

Tropical Cyclone Report
Hurricane Carlotta
18-25 June 2000

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Carlotta was a category 4 hurricane (on the Saffir-Simpson scale) that had a long offshore track parallel to the coast of Mexico. Its maximum winds of 135 kt make Carlotta the second strongest June hurricane (to Ava in 1973) in the east Pacific record since 1966. Although the hurricane did not make landfall, it was responsible for 18 deaths when the Lithuanian freighter MV Linkuva was caught in the hurricane and was lost at sea.

a. Synoptic History

A tropical wave that emerged from the coast of Africa on June 3rd, and crossed into the eastern Pacific basin on the 15th, appears to have been the precursor disturbance of Hurricane Carlotta. Surface analyses show a weak low beginning late on the 16th near 8°N, 88°W, and Dvorak satellite classifications began around 1200 UTC on the 17th. Convection was broadly distributed and disorganized, however, until about 1200 UTC on the 18th, when a concentration of deep convection developed just south of the Gulf of Tehuantepec. Ship reports and satellite scatterometer data suggest that the season's third tropical depression formed from this system by 1800 UTC about 235 n mi southeast of Puerto Angel, Mexico.

The best track chart of the tropical cyclone's path is given in Fig. 1, with the wind and pressure history shown in Figs. 2 and 3, respectively. The complete best track is given in Table 1. The depression strengthened as it moved to the west-northwest at about 11 kt, and became Tropical Storm Carlotta at 0000 UTC 19 June when the cyclone was centered about 180 n mi south-southeast of Puerto Angel. As Carlotta edged toward the coast, it came under the influence of a mid-tropospheric ridge to its north and turned slightly to the left; its closest approach to the Mexican coast was about 120 n mi near 1200 UTC on the 19th. Late on the 19th, a ragged banding eye became visible on satellite imagery and this was followed by the appearance of very deep convection around the developing eye. Carlotta reached hurricane status at 0600 UTC on the 20th, when it was about 135 n mi south of Acapulco. Once hurricane strength was attained, the pace of intensification increased dramatically; 24 h later at 0600 UTC on the 21st, Carlotta reached its peak intensity of 135 kt. Although Carlotta exhibited impressive upper-level outflow over its southern semicircle, outflow was limited to the north of the cyclone during most of the intensification period.

Shortly after reaching peak intensity, Carlotta turned from a general westerly heading to a west-northwest track at a reduced speed, about 7-8 kt, around the western edge of the mid-tropospheric ridge over Mexico. By 0000 UTC on the 22nd, Carlotta had weakened to about 100 kt. On the 22nd the weakening trend was temporarily halted with some oscillations in the convective intensity and eye definition. The weakening trend resumed for good on the 23rd. Over the next two

days, Carlotta moved to the northwest between 10 and 14 kt over cooler waters, falling below hurricane strength shortly after 0000 UTC on the 24th, when it was centered about 225 n mi west-southwest of Cabo San Lucas. Convection continued to diminish and the system became a tropical depression by 0000 UTC on the 25th. No further deep convection was noted after 0600 UTC on the 25th, when the tropical cyclone dissipated about 415 n mi west of Cabo San Lucas. A swirl of low clouds persisted in this area for several days thereafter.

b. Meteorological Statistics

Observations in Hurricane Carlotta (Figs. 2 and 3) include satellite Dvorak 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). In addition, flight-level and dropwindsonde observations were available from a flight of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command.

Of particular interest is a comparison of the aircraft and satellite-based intensity estimates during the period of reconnaissance coverage from about 1900-2200 UTC on the 20th. It is clear that the satellite intensity estimates were substantially in error, having overstated the intensity of Carlotta during this period by about 20 mb and 15-20 kt. The reconnaissance aircraft measured a minimum sea-level pressure of 977 mb at 1901 UTC, while the Dvorak estimate from TAFB and SAB (interpolated to the time of the reconnaissance fix) was about 20 mb lower. Similarly, the Dvorak-based maximum wind estimate at this time was about 105 kt, while the aircraft found peak flight-level winds no higher than 96 kt (estimated equivalent of 86 kt at the surface) during its first full “alpha” pattern. A GPS dropwindsonde at 2040 UTC in the northwest eyewall, where the maximum flight-level winds were found during the first alpha pattern, reported a surface wind of 91 kt, about 17 kt less than the satellite estimate (interpolated to the time of the drop).

