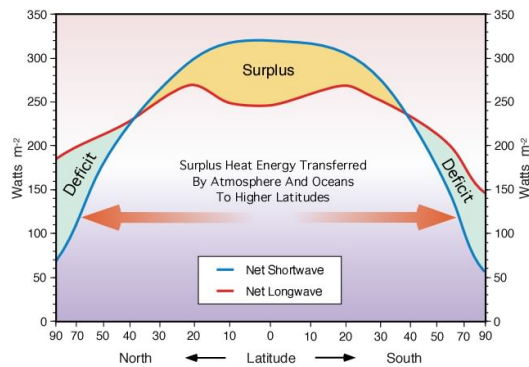
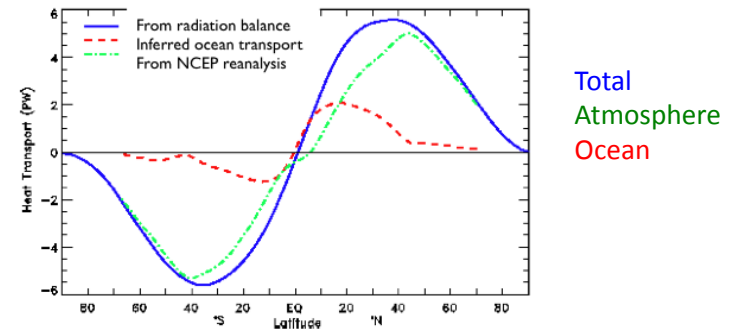


## Annual Radiation Balance



The meridional gradient in Absorbed Solar Radiation drives circulation.

## Northward Energy Transport

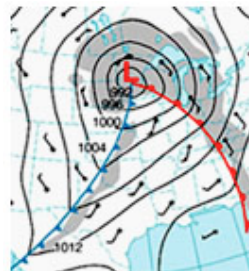
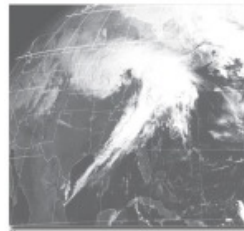


Ocean does most of the transport in the deep tropics (15°S-15°N)

Atmosphere does most of the transport poleward of 30°N,S

## What does the energy transport?

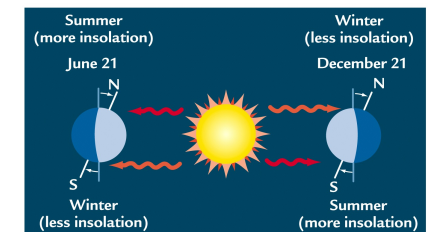
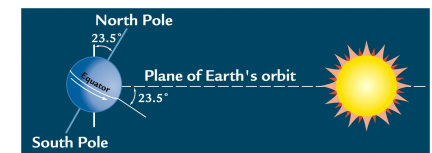
- Circulation move excess heat and moisture from tropics to the poles
  - Advection of warm/cold air by midlatitude storms accounts for ~40%
  - Net evaporation in tropics -> net condensation in polar regions accounts for ~40%
  - Ocean currents (~20%)

