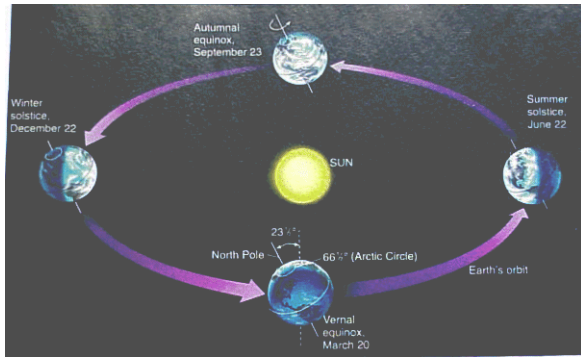
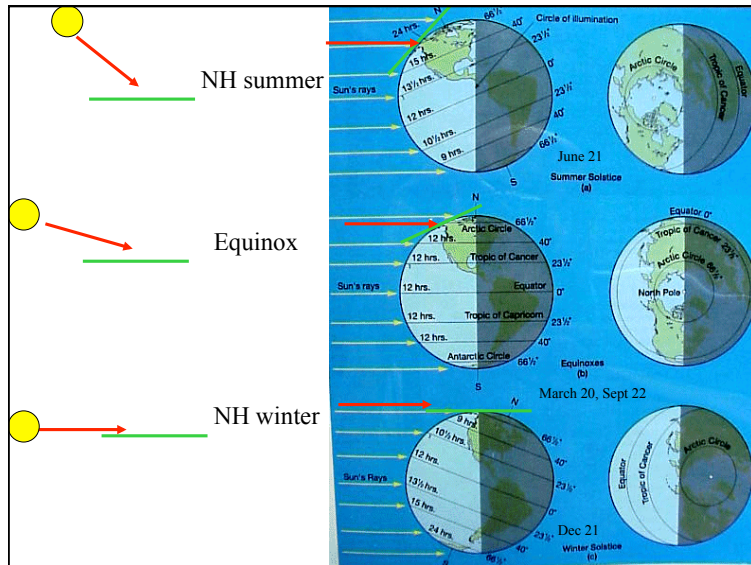
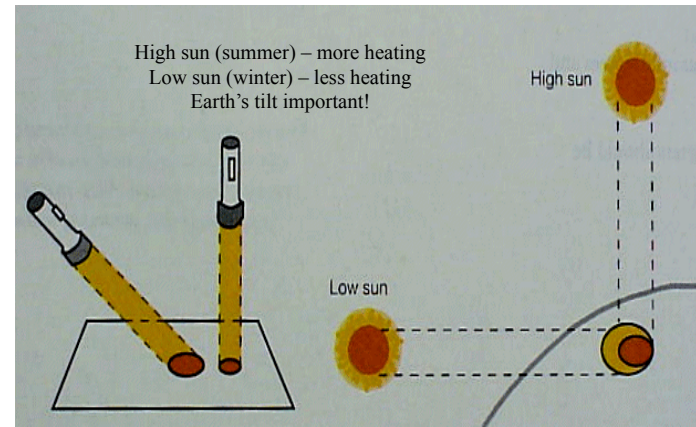


The Earth's Orbit Around the Sun

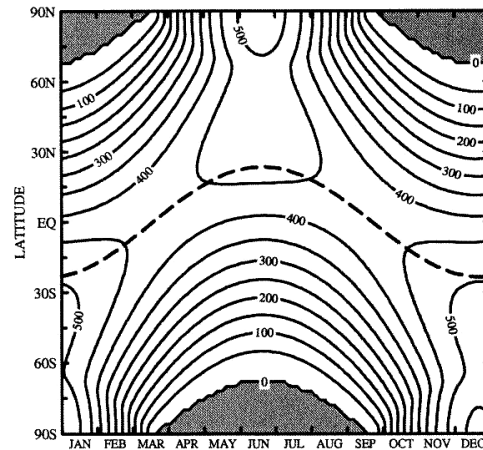


- Seasonally varying distance to sun has only a minor effect on seasonal temperature
- The earth's orbit around the sun leads to seasons because of the tilt of the Earth's axis

Smaller angle of incoming solar radiation: the same amount of energy is spread over a larger area



