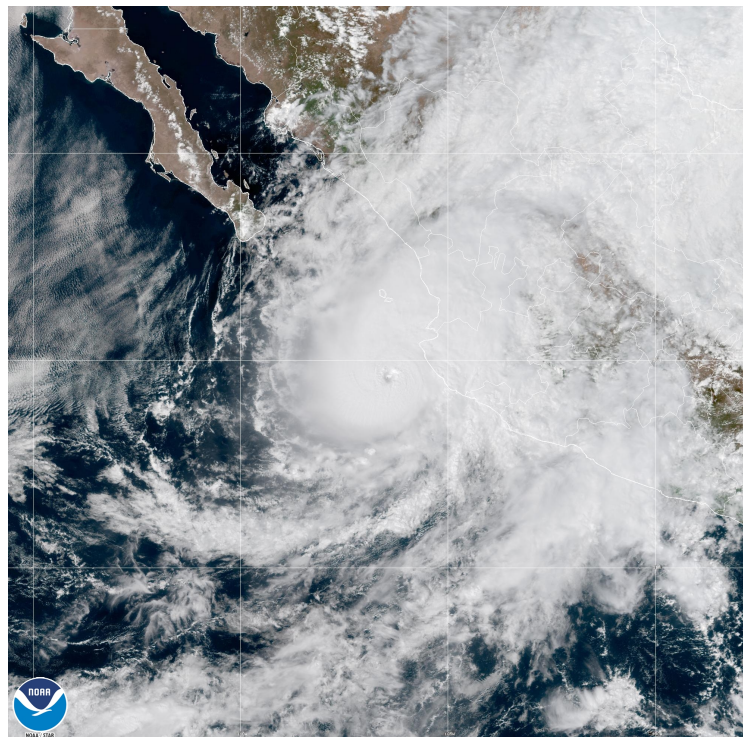# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE LIDIA
(EP152023)

3–11 October 2023

Richard J. Pasch
National Hurricane Center
22 March 2024[1]

10 Oct 2023 21:00Z - NOAA/NESDIS/STAR GOES-West - GEOCOLOR Composite - HU Lidia

GOES-18 GEOCOLOR IMAGE OF HURRICANE LIDIA NEAR PEAK INTENSITY AT 2100 UTC 10 OCTOBER 2023. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Lidia made landfall in Mexico as a category 4 hurricane (on the Saffir-Simpson Hurricane Wind Scale) in a sparsely settled area to the south-southwest of Puerto Vallarta.

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[1] Original Report date 15 March 2024. This version amends the direct fatality count based on information provided by the National Meteorological Service of Mexico (CONAGUA).

Hurricane Lidia

3–11 OCTOBER 2023

SYNOPTIC HISTORY

Lidia appears to have formed from a tropical wave that moved off the west coast of Africa as a weak, low-latitude system around 14 September and crossed southern Central America on 27 September, although it was difficult to track this wave across the Atlantic basin. After entering the east Pacific, the wave moved slowly westward to the south of Central America and eastern Mexico for the next few days while the associated deep convection gradually increased. By 30 September, cloudiness and showers began to become more consolidated to the south of the Gulf of Tehuantepec, and the system's organization increased very slowly from 1 to 2 October. The system acquired a well-defined low-level center and sufficiently organized deep convection to become a 30-kt tropical depression that was centered about 500 n mi south of Manzanillo, Mexico, around 0000 UTC 3 October. It soon strengthened into a 35-kt tropical storm around 0600 UTC 3 October. The "best track" chart of Lidia'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[2].

On 3 and 4 October, the storm moved on a northwestward to north-northwestward heading on the southwest side of a mid-level ridge. Lidia was not a well-organized tropical storm, with the center near the southeastern edge of the main area of deep convection. This structure was likely due to easterly to southeasterly shear associated with an upper-tropospheric anticyclone centered over southern Mexico. While moving slowly, Lidia turned toward the west-northwest on 5 October and to the west on 6 October as a weak mid-level ridge developed to the north of the cyclone. Although still rather disorganized, with the center remaining near the eastern side of the deep convection, the system managed to strengthen to an intensity of 60 kt on the 6th. The storm moved slowly and generally westward for a day or two with little change in strength although satellite images suggested slight weakening on the 7th. Then, a trough approaching the Baja California peninsula induced Lidia to turn northward on 8 October, and northeastward to eastward on the 9th. Vertical wind shear had weakened over the system, setting the stage for strengthening. Around 1800 UTC 9 October, Lidia re-formed slightly to the south while intensifying into a hurricane. The system then accelerated east-northeastward toward the coast of mainland Mexico, on the south side of a broad mid-tropospheric trough. The hurricane underwent rapid intensification on 10 October, with its peak winds increasing by 45 kt over the 18-h period beginning at 0600 UTC that day, peaking as a 120 kt category 4 hurricane.   Lidia's eye made landfall shortly before, or approximately at 0000 UTC 11 October near Las Peñitas in the state of Jalisco, Mexico, about 35 n mi southwest of Puerto Vallarta. The eye had become quite well defined in the few hours before reaching the coast (cover photo), and Lidia's landfall intensity is

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[2] 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.

also estimated to be 120 kt. After crossing the coastline, the cyclone quickly lost strength over the mountainous terrain of Mexico. It weakened to a tropical storm around 0600 UTC 11 October and degenerated into a remnant low over northern Mexico by about 1200 UTC that day.

METEOROLOGICAL STATISTICS

Observations in Lidia (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 flights of the 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command (AFRES). 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 Lidia.

There were two AFRES missions into Lidia, on 9 and 10 October, that provided four center fixes, two near 1800 UTC each day. Figure 4 shows the flight tracks of these missions.

There were no ship reports received of winds of tropical storm force associated with Lidia.

Winds and Pressure

Lidia's peak intensity of 120 kt, which occurred just before landfall in Mexico around 0000 UTC 11 October, is based on a subjective Dvorak estimate of 115 kt and increasing objective Dvorak intensity estimates up to that time. Peak 700-mb flight-level winds of 116 kt and highest SFMR-observed surface winds of 108 kt were observed by the AFRES about 5 h before landfall. Earlier, the system is analyzed to have become a hurricane around 1800 UTC 9 October based on AFRES 700-mb flight-level wind observations of 73 kt. There were a number of objective and subjective estimates at hurricane intensity on 6–8 October, but these were apparently too high primarily due to an erroneous location of the cyclone center which was not well embedded within the main mass of deep convection. SATCON intensity estimates, which incorporated microwave data, generally supported an intensity of 55–60 kt during this period. ASCAT observations on 7 October also indicated an intensity below hurricane strength.

