Name ___________________________

Date _____________________________

ERTH 465
Fall 2017

Lab Exercise 4
100 pts

**Contouring of Isobars and Isohypses**
Grounded in Learning Objectives 1, 2 and 4 (see class syllabus)
Last Day to Work On This Lab in Class: Thursday 28 September

Insert in **ringed**-three hole binder.

Point deductions for sloppy or late work.

## I. Contouring Weather Data

You are now somewhat accustomed to seeing the great amount of weather data that can be plotted on plan view and cross section charts. Clearly, one can deduce patterns in the data that need to be explained. For example, you have now drawn streamlines that suggest organized circulation systems on the weather maps at different levels.

But what is equally clear is that it is difficult for the brain to process the large amount of information on any of the charts we have looked at. The easiest way to organize the information so that it is easier to deduce patterns is draw contours connecting values of a given piece of weather information that have the same value. Such lines, or contours, are called isopleths. In meteorology, isopleths are used to show patterns of pressure, temperature, dew point temperature and wind speed, for example.

The prefix 'iso' means "equal value" and "pleth" means a line or braid. Here are a few of the actual names used in meteorology and oceanography given to common isopleths:

- Isobar – pressure
- Isotherm – temperature
- Isodrosotherm - dew point temperature
- Isotach – wind speed
- Isopycnic of Isopycnal – density
- Isohypse – height contour
- Isostere – volume

In modern meteorology and oceanography, it is common for students to look at contoured fields. It turns out that fields contoured by computer programs (called "objectively analyzed fields" are the ones most commonly examined by students and found on weather maps. It also turns out that such objectively-analysed fields, by definition, come from computers that are "taught" a set of rules to use in order to take actual observations and infer the values of a variable between observation points. Unfortunately, these rules often result in unrealistic patterns produced on weather charts. Only a trained meteorologist can deduce that a given pattern, as elegant as it appears on a chart, is physically realistic or unrealistic.

On the other hand, humans themselves can contour weather information. Fields contoured by a human are called "subjectively analyzed". Humans who are attempting a subjective analysis also work from a set of rules. But the human brain is much more flexible in judging exceptions or complications in the pattern, while computers will continue to draw a contour even if its location or existence is not physically realistic.

This is not to say that subjective analyses are necessarily superior to those drawn objectively. We will delve into this topic more during the semester. Suffice it to say that once you learn the rules of contouring and begin to understand the reason for flow patterns in the atmosphere, you will be able to deduce areas on objectively drawn charts that are egregiously ridiculous. Being able to do so allows you to be an informed user of the many objectively drawn weather maps and charts available on the web, for example. Being able to so distinguishes you as a practitioner of meteorology, rather than as a mere technician blindly accepting patterns "because they look elegantly drawn."

In this lab, you will be contouring surface isobars and 500 mb contours on two of the plots you got in Lab 2. Those two plots are:

Chart 1: sfcwx 12020312 -re=us -var=full -stat_prior=1 -cod=green:hi=.8
Chart 3: upairwx 12020312 -lev=500 -var=all

In a future lab you will be learning more about the observations that are plotted on these charts, and in the lab after that, how to draw other features (such as fronts, trough lines, outflow boundaries, isotherms) on these charts. But in this lab you will be merely contouring surface pressure (isobars) and 500 mb height contours (isohypses).

## II. Rules of Contouring

A contour is a line that connects points experiencing the same value of some variable. By definition, this implies that if a contour is drawn between two weather stations experiencing the same pressure, for example, that the same pressure can be inferred to exist between the two stations. Likewise, you will learn that there is a conventional contour interval for each variable depending upon the scale of the chart. For example, for a synoptic scale sealevel pressure map of the United States, the conventional interval is 4 mb starting with 1000.0 mb. If the two adjacent stations have pressures of 1001.2 mb and 998.8 mb, one can infer that there is a pressure of 1000.0 mb roughly halfway between the two stations.

The result of these two simple inferences is that contours form closed curves (although the map boundary may make it appear that the curves just end at the map edge) that eventually connect, and that the same sense of values exist along the path of the curve. The latter fact simply means that if pressures are higher on the “right” side and lower on the “left” side of the isobar as you draw it, that continues along the whole isobar.

Here is a review of the major rules of contouring isobars and isohypses:

- All contours eventually connect because they form closed curves, but can end at map borders (they connect off of the map space).
- Contours should be smooth curves, except at fronts, outflow boundaries, surrface troughs, drylines, where contours should be kinked AWAY from low pressure.
- Contours do not cross, do not end in space (except at map boundaries) and contours with different values do not connect.
- Contours should be labeled at convenient locations and at ends near the periphery of charts.
- Contours should be drawn at conventional intervals and at conventional initial values (i.e., on surface chart, 4 mb intervals (2 mbsubsynoptic) starting at 1000 mb etc.).
- Areas of low and high pressures (heights) should be labeled with red "L" (or "Low") and blue "H" (or "High"), respectively.
- When analyzing charts, a rough draft should be done on acetate first. No erasures or sloppiness on final drafts is tolerated. After you are satisfied with your acetate analysis, then you can transfer to final copy using a light table.

There are two more “rules” that will make sense later in the semester.

- Winds should be in either geostrophic/gradient balance or "friction" (boundary layer) wind balance with contours depending upon analysis level. Disturbances with wavelength less than about 200 km or so should NOT appear on contour patterns for 700 mb and above. This is because the radiosonde network is too coarse to resolve disturbances of this scale. Such disturbances appearing on computer analyzedcharts are usually spurious and should be ignored.
- Contour patterns should be consistent with previous charts.

## III. Exercises

Practice Exercises:

1. Simple contour drawing exercise.

2. Contouring a field of values.
3. Contouring a more complex field.

Map Exercises:

Contour the surface and 500 mb charts at conventional intervals, as explained in class. You will contour the surface chart again in a future lab after we go over frontal analysis. (50 pts each for a total of 100 pts)

1. Assemble all your analysis tools: (a) clean copy of plotted data; (b) for rough draft - grease pencils, clean acetate, alcohol and rags; (c) for final draft - colored pencils and pens.

2. Examine the plotted data to "characterize" or "diagnose" the patterns on it. Mentally note any circulations apparent, large wind shifts etc.

3 . On acetate, find the lowest or highest pressure (or heights) and start drawing IN BLACK isobars as follows: (a) 4 mb interval; (b) isobars on surface charts are drawn STARTING with 1000 mb (e.g., 1000, 1004, 1008, 1012 etc). Make sure to label Highs (blue H) and Lows (red L) at the center of the patterns, and to label isobars clearly so you dont get confused when you transfer. For the 500 mb chart, heights are in decameters and are contoured (in black) at 6 decameter intervals starting with 564 dm (e.g., 552, 558, 564, 570 etc.)

4. Show rough draft to instructor for OK.

5. Transfer to hard copy using the light tables. Final analysis MUST be neat. No erasures. No grease pencil. Isobars/height contours - black (or pencil).