NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE ORLENE

(EP162022)

28 September–3 October 2022

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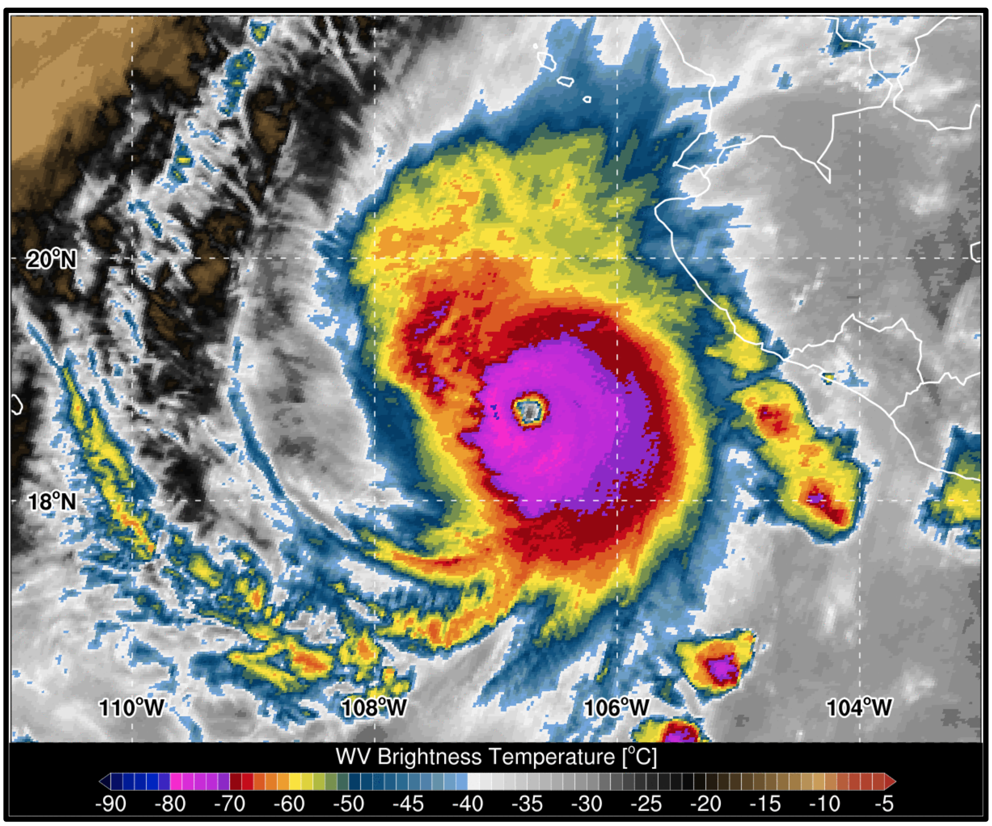
National Hurricane Center
9 March 2023



GOES-17 WATER VAPOR IMAGE AT 0700 UTC 2 OCTOBER 2022, SHOWING HURRICANE ORLENE NEARING PEAK INTENSITY. DATA USED TO CREATE THIS IMAGE COURTSEY OF THE NOAA BIG DATA PROJECT

Orlene rapidly intensified and was briefly a category 4 hurricane (on the Saffir-Simpson Hurricane Wind Scale) off the west-central coast of Mexico before rapidly weakening and making landfall as a category 1 hurricane near Caimanero in Sinaloa, Mexico.

Hurricane Orlene

28 SEPTEMBER–3 OCTOBER 2022

SYNOPTIC HISTORY

Orlene's precursor system appears related to a combination of nocturnal convection that formed along the southern Mexican coast early on 25 September and the pre-existing monsoon trough over the eastern Pacific. Gap wind flow observed over the Gulf of Tehuantepec on 25–26 September may have also provided additional surface convergence that assisted in convective development in that area. While the associated convection was initially diurnally driven, peaking during the mornings on 26 and 27 September, this activity began to focus in a small area several hundred miles off the southwest coast of Mexico by 0000 UTC 28 September. This small but concentrated area of showers and thunderstorms persisted through the night, improved in organization, and resulted in the development of a small low-pressure area on the morning of 28 September. Scatterometer data later that morning confirmed that a small, closed surface circulation had developed, and a tropical depression is estimated to have formed by 1800 UTC 28 September, about 230 n mi south of Zihuatanejo, Mexico. The depression became Tropical Storm Orlene 6 h later. The "best track" chart of Orlene'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].

The environment surrounding Orlene was favorable for additional intensification, with 200–850 mb vertical wind shear under 10 kt, warm 28–29°C sea surface temperatures, and a sufficiently moist mid-level environment. Orlene intensified gradually between 28–30 September, with the cyclone becoming a 55-kt tropical storm by 0000 UTC 1 October. Orlene was initially steered to the west-northwest by a narrow mid-level ridge centered over northern Mexico and southern Texas. An approaching mid-latitude trough moved into the western United States which created a weakness on the western side of the ridge and resulted in Orlene slowing its forward motion as it turned northwest and north late on 30 September.

Microwave imagery early on 1 October (Fig. 4a) suggested that Orlene was developing an inner core, and the system soon became a hurricane by 1200 UTC that day, when it was located about 180 n mi west-southwest of Manzanillo, Mexico. Within continued conducive environmental conditions, Orlene underwent a 24-h period of rapid intensification where the maximum sustained winds increased by 50 kt and the hurricane reached a peak intensity of 115 kt (category 4 hurricane) at 1200 UTC 2 October. At the time, Orlene was centered about 120 n mi southwest of Puerto Vallarta, Mexico, and the hurricane exhibited an impressive presentation on infrared satellite imagery, with a well-defined warm eye surrounded by a closed ring of -70 to -75°C cloud top temperatures (cover photo). In addition, microwave satellite imagery

[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.

depicted a thick, closed eyewall with a small, embedded eye (Fig. 4b). As Orlene rapidly intensified, the hurricane continued moving slowly northward into the mid-level weakness in the ridge produced by an approaching mid-latitude trough.

Orlene's rapid intensification came to a halt later on 2 October as the hurricane started an eyewall replacement cycle while southwesterly vertical wind shear increased ahead of the mid-latitude trough. Air Force Reserve Hurricane Hunter aircraft data in combination with satellite intensity estimates indicated that Orlene quickly weakened below major hurricane intensity by 0000 UTC 3 October. While an eye feature was still apparent on microwave satellite imagery, the surrounding convective bands became less symmetric (Fig. 4c), favoring the down-shear quadrant as vertical tilt between Orlene's low- and mid-level centers increased. Orlene also started moving north-northeast at a slightly faster forward speed as mid-level ridging nosed southeast of the hurricane.

Ultimately, the increased shear led to the low- and mid-level centers decoupling just before Orlene made landfall (Fig. 4d). Orlene moved ashore as a category 1 hurricane around 1435 UTC 3 October near Caimanero, Mexico, with estimated maximum sustained winds of 70 kt. Orlene continued to rapidly weaken below hurricane intensity shortly after landfall, and its low-level circulation soon became disrupted by the high, rugged terrain of western Mexico. The center could no longer be tracked and is estimated to have dissipated by 0000 UTC 4 October as Orlene's remnants pushed into western Mexico near the state border of Sinaloa and Durango.

