

NOAA Technical Memorandum NWS SR-151

PENINSULAR FLORIDA TORNADO OUTBREAKS

(1950-1993)

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January 1994

UNITED STATES  
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## 1. INTRODUCTION

A systematic investigation of central Florida tornado environments began in late 1989 at the Melbourne National Weather Service (NWS) Office. Early research concentrated on establishing a tornado climatology (Schmocker et al. 1990) and investigating seasonal characteristics of tornado proximity soundings (Hagemeyer and Schmocker 1991). Further analysis of the tornado forecast challenge concentrated on the characteristics of central Florida tornado outbreaks (Hagemeyer and Schmocker 1992, Hagemeyer and Matney 1993a and 1993b). The investigation was expanded to include all of peninsular Florida (south of 30° latitude) in the fall of 1993. The results of this latest study are presented here in the form of a detailed peninsular Florida tornado outbreak climatology and brief case studies of all known outbreaks from 1950 through 1993.

The case studies include plots of severe weather reports, soundings and hodographs most representative of the severe weather environment, and surface and upper air data. The case study presentations were inspired by the series of annual severe thunderstorm cases prepared by the National Severe Storm Forecast Center (Hales and Polston 1993). It is expected that the outbreak climatology and case study data will be useful training tools for new and seasoned forecasters alike. This study should facilitate a rapid accumulation of historical knowledge that would otherwise take many decades to accrue on the job. It can also serve as a ready historical reference to provide perspective as new outbreaks occur or are forecast to occur. Dissemination of this information will become more crucial over the next few years as changes in forecast staffing occur due to the Modernization and Associated Restructuring (MAR) of the NWS in Florida.

## 2. TORNADO OUTBREAK CLIMATOLOGY

What is a peninsular Florida tornado outbreak? This fundamental question had to be answered before an objective study of outbreak characteristics could proceed. Galaway (1977) looked into the need for a reasonable tornado outbreak definition that might apply to most of the nation east of the Continental Divide, but came up with no hard and fast rules. Grazulis (1993) used a six tornado outbreak definition in his book.

Peninsular Florida is isolated from surrounding states. It seemed likely then, that a unique *regional* definition of a tornado outbreak was needed. An analysis of the 1372 tornadoes documented by the National Severe Storms Forecast Center (NSSFC) from 1950 through 1992 at, or south of, 30° latitude in Florida was completed to address this issue.

The number of tornadoes reported per tornado day is shown in Fig. 1 (a tornado day is any calendar day with at least one tornado reported). The graph clearly shows that most tornadoes occur singly, and rarely are more than three tornadoes reported on one day. Indeed, only 41 (3%) of 920 tornado days had four or more tornadoes reported. This threshold of four tornadoes per day provided a logical starting point in the regional definition of an outbreak.

The next step was to establish an objective outbreak time limit. A graph of the minimum length of time it took for at least four tornadoes to occur in the 41 cases on which four or more tornadoes occurred on the same day is shown as Fig. 2. The graph clearly shows that the great majority (83%) of the four tornado or more events occur in four hours or less (outbreaks stretching over two days, i.e., in progress at midnight, were taken into account). Thus, a

peninsular Florida tornado outbreak was defined to be the occurrence of four or more tornadoes in four hours or less at, or south of, 30° latitude. This criterion seems reasonable for the Florida peninsula which is only 125 nm across at its widest point. Since most synoptic systems that cause outbreaks are relatively fast moving, the short duration of many of the outbreaks is understandable.

The beginning time of an outbreak was defined as the time of the first tornado, when four or more occurred in four hours or less. The ending time was defined as the time of the last tornado in the outbreak, prior to a four-hour break in tornado activity. These criteria eliminated seven of the 41 candidate cases.

A further constraint was that the tornadoes had to be related to the same synoptic forcing mechanism to be considered part of a true outbreak. An example of a case which would not be termed an outbreak would be during the wet season when two tornadoes might occur near Tampa, associated with the west coast sea breeze; and two tornadoes might occur along the southeast coast, associated with the east coast sea breeze, all within a few hours of each other. This criterion eliminated four of the 34 remaining candidate cases, and it is the reason readers will find most true tornado outbreaks to have occurred with strong synoptic forcing.

The yearly distribution of the outbreaks and their associated tornadoes from 1950-1993 is shown in Fig. 3. The documentation of outbreaks is probably reliable since the mid 1960s. The scarcity of outbreaks prior to 1964 is related to lower population density and the fact that only the most significant tornadoes tended to be reported prior to increased emphasis on verification in the 1970s. Grazulis (1993) provides a comprehensive discussion of the problems with the national tornado data base and the challenges of accurate tornado documentation.

A discussion of the significance of the outbreak distribution since 1964 is beyond the scope of this paper, but future research into long-range prediction of tornado outbreak potential is planned. It is noteworthy that the longest period without an outbreak since 1964 was the five years from March 1986 to March 1991, while five outbreaks occurred from March 1991 to April 1993.

Based on research by Grazulis (1993), which covered only F2 or greater tornadoes and killer tornadoes, it is likely the first documented pre-1950 tornado outbreak occurred on September 9-10, 1882, over north-central Florida and the Panhandle. Other documented outbreaks occurred on February 26, 1934; December 26-27, 1940; and October 5, 1948; but many other undocumented outbreaks undoubtedly occurred prior to 1950.

The monthly distribution of the 32 peninsular Florida outbreaks from 1950-1993 is shown in Fig. 4. These outbreaks are predominately associated with extratropical cyclones during the traditional dry season (November through April) with peak occurrences in March and April. Hurricanes have caused outbreaks in June, September, and October. Hybrid cyclones with tropical and subtropical characteristics and mid-latitude interactions have occurred in May, June, and October during the transitions from dry to wet or wet to dry seasons (Hagemeyer and Matney 1993b).

Noteworthy is the lack of outbreaks in July and August in the middle of the wet season when mid-latitude disturbances are least likely to affect the peninsula. These months are also between the early hurricane season tendency for tropical and hybrid cyclones to develop in the northwest Caribbean and southern Gulf of Mexico and the primary peak of tropical cyclone development from African easterly waves in September (NOAA, 1985).

The hourly distribution of outbreak tornadoes is shown in Fig. 5. There are too few tropical cyclone cases to make meaningful interpretation of their tornado distributions. With the extratropical cases, however, clearly most tornadoes occur from mid-morning to early afternoon, with peaks at 11 a.m. and 2 p.m. Anthony (1988) noted a secondary maximum of morning tornadoes in Florida. Schmocker et al. (1990) documented that most of the strong and violent tornadoes in central Florida occur during the dry season in the morning. The distribution of significant tornadoes in Grazulis (1993) also shows a peak in the morning for southeastern states in general, but the Florida morning maxima is most striking. Of the 32 outbreaks, 19 (59%) began before noon, 12 before 9 a.m., and seven before 6 a.m.

The monthly distribution of outbreak tornadoes by F-Scale (Fujita 1981) is shown in Fig. 6. Most outbreak tornadoes are F0 or F1 (72%), and their numbers peak in March. Of the outbreak tornadoes in the F2-F4 range, most are in fact F2s. Only five F3 and two F4 tornadoes were reported during the period of this study.

Statistics gleaned from *Storm Data* entries for each tornado outbreak are listed in Table 1. The outbreaks are listed in chronological order by month and day (but not year). Table 1 contains information on the duration of each outbreak, number and intensity of tornadoes, deaths and injuries and their causes, and whether reports were received of severe thunderstorm winds, hail, heavy rain or flooding, and lightning.

The outbreaks often produced hazardous weather, in addition to tornadoes, which have been responsible for 68 deaths and 1150 injuries. Most interesting is the fact that drowning accounted for 32 deaths while tornadoes accounted for 28 deaths. Drownings resulted from boats capsizing on lakes and coastal waters, storm surge inundation, river flooding, and urban flooding of roadways and drainage ditches. Tornado deaths and serious injuries were most often associated with occupants of trailers or wood-framed structures. Seven of the eight deaths attributed to severe thunderstorm winds occurred in "windstorms" associated with Hurricane Agnes that struck trailer parks in June 1972 (Case 26 in Table 1). These "windstorms" may have been tornadoes and are a subject of ongoing debate (Grazulis 1993).

TABLE 1

## Peninsular Florida Tornado Outbreaks (1950-1993)

Date	Duration (EST)	Tornadoes						vDeaths/ Injuries	w h r l i a a t n i i n d l n g				
		F0	1	2	3	4	?						
1. 01-06-70	1005-1135		1	1			2	0/5	X				
2. 01-19-78	1350-1703	3	2					0/0	X				
3. 01-24-79	0200-0555						6	0/1	X				
4. 01-28-73	1135-1330		1	3				0/24					
5. 02-02-83	0430-1320	1	7	6				"2/31"	X				
6. 02-03-70	0730-0945	1	2	3			1	0/0	X				
7. 02-23-65	1050-1245		2	1	1			0/8	X				
8. 03-03-71	1431-1740	2	4	1				&1/1"	X				
9. 03-03-78	1235-1504		5					0/1"	X				
10. 03-03-91	0920-1450	5	3					0/1*	X	X			
11. 03-12-93	2338-0110	4	2	3				-&23/91&"-1	X	X			
12. 03-14-86	0617-1045	4	4	1				0/1##	X			X	
13. 03-17-73	0300-0500		3	2				0/3"	X				
14. 03-31-72	0415-0700	2	2	4				0/9"	X	X			
15. 04-04-66	0815-1015			1		1	2	11/530					
16. 04-05-93	0130-0430	8	1	1				0/5"	X				
17. 04-09-84	1250-1400	2	2					0/0	X	X	X		
18. 04-11-75	0930-1520	1	4					0/1	X		X	X	
19. 04-15-58	1200-1309		1		2	1		0/36	-	-	-	-	
20. 04-23-83	0830-1430		6					0/7	X				
21. 04-25-91	1417-1630	5	2					0/2"	X	X			
22. 05-04-78	0800-1500	6	1		1			3/97	X		X		
23. 05-08-79\$	0530-1630	15	3	1				&4/49			X		
24. 06-08-57\$	1458-1715		1	4			1	&5/?	-	-	X	-	
25. 06-17-82\$	1900-0309	3	5	2				&3/13	X		X		
26. 06-18-72*	1255-1846	1	4	5				&"8/67"	X				
27. 09-03-79*	1800-2100	2	1	2				0/0					
28. 10-03-92\$	0940-1740	3	4	1	1			4/77	X		X		
29. 10-14-64*	1510-2250		4	4			1	&2/48					
30. 11-09-68	1255-1900		6	3				2/29					
31. 11-11-68	1115-1330		1	2			1	0/3	X				
32. 12-03-71	1000-1345		2	3				0/10	X		X		
Totals:		68	86	54	5	2	14	68/1150	24	5	8	2	
		Tornado		28/1080									
		Drowning		21/0									
		St Surge		11/2									
		Tstm Wind		8/66									
		Lightning		0/1									
		Hail		0/1									

vIncludes: Tstm Wind ("), Lightning (##), Hail (\*), Drowning (&), and Storm Surge (-) victims

\* HURRICANE CASES (3)

\$ HYBRID CASES (4)

Major outbreaks can produce high seas, coastal flooding, beach erosion, storm surge, local flooding rains, and river flooding, as well as tornadoes and severe thunderstorms. Clearly, individuals at greatest risk are occupants of mobile homes or manufactured housing, mariners or motorists, and residents of the immediate coastal zone and other flood-prone areas.

The two deadliest outbreaks, April 4, 1966, and March 12-13, 1993, account for half (34) of all outbreak deaths. However, the most consistently deadly outbreaks have occurred in the wet season (May to October). Many of the extratropical outbreaks are at the lower end of the outbreak intensity spectrum, in terms of deaths. Less than a fourth of the extratropical dry season outbreaks caused fatalities while seven of the eight wet season outbreaks were killers, resulting in a combined total of 29 fatalities.

As can be seen from Table 1, severe thunderstorm winds (i.e., winds in excess of 50 kt) are common with tornado outbreaks (24 of 32); however, the severe thunderstorm database is deficient for earlier cases. Not surprisingly, every tornado outbreak since 1979 had severe thunderstorm winds reported. Large hail would appear to be rare in tornado outbreaks, but the hail database is more deficient for earlier cases than the thunderstorm wind database. Only one outbreak case prior to 1986 had hail reported. Lightning reports are noticeably lacking in the outbreaks. Remarkably, given the relatively high incidence of lightning-related injury in general, only one injury due to lightning and one instance of lightning damage were reported in the 32 tornado outbreaks.

Knowledge of the climatology of peninsular Florida tornado outbreaks is necessary to better forecast their occurrence and likely consequences. Knowledge of the synoptic patterns associated with tornado outbreaks and experience in diagnosing the observational data are equally important. In the following sections we provide more detailed information concerning each tornado outbreak.

### 3. OUTBREAK CASE DATA

Case study data for each outbreak are included in Appendix A. The cases are organized by day of the year to simplify synoptic pattern assessment through a normal yearly progression. The idea is to provide as much data as possible to allow readers to make their own interpretations. Rather than summarize these outbreaks by showing *mean* soundings and *mean* synoptic patterns, we believe there is value in presenting data for individual cases, especially for those who are responsible for forecasting severe weather for the Florida peninsula or requiring working knowledge of the characteristics of associated weather.

It should be remembered that data are shown only for peninsular Florida tornado *outbreaks*, which comprise only 3% of the tornado days in Florida. Outbreaks present the greatest threat to life and property, but 97% of the tornado days do not meet our criteria for classification as outbreaks. We believe that most cases of several tornadoes in a day, or of isolated, strong tornadoes (even if they do not meet the outbreak criteria), will resemble the synoptic outbreak patterns to some degree. Patterns associated with single-tornado days will probably not. There is no doubt, however, that non-outbreak tornadoes have caused significant damage and injuries, and some deaths.

Severe weather plots were made using the *Severe Plot* program for PCs developed at NSSFC (Hart 1992). All severe reports on the day of an outbreak were plotted, including those that occurred north of 30° latitude. Tornadoes are indicated by either their F-Scale number or a dark triangle. Paths of tornadoes are shown as heavy dark lines. Severe thunderstorm wind reports are indicated by crosses, or the actual speed in knots, when reported. Reports of hail 0.75 in or greater are shown by either filled circles or the reported size in inches without a decimal (for example the April 9, 1984, outbreak plot on page A-56 shows 2.75-in hail between West Palm Beach and Miami).

Summaries of the total number of severe reports and numbers of tornado, hail, and high wind reports are contained along the left margin of each plot. Numbers of tornadoes on the plots and on Table 1 may not match, because only the tornadoes occurring in the actual outbreak interval are included on Table 1, while an effort was made to include all severe weather associated with the weather system causing the outbreak on the plots to gain greater appreciation of their magnitude and extent. There are also some limitations on plotting tornado segments with the *Severe Plot* program that are discussed by Hart (1992); however, manual verification of the outbreak plots indicated the tornado database contains few errors.

Thermodynamic soundings and hodographs for each case were made from the best available upper air observation, most representative of the severe weather environment, using the *Skew-T/Hodograph Analysis and Research Program (SHARP)*, Hart and Korotky 1991). Thermodynamic indices were calculated using the mean low-level lifted parcel, and dynamic indices were calculated using the default storm motion (see Hart and Korotky 1991). Caution should be used in correlating the sounding data to the tornado outbreak environment without allowing for time and space adjustments. In a number of cases, especially with fast moving synoptic systems, maxima of important indices occurred between scheduled sounding release times. A good example is the so-called "Storm of the Century" of March 12-13, 1993. The 0000 UTC March 13 Tampa Bay (Ruskin) sounding indicated a relatively low 0-3 km storm-relative helicity value of 179 m<sup>2</sup>/s<sup>2</sup>, but helicity calculated just five hours later using hourly surface data and data from the Melbourne WSR-88D radar was over 700 m<sup>2</sup>/s<sup>2</sup> (see page A-31).

Available information on surface and upper air features is included for each outbreak case. Data for cases prior to the late 1970s were of varying quality. In a number of cases the microfiche of the original hand-analyzed NMC charts provided poor quality copies. In all but one case the two surface analyses most closely bracketing the outbreak period are included. In most cases 850 mb, 700 mb, 500 mb, and 200 mb charts, or at least a low-level and high-level chart, are included to provide for basic synoptic pattern recognition. Composite severe weather analyses for five of the outbreaks have been published previously and are included with their case data for reference. Data for the six outbreaks which occurred since 1986 were available through the Service Record Retention System (SRRS) which is managed by NCDC. The data are presented without analysis so they may be used in diagnostic training exercises.

A few WSR-88D products are included for the last three outbreaks (cases 11, 16, and 28 in Table 1). Interested readers should also be able to acquire gridded NMC model data for use with PC-GRIDDS for these three outbreaks.



#### 4. CONCLUDING REMARKS

The authors anticipate that readers with an interest in peninsular Florida tornado outbreaks will find this summary to be a valuable forecast reference and that they will also try their hands at diagnosing the six most recent cases which include the "Storm of the Century" and the hybrid Tampa Bay area outbreak. A challenge is issued to the most perceptive of analysts to diagnose the case of April 25, 1991—perhaps the most unusual of all tornado outbreaks. It is hoped this paper will contribute to improvements in forecasting future peninsular Florida tornado outbreaks.

#### ACKNOWLEDGEMENTS

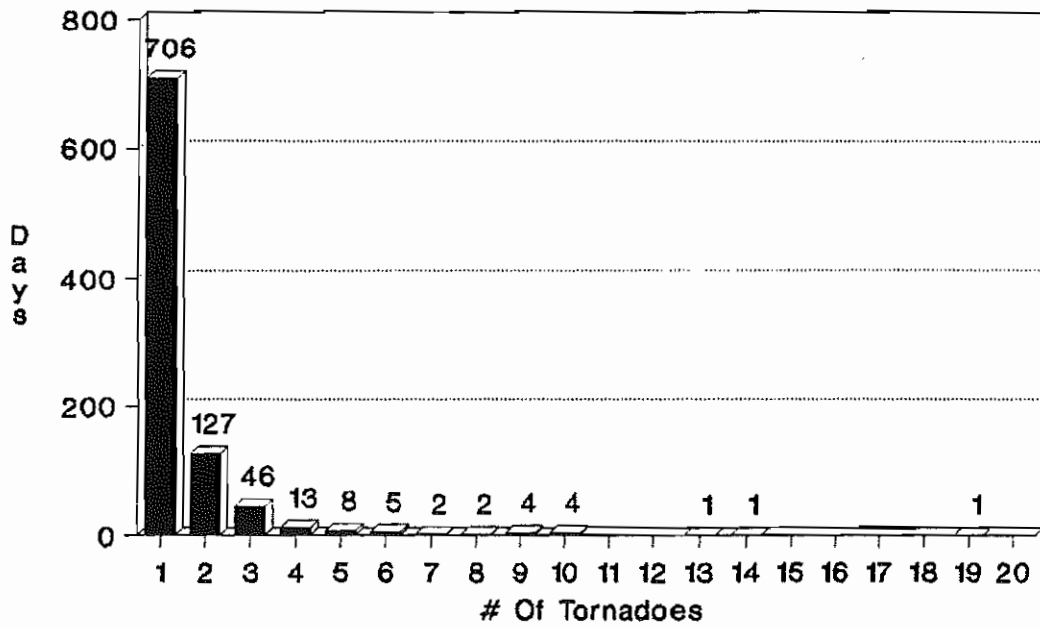
Jo Ann Carney ably assisted in figure preparation and layout. Marsha Spencer provided the final editorial support. Data were obtained through NWS Southern Region Scientific Services Division; Irv Watson, National Severe Storms Lab; and Barry Schwartz, NOAA Forecast Systems Lab. Severe weather plot data were provided by the NSSFC Verification Unit.

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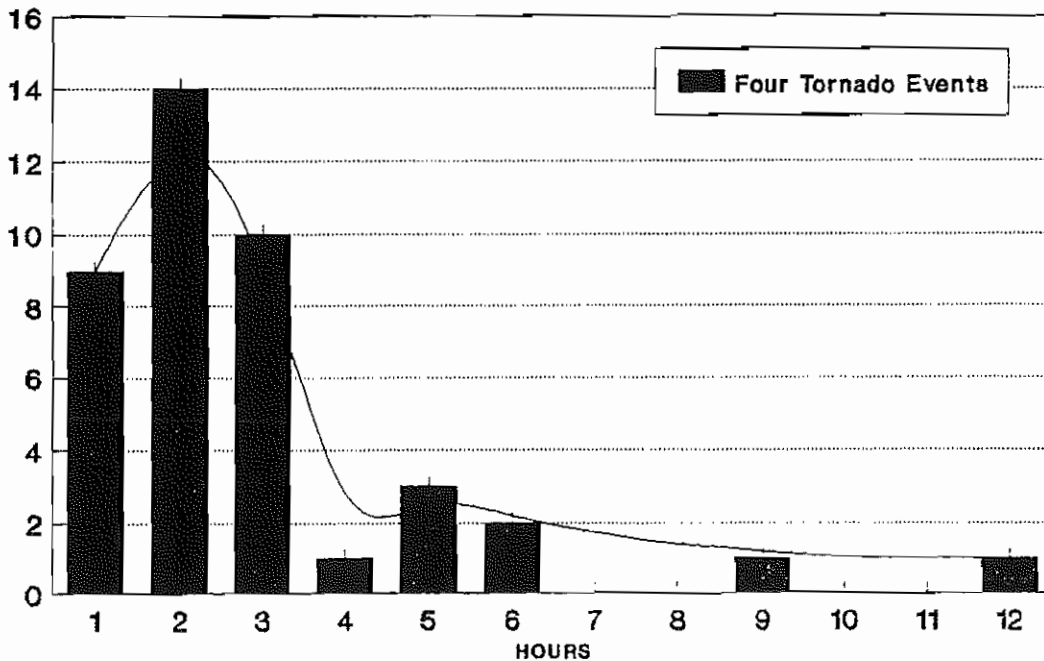
## PENINSULAR FLORIDA TORNADOES PER TORNADO DAY (1950-1992)



Tornado Day = At Least One Reported  
Tornado (1372 Tornadoes In 920 Tornado  
Days)

Fig. 1

## Minimum Durations Of Four-Tornado Occurrences In Peninsular Florida (1950-1992)



41 Four-Tornado Or Greater Days

Fig. 2

### YEARLY DISTRIBUTION OF TORNADO OUTBREAKS AND OUTBREAK TORNADOES (1950-1993)

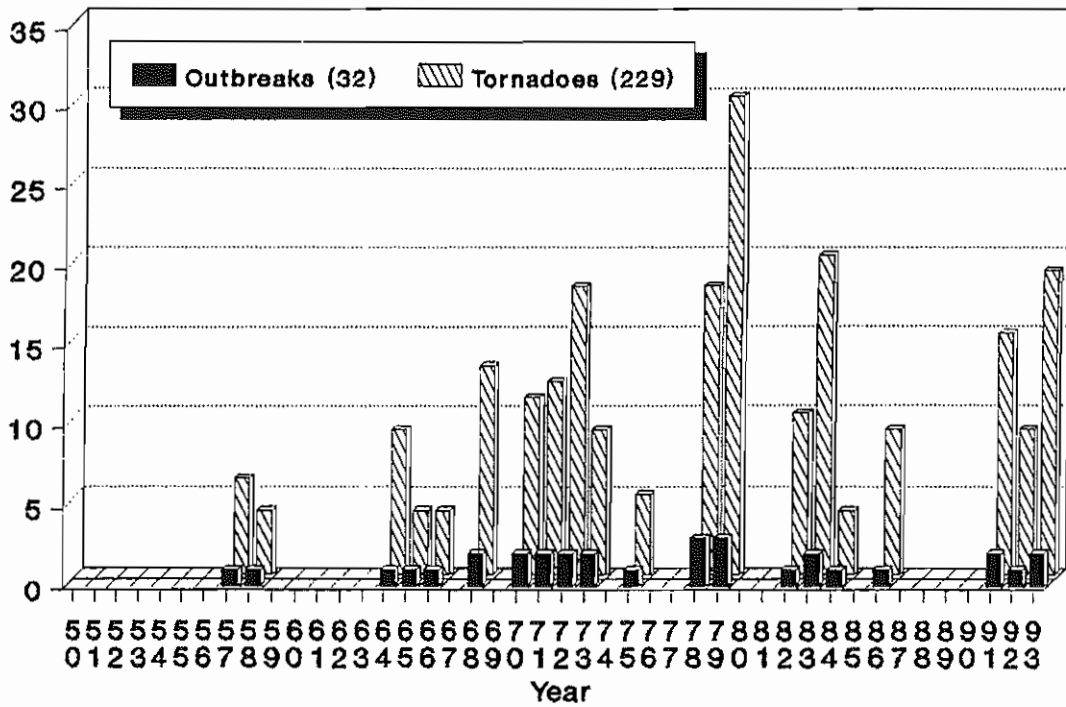
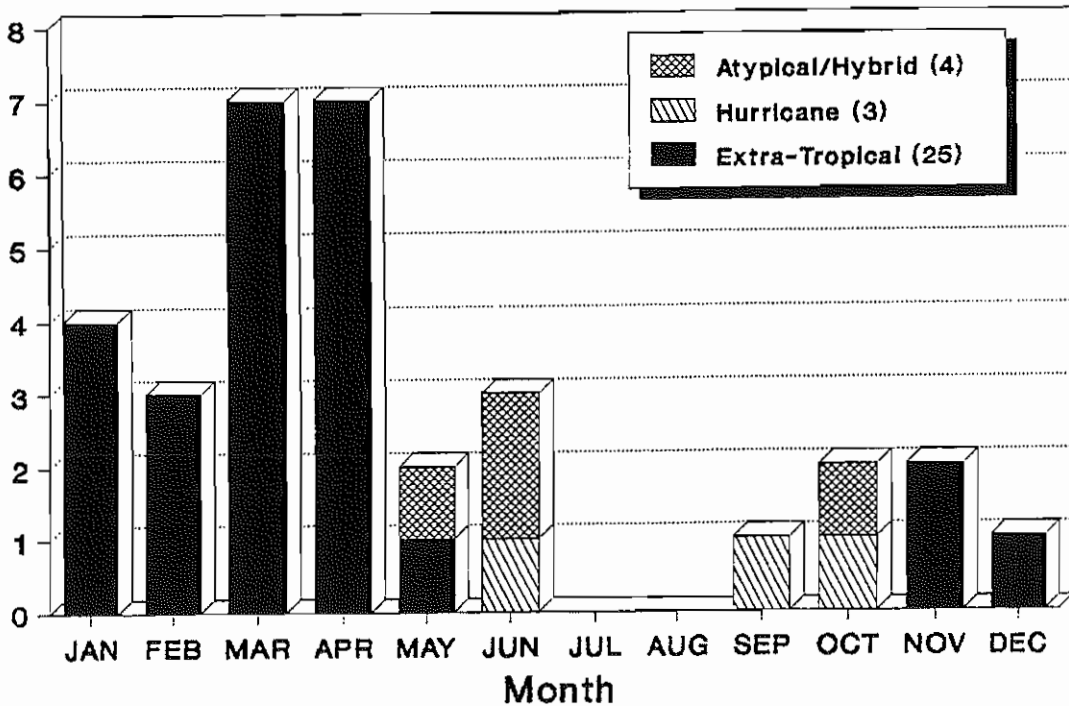


Fig. 3

### MONTHLY DISTRIBUTION OF PENINSULAR FLORIDA TORNADO OUTBREAKS (1950-1993)



32 Outbreaks

Fig. 4

### HOURLY DISTRIBUTION OF PENINSULAR FLORIDA OUTBREAK TORNADOES (1950-92)

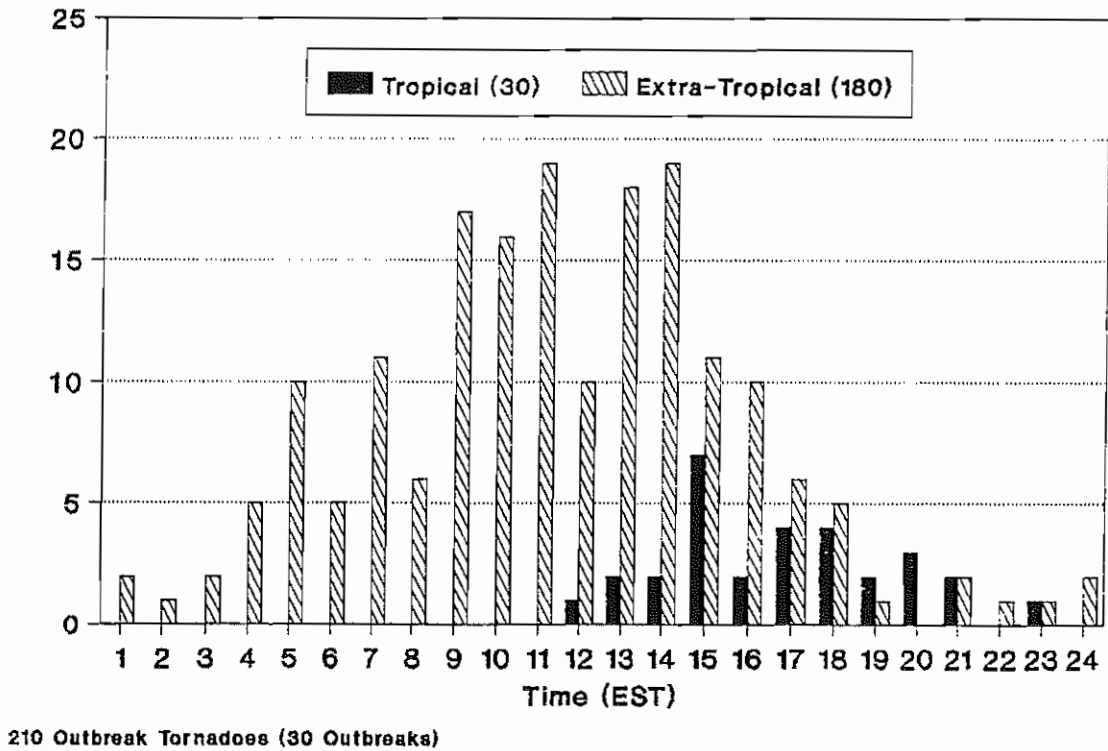


Fig. 5

### DISTRIBUTION OF OUTBREAK TORNADOES BY F-SCALE (1950-1993)

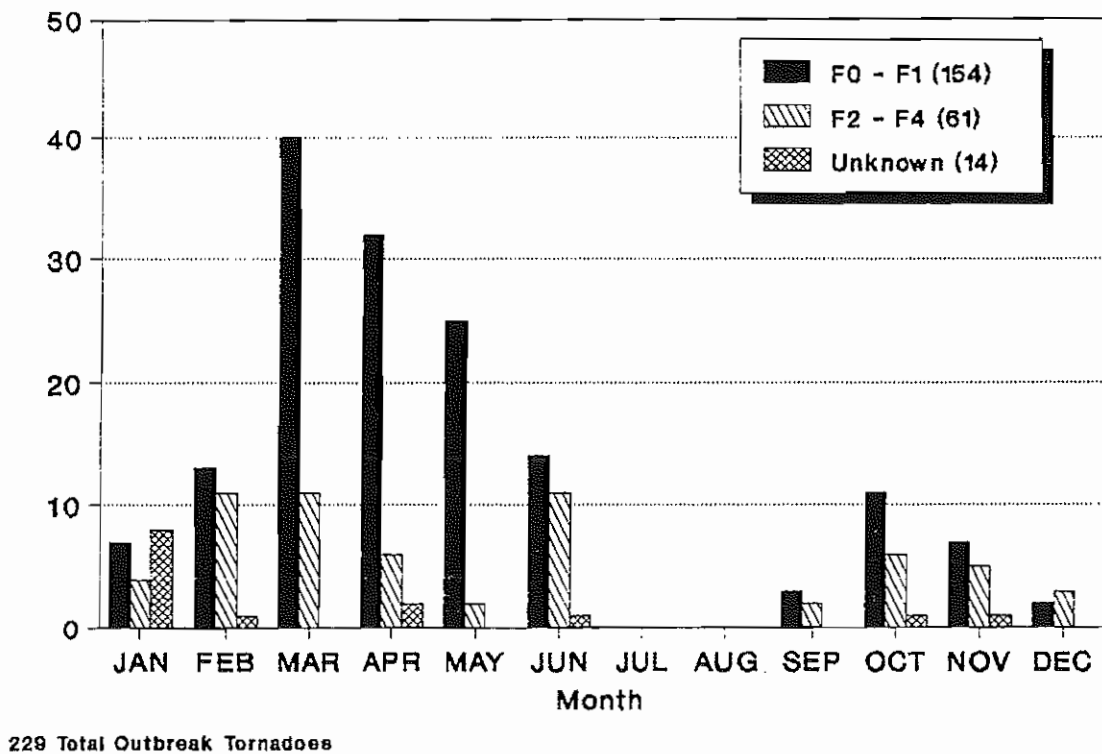


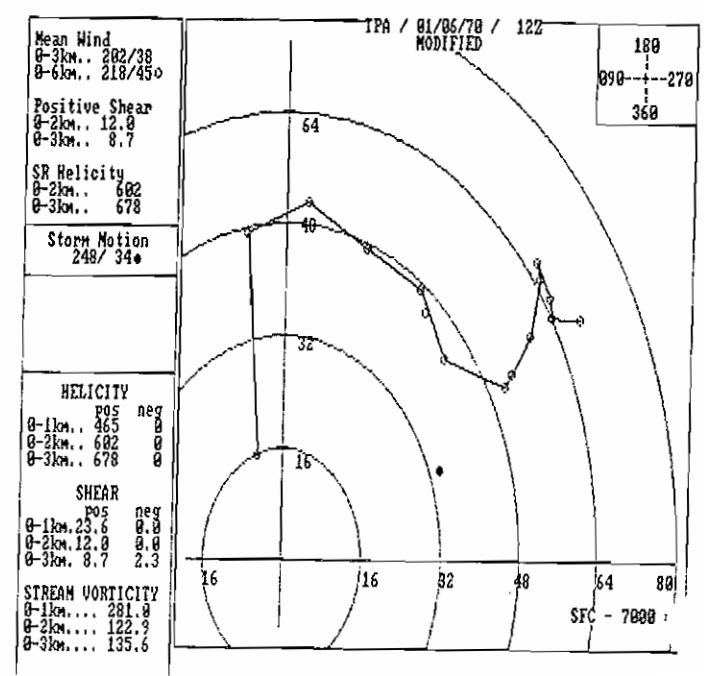
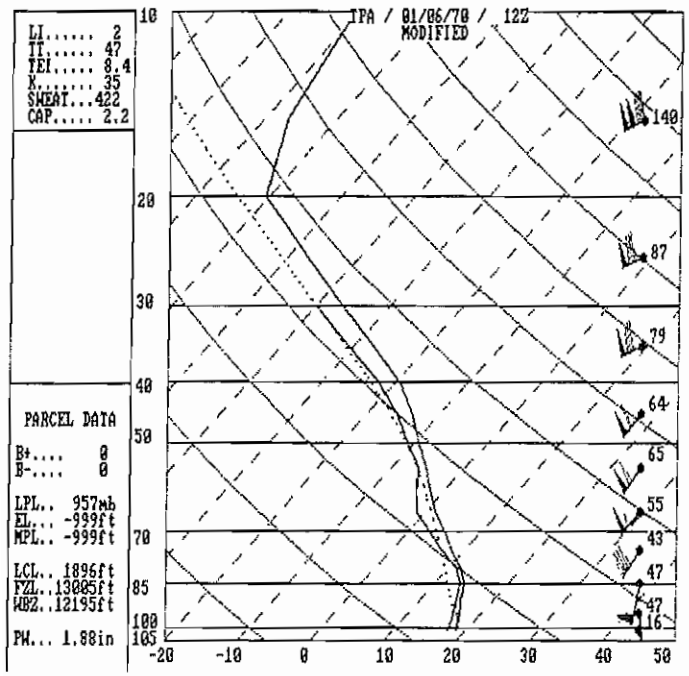
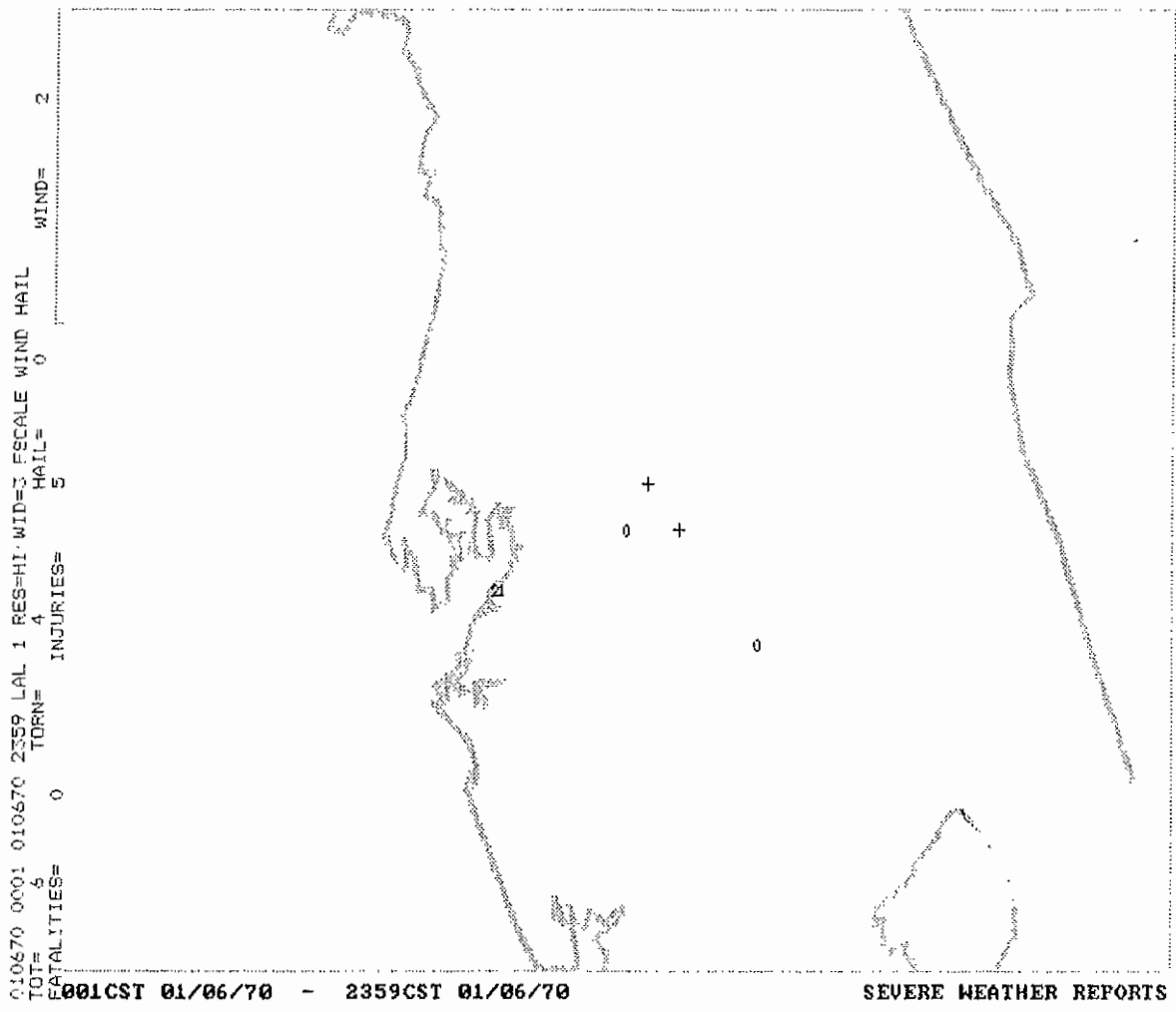
Fig. 6

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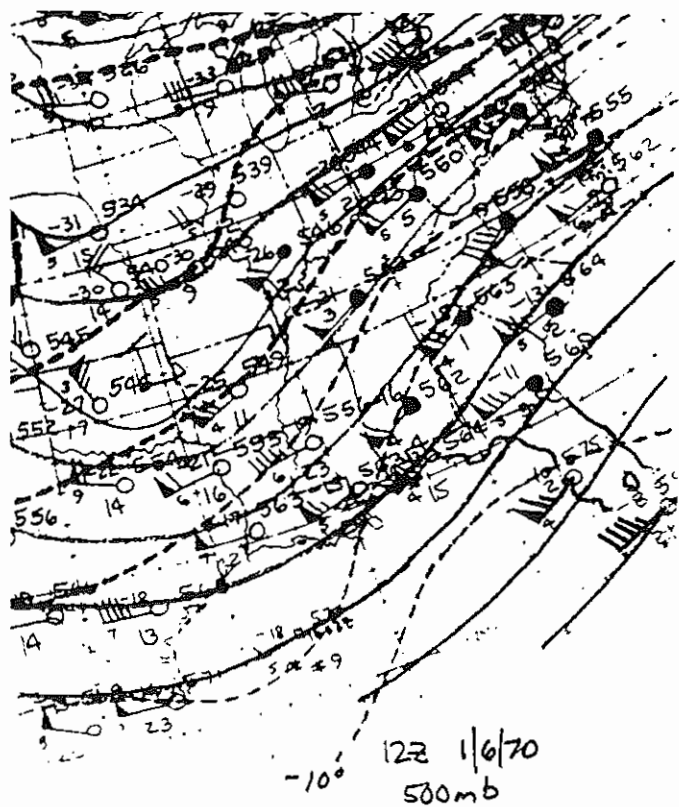
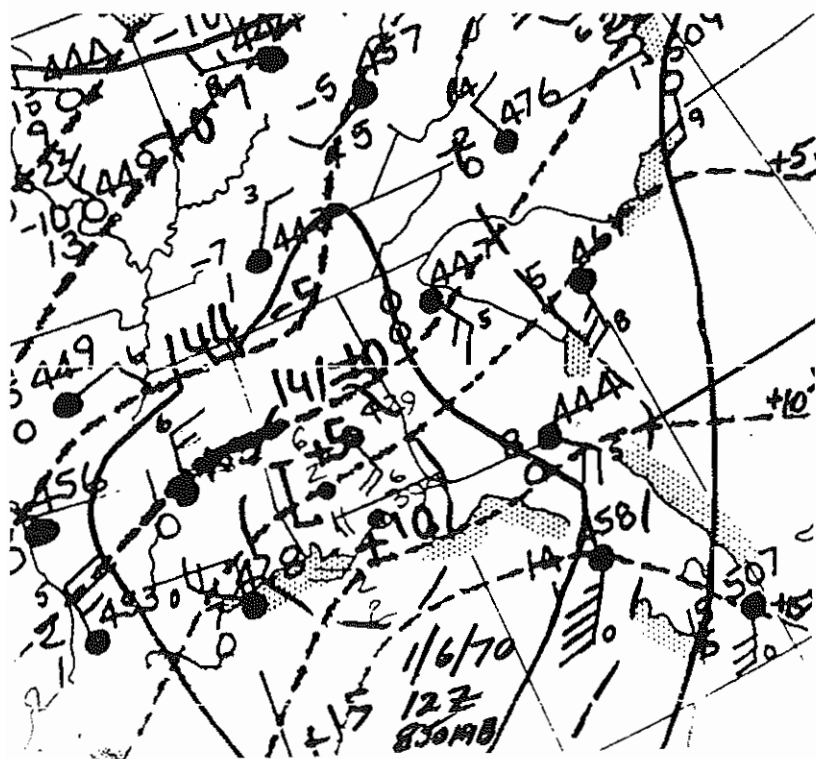
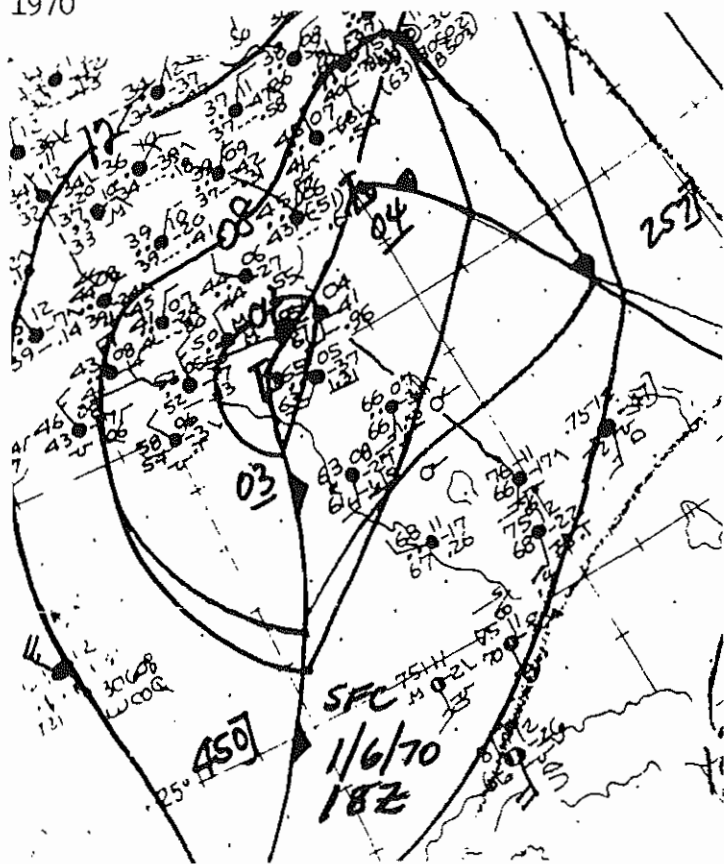
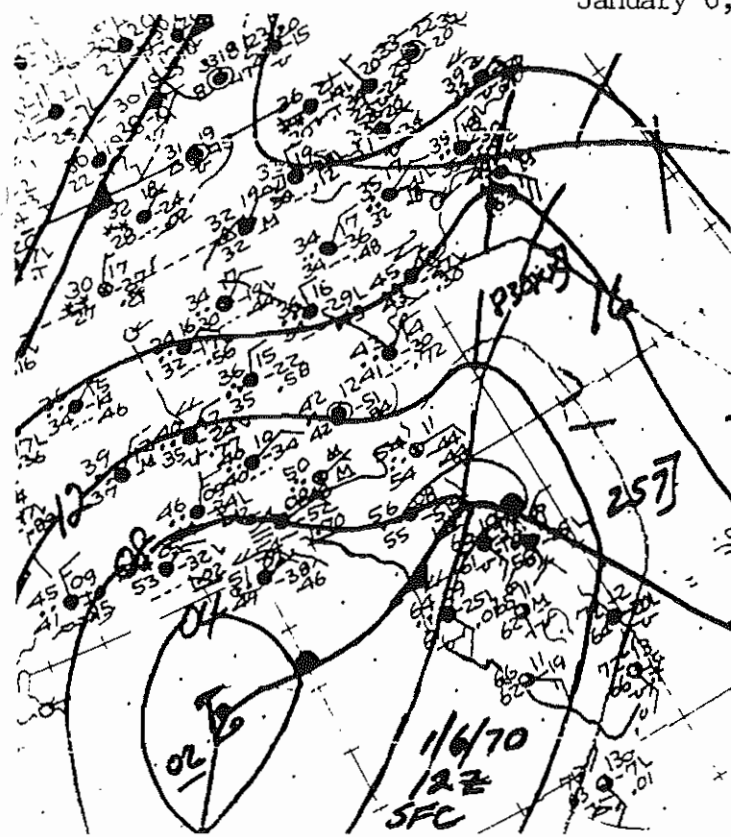
# APPENDIX A

## Peninsular Florida Outbreak Case Studies

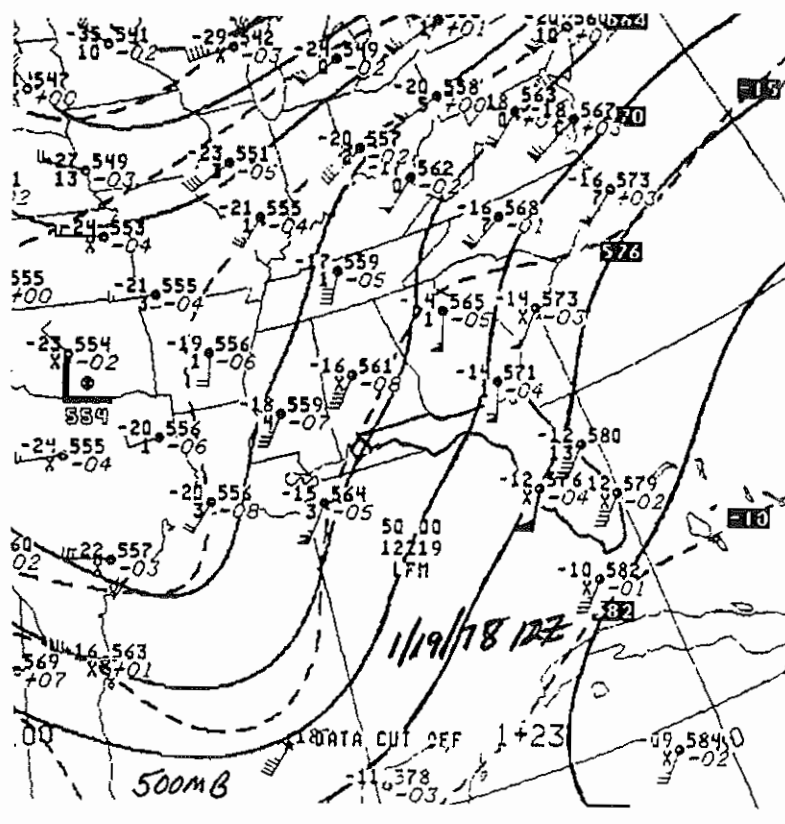
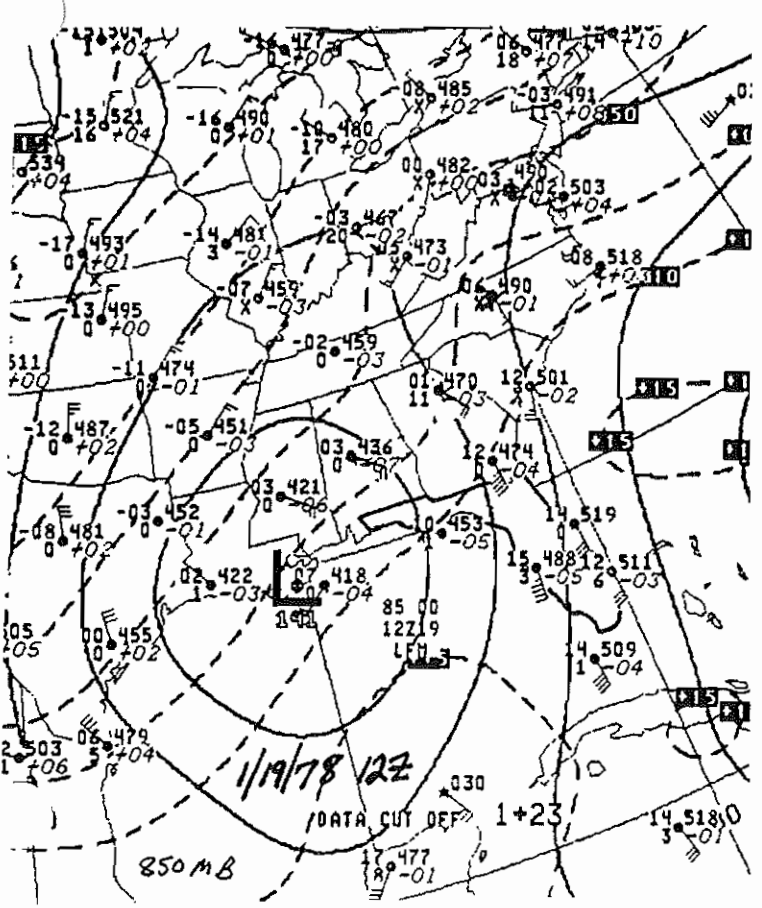
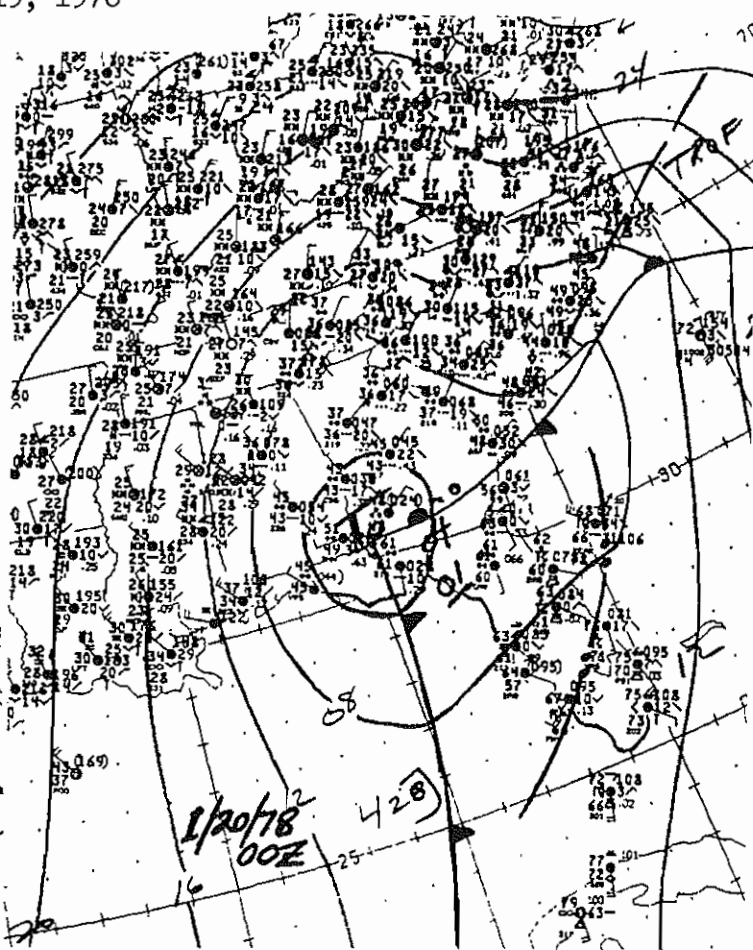
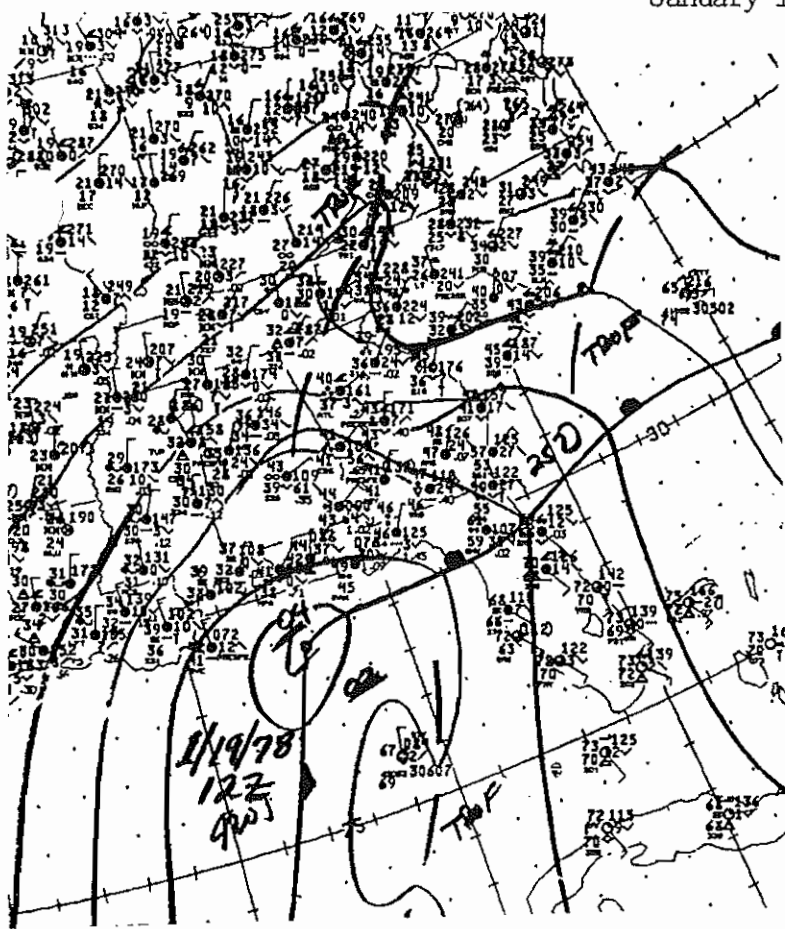
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January 6, 1970	1
January 19, 1978	3
January 24, 1979	5
January 28, 1973	8
February 2, 1983	10
February 3, 1970	14
February 23, 1965	16
March 3, 1971	18
March 3, 1978	20
March 3, 1991	22
March 12-13, 1993	27
March 14, 1986	36
March 17, 1973	40
March 31, 1972	42
April 4, 1966	44
April 5, 1993	50
April 9, 1984	56
April 11, 1975	59
April 15, 1958	61
April 23, 1983	63
April 25, 1991	67
May 4, 1978	75
May 8, 1979	78
June 8, 1957	81
June 17-18, 1982	83
June 18-19, 1972	87
September 3, 1979	91
October 3, 1992	94
October 14, 1964	100
November 9, 1968	102
November 11, 1968	105
December 3, 1971	107



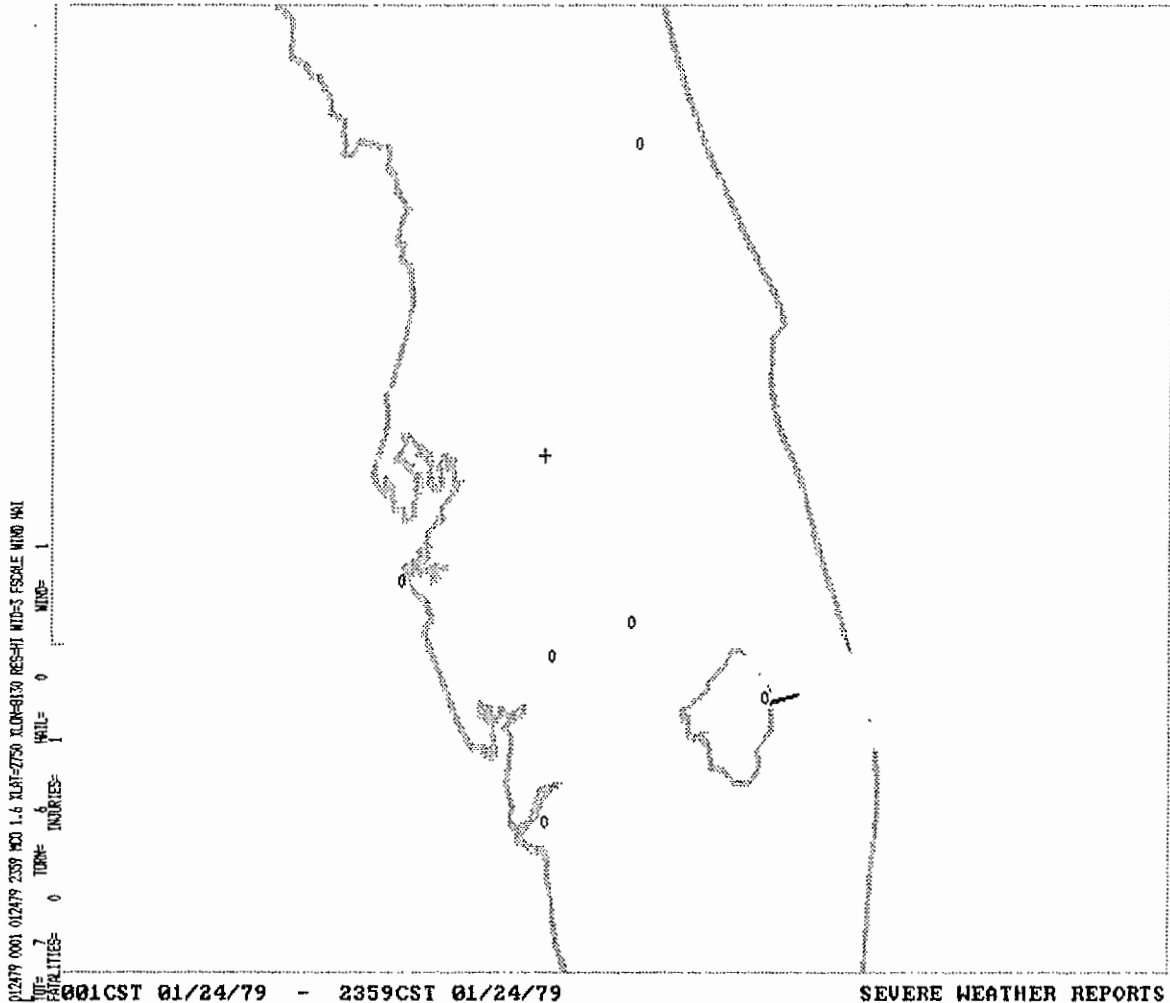








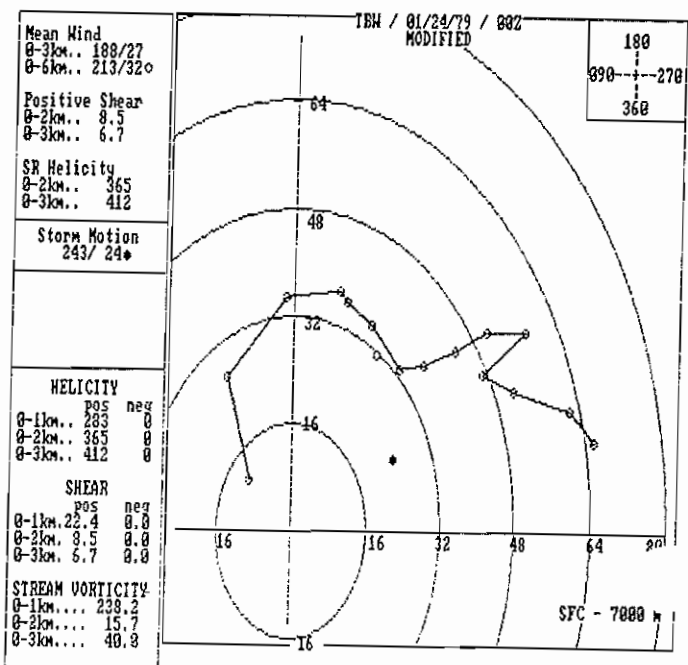
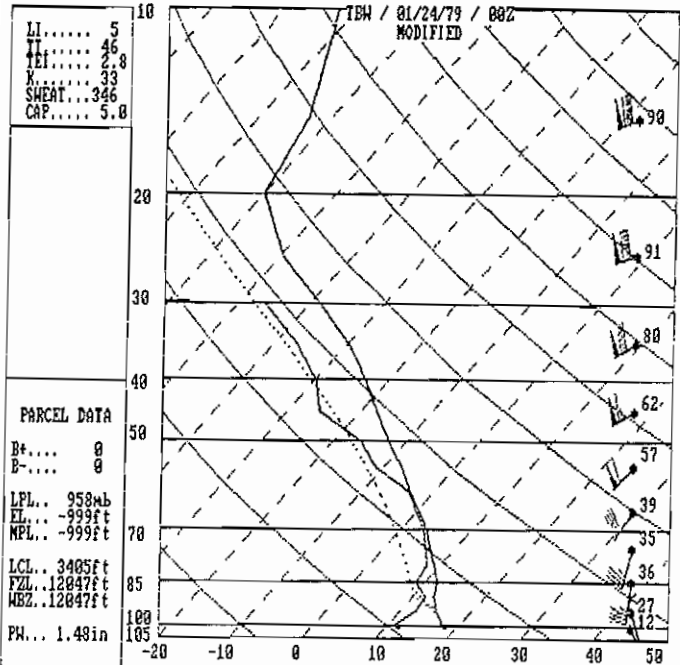
January 24, 1979

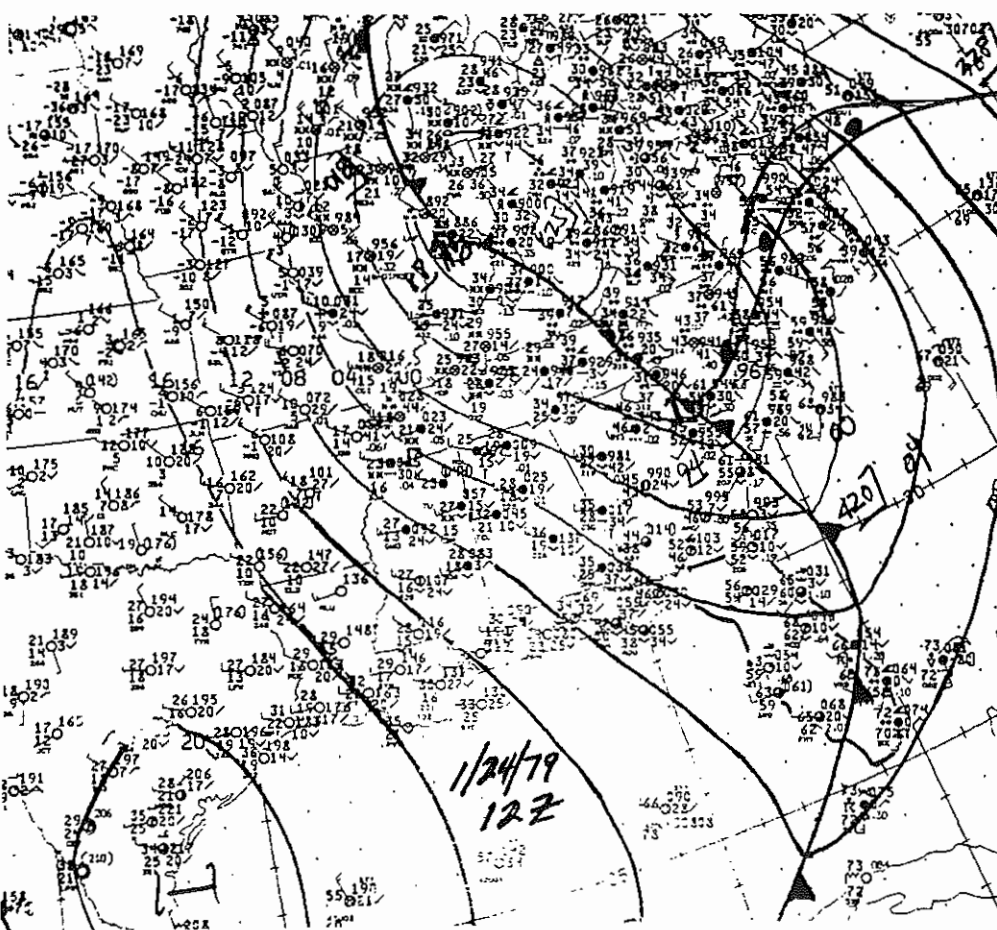
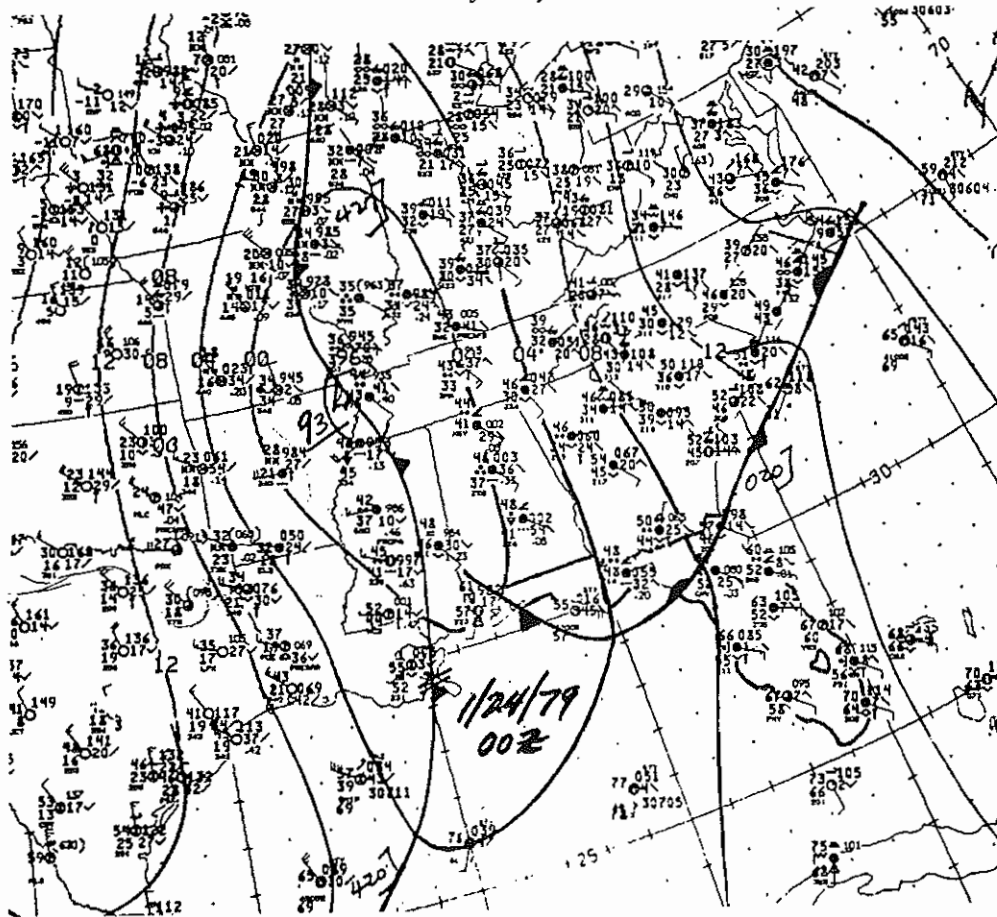


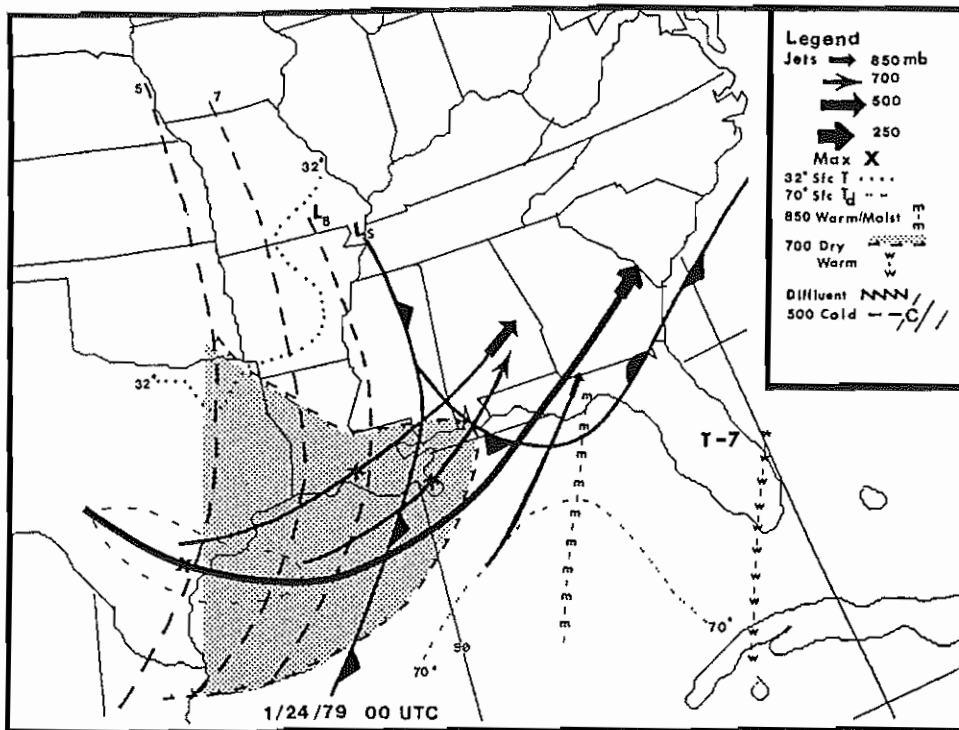
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 TIME QUALITIES= 0 TDW= 6 INURIES= 1  
 MWD= 1  
 MFL= 0  
 MFL= 1

001CST 01/24/79 - 2359CST 01/24/79

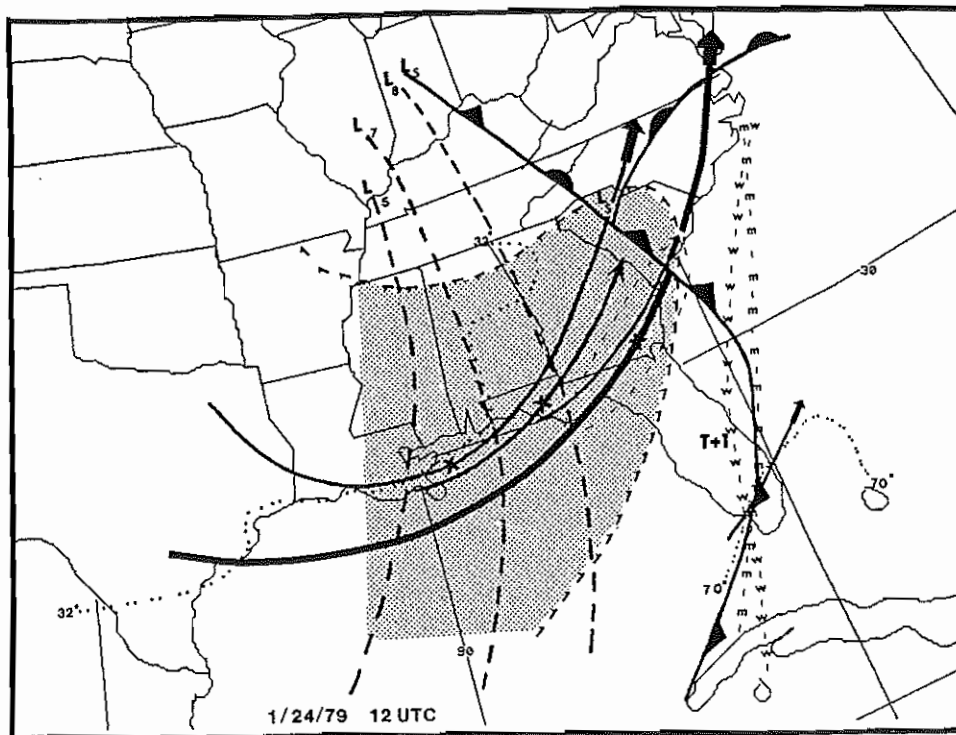
SEVERE WEATHER REPORTS







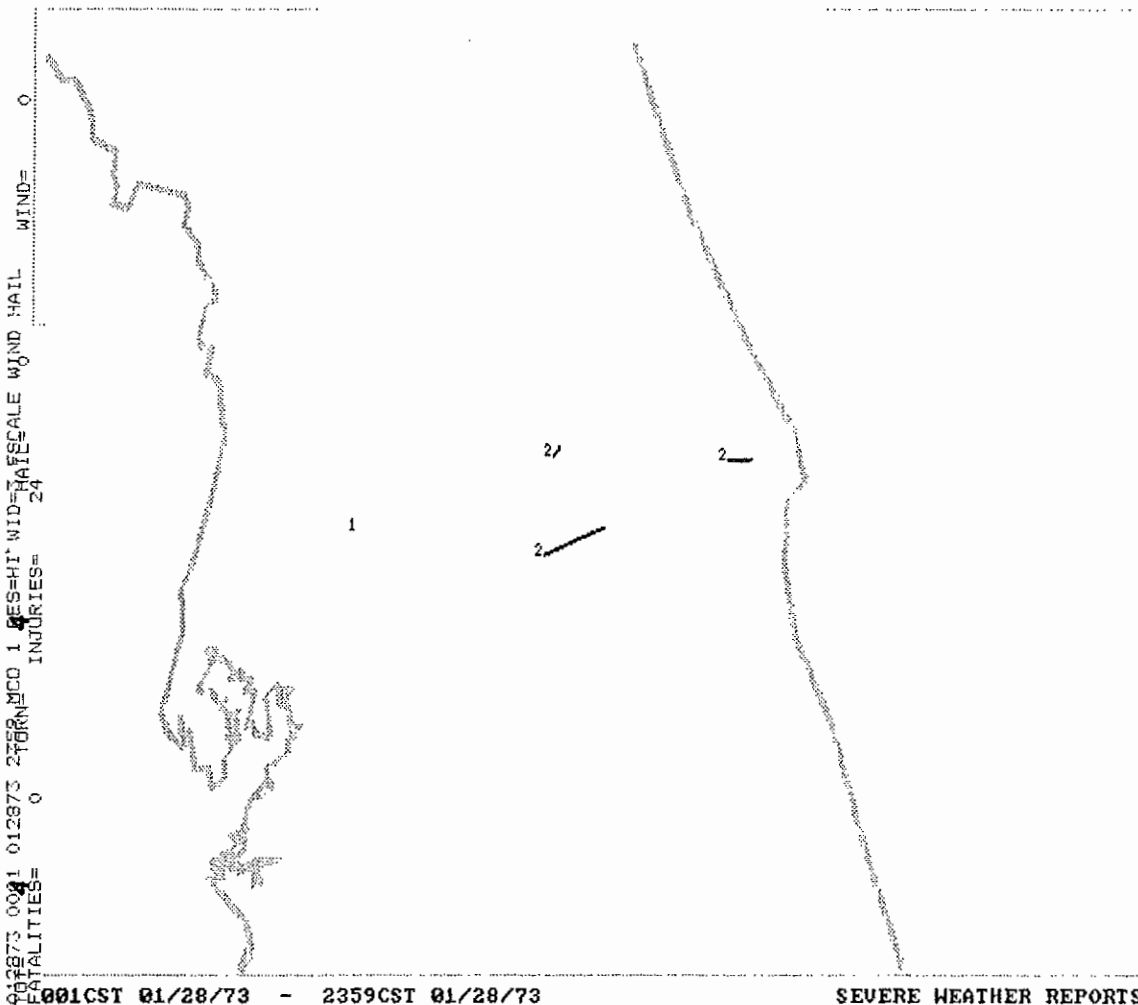
(From Hagemeyer and Schmocker 1992)



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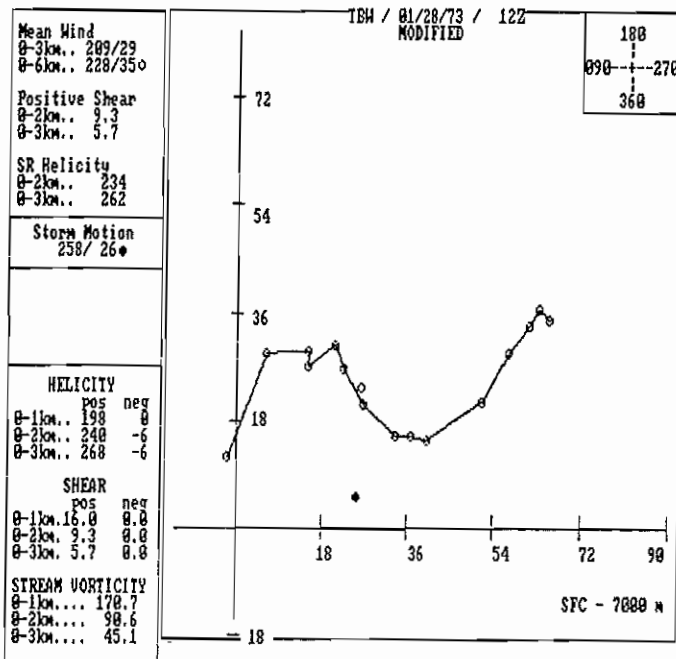
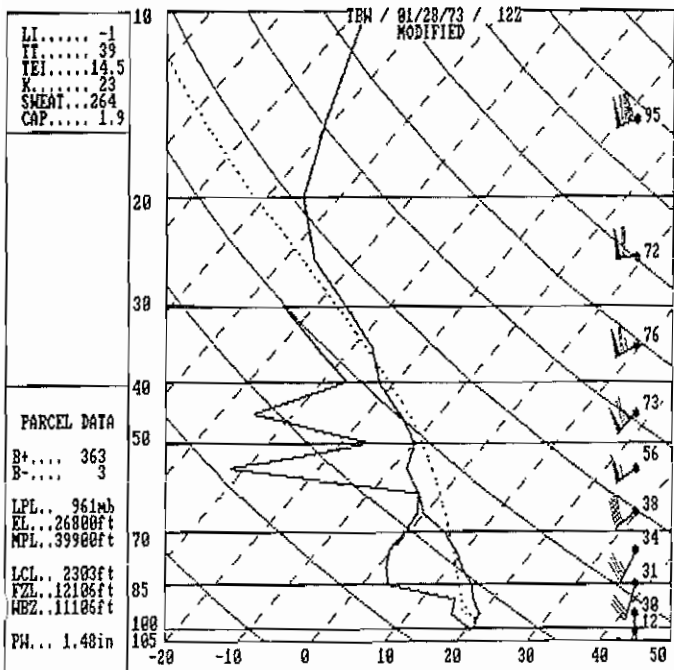


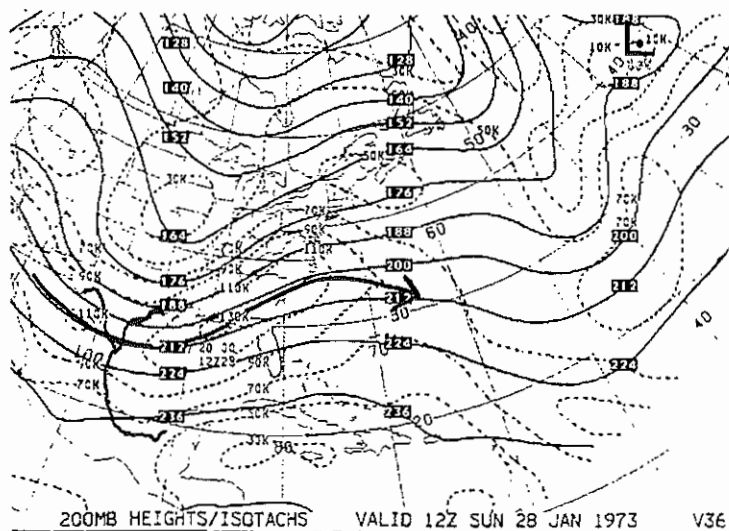
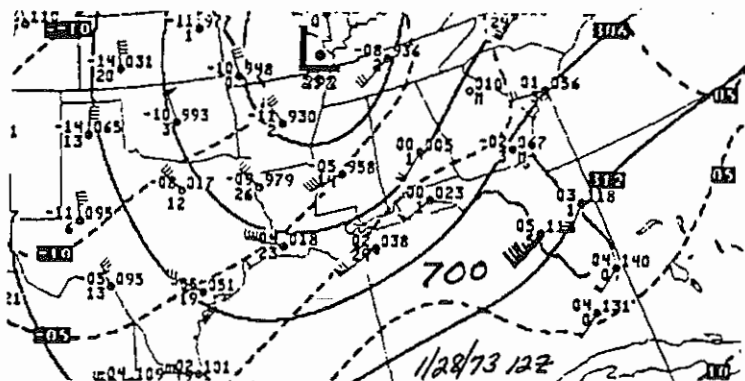
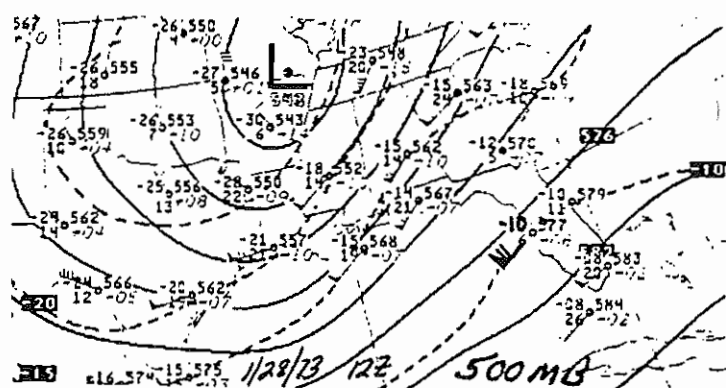
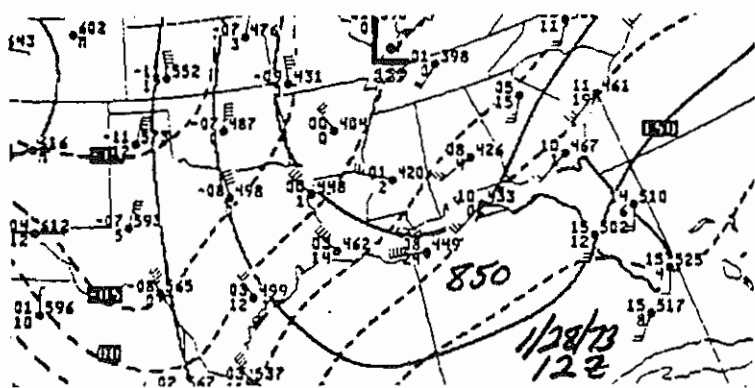
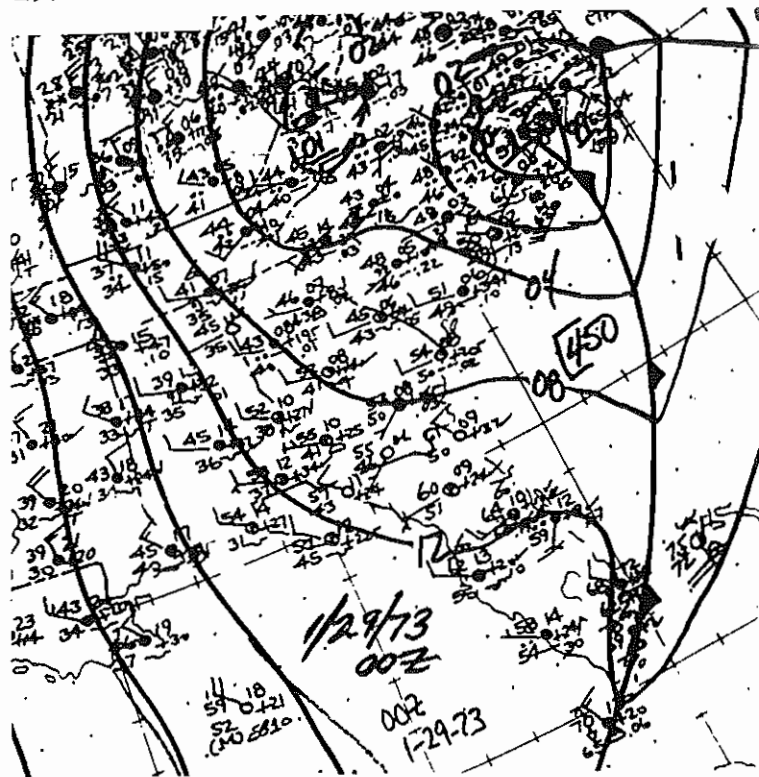
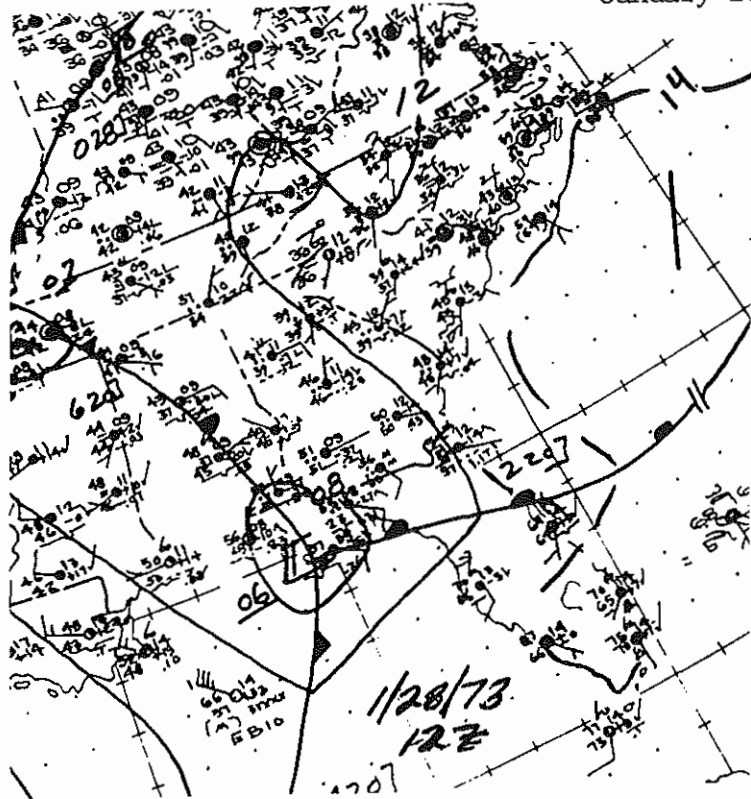


