36-315: Statistical Graphics and Visualization

Handout 17
Date: March 17, 2003

Maps

A map must be drawn to scale, otherwise it is a *cartogram*.

Latitude is north-south position. The equator has latitude 0, the U.S. has latitude 40, a.k.a. $40°N$. Circles of equal latitude are called *parallels*.

Longitude is east-west position. The Prime Meridian has longitude 0, the U.S. has longitude -100, a.k.a. $100°W$. Lines of equal longitude are called *meridians*.

Projection is necessary to represent the 3D globe with a 2D map. The sphere is projected onto a surface which can be unrolled. A projection always distorts some property of the original globe, but we can choose the projection to preserve what we care about, and distort what we don't.

- *Cylindrical* projection: project the sphere onto a surrounding cylinder, then cut and unroll the cylinder.
- *Conic* projection: project the sphere onto a surrounding cone, then cut and unroll the cone.
- *Planar* or *azimuthal* projection: project the sphere directly onto an oriented plane.

Cylinders and cones are attached to the sphere at one or two *standard lines*. The projective distortion is minimum at these lines. A *tangent* surface has one standard line, a *secant* surface has two. Planes are attached at only point.

A line in a projection is *true* if its length is the same as on the globe of corresponding scale to the map. Only some lines can be true. Standard lines are always true.

The R names of projections and what they preserve:

Preserves	Cylindrical	Conic	Planar
	`rectangular`	`conic`	`orthographic`
Area	`cylequalarea`	`albers`	`azequalarea`
Area	`sinusoidal`	`bonne`	
Angle	`mercator`	`lambert`	`stereographic`
Distance			`azequidistant`

List of figures:

1. Map projection and unrolling (fig 2.3 in Monmonier)
2. Various projections of the globe (12)

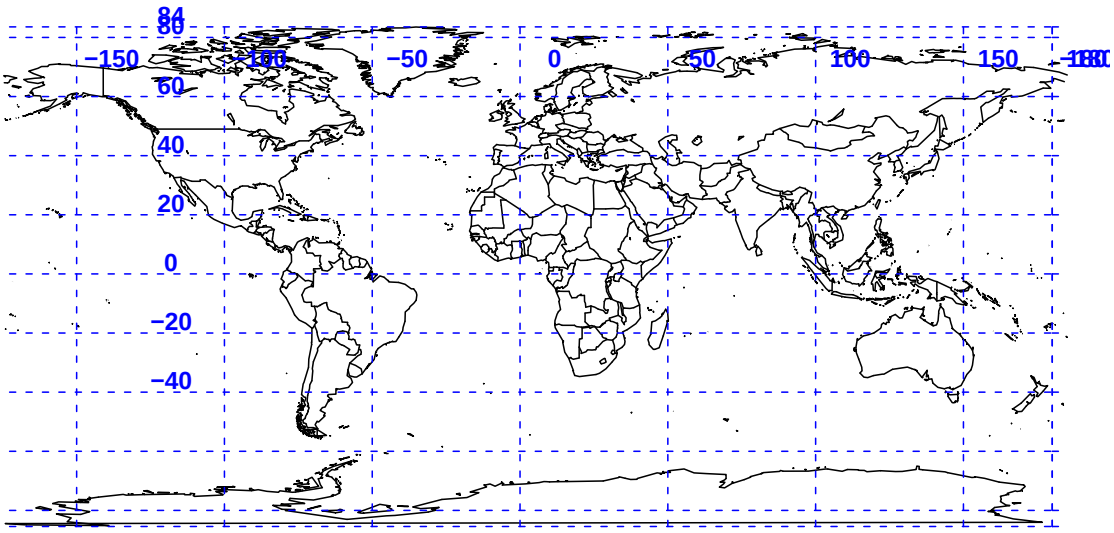
References

[1] Mark Monmonier. *How to lie with maps.* University of Chicago Press, second edition, 1996.

