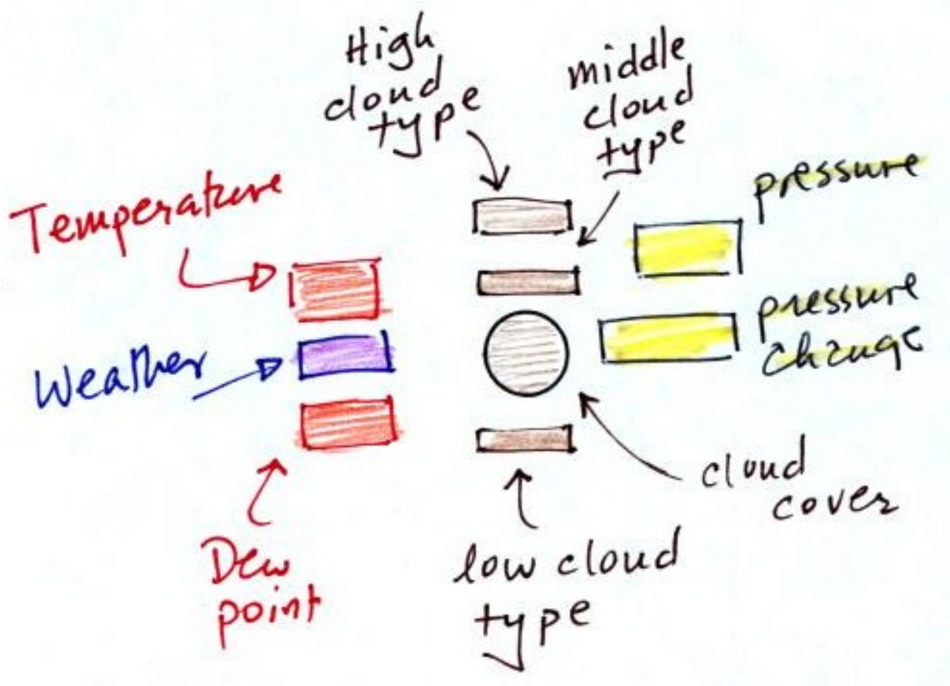
Goals for Module 3:

- Develop tools to read and understand surface weather maps.
- Analyze weather plots at surface and different altitudes.

