GEOS 24705 / ENST 24705
Problem set #1
Due: Th. March 28

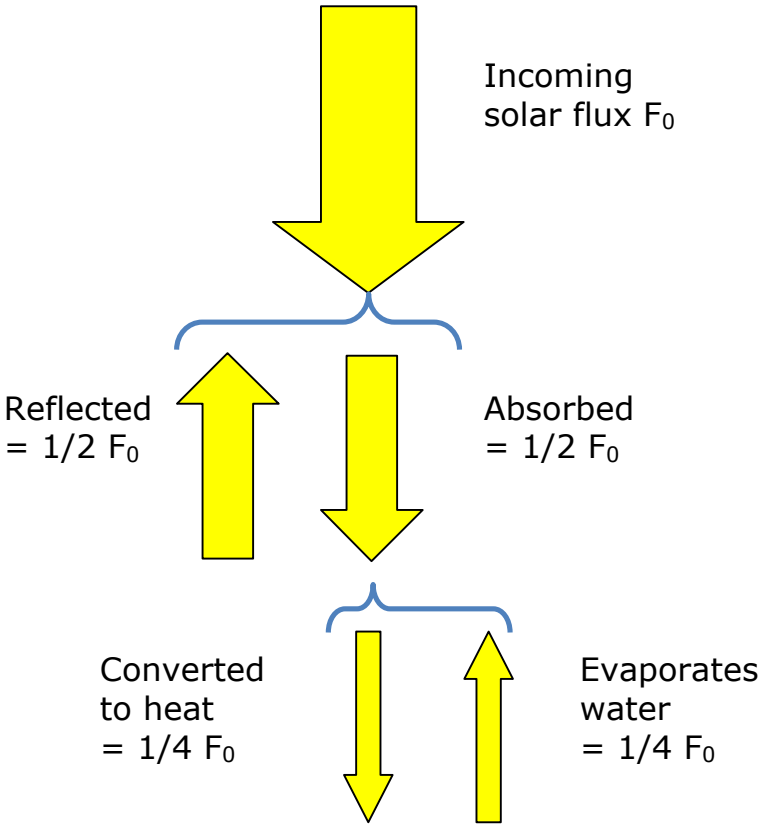
Problem 1: Solar energy flux

In class we got most of the way through estimating the average flux of energy from the sun (energy/time/area or W/m2). In this problem you'll finish that estimation.

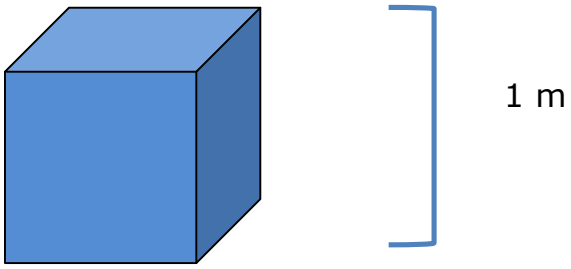
You need to figure out how many W/m2 go to evaporating water, and then back out the total average W/m2 that strike the Earth's surface.

What we did in class

In class we estimated roughly that the flux of energy going to evaporate water might be ~ ¼ of the total flux of energy from the sun striking the Earth's surface. At least that was a good first attempt.



The class also decided that the amount of rainfall that fell on the surface of the Earth each year was 1 m, so that a 1 m2 area would receive one cubic meter of water per year.



And people concluded that 1 m3 must contain 1000 liters of water.

Finally, people pondered how much energy it would take to evaporate 1 liter of water by considering a microwave oven with a liter of already-hot water in it. They estimated that the power output of the microwave was 1000 W and that the liter of hot water would take anywhere between 10 minutes -> 2 hours to evaporate fully.

Questions

1) How much energy does it take to evaporate the liter of water? (give your answer in Joules/liter or Joules/kg. This is also called the "latent heat of vaporization").
2) How much energy does it take (Joules) to evaporate 1m3 of rainfall?
3) What is the flux of solar energy (W/m2) that goes to evaporating water that later falls as rain?

4) What is your estimate of the total solar flux (W/m2) that strikes the ground?

5) Google to check: how does your estimate compare with values you can find for the incoming solar flux? (Remember to find values for what strikes the ground, not total radiation incident at the top of the atmosphere – some is absorbed in the atmosphere. Also remember to find averaged values, i.e. averaged over both day and night).

6) Google to check: how does your latent heat of vaporization estimate compare to published values?