CLIMATE MODELING
PROBLEMS-1

Due: 16 September 2015

There are 3 problems. You should work on this in your "science team" groups. However, you are also welcome (in fact encouraged) to consult with others (as well as me) if you have difficulty working on these. Please turn in your team's work via email to gutowski@iastate.edu. To help me spot it in my Inbox, please have the subject line read:
Subject: Climate Modeling, Problem Set 1

1. Following on our class discussion and the lectures, let's use our understanding of radiative balance to estimate the temperatures of various planets and dwarf planets. For this calculation, it is important to note that the intensity of radiation from the sun decreases with the *square* of distance from the sun. At the orbit of the earth (1 Astronomical Unit from the sun), assume the solar energy flux = 1360 W-m^{-2}. For the earth's albedo, radiative balance led to an average outgoing flux of 238 W-m^{-2} and a radiative temperature of 255 K.

Fill in the average outgoing flux and radiative temperatures for these objects orbiting the sun:

Planet	**Distance from sun [A.U.]**	**Albedo**	**Outgoing radiation [W-m^{-2}]**	**Radiative temperature [K]**
Earth	1.00	0.30	238	255
Venus	0.72	0.76		
Mars	1.52	0.16		
Jupiter	5.20	0.51		

Dwarf Planet	**Average dist. from sun [A.U.]**	**Albedo**	**Outgoing radiation [W-m^{-2}]**	**Radiative temperature [K]**
Pluto	39	0.5		
Quaoar	42	assume 0		

2. Jupiter actually emits somewhat more than it absorbs, so it is not in pure radiative balance. What might be the source of this additional energy for emission?

3. Venus has an estimated surface temperature of 482 ˚C, and Mars has an estimated surface temperature of - 63˚C. Why do they approximately match or not match the radiative temperature?