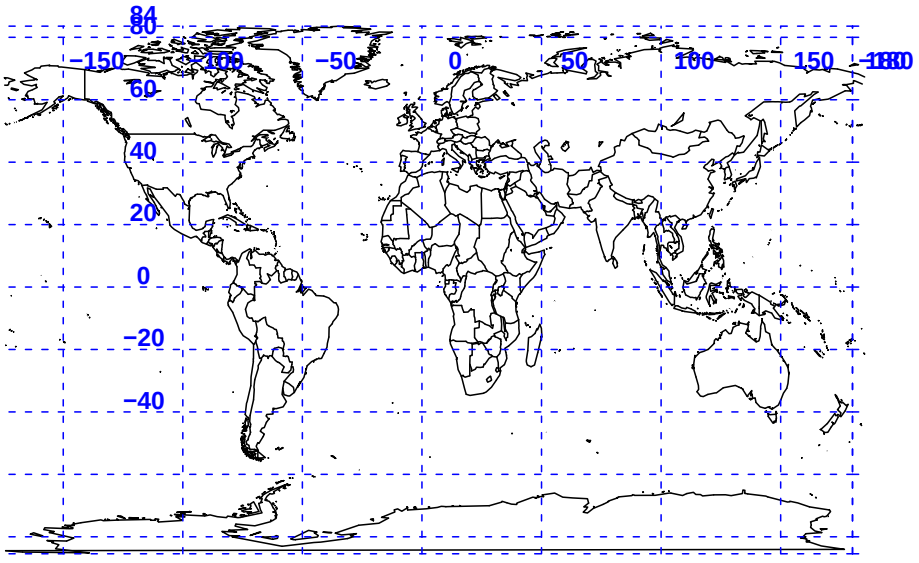
[2] Peter H. Dana. *Map Projections Overview.* The Geographer's Craft Project, Department of Geography, The University of Colorado at Boulder.
`http://www.colorado.edu/geography/gcraft/notes/mapproj/mapproj_f.html`

Orthogonal projection:

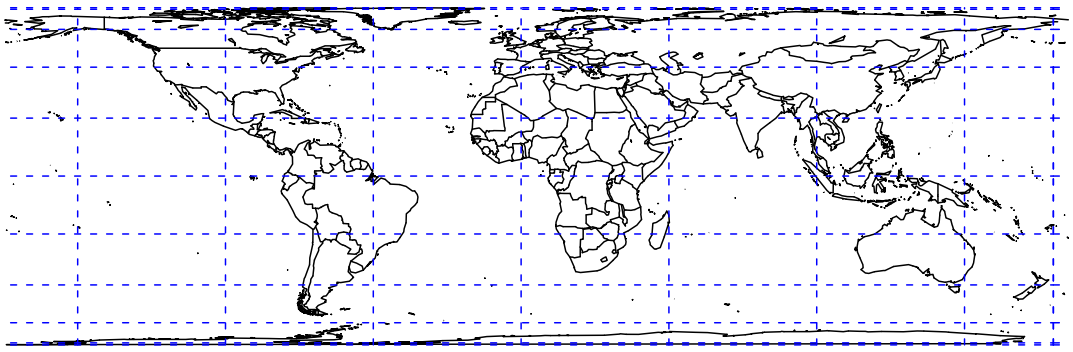
Rectangular:



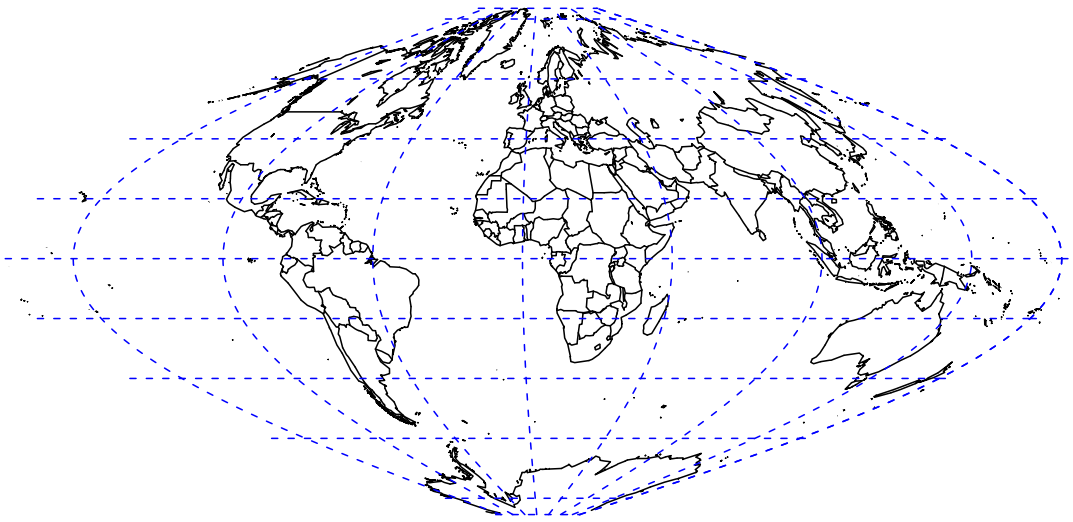
Rectangular secant at 40° N and S:



