

Tropical Cyclone Report
Hurricane Bud
(EP022012)
20 – 26 May 2012

Eric S. Blake
National Hurricane Center
9 October 2012

Bud was an early-season major hurricane that brought tropical storm conditions to portions of southwestern Mexico before dissipating just offshore.

a. Synoptic History

The precursor to Bud was a low-latitude tropical wave that left the coast of west Africa on 5 May. This system became better defined as crossed into the eastern Caribbean Sea six days later, causing an area of showers and thunderstorms over the Windward Islands as it passed. The wave moved rapidly westward into the far eastern Pacific on 13 May, and a broad low formed from the wave on 16 May several hundred miles south of Acapulco, Mexico. This low turned to the northwest and slowed on 17 May, while the low-level circulation became better defined. However, development was interrupted by strong southeasterly shear as the low began moving toward the southeast into a large ITCZ circulation, and the low degenerated into a trough early on 19 May. Despite the decrease in low-level organization, convection then increased over a large area near the system later that day, probably due to a Kelvin wave passage. These thunderstorms led to the development of another westward-moving low pressure area early on 20 May. Convection became organized in bands later that day, leading to the formation of a tropical depression around 1800 UTC 20 May about 450 n mi south of Acapulco. The “best track” chart of Bud’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.

Initially, easterly wind shear prevented much development, and the system was only a minimal tropical storm 42 h after genesis. The wind shear then diminished, and Bud intensified quickly, with the Advanced Dvorak Technique and AMSU data suggesting that it became a hurricane late on 23 May. The cyclone continued to intensify rapidly, and Air Force Reserve reconnaissance data indicate that Bud reached its peak intensity of about 100 kt at 0000 UTC 25 May (Fig. 4) about 165 n mi southwest of Manzanillo, Mexico. During the intensification period, Bud turned from a general northwestward track and to northeastward ahead of a mid-latitude trough over the southwestern United States.

After the time of peak intensity, southwesterly shear increased and Bud weakened rapidly as it approached the coast of Mexico. It became a tropical storm about 40 n mi southwest of the

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.

coast of Mexico late on 25 May, and tropical-storm-force winds brushed the coast as the center passed just offshore. All convection dissipated by 0600 UTC 26 May and Bud degenerated into a post-tropical cyclone while centered about 15 n mi offshore. A combination of the southwesterly shear, interaction with the high terrain of Mexico, and entrainment of more stable air from the northwest likely caused the rapid dissipation of the system. The remnants of the cyclone moved northward very close to the coast of southwestern Mexico, and dissipated by 1800 UTC 26 May.

b. Meteorological Statistics

Observations in Bud (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), as well as the Advanced Dvorak Technique from the University of Wisconsin-Madison/Cooperative Institute for Meteorological Satellite Studies (UW-CIMSS). Two aircraft flights of the Air Force Reserve 53rd Weather Reconnaissance Squadron provided flight-level, stepped frequency microwave radiometer (SFMR) surface wind, and dropsonde data. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), Defense Meteorological Satellite Program (DMSP) satellites and the European Advanced Scatterometer (ASCAT) satellite, among others, were also useful in constructing the best track of Bud.

The 100-kt analyzed peak intensity of Bud is primarily based on a flight-level wind adjustment of peak 700-mb winds of 120 kt and peak SFMR values of 89 kt. While a typical adjustment from that flight level would give an intensity of 105-110 kt, SFMR data suggest a lower value, so a more conservative blend has been used. It is worth noting that the 120-kt value was measured on the last outbound leg of the aircraft flight, so only a limited amount of data was collected for comparison after that time.

The minimum central pressure of Bud is estimated at 961 mb. The lowest pressure measured was a 964 mb dropsonde at 1917 UTC 24 May with 19 kt of wind, leading to an estimate of 962-963 mb. Bud did show some improvement in satellite images after that drop, along with higher flight-level winds, and the final estimate of 961 mb is based on these factors.

