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FORECASTING CONVECTION WITH THE AFOS DATA ANALYSIS PROGRAMS (ADAP-VERSION 2.0)

Phillip D. Bothwell
Scientific Services Division
Fort Worth, TX

Scientific Services Division
Southern Region
Fort Worth, TX
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C. William Verity, Secretary

National Oceanic and Atmospheric Administration
Melvin N. A. Peterson
Acting Under Secretary and Administrator

National Weather Service
Richard E. Hallgren
Assistant Administrator

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PHILLIP D. BOTHWELL

TABLE OF CONTENTS

PREFACE

The original version of the AFOS Data Analysis Programs (ADAP) was first introduced in Southern Region Technical Memo 114 (Bothwell, 1985). It contained a brief description of the programs and sample output. Since that time, a series of notes on the programs have appeared as Technical Attachments to the Southern Region Administrative Notes. The purposes of this Technical Memo are to consolidate previous Technical Attachments and expand upon the latest version of ADAP and allow for a more thorough discussion of thunderstorm forecasting using the programs.

In Chapter 1, each of the individual ADAP fields will be examined. A decision tree will be covered in Chapter 2 to illustrate the incorporation of the ADAP graphics into the forecaster's routine. The decision tree cannot be an absolute, infallible, cure-all for the problem of thunderstorm forecasting. Rather, it is part of a simple model and presents forecast guidelines. If it stimulates and aids the thought process, then it has served its purpose. Case studies are presented in Chapter 3. The Appendices discuss the setting up and execution of the AFOS programs in detail.

The use of the ADAP fields need not be restricted entirely to convective weather (e.g., the fields that display changes of pressure, wind, temperature and dew point can be used anytime of the year (Mogil, 1978)). Several subjective studies (Bartels, 1986; and Branick, 1986) have evaluated the original ADAP fields. Bartels' study was a subjective evaluation of the ADAP graphics used during the Kansas-Oklahoma PRE-STORM experiment in 1985. In the experiment, the original ADAP package was run every three hours. Since the program originated at WSFO OKC and was used there for the PRE-STORM experiment, that study recommended the forecasters at WSFO OKC be polled as to their feelings about the ADAP products which were generated. This poll was summarized by Branick (1986). Important comments from those papers are incorporated into this Tech Memo.

ADAP represents a philosophy as much as a computer technique. It was developed with these main ideas.

1. THE COMPUTER SHOULD PROVIDE FIELDS NOT EASILY DIAGNOSED MANUALLY OR ALREADY AVAILABLE IN REAL TIME TO THE METEOROLOGIST.
2. THE COMPUTER IS USED TO SUPPLEMENT THE HAND ANALYSIS..NOT REPLACE IT. THE METEOROLOGIST CAN (AND IS ENCOURAGED TO) PRODUCE A SUPERIOR HAND ANALYSIS OF MOISTURE, PRESSURE SYSTEMS, OUTFLOW BOUNDARIES, FRONTS, ETC..
3. THE QUALITY OF OUTPUT IS ONLY AS GOOD AS THE QUALITY OF THE INPUT.
4. THE METEOROLOGIST SHOULD BE ABLE TO EDIT THE DATA QUICKLY AND EASILY IF THE NEED ARISES.
5. THE OBJECTIVE ANALYSIS PROGRAM (MESOS) USES TIME AND DISTANCE WEIGHTING OF OBSERVATIONS TO LESSEN THE IMPACT OF MISSING OR ERRONEOUS DATA.
6. THE DERIVED FIELDS SHOULD (AND DO) EXHIBIT GOOD CONTINUITY FROM ONE HOUR TO THE NEXT.

CHAPTER 1 ADAP PRODUCTS

1.1 INSTABILITY

Two stability indices are produced hourly as in Tech Memo 114 (Bothwell, 1985). They are the AFOS graphics NMCGPHSSL and NMCGPHSSU. Hereafter, the AFOS graphics will simply be referred to by the last three characters, xxx, of the AFOS graphic ID, NMCGPHxxx, (the NMCGPH will be assumed). Each stability index is calculated at a grid point proceeding dry-adiabatically from the surface grid point temperature and dew point to saturation and then moist-adiabatically (see Fig. 1) to 500 mb (SSL) and one of the following, 400, 300, 250, or 200 mb (SSU). The wet-bulb potential temperature of this moist adiabat is subtracted from the pre-calculated grid point environmental wet-bulb potential temperature at the appropriate pressure level. This is then converted back to an actual temperature difference in degrees C. These stability indices can also be referred to as Surface Parcel Lifted Indices, and are the same as the stability indices in Tech Memo 114. Examples are shown in Fig. 2.

The additional "upper" stability index (SSU) can be used to supplement the more traditional 500 mb lifted index by helping to diagnose the depth of the instability and/or the amount of instability. It is not uncommon in severe thunderstorm events for the ADAP instability above 500 mb to be even larger than that present at 500 mb. The 300 mb level is generally used for the upper level stability index in spring through fall, although 400 mb is recommended in the winter due to the presence of cooler surface temperatures and limited moisture which result in a moist adiabat that intersects the sounding at a higher pressure (lower height) than one for very warm and moist air. A quick look at the stability can serve to help diagnose the expected type of weather. Quite simply put, the more negative the indices the more that the weather watch for convection should be increased, given that a triggering mechanism exists or is expected.

Observations indicate that increases in temperature and dew point at the surface increase the instability more often than changes aloft. Also, the instability will increase faster by increasing moisture than by increasing temperature in warm, humid air (Sanders, 1986). Instability can be further increased if cold air in the mid-levels is advected over the area. The winds and temperature aloft forecasts from NMC model output can be used to anticipate significant changes in temperatures. If important temperature changes aloft are anticipated, they can be edited into the appropriate upper-air data file.

Operational use (Bothwell, 1985) has shown that the area of maximum instability can be quite narrow, sometimes only 50 to 75 miles in width (well below the resolution of indices calculated only at upper-air stations). For more information on sounding analysis, two excellent references are Doswell (1982) and Liles (1985).

Lest we all be lulled into a false sense of security in the age of computers, it is worth repeating a word of advice from Doswell (1982).

> "Nothing can or should replace an examination of the individual sounding."

Two additional stability indices (SXL and SXU) have been added that use only objectively analyzed maximum wet-bulb potential temperature (lowest 300 mb, Fig. 3) from significant level upper-air messages every twelve hours (Fig. 4). These have been added to better represent stability during the night when cooler (more stable) surface conditions may not represent conditions aloft, or in the case of shallow cold fronts where warm moist (unstable) air overruns the cold air. Since only data from the upper-air sites are used, the analyses (SXL, SXU) have less resolution than SSL or SSU. Aside from this difference, the actual calculation is similar to that of the surface based stability indices (SSL and SSU).

1.2 THE CAP STRENGTH

Quite often, large areas are diagnosed by most stability indices as having unstable air, yet convection does not develop due in part to a capping inversion. Areas that are capped by an inversion can be evaluated through the AFOS graphic for cap strength, SSC (Fig. 5). The cap strength has also been referred to in the literature as lid strength (i.e., the inversion acts as a "lid" to suppress convection); (see Carlson and Ludlam, 1968). The calculation of the cap strength proceeds much like that of the stability indices. Instead of comparing surface wet-bulb potential temperature to those of 500, 400 mb, etc. (as in the stability index calculations), the wet-bulb potential temperature of the moist-adiabat is compared to the pre-calculated grid point maximum saturation wet-bulb potential temperature from significant level upper-air data (see Fig. 1). This difference between the two moist-adiabats in degrees C is the cap strength. This method is similar to Graziano (1985) and Graziano and Carlson (1987).

Graziano (1985) has found that with a cap strength greater than 2 degrees C, the chances of deep convection decrease dramatically. According to Graziano:

> "By means of a thorough statistical analysis of a large number of thunderstorm events it was determined that an effective critical magnitude of the lid term in the Lid Strength Index does exist. The lid term...quantifies the extent to which a low or middle-tropospheric inversion inhibits deep convection and the critical value represents the magnitude above which deep convection tends to be suppressed."

Graziano and Carlson (1987) recommend using the 2C isopleth of cap (lid) strength to define the lateral boundaries of the lid. They also state that if, for some reason, convection does occur in unstable air where the cap strength has been previously diagnosed to be greater than 2C, it will very likely become severe. When superimposed on the 500 mb stability, this critical cap (or lid) strength allows the forecaster to more effectively concentrate on a small area within a larger unstable airmass.

The areas in Graziano's study included most of the central and eastern United States. It is significant that he did not restrict his investigation to strictly mid-western events. Thus, whether the inversion arises from advection of air from the Mexican plateau, Carlson and Ludlam (1968), subsidence, or other processes, the important point is that a critical lid strength (approximately 2C) appears to be a useful tool (see also Bothwell, 1987b).

It is equally important, however, that once the lid strength term has been evaluated, forecasters should anticipate any significant changes that would either strengthen or weaken the inversion. One particularly good method recommended by Graziano (1985) for evaluating the cap and any changes it might undergo is the use of isentropic analysis. The surface to evaluate would correspond to one that has a potential temperature of the lid base (see Little (1985) for AFOS based program).

As was the case with the stability indices mentioned previously, a cap strength, SXC (Fig. 6), based only on significant level upper-air data is calculated every twelve hours. It is calculated similar to the surface cap strength, except it is based on the objectively analyzed maximum wet-bulb potential temperature of the lowest 300 mb of each sounding. Note that <u>if</u> the maximum wet-bulb potential temperature is <u>above</u> the capping inversion, the index would have little use.

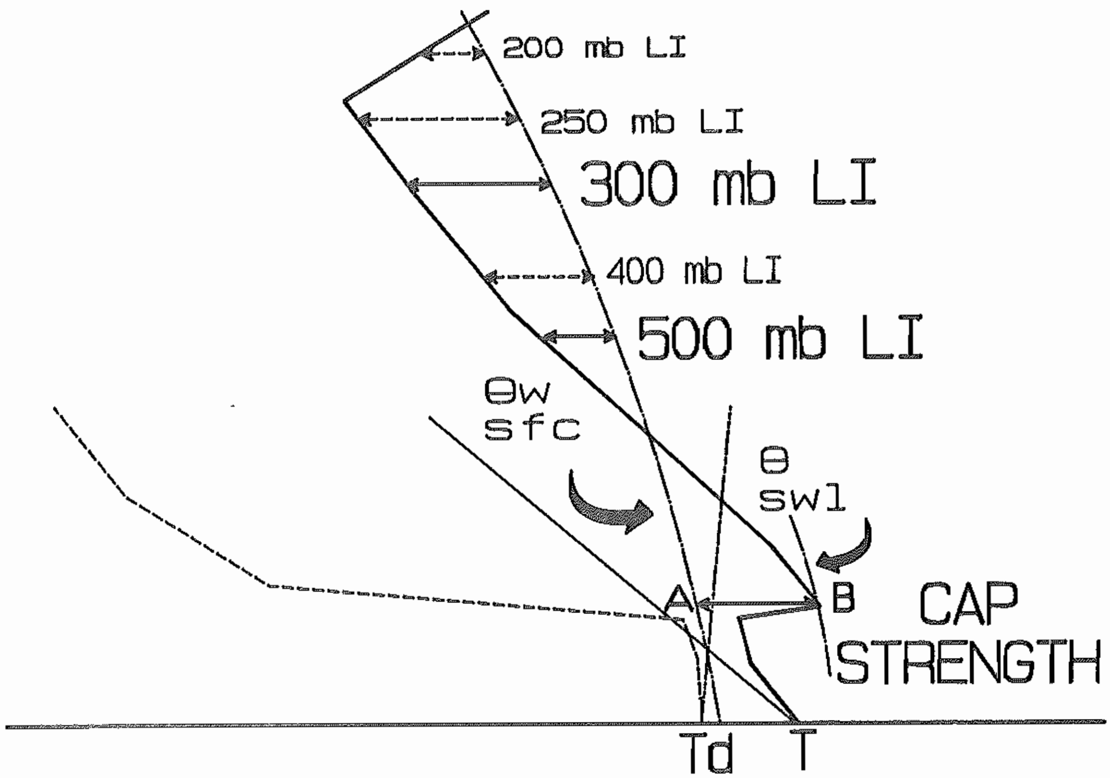


Figure 1 Example of ADAP stability indices and cap strength on skew T-log P as calculated (at each grid point) by AFOS program MESOS. 500 mb LI and 300 mb LI are normally calculated although 300 mb can be replaced by 400, 250, or 200 mb LI. Magnitude of cap strength term is denoted by line AB. Bold solid line is temperature trace, dashed line is dew point trace. Dashed-dotted lines are moist adiabats (Theta w (sfc) corresponding to moist adiabat based on surface temperature and dew point and Theta swl based on maximum saturation wet-bulb potential temperature in the lid as determined in lowest 300 mb of sounding). Dashed-double dotted line is line of constant mixing ratio and sloping thin solid line is dry adiabat.

*These lines are called "hidden titles" which can be used in additional graphic transformations on AFOS.

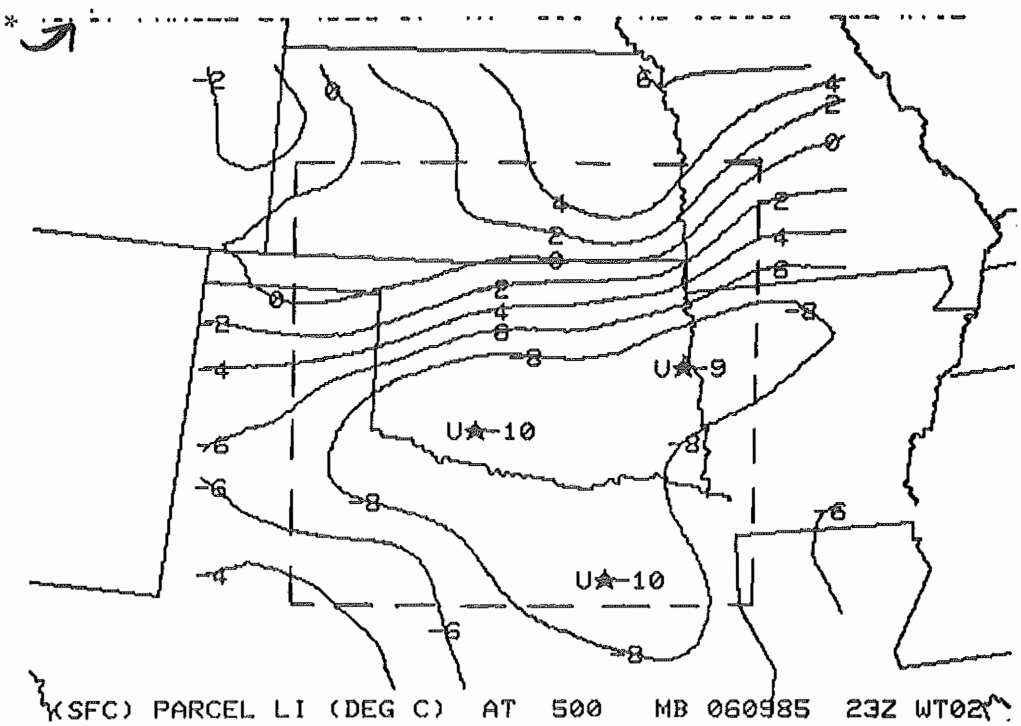
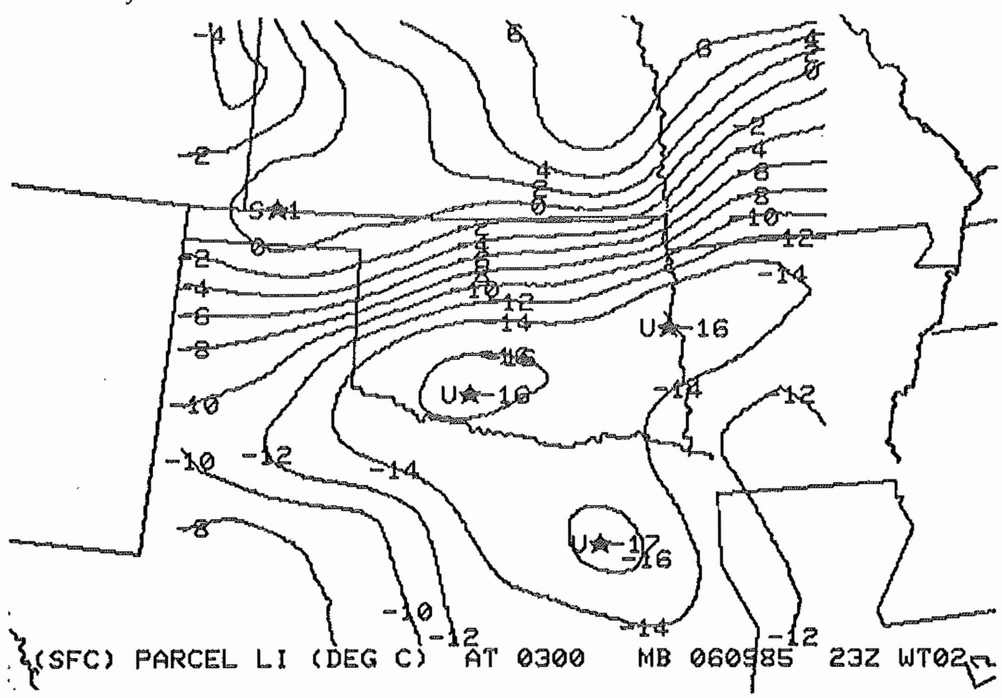


Figure 2 ADAP stability indices from program MESOS based on 23Z surface data and 12Z upper-air data. Fig. 2a (top) is AFOS graphic SSL and Fig. 2b (bottom) is SSU. Contoured fields in ADAP Version 2 also have max and min centers to enhance the analysis. For the stability indices, a "U" followed by a star and a number denotes the most Unstable air (determined mathematically). An "S" followed by a star and a number denotes most stable.



Note also the routine that determines and plots max and min centers cannot determine a max or min on the outermost top and bottom two rows and left and right two columns of grid points-only within the area enclosed by the dashed box in Fig 2a.

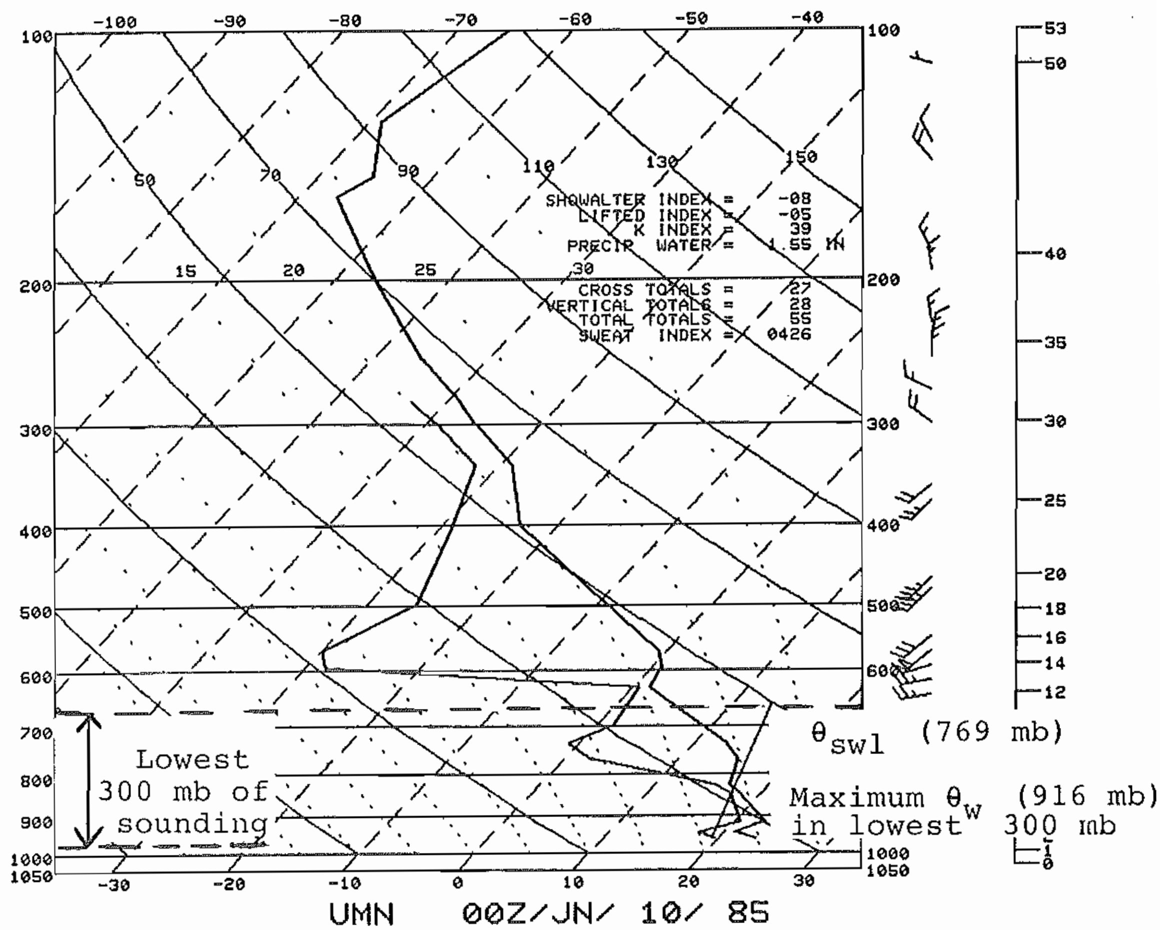


Figure 3 Skew t-log P from Monett Missouri from 6/10/85 at 00Z. The maximum wet-bulb potential temrerature in the lowest 300 mb of the sounding (Theta w-used in the calculation of SXL and SXU) is at 916 mb with a temperature of 24.2C and a dew point of 22.1C. The maximum saturation wet-bulb potential temperature of the lid (Theta swl-used with Theta-w in the calculation of SXC) is at 769 mb with a temperature of 16.6C. The interval searched in the vertical for Theta swl is from 50 mb to 300 mb above the surface in order to not pick up shallow radiationally induced inversions.

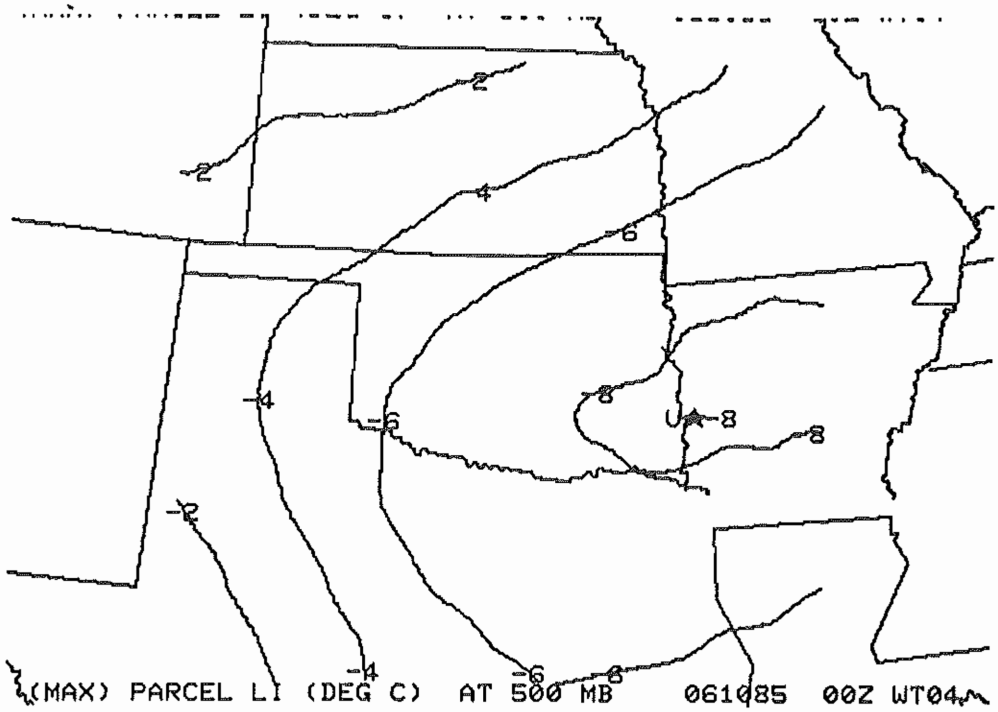
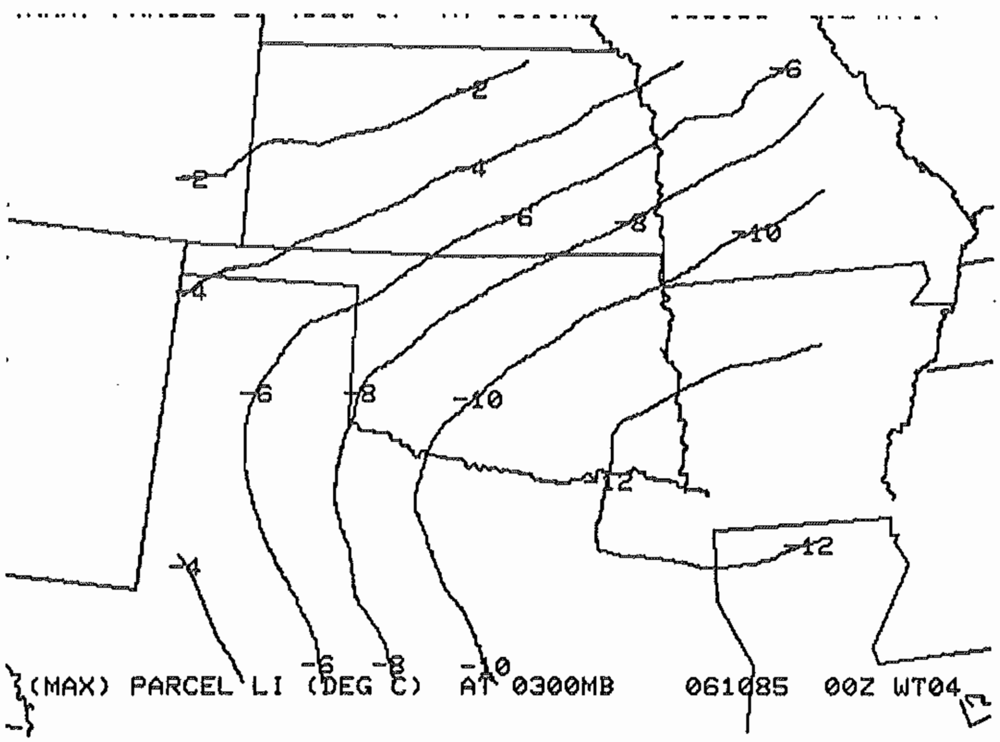


Figure 4 Lifted indices based only on data from upper-air sites. Fig. 4a (top) is SXL and Fig. 4b (bottom) is SXU. "Max" parcel in graphic title refers to the use of the maximum wet-bulb potential temperature in the lowest 300 mb of the sounding. They are calculated only every 12 hours.



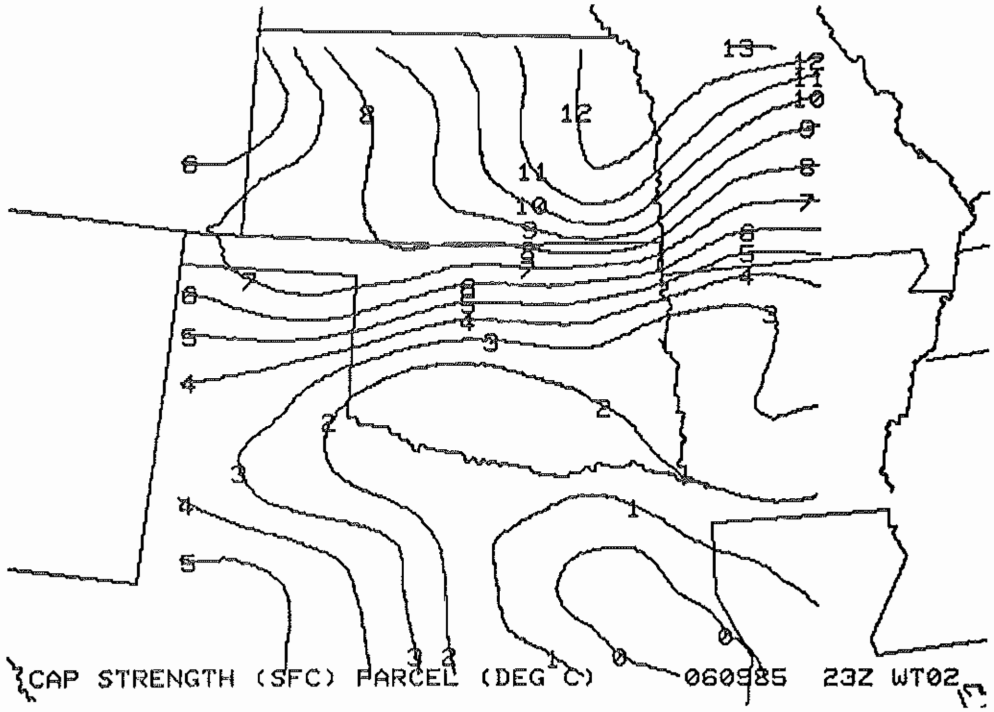
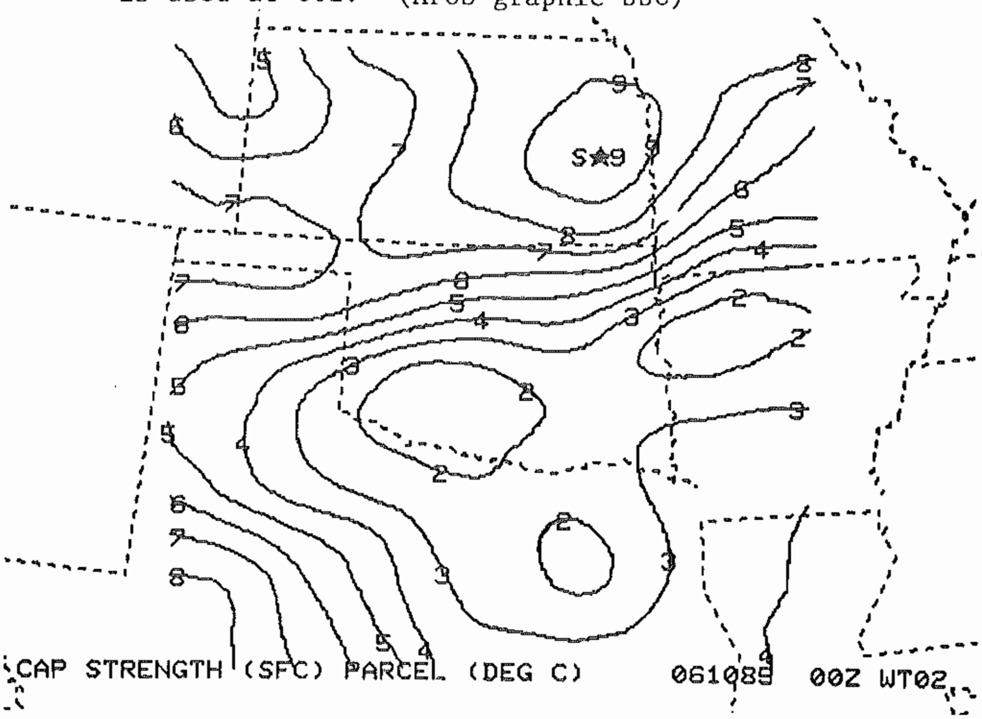


Figure 5 Strength of capping inversion based on 23Z surface data and 12Z upper-air data in Fig. 5a (top) and one hour later based on 00Z surface data and <u>00Z upper-air data</u> in Fig. 5b (bottom). Notice how the cap strength changes over northeast Texas when the most recent upper-air data is used at 00Z. (AFOS graphic SSC)



Max and min locations (when plotted) are labeled following the same format as for the stability indices. "S" where the cap is strongest or <u>s</u>table and "U" where the cap is weakest or <u>u</u>nstable.

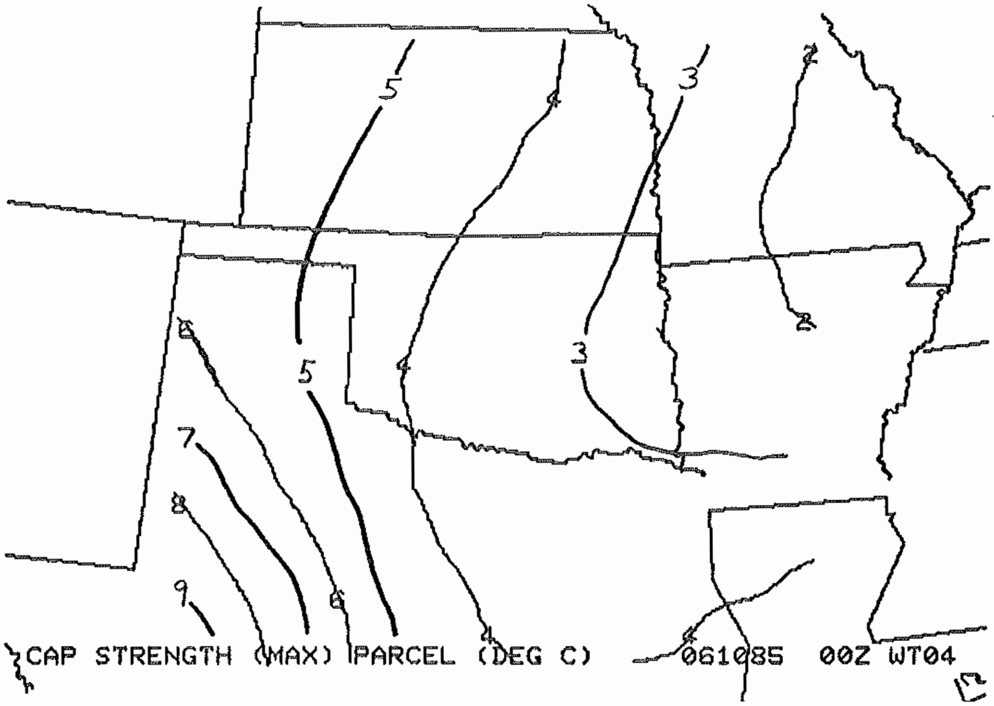


Figure 6 Strength of capping inversion calculated from the maximum wet-bulb potential temperature data from upper-air sites at 00Z. Note the differences between the surface based "parcels" (Figs. 2 and 5) and maximum wet-bulb "parcels" (Figs. 4 and 6). (AFOS graphic SXC)

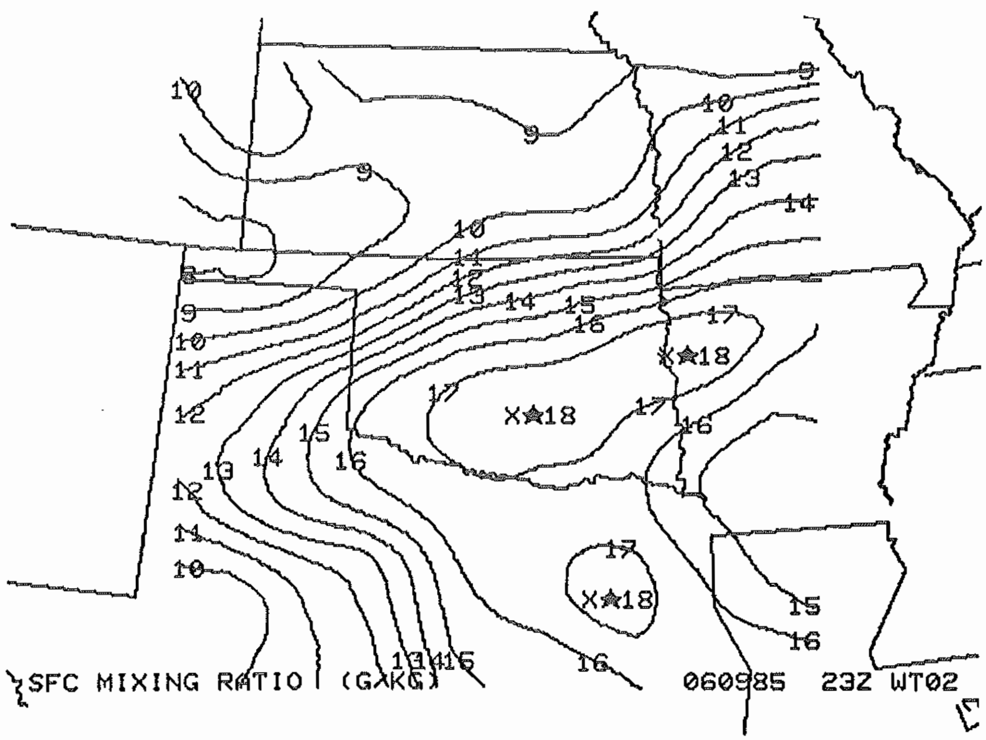


Figure 7 Surface mixing ratio.
X=maximum (AFOS graphic SMR)
N=minimum

1.3 MOISTURE

Next we will evaluate ADAP products dealing with the surface moisture (i.e., surface mixing ratio, SMR; moisture flux convergence, SMC; changes in the moisture flux convergence, SCC; changes in grid point mixing ratio, SQC; station dew point changes, SC2 (or SC1); Figs. 7, 8, 9, 10, and 11a respectively). SC1 contains the same data as SC2, but on a different map background. Figure 11b illustrates how to interpret the station change charts. Moisture flux convergence can be one of the most important short-range prognostic fields for forecasting convection. Unfortunately, it can also be one of the most misused fields. A very informative and concise discussion of the moisture convergence is to be found in Doswell (1982). Here is a brief list of the important points to consider when using moisture flux convergence. (A more thorough discussion follows this list).

1. Moisture flux convergence is made up of two terms. It is:

   a. Wind convergence multiplied by the mixing ratio (i.e.,mass convergence), plus
   b. Moisture advection. Note: Moisture flux convergence is the same as the moisture convergence in SR Tech Memo 114. It should be called moisture flux convergence to be correct when it includes both terms.

2. It usually takes several hours for moisture flux convergence to initiate convection. Thus, you should look for areas of sustained (or pre-existing) moisture flux convergence.

3. Moisture flux convergence is highly scale-dependent.

4. Surface moisture flux convergence depicted by ADAP does not always reflect what is occurring aloft (where storm updrafts may be rooted). This is especially true with nocturnal convection.

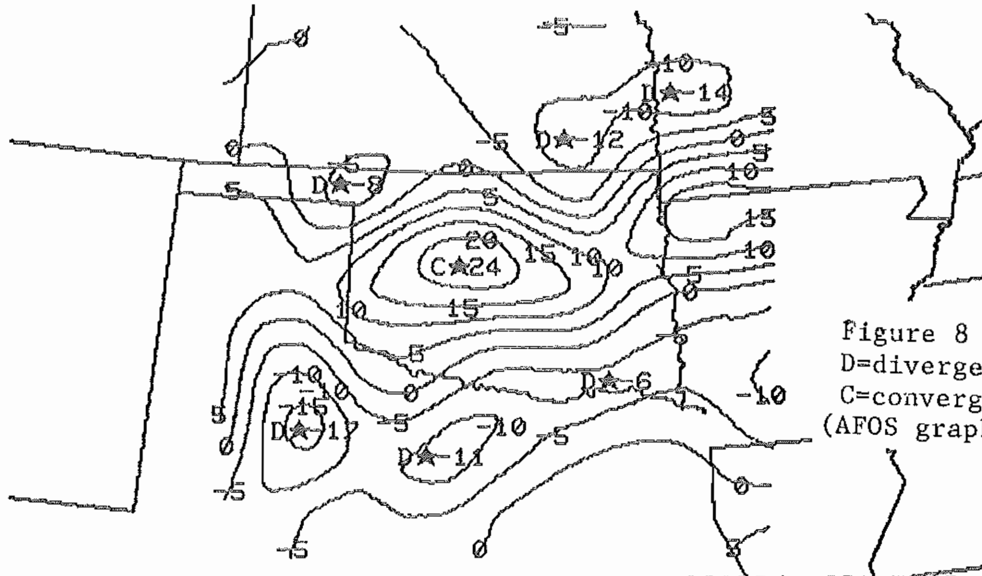
5. Moisture flux convergence can be very susceptible to noise in the wind field and to a lesser degree the moisture field.

6. It is impossible to assign a magic number to moisture flux convergence that will lead to convection (i.e., 40 "units" of moisture flux convergence that aided in producing storms on one day will likely not lead to convection the next day or even the same day at a different location).

7. Often it is the change in moisture flux convergence, SCC, that is more significant than the magnitude of the absolute value of moisture flux convergence.

8. Storms can develop in the area where the moisture flux convergence increases rapidly over a given distance (where the gradient of moisture flux convergence is large). Development occurs on the moist side of the moisture flux convergence axis. This has been called the "gradient area."

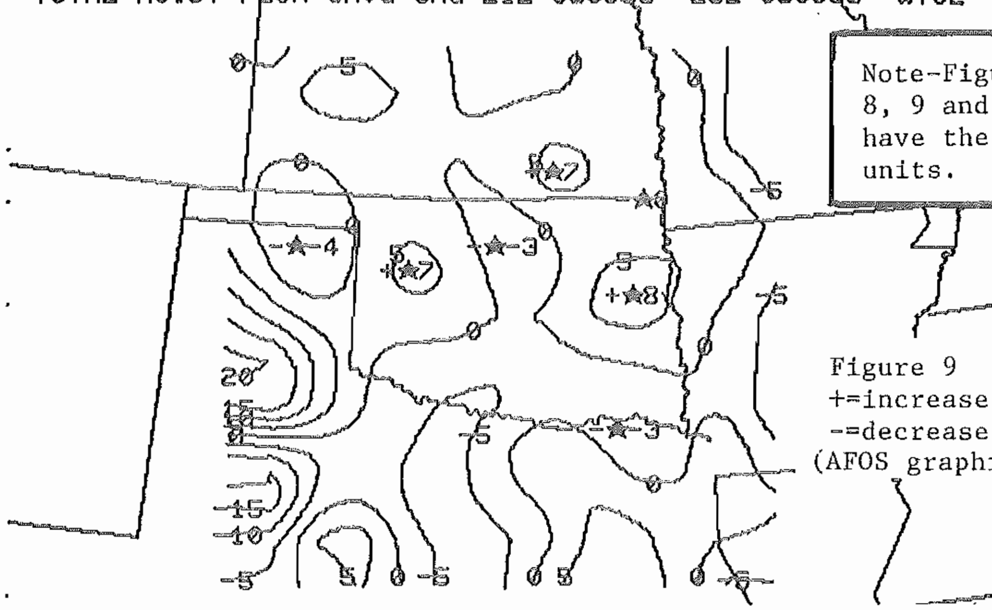
9. Storm severity can be increased when a strong moisture flux convergence center is coupled with a strong divergence center with the highest mixing ratio between the two centers.



SFC MOIST FLUX CNVG. (G KG-1 HR-1X10) 060985 23Z WT02

Figure 8
D=divergence
C=convergence
(AFOS graphic SMC)

TOTAL MOIST FLUX CNVG CHG 21Z 060985- 23Z 060985 WT02



Note-Figures 8, 9 and 10 have the <u>same</u> units.

Figure 9
+=increase
-=decrease
(AFOS graphic SCC)

MXNG RATIO CHG(G/KG/HR*10)21Z 060985- 23Z 060985 WT02

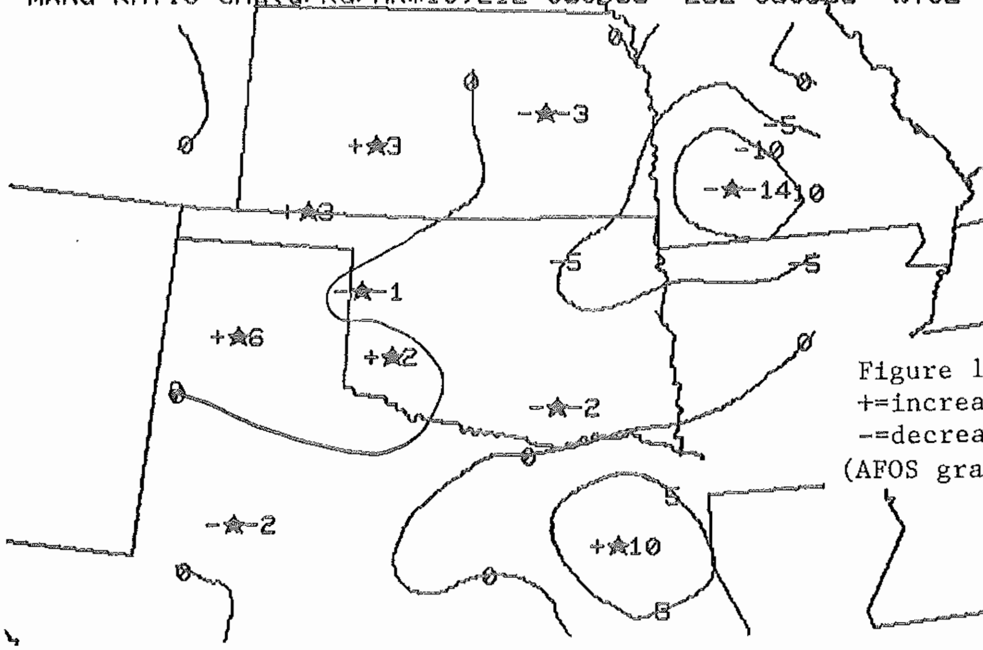


Figure 10
+=increase
-=decrease
(AFOS graphic SQC)

Wind vector changes of 1 or 2 knots are plotted at the station as an open circle.

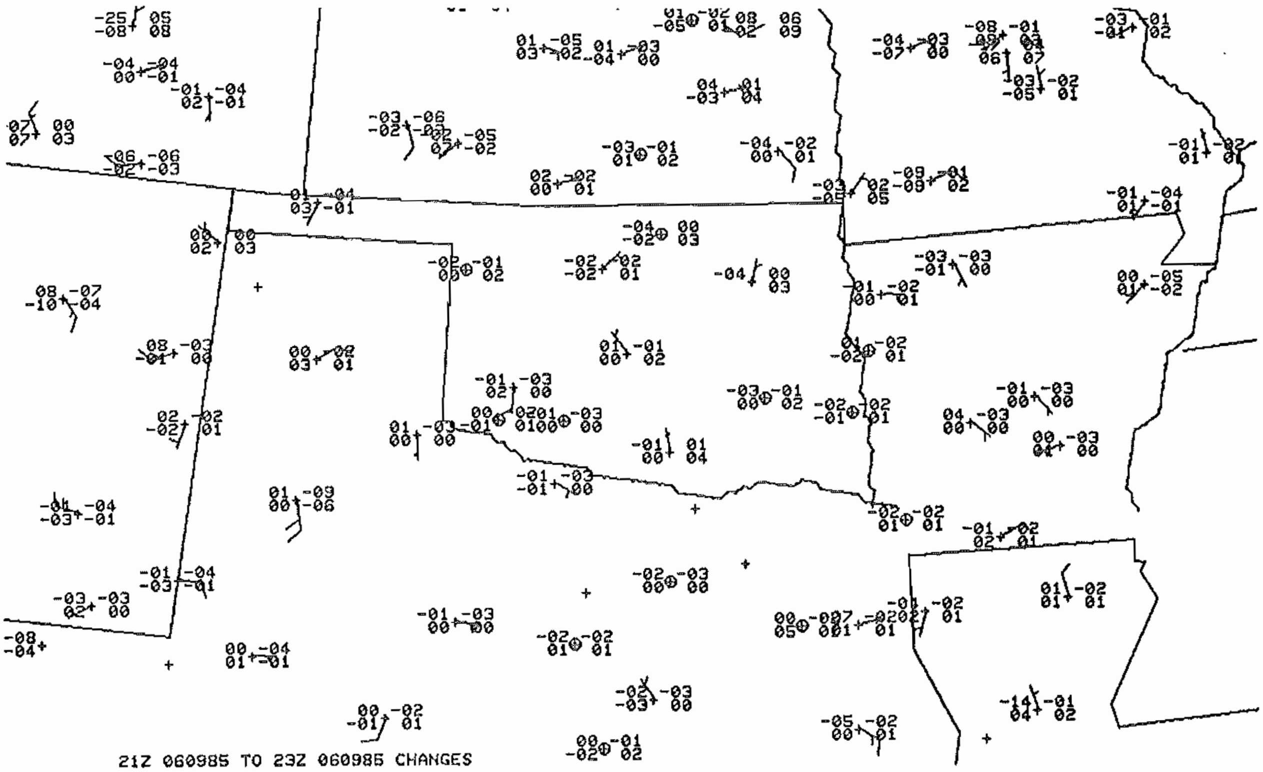
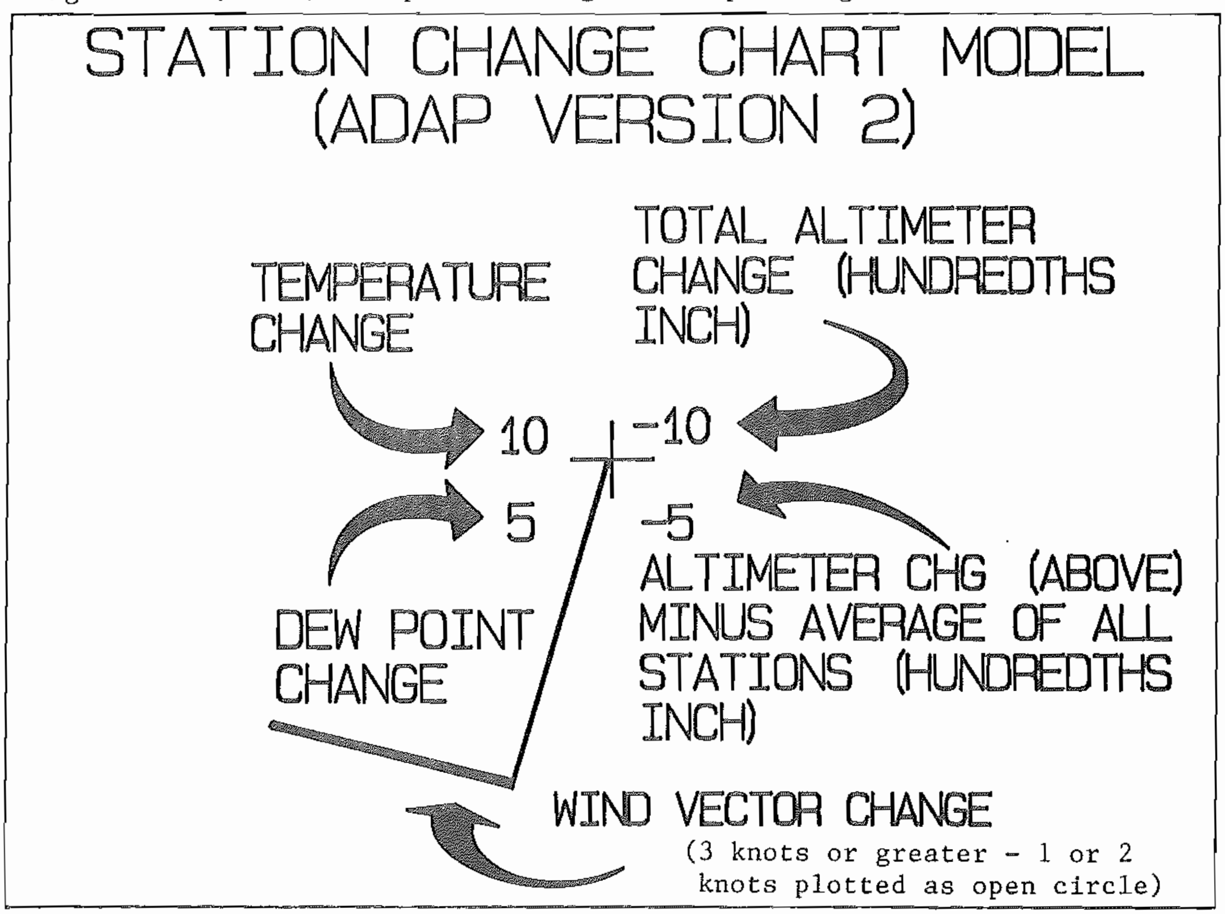


Figure 11a (Top) Plot of station changes from 21Z to 23Z 6/9/85. (AFOS graphic SC2)
Figure 11b (Botom) Example of change chart plotting convention.



10. The pattern of the moisture flux convergence (e.g., axis of convergence oriented east-west) can partially serve to indicate general storm types (e.g., supercell, squall line, etc.).

11. Changes in mixing ratio, SQC, or surface dew point temperature, SC1 or SC2, can be used to highlight areas within the moisture flux convergence area where the moisture remains high and/or is increasing.

Of the two terms that make up moisture flux convergence, the product of wind convergence and mixing ratio is usually much stronger than the moisture advection. Observations tend to indicate that the moisture advection component (although smaller) can contribute significantly to the development or intensification of storms. Another tool to evaluate moisture convergence is the mixing ratio change. Look for changes in mixing ratio, SQC. Areas of decreasing (increasing) mixing ratio probably have decreased (increased) risk of significant convection.

Wind convergence serves as the low level forcing; however, many times the presence of an inversion (cap) above the forcing precludes any convection. The inversion must be removed (or weakened) by a lifting mechanism or advection before the effects of wind convergence can be realized. If the inversion intensifies or remains very strong, it is unlikely significant convection will develop in the area of convergence.

Why is it that storms sometimes will form not at the moisture flux convergence maximum, but where the convergence is much less? The process of "underrunning" may help to explain this. Carlson *et al*. (1983) and Means (1952) used "underrunning" to:

> "...refer to stability change via differential advection with respect to the low-level air parcel flowing out from under a 'stationary hub of warm air' found over the Southwestern United States."

The area of moisture convergence is often capped by a restraining inversion from this "hub of warm air." Moisture may continue to build up with the time under this inversion. As it flows under the weakest point in the inversion, storms may develop. At the weak point in the inversion, the surface moisture flux convergence may not be very strong, but it may be enough to punch through the remaining cap. "Underrunning" can help explain some of the dangers of relying on moisture convergence alone. At times we have seen areas of strong moisture convergence remain virtually cloud free while areas downwind of the maximum convergence (much weaker convergence) have exploded with violent storms. A small increase in mixing ratio combined with sufficient forcing was able to break the cap. This is just one of the reasons why it is impossible to guarantee that a given number of moisture convergence "units" will produce convection.

Another reason it is so hard to assign a "magic number" to convergence that will produce significant convection is that it is highly scale dependent. As pointed out by Fritsch (1975), Fritsch et al. (1976), Doswell (1977) and Doswell (1982), on the scale we are calculating moisture convergence, it would take nearly a five-fold increase in the moisture convergence to fuel a severe thunderstorm complex. Clearly we are not able to sample this small scale convergence. Thus, the convergence that we are seeing with our current network is not necessarily fueling individual storms. This unresolvable smaller scale likely helps explain why we observe that not all storms in an area of moisture convergence become severe. There are (and will continue to be) scales we cannot resolve.

A point Doswell (1982) mentions is that the fields themselves are dependent on the availability of data. Data sparse areas that show convergence (e.g., the data sparse area southwest of Wichita Falls, Texas) should be evaluated cautiously, since the lack of data may cause the convergence field to not be representative of the actual convergence.

Moisture flux convergence is evaluated as a mathematical derivative; thus different amounts of moisture convergence can be obtained if the distance between grid points changes. In addition, each of the filter weights built into the objective analysis (AFOS program MESOS) (weights 1, 2, and 3) will produce differing moisture convergence fields given exactly the same input data and grid (more smoothing of the fields with filter weight 3 vs. weight 1).

If (as is common at night) the updrafts of storms are not well rooted in the lower levels, fields such as surface moisture flux convergence can give false indications of what is occurring aloft. In the case of an east-to-west oriented warm front, the moisture flux convergence is in the vicinity of the front. However, with additional lifting along the frontal surface, the heaviest rain occurs to the north of the front and the moisture convergence maximum.