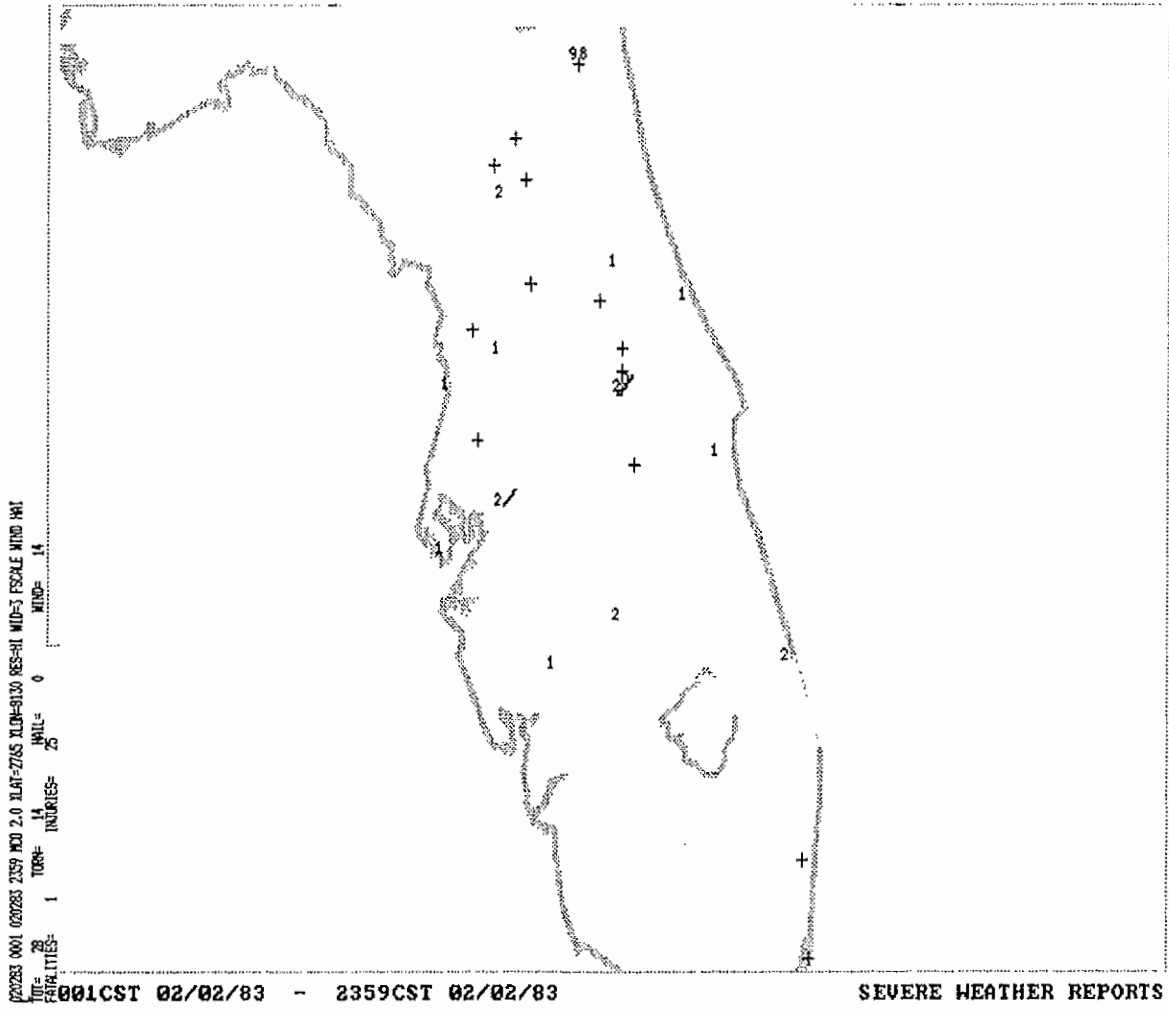


001CST 01/28/73 - 2359CST 01/28/73

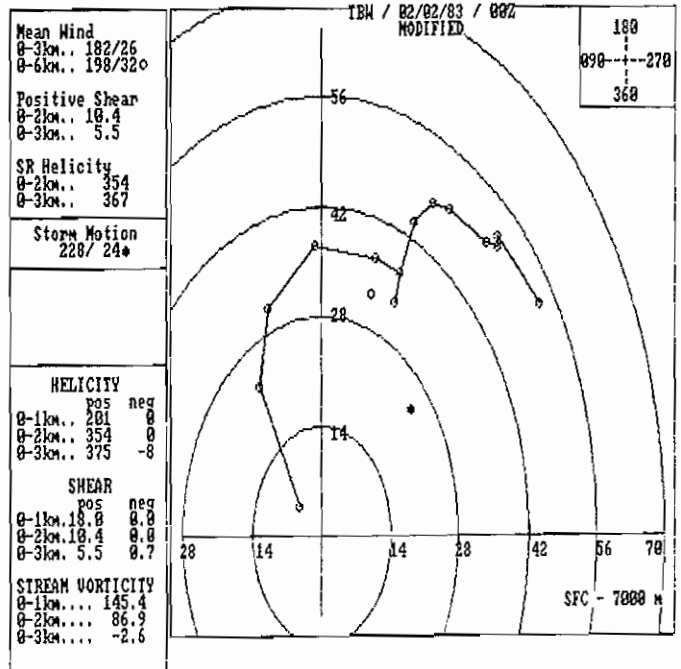
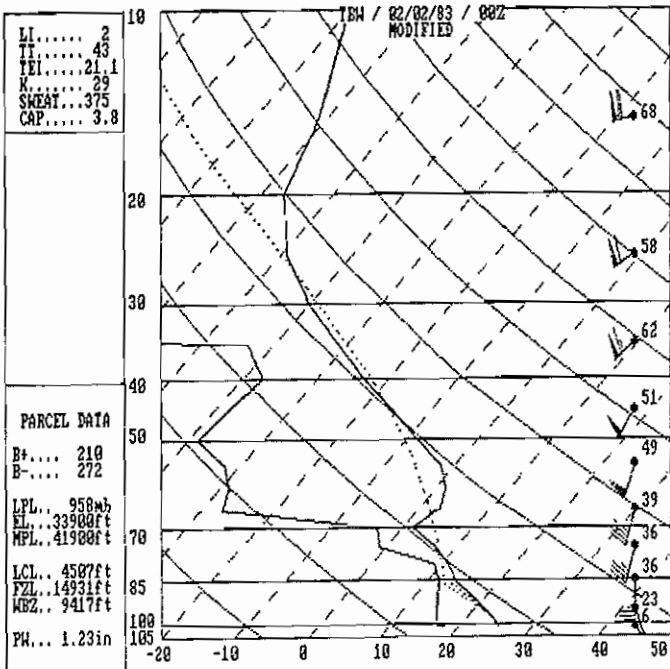
SEVERE WEATHER REPORTS

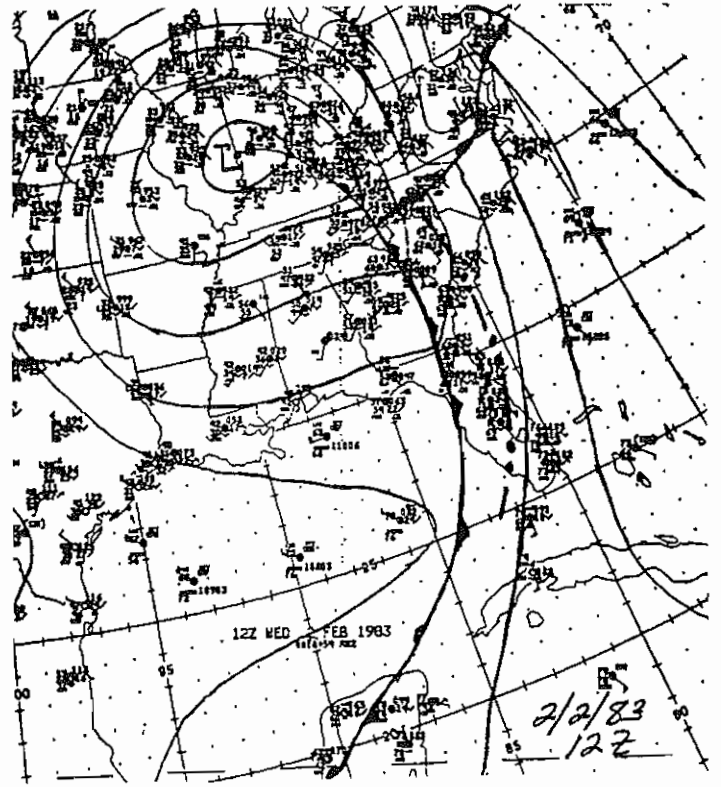
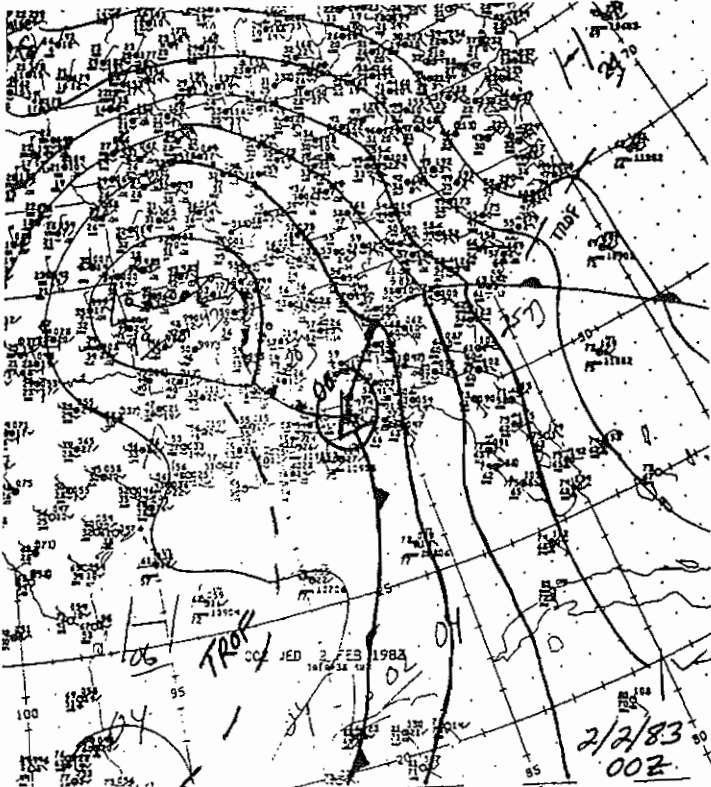
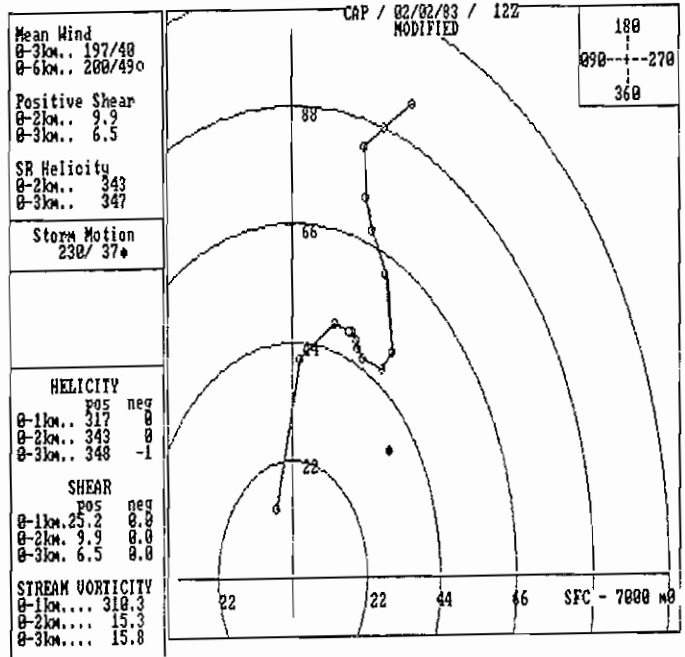
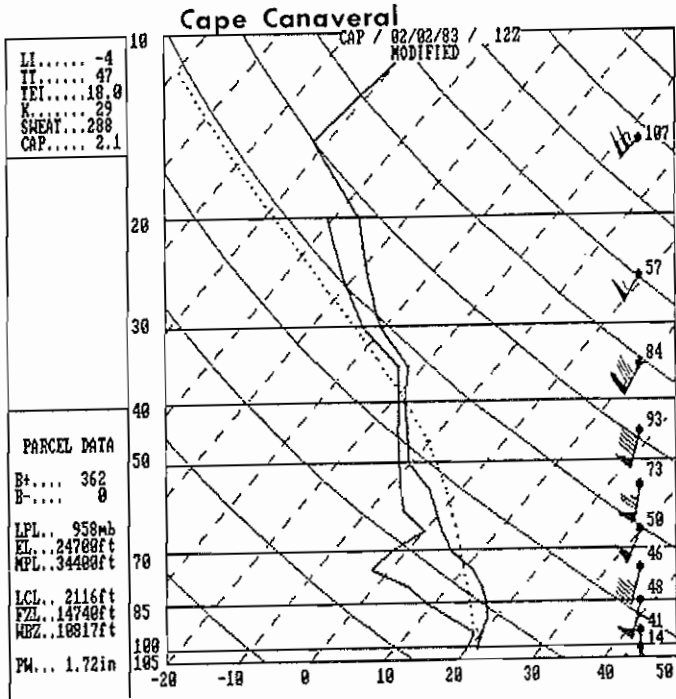




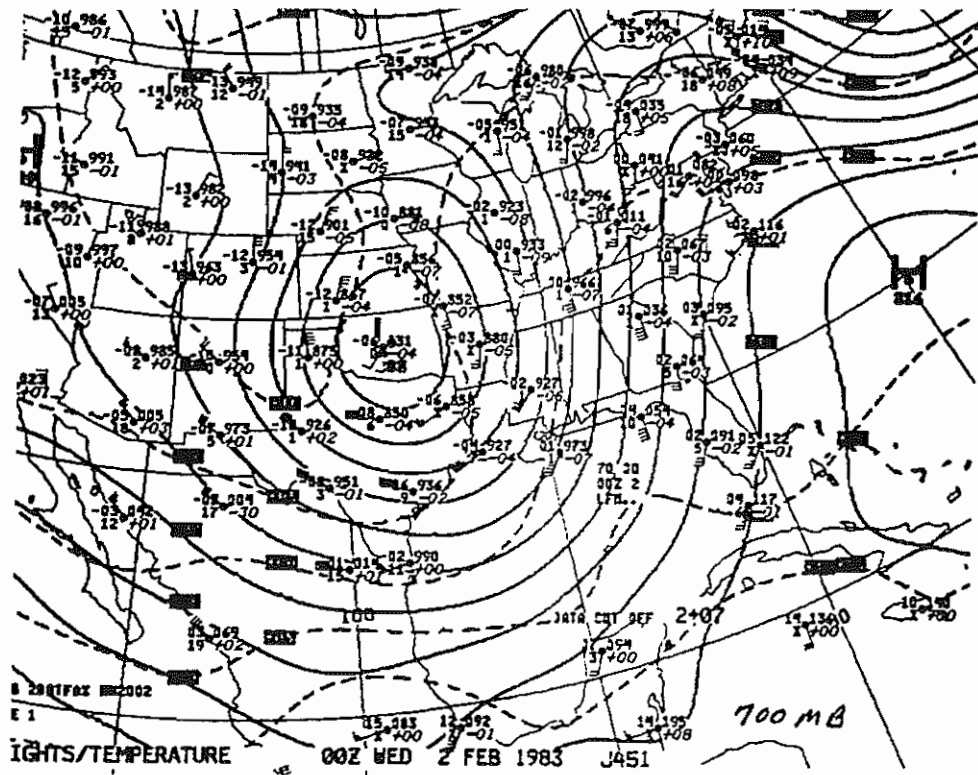
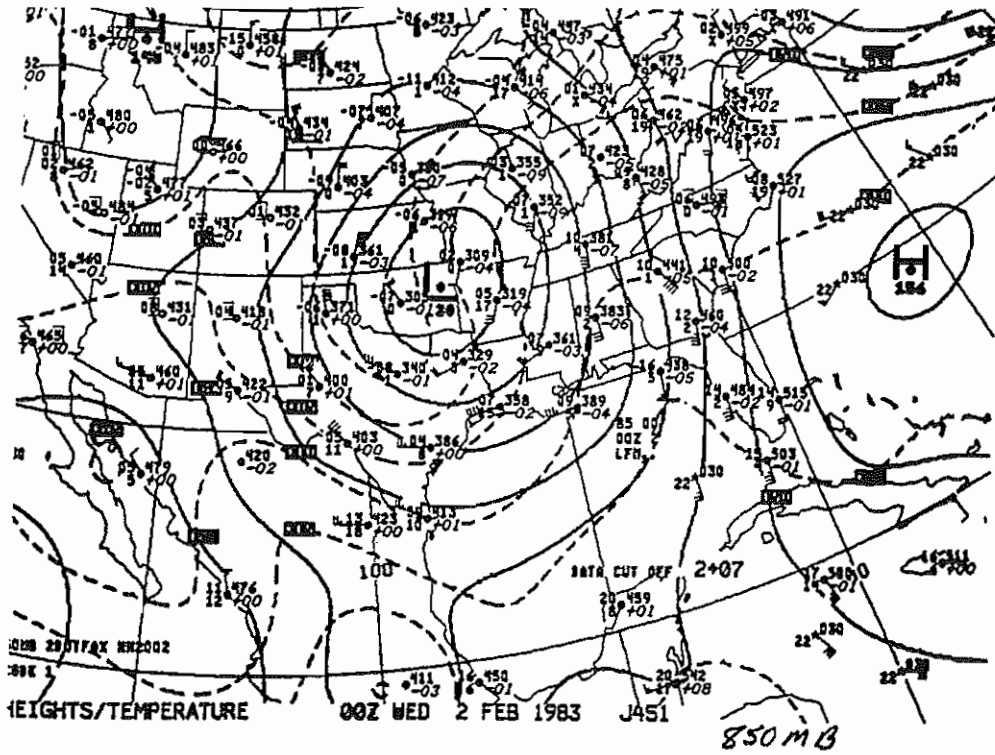


(See Colin 1983)

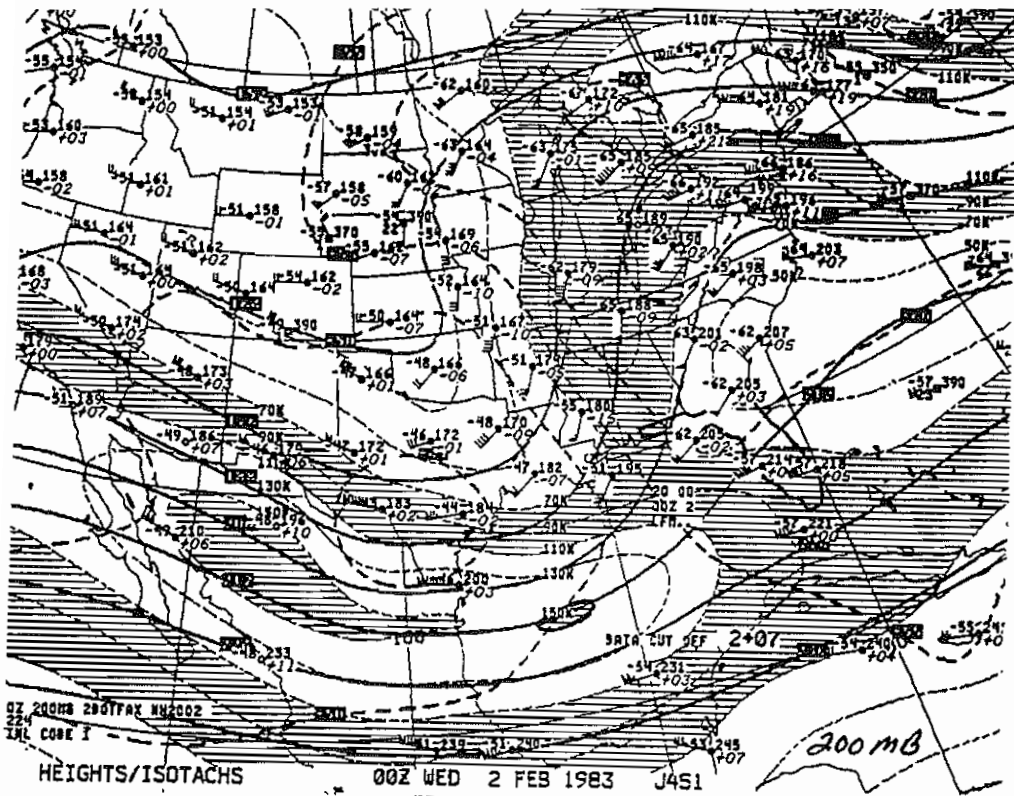
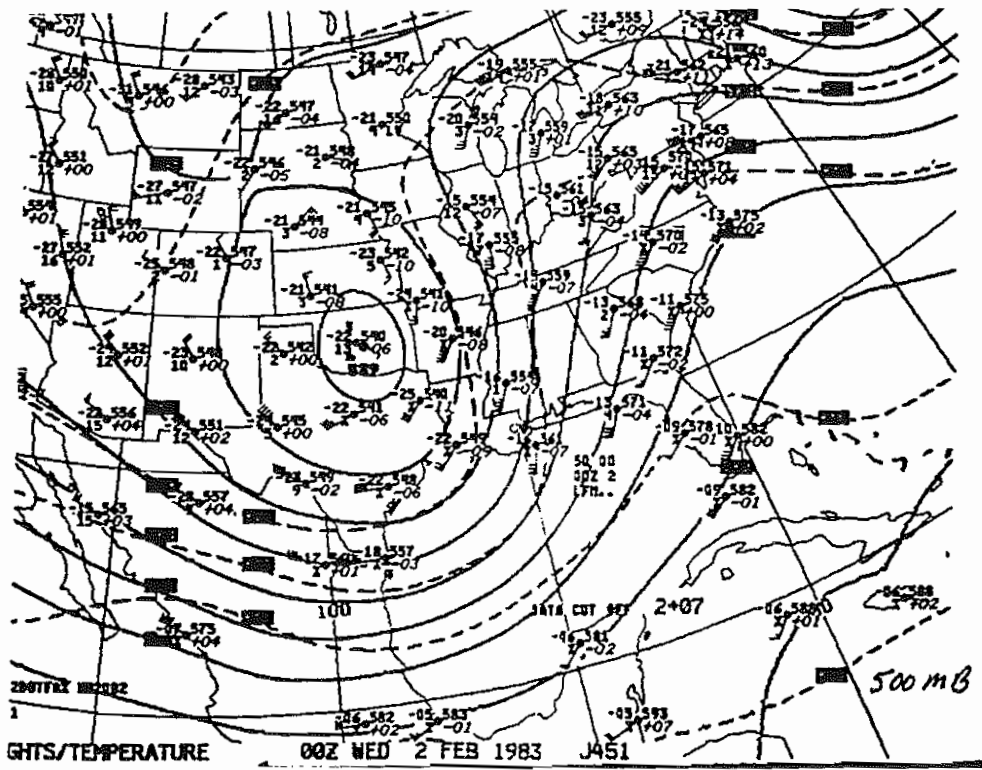


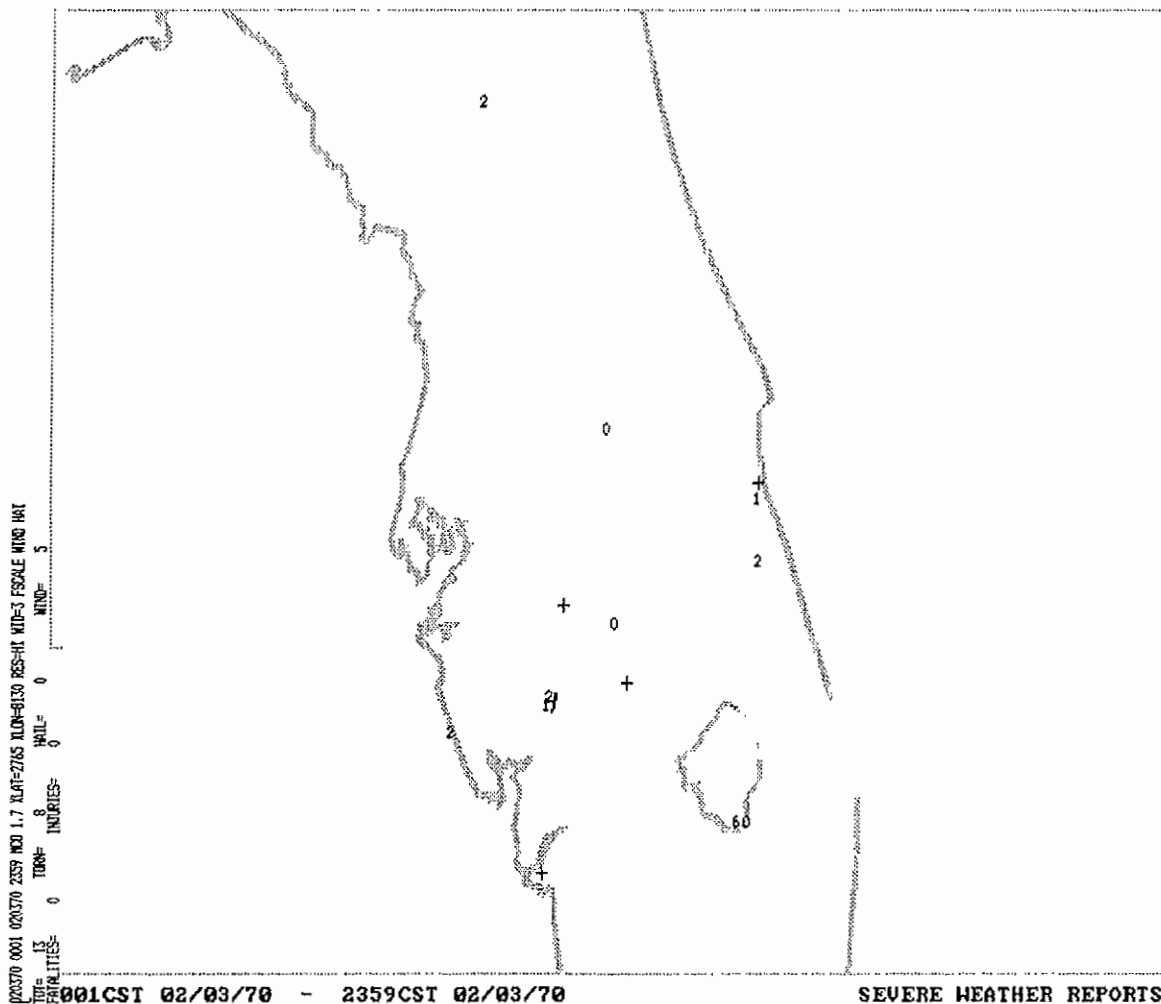


February 2, 1983

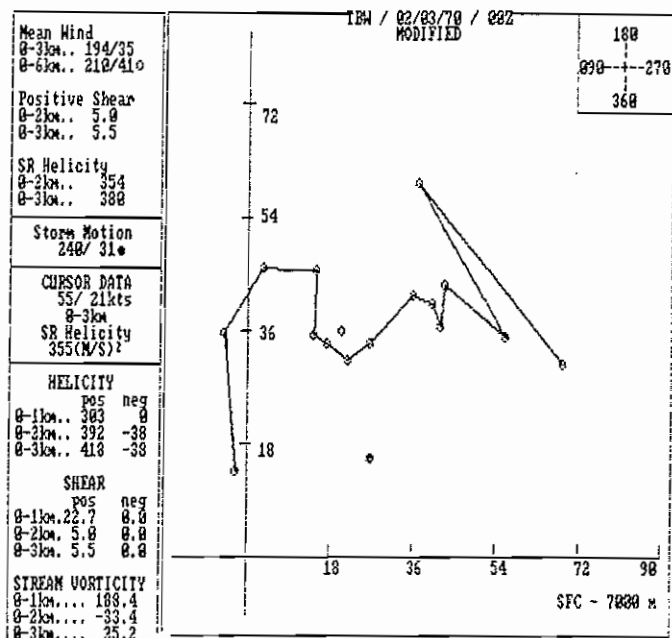
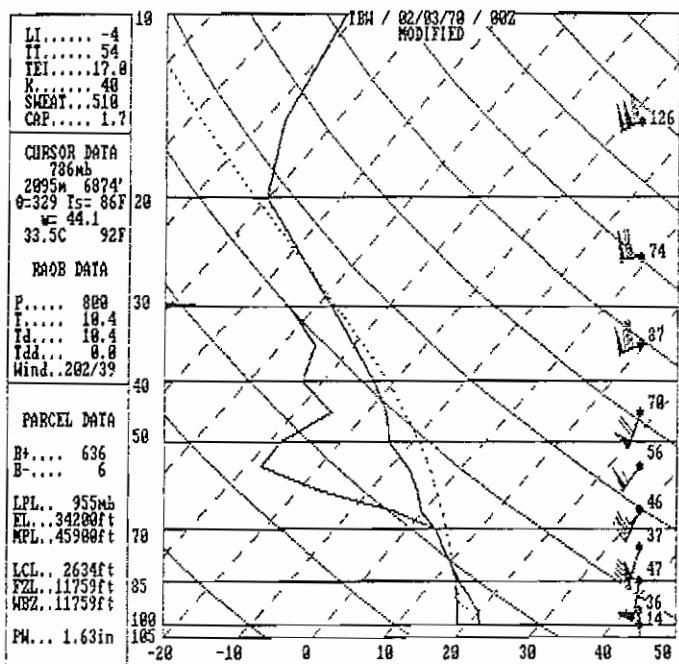


February 2, 1983

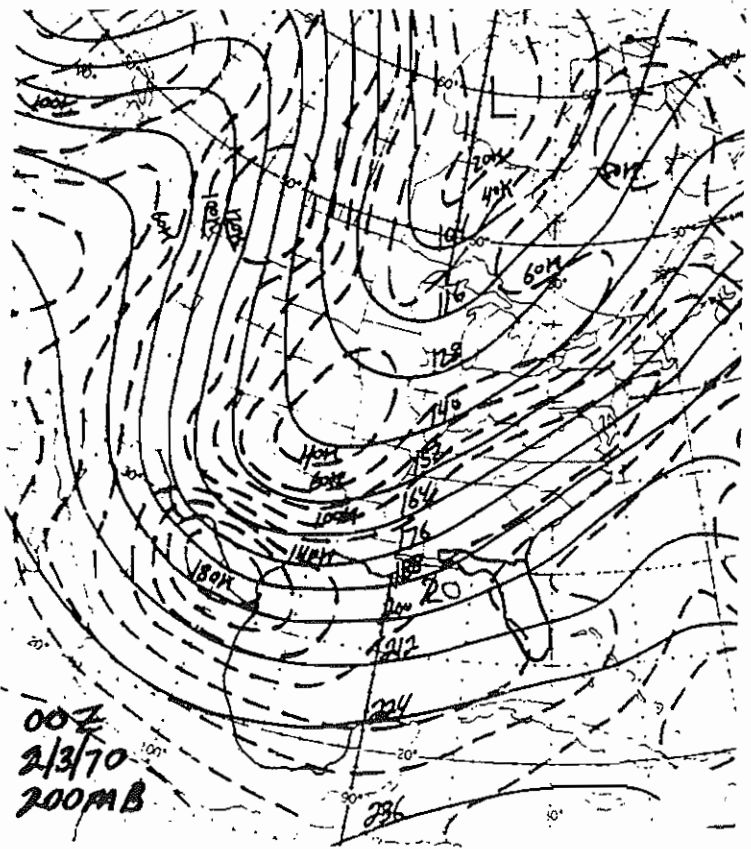
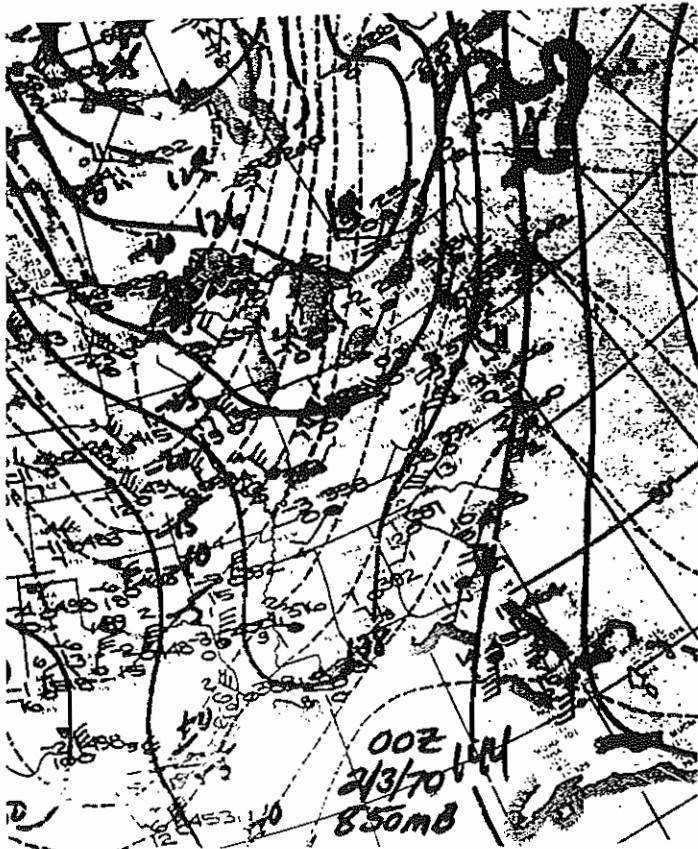
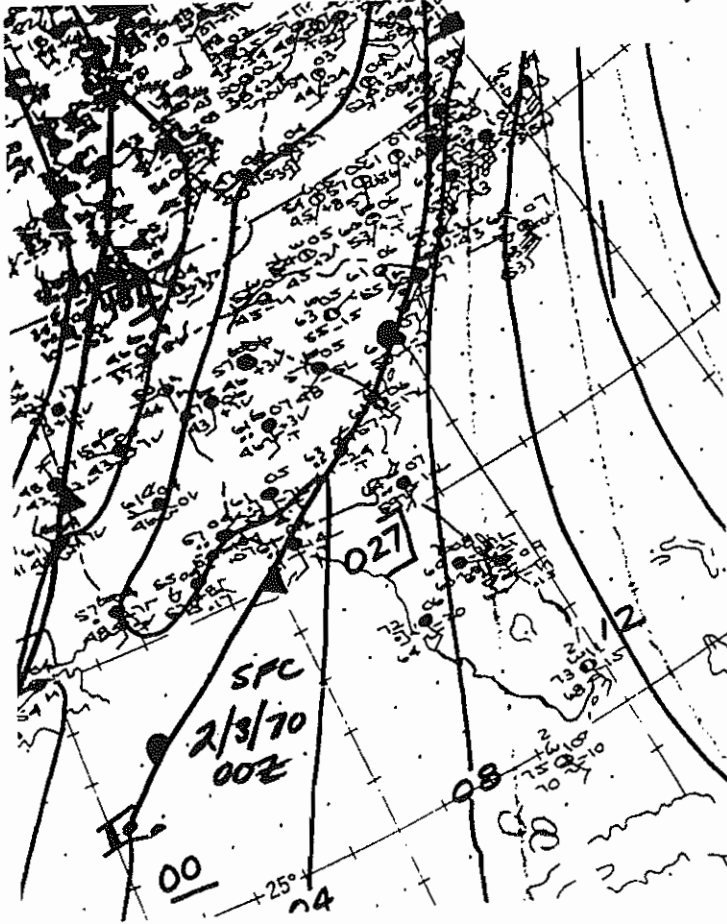




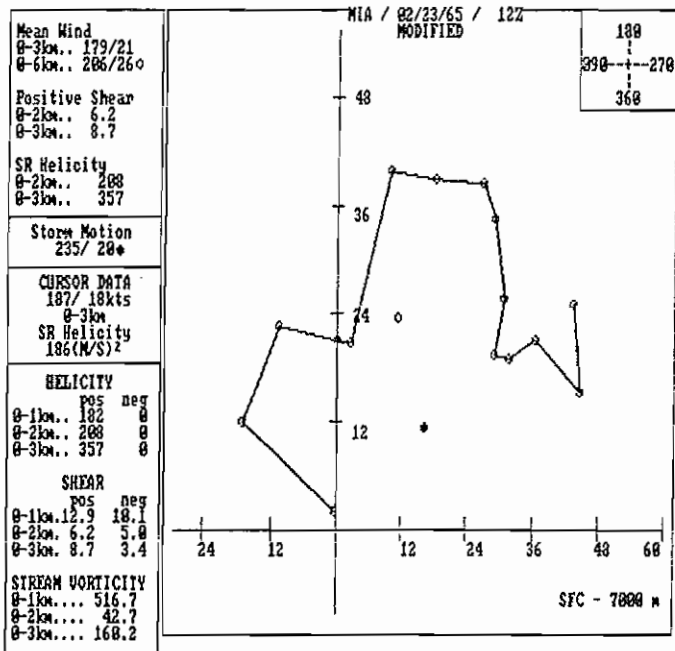
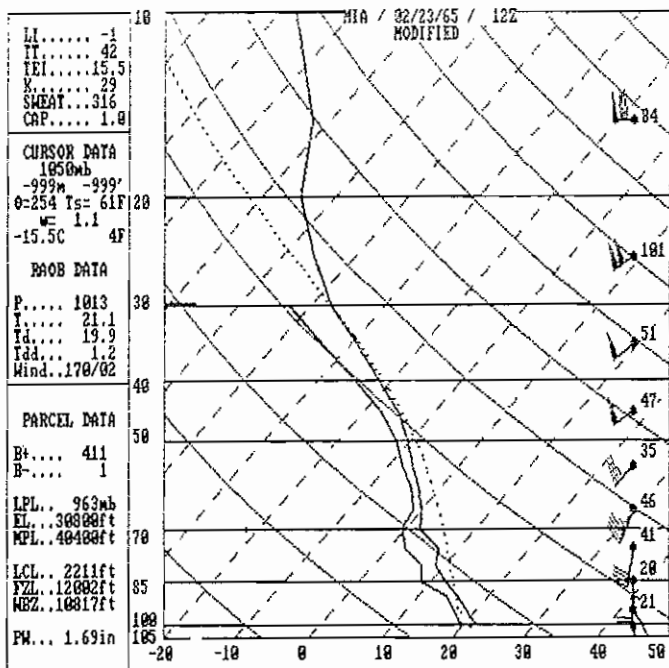
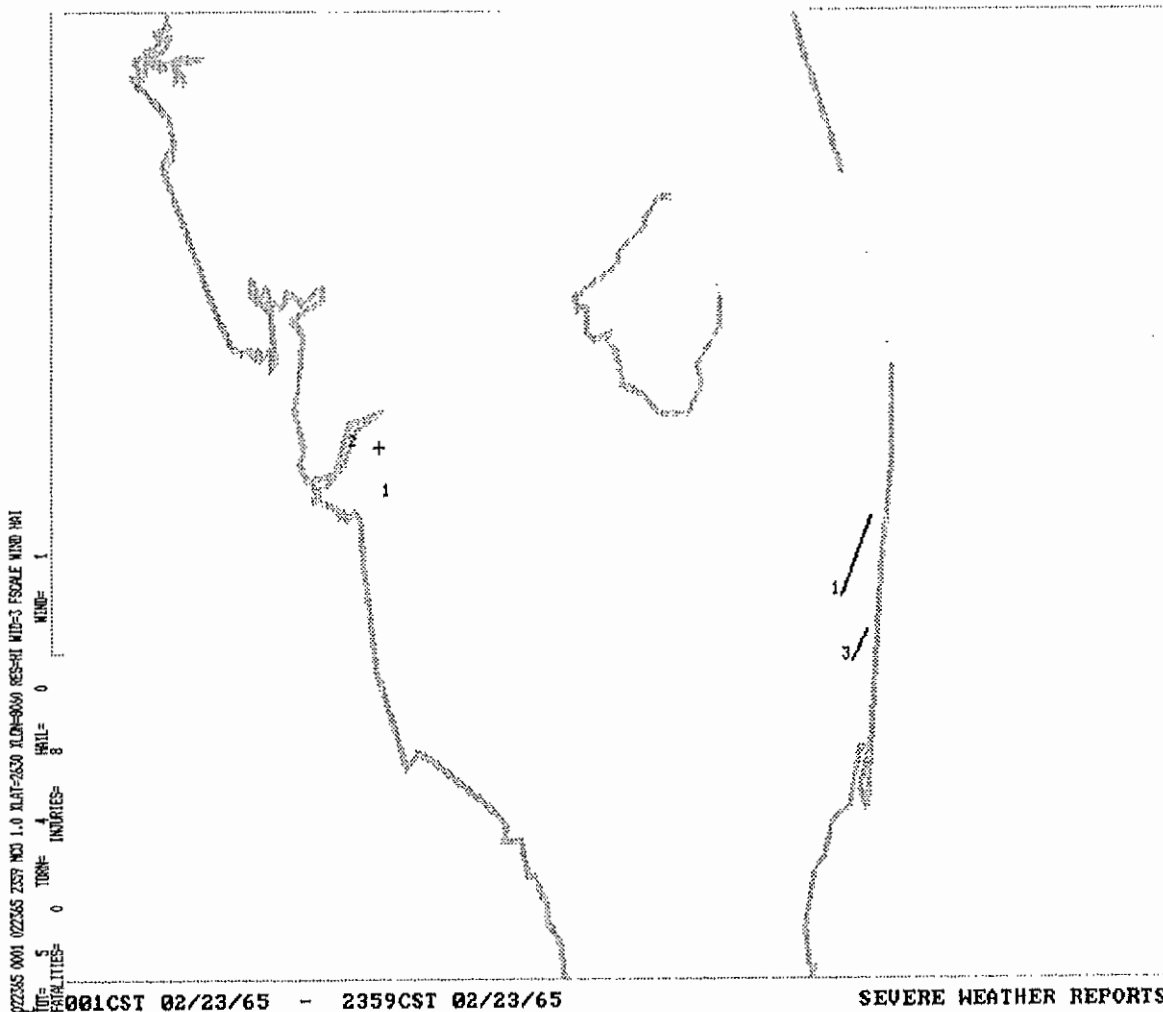
020370 0001 020370 2359 MOD 1.7 XLAT=21AS XLON=8130 RES=HK MTP=3 FSCALE MIND HRT  
 TYP= IS FATALITIES= 0 TORN= 8 INJURIES= 0 HAUL= 0 MIND= 5

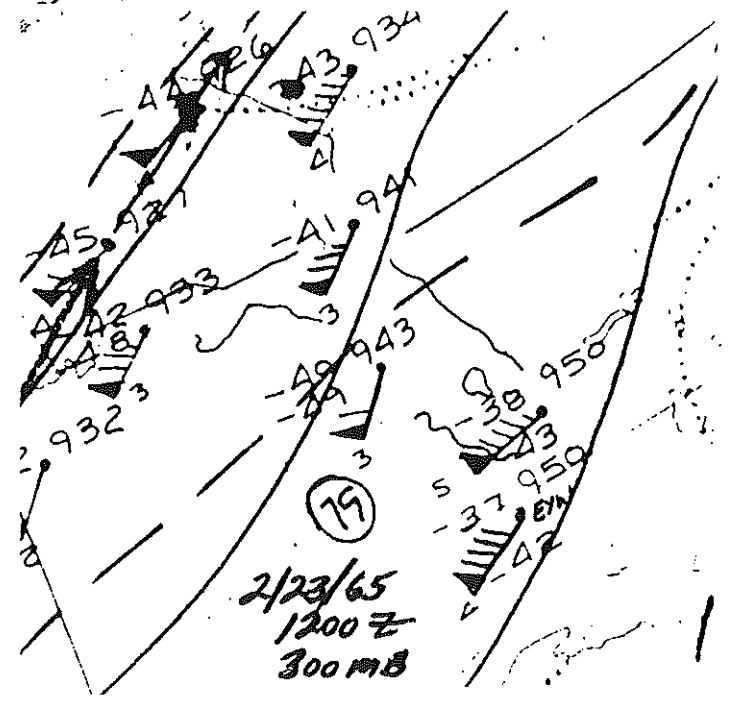
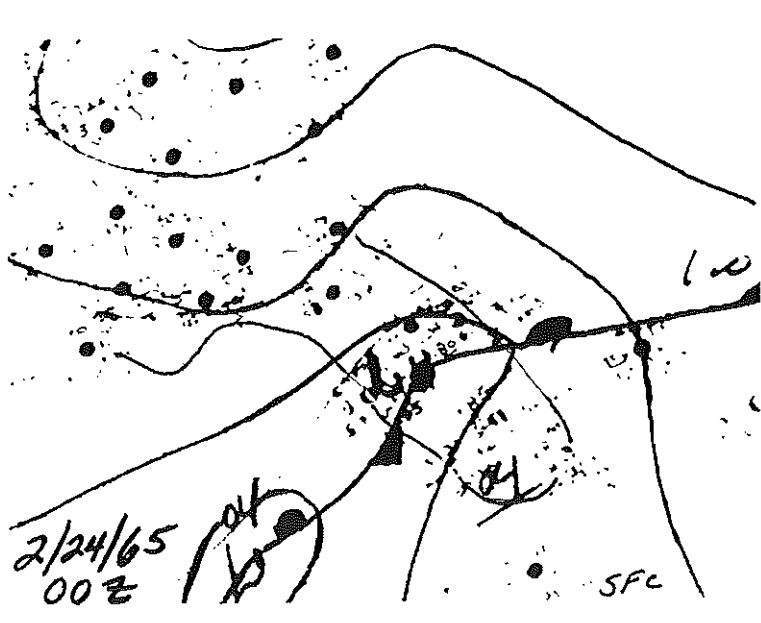
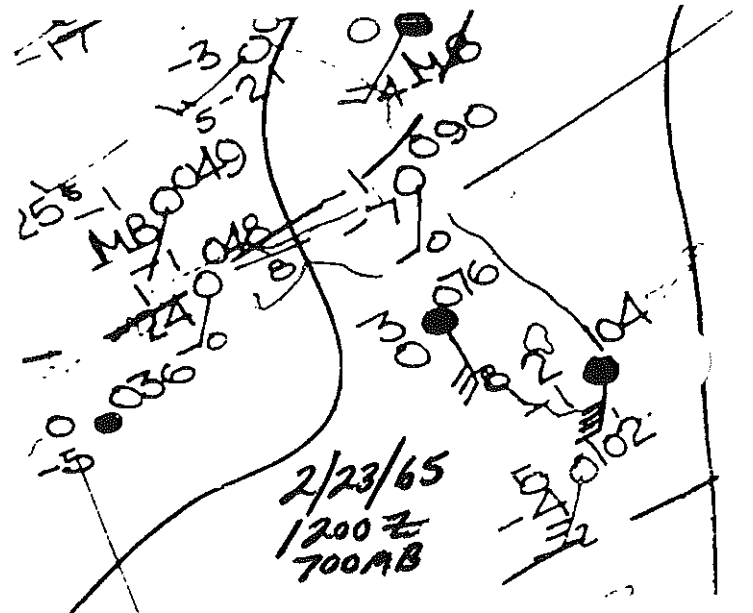
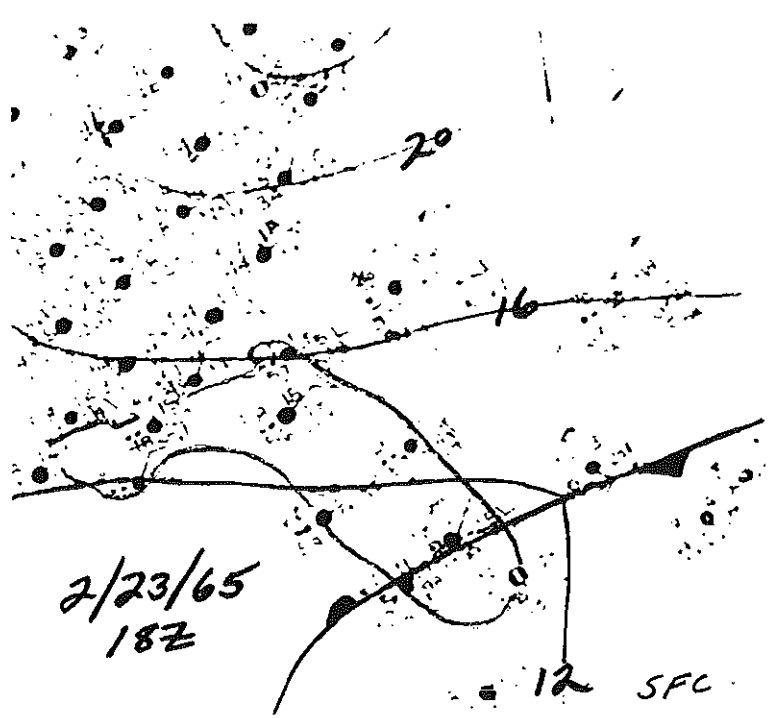
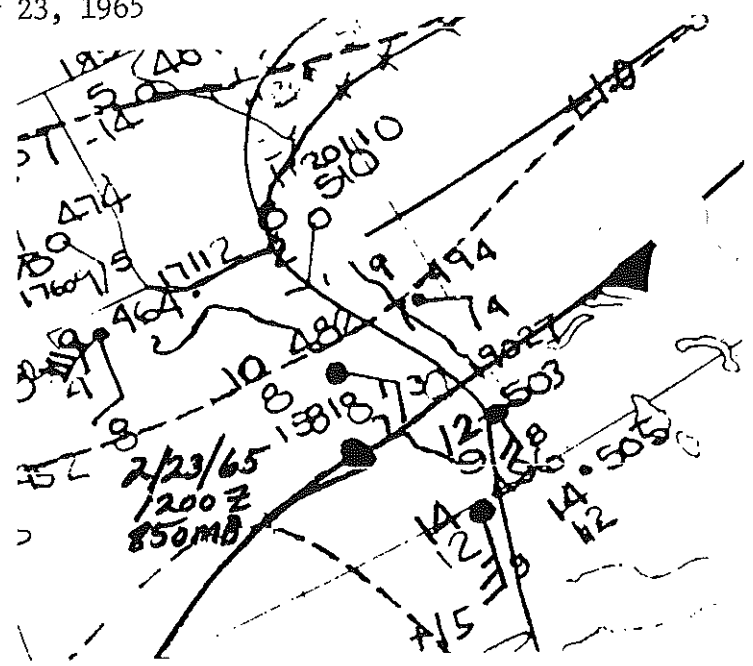
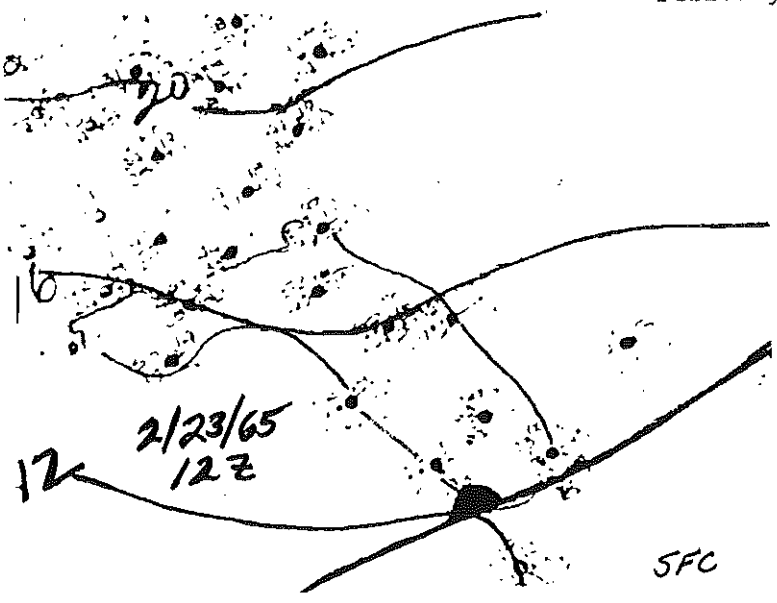


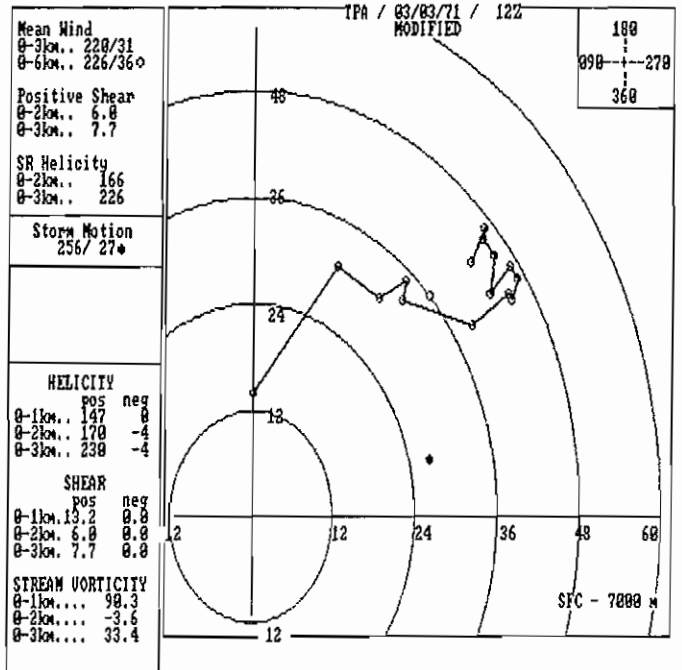
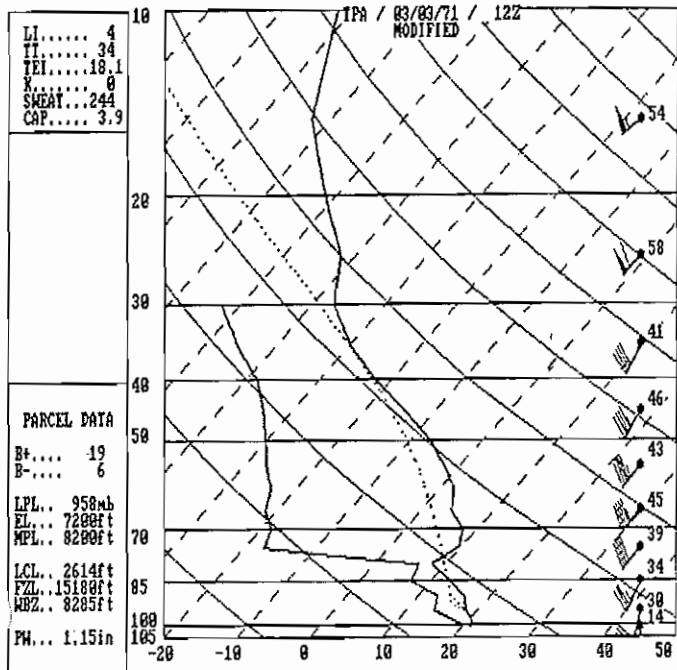
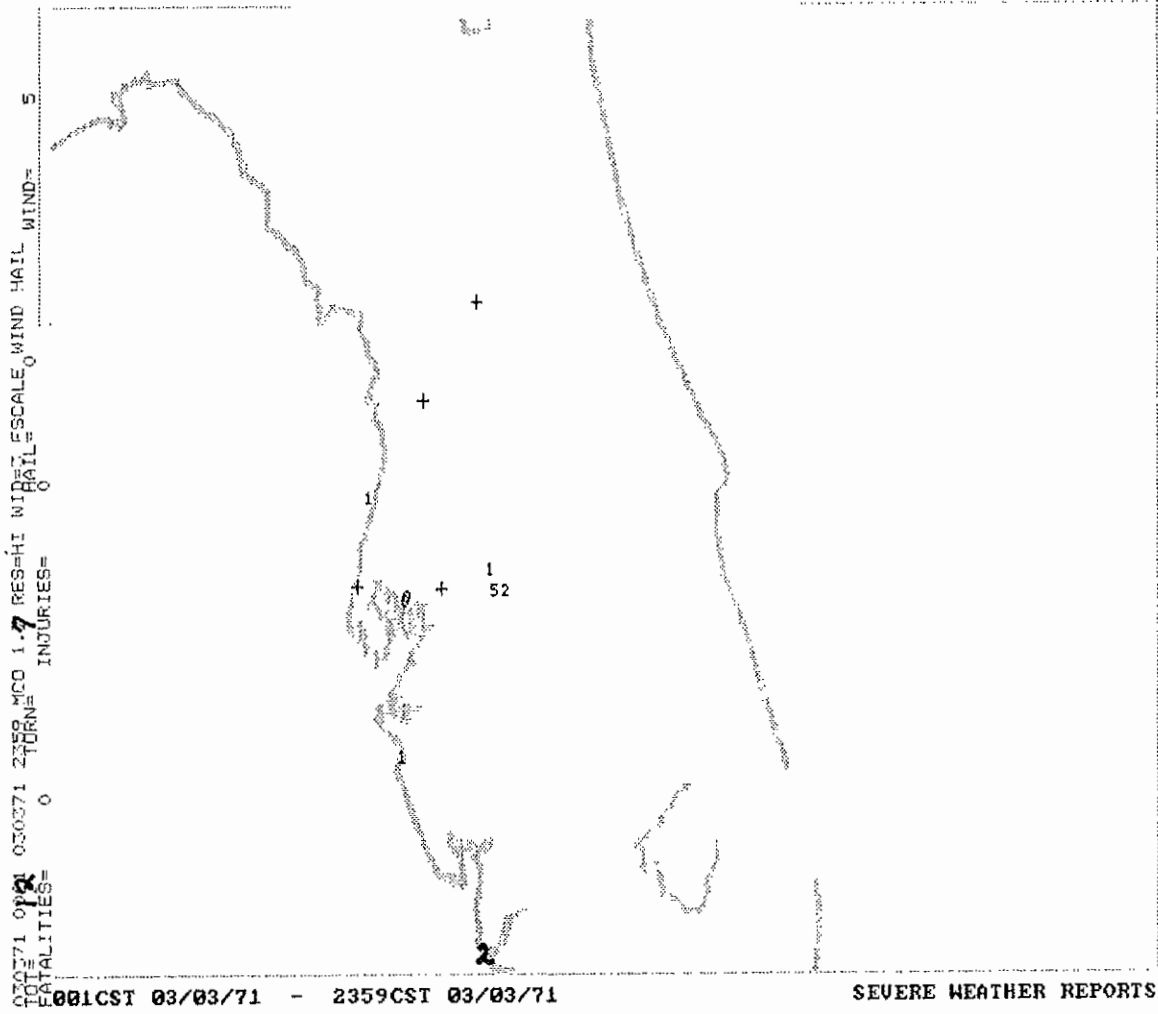
February 3, 1970



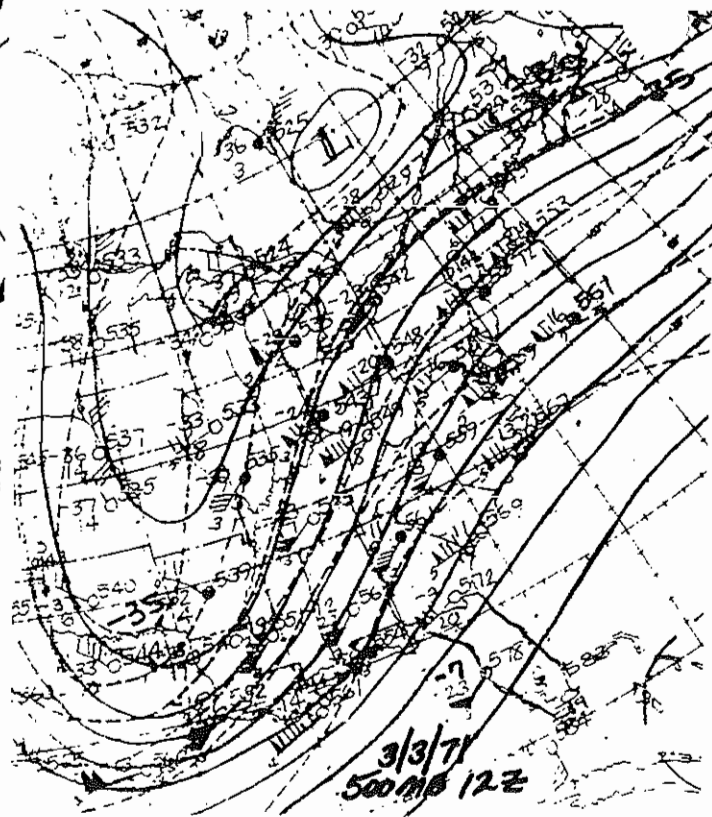
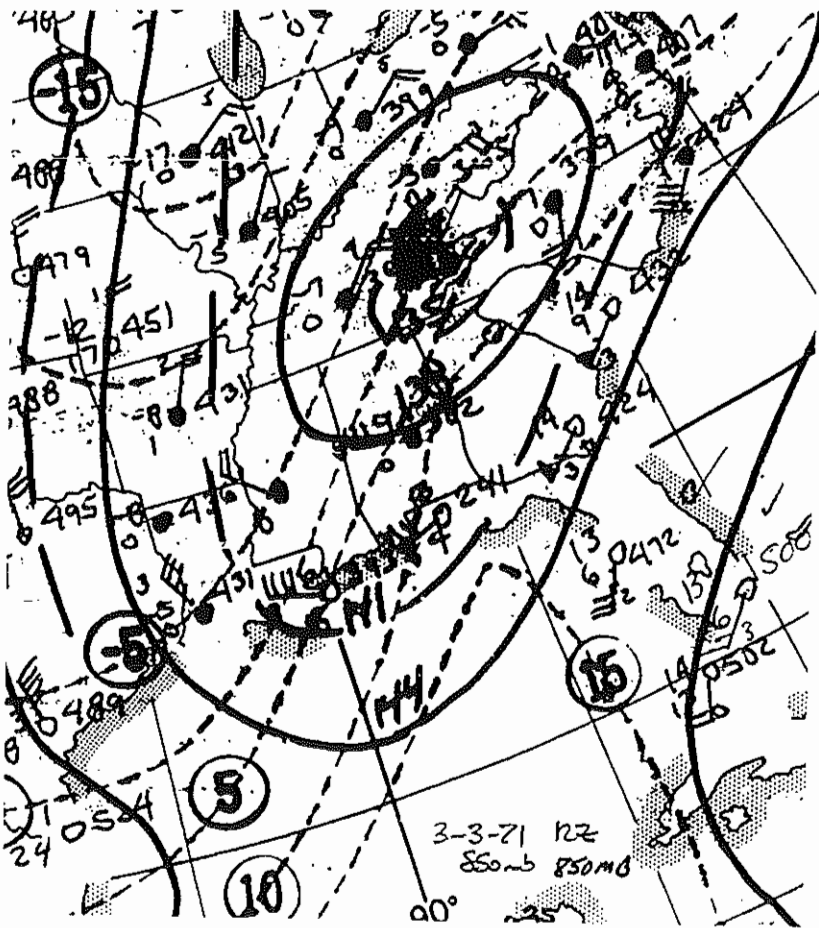
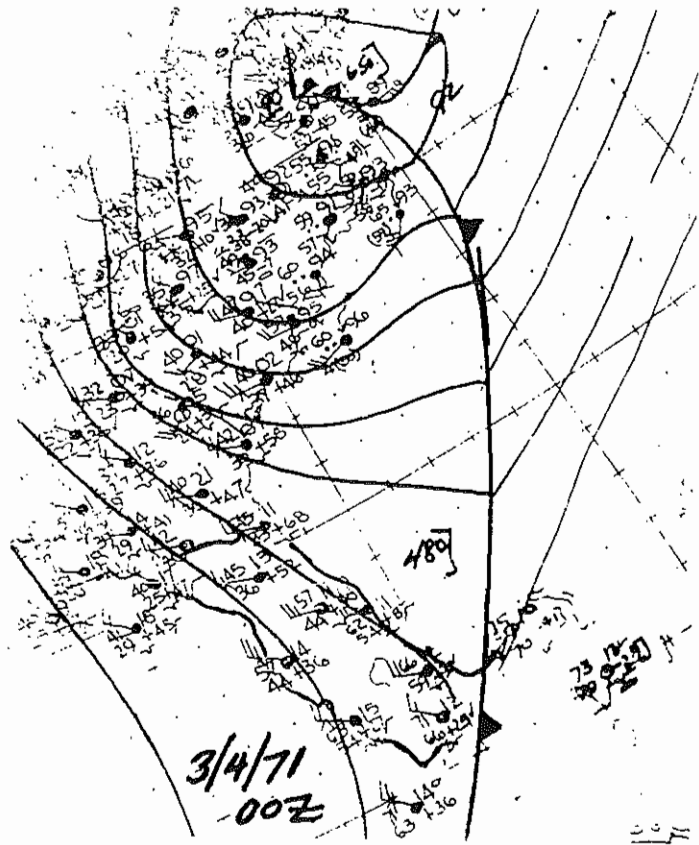
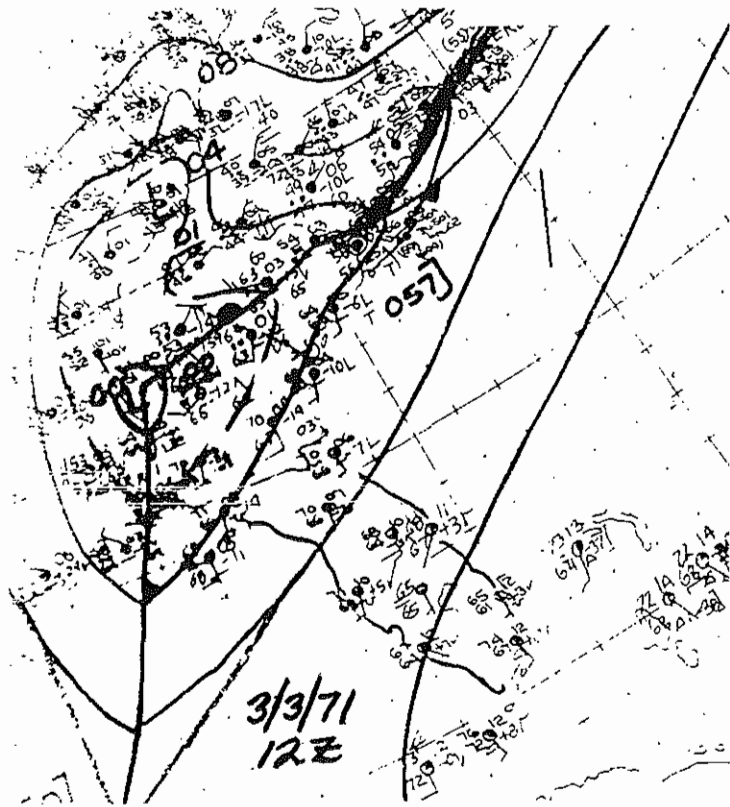


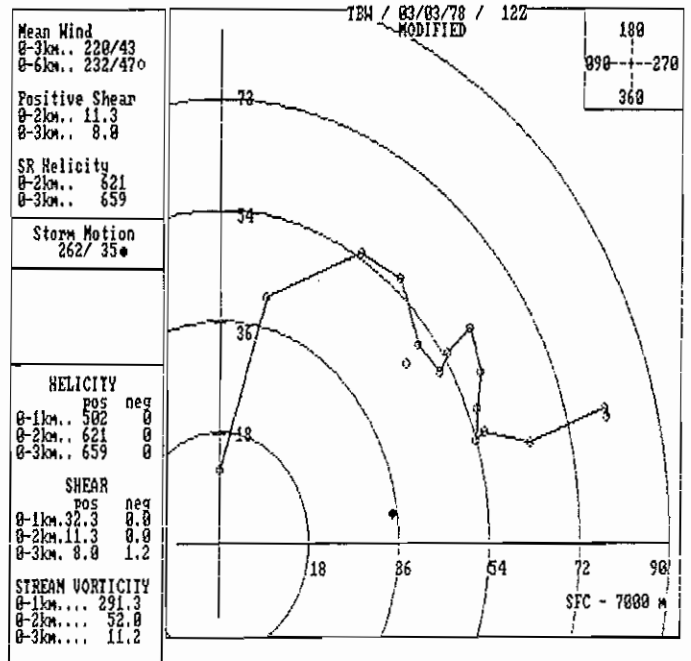
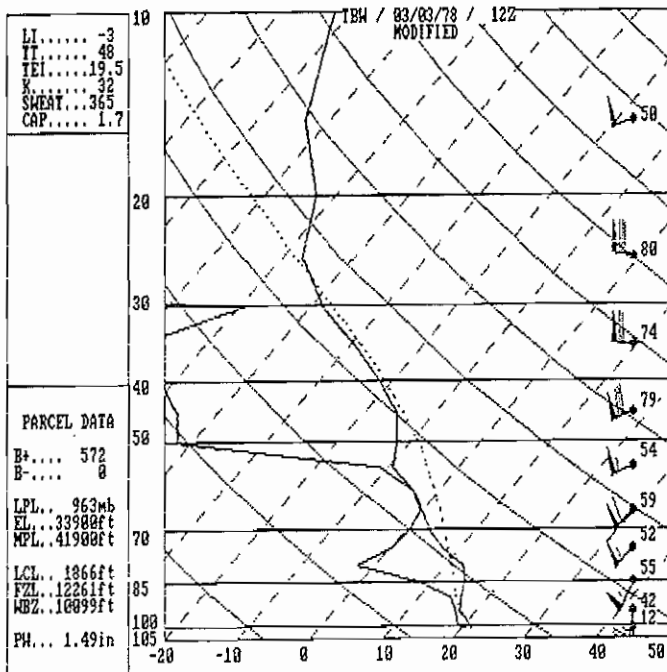
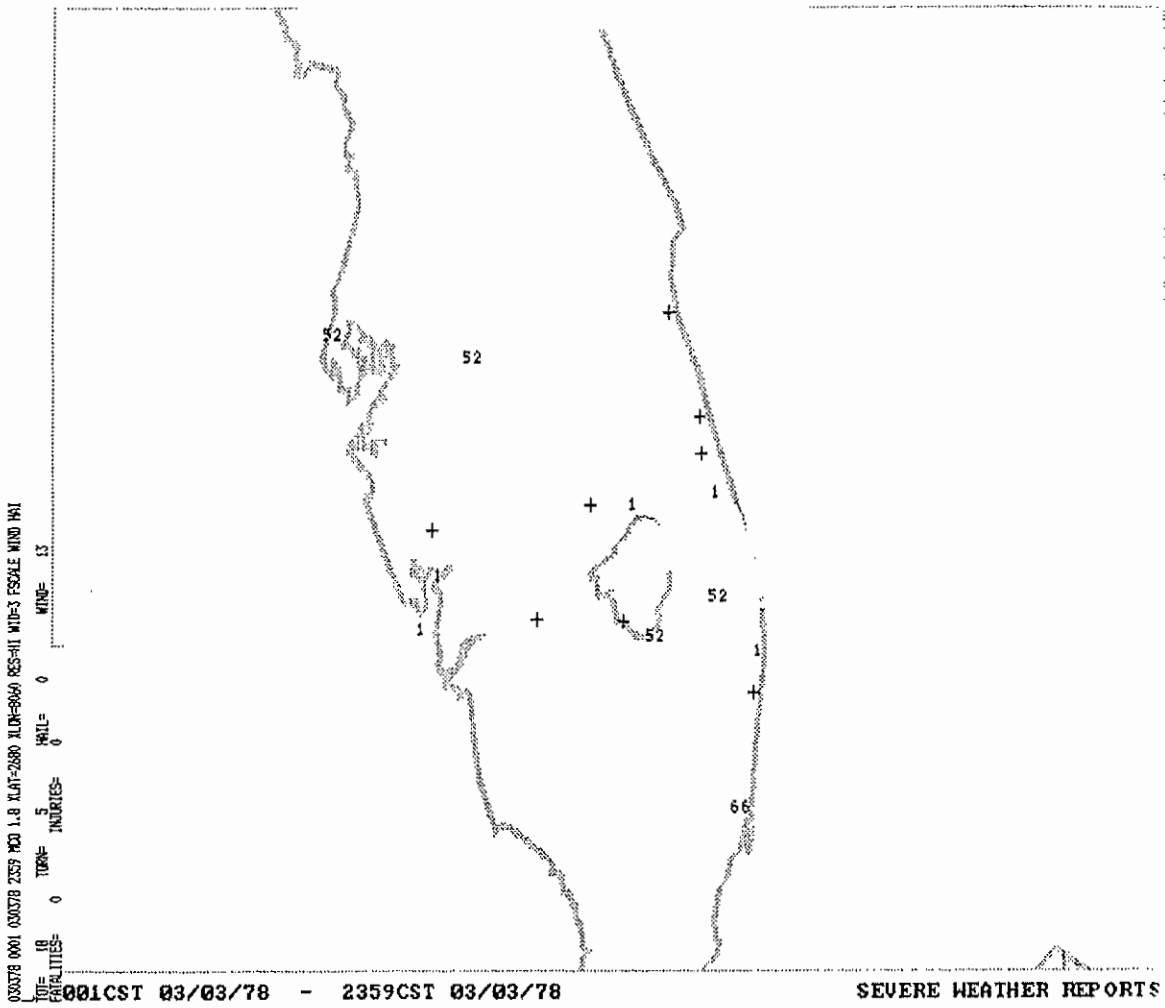


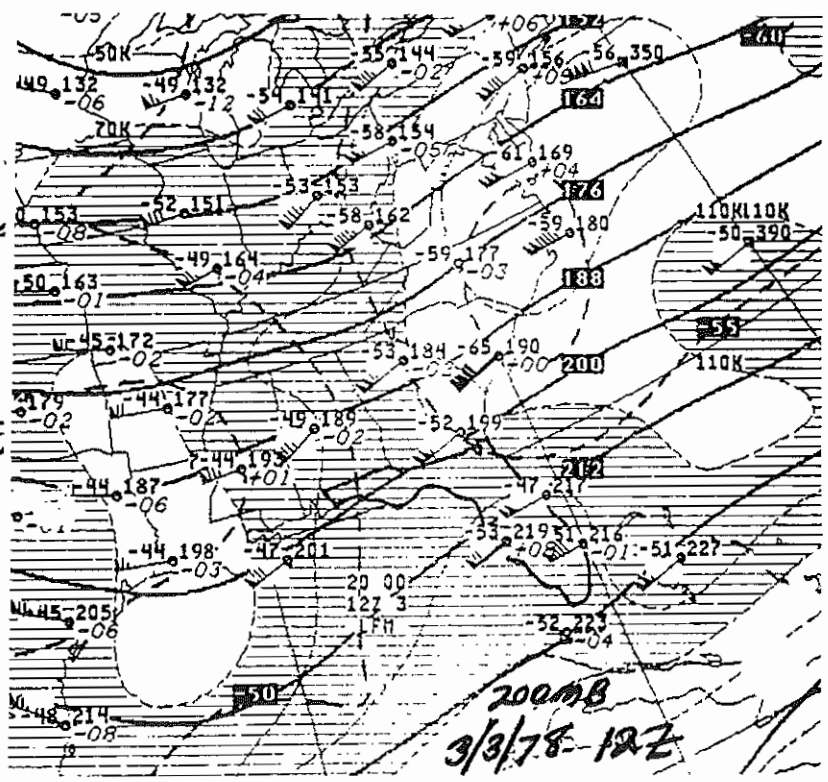
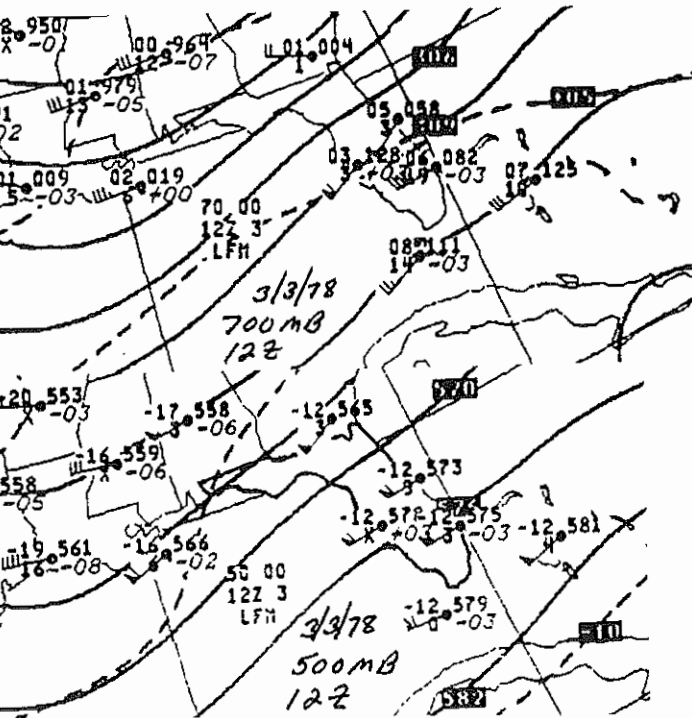
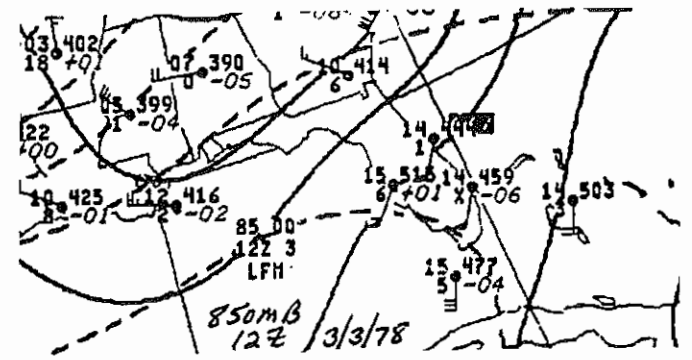
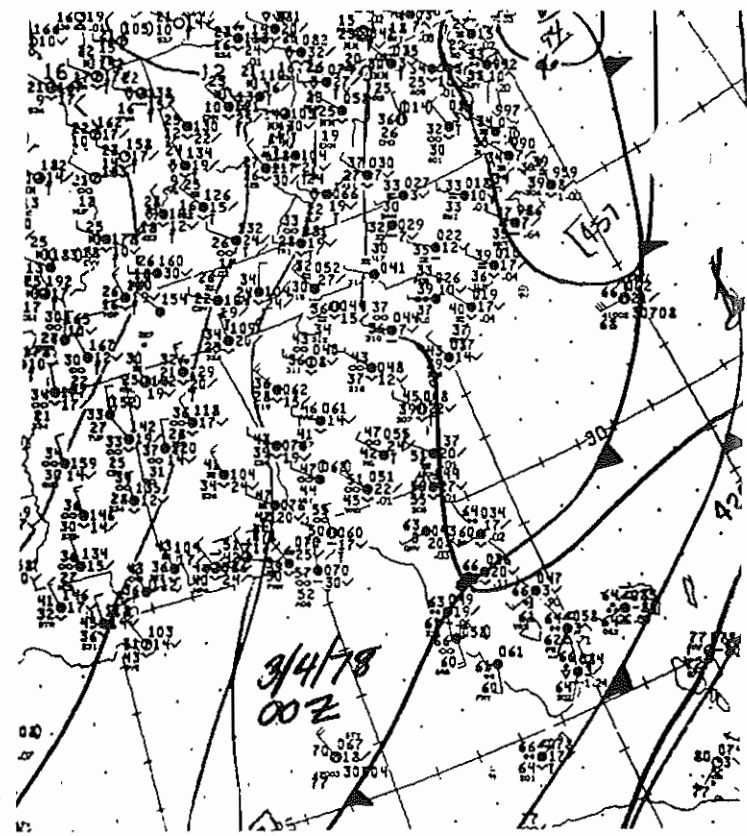
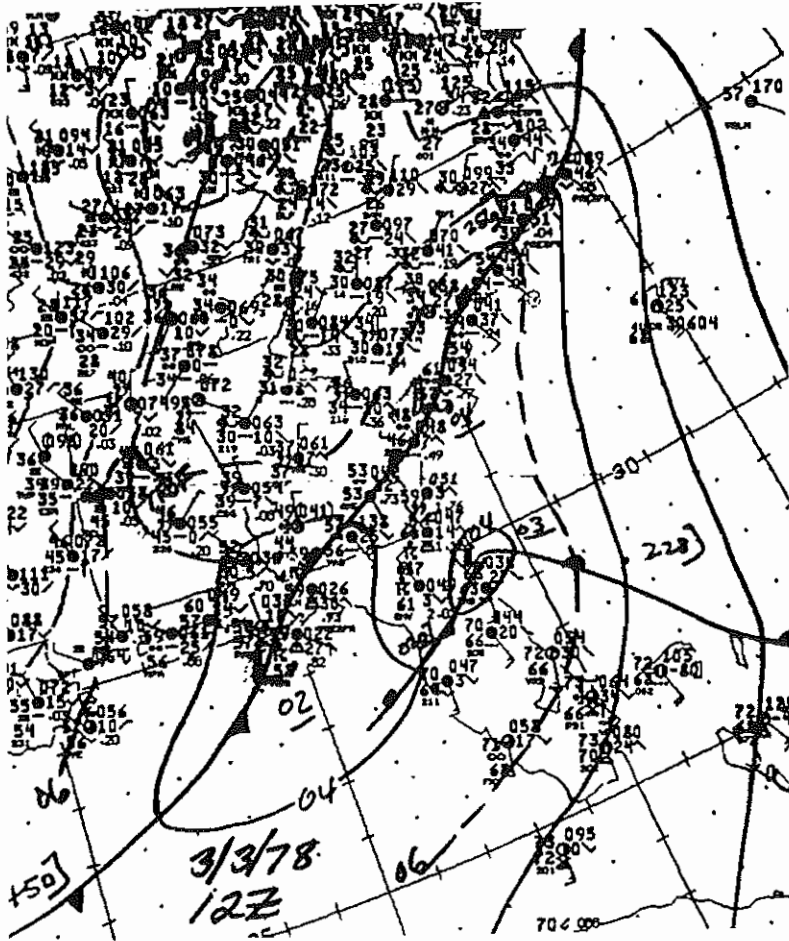