METEOROLOGICAL STATISTICS

Observations in Orlene (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. Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from 2 flights of the 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command. 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 Orlene.

Winds and Pressure

Orlene's estimated peak intensity of 115 kt at 1200 UTC 2 October is based on a blend of peak subjective satellite estimates of T5.5/102 kt from TAFB and SAB and objective satellite estimates of T6.2/120 kt from ADT and 104 kt from SATCON. The estimated peak leans towards the higher ADT estimate partially because some of the subjective Dvorak estimates earlier that morning at 0600 UTC 2 October were constrained from providing higher estimates as Orlene was rapidly intensifying. In addition, the small size of an inner core, such as that of Orlene near its time of peak intensity (Fig. 4b), can result in SATCON intensity underestimation for small tropical cyclones (Velden and Herndon 2020). Observations from the two Air Force Reserve Hurricane Hunter flights into Orlene were only available before and after Orlene reached peak intensity, though their data helped show Orlene was quickly intensifying and weakening on 1 and 2 October, respectively.

Orlene's landfall intensity of 70 kt at 1435 UTC 3 October is partially based on subjective Dvorak estimates of T4.0/65 kt from SAB and T4.5/77 kt from TAFB at 1200 UTC 3 October, in addition to a SATCON estimate of 72 kt at 1420 UTC 3 October. While objective ADT current intensity estimates were higher at T4.8/85 kt at 1420 UTC 3 October, the raw values were rapidly decreasing as the satellite structure quickly deteriorated before landfall. While Orlene was operationally assessed in real-time to have made landfall a little earlier and a little farther south, a post-assessment of microwave imagery (Fig. 4d) in addition to surface observations with an eyewitness report from Josh Morgerman of iCyclone were helpful in showing that Orlene's surface center moved ashore a little less than an hour later a bit further north and west near the town of Caimanero in Sinaloa, Mexico.

Orlene was a small tropical cyclone with sustained hurricane-force-wind radii never extending beyond 15 n mi from the center, so hurricane impacts were likely confined near where the center made landfall in Sinaloa, Mexico, in addition to the Islas Marias, which Orlene moved very close to early on 3 October. A somewhat larger area of tropical-storm-force winds likely occurred in Sinaloa and Nayarit and potentially extended into Durango. Surface observations were quite sparse, and the highest sustained wind report was 58 kt with a gust to 80 kt at Maria Madre Island at 0445 UTC 3 October. In mainland Mexico, a sustained wind of 38 kt with a gust to 70 kt was reported at Marismas Nacionales near Felipe Angel in the state of Nayarit at 1310 UTC 3 October, while a gust of 64 kt was reported farther inland near the elevated site (~8000 ft) of La Michilia in Durango, Mexico.

Orlene's estimated minimum central pressure of 954 mb at 1200 UTC 2 October is based on a blend of subjective and objective satellite estimates, including the Knaff-Zehr-Courtney pressure-wind relationship. As Orlene quickly weakened early on 3 October, a surface pressure of 977.8 mb was observed at Maria Madre Island at 0530 UTC 3 October. The surface pressure continued to rise, and shortly before landfall, storm chasers from iCyclone measured a surface pressure near the location of landfall of 991.3 mb at 1411 UTC 3 October. Orlene's pressure at landfall was estimated to be 990 mb, slightly lower than this pressure observation because it was recorded a bit prior to landfall.

Rainfall and Flooding

Between 1 and 3 October, Orlene produced two separate areas with greater than 4 inches (>100 mm) of rainfall in Mexico (Fig. 5). The first area was along the southwest coast of Mexico in the states of Jalisco and Colima, with a peak total of 7.62 inches (193.8 mm) at Cihuatán in Jalisco. Further north, a second area of heavy rainfall was observed in the states of Nayarit and Sinaloa, with peak totals of 6.48 inches (164.7 mm) at La Estancia, and 6.30 inches (160.0 mm) in Acaponeta, both located in Nayarit. Even though Orlene's center made landfall in the state of Sinaloa, the heaviest rainfall totals occurred farther south and east as the shower and thunderstorm activity became increasingly separated away from the center at landfall.

CASUALTY AND DAMAGE STATISTICS

As of this writing, no fatalities have been reported with Orlene. Local and state officials attributed the lack of deaths due to a combination of evacuations into shelters, the closure of schools and other businesses, along with other safety preparations made in anticipation of Orlene.

Orlene made landfall in a sparsely populated area of Mexico, which limited overall damage impacts for the country. While the total damage estimated from Orlene is not yet available as of the release of this report, at least 12 million pesos (600,000 USD) of estimated damage was assessed for the San Blas municipality of Mexico, and it is likely the overall damage total in Mexico is higher.

Media reports indicate that Orlene caused flooding, landslides, toppled trees, and downed powerlines in Nayarit, Sinaloa, and Jalisco leading to significant damage. Flooding was reported in Puerto Vallarta in numerous local communities, prompting the opening of several shelters to house displaced residents. Landslides and sinkholes also led to road closures in several federal highways linking Puerto Vallarta with Cihualtlán. Flooding in the Jalisco town of La Huerta damaged an estimated 80 homes. Further north in Sinaloa, a major landslide temporarily blocked traffic on a major highway that linked Mazatlán to Durango at mile marker 128 (Fig. 6, bottom). Heavy rainfall caused the Canas River to overflow its banks, resulting in flooding in the nearby towns in Sinaloa, (Fig. 6, top right). Near Caimanero, storm chaser Josh Morgerman of iCyclone observed downed powerlines (Fig. 6, top left), some damaged rooftops and additional scattered debris due to strong winds before Orlene made landfall. Minor freshwater flooding was also noted between Caimanero and Mazatlán. Finally, significant structural damage was noted in Nayarit in the municipality of San Blas, with several collapsed homes related to a landslide caused by an overflowing stream. Per the Federal Electricity Commission of Mexico, about 50,000 people lost power across both Nayarit and Sinaloa due to Orlene.

FORECAST AND WARNING CRITIQUE

The genesis of Orlene was forecast with less-than-optimal lead time in both the 5- and 2-day Tropical Weather Outlooks (TWOs). The system that went on to become Orlene was first introduced in the 5-day Tropical Weather Outlook (TWO) with a low chance (<40%) of development at 0000 UTC 26 September 2022, about 66 h prior to genesis (Table 2). The probabilities were increased to medium (40–60%) at 1200 UTC 26 September, about 54 h prior to development, and high (>60%) at 1200 UTC 27 September, about 30 h prior to development. In the 2-day TWO, low probabilities were introduced 42 h prior to genesis, and raised to medium and high probabilities 24 h and 6 h before formation, respectively. The lack of significant lead time in the TWO could be related to the small size of the pre-Orlene system, which was not very well depicted in the global model guidance (not shown). However, the 5-day genesis areas correctly captured where Orlene would ultimately develop, with a 100% hit rate for each of the 12 TWOs issued leading up to its occurrence (Fig. 7).