The aircraft did find that Carlotta was deepening rapidly; from 1901 to 2142 UTC the minimum pressure fell by 7-8 mb to 970 mb, representing a deepening rate of just less than 3 mb h⁻¹. At 2146 UTC, the aircraft reported a flight-level wind of 105 kt (estimated equivalent of 95 kt at the surface). By this time, however, the satellite intensity estimates had also increased, to 110 kt and about 952 mb.

The sizable discrepancy between the satellite and reconnaissance estimates makes determining the maximum intensity of Carlotta problematic, as satellite imagery indicates that Carlotta continued to strengthen rapidly for another 9 hours or so after the conclusion of the reconnaissance coverage. Conventional Dvorak estimates reached 140 kt (921 mb) at 0600 UTC on the 21st, and the University of Wisconsin objective Dvorak 12-h weighted average estimate peaked at this time with a value of 146 kt (915 mb). For purposes of determining the best track intensity, it is assumed that the satellite high bias was present for about 24 hours before and after the time of the reconnaissance flight. Using this approach, the maximum intensity of Carlotta is estimated to have been 135 kt. The estimated time of peak intensity (0600 UTC 21 June) is based on the sequence of objective Dvorak numbers.

There is considerable uncertainty regarding the minimum pressure attained by Carlotta. The Dvorak pressure-wind curve associates a pressure of 926 mb with winds of 135 kt. However, a

comparison of reconnaissance winds and pressures suggests that the observed pressures in Carlotta were 5-10 mb higher than those predicted by the Dvorak pressure-wind curve. Therefore, the minimum pressure, which occurred shortly thereafter, is believed to be somewhat higher than 926 mb. The final value of 932 mb at 0600 UTC on the 21st was obtained by assuming a deepening rate of 5 mb h⁻¹ subsequent to the best track estimate of 962 mb at 21/0000 UTC. This assumed deepening rate is close to the extreme short term intensification rates observed in 1988's Hurricane Gilbert and 1995's Hurricane Opal, and as a result, the assigned 932 mb minimum pressure for Carlotta probably represents a lower bound on the true value.

Ship reports of winds of tropical storm force associated with Carlotta are listed in Table 2. No land stations reported sustained tropical storm force winds. Bahias De Huatulco (MMBT) reported a gust to 38 kt at 1300 UTC on June 19th.

c. Casualty and Damage Statistics

According to media reports, the Lithuanian freighter MV Linkuva, along with its crew of 18 persons, was lost when the ship was caught in the hurricane 220 miles southwest of Acapulco late on June 20th after an engine failure. The last contact with the MV Linkuva occurred during the period of rapid intensification and just before the Carlotta reached its peak intensity. The vessel was en route to Long Beach, California.

There are no other reports of damage or casualties.

d. Forecast and Warning Critique

Average official track errors for Carlotta were 29, 59, 92, 110, and 124 n mi for the 12, 24, 36, 48, and 72 h forecasts, respectively; these were somewhat lower than the average official track errors for the 10-yr period 1990-1999 (Table 3). However, the track errors for Carlotta were somewhat larger than the guidance from the UK Met. Office global model (UKMI). The GFDL model had a significant rightward bias with errors much larger than the official forecast, presumably due to a poor vortex initialization in the Aviation model. Although the official track forecast errors were smaller than the long-term mean, Fig. 4 shows that the three modest changes in Carlotta's track: the initial leftward turn near 96°W, the turn to the northwest near 106°W, and the final leftward turn near 114°W, were not well anticipated.

Figure 5 shows selected official intensity forecasts plotted against the best track. The initial intensification to hurricane strength was well forecast; however, the rapid strengthening to category 4 was not, even after the process was underway. The worst forecast errors (all underestimates) for the 12, 24, 36, 48, and 72 h forecasts were 40, 45, 50, 60, and 50 kt, respectively. Neither the SHIPS nor GFDL guidance models forecast the rapid strengthening to category 4. The decay stage was reasonably-well forecast.

Table 4 lists the watches and warnings associated with Carlotta issued by the government of Mexico. As noted above, no sustained tropical storm force winds were observed over land.

