



# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

## TROPICAL STORM JAVIER (EP112016)

7 – 9 August 2016

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2000 UTC 8 AUGUST 2016 VIIRS VISIBLE IMAGE FROM NASA-NOAA'S SUOMI NPP SATELLITE SHOWING JAVIER NEAR THE SOUTHERN TIP OF BAJA CALIFORNIA SUR, MEXICO. (IMAGE COURTESY OF NASA/NOAA RAPID RESPONSE TEAM)

Javier was a tropical storm that formed from the remnants of Atlantic Hurricane Earl, and made landfall on the southern tip of the Baja California peninsula near Cabo San Lucas, Mexico. The tropical cyclone brought beneficial rainfall to portions of western mainland Mexico and Baja California Sur.

# Tropical Storm Javier

7 – 9 AUGUST 2016

## SYNOPTIC HISTORY

Javier formed from the remnants of Atlantic Hurricane Earl, which struck Belize as a category 1 hurricane (on the Saffir-Simpson Hurricane Wind Scale) early on 4 August. Earl's low-level circulation moved farther inland and dissipated over the mountains of eastern Mexico on 6 August. The remnant mid-to-upper-level circulation continued to move quickly westward across central Mexico, passing near Mexico City later that day, while the southern portion of Earl's broad circulation began interacting with the eastern North Pacific intertropical convergence zone (ITCZ), which was situated very near the coast of Mexico. By 1800 UTC, surface observations indicated that a small low pressure system had formed along the ITCZ just west of Acapulco, Mexico, as new convection began developing over the waters of the Pacific and also over land. This convective activity became better organized over the next 18 h and it is estimated that Tropical Depression Eleven-E<sup>1</sup> formed by 0600 UTC 7 August, about 105 n mi south-southeast of Manzanillo, 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.

The small tropical cyclone moved northwestward around the periphery of a deep-layer subtropical ridge for the next 48 h, remaining just offshore of the southwestern coast of Mexico. Sustained winds of 40 kt were reported at Manzanillo, indicating that the depression had intensified into a tropical storm around 1200 UTC 7 August when the cyclone was located about 45 n mi south of Manzanillo. Although the 850–200-mb vertical wind shear was less than 10 kt and sea-surface temperatures were greater than 28.5° C throughout Javier's lifetime, conditions that generally favor significant strengthening, Javier struggled to intensify due to northeasterly to easterly mid-level shear of 15–20 kt, which caused the cyclone's circulation to acquire a westward tilt. However, a NOAA Hurricane Hunter aircraft found that Javier had still managed to strengthen to 55 kt around 1800 UTC 8 August, when the cyclone was located about 60 n mi southeast of Cabo San Lucas, Mexico. Shortly after reaching peak intensity, increasing easterly mid-level shear (Fig. 4) caused Javier's low-level and mid-level circulations to decouple, resulting in gradual weakening until landfall occurred.

Javier made landfall around 0330 UTC 9 August along the southern tip of Baja California Sur near San Jose del Cabo, Mexico, as a 45-kt tropical storm and passed over or just east of Los Cabos International Airport, Mexico (MMSD), about 15 minutes later (Fig. 5). Interaction with the mountainous terrain of the Baja California peninsula caused Javier to quickly weaken, with the cyclone becoming a depression by 1200 UTC and a remnant low 6 h later when the system

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<sup>1</sup> Current operational policy is that tropical cyclones crossing into another basin retain their original name; since Earl had dissipated as a tropical cyclone prior to entering the eastern North Pacific basin, the new depression was properly named Eleven-E, rather than Earl.

was located about 45 n mi south of Cabo San Lazaro, Mexico. By 1800 UTC 10 August, Javier's remnant circulation dissipated just west of La Bocana, Mexico.

## METEOROLOGICAL STATISTICS

Observations in Javier (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison (UW-CIMSS). Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from one flight made by the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command and two flights conducted by NOAA/AOC "Hurricane Hunter" reconnaissance aircraft. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Javier.

No ship reports of tropical-storm-force winds were received. However, sustained winds of 40 kt were reported at Playa de Oro International Airport, Manzanillo, Mexico (MMZO), at 1522 UTC and 1541 UTC 7 August. A sustained wind of 34 kt and a gust to 51 kt were reported at 0550 UTC 9 August by the Mexican National Meteorological Service CONAGUA observing station at Cabo Pulmo (elevation 26 m ASL) located on the southeastern tip of Baja California Sur, Mexico.

