

EOSC 112: THE FLUID EARTH

CORIOLIS EFFECT AND GEOSTROPHY

Atm3 Read: Kump et al. Chap.4, p. 61-68

Why do weather / climate vary around the globe?

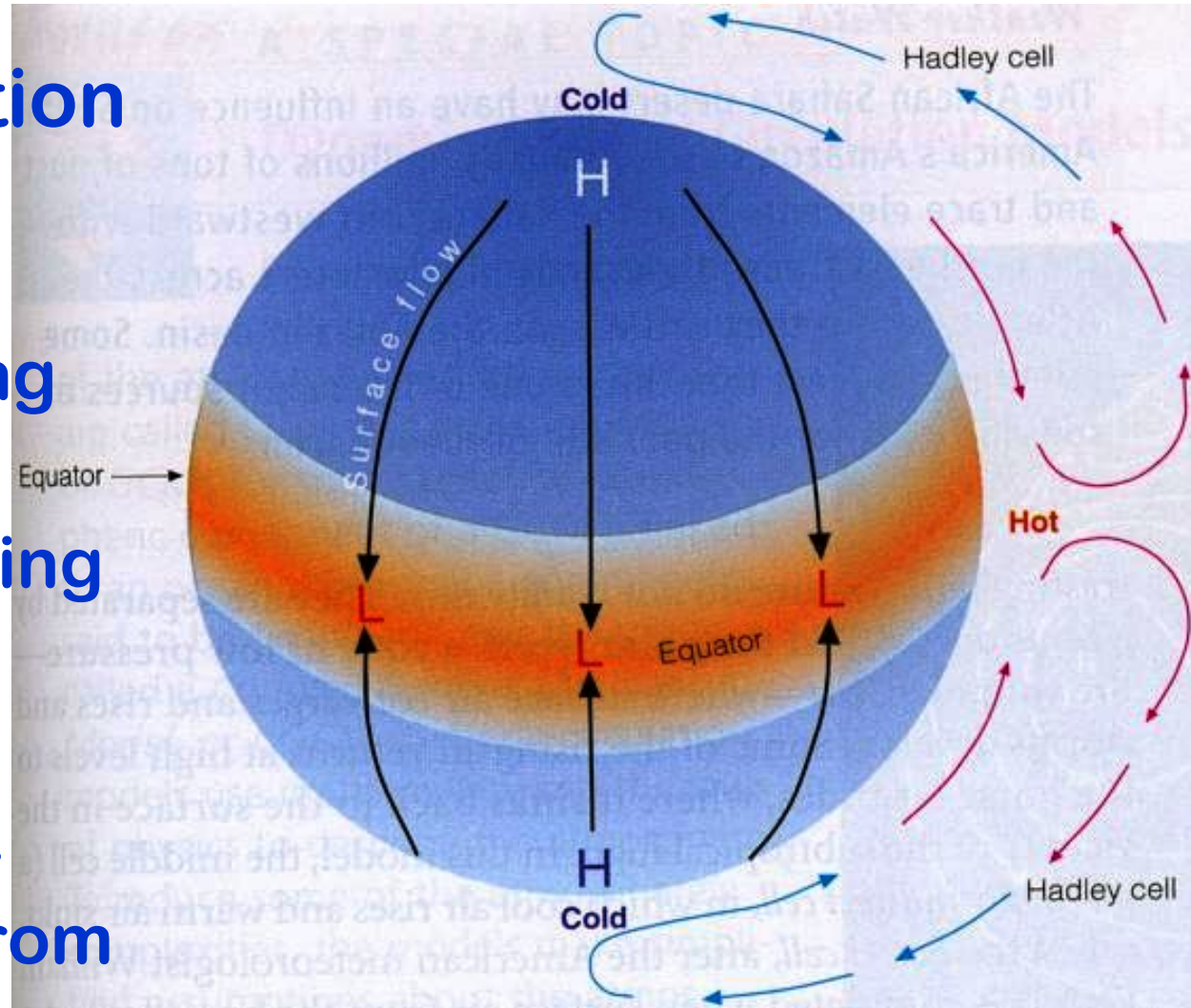
**Why is the response to a global climate
perturbation not necessarily uniform around the
globe?**

Objectives:

- 1.To explain the Coriolis effect;**
- 2.To describe Geostrophic balance;**
- 3.To describe the general pattern of Global
Winds on a rotating planet.**

