

Tropical Cyclone Report
Hurricane Bud
(EP032006)
11-16 July 2006

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Bud was a compact hurricane that reached category 3 intensity (on the Saffir-Simpson Hurricane Scale) but did not affect land.

a. Synoptic History

Bud developed from a tropical wave that emerged from the west coast of Africa on 27 June and reached the eastern North Pacific basin by 7 July. An area of low pressure formed along the wave on 9 July approximately 550 n mi south of Manzanillo, Mexico. The next day the system received its first Dvorak classifications from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB). Showers and thunderstorms associated with the low pressure area gradually became better organized, and early on 11 July a tropical depression formed approximately 700 n mi south of Cabo San Lucas, Mexico. 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.

The tropical cyclone moved west-northwestward throughout its entire life span, with steering provided by a persistent mid-level subtropical ridge extending westward from northern Mexico. Initially, very early on 11 July, the depression encountered northerly wind shear. The shear decreased later that day, however, and the cyclone developed rapidly over warm waters, reaching hurricane strength very late that evening. Intensification continued on 12 July, as outer bands dissipated while inner-core convection consolidated. Bud became a major hurricane on 13 July, reaching its estimated maximum intensity of 110 kt (category 3) that day while centered about 650 n mi west-southwest of Cabo San Lucas. Thereafter, Bud encountered increasingly cooler waters and stable air that induced rapid weakening. Bud dropped below hurricane strength early on 14 July, and it lost much of its deep convection later that day. Bud weakened to a depression early on 15 July and degenerated into a remnant low pressure area the next day. The low dissipated within the low-level easterly trade winds on 17 July about 650 n mi east-northeast of Hawaii.

b. Meteorological Statistics

Observations in Bud (Figs. 2 and 3) are limited to satellite observations, primarily the geostationary satellite-based Dvorak technique intensity estimates from TAFB, SAB and the U.

S. Air Force Weather Agency (AFWA). Microwave satellite data and imagery from NOAA polar-orbiting satellites, Defense Meteorological Satellite Program (DMSP) satellites, and National Aeronautics and Space Administration (NASA) satellites including the Tropical Rainfall Measuring Mission (TRMM), QuikSCAT, and Aqua were also useful in tracking Bud. The peak intensity of 110 kt at 0600 UTC 13 July is based upon a blend of the subjective Dvorak intensity estimates at that time. QuikSCAT data from early on 14 July indicate that Bud subsequently weakened faster than indicated by the Dvorak estimates.

c. Casualty and Damage Statistics

There were no reports of damages or casualties associated with Hurricane Bud.

d. Forecast and Warning Critique

The NHC eastern Pacific Tropical Weather Outlook (TWO) products first mentioned early on 9 July the system that eventually became Bud. The possibility of tropical cyclone development was conveyed early on 10 July, just slightly less than 24 hours prior to the formation of a tropical depression.

A verification of official and guidance model track forecasts is given in Table 2. Average official track errors for Bud were 23, 49, 77, 100, 209, 399, and 629 n mi for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. The number of verifying forecasts ranged from 20 at 12 h to only two at 120 h. The errors out to 48 h are less than the average long-term official track errors, but the errors at longer lead times, albeit based on very few forecasts, are much larger than the long-term averages (Table 2). Overall, both official and model track forecasts had a slow bias. In particular, the very large errors at 3-5 days mostly result from incorrectly anticipating, especially during the first couple of days of Bud's existence, a much slower west-northwestward motion than actually materialized. The official track forecasts had smaller average errors than all of the individual dynamical models at 12 and 24 h, but the interpolated GFDL model (GFDI) had smaller average errors than the official forecast at all other lead times. The CONU and GUNA consensus guidance tracks had smaller average errors than the official forecast at all lead times.

A verification of official and guidance model intensity forecasts is given in Table 3. Average official intensity errors were 11, 16, 18, 19, 16, 21, and 20 kt for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. These errors are generally larger than the corresponding long-term averages (Table 3). The official intensity forecasts did not capture either the rapid intensification of Bud during 11-13 July or its rapid weakening on 13 and 14 July. Rapid intensity changes continue to be an operational forecast challenge. However, official intensity forecast errors were smaller than the errors from most of the guidance (Table 3). A notable exception was the Florida State University Superensemble (FSSE) that had the smallest errors at 24-48 h.