Table 1. Best track for Hurricane Carlotta, 18-25 June 2000.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18 / 1800	12.5	94.0	1003	30	tropical depression
19 / 0000	13.0	95.0	1002	35	tropical storm
19 / 0600	13.5	96.1	1000	45	"
19 / 1200	13.8	97.2	998	50	"
19 / 1800	14.1	98.3	995	55	"
20 / 0000	14.3	99.3	992	60	"
20 / 0600	14.5	100.2	989	65	hurricane
20 / 1200	14.7	101.2	985	75	"
20 / 1800	14.9	102.1	981	85	"
21 / 0000	15.1	103.1	962	110	"
21 / 0600	15.1	103.8	932	135	"
21 / 1200	15.3	104.5	934	135	"
21 / 1800	15.6	105.3	938	130	"
22 / 0000	15.9	106.0	949	115	"
22 / 0600	16.3	106.6	960	100	"
22 / 1200	16.8	107.2	960	100	"
22 / 1800	17.3	107.9	960	100	"
23 / 0000	17.9	108.7	960	100	"
23 / 0600	18.6	109.6	963	95	"
23 / 1200	19.4	110.5	970	85	"
23 / 1800	20.3	111.5	979	75	"
24 / 0000	21.2	112.7	987	65	"
24 / 0600	22.0	113.8	994	55	tropical storm
24 / 1200	22.6	114.8	999	45	"
24 / 1800	23.2	115.8	1002	35	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 0000	23.6	116.6	1004	30	tropical depression
25 / 0600	24.0	117.3	1006	25	"
21 / 0600	15.1	103.8	932	135	minimum pressure

Table 2. Ship reports with winds of at least 34 kt for Hurricane Carlotta, 18-25 June 2000.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
18/1800	4XGT	13.2	93.8	070/35	1008.8
19/1800	KAOU	15.0	98.0	070/36	1010.0
19/2100	KAOU	15.0	98.0	090/40	1008.0
20/0000	KAOU	15.1	98.1	110/35	1009.1
20/1500	OWZU2	16.8	100.8	100/35	1010.0
21/1500	4XFD	18.1	103.4	090/40	1011.0
22/0000	DGOS	17.9	103.4	090/34	1011.0
23/0000	JFUG	19.8	106.0	120/39	1009.3
23/0600	ELWZ5	20.7	106.8	140/35	1012.0

Table 3. Preliminary forecast evaluation (heterogeneous sample) for Hurricane Carlotta, 18-25 June 2000. Forecast errors for tropical storm and hurricane stages (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type.

Forecast Technique	Forecast Period (h)				
	12	24	36	48	72
CLIP	31 (22)	64 (20)	109 (18)	148 (16)	191 (12)
GFDI	43 (22)	105 (20)	196 (18)	226 (14)	325 (8)
LBAR	26 (22)	60 (20)	113 (18)	176 (16)	312 (12)
AVNI	46 (15)	102 (15)	168 (12)	109 (3)	147 (3)
BAMD	34 (22)	57 (20)	86 (18)	125 (16)	210 (12)
BAMM	30 (22)	49 (20)	86 (18)	135 (16)	262 (12)
BAMS	30 (22)	45 (20)	73 (18)	117 (16)	233 (12)
NGPI	42 (21)	100 (19)	95 (15)	134 (13)	201 (5)
UKMI	26 (20)	44 (18)	68 (16)	93 (14)	132 (10)
GUNS	29 (20)	66 (18)	72 (14)	80 (12)	89 (4)
NHC Official	29 (22)	59 (20)	92 (18)	110 (16)	124 (12)
NHC Official (1990-99 mean)	37 (2494)	69 (2245)	101 (1993)	132 (1760)	189 (1353)

Table 4. Watch and warning summary for Hurricane Carlotta, 18-25 June 2000.