The only reports received of sustained tropical-storm-force winds were from the airport in Manzanillo. The station reported 10-min sustained winds of 36 kt at 1400 UTC 25 May, and a peak gust of 49 kt 4 h later. There were no ship reports of tropical-storm-force winds in association with Bud.

c. Casualty and Damage Statistics

Only minor damage, including the washing out of a few roads near Manzanillo, was reported in southwestern Mexico. There were no reports of casualties.

d. Forecast and Warning Critique

The genesis of Bud was not well forecast. The precursor wave was introduced into the Tropical Weather Outlook with a low chance of genesis five days prior to its formation. However, this probability was increased to a medium chance (30-40%) about four days prior to genesis. This probability decreased with time as the system showed fewer signs of development and eventually reached near a 0% chance 48 h before genesis. The genesis probability was raised to a 30% chance only 18 h before the formation of the cyclone.

A verification of NHC official track forecasts for Bud is given in Table 2a. Official forecast track errors were near or above the mean official errors for the previous 5-yr period through 120 h. The OCD5 (CLIPER) errors for this system were even larger, suggesting these forecasts were more difficult than normal, on average, and that the OFCL forecasts displayed a substantial amount of skill. The official forecasts did have a southward bias in the latter parts of the forecast period. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. Because the official forecasts tended to lean toward the EMXI aid more than other models beyond 48 h, OFCL had higher errors than most of the guidance at longer range. The GUNA consensus aid had particularly low errors at days 3 and 4.

A verification of NHC official intensity forecasts for Bud is given in Table 3a. Official forecast intensity errors were higher than the mean official errors for the previous 5-yr period, except at 72 and 96 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. In contrast to the track forecasts, the official intensity forecasts were superior to much of the model guidance throughout the period, although it struggled with the rapid weakening phase of the cyclone. The LGEM and DSHP models had a particularly difficult time with Bud, with notable low biases.

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

Table 1. Best track for Hurricane Bud, 20 – 26 May 2012.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
20 / 1200	9.0	98.1	1006	25	low
20 / 1800	9.1	98.7	1006	25	tropical depression
21 / 0000	9.1	99.3	1005	30	"
21 / 0600	9.2	99.9	1005	30	"
21 / 1200	9.3	100.4	1005	30	"
21 / 1800	9.4	100.9	1005	30	"
22 / 0000	9.7	101.6	1004	35	"
22 / 0600	10.2	102.6	1004	35	tropical storm
22 / 1200	10.8	103.6	1004	35	"
22 / 1800	11.7	104.6	1003	40	"
23 / 0000	12.5	105.6	1001	45	"
23 / 0600	12.9	106.6	999	50	"
23 / 1200	13.1	107.4	997	55	"
23 / 1800	13.6	107.7	993	60	"
24 / 0000	14.1	107.7	985	70	hurricane
24 / 0600	14.6	107.4	978	80	"
24 / 1200	15.2	107.0	970	90	"
24 / 1800	16.0	106.5	962	95	"
25 / 0000	16.8	106.1	961	100	"
25 / 0600	17.5	105.8	964	95	"
25 / 1200	18.2	105.6	973	85	"
25 / 1800	18.9	105.5	990	70	"
26 / 0000	19.5	105.6	996	55	tropical storm
26 / 0600	20.1	105.7	1002	40	low
26 / 1200	20.5	105.8	1007	25	"
26 / 1800					dissipated
25 / 0000	16.8	106.1	961	100	minimum pressure and maximum winds

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Bud. Mean errors for the 5-yr period 2007-11 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	28.4	50.0	70.2	91.0	116.4	147.3	262.3
OCD5	42.1	93.5	183.0	267.7	367.4	426.7	461.4
Forecasts	19	17	15	13	9	5	1
OFCL (2007-11)	28.6	46.3	62.7	78.1	108.0	145.3	181.1
OCD5 (2007-11)	38.5	74.8	116.0	159.8	246.1	324.2	392.8

