

Tropical Cyclone Report
Hurricane Marty
18-24 September 2003

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Marty was a category 2 hurricane (on the Saffir-Simpson Hurricane Scale) when it made landfall on the southern Baja California peninsula. Marty then spread strong winds and heavy rains up the entire Gulf of California before dissipating. Marty was responsible for 12 deaths.

a. Synoptic History

Marty developed from a tropical wave that moved into the eastern North Pacific basin from Central America on 10 September. Convection associated with the wave became more persistent on 16 September south of Manzanillo, Mexico, and on 18 September the convection began to become organized. The system received its initial Dvorak classification at 1200 UTC that day, and it is estimated that a tropical depression had formed by 1800 UTC, about 450 miles south-southeast of Cabo San Lucas, Mexico.

The “best track” chart of the tropical cyclone’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. South of a weak mid-level ridge and in a light shear environment, the depression moved to the west-northwest at about 5 kt and strengthened, becoming a tropical storm at 0600 UTC 19 September about 400 n mi south-southeast of Cabo San Lucas. Relatively little development occurred over the next day or so, perhaps due to some relatively dry air entering the system from the east. Around 1200 UTC 20 September, Marty’s very intense but previously shapeless convection began to develop into bands and the pace of development increased as the system moved slowly northwestward. Marty became a hurricane at 0000 UTC 21 September about 265 miles south-southeast of Cabo San Lucas. Late on 21 September, Marty turned to the north-northwest around the periphery of the mid-level ridge and began to accelerate and strengthen in a region of enhanced upper-level divergence. By 0600 UTC 22 September, when Marty was 165 miles south-southeast of Cabo San Lucas, the hurricane’s maximum winds had reached their peak intensity of 85 kt. Marty was moving northward at about 17 kt when it made landfall at 0930 UTC 22 September near San Jose del Cabo, just east of Cabo San Lucas, with estimated maximum winds of 85 kt.

Shortly after 1200 UTC, Marty turned to the north-northwest and the center entered the Gulf of California near La Paz. Marty then moved along the eastern coast of southern Baja California, possibly making numerous landfalls on the islands and/or the coastline south of Santa Rosalia during the afternoon and evening of 22 September. Marty weakened to a tropical storm by 0000 UTC 23 September near Santa Rosalia, and then headed into the northern Gulf of California where it was stalled by a mid-level high over Nevada. Although the cyclone’s winds were decreasing, Marty continued to produce heavy rains that primarily affected mainland Mexico and then spread into

Arizona, New Mexico, and western Texas. Deep convection with the cyclone began to diminish and Marty weakened to a tropical depression late on 23 September. Over the next two days Marty meandered in and around the northern Gulf of California, degenerating to a non-convective remnant low by 0000 UTC 25 September. The remnant circulation drifted south-southwestward and dissipated over the northern Baja California peninsula early on 26 September.

b. Meteorological Statistics

Observations in Marty (Figs. 2 and 3) primarily consisted of satellite-based 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).

Ship reports of winds of tropical storm force associated with Marty are given in Table 2. The ship observation at 0600 UTC 19 September contributed to the decision to upgrade Marty to a tropical storm. Selected surface observations from land stations are given in Table 3. Sustained winds (10-min average) of 76 kt, with a gust to 102 kt, were recorded at Cabo San Lucas. Cabo San Lucas also reported 8 in of rain. There was an unofficial report from the marine vessel **S. V. Sea Witch**, anchored in La Paz harbor, of a minimum pressure of 971.9 mb during the passage of the center over La Paz. As Marty moved up the Gulf of California, tropical storm conditions were reported in a number of locations, including Santa Rosalia on the Baja peninsula and Los Mochis on the Mexican mainland (Table 3).

c. Casualty and Damage Statistics

The Mexican government reports 12 deaths associated with Marty in three states: 5 in Southern Baja California, 5 in Sonora, and 2 in Sinaloa. These totals include two individuals officially listed as missing but who are presumed dead. Media reports indicate that the deaths in Southern Baja California were associated with vehicles being swept away by rising river waters, with some or all of the deaths in Sonora associated with the sinking of a fishing boat near Guayamas. No monetary damage estimates have been provided, although media reports indicate that roughly 4000 homes were damaged in Southern Baja California. There was extensive damage to marine interests in the La Paz area, in Puerto Escondido, and from other locations along the Baja peninsula. Some beach erosion was reported at San Felipe in the northern Gulf of California.