Lidia's central pressure is based primarily on the Knaff-Zehr-Courtney (KZC) pressure-wind relationship along with a few dropsonde measurements from the AFRES on 9 and 10 October.

There were no wind observations received near the landfall location on the coast. A couple of *highly* elevated wind reports from well inland, near mountain tops over Jalisco, were gusts to 69 kt at Sierra de Manantlan at 2250 UTC 10 October and sustained winds of 42 kt with a gust to 71 kt at Nevado de Colima at 0140 UTC and 0440 UTC 11 October, respectively.

Storm Surge

Although inundation was likely very significant near and just south of where the center of the hurricane crossed the coast, no storm surge observations were available for Lidia's landfall.

Rainfall and Flooding

Figure 5 shows a map of the rainfall totals associated with Lidia over Mexico. The peak reported amount was 11.95 inches (303.6 mm) in Suchitlán, Colima, well to the southeast of the track.

CASUALTY AND DAMAGE STATISTICS

There were 3 direct deaths[3] caused by Lidia in Mexico.

A man drowned in the state of Jalisco, to the south of Puerto Vallarta, when he tried to cross an overflowing stream in his truck, and a man died when a tree fell on his car during the storm near the beach resort of Punta Mita, just north of Puerto Vallarta in the state of Nayarit. A person was killed as a result of a bridge collapse in Villa de Álvarez in the state of Colima.

There were numerous trees downed and roofs damaged (or removed) in Jalisco, including the area around Puerto Vallarta. Downed trees and landslides reportedly blocked parts of Federal Highway 200 just inland from the coast. More significant damage apparently was inflicted in the municipality of Tomatlan, to the south of Puerto Vallarta which was probably near the eyewall of Lidia. The governor of Jalisco gave a damage estimate of $77.6 million in U.S. dollars for the state, although that figure is likely incomplete.

FORECAST AND WARNING CRITIQUE

The genesis of Lidia was not particularly well forecast (Table 2). The system was introduced in the Tropical Weather Outlook (TWO) at 0000 UTC 29 September, 96 h prior to genesis with a low (<40%) chance of development within 7 days. The 7-day formation probability

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[3] 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.

was not raised to high (>60%) until 54 h before genesis, and the 2-day formation probability was put into the high category 18 h prior to genesis. The expected location of Lidia's genesis in the graphical TWOs was fairly well specified (Fig. 6), although the predicted area of formation was a bit too far to the northwest in the earlier forecasts.

A verification of NHC official track forecasts for Lidia given in Table 3a. Official track forecast errors were lower than or comparable to the mean official errors for the previous 5-yr period through 96 h, and higher than the long-term mean at 120 h. A homogeneous comparison of the mean official track errors with selected guidance models is given in Table 3b. The guidance was not significantly better than the official forecasts through 72 h, but a number of the objective aids had lower errors than the NHC forecasts at 96 h and 120 h. In particular, the HCCA guidance was better than the official forecasts at all forecast intervals. Figures 7a and 7b show the official and HCCA track forecasts for Lidia, and it can be seen that the HCCA predictions more realistically captured the northward turn of the system than the official forecasts.

A verification of NHC official intensity forecasts for Lidia is given in Table 4a. Official intensity forecast errors were lower than the mean official errors for the previous 5-yr period at all forecast intervals. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The official intensity errors were lower than all of the guidance through 96 h, and comparable to or lower than the guidance at 120 h. Although the overall intensity errors were not that high, it should be noted that the official forecasts seriously underestimated the rapid strengthening of Lidia prior to landfall.

Watches and warnings associated with Lidia are given in Table 5. A Hurricane Watch was issued for the area encompassing the landfall location about 50 h before the arrival of tropical-storm-force winds. A Hurricane Warning was issued for the same area about 31 h prior to the onset of tropical-storm-force winds.

ACKNOWLEDGEMENTS

Table 1.   Best track for Hurricane Lidia, 3–11 October 2023.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
03 / 0000	11.2	105.8	1007	30	tropical depression
03 / 0600	11.5	106.4	1006	35	tropical storm
03 / 1200	11.9	107.0	1005	35	"
03 / 1800	12.5	107.4	1005	35	"
04 / 0000	13.2	107.8	1005	35	"
04 / 0600	13.9	108.2	1003	40	"
04 / 1200	14.6	108.6	1001	45	"
04 / 1800	15.1	108.8	1001	45	"
05 / 0000	15.4	109.0	1001	45	"
05 / 0600	15.6	109.2	1001	45	"
05 / 1200	15.8	109.4	999	50	"
05 / 1800	15.9	109.6	999	50	"
06 / 0000	16.0	109.8	996	55	"
06 / 0600	16.1	110.1	990	60	"
06 / 1200	16.2	110.5	991	60	"
06 / 1800	16.2	110.9	991	60	"
07 / 0000	16.2	111.3	994	55	"
07 / 0600	16.1	111.7	995	55	"
07 / 1200	16.0	112.0	995	55	"
07 / 1800	16.0	112.2	995	55	"
08 / 0000	16.0	112.4	990	60	"
08 / 0600	16.3	112.6	990	60	"
08 / 1200	16.7	112.8	990	60	"
08 / 1800	17.3	112.8	990	60	"
09 / 0000	17.8	112.7	990	60	"
09 / 0600	18.1	112.4	992	55	"
09 / 1200	18.1	112.0	992	55	"
09 / 1800	17.8	111.4	985	65	hurricane
10 / 0000	18.1	110.6	981	70	"
10 / 0600	18.4	109.7	979	75	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
10 / 1200	18.8	108.5	973	80	"
10 / 1800	19.3	107.1	952	105	"
11 / 0000	20.1	105.5	942	120	"
11 / 0600	21.7	103.5	994	60	tropical storm
11 / 1200	24.5	100.5	1004	20	low
11 / 1800					dissipated
11 / 0000	20.1	105.5	942	120	minimum pressure and maximum winds
11 / 0000	20.1	105.5	942	120	landfall near Las Peñitas, Jalisco, 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	**168-Hour Outlook**
Low (<40%)	54	96
Medium (40%-60%)	36	72
High (>60%)	18	54

Table 3a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Lidia, 3–11 October 2023. 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	23.5	35.7	**39.8**	**45.2**	**48.8**	**52.3**	101.5	201.4
OCD5	44.3	95.4	149.3	204.9	256.9	308.4	384.0	469.6
Forecasts	31	29	27	25	23	21	17	13
OFCL (2018-22)	22.1	34.0	45.4	56.0	70.9	78.7	100.5	117.8
OCD5 (2018-22)	36.7	73.4	114.0	156.9	193.2	244.5	317.0	376.0