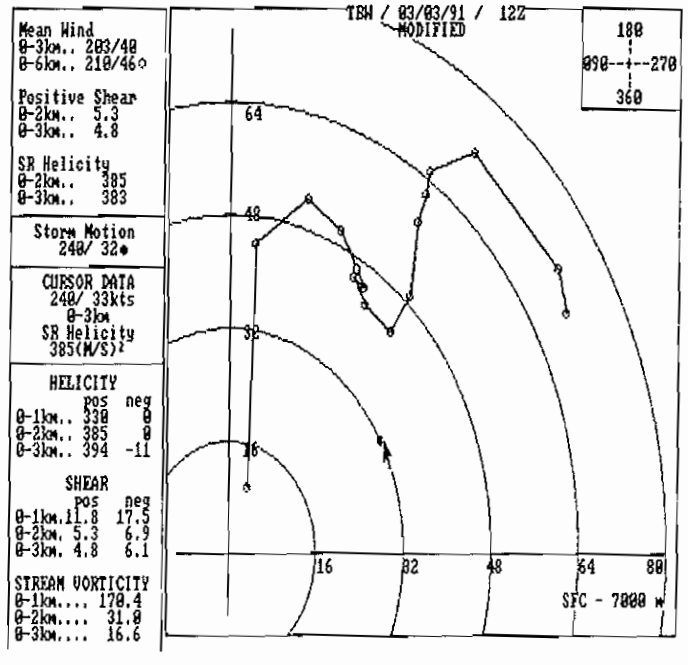
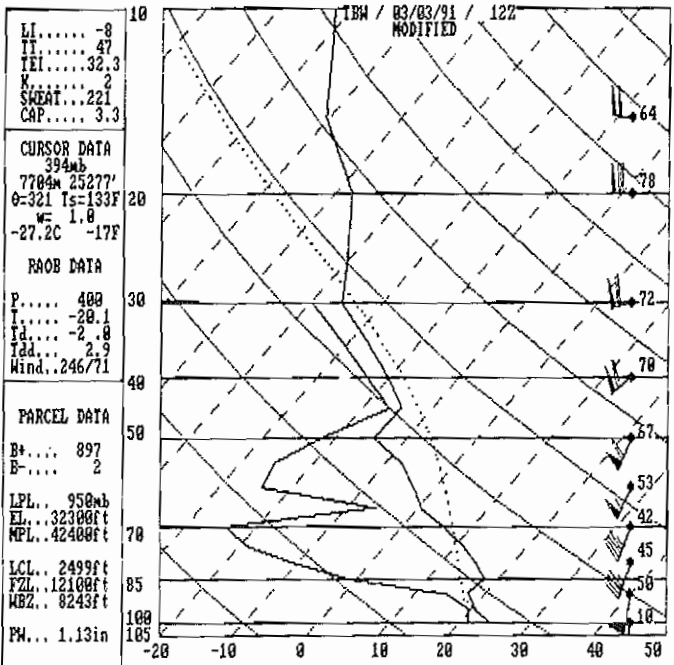
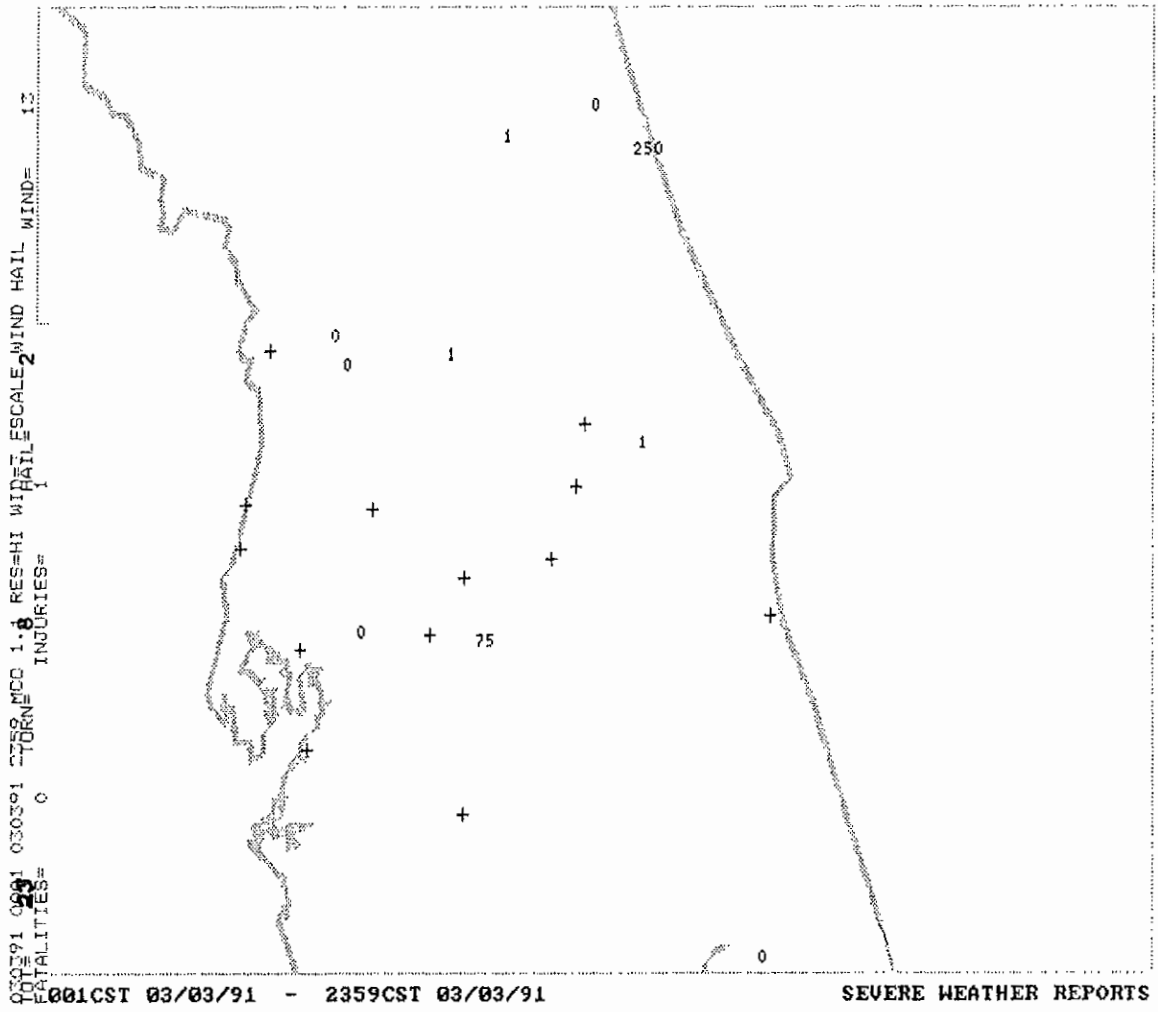


March 3, 1971

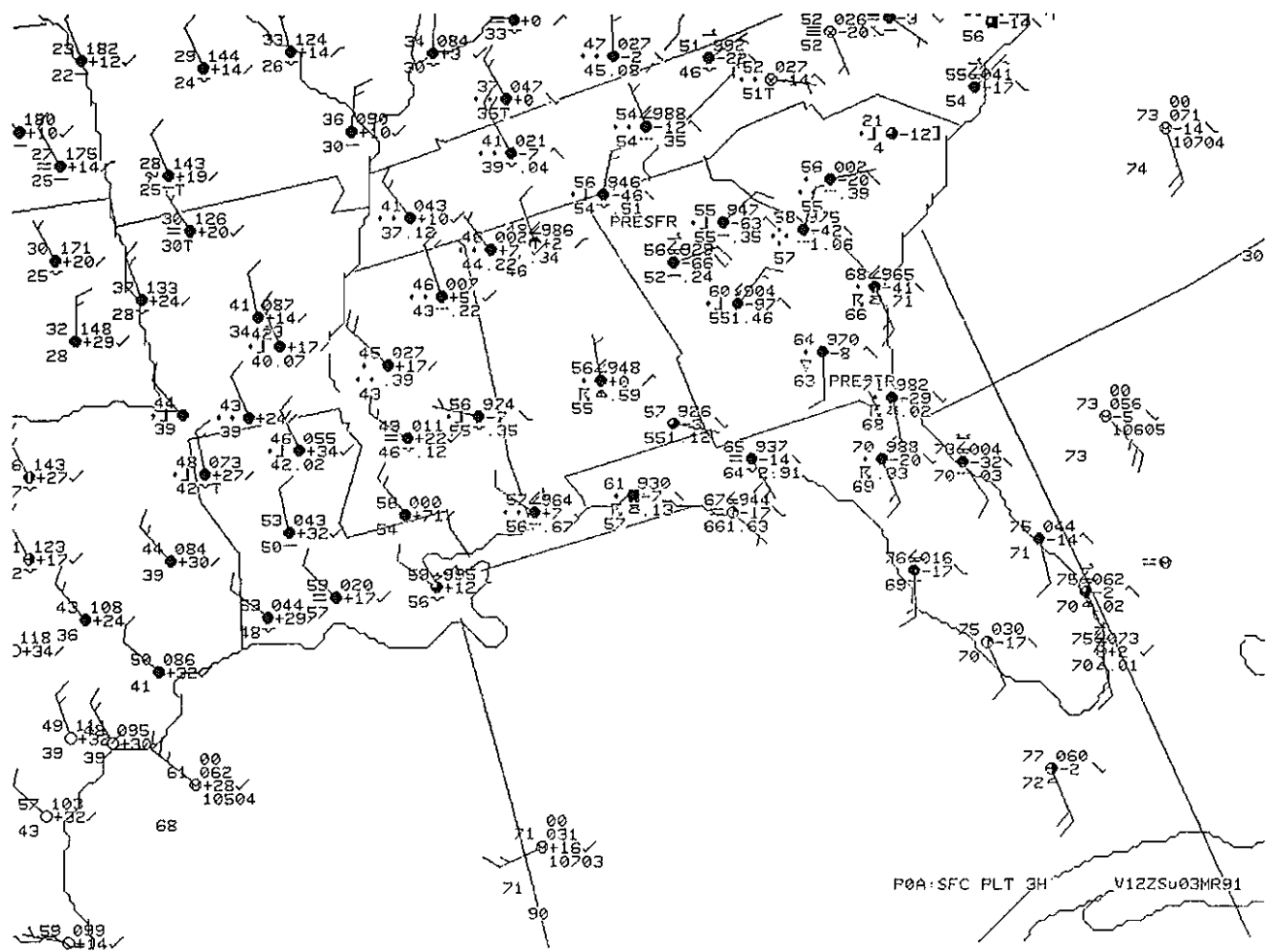
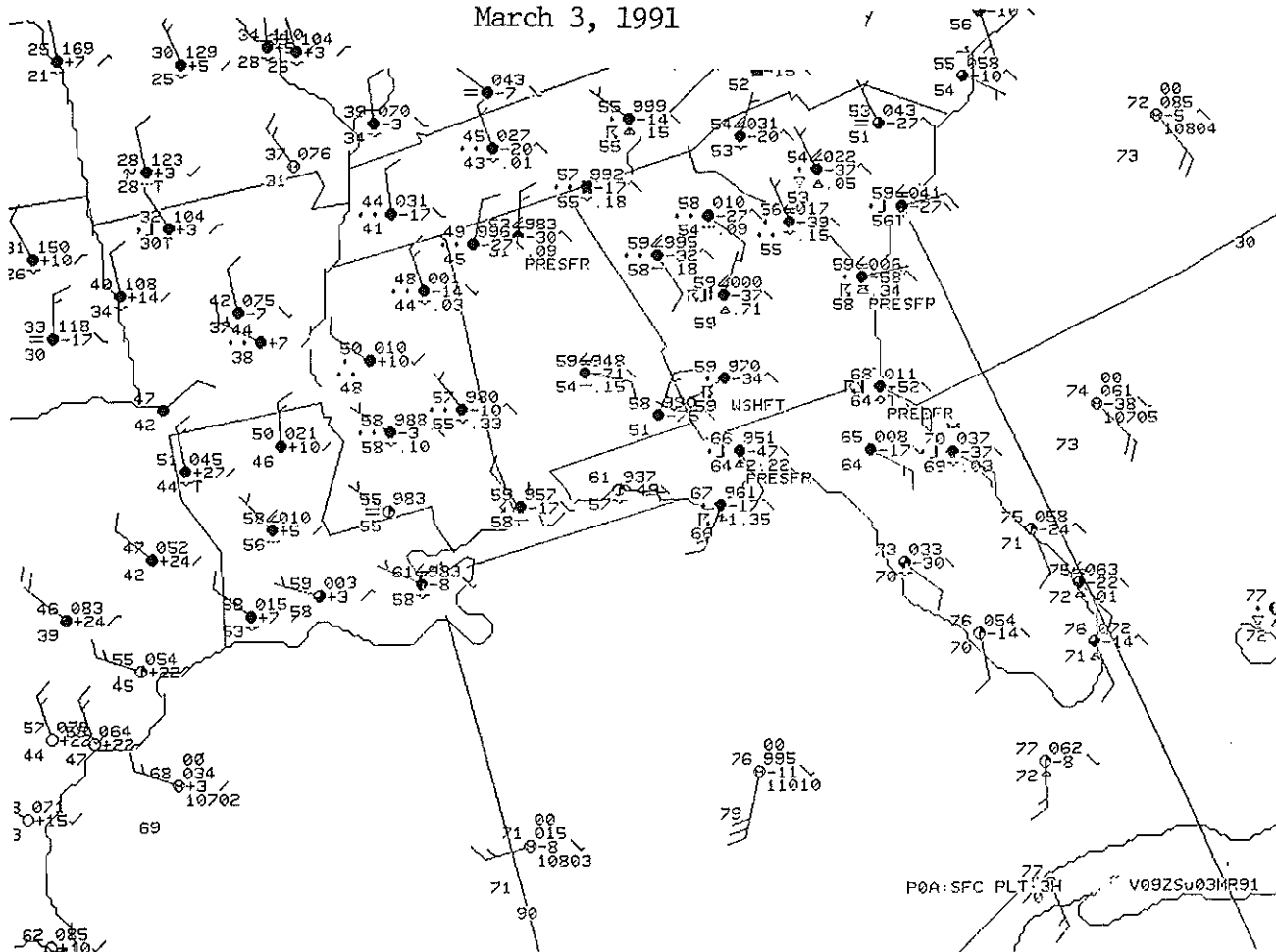






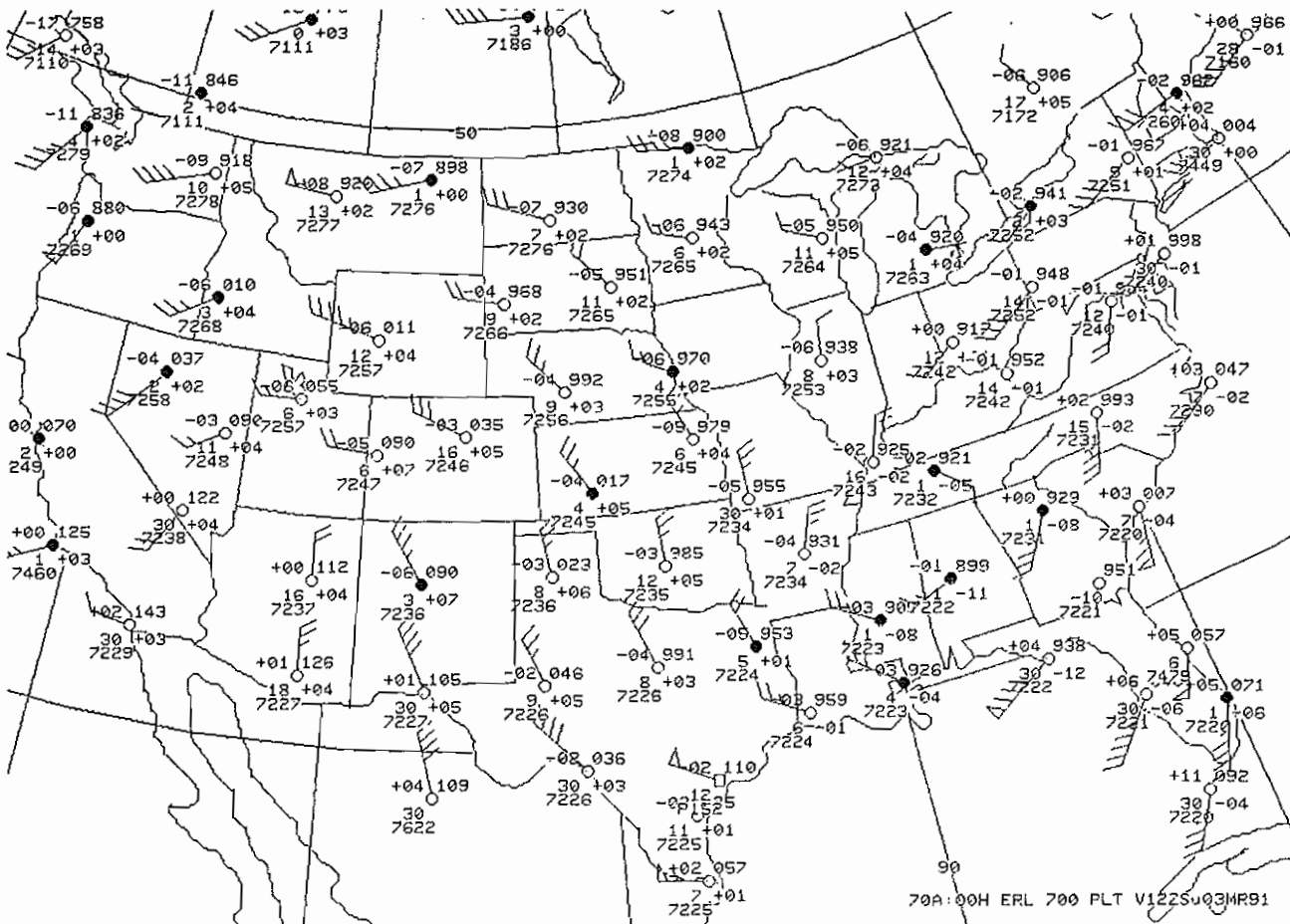
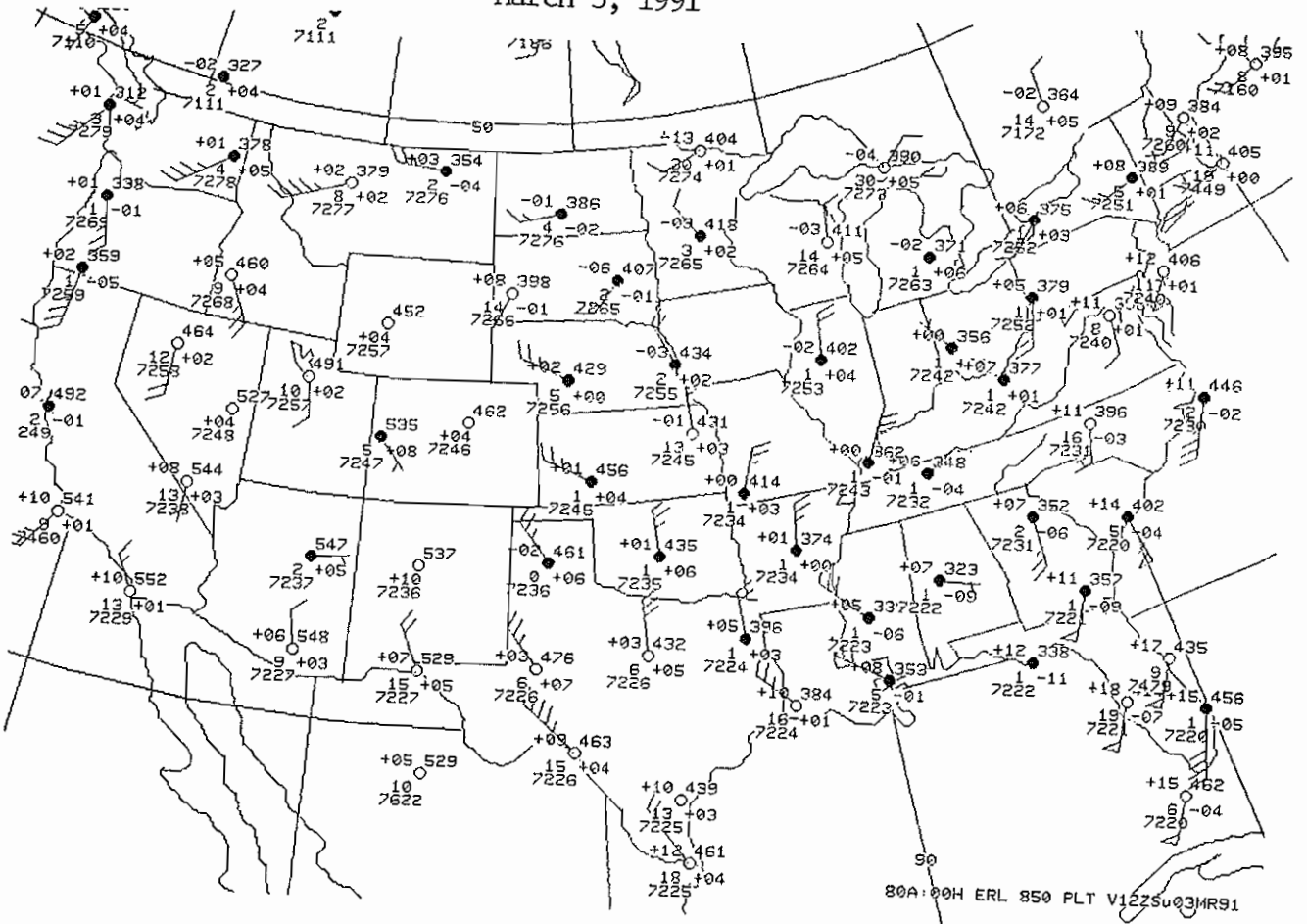


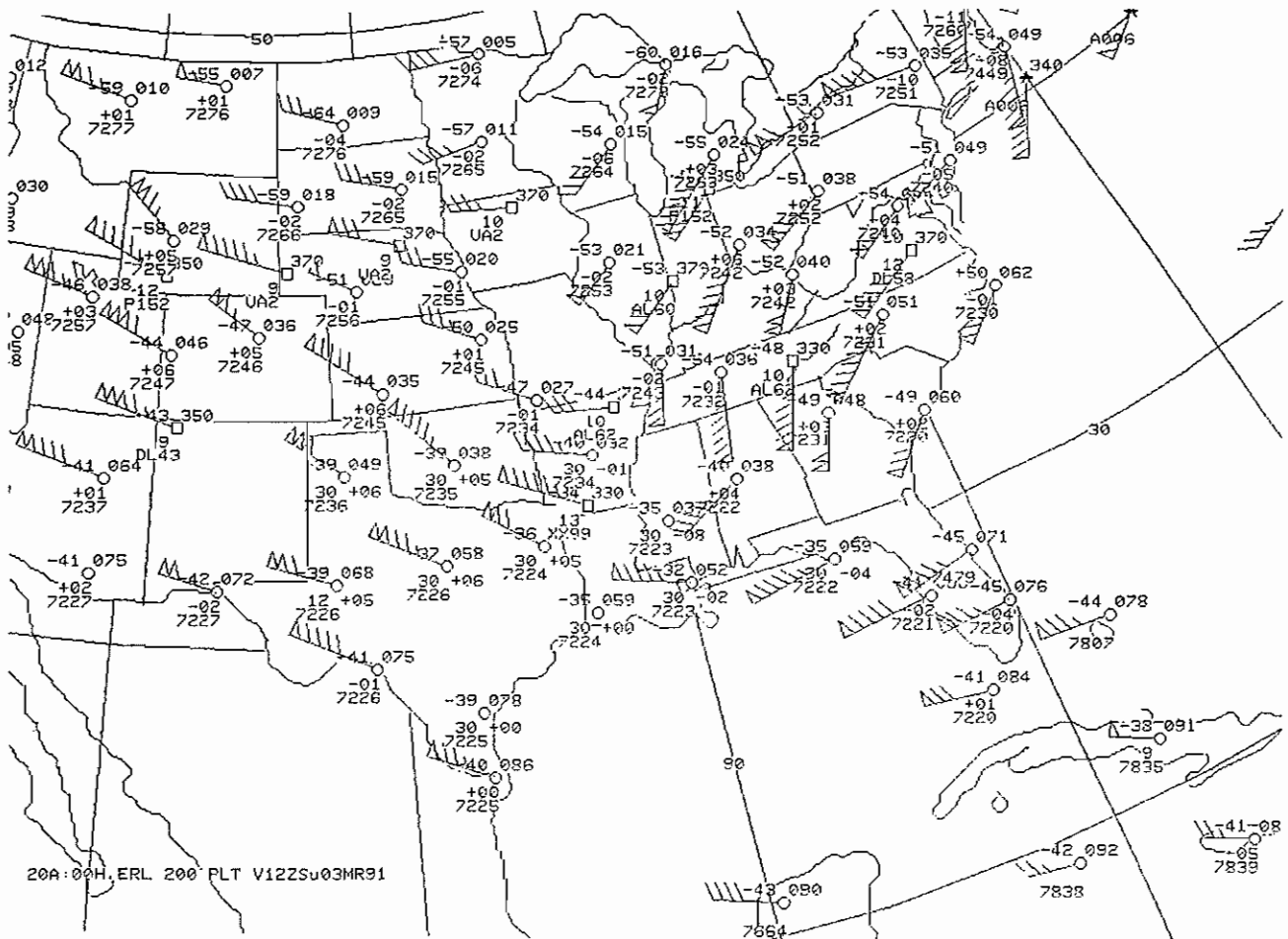
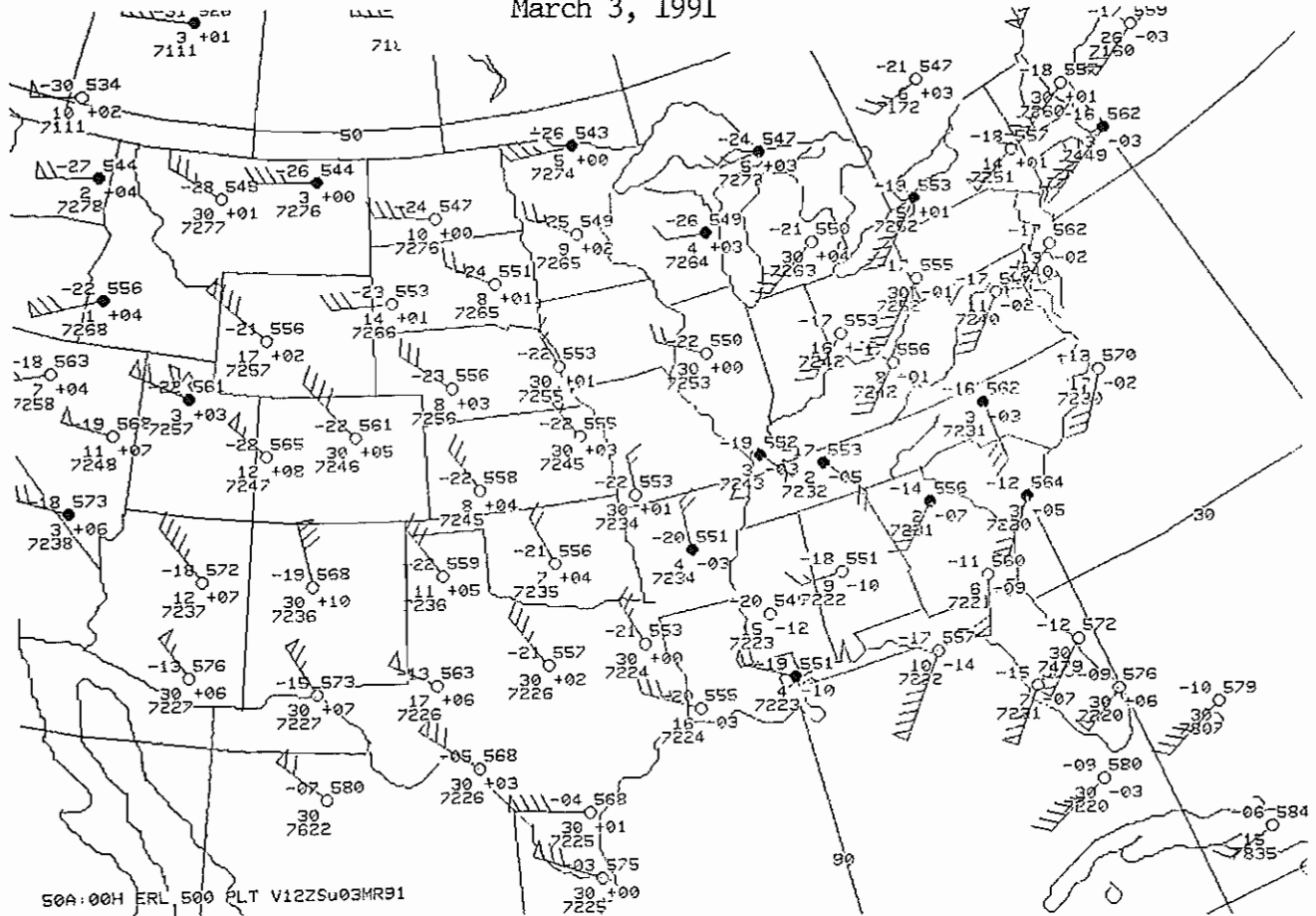
March 3, 1991



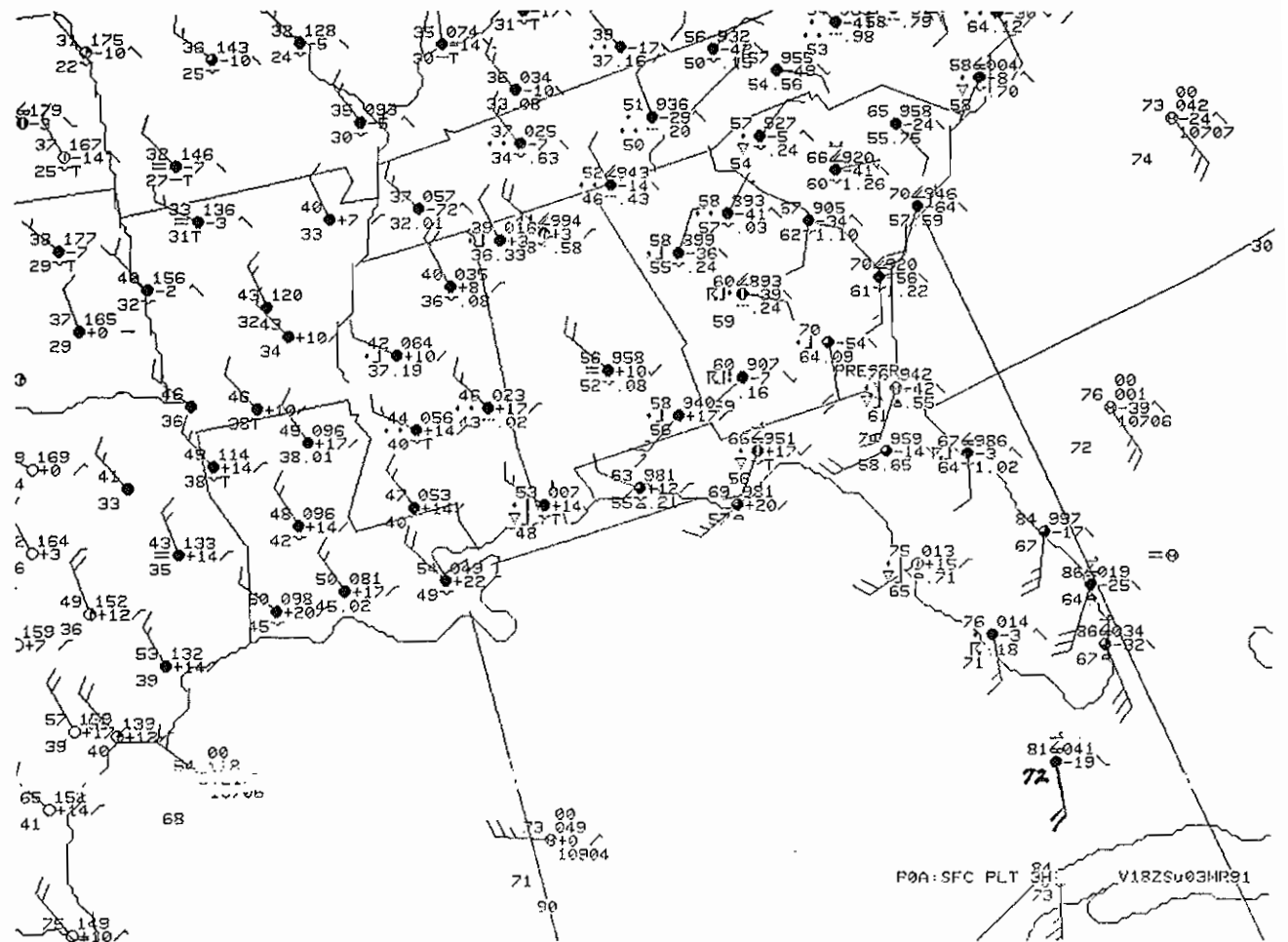
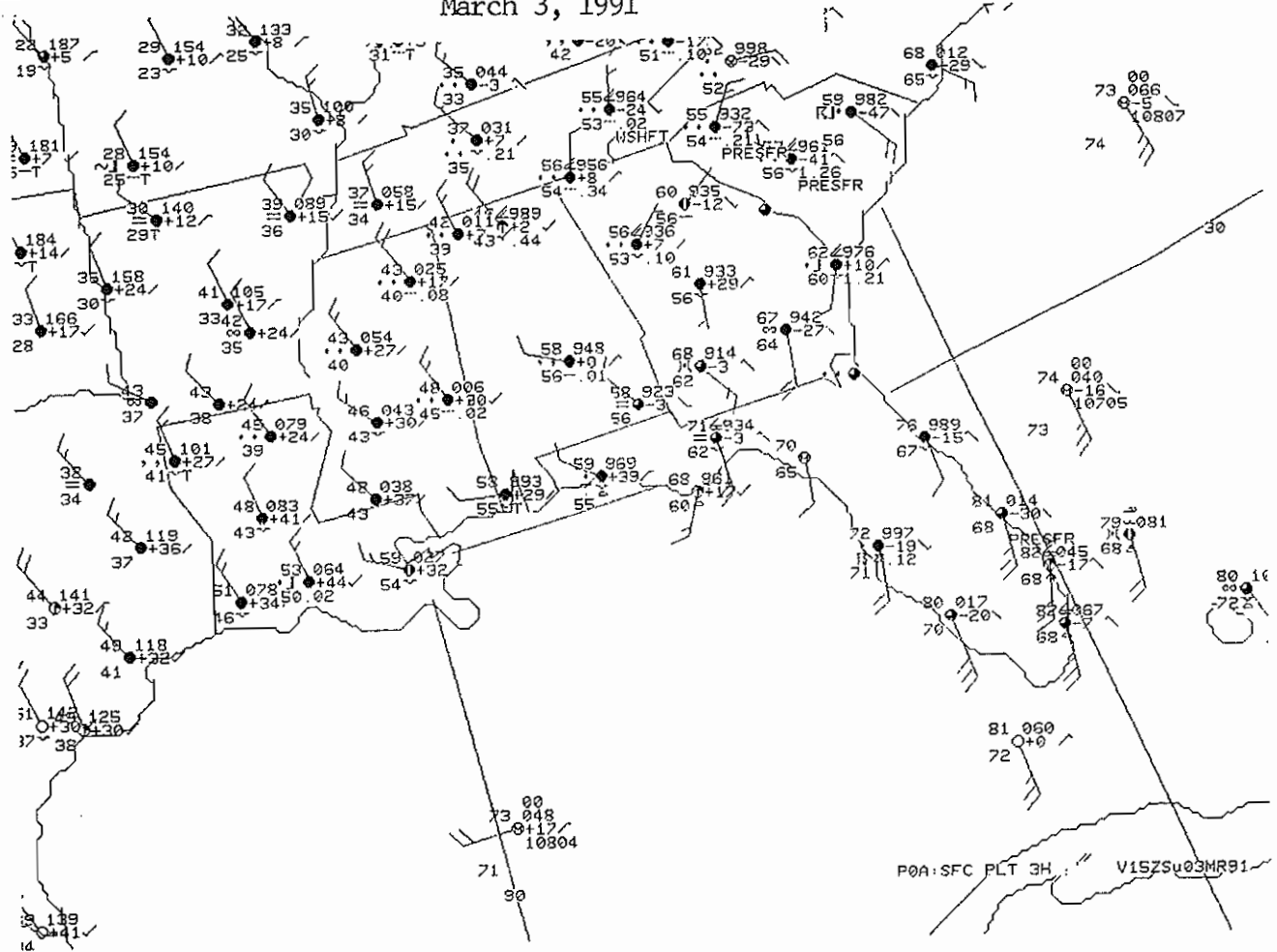


March 3, 1991





March 3, 1991



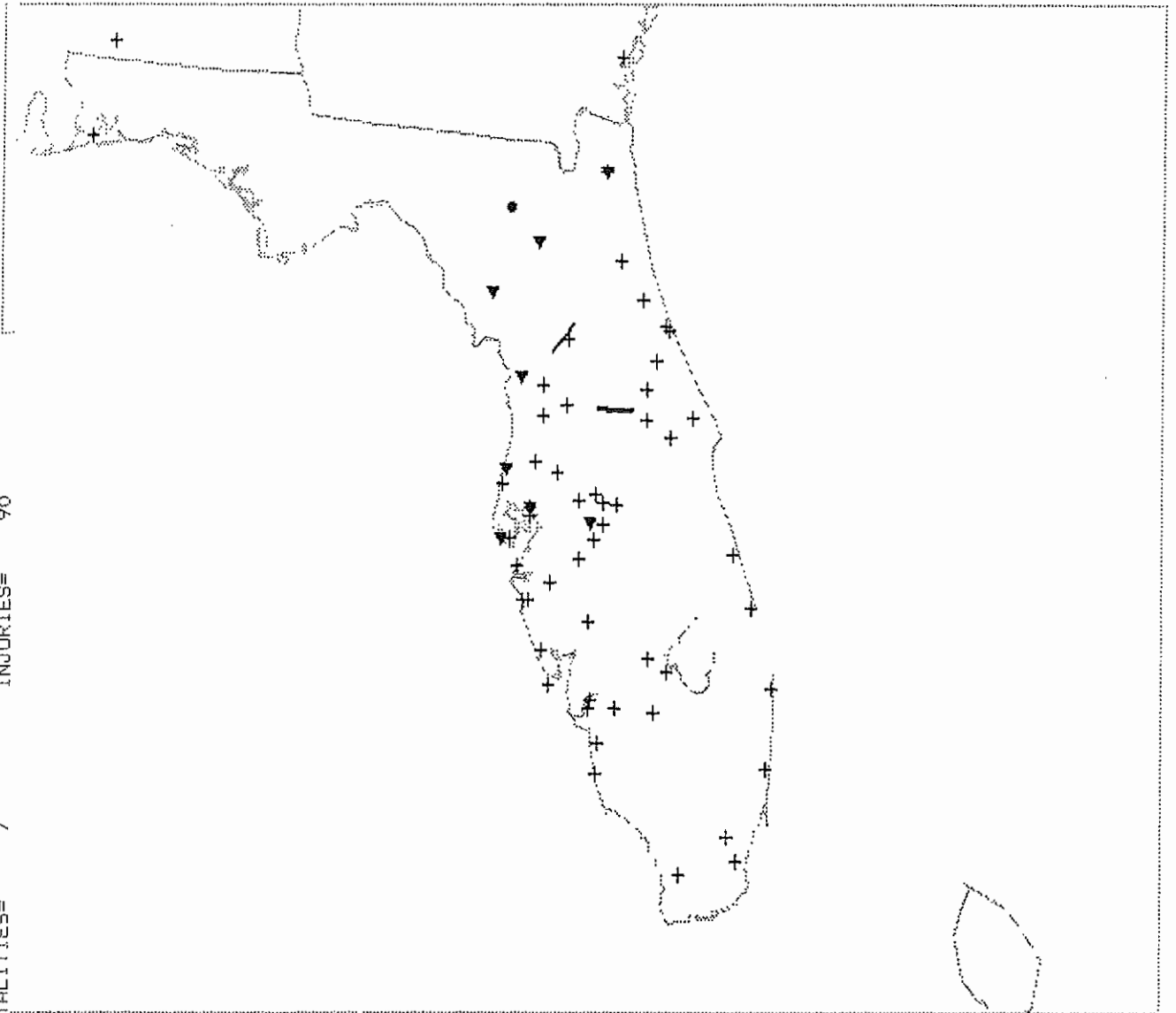
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031293 0000 031393 2359 LAL 3.0 RES=HI  
 TOT= 72 TORN= 11 INJURIES=  
 FATALITIES= 7

WIND= 59

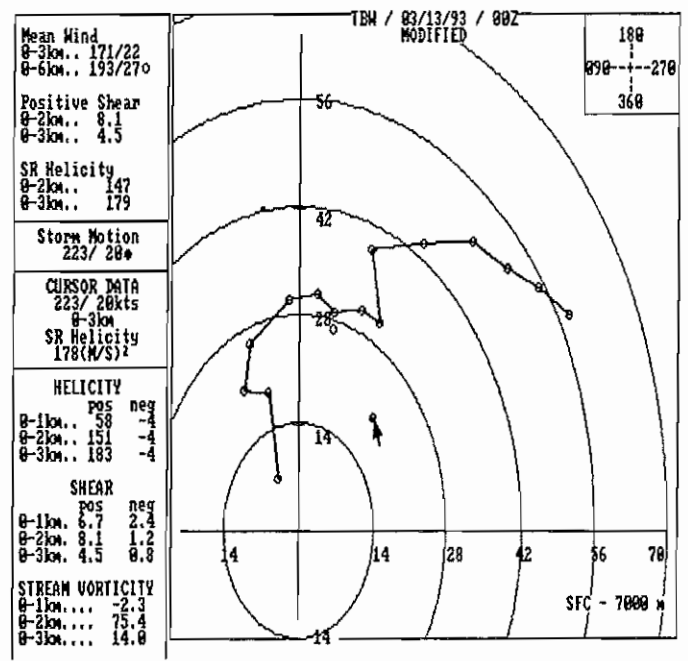
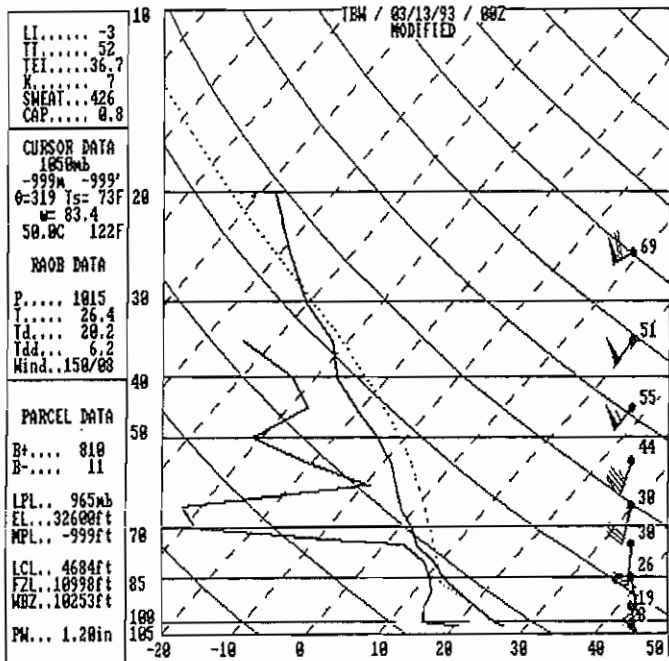
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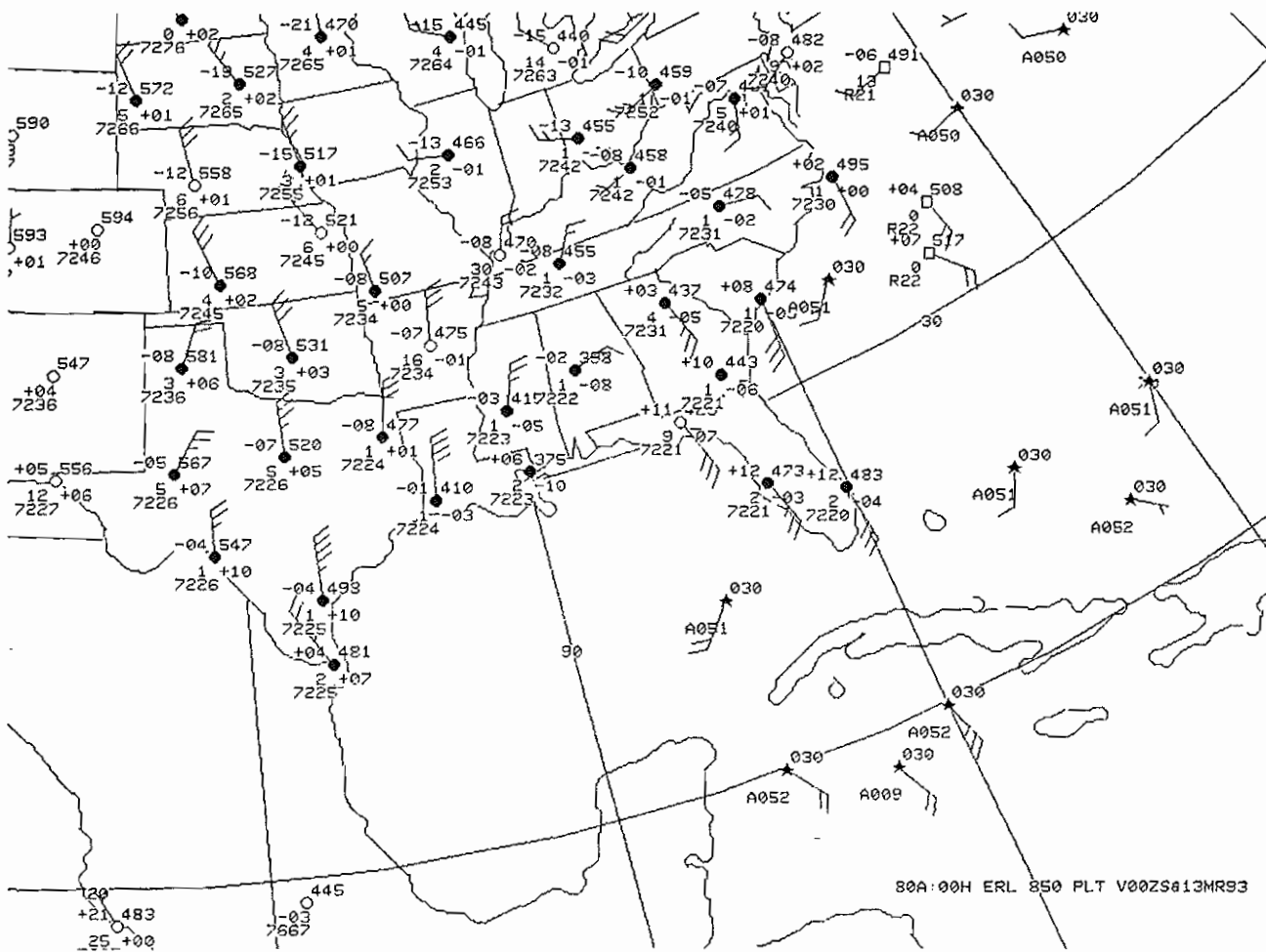
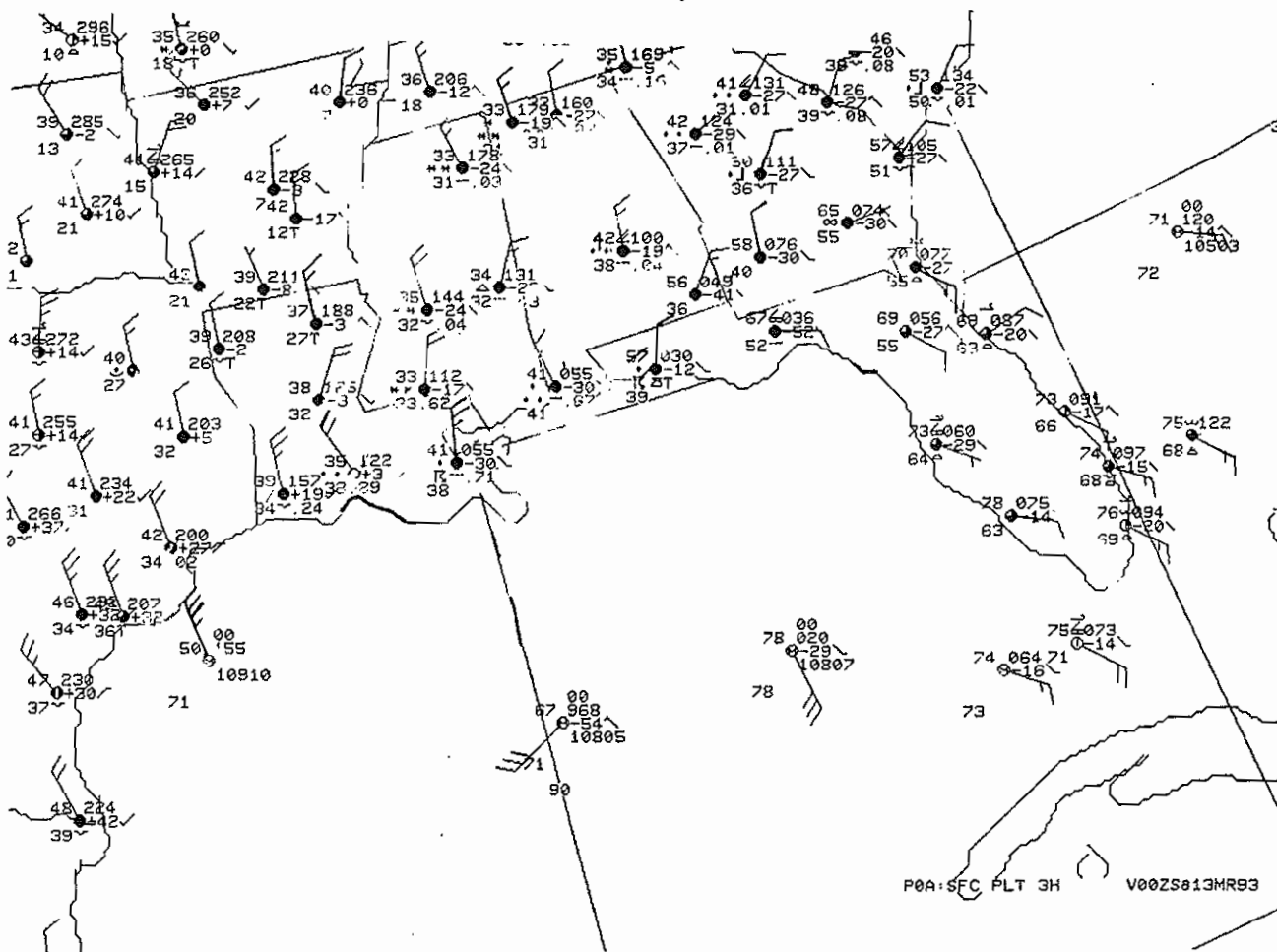
HAIL= 90



0000ST 03/12/93 - 2359CST 03/13/93

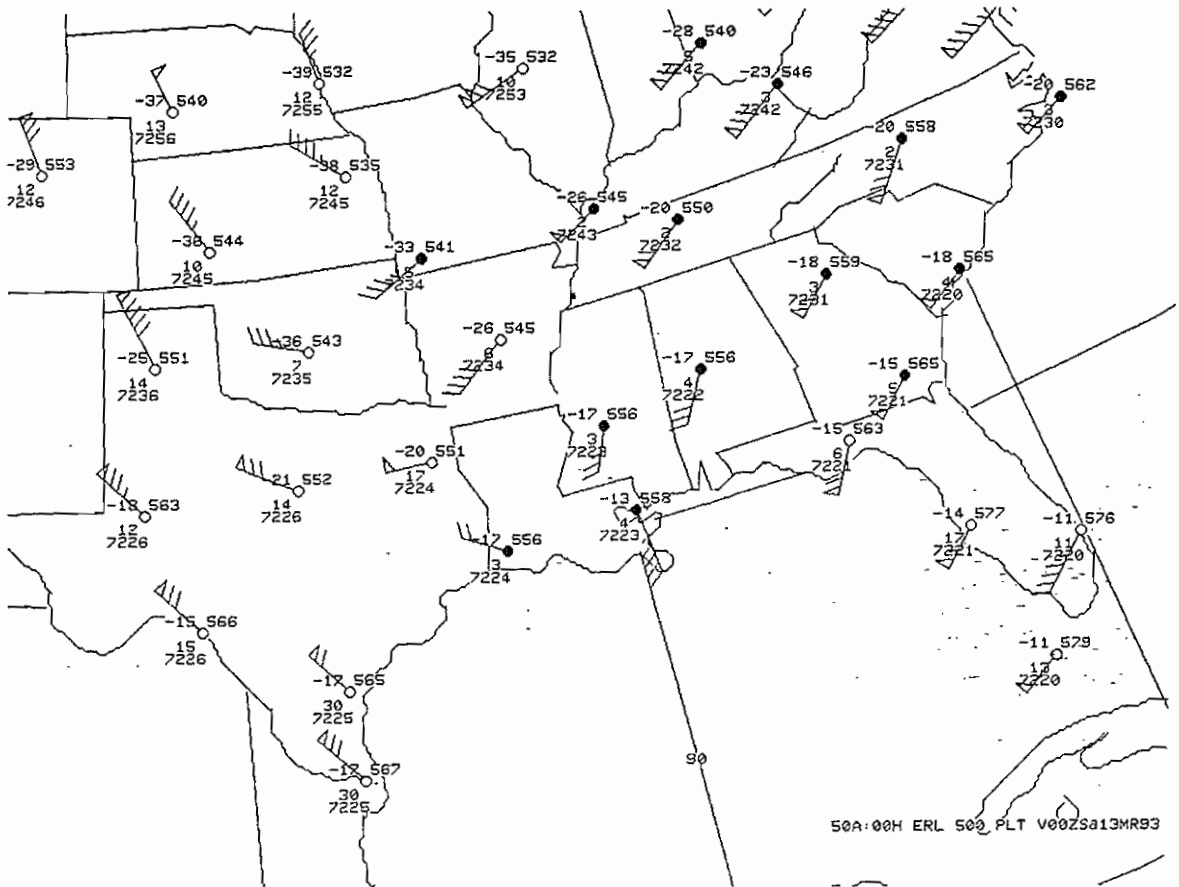
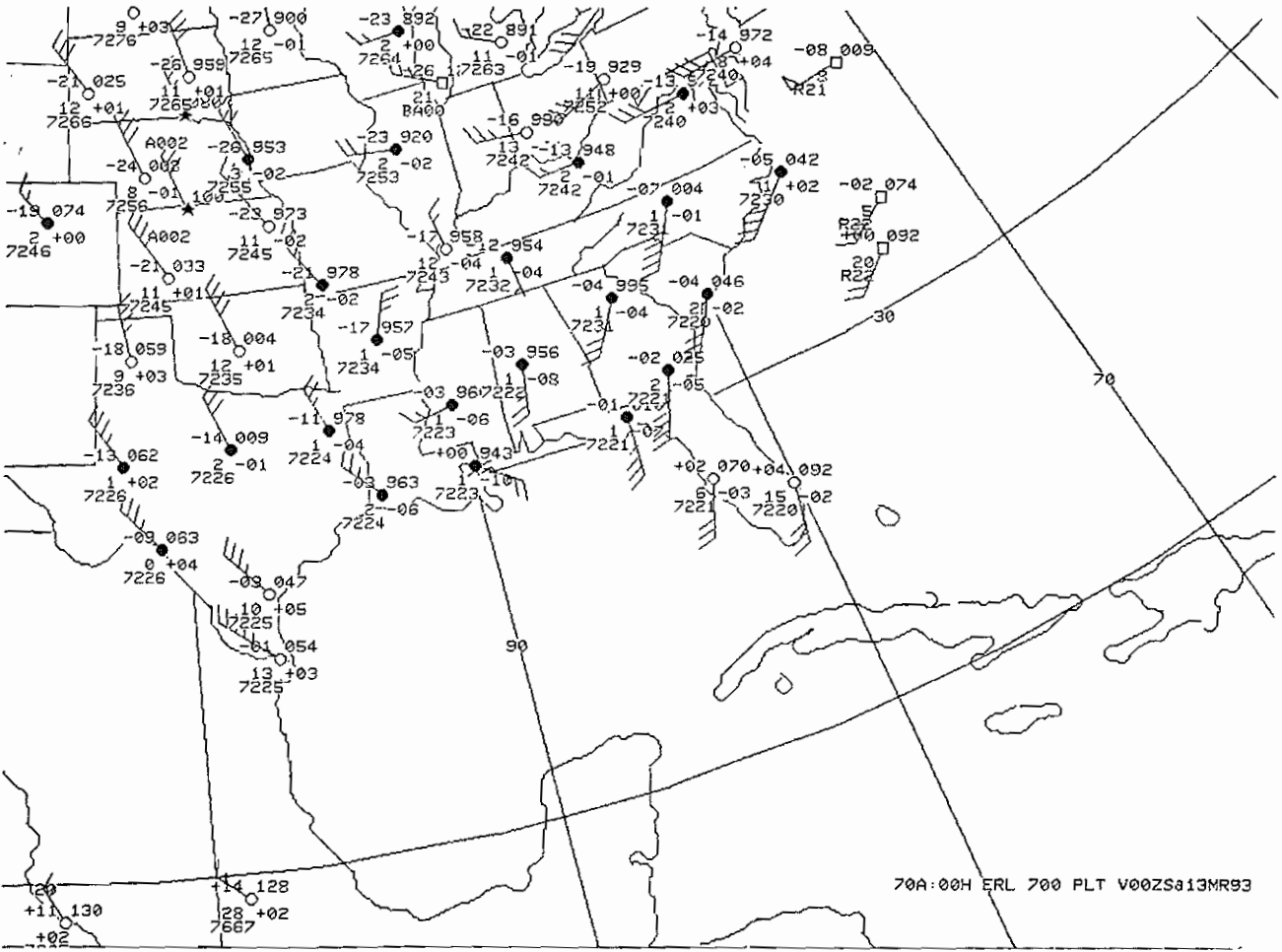
SEVERE WEATHER REPORTS



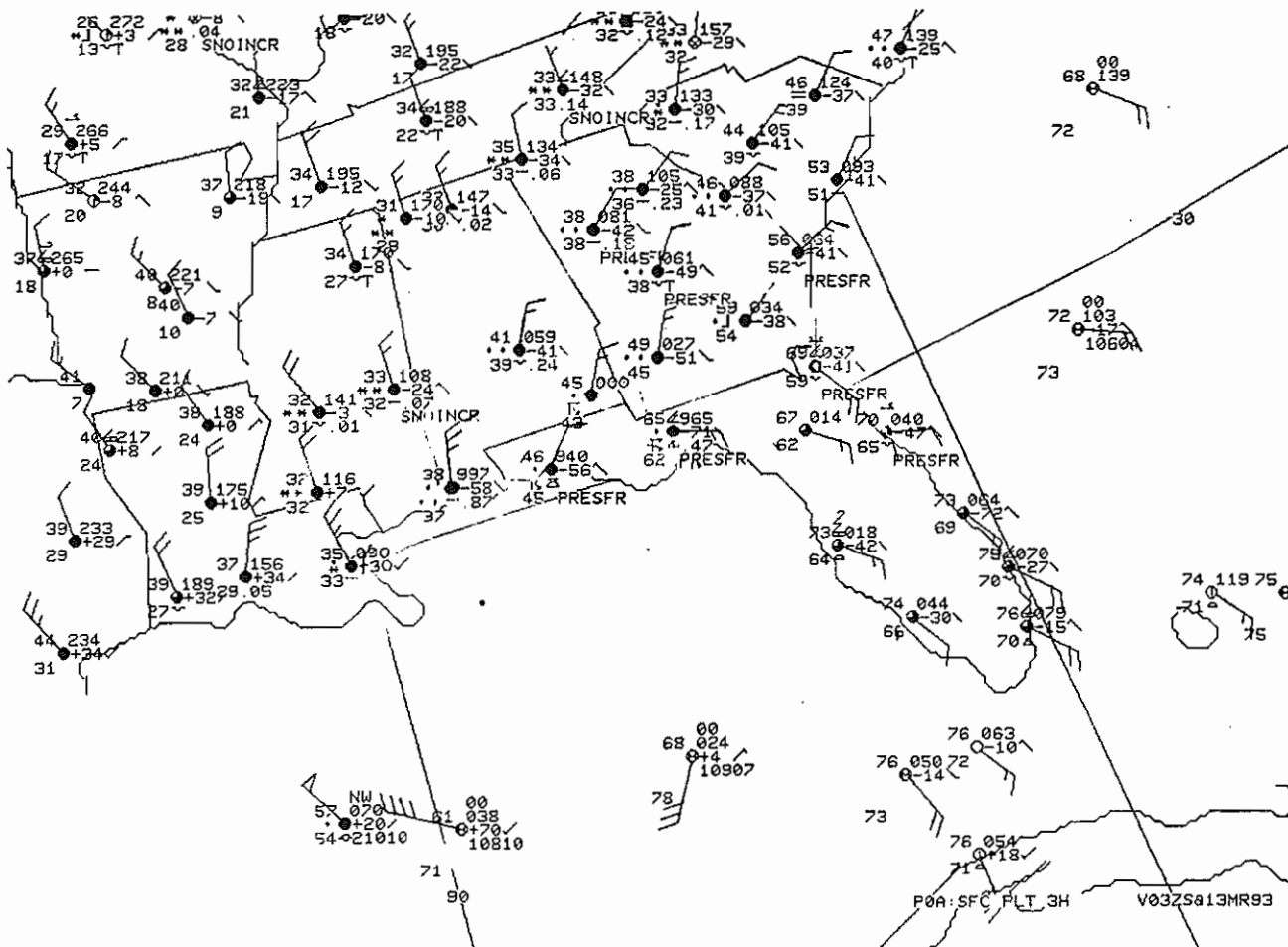
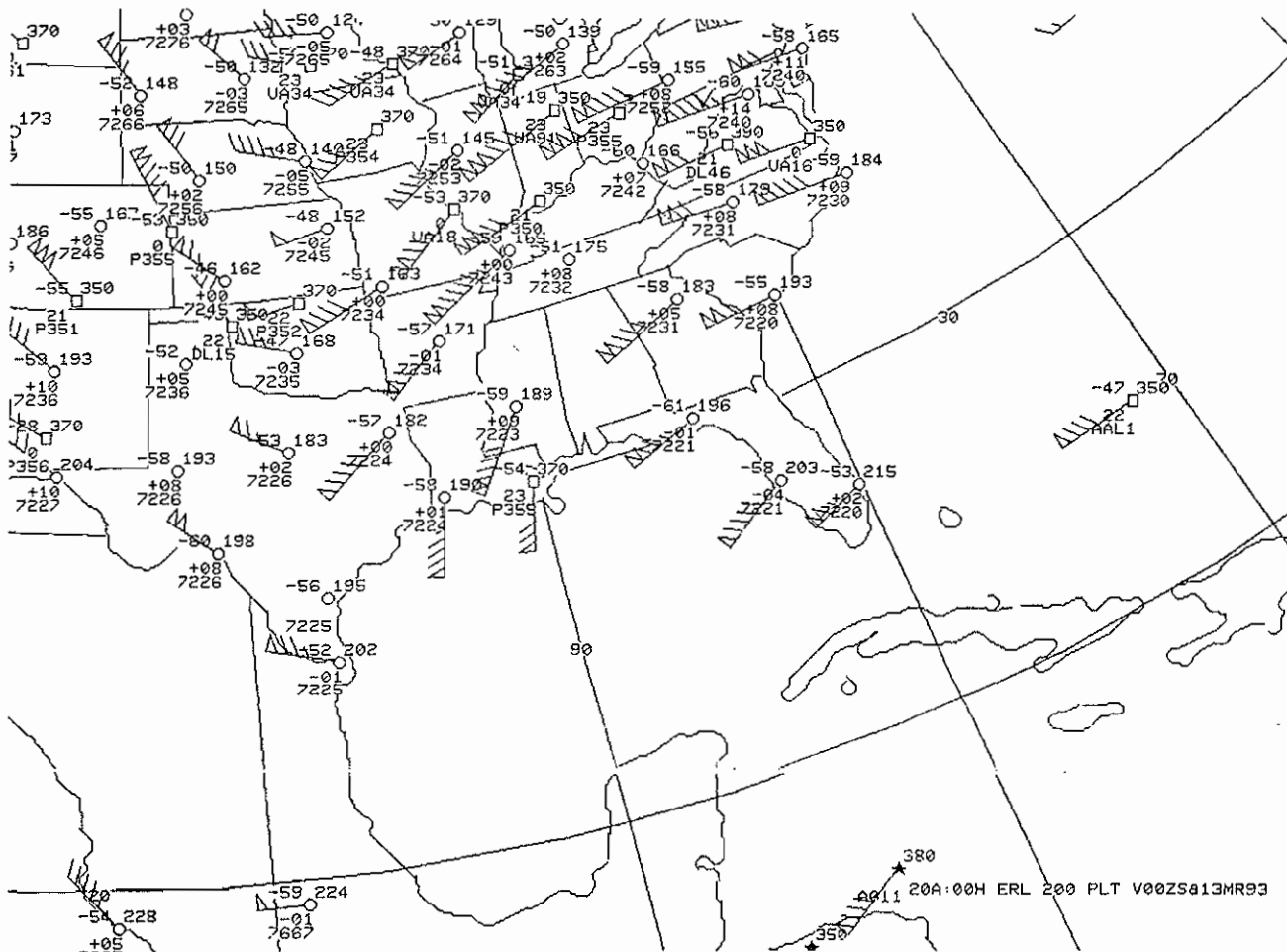


March 12-13, 1993

29

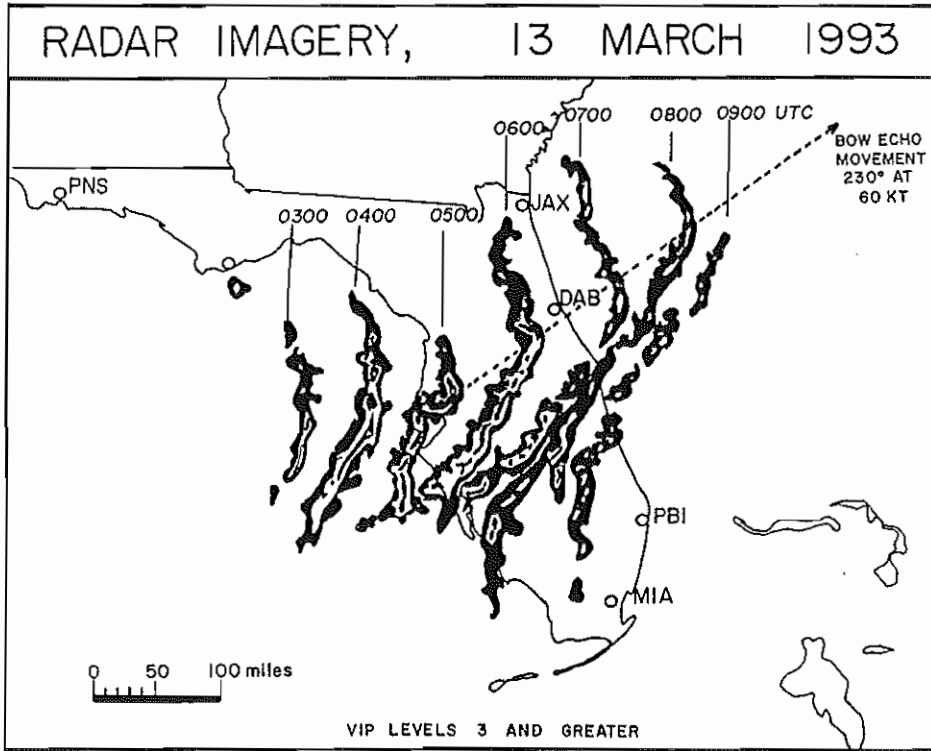


March 12-13, 1993

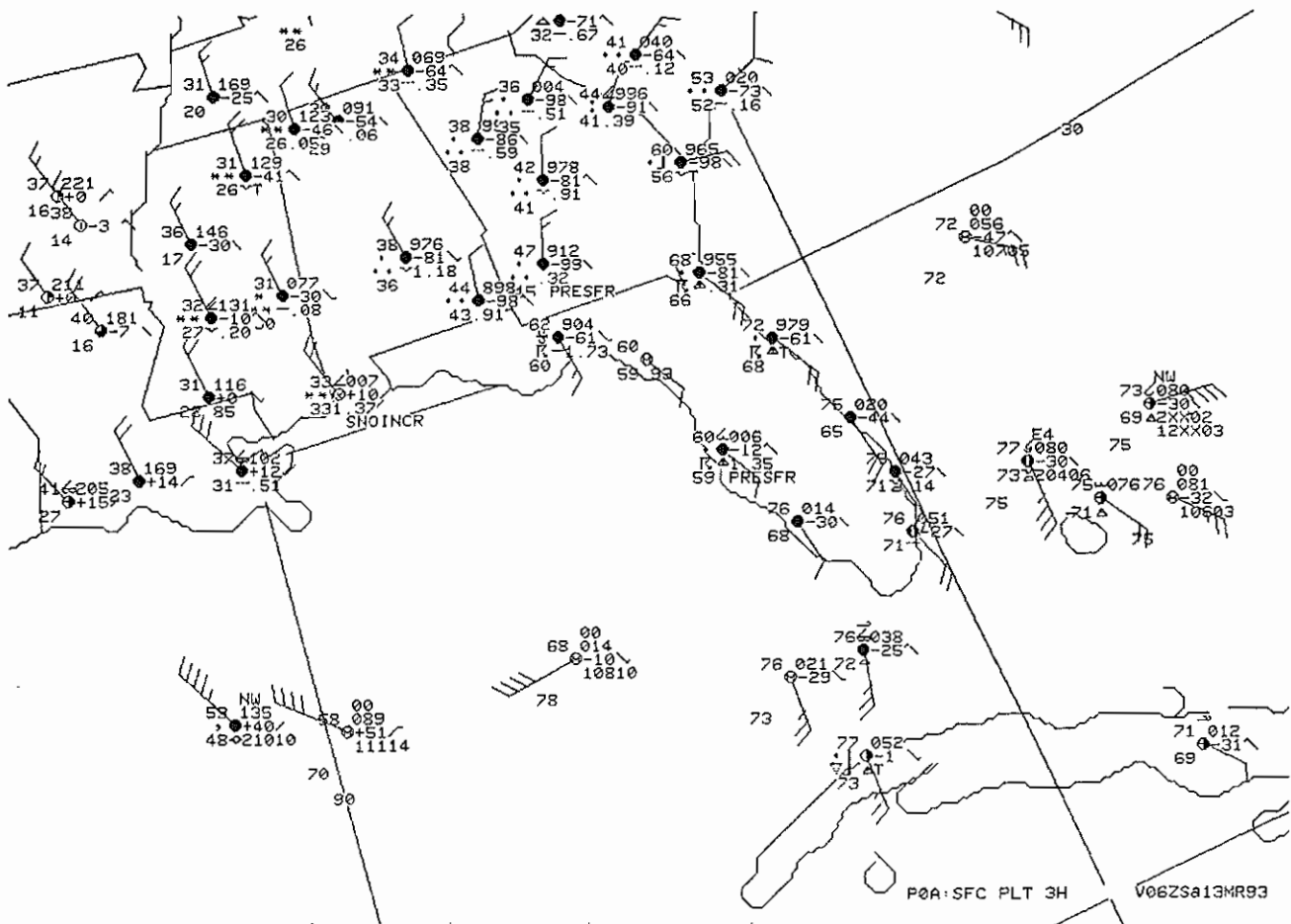


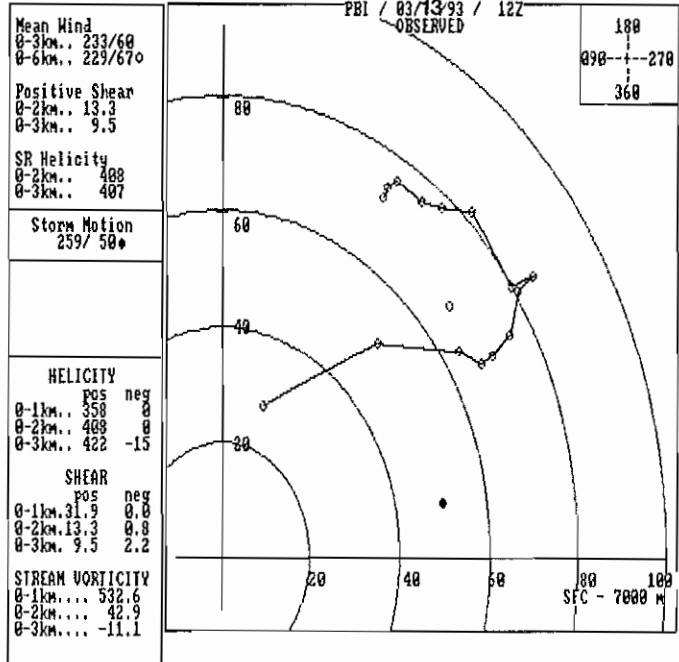
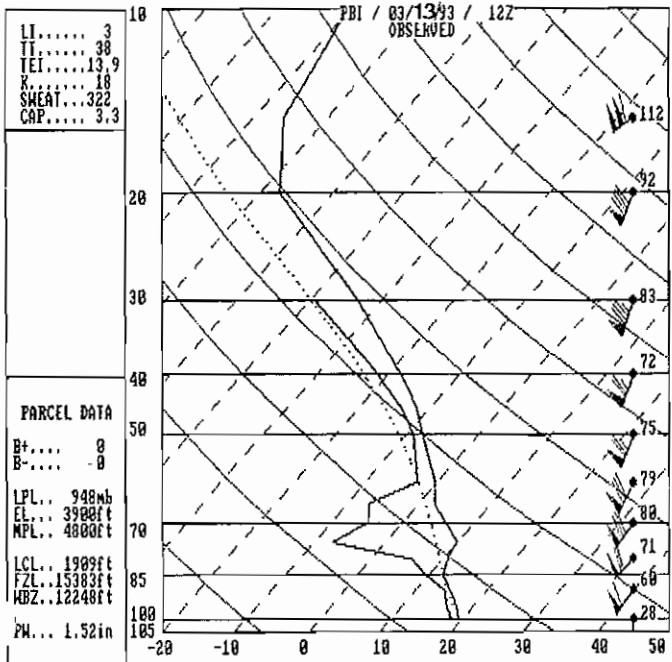
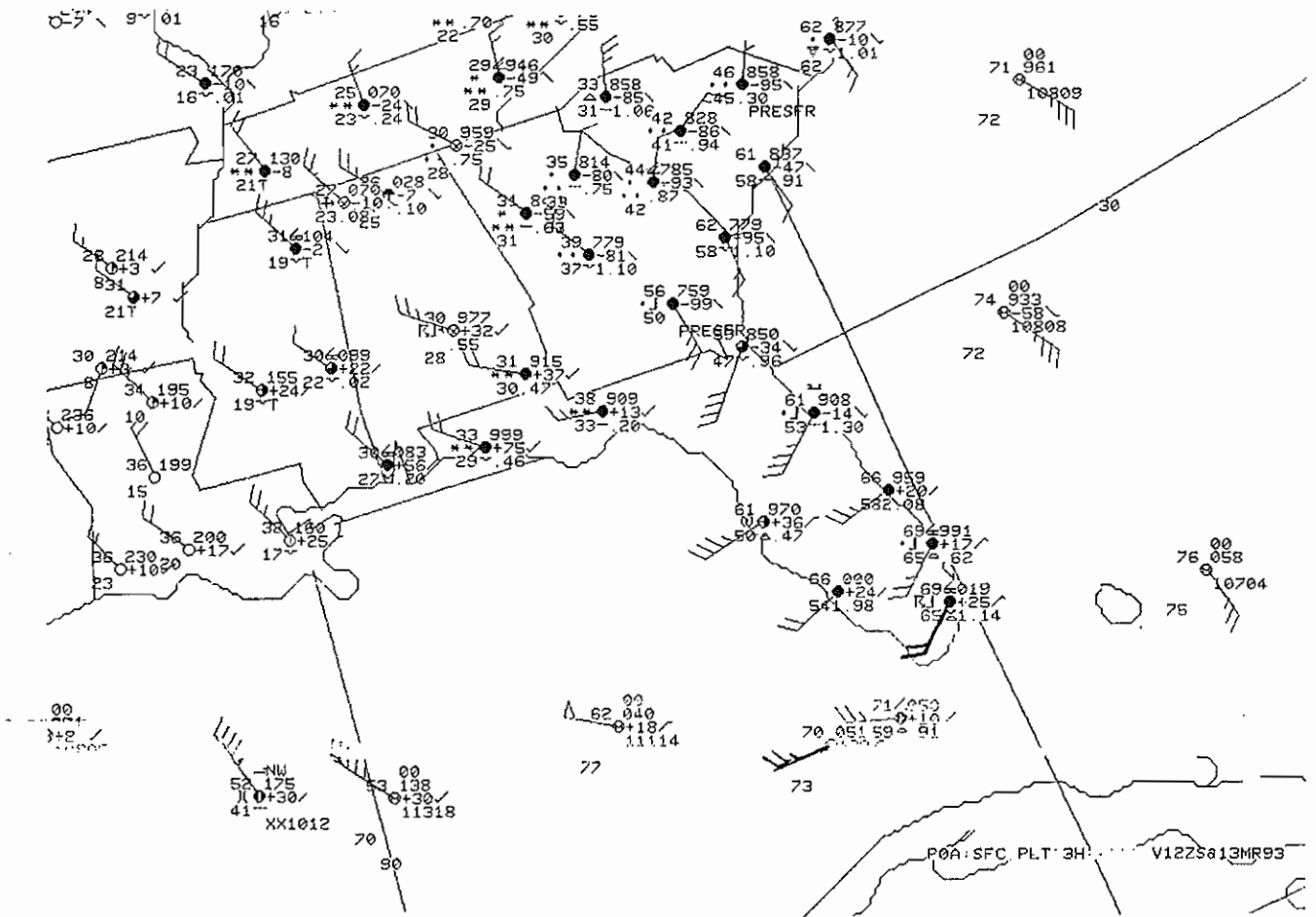


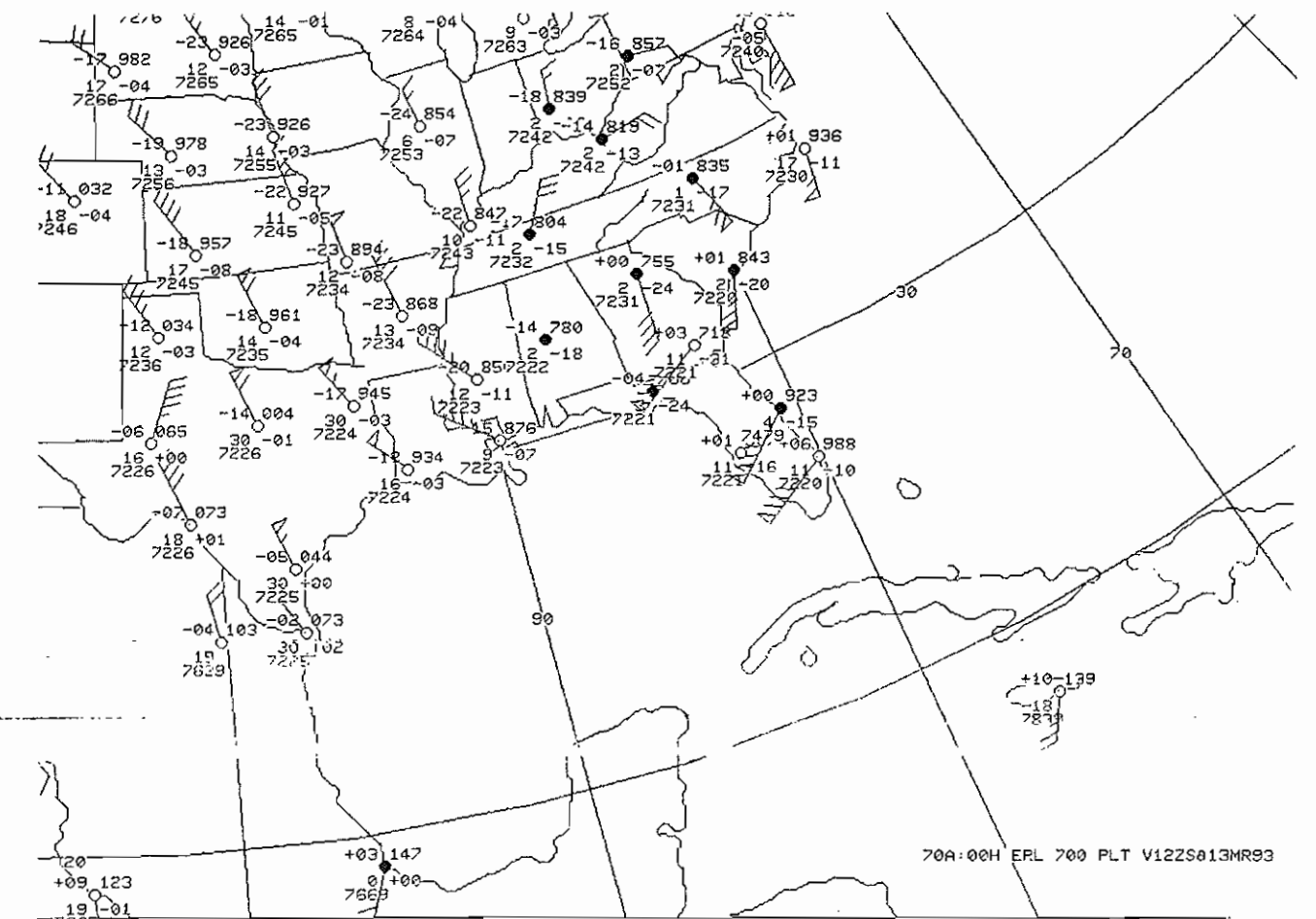
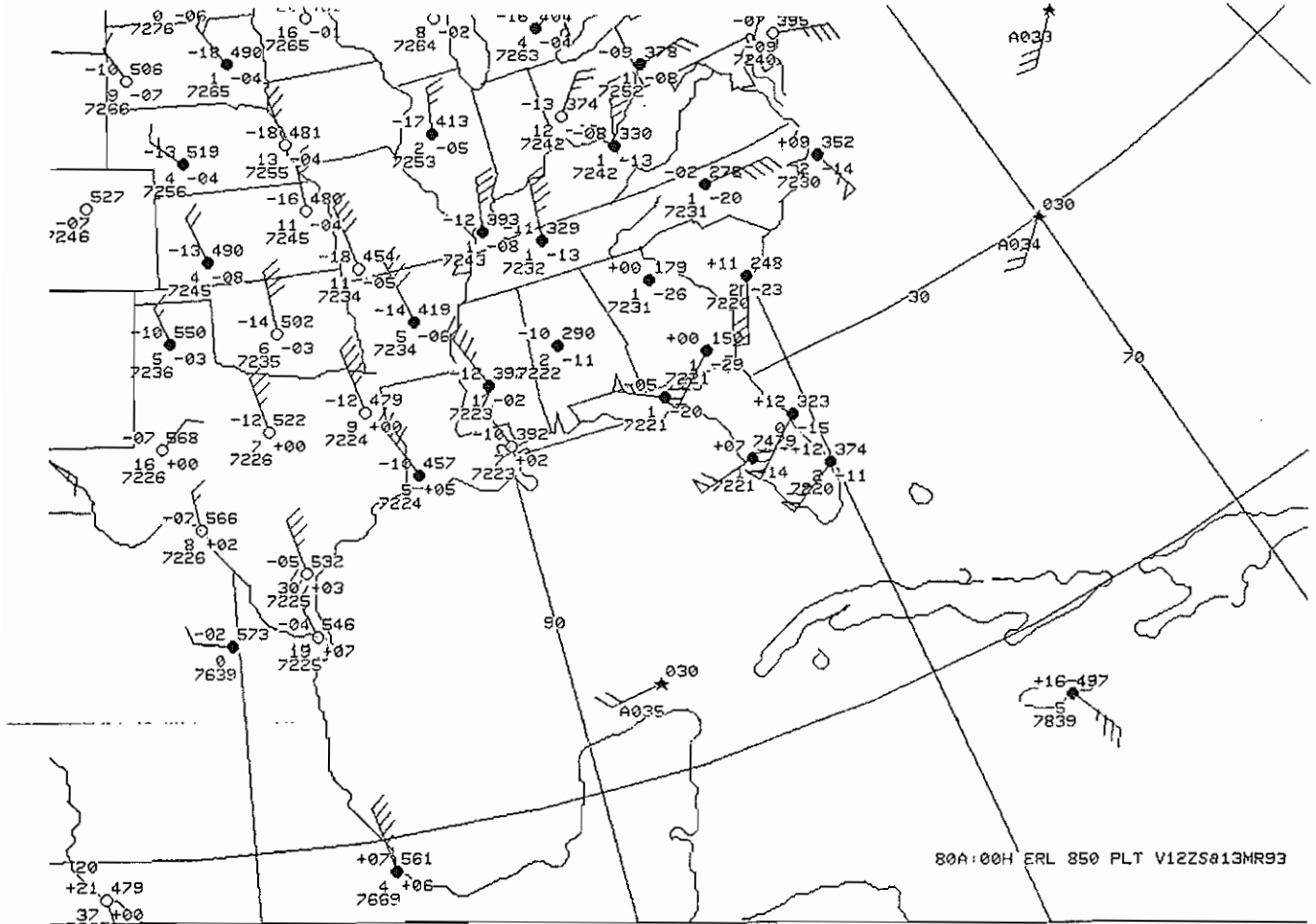