Daily Total Sunshine

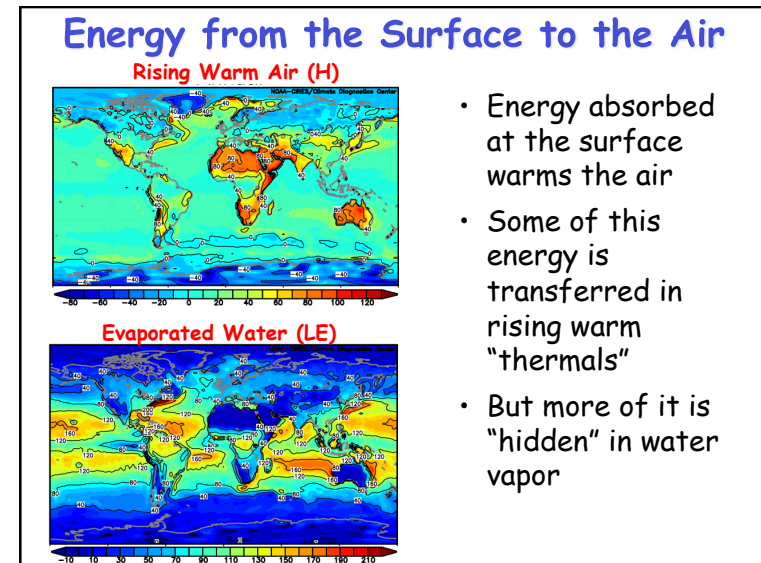
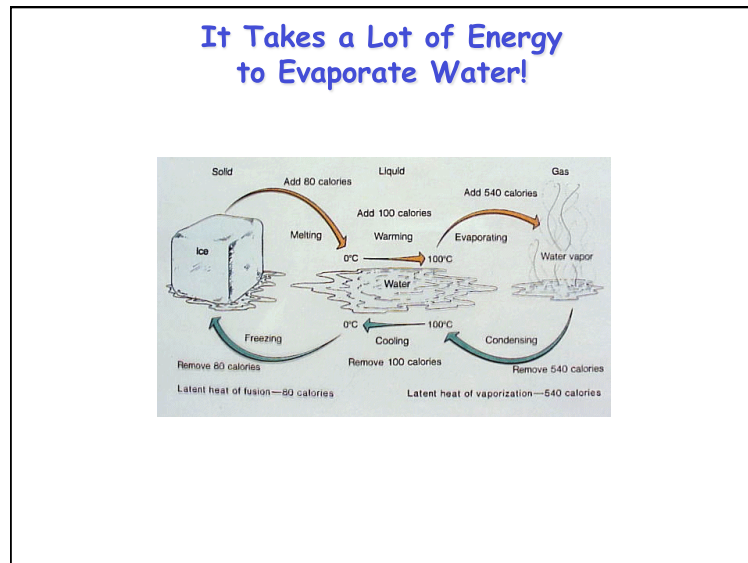
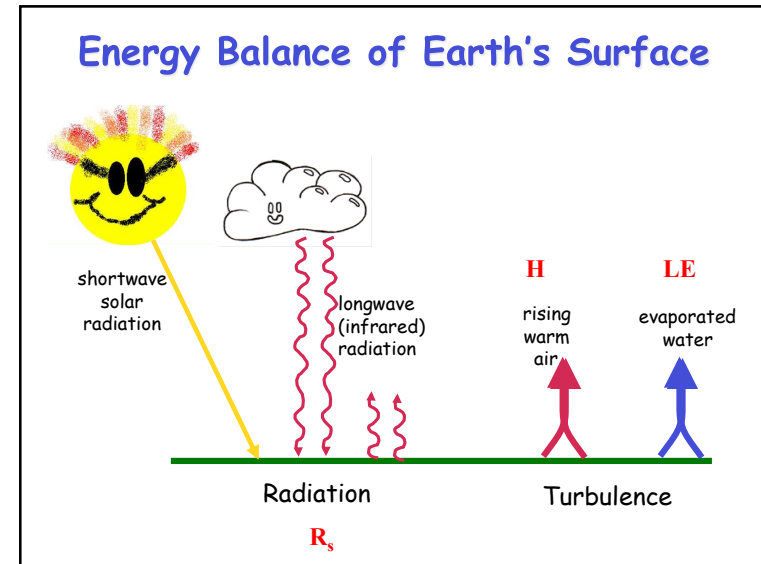


- 75° N in June gets more sun than the Equator
- N-S gradient very strong in winter, very weak in summer
- Very little tropical seasonality

Surface Albedos (percent)

Surface type	Range	Typical value
Water		
Deep water: low wind, low altitude	5-10	7
Deep water: high wind, high altitude	10-20	12
Bare surfaces		
Moist dark soil, high humus	5-15	10
Moist gray soil	10-20	15
Dry soil, desert	20-35	30
Wet sand	20-30	25
Dry light sand	30-40	35
Asphalt pavement	5-10	7
Concrete pavement	15-35	20
Vegetation		
Short green vegetation	10-20	17
Dry vegetation	20-30	25
Coniferous forest	10-15	12
Deciduous forest	15-25	17
Snow and ice		
Forest with surface snowcover	20-35	25
Sea ice, no snowcover	25-40	30
Old, melting snow	35-65	50
Dry, cold snow	60-75	70
Fresh, dry snow	70-90	80

- Snow and ice brightest
- Deserts, dry soil, and dry grass are very bright
- Forests are dark
- Coniferous (cone-bearing) needleleaf trees are darkest



Things to Remember

- All energy exchange with Earth is **radiation**
- Outgoing radiation has longer waves (cooler)
- Longwave radiation is **absorbed and re-emitted by molecules** in the air (H_2O & CO_2)
- Recycling of energy between air and surface is the **"greenhouse effect"**
- Changes of **angle of incoming sunlight** and length of day & night are responsible for seasons and for north-south differences in climate
- Regional energy surpluses and deficits drive the **atmosphere and ocean circulations** (wind & currents)