

MAE 578 Homework #4

Parameters for moist air

1. An air parcel has an initial temperature of 30 °C and initial pressure of 1000 mb. It also contains water vapor with a relative humidity of 50%. (a) Evaluate the specific humidity, q , and the partial pressure for water vapor, e , for this air parcel. (b) If the parcel is adiabatically lifted to 900 mb, would the adiabatic cooling be enough to cause condensation at that level? If not, what is the relative humidity of the air parcel at the 900 mb level? Hint: If needed, you may use Eq. (1-4) in M&P textbook for the calculation of saturation vapor pressure. Our slide set #11 has useful discussions on the parameters for a moist atmosphere. (2 points)

Moist convection and precipitation

2. Solve Prob 11 of Chapter 4 in M&P textbook. Note that the assumption of "no entrainment" means that there is no lateral exchange of mass and water between the cloud (gray area) and its drier surroundings (white area in Fig. 4.29). Mass/water enters or leaves the cloud only through its bottom and top. Also, you may assume that L and C_p are constants. If needed, use $C_p = 1005 \text{ J kg}^{-1} \text{ }^\circ\text{K}^{-1}$ and $L = 2.5 \times 10^6 \text{ J kg}^{-1}$. (4 points)

Energy balance and vertical motion

3. Solve Prob 12 of Chapter 4 in M&P textbook. Is the vertical velocity that you obtained in Part (c) comparable to the observed vertical velocity over the Sahara region? As a quick reference, a map of the climatological mean of vertical velocity at 500 mb (mid-tropospheric level) is posted at our course website. (4 points)