Tropical Cyclone Report
Hurricane Isaac
21 September - 1 October 2000

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Isaac was a Cape Verde hurricane that followed a long, parabolic path over the eastern half of the Atlantic. Its maximum sustained winds reached an estimated 120 kt, tying it with Keith for the strongest hurricane of the season.

a. Synoptic History

A strong tropical wave emerged from western Africa on 20 September with some curvature in the associated deep convective clouds. The system produced a very well-defined lower-tropospheric wind shift in the time section from Dakar, Senegal. Later that day, the system was given an initial Dvorak classification. On the following day, the cloud pattern became better organized and a tropical depression (Thirteen) formed, a couple hundred miles to the south of the Cape Verde Islands (Table 1 and Fig. 1).

A mid-tropospheric ridge was present over the eastern Atlantic to the north of the tropical cyclone, and this provided a west-northwestward steering for several days. Vertical wind shear was weak, and this allowed the system to gradually strengthen into Tropical Storm Isaac by 0000 UTC 22 September. Strengthening continued, and Isaac became a hurricane around 1200 UTC on the 23rd, when a faint eye was evident on visual satellite imagery. Soon thereafter, the eye became much better defined on the images, and the hurricane quickly strengthened to 105 kt by 0000 UTC 24 October. Afterwards on the 24th, the cloud pattern became less organized; core convection became less symmetric and the eye was not as well-defined as it had been the day before. This appeared to be mainly the result of internal fluctuations, as the large-scale atmospheric environment remained favorable. Isaac's winds decreased to about 90 knots on the 25th, when west-southwesterly vertical shear became more evident over the system; slightly cooler ocean waters may have also played a role in the weakening of the hurricane. By around 1200 UTC on the 26th, the low-cloud center of Isaac was near the southwest edge of the main area of deep convection, and the hurricane's winds had decreased to an estimated 75 kt. Later on the 26th, the shear relaxed somewhat, and deep convection became organized more symmetrically around the center. Isaac re-strengthened on the 27th. A distinct eye again became visible, and Isaac re-attained category three status around 0000 UTC 28 September. The hurricane turned toward the northwest about that time. Isaac continued to

intensify, and reached its peak strength of 120 knots, category four on the Saffir-Simpson Hurricane Scale, around 1800 UTC on the 28th.

Not long after reaching its maximum intensity, the hurricane turned north-northwestward. Continuing its movement around the western periphery of a mid-tropospheric anticyclone, Isaac turned northward and then north-northeastward. The center passed about 440 n mi east of Bermuda on the 29th. When the cyclone moved over cooler waters, the maximum winds gradually decreased, and were down to category one intensity on the 30th. By this time, Isaac was accelerating northeastward. The system weakened to a tropical storm on 1 October, and became extratropical later that same day. Isaac's remnant, a strong extratropical cyclone with winds of 55 to 60 kt, moved rapidly east-northeastward over the Atlantic. By 3 October, the cyclone turned north-northeastward, skirting the western British Isles. The system's maximum winds had decreased to near 45 knots by this time. Early on 4 October, the cyclone merged with a larger extratropical low to the north of Scotland.

b. Meteorological Statistics

Table 1 lists the best track positions and intensities of Isaac at six-hourly intervals. Figure 1 is a display of this track. Figures 2 and 3 depict the curves of maximum one-minute average "surface" (10 m above ground level) wind speed and minimum central sea-level pressure, respectively, as functions of time. Also plotted are the observations on which the curves are based. These consist of Dvorak-technique estimates using satellite imagery by the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB), and the U.S. Air Force Weather Agency (AFWA).

Isaac's maximum intensity, 120 kt, is based on a blend of both subjective and objective Dvorak intensity estimates. Subjective Dvorak classifications around 1800 UTC 28 September gave an estimate of 115 kt. However, the three-hourly average of objective Dvorak T-numbers around that time corresponds to 125 kt.

