

Preliminary Report
Hurricane Bonnie
23-28 June 1986
by
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INTRODUCTION

Hurricane Bonnie was the second tropical cyclone that formed in the Atlantic basin in June 1986. There have been seven other years this century when two or more tropical cyclones reaching at least tropical storm strength formed there in that month. Bonnie was the eleventh hurricane this century to make landfall on the U.S. coast in June. Six of those strikes occurred in Texas, four in Florida, and one in Louisiana. Audrey (1957, category 4), Alma (1966, category 2), and Agnes (1972, category 1) were among those striking the coast in June. Although, Bonnie had the highest central pressure of the eleven at landfall, it generated appreciable weather and damage for its compact size.

SYNOPTIC HISTORY

The early history of Bonnie can be traced to a mid/upper level vortex in conjunction with a quasi-stationary frontal (baroclinic) zone at the surface extending east-west across north Florida and into the extreme northeast Gulf of Mexico. The system began moving southward on June 20th with the vortex aloft appearing progressively at lower levels in the atmosphere. Satellite specialists at NHC stated in their Satellite Interpretation Messages (AFOS header MIASIMMIA) that the vortex reached the low/mid portion of the atmosphere in the Tampa Bay area on June 21st, and was clearly a low-level vortex just west of Sarasota, Florida early on June 22nd.

The low-level center moved toward the southwest without organized deep convection and passed just to the south of Buoy #42003 (26.0N 85.9W) in the eastern Gulf of Mexico according to the wind shifts and pressure reports at that buoy, and satellite position estimates. Satellite imagery indicated that the convection had organized sufficiently for the system to be formally classified as a tropical cyclone at 1800Z June 23. Technically with the low-level counter-clockwise circulation and the convection appropriately organized, the remaining criterion for labeling the system as a tropical depression was evidence that the circulation existed at the surface with wind speeds less than 34 knots. Although that evidence was not yet available from reconnaissance flights, hourly buoy reports in the central Gulf of Mexico substantiated that a low pressure center was present at the surface and thus the first tropical depression advisory was issued by the NHC at 2200Z June 23.

The organization of the convection fluctuated as the depression took a more west northwest and then northwesterly course at 5 knots. Upon investigating the depression at 1500Z June 24, Air Force reconnaissance estimated surface winds of 50 knots and the NHC issued the first advisory on T.S. Bonnie at 1600Z.

During the next 24 hours, Bonnie moved on a more west northwesterly course at a slightly faster forward speed of 7 knots and continued to strengthen with satellite imagery showing appreciable outflow at the upper levels. Reconnaissance reports at 1414Z June 25 indicated that the winds had reached 68 knots at an altitude of 1500 feet. Thus, Bonnie was upgraded to a hurricane on the 1600Z June 25 advisory. Bonnie's forward speed continued to accelerate to 10 knots while taking a more northwesterly course passing over Conoco oil rig WC 459A (28.3N 93.0W), just south of Mobil oil rig P12 (WC 353...29.ON 93.5W), and over the ship Chesapeake Trader at 29.45N 94.0W before making landfall as a category 1 hurricane, on the Saffir/Simpson Scale, immediately southwest of Sea Rim State Park which is close to the Texas/Louisiana border.

Bonnie weakened rapidly while gradually turning on a more northerly course inland passing west of Beaumont, near Lufkin and near Longview in east Texas. The remnants continued northeastward across Arkansas and into extreme southeast Missouri before being absorbed in a frontal zone. A summary of the preliminary best track for Bonnie with 6-hourly wind and pressure conditions is presented in Figures 1-3 and Table 1. It is noted that the standard pressure/wind relationship underestimated the strength of this storm.

METEOROLOGICAL STATISTICS

The highest winds observed at oil rigs were gusts to 84 knots at P12 (anemometer height 181 ft MSL), and 72 knots (sustained) at WC 459A with gusts to 79 knots (anemometer height 80 ft MSL).

The ship Chesapeake Trader enroute from Sabine Pass to Galveston, Texas went through the eye of Bonnie 15 nm off the Texas coast. The barogram from that ship showing a minimum pressure of 990 mb is presented in Figure 4. The corrected barogram from Sea Rim State Park, see Figure 5, shows a similar pressure at landfall. The winds at Sea Rim State Park, see Figure 6, reached 67 knots (sustained) with gusts to 85 knots. A time plot of the meteorological conditions obtained at the Coastal - Marine Automated Network (C-MAN) station located at Sea Rim State Park is shown in Figure 7. The C-MAN data were measured during a 2-minute averaging period at 25 minutes after the hour and the peak gust is the highest 5-second average taken during that 2-minute period. Since the sampling was not continuous, the C-MAN data in this case did not represent peak conditions. In fact, there is a good chance that peak conditions will be missed most of the time due to the 2-minute sampling. It is clearly seen in Figures 6 and 7 that the highest wind at Sea Rim State Park occurred after the eye made landfall. The highest sustained wind at landfall was estimated to be 75 knots based on continuity from reconnaissance and oil rig data just prior to landfall. The hourly changes in wind direction substantiate that the center of the eye passed just southwest of Sea Rim State Park near 0500 CDT (1000Z). Actually Figure 6 shows eye effects from 0518 CDT to 0555 CDT but the lowest winds did not drop below 37 knots during passage of the eye.

