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Geography 11
Tuesday January 24, 2006 Konrad

Announcements:
Test dates have been posted on the website.

Errata:

Notes Begin:

***See Power Point presentation "Heat Transfer" on Blackboard for lecture slides.**

Radiation Transfer

A. **Q* > 0 in the morning**
B. **Q* < 0 at night**
    a. **There is no shortwave radiation and there is more longwave leaving than coming in. This means the temperature of the atmosphere is less than the temperature of the surface.**
C. **What factors control the values of the following radiation terms?**
    a. **K : solar elevation (when the sun is higher, radiation is greater); clear atmosphere (more shortwave penetrates)**
    b. **K : albedo of the surface (light surface is more reflective and there is higher K , dark surface has low albedo and lower K)**
    c. **L : correlated with mean temperature of the atmosphere (Stefan – Boltzman law)**
    d. **L : temperature of surface (when we reach maximum temperatures in the afternoon the most radiation is going out to space)**
D. **Refer to Graph "Local Radiation Budget"**
    a. **Net Incoming K: Positive values before sun rise leads to diffuse radiation/scattered light. If there is more "stuff" in the atmosphere, light is visible earlier and it stays dark later because of increased scattering.**
    b. **Midnight: Positive outgoing L – moving through the night the value decreases because surface temperature gets lower. Even at sunrise (6 AM) outgoing L still exceeds incoming K so the temperature continues to cool.**
        i. **The coolest time of the day is between 7:30 and 8:00 AM when Q* = 0.**
    c. **The surface warms throughout the day, outgoing L increases, and at noon incoming K is the greatest. However, the warmest temperatures are not until 3-4 PM because there is still more warming after noon as more radiation continues to come in than leave. It is not until the cross over point when Q* goes back to zero that warming stops.**
    d. **Sunset: Largest disparity and Q* is most negative so temperature drops most rapidly.**
    e. **Q* is the highest between 10 and 11 AM.**
E. **How does the local radiation budget plot change if the following conditions are observed?**

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a. Cloudy skies: prevent direct beam radiation (peaks on both lines would be lower) and at night longwave is absorbed by clouds so the atmosphere is warmer and more longwave is reradiated back to the surface.
b. Dry conditions: The atmosphere is very transparent to longwave, so while the surface radiates longwave away, not much is coming back. This means more cooling.
c. Snow cover: Affects both long and shortwave. Increases albedo, leads to more outgoing shortwave, and prevents warming.
    i. Snow is a perfect radiator and a good insulator.

F. Conduction
a. What controls thermal conductivity at the molecular level?
    i. Density – the metals at the top of the conductivity list are much denser than the materials at the bottom.
b. Examples of Thermal Conductivity
    i. Swimming: The pool feels cool at first. As soon as you get in there is a very strong temperature difference and water carries heat away from your skin.
    ii. Wet Clothes: Heat is conducted out of the body by water.
    iii. Insulation: Does not conduct heat well because lots of air is trapped in it.
    iv. Dog Fur: Fur traps air.
    v. Floors: Concrete has somewhat high thermal conductivity, wood is moderate, but carpet is a good insulator because it traps air.

G. Convection
a. As air gets warmer it expands, density increases, and air begins to rise.
b. This can lead to formation of cumulus clouds and eventually to formation of thunderstorms.
c. Equatorial Low: There is lower pressure than to the N and S, air rises, some goes N and some moves S. Convection is the pump. The more convection, the faster the Hadley cell moves.
d. Convection occurs globally and locally.
e. Examples
    i. Boiling water: Water behaves like the atmosphere. Boiling creates convection where warm water rises up and cool water sinks down.
    ii. Cumulus cloud: An indicator of convection and potential seed of a thunderstorm.

H. Latent Heat Flux
a. Evaporation requires heat - it is absorbed, and goes from sensible to latent state. Condensation releases latent heat.
b. Latent heat depends on how dry the atmosphere is.

I. Energy Imbalances and Heat Transfer

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a. Global
   i. As the northern hemisphere gets warmer, cool air from the N and heat from the S move and mix to compensate for differences in net radiation.