

Preliminary Report
Tropical Storm Cindy
14-17 August 1993

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a. Synoptic History

Cindy formed from a tropical wave that moved off the northwest coast of Africa on 8 August. The cloud mass associated with this wave was easily tracked on satellite imagery as it moved west-northwestward between 15 and 20 kt across the tropical Atlantic for the next several days. Dvorak classifications began on 10 August but remained at the T1.0 or T1.5 level until the 14th. An Air Force Reserve Unit aircraft investigated the disturbance on 13 August but found no organized surface circulation. On the next day, another aircraft found that the low-level circulation had become better organized and the "best track" indicates that a tropical depression formed from this activity at 1200 UTC on 14 August (Table 1 and Fig. 1).

The tropical depression moved toward the west-northwest, steered by the low- to mid-level flow, and its forward motion slowed to between 10 and 15 kt. The depression was upgraded to Tropical Storm Cindy at 1800 UTC on the 14th while over the island of Martinique, based on 1500-ft flight-level winds of near 40 kt from an aircraft and the observation of a central dense overcast in satellite imagery. Although the system had an outflow pattern aloft when it was near the Lesser Antilles, this upper-level structure deteriorated and only a little additional strengthening occurred.

Cindy reached its estimated peak intensity of 40 kt at 1200 UTC on 16 August while centered about 75 n mi southeast of Santo Domingo, Dominican Republic. The lowest pressure reported by reconnaissance aircraft was 1007 mb at 1113 UTC. A relatively large area of 35 to near 50 kt winds was also reported from the aircraft at a flight level of 1500 ft near this time.

The tropical cyclone weakened when part of the circulation began interacting with the mountains of Hispaniola. Cindy was downgraded to a tropical depression at 2100 UTC on the 16th when the poorly defined center moved over Barahona, Dominican Republic. The circulation rapidly became disorganized and the depression dissipated by 0000 UTC on 17 August. However, the remnant cloudiness and showers spread over the southern Bahamas through the 18th.

b. Meteorological Statistics

The best track data were derived primarily from aircraft observations and Dvorak technique estimates. Figures 2 and 3 show the curves of minimum central pressure and maximum one-minute wind speed, respectively, versus time, along with the observations on

which they are based. The satellite data were from the Air Force Global Weather Central (AFGWC), the NESDIS Synoptic Analysis Branch (SAB) and the NHC Tropical Satellite Analysis and Forecast (TSAF) unit. No sustained tropical storm force winds were reported from ships or island stations, but gusts to near 35 kt were reported on Martinique. Gusts to 30 kt were observed at St. Croix in the U.S. Virgin Islands and at Aquadilla, Puerto Rico.

The largest reported storm total rainfall was 12 inches at Precheur on the island of Martinique. Several reports of 4 to 10 inches of rain were received from various locations in the Dominican Republic and elsewhere over Martinique, while 3 to 4 inches of rain were reported over portions of Puerto Rico. It is likely that locally heavy rains occurred elsewhere over some of the Lesser Antilles and over Haiti.

c. Casualty and Damage Statistics

Four deaths were reported in association with flooding produced by Cindy. Two of these deaths occurred in Martinique, and two occurred in the Dominican Republic. Two persons were also reported missing in the Dominican Republic. Several hundred people were evacuated from flood-prone areas in Puerto Rico but no storm related deaths were reported from this island.

Estimates of several million dollars in damage to private and public property including houses, roads and seawalls have been reported from Martinique. There have been no other reports of significant damage received at the National Hurricane Center related to Cindy.

d. Forecast and Warning Critique

The NHC official mean track forecast errors ranged from 24 n mi at 12 hours (7 cases) to 67 n mi at 48 hours (1 case) and are lower than the past 10-year averages. The few verifying intensity forecasts had a positive bias (i.e., intensity was overestimated) for nearly all time periods. However, no meaningful verification of track and intensity forecasts is possible since Cindy was so short-lived.

Table 2 lists the coastal watches and warnings associated with Tropical Storm Cindy.

Table 3 lists the probabilities of Tropical Storm Cindy passing within 65 miles of listed locations by date and time.

Figure Captions:

- Fig. 1. Best track positions for Tropical Storm Cindy 14-17 August 1993.
- Fig. 2. Best track minimum central pressure curve for Tropical Storm Cindy.
- Fig. 3. Best track maximum sustained wind speed curve for Tropical Storm Cindy.