d. Forecast and Warning Critique

Average official track errors for Marty (Table 4) were 42, 84, 120, 156, 248, 399, and 670 n mi for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively¹. These errors are larger than

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.

the average official track errors for the 10-yr period 1993-2002² - considerably so for the longer forecast periods. Official track forecasts for Marty had a significant westward bias (Fig. 4) that persisted until less than 24 h prior to landfall. Early model guidance, especially the GFS (and the models dependent on the GFS), did not sufficiently weaken the mid-level ridge north of the cyclone and as a result also had a westward bias. The GFDL was the first model to predict a more northward track, but perhaps because this model has often had a northward bias in the eastern Pacific, the official forecasts were adjusted northward only slowly. Although the official forecasts were incrementally shifted to the right with each forecast cycle, they remained consistently to the west of the GUNS and GUNA consensus models, which outperformed the official forecasts by a substantial margin (Table 4). The hurricane's acceleration just prior to landfall was also under-forecast.

Average official intensity errors were 7, 9, 11, 11, 13, 24, and 39 kt for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1993-2002² are 6, 11, 15, 17, 20, 18, and 19 kt, respectively. The official forecast errors were smaller than the long-term average through 72 h; beyond that, the forecast intensities were too high because the track forecasts did not anticipate Marty's landfall (and associated weakening).

Table 5 lists the watches and warnings associated with Marty. A hurricane warning was issued at 1500 UTC 21 September, about 18.5 h prior to the arrival of the center; this is less warning than is typically provided or considered desirable. The slow and westward biases in the official forecasts contributed to the relatively short lead time of the hurricane warning. Despite official forecasts that anticipated a landfall on the western side of southern Baja California, both sides of the peninsula were correctly included in the hurricane warning area.

Acknowledgments:

The Weather Service of Mexico and the U. S. National Weather Service Weather Forecast Office in Tucson, AZ contributed data for this report.

² Errors given for the 96 and 120 h periods are averages over the two-year period 2001-2.

Table 1. Best track for Hurricane Marty, 18-24 September 2003.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18 / 1800	16.5	105.7	1004	25	tropical depression
19 / 0000	16.8	106.3	1002	30	"
19 / 0600	16.9	106.8	1000	35	tropical storm
19 / 1200	17.1	107.1	999	35	"
19 / 1800	17.3	107.2	998	40	"
20 / 0000	17.5	107.3	998	40	"
20 / 0600	17.7	107.5	997	45	"
20 / 1200	18.0	107.9	997	45	"
20 / 1800	18.3	108.3	994	55	"
21 / 0000	18.6	108.6	987	65	hurricane
21 / 0600	18.9	108.8	987	65	"
21 / 1200	19.3	109.1	987	65	"
21 / 1800	20.1	109.4	987	65	"
22 / 0000	21.0	109.5	980	75	"
22 / 0600	22.0	109.6	970	85	"
22 / 1200	23.7	109.9	971	80	"
22 / 1800	25.4	110.8	980	70	"
23 / 0000	27.0	111.8	985	60	tropical storm
23 / 0600	28.3	112.5	993	50	"
23 / 1200	29.4	113.2	999	35	"
23 / 1800	29.9	113.5	1002	30	tropical depression
24 / 0000	30.5	113.7	1003	30	"
24 / 0600	30.8	113.5	1004	30	"
24 / 1200	31.1	113.3	1007	25	"
24 / 1800	31.5	113.6	1007	20	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 0000	31.5	114.1	1007	20	remnant low
25 / 0600	31.1	114.2	1008	20	"
25 / 1200	30.7	114.3	1010	20	"
25 / 1800	30.2	114.5	1012	20	"
26 / 0000	29.9	114.7	1012	20	"
26 / 0600					dissipated
22 / 0930	23.0	109.7	970	85	landfall near San Jose del Cabo
22 / 0600	22.0	109.6	970	85	minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Marty, 18-24 September 2003.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
19 / 0600	4XFP	18.2	104.1	130 / 35	1006.0
19 / 2100	DEHY	18.4	104.0	130 / 35	1003.9

