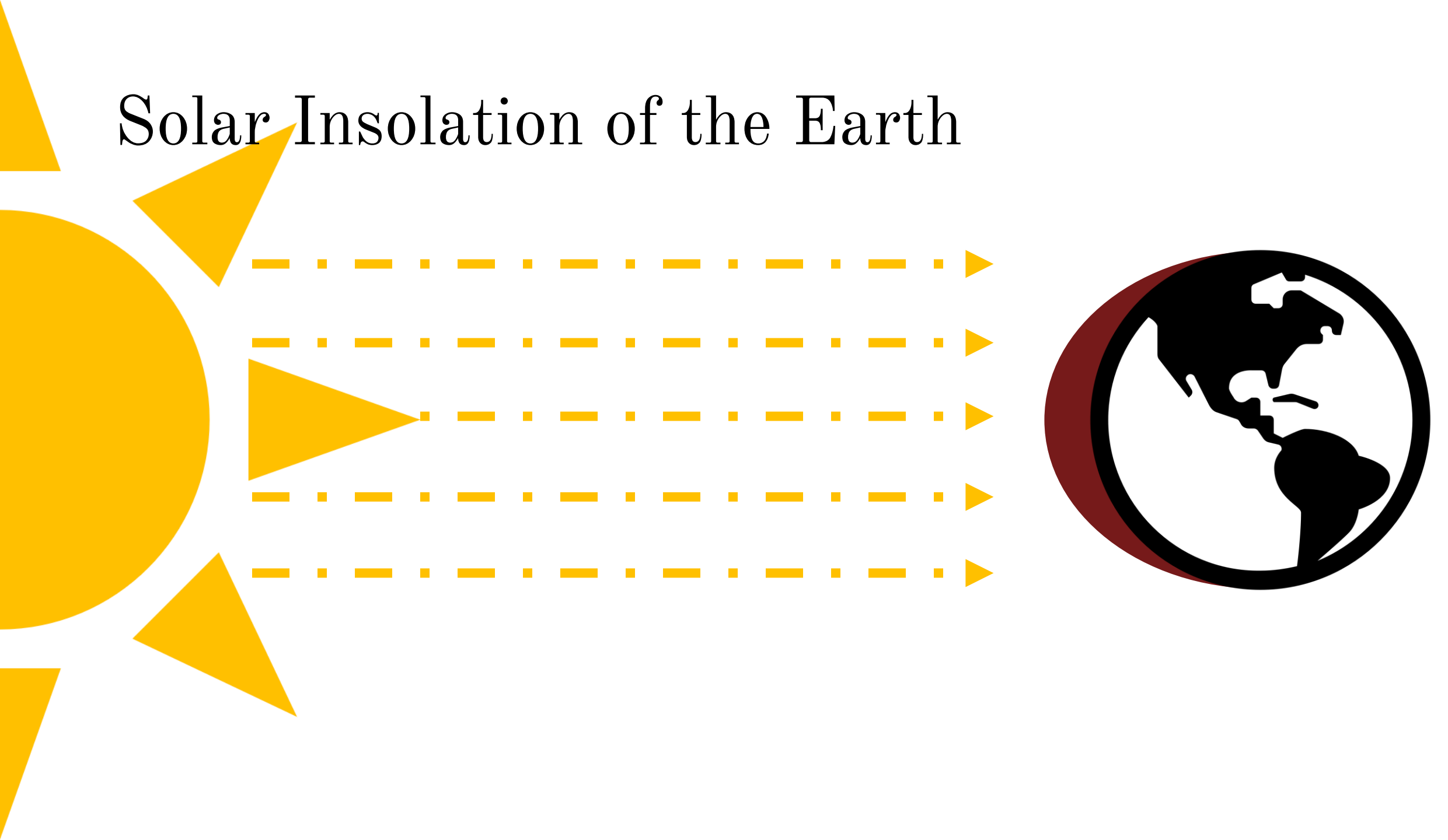


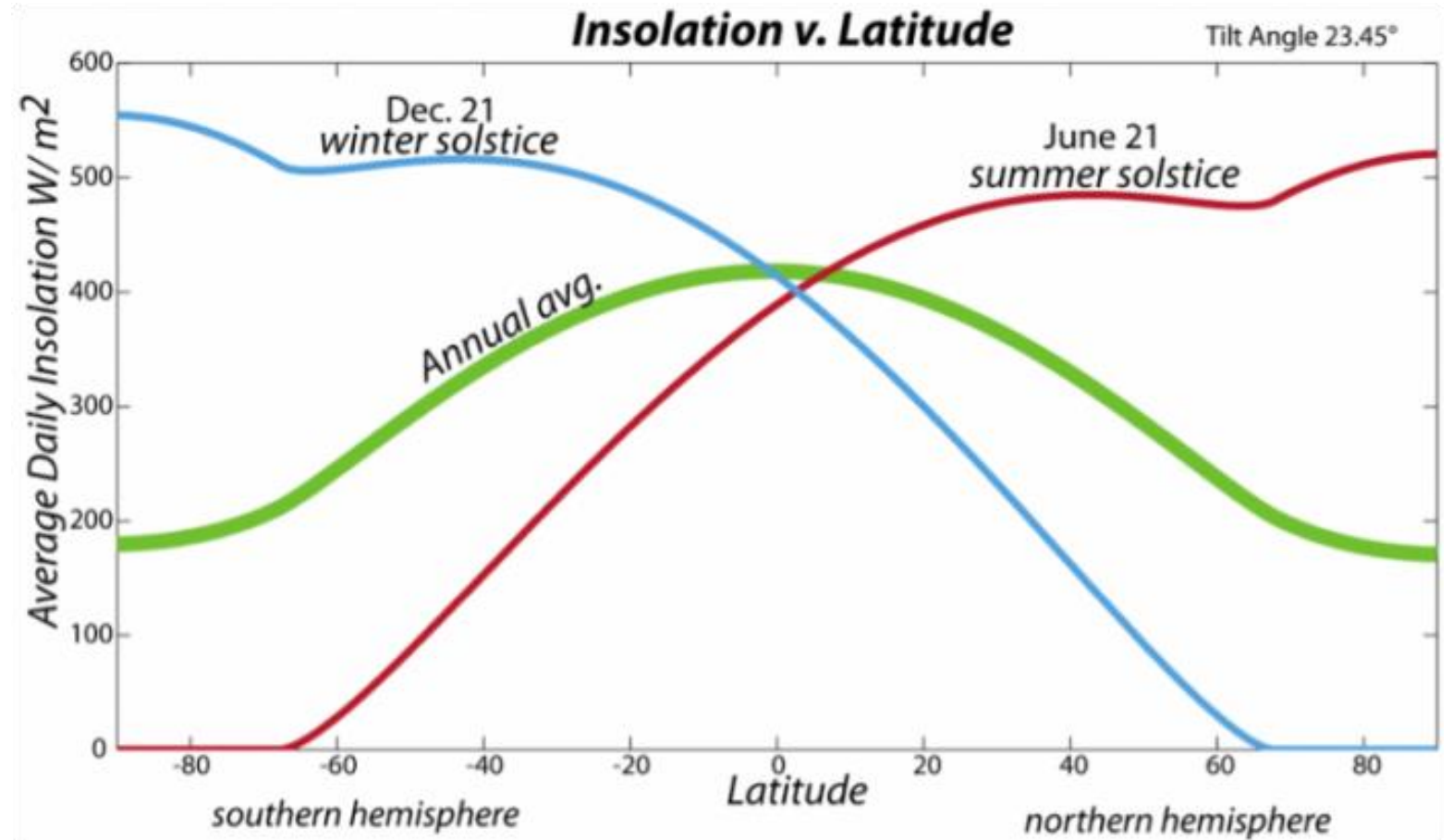
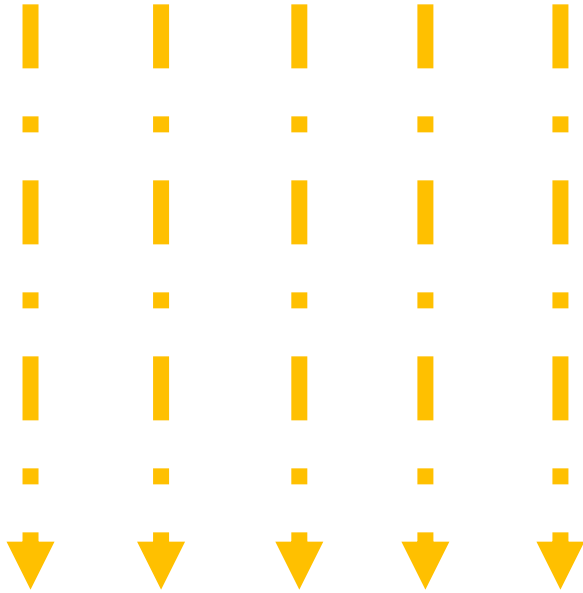
The Atmospheric General Circulation