A verification of NHC official track forecasts for Orlene is given in Table 3a. The official track forecast errors were slightly higher than the mean official errors of the previous 5-yr period for 12–48 h forecast times (though less than 10 n mi above the mean), but then lower than the mean official errors for the 60–96 h forecast times. Climatology-persistence (OCD5) track errors were near their respective 5-yr means at 12–24 h, but then became much greater than the mean thereafter, suggesting that Orlene was a harder-than-usual tropical cyclone to forecast track-wise in the eastern Pacific. The higher track forecast errors at shorter lead times were likely related to the first few track forecasts on 28–29 September that took Orlene too far west (Fig. 8a). Subsequent forecasts after the storm turned northward on 1–3 October better captured the ultimate track (Fig. 8b).

A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. In general, the official track forecasts outperformed most of the deterministic models, except for a handful of forecast times in the Canadian (CMCI), NAVGEM (NVGI), and HMON (HMNI). The consensus models performed better, with the HFIP corrected consensus approach (HCCA), TVCE, and TVDG beating the official track forecast at most times from 12–72 h. Interestingly, a blend of the GFS and ECMWF track forecasts (GFEX) also outperformed the official forecast at 24–60 h even though neither individual model performed as well.

A verification of NHC official intensity forecasts for Orlene is given in Table 4a. Intensity errors were generally higher than the mean official errors for the previous 5-yr period, except for the 60-h lead time which was slightly lower. OCD5 errors were also generally higher than their respective 5-yr means, suggesting that Orlene was a harder-than-usual tropical cyclone to forecast intensity-wise in the eastern Pacific. While most of the NHC forecasts showed significant intensification with Orlene, rapid intensification (at least a 30-kt increase in winds over a 24-h period) was not explicitly forecast, which ultimately did occur between 1–2 October (Fig. 9). In addition, the rate of weakening that occurred on 3 October was faster than anticipated.

A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The best performing deterministic intensity guidance in the short-term intensity forecast was the HMON (HMNI) model, which beat the official intensity forecast from 12–36 h, though it had much larger intensity errors at longer lead times (e.g., 96 h). In addition, the consensus intensity aids were only able to beat the official forecast for a handful of time periods (12 h for IVDR, 24 h for IVCN and IVDR, and 72 h for HCCA). While the global model NAVGEM (NVGI) also beat the official intensity forecast for a few forecast lead times (24–36 h and 96 h), this model commonly has a high intensity bias that likely resulted in lower errors since Orlene intensified more than anticipated.

Coastal watches or warnings issued by the government of Mexico in association with Orlene are listed in Table 5.

REFERENCES

Velden, C. S., and D. Herndon, 2020: A consensus approach for estimating tropical cyclone intensity from meteorological satellites: SATCON. *Wea. Forecast.*, **35**, 1645–1662, https://doi.org/10.1175/WAF-D-20-0015.1.

ACKNOWLEDGMENTS

Rainfall data (Fig. 5) was provided by CONAGUA, the national meteorological service of Mexico. Josh Morgerman of iCyclone is thanked for his data collection and eyewitness reports near Orlene's location of landfall.

Table 1. Best track for Hurricane Orlene, 28 September – 3 October 2022.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 1800	13.8	102.3	1007	30	tropical depression
29 / 0000	14.1	103.2	1006	35	tropical storm
29 / 0600	14.5	104.4	1004	40	"
29 / 1200	14.9	105.4	1004	40	"
29 / 1800	15.1	106.0	1002	45	"
30 / 0000	15.3	106.5	1002	45	"
30 / 0600	15.6	106.7	999	50	"
30 / 1200	15.9	106.8	998	50	"
30 / 1800	16.3	106.9	997	50	"
01 / 0000	16.7	107.0	994	55	"
01 / 0600	17.1	107.0	991	60	"
01 / 1200	17.4	107.0	987	65	hurricane
01 / 1800	17.7	107.1	979	75	"
02 / 0000	18.1	107.0	970	90	"
02 / 0600	18.6	106.9	961	105	"
02 / 1200	19.3	106.9	954	115	"
02 / 1800	20.0	107.0	972	100	"
03 / 0000	20.8	106.8	974	95	"
03 / 0600	21.7	106.6	976	85	"
03 / 1200	22.6	106.2	983	75	"
03 / 1435	22.9	106.1	990	70	"
03 / 1800	23.2	106.0	998	45	tropical storm
04 / 0000					dissipated
02 / 1200	19.3	106.9	954	115	Maximum winds and minimum pressure
03 / 1435	22.9	106.1	990	70	Landfall near Caimanero, Sinaloa, Mexico

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%)	42	66
Medium (40%-60%)	24	54
High (>60%)	6	30

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Orlene, 28 September – 3 October 2022. 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	23.2	42.3	55.3	60.9	**58.1**	**58.7**	**85.0**	
OCD5	29.1	66.1	116.3	182.7	254.4	344.4	520.3	
Forecasts	18	16	14	12	10	8	4	
OFCL (2017-21)	21.9	33.8	45.6	56.9	74.8	79.9	99.5	121.3
OCD5 (2017-21)	35.8	72.3	112.7	155.0	198.7	239.0	309.2	372.2

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Orlene, 28 September – 3 October 2022. 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	60	72	96	120
OFCL	23.3	42.3	55.3	60.9	58.1	63.5	94.0	
OCD5	29.9	66.1	116.3	182.7	254.4	352.4	480.2	
GFSI	26.7	45.9	67.0	82.5	101.2	117.7	174.7	
EMXI	24.9	46.8	65.0	81.7	107.2	149.8	321.6	
CMCI	24.8	**32.6**	**45.4**	65.8	87.6	106.4	142.3	
NVGI	29.6	**41.6**	**45.9**	**60.1**	86.8	122.6	122.0	
HWFI	26.1	44.9	61.1	65.9	78.3	75.6	155.8	
HMNI	26.4	43.2	**55.1**	66.0	83.6	112.5	242.4	
HCCA	**20.8**	**37.6**	**48.7**	**49.2**	**54.0**	**61.8**	127.6	
AEMI	28.0	48.2	60.2	67.9	75.7	85.3	124.3	
GFEX	24.0	**40.6**	**54.4**	**58.3**	**57.9**	66.9	107.3	
TVCE	**22.8**	**41.8**	**54.8**	**56.9**	**57.5**	67.6	126.3	
TVCX	23.7	**41.6**	56.0	**56.4**	**56.8**	**62.7**	107.7	
TVDG	**23.1**	**40.3**	**55.1**	**56.9**	**55.0**	**62.4**	96.4	
TABS	35.0	67.5	86.8	92.7	97.9	84.9	**57.6**	
TABM	**22.7**	**42.0**	59.2	70.0	83.1	113.7	177.1	
TABD	**21.6**	**40.6**	64.4	97.2	156.6	231.1	440.0	
Forecasts	17	16	14	12	10	7	3	