Module 3: Lecture 7

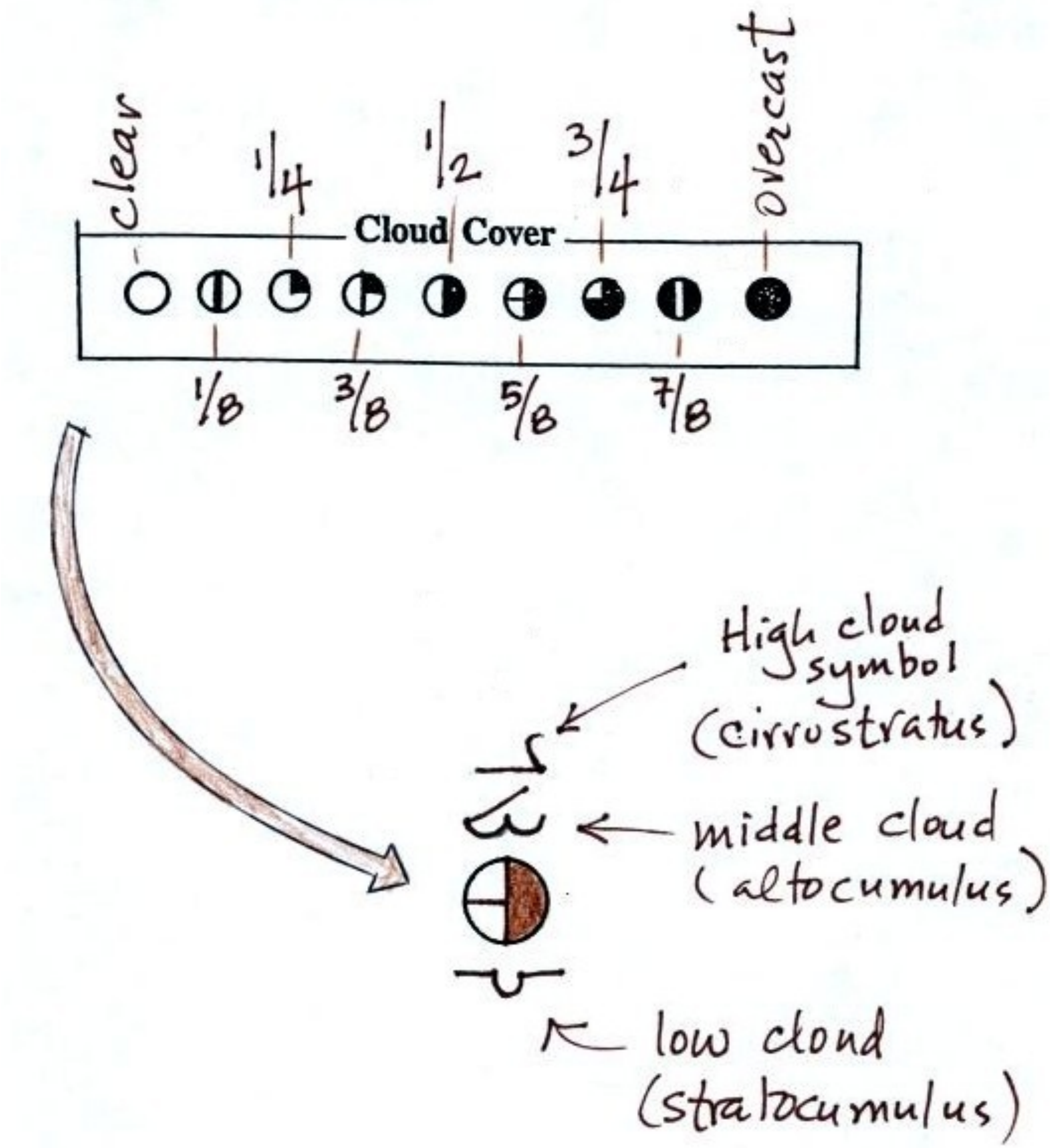
Much of our weather is produced by relatively large (synoptic scale) weather systems. To be able to identify and characterize these weather systems, you must first periodically collect weather data (temperature, pressure, wind direction and speed, dew point, cloud cover, etc) from stations across the country and plot the data on a map. The large amount of data requires that the information be plotted in a clear and compact way. The station model notation is what meteorologists use.



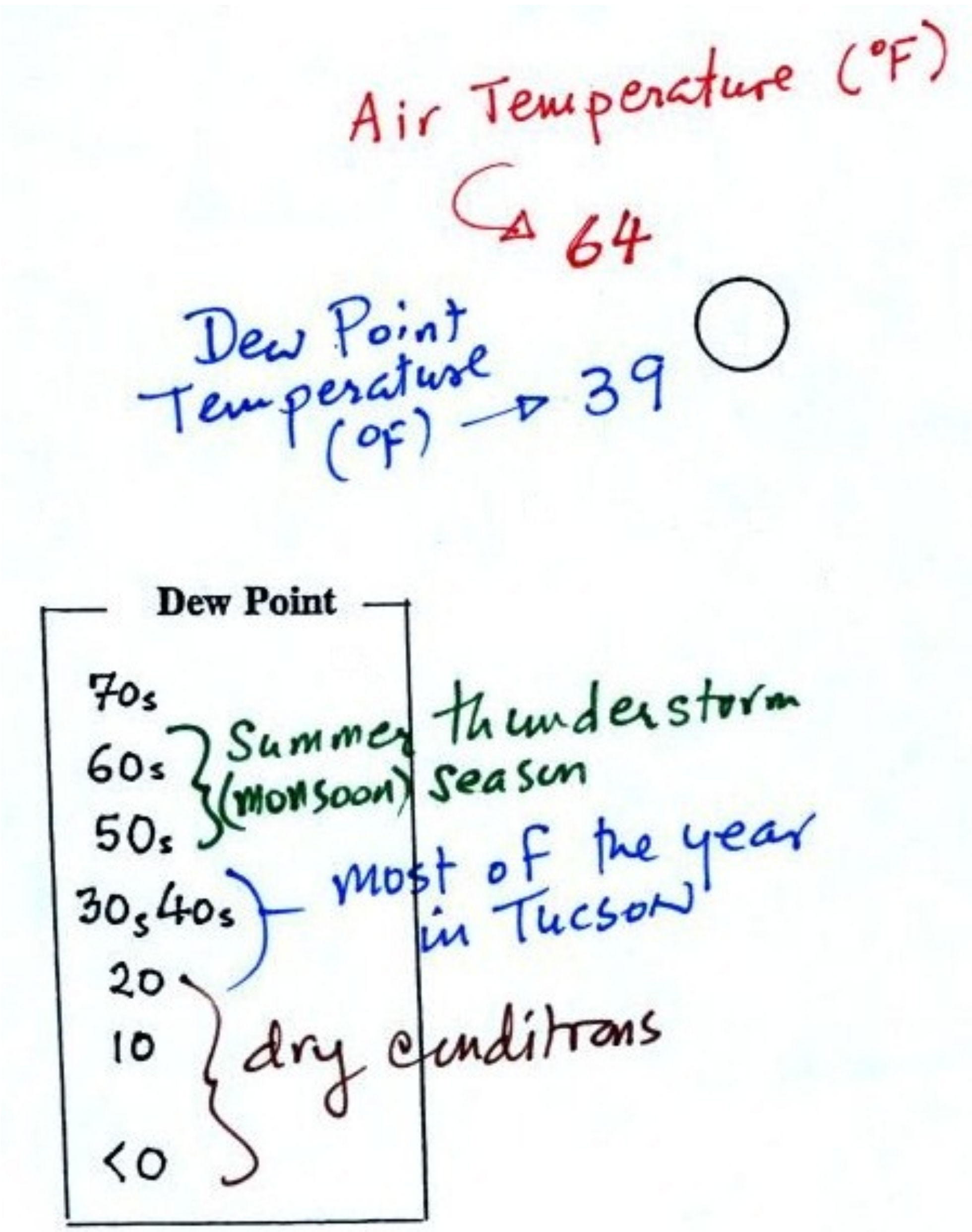
The dew point temperature is defined as the temperature to which air must be cooled for condensation. The more moisture the air contains, the higher the dew point temperature. You can see this effect during the summer monsoon season. During the dry season in Tucson, there is no condensation on the sides of a glass containing a cold beverage. But during the summer monsoon, you will notice a puddle of water underneath the glass.

