

Tropical Cyclone Report
Tropical Storm Ana
20-24 April 2003

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19 December 2003

Ana was the first Atlantic tropical storm of record to form in April. It moved generally eastward across the central Atlantic.

a. Synoptic History

A non-tropical low formed about 210 n mi south-southwest of Bermuda on 18 April when an upper-level trough interacted with a surface frontal system. Moving generally northward, the low produced sporadic bursts of central convection starting early on 19 April. After turning northwestward, the low looped back toward the southeast early on 20 April. The central convection became better organized and the low separated from the frontal system. It is estimated the low became a subtropical storm at 0600 UTC 20 April about 215 n mi west of Bermuda. The “best track” chart of Ana’s path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1.

Additional development occurred during its first day, and based on satellite microwave data showing a warm core it is estimated that Ana became a tropical storm near 0000 UTC 21 April with winds of 50 kt. This would be the peak intensity of the system. Ana turned east-southeastward on 21 April and eastward the next day while maintaining 45-50 kt winds. The system turned east-northeastward on 23 April while gradually weakening, and it merged with a cold front the next day about 810 n mi east of Bermuda.

Ana continued eastward as a 30-35 kt extratropical low through 25 April. It turned east-northeastward with some intensification on 26 April, then it was absorbed by a frontal system between the Azores and Portugal the next day.

Ana is the first tropical storm of record in April in the north Atlantic basin. The only other tropical or subtropical cyclone known in April is a subtropical storm between Puerto Rico and Bermuda from 21-24 April 1992.

b. Meteorological Statistics

Observations in Ana (Figs. 2 and 3) include satellite-based Dvorak and Hebert-Poteat technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB) and the U. S. Air Force Weather Agency (AFWA). Microwave satellite imagery from the NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission

(TRMM), the NASA Quikscat, and the Defense Meteorological Satellite Program (DMSP) satellites were also useful in tracking Ana.

Two ships reported tropical-storm force winds during Ana. The **Atlantic Forest** reported 44-kt winds and a pressure of 998.0 mb at 0900 UTC 22 April. The **Rosa Delmas** reported 41-kt winds at 0300 UTC 23 April.

Several aspects of Ana's best track are problematic. The first is the timing of the cyclone's transition from an extratropical to a subtropical cyclone. Satellite microwave wind data showed that a tight inner wind core - a step in that transition - formed early on 19 April. However, conventional satellite imagery showed that the cyclone was still attached to the frontal system at that time. The cyclone separated from the front near 0600 UTC 20 April and therefore is estimated to have become subtropical at that time.

A second issue is the time Ana transitioned to a tropical cyclone. Data from the Advanced Microwave Sounder Unit on the NOAA polar-orbiting satellites indicated that an upper-level warm core was present by late on 20 April. Based on this, Ana is estimated to have become tropical by 0000 UTC 21 April. However, experimental cyclone phase diagrams (Hart 2003) suggest that the transition could have occurred 6-18 h earlier.

A final issue regards the maximum intensity. Estimates from satellite imagery using the Dvorak and Hebert-Poteat techniques suggest maximum winds of 45 kt. However, data from the Seawinds scatterometer on the Quikscat satellite showed 55 kt winds west of the center at 2311 UTC 20 April. While the accuracy of this measurement is uncertain due to the possibility of rain contamination, it appears at least somewhat reliable when compared to other nearby Seawinds data. The maximum intensity is set to 50 kt in a compromise between the scatterometer winds and the intensity estimates from the Hebert-Poteat technique. There is a possibility that Ana could have been stronger than 50 kt at the time of that Seawinds overpass.

c. Casualty and Damage Statistics

Ana did not significantly affect any land areas, and there were no casualties or damages from its winds and rains. However, swells generated by Ana caused a boat to capsize at Jupiter Inlet, Florida on 20 April. Two people onboard drowned.