A summary of the meteorological statistics available at this time associated with Bonnie's landfall is presented in Tables 2 and 3.

Bonnie produced heavy rainfall and at least 11 tornadoes inland. Ace, Texas received 13 inches, and greater than 10 inches were observed at several

locations in east Texas and west of Shreveport, Louisiana. The heavy rainfalls produced street flooding and caused flooding along the Sabine and Neches rivers. There was water in some homes in the Bridge City, Texas area for about six hours. Four tornadoes in east Texas and seven in Louisiana were attributed to Bonnie.

CASUALTY AND DAMAGE STATISTICS

There were 3 deaths attributed to Bonnie according to the Weather Service Office in Port Arthur, Texas. A partially paralyzed woman died after being trapped inside her burning Port Arthur home by wind-fanned flames. It is thought that the fire was started by candles. A 56-year-old man was killed when he pulled his automobile off the road because of the bad weather and was hit by another vehicle. Another man was killed in a head-on collision. A dozen others were injured.

The storm produced power outages in the Port Arthur area and the city experienced broken store windows, scattered tree limbs, and debris-filled streets. In southwest Louisiana, about 25 homes, trailers, and fishing-camp cabins were destroyed. A small dam in Big Thicket Lake Estates (northern Liberty County, Texas) collapsed. There was considerable flooding of streets and underpasses.

Damage estimates and the number of people evacuated were:

<u>Location</u>	<u>Amount</u>	<u>Evacuations</u>	<u>Source</u>
Galvestion County	\$30,000		WSO Houston
Galveston Island		5,000	"
Bolivar Peninsula		5,000	"
Brazoria County		4,000	"
Chambers County	\$1,000,000	500	"
Harris County		500	"
Matagorda County		200	"
Cameron Parish	\$400,000	7,000	WSO Lake Charles

FORECAST AND WARNING CRITIQUE

The first advisory on Bonnie as a depression was issued only 60 hours before actual landfall, the first advisory as a storm 42 hours and the first advisory as a hurricane only 18 hours before actual landfall. Although the relatively short history restricted the time for planning, it is noted in Table 4 that the probabilities from Port O'Connor to Port Arthur, Texas were essentially the same 32 hours before landfall. Subsequently the forecast track was gradually shifted northward in response to weakening ridging conditions to the north of the system. That shifting caused the highest probabilities to be shifted toward the Port Arthur area. Thus the trend in the probabilities provided significant information for planning within the warning area, see Table 5.

The error in the 24-hour forecast valid at 0600Z June 26 (4 hours before actual landfall) was 95 nm and in the forecast valid at 1200Z June 26 (2 hours

after actual landfall) was 55 nm. Both forecasts were to the left of the actual 24-hour best track position. The landfall error based on the 24-hour forecast valid at 0600Z June 26 was 85 nm.

Forecast conditions for landfall were quite close to what was observed (see below).

	<u>Forecast</u>	<u>Observed</u>
Sustained wind speed (kt)	75	67 (72 at oil rig)
Storm Surge (ft)	5 to 7	5.2
rainfall (inches)	>5	13
tornadoes	risk	11

TABLE 1. Preliminary best track, Hurricane Bonnie, 23-28 June 1986

DATE	TIME (GMT)	POSITION		PRESSURE (mb)	WIND kt	STAGE
		LATITUDE	LONGITUDE			
23 June	1800	25.6	87.2	1014	25	TD
24 June	0000	25.7	87.8	1013	25	"
	0600	26.0	88.4	1014	25	"
	1200	26.4	88.9	1011	30	"
	1800	26.6	89.5	1006	40	TS
25 June	0000	26.7	90.3	1001	45	"
	0600	26.8	91.0	1002	50	"
	1200	27.2	91.7	997	55	"
	1800	27.7	92.2	1001	65	H
26 June	0000	28.2	92.9	999	70	"
	0600	29.0	93.7	995	75	"
	1200	29.9	94.3	992	65	"
	1800	30.9	94.7	1000	35	TS
27 June	0000	31.8	94.7	1009	30	TD
	0600	32.8	94.7	1015	25	DISSIPATING
	1200	33.9	94.3	1016	20	"
	1800	34.8	93.5	1016	20	"
28 June	0000	35.6	92.5	1014	15	"
	0600	36.5	91.3	1013	10	"
	1200	37.2	90.0	1012	10	"

26 June	0900	29.5	94.0	990	75	Minimum Pressure
26 June	1000	29.6	94.2	990	75	Landfall* (Also Minimum Pressure)

*Landfall location between Sea Rim State Park and High Island, Texas
 *Motion at landfall 335/10kt
 *Eye diameter at landfall 15nm