Date/Time (UTC)	Action	Location
18 / 2100	Tropical Storm Warning issued	Salina Cruz to Acapulco
19 / 0900	Hurricane Watch issued	Puerto Angel to Zihuatanejo
19 / 0900	Tropical Storm Warning extended	Acapulco to Zihuatanejo
19 / 1800	Tropical Storm Warning discontinued	Salina Cruz to Puerto Angel
20 / 0300	Hurricane Watch discontinued	Puerto Angel to Acapulco
20 / 0900	Hurricane Watch discontinued	Acapulco to Zihuatanejo
20 / 1200	Tropical Storm Warning discontinued	Puerto Angel to Acapulco
20 / 1500	Tropical Storm Warning discontinued	Acapulco to Zihuatanejo
23 / 0900	Tropical Storm Watch issued	Baja California south of Cabo San Lazaro
23 / 2100	Tropical Storm Watch discontinued	Baja California south of Cabo San Lazaro

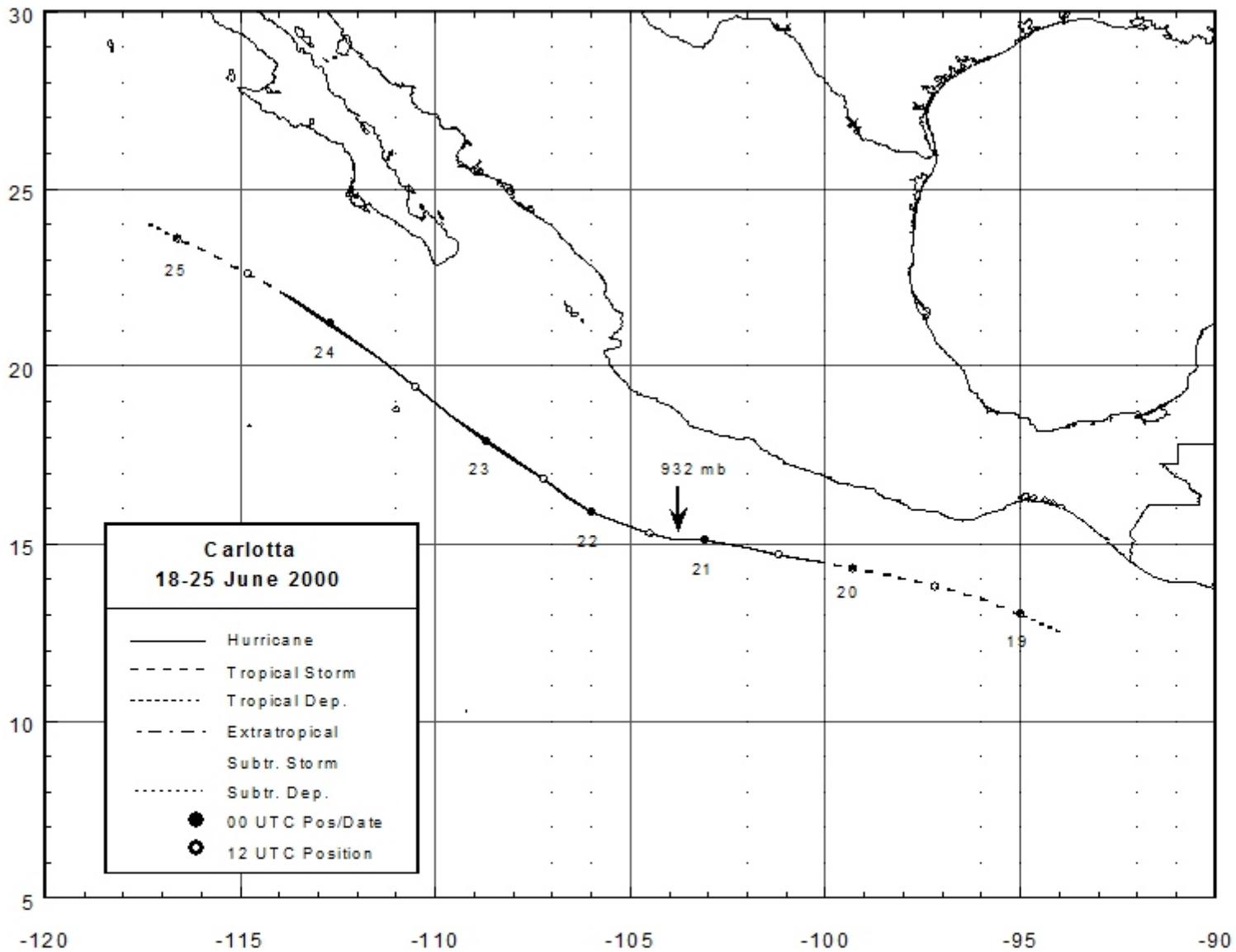


Figure 1. Best track positions for Hurricane Carlotta, 18-25 June 2000.

