NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM CELIA

(EP032022)

16–28 June 2022

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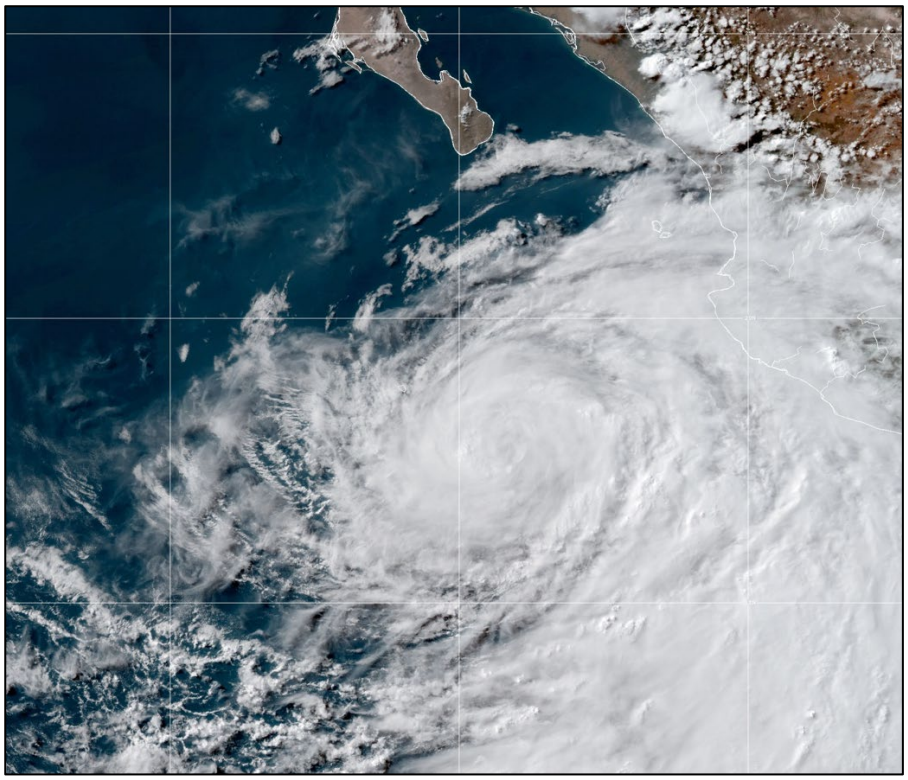
National Hurricane Center
1 November 2022



GOES-17 GEO-COLOR IMAGE OF TROPICAL STORM CELIA AT 0000 UTC 25 JUNE 2022 DURING THE TIME OF THE CYCLONE'S PEAK INTENSITY. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Celia was a long-lived June tropical storm that developed unusually far east in the eastern Pacific basin. Celia moved offshore of, but parallel to, the coasts of Central America and Mexico, and did not directly impact land.

Tropical Storm Celia

16–28 JUNE 2022

SYNOPTIC HISTORY

Celia's incipient disturbance appears to have formed from the interaction between a westward-moving tropical wave and a convectively active monsoon trough over the far eastern Pacific waters. The low-latitude tropical wave exited the west coast of Africa on June 5 (Fig. 1), and it produced limited shower activity while moving quickly westward across the tropical Atlantic and Caribbean Sea during the next week. The wave was accompanied by a surge of low-level moisture that crossed Central America on 12 June, which caused some flooding across that region. As the wave moved into the far eastern Pacific waters early on 13 June, it encountered a favorable phase of the Madden-Julian Oscillation (MJO, not shown) and an associated active monsoon trough. This resulted in the formation of a surface trough of low pressure just west of the Pacific coast of Nicaragua by 1200 UTC 13 June. Although the wave continued westward at a relatively quick pace, the surface trough moved very slowly west-northwestward over the next couple of days while disorganized shower and thunderstorm activity increased over the far eastern Pacific waters. On 15 June, a broad area of low pressure formed a couple of hundred n mi south of the coasts of Guatemala and El Salvador. By 0000 UTC 16 June, geostationary and microwave satellite imagery indicated that the circulation of the low became better defined while the system moved on an unusual east-southeastward track around broad cyclonic low-level flow that was established over the eastern Pacific. Over the next 12–18 h, shower and thunderstorm activity associated with the low increased and became better organized. This led to the formation of a tropical depression by 1800 UTC that day, about 170 n mi south of Los Cobanos, El Salvador. Scatterometer data indicated that the system became a 35-kt tropical storm 6 h later. The "best track" chart of Celia's path is given in Fig. 2, with the wind and pressure histories shown in Figs. 3 and 4, respectively. The best track positions and intensities are listed in Table 1[1].

Over the next 48 h, Celia was steered around the eastern portion of a cyclonic gyre located over the eastern Pacific and Central America, with the tropical cyclone completing about half of a large cyclonic loop to the south of El Salvador and Guatemala. The tropical storm did not strengthen further, and by 1800 UTC 17 June, the center became exposed to the east of the deep convection due to moderate easterly shear. Celia weakened to a tropical depression by 0000 UTC 18 June, when it was located about 100 n mi south-southeast of Los Cobanos, El Salvador. Additional weakening occurred as easterly shear increased further, and the system was only a 25-kt tropical depression when it passed only 35 n mi west-southeast of Los Cobanos around 1800 UTC 18 June. Over the next couple of days, strong easterly vertical wind shear prevented

[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.

the system from reorganizing. However, deep convection continued to occur in bursts primarily over the western portion of the circulation, which was just enough to maintain Celia's status as a tropical cyclone. During this time, Celia turned westward to west-southwestward around the southern extent of a strengthening mid-level ridge over the southern United States.

By 1800 UTC 20 June, Celia re-strengthened slightly but remained a tropical depression when it passed about 240 n mi south of Puerto Angel, Mexico. Although easterly shear continued to affect Celia, deep convection increased and became slightly better organized around the western portion of the circulation early on 21 June. This resulted in the cyclone regaining tropical storm status by 1200 UTC that day when it was located about 300 n mi south of Acapulco, Mexico. After that time, Celia turned west-northwestward around the southwestern portion of the aforementioned ridge. During the next couple of days, the shear over Celia gradually decreased, and slow strengthening occurred. By late on 23 June, the 850-200 mb deep-layer shear dropped to around 10 kt, and Celia reached its estimated peak intensity of 50 kt at 0600 UTC 24 June when it was located about 385 n mi south-southeast of the southern tip of the Baja California peninsula. Celia maintained an intensity of 50 kt for a little more than 24 h, and despite a somewhat improved satellite presentation by 0000 UTC 25 June (cover photo), microwave satellite imagery and scatterometer data indicated that the system had a broad, sprawling structure and lacked a well-defined inner core.