September 9, 2019

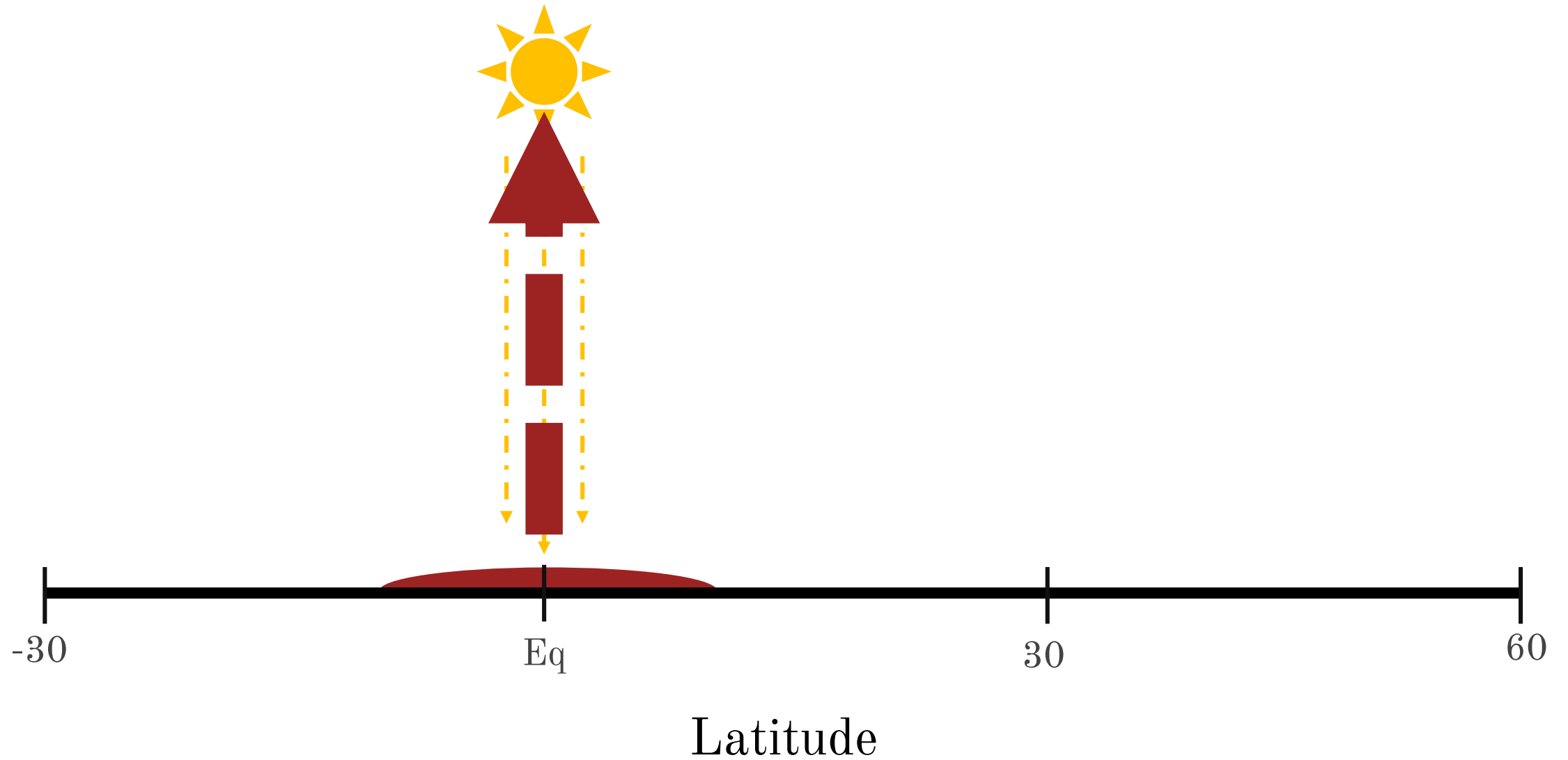
Solar Insolation of the Earth



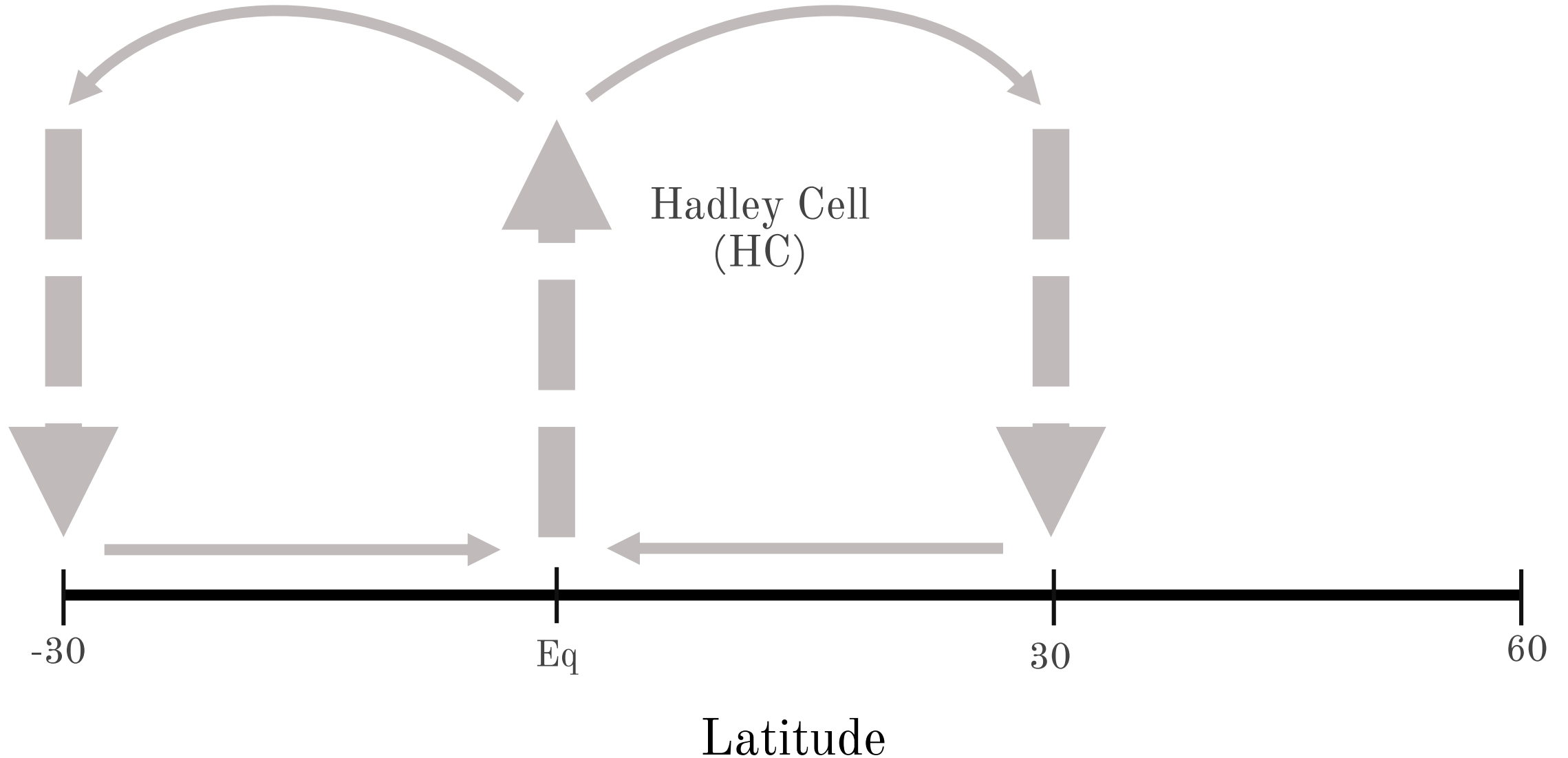
Solar Insolation of the Earth



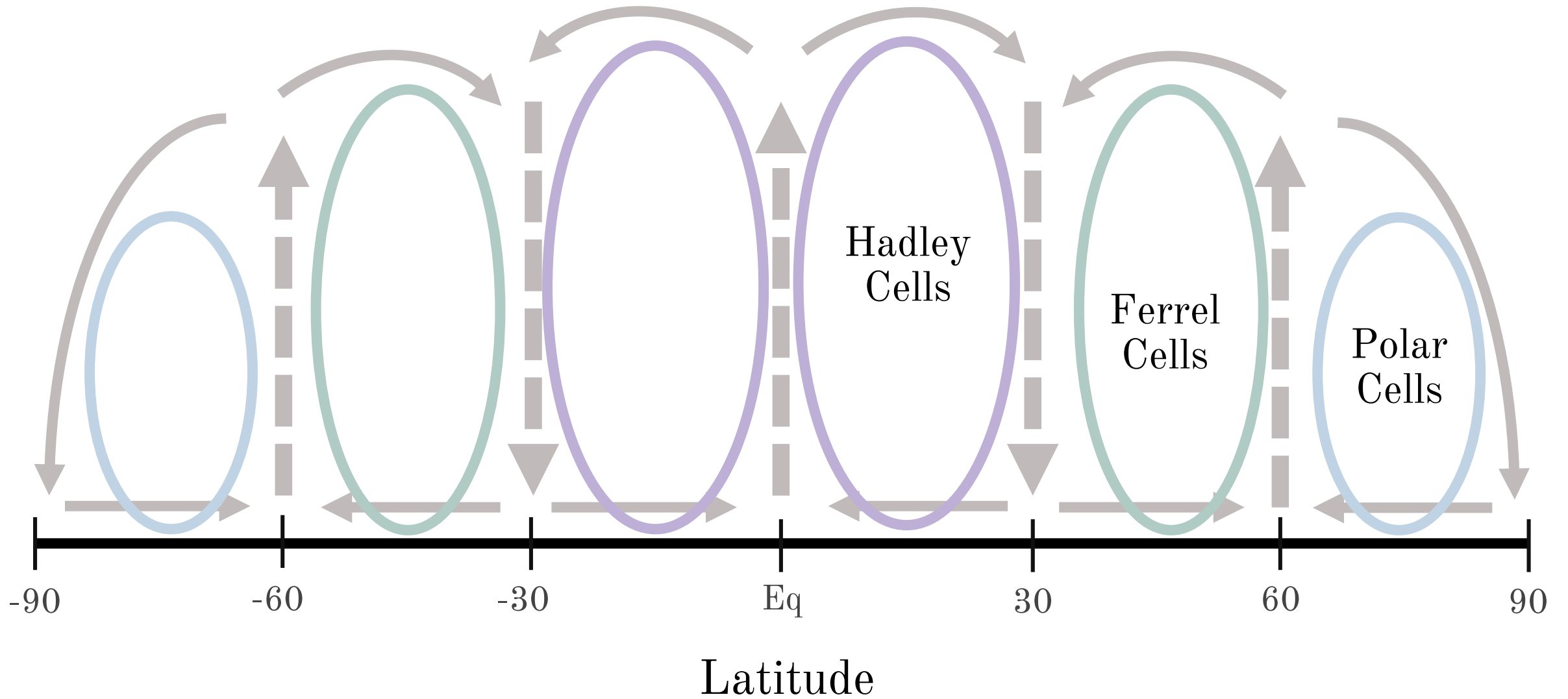
