Atmos 6220 Exercise on Turbulent Fluxes Due Sep. 18, 2013

1. The surface sensible heat flux $F_s = \rho c_p \overline{w'T'} = 1000 \text{ W m}^{-2}$ and the atmospheric boundary layer (ABL) depth h = 500 m. How much does the average ABL temperature change during 3 h? Use $\rho = 1.2 \text{ kg m}^{-3}$.

2. Same as problem 1 but in this case $F_s = -50$ W m⁻² and h = 50 m.

3. 1 cm of water evaporates from the ocean into an ABL that is 500 m deep.
(a) What is the change in the average ABL water vapor mixing ratio (mass of water vapor per unit mass of dry air), Δq? Use ρ = 1.2 kg m⁻³.
(b) If this process occurs over 4 h, what is the average surface flux of water vapor, F_q = ρwqq'?
(c) What is the latent heat flux, LF_q? L = 2.5 × 10⁶ J kg⁻¹ is the latent heat of vaporization.

- 4. The friction velocity $u_* = 0.3 \text{ m s}^{-1}$.
 - (a) What is the magnitude of the surface stress? Use $\rho = 1.2$ kg m⁻³.

(b) If h = 500 m, how much would the average ABL wind velocity change over 24 h due to the surface stress alone? Assume that the wind velocity and surface stress vectors are parallel.

(c) What additional forces act to maintain the ABL wind?