Celia continued moving west-northwestward, passing about 20 n mi southwest of Socorro Island around 1800 UTC 25 June. By that time, the cyclone was located over water temperatures below 26° Celsius, and Celia began a slow weakening trend. The tropical storm moved over even cooler waters and into a more stable environment over the next couple of days, and Celia weakened to a tropical depression by 0600 UTC 28 June. The remaining deep convection dissipated shortly thereafter, and Celia degenerated into a remnant low by 1800 UTC that day when it was located about 600 n mi west of the southern tip of the Baja California peninsula. The remnant low continued to weaken over the next couple of days while it moved west-northwestward. By 1800 UTC 30 June, the remnant low finally degenerated into a trough of low pressure about 850 n mi west of the southern tip of the Baja California peninsula.

METEOROLOGICAL STATISTICS

Observations in Celia (Figs. 3 and 4) 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. 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 Celia.

Ship reports of winds of tropical storm force associated with Celia are given in Table 2.

Winds and Pressure

Celia's intensity when it first became a tropical storm at 0000 UTC 17 June is based on ASCAT-B and -C data from around 0300-0400 UTC that day that revealed believable peak winds around 35 kt.

The peak intensity of Celia has higher-than-normal uncertainty due to the large range of subjective and objective satellite intensity estimates. Celia's satellite presentation peaked between 1800 UTC 24 June and 0000 UTC 25 June. Around that time, subjective and objective Dvorak satellite T-numbers increased to around T4.0 (65 kt), and SATCON estimates peaked just below that. However, scatterometer data between 1627 and 1720 UTC 24 June (Fig. 6) revealed peak winds of only 36 to 38 kt. During that time, Celia exhibited a large and sprawling structure, and microwave imagery (Fig. 5) indicated that the storm did not have a well-defined inner core. Therefore, it is likely that the Dvorak satellite classifications overestimated the maximum winds in the cyclone. The peak intensity is estimated to have been 50 kt, which is a compromise between the higher Dvorak estimates, and the lower scatterometer data, owing to some typical undersampling of the scatterometer instrument.

As the center of Celia passed about 20 n mi to the southwest of Socorro Island, wind gusts to tropical storm force were recorded at an automated weather station on that island. The highest sustained wind reported was 33 kt with a gust to 42 kt at 1515 UTC 25 June. The automated station reported a minimum pressure of 990.1 mb at 1600 UTC that day, but that station has had a known low pressure bias, and that data was not used in the determination of Celia's minimum pressure around that time.

Celia's 12 days as a tropical cyclone ranks it as the third longest-lived early season (May or June) tropical cyclone in the eastern Pacific basin since 1966. The 20.5 days Boris (1984) and the 15.25 days Connie (1974) spent as tropical cyclones ranked as the only ones higher. Overall, Celia is the 14th longest-lived tropical cyclone in the eastern Pacific basin since 1966.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Celia was fairly well forecast, especially for a system that formed so far east in the basin. The potential for tropical cyclone formation was first introduced in the Tropical Weather Outlook at 0000 UTC 12 June with a low (<40%) chance of development over the next five days (Table 3). This provided 114 h of lead time before formation occurred. The 5-day chance

of development was raised to the medium (40-60%) category 54 h before formation, and the high category (>60%) 18 h before genesis occurred. The 2-day probabilities also provided sufficient lead time on genesis. The system was assigned a low 2-day probability of formation 78 h before development, and the probabilities were raised to the medium and high categories 54 and 18 h before formation, respectively. The location of tropical cyclone formation was also well captured as it occurred within most of the genesis areas depicted on the NHC Graphical Tropical Weather Outlook (Fig. 7).

A verification of NHC official track forecasts for Celia is given in Table 4a. Official track forecast errors were much lower than the mean official errors for the previous 5-yr period, except at 12 h when it was near the long-term mean. The longer range (72-120 h) forecasts for Celia were between 37% and 42% better than the long-term mean. The OCD5 errors were a little below the long-term mean, suggesting that the track forecasts for Celia were a little easier than average. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. The official forecast performed quite well as compared to the individual dynamical models. Only the ECMWF (EMXI) and COAMPS-TC (CTCI) bested the official forecasts at any time period. The EMXI had slightly lower mean errors than the NHC forecast at 72 and 120 h, and the CTCI model performed slightly better at 24 h. The NHC forecasts outperformed many of the consensus aids, except for the GFEX model (consensus of the GFS and ECMWF). That consensus aid bested the NHC forecast at each verifying lead time, except 60 h.

A verification of NHC official intensity forecasts for Celia is given in Table 5a. Official intensity forecast errors were lower than the mean official errors for the previous 5-yr period at all verifying lead times. The OCD5 errors were also lower than the 5-yr mean, suggesting that the intensity forecasts for Celia were less difficult than average. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. Unlike for track, several of the individual intensity models and intensity consensus aids had lower mean errors than the NHC forecast. The HMNI, EMXI, and LGEM models consistently performed better than the official forecasts. The climatology and persistence model (OCD5) had lower mean errors than OFCL between 60 and 120 h, indicating that the official forecasts were not skillful at the longer lead times. Beginning with the forecast issued at 1500 UTC 19 June, the NHC forecasts for several days called for Celia to become a hurricane (Fig. 8). The system did not strengthen as much as anticipated, likely due to its large and sprawling structure. The result was a high bias in many of the official intensity forecasts, and a lack of skill in the longer-range NHC predictions.

There were no coastal watches or warnings issued in association with Celia.

