Tropical Cyclone Report
Hurricane John
(EP112006)
28 August-4 September 2006

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National Hurricane Center
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Hurricane John struck southern Baja California as a category 2 hurricane (on the Saffir-Simpson Hurricane Scale) and was responsible for five deaths.

a. Synoptic History

A tropical wave that departed western Africa on 17 August and entered the eastern North Pacific Ocean late on 24 August appears to be responsible for the formation of John. The cloud pattern associated with this system, which was not impressive during its trek across the Atlantic basin, almost immediately showed signs of organization when the wave crossed into the Pacific. The first Dvorak satellite classification was done at 2345 UTC 24 August, when the system was located just to the west of Costa Rica. Tropical cyclone formation is rather infrequent so far east in the eastern Pacific basin, and there was little or no additional development while the system moved west-northwestward to the south of Central America over the next few days. On 27 August, curved bands of deep convection became better defined over the area to the south-southeast of the Gulf of Tehuantepec, and by 0000 UTC 28 August the system became sufficiently well-organized to warrant its designation as a tropical depression, while centered about 235 n mi south of Salina Cruz, Mexico. A continued increase in organization occurred, and the cyclone became a tropical storm by 1200 UTC 28 August.

The "best track" map 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. A rather weak mid-level ridge was situated over Mexico, and the flow to the south of this ridge moved John northwestward to west-northwestward at 6-10 kt for several days. On this track, the center of the cyclone moved roughly parallel to, but not far offshore of the coast of mainland Mexico. Meanwhile, an environment of low vertical shear and a very warm ocean promoted significant intensification. John became a hurricane by 1200 UTC 29 August, and strengthened into a major hurricane just 12 h later. The storm's peak intensity of 115 kt (category 4 on the Saffir-Simpson Hurricane Scale) was reached around 1800 UTC 30 August. Weakening to below major hurricane status took place over the next day or so, probably in association with at least one eyewall replacement. During this time, John's eye came within about 50 n mi of the coastline between Manzanillo and Lazaro Cardenas early on 31 August. On 1 September, the hurricane re-intensified to category 3 status while headed in the general direction of Baja California. Late on 1 September, the tropical cyclone turned toward the north-northwest as the mid-level ridge to the north of the hurricane weakened slightly. The 10-12 n mi diameter eye of John made landfall in extreme southern Baja California at Cabo del Este, about 40 n mi northeast of Cabo San Lucas, around 0200 UTC 2 September. Although there had been some slight weakening, the hurricane's maximum winds were estimated to be near 95 kt at

landfall. John moved northwestward near or just inland of the eastern coastline of the Baja peninsula, with the center of the weakening hurricane passing near La Paz shortly before 1200 UTC 2 September. John then moved up the hilly Baja California peninsula while continuing to decrease in intensity; it became a tropical storm by 1800 UTC 2 September, and eventually weakened to a tropical depression by 0000 UTC 4 September. The cyclone dissipated near the east coast of the north-central Baja California peninsula shortly after 1200 UTC 4 September.

b. Meteorological Statistics

Observations in John (Figs. 2 and 3) include 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), as well as flight-level and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve (AFRES) Command. Microwave satellite imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, and Defense Meteorological Satellite Program (DMSP) satellites were also useful in tracking John. The 115-kt estimated maximum intensity of this hurricane is based on a 700 mb flight-level wind of 126 kt from AFRES at 1256 UTC 30 August, a lowest 150-m average wind speed of 131 kt from a dropsonde at about the same time, and Dvorak intensity estimates of 115 kt from both TAFB and SAB at 1800 UTC 30 August. The lowest aircraft-measured central pressure was 950 mb at 1254 UTC 30 August. Since the central pressure was falling prior to the time of this observation, and the plane departed the storm shortly thereafter, it is presumed that the pressure was a little lower, 948 mb, at 1800 UTC that day – which is the lowest central pressure for the life of the hurricane. No hurricane-force wind speed measurements from ground-based stations were received. However, the 95-kt estimate of John's strength at landfall in southern Baja California is consistent with AFRES flight-level winds of 102 kt about 8 h before landfall and images from the Los Cabos radar that showed the eyewall structure being maintained, or becoming even a little better defined, up until the time that the center crossed the coast (Fig. 4).

