

PRELIMINARY REPORT
Hurricane Alma
20-27 June 1996

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Hurricane Alma, the first hurricane of the 1996 eastern north Pacific hurricane season, hit the southwestern coast of Mexico causing at least three direct deaths.

a. Synoptic History

Alma, the first named tropical cyclone of the 1996 eastern north Pacific hurricane season developed about 240 n mi south of Acapulco Mexico. Although it is difficult to identify the origin of this disturbance, it appears to be related to the southern extension of the same tropical wave which triggered Tropical Storm Arthur in the Atlantic. The incipient disturbance crossed from the southwestern Caribbean to the eastern Pacific between the 17th and the 18th of June as indicated by upper-air observations from Central America and satellite images. This disturbance was accompanied by an anomalous upper-level anticyclone (200 mb) as shown in Fig. 1a.

The disturbance moved into the eastern Pacific over warmer than normal waters. Initially, stronger than normal 200 mb northeasterly winds and 850 mb southwesterly winds prevailed as indicated in Figs. 1b and 1c. This pattern resulted in a shearing environment and a low-level center located to the northeast of the convection. However, the shear was not strong enough to prevent strengthening and the deep convective activity gradually became aligned with the low-level center. Then, a tropical depression formed at 0000 UTC June 20 and reached tropical storm intensity by 1800 UTC as indicated by satellite intensity estimates.

When the shear relaxed, Alma intensified and became a hurricane at 0000 UTC 22 June while moving on a general northwest track. A mid-level trough located in the vicinity of Baja California in combination with a mid-to upper-level low over the southwestern Gulf of Mexico steered Alma slowly northward toward the southwest coast of Mexico. On that heading, Alma reached its maximum intensity of 90 knots and minimum pressure of 969 mb at 1200 UTC 23

June. At that time, objective and subjective T-numbers were oscillating near 5.0 on the Dvorak scale. Figure 2 is a visible satellite image of Hurricane Alma just prior to landfall.

The steering flow collapsed and Alma began to drift near the coast. Alma made landfall near the town of Lazaro Cardenas but it did not move farther inland. The center moved back over water but a portion of the circulation was involved with land. Alma meandered for another 36 hours near the coast and never reintensified. Apparently, the inner core circulation was severely disrupted by the steep topography of Mexico. It gradually weakened until dissipation while moving slowly on a track parallel and not far from the coast.

Alma's track is shown in Fig. 3. Table 1 is a listing, at six-hour intervals, of the best-track position, estimated minimum central pressure and maximum 1-minute surface wind speed.

b. Meteorological Statistics

The best track pressure and wind curves as a function of time shown in Figures 4 and 5 are based on satellite intensity estimates from the Tropical Analysis and Forecast Branch of the Tropical Prediction Center (TAFB), and denoted as TSAF in the figures. It was also used estimates from the Satellite Analysis Branch (SAB) and the Air Force Global Weather Central (AFGWC). Alma was an intense hurricane with a very small diameter. The strongest winds were concentrated within a small area surrounding the eye. This was suggested by sparse surface observations within the area of influence of Alma, as well as satellite images. Images from Acapulco and Cuyutlan radars, provided by the "Servicio Meteorologico Nacional de Mexico" confirmed that Alma was a small diameter tropical cyclone. These radar images, received in near real-time, were extremely useful to track Alma. There are no reports of measured strong winds received at this time. Manzanillo reported 68.8 mm of rainfall in 24 hours.

c. Casualty and Damage Statistics

Newspapers reports from Mexico stated that three people were killed by Alma in a small town near Lazaro Cardenas when their house collapsed. Numerous houses were damaged and power failed in

various coastal towns where roads were covered by debris and water. In Zihuatanejo, several houses and trees were also damaged. There are unconfirmed reports (Miami Herald, June 25, 1996) that at least 17 people were killed by flooding in Puebla, about 300 n mi to the east of the landfall point. These rains were probably related to Alma.

d. Forecast and Warning Critique

Table 2 shows the preliminary forecast errors for Hurricane Alma. The official forecast errors were by far much smaller than the 1985-1994 average, and generally better than the track models. The purely dynamical models performed poorly, in particular the AVN and GFDL models. One attribute such large errors produced by dynamical models to the lack of upper-air data over the ocean south and west of the hurricane. Mexican upper-air data were available at all times during Alma. Numerical track forecast by the "Universidad Autonoma de Mexico" were of comparable accuracy to U.S. dynamical models. However, model output from Mexico was received at the NHC only twice during Alma.

