Tutorial 5

Vertical properties of the atmosphere

1. Adiabatic and pseudo-adiabatic change of temperature

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

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

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

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

   (a) Calculate parameters (T, p, z) of the lifting condensation level (LCL).

   (b) Calculate parameters (T, p, z) of the level of free convection (LFC).

   (c) Calculate parameters (T, p, z) of the level of neutral buoyancy.

   (d) Calculate the value of the convective available potential energy (CAPE).