Meridian convergence in map projections

Definition: on a map, at a given point, meridian convergence is the angle measured clockwise from the tangent to the projection of the meridian to the northing coordinate line (grid north)—also called map angle or mapping angle.

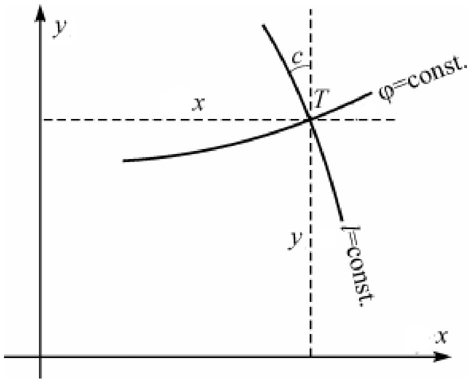

Fig 1. Meridian convergence c

Mapping equations

$$x = f(\varphi, \lambda)$$

$$y = g(\varphi, \lambda)$$

Total differentials of *x* and *y* are

$$dx = \frac{\partial x}{\partial \varphi} d\varphi + \frac{\partial x}{\partial \lambda} d\lambda$$

$$dy = \frac{\partial y}{\partial \varphi} d\varphi + \frac{\partial y}{\partial \lambda} d\lambda$$

For meridian, we have $\lambda = const.$

$$x = f(\varphi, \lambda = const.)$$

$$y = g(\varphi, \lambda = const.)$$

Total differentials of *x* and *y* are

$$dx = \frac{\partial x}{\partial \varphi} d\varphi + 0$$

$$dy = \frac{\partial y}{\partial \varphi} d\varphi + 0$$

Meridian convergence as defined above is given by

$$\tan c = \frac{-dx}{dy}.$$

Finally

$$\tan c = -\frac{\frac{\partial x}{\partial \varphi}}{\frac{\partial y}{\partial \varphi}}.$$

In special case of conformal projections angle between parallel and x-axis is the same as the angle between meridian and y-axis since meridian-parallel angle θ is 90° and due to Cauchy-Riemann equations

$$\frac{\partial x}{\partial \varphi} = \frac{\partial y}{\partial \lambda}$$

$$\frac{\partial y}{\partial \varphi} = -\frac{\partial x}{\partial \lambda}$$

meridian convergence is also given as

$$\tan c = \frac{\frac{\partial y}{\partial \lambda}}{\frac{\partial x}{\partial \lambda}}$$

which is more practical for some projections. See e.g. CONFORMAL MAP PROJECTIONS IN GEODESY by E. J. KRAKIWSKY (http://www2.unb.ca/gge/Pubs/LN37.pdf) , pages 40-43.

For non-conformal projections

$$\tan c = \frac{\frac{\partial y}{\partial \lambda}}{\frac{\partial x}{\partial \lambda}}$$

gives angle between parallel and x-axis ($\varphi = const.$).