Experience with ADAP has indicated that much of the noise in the derived fields such as moisture flux convergence has been effectively suppressed (Bothwell et al., 1985). Changes in moisture flux convergence fields (SCC) seem to reflect actual important changes taking place.

By now, hopefully it is becoming obvious that there is no magic number for moisture flux convergence. In computing a number for moisture flux convergence, we have quantified what we have qualitatively observed when we analyze a map.

Areas of increasing moisture flux convergence should be monitored if other indications point to the possibility of significant storms. This is true in highly baroclinic situations in the springtime as well as for summertime convection. When moisture flux convergence decreases (increases), the chances of convection decrease (increase). When we have an increase in moisture flux convergence, one or more things are coming about (all of which can lead to convection).

This includes:

1. Increasing wind convergence (more low level forcing)
2. Increasing moisture (greater moisture and instability to fuel storms
3. Moisture advection may be increasing (helping to further fuel the storms).

Hirt (1982) discussed two types of moisture convergence centers. The first was a single convergent center. The second was a convergent center coupled with a divergent center. The latter was more likely to have severe weather associated with it. ADAP data tend to support this. This is an area where more documented cases would help in understanding what is really occurring when we see this "couplet." For either type, Hirt found that storms are likely to develop in the "gradient region." Observations tend to support this.

What general types of weather are associated with different types of moisture flux convergent patterns? Some idealized patterns have emerged after several years of observations. Most of what follows should make intuitive sense. This is not to say that patterns of moisture flux convergence "cause" storm types. Rather, storms are able to draw on moisture in a particular way due to the orientation of moisture flux convergence.

a. Stationary centers of moisture flux convergence can be areas of excessive heavy rainfall and/or severe weather (Weaver (1979)).

b. When the pattern is a small circular "bull's-eye" pattern, a single thunderstorm complex (or supercell) can develop.

c. An east-west oriented axis of moisture convergence can lead to a line of convection (squall line). With moist southerly low-level flow, nearly all cells in the line can be supplied with moisture. If the moisture convergence is not shifting with time, and cells are continually moving across the same areas, flooding could be a possibility with this pattern (the so-called "train-echo" effect).

d. A north-south (or northeast-southwest) oriented axis of moisture flux convergence can also lead to a line of thunderstorms. Storms may initially form in the gradient area nearest the maximum of convergence and build up (or down) the axis of convergence. There is a greater tendency for some cells especially the initial cells) to become severe than in the previous case. Certain cells have preferential access to available moisture, as opposed to east-west orientation.

Moisture flux convergence has proven to be an important aid in forecasting convection. It is not by itself the final answer, however. Meteorologists must still strive to develop a three-dimensional picture of the atmosphere, the changes it is undergoing, and how it may respond to moisture flux convergence.

1.4 PRESSURE CHANGE

With ADAP, pressure change can be evaluated either via the contoured grid point altimeter change field, SAC (Fig. 12), or the station changes, SC2 (or SC1) or SPC (see Figs. 11 and 13). Station altimeter setting changes of six hundredths or more are displayed on SPC. The pressure change fields produced by ADAP are perhaps one of the most "all weather fields." As Doswell (1982) says:

> "It is not an exaggeration to say that an analysis of the changes in surface pressure is probably more valuable than the pressure pattern itself."

Our current ability to sample the atmosphere (except for the surface) is limited by upper-air soundings every twelve hours. However, since pressure is the weight of the atmosphere per unit area above a point, surface pressure changes reflect the vertically averaged effect of processes occurring aloft. Surface pressure falls can result from net mass divergence in the column, an increase in mean temperature and vertical motion (Doswell, 1982).

Changes in the altimeter setting field can be important regardless of whether we expect severe storms in April or a snowstorm in December (see Mogil, 1978). The altimeter setting has been chosen over sea level pressure because of the greater spatial density of observations. Also, since we are concerned only with changes, the programs should work well over mountainous or elevated terrain as well as other areas.

According to Hoxit and Chappell (1975):

> "Of the observations routinely included in a surface report, only the pressure tendency provides an indication of a net change in the atmospheric mass above the station. Assuming hydrostatic equilibrium, changing surface pressure can also be interpreted as a change in the mean temperature of the atmospheric column above."

Plots of station altimeter setting changes (included in SC1 and SC2) can be produced. SC1 and SC2 contain the same data but on different map backgrounds. There is a difference between the contoured grid point and station altimeter setting changes, and it is important. Since the grid point altimeter changes are produced by subtracting the output from objective analyses at two different times, the graphic, SAC, represents a somewhat smoothed analysis as opposed to the station (point) values in SC2 (SC1) and SPC. These absolute values of the station changes (SC2 (SC1) and SPC) will generally be larger than the grid point changes because of smoothing in the latter. Remember that pressure changes can represent changes from many different atmospheric processes and scales. These scales could be storm-scale, mesoscale, and/or synoptic scale.

Some guidelines regarding interpretation of the grid point altimeter changes are:

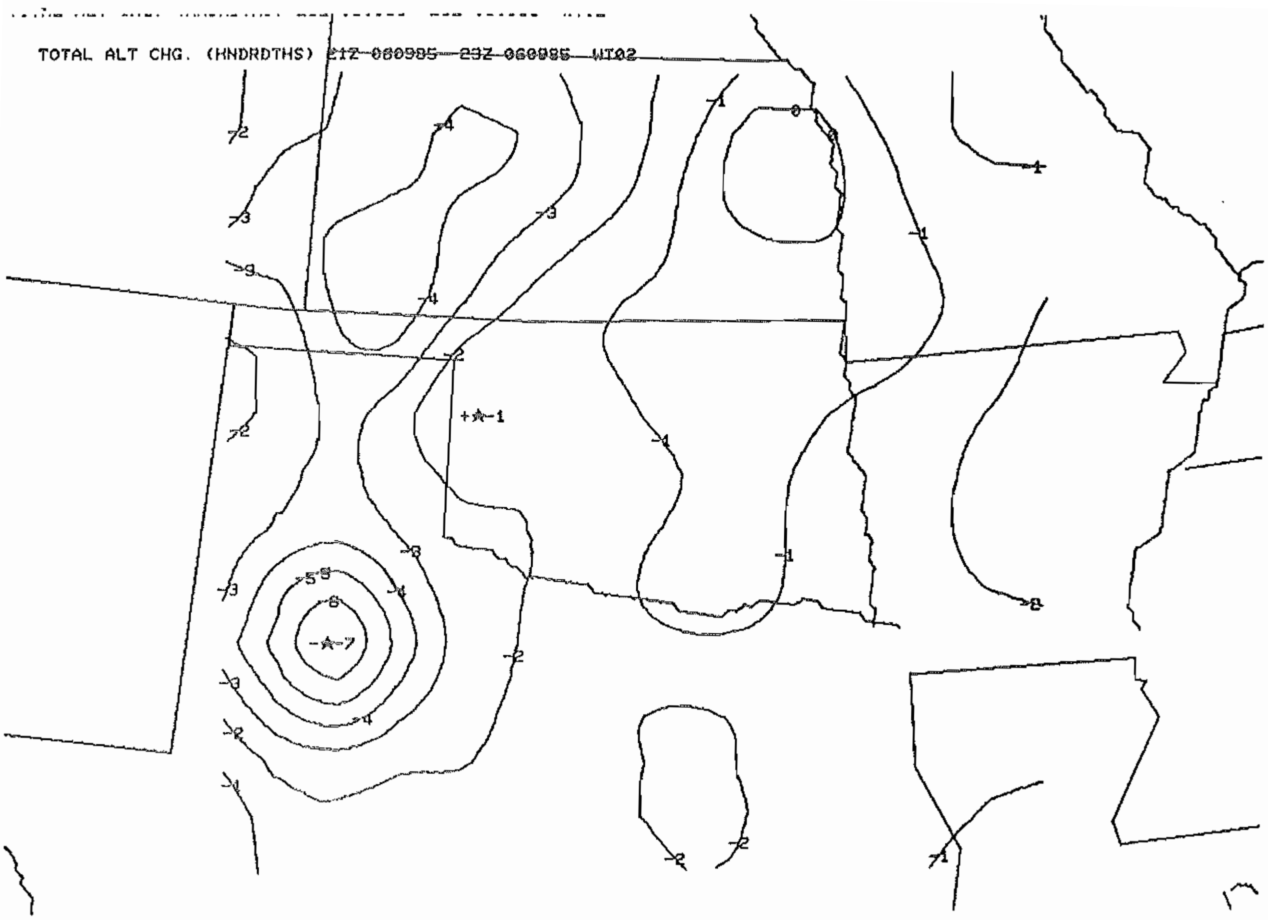


Figure 12 Total altimeter change from 21 to 23Z 6/9/85.
(hundredths inch) (AFOS graphic SAC)
+=pressure rising
-=pressure falling

```
21Z 060985 TO 23Z 060985 CHANGES
 -03 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
LVS 07
CPR 06
CYS 06
LND 07
RKS 06
RWL 07
SHR 06
WRL 09
EGE 06
TAD 06
RAP 06
REJ 06
LBB 09
REE 08
AIA 07
BFF 06
CDR 07
GCK 06
HLC 07

TOTAL=  19
```

Figure 13 Listing of all stations with altimeter falls of 6 hundredths or more from 21 to 23Z 6/9/85 and average change of all stations. (AFOS graphic SPC)

1. Pressure fall centers can precede severe weather (especially tornadic activity) by several hours. Thus, they may have prognostic value. The centers can remain nearly stationary or move extremely fast (at 50 to 60 miles an hour). However, cases have occurred where weather does not appear to have been associated with a pressure-fall center.

2. Pressure rise-fall centers can be followed anytime of year, not just during convective weather (Mogil, 1978).

3. Large pressure rises (initially appearing well behind an active convective line and not associated with the "bubble high") can greatly increase the chance of damaging thunderstorm winds. Often this pressure rise center will show up in the contoured field well behind the thunderstorm line several hours before the damaging winds occur (thus, rise centers also have prognostic value). Experience suggests the point at which an imaginary line connecting a rise/fall couplet crosses a thunderstorm line is the location most likely to experience damaging winds.

4. Look for continuity in pressure rise/fall centers. The fall center can be extrapolated ahead in space and time, thus making it an important prognostic tool. Some will be short-lived centers, others will last many hours. This field may be one of the most important to analyze both before and after convection has started. Remember that data voids can still cloud the issue as you look for continuity in the fields. Ask yourself, "Are the data there to support my conclusions?" According to Doswell (1982):

   "Very small-scale, transient phenomena are indistinguishable from noise, even if their origins are in real atmospheric processes. Only those which affect several observation points in space and/or time are likely to have some influence on mesoscale weather."

5. Signs that a moving pressure fall center is about to interact with a line of convection as it moves toward the line could greatly increase the chance of severe weather (even tornadoes) near the point where it intersects the line.

6. A pressure fall center concentrated over a small area appears to be much more capable of producing severe weather (including a tornado) than the same magnitude of pressure fall over a larger geographical area.

7. Pressure changes are not limited to daytime use. They can be easily followed even at night.

8. Two-hour pressure changes are routinely analyzed at SELS (Doswell 1982). It is desirable to perform this in an operational setting with ADAP.

There appear to be different ways for pressure fall centers to evolve, although more study is needed in this area. Some fall centers remain nearly stationary while others move rapidly. Carlson, et al. (1983) related pressure rise/fall centers to the entrance/exit regions of mid-tropospheric wind maxima or jet-streaks. These wind maxima were barely visible in the high time and space density SESAME upper-air data set of 1979, yet easily defined in the surface pressure field.

Hoxit and Chappell (1975) proposed a method by which the thunderstorms themselves give birth to the pressure fall center by interaction with the environment. This fall center precedes the storms by an appreciable difference. The same authors listed the mechanisms for producing these mesoscale pressure-fall centers:

The atmospheric column may be warmed by any or combinations of the following:

1. Warm air advection
2. Solar insolation either through absorption at the ground and subsequent transfer to the atmosphere, or absorption directly into the atmosphere
3. Release of latent heat, or
4. Adiabatic warming via sinking motion.

Their conclusions were that the thunderstorms (by interacting with the environment) help to form the pressure-fall center, which in turn helps sustain the storms.

Field experience also indicates that local warming from solar insolation can produce the nearly stationary pressure fall center that can also precede severe weather.

Whatever the origin of the mesolow and/or fall center, as Doswel (1982) states:

> "The mesolow is most important insofar as it can enhance the potential for severe weather."

Experience with ADAP indicates that all too often, altimeter settings are incorrectly transmitted in the observations (sometimes as much as one inch too high (or low)). These errors usually appear as large circular contours in the altimeter change graphic SAC. If this occurs, try to edit the data, correcting the offending station, and rerun the programs. Alternatively, the station change graphics (SC2/SC1) can be used to find these errors.

1.5 THE STATION CHANGE CHARTS

The discussion of the ADAP programs would not be complete without covering the station change charts SC2 (SC1) (see Figs. 11a and 11b). As meteorologists, we should be concerned with changes in reported surface fields (temperature, dew point, wind and pressure). Often changes in surface data precede a significant event. Changes in station data can be displayed on on two charts (SC1 and SC2). SC1 and SC2 contain the same data, but on different map backgrounds. Although the discussion here centers primarily around convective weather, the charts can be used year-round.

An excellent article on changes of surface data in short range forecasting is presented by McGinley (1986). Some of his main points will be reviewed here. He strongly recommends monitoring of the temporal changes of surface fields.

According to McGinley:

> "Observations from stations that are heating rapidly, cooling, or have stopped heating can hint at the vertical structure of the lower atmosphere."

One of the areas of concern in convective weather forecasting is diagnosing the presence of a capped layer aloft. Rapid rises in temperatures imply shallow or capped layers. When temperature rises begin to slow, the heat input is likely being mixed through a deep layer. These temperature changes can be used in conjunction with proximity soundings to estimate the change in capping layers aloft.

For example, in estimating the effect of the morning low-level inversion in the sounding at a station, the temperature should have risen rapidly to 98F before the temperature rise slowed as the heat was then dispersed through a much deeper layer. However, it continues to jump the next hour to 102F, suggesting that the inversion may have strengthened. Another station 50 miles away reached 98F at the same time and only increased to 99F the next hour suggesting that in that area heat was being mixed throughout a deep layer. See Fig. 14a (after McGinley, 1986).

Dew point changes should be monitored. As stated by McGinley:

> "The dew point change is often more pronounced than temperature change and therefore more useful in locating weak (but possibly significant) boundaries.... A rapid drop in an hourly dew point observation often indicates that a stable layer has been eliminated by heating. Typically, this will be accompanied by slower rises in temperature." (Again, see Fig. 14a.)

Dew point increases in an area of moisture flux convergence could signal an increased chance of convection while decreases in dew point would result in a decreased chance. Even if dew points change little if any, it could be a signal that the depth of the low level moisture is increasing. This would also aid severe convection.

Pressure changes are very important (Doswell, 1982; Mogil, 1978; Moller, 1980). The changes in pressure reflect many different scales, superimposed one on another. Two different altimeter setting changes are plotted on both SC1 and SC2. The first change is the total altimeter change at the station. The second, plotted below the first change, is the total change minus the average change of all stations (normally, the semi-diurnal change). This large scale change can be calculated internally by the program, or it can be input by the forecaster. By subtracting out the semi-diurnal change, true rise/fall centers can be more accurately depicted.

Wind changes can also be very important. See Fig. 14b (after McGinley, 1986). McGinley (1986) notes:

> "Analyses of winds and wind trends can lead to diagnosis of convergent/divergent areas and time tendencies, location of outflow boundaries, land/sea breezes, low level jet maxima, and movement of upper level systems. The wind vector change is the vector sum of the Coriolis acceleration of the ageostrophic wind, the inertial acceleration and friction or Reynolds stress, including accelerations from turbulent transport of momentum. Although often a very noisy field, a plot of wind vector changes can reveal areas where adjustments are taking place. When combined with 1-3 hourly changes of all surface parameters (Sasaki and Tegtmeier, 1974), the wind change chart becomes a powerful nowcasting tool. Siebers and Schaefer (1983) showed the value of such a product. Convection will frequently develop where there is convergence in the vector change field, implying a negative divergence tendency." (See also McGinley et al., 1987)

Any time interval (from one to twenty-four hours) may be used for the station change charts. One recommended use for the charts is when the weather appears at first to change very little from day to day. The 24-hour change chart can show how conditions have changed at any of the stations relative to one another (e.g., are dew points at 14Z or 15Z a few degrees lower than 24 hours earlier? If so, afternoon highs may be a little higher than the previous day in the slightly drier air (assuming other factors are the same)).

Look for clues that may signal significant changes about to take place. The sudden fall in pressure accompanied by a wind change and an increase in the dew point may signify the increased threat of severe weather. Although it is not easy, the meteorologist must distinguish between what is noise and what is real. Except for the small scale changes which may affect only one station at one hour, time and space continuity should help separate the noise from the real signal in the data.

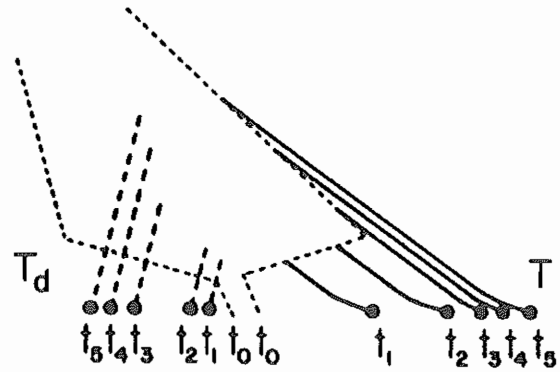
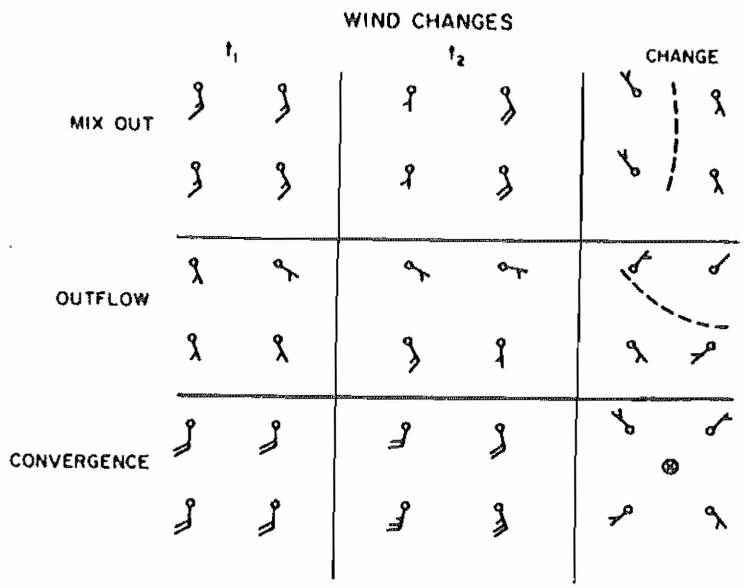


Figure 14a (Top) Time evolution of a sounding from surface observations. Moisture decrease at t3 and slowing of heating rate indicates cap may have been eliminated. (After McGinley, 1986)

Figure 14b (Bottom) Examples of wind changes over 1-3 hours. Subtle changes (easily missed) assist in locating a variety of potentially weather-producing features. Observations at t1 and t2 give change at hour t2. Dashed lines indicate hidden boundaries. Circled x indicates convergence center (also after McGinley,1986). These wind vector changes are the same as displayed on AFOS graphics SC2 and SC1.



1.6 WARM AND COLD ADVECTION

The AFOS graphics, STA and SAA, (Fig. 15a and 15b) displays warm and cold advection (on a constant pressure surface) [(deg F/hr) x 10] with negative (positive) numbers corresponding to cold (warm) advection. If no other processes were occurring (i.e., radiation, rising or sinking air, etc.), this is the amount the temperature should change at that point in one hour. The effect of elevation in temperature can cause spurious warm and cold advection centers to appear in the analyzed fields. Thus, station temperatures are reduced dry-adiabatically to a constant pressure surface (normally 1000 mb). These temperatures are then objectively analyzed along with the u and v wind components and the resultant advection of temperature on a constant pressure surface is computed and plotted. To a first approximation, this pressure surface is nearly a constant height (e.g., we are all used to potential temperature (Theta) for 1000 mb). Advection of this potential temperature (Theta) by the surface wind is computed; thus it has been called Theta Advection.

In an area undergoing frontogenesis, isotherms would move closer together with time (the temperature gradient would tighten up). One way this is accomplished is by strong cold advection to the rear of the frontogenetic area and warm advection ahead of it. An area that is experiencing frontogenesis can be more capable than other areas of producing significant weather (Berry and Bluestein, 1982; Koch, 1984).

Areas that are experiencing low-level warm advection can have an increased chance of severe weather.

As Davies-Jones (1983) states:

> "...low-level warm advection enhances wind-veering in the Ekman layer...and (incidentally) also is associated with synoptic-scale upward motion and consequential destabilization of the air mass. The combination of Ekman turning and strong low-level warm advection yields a hodograph with (probable) storm-relative winds that veer markedly in the first 3 km above ground....Local regions of backed surface winds near warm fronts or subsynoptic features may signify important low-level modification of the hodograph which make these areas more susceptible to severe weather than others."

The effects of low-level warm advection can be very significant. An area may be marginally favorable for tornadoes; however, localized warm advection in that area could modify the sounding significantly to make it more conducive for tornadoes. To aid in the production of severe convection, warm advection should not be a transient feature. Analysis of the fields has shown the warm advection has pre-existed from two to six hours in the areas where tornadoes subsequently have occurred. This seems reasonable, since there must be sufficient time for the wind field to respond to warm advection. Normally, the warm advection pattern becomes established by late morning and continues through the remainder of the afternoon as the boundary layer is thoroughly mixed. The exception to this would be a warm front retreating rapidly northward.

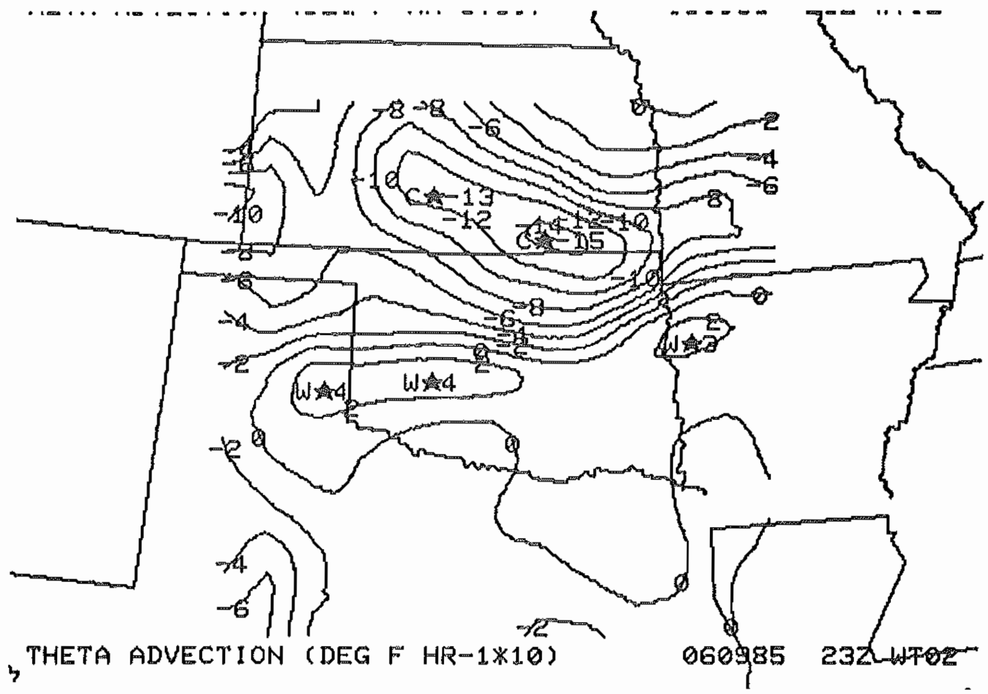
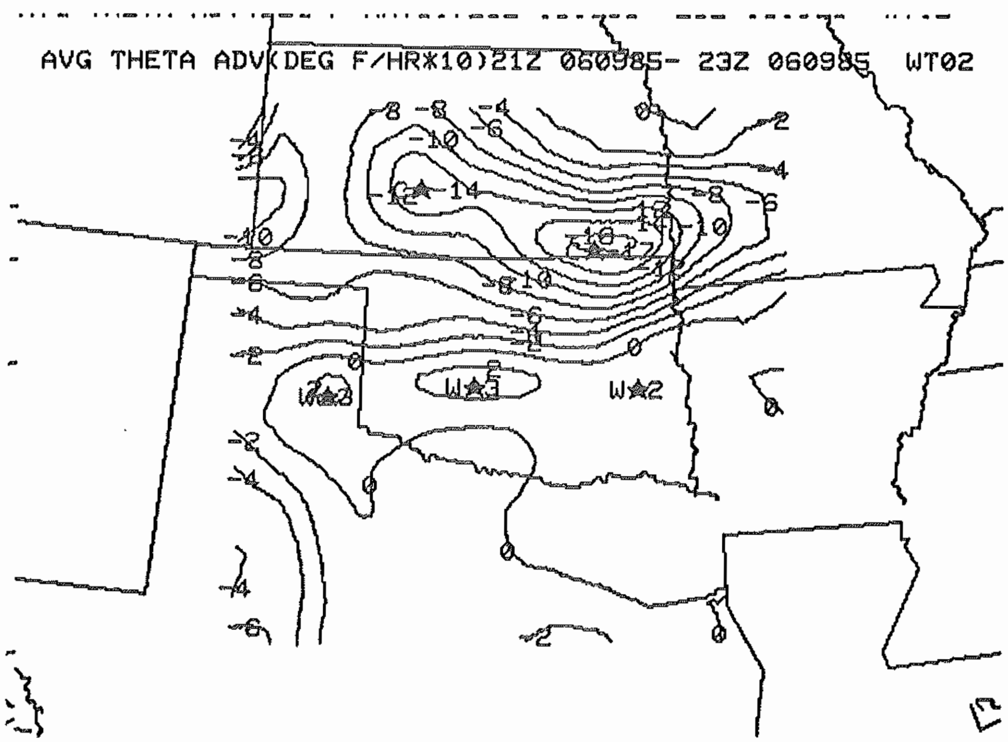


Figure 15a (Top) Advection of Potential Temperature (Theta) by surface wind. (AFOS graphic STA)
C=cold advection
W=warm advection

Figure 15b (Bottom) Average Theta Advection from 21 to 23Z 6/9/85 (AFOS graphic SAA)



Another look at warm advection is from Moller (1980). He stresses that the

> "...proper alignment of the thermodynamic fields is critical in most corridor and cluster situations.... Corridor and cluster thunderstorms usually develop in the strongest gradient area on the northeast side of a strong thermal ridge.... Others... have also discussed the importance of strong thermal boundaries and the resultant warm advection pattern in tornado outbreaks. When the thermodynamic fields...coincide with the favored areas, the potential for a tornado outbreak is considerable."

Another feature that makes warm advection so important is the pressure fall center in the area of warm advection. If other processes are not offsetting the warm advection, the surface pressure would fall as the thickness of the column increases. Falling pressures, as we have seen, normally increase the chance of severe weather.

By now, it should be obvious why the area of warm advection can be so important and should be monitored closely if other indicators point toward the possibility of severe weather. Results correlating tornado occurrences to areas of sustained warm advection have been encouraging to date. Also, very violent storms (high wind and large hail) have occurred without tornadoes in areas of neutral or very weak advection. Further documentation and additional research are needed in this area, but it seems likely that in the case of at least some tornadoes, the local storm environment may be favorably modified by low-level warm advection over a period of hours to produce the low-level veering of the winds.

As always, a word of caution -- since the graphic, STA, is a derived field, it is only as good as the data that goes into it. Data void areas can still cause problems. Obviously a skilled analyst can and should use meso-analysis to help supplement the computer derived field. This method cannot cover all types of tornado situations; however, it is offered to help the meteorologist narrow down the area of concern.

1.7 SURFACE STREAMLINES/WIND VECTOR PLOT

The AFOS graphic, SSW (Fig. 16), which shows surface streamlines and/or wind vectors has been added to Version 2 of ADAP. With the ADAP software, it is possible to plot streamlines on SSW; wind vectors; or both. The advantage to plotting both streamlines and wind barbs together is that in addition to the direction in the wind, the actual speed is also shown. This graphic can be used with fields such as moisture flux convergence to further refine the area of concern within an area of positive moisture flux convergence. SSW appears to visually highlight significant features very well. See Hess (1959) for examples of streamlines showing translation, vorticity, divergence, and deformation. Forecasters may also want to use it to determine how accurate the analysis has done over data sparse areas. The streamlines and/or wind barbs can be used any time of the year to highlight significant features.

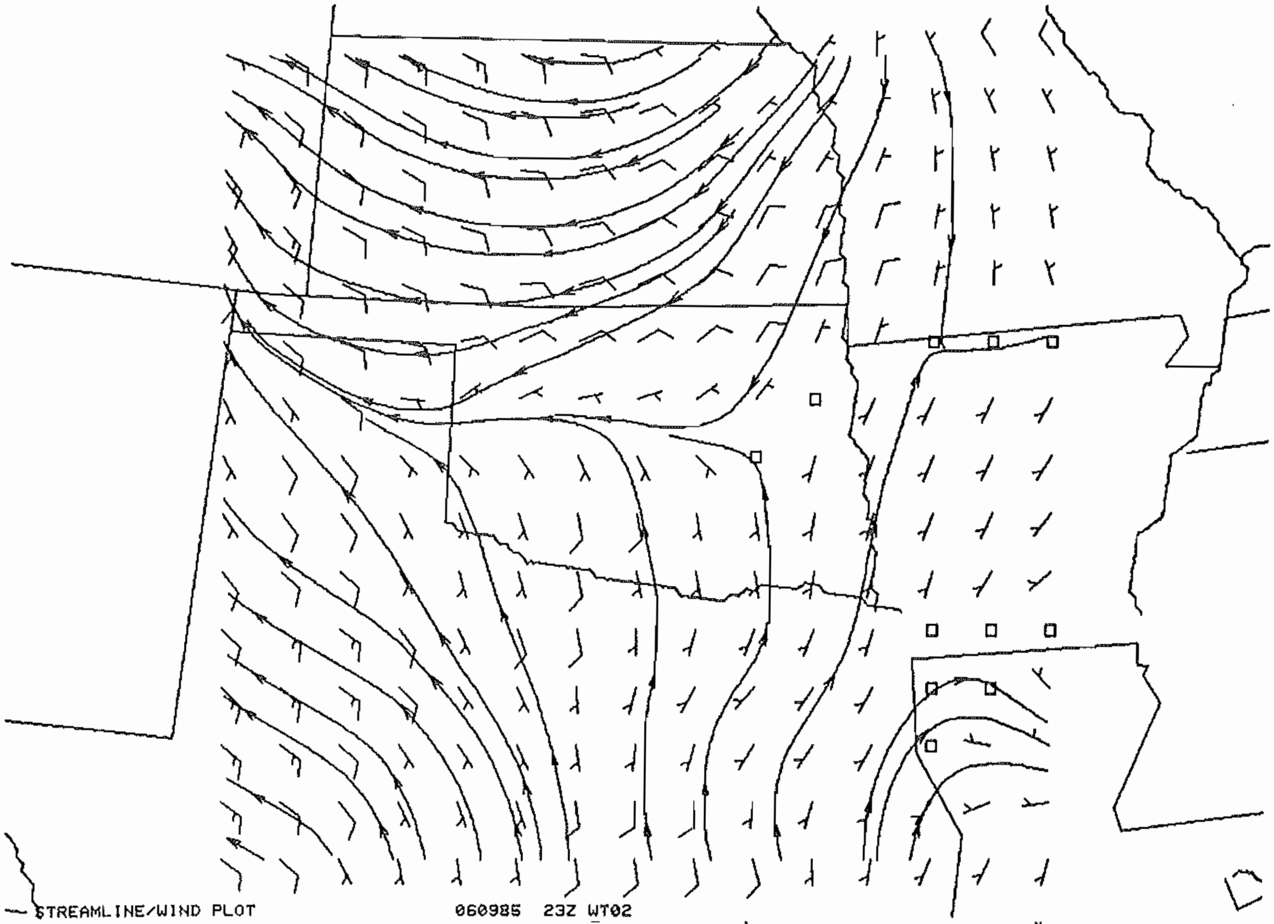


Figure 16 Surface streamlines and wind vector plot-23Z 6/9/85 (AFOS graphic SSW)

Wind speeds of 1 to 2 knots at the grid points are denoted by the small square.

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CHAPTER 2 FORECASTING CONVECTION WITH THE ADAP DECISION TREE

2.1 INGREDIENTS FOR CONVECTION

We will begin our discussion of convective weather forecasting by reviewing a set of ingredients needed to produce significant convection (McNulty (1983)). We will then discuss how the ADAP products can help meteorologists evaluate each of the ingredients. These ingredients are:

1. Unstable air (instability)
2. Moisture
3. Divergence aloft
4. Lift - low level convergence (including terrain forcing).

An additional and often overlooked fifth factor (Carlson et al., (1983)) in forecasting convection is:

5. Capping inversion (or lid).

Lack of an inversion may result in convection occurring over a large area, but it generally will be weak convection as all storms compete for moisture. We know that an inversion is often important to severe thunderstorm formation. Generally, the capping inversion (or lid) will restrict thunderstorms until the layer under the inversion is "primed" through heating and/or increasing moisture. Once the inversion is broken, explosive development can and does occur. Often there can be a fine line between convection and no convection (it depends in part on the strength of the cap). Note that while ADAP can show large areas of instability and/or moisture convergence, the major limiting factor is very often the cap which can serve to focus the convection near the edge of the cap.

These five ingredients are not independent of each other. Rather they are all interlocking pieces of the forecasting puzzle which we as meteorologists are trying to piece together.

Since the ADAP routines depend on surface data (except for the stability indices and cap strength), divergence aloft <u>will not</u> be covered here except to note that:

> "Weak to moderate upper divergence appears to create the most favorable environment for significant convection." (McNulty (1983)).

How does ADAP relate to the parameters mentioned above? Bartels (1986) and Branick (1986) found a minimum of three of four carefully chosen ADAP products could be sufficient to diagnose moisture, instability, and lift (although more charts would be needed in some cases). As a result, some graphics from Version 1 of ADAP (see Bothwell, 1985) have been dropped from Version 2, and some new graphics such as the cap strength have been added.

It is generally accepted that surface data can reveal a wealth of information concerning processes both at the surface and aloft (e.g., pressure change at the surface reflects changes in the entire column of air above that point). There are signals in the surface data that we want to be able to pick out. It is important for meteorologists to learn how to glean the most from surface observations in a timely manner and ADAP can help. Because of the number of products generated by ADAP, a systematic approach is called for in applying them.

2.2 THE ADAP DECISION TREE

The ADAP Decision Tree (see Fig. 17) has been developed to relate the ADAP derived fields to the ingredients necessary for convection in a logical and orderly fashion (see also Fig. 18). Several of these types of fields (e.g., warm advection) are also found in a decision tree by Moller (1980). The goal is to narrow down the geographical area of concern as we go through the decision tree (i.e., define a final threat area after starting from an initial threat area) (Fig. 18). By concentrating on our final threat area, we can utilize our resources better. It is doubtful any decision tree could cover every case. The motivation behind it is to present a simplified and orderly method for assimilating the ADAP fields. It is meant to be used with, but not replace other forecasting tools. It has been applied successfully in post-analysis studies as well as real-time forecasting situations.

Five convective categories are realized in the ADAP Decision Tree. These five categories are not rigid, but represent general outlines as to the maximum severe weather event to be expected. These categories have emerged after using ADAP for several years. They are:

NO CONVECTIVE POTENTIAL

WEAK POTENTIAL
Some convection possible, but severe or heavy rainfall events unlikely. Small hail under 3/4 inch.

MODERATE POTENTIAL
Hail and some strong winds possible with maximum hail less than or equal to 1 3/4 inch and maximum winds around 50 to 60 knots. (Note that if moisture flux convergence moves little, and/or it increases in the same area, or the dew point (or the mixing ratio) holds nearly steady or increases, the potential for heavy rainfall increases.)

STRONG POTENTIAL
Large hail greater than 1 3/4 inches, damaging winds (greater than 60 knots) and/or tornadoes possible.

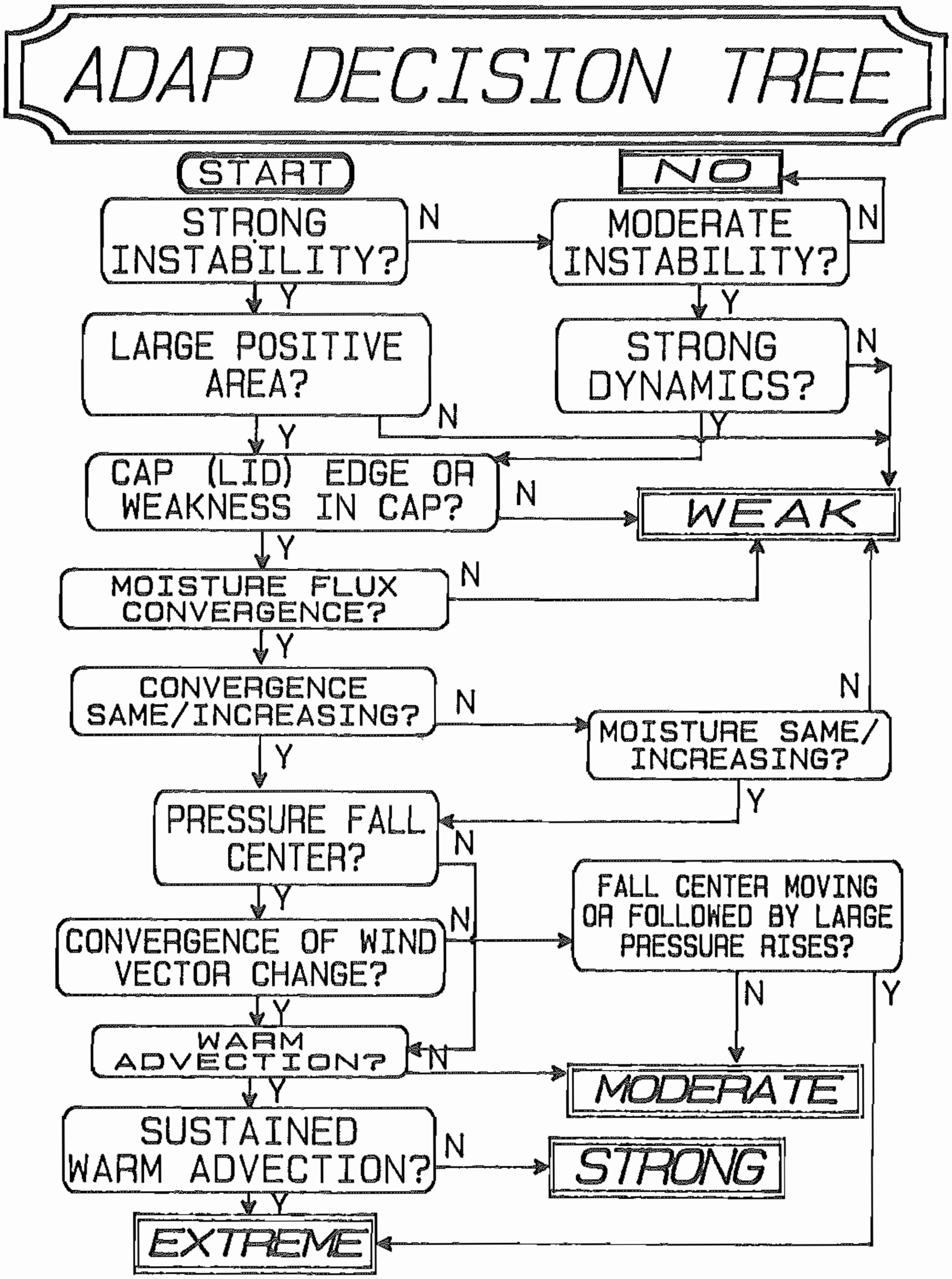
EXTREME POTENTIAL
Very large hail, damaging winds and maxi-tornadoes (or tornado outbreaks) likely.

As we begin the ADAP Decision Tree (see Fig. 17 and 18), all nine character AFOS graphics, NMCGPHxxx, will again be denoted by the last three characters, xxx, (the NMCGPH is assumed). As you proceed through the decision tree, refer to the ADAP graphics in Chapter 1. The satellite photos in Fig. 19 show what transpired after the map time of ADAP graphics in Chapter 1, and Fig. 20 shows the significant weather after that time. We enter the ADAP Decision tree by considering the ADAP stability graphics, the 500 mb lifted index, SSL or SXL, and the upper level lifted index, SSU or SXU, at one level above 500 mb (i.e., 400, 300, 250, or 200 mb). Normally, this upper-level stability index, SSU or SXU is 300 mb (400 mb should be used during the winter season). If you are sure the stability and cap strength have changed little from the last time they were evaluated (i.e., the initial threat area has been remaining the same) and you have strong convection in this area, proceed directly to look at the moisture flux convergence.

The ADAP software is designed to calculate lifted indices for surface based parcels, SSL and SSU, or using the parcels with the maximum wet-bulb potential temperature as determined from the lowest 300 mb of each sounding, SXL and SXU. SXL and SXU would be used if warm moist air is overrunning a shallow dome of cold air or during the night when surface based temperatures do not properly reflect the instability present just above the surface. These fields help us diagnose the degree and depth of instability (i.e., defining our initial threat area see Fig. 18a). If the area enclosed by -6C at 500 mb does not extend to the upper level (also -6C), then the potential for significant convection is weak.

If the instability at 500 mb is not at least -6C (or more negative), the decision tree branches immediately to check for instability in the range from -2 to -5C. Thus, a moderate or higher potential is still possible if strong dynamics and other parameters in the decision tree fall into place (again see Fig. 17). Indicators of strong dynamics could be 12 hour 500 mb height changes of 60 meters or more, or 12 hour surface pressure falls of 5 mb or more (Miller, 1972). If instability is not in the range from -2 to -5C and there are no significant dynamics, then a weak potential exists. When storms move out of the area of most unstable air, they will usually decrease in intensity. In areas where the gradient of the LIs is large (e.g., along a warm front), consider the LI of the storm inflow air.

Once we have defined an initial threat area with the stability indices (see Fig. 18a), we will examine the cap strength graphics, SSC (surface parcel) or SXC (max wet-bulb potential temperature parcel) (Fig. 17). Often, stability indices (including ADAP lifted indices) show large areas with unstable air, yet an inversion can suppress all activity. It has been shown in a statistical study by Graziano and Carlson (1987) that if the strength of the capping inversion is larger than +2C, there is very little chance of convection since the cap (or lid) would prevent it. Thus, large areas of unstable air which may appear ripe for convection can be eliminated by using the cap strength (Fig. 18b). A word of caution with the graphic SXC. If the maximum wet-bulb potential temperature parcel is at a level above the capping inversion, the cap strength (which assumes the parcel is below the cap) has no meaning.



ADAP DECISION TREE
START
NO
STRONG INSTABILITY?
MODERATE INSTABILITY?
LARGE POSITIVE AREA?
STRONG DYNAMICS?
CAP (LID) EDGE OR WEAKNESS IN CAP?
WEAK
MOISTURE FLUX CONVERGENCE?
CONVERGENCE SAME/INCREASING?
MOISTURE SAME/ INCREASING?
PRESSURE FALL CENTER?
FALL CENTER MOVING OR FOLLOWED BY LARGE PRESSURE RISES?
CONVERGENCE OF WIND VECTOR CHANGE?
WARM ADVECTION?
MODERATE
SUSTAINED WARM ADVECTION?
STRONG
EXTREME

Figure 17

ADAP DECISION TREE FIELDS | AFOS GRAPHIC

STRONG INSTABILITY (ADAP 500 mb LI OF -6, -7, -8C, etc.) ... (SSL/SXL)

MODERATE INSTABILITY (ADAP 500 mb LI OF -2, -3, -4, -5) .... (SSL/SXL)

STRONG DYNAMICS..12-HR 500 mb HT CHG and/or 12 HR SFC PRESS FALLS

LARGE POSITIVE AREA (ADAP 300 or 400 mb LI -6, -7, -8, etc) (SSU/SXU)

CAP (LID) EDGE OR WEAKNESS IN CAP (2C OR LESS) .... (SSC/SXC)

MOISTURE FLUX CONVERGENCE.................................... (SMC)

CONVERGENCE SAME/INCREASING................................. (SCC)

MOISTURE SAME/INCREASING........................... (SQC, SC1, SC2)

PRESSURE FALL CENTER........................... (SAC, SC1, SC2, SPC)

CONVERGENCE OF WIND VECTOR CHANGE...................... (SC1, SC2)

FALL CENTER MOVING OR
FOLLOWED BY LARGE PRESSURE RISES.................... (SAC, SC1, SC2)

WARM ADVECTION... (STA)

SUSTAINED WARM ADVECTION..................................... (SAA)

STRONG DYNAMICS AS LISTED IN THE DECISION TREE CAN NORMALLY BE INFERRED FROM MORE TRADITIONAL FIELDS SUCH AS THE TWO LISTED OR OTHERS FOUND IN MILLER (1972). ADAP CAN CALCULATE 12 HOUR SURFACE PRESURE CHANGES (see SAC, SC1 OR SC2).
NOTE THAT THE STATION CHANGE CHARTS SC1 AND SC2 CONTAIN THE SAME INFORMATION, THEY ARE PLOTTED ON DIFFERENT MAP BACKGROUNDS.

Figure 17 (continued)

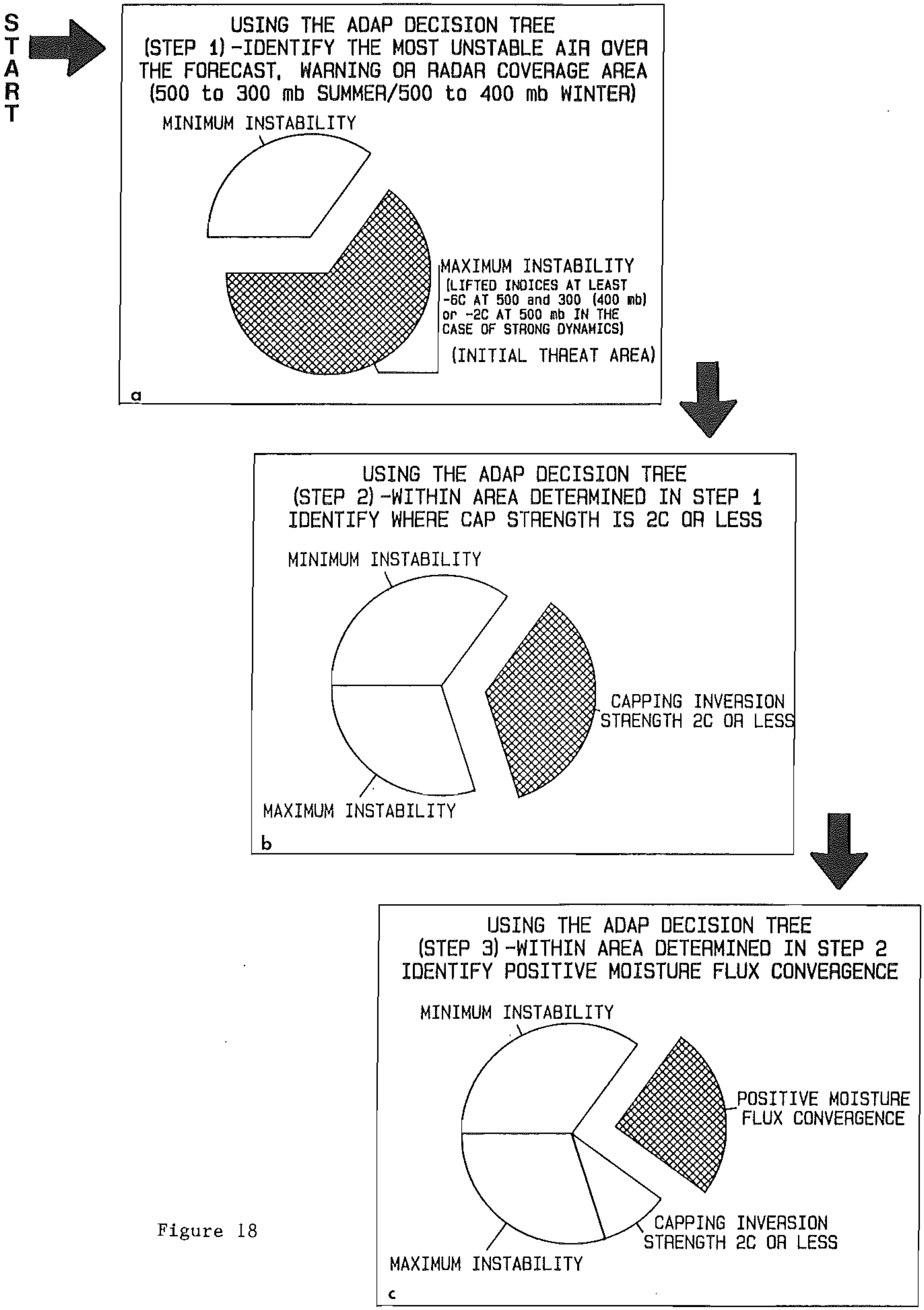

START
USING THE ADAP DECISION TREE
(STEP 1) -IDENTIFY THE MOST UNSTABLE AIR OVER THE FORECAST, WARNING OR RADAR COVERAGE AREA
(500 to 300 mb SUMMER/500 to 400 mb WINTER)
MINIMUM INSTABILITY
MAXIMUM INSTABILITY
(LIFTED INDICES AT LEAST -6C AT 500 and 300 (400 mb) or -2C AT 500 mb IN THE CASE OF STRONG DYNAMICS)
(INITIAL THREAT AREA)
a
USING THE ADAP DECISION TREE
(STEP 2) -WITHIN AREA DETERMINED IN STEP 1 IDENTIFY WHERE CAP STRENGTH IS 2C OR LESS
MINIMUM INSTABILITY
CAPPING INVERSION STRENGTH 2C OR LESS
MAXIMUM INSTABILITY
b
USING THE ADAP DECISION TREE
(STEP 3) -WITHIN AREA DETERMINED IN STEP 2 IDENTIFY POSITIVE MOISTURE FLUX CONVERGENCE
MINIMUM INSTABILITY
POSITIVE MOISTURE FLUX CONVERGENCE
CAPPING INVERSION STRENGTH 2C OR LESS
MAXIMUM INSTABILITY
c

Figure 18

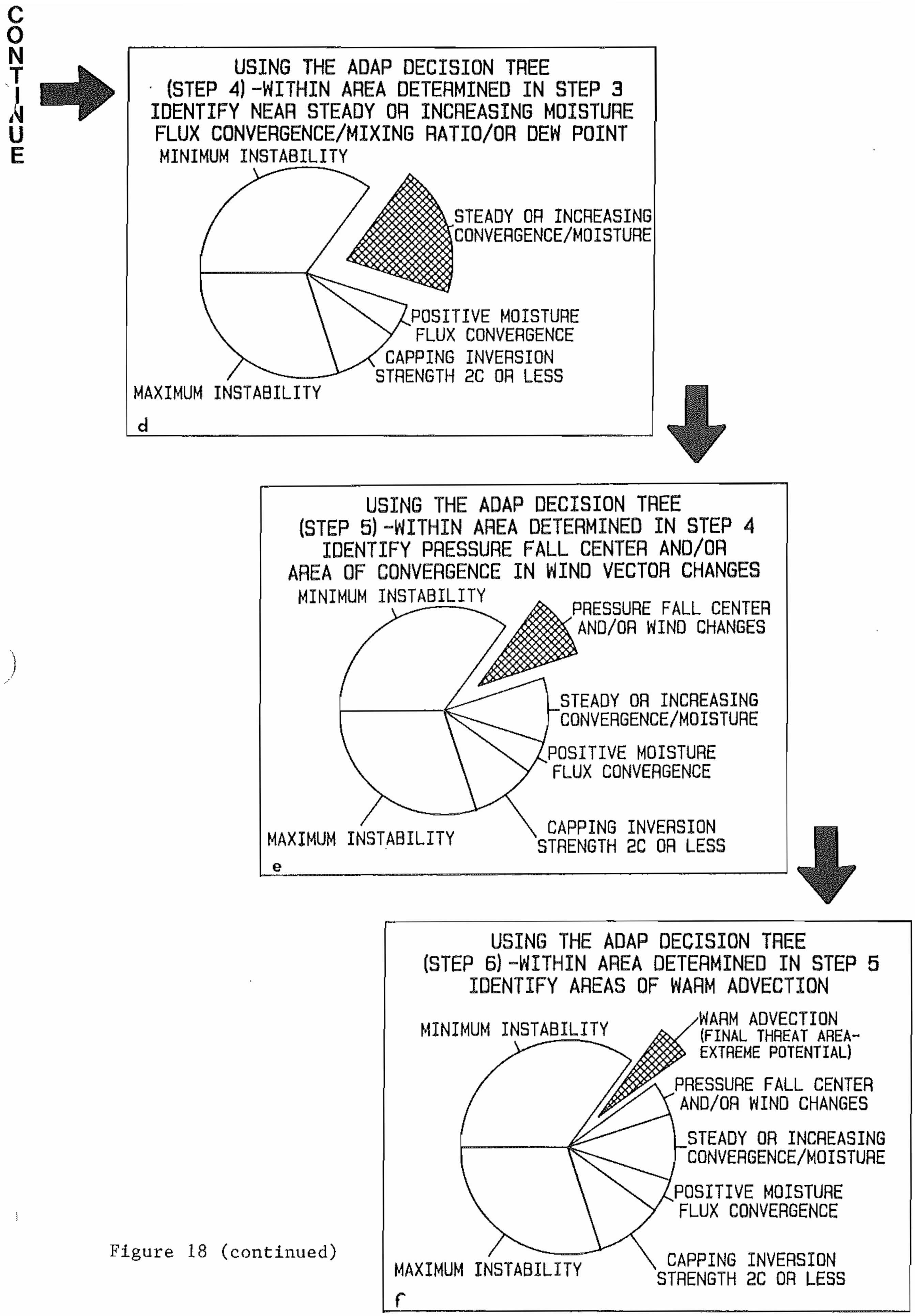


Figure 18 (continued)

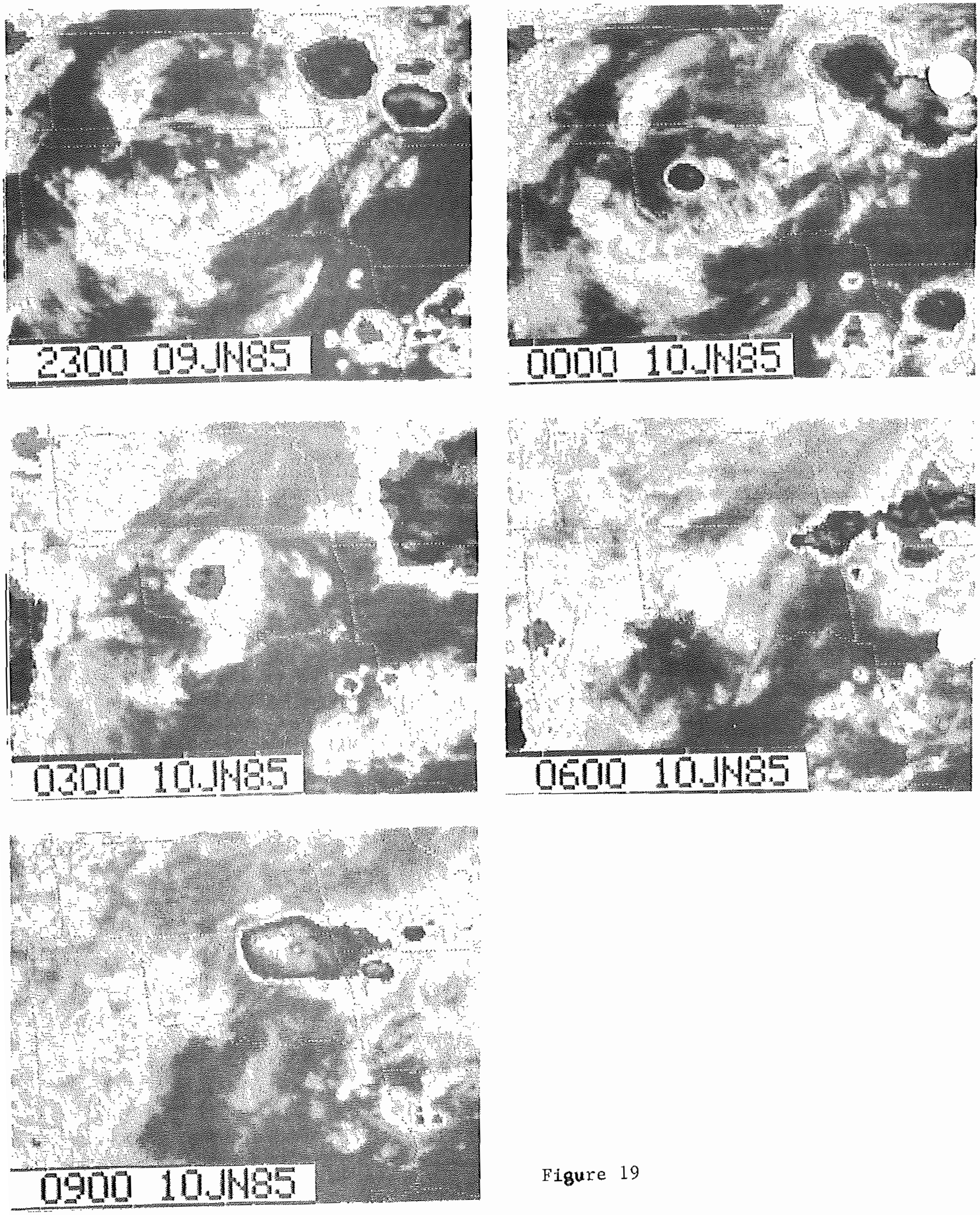

2300 09JN85
0000 10JN85
0300 10JN85
0600 10JN85
0900 10JN85

Figure 19

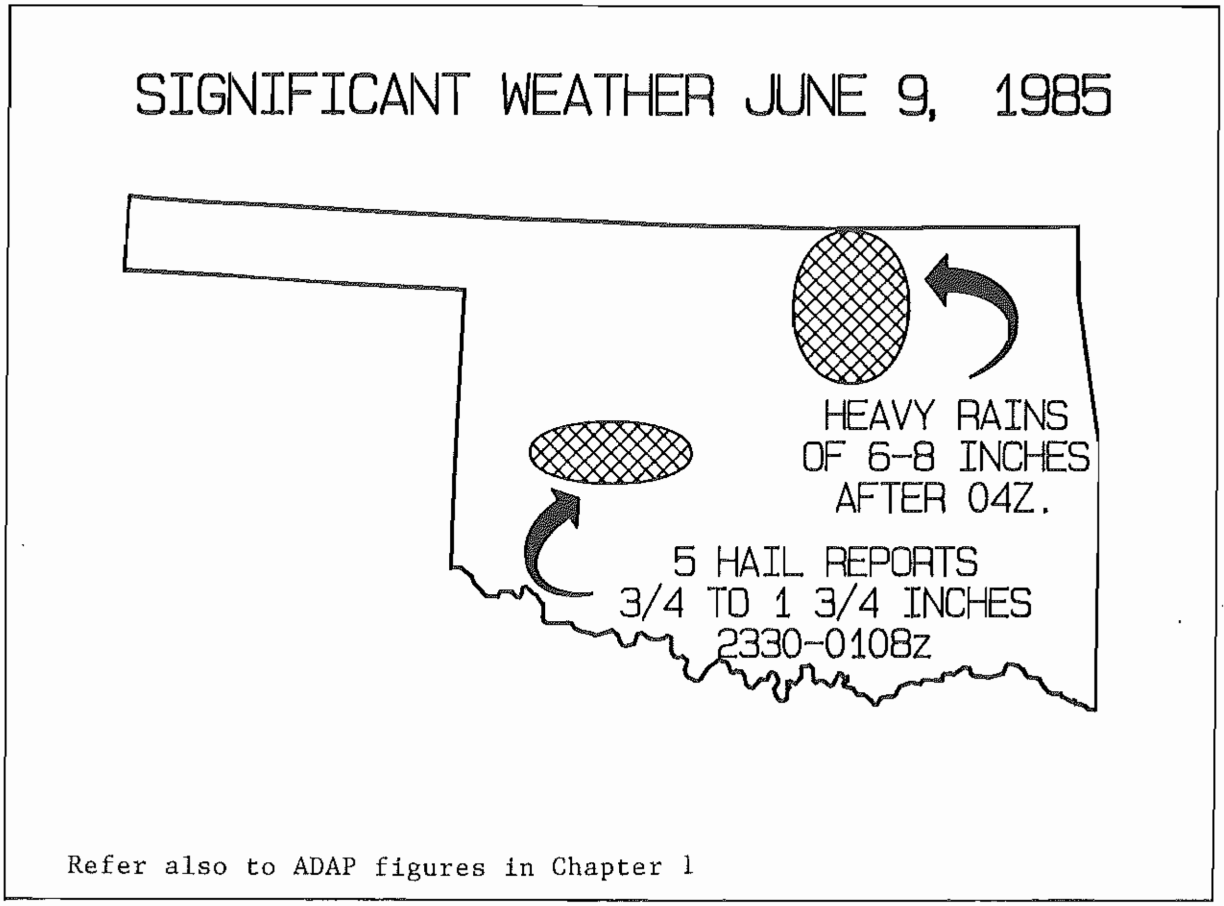

SIGNIFICANT WEATHER JUNE 9, 1985
HEAVY RAINS
OF 6-8 INCHES
AFTER 04Z.
5 HAIL REPORTS
3/4 TO 1 3/4 INCHES
2330-0108z
Refer also to ADAP figures in Chapter 1

Figure 20

Moisture flux convergence, SMC, which includes both moisture advection and mass convergence is used to diagnose where there is lift and/or moisture in the threat area after the area has been narrowed down by evaluating the stability and the cap (Fig. 18c). Lack of positive moisture flux convergence generally means divergence at the surface and hence downward motion, resulting in a weak potential (Fig. 17).

