

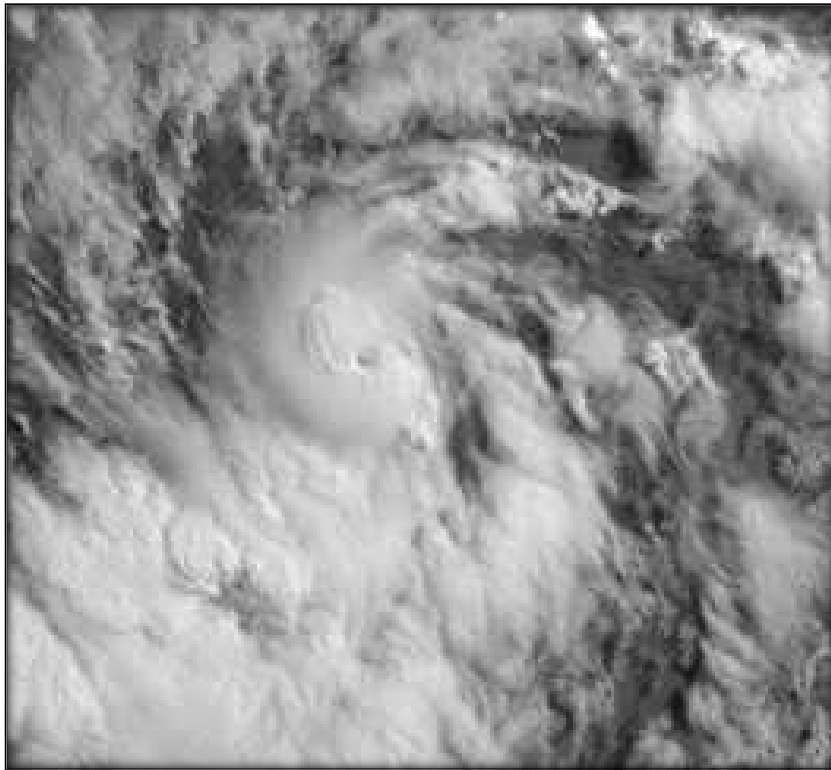


NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE BERYL (AL022018)

4–15 July 2018

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GOES 16 VISIBLE SATELLITE IMAGE OF HURRICANE BERYL AT 1200 UTC 6 JULY 2018.

Beryl was an unusual, but not unique, small-sized hurricane that developed in the tropical Atlantic between Africa and the Lesser Antilles.

Hurricane Beryl

4–15 JULY 2018

SYNOPTIC HISTORY

A convectively active tropical wave, accompanied by cyclonic rotation in the mid-levels and a small surface area of low pressure moved off the west coast of Africa on 1 July. Over the next two days, the convective activity diminished while the system moved toward the west-southwest. By 3 July, a small but circular area of thunderstorms formed over the area of low pressure, and a few convective bands began to develop on the equatorward side of the disturbance. It is estimated that a tropical depression formed at 1200 UTC 4 July about 1300 n mi west-southwest of the Cabo Verde Islands. The “best track” chart of the tropical cyclone’s path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1¹.

The depression became a tropical storm at 0000 UTC 5 July, and despite the presence of relatively cool waters, Beryl rapidly intensified. By the next day, microwave data revealed that the cyclone had developed a well-defined 5 n mi wide mid-level eye around 0600 UTC 6 July, and visible satellite images confirmed the presence of a pinhole eye. It is estimated that the small cyclone had become a hurricane with an intensity of 70 kt at 0600 UTC 6 July. The eye was present for several hours, but then began to fade as the cyclone moved toward an environment of increasing shear. Beryl weakened to a tropical storm as it moved quickly toward the west, and it degenerated into a tropical wave around 1200 UTC 8 July just before reaching the Lesser Antilles. A vigorous mid-level circulation with tropical-storm-force winds continued to move west-northwestward across the northeastern Caribbean Sea, passing just south of Puerto Rico and over eastern Hispaniola during the next couple of days. The disturbance continued to produce intermittent bursts of deep convection, and by 10 July it had moved over the southeastern Bahamas with still no signs of tropical cyclone regeneration.

