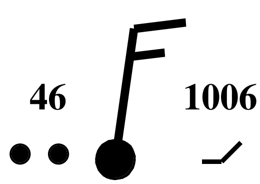
Atmospheric Sciences 101
Homework Assignment #7 (assigned 3/4/99, due in class 3/11/99)

1. On October 17-18, 1996, a wave cyclone moved across the central U.S. and severe weather was reported over the Great Lakes region and also many Midwestern states. Figure 1 (on the back of this page) is a surface map for the central and eastern United States at 12:00 p.m. G.M.T. (Greenwich Mean Time) on October 17, 1996. The surface pressure, surface temperature, and surface winds are displayed on Figure 1 using white contours, grayscale shading, and wind barbs, respectively. The infrared satellite image corresponding to this time can be viewed on the class website at:

http://www.atmos.washington.edu/1999Q1/101/hmwks.html

Study the surface fields and the satellite image for a few minutes, then draw the following on Fig. 1. *(Hint: draw everything lightly in pencil first in case you make a mistake, then go back and darken).*
(a) <u>Label</u> the low pressure center (**L**) and any high pressure centers (**H**) *(use black pencil or pen).*
(b) Identify the air masses in the figure and <u>label</u> the warm sector *(use red pencil or pen)*
(c) Identify and <u>draw</u> the cold front for this wave cyclone (*use blue pencil or pen*). Recall that a cold front usually extends south from the low pressure center and represents the boundary between the warm air ahead of the front and the cold air behind the front. The cold front also usually occurs along a "trough" in sea level pressure, and the wind direction usually shifts from southerly (or southwesterly) to westerly (or northwesterly) as you move across the front to the west.
(d) Identify and <u>draw</u> the warm front for this wave cyclone (*use a red pencil or pen*). A warm front typically extends to the east of the low pressure center and again represents the boundary between cold air and warm air (although the cold air is now ahead of the surface front). This particular warm front has a rather weak pressure trough (although this is not always the case), but it does exhibit the typical shift in wind direction from southerly to easterly and a pronounced temperature gradient.
2. Answer the following questions about this cyclone using both Figure 1 and the satellite image:
(a) Examining the different stages in the formation of a mid-latitude cyclone that we discussed in class (or in Chapter 8), identify the stage which most resembles the situation in Figure 1.
(b) What cloud structures do you see in the vicinity of the cold front on the satellite image? Are these the types of clouds you expect to see associated with a cold front? Explain.
(c) What cloud structures can you see ahead of the warm front? Is this what you expect? Why?
(d) Note the presence of some non-frontal clouds in the warm sector between the two fronts (e.g. over Illinois) and in the cold air mass behind the cold front (e.g. over Colorado and Wyoming). What types of clouds do you think these are? Why?
3. On a separate sheet of paper, <u>draw the surface station</u> information for the following cities: Lincoln, Nebraska; Kansas City, Missouri; and Green Bay, Wisconsin. Include the following data: (use the surface station model introduced in class and reproduced in Appendix C)

Example: Fargo, ND



-surface temperature in °F (note that Figure 1 is in °C)
-surface pressure (use millibars instead of the abbreviated notation)
-pressure tendency (just the "line", not the numerical value)
-wind direction and speed (full barb = 10 knots, half barb = 5 knots)
-present weather <u>and</u> sky cover (use the satellite image and your knowledge of frontal precipitation)
(You do not need to indicate the 3-hour surface pressure change or the dewpoint temperature on your surface station diagrams.)

4. Using the scale on the bottom of Figure 1 and your knowledge of typical frontal speeds (for this case, use cold front = 15 m/s, warm front = 5 m/s), estimate the location of the cold front and the warm front in 12 hours and in 24 hours. <u>Draw</u> these on Figure 1 using the same color scheme but using <u>dashed</u> lines. If you think that a frontal occlusion will occur during this timeframe, you should indicate this with the proper notation and use a purple or black pen (but still use dashed lines).
5. <u>Write</u> a short forecast for Little Rock, Arkansas for the next 36 hours. Be sure to mention the pressure, temperature, cloudiness, chance of rain, the direction and strength of the wind.