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Orlene, 28 September – 3 October 2022. 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	8.9	13.1	15.4	14.2	**14.5**	21.9	23.8	
OCD5	10.8	17.9	22.4	25.2	28.5	33.5	25.0	
Forecasts	18	16	14	12	10	8	4	
OFCL (2017-21)	5.5	9.1	11.1	12.9	15.3	15.6	16.4	17.0
OCD5 (2017-21)	7.0	12.2	15.8	18.6	20.4	21.2	22.3	21.8

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Orlene, 28 September – 3 October 2022. 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	7.6	13.1	15.4	14.2	14.5	24.2	25.0	
OCD5	10.5	17.9	22.4	25.2	28.5	39.8	30.7	
HWFI	8.4	**11.9**	16.9	16.0	18.4	28.0	**24.7**	
HMNI	**7.1**	**11.8**	**14.2**	16.9	17.5	25.2	67.0	
DSHP	8.9	16.6	20.3	20.9	21.8	28.8	41.7	
LGEM	9.3	15.3	19.1	21.8	24.5	35.5	41.3	
IVCN	7.6	**12.5**	17.4	18.7	20.3	27.2	44.7	
IVDR	**7.4**	**11.8**	17.1	18.4	20.3	27.0	45.0	
HCCA	8.1	13.7	19.1	19.5	17.5	**22.0**	37.7	
GFSI	8.7	**13.0**	19.5	27.0	33.2	36.2	42.3	
EMXI	13.6	24.0	29.7	36.5	45.8	65.0	62.0	
CMCI	13.6	23.4	26.1	27.5	33.8	51.8	41.7	
NVGI	8.9	**8.5**	**9.9**	14.8	14.7	29.0	**8.3**	
Forecasts	17	16	14	12	10	6	3	

Table 5. Watch and warning summary for Hurricane Orlene, 28 September–3 October 2022.

Date/Time (UTC)	Action	Location
30 / 2100	Tropical Storm Watch issued	Manzanillo to San Blas
30 / 2100	Hurricane Watch issued	Las Islas Marias
1 / 0300	Tropical Storm Warning issued	Playa Perula to San Blas
1 / 0300	Hurricane Watch issued	north of San Blas to Bahia Tempehuaya
1 / 1500	Hurricane Warning issued	Las Islas Marias
2 / 0300	Hurricane Warning issued	North of San Blas to Mazatlan
2 / 0300	Hurricane Watch issued	Playa Perula to San Blas
2 / 2100	Tropical Storm Warning issued	Mazatlan to Bahia Tempehuaya
2 / 2100	Tropical Storm Watch discontinued	South of Playa Perula to Manzanillo
3 / 1500	All warnings discontinued	south of Playa Mita
3 / 1500	Hurricane Watch discontinued	All
3 / 1500	Hurricane Warning discontinued	Las Islas Marias
3 / 1800	Hurricane Warning changed to a Tropical Storm Warning	San Blas to Bahia Tempehuaya
3 / 2100	Tropical Storm Warning discontinued	All

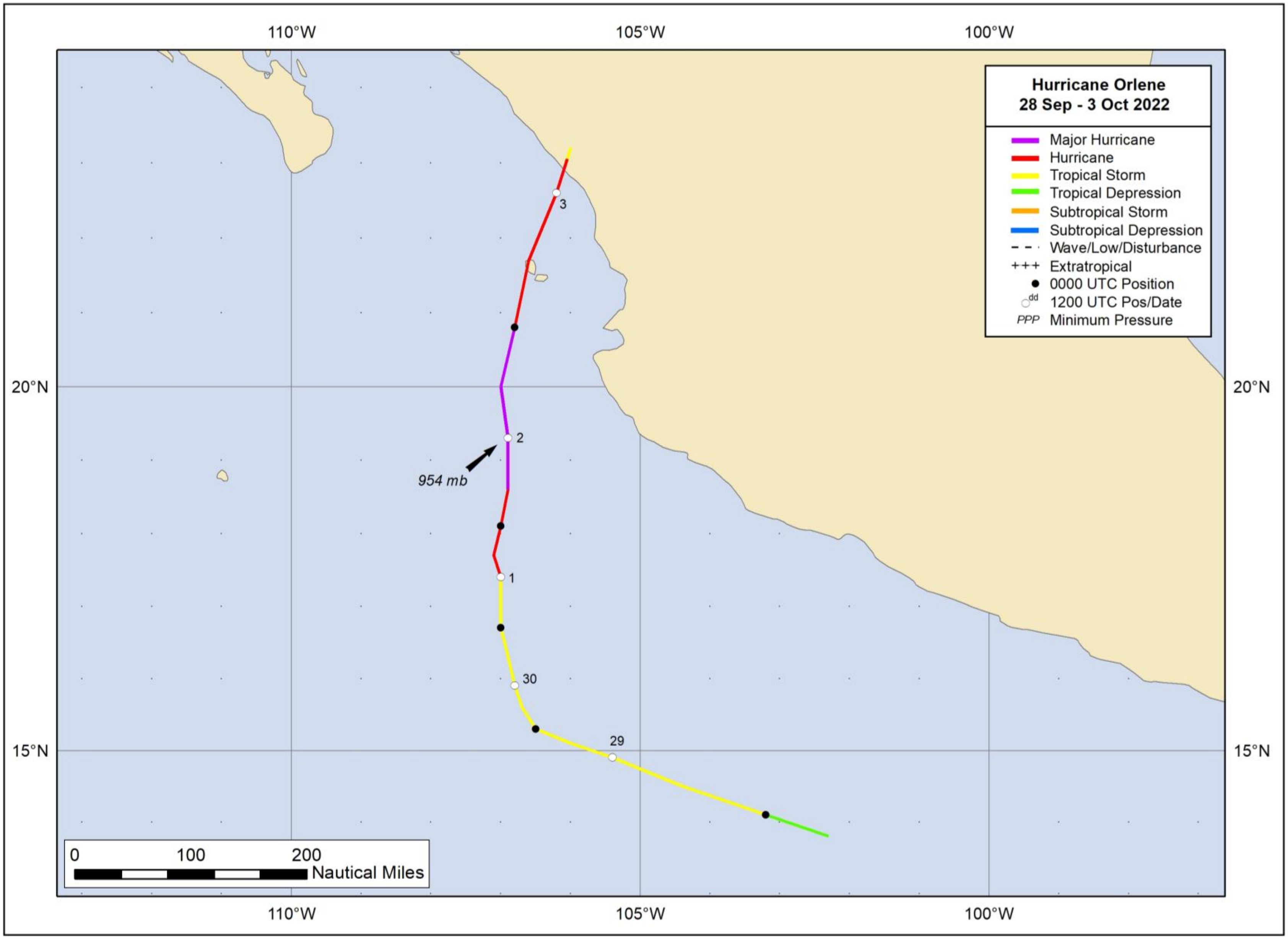


Figure 1. Best track positions for Hurricane Orlene, 28 September – 3 October 2022.