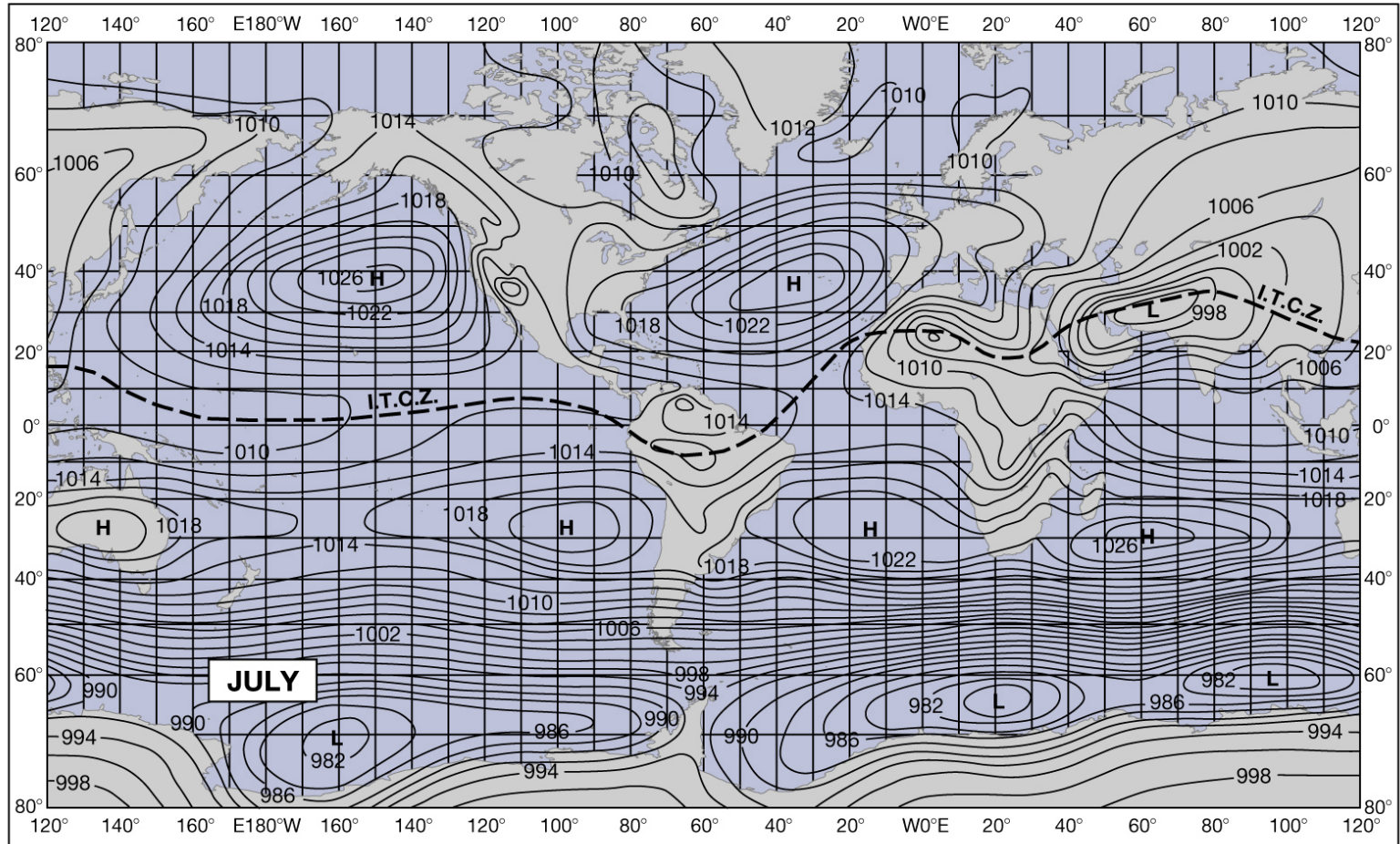
Hadley circulation

- Hadley (1735):
Warm Eq. => rising
air & low p.
Cold Pole => sinking
air & high p
Surface air flows
from Pole to Eq.
Upper air flows from
Eq. to Pole.
=> Hadley cell



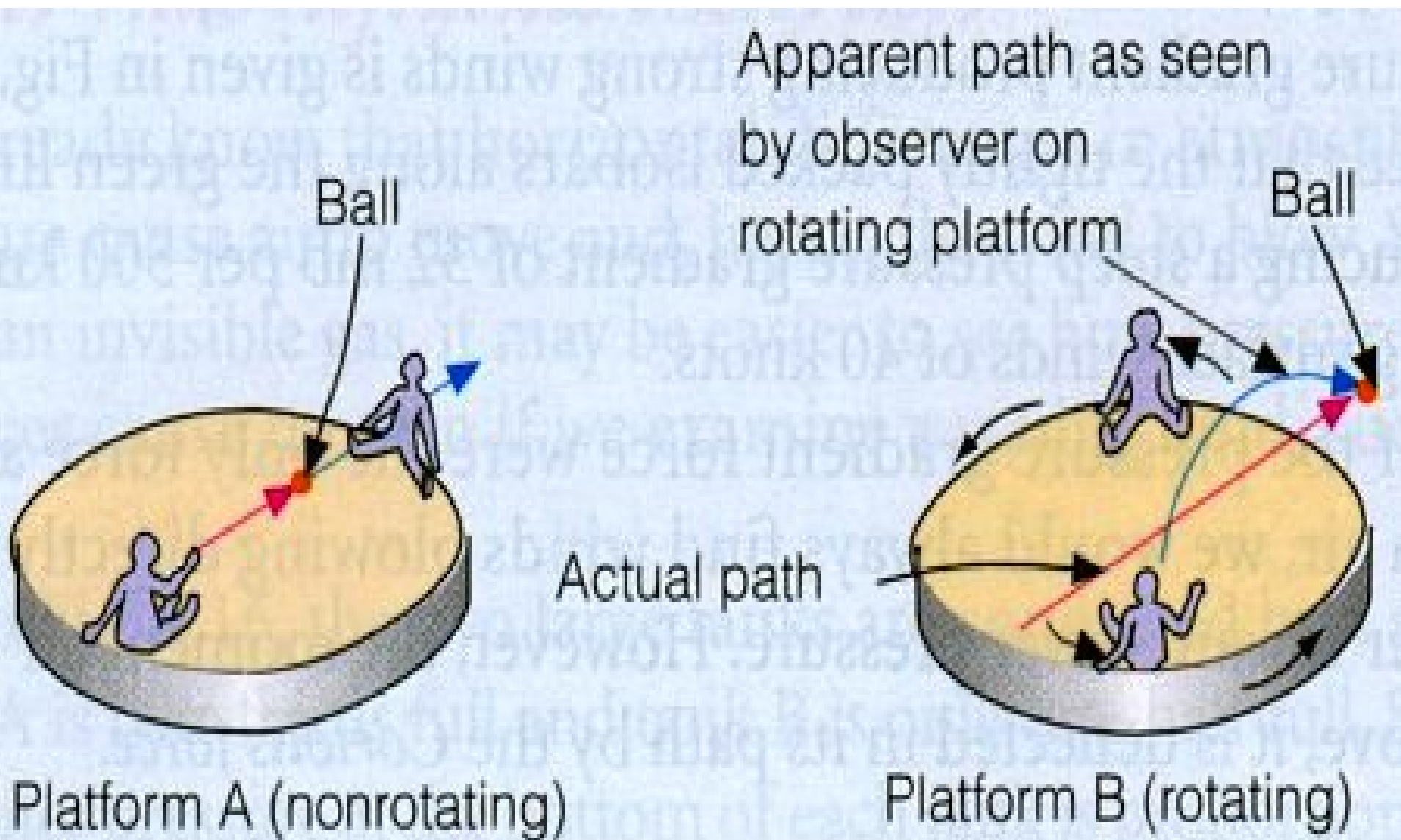
**Assumes: No rotation,
no continents.**

Average Sea-level Pressure (July)

