

Tropical Cyclone Report
Hurricane Jimena
(EP132009)
28 August – 4 September 2009

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29 January 2010

Jimena was a high-end category 4 hurricane (on the Saffir-Simpson Hurricane Scale) off the western coast of Mexico. It made landfall on the Pacific coast of Baja California as a category 2 hurricane (tied for the strongest landfall of record in that area), causing widespread wind and freshwater flood damage in both Baja California and northwestern mainland Mexico.

a. Synoptic History

Jimena was spawned by a tropical wave that moved westward from the coast of Africa on 15 August. The wave traveled uneventfully westward across the Atlantic and Caribbean and moved into the eastern Pacific basin on 25 August. The associated shower activity increased in coverage on 27 August, and early the next day a low pressure area formed in it about 265 n mi southeast of Acapulco, Mexico. Development continued, and it is estimated that a tropical depression formed near 1800 UTC 28 August about 190 n mi south of Acapulco. 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 1¹.

The depression moved westward initially on the south side of a mid-level ridge over Mexico. It then turned northwestward on 30 August. Microwave imagery suggested that the depression had a small radius of maximum winds at the time of genesis, and this possibly aided the subsequent rapid development. The cyclone became a tropical storm early on 29 August and a hurricane later that day. Strengthening continued until Jimena reached an estimated intensity of 120 kt on 30 August, when development was interrupted by an eyewall replacement cycle. The cycle finished early on 31 August, and Jimena again strengthened, this time to a peak intensity of 135 kt by 1800 UTC that day.

Late on 31 August, Jimena turned north-northwestward between the ridge over Mexico, Tropical Storm Kevin to the west, and a mid/upper-level low west of Baja California. A combination of increasing vertical wind shear, decreasing sea surface temperatures, and a second eyewall replacement caused the hurricane to weaken starting early on 1 September. A steady weakening and a north-northwestward motion continued until Jimena made landfall over Isla Santa Margarita, Baja California del Sur, about 1200 UTC 2 September. At that time, the

¹ A digital record of the complete best track, including wind radii, can be found on line at <ftp://ftp.nhc.noaa.gov/atcf>. Data for the current year’s storms are located in the *brk* directory, while previous years’ data are located in the *archive* directory.

estimated intensity was 90 kt – category 2 on the Saffir-Simpson Hurricane Scale (SSHS). A second landfall at the same intensity occurred an hour later at Puerto San Carlos, Baja California del Sur.

The center of Jimena briefly emerged over the Pacific a few hours after the second landfall. The hurricane turned northward and weakened to category 1 on the SSHS before making a third landfall just east of San Juanico in Baja California del Sur at about 2100 UTC 2 September. Jimena continued northward across Baja California while weakening to a tropical storm, with the center emerging into the central Gulf of California near 0600 UTC 3 September. The steering currents then collapsed, and Jimena drifted erratically over the Gulf for the next 24 h. During this time, vertical shear and interaction with land caused weakening, with Jimena becoming a depression early on 4 September. The depression started a southwestward motion later that day and made its final landfall near Santa Rosalia, Baja California del Sur, around 1900 UTC 4 September. The depression degenerated to a remnant low while it crossed Baja, with the low dissipating over the Pacific on 5 September.

b. Meteorological Statistics

Observations in Jimena (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), as well as flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites (including AMSU-based intensity estimates), the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Jimena.

The U. S. Air Force Reserve Hurricane Hunters conducted two flights into Jimena – one each on 31 August and 1 September. The maximum 700 mb flight-level wind was 149 kt at 1921 UTC 31 August, and the maximum surface winds estimated from the SFMR was 132 kt a minute earlier. These data are the basis for the peak intensity of 135 kt. The minimum observed central pressure was 931 mb at 1919 UTC that day. The central pressure was falling rapidly at that time, and the satellite intensity signature of Jimena did not reach its peak until 2100 UTC. Thus, there is a chance the hurricane continued to strengthen for a few hours after the aircraft left the storm.

