

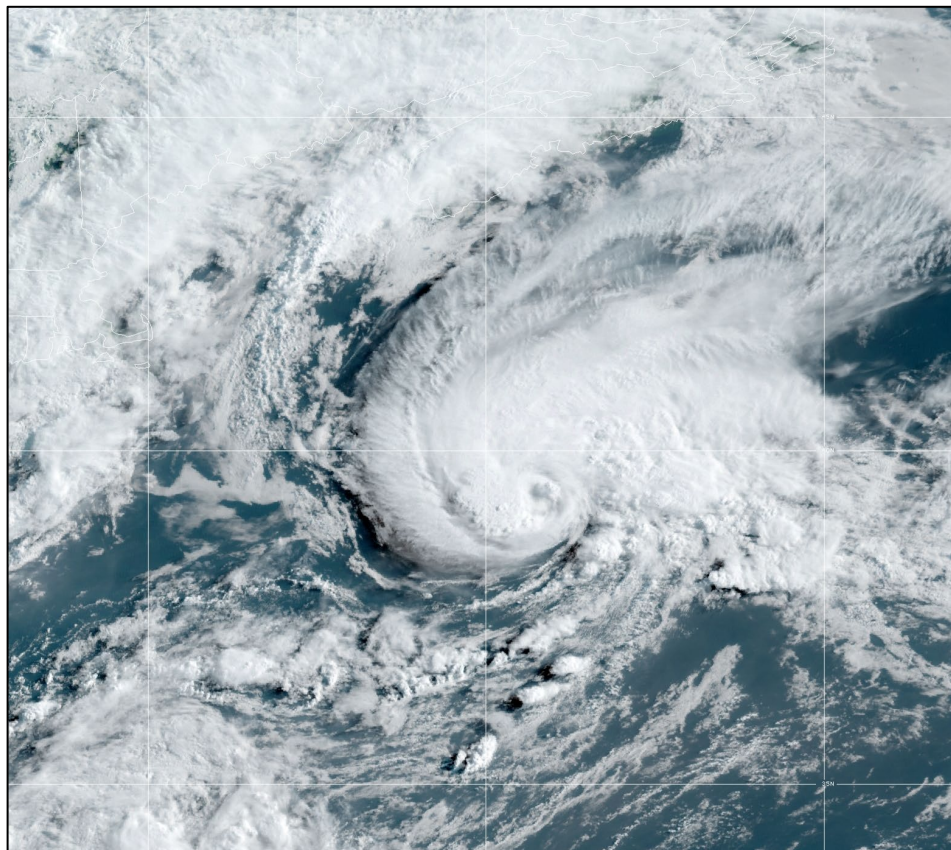


# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

## TROPICAL STORM BILL (AL022021)

14–15 June 2021

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National Hurricane Center  
27 September 2021



GOES-16 GEO-COLOR IMAGE OF TROPICAL STORM BILL AT 1100 UTC 15 JUNE 2021,  
NEAR THE TIME OF PEAK INTENSITY.

Bill was a short-lived tropical storm that formed off the coast of the Carolinas and moved northeastward away from the east coast of the United States.

# Tropical Storm Bill

14–15 JUNE 2021

## SYNOPTIC HISTORY

The genesis of Bill can be traced back to a front that stalled just offshore the coasts of North and South Carolina in mid-June. The cold front initially moved southward along the Mid-Atlantic coast of the United States on 10 June, and it became stationary near southeastern Virginia the next day. A shortwave trough that dug southward over the southern Appalachians produced a frontal wave over eastern North Carolina that helped push the front southward across North Carolina on 12 June, and by early the next day the front sagged southward off the coast of South Carolina. By 1200 UTC 13 June, showers and thunderstorms developed over the coastal waters of South Carolina, and a broad area of low pressure formed along the western end of the now decaying stationary front. The circulation of the low, while somewhat elongated from northeast to southwest, gradually became better defined that day as it began moving northeastward at about 10 kt. Early on 14 June, while the low moved offshore of, but parallel to, the southeastern U.S. coastline, shower and thunderstorm activity began to increase and become better organized. This led to the formation of a tropical depression by 0600 UTC 14 June about 110 n mi east-southeast of Cape Fear, North Carolina. At the time of genesis, the decaying front was still nearby, but it is analyzed to have been located just northwest of the center of the tropical depression. 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<sup>1</sup>.