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Bud. 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	29.5	50.6	66.9	83.5	96.4	128.7	
OCD5	43.7	97.9	185.0	274.6	399.7	473.8	
GFSI	33.1	56.3	70.4	88.1	71.2	81.7	
GHMI	31.8	55.9	73.5	82.7	71.0	93.8	
HWFI	31.1	59.9	81.2	103.9	100.9	196.5	
NGPI	40.8	62.0	74.6	81.0	64.2	101.5	
EMXI	28.9	43.9	59.7	68.2	107.3	172.1	
EGRI	43.5	77.0	107.4	113.2	100.2	104.3	
AEMI	29.8	53.3	77.0	103.3	90.1	93.4	
CMCI	43.3	64.0	58.4	52.0	65.3	106.3	
TVCA	28.9	50.4	68.3	82.3	65.9	87.5	
TVCE	30.3	51.7	68.5	81.7	64.8	80.7	
TCON	31.5	51.4	67.2	80.3	53.1	69.7	
LBAR	37.4	59.5	70.1	70.5	86.8	161.0	
BAMD	40.9	61.5	70.6	75.8	79.1	139.5	
BAMM	36.5	61.0	75.1	89.0	88.5	96.4	
BAMS	40.9	76.1	120.0	153.4	150.1	105.4	
GUNA	32.2	51.7	69.9	78.3	48.3	55.9	
Forecasts	16	14	13	11	8	4	

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Bud. Mean errors for the 5-yr period 2007-11 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	8.7	14.1	19.0	18.5	11.1	11.0	25.0
OCD5	11.2	18.6	23.1	22.8	25.0	19.8	6.0
Forecasts	19	17	15	13	9	5	1
OFCL (2007-11)	6.4	10.6	13.7	15.1	17.0	18.5	17.8
OCD5 (2007-11)	7.5	12.4	16.1	18.4	20.1	20.1	20.8

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Bud. 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	8.7	14.1	19.0	18.5	11.1	11.0	25.0
OCD5	11.2	18.6	23.1	22.8	25.0	19.8	6.0
GHMI	9.9	16.4	21.5	18.8	11.7	16.6	25.0
HWFI	9.7	17.3	20.5	18.7	10.8	36.4	37.0
DSHP	9.5	15.2	21.7	23.9	17.3	12.4	6.0
LGEM	10.2	16.0	20.8	22.9	21.7	10.4	25.0
ICON	9.8	15.6	19.9	19.8	14.9	17.8	8.0
IVCN	9.6	15.2	19.9	21.0	14.7	18.4	8.0
Forecasts	19	17	15	13	9	5	1

Table 4. Mexican watches and warnings for Hurricane Bud, 20 – 26 May 2012.

Date/Time (UTC)	Action	Location
24 / 0300	Tropical Storm Watch issued	Punta San Telmo to La Fortuna
24 / 0900	Tropical Storm Watch discontinued	All
24 / 0900	Tropical Storm Warning issued	Punta San Telmo to Cabo Corrientes
24 / 0900	Hurricane Watch issued	Punta San Telmo to Cabo Corrientes
24 / 2100	Tropical Storm Watch issued	Cabo Corrientes to San Blas
24 / 2100	Tropical Storm Warning modified to	Punta San Telmo to Manzanillo
24 / 2100	Hurricane Watch modified to	Punta San Telmo to Manzanillo
24 / 2100	Hurricane Warning issued	Manzanillo to Cabo Corrientes
26 / 0000	Hurricane Warning changed to Tropical Storm Warning	Manzanillo to Cabo Corrientes
26 / 0000	Tropical Storm Warning modified to	Manzanillo to Cabo Corrientes
26 / 0000	Hurricane Watch discontinued	All
26 / 0900	Tropical Storm Watch discontinued	All
26 / 0900	Tropical Storm Warning discontinued	All