Table 1. Best track for Tropical Storm Celia, 16–28 June 2022.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
16 / 0000	11.1	91.1	1007	25	low
16 / 0600	10.9	90.7	1007	25	"
16 / 1200	10.7	90.3	1007	25	"
16 / 1800	10.7	90.0	1006	30	tropical depression
17 / 0000	10.8	89.7	1004	35	tropical storm
17 / 0600	11.1	89.5	1004	35	"
17 / 1200	11.4	89.4	1004	35	"
17 / 1800	11.7	89.3	1004	35	"
18 / 0000	12.0	89.2	1005	30	tropical depression
18 / 0600	12.4	89.4	1006	30	"
18 / 1200	12.8	89.7	1007	25	"
18 / 1800	13.0	90.0	1007	25	"
19 / 0000	13.1	90.4	1007	25	"
19 / 0600	13.1	91.0	1007	25	"
19 / 1200	12.9	91.9	1007	25	"
19 / 1800	12.7	92.7	1008	25	"
20 / 0000	12.3	93.4	1008	25	"
20 / 0600	11.9	94.0	1008	25	"
20 / 1200	11.7	94.7	1008	25	"
20 / 1800	11.7	95.8	1006	30	"
21 / 0000	11.7	96.9	1006	30	"
21 / 0600	11.7	98.0	1006	30	"
21 / 1200	11.8	99.3	1005	35	tropical storm
21 / 1800	12.3	100.5	1005	35	"
22 / 0000	12.8	101.5	1005	35	"
22 / 0600	13.2	102.5	1005	35	"
22 / 1200	13.4	103.2	1003	40	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
22 / 1800	13.6	103.9	1001	45	"
23 / 0000	14.2	104.2	1001	45	"
23 / 0600	15.1	104.7	1001	45	"
23 / 1200	15.7	105.5	1001	45	"
23 / 1800	16.2	106.4	1000	45	"
24 / 0000	16.6	107.1	999	45	"
24 / 0600	16.8	107.7	998	50	"
24 / 1200	16.9	108.2	998	50	"
24 / 1800	17.1	108.7	997	50	"
25 / 0000	17.5	109.2	997	50	"
25 / 0600	17.9	109.8	998	50	"
25 / 1200	18.2	110.5	999	50	"
25 / 1800	18.5	111.3	1000	45	"
26 / 0000	18.8	112.1	1001	45	"
26 / 0600	18.9	112.7	1001	45	"
26 / 1200	19.0	113.3	1001	45	"
26 / 1800	19.3	113.8	1002	45	"
27 / 0000	19.8	114.6	1003	45	"
27 / 0600	20.1	115.5	1004	45	"
27 / 1200	20.4	116.5	1005	40	"
27 / 1800	20.7	117.5	1006	35	"
28 / 0000	21.1	118.3	1006	35	"
28 / 0600	21.6	119.1	1007	30	tropical depression
28 / 1200	22.0	120.0	1007	30	"
28 / 1800	22.4	120.9	1008	30	low
29 / 0000	22.9	121.9	1008	30	"
29 / 0600	23.3	123.0	1009	25	"
29 / 1200	23.5	124.0	1010	25	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
29 / 1800	23.6	124.4	1010	25	"
30 / 0000	23.8	124.8	1010	25	"
30 / 0600	23.9	125.1	1010	20	"
30 / 1200	24.0	125.4	1010	20	"
30 / 1800					dissipated
24 / 1800	17.1	108.7	997	50	maximum winds and minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Tropical Storm Celia, 16–28 June 2022.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
23 / 1200	9HA212	18.0	103.2	110 / 35	1013.0
25 / 1500	9HA502	20.9	108.5	110 / 39	1010.2

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%)	78	114
Medium (40%-60%)	54	54
High (>60%)	18	18

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Celia, 16–28 June 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	22.8	**31.2**	**37.0**	**43.1**	**45.1**	**48.5**	**62.8**	**70.3**
OCD5	41.3	72.3	103.1	136.4	175.1	209.2	260.6	314.3
Forecasts	46	44	42	40	38	36	32	28
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 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Celia, 16–28 June 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	23.3	29.5	35.6	44.8	50.2	55.1	63.5	73.3
OCD5	42.0	70.9	99.7	131.5	165.3	194.2	221.6	260.8
GFSI	24.1	32.1	44.0	64.0	77.4	80.9	96.4	107.1
HMNI	27.7	42.1	57.5	71.1	86.3	102.1	131.7	184.6
HWFI	32.0	60.3	89.3	112.0	137.7	157.7	214.3	304.5
EMXI	23.5	30.6	39.0	47.9	51.5	**54.4**	64.5	**71.6**
CMCI	24.6	38.9	53.9	78.6	94.2	107.9	137.0	159.4
NVGI	32.3	50.7	66.1	79.3	87.8	99.7	111.8	136.9
CTCI	26.5	**28.8**	38.7	60.3	78.3	96.6	111.7	131.5
AEMI	24.6	33.7	47.1	63.1	76.7	86.4	107.7	127.3
HCCA	**21.6**	29.5	38.3	49.2	57.2	61.0	76.2	98.7
TVCX	24.1	**29.2**	37.7	47.6	54.2	58.8	77.6	102.2
GFEX	**20.9**	**24.1**	**29.9**	**43.7**	50.4	**50.0**	**58.8**	**69.5**
TVCA	24.5	30.0	38.2	48.5	54.4	61.8	79.6	108.7
TVDG	24.2	29.7	38.3	50.5	58.4	64.8	79.9	98.7
TABD	32.9	51.2	61.3	69.9	79.4	95.6	147.3	182.2
TABM	32.6	46.1	49.0	53.6	66.0	81.2	105.7	94.8
TABS	38.0	62.6	92.6	116.0	135.5	152.8	166.4	138.8
Forecasts	40	35	33	30	28	26	23	20

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Celia, 16–28 June 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	**3.6**	**5.9**	**8.1**	**10.2**	**12.1**	**12.6**	**13.6**	**14.3**
OCD5	4.7	9.8	12.4	13.7	9.8	9.9	11.8	12.0
Forecasts	46	44	42	40	38	36	32	28
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 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Celia, 16–28 June 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 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	3.1	5.0	6.8	9.4	11.4	12.3	14.3	15.0
OCD5	4.3	8.1	10.8	12.4	**8.5**	**8.4**	**11.3**	**12.6**
GFSI	3.8	6.2	8.3	10.7	12.1	13.3	**11.8**	**9.5**
HMNI	4.5	5.4	**6.2**	**7.3**	**7.1**	**8.0**	**10.8**	**13.8**
HWFI	3.7	**4.9**	**5.2**	**8.6**	13.4	16.8	25.3	31.3
CTCI	5.3	6.7	8.1	10.6	12.6	14.3	**13.5**	**8.9**
EMXI	3.5	**4.4**	**5.0**	**5.7**	**6.4**	**7.6**	**9.2**	**9.9**
DSHP	4.2	6.7	9.4	12.3	16.2	19.8	23.3	24.1
LGEM	3.6	**4.3**	**5.3**	**7.1**	**8.9**	**9.7**	**8.3**	**6.6**
ICON	3.5	**4.4**	**5.2**	**6.6**	**9.6**	**11.5**	15.4	18.1
IVDR	3.6	**4.5**	**5.2**	**7.4**	**10.0**	**11.5**	14.7	15.8
IVCN	3.7	**4.5**	**5.4**	**7.4**	**10.1**	**11.9**	14.9	16.0
HCCA	4.4	7.5	8.8	10.0	**10.4**	**9.2**	**7.3**	**7.3**
Forecasts	40	35	33	31	28	26	23	20