Table 3b.   Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Lidia, 3–11 October 2023. 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	20.6	32.2	36.2	44.9	50.2	53.7	111.5	213.0
OCD5	41.3	88.9	147.3	213.1	270.6	326.9	399.0	453.0
GFSI	21.9	36.8	49.4	68.5	80.2	95.6	115.3	**179.5**
EMXI	24.0	36.8	46.1	54.7	71.0	89.2	146.5	234.6
NVGI	33.3	56.2	87.5	118.7	144.8	167.8	202.3	**212.3**
CMCI	27.3	45.4	58.0	65.9	78.1	85.9	**106.1**	**142.0**
EGRI	25.8	49.4	81.1	112.1	146.0	184.1	294.5	487.4
HWFI	23.8	38.8	50.7	71.6	96.0	126.6	233.5	335.5
HMNI	27.7	48.3	67.6	85.8	108.1	124.5	181.9	286.4
HFAI	24.1	34.4	42.6	56.7	69.6	78.3	**108.3**	**117.0**
HFBI	23.9	36.6	46.5	56.8	68.4	76.7	**102.2**	**126.8**
CTCI	27.7	44.7	56.0	72.0	80.2	77.2	**86.6**	**138.6**
HCCA	**17.9**	**25.9**	**30.6**	**41.2**	**44.7**	**41.2**	**50.2**	**122.1**
FSSE	**19.4**	**30.0**	38.6	49.1	56.0	58.4	115.1	216.9
AEMI	21.8	34.6	44.1	58.4	64.5	71.8	**80.3**	**144.4**
TVCE	20.7	32.6	40.8	52.2	62.7	71.1	**106.2**	**191.6**
GFEX	21.0	32.2	39.6	50.4	61.0	79.1	**111.2**	**192.0**
TVCX	**20.5**	**32.0**	40.2	51.7	62.3	71.9	**110.2**	**194.6**
TVDG	**20.5**	**32.1**	41.8	55.0	65.8	77.5	122.0	216.1
TABD	29.9	50.6	70.3	89.6	100.8	117.1	152.8	**194.9**
TABM	26.8	51.4	75.1	97.9	126.3	150.8	172.4	253.0
TABS	37.6	79.9	118.1	147.2	169.2	190.9	272.3	397.6
Forecasts	26	24	23	22	20	18	14	10

Table 4a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Lidia, 3–11 October 2023. 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	**5.3**	**6.4**	**7.8**	**7.2**	**9.3**	**9.3**	**11.5**	**16.9**
OCD5	8.2	11.0	12.1	11.9	11.3	11.9	14.6	21.6
Forecasts	31	29	27	25	23	21	17	13
OFCL (2018-22)	5.4	8.9	11.0	12.8	14.3	15.8	17.0	17.6
OCD5 (2018-22)	6.9	12.1	15.9	18.6	18.7	21.0	22.3	22.1

Table 4b.   Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Lidia, 3–11 October 2023. 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	5.2	6.6	6.9	7.2	9.5	9.7	11.7	19.1
OCD5	7.2	10.2	9.2	11.2	10.9	12.3	15.7	25.0
DSHP	7.5	10.5	9.8	11.5	13.0	13.8	16.1	19.4
LGEM	7.9	10.6	10.8	13.1	15.6	15.9	14.7	**19.0**
HWFI	8.9	10.0	11.6	14.9	17.6	19.5	23.8	22.4
HMNI	7.3	7.9	8.4	14.2	18.4	20.7	30.7	40.6
HFAI	8.0	10.8	8.9	12.3	13.8	12.5	17.9	21.4
HFBI	7.5	10.5	9.4	12.5	14.9	15.4	16.0	19.1
CTCI	6.4	10.1	11.8	16.3	20.0	18.5	17.2	**15.6**
FSSE	5.6	7.7	7.7	9.3	11.6	10.6	21.1	27.6
GFSI	7.6	10.4	10.0	13.3	14.1	14.2	17.2	20.5
EMXI	8.8	12.3	12.8	16.2	19.0	19.9	30.5	39.1
ICON	6.6	8.4	8.0	10.9	12.2	13.4	18.4	21.2
IVCN	6.0	8.0	7.9	10.4	12.4	11.4	15.7	**18.6**
IVDR	6.2	8.0	8.1	10.6	12.5	11.4	15.5	**18.3**
Forecasts	27	25	24	23	20	19	15	11

Table 5.   Watch and warning summary for Hurricane Lidia, 3–11 October 2023.

Date/Time (UTC)	Action	Location
8 / 2100	Tropical Storm Watch issued	Manzanillo to Playa Perula
8 / 2100	Tropical Storm Watch issued	Mazatlan to Bahia Tempehuaya
8 / 2100	Hurricane Watch issued	Las Islas Marias
8 / 2100	Hurricane Watch issued	Playa Perula to Mazatlan
9 / 0900	Hurricane Watch changed to Hurricane Warning	Las Islas Marias
9 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Manzanillo to Playa Perula
9 / 1500	Tropical Storm Watch discontinued	All
9 / 1500	Tropical Storm Warning issued	Escuinapa to Bahia Tempehuaya
9 / 1500	Hurricane Watch discontinued	All
9 / 1500	Hurricane Warning issued	Playa Perula to Escuinapa
10 / 0300	Tropical Storm Warning modified to	Escuinapa to Mazatlan
10 / 0900	Hurricane Watch issued	Manzanillo to Playa Perula
10 / 1500	Tropical Storm Warning modified to	Punta San Telmo to Manzanillo
10 / 1500	Tropical Storm Warning modified to	El Roblito to Mazatlan

