Tropical Cyclone Report
Tropical Storm Bret
(AL022011)
17-22 July 2011

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Updated 1 February 2012 for best track data in Table 1

Bret was a tropical storm that remained over the open ocean throughout its lifetime and briefly threatened the northern Bahamas.

a. Synoptic History

Bret's origin was non-tropical. Early on 16 July, a shortwave trough that moved off the coast of the southeastern United States induced the formation of a broad low pressure system along a weak stationary frontal boundary that lay just off the U.S. southeast coast. Although the initial surface circulation was originally baroclinic in nature, it only took about 24 h over the warm waters of the western Atlantic for the lower troposphere of the incipient low to modify and become a shallow warm core system. During that time, the low moved slowly south-southeastward to a position about 120 n mi east of Cape Canaveral, Florida, while convection gradually developed and also became better organized near the low-level center. The middle- to upper-level trough that helped initiate the surface low gradually fractured, with the main shortwave trough lifting out to the northeast well north of Bermuda while the trailing portion of the trough moved southwestward into the Gulf of Mexico as a weak upper-level low. The surface low was then located in the col region between these two upper-level features, which allowed for convection to increase due to decreasing upper-level vertical wind shear. Dvorak satellite classifications were initiated early on 17 July, and data from an Air Force Reserve reconnaissance flight into the disturbance that afternoon indicate that a tropical depression had formed around 1800 UTC about 60 n mi north of Grand Bahama Island. 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 1[1].

The depression moved slowly southeastward and steadily intensified, and became a tropical storm 6 h later. It reached its closest point of approach to Grand Bahama Island, just 40 n mi north of the island early on 18 July, before lifting out to the northeast. As vertical wind shear steadily decreased, convection gradually increased near the storm's center and an upper-level anticyclone formed over the system, which was coincident in time with the formation of an eye feature in visible and microwave satellite imagery (Figs. 4 and 5). A reconnaissance plane

[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.

sampling the cyclone's inner core wind field found a reliable surface wind of 59 kt at about the same time that the eye appeared in satellite imagery, and it is estimated that Bret reached its peak intensity of 60 kt at 1800 UTC 18 July when the cyclone was located about 110 n mi north-northeast of Grand Bahama Island. This intensity was maintained for another 6 h.

Shortly thereafter, the vertical shear affecting Bret began to increase as the cyclone came under the influence of increasing southwesterly upper-level wind flow ahead of a second shortwave trough. The cyclone began a slow weakening trend that lasted for the next 72 h as Bret moved northeastward at 7-10 kt. By 0000 UTC 22 July, Bret began to accelerate to the northeast and weakened to a tropical depression about 270 n mi northwest of Bermuda. The combination of vertical shear in excess of 30 kt and lower sea-surface temperatures quickly took their toll on the cyclone. Bret lost all of its deep convection and became a remnant low pressure system just 12 h later. The remnant low moved northeastward at 20-25 kt over the very cold water of the far north Atlantic for the next 24 h, and the system dissipated by 1200 UTC 23 July, when centered about 425 n mi south-southwest of Cape Race, Newfoundland.

b. Meteorological Statistics

Observations in Bret (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). Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron (53WRS) of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM) and Aqua, 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 Bret. Objective Dvorak estimates (ADT) from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison were not used since they appeared to be too low when compared to other data sources.

There were no ship or land station reports of sustained tropical-storm-force winds associated with Bret. However, NOAA buoy 41048 (31.98^{o}N 69.65^{o}W) reported a 1-minute mean wind of 33 kt with a gust to 37 kt at 1045 UTC 21 July when Bret passed about 120 n mi northwest of its location. Also, unofficial reports from Rocky Bay, Elbow Cay, Abaco Island (Site ID: IABACOEL1) in the northwestern Bahamas indicate a wind gust of 37 kt was observed at 0241 UTC 18 July and a gust of 42 kt occurred at 0423 UTC later that day.

