NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE ENRIQUE

(EP052021)

25–30 June 2021

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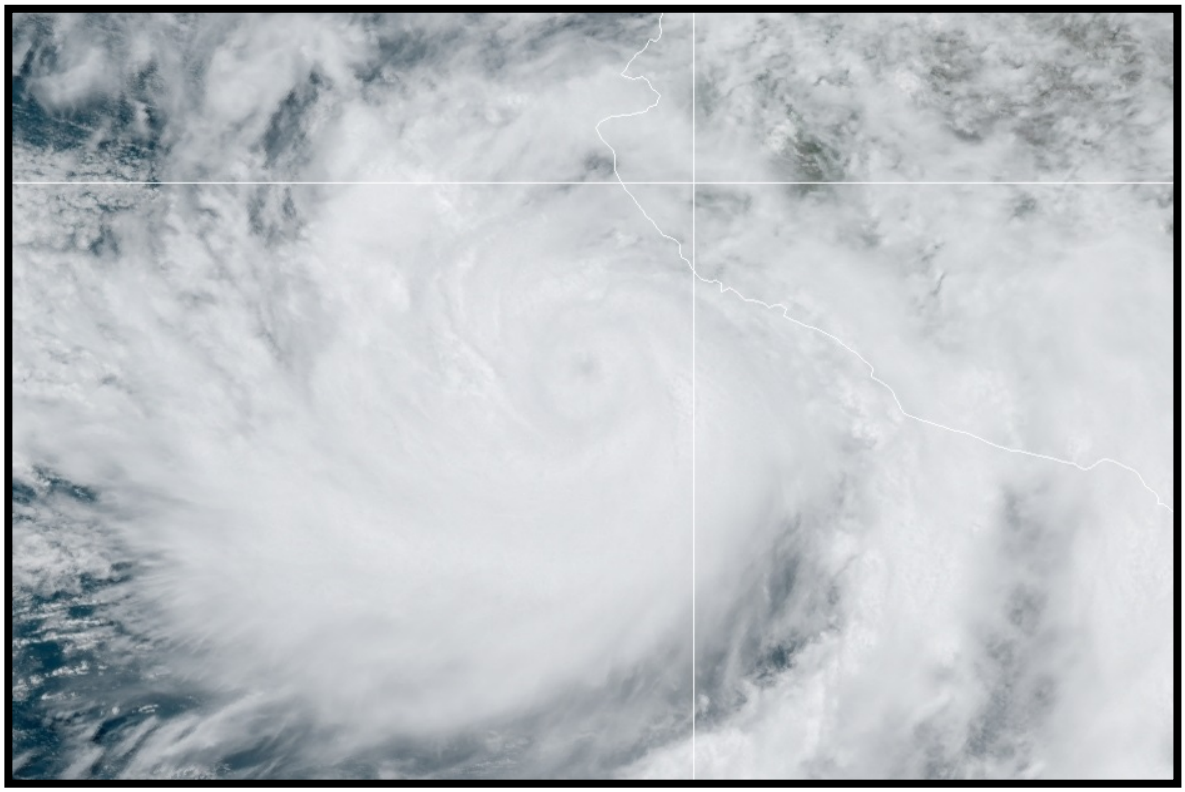

GOES-EAST GEOCOLOR VISIBLE IMAGE OF HURRICANE ENRIQUE AT 1800 UTC 27 JUNE 2021 WHILE IT WAS NEAR THE WEST COAST OF MEXICO. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Enrique passed just offshore of the coast of southwestern Mexico as a hurricane, bringing torrential rains, strong winds, and high surf to portions of the region. These conditions resulted in 2 direct fatalities and damaged hundreds of homes. The cyclone weakened and dissipated as it neared the Baja California peninsula.

Hurricane Enrique

25–30 JUNE 2021

SYNOPTIC HISTORY

Enrique formed from a tropical wave that departed the west coast of Africa on 14 June, reaching the Windward Islands on 19 June and then Central America by 21–22 June. Convection associated with the wave gradually increased in coverage and organization over the next few days as the disturbance moved over the eastern Pacific waters and passed south of southern Mexico. By early 25 June, scatterometer wind data showed that the system was developing a well-defined low-level center, and the associated winds were already 35 kt. The convective structure continued to become better organized, and the system became a tropical storm by 0600 UTC that day while located about 280 n mi south-southeast of Manzanillo, Mexico. The "best track" chart of Enrique'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].

For the first 36 h or so after it became a tropical storm, Enrique was steered west-northwestward to the south of a mid-level ridge centered over Mexico. Moderate northeasterly vertical wind shear initially inhibited fast strengthening of the cyclone, despite the presence of abundant atmospheric moisture and warm ocean waters. This shear decreased by late on 25 June, and subsequently Enrique underwent a 24-h period of rapid intensification. By 1200 UTC 26 June, the cyclone became a hurricane while located about 150 n mi south of Manzanillo. Enrique continued to strengthen and reached an estimated peak intensity of 80 kt by 0600 UTC 27 June. Despite generally favorable environmental conditions, the hurricane's intensity plateaued for 24 h, possibly due to some dry air entrainment from the higher terrain of Mexico. The steering currents began to break down around the same time that Enrique became a hurricane, which resulted in a slowing of its forward motion. Early on 27 June, the hurricane turned northward in the general direction of a weak mid-level trough located over extreme northwestern Mexico, and this motion continued for about 24 h, which brought the center of the hurricane to within 40 n mi of the coast of west-central mainland Mexico.