TABLE 2. Meteorological data, Hurricane Bonnie, 23-28 June 1986

LOCATION	WIND						TIDE		RAINFALL					
	LOWEST PRESSURE		HIGHEST SUSTAINED		PEAK GUST		HT ABOVE NORMAL		1HR	6HR	12HR	24HR	STORM	
	(MB)	DATE/TIME(Z)	KT	DATE/TIME(Z)	KT	DATE/TIME(Z)	(FT)	DATE/TIME(Z)	(IN)	(IN)	(IN)	(IN)	(IN)	
WSO Galveston, TX	1011.1	26/0910	NW/24	26/0930	NW/30	25/0911								0.38
WSO Houston (Alvin), TX			SSW/16	26/2007	SSW/21	26/2007								0.62
IAH, TX	1012.7	26/0852	SE/20	25/2252	SE/28	25/2243								0.15
Hobby, TX	1012.4	26/0848	SSW/18	26/2048	SSW/25	26/2048								0.04
High Island, TX					75(est)									6.36
Winnie, TX					55(est)									
Anahuac, TX					35(est)									
Galveston Island, TX							2.2	25/2300						
Bolivar Peninsula, TX							3-4							
Ace, TX														13.0
IOS Livingston Dam, TX														11.5
Goodrich, TX														9.0
Eastern Chambers County, TX														4-6
Vidor, TX														8.0
Port Arthur, TX	1004.5	26/1242	SE/48	26/1254	SE/66	26/1246			1.05	2.95	4.82	4.87		
Sea Rim State Park, TX	990.5	26/1000	SSW/67		SSW/85	26/1100								
Sabine Pass, TX	1005.1	26/1000	ESE/55				5.2	26/1145						
NW Sabine Lake, TX	1010.0	26/1146	35		55	26/1146								
Lake Charles, LA	1013.6	26/0758	SE/22	26/1237	SE/36	26/1102			0.15	0.40	0.48	0.49		
Cameron, LA	1012.9	26/0900	S/47	26/1138	S/54	26/1025								
Calcasieu Pass							2-3							
New Orleans (MSY), LA	1015.4	25/0654	SSE/19	25/1521	SSE/28	25/1536								0.30
New Orleans (NEW), LA	1015.0	25/0650	E/12	25/1352	E/17	25/1550								
Bayou Bienvenue, LA							2.4 MSL	25/2301						
Paris Rd, LA							2.7 MSL	25/2300						
Rigolets, LA							1.7 MSL	25/2201						
Industrial Canal, LA							1.6 MSL	25/2201						

TABLE 3. Location of tornadoes associated with Hurricane Bonnie, June 1986.

<u>Location</u>		<u>Date/Time(Z)</u>
1. Beaumont TX	(10 NNW BPT)	26/1227Z
2. Winnie TX	(23 WSW BPT)	26/1240Z
3. NW Jefferson CO. TX	(15W BPT)	26/1352Z
4. N Kirbyville TX	(48 N BPT)	26/1730Z
5. Grand Cane LA	(25 S SHV)	27/0710Z
6. Shreveport LA	(5 ENE SHV)	27/1340Z
7. 1 N Springhill LA	(39 WSW ELD)	28/0008Z
8. 2 W Springhill LA	(42 WSW ELD)	28/0022Z
9. Nr. Cullen LA	(40 WSW ELD)	28/0025Z
10. Nr. Midway LA	(22 NE SHV)	28/0025Z
11. Nr. Shongaloo LA	(34 SW ELD)	28/0040Z

TABLE 4. Chances of the center of Bonnie passing within 65 miles of the listed location by date and time (CDT) indicated. Probabilities in percent.

ADVISORY DATE/TIME PROBABILITY THRU	<u>24/11AM</u> <u>27/7AM</u>	<u>24/5PM</u> <u>27/1PM</u>	<u>24/930PM</u> <u>27/7PM</u>	<u>25/5AM</u> <u>28/1AM</u>	<u>25/7AM</u> <u>28/1AM</u>	<u>25/11AM</u> <u>28/7AM</u>	<u>25/5PM</u> <u>28/1PM</u>	<u>25/11PM</u> <u>28/7PM</u>	<u>26/5AM</u> <u>29/1AM</u>
Cedar Key, FL	2	3							
St Marks, FL	3	5							
Apalachicola, FL	4	6							
Panama City, FL	5	7							
Pensacola, FL	8	11		2			2	2	
Mobile, AL	9	13	3	3	2	3	4	4	
Gulfport, MS	11	5	4	4	3	4	6	5	
Buras, LA	15	21	7	4	4	5	7	4	
New Orleans, LA	14	19	9	7	6	9	11	8	
New Iberia, LA	16	19	14	14	14	21	23	27	12
Port Arthur, TX	15	16	18	22	22	31	32	60	97
Galveston, TX	16	15	22	30	31	35	32	50	73
Freeport, TX	15	14	22	31	31	30	25	32	29
Port O'Connor, TX	14	12	19	26	26	19	16	10	
Corpus Christi, TX	12	10	15	18	17	12	10	4	
Brownsville, TX	12	9	11	10	9	5	5		
Gulf 29N 85W	4	5							
Gulf 29N 87W	7	11							
Gulf 28N 89W	24	34	7	2		2	3		
Gulf 28N 91W	38	41	60	42	51	68	40	10	
Gulf 28N 93W	27	22	46	61	70	76	88	93	
Gulf 28N 95W	17	15	30	38	38	29	23	23	
Gulf 27N 96W	15	12	19	24	23	13	12	3	
Gulf 25N 96W	13	9	10	7	6	3	3		

