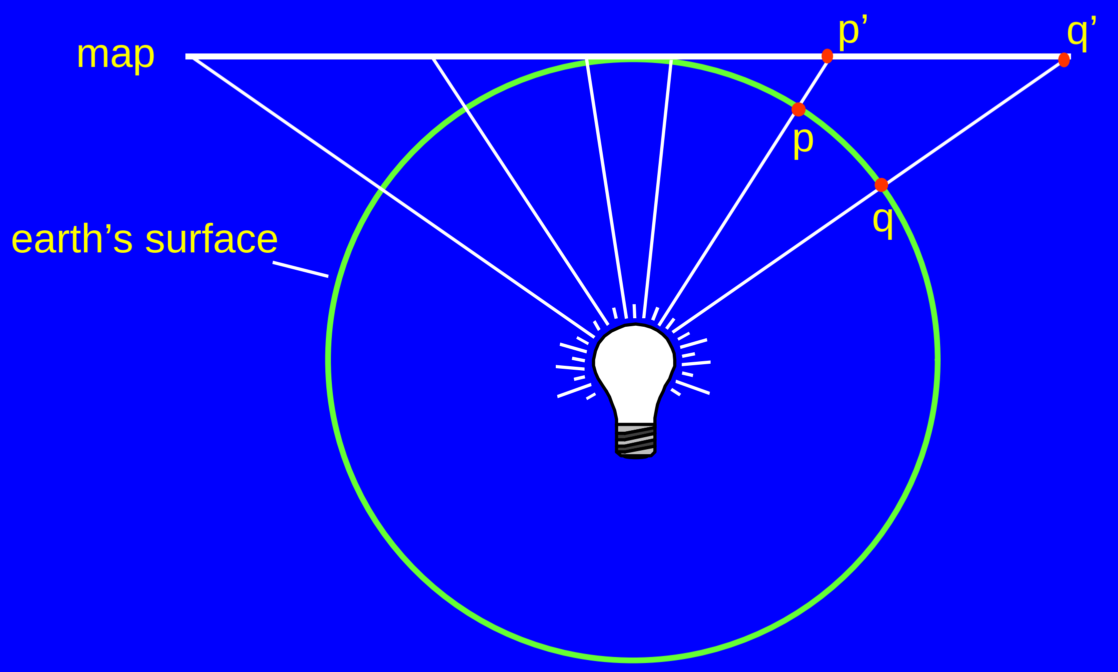
Map Projections

Map Projections

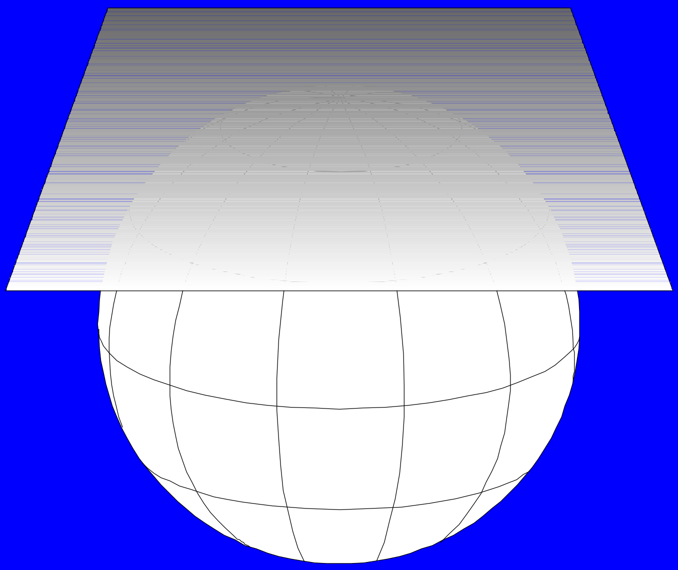
- Curved surface of the earth needs to be “flattened” to be presented on a map
- projection is the method by which the curved surface is converted into a flat representation

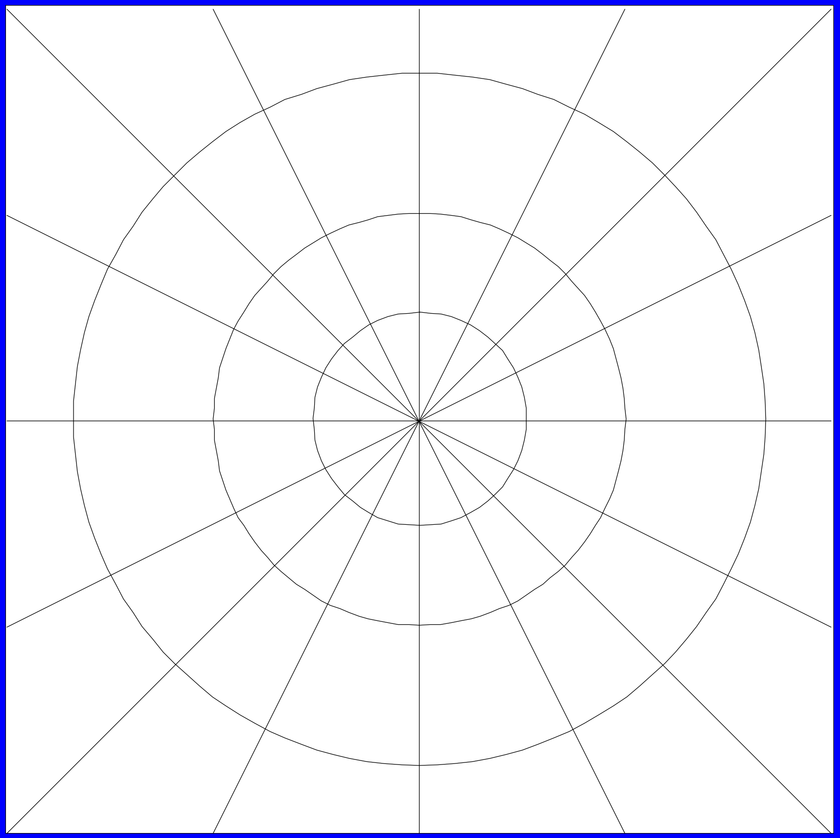
Map Projections

- we can literally think of a projection as a light source located inside the globe which projects the features on the earth’s surface onto the flat map
- point p on the globe becomes point p’ on the map