d. Forecast and Warning Critique

Average official track errors (with the number of cases in parentheses) for Ana were 37 (11), 46 (9), 79 (7), 123 (5), and 98 (1) n mi for the 12, 24, 36, 48, and 72 h forecasts, respectively¹. These

¹ All forecast verifications in this report include the depression stage of the cyclone. National Hurricane Center verifications presented in these reports prior to 2003 did not include the depression stage.

errors are lower than the average official track errors for the 10-yr period 1993-2002 (45, 81, 116, 150, and 225 n mi, respectively). These errors are also lower than those for the Climatology-Persistence method (58, 140, 269, 429, and 621 n mi for the 12, 24, 36, 48, and 72 h forecasts, respectively), and thus the forecasts have skill relative to that measure.

Average official intensity errors were 9, 9, 9, 9, and 10 kt for the 12, 24, 36, 48, and 72 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1993-2002 are 6, 10, 13, 15, and 19 kt respectively.

No watches or warnings were issued for Ana.

References:

Hart, R.E., 2003: A cyclone phase space derived from thermal wind and thermal asymmetry. *Mon. Wea. Rev.*, **131**, 585-616.

Table 1. Best track for Tropical Storm Ana, 20-24 April 2003.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18 / 0000	29.1	66.2	1008	30	extratropical
18 / 0600	29.9	66.0	1008	30	"
18 / 1200	30.8	65.8	1008	30	"
18 / 1800	31.9	66.3	1007	30	"
19 / 0000	33.0	66.9	1007	30	"
19 / 0600	33.8	67.6	1006	35	"
19 / 1200	34.5	68.6	1006	35	"
19 / 1800	34.3	69.1	1006	35	"
20 / 0000	33.6	69.0	1005	40	"
20 / 0600	32.7	68.9	1003	40	subtropical storm
20 / 1200	32.0	68.2	1000	45	"
20 / 1800	31.7	67.3	998	45	"
21 / 0000	31.4	66.4	995	50	tropical storm
21 / 0600	30.6	65.8	995	50	"
21 / 1200	30.0	64.8	995	50	"
21 / 1800	29.4	63.1	994	50	"
22 / 0000	29.4	61.5	994	50	"
22 / 0600	29.5	60.1	994	50	"
22 / 1200	29.6	58.5	995	45	"
22 / 1800	29.7	56.6	996	45	"
23 / 0000	30.0	54.7	998	40	"
23 / 0600	30.6	53.0	1000	40	"
23 / 1200	31.4	51.5	1000	40	"
23 / 1800	31.9	50.6	1001	35	"
24 / 0000	32.1	49.6	1003	35	"
24 / 0600	32.0	48.7	1004	35	extratropical
24 / 1200	31.8	47.8	1005	35	"
24 / 1800	31.5	46.6	1005	35	"
25 / 0000	31.5	45.4	1005	35	"
25 / 0600	31.6	44.2	1004	35	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 1200	31.7	43.1	1003	30	"
25 / 1800	31.8	42.1	1004	30	"
26 / 0000	31.9	40.8	1005	30	"
26 / 0600	32.3	38.4	1002	35	"
26 / 1200	32.9	35.6	1002	35	"
26 / 1800	33.6	32.8	1002	40	"
27 / 0000	34.4	29.2	1002	40	"
27 / 0600	35.3	25.8	999	40	"
27 / 1200	36.1	22.4	1000	40	"
27 / 1800					absorbed by frontal system
21 / 1800	29.4	63.1	994	50	minimum pressure
22 / 0000	29.4	61.5	994	50	"
22 / 0600	29.5	60.1	994	50	"