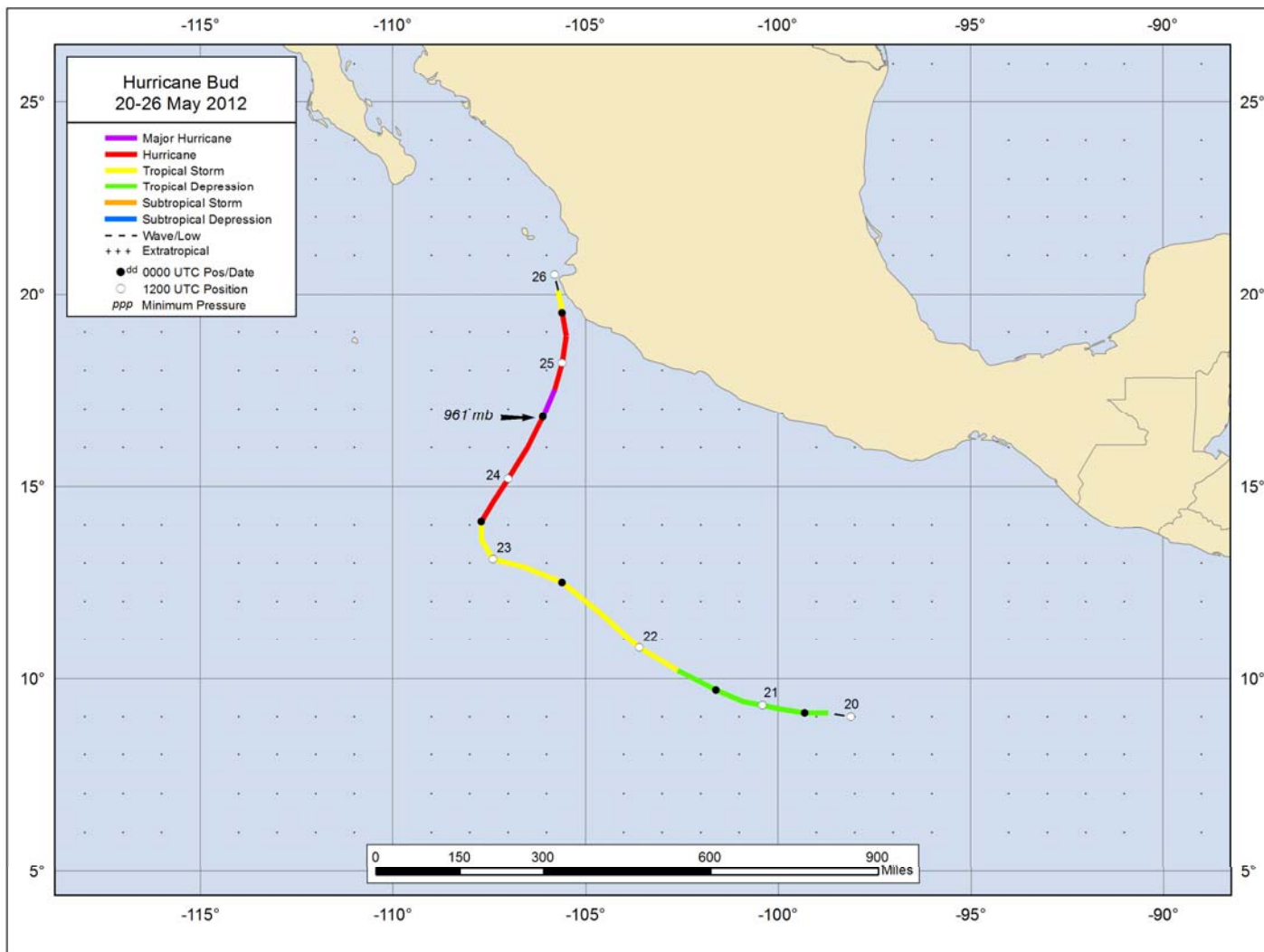


Figure 1. Best track positions for Hurricane Bud, 20 - 26 May 2012.