The total moisture flux convergence change, SCC, is used to further eliminate areas within the positive moisture flux convergence field where the convergence is weakening and/or moisture is decreasing (Fig. 18d). However, within an area where positive moisture flux convergence is decreasing, graphics showing changes in mixing ratio, SQC, or dew points, SC1 or SC2, can be used to monitor changes in the low-level moisture. If the dew points or mixing ratios are dropping, then this usually signifies a weak potential (Fig. 17). However, if dew points or mixing ratios are remaining relatively steady or increasing, there is still a moderate or higher potential (See Fig. 17 and also Fig. 18d). These changes in surface low-level moisture can aid in the evaluation of what is actually occurring in the areas of positive moisture flux convergence.

The grid point altimeter change chart graphic, SAC, and/or station change chart graphics, SC1 or SC2 (also SPC), diagnose the general (smoothed) pressure change field and actual station (point) pressure changes respectively. A pressure fall center can act to increase the convergence by ageostrophic adjustments in the wind field, including, but not limited to a backing of the winds in advance of the fall center. Use either SC1 or SC2 to monitor for significant wind changes (including convergence in the wind vector changes). Thus, you should use SAC, SC1, SC2, and SPC to diagnose pressure fall centers and/or convergence in the wind vector changes (Figs. 17 and 18e). The pressure fall center can increase the low level moisture and correspondingly increase the instability. It could possibly help erode the cap through upward vertical motion.

While a pressure fall center could have significant weather associated with it at any location, it is especially significant if the fall center is in an area of positive moisture flux convergence. Neglecting net warm/cold advection in this case, falling pressure in an area of surface convergence could mean that more mass is being removed out the top of column of air than is coming in through the bottom. This would imply divergence aloft which is what is needed in the severe storm environment.

Since we are generally referring to a small (i.e., subsynoptic scale or smaller) pressure fall center, the wind field usually cannot adjust immediately, but over a period of time. Thus, if we have a pressure fall center and there is no significant wind changes, we must branch in the decision tree to see if the pressure fall center is stationary or moving (Fig. 17). If the fall center is moving slowly or is nearly stationary with no significant wind changes, then there is only a moderate potential. However, if the pressure fall center is moving and/or is followed by very large pressure rises (not merely the "bubble high" associated with convection), then there is usually insufficient time for the winds to change and we probably have strong dynamics responsible for the pressure fall (and/or rise) so we consider the potential to be extreme at this point (Fig. 17). In a pressure fall center, the closer spaced the isallobars, or the larger the fall, the greater is the chance of severe weather.

It is important to note that often the grid point altimeter change chart, SAC, can adequately and quickly display larger scale significant changes. The problem arises when a significant pressure change occurs at only one isolated station. This is why the station change charts, SC2 (SC1) or SPC, can be so important to pick up these important changes. To highlight station pressure changes of six hundredths or more occurring during any time interval, the graphic, SPC, will list these stations and the the amount of change as well as the average change of all stations. Also, in addition to the total station altimeter fall, immediately below it on either SC1 or SC2, the total change minus the average change of all stations is displayed. This accounts for and essentially eliminates the semi-diurnal change where the pressure at the stations periodically rises and falls.

There are cases where pressure fall centers are not easily detected (if at all) in association with severe weather. In this case, or if there have been significant wind vector changes, strong warm potential temperature (Theta) advection on the graphics STA and SAA (average Theta advection) indicates a strong or extreme potential still exists (Figs. 17 and 18f). If the maximum ADAP Theta advection is between -0.25C and +0.25C per hour, it can generally be considered as weak advection. The absence of strong advection would lead to a moderate potential (Fig. 17).

Warm advection in the low levels, STA and SAA, can serve to increase the instability and at the same time allow convection to develop by warming the low-level air until the cap strength has been reduced to the point where low-level forcing can punch through the inversion. Warm advection would also produce upward vertical motion which might help erode a cap. Localized warm advection that has persisted for at least two to three hours has sufficient time to produce a veering in the geostrophic wind in the low levels. The graphic SAA displays the average advection. Sustained warm advection is what can lead to the extreme potential (Figs. 17 and 18f). If the warm advection has not been present for two to three hours, then conditions are still favorable for the strong potential. Remember to be careful when evaluating these fields over data void areas.

2.3 TIME INTERVAL FOR ADAP CHANGE FIELDS

A logical question to ask is, "How often should I run the ADAP program?" The time interval that is recommended for routine change fields is two hours. This is the time interval for changes that are used routinely by the Severe Storms Forecast Center. One hour changes will be more susceptible to minor fluctuations in the data that are not a part of any disturbance. On the other hand, it is possible to miss important features if the time interval is three hours or longer. With ADAP, it should be possible to examine two hour changes each hour if necessary. Several points need to be stressed here.

1. It is very important to use the most current upper-air data to evaluate the stability and/or capping inversion if you have reason to believe the conditions have changed markedly aloft. (i.e. strongly baroclinic situations). The 12Z and 00Z upper air messages should be decoded as soon as possible for incorporation into the ADAP Lifted-Indices and cap strength.

2. If you have reason to believe strong cold advection will alter the stability indices significantly before the new data are in, edit the temperatures for 500 mb and the level (normally 300 mb) at which the upper level stability index is calculated. The NMC 12 hour forecasts of winds and temperatures aloft can aid in this decision.

3. Try to decode surface data hourly so time weighting will be used in the objective analysis. This can partially alleviate the problems of missing or erroneous data for the current hour.

4. Rapid changes in temperature, dew point, wind or pressure at any one station produced by a single thunderstorm could result in large changes in the objectively analyzed ADAP fields over a much larger area than the actual thunderstorm. Thus, even though the observation may be totally correct, be aware that changes it produces in the derived fields may be misleading.

5. For obvious reasons, observations are most important from potential threat areas and from data-sparse areas in or immediately adjacent to your forecast and/or warning area. As time and staffing permit, every effort should be made to edit the current hourly data file, SAxxZ.DT, to add or correct the most important observations.

The ADAP mode of operation does not preclude other methods of operations. For example the ADAP fields can be viewed individually on the AFOS GDM (as well as the Satellite Weather Information System-SWIS). Obviously, use of the ADAP output fields should in no way preclude use of additional data as well. The procedures described above represent only a suggested "short form" for assimilating observations and derived fields.

CHAPTER 3 CASE STUDIES

3.1 FORMAT

In this chapter, case studies will illustrate the main points covered in the previous two chapters. Each case study will contain a general description of important features, a diagram showing the general path followed through the ADAP Decision Tree, the 12Z surface and 500 mb upper-air maps, selected ADAP fields in the general order they would be viewed while using the decision tree and a graphic (if available) showing what happened after the map times. More than one outcome from the decision tree is possible for a given event, thus these case studies will cover only the decision tree path suggested by most of the data that would be available in real-time.

3.2 May 7, 1985 (afternoon)

The remains of a thunderstorm complex over Oklahoma the night previous were drifting eastward into Arkansas at 17Z. The airmass was the most unstable from the Texas Panhandle southeastward into north Texas. However, the cap strength over a large part of this unstable air was greater than 2 degrees C suggesting that it was effectively capped off. Also, surface moisture flux divergence was noted over this area. The airmass was only moderately unstable where surface convergence was strongest (i.e., over southeast Oklahoma) and strong dynamics were not present over the threat area in this case. (Notice also how well the surface streamlines delineate surface features at 20Z.) Based on these factors the decision tree would indicate only weak convection. After map time (20Z) only a few showers were noted in southeast Oklahoma near the area of convergence.

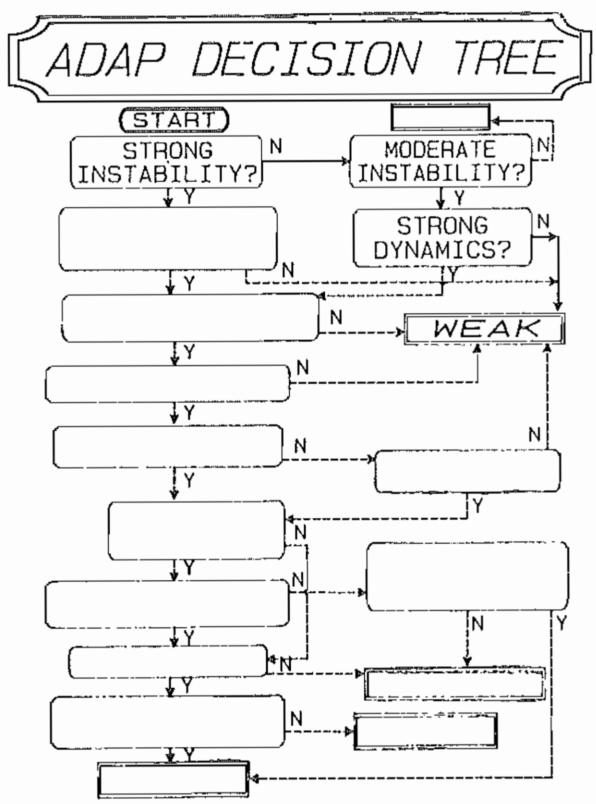


Figure 21

ADAP Decision Tree

for May 7, 1985

(afternoon)

3.3 May 7, 1985 (evening)

While the previous case indicated a generally weak potential, by late in the day, conditions began to change. As we see at 00Z strong instability from the Texas Panhandle southeastward into north Texas was present and the cap strength over a large part of this area was 2 degrees C or less. Convergence was noted over the Texas panhandle (near the edge of the grid) and the convergence was increasing. Moisture significantly increased over north Texas. Although the mixing ratio appears to be decreasing over the Texas Panhandle, note that Amarillo, Texas actually increased 2 degrees F from 22 to 00Z. The surface streamlines and wind vector changes would indicate that the upslope flow over the Texas panhandle was increasing. Warm advection appeared weak at 00Z (in fact cold advection was noted over much of the Texas Panhandle). The grid point altimeter change chart was not available, however, notice the the pressure fell 3 hundredths of an inch at Lubbock, Texas from 22 to 00Z. Based on this data the decision tree as shown below would generally indicate a moderate potential for severe weather from the Texas Panhandle into north Texas. The satellite picture valid at 03Z shows several storm complexes. Baseball sized hail was reported with both of these storm complexes after 00Z.

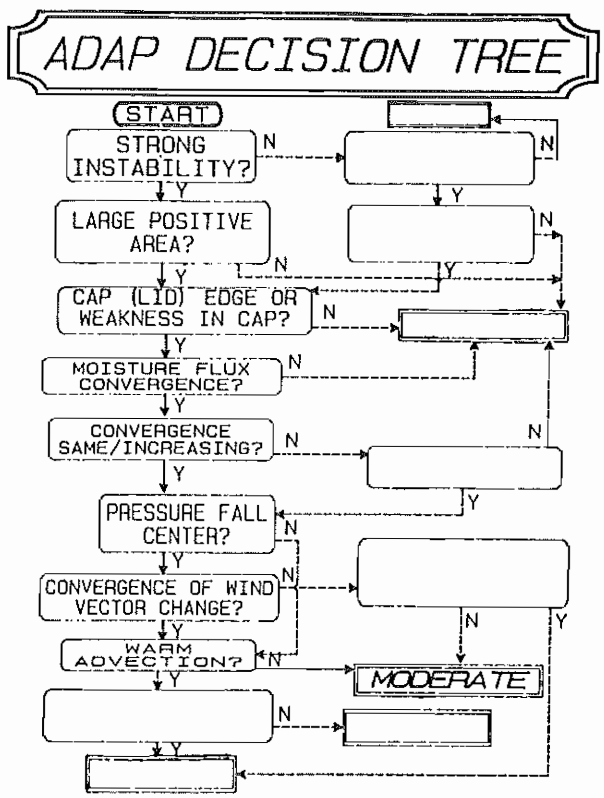


Figure 22 ADAP Decision Tree for May 7, 1985 (evening)

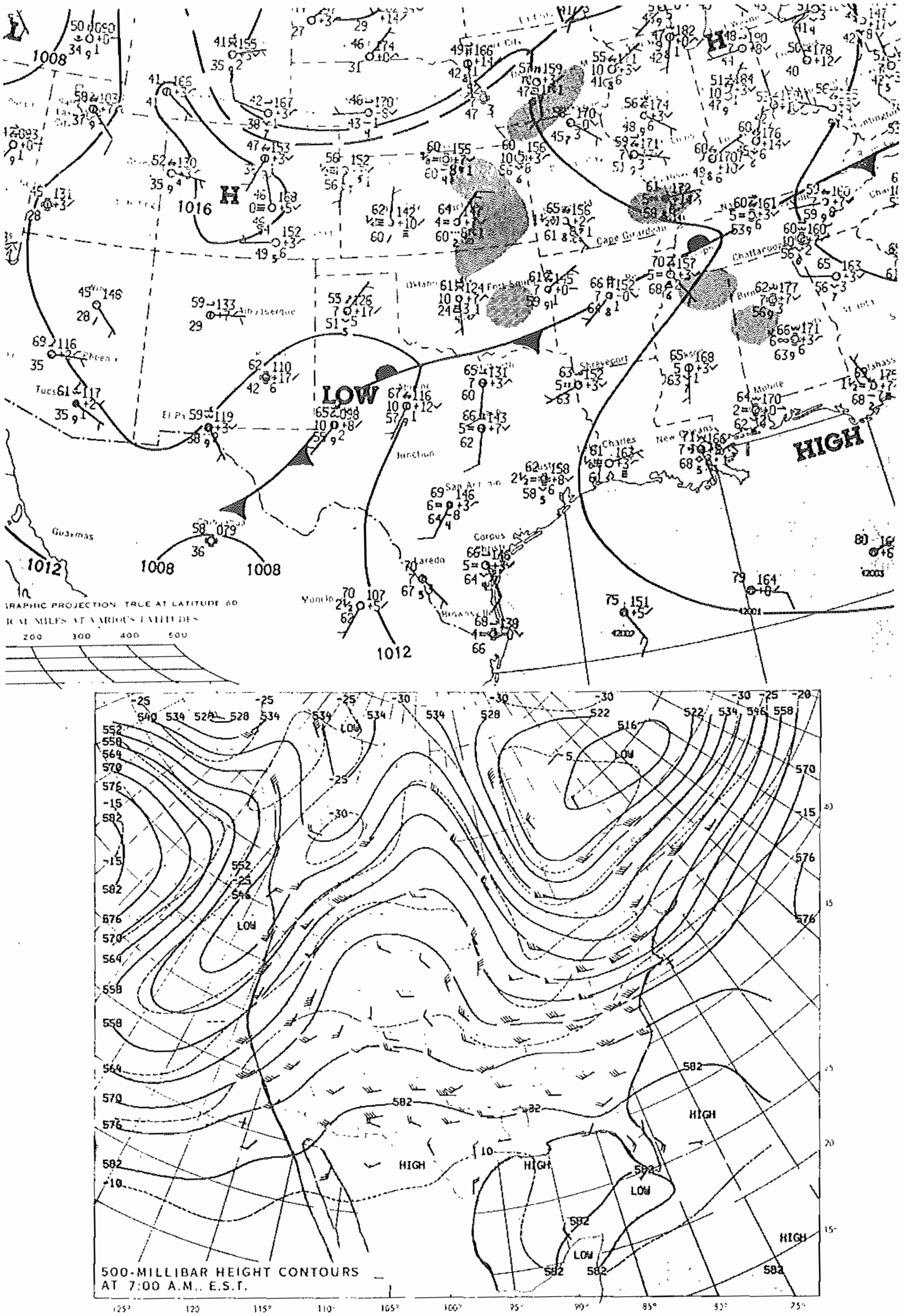
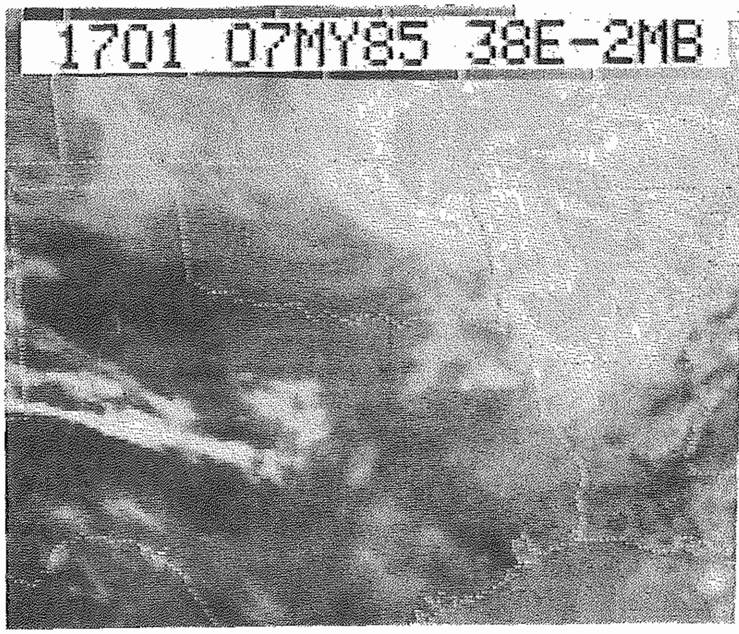
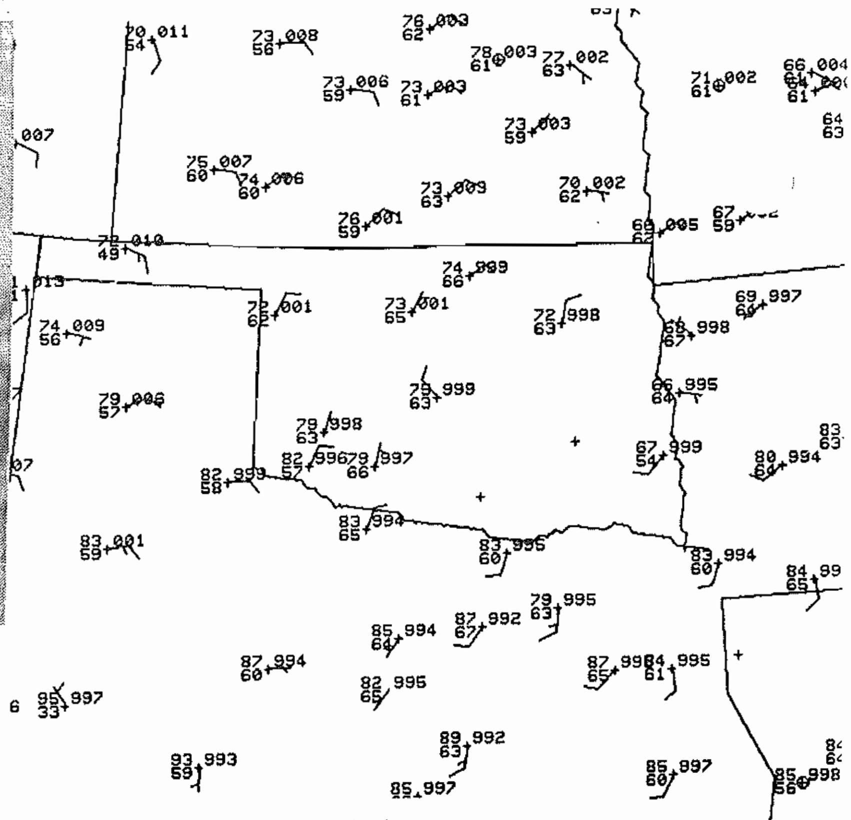


Figure 23 Surface and 500 mb maps for 12Z May 7, 1985

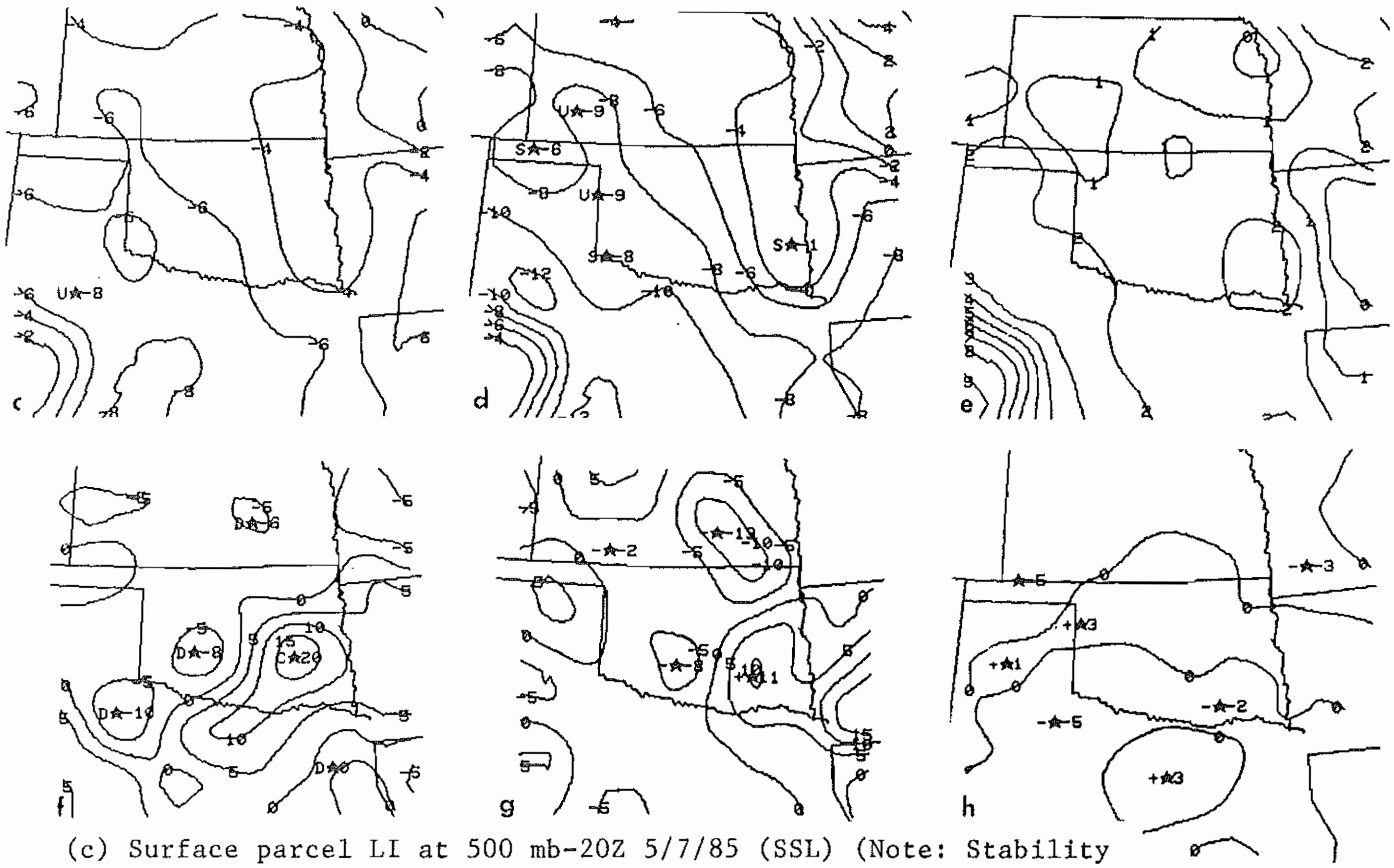


(a) IR Satellite image-17Z 5/7/85

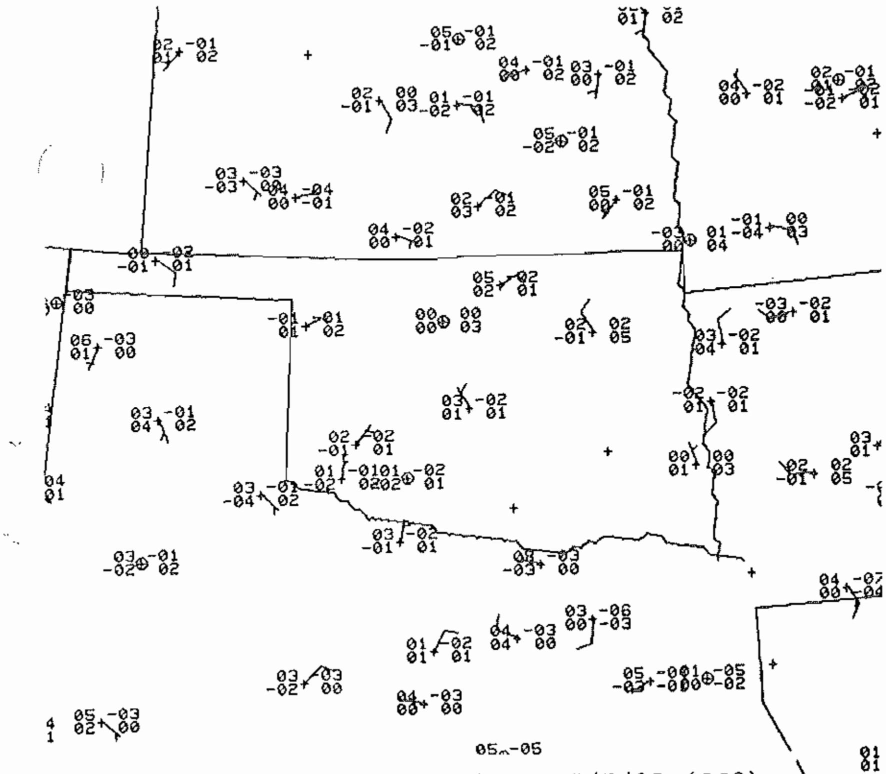
Figure 24 (afternoon)



(b) Surface map-20Z 5/7/85



(c) Surface parcel LI at 500 mb-20Z 5/7/85 (SSL) (Note: Stability indices and cap strength based on 20Z surface and 12Z upper-air data.) (d) Surface parcel LI at 300 mb for 20Z (SSU) (e) Cap strength at 20Z (SSC) (f) Surface moisture flux convergence-20Z (SMC) (g) Changes in Surface Moisture Flux Convergence (SCC) and (h) Changes in Surface Mixing Ratio-(18-20Z) (SQC) (Note: (f), (g) and (h) have the same units- See Figs. 8,9, 10)

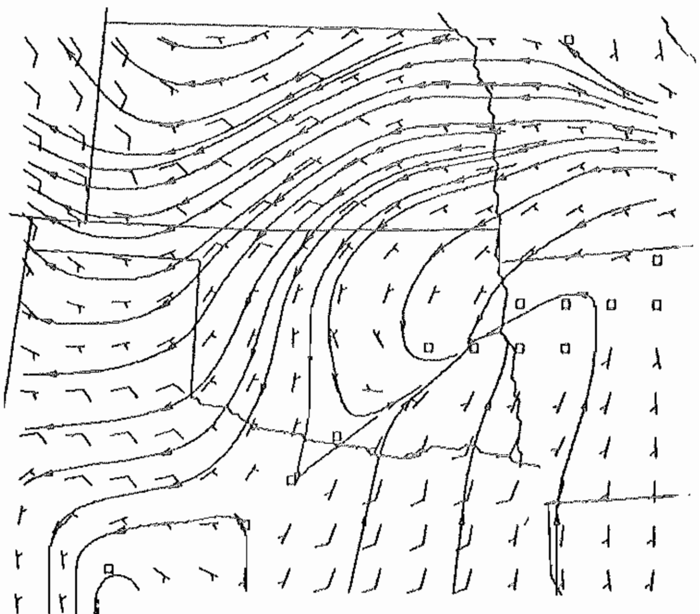


(i) Station Changes from 18-20Z 5/7/85 (SC2)

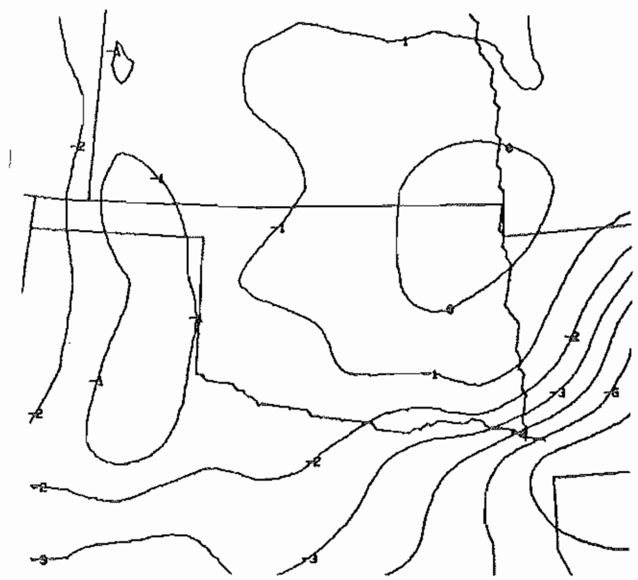
18Z 050785 TO 20Z 050785 CHANGES
-03 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
ISN 06
LND 06
SHR 07
GRK 06
GVT 06
LFK 07
ELD 07
JBR 10
LRF 06
PBF 07
AEX 07
ESF 06
MLU 08
POE 06
CLL 06

TOTAL= 15

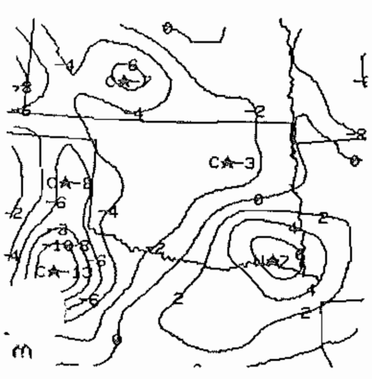
(j) Stations with pressure fall of 6 hundredths or more-(18-20Z) (SPC)

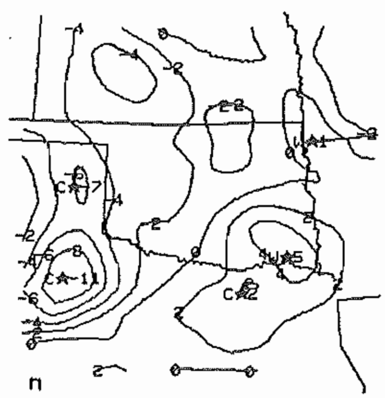


(k) Surface streamlines and wind vectors-20Z 5/7/85 (SSW)

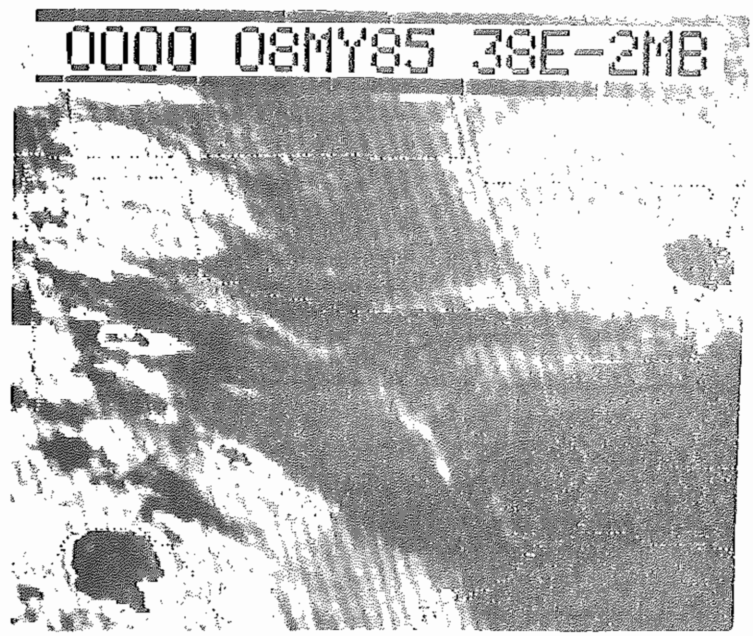


(l) Total altimeter change-(18-20Z) (SAC)

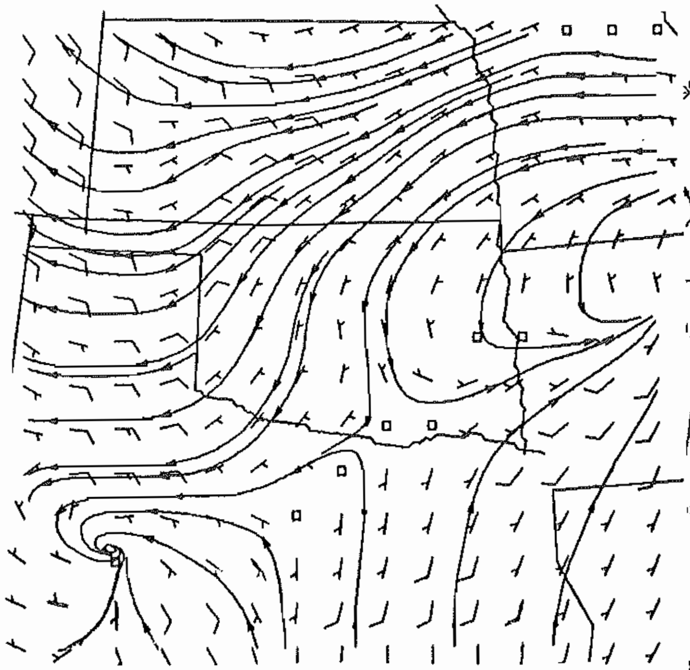




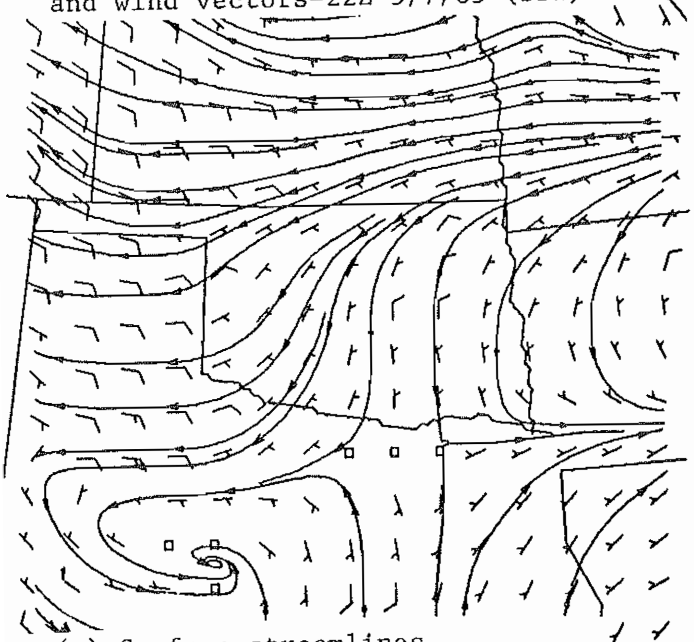
(m) Theta Advection 20Z (STA) (n) Average Theta Advection-(18-20Z) (SAA)



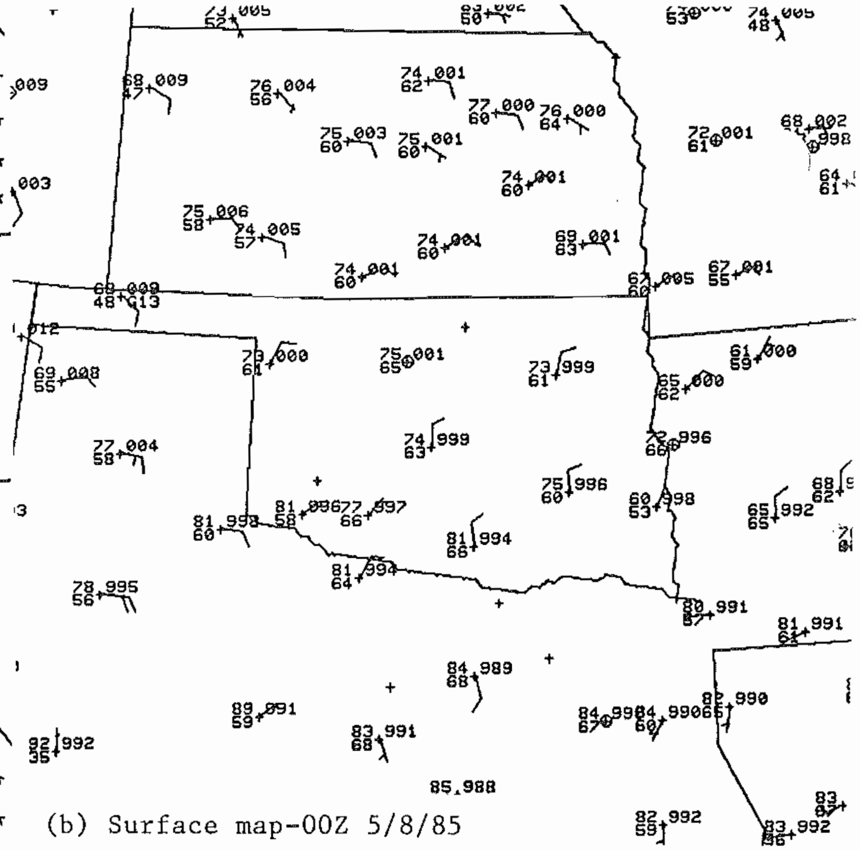
(o) IR Satellite image-00Z 5/8/85



(a) Surface streamlines
and wind vectors-22Z 5/7/85 (SSW)



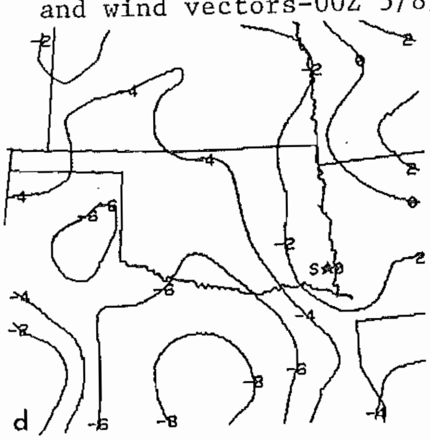
(c) Surface streamlines
and wind vectors-00Z 5/8/85 (SSW)

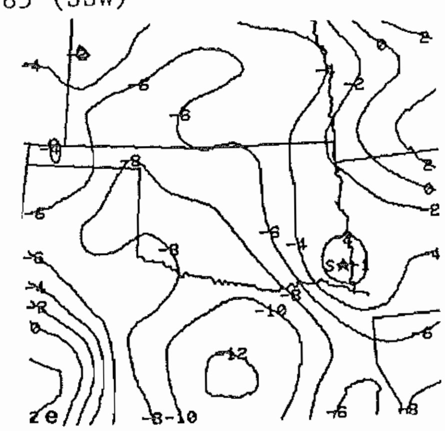


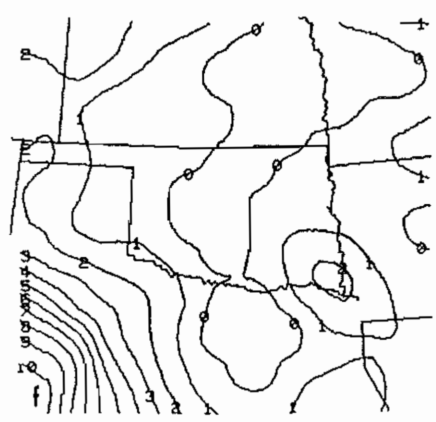
(b) Surface map-00Z 5/8/85

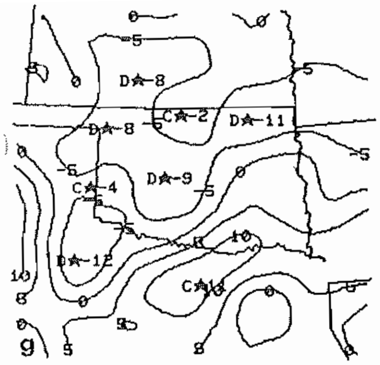
Figure 25 (evening)

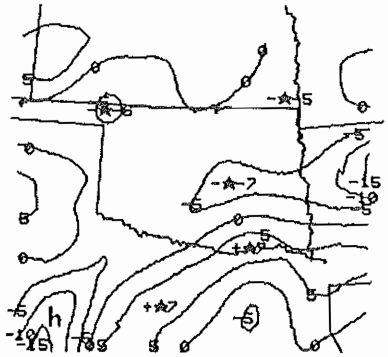
(d) Surface parcel LI at 500 mb-00Z 5/8/85
(SSL) (Note: Stability indices and cap strength
based on 00Z surface and upper-air data)
(e) Surface parcel LI at 300 mb for 00Z
(f) Cap strength-00Z 5/8/85

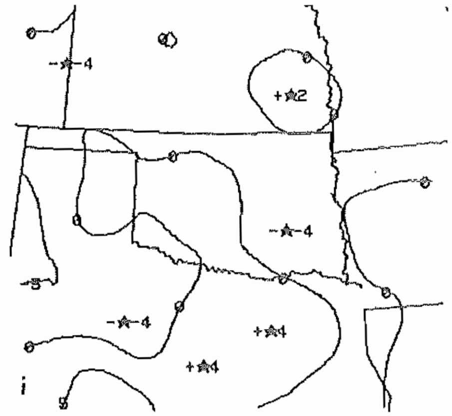




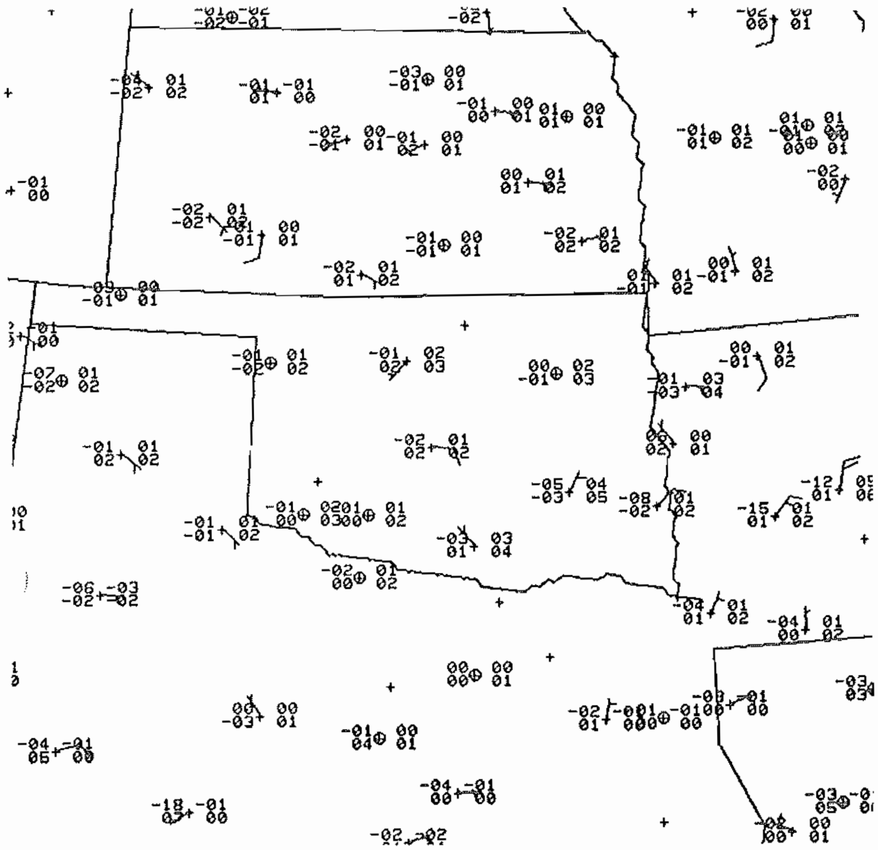








(g) Surface moisture flux convergence-00Z 5/8/85 (SMC)
(h) Changes in surface moisture flux convergence-(22-00Z) (SCC)
(i) Changes in surface mixing ratio-(22-00Z) (SQC)

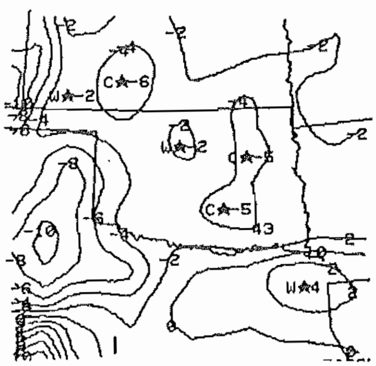


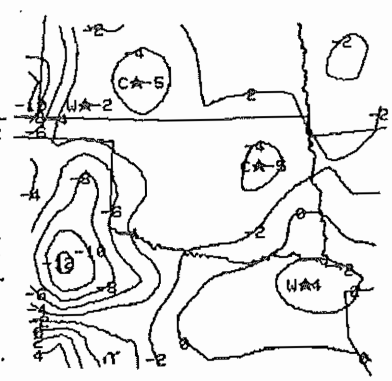
(j) Station changes 22-00Z (SC2)

```
22Z 050785 TO 00Z 050885 CHANGES
 -01 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
DIK 06
ISN 07

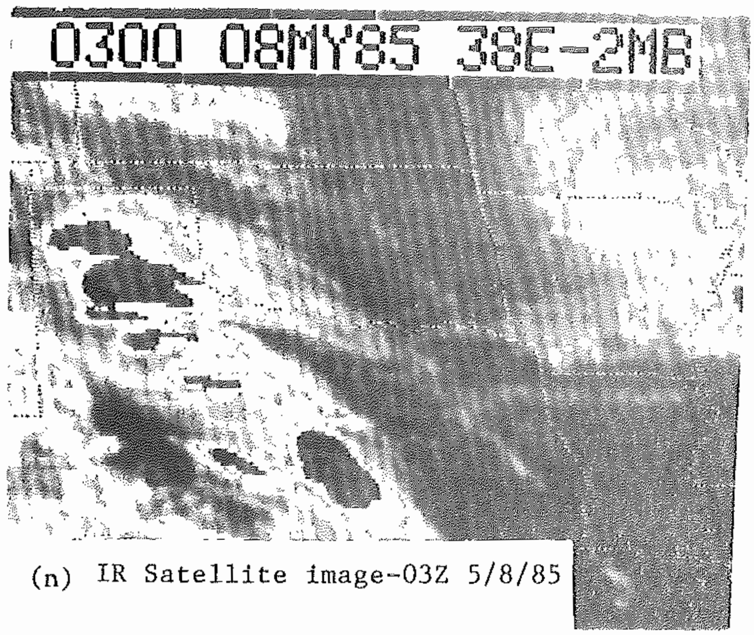
TOTAL=  02
```

(k) Stations with pressure fall of 6 hundredths or more-(22-00Z) (SPC)





(l) Theta Advection-00Z 5/8/85 (STA)
(m) Average Theta Advection-(22-00Z) (SAA)



(n) IR Satellite image-03Z 5/8/85

3.4 June 3, 1985

ADAP lifted indices were indicating extremely unstable air (-12C LI at 500 mb and -16C LI at 300 mb) by 22Z over northwest Oklahoma. This was also where the cap was diagnosed to be the weakest (less than 2C). Moisture convergence was very strong and it was increasing in northwest Oklahoma. The 22Z observation at Gage, Oklahoma appears to have been influenced by thunderstorms and may not reflect actual conditions outside the thunderstorm area. Enid, Oklahoma reported a dew point increase of 4 degrees F and an altimeter setting fall of 6 hundredths from 19 to 22Z prior to thunderstorms moving into the Enid area. Pronounced warm advection was also indicated over the threat area. Based on these factors, the potential was extreme over northwest Oklahoma. An F1 tornado occurred near Enid shortly after 00Z. (see satellite photo for 0030Z-note also the location of the storms relative to the cap strength at 22Z). Hail (golfball to baseball sized) was also reported in northwest Oklahoma (afternoon and evening).

