12.815

**Atmospheric Radiation and Convection**

Problem Set 3

1. A two-dimensional line continuously supplies buoyancy to an unstratified, Boussinesq fluid at a rate given by. By drawing an analog to the maintained point source of buoyancy discussed in class, determine the dimensions of in terms of the primary quantities length and time. Now, using dimensional analysis, find the dependencies of the plume’s radius, buoyancy, and vertical velocity on and on the distance  above the line source. Assume that the plume is fully turbulent.
2. Estimate the maximum altitude to which the thermal arising from a 1-megaton bomb explosion near the surface will rise through a calm, Boussinesq atmosphere. Assume that all the energy from the explosion is turned into heat and ignore exotic effects such as breakdown of the Boussinesq and continuum approximations, magneto-hydrodynamical effects, and continued heating from, e.g., radioactivity and condensation. Assume the following:
   1. Buoyancy frequency of the stratified atmosphere is 
   2. Entrainment parameter 
   3. 1 megaton (of dynamite) 