Early on 28 June, a ridge began to build to the northeast of the cyclone, resulting in a north-northwestward to northwestward motion. This steering flow took Enrique into a drier airmass and over cooler waters, which resulted in rapid weakening as the cyclone distanced itself from mainland Mexico and moved toward the southern Baja California peninsula. By 1800 UTC that day, Enrique weakened to a tropical storm while located about 200 n mi southeast of Cabo San Lucas, Mexico. The storm continued weakening as it approached the peninsula through early 29 June. However, the weakening trend briefly paused later that day as Enrique passed over the warmer waters of the Gulf of California. On 30 June, dry air took its toll on the cyclone and 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 *btk* directory, while previous years' data are located in the *archive* directory.

system weakened to a tropical depression by 1200 UTC while located about 30 n mi northeast of La Paz, Mexico. The low-level center of the depression was absorbed by a broad trough of low pressure to its southeast a few hours later.

METEOROLOGICAL STATISTICS

Observations in Enrique (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), subjective Dvorak technique estimates from the Satellite Analysis Branch (SAB), and objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. 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 Enrique.

Ship reports of tropical-storm-force winds associated with Hurricane Enrique are given in Table 2.

Winds and Pressure

Hurricane Enrique's peak intensity of 80 kt from 0600 UTC 27 June through 0000 UTC 28 June is based on Dvorak satellite intensity estimates. At 0600 UTC 27 June, the satellite estimates included T5.0/90 kt from TAFB, T4.5/77 kt from SAB, and T4.1/67 kt from ADT. The structure of Enrique changed relatively little over the next 18 h, and by 0000 UTC 28 June both TAFB and SAB provided Dvorak intensity estimates of T4.5/77 kt. The minimum pressure of 972 mb is based on the Knaff-Courtney-Zehr (KZC) pressure-wind relationship.

Surface observations were scarce along the portion of the coast of mainland Mexico that Enrique affected, but it is likely that sustained winds of tropical storm force occurred along the coast of the state of Jalisco where Enrique made its closest approach to the mainland. When Enrique was a little farther offshore, a weather station in Manzanillo in the state of Colima reported sustained winds of 30 kt and a gust to 40 kt at 1940 UTC 27 June, at an elevation of 9 m.

Rainfall and Flooding

Widespread heavy rainfall in excess of 4 inches caused inland freshwater floods, river flooding, and landslides across the Mexican states of Colima, Guerrero, Jalisco, Michoacán, and Nayarit. Rainfall totals exceeding 8 inches were reported in localized areas of Colima, Jalisco, and Michoacán. The highest rainfall amounts reported were 21.34 inches (542.0 mm), observed at Lázaro Cárdenas, 15.11 inches (383.9 mm), also observed at Lázaro Cárdenas, and 14.26 inches (362.2 mm) at Higuera Blanca (Fig. 4).

CASUALTY AND DAMAGE STATISTICS

Media reports indicated that Enrique caused 2 direct deaths[2] in Guerrero due to high surf and rip currents. The cyclone also resulted in damage to homes, downed trees and power lines, flooding, and mudslides in the Mexican states of Colima, Guerrero, Jalisco, Michoacán, and Nayarit.

Strong winds from Enrique caused more than 115,000 customers to lose power in Jalisco. These winds uprooted trees, which damaged homes and knocked down power lines in Nayarit, causing a city-wide power outage in the town of Tepic. In Manzanillo, the winds produced mainly minor damage to homes.

The heavy rainfall from Enrique resulted in widespread flooding across portions of mainland Mexico. In Guerrero, over 200 homes were damaged by landslides and winds, although the rainfall there likely had greater impacts than the winds (Fig. 5). In Coahuayutla, heavy rainfall and flooding caused the roofs of 120 homes to collapse, and 70 additional homes were damaged. In Colima, the El Carizzo bridge collapsed due to flash flooding (Fig. 6). In Lázaro Cárdenas, some areas were inundated by over 4 feet of floodwater.

FORECAST AND WARNING CRITIQUE

Enrique's genesis was well forecast. Table 3 provides the number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in each likelihood category. The tropical wave from which Enrique formed was first introduced in the TWO and given a low (<40%) chance of genesis during the next 5 days 114 h before tropical cyclone formation occurred. The 5-day chance of genesis was raised to the medium (40–60%) and high (>60%) categories 96 h and 78 h before formation, respectively. A 2-day probability of genesis was first introduced in the low category 66 h before formation occurred. These chances were then raised to the medium and high categories 54 h and 42 h before formation, respectively.

A verification of NHC official track forecasts (OFCL) for Enrique is given in Table 4a. Official forecast track errors were slightly below the mean official errors for the previous 5-yr period through 48 h, and above the mean errors beyond 48 h. The 96- and 120-h errors were over 50 and 100 n mi higher than their 5-yr means, respectively. Climatology and persistence model (OCD5) errors were also below their respective means for shorter forecast lead times, but the OCD5 errors were well over 100 n mi above their 5-yr means at 96 and 120 h, suggesting that Enrique's track was more difficult than normal to forecast at longer time frames. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. The OFCL forecasts outperformed most of the track guidance through 72 h but did not perform as well

[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.

as most guidance models at 96 h. The best performing model was the HFIP corrected consensus, HCCA, whose errors were lower than OFCL at all time periods. Figure 6a illustrates the left-of-track bias that the NHC track forecasts had for Enrique for the 3-to-5-day period for forecasts issued during the first 24 h of the cyclone's existence. Figure 6b shows that the larger-than-normal error was at least partially due to a multi-model bias that forecasted Enrique to turn toward the west-northwest by 28 June. An examination of the mid-level wind pattern at 1200 UTC 25 June (Fig. 7a) and 1800 UTC 27 June (Fig. 7b) shows the evolution of a mid-tropospheric trough to the north of the cyclone. Although the model guidance anticipated that Enrique's track would bend to the right by 27 June (Fig. 6b), the models underestimated how much the trough would affect the motion of the cyclone as it dug southeastward over the western United States and northern Mexico.