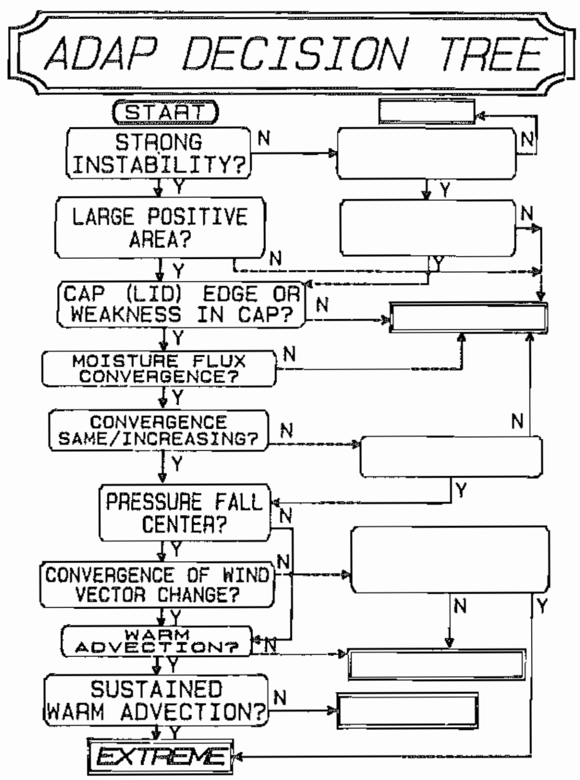


Figure 26 ADAP Decision Tree for June 3, 1985

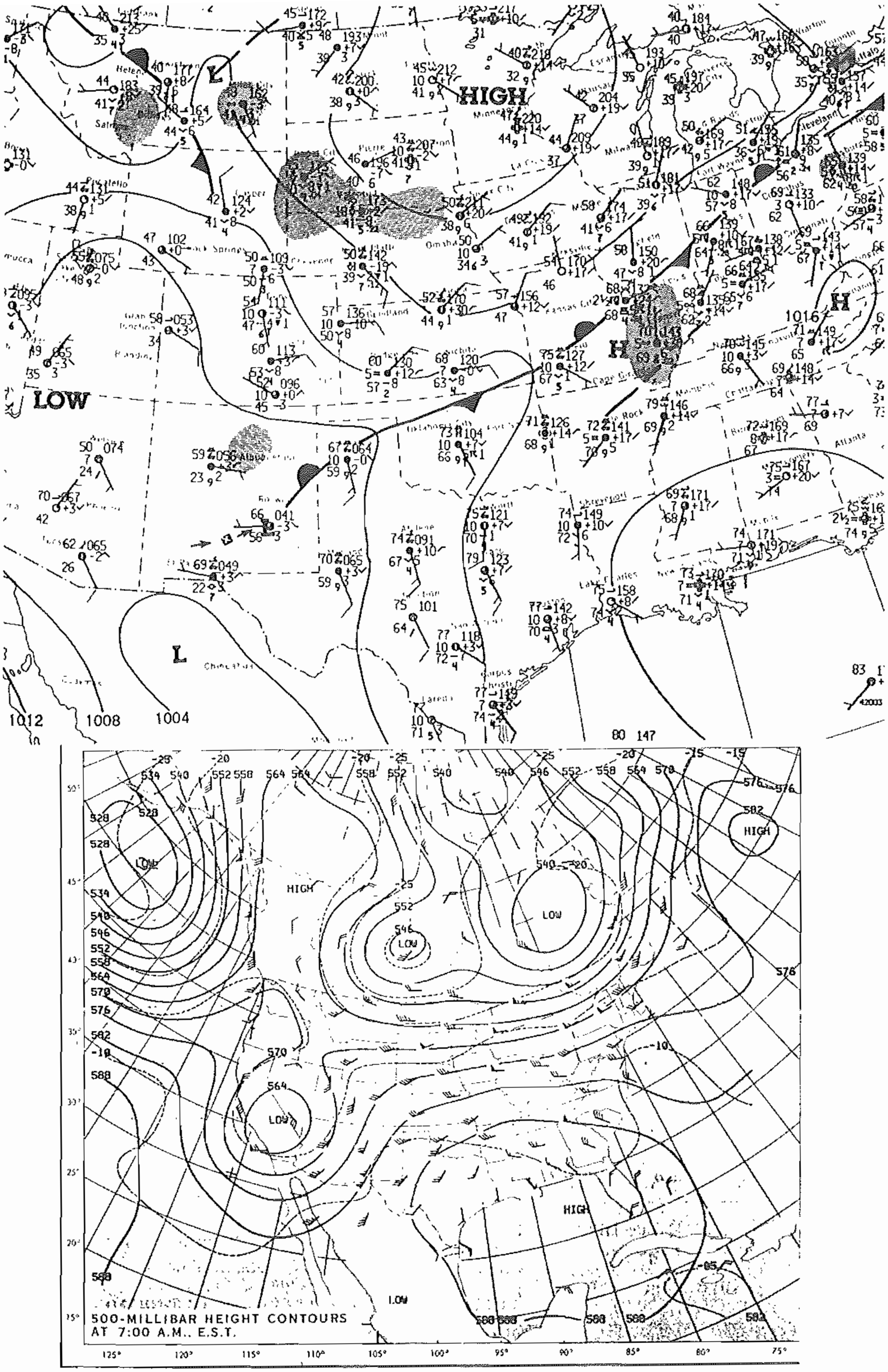
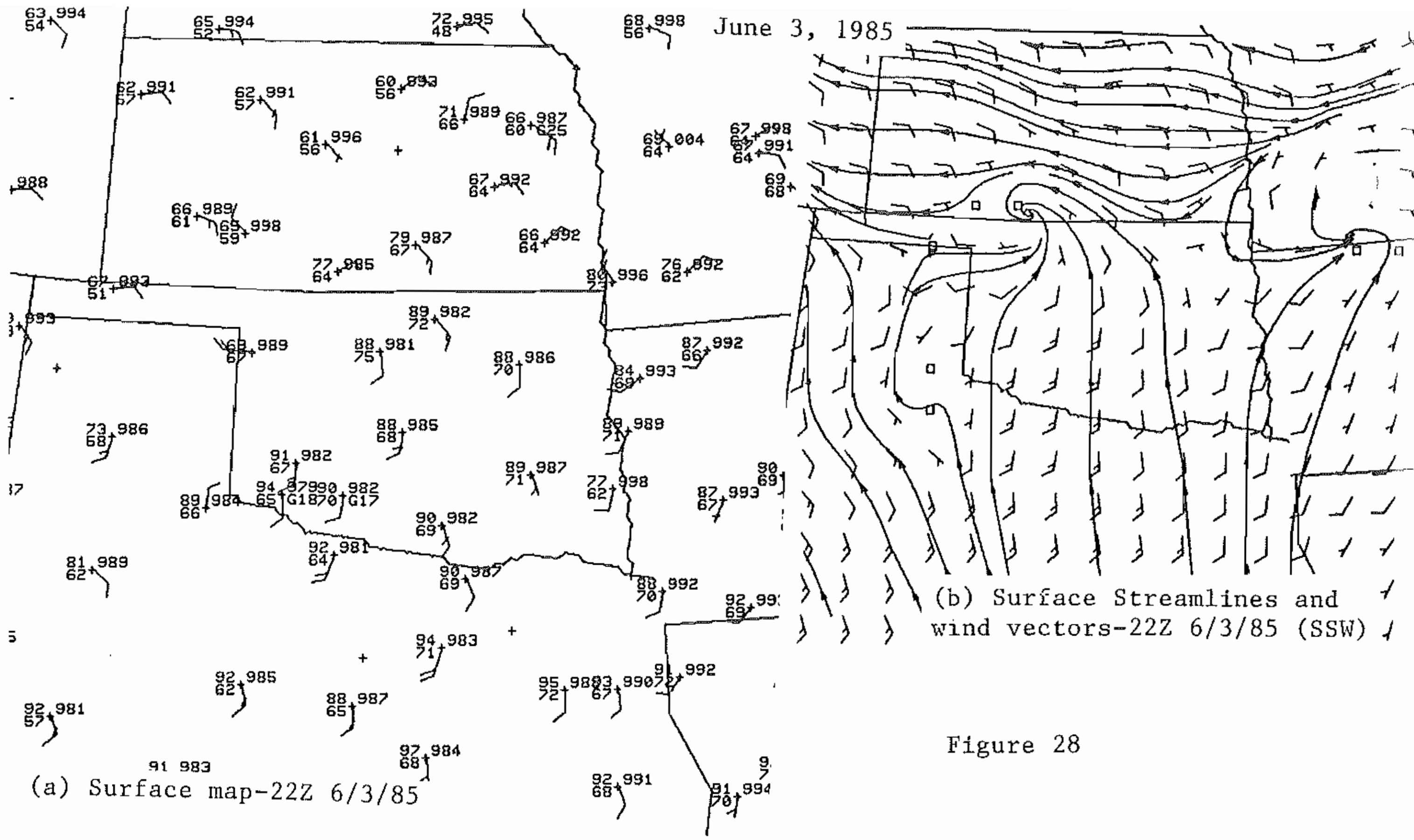


Figure 27 Surface and 500 mb maps for 12Z June 3, 1985

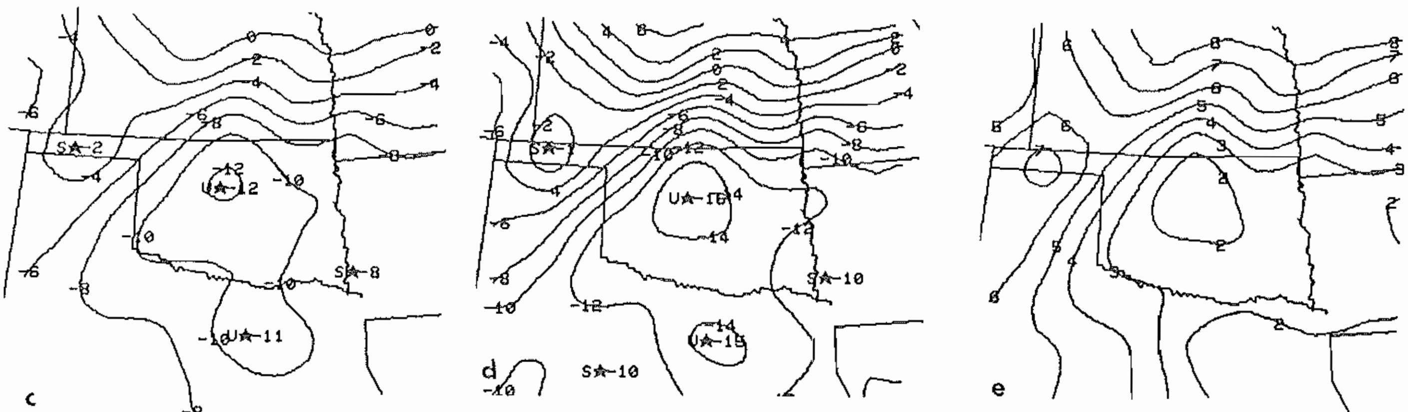
June 3, 1985



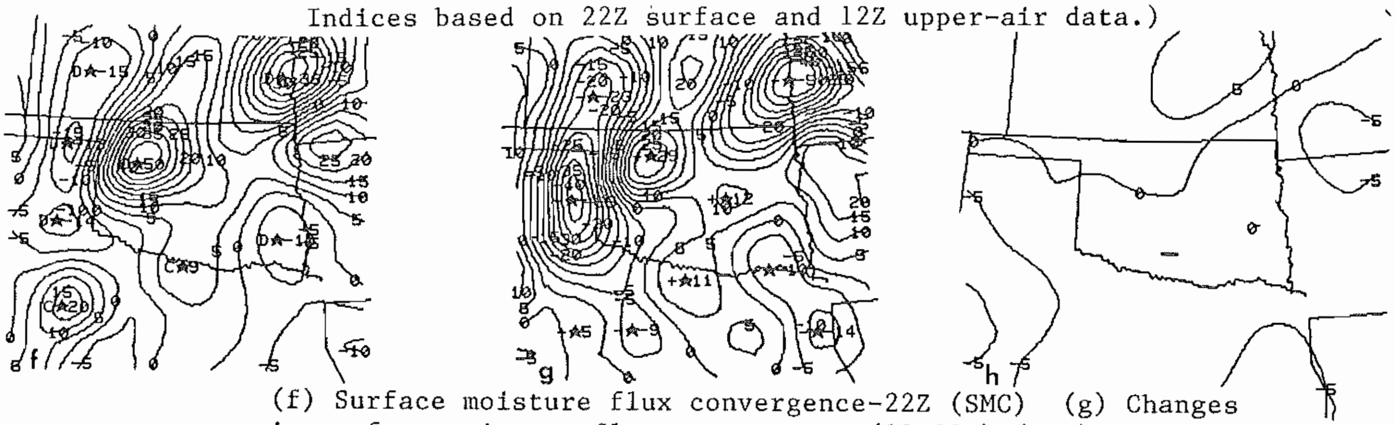
(a) Surface map-22Z 6/3/85

(b) Surface Streamlines and wind vectors-22Z 6/3/85 (SSW)

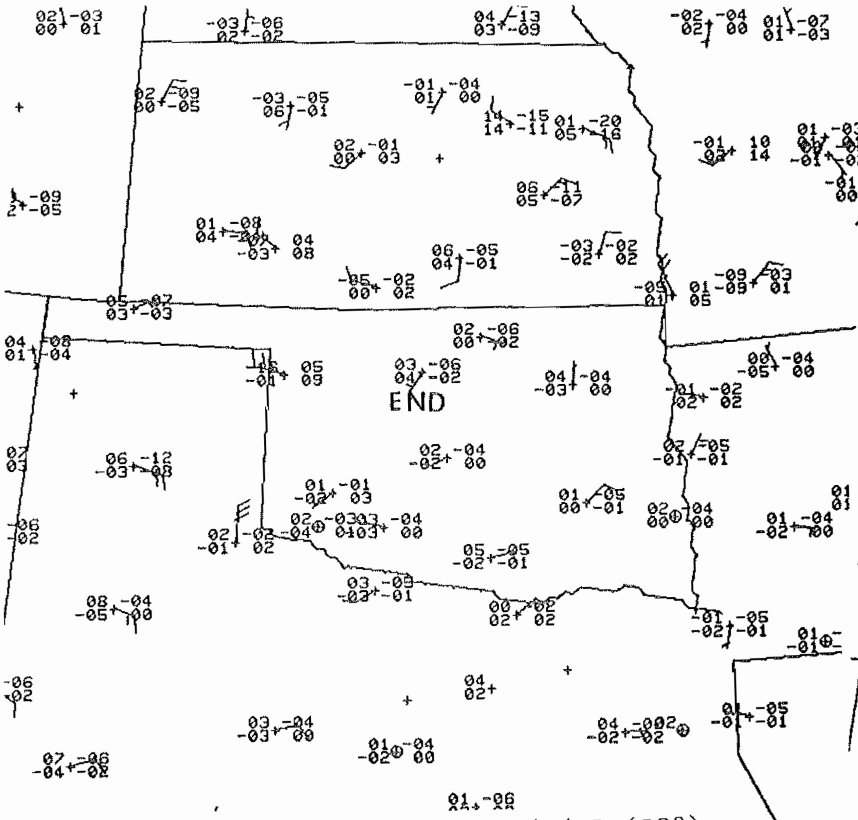
Figure 28



(c) Surface parcel LI at 500 mb-22Z (SSL) (d) Surface parcel LI at 300 mb-22Z (SSU) (e) Cap strength 22Z (SSC) (Note: Indices based on 22Z surface and 12Z upper-air data.)



(f) Surface moisture flux convergence-22Z (SMC) (g) Changes in surface moisture flux convergence-(19-22Z) (SCC) and (h) Changes in surface mixing ratio-(19-22Z) (SQC)



(i) Station changes (19-22Z) 6/3/85 (SC2)

```
19Z 060385 TO 22Z 060385 CHANGES
 -04 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
ABQ 07 AEX 06 GLD 09
CAO 08 BTR 06 MHK 15
CNM 06 END 06 TOP 20
CVS 06 PNC 06
DMN 07 WDG 06 TOTAL=  53
FMN 07 BIE 13
GUP 06 GRI 07
HMN 06 HSI 07
HOB 06 LNK 09
LVS 06 MCK 06
SAF 06 OFK 06
TCC 07 OLU 06
TCS 07 AUS 06
ALS 07 CLL 06
LHX 09 DLF 07
TAD 07 DRT 08
ACT 06 JCT 06
FWH 06 SAT 06
GRK 06 IRK 07
TYR 06 JEF 06
AMA 12 VIH 06
ELP 06 1KS 07
GDP 06 EMP 11
MAF 06 FRI 15
REE 06 GCK 08
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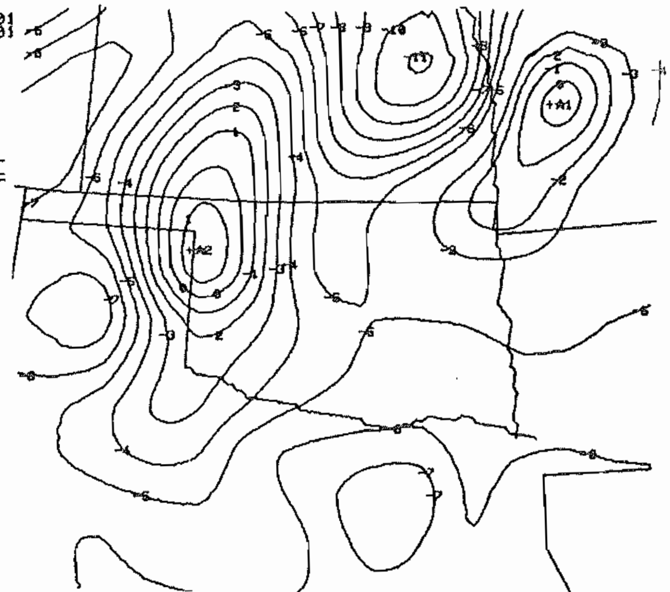
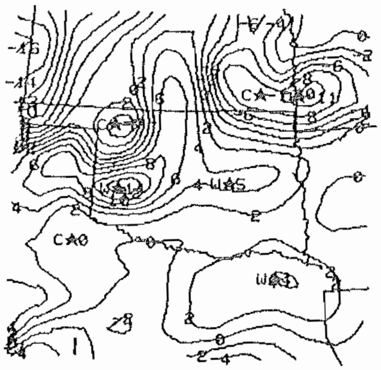
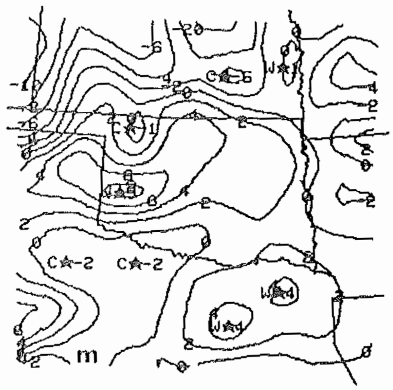
(j) Stations with pressure fall of 6 hundredths or more (19-22Z) 6/3/85 (SPC)



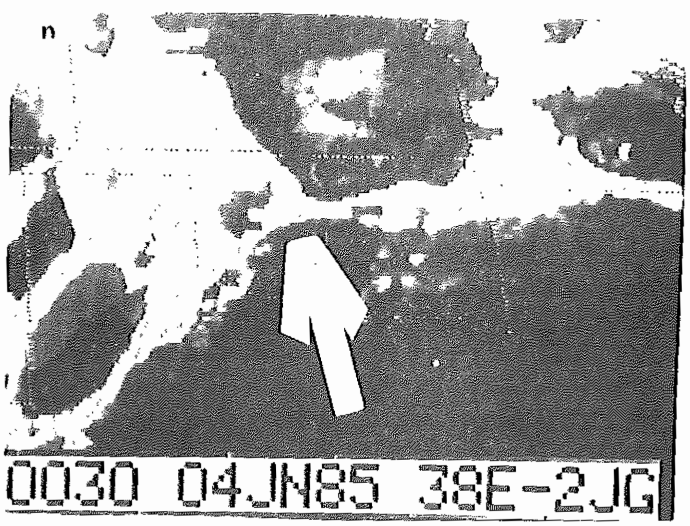
(k) Total altimeter change-(19-22Z) (SAC)





(l) Theta Advection 22Z (STA)

(m) Average Theta Advection-(19-22Z) (SAA)



(n) IR Satellite image 0030Z 6/3/85 F1 tornado in progress (location denoted by white arrow)

3.5 June 26, 1985

On this particular afternoon unstable air was present over most of Oklahoma and north Texas with little evidence of a cap that would prevent (or focus) convection. Several areas of convergence were present from the Texas Panhandle through northwest Oklahoma and into south-central Kansas. Some increase in convergence was noted along with an increase in moisture. However, pressure falls were not coincident with the other indicators such as convergence and there were no concentrated falls except in northeast Kansas. Warm advection was present over northwestern Oklahoma. Notice how the surface streamlines show how the wind field backed prior to convection in the Texas Panhandle. The decision tree arrived at the extreme potential. Thunderstorms did occur, but only one severe report was received during the afternoon (wind damage reported near Topeka, Kansas). From the data presented, the fact that there was the general absence of a cap (all storms competing for the available moisture) plus the absence of a concentrated pressure fall center over the threat area may have contributed to the lack of severity.

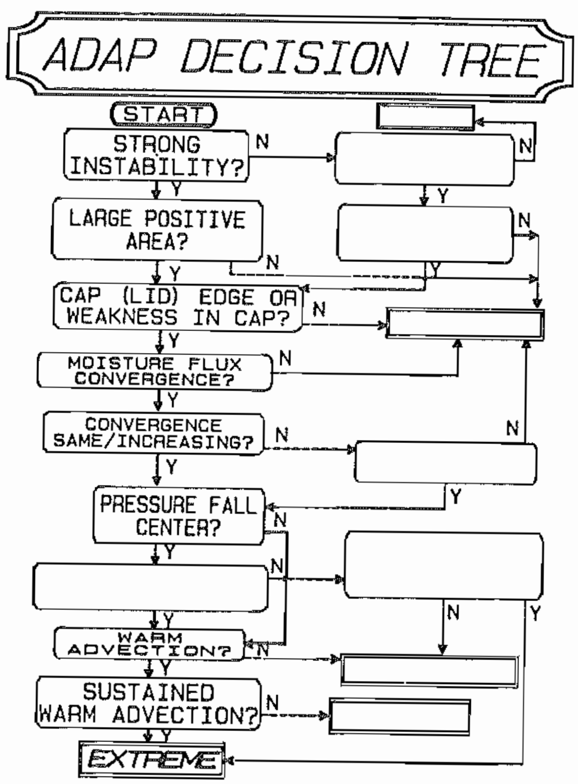


Figure 29 ADAP Decision Tree for June 26, 1985

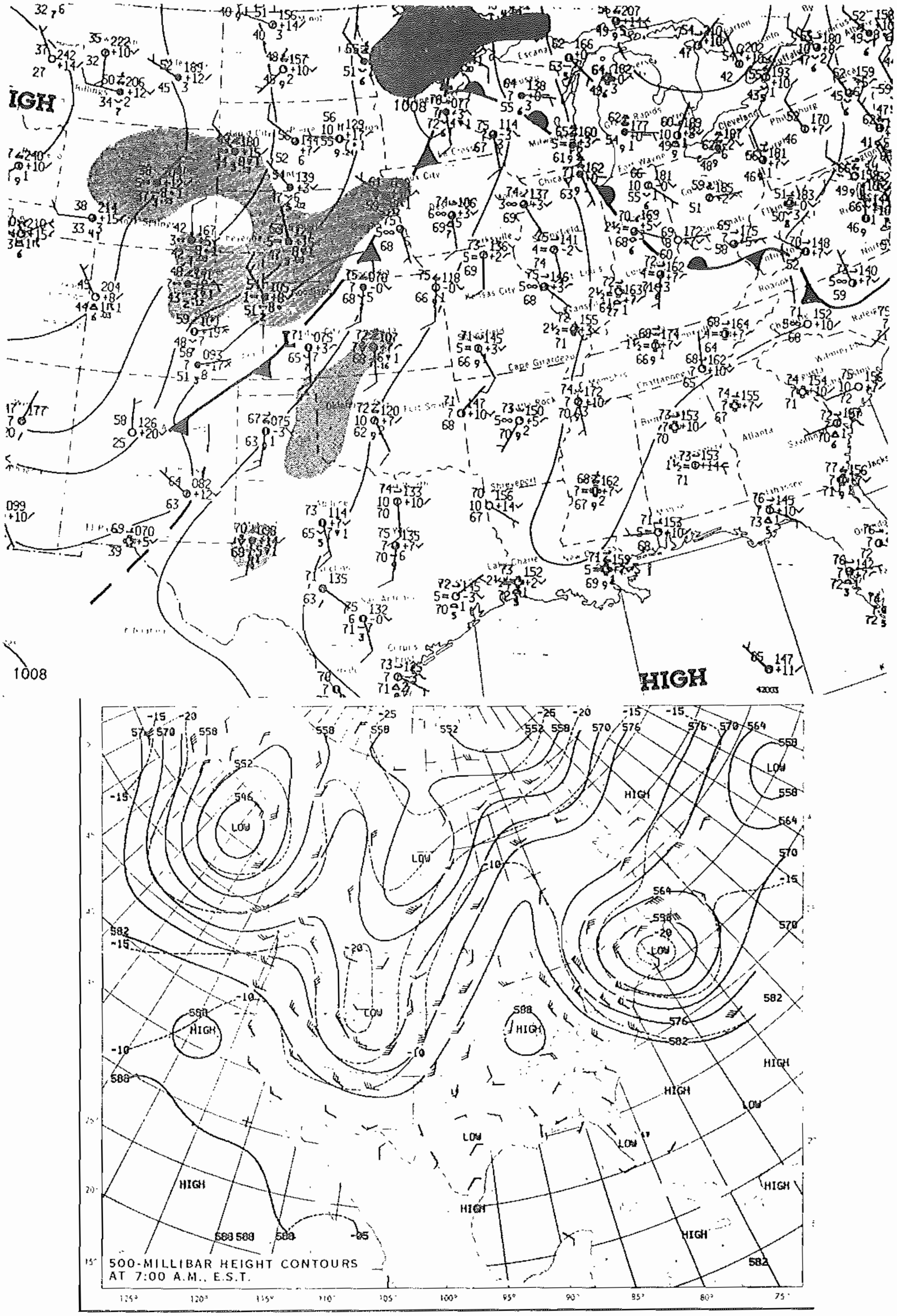


Figure 30 Surface and 500 mb maps for 12Z June 26, 1985

June 26, 1985

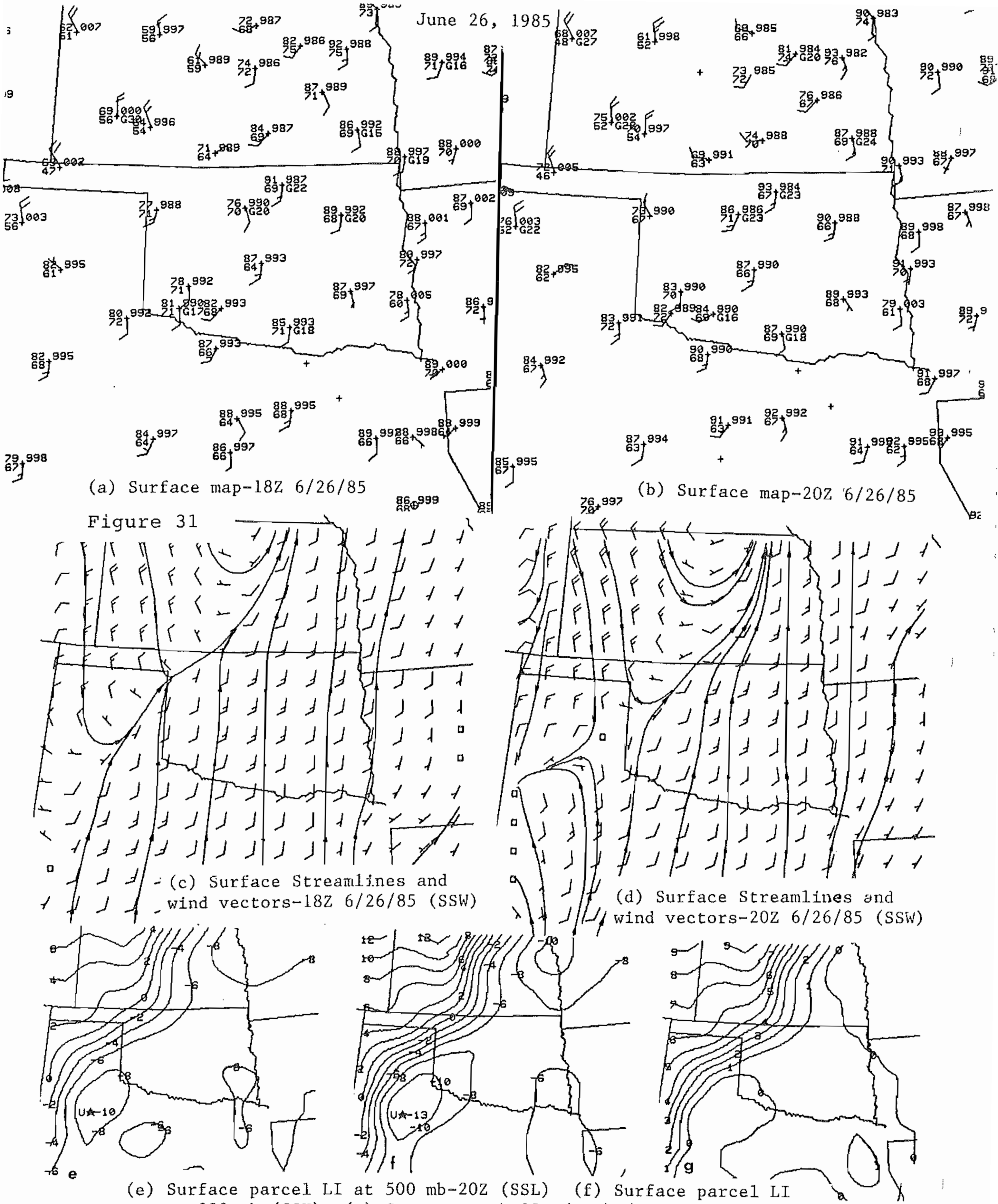


Figure 31

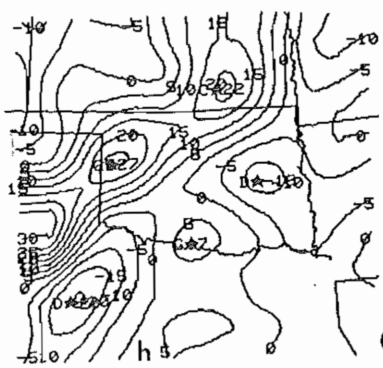
(a) Surface map-18Z 6/26/85

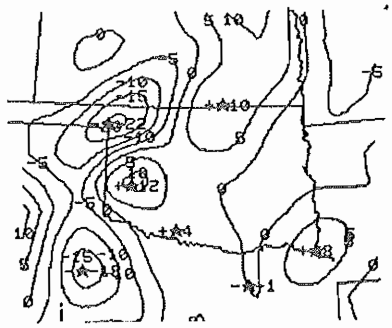
(b) Surface map-20Z 6/26/85

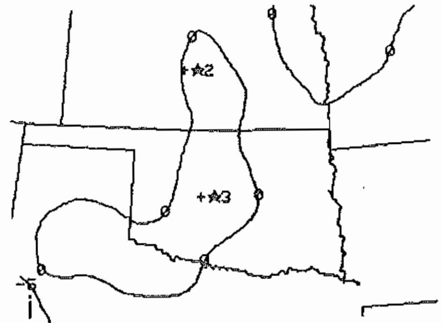
(c) Surface Streamlines and wind vectors-18Z 6/26/85 (SSW)

(d) Surface Streamlines and wind vectors-20Z 6/26/85 (SSW)

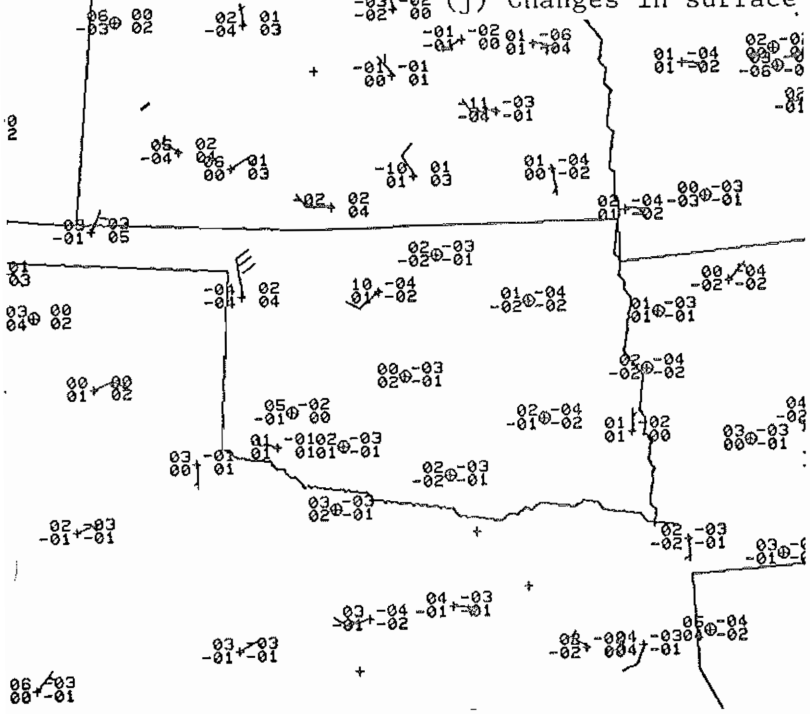
(e) Surface parcel LI at 500 mb-20Z (SSL) (f) Surface parcel LI at 300 mb (SSU) (g) Cap strength 20Z (SSC) (Note: Indices based on 20Z surface and 12Z upper-air data.)



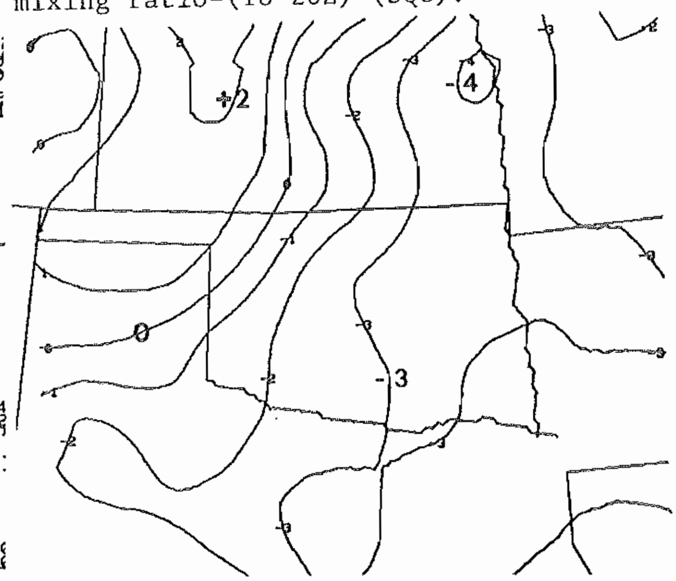




(h) Surface moisture flux convergence-20Z (SMC) (i) Changes in surface moisture flux convergence-(18-20Z) (SCC) and (j) Changes in surface mixing ratio-(18-20Z) (SQC).



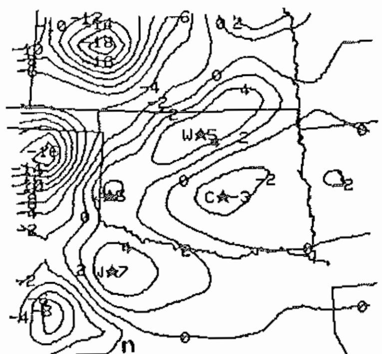
(k) Station changes-(18-20Z) 6/26/85 (SC2)

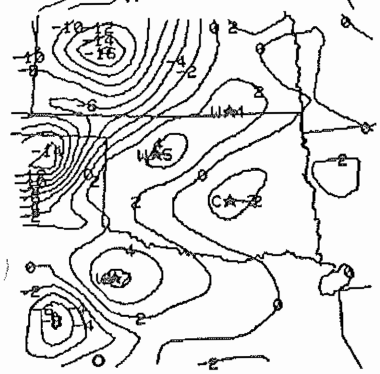


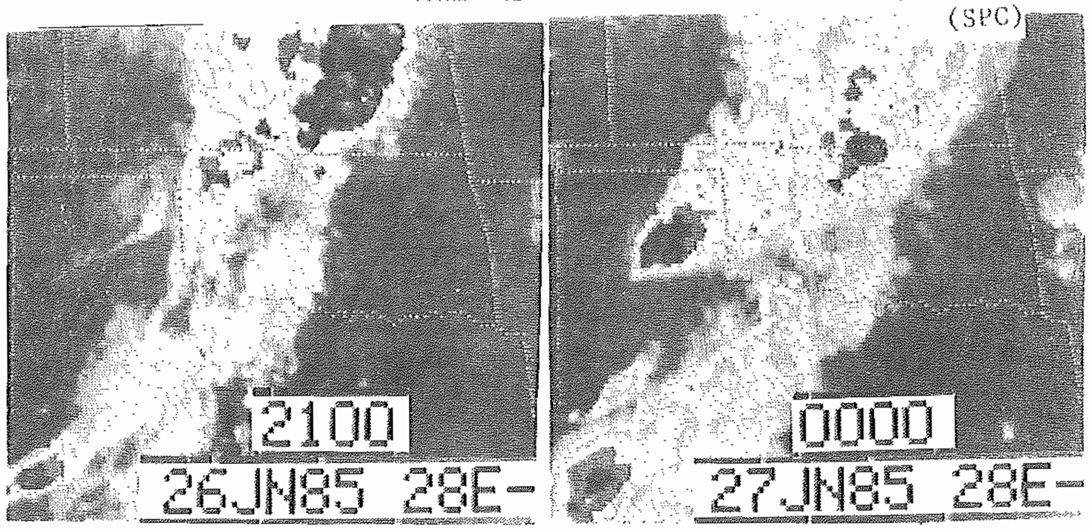
(l) Total altimeter change-(18-20Z) (SAC)