Once Bret moved into a low-shear, upper-level col region early on 18 July, the development of the cyclone increased markedly. An eye-like feature first became apparent in an 1121 UTC WINDSAT 37 GHz microwave pass, which revealed a 75% closed eye. This feature also appeared at 1131 UTC as a closed 12-n-mi-diameter, circular eye in the Melbourne, Florida (KMLB) WSR-88D Doppler radar data at an altitude of 31 Kft, just before the cyclone moved out of radar range. The eye-like feature persisted in microwave (SSMIS) and conventional satellite imagery until at least 2312 UTC that same day.

Bret's estimated peak intensity of 60 kt is based on an uncontaminated SFMR surface wind speed value of 59 kt measured at 1927 UTC 18 July by an aircraft from the 53WRS as it flew into and out of the inner core convection during a pass through the northwestern quadrant of the eye-like feature.

c. Casualty and Damage Statistics

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

d. Forecast and Warning Critique

The genesis of Bret was not well anticipated. The precursor disturbance was first introduced in the Tropical Weather Outlook (TWO) at 1800 UTC 16 July with having a 20% probability of development just 24 h before genesis occurred. The probability of formation reached 30% at 1200 UTC 17 July and only reached 40% at 1800 UTC, which was near the time that genesis is now thought to have occurred. Forecasting the exact time when an extratropical or subtropical low pressure system will become a tropical cyclone remains a significant operational challenge.

A verification of NHC official track forecasts for Bret is given in Table 2a. Bret was forecast quite well given the limited number of forecasts available for verification purposes. Official forecast track errors (OFCL) were much lower than the mean official errors for the previous 5-yr period at all times. In fact, at 24-72 h, the official forecast errors were more than 50% lower than the 5-yr mean. However, the OCD5 climatology-persistence model errors were also much lower than average, which means that Bret was easier to forecast on average. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b.

A verification of NHC official intensity forecasts for Bret is given in Table 3a. As were the track forecasts, the official forecast intensity errors were much lower than the mean official errors for the previous 5-yr period. Through 24 h, the intensity errors were more than 50% lower than average, and beyond that the errors were about 60% lower than the 5-yr average. Although OCD5 intensity errors were also lower than average, the percentage difference was less for OCD5 than for OFCL, which means the official intensity forecasts still showed considerable skill when compared to climatology. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b.

Watches and warnings associated with Bret are listed in Table 4.

Table 1. Best track for Tropical Storm Bret, 17-22 July 2011.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
16 / 0600	30.7	79.7	1014	20	low
16 / 1200	30.3	79.4	1014	20	"
16 / 1800	29.8	79.1	1014	20	"
17 / 0000	29.3	78.8	1014	20	"
17 / 0600	28.8	78.5	1014	20	"
17 / 1200	28.3	78.3	1013	25	"
17 / 1800	27.8	78.2	1011	30	tropical depression
18 / 0000	27.5	78.1	1008	35	tropical storm
18 / 0600	27.1	78.0	1001	40	"
18 / 1200	27.4	77.5	999	45	"
18 / 1800	27.8	77.1	995	60	"
19 / 0000	28.4	76.8	996	60	"
19 / 0600	29.0	76.6	999	50	"
19 / 1200	29.5	76.2	999	45	"
19 / 1800	30.0	75.8	999	45	"
20 / 0000	30.5	75.3	1000	45	"
20 / 0600	30.9	74.7	1001	45	"
20 / 1200	31.4	74.1	1002	45	"
20 / 1800	31.9	73.4	1005	45	"
21 / 0000	32.4	72.7	1005	45	"
21 / 0600	33.0	72.0	1005	40	"
21 / 1200	33.5	71.2	1006	35	"
21 / 1800	34.1	70.1	1007	35	"
22 / 0000	35.1	68.9	1008	30	tropical depression
22 / 0600	36.2	67.4	1008	30	"
22 / 1200	37.3	65.2	1009	30	low
22 / 1800	38.3	62.8	1009	30	"
23 / 0000	39.2	60.1	1010	25	"
23 / 0600	39.8	57.0	1010	25	"
23 / 1200					dissipated
18 / 1800	27.8	77.1	995	60	minimum pressure & maximum intensity