Table 1. Preliminary best track, Tropical Storm Cindy, 14-17 August 1993.

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
14/1200	14.1	59.5	1012	30	Trop. Depression
1800	14.5	60.9	1012	35	Tropical Storm
15/0000	14.9	62.2	1011	35	" "
0600	15.2	63.5	1011	35	" "
1200	15.4	64.8	1013	35	" "
1800	15.8	66.0	1012	35	" "
16/0000	16.4	66.9	1010	35	" "
0600	17.0	68.0	1008	35	" "
1200	17.3	69.3	1007	40	" "
1800	17.9	70.6	1008	35	" "
2100	18.3	71.0	1009	30	Trop. Depression
17/0000	18.8	71.3	1010	30	" "
0600					Dissipated
<hr/>					
16/1200	17.3	69.3	1007	40	Minimum Pressure
Landfall over Martinique					
14/1800	14.5	60.9	1012	35	Tropical Storm
Landfall near Barahona, Dominican Republic					
16/2100	18.3	71.0	1009	30	Trop. Depression

Table 2. Watch and warning summary, Tropical Storm Cindy.

<u>Date/Time(UTC)/Action</u>	<u>Location</u>
14/1500 Tropical Storm Warning	Lesser Antilles from Martinique north and westward through the U.S. Virgin Islands including Martinique, Dominica, Guadalupe, Antigua, Barbuda, St. Martin, St. Croix, St. Thomas and surrounding islands
14/1500 Tropical Storm Watch	Puerto Rico
15/0900 Tropical Storm Warning Discontinued	Lesser Antilles from St. Martin east and southward through Martinique
15/1200 Tropical Storm Warning	Puerto Rico
15/1500 Tropical Storm Watch	Dominican Republic from Cabo Engano westward to Samana on the north coast and to Isla Beata on the south coast
15/2100 Tropical Storm Warning	Dominican Republic from Cabo Engano westward to Samana on the north coast and to Isla Beata on the south coast
16/0300 Tropical Storm Warning Discontinued	The British and U.S. Virgin Islands
16/1200 Tropical Storm Warning Discontinued	Puerto Rico
16/2100 Tropical Storm Warning Discontinued	Dominican Republic from Cabo Engano westward to Samana on the north coast to Isla Beata on the west coast