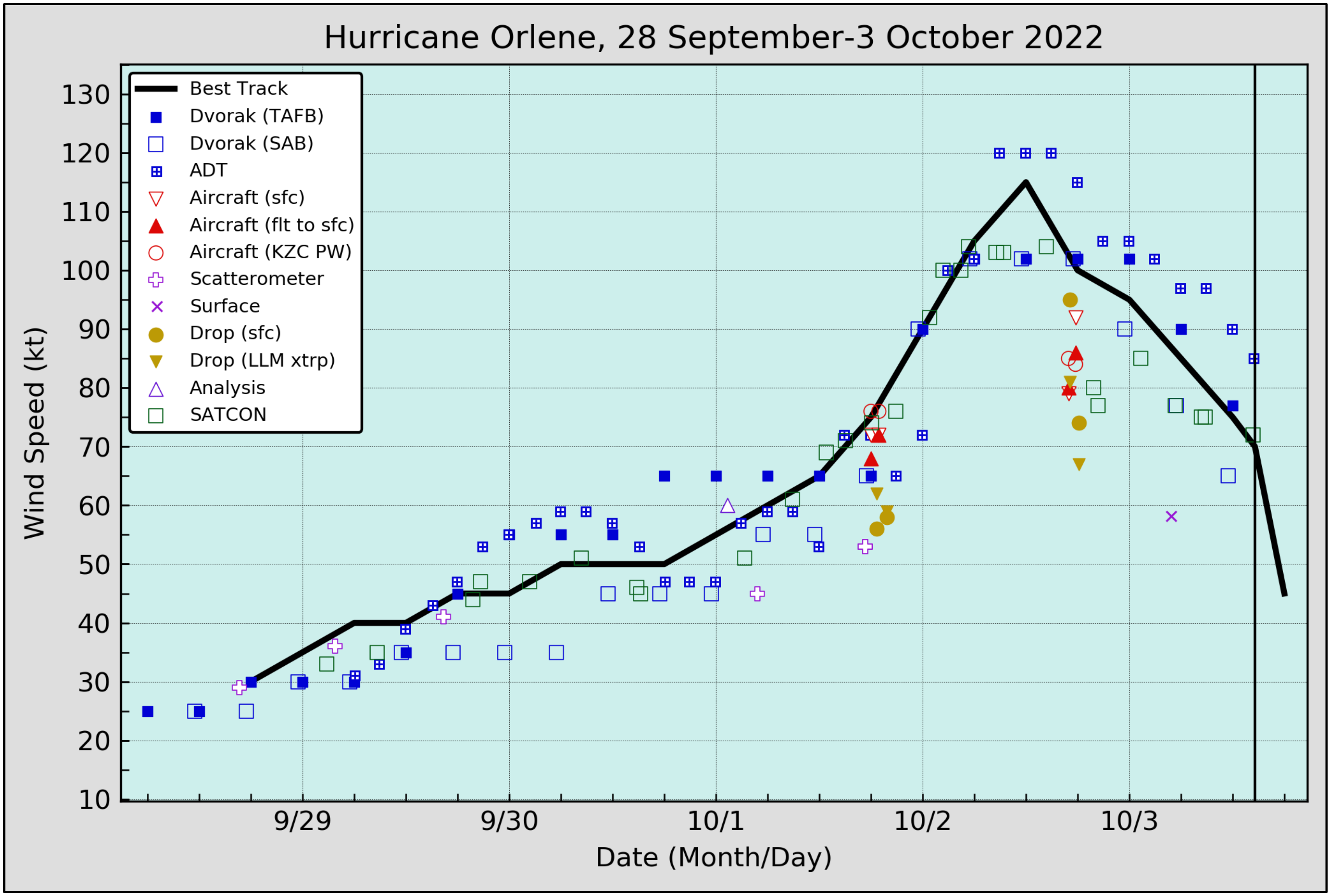


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Orlene, 28 September–3 October 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

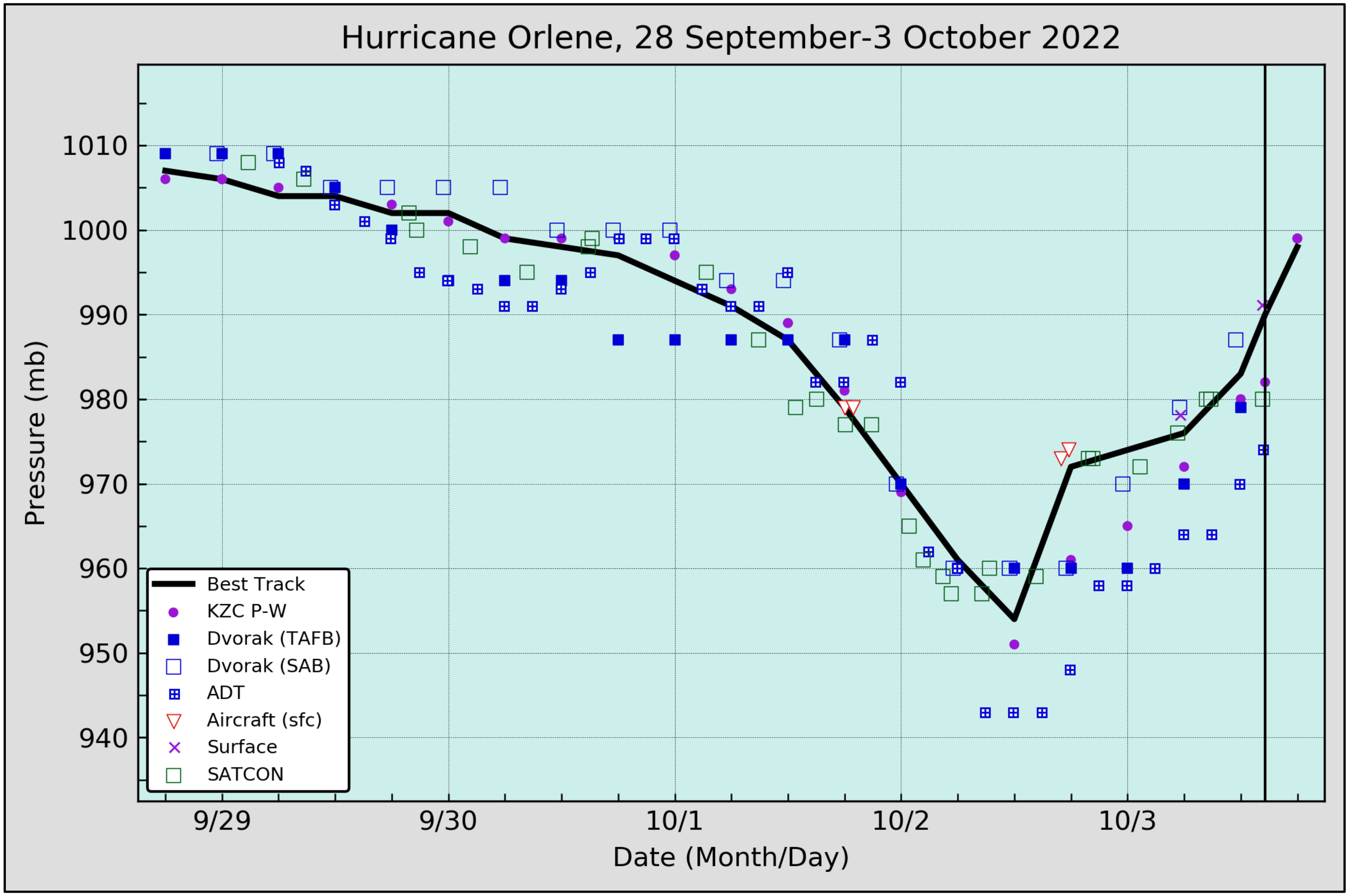


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Orlene, 28 September – 3 October 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute 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.

