NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM JULIAN

(AL112021)

28–30 August 2021

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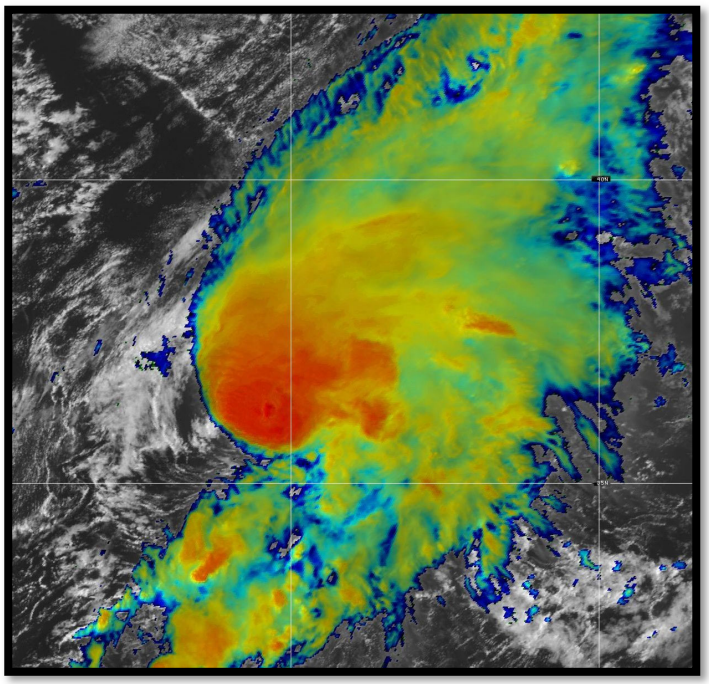

GOES-16 COMPOSITE VISIBLE AND INFRARED IMAGE OF TROPICAL STORM JULIAN AT 1800 UTC 29 AUGUST 2021. IMAGE COURTESY NOAA/NESDIS/STAR.

Julian was a short-lived tropical storm that formed over the subtropical central Atlantic Ocean and transitioned to an extratropical cyclone as it moved northeastward over open waters.

Tropical Storm Julian

28–30 AUGUST 2021

SYNOPTIC HISTORY

Julian originated from a tropical wave that emerged off of the west coast of Africa on 20 August. The wave moved west-northwestward at about 15 kt for the next couple of days across the far eastern tropical Atlantic while producing some disorganized shower activity. On 23–24 August, the northern portion of the wave separated from the parent feature and moved quickly northwestward at 20–25 kt around the southwestern periphery of a subtropical ridge over the eastern Atlantic. Shower and thunderstorm activity increased in association with the wave on 24–25 August, and a broad surface trough developed over the central Atlantic. However, the associated convection remained disorganized, likely due to the relatively dry mid-level environment and some moderate deep-layer (200–850 mb) west-northwesterly wind shear. The disturbance slowed down over the next couple of days, and eventually turned northward as it reached the western extent of the subtropical ridge. Convection increased near the trough on 26 August within an environment of 28–29°C sea-surface temperatures (SSTs) and weak (≤ 10 kt) deep-layer shear. However, the elongated cyclonic circulation at the surface revealed by scatterometer data lacked a well-defined center and was decoupled from the mid-level vortex. The disturbance remained broad and ill-defined with peak winds of less than 20 kt on 27 August as it meandered over the central subtropical Atlantic and continued to produce disorganized shower and thunderstorm activity.

Early on 28 August, convection increased near the trough once again, and satellite imagery indicated the low-level circulation was becoming better defined. It is estimated that a well-defined low-pressure system formed by 1200 UTC that day, about 650 n mi east of Bermuda. Satellite imagery and microwave data over the next several hours revealed increasing signs of convective organization, as a curved band of convection developed around the southeastern portion of the circulation. This marked the formation of a tropical depression by 1800 UTC that day, about 700 n mi east of Bermuda. Despite 15–20 kt of deep-layer westerly shear, deep convection persisted downshear of the center as the system's organization continued to improve. It is estimated that the depression strengthened into Tropical Storm Julian by 0600 UTC 29 August, when it was centered about 775 n mi east of Bermuda. The "best track" chart of Julian'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].