After losing tropical characteristics, Isaac lashed portions of the western British Isles with winds near gale force on 3 October.

c. Casualty and Damage Statistics

Even though Isaac remained far to the east of the U.S. eastern seabord, swells generated by this large and powerful hurricane caused a boat with four passengers to capsize in Moriches Inlet (Long Island), New York on 30 September. One of the passengers, a 54-year old Bronx man, drowned.

d. Forecast and Warning Critique

Excluding the tropical depression and extratropical stages of Isaac, the average official track forecast errors were 29, 52, 78, 101, and 173 n mi at 12, 24, 36, 48, and 72 h respectively. These errors are smaller than the most recent ten-year averages (46, 85, 122, 158, and 235 n mi respectively). For all forecast times, the GFDI model and the GUNS ensemble produced lower track errors than the official forecast. Table 2 summarizes the performance for several of the track models and the official track forecasts. Overall the numerical guidance was quite consistent, with the models showing the northward turn well in advance.

The mean absolute wind speed errors for the official forecasts were 8, 14, 18, 20, and 18 kt for 12, 24, 36, 48, and 72 h respectively. At 12 and 72 h these mean intensity errors are comparable to the latest ten-year averages, however for 24 h through 48 h the mean intensity errors for Isaac were several knots higher than the longer-term averages. In general, the official forecasts under-predicted the rate of Isaac's strengthening and weakening. The SHIPS guidance showed similar biases.

Table 1. Best track, Hurricane Isaac, 21 September - 1 October 2000.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
21 / 1200	11.5	23.0	1008	30	tropical depression
21 / 1800	11.9	24.5	1008	30	"
22 / 0000	12.3	25.9	1005	35	tropical storm
22 / 0600	12.7	27.2	1001	40	"
22 / 1200	13.1	28.7	1000	45	"
22 / 1800	13.5	30.1	1000	45	"
23 / 0000	13.7	31.2	997	50	"
23 / 0600	13.9	32.3	994	55	"
23 / 1200	14.3	33.2	984	70	hurricane
23 / 1800	14.6	34.2	973	85	"
24 / 0000	14.9	35.0	960	105	"
24 / 0600	15.1	35.8	960	100	"
24 / 1200	15.5	36.8	960	100	"
24 / 1800	15.8	37.8	960	100	"
25 / 0000	16.3	38.6	965	95	"
25 / 0600	16.7	39.5	965	95	"
25 / 1200	17.2	40.4	970	90	"
25 / 1800	17.6	41.2	970	90	"
26 / 0000	17.9	42.0	970	90	"
26 / 0600	18.3	42.9	973	85	"
26 / 1200	18.6	43.9	980	75	"
26 / 1800	19.1	45.0	980	75	"
27 / 0000	19.6	46.0	977	80	"
27 / 0600	20.4	47.0	973	85	"
27 / 1200	21.0	48.1	970	90	"
27 / 1800	21.9	49.5	965	95	"
28 / 0000	22.8	50.6	960	100	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 0600	23.8	52.0	955	105	"
28 / 1200	25.0	52.9	950	110	"
28 / 1800	26.6	54.2	943	120	"
29 / 0000	28.0	55.1	948	115	"
29 / 0600	29.7	55.9	950	110	"
29 / 1200	31.2	56.2	955	105	"
29 / 1800	32.9	55.9	965	90	"
30 / 0000	34.4	55.2	970	85	"
30 / 0600	35.7	54.0	975	80	"
30 / 1200	37.0	51.8	979	75	"
30 / 1800	38.3	49.8	985	70	"
01 / 0000	39.7	47.9	987	65	"
01 / 0600	40.9	45.7	990	60	tropical storm
01 / 1200	42.1	43.6	990	55	"
01 / 1800	43.5	39.5	990	55	extratropical
02 / 0000	44.5	36.5	982	55	"
02 / 0600	45.7	33.0	972	60	"
02 / 1200	47.0	29.0	975	60	"
02 / 1800	48.5	25.0	976	60	"
03 / 0000	49.5	20.5	976	60	"
03 / 0600	50.5	16.5	978	60	"
03 / 1200	52.0	12.0	982	55	"
03 / 1800	55.0	9.0	988	45	"
04 / 0000	58.0	6.0	989	45	"
04 / 0600	62.0	4.0	994	45	"
04 / 1200					merged
28 / 1800	26.6	54.2	943	120	minimum pressure

Table 2.