A small circle is plotted on the map at the location where the weather measurements were made. The circle can be filled in to indicate the amount of cloud cover. Positions are reserved above and below the center circle for special symbols that represent different types of high, middle, and low altitude clouds. The air temperature and dew point temperature are entered to the upper left and lower left of the circle respectively. A symbol indicating the current weather (if any) is plotted to the left of the circle in between the temperature and the dew point; you can choose from close to 100 different weather symbols. The pressure is plotted to the upper right of the circle and the pressure change (that has occurred in the past 3 hours) is plotted to the right of the circle.

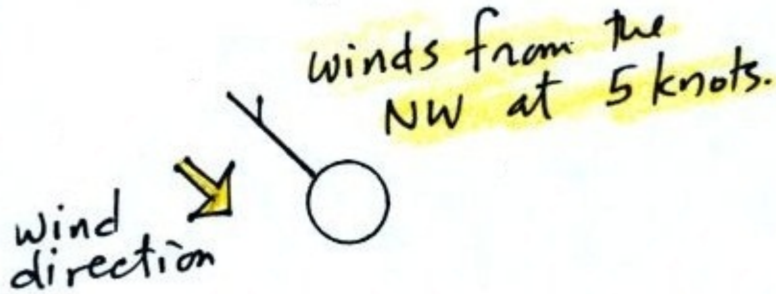
The center circle is filled in to indicate the portion of the sky covered with clouds (estimated to the nearest 1/8th of the sky) using the code at the top of the figure. 1/2 of the sky is covered with clouds in the example above. Symbols are used to identify the actual types of high, middle, and low altitude clouds.