After formation, the depression began to accelerate northeastward ahead of an amplifying mid-latitude trough that was approaching the northeastern United States. Convective banding associated with the system increased over the next 6 h and the depression gradually strengthened. Although southwesterly shear caused the convection to become displaced to the northeast of the tight low-level center during the afternoon, the depression managed to strengthen into a tropical storm by 1800 UTC 14 June when it was located about 135 n mi east of Cape Hatteras, North Carolina. Scatterometer surface wind data from early on 15 June showed that the sheared tropical storm attained an intensity of 40 kt by 0000 UTC that day. Deep convection redeveloped over the low-level center during the next 12 h, which led to a significant increase in banding over the northern and western portions of the circulation (Fig. 4). This structure resulted in a faster rate of strengthening, and it is estimated that Bill reached a peak intensity of 55 kt at

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<sup>1</sup> 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.

1200 UTC 15 June when it was centered about 300 n mi east-southeast of Chatham, Massachusetts.

Shortly thereafter, strong southwesterly shear and decreasing sea-surface temperatures along the path of the cyclone caused rapid weakening. By late on 15 June, the approaching mid-latitude trough led to a swift extratropical transition of the system, and Bill became a 35-kt extratropical cyclone by 0000 UTC 16 June when it was centered about 320 n mi east-southeast of Halifax, Nova Scotia. The extratropical cyclone quickly degenerated into a trough of low pressure 6 h later, and soon thereafter the trough passed over portions of southeastern Newfoundland.

## METEOROLOGICAL STATISTICS

Observations in Bill (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 Bill.

Bill's estimated peak intensity of 55 kt is based on ASCAT-C data that revealed peak winds of 52 kt in the southeastern quadrant of the storm at 1430 UTC 15 June. That was around the time that the banding features were most well established (cover photo, Fig. 4). The 55-kt peak intensity is also supported by a SAB subjective Dvorak classification of T3.5 (55 kt) at 1200 UTC 15 June.

There were no ship or land-based reports of winds of tropical storm force in association with Bill.

## CASUALTY AND DAMAGE STATISTICS

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

## FORECAST AND WARNING CRITIQUE

The genesis of Bill was poorly forecast. The precursor disturbance was not mentioned in the Tropical Weather Outlook until 12 h prior to formation. At the time it was introduced into the TWO with a low (<40%) chance of formation in both the 2- and 5-day time periods (Table 2). The probabilities did not reach the medium (40-60%) or high (>60%) categories before genesis is



deemed to have occurred in the best track. Operationally, the genesis probabilities were raised to the medium category with the issuance of a Special Tropical Weather Outlook at 0900 UTC 14 June and increased to the high category in the routine issuance of the TWO at 1200 UTC that day; however, the final best track indicates that the disturbance had become a tropical depression by 0600 UTC that morning. The lack of anticipation of genesis is primarily the result the expectation that the system would remain extratropical, attached to the front that was located off the coast of North and South Carolina. Instead, the low developed just southeast of the decaying frontal system and quickly became a tropical cyclone. Additionally, some of the global model guidance did not predict the formation of a low until around the time that the system developed.

A verification of NHC official track forecasts for Bill is given in Table 3. Official forecast track errors were about double the long-term means, albeit for a small sample size of only four verifying 12-h forecasts and two 24-h forecasts. The climatology and persistence (OCD5) model errors were also significantly larger than their 5-year averages, suggesting that the track of Bill was more difficult than average to predict. This was likely due to the atypically fast (>30 kt) forward speed of the tropical cyclone by 15 June. Official forecast intensity errors were slightly lower than the mean errors for the previous 5-yr period (Table 4).

Due to Bill's brief existence as a tropical cyclone, a meaningful comparison of official forecasts and track and intensity model guidance cannot be made.

There were no watches and warnings for any land areas in association with Bill.