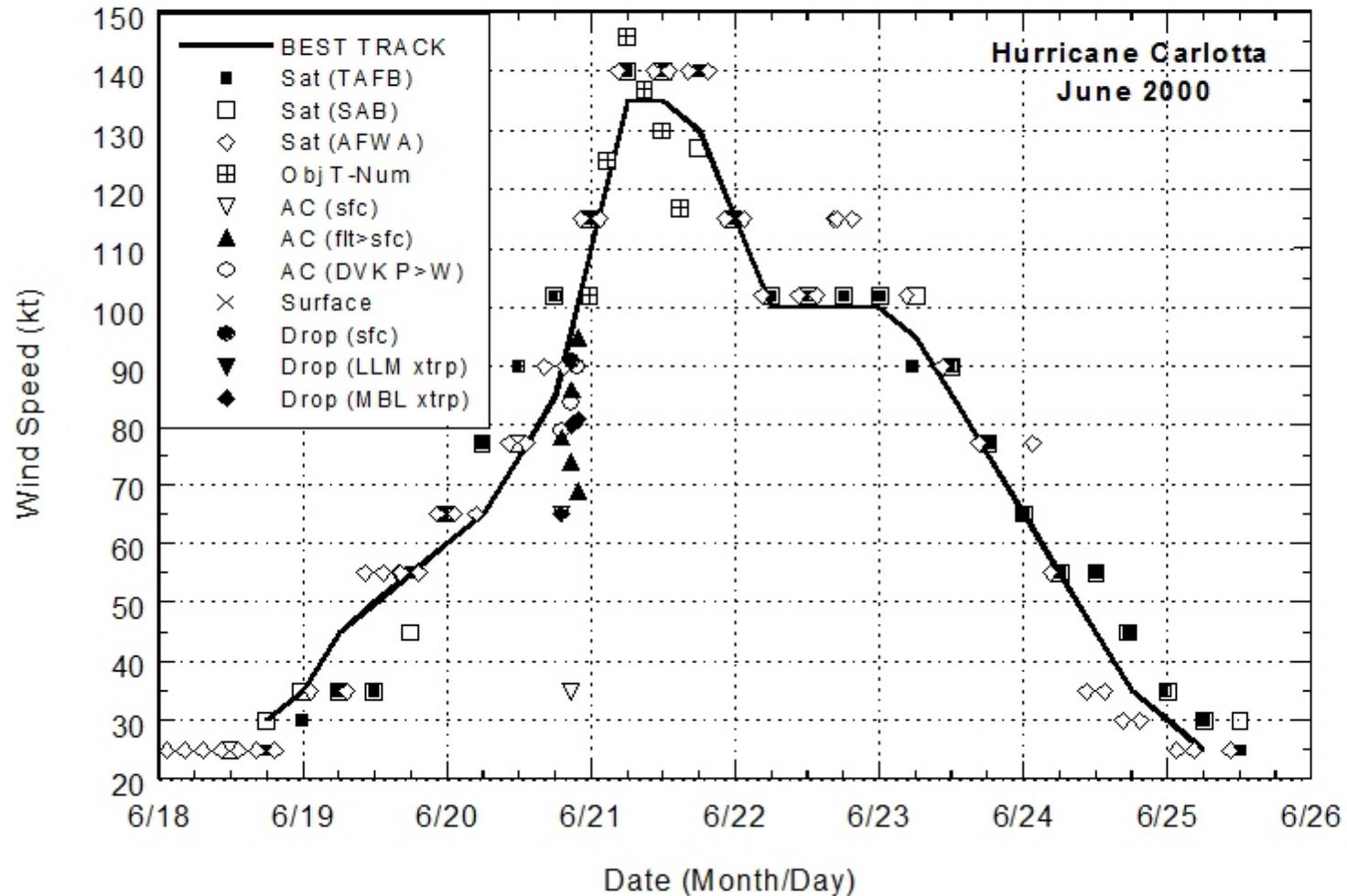


Figure 2. Best track maximum sustained surface wind speed curve for Hurricane Carlotta, 18-25 June 2000, and the observations on which the best track curve is based. Aircraft observations have been adjusted for elevation using 90%, 80%, and 85% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the sounding boundary layer mean (MBL). Objective Dvorak estimates are 12-h averages, weighted most heavily by the most recent values.

