ESE 134: Cloud and Boundary Layer Dynamics (HW 2, due April 26):

[Problems adapted from Stull (1988).]

1. **Dimensional analysis.** Suppose the wind speed \( \bar{u}(z) \) near the surface at night is a function of \( g/\overline{\theta}_v, w/\overline{\theta}_v, \partial \tilde{p}/\partial x, \partial \overline{\theta}_v/\partial z, z_0 \) (roughness length), and \( u_g \) (geostrophic wind). On which nondimensional groups can the mean wind speed depend?

2. **Similarity theory.** Suppose the following was observed on a clear night (no clouds) over farmland with roughness length \( z_0 = 0.067 \) m, Obukhov length \( L = 30 \) m, and friction velocity \( u_* = 0.2 \) m s\(^{-1}\). Find and plot the mean wind \( \bar{u}(z) \) as a function of height up to 50 m.