NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM DEBBY

(AL042018)

7–9 August 2018

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National Hurricane Center
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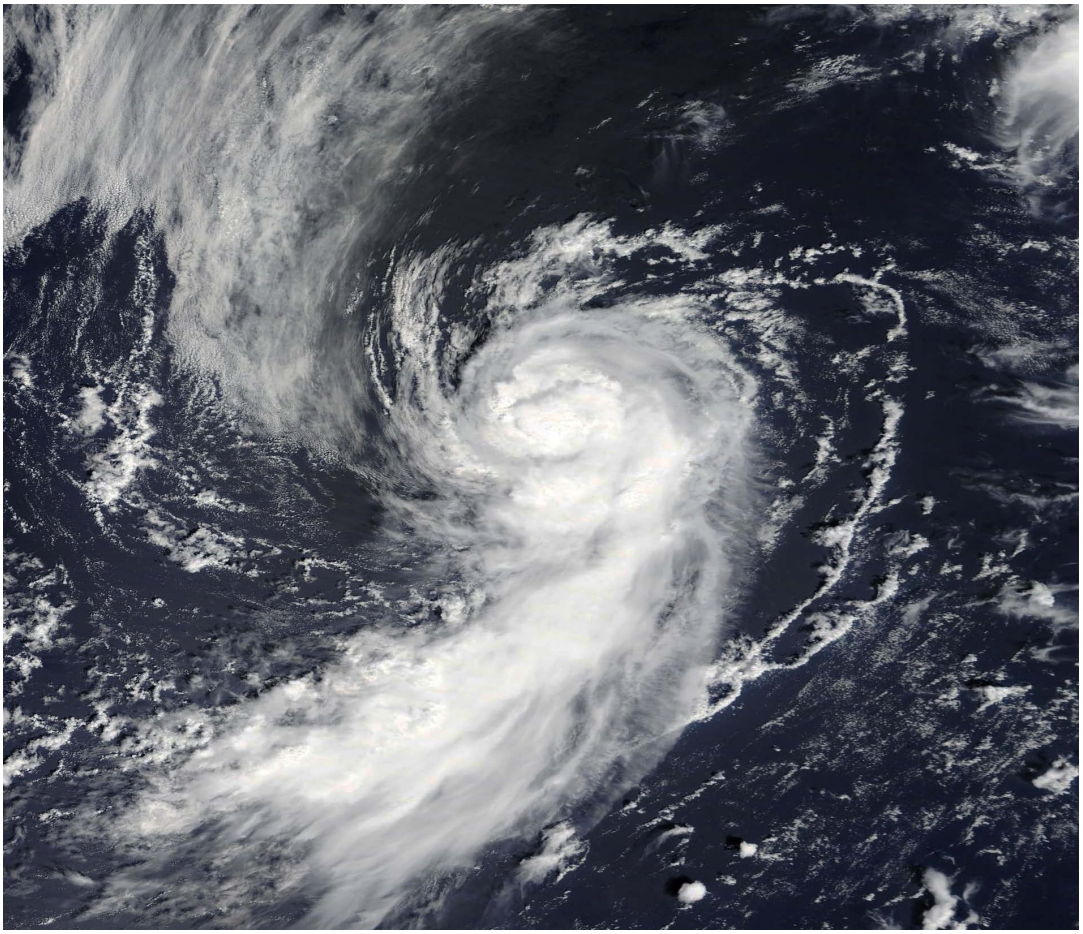

TERRA MODIS VISIBLE IMAGE OF DEBBY AT 1430 UTC 8 AUGUST 2018, COURTESY OF NASA.

Debby made a transition from an extratropical cyclone to a subtropical storm, and eventually became a high-latitude tropical storm, while remaining out at sea.