A verification of NHC official intensity forecasts for Enrique is given in Table 5a. Official forecast intensity errors were near the mean official errors for the previous 5-yr period through 48 h and lower than the means at 60–120 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. Overall, the official intensity forecasts were better than the individual model guidance. However, the NHC forecasts were outperformed by the HCCA and the FSU Superensemble (FSSE) consensus models at all but one verifying time period (120 h).

Coastal watches and warnings associated with Enrique are given in Table 6.

Table 1. Best track for Hurricane Enrique, 25–30 June 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 0600	15.2	101.3	1006	35	tropical storm
25 / 1200	15.5	102.1	1004	40	"
25 / 1800	15.8	103.0	1001	45	"
26 / 0000	16.2	103.8	993	55	"
26 / 0600	16.5	104.5	988	60	"
26 / 1200	16.8	105.1	983	70	hurricane
26 / 1800	16.9	105.6	978	75	"
27 / 0000	17.1	105.9	977	75	"
27 / 0600	17.5	105.9	973	80	"
27 / 1200	18.0	105.8	973	80	"
27 / 1800	18.7	105.7	972	80	"
28 / 0000	19.4	105.9	972	80	"
28 / 0600	19.8	106.2	975	75	"
28 / 1200	20.2	106.6	978	70	"
28 / 1800	20.5	107.0	983	60	tropical storm
29 / 0000	20.9	107.3	992	50	"
29 / 0600	21.5	107.4	995	45	"
29 / 1200	22.2	107.5	999	40	"
29 / 1800	22.9	108.0	1003	35	"
30 / 0000	23.5	108.7	1003	35	"
30 / 0600	24.0	109.3	1003	35	"
30 / 1200	24.3	109.8	1005	30	tropical depression
30 / 1800					dissipated
27 / 1800	18.7	105.7	972	80	maximum winds and minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Enrique, 25–30 June 2021.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
26 / 2000	9V3387	13.5	103.6	230 / 38	1006.5
27 / 0000	9V5293	15.4	103.1	190 / 39	1005.6
27 / 1800	3EEX6	16.3	109.7	300 / 38	1007.8

Table 3. 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%)	66	114
Medium (40%-60%)	54	96
High (>60%)	42	78

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Enrique, 25–30 June 2021. 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	60	72	96	120
OFCL	**18.4**	**28.1**	**38.0**	**52.4**	69.3	84.5	140.3	222.3
OCD5	36.4	72.1	102.7	152.6	225.1	290.9	428.7	488.5
Forecasts	20	18	16	14	12	10	6	2
OFCL (2016-20)	21.3	33.1	44.0	54.6	65.3	76.0	95.9	116.6
OCD5 (2016-20)	33.1	69.4	107.8	147.0	183.4	219.7	280.2	342.0

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Enrique, 25–30 June 2021. 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	60	72	96	120
OFCL	15.8	22.8	34.9	55.6	67.8	82.5	136.9	
OCD5	39.2	79.4	114.0	156.1	224.7	293.1	440.4	
GFSI	18.5	27.2	35.3	**52.4**	68.0	91.7	**134.6**	
HMNI	18.3	32.7	51.3	69.6	76.4	**78.4**	**114.7**	
HWFI	20.3	38.8	69.4	83.2	72.9	87.3	**110.4**	
EGRI	24.1	40.1	68.4	93.7	105.0	106.0	**123.6**	
EMXI	17.3	31.8	47.3	63.2	78.4	100.7	188.5	
CMCI	20.7	33.3	42.9	55.8	**62.0**	85.9	182.3	
NVGI	25.0	41.5	63.1	87.0	107.2	115.1	178.4	
AEMI	19.2	30.3	46.7	70.7	88.6	106.2	**136.1**	
HCCA	**15.4**	**21.6**	**34.4**	**51.4**	**60.2**	**71.8**	**113.7**	
FSSE	**14.5**	23.7	**31.4**	**49.2**	**58.1**	**65.2**	**119.9**	
TVCX	**14.4**	24.2	40.2	58.8	**66.3**	**78.6**	**123.6**	
TVCE	**14.9**	24.8	39.9	59.4	**64.9**	**76.2**	**113.7**	
TVDG	**14.4**	25.0	41.1	62.3	70.9	83.8	**124.1**	
GFEX	**15.1**	23.3	35.6	**55.2**	69.8	94.3	156.7	
Forecasts	16	14	12	12	10	8	4	0

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Enrique, 25–30 June 2021. 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	60	72	96	120
OFCL	**5.0**	9.2	11.2	**12.5**	**10.8**	**10.0**	**10.8**	**10.0**
OCD5	5.6	10.1	13.6	15.8	17.2	16.6	10.3	11.0
Forecasts	20	18	16	14	12	10	6	2
OFCL (2016-20)	5.6	9.0	10.9	12.6	14.0	15.3	16.0	16.7
OCD5 (2016-20)	7.2	12.0	15.3	17.6	19.0	20.4	21.2	20.8

