

LAB: Cyclonic Weather Systems

Name _____

INTRODUCTION: The United States Weather Service is a division of the National Oceanic and Atmospheric Administration (NOAA). Data is received from about 600 stations in the United States, as well as from foreign countries and from ships at sea. This information is transmitted to centers every three hours, beginning at 1 A.M. The centers then plot the information on synoptic maps which are used to predict any weather changes.

Various hazardous weather conditions are threats to different geographic areas of the United States. The National Severe Storm Forecast Center in Kansas City, Missouri studies and monitors tornadoes while hurricanes are watched by the National Hurricane Center in Miami, Florida. In addition to using traditional synoptic maps to forecast these violent weather conditions, these centers also employ technologies such as GOES Next satellites and Nexrad doppler radar.

OBJECTIVE: Using a series of synoptic weather maps you will determine the track of a weather system and make a 24 hour prediction for a given location. You will use storm tracks of a hurricane and a tornado to compare the characteristics of these severe storms.

VOCABULARY:

prevailing westerlies:	- winds tending to blow from the west in U.S.	hurricane:	- a tropical cyclone with winds of 74+ knots.
trade winds:	- winds tending to blow from the northeast between 0°N to 30°N.	tornado:	- a strong, rotating column of air extending from a cumulus cloud to the ground.
jet stream:	- high speed, high altitude winds.	Saffire/Simpson Scale:	- a measure of hurricane intensity (from 1 to 5).
storm track:	- the path a storm takes.	Fujita Scale:	- a measure of wind damage (from 0 to 5).
storm surge:	- the rapid rise in sea level as a hurricane arrives.		

PROCEDURE A: SYNOPTIC MAP STORM TRACK

1. Examine the sequence of synoptic weather maps provided by your instructor.
2. On MAP A: STORM TRACKS, plot an "L" in the location of the low pressure center for the first map of the sequence. Label its date.
3. Repeat Procedure 2 for each of the other maps provided.
4. Using the scale at the bottom of MAP A, calculate the average velocity of the low pressure center in miles per day. **SHOW ALL WORK AND LABEL PROPERLY.**

CALCULATIONS: $\text{velocity (mpd)} = \frac{\text{total miles}}{\text{total \# days}}$

5. Using the scale at the bottom of MAP A, calculate the average velocity of the low pressure center in miles per hour. **SHOW ALL WORK AND LABEL PROPERLY.**

CALCULATIONS: $\text{velocity (mph)} = \frac{\text{total miles}}{\text{total \# hours}}$

6. Predict the location of the low pressure center on the day following the date of the last map of the series. Plot this in red on MAP A. **NOTE: use your calculations of mpd!**

