AOS 100/101
Spring 2019

Homework #4
SOLUTIONS

1)

The relative humidity (RH) is defined as either

RH = mixing ratio / saturation mixing ratio

or

RH = vapor pressure / saturation vapor pressure.

In either expression, the ratio describe the actual amount of water vapor *relative* to the total possible amount at the given temperature and pressure. Thus, an RH value of 90% in January means simply that the air on such a day has 90% of the total possible water vapor it could have at the temperature and pressure on that day. The same is true regarding the RH value of, say, 65% for the July day.

Since warm air has a greater capacity for water vapor than cold air, it is very likely that 90% capacity on a cold day (90% of 3 g/kg, for instance, is 2.7 g/kg) means alot less actual water vapor than does 65% capacity (65% of 10 g/kg = 6.5 g/kg) on a hot July day.

2)

Shower fog will only form in the bathroom when the air there is saturated. If the amount and temperature of the water coming out of your showerhead is the same on both days, then shower fog will develop on the day with an initial RH of 40% because on that day less evaporation of the water from the showerhead is required to saturate the air (i.e. increase its RH to 100%).

3)

In Miami, upon stepping out of the pool, the dewpoint depression is 7. Upon stepping out of the pool at Palm Springs, CA, the dewpoint depression is 27! This difference indicates that the air in Palm Springs is much drier (has a much lower relative humidity) than the air in Miami. Liquid water is covering your body in both cases but is much more readily evaporated in Palm Springs than in Miami because the air in Palm Springs is so much drier. When the liquid water evaporates it cools your skin and therefore if it evaporates quickly (as in Palm Springs) it will result in a dramatic cooling of your skin. Thus, you would feel alot cooler in the Palm Springs case despite the air temperatures being identical.

EXTRA CREDIT

The air immediately in contact with a raindrop is always receiving water vapor molecules from the adjacent liquid drop as evaporation of its surface is constantly occurring. The air is cooled by this evaporation AND its water vapor content is increased as well up until that air is saturated. At that point, every additional vapor molecule received via evaporation of the liquid surface is balanced by condensation of a different vapor molecule. As a result, the air immediately surrounding the drop – having been brought to saturation by both evaporative cooling and addition of water vapor – reaches saturation at the wetbulb temperature.