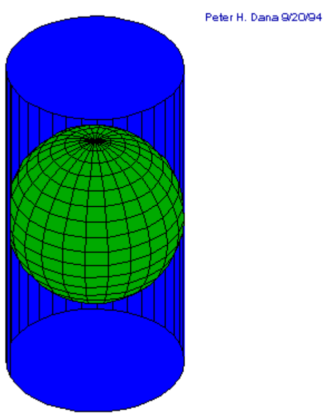
# Map projections

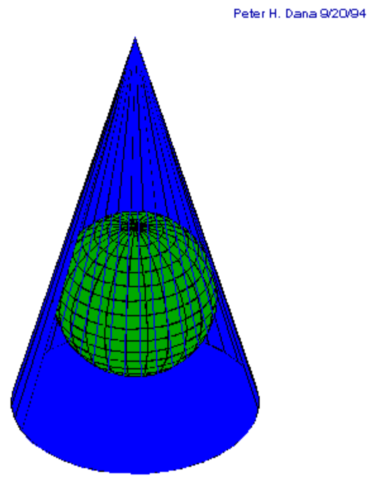
- 3-dimensional Earth's surface represented in 2-dimensions $\longrightarrow$ distorsion of directions, distances, areas.
- **Scale**: ratio of a distance on a map and that same distance on Earth.
- Projections attemps to minimize distorsions:
  - **Conformal**: scale is the same in all directions $\longrightarrow$ meridians and parallel intersect at right angles.
  - **Equidistant**: distances from the center of the projection to points at equal distancea appear equal on the map.
  - **Equi-direction**: azimuths are correctly portrayed on the map in all directions.
  - **Equal-area**: proportional relationship between areas is preserved on the map.

# Map projections

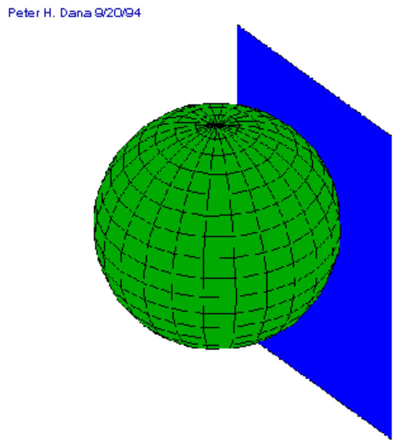
- **Cylindrical**: projection of a spherical surface on a cylinder
- **Conic**: projection of a spherical surface on a cone
- **Planar or Azimuthal**: projection of a spherical surface on a plane