Selected surface observations from land stations and data buoys are given in Table 2. The highest sustained wind from any land station was 61 kt with a gust to 79 kt at Ciudad Constitucion in Baja California del Sur. While there are no reports of sustained hurricane-force winds, hurricane conditions likely affected much of the data-sparse Pacific coast of Baja California south of San Juanico. Storm chasers in Puerto San Carlos reported a pressure of 973.0 mb as the eye of Jimena passed over the town.

Jimena produced widespread heavy rains over central and southern Baja California, as well as over the Mexican mainland state of Sonora. The maximum reported storm-total rainfall

was 26.46 inches at Guaymas in Sonora. However, this amount is twice that of the nearby station at Empalme, and its accuracy is uncertain. Other significant rainfall totals are included in Table 2.

A ship with the call sign **VRCQ2** reported 38-kt winds on four occasions between 0900 and 1800 UTC 31 August. This was only ship that reported tropical-storm-force winds associated with Jimena.

Jimena's 90-kt intensity at landfall ties it with Hurricane Norbert of 2008 as the strongest landfalling hurricane of record on the west coast of Baja California.

c. Casualty and Damage Statistics

One death has been attributed to Jimena – a drowning due to freshwater floods in Mulege, Baja California del Sur.

Media reports indicate that Jimena's winds and rains caused widespread damage on the central and southern Baja California peninsula. The cities of Ciudad Constitución, Mulege, and Loreto were reported to be hard hit, as well as many of the smaller towns near the track of the center. Severe freshwater floods occurred on the Mexican mainland near Guaymas. While no totals are available, the reports suggest that the number of damaged buildings was in the tens of thousands. No monetary damage figures are available as of this writing.

d. Forecast and Warning Critique

The genesis of Jimena was not well anticipated. While the precursor disturbance was noted in the Tropical Weather Outlook as early as 25 August, it was given a low probability of development until 27 August. A medium probability was given on 27-28 August starting about 24 h before genesis, while a high probability was not given until the time that genesis occurred on 28 August.

A verification of NHC official track forecasts for Jimena is given in Table 3a. The official forecast track errors were 23, 44, 59, 64, 52, 109, and 219 n mi at 12, 24, 36, 48, 72, 96, and 120h respectively. These errors are significantly lower than the mean official errors for the previous five-year period for 12-96 h and a little above the five-year mean at 120 h. The errors for climatology and persistence (OCD5) are larger than the five-year mean for the 36-120 h periods, suggesting these forecasts were more difficult than normal. Examination of the individual track forecasts (not shown) show that the majority were very close to the track of Jimena. However, some of the early forecasts had a left bias at 96-120 h, and later forecasts did not adequately anticipate Jimena's erratic motion over the Gulf of California. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The errors for the official forecasts were generally lower than those of the forecast guidance, although the BAM trajectory models and the consensus models TVCN and TVCC had comparable or lower errors than the official forecasts. It should be noted that verification

statistics for several models normally seen in the homogeneous comparison (including HWFI, GUNA, and the Florida State Superensemble) are not included due to a lack of cases at 120 h.

A verification of NHC official intensity forecasts for Jimena is given in Table 4a. Official forecast intensity errors were comparable to the mean official errors for the previous five-year period for 12-36 h, then they were significantly lower for the later forecast periods. The errors for OCD5 are larger than the five-year mean for all forecast times, again suggesting these forecasts were more difficult than normal. Examination of the individual forecasts shows that the early forecasts, as is often the case, underforecast the intensity during the initial rapid intensification. Some later forecasts kept Jimena too strong during its interaction with Baja California. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The official forecasts had lower average errors than all the guidance through the first 72 h, with the DHSP, LGEM, and IVCN models occasionally outperforming the official errors after that time.