For the next 2 to 3 days, the remnants of Beryl moved northward and northeastward around the subtropical ridge, and on 13 July a surface low developed about 300 n mi west-northwest of Bermuda. The low was associated with an upper-level trough that moved eastward from the eastern United States, and convection redeveloped near the low. It is estimated that Beryl regenerated at 1200 UTC 14 July, but this time as a subtropical storm since it was collocated with an upper-level low. Beryl moved very slowly while it interacted with the upper low, but once it became embedded within the mid-latitude westerly flow it moved northeastward over cooler waters. The system degenerated into a post-tropical cyclone at 0000 UTC 16 July and then became a trough just south of Newfoundland by 1200 UTC 17 July.

¹ A digital record of the complete best track, including wind radii, can be found on line at <ftp://ftp.nhc.noaa.gov/atcf>. Data for the current year’s storms are located in the *btk* directory, while previous years’ data are located in the *archive* directory.

METEOROLOGICAL STATISTICS

Observations in Beryl (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB). The best track also incorporates objective Advanced Dvorak Technique (ADT) and Satellite Consensus (SATCON) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Observations also include flight-level and stepped frequency microwave radiometer (SFMR) data from a flight 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 Beryl.

Beryl was upgraded to hurricane status based on the presence of an eye in both microwave and conventional satellite imagery. The peak intensity estimate of 70 kt is a little above the peak Dvorak estimates given that the technique was not designed for very small systems. This discrepancy has been noted in the past in systems which reconnaissance aircraft data was available (Hurricane Danny, 2015 and Humberto, 2007). An Air Force plane flew one mission into the system just east of the Lesser Antilles around 1300 UTC 8 July, and although there was no closed circulation, there were reports of at least 50-kt winds at 1500 feet associated with the northern portion of the wave. The remnants of Beryl brought tropical storm force wind gusts to portions of the Leeward Islands. Selected surface observations from Guadeloupe are given in Table 2.

CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Beryl. More than 47,000 customers in Puerto Rico briefly lost electricity due to squally weather associated with the remnants of Beryl. Power outages also were reported on the U.S. Virgin Island of St. Croix, where officials ordered closure of schools and government offices. The National Weather Service indicated that 1 to 5 inches of rain fell across Puerto Rico and the island experienced sustained winds of 25 to 30 kt. Several landslides were reported.

FORECAST AND WARNING CRITIQUE

The genesis of Beryl was not well forecast. The wave from which Beryl first formed was introduced in the 5-day Tropical Weather Outlook with a low chance of formation 60 h prior to genesis, and was only given a low chance of formation in 48 h 12 h prior to genesis (Table 3a). In fact, in post-analysis, Beryl was classified as a tropical cyclone 24 hours earlier than when advisories were initiated. The weakening and dissipation of Beryl in the eastern Caribbean Sea

was indicated in the NHC forecasts and the possibility of the regeneration was also indicated correctly in the TWO, although the chances were never high (Table 3b).

A verification of NHC official track forecasts for Beryl is given in Table 4a. Official forecast track errors were greater than the mean official errors for the previous 5-yr period from 12 to 48 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. The HMNI, CMCI and TABM models performed better than the official forecast at most of the forecast times.

A verification of NHC official intensity forecasts for Beryl is given in Table 5a. Official forecast intensity errors were in general much larger than the long-term mean official errors for the previous 5-yr period. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. Most of the dynamical hurricane models performed better than the NHC forecast up to 48 h. The statistical intensity model LGEM did not perform well.

Watches and warnings associated with Beryl are given in Table 6.