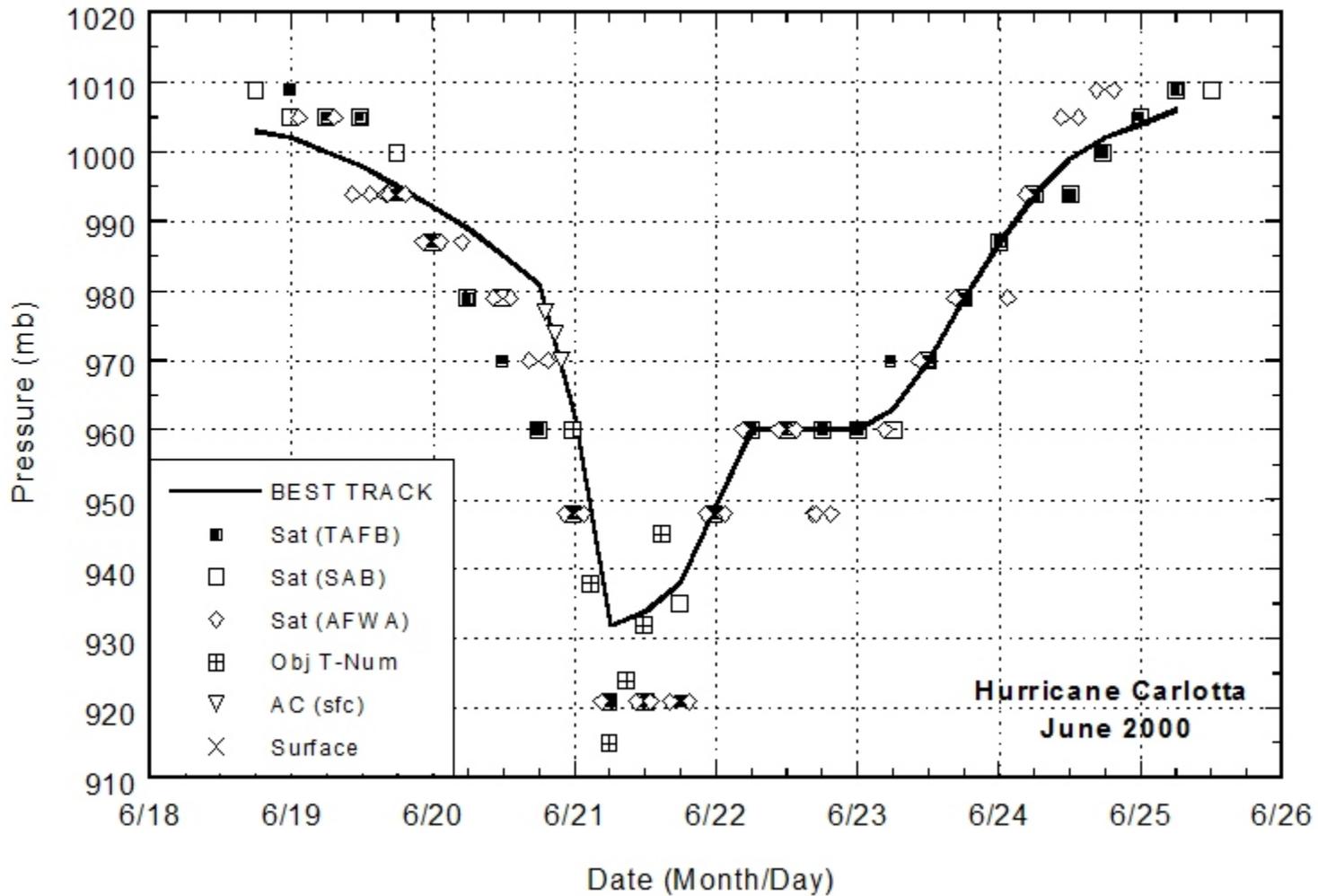


Figure 3. Best track minimum central pressure curve for Hurricane Carlotta, 18-25 June 2000, and the observations on which the best track curve is based. Objective Dvorak estimates are 12-h averages, weighted most heavily by the most recent values.