No coastal watches or warnings were necessary in association with Bud.

Table 1. Best track for Hurricane Bud, 11-16 July 2006.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
11 / 0000	13.2	110.3	1007	30	tropical depression
11 / 0600	13.5	111.0	1003	40	tropical storm
11 / 1200	13.8	111.7	998	50	"
11 / 1800	14.1	112.6	991	60	"
12 / 0000	14.4	113.5	983	75	hurricane
12 / 0600	14.8	114.6	976	80	"
12 / 1200	15.4	115.7	973	85	"
12 / 1800	16.0	116.9	970	90	"
13 / 0000	16.6	118.2	962	100	"
13 / 0600	17.2	119.8	953	110	"
13 / 1200	17.7	121.3	959	100	"
13 / 1800	18.2	122.7	966	90	"
14 / 0000	18.6	124.0	975	75	"
14 / 0600	19.1	125.3	985	60	tropical storm
14 / 1200	19.4	126.5	995	50	"
14 / 1800	19.7	127.8	1001	40	"
15 / 0000	19.9	129.2	1003	35	"
15 / 0600	20.2	130.7	1005	30	tropical depression
15 / 1200	20.6	132.2	1006	25	"
15 / 1800	21.0	133.7	1007	25	"
16 / 0000	21.5	135.2	1008	25	"
16 / 0600	22.0	136.8	1009	25	"
16 / 1200	22.5	138.3	1010	20	remnant low
16 / 1800	23.0	139.8	1012	20	"
17 / 0000	23.5	141.3	1013	20	"
17 / 0600	24.1	143.0	1013	20	"
17 / 1200	24.8	144.8	1013	20	"
17 / 1800					dissipated
13 / 0600	17.2	119.8	953	110	minimum pressure

Table 2. Preliminary track forecast evaluation (heterogeneous sample) for Hurricane Bud, 11-16 July 2006. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
CLP5	26 (20)	54 (18)	91 (16)	137 (14)	281 (10)	430 (6)	608 (2)
GFNI	42 (17)	67 (14)	92 (14)	128 (12)	229 (8)	385 (3)	
GFDI	29 (19)	53 (17)	66 (15)	68 (13)	144 (9)	305 (5)	450 (1)
GFSI	38 (19)	77 (12)	142 (10)	206 (5)	192 (2)		
AEMI	39 (20)	81 (17)	126 (15)	184 (10)	279 (2)		
NGPI	37 (18)	68 (16)	100 (14)	145 (12)	280 (8)	528 (4)	
UKMI	36 (18)	56 (17)	92 (15)	85 (11)	122 (6)		
BAMD	34 (20)	59 (18)	89 (16)	124 (14)	187 (10)	248 (6)	487 (2)
BAMM	30 (19)	52 (17)	71 (15)	92 (14)	130 (10)	199 (6)	546 (2)
BAMS	26 (19)	42 (17)	56 (15)	73 (14)	126 (10)	249 (6)	649 (2)
CONU	22 (19)	41 (17)	64 (15)	89 (13)	182 (9)	390 (4)	
GUNA	16 (17)	40 (12)	50 (10)	47 (4)			
FSSE	21 (17)	49 (16)	75 (14)	96 (12)	211 (8)	395 (4)	
OFCL	23 (20)	49 (18)	77 (16)	100 (14)	209 (10)	399 (6)	629 (2)
NHC Official (2001-2005 mean)	35 (1300)	60 (1152)	83 (1009)	103 (877)	145 (652)	192 (465)	231 (313)