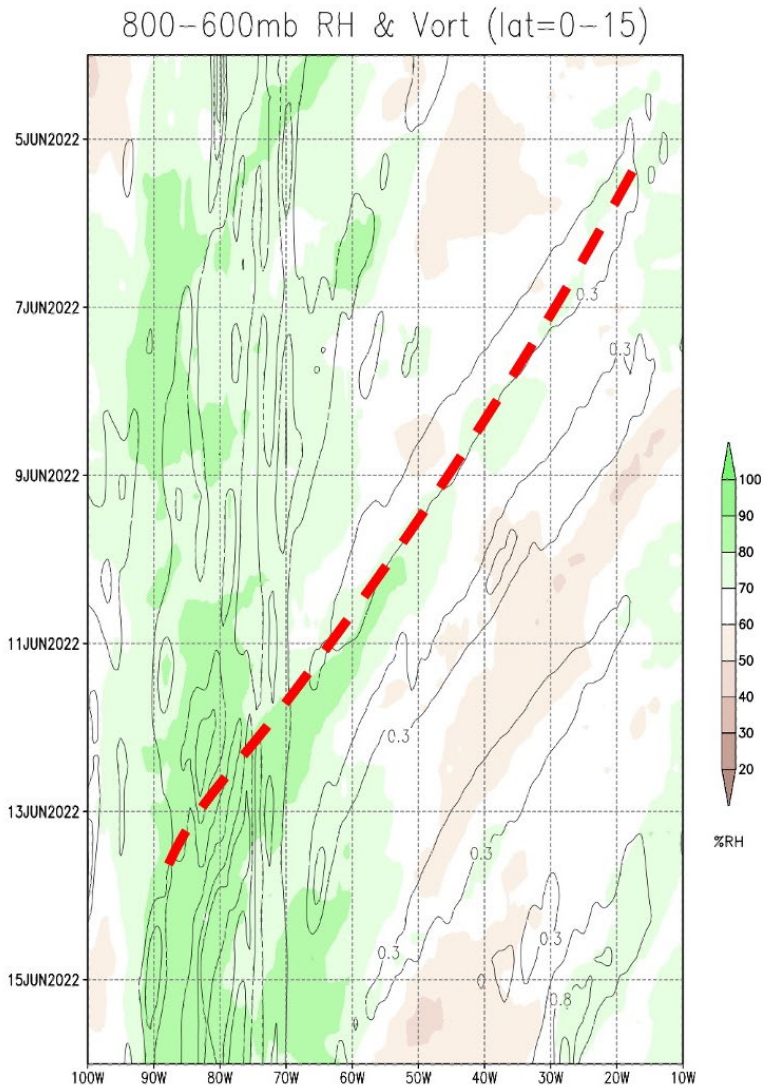


Figure 1. Hovmöller diagram showing the 800-600 mb relative humidity and vorticity from 0°–15°N between 10° –100°W from 4–16 June 2022. The red line denotes the progression of the tropical wave (dashed red line) that was associated with the development of Celica.