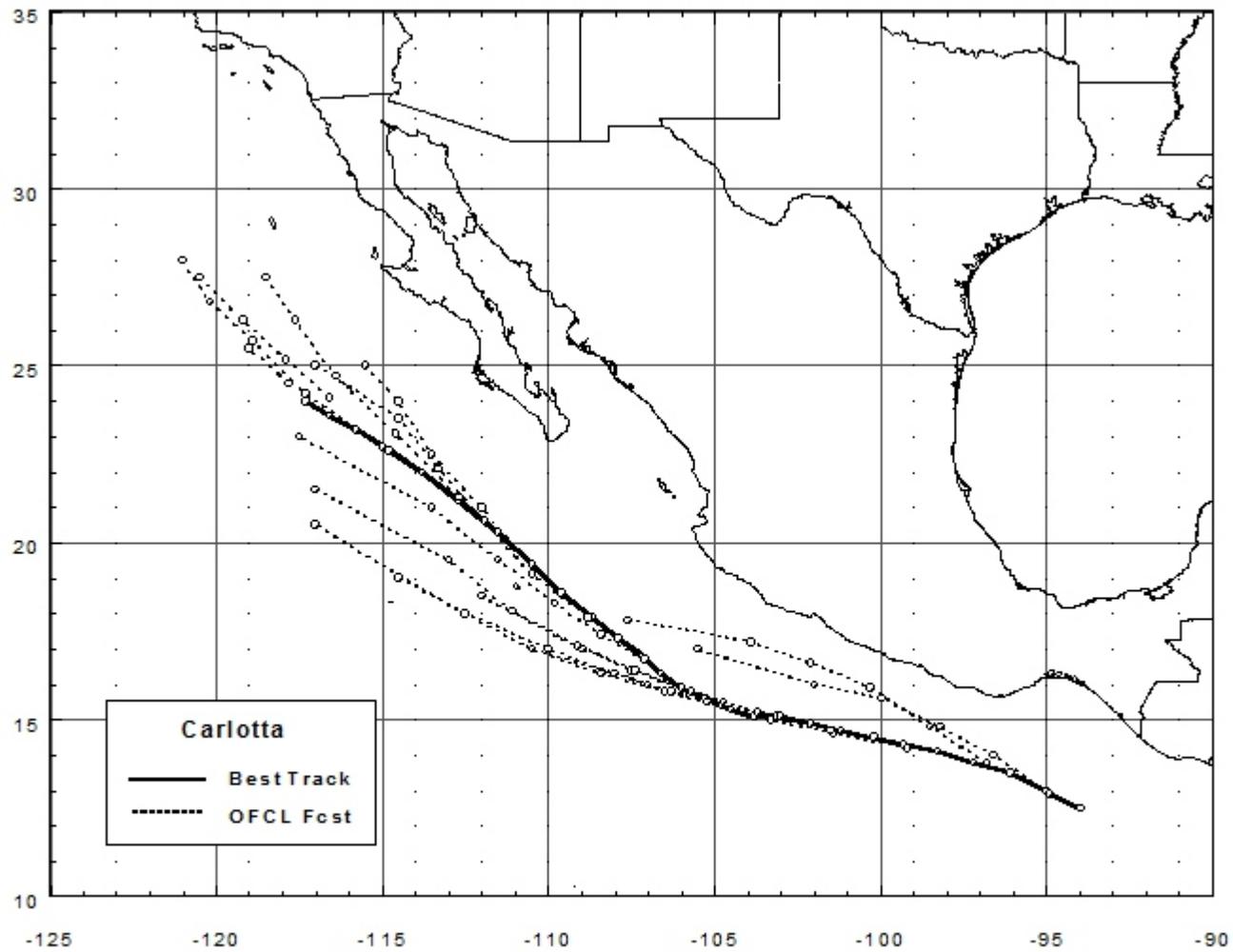


Figure 4. Selected official track forecasts (dashed lines, with 0, 12, 24, 36, 48, and 72 h positions indicated) for Hurricane Carlotta, 18-25 June 2000. The best track is given by the thick solid line with positions given at 6 h intervals.