Cylindrical Projection Surface




Conical Projection Surface




Planar Projection Surface

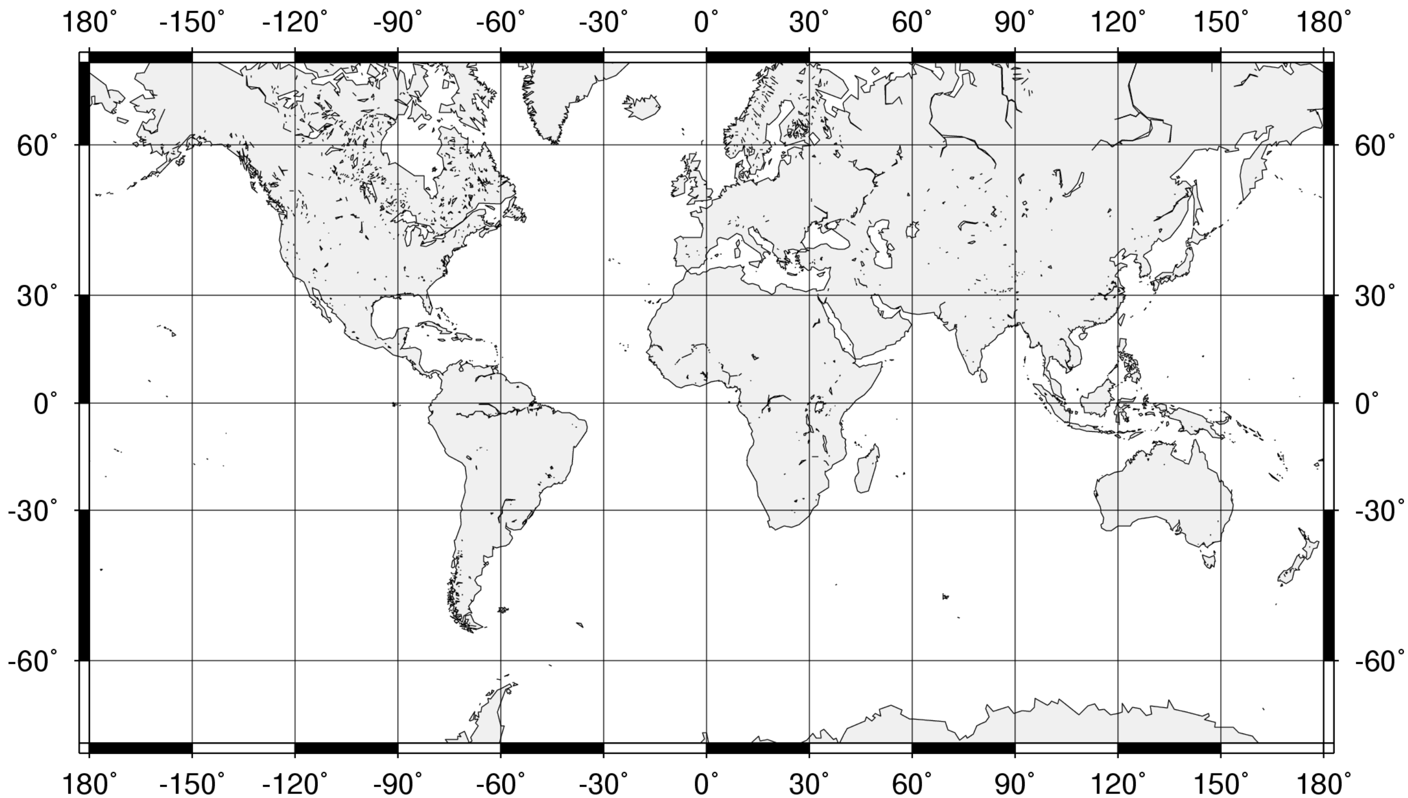
## A cylindrical projection: Mercator

- Straight meridians and parallels that intersect at right angles.
- Scale is true at the equator or at two standard parallels equidistant from the equator.
- Often used for marine navigation because all straight lines are lines of constant azimuth.
- **In GMT**:

```
-Jmscale or -JMwidth
    Give scale along equator (1:xxxx or UNIT/degree)
-Jmlon0/lat0/scale or -JMlon0/lat0/width
    Give central meridian, standard latitude  and
    scale along parallel (1:xxxx or UNIT/degree)
```