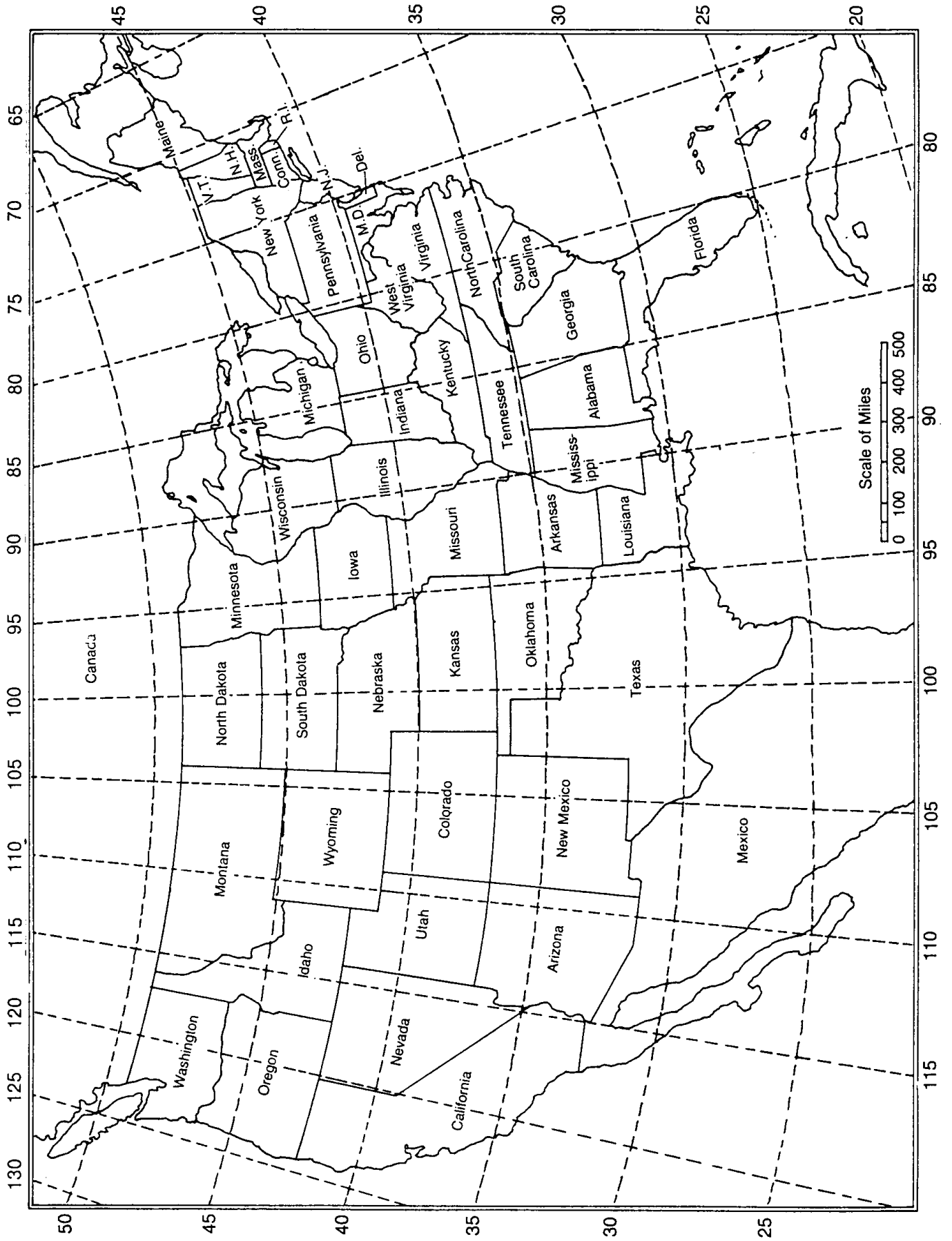
PROCEDURE B: HURRICANE ANDREW

1. Using the HURRICANE ANDREW DATA CHART plot the positions of the tropical cyclone from August 20th through August 27th on MAP B.
2. For each position label the date and time.
3. Using the wind information in the DATA CHART and the Saffir/Simpson Hurricane Scale, determine the tropical cyclone's category for each position. Label each position using the following abbreviations: TD = Tropical Depression; TS = Tropical Storm; H-I = Category I; H-II = Category II; H-III = Category III; H-IV = Category IV.
4. Connect each position with a solid line.
5. Draw an arrow along the solid line showing the cyclone's direction of movement.
6. Referring to the Planetary Wind Diagram on page 15 of the ESRT,
 - a) Draw a large arrow on MAP B representing the trade winds (between 0° and 30° N Latitude). Position it over the Gulf of Mexico.
 - b) Draw a large arrow on MAP B representing the prevailing southwesterly winds (between 30° and 60° N Latitude). Position it over the continental United States.

PROCEDURE C: WICHITA-ANDOVER TORNADO

1. Determine the direction of the tornado's movement.
2. Determine the distance in miles the tornado was on the ground.
3. Determine the total time the tornado was on the ground.
4. Using the information from Procedures 2 and 3 determine the tornado's average rate of movement in miles per hour. **SHOW WORK AND LABEL PROPERLY.**
See ESRT
5. Determine the width of the tornado's path at:
 - a) Clearwater at 5:57 P.M. CDT
 - b) Golden Spur Mobile Home Park