[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 tropical storm accelerated northeastward on 29–30 August ahead of an approaching deep-layer trough and its associated cold front. Julian quickly assumed the appearance of a sheared tropical cyclone in satellite imagery (cover photo), as the associated convection was displaced to the northeast of its partially exposed low-level center. However, the storm was able to sustain enough deep convection near its center to strengthen while moving over 26.5°–27°C SSTs, as revealed by a series of scatterometer passes on 29 August. Julian reached an estimated peak intensity of 50 kt by 1800 UTC that day, and shortly thereafter began extratropical transition. Microwave imagery just before 0600 UTC 30 August showed that Julian's small inner core was still intact and separate from the approaching cold front. It is estimated that Julian completed extratropical transition and merged with the frontal system by 1200 UTC that day, when it was located about 750 n mi east-southeast of Cape Race, Newfoundland. The extratropical cyclone continued racing northeastward, and then turned northward early on 31 August as it began rotating cyclonically around a mid- to upper-level low centered over the Labrador Sea. Scatterometer data from around 1330 UTC that day indicated that the system no longer had a closed surface circulation, and it was absorbed shortly thereafter by a large, complex extratropical low-pressure system located several hundred n mi south of the southern tip of Greenland.

METEOROLOGICAL STATISTICS

Observations in Julian (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. 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 Julian.

Julian's estimated peak intensity of 50 kt occurred from 1800 UTC 29 August through its extratropical transition at 1200 UTC 30 August. This intensity is supported by ASCAT-A and -C passes at 2248 UTC and 2318 UTC 29 August, respectively, that showed winds of around 45–50 kt in the southeastern quadrant of Julian. These wind retrievals are consistent with the ADT and SATCON estimates of 45–51 kt during this period. The estimated minimum central pressure of 993 mb is based on the Knaff-Zehr-Courtney (KZC) pressure-wind relationship.

There was one ship report of tropical-storm-force winds associated with Julian. The oil tanker *Phoenix Jamnagar* (call sign 9V6316) reported 36-kt winds to the south of Julian's center at 0600 UTC 30 August.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The long-range genesis forecast for Julian was adequate, but the timing of its formation was not well forecast (Table 2). NHC forecasters recognized the genesis potential of the wave from which Julian developed very early, and it was introduced in the Tropical Weather Outlook (TWO) with a low (<40%) chance of formation 210 h (8.75 days) prior to genesis. The 5-day formation chances were raised to the medium (40–60%) and high (>60%) categories 120 h and 96 h, respectively, before a tropical depression formed. For the 2-day outlook, a low formation chance was introduced into the TWO 120 h before genesis, and a medium chance was shown 72 h before genesis. However, the disturbance remained disorganized as it struggled to capitalize on warm SSTs and relatively weak deep-layer shear, perhaps due to dry mid-level air (40–50% relative humidity) in its surrounding environment. Based on its lack of organization and waning model support for genesis as the system moved into the mid-latitudes, the 5-day formation chance was lowered from high to medium at 0600 UTC 27 August. Nevertheless, the disturbance that became Julian quickly became better organized on 28 August, and genesis occurred shortly before environmental conditions became increasingly hostile for tropical cyclone development. The formation probabilities were not raised to the high category in the 5-day or 2-day outlook before the best track genesis time, likely due to mixed signals in the guidance as to whether formation would occur before the system became fully baroclinic.

A verification of NHC official track and intensity forecasts for Julian is given in Tables 3 and 4, respectively. Official forecast track errors were greater than the mean official errors for the previous 5-yr period, albeit for a small sample size of only four verifying 12-h forecasts and two 24-h forecasts. Official forecast intensity errors were slightly greater than the mean official errors for the previous 5-yr period at 12 h and much lower at 24 h. Due to Julian's brief existence as a tropical cyclone, no meaningful comparisons can be made with the models.

There were no land-based watches and warnings associated with Julian.

Table 1. Best track for Tropical Storm Julian, 28–30 August 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 1200	32.1	51.7	1010	25	low
28 / 1800	32.2	51.0	1008	30	tropical depression
29 / 0000	32.6	50.1	1006	30	"
29 / 0600	33.5	49.3	1003	35	tropical storm
29 / 1200	34.5	47.8	997	45	"
29 / 1800	35.9	45.7	995	50	"
30 / 0000	37.1	42.6	994	50	"
30 / 0600	38.9	40.0	993	50	"
30 / 1200	40.6	37.9	993	50	extratropical
30 / 1800	42.5	36.0	995	45	"
31 / 0000	44.8	35.1	997	45	"
31 / 0600	47.5	34.5	999	45	"
31 / 1200	50.5	35.5	1000	45	"
31 / 1800					dissipated
30 / 0600	38.9	40.0	993	50	minimum pressure and maximum wind