Table 1. Best track for Tropical Storm Bill, 14–15 June 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
13 / 1800	31.9	78.1	1008	20	low
14 / 0000	32.5	77.1	1007	20	"
14 / 0600	33.2	75.9	1006	25	tropical depression
14 / 1200	34.0	74.5	1005	30	"
14 / 1800	34.9	72.8	1003	35	tropical storm
15 / 0000	36.0	70.8	1000	40	"
15 / 0600	37.6	67.8	996	50	"
15 / 1200	39.4	64.0	992	55	"
15 / 1800	40.9	60.8	997	45	"
16 / 0000	42.5	57.9	1002	35	extratropical
16 / 0600					dissipated
15 / 1200	39.4	64.0	992	55	maximum wind and minimum pressure



Table 2. 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%)	12	12
Medium (40%-60%)	-	-
High (>60%)	-	-

Table 3. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Bill, 14–15 June 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	53.9	70.9						
OCD5	115.1	251.4						
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 Bill, 14–15 June 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	<b>5.0</b>	<b>5.0</b>						
OCD5	11.0	9.5						
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

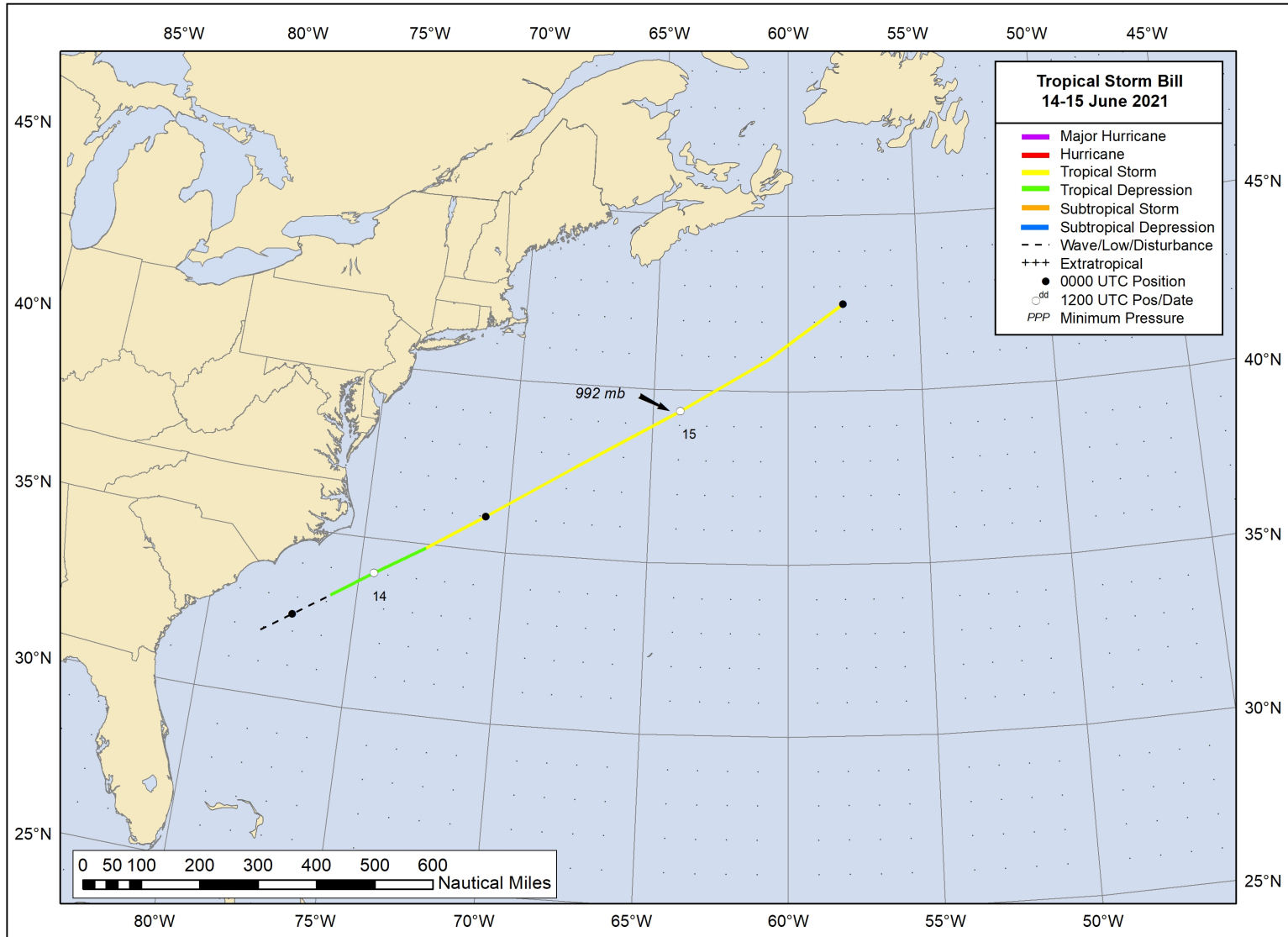


Figure 1. Best track positions for Tropical Storm Bill, 14–15 June 2021. The track during the extratropical stage is partially based on analyses from the NOAA Ocean Prediction Center.