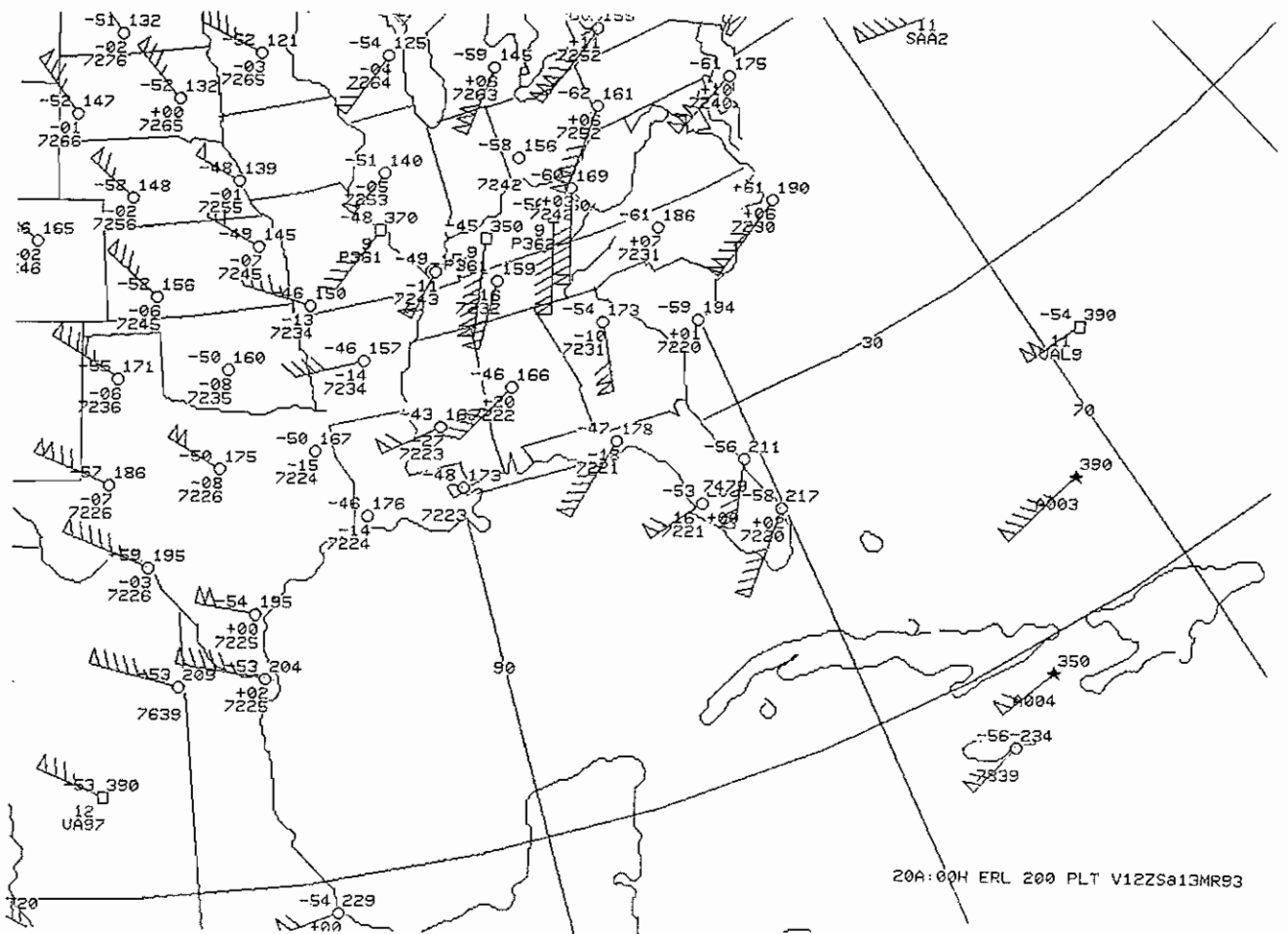
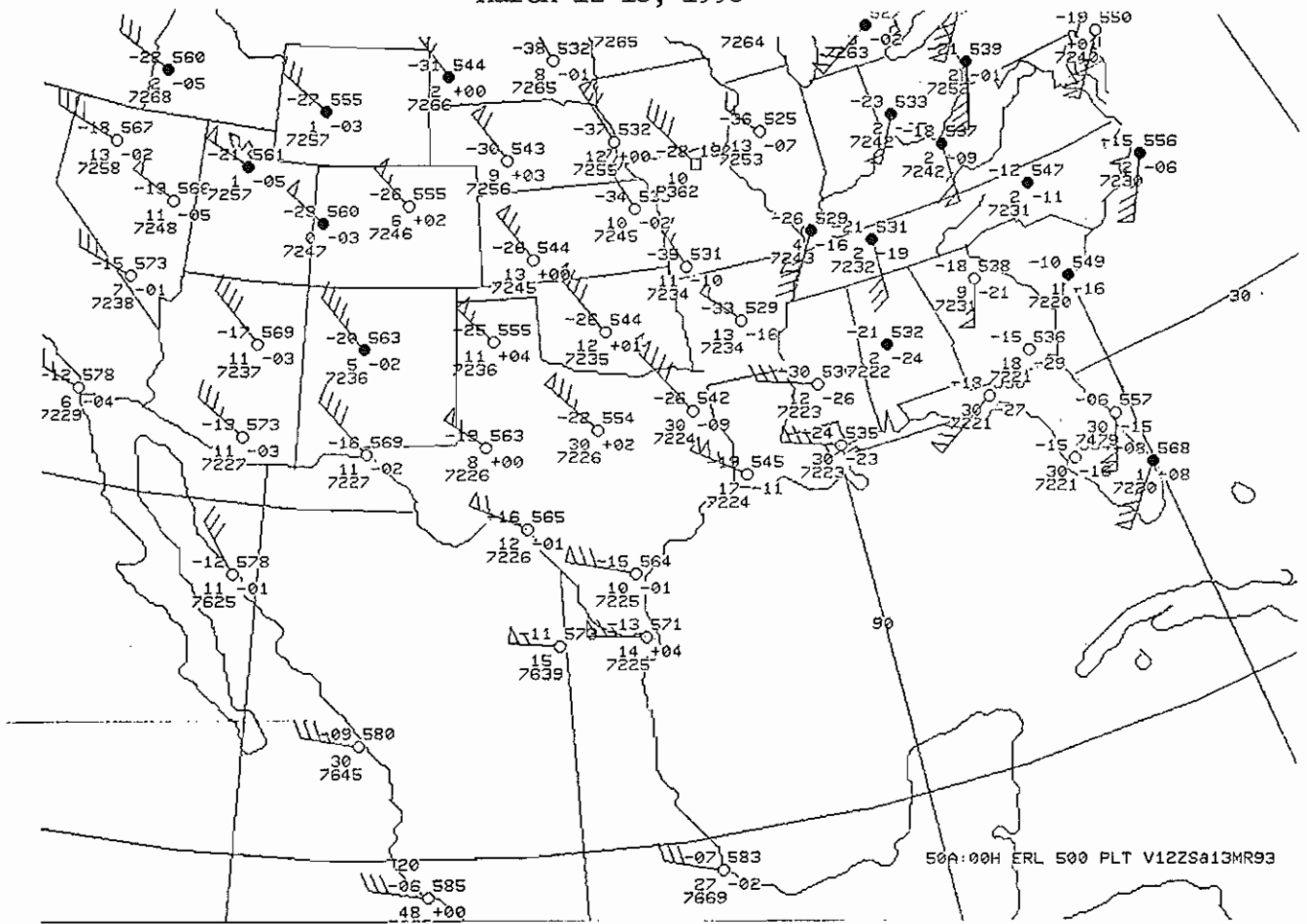
(From NOAA Disaster Survey)





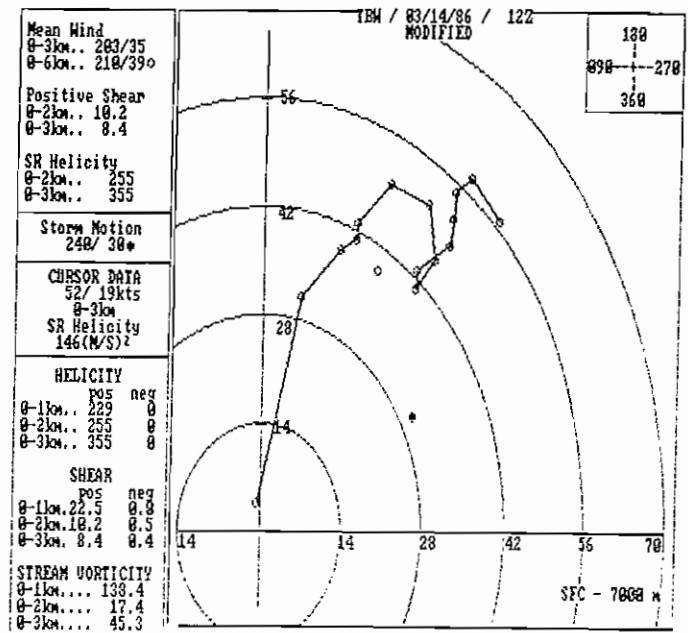
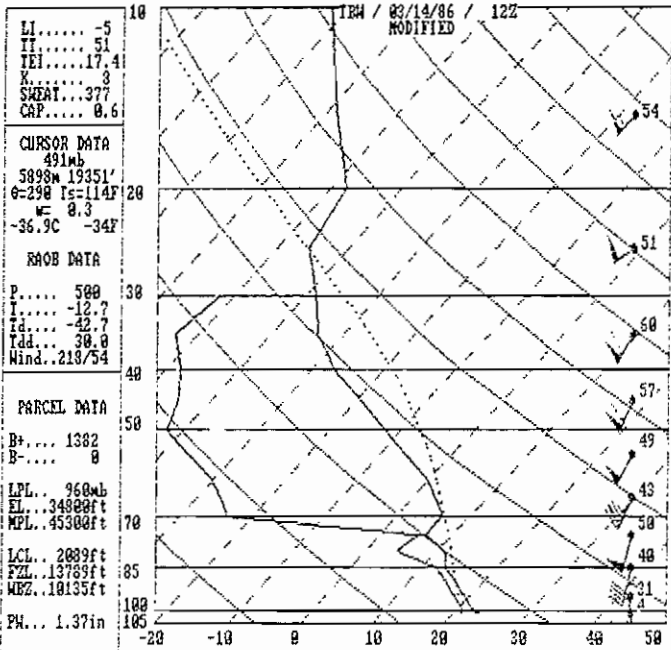
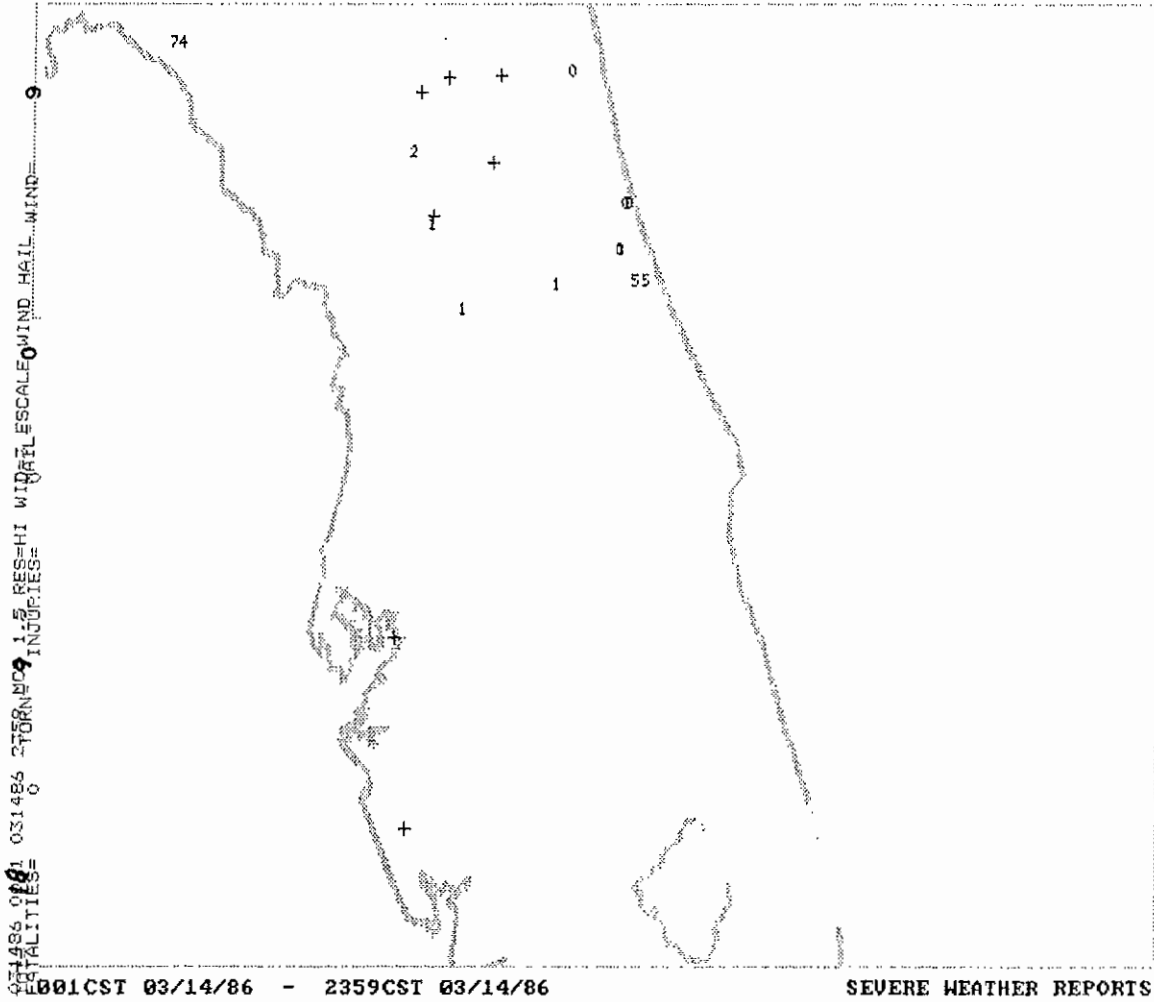


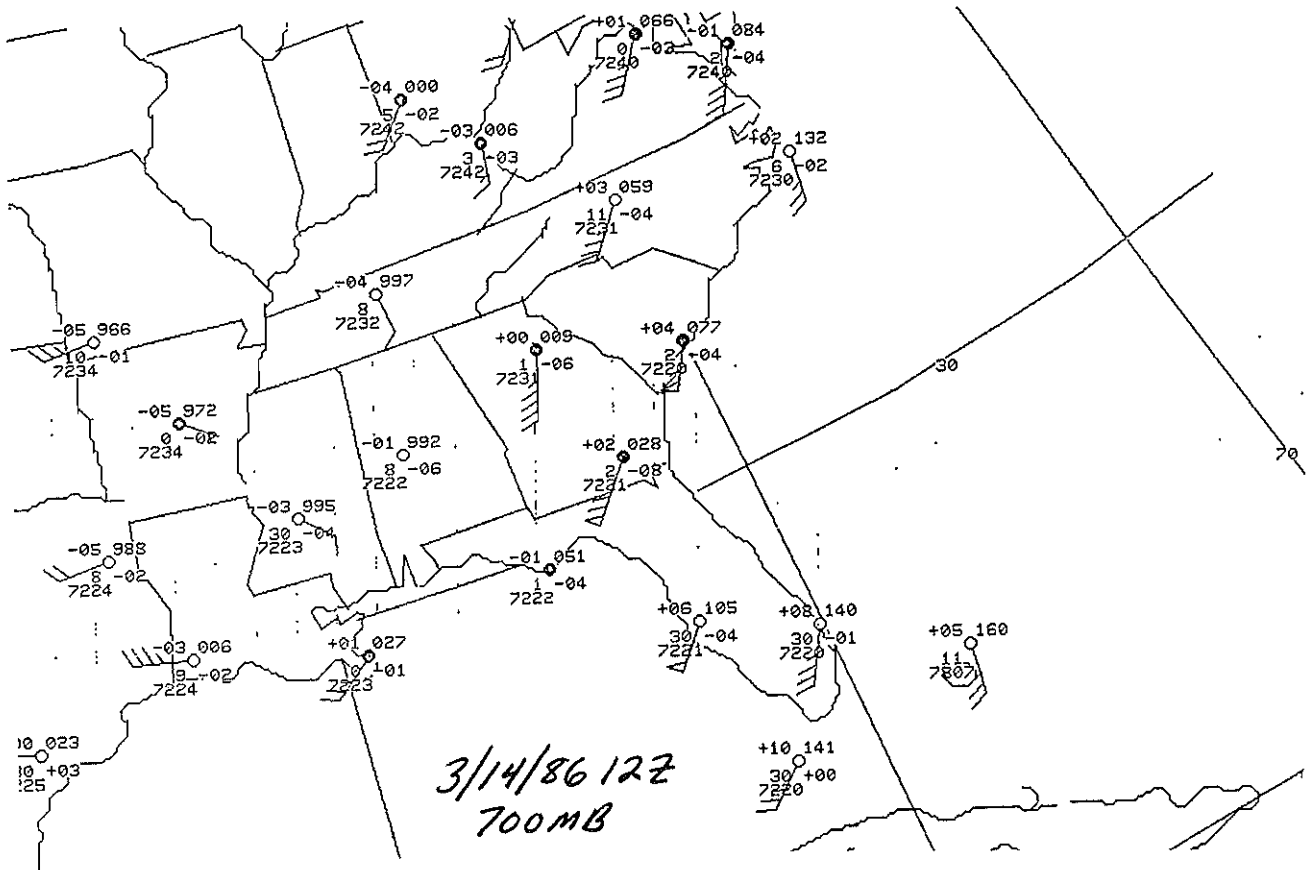
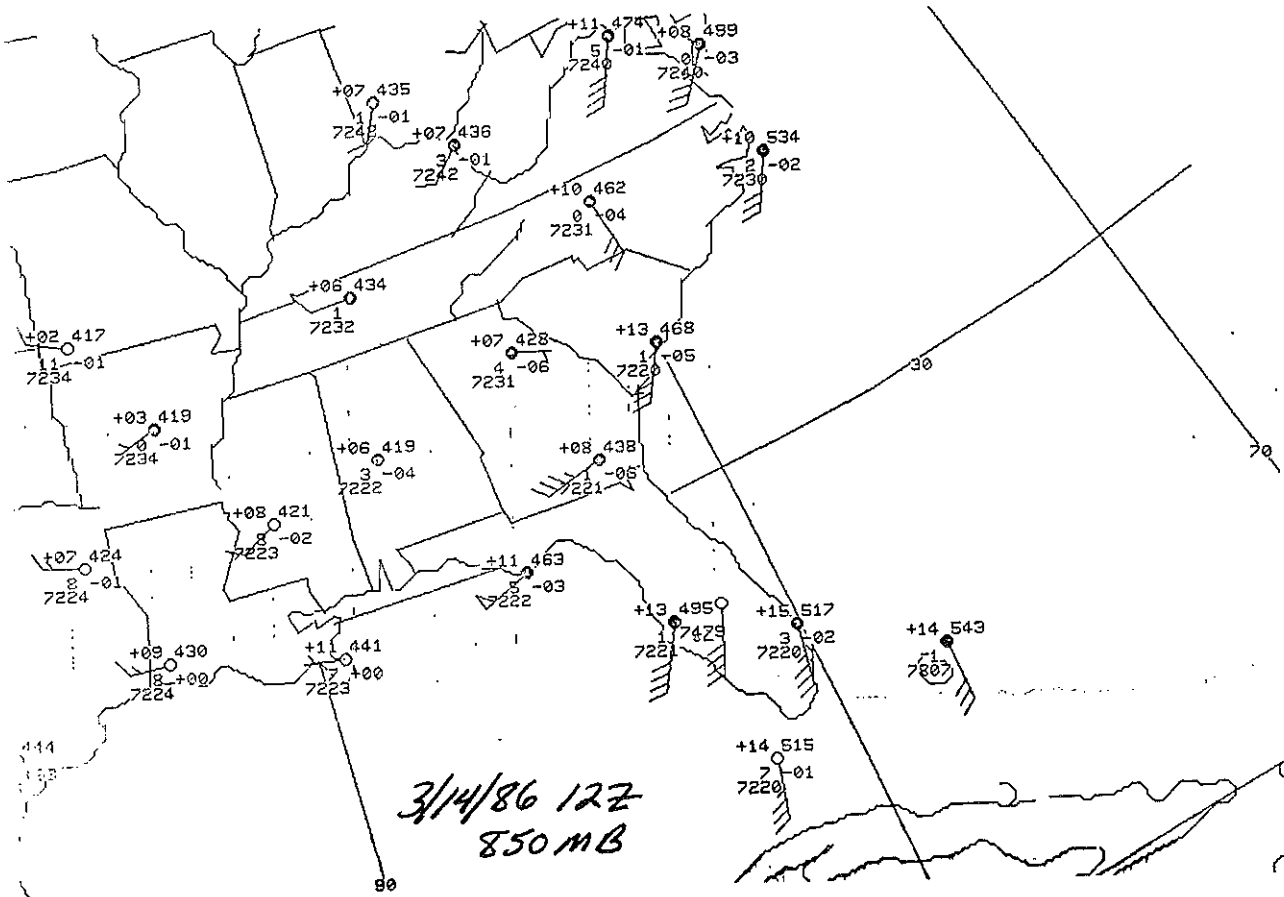
March 12-13, 1993



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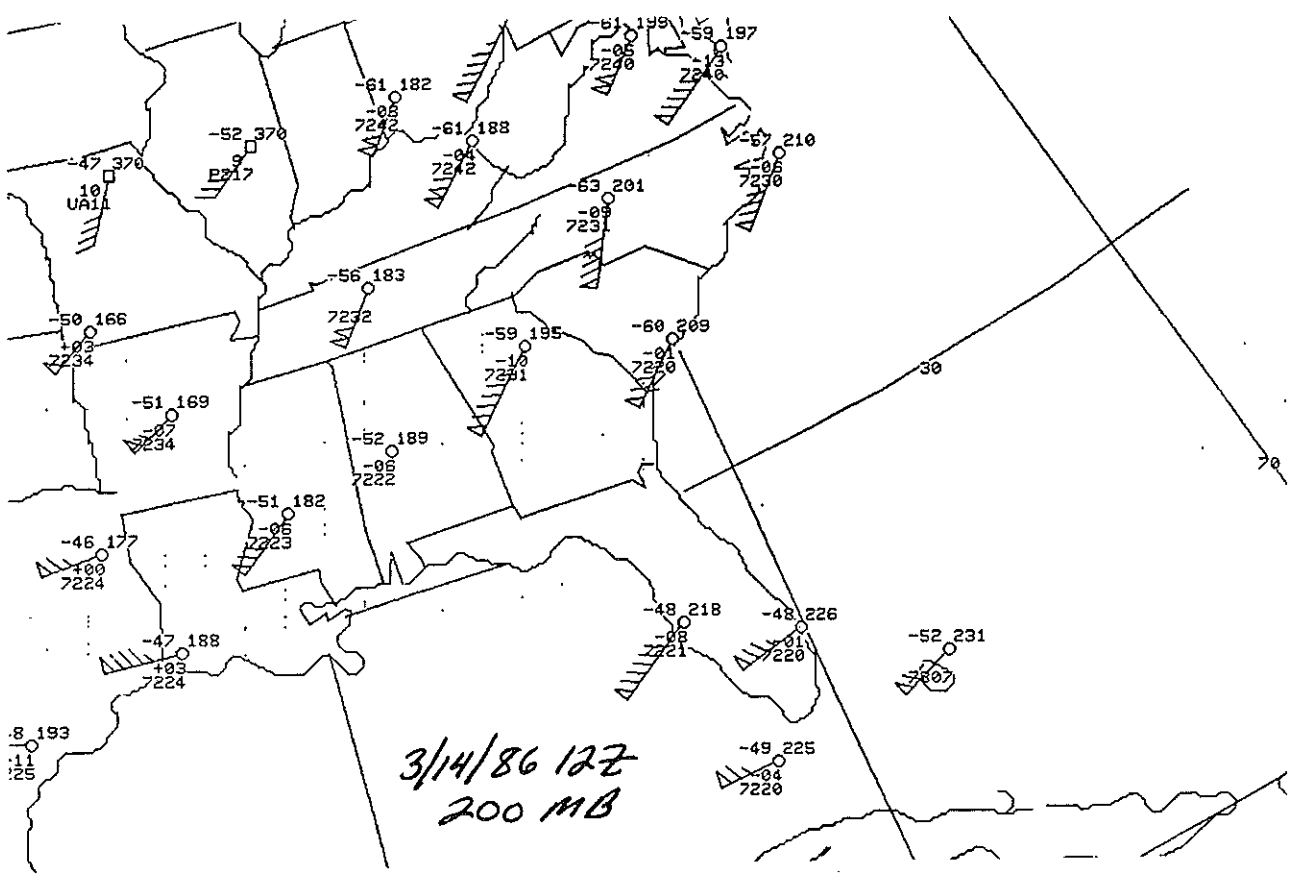
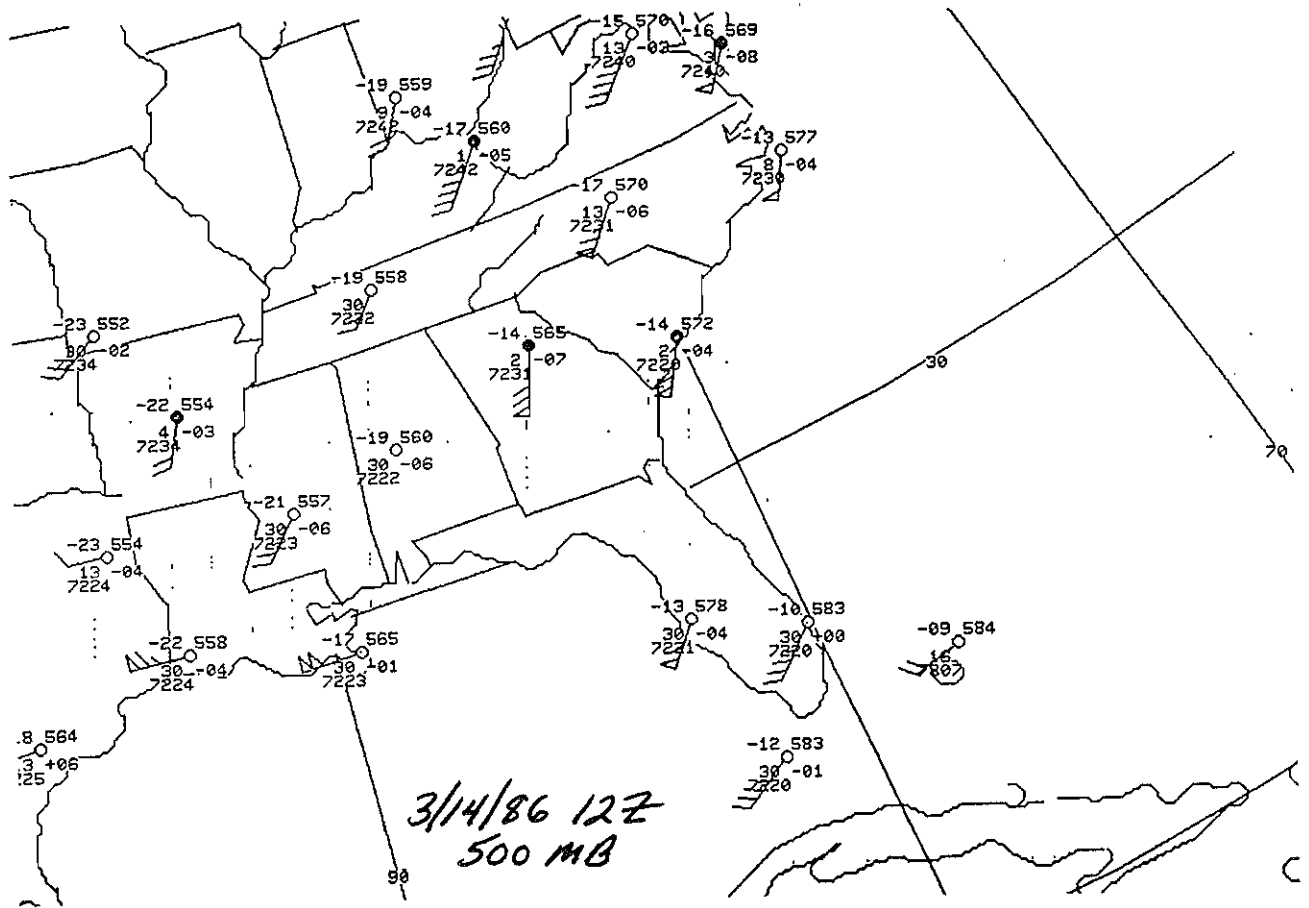
March 14, 1986

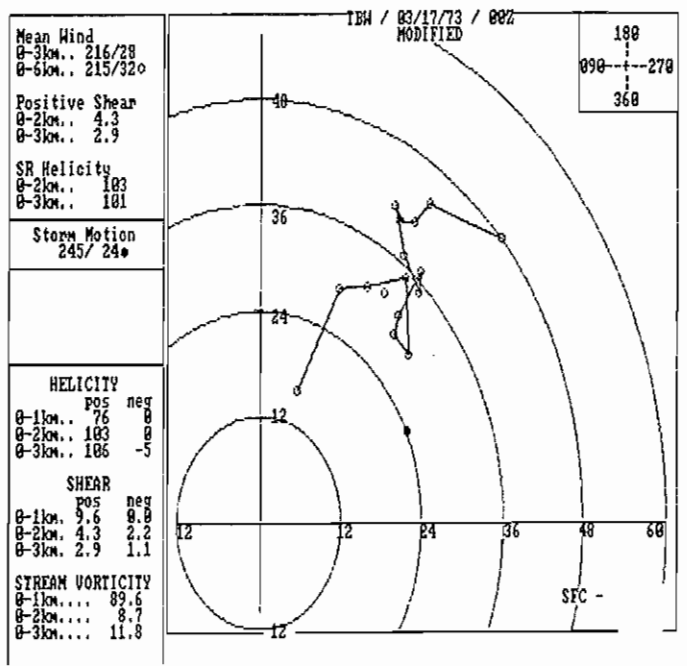
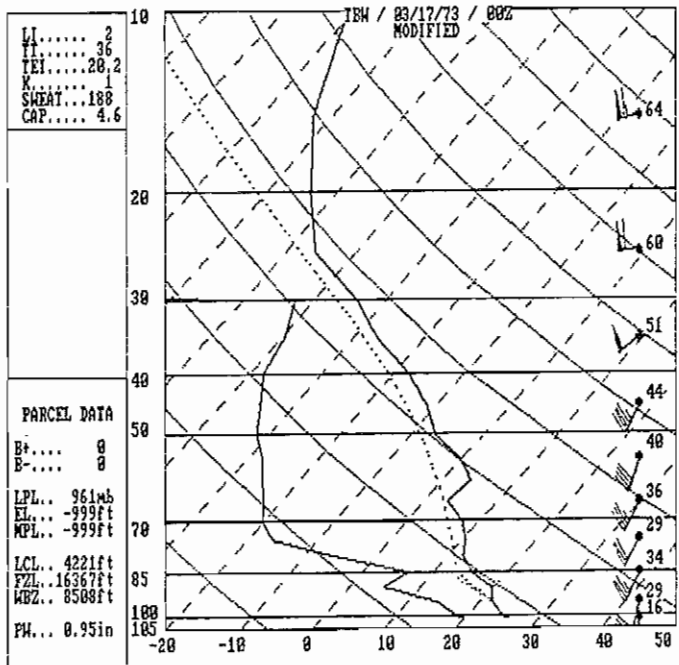
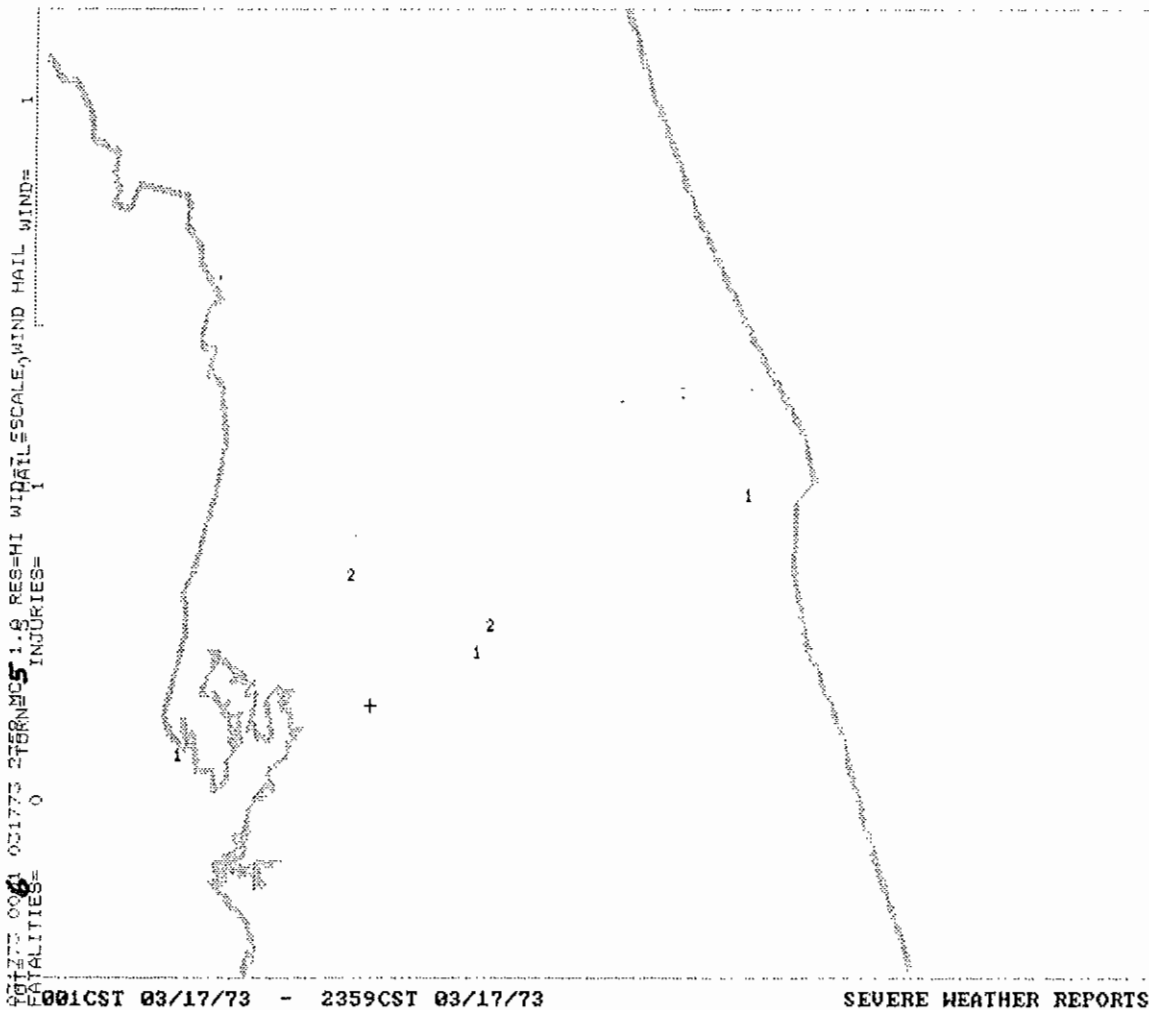




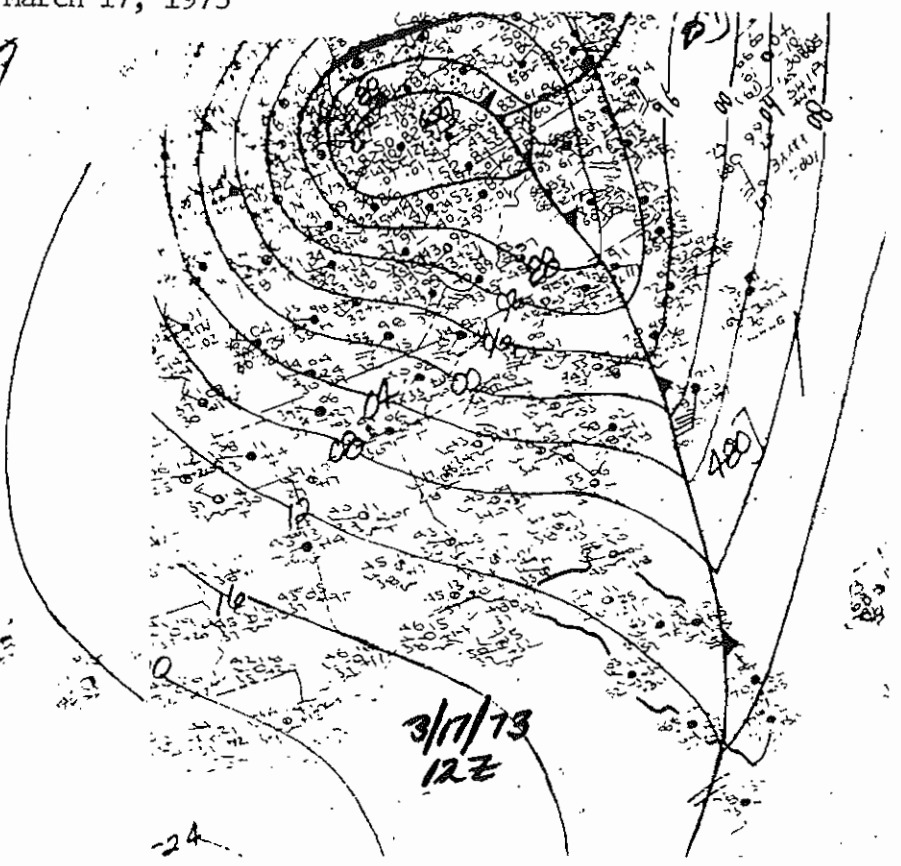
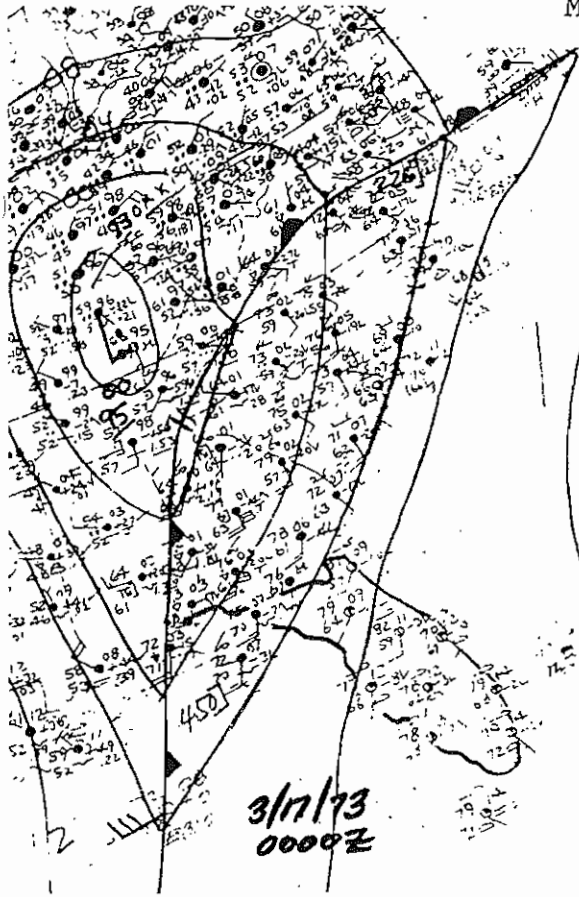


March 14, 1986

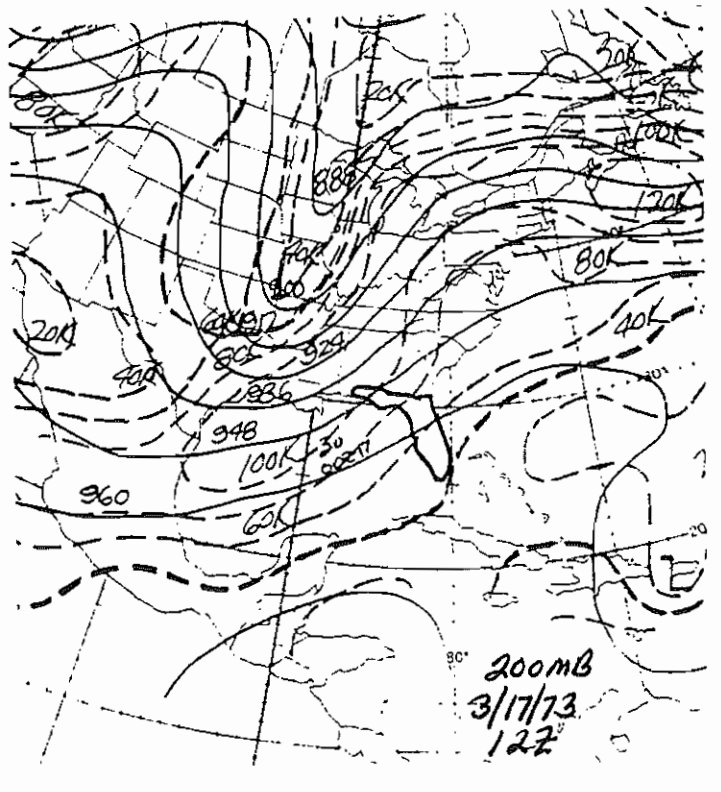
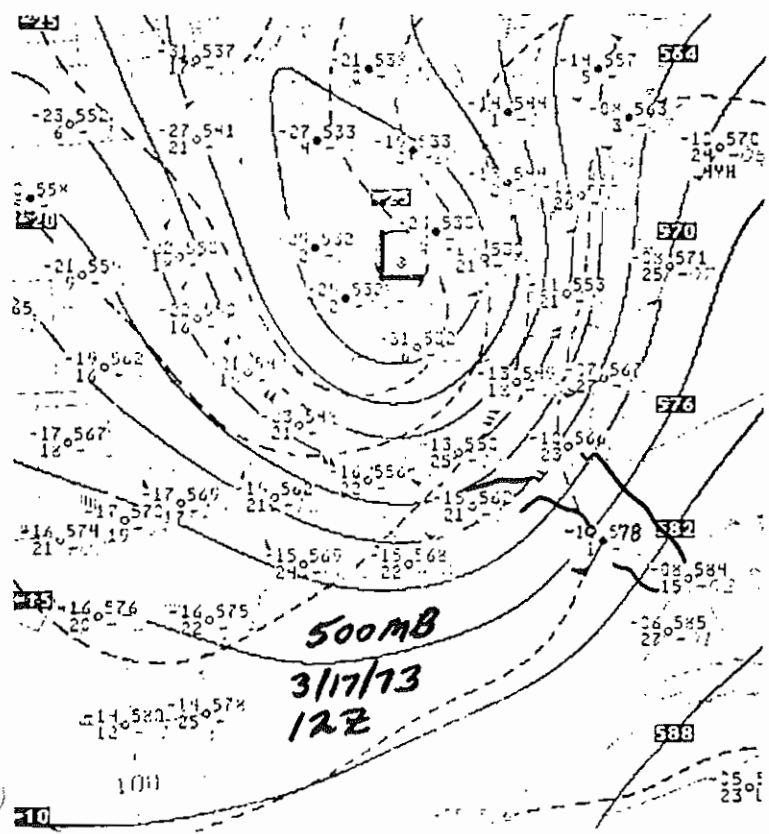


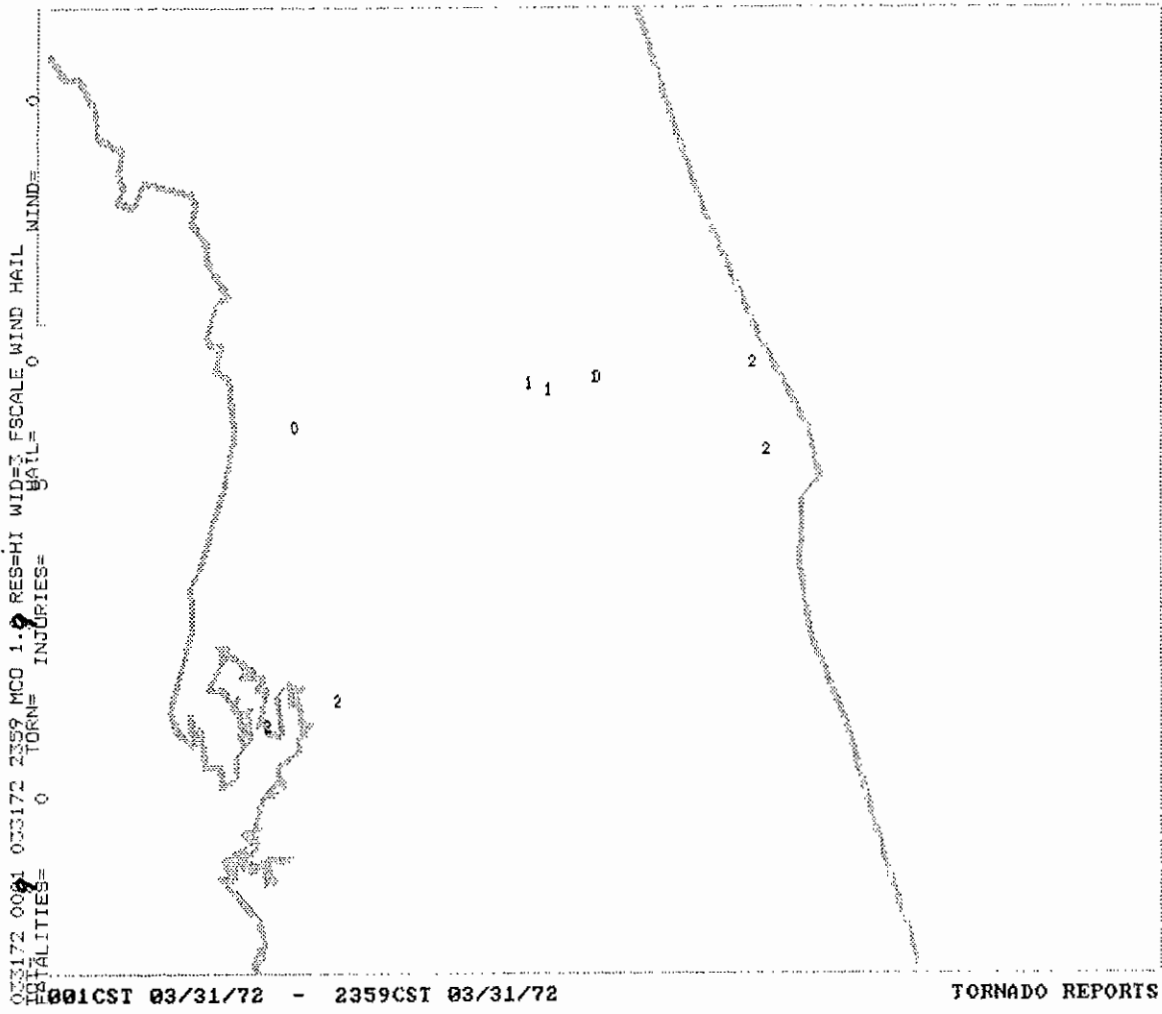


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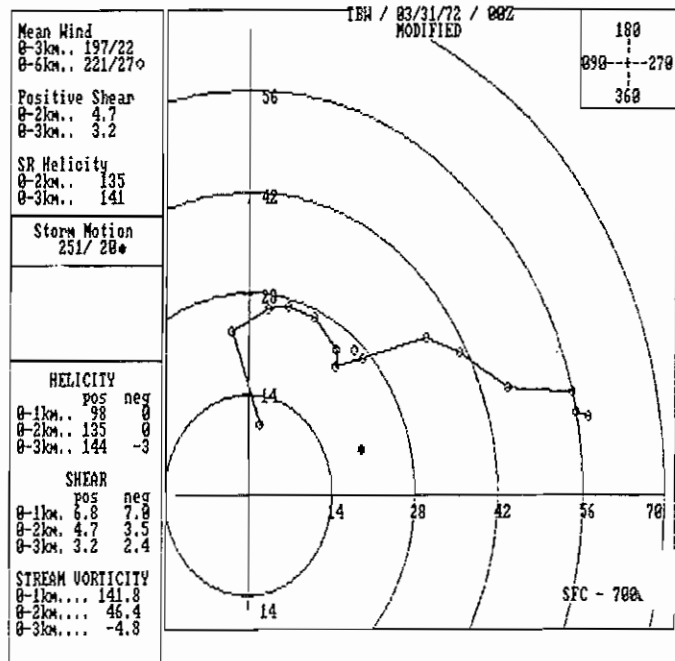
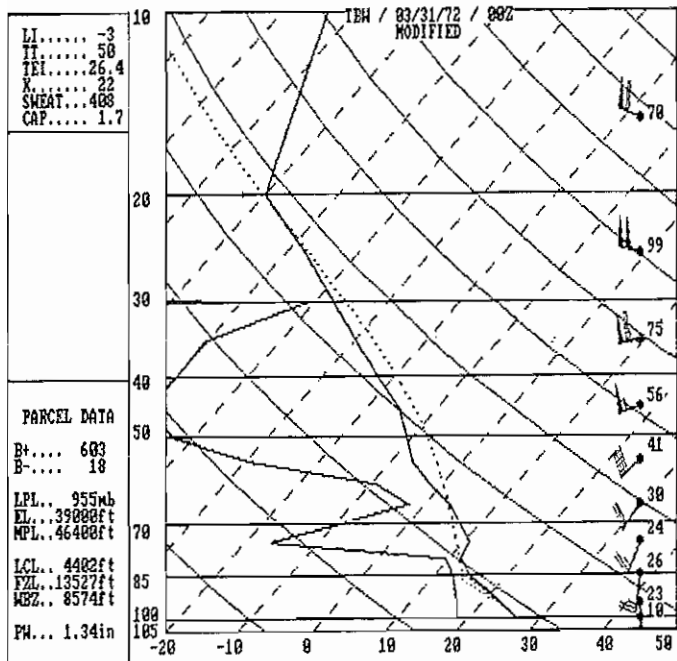


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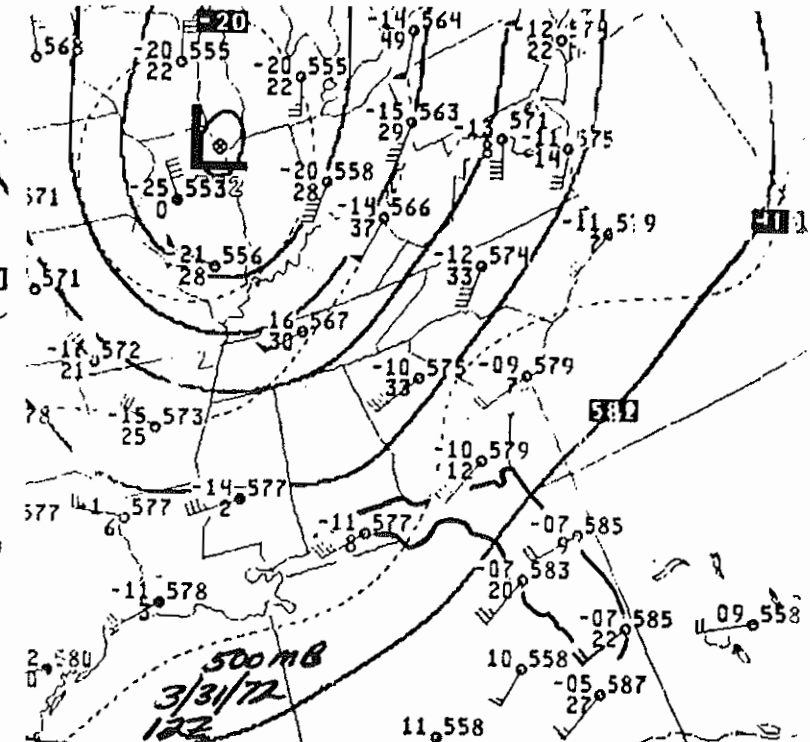
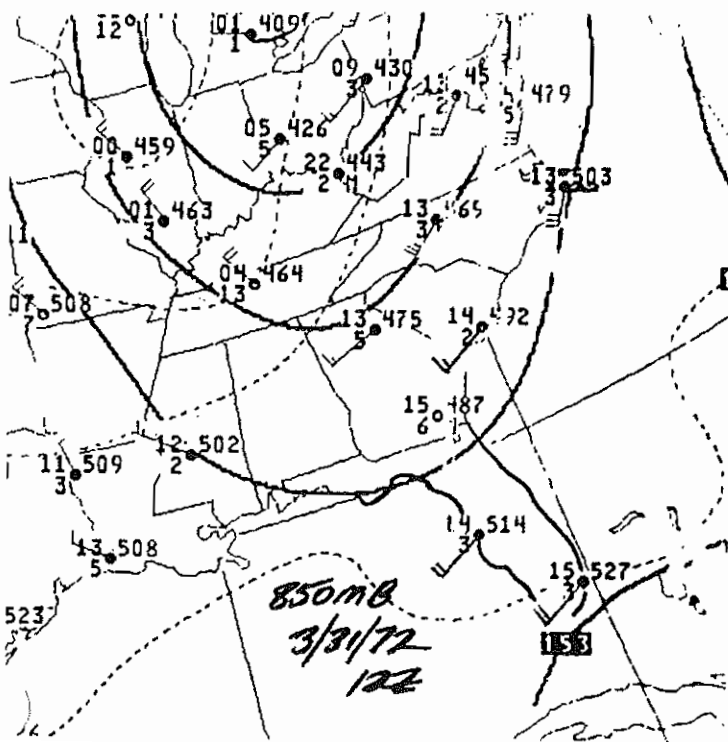
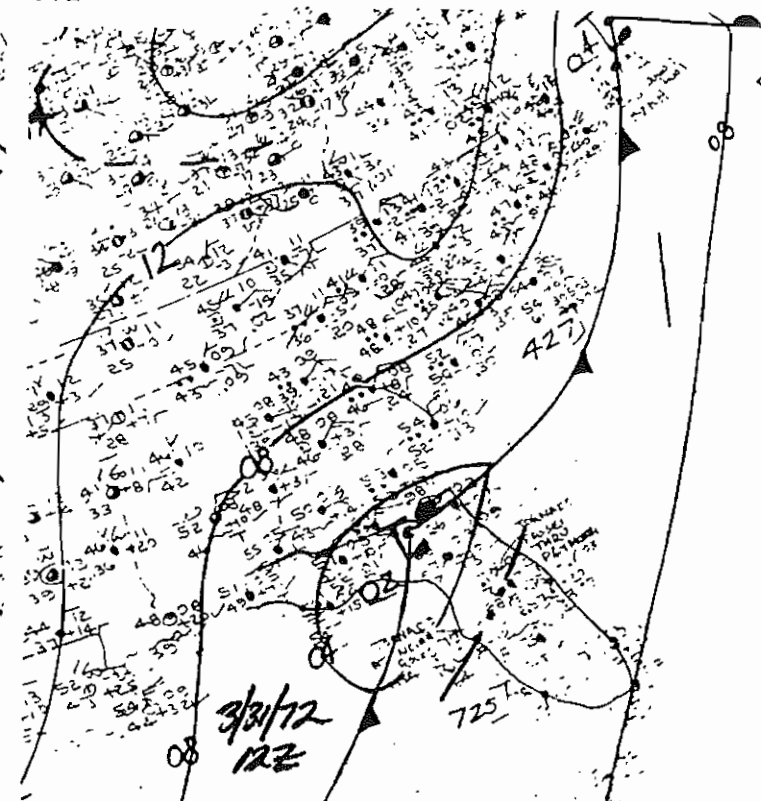
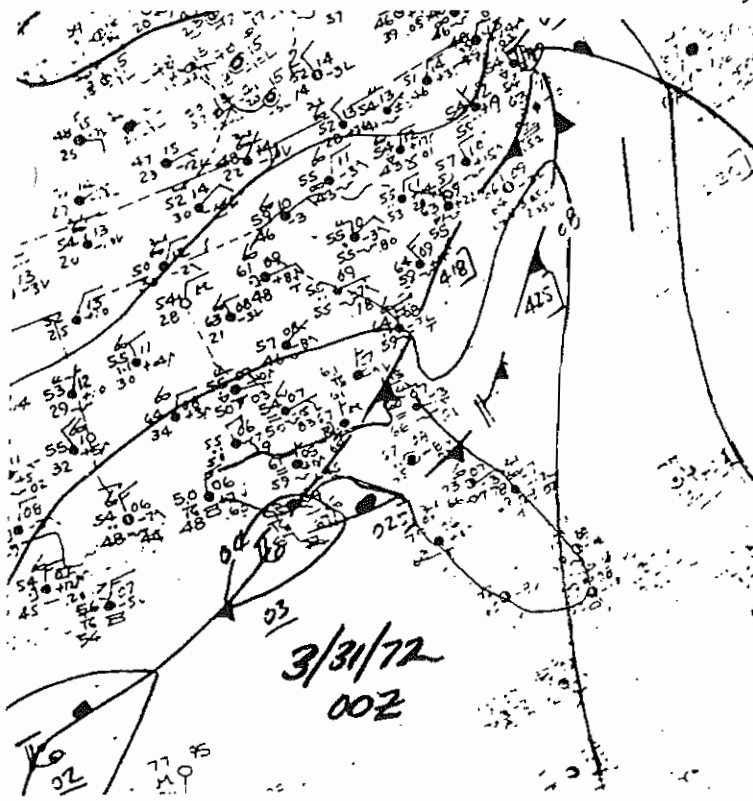


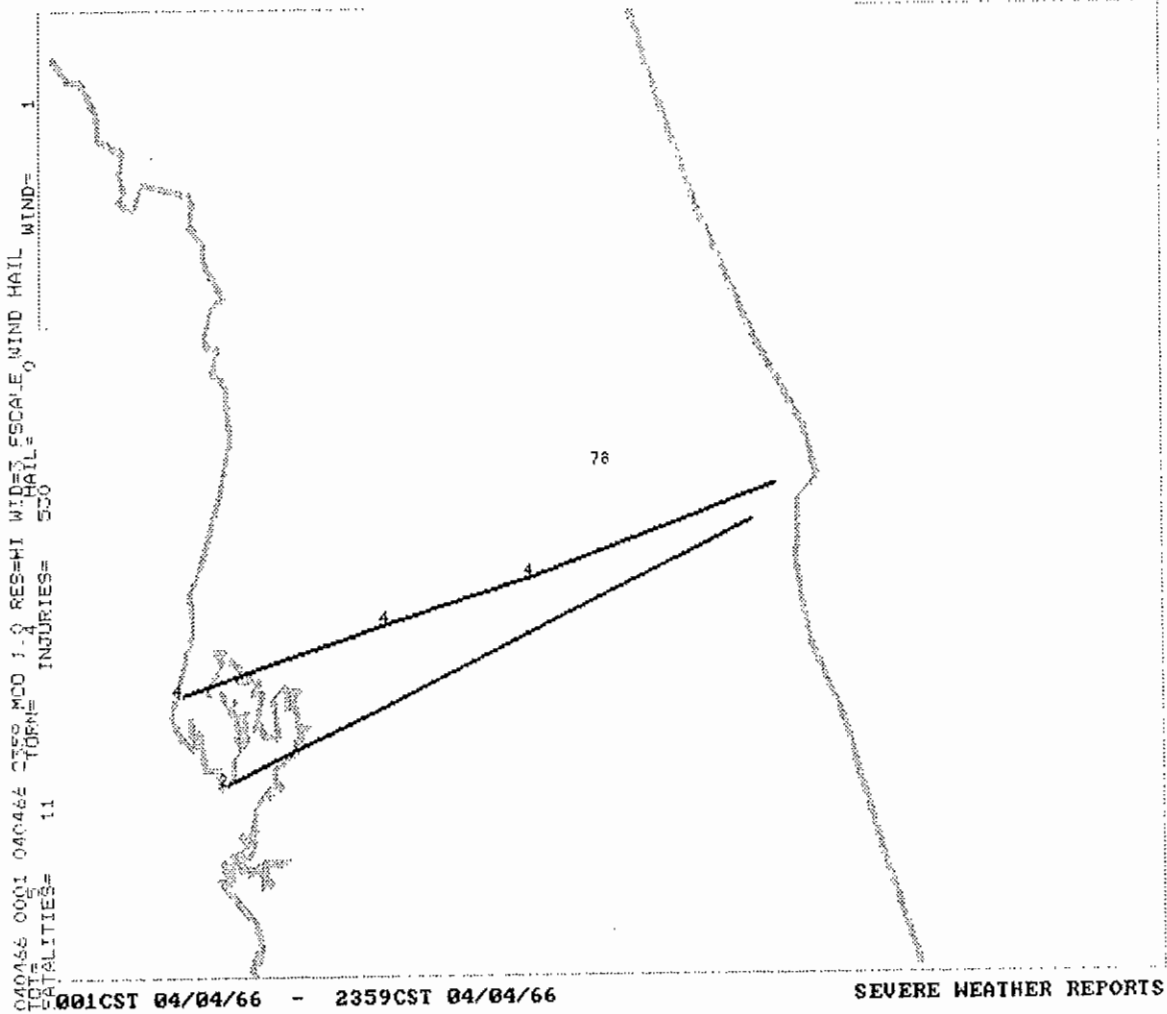


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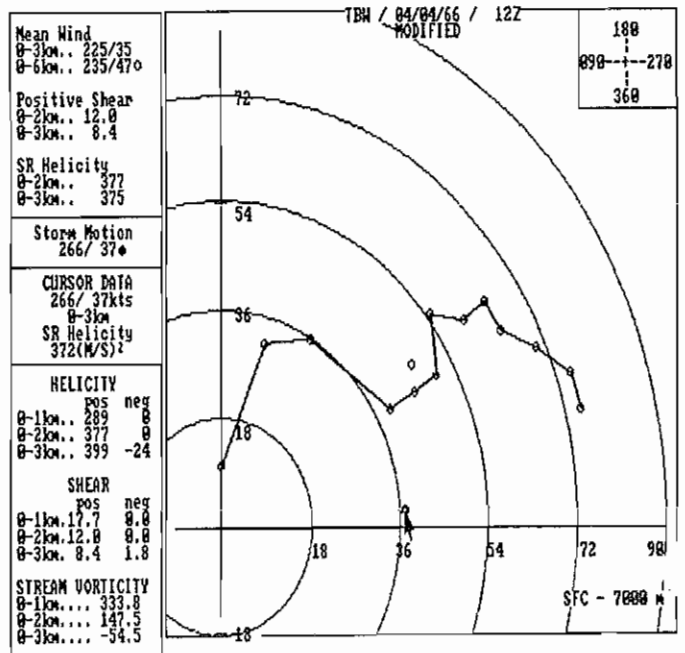
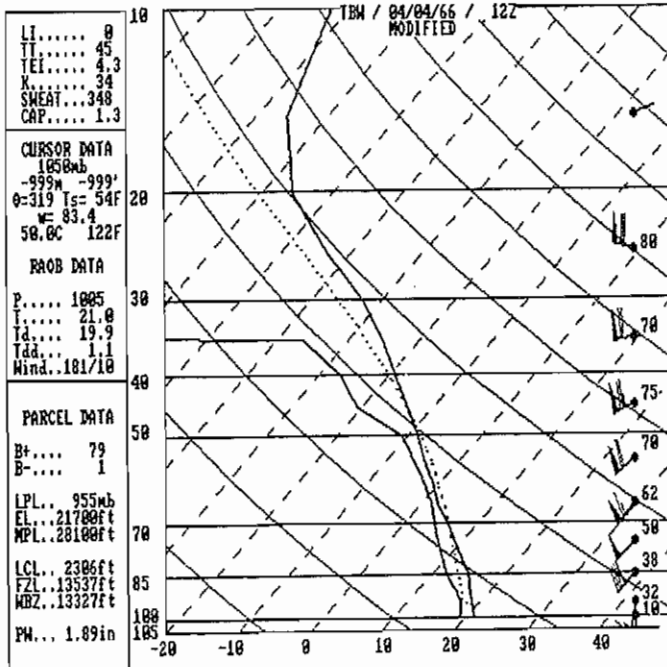


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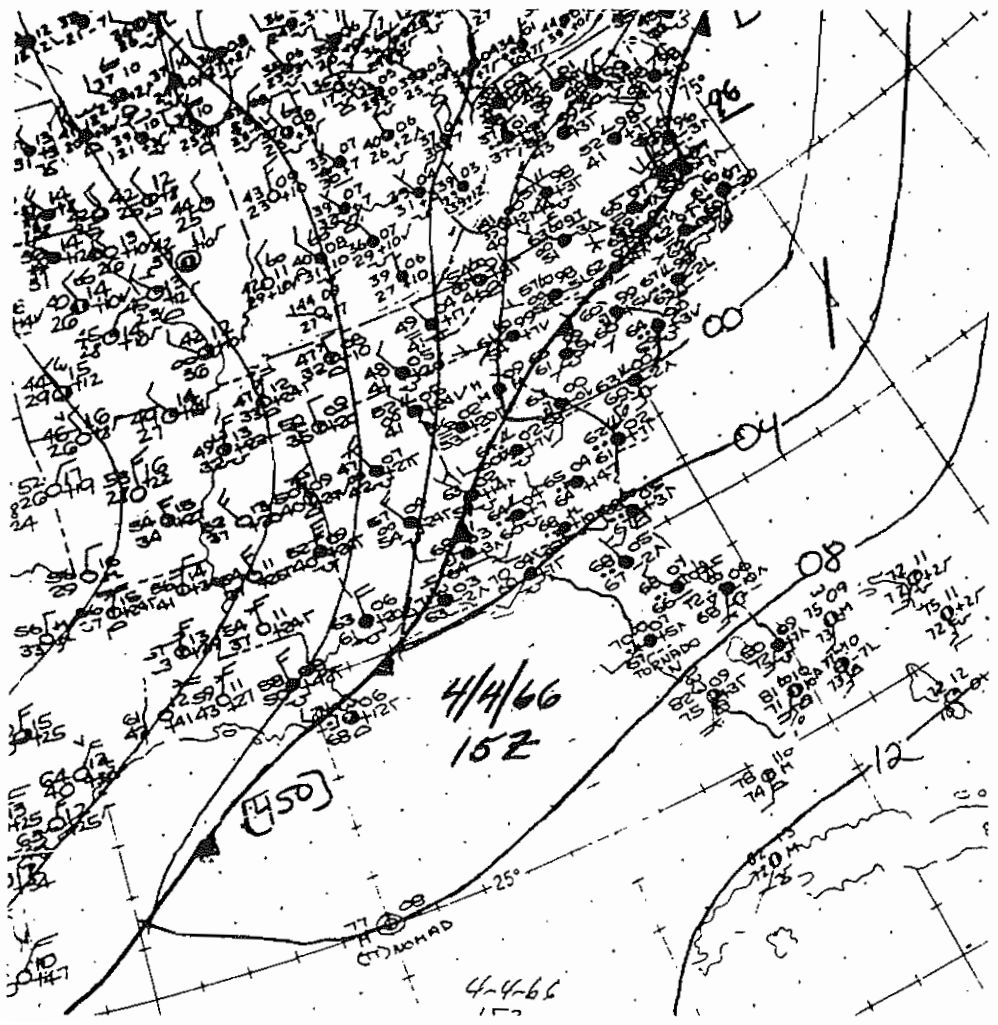
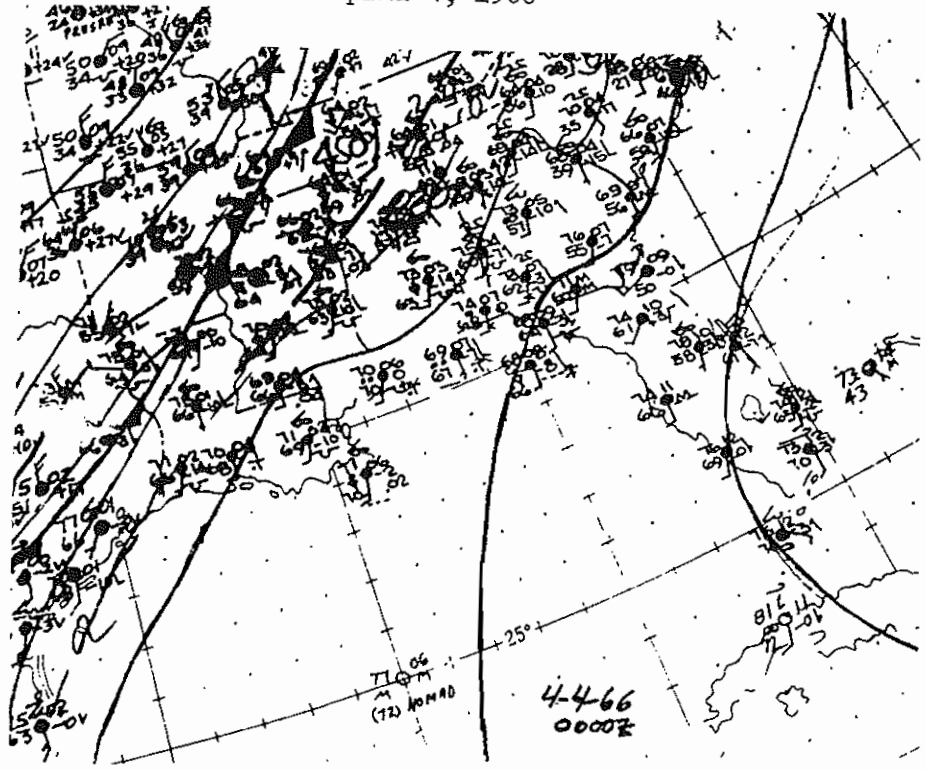




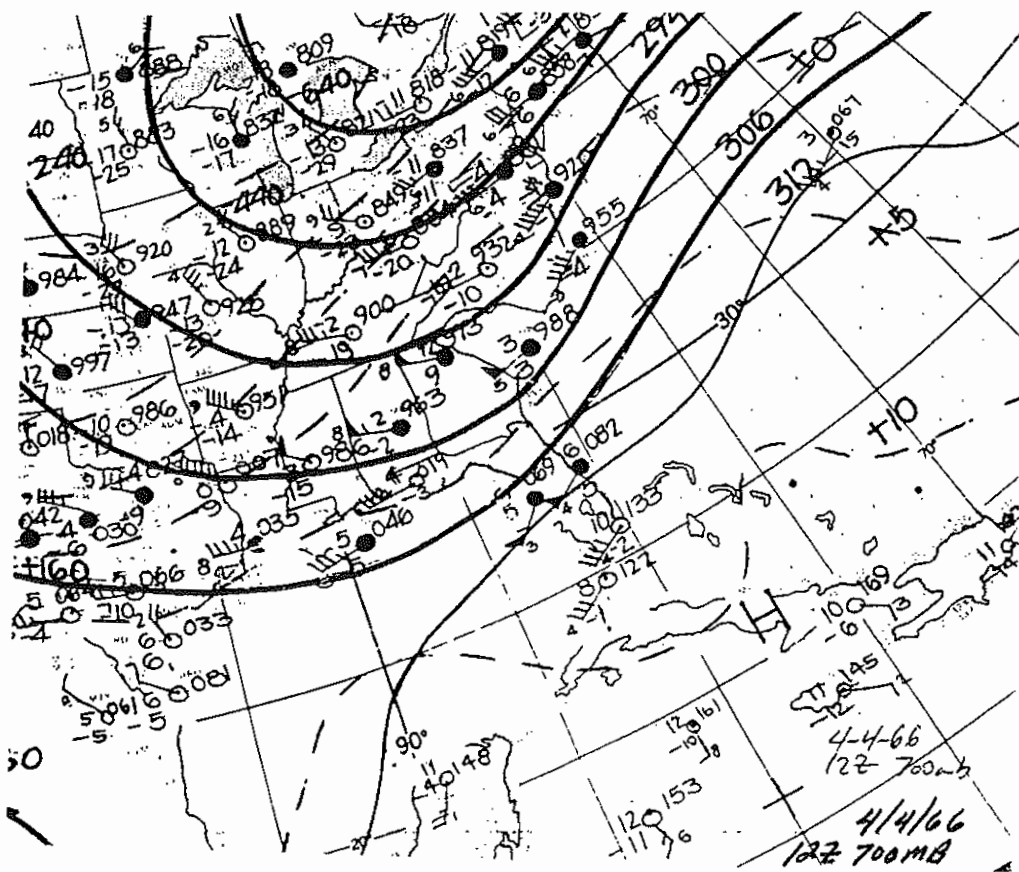
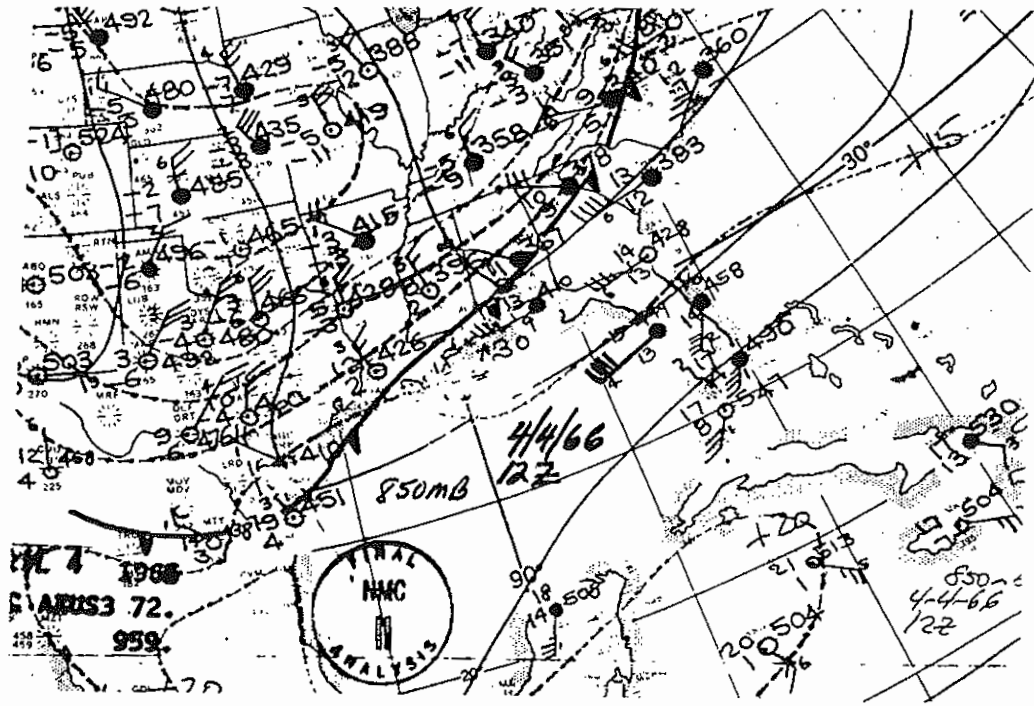
**Deadliest Peninsular Florida Outbreak!**  
(Note: One of two outbreaks to produce F4 tornadoes)



April 4, 1966

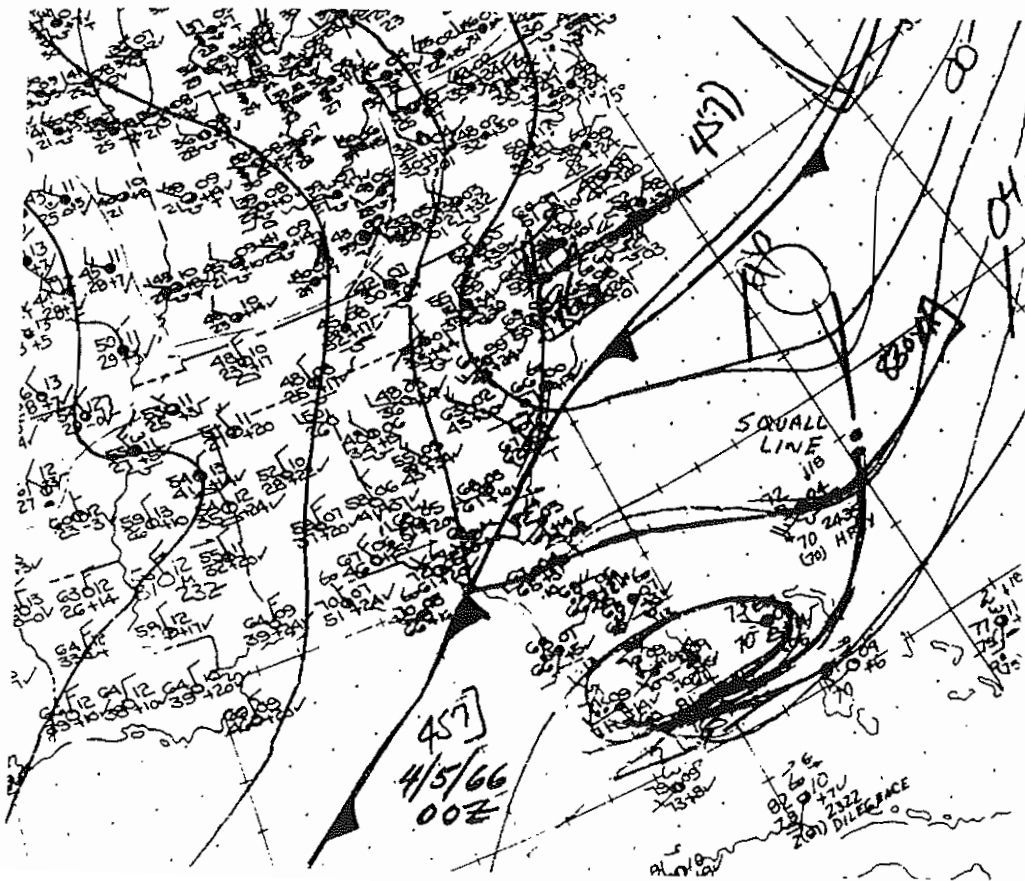
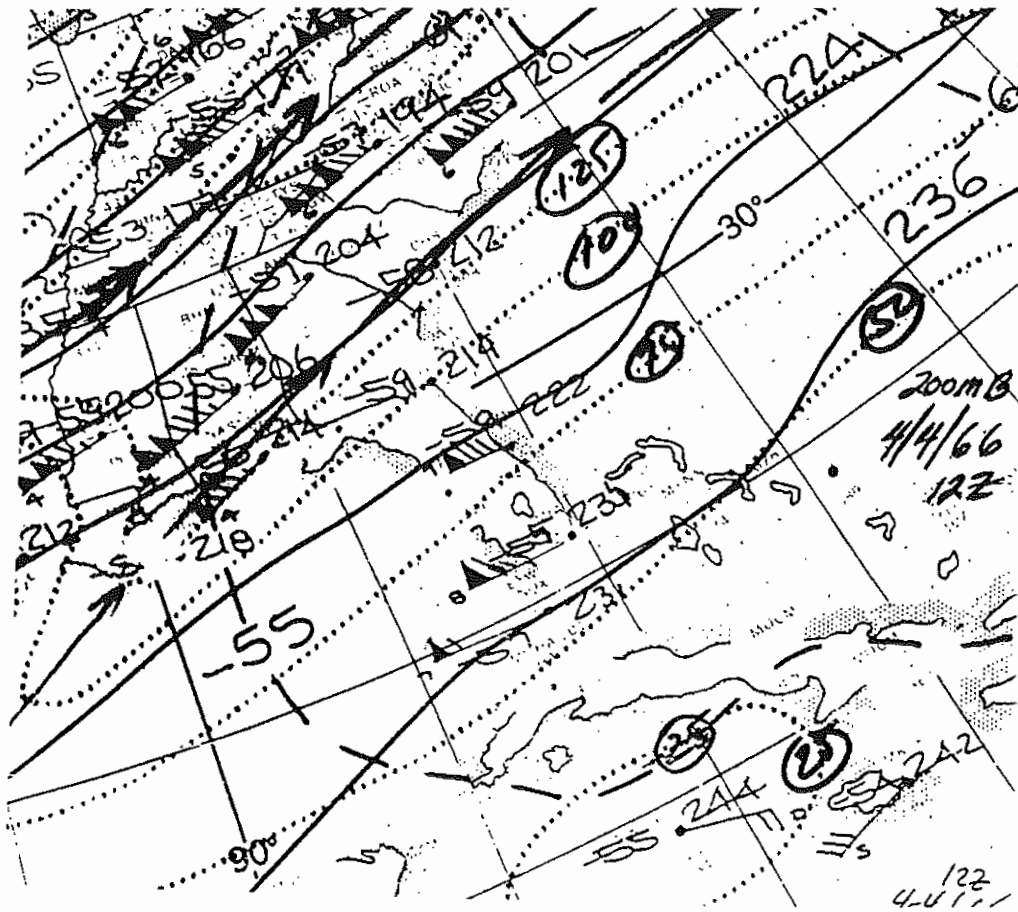


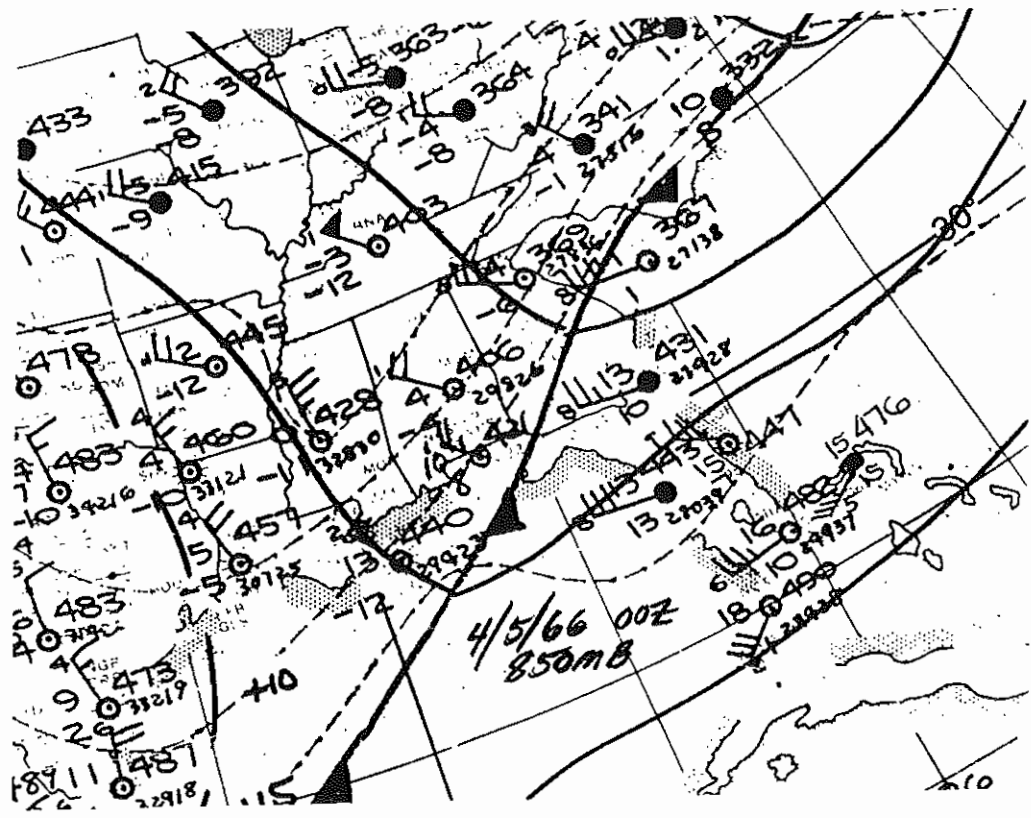
April 4, 1966



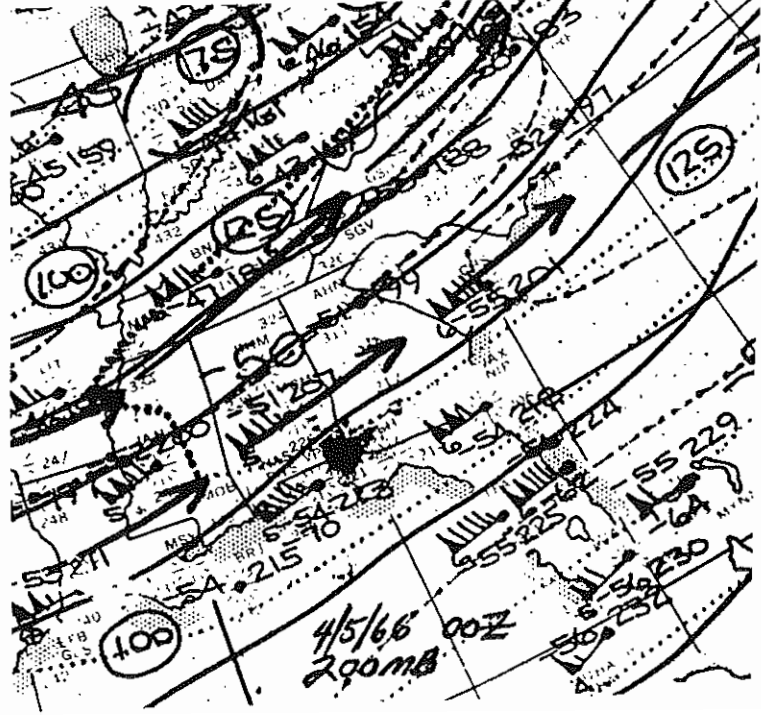
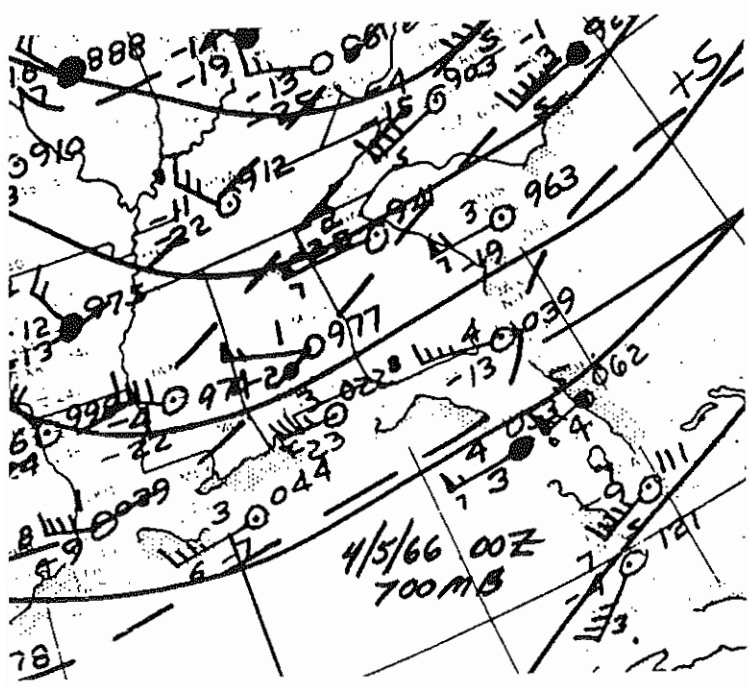


April 4, 1966





(Note 135 kt jet max over Cape Canaveral)



# TODAY

Florida's Space Age Newspaper

Highlights  
out in Ft. Worth, TX,  
have high hopes for  
a sea slide for Paul  
repeats, LSH

4/5/66  
Tuesday, April 5, 1966

Published in Brevard County, Florida

The Daily, Six Weeks

Next Space Shots  
including Astronauts of observation  
of May 2 11:30 a.m. Tuesday, Atlas  
launcher, 12:00 a.m. Wednesday.  
TODAY'S Weather:  
Brevard and surrounding areas  
cloudy, showers, thunder, gusty  
winds, high of 75.  
Complete weather, 23

## Ike Roar of 1,000 Freight Trains, Wisters Batter Florida, Kill Nine

### After the Storm: 10 Dead Ruin, Hope and Prayers

4/6/66

## Erratic Twisters Catch Weathermen by Surprise

By JACK BRIEBART  
TODAY Staff Writer

Monday's tornadoes caught weathermen by surprise.