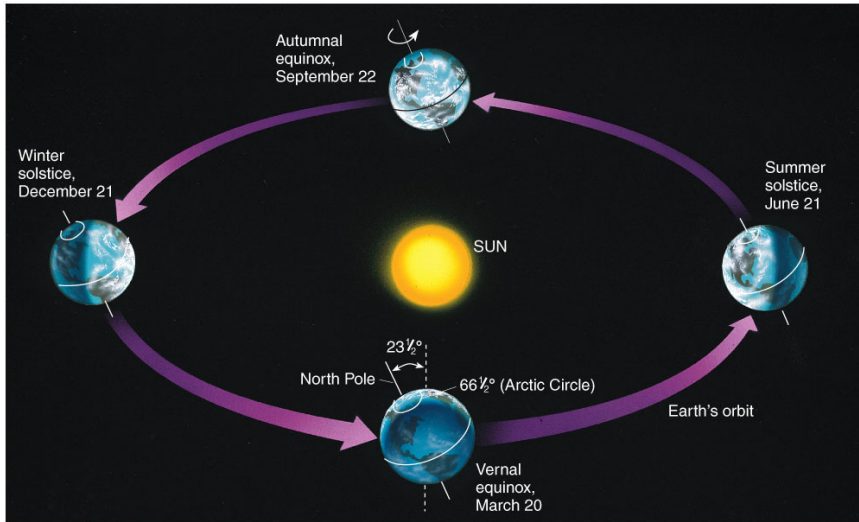


## Orbital Variations and Insolation

### Obliquity or Tilt

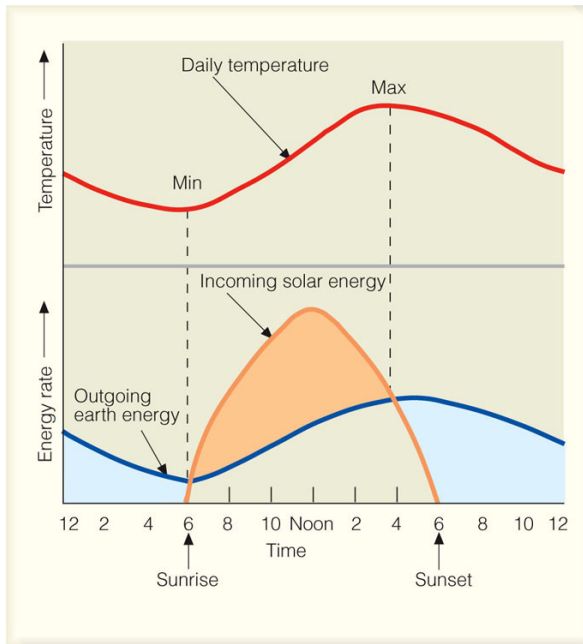
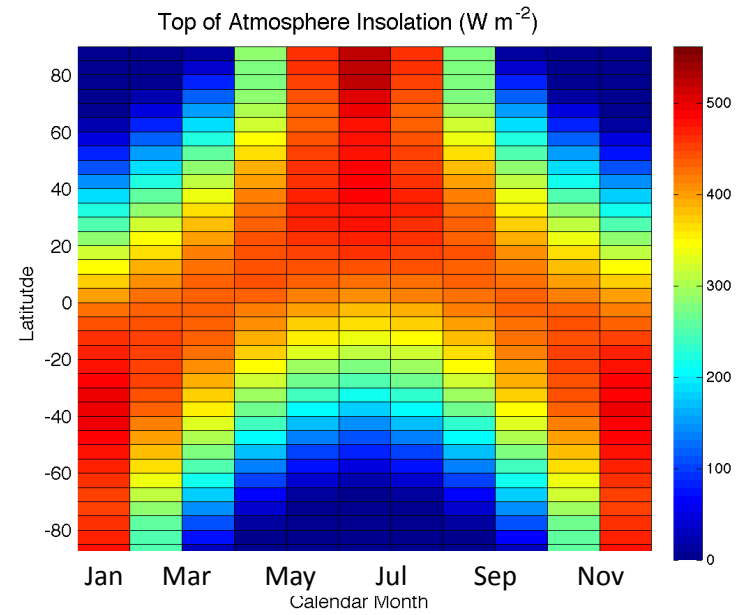
- Tilt angle is presently 23.44°
- Tilt is the main reason why we have large seasonal cycles in mid-latitudes and polar regions
  - More tilt, more extremes in seasonal cycle
  - No tilt, no seasons





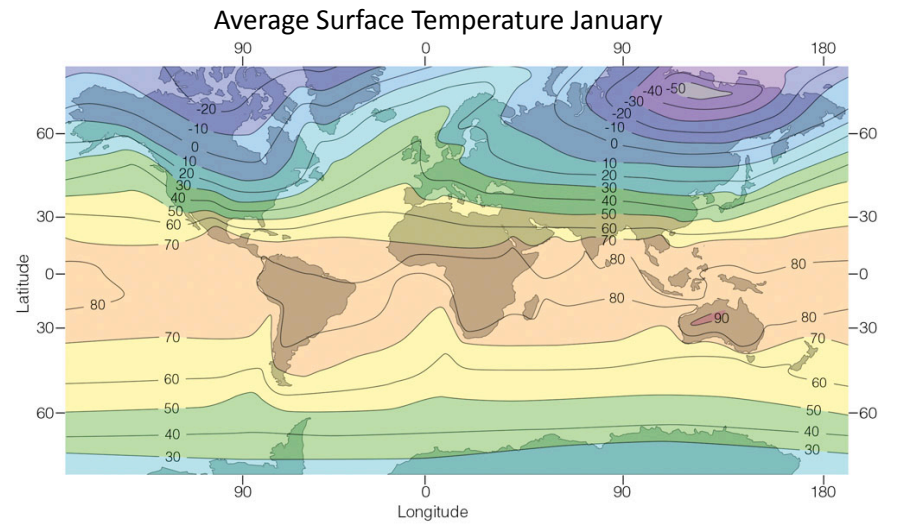
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Fig. 3-3, p. 57