```
18Z 062685 TO 20Z 062685 CHANGES
 -02 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
STJ 06
TOP 06
TOTAL= 02
```

(m) Stations with pressure fall of 6 hundredths or more-(18-20Z) (SPC)







(n) Theta Advection 20Z (STA) (o) Average Theta Advection-(18-20Z) (SAA) (p) IR Satellite image 21Z 6/26/85 and 00Z 6/27/85

3.6 September 15, 1987

This case is an excellent example of how the Satellite Weather Information System (SWIS) can be used to combine the ADAP fields and satellite image to aid in the analysis. The axis of moist unstable air stretched across central Oklahoma by mid-afternoon. The cap strength was weakest over central Oklahoma. Moisture flux convergence was present over south-central Oklahoma and it (along with the mixing ratio) was increasing. An area of pressure falls were concentrated in central Oklahoma and convergence in the wind vector change field was present also (southwest of Oklahoma City). Warm advection was particularly weak in this case at this time. With the above factors present, the ADAP Decision Tree predicted a moderate potential. The severe hail and wind reports that occurred after this map time are also shown on the satellite image.

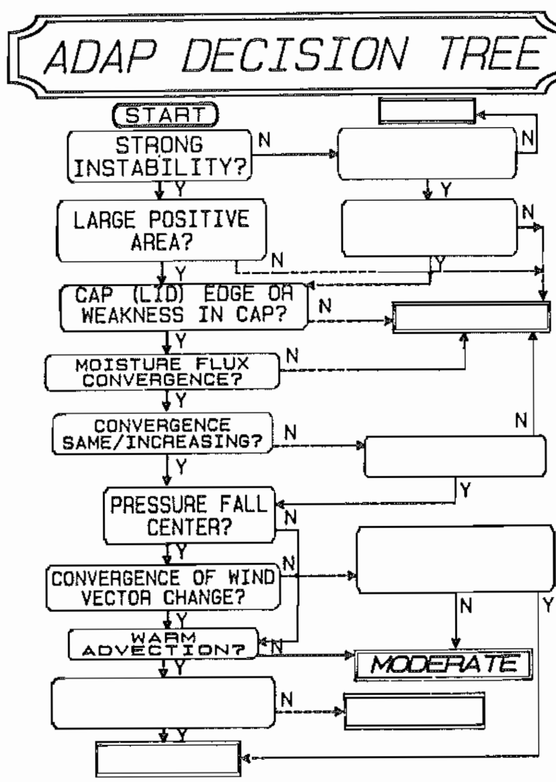


Figure 32 ADAP Decision Tree for September 15, 1987

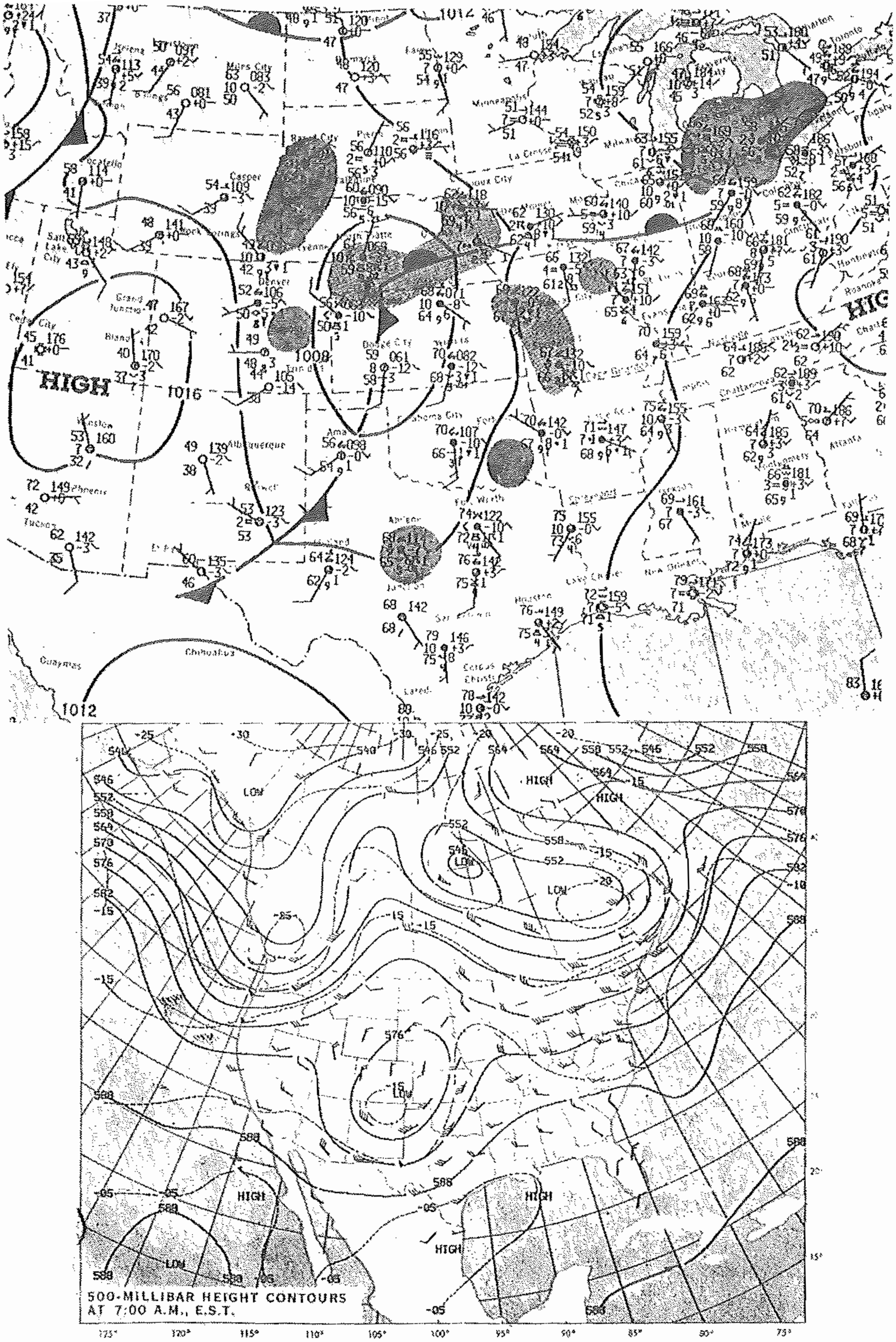
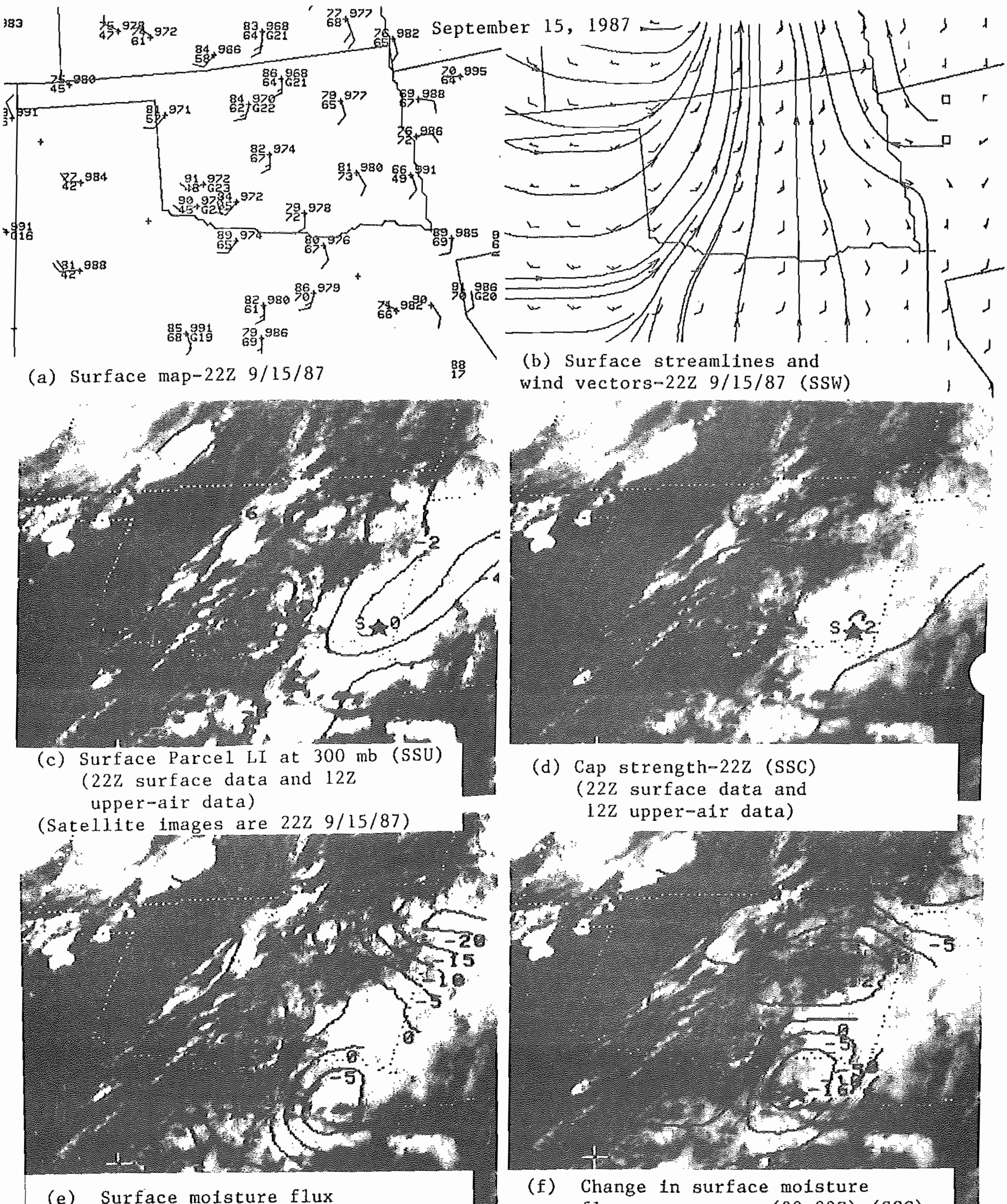


Figure 33 Surface and 500 mb maps for 12Z September 15, 1987



(a) Surface map-22Z 9/15/87

(b) Surface streamlines and wind vectors-22Z 9/15/87 (SSW)

(c) Surface Parcel LI at 300 mb (SSU) (22Z surface data and 12Z upper-air data)

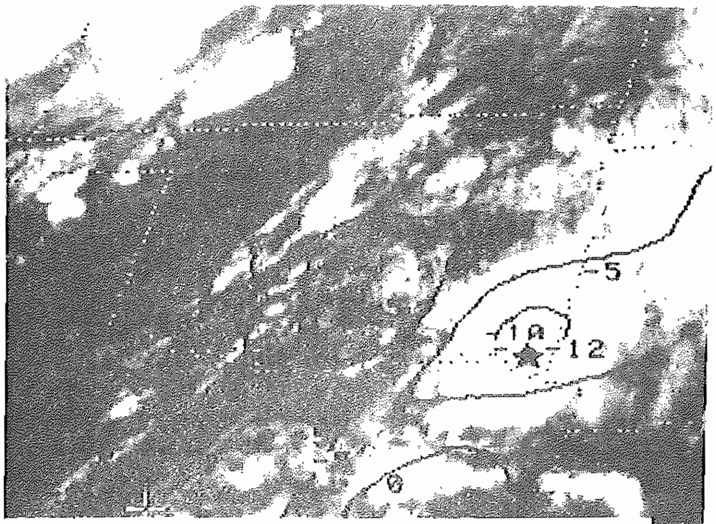
(d) Cap strength-22Z (SSC) (22Z surface data and 12Z upper-air data)

(Satellite images are 22Z 9/15/87)

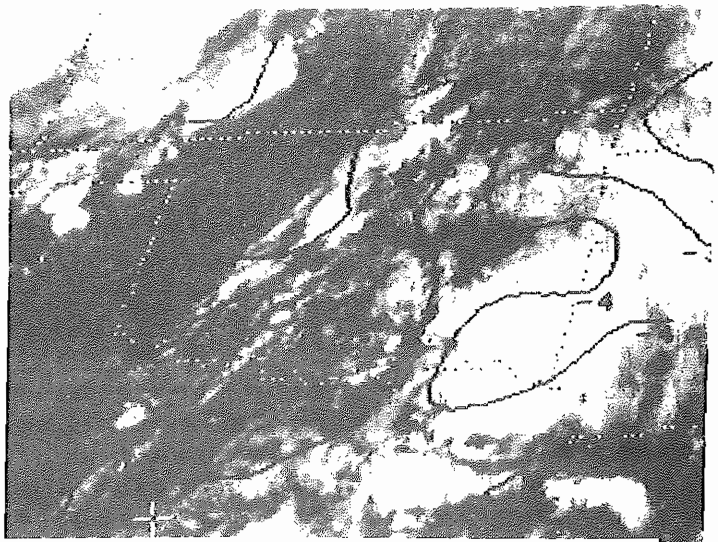
(e) Surface moisture flux convergence-22Z (SMC)

(f) Change in surface moisture flux convergence-(20-22Z) (SCC)

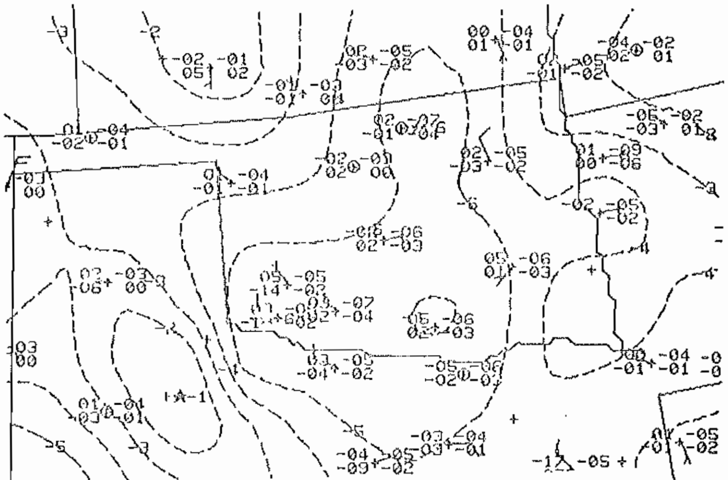
Figure 34



(g) Change in mixing ratio-
(20-22Z) (SQC) 9/15/87



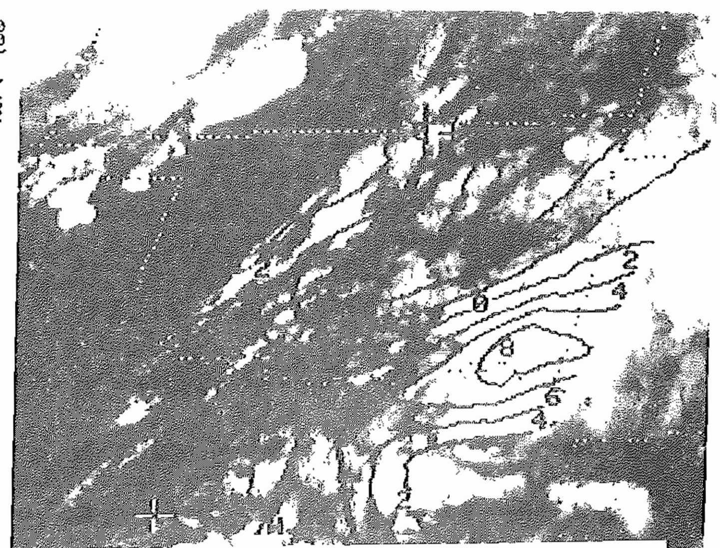
(h) Total altimeter change-
(20-22Z) (SAC) 9/15/87



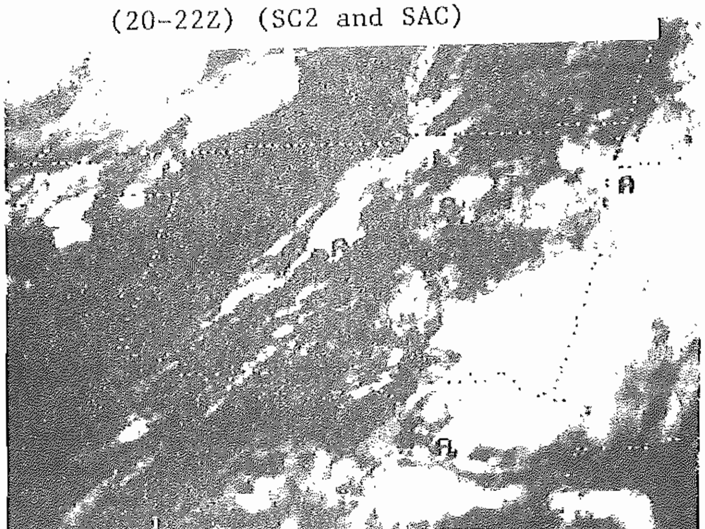
(i) Station change chart and
total alimeter change-
(20-22Z) (SC2 and SAC)

20Z 091587 TO 22Z 091587 CHANGES
-03 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
CNM 06
HMN 06
F39 06
FYV 09
POE 06
ADM 06
FSI 07
MLC 06
OKC 06
PNC 07
CLL 06
COT 06
DRT 06
LRD 06

(j) Stations with pressure fall
of 6 hundredths inch-(20-22Z)
(SPC)



(k) Average Theta advection
(20-22Z) (SAA)



(l) Severe reports 9/15/87
A=Severe hail
W=Severe wind
G=severe wind gust.

3.7 September 17, 1987

This was a day with very unstable air in place over the eastern section of north Texas as seen in the ADAP Lifted indices. Also, the air over east Texas is uncapped. Weak moisture flux convergence is present and increasing slightly. However, several things work against severe convection in this case. Notice in the two graphics showing mixing ratio change (SQC) that very significant mixing ratio decreases are seen from 18-20Z and from 20-22Z. Also, the most significant pressure change is a rather large fall center over southwest Texas near the edge of the grid. Although the decision tree could show a moderate potential, this case shows how important the low level moisture is and that a more logical path (considering moisture) would give a weak potential. No severe weather was reported over north Texas during the afternoon.

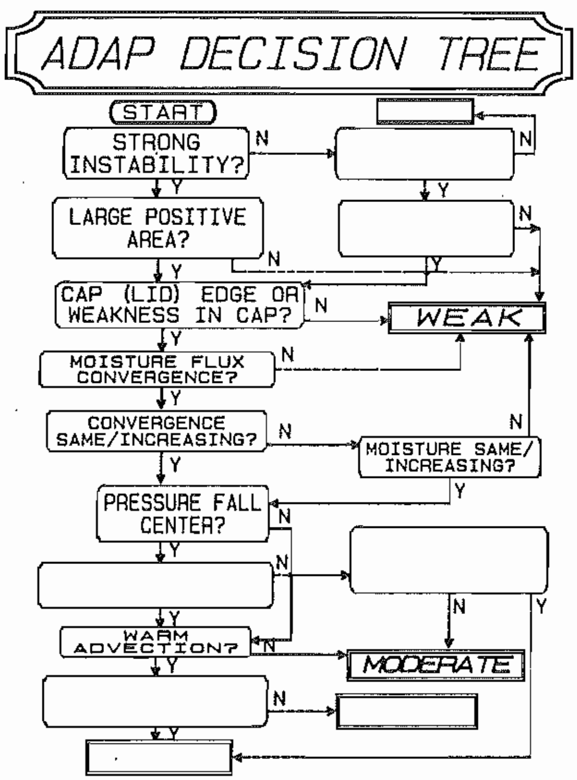


Figure 35 ADAP Decision Tree for September 17, 1987

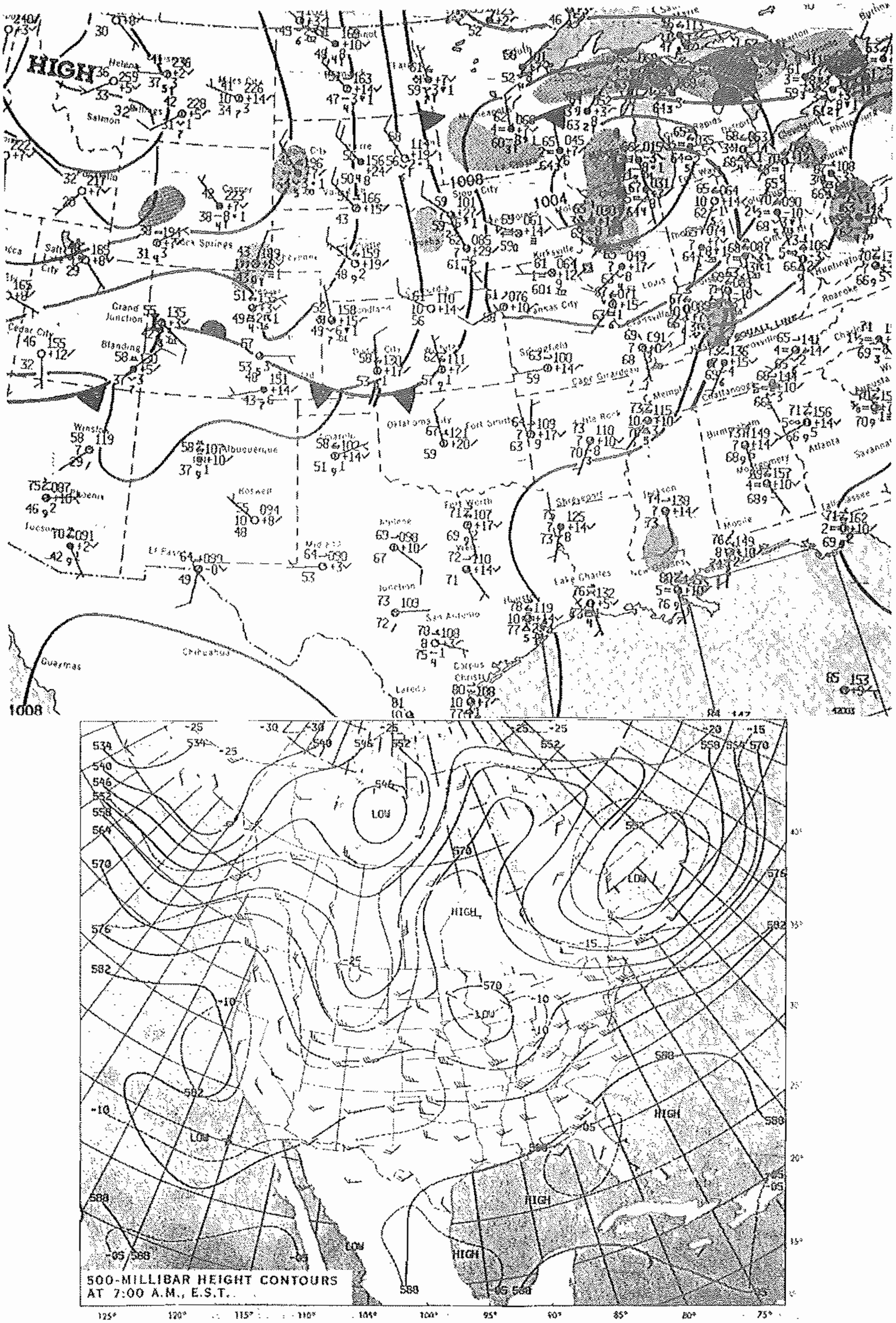
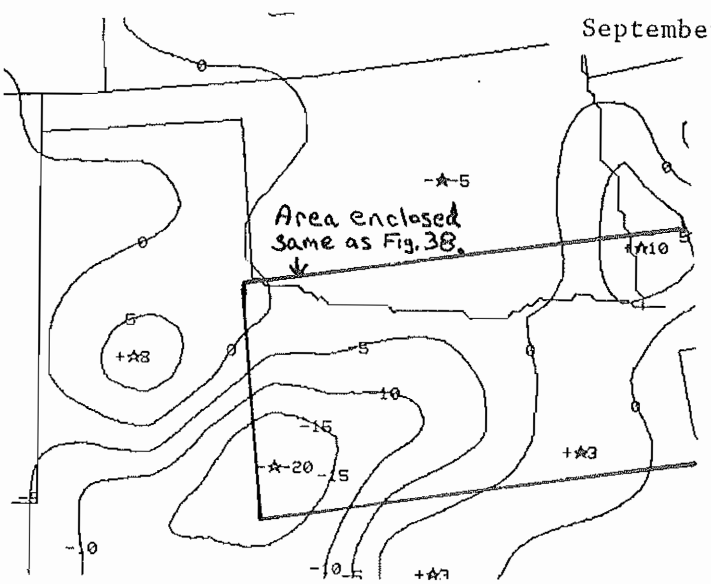
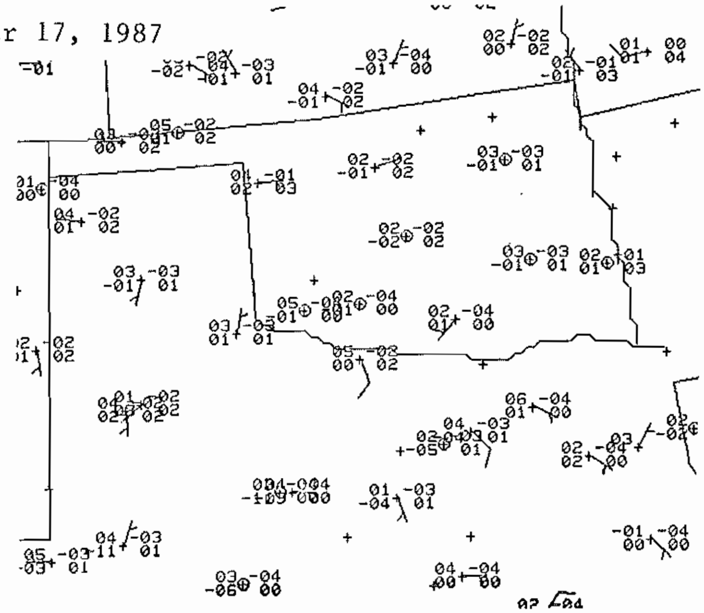


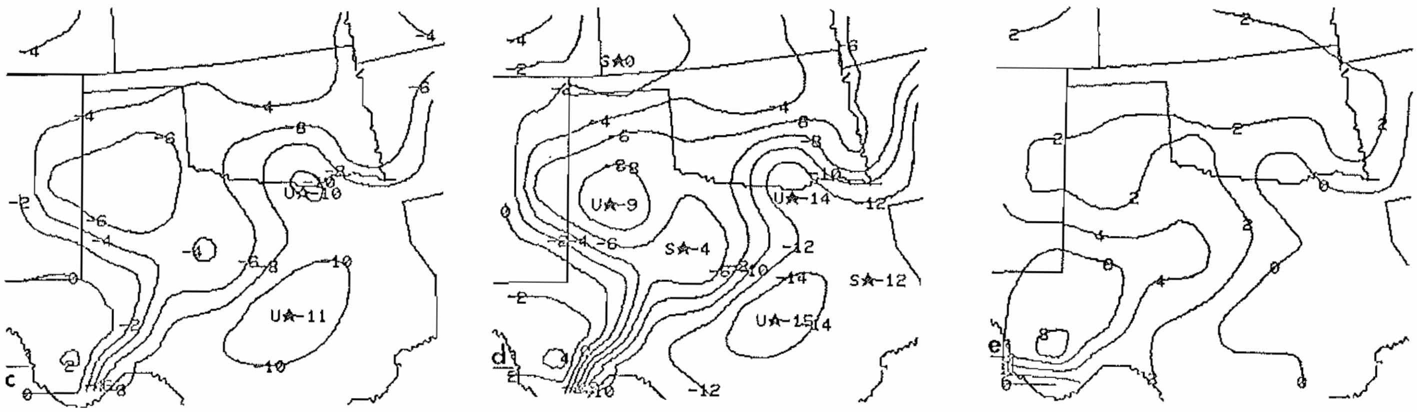
Figure 36 Surface and 500 mb maps for 12Z September 17, 1987



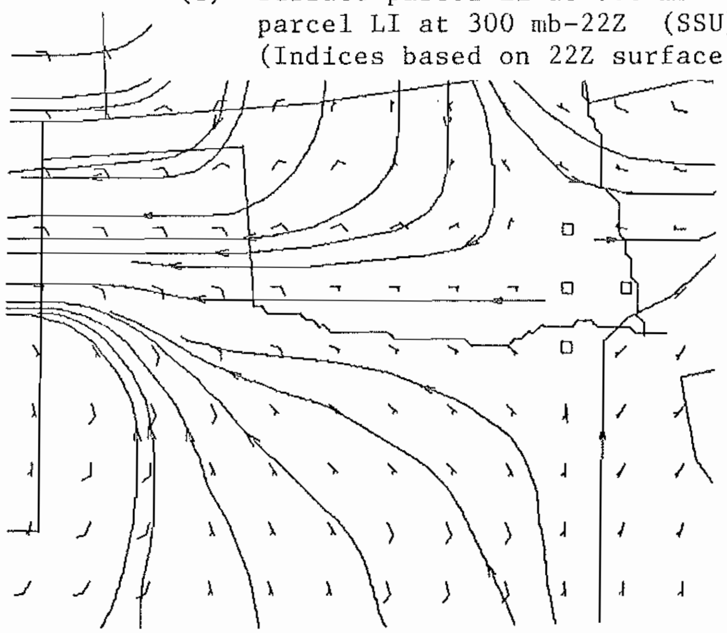
(a) Surface mixing ratio change-(18-20Z) (g/kg/hr*10) (SQC)



(b) Station change chart-(18-20Z) (SC2)

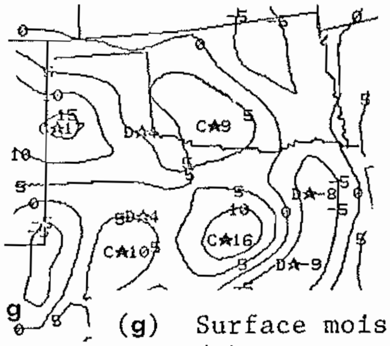


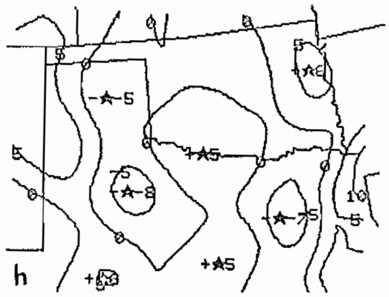
(c) Surface parcel Li at 500 mb-22Z 9/17/87 (SSL) (d) Surface parcel LI at 300 mb-22Z (SSU) (e) Cap strength-22Z (SSC) (Indices based on 22Z surface and 12Z upper-air data)

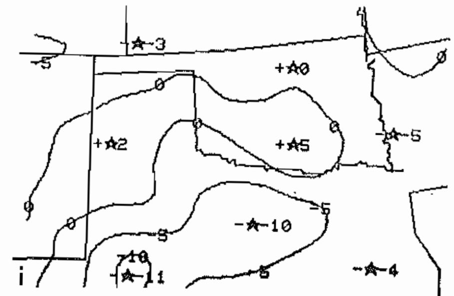


(f) Surface streamlines and and wind vectors-22Z (SSW)

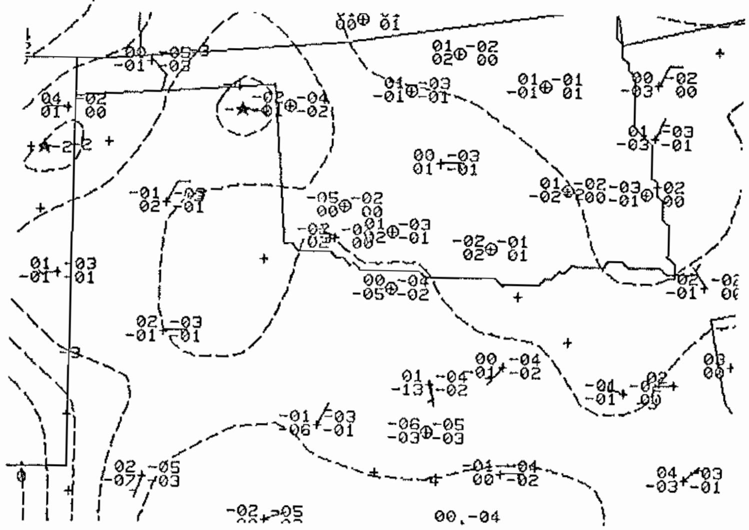
Figure 37





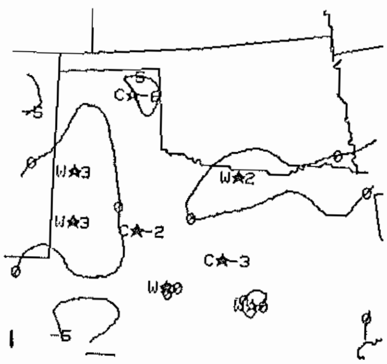


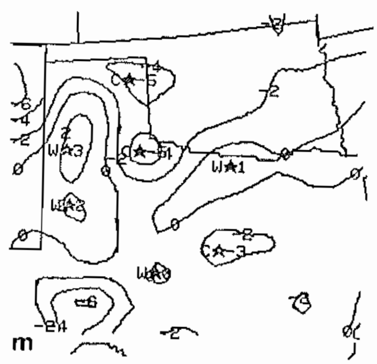
(g) Surface moisture flux convergence-22Z 9/17/87 (SMC),
(h) Changes in surface moisture flux convergence-(20-22Z)
(SCC) and (i) Changes in surface mixing ratio-(20-22Z) (SQC)
(all in units of g/kg/hr*10)



(k) Station pressure falls of 6 hundredths or more (20-22Z) (SPC)

(j) Station change chart-(20-22Z) (SC2) and
Total altimeter change-(20-22Z) (SAC)





(l) Theta Advection-(22Z) (STA)
(m) Average Theta advection-(20-22Z) (SAA)

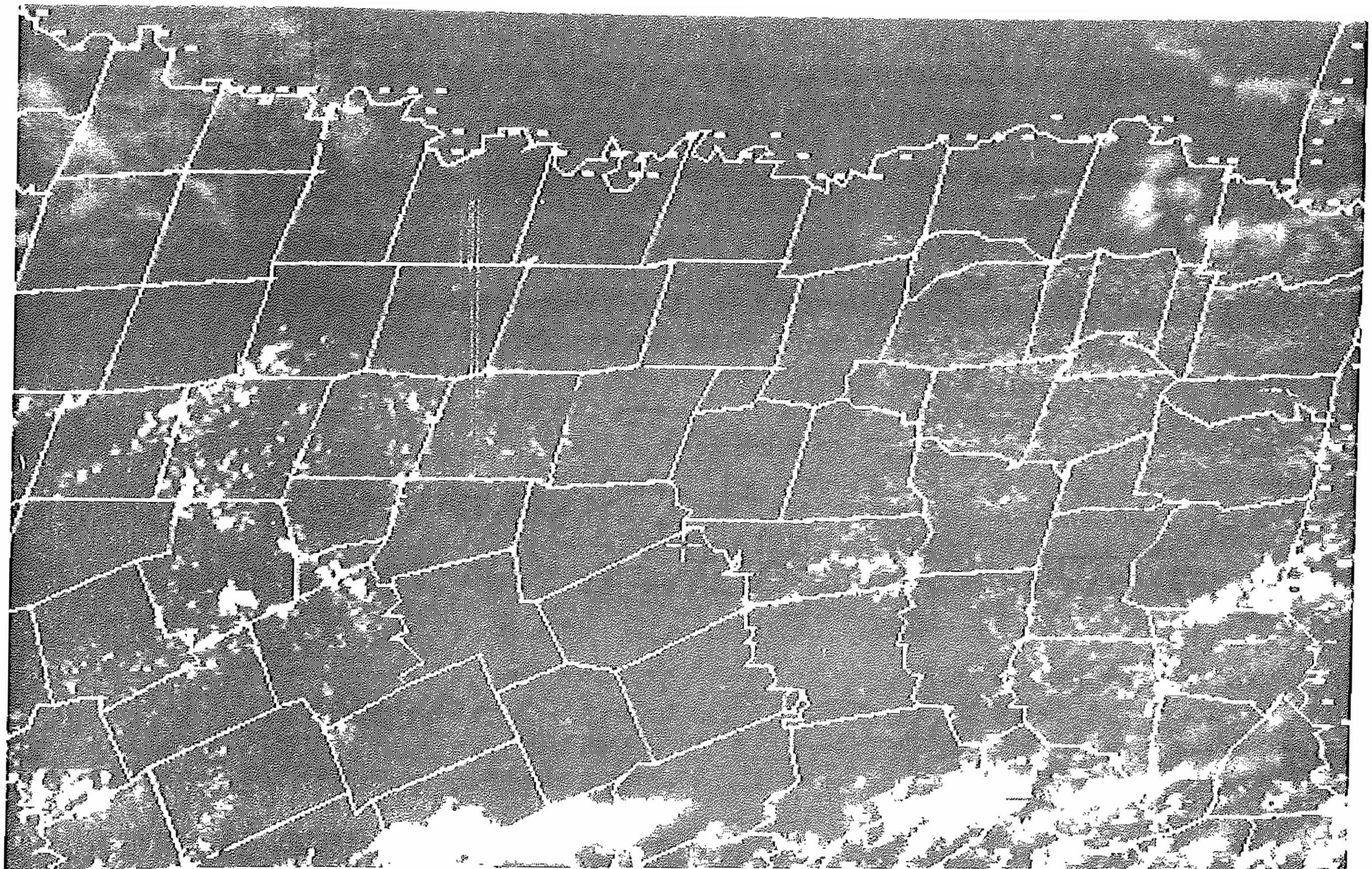
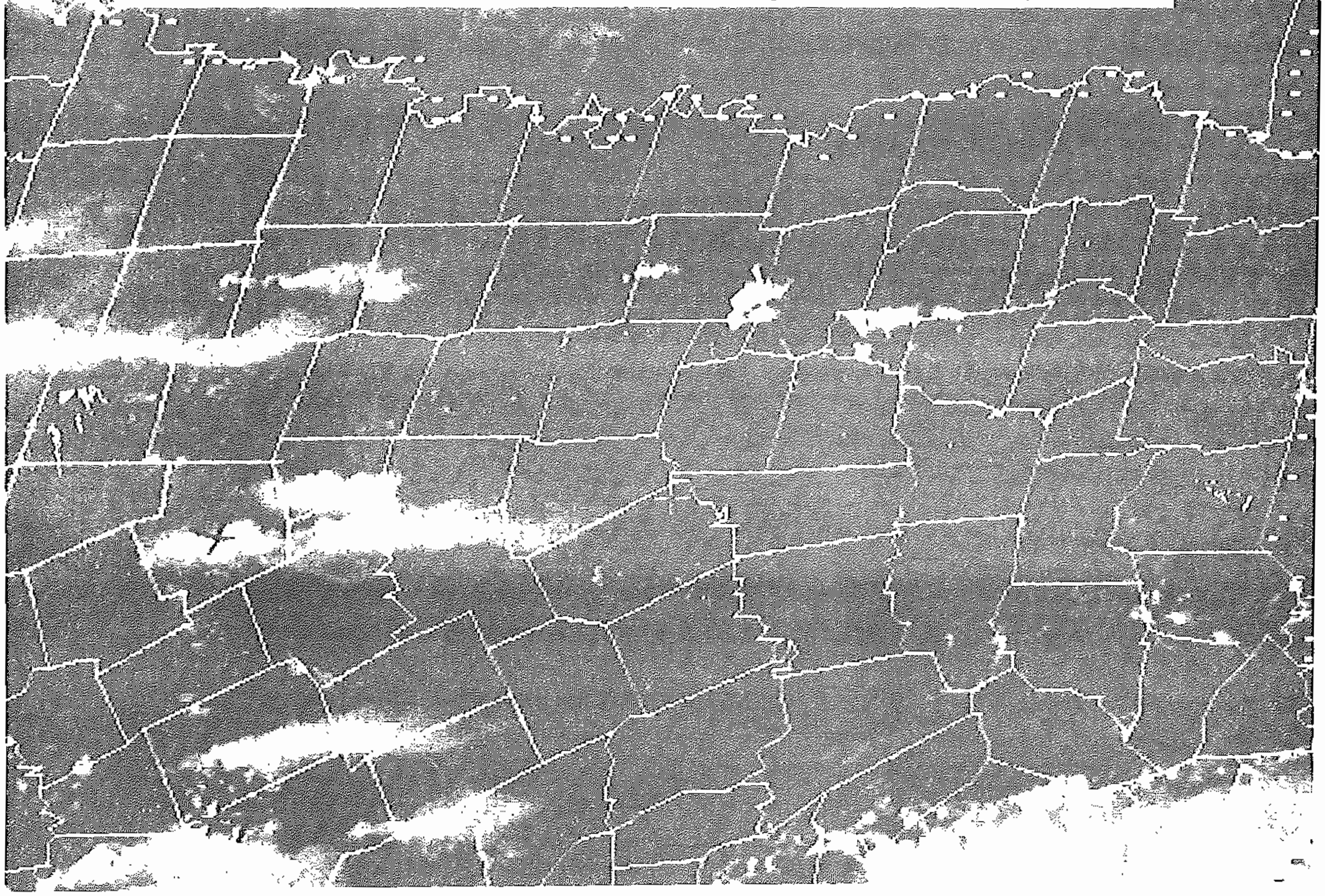


Figure 38 (a) (top) Visual satellite image covering north Texas counties at 1931Z 9/17/87
(b) (bottom) same as (a) except at 2131Z 9/17/87



3.8 October 30, 1987

Surface lifted indices from ADAP at 500 mb were moderately unstable (-4C). The -6C LI at 300 mb would likely be sufficient to consider the case to have strong instability. Based on 23Z surface data and 12Z upper-air data, the cap appears to sufficiently strong to prevent convection. When the case was rerun with 00Z data, the cap appears to have weakened a little. (Note that as a result of this case, the contour interval for the cap strength was changed to every degree C to highlight the features better.) When originally run, the case was missing data for Altus (LTS) at 23Z. As it turns out, this was an extremely crucial observation. When the case was rerun again (with LTS), the weakest point in the cap as diagnosed by ADAP was over southwestern Oklahoma. The dew point increased 5 degrees F at LTS from 21 to 23Z. This turned out to be very significant. Very weak pressure falls were noted over southwest Oklahoma. The small area of rises near Childress (CDS) is likely due to the fact that that station had not reported that hour and it was near a data-void area. Severe convection formed and produced hail over a very small portion of the state for several hours. Convergence and the cap likely played a major roll in allowing the convection to remain severe for several hours in southwest Oklahoma.

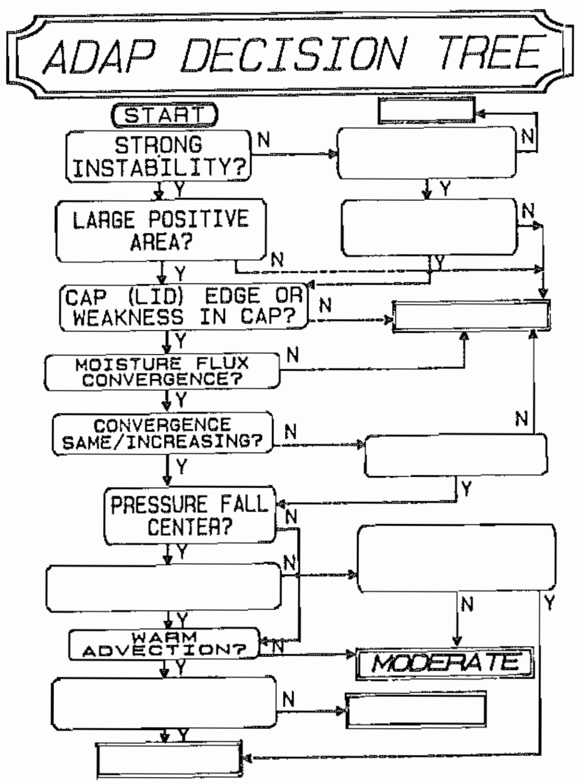


Figure 39 ADAP Decision Tree for October 30, 1987

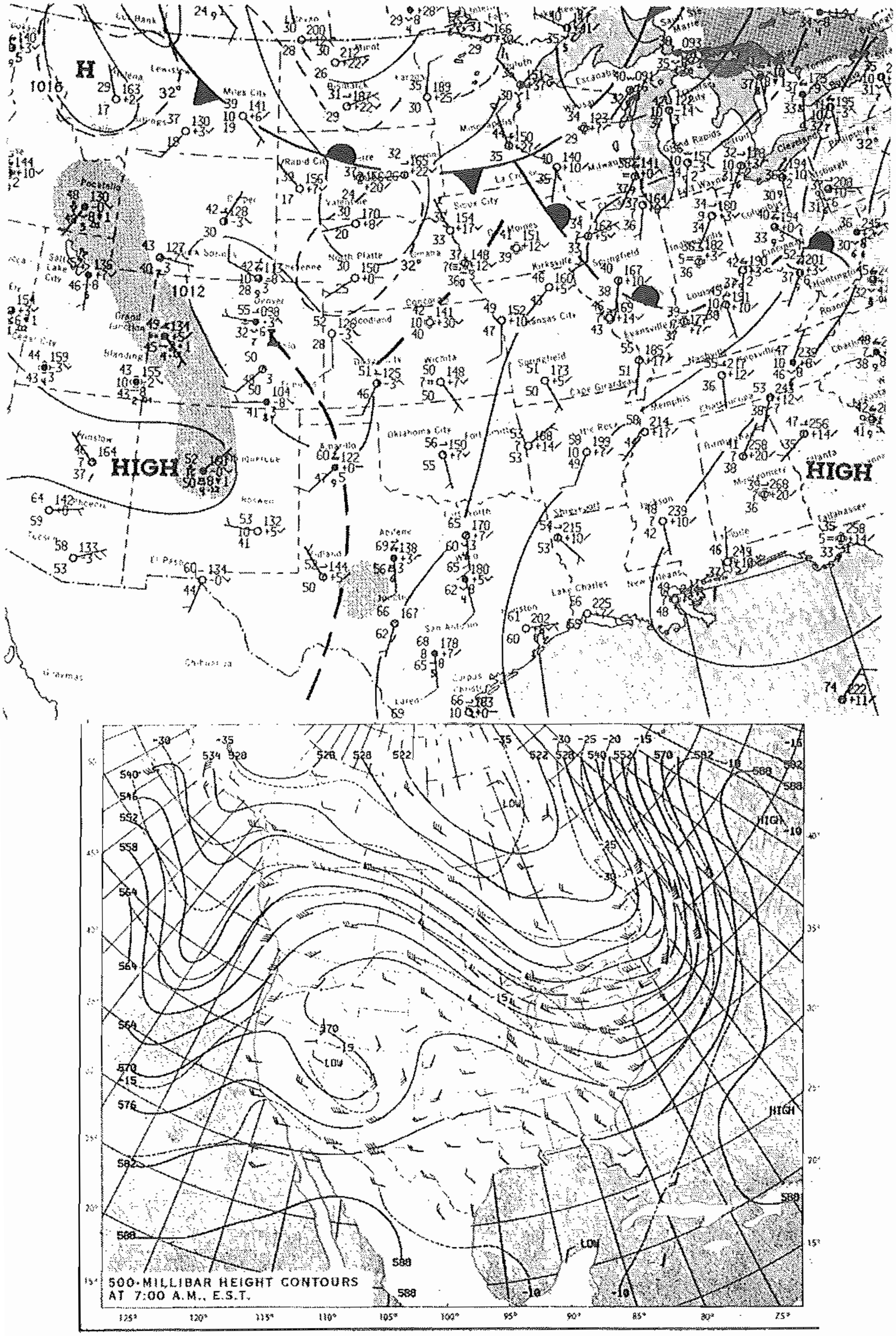
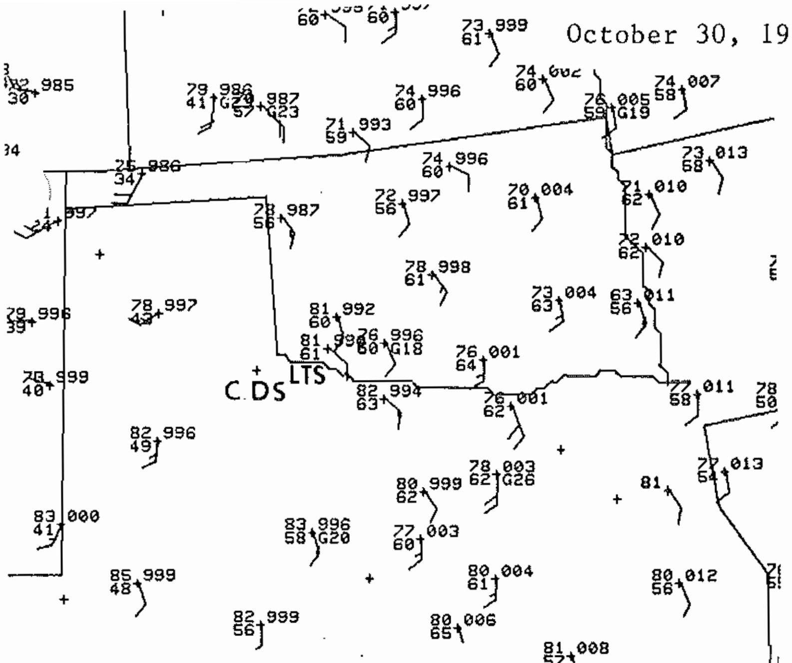
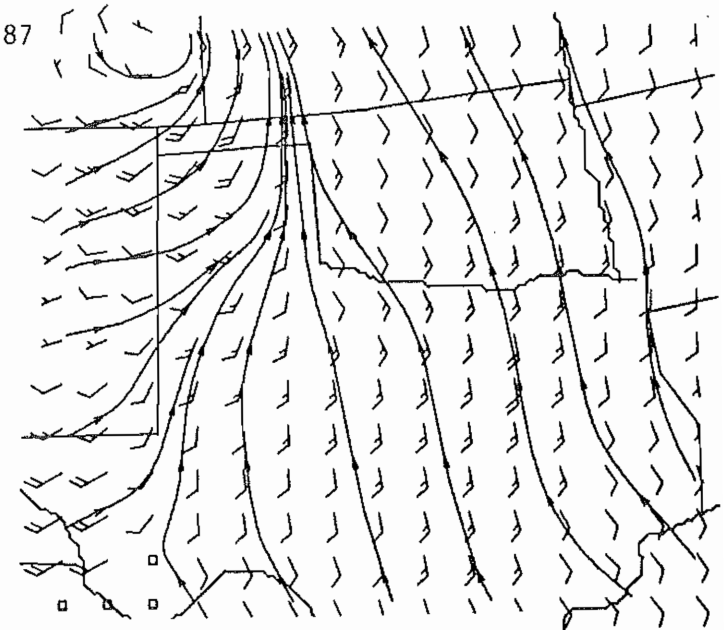


Figure 40 Surface and 500 mb maps for 12Z October 30, 1987

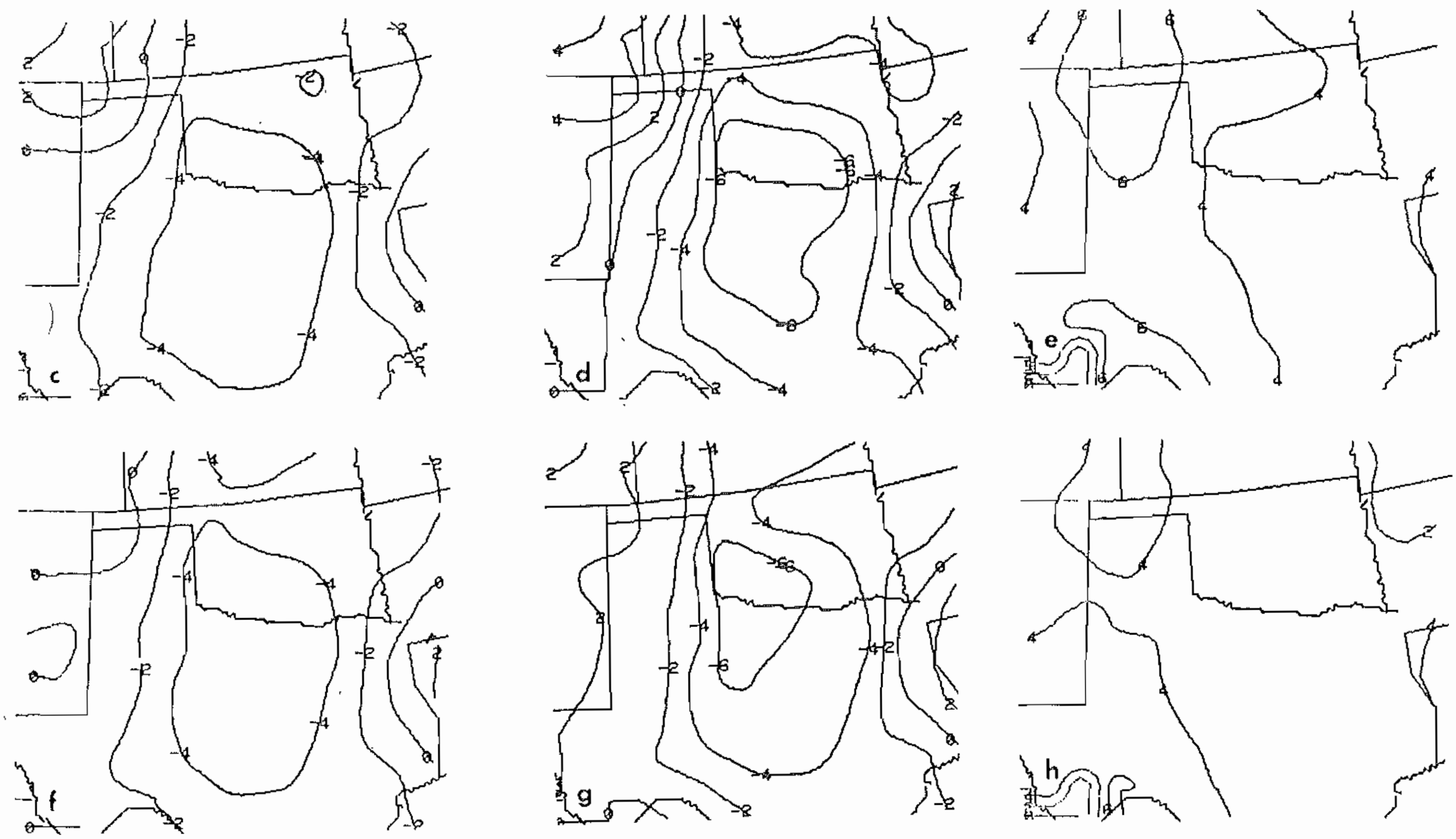
October 30, 1987

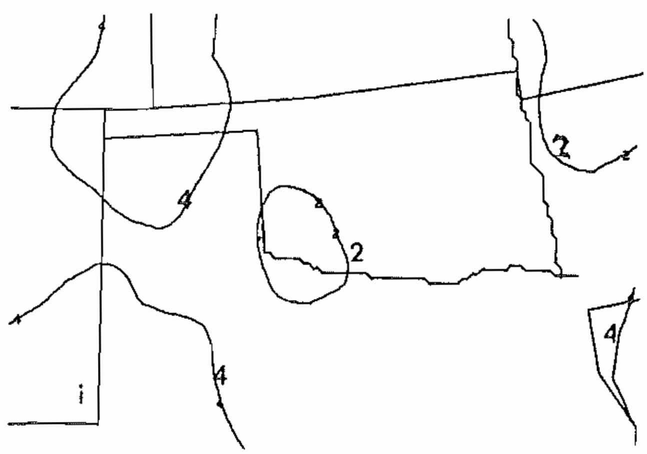


(a) Surface map-23Z 10/30/87



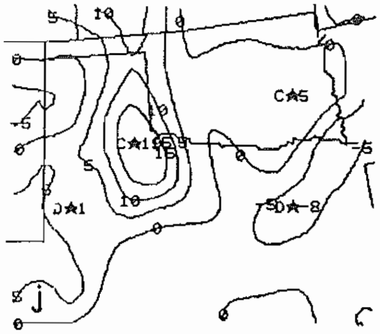
(b) Surface Streamlines and wind vectors-23Z 10/30/87 (SSW)

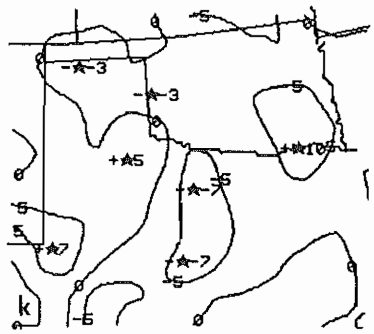


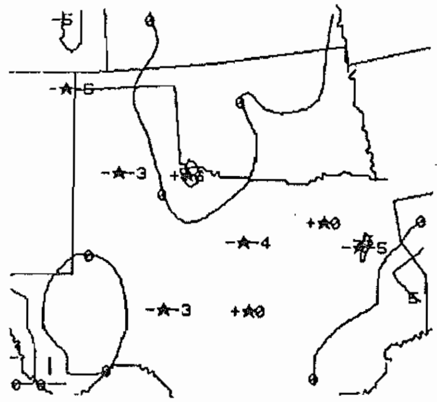


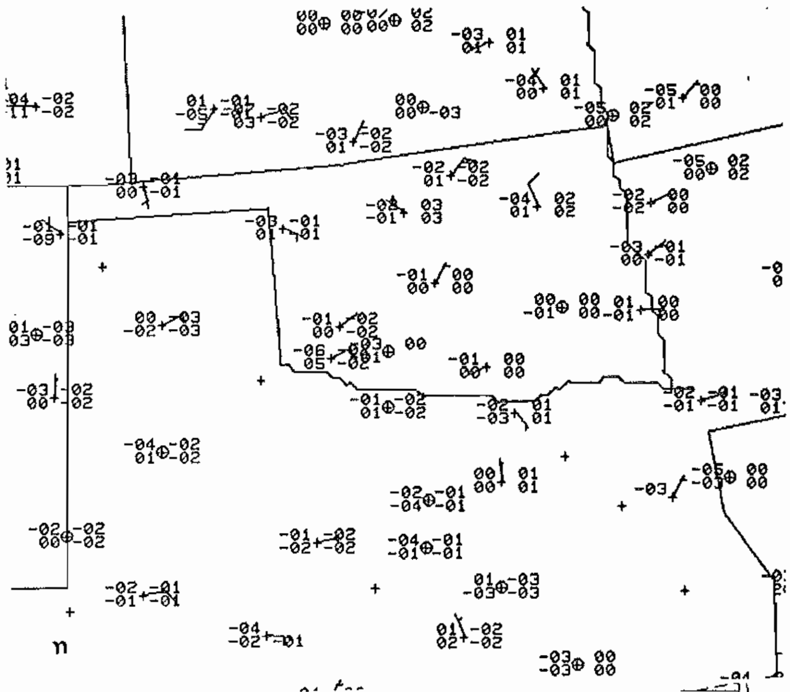
(c) Surface parcel LI at 500 mb-23Z (SSL)
(d) Surface parcel LI at 300 mb-23Z (SSU)
(e) Cap Strength-23Z (SSC) (indices in c, d and e based on 23Z surface (missing LTS) and 12Z upper-air) (f) (g) and (h) same as c, d and e except using 00Z upper-air and (i)same as (h) except adding LTS 23Z surface observation.

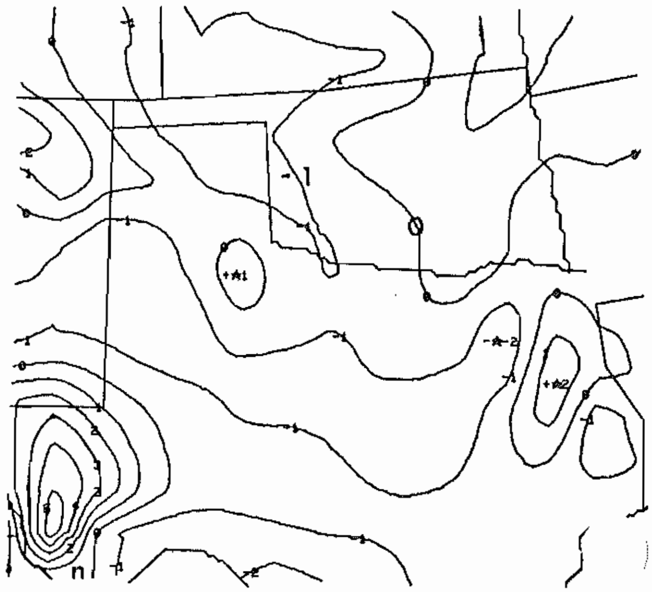
Figure 41





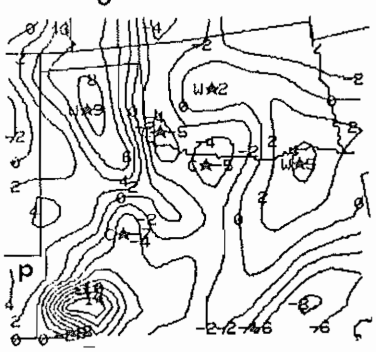


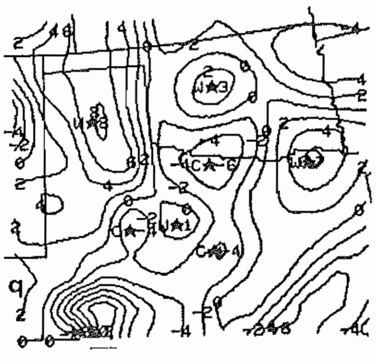


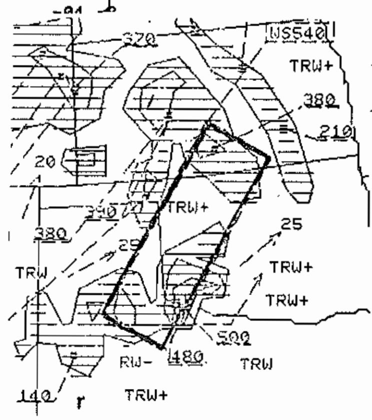


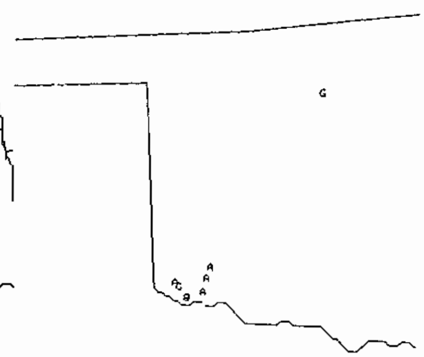
21Z 103087 TO 23Z 103087 CHANGES
00 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
NONE

o









(j) Surface moisture flux convergence-23Z (SMC)
(k) Changes in surface moisture flux convergence-(21-23Z) (SCC)
(l) Changes in surface mixing ratio-(21-23Z) (SQC)
(m) Stations changes (21-23Z) 10/30/87 (SC2)
(n) Total altimeter change-(21-23Z) (SAC)
(o) Stations with pressure fall of 6 hundredths or more-(21-23Z) (SPC)
(p) Theta advection-23Z (STA)
(q) Average Theta advection-(21-23Z) (SAA)
(r) Radar reports for 0035Z 10/31/87
(s) Severe reports for 10/30/87
A=severe hail; G=severe wind gust.

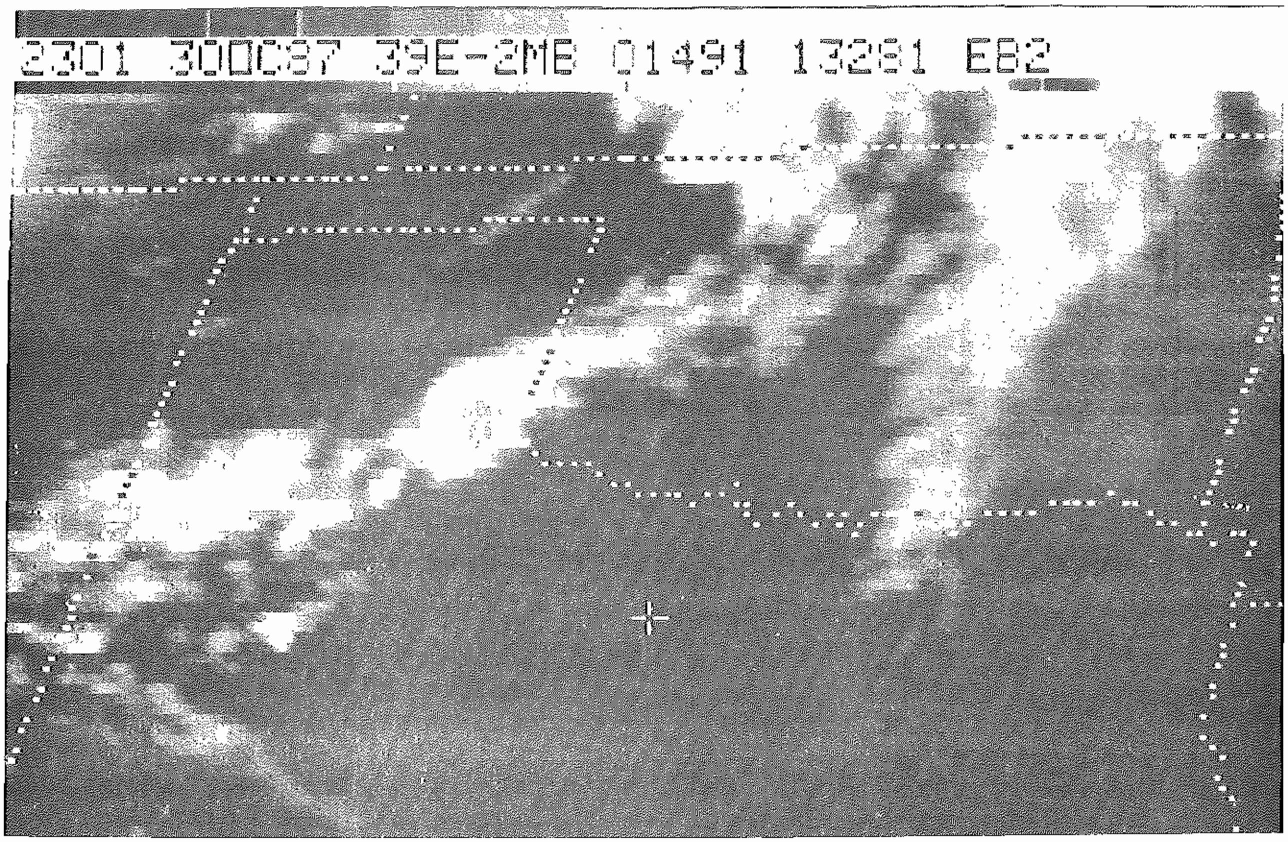
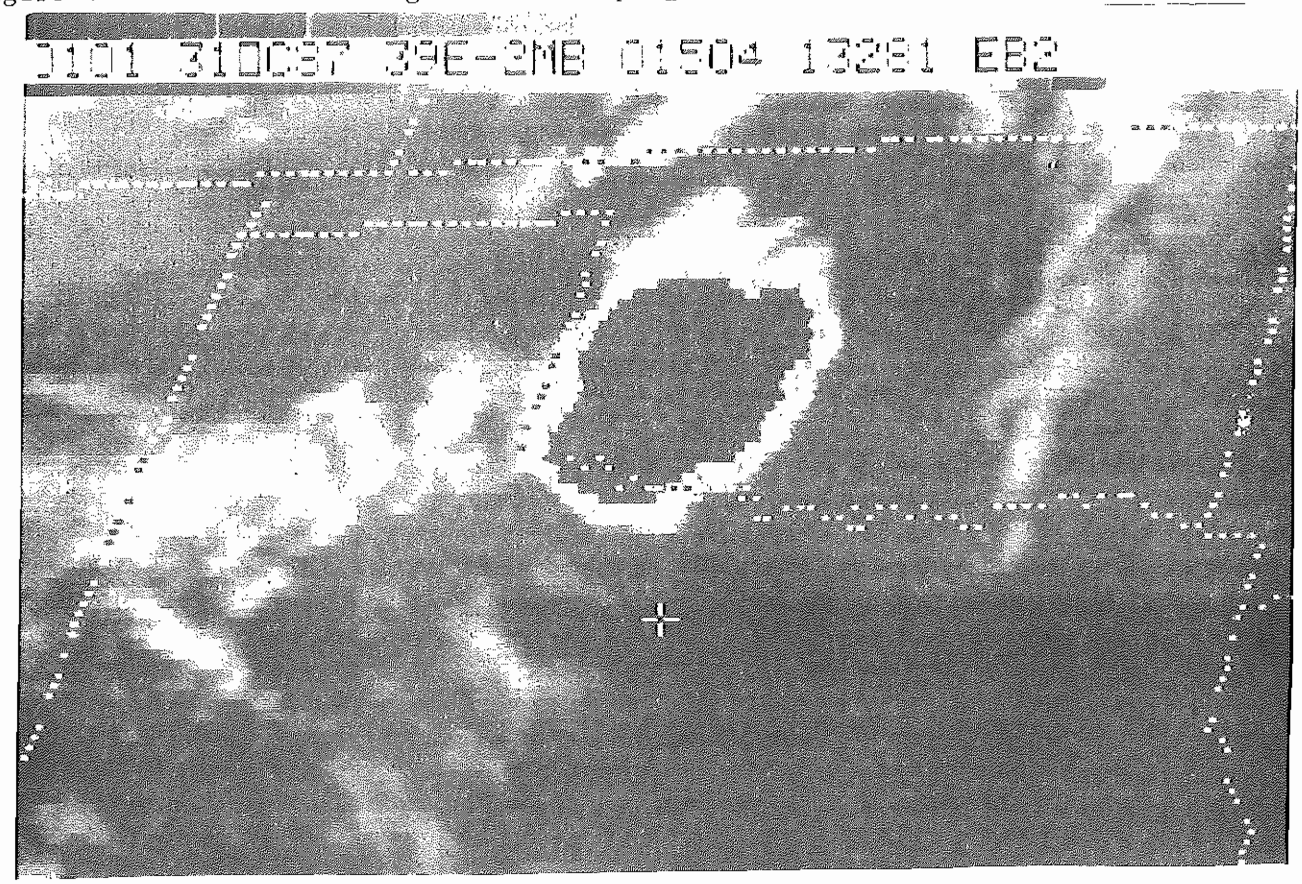


Figure 42 IR satellite images of developing storm over southwest Oklahoma 10/30/87



3.9 November 16, 1987 (Part 1 15-17Z)

The ADAP lifted indices indicated very unstable air over Louisiana and southern Mississippi with the absence of a capping inversion. Moisture flux convergence was very strong and a strong increase in the convergence accompanied by an increase in moisture were present over west central Mississippi. Notice the station change chart (SC2) and the extreme changes from 15-17Z at Jackson (JAN). The pressure fall center at Jackson was also shown in the grid point altimeter change chart (SAC). Finally, very strong warm advection was present over this area. The ADAP Decision Tree illustrates this case of an extreme potential. Several tornadoes were reported with some wind damage and even flash flooding from 17 to 18Z.

3.10 November 16, 1987 (Part 2 18-20Z)

Very unstable air continued over southern Mississippi with the absence of a capping inversion as noted earlier. Surface moisture flux convergence remains strong in west-central Mississippi along with a very significant increase in the mixing ratio. One strong pressure fall center was noted in south-central Mississippi and one in northeastern Mississippi. Warm advection was extremely strong in this case. Again, the ADAP decision tree would indicate the extreme potential existed and severe weather was reported.

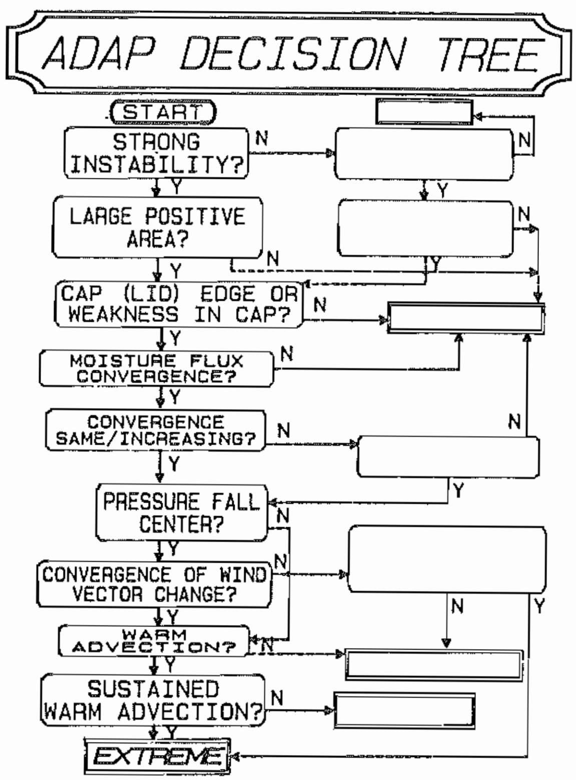


Figure 43 ADAP Decision Tree for 11/16/87
(15-17Z and 18-20Z)

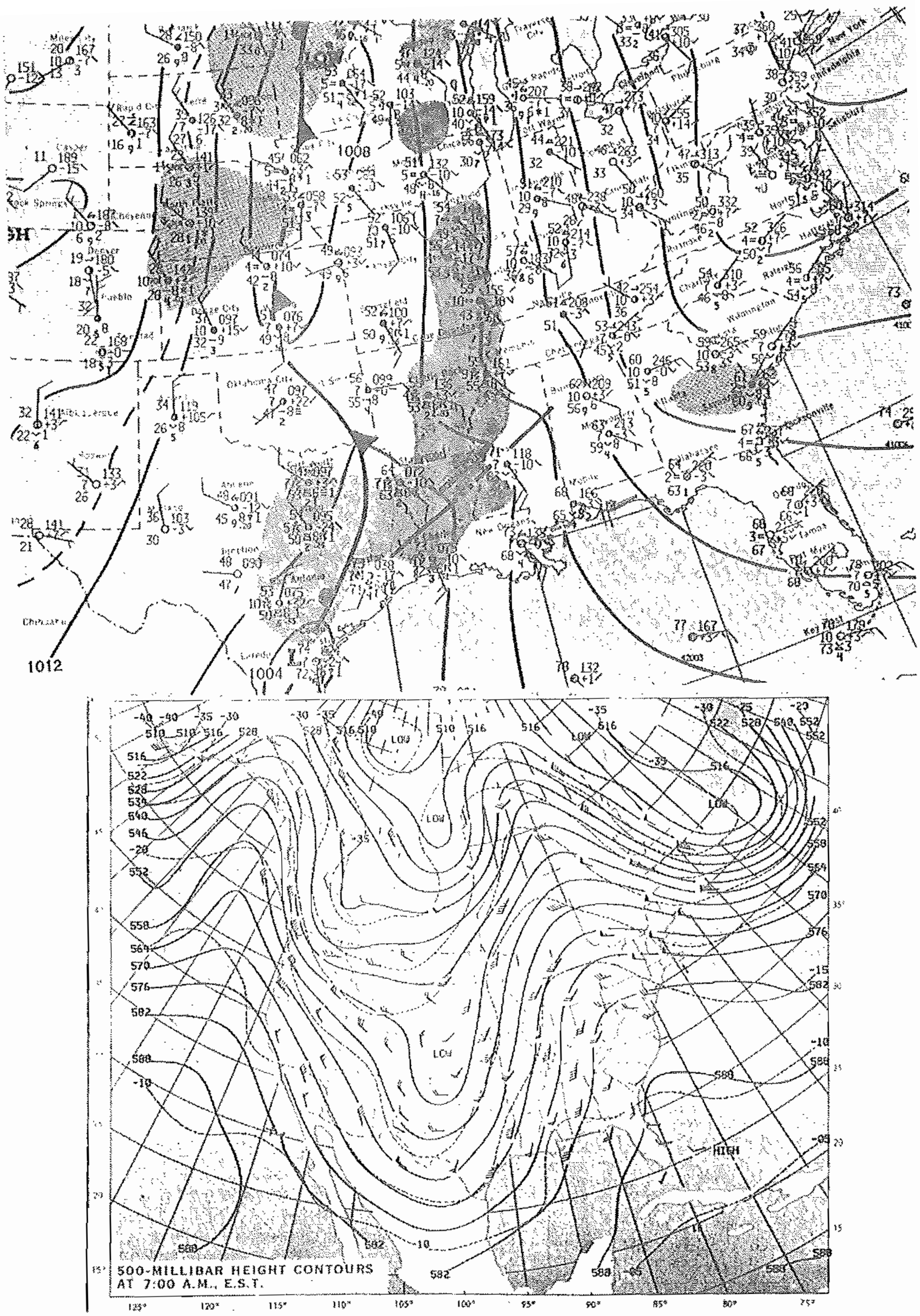
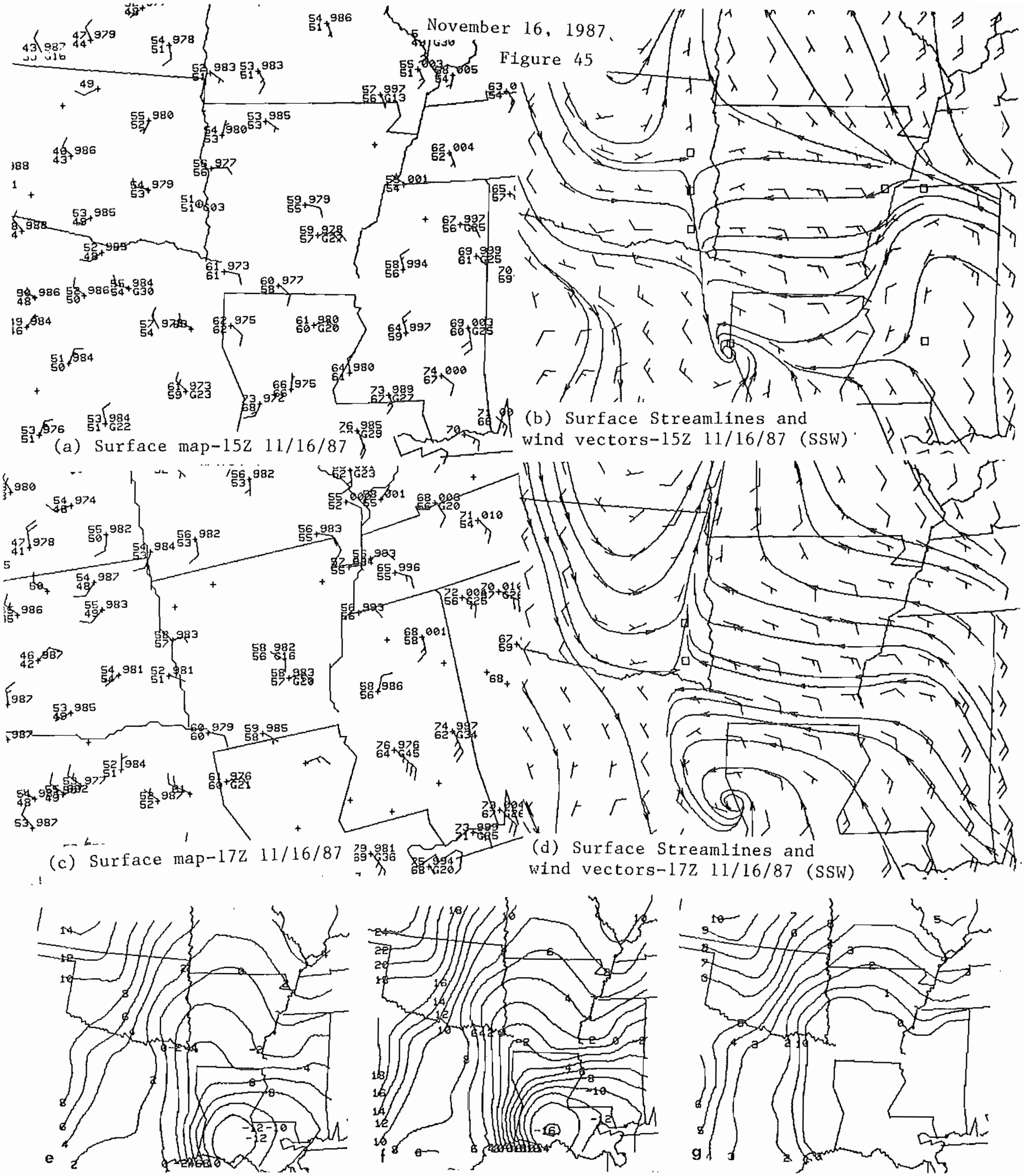


Figure 44 Surface and 500 mb maps for 12Z 11/16/87.

November 16, 1987

Figure 45



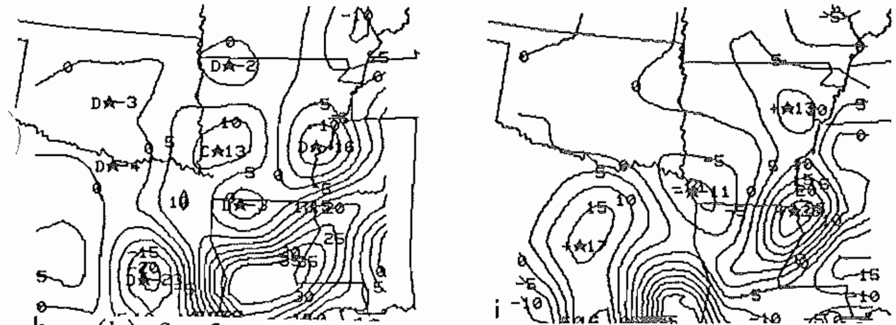
(a) Surface map-15Z 11/16/87

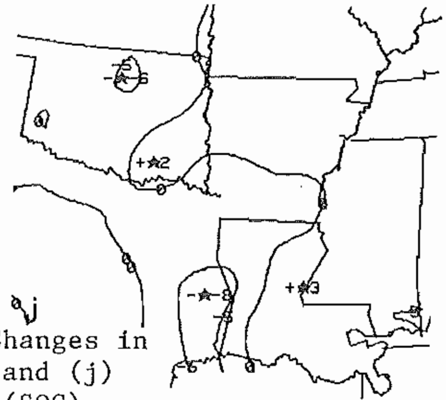
(b) Surface Streamlines and wind vectors-15Z 11/16/87 (SSW)

(c) Surface map-17Z 11/16/87

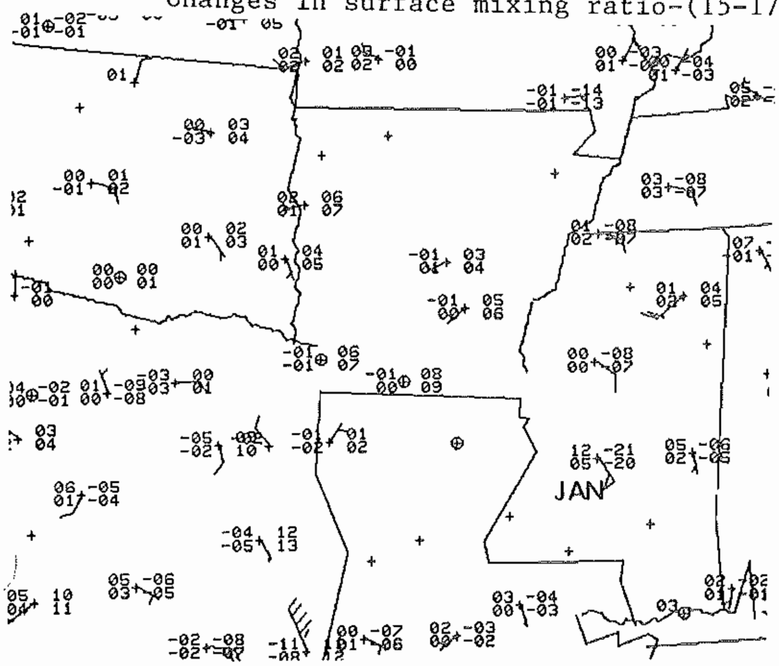
(d) Surface Streamlines and wind vectors-17Z 11/16/87 (SSW)

(e) Surface parcel LI at 500 mb-17Z (SSL) (f) Surface parcel LI at 300 mb-17Z (SSU) (g) Cap strength-17Z 11/16/87 (SSC) (Note: Indices based on 17Z surface data and 12Z upper-air data.)





(h) Surface moisture flux convergence-17Z (SMC) (i) Changes in surface moisture flux convergence-(15-17Z) (SCC) and (j) Changes in surface mixing ratio-(15-17Z) 11/16/87(SQC)



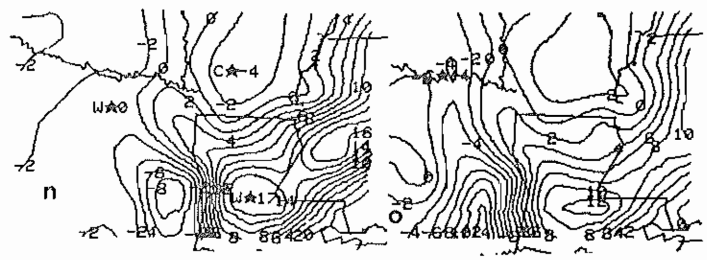
(k) Station changes-(15-17Z) 11/16/87 (SC2)

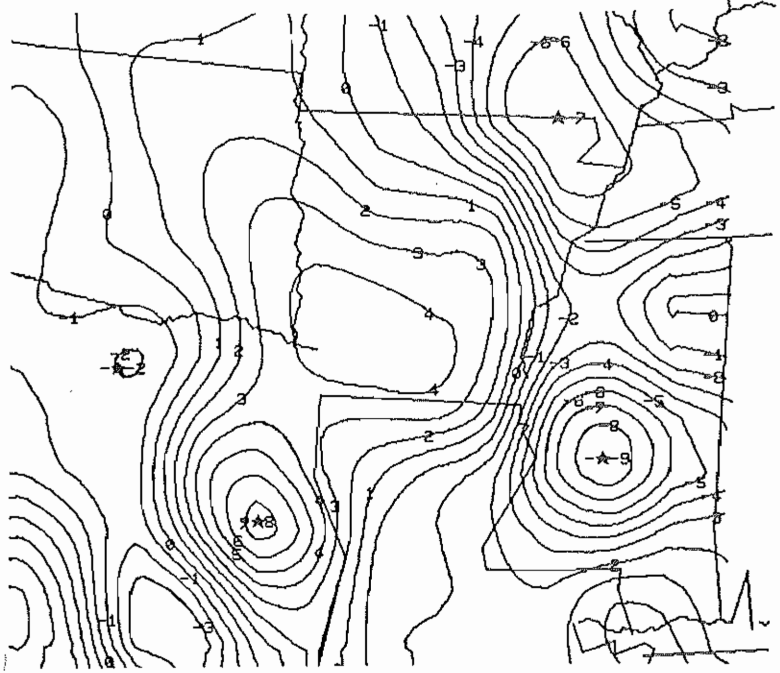
```
15Z 111687 TO 17Z 111687 CHANGES
 -01 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
CSG 06
DFW 09
GWO 08
JAN 21
MEI 06
BYH 07
MEM 08
MKL 08
TYS 07
LCH 07
CLL 06
IAH 08
LEX 06
P02 14
STL 08