Table 3. Preliminary intensity forecast evaluation (heterogeneous sample) for Hurricane Bud, 11-16 July 2006. Forecast errors (kt) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
SHF5	13.4 (20)	20.6 (18)	24.5 (16)	31.8 (14)	25.7 (10)	27.8 (6)	27.0 (2)
GFDI	14.3 (19)	23.9 (17)	28.4 (15)	28.2 (13)	13.9 (9)	9.6 (5)	8.0 (1)
SHIP	13.3 (20)	20.5 (15)	18.5 (14)	20.1 (13)	15.2 (10)	27.5 (6)	28.0 (2)
DSHP	13.3 (20)	20.5 (15)	18.5 (14)	20.1 (13)	15.2 (10)	27.5 (6)	28.0 (2)
FSSE	11.9 (17)	14.0 (16)	14.0 (14)	16.8 (12)	29.6 (8)	34.8 (4)	
ICON	13.4 (19)	23.4 (14)	24.6 (13)	20.5 (12)	11.0 (9)	16.8 (5)	11.0 (1)
OFCL	11.0 (20)	15.6 (18)	17.8 (16)	18.6 (14)	15.5 (10)	20.8 (6)	20.0 (2)
NHC Official (2001-2005 mean)	6.2 (1300)	10.8 (1152)	14.3 (1009)	16.5 (876)	18.7 (652)	18.3 (465)	19.3 (313)

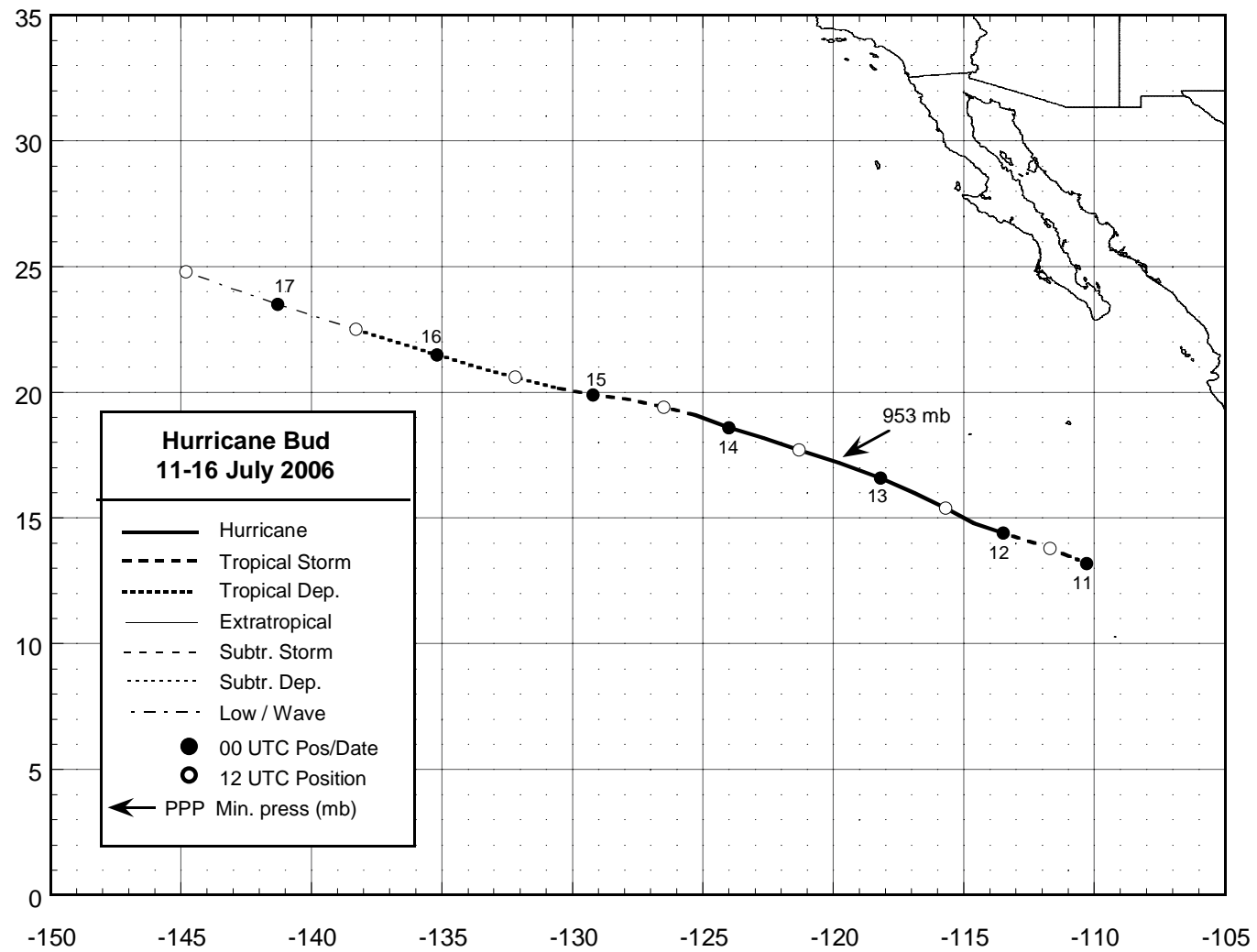


Figure 1. Best track positions for Hurricane Bud, 11-16 July 2006.