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Bret. Mean errors for the 5-yr period 2006-10 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	**16.1**	**23.1**	**32.8**	**42.7**	**66.1**	**133.4**	
OCD5	27.3	49.6	74.2	109.4	189.9	408.7	
Forecasts	17	15	13	11	7	3	
OFCL (2006-10)	31.0	50.6	69.9	89.5	133.2	174.2	
OCD5 (2006-10)	47.7	98.3	156.4	218.1	323.3	402.2	

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Bret. 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 2a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	12.7	21.3	32.6	45.7	130.3		
OCD5	23.5	45.0	61.9	97.6	**109.0**		
GFSI	17.5	31.3	54.1	93.1	185.6		
GHMI	20.6	34.8	48.3	55.2	161.7		
HWFI	19.1	33.9	52.2	66.1	217.2		
GFNI	29.2	68.1	111.9	197.1	314.8		
NGPI	23.6	44.1	70.6	91.2	138.1		
EGRI	19.7	31.2	52.9	65.2	**61.6**		
EMXI	21.7	37.9	58.7	76.0	148.7		
CMCI	37.4	84.8	131.3	189.0	267.6		
TCCN	14.9	21.3	32.7	**38.2**	**116.2**		
TVCN	15.1	22.4	37.1	50.7	**109.8**		
TVCA	14.6	21.5	33.3	**45.6**	**102.2**		
TVCC	14.2	**21.1**	**31.4**	45.7	**102.8**		
GUNA	14.3	**20.0**	35.5	**45.1**	**121.2**		
FSSE	18.5	26.8	35.0	**45.1**	133.3		
AEMI	18.6	32.9	60.7	108.9	212.2		
BAMS	24.2	44.1	63.9	74.7	**65.1**		
BAMM	39.4	70.4	114.1	152.5	244.1		
BAMD	78.8	142.1	226.5	306.8	549.8		
Forecasts	13	10	10	6	2		

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Bret. Mean errors for the 5-yr period 2006-10 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	**2.9**	**5.3**	**5.4**	**3.6**	**5.7**	**6.7**	
OCD5	3.3	7.9	12.8	16.1	21.3	19.3	
Forecasts	17	15	13	11	7	3	
OFCL (2006-10)	7.2	11.0	13.2	15.1	17.2	17.9	
OCD5 (2006-10)	8.5	12.3	15.4	17.8	20.2	21.9	

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Bret. 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	72	96	120
OFCL	3.0	5.4	5.9	3.9	7.5	5.0	
OCD5	3.5	8.7	13.4	16.1	24.8	21.0	
LGEM	3.1	6.0	6.5	4.4	9.5	16.0	
DSHP	3.7	5.5	6.9	7.3	**3.5**	**3.0**	
HWFI	**2.9**	**3.8**	**5.5**	**3.8**	**3.8**	7.0	
GHMI	3.3	6.0	6.2	7.2	14.0	15.0	
GFNI	5.0	6.1	**4.4**	5.2	**6.8**	10.0	
FSSE	3.5	5.8	5.9	4.4	**4.0**	6.0	
ICON	3.1	**4.9**	**4.8**	3.9	**6.8**	11.0	
IVCN	3.3	**4.6**	**4.2**	**2.8**	**7.0**	6.0	
Forecasts	15	12	11	9	4	1	

Table 4. Watch and warning summary for Tropical Storm Bret, 17-22 July 2011.

Date/Time (UTC)	Action	Location
17 / 2100	Tropical Storm Watch issued	Grand Bahama Island and Abaco Islands
18 / 0600	Tropical Storm Watch changed to Tropical Storm Warning	Grand Bahama Island and Abaco Islands
18 / 2100	Tropical Storm Warning discontinued	Grand Bahama Island and Abaco Islands