Figure Captions:

- Fig. 1(a) 200 mb wind anomalies for 0000 UTC 18 June and (b) for 0000 UTC 20 June. (c) Same as (b) but for 850 mb level. Anomalies are computed from the Aviation model analysis for the specified time minus aviation model climatology from 1979 to 1995. Dot represents the center of the tropical disturbance or depression.
- Fig. 2 GOES 9 visible satellite image of Alma at 2100 UTC 23 June.
- Fig. 3. Best track positions for Hurricane Alma, 20 - 27 June 1996.
- Fig. 4. Best track one-minute surface wind speed curve for Hurricane Alma.
- Fig. 5. Best track minimum central pressure curve for Hurricane Alma.

Table 1. Preliminary best track, Hurricane Alma,
20-27 June, 1996.

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
20/0000	13.1	98.7	1009	30	Tropical Depression
0600	13.5	99.3	1009	30	" "
1200	13.9	99.9	1007	30	" "
1800	14.4	100.3	1005	35	Tropical Storm
21/0000	14.9	100.7	1002	40	" "
0600	15.4	101.1	1000	45	" "
1200	15.7	101.5	997	50	" "
1800	15.8	102.0	994	55	" "
22/0000	15.8	102.4	987	65	Hurricane
0600	15.9	102.7	985	75	" "
1200	16.2	102.6	978	85	" "
1800	16.6	102.6	975	85	" "
23/0000	16.7	102.8	972	85	" "
0600	16.9	102.9	970	85	" "
1200	17.2	102.8	969	90	" "
1800	17.5	102.6	970	90	" "
24/0000	18.0	102.4	973	90	" "
0600	17.8	102.6	975	80	" "
1200	17.7	102.8	979	65	" "
1800	17.7	102.8	985	60	Tropical Storm
25/0000	17.6	102.7	995	55	" "
0600	17.5	102.4	1000	45	" "
1200	17.3	102.5	1005	35	" "
1800	17.3	102.7	1009	30	Tropical Depression
26/0000	17.4	102.9	1009	30	" "
0600	17.5	103.5	1009	30	" "
1200	17.7	104.0	1009	30	" "
1800	18.0	104.5	1009	30	" "
27/0000	18.4	105.0	1009	25	" "
0600	18.7	105.5	1009	25	" "
1200	18.9	106.2			Dissipating
23/1200	17.2	102.8	969	90	Minimum Pressure
24/0000	18.0	102.4	973	90	Landfall

(Near Lazaro Cardenas)

Table 2

PRELIMINARY FORECAST EVALUATION HURRICANE ALMA
HETEROGENEOUS SAMPLE

(Errors in nautical miles for tropical storm
and hurricane stages with number
of forecasts in parenthesis)

Forecast Technique	Period (hours)				
	12	24	36	48	72
OFCI	40 (18)	67 (16)	94 (14)	109 (12)	129 (8)
AVNI	39 (16)	69 (14)	131 (12)	220 (12)	467 (8)
GFDI	131 (13)	210 (11)	276 (7)	306 (5)	302 (1)
CLIP	36 (18)	69 (16)	109 (14)	153 (12)	310 (8)
BAMD	48 (18)	77 (16)	101 (14)	132 (12)	160 (8)
BAMM	49 (18)	77 (16)	104 (14)	129 (12)	159 (8)
BAMS	43 (18)	69 (16)	88 (14)	98 (12)	141 (8)
NHC Official	34 (18)	65 (16)	89 (14)	112 (12)	129 (8)
NHC Official (1985-94 10-yr average)	50	98		194	296