Date/Time (UTC)	Action	Location
10 / 1500	Hurricane Watch discontinued	All
10 / 1500	Hurricane Warning discontinued	Playa Perula to Escuinapa
10 / 1500	Hurricane Warning issued	Manzanillo to El Roblito
11 / 0300	Tropical Storm Warning discontinued	El Roblito to Mazatlan
11 / 0300	Hurricane Warning discontinued	Las Islas Marias
11 / 0300	Hurricane Warning modified to	Manzanillo to San Blas
11 / 0600	Tropical Storm Warning modified to	Punta San Telmo to San Blas
11 / 0600	Hurricane Warning discontinued	All
11 / 0900	Tropical Storm Warning discontinued	All
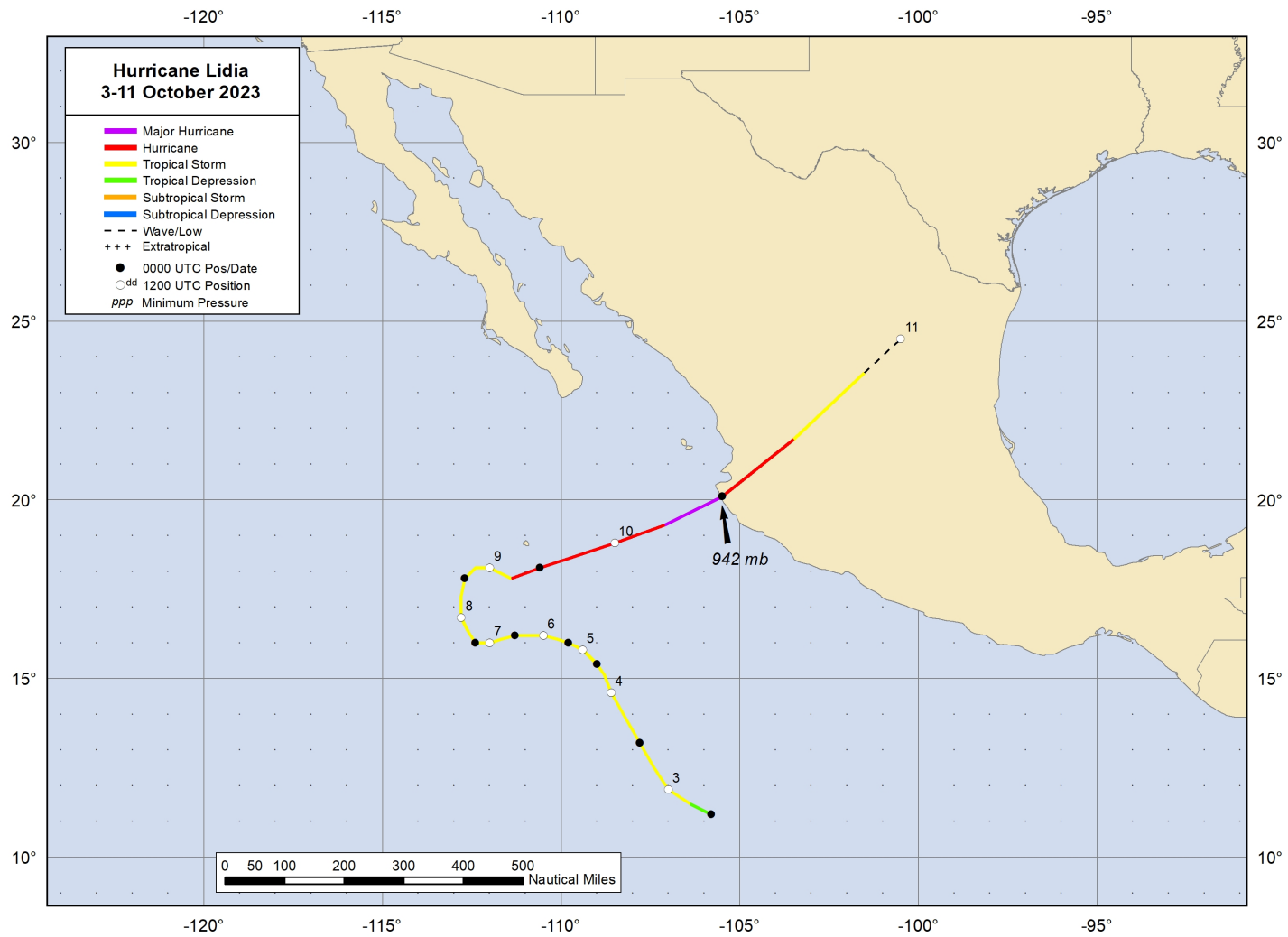
Figure 1.   Best track positions for Hurricane Lidia, 3–11 October 2023.
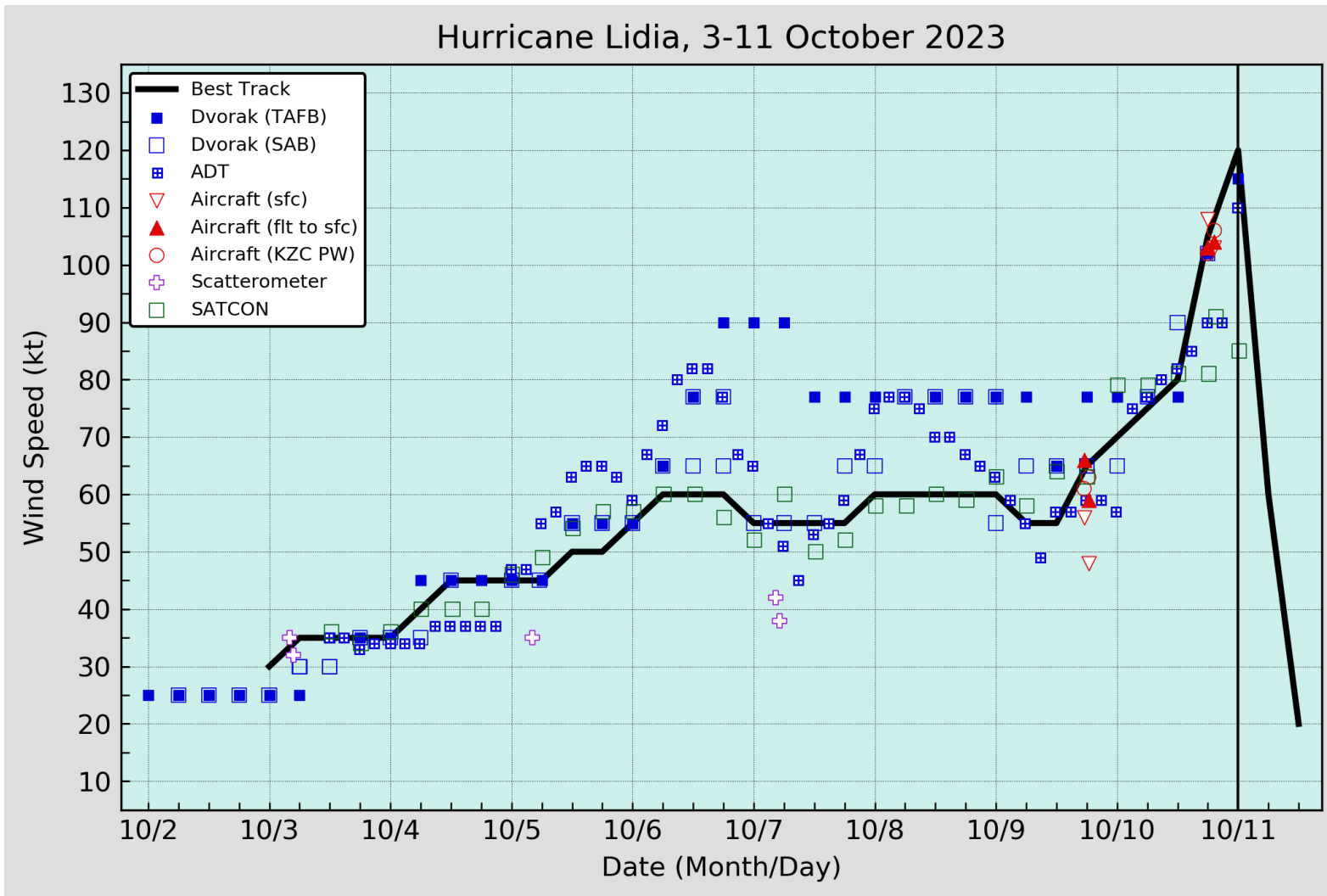
Figure 2.   Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Lidia, 3–11 October 2023. Aircraft observations have been adjusted for elevation using 90%, 80%, and 75% adjustment factors for observations from 700 mb, 850 mb, and 925 mb, respectively. Advanced 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.
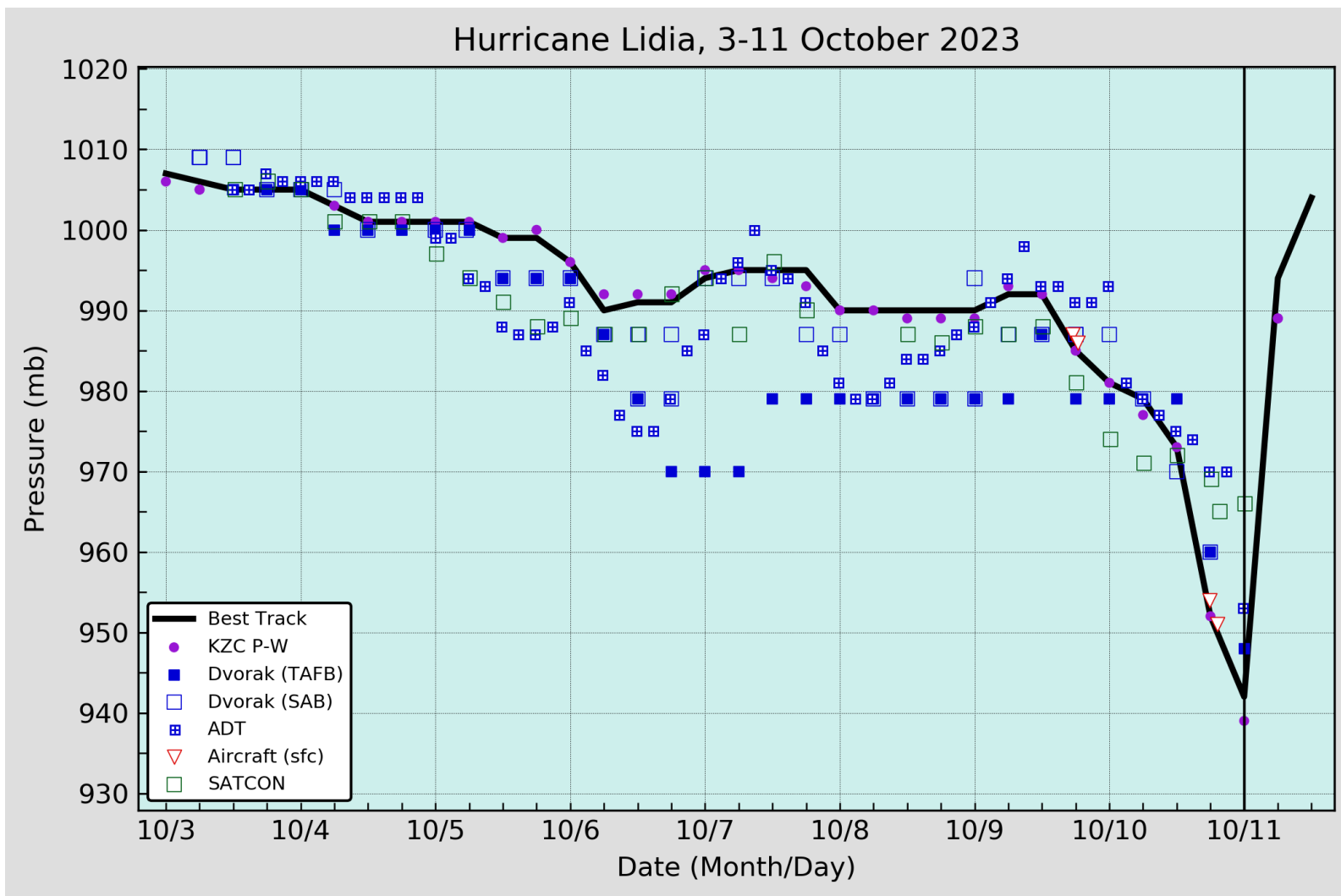
Figure 3.   Selected pressure observations and best track minimum central pressure curve for Hurricane Lidia, 3–11 October 2023. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.
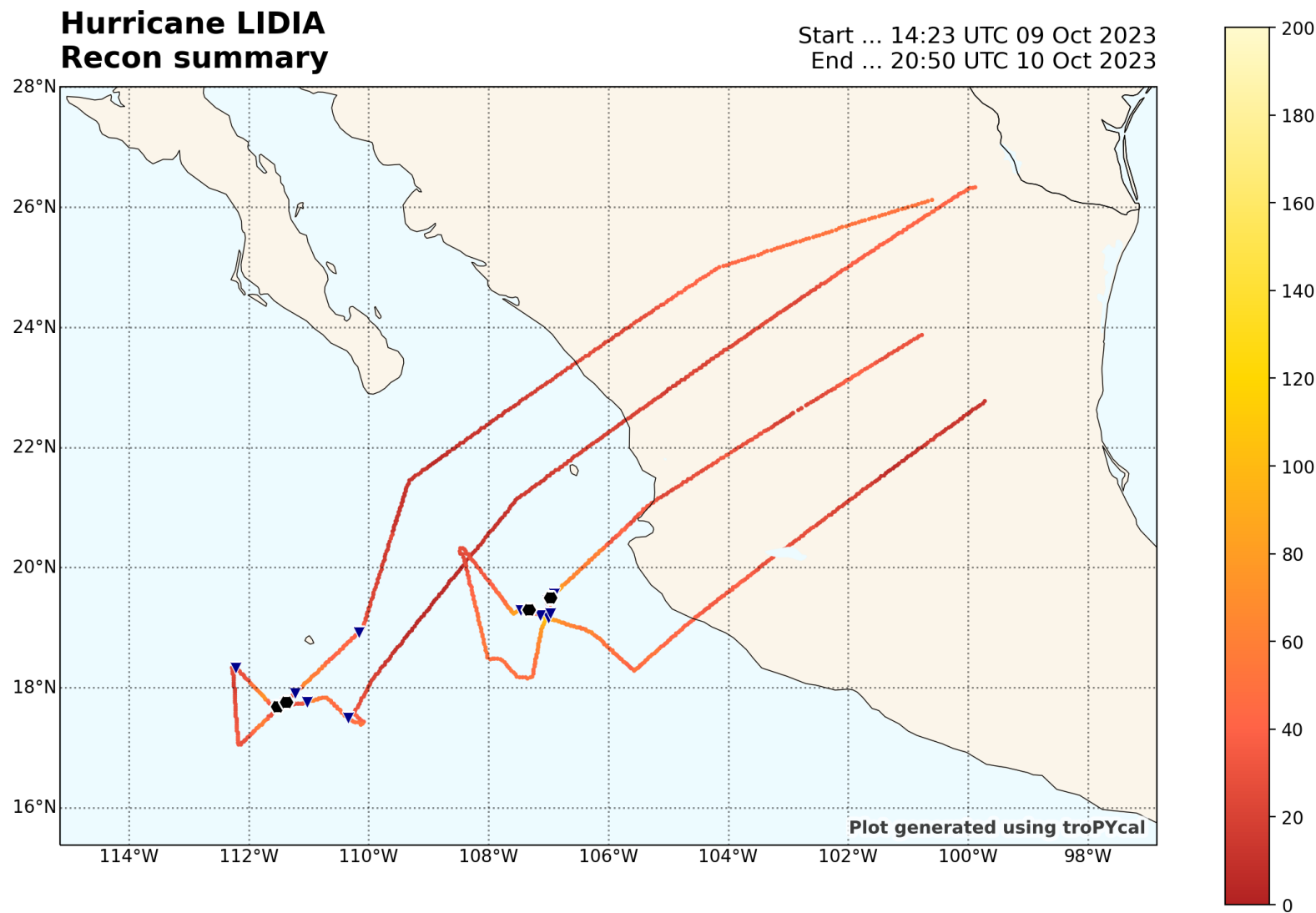
Figure 4.   AFRES flight tracks for missions into Hurricane Lidia, 9 and 10 October 2023. The black markers denote center fixes, and the blue triangles indicate dropsonde locations. The color coding of the flight tracks is based on the observed flight-level wind speed with the color legend to the right of the map representing the color associated with the various wind speeds in knots. Figure courtesy of Lisa Bucci, NHC.