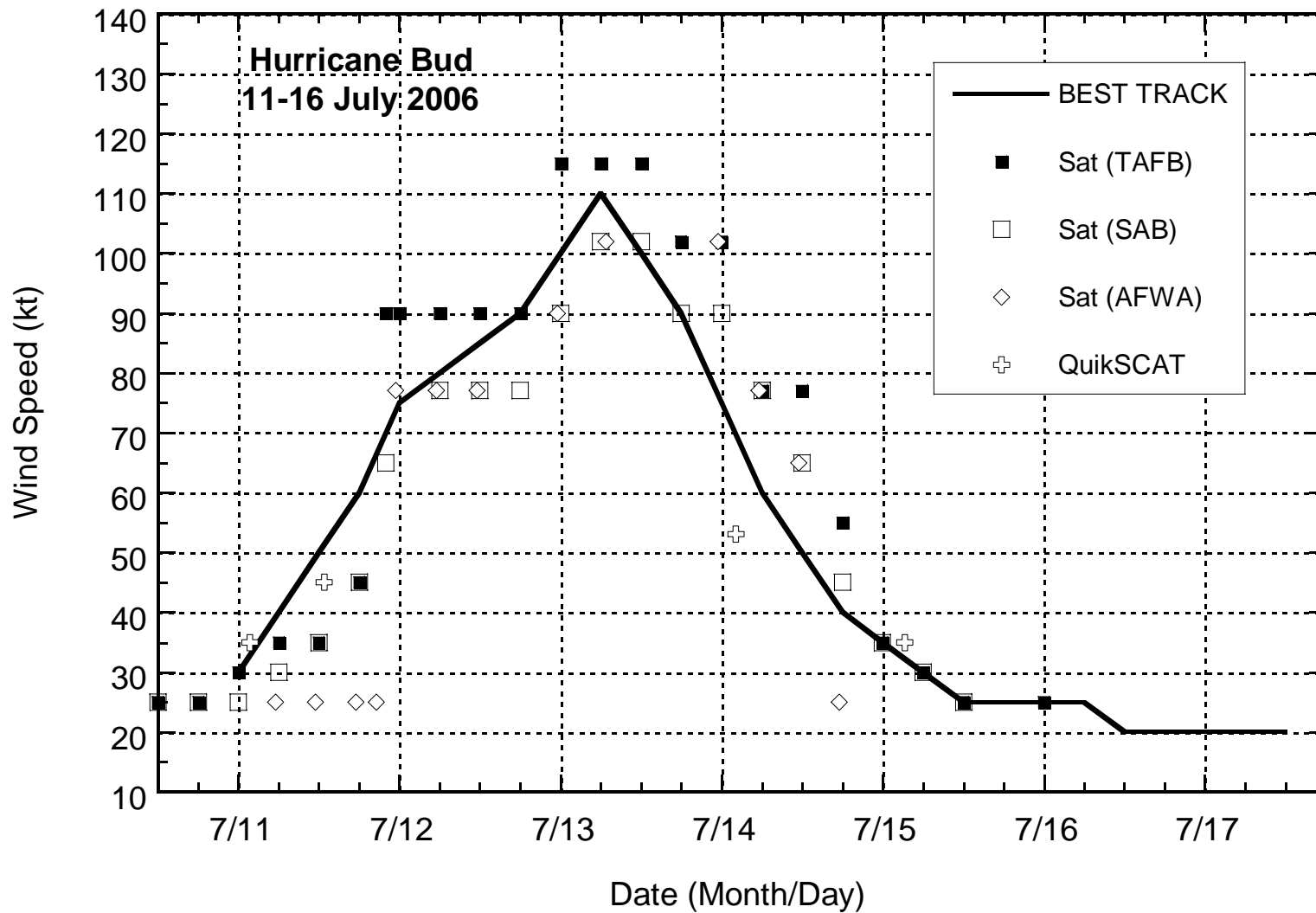


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Bud, 11-16 July 2006.