A ship report of winds of tropical storm force associated with John is given in Table 2, and selected surface observations from land stations are given in Table 3. The strongest winds observed over land were from the La Paz Observatory, where maximum sustained winds of 45 kt with a gust to 57 kt were reported. A rainfall total of 12.5 inches was measured at Los Planes, with almost 11 inches of this falling in a 24-h period.

c. Casualty and Damage Statistics

According to press reports, John caused five deaths, all in Baja California. Two-hundred homes were said to have been destroyed in the vicinity of La Paz. Over 250 homes were damaged or destroyed in the city of Mulege, located on the eastern coast of south-central Baja California. Heavy rains resulted in the overflow of the Iguagil dam in Comundu, which isolated 15 towns due to 4-foot floodwaters. Winds and rains destroyed crops in large areas and killed many livestock in southern Baja California. Although the eye of the hurricane remained offshore of mainland Mexico, John's circulation affected the coast with very heavy rains and strong winds. A 10-foot storm surge was reported in Acapulco, causing flooding of coastal roads in that area; however this flooding may have been due to the combined effects of waves and tides. Heavy rains produced mud slides in the Costa Chica region of Guerrero, which left around 70

communities isolated. Moisture and locally heavy rains also spread over portions of northwestern Mexico and the southwestern United States. Twenty neighborhoods were flooded by rainfall from the remnants of John in Ciudad Juarez, located across the border from El Paso, Texas. Over 3 inches of rain fell in El Paso, causing some flooding and closure of roads in that area.

d. Forecast and Warning Critique

John's development was well-anticipated in the National Hurricane Center's Tropical Weather Outlook (TWOs). Disturbed weather associated with the tropical wave that spawned John had been mentioned in the TWO as early as 1700 UTC 25 August, when the system was near Central America. The first TWO to acknowledge that the pre-John disturbance could become a tropical cyclone was issued at 2300 UTC 26 August, or 25 h prior to genesis.

A verification of official and guidance model track forecasts for John is given in Table 4. Average official track errors were 24, 37, 51, 71, 145, 242, and 334 n mi for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. The number of forecasts ranged from 28 at 12 h to 10 at 120 h. These errors are lower than or comparable to the average long-term official track errors (Table 4) for 12 through 72 h and greater than the average for 96 and 120 h. Both GUNA and FSSE had lower average errors than the official forecast for 48 through 120 h. It should be noted that the GFDI model had remarkably low mean track errors beyond 72 h, and was as good or better than the consensus guidance at these forecast times. There was a substantial left bias in the official track forecasts, especially at days 4 and 5, as depicted in Fig. 5. In general, the longer-term official forecasts incorrectly called for the hurricane to pass to the south and southwest of Baja California. Shorter-term forecasts issued within about 60 h of landfall did indicate that the center would pass near or over southern Baja California. However nearly all of these forecasts called for the center to pass close to Cabo San Lucas, rather than over the sparsely-settled area to the northeast -- where landfall actually occurred.

A verification of official and guidance model intensity forecasts for John is given in Table 5. Average official intensity errors were 10, 15, 19, 21, 27, 33, and 33 kt for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. These mean errors are substantially higher than the average long-term official intensity errors of 6, 11, 14, 17, 19, 18, and 19 kt, respectively. The mean official intensity forecast errors for John were also larger than the climatology and persistence model SHIFOR at all forecast times, indicating no skill. The first few official intensity forecasts did not anticipate that the cyclone would strengthen as rapidly as it did. Since many official forecasts kept John offshore of Baja California, however, there was a high bias in the *mean* official wind speed forecasts, particularly at days 4 and 5.

Watches and warnings that were issued for John are listed in Table 6. A hurricane warning was issued for southern Baja California at 0300 UTC 31 August, 47 h prior to landfall.

e. Acknowledgements

Michael Rosengaus and Alberto Hernandez Unzon of the Meteorogical Service of Mexico provided meteorological observations and other information concerning John.

Table 1. Best track for Hurricane John, 28 August-4 September 2006.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 0000	12.3	94.6	1005	25	tropical depression
28 / 0600	12.7	95.0	1005	30	"
28 / 1200	13.1	95.6	1004	35	tropical storm
28 / 1800	13.5	96.3	1002	40	"
29 / 0000	13.7	96.9	997	50	"
29 / 0600	13.8	97.5	990	60	"
29 / 1200	14.0	98.3	980	75	hurricane
29 / 1800	14.2	99.2	965	95	"
30 / 0000	14.9	100.0	962	100	"
30 / 0600	15.3	100.8	960	105	"
30 / 1200	16.0	101.7	950	115	"
30 / 1800	16.9	102.7	948	115	"
31 / 0000	17.6	104.0	950	110	"
31 / 0600	18.2	104.9	950	110	"
31 / 1200	19.0	105.8	960	100	"
31 / 1800	20.2	106.7	968	90	"
01 / 0000	21.0	107.6	968	90	"
01 / 0600	21.4	108.4	955	100	"
01 / 1200	21.7	108.7	955	100	"
01 / 1800	22.4	108.9	958	95	"
02 / 0000	23.2	109.2	958	95	"
02 / 0600	23.8	109.9	962	85	"
02 / 1200	24.2	110.5	975	70	"
02 / 1800	24.8	111.0	985	60	tropical storm
03 / 0000	25.4	111.4	988	50	"
03 / 0600	26.0	111.8	990	45	"
03 / 1200	26.7	112.3	992	40	"
03 / 1800	27.4	112.5	996	35	"
04 / 0000	27.9	112.9	1002	30	tropical depression
04 / 0600	28.4	113.1	1004	25	"
04 / 1200	28.9	113.2	1004	25	"
04 / 1800					dissipated
30 / 1800	16.9	102.7	948	115	minimum pressure
02 / 0200	23.3	109.4	958	95	landfall over Cabo del Este, Baja California Sur

Table 2. Ship report of winds of at least 34 kt for Hurricane John, 28 August-4 September 2006.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
03 / 0700	D5XH	26.5	111.2	120 / 37	996.0

Table 3. Selected surface observations for Hurricane John, 28 August-4 September 2006.