"Conditions which favor the formation of severe tornadoes rarely occur this far South," said Forecaster Raymond Kraft, at the U. S. Weather Bureau in Miami.

What it takes for a tornado to form is very strong winds four miles or more above the earth and some pretty strong southerly winds.

"I wouldn't guess at the odds for getting a combination of the two things in Florida," said Kraft, "but they are very rare."

Why is not exactly known but the warm weather has something to do with it. "We've never, as far as I know, had a tornado in a tropical climate," said Kraft.

When the strong winds aloft and the southerly winds combine, they form an updraft — which is the tornado.

"It's sort of the reverse of pulling the plug out of a bathtub," said Kraft.

Unlike hurricanes, tornadoes can form quickly.

"In the Midwest," said Kraft, "they've been known to form out of a clear sky . . . but generally they form in squally weather."

Kraft admitted even looking back over all the information

### WEZY Rebounds

Cocoa Radio station WEZY was knocked off the air during the storm Monday but bounced back with emergency power. When the generators ran out of gas, employes siphoned gas out of their cars to keep the generators humming.

available to the weather bureau Sunday night and early Monday morning, he could not predict a tornado.

"And if I would have, I would have predicted the wrong area," he added.

Once it's determined conditions are favorable for a tornado, weathermen then can determine a belt in which tornadoes are likely to occur. Monday's belt, according to Kraft, was about 25 to 30 miles wide across the state.

Kraft said there were 10 actual tornadoes pinpointed across Florida Monday but he would guess there were many more.

"These things are very small. Most of the actual areas of total destruction are from 100 to 300

yards in diameter. And they are erratic.

"They'll bounce around and change paths and they usually don't last long. Their average life is only about half an hour."

Winds in tornadoes never have been measured but Kraft figures the ones Monday probably had highs of around 200 miles an hour.

"Estimates of some tornadoes have been as high as 600 miles an hour," Kraft said.

Damage is caused by the winds but much destruction is also the result of the change of pressure in the center of the winds.

"This pressure drops so quickly it literally causes explosions," said Kraft.

### Earlier State Disasters

Florida has been battered by nature seven times since the Federal Disaster Act was passed in 1950. The following box shows the date of declaration making Florida available for federal aid, the type of disaster and the amount of federal funds allocated.

Date of Declaration	Type	Funds Allocated
Oct. 22, 1953	Flood	\$ 363,559
March 23, 1960	Severe Weather	\$1,700,000
Sept. 12, 1960	Hurricane	\$1,350,000
Dec. 17, 1962	High Tides	\$1,714,000
Sept. 8, 1964	Hurricane Cleo	\$2,300,000
Sept. 10, 1964	Hurricane Dora	\$8,200,000
Sept. 14, 1965	Hurricane Betsy	\$2,500,000

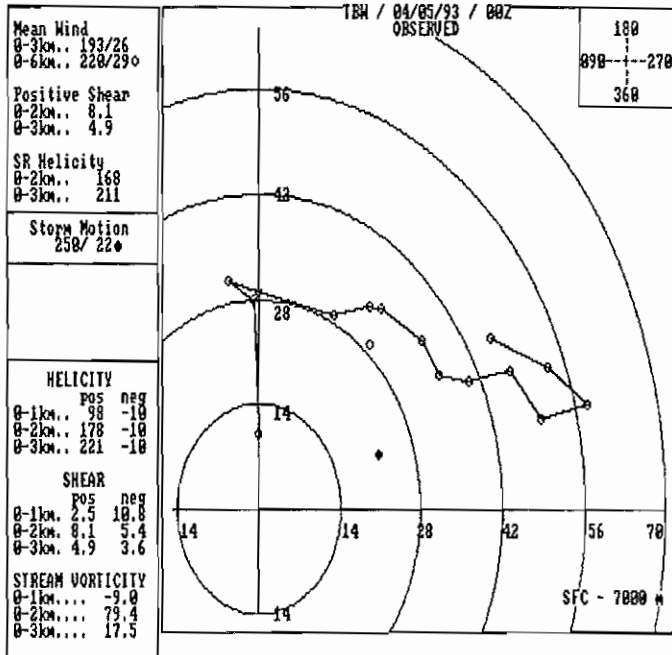
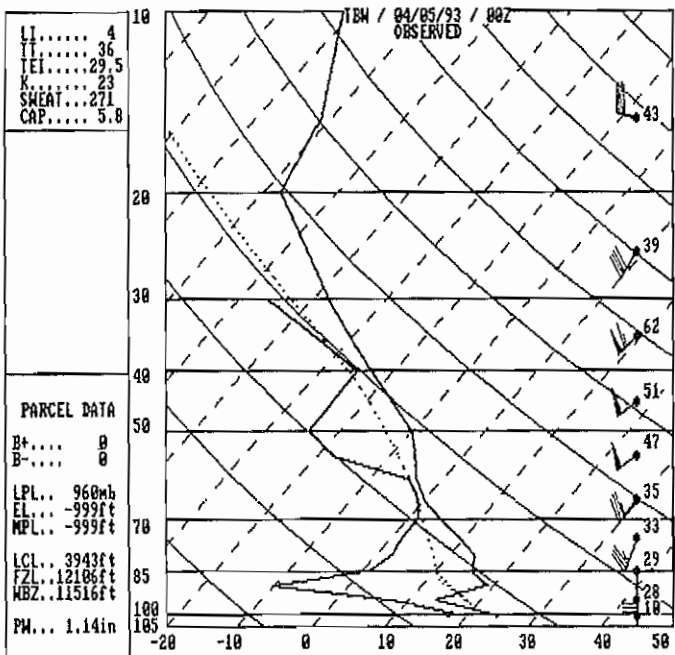
Hurricane Betsy figure could go higher, since all claims have not been processed. The assistance monies refer only to federal disaster funds from the Public Law 875 and do not include funds expended by other federal agencies.

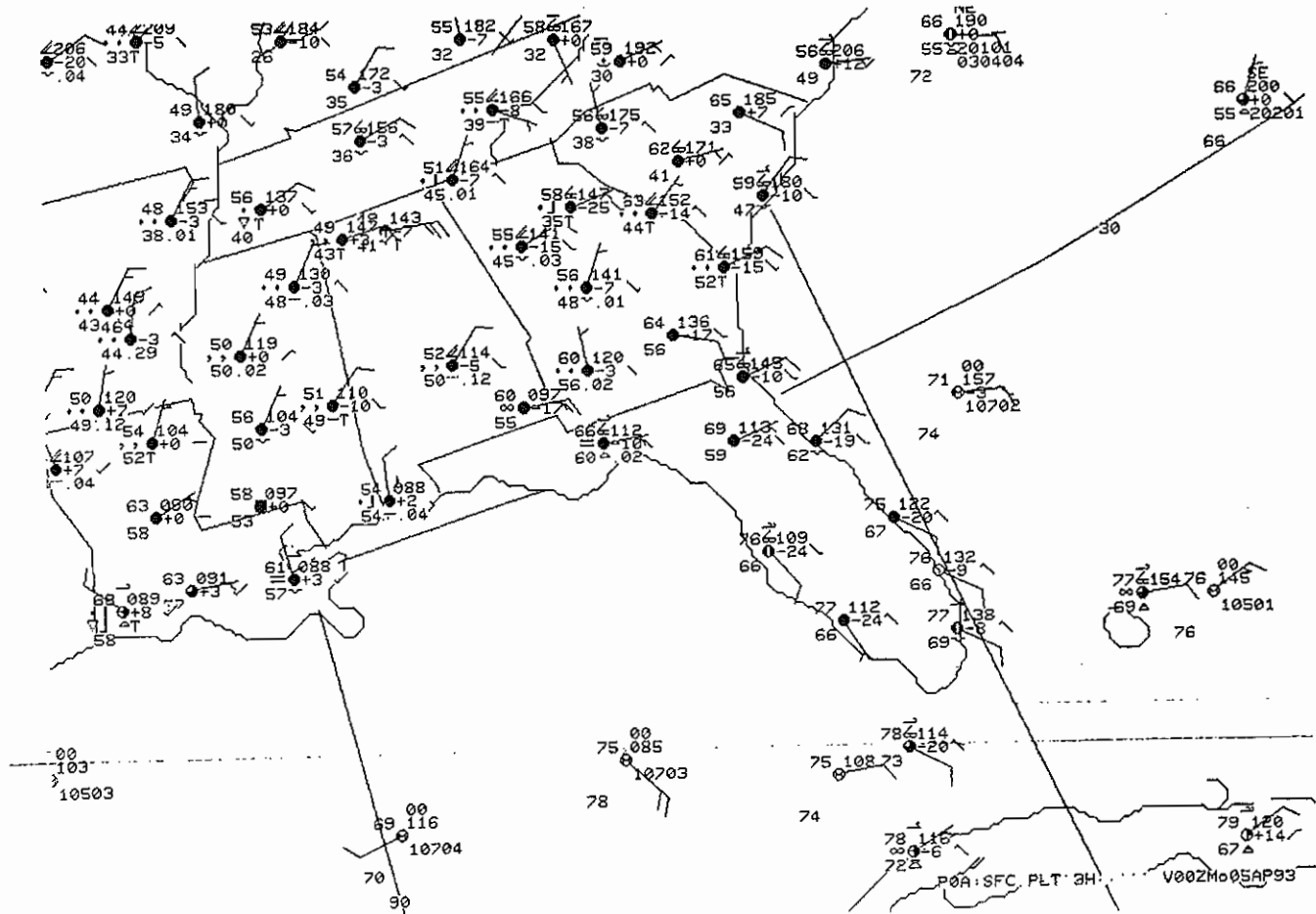
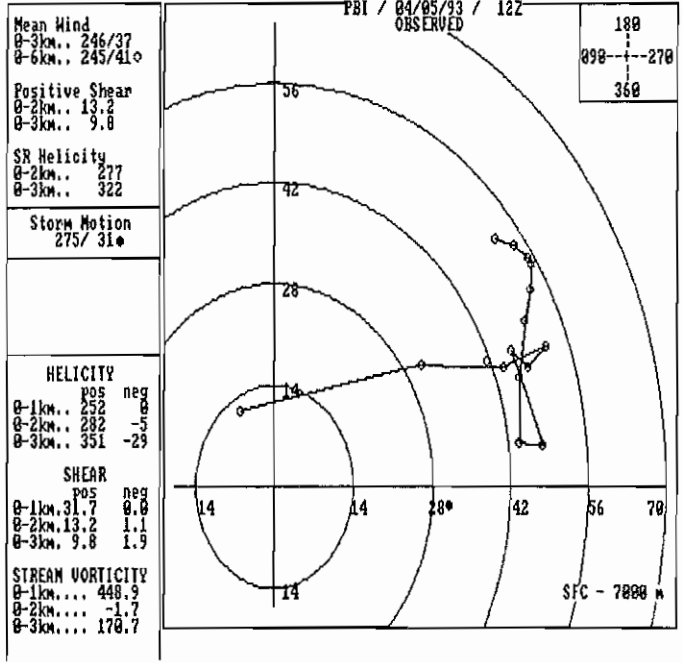
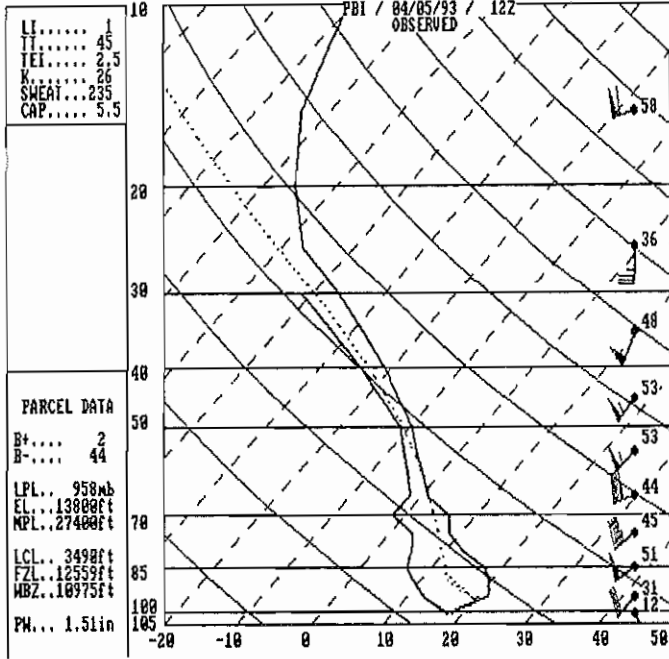
4/5/66

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 FATALITIES= 0 TORNE INJURIES= 5  
 HAIL= 0 WIND= 8

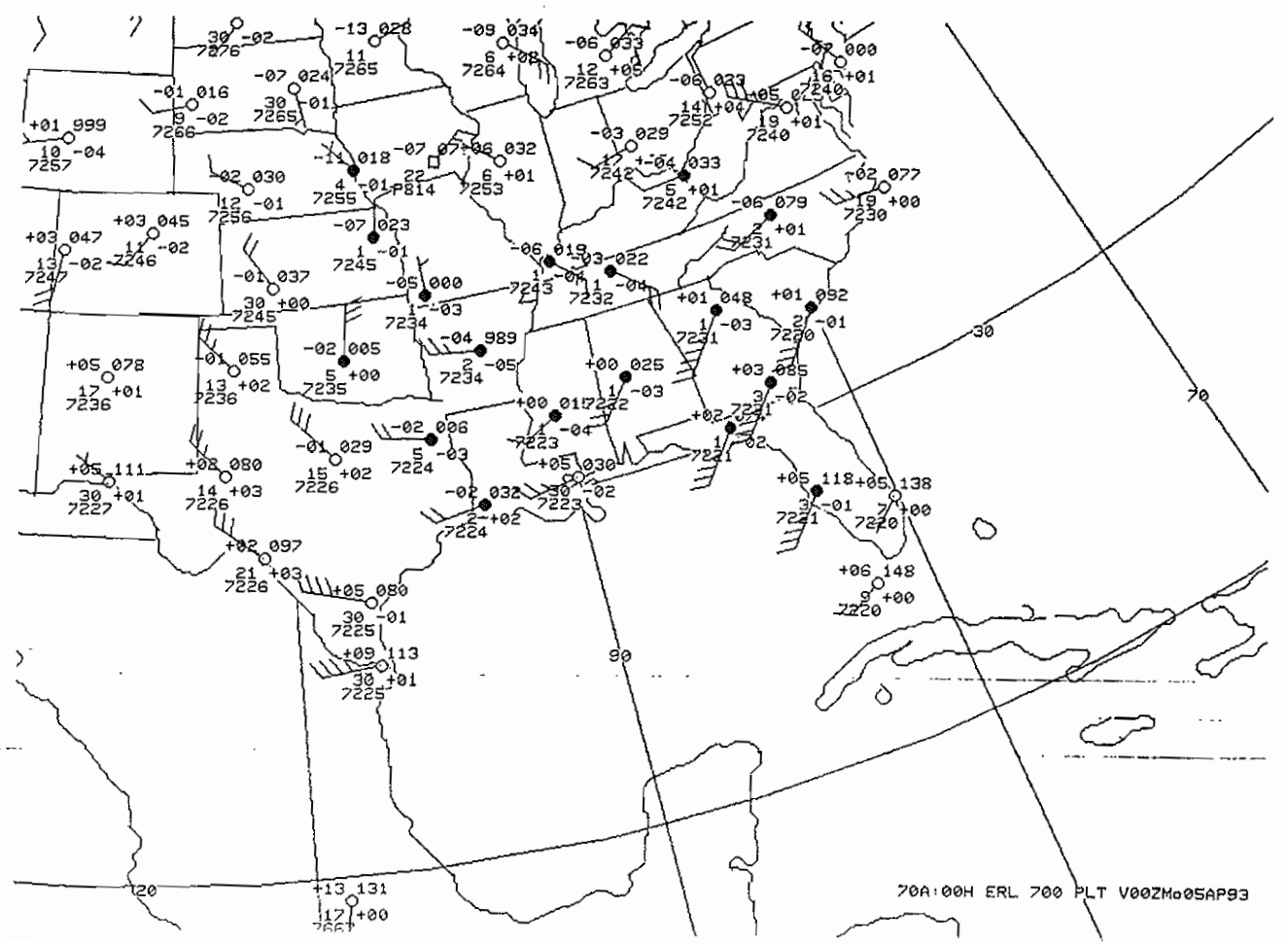
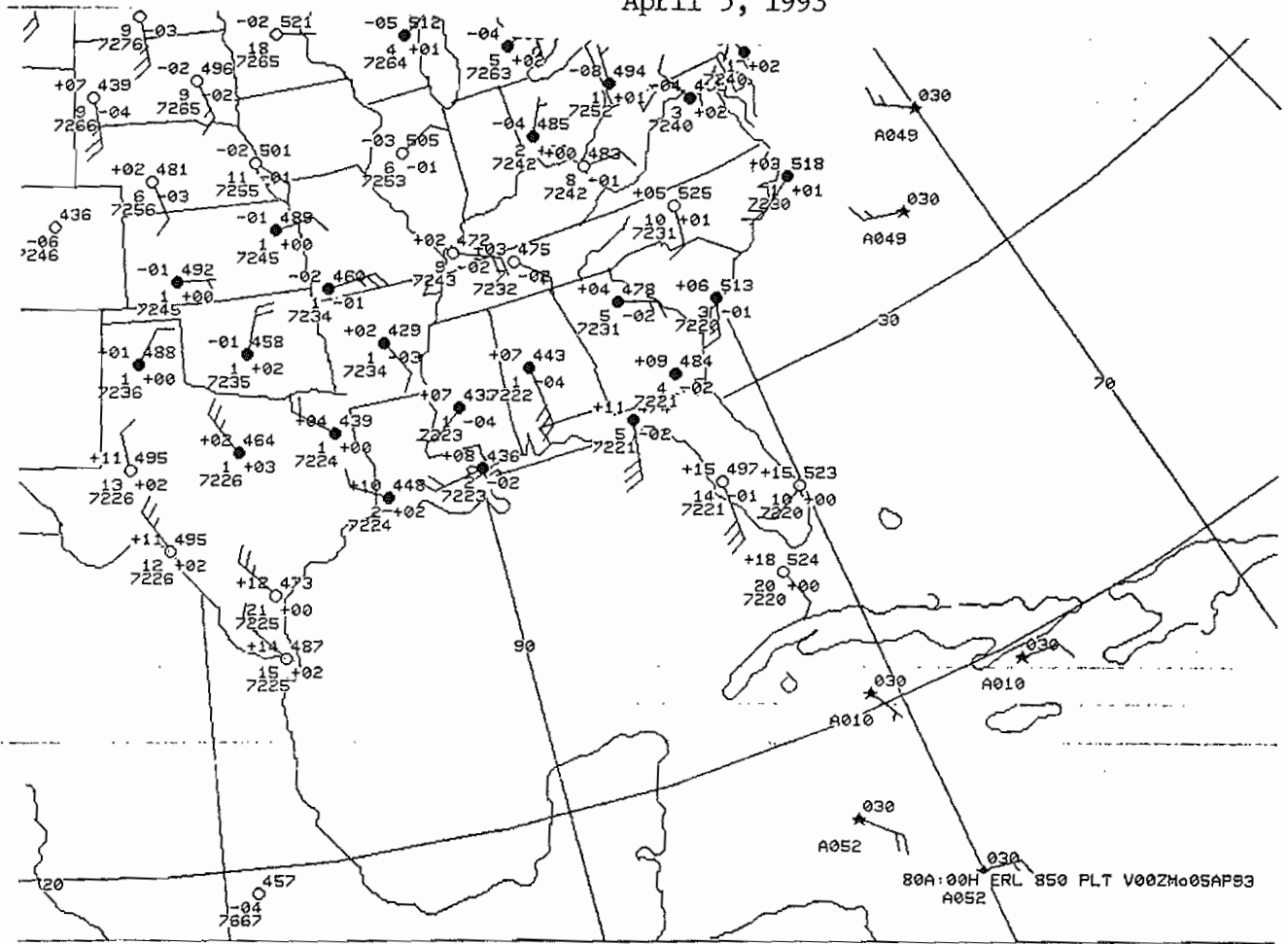
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SEVERE WEATHER REPORTS

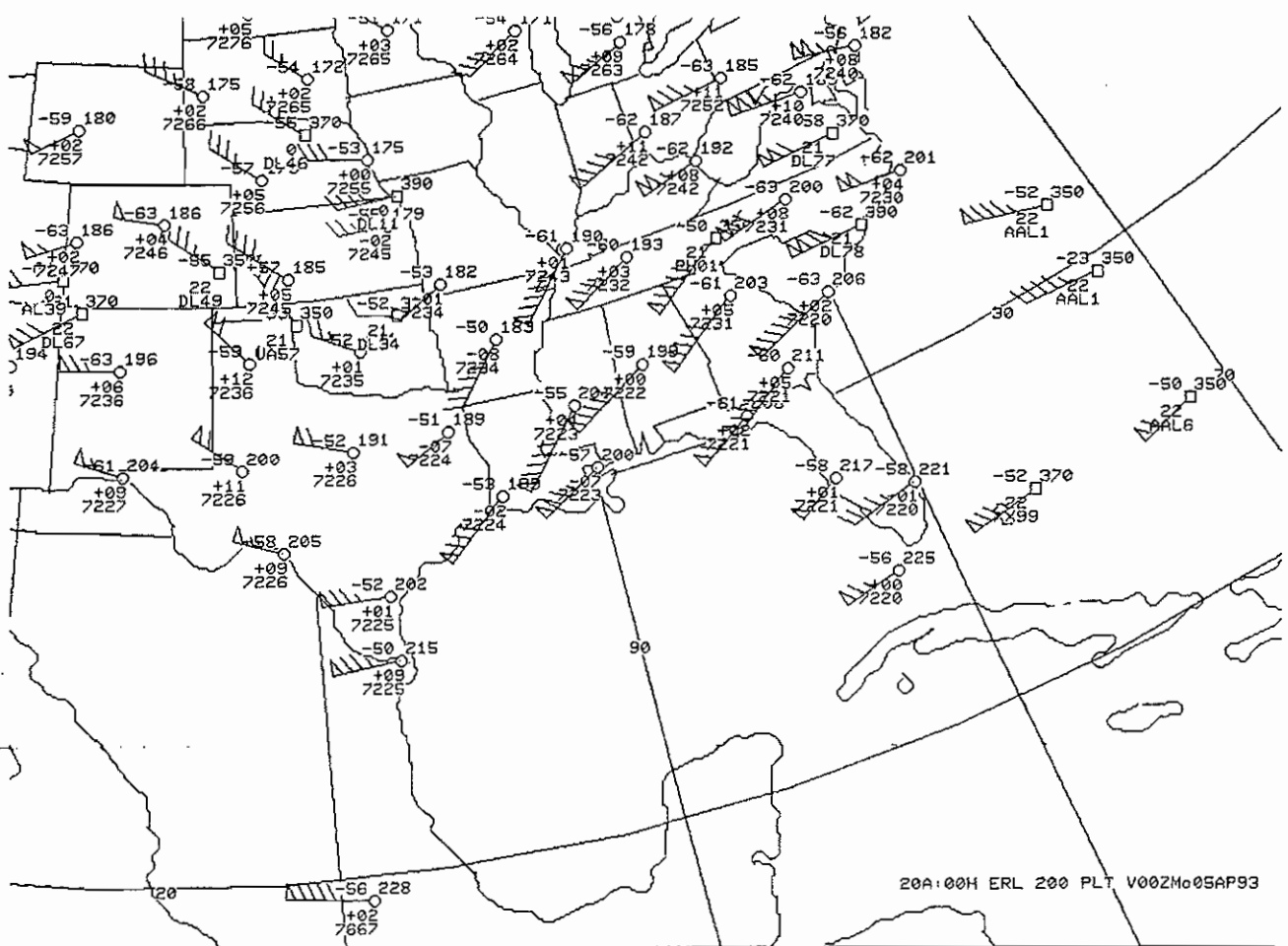
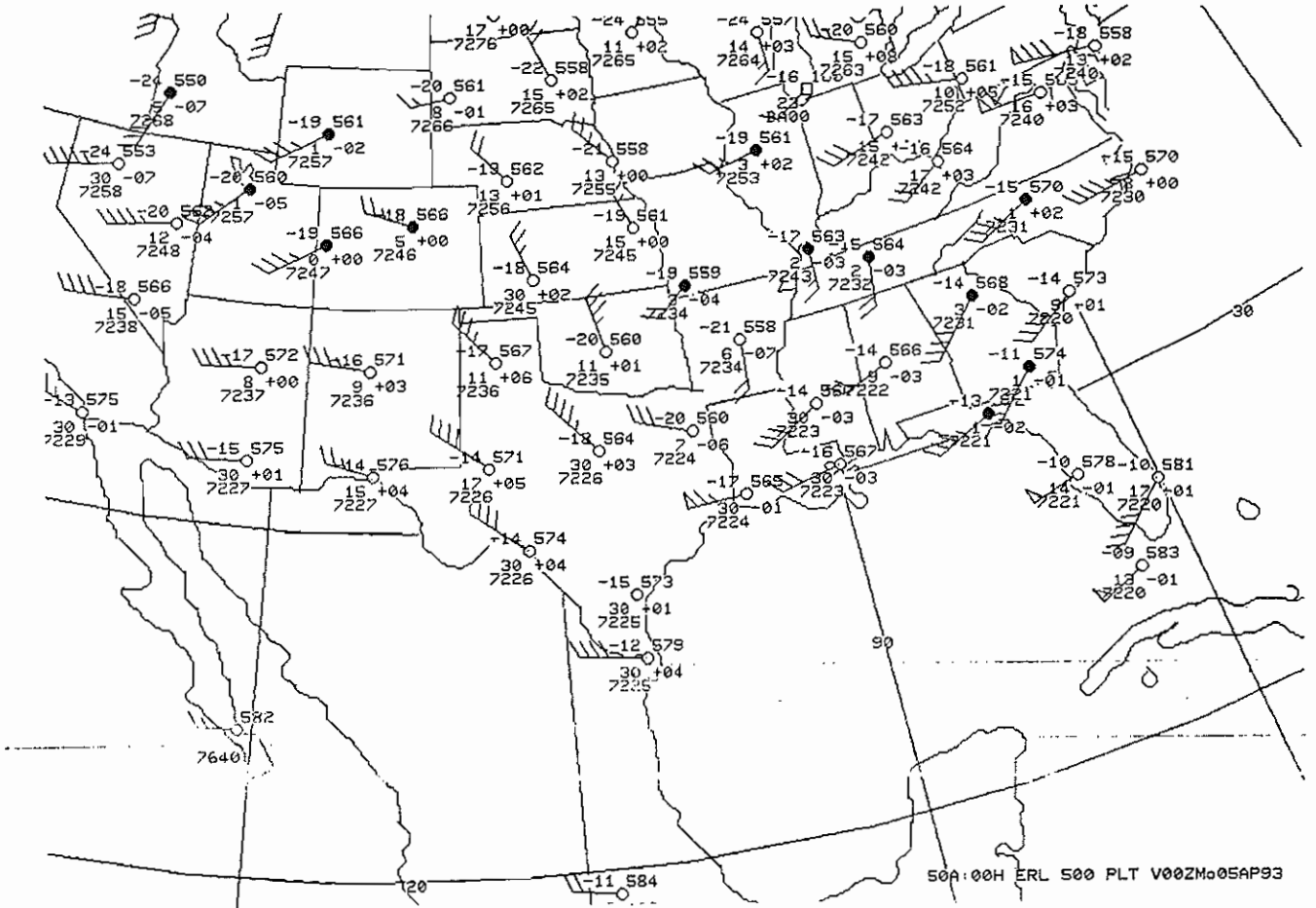




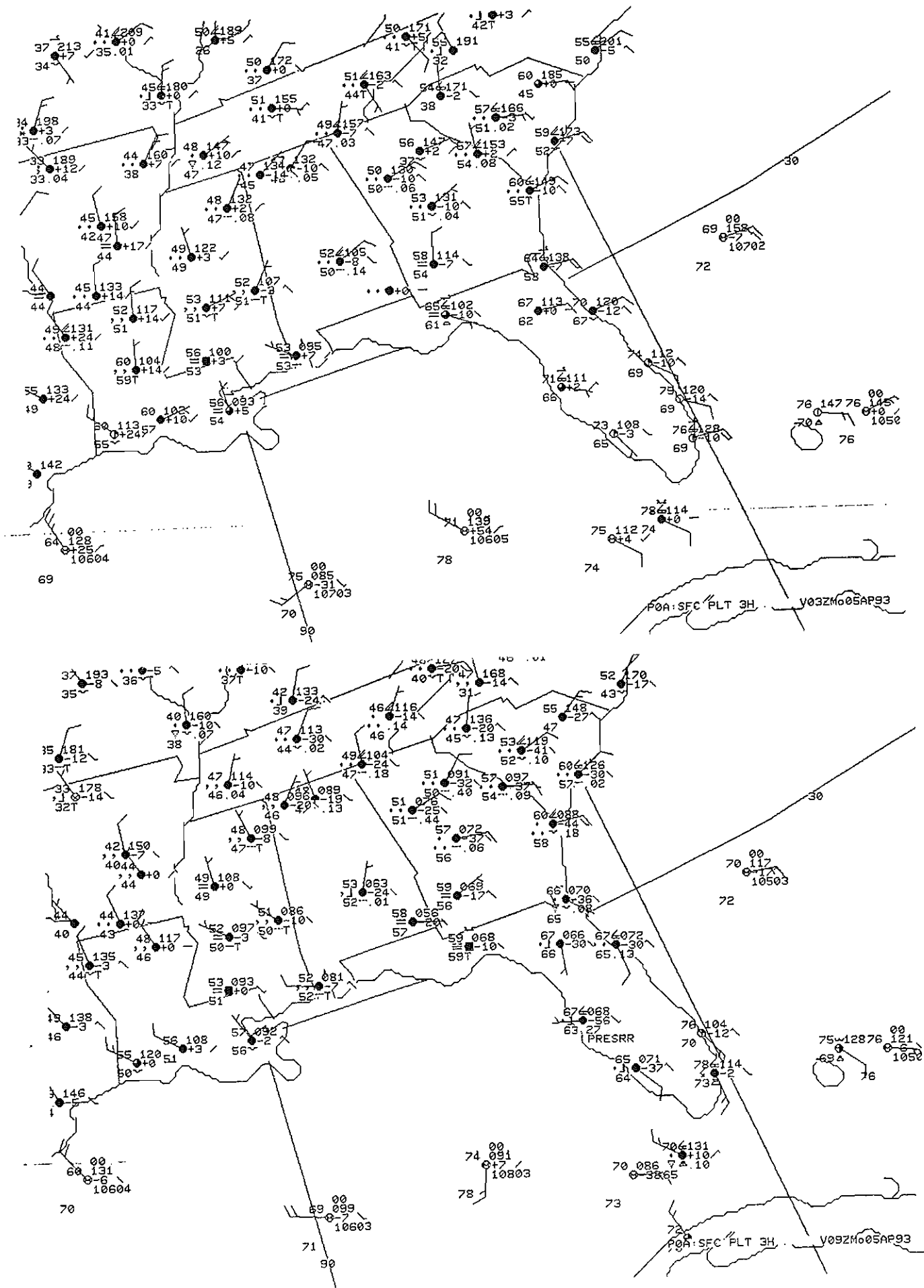
April 5, 1993



April 5, 1993



April 5, 1993





MLB WSR-88D

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04/05/93 08:21  
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TIME 11 30 30 40  
ELEM 4 5 00  
MODE 0 0 0  
UNIT 10000 0.000  
MODE 00 000

HD DBZ

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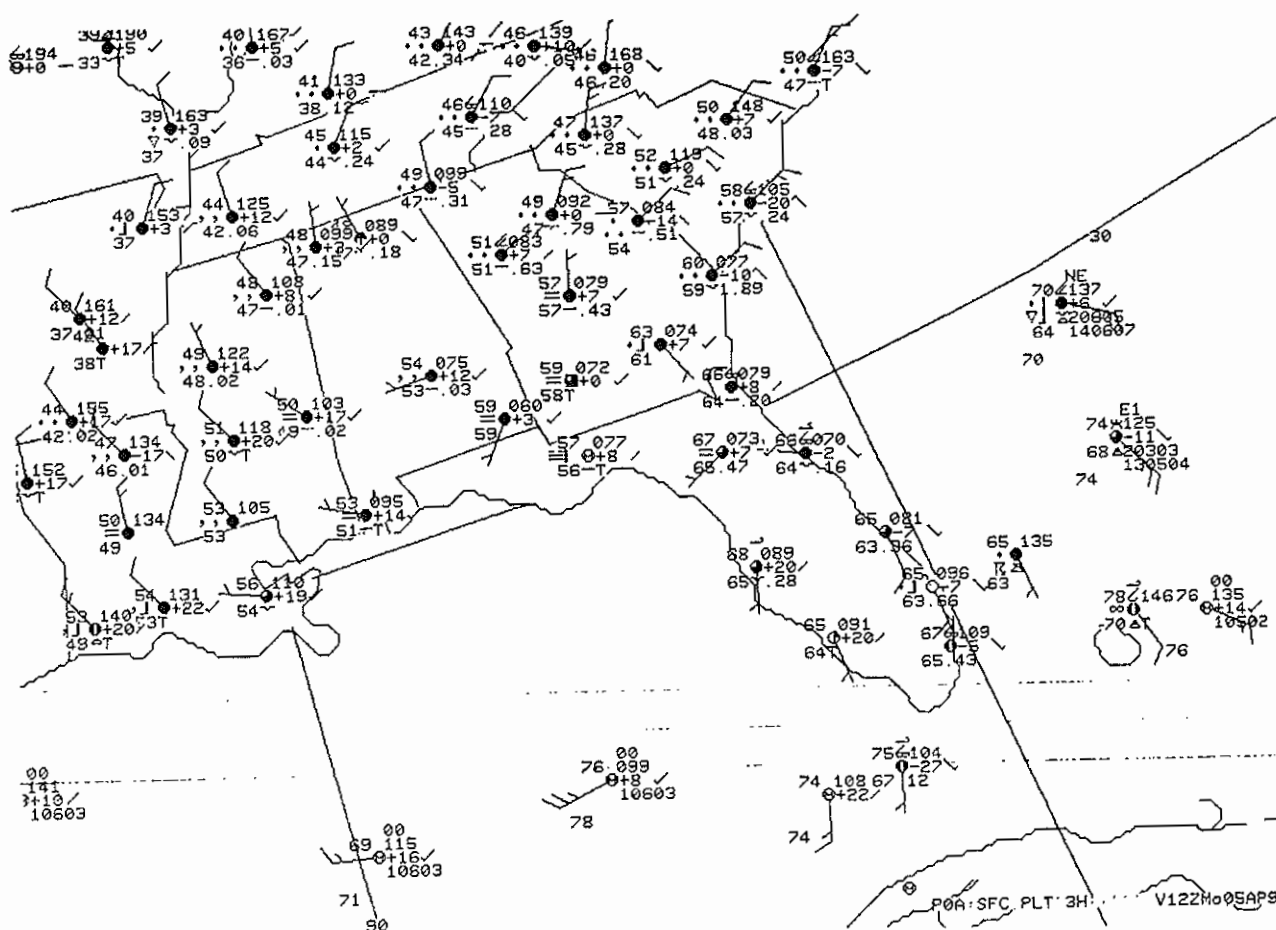


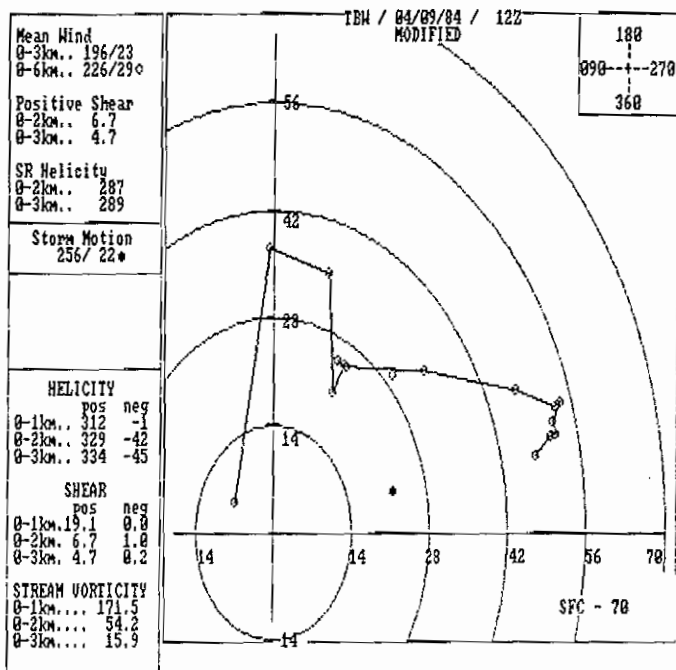
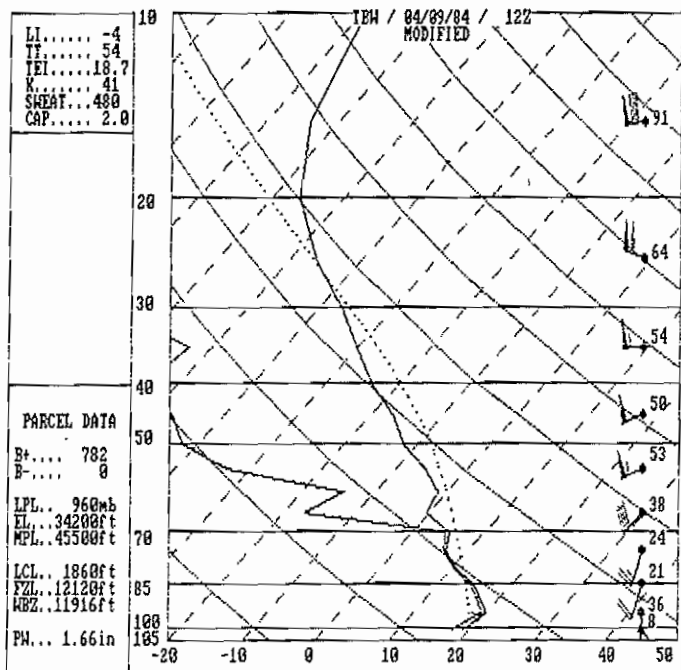
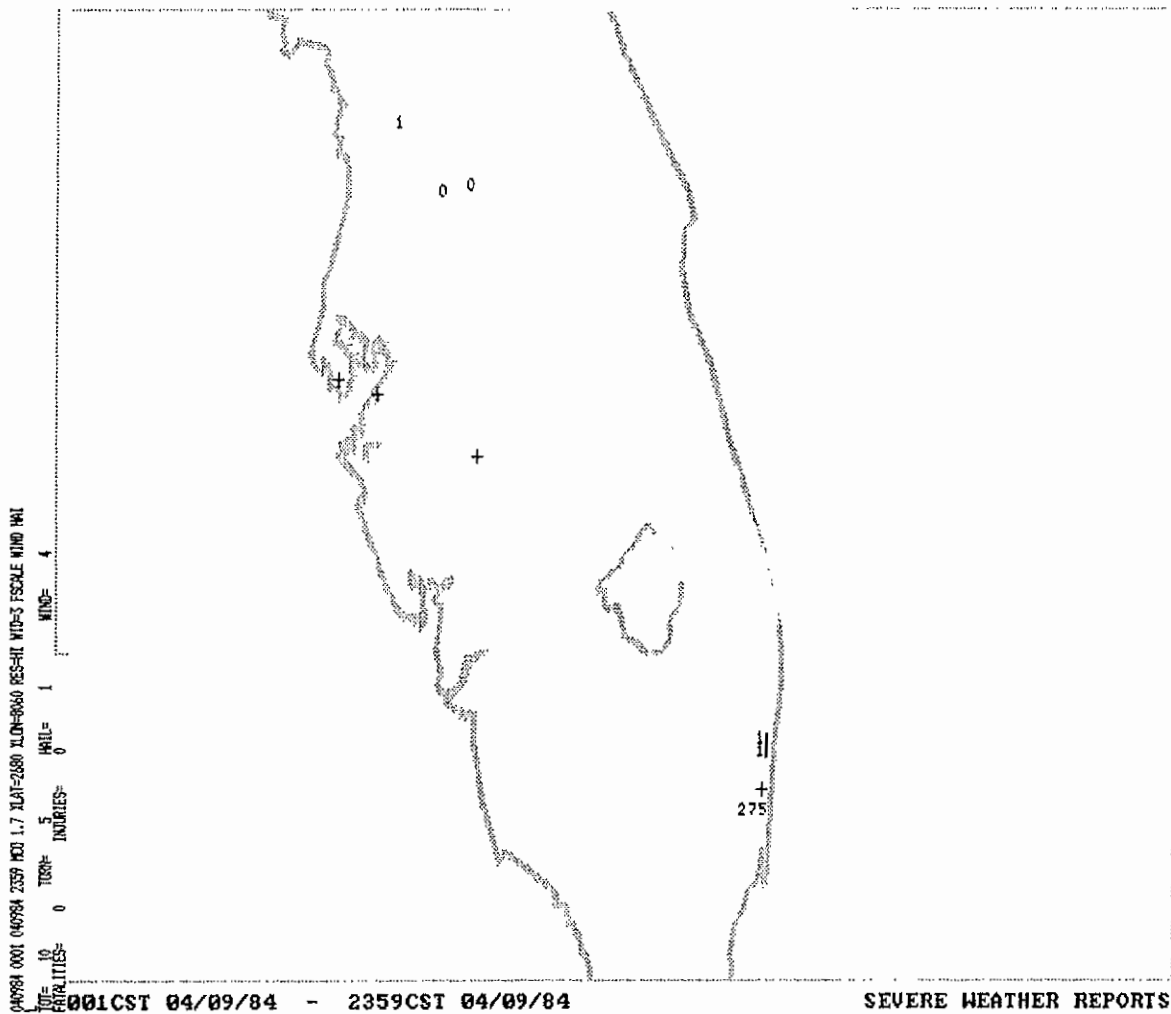
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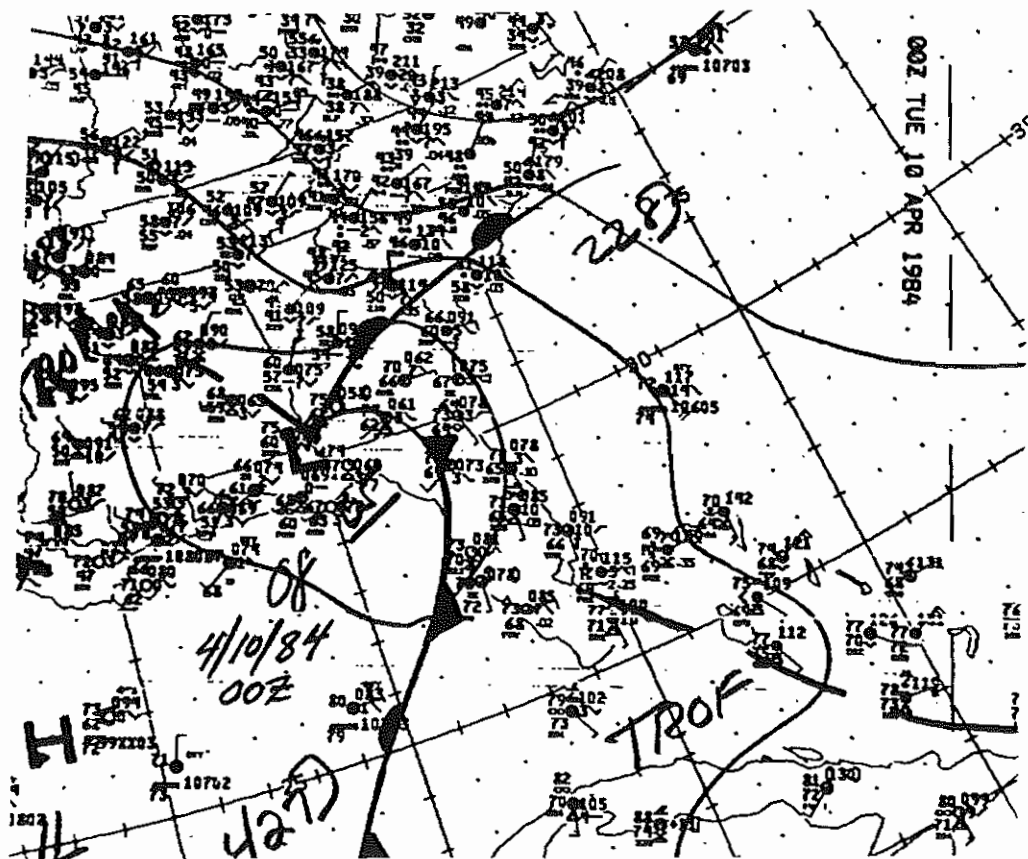
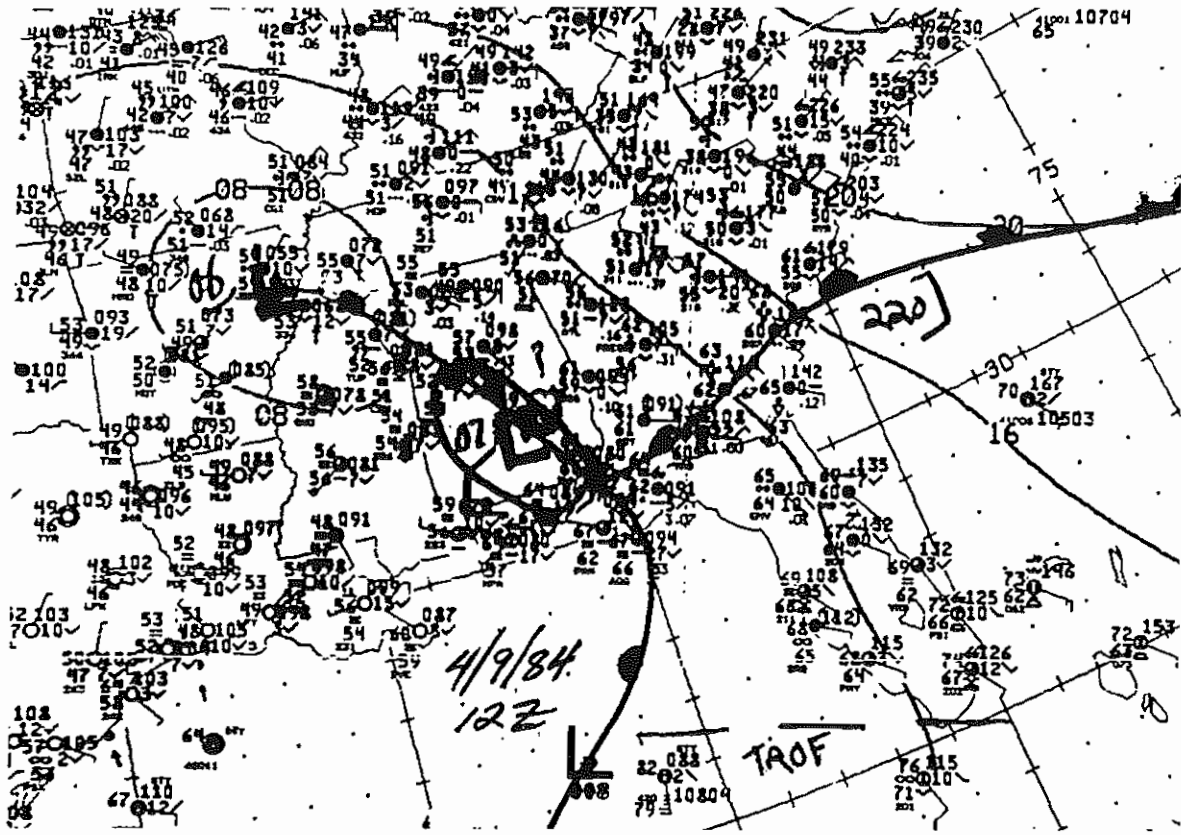
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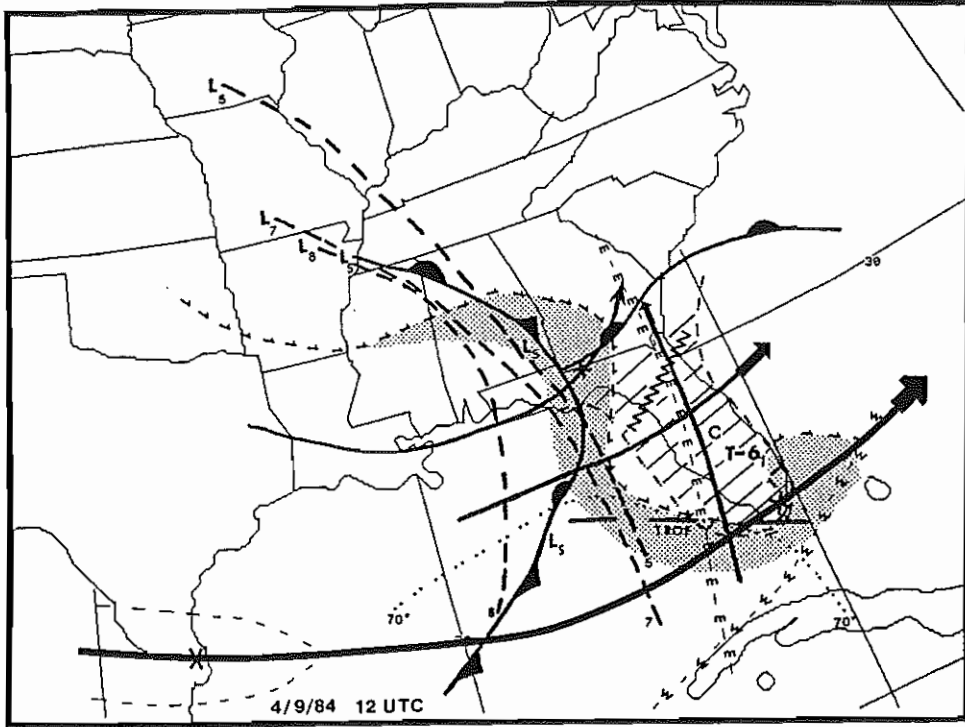
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ACCEPTED



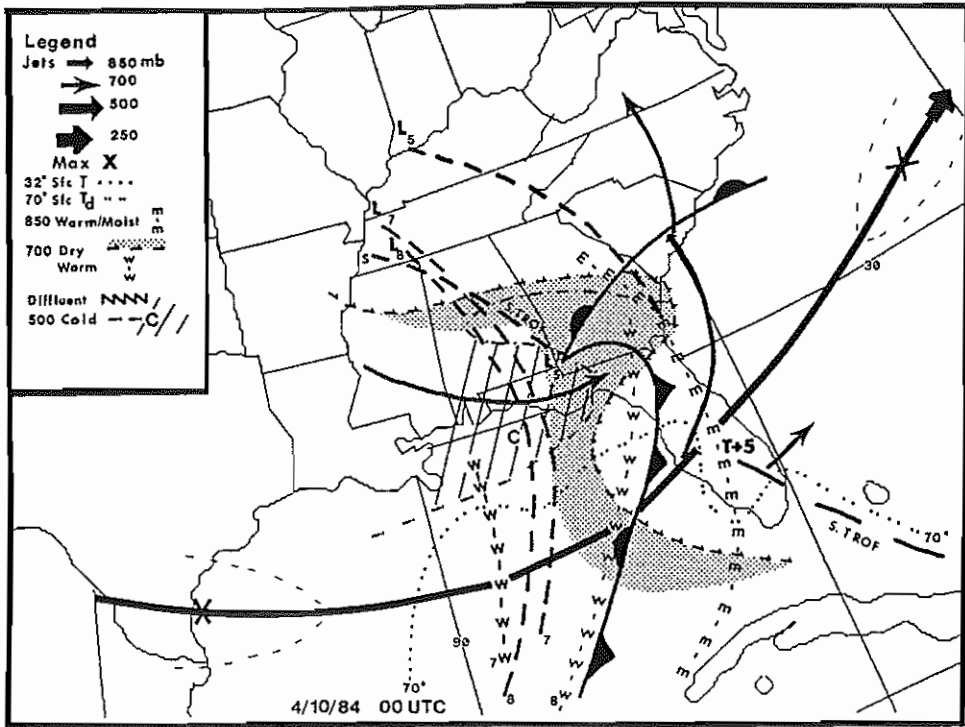


April 9, 1984

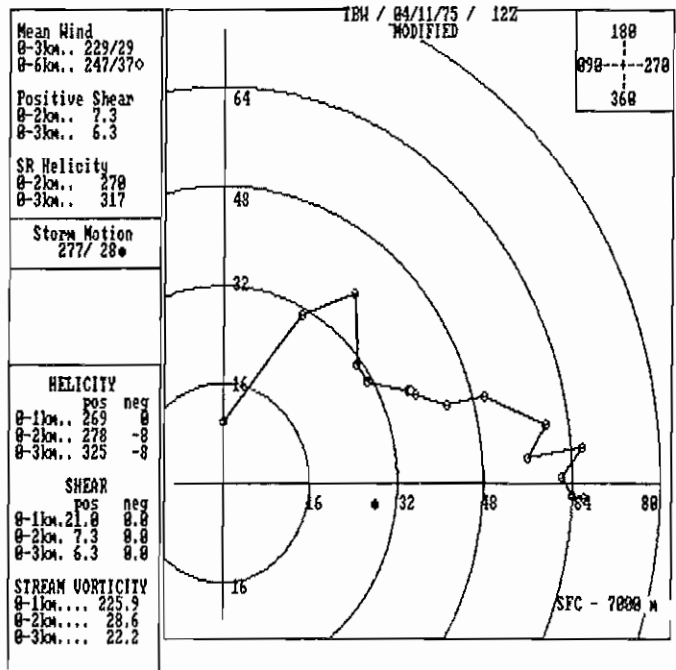
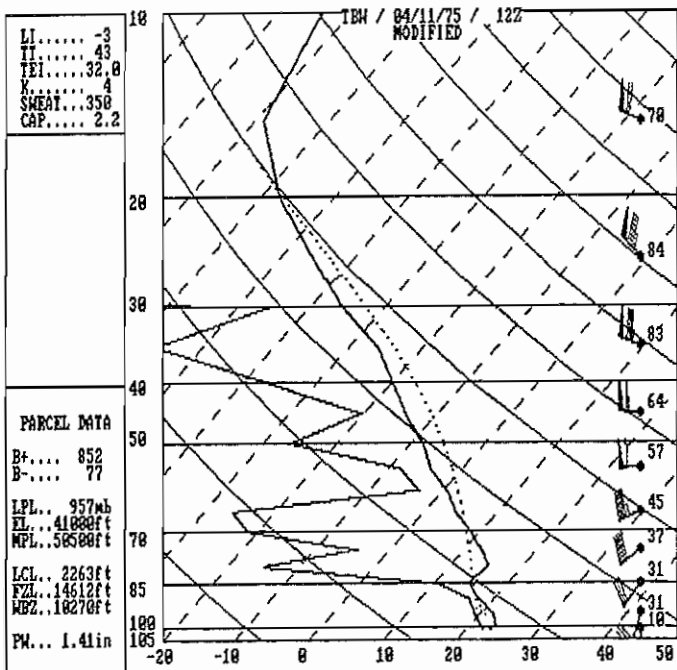
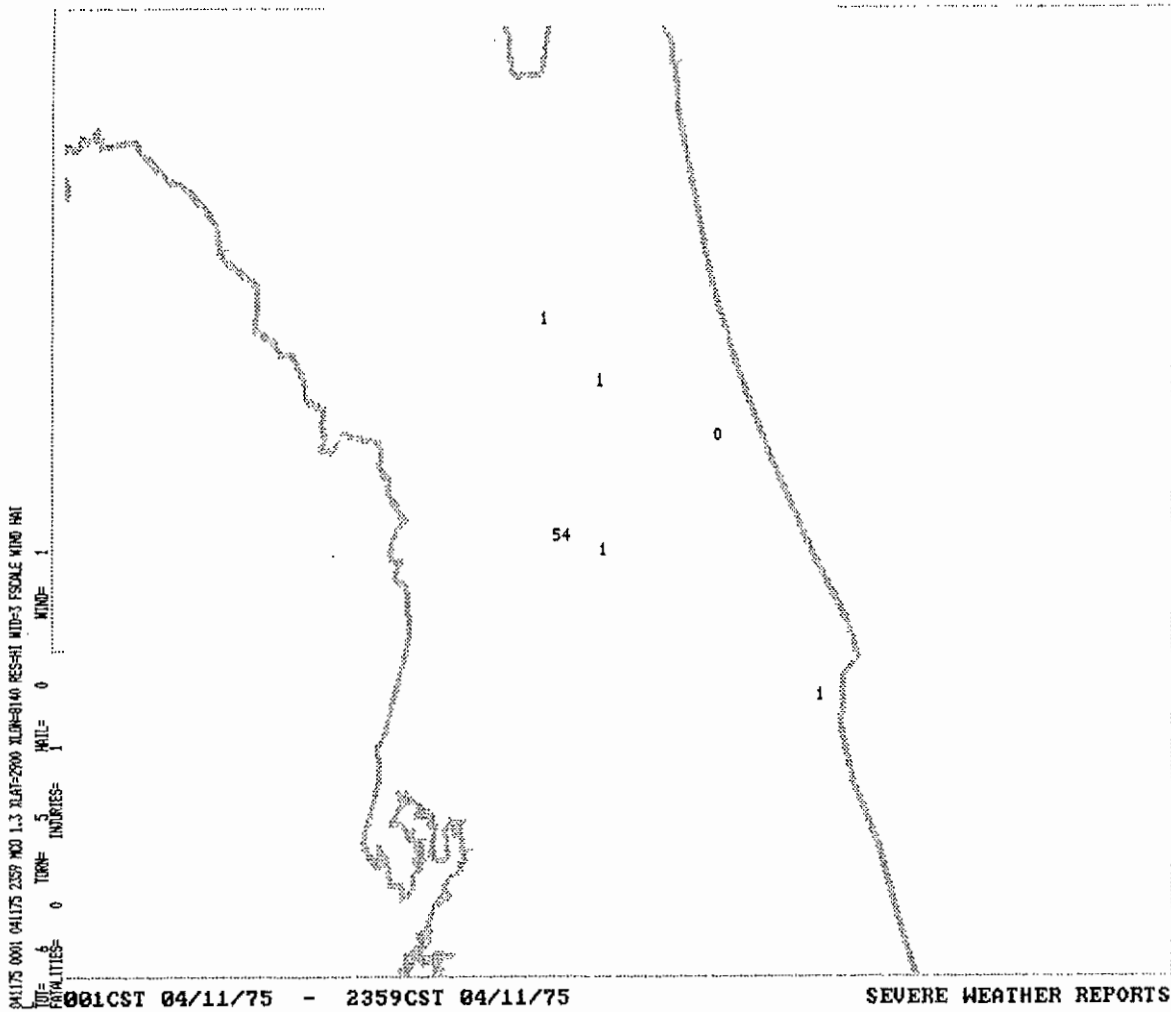


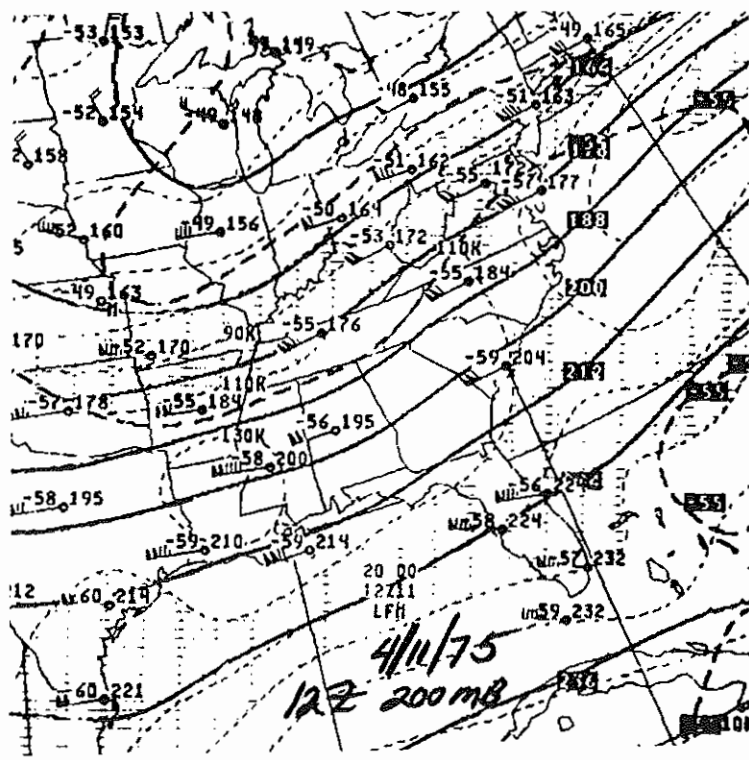
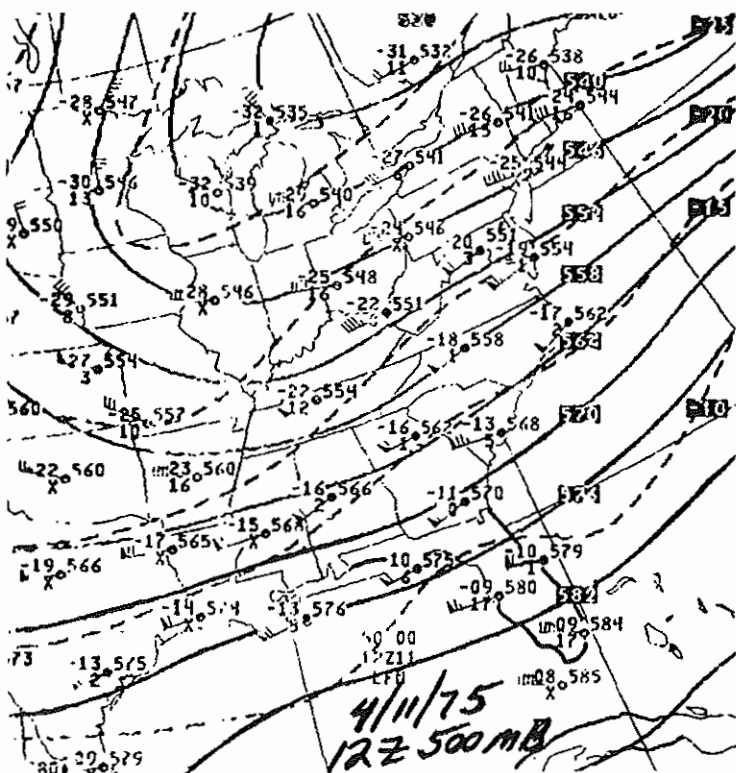
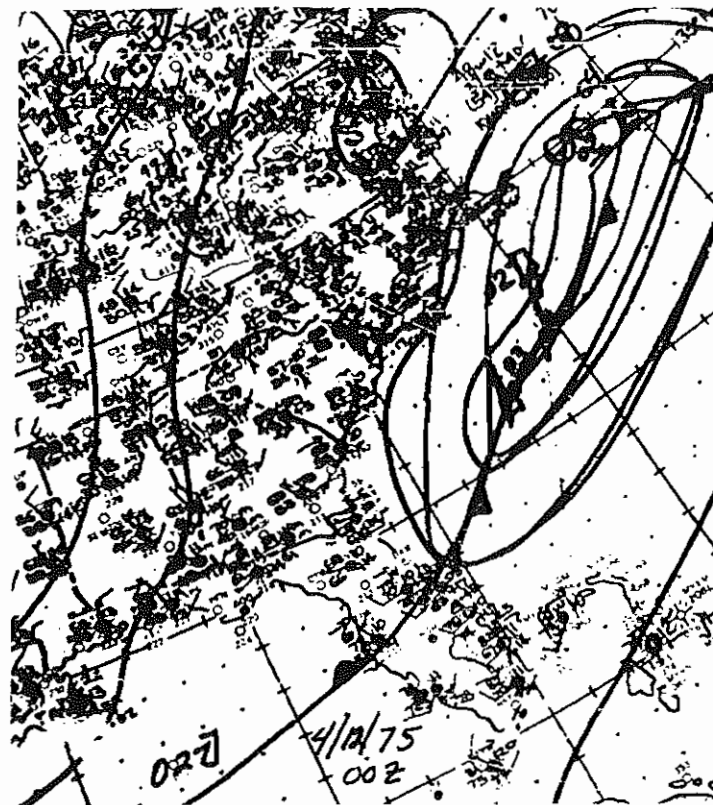
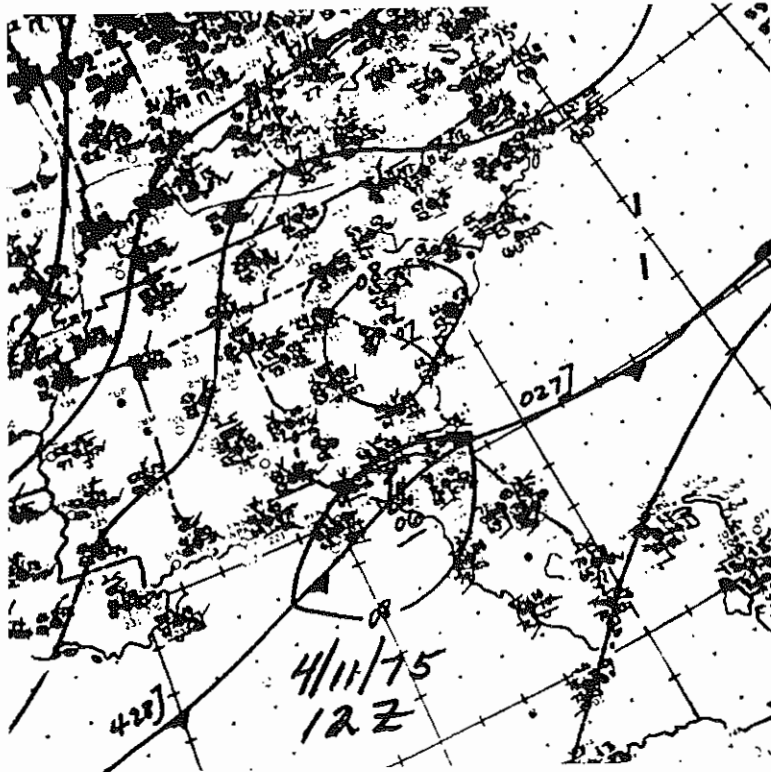


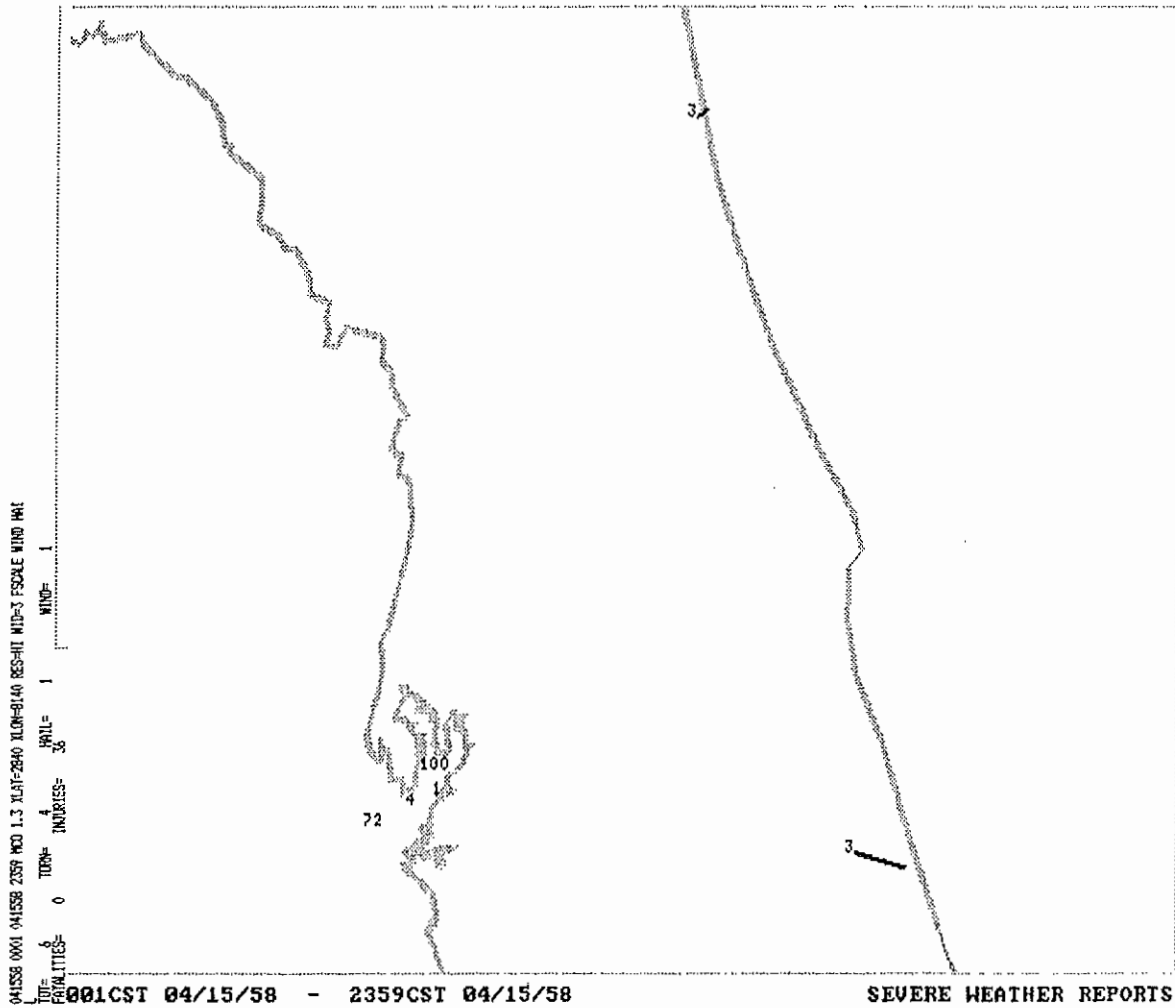
(From Hageneyer and Schmocker 1992)



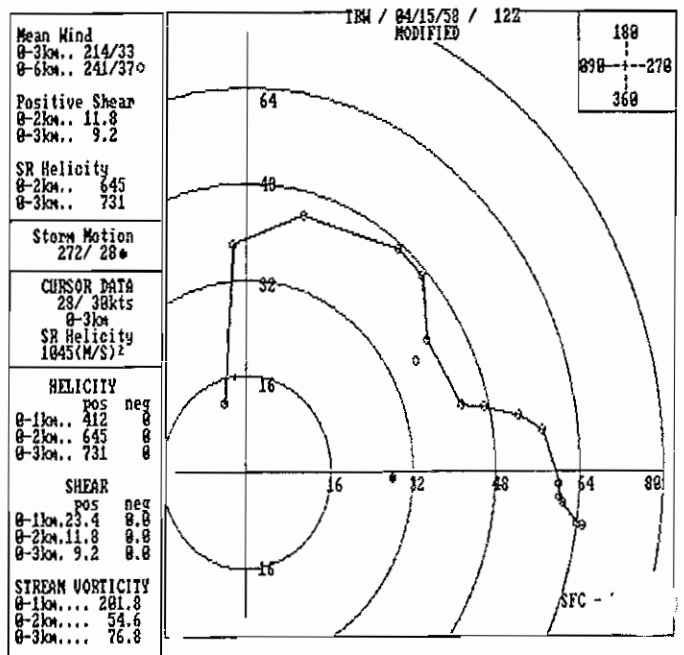
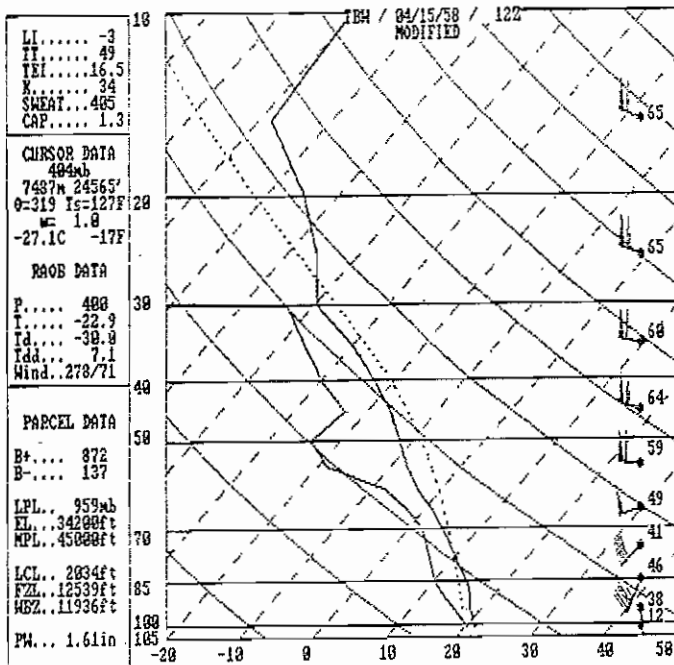
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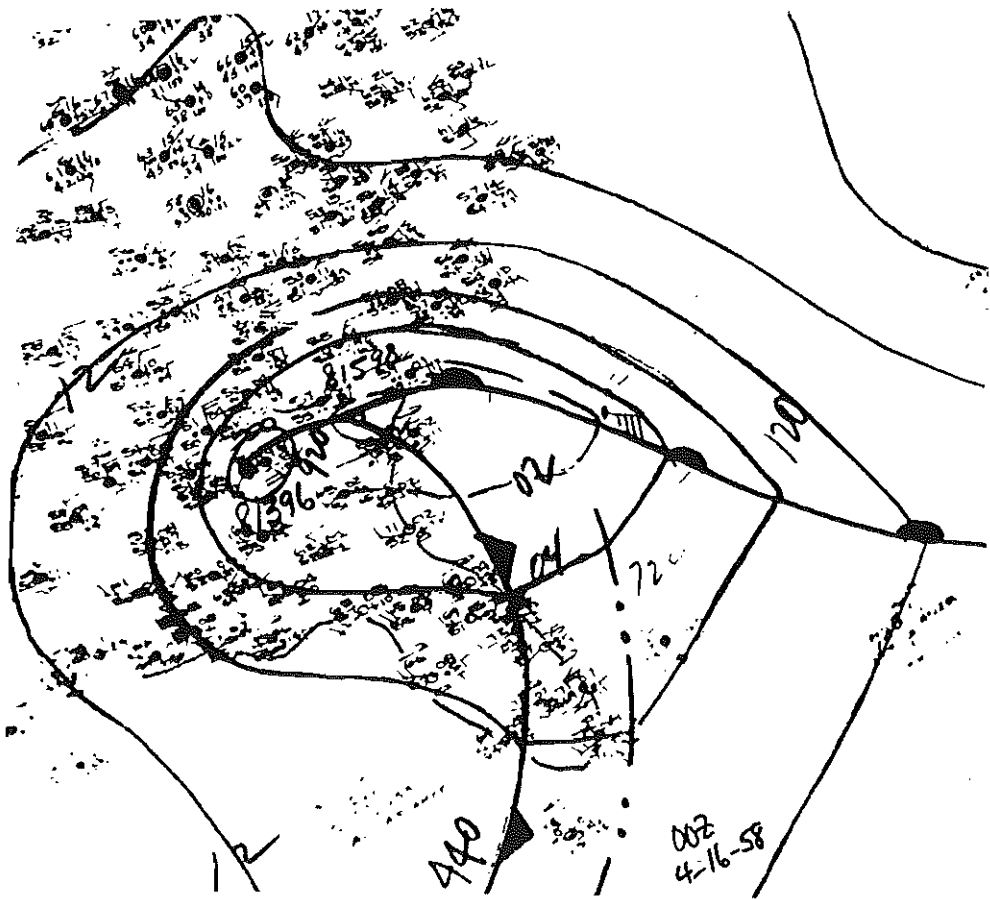
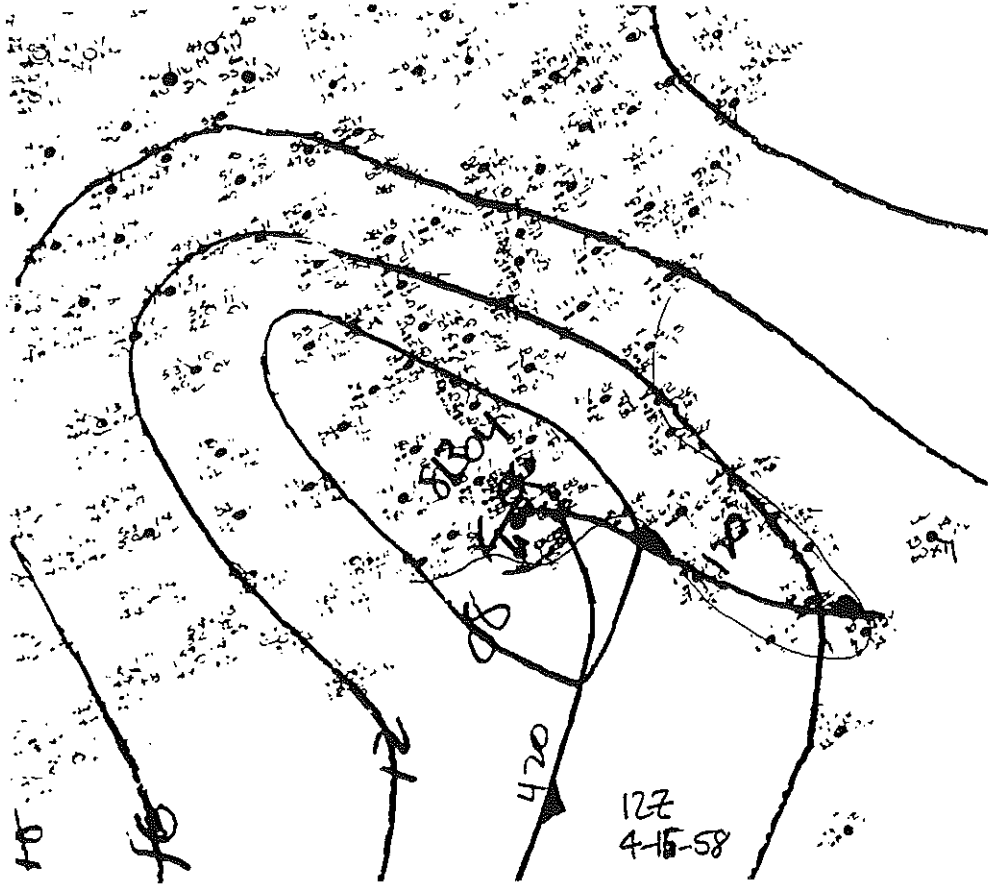
(Note: One of two outbreaks to produce F4 tornadoes)