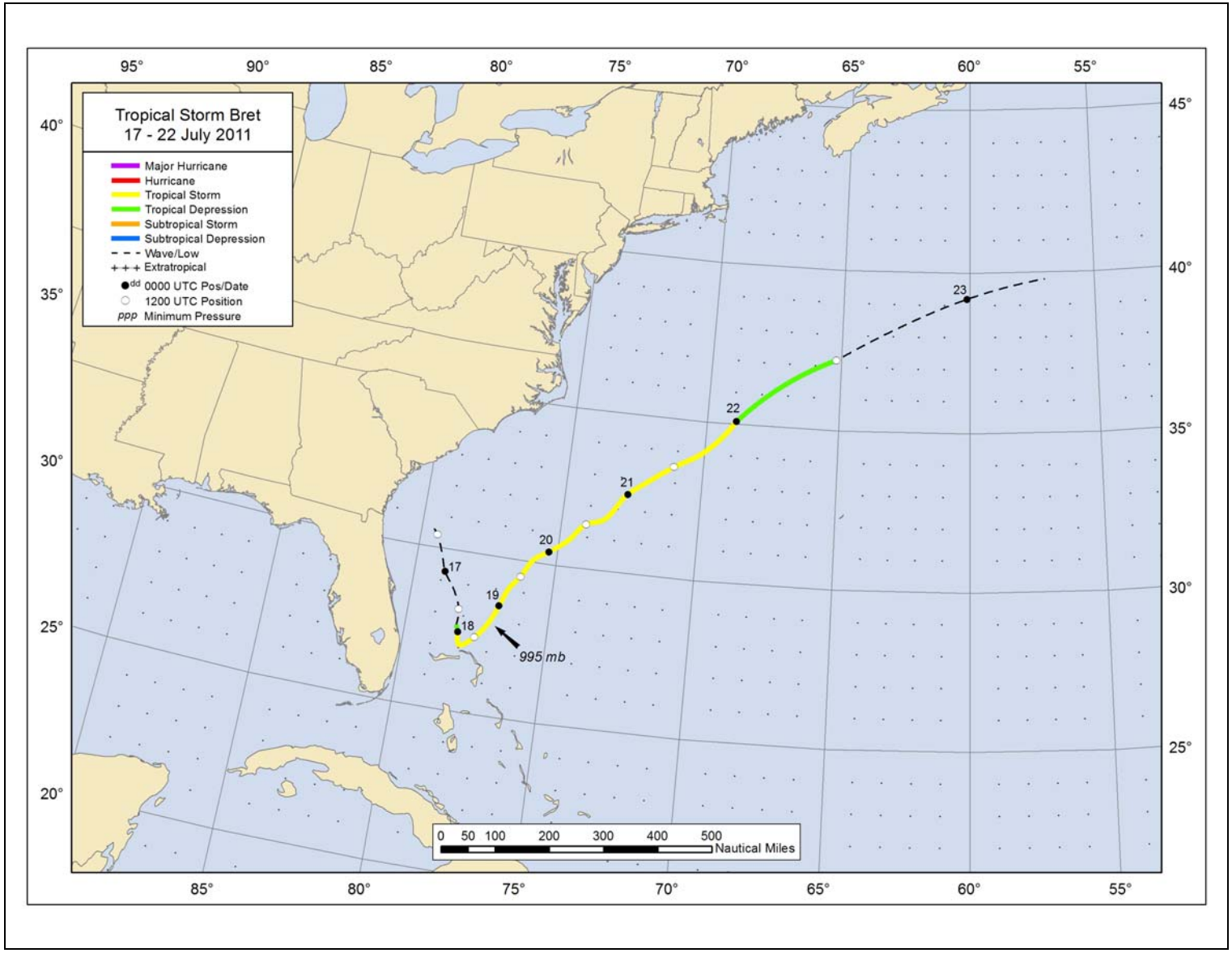

Figure 1. Best track positions for Tropical Storm Bret, 17-22 July 2011. Track during the post-tropical remnant low stage is based partly on analyses from the NOAA Ocean Prediction Center.