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)	Gust (kt)			
Mexico								
Ciudad Constitución	2 / 2200	990.4	2 / 1550	23	34			
Ciudad Constitución (EMA)		997.8		12	34			
La Paz	2/ 0930	986.8	2 /1000	45	57			
Loreto								3.73
Puerto Cortés	2 / 2100	999.7	2 / 1530	31	42			
San Jose del Cabo								5.63[b]
San Jose De Los Planes								12.50
Santa Rosalía	3 / 1200	995.3	3 / 1200	34	45			5.77
Santiago								6.32
Topolobampo			2 / 1130		36			

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Twenty-four hour total.

Table 4. Preliminary track forecast evaluation (heterogeneous sample) for Hurricane John, 28 August-4 September 2006. 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.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
CLP5	31 (29)	54 (27)	86 (25)	116 (23)	197 (19)	285 (15)	353 (11)
GFNI	38 (24)	69 (22)	107 (20)	158 (18)	231 (14)	323 (10)	537 (6)
GFDI	39 (28)	68 (26)	89 (24)	111 (22)	158 (18)	**166** (14)	**157** (9)
GFSI	42 (28)	70 (26)	98 (24)	121 (22)	213 (18)	339 (14)	432 (11)
AEMI	43 (29)	76 (27)	115 (25)	145 (23)	219 (19)	318 (15)	375 (11)
NGPI	40 (29)	70 (27)	92 (25)	118 (23)	241 (17)	384 (13)	509 (8)
UKMI	50 (26)	88 (24)	122 (22)	137 (18)	235 (14)	346 (8)	458 (2)
BAMD	26 (29)	37 (27)	53 (25)	80 (23)	146 (19)	255 (15)	374 (11)
BAMM	28 (29)	46 (27)	70 (25)	101 (23)	205 (19)	365 (15)	520 (11)
BAMS	32 (29)	56 (27)	82 (25)	110 (23)	198 (19)	323 (15)	468 (11)
CONU	30 (29)	46 (27)	61 (25)	77 (23)	**139** (19)	**230** (15)	**332** (11)
GUNA	27 (25)	42 (23)	57 (21)	**68** (17)	**128** (13)	**209** (7)	**315** (2)
FSSE	25 (25)	41 (24)	54 (22)	**61** (20)	**90** (16)	**166** (12)	**281** (8)
OFCL	24 (28)	37 (26)	51 (24)	71 (22)	145 (18)	242 (14)	334 (10)
NHC Official (2001-2005 mean)	35 (1300)	60 (1152)	83 (1009)	103 (877)	145 (652)	192 (465)	231 (313)

Table 5. Preliminary intensity forecast evaluation (heterogeneous sample) for Hurricane John, 28 August-4 September 2006. Forecast errors (kt) 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.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
SHF5	**9.2** (29)	**14.6** (27)	**18.8** (25)	**17.9** (23)	**19.4** (19)	**26.1** (15)	**23.2** (11)
GFDI	13.0 (28)	22.2 (26)	30.5 (24)	34.4 (22)	27.1 (18)	**21.4** (14)	**16.9** (9)
SHIP	12.4 (29)	21.4 (27)	29.6 (25)	33.5 (23)	31.7 (19)	**32.7** (15)	33.1 (11)
DSHP	10.7 (29)	17.0 (27)	24.6 (25)	28.0 (23)	30.7 (19)	**32.0** (15)	33.1 (11)
FSSE	**9.4** (25)	14.8 (24)	**14.2** (22)	**13.2** (20)	**12.8** (16)	**16.1** (12)	**19.5** (8)
ICON	10.1 (27)	**14.5** (25)	**19.3** (23)	**21.3** (21)	**19.5** (17)	**15.9** (13)	**16.0** (8)
OFCL	9.5 (28)	14.8 (26)	19.4 (24)	21.4 (22)	26.9 (18)	33.2 (14)	32.5 (10)
NHC Official (2001-2005 mean)	6.2 (1300)	10.8 (1152)	14.3 (1009)	16.5 (876)	18.7 (652)	18.3 (465)	19.3 (313)

Table 6. Watch and warning summary for Hurricane John, 28 August-4 September 2006.