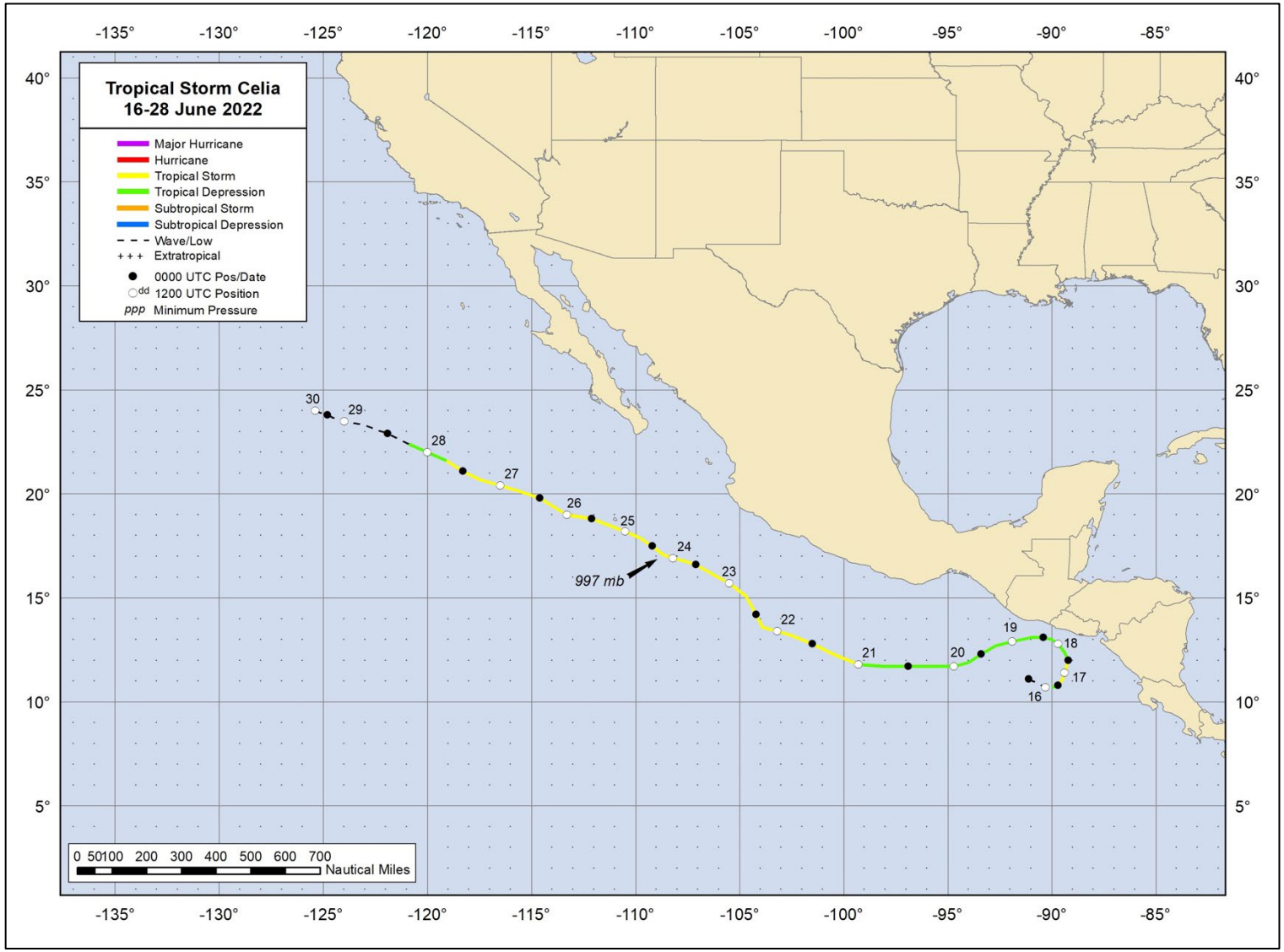


Figure 2. Best track positions for Tropical Storm Celia, 16–28 June 2022.

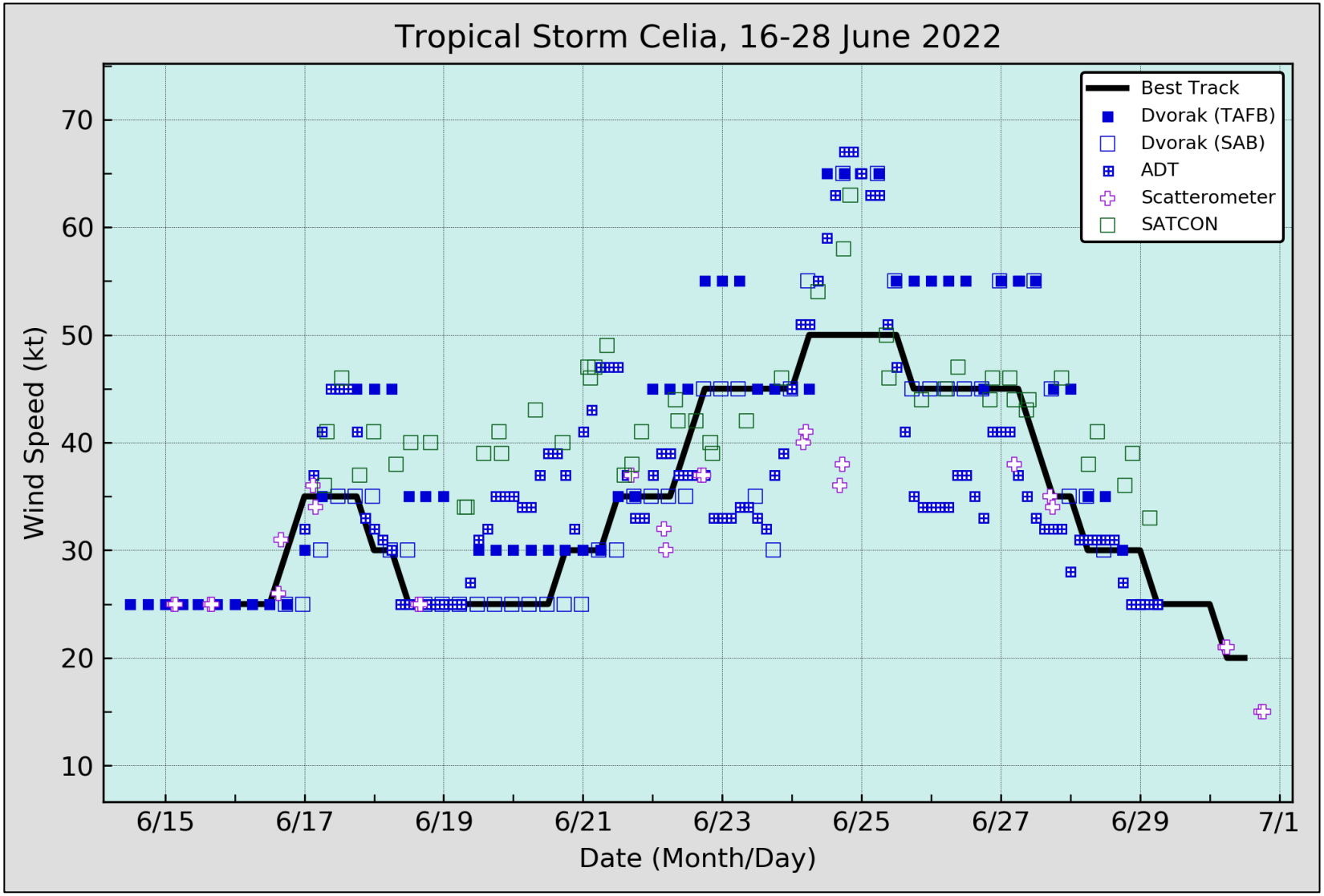


Figure 3. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Celia, 16–28 June 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

