

CEE6400 Physical Hydrology

Homework 2. The Climate System and Global Hydrology

Date: 9/12/16

Due: 9/19/16

Objectives.

1. To gain experience in the analysis of the global energy balance and sensitivity of surface temperature to factors involved, such as albedo and the greenhouse effect.
2. To quantify the water balance and its sensitivity to climate for a watershed of interest.

Reading

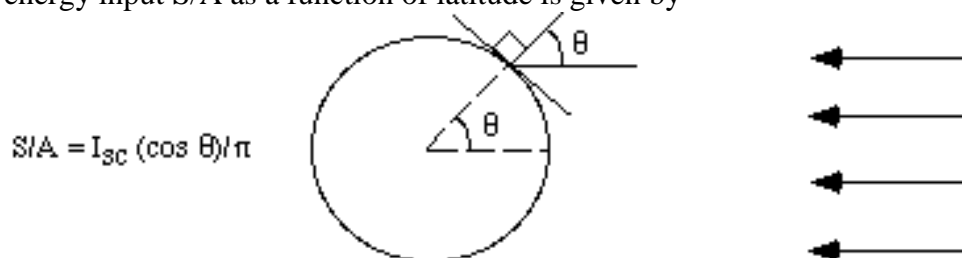
Dingman Chapter 3, Climate section from Dingman 2015 Chapter 2

Questions

1. Dingman 3.1
2. Box 3.1 and problem 3.1 was posed in terms of energy totals over the whole surface of the earth. It could equally well have been posed on a per unit area basis with the input energy per unit area S/A and outgoing longwave radiation σT^4 . Figure 3.4 depicts the variation of energy input with latitude. The solar constant has the value (page 36)

$$I_{sc} = 1367 \text{ W/m}^2$$

Neglecting the tilt of the earth (seasonal effects of solar declination) the per unit area solar energy input S/A as a function of latitude is given by



Use a procedure similar to box 3.1 to calculate the radiational temperature at latitudes of 20° and 40° North.

3. Dingman 3.2. The equation to derive should be 3B2-4 in Box 3-2.
4. Dingman 3.3. While the question says to use Excel, this problem is easily solved using R, so you may use either.
5. Dingman 3.4. You may do this and the next question for any watershed that interests you, including the one you used in the first homework.

6. [This refers to the Climate section from Dingman 2015, Chapter 2 provided, and is based on questions 6 and 7 in that chapter].
 - a. For a watershed of interest estimate the mean annual air temperature and regional PET using equation 2B4.2.
 - b. Then determine a best-fit value of the storage parameter w in the Budyko equation [equation 2.12] by programming the equation in Excel or R, and adjusting the value of w until the calculated value of RO most closely approximates the value for your watershed.
 - c. Estimate the elasticity of runoff to precipitation via equation 2B4.1. In addition to giving the numeric value, write a few sentences that explain in layman's terms what this means.
 - d. Estimate the relative change in runoff due to a temperature increase of $1\text{ }^{\circ}\text{C}$ via equation 2B4.7