Meridional Circulation



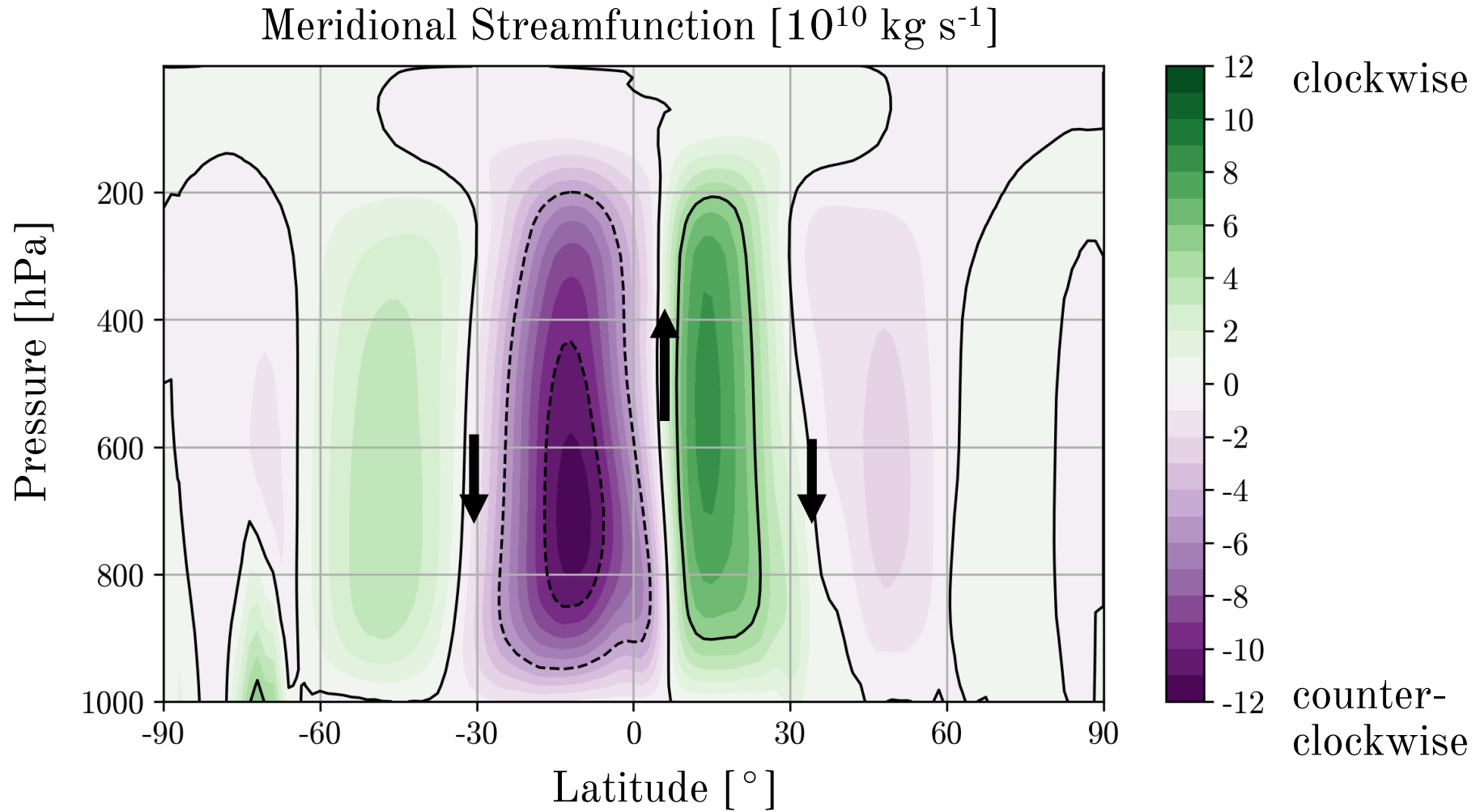
Meridional Circulation



General Circulation



General Circulation



Conservation of Angular Momentum

Angular Momentum, M :