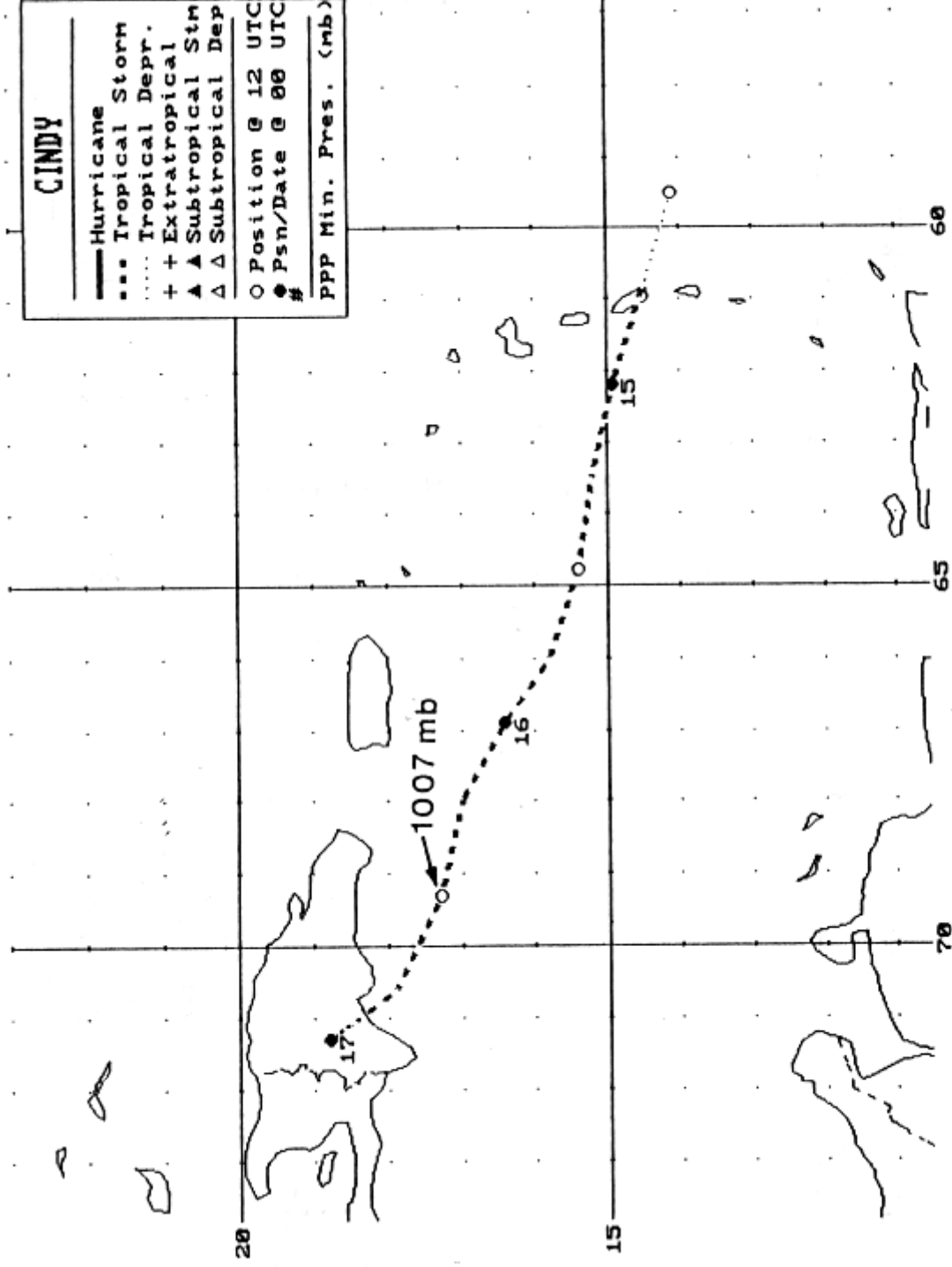


Fig. 1. Best track positions for Tropical Storm Cindy, 14-17 August 1993.

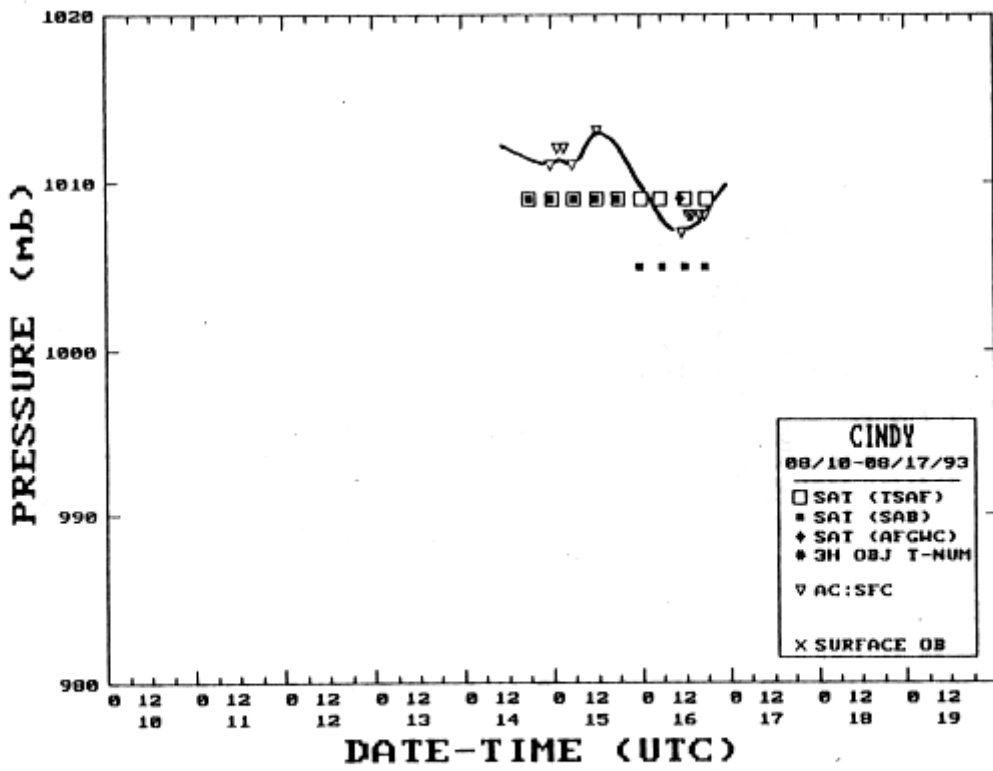


Fig. 2. Best track minimum central pressure curve for Tropical Storm Cindy.