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Enrique, 25–30 June 2021. 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 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	5.0	9.1	11.0	12.7	11.4	10.6	11.0	10.0
OCD5	5.7	10.1	13.1	15.2	16.4	15.9	12.2	13.0
HWFI	7.9	9.1	11.2	12.9	18.2	23.9	25.4	17.0
HMNI	5.7	**5.2**	**6.9**	**10.1**	11.9	13.0	12.8	31.0
DSHP	**4.9**	10.4	16.5	16.0	**10.2**	**8.3**	**7.2**	10.0
LGEM	5.1	9.5	12.7	13.0	**8.5**	**9.1**	15.2	18.0
HCCA	**3.8**	**5.3**	**9.8**	**10.0**	**7.7**	**8.2**	**8.0**	16.0
FSSE	**3.8**	**5.8**	**7.8**	**8.3**	**5.1**	**5.6**	**5.4**	14.0
IVCN	**4.6**	**6.8**	**8.9**	**10.0**	**10.5**	12.2	14.0	19.0
IVDR	5.2	**6.8**	**8.6**	**9.9**	**9.9**	10.7	12.4	18.0
GFSI	7.5	11.2	13.4	15.5	15.0	14.0	**9.8**	**0.0**
EMXI	8.0	12.2	14.1	14.8	14.8	10.8	**4.8**	**7.0**
Forecasts	19	17	15	13	11	9	5	1

Table 6. Wind watch and warning summary for Hurricane Enrique, 25–30 June 2021.

Date/Time (UTC)	Action	Location
25 / 1500	Tropical Storm Watch issued	Punta San Telmo to Cabo Corrientes
25 / 2100	Tropical Storm Watch modified to	Cabo Corrientes to San Blas
25 / 2100	Tropical Storm Warning issued	Zihuatanejo to Cabo Corrientes
27 / 0300	Tropical Storm Watch modified to	Punta Mita to San Blas
27 / 0300	Tropical Storm Warning discontinued	Zihuatanejo to Cabo Corrientes
27 / 0300	Tropical Storm Warning issued	Punta San Telmo to Punta Mita
27 / 0300	Hurricane Watch issued	Manzanillo to Cabo Corrientes
27 / 2100	Hurricane Watch modified to	Manzanillo to Playa Perula
27 / 2100	Hurricane Warning issued	Playa Perula to Cabo Corrientes
28 / 1500	Tropical Storm Watch issued	Cabo San Lucas to Los Barriles
28 / 1800	Tropical Storm Warning modified to	Playa Perula to Punta Mita
28 / 1800	Hurricane Watch discontinued	All
28 / 1800	Hurricane Warning discontinued	All
29 / 0000	Tropical Storm Watch discontinued	Punta Mita to San Blas
29 / 0000	Tropical Storm Warning discontinued	All
29 / 2100	Tropical Storm Watch discontinued	All