Table 1. Best track for Hurricane Beryl, 4–15 July 2018. Since no surface low was present during the disturbance stage, the location of Beryl was given by position of the low- to mid-level tropospheric vorticity maximum.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
04 / 1200	10.0	34.9	1008	30	tropical depression
04 / 1800	10.1	36.5	1008	30	"
05 / 0000	10.1	38.0	1007	35	tropical storm
05 / 0600	10.1	39.5	1007	35	"
05 / 1200	10.2	40.9	1005	40	"
05 / 1800	10.3	42.3	1003	45	"
06 / 0000	10.3	43.4	999	55	"
06 / 0600	10.5	44.6	991	70	hurricane
06 / 1200	10.7	46.0	992	70	"
06 / 1800	10.6	47.3	993	65	"
07 / 0000	10.7	48.3	994	65	"
07 / 0600	11.1	49.3	995	65	"
07 / 1200	11.7	50.4	999	55	tropical storm
07 / 1800	12.4	52.0	1003	45	"
08 / 0000	12.9	53.6	1005	45	"
08 / 0600	13.4	55.2	1006	45	"
08 / 1200	14.1	56.9	1006	45	disturbance
08 / 1800	14.8	59.2	1008	40	"
09 / 0000	15.5	61.3	1010	35	"
09 / 0600	16.2	63.2	1011	35	"
09 / 1200	16.6	65.3	1013	35	"
09 / 1800	17.1	67.1	1013	35	"
10 / 0000	17.6	68.9	1013	35	"
10 / 0600	18.1	70.5	1013	30	"
10 / 1200	19.3	71.6	1013	30	"
10 / 1800	20.2	72.4	1013	30	"
11 / 0000	21.3	73.0	1013	25	"
11 / 0600	22.4	73.6	1013	25	"



11 / 1200	23.7	73.8	1013	25	"
11 / 1800	25.2	73.8	1013	25	"
12 / 0000	26.7	73.6	1013	25	"
12 / 0600	28.2	73.1	1013	25	"
12 / 1200	29.6	72.4	1013	25	"
12 / 1800	30.8	71.6	1013	25	"
13 / 0000	31.9	70.7	1013	25	"
13 / 0600	32.6	70.1	1013	25	"
13 / 1200	33.3	69.4	1013	25	low
13 / 1800	33.9	68.6	1013	25	"
14 / 0000	34.5	68.0	1013	25	"
14 / 0600	35.0	67.3	1013	30	"
14 / 1200	35.6	66.2	1008	35	subtropical storm
14 / 1800	36.7	65.5	1007	35	"
15 / 0000	37.8	65.5	1005	35	"
15 / 0600	38.2	65.4	1006	35	"
15 / 1200	38.1	65.1	1008	35	"
15 / 1800	38.0	64.3	1009	35	"
16 / 0000	38.3	63.1	1010	35	low
16 / 0600	38.7	61.8	1011	35	"
16 / 1200	39.5	60.2	1011	35	"
16 / 1800	40.7	58.5	1012	35	"
17 / 0000	43.0	57.1	1012	30	"
17 / 0600	45.5	55.7	1012	30	"
17 / 1200					dissipated
06 / 0600	10.5	44.6	991	70	minimum pressure



Table 2. Selected surface observations for Beryl, 4–15 July 2018. Beryl had degenerated into a tropical wave when it passed south of Guadeloupe during 9 and 10 July.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)	Storm tide (ft)	Estimated Inundation (ft)	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt)	Gust (kt)				
Guadeloupe, France									
Le Moule			9/1900		54				4.1
Desirade			10/0400	32	45				
Raizet Airport			10/0300		46				
Pointe Noir			10/ 0000		43				
Saint-Claude									7.8
Petit Bourg									6.3
Sainte-Rose									6.2
Baie-Mahault									4.6
Saint-Anne									3.7

^a Date/time is for sustained wind when both sustained and gust are listed.