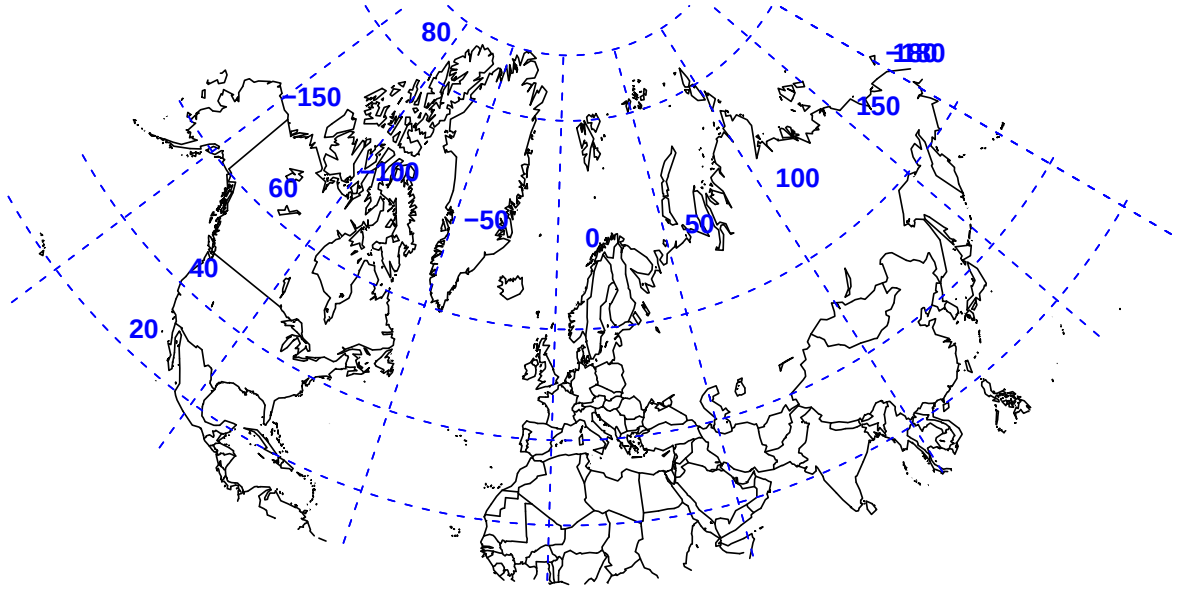
Cylindrical equal-area (`cylequalarea`):



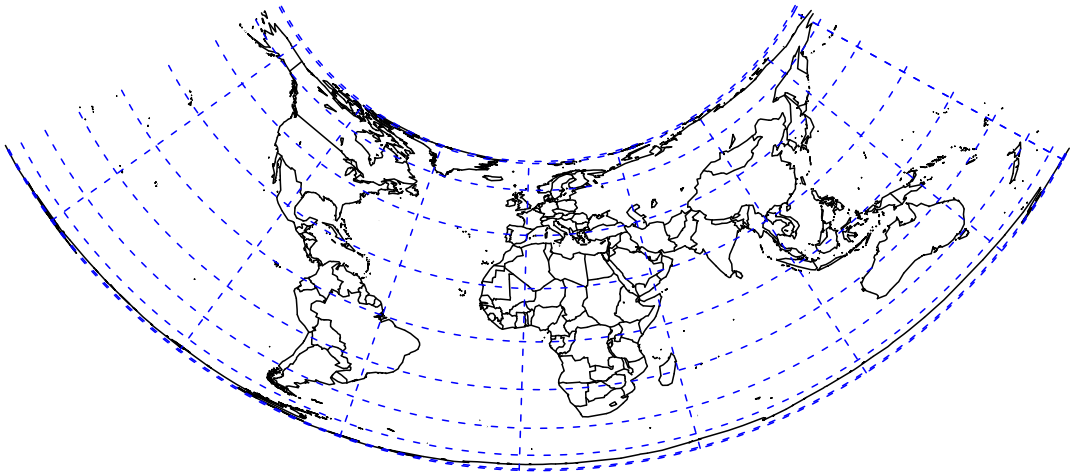
Another cylindrical equal-area (sinusoidal):