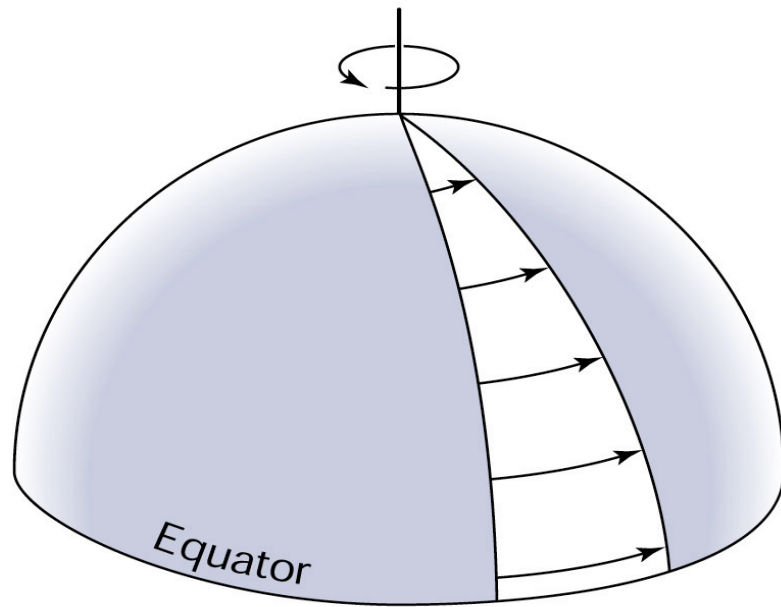


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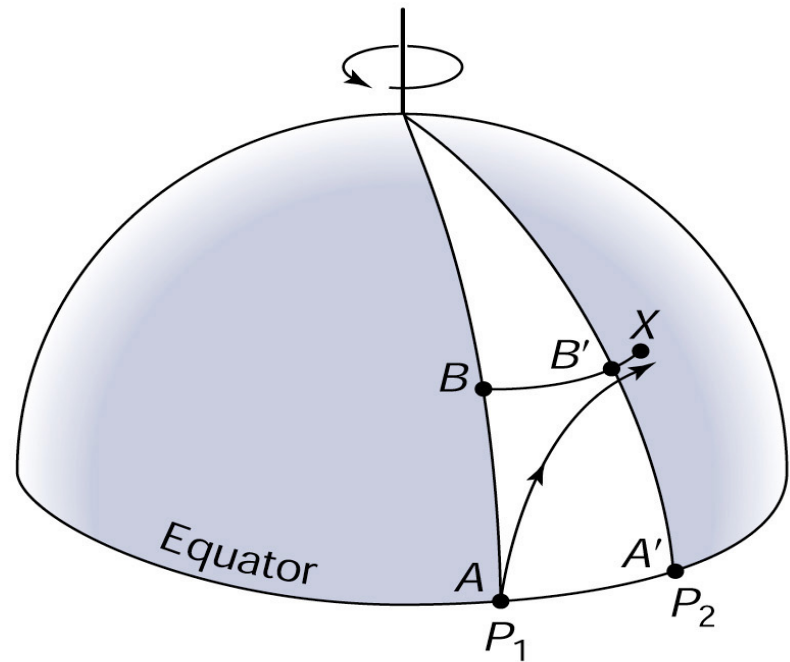
1. Coriolis effect on a rotating platform



Coriolis effect on Earth



(a)



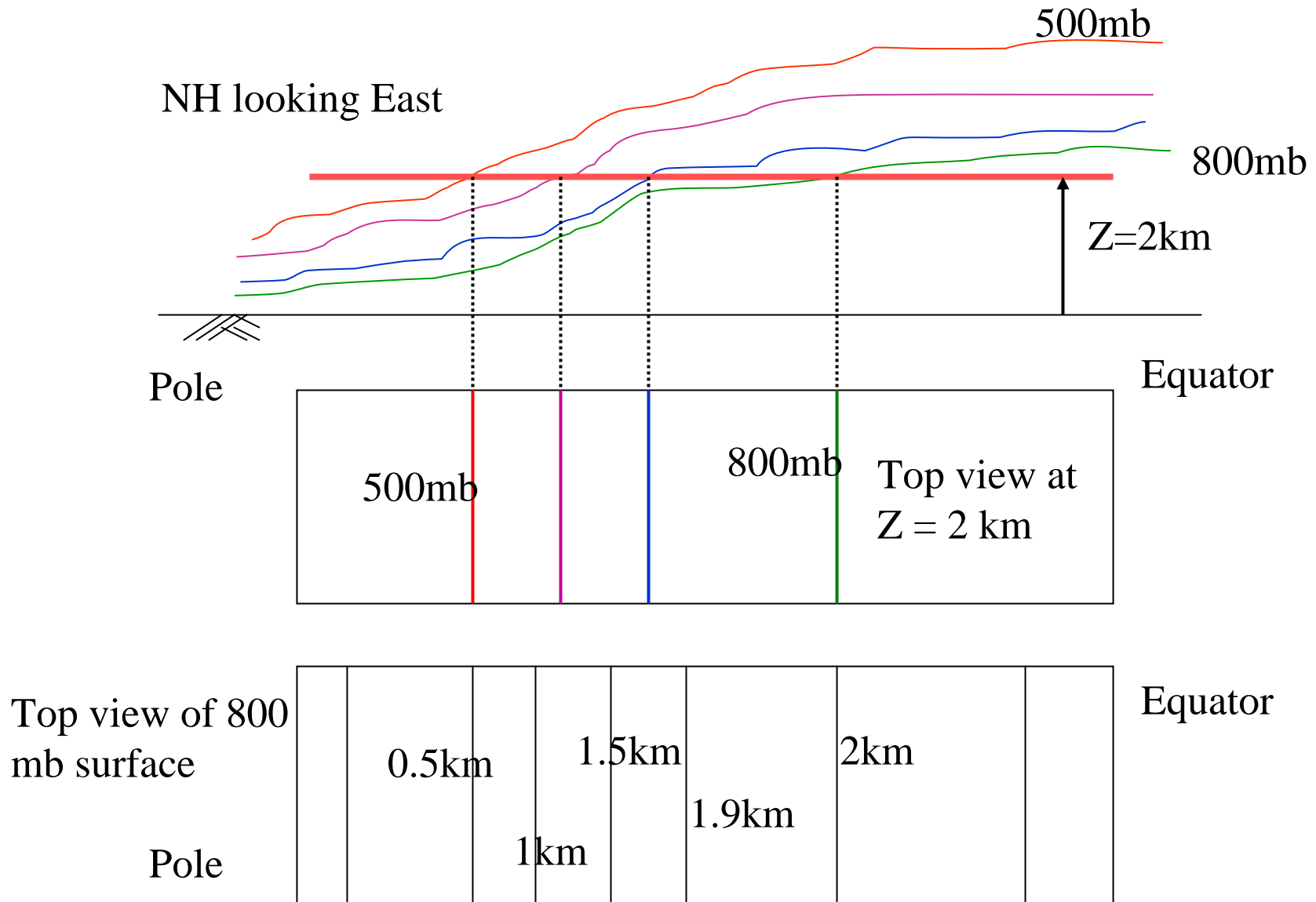
(b)

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Coriolis “Force”:

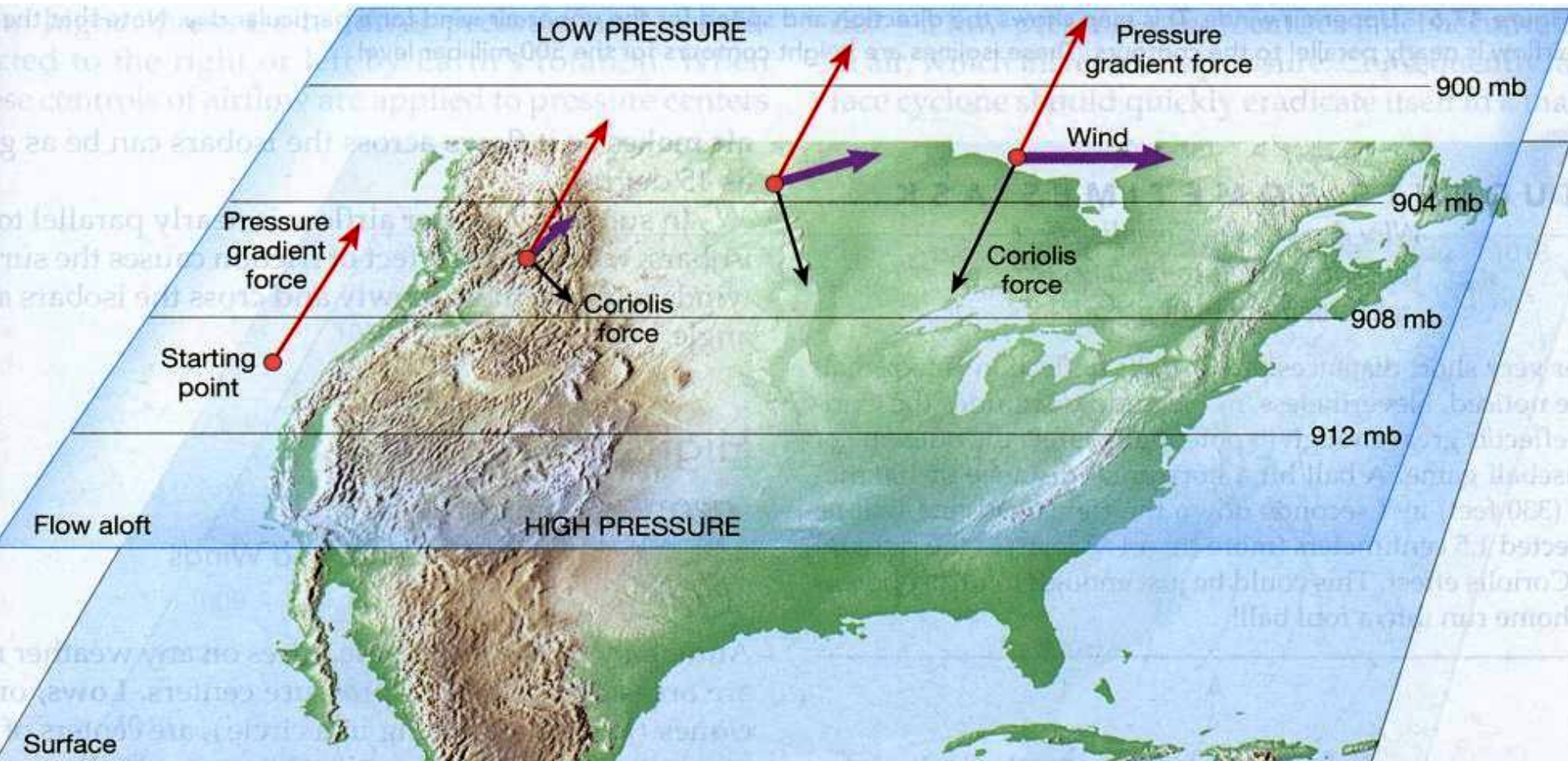
- directed at right angles to the airflow,
- hence, affects only wind direction, not speed,
- has magnitude proportional to wind speed,
- maximum at poles, weakens toward equator.

Relationship between Surfaces of Constant Elevation and Surfaces of Constant Pressure

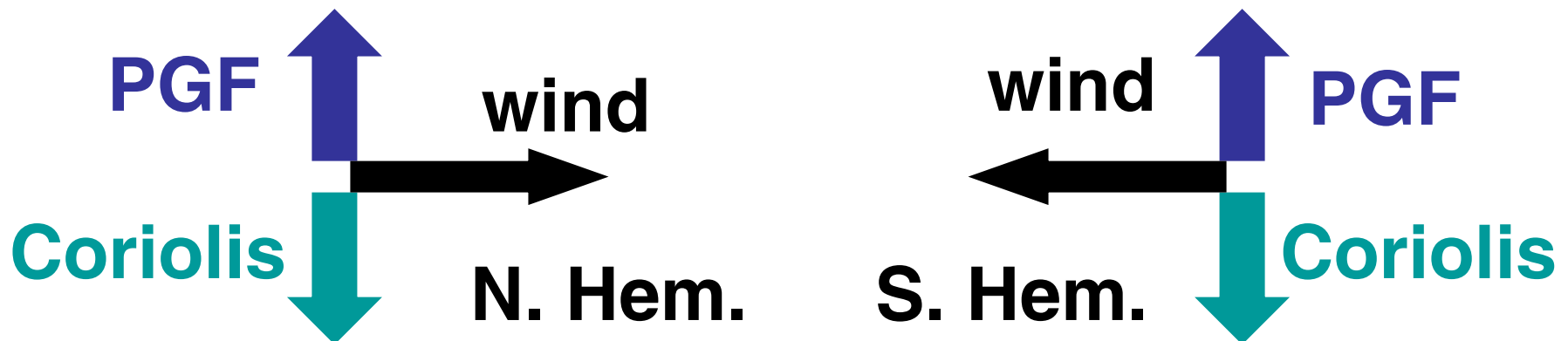


2. Geostrophic balance

- P diff. \Rightarrow pressure gradient force (PGF)
 \Rightarrow air parcel moves \Rightarrow Coriolis force
- Geostrophy = balance between PGF & Coriolis force