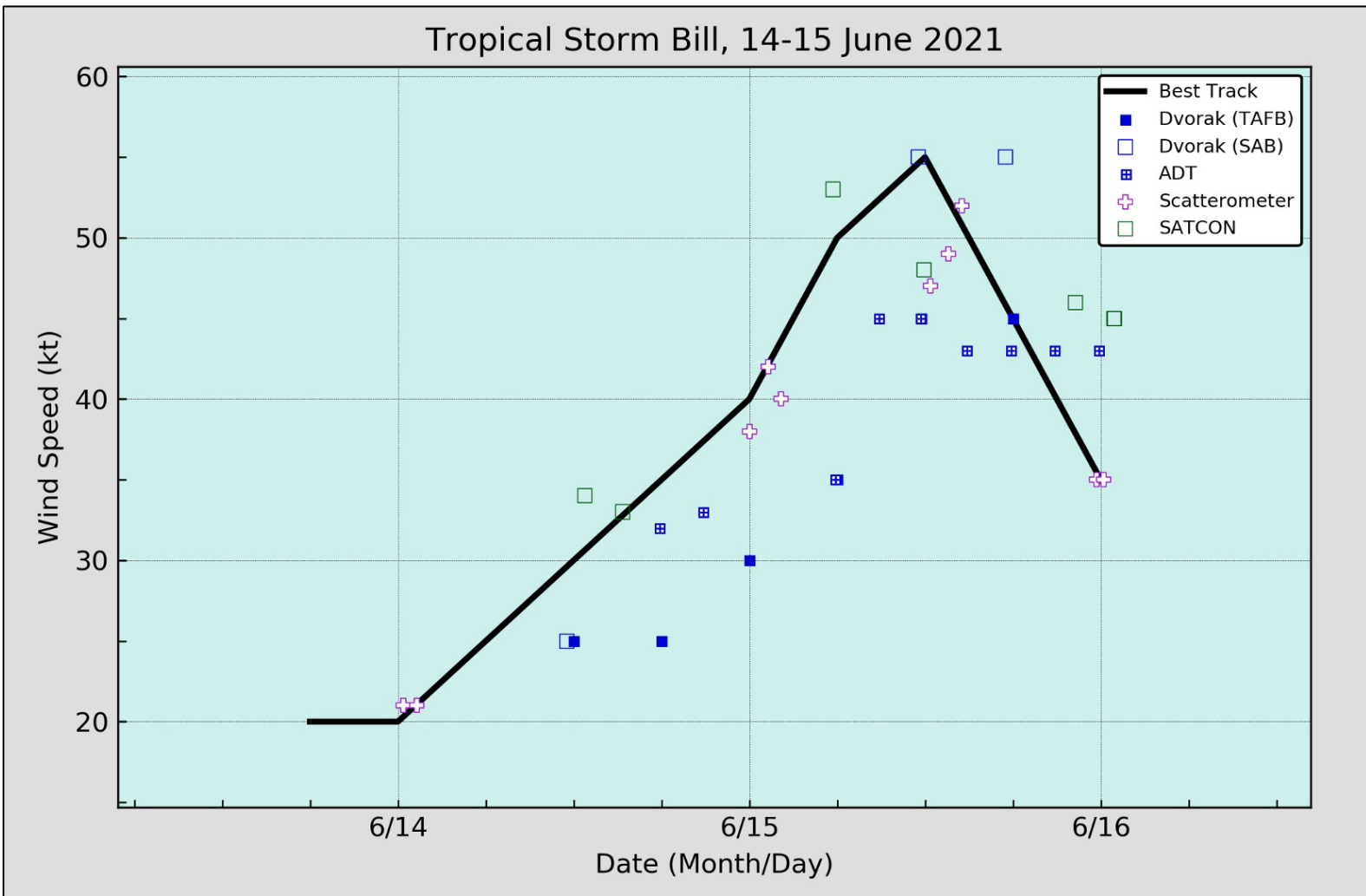


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Bill, 14–15 June 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