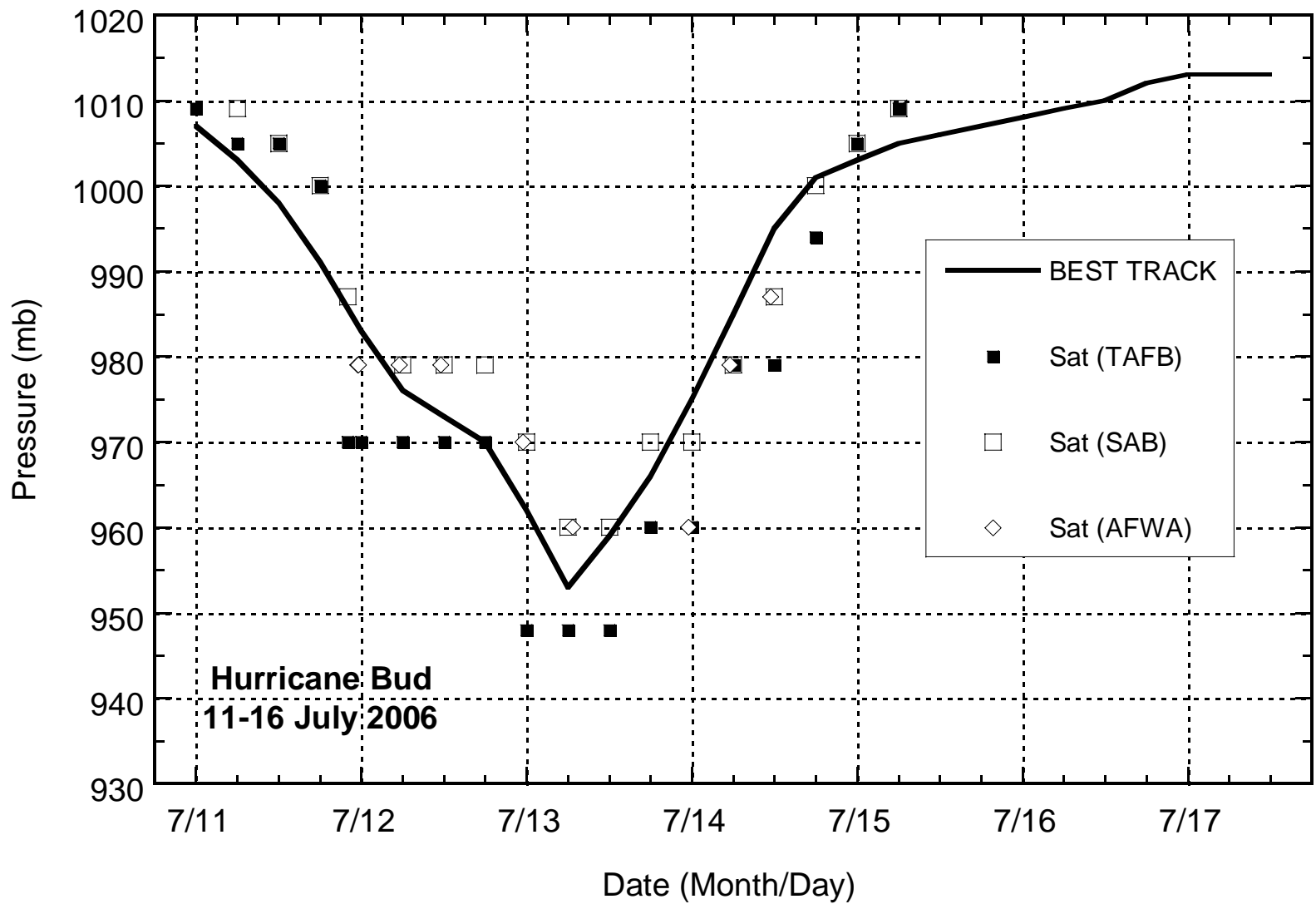


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Bud, 11-16 July 2006.