Table 3. Selected surface observations for Hurricane Marty, 18-24 September 2003.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)	Storm tide (ft)	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^c	Gust (kt)			
Mexico								
Cabo San Lucas			22/0900	76	102			8.00
Loreto	22/2100	983.8 ^b						5.93
Santa Rosalia	22/2300	1003.1 ^b	23/0000	33	53			7.76
La Paz								4.70
La Paz Harbor		971.9						
S.V. Sea Witch								
Todos Santos								7.78
Los Mochis	22/1600	1002.0 ^b	22/1600	40 ^b				
Arizona								
Organ Pipe Cactus National Monument								2.25
Tanque Verde								1.82
Red Mountain								1.73
Tucson Intl. Airport								1.70
Three Points								1.66
Corona de Tucson								1.61

^a Date/time is for sustained wind when both sustained and gust are listed.

^b Record incomplete. More extreme values may have occurred.

^c 10-minute average.

Table 4. Preliminary forecast evaluation (heterogeneous sample) for Hurricane Marty, 18-24 September 2003. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage, but does not include the extratropical stage, if any. The table includes only those models typically available at forecast time.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
CLP5	54 (23)	116 (21)	190 (19)	267 (17)	369 (13)	439 (9)	491 (5)
GFNI	45 (18)	93 (16)	168 (14)	258 (14)	366 (10)		
GFDI	38 (22)	74 (20)	98 (18)	99 (16)	178 (12)	277 (7)	443 (4)
LBAR	53 (23)	109 (21)	181 (19)	246 (17)	313 (13)	413 (9)	651 (5)
AVNI	33 (20)	62 (18)	89 (16)	117 (14)	183 (10)	269 (6)	523 (2)
AEMI	53 (10)	113 (9)	187 (7)	226 (7)	307 (5)	307 (2)	184 (1)
BAMD	55 (23)	104 (21)	160 (19)	214 (17)	324 (13)	603 (9)	1164 (5)
BAMM	45 (23)	88 (21)	140 (19)	193 (17)	315 (13)	535 (9)	894 (5)
BAMS	49 (23)	101 (21)	159 (19)	224 (17)	378 (13)	567 (9)	767 (5)
NGPI	63 (21)	174 (19)	327 (17)	528 (15)	364 (9)	589 (6)	1033 (2)
UKMI	82 (17)	168 (16)	206 (15)	197 (12)	309 (7)	303 (5)	469 (1)
GUNS	42 (16)	81 (15)	91 (14)	122 (12)	208 (6)	244 (4)	389 (1)
GUNA	40 (16)	74 (15)	90 (14)	119 (12)	196 (6)	227 (4)	399 (1)
OFCL	42 (22)	84 (20)	120 (18)	156 (16)	248 (12)	399 (8)	670 (4)
NHC Official (1993-2002 mean)	39 (2864)	72 (2595)	103 (2314)	131 (2050)	186 (1603)	197 (210)	223 (143)

Table 5. Watch and warning summary for Hurricane Marty, 18-24 September 2003.

Date/Time (UTC)	Action	Location
20 / 2100	Hurricane Watch issued	Bahia Magdalena to San Evaristo
21 / 1500	Hurricane Watch changed to Hurricane Warning	Bahia Magdalena to San Evaristo
21 / 1500	Hurricane Watch issued	Punta Abrejos to Bahia Magdalena
21 / 1500	Hurricane Watch issued	Mulege to San Evaristo
22 / 0000	Hurricane Watch issued	Altata to Guaymas
22 / 0300	Hurricane Watch discontinued	Mulege to San Evaristo
22 / 0300	Hurricane Watch modified	Altata to Bahia Kino
22 / 0300	Hurricane Watch issued	Bahia San Juan Bautista to Loreto
22 / 0300	Hurricane Warning modified	Bahia Magdalena to Loreto
22 / 0900	Hurricane Watch modified	Mulege to Bahia San Juan Bautista
22 / 0900	Hurricane Watch modified	Topolobampo to Altata
22 / 0900	Hurricane Warning modified	Bahia Magdalena to Mulege
22 / 0900	Hurricane Warning issued	Topolobampo to Guaymas
22 / 1500	Hurricane Watch discontinued	Mulege to Bahia San Juan Bautista
22 / 1500	Hurricane Watch discontinued	Guaymas to Bahia Kino
22 / 1500	Hurricane Warning modified	Bahia Magdalena to Bahia San Juan Bautista
22 / 1500	Hurricane Warning modified	Bahia Kino to Topolobampo
22 / 2100	Hurricane Watch discontinued	All
22 / 2100	Hurricane Warning modified	Loreto to Bahia San Juan Bautista
23 / 0300	Tropical Storm Warning issued	Bahia San Juan Bautista to Colorado River
23 / 0300	Tropical Storm Warning issued	Bahia Kino to Colorado River
23 / 0300	Hurricane Warning discontinued	All
23 / 2100	Tropical Storm Warning discontinued	All