Table 2. Number of hours in advance of formation of Julian 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. Numbers in parentheses ( ) indicate the number of hours in advance that the system was first mentioned in the outlook before the category was lowered.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<40%)	120	210
Medium (40%-60%)	72	120
High (>60%)	0	(96) 0

Table 3. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Julian, 28–30 August 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	40.6	53.9						
OCD5	113.2	309.0						
Forecasts	4	2						
OFCL (2016-20)	23.9	36.3	49.1	63.9	83.7	94.1	128.1	169.7
OCD5 (2016-20)	45.1	97.2	157.2	216.7	257.6	325.4	414.4	490.0

Table 4. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Julian, 28–30 August 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	6.2	**2.5**						
OCD5	10.0	10.5						
Forecasts	4	2						
OFCL (2016-20)	5.4	8.0	9.6	10.9	11.5	12.1	13.3	14.5
OCD5 (2016-20)	7.0	11.0	14.3	16.8	18.5	19.7	21.7	23.0

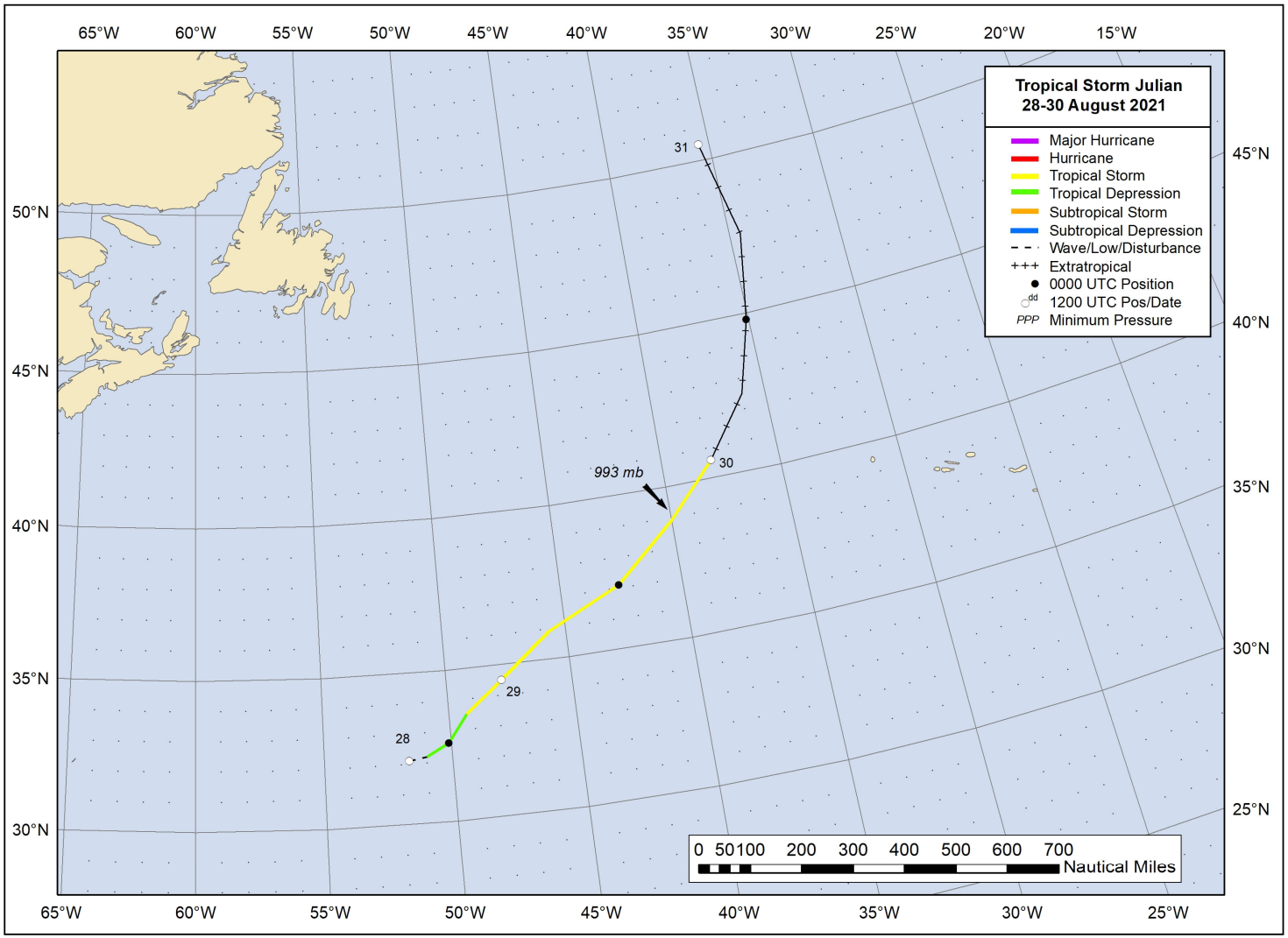

Figure 1. Best track positions for Tropical Storm Julian, 28–30 August 2021. Tracks during the extratropical stage are partially based on analyses from the NOAA Ocean Prediction Center.

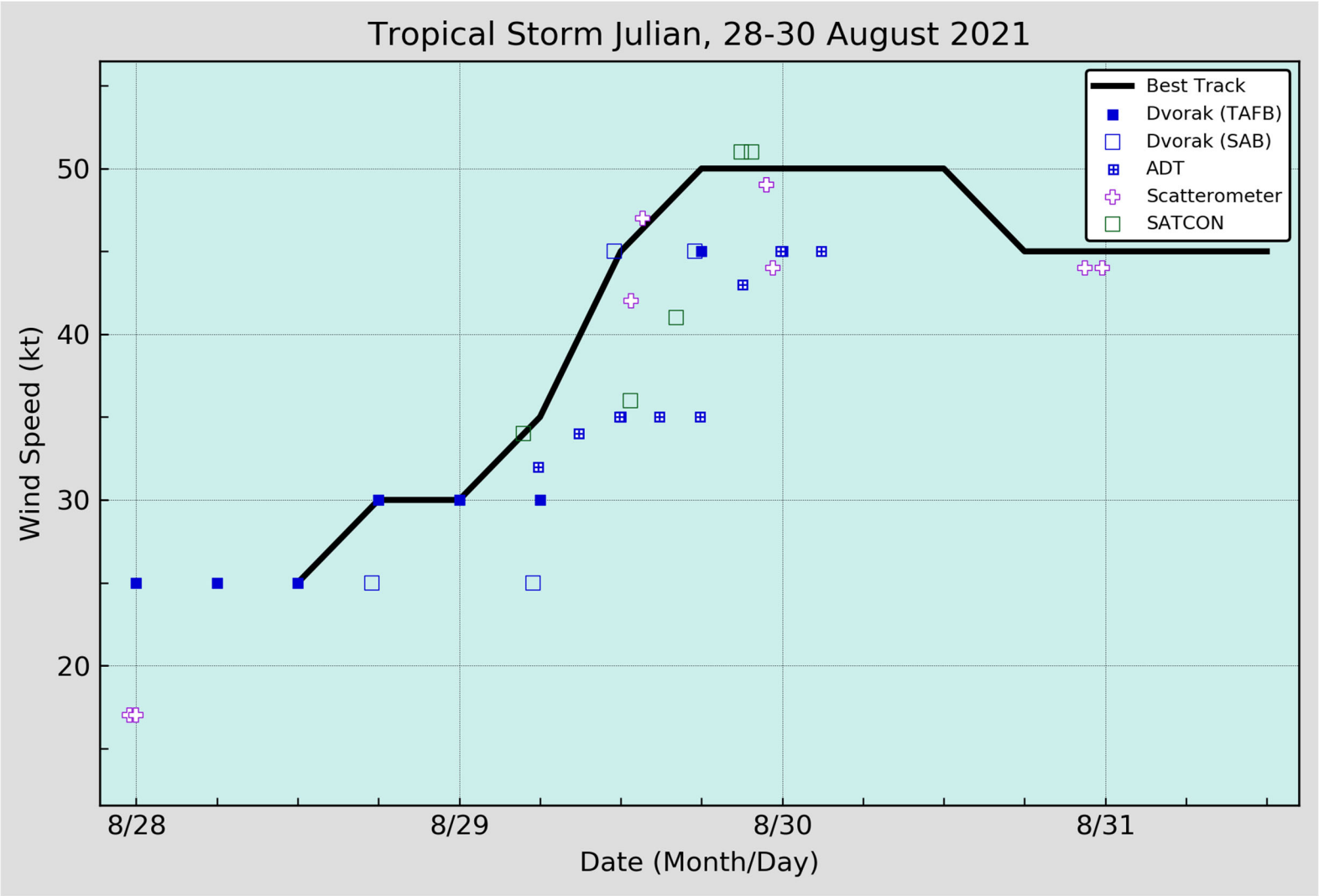

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Julian, 28–30 August 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