TABLE 5. Warnings

<u>LOCATION</u>	<u>TYPE</u>	<u>EFFECTIVE</u>	<u>DISCONTINUED</u>
Port O'Connor, TX to Mouth of the Mississippi River	Gale Warning for 70 mph Winds and Hurricane Watch	25/1200Z	26/1000Z
West of Morgan City, LA to Freeport, TX	Hurricane Warning	25/1600Z	26/1400Z

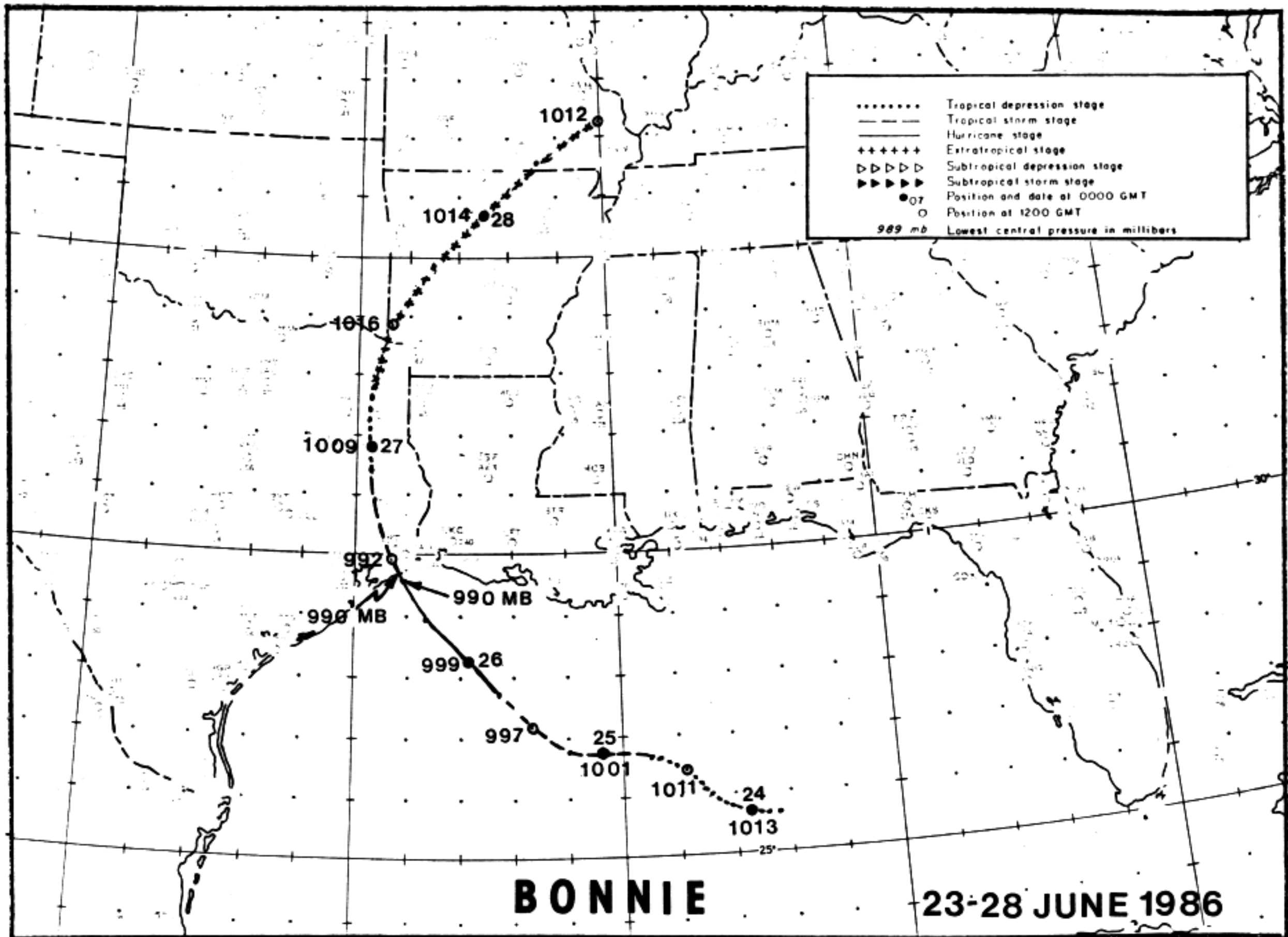


FIG. 1. Hurricane Bonnie track, 23-28 June 1986.