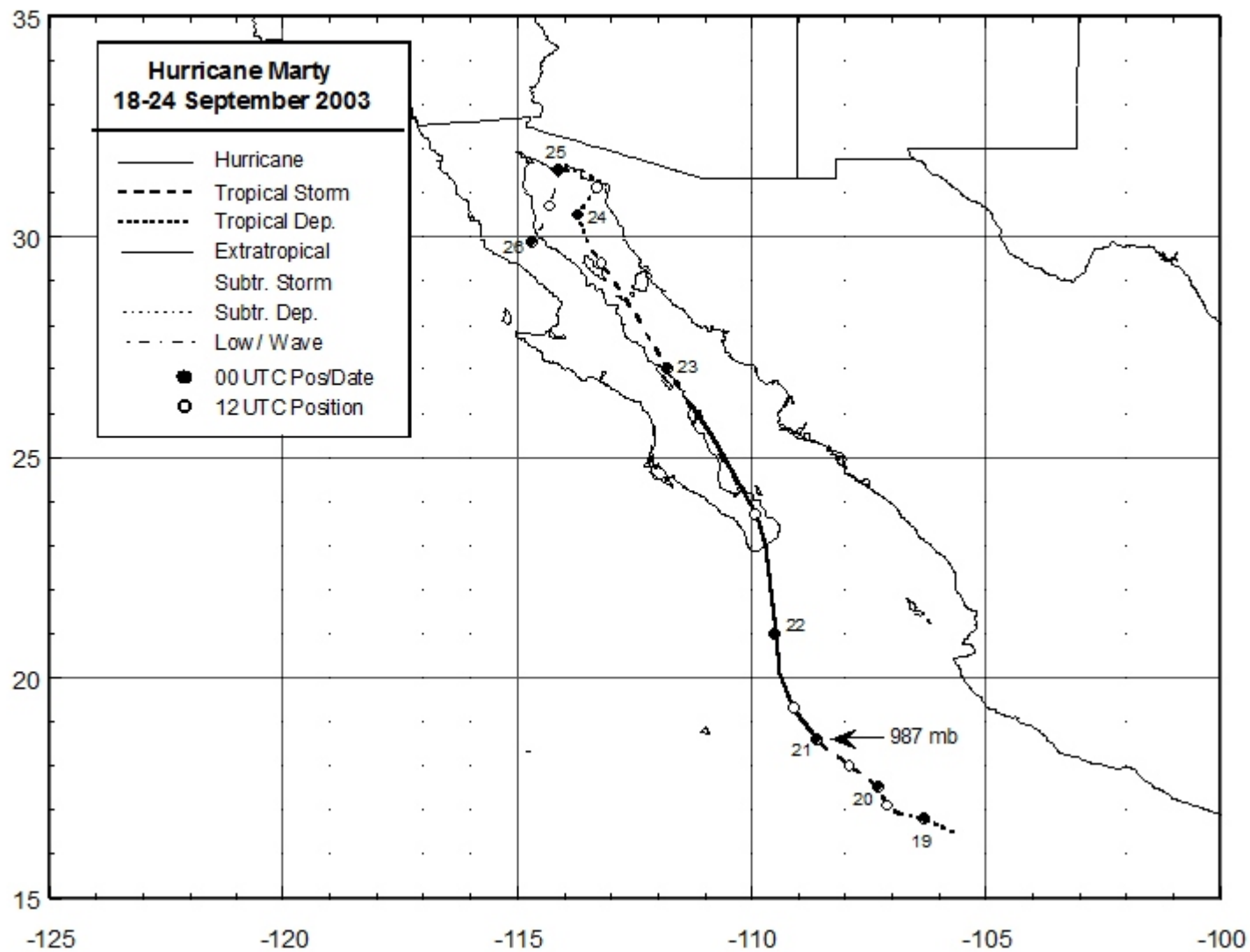


Figure 1. Best track positions for Hurricane Marty, 18-24 September 2003.