Date/Time (UTC)	Action	Location
29 / 0300	Tropical Storm Watch issued	Lagunas De Chacahua to Lazaro Cardenas
29 / 1500	Tropical Storm Watch modified to	Lagunas De Chacahua to Acapulco
29 / 1500	Tropical Storm Warning issued	Lazaro Cardenas to Acapulco
29 / 2100	Tropical Storm Watch discontinued	Lagunas De Chacahua to Acapulco
29 / 2100	Tropical Storm Watch modified to	Lazaro Cardenas to Cabo Corrientes
29 / 2100	Tropical Storm Warning modified to	Lazaro Cardenas to Lagunas De Chacahua
30 / 0300	Tropical Storm Watch discontinued	All
30 / 0300	Tropical Storm Warning modified to	Lazaro Cardenas to Punto Maldonado
30 / 0300	Hurricane Watch issued	Tecpan De Galeana to Lazaro Cardenas
30 / 0300	Hurricane Watch issued	La Fortuna to Cabo Corrientes
30 / 0300	Hurricane Warning issued	Lazaro Cardenas to La Fortuna
30 / 1500	Tropical Storm Watch issued	Cabo Corrientes to El Roblito
30 / 1500	Tropical Storm Warning modified to	Lazaro Cardenas to Acapulco
30 / 1500	Hurricane Watch discontinued	La Fortuna to Cabo Corrientes
30 / 1500	Hurricane Watch issued	Islas Marias
30 / 1500	Hurricane Warning modified to	Lazaro Cardenas to Cabo Corrientes
30 / 2100	Tropical Storm Watch modified to	Cabo Corrientes to Mazatlan
30 / 2100	Hurricane Watch issued	La Paz to Santa Fe
31 / 0300	Hurricane Watch changed to Hurricane Warning	La Paz to Santa Fe
31 / 0300	Hurricane Watch changed to Hurricane Warning	Islas Marias
31 / 0300	Tropical Storm Watch discontinued	All
31 / 0300	Tropical Storm Warning discontinued	Lazaro Cardenas to Acapulco
31 / 0300	Tropical Storm Warning issued	San Blas to Mazatlan
31 / 0300	Hurricane Watch discontinued	All
31 / 0300	Hurricane Warning modified to	Lazaro Cardenas to San Blas
31 / 1500	Hurricane Warning modified to	Manzanillo to San Blas
31 / 2100	Hurricane Warning modified to	Cabo Corrientes to San Blas
31 / 2100	Hurricane Warning discontinued	La Paz to Santa Fe
31 / 2100	Hurricane Warning issued	San Everisto to Bahia Magdalena
1 / 0300	Tropical Storm Warning issued	Punta Abreojos to Bahia Magdalena

1 / 0300	Tropical Storm Warning issued	San Evaristo to Loreto
1 / 0600	Tropical Storm Warning discontinued	San Blas to Mazatlan
1 / 0900	Tropical Storm Watch issued	Loreto to Mulege
1 / 0900	Hurricane Watch issued	Bahia Magdalena to Punta Abreojos
1 / 0900	Hurricane Warning discontinued	Cabo Corrientes to San Blas
1 / 1500	Hurricane Warning discontinued	Islas Marias
2 / 0000	Hurricane Watch changed to Tropical Storm Warning	Punta Abreojos to Bahia Magdalena
2 / 0300	Tropical Storm Watch modified to	Bahia San Juan Bautista to Mulege
2 / 0300	Tropical Storm Watch issued	Punta Eugenia to Punta Abreojos
2 / 0300	Tropical Storm Watch issued	Altata to Guaymas
2 / 0300	Tropical Storm Warning discontinued	All
2 / 0300	Hurricane Warning discontinued	San Everisto to Bahia Magdalena
2 / 0300	Hurricane Warning issued	Mulege to Punta Abreojos
2 / 0900	Tropical Storm Watch changed to Tropical Storm Warning	Bahia San Juan Bautista to Mulege
2 / 2100	Tropical Storm Watch discontinued	All
2 / 2100	Tropical Storm Warning modified to	Bahia San Juan Bautista to San Evaristo
2 / 2100	Tropical Storm Warning issued	Punta Eugenia to Santa Fe
2 / 2100	Hurricane Warning discontinued	All
3 / 0900	Tropical Storm Warning modified to	Punta Eugenia to Bahia Magdalena
3 / 1500	Tropical Storm Warning discontinued	Bahia San Juan Bautista to San Evaristo
3 / 1500	Tropical Storm Warning modified to	Punta Eugenia to Punta Abreojos
3 / 1500	Tropical Storm Warning issued	Bahia De Los Angeles to Loreto
3 / 2100	Tropical Storm Warning modified to	Bahia De Los Angeles to Mulege
3 / 2100	Tropical Storm Warning discontinued	Punta Eugenia to Punta Abreojos
3 / 0000	Tropical Storm Warning discontinued	All