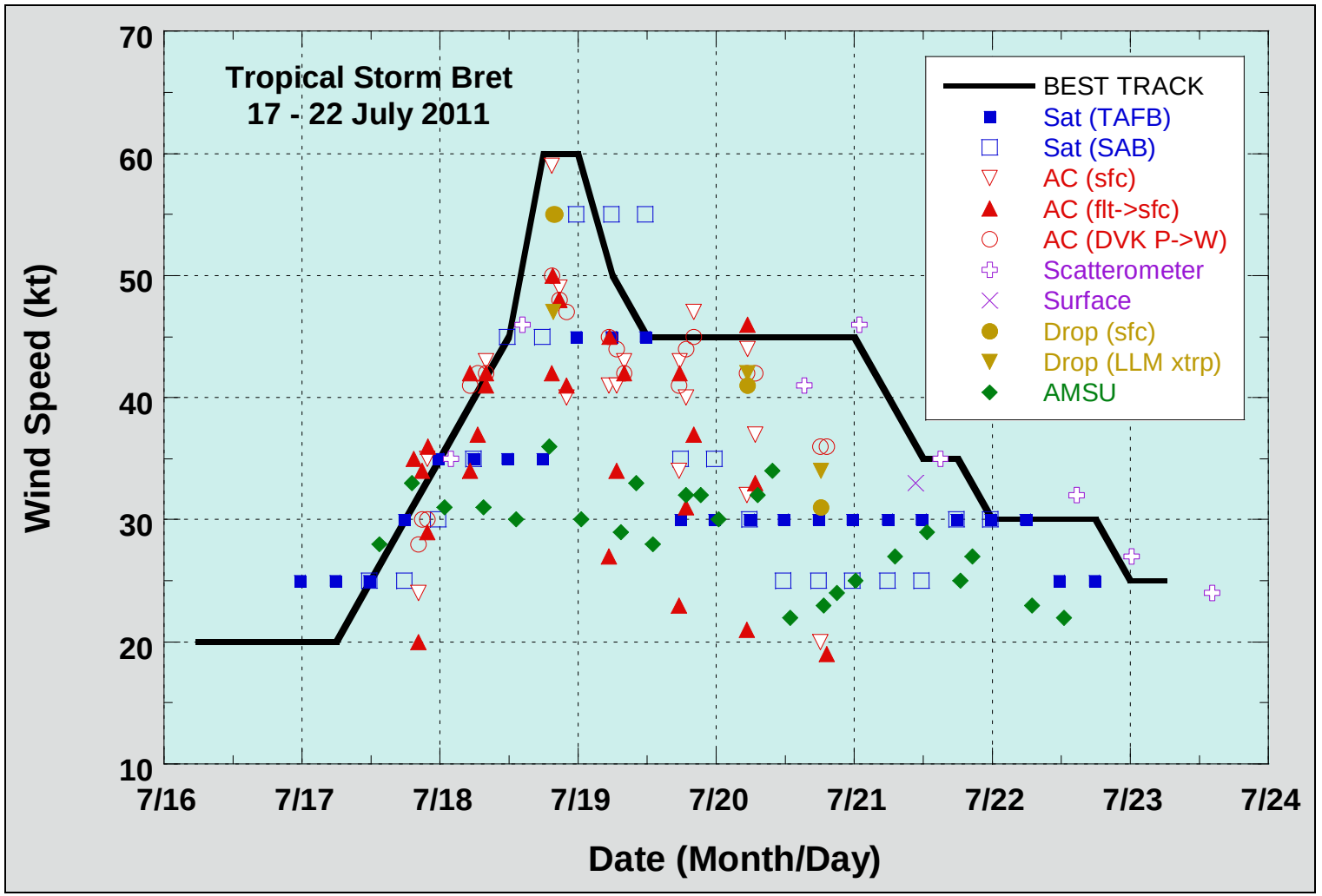

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Bret, 17-22 July 2011. Aircraft observations have been adjusted for elevation using an 80% adjustment factor for observations from both 850 mb and 1000 ft. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Estimates during the post-tropical stage are based partly on analyses from the NOAA Ocean Prediction Center. Dashed vertical lines correspond to 0000 UTC.