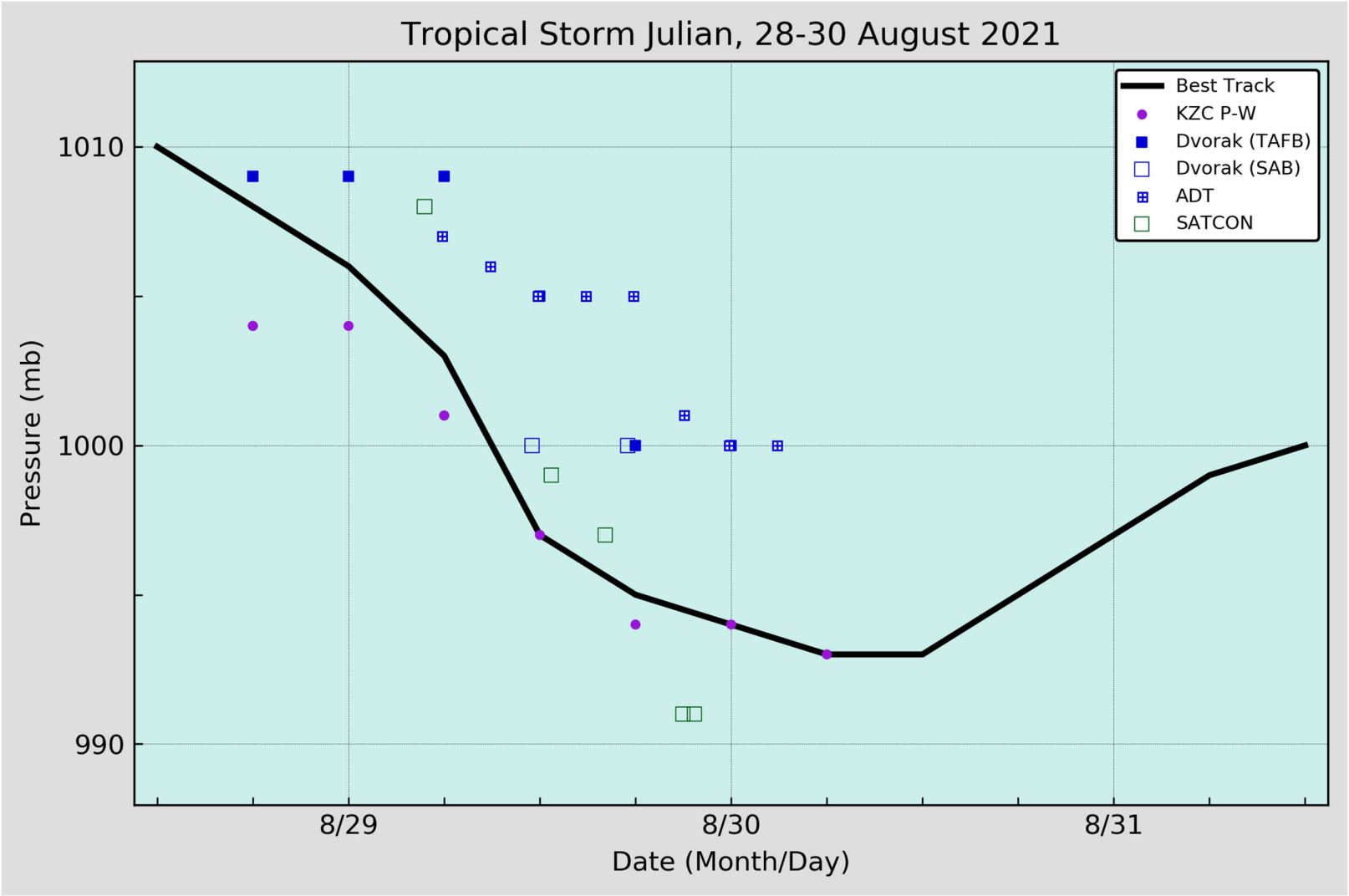

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Julian, 28–30 August 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.