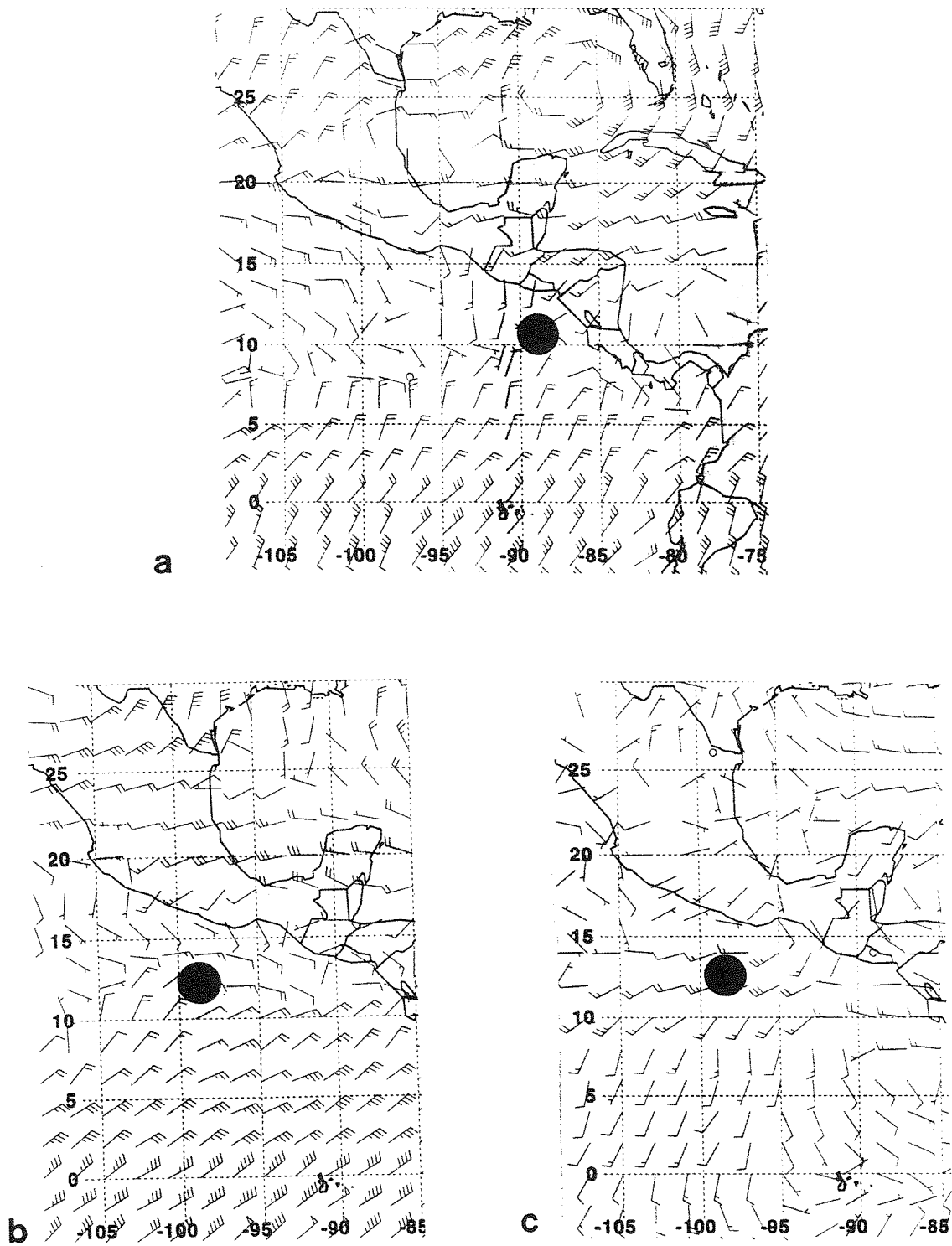


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