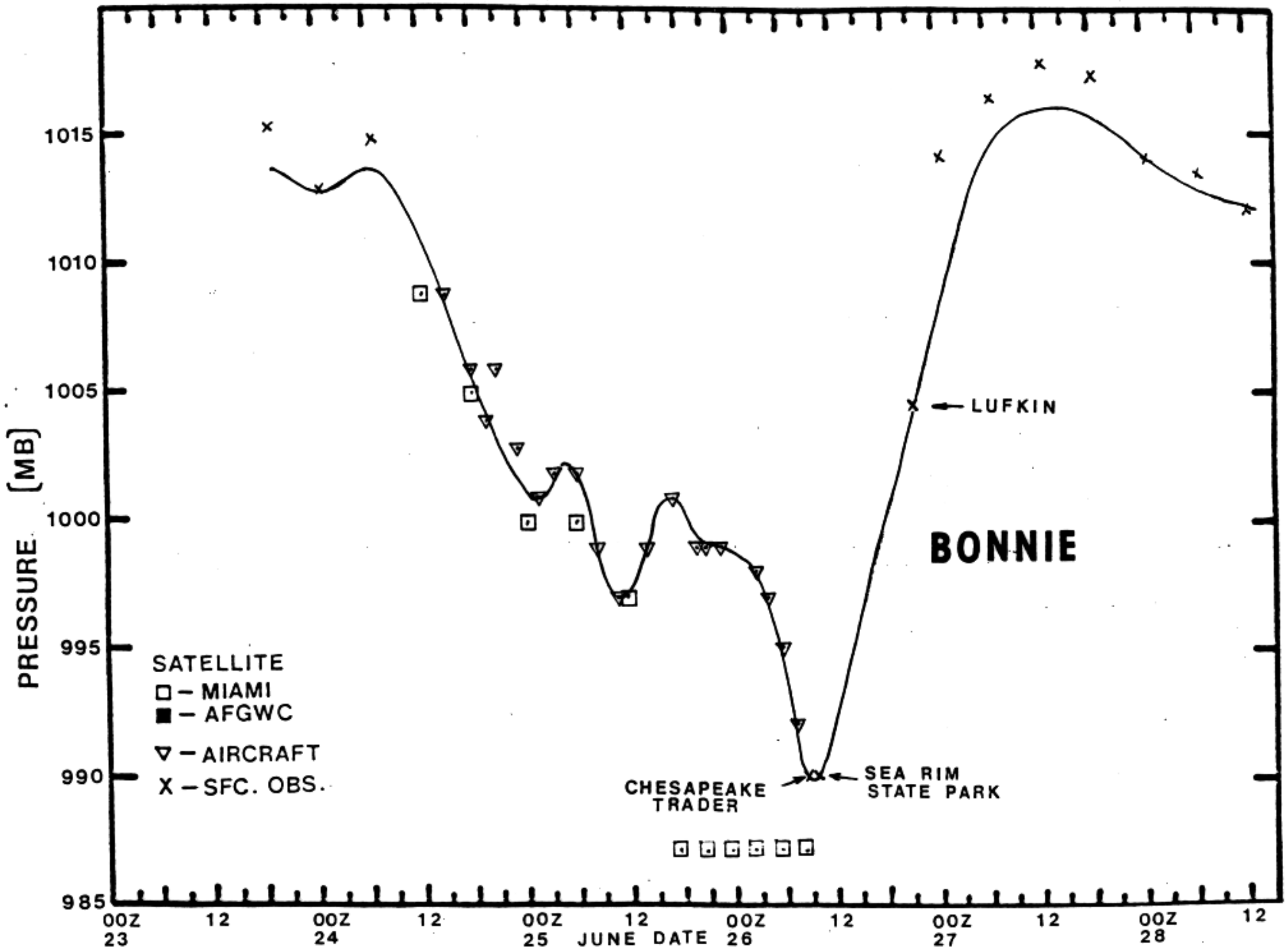


FIG. 2. "Best track" minimum pressure curve for Hurricane Bonnie, 23-28 June 1986