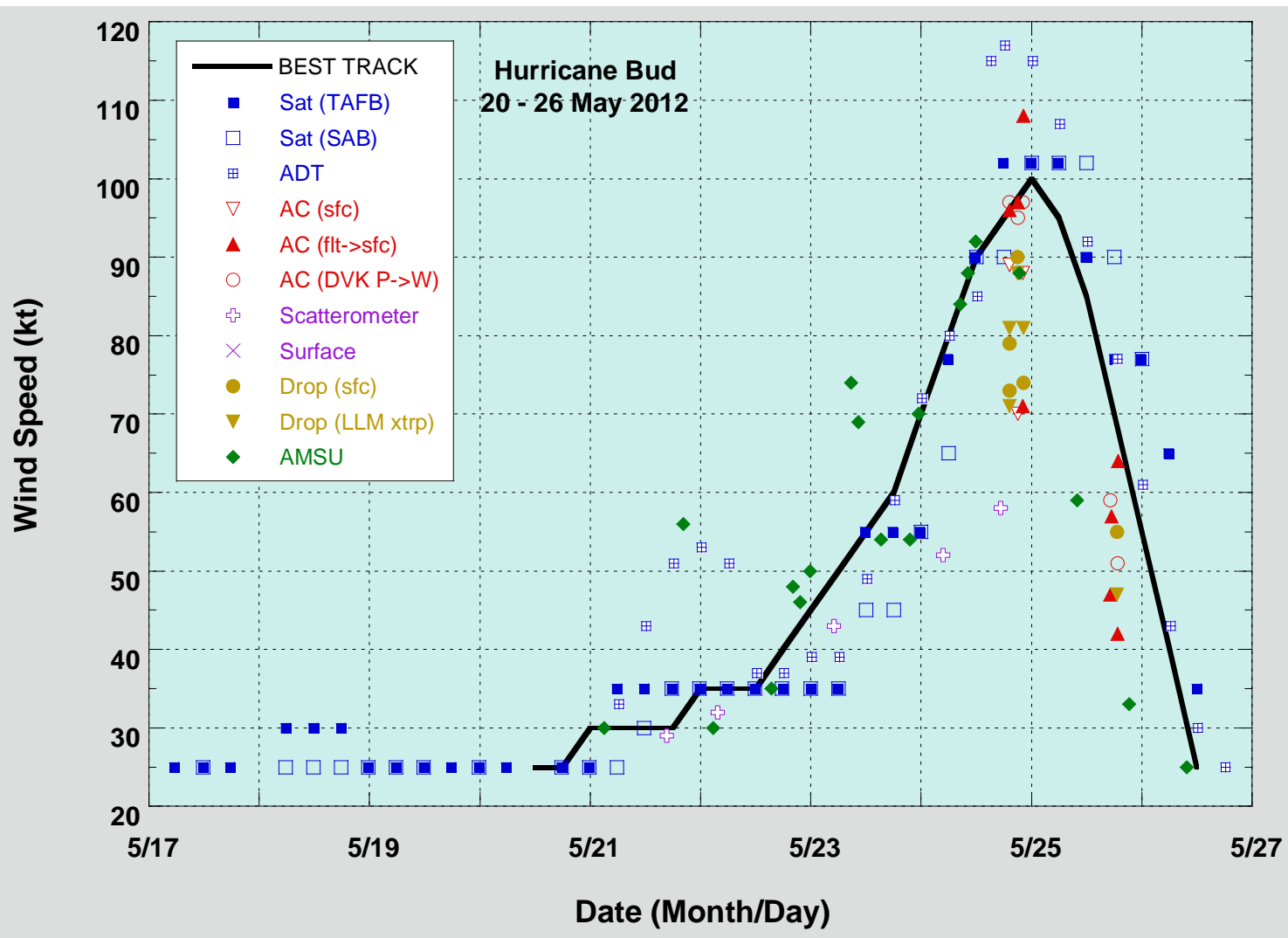


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Bud, 20 – 26 May 2012. Advanced Dvorak Technique (ADT) estimates courtesy of UW-CIMSS. AMSU estimates are derived from the UW-CIMSS technique. Dashed vertical lines correspond to 0000 UTC.