Watches and warnings associated with Jimena are given in Table 5. The track of Jimena was nearly parallel to the Baja California peninsula, and thus required watches and warnings over large areas of the central and southern peninsula. The initial hurricane warning was issued about 45 h before the center made its initial landfall and about 35 h before the center made its closest approach to the Cabo San Lucas area.

Acknowledgements:

Data from Mexico were provided by the Meteorological Service of Mexico, and by Erik Pytlak of the National Weather Service WFO in Tucson, Arizona. Storm chasers Jim Edds and Josh Mongerman provided the landfall data for Puerto San Carlos.

Table 1. Best track for Hurricane Jimena, 28 August – 4 September 2009.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 0000	13.4	96.8	1008	25	low
28 / 0600	13.5	97.9	1008	25	"
28 / 1200	13.5	99.0	1008	25	"
28 / 1800	13.6	100.0	1007	30	tropical depression
29 / 0000	13.7	101.0	1005	35	tropical storm
29 / 0600	13.8	101.9	1000	45	"
29 / 1200	14.2	102.9	990	60	"
29 / 1800	14.8	103.8	980	75	hurricane
30 / 0000	15.4	104.7	970	90	"
30 / 0600	15.7	105.5	957	105	"
30 / 1200	16.0	106.0	948	115	"
30 / 1800	16.3	106.6	945	120	"
31 / 0000	16.7	107.1	945	120	"
31 / 0600	17.2	107.6	945	120	"
31 / 1200	17.7	108.2	945	120	"
31 / 1800	18.2	108.9	935	135	"
01 / 0000	18.9	109.4	931	135	"
01 / 0600	19.7	109.9	933	130	"
01 / 1200	20.6	110.5	940	125	"
01 / 1800	21.5	111.0	948	115	"
02 / 0000	22.4	111.4	957	105	"
02 / 0600	23.4	111.7	965	95	"
02 / 1200	24.6	112.0	971	90	"
02 / 1800	25.8	112.4	977	80	"
03 / 0000	26.7	112.4	985	65	"
03 / 0600	27.4	112.3	997	50	tropical storm
03 / 1200	27.6	112.3	999	45	"
03 / 1800	27.8	112.1	1002	40	"
04 / 0000	27.6	111.9	1004	35	"
04 / 0600	27.5	111.7	1005	30	tropical depression
04 / 1200	27.7	111.7	1006	25	"
04 / 1800	27.4	112.2	1006	25	"
05 / 0000	27.2	112.5	1007	20	low
05 / 0600	26.9	112.9	1008	20	"
05 / 1200	26.5	113.3	1010	15	"
05 / 1800					dissipated
31 / 1900	18.3	109.0	931	135	minimum pressure
02 / 1200	24.6	112.0	971	90	Landfall on Isla San Margarita, Baja California del Sur

02 / 1300	24.8	112.1	972	90	Landfall at Puerto San Carlos, Baja California del Sur
02 / 2100	26.3	112.4	980	75	Landfall just east of San Juanico, Baja California del Sur
04 / 1900	27.4	112.3	1006	25	Landfall near Santa Rosalia, Baja California del Sur

Table 2. Selected surface observations for Hurricane Jimena, 28 August – 4 September 2009.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Mexico								
International Civil Aviation Organization (ICAO) Sites								
MMGM - Guaymas, Sonora (27.97N 110.93W)			03/1442	25	50			26.46
Mexican Automated Stations								
Ciudad Constitucion (Baja Cal. del Sur)	02/1350	976.5	02/1340	61	79			13.12
San Juanico (Baja Cal. del Sur)	02/2030	988.1	02/2110	38	63			
San Lucas (Baja Cal. del Sur)			01/2350	49	60			
Socorro Island (Colima)	01/0800	997.5	01/0800	29	38			
Mexican Rainfall Stations								
Ciudad Obregon (Sonora)								3.01
Cocoraque (Sonora)								3.96
El Cajoncito (Baja Cal. del Sur)								3.70
Empalme (Sonora)								13.72
La Palmillita (Baja Cal. del Sur)								5.51
Loreto (Baja Cal. del Sur)								4.08
Navojoa (Sonora)								4.65
San Bartolo (Baja Cal. del Sur)								5.39
Santa Rosalia (Baja Cal. del Sur)								6.59
Public/Other								
La Paz (Costa Baja Resort)	02/0632	1006.1	02/1047		45			
Puerto San Carlos (Edds/Mongerman)	02/1310	973.0						