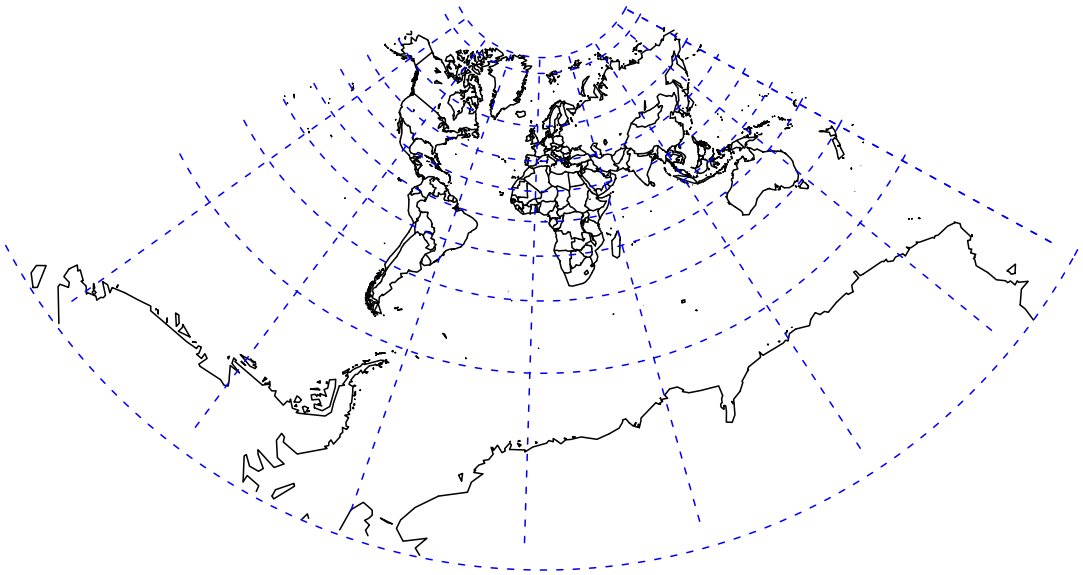
Conic tangent at 20° N:



Conic equal-area (Albers):

