ERTH 465
Fall 2017

Laboratory Exercise 5

Surface Weather Observations (METARS) and Frontal Analysis (300 pts)

- Insert in **ringed**-three hole binder.
- Point deductions for sloppy or late work.
- Due date: Tuesday **10 October**

I. Introduction

A careful analysis of surface data is one of the most important techniques the operational meteorologist can master. Since most users of weather information or forecast services live at sealevel, it is obvious that a an accurate portrayal of present conditions at that elevation is fundamental.

II. METAR decoding

The surface data is coded on the basis of international convention. Observations are made hourly, and each "observer" is given a ten minute time window, between 10 minutes before the hour to the hour to make the mandatory surface observation. Any unusual conditions or events that occur out of the time window mandate that a "special" observation be taken. These reports are called "Metars".

The word METAR is from the French, "message d'observation météorologique régulière pour l'aviation," and is thought to have originated as a contraction from MÉTéorologique ("Weather") Aviation Régulière ("Routine"). The Federal Aviation Administration (FAA) may consider it to be erroneous to abbreviate METAR as METeorological Airport Report.[citation needed] The FAA and National Oceanic and Atmospheric Administration (NOAA) specifically define a METAR as an "aviation routine weather report," an approximate translation of the French.

Once the observations are plotted on a map, they can be contoured carefully, as you did in the first part of the lab. It is important to keep in mind that a careful analysis of these observations is critical. Not only does such an analysis yield positions of low and high pressure areas, and troughs and ridges, but because a diagnosis of the patterns on such analyses can yield clues about weather development. For example, surface boundaries (cold/warm air, high humidity/low humidity, wind shift or trough lines) are often foci for the formation of thunderstorms, frontal waves etc.. Only an accurate analysis of the surface data can disclose these important features.

We will "pretend" that each student has obtained the METARS for 12 UTC 3 February 2012 and plotted them on the surface chart you analyzed in Lab 4. But for practice in learning the METAR code, you will decode a number of Kansas METARS for 05 UTC 3 February 2012.

III. Synoptic-scale Analysis

It is important that the beginning meteorologist accept the following: although objective (computer) analysis of weather data has provided an important service to operational meteorology, it is not a substitute, by any means, for hand analysis. Even at the synoptic scale, computer analyses tend in some cases to oversmooth ALL (even meteorologically-significant) smaller-scale irregularities in the pressure field, often obscuring the important boundaries alluded to in the last paragraph. And in some cases, the contouring algorithms do just the opposite, creating a busy, overly textured set of fields.

In addition, the smoothing-procedure often results in isobars being drawn incorrectly with respect to station data. Meteorologists who have experience in making field operational decisions WILL NEVER exclusively depend upon machine-generated analyses and will always complete an analysis of the data (even if it is a "quick and dirty" analysis) themselves.

In reality, there are many facets to the manual analysis of surface data. Some of the more difficult tasks, including the more detailed technical aspects of frontal analysis, will be left to future classes (Metr 430).

A. Establishing a Synoptic History

In order to provide onself with guidance about what the present analysis should basically look like, the analyst MUST examine the series of analyzed surface maps preceding the synoptic time of the data to be analyzed. Pressure systems should maintain some continuity, that is to say, should not disappear from the map, should continue to intensify or weaken (depending upon the trends determined from the recent "history" as depicted on the last few maps) and should shift position in smooth arcs. Normally an analyst will have also drawn the previous maps and will have some knowledge of these prior conditions. For this lab, I will provide you with a couple of charts to establish history.

B. Fronts

1. Surface warm, cold and stationary fronts are drawn on the warm-air side of packing in the surface isotherms. Classic surface

2. occluded fronts are found under the thickness tongue (as shown in a future class) and join the cold and warm fronts at the triple point,
3. equatorward of which there is considerable packing of the thickness arrows.
4. Fronts are found in regions of locally reduced pressure (sharp troughs evident as kinks on isobars)
5. Usually (but not always) sharp wind shifts (veer of wind from warm air side to cold air side of fronts) occur
6. Usually, pressures fall markedly ahead of fronts and rise behind.
7. A first guess at frontal positions should be made on the basis of the history and a synoptic-scale analysis of the thickness field (explained below and in class).