Tropical Storm Debby

7–9 AUGUST 2018

SYNOPTIC HISTORY

Debby was of non-tropical origin. An extratropical low formed along a frontal zone, centered a couple of hundred miles northwest of the westernmost Azores on 2 August. By 3 August, the low was producing gale-force winds, and later that day it lost frontal features. The system moved quickly west-southwestward and weakened below gale force on 4 August while producing little or no shower activity. The low then began to produce some scattered, disorganized deep convection over the eastern semicircle of its circulation while moving south-southwestward and then north-northeastward on an elongated looping track on 5–6 August. Early on 7 August a broad cyclonically curved band of deep convection formed, well removed from the center of the low, and winds increased to tropical storm force in the band. This signified the formation of a subtropical storm at 0600 UTC that day, centered about 800 n mi west of the westernmost Azores. The "best track" chart of the 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 1[1].

Debby moved northward on the western side of a mid-level ridge located to the west of the Azores. Around 0000 UTC 8 August, deep convection increased near the center of the cyclone, and it is estimated that Debby became a tropical storm at that time. Convective banding soon became better defined over the southern and eastern semicircles of the circulation. Over the next day, while turning north-northeastward to northeastward over marginal sea surface temperatures, Debby strengthened slightly. The storm reached its peak intensity of 45 kt around 0000 UTC 9 August while centered about 365 n mi southeast of Cape Race, Newfoundland. Although the cyclone's passage over a warm Gulf Stream eddy allowed the storm to maintain some of its intensity for a short time, the entrainment of drier air and passage over cooler waters caused Debby's deep convection to dissipate later in the day. The cyclone accelerated northeastward and degenerated into a remnant low by 1800 UTC 9 August, and the system soon interacted with a frontal zone and reverted back into an extratropical cyclone. By 1800 UTC 10 August, the cyclone was absorbed by a larger extratropical low over the northern Atlantic.

METEOROLOGICAL STATISTICS

Observations in Debby (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite

[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.

Analysis Branch (SAB), and 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/JAXA 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 Debby.

The estimated maximum intensity of the system, 45 kt, is based on subjective Dvorak classifications from both TAFB and SAB as well as ASCAT data and a SATCON intensity estimate.

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

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

Debby's genesis was not very well predicted. The extratropical low that developed into Debby was first mentioned in the Tropical Weather Outlook 72 h prior to genesis, with a low (<40%) chance of development within 48 h or 120 h (Table 3). The 120-h genesis probability was raised to the medium (40–60%) category 48 h before genesis. The 48-h and 120-h genesis probabilities were never raised to the high (>60%) category prior to Debby's formation.

A verification of NHC official track forecasts for Debby is given in Table 4a. The official track forecast errors were comparable to, but a little higher than, the mean official errors for the previous 5-yr period for the 12- through 36-h forecast intervals. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. For a small sample of cases, the simple and corrected consensus models, TVCA, HCCA, and FSSE, were more accurate than the official forecasts for the 12- through 36-h forecast intervals.

A verification of NHC official intensity forecasts for Debby is given in Table 5a. The mean official intensity forecast errors were slightly lower than the long-term means for the 12- and 24-h forecast intervals, and slightly higher than the long-term mean at 36 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. The DSHP and LGEM models had lower intensity errors than the official forecasts, as did the simple and corrected consensus models, ICON, IVCN, HCCA, and FSSE.

There were no coastal watches or warnings required for Debby.

ACKNOWLEDGMENTS

Andrew B. Penny produced the track and intensity verification statistics.