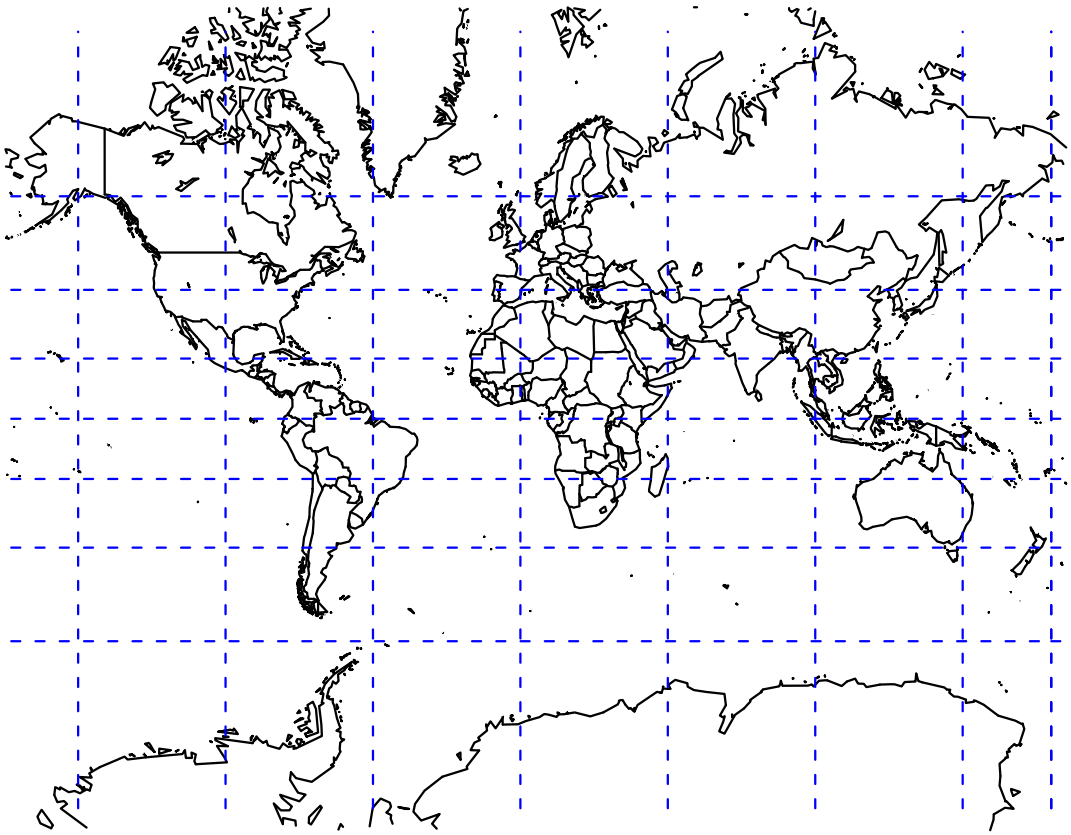


Conic equal-angle (Lambert):