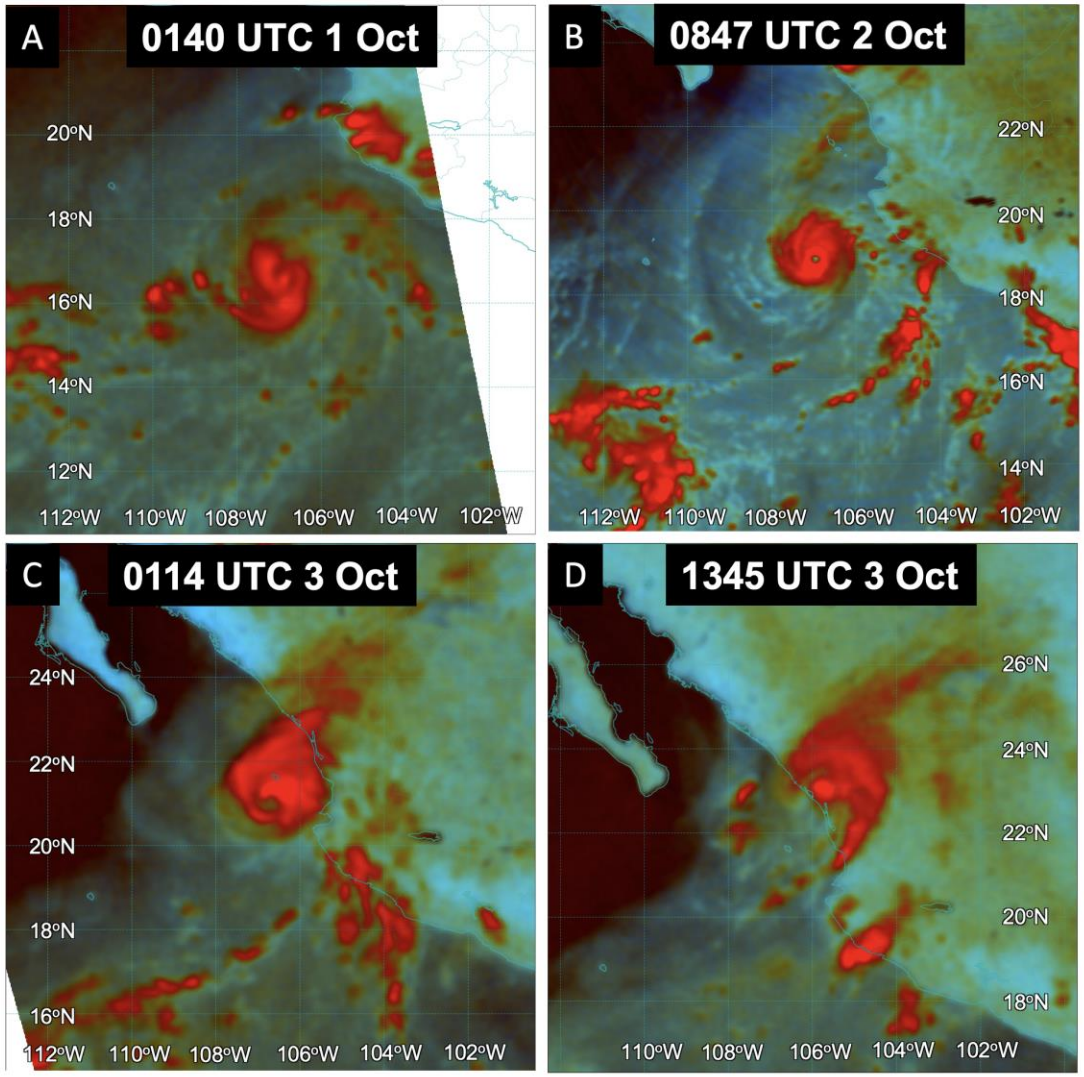


Figure 4. Passive microwave satellite 89–91-GHz color composite imagery showing Orlene's structural evolution from 1–3 October 2022. (a) 0140 UTC 1 October SSMIS pass showing a formative inner core prior to Orlene beginning rapid intensification. (b) 0847 UTC 2 October AMSR2 pass showing Orlene near peak intensity with a well-defined eye signature and solid closed eyewall. (c) 0114 UTC 3 October SSMIS pass showing Orlene weakening with a less symmetric core. (d) 1345 UTC 3 October SSMIS pass showing Orlene's low-level center decoupling from mid-level convection already onshore prior to landfall.