TOTAL=  15
```

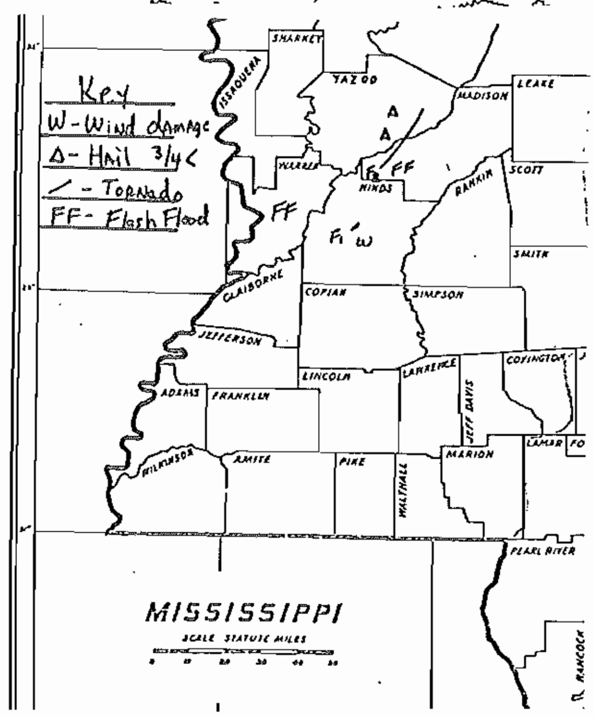
(m) Stations with pressure fall of 6 hundredths or more (15-17Z) 11/16/87 (SPC)

(n) Theta Advection-17Z (STA)
(o) Avg. Theta advection-(15-17Z) (SAA)



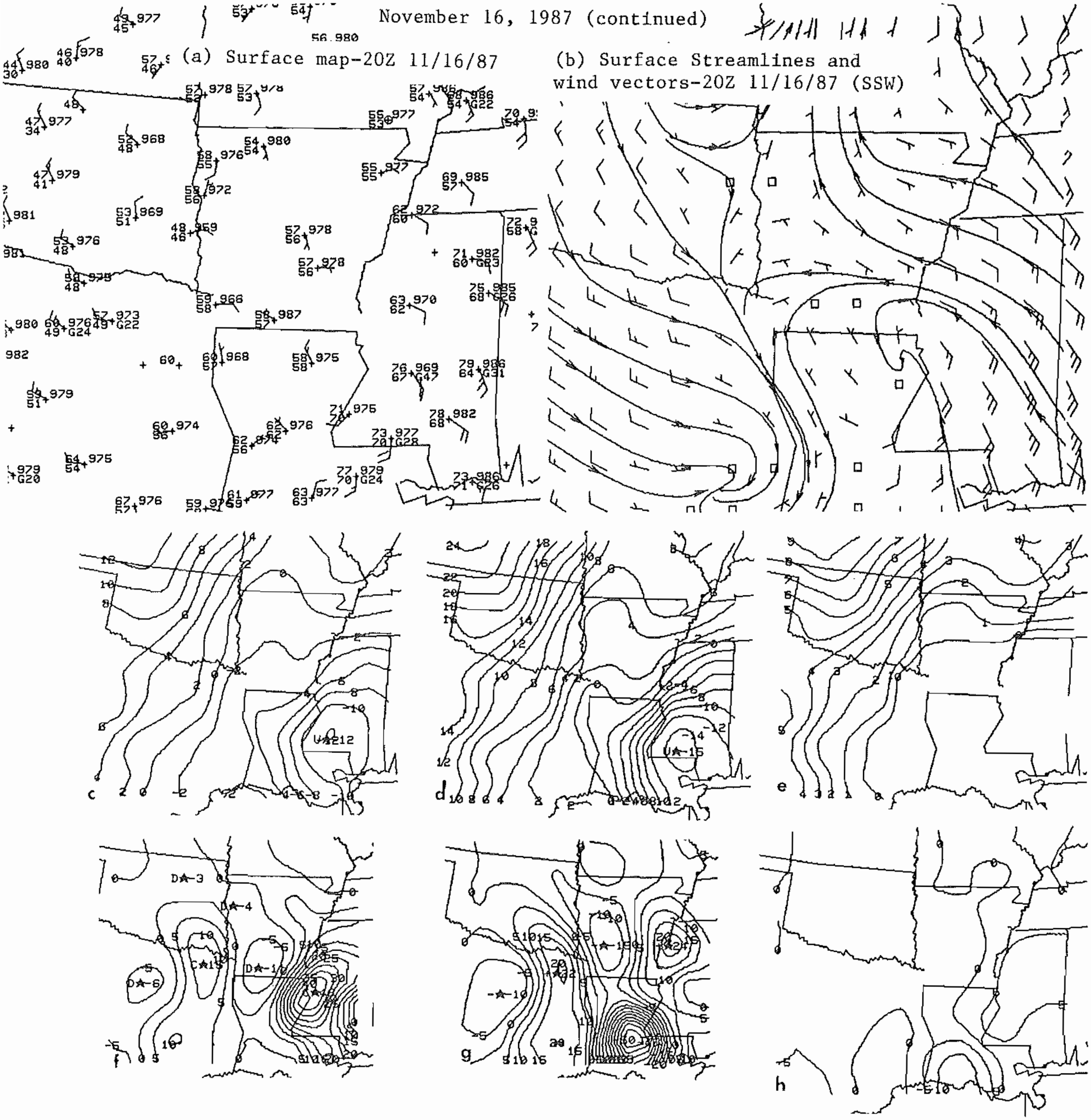


(l) Total altimeter change-(15-17Z) (SAC)



(p) Preliminary damage from 17-18Z 11/16/87 over Mississippi

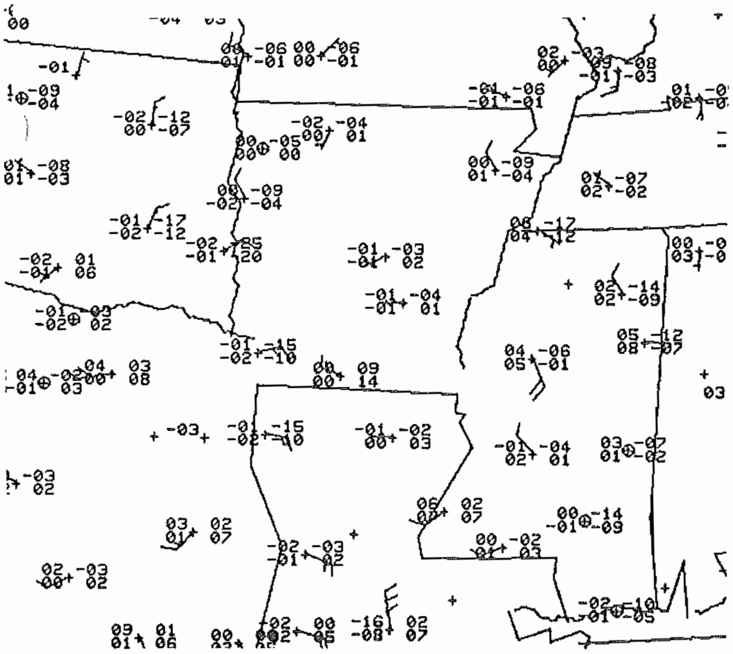
November 16, 1987 (continued)

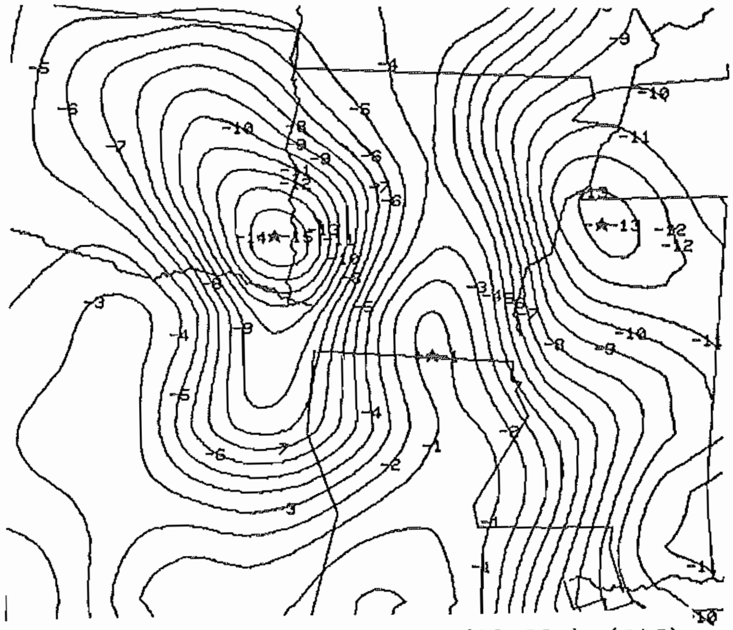


(c) Surface parcel LI at 500 mb-20Z (SSL) (d) Surface parcel LI at 300 mb-20Z (SSU) (e) Cap strength-20Z (SSC) (Note: Indices based on 20Z surface and 12Z upper-air data.) (f) Surface moisture flux convergence-20Z (SMC) (g) Changes in surface moisture flux convergence-(18-20Z) (SCC) and (h) Changes in surface mixing ratio-(18-20Z) (SQC)

Figure 46

(i) Station changes-(18-20Z) 11/16/87 (SC2)

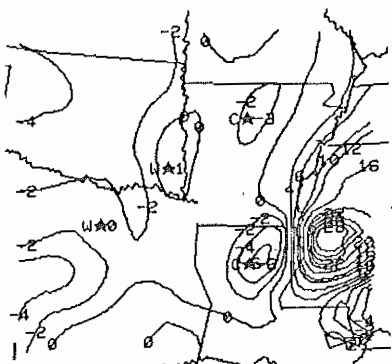




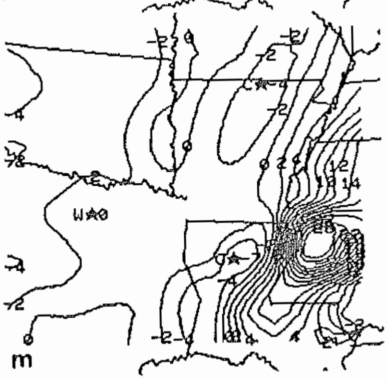
(j) Total altimeter change-(18-20Z) (SAC)

```
18Z 111687 TO 20Z 111687 CHANGES
 -05 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
ABQ 07 LHX 07 SHV 15
CNM 06 PUB 07 BVO 07
LVS 06 TAD 06 END 09
ROW 07 ABI 06 HBR 06
SAF 07 DYS 06 MLC 17
ABY 08 SPS 06 OKC 08
AGS 06 BIX 10 PGO 25
AHN 06 CBM 12 TUL 12
AMG 06 GWO 06 CLT 11
ATL 07 MEI 07 GSO 06
AYS 06 PIB 14 ALI 06
CSG 08 TUP 14 BRO 06
MCN 08 INK 07 DRT 06
VLD 07 SJT 06 LRD 06
ANB 06 FSM 09 SAT 06
CEW 06 JBR 09 BWG 07
DHN 08 TXK 15 HOP 09
MGM 07 DYR 09 LEX 07
MSL 07 MEM 17 PAH 08
NSE 06 MKL 07 SDF 09
OZR 09 TYS 07 JLN 06
PAM 09 BOW 06 P02 06
PNS 07 TLH 09 SGF 06
TOI 08 BVE 07
CAE 06 NEW 07 TOTAL=  73
```

(k) Stations with pressure fall of 6 hundredths or more (18-20Z) (SPC)

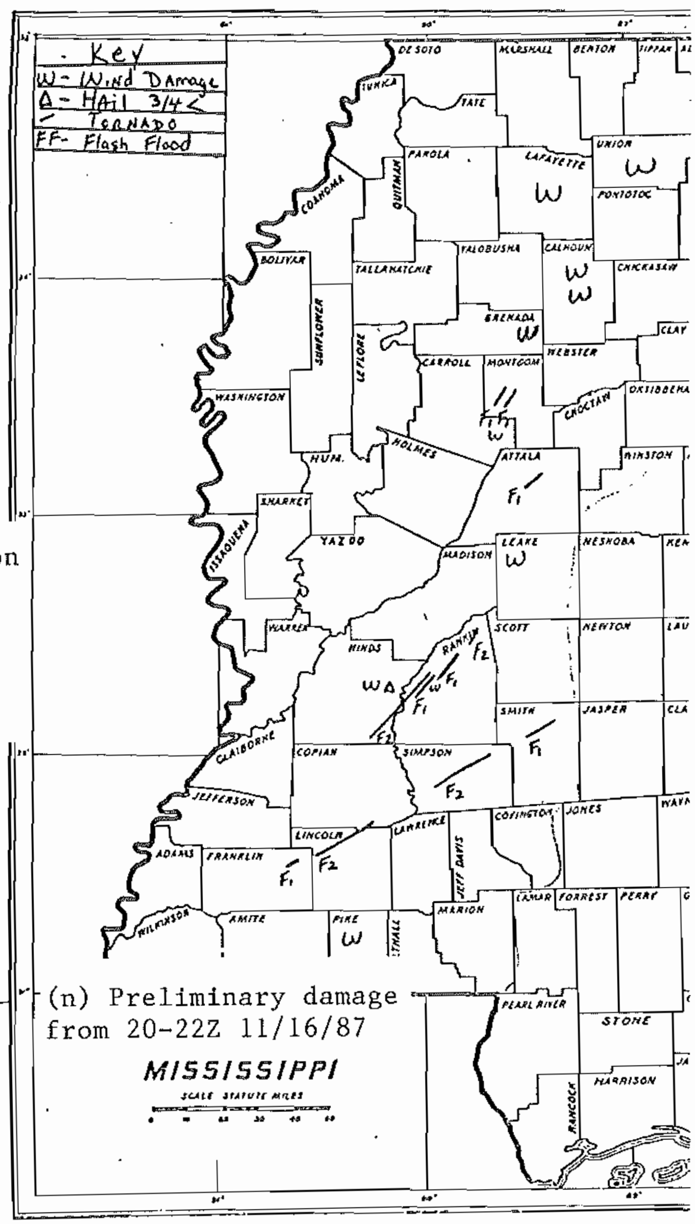


(l) Theta Advection (20Z) (STA)



m

(m) Average Theta advection-(18-20Z) 11/16/87 (SAA)



(n) Preliminary damage from 20-22Z 11/16/87

3.11 December 14, 1987

Surface streamlines and wind vectors show a very well defined low level circulation at 02Z. Strong instability was indicated over western Mississippi with little evidence of a cap over the unstable air. Moisture convergence (which had increased dramatically from 00Z to 02Z) was very strong over west-central Mississippi. Notice also the very strong increase in moisture near Memphis (MEM) (over 1 g/kg/hr). The station change chart (SC2) and altimeter change chart (SAC) show an area of very strong pressure falls and convergence in the wind vector changes in extreme southeast Missouri and west of Memphis, Tennessee. Also, very strong warm advection was present. The ADAP decision tree indicated the extreme potential. The tornadoes occurred after 02Z.

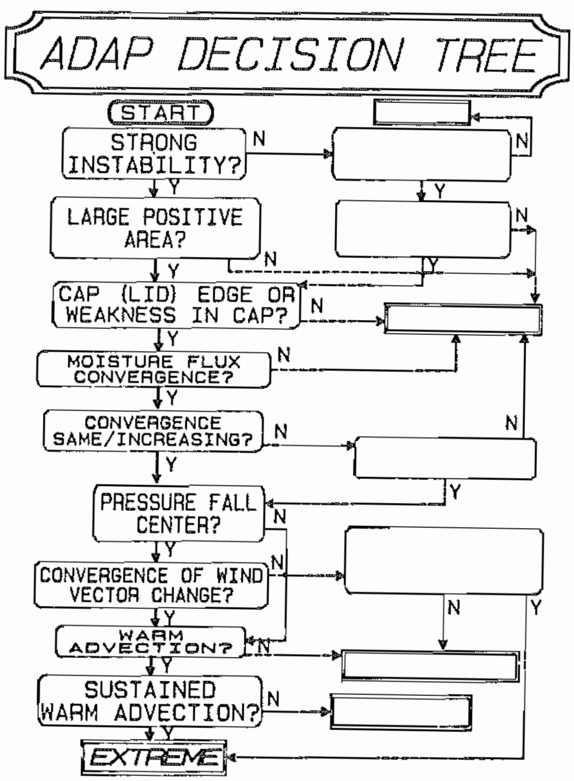


Figure 47 ADAP Decision Tree for 12/14/87.

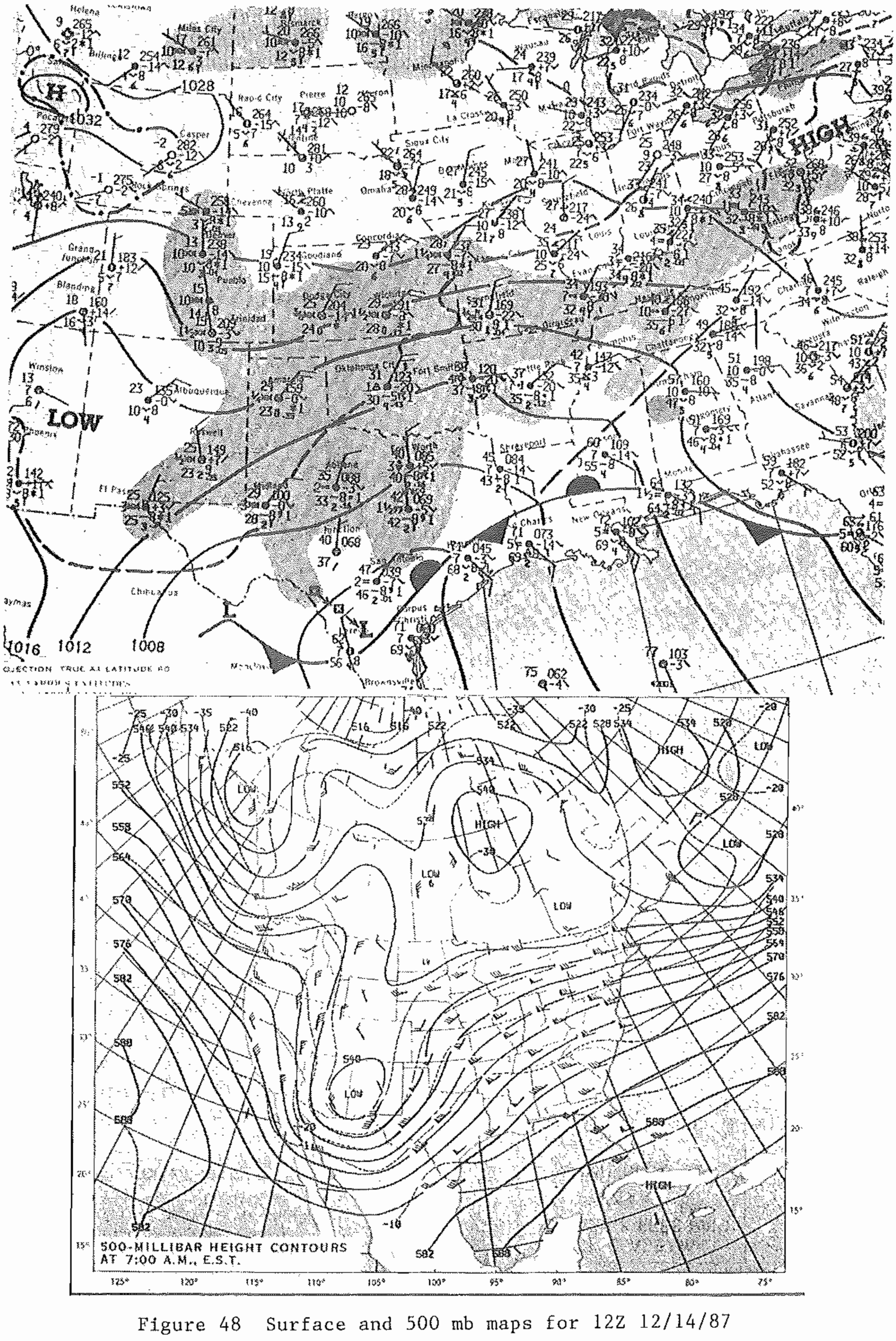
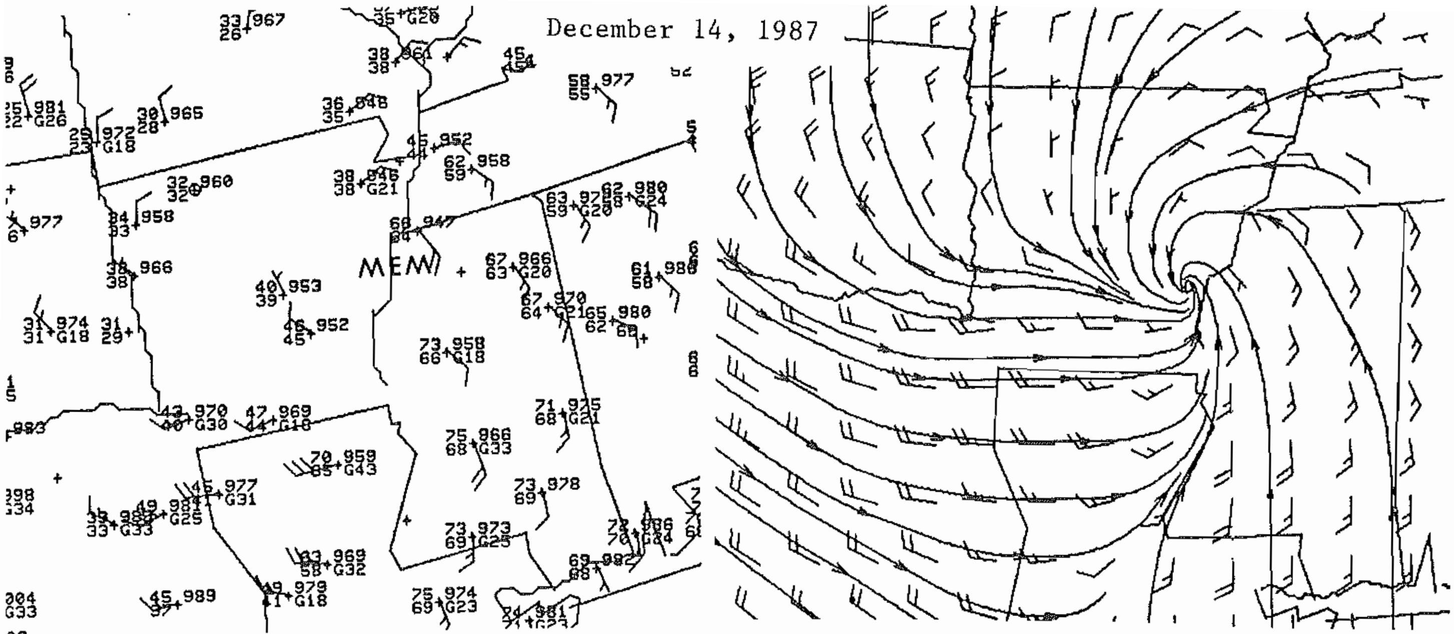


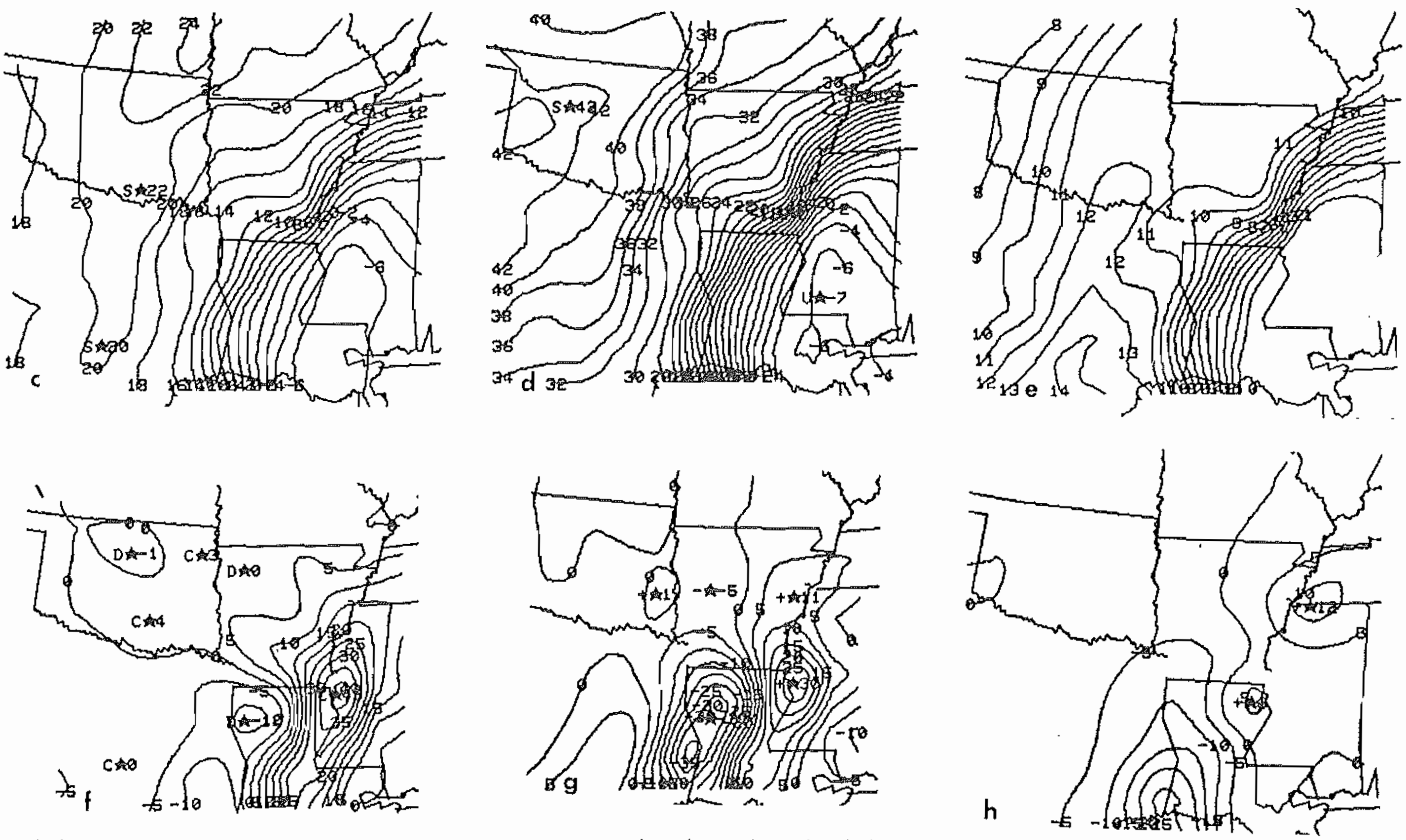
Figure 48 Surface and 500 mb maps for 12Z 12/14/87

December 14, 1987



(a) Surface map-02Z 12/15/87

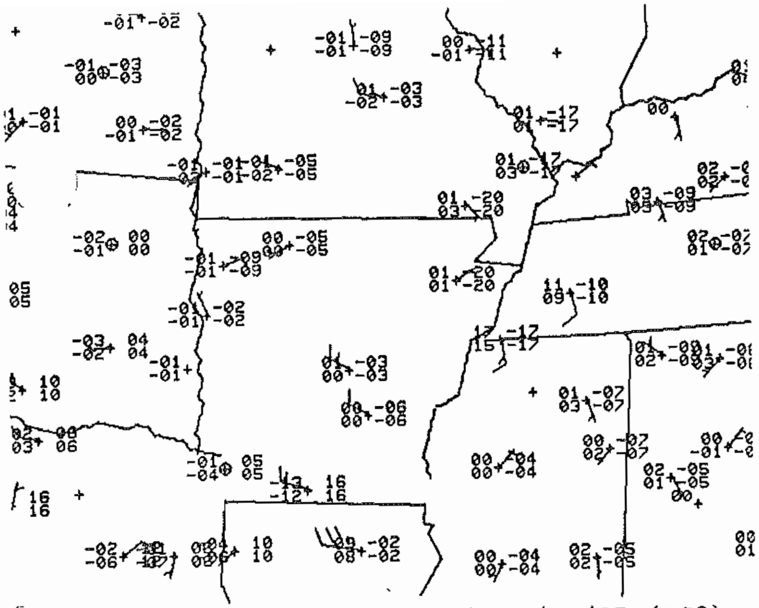
(b) Surface Streamlines and wind vectors-02Z 12/15/87 (SSW)



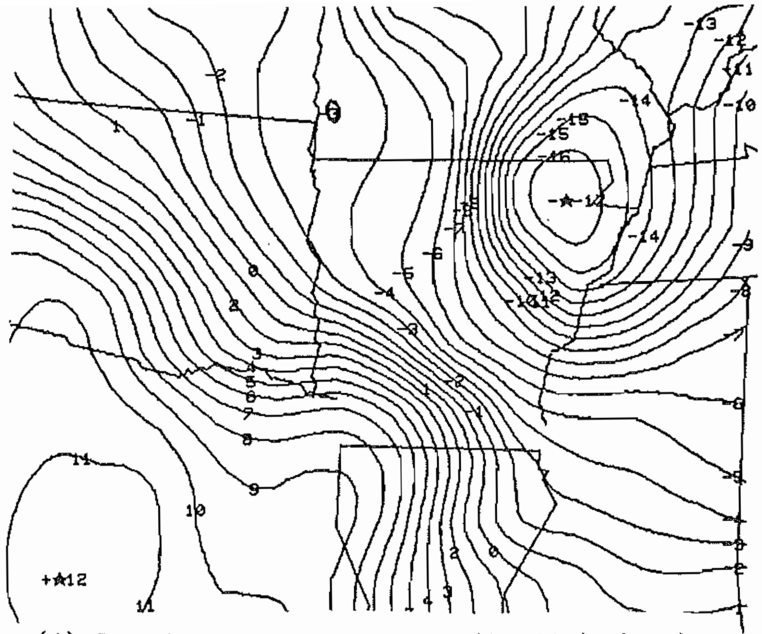
(c) Surface parcel LI at 500 mb-02Z 12/15/87 (SSL) (d) Surface parcel LI at 300 mb-02Z (SSU) (e) Cap strength-02Z (SSC) (Note: Indices based on 02Z surface data and 00Z upper-air data.)

(f) Surface moisture flux convergence-**02Z** (SMC) (g) Changes in surface moisture flux convergence-(00-02Z) (SCC) (h) Changes in surface mixing ratio-(00-02Z) (SQC).

Figure 49



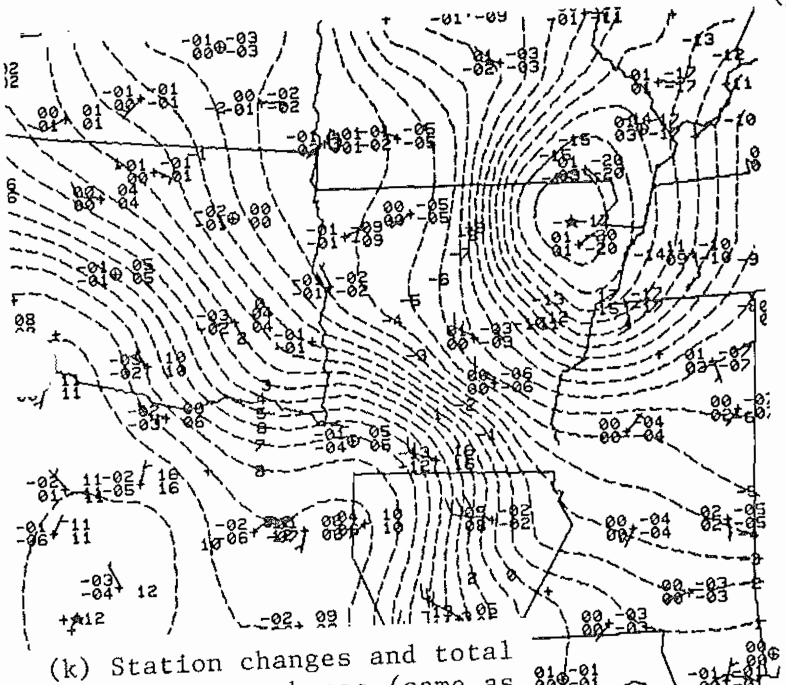
(i) Station changes-(00-02Z) 12/15/87 (SC2)



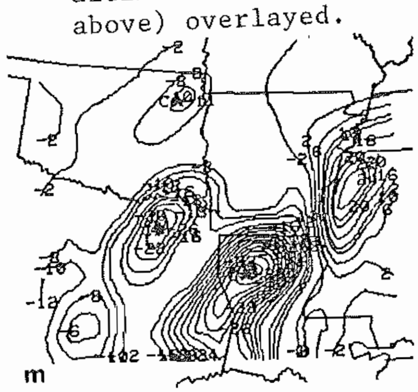
(j) Total Altimeter change-(00-02Z) (SAC)

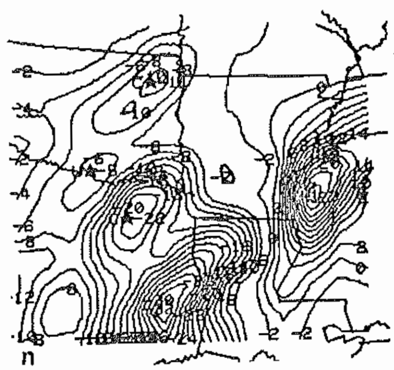
```
00Z 121587 TO 02Z 121587 CHANGES
  00 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
HSV 06
MSL 09
MDH 17
CBM 07
TUP 07
FYV 09
JBR 20
PBF 06
BNA 07
DYR 17
MEM 17
MKL 10
BWG 08
HOP 09
LEX 07
SDF 10
CGI 17
COU 09
P02 20
STL 11
TOTAL = 20
```

(l) Stations with pressure fall of 6 hundredths or more-(00-02Z) (SPC)

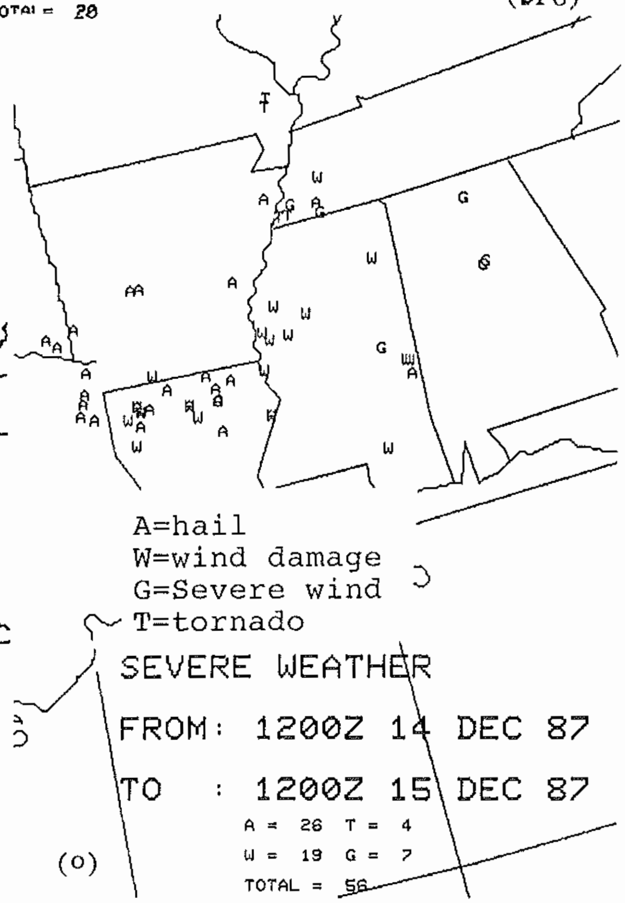


(k) Station changes and total altimeter change (same as above) overlayed.





(m) Theta advection 02Z (STA) (n) Average Theta advection (00-02Z) (SAA)



(o)

3.12 January 19, 1988 (13-15Z)

Strong instability was present over Mississippi. A capping inversion was not present. An area of moisture flux convergence was noted over western Mississippi along with an increase in the convergence and mixing ratio. Significant pressure fall centers in the station change chart (SC2) and altimeter change chart (SAC) were noted over these two areas. Notice the convergence in the wind vector changes in west-central Mississippi. Warm advection was very pronounced from west-central to northeast Mississippi. The ADAP Decision Tree indicated an extreme potential.

3.13 January 19, 1988 (15-17Z)

At 17Z, the surface streamlines highlight the developing circulation around a surface low pressure system moving into northeastern Arkansas. Moisture flux convergence continued over the western portion of Mississippi. Pressures continued to fall from southeast Missouri into eastern Mississippi. Convergence of the wind vector change was evident over northeast Mississippi. Warm advection remained very strong over the northern portion of Mississippi in the area of pressure falls. The decision tree continued to indicate the extreme potential.

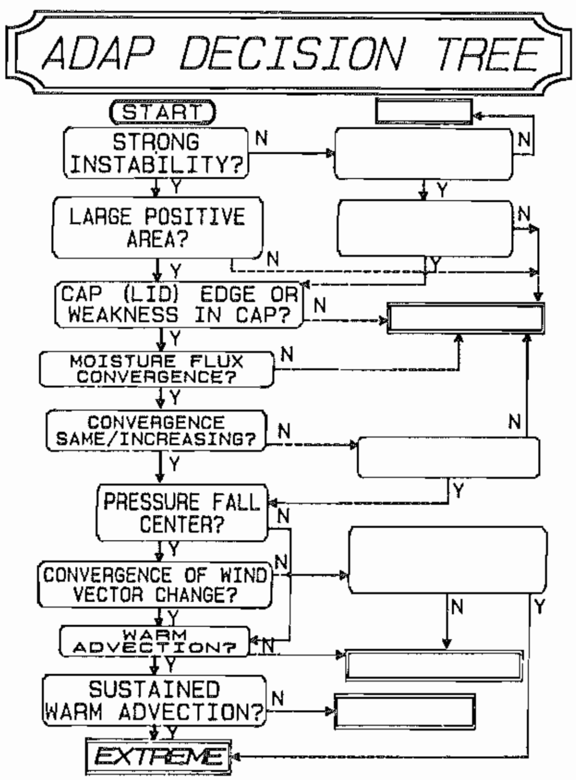


Figure 50 ADAP Decision Tree for 1/19/88

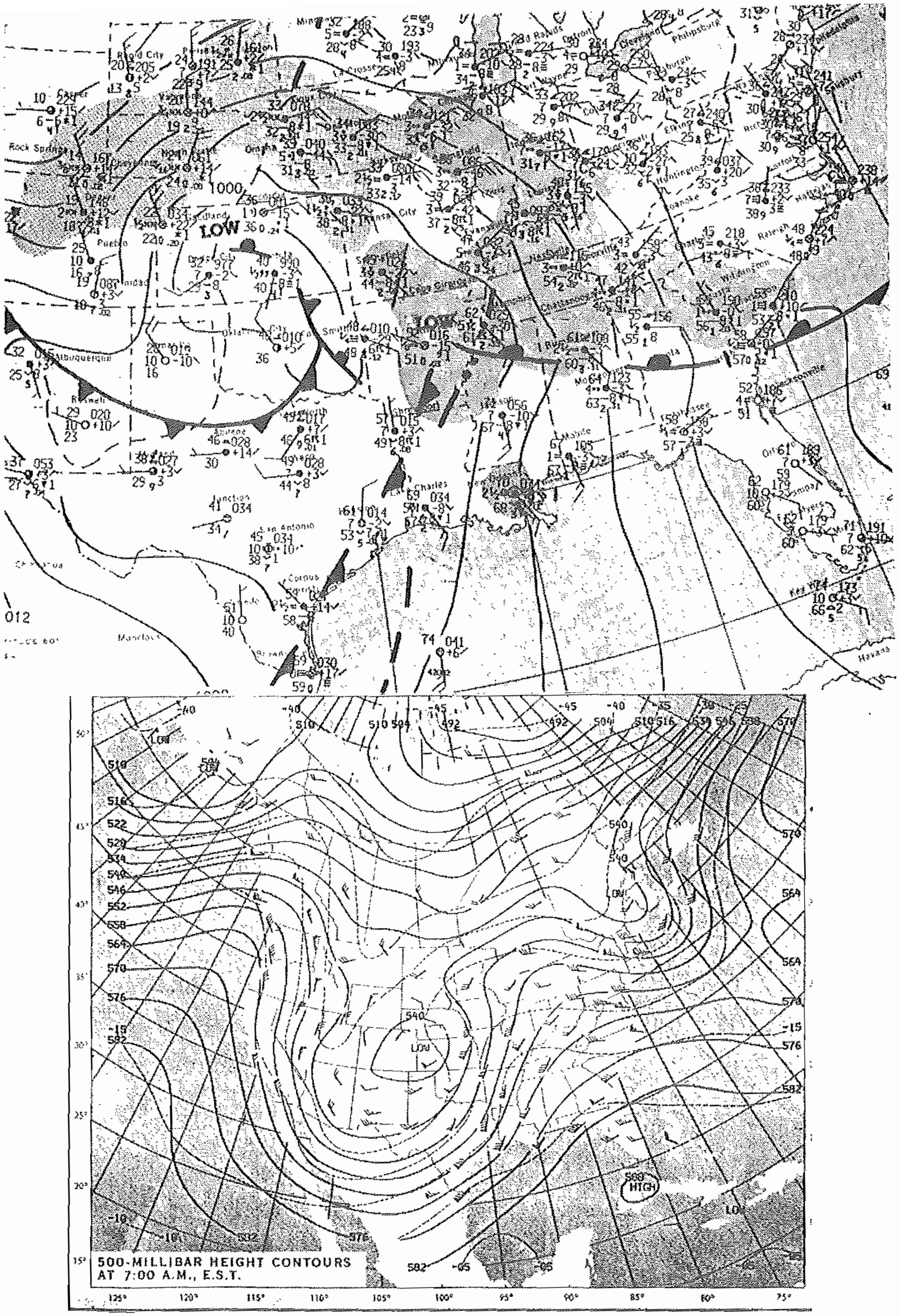
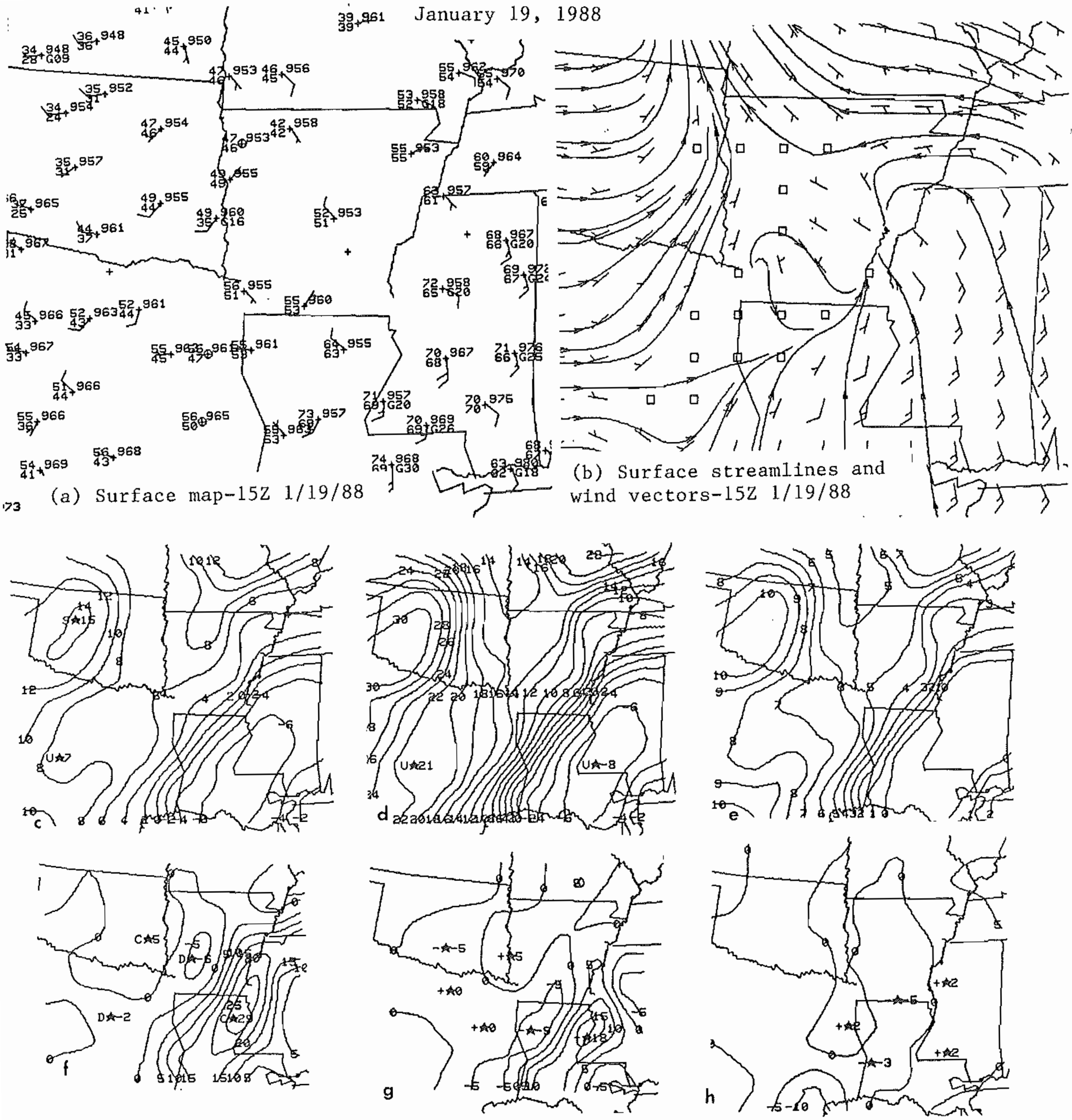


Figure 51 Surface and 500 mb maps for 12Z 1/19/88

January 19, 1988

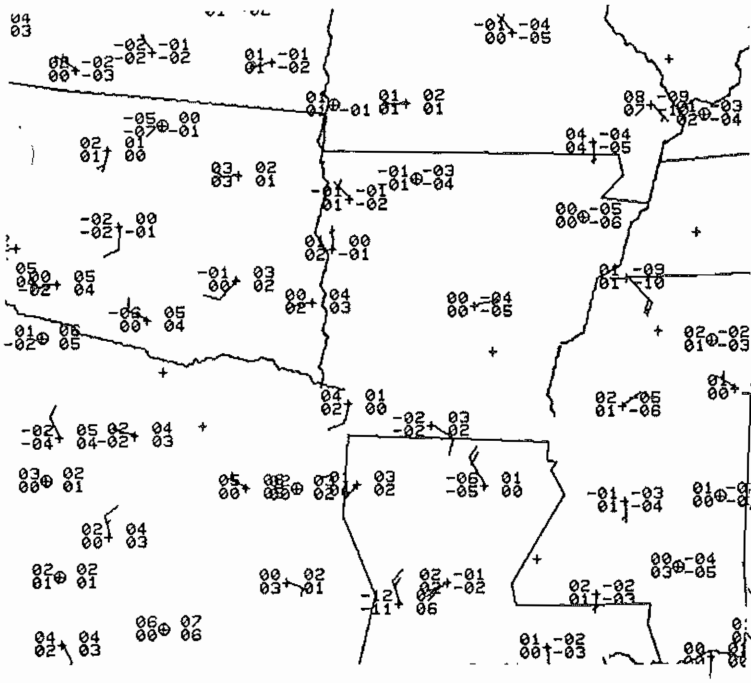


(a) Surface map-15Z 1/19/88

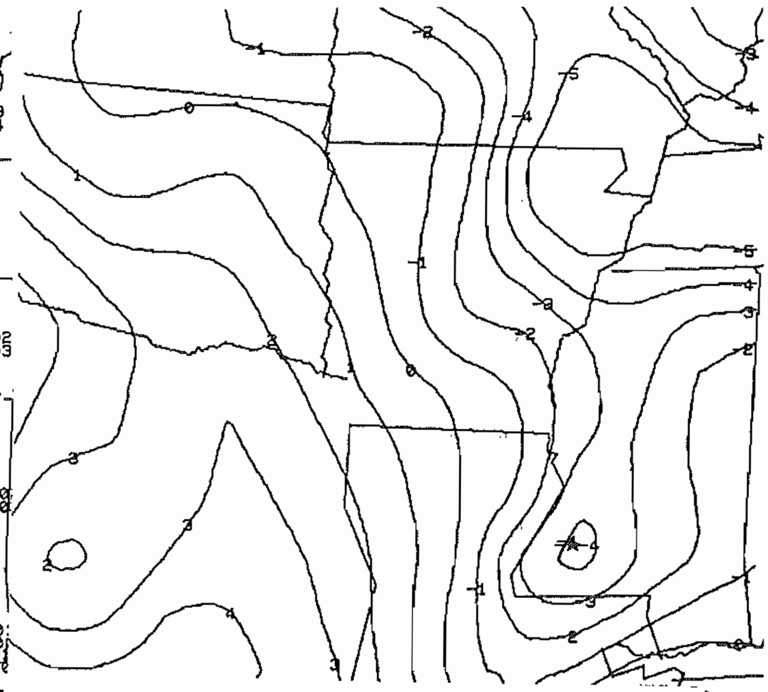
(b) Surface streamlines and wind vectors-15Z 1/19/88

(c) Surface parcel LI at 500 mb-15Z (SSL) (d) Surface parcel LI at 300 mb-15Z (SSU) (e) Cap strength-15Z (SSC) (Note: Indices based on 15Z surface and 12Z upper-air data.) (f) Surface Moisture flux convergence-15Z (SMC) (g) Changes in surface moisture flux convergence-(13-15Z) (SCC) and (h) Changes in surface mixing ratio-(13-15Z) (SQC)

Figure 52



(i) Station changes-(13-15Z) 1/19/88 (SC2)

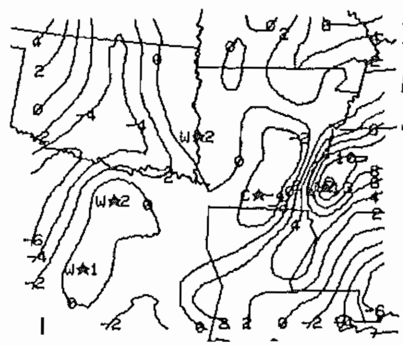


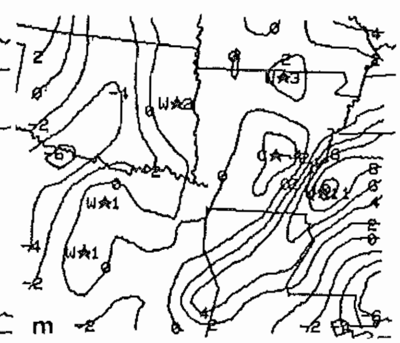
(j) Total altimeter change-(13-15Z) (SAC)