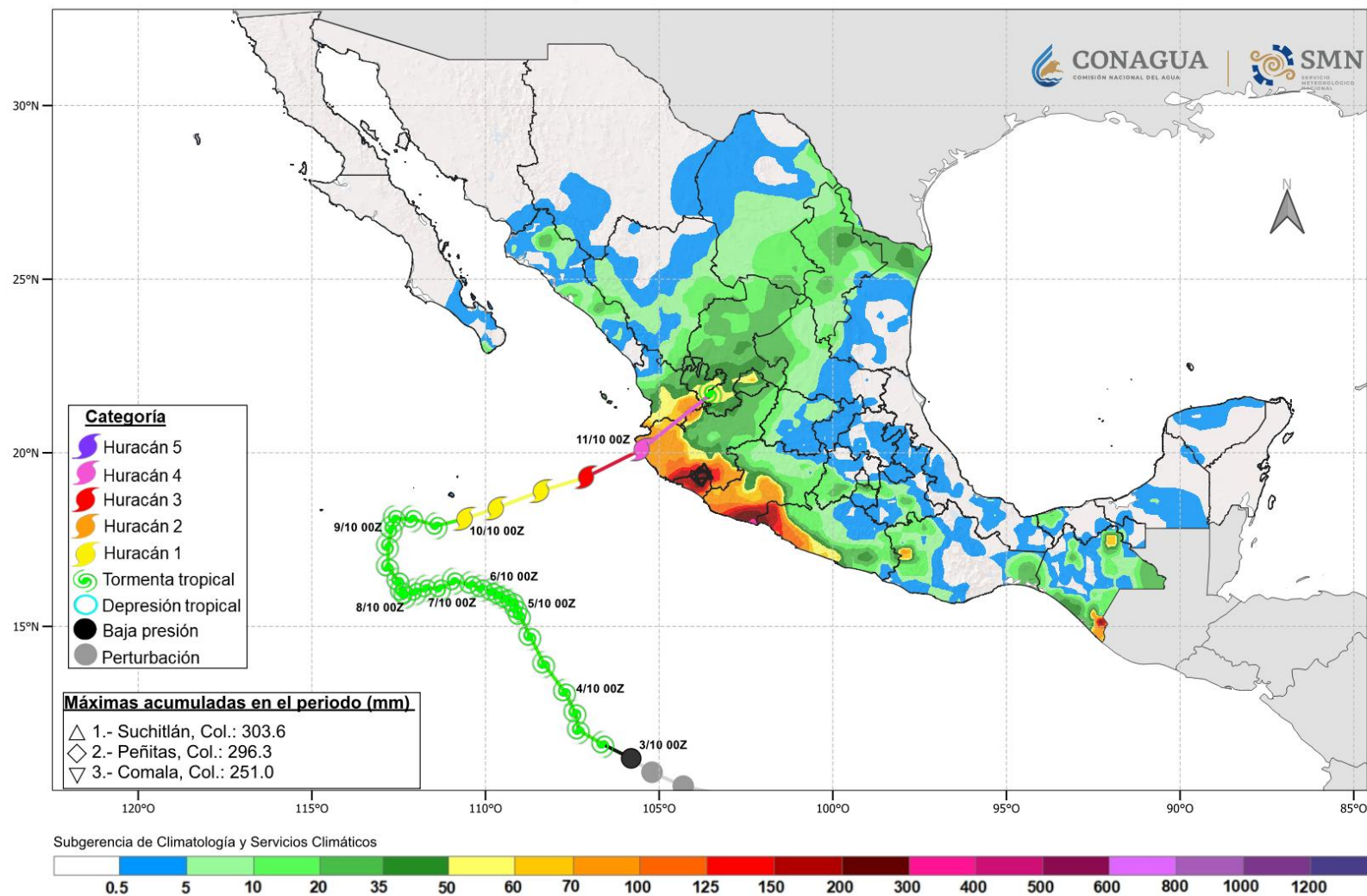
Figure 5.   Rainfall totals associated with Hurricane Lidia, 10–11 October 2023. Not all of the rainfall is directly due to Lidia, and the track is based on operational assessments. Figure courtesy of CONAGUA.
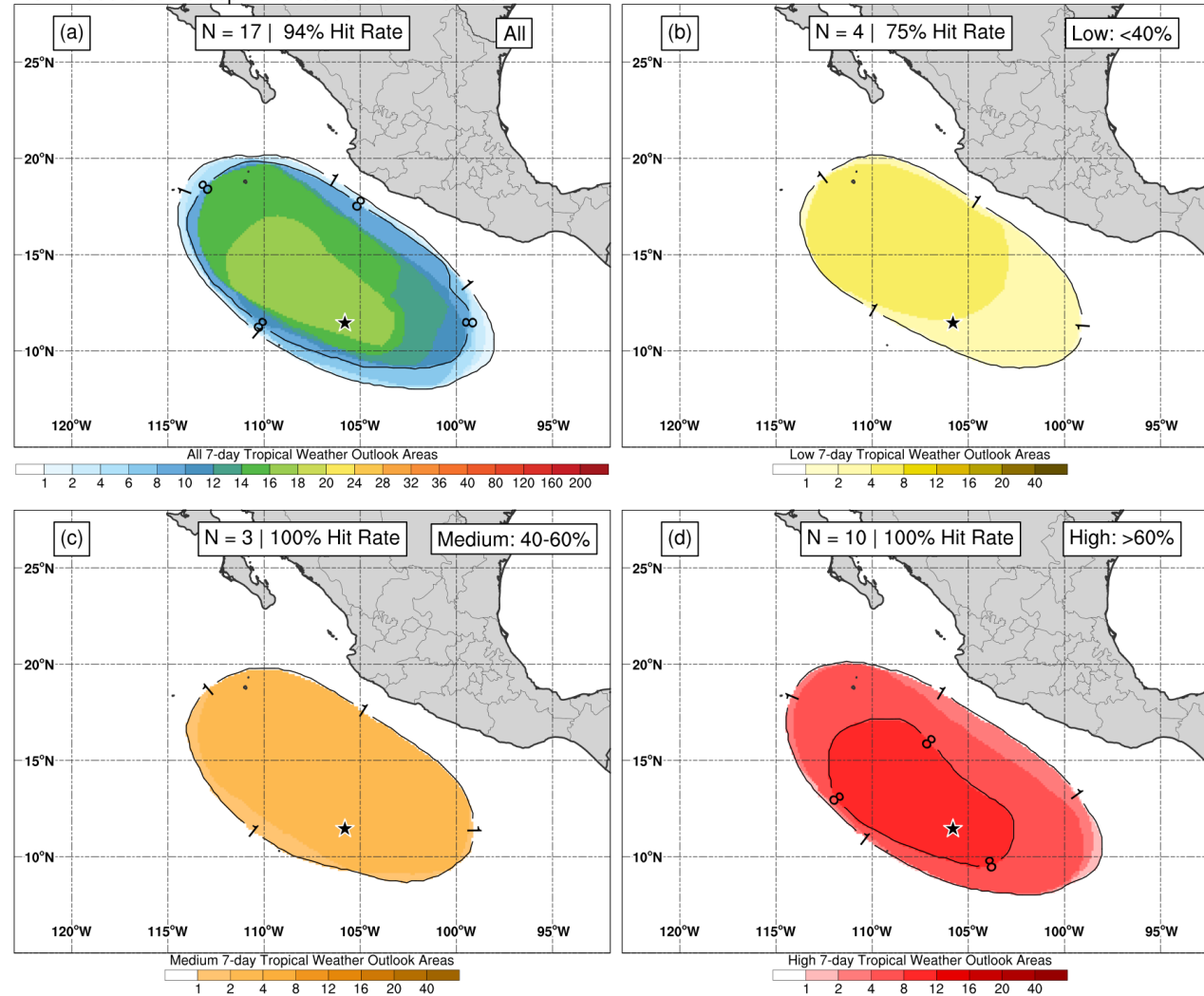
Figure 6.   Composites of 7-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Lidia for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. The location of genesis is indicated by the black star.