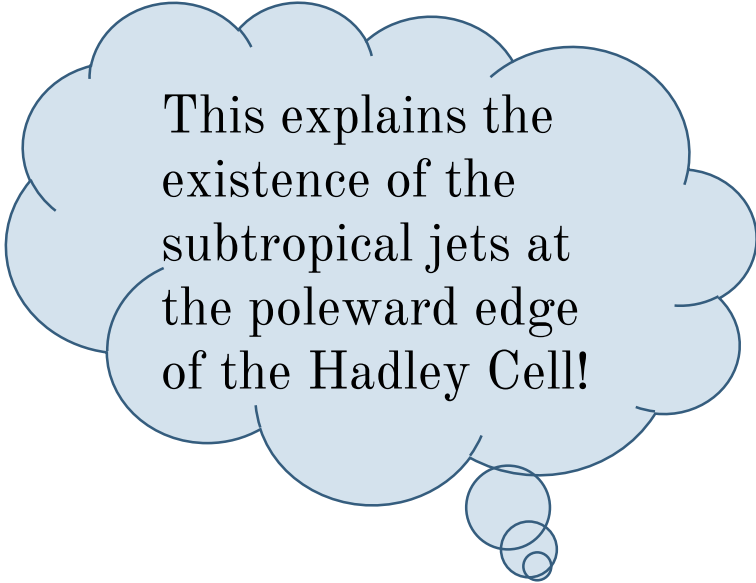
$$M = (u + \Omega a \sin\phi)a \sin\phi$$

Angular momentum conserving wind, u_M :

$$u_M = \frac{\Omega a^2 \sin^2 \phi}{a \cos \phi}$$

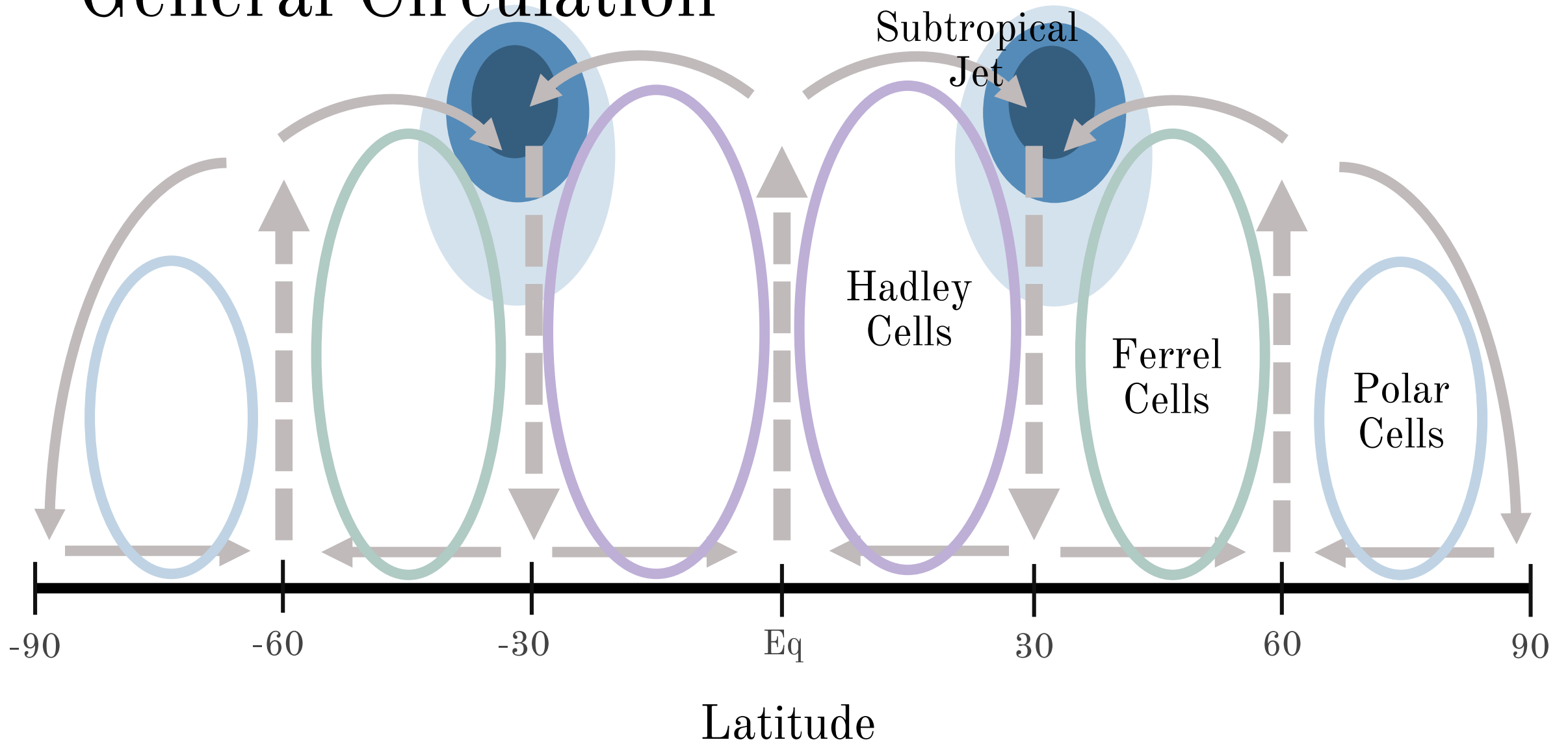
Radius of the earth: $a = 6371$ km

Angular velocity of the earth: $\Omega = 7.29(10^{-5})$ rad s⁻¹



This explains the existence of the subtropical jets at the poleward edge of the Hadley Cell!

General Circulation



Coriolis Force

Coriolis acceleration:

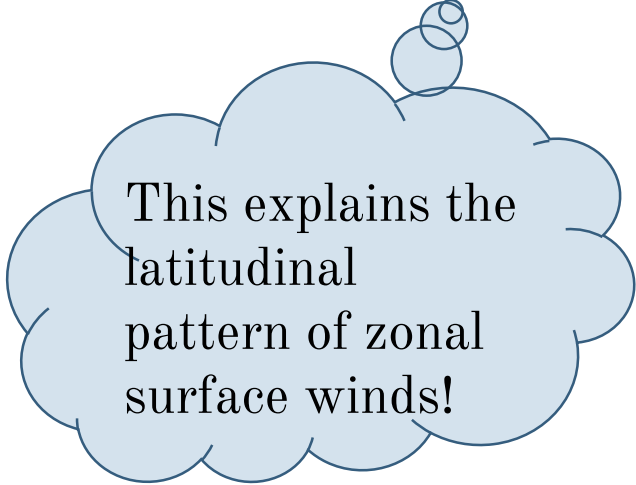
$$a_c = -2\vec{\Omega} \times \vec{U}$$

Coriolis parameter (f-plane approximation):

$$f = 2\Omega \sin\phi \quad a_c = \frac{\partial \vec{U}}{\partial t} = -f\hat{z} \times \vec{U}$$

$$\text{x-direction: } \frac{\partial u}{\partial t} = fv$$

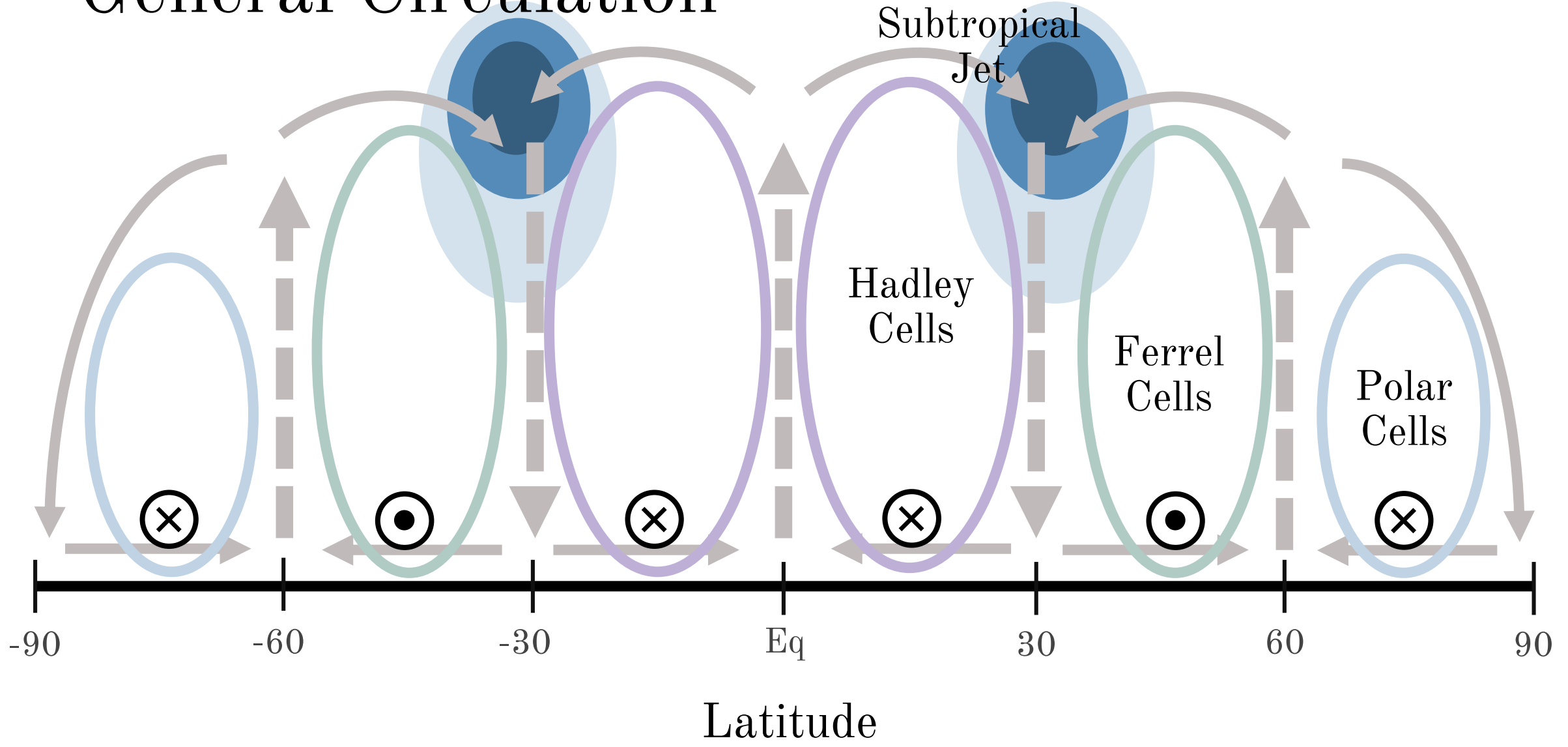
$$\text{y-direction: } \frac{\partial v}{\partial t} = -fu$$



