1. 7.1 in Campbell and Norman.

2. What is the consequence of assuming neutral stability ($\Psi_M = \Psi_H = 0$) when estimating the turbulent conductance of the atmospheric surface layer? To find out, do the following.

(a) Include the two vectors $L_{\text{min}}$ and $L_{\text{max}}$ and the time vector defined by the m–file `obu.m` on the course website in your own m–file. I created these three vectors to produce Figure 1 which represents the extreme values that the Obukhov length, $L$, can take over the course of a day. Compare this with the Stull figure that I presented in class. Then use these vectors to plot the diurnal variation of the extreme values of the stability parameter $\zeta = z/L$ for a reference height (height at which you would mount an anemometer and temperature sensor) of $z = 10\text{ m}$.

(b) Plot the diurnal variation of the extreme values of the profile correction factor for heat, $\Psi_H$, using (7.26) and (7.27) from Campbell and Norman.

(c) Plot the diurnal variation of the extreme values of the profile correction factor for momentum, $\Psi_M$, using (7.26) and (7.27) from Campbell and Norman.

(d) Now plot the diurnal variation of the extreme values of the turbulent conductance of the atmospheric surface layer. Include a line representing the turbulent conductance for neutral conditions. Assume the wind speed at $z = 10\text{ m}$ is $5\text{ m s}^{-1}$ and the height of the vegetation canopy is $1\text{ m}$.

(e) How does the diurnal variation of the conductance computed using non–zero profile correction factors ($\Psi_H \neq 0$, $\Psi_M \neq 0$) compare to the neutral conductance ($\Psi_H = \Psi_M = 0$)? Do you see a day–night pattern?

(f) What is the range in sensible heat flux from the land surface to the atmosphere, $H$, at 3 pm if the air temperature at $z = 10\text{ m}$ is $18\text{ °C}$ and the aerodynamic temperature $T_o = 20\text{ °C}$? What is the sensible heat flux assuming neutral conditions?
Figure 1: Diurnal variation of the Obukhov length, L.

(g) If you want to estimate the instantaneous sensible heat flux (the sensible heat flux at a specific time of day), may it be acceptable to assume neutral stability? Why or why not?

(h) If you want to estimate the sensible heat flux for the entire day, may it be acceptable to assume neutral stability? Why or why not?

3. 7.3 in Campbell and Norman. Remember that the total heat flux is equal to the sensible and latent heat flux. Assume the relative humidity of the room is 0.4.

4. 7.4 in Campbell and Norman. Assume that the tissue conductance of a sheep is 1 mol m\(^{-2}\) s\(^{-1}\). Only estimate the sensible heat flux.

5. 7.5 in Campbell and Norman.

6. Read “Simple Versus Complex Climate Modeling” in Eos on the course website.

   (a) What warning does the author give in the second paragraph?
   (b) Describe in your own words what you think a “subgrid process” is.
   (c) Why is the Reynolds number relevant?
   (d) What is the “crucial difference” between climate modeling and weather prediction?