Tutorial 3

Humidity, Clausius-Clapeyron equation

1. Saturated vapor pressure

   - Check the validity of different expressions for the saturated vapor pressure against the exact solution (a polynomial fit to observations). Take into account three expressions:
     (a) solution of the Clausius-Clapeyron equation where $L_{vl} = const = L_{vl}(T_0)$, $T_0 = 273.15K$,
     (b) solution of the Clausius-Clapeyron equation where L_{vl} depends on temperature T,
     (c) Magnus-Tetens formula $e_s(t) = e_{s0} exp\left(\frac{17.27t}{t+237.7}\right)$, where t is in degrees C and e_{s0} =6.112 hPa is the saturation vapor pressure at t=0°C.
   - Check the validity of expression for the saturated vapor pressure over ice (solution of the Clausius-Clapeyron equation with $L_{vi} = const$) against the exact solution.

2. Mixing ratio and specific humidity

   - Compare values of mixing ratios and specific humidities for saturated conditions at different temperatures and pressures.
   - Chceck the validity of simplified formulas for mixing ratio and specific humidity for saturated conditions at different temperatures and pressures.
   - Assume that temparature decreases with altitude at constant rates, i.e. Γ=0.01, 0.006 K/m. Calculate values of mixing ratio and specific humidity for saturated conditions at different altitudes. Assume that temperature at the ground level is 300 K (tropical conditions), 285 K (mid latitudes) or 270 K (polar regions).