```
13Z 011988 TO 15Z 011988 CHANGES
  01 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
DYR 08
MEM 09
TYS 08
SDF 08
CGI 09
COU 07
STL 06

TOTAL=  07
```

(k) Stations with pressure fall of 6 hundredths or more-(13-15Z) 1/19/88 (SPC)

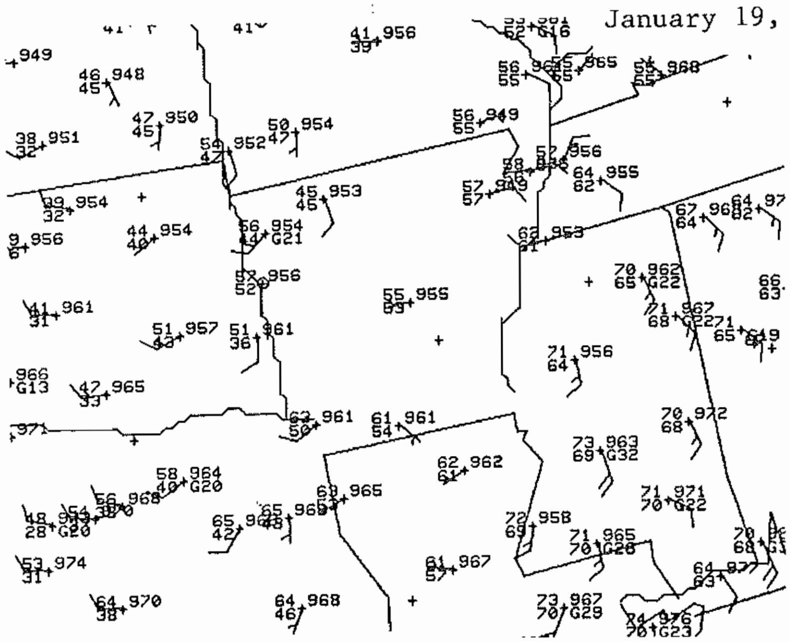




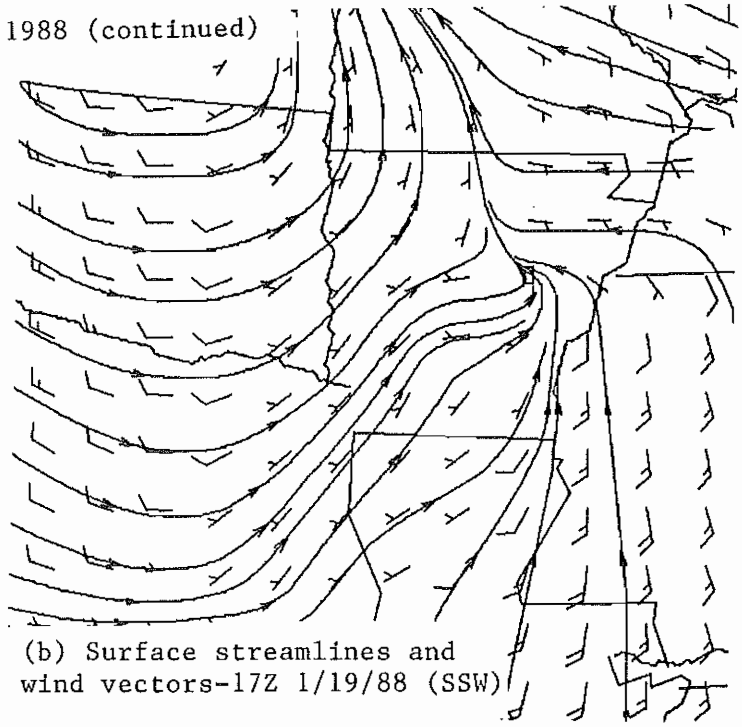
(m) Average Theta Advection-(13-15Z) (SAA)

(l) Theta Advection-15Z (STA)

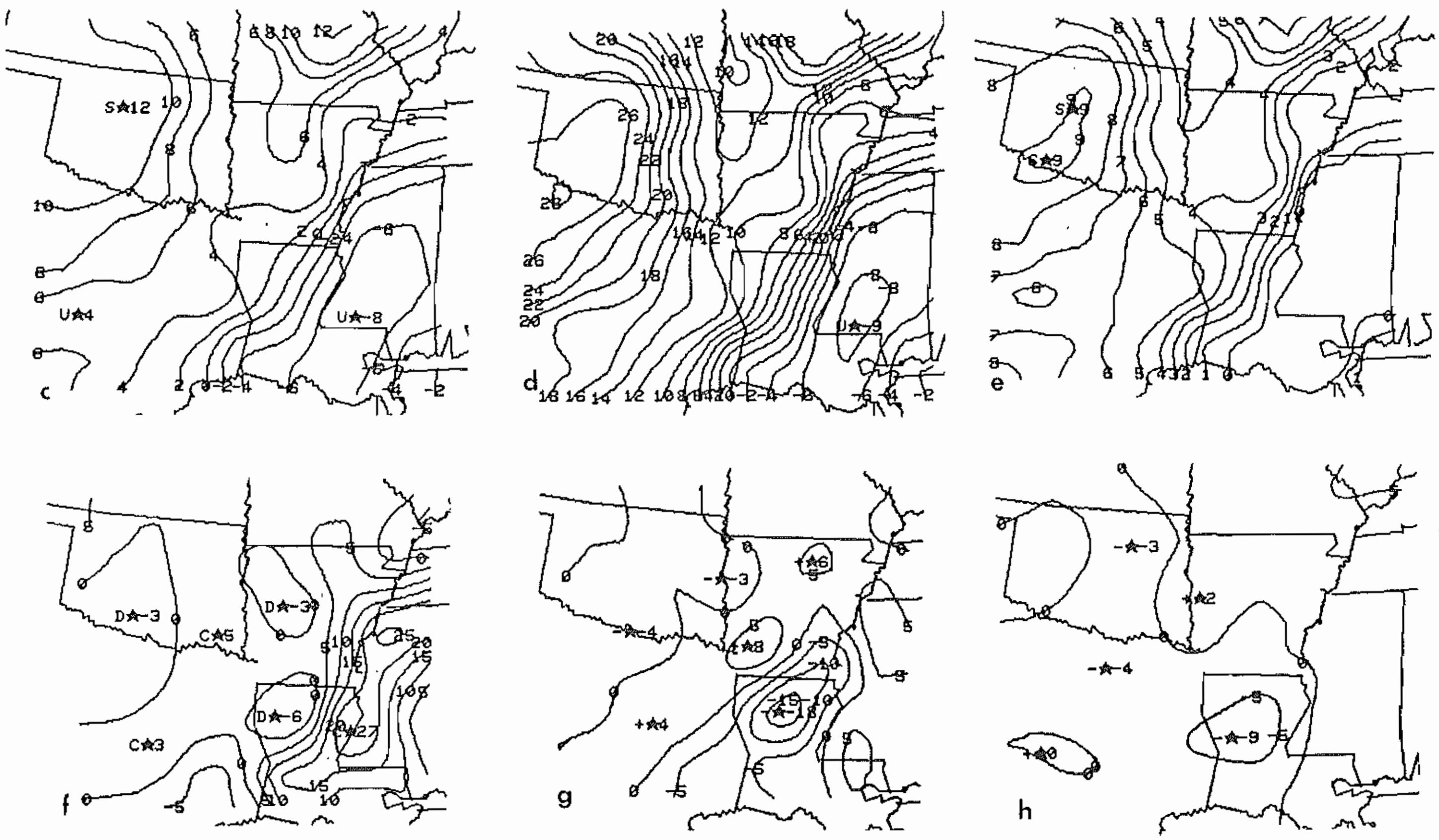
January 19, 1988 (continued)



(a) Surface map-17Z 1/19/88

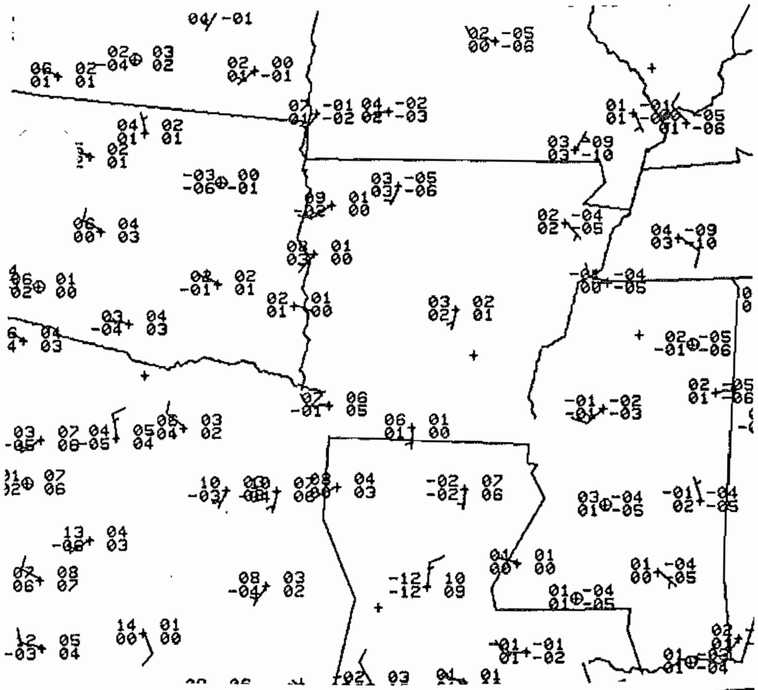


(b) Surface streamlines and wind vectors-17Z 1/19/88 (SSW)

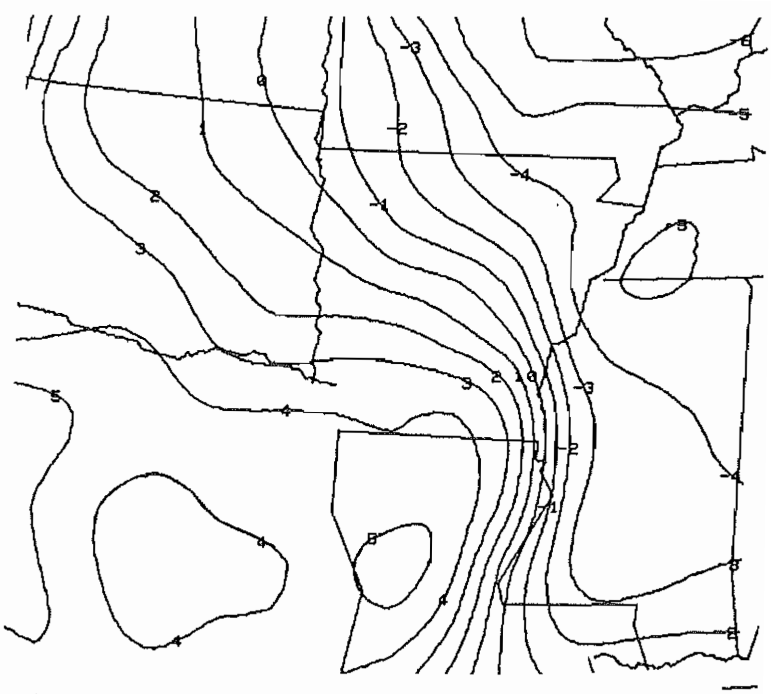


(c) Surface parcel LI at 500 mb-17Z (SSL) (d) Surface parcel Li at 300 mb-17Z (SSU) (e) Cap strength-17Z (SSC) (Note: Indices based on 17Z surface and 12Z upper-air data.) (f) Surface moisture flux convergence-17Z (SMC) (g) Changes in surface moisture flux convergence-(15-17Z) (SCC) and (h) Changes in surface mixing ratio-(15-17Z) (SQC)

Figure 53



(i) Station changes-(15-17Z) 1/19/88 (SC2)



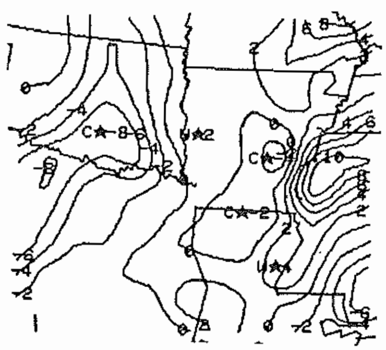
(j) Total altimeter change-(15-17Z) (SAC)

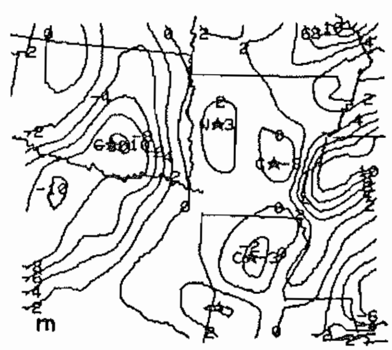
```
15Z 011988 TO 17Z 011988 CHANGES
  01 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
CSG 06
MKL 09
BWG 08
LEX 09
LOZ 09
SDF 06
P02 09
STL 08

TOTAL=  08
```

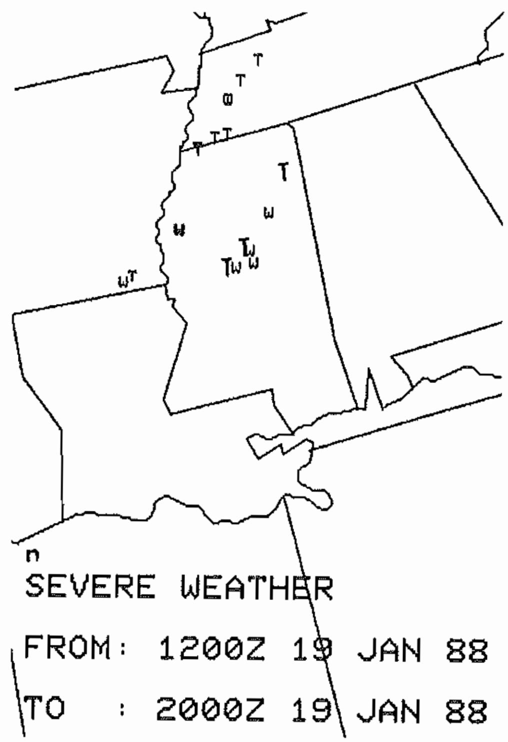
(k) Stations with pressure fall of 6 hundredths or more (15-17Z) 1/19/88 (SPC)

(n) Preliminary damage from 12-20Z 1/19/88
T=tornado
A=severe hail
W=wind damage
G=severe wind

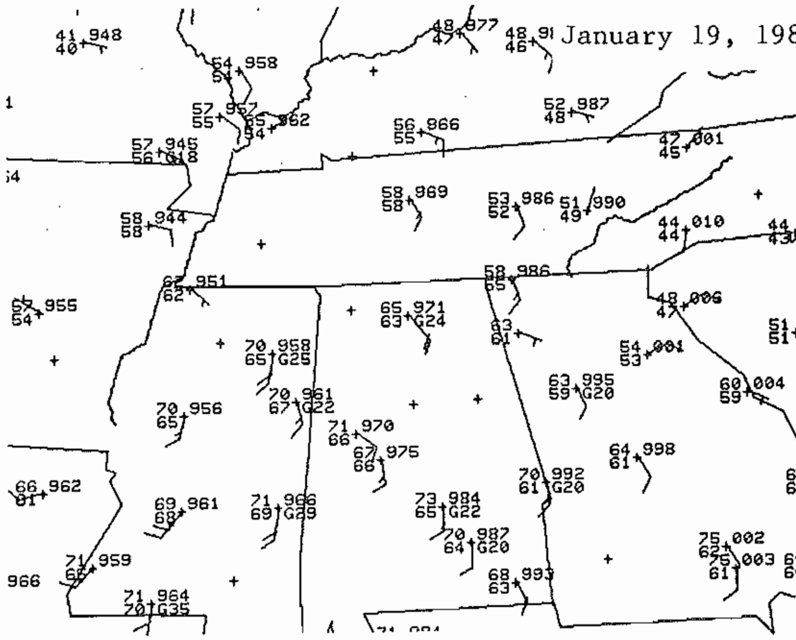




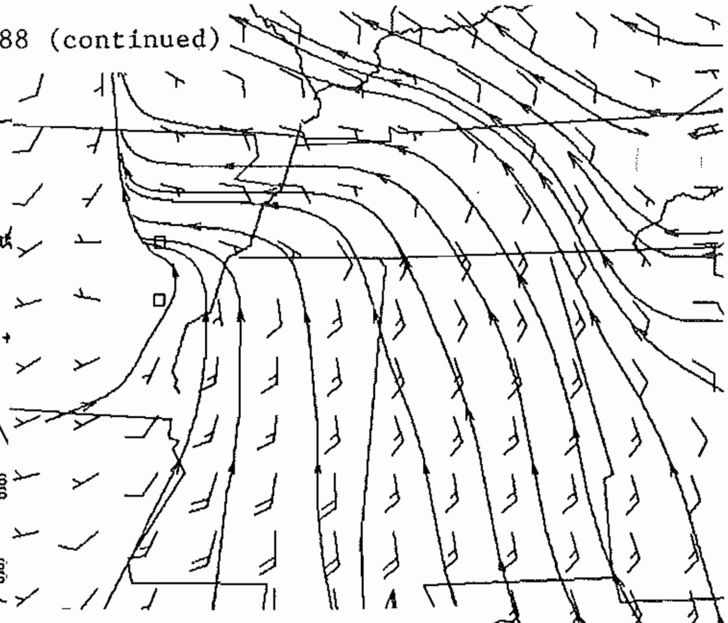
(l) Theta advection 15Z (STA)
(m) Average Theta advection-(15-17Z) (SAA)



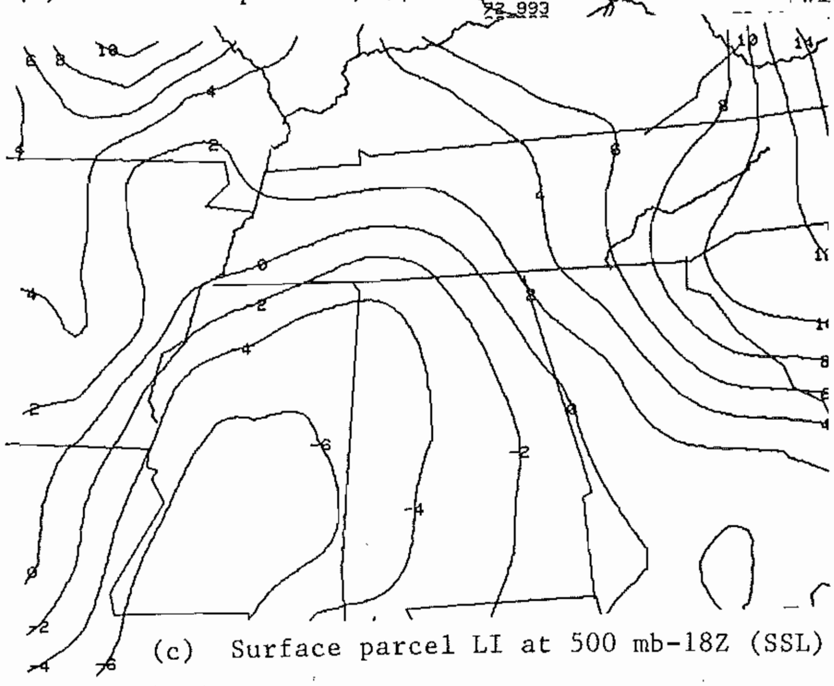
January 19, 1988 (continued)



(a) Surface map-18Z 1/19/88

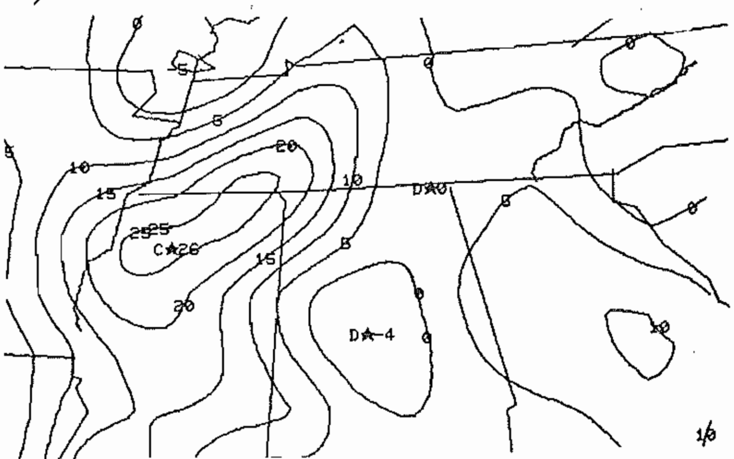


(b) Surface streamlines and wind vectors-18Z 1/19/88



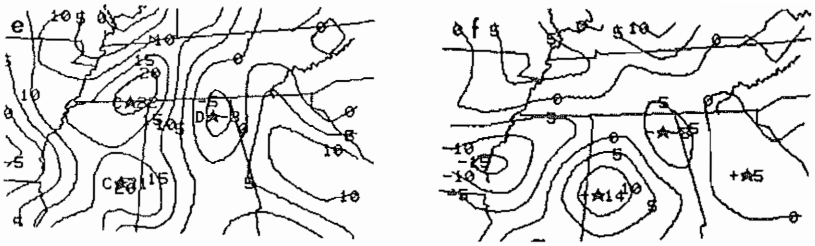
(c) Surface parcel LI at 500 mb-18Z (SSL)

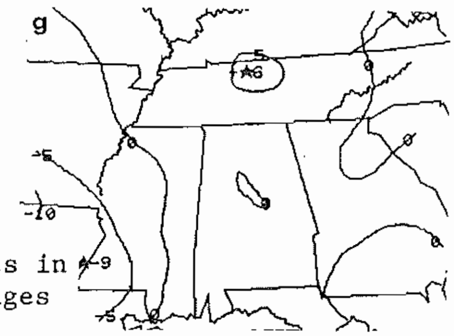
(For discussion-see page 88)



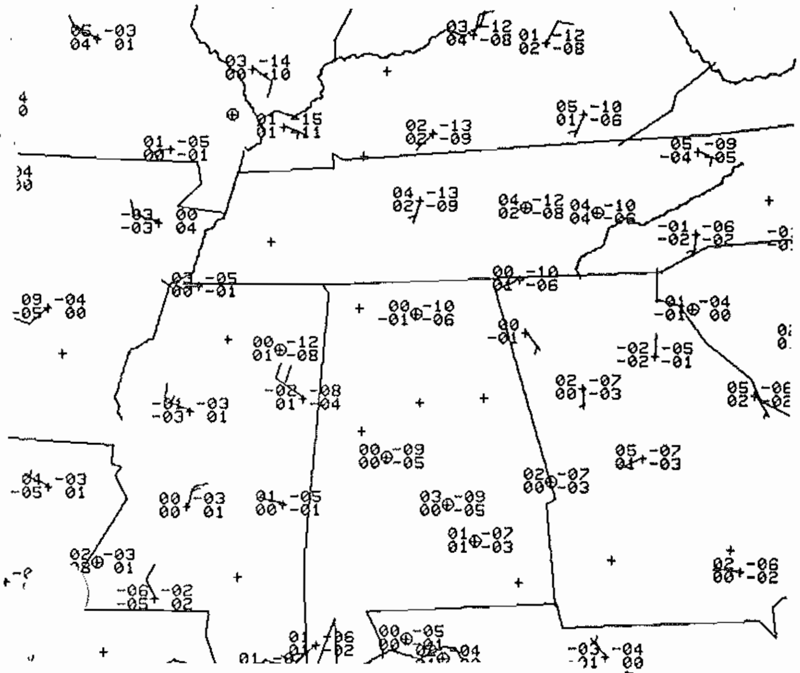
(d) Surface moisture flux convergence-18Z 1/19/88 (SMC)

Figure 54

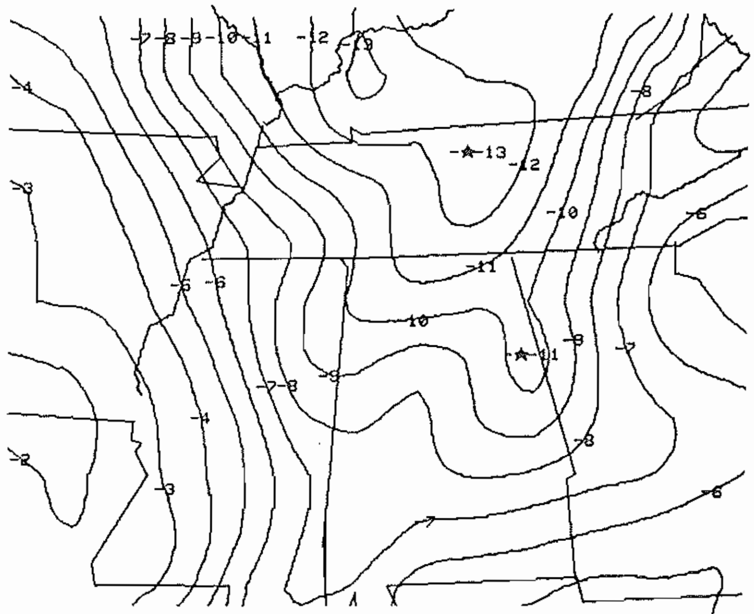




(e) Surface moisture flux convergence-20Z (SMC) (f)Changes in surface moisture flux convergence (18-20Z) (SCC) (g) Changes in surface mixing ratio-(18-20Z) (SQC)



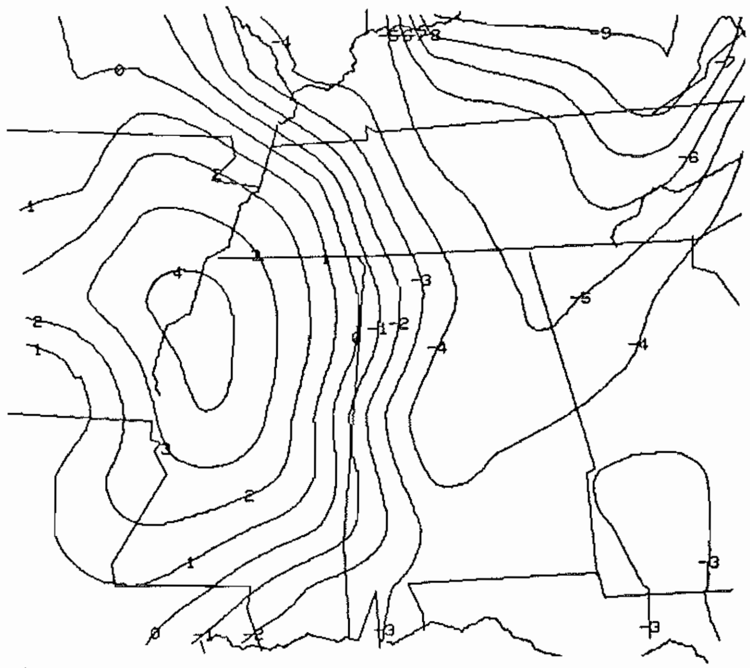
(h) Station changes (18-20Z) (SC2)



(i) Total altimeter change-(18-20Z) (SAC)

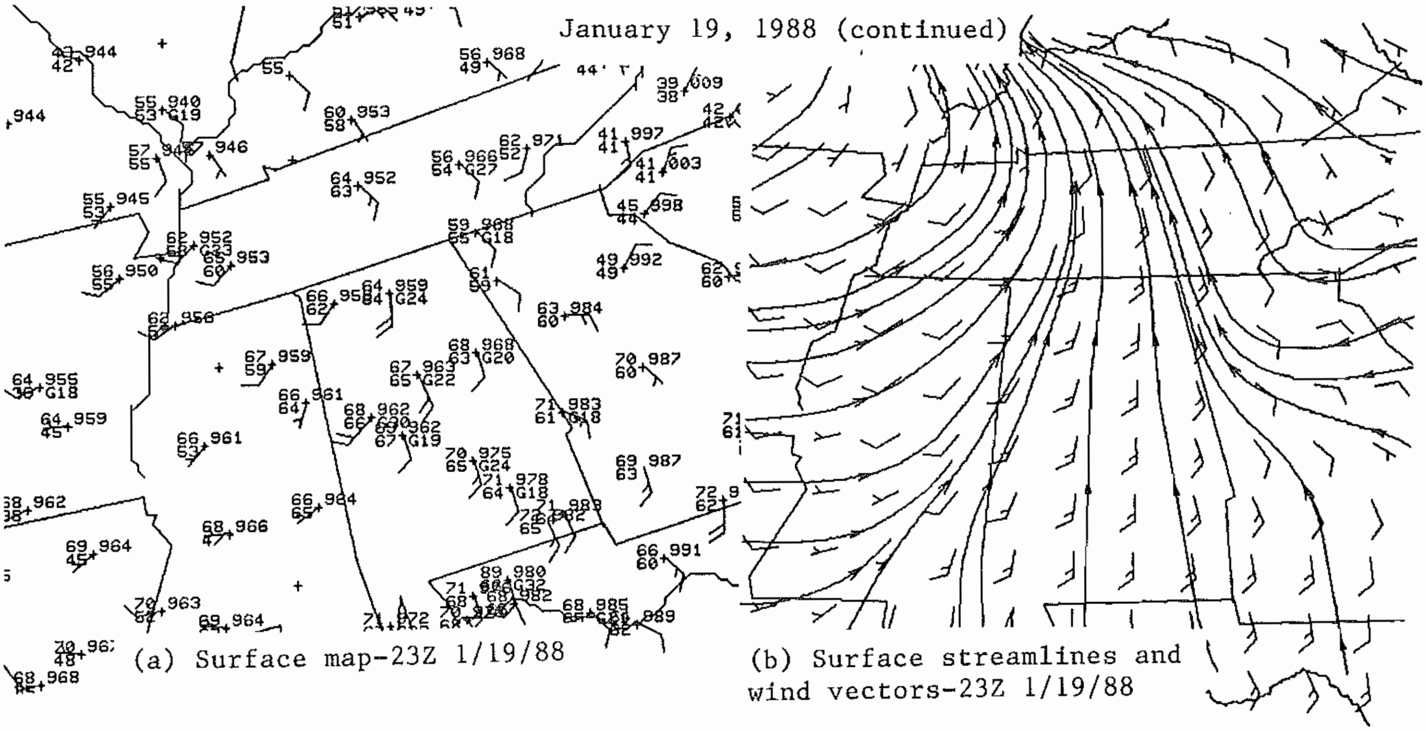
```
18Z 011988 TO 20Z 011988 CHANGES
 -04 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
AGS 06 GNV 06
ATL 07 BVE 07
AYS 06 NEW 06
CSG 07 AVL 06
LHW 06 ALI 06
MCN 07 COT 08
SAV 06 BWG 13
CKL 09 LEX 12
HSV 10 LOZ 10
MGM 09 PAH 15
MOB 06 SDF 12
OZR 06
TOI 07 TOTAL=  36
CHS 06
MDH 14
BIX 07
CBM 08
TUP 12
BNA 13
CHA 10
CSV 12
DYR 19
TRI 09
TYS 10
AGR 07
```

(j) Stations with pressure fall of 6 hundredths or more-(18-20Z) (SPC)



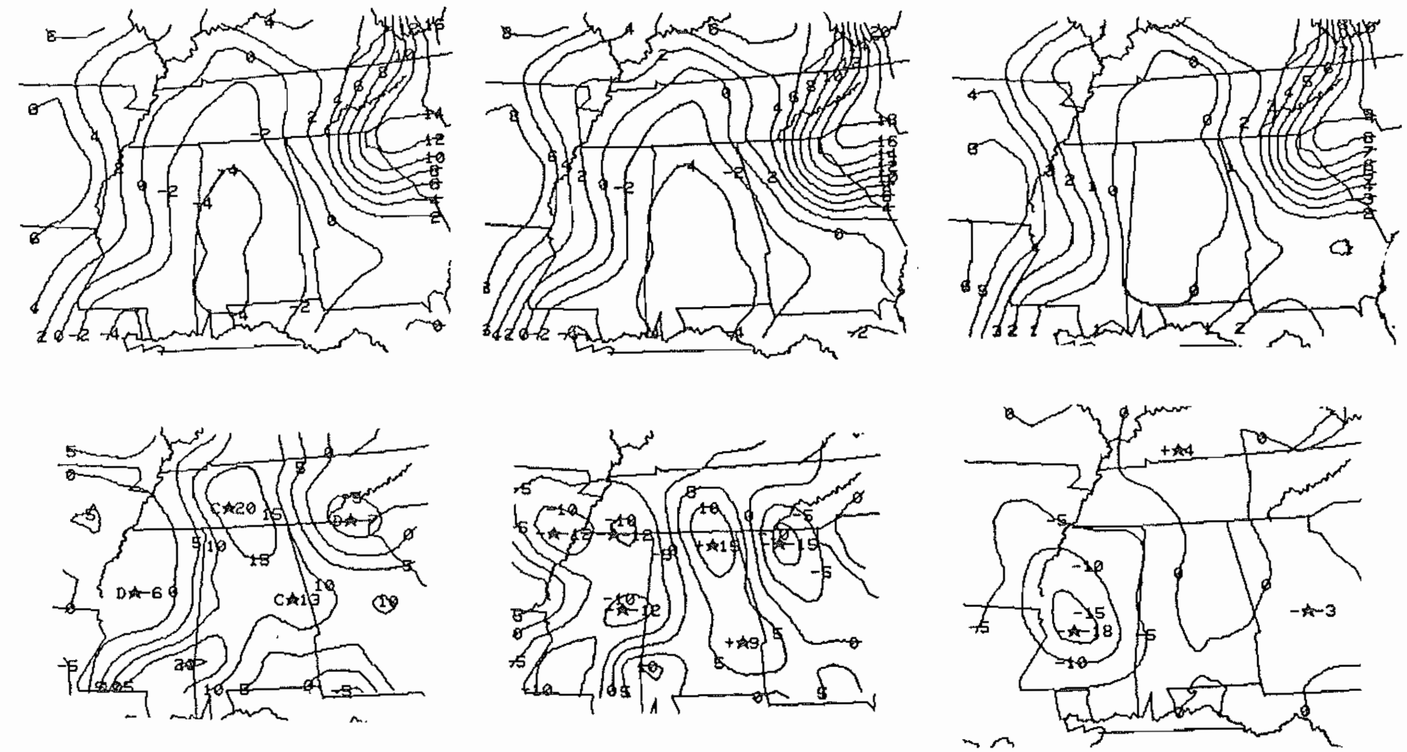
(k) Total altimeter change-(20-22Z) (SAC)

January 19, 1988 (continued)



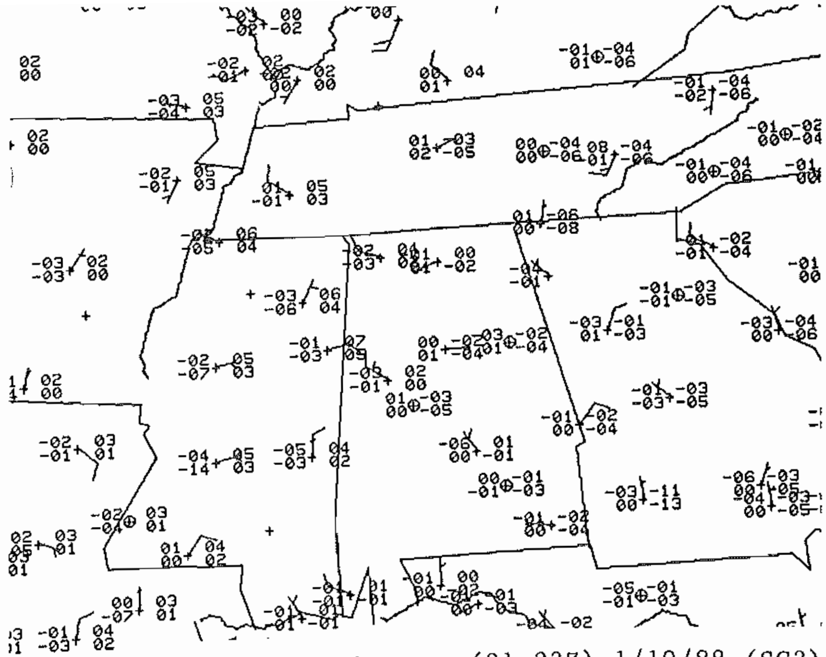
(a) Surface map-23Z 1/19/88

(b) Surface streamlines and wind vectors-23Z 1/19/88



(c) Surface parcel LI at 500 mb-23Z (SSL) (d) Surface parcel LI at 400 mb-23Z (SSU) (e) Cap strength-23Z (SSC) (Note: Indices are based on 23Z surface and 12Z upper-air data.) (f) Surface moisture flux convergence-23Z (SMC) (g) Changes in surface moisture flux convergence-(21-23Z) (SCC) (h) Changes in surface mixing ratio-(21-23Z) (SQC).

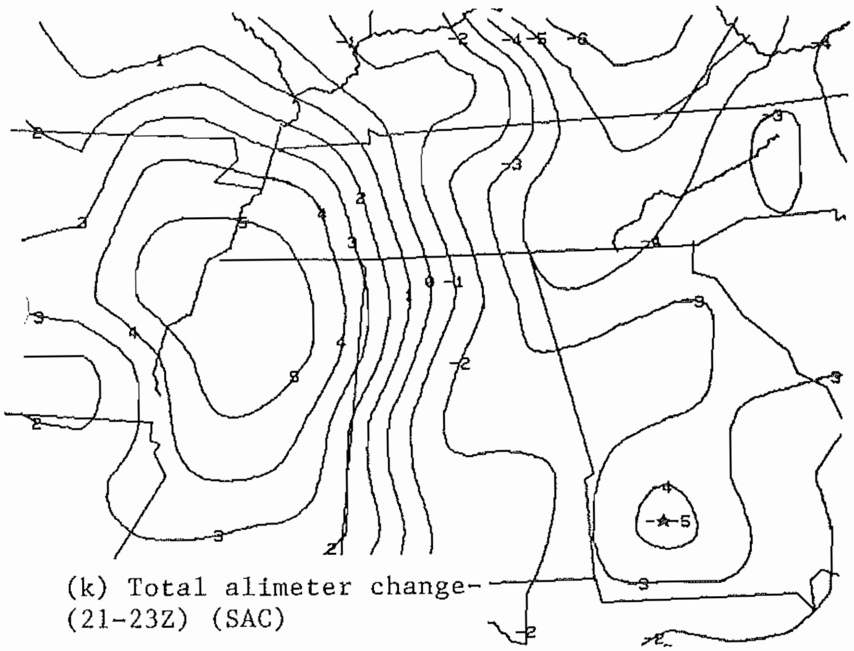
Figure 55



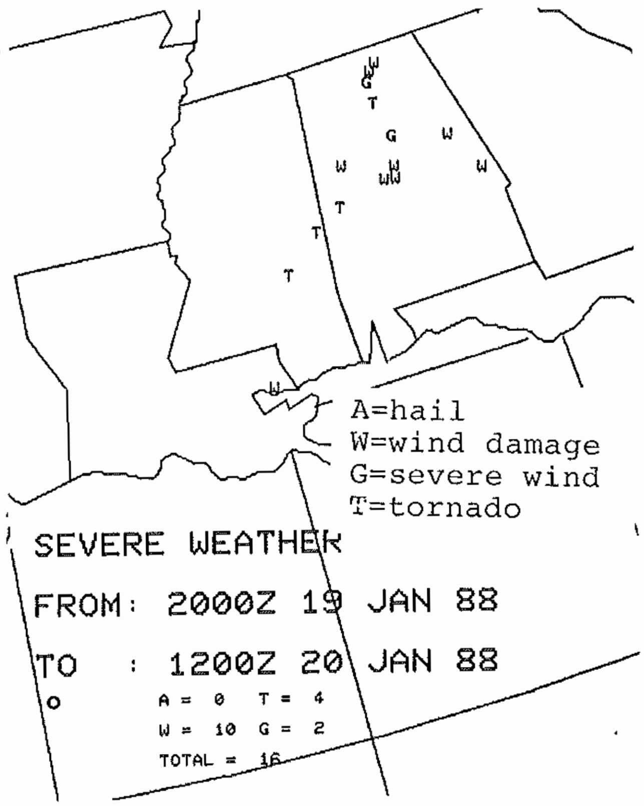
(i) Station changes (21-23Z) 1/19/88 (SC2)

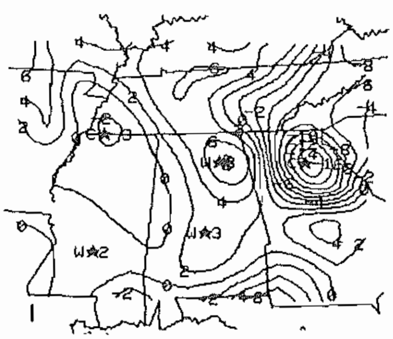
21Z 011988 TO 23Z 011988 CHANGES
02 =AVERAGE ALTIMETER CHANGE OF ALL STATIONS
STATION(S) WITH ALTIMETER FALL OF 6 HUNDREDTHS OR MORE
AND AMOUNT OF FALL (HUNDREDTHS). **=1 INCH OR GREATER
ABY 11
CAE 07
CHA 06
GSO 09
LEX 06
TOTAL= 05

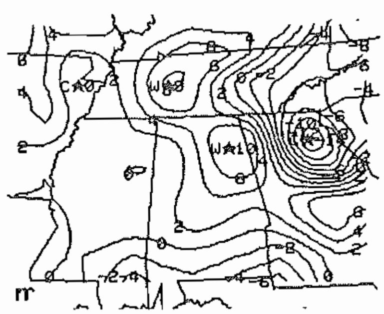
(j) Stations with pressure fall of 6 hundredths or more (21-23Z) (SPC)

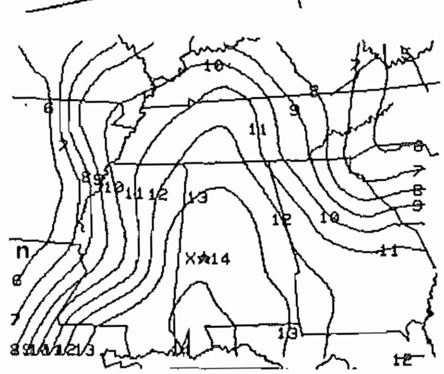


(k) Total alimeter change-(21-23Z) (SAC)









(l) Theta advection-23Z (STA) (m) Average Theta advection-(21-23Z) (SAA) (n) Surface mixing ratio-23Z and (o) Preliminary reports of severe weather-20Z 1/19 to 12Z 1/20/88.

3.14 January 19, 1988 (18-20Z)

By 20Z, the area of concern had begun to shift eastward into Alabama. Data from 18Z had indicated divergence over the central portion of Alabama with only moderately unstable air (-4C) over the western portion of the state. However, by 20Z moisture flux convergence had rapidly increased in the west-central section of the state. A large area of significant pressure falls was present over Alabama. The area of presure falls continued through 22Z. In this case, moderate instability in the western part of the state combined with the strong dynamics to continue to produce an extreme potential. Refer to the ADAP Decision Tree (Fig. 17) in Chapter 1 to see how moderate instabilities and strong dynamics can produce the extreme potential case.

3.15 January 19, 1988 (21-23Z)

By 23Z, an area of moderate instability (-4C) was noted over all of Alabama. (Again, refer to Fig. 17 to see how the ADAP Decision Tree can produce the extreme potential case when strong dynamics are present). Moisture flux convergence along with increasing moisture flux convergence and nearly steady or increasing mixing ratios in northern Alabama indicated the potential for strong storms in northern Alabama. Pressures over central and northern Alabama continued to fall although not as sharply as before. Warm advection continued strong in northern Alabama. The surface mixing ratio from 23Z indicates the moisture axis across central Alabama. The ADAP Decision Tree continued to predict the extreme potential for severe storms although by this time it was increasingly likely that the storms would begin to diminish as they moved to the east of the moisture axis.

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XXX CP YY-N
December 1987

Program to BuiLD WXData1.dt

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: BLDWXD

AAL ID:
Revision No.: 02.00

PURPOSE: To read data from RDOS file NSTATIONS and create RDOS file WXDATA1.DT. This file, WXDATA1.DT, sets up a site specific (WSFO or WSO) mesoscale database used by SAVOBS, UPRFMT, UPROA, MESOS, MAXTW, STRM.

PROGRAM INFORMATION

Development Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Fort Worth, TX
Phone: FTS 334-2671

Maintenance Programmer:
Phillip D. Bothwell

Location:
Same

Phone: Same

Language: Fortran IV/Rev 5.57

Type: Standard

Save file creation dates:BLDWXD.SV
Original Release/Rev 01.00 8/15/85
Second Release/Rev 02.00 10/23/87
Running time: Five to six minutes.

Disk space: Program files - 66 Blocks
Data files - 12 Blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
BLDWXD.SV, BOXVIEW.SV ULPMESO.PF, URPMESO.PF, LLPMESO.PF, LRPMESO.PF, and B3P.MC	

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
STDIR.MS	(APPROPRIATE	R	Master station directory.
WXDATA1.DT	DIRECTORIES)	W	May be moved to appropriate directory and linked from SYSZ. (It cannot be displayed.)
NSTATIONS	SYSZ	R	Required only for BLDWXD program. Type DSP:NSTATIONS to display.
MESOSGRID	SYSZ	W	Same as POA. Requires map background B02. First, create null file by typing CRAND MESOSGRID on dasher. File must be permanent (type CHATR +P on dasher). It can be displayed by typing DSP:MESOSGRID.
PREFORMAT	SYSZ		

AFOS Products:

ID	ACTION	COMMENTS
NMCGPHPOA	Stored	This product is the same as file MESOSGRID, but will be deleted as new POA (surface plots) maps are produced.
cccMCPNST	Read	

LOAD LINE

BLDWXD: RLDR BLDWXD BLK3 RDPRE PIXEL ZHDST UPRCK AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION*

1. Make sure STDIR.MS is on SYSZ or linked from SYSZ to the appropriate directory.

2. Make sure keys, NMCGPHPOA and cccMCPNST exist, or add them to wish list. (ccc is your Node).

3.**Move PREFORMAT, ULPMESO.PF, URPMESO.PF, LLPMESO.PF, LRPMESO.PF and B3P.MC from DP3 to SYSZ. Move BLDWXD and BOXVIEW from DP3 to the appropriate directory. From SYSZ link BLDWXD.SV and BOXVIEW.SV to the appropriate directory.

4. Store the preformat (PREFORMAT) as cccMCPNST by typing:

   STORE:PREFORMAT cccMCPNST (ccc is your Node)

5. PMOD.SV, GENUTF.SV and HCOPY.SV should already be on SYSZ or linked from SYSZ to the appropriate directory.

**These instructions/commands are included in the macro included on the floppy in DP3(ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

PROGRAM TO BuiLD WXData1.dt

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: BLDWXD

AAL ID:
Revision No.: 02.00

PROGRAM EXECUTION

1. If you have already used the previous version of BLDWXD, you are not required to rerun BLDWXD and generate a new WXDATA1.DT. You must run step number 8 to create a 3 panel map background. It is strongly recommended BLDWXD (02.00) be run for the following reasons.

   a) For WSFOs and WSOs, it is recommended that the first list in NSTATIONS be limited to 100 stations or less and be identical to the second list. The other ADAP programs will execute faster, and it will be easier to edit incorrect or missing stations in a shorter file.

   b) The graphic (NMCGPHPOA -- map background B02) that is produced will display on SWIS. (Previous version (01.00) would not display all data on SWIS.)

   c) Stations not in the STDIR.MS will be displayed on the Dasher. These missing stations would be a source of errors in later programs. Also, this will make it easier to find typographical errors in NSTATIONS.

   d) Since hourly observations can be in error or missing, it is recommended that all stations within and close to the edge of the grid be included in the first and second list of NSTATIONS. Stations must report temperature, dew point, wind direction and speed, and altimeter. Try to include stations that are close together as they will serve to "backup" one another in the event one is missing or in error.

   e) Version 02.00 will print the latitude and longitude of all four corner points. These corner points can be used as input with programs such as MDRPLT (Newton 1984), MDRWATCH (Norman and Newton 1987). Thus, plotted MDR values can be overlayed on individual graphics from ADAP. Version 02.00 also prints the center point of the grid (i.e., grid point (8,8)).

If you are running BLDWXD for the first time, complete step 2.
If not, then edit NSTATIONS with E:F/ command and skip step 2.

2. Complete the preformat cccMCPNST (for your area of interest) and store in the database as a temporary scratch file such as cccWRKxxx. Save this temporary file as RDOS file NSTATIONS by typing the following command at an ADM.

   SAVE:cccWRKxxx NSTATIONS

3. From an ADM, enter the command

   RUN:BLDWXD (or just type BLDWXD at the Dasher)

4. The message "BLDWXD COMPLETED: OUTPUT IN FILE NMCGPHPOA" alerts on the ADM when the program finishes. (If initiated at the Dasher, you will not get this message.) At this point, the file WXDATA1.DT has been completed and the map showing the grid and stations is on NMCGPHPOA (and also the RDOS file MESOSGRID which can be displayed via DSP:MESOSGRID and overlaying map background B02).

   NOTE: Since you must use some of the information printed out by BLDWXD on the Dasher, it is strongly recommended that you keep the printout for 1) use in the following step, and 2) in case you need to rerun the program or change the initial conditions.

   The next steps describe how to create the map background for your specific site.

   If the map as shown by the area enclosed in the box in step 4 does not change, you do not have to run steps 5 through 7.

5. This step must be executed at the Dasher by typing

   ```
   BOXVIEW
   ```

   Boxview will ask for the lower left latitude and longitude as well as the lower right latitude and longitude. The information you just input is on the dasher printout from Step 3. After you input the lower left lat, lon, strike RETURN and it will ask for the lower right lat, lon. After this, again strike RETURN and it will ask for the map selection. Enter 2 and strike RETURN. The program will finish by outputing files BOXVIEW.PF and BOXVIEW.CF to the disk. The files must be renamed according to the map background you want to use at your site.

6. Rename the files by typing at the Dasher

   ```
   RENAME BOXVIEW.PF NAxx.PF      (where xx is the map
   RENAME BOXVIEW.CF NAxx.CF      . background number)
   ```

7. Generate the map background by typing at the Dasher

   ```
   HCOPY B02 NAxx.CF   (xx is again the map background
                        number you want to use)