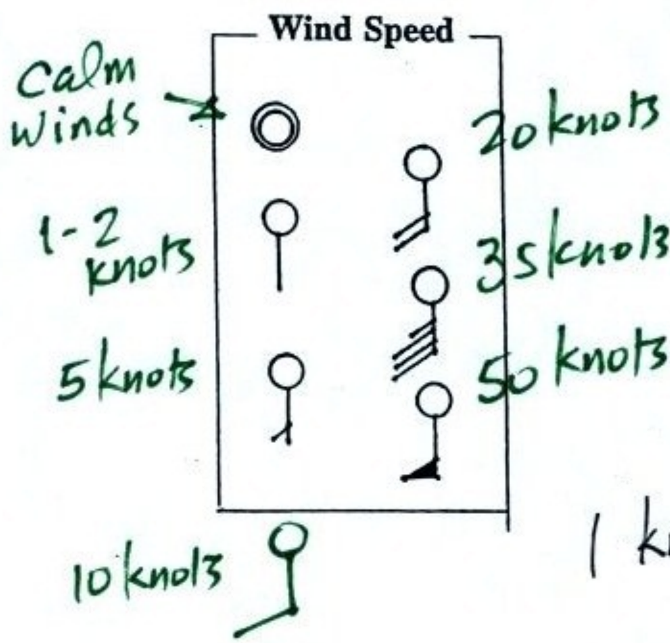


The air temperature in this example is 64^o F (this is plotted above and to the left of the center circle). The dew point temperature was 39^o F and is plotted below and to the left of the center circle. The box at lower left reminds you that dew points range from the mid 20s to the mid 40s during much of the year in Tucson. Dew points rise into the upper 50s and 60s during the summer thunderstorm season (dew points are in the 70s in many parts of the country in the summer). Tucson dew points are typically 10 to 20 degrees Fahrenheit, and may even drop below 0 during dry periods.



A straight line extending out from the center circle shows the wind direction. Meteorologists always give the direction the wind is coming **<u>from.</u>** In this example the winds are blowing from the NW toward the SE at a speed of 5 knots. A meteorologist would call these northwesterly winds. Small barbs at the end of the straight line give the wind speed in knots. Each long barb is worth 10 knots, the short barb is 5 knots. Knots are nautical miles per hour. One nautical mile per hour is 1.15 statute miles per hour. We will not worry about the distinction in this class, so you can just pretend that one knot is the same as one mile per hour.