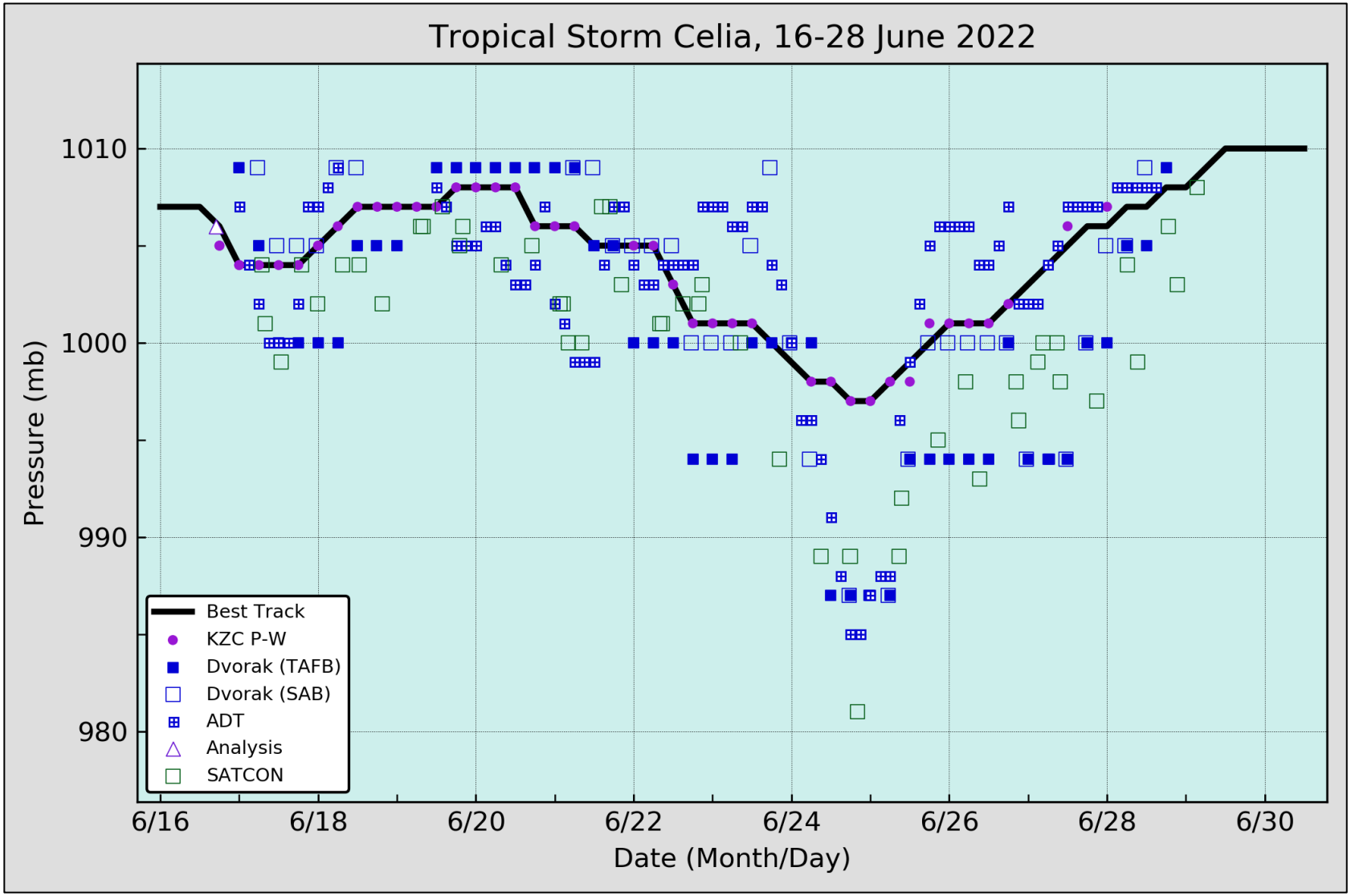


Figure 4. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Celia, 16–28 June 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.

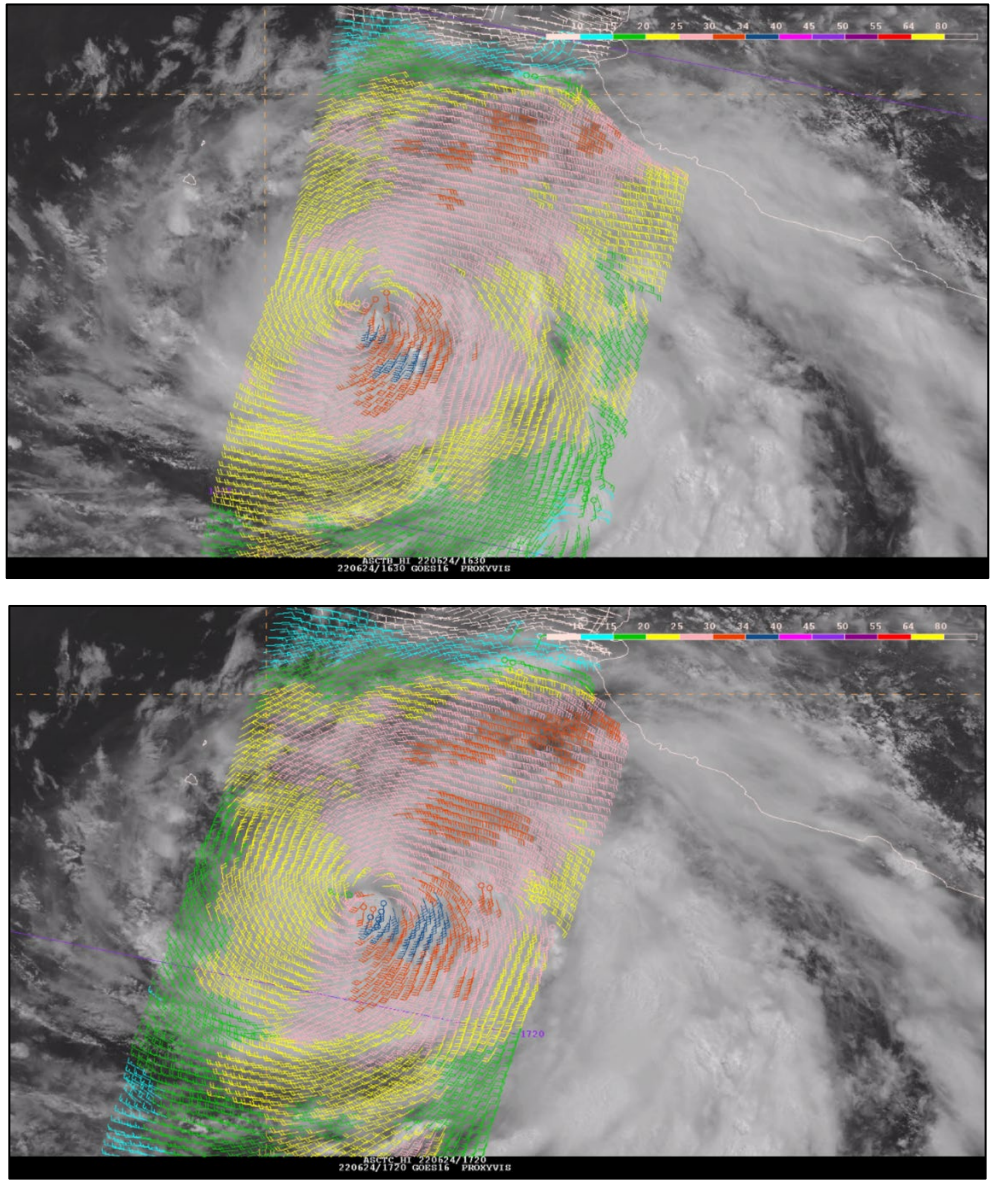


Figure 5. ASCAT-B (top) at 1627 UTC 24 June and ASCAT-C (bottom) at 1720 UTC on 24 June. Note the large radius of maximum winds and sprawling wind field the system exhibited at that time. The maximum winds in those passes were 35 to 40 kt.

