Chapter 2.
Solar Radiation and the Seasons

Energy
• Solar Radiation
  – Creates atmospheric motions and weather processes

• 2 Energy Classifications
  – _____ - energy in motion. Described as energy in use.
  – Potential – energy stored. Described as energy that hasn’t yet been used.

Energy Transfer Mechanisms
• All objects emit energy

• Energy transfer through direct contact
  • Heating a metal rod causes energy to move from hot end to the colder end
  • Metals are good conductors
  • Air is a poor conductor
  • Ineffective in affecting weather processes

Energy Transfer Mechanisms
• Convection
  – Energy transfer through gases or liquids without physical contact
  – Bubbles rise in a pan of boiling water by conduction
  – Extremely effective in creating weather phenomena

Energy Transfer Mechanisms
• Radiation
  – No physical medium required for transmission
  – The Sun is the driving force for all weather processes
  – All energy is electromagnetic
  – Travels in a wave-like pattern

• Radiation
  – Electric waves and magnetic waves travel perpendicular to one another

  – Radiation quantity and quality
    • amplitude - the wave height which determines the amount of energy
    • wavelength - determined by the length of the wave which identifies the type of energy
      – measured in microns (____)
  – Types of radiation
    • Gamma rays, X-rays, ultraviolet (UV), visible, infrared (IR), and radio waves

• Radiation Laws
  – Physical laws define the amount and wavelength of emitted energy
  – Stefan-Boltzmann Law
    •
• E =
• E =
  – Stefan-Boltzmann Law
    • Blackbodies emit the maximum amount of energy
    • Graybodies emit a percentage of the maximum possible for a temperature
  • Emissivity (ε) – the percentage of energy emission of a substance as compared to a blackbody
  – ________________
    • Determines peak wavelength
    • _______ = 2900/T
  • Sun = _______ (___________ energy)
  • Earth = _______ (___________ energy)
  • Helps determine cloud heights from IR satellites
• The Solar Constant
  – The average amount of energy received from the Sun by the Earth
    • Solar constant = 1367 W/m²
  – Energy intensity decreases in proportion to the distance squared (Inverse square law)
  – Insolation –
• Earth’s Seasons
  – Earth’s rotation axis is tilted ______________ (inclination axis)
  – As the Earth travels around the sun the orientation of Earth to Sun constantly changes
    – 4 seasons
      • Winter Solstice
      • Vernal Equinox
      • Summer Solstice
      • Autumnal Equinox
• Earth’s Seasons
  – Rotation –
    • Takes 24 hours (23h 56’ 4”)
    • Causes day and night
    • North star (Polaris) directly above North Pole
    – ______________ – Earth in orbit around the Sun
      • Takes 365.25 days
      • Travels on a flat plane called ecliptic plane
      • Perihelion – Earth closest to Sun (Jan. 3)
      • Aphelion – Earth farthest from Sun (July 3)
• Winter Solstice
  – December 21st – 22nd
– **Subsolar point** – location on the Earth where the Sun’s rays are directly overhead at 90°
  • Tropic of Capricorn (23.5°S)
  – Southern hemisphere receives more energy
  – Short days and long nights

•
  – June 21st – June 22nd
  – Earth’s axis is tilted towards the Sun
  – Subsolar point = 23.5°N
  • Tropic of Cancer
  – Northern hemisphere receives more energy
  – Long days and short nights

• **Vernal Equinox**
  – March 21st – 22nd
  – Earth is not tilted towards or away from Sun
  – Subsolar point = 0° (Equator)

• **Autumnal Equinox**
  – September 22nd – 23rd
  – Subsolar point = 0° (Equator)
  – Every location receives 12 hours of daylight

• **Receipt of Incoming Solar Energy**
  – Length of daylight
  • __________ always receives 12 hours daylight
  • Arctic circle 66.5°N
  • Antarctic circle 66.5°N
  • Locations north of Arctic circle and south of the Antarctic circle sometimes receive 24 hours daylight and darkness

• **Receipt of Incoming Solar Energy**
  – **Solar angle** – angle of sun above horizon
  • More energy with higher Sun angles due to less beam spreading
  • **Angle of incidence** – angle at which Sun’s rays hit the surface

• **Receipt of Incoming Solar Energy**
  – __________ – latitude of the subsolar point
  • Winter Solstice = _______ (Tropic of Capricorn)
  • Summer Solstice = _______ (Tropic of Cancer)
  • Vernal Equinox = _____ (Equator)
  • Autumnnal Equinox = ____ (Equator)
  – Noon sun angle (NSA) – angle of noon Sun above the horizon

• NSA = 90° – (latitudinal degrees between observer and solar declination)

**Receipt of Incoming Solar Energy**
– Atmospheric Beam Depletion – amount of atmosphere Sun’s rays have to travel through
  • Explains why you can look at the Sun during sunset or sunrise
  • Sun is most intense at noontime