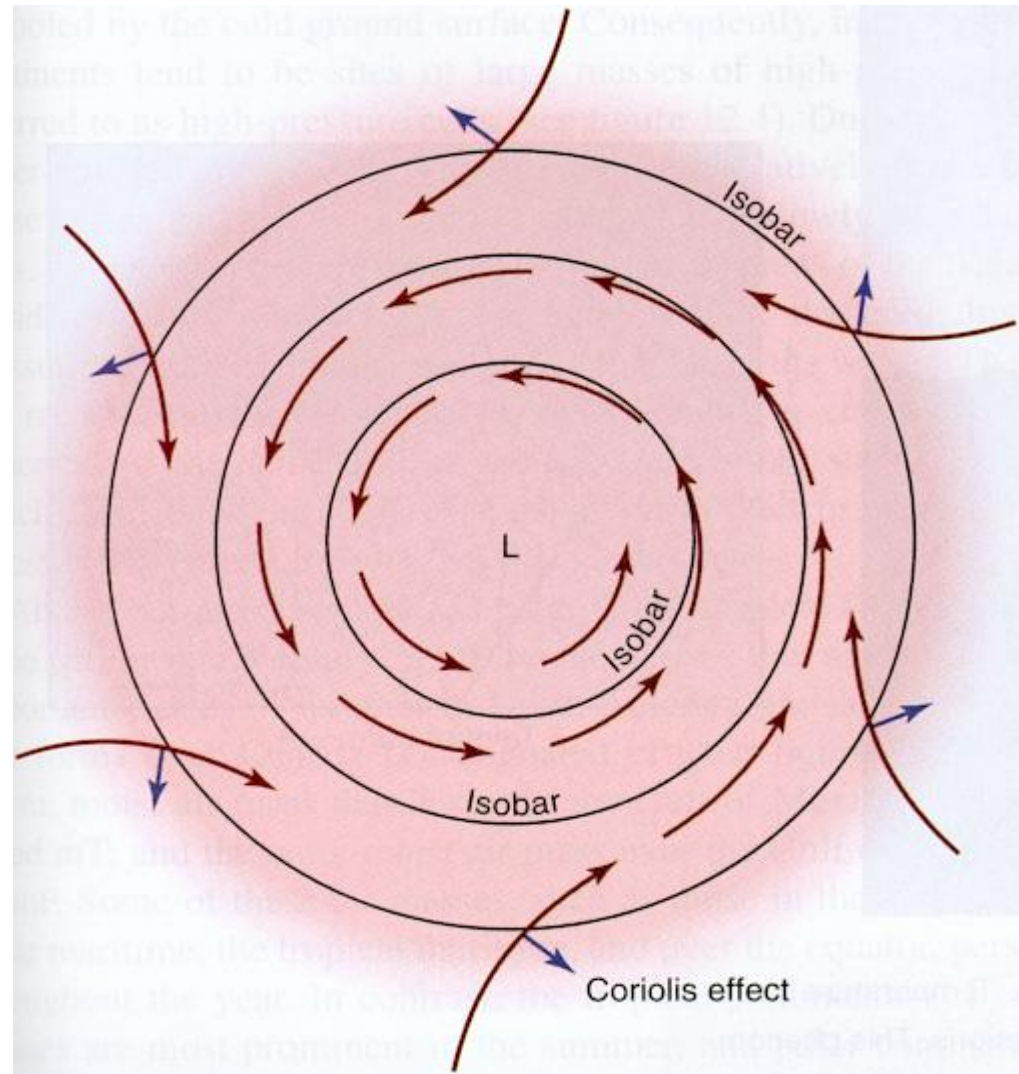


- Approximate geostrophic balance for large-scale flow away from Equator
- Why no geostrophic balance at Equator?
- In N. Hem., geostrophic wind blows to the right of PGF
- In S. Hem., geostrophic wind to left of PGF.



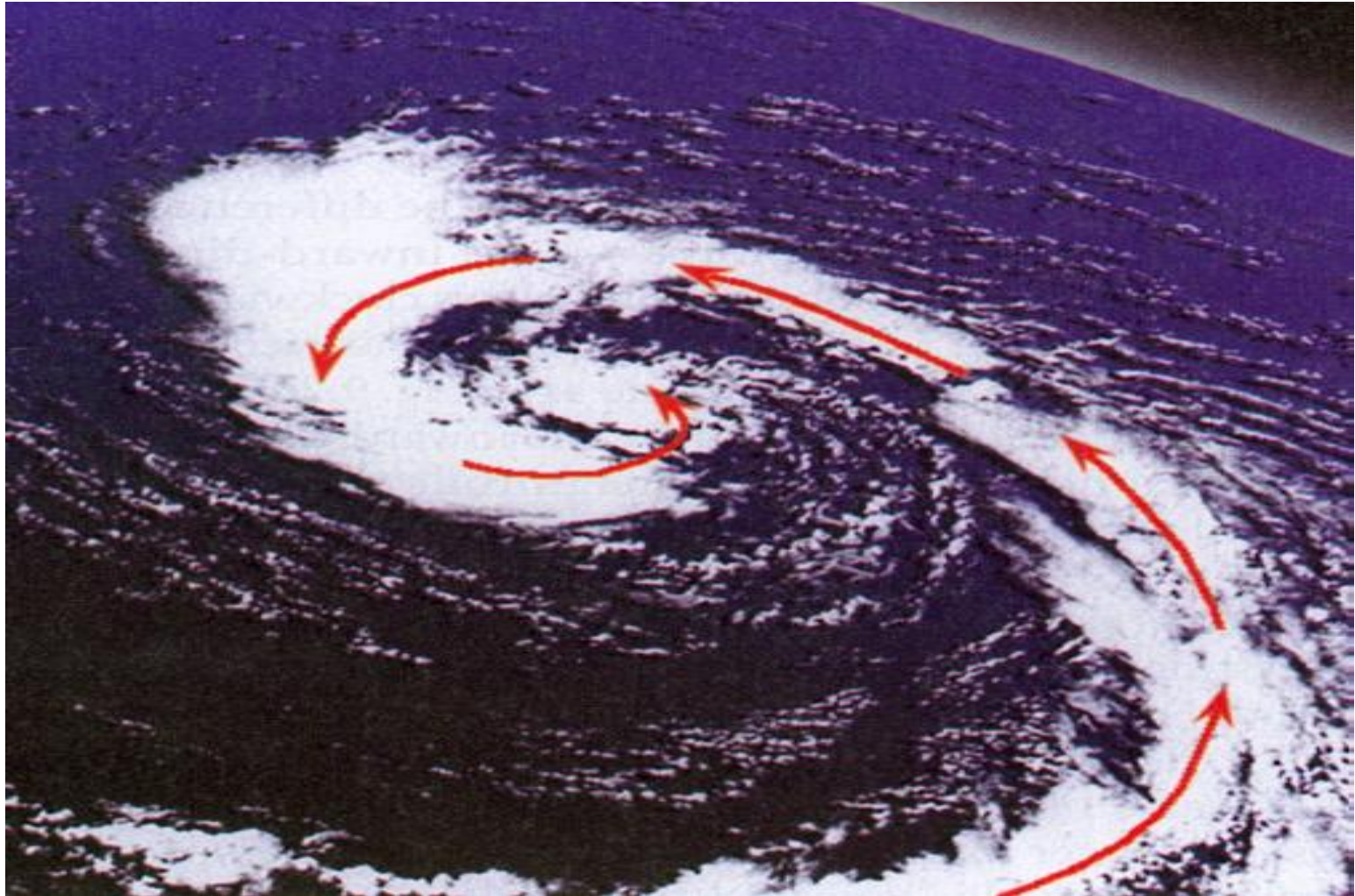
Surface Cyclone

- Low pressure cells are cyclones, (high pressure cells anticyclones).
- Air driven towards the centre of a cyclone by the PGF gets deflected by the Coriolis “force” to spiral around the centre.