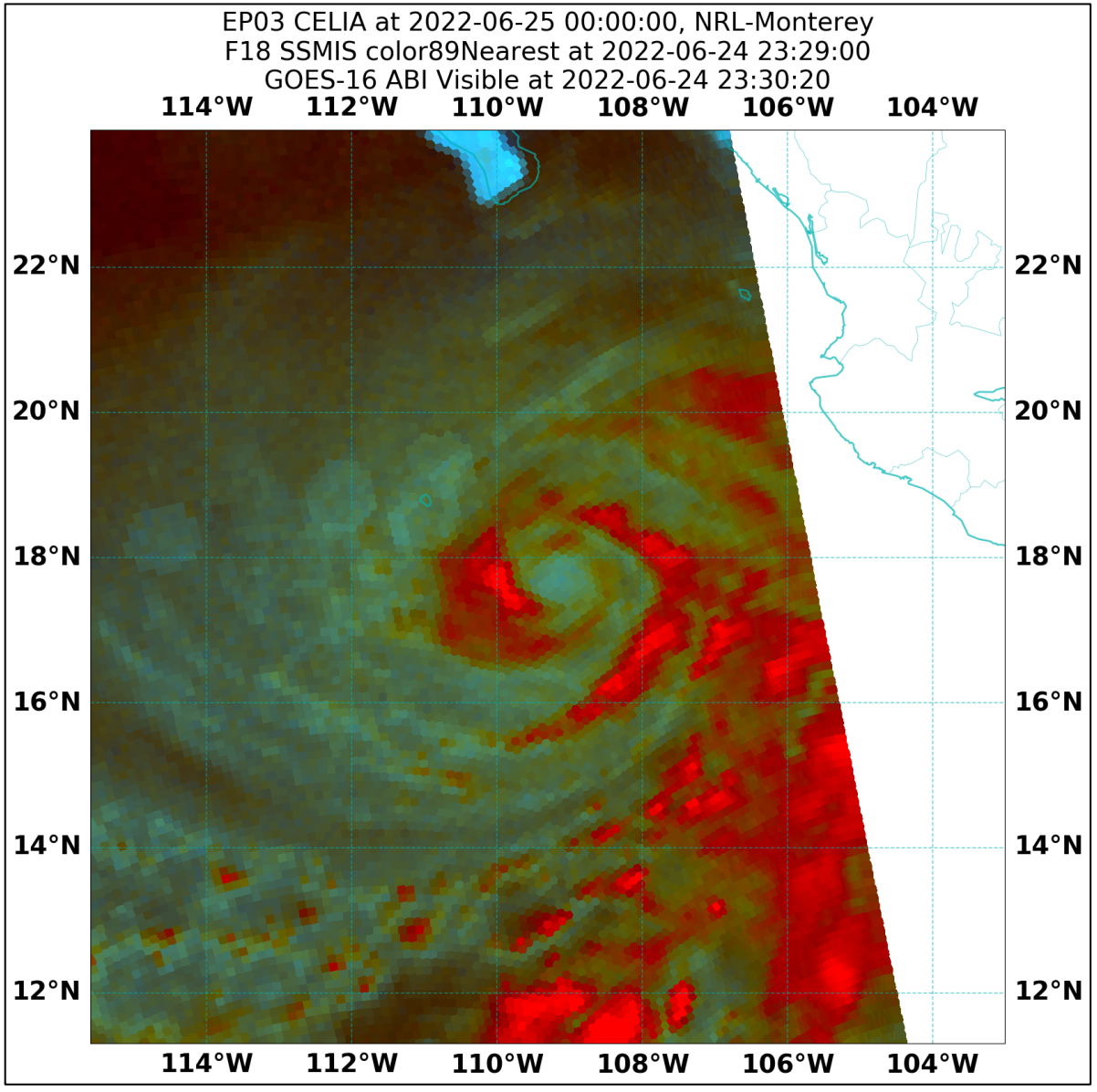


Figure 6. SSMIS 89-GHz Color Composite image of Tropical Storm Celia at 2329 UTC 24 June.

