ESCI 107/109 – The Atmosphere
Lesson 4 - Humidity

Reading: *Meteorology Today*, Chapter 4

THE WATER CYCLE

- **Evaporation**
- **Transpiration**
- **Precipitation**
- **The water cycle is in balance, so that evaporation and transpiration balance the precipitation**
  - **A water molecule has an atmospheric "lifetime" of about 10 days.**

CHANGES OF PHASE

- **Water is unique in that it can exist in all three phases (solid, liquid, vapor) in the atmosphere**
- ***Latent heat* vs. *sensible heat***
  - ***Latent heat* – results in a change of phase**
  - ***Sensible heat* – results in a change of temperature**
- **Types of phase changes**
  - ***Evaporation* – liquid to vapor, absorbs heat**
  - ***Condensation* – vapor to liquid, releases heat**
  - ***Melting* – solid to liquid, absorbs heat**
  - ***Freezing* – liquid to solid, releases heat**
  - ***Sublimation* – solid to vapor, absorbs heat**
  - ***Deposition* – vapor to solid, releases heat**

VAPOR PRESSURE AND SATURATION

- ***Vapor pressure* – the part of total atmospheric pressure attributable to water vapor**
- **If there are too many water molecules in a given volume, they may begin to stick together to form liquid droplets. This is called the *saturation point*, and the**

vapor pressure at this point is called the *saturation vapor pressure*. Any addition of water molecules after saturation will result in the formation of more liquid droplets.

- **A commonly made statement is that "air can only hold so much water vapor, and that when this amount is reached the air is saturated. Though it may be helpful to think of it in these terms, *this is technically not correct*, since saturation would be reached whether or not there was air present in the volume.**

- **Saturation vapor pressure increases with increasing temperature (a warm volume of gas would have a higher saturation vapor pressure than a cold volume of gas).**

RELATIVE HUMIDITY AND DEW-POINT TEMPERATURE

- ***Relative humidity* – ratio of vapor pressure to saturation water vapor pressure.**
  - **For example, if the vapor pressure is 10 mb, and the saturation vapor pressure is 14 mb, then the relative humidity is (10/14) x 100% = 71.4%**
  - **Two ways to change relative humidity are to change water vapor content, or change temperature**
- ***Dew point* – temperature to which air must be cooled in order to reach saturation**
  - **Higher dew points indicate moister air**
  - **If saturation occurs below 32 degrees F then this is referred to as the *frost point*.**
  - **Dew point is a measure of actual moisture content, not relative moisture content.**
  - **An increase of 10°C (18°F) in dew point means a doubling of moisture!**
  - **Dew points above 70°F mean very moist air!**

MEASURING HUMIDITY

- **An instrument that measures humidity is called a *hygrometer***

- **A *hair hygrometer* uses the lengthening or shrinking of hair as a humidity determiner.**
- **A *psychrometer*, which is a type of hygrometer, is one of the most accurate ways to determine the dew point and the relative humidity.**
  - **A psychrometer uses a thermometer with a moistened bulb, called the *wet-bulb* thermometer to measure the *wet-bulb temperature*. It compares this temperature with the *dry-bulb temperature* (which is just the air temperature) and uses special tables to determine dew point and relative humidity.**
  - **The larger the difference between the wet-bulb and dry-bulb temperatures, the drier the air is.**