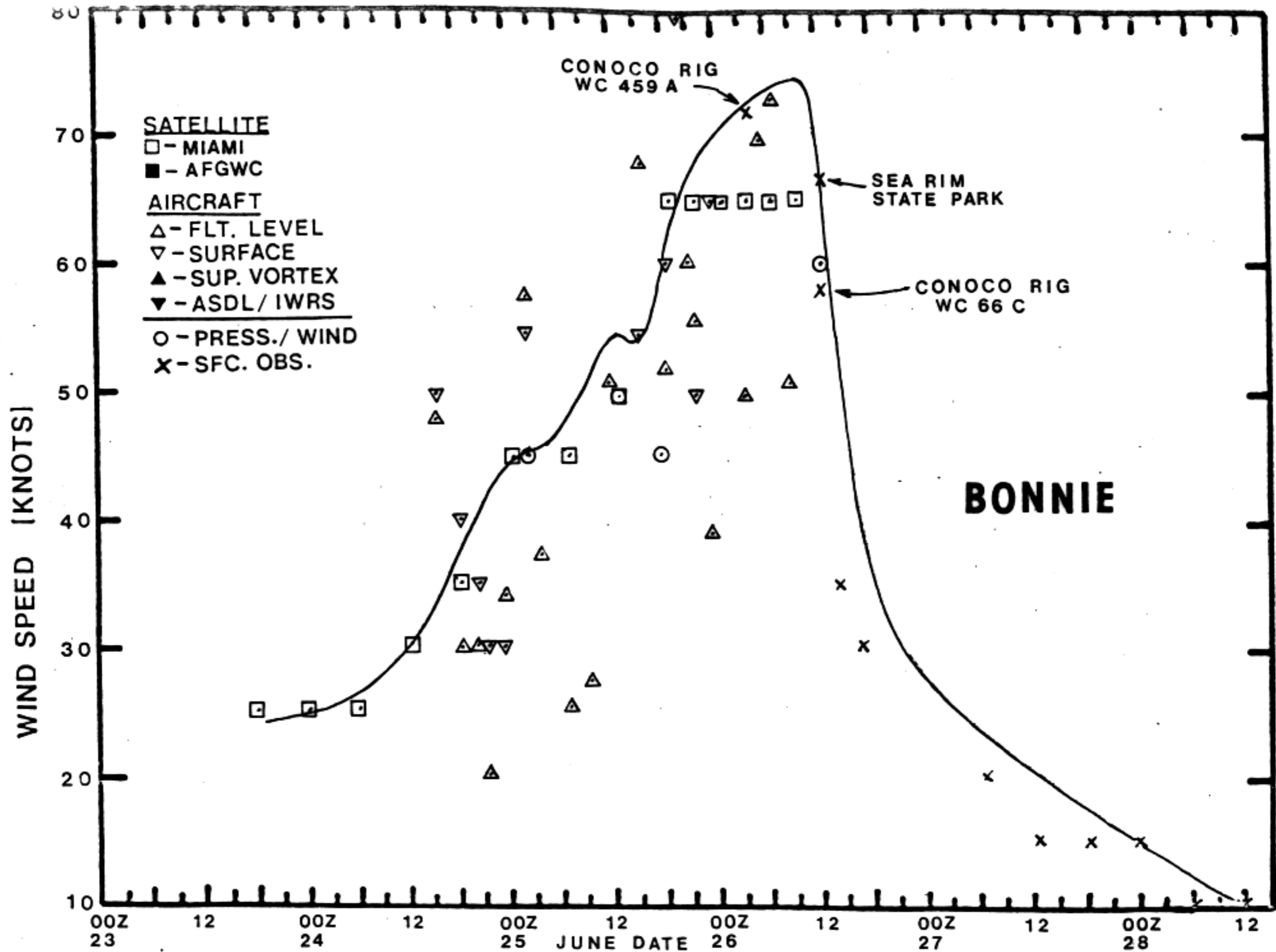


FIG. 3. "Best track" maximum wind speed curve for Hurricane Bonnie, 23-28 June 1986