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

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Jimena, 28 August – 4 September 2009. Mean errors for the five-year period 2004-8 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (Jimena)	23.3	43.5	58.9	64.4	52.4	109.4	218.8
OCD5 (Jimena)	34.0	71.5	116.8	157.0	241.0	372.2	503.4
Forecasts	26	24	22	20	16	12	8
OFCL (2004-8)	31.0	51.7	71.7	90.2	123.6	161.3	201.8
OCD5 (2004-8)	38.4	73.6	111.9	149.1	214.2	261.1	311.5

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Jimena, 28 August – 4 September 2009. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 3a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	22.8	42.0	58.3	64.3	49.6	114.3	254.1
OCD5	31.8	70.4	119.5	159.8	250.2	376.4	495.4
GFSI	32.4	61.1	83.5	100.4	92.3	119.9	283.5
GHMI	32.9	68.1	106.4	154.6	290.7	458.5	447.4
GFNI	29.3	58.9	82.5	110.6	177.9	314.7	422.2
NGPI	24.1	42.6	59.1	83.5	132.2	206.3	426.4
EGRI	34.7	68.5	94.7	122.5	232.7	443.3	562.8
EMXI	22.2	37.7	65.1	93.1	162.0	299.1	465.6
TVCN	20.8	37.2	53.6	67.4	75.6	87.7	226.8
TVCC	27.5	50.3	67.9	73.6	76.0	92.0	253.2
BAMS	31.1	58.6	87.9	117.9	166.3	247.5	382.4
BAMM	24.9	40.3	59.5	80.6	124.1	138.5	159.1
BAMD	22.0	29.9	48.6	67.9	118.4	208.0	258.9
LBAR	25.5	59.2	103.5	154.2	250.1	264.1	243.8
Forecasts	22	21	20	18	13	10	3

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Jimena, 28 August – 4 September 2009. Mean errors for the five-year period 2004-8 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (Jimena)	6.9	10.4	14.1	11.5	12.5	10.0	8.9
OCD5 (Jimena)	8.6	13.1	15.8	17.2	25.6	26.0	22.1
Forecasts	26	24	22	20	16	12	8
OFCL (2004-8)	6.2	10.2	13.3	15.1	17.7	19.0	18.8
OCD5 (2004-8)	7.1	11.5	14.7	16.8	18.9	20.3	20.2

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Jimena, 28 August – 4 September 2009. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	6.9	10.4	14.1	11.5	12.5	10.0	6.4
OCD5	8.6	13.1	15.8	17.2	25.6	26.0	22.3
GHMI	11.1	17.5	20.6	18.5	34.5	26.6	13.3
DSHP	8.7	12.0	15.3	14.6	12.9	7.6	13.9
LGEM	8.5	12.5	15.7	14.9	16.9	8.8	6.7
IVCN	8.8	12.5	14.1	14.6	24.5	16.1	3.3
Forecasts	26	24	22	20	16	12	7

Table 5. Watch and warning summary for Hurricane Jimena, 28 August – 4 September 2009.