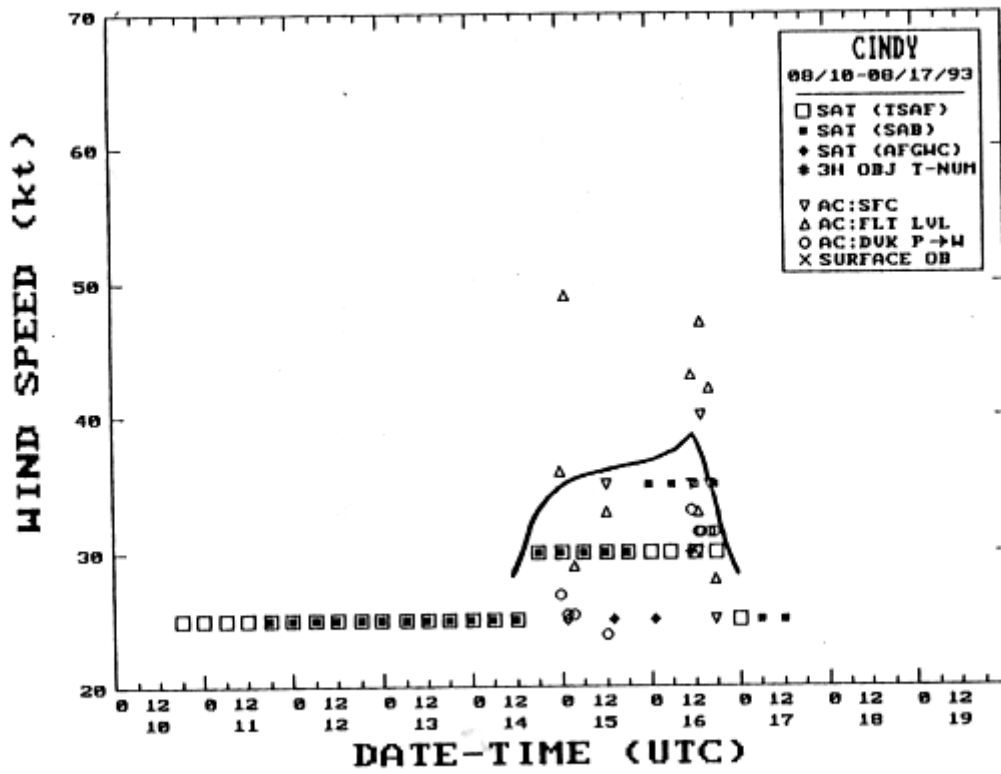


Fig. 3. Best track maximum sustained wind speed curve for Tropical Storm Cindy.

Table 3. Chance of the center of Tropical Storm Cindy passing within 65 miles of listed locations by date and time (AST) indicated; probabilities in percent with X for less than 2 percent.

	ADVISORY ISSUE TIME: 14/11AM	14/5PM	14/11PM	15/5AM	15/11AM
	PROBABILITY END TIME: 17/8AM	17/2PM	17/8PM	18/2AM	18/8AM
SKPG 125N 717W	5	5	5	2	4
TNCC 122N 690W	5	4	5	2	3
TBPB 131N 595W	56	8	X	X	X
TVSV 131N 612W	29	5	X	X	X
TLPL 138N 610W	99	99	28	X	X
TFFF 146N 610W	99	99	91	X	X
TDPR 153N 614W	93	99	99	X	X
TFFR 163N 615W	54	95	55	X	X
TAPA 171N 618W	12	12	3	X	X
TKPK 173N 627W	17	22	17	X	X
TNCM 181N 631W	8	9	4	X	X
TISX 177N 648W	22	30	30	38	32
T1ST 183N 650W	16	21	17	18	8
TJPS 180N 666W	24	28	29	43	46
MDSO 185N 697W	22	23	25	36	39
MDCB 176N 714W	21	21	23	25	26
MTPP 186N 724W	19	19	21	24	23
MTCA 183N 738W	16	16	18	18	18
MKJP 179N 768W	10	10	12	9	9
MKJS 185N 779W	8	9	10	7	8
MWCG 193N 814W	2	3	3	X	2
MUGM 200N 751W	14	14	16	18	16
MUCM 214N 779W	9	9	11	11	10
MUCF 221N 805W	4	4	6	5	5
MUSN 216N 826W	2	2	2	X	2
MUHA 230N 824W	2	2	3	2	2
TJSJ 184N 661W	19	23	22	30	27
MDPP 198N 707W	18	19	21	28	28
MBJT 215N 712W	13	15	15	20	20
MYMM 224N 730W	11	12	13	18	17
MYSM 241N 745W	7	8	9	14	14
MYEG 235N 758W	8	9	10	14	13
MYAK 241N 776W	6	6	8	11	10
MYNN 251N 775W	5	5	6	10	10
MYGF 266N 787W	2	2	3	7	7
ST CROIX VI	22	30	30	38	32
ST THOMAS VI	16	21	17	18	8
SAN JUAN PR	19	23	22	30	27
PONCE PR	24	28	29	43	46
MARATHON FL	2	2	4	4	4
MIAMI FL	2	2	3	5	5
W PALM BEACH FL	2	X	2	5	5
KEY WEST FL	2	2	3	3	3
MARCO ISLAND FL	X	X	2	3	3
FT MYERS FL	X	X	2	3	3
FT PIERCE FL	X	X	X	4	5
COCOA BEACH FL	X	X	X	3	4
DAYTONA BEACH FL	X	X	X	2	3
VENICE FL	X	X	X	2	2
TAMPA FL	X	X	X	2	2
SAVANNAH GA	X	X	X	X	2
JACKSONVILLE FL	X	X	X	X	2
CEDAR KEY FL	X	X	X	X	2

