Tutorial 5

Vertical properties of the atmosphere

1. Adiabatic and pseudo-adiabatic temperature changes

   Assume that an air parcel is saturated with water vapor at ground level ($z = 0m$, $p = 1000hPa$) at temperature T_0. The parcel ascends. Calculate how the temperature changes with altitude, assuming that process is (1) moist adiabatic or (2) pseudo-adiabatic.

2. Calculation of condensed water

   Calculate the amount of water (specific mass q_l and LWC) condensed during the adiabatic ascent of moist air. Consider both moist adiabatic and pseudo-adiabatic temperature lapse rates.

3. Convective parameters in a conditionally unstable layer

   Consider an initially unsaturated air parcel lifted through a conditionally unstable layer. Assume a constant lapse rate $\Gamma = 0.008K/m$ up to the height $z = 10km$ and a lapse rate $\Gamma = 0K/m$ above that height (matching the conditions presented in lecture thermodynamics_12).

   The air parcel is lifted from ground level ($p = 1000hPa$) with an initial temperature 20^oC and a specific humidity $q_v = 7.48g/kg$.

   (a) Calculate the parameters (T, p, z) of the Lifting Condensation Level (LCL).

   (b) Calculate the parameters (T, p, z) of the Level of Free Convection (LFC).

   (c) Calculate the parameters (T, p, z) of the Level of Neutral Buoyancy (LNB).

   (d) Calculate the Convective Available Potential Energy (CAPE).