Preliminary forecast evaluation of Hurricane Isaac
Heterogeneous sample

(Errors in nautical miles for tropical storm
and hurricane stages with number
of forecasts in parentheses)

Technique	**Period (hours)**				
	12	**24**	**36**	**48**	**72**
AVNI	38 (37)	63 (35)	87 (33)	110 (31)	159 (27)
CLIP	38 (37)	83 (35)	138 (33)	194 (31)	286 (27)
GFDI	35 (37)	52 (35)	65 (33)	91 (31)	162 (27)
GUNS	26 (34)	33 (32)	52 (31)	79 (29)	145 (25)
NGPI	34 (35)	48 (33)	67 (31)	101 (29)	197 (25)
UKMI	55 (36)	59 (34)	87 (33)	105 (31)	163 (27)
NHC OFFICIAL	29 (37)	52 (35)	78 (33)	101 (31)	173 (27)
NHC OFFICIAL 1990-1999 10-year average	46 (2057)	85 (1842)	122 (1650)	158 (1471)	235 (1164)

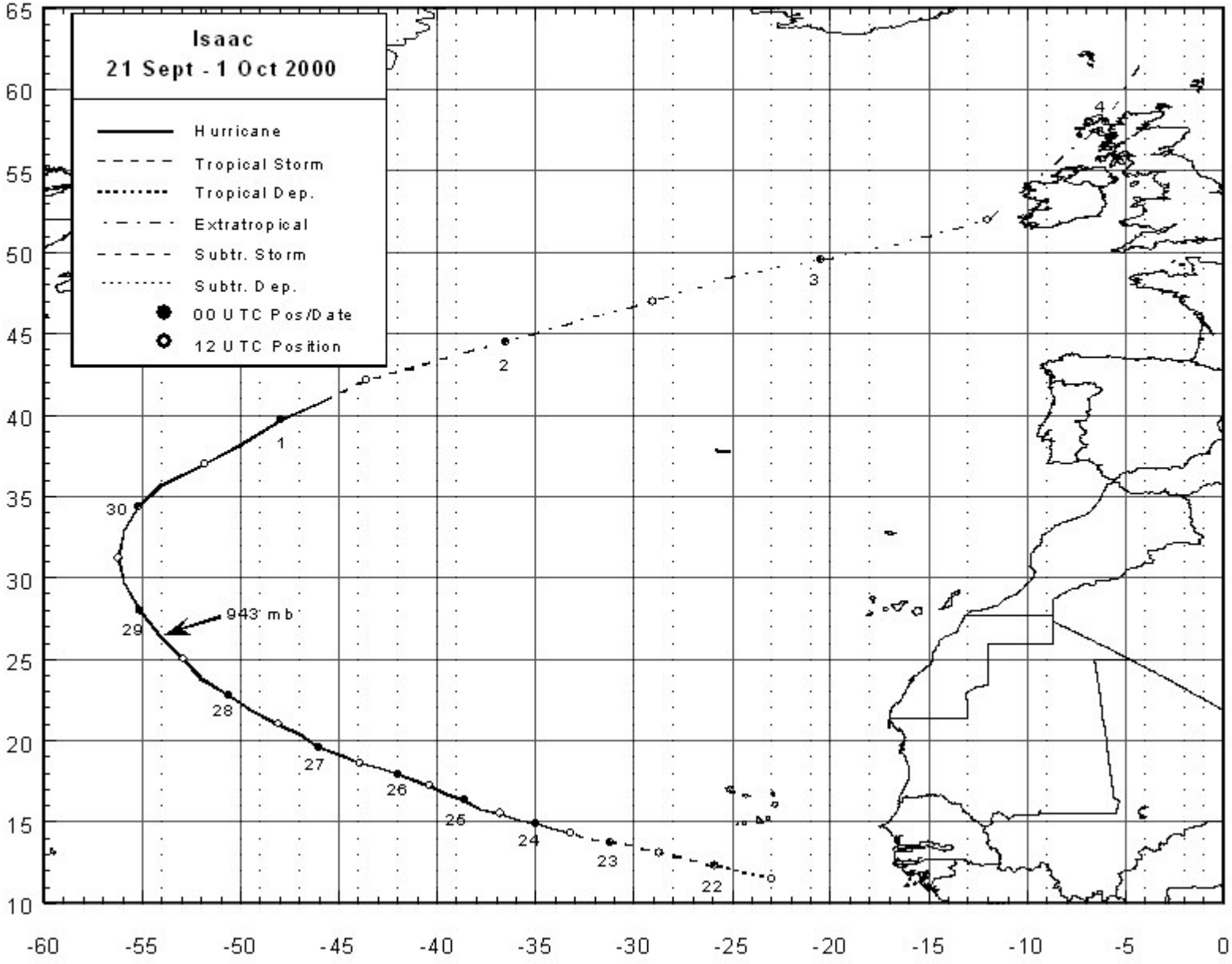

Fig. 1. Best track positions for Hurricane Isaac, 21 September-1 October 2000.