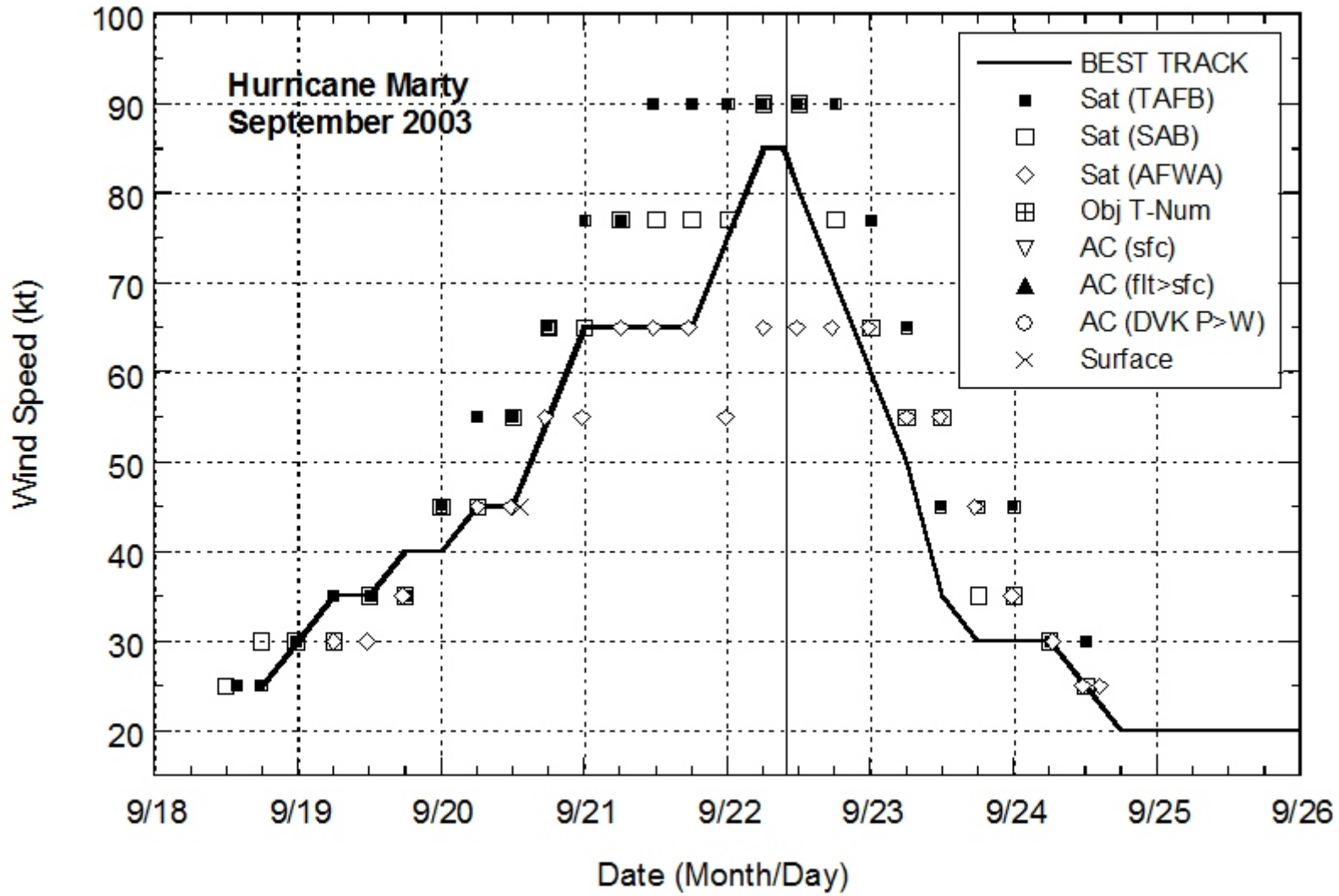


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Marty, 18-24 September 2003. Solid vertical line indicates Marty's landfall in southern Baja California. A scatterometer wind estimate is indicated by the "x".