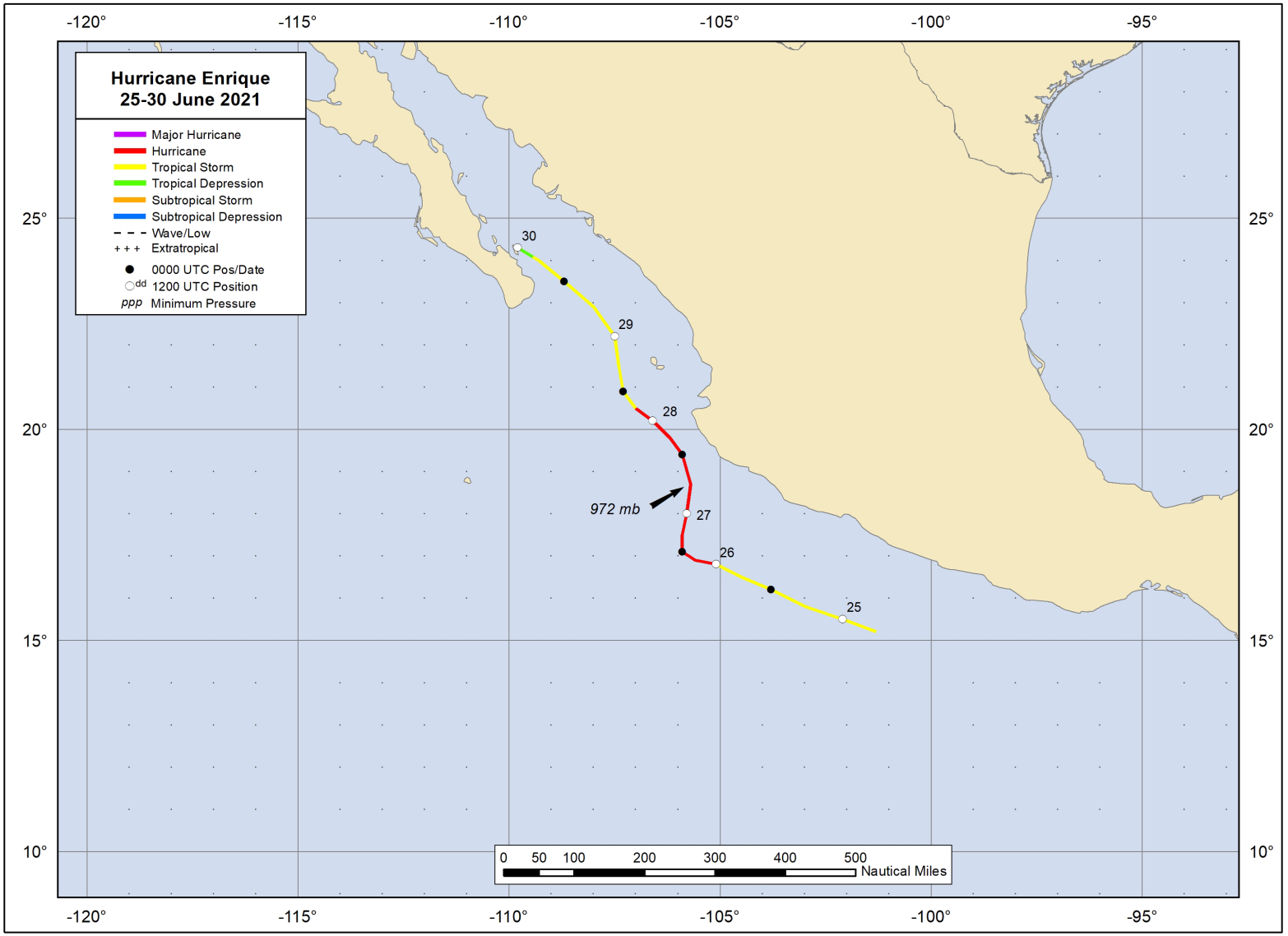

Figure 1. Best track positions for Hurricane Enrique, 25–30 June 2021.

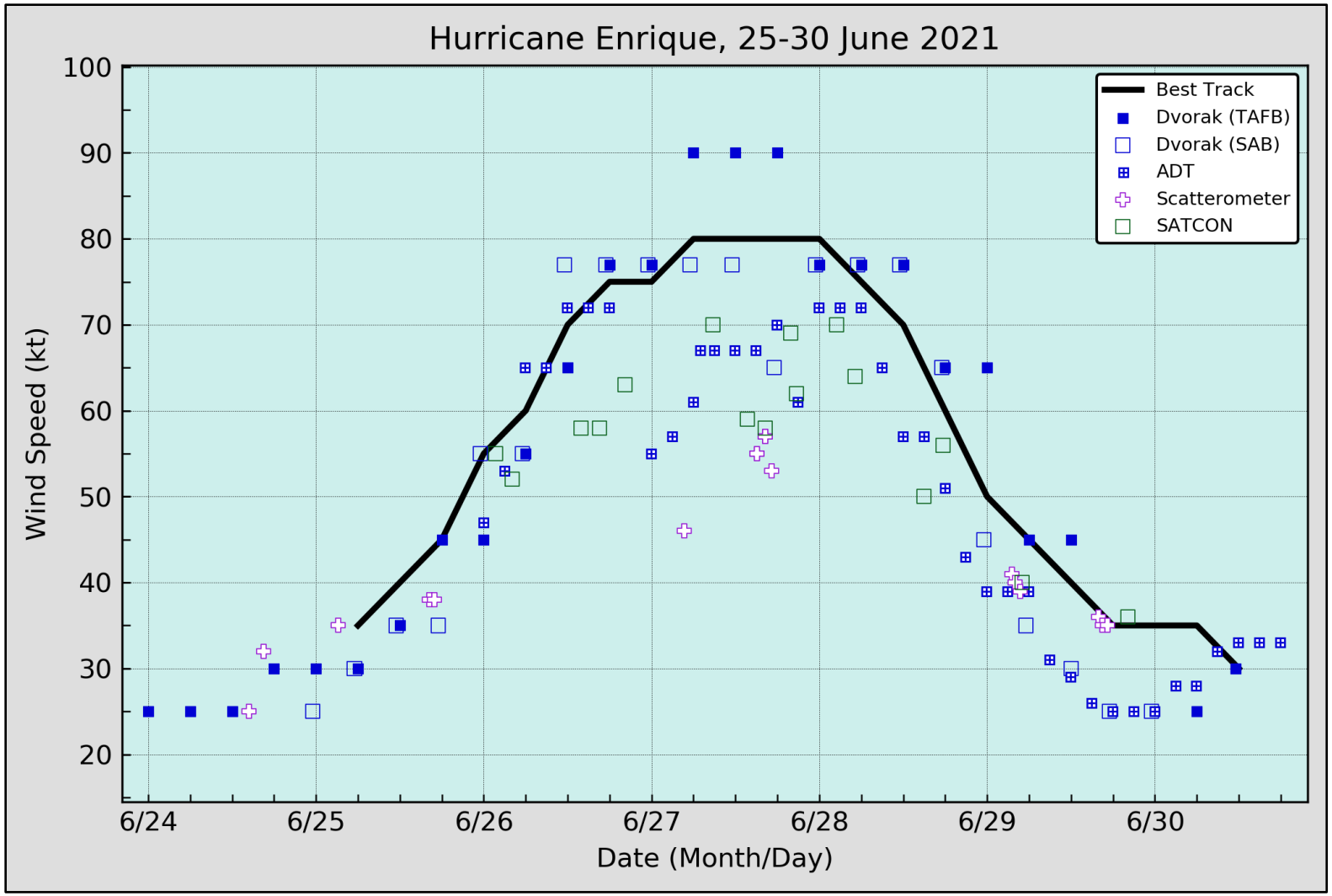

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Enrique, 25–30 June 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