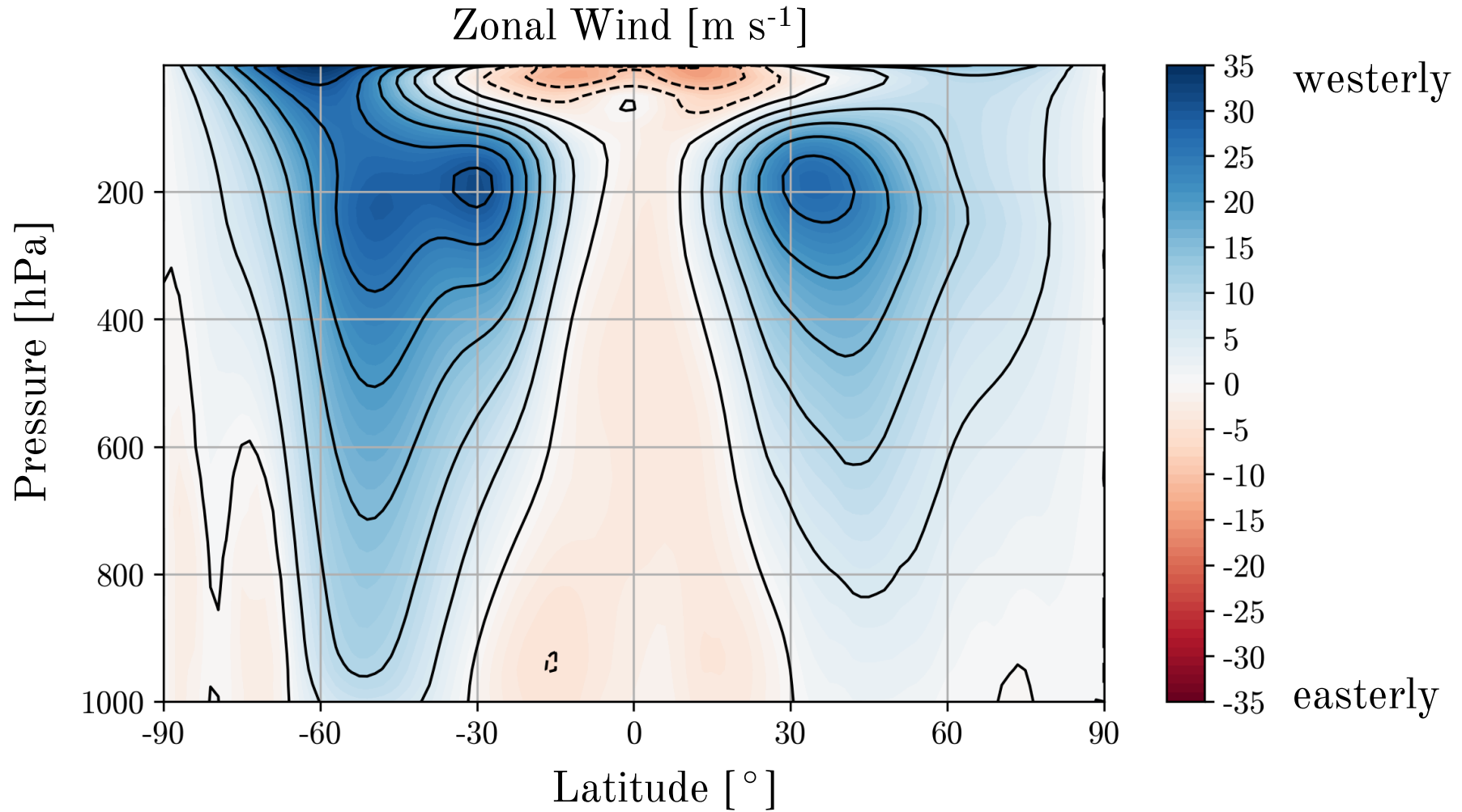
This explains the latitudinal pattern of zonal surface winds!

