What Drives Circulation of Upper Ocean?

Short answer: Energy from the Sun and Earth’s rotation

Atmospheric circulation on an idealized non-rotating Earth

- Energy from Sun causes differential heating of ocean and atmosphere

Coriolis Effect

- Arises from motion on a rotating earth
- Depends on observer’s frame of reference
**Coriolis Force**

From space, we see that it arises from the conservation of momentum as the earth rotates under a moving object.

**Magnitude:** \[ F/m = 2\Omega \sin\varphi \cdot v \]

Where: 
- \( \Omega \) is earth’s rotational velocity (constant)
- \( \varphi \) is latitude, and
- \( v \) is velocity of the object.

**Direction:**
- Right in the Northern Hemisphere
- Left in the Southern Hemisphere

---

**Atmospheric circulation on an idealized rotating earth (with Coriolis Effect)**

- Polar easterlies
- Subpolar low
- Westerlies
- Subtropical high
- NE trade winds
- SE trade winds
- Subtropical high
- Westerlies
- Subpolar low
- Polar easterlies

---

**Atmospheric circulation and source of planetary winds**

- Polar front
- Subpolar temperate
- Subtropical ”Horse Latitudes”
- Equatorial Doldrums
- Subtropical ”Horse Latitudes”
- Temperate
- Subpolar
- Antarctic front
- Polar front
- PF
- AF
- ITCZ
- PF
- Antarctic Front
- AF
The weather patterns of Temperate Regions

Atmospheric Pressure Systems

- Land masses heat in summer and cool in winter faster than ocean, because land has lower heat capacity than water.
- This leads to seasonal effects: formation of cold high pressure systems over continents in winter and warm low pressure systems over continents in summer.

Atmospheric Pressure Systems: Northern Hemisphere Winter

Atmospheric Pressure Systems: Northern Hemisphere Summer
High and Low Pressure Cells: Geostrophic Balance

Undulations in the Jet Stream and Polar Front