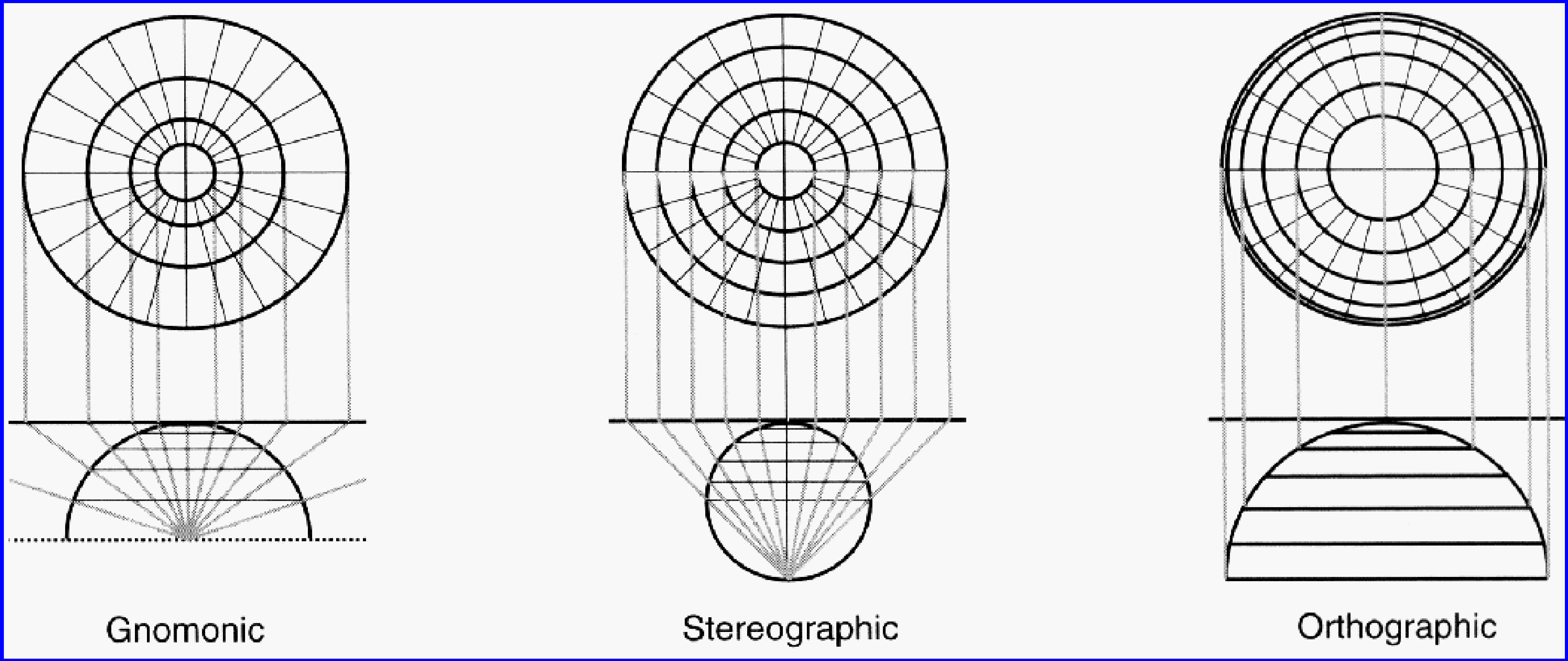


Azimuthal Projections

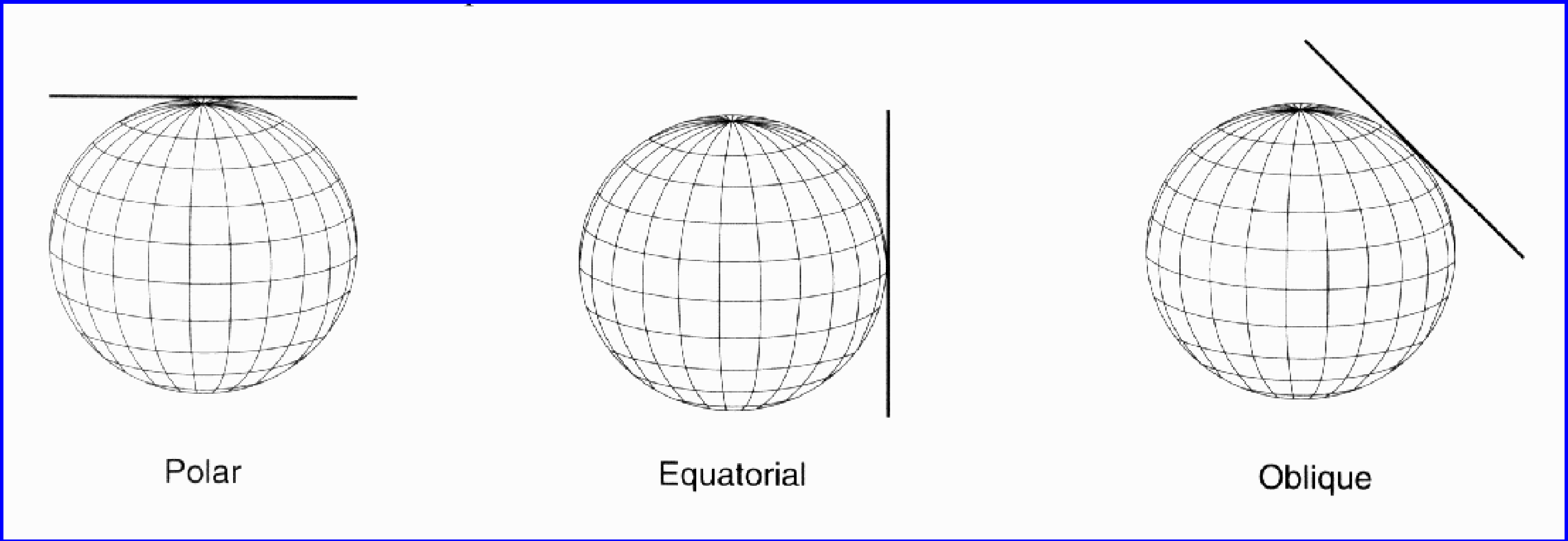




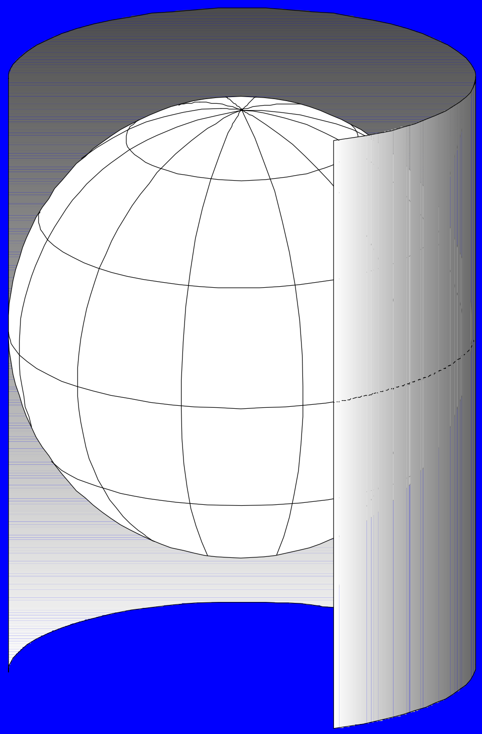
Azimuthal Projections

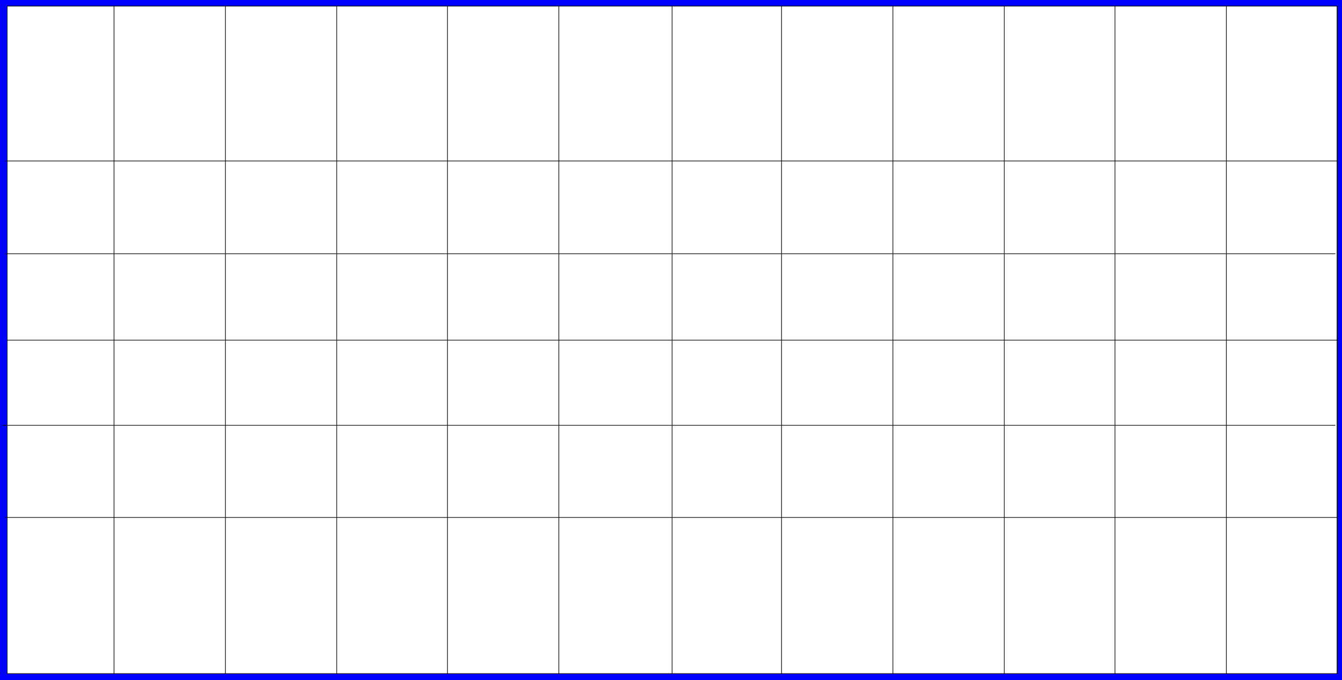


Azimuthal Projections
Aspect