- ⊗ easterlies
- ⊙ westerlies

General Circulation

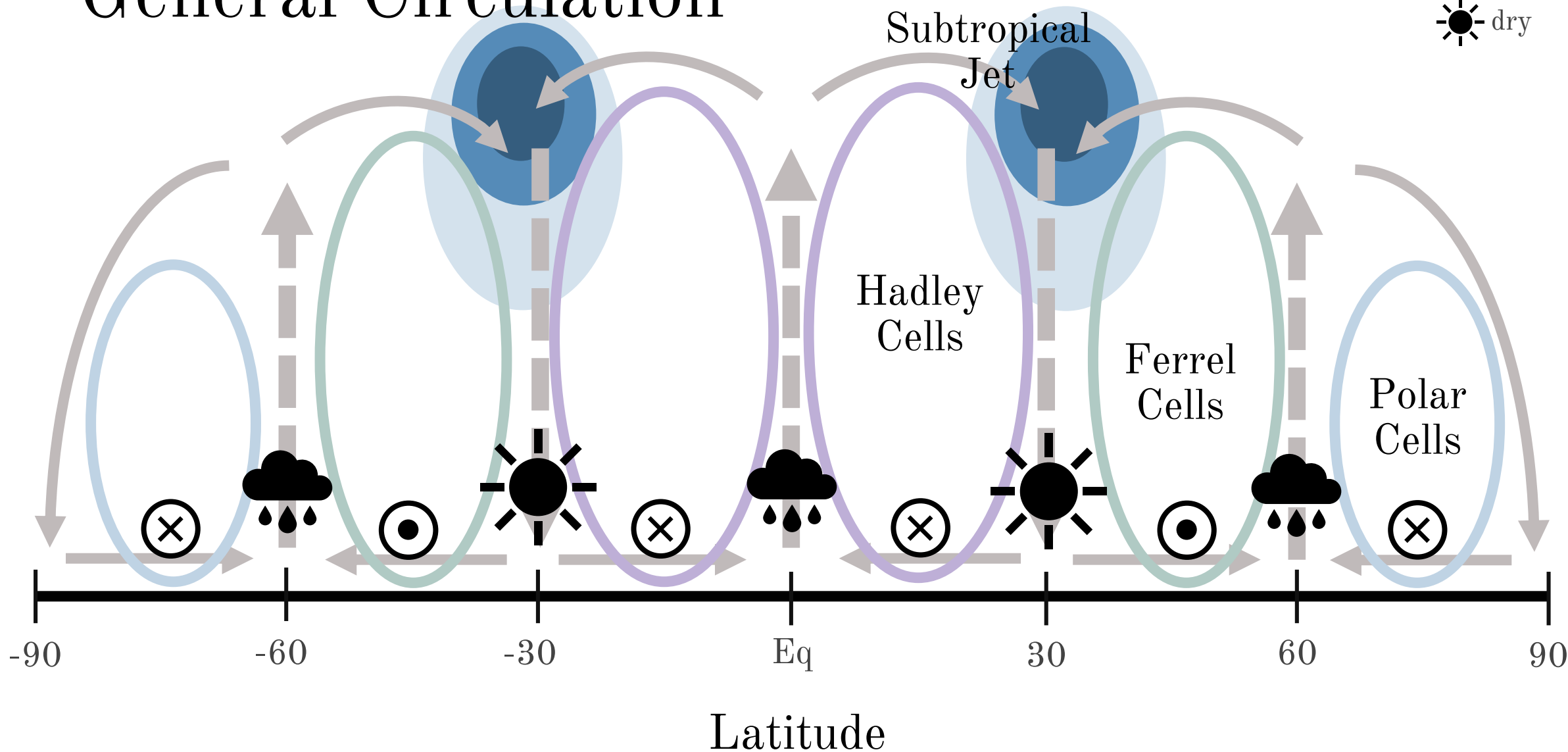


General Circulation

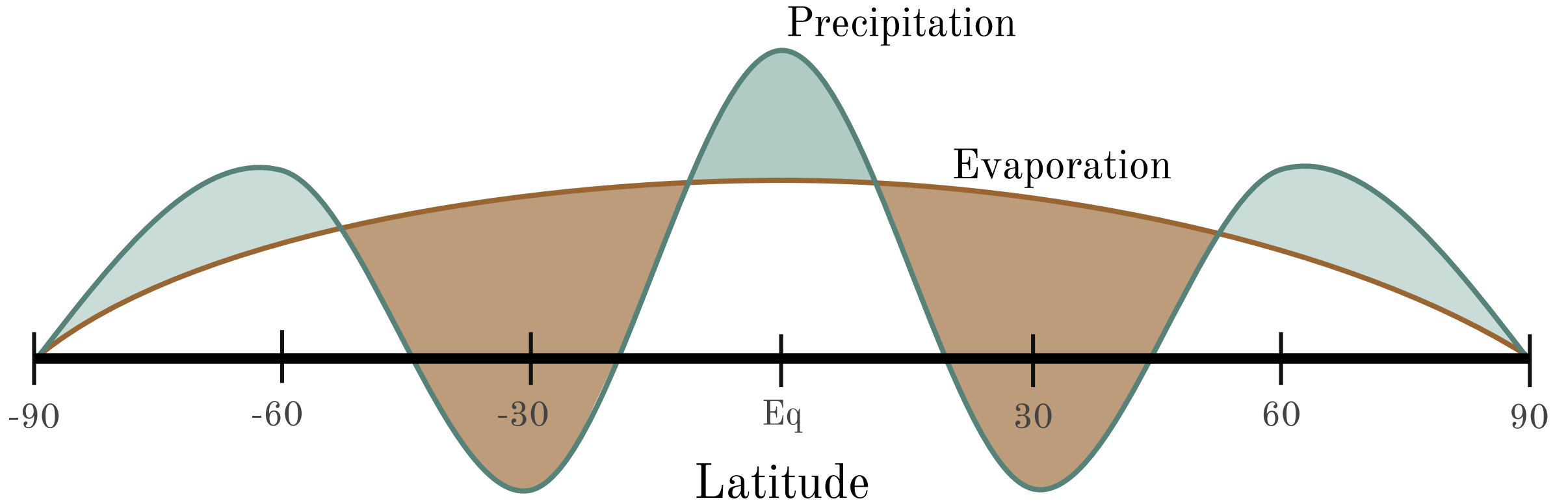
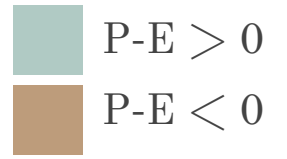


General Circulation

- ⊗ easterlies
- ⊙ westerlies
- ☁️ rainy