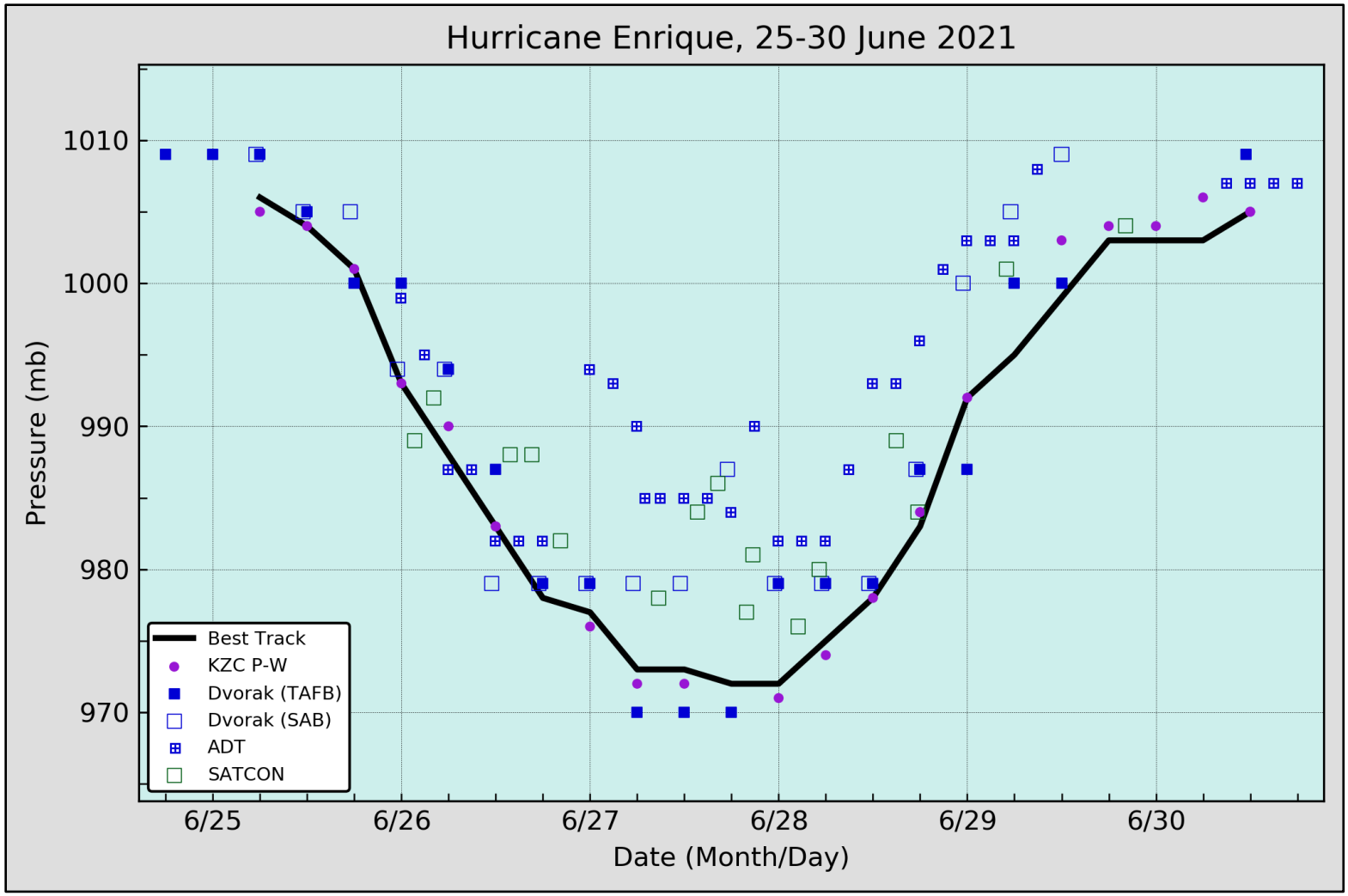

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Enrique, 25–30 June 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.

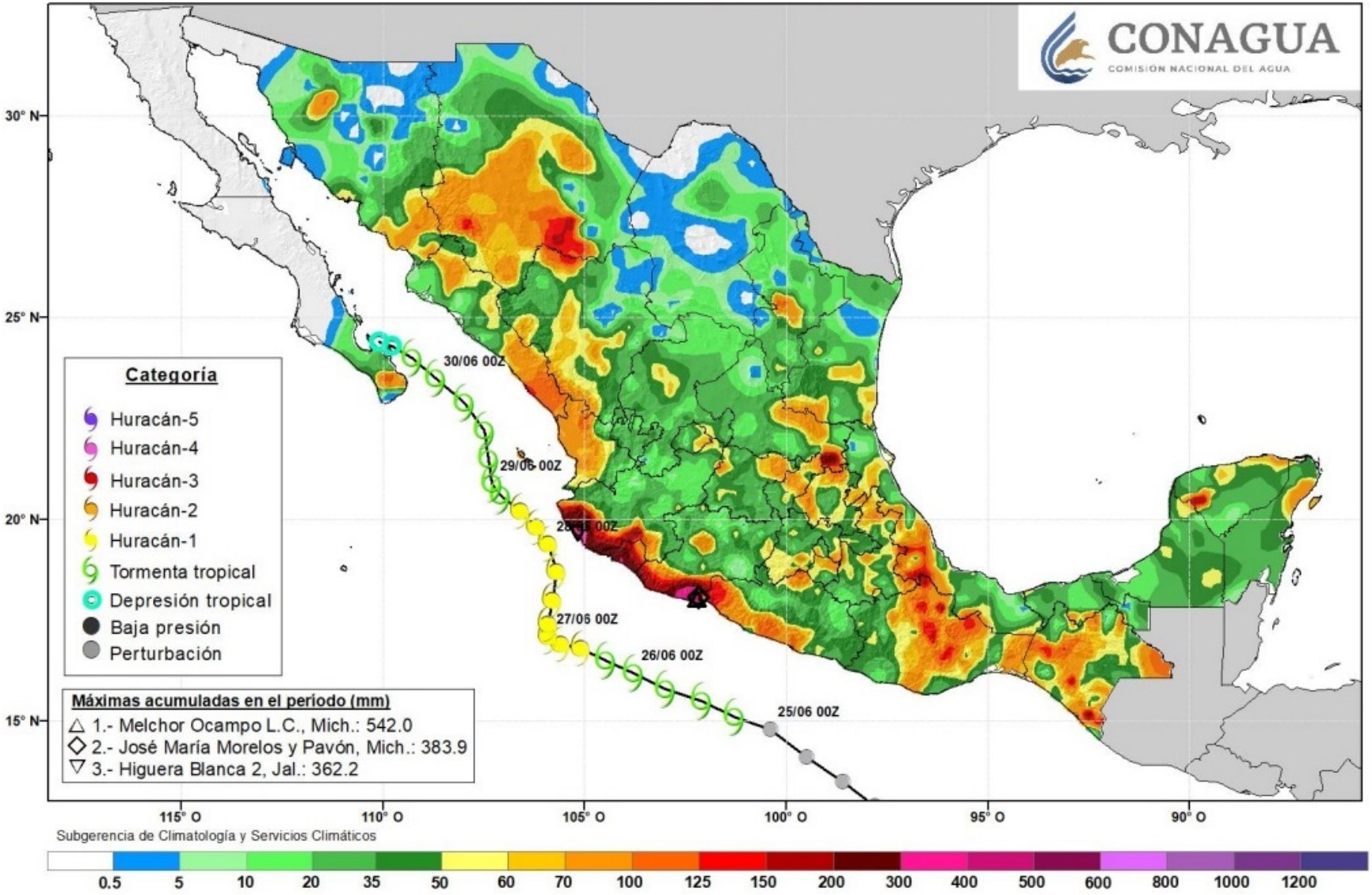

Figure 4. Total rainfall (mm) during the period 25–30 June 2021 when Enrique was a tropical cyclone. Map courtesy of the Servicio Meteorológico Nacional (Mexican Meteorological Service).

Figure 5. Flash flooding in Guerrero as Enrique passed by the region. Image courtesy of *Mexico News Daily*.

Figure 6. Collapsed bridge in Colima. Image courtesy of *Mexico News Daily*.