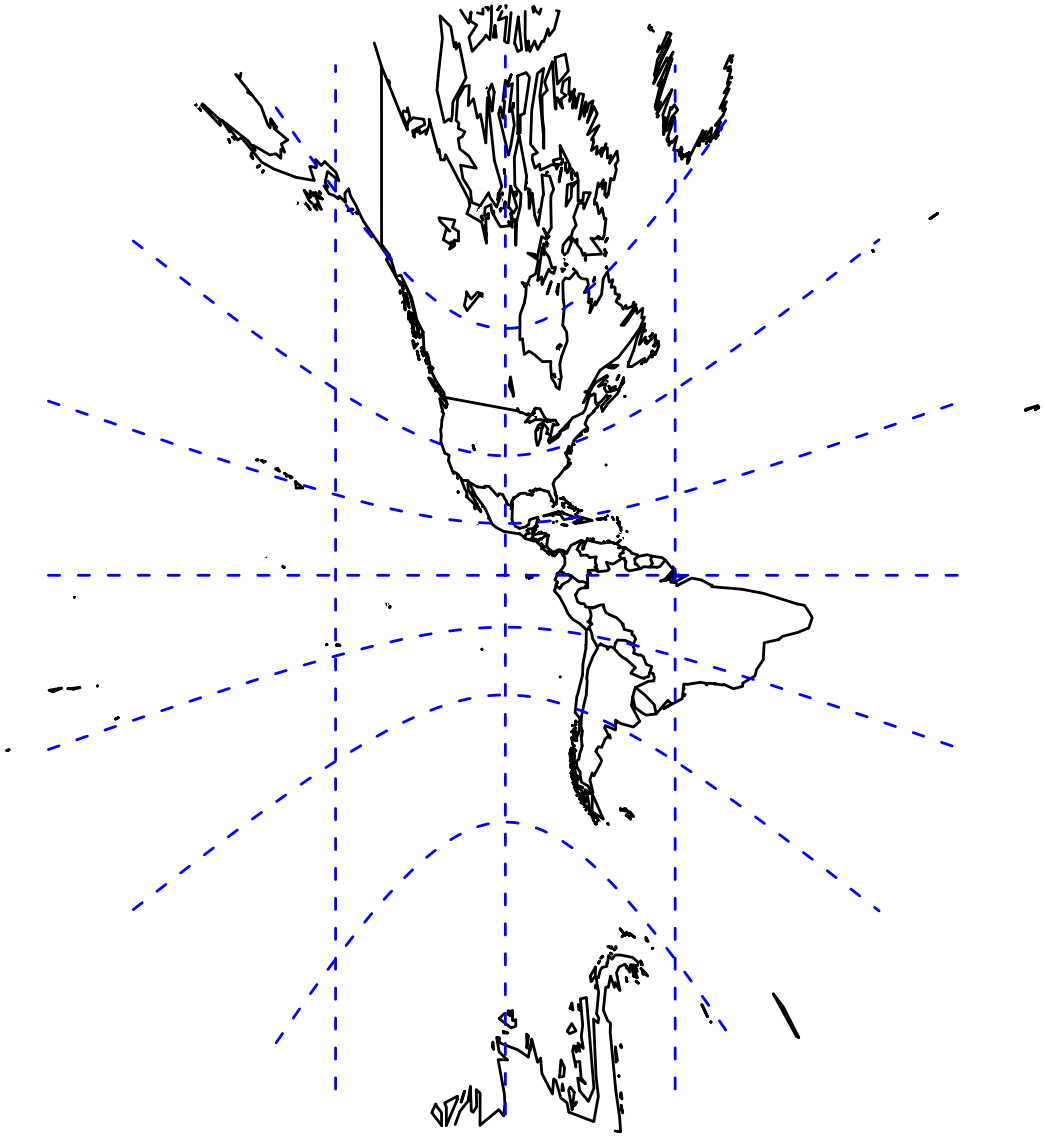


Direction-preserving navigation charts

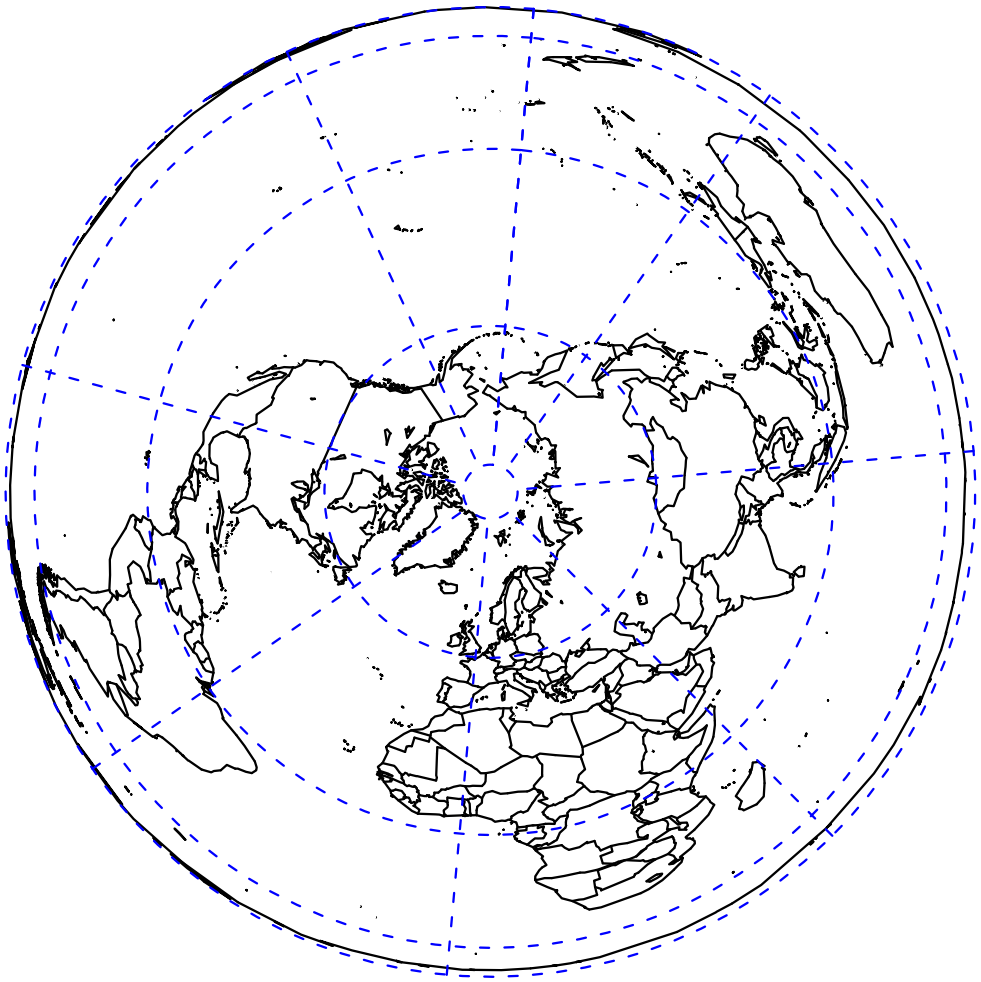
Mercator:



Gnomonic:



Planar equal-area:



Planar equidistant: