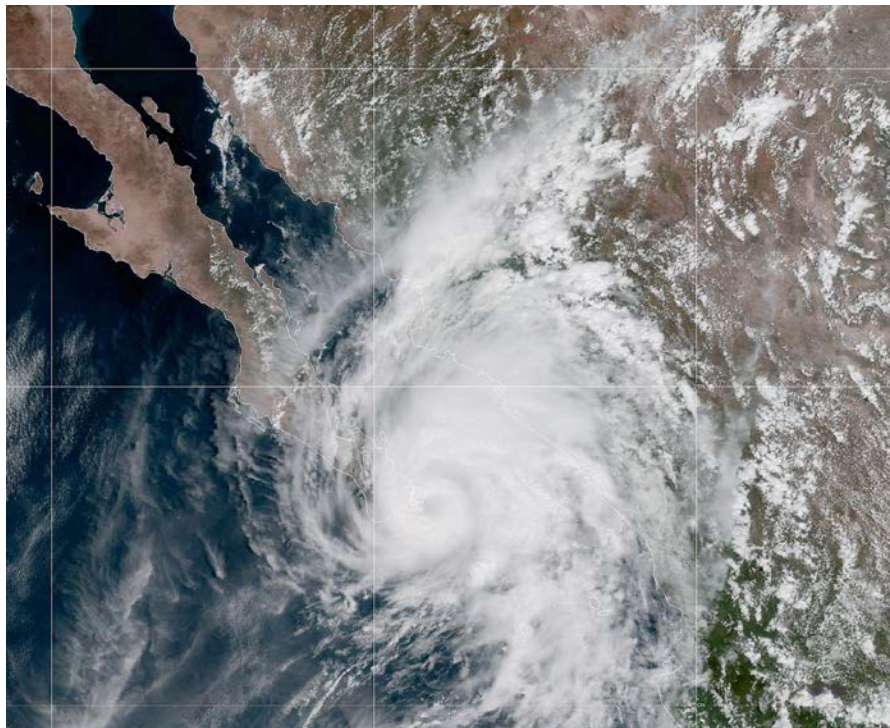# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE LORENA
(EP152019)
17–22 September 2019

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National Hurricane Center
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GOES WEST GEOCOLOR IMAGE AT 1940 UTC 20 SEPTEMBER SHOWING HURRICANE LORENA APPROACHING BAJA CALIFORNIA SUR.

Lorena was a category 1 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that made landfall near Chamela-Cuixtala, Jalisco, and a second landfall near the town of La Ventana, Baja California Sur. Lorena then weakened and reached the coast of mainland Mexico just north of Guaymas as a broad area of low pressure and dissipated.

Hurricane Lorena

17–22 SEPTEMBER 2019

SYNOPTIC HISTORY

A tropical wave moved westward off the west coast of Africa on 4 September, accompanied by fairly well-organized convection with some cyclonic rotation in the middle levels of the atmosphere. The wave had a large envelope with two distinct convective areas. The two areas merged as the wave moved westward, but by the time the wave was crossing the Lesser Antilles around 13 September, the thunderstorm activity decreased significantly. The wave continued westward across the Caribbean Sea, and as soon as it crossed Central America between 15 and 16 September, the shower activity increased markedly and gained organization. In fact, although there was no well-defined center of circulation at that time, the disturbance was already producing tropical-storm-force winds late on 16 September. By 17 September, visible satellite imagery indicated that the disturbance had developed a well-defined center, and it is estimated that Tropical Storm Lorena formed at 0600 UTC 17 September about 290 n mi southeast 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 1[1].

Lorena moved northwestward toward the coast of southwestern Mexico while gathering strength, and it is estimated that it reached hurricane status with 70-kt winds at 0000 UTC 19 September very close to the coast of Jalisco, about 50 n mi south-southeast of Manzanillo. Slight weakening occurred due to the interaction with land, and Lorena's eye made landfall near the town of Chamela-Cuixmala with 65-kt winds around 0600 UTC 19 September. After landfall, Lorena continued moving very near or along the coast between Manzanillo and Cabo Corrientes for the next 6 h. A weakened Lorena moved back over water near 1200 UTC 19 September just west of Cabo Corrientes. The hurricane had weakened to a tropical storm due to its interaction with land, but once the core moved back over the warm waters of the Gulf of California, it re-strengthened and reached a peak intensity of 75 kt with an estimated minimum central pressure of 986 mb at 1800 UTC 20 September. At that time, visible satellite images revealed the presence of an eye about 35 n mi east of Cabo San Lucas (cover photo). The hurricane moved north-northwestward hugging the southeastern coast of the peninsula and made a second landfall at 0300 UTC 21 September near the town of La Ventana with 70-kt winds. Lorena gradually weakened to a tropical storm due to interaction with the high terrain of Baja California Sur while moving northward and became a tropical depression by 0600 UTC 22 September. It then degenerated into a broad area of low pressure when it reached the coast of mainland Mexico about 50 n mi north of Guaymas 6 h later. The low then dissipated over land.

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[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 *btk* directory, while previous years' data are located in the *archive* directory.

METEOROLOGICAL STATISTICS

Observations in Lorena (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), objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. The 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command flew a couple of missions into Lorena on 20 and 21 September. Flight-level and stepped frequency microwave radiometer (SFMR) data from those flights were included in the analysis. 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 Lorena. Data from the Mexican Navy's automatic weather stations were very useful in analyzing the cyclone.

Lorena's first intensity peak of 70 kt at 0000 UTC 19 September, just before landfall near Chamela-Cuixmala, was based on a blend of subjective and objective Dvorak intensity estimates and the presence of a microwave eye feature. The second peak of 75 kt at 1800 UTC 20 September occurred over water near the southeastern portion of the Baja California peninsula and is based on a combination of Dvorak estimates and data from an Air Force reconnaissance aircraft.

A Servicio Meteorologico Nacional (SMN) automatic weather station at Chamela-Cuixmala, Jalisco, reported sustained winds of 49 kt and a gust to 78 kt at 0720 UTC 19 September accompanied by a wind shift, when the core of Lorena moved over or near that station. A Mexican Navy automatic station at Manzanillo reported a wind gust of 45 kt at 0245 UTC 19 September and another Mexican Navy station at Islas Marias reported a sustained wind of 40 kt with a gust of 57 kt at 1945 UTC 19 September when Lorena was moving nearby. A weather station located at La Ventana reported sustained winds of 54 kt and gusts to 71 kt at 0342 UTC 21 September, when the core of Lorena moved nearby that location.

Heavy rains occurred along and near the path of Lorena. The heaviest rainfall of 343 mm (13.5 in.) occurred at Chamela-Cuixmala as shown in Fig. 4.

CASUALTY AND DAMAGE STATISTICS

Since Lorena was a very small hurricane, damage was not extensive. However, significant damage affected the banana crop in areas near the eye along the coast in the town of Tomatlan, Jalisco. There were also reports of significant damage in the small town of La Ventana on the southeast coast of the Baja California Peninsula near La Paz. (Fig 5).

Media reported that a man vacationing with his wife and children in Los Cabos was walking along the boardwalk with his son when a large wave swept them out to sea. The son survived,

but the father who was trying to rescue his son was pronounced dead[2]. Around 200 people were evacuated and some roads were flooded in Jalisco. Civil Protection authorities rescued two men who were trapped in their flooded home from the Villa Purificación River in the town of Agua Caliente in La Huerta. Civil Protection also carried out flood rescues in the town of Chamela.

FORECAST AND WARNING CRITIQUE

The genesis of Lorena was fairly well forecast at long range but not as well at short range. The disturbance from which Lorena developed was introduced in the 5-day Tropical Weather Outlook (TWO) with a low chance (< 40%) of formation 132 h prior to genesis, but it was not increased to a high chance of formation (> 60%) until 36 h before genesis. In the 2-day TWO, the system was included with a high chance of formation only 12 h before genesis occurred (Table 2).

A verification of NHC official track forecasts for Lorena is given in Table 3a. Official forecast track errors were much higher than the mean official errors for the previous 5-yr period. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Most of the track models forecast a strong ridge over Mexico, and this pattern should have steered the hurricane west of the Baja California Peninsula as shown by the different model tracks. However, the ridge was weaker than anticipated, and Lorena ended up moving along the east coast of the peninsula instead (Fig. 6). The ECMWF model had errors much lower than the NHC forecasts. However, in some runs that model dissipated the cyclone within 12 to 24 h.

A verification of NHC official intensity forecasts for Lorena is given in Table 4a. Official forecast intensity errors for some periods were lower 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. There is not a consistent pattern showing good model performance, and most models had errors larger than climatology and persistence (OCD5). Considering the high track errors, the NHC predictions were fairly skillful.

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

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[2] Deaths occurring as a direct result of the forces of the tropical cyclone are referred to as "direct" deaths. These would include those persons who drowned in storm surge, rough seas, rip currents, and freshwater floods. Direct deaths also include casualties resulting from lightning and wind-related events (e.g., collapsing structures). Deaths occurring from such factors as heart attacks, house fires, electrocutions from downed power lines, vehicle accidents on wet roads, etc., are considered indirect" deaths.

Table 1.   Best track for Hurricane Lorena, 17–22 September 2019.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
17 / 0600	12.3	98.4	1006	35	tropical storm
17 / 1200	13.2	99.6	1004	40	"
17 / 1800	14.1	100.8	1002	40	"
18 / 0000	14.8	101.8	1000	45	"
18 / 0600	15.8	102.4	998	50	"
18 / 1200	16.8	103.1	995	55	"
18 / 1800	17.6	103.8	990	60	"
19 / 0000	18.4	104.2	985	70	hurricane
19 / 0600	19.3	104.8	990	65	"
19 / 1200	20.3	105.6	994	60	tropical storm
19 / 1800	21.3	106.7	994	55	"
20 / 0000	21.9	107.5	994	55	"
20 / 0600	22.3	108.2	992	60	"
20 / 1200	22.6	108.8	989	65	hurricane
20 / 1800	23.0	109.2	986	75	"
21 / 0000	23.7	109.5	987	70	"
21 / 0300	23.9	109.8	987	70	"
21 / 0600	24.2	110.2	989	60	tropical storm
21 / 1200	25.0	110.6	994	55	"

21 / 1800	25.9	111.0	1002	45	"
22 / 0000	26.9	111.4	1004	35	"
22 / 0600	27.9	111.5	1005	30	tropical depression
22 / 1200	28.5	111.5	1006	25	low
22 / 1800					dissipated
20 / 1800	23.0	109.2	986	75	maximum winds
19 / 0000	18.4	104.3	985	70	minimum pressure
19 / 0600	19.3	104.8	990	65	landfall near Chamela-Cuixmala, Jalisco
21 / 0300	23.9	109.8	987	70	landfall near La Ventana, Baja California Sur

Table 2.   Number of hours in advance of formation 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%)	72	132
Medium (40%-60%)	24	108
High (>60%)	12	36

Table 3a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Lorena. 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	27.6	57.9	105.9	148.5	210.3	278.6	
OCD5	39.9	76.8	103.0	106.1	149.6	285.4	
Forecasts	18	16	14	12	8	4	
OFCL (2014-18)	21.1	32.2	41.8	51.8	75.7	101.1	133.7
OCD5 (2014-18)	34.0	69.7	109.0	148.4	223.5	285.5	356.7

Table 3b.   Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Lorena. 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	29.4	54.8	108.7	159.3	194.1		
OCD5	40.8	77.8	**111.3**	**120.7**	**148.0**		
GFSI	46.3	93.4	138.0	208.4	202.5		
HWFI	38.5	79.7	152.9	207.1	216.2		
EMXI	31.0	**50.8**	**106.6**	**158.7**	**165.3**		
AEMI	40.0	71.8	127.7	181.8	199.5		
FSSE	30.8	59.7	116.0	168.7	**184.4**		
TVCX	31.9	59.2	113.1	170.1	**184.1**		
TVCE	32.4	63.3	117.7	172.3	**193.1**		
TVDG	35.4	64.9	115.9	175.4	**187.2**		
TABD	45.8	85.3	130.1	203.5	320.6		
TABS	38.3	85.7	159.2	263.4	352.2		
TABM	38.2	65.9	**108.1**	185.0	223.9		
HCCA	34.2	66.3	123.8	181.2	**190.3**		
Forecasts	15	13	11	8	4	0	0

Table 4a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Lorena. 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	7.5	12.8	**12.8**	**11.7**	22.5	**13.8**	
OCD5	8.4	9.9	9.9	9.1	10.0	15.0	
Forecasts	18	16	14	12	8	4	
OFCL (2014-18)	6.1	10.0	12.2	13.7	15.5	15.4	15.7
OCD5 (2014-18)	7.9	13.1	16.7	19.2	21.8	22.9	22.1

Table 4b.   Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Lorena. 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	7.5	12.8	12.1	11.7	24.3	18.3	
OCD5	8.4	**9.9**	**9.9**	**9.1**	**10.7**	19.0	
DSHP	10.9	17.8	22.6	23.7	27.9	34.0	
LGEM	10.0	15.4	19.4	22.3	33.6	40.7	
IVCN	7.7	**11.2**	12.1	13.3	**22.7**	26.0	
HWFI	9.1	**12.5**	**11.4**	12.7	26.3	29.7	
GFSI	11.6	13.6	16.1	16.1	**17.0**	19.0	
HCCA	**7.1**	**10.8**	15.8	14.8	**21.1**	28.0	
FSSE	7.6	**11.8**	16.5	19.6	29.4	22.0	
Forecasts	18	16	14	12	7	3	0

Table 5.   Watch and warning summary for Hurricane Lorena, 17–22 September 2019.

Date/Time (UTC)	Action	Location
17 / 1500	Tropical Storm Watch issued	Zihuatanejo to Cabo Corrientes
17 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Zihuatanejo to Cabo Corrientes
18 / 1200	Hurricane Watch issued	Punta San Telmo to Cabo Corrientes
18 / 1500	Hurricane Watch changed to Hurricane Warning	Punta San Telmo to Cabo Corrientes
18 / 1500	Tropical Storm Warning modified to	Zihuatanejo to Punta San Telmo
19 / 0300	Tropical Storm Warning discontinued	Zihuatanejo to Punta San Telmo
19 / 0900	Hurricane Warning modified to	Manzanillo to Cabo Corrientes
19 / 1200	Hurricane Watch issued	La Paz to Santa Fe
19 / 1500	Tropical Storm Warning modified to	Manzanillo to Punta Mita
19 / 1500	Tropical Storm Warning issued	Los Barriles to Todos Santos
19 / 1500	Hurricane Warning discontinued	All
19 / 2100	Hurricane Watch changed to Hurricane Warning	La Paz to Santa Fe
19 / 2100	Tropical Storm Warning discontinued	Los Barriles to Todos Santos
19 / 2100	Hurricane Watch issued	La Paz to San Evaristo
19 / 2100	Hurricane Watch issued	Santa Fe to Puerto Cortes
20 / 0300	Tropical Storm Watch issued	San Evaristo to Loreto

20 / 0300	Tropical Storm Watch issued	Puerto Cortes to Puerto San Andresito
20 / 0300	Tropical Storm Warning discontinued	All
20 / 0300	Hurricane Watch discontinued	Santa Fe to Puerto Cortes
20 / 0300	Hurricane Warning modified to	La Paz to Puerto Cortes
20 / 1500	Tropical Storm Watch modified to	Cabo San Lazaro to Puerto San Andresito
20 / 1500	Tropical Storm Warning issued	Puerto Cortes to Cabo San Lazaro
20 / 2100	Tropical Storm Watch discontinued	San Evaristo to Loreto
20 / 2100	Tropical Storm Watch issued	Topolobampo to Guaymas
20 / 2100	Tropical Storm Warning issued	La Paz to Santa Rosalia
20 / 2100	Hurricane Watch modified to	La Paz to Santa Rosalia
21 / 0300	Tropical Storm Watch discontinued	Topolobampo to Guaymas
21 / 0300	Tropical Storm Warning modified to	Bahia San Juan Bautista to Santa Rosalia
21 / 0300	Hurricane Watch modified to	Bahia San Juan Bautista to Santa Rosalia
21 / 0300	Hurricane Watch issued	Altata to Bahia Kino
21 / 0300	Hurricane Warning modified to	Santa Rosalia to Puerto Cortes
21 / 0900	Tropical Storm Watch issued	Bahia Kino to Puerto Libertad
21 / 0900	Tropical Storm Warning modified to	Los Barriles to Cabo San Lazaro
21 / 0900	Hurricane Warning modified to	Santa Rosalia to Los Barriles

| 21 / 1200	Tropical Storm Watch discontinued	Cabo San Lazaro to Puerto San Andresito
21 / 1200	Tropical Storm Warning discontinued	Los Barriles to Cabo San Lazaro
21 / 1200	Tropical Storm Warning issued	Huatabampito to Bahia Kino
21 / 1500	Tropical Storm Watch discontinued	All
21 / 1500	Tropical Storm Warning modified to	Huatabampito to Puerto Libertad
21 / 1500	Tropical Storm Warning modified to	Bahia San Juan Bautista to San Evaristo
21 / 1500	Hurricane Watch discontinued	Bahia San Juan Bautista to Santa Rosalia
21 / 1500	Hurricane Watch discontinued	Altata to Bahia Kino
21 / 1500	Hurricane Watch issued	Huatabampito to Puerto Libertad
21 / 1500	Hurricane Warning discontinued	All
21 / 2100	Hurricane Watch changed to Tropical Storm Warning	Huatabampito to Puerto Libertad
21 / 2100	Tropical Storm Warning discontinued	Bahia San Juan Bautista to San Evaristo
22 / 0900	Tropical Storm Warning discontinued	All
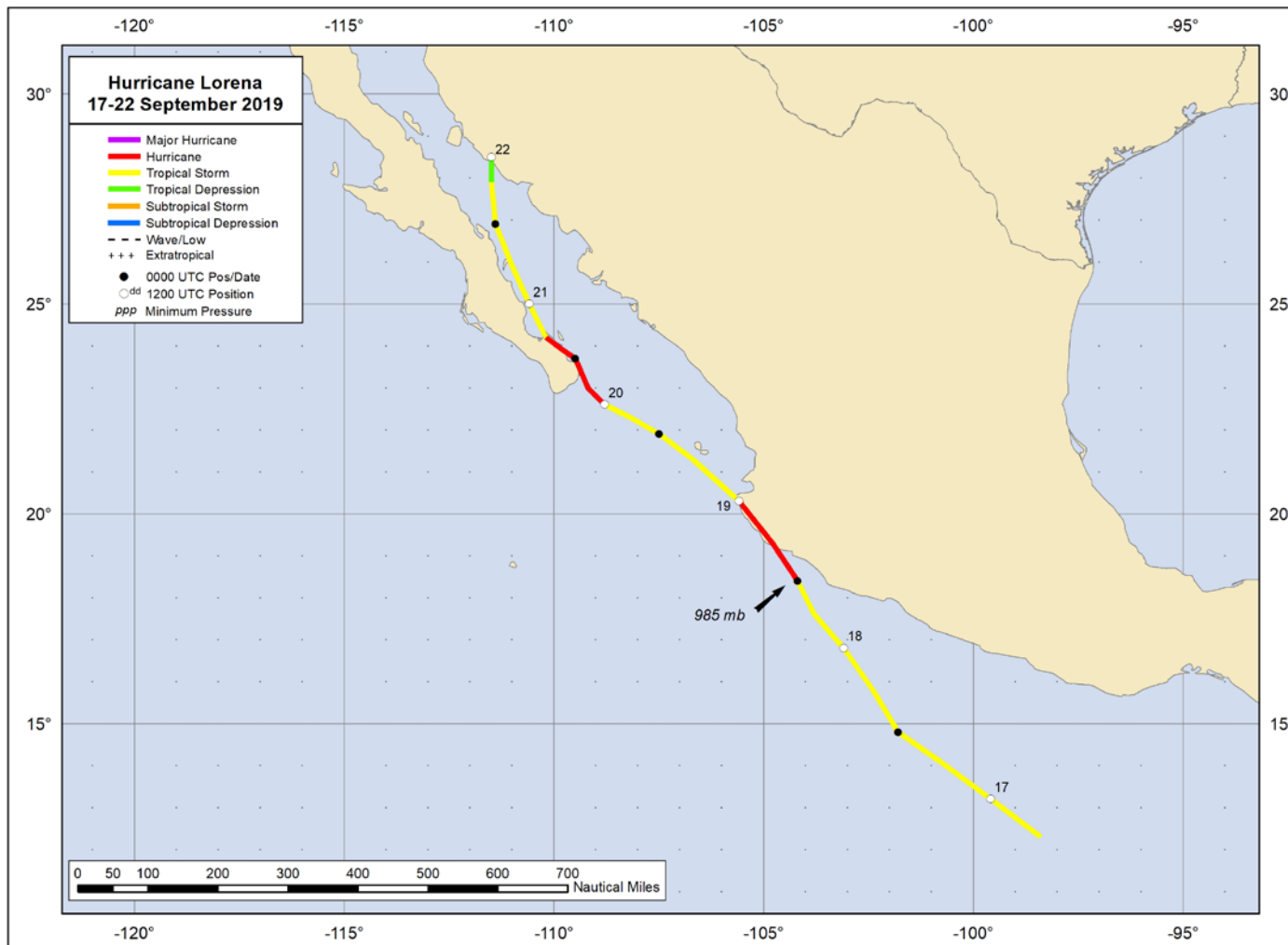
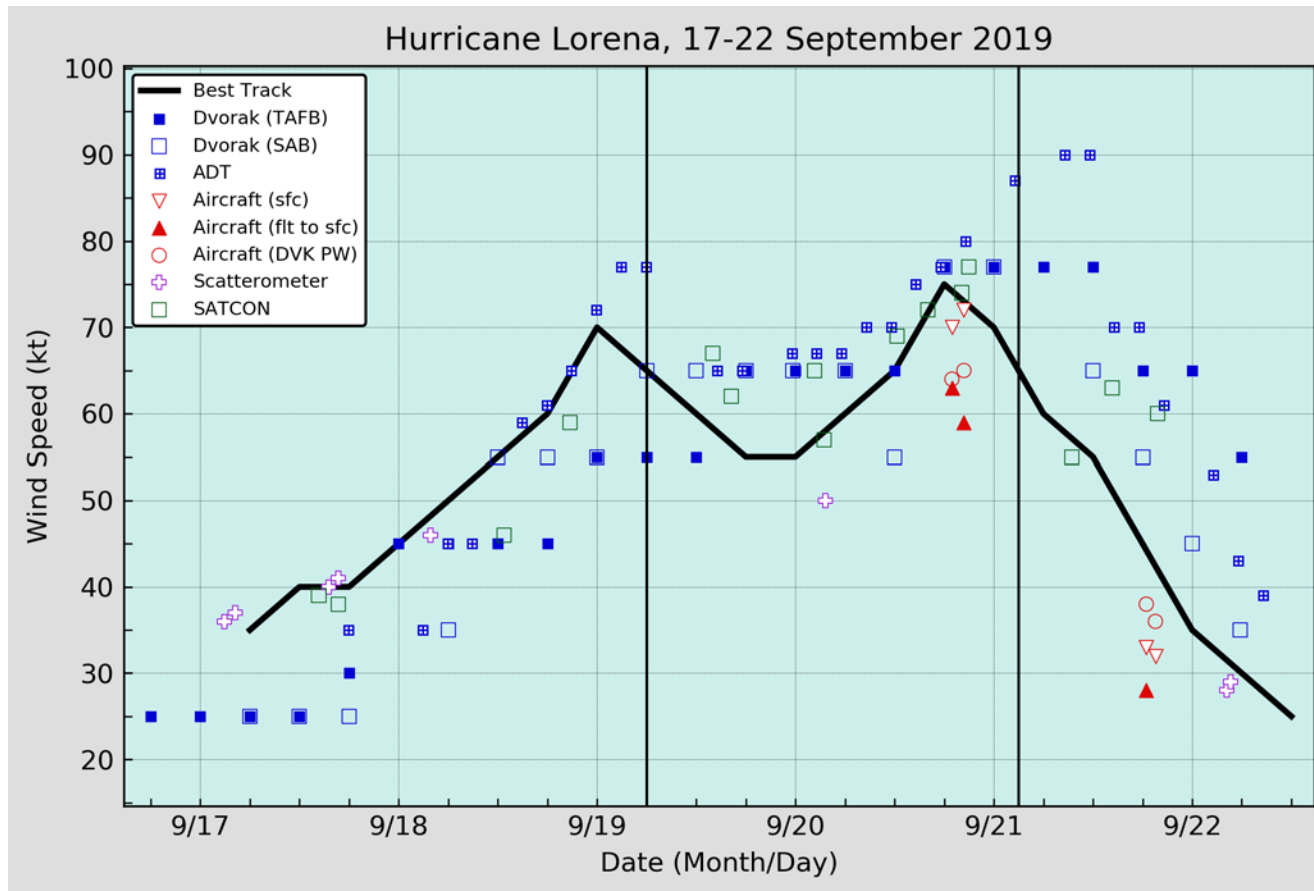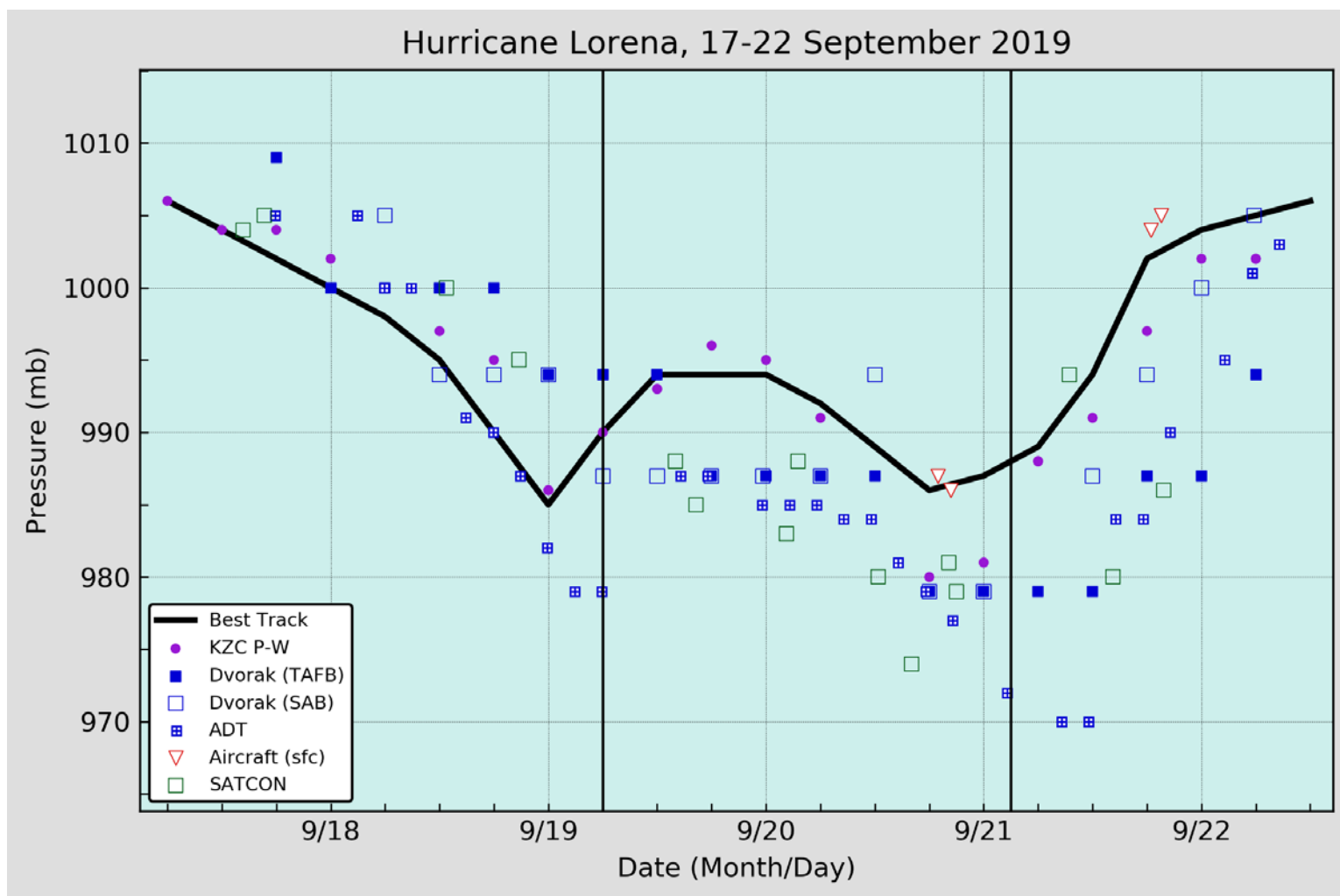Figure 1.   Best track positions for Hurricane Lorena, 17–22 September 2019.

Figure 2.   Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Lorena, 17–22 September 2019. Aircraft observations have been adjusted for elevation using a 90% adjustment factor for observations from 700 mb. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

Figure 3.   Selected pressure observations and best track minimum central pressure curve for Hurricane Lorena, 17–22 September 2019. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

Precipitación acumulada (mm) del 18 al 22 de septiembre de 2019 por el huracán Lorena
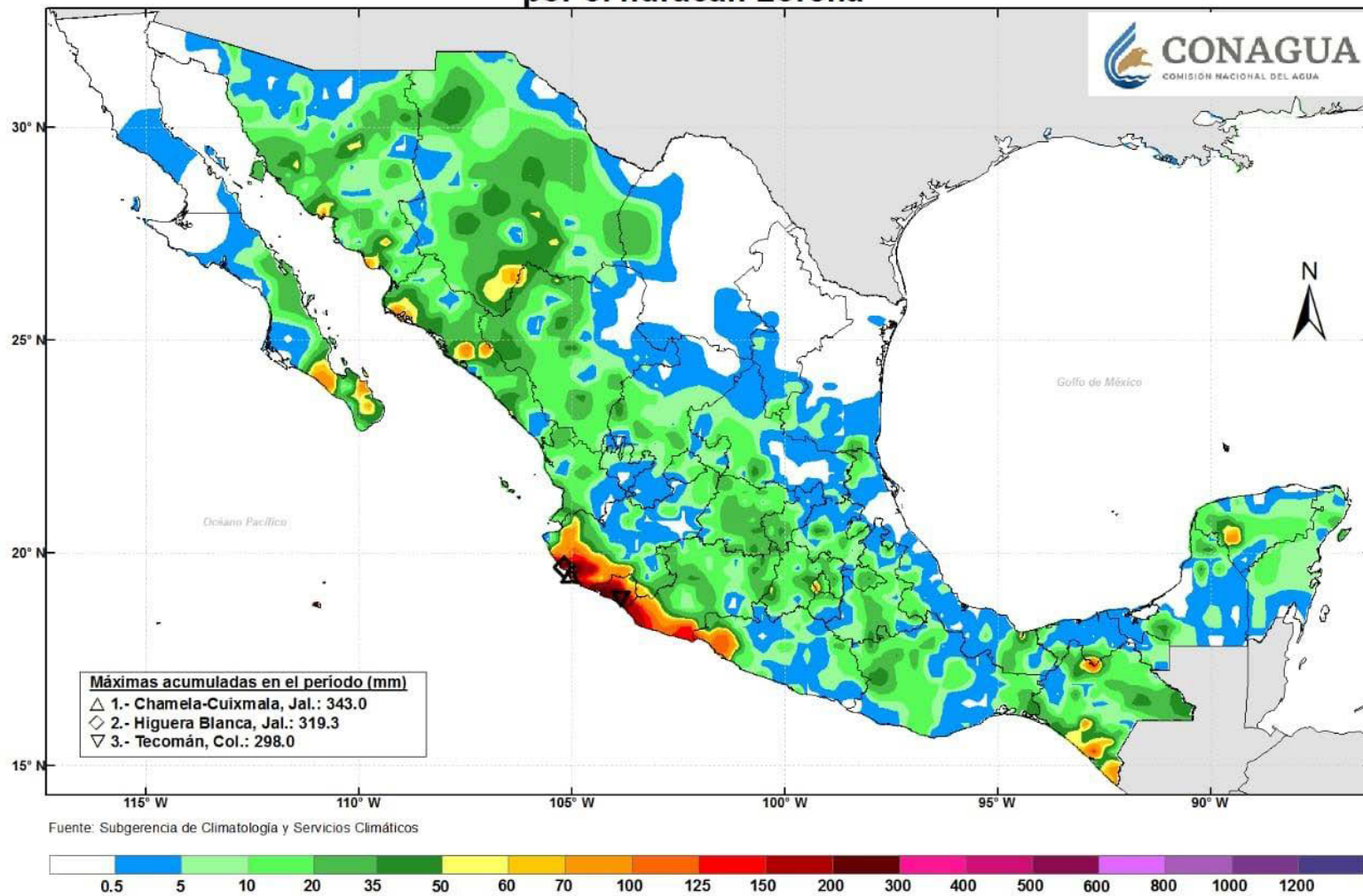

Figure 4.   Total rainfall (mm) in the 96 hours from 18–22 September 2019 associated with Lorena. The area of maximum rainfall occurred along the coast of Jalisco. Figure provided by the Servicio Meteorologico Nacional de Mexico, CONAGUA.
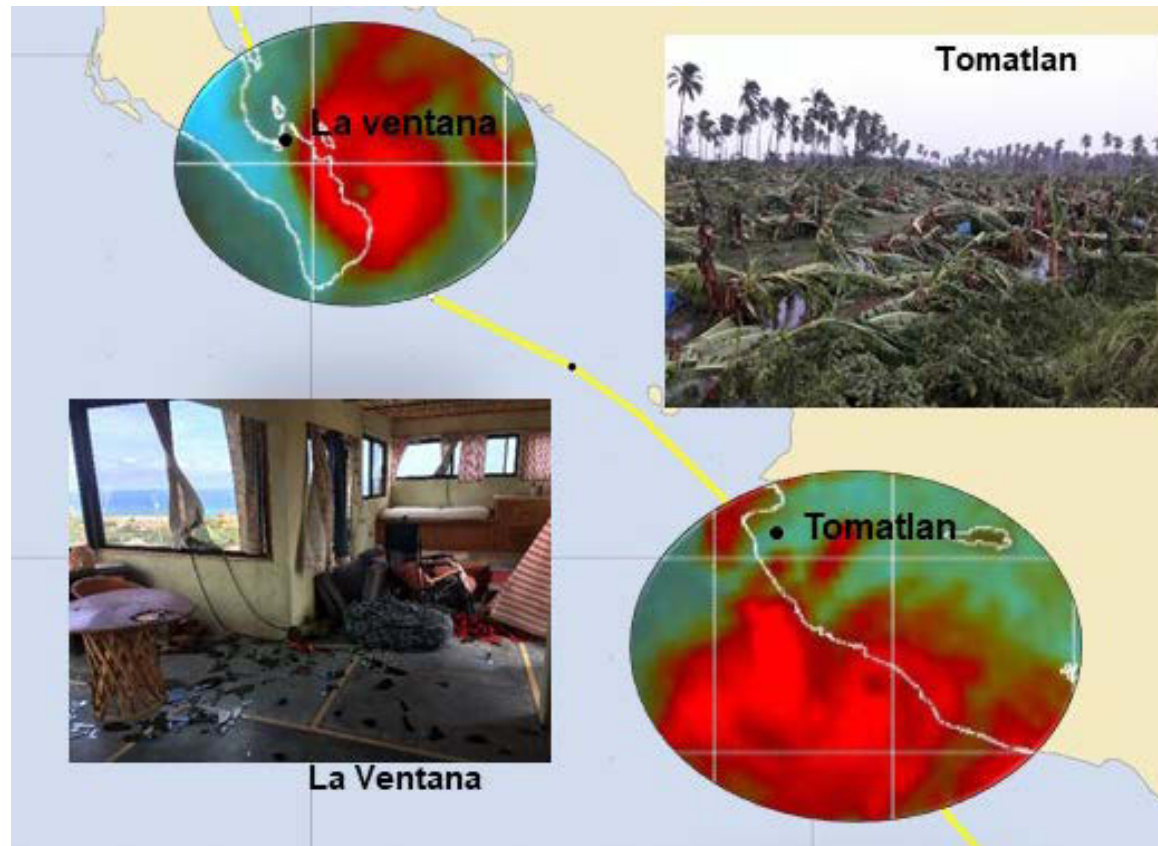
Figure 5.   Microwave images of Lorena and pictures of damage that occurred in the towns of Tomatlan, Jalisco, and La Ventana, Baja California Sur, as the eye of Lorena passed nearby.
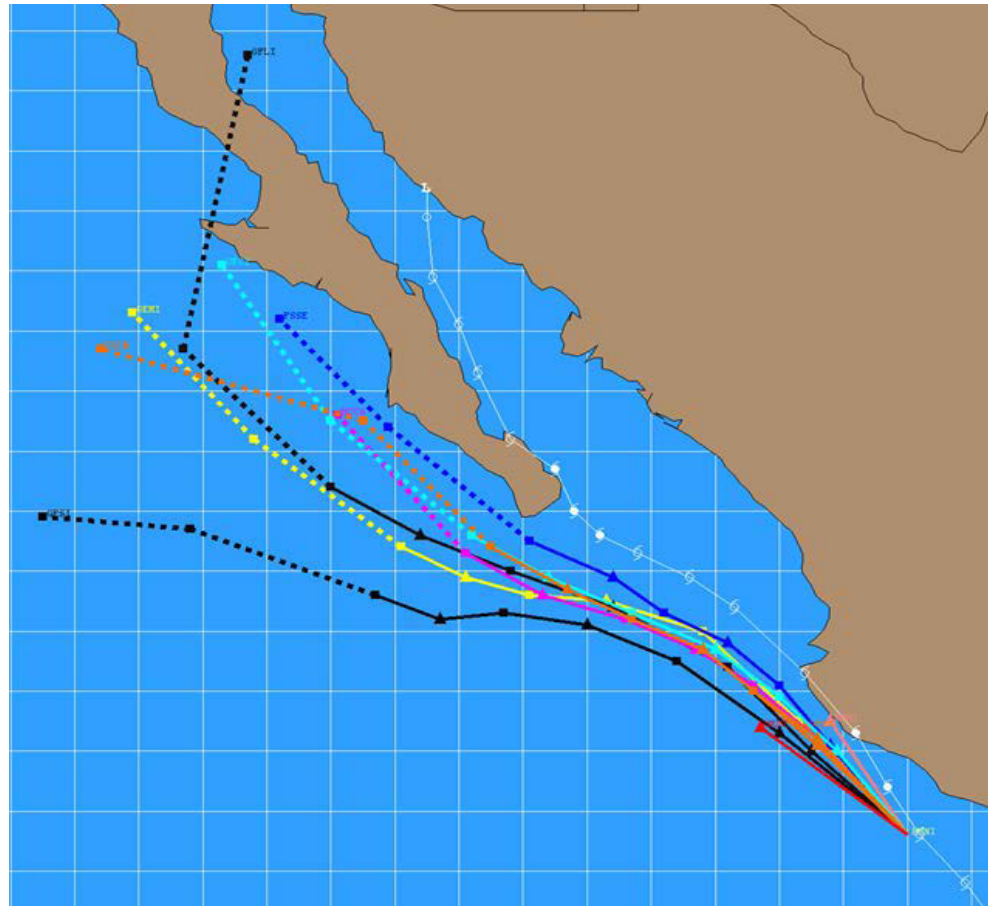
Figure 6.   Selected track model guidance at 1800 UTC 18 September 2019. The best track is given by the white solid line with positions shown at 6 h intervals.