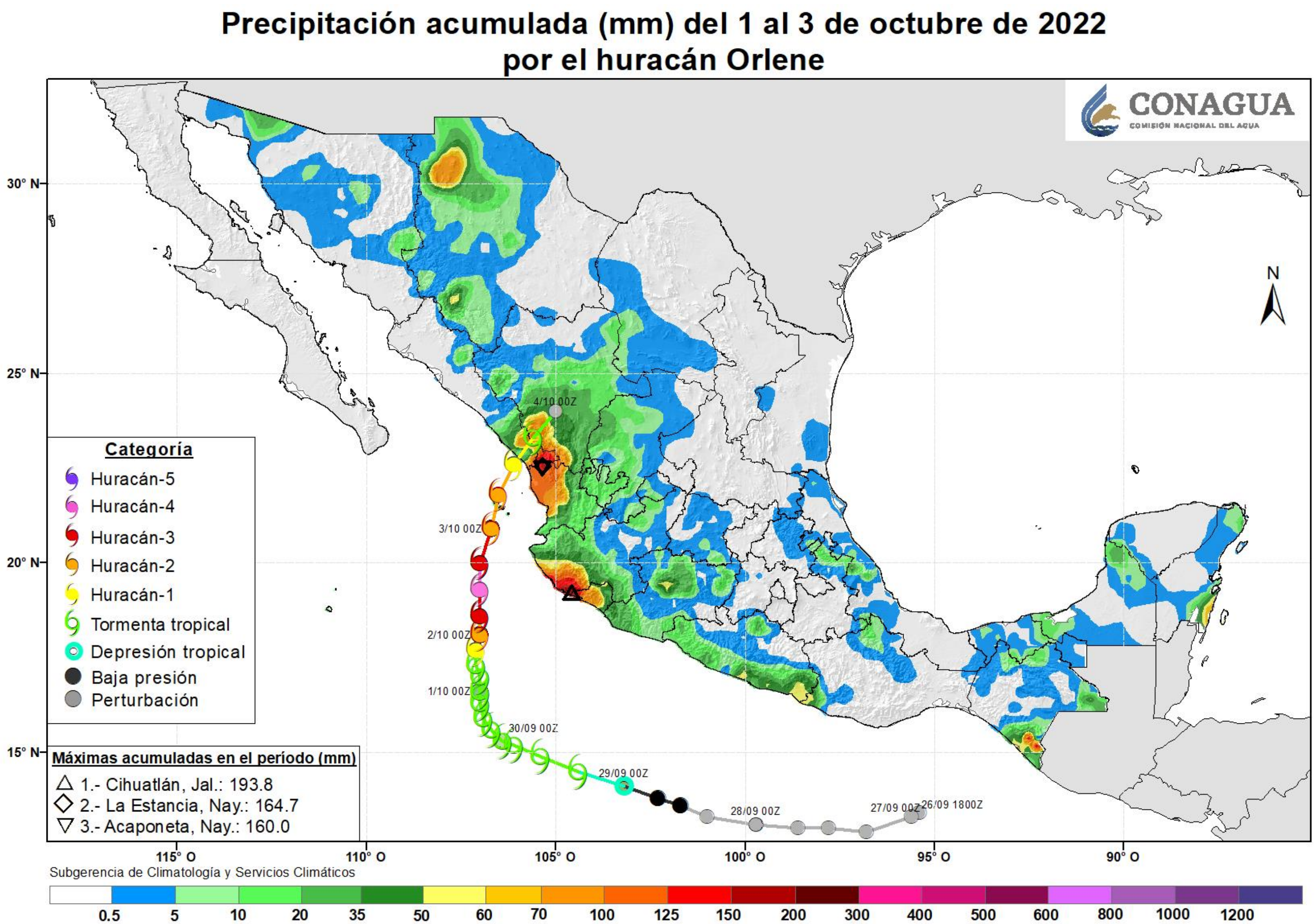


Figure 5. Rainfall accumulations (mm) in Mexico from 1 to 3 October 2022, including the effects of Hurricane Orlene. Orlene's track is based on operational location and intensity estimates. Image courtesy of CONAGUA, the National Meteorological Service of Mexico.

Figure 6. Select images illustrating wind and flooding impacts associated with Hurricane Orlene in Mexico. Images via Josh Morgerman, iCyclone, Reuters, and the State Coordination of Civil Protection in Durango, Mexico.

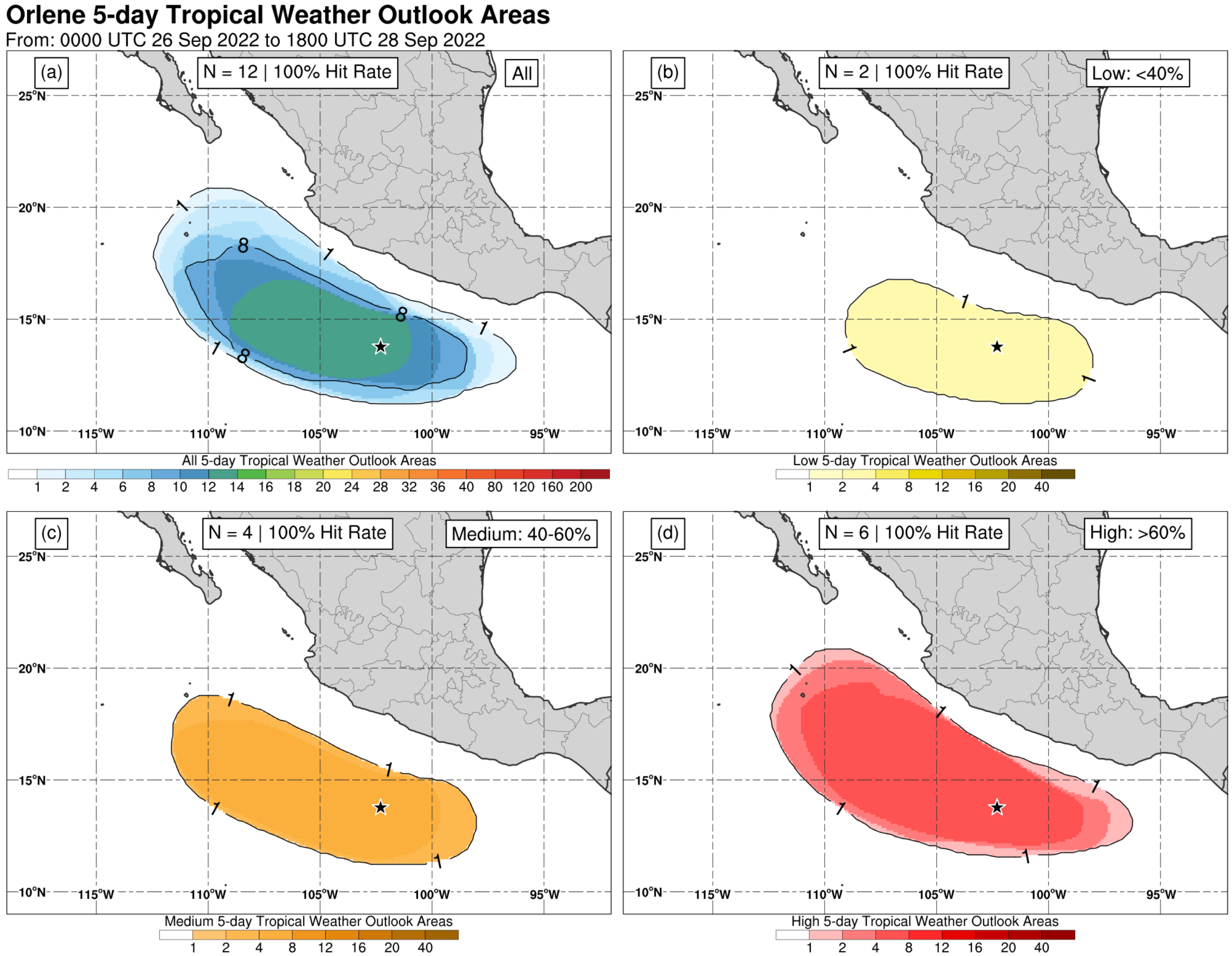


Figure 7. 5-day Tropical Weather Outlook genesis areas associated with the disturbance that developed into Hurricane Orlene for (a) all probability areas (10–100%, multi-color shading), (b) low probability areas (< 40%, yellow shading), (c) medium probability areas (40–60%, orange shading), and (d) high probability areas (> 60%, red shading). The black star in each panel indicates the genesis location of Orlene. Hit rate indicates the percentage of outlook areas where the genesis location was captured within.

