

Class Activity #2

1. Following Class Activity 1, use the soundings to calculate the vertical profiles of the **specific humidity** and **virtual temperature**. Plot the vertical profiles of **virtual temperature**, **specific humidity**, and **temperature**. Discuss their vertical structures. (Plot them in height coordinate up to lower stratosphere)
2. Following 1., calculate the vertical profiles of **the difference between the virtual temperature and temperature**. Start from the surface and find the level when the difference is smaller than 0.1K.
3. Consider a dry air parcel at the surface that has the same density as the first level of your sounding. Set your sounding as environment, what is the buoyancy when the air parcel is lifted to the top of tropopause and 1 km height (Plot the buoyancy profile of the parcel and discuss the feature and value of the profile. Assume that the surface parcel is dry and there's no condensation, the temperature lapse rate of the parcel is $-\frac{dT}{dz}=9.8$ K/km)
4. Same as 3, but the temperature of the parcel is 10 K higher. Moreover, discuss the difference between 3 and 4.

You can follow these steps to calculate **specific humidity**:
(Please check the unit of variables)

1. Calculate the saturation water vapor pressure following the approximation below:

$$e_s = A \exp^{-B/T}$$

$$A = 2.53 \times 10^8 \text{ kPa}, B = 5.42 \times 10^3 \text{ K}$$

2. Calculate the actual vapor pressure:

$$e = e_s \times RH$$

3. Calculate the specific humidity:

$$q_v = \frac{\rho_v}{\rho_d + \rho_v} = \frac{\varepsilon e}{p - (1 - \varepsilon)e} \quad \varepsilon = \frac{R_d}{R_v} = 0.622$$