Table 1. Best track for Tropical Storm Debby, 7–9 August 2018.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
02 / 1800	41.2	33.7	1012	30	extratropical
03 / 0000	40.8	35.5	1011	35	"
03 / 0600	40.4	37.2	1011	35	"
03 / 1200	39.9	38.9	1011	35	"
03 / 1800	39.2	40.5	1010	35	low
04 / 0000	38.6	42.2	1010	35	"
04 / 0600	37.8	44.0	1010	30	"
04 / 1200	36.7	45.1	1010	30	"
04 / 1800	35.7	46.0	1010	30	"
05 / 0000	34.8	47.2	1010	30	"
05 / 0600	33.9	48.4	1010	30	"
05 / 1200	32.9	49.2	1010	30	"
05 / 1800	32.2	49.8	1010	30	"
06 / 0000	31.7	50.3	1010	30	"
06 / 0600	31.3	50.0	1010	30	"
06 / 1200	31.9	49.5	1010	30	"
06 / 1800	32.6	48.9	1010	30	"
07 / 0000	33.7	47.9	1009	30	"
07 / 0600	36.0	47.6	1008	35	subtropical storm
07 / 1200	37.9	48.1	1008	35	"
07 / 1800	39.0	49.0	1008	35	"
08 / 0000	39.7	49.2	1006	35	tropical storm
08 / 0600	40.4	49.0	1003	40	"
08 / 1200	41.0	48.6	1003	40	"
08 / 1800	41.6	48.1	1000	40	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
09 / 0000	42.4	47.2	998	45	"
09 / 0600	43.2	46.0	1000	40	"
09 / 1200	44.0	44.4	1002	40	"
09 / 1800	45.1	42.0	1004	35	low
10 / 0000	45.9	38.5	1004	35	extratropical
10 / 0600	46.5	34.7	1004	35	"
10 / 1200	47.0	30.8	1004	30	"
10 / 1800					absorbed
09 / 0000	42.4	47.2	998	45	maximum wind and minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Tropical Storm Debby.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
02 / 1800	9V8585	38.9	33.8	230 / 37	1013.1
02 / 2200	WLPI	41.3	37.1	030 / 35	1015.0
03 / 0000	DJQA2	41.3	37.2	360 / 35	1015.6
07 / 1400	TCMO2	37.9	44.9	180 / 35	1014.4
08 / 0000	TCMO2	38.0	43.0	170 / 35	1018.0
09 / 2200	WNTL	41.6	40.7	230 / 40	1016.9
10 / 0000	WNTL	41.6	41.6	230 / 40	1017.6

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%)	72	72
Medium (40%-60%)	-	48
High (>60%)	-	-

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Debby. 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	32.6	37.5	52.9				
OCD5	67.2	151.4	256.6				
Forecasts	7	5	3	0	0	0	0
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 Tropical Storm Debby. Errors smaller than the NHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	32.6	37.5	52.9				
OCD5	67.2	151.4	256.6				
GFSI	42.1	38.4	**31.9**				
HWFI	39.2	**31.9**	**38.9**				
HMNI	40.1	49.6	68.9				
EMXI	**28.5**	40.8	56.8				
NVGI	40.3	65.2	59.8				
CMCI	**27.7**	**37.0**	**27.6**				
GFEX	35.4	38.2	**42.2**				
TVCX	**31.3**	**32.4**	**43.0**				
TVCA	**32.0**	**32.7**	**43.6**				
HCCA	**31.3**	**33.8**	**44.8**				
FSSE	**31.9**	**34.0**	**32.4**				
AEMI	38.8	**35.2**	**41.4**				
TABS	45.0	71.3	74.1				
TABM	40.7	51.9	56.1				
TABD	45.0	76.3	115.0				
Forecasts	7	5	3	0	0	0	0

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Debby. 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	**4.3**	**6.0**	11.7				
OCD5	3.4	5.8	7.7				
Forecasts	7	5	3	0	0	0	0
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 Tropical Storm Debby. Errors smaller than the NHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	4.3	6.0	11.7				
OCD5	**3.4**	**5.8**	**7.7**				
HWFI	4.7	**4.6**	**6.0**				
HMNI	4.4	9.8	**11.3**				
DSHP	**3.0**	**2.6**	**2.7**				
LGEM	**3.6**	**3.8**	**3.3**				
ICON	**3.6**	**4.6**	**5.0**				
IVCN	**4.1**	**5.4**	**6.7**				
GFSI	5.4	6.4	**10.0**				
EMXI	5.7	8.6	12.7				
HCCA	**4.1**	**4.2**	**4.7**				
FSSE	**3.3**	**2.8**	**2.0**				
Forecasts	7	5	3	0	0	0	0

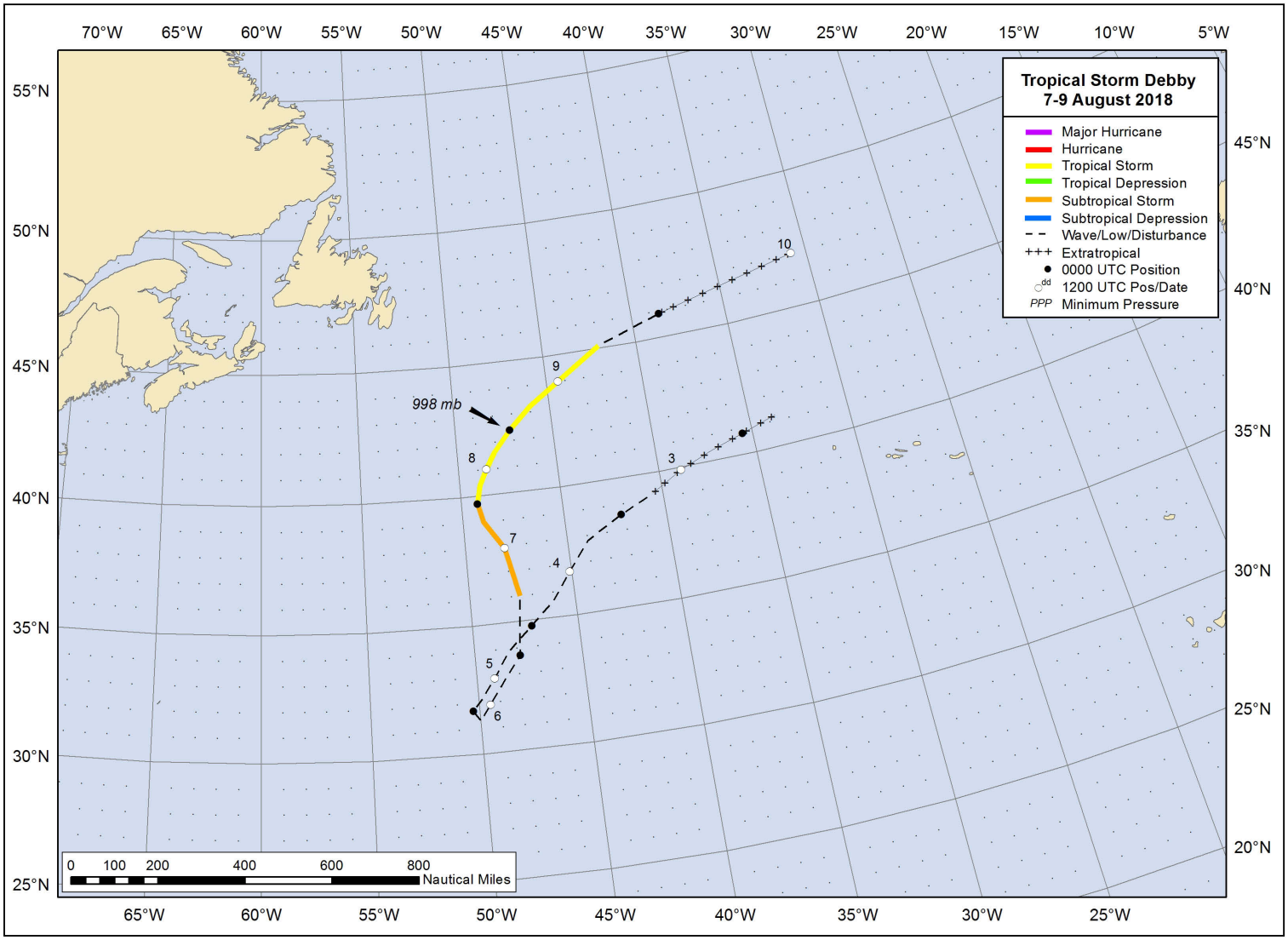

Figure 1. Best track positions for Tropical Storm Debby, 7–9 August 2018. Tracks during the extratropical stages are partially based on analyses from the NOAA Ocean Prediction Center.

