ATSC5010

Homework #1 (Aug 30)

Due beginning of class Sept 8

1. During the summer, you inflate your car tires to a pressure of 35 PSI. Six months later, in the middle of Laramie winter, you note that the tire pressure is only 32 PSI. You conclude that you have a slow leak in your tires. Is your conclusion correct? Why? Later that day you decide to drive your vehicle to Cheyenne to have it worked on. You stop at the Lincoln monument at the top of the Laramie Range (mountains) and check you're your tires. They are now at 34 PSI. Explain.

2. If the lapse rate of the atmosphere were constant with height, what would be the thickness of the entire atmosphere?

3. Evaluate the thickness of a layer of atmosphere between 800 and 900 mb with average temperature 300K and specific humidity 20 g kg^{-1}. Compare the thickness determined with the virtual temperature versus that determined without considering moisture (for a dry layer).

4. Assuming an atmosphere in hydrostatic balance that is isothermal, derive a relationship between pressure and height. Using your relationship just derived, compute the height of the 800 mb level, assuming that the surface (z=0) is located at 850 mb and the temperature is 5 degC and the layer is devoid of water vapor (ie its dry).
    a. If the layer were not dry (ie it contained some amount of water vapor) would the height of the 800 mb level be greater, less than, or the same as what you computed in (2)? Explain
    b. Rarely are atmospheric layers isothermal. In the lower troposphere the atmosphere generally cools with height. Considering a layer that is 5 degC at the surface but cools to 0 degC at 800 mb, would the 800 mb level height be greater, less than, or the same as what computed in (2)? Explain.

5. In class we discussed how a barometer works. We also stated that, at sea level, atmospheric pressure is about 760 mm of Hg (mercury); that is a column of Hg 760 mm up the tube. For a given atmospheric pressure does the height of the mercury column change if we change the diameter of the tube? Use balance of forces to support your answer.