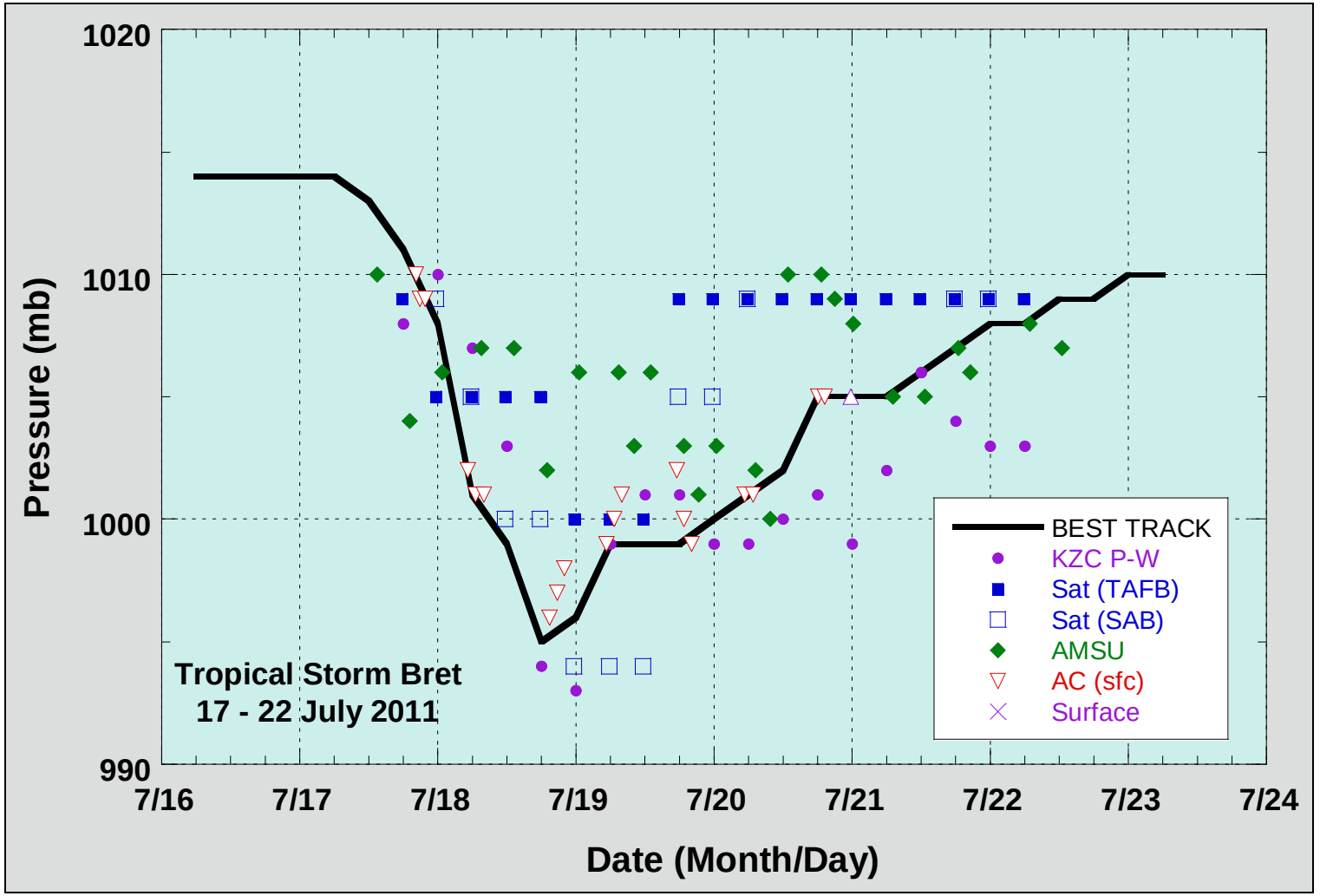

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Bret, 17-22 July 2011. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W values are obtained by applying the Knaff-Zehr-Courtney pressure-wind relationship to the best track data. Estimates during the post-tropical stage are based partly on analyses from the NOAA Ocean Prediction Center. Dashed vertical lines correspond to 0000 UTC.