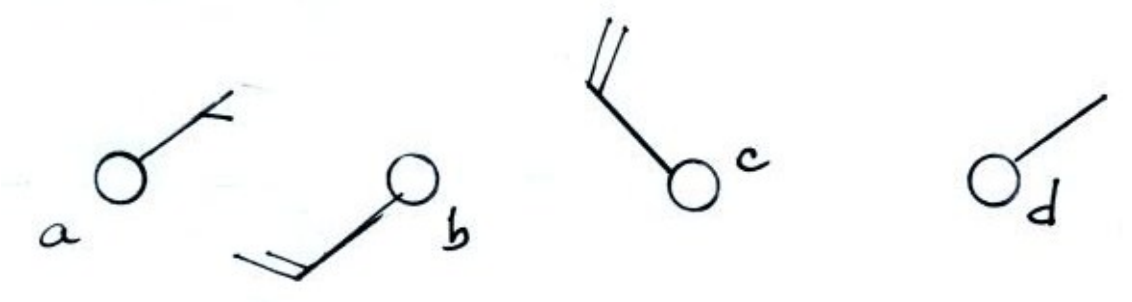




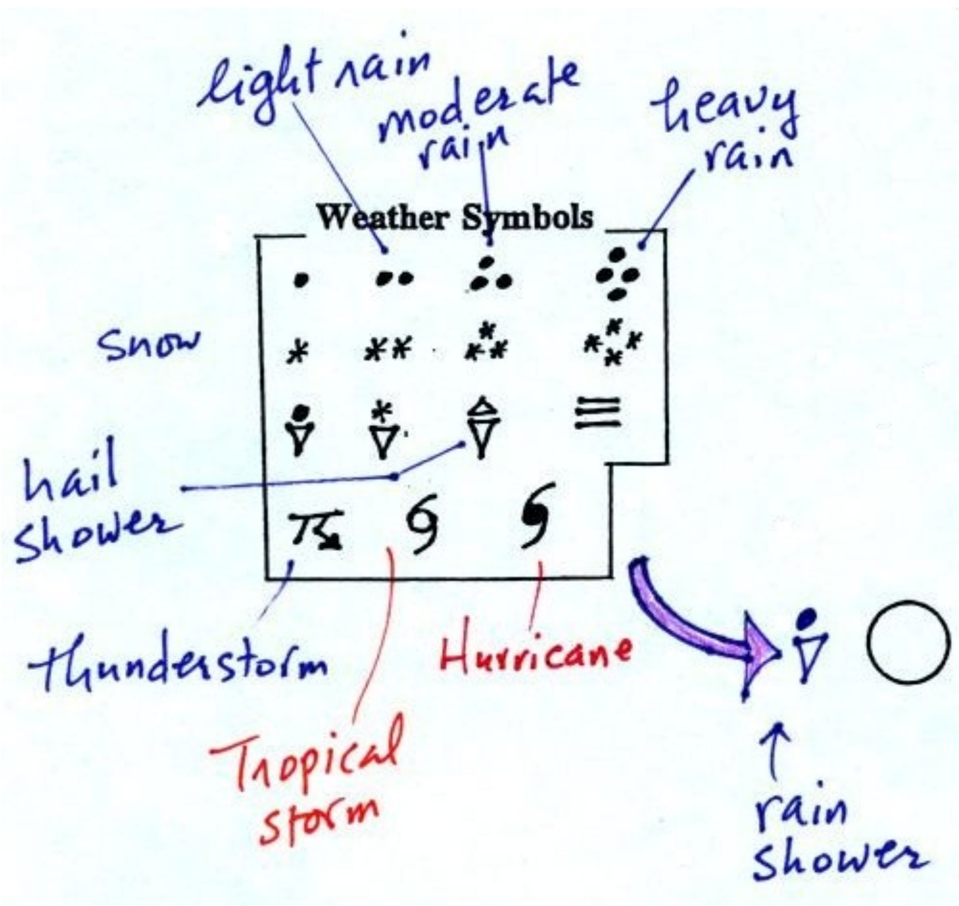
1 knot = 1 nautical mile per hour

1 knot is about 1 MPH

Here are some additional wind examples. In (a) the winds are from the NE at 5 knots, in (b) from the SW at 15 knots, in (c) from the NW at 20 knots, and in (d) the winds are from the NE at 1 to 2 knots.

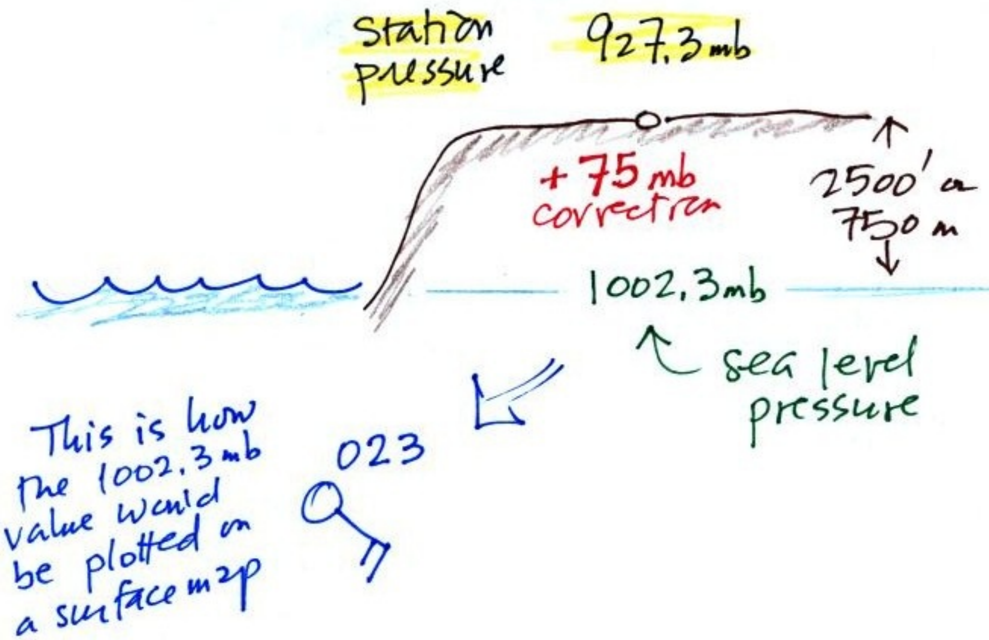


A symbol representing the weather that is currently occurring is plotted to the left of the center circle (in between the temperature and the dew point). Some of the common weather symbols are shown. There are about 100 different weather symbols that you can choose from.