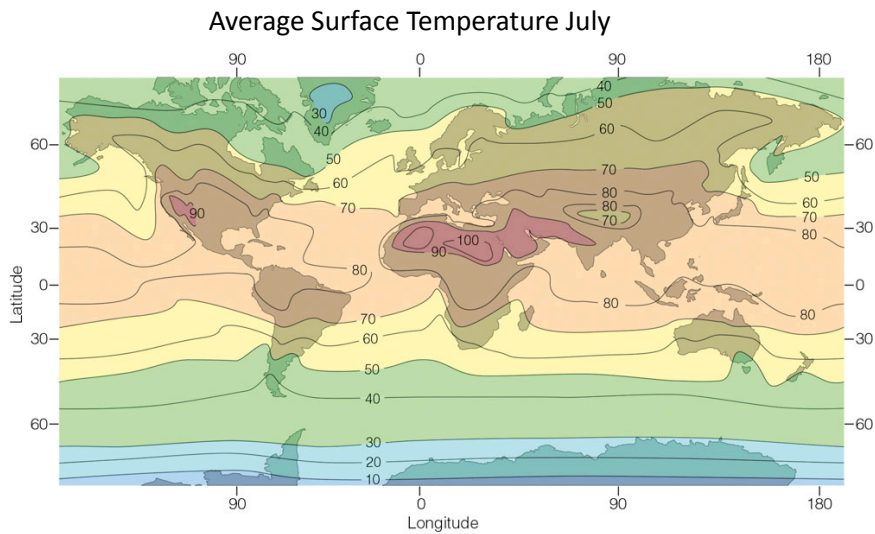
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Fig. 3-13, p. 65



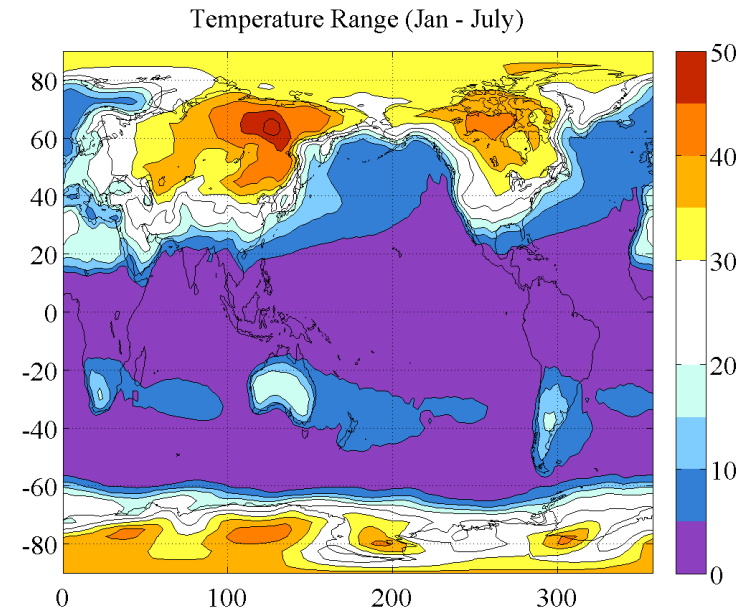
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Fig. 3-20, p. 72



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Fig. 3-21, p. 72



## Periodic Temperature Cycles

- The Annual Average Equator-to-Pole Temperature difference
  - Due mainly to differences in Solar energy absorbed at the surface, which is mainly due to
    - Differences in *intensity* (energy per unit area) of insolation at the top of the atmosphere (2/3)
    - Distribution of clouds vs. latitude (more in midlats and polar regions, less in tropics) that reflect sunlight (1/3)
- The Diurnal (day-night) Cycle of Temperature
- The Annual Cycle of Temperature
  - Due to Earth's "tilt" (rotational axis not perpendicular to plane of the Earth-Sun orbit)
- Maritime vs. Continental
  - Mainly due to different amount of mass that is heated
- Odds and Ends
- Summary of Temperature Controls