1. Atmospheric Circulation
• Do tropics have seasons?
• Would seasons exist if Earth’s spin axis was not inclined at all?
What if Earth’s spin axis was exactly vertical to the orbital plane?
Latitude variation in solar heat input

- Strong reflection
  - Large "footprint"
  - Solar radiation
- Weak reflection
  - Small "footprint"
  - Solar radiation

Same input
Same input
Air heated by the ground
As the moisture-laden warm air rises, it must cool down because the tropospheric temperatures decrease with height. The resulting cooled, and therefore denser, air must now fall.

- What if the tropospheric temperature gradient changes?
- Why is ozone good over Antarctica but bad over Southern California?
Three forces govern tropospheric circulation:

- **Differential heating:**
  Tropics receive most solar heating.

- **Differential gravity:**
  Gravitational acceleration is most at the poles, least at the equator.

- **Differential rotation:**
  Equatorial surface wind blows to the west, against the direction of Earth’s spin.
Patterns in Global Air Circulation

- Polar easterlies
- Polar high
- Polar front
- Polar cell
- Air rises
- Ferrel cell
- Horse latitudes
- Hadley cell
- Doldrums (ITCZ)
- Air falls
- NE trade winds
- SE trade winds
- Westerlies
The rotational rate displays a pronounced latitudinal effect.

Quito moves at 1,658 km/hr (1,036 mi/hr). Note: Quito’s longer distance through space in 1 hour—still 15°.

Buffalo moves at 1,260 km/hr (787 mi/hr)
Note: Buffalo’s shorter distance through space in 1 hour—still 15°.
Major surface wind patterns

- Westerlies
- Trades
Sea Surface Salinity

Tropical cyclones develop in the hot, humid air over a sea surface exceeding 26°C in temperature.