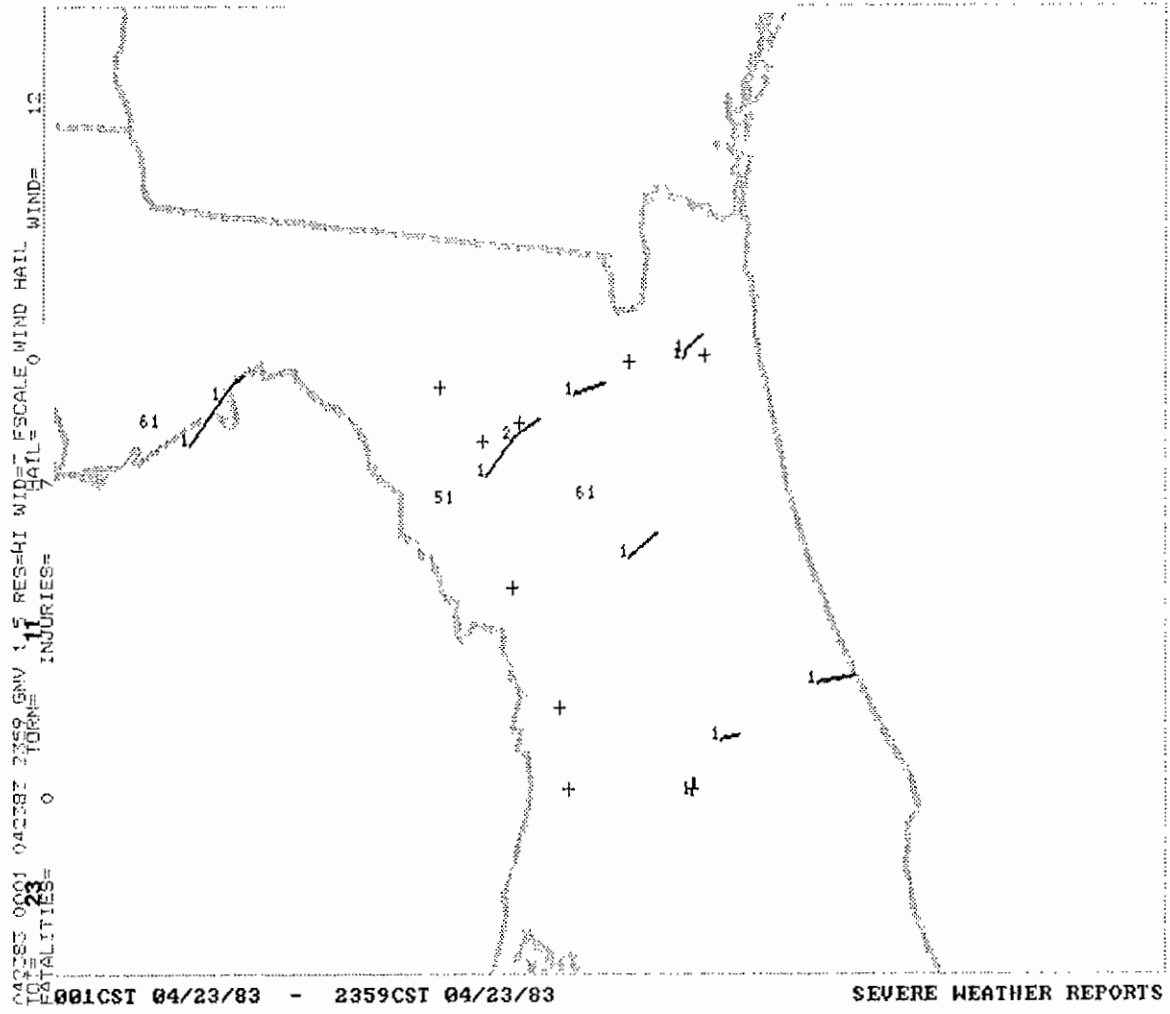




April 15, 1958

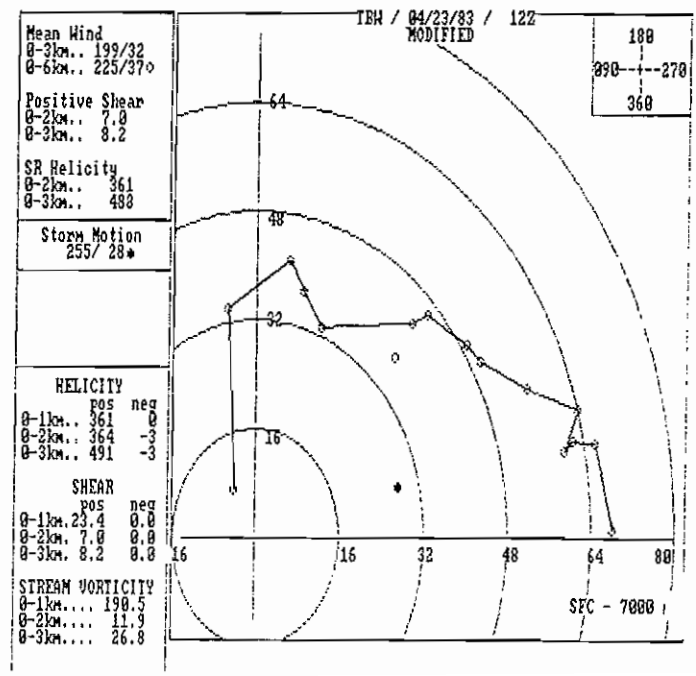
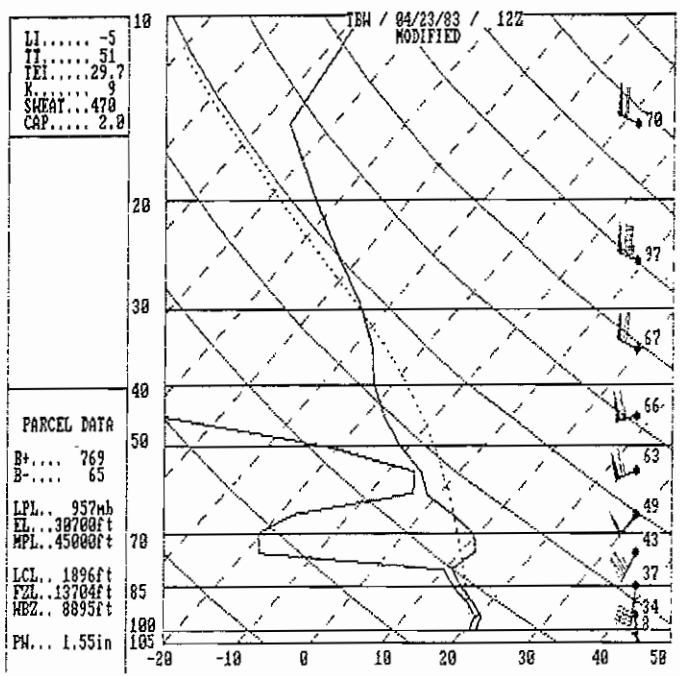
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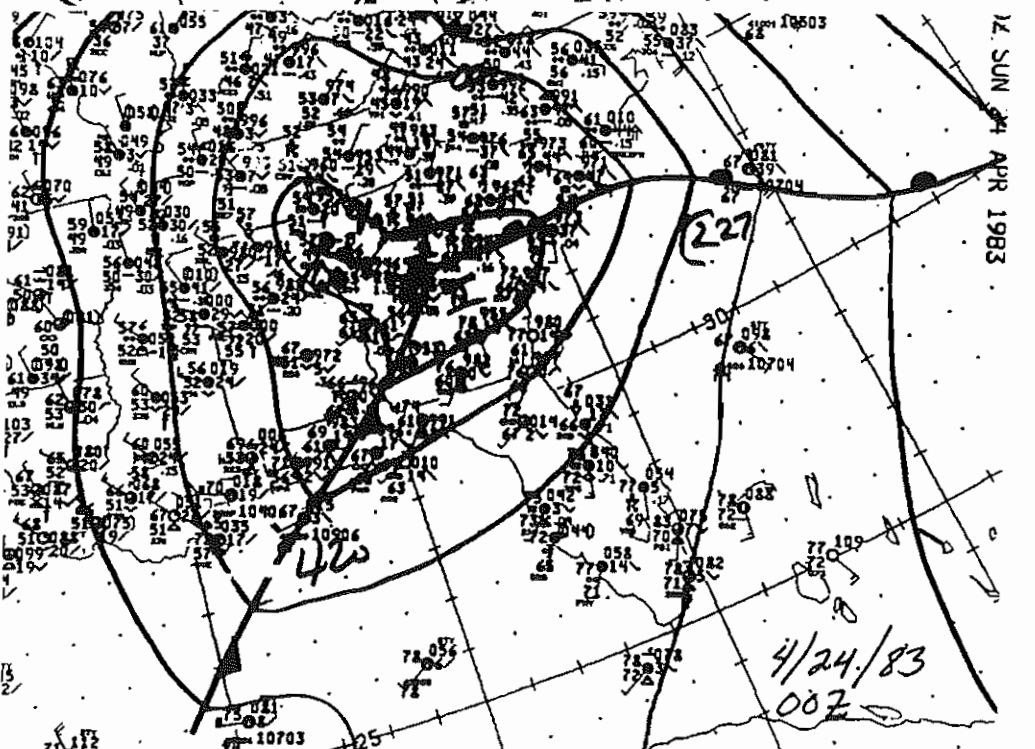
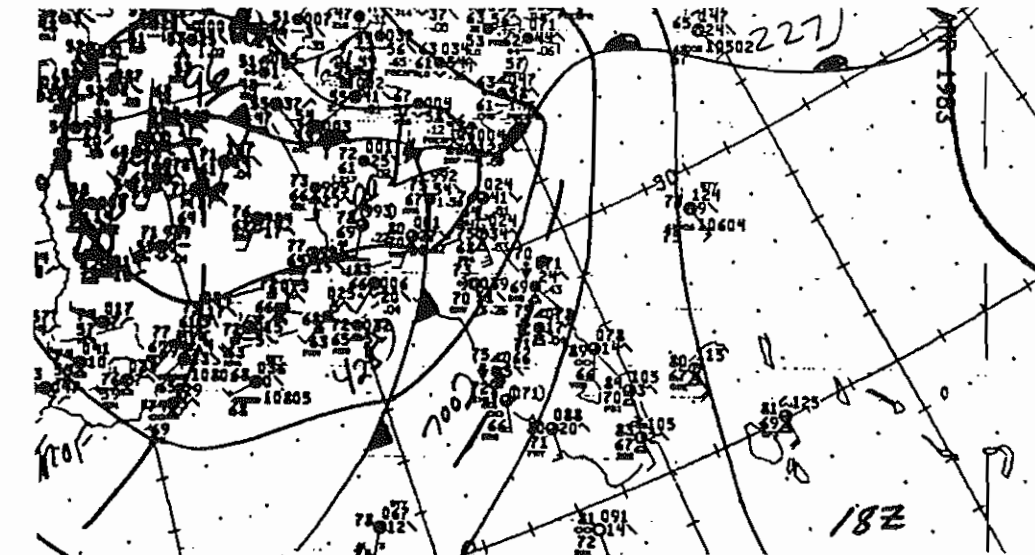
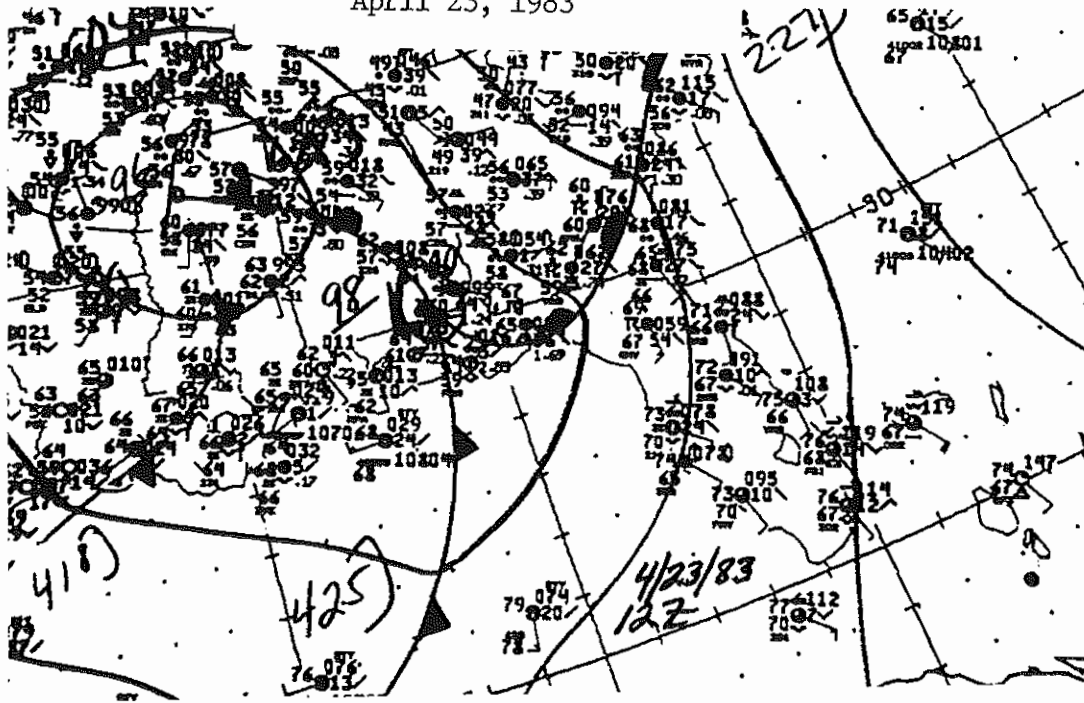


001CST 04/23/83 - 2359CST 04/23/83

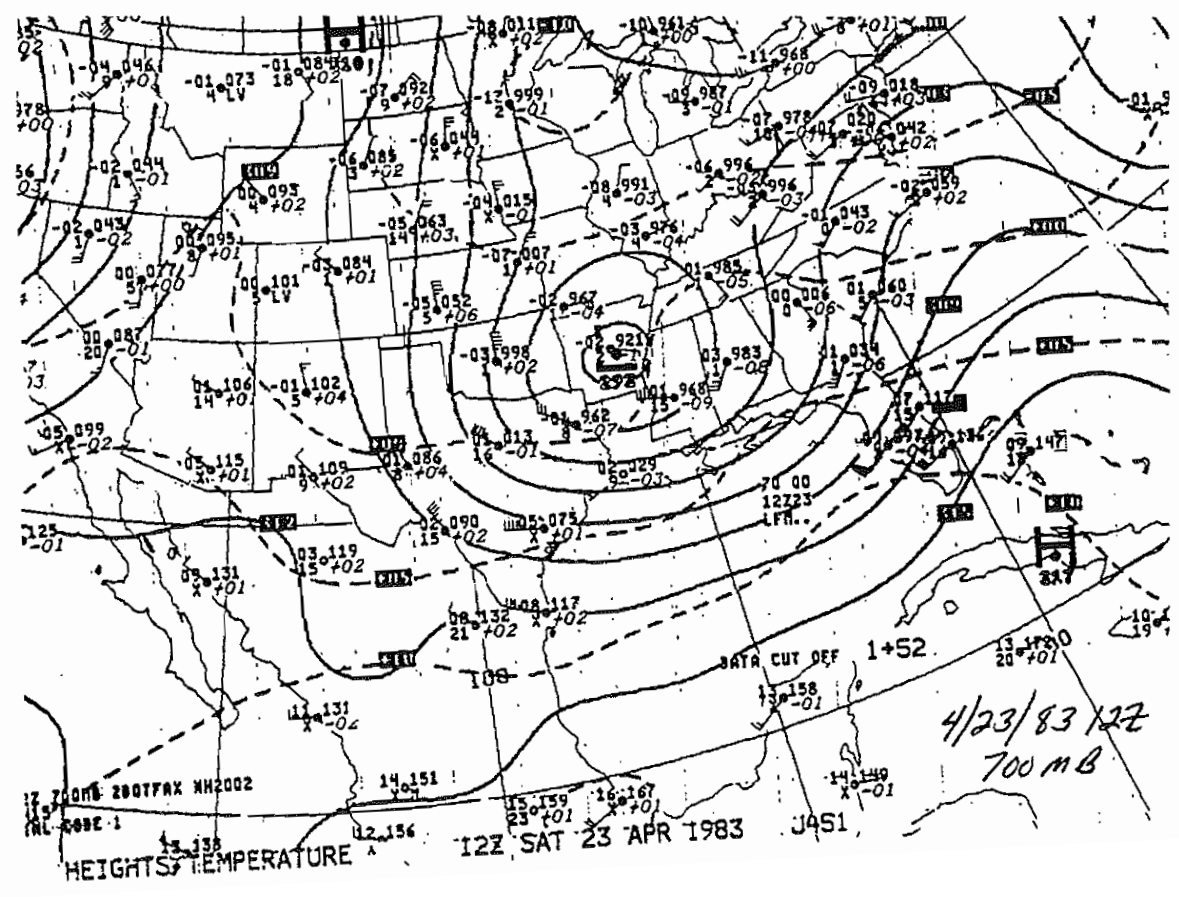
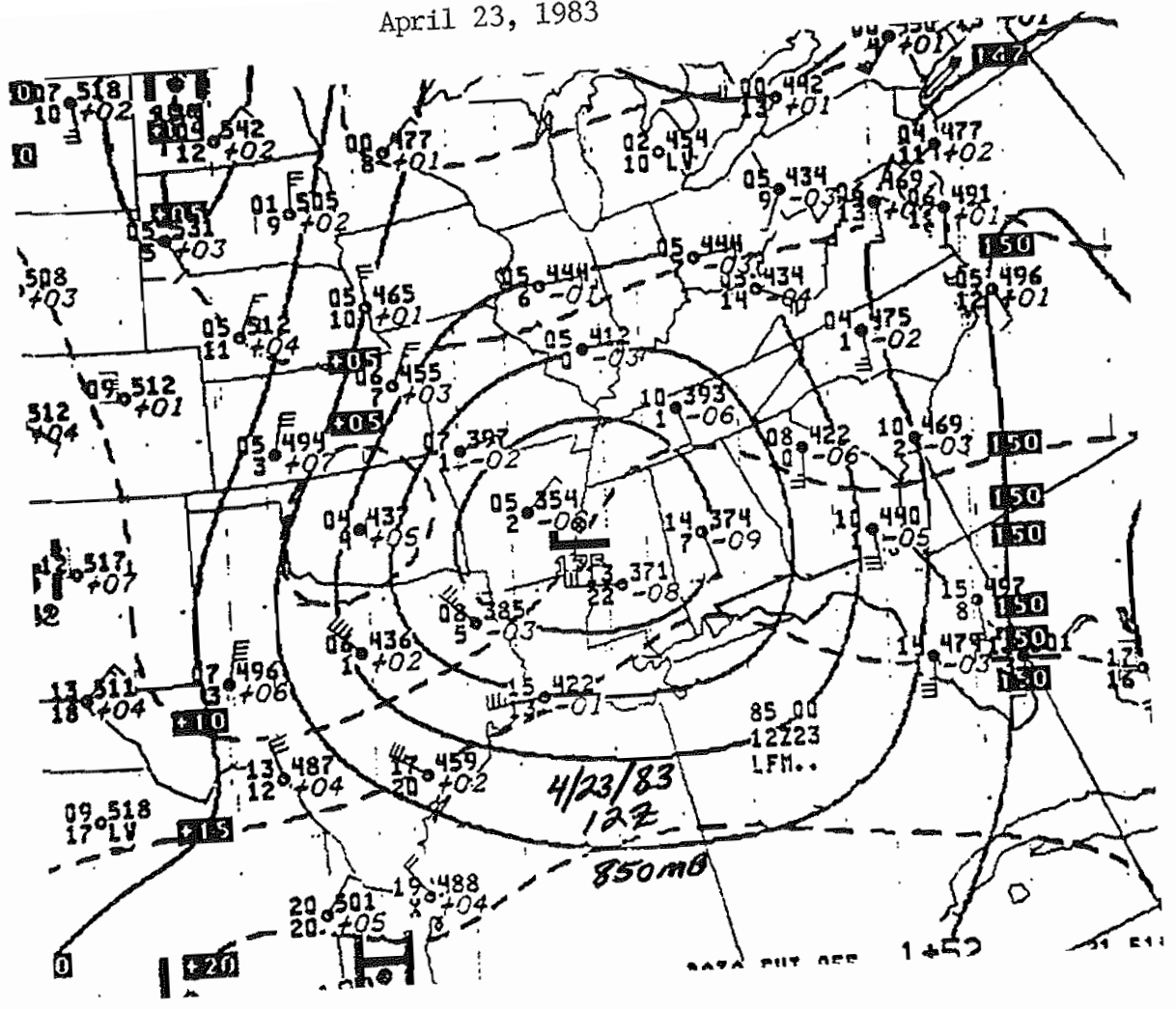
SEVERE WEATHER REPORTS



April 23, 1983



April 23, 1983

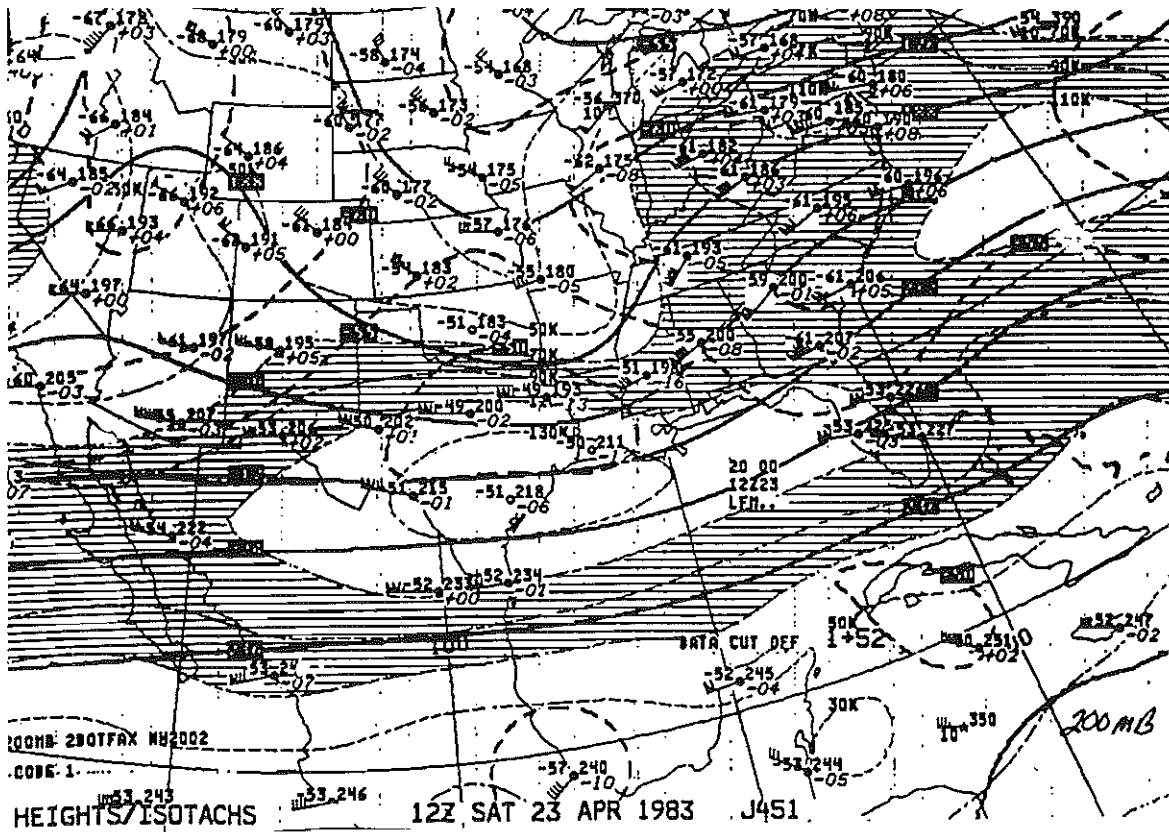
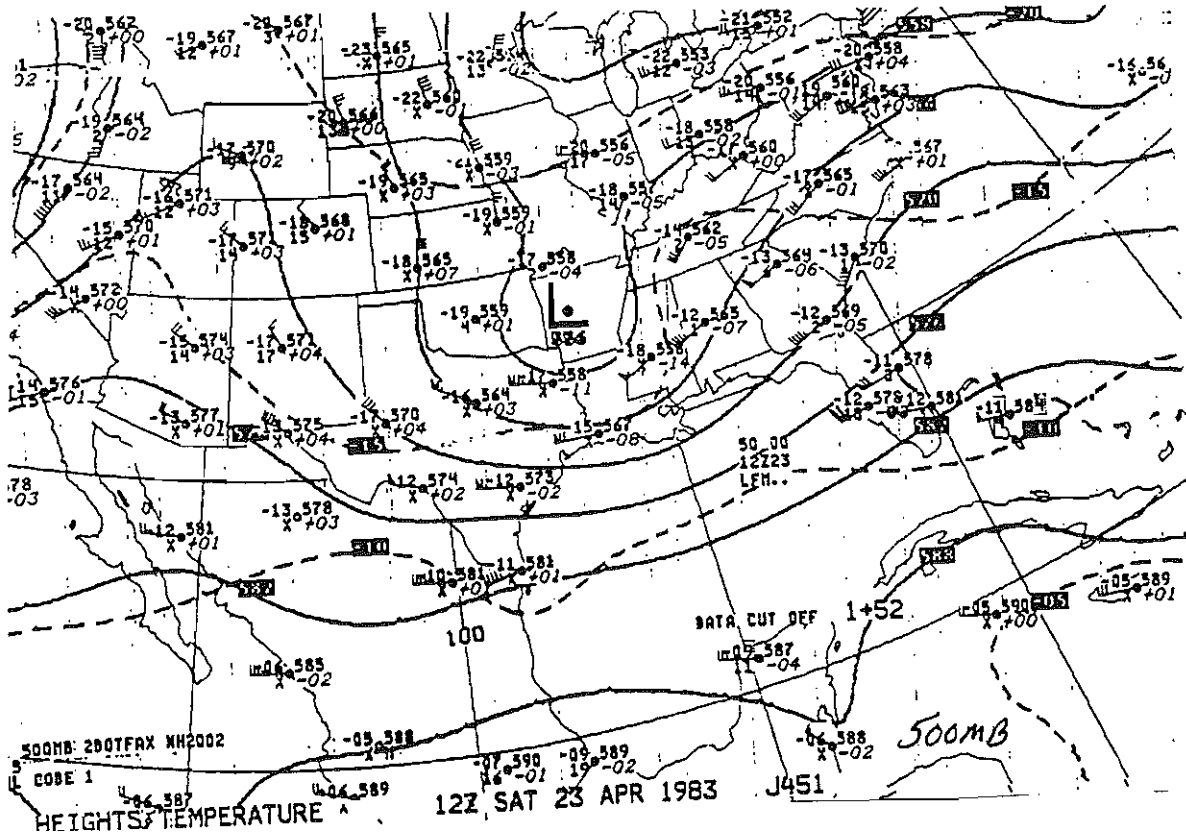


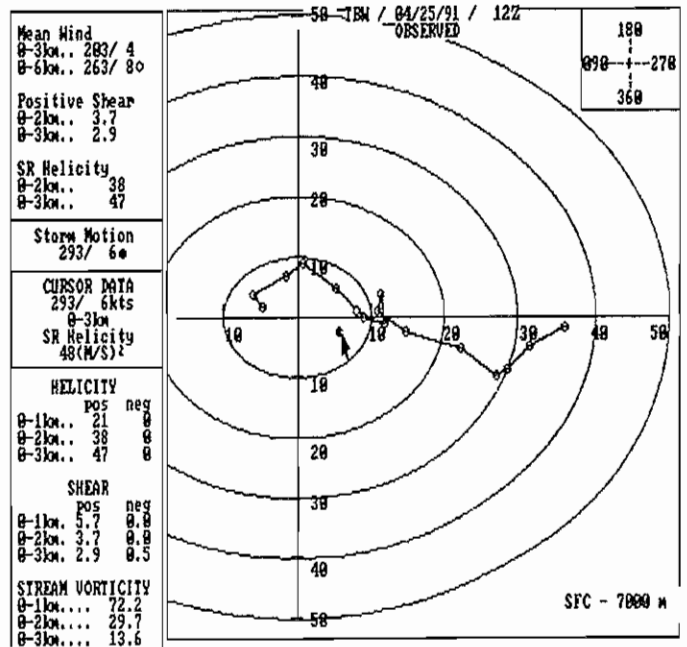
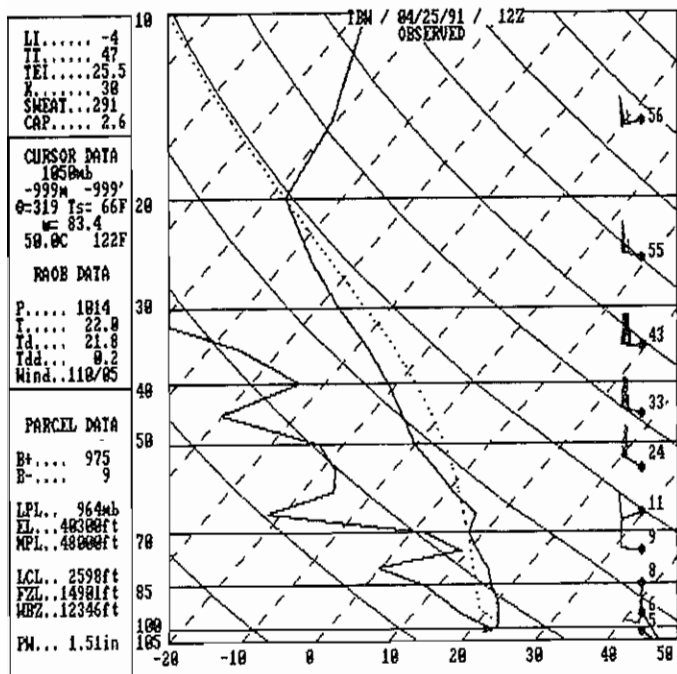
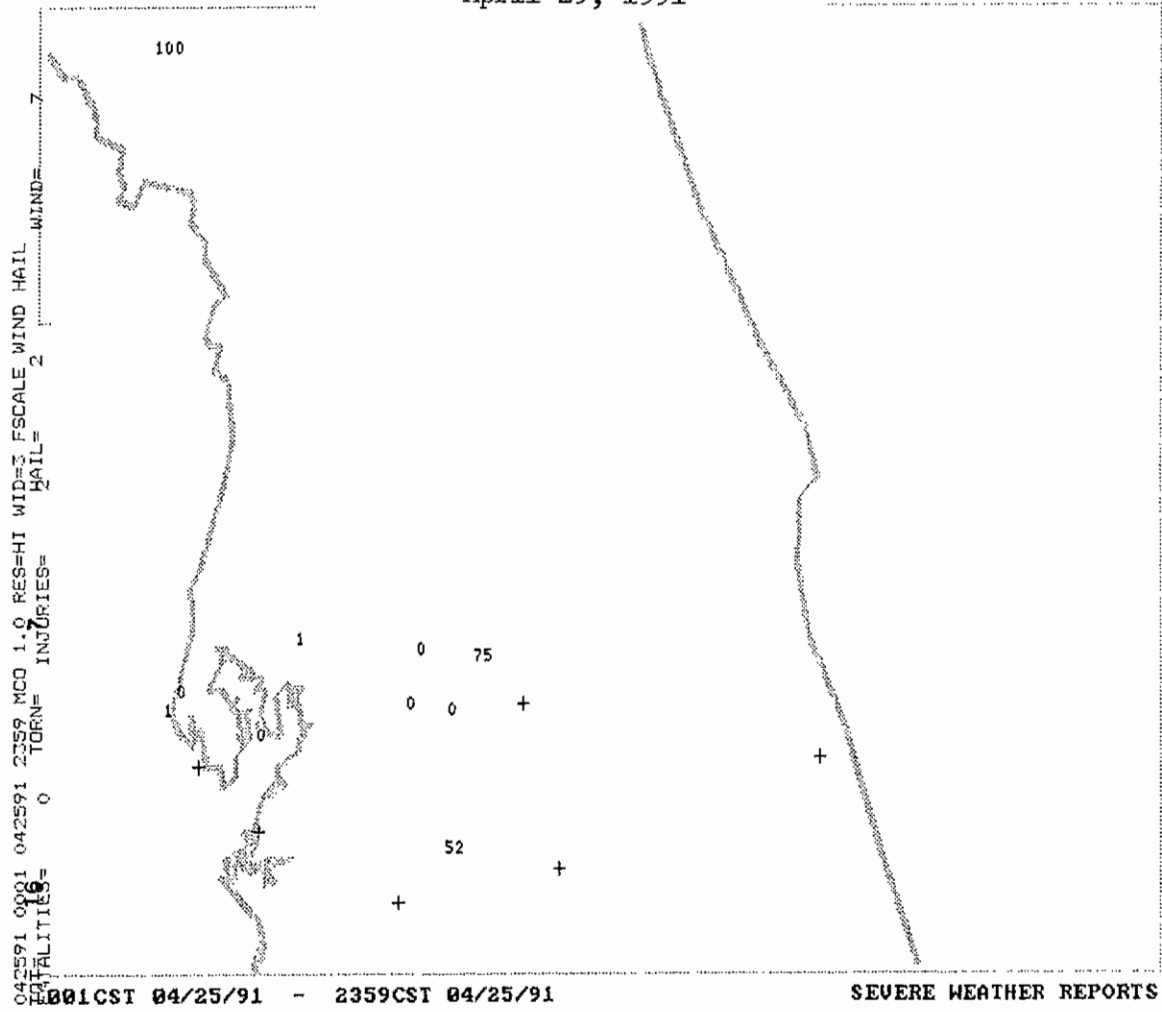
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HEIGHTS/TEMPERATURE

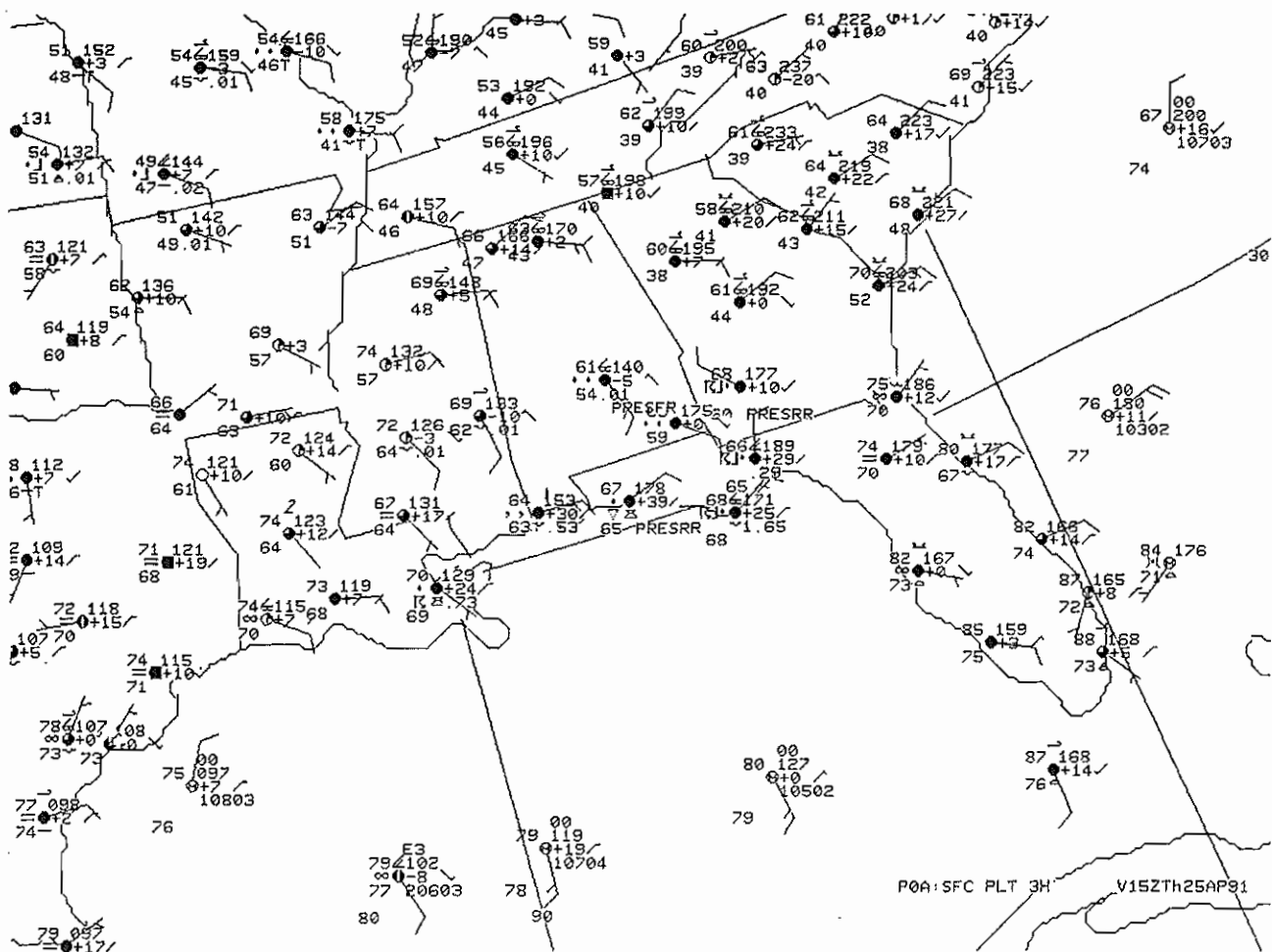
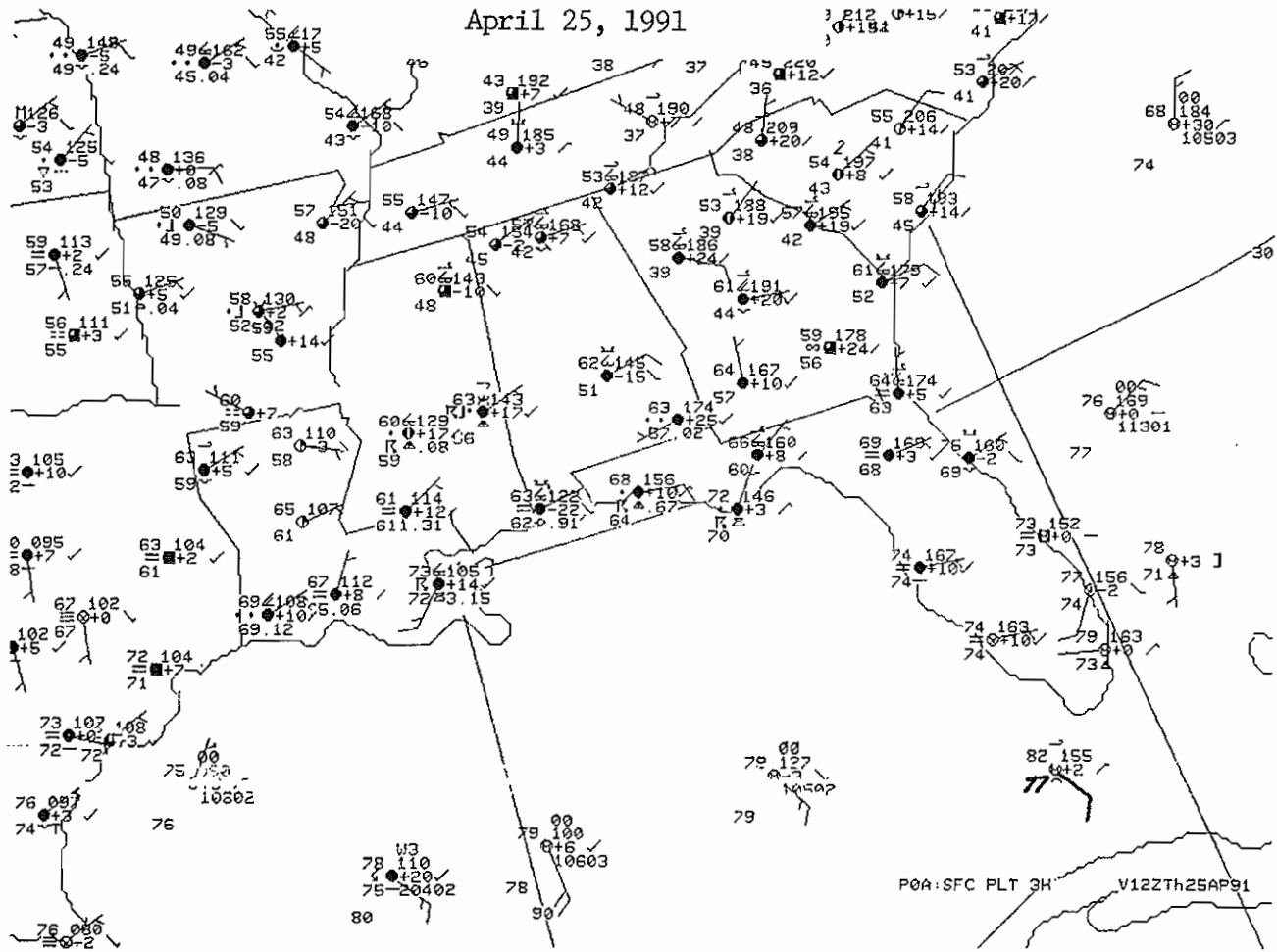
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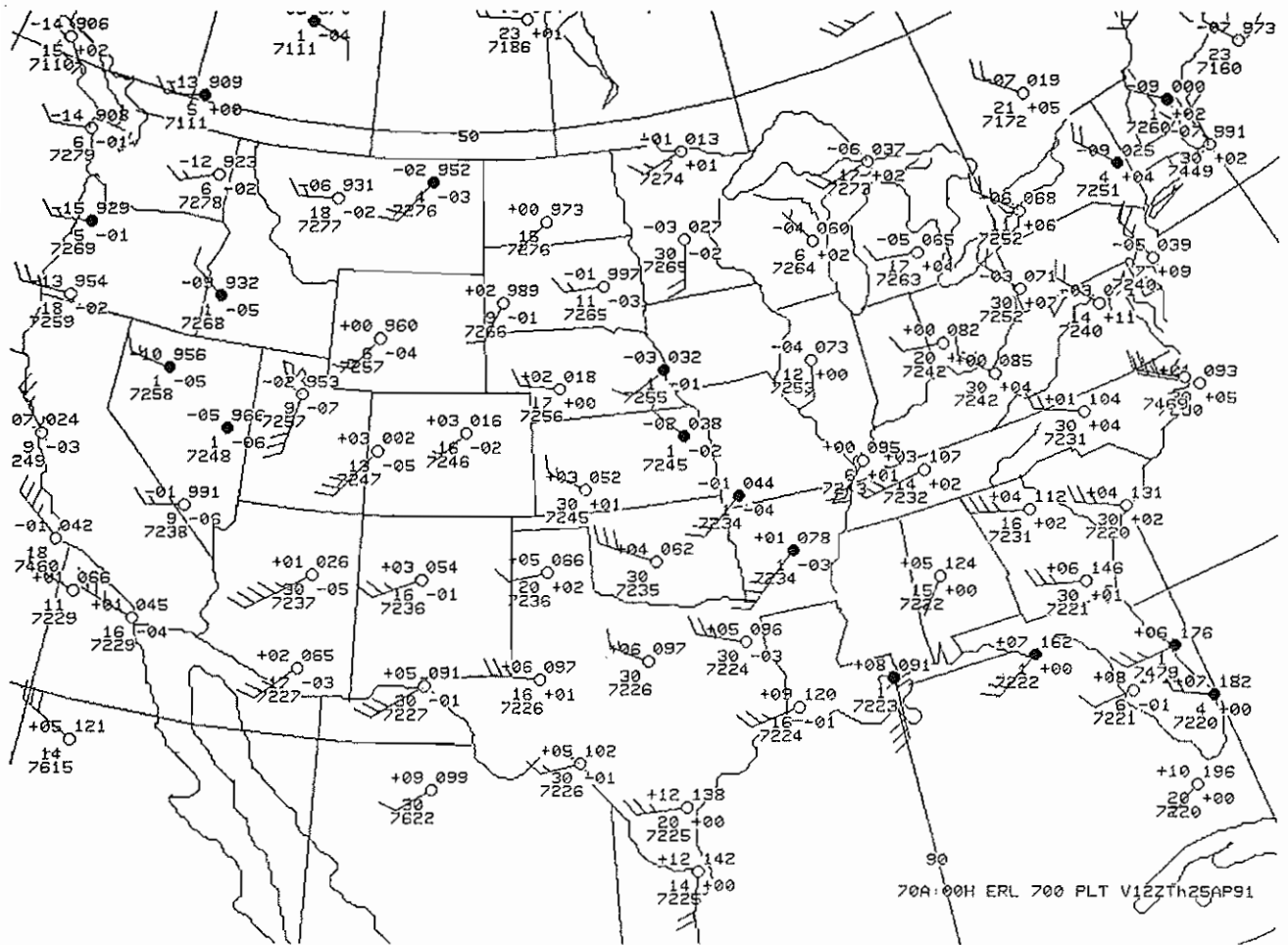
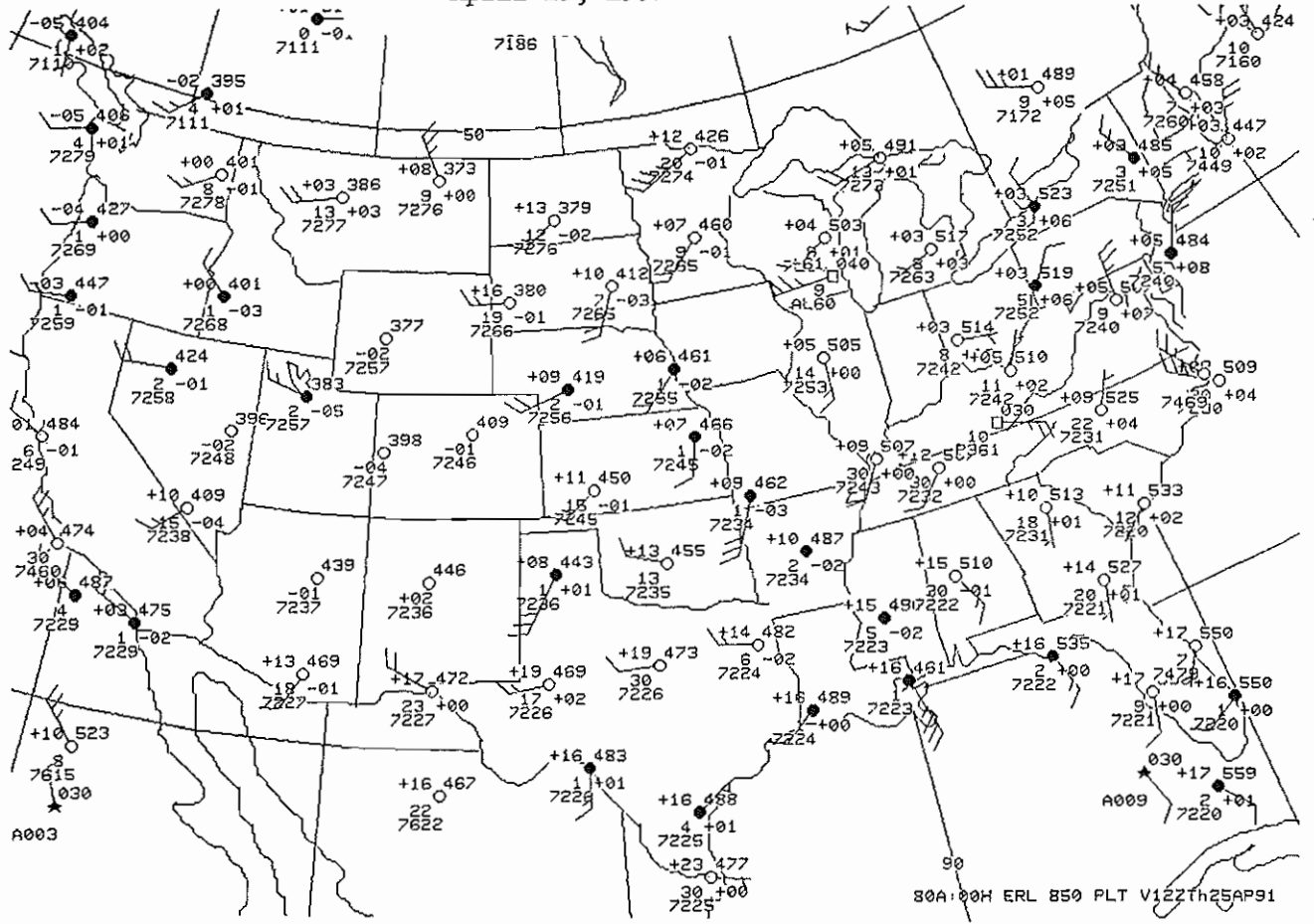




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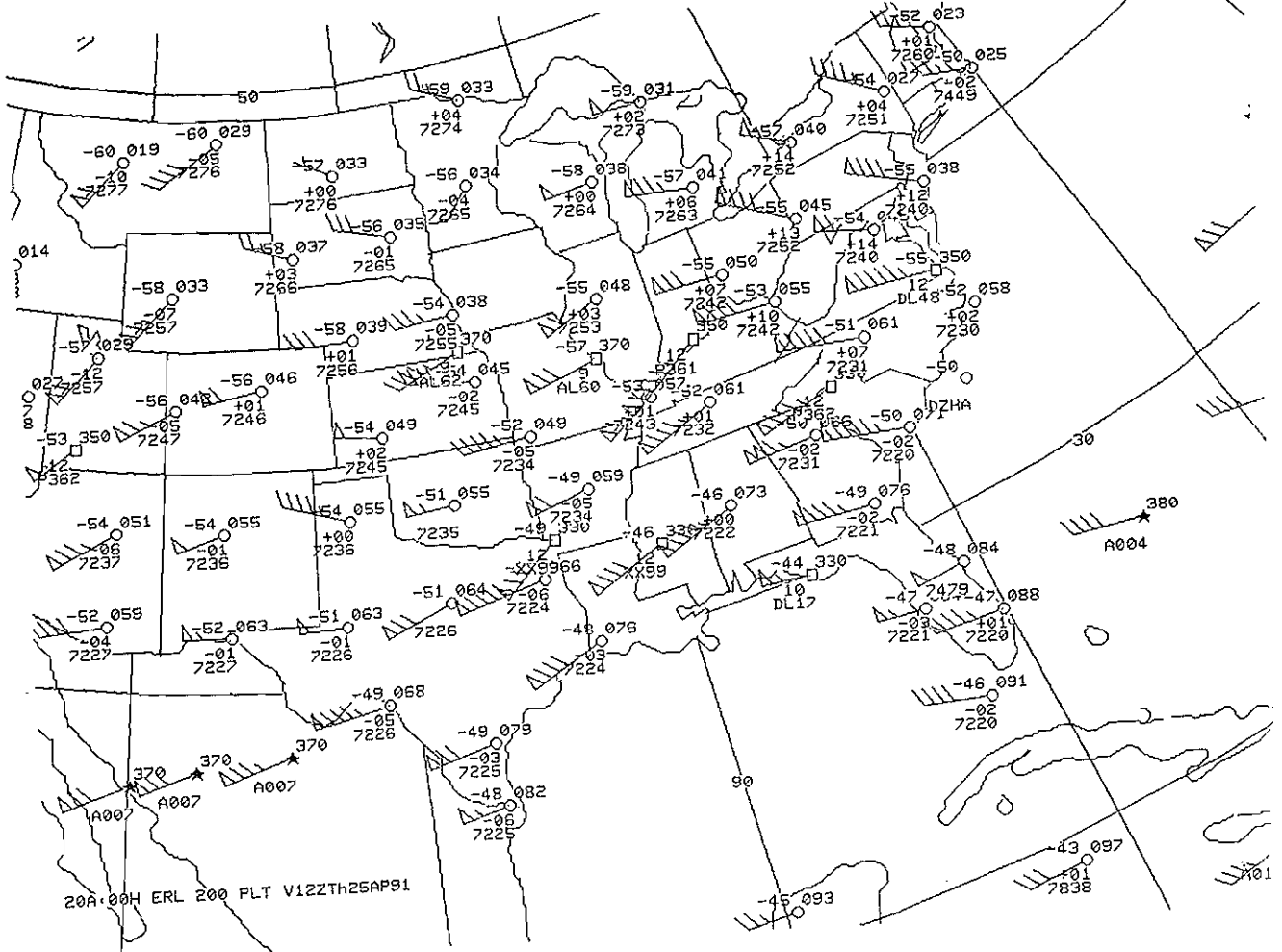
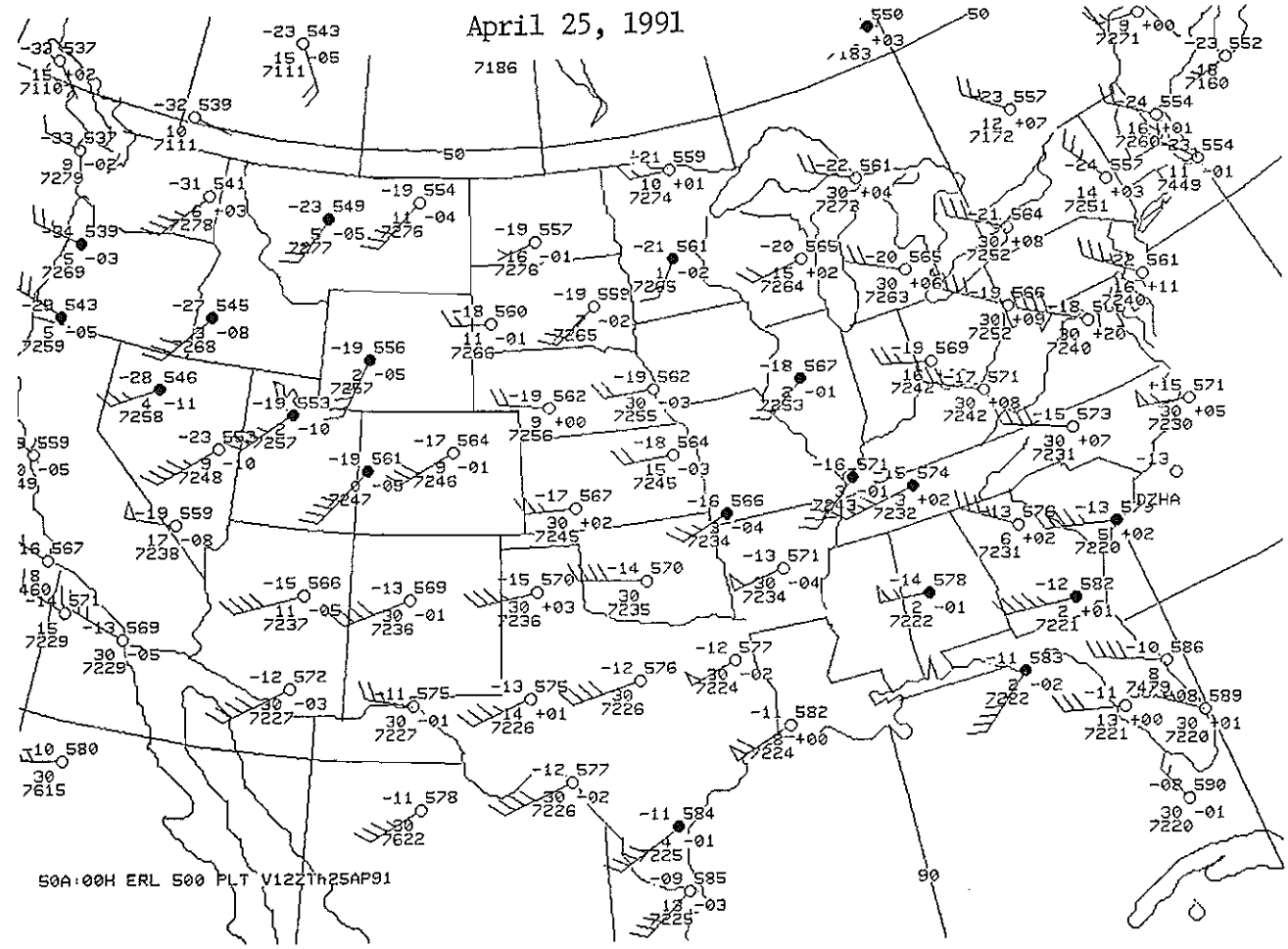


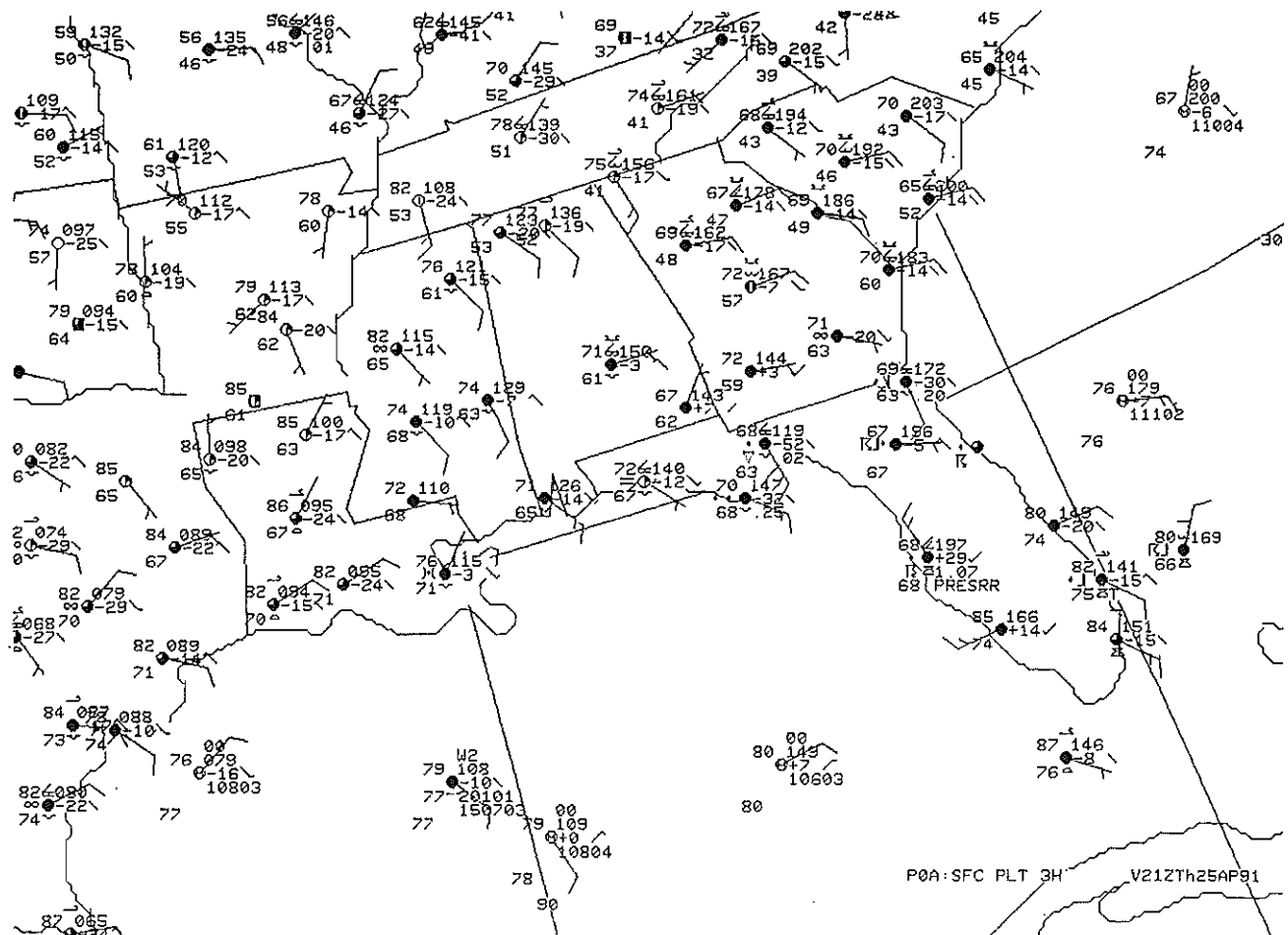
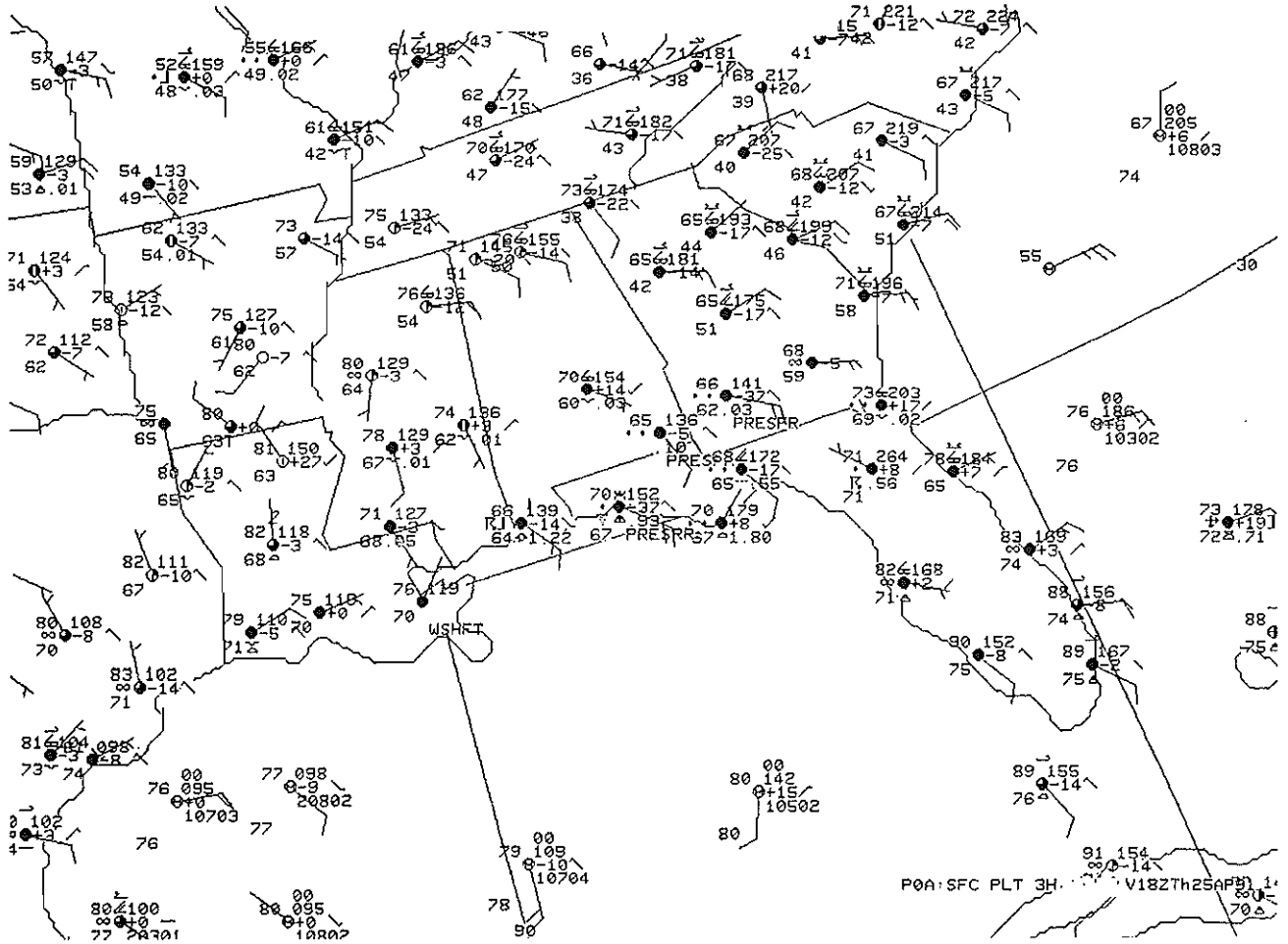
April 25, 1991

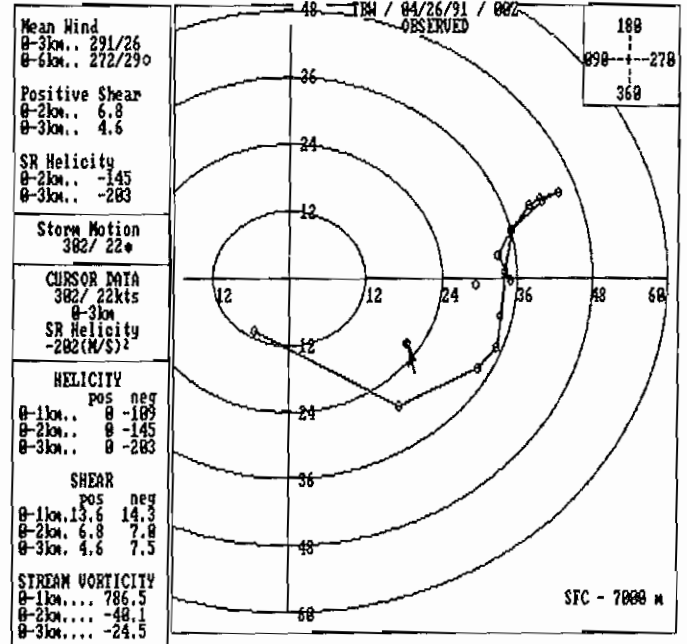
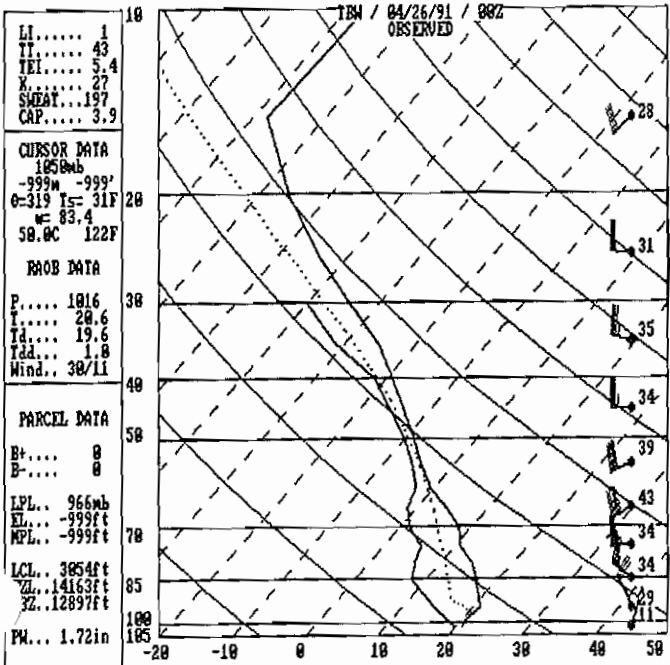
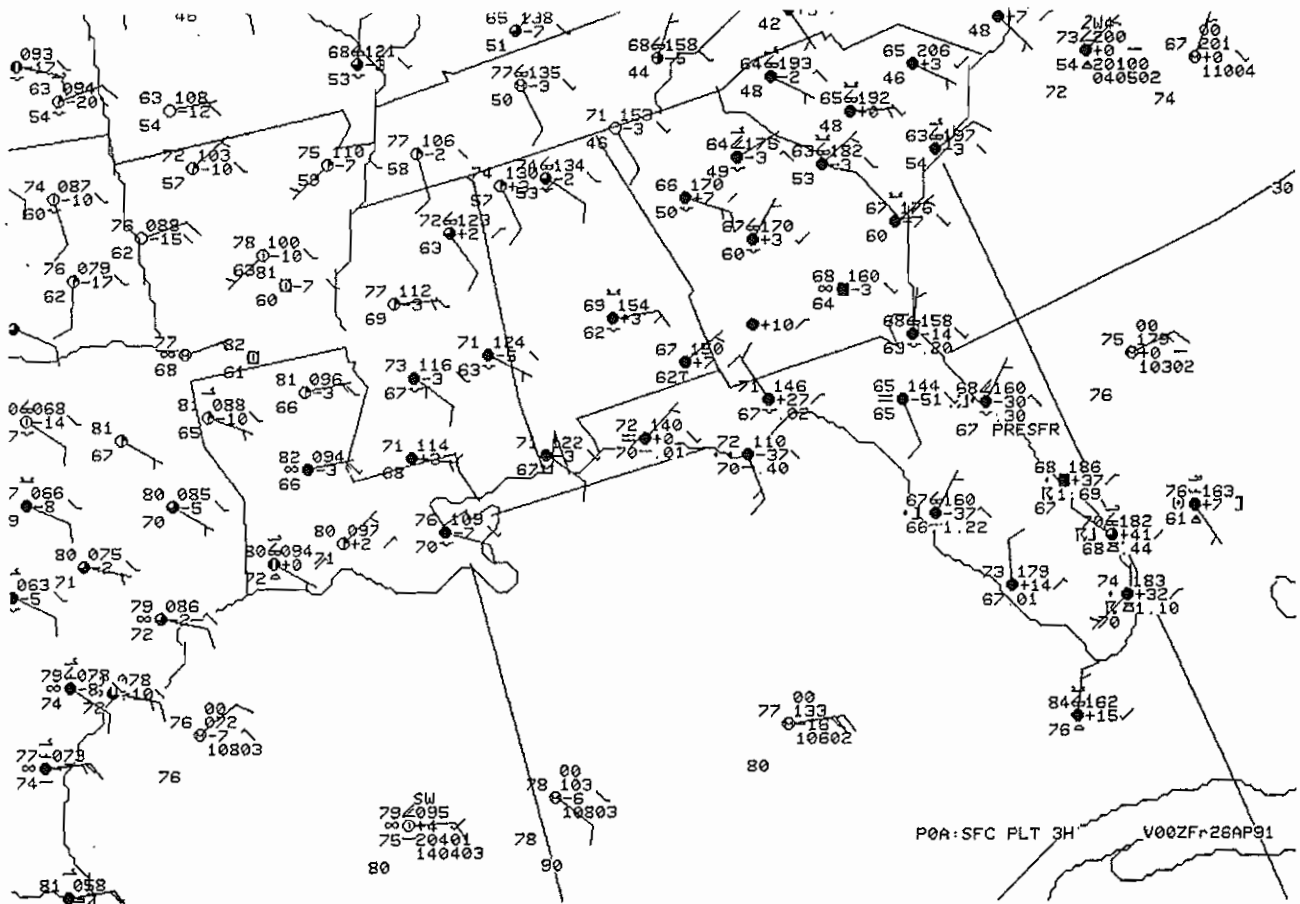




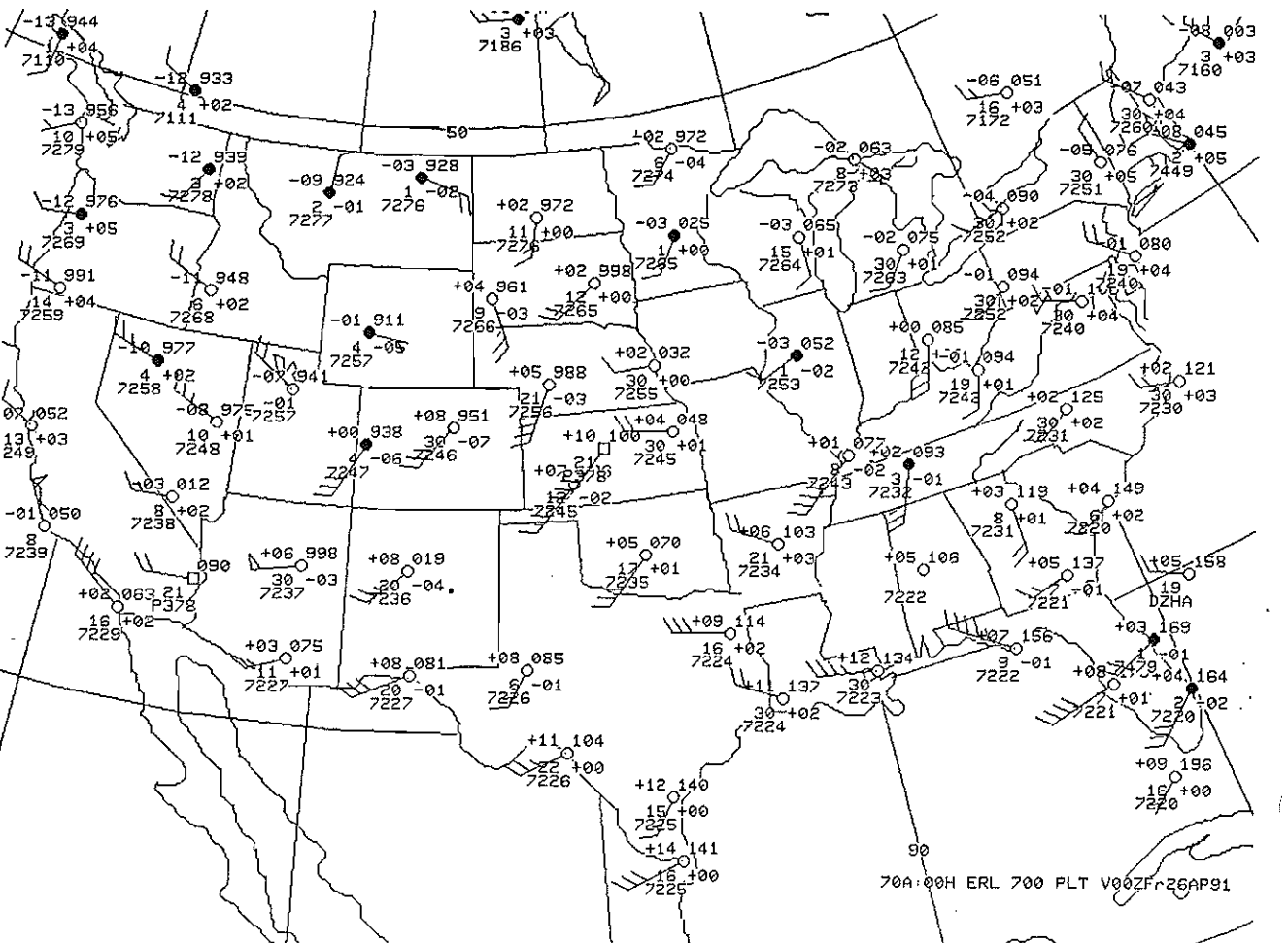
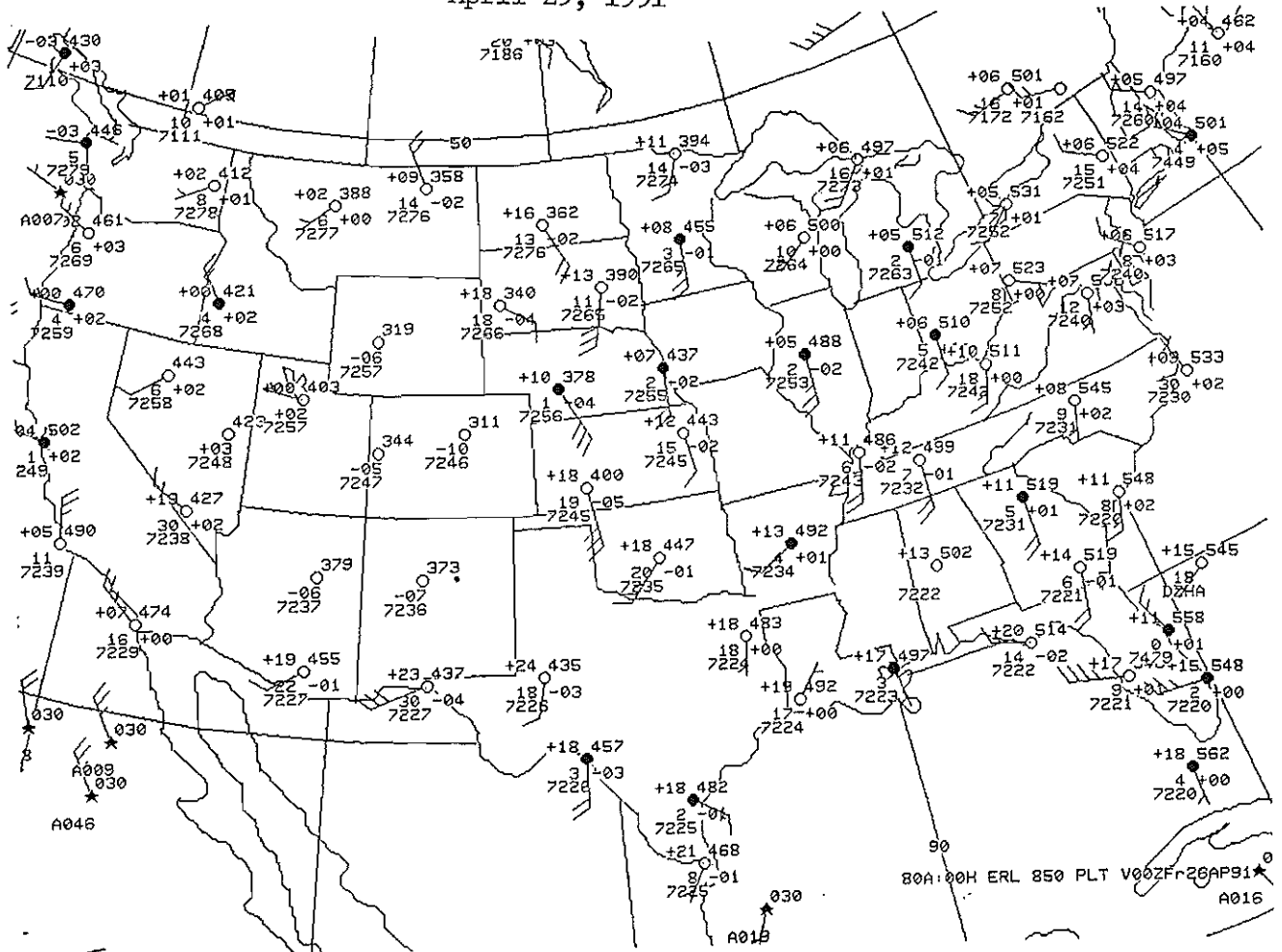
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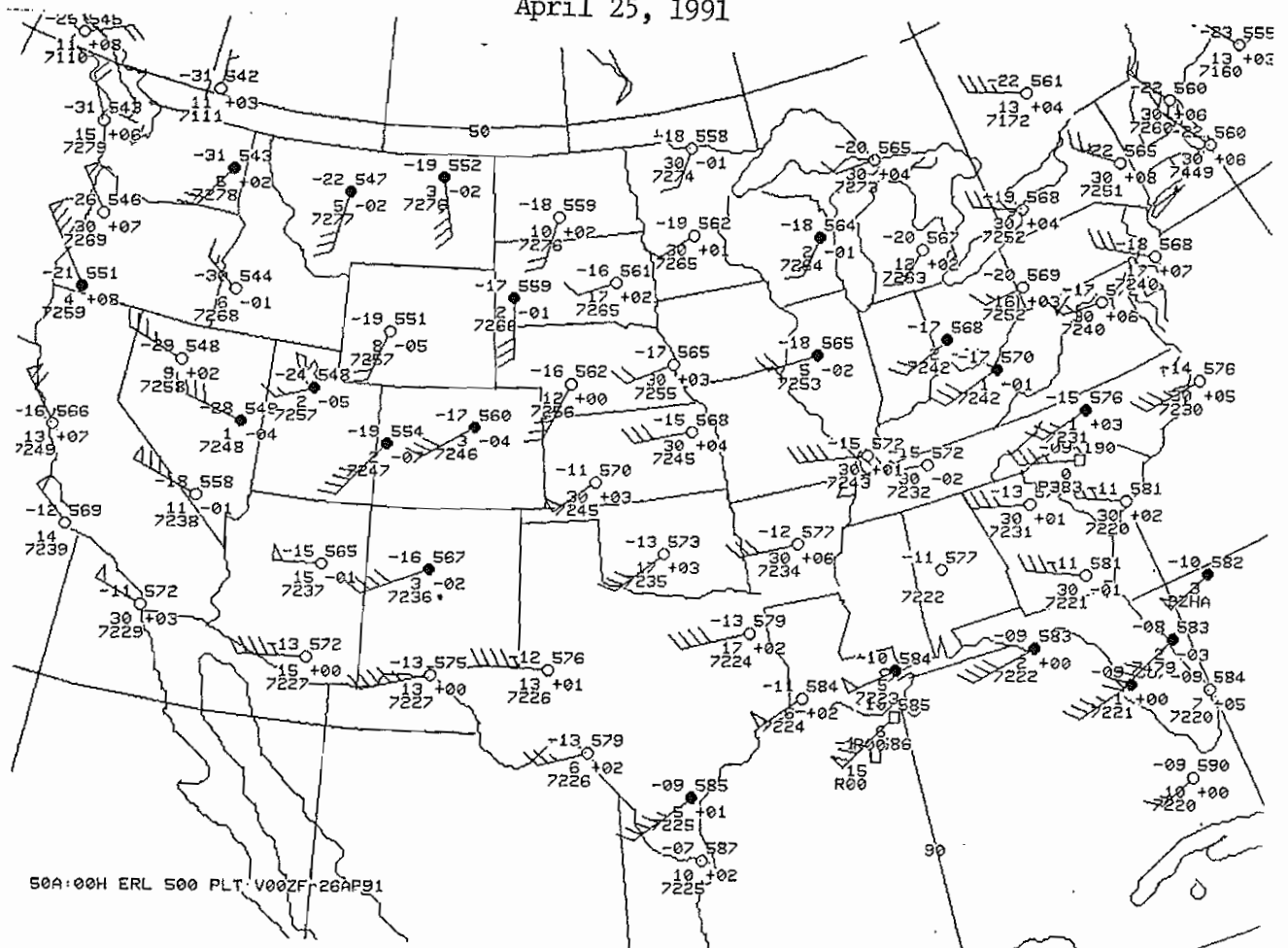




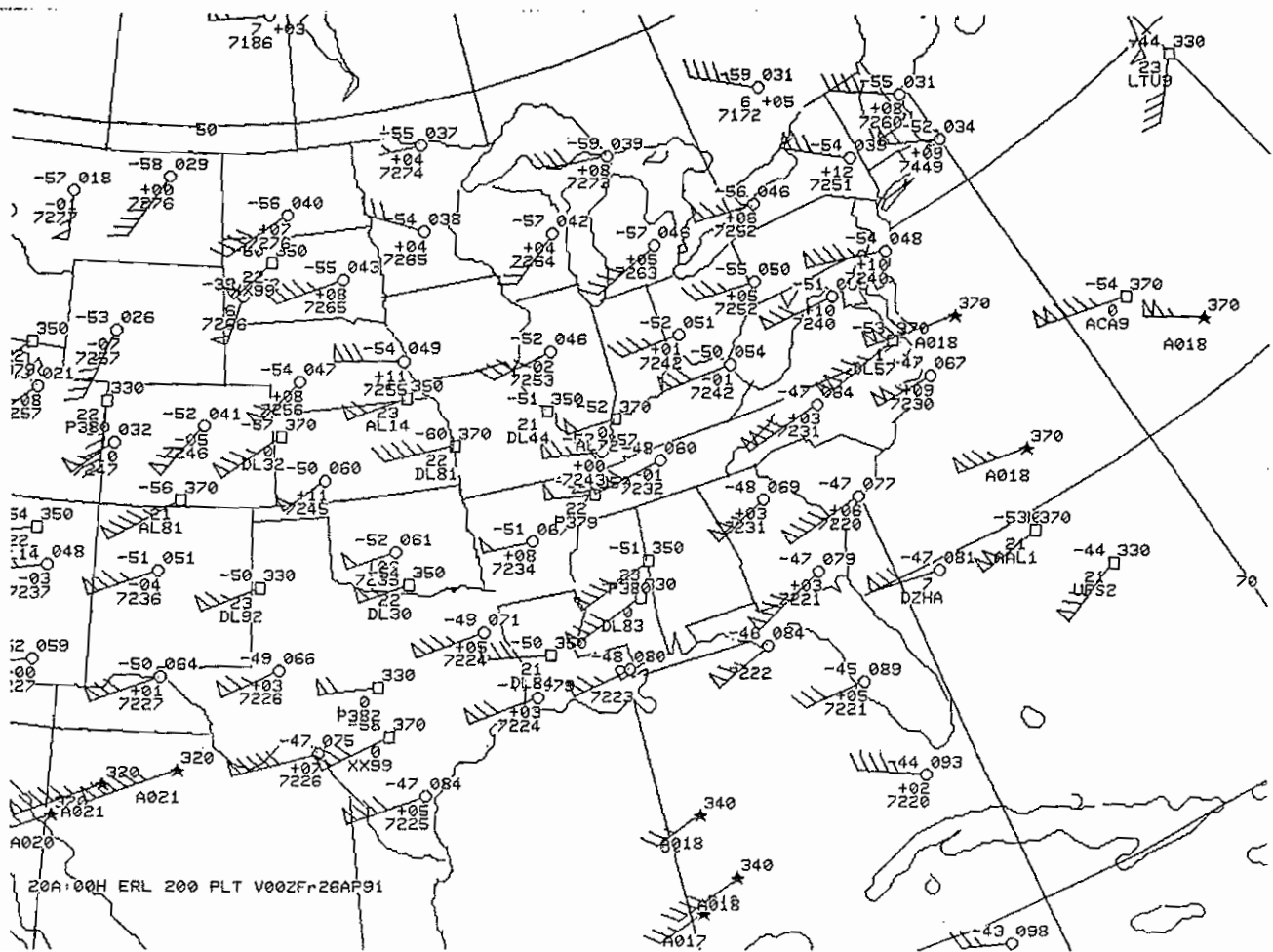
April 25, 1991



April 25, 1991

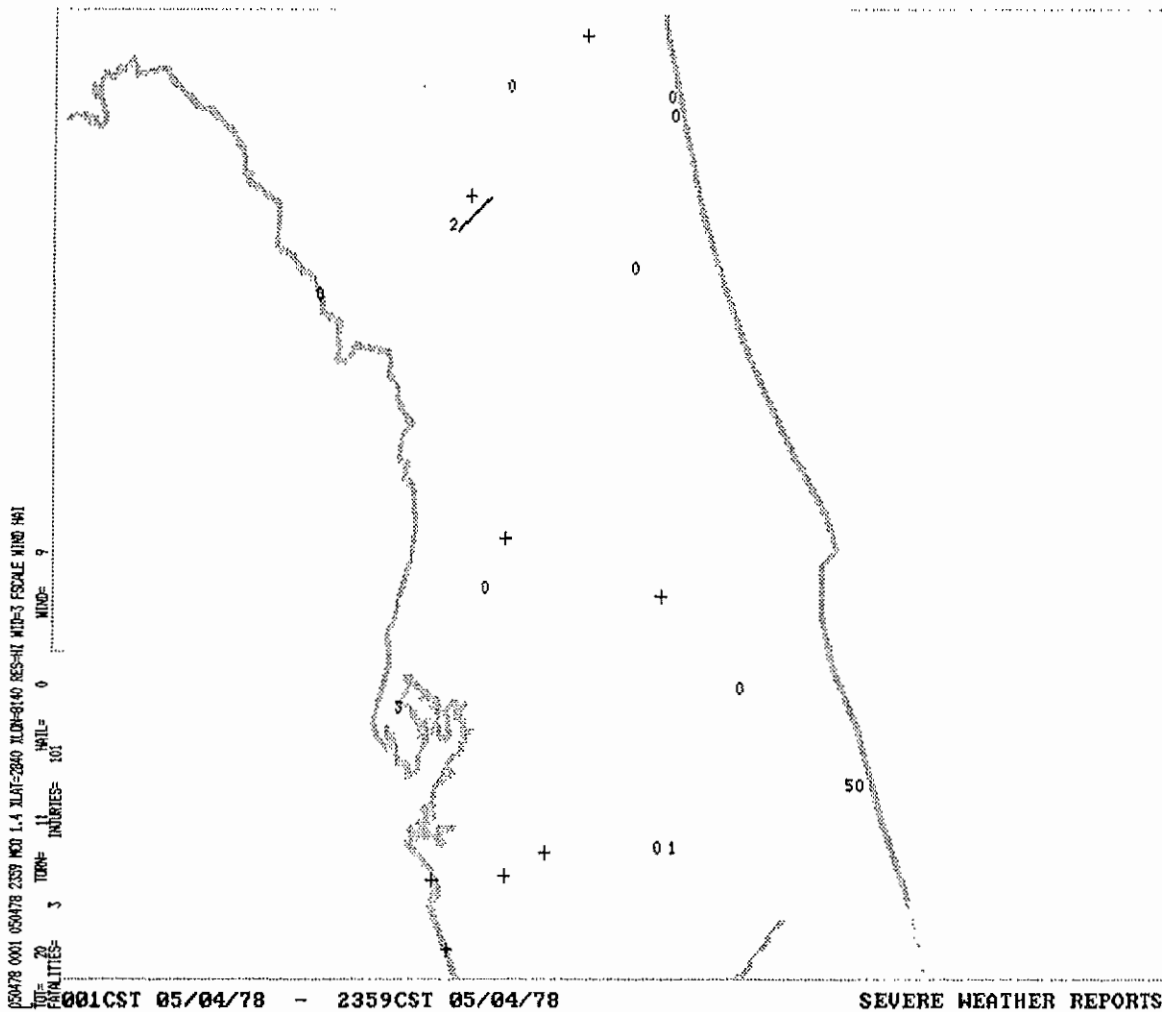


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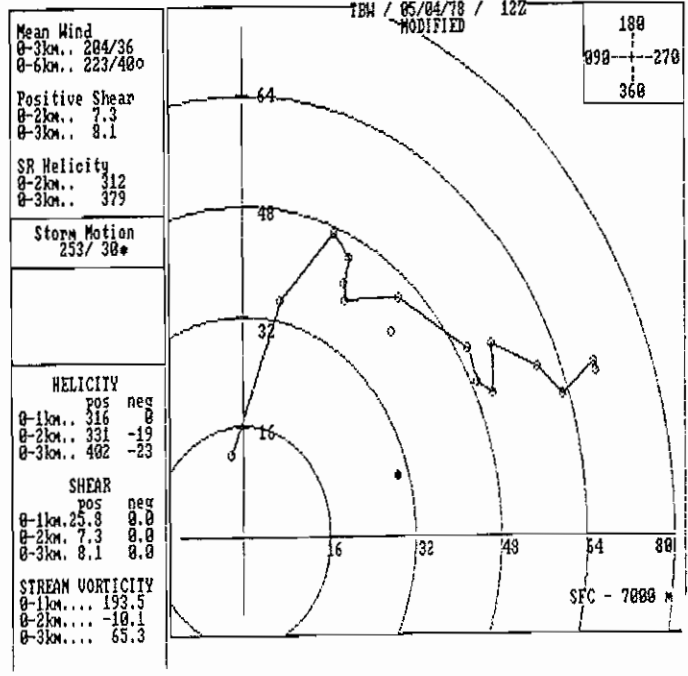
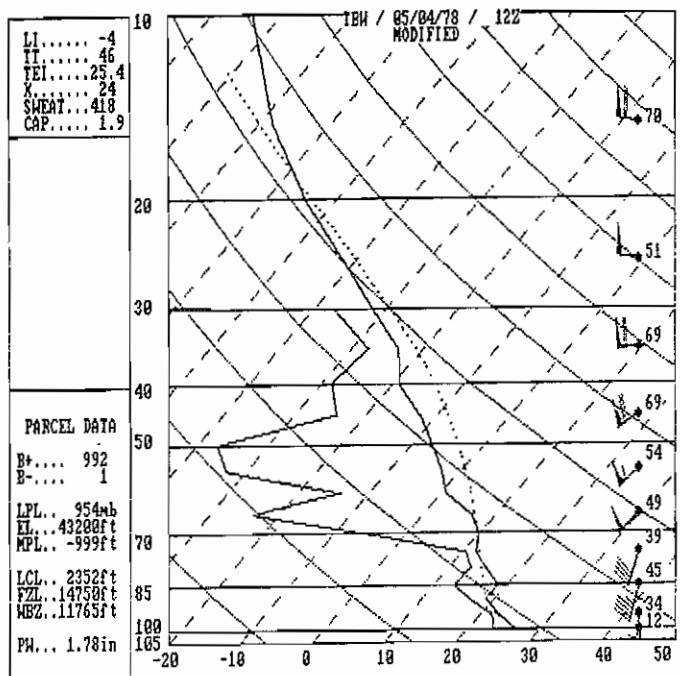