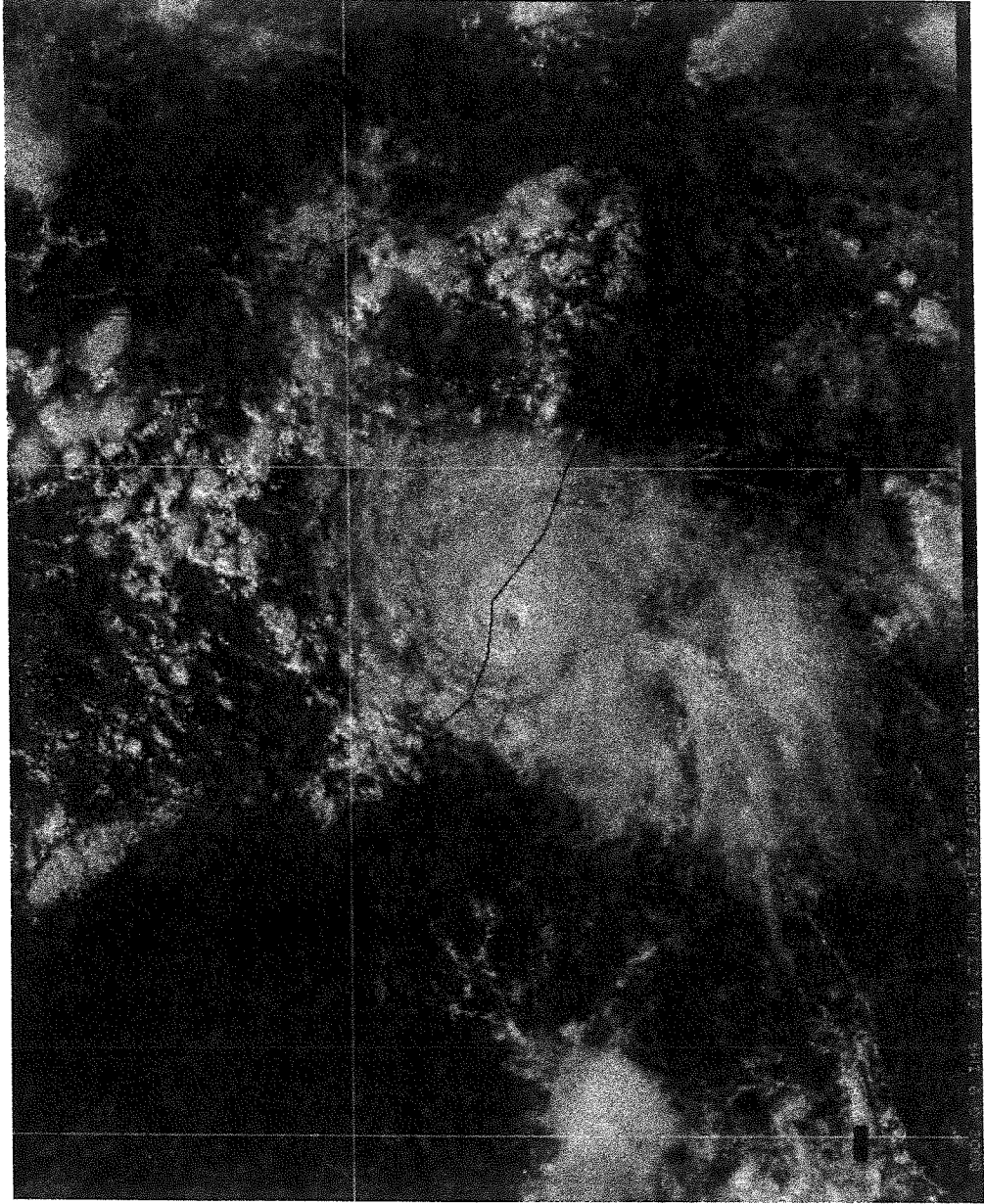


Fig. 2 GOES 9 visible satellite image of Alma at 2100 UTC 23 June.