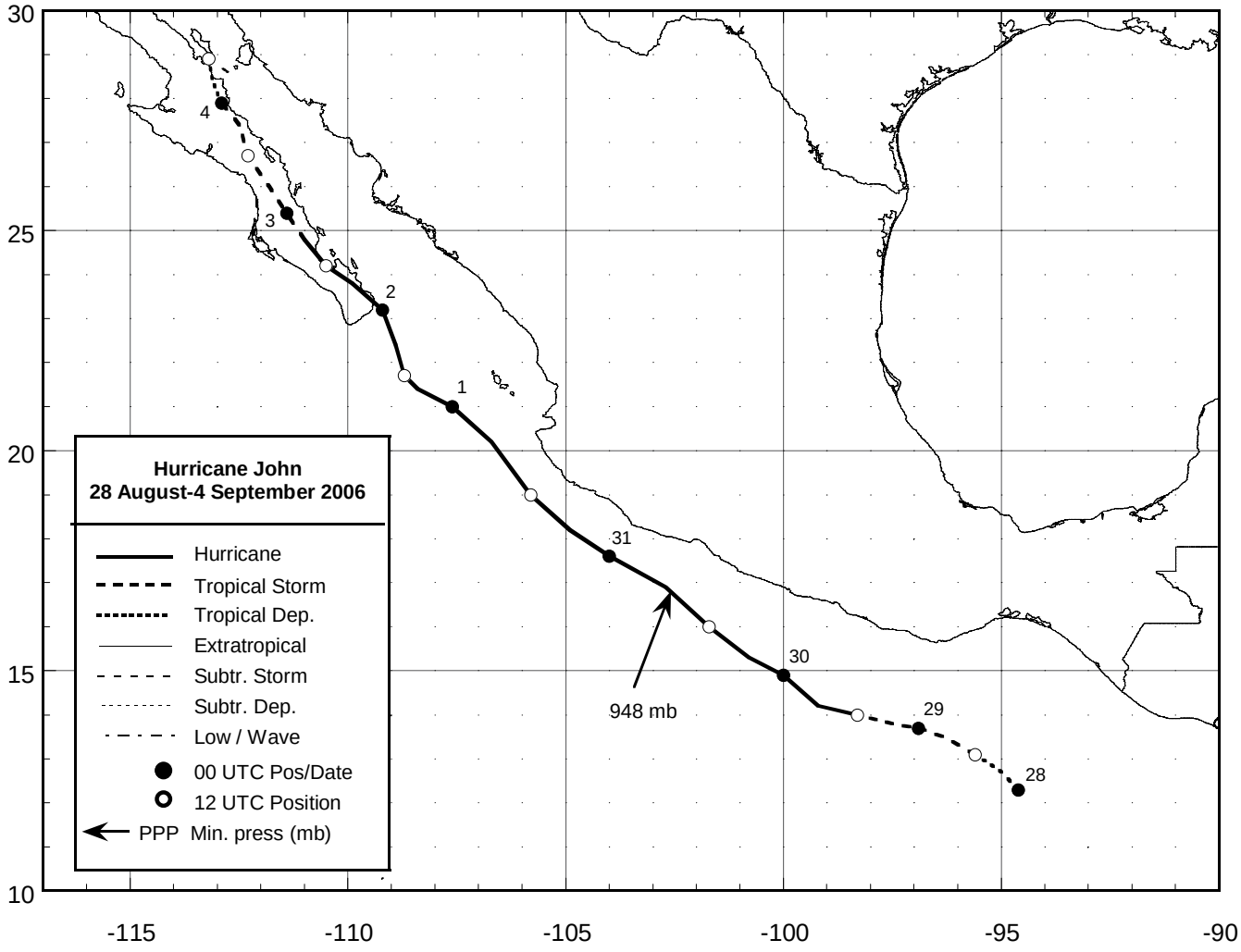

Figure 1. Best track positions for Hurricane John, 28 August-4 September 2006.