Date/Time (UTC)	Action	Location
31 / 0300	Hurricane Watch issued	Baja California from Bahia Magdalena to San Evaristo
31 / 1500	Hurricane Warning issued	Baja California from Bahia Magdalena to San Evaristo
31 / 1500	Hurricane Watch issued	Baja California from Punta Abreojos to Bahia Magdalena
31 / 1500	Hurricane Watch issued	Baja California from Mulege to San Evaristo
1 / 0300	Tropical Storm Watch issued	Mainland Mexico from Altata to Huatabampito
1 / 0300	Hurricane Watch modified to	Baja California from Punta Eugenia to Bahia Magdalena
1 / 0300	Hurricane Watch modified to	Baja California from Bahia San Juan Bautista to San Evaristo
1 / 0900	Hurricane Watch modified to	Baja California from Punta Eugenia to Puerto San Andresito
1 / 0900	Hurricane Watch modified to	Baja California from Bahia San Juan Bautista to Loreto
1 / 0900	Hurricane Warning discontinued	Baja California from Bahia Magdalena to San Evaristo
1 / 0900	Hurricane Warning issued	Baja California from Puerto San Andresito to Loreto
1 / 1500	Hurricane Watch modified to	Baja California from Punta Eugenia to Punta Abreojos
1 / 1500	Hurricane Watch modified to	Baja California from Bahia San Juan Bautista to Mulege
1 / 1500	Hurricane Warning discontinued	Baja California from Puerto San Andresito to Loreto
1 / 1500	Hurricane Warning issued	Baja California from Punta Abreojos to Mulege
1 / 2100	Tropical Storm Watch modified to	Altata to Bahia Kino
2 / 0300	Tropical Storm Warning issued	Baja California from Punta Eugenia to Punta Abreojos
2 / 0300	Tropical Storm Warning issued	Baja California from Bahia San Juan Bautista to Mulege
2 / 0900	Tropical Storm Watch issued	Baja California from Punta Eugenia to San Jose de Las Palomas
2 / 0900	Tropical Storm Watch issued	Baja California from Bahia San Juan Bautista to Bahia de Los Angeles

2 / 0900	Hurricane Warning modified to	Baja California from Punta Abrejos to Agua Blanca
2 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Baja California from Punta Eugenia to San Jose de Las Palomas
2 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Baja California from Bahia San Juan Bautista to Bahia de Los Angeles
2 / 2100	Tropical Storm Warning issued	Mainland Mexico from Huatabampito to Bahia Kino
2 / 2100	Hurricane Warning modified to	Baja California from Punta Abrejos to Bahia Magdalena
2 / 2100	Hurricane Warning modified to	Baja California from San Evaristo to Mulege
3 / 0000	Tropical Storm Warning modified to	Baja California from Punta Eugenia to Punta Abrejos
3 / 0000	Tropical Storm Warning modified to	Baja California from Bahia San Juan Bautista to Mulege
3 / 0300	Tropical Storm Warning discontinued	Baja California from Punta Eugenia to Punta Abrejos
3 / 0300	Tropical Storm Warning discontinued	Baja California from Bahia San Juan Bautista to Mulege
3 / 0300	Tropical Storm Warning modified to	Baja California from Puerto San Andresito to San Jose de Las Palomas
3 / 0300	Tropical Storm Warning modified to	Baja California from Loreto to Bahia de Los Angeles
3 / 0300	Hurricane Watch discontinued	All
3 / 0300	Hurricane Warning discontinued	All
3 / 0900	Tropical Storm Warning modified to	Baja California from Loreto to Calamejue
3 / 0900	Tropical Storm Warning modified to	Mainland Mexico from Huatabampito to Puerto Libertad
3 / 2100	Tropical Storm Warning discontinued	Baja California from Puerto San Andresito to San Jose de Las Palomas
3 / 2100	Tropical Storm Warning discontinued	Baja California from Loreto to Calamejue
3 / 2100	Tropical Storm Warning modified to	Mainland Mexico from Huatabampito to Bahia Kino
4 / 0900	All warnings discontinued	

