

## 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  $L_{vl} = \text{const} = L_{vl}(T_0)$ ,  $T_0 = 273.15\text{K}$ ,
  - (b) solution of the Clausius-Clapeyron equation where  $L_{vl}$  depends on temperature  $T$ ,
  - (c) Magnus-Tetens formula  $e_s(t) = e_{s0} \exp\left(\frac{17.67t}{t+243.5}\right)$ , where  $t$  is in degrees C and  $e_{s0} = 6.112$  hPa is the saturation vapor pressure at  $t=0^\circ\text{C}$ .
- Check the validity of expression for the saturated vapor pressure over ice (solution of the Clausius-Clapeyron equation with  $L_{vi} = \text{const}$ ) against the exact solution.

#### 2. Mixing ratio and specific humidity

- Assume that temperature decreases with altitude at constant rates, i.e.  $\Gamma=0.01, 0.006$  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).