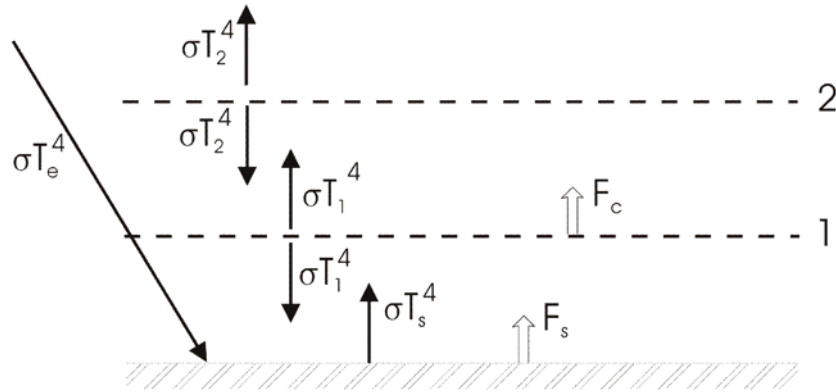


Tropical Meteorology

Problem Set 1

Consider the simple two-layer model of radiative-convective equilibrium discussed in class and illustrated below:



Remember that in convective equilibrium, $T_1 = T_2 + \Delta T$, and $T_s = T_2 + 2\Delta T$. Add a third layer to the top of this atmosphere that has a non-zero *shortwave* absorptivity ε_s and a *longwave* emissivity ε_3 . (Remember that the emissivities of the bottom two layers are taken to be one in this model.) This third layer is assumed to have a radiative equilibrium temperature that is above the threshold for convection, so that convective neutrality should *not* be enforced between layers 2 and 3. By considering the energy balance at the top of the atmosphere and the energy balance of layer 3, find expressions for the temperature of layers 2 and 3 as a function of the effective planetary emission temperature T_e and of ε_s and ε_3 . What are the smallest and largest temperatures achievable in layers 2 and 3, and for what values of the parameters do they occur?