

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 $g/\bar{\theta}_v$, $\overline{w'\theta'_v}$, $\partial\bar{p}/\partial x$, $\partial\bar{\theta}_v/\partial z$, 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.