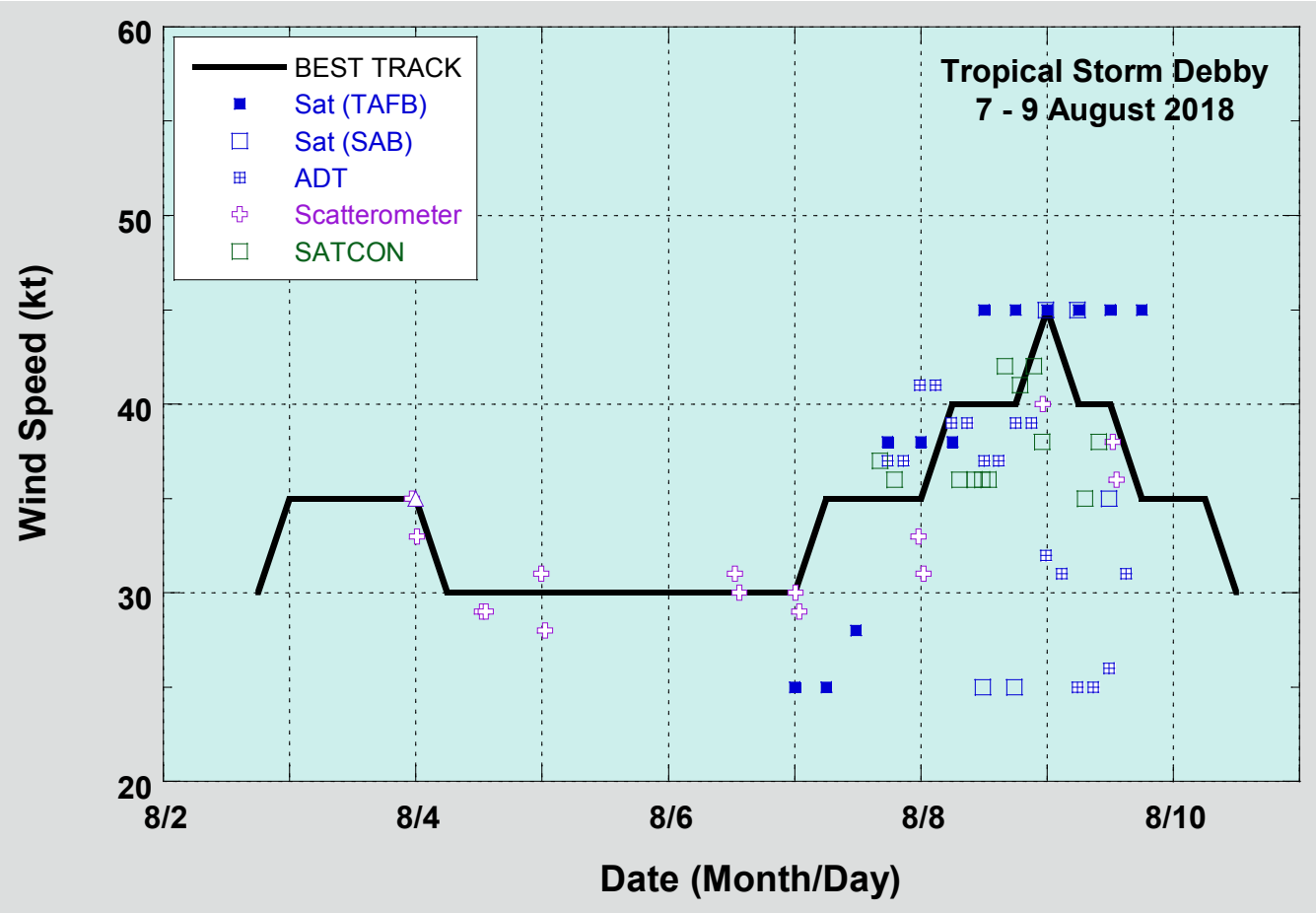

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Debby, 7–9 August 2018. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