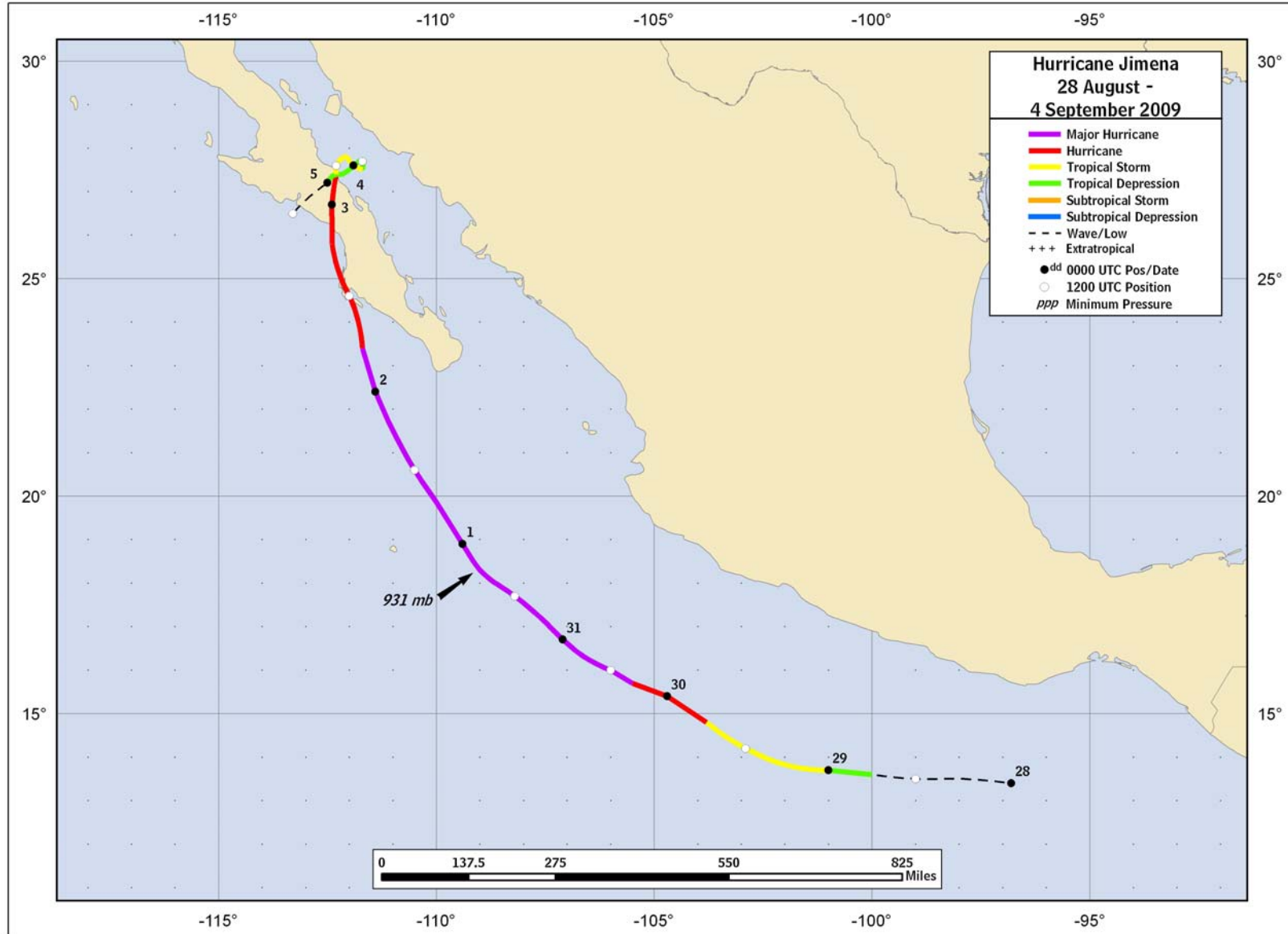


Figure 1. Best track positions for Hurricane Jimena, 28 August – 4 September 2009.