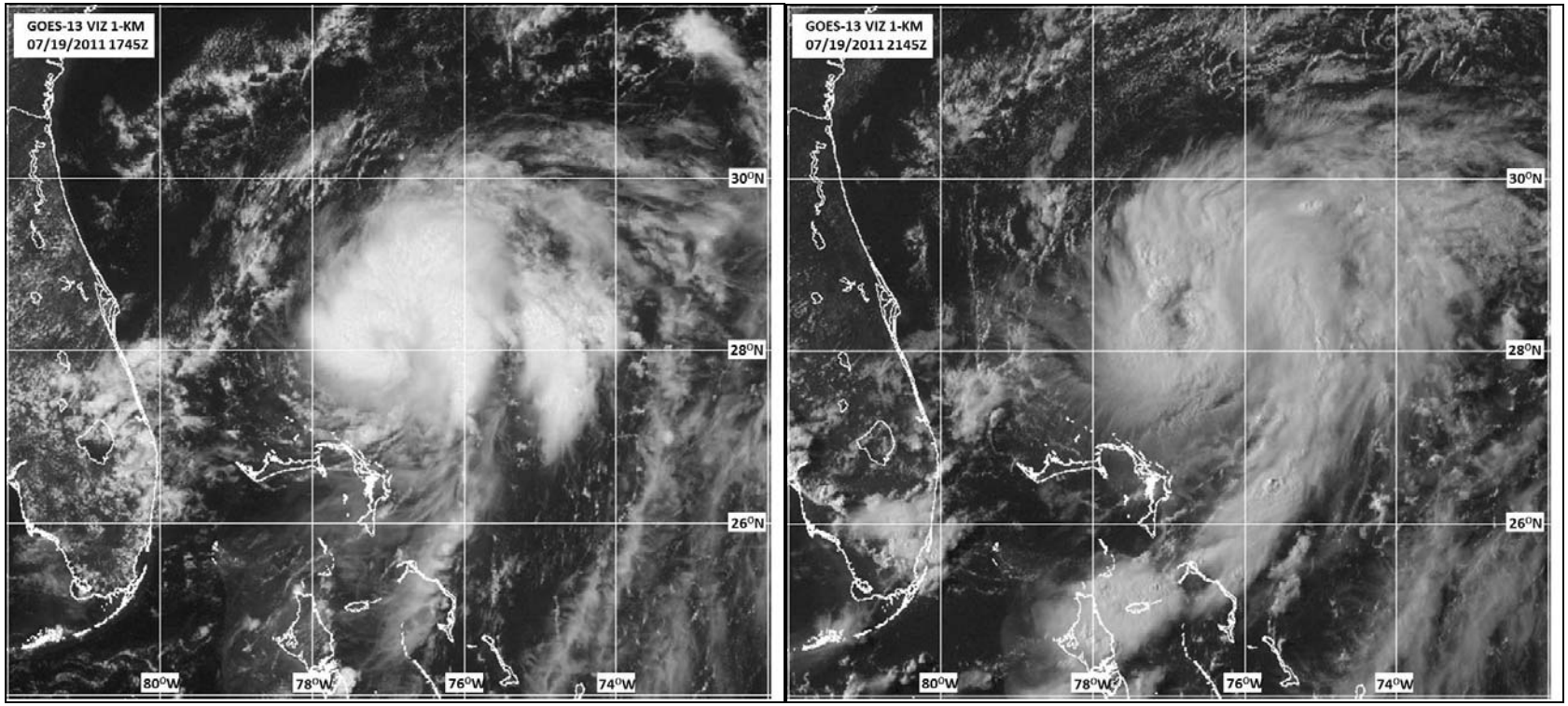

Figure 4. GOES-13 visible images at 1745 UTC (left) and 2145 UTC (right) on 18 July 2011 showing an eyelike feature during Bret's peak intensity period. Images courtesy U.S. Navy Fleet Numerical Meteorology and Oceanography Center, Monterey, CA.