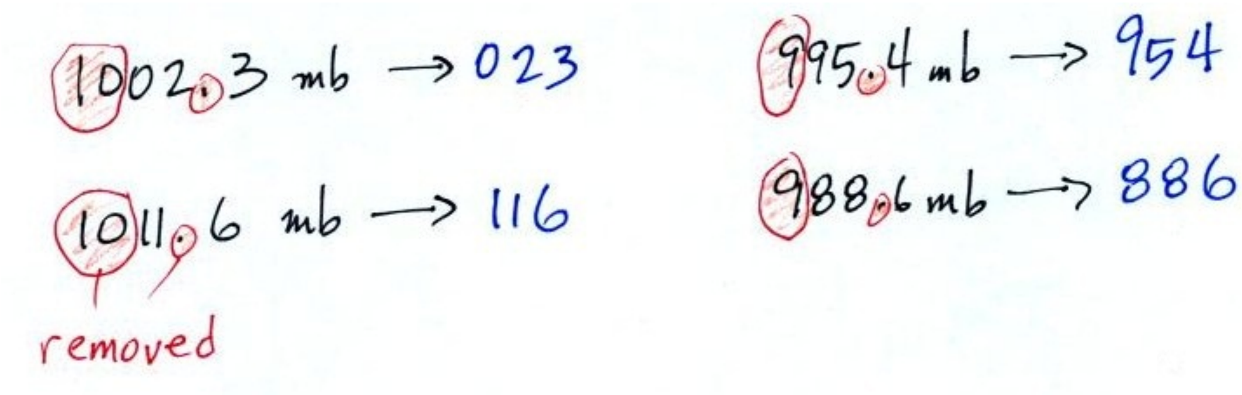


The atmospheric pressure changes much more quickly in the vertical direction than horizontally. But it is the small horizontal pressure changes that produce wind and storms. Meteorologists need to map out the small horizontal pressure changes on surface weather maps so that they can study weather. To compare air pressure data from different stations, the station pressures are converted to sea level pressure. If this were not done large differences in pressure at different cities at different altitudes would completely obscure the smaller horizontal changes.

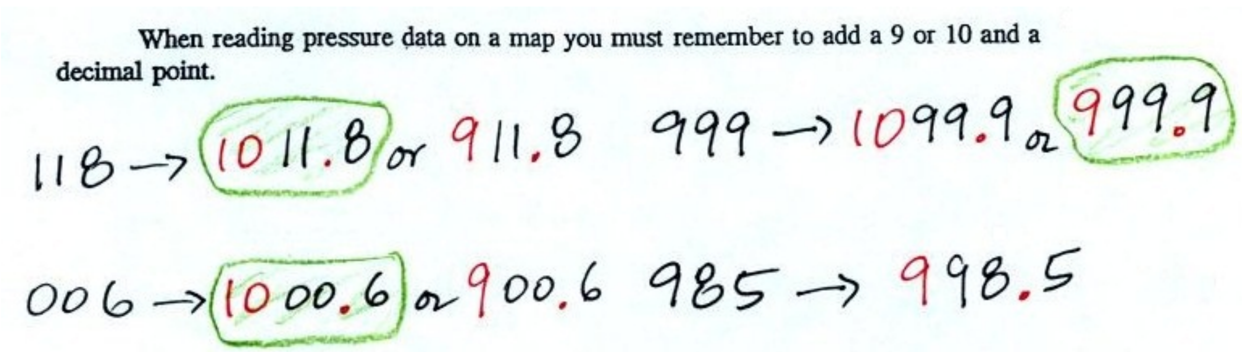
In the example below, a station pressure value of 927.3 mb is measured in Tucson. Since Tucson is about 750 meters above sea level, a 75 mb correction is added to the station pressure (1 mb for every 10 meters of altitude). The sea level pressure estimate for Tucson is 927.3 + 75 = 1002.3 mb. The sea level pressure is shown above and to the right of the center circle.



The sea level pressure is shown **above and to the right** of the center circle. To save space on the weather map, the leading 9 or 10 on the sea level pressure value and the decimal point are removed before plotting the data on the map. For example, the **10** and the **decimal point** in **10**02**.**3 mb would be removed; 023 would be plotted on the weather map (to the upper right of the center circle). More examples are shown below.



Sea level pressures usually fall between 950 and 1050 mb. 118 could be either 911.8 or 1011.8 mb. You need to pick the value that falls between 950.0 mb and 1050.0 mb, so 1011.8 mb would be the correct value while 911.8 mb would be too low.



Pressure change data (how the pressure has changed during the preceding 3 hours) is shown **below and to the right** of the center circle. You must remember to add a decimal point. Pressure changes are usually pretty small.