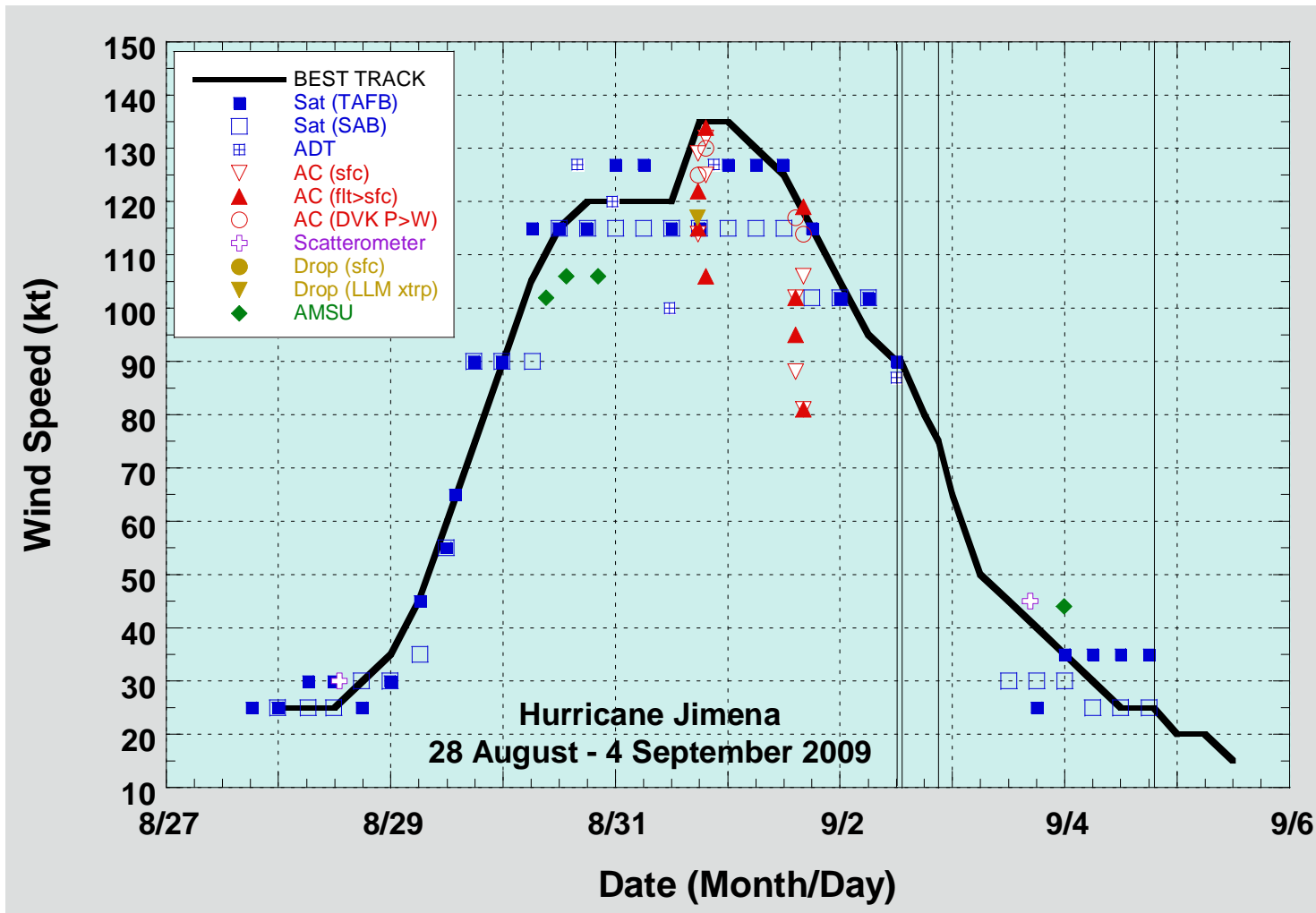


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Jimena, 28 August – 4 September 2009. Aircraft observations have been adjusted for elevation using a 90% adjustment factor for observations from 700 mb. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC. Solid vertical lines denote landfalls.