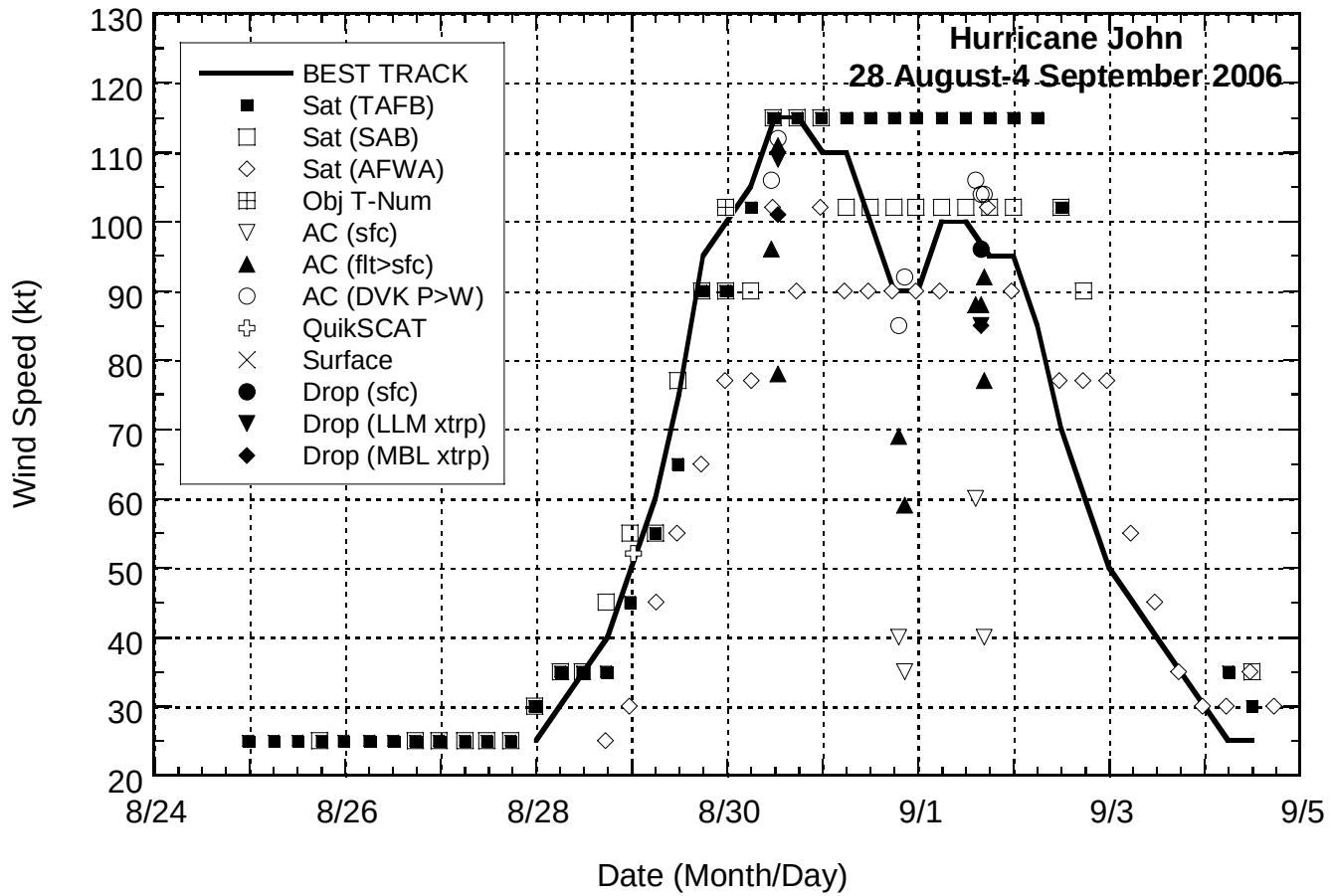

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane John, 28 August-4 September 2006. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM), and from the sounding boundary layer mean (MBL). Objective Dvorak estimate represents a linear average over a three-hour period centered on the nominal observation time.

