Name _____

MTEOR 605

Fall 2017

Supplementary problem for Chapter 3

When deriving the linearized equation of state for turbulent fluctuations we used 1 K as a rough magnitude of the temperature perturbation from the surrounding environment. We also showed that we can use either potential temperature or temperature in the vertical equation of motion for perturbations; i.e., the "warm air rises, cold air sinks" equation at the end of class on Thursday. (This is eq. 3.3.3b in Stull.) Assume we are near mean sea level so $\theta_v\prime \approx T_v\prime$.

i. Given this magnitude of $\theta_v\prime$ as the perturbation of a boundary-layer parcel starting at rest near the surface, along with a reasonable value for $\overline{\theta_v}$, compute the parcel's vertical acceleration $dw\prime/dt$. Consider only the buoyant acceleration term.

ii. A typical lifetime for a boundary-layer "thermal" is about half an hour. Given your answer to (i) above, compute the speed of the rising parcel after half an hour. Assume the parcel is rising through the daytime mixed layer so that $\overline{\theta_v}$ is constant with height.

iii. Is your value in (ii) reasonable? Comment briefly.