METEO 469 PROBLEM SET #4

NAME:

DUE:

Modeling the Earth's Climate Using One-Layer Energy Balance Model

**1. *Worksheet successfully downloaded!***

**2. This exercise will work with solar insolation and the one-dimensional energy-balance model.**

**a. Using the provided Excel spreadsheet, calculate values of global surface temperature and global tropospheric temperature for varying values of the solar constant, ranging from 0 to 2000 W m-2, incremented by 100 W m-2. Assume that the value of planetary albedo is 0.32, emissivity is 0.77, and Stefan-Boltzmann constant is 5.67 x 10-8 W m-2 K-4. Construct a table to show your results.**

**b. Using the values you obtained in (a), plot both global surface temperature and global tropospheric temperature as a function of solar constant; use the same grid for both sets of temperature values. That is, the horizontal axis of the plot should give values of solar constant, and the vertical axis should give values of temperature. Use Excel or another plotting utility of your choice.**

**c. Describe the relationship between solar constant and global surface and tropospheric temperature. Comment on the approximate range of values of solar constant that could support human life on Earth.**

**3. This exercise will work with planetary reflectivity and the one-dimensional energy-balance model.**

**a. Using the provided Excel spreadsheet, calculate values of global surface temperature and global tropospheric temperature for varying values of planetary albedo, ranging from 0 to 1, incremented by 0.05. Assume that the value of the solar constant is 1360 W m-2, emissivity is 0.77, and Stefan-Boltzmann constant is 5.67 x 10-8 W m-2 K-4. Construct a table to show your results.**

**b. Using the values you obtained in (a), plot both global surface temperature and global tropospheric temperature as a function of planetary albedo; use the same grid for both sets of temperature values. That is, the horizontal axis of the plot should give values of planetary albedo, and the vertical axis should give values of temperature.**

**c. Describe the relationship between planetary albedo and global surface and tropospheric temperature. Comment on the approximate range of values of planetary albedo that could support human life on Earth.**

**4. This exercise will work with planetary emissivity and the one-dimensional energy-balance model.**

**a. Using the provided Excel spreadsheet, calculate values of global surface temperature and global tropospheric temperature for varying values of planetary emissivity, ranging from 0 to 1, incremented by 0.05. Assume that the value of the solar constant is 1360 W m-2, planetary albedo is 0.32, and Stefan-Boltzmann constant is 5.67 x 10-8 W m-2 K-4. Construct a table to show your results.**

**b. Using the values you obtained in (a), plot both global surface temperature and global tropospheric temperature as a function of planetary emissivity; use the same grid for both sets of temperature values. That is, the horizontal axis of the plot should give values of planetary albedo, and the vertical axis should give values of temperature.**

**c. Describe the relationship between planetary emissivity and global surface and tropospheric temperature. Comment on the approximate range of values of planetary emissivity that could support human life on Earth.**

**5. Discuss the various energy-balance models covered in Lessons 4 and 5, comparing and contrasting their assumptions. Limit your discussion to a paragraph.**