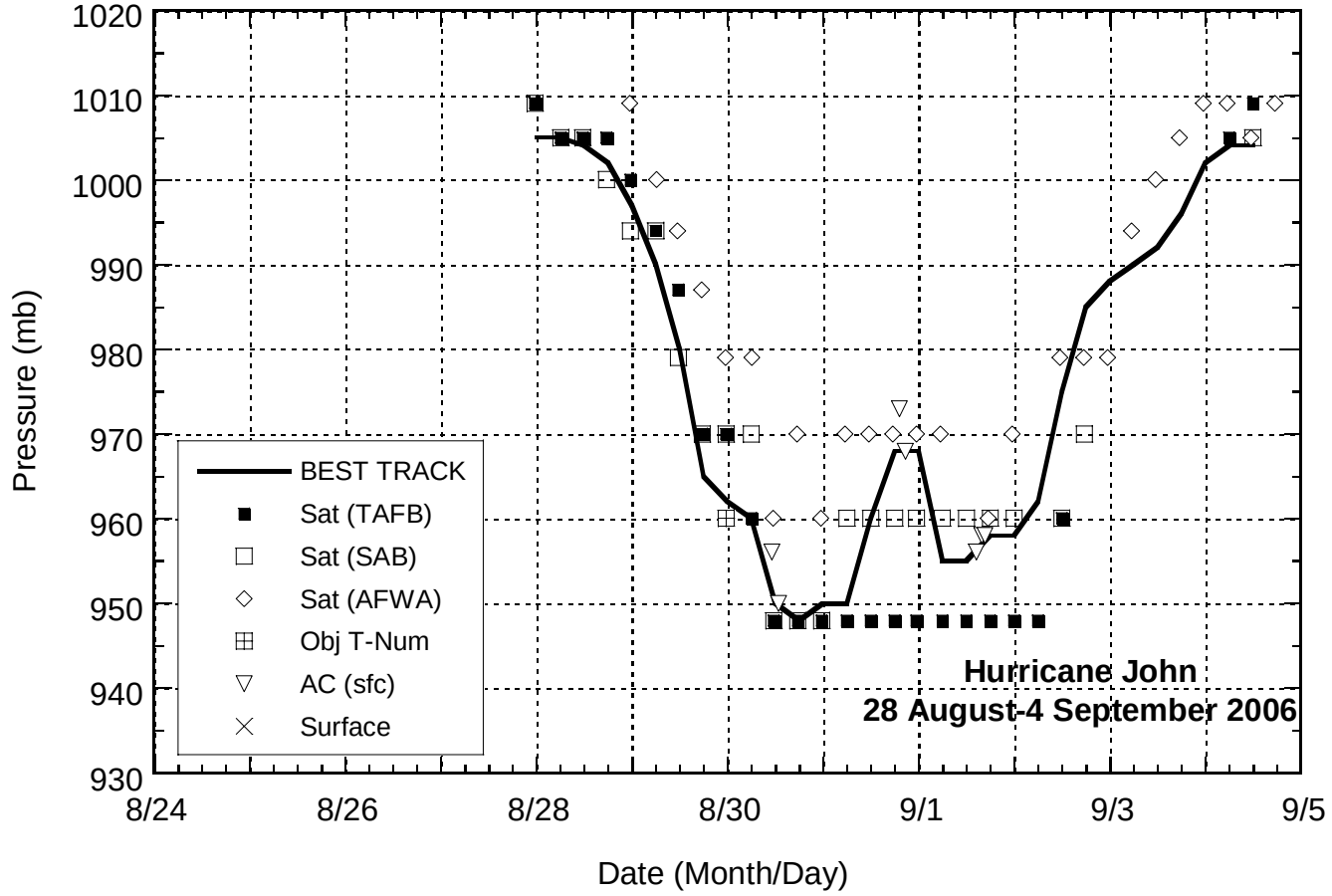

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane John, 28 August-4 September 2006. Objective Dvorak estimate represents a linear average over a three-hour period centered on the nominal observation time.