- ☀️ dry



Hydrological Pattern



Hydrological Pattern

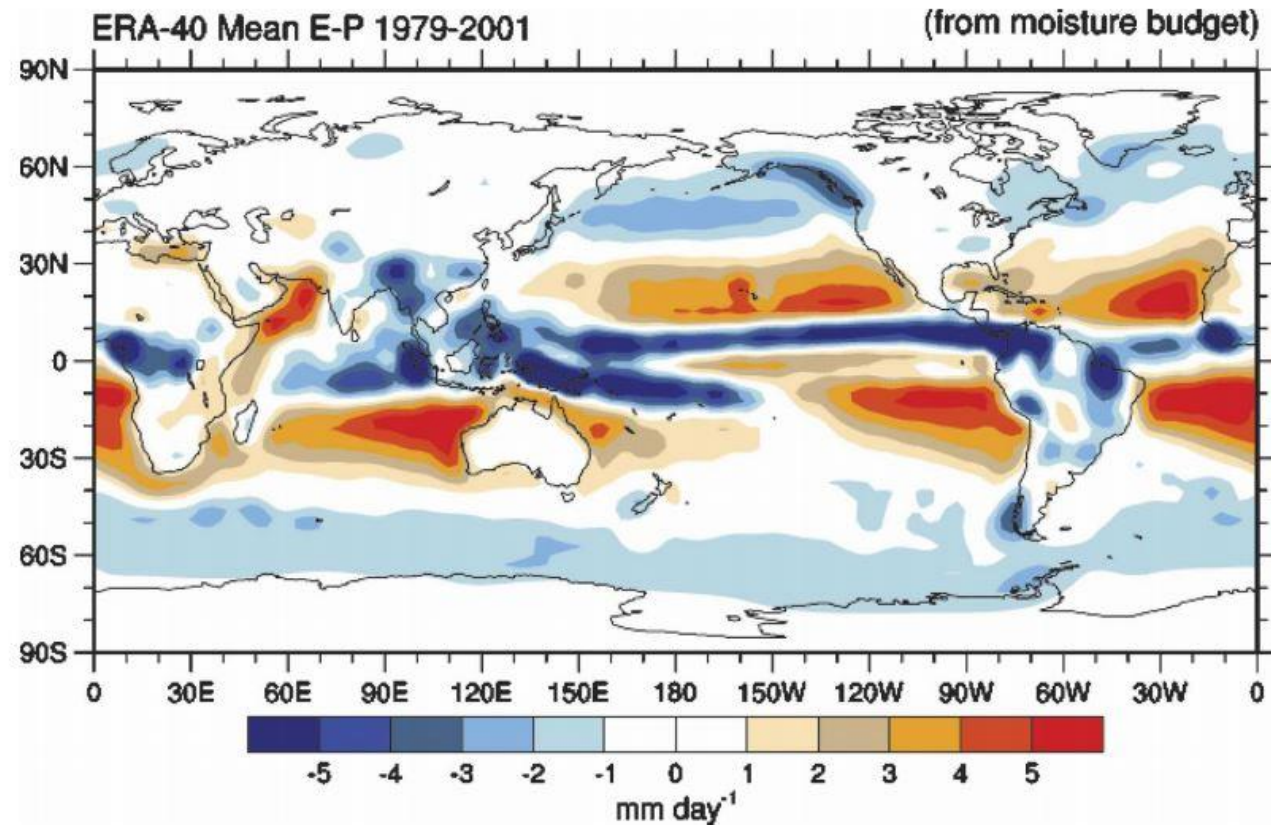


FIG. 3. The long-term 1979–2001 annual mean $E - P$ computed from monthly means of the vertically integrated atmospheric moisture budget using ERA-40 reanalyses every 6 h.