# Hammer-Aitoff map projection

## Conversion to/from longitude/latitude

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**An Aitoff map projection (attributed to David Aitoff circa 1889) is a class of azimuthal projection, basically an azimuthal equidistant projection where the longitude values are doubled (squeezing 2pi into pi) and the resulting 2D map is stretched in the horizontal axis to form a 2:1 ellipse. A modification to the Aitoff projection is the Hammer-Aitoff projection which has the property of preserving equal area over the whole map.**

**Conversion from longitude/latitude to Hammer-Aitoff coordinates (x,y)**

**Consider longitude to range between -pi and pi, latitude between -pi/2 and pi/2.**

$$z^2 = 1 + \cos(\text{latitude}) \cos(\text{longitude}/2)$$

$$x = \cos(\text{latitude}) \sin(\text{longitude}/2) / z$$

$$y = \sin(\text{latitude}) / z$$

**(x,y) are each normalised coordinates, -1 to 1.**

**Conversion of Hammer-Aitoff coordinates to longitude/latitude**

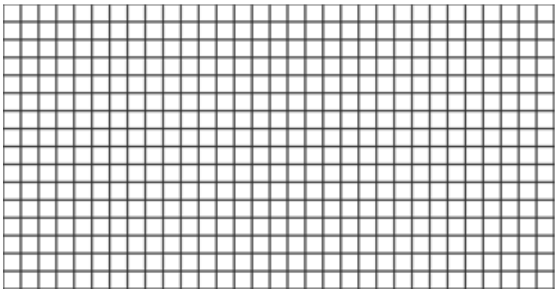
$$z^2 = 1 - x^2/2 - y^2/2$$

$$\text{longitude} = 2 \operatorname{atan}(\sqrt{2}\, x\, z / (2 z^2 - 1))$$

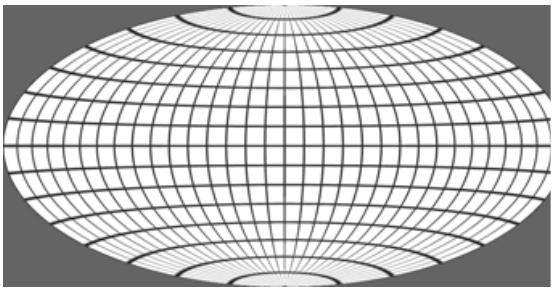
$$\text{latitude} = \operatorname{asin}(\sqrt{2}\, y\, z)$$

**The Hammer-Aitoff map is limited to where (x longitude) >= 0.**

**Example: Conversion of longitude/latitude to Hammer-Aitoff coordinates**

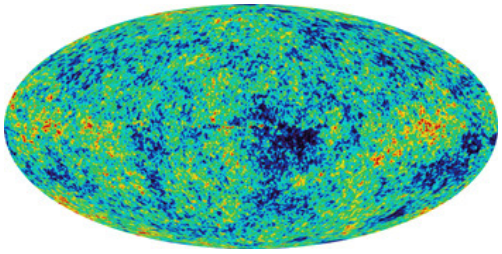


Grid pattern

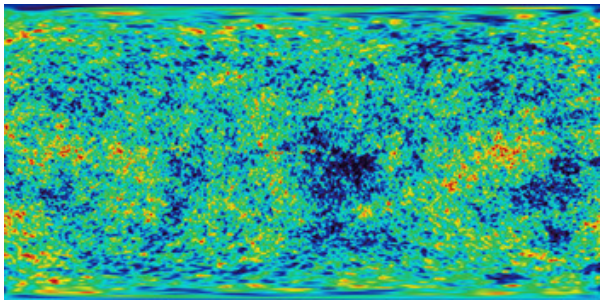


Resulting Hammer-Aitoff projection

**Example: Conversion of Hammer-Aitoff coordinates to longitude/latitude**



Cosmic microwave background



Spherical projection