   GENUTF XPLOT Bxx    (xx is map background number)
   ```

   For additional information on HCOPY and GENUTF, see PMOD plotting system for AFOS, R. A. Davis, 1983.

8. Generate the three panel map background by executing the macro B3P.MC (shown here)

   ```
   HCOPY B18 ULPMESO.PF B18 URPMESO.PF B18 LLPMESO.PF
   GENUTF XPLOT B68
   ```

NOTE: Change B18 to agree with map background generated in step 7 and B68 to your map background number that can be used for a three panel graphic.

ERROR MESSAGES

Error messages from BLDWXD will be typed at the Dasher. They are as follows:

1 OPEN ERROR-NSTATIONS
2 CLOSING ERROR-NSTATIONS (Check to make sure file NSTATIONS is on SYSZ and is complete.)
3 ERROR CREATING WXDATA1.DT
4 CHANNEL ERROR-WXDATA1.DT
5 OPEN ERROR-WXDATA1.DT
6 WRITING ERROR 1-WXDATA1.DT
7 WRITING ERROR 2-WXDATA1.DT
8 WRITING ERROR 3-WXDATA1.DT
9 WRITING ERROR 4-WXDATA1.DT
10 CHANNEL ERROR STDIR.MS
11 OPEN ERROR-STDIR.MS
12 READ ERROR-STDIR.MS
13 ***CHECK XYZ-NOT FOUND IN STDIR.MS*** (XYZ is the station ID -- the station was not in STDIR.MS- add it to STDIR.MS if needed.)
14 CLOSING ERROR-STDIR.MS
15 WRITE ERROR-WXDATA1.DT
16 WRITE ERROR (UPPER AIR)-WXDATA1.DT
17 CLOSING ERROR-WXDATA1.DT (Check input from NSTATIONS and if necessary rerun BLDWXD.)

If the proper files exist, there may be a system or disk problem if these errors occur (except for error number 13).

Program to SAVe surface OBServations

Part A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: SAVOBS

AAL ID:
Revision No: 02.00

PURPOSE: This program will perform an error check of previously decoded data (SAODATA) and format the data for display and/or editing on an AFOS ADM. This data can be replotted once it has been updated and the updated data set can be saved on floppy disk after a significant weather event. SAVOBS must be run before CHG or MESOS. The only changes from Revision 01.00 involve the pressure error checking cut-off increased from 3 to 5 standard deviations (see local switch S which allows for operator input cutoff) and a change to allow for stations not in alphabetical order (from node to node and within node). These changes are transparent in the normal operation of the program.

PROGRAM INFORMATION

Development Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Phone: FTS 334-2671

Maintenance Programmer:
Phillip D. Bothwell

Location:
Same
Phone: Same

Language: Fortran IV/Rev 5.57

Type: Standard

Save file creation dates: SAVOBS.SV
Original Release/Rev. 01.00 8/3/85
Second Release/Rev. 02.00 10/23/87

Running time: 25-30 seconds (maximum) depends on number of stations.

Disk space:

Program Files	- 43 Blocks
Data Files	- 11 Blocks maximum (each SAxxZ.DT file). Length depends on number of stations.
	- 10 Blocks (SAVOBS.DT)

PROGRAM REQUIREMENTS

Program Files:

NAME	COMMENTS
SAVOBS.SV	

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
SAxxZ.DT	SYSZ	R/W	xx refers to the hour of the data (GMT hour). (e.g. SA18Z.DT is hourly surface data for 18Z.) Up to 24 files (each a maximum of 11 blocks) can accumulate in one day. Can be edited.
SATMP.DT	SYSZ	W	24 hour old data.
SAVOBS.DT	SYSZ	W	Listing of erroneous data and missing data. Only one file. (SAxxZ.DT, SATMP.DT, and SAVOBS.DT may be displayed at the ADM/GDM by typing DSP:FILENAME).
WXDATA1.DT	Appropriate directory (Linked from SYSZ)	R	(Cannot be displayed at ADM)
SAODATA	SYSZ	R	Output from program SAODEC

AFOS Products: None

LOAD LINE

SAVOBS: RLDR SAVOBS BLK STDCK CKLST WRTDTA BG.LB UTIL.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION*

1. Move the program SAVOBS.SV from DP3 to appropriate directory.

2. From SYSZ, link to SAVOBS.SV on appropriate directory.

These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Program to SAVe surface OBServations

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: SAVOBS

AAL ID:
Revision No. 02.00

PROGRAM EXECUTION

1. The program is executed simply by typing (at an ADM)

   RUN:SAVOBS [s/S] .

   Local switch S is optional.

   It is strongly recommended that this program be included in the local surface observation decoder/plotting AFOS macro. It requires SAODATA, the output from SAODEC. Once it is included in the surface AFOS macro, the program will run automatically with no forecaster intervention (except to correct and/or add data).

   When the program finishes the messages

   SAVOBS COMPLETED:OUTPUT IN FILE SAxxZ.DT
   JOB SAVOBS COMPLETED: PRODUCT SAVOBS.DT STORED

   will alert your ADM. (xx will be the GMT hour.)
   To list all available SAxxZ.DT files at the ADM type
   L:SYSZ:/E SA-.DT .

ERROR MESSAGES (DASHER MESSAGES)

1. CHANNEL ERROR-WXDATA1.DT
2. OPEN ERROR-WXDATA1.DT
3. READ ERROR-1-WXDATA1.DT
4. READ ERROR 2-WXDATA1.DT
5. CLOSING ERROR-WXDATA1.DT
6. CHANNEL ERROR-SAODATA
7. OPEN ERROR-SAODATA
8. ERROR CREATING SAVOBS.DT
9. OPEN ERROR FOR SAVOBS.DT
10. READ ERROR 1-SAODATA
11. READ ERROR 2-SAODATA
12. CLOSING ERROR-SAODATA
13. CHANNEL ERROR-COMMAND LINE
14. NO DATA TO CHECK-PROGRAM SAVOBS TERMINATED (problem with input data)
15. CLOSING ERROR-SAODATA
16. CLOSING ERROR-SAVOBS.DT
17. OPEN ERROR (FOR READ)-SAXXZ.DT
18. OPEN ERROR (AFTER READ)-SAXXZ.DT
19. RENAMING ERROR-SATMP.DT
20. ERROR CREATING IFILE (IFILE is SAxxZ.DT where xx is the GMT hour)
21. OPEN ERROR (FOR WRITE)-SAXXZ.DT
22. CLOSING ERROR-SAXXZ.DT

#14 means that no stations were found in the file to check, so check SAODATA. Other errors are standard AFOS error messages and may indicate possible system or disk problems IF WXDATA1.DT and SAODATA are on SYSZ or linked to it from SYSZ to the appropriate directory.

Local switch S is optional and is usually not used. In the pressure checking routines, it is used to specify the range of valid pressures allowed. It specifies the number of standard deviations either side of the mean that pressure data will be allowed. The number may be one or two digits. The default (no switch) is five standard deviations either side of the mean. Pressures (either altimeter or sea level pressure) outside this range will be flagged in file SAVOBS.DT and as -99 in file SAxxZ.DT. If it is felt that valid pressures are being flagged as erroneous, increase the value specified by using switch S (i.e., to a number greater than 5). This will increase the range allowed by increasing the number of standard deviations either side of the mean of the pressure.

Program to take mandatory and significant UPpeR-air data and ForMaT it

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: UPRFMT

AAL ID:
Revision No.: 01.00

PURPOSE: This program is designed to take previously decoded upper-air data (TTBBD.SV) and format the data in a file (UPRDATAF.DT) so that it may be displayed and (if necessary) edited at an ADM. This program replaces MANDECF.SV.

PROGRAM INFORMATION:

Development Programmer: Phillip D. Bothwell	Maintenance Programmer: Phillip D. Bothwell
Location: Scientific Services Division Phone: FTS 334-2671	Location: Same Phone: Same
Language: Fortran IV/Rev 5.57	Type: Standard

Save file creation dates: UPRFMT.SV
Original Release/ Rev 01.00 2/15/88
Running time: Around 50 seconds.

Disk space: Program files - 41 Blocks
Data files - Approximately 12 Blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
TTBBD.SV	Data must first be decoded with this program. MUST be run first.
UPRFMT.SV	

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
mmddyyu.hh	SYSZ	R	UPRFMT.SV reads these files.
mmddyys.hh	SYSZ		(Output from TTBBD.SV)
UPRDATAF.DT	SYSZ	W	Formatted upper-air data. (To display this file type DSP:UPRDATAF.DT)
WXDATA1.DT	Appropriate directory	R	(This file cannot be displayed)

AFOS Products: NONE

LOAD LINE

UPRFMT: RLDR UPRFMT ISN11 RDWXD BG.LB UTIL.LB.THERMO.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION*

1. Move the program UPRFMT.SV from DP3 to appropriate directory.

2. From SYSZ, link these programs to appropriate directory.

These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Pressure (850 mb)-two digit number (85) multiplied by 10 to get actual mb
Height (meters)
Temperature (Degrees and tenths)
Dew point (Degrees and tenths)
700 mb
500mb
400 mb

```
UMN 85  1513  198  190 70  3085   106   26 50  5710   -79 -249 40  -999 -223 -283
    30  -999 -349 -384 25  -999  -451 -751 20  -999  -559 -859 15  -999 -645 -945
    10  -999 -645 -945 769ITHWX   166   36 916MAXTW  242  221
(100mb)
```

Pressure, temperature, and dew point* for Maximum wet-bulb potential temperature.

Pressure, temperature and dew point* for maximum saturation wet-bulb potential

*(Temperature and dew point all in degrees and tenths) Pressure in whole mb for these two levels)

Example of upper-air data as formatted by UPRFMT.SV (file UPRDATAF.DT)

Program to take mandatory and significant UPpeR-air data and ForMaT it

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: UPRFMT

AAL ID:
Revision No.: 01.00

PROGRAM EXECUTION

1. To execute the program at the ADM type:

RUN:UPRFMT [mm/M] [dd/D] [yy/Y] [tt/T]

These optional switches are for use with upper-air data from a previous day and/or time (e.g. post analysis). mm is the one or two digit month (i.e., 1-12), dd is the one or two digit day (according to GMT time), yy is the last two digits of the year (e.g., 87 for 1987), and tt is the time (e.g., 12 for 12Z). UPRFMT.SV should be included after TTBBD.SV at the end of the local station's upper-air plotting macro or in a decoding macro including TTBBD.SV. This way, the program will be executed every 12 hours after the upper-air data is in, and it will be done automatically with no forecaster intervention.

When the programs are finished, the messages

UPRFMT COMPLETED: OUTPUT IN UPRDATAF.DT

will alert at your console.

ERROR MESSAGES

1. CHANNEL ERROR-COMMAND LINE
2. ERROR GETTING CHANNEL KCHN
3. ERROR OPENING WXDATA1.DT
4. ERROR IN FIRST READ OF KCHN
5. ERROR IN LAST READ OF WXDATA.DT
6. ERROR IN KLOSING WXDATA1.DT
7. ERROR CREATING UPRDATAF.DT
8. CLOSING ERROR-UPRDATAF.DT

If you encounter any of these DASHER error messages, and WXDATA1.DT is on SYSZ or linked to it, there may be a system or disk problem. (REMEMBER, TTBBD MUST BE RUN BEFORE UPRFMT).

Program to compute wet-bulb potential UPpeR-air temperatures at grid points via Objective Analysis

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: UPROA

AAL ID:
Revision No.: 01.00

PURPOSE: This program will compute (for each sounding) then objectively analyze wet-bulb potential temperatures at 850, 700, 500, 400, 300, 250, 200, 150, 100, the maximum saturation wet-bulb potential temperature and the maximum wet-bulb potential temperature. The data is written to disk for later use by programs MESOS.SV and MAXTW.SV.

PROGRAM INFORMATION:

Development Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Phone: FTS 334-2671

Maintenance Programmer:
Phillip D. Bothwell

Location:
Same
Phone: Same

Language: Fortran IV/Rev 5.57

Type: Standard

Save file creation dates: UPROA.SV
Original Release/Rev 01.00 10/23/87

Running time: Approximately 4 minutes

Disk space: Program files - 35 Blocks
Data files - 35 Blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
UPROA.SV	TTBBD and UPRFMT must be run prior to running UPROA. UPROA replaces COMTP.

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
UPRDATAF.DT	SYSZ	R	Input data. (To display this, type DSP:UPRDATAF.DT)
UPROUT.DT	SYSZ	W	Output data. (This file cannot be displayed)
WXDATA1.DT	SYSZ	R	(This file cannot be displayed)

AFOS Products: NONE

LOAD LINE
UPROA: RLDR UPROA UPIN RDWXD UPRTP BG.LB THERMO.LB UTIL.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION

1. Move the program UPROA.SV from DP3 to appropriate directory.

2. From SYSZ, link UPROA.SV to appropriate directory.

   These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

   ADAP87 .

   The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Program to compute wet-bulb potential UPpeR air temperatures at grid points via Objective Analysis

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: UPROA

AAL ID:
Revision No.: 01.00

PROGRAM EXECUTION

1. To run the program (after TTBBD.SV and UPRFMT.SV have run), type

RUN:UPROA [ppp/P] .

Switch P is optional. It allows the user the option of choosing at which level above 500 mb (400, 300, 250, or 200 mb) to compute stability indices for MESOS. Default (no switches) is 300 mb. To compute stability indices at 500 mb and 400 mb, type

RUN:UPROA 400/P .

When the program finishes the message

UPROA COMPLETED: OUTPUT IN FILE UPROUT.DT

will alert at your console.

ERROR MESSAGES (DASHER MESSAGES)
1. ERROR GETTING CHANNEL IC IN FCOM
2. ERROR CREATING UPROUT.DT
3. ERROR OPENING CHANNEL FOR UPROUT.DT
4. ERROR GETTING CHANNEL KCHN
5. ERROR OPENING WXDATA1.DT
6. ERROR IN FIRST READ OF KCHN
7. ERROR IN LAST READ OF WXDATA1.DT
8. ERROR IN KLOSING WXDATA1.DT
9. ERROR OPENING UPRDATAF.DT
10. ERROR CLOSING ICHN
11. WEIGHT.LE.0...OA TERMINATED

The most likely source of errors if if WXDATA1.DT does not exist. If WXDATA1.DT and UPRDATAF.DT are on SYSZ or linked to it, there may be a system or disk problem. Error 11 indicates not enough data was available for the upper objective analysis. In this case, check data in UPRDATAF.DT. Some temperatures may have to be manually entered into UPRDATAF.DT (via E:F/UPRDATAF.DT) at 500 mb and the other pressure level desired if a large number of stations are missing.

Program to compute and plot CHanGes in surface data

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: CHG

AAL ID:
Revision No.: 02.00

PURPOSE: The program computes changes in temperature, dew point, wind direction, speed, and pressure (altimeter setting) for as many as 200 stations (100 or less is recommended - see BLDWXD Revision 02.00). Any time interval from one to twenty-four hours may be specified. The program creates a graphic of changes for display on an AFOS GDM or SWIS. CHG can also be used to replot surface data for AFOS and/or SWIS.

PROGRAM INFORMATION:

Development Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Phone: FTS 334-2671

Maintenance Programmer:
Phillip D. Bothwell

Location:
Same
Phone: Same

Language: Fortran IV/Rev 5.57

Type: Standard

Save file creation dates: CHG.SV
Original Release/Rev 01.00 5/03/85
Second Release/Rev 2.00 11/30/87

Running time: About 50 seconds (including graphic generation)
(Time depends on number of stations)

Disk space: Program files - 87 Blocks
Data files - 22 Blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
CHG.SV	
CHGMAC.MC, REPLOT.MC, SPC.MC, SC1.MC, SC2.MC, SWISCHG.MC, SWISSFC.MC	Macros to complete graphics
PMOD.SV, HCOPY.SV, GENUTF.SV	PMOD software

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
SAxx.DT	SYSZ	R	Two input files (SAxxZ.DT) are required to compute changes. Only one is required to replot data. (To display those files, type DSP:SAxxZ.DT where xx is the GMT hour)

AFOS PRODUCTS:

ID	ACTION	COMMENTS
NMCGPHSC1 (Map background B02)	STORED	This chart displays changes in temperature, dew point, wind direction, total altimeter changes (in hundredths inch), and altimeter change with average change of all stations subtracted out.
NMCGPHSC2 (Local map background)	STORED	Same as NMCGPHSC1 except on local map background compatible with other ADAP graphics.
NMCGPHSPC (3 panel map background)	STORED	Listing of stations with pressure fall of six hundredths or more and the amount of change. Average change of all stations is also listed.

LOAD LINE

CHG: RLDR CHG BLK2 RDCOM GETDTA APLTDT SPLTDT BNSCH BG.LB UTIL.LB TOP.LB UGG.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION*

1. Move CHG.SV from DP3 to the appropriate directory.
2. Move SPC.MC, SC1.MC, SC2.MC, SWISCHG.MC, CHGMAC.MC, REPLOT.MC and SWISSFC.MC to SYSZ.
3. From SYSZ, link CHG.SV to appropriate directory.

These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Program to compute and plot CHanGes in surface data

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: CHG

AAL ID:
Revision No.: 02.00

PROGRAM EXECUTION

1. It is recommended that CHG (no switches) be incorporated in an hourly surface decoding/plotting macro to produce 2 hourly changes automatically. To execute the program at the ADM type

```
RUN:CHG [/A]  [/L]  [/C]  [xx/X]  [yy/Y]  [pp/P]  [hh/H]  [zz/Z]
        [bbb/B] [eee/E]  [s/S]
```

GLOBAL SWITCHES (A, L, C) - Optional

/A - Plot temperature, dew point, wind direction and speed, and Altimeter for current hour. No other switches needed unless SWIS compatible graphic desired (local switch "S").

/L - Same as "/A" except sea Level pressure plotted in place of altimeter using data for current hour.

/C - Plot ONLY city locations on SWIS compatible graphic. Local switches "bbb/B" and "eee/E" can be used to specify which cities are plotted. Local switch "s/S" is not required. (Will default to current hour unless specified differently with local switches "X" and "Y".)

LOCAL SWITCHES - Optional

xx/X and yy/Y and pp/P remain unchanged from Revision 01.00. Change is computed from hour (GMT) "xx" to hour "yy" (GMT). Optional pressure change switch "pp/P" specifies amount (hundredths inch) of average altimeter setting change. Switches X and Y are not needed if two hour change from current hour is desired or switch H is used. Default (no X or Y switch) is 2 hour change from current hour.

hh/H - Time interval of change (in hours - up to 24 hours) from current hour. Local switches "X" and "Y" are not needed. Default (no switch) 2 hour interval; change from 2 hours prior to current hour.

zz/Z - Specifies zoom cutoff for stations to be plotted. Stations with zoom threshold larger than this will NOT be plotted (e.g. 4/Z to plot only stations with 4:1 and 1:1 zoom ratios. Useful if plot is to go to SWIS. Default (no switch) is to plot all stations for SWIS plot regardless of zoom.

bbb/B and eee/E - Start plotting stations beginning a station number bbb and ending in station number eee. bbb and eee can be 1, 2, or 3 digits (i.e., 1 to 200). Default is no switches.

s/S - Program will output a SWIS compatible plot.
s = 1 for half-mile subsector. s = 2 for half-mile full sector.
s = 3 for one-mile subsector. Default (no switch) is 3 (for one-mile subsector).

GRAPHIC GENERATION

Several possibilities exist for graphic generation. Graphics can be generated individually or in other AFOS macros, such as the ADAP macro. The ADAP macro includes CHGMAC and OUTMAC, both of which include smaller individual macros.

CHGMAC.MC - includes SPC.MC (graphic of station altimeter changes of 6 hundredths or more) and SC1.MC (station changes plotted on map background B02).

OUTMAC.MC - includes SC2.MC, a macro that replots the data on local map background (same background as other ADAP graphics).

REPLOTTING SURFACE DATA FROM FILES SAxxZ.DT for AFOS graphic. Surface data can be replotted via a macro such as REPLOT.MC. Note: To replot the current hour's data, use global switch A or L. To replot an hour that is not the current hour, use local switches X & Y (e.g., 99/X 21/Y for plot with altimeter at 21Z, or 49/X 21/Y for plot with sea level pressure at 21Z).

GENERATING A GRAPHIC FOR SWIS

A change chart can be generated for SWIS with the macro SWISCHG.MC. Surface data can be replotted by macro SWISSFC.MC. These macros have been set to plot (local switch S) on any "B" (one-mile) sub-sector satellite image. To plot on a SWIS "A" full sector (half-mile) image, use 2/S on the command line; and to plot on the SWIS "A" sub-sector, use 1/S.

When a macro is executed at an ADM, each graphic generated will alert at the ADM when it is finished. The AFOS graphic can also be set to alert the forecaster's ADM when it is finished, if the program is run automatically by one of several methods (e.g., TIMECHEK, AEX).

ERROR MESSAGES (DASHER MESSAGES)

1. ERROR-FCOM
2. OPEN ERROR-SAXXZ.DT
3. CLOSING ERROR-SAXXZ.DT
4. OPEN STDIR.MS ERROR
5. I1
6. RDS - IC1
7. I2
8. RDS-IC2
9. I5
10. 16
11. IER3
12. TOO MANY RECORDS IN FILE
13. KLOSING ERROR-STDIR.MS

ERROR MESSAGES (GRAPHICS NMCGPHSPC AND NMCGPHSC1(SC2))

STATIONS IN SAXXZ.DT DO NOT MATCH SAYYZ.DT

or

SAxxZ.DT MISSING

Check the input data files (SAxxZ.DT and SAyyZ.dt) if one of these errors occur. Data may be incorrect or missing in one or both files.

MESOS - Program to objectively analyze surface data

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: MESOS

AAL ID:
Revision No: 02.00

PURPOSE: Program objectively analyzes surface data using both time and distance Gaussian weighting schemes.

PROGRAM INFORMATION:

Development Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Fort Worth, Texas
Phone: FTS 334-2671

Maintenance Programmer:
Phillip D. Bothwell

Location:
Same

Phone: Same

Language: Fortran IV/REV 5.57

Type: Standard

Save file creation dates: MESOS.SV
Original Release/Rev 01.00 8/31/85
Second Release/Rev 02.00 2/15/88

Running time: Approximately 2 to 3 minutes (including graphic generation)

Disk space: Program files - 76 Blocks
Data files - Approximately 95 Blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
MESOS.SV	Main program
GENUTF.SV	Generates graphics from Internal Product Files (IPF) created by MESOS.SV
MESOSMAC.MC, SSL.MC, SSU.MC, SSC.MC, SMC.MC, STA.MC, SMR.MC	Macro that generates graphics from IPFs in MESOS.

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
WXDATA1.DT	Appropriate Directory	R	(This file cannot be displayed)
SAxxZ.DT	SYSZ	R	xx is the GMT hour. Up to 3 hourly files may be used at one time. (To display this file, type DSP:SAxxZ.DT)

Data Files (Continued):

NAME	DP LOCATION	READ/WRITE	COMMENTS
UPROUT.DT	SYSZ	R	Upper-air data file containing grid point data. (This file cannot be displayed). Output from UPROA.SV.
SFCOUTxxZ.DT	SYSZ	W	Grid point output for use in program OACHG.SV. (This file cannot be displayed on an ADM.)

Internal Product Files (SLPLOT, SUPLOT, SCPLOT, MCPLOT, TAPLOT, and MRPLOT) are R/W on SYSZ.

AFOS Products:

ID	ACTION	COMMENTS
NMCGPHSSL	STORED	Stability Index at 500 mb (Based on surface parcel)
NMCGPHSSU	"	Stability Index at user specified level (400, 300, 250, or 200 mb. Default 300 mb)
NMCGPHSSC	"	Strength of Capping Inversion
NMCGPHSMC	"	Surface Moisture Flux Convergence (Positive is moisture convergence)
NMCGPHSTA	"	Advection of Potential Temperature (Positive is warm advection)
NMCGPHSMR	"	Surface Mixing Ratio

LOAD LINE

```
MESOS: RLDR MESO BLK4 SETUP INPUT DAYTST ORDER FMIX WEIGHT SFCDER
       OAOUT BG.LB UTIL.LB UGG.LB THERMO.LB FORT.LB
       AFOSE.LB
```

PROGRAM INSTALLATION*

1. Move the program MESOS.SV from DP3 to the appropriate directory
2. Move MESOSMAC.MC, SSC.MC SSL.MC, SMC.MC STA.MC, SMR.MC, to SYSZ.
3. From SYSZ, link MESOS.SV to appropriate directory.

These instructions/commands are included in the macro included on the floppy in DP3 (MESOS-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87.

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCE TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIES THIS INSTRUCTION PACKAGE.

MESOS - Program to objectively analyze surface data

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: MESOS

AAL ID:
Revision No.: 02.00

PROGRAM EXECUTION

1. The program can run without any switches, but local switches add enhanced capabilities to the program as follows.

   MESOS [tt/T] [w/W] [pppp/P]

   a. Switch T refers to the initial time of the observation (e.g., tt is 17 for 17Z). By default (no switch), the program will use the current hour. The program also uses data from one and two hours previous to the initial hour in the Gaussian (exponential) time weighting. The only requirement is that the initial hour data be present. The program can run just on the initial hour, the initial hour and one hour prior, etc.

   b. Switch W refers to the distance weights used by the program. Default is weight table 2. (i.e., local switch W not used) (Recall not the printout from BLDWXD.SV, the program you used to build WXDATA1.DT) In the printout, the AVERAGE STATION SPACING IN KM was printed out. This is the average distance from each station to its nearest neighbor. In MESOS, there are 3 sets of distance weights or "weight tables." Weight table 1 corresponds to an average station spacing of 100 km. Weight table 2 is for an average station spacing of 125 km. Weight table 3 is for an average station spacing of 150 km. You should use a weight table that would be equal to or slightly larger than your average station spacing. (e.g., If the average station spacing according to BLDWXD was 115 km, then you should use weight table 2 (125 km)). This variable distance weighting was included in the program since data density varies from state to state (and from day to night).

   c. Switch P refers to the pressure level that stations temperatures are reduced to. Default pressure is 1000 mb. You can use a pressure near the center of the grid (e.g., 970 mb). With this switch, all temperatures are reduced to a constant pressure surface which is a nearly horizontal plane. From this data, THETA (potential temperature) advection (NMCGPHSTA) is calculated. This removes spurious warm/cold advection centers from elevated terrain sources that would contaminate the results.

EXAMPLE

WSFO XXX has data files SA18Z.DT, SA17Z.DT, and SA16Z.DT. The average station spacing was calculated at 96.75 km. Near the center of the grid, the station pressure (converted to mb) is approximately 980 mb. The command line would be typed as

RUN:MESOS 18/T 1/W 980/P .

(Remember, the program will use the data from 17 and 16Z, and generally produce a better analysis. However, only data from 18Z was necessary.)

At this point, it is important to note that no graphics have yet been generated. The Internal Produce Files (IPFs) are what is generated. To generate the graphics (NMCGPH...), a macro called MESOSMAC.MC has been set up. To run this, type

RUN:MESOSMAC .

MESOSMAC.MC is actually a set of macros, each of which can be run individually. It is composed of the following,

SSL.MC - NMCGPHSSL (STABILITY INDEX AT 500 MB)

SSU.MC - NMCGPHSSU (STABILITY INDEX AT 400, 300, 250, OR 200 MB)

SSC.MC - NMCGPHSSC (STRENGTH OF CAPPING INVERSION)

SMC.MC - NMCGPHSMC (SURFACE MOISTURE FLUX CONVERGENCE)

STA.MC - NMCGPHSTA (ADVECTION OF TEMPERATURE ON A CONSTANT PRESSURE SURFACE. i.e., Theta (potential temperature) advection)

SMR.MC - NMCGPHSMR (SURFACE MIXING RATIO)

To produce the graphic NMCGPHSMC, just type

RUN:SMC .

The individual macros will alert at the ADM when they are complete.

ERROR MESSAGES

1. NO INITIAL HOUR FOUND..MESO ANALYSIS TERMINATED-This means that it could not find any surface data for the initial hour specified. If you get this dasher message, recheck the data by typing

   DSP:SAxxZ.DT . (xx is the GMT hour)

2. Errors will occur if SAVOBS (for the initial hour) or TTBBD, UPRFMT, UPROA(every 12 hours) were not run, or successfully completed.

Other errors (not listed here) would come from opening and closing files and in channel use. These errors (if they were to occur), would likely be from system or disk problems.

Program to compute Objective Analysis grid point CHanGes

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: OACHG

AAL ID:
Revision No.: 02.00

PURPOSE: Program will compute changes in grid point values of altimeter setting, moisture flux convergence, and mixing ratio per hour, and average Theta advection from one to twenty-three hours. Twenty-four hour grid point changes are not computed.

PROGRAM INFORMATION

Development Programmer:
Phillip D. Bothwell

Maintenance Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Phone: FTS 334-2671

Location:
Same
Phone: Same

Language: Fortran IV/Rev 5.57

Type:Standard

Save file creation dates: OACHG.SV
Original Release/Rev 01.00 8/31/85
Second Release/Rev 02.00 3/4/88

Running time: About 90 seconds.

Disk space: Program files - 54 Blocks
Data files - 58 Blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
OACHG.SV	Requires OACHGMAC.MC to produce AFOS graphics from Internal Product Files.
OACHGMAC.MC, SAC.MC, SQC.MC, SCC.MC, SAA.MC, SS1.MC, SS2.MC, SS3.MC, OUTMAC.MC, ADAP.MC	Macros that generate graphics
GENUTF.SV	

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
SFCOUTxxZ.DT	SYSZ	R	xx is the GMT hour. Requires two hours.
ACPLOT			
CCPLOT			
QCPLOT			
AAPLOT	SYSZ	R/W	Internal Products Files

AFOS Products:

ID	ACTION	COMMENTS
NMCGPHSAC	Stored	Grid point total altimeter change
NMCGPHSCC	Stored	Grid point total moist. flux convg. change
NMCGPHSQC	Stored	Grid point mixing ratio change per hour
NMCGPHSAA	Stored	Grid point average Theta advection

LOAD LINE

OACHG: RLDR OACHG BLK4 TMCHG CHGOUT BG.LB UTIL.LG UGG.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION*

1. Move the program OACHG.SV from DP3 to appropriate directory.
2. Move the macros OACHGMAC.MC, SAC.MC, SCC.MC, SQC.MC, SAA.MC, SS1.MC, SS2.MC, SS3.MC, OUTMAC.MC, and ADAP.MC from DP3 to SYSZ.
3. From SYSZ link SAVOBS.SV to appropriate directory.

These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Program to compute Objective Analysis grid point CHanGes

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: OACHG

AAL ID:
Revision No.: 02.00

PROGRAM EXECUTION

1. This program is executed by typing

RUN:OACHG [xx/X] [yy/Y] [hh/H]
RUN:OACHGMAC .

xx refers to the oldest hour and yy refers to the most recent hour. The changes are computed from time xx to time yy. hh is the number of hours of the desired interval. xx and yy can be specified, or hh can be specified and program will use current hour and the hour "hh" hours previous. Default (no switches) will be two hour changes from current hour.

RUN:OACHG 15/X 17/Y (or RUN:OACHG after MESOS.SV at 17Z)
or
RUN:OACHG 3/H - computed 3 hour change from current (GMT) hour

(Note that MESOS must have been run for the two times, and there is the additional stipulation that the weights (the distance weighting in MESOS) MUST be the same both times it was run. Otherwise, the program will abort.)

A macro, OACHGMAC.MC will plot the AFOS graphics from Internal Product Files. It is

RUN:SAC.MC - Generates NMCGPHSAC (total altimeter change at grid points)
RUN:SCC.MC - Generates NMCGPHSCC (total moist. flux convg. change at grid points)
RUN:SQC.MC - Generates NMCGPHSQC (change in mixing ratio per hour at grid points)
RUN:SAA.MC - Generates NMCGPHSAA (average Theta advection)

The individual macros will alert at the ADM when they are complete.

ERROR MESSAGES (DASHER MESSAGES)

1. CHANNEL ERROR-SFCOUTXXZ.DT
2. OPEN ERROR-SFCOUTXXZ.DT
3. CHANNEL ERROR-SFCOUTYYZ.DT
4. OPEN ERROR-SFCOUTYYZ.DT
5. READ ERROR-SFCOUTYYZ.DT
6. READ ERROR 1
7. READ ERROR 2
8. READ ERROR 3
9. READ ERROR 4

Errors 1 and 3 may mean a system problem.
Errors 2 and 4-9 may indicate problems with the data, rerun MESOS.SV for the offending hour.

GRAPHIC MESSAGES

WEIGHTS UNEQUAL

The weights for the two hours were not the same. Rerun MESOS.SV so that both hours have the same weight (switch W in MESOS.SV command line)

NO DATA RUN MESOS FOR XXZ FIRST

Program could not find the input data generated by MESOS.SV You should check the data. A listing of the files can be obtained by typing

```
L:SYSZ:/E SFCOUT-Z.DT
```

Program to produce STReaMlines and/or wind plot
of surface data

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: STRM

AAL ID:
Revision No.: 01.00

PURPOSE: This program is designed to produce a plot of surface streamlines and/or wind barb plots from the U and V wind components as computed and written to disk by MESOS.SV.

PROGRAM INFORMATION:

Development Programmer:
Phillip D. Bothwell

Maintenance Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Fort Worth, TX
Phone: FTS 334-2671

Location:
Same
Phone: Same

Language: Fortran IV/Rev 5.57

Type: Standard

Save file creation dates: STRM.SV
Original Release/Rev 01.00 1/21/88

Running time: Approximately 20 seconds

Disk space: Program files - 35 Blocks
Data files - 29 Blocks

PROGRAM REQUIREMENTS

Program files

NAME	COMMENTS
STRM.SV	Program is run after MESOS.SV
STRMMAC.MC	Generates NMCGPHSSW (includes SSW.MC)
SSW.MC	Generates NMCGPHSSW

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
SFCOUTXXZ.DT	SYSZ	R	Output file from MESOS.SV.

AFOS PRODUCTS:

ID	ACTION	COMMENTS
NMCGPHSSW	Stored	Plot of Streamlines and/or wind barb plots from grid point locations in MESOS.SV.

LOAD LINE

STRM: RLDR STRM BLK4 UVOUT BG.LB UTIL.LB UGG.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION

1. Move STRM.SV from DP3 to the appropriate directory.
2. From SYSZ, link to STRM.SV on the appropriate directory.
3. Move STRMMAC.MC and SSW.MC to SYSZ.

These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Program to produce STReaMlines and/or wind plot
of surface data

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: STRM

AAL ID:
Revision No.: 01.00

PROGRAM EXECUTION

1. To run the program (after MESOS.SV has run), type

RUN: STRM [/B] [/S] [tt/T]

Default is no switches in which case the program will use data from the current (GMT) hour in file SFCOUTttZ.DT (from MESOS.SV) and will produce a graphic (NMCGPHSSW) of both streamlines and wind barbs plots at the grid points. If a time other than the current hour is needed, then tt is the GMT hour desired (e.g., 11/T for 1100 GMT).

To produce a plot of only streamlines (no wind barbs), use local switch S. To produce a plot of only wind barb plots, use local switch B. The default (no switches) was chosen to plot both streamlines and wind barbs together since streamlines show direction, and the wind barbs indicate the speed, thus they both complement each other.

To produce the graphic NMCGPHSSW, just type either

RUN:STRMMAC
OR RUN:SSW .

The graphic will alert at the ADM when it is stored.

ERROR MESSAGES (1-5 ARE DASHER MESSAGES)

1. ERROR-FCOM
2. CHANNEL ERROR-SFCOUTXXZ.DT
3. OPEN ERROR-SFCOUTXXZ.DT
4. READ ERROR-SFCOUTXXZ.DT
5. READ ERROR-1
6. NO DATA-RUN MESOS FOR XXZ FIRST. (Error message produced on graphic NMCGPHSSW when there is no data (i.e., MESOS has not been run for the particular hours.)

Other errors (not listed here would come from opening and closing files and in channel use. These errors, if they were to occur, would likely be from system disk problems.

Program to calculate stability indices and cap strength based on MAXimum wet-bulb potential temperature (Theta-W)

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: MAXTW

AAL ID:
Revision No.: 01.00

PURPOSE: This program is designed to compute stability indices and cap strength (similar to MESOS.SV) from the grid-point maximum wet-bulb potential temperature as determined by program UPROA.SV. The program UPROA.SV has objectively analyzed the maximum wet-bulb potential temperature from each sounding (the lowest 300 mb) in the file UPRDATAF.DT. Thus, the maximum wet-bulb potential temperature may not be (and often is not) at the surface. Useful at night or in the case of shallow fronts.

PROGRAM INFORMATION:

Development Programmer:
Phillip D. Bothwell

Maintenance Programmer:
Phillip D. Bothwell

Location:
Scientific Services Division
Fort Worth, TX
Phone: FTS 334-2671

Location:
Same
Phone: Same

Language: Fortran IV/Rev 5.57

Type: Standard

Save file creation dates: MAXTW.SV
Original Release/Rev 01.00 2/15/87

Running time: Approximately 30 seconds

Disk space: Program files - 38 Blocks
Data files - 23 Blocks

PROGRAM REQUIREMENTS
Program files

NAME	COMMENTS
MAXTW.SV	Program can be run after UPROA.SV
MAXTWMAC.MC	
SXL.MC, SXU.MC, SXC.MC, SS4.MC	Macros to generate graphics

Data Files:

NAME	DP LOCATION	READ/WRITE	COMMENTS
UPROUT.DT	SYSZ	R	Output file from UPROA.SV. (cannot be displayed)
WXDATA1.DT	APPROPRIATE DIRECTORY	R	(Cannot be displayed)

AFOS Products:

ID	ACTION	COMMENTS
NMCGPHSXL	Stored	Stability index at 500 mb based on max Theta-W.
NMCGPHSXU	Stored	Stability index at either 400, 300, 250, or 200 mb (default 300 mb) based on max Theta-W.
NMCGPHSXC	Stored	Cap strength based on Maximum Theta-W.
NMCGPHSS4	Stored	3 panel graphic (includes NMCGPHSXL, (SXU), and (SXC)).

LOAD LINE

MAXTW: RLDR MAXTW BLK4 RDWXD OAOUT BG.LB UGG.LB UTIL.LB FORT.LB AFOSE.LB.

PROGRAM INSTALLATION*

1. Move MAXTW.SV from DP3 to the appropriate directory.
2. From SYSZ, link to MAXTW.SV on the appropriate directory.
3. Move SXL.MC, SXU.MC, SXC.MC and SS4.MC to SYSZ.

These instructions/commands are included in the macro included on the floppy in DP3 (ADAP87-SETUP) and will be performed automatically once you direct to DP3 and execute the command (from the Dasher)

ADAP87 .

The macro ADAP87.MC will assume the appropriate directory is APPL1. This can be changed by editing the macro.

*ALL REFERENCES TO DP3 REFER TO THE FLOPPY THAT ACCOMPANIED THIS INSTRUCTION PACKAGE.

Program to calculate stability indices and cap strength based on MAXimum wet-bulb potential temperature (Theta-W)

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: MAXTW

AAL ID:
Revision No.: 01.00

PROGRAM EXECUTION

1. To run the program (after UPROA.SV has run), type

RUN: MAXTW [ppp/P]

Default is no switches in which case the program will use data from 300 mb for the upper level stability index. Local switch P can be used to calculate an upper-level stability index at 400, 250, or 200 mb if needed.

To produce the graphic NMCGPHSXL, NMCGPHSXU, NMCGPHSXC, just type

RUN:SXL

RUN:SXU

RUN:SXC

The graphic(s) will alert at the ADM when stored.

To produce a three panel graphic of NMCGPHSXL, (SXU) and (SXC), type

RUN:SS4

or RUN:MAXTWMAC (Does SXL, SXU, SXC and SS4)

ERROR MESSAGES (Dasher)

1. ERROR GETTING CHANNEL KCHN
2. ERROR IN OPENING WXDATA1.DT
3. ERROR IN FIRST READ OF KCHN
4. ERROR IN LAST READ OF WXDATA1.DT
5. ERROR IN KLOSING WXDATA1.DT
6. CHANNEL ERROR-UPROUT.DT
7. OPEN ERROR-UPROUT.DT (This will occur if UPRFMT and UPROA have not been executed. The necessary data has not been output to UPROUT.DT.)
8. READ ERROR 1-UPROUT.DT
9. ERROR KLOSING ERROR-UPROUT.DT

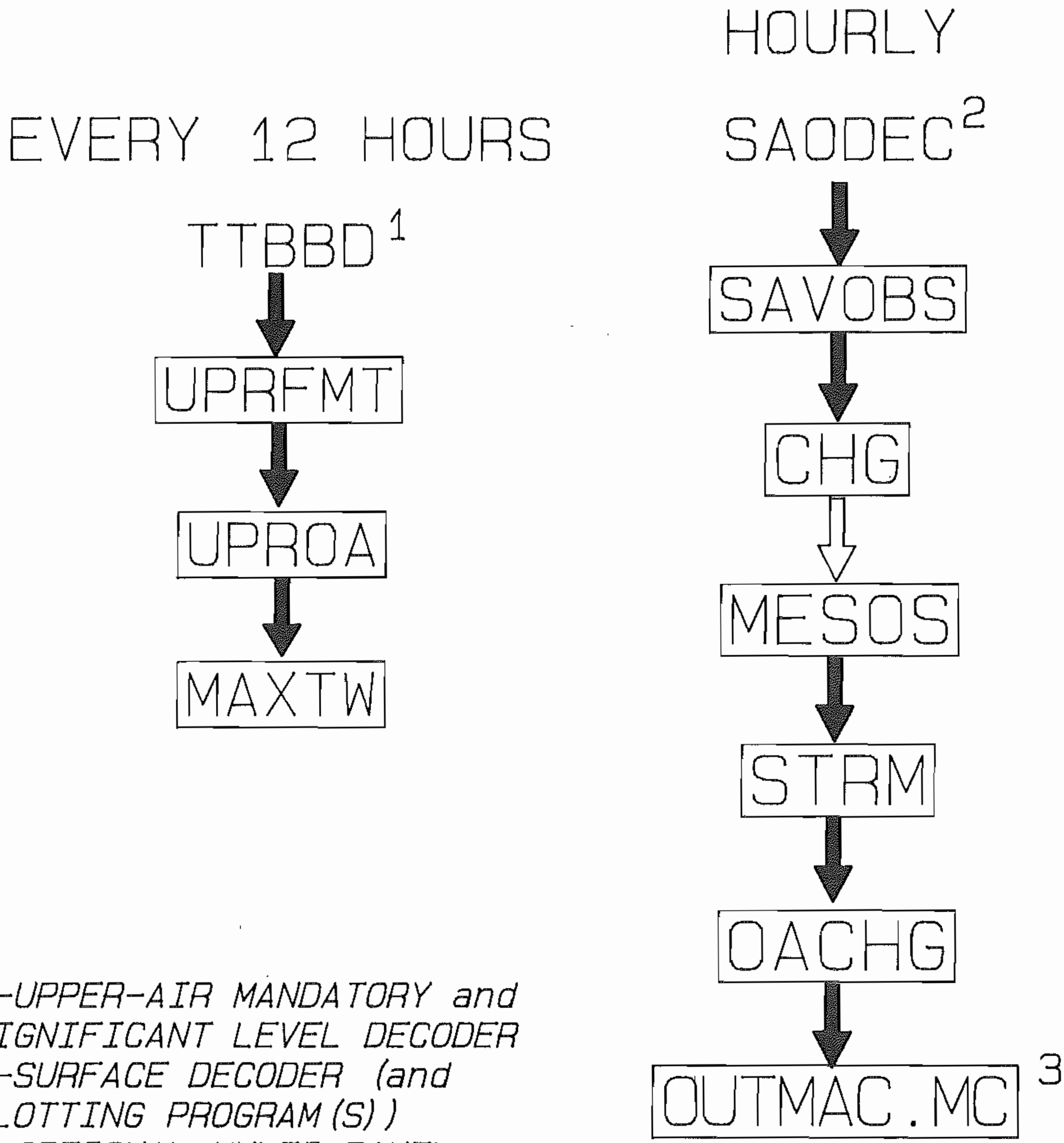
Other errors (not listed here) would come from opening and closing files and in channel use. These errors (if they were to occur), would likely be from system or disk problems.

APAP87.MC Listing

```
MESSAGE *****BEGINNING ADAP87-SETUP PROCEDURE...DELETING OLD FILES FIRST*****
DIR APPL1
GDIR
MESSAGE                          *****
MESSAGE *****NOW DELETING OLD FILES ON APPL1*****
MESSAGE                          *****
CHATR BLDWXD.SV 0 SAVOBS.SV 0 CHG.SV 0 MESOS.SV 0 COMTP.SV 0 MANDECF.SV 0
CHATR OACHG.SV 0
DELETE/V BLDWXD.SV SAVOBS.SV CHG.SV MESOS.SV COMTP.SV MANDECF.SV OACHG.SV
DIR SYSZ
GDIR
MESSAGE                          *****
MESSAGE *****NOW DELETING OLD FILES ON SYSZ*****
MESSAGE                          *****
DELETE/V STW.MC SSL.MC SSU.MC SMC.MC SWC.MC STH.MC STA.MC SMR.MC SRV.MC
DELETE/V SAC.MC SCC.MC SRC.MC CHG1.PM CHG2.PM MESOSMAC.MC OACHGMAC.MC
DELETE/V CHGMAC.MC REPLOT.MC SPC.MC SS1.MC SS2.MC SS3.MC SS4.MC
DELETE/V UPRDATAF.DT UPROUT.DT SFCOUT-.DT
DIR DP3
GDIR
MESSAGE                          *****
MESSAGE *****NOW ON DP3 TO MOVE NEW FILES TO SYSZ*****
MESSAGE                          *****
MOVE/A/V SYSZ SAA.MC SAC.MC SC1.MC SC2.MC SCC.MC SMC.MC SMR.MC SPC.MC
MOVE/A/V SYSZ SQC.MC SS1.MC SS2.MC SS3.MC SS4.MC SSC.MC SSL.MC SSU.MC
MOVE/A/V SYSZ SSW.MC STA.MC STRMMAC.MC SWISCHG.MC SWISSFC.MC
MOVE/A/V SYSZ SXC.MC SXL.MC SXU.MC ULPMESO.PF URPMESO.PF LRPMESO.PF
MOVE/A/V SYSZ LLPMESO.PF B3P.MC CHGMAC.MC MESOSMAC.MC OACHGMAC.MC
MOVE/A/V SYSZ MAXTWMAC.MC PREFORMAT OUTMAC.MC ADAP.MC REPLOT.MC
MESSAGE                          *****
MESSAGE *****NOW MOVING MAIN PROGRAMS TO APPL1*****
MESSAGE                          *****
MOVE/A/V APPL1 SAVOBS.SV CHG.SV MESOS.SV OACHG.SV STRM.SV MAXTW.SV
MOVE/A/V APPL1 UPRFMT.SV UPROA.SV BLDWXD.SV
DIR SYSZ
GDIR
RELEASE DP3
MESSAGE                          *****
MESSAGE *****NOW DIRECTING TO SYSZ AND RELEASING DP3*****
MESSAGE *****FINAL STEP IS TO ESTABLISH LINKS TO PROGRAMS FROM*****
MESSAGE       SYSZ TO APPL1 AND GETTING RID OF OLD LINKS
MESSAGE       NO LONGER NEEDED.
MESSAGE                          *****
UNLINK COMTP.SV
UNLINK MANDECF.SV
LINK UPRFMT.SV APPL1:UPRFMT.SV
LINK UPROA.SV APPL1:UPROA.SV
LINK STRM.SV APPL1:STRM.SV
LINK MAXTW.SV APPL1:MAXTW.SV
MESSAGE   ............................................
MESSAGE ***JOB COMPLETE.    REMOVE FLOPPY FROM DP3***
```

APPENDIX B ADAP OVERVIEW

ADAP PROCEDURE



1-UPPER-AIR MANDATORY and SIGNIFICANT LEVEL DECODER
2-SURFACE DECODER (and PLOTTING PROGRAM(S))
3-OPTIONAL MULTI-PANEL AFOS GRAPHIC MACRO
[SOLID ARROWS INDICATE PROGRAMS NORMALLY EXECUTED TOGETHER (i.e., in AFOS Macros)]

AFOS multi-panel parameter text files

0
0
2048
1536
50
0
0
0
768
-10
-100
0

ULPMESO.PF

0
0
2048
1536
50
0
0
1024
768
-10
-100
0

URPMESO.PF

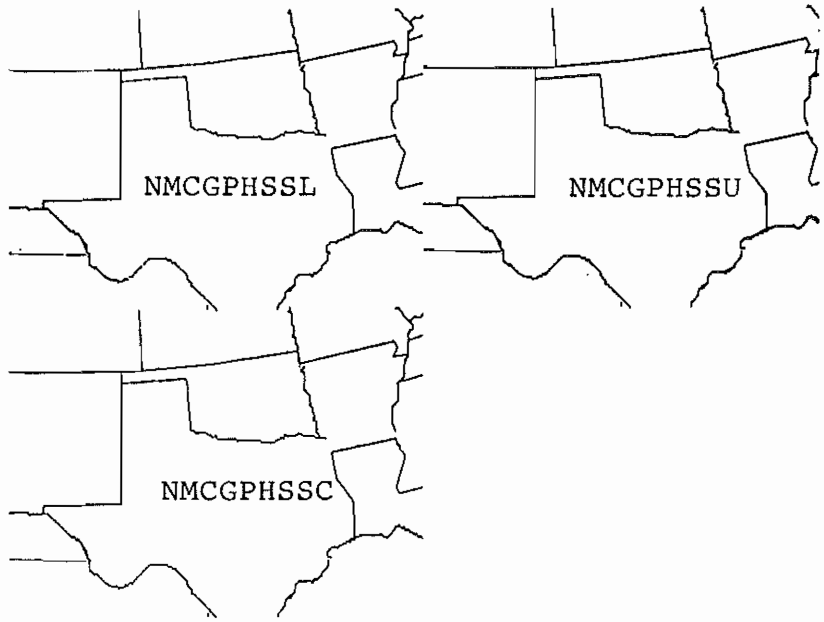
0
0
2048
1536
50
0
0
0
0
-10
-100
0

LLPMESO.PF

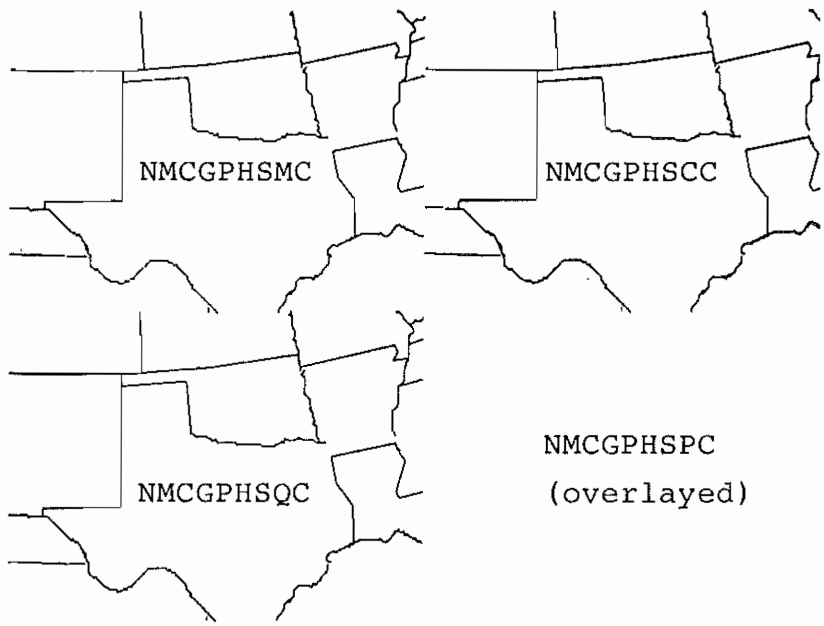
0
0
2048
1536
50
0
0
1024
0
-10
-100
0

LRPMESO.PF

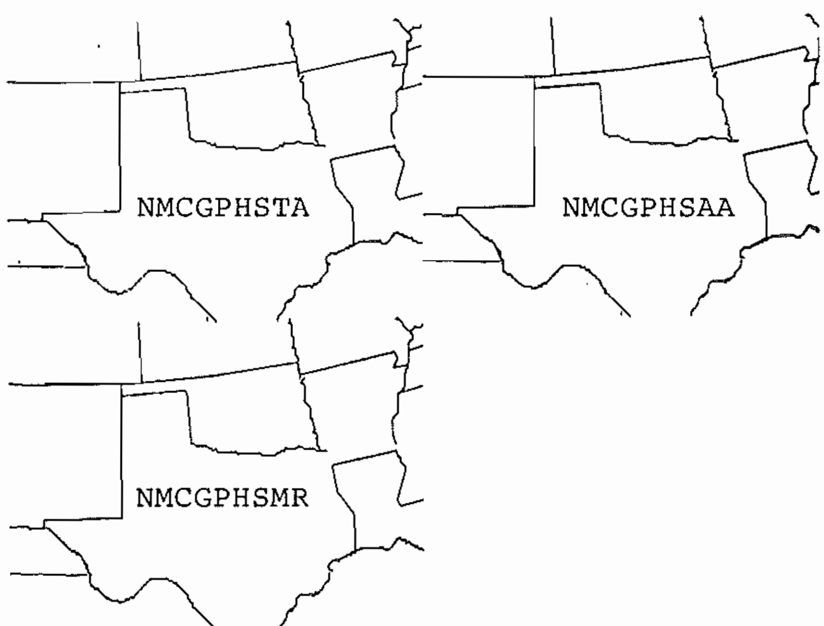
Examples of Multi-panel graphics



NMCGPHSS1



NMCGPHSS2



NMCGPHSS3

APPENDIX C

TRANSFORMATION OF ADAP GRAPHICS TO THE SATELLITE WEATHER INFORMATION SYSTEM (SWIS)

With the advent of the PMOD software, we have been able to create local and regional map backgrounds using B02 as the original or "parent" map background. We have been able to take graphics such as the radar map (NMCGPH90R) on map background B02 and transfer them to regional or local map backgrounds.

The reverse process, transferring one of the products with a regional or local map background back to the "parent" background, can also be done with PMOD parameter text files (-.PF and -.CF). In this manner, the ADAP graphics can be overlayed on SWIS. Roger Davis has supplied the basic transformation equations. The new parameter text file will have the extension (-.CF) since it creates a "large" (4096 x 3072 pixels) AFOS graphic. The original -.PF file was generated from program BOXVIEW when ADAP was set up with program BLDWXD. Here are the transformation equations for a typical -.PF file.

Original -.PF file	New -.CF file
IOFF = 907	IOFF' = 0
JOFF = 283	JOFF' = 0
ICHRT = 2048	ICHRT' = 4096
JCHRT = 1536	JCHRT' = 3072
ISCAL = 514	ISCAL' = (10000/ISCAL)*2 = 38
ICANT = 1305	ICANT' = ICNT-IOFF = 398
JCANT = 283	JCANT' = JOFF-JCNT = 0
NROT = 0	NROT' = IOFF*2 = 1814
JSTRIP= 0	JSTRIP'= JOFF*2 = 566
LDENS = -1	LDENS' = -10
ITLE = 926	ITLE' = ITLE OR 0
JTLE = 333	JTLE' = JTLE OR 0

Titles will likely not appear in the proper location the first time you attempt this. Experiment with ITLE and JTLE until you get the title where you want. See section 3.6 and Bothwell (1987a) for examples of ADAP graphics on SWIS.