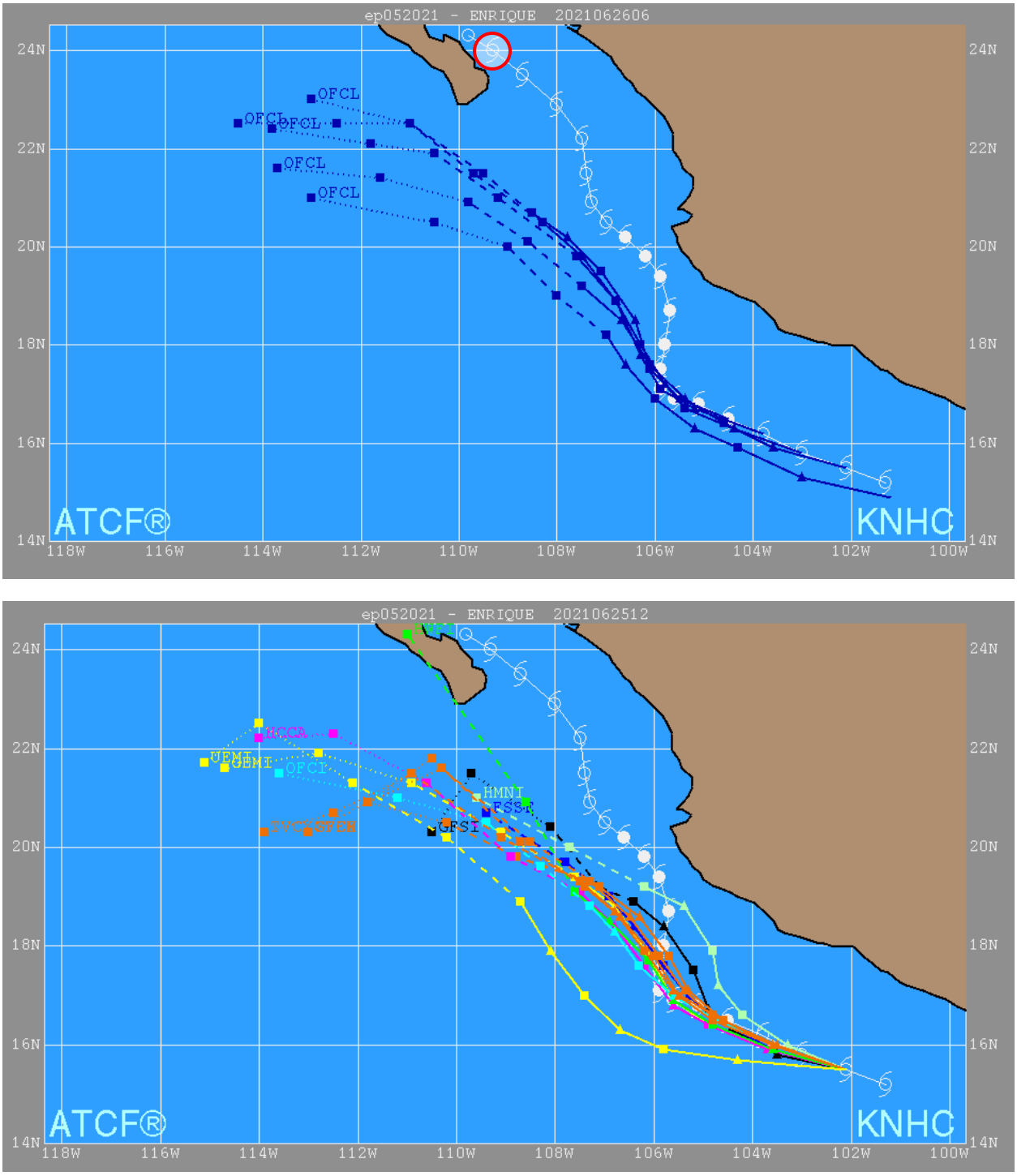

Figure 6. (a) All NHC official five-day track forecasts (blue lines) for Enrique from 0600 UTC 25 June through 0600 UTC 26 June. Enrique's best track is indicated by the white line and symbols, with the red circle in (a) denoting the storm's location five days after its genesis. (b) Five-day track models for Hurricane Enrique from the 1200 UTC 25 June forecast cycle.

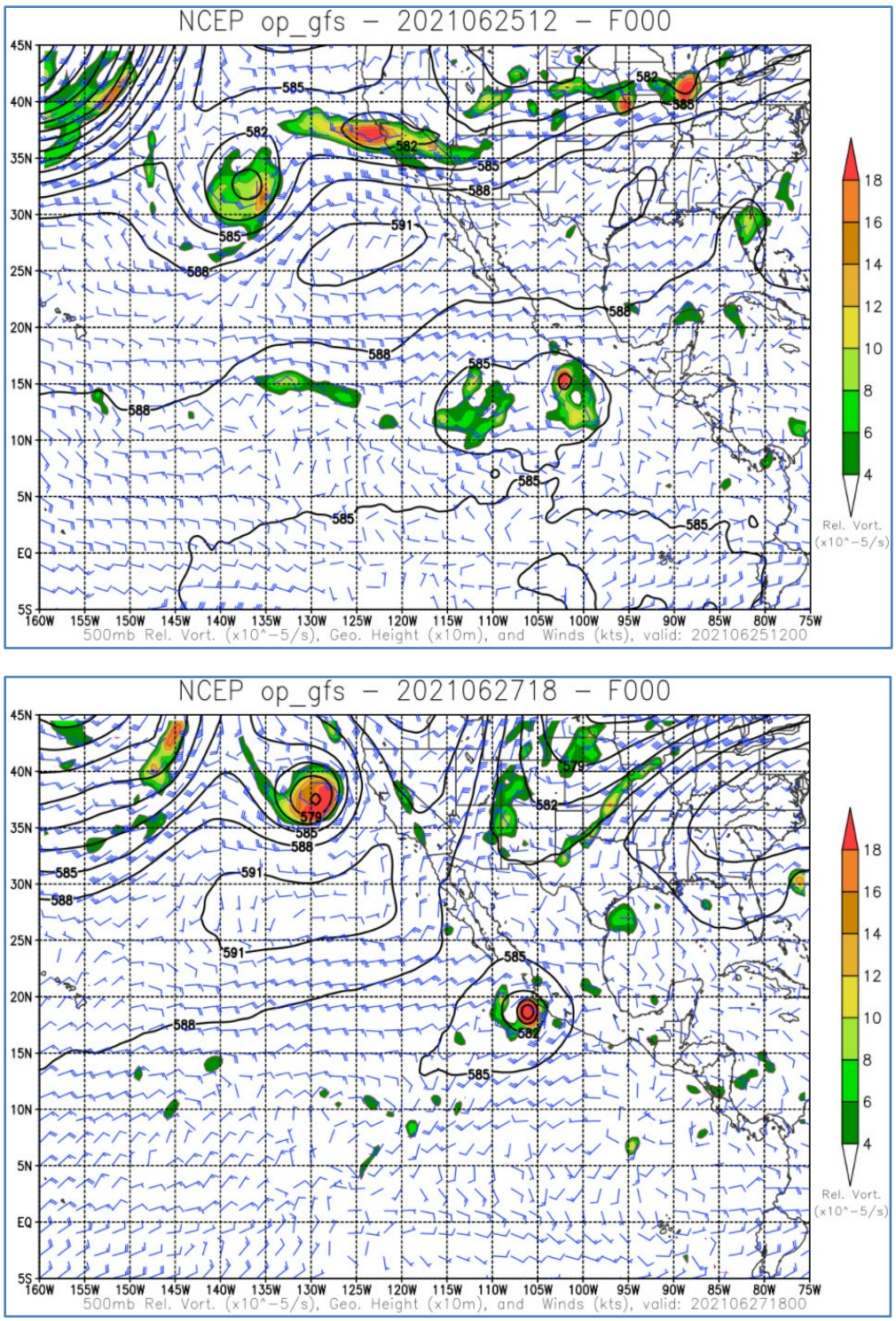

Figure 7. GFS analysis of 500-mb relative vorticity (shaded), geopotential height (black lines), and wind barbs (blue, kt) for (a) 1200 UTC 25 June, and (b) 1800 UTC 27 June.