Geography 411
Lecture 5
Terrestrial Radiation

Needs: 2 OVR

A. General

1. all objects above 0°K emit radiation at intensities proportional to the fourth power of their temperature
2. unlike the solar flux, the terrestrial flux is continuous but much smaller in energy per unit area

   a. by S-B law, $E = \epsilon\sigma T^4$

   Examples: for $\epsilon = 1$

   300°K (27°C) = 4.6×10^2 W/m^2

   280K (7°C) = 3.5×10^2 W/m^2

3. 90% of the energy radiated upward to space is absorbed by the atmosphere--mostly by clouds, carbon dioxide, and water vapor
   a. most of this is "back" or counterradiated to the earth

OVR1

   b. what gets out (and in) is at the atmospheric windows, mainly in the visible range (.4 -.7 μm), and around 9 and 10 μm (far-IR ,near the peak radiation level for the earth by Wien's law
   c. all layers absorb, but those near the surface contribute the most, due the abundance of water vapor and higher pressures

B. Measuring and estimating Longwave radiation

1. accurate measurement more difficult than solar, so many empirical relationships to easily measurable atmospheric parameters have been developed
   a. due to large number of materials involved and different emmisivities and effective temperatures
2. longwave from the sky (Swinbank's equation)

   $R_{lw} = 5.31 \times 10^{-13} T^6$ [1.24 text]

   W/m^2 °K (at 1.5 m shelter height)

   Examples:

   300°K = 3.9×10^2 W/m^2
   280°K = 2.6×10^2 W/m^2

   a. most accurate at night, problems during day

3. effective terrestrial radiation (difference between outgoing and counter radiation, Brunt's equation)

$R_t = \sigma T^4(a - b\sqrt{e})(1 - cC)$ [1.25 text]

W/m^2, e = water vapor pressure in kPa, a, b, c are constants, and C is cloud cover in tenths (c depends on cloud type)

a. suggested values for a = 0.6, b = 0.05

OVR2 b. estimated seasonal and geographical variations across the U.S.