Global Temperatures

Physical Geography Lecture – GEOG B1
Available on: www.cherylnail.com

Heat is…

- Heat is a form of energy
- Temperature is not.
- Temperature is a measure of the average kinetic energy of individual molecules in matter.
- **Temperature is a measure of heat.**
- Heat flows from matter at higher temperatures toward matter at lower temperatures. Heat transfer results in a change of temperature

Temperature Scales

- Temperature at which atomic and molecular motion completely stops is **absolute zero.**
  - 0° Kelvin
  - -273°C
  - -459°F
- Fahrenheit scale: Ice melts at 32°F/water boils at 212°F
- Celsius scale: Ice melts at 0°C/water boils at 100°C

(at sea level)

Temperature Scales (cont.)

- Kelvin scale: starts at absolute zero, and makes temperature readings proportional to actual kinetic energy.
- Ice melts at 273°K/water boils at 373°K

- See **Figure 5.3** for all three scales

Thermometers

- A standard thermometer is a sealed tube that contains liquid that expands and contracts according to the addition or removal of heat.
- Fluid is stored in a reservoir and the tube has calibrated markings

Official Temperature Readings

- Standardized Official Temperature readings come from thermometers that are housed in instrument shelters.
- The instrument shelters shade and protect the thermometers (and other instruments) against direct sun exposure. See **Figure 5.4**
    - White – have an increased albedo
    - Louvered to increase ventilation
    - Mounted at least 1 meter above the ground on turf
- 16,000 weather stations worldwide
    - Provide at least once daily reading
    - Sometimes hourly reading

World Meteorological Organization

- 1992 – Global Climate Observing System
    - Coordinates reading and recording of temperature and other climate data worldwide
- Satellites measure land-surface temperature (LST) -- Satellites can’t measure air temperature

Latitude Temperature Controls

- Subsolar Point: Sun directly above
- 23.5°S to 23.5°N
- experiences intense insolation
- Insolation is less intense poleward
- Decreased sun angles
- More atmosphere to
- Variable day length
- Seasonal variations in temperature

Altitude vs. Elevation

- Temperature decreases with an increase in altitude
  - Mountainous areas have lower temperatures compared to sea level areas.
- Altitude refers to airborne objects
- Elevation refers to the height of a point on a surface.

Effects of Latitude & Elevation

- Latitude and elevation combine to create temperature characteristics at many locations.

Cloud Cover

- At anytime 50% of the Earth is covered in clouds
- Clouds affect Earth-atmosphere energy balance by reflecting (albedo?) and absorbing radiation
- Cloud cover can moderate temperature
- air temperatures are colder on clear nights
- Cloud cover is the most variable factor influencing Earth's radiation budget

Land-Water Heating Differences

- Land heats and cools faster than water
  - See **Figure 5.7**
- **Evaporation** dissipates significant amounts of energy(heat) arriving at the ocean surface.
  Aka: Evaporative heat loss

Land-Water Heating Differences

- Insolation hits water surface and passes through due to its ***transparency*** – causing available heat energy to be dissipated over a depth of 60-300 meters.
- Insolation hits soil surfaces and does not pass through—it is absorbed and heats at the surface.

Land-Water Heating Differences

- Specific Heat: heat capacity of a substance
- Energy needed to increase the temperature of water is greater than for an equal volume of land.
- Water can hold more heat than soil.
- The specific heat of water is approx. 4 times that of land.
- Water is an energy reservoir – it heats and cools more slowly
- Temperatures near large bodies of water tend to be moderated rather than experience large

Land-Water Heating Differences

Water moves!

- it mixes cooler and warmer waters
- Spreads energy over greater volume
- Ocean currents move warmer waters to cooler land climates.

Land – doesn't move

Example: ***Gulf Stream*** See **Figure 5.8**

moves warmer water from the Caribbean to the N. Atlantic

Land-Water Heating Differences

- ***Marine Effect*** (maritime effect) – refers to temperature moderating influences of ocean usually in locations along coastlines and islands
- ***Continental Effect*** (Continentality) – refers to greater range between maximum and minimum temperatures in areas inland from large bodies of water.

See **Figure 5.10** & **5.11**

Temperature Patterns of Earth

- Isotherm – lines on temperature maps
- Isoline – lines that connect points of equal temperature (helps show patterns)
- Thermal Equator – isotherm connecting all points of highest mean temperature

See **Figure 5.12 & 5.13**

Polar Regions

- January Averages see **Figure 5.14**
  - Winter in the Northern Hemisphere
  - North Polar region – water surrounded by land
  - South Polar Region – ice sheet over continent surrounded by water
- July Averages see **Figure 5.15**
  - Winter in the Southern Hemisphere

Recent Temperature Trends & Human Response

- Study past climates
- Present temperatures are higher than at any time in past 125,000 years
- Heat waves on the rise
- Temperature increase an average of 0.17°C (0.3°F) per decade since 1970
    - See **Figure 5.17**

Recent Temperature Trends & Human Response

According to US Natural Research Council of Natural Academy of Sciences:

For each °C of global temperature increase we can expect:

- 5 – 10% change in precipitation
- 3-10% increase in amount of precipitation falling during heaviest precipitation events
- 5-10% change in flows of streams or rivers (up/down)
- 25% decrease in extent of Arctic Summer Ice
- 5-15% reduction in crop yields
- 200-400% increase in areas burned by wildfires

Recent Temperature Trends & Human Response

- Global warming is related to complex changes in lower atmosphere
- Human activities increasing atmospheric greenhouse gases that absorb LW radiation – delaying losses of heat energy to space
- Enhancing natural greenhouse effect & forcing climate change

Recent Temperature Trends & Human Response

- Global Warming is **NOT** the same thing as climate change!
- Climate Change includes all effects of atmospheric warming
- Climate is always changing but human activities are speeding it up unnaturally.
  - see **Pg. 129**: Human Denominator 5: Global Temperatures

Heat Stress & Heat Index

- Heatwave – prolonged period of abnormally high temperatures (see **Pg. 126-127** [Focus Study 5.1])
- Heat causes humans to perspire, which cools us down.
- But if humidity is up also, sweating won't cool us down as well, which leads to problems for the young, old, and sick.
- The aforementioned problems lead to heat stress

- see **Figure 5.18** – Heat Index