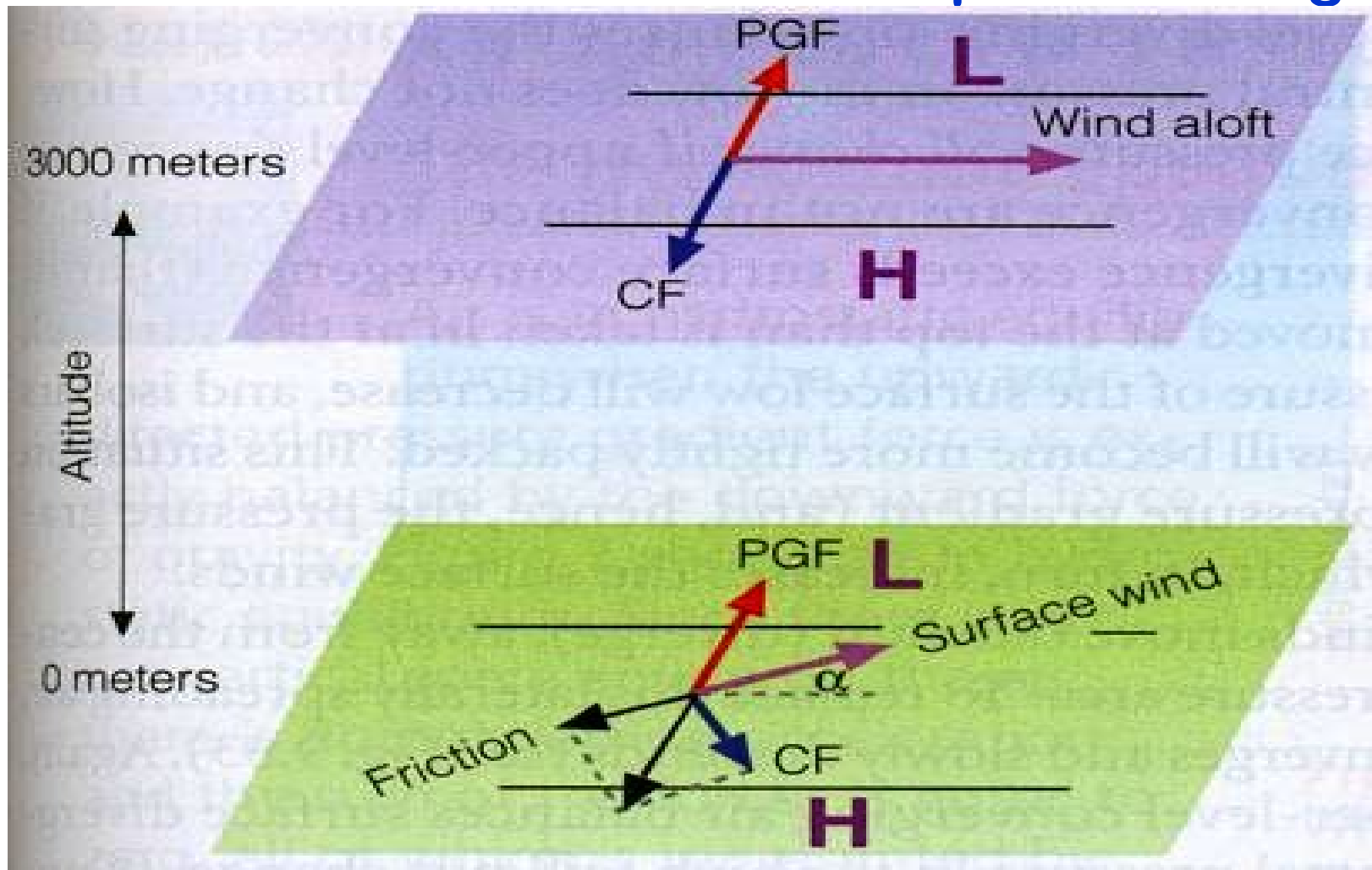
3. Global Winds on a rotating planet

Comma-shaped cloud structure of a cyclone in temperate latitudes



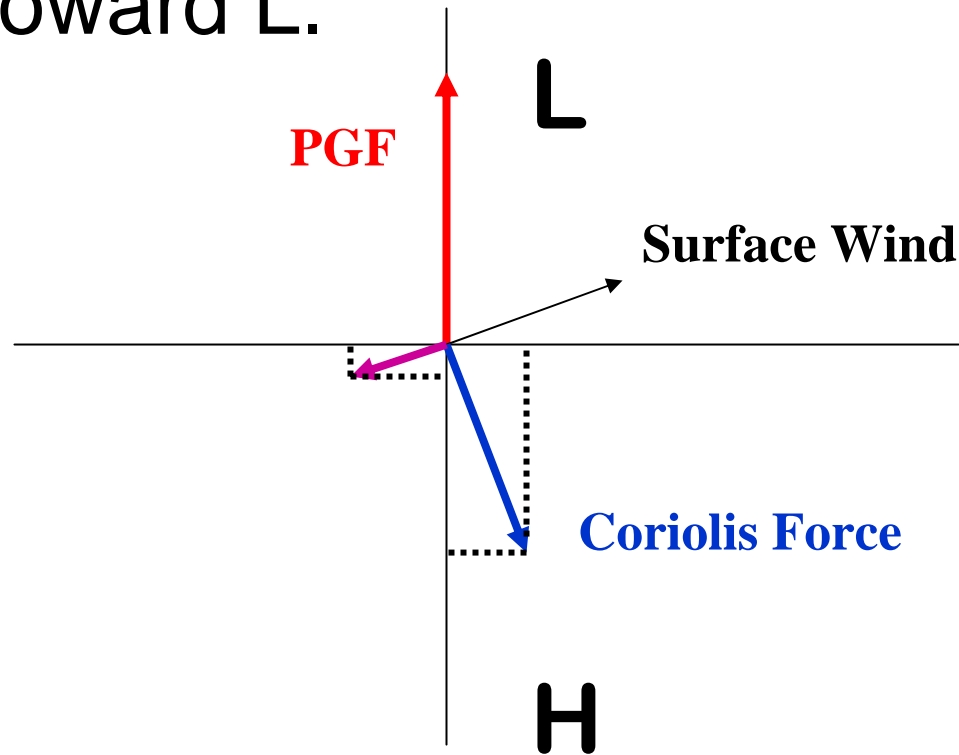
Role of Friction

- Ground friction slows wind => CF weakens.
- CF+friction balances PGF.
- Surface wind tilted toward low pressure region.