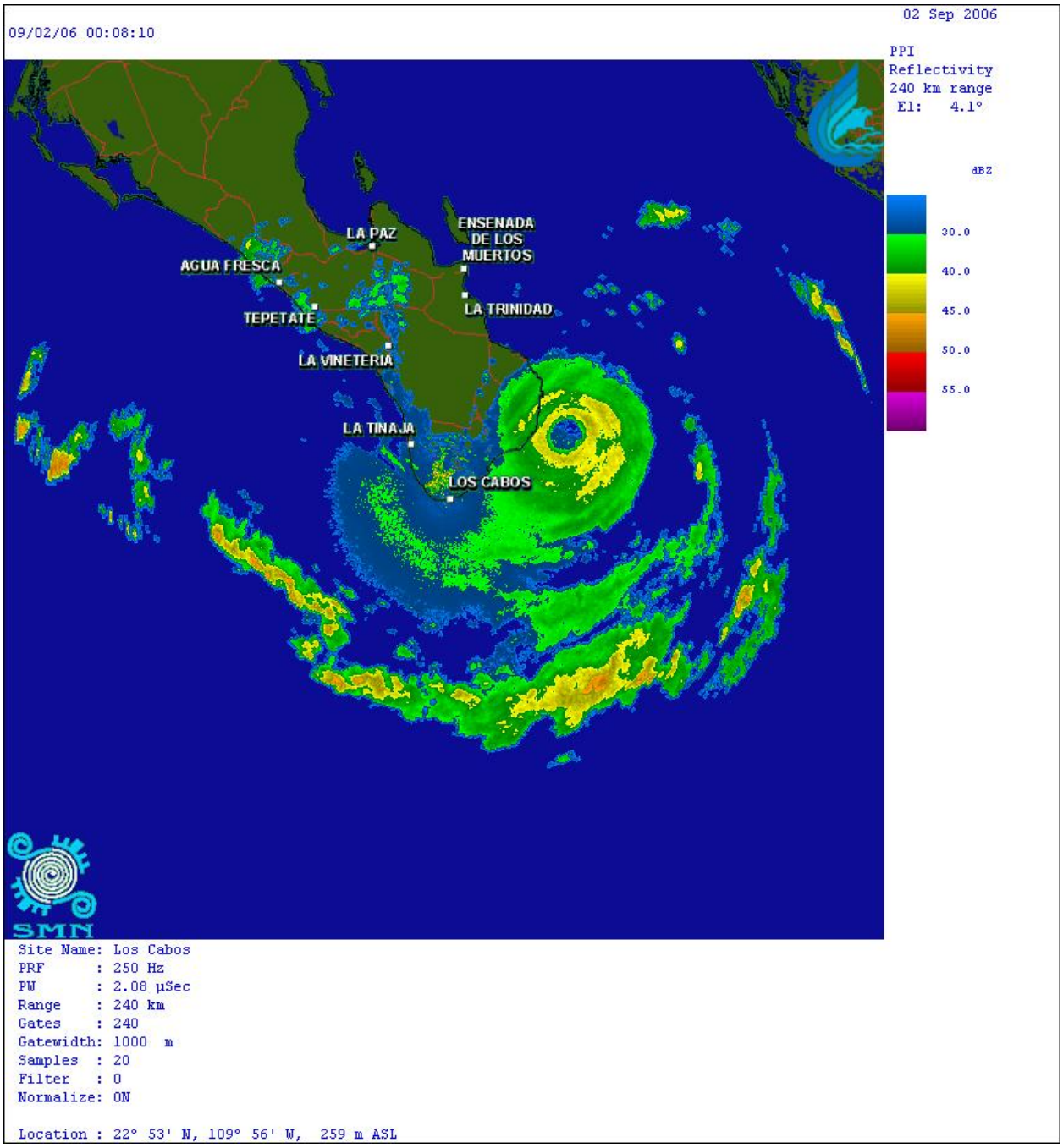

Figure 4. Image from the Meteorological Service of Mexico's Los Cabos radar exhibiting the well-defined eyewall of Hurricane John shortly before landfall in southern Baja California.

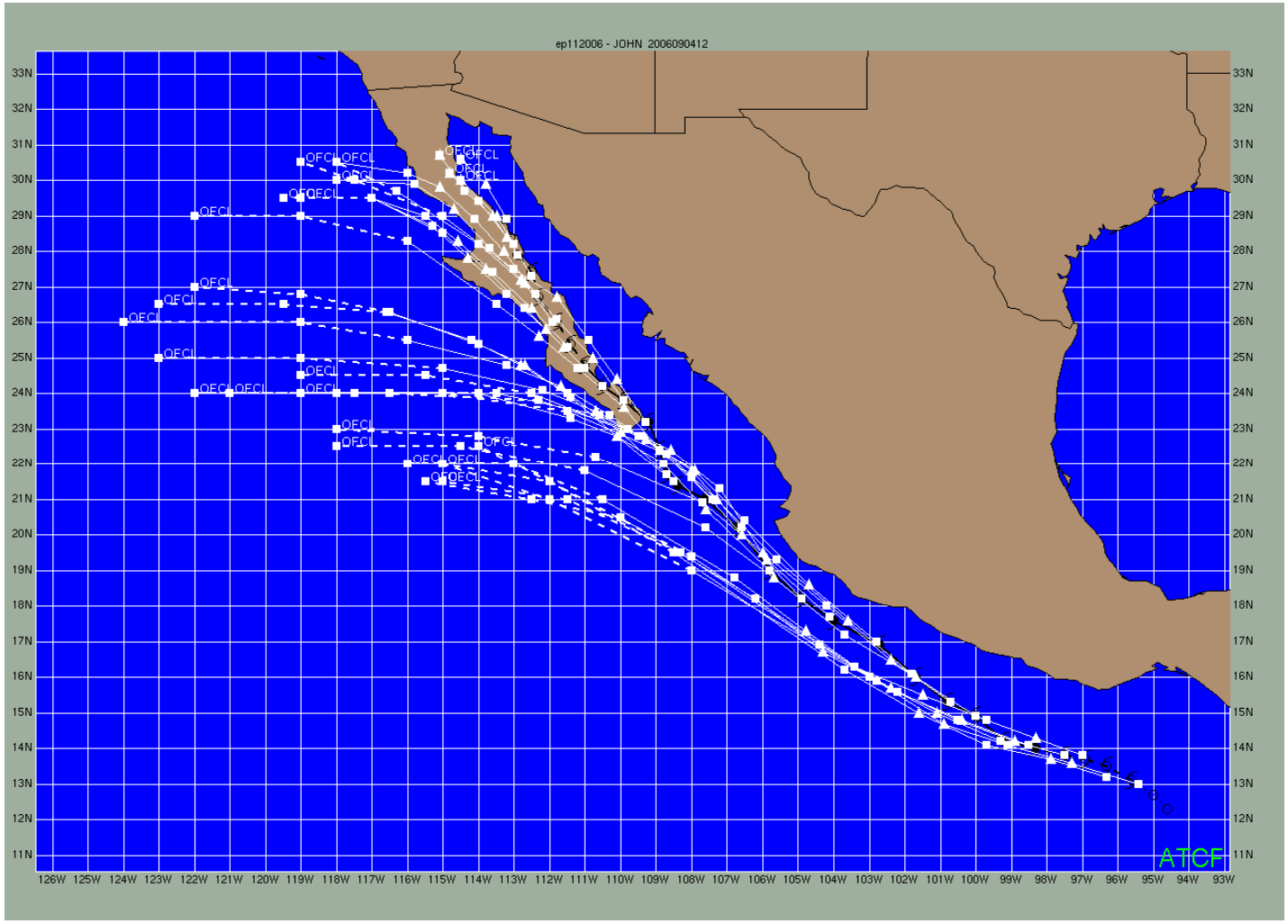

Figure 5. Official track forecasts (white) and Best Track (black) for Hurricane John, 28 August-4 September 2006.