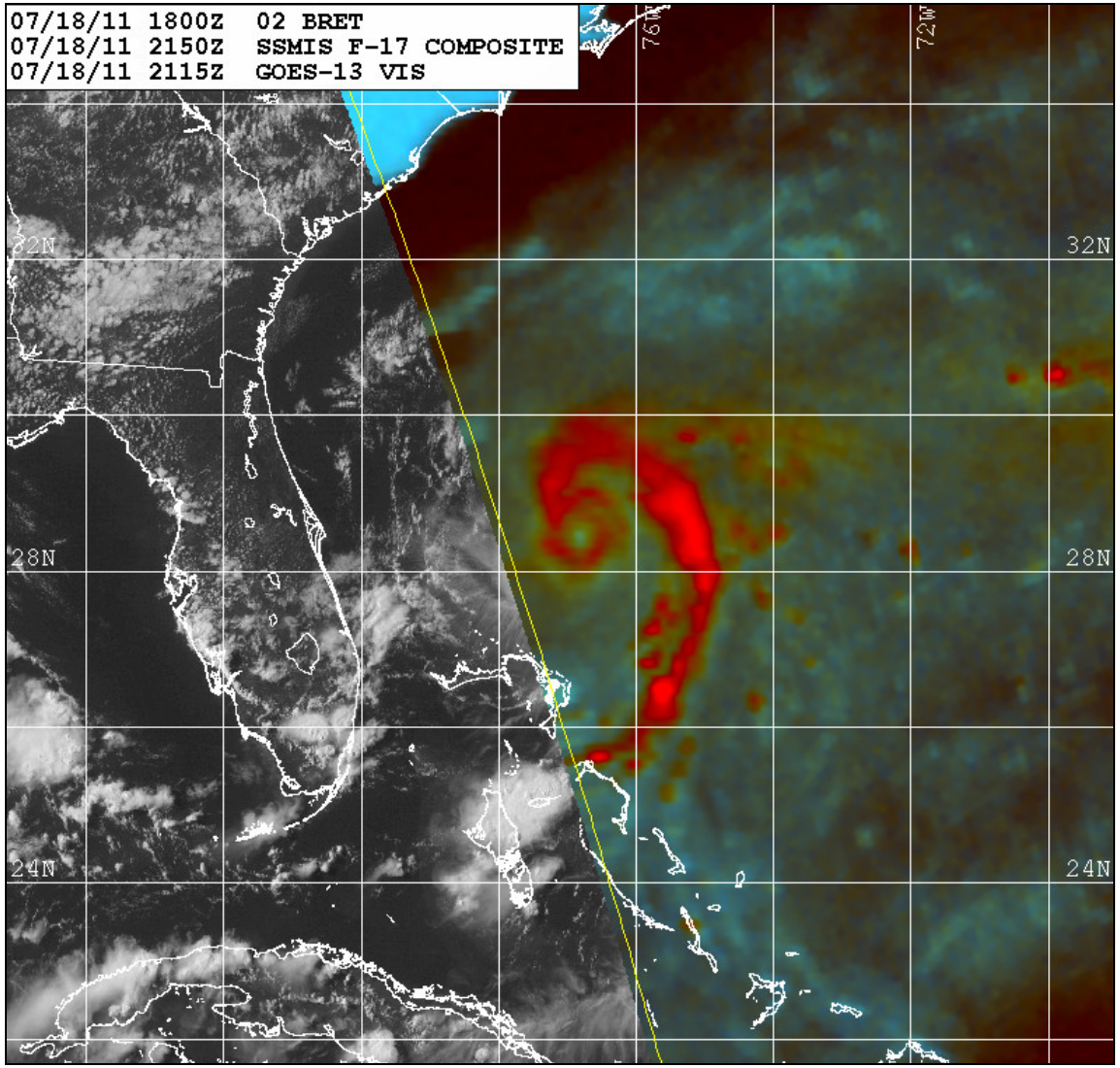

Figure 5. SSMI/S 91 GHz microwave image at 2145 UTC 18 July 2011 showing a mid-level eye feature when Bret was at its peak intensity of 60 kt. Other microwave channels indicated this feature was not due to contamination by either large ice particles or large concentrations of ice. Image courtesy U.S. Navy Fleet Numerical Meteorology and Oceanography Center, Monterey, CA.