MAP A: STORM TRACKS



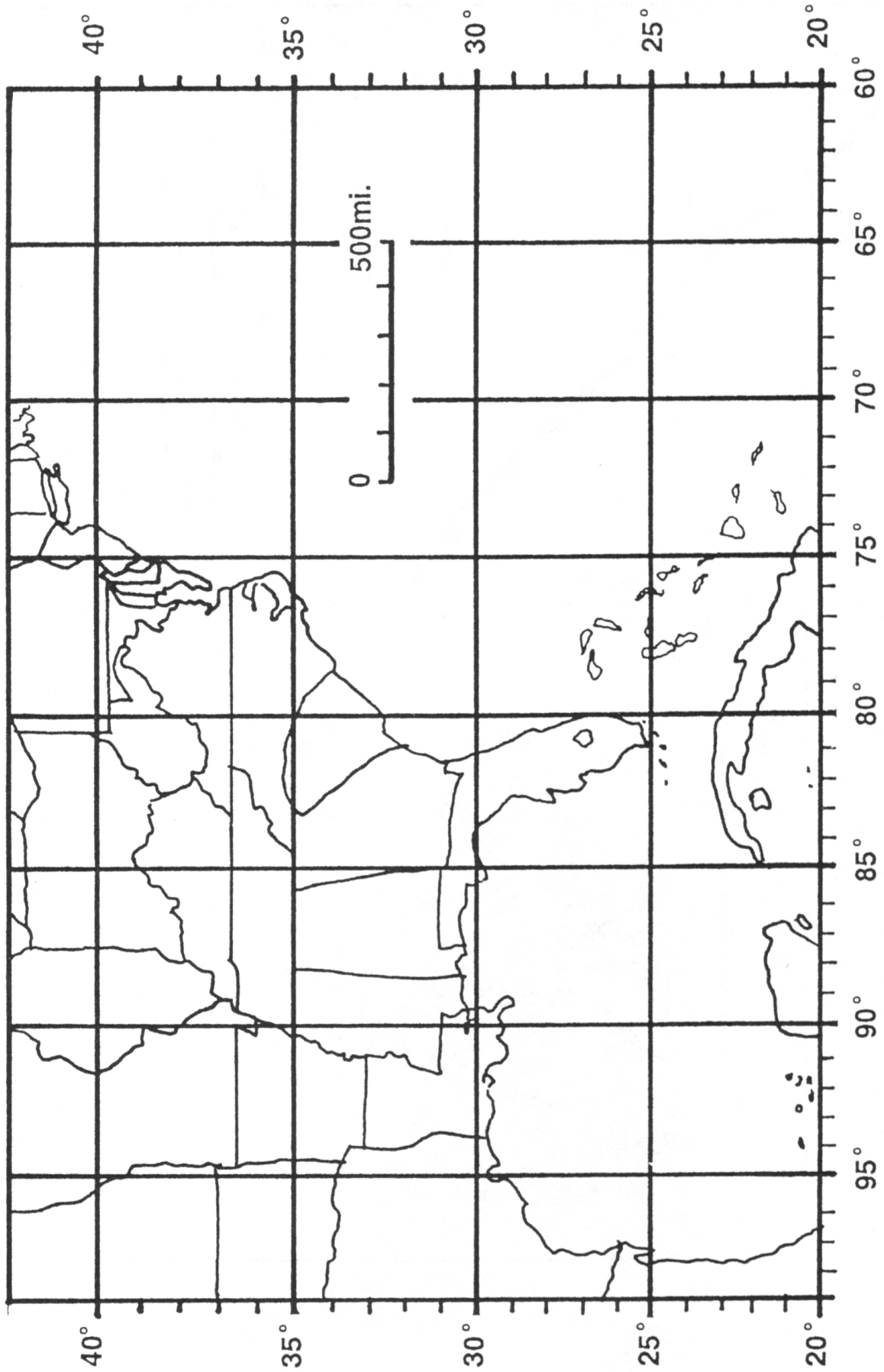
HURRICANE ANDREW DATA CHART (AUGUST, 1992)

DATE/TIME (E.S.T)	LAT. (N)	LONG.(W)	PRESSURE (mb)	WIND (MPH)
20/8 pm	23.0	62.5	1014	52
21/8 am	24.5	64.0	1007	58
8 pm	25.5	66.0	1000	69
22/8 am	26.0	68.5	981	81
8 pm	25.5	71.0	961	104
23/8 am	25.5	74.0	933	138
8 pm	25.5	77.5	930	144
24/8 am	25.5	81.0	951	127
8 pm	26.0	85.0	943	132
25/8 am	27.0	88.0	946	132
8 pm	28.5	90.5	937	138
26/8 am	30.0	91.5	973	92
8 pm	31.5	91.0	995	40
27/8 am	33.0	89.5	998	35
8 pm	34.5	86.5	1000	23