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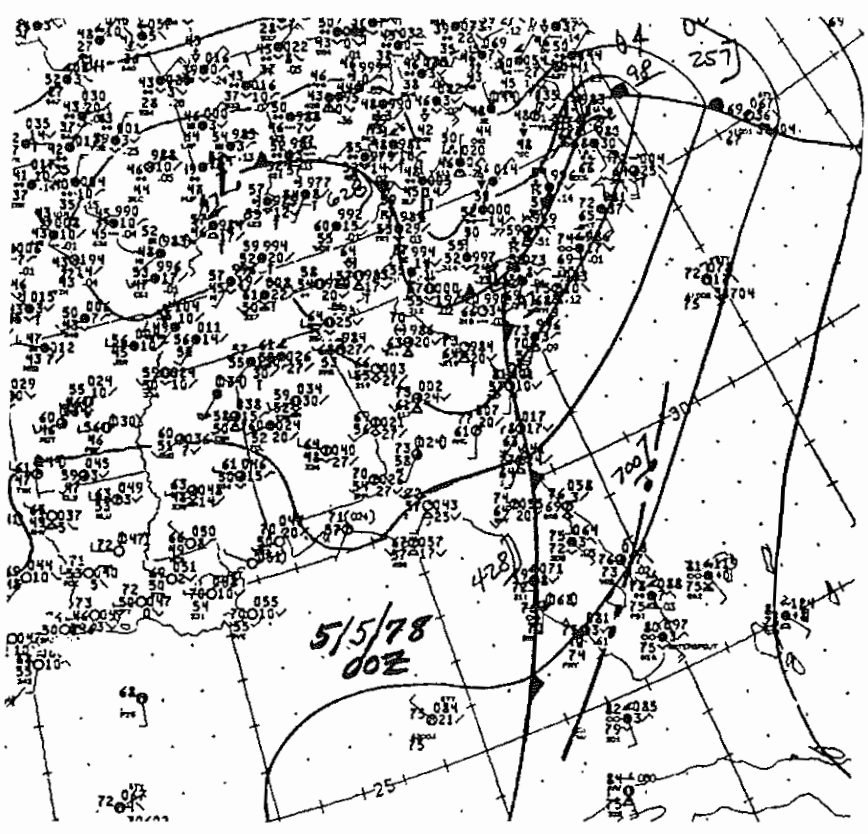
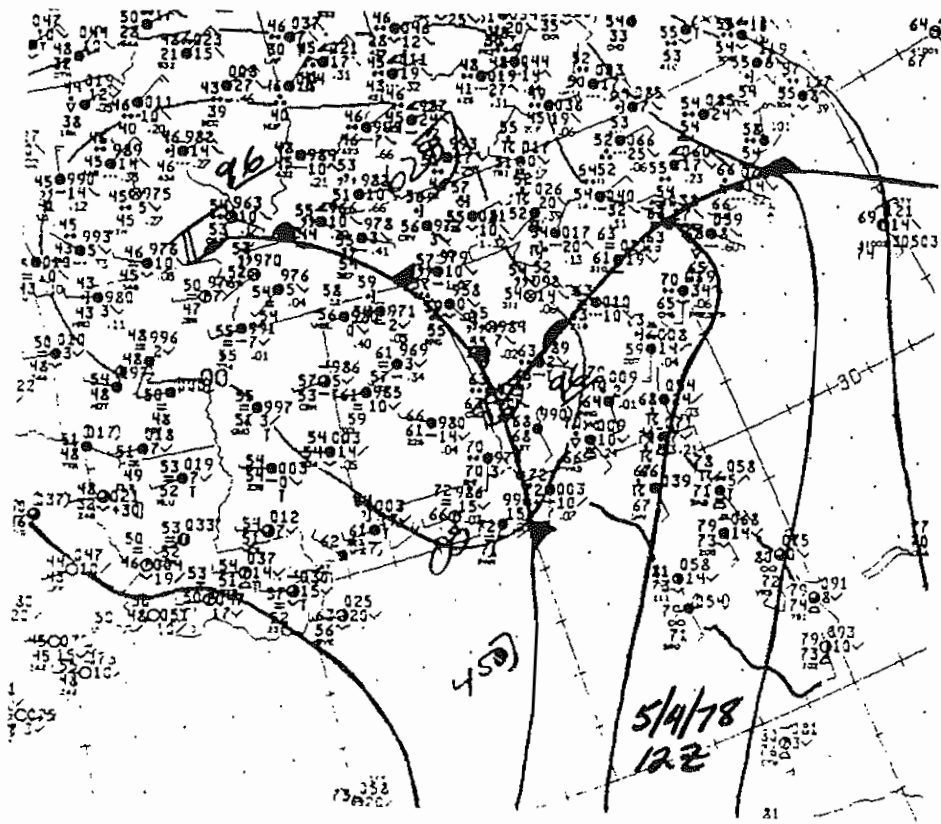
May 4, 1978



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 TIME 001CST 05/04/78 - 2359CST 05/04/78  
 PARALLIT= 20 INDI= 101  
 TIME 001CST 05/04/78 - 2359CST 05/04/78  
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May 4, 1978

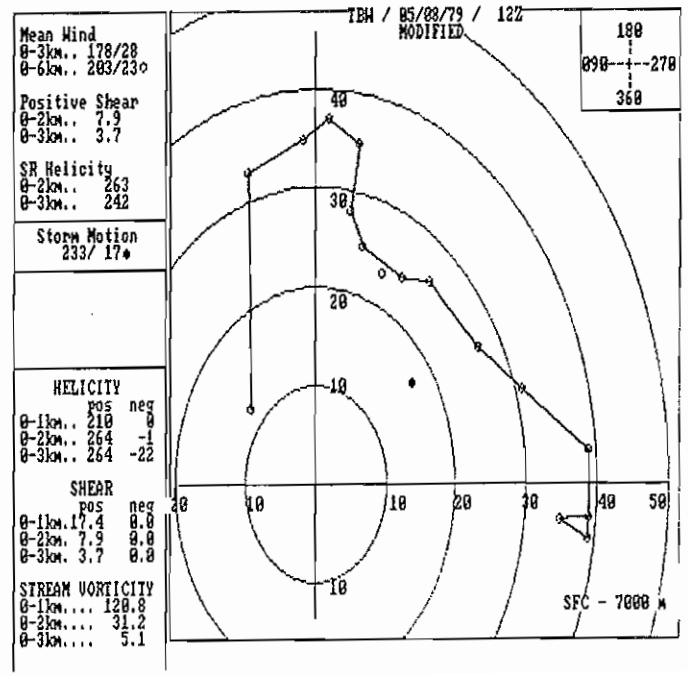
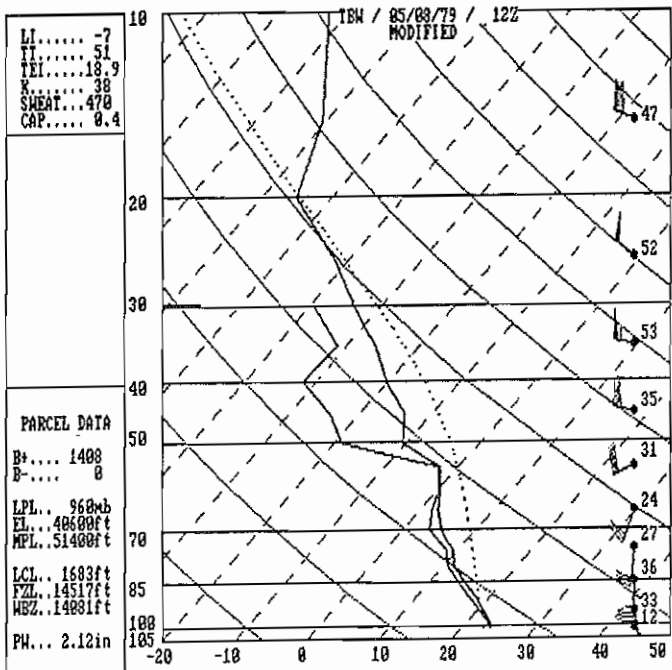
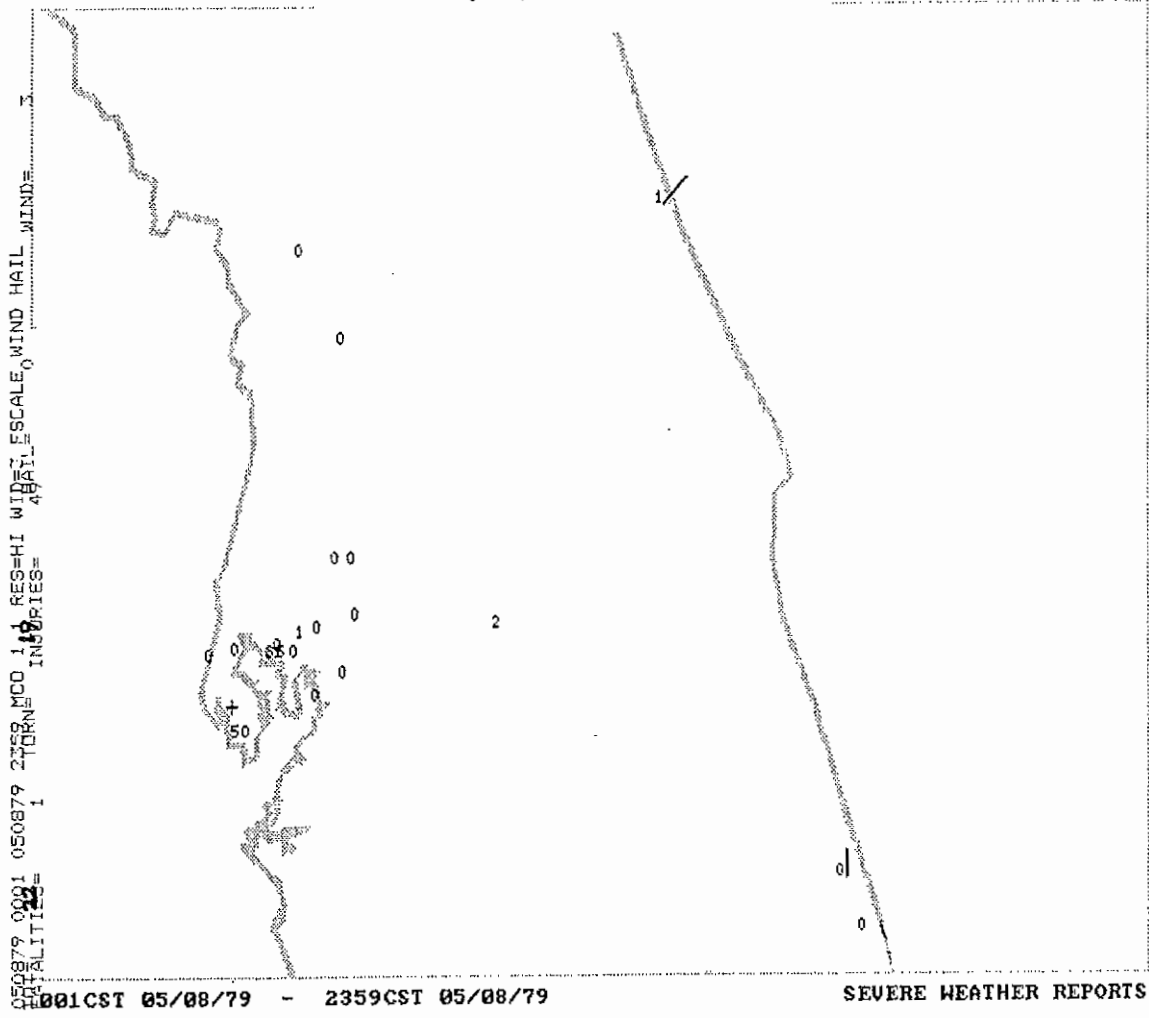




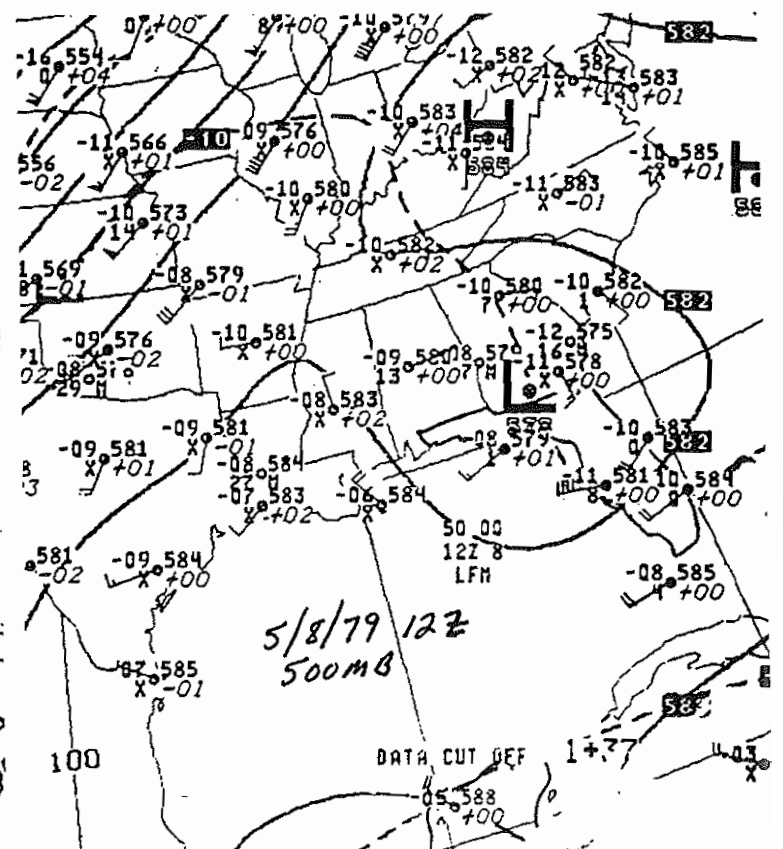
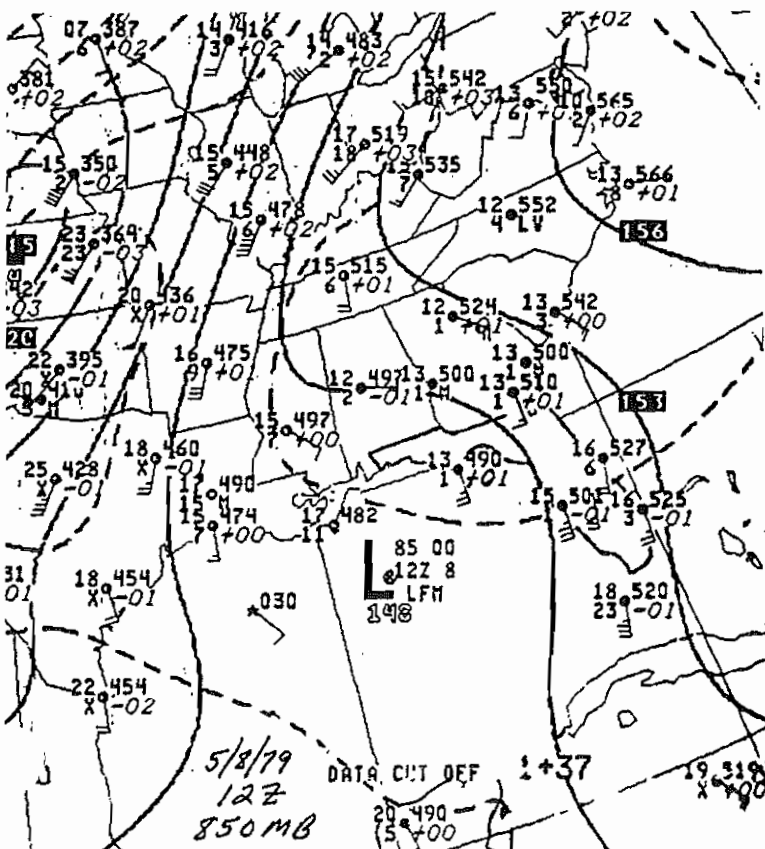
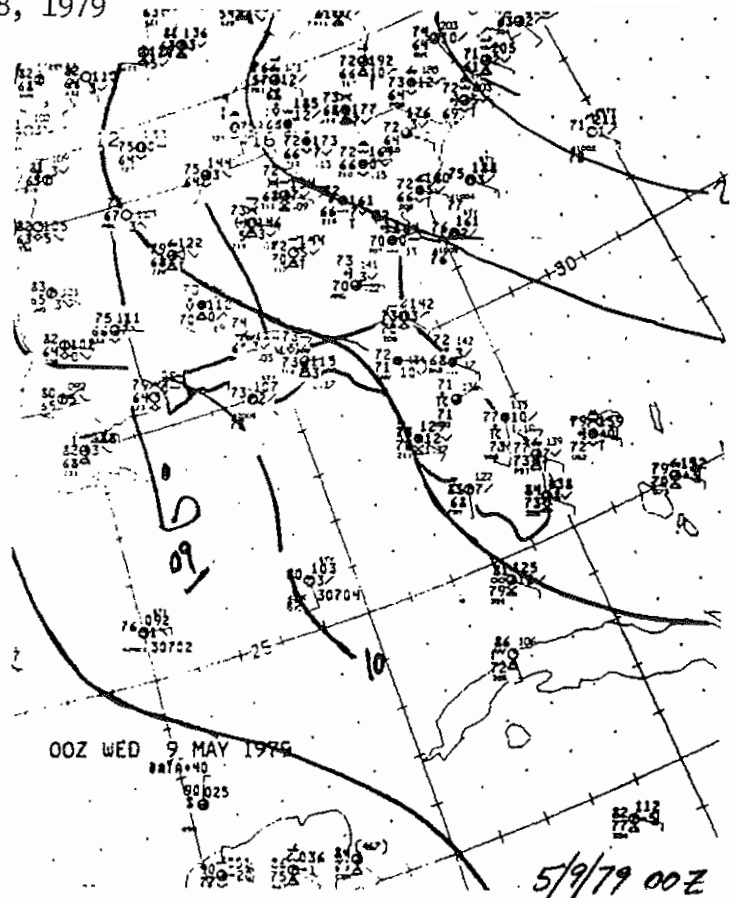
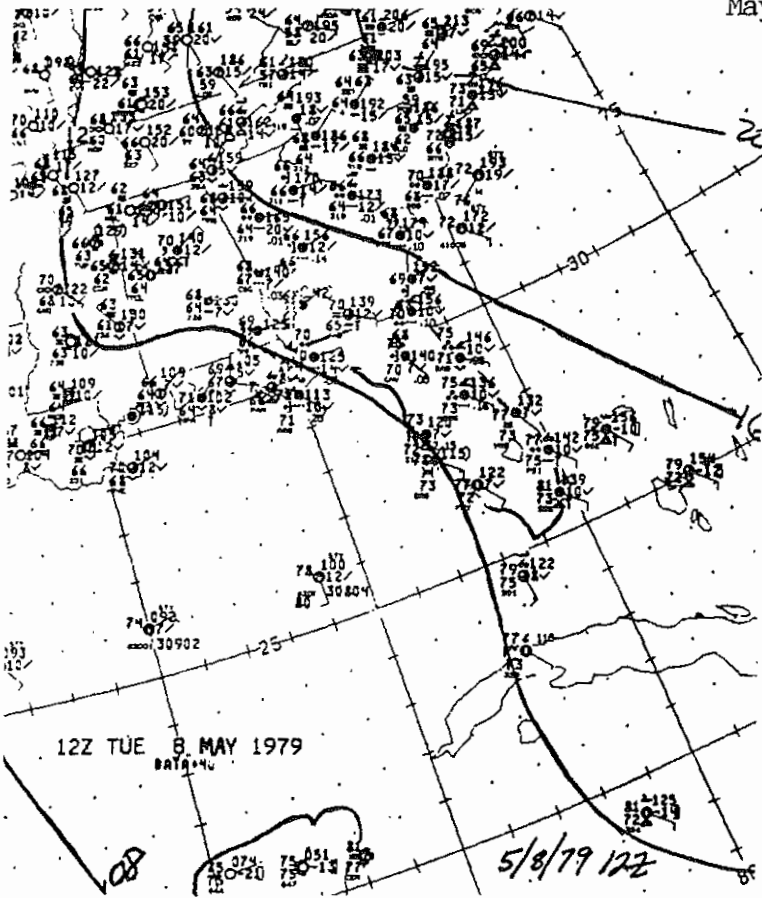


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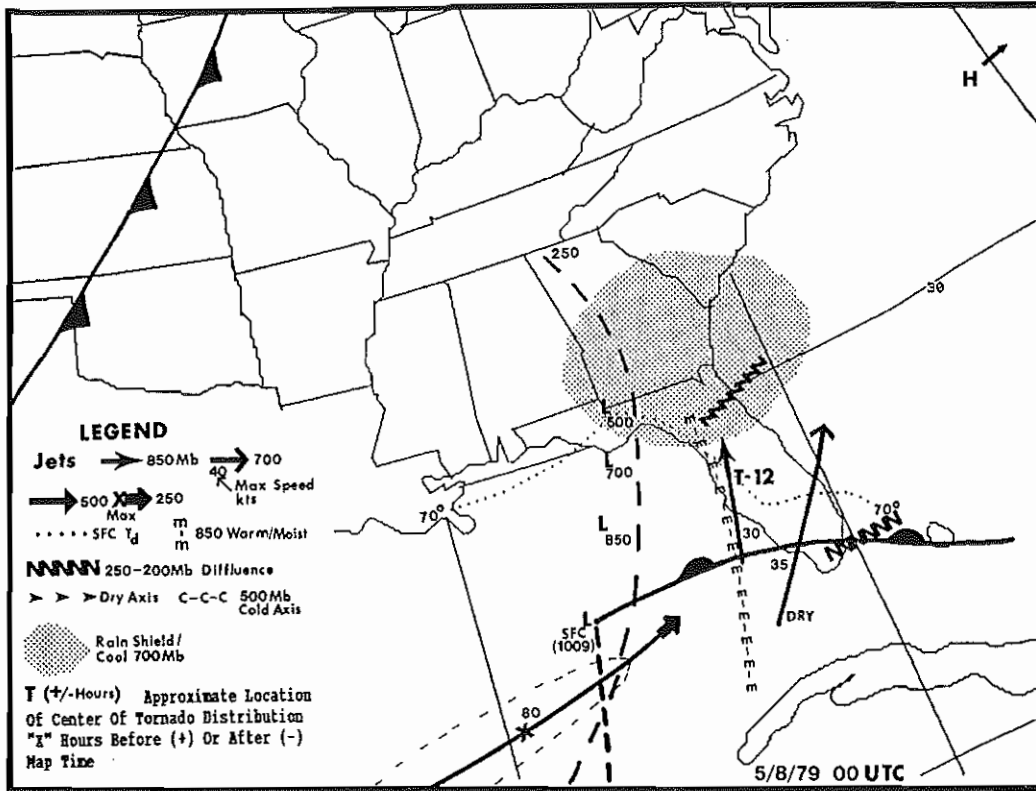
May 8, 1979



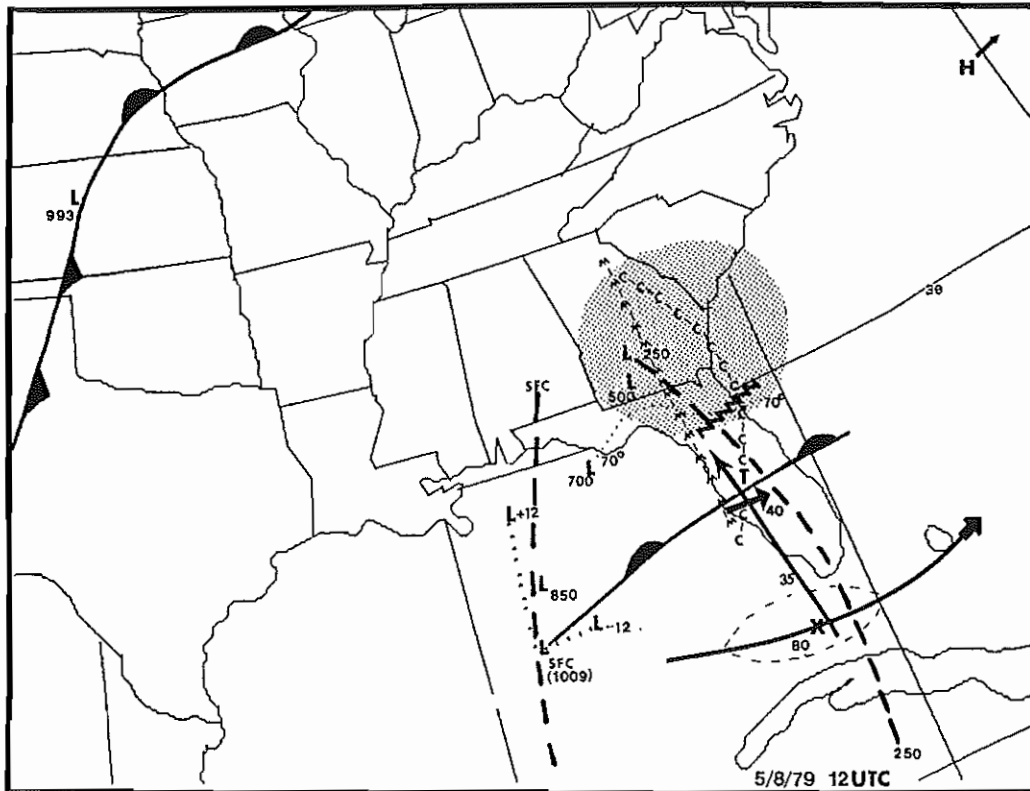
May 8, 1979



May 8, 1979

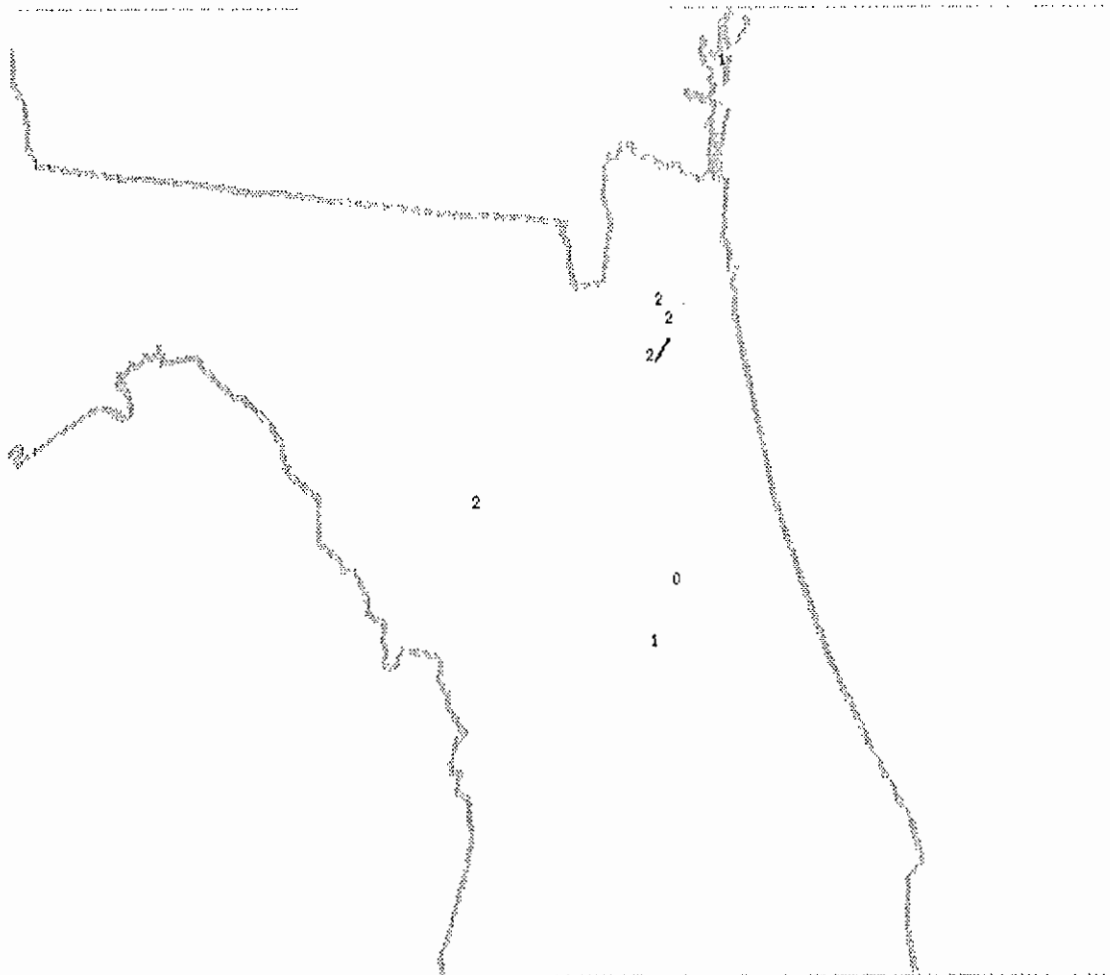


(From Hagemeyer and Matney 1993b)



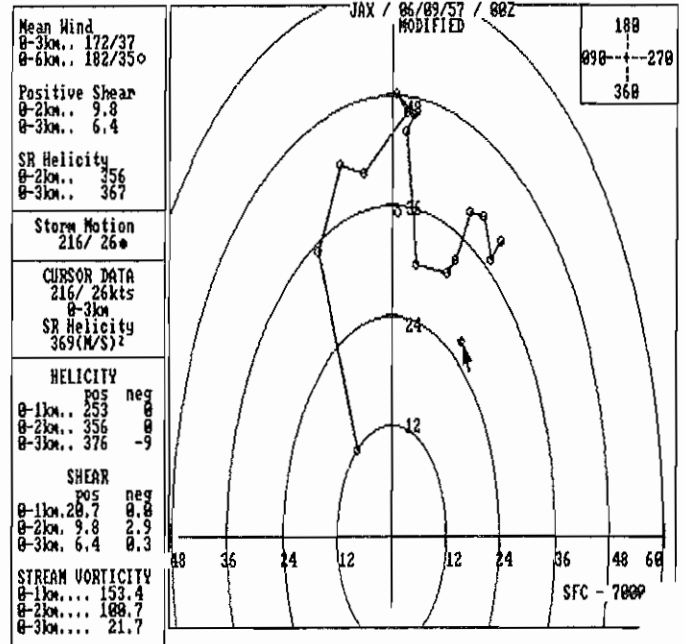
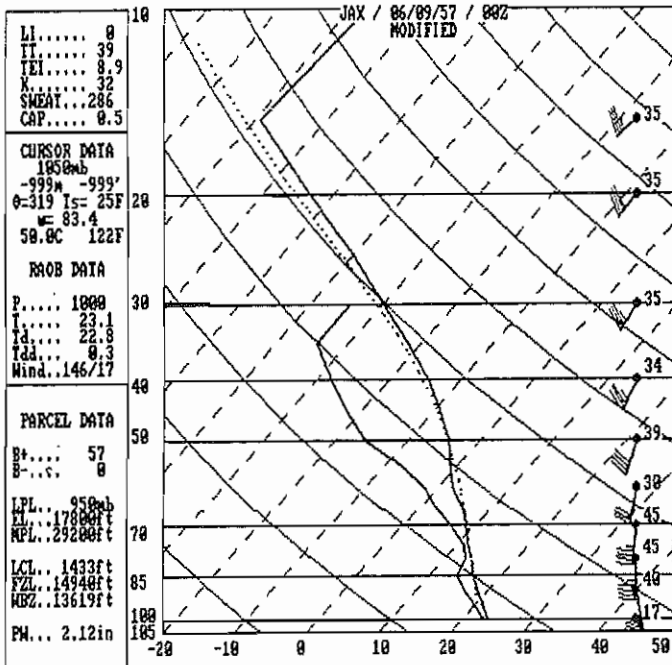
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June 8, 1957



001CST 06/08/57 - 2359CST 06/08/57

SEVERE WEATHER REPORTS



# THE HURRICANE SEASON OF 1957

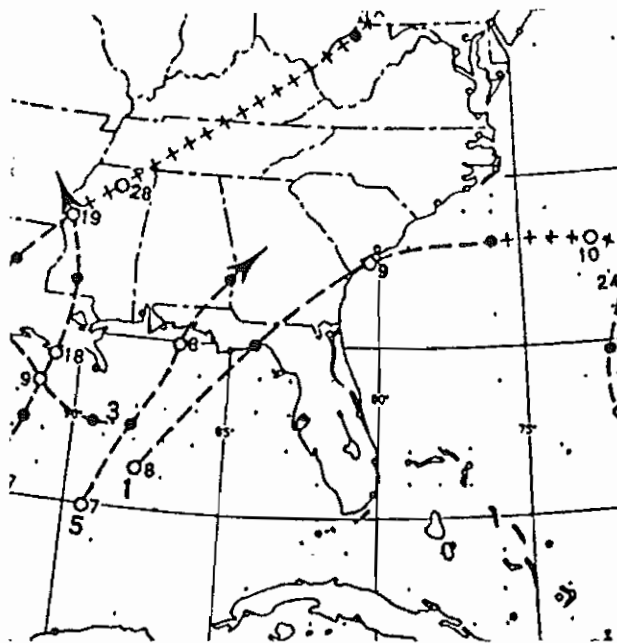
PAUL L. MOORE AND STAFF  
 Weather Bureau Office, Miami, Fla.

*Tropical Storm (unnamed), June 8-14.*—Pressures were abnormally low over the southwestern Gulf of Mexico and Yucatan area on June 7 but lack of upper-air wind observations from Mexico made the amount of circulation uncertain. However, late on the 7th and early on the 8th it became evident that a tropical depression existed. It moved rather rapidly northeastward with some deepening but little organization and crossed the Florida coastline in Apalachee Bay during the early evening. Two ships, one about 150 to 200 miles southeast of the center and later another 100 to 150 miles west of the center, reported

winds of 45 knots. However, over coastal areas all strong winds were on the east side of the storm. Exposed places along the coast from Sarasota to north of Cedar Keys, Fla., experienced winds of 40 m. p. h. or more and tides 2 to 3 feet above normal with some damage. The storm weakened as it moved inland but set off an active frontal wave after moving off the Georgia coast on the 9th. Late on the 9th when the storm became extratropical off the Atlantic coast, ship reports indicated winds up to 65 knots.

Exceptionally heavy rain attended passage of this storm, particularly in Suwannee and all adjacent counties; 48-hour amounts of nearly 15 inches at official stations and some unofficial amounts as high as 19 inches. There was considerable damage to field and truck crops, particularly to tobacco and watermelons. Between 100 and 200 families were evacuated near Perry, Fla. According to the Meteorologist in Charge at Jacksonville, at least nine tornadoes or damaging wind storms were reported in northeastern Florida on the afternoon and evening of the 8th and another tornado over Jekyll Island in southeastern Georgia. No deaths were reported from these tornadoes and the damage and injuries were small.

One small craft capsized in the Gulf of Mexico and five of the seven persons aboard were apparently drowned. Damage in northwestern Florida from sea and rainfall flooding from the mouth of the Suwannee River to Port St. Joe was estimated at \$30,000 and damage from tidal action along the Florida west coast was about \$10,000. Tornado damage is estimated at \$12,000. Therefore, total damage from this tropical storm was around \$52,000 and there were five deaths.

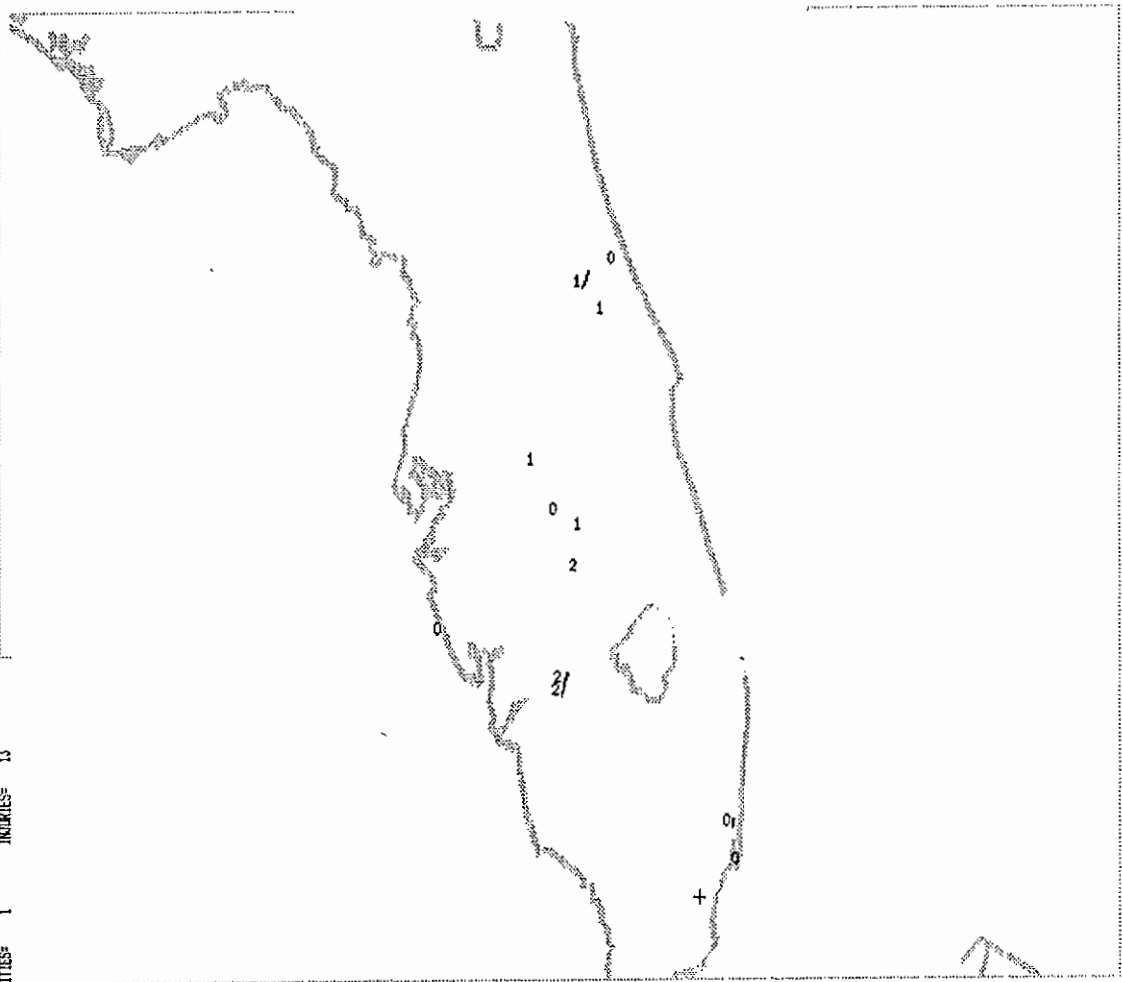


## NORTH ATLANTIC TROPICAL STORMS 1957

NUMBER	NAME	DATE
1 (T)	UNNAMED	June 8-14
2 (H)	AUDREY	June 25-28
3 (T)	BERTHA	Aug. 8-11
4 (H)	CARRIE	Sept. 2-24
5 (T)	DEBBIE	Sept. 7-8
6 (T)	ESTHER	Sept. 16-19
7 (H)	FRIEDA	Sept. 20-27
8 (T)	UNNAMED	Oct. 22-27

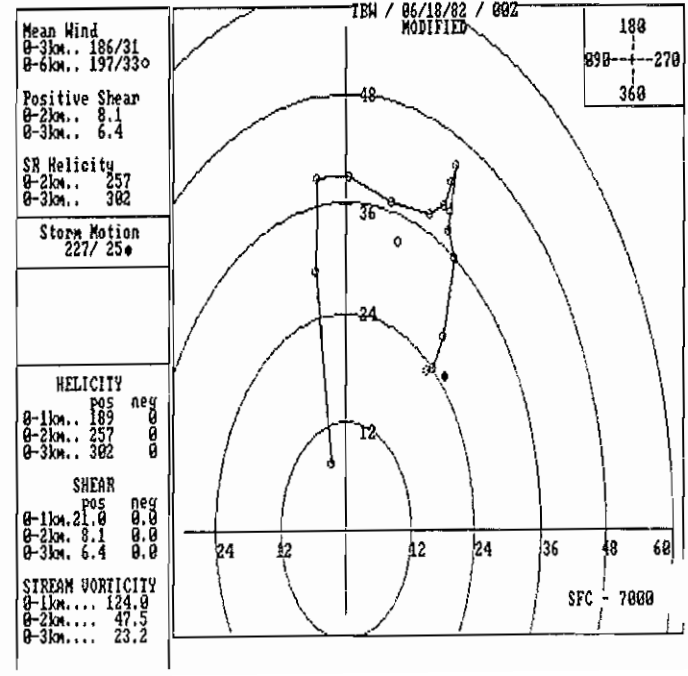
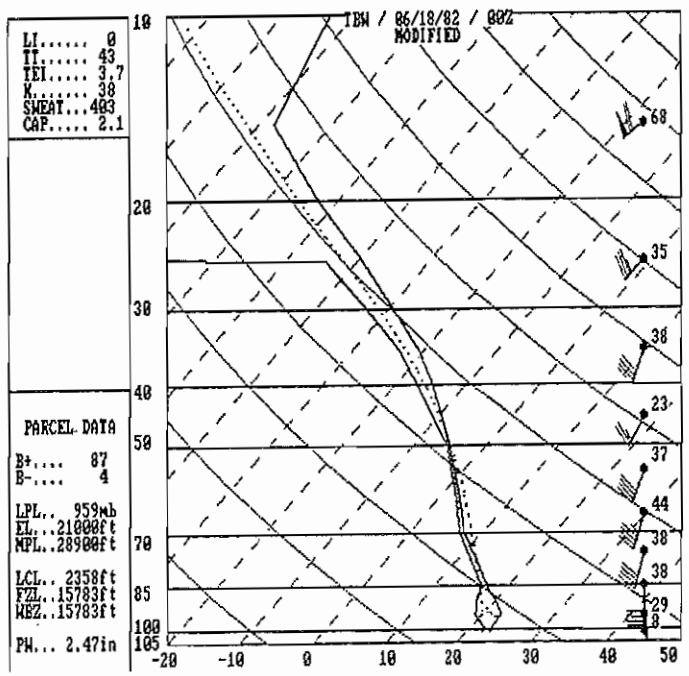
(T) TROPICAL STORM: Did not reach hurricane intensity.  
 (H) HURRICANE: Reached hurricane force at some point along its path.  
 ..... Development Stage  
 - - - - - Tropical Storm Stage  
 ——— Hurricane Stage  
 \*++++\* Frontal Stage  
 ○ Position at 7:00 a.m., E.S.T. of date shown  
 ● Position at 7:00 p.m., E.S.T.

041702 0001 041802 ZSSY MOJ 2.3 ILLI=2750 ILLW=8100 RES=HI WIND=3 FSCALE WIND IRI  
 TIME: 11 TOR# INJURIES= 13  
 CASUALTIES: 1

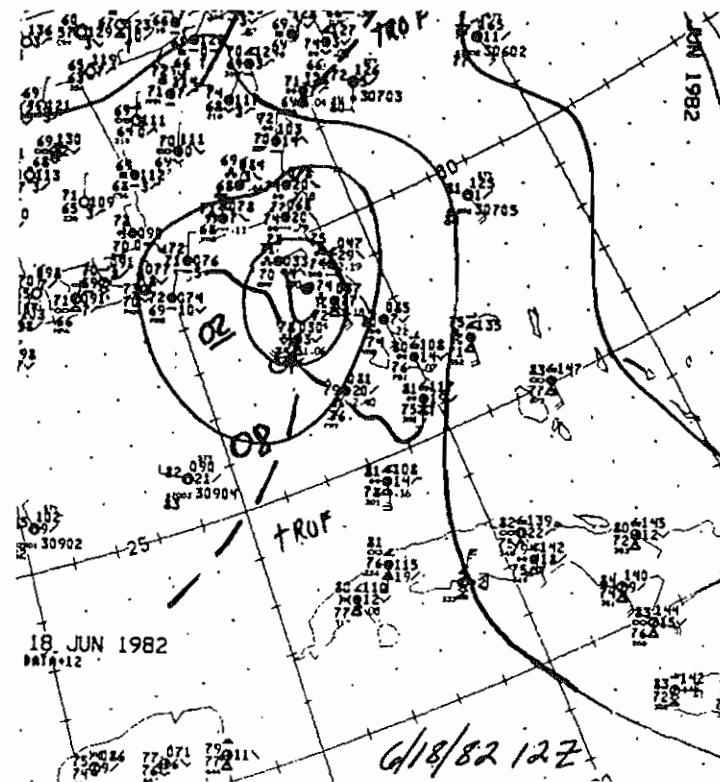
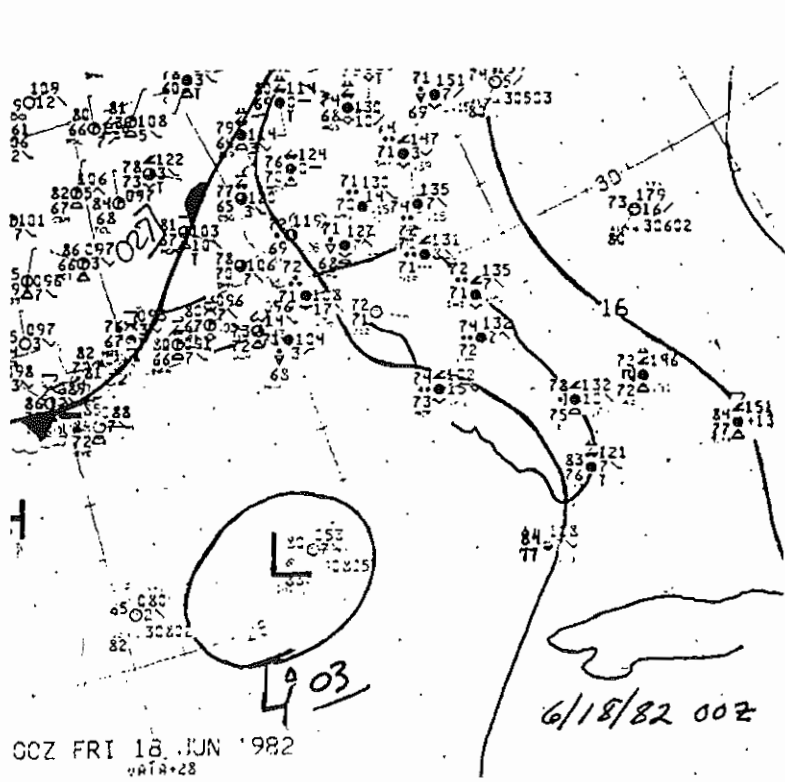
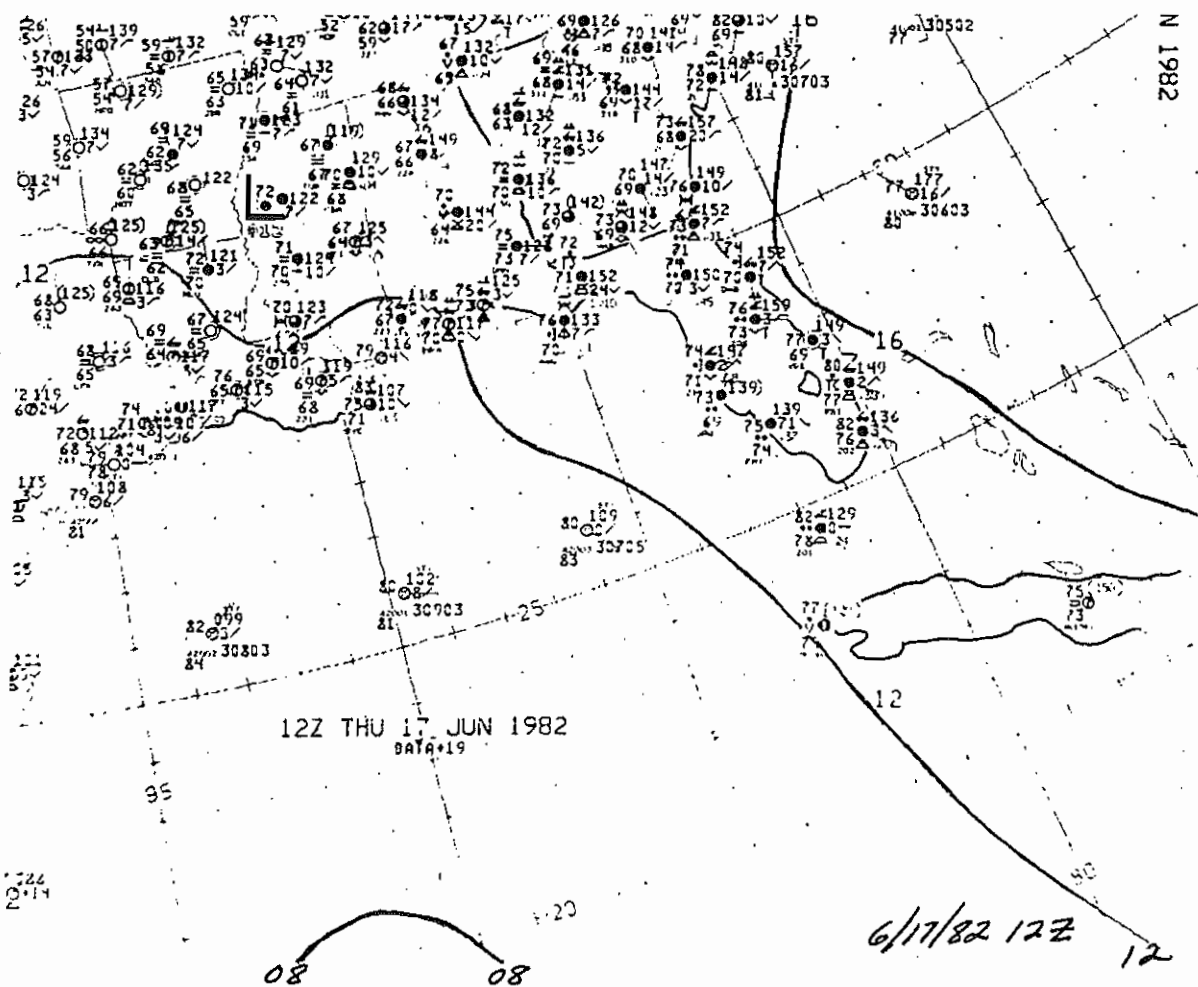


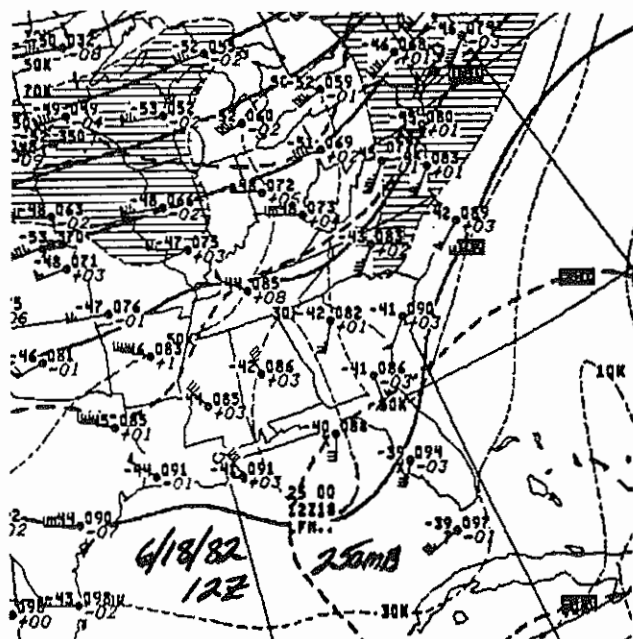
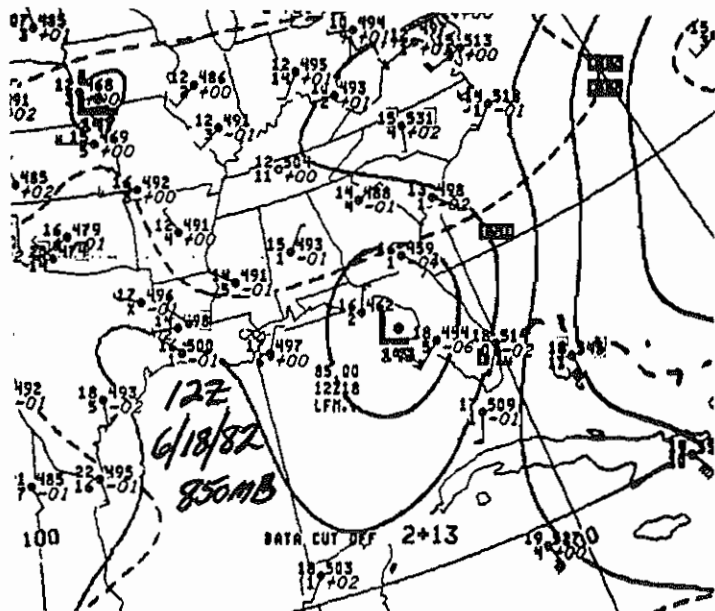
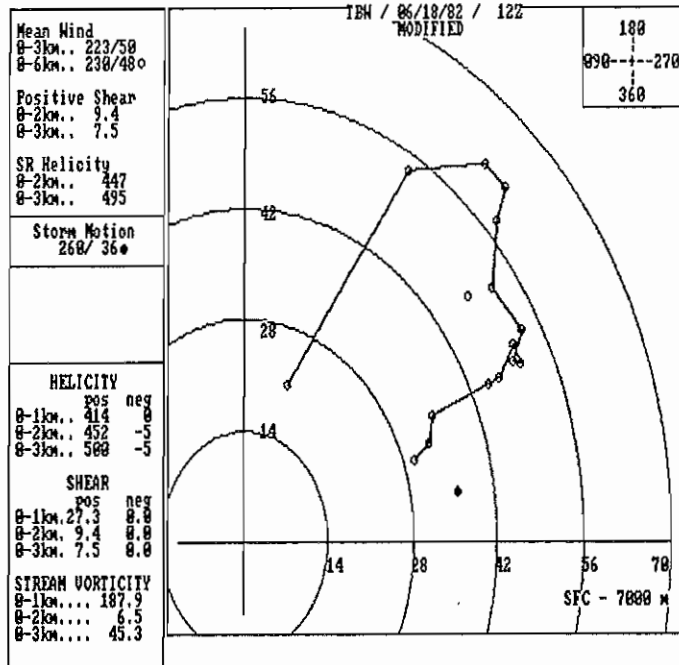
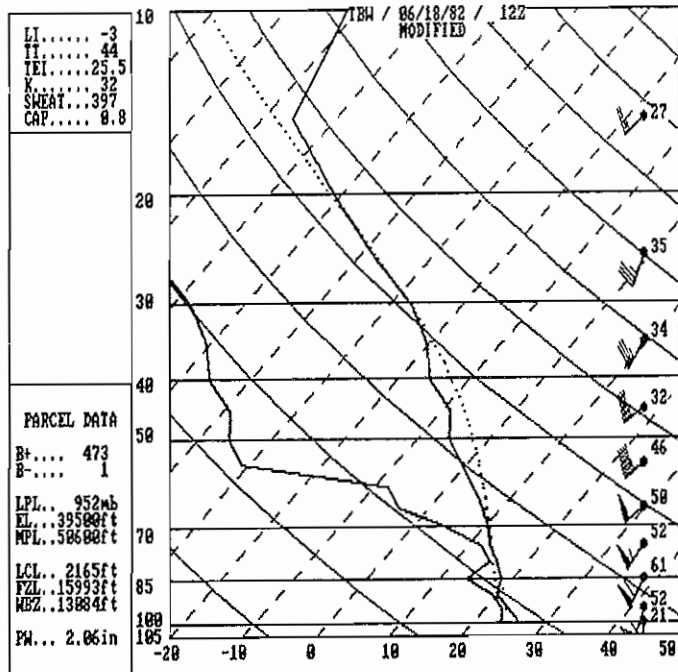
0001CST 06/17/82 - 2359CST 06/18/82

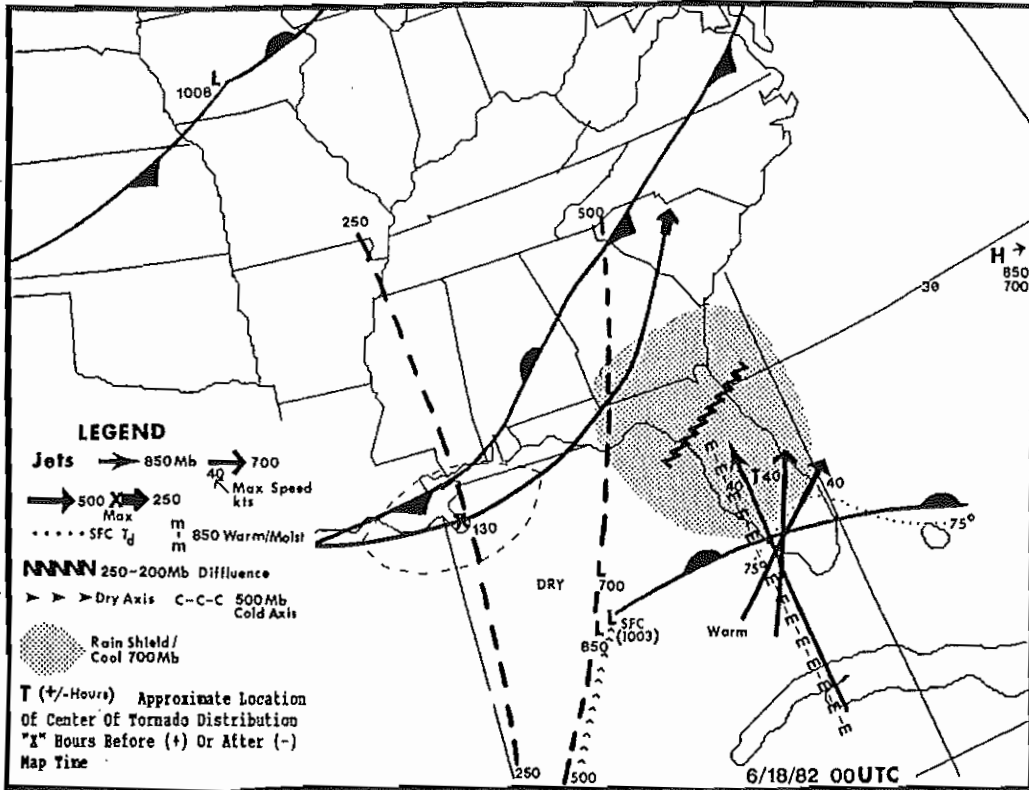
SEVERE WEATHER REPORTS



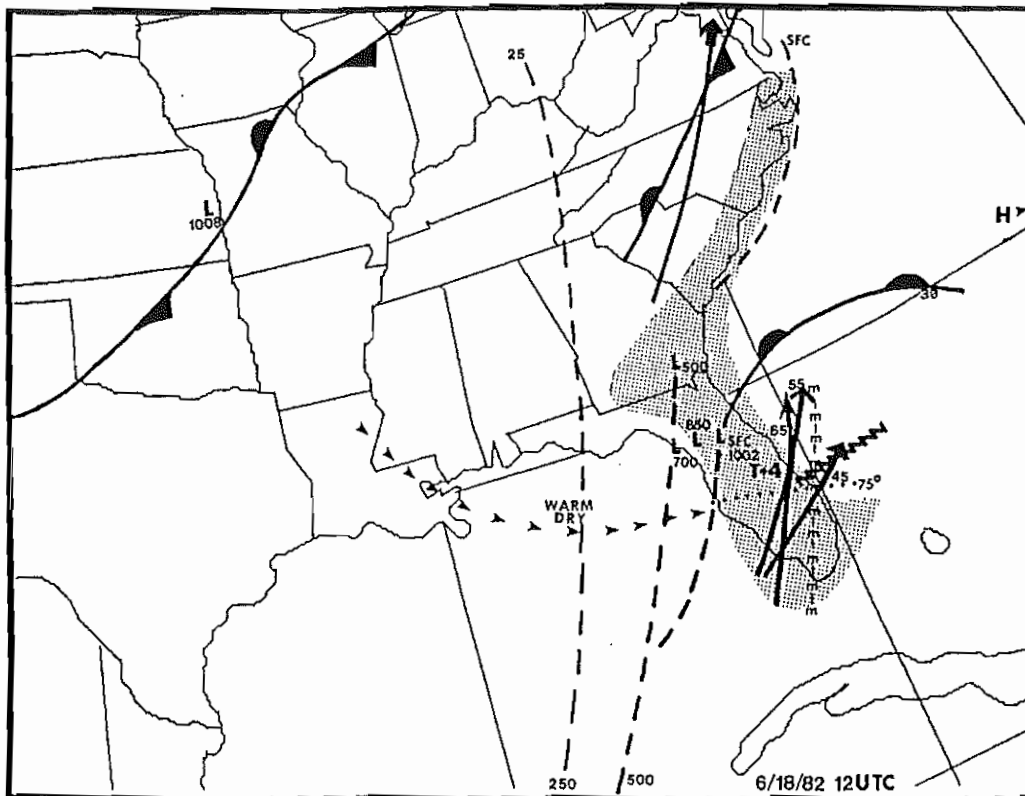


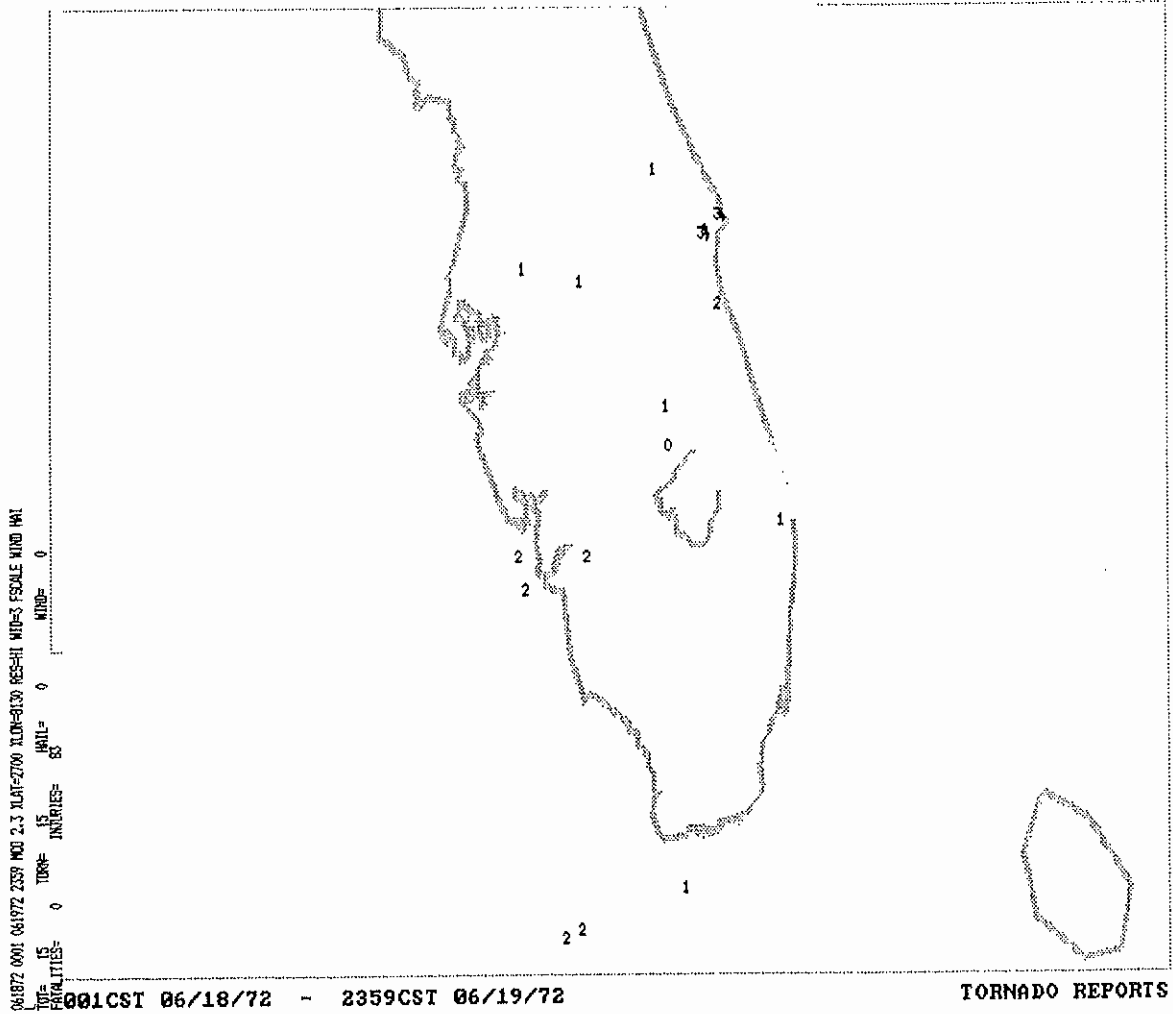




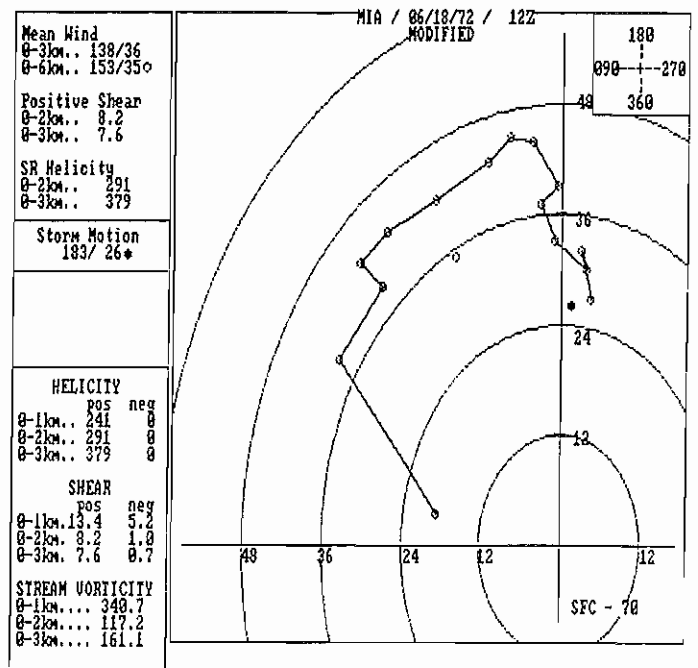
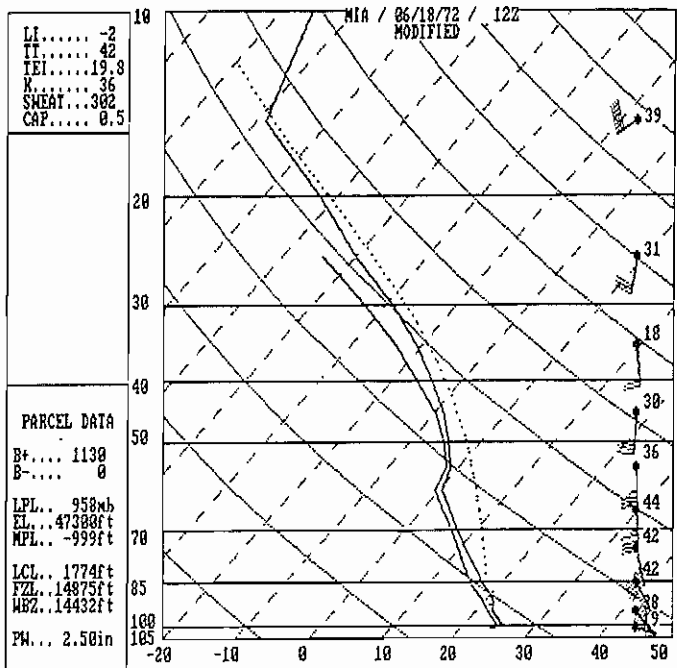


(From Hagemeyer and Matney 1993b)

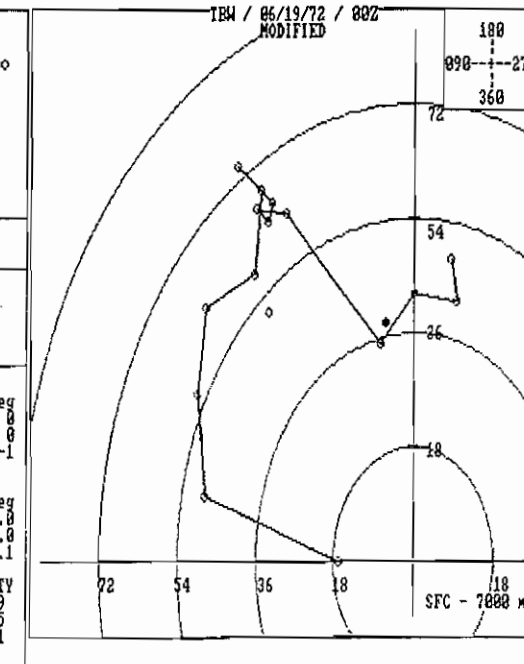
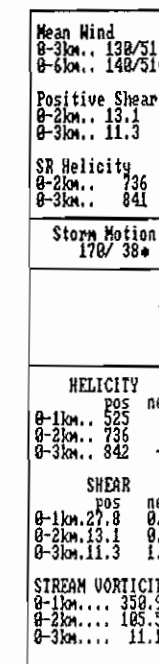
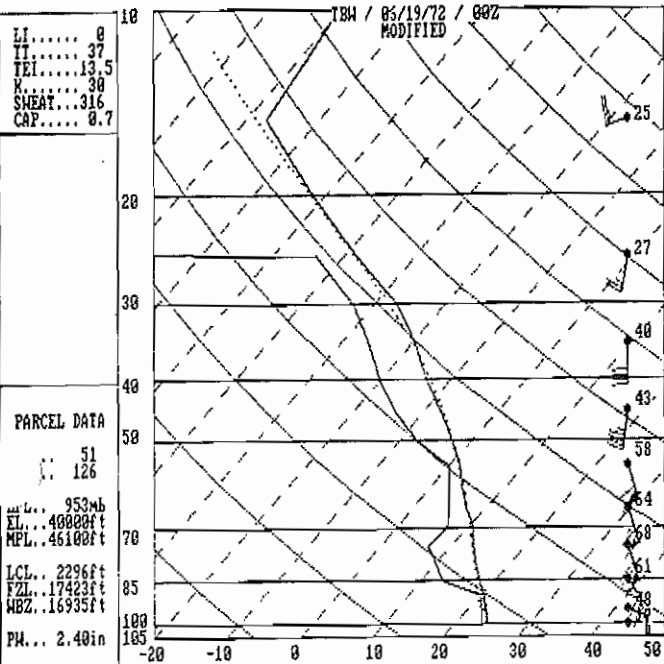
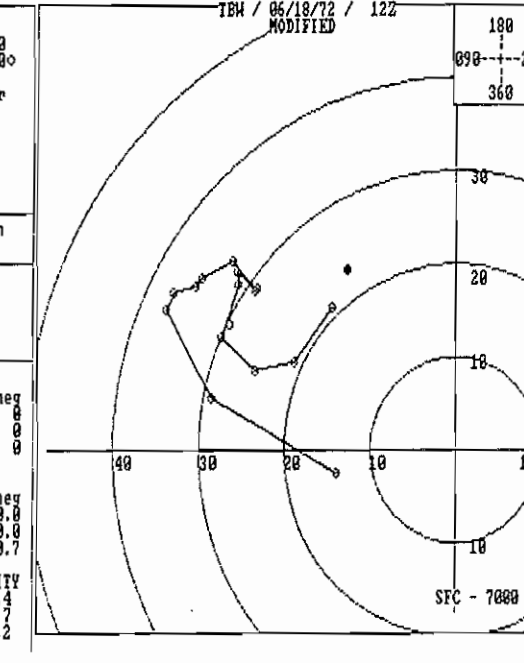
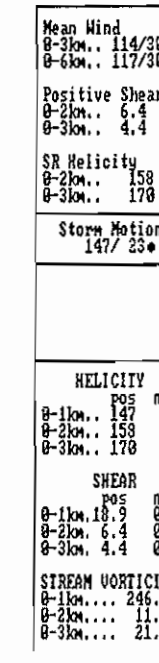
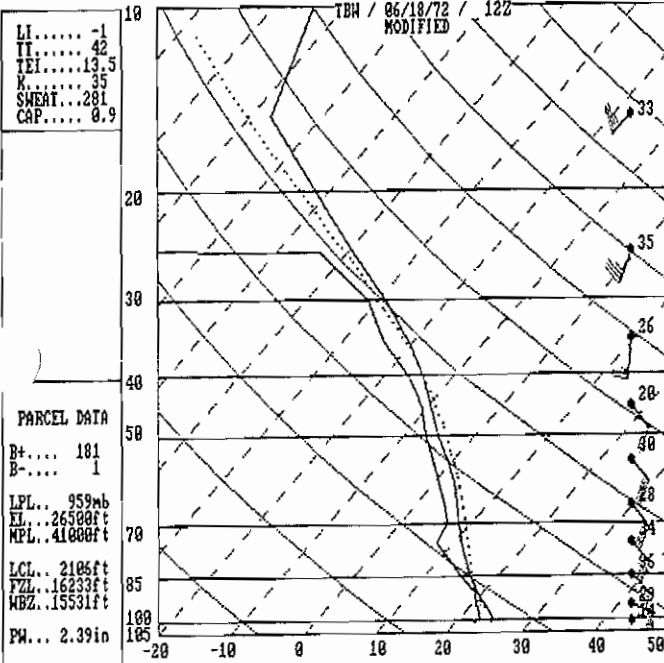
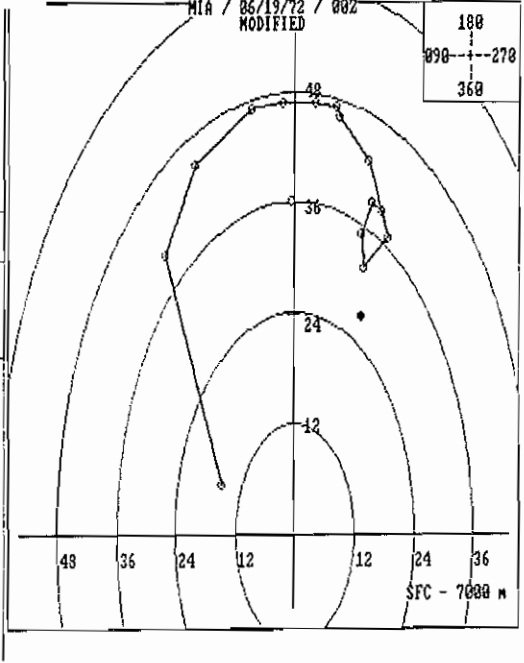
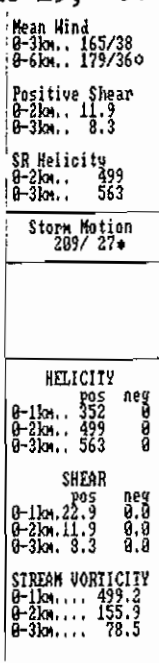
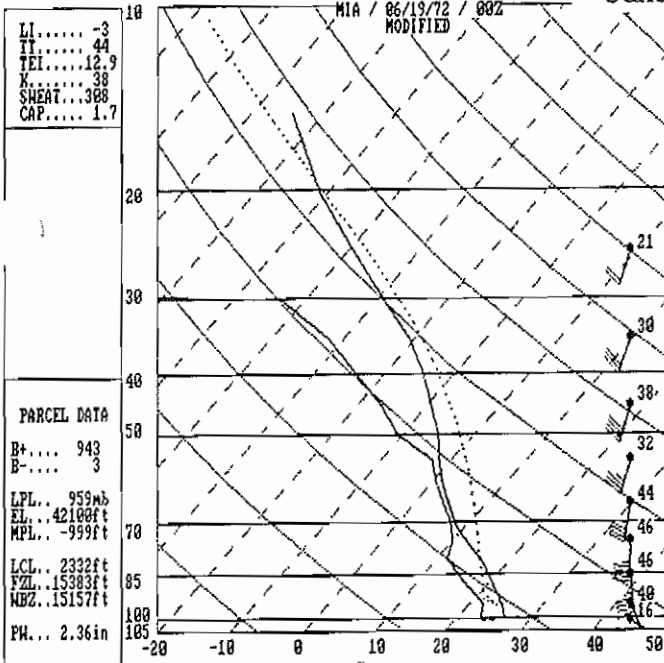




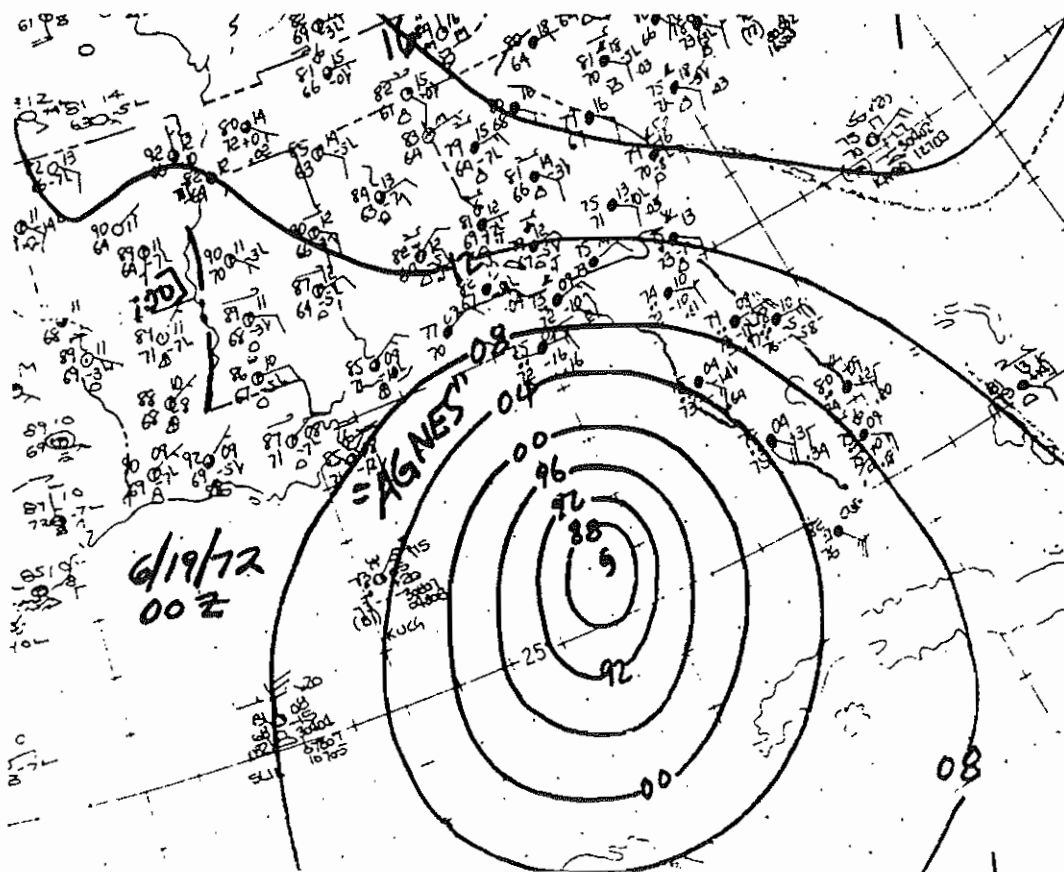
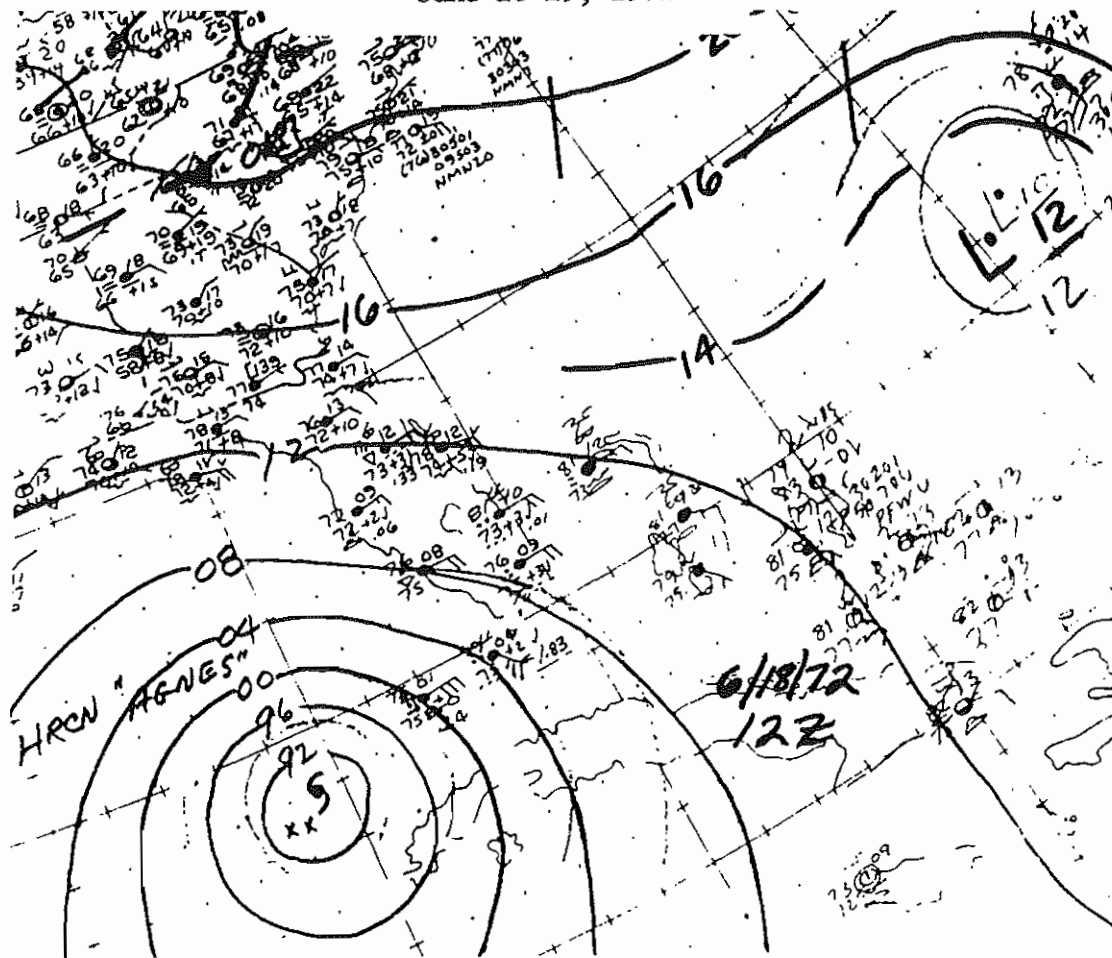
(See McCaul 1991 for additional information on buoyancy and shear characteristics of hurricane-tornado environments and many good references on the topic of hurricane-spawned tornadoes)

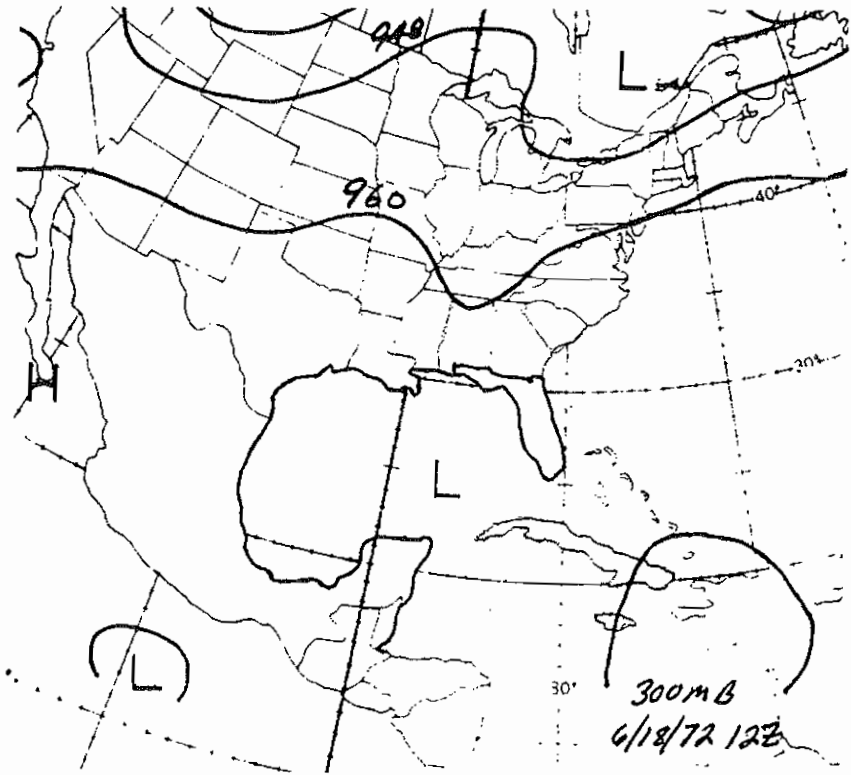
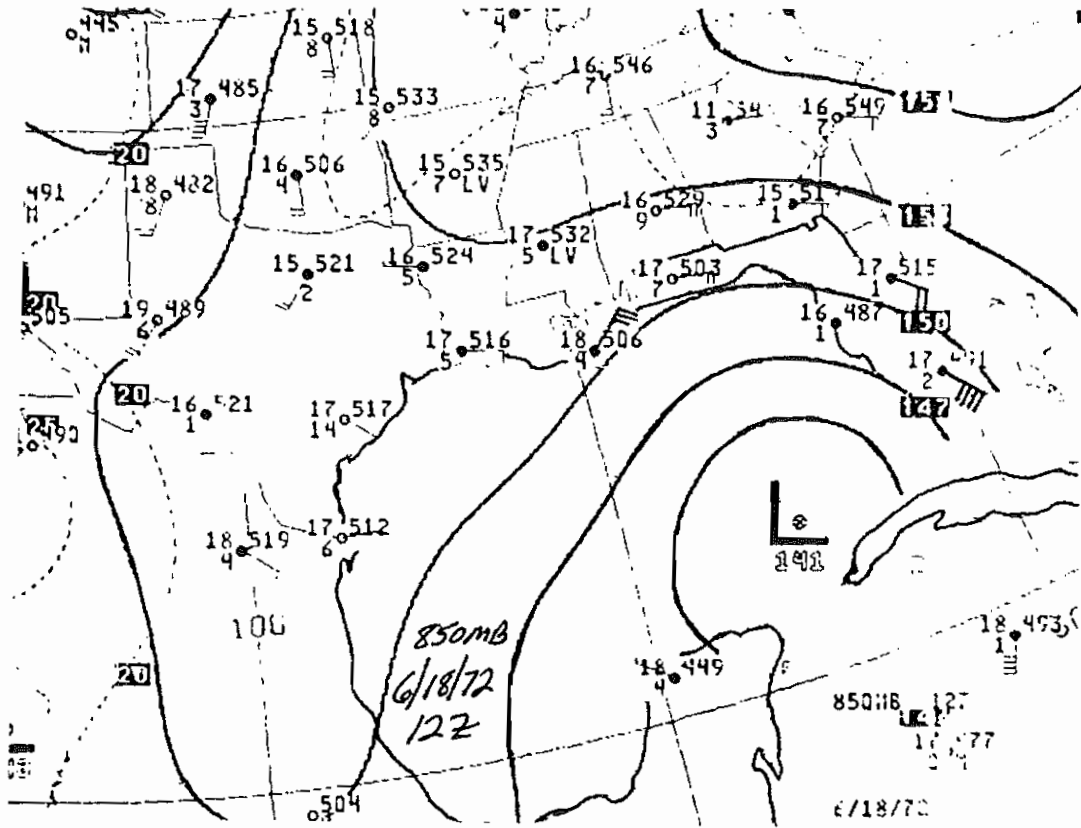