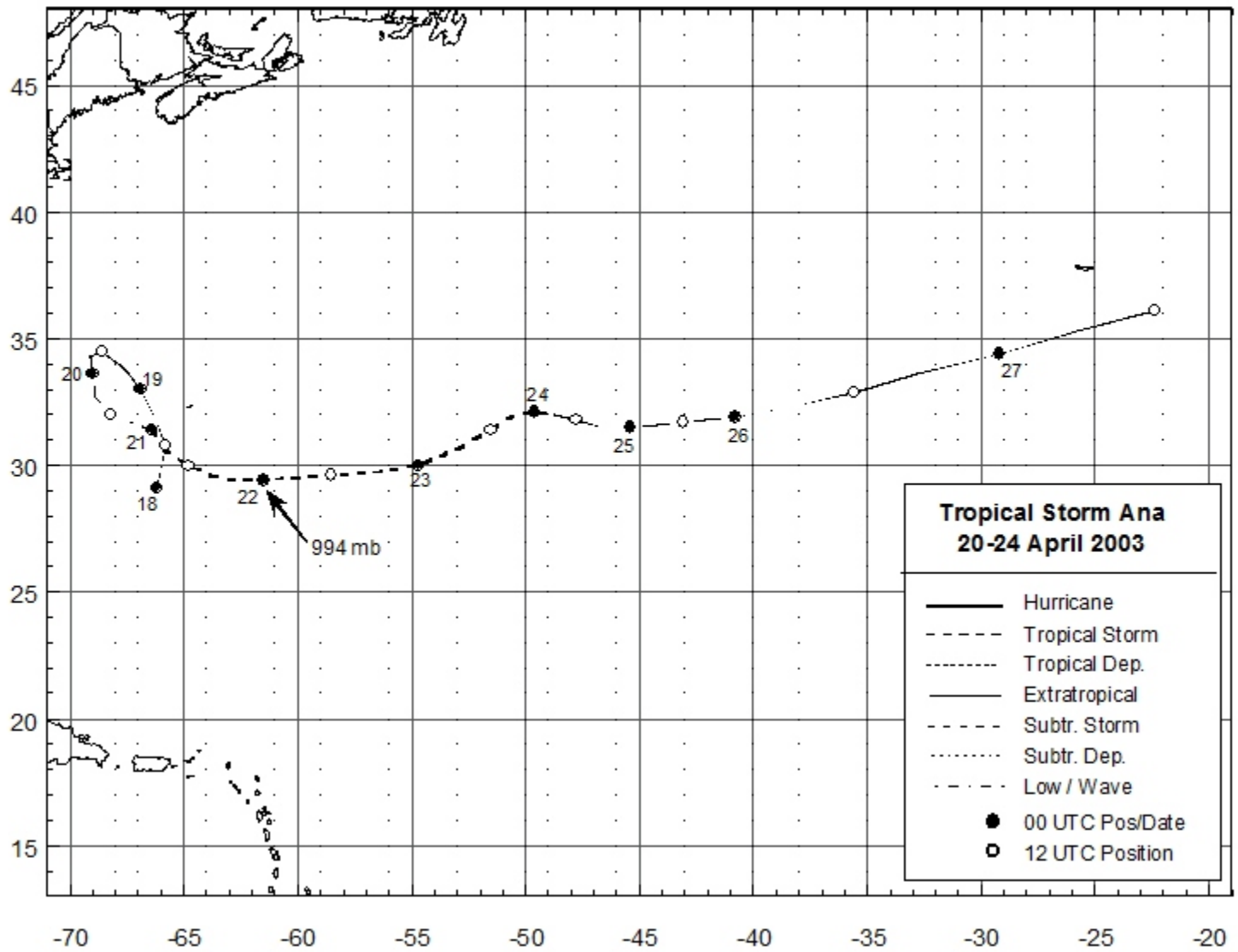


Figure 1. Best track positions for Tropical Storm Ana, 20-24 April 2003.