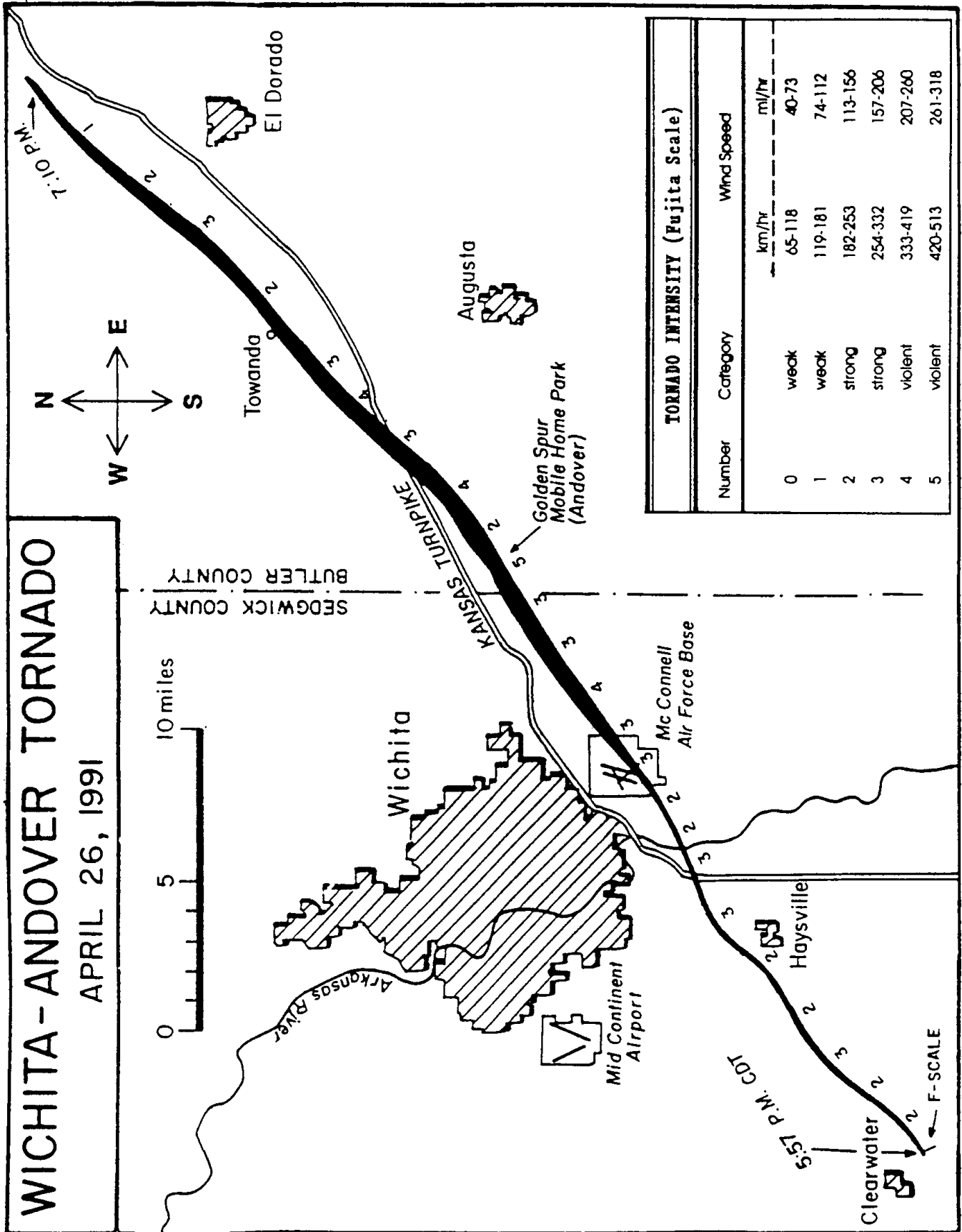
SAFFIR/SIMPSON HURRICANE SCALE

SCALE NUMBER (CATEGORY)	PRESSURE (millibars)	WINDS (mph)	STORM SURGE (ft)	DAMAGE
TROP. DEPRESSION	---	<38	---	---
TROPICAL STORM	---	39-73	---	---
I	>979	74-95	4-5	Minimal
II	965-979	96-110	6-8	Moderate
III	945-964	111-130	9-12	Extensive
IV	920-944	131-155	13-18	Extreme
V	<920	>155	>18	Catastrophic

MAP B: HURRICANE ANDREW



MAP C: WICHITA-ANDOVER TORNADO



Mapping and Aerial Damage Survey by Brion E. Smith, NSSFC

Map Courtesy of NOAA

DISCUSSION QUESTIONS: (Answer in Complete Sentences.)

1. What is the general direction of the track of a low pressure center in the United States?
2. What factors are responsible for the general direction in which low pressure centers move across the contiguous United States?
3. How can a series of synoptic weather maps be used to predict the future location of a low pressure center?
4. According to the HURRICANE ANDREW DATA CHART, what is the relationship between air pressure and wind velocity in a tropical cyclone?
5. Compare the distance the hurricane traveled in equal times between August 25 from 8 am to 8 pm and August 26 from 8 am to 8 pm.
6. Compare the pressure and wind velocity on August 25 (from 8 am to 8 pm) to the pressure and wind velocity from 8 am to 8 pm on August 26.
7. Considering your answers to questions five and six, what might be a source of a hurricane's energy?
8. According to the Saffire/Simpson Scale, what storm surge and type of damage was most likely experienced in Homestead, Florida which was directly in the path of the hurricane on the east coast?

9. If a hurricane moved along Florida's east coast north of 30° N latitude, what general direction would it most probably travel?

10. Based on Procedure C, what appears to be the relationship between a tornado's width and its intensity on the Fujita scale (F-Scale)?

11. Compare the duration of the Wichita-Andover tornado to that of Hurricane Andrew.

12. Thirteen of the 19 lives lost due to the Wichita-Andover Tornado were at the mobile home park in Andover. Even though there was some advanced warning, what could explain the relatively high death toll at this location?

CONCLUSION: What information is required to provide advanced warnings of severe weather conditions?