### *Winds and Pressure*

Javier's estimated peak intensity of 55 kt at 1800 UTC 8 August is based on SFMR-measured surface winds of 55 kt at 1721 UTC and 1841 UTC; the estimated minimum central pressure of 997 mb is based on a dropwindsonde surface pressure measurement of 998 mb at 1843 UTC.

### *Rainfall*

Rainfall amounts were generally less than 2 inches across western Mexico and less than one inch across Baja California Sur. These rains were beneficial to the region, and no significant flooding was reported.

## CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Javier.

## FORECAST AND WARNING CRITIQUE

The genesis of Javier was adequately forecast, especially given the uncertainty concerning whether the remnants of Atlantic Hurricane Earl would emerge over the eastern North Pacific or dissipate over the mountains of Mexico. Table 2 provides the number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in each likelihood category. A low (< 40%) chance of formation during the next five days was introduced into the TWO 96 h before Javier developed, and the probability was raised to a high (> 60%) chance 60 h before genesis occurred. The precursor disturbance was given a low chance of formation during the next two days 60 h before genesis, but the 48-h probability was raised to a high chance only 12 h before genesis.

A verification of NHC official track forecasts (OFCL) for Javier is given in Table 3a. Official forecast track errors were somewhat greater than the mean official errors for the previous 5-yr period at all forecast times. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The larger-than-average track errors were due to left-of-track and faster along-track speed biases. These biases were the result of Javier expected to have been a more vertically deep hurricane and, therefore, move faster and to the west of the Baja California peninsula. Although the objective models sample size is too small to make any meaningful comparisons, it is worth noting that OFCL track forecasts still outperformed the majority of the guidance at every available forecast period.

A verification of NHC official intensity forecasts for Javier is given in Table 4a. Similar to the track errors, official forecast intensity errors were greater than the mean official errors for the previous 5-yr period. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The larger-than-average official intensity errors had a high bias, resulting in OFCL forecasts being bested by almost every intensity model at the 24-, 36, and 48-h periods. Only at 12 h were OFCL forecasts better than all of the intensity models.

Watches and warnings associated with Javier are given in Table 5.



Table 1. Best track for Tropical Storm Javier, 7-9 August 2016.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
06 / 1800	17.7	102.5	1004	25	low
07 / 0000	18.0	103.5	1003	30	"
07 / 0600	18.5	104.5	1002	30	tropical depression
07 / 1200	19.0	105.5	1001	35	tropical storm
07 / 1800	19.6	106.4	1000	40	"
08 / 0000	20.4	107.2	999	45	"
08 / 0600	21.1	108.1	999	45	"
08 / 1200	21.7	108.8	998	50	"
08 / 1800	22.2	109.3	997	55	"
09 / 0000	22.6	109.5	999	50	"
09 / 0330	23.1	109.7	1002	45	"
09 / 0600	23.4	110.2	1004	35	"
09 / 1200	23.9	110.9	1005	30	tropical depression
09 / 1800	24.4	111.6	1007	25	low
10 / 0000	24.7	112.1	1008	25	"
10 / 0600	25.2	112.3	1009	20	"
10 / 1200	25.7	112.5	1009	20	"
10 / 1800					dissipated
09 / 0330	23.1	109.7	1002	45	landfall near San Jose del Cabo, Mexico
08 / 1800	22.2	109.3	997	55	minimum pressure and maximum intensity

Table 2. Number of hours in advance of formation of Tropical Storm Javier associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the “Low” category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	120-Hour Outlook
Low (<40%)	60	96
Medium (40%-60%)	42	84
High (>60%)	12	60

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Javier, 7-9 August 2016. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	33.5	43.9	60.8	68.7			
OCD5	60.1	95.6	150.0	215.6			
Forecasts	8	6	4	2			
OFCL (2011-15)	23.4	36.4	47.2	59.4	89.0	123.6	159.5
OCD5 (2011-15)	36.6	74.2	116.5	159.7	245.6	331.1	427.4



Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Javier, 7-9 August 2016. 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	25.3	31.6	60.6				
OCD5	42.8	64.6	125.3				
GFSI	30.5	60.8	93.7				
EMXI	<b>25.2</b>	63.7	149.5				
CMCI	30.5	49.2	70.4				
NVGI	48.4	83.3	131.2				
AEMI	27.2	52.3	80.3				
GFEX	27.3	61.1	120.6				
TVCE	<b>24.2</b>	42.8	60.6				
TVCX	<b>22.7</b>	43.5	73.9				
HCCA	<b>23.4</b>	45.2	89.8				
HWFI	30.4	48.6	<b>56.9</b>				
GHMI	25.8	<b>29.2</b>	<b>26.4</b>				
GFNI	46.1	66.8	60.6				
BAMD	41.7	64.7	125.3				
BAMM	40.4	64.0	103.8				
BAMS	51.5	75.2	114.4				
LBAR	34.8	56.7	87.7				
Forecasts	6	4	2				



Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Javier, 7-9 August 2016. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	8.8	14.2	17.5	17.5			
OCD5	9.8	8.2	12.5	10.5			
Forecasts	8	6	4	2			
OFCL (2011-15)	5.9	9.8	12.5	14.0	15.5	16.3	14.9
OCD5 (2011-15)	7.7	12.8	16.4	18.8	21.1	20.9	19.7





Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Javier, 7-9 August 2016. 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	8.8	14.2	17.5	17.5			
OCD5	9.8	<b>8.2</b>	<b>12.5</b>	<b>10.5</b>			
GFSI	11.9	14.3	17.5	<b>9.0</b>			
EMXI	12.5	<b>11.3</b>	<b>15.3</b>	<b>7.0</b>			
CMCI	12.9	<b>9.2</b>	<b>9.8</b>	<b>5.0</b>			
AEMI	13.4	<b>13.5</b>	<b>14.3</b>	<b>7.5</b>			
HCCA	9.3	<b>10.2</b>	<b>17.3</b>	<b>4.5</b>			
HWFI	11.4	<b>12.3</b>	<b>16.0</b>	<b>4.0</b>			
GHMI	9.9	<b>10.0</b>	<b>14.0</b>	<b>2.0</b>			
GFNI	11.9	<b>11.2</b>	<b>16.5</b>	<b>4.0</b>			
DSHP	9.6	<b>12.0</b>	<b>16.8</b>	<b>16.5</b>			
LGEM	10.6	<b>10.7</b>	18.8	<b>3.0</b>			
IVCN	9.8	<b>9.8</b>	<b>14.8</b>	<b>3.5</b>			
ICON	9.5	<b>10.2</b>	<b>16.3</b>	<b>5.5</b>			
Forecasts	8	6	4	2			

Table 5. Watch and warning summary for Tropical Storm Javier, 7-9 August 2016.

<b>Date/Time (UTC)</b>	<b>Action</b>	<b>Location</b>
<b>7 / 0900</b>	Tropical Storm Watch issued	La Paz to Santa Fe
<b>7 / 0900</b>	Tropical Storm Warning issued	Manzanillo to Cabo Corrientes
<b>7 / 2100</b>	Tropical Storm Watch changed to Tropical Storm Warning	La Paz to Santa Fe
<b>7 / 2100</b>	Tropical Storm Watch issued	Santa Fe to Cabo San Lazaro
<b>8 / 0000</b>	Tropical Storm Warning discontinued	Manzanillo to Cabo Corrientes
<b>8 / 0300</b>	Tropical Storm Watch discontinued	Santa Fe to Cabo San Lazaro
<b>8 / 0300</b>	Tropical Storm Watch issued	Loreto to San Evaristo
<b>8 / 0300</b>	Tropical Storm Warning discontinued	La Paz to Santa Fe
<b>8 / 0300</b>	Tropical Storm Warning issued	San Evaristo to Cabo San Lucas
<b>8 / 0300</b>	Hurricane Watch issued	Todos Santos to Cabo San Lazaro
<b>8 / 0300</b>	Hurricane Warning issued	Cabo San Lucas to Todos Santos
<b>8 / 0900</b>	Tropical Storm Watch issued	Cabo San Lazaro to Puerto San Andresito
<b>8 / 0900</b>	Tropical Storm Warning modified to	San Evaristo to Los Barriles
<b>8 / 0900</b>	Hurricane Warning modified to	Los Barriles to Todos Santos
<b>8 / 1800</b>	Hurricane Warning discontinued	All
<b>8 / 1800</b>	Tropical Storm Warning modified to	San Evaristo to Cabo San Lazaro
<b>9 / 0300</b>	Hurricane Watch discontinued	All
<b>9 / 1200</b>	Tropical Storm Watch discontinued	All
<b>9 / 1200</b>	Tropical Storm Warning discontinued	All

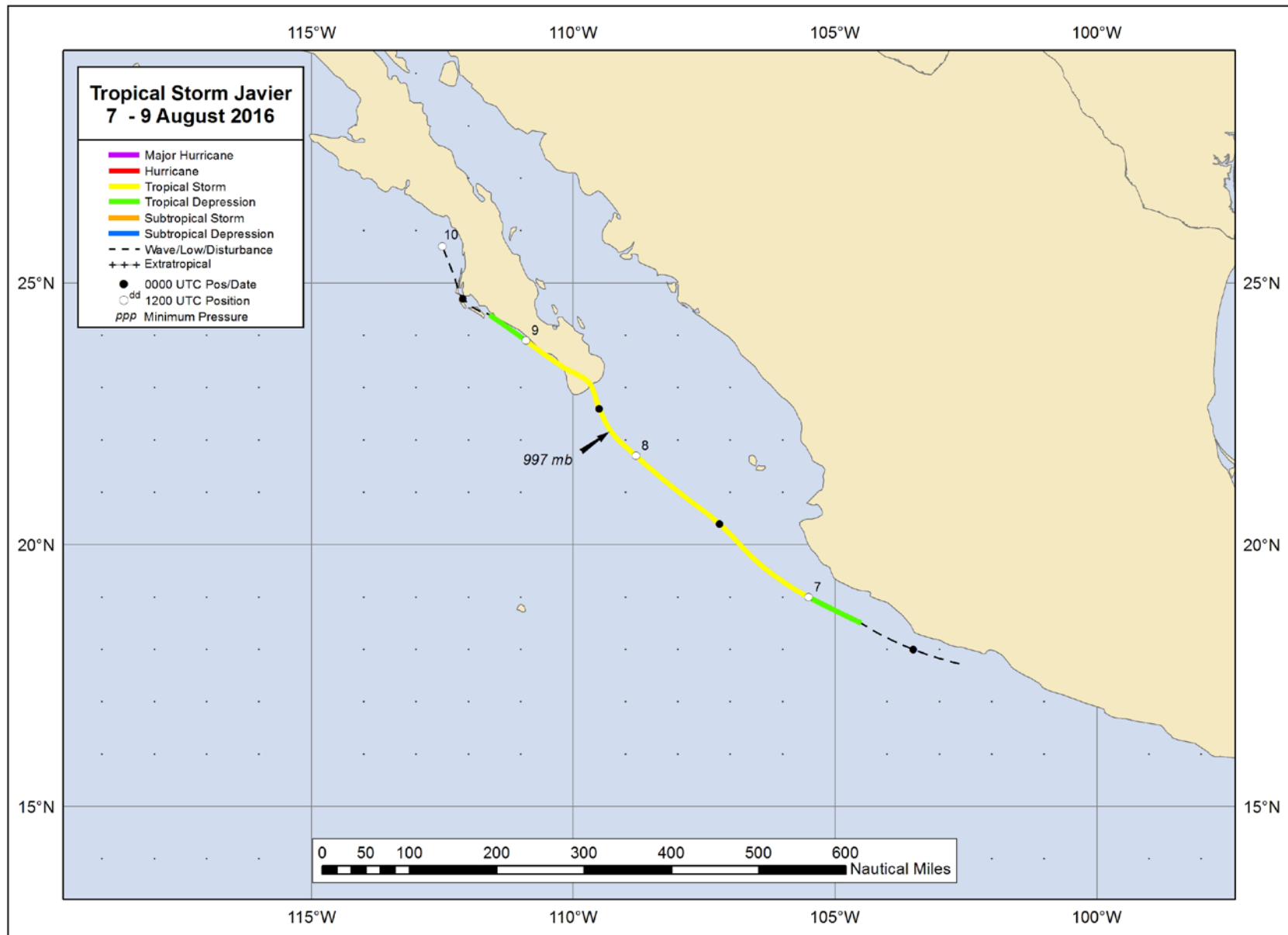


Figure 1. Best track positions for Tropical Storm Javier, 7-9 August 2016.

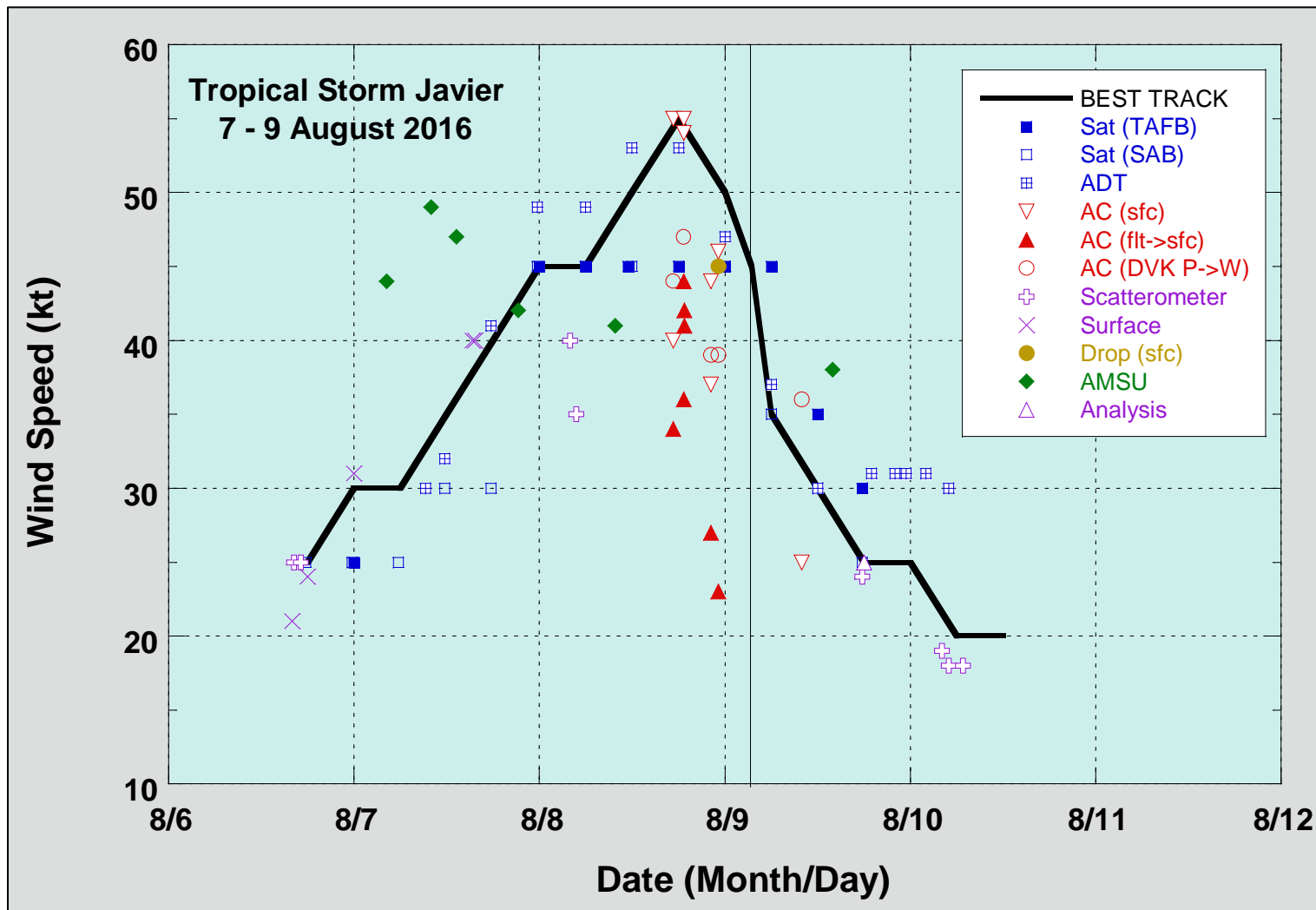


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Javier, 7-9 August 2016. Aircraft observations have been adjusted for elevation using 80% and 90% adjustment factors for observations from 850 mb and 700 mb, respectively. The dropwindsonde observation includes actual 10 m winds (sfc). Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and the solid vertical line corresponds to landfall.

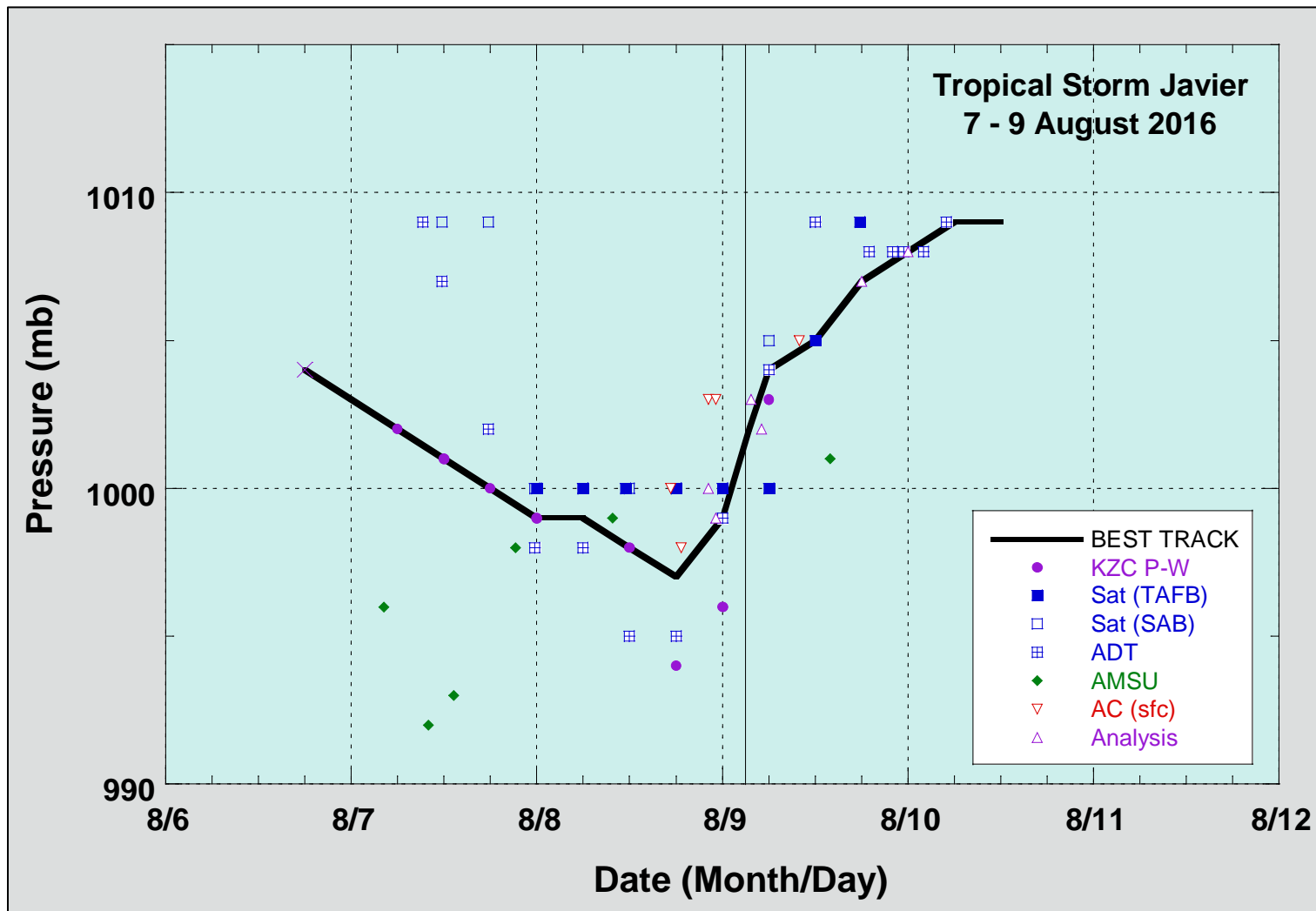


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Javier, 7-9 August 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and the solid vertical line corresponds to landfall.

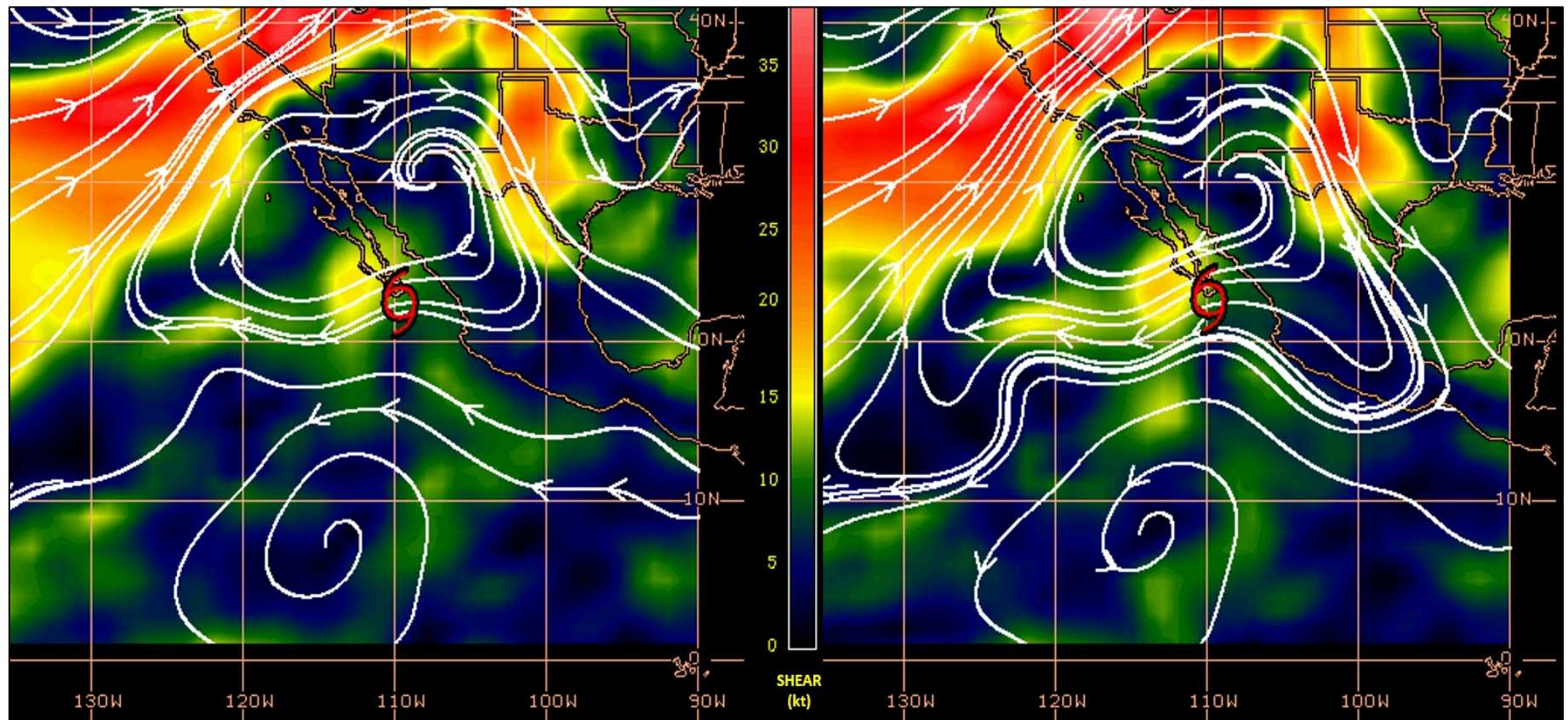


Figure 4. Mid-level (850–500 mb) vertical wind shear analyses on 9 August 2016 at 0300 UTC (left panel) and 0600 UTC (right panel). Red tropical storm symbol indicates location of Javier, white arrows represent wind shear direction, and colored shading depicts shear values (kt). Images and data courtesy of UW-CIMSS.

