Problems - 1 Due: 11 Sept. 2019

Group Problem - See Class Web Page for Guidelines

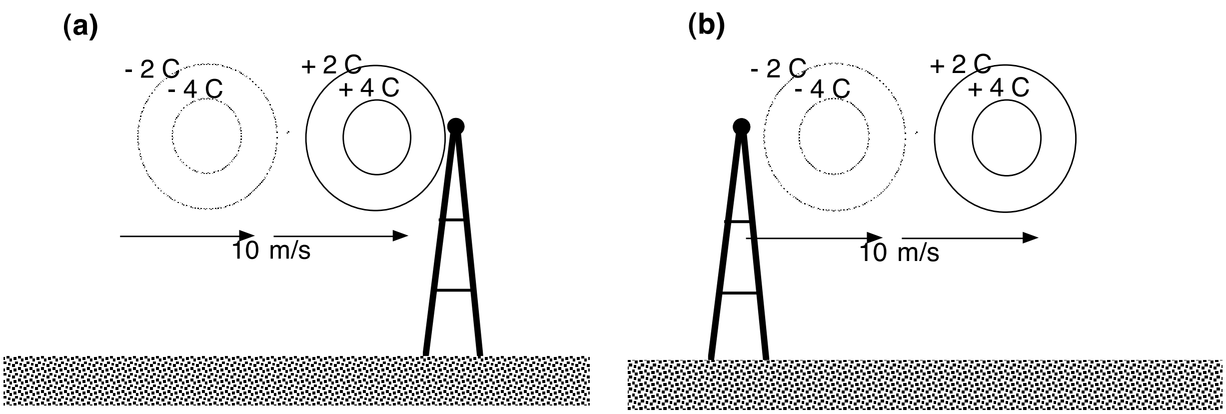
1. In the Boussinesq approximation, what is the quantity assumed to be constant in almost all of our dynamical equations (conservation laws)? Why is this a reasonable assumption?

2. In 1938, G.I. Taylor suggested that for some special cases, turbulence might be considered to be *frozen* as it advects past a sensor. Thus, the wind speed could be used to convert turbulence measurements as a function of time into corresponding measurements in space. This means we can develop a *spatial* picture of PBL turbulence from a limited number of fixed instruments (perhaps only one). For example, if **V** is the advecting wind speed and an eddy is advected past a sensor in a time τ, then we can estimate the eddy diameter D to be

$$D = \mathbf{V} \cdot \tau$$

An important assumption in Taylor's hypothesis is that the eddy lasts longer than the time it takes to blow it past the instrument.

For example, consider the eddy advecting past the instrument tower shown below, where the advecting wind = 10 m/s. The eddy consists of the positive/negative temperature pattern. Figures (a) and (b) are snapshots taken 2 seconds apart.



(a) What is the size of the eddy?

(b) The temperatures shown are T'. Suppose $\overline{T}$ = 10° C. Sketch a graph showing the temperature as a function of time as the eddy approaches, passes through, and then leaves behind the thermometer on the instrument tower. Be sure to show clearly the temperature magnitudes, range, etc.