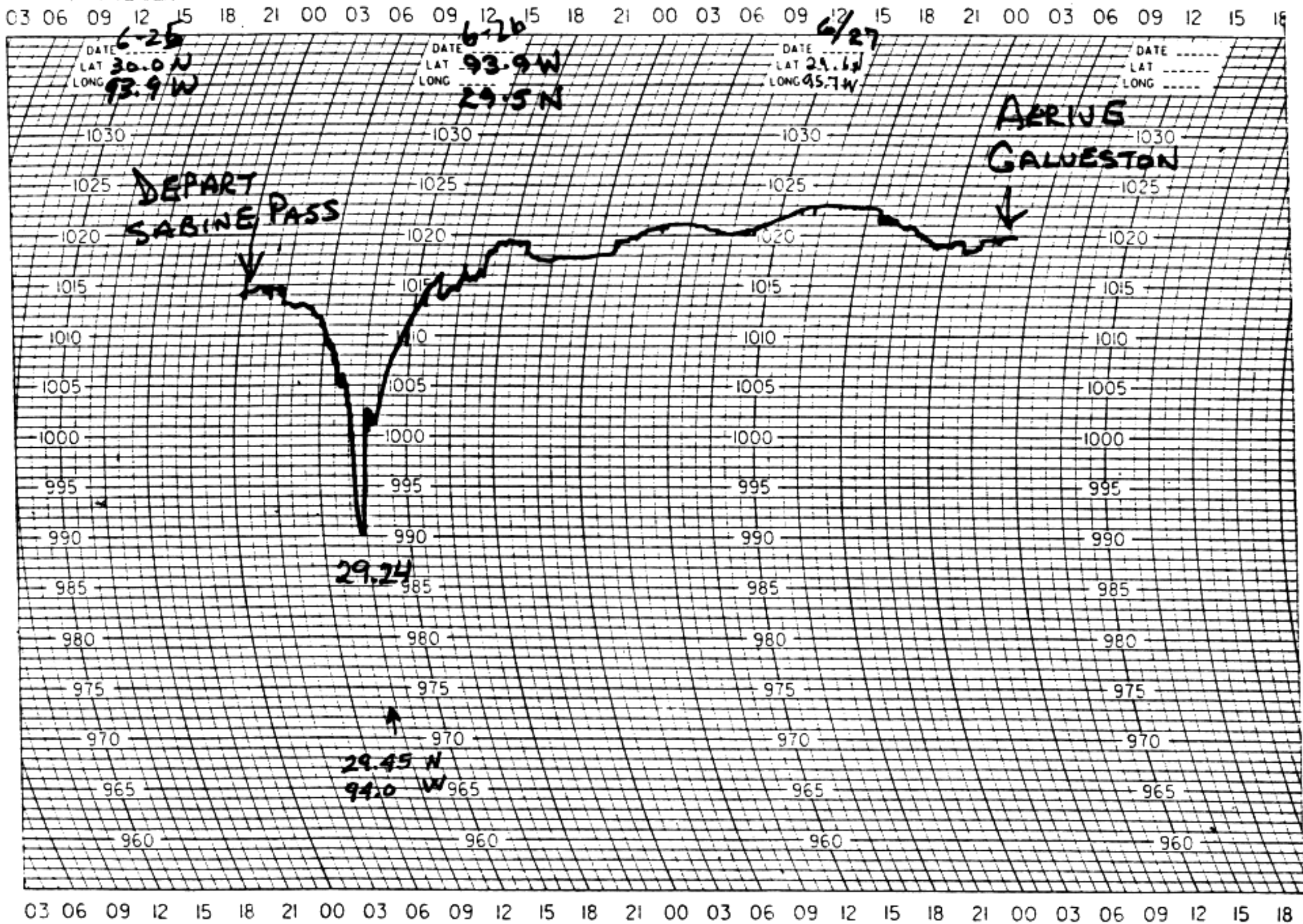


FIG. 4. Barogram from MT Chesapeake Trader, 0030Z June 26, 1986 to 0500Z June 28, 1986. All times Greenwich Meridian.