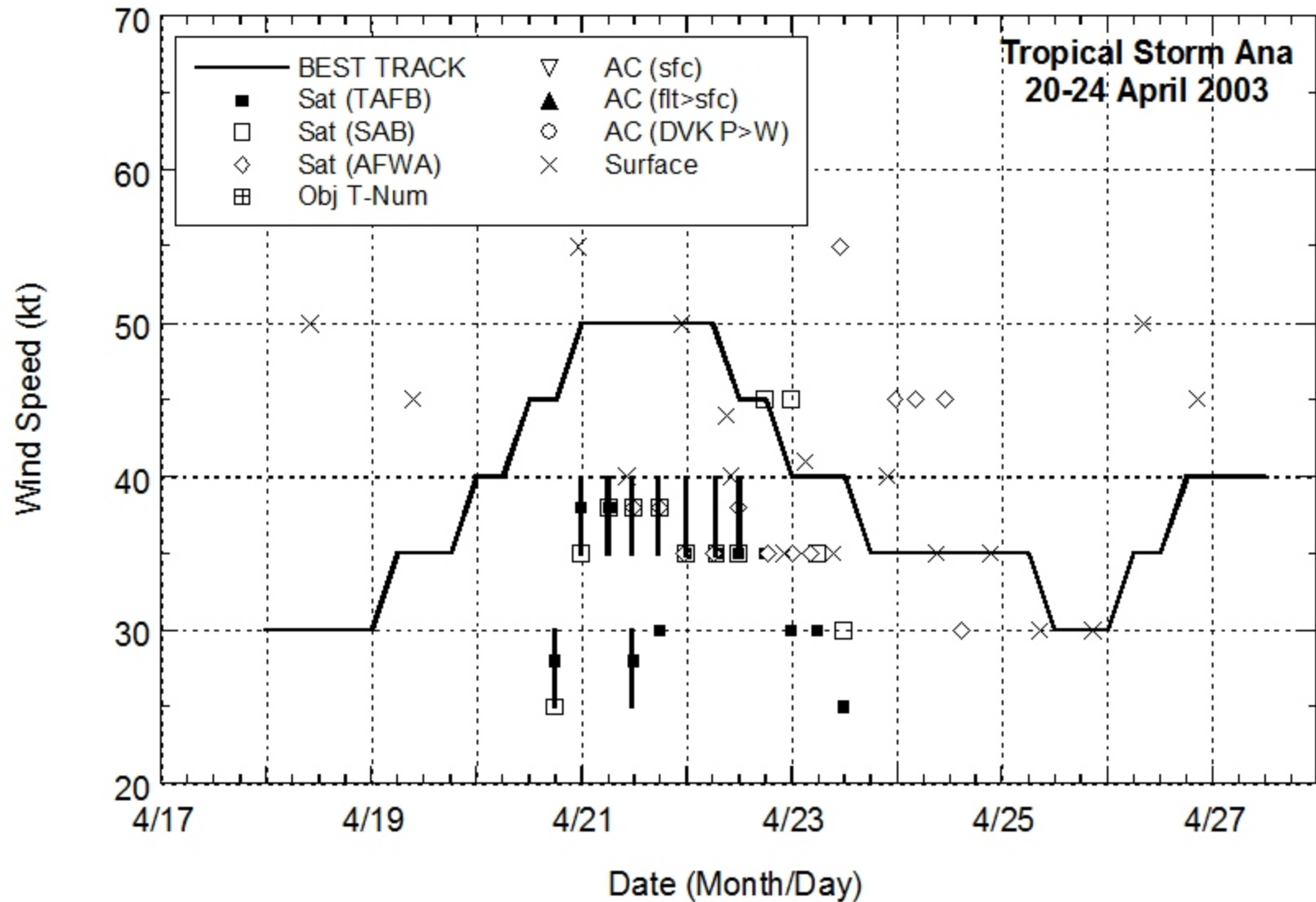


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Ana, 20-24 April 2003. Solid black bars denote wind ranges for the Hebert-Poteat subtropical cyclone technique. X's include surface winds from ships and the QuikScat scatterometer.