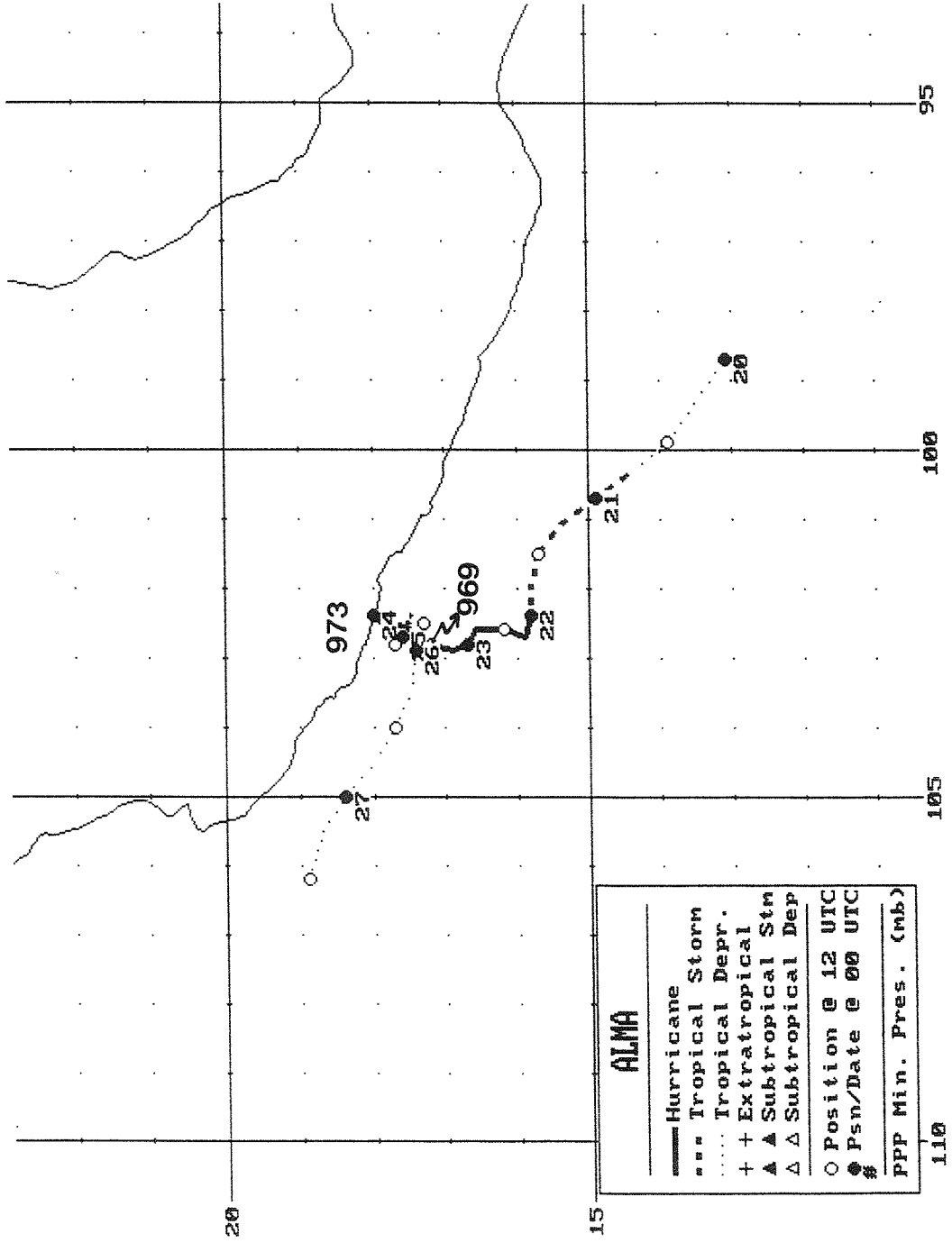


Fig. 3. Best track positions for Hurricane Alma, 20 - 27 June 1996.