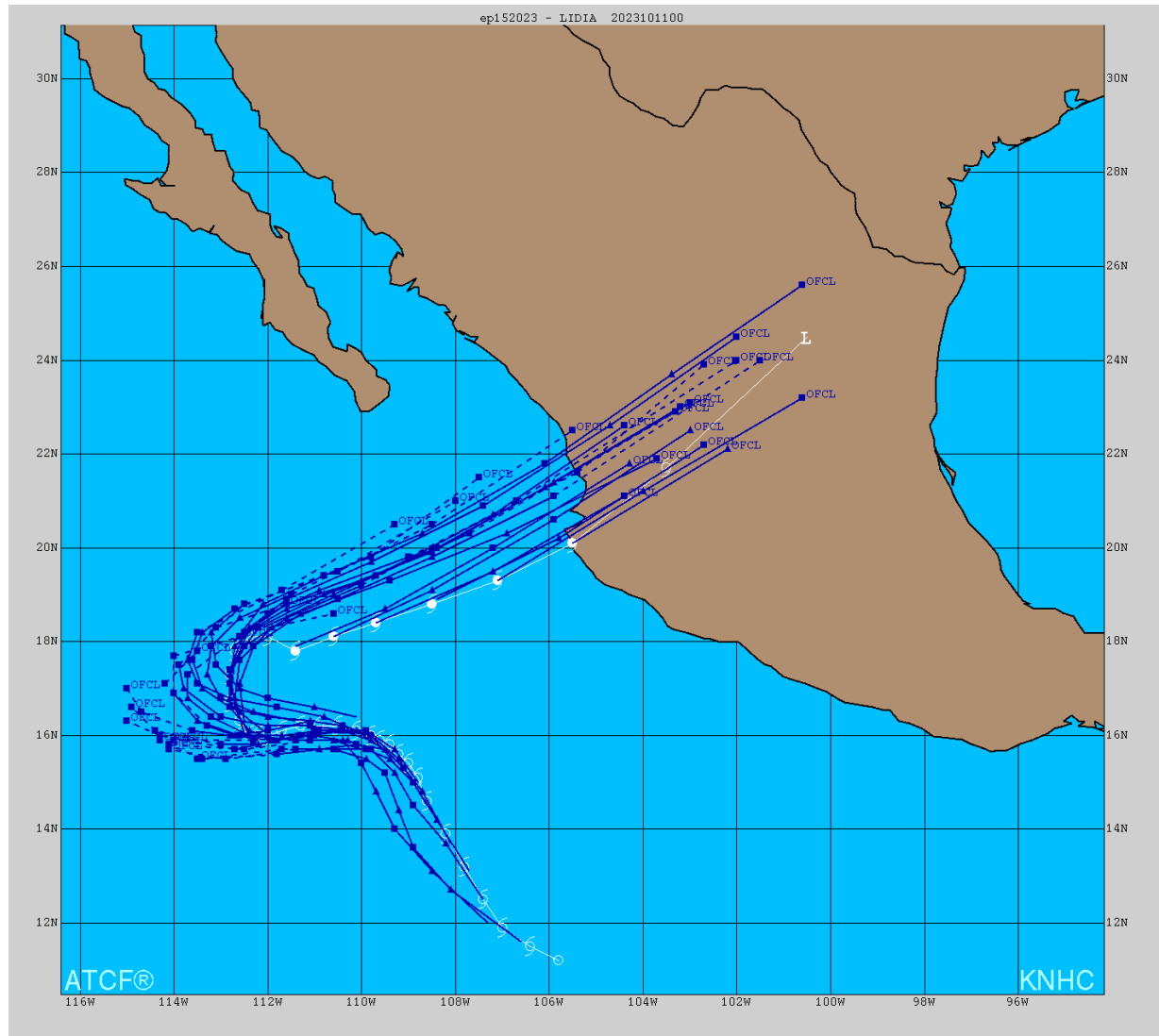
Figure 7a.   Official track forecasts (blue lines, with 0, 12, 24, 36, 48, 60, 72, 96, and 120 h positions indicated) for Hurricane Lidia, 3–11 October 2023. The best track is given by the white solid line with positions given at 6 h intervals.
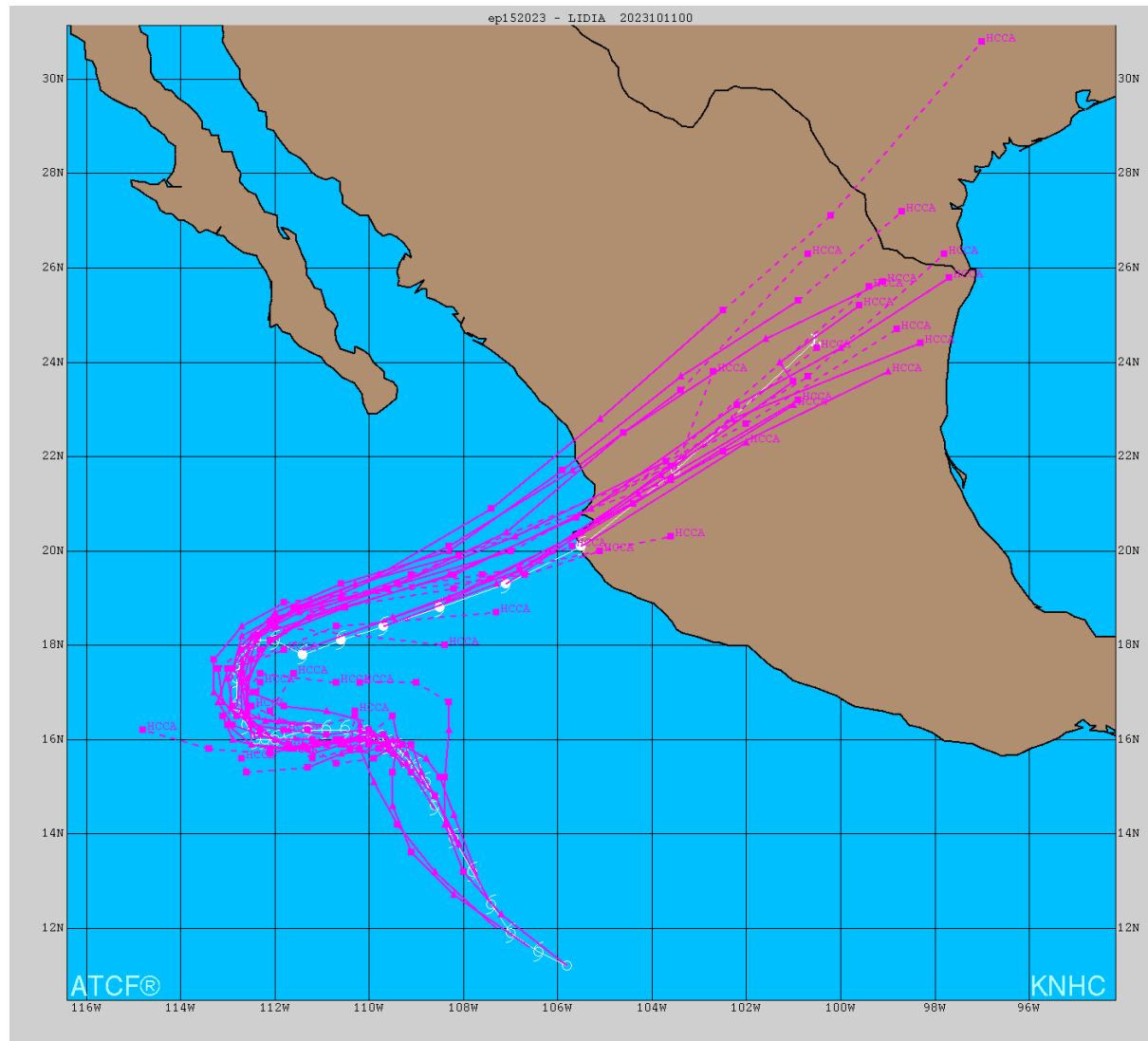
Figure 7b.   HCCA track forecasts (magenta lines, with 0, 12, 24, 36, 48, 60, 72, 96, and 120 h positions indicated) for Hurricane Lidia, 3–11 October 2023. The best track is given by the white solid line with positions given at 6 h intervals.