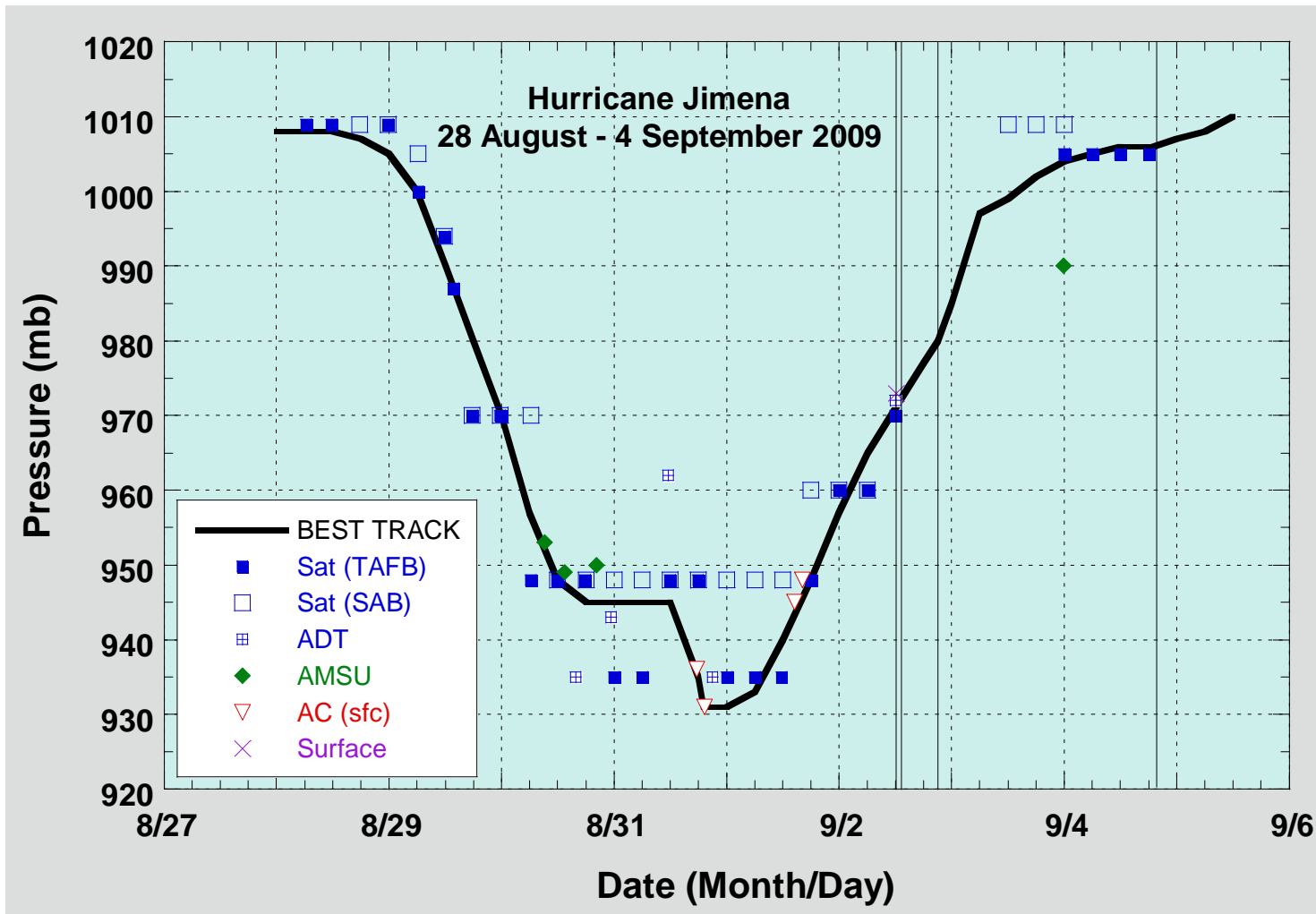


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Jimena, 28 August – 4 September 2009. Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC. Solid vertical lines denote landfalls.