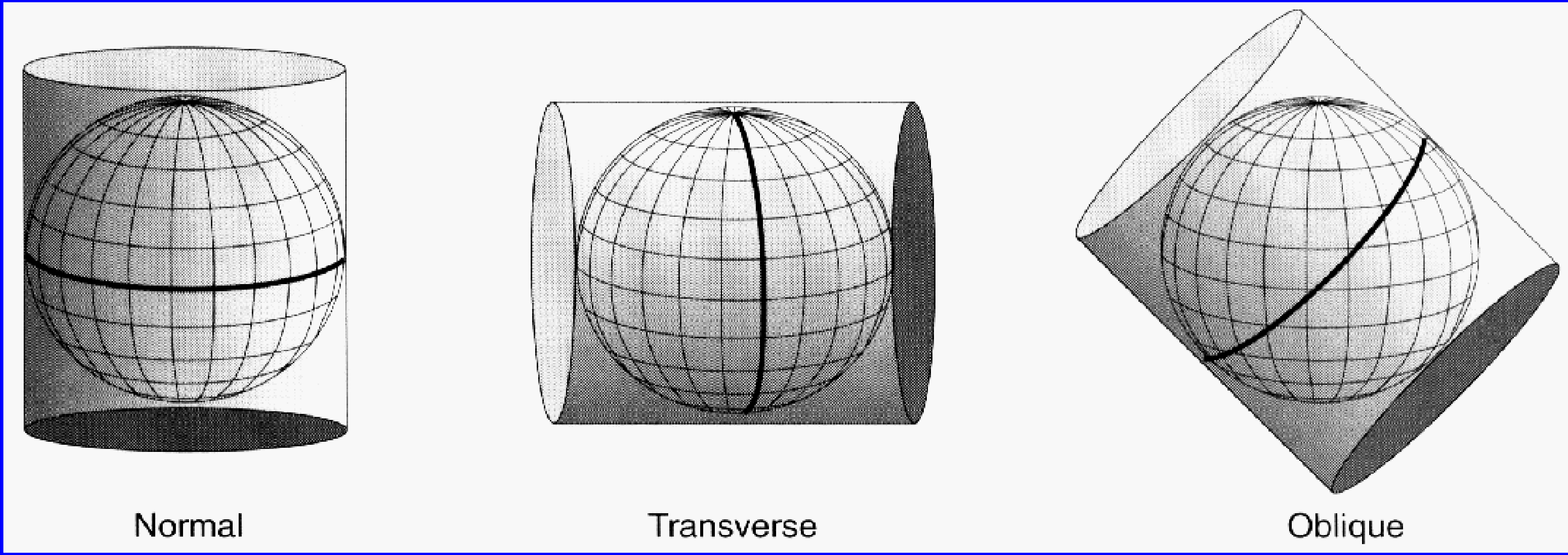


Cylindrical Projections

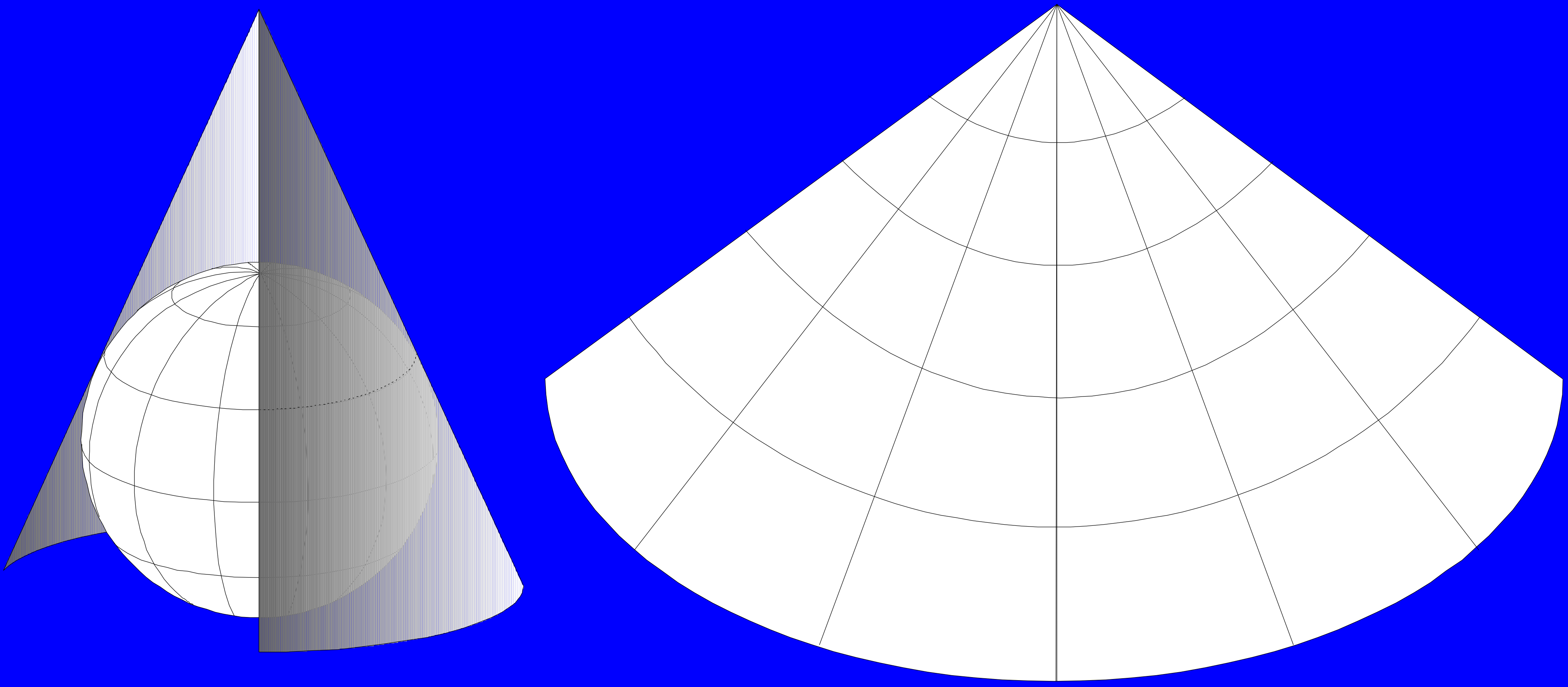




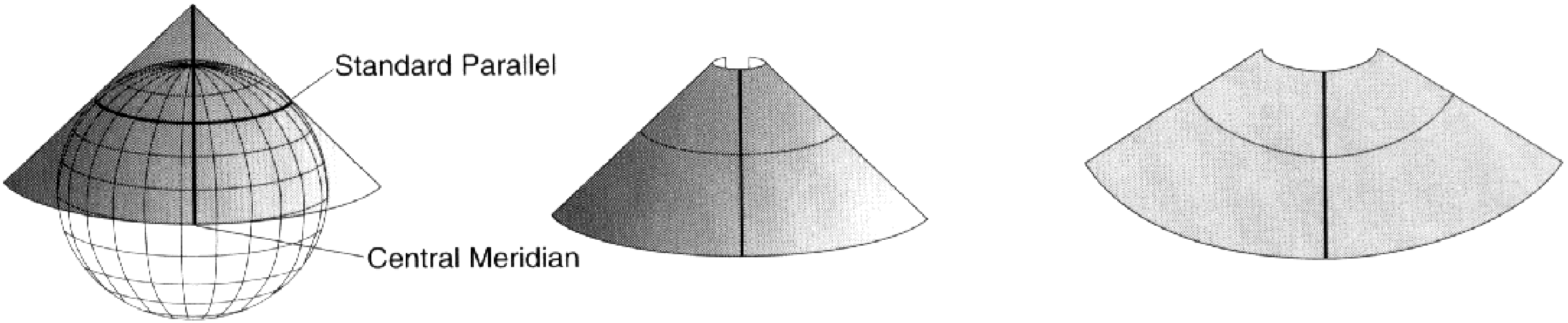
Cylindrical Projections



Conic Projections



Conic Projections



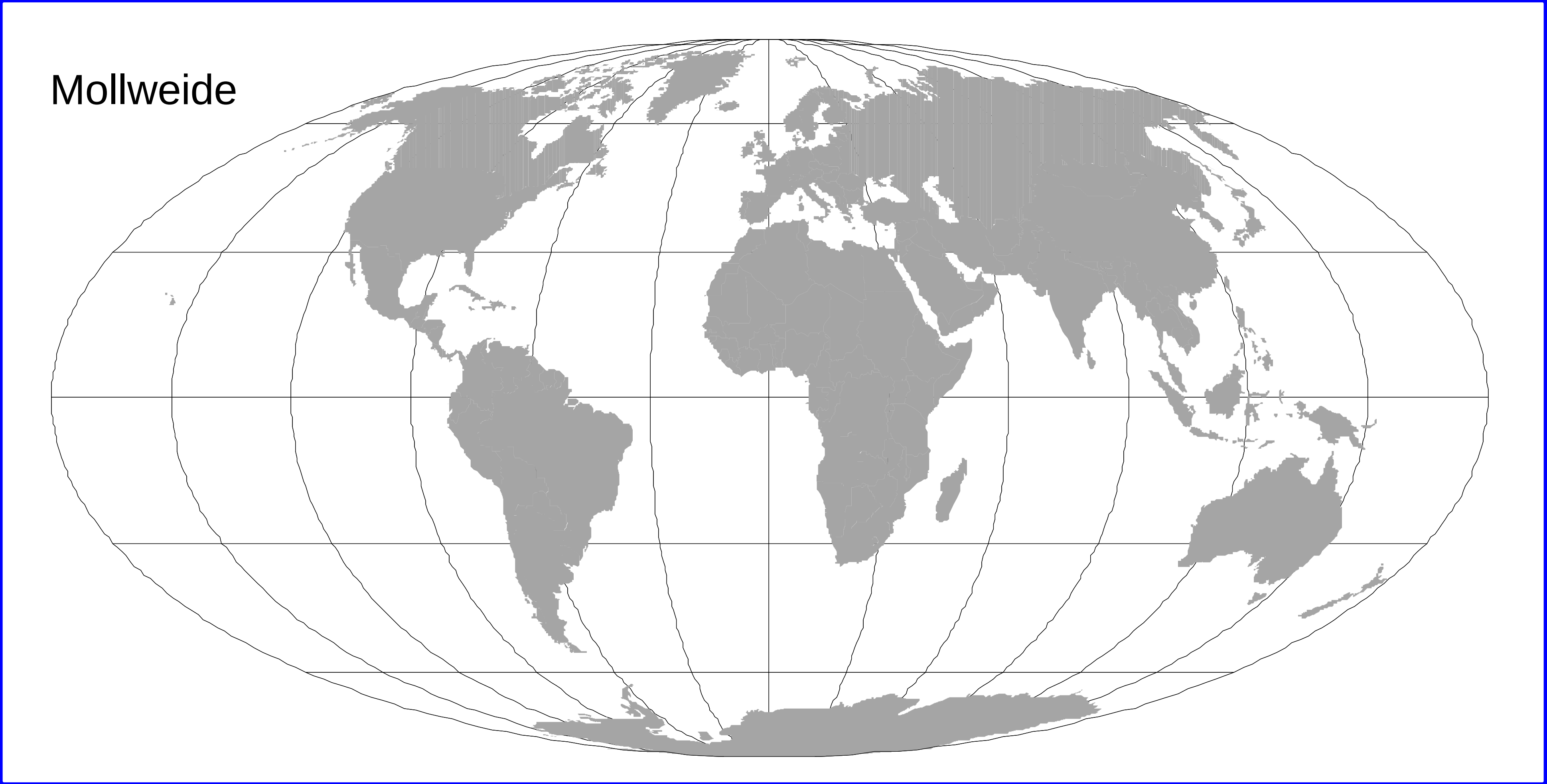
Distortion in Map Projections

- some distortion is inevitable
- less distortion if maps show only small areas, but large if the entire earth is shown
- projections are classified according to which properties they preserve: area, shape, angles, distance

Equal area projections

- area on the map is proportional to the true area on the earth’s surface
- required when area measures are made
- popular in GIS

Equal area projections



Conformal projections

- preserve the shape of small features
- show angles (bearings) correctly
- useful in navigation