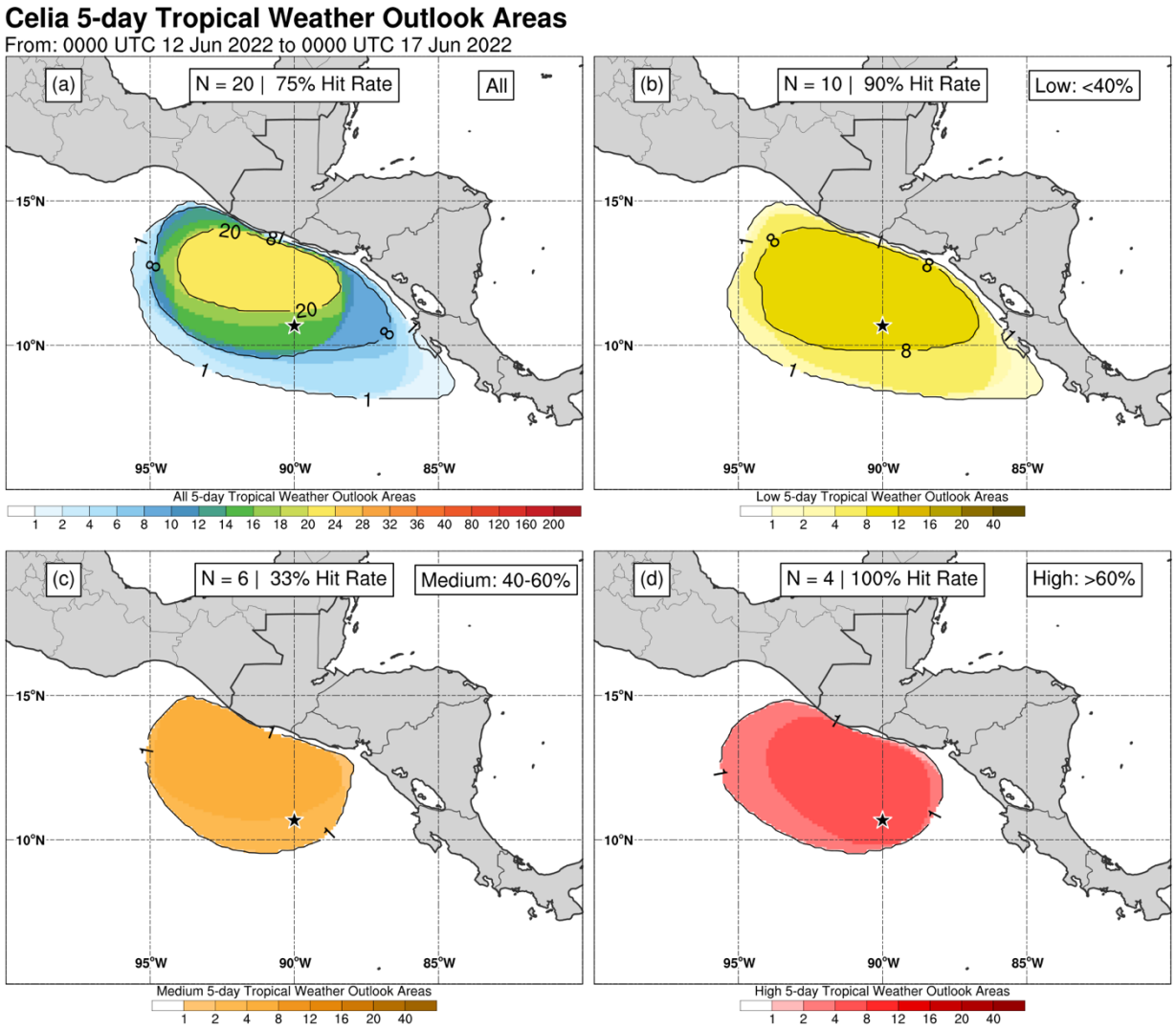


Figure 7. 5-day Tropical Weather Outlook genesis areas associated with the disturbance that developed into Tropical Storm Celia for (a) all probability areas (10–100%, multi-color shading), (b) low probability areas (< 40%, yellow shading), (c) medium probability areas (40–60%, orange shading), and (d)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

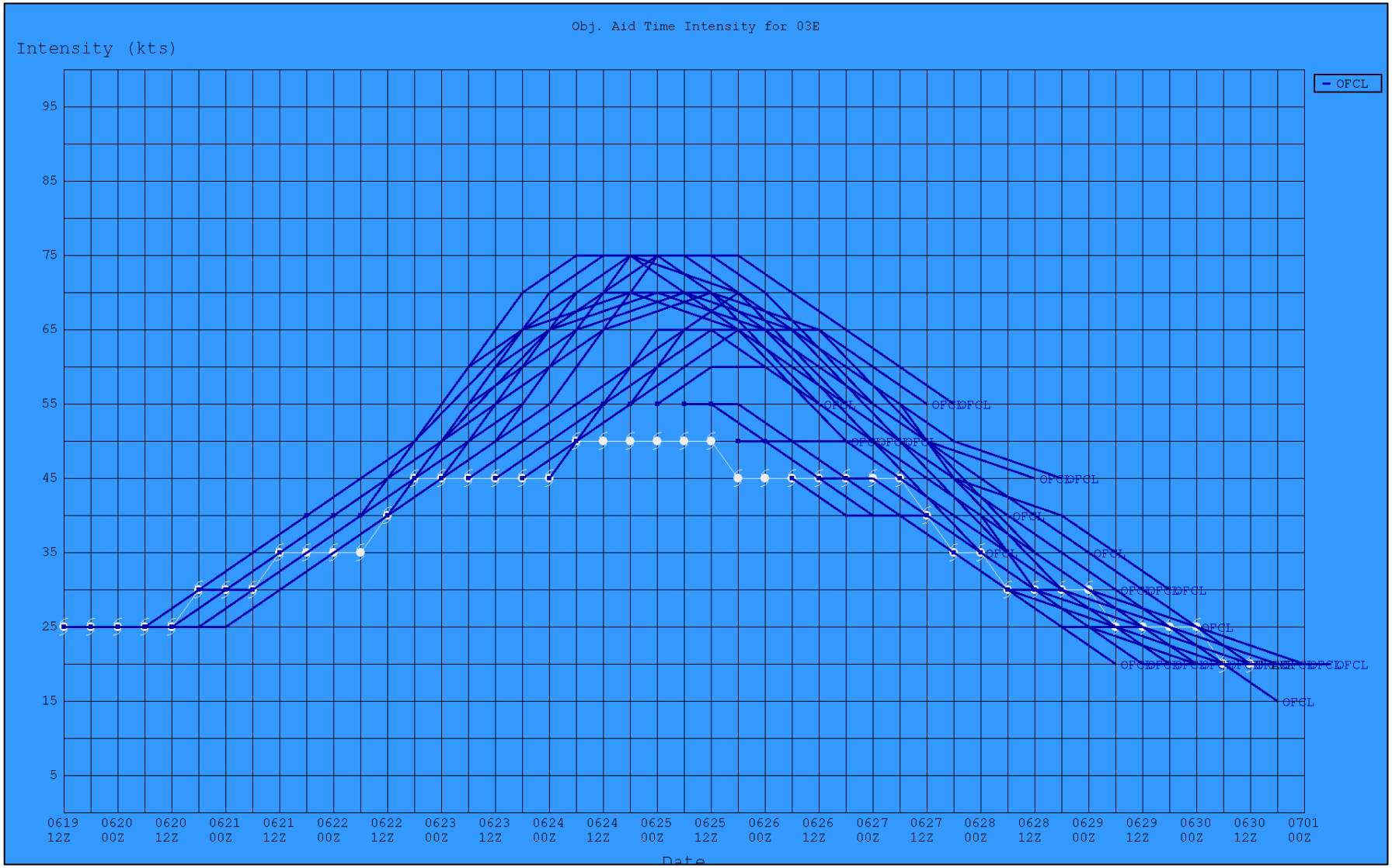


Figure 8. Official intensity forecasts from 1200 UTC 19 June through 1800 UTC 28 June (dark blue). The solid white line and storm symbols at 6-h intervals denote Celia's actual intensity. Note the NHC intensity forecasts issued from 1200 UTC 19 June through 1800 UTC 24 June predicted Celia to become a hurricane, which did not occur. This resulted in a high bias and lack of skill in the longer-lead time forecasts for the tropical storm.