# A cylindrical projection: Mercator

```
pscoast -R-180/180/-70/70 -JM6i -B30g30 -W1/0
-G240 -Dc -P > mercator.ps
```



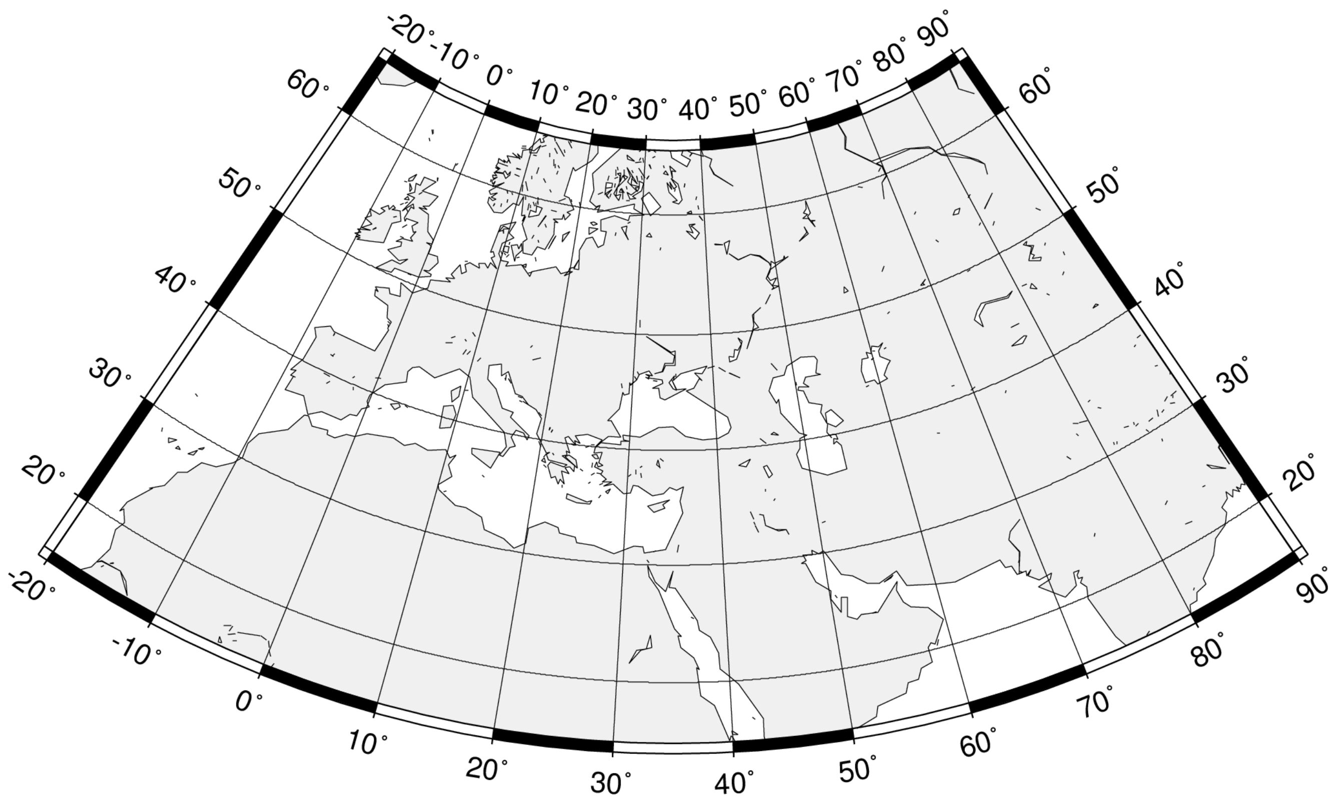
# A conic projection: Lambert

- Lambert Conformal Conic
- Area and shape are distorted away from standard parallels.
- Directions are true in limited areas.
- Used for maps of North America.

```
-Jblon0/lat0/lat1/lat2/scale
-JBlon0/lat0/lat1/lat2/width
    Give projection center,two standard parallels,
    and scale (1:xxxx or UNIT/degree).
```

# A conic projection: Lambert

```
pscoast -R-20/90/15/65 -JL35/40/32/45/6i -B10g10
-W1/0 -G240 -Dc -P > lambertc.ps
```



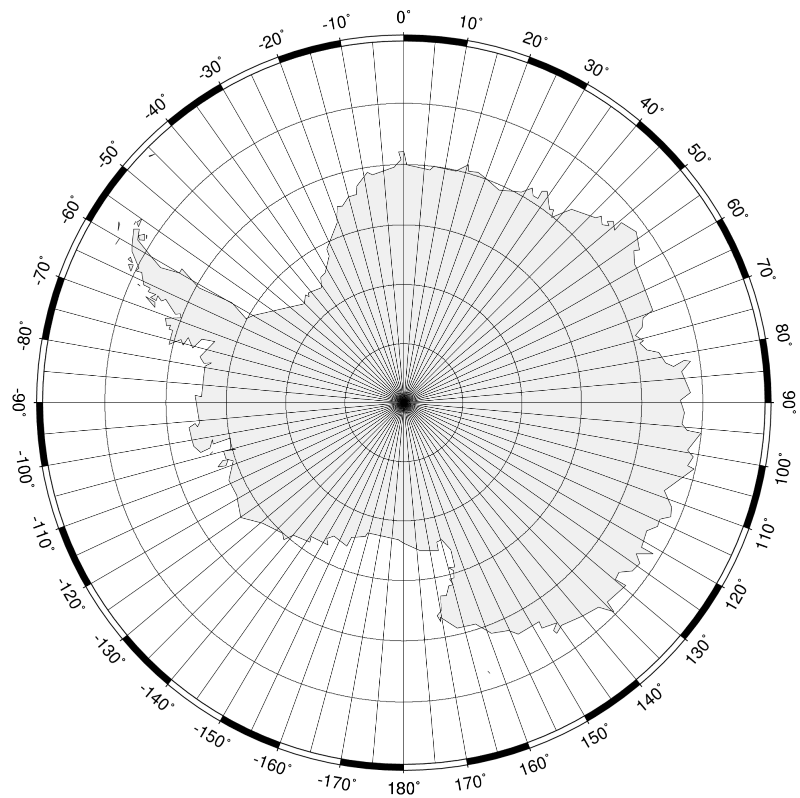
## An azimuthal projection: Stereographic