100 ← 1010.0mb

+25 ← pressure fell then rose. Overall change is +2.5mb

Pressure Change

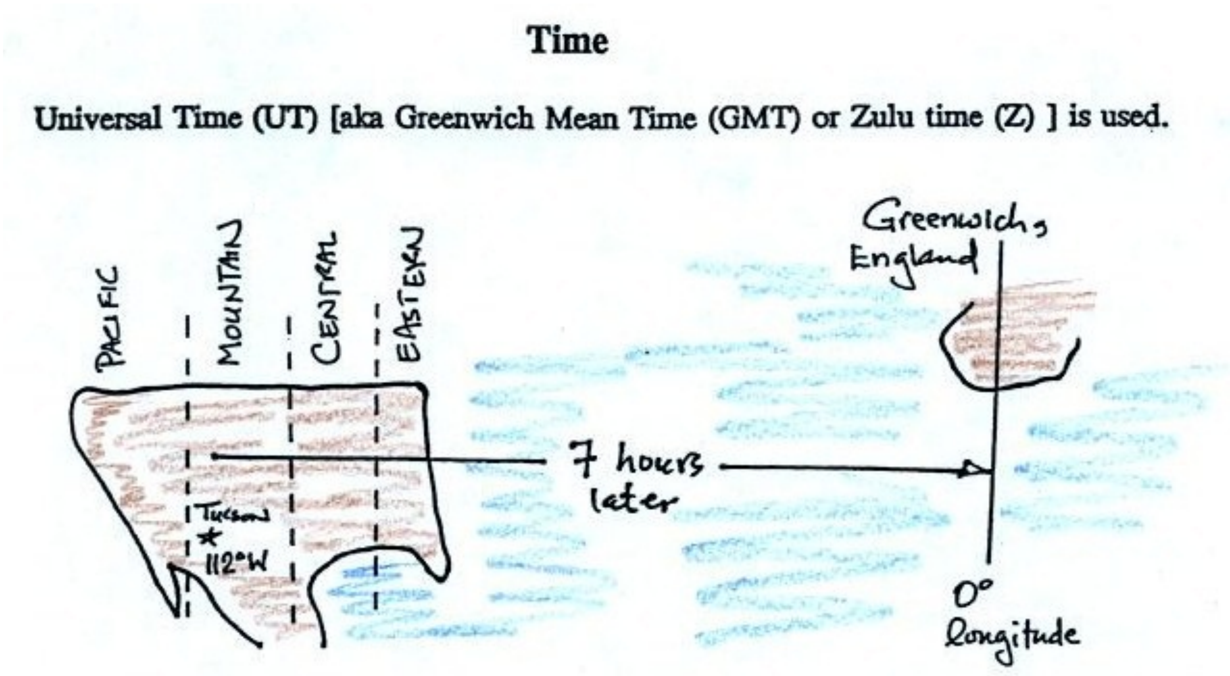
−15 = −1.5 mb

−7 = −0.7mb

+20 = +2.0 mb

+3 = +0.3mb

Another important piece of information that that is included on a surface weather map is the time the observations were collected. Time on a surface map is converted to a universally agreed upon time zone called Universal Time (or Greenwich Mean Time, or Zulu time). That is the time at 0 degrees longitude. There is a 7 hour time zone difference between Tucson (Tucson stays on Mountain Standard Time year round) and Universal Time. You must add 7 hours to the time in Tucson to obtain Universal Time.



Here are some examples:

2:45 pm MST:
First convert 2:45 pm to the 24 hour clock format 2:45 + 12:00 = 14:45 MST
Add the 7 hour time zone correction --->   14:45 + 7:00 = 21:45 UT (9:45 pm in Greenwich)

9:05 am MST:
Because this time is before noon, it is already in the 24 hour clock format.
Add the 7 hour time zone correction ---> 9:05 + 7:00 = 16:05 UT (4:05 pm in Greenwich)

18Z:
Subtract the 7 hour time zone correction ---> 18:00 - 7:00 = 11:00 am MST

02Z:
If we subtract the 7 hour time zone correction we will get a negative number.
We will add 24:00 to 02:00 UT then subtract 7 hours
02:00 + 24:00 = 26:00
26:00 - 7:00 = 19:00 MST on the previous day

Here are some links to surface weather maps with data plotted using the station model notation:
University of Arizona Atmospheric Sciences Department Weather Page
http://www.atmo.arizona.edu/gifs/USPLOT.GIF

National Weather Service Hydrometeorological Prediction Center
http://www.hpc.ncep.noaa.gov/html/sfcloop/currobs.html

American Meteorological Society
http://www.ametsoc.org/amsedu/dstreme/images/sfcpmap.gif

Unisys Weather
http://weather.unisys.com/satellite/sat_sfc_map.gif