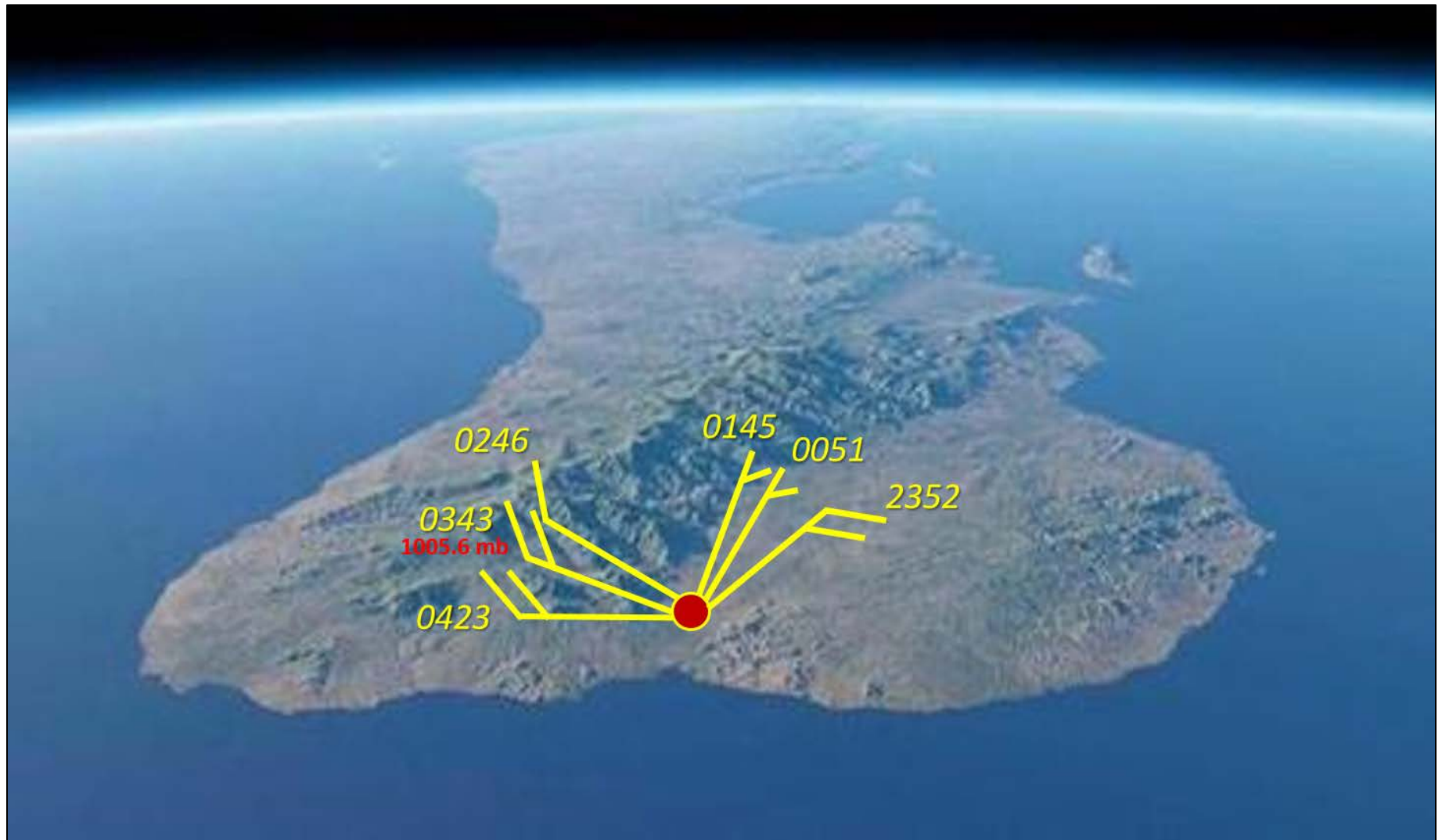


Figure 5. Wind rose plot of surface winds from Los Cabos International Airport, Mexico (MMSD), when the center of Tropical Storm Javier was passing over or near the station (red dot) on 8-9 August 2016. Observations times (UTC) are plotted at the end of the wind shafts. A minimum sea-level pressure of 1005.6 mb (red print) was reported at 0343 UTC 9 August.