Assignment 6: Climate feedbacks in the 1D energy balance model
Due Tuesday April 15 at 5 pm.

Instructions:
Same as for the previous assignment, you will hand in a single well-commented
Python code file (saved with your name in the title and the extension .py) that
includes the code necessary to make all the calculations and figures, as well as your
text answers to the questions in comments. Also submit your figures as graphics
files.

Questions

1) Use the `ebm.py` code to set up a 1D energy balance model with annual mean
   insolation and default parameters (no albedo feedback).
   a) Integrate to equilibrium. Verify that the global mean planetary energy
      balance is closed.
   b) Repeat part (a) after decreasing A (the constant in the OLR
      parameterization) by 4 W m^{-2} (a global warming experiment).
   c) Make two nicely labeled graphs, each with 2 curves (including legends): one
      graph showing temperature before and after the global warming, the other
      showing heat transport before and after.
   d) Did the heat transport change? Why or why not?
   e) Calculate change in global mean temperature.
   f) Based on this temperature change, calculate the net climate feedback for
      this model. Recall that the net feedback lambda is a negative number in W
      m^{-2} ºC^{-1} (or W m^{-2} K^{-1}, same thing). Here the forcing is $\Delta A = 4$ W m^{-2}, so the
      feedback is $\lambda = -\frac{\Delta A}{\Delta \langle T \rangle}$ (where the angle brackets signify global average).
   g) What parameter do you think you would have to change in the model to get
      a different net feedback?

2) Repeat Question 1, this time using a model with albedo feedback. Follow this
   example code to set up the model with appropriate albedo values:
```
thismodel = ebm.EBM_annual()
thismodel.albedo_noice = 0.3 + 0.078 * ebm.P2( sin( thismodel.phi ) )
thismodel.albedo_ice = 0.62 * ones_like(thismodel.phi)
```

   a) Same as question 1.
   b) .
   c) .
   d) .
   e) .
   f) .
   g) Compare to your results from Question 1 and comment on the effects of
      albedo feedback on:
      i) the spatial pattern of warming (i.e. do some latitudes warm more than
         others?)

      ii) the climate sensitivity (change in global mean temperature)
     iii) the net feedback.
h) Estimate the albedo feedback in this model, in W m^{-2} $^{\circ}$C^{-1}. *Recall that the net feedback can be written as the sum of individual feedbacks.*
i) Express in words why the albedo feedback is *positive*.