Table 3a. Number of hours in advance of Beryl’s first 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%)	12	60
Medium (40%-60%)	-	-
High (>60%)	-	-

Table 3b. Number of hours in advance of regeneration of Beryl associated with the 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 Regeneration	
	48-Hour Outlook	120-Hour Outlook
Low (<40%)	114	132
Medium (40%-60%)	-	120
High (>60%)	-	-

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Beryl. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	41.2	71.0	63.1	67.1			
OCD5	53.9	85.8	77.2	104.2			
Forecasts	14	10	6	4			
OFCL (2013-17)	24.1	37.4	50.5	66.6	98.4	137.4	180.7
OCD5 (2013-17)	44.7	95.8	153.2	211.2	318.7	416.2	490.6

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Beryl. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	37.8	51.2	63.1	67.1			
OCD5	46.9	56.0	77.2	104.2			
GFSI	44.9	66.7	81.7	79.0			
HMNI	37.2	46.4	53.3	64.1			
HWFI	39.3	51.4	67.7	59.5			
EMXI	34.5	56.0	75.7	91.6			
CMCI	43.1	46.1	61.7	63.8			
NVGI	56.4	86.5	105.1	123.6			
AEMI	43.9	65.1	74.8	73.3			
CTCI	48.5	75.8	101.0	120.2			
HCCA	36.2	52.9	65.9	67.3			
TVCX	37.5	54.6	70.2	78.8			
GFEX	37.5	54.6	70.5	79.8			
TVCA	39.2	58.5	73.2	79.3			
TABD	33.1	53.1	94.5	141.7			
TABM	35.4	43.9	62.8	80.5			
TABS	41.5	52.9	66.1	74.1			
Forecasts	9	7	6	4	0	0	0



Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Beryl. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	9.3	16.0	22.5	15.0			
OCD5	9.8	17.7	25.7	26.2			
Forecasts	14	10	6	1			
OFCL (2013-17)	5.5	8.0	10.1	11.4	12.7	14.5	15.0
OCD5 (2013-17)	7.1	11.1	14.4	17.4	20.6	22.3	23.7

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Beryl. 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	72	96	120
OFCL	11.7	20.0	22.5	15.0			
OCD5	11.0	20.0	25.7	26.2			
HWFI	11.0	20.7	23.7	12.0			
HCCA	10.2	19.4	21.0	13.0			
DSHP	10.7	18.1	21.5	20.8			
LGEM	10.9	21.0	25.3	25.8			
GFSI	10.2	19.1	21.0	11.5			
EMXI	11.0	19.0	18.8	12.0			
HMNI	11.9	18.9	23.2	20.2			
CTCI	11.1	20.4	21.3	14.5			
IVCN	11.0	19.6	22.3	17.2			
Forecasts	9	7	6	4	0	0	0

Table 6. Watch and warning summary for Hurricane Beryl, 4–15 July 2018.

Date/Time (UTC)	Action	Location
6 / 2100	Tropical Storm Watch issued	Martinique/Guadeloupe and Saint Barthelemy
6 / 2100	Hurricane Watch issued	Dominica
7 / 0900	Tropical Storm Watch issued	Saint Lucia
7 / 0900	Tropical Storm Watch issued	Barbados
7 / 1500	Hurricane Watch changed to Tropical Storm Warning	Dominica
7 / 1500	Tropical Storm Watch issued	Saba/Saint Eustatius
7 / 2100	Tropical Storm Watch discontinued	Martinique/Guadeloupe and Saint Barthelemy/St Martin
7 / 2100	Tropical Storm Watch issued	Saint Maarten
7 / 2100	Tropical Storm Warning issued	Guadeloupe
8 / 0900	Tropical Storm Watch discontinued	Saint Lucia
8 / 1500	Tropical Storm Watch discontinued	Barbados
8 / 2100	Tropical Storm Warning changed to Tropical Storm Watch	Dominica
8 / 2100	Tropical Storm Warning discontinued	All
9 / 0300	Tropical Storm Watch discontinued	Dominica