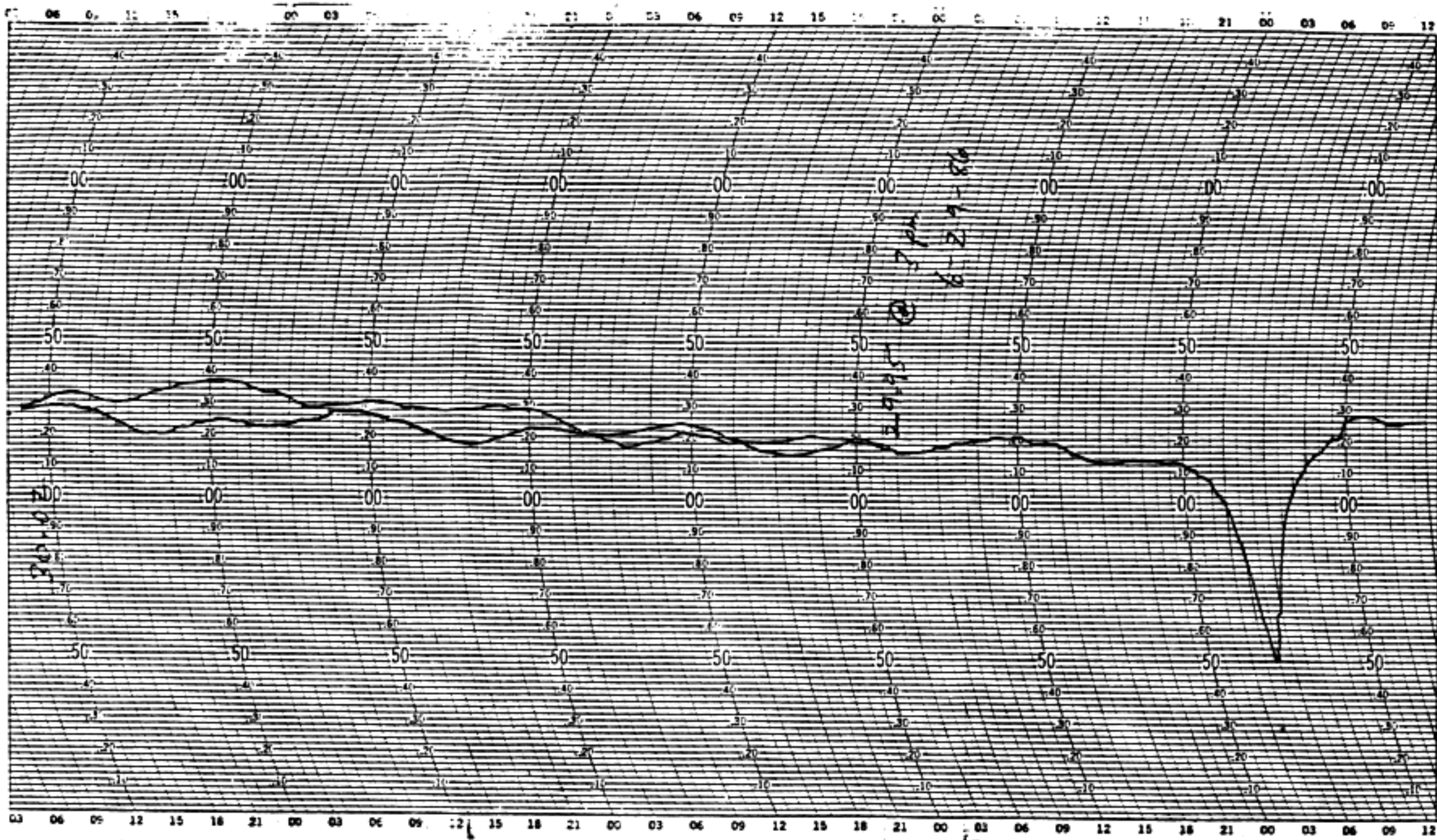


FIG. 5. Barogram from Sea Rim State Park, Texas, 0920 CDT June 22, 1986 to 0200 CDT June 30, 1986. All times CDT; pressure in inches of mercury. (Note: Chart is everywhere 0.25 inches of mercury too high. Chart placed on at 30.27 when the actual pressure was 30.02. Chart at 1500 CDT June 29, 1986 shows 30.20 when the actual pressure was 29.95. Therefore, the lowest pressure associated with Bonnie making landfall was 29.50 minus 0.25 equals 29.25 inches or 990 mb.)

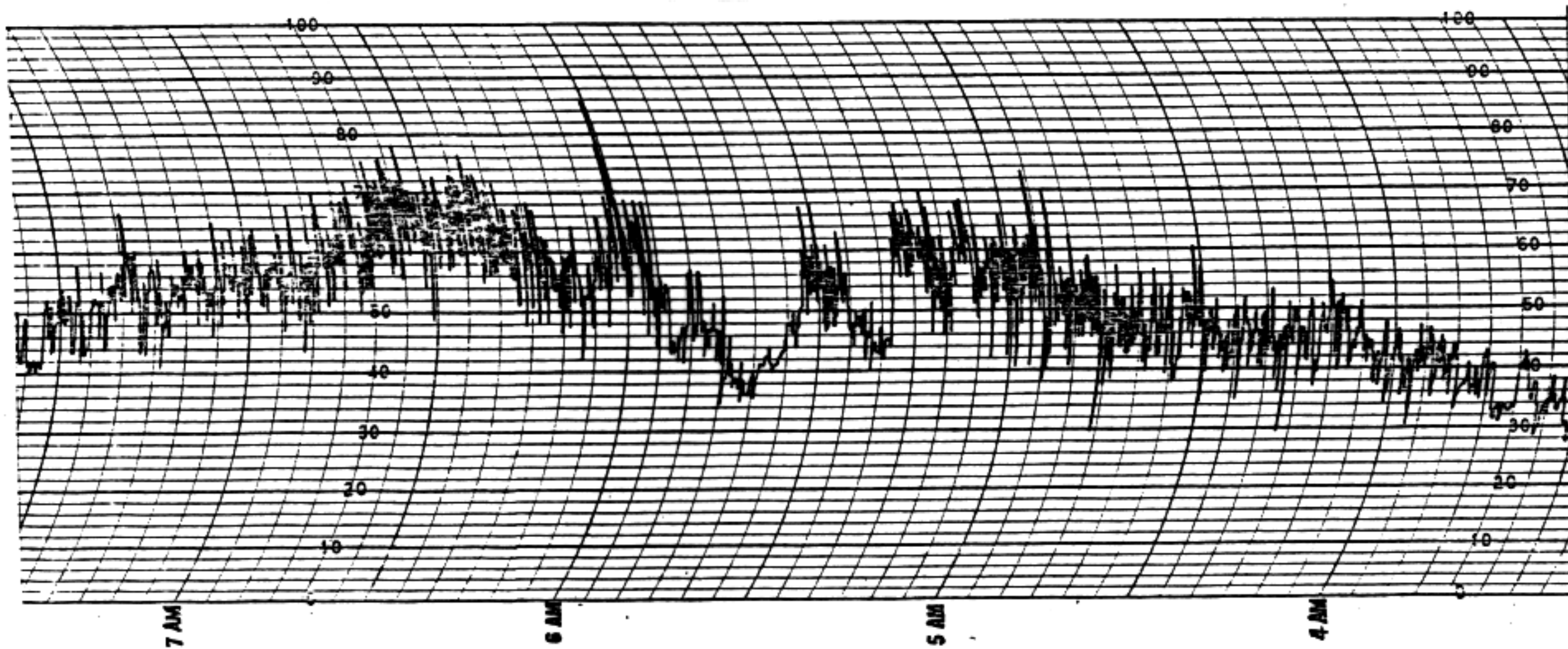


FIG. 6. Wind speed chart from Sea Rim State Park, Texas, June 26, 1986.
All times CDT; wind speed in knots.

FIG. 7. Time series plot from the C-MAN station at Sea Rim State Park

WSPD1
GUST1
BAR01

—●—
—□—
—○—

WDIR1

—◆—