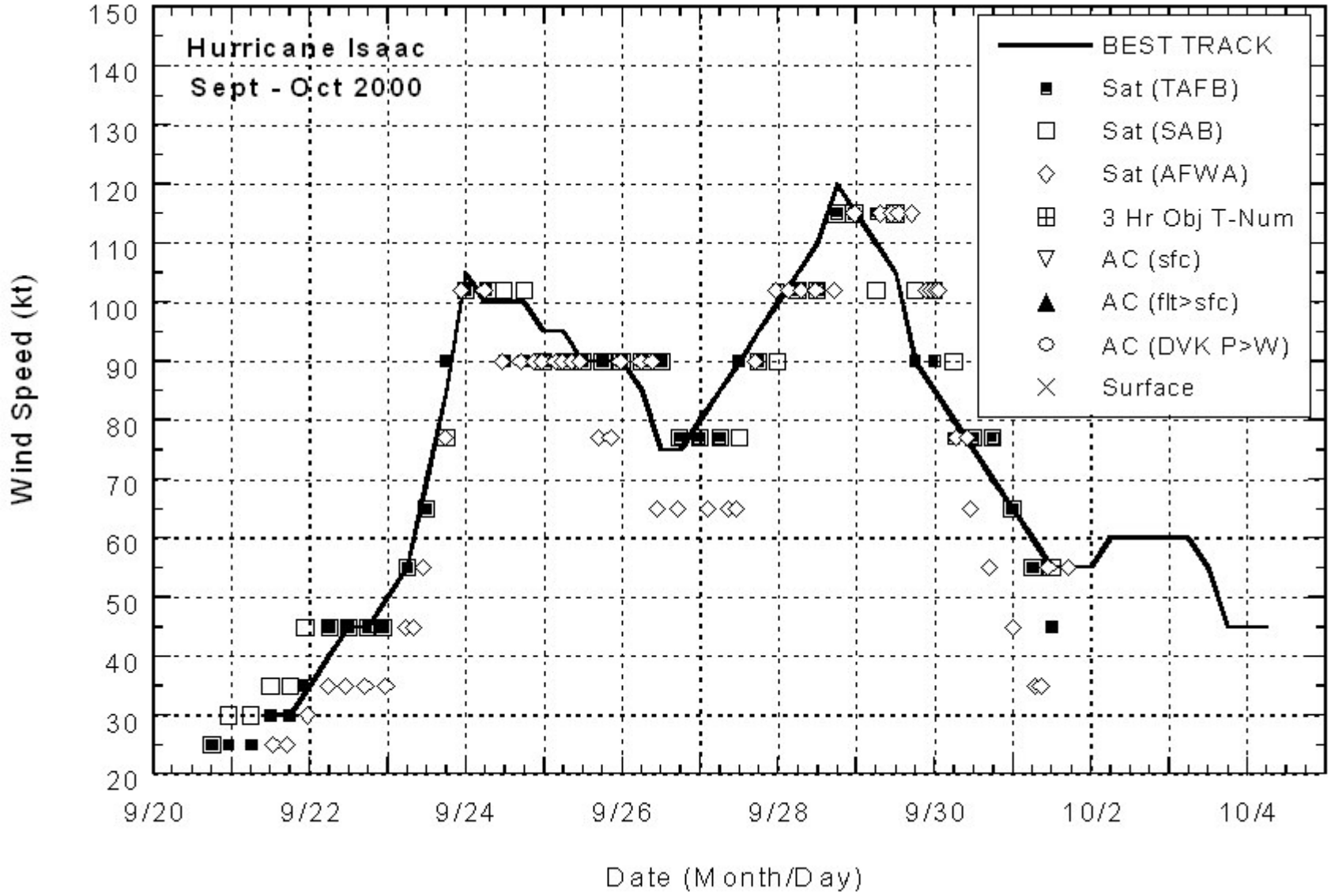

Fig. 2. Best track maximum sustained surface wind speed curve for Hurricane Isaac, 21 September-1 October 2000, showing the various satellite-based intensity estimates.