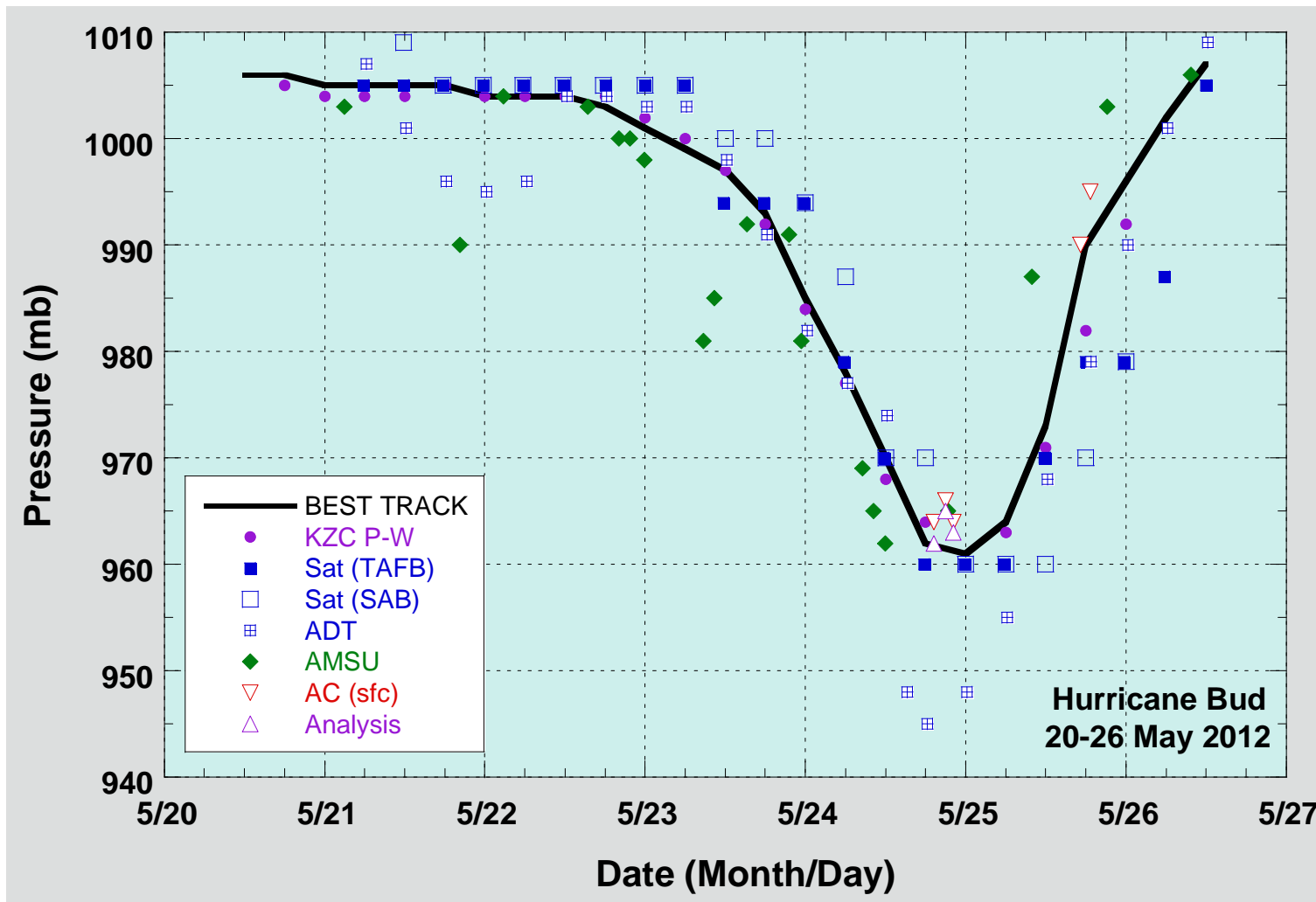


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Bud, 20 – 26 May 2012. Advanced Dvorak Technique (ADT) estimates courtesy of UW-CIMSS. Dashed vertical lines correspond to 0000 UTC. KZC P-W refers to pressure estimates derived by applying the Knaff-Zehr-Courtney pressure-wind relationship to the best track wind speeds. AMSU estimates are derived from the UW-CIMSS technique.