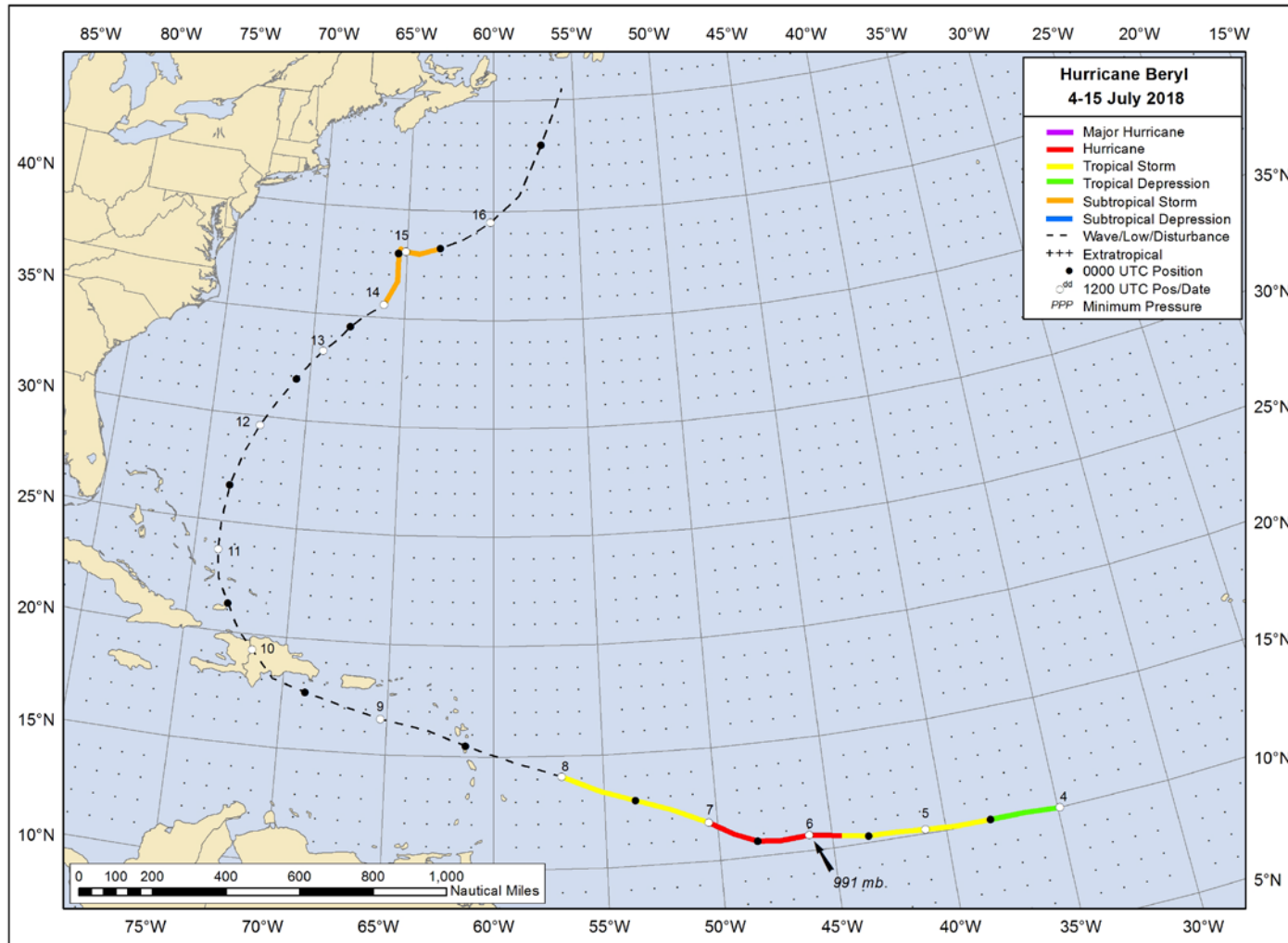


Figure 1. Best track positions for Hurricane Beryl, 4–15 July 2018.