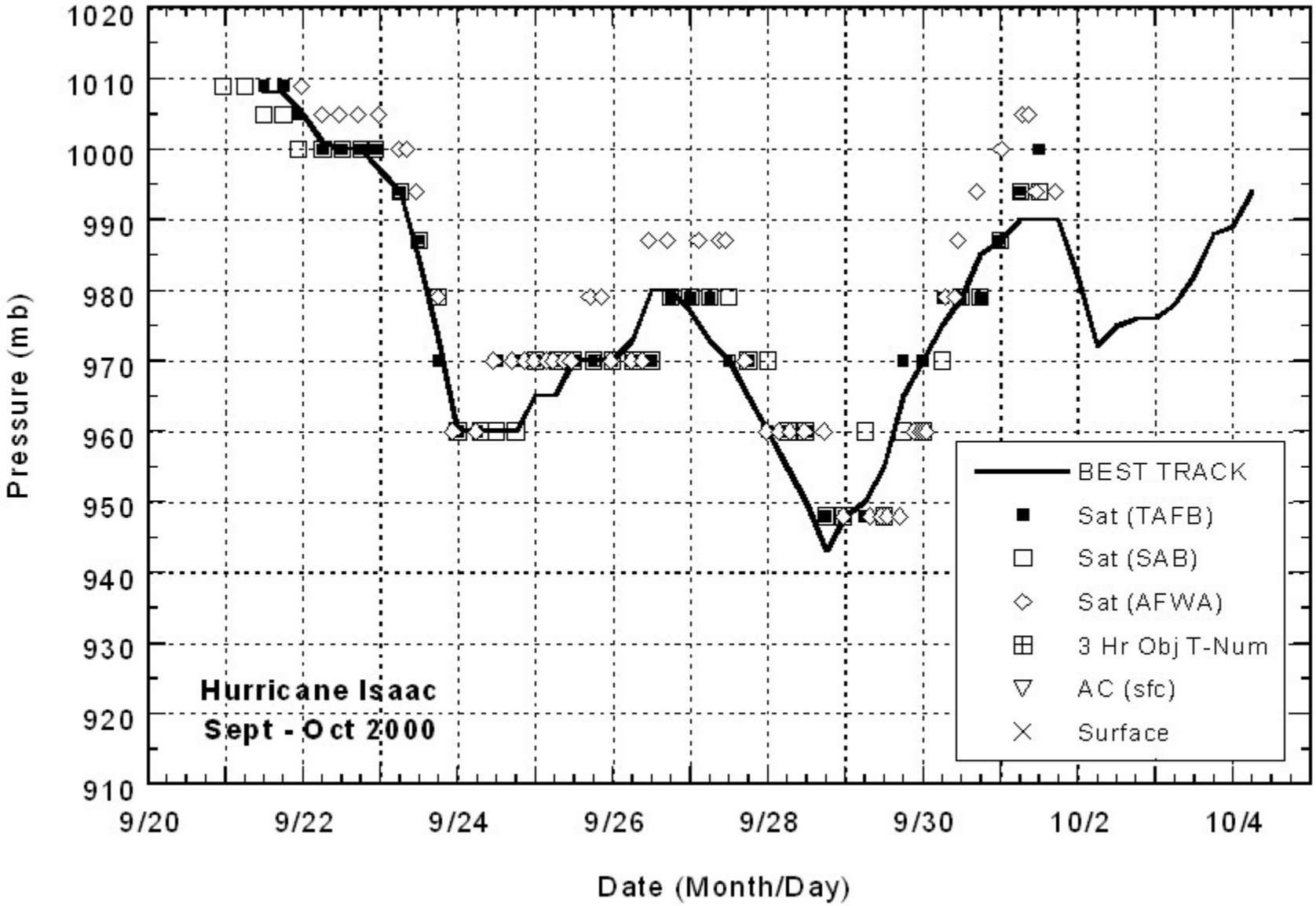

Fig. 3. Best track minimum central pressure curve and satellite-based central pressure estimates for Hurricane Isaac, 21 September-1 October 2000.