Mid Term Exam

ATM 111 Winter 2007 50 points possible

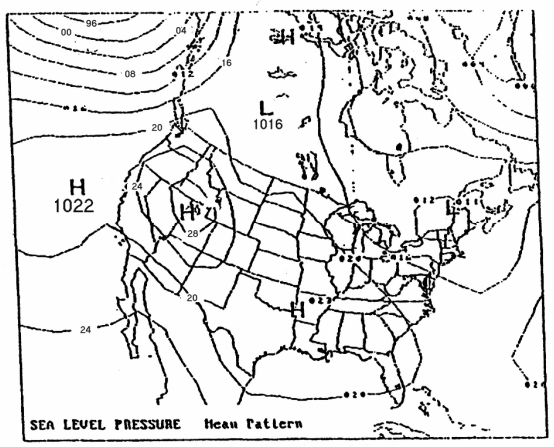
(4 pts)1. Circle the correct answer to describe the most likely weather experienced at Sacramento for the SLP and 500 mb Z fields shown.

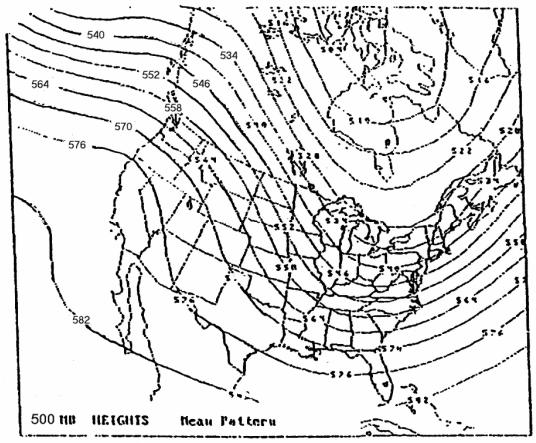
Rainfall over the next hour is likely to be **(none, light, heavy)**

Surface wind direction is from the **(SW, SE, NE, NW)**

Surface wind is likely **(strong (>20 knots), moderate (10-15 knots), weak (<5 knots))**

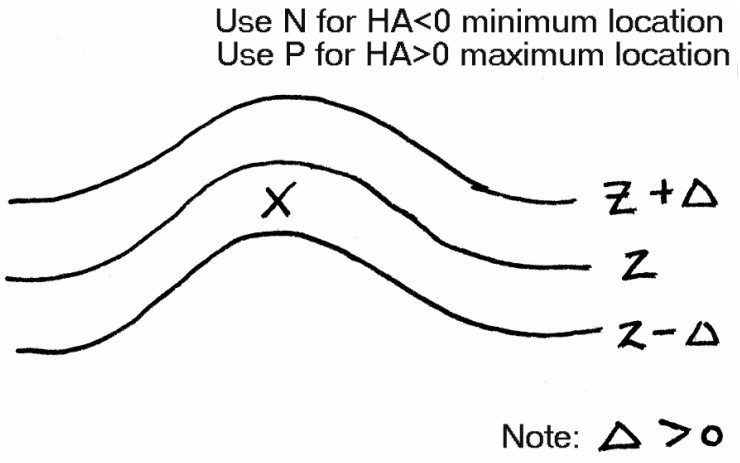
Surface temperature at Davis is likely **(cold: <1C, cool 1-15C, warm 15-25C, hot >25C)**





2. Regarding the vorticity, ζ equation. Answer the following:

a. (4 pts) Horizontal advection, term **HA at 200 mb.** On the chart at right: **draw representative contour(s) to illustrate the pattern**, and use a letter "P" to locate the positive maxima (if present) and "N" to locate the negative extrema (minimum, if present). The "X" marks where vorticity is an extremum (positive or negative). **Draw an arrow** to indicate geostrophic wind motion.



b. (1 pt) What is a typical maximum amplitude (in our units of 10^{-10} s^{-2}) for the HA term at 200 mb?

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3. (11 pts) True (T) or False (F), circle the correct response to the following statements:

T F Cloud-tracked winds are obtained by tracking cloud motions with radar.

T F Freezing rain tends to occur near intense wintertime warm fronts.

T F "WRF" stands for "wrong rain forecasts" model.

T F If you double the grid interval in both horizontal directions, the WRF model will take at least 4 times longer to run.

T F Chinook winds can occur on the windward side of a north-south mountain range.

T F The 'modified sigma' vertical coordinate in the WRF model intersects only the tallest mountains.