C. Exercises

1. *METAR Decoding (60 pts)*

You are provided with portions of the Federal Meteorological Handbook 1 (the complete Handbook is available as a pdf). A sample METAR observation and its decoded version can be found here and a short guide from the NWS here.

Decode the following METARs for stations in Kansas at 05 UTC 3 February 2012. The station identifiers can be found here. (10 pts each for 60 pts)

KIAB 030455Z AUTO 11021G28KT 10SM FEW039 BKN130 12/06 A2994 RMK AO2 PK WND 11028/0447 PRESFR SLP139

KPTT 030535Z AUTO 05013KT 10SM TS OVC060 06/05 A2993 RMK AO2 LTG DSNT ALQS

KDDC 030536Z AUTO 35014KT 4SM VCTS RA BR SCT016 SCT028 OVC038 07/06 A2996

KGBD 030535Z AUTO 06018G23KT 10SM SCT006 OVC065 05/03 A2994 RMK AO1 LTG DSNT SE

KSLN 030530Z AUTO 03011KT 5SM +RA OVC033 07/03 A3002

KGLD 030535Z AUTO 08013KT 4SM -SN BR BKN003 OVC008 01/01 A3002

2. *Surface Frontal Analyses* (240 pts)

In this exercise, you will be recontouring the surface chart and 500 mb charts for 1200 UTC 3 February 2012. You are also provided with the 0000 UTC and 0600 UTC surface analyses from the Hydrometeorological Prediction Center (HPC) to establish a history and continuity. You are also provided with the 1200 UTC 3 February 2012 equivlaent of nam_maps nam_thick from our lab, which is an overlay of the 1000-500 mb thickness field on surface isobars.

Charts

I. Surface plot for 12 UTC 3 February 2012
II. Analyzed 500 mb Height map for 12 UTC 3 February 2012
III. HPC Surface Analysis for 0000 UTC 3 February 2012 and HPC Surface Analysis for 0600 UTC 3 February 2012
IV. Surface Isobars with 1000-500 mb Thickness for 12 UTC 3 February 2012: Colorized and Black/White

The steps involved in this lab include reanalyzing the surface chart for isobars, but adding fronts.

Exercises

a) Examine the history charts (Charts III) to see how HPC analyzed the history of this disturbance. Careful...do not use "argument by authority", assuming that their analyses are correct. **Now write a paragraph or two of discussion on what the analyses depict for the cyclone you found in Lab 4 over the southern Great Plains. (20 pts)**

b) To see the relationship of the thickness contours to the temperatures at 500 mb (to determine if the gradients and location of cold and warm air masses is relatively the same) perform an isotherm analysis on the 500 mb chart provided (Chart II). **Use acetate first, and draw**

contours at 5 degree C intervals starting with 0, -5, -10 or 10, 15 etc. (60 pts)

c) **Perform an advection/frontal analysis on the the black and white version of nam_thick** (Charts IV). You will turn in a NEAT version of the frontal analysis , with advection arrows and fronts drawn correctly. This will help you in visualizing the position of actual fronts. **(50 pts)**

d) Now you have enough information to **reanalyze the surface chart** (Chart I). **(110 pts)**

General Procedure:

- Sketch frontal positions in lightly on acetate on the basis of the steps above.
- Please use proper color conventions.
- Now draw isobars to fit the frontal position.
- Once frontal positions are finalized, make sure isobars KINK AWAY from low pressure, as shown in class.

Your Analysis Should Have

- Present weather symbols color-coded (on hard copy)
- Isobars at 4 mb intervals (on acetate)
- Fronts High and Low pressure areas, Dry Lines (on separate acetate)

Remember the following

- fronts do not "back" up
- low and high pressure areas do not move discontinuously (they don't move back west, then back east) on successive charts
- sticking close to the rules of contouring will keep you from gettting confused