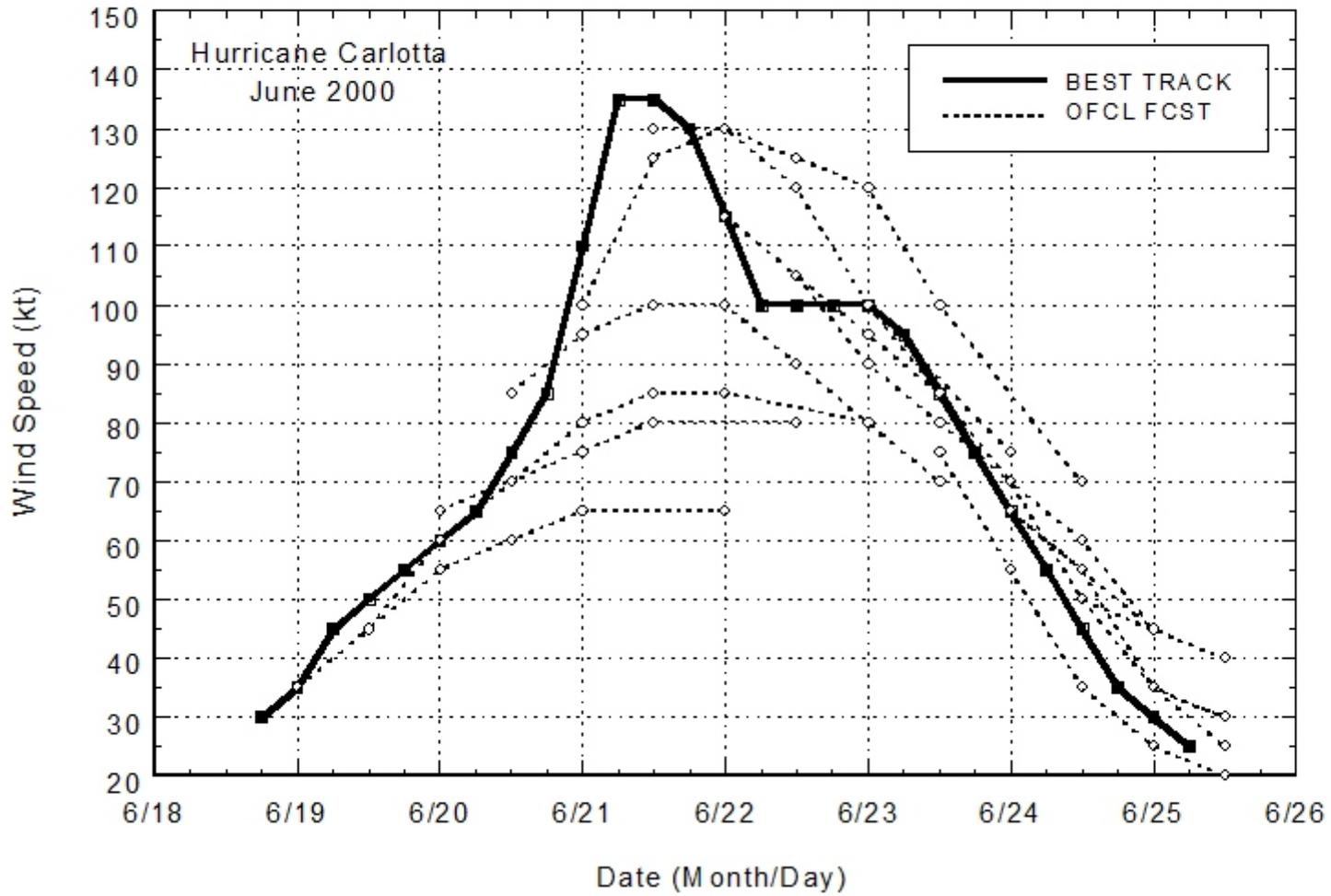


Figure 5. Selected official intensity forecasts (dashed lines) for Hurricane Carlotta, 18-25 June 2000. The best track intensity is given by the thick solid line.