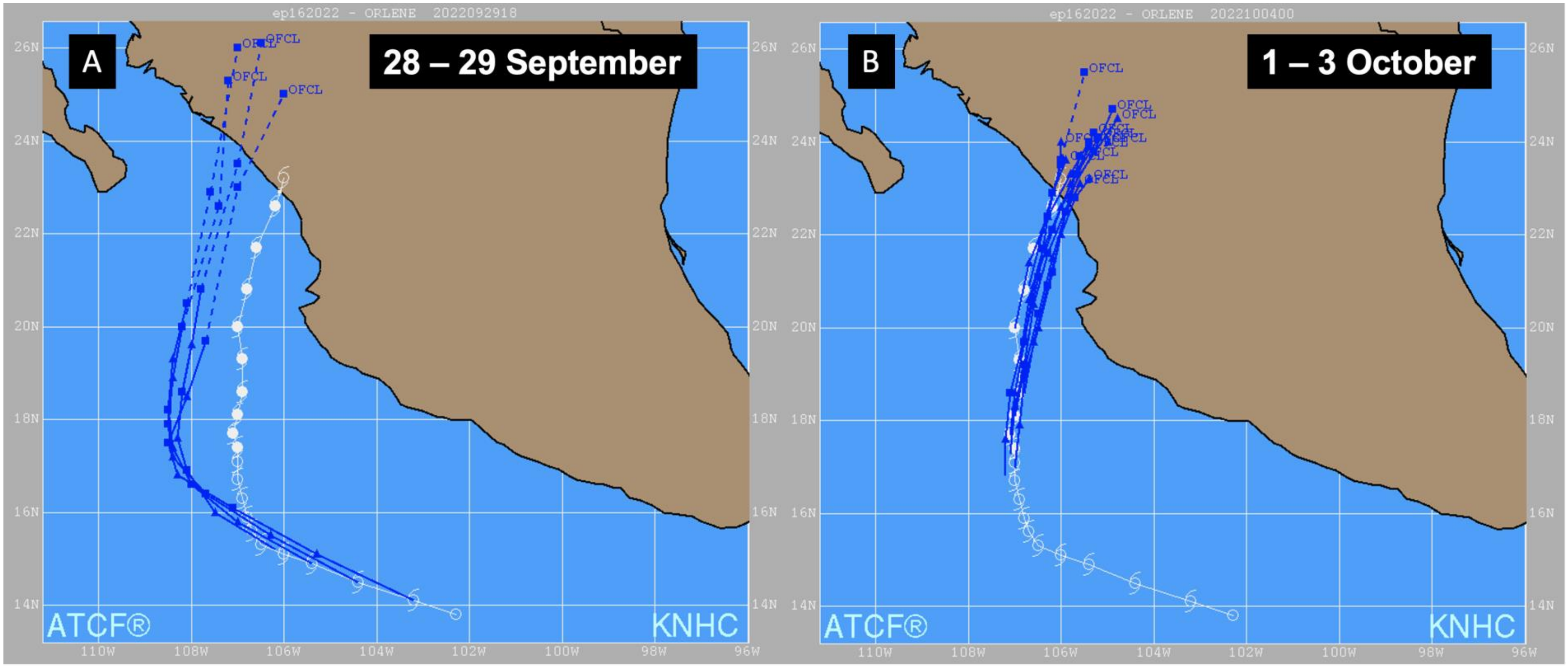


Figure 8. Comparison of official track forecasts of Orlene (blue lines) with the best track overlaid (white line) for (a) 28–29 September 2022 and (b) 1–3 October 2022.

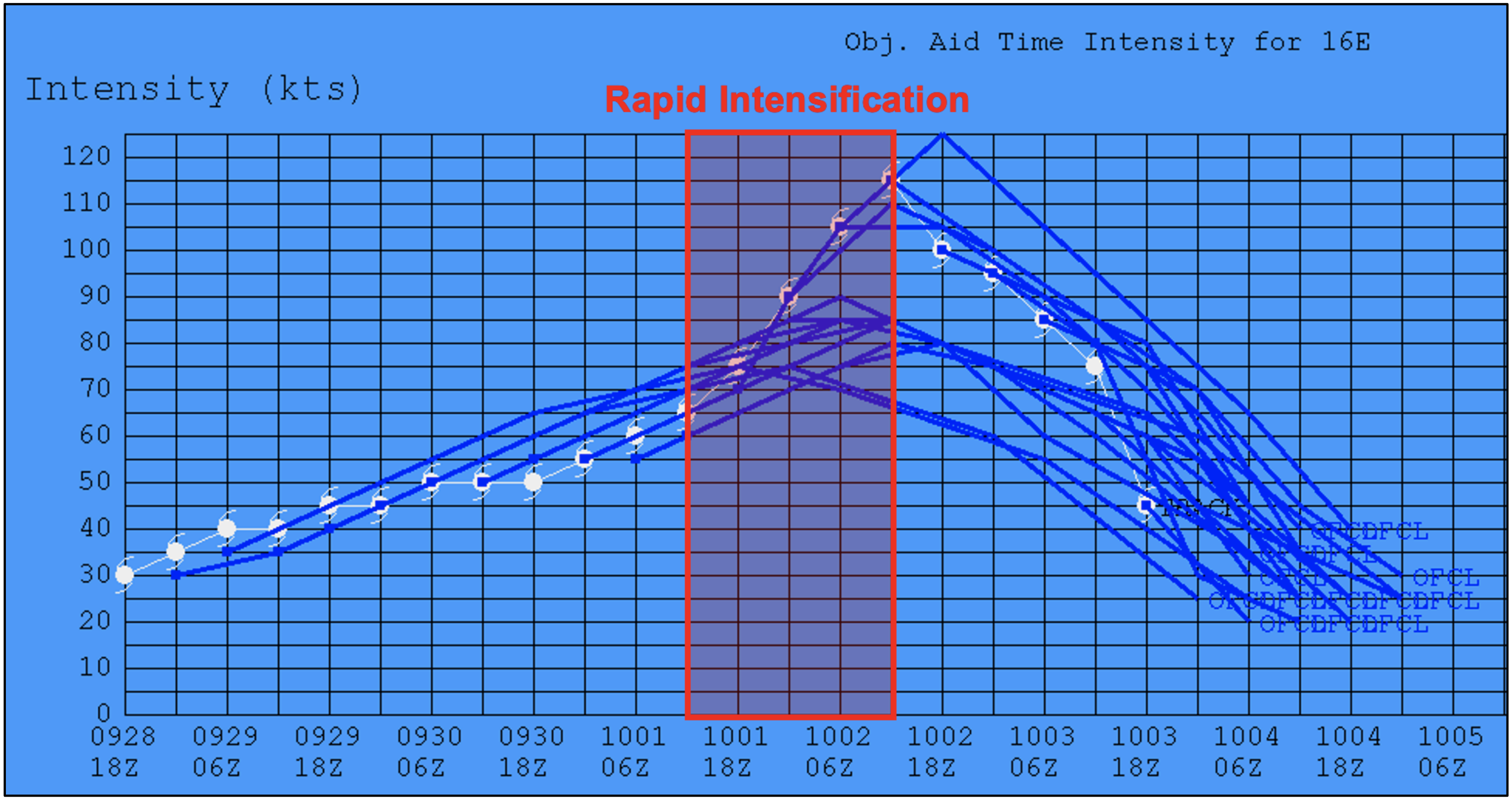


Figure 9. Official intensity forecasts for Orlene from 28 September–3 October 2022 (blue lines) with the best track intensity overlaid (white line). The 24-h period where Orlene underwent rapid intensification from 65 kt to 115 kt is highlighted in red.