- Used for navigation in polar regions.
- Directions are true from the center point and scale increases away from the center point as does distortion in area and shape.

```
-Jslon0/lat0/scale or -JSlon0/lat0/width
   lon0/lat0 specifies the projection center.
   Give scale as 1:xxxx (true at pole) or
   slat/1:xxxx
   (true at standard parallel slat) or radius/lat
   (radius in UNIT from origin to the oblique
   latitude lat).
```

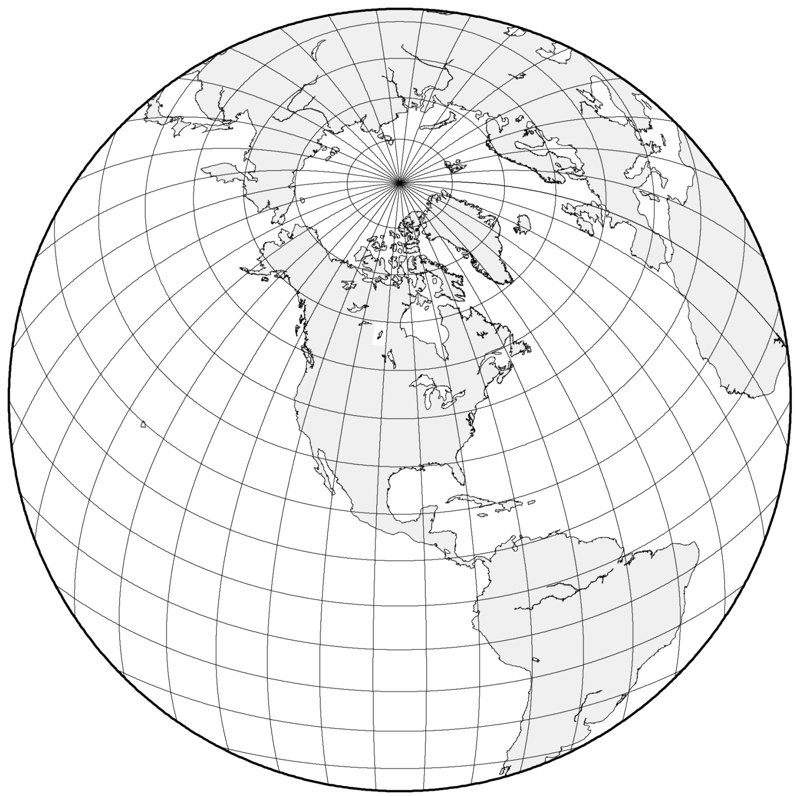
# An azimuthal projection: Stereographic

```
pscoast -R-180/180/-90/-60 -Js0/-90/3i/-60 -B10g5
-W1/0 -G240 -Dc -P > stereo.ps
```



# An azimuthal projection: Lambert

```
pscoast -R-140/-50/20/65 -JA-95/44/6i -W1/O -G240
-Bg10 -Di -A5000 -P > lamberta.ps
```



# Choosing a projection

- Rule of thumb:
  - A country in the tropics asks for a cylindrical projection.
  - A country in the temperate zone asks for a conical projection.
  - A polar area asks for an azimuthal projection.
- Goal = minimize distortion:
  - Cylindricals are true at the equator and distortion increases toward the poles.
  - Conics are true along some parallel somewhere between the equator and a pole and distortion increases away from this standard.
  - Azimuthals are true only at their center point, but generally distortion is worst at the edge of the map.

# Choosing a projection

```
gmtset BASEMAP_TYPE plain
pscoast -R-140/-50/20/65 -JM6i -W1/255/0/0 -Bg10 -Di -A5000 -K >! noam_proj.ps
pscoast -R-140/-50/20/65 -JL-95/44/20/65/6i -W1/0/255/0 -Bg10 -Di -A5000 -O >> noam_proj.ps
```