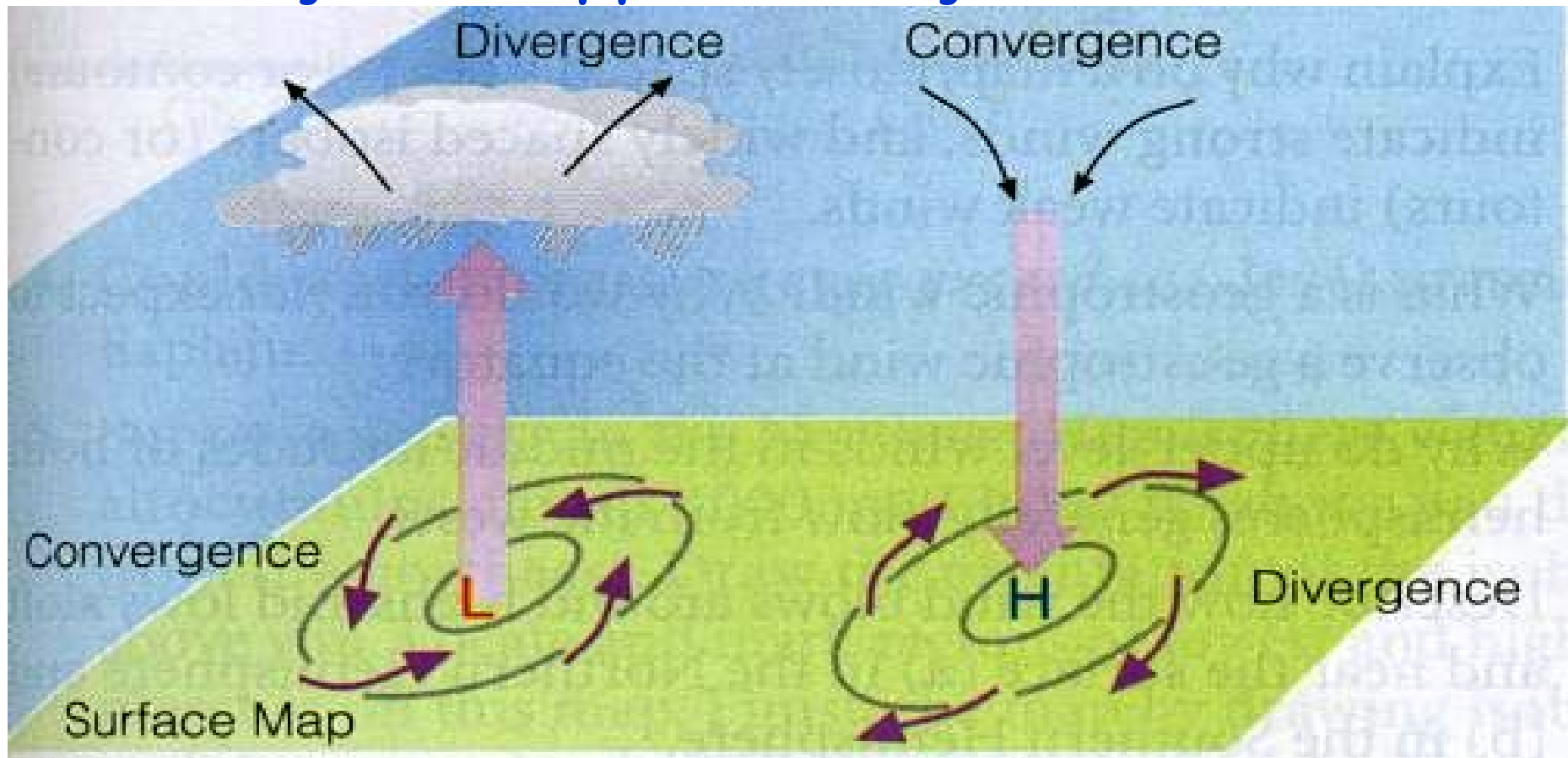
Vector addition for Geostrophic Balance with Friction

Net sum of force vectors must be zero. For this to happen, surface wind must point slightly toward L.

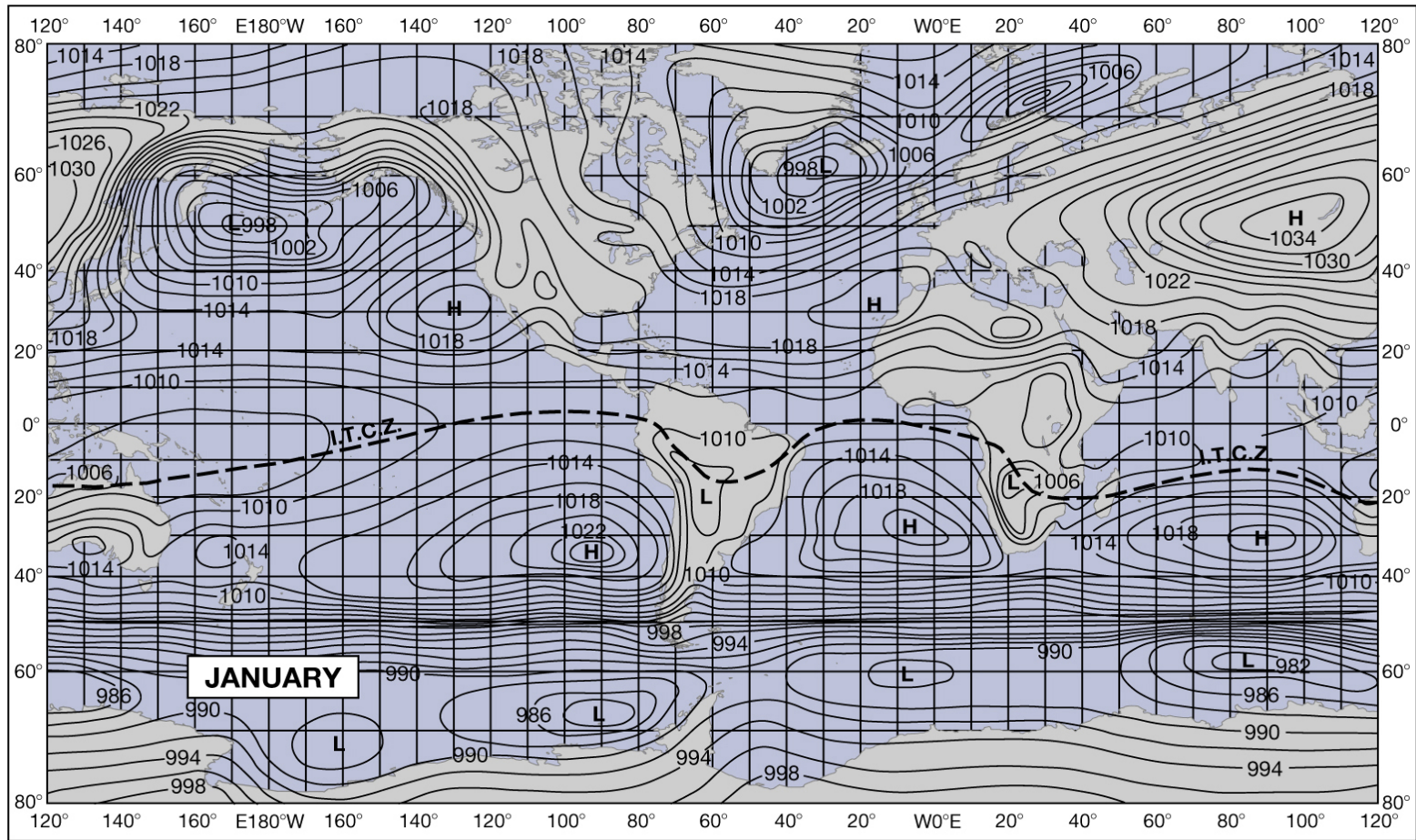


Convergence & divergence

- Cyclone has convergence near ground but divergence at upper level.
- Anticyclone: opposite of Cyclone.