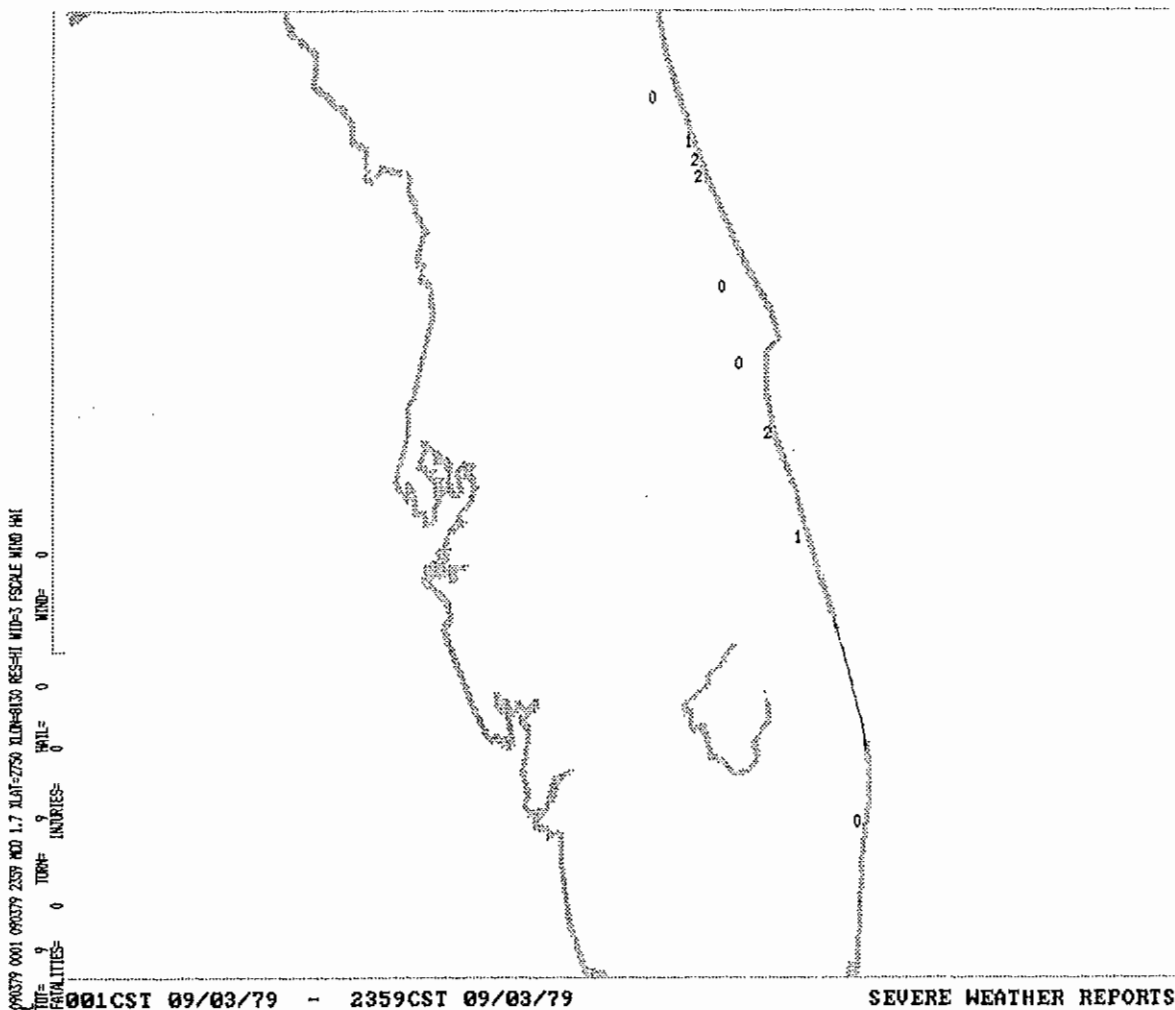
June 18-19, 1972



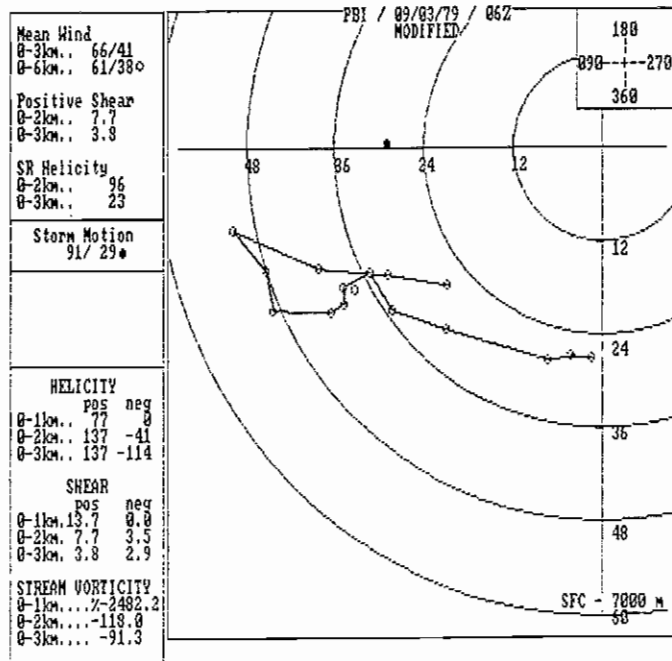
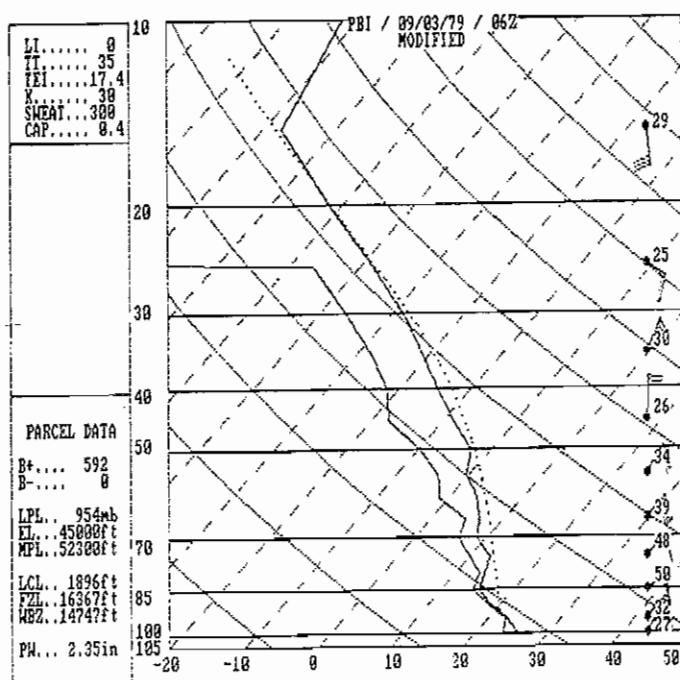
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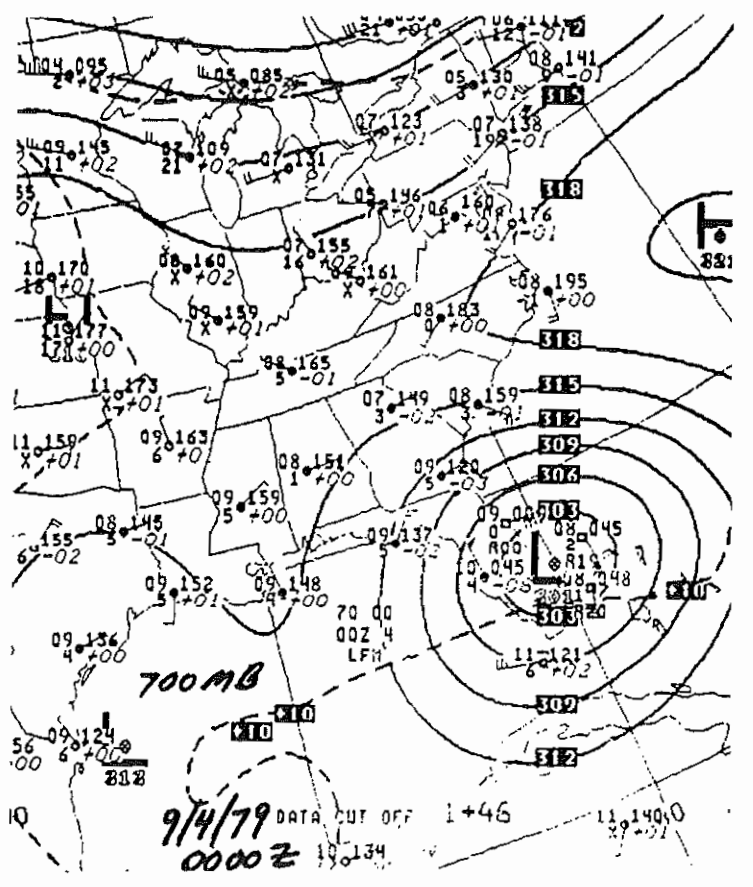
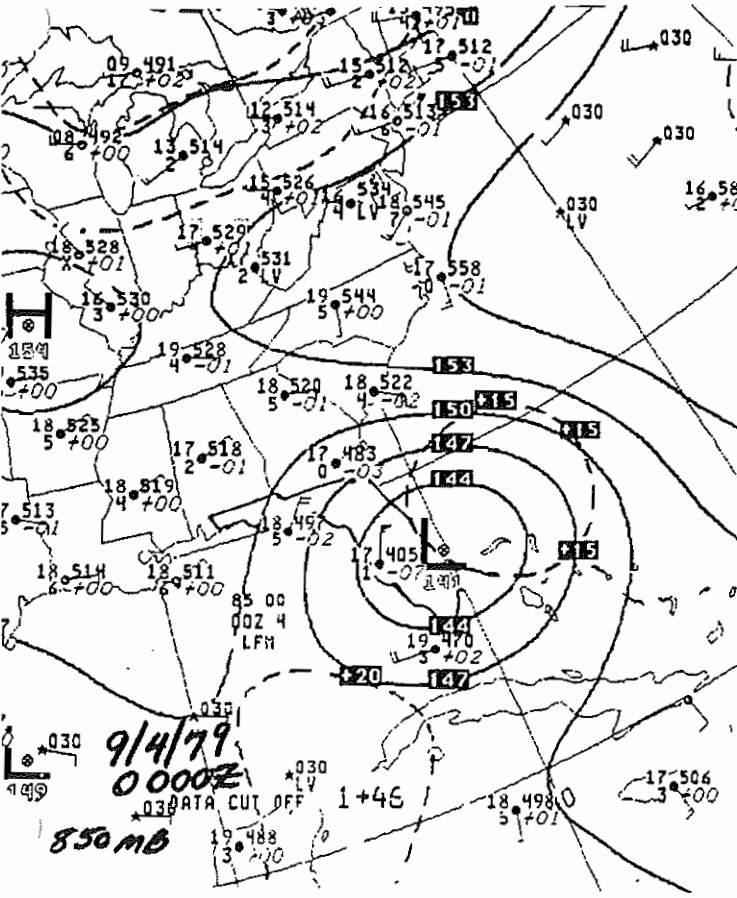
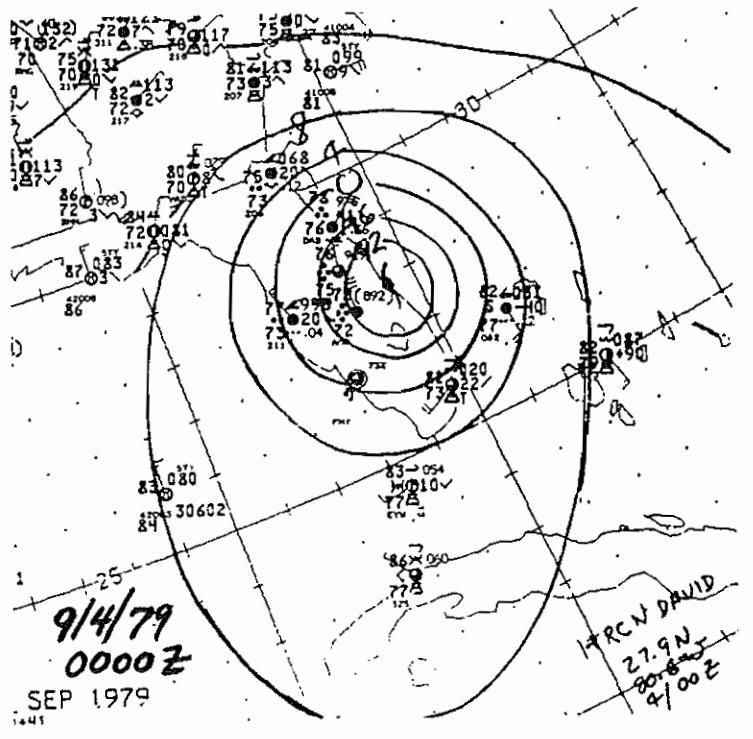
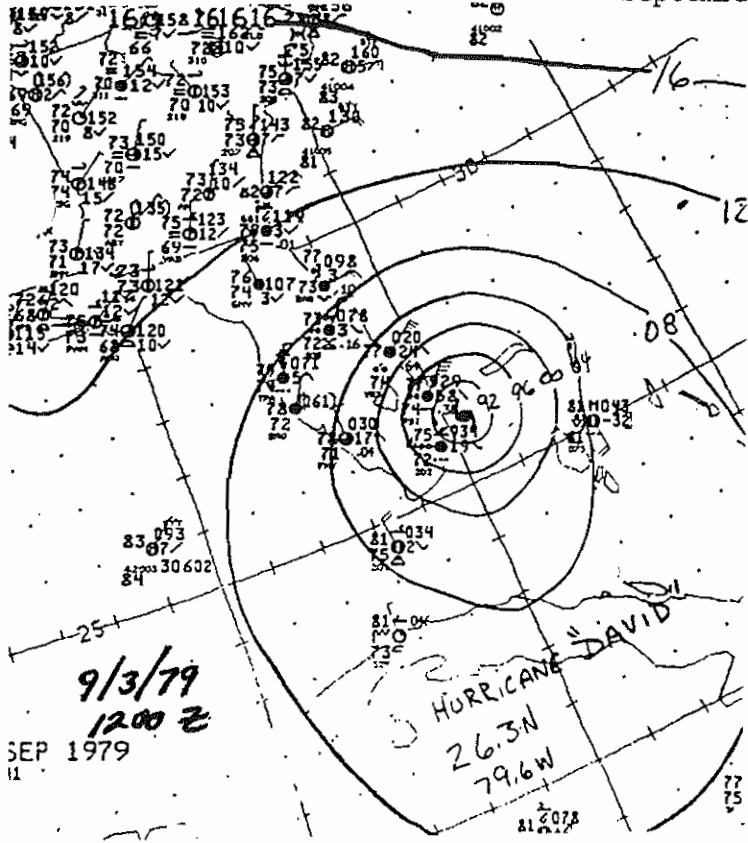




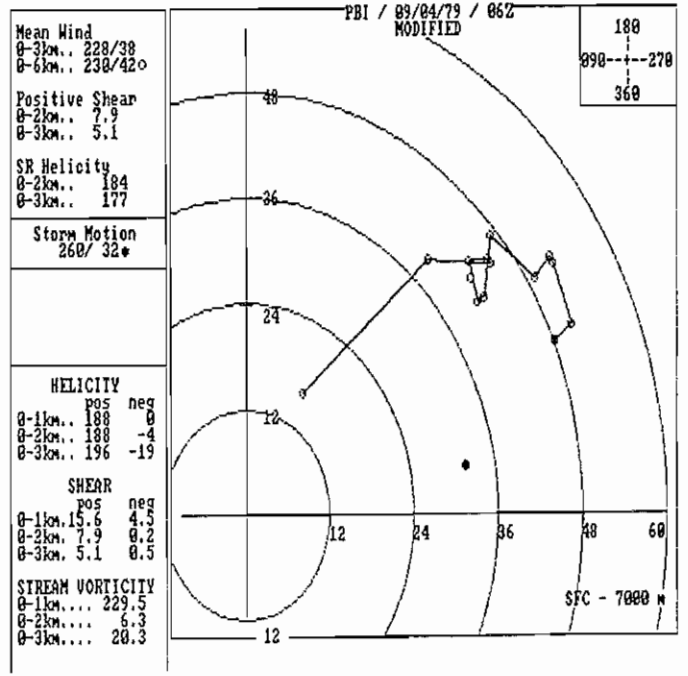
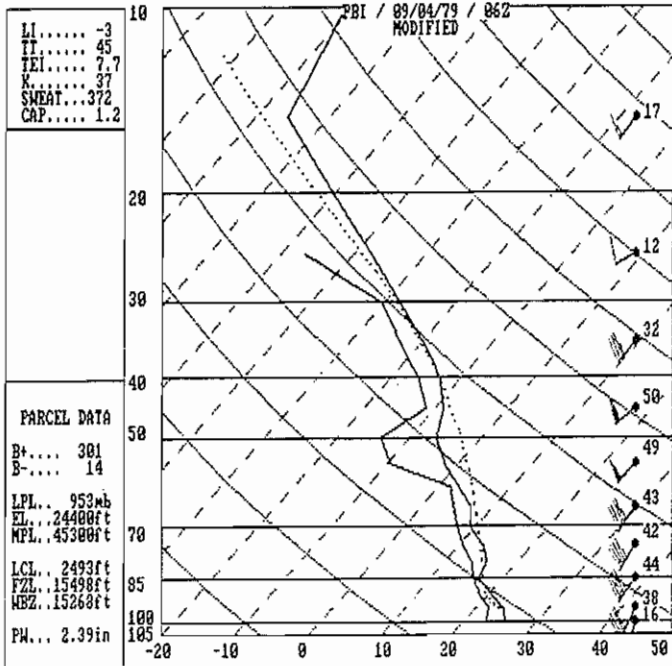
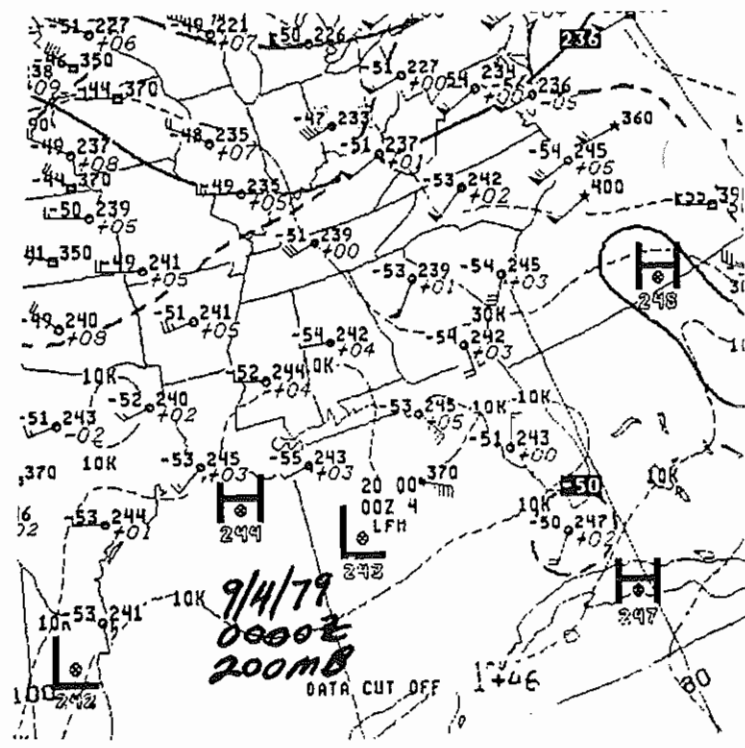
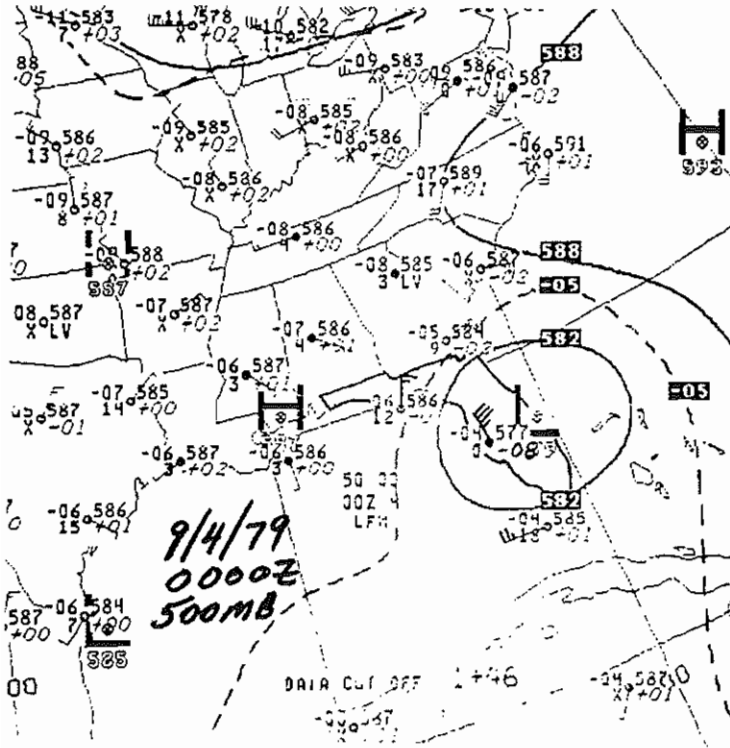
(See McCaul 1991 for additional information on buoyancy and shear characteristics of hurricane-tornado environments and many good references on the topic of hurricane-spawned tornadoes)





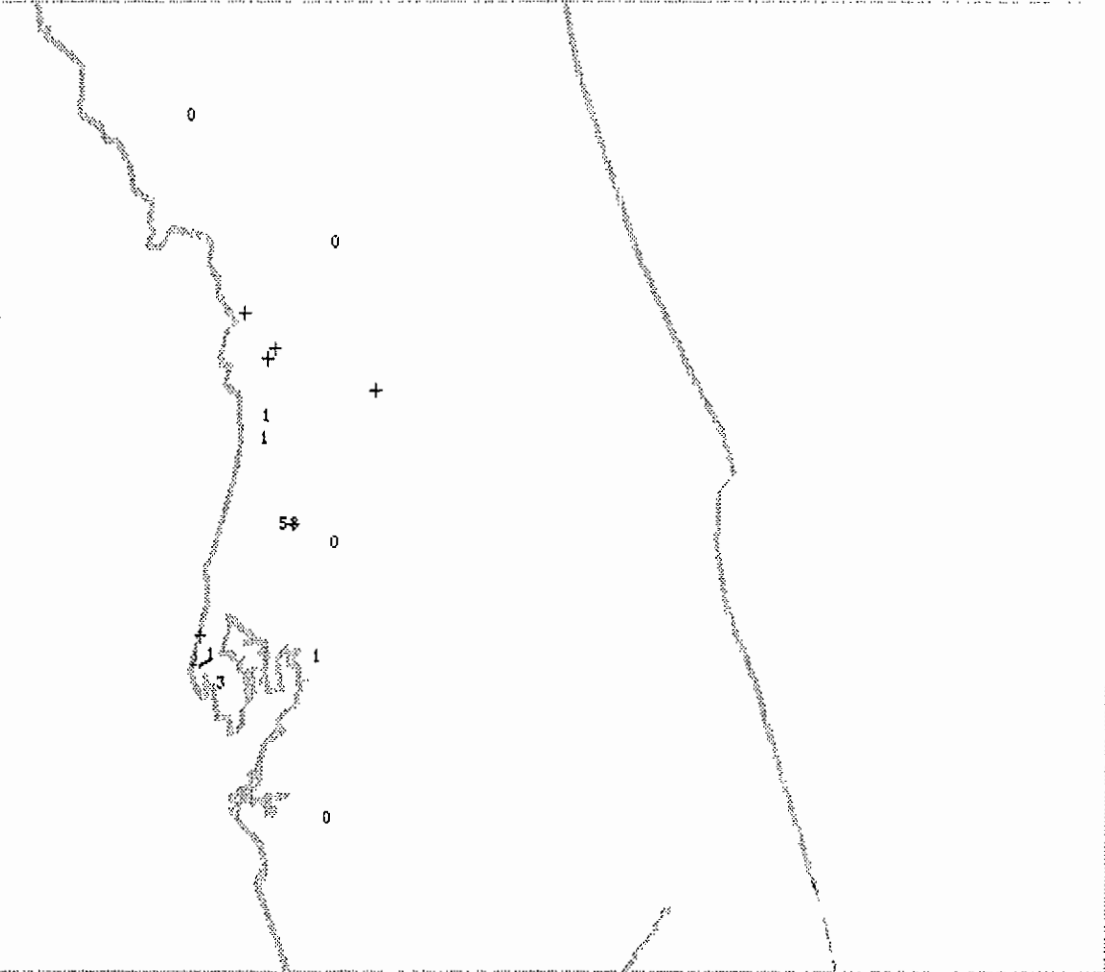


September 3, 1979



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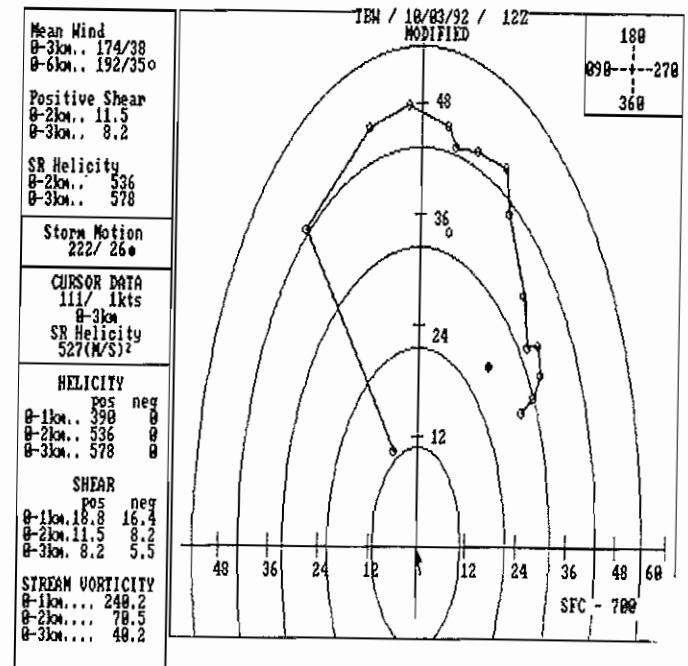
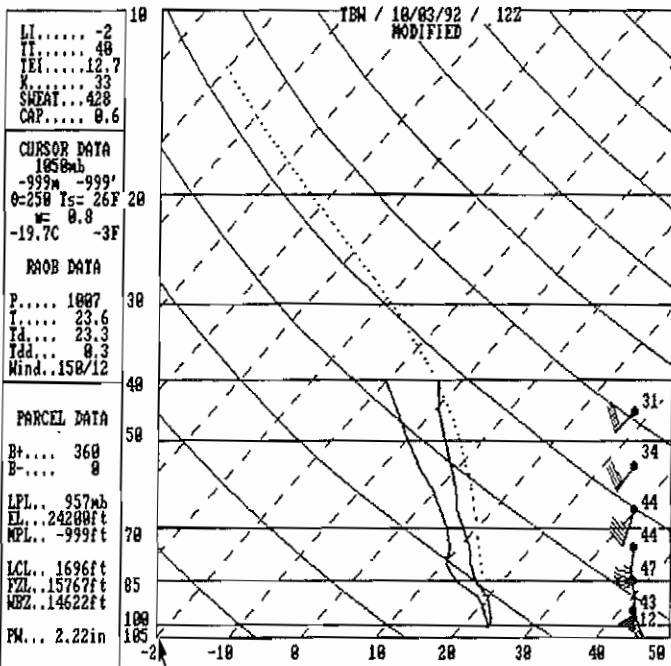
100392 0001 100392 2359 MCO 1 0 RES=HI WID=7 FSCALE WIND HAIL  
 PARALITIS= 4 TURNE INJURIES= 7 HAIL= 0 MIND= 7



001CST 10/03/92 - 2359CST 10/03/92

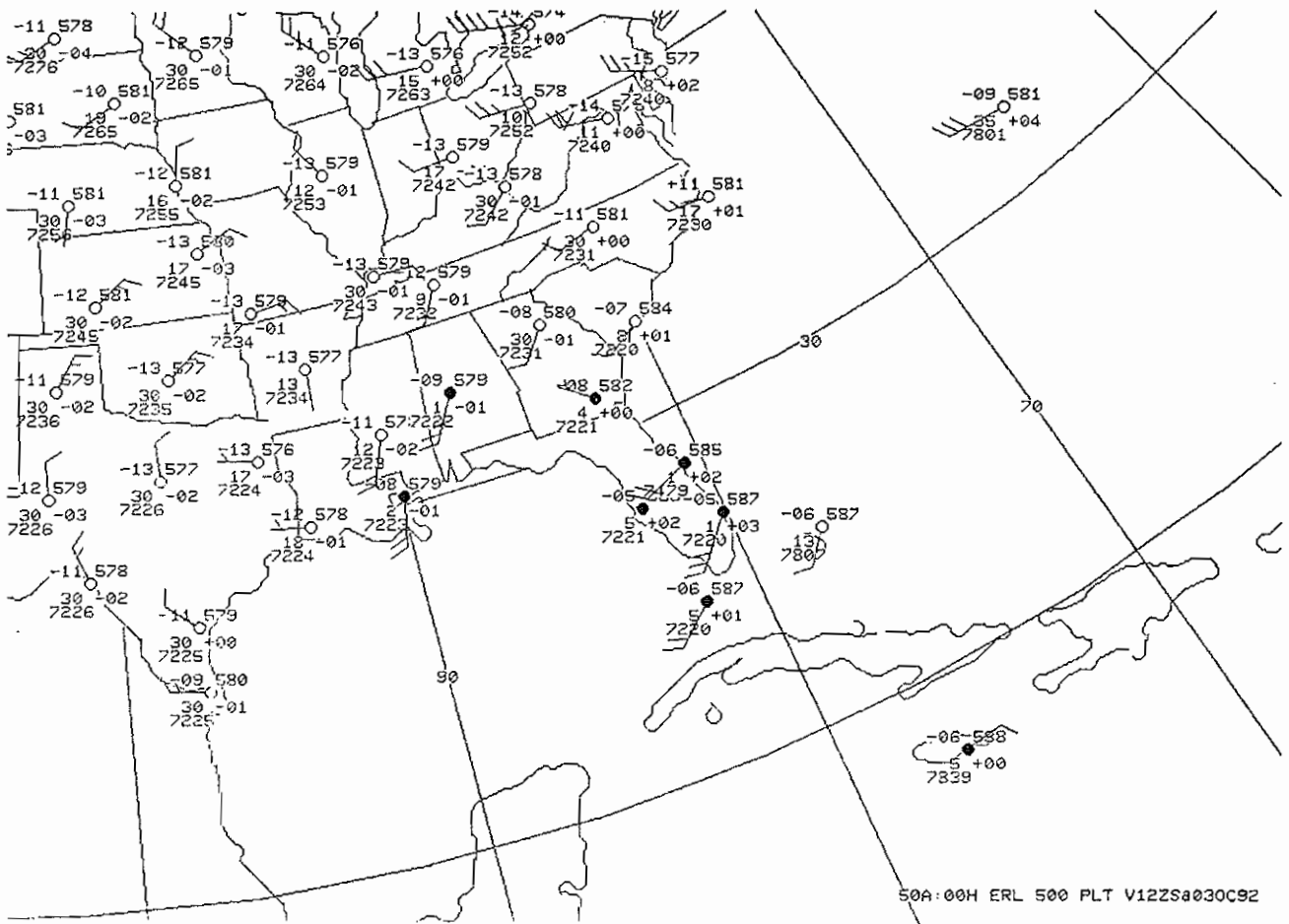
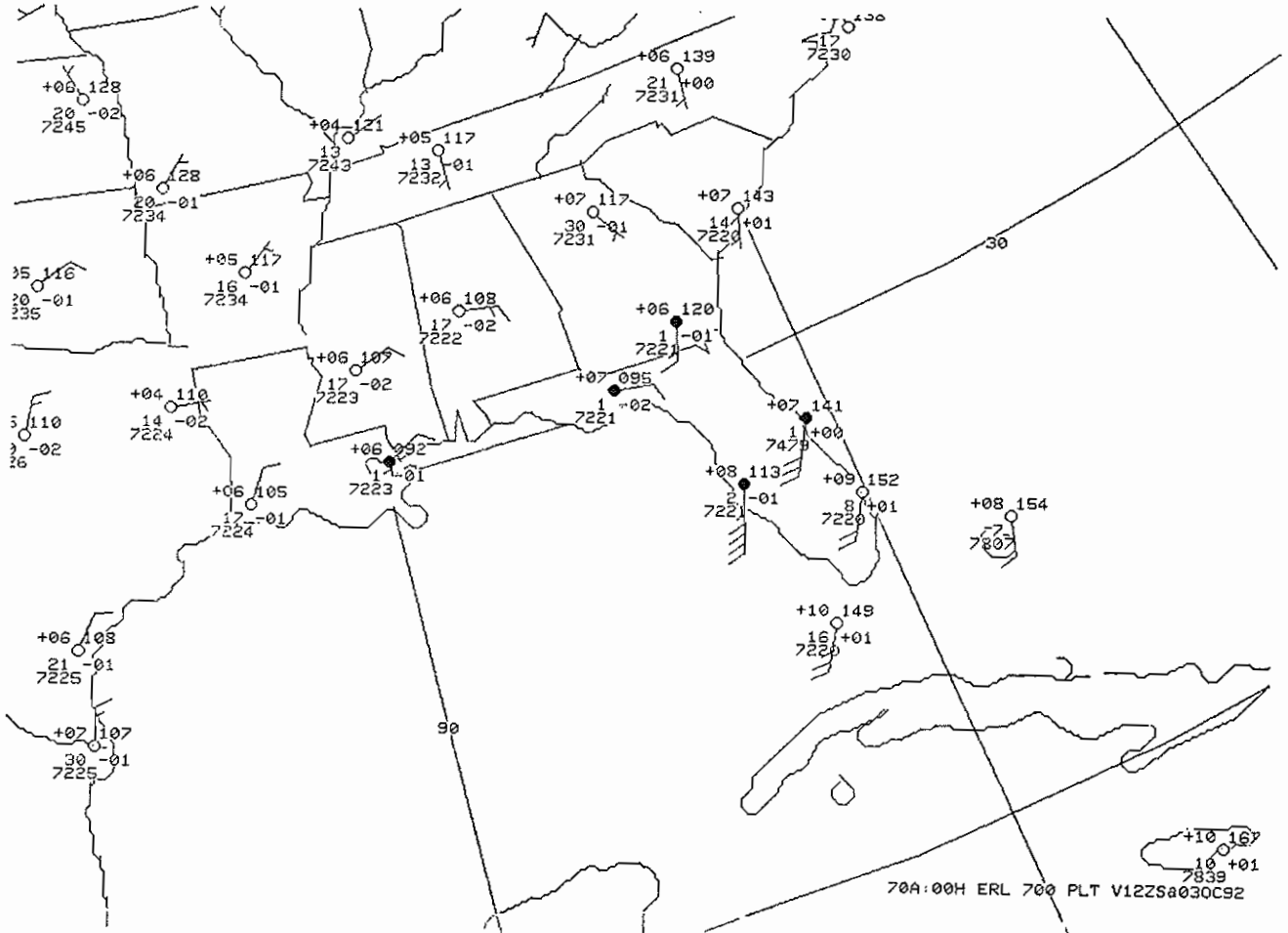
SEVERE WEATHER REPORTS

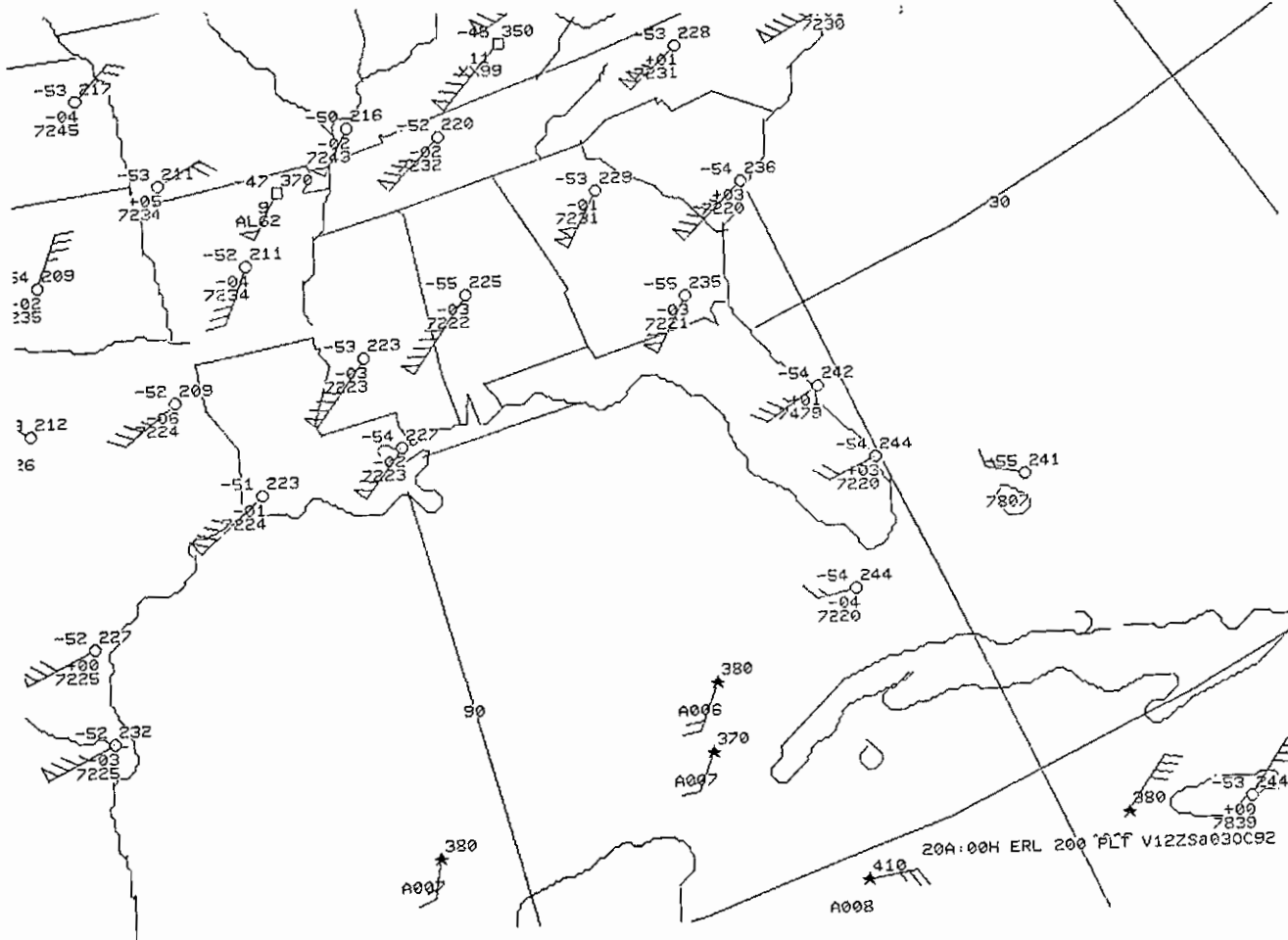
(See: NOAA Disaster Survey, Hagemeyer and Matney 1993b, Anthony 1993, and Davies 1993)





October 3, 1992





MLB WSR-88D

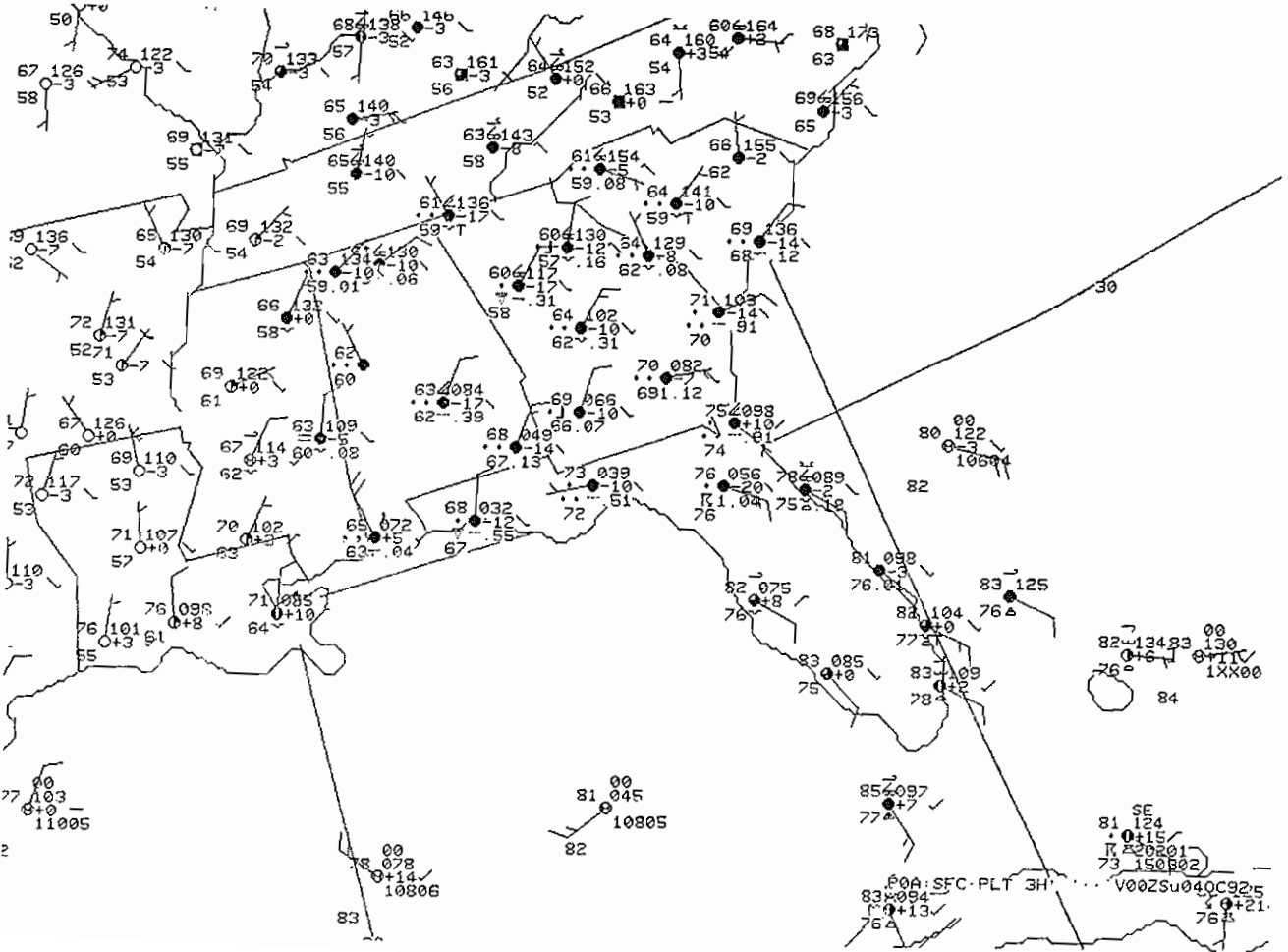
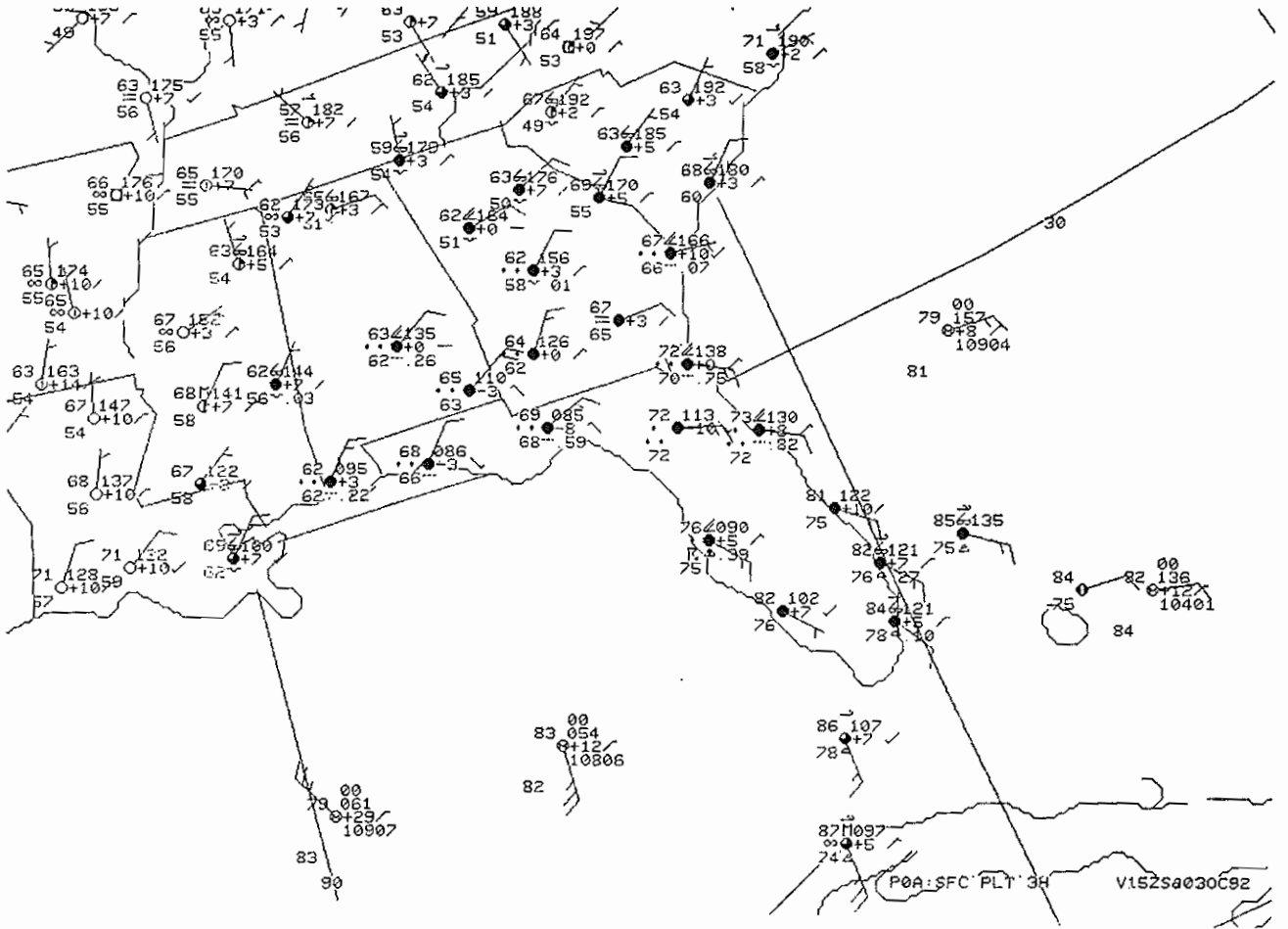
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45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35											
30											
28											
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4											
3											
2											
1											
TIME	1342	1348	1354	1400	1405	1411	1417	1423	1429	1435	1441

VAD WIND PROFILE  
 48 WMP  
 10/03/92 14:41  
 FQA:KHLB 23/06/46H  
 116 FT 80/33/14N  
 MODE A / 21  
 MAX=217 DEG 35 KT  
 ALT: 15000 FT  
 0 KT RMS  
 4  
 8  
 12  
 16

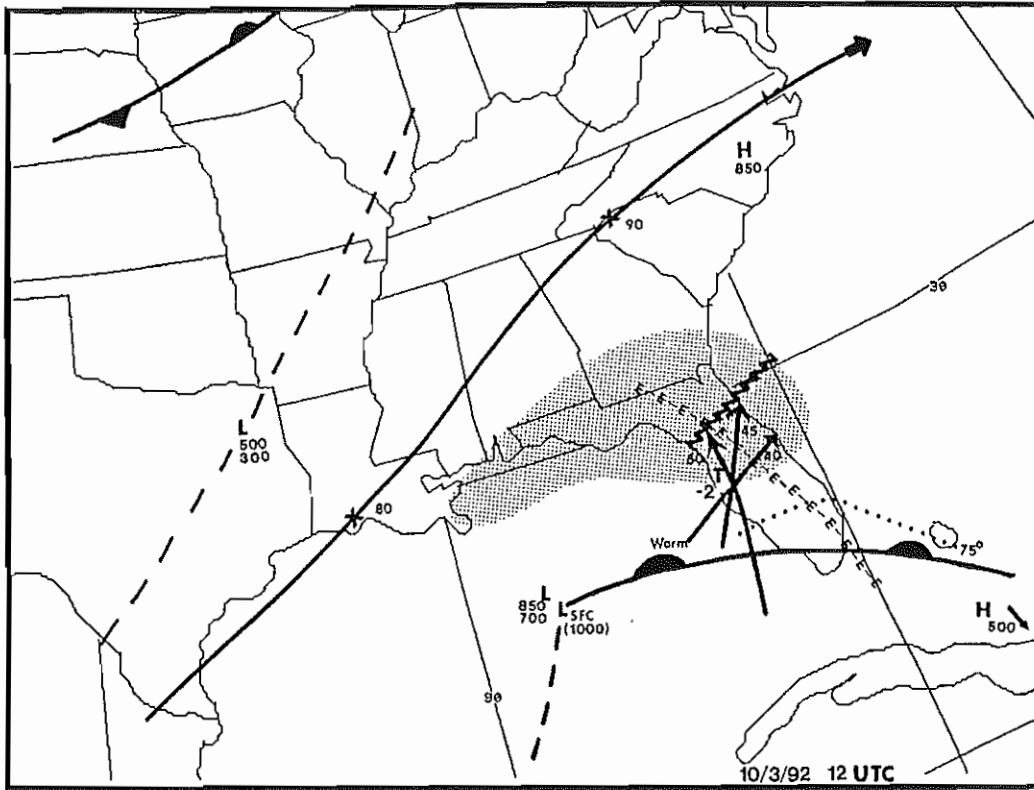
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 ACCEPTED  
 ALERTS:  
 1) GU GT 2) GU GP

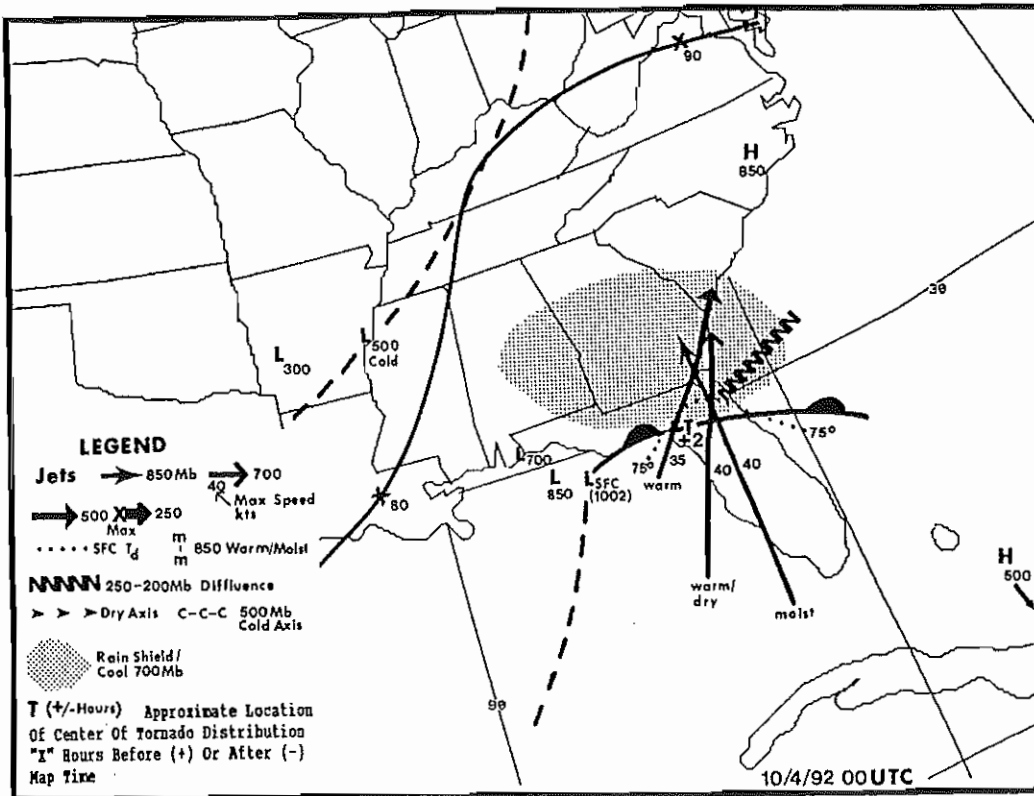
October 3, 1992

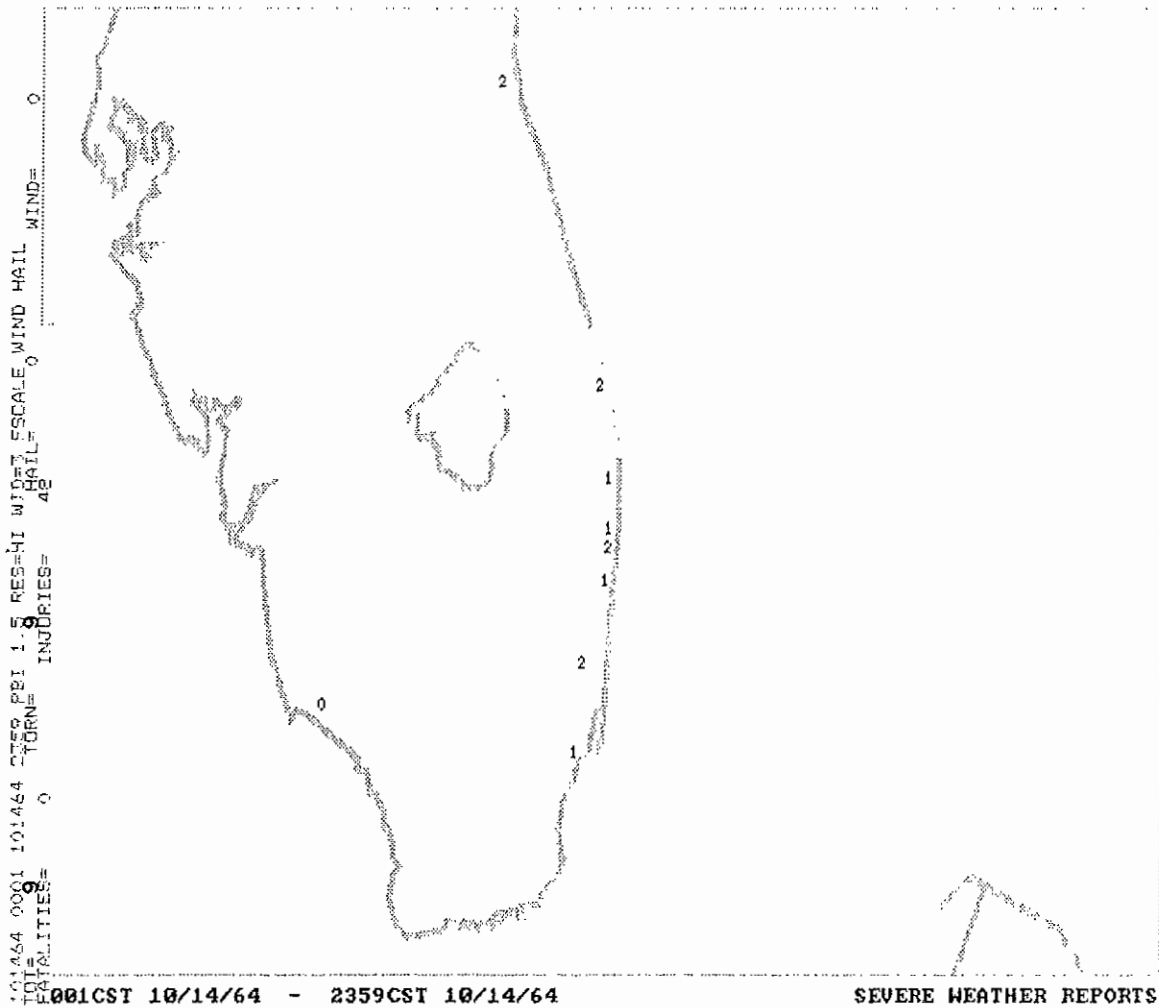




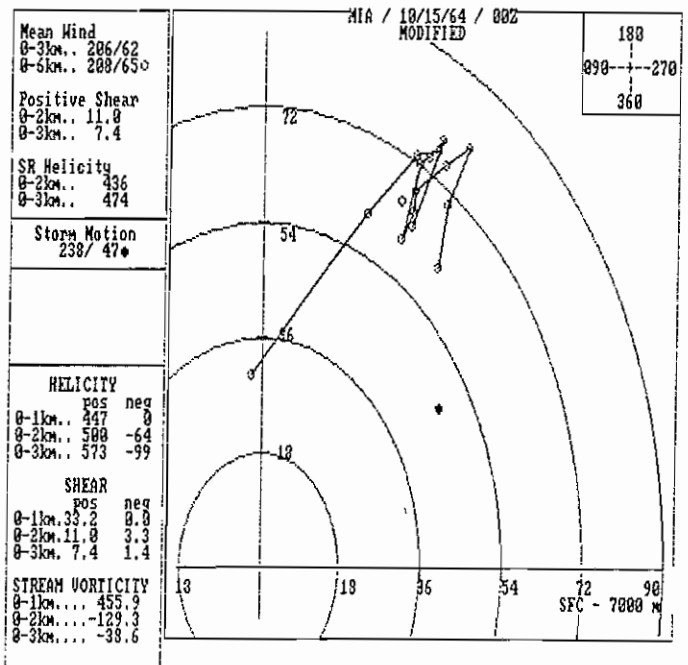
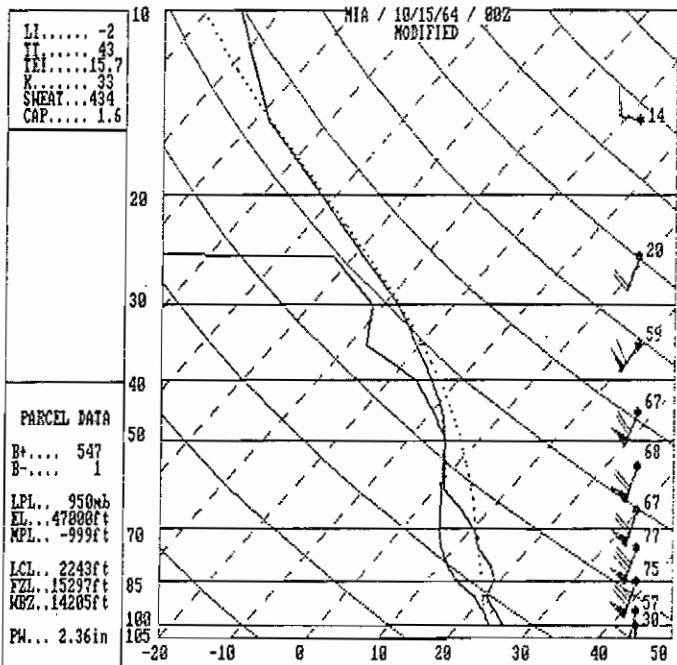


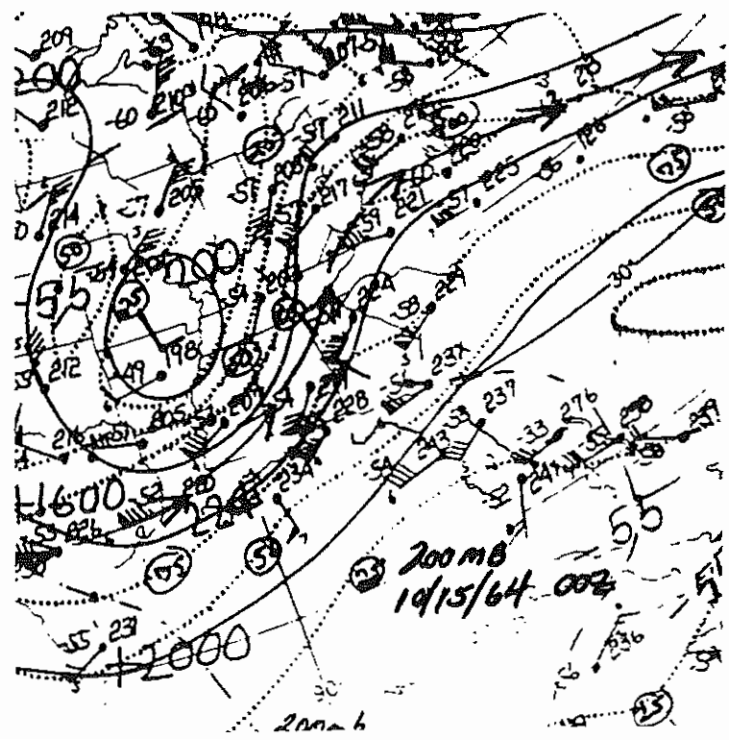
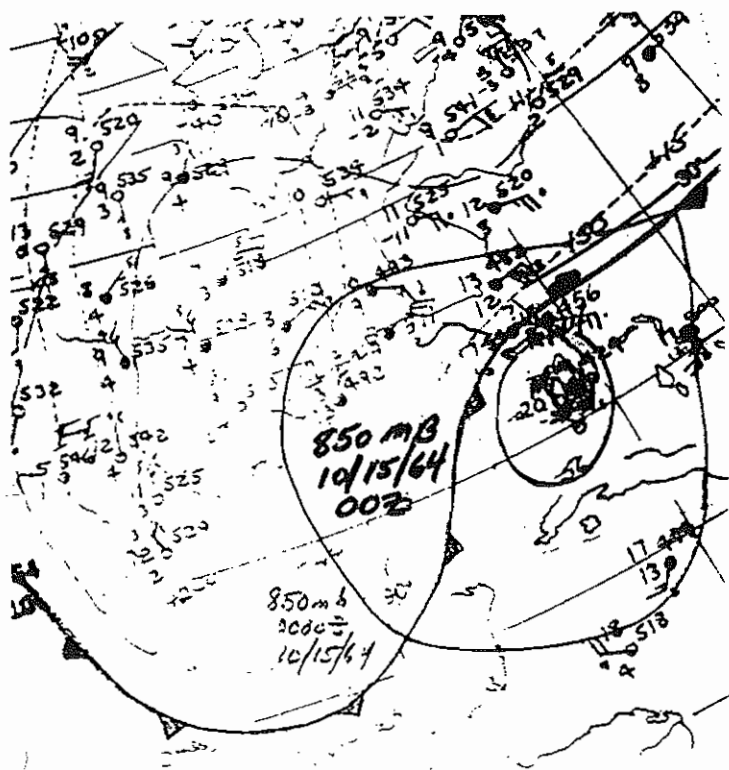
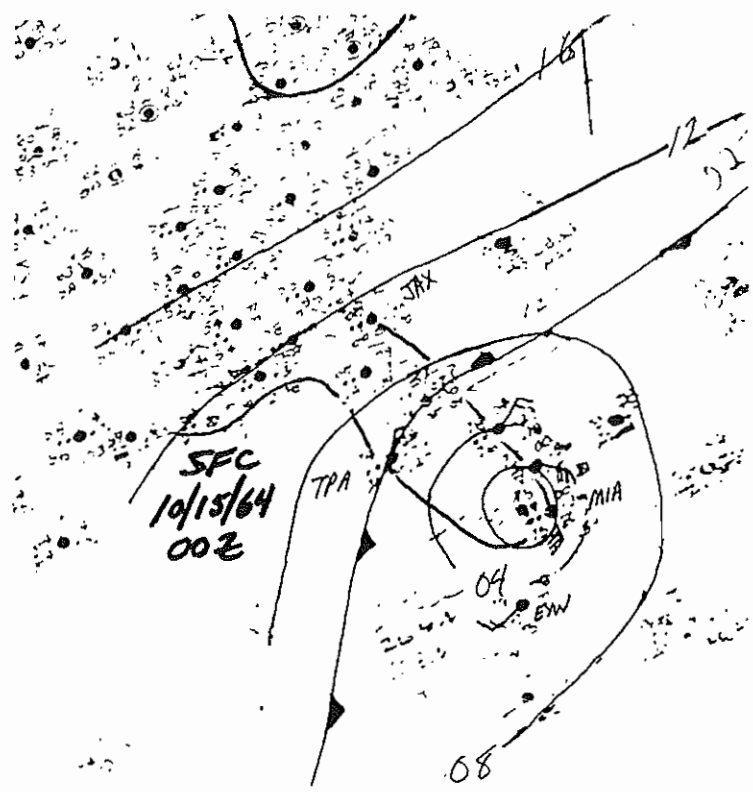
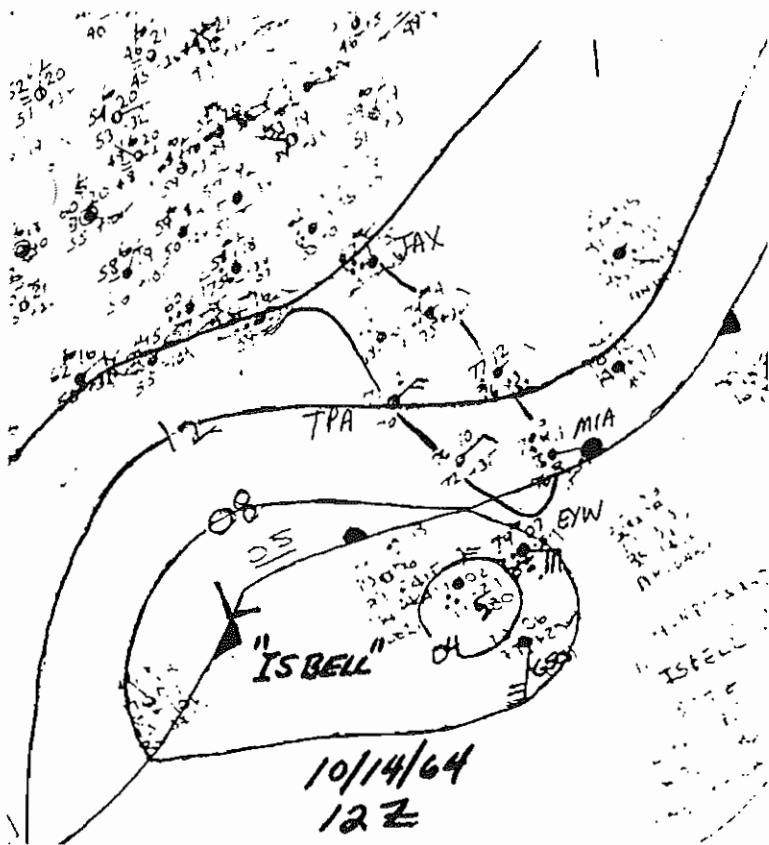
(From Hagemeyer and Matney 1993b)

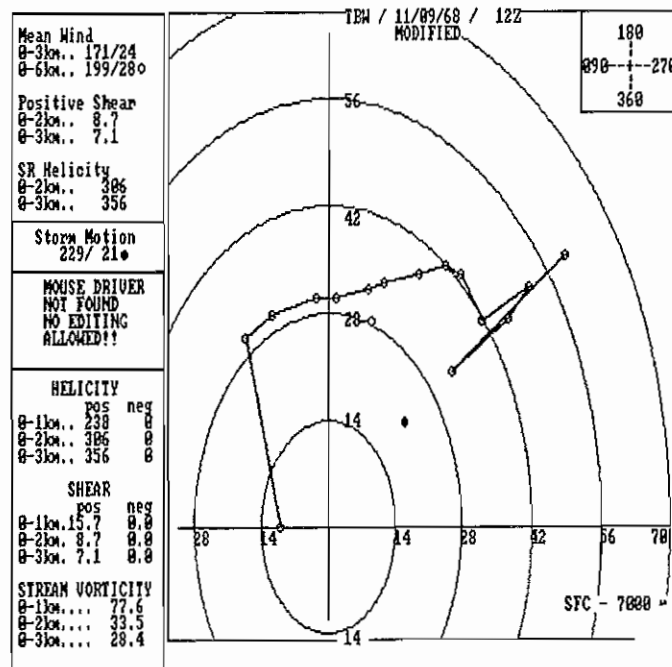
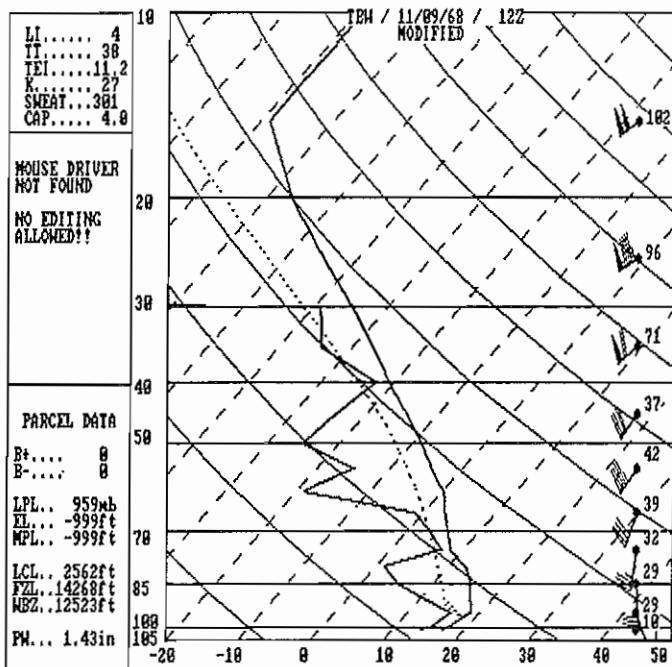
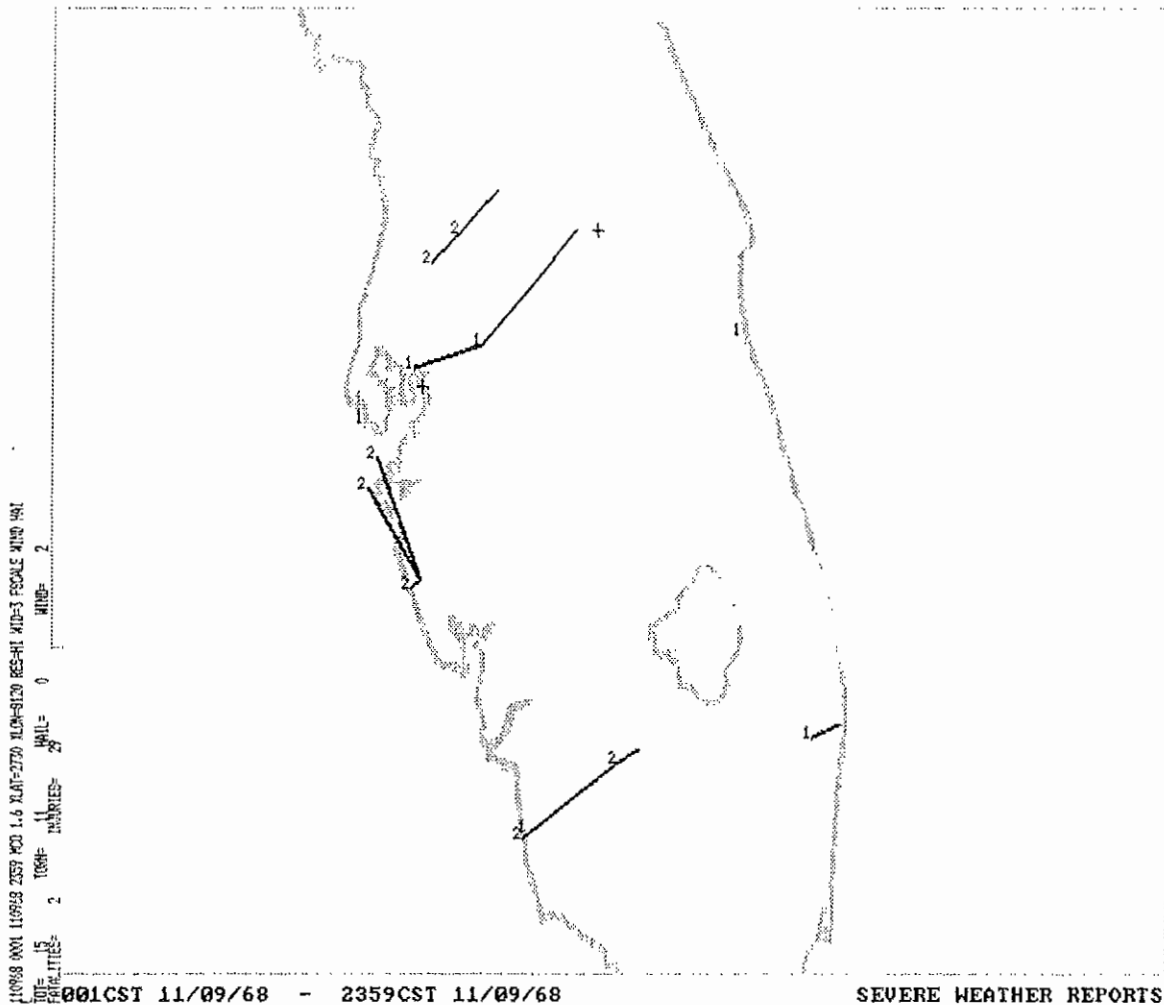


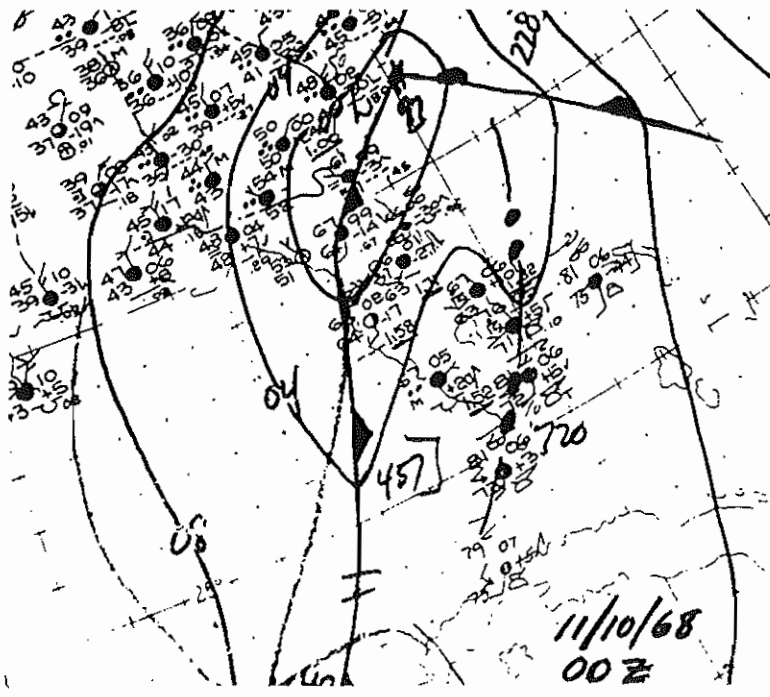
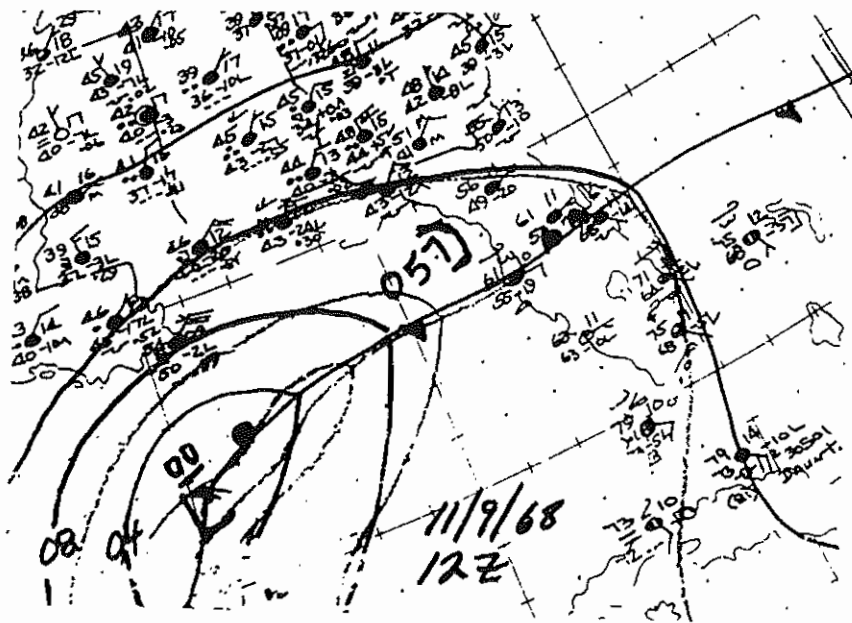
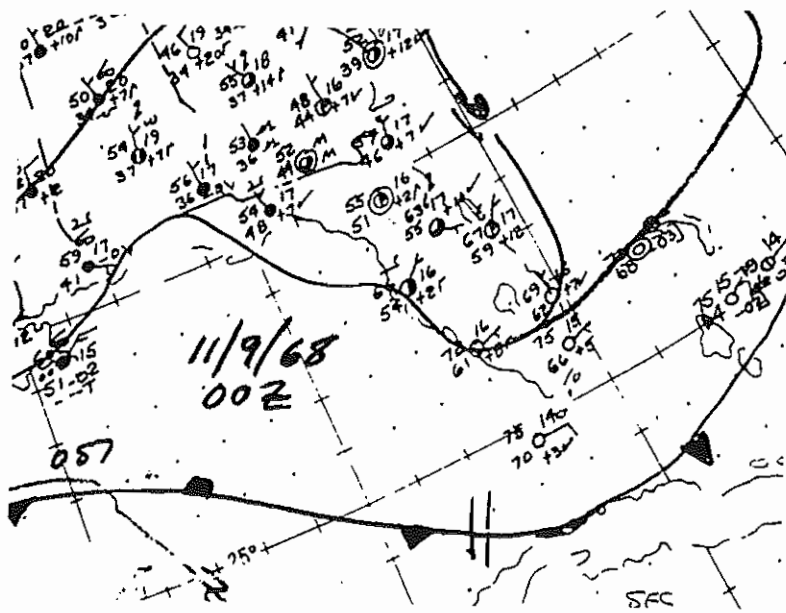


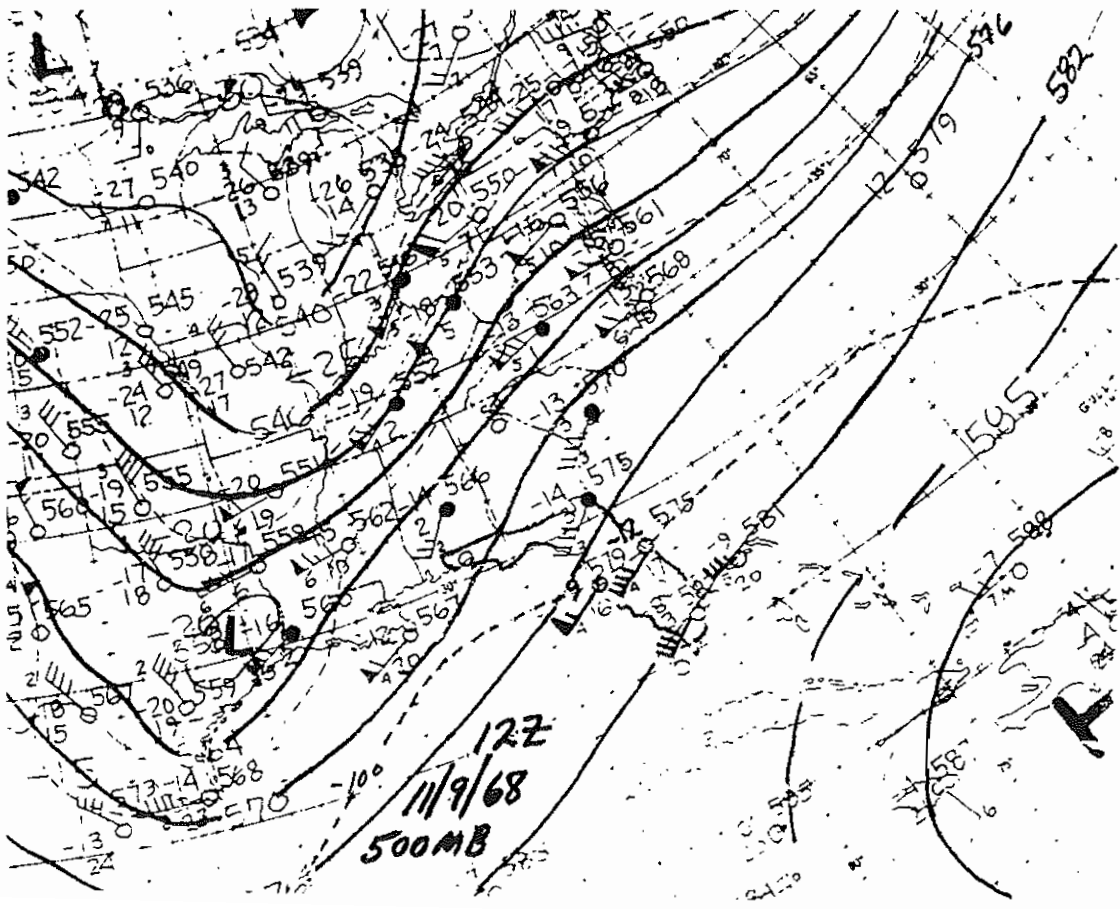
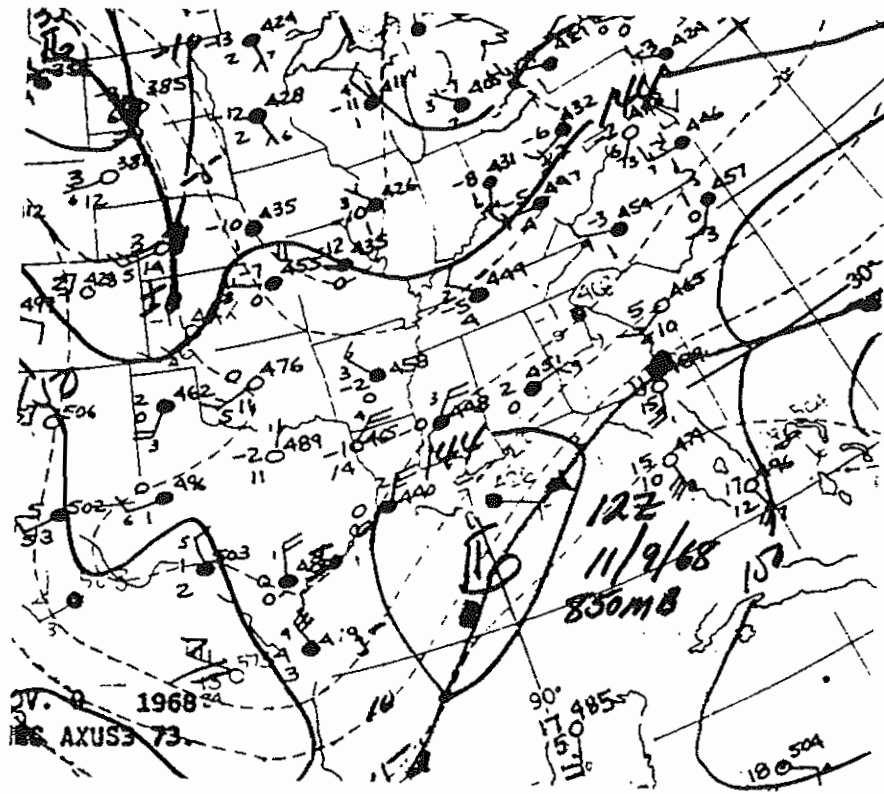
(See McCaul 1991 for additional information on buoyancy and shear characteristics of hurricane-tornado environments and many good references on the topic of hurricane-spawned tornadoes)











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