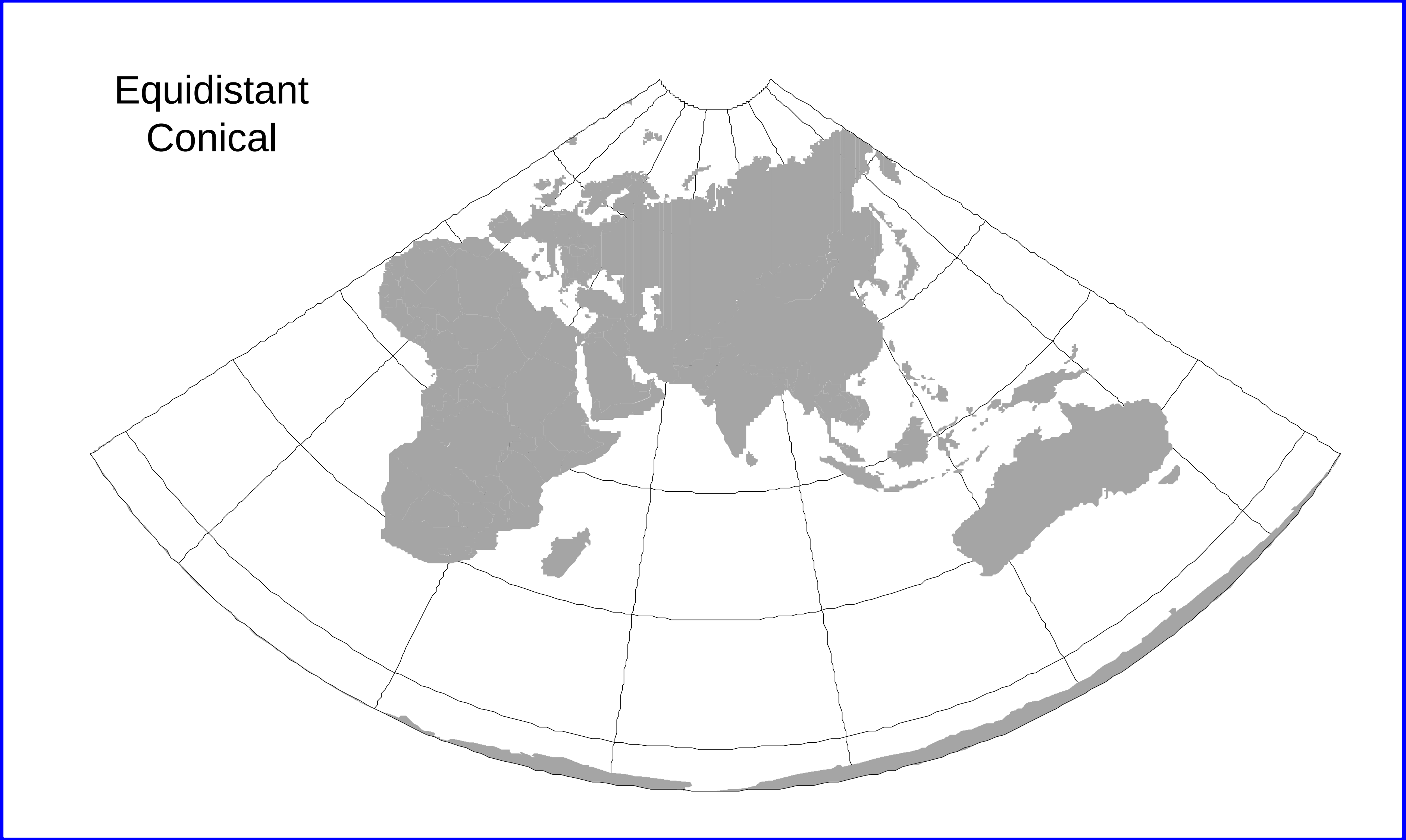
Equidistant projections

- represent the distances to other locations from either one or two points correctly
- no map represents all distances correctly!

Equidistant projections

- on large scale maps (e.g., local topo maps for a small region), the error is usually small
- on small scale GIS maps (e.g., entire country) it is better to compute distances using an exact formula

Equidistant projections

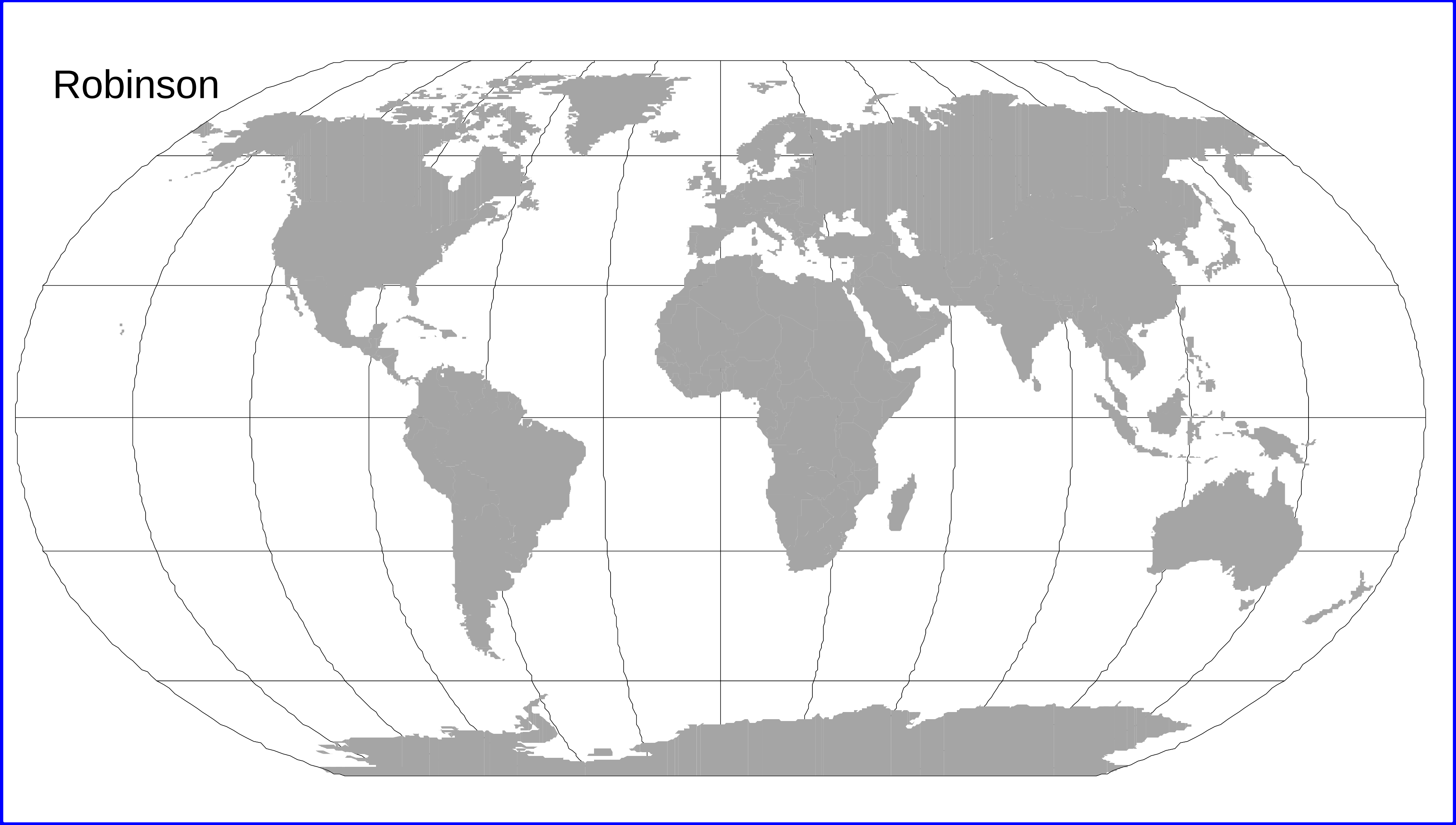


Compromise projections

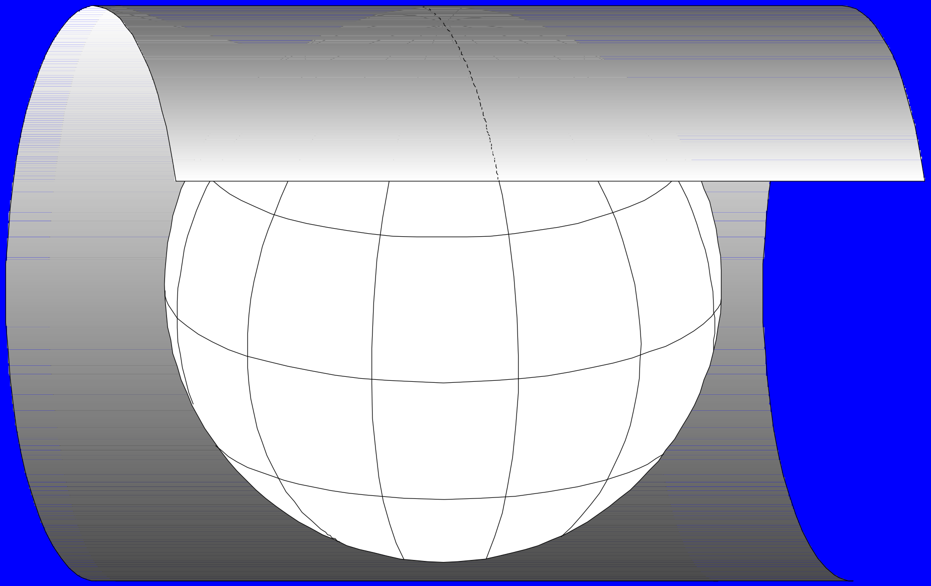
- do not preserve any property, but represent a good compromise between the different objectives