T F Lake effect snows can occur on the downwind side of a large lake.

T F In MOS, "reduction of variance" refers to how much your choice of predictors reduces the variation in your estimate.

T F In MOS, the first predictor is usually that with the highest correlation to the predictand, regardless of the sign of the correlation.

T F A CAPE value of 2500 J/kg is sufficient to forecast convection.

T F The more solenoids (from intersections of 1000-500 hPa thickness and sea level pressure contours) that fit within a given area, the greater the temperature advection.

4. Models parameterize various processes.

a. (2 pts) What does "parameterization" mean?

b. (3 pts) List 3 different processes that are parameterized in the GFS.

1.

2.

3.

5. Measures of skill and error. You are given i=1 to N grid points and k=1 to M forecasts, $f_{i,k}$ and observations, $O_{i,k}$
a. (3 pts) Write down a formula for *mean* forecast bias at grid point i=6.

MFB =

6. Weather map conventions.
a. (1 pt) Why would the 5400m contour of 1000-500 hPa thickness be highlighted on a weather map?

b. (2 pts) Give **2** reasons why absolute vorticity would be plotted on the same map as geopotential height at 500 hPa.

7. (3 pts) Briefly describe 3 of the 4 ways topography can enhance precipitation.

i.

ii

iii.

8. (3 pts) What are the 3 *sources* of data (not the 4 *types*) that can be used as predictors in a MOS scheme?

i.

ii.

iii.

9. (3 pts) Spectral models.
a. Spectral models like the GFS use 'global functions' (like sines and cosines in the east-west direction). In class, 3 types of calculations were identified that need special treatment when using global functions. Discuss **1** of those 3 types by: identifying the **type of calculation by name** and then **describing how the GFS performs that type of calculation**.

Name: _____
Description of procedure:

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10. Observational increments at radiosonde stations are cross correlated and plotted as a function of the distance between the stations in the figure at the right. The average correlation for stations in a small range of distances apart is positive. The average correlation *de*creases as range of distances between radiosonde stations *in*creases until a distance **D** is reached whereupon the *average* correlation at that distance becomes the **most negative**.

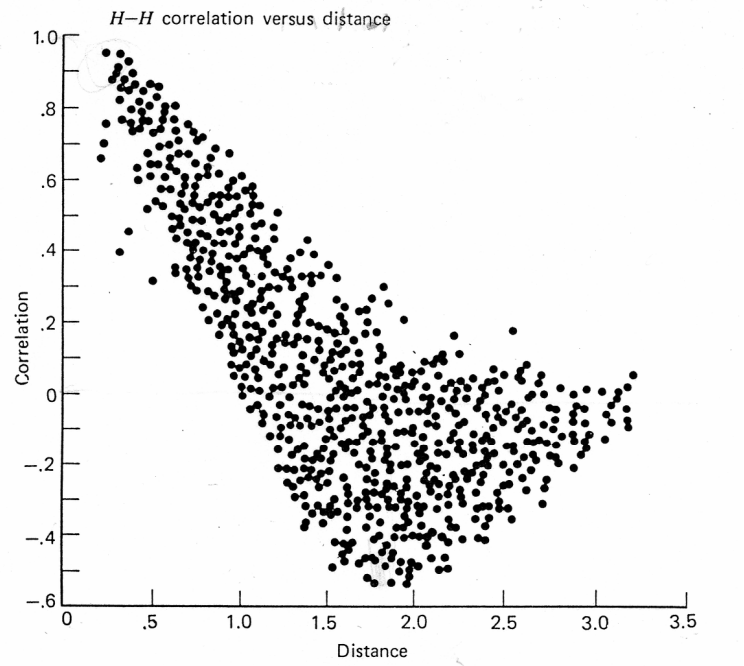

Figure 11-2 Forecast-error correlation for the height field as a function of separation distance (10^3 km) between every pair of points for 50 U. S. radiosonde stations. The damped persistence forecast was used as a first guess. (*After Schlatter, 1975*.) (From T. Schlatter, ''Some Experiments with a Multivariate Statistical Objective Analysis Scheme.'' *American Meteorological Society*, 1975.)

a. (3 pts) What is an 'observational increment'?

b. (2 pts) Estimate the value of '**D**' from the figure. (Include units!)

c. (1 pts) What average *property* of the weather over the US does '**D**' indicate?

d. (4 pts) How might you use the information in this figure when constructing a Cressman-type objective analysis scheme?