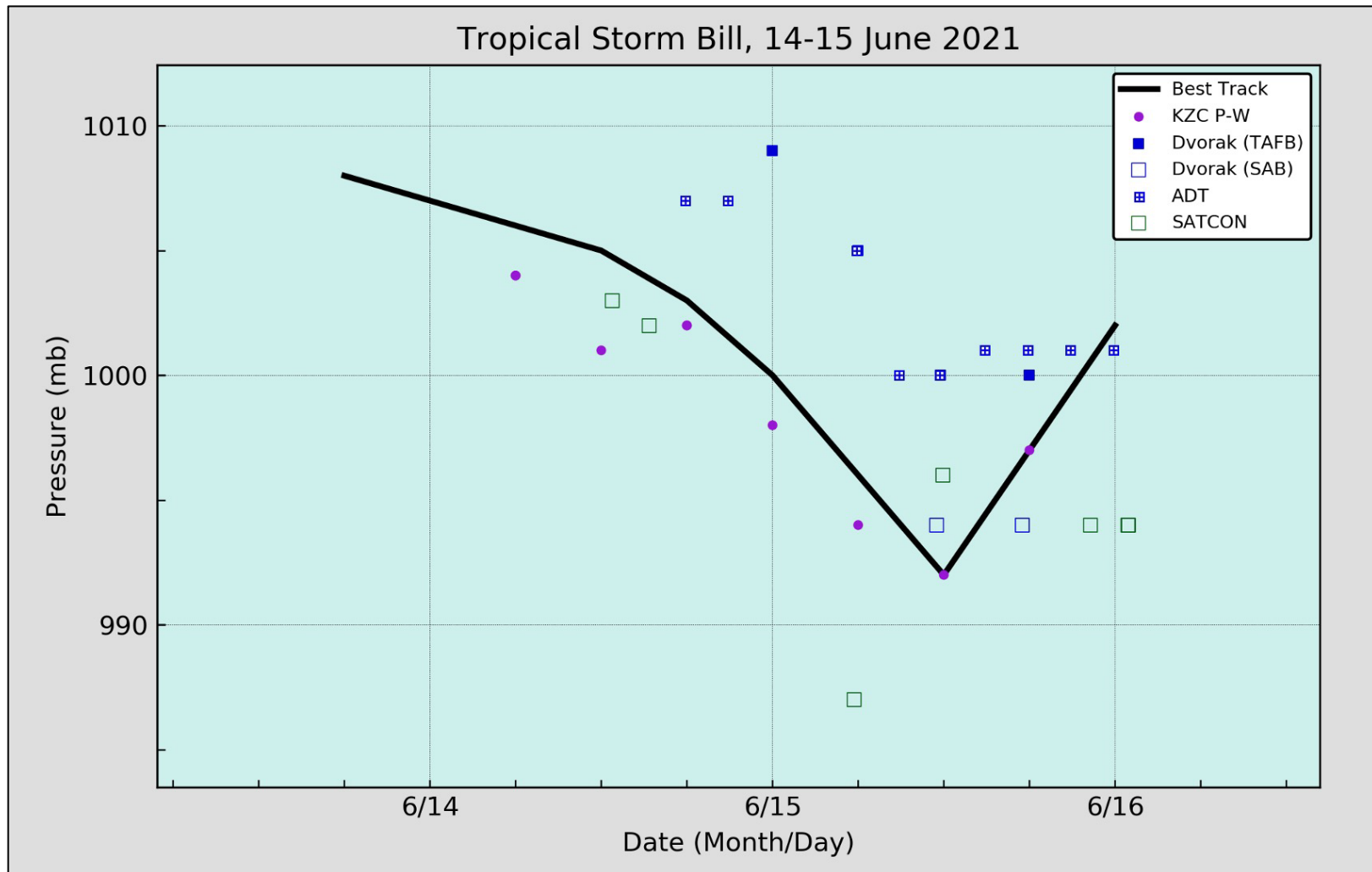


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Bill, 14–15 June 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.

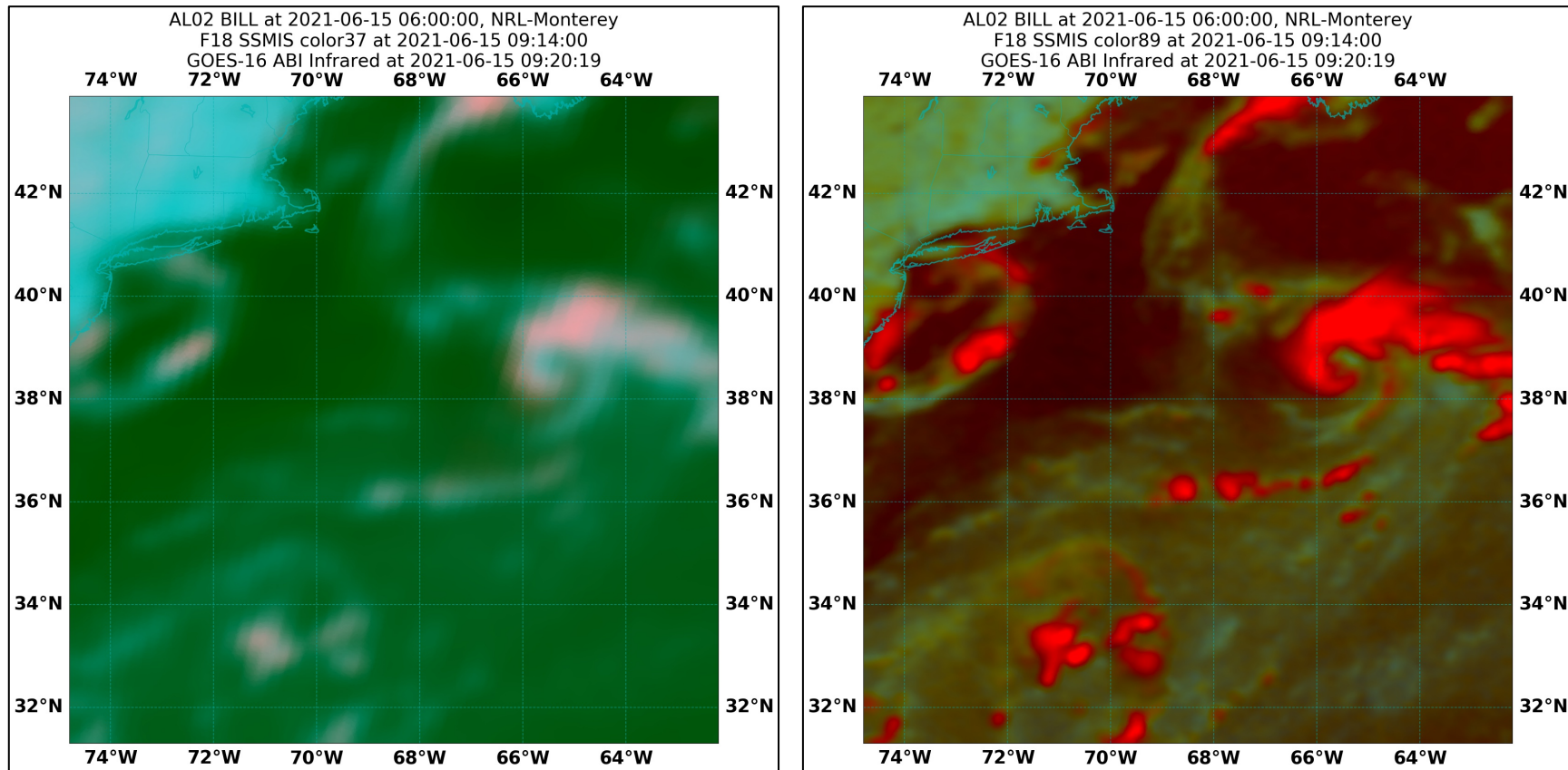


Figure 4. Special Sensor Microwave Imager/Sounder (SSMIS) 37-GHz (left) and 91-GHz (right) color composite images of Tropical Storm Bill near peak intensity at 0914 UTC 15 June. Note the convective band that wraps around the northern and western side of the circulation. Images courtesy of the Naval Research Laboratory (NRL).