  e.g., Robinson's projection for the World

Compromise projections



UTM



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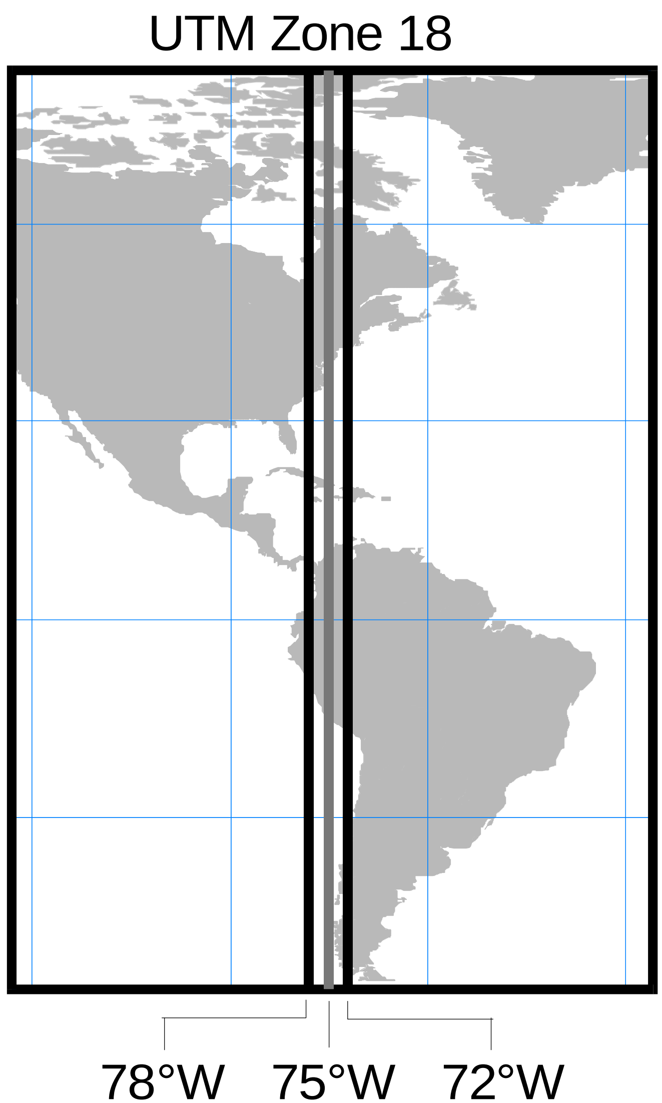
  cylindrical projection
  with a central meridian that is
  specific to a standard UTM zone
- there are 60 zones around the world