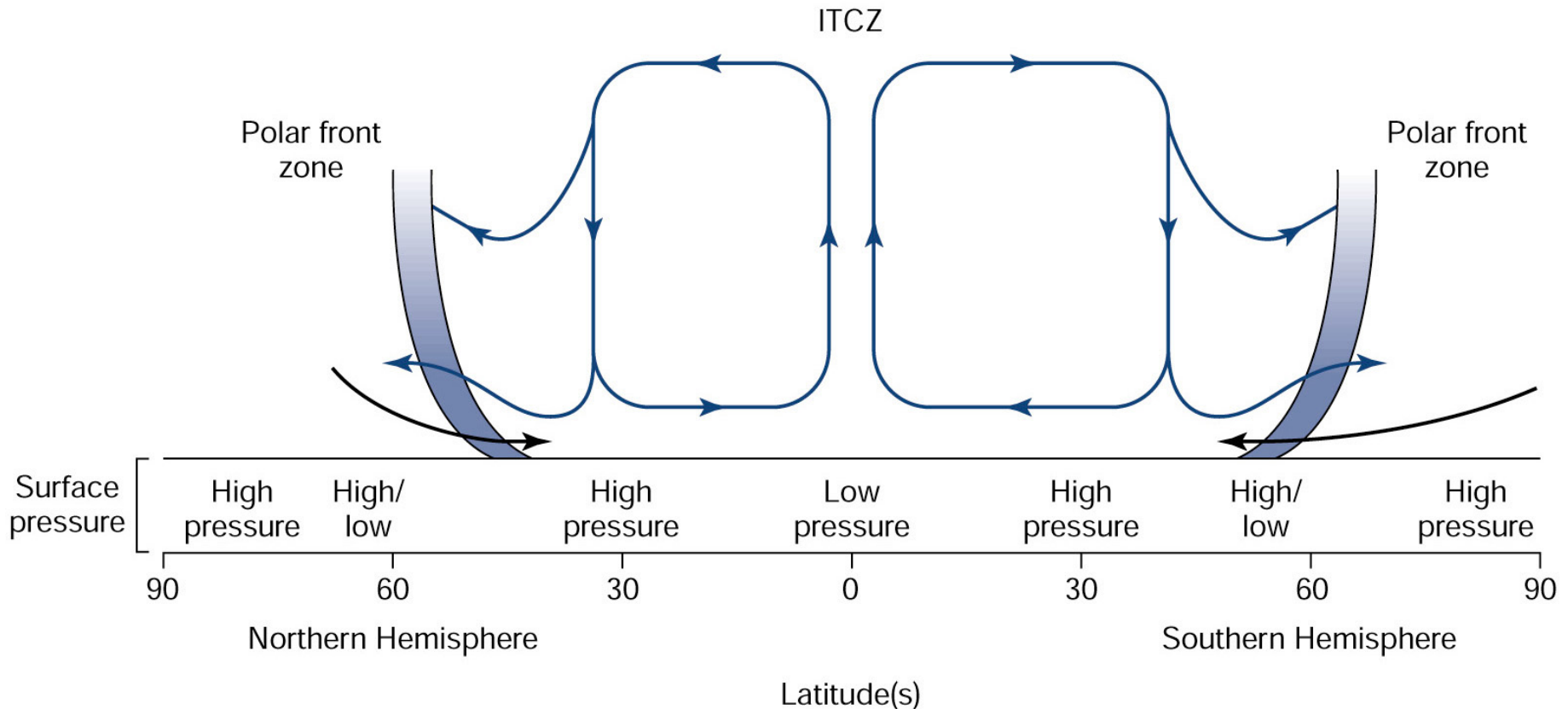


Average Sea-level Pressure (January)



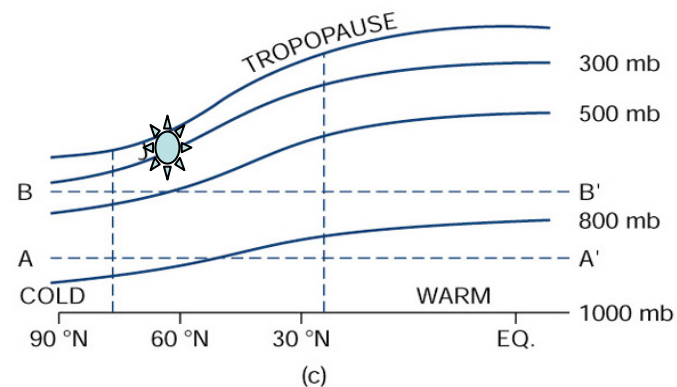
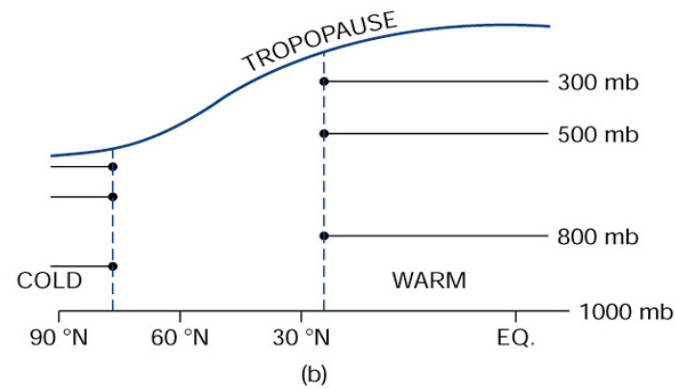
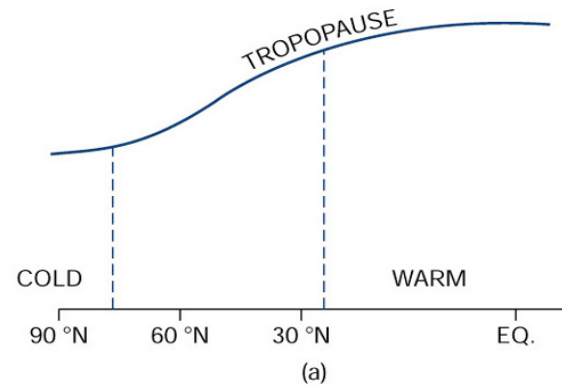
(a)

Global winds on a rotating planet



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The Jet Stream



Global upper-level winds (300mb)