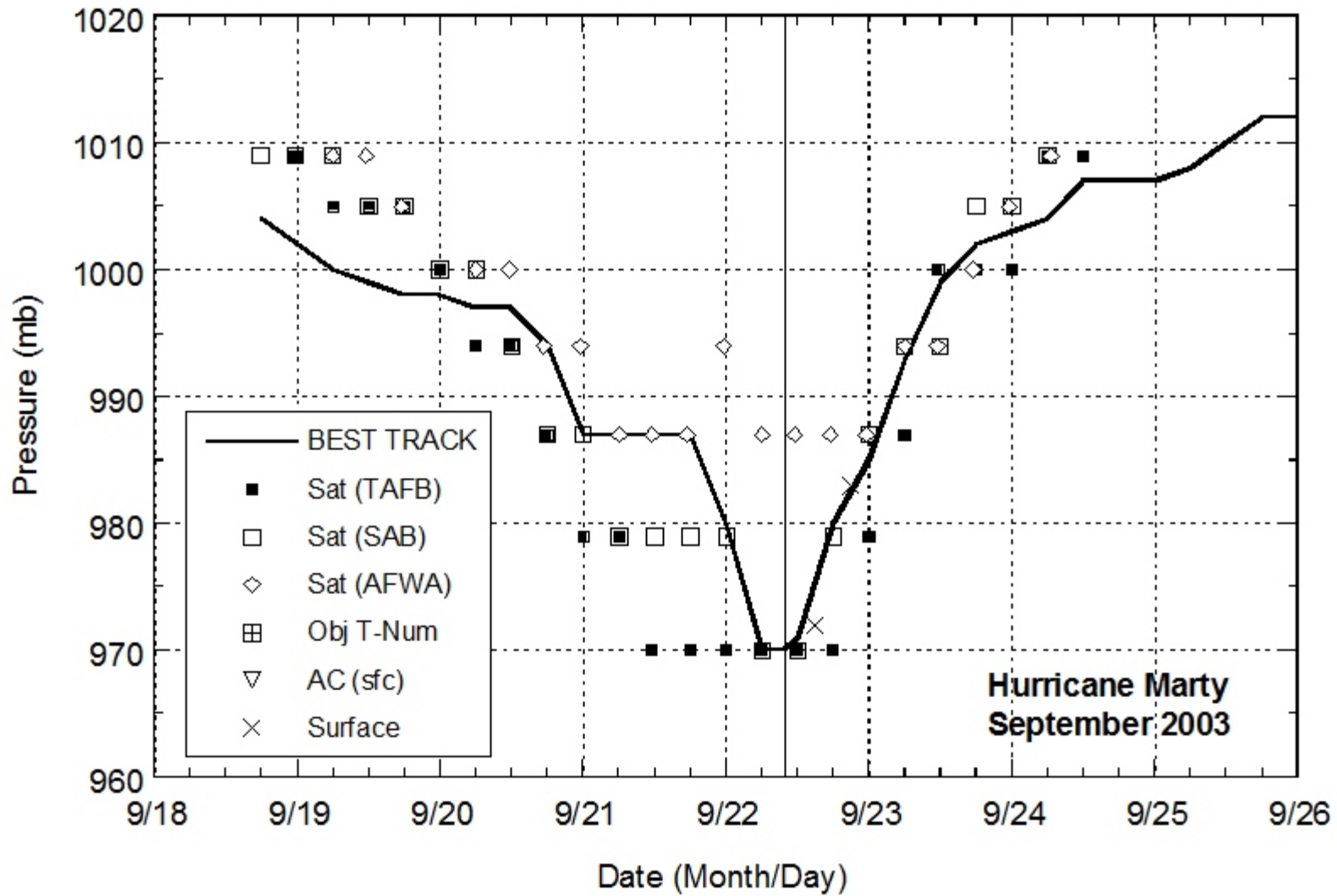


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Marty, 18-24 September 2003. Solid vertical line indicates Marty's landfall in southern Baja California.