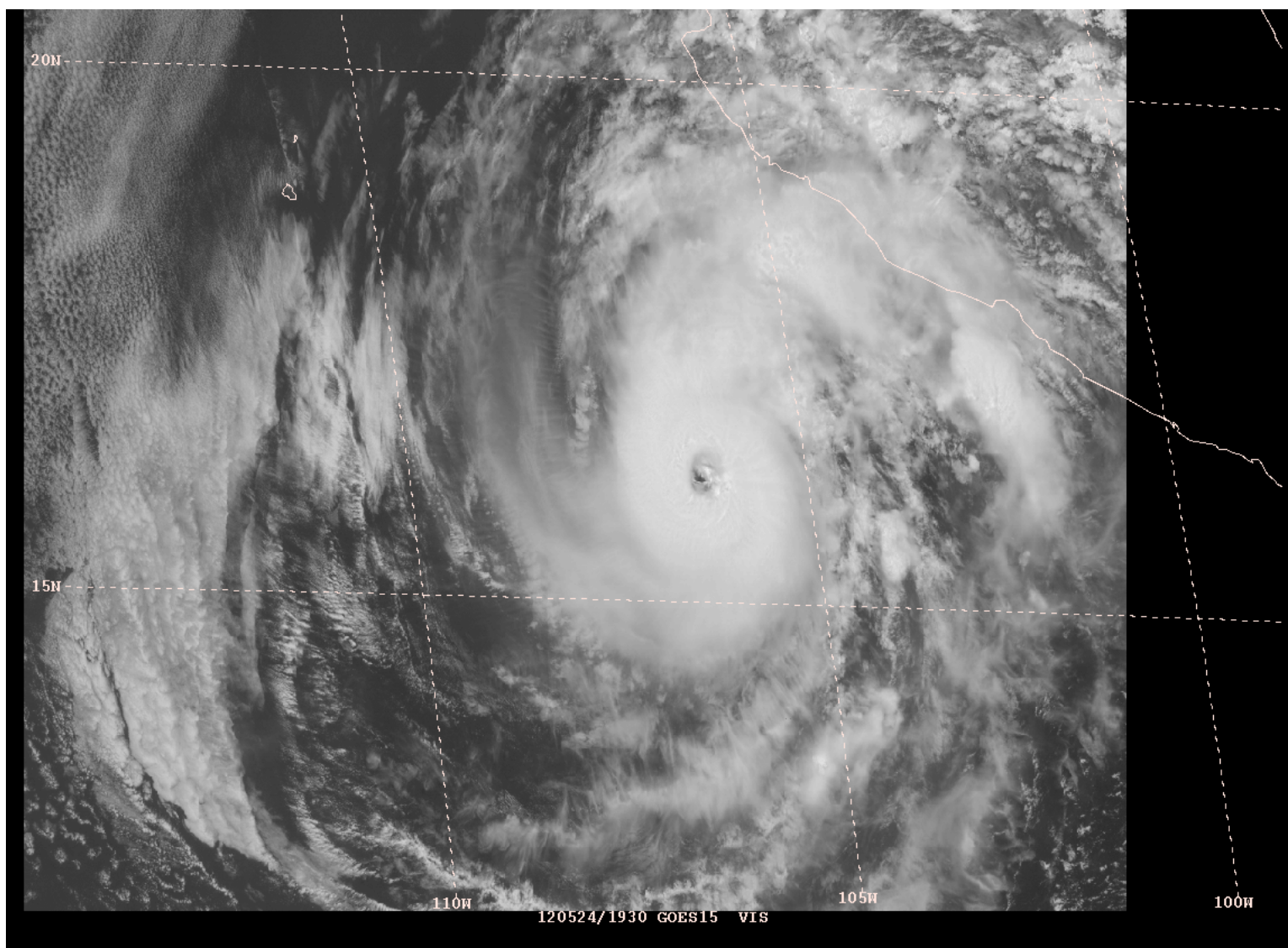


Figure 4. GOES-W visible satellite picture of Bud near peak intensity at 1930 UTC 24 May 2012.