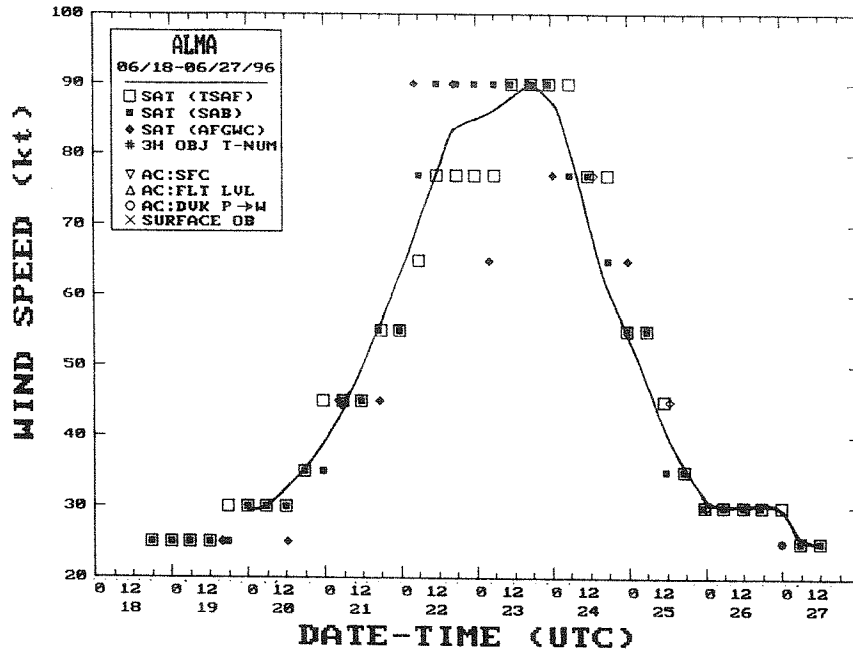


Fig. 4. Best track one-minute surface wind speed curve for Hurricane Alma.

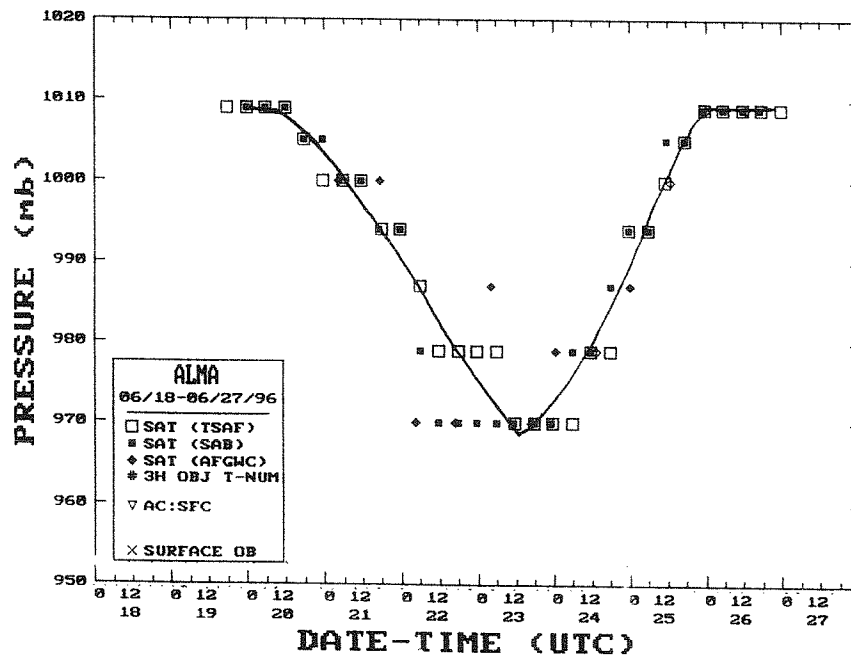


Fig. 5. Best track minimum central pressure curve for Hurricane Alma.