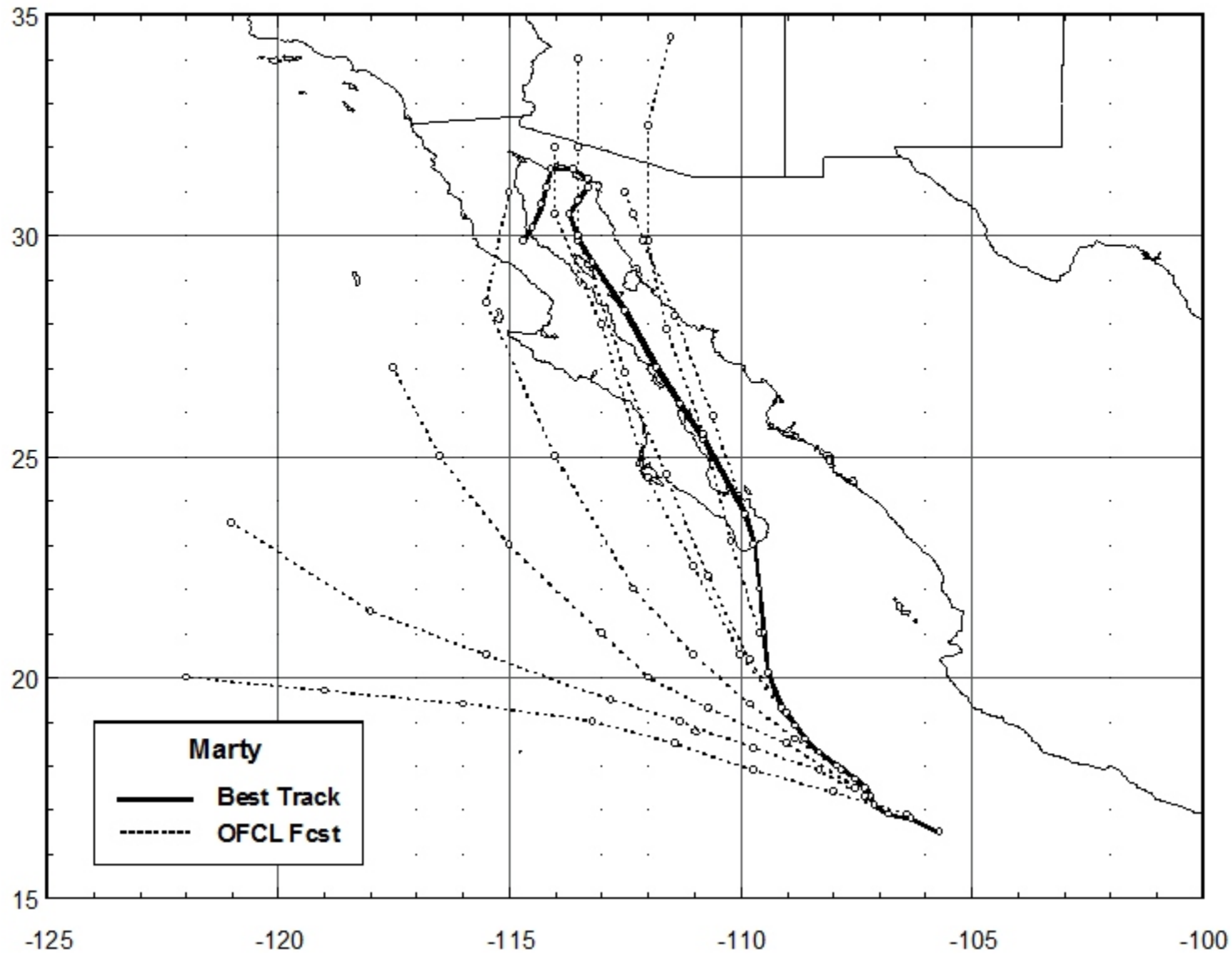


Figure 4. Selected official track forecasts (at 12 h intervals) for Hurricane Marty, 18-24 September 2003 (dashed lines, with 0, 12, 24, 36, 48, and 72 h positions indicated). The best track is given by the thick solid line with positions given at 6 h intervals.