

Supplementary exercises II

S1 Santa Ana wind scenario in Southern California: $T = 32^\circ\text{C}$, $\text{RH} = 4\%$, $p = 1000 \text{ hPa}$. Estimate the mixing ratio and the dew point.

S2 If the air in S1 descended dry adiabatically from the high desert, where $p \sim 870 \text{ hPa}$, conserving its water vapor mixing ratio as it descends. Estimate the temperature, relative humidity, and dew point of the air before it began its descent.

S3 To what temperature can the hot, dry, Southern California air in S1 can be cooled by evaporating water into it by spraying a fine mist until the air becomes saturated with water vapor locally? What will be the mixing ratio of the air when it reaches saturation?

S4 An air parcel initially at 1000 hPa having a temperature of 25°C and a dew point of 15°C is lifted in a strong convective updraft. (a) Estimate the height of cloud base, and the temperature and water vapor mixing ratio of the air parcel when it reaches the 300 hPa level. (b) How much do the potential and equivalent potential temperatures increase during the ascent from 1000 to 300 hPa? (c) Using the standard atmosphere height scale on the left hand margin of the diagram, estimate the corresponding changes in dry and moist static energy.

S5 Construct an idealized environmental sounding by drawing a straight line connecting the state points (1000 hPa, 25°C) and (200 hPa, -70°C) for the tropospheric portion and assume that the stratosphere is isothermal with a temperature of -70°C . Draw the sounding on a skew $T - \ln p$ chart. (a) For the updraft in S4, locate the level of free convection (LFC) and the equilibrium level (EL). (a) Compare the sizes of the areas on the plot that are proportional to the values of CAPE and CIN using 1000 hPa for the reference air parcel.