Table 3. Chance of the center of Tropical Storm Cindy passing within 65 (cont.) miles of listed locations by date and time (AST) indicated; probabilities in percent with X for less than 2 percent.

ADVISORY ISSUE TIME:	15/5PM	15/11PM	16/5AM	16/11AM	16/5PM
PROBABILITY END TIME:	18/2PM	18/8PM	19/2AM	19/8AM	19/2PM
SKPG 125N 717W	2	2	X	X	X
TISX 177N 648W	7	X	X	X	X
TIST 183N 650W	2	X	X	X	X
TJPS 180N 666W	48	98	7	X	X
MDSD 185N 697W	44	56	77	99	57
MDCB 176N 714W	33	36	37	62	99
MTPP 186N 724W	27	33	37	55	81
MTCA 183N 738W	21	23	25	35	36
MKJP 179N 768W	11	12	13	X	X
MKJS 185N 779W	10	10	12	X	X
MWCG 193N 814W	4	4	5	X	X
MUGH 200N 751W	19	20	23	26	X
MUCH 214N 779W	13	14	16	X	X
MUCF 221N 805W	8	9	10	X	X
MUSN 216N 826W	4	4	5	X	X
MUHA 230N 824W	5	5	7	X	X
TJSJ 184N 661W	13	25	X	X	X
MDPP 198N 707W	30	34	40	45	26
MBJT 215N 712W	20	21	24	15	X
MYMM 224N 730W	19	19	22	16	X
MYSM 241N 745W	15	16	17	X	X
MYEG 235N 758W	16	16	18	X	X
MYAK 241N 776W	13	14	16	X	X
MYNN 251N 775W	13	13	15	X	X
MYGF 266N 787W	10	10	12	X	X
ST CROIX VI	7	X	X	X	X
ST THOMAS VI	2	X	X	X	X
SAN JUAN PR	13	25	X	X	X
PONCE PR	48	98	7	X	X
MARATHON FL	8	8	10	X	X
MIAMI FL	9	9	11	X	X
W PALM BEACH FL	9	9	11	X	X
KEY WEST FL	6	7	8	X	X
MARCO ISLAND FL	7	7	9	X	X
FT MYERS FL	6	6	8	X	X
FT PIERCE FL	8	8	10	X	X
COCOA BEACH FL	7	7	9	X	X
DAYTONA BEACH FL	6	6	7	X	X
VENICE FL	5	5	7	X	X
TAMPA FL	5	5	7	X	X
SAVANNAH GA	3	3	4	X	X
JACKSONVILLE FL	4	4	6	X	X
CEDAR KEY FL	4	4	5	X	X
CHARLESTON SC	2	2	4	X	X
MYRTLE BEACH SC	2	2	2	X	X
ST MARKS FL	2	2	4	X	X
APALACHICOLA FL	2	2	3	X	X
PANAMA CITY FL	2	2	2	X	X
GULF 29N 85W	2	2	3	X	X
WILMINGTON NC	X	X	2	X	X