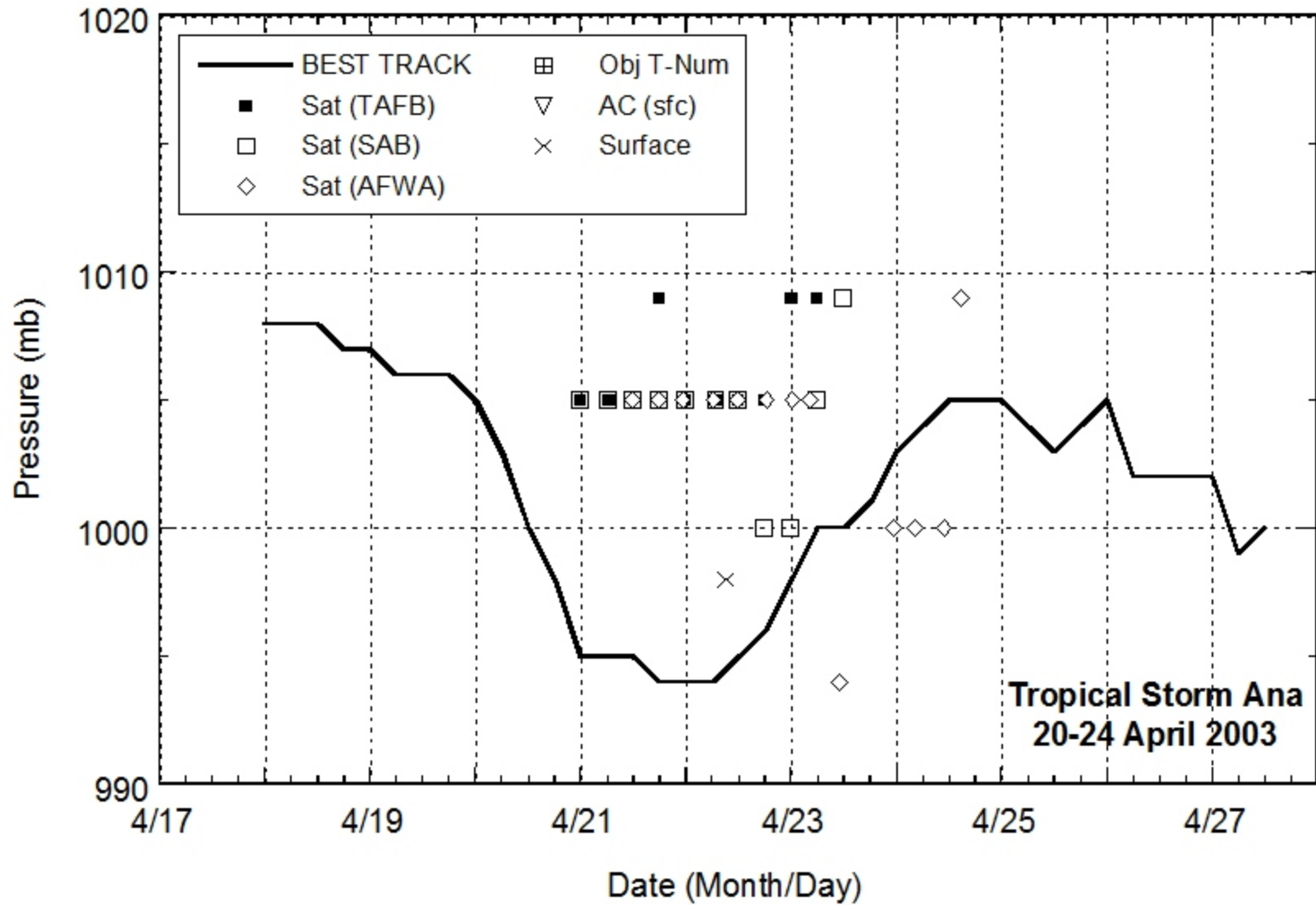


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Ana, 20-24 April 2003.