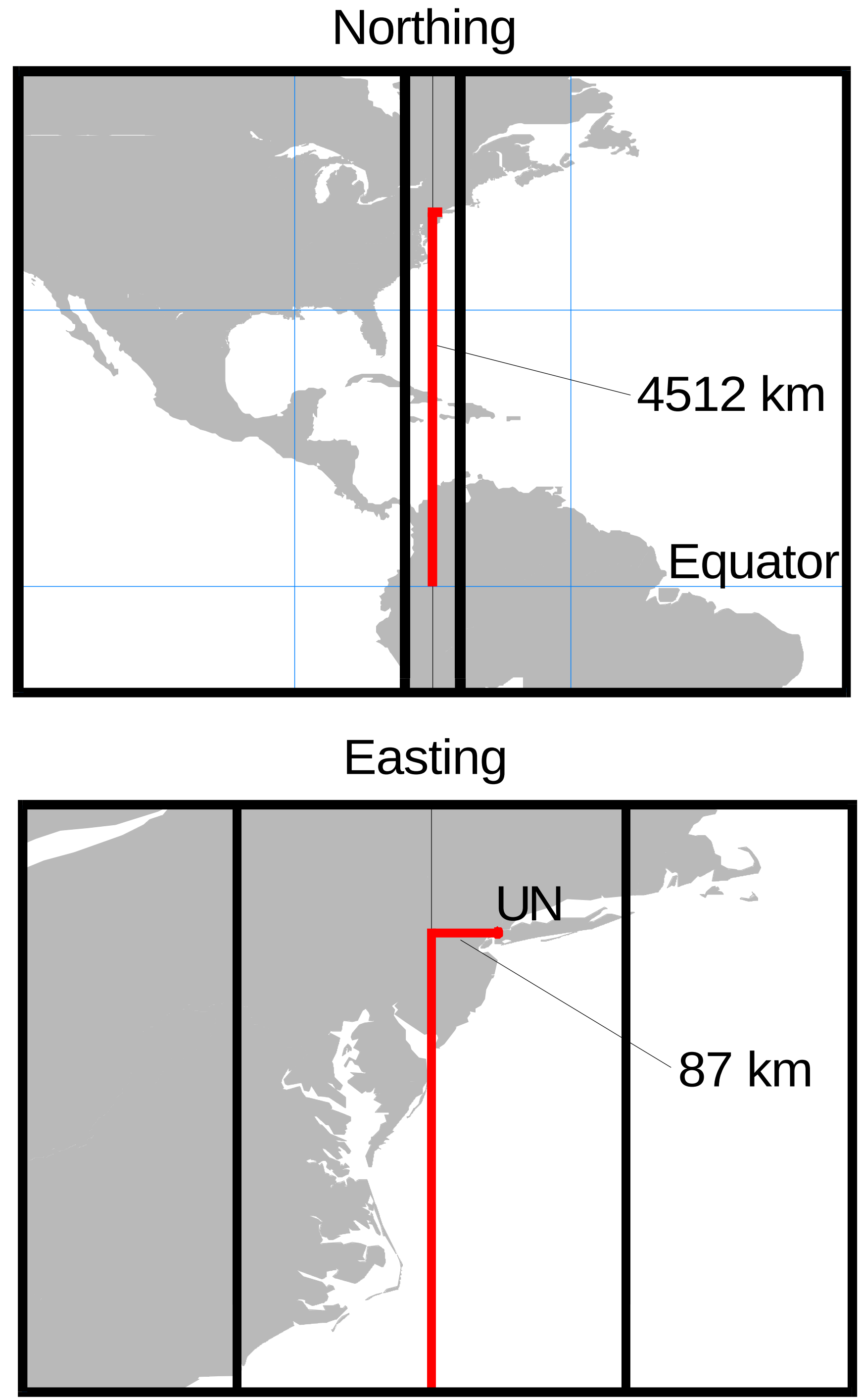
UTM

- minimal distortions of area, angles distance and shape at large and medium scales
- very popular for large and medium scale mapping (e.g., topographic maps)

UTM

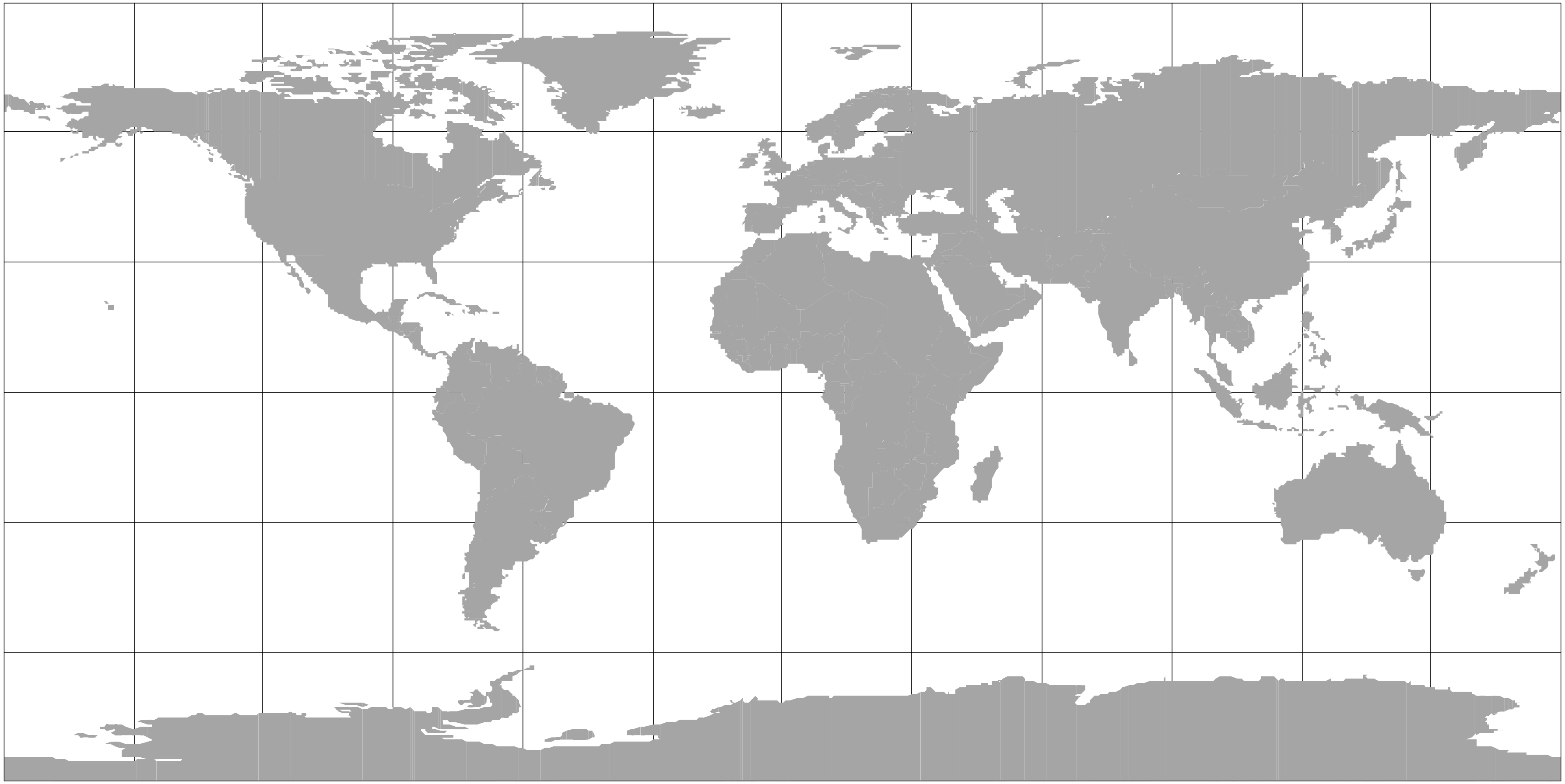
- coordinates are usually measured in meters from the central meridian (x) and the equator (y)
- 500,000 is added to the easting (x) to avoid negative numbers. For the same reason, 10,000,000 is added to the northing (y), but only for coordinates in the Southern hemisphere





United Nations Headquarters
40°45’01” N and 73°58’04” W
UTM coordinate in meters:
587,139.0 and 4,511,549.7

Lat/Long can also be represented in planar form (but is not technically a projection)



Parameters required for projecting a map

- latitude of origin
- central longitude (meridian)
- spheroid/datum
- false easting/northing (., an offset to avoid negative numbers)
- map units
- always record all information included on a map sheet!

The concept of scale

- scale is the ratio between distances on a map and the corresponding distances on the earth’s surface
- e.g., a scale of 1:50,000 means that 1cm on the map corresponds to 50,000cm or 0.5km in the real world

The concept of scale

- scale is essentially a ratio or representative fraction
- small scale
  1:10,000,000
  shows only large features
- large scale
  1:25,000
  shows great detail for a small area

The concept of scale

- small scale versus large scale often confused
- e.g., large scale models in climatology operate on large areas
- best to say “cartographic scale” or “geographic scale”

The concept of scale

- scale shows not only how features are shown but also what features are shown
- e.g., large scale map of 1:25,000 may show individual houses
  smaller scale map of 1:500,000 shows only points representing villages
- importance of generalization