

## Climate Change:

### Earth, The Sun, & The Seasons:

- Insolation (incoming solar radiation)
  - Insolation  $\uparrow$  Temp  $\uparrow$ 
    - Temperature  $\downarrow$  altitude  $\uparrow$  EXCEPT Thermosphere
  - Highest at equator
- Rate of incoming energy outside the atmosphere:  $\sim 1360 \text{ W m}^{-2}$
- Seasonal temperature contrasts due to tilt of Earth's axis + angle of Sun's rays (23.5 degrees)
  - + wind cells shift + large bodies of water
- Earth's axis is always tilted in same direction causing distribution of insolation to change with seasons
  - March – equinox – 12hr daylight, 12 hr darkness
  - June – summer solstice – summer in NH (tilt toward sun), winter in SH
  - September – equinox – 12hr daylight, 12 hr darkness
  - December – winter solstice – summer in SH (tilt toward sun), winter in NH

### Net Radiation:

- Difference between incoming and outgoing radiation
- High latitudes = energy deficit
- Poleward heat transfer moves surplus energy from low (equator) to high (poles) latitudes
  - Incoming energy gain between tropics + equator
  - Outgoing energy deficit at poles
- Largely due to wind

### Ice Albedo Effect:

- Cold  $\rightarrow$  more snow  $\rightarrow$  more sunlight reflects
  - Less heat retained each cycle = colder
- 30% reflected = albedo

### Earth's Energy Budget:

- Incoming solar energy (100%)  $\rightarrow$ 
  - 16% absorbed by atmosphere
  - 3% absorbed by clouds
    - Although atmosphere = atmosphere + clouds
  - 51% absorbed by surface
  - 6% reflected by atmosphere
    - 6% reflected directly into space
  - 20% reflected by clouds
  - 4% reflected by Earth's surface
- 20% absorbed by air systems
- 50% absorbed by earth
  - Absorbed  $\uparrow$  kinetic energy  $\uparrow$  temp
- 30% reflected
  - Not immediately lost, stored for period of time