Assignment #2 Due Feb. 18

1. The observed mean geopotential height at 500 mb for January is shown in figure 1. (a) Sketch the direction of the mid-latitude, geostrophic winds in figure 1; (b) why are the winds in this direction? (c) At which location the winds are stronger, A or B? Why? [15 points]

2. Label the Northeasterly trades, southeasterly trades, and the Intertropical Convergence Zone (ITCZ) in figure 2. Discuss how the observed strong annual mean rainfall belt near 7°N across the Pacific is formed (see figure 3). (10 points)

3. Calculate the density of water vapor which exerts a pressure of 9 mb at 20°C. [Note: change the units for each variable to MKS units before the calculation.] (10 points)

4. Calculate the thickness of the layer between the 1000mb and 500mb pressure surfaces (a) at a point in the tropics when the mean virtual temperature of the layer is 9°C, and (b) at a point in the polar region where the corresponding mean virtual temperature is -40°C. (15 points)

5. (a) What is the latent heat of melting? (2 points) What is the latent heat of vaporization? (2 points) What is the adiabatic process? (2 points) What is potential temperature? (2 points) (b) On the p-V diagram (see figure 4), an air parcel changes from point A via isothermal process to point B where volume at B is smaller than the volume at A \( V_B < V_A \). Plot point B in figure 4, and sketch the isotherm between A and B. For the air parcel changes from point A via adiabatic process to point C where \( V_C < V_A \). Give point C in the figure and sketch the adiabat between A and C. (7 points)

6. A parcel of air has a temperature of 250°K at the 200mb level in the pseudoadiabatic chart (figure 5). What is its potential temperature? [5 points] What temperature will the parcel have if it descends adiabatically to the 400mb level? (5 points)

7. If air contains water vapor with a mixing ratio of 20 g kg\(^{-1}\) and the total pressure is 1025 mb, calculate the vapor pressure \( e \). [Provide the details to show how you obtained the results.] (15 points)

8. Calculate the virtual temperature of moist air at 30°C which has a mixing ratio of 5.5 g kg\(^{-1}\). [Hint: use the virtual temperature definition and the result from question 7.] (10 points)