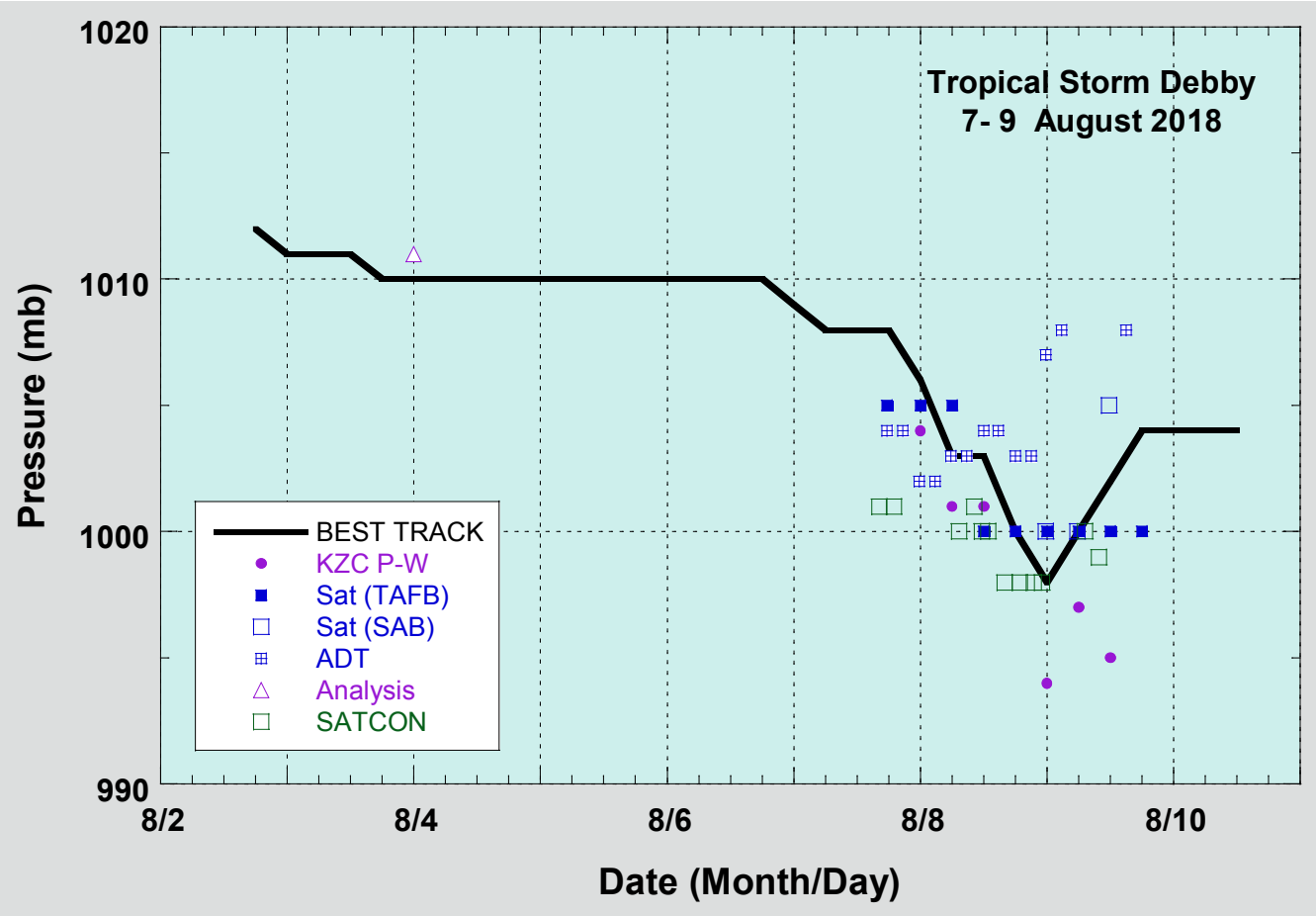

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Debby, 7–9 August 2018. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.