

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 height $z = 10km$ 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 $20^\circ C$ 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).